REPUBLIC OF HONDURAS

REPORT ON GEOLOGICAL SURVEY OF THE WESTERN AREA

VOL. 4

FEBRUARY 1980

METAL MINING AGENCY

JAPAN INTERNATIONAL COOPERATION AGENCY

GOVERNMENT OF JAPAN

PREFACE

The Government of Japan, in reponse to a request by the Government of the Republic of Honduras, decided to investigate the potentiality of mineral resources in the western part of the Republic of Honduras and entrusted the geological and other survey works to Japan International Cooperation Agency. The Agency, considering the nature of the works to belong to special field of the investigation of geology and mineral resources, sought the cooperation of the Metal Mining Agency of Japan to accomplish the task.

The survey works of this year comprising the third phase, as a part of the survey works, the Metal Mining Agency of Japan organized a 10-men survey team headed by Mr. Tadashi Sakuma of MESCO, Inc. and sent the team to the Republic from May 21st to September 7th of 1979. During this period, the team, with the help of the Government of the Republic of Honduras and its various agencies, was able to complete survey works on schedule for the current year.

This report summarises the results of the survey of the third phase and will form a portion of the final survey reports that will be prepared with regards to the results obtained in the first and second phases of this survey.

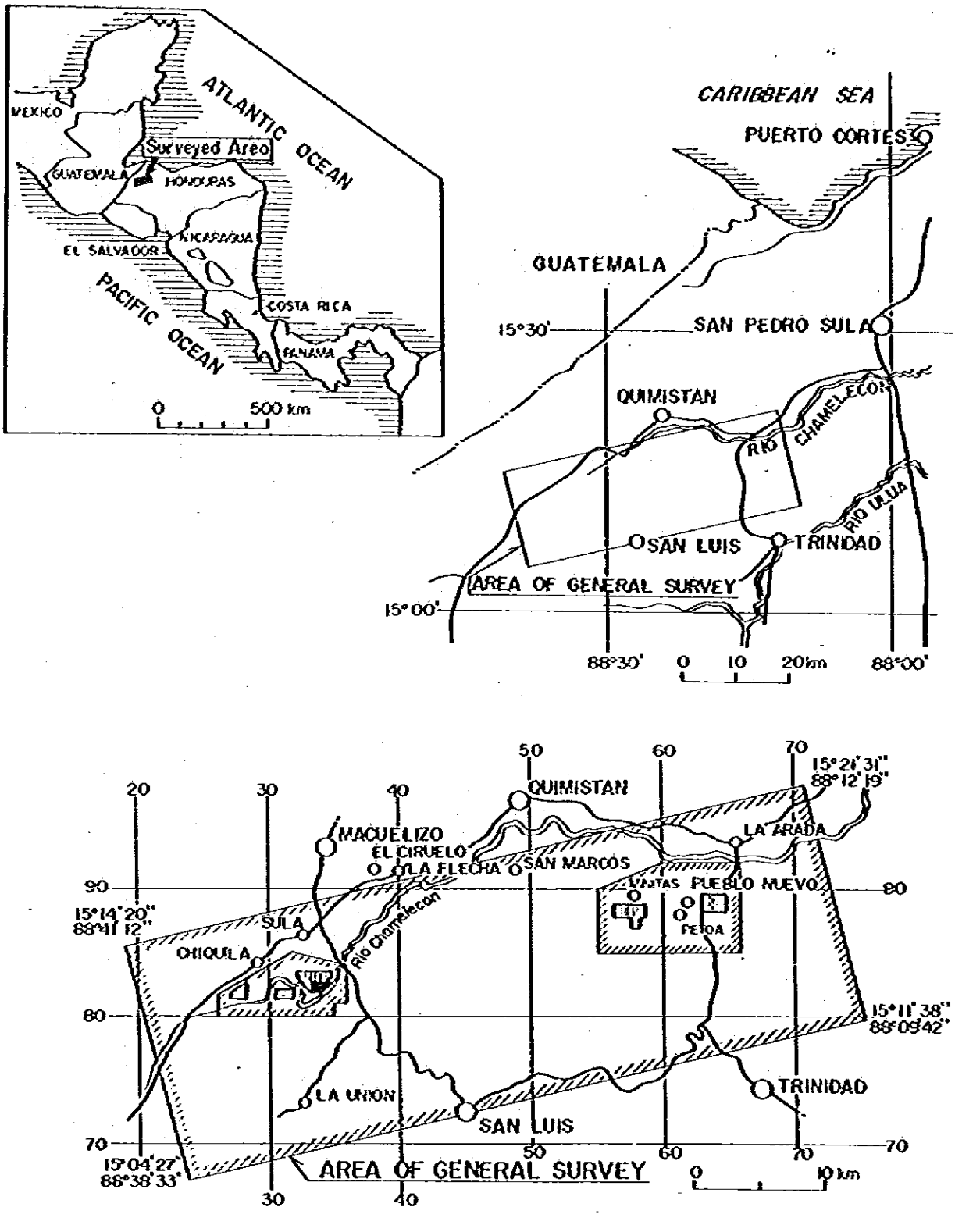
I wish to take this opportunity to express my heartful gratitude to the officials of the Government of the Republic of Honduras and its various agencies, as well as to the Ministry of International Trade and Industry, the Ministry of Foreign Affairs and cooperating companies, for the cooperation and support extended to the Japanese survey team.

February 1980

Keisuke Arita
the president of Japan International Cooperation Agency

Masayuki Nishiie
the president of Metal Mining Agency of Japan

Fig.1-1 LOCATION MAP OF THE SURVEYED AREA



Surveyed area in 1977 Surveyed area in 1978 Surveyed area in 1979

INTEGRATED CONTENTS

ABSTRACT

(1) As the third phase of the Basic Geological Survey for the Development of Mineral Resources in the western part of the Republic of Honduras, detailed geological survey and diamond drilling were completed, for the purpose to investigate more concrete potentiality of the emplacement of mineral resources, in the Vueltas del Rio area, which had been selected from the four favourable areas, through the results of the detailed geological survey and the diamond drilling carried out in the second phase of this Basic Geological Survey. These four favorable areas were originally extracted from the subject area of the first phase survey, by the results of the geological survey, the geochemical survey, the geophysical survey (IP method) and the diamond drilling then performed.

(2) The survey area is situated about 75 km south of the town of San Pedro Sula in the northwestern part of the Republic of Honduras. It lies in the low mountainous land of the height of 200 to 510 meters above sea level, and geologically the survey area belongs to the geo-structural unit of the Sierra of Northern Central America.

As for the geology of the survey area, carrying Paleozoic mica schist formation in its north, the area is underlain mainly by the Veultas del Rio Formation. In the south of the area, Mesozoic Atima massive limestone Formation and Guare Formation of limestone and shale are distributed. The area further south is occupied extensively by the Tertiary volcanic layers of Matagalpa Formation.

The boundary between Paleozoic sediments and other formations is represented by east-west trending Pueblo Nuevo overthrust. Dykes and stock-like igneous rocks composed of quartz diorite, andesite, diabase, are found in the zone extending east-west within about 5 km from the

overthrust. Some of them intruded into the Paleozoic and Mesozoic sedimentary rocks, and influence by such intrusion is observed as alteration and structural disturbance.

As the indications of mineralization in the subject survey area, those of veinlet or dissemination copper type, gold-copper vein type and autochthonous residecal gold type are known, emplaced in the Vueltas del Rio Formation.

(3) The following geological features have been confirmed as for the geology of the Vueltas del Rio area, through the results of the detailed geological survey accompanied by trenching and the diamond drilling of 8 holes, total length of which reaches 2,102.7 meters.

A) Carrying Paleozoic metamorphic rocks in the north and Mesozoic Cretaceous Atima Formation of limestone in its south, this area is underlain by metamorphosed volcanic pyroclastics and volcanic rocks, which comprise a part of a formation tentatively grouped and called as Vueltas del Rio Formation, composed of tuff, tuff breccia, andesite and shale.

B) The beds show a synclinorium with the axis trending east-north-east and west-south-west, and dipping 5 to 10 degrees to the east. Foldings are much complicated. In the south they are bounded by a fault of the same trending with the Atima Formation.

C) As for alteration, sericitization and silicification are remarkable near the surface. In the northern part and at the depth, chloritization is well recognized.

Argilization is seen near the surface as well, with occasional pyritization and carbonatization. Oxidation and secondary enrichment of minerals can be traced to the depth of 150 to 200 meters.

D) Dykes of quartz porphyry, dacitic porphyry and andesite are subjected to alteration, but they seem to have no particular relation to geological

structure, alteration concerning mineralization and mineral indications. Therefore, it is not obvious which igneous rock is related to mineralization.

E) Mineral indications of copper, gold and zinc are found at 15 locality by every hole of diamond drilling except for Hole No. 54-5. They are indications of mesothermal to epithermal ore veins or networks, rarely of dissemination type, with the mineral assemblage of chalcopyrite, sphalerite, galena, electrum, pyrite and quartz.

F) Through the detailed geological survey with surface trenching, a zone of indication of gold mineralization has been confirmed in an area of 150 meters in width and 1,200 meters in length, in the surface oxidation zone and secondary gold enrichment zone, where the San Martin old workings and the Nelson trenches are included. It has gold grade of 1.0 to 10 g/t and it would be possible to make an estimation of ore reserves to the approximate depth of 20 meters. Exploration works (for the development of this gold mine) are necessary for the confirmation of the condition of the mineral emplacement in this zone, and study and consideration are recommended for the detailed estimation of ore reserves and ore grade, for the characteristics of ore, and for the recovery of minerals. For this purpose, trenching of regular intervals, shallow grid drilling of appropriate intervals in the necessary small areas, study of the assemblage and occurrence of gold minerals, concentration test and F/R study are recommended to be carried out, in this order, for the total analysis to make clear the possibility of the development.

G) As for the mineral indications of the vein type at the depth, it is desirable to carry out careful exploration works in the order of more-detailed geological survey on the surface--trenching--drilling of the depth of minimum necessity, mainly in order to check the extension

especially in relation to the indications recognized on the surface, giving preferential treatment to those of better grade and size.

GENERALS

GENERALS

Chapter 1 Introduction

1-1 Particulars and Purpose of the Survey

The government of the Republic of Honduras, with the cooperation of United Nations, conducted, for five years from 1969 to 1974, regional geological survey and geochemical exploration in the total area of 10,800 km^2 of the northwestern part of the Republic, and also performed systematic exploration works, in the selected areas, by the combination of the methods such as detailed geological survey, detailed geochemical exploration, geophysical survey, pitting, trenching and diamond drilling. Based on the results of the works, several favorable areas bearing indications of mineralization of dissemination-type and skarn-type, associated with metal minerals of copper, gold, lead and zinc were recommended, and the government of the Republic of Honduras requested the government of Japan for Basic Geological Survey for the Development of Mineral Resources in October of 1975.

The government of Japan despatched the mission for the project selection three times and selected the area including Chamerecon area and Petoa area. The Basic Geological Survey for the Development of Mineral Resources was commenced in May of 1977.

The survey was performed to confirm geology and structure of the selected areas by geological survey and geochemical survey, to select two favorable areas of Chamelecon and Petoa as the high potentiality areas for mineral resources. Conducting geological survey with trenching, geophysical prospecting by IP method, geochemical survey and diamond drilling, as well as examining the reported data in the past and UNDP survey results, it has been ascertained, after confirmation of the distribution and the alteration of the rocks at depth and the characteristics of the mineralization, that

these areas are favorable for the mineral resources of various types as disseminated copper type, vein type, contact replacement type and weathered residual type.

Furthermore, for more concrete investigation of igneous rocks related to the mineralization and of features of alteration and mineralization, four favorable areas of Vueltas del Rio, Minitas, Laguna Seca and Pueblo Nuevo were extracted in the second phase surveys, and the geological survey and the diamond drillings were carried out to elucidate in detail the relation of the mineralization and the geological structure. In the Vueltas del Rio area, vein type mineralization of the grade of more than 1 % of copper was confirmed in the three drill holes, while in the Minitas area, mineralization zone of copper, lead, zinc and iron was ascertained in the skarn zone around the granite porphyry and the diorite porphyry. Therefore, it was thought that further investigation would be necessary for the comprehension of the features of the mineralization in detail.

In this third phase, for more detailed investigation of the mineralization and for the elucidation of the geological structure, detailed geological survey and diamond drilling were carried out in the Vueltas del Rio area that had been selected in the above-mentioned way.

1-2 Outline of the Survey Works

1-2-1 Area of the Survey (Refer to Fig. I-1)

The survey area is located about 75 km southwest of the city of San Pedro Sula and occupies an area of roughly 2 km^2 in the subject area of the geological survey in the first phase.

1-2-2 Detailed Geological Survey

Outline of the geology and the structure as well as outline of the features of the mineral indications in this area had been comprehensively

grasped by the first and second phase surveys of detailed geological survey, geophysical prospecting (IP method) and diamond drillings, in addition to the results of the UNDP surveys. However, rock exposures are poor due to remarkable weathering and alteration on the surface in this area, trenching was carried out in this third phase survey, using bulldozers, total length of which reaches 6.6 km, and detailed geological mapping of the scale of 1 to 1,000 was completed by easy transit compasses and measuring tapes. Especially in this third phase survey, systematic sampling was carried out in remarkable indications of mineralization, through establishing the necessary area around the gold geochemical anomalies and the indications of gold mineralization. And analysis of the features of mineralization and alteration was accomplished by microscopy, X-ray diffraction and chemical analysis of gold, copper, lead and zinc. Meanwhile, the surveys in the Olancho area, was performed by two survey parties responsible respectively for southern part and northern part, based on the topographical map of the scale of 1 to 50,000 and on the existing data and references, and the materials for the consideration of the extraction of areas for further exploration were successfully obtained. Separate report has been prepared for this Olancho area, for reference.

These fieldworks were performed by Japanese 3 members with geologists of the Direccion General de Minas e Hidrocarburos of the Republic of Honduras, for about three months and a half.

1-2-3 Diamond Drilling

Based on the information obtained through the geological survey and others up to last phase, consideration was given for the determination of the locations of the drill holes, with regards to the indications of mineralization. And the diamond drillings with total length of 2,102.7 meters of 8 holes were completed as follows;

. 6 holes, total length 1,500 meters

in the central part of the Vueltas del Rio area, and

. 2 holes, total length 600 meters

in the eastern plain part of the area.

The term for the drill works was 96 days from June 4th to September 7th in 1979.

A survey member in charge of the drilling was sent in advance to the field of La Flecha on 21st of May, 1979, and did the inspection of the drill machines, as well as observation and land survey of the actual locations for the drilling. And the construction of the access roads and the drill sites were carried out by this advance member. Another Japanese 7 members arrived on 4th of June, according to the schedule of the delivery, at the port, of the materials and supplemental parts and tools. Thus construction works were commenced. In the first place, construction and arrangement of the transportation roads and the drill sites by bulldozers and preparation of water supply required for the drilling were completed.

Two drill machines of TCM-5A were used. (Its capacity of drilling is 510 meters in final NQ size and 660 meters in final BQ size.) The machines were operated by wire-line method, through three shifts per day, each shift comprising 8 hours. Bentonite-mud water was used for the drilling. Transportation of water was done by tank truck. The parts near surface were drilled with metal bits without consuming water, and the attempt to recover as much cores as possible was successful. The total core recovery was 94.9 %.

After completion of the drilling for three months, the cores were stocked in the warehouse in the sites at La Flecha, by the instruction of the Direccion General de Minas e Hidrocarburos of the Republic of Honduras while the machines were packed for transportation after repairs. All the

members returned to Japan on 7th of September.

All the cores were logged as for lithology, alteration and mineralization, and the data were described on the core-logging charts of the scale of 1 to 200. Systematic sampling was carried out with the drill cores to confirm the grade of mineralization. The samples were analysed in Japan and also at the Direccion General de Minas e Hidrocarburos of the Republic of Honduras.

1-3 Members of the Survey Team

Members of the survey team joined from both country are as follows;

Japan side ----

Leader:	Tadashi Sakuma	MESCO, Inc.
General Affairs:	Masaru Tateishi	JICA
	Makoto Ishida	MMAJ
	Yukio Harada	MMAJ
	Nobuhisa Nakajima	MMAJ

Survey Member:

Liaison representative in the field (Geology)

	Kiyohisa Shibata	MESCO, Inc.
Geology	Ikuhiro Hayashi	MESCO, Inc.

