REPORT ON THE MINERAL EXPLORATION IN SABAH, MALAYSIA

PHASE II

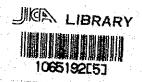
MARCH, 1988

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

MPN SC 88-10

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PREFACE

In response to the request of the Government of Malaysia, the Government of Japan agreed to conduct a collaborative mineral exploration project to confirm the possibility of occurrence of mineral resources in Sabah region, Malaysia and entrusted the survey to the Japan International Cooperation Agency and the Metal Mining Agency of Japan. This project is designed to be carried out in three phases spaced over three years commencing at the beginning of August, 1985.

Phase III of the project consisting mainly of drilling was accomplished jointly by a Japanese team and staff of the Geological Survey of Malaysia, Sabah, in 1987.

This report summarizes the results of the afore-mentioned undertaking and also forms a part of the final consolidated report which will be submitted to the Government of Malaysia after completion of the project.

We hope that this report will serve and contribute to the promotion of friendly relations between our two countries.

We with to express our deep appreciation to the Governmental Organizations of Malaysia for their close cooperation extended during the course of the project.

February, 1988

Censuke Yanagiya

President

Japan International Cooperation Agency

President

Metal Mining Agency of Japan

In Ee Heng

Director-General

Geological Survey of Malaysia

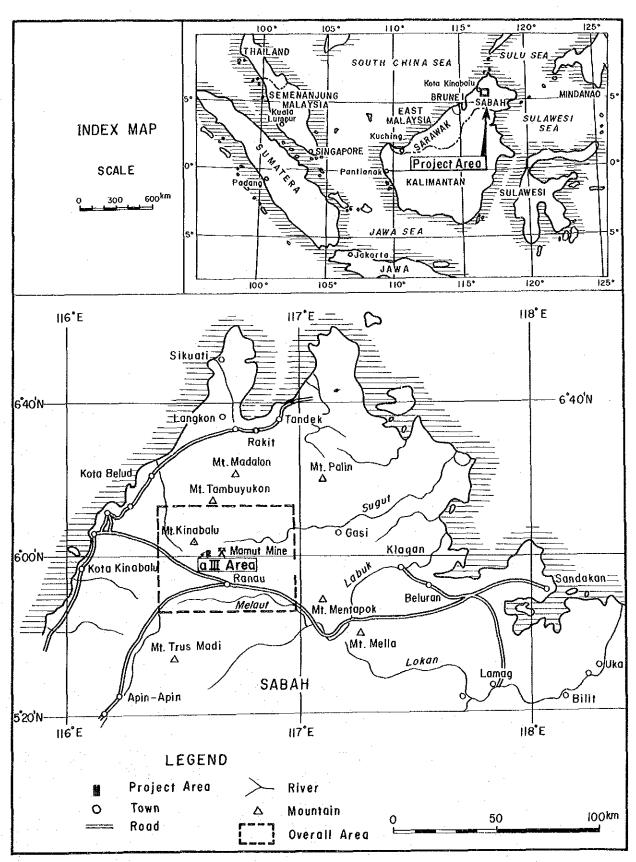


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ABSTRACT

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In the Mt. Kinabalu - Ranau area, Sabah, Malaysia, thick geosynclinal sediments (from later Cretaceous to early Miocene), ultrabasic to basic igneous rocks (later Miocene) and intermediate to acidic igneous rocks (latest Miocene) are widely distributed.

The copper showings of porphyry copper type, a series of massive sulphide floats of the Cyprus-type ore deposit and the occurrence of massive chromite ore deposit have been recognized. Among all of these, the predominant one is the porphyry copper type mineralization, one of which is the Mamut copper mine now in operation since 1975.

The collaborative mineral exploration programme, in Sabah, Malaysia has the purpose to assess potential anomalies and mineral showings delineated by the previous surveys.

The geological, geochemical and geophysical survey method followed by the drilling were applied in three selected areas, namely, Bambangan, Mankadau and Paliu.

The Phase III programme consists of the drilling, conducted in the Bambangan (namely, aIII) area to confirm not only the lateral and vertical extent of porphyry copper type mineralization, but also the grade of ore, which was found in Phase I and Phase II programme.

The drill hole MJM-8, located in the west bank of Bambangan creek, were sunk for testing the geophysical IP-SIP anomalies (showing 3 - 4% of Frequency Effect).

The said IP-SIP anomalies were concluded to the result from the veinlet/network shape of disseminated chalcopyrite-pyrite.

Assay values for the mineralized sections, immediately below the thick layers of the Pinosuk Gravels (from surface to a depth of 107.80m), are as follows:

Secondary (oxidized) zone

and the first transfer of the control of

length of drilling: 72.20m (107.80m - 180.00m)

Au 0.1 gr/t, Cu 0.12%, Mo 7ppm

Primary zone sy when the whole were the provided the

length of drilling: 111.10m (180.00m - 291.10m)

Au 0.2 gr/t, Cu 0.44%, Mo 59ppm

Two more drill holes (MJM-11 and MJM-12) were sunk in Phase II programme to confirm the extension of the said mineralized zone, one for the north, the other for the south, of the zone, respectively.

The extensions of the mineralization discovered by the hole MJM-8 in Phase I, were also confirmed by these two drill holes, indicating a continuation of more than 400m towards north-south.

The average grade of the mineralized zone in hole MJM-12 is shown as follows: length of mineralization: 81.7 m

Au 0.15 g/t, Cu 0.28%, Mo 33ppm

Based on the results of Phase II drilling survey, five drill holes in Phase III programme were drilled in the southern side of hole MJM-8, with the aggregate depth of 1,507.10m. Finally, the mineralized zone was confirmed to extend about 250m to the south from MJM-8, however, the grade of mineralization decreases towards the south.

As the results of three years survey, it was confirmed that the mineralized zone along the Bambangan creek is a porphyry copper type containing mostly dissemination/fine veinlets of pyrite and minor chalcopyrite.

This zone has an extension of 400M along N-S direction 200-250M along E-W, and a thickness of 90m at the central part, with an average grade of Cu 0.14%, Au 0.07 g/t, Mo 31ppm. However, this mineralized zone is overlain by the Pinosuk Gravels of 70 - 170m thick and with a grade of mineralization is very low in comparison with that from the Mamut ore deposit (Cu 0.56%, Au 0.6 g/t).

The above results seem to be suggestive that, so far as present stage is concerned a low possibility of new mine development is seen.

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However, it is suggested that some mineralized zone which may be as similar zone as these of the Bambangan, occurs in some places underneath of the Pinosuk Gravels.

In A-area other than the A-1 area, two low resistivity zones were detected by CSAMT method. Among these, A-3 zone in Kundasang side seems to have a relation with mineralization, but no further survey has been done. Therefore, for this anomaly (A-3), the follow-up IP-SIP geophysical survey (and drilling based upon the results of IP.SIP survey) is considered necessary.

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PART I GENERAL

Chapter 1 Introduction

1-1 Background of Survey

In the Mt. Kinabalu area, Sabah, Malaysia, ultrabasic to acidic igneous rocks are widely distributed and various types of mineralization have been known to occur, including copper mineralization of porphyry type and Cyprus-type and chromite ore deposit related to ultrabasic rocks.

Furthermore, there also occur several geochemically anomalous zones which have been found by exploration activities during the past years.

Three areas which seem to have potential for mineralization, have been selected (for the collaborative mineral exploration programme in Sabah region), namely the Bambangan, the Mankadau and the Paliu areas.

The field work for these areas has been carried out since 1985 of Phase I to clarify the geology, the geological structure, volcanic activities and the characteristics of mineralization and to delineate and evaluate the occurrence of mineralization.

The survey results of Phase I (1985) and Phase II (1986) are summarized as follows:

1. Bambangan (A, a, 100 km²) area

Phase I programme involved the geophysical survey (CSAMT, IP and SIP methods) and the drilling, Phase II involved the geological mapping and the drilling survey, to find a significant mineralization similar to the Mamut.

The survey results are summarized as follows; the porphyry copper type mineralization occurring in the stock of adamellite porphyry and in the surrounding hornfels was disclosed in the Bambangan area.

2. Mankadau (B, b, 100 km²) area

Phase I programme including the geological mapping, the soil geochemistry and the geophysical survey (CSAMT method) were implemented in the Lingangaa creek area, a tributary of the Mankadau river to investigate the source of floats of extremely high grade (Cu 25 - 60%) of the Cyprus-type copper ore associated with copper mineralization, as well as to test a further potential of chromite ore which was newly discovered as floats in the uppermost stream of the Lingangaa creek, and the other occurring of the chromite ore deposit in the Paranchangan.

All of these areas were covered by semi-detailed geochemical soil survey for Phase II programme together with the semi-detailed geological mapping.

However, neither sources for floats of both copper ore and chromite were detected, nor the extension of known chromite ore deposit or a new indication and anomaly were found.

3. Paliu (c, 4km²) area

Phase I programme including the geological mapping and stream sediment/soil geochemistry, followed by the trenching survey of Phase II, was conducted in the area to clarify the nature of known Cu-Pb-Zn geochemical anomalies.

However, no anomalous zone and mineralization to warrant further exploration were detected.

1-2 Conclusions and Recommendations of Phase II Survey

1-2-1 Conclusions of Phase II Survey

The conclusions obtained from the result of Phase II survey in each area are as follows:

1. Bambangan area

- (1) The mineralized zone in adamellite porphyry intersected by the drill hole MJM-8 occurs also in hornfels and peridotite.
- (2) The stock of microdiorite near the mineralized zone controls the distribution of mineralization.
- (3) The area of mineralization seems to occur in the stock of adamellite porphyry and in the surrounding host rock with an elliptical shape, spreading the area of about 600m in N-S direction and about 300m in E-W direction.
- (4) The pyritized zone in the hole MJM-5 of Phase I was not confirmed by the hole MJM-13 of Phase II.

2. Mankadau area

Regarding the floats of massive sulphide copper ore, its source and occurrence were unrecognizable, despite of the geological survey and the soil geochemistry covering wide areas in Phase II.

It is almost confirmed that the indication of chromite mineralization is partial and small in scale, because of the discovery as only floats during Phase I and the survey of the Paranchangan outcrop in Phase II.

It is assumed that the zone of pyrite impregnation in the west part of the survey area has a low potentiality to develop into a large scaled ore deposit due to its limited occurrence.

3. Paliu area

The result of ten trenches made in the weakly anomalous zone shows a little significant values of the chemical analysis for both Pb content in No. 2 trench and Au content in No. 6 trench, but no continuity of the mineralization could be traced as well as these in the other trenches.

1-2-2 Recommendations for Phase III Survey

The recommendations for Phase III survey based on the result of Phase II survey is as follows:

Regarding aIII (Bambangan) area, the diamond drilling is recommended to confirm the extension of the mineralized zone, detected in the central zone, which is delineated as porphyry copper type mineralization.

For bII (Mankadau) area and cII (Paliu) area, no further survey is advisable, since the area shows a poor mineralization and is not worthwhile for the exploration.

1-3 Outline of Phase III Survey

1-3-1 Survey Area

The survey area, as shown in Fig I and Fig I-1, was a small area (as aIII) of the Bambangan, within A area (100km²), where the mineralized zone was obtained in the northern end of the same area of Phase I and Phase II.

The area is located 2.5km west of the Mamut mine which is 12km NNW of Ranau.

The Ranau town is located 70km direct east from Kota Kinabalu, the state capital of Sabah.

Within the survey area (aIII) the water intake for the Mamut mine is located and there is a gravel road which belongs to the mine, so that the accessibility is rather convenient.

1-3-2 Purpose of Survey

Based on the recommendations of phase II survey, the phase III drilling aimed at checking a southousand lateral and vertical extension of the mineralized zone along the Bambangan creek, and charifying its occurrence and grade in order to assess its potential for development.

1-3-3 Method of Survey

To achieve the above-mentioned purposes, five drill holes were allocated in the southern side of the hole MJM-8, including two holes (MJM-14, MJM-15) in east side and the rest of three holes in west side of the Bambangan creek (Fig.II-1).

			Drill Le	ngth m
Hole No.	Bearing	Inclination	Planned	Actual
MJM-14	-	-90°	300	301.00
MJM-15	-	-90°	300	300.60
MJM-16	^	-90°	300	304.00
MJM-17	۳	-90°	300	301.00
MJM-18		-90°	300	300.50
Total			1,500	1,507.10

Two drilling machines equipped with a wire-line (TGM-2C and TGM-5) were used. All holes were drilled in "BQ" size and the core recovery was kept as high as possible.

The core samples, which contain the sulphide mineralization, were chemically analysed for six elements of Cu, Au, Mo, Pb, Zn and Ag in the Geological Survey of Malaysia, Sabah, Kota Kinabalu.

For the representative core samples of rock and ore mineral, the laboratory study of thin section, polished section and X-ray diffractive analysis were carried out.

The list of analysis test for specimens is as follows:

	No. of	•	Rock	Ore	
	Core S	Sample	Thin	Polished	X-Ray
(Holl No.)	(No. o	f Elemnts)	Section	Section	Diffractive
MJM-14	121	(726)	3	5	2
MJM-15	91	(546)	3	3	3
MJM-16	64	(384)	2	1	1
MJM-17	84	(504)	1	3	4
MJM-18	110	(660)	3	3	- 3
Total	470	(2,820)	12	15	13

1-3-4 Organization of Mission

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The members participating in the planning and negotiation of the survey and in the field survey are as follows.

Planning and Negotiation

Japanese Counterparts

Seiichi Ishida

Metal Mining Agency of Japan

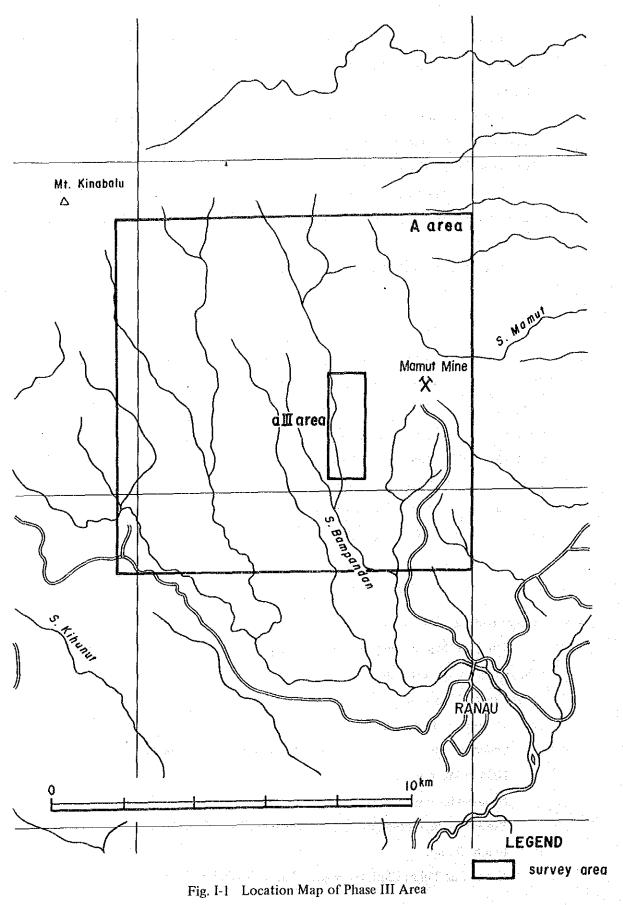
Natsumi Kamiya

Malaysian Counterparts

Yin Ee Heng, Geological Survey (Head Office in Kuala Lumpur)

Fateh Chand,

David Lee Thien Choi, Geological Survey (Sabah Office)



Field Survey		
Japanese Team		
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	core logging	Co., Ltd.
	and report)	
Hirofumi Taniguchi		
	(Leader, core	" (26th Aug.
	logging and	9th Oct.)
	report)	
Tadashi Yamakawa	(Geology and	<i>"</i>
	geochemistry)	
Mahito Hamazaki	(Drilling)	,,
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Chan Fook On	(Chemical analysis	" "
Technical Assistant		
Japili Samin	(Drilling)	<i>"</i>
Roger Jinijo Totu	(")	" "
Francis Geoffery	(")	" "
Chua Yun Ling	(")	" "

1-3-5 Duration of Survey

The field work was started on 1st July, 1987 and completed on 9th October, 1987. Data interpretation and report preparation were made in Japan. All the works were completed on 10th February, 1988.

The timetable of Phase III work is shown in Table I-1.

Table I-1 Timetable of Phase III Work

	July,	Aug.,	Sept.,	Oct.,	Nov.,	Dec.,	Jan.,	Feb.,
		0			/0/1	70/1	1700	1200
Mobilization & Preparation	1 16						,	
Drilling Work								
Hole MJM-14	17 31	:						
Hole MJM-15		<u>"</u> []						
Hole MJM-16			11 26					
Hole MJM-17	÷ ,	13 25		•				
Hole MJM-18	······································	11	-4Π_					
Dismantlement & Demobili	ilization		27	ω Γ				
Analysis & Compilation (in Malaysia)			27	ீ∏				
Analysis & Compilation				10			15	
(in Japan)							Ì	
Report			. ,				1.6	°

Chapter 2 Geography of Survey Area

2-1 Topography and River System

The area for survey (aIII) is located within the area showing a steep topography.

The Bambangan area is located around the steep portion on the south-east side of Kinabalu mountain. The highest point in the northern end of the survey area lies at an elevation of 1,833.20m ASL, decreasing the elevation towards south. The lowest point in the south end of the area has an elevation of 1,300m ASL, and the topography changes to the elevated plain. Bambangan valley running to the south with a rapid current forms a deeply desected V-shaped valley with steep cliffs on both sides. The eastern part of the area has a topography of steep cliff in places due to the occurrence of hard portion of "solid" Pinosuk Gravels.

The river systems run from north to south where the Bambangan creek is joining into Liwaou river in Ranau area, then running to east direction.

2-2 Climate and Vegetation

Climate in Sabah state is tropical and oceanic.

Ranau area belongs to the inland region, it has been said that the period of the rainy season is from October to the following February, next year. However, the seasonal change of precipitation is rather small.

The annual precipitation in the mountainous area is from 1,500 to 2,000 milimetres and exceeds more than 3,000 milimetres in the mountains. The annual precipitation in Mamut mine falls in the range of 2,100 milimetres to 4,000 milimetres.

No seasonal variation of the temperature is clearly recorded. It varies from 12°C to 22°C in the mountainous area, showing a notable daily variation. The humidity is high throughout the region.

The area is located in the midst of the densely tall and dwarf trees, harbaceous plants and ferns grow very thick due to the high moisture, leading to take time for making the route for drilling.

Chapter 3 General Geology

The Geology of the project area including Mt. Kinabalu and its vicinity, as is shown in Fig. I-2, comprises the thick sequence of volcanic and sedimentary rocks of the "Northwest Borneo Geosyncline" overlying the crystalline basement, which are intruded in places by igneous rocks of ultrabasic to acidic composition.

1. Stratigraphy

Volcanics and sedimentary sequence of the area are divided into five units in ascending order; (1) basement, (2) Undifferentiated sedimentary and metamorphic rocks, (3) Chert-Spilite Formation, (4) Rajang Group, and (5) Pinosuk Gravels (Fig. I-3). The main lithofacies of these rocks can be summarized as follows.

(1) Basement

The basement rock around Mt. Kinabalu is generally called "Crystlline Basement" consisting of schist and gneiss of Jurassic to Triassic or older age. Small exposures of the Crystalline Basement are distributed in the headwaters of the Bambangan valley and in the western flank of Mt. Kinabalu.

(2) Undifferentiated Sedimentary and Metamorphic Rocks

This unit, which is composed of hornfels of mudstone and sandstone origin, is distributed from the northern part of Mamut mine to upstream of the Mankadau river.

(3) Chert-Spilite Formation

This formation consisting chiefly of spilitic basalt lava with interbeded chert, sandstone and mudstone is believed to be derived from basic volcanic activities of the Northwest Borneo Geosyncline of early stage, probably of late Cretaceous to Paleocene. The spilitic basalt lava is characterized by pillow structure. The Chert-Spilite Formation is well exposed to the north of the Mankadau river, though not shown in the geologic map of the Kinabalu area (Fig. 1-2).

(4) Rajang Group

This is composed of the thick sedimentary sequence deposited in the Northwest Borneo Geosyncline during the Paleocene to early Miocene age. The difference of lithofacies allows the unit to be divided into the Trusmadi Formation of Paleocene to Eocene and the Crocker Formation of Oligocene to early Miocene. The stratigraphy of the two formations has not fully been established yet, as each of them indicates

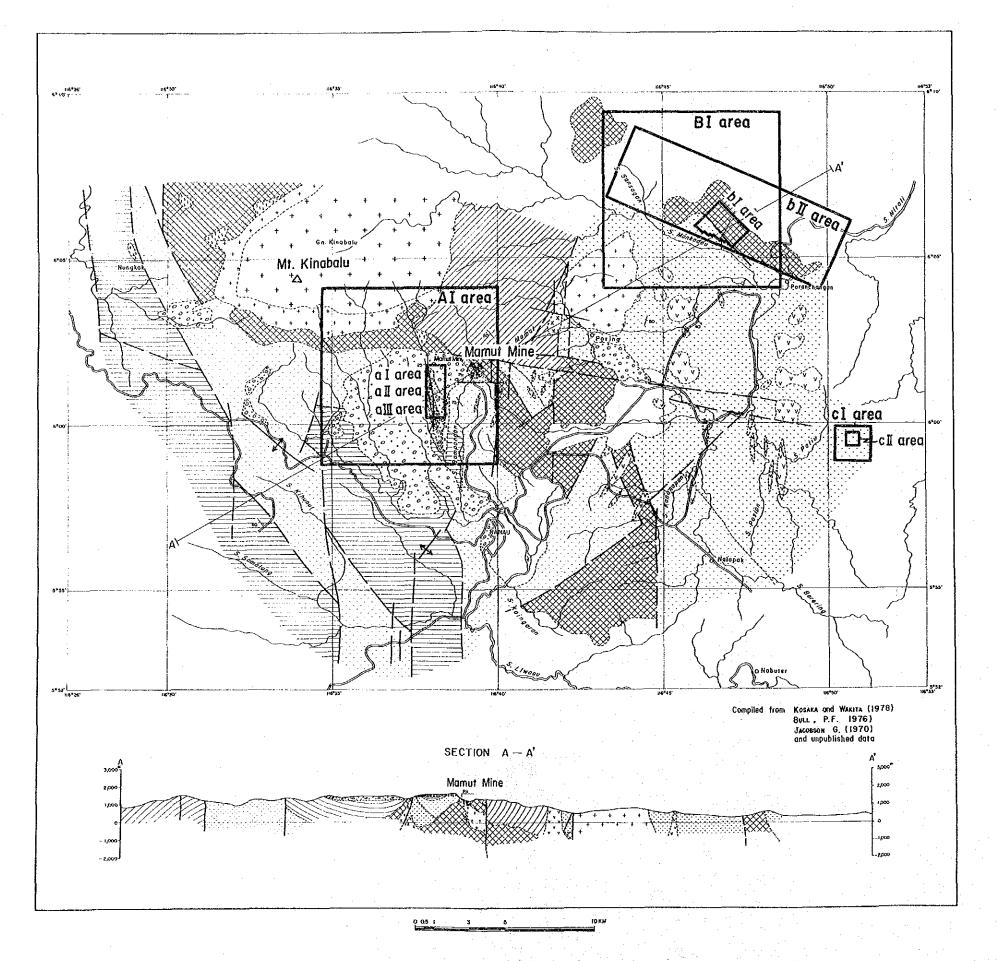
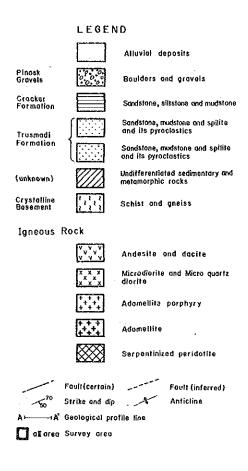
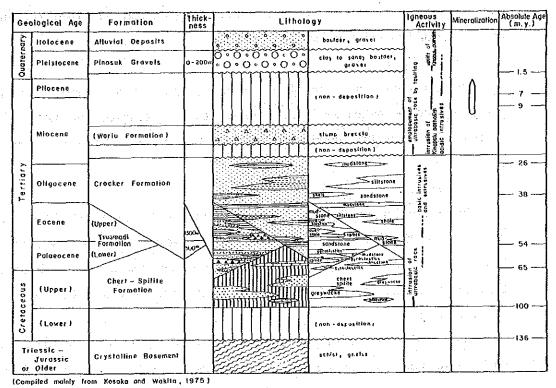
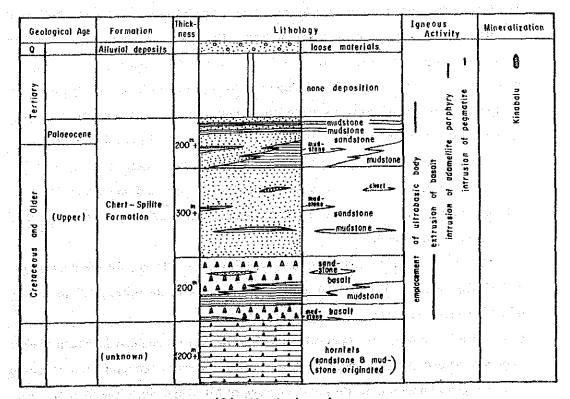


Fig. I-2 Geological Map of Kinabalu Area





(1) Kinabalu – Ranau Region



(2) Mankadau Area

Fig. I-3 Generalized Stratigraphic Section of Kinabalu Area

contemporaneous heterotopic facies in the interfingered part. The lithofacies and distribution of the two formations are given below.

(i) Trusmadi Formation

This formation is made up of gray to dark gray argillaceous rocks, slate and partly siltstone and sandstone with occasional occurrence of pyroclastic material. Its distribution is generally limited to the east side of N-S tie-line between Mamut & Ranau.

(ii) Crocker Formation

The Crocker Formation is widely exposed in the area from the west of the above N-S tie-line to Kundasang and also around the small adamellite stock of Mt. Nungkok. The Formation is chiefly composed of sandstone, siltstone and gray to red slate. Generally arenaceous facies is more dominant in this formation than in the Trusmadi.

(5) Pinosuk Gravels

Overlying the above described units are Quaternary sediments. This unit is distributed for an approximate aerial extent of 50km^2 at an elevation between 1,200 and 1,500 metres on the southern side of Mt. Kinabalu from the upper flank of the relatively gentle slope, where a steep landform of the intrusive mass comes to an end, towards the south through the Pinosuk settlement. The lower end of the unit collapsed and flowed out as mud flow to reach the Ranau floodplain on the southeast, and the large boulders have been left in the riverbed of the drainage system flowing along the western margin and in the alluvial floodplain of the Ranau basin. The pebbles are composed of every kind of rocks in the area, including adamellite, adamellite porphyry, peridotite, Tertiary sedimentary rocks, and even mineralized rocks occasionally. The size of pebbles widely ranges from 1 - 50cm to 1 - 5m, rarely reaching up to 10 - 20m. They are generally subangular and sometimes breccias and rarely round pebbles are also found. The groundmass is variably solidified, consisting of coarse-grained sand of adamellite origin.

Radiocarbon dating of buried wood has given 7,980 \pm 100 years for the uppermost, and 34,000 (+2,200 - 1,800) years and 39,900 \pm years for the other parts, indicating of the late Pleistocene age.

Unconformity showing on genetical differences of the bed enabled Jacobson (1970) to divide the bed into two layers; the lower section consists of conglomerate resulting from periglacial phenomena during the ice age of Mt. Kinabalu, while the upper section consists of sediments of mudflow from high peaks partly containing reworked

glacial moraine.

2. Intrusive Rocks

Around Mt. Kinabalu there are various kinds of intrusive rocks, which are chiefly composed of adamellite and peridotite. Their characteristics are summarized as follows.

(I) Adamellites

Adamellite is an intrusive batholith constituting the main part of Mt. Kinabalu, showing a peculiar landform with an altitude of 4,101 metres ASL. Its exposure has an area of 155 square kilometres (i.e., 60 square miles) extending rather northeasterly, whereas its subsurface distribution is considered to spread over 500 square miles (i.e. 1,300 square kilometres) (Jacobson, 1970).

Therefore, the surface and subsurface distribution of adamellite batholith extends over the whole project area. Its periphery tends to be porphyritic, particularly on the southern and western slope zonally around Mt. Kinabalu.

It is also exposed north of the Poring settlement, forming a low maintain mass, and extending northeasterly with an elevation of about 750 metres and a diameter of 5 kilometres.

The whole area of Mamut ore deposit which is adjacent to the south of Mt. Kinabalu, is considered to lie on the extent of batholith.

The cupolas or apophyses branched off from the adamellite batholith of Mt. Kinabalu resulted in the formation of adamellite porphyry stock, which is considered to be genetically related to mineralization of the Mamut deposit, and formation of dikes abundantly occurred on the top and periphery of Mt. Kinabalu. The adamellite porphyry stock, which has a surface extent of about 800 metres in N-S and 300 metres in E-W with an eastward dip of 40°, (Kosaka and Wakita, 1975), forms the major host rock of the Mamut deposit.

Radiometric date of adamellite intrusives has 9m.y., corresponding to the later stage of the orogenic movement which took place from late Miocene to early Eocene, or immediately after that age.

(2) Peridotite

Peridotite in the project area lies in the southern and western parts of the Kinabalu mountain mass, in the southeastern part of Mamut and in the southwest of Ranau.

The rocks are mostly peridotite and local dunite. These rocks have been sheared and fractured into breccias in many cases. Serpentinization is generally observable. In

Sabah State, peridotite often occurs in contact with spilitic basalt lava of the Chert-Spilite Formation, and it shows a broad distribution in southern fault contact with spilitic basalt lava.

The age of peridotite intrusion is considered to be late Cretaceous, earlier than adamellite intrusion.

3. Alteration

Contact metamorphism, which resulted from the intrusion of adamellite batholith of Mt. Kinabalu, develops in the Rajang Group, particularly in the Trusmadi Formation close to the batholith (east to south of Mt. Kinabalu). A zone of contact metamorphism of hornfels generally extends over 1,500 metres from the contact with the batholith.

4. Geologic Structure

The project area is regionally located in the tectonic zone called "Kinabalu Fault" (Tokuyama and Yoshida, 1974) which is characterized by NW-SE trending strike-slip faults, where intrusive and extrusive igneous activities of ultrabasic to acidic rocks are predominant.

N-S trending faults in addition to NW-SE fault system also predominate in the project area around Mt. Kinabalu. Subsequent block movements occurred repeatedly in the formations distributed east to south of Mt. Kinabalu, with the southern and eastern side of the block slipped down. E-W and NE-SW trending faults, which are smaller in scale than those of NW-SE and N-S systems, are also present in the project area, giving a local control on the geologic structure.

Chapter 4 Overall Discussion of Survey Result

It was confirmed, by drilling in Phase III, the occurrence of the mineralized zone in the Bambangan creek, the characteristics of mineralization and its extension.

For this year, as the last phase of the collaborative mineral resources exploration survey, the potential of the occurrence of ore deposit was discussed.