Liaison representative in the field (Drilling)

	Harukichi Shimode	MESCO, Inc.
Drilling	Shigeo Sekiguchi	MESCO, Inc.
	Munenori Ohnuki	MESCO, Inc.
	Kiyomi Miura	MESCO, Inc.
	Tsutomu Aoyama	MESCO, Inc.
	Shigemitsu Watanabe	MESCO, Inc.
	Kazutoshi Uchimura	MESCO, Inc.

Honduras side ----

Ing.	Guillermo Houghton	Departments de Geologia (DGMI)
Ing.	Napoleón Ramos	"
Ing.	José Maria Gutierrez	"
Ing.	Francisco Galeano	"

JICA : Japan International Cooperation Agency

MMAJ : Metal Mining Agency of Japan

DGMH : Direccion General de Minas e Hidrocarburos

Chapter 2 General Consideration

2-1 General Geology of the Survey Area (Refer to Fig. I-2, Fig. I-3)

The survey area is located in the northwestern part of the Republic of Honduras, and is situated in the hilly mountainous land of the altitude of 200 to 500 meters above sea level.

The survey area belongs to geostructural unit of Sierra of Northern Central America and is underlain by Paleozoic metamorphic rocks, Mesozoic sedimentary rocks and igneous rocks intruding them, while Tertiary volcanic rocks are distributed in the southern part.

The subject area for this third phase survey is constituted mainly by hilly mountainous land of Vueltas del Rio area, where meandering part of the Chamerecon River is included. In the north, Paleozoic metamorphic rocks are well developed with the trend of east-west, while in the south there is distribution of Atima limestone formation which belongs to Yojoa Group of Mesozoic Cretaceous age. Between the Paleozoic and the Atima Formation, the Vueltas del Rio Formation composed of metamorphosed sedimentary rocks mainly of volcanic pyroclastics are distributed.

The Vueltas del Rio Formation is composed mainly of volcanic rocks and pyroclastic rocks of acidic to basic character, and the rocks are weakly metamorphosed and schistosity is observed to be developed. They are complicatedly folded with the axis of east and west, and are bounded with faults to the Paleozoic in the north and to the Atima limestone formation in the south.

Intruding the Vueltas del Rio Formation, dykes and stocks of diabase, andesitic porphyries, quartz diorite and dacitic porphyries are observed. They were subjected to alteration, with surrounding rocks, as sericitization, silicification, chloritization, etc., makes it quite hard to estimate

original rocks, added by oxidation on the surface.

In this area, geochemical exploration, geological survey and diamond drillings were carried out by UNDP team and strong anomalies of gold, copper and zinc were detected. And many indications of gold and copper mineralization were found by over 30 holes of short drilling. Copper and gold ore reserves of more than several million tons were inferred at this time. With regards to the existence of more than 7 old workings showing gold exploration in old days in the central part of this area, the Vueltas del Rio area was one of the favorable area where gold and copper mineralization would possibly be expected.

2-2 Geological Survey

In this third phase survey, detailed geological survey accompanied by trenching was carried out, concentrating the works in the extracted Vueltas del Rio area. Consideration was given to the identification of original rocks, to the geological structure and especially to the distribution of gold minerals.

In this Vueltas del Rio area, the Vueltas del Rio Formation of unknown age is distributed except for a part of southern end, where Mesozoic Cretaceous Atima limestone formation is recognized. The Vueltas del Rio Formation is, in the apparent order from the lowest to upper, composed of alternation of schalstein, metamorphosed tuff and metamorphosed tuff breccia, alternation of metamorphosed andesite, metamorphosed tuff and tuff breccia and metamorphosed welded tuff, and combination of metamorphosed volcanic pyroclastic rocks and metamorphosed volcanic rocks partly with insertions of shale and conglomerate. Intruding these rocks belonging to the Vueltas del Rio Formation, dykes of dacitic porphyry and andesite are recognized. In the western neighbouring area, quartz porphyry dykes are observed.

These rocks have undergone alteration such as strong silicification, carbonatization, sericitization, chloritization and argillization, and the identification of lithofacies is quite difficult by such alteration in addition to metamorphism. However, classification of these rocks have been attempted successfully after careful study and consideration.

The beds have general trend of east-north-east and west-south-west, although east and west trending is general in the northern neighbouring area. As a whole, the Formation reveals synclinorium composed of one anticlines and two synclines with the axes of east-north-east and west-south-west. The folding is wavy and quite tight. This structure has been confirmed by the correlation of the beds caught in the drill holes, regarding the metamorphosed andesite as a key bed. By the data, the folding axes are dipping 5 to 10 degrees to the east. It is thought to be because the alteration is well harmonized with the geological structure of this gentle inclination that the alteration such as argillization, sericitization and silicification is remarkable on the surface while chloritization is found at depth. In another words, alteration zone itself is gently dipping to the east.

In the area, indications of gold and copper mineralization are known. As for gold, the indications are redidual gold mineral zone found in oxidation zones on the surface and gold-bearing quartz veins found in the altered rocks. As for copper, the indications are dissemination of green oxide copper minerals and chalcopyrite-bearing quartz calcite veins found at several localities in the drill holes. Also, as for zinc, extensive distribution of geochemical anomalies on the surface has been recognized, though they are of low grade, and indications of disseminated zinc mineralization has been found in the drill holes.

Indications of gold mineralization are recognized with quartz veins

in the metamorphosed tuffs at 10 localities mainly around known San Martin old workings and around Nelson trenching. They are of the scale of the width of 0.5 to 3 meters with the grade of 1.1 g/t to 10 g/t of gold.

Through the detailed geological survey with trenching in these localities, distribution of the indications has been confirmed and it has been clarified that gold ore reserves of several hundred thousand tons can be expected.

By the analysis of the above-mentioned data obtained through the various surveys of this series, the following geological circumstances are estimated as for mineralization in this area.

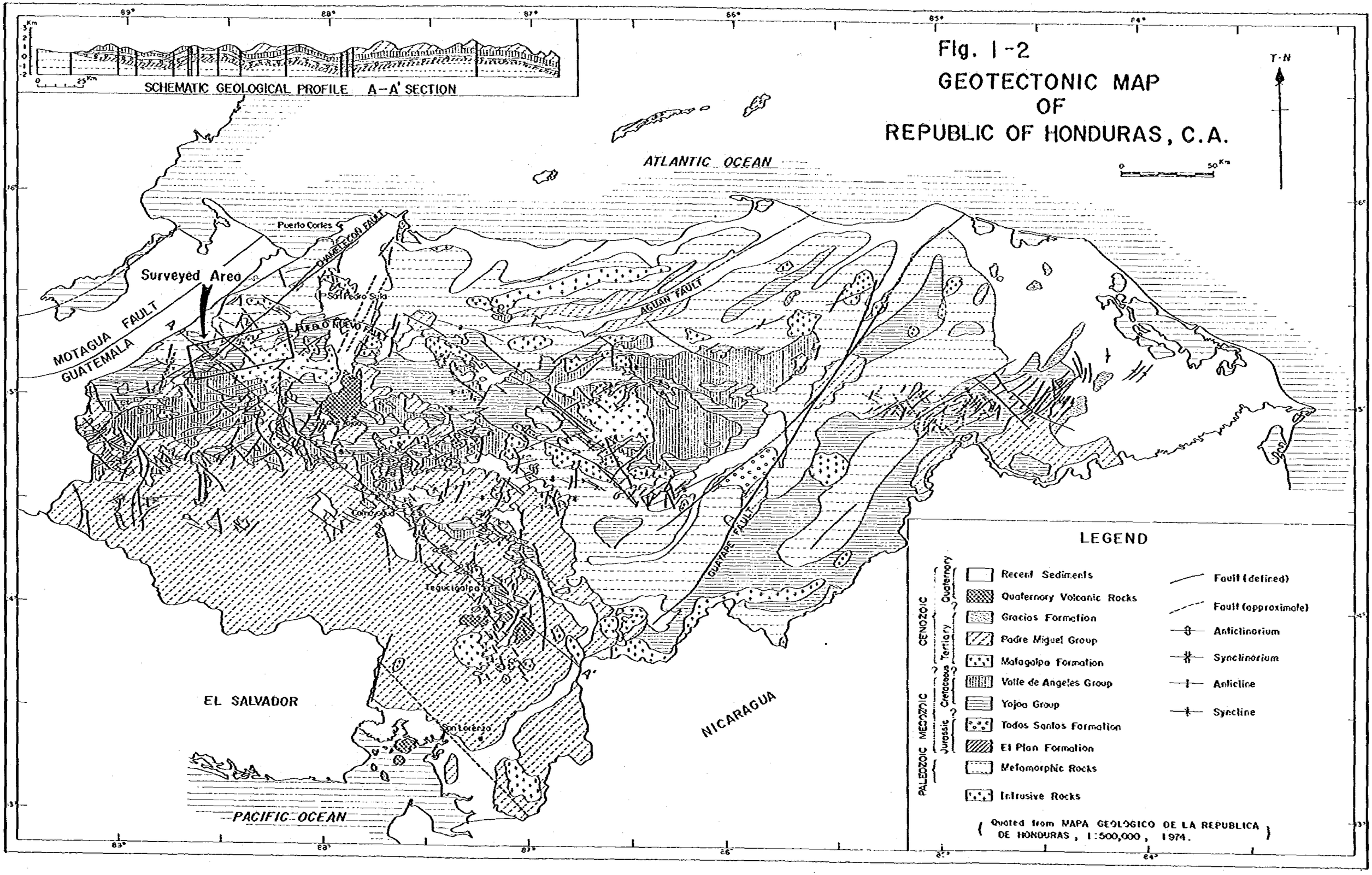
The Vueltas del Rio Formation is a formation composed mainly of metamorphosed volcanic pyroclastics and volcanic rocks, and is older than Jurassic El Plan Formation which comprises detrital deposits without igneous activity. Therefore, it is possible that the Vueltas del Rio Formation would be Paleozoic. These layers of metamorphosed tuff breccia and tuff, andesite are developed over 700 meters in thickness, composing several repetitions of alternation, with insertions of shale and conglomerate layers. It is evident from this fact that repeated igneous activities were there several times before metamorphism took place.

As the intrusive rocks, dacitic porphyry, andesite and quartz porphyry have been confirmed. They form dykes and are subjected to alteration, but, as no positive data of these dyke rocks to be related to the indications of mineralization have been obtained, it is not obvious if they have any role to the mineralization in this area as well as to the formation of the geological structure.

Many indications of gold and copper mineralization are found in such zones where sericitization and silicification are frequently observed, and these alteration zones are dipping gently toward the east in good harmony

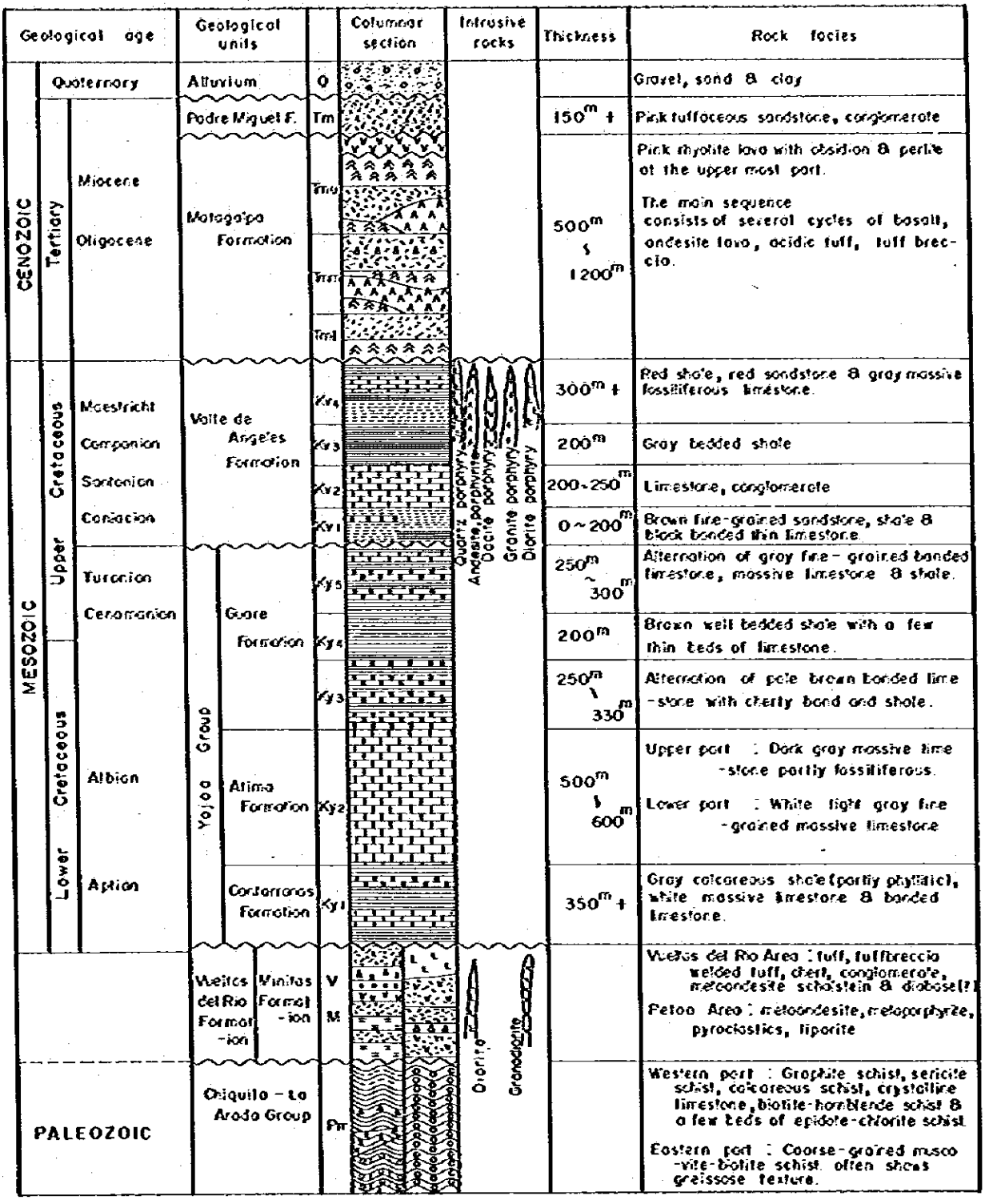
Fig. 1-2

GEOTECTONIC MAP OF REPUBLIC OF HONDURAS, C.A.



(Quoted from MAPA GEOLOGICO DE LA REPUBLICA DE HONDURAS, 1:500,000, 1974.)

Fig. 1-3 SCHEMATIC GEOLOGICAL COLUMN OF THE SURVEYED AREA



with the geological structure. However, no intimate relation has been found between the geological structure and the indications of mineralization. It can be said as for genetic features of the mineralization that the mineralization in the Vueltas del Rio area is of the type of fracture filling gold copper veins, related to the structure of the east-west trending, considering that neither skarn nor halogen minerals have been found in addition that no related igneous rocks have been confirmed as mentioned above.

Indications of gold mineralization of autochthonous residual type in secondary enrichment zones on the surface are distributed in the northwestern part of the area and so this part is left to further consideration.

2-3 Diamond Drilling

In the central part of the Vueltas del Rio area, diamond drilling of 6 holes was carried out for the investigation of the features of two mineralization zones which had been caught by the analysis of mineral indications confirmed in the first and second phases. These zones are a fractured zone including east and west trending geochemical gold anomaly and another zone carrying remarkable iron gossans on the surface along a tectonic line trending northeast and southwest.

It is obvious that the distribution of the Vueltas del Rio Formation is confined to the area between the Paleozoic metamorphic rocks and the Mesozoic limestone formation. The western limit of the distribution has been confirmed and the formation is known to disappear in the Laguna Seca area by a fault. On the other hand, eastern extension of this formation is uncertain as it is covered with younger sediments in Valle de Quimistan (Plain of Quimistan). Furthermore, it is shown that the alteration zones such as sericitization and silicification, including many indications of mineralization, are gently dipping to the east, structurally. Accordingly,

it was thought that the eastern extension of this Vueltas del Rio Formation would require further exploration for the possibility of presence of mineral indications, and diamond drilling of 2 holes was carried out, in this phase of the survey, along the bank of the Chamelecon River in the eastern Plain over Begona.