- 1. The mineralized zone is of a porphyry copper type, forming in hornfels and peridotite and adamellite porphyry stock intruded along N-S direction in the Bambangan creek. An occurrence is as similar as these of the Mamut.
- The ore minerals consist of pyrite and chalcopyrite accompanying a minor amount of molybdenite. In a shallow zone of the drill holes, it is found cuprite, tenorite, chalcocite and native copper, all as secondary minerals forming a weak oxidized zone.
- The intensity of mineralization is different among host rocks, as it is predominant in adamellite porphyry stock as well as in hornfels occurring in the surrounding area of an intrusive mass.
 - The mineralization becomes gradually weak as it goes away from the boundary zone. The mineralization in peridotite is weak and local.
- 4. The intrusive of adamellite porphyry stock is, as shown in Map I-4, of ellipsoidal shape, extending to N-S direction, and plunges to south.
- 5. The mineralized zone occurs around adamellite porphyry stock, and extends to the surrounding rocks. Based on the drilling results of 5 holes in Phase III together with those in Phases I and II, the mineralized zone seems to extend about 400 m in N-S direction and about 200-250 in E-W direction with a thickness of 90 m at the center.
- 6. Regarding the grade, the average value is as follows;
 - 1) 96m, Cu 0.06%, Au 0.04 g/t, Mo 24 ppm, for five holes in Phase III
 - 2) 91.4m, Cu 0.14%, Au 0.07 g/t, Mo 31 ppm for seven holes including MJM-8 and MJM-12. For reference, the average grade for MJM-8 in Phase I are:

110m, Cu 0.44%, Au 0.2 g/t, Mo 59 ppm

and for MJM-12 in Phase III are:

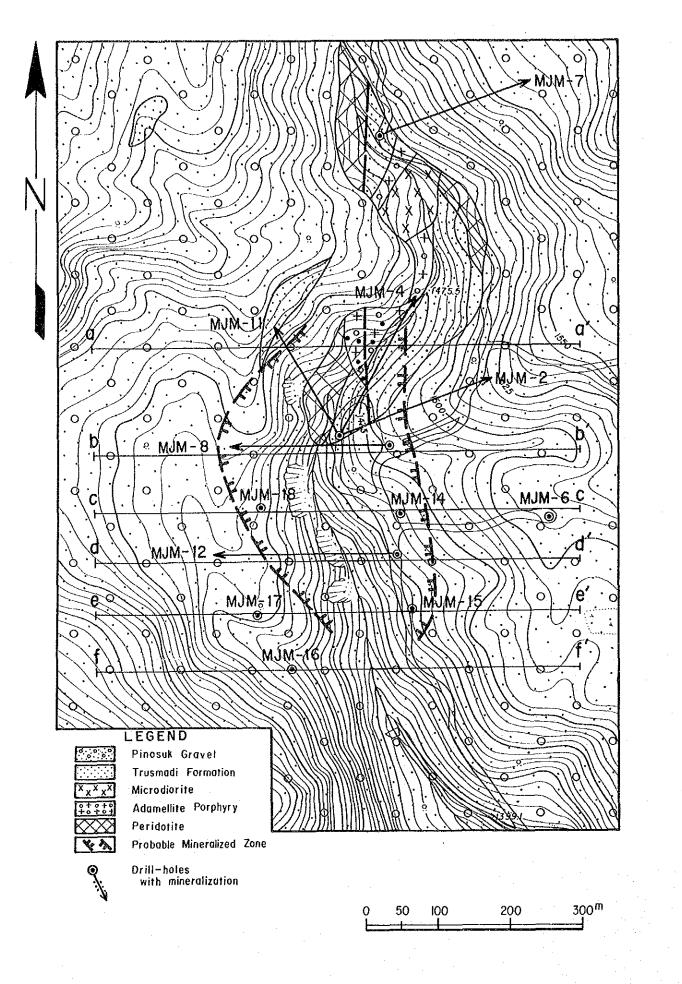
51m, Cu 0.35%, Au 0.06 g/t, Mo 36 ppm

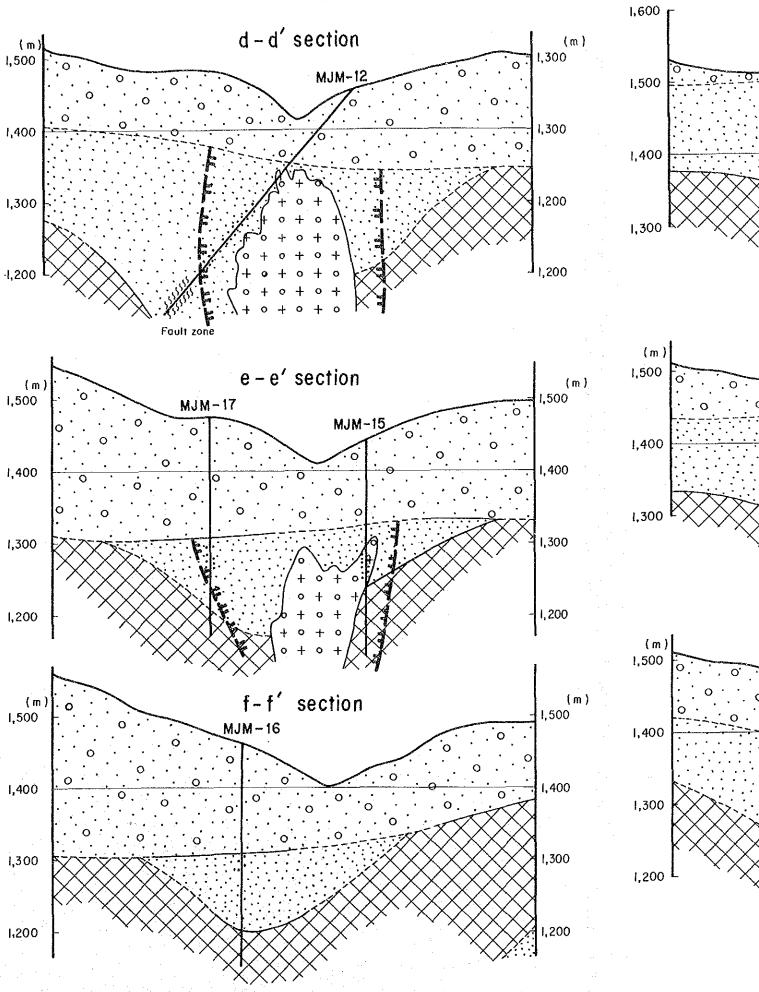
The above-mentioned figures show a much lower grade than those of the Mamut ore deposit (i.e. Cu 0.56%, Au 0.6 g/t).

7. The Pinosuk Gravels covers the mineralized zone with a thickness of 70 - 170m, as shown in Map I-4.

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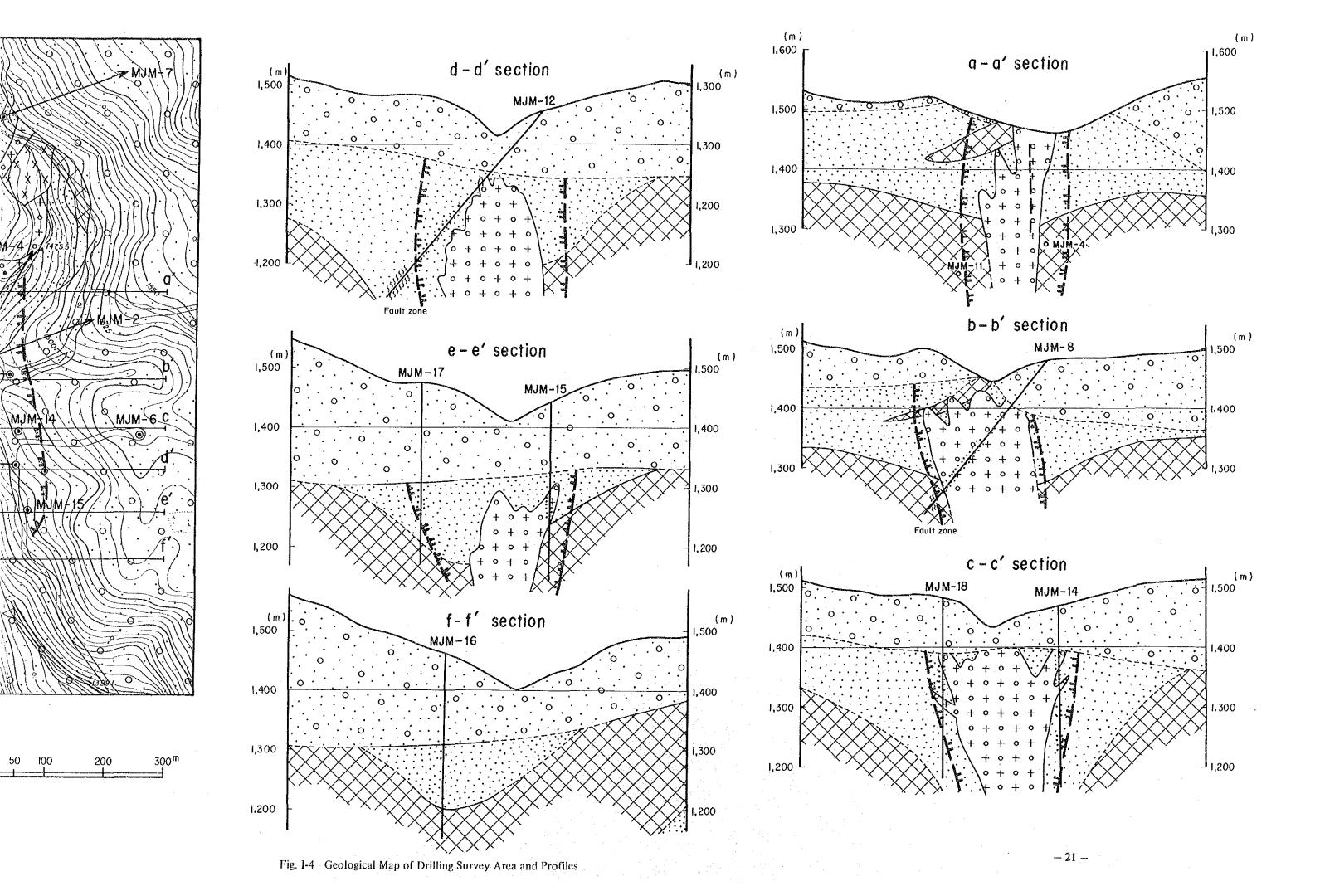
- 8. As stated above, the mineralized zone, discovered in the Bambangan creek, has a low possibility for becoming an economical ore deposit.
- 9. However, the discovery of blind mineralized zone under the thick Pinoruk Gravels by geophysical survey and drilling is much significant from the geological and exploratory points of view, which suggests a potential for existence of similar mineralized zones under the Gravels.





(m)

Fig. I-4 Geological Map of Drilling Survey Area and Profiles



Chapter 5 Conclusions and Recommendations

5-1 Conclusions

A porphyry copper type mineralized zone was discovered underneath thick Pinosuk Gravels in the Bambangan creek. However, its average grade of mineralized zone of seven drill holes (consisting MJM-8 and MJM-12 of Phase I and II, MJM-14 — MJM-18 of Phase III) is very low, with 91.4m in length of drilling vertical and with the grade of Cu 0.14%, Au 0.07 g/t, Mo 31 ppm (even though containing a better part of Cu 0.35 - 0.44% partially). The mineralized zone is covered by thick Pinosuk Gravels (70 - 170m thick). Therefore, it is thought that the mineralized zone presents a rather small economical value and consequently low potential for development so far at present stage is concerned.

However, it is suggested that some mineralized zone which may be the similar zone to these of the Bambangan, could be occurred in some places underneath the Pinosuk Gravels.

5-2 Recommendations

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According to the above conclusions, no further exploration for the mineralized zone in the Bambangan area is seen necessary.

However, in A area other than A-1 area, two low resistivity zones were detected by CSAMT method. Among these, A-3 zone in Kundasang side seems to have a relation with meneralization, but no further survey has been done. Therefore, for this anomaly (A-3), the follow up IP.SIP method survey (drilling based upon the results of IP SIP survey) is considered necessary.

PART II DRILLING

Chapter 1 Drilling Method

1-1 Allocation of Holes

The location of the drill holes was selected in the south side of the hole MJM-8 to confirm the lateral and vertical extension of mineralized zone together with ore grade.

The allocation of five holes in Phase III is shown in Fig.II-1...

1-2 Drilling Method

Regarding casing programme, for the portion of overburden, firstly the hole was started, using HW casing pipe equipped with diamond shoe. Secondly, inserting the NW casing pipes with diamond shoe, the work were continued by NQWL with diamond bit. Top part of the ground in all holes consists of the Pinosuk Gravels, having a fragile character. Therefore in the same drilling process, after drilling by NQWL, the diametre of hole were enlarged using NW casing. When NW casing pipe can not be inserted, it was started to drill by NQWL.

If the hole encountered the fractured zone before the depth of BW casing pipe to be inserted and the fractured zone showed the low or high water pressure, the cementation method was applied.

For the drilling, bentonite mud water method was applied, more-over mud water mixed with CMC mud oil and mud fluid ("Libonite") was used when the hole encountered the sheared zone or the Pinosuk Gravels.

1-3 Drilling Machine and Consumed Materials

The drilling machines consists of a set of Tone Boring TGM-5 and a set of TGM-2C (both drilling capacities are 510m in NQ size and 660m in BQ size). For the pump and mixer, the engines were overhauled before use.

The specifications of drilling machines and pumps, diamond bits and the details of consumed materials such as bentonite, light oil and mud materials are shown in Tables II-1, 2, 3.

1-4 Form of Works

For the preparations of drilling site, removal and dismantlement of drilling machine, one shift per day was applied, and the drilling work was done by three shifts of eight hours each in a day. The number of personnel for drilling work per shift were five, consisting of one Japanese engineer, one counterpart from the Geological Survey of Malaysia, Sabah and three local employees.

Results of the time table of drilling work are shown in Table II-4, the summary record of drilling results is in Table II-5, progress record of diamond drilling is in Fig.II-2.

1-5 Transportation of Machines, Equipments, Materials, and Preparatory Work

Immediately after the arrival of crew members, the preparatory work were carried out;

- maintenance of road leading to the drill site,
- the ground levelings of the site of holes MJM-14 and MJM-15,
- transportation of two machines, auxiliary equipments and materials which have been kept in the advanced base camp of the Geological Survey of Malaysia, Sabah near Batu-2 in Ranau.

(The starts of drilling work of MJM-14 hole and MJM-15 hole were on July 17 and on July 21, respectively.)

1-6 Water Supply

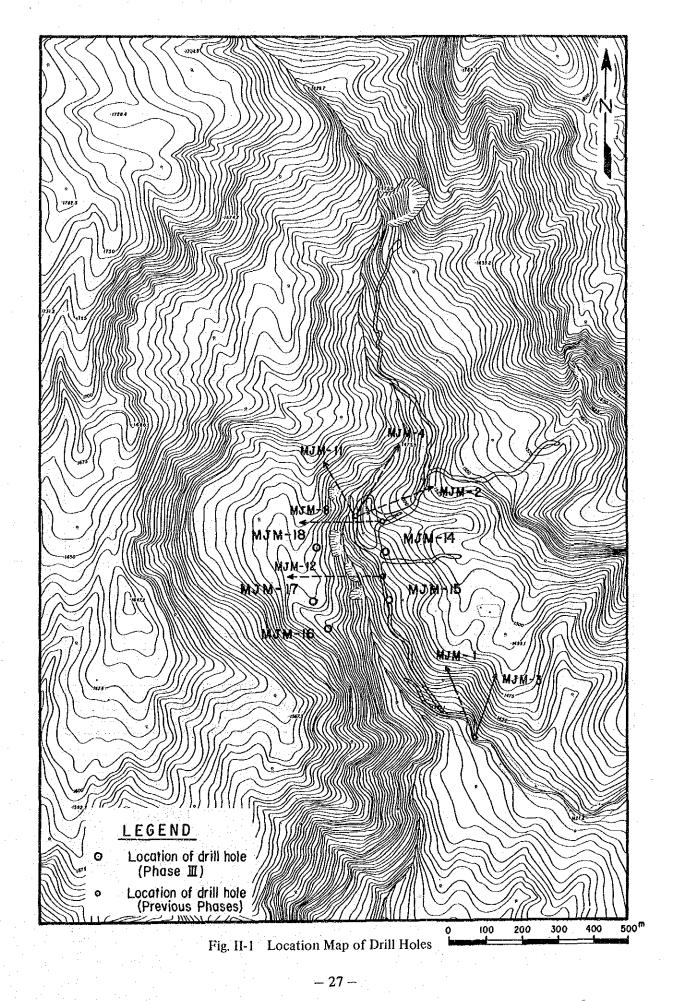
The water for drilling work of hole MJM-15 was collected from the upper reach of Bambangan creek, using a line of plastic pipe with a length of 250m.

For the other holes, the water was supplied from the upper reach of the creek nearby. The distances were 200m for hole MJM-14, 250m for hole MJM-18, 300m for hole MJM-17 and 300m for hole MJM-16.

1-7 Dismantlement

After the completion of drilling work, all items were collected, then the machines and equipments were shipped back to Japan, except some items which were donated to the Geological Survey of Malaysia in Kota Kinabalu.

All cores were put in the core box, and transferred to the office of Geological Survey of Malaysia, Sabah.



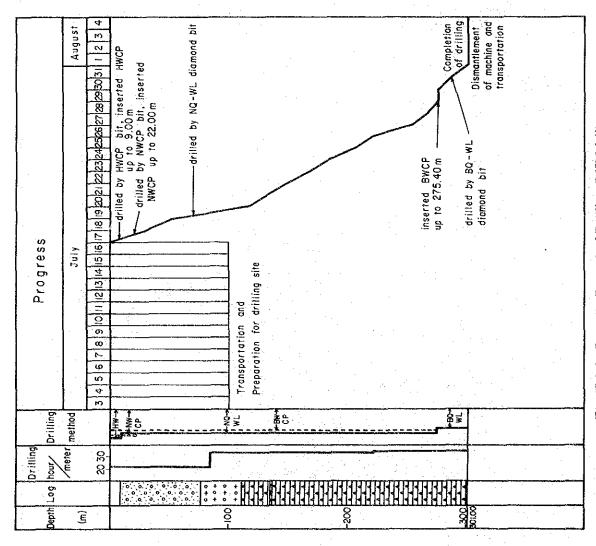


Fig. II-2-1 Progress Record of Drilling (MJM-14)

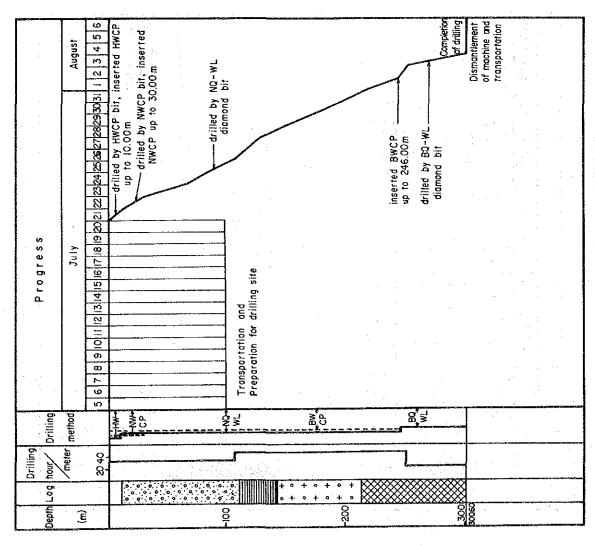


Fig. II-2-2 Progress Record of Drilling (MJM-15)

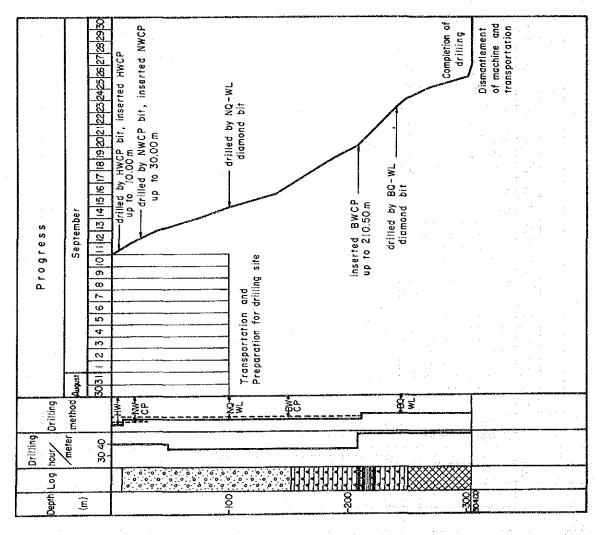
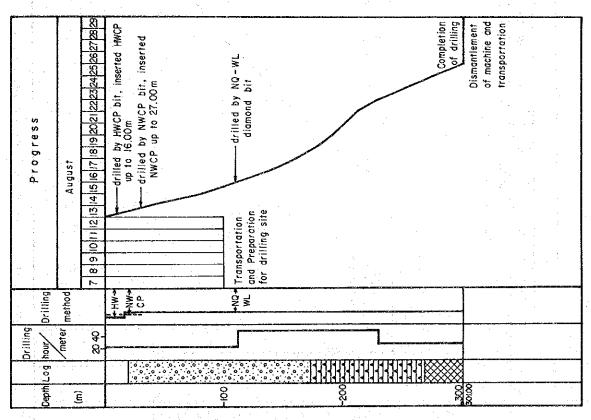


Fig. II-2-3 Progress Record of Drilling (MJM-16)



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Fig. II-2-4 Progress Record of Drilling (MJM-17)

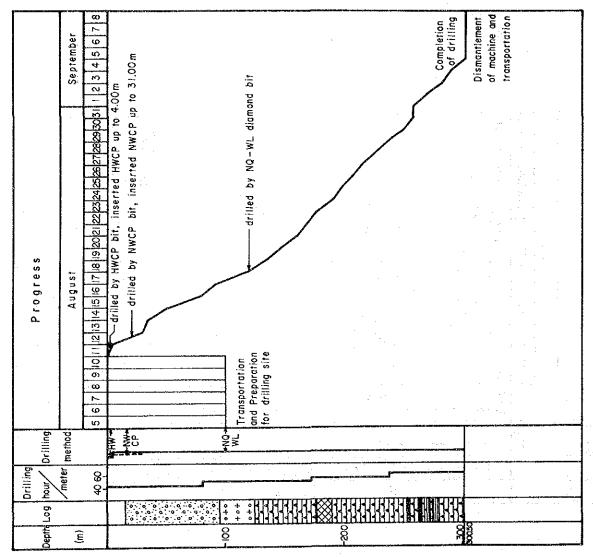


Fig. II-2-5 Progress Record of Drilling (MJM-18)

Table II-1-1 Specification of Drilling Machine (MJM-14)

Drilling Machine TGM-2C	1 set
Specifications:	
Capacity	660m (BQWL)
Dimensions L×W×H(mm)	2,430×990×1,520
Hoisting capacity	2,200 kg
Spindle speed (r.p.m.)	Forward 170, 405, 630, 825
Engine	"F3L-912"
Drilling Pump "NAS-3C"	1 set
Cylinder bore dia.	75mm
Capacity	22, 130½/min
Engine	"NS-130C"
Water supply pump "NES-100B"	
Capacity	100g/min
Engine	"NS-65"
Wire line Hoist "WHS-600"	1 set
Rope capacity	600m
Engine	Drilling machine's engine power take off
Mud Mixer "MLE-100"	1 set
	1258
Engine	"NS-65"
Generator	-1 set
	YAMMAR Model "YSG-2SN"
Drilling Tools	
Drilling Rod	NQ-WL 3.0m 92 pcs.
	BQ-WL 3.0m 101 pcs.
Casing Pipe	HW 1.0m 9 pcs.
1.00 %. 000 m	NW 1.0m 22 pcs.
n de Marie Verrande de Grande de Carlos de Grande de Carlos de Carlos de Carlos de Carlos de Carlos de Carlos d Carlos de Carlos de Carl	BW 3.0m 92 pcs.
Derrike	1 set
The Mark Charles	Model "DRP-9-5"

Table II-1-2 Specification of Drilling Machine (MJM-15)

Drilling Machine TGM-5	1 set	
Specifications:		
Capacity	660m (BQWL)	
Dimensions L×W×H(mm)	2,720×1,130×1,640	
Hoisting capacity	2,200 kg	
Spindle speed (r.p.m.)	Forward 170, 405, 630,	825
Engine	"F3L-912"	
Drilling Pump "NAS-3T4"	1 set	
Cylinder bore dia.	75 mm	$x^{-1/2} = x^{-1/2} + x^{-1/2}$
Capacity	22, 130l/min	4 - \$15 -
Engine	"TS-155C"	
Water supply pump "NES-100"		e, etc. d
Capacity	1001/min	
Engine	"NS-65"	
Wire line Hoist "WHS-600"	1 set	
T)	600m	
Rope capacity	OOOM	 A second control of the control of the
Rope capacity Engine	Drilling machine's engin	e power take off
		e power take off
Engine	Drilling machine's engin	e power take off
Engine Mud Mixer "MLE-100"	Drilling machine's engin	e power take off
Engine Mud Mixer "MLE-100" Capacity	Drilling machine's engin 1 set 1258	e power take off
Engine Mud Mixer "MLE-100" Capacity Engine Generator	Drilling machine's engin 1 set 1258 "NS-65"	
Engine Mud Mixer "MLE-100" Capacity Engine Generator	Drilling machine's engin 1 set 1258 "NS-65"	
Engine Mud Mixer "MLE-100" Capacity Engine Generator	Drilling machine's engin 1 set 1258 "NS-65"	
Engine Mud Mixer "MLE-100" Capacity Engine Generator Drilling Tools	Drilling machine's engin 1 set 1258 "NS-65" 1 set YAMMAR Model "YDO	G-2000E"
Engine Mud Mixer "MLE-100" Capacity Engine Generator Drilling Tools	Drilling machine's engin 1 set 1258 "NS-65" 1 set YAMMAR Model "YDO NQ-WL 3.0m	G-2000E" 83 pcs.
Engine Mud Mixer "MLE-100" Capacity Engine Generator Drilling Tools Drilling Rod	Drilling machine's engin 1 set 1258 "NS-65" 1 set YAMMAR Model "YDC NQ-WL 3,0m BQ-WL 3,0m	83 pcs. 101 pcs.
Engine Mud Mixer "MLE-100" Capacity Engine Generator Drilling Tools Drilling Rod	Drilling machine's engin 1 set 1252 "NS-65" 1 set YAMMAR Model "YDO NQ-WL 3.0m BQ-WL 3.0m HW 1.0m	83 pcs. 101 pcs. 10 pcs.
Engine Mud Mixer "MLE-100" Capacity Engine Generator Drilling Tools Drilling Rod	Drilling machine's engin 1 set 125g "NS-65" 1 set YAMMAR Model "YDC NQ-WL 3.0m BQ-WL 3.0m HW 1.0m NW 1.0m	83 pcs. 101 pcs. 10 pcs. 30 pcs.

Table II-1-3 Specification of Drilling Machine (MJM-16)

Make the form of the contract			
Drilling Machine TGM-5	1 set		
Specifications:			. : "
Capacity	660m (BQW	L)	•
Dimensions L×W×H(mm)	2,720×1,130	×1,640	•
Hoisting capacity	2,200 kg	ž.	
Spindle speed (r.p.m.)	Forward 170	, 405, 630, 82	.5·
Engine	"F3L-912"		
Drilling Pump "NAS-3T4"	l set		
Cylinder bore dia.	75mm		
Capacity	22, 130º/mii	n,	
Engine	"TS-155C"		Tytol
Water supply pump "NES-100"			
Capacity	100g/min		
Engine	"NS-65"		
		~ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	
Wire line Hoist "WHS-600"	1 set		
Rope capacity	600m		
Engine	Drilling macl	hine's engine p	ower take off
Mud Mixer "MLE-100"	· l set	14.31.	
Capacity	1258	•	
Engine	"NS-65"		, W
		<u> </u>	
Generator	1 set	•	
e de la company de la comp La company de la company d	YAMMAR M	Iodel "YDG-2	000E"
Drilling Tools			
Drilling Rod	NQ-WL	3.0m	71 pcs.
Lister Services Translated	BQ-WL	3.0m	102 pcs.
Casing Pipe	HW	1.0m	10 pcs.
wales to be a set of the	NW	1.0m	30 pcs.
	BW	3.0m	71 pcs.
Domito	1*		
<u>Derrike</u>	1 set) () E''	
	Model "DRP	'-y- 3¨	
		4 4 4 4	

Table II-1-4 Specification of Drilling Machine (MJM-17)

<u>Derrike</u>	1 set Model "DRP-9) ₋ 5"	
	NW	1.0m	27 pcs.
Casing Pipe	HW	1.0m	16 pcs.
	:		
Drilling Rod	NQ-WL	3.0m	101 pcs.
Drilling Tools		÷	al pagabag Marajaran
	YAMMAR Mo	odel "YDG-2	000E"
Generator	1 set		
Engine	"NS-65"		
Capacity	1258		Section 2
Mud Mixer "MLE-100"	1 set	÷	
Engine	Drilling machi	ne's engine	power take off
Rope capacity	600m		es e
Wire line Hoist "WHS-600"	1 set		
Engine	"NS-65"		
Capacity	100g/min		
Water supply pump "NES-100"			
Engine	"TS-155C"		
Capacity	22, 130l/min		to see the property
Cylinder bore dia.	75mm	+ -	
Drilling Pump "NAS-3T4"	1 set		
Engine	"F3L-912"		1
Spindle speed (r.p.m.)	Forward 170,	405, 630, 8	25
Hoisting capacity	2,200 kg	2.50	+ 1
Dimensions L×W×H(mm)	2,720×1,130×	•	
Capacity	660m (BQWL)	
Drilling Machine TGM-5 Specifications:	1 set		

Table II-1-5 Specification of Drilling Machine (MJM-18)

Drilling Machine TGM-2C	1 set
Specifications:	
Capacity	660m (BQWL)
Dimensions L×W×H(mm)	2,430×990×1,520
Hoisting capacity	2,200 kg
Spindle speed (r.p.m.)	Forward 170, 405, 630, 825
Engine	"F3L-912"
Drilling Pump "NAS-3C"	1 set
Cylinder bore dia.	75mm
Capacity	22, 130½/min
Engine	"NS-130C"
Water supply pump "NES-100B"	
Capacity	100¢/min
Engine	"NS-65"
Wire line Hoist "WHS-600"	1 set
Rope capacity	600m
Engine	Drilling machine's engine power take off
Mud Mixer "MLE-100"	1 set
Capacity	1252
Engine	"NS-65"
Generator_	1 set
	YAMMAR Model "YSG-2SN"
Drilling Tools	
Drilling Rod	NQ-WL 3.0m 101 pcs.
Casing Pipe	HW 1.0m 4 pcs.
	NW 1.0m 31 pcs.
Derrike	1 set
	Model "DRP-9-5"

Table II-2-1 Drilling Meterage by Diamond Bit

Item Size of Bit Type of Bit Carats per Bit Matrix Stones per Carat Water way Total bit Used Diamond Bit Total 870 E 25 4 29 S9.6mm BQ-WL 20 E 25 4 4 Total 80 E 25 4 4 Grand Total *950 R *950 8 33								
Diamond Bit Total NQ-WL 30 E 25 4 S9-6mm BQ-WL 20 E 25 4 Total 80 R 4 8 Grand Total *950 *950 R 4	Item	Size of Bit	Type of Bit	Carats per Bit	Matrix	Stones per Carat	Water way	
Diamond Bit Total 870 E 25 4 59.6mm BQ-WL 20 E 25 4 Total 80 80 8 Grand Total *950 *950		75.3	NQ-WL	30	ជ	25	4	29
59.6mm BQ-WL 20 E 25 4 Total 80 *950		Total		870				29
Total 80 *950		59.6mm	BQ-WL	20	Ħ	25	4	4
056*		Total		80				4
	Grand Tot	tal		056*				33

E: for ordinary rock
*: Total amount of Diamond Carat

Table II-2-2 Drilling Meterage by Diamond Bit

()

	Carrier and the second property of the second	D:4 N7			Drilling Meterage by hole (m)	y hole (m).		
IIeIII	Size	DIL INO.	MJM-14	MJM-15	MJM-16	MJM-17	MJM-18	lotai (m)
		ON6-12	50.80					50.80
		1851764	49.60					49.60
		187559	55.80					55.80
		187560	61.40					61.40
		187316	57.80					57.80
		187318		49.20				49.20
		187321		48.70				48.70
		187315		61.40				61.40
Diamond Bit	NQ-WL	187322		32.50				32.50
		187320		54.20				54.20
	· ·	187317			42.10			42.10
	·.	187319			44,40			44,40
		187323			40.30			40.30
		187324			41.50			41.50
		187371			42.20			42.20
		187370				75.30		75.30
		187683				101.20		101.20
		187684				59,20		59.20
		187369				65.30		65.30
		187723					29.30	29.30
		187725					40.50	40.50
		187726					31.20	31.20
		187729					29.80	29.80
		187730					33.40	33.40
		187372					40,40	40,40
	٠.,	187373					25.60	25.60
		187374					31.40	31.40
	-	187731					29.50	29.50
		187732					9.40	9.40
	Total		275.40	246.00	210.50	301.00	300.50	1333.40
	Totai				Drilled length/Bit (1,333.40/29)	1,333.40/29)		45.98