By this diamond drilling of 2 holes, it has been clarified that the Vueltas del Rio Formation extends eastwards to the plain with same lithofacies, as so far evidenced. Also, alteration such as sericitization, silicification and pyritization has been recognized, although the degree of alteration is rather weak. No remarkable change has been detected as for the geological structure of the area where this drilling was done, compared to that of the subject survey area. Accordingly the estimated fault of the trend of north-east and southwest, which had been drawn topographically along the Chamelecon River in the area around Begona, bounding the Vueltas del Rio Formation to the Atima limestone formation, has been proved to be passing in the south of the drill holes. Therefore, it is thought that the trend of the fault would be changed to east-north-east and west-south-west.

Topographically, detrital sediments are recognized in these two drill holes down to the depth of about 120 to 150 meters and so the slope seen on the surface is thought to extend toward the plain with almost same degree of dipping as the inclination of the basement. The tectonic line with north-south trend, which is thought to form the Quimistan plain, has been proved to be present in the area further east or to be disappearing.

Where these drill holes are located on the lithofacies of many of the rocks which are hard to distinguish on the surface, identification has become possible by the fresh rocks taken out from the depth by the diamond drilling, and the distribution of lithofacies, alteration and ore grade at depth has been clarified.

To the approximate depth of 150 meters, oxidation and secondary enrichment of minerals are remarkable. Especially in the shallow part down to 13 to 27 meters, strong argillization caused by the oxidation is recognized to form reddish brown clay.

Classifying the rocks into metamorphosed tuff, metamorphosed tuff breccia, metamorphosed andesite and metamorphosed welded tuff, and taking the metamorphosed andesite as a key bed, it has been inferred, through integrated analysis of the results of the surveys carried out up to last year, that the Vueltas del Rio area is underlain by the layers forming synclinorium structure with the axis of east and west trending and with the gentle dipping to the east.

As for alteration, silicification and sericitization are found more in the shallow part, while chloritization is recognized at depth as well as in the andesites. It has become evident that the alteration zone is dipping gently to the east in good harmony with the geological structure.

Andesite dykes have been recognized as igneous rock in the area, but relation to the indications of mineralization has not been confirmed with such igneous rock.

By the diamond drilling carried out in this phase of the survey, indications of copper and gold mineralization have been confirmed with each hole of No. 54-1, No. 54-2, No. 54-3, No. 54-4, No. 54-6, No. 54-7 and No. 54-8.

The indications thus caught are as follows: (Refer to Pl.II-3)

Indication	Hole No.	Depth (m)	Length (m)	Assay Result
Cu	54-1	14 - 20	6	average 0.83%
	54-1	248 - 250	2	0.25%
	54-2	28 - 32	4	average 0.32%
	54-3	176 - 178	2	0.22%
	54-4	109 - 110	1	0.63%
	54-4	189.0-189.1	0.1	1.0-2.0%
	54-8	240 - 242	2	0.51%
Au	54-2	2 - 8	6	average 1.54 g/t
	54-4	10 - 12	2	3.24 g/t
Zn	54-3	36 - 50	14	average 0.83%
	54-3	58 - 78	20	" 0.43%
	54-4	0 - 36	36	" 0.32%
	54-4	62 - 80	18	" 0.31%
	54-4	94 - 102	8	" 0.50%
	54-6	0 - 30	30	" 0.26%
	54-7	170 - 176	6	" 0.38%

Most of these indications of mineralization are found in the shallow part at the depth of less than 200 meters, corresponding to the secondary enrichment zone. They are contained in strong alteration zone such as sericitization and argillization in the metamorphosed tuff and in the

metamorphosed tuff and in the metamorphosed tuff breccia, although partly zinc mineralization has been found in the andesite. The ore minerals are chalcopyrite, sphalerite, chalcocite, galena and electrum, associated with pyrite and hematite, partly accompanying green copper minerals. Gangue minerals are quartz and calcite, occasionally with clay minerals.

Chapter 3 Conclusion and a View to Future Program

3-1 Conclusion

The present survey has been carried out as the fourth stage of the Basic Geological Survey for the Development of Mineral Resources in the western part of the Republic of Honduras. As the first stage, the geological survey and the geochemical survey in the total area of 1,000 km^2 in addition to the detailed geological survey and geochemical survey in the selected two areas of Chamelecon area and Petoa area were performed. In the second stage of the survey, the geophysical prospecting (IP method) and the diamond drilling were carried out both in the Chamelecon area and in the Petoa area, and by the results of these surveys four favorable areas, situated in the area between the Paleozoic group and the Atima limestone formation, were extracted as the areas of high potentiality of mineralization. In these four areas, that is, Vueltas del Rio, Laguna Seca, Minitas and Pueblo Neuvo, the detailed geological survey accompanied by trenching was carried out as the third stage survey works. Especially, in Minitas and in Vueltas del Rio, diamond drilling was performed, and many indications of copper and gold mineralization were found at depth. It was concluded that it would be necessary to consider further surveys as detailed trenching for the indications of skarn type mineralization in Minitas area, while Vueltas del Rio area was extracted as the favorable area of high potentiality for the emplacement of ore deposits.

As the fourth stage of the survey, the detailed geological survey accompanied by trenching and diamond drilling were carried out in the Vueltas del Rio area. The results obtained through such surveys are as follows;

(1) The area is underlain by such rocks as metamorphosed pyroclastic rocks and volcanic rocks, and is occupying an area between the Paleozoic

metamorphic rocks in the north and the Mesozoic Cretaceous Atima limestone formation to the southern side. In this area, tuff, tuff breccia, andesite and partly shale are well distributed. The age of the rocks composing the Vueltas del Rio Formation is assumed to be late Paleozoic.

(2) The formation reveals synclinorium with the axis of the trend of east-north-east and west-south-west, gently dipping toward the east. The formation as well as the geological structure is extended to the plain in the east.

(3) As for alteration, sericitization and silicification are rather strong, while chloritization is recognized to be present in the northern part and at depth, where partly pyritization and carbonatization are found. Surface oxidation and secondary enrichment of minerals are recognized to the depth of 150 to 200 meters. The alteration seems to be in good harmony with the geological structure, and sericitization and silicification in the shallow part are recognized to be extending toward eastern neighbouring area.

(4) The dykes and stocks of quartz porphyry, dacitic porphyry and andesite are found to have intruded the Vueltas del Rio Formation and are subjected to the alteration such as sericitization and silicification, in this area. However, these dykes and stocks have no particular relation to geological structure, alteration and mineralization, and therefore igneous rock related to the mineralization is not certain, if any.

(5) Remarkable indications of mineralization have been confirmed through the surveys of this phase. They are the indications of copper, gold and zinc mineralization contained in the metamorphosed tuff breccia and tuffs and partly in the andesite, all of which are components of the Vueltas del Rio Formation.

In the hole No. 54-1, copper ----- 2 localities

In the hole No. 54-2, copper and gold ----- 1 locality each

In the hole No. 54-3, copper and zinc ---------- total 3 localities

In the hole No. 54-4, copper, gold and zinc ---- total 6 "

In the hole No. 54-6, zinc ---------- 1 locality

In the hole No. 54-7, zinc ---------- 1 "

In the hole No. 54-8, copper ---------- 1 "

By the detailed geological survey with surface trenching, a zone of indication of gold mineralization has been confirmed in an area of 150 meters in width and 1,200 meters in length, in the surface oxidation zone and secondary gold enrichment zone, where the San Martin old workings and the Nelson trenches are included. It has gold grade of 1.0 to 10 g/t and it would be possible to make an estimation of ore reserves to the approximate depth of 20 meters.

(6) These indications of gold and copper mineralization found at depth of the drill holes are quartz veins and fracture veins contained in the metamorphosed Pyroclastic rocks, and they are rarely found at the depth of more than 200 meters. It can be said that they are of the type of mesothermal to epithermal fracture filling ore veins, with the mineral assemblage of gold, chalcopyrite, sphalerite, galena, pyrite and hematite.

3-2 View to Future Program

In the subject area, indications of gold, copper and zinc mineralization have been confirmed on the surface and in the drill holes, through various surveys carried out in these three years. It is the problem to be discussed hereafter whether the indicated areas should be developed.

In this area, through the survey results of the diamond drilling and exploration works with trenching in the confined area where over several million tons of gold and copper ore reserves were inferred for the estimation by the surveys of UNDP team, it has become evident that the area and

the ore grade estimated by the UNDP team should be widely decreased.

The items to be considered in the process for the development in this area are as follows.

(1) Exploration program will be necessary to confirm the gold ore reserves and the ore grade more in detail in the mineralization zone of 150 meters in width and 1,200 meters in length, where San Martin old workings and Nelson trenches are included. Through this program, it is necessary to assure the accuracy of the ore reserves by improving them to "proved ore reserves" after attempting study of the features of mineral assemblage and recovery of ore minerals. For this purpose, detailed sampling and trenching with regular interval as well as shallow grid drilling of appropriate spacing are required, in order to re-calculate more in detail the ore reserves and ore grade through the analysis of the assay results of the ore and other samples thus obtained. It is necessary to determine whether this project should be developed by the F/R study, after general consideration of the features and occurrences of the gold minerals.

(2) Meanwhile, it is certain that the indications of gold, copper and zinc mineralization caught in the drill holes are of the types of quartz veins, fracture veins and networks. Regarding most of these indications, continuity or trend with dipping are uncertain because of the wide spacing of drill holes and the fair distance between the location of the indication in the hole and that on the surface.

Such ore veins as are located at the depth of more than 100 meters, with the width of less than 2 meters and with the grade of less than 1 % of copper, less than 3 % of zinc and less than 3 g/t of gold would be treated less preferentially as the subject of consideration for the time being, as it is obvious that they will be difficult to be developed.

It is desirable as to the indications of mineralization at depth to

proceed with exploration program carefully in such way to employ the methods of detailed surface geological survey --- trenching for the confirmation of extension of the indications --- drilling with the depth of minimum necessity, in this order, mainly to check the extension of the indications, considering the above-mentioned various conditions.

PARTICULARS

PART I GEOLOGICAL SURVEY

PARTICULARS

PART I GEOLOGICAL SURVEY

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Chapter 1 Geology

1-1 Geography

The subject survey area is located in the state of Santa Barbara, in the northwestern part of the Republic of Honduras. The access is by the sealed road of the distance of about 75 km (one and a half hour's drive by vehicle) from the city of San Redro Sula (the largest commercial and industrial town in the Republic of Honduras), to La Flecha, where the base camp was set up, from where the survey area is accessible through an unsealed road (mountain road) of the distance of about 10 km.

The area is situated on the southern slope of the Vueltas del Rio hilly mountainous land of the altitude of 210 to 510 meters above sea level, and occupies an area of 1.2 km in east and west and of 1.0 km in north and south. In the southern part to the eastern part of this area, the Chamelecon River flows and vast alluvial plain has been formed in the eastern part. The hills are covered with vegetation of pine trees and miscellaneous woods, while the plain along the Chamelecon River is cultivated for sugar cane, corns and pine-apple, although it is utilized as pasture partly.

The climate is typically tropical, as the area is situated in latitude of 15°20' north. Dry season is from December to April, while rainy season is from May to October. Especially, in June to August, rain is usually torrential with thunderstorm and rivers are often in flood. It becomes impossible to ford Chamelecon River in such time. It is very hot in day time in this season as the temperature is as high as over 30°C, but it is rather cool in morning and evening.

There are dangerous creatures like tick, venomous serpent and scorpion in the area. But no malaria has been found during the survey though dengue

fever was reported.

1-2 Outline of Geology and Stratigraphy (Refer to PL. I-1, PL. I-2)

In this area, there is widely distributed the Vueltas del Rio Formation composed of metamorphosed volcanic rocks and pyroclastic rocks, which is bounded in the south by a fault with Atima limestone formation. As igneous rocks, there are andesite and porphyrite dykes in the central part, though quartz porphyry is found beyond the southwestern limit of the area, and dacitic porphyry is recognized on the hill top beyond the north border of this area.

1-2-1 Vueltas del Rio Formation

The Vueltas del Rio Formation is composed mainly of tuff, welded tuff, tuff breccia, andesite and schalstein, all of which are metamorphosed, with occasional insertion of shale.

a) Metamorphosed tuff

The metamorphosed tuff is distributed as three layers, in the northern part, in the central part and in the southern part. Each of them has approximate thickness of 100 meters, with the trend of east-north-east and west-south-west. The rock is white to grey in color and medium to coarse grained liparitic tuff. Generally schistosity is clearly developed, and lamella structure is recognized. In such part as the lamella structure is observed, sericite which seems to have been formed by alteration of feldspar is observed to be in lenticular form. In and around such sericite, dissemination of very fine grained pyrite is seen coated with dark covering caused by oxidation, which makes it appear to be schistose or dot-like. They usually are associated with intense sericitization, carbonatization and argillization.

b) Metamorphosed welded tuff

The metamorphosed welded tuff is distributed around the drill hole No. 54-2 in the central northern part of the subject area. The rock is grey to brown in color and schistosity is not clear, as it has been affected by intense silicification and weak metamorphism and alteration. Porphyritic texture with phenocrysts and fragments of feldspar is observed to have been remarkably developed.

c) Metamorphose

This rock is distributed in four layers in narrow zones trending east-north-east and west-south-west, over northern part and southern part. The rock is grey to pale green in color, and fine to medium grained. The breccias are as big as pea to hen's egg, contained in the matrix of chlorite, feldspar and quartz. The breccias are andesite, pink felsite and tuff.

d) Metamorphosed andesite

The metamorphosed andesite is distributed in two localities forming narrow zones of the trend of east and west. One locality is between the drill holes No. 54-6 and No. 54-5. The rock is green in color, and fine to medium grained. The matrix is composed of quartz, plagioclase, chlorite and sericite while the phenocrysts are sericitized plagioclase, granular quartz, secondary chlorite and calcite.

e) Schalstein and diabase

These rocks are distributed beyond the northern limit of the area, and occupy the apparent lowest part of the Vueltas del Rio Formation. By the intense chloritization, the rocks reveal green color, and are easily affected by alteration as sericitization, silicifi-

cation and so on. Phenocrysts are various as feldspar, quartz and other granular minerals.

f) Shale (fine grained tuff)

The exposure of this rock can be traced from the road near the drill hole No. 52-4 in the western part of the area to Las Minas valley in the area further west. The rock is dark grey to black in color, remarkably well stratified and has foliation with interval of several centimeters.

Stratigraphically, the Vueltas del Rio Formation is composed, apparently from the lowest to the upper, of schalsteins, alternation of metamorphosed tuff and metamorphosed tuff breccia, alternation of metamorphosed andesite, metamorphosed tuff and tuff breccia, and alternation of the beds belonging to this alternation and welded tuff layers. No remarkable pinch or swell of the formation has been recognized.

1-2-2 Atima Limestone Formation

There is a fault with the trend of N 70°E, running in the southernmost part of the area. The Atima limestone formation is exposed in the area south of this fault. It is grey to light grey in color, and fine grained massive limestone. Close to the fault, thin layers of grey quartzite are recognized.

1-3 Igneous Activity

a) Quartz porphyry: This rock is exposed near the junction of Chamelecon River and Las Minas valley beyond the south-western limit of the area. The quartz porphyry is greyish white to greyish green in color and compact massive rock. On the surface, limonitized pyrite bearing quartz veins are crowded in some parts.

b) Dacitic porphyry: This rock is exposed around the drill hole No. 53-5

on the hill top beyond the northern limit of the area, with the trend of east and west. It is whitish in color and medium to coarse grained. This dacitic porphyry has been subjected to silicification and sericitization intensely.

c) Andesite and porphyrite: These rocks are exposed in the central part of the area in the form of dyke of the width of 2 to 20 m with east and west trending and with northeast and southwest trending. They show porphyritic texture with the phenocrysts of plagioclase, and have undergone alteration such as chloritization and carbonatization.

All of these dyke rocks have been affected by alteration and have intruded the Vueltas del Rio Formation. No dyke rock except for andesite has been recognized in the younger beds than Atima Formation, but as it is certain that the folding structures have been cut by these dykes, the age of the intrusion is thought to be possibly at the end of Paleozoic Era, when the folding structures were formed, though there is no positive data to show the age certainly. As to andesite, its age of intrusion should be considered with the age of alteration although the correlation with andesite found in the Atima Formation would be possible. The alteration which this andesite has undergone is chloritization and the distribution of this chloritization is recognized to be same as that of the Vueltas del Rio Formation. Therefore, the age of the intrusion of this andesite is not certain, although it can be said the age is before the alteration.

1-4 Geological Structure

The general trend of the beds belonging to the Vueltas del Rio

Formation in this area is east-north-east and west-south-west, but in the area beyond the north limit of the subject area the trend of east and west is prevalent. In the western neighbouring area, the beds are observed to form wavy shaped intense synclinorium bearing two syncline axes and one anticline axes of the trend of east-north-east and west-south-west, exhibiting complicated structure with small but tightly folded drag foldings. The plunge of the above-stated folding axes is 5 to 10 degrees to the east, considering on the profile of east-west direction tying the hilly land and the drill hole along the Chamelecon River, with the metamorphosed andesite to be taken as key bed.

Several faults and fissures are developed in the direction of north-east and southwest, which is oblique to the trend of the folding axes. The beds are dislocated to a certain degree by these faults. Around the folding axes and the faults, small fissures and cracks are developed with various trends of east and west, of south and north and of northeast and southwest. They are almost vertical. Along these fissures, limonite-bearing quartz veins of the width of 1 to 10 cm are often associated.

1-5 Geology of Trenches (Refer to PL. I-3)

It is presumed that a fracture zone is present in this subject area, trending east and west, which is represented by old gold workings and geochemical high anomalies. Also, an intense iron contamination zone is widely spread. For the confirmation of the features of gold in the shallow part of the fracture zone, detailed geological mapping with trenching was carried out.

1-5-1 Methods of Trenching and Sampling

Trenching was carried out by bulldozers in the whole zone, establishing roughly horizontal trench-lines along the topographical center lines, with

the interval of 150 to 200 meters. The total length of the trench-lines is 6,660 meters, comprising seven trenches of No. 1 to No. 7 trench, as is shown on the attached map (PL. I-3).

Trench No.	Length	Trench No.	Length
No. 1	810m	No. 5	492m
No. 2	1,350	No. 6	1,710
No. 3	1,120	No. 7	640
No. 4	538		

Samples were collected every 50 cm mainly from B bed of the soil which appeared on the wall of each trench. After removing plant roots etc., about 500 grams of each sample were packed into vynil bag. Total 169 samples were forwarded to the Direccion General de Minas e Hydrocarburos of the Republic of Honduras, where assays for gold, copper and zinc were carried out by atomic absorption method.

1-5-2 Geology of Each Trench

No. 1 Trench

This trench is 810 meters in length, running along the southern slope of small hills, from the drill hole No. 53-4, which is located on the hill top of the altitude of 470 meters above sea level, to the drill hole No. 54-1 of the height of 412 meters above sea level.

a) Geology --- Below surface, there are dark-colored humus, reddish brown soil and exposed rocks. The dark-colored humus is down to the depth of 60 cm with plant roots of pine trees and other miscellaneous woods. The reddish brown soil is 50 to 200 cm but averagely 120 cm in thickness, and contains granular or fragmental quartz grains and fragments of pyroclastic rocks (diameter of which is 0.5 to 1 cm). The exposed rocks are mostly metamorphosed tuff, intruded by porphyrite dyke.

The exposure of the metamorphosed tuff is usually reddish brown, as the result of remarkable oxidation near the surface, but fresh face of this rock reveals that it is white to grey in color, and fine to medium grained liparitic tuff. Partly schistosity can be observed, where sericite, which seems to have been formed by alteration of feldspar, is observed to be in lenticular form, in and around which dissemination of very fine grained pyrite is seen coated with dark covering caused by oxidation, which makes it appear to be schistose or dot-like.

The porphyrite dyke is observed along the road in the midway of the trench at the height of 430 meters above sea level. The rock is compact and dark green in color. Porphyritic texture is developed with phenocrysts of feldspar 2 to 5 mm in size. It is seen to have intruded the metamorphosed tuff as a dyke about 3 meters in width, with the trend of east and west, steeply dipping to the north.

b) Geological Structure --- The schistosity along the trench changes as follows; in the northern part near the drill hole No. 53-4, the trend is east and west, and the dip is 40° to the north; in the central part, the dip is north or south, which exhibits the part to be in some disturbance zone; and in the southern part, the trend is N 70°E with the dip of 30° to 40° to the south.

An anticline is presumed near the drill hole No. 52-4 located almost at the northwestern end of the area, where folding of shale bed can be seen. The disturbance zone in the central part of this trench is situated along the eastern extension of the folding axis of the above fold. Thus, it is thought that there would possibly be an anticline structure with the beds found in this trench, the

axis of which is in the same east-north-east and west-south-west direction as the axis of the above-mentioned folding has.

c) Indication of Mineralization --- Among the soil samples (29 samples) taken along this trench and from the old trench nearby, anomalous assay values of more than 1 g/t of gold have been recognized with the samples collected at 7 localities,---4 around the drill hole No. 54-1, 1 in the middle part and 1 in the higher part. In the topographically higher part of these localities, many old workings for gold are scattered, and it is thought that gold bearing quartz veins have been weathered and oxidized so that gold might have been concentrated in soils which have also been formed through weathering.

No. 2 Trench

This No. 2 trench is located in the western part of the area. Total length of this trench is 1,350 meters, from the drill hole No. 52-3 to west-south-west.

a) Geology --- In this trench, dark-colored humus (depth down to 5 to 50 cm, average 20 cm) and underlying reddish brown soil with sands and pebbles (depth 20 to 60 cm, average 40 cm) are found on the base rocks exposed at the bottom.

The rocks are, downward from the top, metamorphosed tuff, tuff breccia, welded tuff and tuff breccia, and they form alternation. Andesite dykes are observed to have intruded them.

The metamorphosed tuff is exposed in the westside and in the eastside of the small stream running southeastward near the midway of this trench. This rock is found to be in two parallel layers with the width of 50 cm and 70 cm. Lighologically it is white to reddish purple, altered fine grained tuff. The groundmass composed of

feldspar, sericite and quartz is microcrystalline, and the phenocrysts are feldspar, chlorite and rarely quartz. The tuff breccia is distributed extensively around the drill hole No. 53-3 and from the central part of this trench to the southern end. It has insertions of this layers of welded tuff. Oxidation is developed remarkably, and the rock reveals reddish purple in color, but the exposed fresh face is grey to pale green. The matrix is fine to medium grained, acidic to intermediate tuff containing quartz, calcite and sericite. The fragments of andesite, pink feldspar and white glass are contained in the forms of breccia and pebbles of various sizes of 1 to 5 cm. In the middle of the trench networks of disseminated pyrite have been observed.

The welded tuff is exposed in the northern part and at the southern end of the trench, with the width of 5 to 10 meters. The rock is grey to reddish brown in color, and has phenocrysts of feldspar 2 to 3 mm in diameter contained in the microcrystalline groundmass.

The andesitic rock is found as three dykes of the width of 4 to 15 meters, trending northeast and southwest with almost vertical dip, intruding the metamorphosed tuff and tuff breccia, near the midway of this trench. At the exposure, the rock is greyish white and soft owing to weathering and alteration. It is fine grained and has phenocrysts of feldspar 3 to 5 mm in diameter. Near the contact zone 1 to 2 cm wide with the pyroclastic rocks, this andesitic rock is especially fine grained, which indicates the part to be marginal rapidly-cooled facies.

b) Geological Structure --- The metamorphosed tuff extending about 40 m, distributed in the midway of the trench, shows the strike of N 80°E and the dip of 70°S in the northern part while its trend in

the south is N 70°E, dipping 60° to the north. As the schistosity of this metamorphosed tuff layers in the north is mostly dipping 60° to 70° to the south, while in the south these beds are dipping 30° to 60° to the north, an syncline with the axis of east-north-east and west-south-west is presumed to be present in this area.

c) Indication of Mineralization --- Many fractures of the trend of N 80°E are developed in the metamorphosed tuff breccia and welded tuff, at around the south end of this trench. These fractures are composed of pyrite-bearing quartz veinlets of the width of 1 to 5 cm. Assay result of these quartz veinlets for gold has shown as small value as 0.02 to 0.20 g/t of gold grade. As the soil samples of the geochemical survey (total 25 samples) has also shown the gold content of less than 0.20 g/t in average, it is thought that the area of this trench would be out of the gold mineralization zone.

No. 3 Trench

This trench is located from near the drill hole No. 54-2 (altitude 265 meters above sea level) in the central part of the area to the south-western end of the area, through the drill hole No. 53-3. Total length of this No. 3 trench is 1,120 meters.

a) Geology --- Below surface, there are humus (20 to 50 cm in thickness) and underlying soil, grey, reddish brown and reddish purple in color (10 to 80 cm in thickness), covering the base rocks.

The base rocks are mostly metamorphosed tuff breccia with insertions of thin layers of metamorphosed tuff, welded tuff and andesite, while the limestone of the Atima Formation is distributed in the southernmost part of the area.

The metamorphosed tuff breccia is exposed as four layers of east and west, occupying most of the northern to middle part of this trench.

The rock is reddish brown in color and dacitic lithologically. Breccias are subangular or round with diameter of 2 to 5 cm, which are composed of pieces of andesite and fragments of feldspar.

The metamorphosed tuff is found in the southern part of this trench, with the width of about 150 meters. At the south end, this rock is in contact with limestone of the Atima Formation, bounded by a fault of the trend of N 70°E. This rock is grey to brown colored coarse grained silicified tuff. In this rock limonite gossan bearing networks and quartz veinlets are well developed in east-west direction, which is slightly oblique to the tectonic lines trending east-north-east and west-south-west.

The welded tuff is exposed in east-west direction near the drill hole No. 53-3, with the approximate width of 50 meters. Porphyritic texture can be observed remarkably with the phnocrysts of feldspar in the leucocratic rock, intensely silicified and argillized.

The metamorphosed andesite is found to be inserted conformably, with the width of 30 meters, in the metamorphosed tuff breccia, about 100 meters south of the drill hole No. 53-3. This rock is green in color, and fine to medium grained. Phenocrysts of granular quartz and anhedral plagioclase crystals are found in the ground-mass composed of quartz, plagioclase, chlorite and sericite.

b) Geological Structure --- No remarkable schistosity can be seen in this trench. A disturbance zone associated with clay, of the width of 2 meters can be observed trending N 60°E, about 100 meters south of the drill hole No. 53-3.

c) Indication of Mineralization --- In this trench 19 soil samples were collected. There is none suggesting high gold content, except for the sample No. T91, whose assay result has shown anomalous

value as high as 0.90 g/t of gold. This sample was taken at the junction of this trench and the small stream running southeastwards from the old workings in the northwestern part of the area. In the drill hole No. 53-3, which were completed last year, a mineralized zone with the grade of 0.22 % Cu was found in calcite networks over the length of 22 meters between 104 m and 126 m of the depth. The extension of this indication had been left uncertain, but in this year, several gossaneous quartz veins (2 to 10 cm wide) trending N 80°E with the dip of 80° to the north were recognized near the mouth of the subject drill hole in this trench, and as two of these quartz veins have shown copper assays of 938 ppm and 1,013 ppm respectively, it is thought that this quartz veins would be the extension of the indication of copper mineralization caught in the drill hole.

Also, an anomalous zone with comparatively high assay values of zinc has been found at three localities around the south end of this trench, where the collected soil samples contain 1,600 ppm, 2,000 ppm and 6,500 ppm respectively.

No. 4 Trench

This trench is that of the length of 538 meters, running almost parallel with a fault of the trend of N 70°E expending westward from the drill hole No. 54-5 in the southern part of the area.

a) Geology --- Dark colored humus (10 to 70 cm in thickness) and underlying red to dark brown soil (30 to 80 cm in thickness) are covering the base rocks of metamorphosed tuff, metamorphosed andesite and limestone.

The metamorphosed tuff is white, medium to coarse grained liparitic tuff with phenocrysts of feldspars. The tuff found near the drill

hole No. 54-5 has repetition of variation of grain size of groundmass, fine to coarse, roughly every 10 cm.

The metamorphosed andesite is exposed around a small valley in the midway of this trench. This rock is inserted conformably in the metamorphosed tuff with the width of 40 cm. This andesite is dark grey in color, and is fine grained rock with phenocrysts of plagioclase contained in the groundmass of quartz, feldspar and chlorite.

The limestone is distributed south of the fault of the trend of N 70°E almost at the western end of this trench. It is dark grey, massive and compact limestone. Close to the fault, thin layers of quartzite have been recognized.

b) Geological Structure --- In the eastern part of this trench, schistosity of the trend of N 60°E with the dip of 40° - 70° to the north can be recognized. In the central to western part, tectonic line of the trend of N 70°E is running, which forms a disturbance zone with dark-colored clay with the width of more than 2 meters.

c) Indication of Mineralization --- By the assay results of the soil samples collected along this trench, it has been confirmed that gold content is as low as under 0.04 g/t. As to zinc content, anomalous values of 1,750 to 3,300 ppm of zinc are recognized with 2 samples collected in the eastern part of this trench and 3 samples in the western part.

No. 5 Trench

This trench is that of the length of 492 meters, running westward from the drill hole No. 53-2, which is located in the southwestern part of the subject area.

a) Geology --- Below surface, humus (5 to 50 cm in thickness) and

underlying reddish purple soil (15 to 80 cm in thickness) are covering the base rocks, which are metamorphosed tuff, tuff breccia, metamorphosed andesite and the Atima Formation limestone, in the order from north to south of this trench.

The metamorphosed tuff is exposed about 80 m along the trench from the drill hole No. 53-2. This rock is white to greyish brown, medium grained tuff. Schistosity is well developed. It covers the underlying tuff breccia conformably.

The tuff breccia is exposed from the central part to the western end. It contains thin layers of metamorphosed andesite, and is greyish white and soft owing to the weathering. Fragments of andesite 2 to 5 cm in diameter are contained in the matrix having quartz and sericite.

The metamorphosed andesite is seen to be conformably inserted in the metamorphosed tuff breccia, with the width of 20 m, at the point about 200 m southwest from the drill hole No. 53-2. It is yellowish brown and medium grained rock with phenocrysts of plagioclase.

The limestone is observed as floats in the south of the disturbance zone running in the direction of N 70°E around a small ridge in the central part of this trench. It is grey, compact and massive rock.

b) Geological Structure --- The pyroclastic rocks found in this trench reveal the trend of east and west with the dip of 30° to 50° to the north. Downward from the top, metamorphosed tuff, tuff breccia and andesite are accumulated. They form monoclinal structure, inclining to the north.

c) Indication of Mineralization --- By the assay results of the soil samples (9 samples) collected in this trench, it has been

confirmed that gold and copper contents are respectively as low as under 0.04 g/t of gold and under 500 ppm of copper. As for zinc content, the values of 1,800 ppm and 1,950 ppm have been shown with 2 samples collected in the area where metamorphosed tuff breccia is distributed, in the southern part of the trench.

No. 6 Trench

This trench is hill-side trench running from the top of the small hill (altitude 391 meters above sea level) in the eastern part of the area to the drill hole No. 54-3 (altitude 335 meters above sea level), which is located about 300 meters north of the above hill top, and from near the drill hole No. 54-4 to the north end of the area. The length of the trench is 1,710 meters.

a) Geology --- Below surface, dark-colored humus (5 to 30 cm in thickness) and underlying reddish brown soil (B bed, 5 to 80 cm in thickness) are accumulated, covering the base rock. The rocks are alternation of metamorphosed tuff breccia and tuff, from northern to southern part of the area.

The metamorphosed tuff breccia is exposed at two localities in the northern part and in the southern part along the trench, the length of which is about 150 meters each. It is greyish white to reddish purple in color. Consolidated in coarse grained intensely sericitized tuff, subangular to angular breccias of volcanic rocks, 2 to 3 cm in diameter, are recognized to be contained. The tuff is in contact with the underlying metamorphosed tuff with conformity.

The metamorphosed tuff is exposed about 130 meters along the trench near the drill hole No. 54-3, and is also found to be over 70 m in width at the south of the top of the small hill. It is white

to brown, fine to medium grained liparitic tuff.

b) Geological Structure --- The schistosity of the metamorphosed tuff breccia, exposed at the northeast end of the area, is of the trend of east and west with the dip of 40° to the south in the northern part of the subject area while in the southern part the dip is to the north though the trend is still east and west. Therefore, a syncline is presumed there with the axis of east and west. The schistosity of the pyroclastic rocks distributed in further south area is mostly dipping to the north, monoclinally. There is a fault of the trend of N 60°E which runs near the drill hole No. 54-4 and is confirmed in two trenches. It is as wide as 1 meter, and the pyroclastic rocks are seen dislocated by thin fault to some degree. Gossaneous iron contamination is remarkable around this fault, especially along the road in the east of the drill hole No. 54-4, where iron-quartz veinlets are well developed in the direction of east-west and of north-south.

c) Indication of Mineralization --- As for indication of gold mineralization, gold content is low except a sample of the above-stated iron-quartz vein 30 cm wide, which has shown the assay value of 1.74 g/t of gold. Zinc mineralization is observed in two localities --- one is in the metamorphosed tuff breccia in the southern part of the trench, and the other is in the metamorphosed tuff distributed further south. The indications of zinc mineralization found in the metamorphosed tuff breccia recognized at 6 localities in east-west direction, oblique to the fault of the trend of N 60°E. They have shown assay result of 970 to 4,200 ppm of zinc. The indicated zone occupies an area of 400 m in east and west by 50 to 100 m in width. The indication contained in the

metamorphosed tuff is found at the southern end of the trench. It reveals assay results of 3,440 ppm of Cu and of 2,000 ppm of Zn.