Table II-2-3 Drilling Meterage by Diamond Bit

					Drilling Meterage b	y hole (m)		
Item	Size	Bit No.	MJM-14	MJM-15	MJM-16 MJM-17	MJM-17	MJM-18	Total (m)
		177198	25.60					25.60
	<u></u> _	177197		54.60				54.60
		177202			55.50			55.50
		177196			38.00			38.00
		-			-			
		1.						
Diamond Bit	BQ-WL	, .						
			-		-			
			•					
					-			
	Total		25.60	54.60	93.50			173.70
	Total			Drilled le	Drilled length/Bit (173.70/4)	(43.43

Table II-3 Details of Consumed Materials in Drilling

					Control of the last of the las	The state of the last of the l		
Description	Checification				Quantity			70401
Cacingan	opecuiva non	OIIII	MJM-14	MJM-15	MJM-16	MJM-17	MJM-18	10tal
Light Oil		δ	650	4,830	1,440	1,145	4,530	12,595
Bentonite		kg	8,850	4,875	11,375	7,350	13,550	46,000
Liborite		kg	650	195	165	194	246	1,450
C.M.C.		kg	270	170	172	239	466	1,317
Cement		kg	200	1,000	400	260	400	2,560
Diamond Bit	NOWL	bc	5	5.	5	4	10	29
op	BOWL	рď		1	2	0	0	4
op	MN	bc	1	1	Ι	1	1	5
đo	МH	bc	1	1	1	Ţ	1	5
Diamond Reamer	NOWL	рс	2,	4	3	4	6	25
op	BOWL	bc	1	Ţ	2	0	0	4
Core barrel Assy	NOWL	set	1		2	2	2	∞
op	BOWL	set	PP-1	1		0	.0	3
Inner tube	MOML	эď	2	. 2	3	4	4	15.
Inner tube	BQWL	рс	2	2	2	0	0	6
Core lifter	NOWL	рс	2	3	2	4	3	16
Core lifter	BQWL	рď	2	2	2	0	-0	. 9
Core lifter Case	NOWL	рс	2	33	2	Ş	9	18
Core lifter Case	BQWL	ъс	2	2	2	0	0	9

Table II-4-1 Timetable of Drilling Work

h h h h h h h h h h h h h h h h h h h	Drilling Shift Working man Drilling Core Drilling Total Engineer Worker Drilling	Core Shift Working man length Drilling Total Engineer Worker	Shift Working man Total Engineer Worker	Working man otal Engineer Worker	rking man Worker		Drilling		Other Working	Workin Recovering	Working Time	Removing	Road con- structing	G. Total
m m m h		, ["	mgmyr			,			w Oz Kung				and others	
0.00 1 15 49 384 8°10° 2°30° 0°00° 10°40° 48°00° 52°00° 201.80 35 35 35 165 123°20° 155°00° 0°00° 278°20° 52°00° 18.40 9 13 21 94 21°30° 49°30° 0°00° 71°00° 32°00° 52°00° 220.20 1 1 1 51 204 9°20° 3°20° 0°00° 71°00° 32°00° 52°00° 200.20 1 1 1 51 204 9°20° 3°20° 0°00° 12°40° 48°00° 52°00° 200.20 4 5 1 79 20°30° 27°30° 0°00° 48°00° 56°00° 56°00° 200.00 4 5 1		ď	B	shift	shift	man	man	-G	ч		ᆆ	ų	ď	л
201.80 35 35 165 123°20° 155°00° 0°00° 278°20° 18.40 9 13 21 94 21°30° 49°30° 0°00° 71°00° 32°00° 220.20 45 153°00° 207°00° 0°00° 71°00° 80°00° 82°00° 0.00 1 17 51 204 9°20° 3°20° 0°00° 12°40° 64°00° 82°00° 207.20 33 33 135 158°00° 101°20° 0°00° 12°40° 64°00° 86°00° 207.20 33 33 135 158°00° 101°20° 0°00° 48°00° 48°00° 86°00° 256.00 40 59 99 418 187°50° 132°10° 0°00° 14°20° 86°00° 11°20° 0°00° 11°20° 0°00° 11°20° 0°00° 11°20° 0°00° 11°20° 0°00° 0°00° 0°00° 0°00° 0°00° 0°00° 0°00° 0°00°	9.00	2	0.00	-4	15	49	384	8°10′	2°30′	0000	10°40′	48°00′	\$2°00′	110°40′
18.40 9 13 21 94 21°30′ 49°30′ 0°00′ 71°00′ 32°00′ 50°0 220.20 45 63 105 643 153°00′ 207°00′ 0°00′ 71°00′ 32°00′ 52°00′ 0.00 1 17 51 204 9°20′ 3°20′ 0°00′ 12°40′ 64°00′ 56°00′ 207.20 33 33 135 138°00′ 101°20′ 0°00′ 12°40′ 64°00′ 56°00′ 207.20 33 33 135 138°00′ 101°20′ 27°30′ 0°00′ 48°00′ 48°00′ 56°00′ 260.00 40 59 99 418 187°50′ 132°10′ 0°00′ 48°00′ 48°00′ 56°00′ 186.40 27 40 107 125°50′ 35°0 0°00′ 114°20′ 56°00′ 0°00′ 252.30 46 63 100 366°20′ 64°40′ 0°00′ 134°00′ 72°00′ <td>766</td> <td>266.40</td> <td>201.80</td> <td>35</td> <td>35</td> <td>35</td> <td>165</td> <td>123°20′</td> <td>155°00′</td> <td>0000</td> <td>278°20′</td> <td></td> <td></td> <td>278°20′</td>	766	266.40	201.80	35	35	35	165	123°20′	155°00′	0000	278°20′			278°20′
220.20 45 63 105 643 153°00' 207°00' 360°00' 80°00' 80°00' 82°00' 82°00' 0.00 1 17 51 204 9°20' 3°20' 0°00' 112°40' 64°00' 56°00' 207.20 33 33 135 158°00' 101°20' 0°00' 48°00' 48°00' 48°00' 86°00' 260.00 40 59 99 418 187°50' 132°10' 0°00' 14°20' 56°00' 56°00' 186.40 27 27 40 107 125°50' 3°50' 0°00' 114°20' 56°00' 0°00' 65.50 17 22 39 116 69°20' 64°40' 0°00' 134°00' 72°00' 0°00' 252.30 46 63 100 366' 0°00' 368°00' 128°0' 0°00'		25.60	18.40	6	13	21	\$	21°30′	49°30′	0,000	71,000	32°00′		103°00′
0.00 1 17 51 204 9°20' 3°20' 0°00' 12°40' 64°00' 56°00' 207.20 33 33 135 158°00' 101°20' 0°00' 48°00' 48°00' 56°00' 260.00 40 59 418 187°50' 132°10' 0°00' 48°00' 48°00' 56°00' 0.00 2 14 21 143 10°30' 3°50' 0°00' 14°20' 56°00' 0°00' 186.40 27 27 40 107 125°50' 64°40' 0°00' 134°0' 72°00' 0°00' 65.50 17 22 39 116 69°20' 64°40' 0°00' 134°0' 72°00' 0°00' 252.30 46 63 100 366 205°40' 162°20' 0°00' 368°00' 128°0' 0°00'	8	301.00	220.20	45	63	105	643	153 00'	207°00′	0,000	360°00′		\$2°00′	492°00′
207.20 33 33 135 158°00' 101°20' 0°00' 259°20' 48°0' 48°0'		10.00	0.00	ī	17	51	204	9°20′	3°20'	0°00′	12°40′		56°00′	132°40′
52.80 6 9 15 79 20°30' 27°30' 0°00' 48°00' 48°00' 48°00' 8°00' 48°00' 8°00' </td <td>. (3</td> <td>236.00</td> <td>207.20</td> <td></td> <td>33</td> <td>33</td> <td>135</td> <td>158°00"</td> <td>101°20′</td> <td>0°00′</td> <td>259°20′</td> <td></td> <td></td> <td>259°20′</td>	. (3	236.00	207.20		33	33	135	158°00"	101°20′	0°00′	259°20′			259°20′
260.00 40 59 418 187°50' 132°10' 0°00' 320°00' 112°00' 56°00' 0.00 2 14 21 143 10°30' 3°50' 0°00' 14°20' 56°00' 0°00' 186.40 27 27 40 107 125°50' 93°50' 0°00' 219°40' 0°00' 65.90 17 22 39 116 69°20' 64°40' 0°00' 134°00' 72°00' 252.30 46 63 100 366 205°40' 162°20' 0°00' 368°00' 128°00' 0°00'		54.60	52.80		6	15	42	20°30′	27°30'	0,000	48 00,	48,00		.00,96
0.00 2 14 21 143 10°30' 3°50' 0°00' 14°20' 56°00' 0°00' 186.40 27 40 107 125°50' 93°50' 0°00' 219°40' 72°00' 65.90 17 22 39 116 69°20' 64°40' 0°00' 134°00' 72°00' 252.30 46 63 100 366 205°40' 162°20' 368°00' 368°00' 128°00' 0°00'	<u>"</u>	300.60	260.00	40	59	66	418	187°50′	132°10′	0,00,	320°00′	112°00′	56°00′	488°00′
27 27 40 107 125°50' 93°50' 0°00' 219°40' 17 22 39 116 69°20' 64°40' 0°00' 134°00' 72°00' 46 63 100 366 205°40' 162°20' 0°00' 368°00'128°00' 0°00'		9.00	0.00	7	14	21	143	10°30′	3°50′	0°00′	14°20′		0,000	70°20
65.90 17 22 39 116 69°20' 64°40' 0°00' 134°00' 72°00' 252.30 46 63 100 366 205°40' 162°20' 0°00' 368°00' 128°00' 0°00'		01.50	186.40	27	27	40	107	125°50′	93°50′	0,000	219°40′			219°40′
252.30 46 63 100 366 205°40' 162°20' 368°00'128°00' 0°00'		93.50	65.90	17	22	39	116	69°20'	64°40	0°00′	134°00′			206°00′
		304.00	252.30	46	. 63	100	366	205°40′	162°20′	0°60′	368°00′	128°00′	0°00′	496°00′

Table II-4-2 Timetable of Drilling Work

Drilling Shift Working man	Shift	#	a de	Working n	ing n	ıan			Workir	Working Time		,	G Total
Drilling Core Drilling Total Engineer	Drilling Total	Total		Engineer		Worker	Drilling	Other Working	Recovering	Total	Removing	Road con- structing and others	G. 10tal
				4		-					-		
m shift shift man	m shift shift	shift		mam	-	man	-	4	: -4	. =	. ca	ᅽ	. 4,
19.20 0.00 1 7 15	-	1 7 15	7 15	15		68	7°10'	2°30′	0,000	9°40′	9°40′ 24°00′	0,000	33°40′
NQ 281.80 218.90 38 42 54	38 42	7		54		205	163°30′	128°30′	8°00′	300,007 48,007	48°00		348°00′
Total 301.00 218.90 39 49 69	39 49	49		69		294	170°40′	131 00′	8°00′	309°40′ 72°00′	72°00	0°00′	381°40′
15.00 0.00 2 8 22	2 8	· -	· -	22		103	9°40′	3°30′	0,000	13°10′	13°10′ 24°00′	136°00′	173°10′
285.50 226.30 71 77 83	226.30 71 77	77		83		344	250°00′	294°50′	50°00′	594°50′	594°50° 56°00°		650°50′
Total 300.50 226.30 73 85 105	73 85	85		105		447	259°40′	298°20′	50°00′	608 00 80 00	80°00	136°00′	824°00′

Table II-5-1 Summary Record of Drilling Work, MJM-14

				~		Sı	urve	y Perio			:				total m	an day	
		Ì	;		Period				day	ys	work day	(off day	Engine	er	worke	r
	Preparation		3. 7.	. 1987	~ 16. 7	. 1987			14		day 14	'S	days 0	49	man	384	man
tion	Drilling		17. 7.	. 1987	~31.7	. 1987			. 15	.	drilling 15 recovering		0	44		205	
Operation		1			٠						0		0	0		. 0	
	Removing		1.8	. 1987	~ 4.8	. 1987			4		4	T	0	12		54	
	Total		3. 7.	1987	~ 4.8	. 1987			33		33		0	105		643	
	Length			m	Surface		T		m			Co	re recover	y of 100r	n hole		
tt.	planed Increase		300	m	Overbur Quatern			9.00	0 m		Depth of hol	le	tec	ore overy (%)		core recovery cumulated	
g leng	or Decrease		+1.0	00	Core-le	ngth		220.2	0	ļ		<u>:</u>	ļ	·		(%)	
Drilling length	in length					:					0~100	· ·	5	9,78			
	Length		201	m	Core	 	\dagger	75.41	%	10	00 ~ 200	, ,	7	9.40		70.37	·
	drilled		301	.00 T	1ccover)		%	73.41	%	20	00~300	1-	8	5.10		75.43	
	Drilling [,]		4	15	3°00 ^{, h}	43	70	31	"	30	00 ~ 301.0	,	7	0,00		75.41	
	Other work	ing	:	20	7°00′	57		42				Effi	ciency of	Drilling			
	Recovering									T	otal m/work eriod(m/day	;)		.00m/1: .07m/da			
ours	Total Reassen		:	ļ	8°00′ 0°00′	100		73 10	_	T sl	otal m/total hift(m/shift)			.00m/63 8m/shif			
working hours	Disman	tlemen	ıt		2°00′			7			D	rilling	length/bi			- 	
work	Water transportat	ion								В	it size	.; N	w	NO)	ВС	?
	Road const	ructio	n :	5	2°00′			10			orilled ength	: 9	m ,00	266.	.40	25.60	m
	G. Total			49	2°00′			100		C le	ore ength	0		201.	.80	18.40	
erted	Size	mete (n	erage	met dril leng	erage ling x th (%)	100		ecovery (%)				: : :					
Casing pipe inserted	HW		9.00		1.5			100									
d Suist	NW	2:	2.00		7.3			100						•	÷	-	
ပ	BW	27:	5.40		91.5			83.5			e i gen	3	÷		. :		

Table II-5-2 Summary Record of Drilling Work, MJM-15

	i ,				S	urvey	Period	17 7			total	man day
•				Period	- : -			days	work day	off day	Engineer	worker
1	Preparation	5.	7. 198	7 ~ 20. 7	7. 1987			16	days 16	days 0	man 48	man 167
Operation	Drilling	21.	7. 198	7~ 3.8	3, 1987	\$.	·	14	drilling 14 recovering 0	0	42 ° 0 .	198
°	Removing	4.	8. 198	7~ 6.8	. 1987	· ·		. 3	3	0	9	53
	Total			7 ~ 6.8				33	33	0	99	418
-	Length		m	Surface		Γ		m	<u> </u>		y of 100m hol	
Drilling length	planed Increase or	300	m	Overbur Quatern	den ary	-		m	Depth of hole (m)	rec	core covery (%)	core recovery cumulated (%)
rilling	Decrease in length	÷0.0	50	Core	length	.2	260,00) -	0~100		84.89	
	Length			Соте		<u> </u>			100 ~ 200		88.10	86.58
L	drilled	300	,60 -	recovery		<u> </u>	89.47		200~300		94.90	89.45
	Drilling		18	37°50′	58	')	38	%	300 ~ 300.6	10	00	89,47
	Other working	g	13	32°10′	42		27		\$ 14 A	Efficiency of	Drilling	
	Recovering								Total m/work period(m/day)).60m/14 day .47 m/day)	/s
ours	Total Reassembl	age		20°00′ 54°00′	100	• •	65 13		Total m/total shift(m/shift)	300	0.60m/99 shi 0.4m/shift)	ft
working hours	Dismantle	ment	- 4	18°00'			10	1	Dri	Lling length/b	it(each sized b	it)
wox	Water transportation	1		4.5				1	Bit size	NW	NQ	BQ
	Road construe	ction	5	6°00′			12		Drilled length	m 10.00	236.00	m m 54.60
	G. Total		48	38°00′			100		Core length	0	207.20	52.80
erted	Size	meterage (m)	l drii	terage lling x gth (%)	100		covery %)					
Casing pipe inserted	HW	10.00		3.3		1	00					
asing p	NW	30.00		10.0		1	00					
Ü	BW	246.00	1	81.8		1	00			****	1	