No. 7 Trench

This trench is that of the length of 640 meters, linking the drill hole No. 52-1 in the central part of the area, the Nelson trench and the south of the drill hole No. 52-2.

a) Geology --- There are humus (10 to 50 cm in thickness) and underlying reddish brown soil (B bed, 30 to 80 cm in thickness). Metamorphosed tuff breccia and metamorphosed tuff are distributed as base rocks.

The metamorphosed tuff breccia is found near the Nelson trench and in the northern part of this trench. It is composed of brown to yellowish white, remarkably silicified tuff and andesitic tuff. It contains thin layers of well foliated tuffaceous shale on the wall of the old workings located at the next upper area of the Nelson trench.

The metamorphosed tuff is distributed about 100 meters north of the Nelson trench, with the thickness of 60 meters. It is medium grained acidic tuff, showing brown color owing to intense limonitization.

b) Geological Structure --- Schistosity can be observed along the road from the drill hole No. 52-1 and the hole No. 54-3. In the north, it trends east and west with the dip of 20° - 50° to the south, while in the south the trend is N 80°E with the dip of 40° - 80° to the north. A syncline is presumed to be present in the half way of this road, with the axis of east-north-east and west-south-west.

Many quartz veins are developed at the Nelson trench and the upper old workings, in the direction of east-west, north-south and northeast-southwest.

c) Indication of Mineralization --- In the old workings about 120 meters north of the above Nelson trench, there is a quartz vein (30 cm in width) containing 14 g/t of gold. Also, a soil sample collected at the two points 60 meters northeast of the Nelson trench has shown assay value of 3.0 g/t of gold.

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Chapter 2 Ore Deposits

2-1 Indications of Mineralization (Refer to PL. I-3, PL. I-4)

There are indications of gold, copper and zinc mineralization in this area.

(1) The indications of gold mineralization are distributed in the intensely silicified metamorphosed tuff and tuff breccia found in the northern part of the area. There are many small-scaled old workings and trenches where gold reefs were mined, as San Martin mine and Nelson trench. By the results of the geochemical survey carried out by UNDP team, a mineralized zone of strikewise 1,200 m in roughly in east and west by 300 m of the width in north and south has been detected, where gold grade is known to be 1 to 3 g/t. This zone is in good correspondence with the above-mentioned gold fracture zone.

The indication is composed of residual gold zone in the surface oxidized zone and of gold-bearing quartz veins. The occurrences of gold will be described in the paragraph 2-3.

(2) The indications of copper mineralization are observed as dissemination of dark-colored minerals (chalcocite?) in the shallow part less than 32 meters of the depth of the drill hole No. 54-1 and No. 54-2, in addition to the disseminated green copper minerals as malachite and azurite found around the contact zone of the metamorphosed tuff and the metamorphosed andesite, in the western part of the area. There are chalcopyrite-bearing quartz calcite veins of the width of 2 to 10 cm at the depth of more than 100 meters of the drill holes No. 53-3, No. 54-4 and No. 54-8.

(3) The indications of zinc mineralization are found as geochemical anomalies (Zn more than 0.1%) by soil samples around the contact zone by the fault of the Atima limestone formation and the Vueltas del Rio Formation

in the southwestern zone of the area, as well as in the trench about 150 meters south of the drill hole No. 54-3, roughly parallel along the extension of the beds and the fault. The former occupies an area of 400 m in length by 100 m in width, while the latter is 800 m long and as wide as 70 to 80 m.

Indications of disseminated zinc mineralization of the grade of Zn 0.32 to 0.83 % are found with the length of 14 to 30 meters in the shallow part of the depth of less than 100 meters, in the drill holes No. 54-3, No. 54-4 and No. 54-6. Also, at around the depth of 170 meters of the drill hole No. 54-7, located about 200 meters east of the Vueltas del Rio hilly land, a sphalerite-bearing calcite vein has been recognized.

2-1-1 Indications of Gold Mineralization

(1) The following 10 indications of gold mineralization in quartz vein have been confirmed. (contains over 1 g/t gold)

	Location	Sample No.	Width of Sample(m)	Assay (Au g/t)
a	100 m northwest of the drill hole No. 54-1	T2	0.20	2.02
b	100 m south of the drill hole No. 52-4	TM24	0.40	1.24
c	90 m southeast of the drill hole No. 52-4	TM15	3.0	1.60
d	90 m southeast of the drill hole No. 52-4	TM18	3.00	1.62
e	160 m east of the drill hole No. 52-4	TM5	1.30	1.18
f	160 m east of the drill hole No. 52-4	TM6	0.50	6.30
g	160 m east of the drill hole No. 52-4	TM7	0.60	11.60
h	150 m southeast of the drill hole No. 53-4	TM12	0.50	9.20
i	150 m southeast of the drill hole No. 53-4	TM13	1.20	10.40
j	150 m northwest of the drill hole No. 54-3	TM33	0.30	14.00

The 9 indications of a to i are recognized in quartz veins of east-west direction in the metamorphosed tuff distributed on the southern slope and near the ridge of the hills of the altitude of 410 to 450 meters above sea level, in the northwestern part of the area. As the indications of gold-bearing quartz veins, more than 10 old mining sites and several old workings and trenches are scattered over 500 meters in the direction of east-north-east and west-south-west. They are distributed in echelon-like form, parallel to the direction of the ridge, comprising fracture zones of the trend of east and west. The indications of this gold mineralization are represented by tentatively called A old working, B trench and Nelson Trench.

. Tentatively called A old working (Refer to Fig. I-4)

This working is located at the altitude of 428 meters above sea level, in the central part of the No. 1 trench. The tunnel is 25 meters long in the direction of N 60°W. At the heading of it, a vein running east and west is seen to have been traced by a drift of the length of 18 meters. Fissures of the direction of east-west and N 60°E are well developed in the metamorphic tuff in the vicinity. The fissures of the east-west direction comprise gold-bearing calcite quartz veins as wide as 40 to 130 cm, which has width of 130 cm and the gold grade of 1.18 g/t at the heading while it has width of 50 cm and gold grade of 6.80 g/t at the mouth of the tunnel. No quartz nor calcite can be recognized in the fissures of the N 60°E direction, and they are entirely barren. There are three old drifts at the level of 18 meters above this crosscut tunnel, with the length of more than 20 meters in east-west direction. One vein of them has width of 60 cm and has shwon gold grade of 11.60 g/t.

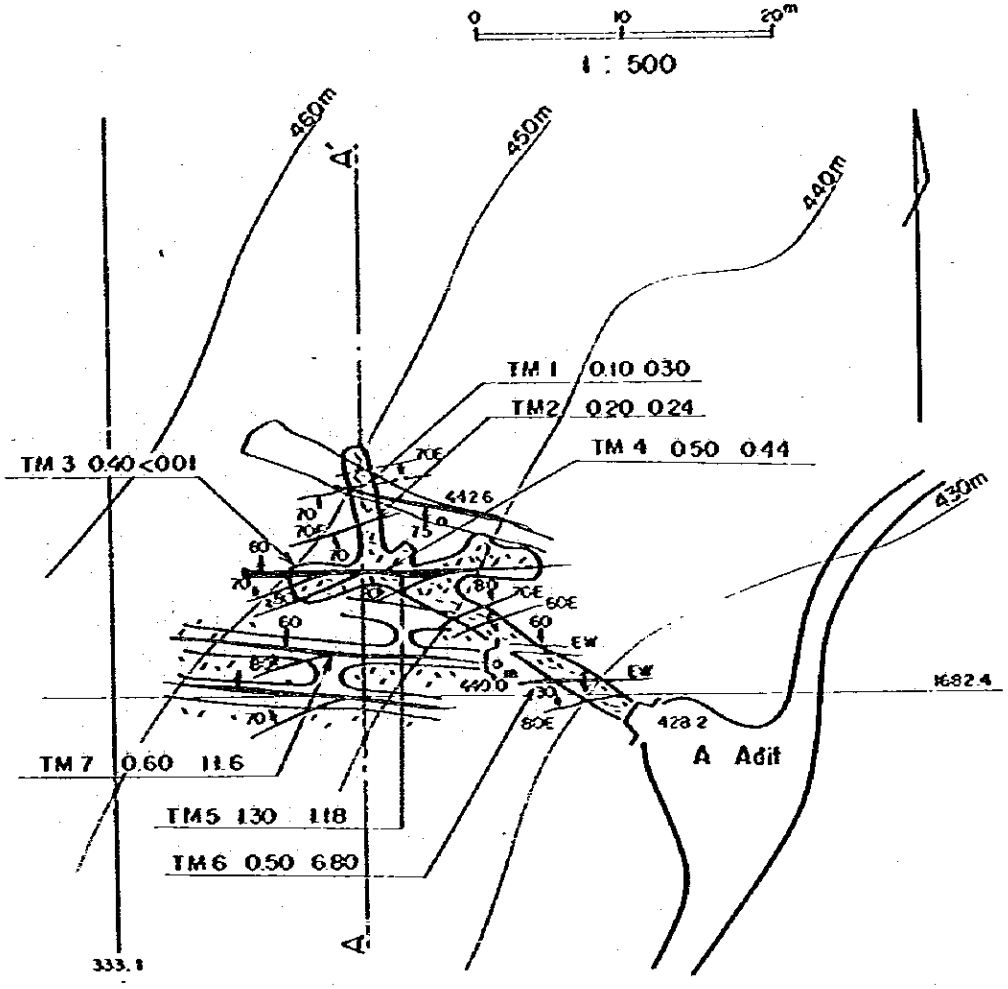
. Tentatively called B trench (Refer to Fig. I-5)

There are two trenches in an area of 25 m in north-south by 20 m in east-west, about 200 meters east of the A old working. Networks of fissures in east-west direction and in northeast-southwest direction are developed there in remarkably silicified metamorphosed tuff. The two samples collected on the wall of the trench in the direction of north-south have shown high assay values such as respectively 50 cm in width with gold grade of 9.20 g/t and 120 cm in width with gold grace of 10.40 g/t. It is known that the drill hole UN22, which were completed by UNDP team at this trench, revealed gold content of 2.27 g/t in average from surface to the depth of 27 meters.

. Nelson Trench (Refer to Fig. I-6)

This trench is located along the road between the drill holes No. 54-2 and No. 54-3 in the central part of the subject area. At the heading of the

Fig. I-4 Sketch Map of A Adit in the Vueltas del Rio Sector



A – A' Section

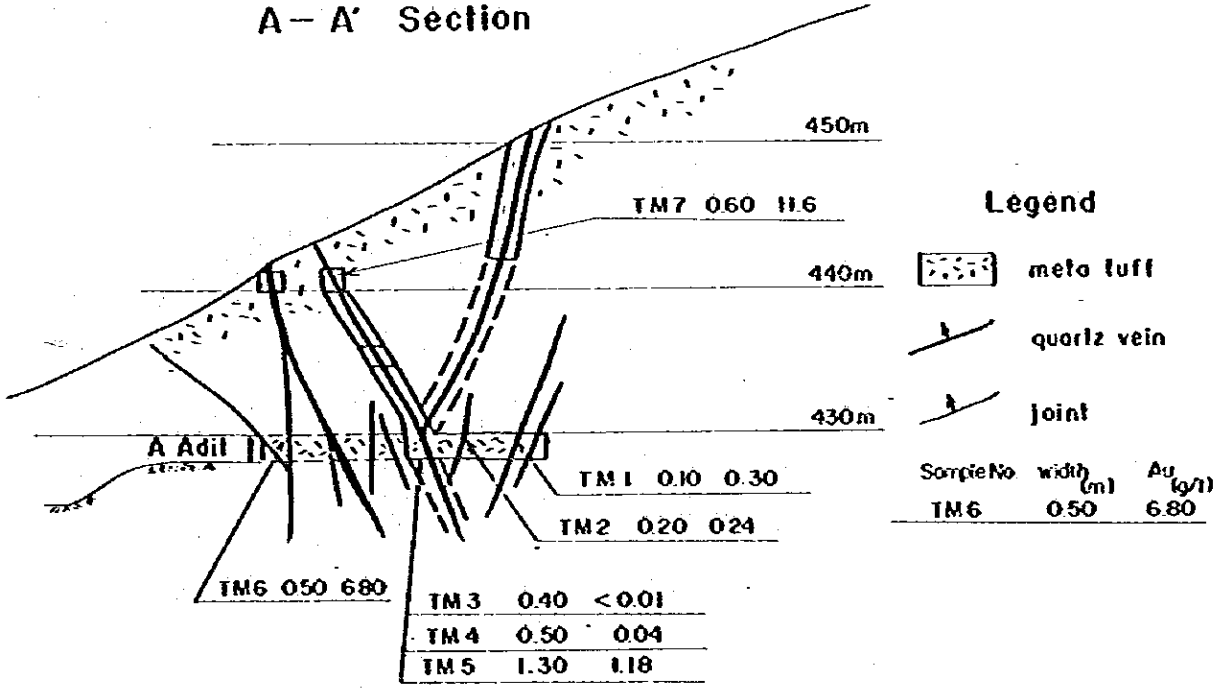


Fig. I-5 Sketch Map of B Trench in the Vueltas del Rio Sector

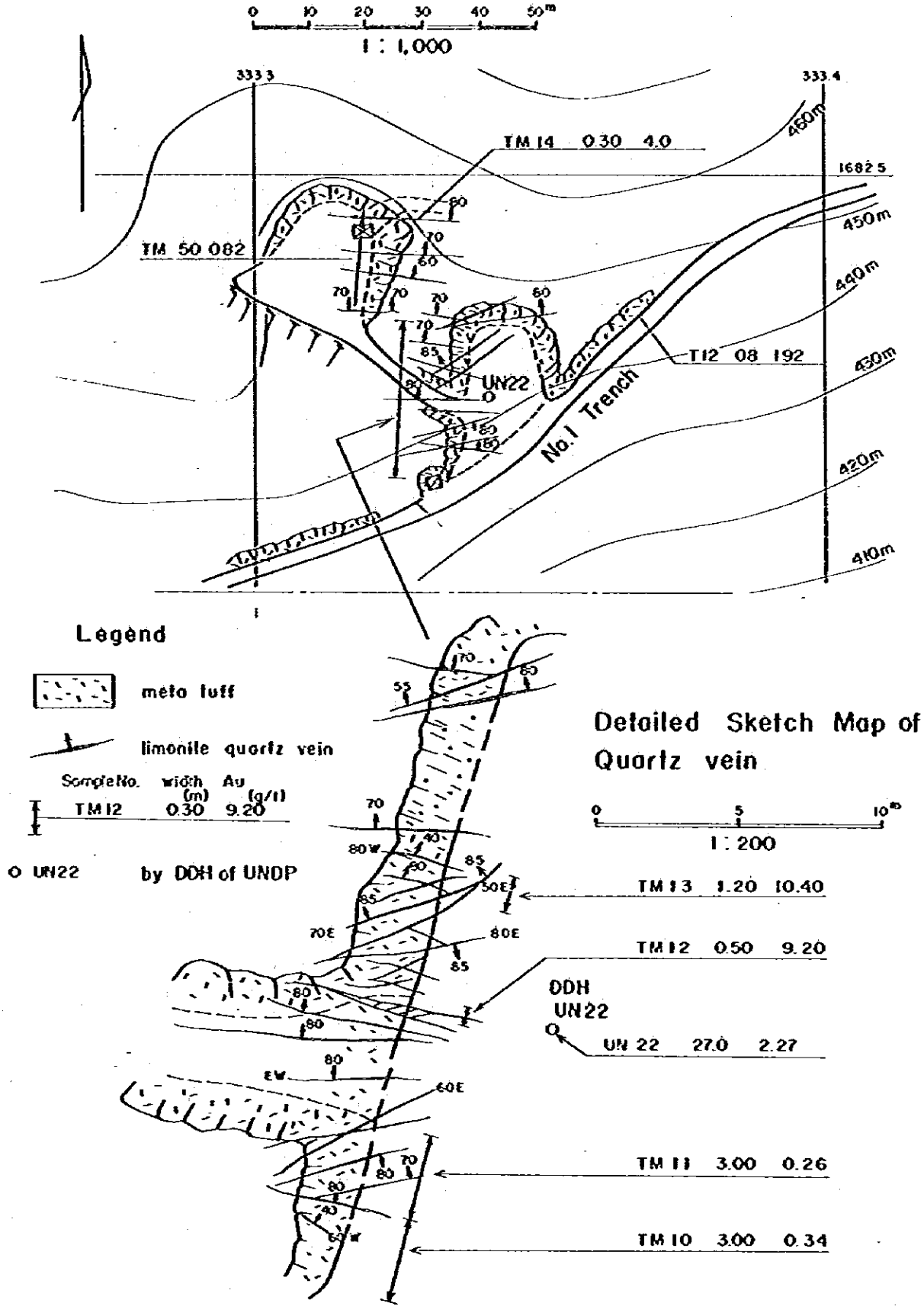
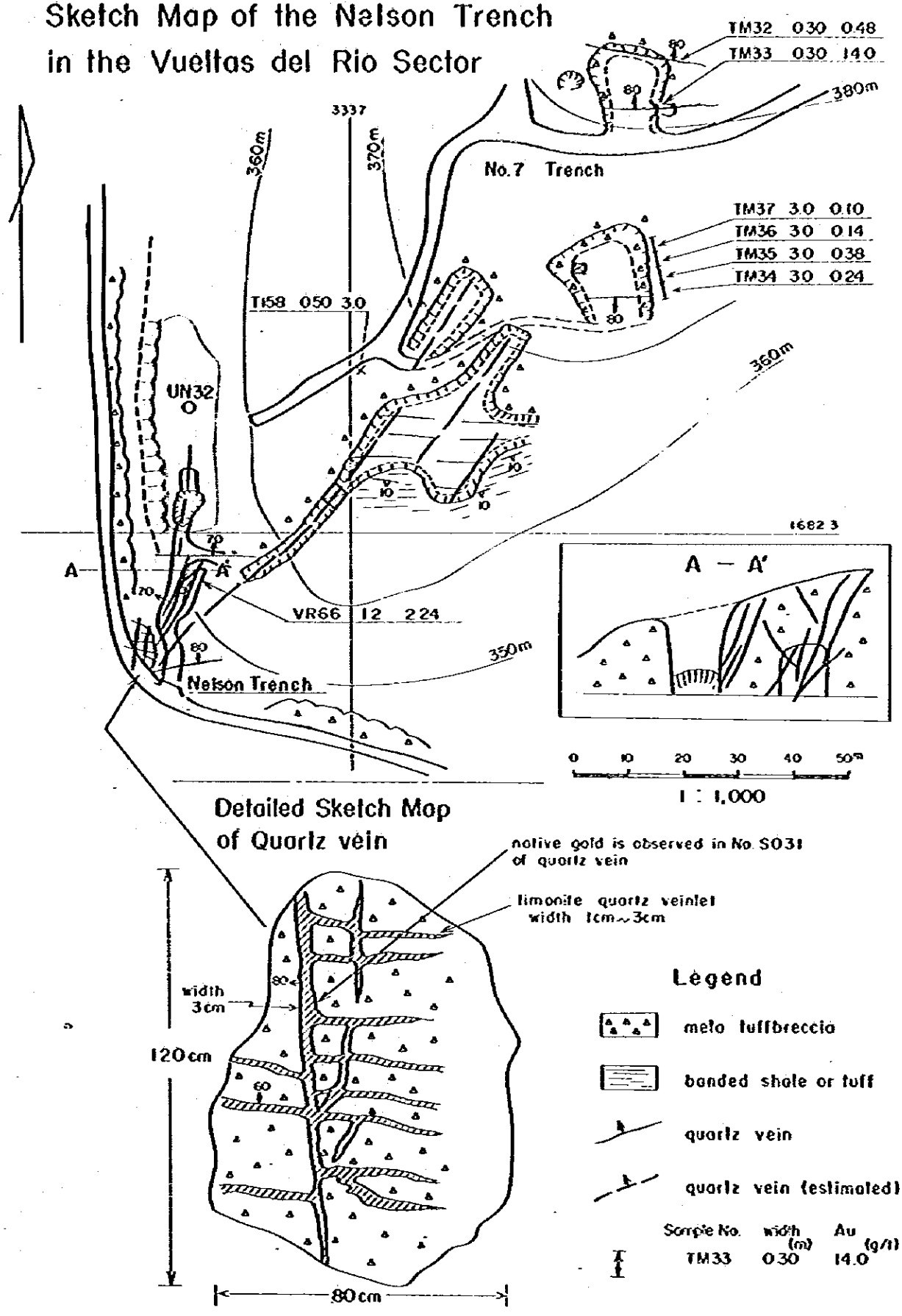


Fig. 1-6

Sketch Map of the Nelson Trench in the Vueltas del Rio Sector



crosscut tunnel of the length of 22 meters in north-south direction, there is a drift of more than 10 meters, in length, along the east-west reef. But it is now collapsed and the feature of the reef is uncertain. Around the heading, crossings of the fissures of the directions of N 20°W and EW are observed. The assay result of the country rock containing veinlets along fissures of N 20°W has shown 2.24 g/t of gold in the width of 120 cm. At the exposure of this trench along the road, networks of limonitic gossaneous quartz veinlets (as wide as 1 to 3 cm) of the directions of east-west and north-south are observed to be well developed in the metamorphosed tuff breccia. There are 4 old mining sites 40 to 120 meters northeast of this trench, forming a line in northeast and southwest. It is thought that gold enrichment zone was formed at the crossing of the fissures of two directions of east-west and northeast-southwest, developed around the contact zone of banded tuffaceous shale and metamorphosed tuff.

(2) The indications of gold mineralization confirmed by means of soil samples are as follows.

	Location	Sample No.	Width (m)	Assay (Au g/t)
a	Southwestern end of No. 1 trench	T43	0.20	2.18
b	Southwestern end of No. 1 trench	T44	0.25	1.30
c	Southwestern end of No. 1 trench	T45	0.30	1.36
d	Southwestern end of No. 1 trench	T48	0.40	1.16
e	Central part of No. 1 trench	T7	0.40	3.80
f	Northeastern part of No. 1 trench	T14	0.50	1.72
g	No. 7 trench	T158	0.50	3.00

Interpretation of each indication of the above mineralization will be omitted here, as these indications are described in the paragraph of 1-5 of the Chapter 1. The indications of gold mineralization in the drill holes are also omitted, as they are described in the paragraph 3-3-2 of the Part II.

2-1-2 Indications of Copper Mineralization

The following two indications have been confirmed as those of copper mineralization.

	Locality	Sample No.	Width (m)	Assay (Cu %)
a	50 m southwest of the drill hole No. 53-3 (quartz vein)	TM45	0.10	0.10
b	60 m east of the drill hole No. 53-3 (quartz vein)	TM51	0.10	0.10

In the drill hole No. 53-3, which was completed last year, a mineralized zone containing 0.122 % of Cu in average was recognized at the depth between 104 m and 126 m (22 m in length) where calcite-quartz veins are crowded in network. To consider over their extension and the relation to the surface, the indications of above a and b are located 50 to 60 meters south of the drill hole No. 53-3 and they comprise anomalous values in a fracture zone containing gossaneous quartz veins, dipping 70° - 80° to the north with the trend of east and west. Therefore, it is considered that these indications would be an extension of the copper indication caught at the depth of the drill hole No. 53-3.

2-1-3 Indications of Zinc Mineralization

The following 5 indications have been confirmed as those of zinc mineralization (in soil).

	Locality	Number of indications	width of sample in average (m)	assay (Zn %) in average
a	Southern part of No. 3 trench	3	0.43	0.44
b	Southern part of No. 4 trench	6	0.70	0.22
c	Southern part of No. 5 trench	2	0.45	0.19
d	Central part of No. 6 trench	6	0.33	0.22
e	Southern part of No. 6 trench	1	0.65	0.44

The localities of these indications are grouped into 4 blocks of southwestern part, southeastern part, central to southern part and central part.

- The indications found in the southwestern part

There are 9 indications in the southern part of the trenches No. 3 and No. 4. They are distributed in tuff, parallel to the fault of the trend of N 70°E bounding the metamorphosed tuff and the limestone of the Atima Formation. The area occupies 400 m in length by 50 to 150 m in width.

- The indications found in the southeastern part

They are narrowly distributed about 100 meters in extension in the metamorphosed tuff breccia along the above-mentioned fault of the trend of N 70°E. The indications found in these two blocks are zinc dissemination zones distributed around the fault bounding the Vueltas del Rio Formation to the Atima Formation, and therefore it is thought that the mineralization would be closely related to the fault.

- The indications found in the central to southern part

There is an indication of zinc mineralization, in the metamorphosed tuff, whose assay has shown 0.44% of zinc at a locality topographically near

the top of the hill at the end of the No. 6 trench. But geological condition for this anamalous value is uncertain.

. The indications found in the central part

There are 6 indications distributed in the metamorphosed tuff in a narrow area of 50 m in width by 90 m in extension along the fault of the trend of N 60°E, crossing the No. 6 trench. They show average assay value of 0.22% of zinc.

2-2 Consideration on the Mineralization

As the indications of mineralization in this area, the following types are confirmed to be present.

Residual gold mineralization in the surface oxidation zone

Gold-bearing quartz vein

Gold-bearing fracture zone

Gold-bearing galena chalcopyrite sphalerite quartz vein

Chalcopyrite quartz vein

Chalcopyrite pyrite dissemination zone

Chalcopyrite calcite quartz network vein

As for country rocks, there is none which is likely to have particular relation to the mineralization, except for the andesite, around which copper seems to be slightly more mineralized.

As for alteration, remarkable silicification can be recognized in addition to sericitization, kaolinization, carbonatization and chloritization, but no particular relation has been observed between alteration and mineralization. In some case, mineralization is present in such area as sericitization is rather intense. Chloritization seems to have no relation to mineralization.

As for the relation between mineralization and geological structure, no particular element of geological structure has been recognized to have

influence to any ore grade, although a synclinorium with the axis of east-north-east and west-south-west has been confirmed by the analysis using key bed of the metamorphosed andesite and through consideration of the results of the diamond drilling.

As for ore minerals, assemblages of electrum-quartz, electrum-Cu-Pb-Zn-quartz, Cu-Fe-quartz and Cu-calcite-quartz have been confirmed. No halogen mineral nor skarn mineral has been confirmed to be present even including gangue minerals. No arsenic and mercury minerals have been detected, either.

Meanwhile, as for intrusive rocks, dykes of quartz porphyry are recognized beyond the western limit of the subject area, intruding the beds of the Vueltas del Rio Formation. Limonitized pyrite bearing quartz veins are developed there, but alteration and mineralization are weak around them. Also, there is dacitic porphyry around the drill hole No. 53-5, which is subjected to silicification and sericitization, but no mineralization can be recognized there. Several dykes of andesite are found in the central part of the area, but no relation to the mineralization has been recognized with them. All of these igneous rocks are found to be in the form of dykes and in some cases stocks, intruding the Vueltas del Rio Formation, but it is impossible to regard any of them to be related to the mineralization. Igneous rock in relation to the mineralization, if any, is uncertain.

According to the data so far obtained, there is no concrete evidence to show the mineralization in this area to be of porphyry copper type, it is thought to be appropriate to regard these indications to be mesothermal or epithermal mineralization of vein type or dissemination type.

A gold enrichment zone is recognized near surface along the fracture zone in east-west direction. This is thought to be of autochthonous residual type in the surface oxidation zone. Parts of high gold content of Au 1 to

10 g/t have been confirmed along fissures of the base rocks and along quartz veins. Secondary enrichment zone of vein type has also been recognized. Depth varies where it is, and along valleys, enrichment zone is in such part as is less weathered and accompanies some rock exposures.

2-3 Occurrences of Gold

In this area, there are residual gold enrichment zones in the surface oxidation zone and primary ore deposits of gold-bearing quartz veins. To obtain information on the occurrences of gold mineralization, bulldozer trenching was carried out in an area of 1,200 m in east-west by 1,000 m in north-south (total 6,660 m). Soil samples (B bed) were collected every 50 meters along the trenches and gold assays and microscopic observation were conducted.

a) The residual gold enrichment zone is recognized in the B bed, which comprises reddish brown soil with small pebbles subjected to limonitization, remarkable argillization and silicification, as well as in the shallow part of the drill hole. The indications containing more than 1 g/t of gold are found as follows;

6 localities along the trench in the lower part of the San Martin old workings in the northwestern part of the area, 1 locality in the Nelson trench in the central part of the area.

In the drill cores 2 to 6 m in length at the depth of less than 12 meters in the drill holes No. 54-2 and No. 54-4.

There is no residual gold enrichment zone in the central to southern part of the area.

b) Iron-quartz veins are contained in the fissures of east-west and north-south direction, developed in the central to northern part of the area. Gold reefs containing more than 1 g/t of gold are found at 9

localities in the San Martin old workings in the northwestern part of the area and 1 locality in the Nelson old workings.

The San Martin old workings are located near the hilly ridge. Structurally they are situated on the south wing of the anticline with the axis of east-north-east and west-south-west, where several sheared fracture zones are developed. The indications of gold mineralization comprise crowded limonite-bearing quartz veinlets, which are branched from the above sheared fracture zone, with the width of 1 to 60 cm, extending 10 to 20 meters in the east-west direction with the dip to the north or to the south.

They are distributed in four groups in echelon form in an area of 500 m in extension by 100 m in width, in the direction of east-north-east and west-south-west.

The Nelson trench is situated along the axis of a syncline, where fissures of various directions as are north-south, east-west and northeast-southwest are well developed. The gold enrichment zone is found around the crossings of such fissures.

c) Under microscope, occurrences of gold are as follows;

i in gold-chalcopyrite-bearing quartz vein

ii in fracture zone containing gold

iii in iron-copper oxides or in gangue minerals

iv among mineral grains in weathered soil

v in gold-galena bearing quartz vein

Grains of gold are 5 to 10 micron in diameter and occur in the forms of dot, prism, oval, corrosion, irregular amoeba, etc., associated with galena and in space of grains of quartz or iron-copper oxides. In many cases, gold is in form of free grain.

It has been confirmed by EPMA that gold is present usually as electrum,

containing small amount of silver.

2-4 Program for the development of Gold

A) As stated above, residual gold enrichment zone in surface oxidation zone and gold-bearing quartz veins are recognized in this subject area. For the possibility of development of these indications of gold mineralization, it is necessary to proceed of exploration works and confirm of proved ore reserves.

Prior to development, it is necessary to assure the accuracy of the ore reserves by improving them to proved ore reserves, through attempting study of the features of mineral assemblage and recovery of ore minerals, as well as through further exploration for confirmation of ore reserves and grade, in the following way.

(1) It is recommended to carry out trenching of the interval of 30 meters in north-south direction, in such zone including the area for the ore reserve estimation, and to conduct quantitative analysis of gold with rock and soil samples collected at the points every 10 meters along the trenches. Considering the results, it is necessary to correct the area for the ore blocks for ore reserve estimation.

(2) In the corrected area for the estimation of ore reserves, it is recommended to carry out shallow drilling of the depth of about 30 meters in the grid system of 50 m interval, collecting core samples every 2 meters for the assay of gold. It is necessary to re-correct the area for ore reserve calculation by the results of this drilling.

(3) By the cores and the surface samples, it is recommended to study in detail the features of gold occurrences to obtain necessary information on grain sizes and assemblages and to consider over methods of concentration.

(4) It is recommended to consider over recovery of gold through concentra-

tion test using collected core and surface samples.

(5) Through the results of the above-mentioned, it is recommended to make F/R, considering over mining, transportation, crushing, milling, market condition, concentration, watering, customers, and so on. If the ore reserves are varied or if the ore grade is remarkably decreased by the results of above test and consideration, in the process, it is necessary to examine whether the investigation should be kept proceeded, by immediate and tentative F/R.

(6) In case the results of these investigations are favorable, the following test and research works are required;

Field climate, condition of location, environment for the construction of factories.