Table II-5-3 Summary Record of Drilling Work, MJM-16

						Sı	urve	ey Perio	d	, 				total m	an day	
					Period				đay	s work	đay	off day	Engine	eer	worke	r
	Preparation		30. 8.	1987	7 *~ 10. 5	0. 1987		,	12	12	days	days O	22	man	142	man
tion	Drilling		11.9	1987	<i>1</i> ∼ 26. 9	. 1987			16	drilling 16		0	36	:	1,84	
Operation		-								0		0	0	· .	0	<u> </u>
	Removing		27.9	1987	² ~ 30. 9	. 1987			4	4		0	42		40	
	Total		30. 8.	1987	~ 30. 9	. 1987			32	32		0	100		366	:
	Length		200.0	m	Surface		Γ	0.00	m			Core recover	y of 100:	n hole		
gth	planed Increase		300.0	m	Overbur Quatern		-	9.00	m	Depth (m	of hole	rec	core overy (%)		core recovery cumulated	
Drilling length	or Decrease in length		+4.00	· •	Core	length		252.3	0 .	0~1	00		98.02		(%)	
A	Length	-			Core		-	<u> </u>	%	100 ~ 2	00		08,00		94.24	ļ .
	drilled		304.0	0	recovery	′	L	85.52		200~3	00		68.40		85.36	5
	Drilling			. 20	h)5°40′	56	%	41	%	300~3	04.0	1.1.1 <u>1</u>	97.50	-	85.52	2
	Other work	ing	. 1.	16	2°20′	44		33			E	fficiency of	Drilling			
	Recovering		: .							Total m/ period(n	work n/day)	i i	304.00n 19.00 n	-	•	
	Total			36	8°00′	100		74		Total m/	total		304.00n			·
working hours	Reassem	blage	1,14	5	6°00′			11		shift(m/s	shift)		4.83 m/			
rking	Dismant	lemer	ıt	7	′2°00′			15	_	<u> </u>	Drill	ling length/b	it(each si	zed bit) 	:
*	Water transportati	on .								Bit size		NW	NO)	BQ	
	Road constr and others	ructio	n				F :			Drilled length		9.00 m	201	.50	93.50))
Ì	G. Total			49	6°00′		•	100		Core length	1	0	186	.40	65.90)
erted	Size		erage n)	met drill leng	terage ling x gth (%)	100	R	ecovery (%)							2 Å	
ipe ins	HW	10	.00		3.3			100		÷		eren er Kal		\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \		
Casing pipe inserted	NW	30	.00		9.9		•	100				gradien in de Gradien in de		* **		
Ö	BW	210	.50	•	69.2	.		91								

Table II-5-4 Summary Record of Drilling Work, MJM-17

					Sı	uve	y Periò	1			to	tal m	an day	
	takin e			Period				days	work day	off day	Engineer	r	work	:r
	Preparation	7, 8	. 198′	7~12.8	. 1987			6	days	days	18	nan	82	man
non	Drilling	13, 8	3. 198	7 ~ 25. 8	3. 1987			13	drilling 12.5 recovering	0	38		150	
Operation	A 1.								0.5	0	1		6	
	Removing	26. 8	. 198	7 ~ 29, 8	. 1987			4	4	0	12		56	
	Total	7.8	. 1987	7 ~ 29. 8	. 1987			23	23	0	69		294	
	Length planed	300.0	m 00	Surface Overbur	den		19.20	m	-	Core recove	y of 100m	hole		
length	Increase or		m	Quatern				m	Depth of hole (m)	te	core covery (%)	0	core recovery umulated (%)	
Drilling length	Decrease in length	+1.00	J	Core 1	length		218.90		0~100	9	1.95			
	Length drilled	301.0	00	Core recovery	,		77.67	%	100 ~ 200	7	6.90		83.62	
-				·	4.2	<u> </u>		%	200 ~ 300	6	6.70		77.60	
	Drilling	· ·	17	70°40′ ^h	55	<u> </u>	45		300 ~ 301.0	10	0.00		77.67	
	Other working		13	1°00′	42		34			Efficiency of	Drilling	1	·	· ·
	Recovering		 	8°00′	3		2		Total m/work period(m/day)		301.00m/ (23.15 m/		*	
ours	Total Reassembla	je		9°40′ 4°00′	100	+	81	-	Total m/total shift(m/shift)		301.00m/- (6.14 m/sł		nift	
working hours	Dismantlem	ent	4	8°00′		-	13		Di	illing length/t	-		· ·	· .
IOM	Water transportation								Bit size	NW	NQ		BQ	
1:	Road construct and others	ion							Drilled length	19.20 m	281.80	m		m
	G. Total		38	1°40′	.1.	13 75	100		Core length	0	218.90		*	
erted) .	eterage (m)	dril	terage ling x gth (%)	100		covery (%)					:		
ipe in	HW 1	6.00		5.3			100			and the second				
Casing pipe inserted	NW 2	7.00		9,0			100						٠.	
	BW										<u>.</u>			

Table II-5-5 Summary Record of Drilling Work, MJM-18

				-	Sı	urve	y Perio	d					total n	an day	
				Period				day	s worl	k day	off day	Engin	eer	worker	
Preparation		5.8	. 1987	7~10.8	. 1987			6	6	days	day 0	18	man	91	man
Drilling		11.8	. 1987	7~4.9.	1987			25	recove	ering	0	71	:	307	
												4			
Removing		5.9	1987	7 ~ 8. 9.	1987		· • · · · · · · · · · · · · · · · · · ·	4	4		0	12	: -	41	
Total	_	5.8	. 1987	<i>1</i> ∼ 8. 9.	1987			35	35		0	105		447	
Length			m.					m		·: ·	Core recove	ry of 100	m hole		<u>:</u>
		300.0)() m				15.00	m			re	core covery (%)			
or Decrease		+0.50)	Core	length		226.3	0	·			<u> 1. : </u>	-		·
length											8	4.00	_		· ·
Length drilled		300.5	0	Core	,		79.26	%	100~	200	8	1.20		82.48	.
		L		<u> </u>	<u> </u>	%	<u> </u>	%					-	79.22	<u>: </u>
Drilling	:		25	9°40′	43		31		300~3	300.5	10	0.00	٠	79.26	, <u>.</u>
Other work	ing 		ļ		49	_	36	\downarrow			Efficiency o	-271		<u></u>	
Other working Recovering Total				8		. 6		period(i	m/day)			-	-		
		60	8°00′	100		73	_	Total m	/total				hift		
Reassem	blage		 -				. 3	_	shift(m _i	(shift)		(3.54m/	shift)	·	· .
Dismant	lemer	nt 	5	6°00′	·		. 7	_	· .	. Drill	ling length/	bit(each si	zed bit) T	
Water transportati	on			:					Bit size		NW	<u> </u>		BQ	-
Road constr and others	uctio	n	13	6°00′			17		Drilled length		15.00 m		***		- m
G. Total		÷	82	4°00′					Core length		. 0	226.3	30		
Size		-	drill	ling x	100		ecovery (%)							: ::::::::::::::::::::::::::::::::::::	
HW		.00		1.3					. :						
NW				10.3				\neg							
BW							1	7		-					
	Drilling Removing Total Length planed Increase or Decrease in length drilled Drilling Other work Recovering Total Reassem Dismant Water transportati Road constrand others G. Total Size HW	Removing Total Length planed Increase or Decrease in length Length drilled Drilling Other working Recovering Total Reassemblage Dismantlemen Water transportation Road construction and others G. Total Size mete (r. HW 4 NW 31	Drilling 11.8 Removing 5.9 Total 5.8 Length planed 300.0 Increase or Decrease in length 40.50 Length drilled 300.5 Drilling Other working Recovering Total Reassemblage Dismantlement Water transportation Road construction and others G. Total Size meterage (m) HW 4.00 NW 31.00	Drilling	Preparation 5.8.1987 ~ 10.8 Drilling 11.8.1987 ~ 4.9. Removing 5.9.1987 ~ 8.9. Total 5.8.1987 ~ 8.9. Length planed 300.00 Surface Overbur Quatern Increase or Decrease in length +0.50 Core Length drilled 300.50 Core Drilling 259°40'h Core Other working 298°20' Recovering Total 608°00' Reassemblage 24°00' Dismantlement 56°00' Water transportation 136°00' Road construction and others 136°00' meterage drilling x length (%) G. Total 824°00' meterage drilling x length (%) HW 4.00 1.3 NW 31.00 10.3	Preparation 5.8.1987 ~ 10.8.1987 Drilling 11.8.1987 ~ 4.9.1987 Removing 5.9.1987 ~ 8.9.1987 Total 5.8.1987 ~ 8.9.1987 Length planed 300.00 Surface soil Overburden Quaternary Increase or Decrease in length +0.50 Core length Length drilled 300.50 Core recovery Drilling 259°40° 43 Other working 298°20′ 49 Recovering 50°00′ 8 Total 608°00′ 100 Reassemblage 24°00′ 100 Water transportation 136°00′ 136°00′ Road construction and others 136°00′ 100 Size meterage drilling x 100 length (%) 100 length (%) HW 4.00 1.3 NW 31.00 10.3	Preparation 5.8.1987 ~ 10.8.1987 Drilling 11.8.1987 ~ 4.9.1987 Removing 5.9.1987 ~ 8.9.1987 Total 5.8.1987 ~ 8.9.1987 Length planed 300.00 Surface soil Overburden Quaternary Increase or Decrease in length +0.50 Core length Length drilled 300.50 Core recovery Drilling 259°40'h 43 Other working 298°20' 49 Recovering 50°00' 8 Total 608°00' 100 Reassemblage 24°00' Dismantlement 56°00' Water transportation 136°00' Road construction and others 136°00' G. Total 824°00' Size meterage (m) Interrage (m) meterage (rilling (%) Road construction and others 1.3 NW 31.00 10.3	Period Preparation 5.8.1987 ~ 10.8.1987 Drilling 11.8.1987 ~ 4.9.1987 Removing 5.9.1987 ~ 8.9.1987 Total 5.8.1987 ~ 8.9.1987 Length planed 300.00 Surface soil Overburden Quaternary 15.00 Increase or Decrease in length +0.50 Core length 226.3 Length drilled 300.50 Core recovery 79.26 Drilling 259°40¹h 43 % 31 Other working 298°20′ 49 36 36 Recovering 50°00′ 8 6 6 Total 608°00′ 100 73 73 Reassemblage 24°00′ 3 Dismantlement 56°00′ 7 Water transportation 136°00′ 17 Road construction and others 136°00′ 17 G. Total 824°00′ 8 Size meterage drilling kaling	Preparation 5. 8. 1987 ~ 10. 8. 1987 6 Drilling 11. 8. 1987 ~ 4. 9. 1987 25 Removing 5. 9. 1987 ~ 8. 9. 1987 4 Total 5. 8. 1987 ~ 8. 9. 1987 35 Length planed 300.00 Surface soil Overburden Quaternary m m Increase or Decrease in length +0.50 Core length 226.30 Length drilled 300.50 Core recovery 79.26 Drilling 259°40° 43 31 Other working 298°20° 49 36 Recovering 50°00° 8 6 Total 608°00° 100 73 Reassemblage 24°00° 3 Dismantlement 56°00° 7 Water transportation 136°00° 17 Road construction and others 136°00° 17 Size meterage drilling x 100 length (%) Recovery (%) HW 4.00 1.3 NW 31.00 10.3	Period	Preparation S. 8. 1987 ~ 10. 8. 1987 S. 6 6 6 6	Period days work day off day	Preparation S. 8. 1987 ~ 10. 8. 1987 Core Core Preparation S. 9. 1987 ~ 8. 9. 1987 Preparation Planed Planed	Preparation S. S. 1987 ~ 10. S. 1987 S. 1987 C. S. 1987 ~ 10. S. 1987 C.	Preparation Preparation S. 8. 1987 ~ 10. 8. 1987 S. 1987 ~ 10. 8. 1987 Regiment Preparation S. 8. 1987 ~ 10. 8. 1987 Regiment Regiment

Chapter 2 Result of Survey

2-1 Geology and Mineralization

Table II-6 shows the results of work for each drill hole including number of samples for chemical analysis and the summary of result of each hole.

The columnar sections and geologic profiles of each hole are shown in Fig.II-3, A-1 and Fig.II-4, respectively.

The geological column of each hole, containing lithology and some assay values, is as follows:

The results of tests of, thin section, polished section and X-ray diffraction of selective cores are shown in A-2, A-3, A-4, A-5 and A-6.

1. MJM-14 (-90°, 301.00m)

(1)	Geology
w	CHOIORA

0 - 9.00m surface soil

9.00- 77.10 Pinosuk Gravels,

loose matrix to 19.50m and solid matrix from

19.50-77.10m; oxidation is widespread

77.10-111.70 adamellite porphyry,

extensive brecciation and shearing; oxidation is

pervasive to 98.10m

111.70-135.10 hornfels,

dark gray-balckish gray color, fine grained, with abundant fissures, silicification and brecciation between 123.40m and 127.30m, a thin layer of turbi-

dite present

135.10-136.50 adamellite porphyry

136.50-301.00 hornfels,

dark gray-blackish gray, mostly compact; massive part with abundant fractured zones in place, intense shearing between 193.60-206.40m, 239.60-241.10m and 298.40-301.00m; thin layers of turbidite between 225.20-226.50m, 229.10-232.10m.

(2) Mineralization

Finely disseminated native copper occurs in adamellite porphyry and hornfels and is restricted to a depth of 167.20m in places, accompanied by disseminations and veinlets of pyrite, chalcopyrite and molybdenite in place. Dissemination of pyrite and chalcopyrite and/or veinlets of pyrite-chalcopyrite-quartz appear below a depth of 167.20m. Mineralization is confined to adamellite porphyry and hornfels.

Under the microscope, fine-grained pyrite and chalcopyrite are main minerals in the adamellite sample taken at 106.10m depth. They are associated with very fine-grained molybdenite, pyrrhotite and marcasite with a few sphalerite.

The result of chemical analysis is as follows:

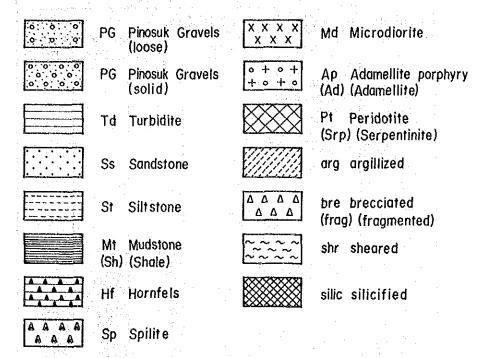
Section	Au(g/t)	Cu(%)	Mo(ppm)
77.10-111.70m	0.07	0.145	16.7
(34.6m, in adamellite porphyry)			
incl. 77.10-98.10m	0.08	0.172	4.0
(21.0m oxide zone)			
111.70-191.50m	0.06	0.045	37.0
(79.8m, in hornfels)	. "	•	

2. MJM-15 (-90°, 300.60m)

(1) Geology

0 - 10.90m	surface soil
10.90-111.40	Pinosuk Gravels,
	bearing boulders and cobbles of adamellite, adamellite porphyry and hornfels in well compacted
	matrix, weaker weathering and oxidation than
	those in MJM-14
111.40-141.70	turbidite,
en e	weak shearing in places.
141.70-142.70	peridotite,
	intensive serpentinization throughout, limited oc-
	currence suggesting xenolithe within adamellite

LEGEND



Abbreviations

bi ;	biotie	bo ;	bornite	mtx	matrix
cal ;	calcite	mal ;	malachite	gr ;	grained
chlo ;	chlorite	pyr ;	pyrrhotite	grvi ;	gravel
cly ;	clay	cup ;	cuprite	sdy ;	sandy
gt ;	garnet	pyrophy	r ; pyrophyllite	imp ;	impregnation
qz ;	quartz	kaol ;	kaolinite	Ins ;	lens
srp ;	serpentine	arg ;	argillized	netwk ;	network
tic ;	taic	bg ;	bearing	oxd ;	oxidized
epi ;	epidote	bichd ;	bleached	strg ;	stringer
gt ;	garnet	bld ;	boulder	vit ;	veinlet
ank ;	ankerite	bre ;	brecciated	wthd ;	weathered
cp ;	chalcopyrite	cls ;	clastic	xeno ;	xenolith
limo ;	limonite	diss ;	dissemination	(vp) ;	(very poor)
moly ;	molybdenite	fin ;	fine	(p);	(poor)
7.77.865.79	pyrite	flt ;	fault	(m);	(moderate)
	magnetite	fract ;	fractured	(a);	(abundant)
mar ;	marcasite	frag ;	fragmented		

		DRILLI	NG CORE	RECOR	D	
Dr	illing N	lo. MJM-I	4 (301.00			90°)
cale		Lithology	Mineralization etc.	Αυ(9/τ)	ssey Result	Mo(ppm)
(m)	Log			1		
-		4 · · ·		0.01 0.1	0.01 0.1	10 100
	0 0	Pinosuk Gravels (loose) Ap.Ad.HI bids with sdy and cly mix.	≇ (m) oxd		•	
	000.	OUT CIN WIX				
	, o , o	Pinosuk Gravels (solid)				
4	. 0. 0.	Ap, sep, Ad blds with ady mix.				
-		Py streaks	11.	1		
Ţ	0 0	Srp and Ad bid	•		· ·	
50	0 0 0	(a)			<u> </u>	ļ
-	.o. o. o.		,	ļ		
_	. <i>o</i>	Ap, Ad blds with (a) of sdy mix	(m) oxd		1	
	0 0 0	(a) or any max	*	ŀ		
_	0 0					
-	0 + 0 + 0 +	AdameNite Parphyry	(m) oxd			
-	~ ~ ~ ~	shr zone	, A			
_	0 + 0	qz sireaks sirg	native Cu			The contract of
100	+ 0 +		Cup, Cp, Py, Pyr			
-	0 + 0	(a) silic Ap	{			
-	7 7	Hornfels				
	A AGE	Adametlite-Posphysy (thin layer)	(P) Py diss			
_	~ ~ ~ ~	(thin loyer) Turbidite	Pyr (m) oxd, native Cu			
	\tilde{\	Hornfels	(in) oxe, name co			
_	4 1	Adomnilità Parchay/	native Cu,Cup			
-	A A A A	Adomellite Porphyry	(m) oxd			
150	AAA	az streak, strg	Co-fine dol			
	A A A	qz strg	1			
,	A . A . A	gz strg as network		歷		
_	4-4-4	in place	} . \			
-	AAAA			15		
		qz streaks-strg	} '			
	A A A A	·				
_	A_A_A	cly shr zone	,			
200	~~~~	lault and/or				
	A A	shear zone az netwk	‡ Py,Mo	ma,		
-	A_A_A	AT DETAIN		ļ	İ	
-	A A A	az chlo strg and vit ba				
٦	A A A		Ĵ Cp,Mo			
-	7~7~7	Turbidite silic Hornfels az stra	•			-
J	TATAT	Turbidite Ca,qz	Î Cp			-
4	A A A	shr zone	T - T			
25.7	10.1			[[
250	A	qz chio vii			 	
1		gz coj streaks	‡ Cp	(CORCOR)		
]		strg and netwa	Cp,Mo			
4		barren az vit	Py Py			
	A A A		1	751 ,		, , , , ,
+	A A A				ļ .	
1	A	az chio streaks			1	11
ו	A, A, A	and stra netwx	. 1		{ ·	
300	∳ Ý Ý	shr zone		L		

Fig. II-3-1 Columnar Section of Drill Hole (MJM-14)

Approximation of the

Drilling No. MJM=15 (300.60m90°)										
m)	Geol. Log	Lithology	Mineralization etc.	Au (9/1)	Cu (%)	Mo (ppm				
				0.01 0.1	0.01 0.1	10 100				
-	0.10.0		♦ (m) oxd							
٦	0.0	Pinosuk Gravels (solid)	φ (m) οχα	1						
	a 0 0		A 1 4 1	}						
-	0.0.0	Sep bld	\$ (m) oxd		,					
-	0 0	Ad, Sip bld	. # weak oxd		<u> </u>					
]	0.0.0			1 1	100					
50	0:0			ļ		<u> </u>				
	0 0 0	(o) Ad bid			100					
-	0 0	Ad bld and crushed								
.]	0.00	Sdy mtx								
_		·		1		}				
-	0 0 0			[
- 1	0.0.0].] ;					
	``o`` o``	weok shr zone	‡(P) òxd							
00	0 0 0			· · · · · · · · · · · · · · · · · · ·						
	; ; ; ; ; ;	weak shr								
_		Turbidite								
-		gz chio streak	\$ Co, Py							
-			{m}-(vp) pyr							
_		qz	,	.						
4	V V V V V V									
50	+ 0 +	Srp. shr arg	Cp,Py dol.							
	0 + 0	Adametlite-Porphyry (wholly brecciated)	strg and diss							
-	+ 0 +	solid part in place								
Н		qz sirg		4						
1	0 + 0	solid part								
-	+ 0 +		1010							
-	0 + 0		(P) Cp dof Ma dat							
	+ 0 +	fract zone in place								
00	0 + 0	salid part	Cp.Py diss							
-	+ 0 +									
j	XXXXX	froet zone	{P]Cp,Py streak	₩ <u> </u>						
4		Peridotite	in place							
		Ap bld	Cp film							
	$\otimes \otimes \otimes$		jepa¥asi i ifi i i i i i i i i i i i i i i i i	1.	1					
7	\bowtie	qz streaks and sirg	l'e	Į.						
50	$\times\!\!\times\!\!\times\!\!\times$	ration to satisf		1:						
22	$\times\!\!\times\!\!\times\!\!\times$	Ca vit mag (mag- netizm) through out			1					
1	\bowtie	The state of the s		10.00	1 1 1 1 1 1					
. 4	$\times\!\!\times\!\!\times\!\!\times$		1 (vp)							
+	$\times\!\!\times\!\!\times\!\!\times$	cal, ax, tic chia	♥ Py doi							
7	\bowtie	fine network	Barry Andrew] :						
_]	$\times\!\!\times\!\!\times\!\!\times$		‡ Py strg							
	$\times\!\!\times\!\!\times\!\!\times$	cly flt with	. * * * * ****************************	1						
4	XXXXXX	shr zone	The second second	1		1				

Fig. II-3-2 Columnar Section of Drill Hole (MJM-15)

	DRILLING CORE RECORD									
Drilling No. MJM-16 (304.00m, -, -90°)										
Scole (m)	Geol. Log	Lithology	Mineralization etc.	Au (9/T)	say Resul Cu(%)	Mo (ppm)				
33312	1.00			0.01 0.1	1.0 10,0					
]		Pinosuk Gravels \		0.01 0.1	0.01 0.1	10 100				
_	66	(cly mix)				. 1				
4	0 0 0	Pinosuk Gravels (solid)	Py diss/strgs	l I	1, 1	4				
	0 0	frag of Ad, Hf	•							
~	0.00	Ad, Hf and Ap bld								
	0.0		Py speck	·						
50	0.00	Ad, Ap and Hf frag								
50	0 0 0	Ad, Hf and chilo rock bid								
_	0. 0.	sdy solid mix				- 1				
7	0 .0 .0		•							
	. 0 . 0 .	Ad dio-porphyry and	Py diss/strgs							
	0.0	ultrabasic rock blds								
-	0, 0 0	Pi, Ad blds	!	·		i ·				
	0.0	•	4							
	0 0 0	Ad, Ap and Hf, Pt bids	Py speck							
100	0.0	altered zone	weak Py diss/strgs							
-	0 0 0	Ad, Ap indurated frag								
		Ad Ap bids	1 Py diss							
	0. 0	1,1	• • • • • • • • • • • • • • • • • • • •							
	0 0 0		. 1	:						
-	.0.0	chio Ap bids								
-	.0 . 0 . 0									
	000	altered zone				170 - 1				
150	2° 2° 2° 2° 2° 2° 2°	shr zone								
-	A A A	Hornfels altered zone	(VP) Py diss notive Cu specks							
		uncies zone		-						
:]		arg. fract or shr zone	Py diss/strgs							
_	A A A	dry, ricer or one zone	weak Py diss							
-		oltered zone	native Cu							
-	*****	shr. bre zone	ļ			E.C.				
		cty shr zone	Py diss/strgs							
200	A A A	cly, oxd zone	Cp, Mo specks							
	~ ~ ~ ~ ~	shr zone								
- 1		Turbidite Hornfels								
		Turbidite	work Du Backstone							
		Hornfels Turbidite	weak Py diss/strgs Cp specks			=				
- 4	A A A	silic. fract	y.weck Py diss/streps							
-	A, A A	bre zone	ļ ļ							
-	A A A	shr zone								
250	A A A	fit zone	# Py diss Mo,Cp specks	30						
		Peridotite								
-{		shr zone, cal,talc srp vils								
4	$\times\!\!\times\!\!\times\!\!\times$	-	1.							
ב		weak shr zone		٠.						
	$\times\!\!\times\!\!\times\!\!\times$	srp	weak Py,Cp specks							
- 4	$\times\!\!\times\!\!\times\!\!\times$									
-{		weak shr zone			319					
300	$\times\!\!\times\!\!\times\!\!\times$	fract shr zone	Py Mo specks							
	$\sim\sim$	and the state of the state of	The second second	l	I	·				

Fig. II-3-3 Columnar Section of Drill Hole (MJM-16)