Bulk treatment test including field test, and the test for the determination of flow sheet.

It is recommended to consider the determination of development after conducting feasibility study including consideration of initial expenses and operation cost as well as income and expenditure, summarizing the results of above-mentioned tests and researches.

B) Parts of high grade gold and copper contents confirmed in the drill holes are as follows.

Drill Hole No.	Depth(m)	Length(m)	Au(g/t)	Ag(g/t)	Cu(%)
53-1	96-98	2	-	-	1.28
53-2	6-8	2	44	-	-
53-2	173-174	1	97	80	5.94
53-3	46-48	2	3.34	-	-
53-3	68-70	2	3.72	-	-
53-3	104-126	22	-	-	0.12
53-3	146-150	4	1.3	-	-
53-4	108-110	2	-	-	1.59
53-7	86-88	2	-	-	0.68
53-7	90-92	2	-	-	1.21
54-1	14-20	6	-	-	0.83
54-2	2-8	6	1.54	-	-
54-4	10-12	2	3.24	-	-

All of these indications are what have been confirmed independently, and their trend, dipping, width and extension are uncertain, requring further investigation. Therefore, they have not been estimated of ore reserve.

PARTICULARS

PART II DIAMOND DRILLING

PART II DIAMOND DRILLING

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Chapter I Introduction

1-1 Purpose of the Survey

As a part of the third phase survey of the Basic Geological Survey for the Development of Mineral Resources in the western part of the Republic of Honduras, an investigation by diamond drilling was carried out to ascertain the relation between geological structure and mineralization in the central and eastern part of the Vueltas del Rio area, which had been extracted as the area where further exploration is required.

In the central part of the Vueltas del Rio area, 8 holes of diamond drill were performed in order to explore the surrounding area of the copper-gold mineralization which had been confirmed by the diamond drilling survey in the previous year (6 holes, 1,500 m total length drilled) and to confirm the mineralization features of the plain area that is the eastern extention of the Vueltas del Rio (2 holes, 600 m total length drilled).

1-2 Outline of the Survey

A survey member in charge of the drilling was sent in advance to the field of La Flecha on 21st of May, 1979 and did the inspection of the drill machines, and the confirmation and the construction of the drill sites. By receiving materials and supplemental supplies and tools as well as mud materials at the port from the vessel, preparation works were performed. The leader of the survey team and another 6 drill-members arrived on 4th of June, and the construction works were commenced. 6 drill sites out of 8 drill sites are located in the pine forests in the Vueltas del Rio area, and construction of access roads and the drill sites were completed by bulldozer. Other 2 drill sites were located in a meadow along Rio Chamelecon

and construction of access roads and the drill sites were completed by man power.

Two drill machines of TCM-5A were used (The capacity of drilling is 510 m in final NQ size and 650 m in final BQ size) to drill 8 holes of total length of 2,102.7 m by wireline method through three shifts per day, each shift comprising 8 hours. Six crews, each of which is composed of 1 driller and 3 workers, were prepared for the drilling in addition to the 2 workers for water carriers. Bentonite base mud was used for the drilling and the part near surface was drilled with metal bits without circulating water. Thus, the attempt to recover as much core as possible was successful, and the total core recovery was 94.9 %. The drill sites (refer to PL. II-1) and the amount of performance are as follows;

Hole No.	Drilled Length(m)	Core Length(m)	Core Recover (%)
54-1	250.2	236.0	94.3
54-2	250.3	245.2	98.0
54-3	250.7	246.4	98.3
54-4	250.4	248.7	99.3
54-5	250.3	241.1	96.3
54-6	250.2	226.4	90.5
54-7	300.2	279.6	93.1
54-8	300.4	272.1	90.6
Total	2,102.7	1,995.5	94.9

The term of the investigation by diamond drilling was 96 days from 4th of June to 7th of September, 1979. After completion of the drilling for three months, the cores and the machines were stocked in the warehouse in the sites at La Flecha.

1-3 Core Logging and Analysis Works

All the cores obtained through the diamond drilling carried out in the present year were logged as for lithology, alteration and mineralization by the geologist stationed there, and the data were recorded on the core-logging charts of the scale of 1 to 200 (refer to PL. II-2). Also, the analysis of geology in the field was performed by the correlation of the result of the core-logging to the surface geology and to the results of the core logging completed up to the last year. Cores were split into halves. Chemical analysis of the core samples was performed by Atomic Absorption Assay Method for Au, Cu, Pb, and Zn in the laboratory of DGMH of Honduras, preparing each sample from every 2 meters of the core length above 100 m depth from surface, although samples comprises 20 meters of the core length in weakly mineralized parts below 100 m depth from surface.

For the geological analysis, thin sections and polished sections of every type of rocks and each mineralized part were prepared, and determination of lithological names of the rocks, classification of alteration of the country rocks and studies of mineral paragenesis were completed by microscope with the help of X-ray analysis.

/Chapter 2 Diamond Drilling Works

2-1 Location of the Drill Holes

The each site where the holes of No. 54-1, 54-2, 54-3, 54-4, 54-5, 54-6, 54-7 and 54-8 were drilled in Vueltas del Rio area where is located about 23 km far from La Flecha via Chiquila Village and it takes about 40 min. by drive. La Flecha is located almost halfway from San Pedro Sula to Copan along the national road connecting both towns and the base camp of the prospecting team was stationed there in La Flecha.

The geographical location and elevation of the drilling holes are as follows.

No. of Holes	Longitudinal Distance	Latitudinal Distance	Elevation(m)
54-1	333.09E	1682.17N	407
54-2	333.52E	1682.26N	354
54-3	333.83E	1682.24N	335
54-4	334.13E	1682.27N	280
54-5	333.49E	1681.72N	282
54-6	333.56E	1681.97N	313
54-7	335.42E	1681.71N	204
54-8	335.40E	1683.24N	201

2-2 Preparatory Works

2-2-1 Road Construction and Maintenance

The incharge of drilling who arrived at the site on 21st, May advancingly, made the ground survey at the drilling sites in Vueltas del Rio to plan the new road construction and existing road maintenance, and the transportation scheme of materials and equipment. He also made an arrangement for labour mobilization and water supply.

The access road to the holes of No. 54-1 and 54-2 was prepared, constructing a new road by using bulldozer by 120 m and mending the present road by 1,200 m and the access road to the holes of No. 54-7 and 54-8 was constructed by man power by 800 m.

Due to the ceaseless heavy rainfall, however, the road condition was so messy that the cumulated distance of the road which was mended by men during the drilling works mounted to 20 km.

2-2-2 Transportation of Equipment and Material

The transportation of equipment and material to the drilling sites of No. 54-1 and No. 54-2 was started on 4th, June by a 6t truck from the warehouse in the base camp in La Flecha via Chiquila and Ojos de Agua.

The supplementaly equipment and material air freighted and shipped from Japan for the drilling works of 1979 were transported to La Flecha by 1t pickup on 8th, June from Tegucigalpa and on 5th, July from Amapala after the custom clearance.

2-2-3 Development of Drilling Sites

The drilling sites of No. 54-1, 54-4 were developed by a bulldozer in connection with the development of the access roads.

The drilling sites of No. 54-2, No. 54-3, No. 54-5 and No. 54-6 which are located along the existing road were developed by a bulldozer.

The drilling sites of No. 54-7, No. 54-8 which are located in a meadow along Rio Chamelecon were developed by man power.

2-2-4 Drilling Water Supply

Since there was no water source near to the holes of No. 54-1 (hauling distance 1,300 m) and No. 54-4 (hauling distance 900 m), water was delivered by a truck equipped with a steel tank of 1,000 ℓ capacity.

To the No. 54-2 (pipe line distance 300 m), No. 54-3 (pipe line distance 400 m), water was pumped up from the water tank (3 m x 4 m x 1 m) which

had been constructed in 1978.

To the No. 54-5 (pipe line distance 150 m), No. 54-6 (pipe line distance 500 m), water was pumped up from the water tank that was constructed in down stream and has a dimension of 3 m x 4 m x 1 m.

To the No. 54-7 (pipe line distance 70 m), No. 54-8 (pipe line distance 80 m), water was directly pumped up from Rio Chamelecon.

2-3 Drilling Works (Refer to Table II, Fig. II)

Since there was a possibility that the surface soil contained gold minerals at the six drill holes out of the eight drill holes, drilled cores were tried to be recovered in the surface layer at each hole. Accordingly, dry drilling was carried out with a metal bit of 116 mm dia. and the core recovery was 100%.

When the holes reached the rock face, drilling was continued with the HQ wireline method and the casing pipes were inserted followingly. And the final part of the holes was drilled with the BQ wireline method.

The drilling progress of each hole was as follows. The meterage in the following paragraphs corresponds the hole depth from the surface.

2-3-1 No. 54-1 hole

Total drilled length : 250.20 m

Core length : 236.00 m

Core recovery : 94.3 %

The hole was drilled down to 3 m in the layer of brown surface soil with a single metal bit of 116 mm dia. without circulating water to reach the rock face. Below this, drilling was continued with a long metal bit of the sane diameter with circulating mud water to 9.00 m, where the rock appeared stable and HW casing pipes were securely inserted.

A HQ-WL bit was employed and the hole was drilled down to 18.50 m,

where the rock facies turned out to tuff breccia with clay and drilling became difficult with increase of water pressure due to squeeze out in the hole. HW casing pipes were extended to 18.00 m after the hole was reamed with HW casing shoe.

Drilling was continued to 60.00 m with a HQ-WL bit in sheared tuff breccia include clay and NW casing pipes were inserted.

The hole was drilled with a NQ-WL bit thereafter to 132.00 m in tuff breccia and BW casing pipes were securely inserted. While drilling was carried out with the same bit in the sheared tuff with clay, core choking and rod jamming were observed, however drilling was able to perform by frequent exchange of circulating mud water.

A BQ-WL bit was employed for drilling thereafter and finished when the hole reached 250.20 m.

While drilling was carried out with the same bit, circulating mud water was completely lost around 207.70 m, where mud balls mixed with Tel-stop and Bentonite were thrown into the hole to stop the circulation loss which was not succeeded. Drilling was able to continue with 20% circulating mud water return after mud balls mixed with Tel-stop, Bentonite and finely chopped pine leaves was thrown into the hole.

2-3-2 No. 54-2 Hole

Total drilled length : 250.30 m

Core length : 245.20 m

Core recovery : 98.0 %

Dry drilling was carried out to 2.20 m in the red brown soil with a single metal bit of 116 mm dia.

Drilling was continued with a long metal bit of the same diameter with circulating mud water to 26.80 m where stable tuff breccia was reached and HW casing pipes were inserted to the same depth.

The bit was changed to that of the HQ-WL size with which drilling was continued to 60.00 m without trouble such as core choking and circulating water loss and NW casing pipes were inserted to the same depth.

A NQ-WL bit was employed and the hole was drilled to 128.80 m. During this, the rock facies of the alternation of tuff breccia, diabase and andesite alteration was so stable that drilling was performed without hitch such as caving and core choking. BW casing pipes were inserted to 128.80 m and a BW-WL bit was employed.

The rock facies of tuff breccia and andesite was so stable that drilling was finished when the hole reached 250.30 m.

2-3-3 No. 54-3 hole

Total drilled length : 250.70 m

Core length : 246.40 m

Core recovery : 98.3 %

Dry drilling with a single metal bit of 116 mm dia. was carried out to 2.90 m in the red brown soil. Drilling was continued with a long metal bit of the same diameter with circulating mud water to 12.00 m where stable tuff was reached and NW casing pipes were inserted to the same depth.

The hole was drilled with a HQ-WL bit to 57.00 m and NW casing pipes were securely inserted. While drilling was carried out with the same bit, the rock facies of tuff breccia was stable that drilling was performed without caving and circulation loss.

Thereafter, a NQ-WL bit was employed and drilling was continued to 129.00 m.

The rock facies was stable tuff breccia and drilling carried out without any hitch.

BW casing pipes were inserted to the same depth and the bit was alonged to BQ-WL one.

The rock facies was tuff breccia and drilling was finished when the hole reached 250.40 m.

2-3-4 No. 54-4 hole

Total drilled length : 250.40 m

Core length : 248.70 m

Core recovery : 99.3 %

Dry drilling with a single metal bit of 116 mm dia. was carried out in the weathered tuff breccia to 1.10 m where a long metal bit was employed and drilling was continued to 15.00 m with circulating mud water. Then HW casing were inserted.

The hole was drilled to 60.00 m with a HQ-WL bit and NW casing pipes were inserted.

Drilling was continued with a NQ-WL bit. Between 24.00 m and 43.00 m the rock facies was argillaceous tuff breccia, however, drilling was performed without core choking and caving. There was complete circulation loss at 48.00 m where mud balls mixed with Tel-stop and Bentonite was thrown into the hole to prevent the circulation loss.

Drilling was continued to 129.00 m with a NQ-WL bit and BW casing pipes were inserted.

Thereafter, a BQ-WL bit was employed and drilling was finished when the hole reached 250.40 m.

2-3-5 No. 54-5 hole

Total drilled length: 250.30 m

Core length : 241.10 m

Core recovery : 96.3 %

Dry drilling with a single metal bit of 116 mm dia. was carried out to 1.85 m in the weathered tuff breccia and the hole was drilled down to 11.85 m in wet drilling with a long metal bit of the same diameter. And

HW casing pipes were inserted.

The hole was drilled down to 62.90 m with a HQ-WL bit and NW casing pipes were inserted.

Choking core was frequently occured with the rock facies of sheared tuff breccia with clay below from 49.60 m.

Then, drilling was continued to 131.90 m with a NQ-WL bit and BW casing pipes were inserted.

Because of the rock facies of sheared tuff breccia, core choking was frequently occurred, drilling was performed using Libonite mud mixture to prevent caving.

A BQ-WL bit was employed for drilling thereafter and finished when the hole reached 250.30 m.

During this, the rock facies of sheared tuff breccia, crack-rich andesite and shale was encountered, however, drilling was performed without caving and circulation loss although core choking was frequently occured.

2-3-6 No. 54-6 hole

Total drilled length : 250.20 m

Core length : 226.40 m

Core recovery : 90.5 %

Dry drilling was carried out to 1.80 m with a single metal bit of 116 mm dia. in the red brown soil and the hole was drilled down to 27.00 m by wet drilling with a long metal bit of the same diameter, where HW casing pipes were inserted.

The hole was drilled down to 59.90 m with a HQ-WL bit and NW casing pipes were inserted.

The rock facies was tuff breccia with clay and drilling was encounted difficulty with squeezing out and deposition of the cuttings on the hole wall.

The hole was drilled down to 135.20 m with a NQ-WL bit and BW casing pipes were inserted.

Because of the rock facies of sheared tuff breccia, core choking was frequently occurred. The hole was continuously drilled in spite of complete circulation loss at 101.00 m caused by fissures which was filled about 80 % with the mud while drilling was going on.

The rock facies was sheared tuff breccia to 200.00 m, which caused core choking and using of circulating Bentonite mud water was able to prevent caving.

When the BW casing pipes were tried to be pulled out, the rod hoist and hydraulic rod feeder could not manage it and all casing pipes were recovered by using a drive hammer.

2-3-7 No. 54-7 hole

Total drilled length : 300.20 m

Core length : 279.60 m

Core recovery : 93.10 %

The hole was drilled to 2.00 m by dry drilling in sand deposit with a single metal bit of 116 mm dia. and extended to 8.80 m by wet drilling with a long metal bit of the same dia. to which depth HW casing pipes were subsequently inserted.

A HQ-WL bit was attached and the hole was drilled to 81.00 m in sand and gravel beds and NW casing pipes were inserted.

However, NW casing pipes were extended to 84.00 m to where the casing was dropped while NQ-WL drilling was on progress. Because of the sand and gravel beds, core choking and bit abrasion especially loss of diamond were experienced.

The hole was drilled down to 165.00 m with a NQ-WL bit and BW casing pipes were inserted. The sand and gravel beds was continued to 130.40 m

where stable rock was reached. Usage of Libonite mud water for circulation was able to drill through the formation without caving although core choking was frequently experienced.

A BQ-WL bit was employed for drilling thereafter and finished when the hole was reached 300.20 m.

While drilling was carried out with the same bit in tuff breccia, circulating mud water was completely lost at 203.50 m where mud balls mixed with Tel-stop and Bentonite were thrown into the hole to minimize circulation loss to 30 % and at 275.00 m where mud balls mixed with Tel-stop, Bentonite and saw dust were thrown to minimize circulation loss to 80 %.