	DRILLING CORE RECORD							
Drilling No. MJM-17 (301.00m, -, -90°)								
Scale (m)	Geol. Log	Lithology	Mineralization etc.	Au (9/ _T)	say Resul Cu(%)	Mo (ppm)		
W.,	-			0.01 0.1	1,0 10.0	001 01		
-			·					
-			· .					
_	0 0	Pinosuk Gravels (loose)						
-	0 0 0	oxd. Ad.Pt bids						
7	0.0							
50	0 0 0 . 0 0 0	Pinosuk Gravels (solid)						
-	0 0	Ap, Ad bids						
-	0 0 0			<u> </u>				
1	. 0 0 .			<u> </u>				
-	0 0 0] .				
1	. 0 0							
-	0 0 0	Ad An district rook				t		
100	0.0.	Ad, Ap dioritic rock and Hf blds	# Py,Co diss in blds		1 · · · · · · · · · · · · · · · · · · ·	- 1		
	0 0 0		7 7 77 OF CISS III CISS					
4	0 0					٠		
1	(0. (0. (0) 0. (0. (0)	chio Ad bids	\$ Py diss	l ·				
, sing	0 0							
-	0 0 0							
4	0.0				* .			
150	.0 .0 .0		and five Cu specks					
4	0.00							
	0 0 0	az trag vein				1		
	~~~~	fit zone (no core)						
		Hornfels	v. weak native Cu Py mineralization					
]	A	fit zone						
-	AA AAA		Cp native Cu specks					
200		-fit zone						
-	A A A A	arg sdy	native Cu ₁ Py specks					
1	A A A A							
-	A A A	QZ vits						
-	A A A		native Cu ₁ Py specks					
-			<b>†</b>					
-			weak Py diss/strgs					
250		frac crushed	Cp specks					
	*****	fit (shr) zone		100 miles				
- 1	¥ ¥ ¥ ¥	april Palan	v. weak Py					
-{	XXXXX	fit zone Peridotite	•					
7.7	XXXX	2 CHOUNG						
		skr (fit) zone	🕽 v. weak Py					
1			\$			\$ ************************************		
300	<b>XXXXX</b>	fit zone	1		<u> </u>			

)

Fig. II-3-4 Columnar Section of Drill Hole (MJM-17)

DRILLING CORE RECORD								
Drilling No. MJM-18 (300.50m, -, -90°)								
cale m)	Geol. Log	Lithology	Mineralization etc.	Au (Q/T)	cu (%)	Mo (ppm		
· IIIV	LVy			0.01 0.1	0.01 0.1	10 100		
				0,01 0.1	0.01 0.1	10 100		
_				  -				
	0 0 0	Pinosuk Gravels (loose)	•					
$\exists$	0 0	Ap blds soily~cly mtx	•	٠.				
	0 0 0	Pinosuit Gravels						
-	0 0	(solid)						
	0.0	Ad, Ap and Hf, Pt srp frag, blds						
50	o. o		. ‡ vp Py speck/stgs					
7	0.0.0		•					
	0 0 0		-					
	0 0					* *		
-	0.00		Py_(cp) specks/strg					
٦	0 0		ŧ·					
	. 9 . 9 . 9	Ad, Ap and ultrobasic rock blds						
	0 . 0 . 0,		‡ native Cu specks					
100	0 + 0	Adamellite Porphyry	( ) ( ) ( )		<del>-</del>	, ` <u>`</u>		
-		shr zone	. 4					
-	2,t.,2	shr zone	Py,Cp diss/strgs	Ministra				
4	+ 0 +	3111 20110						
-		shr zone with cly	ļ.					
1	A A A A	Hornfels	Cp, Mo, Py diss/sl/g					
_]	A A A			Calendary.				
	~ ~ ~ ~ ~	shr zone	Mo,Cp,Py strgs					
50	AAAA	1						
-	A A A A	,						
	AAA	·						
_	A A A		Mo Py strgs/speck					
	XXXX	shr zone with cly Serpentinite	Py Mo Cp strgs					
-	$\times\!\!\times\!\!\times\!\!\times$	qz strgs						
_	$\times\!\!\times\!\!\times\!\!\times$	shr (fit) zone						
4	<b>A A A</b>	Hornfels qz vits	Py Mo diss					
500	AAAA							
-	7 ⁴ ~~~	shr (fit) zone	Py, Mo(Cp) diss/strgs			<b>-</b> -		
	4 2 4 24	shr zone						
-	A A A A		v. weak Py Cp diss/specks					
$\dashv$	AAAA		e a company					
$\exists$	AAAAA	chloritized zone		·				
	A A A		•					
	A . A . A .		Py,Cp,Mo diss/stres					
50			<b>▼</b> :					
-		Turbidite	weak Cp.Py			SSILINE .		
	<u>^ ^ ^</u>	Hornfels	diss/strgs			<b>-</b>		
]	* * * X	Hornfels furbidite	Py diss			Mar-		
4	~ ~ ~ ~	Hornfels/	Py,Mo diss/specks			-		
	A A A	Turbidite.shr zone Hornfels						
-	A A A	'	:	11.				
1		silici. chlo	-	:				
00								

Fig. II-3-5 Columnar Section of Drill Hole (MJM-18)

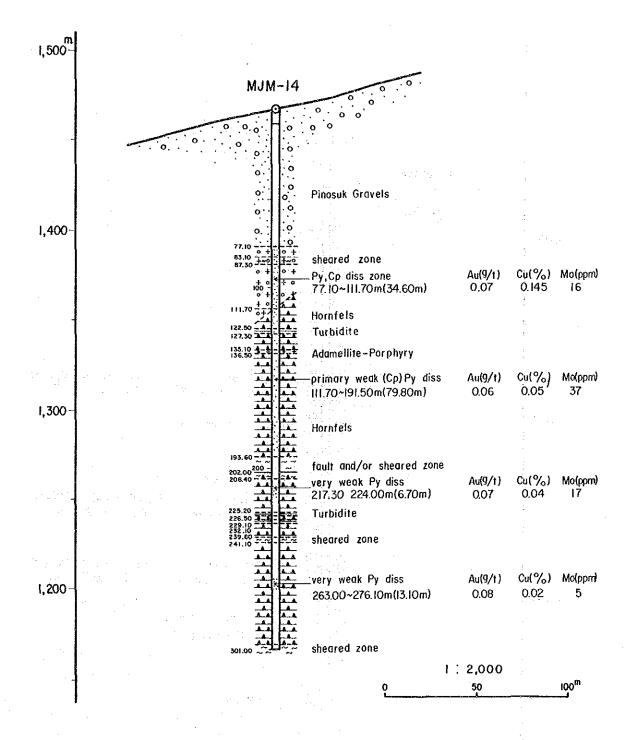


Fig. II-4-1 Geological Section of Drill Hole (MJM-14)

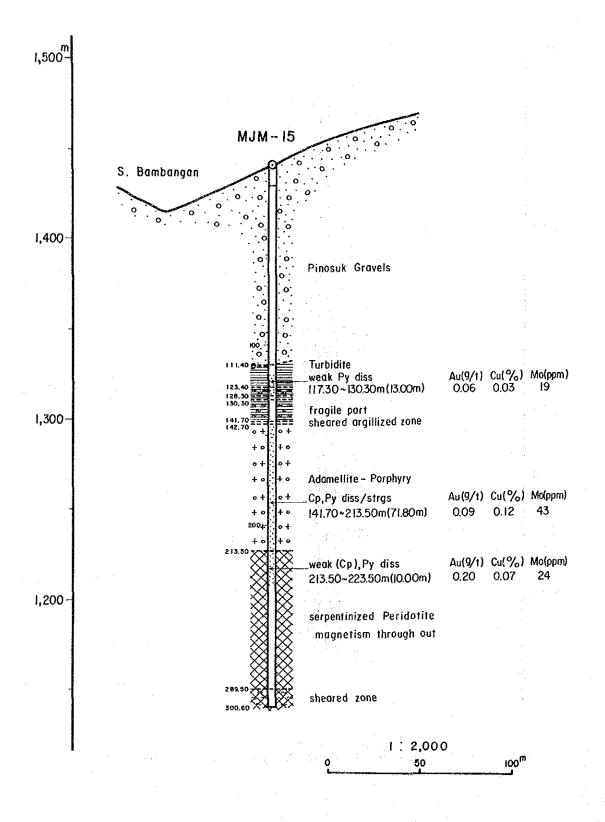


Fig. II-4-2 Geological Section of Drill Hole (MJM-15)

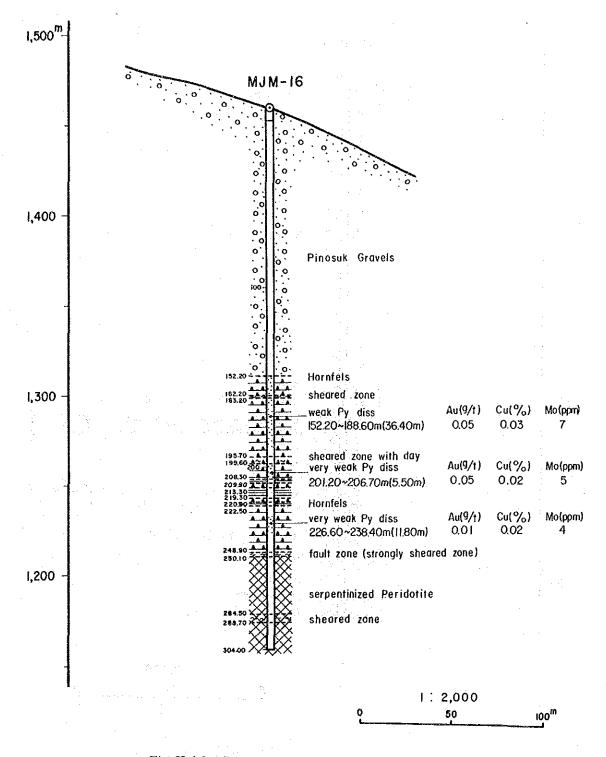


Fig. II-4-3 Geological Section of Drill Hole (MJM-16)

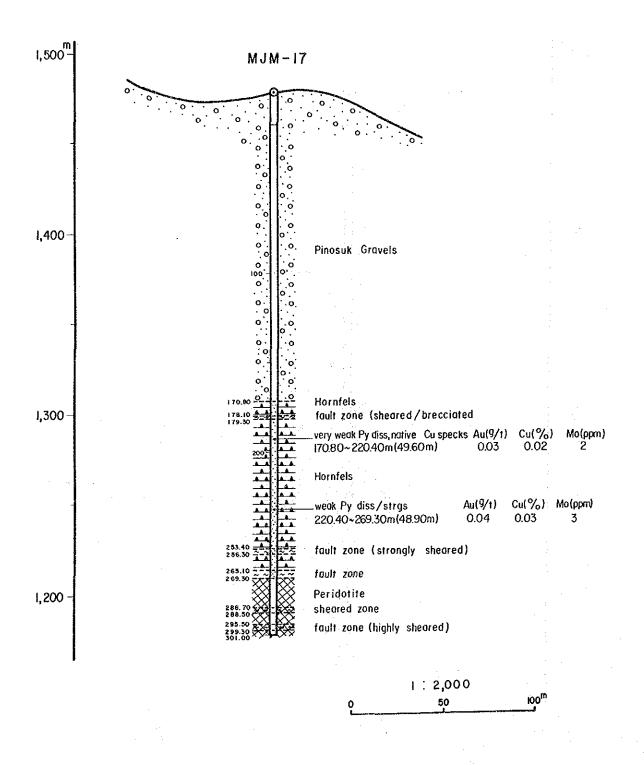


Fig. 11-4-4 Geological Section of Drill Hole (MJM-17)

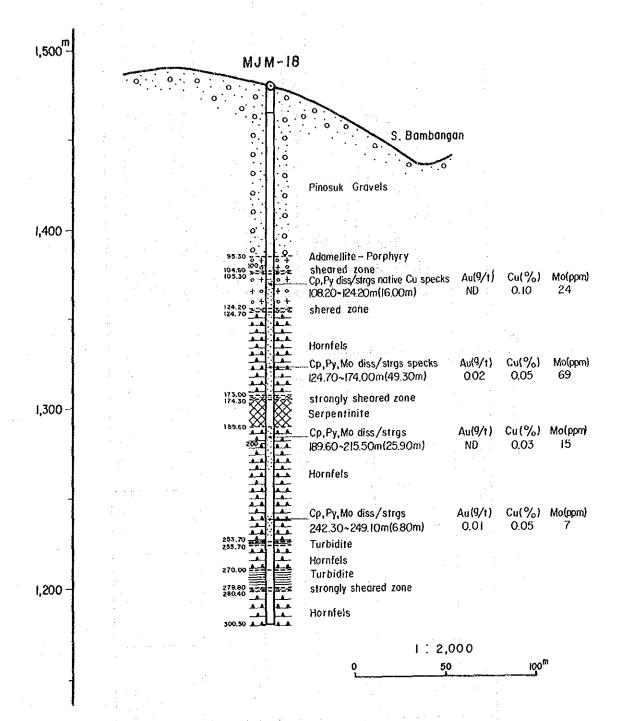


Fig. II-4-5 Geological Section of Drill Hole (MJM-18)

Table II-6 Summary of Results of Drilling Sruvey

	Summary of Result	Rock: hornfels, adamellite porphyry Mintralization: occurring in boundary zone of both rocks	Assertion, in m) Au (g/t) Cu (%) Mo (ppm) (77.10-111.70 0.07 0.145 16.7 111.70-191.50 0.06 0.045 37.0	Rock : hornfels, adamellite porphyry and peridotite Mineralization : occurring in hornfels and adamellite porphyry	Assay Kesuit: 141.70–213.50 0.09 0.117 43 213.50–223.50 0.20 0.072 24	Rock : 152 m of Pinosuk Gravels hornfels, peridotite Mineralization : occurring in hornfels most weak among 5 holes Assay Resuit : 0.05 0.034 7	Rock: same as MJM-16 Mineralization: occurring in hornfels Assay Grade: 170.80-220.40 220.40-269.30 0.04 0.031 3	Rock : hornfels, adamellite porphyry and peridotite         Mineralization : occurring in both hornfels and adamellite         Assay Grade :       0.096         108.20-124.20       ND         124.20-174.00       0.02         189.60-215.50       ND	
30 VN	Sample	pcs 121		91		64	<b>8</b>	110	470
Core Recovery	Except Surface Soil	75.41		89.47	. *	85.52	77.68	79.26	81.51
Core R	Total	73.16	4.1	86.49	*.	82.99	72.72	75.31	78.14
Core		220.20 m		260.00		252.30	218.90	226.30	1,177.70
Length	of Drilling	301.00		300.60		304.00	301.00	300.50	1,507.10
	Duration	July 17 ~July 31		July 21 ~Aug. 3		Sept. 11 ~Sept. 26	Aug. 13 ~Aug. 25	Aug. 11 ~Sept. 4	
	Hole	MJM-14		MJM-15		MJM-16	MJM-17	MJM-18	Total

142.70-213.50

adamellite porphyry,

weak silicification and argillization are widespread with brecciations and shearings, showing marginal

facies

213.50-300.60

peridotite,

dark green-blackish green color, massive, intensive serpentinization, encountered a predominant sheared zone from 239.50m to bottom

## (2) Mineralization

)

Prominent pyrite-chalcopyrite disseminations occur abundantly adamellite porphyry and a lesser intensity in hornfels, associated with fine molybdenite crystals. Mineralization becomes very weaker in peridotite; however, compared with hole MJM-14, it shows less copper mineralizations unlike those of gold and molybdenum.

The result of chemical analysis is as follows:

Section	Au(g/t)	Cu(%)	Mo(ppm)
141.70-213.50m	0.09	0.117	43.1
(71.8m, in hornfels and	es especiale		•
adamellite porphyry)	·		
213.50-223.50m	0.20	0.072	24.2
(10.0m, in peridotite)			

# 3. MJM-16 (-90°, 304.00m)

## (1) Geology

0 - 9.00m

surface soil

9.00-152.20

Pinosuk Gravels,

loose type bearing less amounts of hornfels gravels in clayey matrix to a depth of 13.00m, solid part between 13.00m and 152.20m, including a section consisting solely of hornfels gravels between 133.20m and bottom

152,20-208,30

hornfels

dark gray color, fine grain, sandy, sheared zone with thin clay layers in places accompanied with a

limonite stains

208.30-222.50

hornfels-turbidite alternation

3 brown colored turbidite layers with thickness of 1.60m-6.00m in dark gray colored, fine grained hornfels, turbidite layers consisting mainly of silicified hornfels fragment in a muddy matrix

222.50-250.10

hornfels,

same rock facies as above; however, shearing is

weaker

250.10-304.00

peridotite,

strong serpentinization with dark green, blackish green and greenish brown in color, abundant magnetite accompanied with hematite veinlets in places, fault contact with overlying hornfels judging from the occurrence of sheared zone with clayey layers between 248.90m and 250.10m

S.

#### (2) Mineralization

Specks of native copper occurs in places along fine cracks of hornfels accompanied with a weak pyrite dissemination between 152.20m and 180.30m, and molybdenite dots are rarely found between 163.90m and 166.50m.

Extremely poor mineralization of chalcopyrite and molybdenite in places is observed between 180.30m and 247.80m accompanied by sporadic dissemination of weak pyrite. Finely disseminated pyrite between 280.35m and 283.10m, and dots of pyrite and molybdenite occur between 291.10m and 291.50m without significant chalcopyrite. It can be stated that the hole indicates the poorest mineralization among 5 drill holes in Phase III.

the pyrite stringer in hornfels at 194.70m depth microscopically consists of finegrained pyrite, chalcopyrite and pyrrhotite.

Very fine gold of 0.006mm in size is also recognized in the pyrite.

The result of chemical analysis is as follows:

Section		Au(g/t)	Cu(%)	Mo(ppm)
152.20-188.60m	\$ - "	0.05	0.034	7
(36.4m in hornfels)				·

# 4. MJM-17 (-90°, 301.00m)

### (1) Geology

0 - 19.20m

surface soil

19.20-170.80

Pinosuk Gravels

loose type between 19.20m and 43.45m, solid type between 43.45m and 170.80m, no adamellite and adamellite porphyry among those gravels between 140.60m and 170.80m

170,80-265.10

hornfels,

dark gray color, fine grained (medium-coarse size in places),

partly silicified and overall fracturing accompanied by strong shearing and brecciation between 178.10m and 179.30m, between 185.10m and 186.10m, between 253.40m and 256.30m

265.10-269.30

fault zone

269.30-301.00

peridotite,

dark green-blackish green color, strong serpentinization and argillization

### (2) Mineralization

Weak pyrite disseminations occur between 170.80m and 234.30m partly accompanied with specks of native copper along fine fissures. Based on visual observation, the grade of copper is expected less than 0.05%.

The mineralization between 234.30m and 269.30m consists of pyrite dissemination accompanied with impregnations and stringers of chalcopyrite; however, the grade of copper estimated by visual observation will be 0.1% and/or below, and poor compared with the holes MJM-14 and MJM-15.

The result of chemical analysis is as follows:

		Bootion			54(13)	ting (Literal)
		170.80-220.40m		0.03	0.018	2
		(49.6m in hornfels)			position of the second	· ·
		220.40-269.30m		0.04	0.031	3
		(48.9m in hornfels)			ing to the second	en production of the second
					\$ · · ·	
5.	MJM-1	8 (-90°, 300.50m)				
	(1)	Geology	*.	. :		
		0 - 15.00m	•	surface soil		
		15.00- 95.20		Pinosuk Gravel	s,	
				loose type bet	ween 15.00m an	d 31.10m, solid
				type between	31.10m and 95.	10m, showing a
٠				strong oxidatio	n down to a depth	of around 72m.
		95.20-124.20		adamellite porp	ohyry,	
				massive, howev	ver, showing a frac	tured structure,
				partly limonite	stains,	
				chloritization	throughout and	argillization in
				places.		
		124.20-174.30		hornfels,	•	
				dark gray cole	or, fine grained,	massive shape,
				sheared in place	es	
		174.30-189.60		peridotite,		
				greenish gray-c	lark greenish gray	color, intensive
			•	serpentinization	n, veinlets of tal	c and quartz in
				places.	en e	
		189.60-300.50		hornfels,	a shall the same	
						·
					ng thin layers of	
					and the second s	

Au(g/t)

Section

Cu(%)

Mo(ppm)

## (2) Mineralization

Disseminations of pyrite and chalcopyrite were observed between 108.20m and 148.80m both in adamellite porphyry and hornfels.

Pyrite disseminations are followed at intervals down to a depth of 276.4m.

Remarkable mineralization occurs between 118.40m and 129.50m including the boundary between adamellite porphyry and hornfels; however, based on visual observation, the grade of copper is most likely less than those of MJM-14 and MJM-15.

Under the microscope, the mineralized peridotite at 177.20m depth contains pyrite, chalcopyrite and a few tetrahedrite, molybdenite, galena and sphalerite. Fine-grains of chromite are partly observed.

The result of chemical analysis is as follows:

Section	Au(g/t)	Cu(%)	Mo(ppm)
108.20-124.20m	ND	0.096	24
(16.0m in adamellite porphyry)			
124.20-174.00m	0.02	0.050	69
(49.8m in hornfels)			
189.60-215.50m	ND	0.026	1,5
(25.9m in hornfels)	ž.		

#### 2-2 Summary of Results

The summary of drilling results is as follows:

- 1. The mineralized area along the Bambangan creek and its surroundings are composed of intersely thermally altered sandstone and mudstone (partly intercalated with turbidite) of the Trusmadi Formation, peridotite intrued into the Formation and adamellite porphyry which has intruded into the Formation and peridotite. Adamellite porphyry is a vertical dike extending in the N-S direction under the Bambangan creek (FigI-4).
- 2. The mineralization is of a porphyry copper type consisting of pyrite and a miner amount of chalcopyrite. It is clearly controlled by lithology as shown below,

adamellite porphyry:

remarkable

hornfels:

good near the contact with porphyry but

weaken rapidly towards outside

peridotite:

local and weak mineralization

3. As shown in Fig. I-4, five holes, drilled in Phase III this year, have penetrated hornfels close to the marginal zone of adamellite porphyry intrusives.

Therefore, mineral occurrences in host rocks have demonstrated that the mineralization may not extend in a broader area than what expected and that it occurs about 400m to N-S direction and about 200-250m to E-W direction.

4. Assay values of core samples with a length of at least continuous 5m are given below.

(No. of hole)	(Length of core, m)	Au(g/t)	Cu(%)	Mo(ppm)
MJM-14	134.0m	0.06	0.068	27
MJM-15	94.8	0.09	0.101	27
MJM-16	53.7	0.04	0.029	6
MJM-17	98.5	0.03	0.024	2
MJM-18	98.0	0.01	0.051	43
Average	96.0	0.04	0.058	24

The average grade of mineralized zone is as low as 0.06% Cu.

5. The thickness of the Pinosuk Gravels layer varies from 70-170m in the area. It is much thicker than considered ever.