2-3-8 No. 54-8 hole

Total drilled length : 300.40 m

Core length : 272.10 m

Core recovery : 90.6 %

The hole was drilled to 3.40 m by dry drilling in sand and gravel beds with a single metal bit of 116 mm dia. and extended to 20.80 m by wet drilling with a long metal bit of the same diameter. HW casing pipes were inserted to the same depth. The bit was substituted by a HQ-WL bit and the hole was being drilled the HW casing pipes fell down to 22.00 m because of loose ground.

Accordingly, HW casing pipes were extended to the same depth.

The hole was drilled down to 85.90 m with a HQ-WL bit and NW casing pipes were inserted.

While the hole was drilled with the same bit in the sand and gravel beds, NW casing was sunk. Therefore, it was decided to drill through such loose formation that the hole was drilled with a NQ-WL bit, reamed with a NW casing shoe bit and extended NW casing pipes alternatively. NW casing pipes were inserted to 111.60 m by the above method.

The hole was continued to 149.80 m with a NQ-WL bit in the sand and gravel beds and tuff breccia and BW casing pipes were inserted.

The bit was substituted by a BQ-WL bit and drilling was continued in tuff breccia, meta-tuff and andesite to 300.40 m where the hole was completed.

This hole was carried out satisfactorily without any hitch like caving by using Libonite mud water from the beginning.

2-4 Mobilization and De-mobilization

No. 1 drilling machine was transferred for operation from No. 54-1 to, No. 54-3, No. 54-4 and No. 54-7. Meanwhile, No. 2 drilling machine was transferred from No. 54-2 to No. 54-6, No. 54-5 and then to No. 54-8. This transferring work was done without difficulty since the roads to the drilling sites were developed so that a 6-ton truck was trafficable.

Transfer and re-installation of the drilling machine at the drilling hole of No. 54-1 and No. 54-2 took 8 days as material transportation was done simultaneously but the same work at No. 54-3, 54-4, 54-5 and 54-6 took 3 to 4 days respectively, and respective 5 to 6 days at No. 54-7 and 54-8.

When the de-mobilization from the drilling sites of No. 54-7 and 54-8 was about to start, Rio Chamelecon was flooded due to heavy rainfall in the area of the upper stream. Both drilling sites were almost isolated, however, the de-mobilization was able to continue following day when the flood was subsided.

On the request of a counter part, the drilled cores were temporarily stored in the other storage hut built in the same place last year.

All cores recovered in last three years were transferred and stored in a core storehouse which was built in the yard of Direccion General de Minas e Hidrocarburos in Tegucigalpa last October.

Chapter 3 Geology of the Drill Holes

3-1 Geology of the Drillsites

3-1-1 Hole No. 54-1

The hole is located at the altitude of 407 m above sea level on the southern slope of the Vueltas del Rio hilly land (the highest peak is at the altitude of 514 m above sea level), which runs east and west roughly.

The area is underlain by the metamorphosed tuff, welded tuff and andesite, belonging to the Vueltas del Rio Formation. The beds are trending roughly east and west and dipping to the south. It is correspondent to the marginal zone of the high anomaly of gold and copper shown by the geochemical survey carried out by UNDP.

There are many old workings and trenches, where gold was prospected in those days, about 100 to 200 m north of this drillsite. Gossaneous quartz veins are developed and remarkable silicification is recognized in the above gold prospect zone.

3-1-2 Hole No. 54-2

The hole is located at the altitude of 354 m above sea level at slightly north of the central part of the subject area. It is about 150 m south of the drill hole No. 52-3, which was completed in the first year's survey.

The area is underlain mainly by welded tuff with tuff and tuff breccia of the Vueltas del Rio Formation, intruded by dykes of andesite. It is correspondent to a part occupying an area along the axis of the syncline, in east-west direction. The area is situated in the marginal zone of the gold high anomaly and in the copper high anomaly, both of which have been shown by the geochemical survey by UNDP. Also, the area is at the western end of the intense PE anomaly extending east-north-east and west-south-west,

which has been shown by IP survey. Remarkable iron-oxide gossans are recognized around the drillsite.

3-1-3 Hole No. 54-3

The hole is located at the altitude of 335 m above sea level in the lowland between two hilly lands in the northern part and in the southern part of this Vueltas del Rio area. The beds distributed around the drillsite are metamorphosed tuff and tuff breccia, which form a syncline with the axis of the trend of east and west. The drillsite itself is on the south wing of this syncline. The area is in the marginal zone of the high anomalies of gold, copper, zinc etc. shown by the geochemical survey by UNDP. There is Nelson trench, which was prospected in old days, as well as other trenches and old workings located in the north. Silicified network-like quartz veins and gossans of iron-oxides are well developed.

3-1-4 Hole No. 54-4

The hole is located at the altitude of 280 m above sea level, on the southern slope in the Vueltas del Rio area, which is at about 300 m north of the drill hole No. 53-2 completed in the last year's survey.

Metamorphosed tuff, tuff breccia and welded tuff of the Vueltas del Rio Formation are distributed around the drillsite. Their strike is east and west, with the dip to the north.

The area is in the high anomalies of copper and zinc, shown by the geochemical survey by UNDP. On the cutting face along the road in the east of this drillsite, many joints are developed in the direction of east-west and of north-south, with remarkable gossans of iron-oxides.

3-1-5 Hole No. 54-5

The hole is located at the altitude of 282 m above sea level in the southernmost part of the subject survey area.

The area around this drill hole is underlain by metamorphosed andesite

and tuff belonging to the Vueltas del Rio Formation. The beds exhibit strike of east and west with the dip to the north. About 100 meters south of this drill hole, a fault bounding the Vueltas del Rio Formation and the Atima limestone formation is found to run in the direction of east-north-east and west-south-west.

The area is situated in the extension, in east-west direction, of the high zinc anomaly of the geochemical survey by UNDP. The soils in this area reveal reddish brown color owing to weathering and oxidation.

3-1-6 Hole No. 54-6

The hole is located at the altitude of 313 m above sea level, along the road on the western bank of the small stream flowing southward in the central part of the subject area.

Around the drill hole, metamorphosed tuff and tuff breccia are distributed, with reddish purple soil owing to the development of oxidized gossaneous zone.

It is situated in the marginal zone of the copper high anomaly by the geochemical survey by UNDP, and also in the marginal zone of the medium-grade FE anomaly of the IP survey.

3-1-7 Hole No. 54-7

The hole is located at the altitude of 204 m above sea level, near the river bank at the southeastern part of the area where the meandering of the Chamerecon River change the direction from east-west to north-south in the plain of the altitude of about 100 m in the eastern part of the Vueltas del Rio hilly land.

The pyroclastic rocks of the Vueltas del Rio Formation are distributed as far as to the road at the eastern end of the hilly land while Quaternary eluvial sediments are covering most of the eastern plain.

The locality of this drill hole was determined for the purpose to

obtain information on the relation of the Vueltas del Rio Formation and the Atima Formation, on the potentiality for the emplacement of mineral deposits and on the presence of placer gold in the eluvial sediments.

3-1-8 Hole No. 54-8

The hole is located about 400 m north of the drill hole No. 54-7, at the altitude of 201 m above sea level, on the left bank of the northeastern bending point of the Chamelecon River from the direction of north-south to that of east-west.

In the area around this hole, as in the area around the hole No. 54-7, eluvial sediments are distributed. The location of this hole is determined to obtain informations on the presence of the Vueltas del Rio Formation, on the existence of indications of mineralization and on the presence of placer gold in the eluvial sediments, which are uncertain by the covering of the sediments.

3-2 Geology of the Drill Holes (Refer to PL.II-2, PL.II-3, Fig. II-9)

3-2-1 Hole No. 54-1 (Length 250.30 m, vertical)

(1) Rocks

Soils formed by weathering are there down to the depth of 5.0 m, and from there to the depth of 86.2 m, metamorphosed tuff is distributed with each one thin layer of tuff breccia and welded tuff. Lamelae structure is recognized to be developed well in this metamorphosed tuff. To the depth of 116.8 m, metamorphosed andesite is distributed, which is underlain by banded grey micro-grained tuffaceous shale to the depth of 149.5 m. To the bottom, tuff breccia is predominant with insertions of metamorphosed andesite of the length of 4 m and of metamorphosed tuff of the length of 7 m.

(2) Alteration

Intense limonitization and argillization are recognized from the

surface to the depth of 22 m. Medium grade sericitization and carbonatization are seen in the metamorphosed tuff distributed to the depth of 26 m. Chloritization is recognized remarkably in the metamorphosed tuff although it is less intense in the tuff breccia distributed to the bottom. Medium to rather intense silicification is observed all through the drill core.

(3) Mineralization

Pyritization is slightly recognized in the metamorphosed tuff and the welded tuff below surface to the depth of 86 m, while it is scarcely seen beneath this depth to the bottom.

Copper mineralization is recognized as the dissemination of chalcocite in the length of 6 meters at the depth from 14 m to 20 m, the assay result of which is Cu 0.83% in average.

Between the depth of 140 m and 142 m, there is an indication of sphalerite dissemination in the shale, which shows the assay of Pb 0.12 % and Zn 0.48%.

Also, between the depth of 247.8 m and 248.8 m almost at the bottom of this hole, network-like quartz calcite veinlets are recognized with chalcopyrite, bornite and pyrite in the metamorphosed tuff. The assay result of 248 m to 250 m shows Cu 0.25%.

3-2-2 Hole No. 54-2 (Length 250.30 m, vertical)

(1) Rocks

From the surface to the depth of 22 m, soils formed by weathering are there, covering welded tuff which is distributed to the depth of 59.1 m. Beneath them, tuff breccia is distributed to the depth of 100 m, welded tuff is to 143 m and tuff breccia is to the bottom. Over ten layers of metamorphosed andesite 1 to 14 m in length along the core are inserted in the above rocks. Chilled margins are well recognized along several andesite dykes of the length of 1 to 16 m, intruded in the tuff breccia and the welded tuff at the depth of 86 m to 146 m.

The welded tuff is grey to greyish white in color and has medium grained granular texture.

The tuff breccia is grey in color down to the depth of 170 m, but below there it is pale green. The rock has medium to coarse grained matrix with breccias of tuff and andesite, sub-angular to sub-round and 2 cm by 5 cm in approximate sizes.

The metamorphosed andesite is green to dark green in color and has fine grained porphyritic texture with pheno-crysts mainly of plagioclase 2 to 3 mm in diameter.

(2) Alteration

Over all the drill core, silicification is recognized. Especially, it is remarkable at the depth of 86.0 m to 208 m. Sericitization, carbonatization and argillization are recognized down to the depth of 86 m below surface. The part near surface is particularly affected by these alteration. Chloritization is remarkable in the metamorphosed andesite and in the dykes of andesite distributed from the depth of 86 m to the bottom, but the tuff breccia is not affected.

(3) Mineralization

Pyritization is observed in the pyroclastic rocks from the mouth to the bottom. It is especially intense between the depth of 69 m and 86 m, but it is rather weak near the bottom.

Indications of copper mineralization are recognized as follows;

Depth	Length	Average Assay
28^{m} - 32^{m}	4^{m}	Cu 0.32%
36 - 38	2	Cu 0.13
46 - 48	2	Cu 0.12

The indications comprise dissemination of chalococite contained in the welded tuff.

3-2-3 Hole No. 54-3 (Length 250.70 m, vertical)

(1) Rocks

Soils formed by weathering are there from the mouth of the hole to the depth of 5.5 m. Metamorphosed tuff is distributed from that depth to that of 177 m, with insertions of tuff breccia 28 m in length along the core and of three layers of metamorphosed andesite respectively 3 m, 7 m and 12 m in length. Beneath that to the depth of 240 m tuff breccia is distributed and near at the bottom metamorphosed andesite appears again.

Metamorphosed tuff is white to greyish white in color, and megascopically most of the upper part of this rock is liparitic. Metamorphosed andesite is green in color and is microphanerocrystalline bearing porphyritic texture, with phenocrysts of hornblende and plagioclase, partly with pink feldspar. Tuff breccia has light grey, fine grained matrix with breccias of same sort of tuff usually 1 to 2 cm in size but the biggest so far found is 15 cm in diameter.

(2) Alteration

Sericitization is recognized slightly to the depth of 54 m down from the surface. Argillization is developed intensely to the depth of 42 m. Chloritization is remarkable in the metamorphosed tuff breccia and in the metamorphosed andesite between the depth of 54 m and 178 m. All the cores are affected by medium-grade silicification.

(3) Mineralization

Pyritization is slightly recognized all through the core, and it is rather intense in the metamorphosed tuff between the depth of 152 m and 178 m.

Dark-colored minerals are disseminated in the metamorphosed tuff at the depth from 36 m to 50 m. The assay result of this part of the core has shown Zn 0.83% in average. Especially, in the cores between the depth

of 48 m and 50 m, there are faint quartz veinlets containing chalcocite, chalcopyrite, galena and sphalerite, the assay results of which are Cu 0.22%, Pb 0.41% and Zn 2.30%. Also, very fine grained dark-colored minerals are disseminated in the metamorphosed tuff breccia at the depth from 58 m to 78 m, which has shown the ore grade of Zn 0.4%. The assay result of the cores between the depth of 176 m and 178 m is Cu 0.22%, which is chalcopyrite-bearing quartz calcite veinlets contained in the metamorphosed tuff.

3-2-4 Hole No. 54-4 (Length 250.40 m, vertical)

(1) Rocks

From the mouth of the hole to the depth of 3 m, soils formed by weathering are recognized, and to the depth of 19.2 m the core comprises metamorphosed tuff, oxidized and brown-colored. From there to the bottom, alternation of metamorphosed welded tuff and metamorphosed tuff breccia is seen in repetition cycle of 20 to 50 m. Metamorphosed andesite is inserted in the tuff breccia between the depth of 224 m and 228.2 m.

(2) Alteration

Silicification, sericitization, carbonatization and chloritization are recognized all over the core but generally weak. But remarkable chloritization is observed in the metamorphosed andesite between the depth of 204 m and 218 m.

A fracture zone is developed at the depth of 21 to 38 m which is associated with white clay bearing breccias.

(3) Mineralization

Pyritization is slightly recognized from the surface to the depth of 65 m, but it is rarely seen in the cores of the deeper part.

Dark-colored minerals are observed to be disseminated in the metamorphosed tuff and in the welded tuff from the surface down to the depth

of 36 m, the assay result of which has shown Zn 0.32% in average. Especially, it is notable that the part between the depth of 10 m and 12 m has shown the gold content of Au 3.24 g/t. Also, at the depth of 32 m, there are quartz calcite veins 2 to 5 cm thick, bearing sphalerite and chalcopyrite. The assay results of the cores between the depth of 32 m and 34 m are Cu 0.09% and Zn 2.40%. At the depth of 109.5 m, chalcopyrite-bearing quartz veinlets are recognized in the tuff breccia, and the assay result of the cores between the depth of 109 m and 110 m has shown the grade of Cu 0.63%.

3-2-5 Hole No. 54-5 (Length 250.30 m, vertical)

(1) Rocks

Down to the depth of 3.45 m, soils formed through weathering are there, underlain by grey to brown metamorphosed liparitic tuff with the insertions of andesite 7 m thick to the depth of 49.2 m, from where to the depth of 158.9 m pale green aphanitic tuff breccia is distributed, with the insertions of 2 or 3 thin layers of welded tuff and metamorphosed tuff. To the bottom, the cores comprise metamorphosed andesite, inserted with thin layers of dark phyllitic rock at the depths of near 184 m and 215 m, and with thin layer of tuff breccia at the depth of 224 m.

(2) Alteration

Weak silicification and sericitization are developed down to the depth of 159 m. Chloritization is recognized between the depth of 22 m and 158 m, which are white to green in color, with breccias, affected by remarkable argillization.

(3) Mineralization

Almost no pyritization nor copper mineralization has been recognized in this hole.

3-2-6 Hole No. 54-6 (Length 250.20 m, vertical)

(1) Rocks

Down to the depth of 13.6 m, soils formed through weathering are there, underlain by metamorphosed tuff or liparitic tuff to the depth of 136 m. From there to the bottom, tuff breccia is distributed with insertion of metamorphosed andesite 44 m in length down from the depth of 195.5 m.

(2) Alteration

Silicification is recognized to medium to weak degree all over the cores of this hole. Weak sericitization and carbonatization are observed in the tuff down to the depth of 118 m. The shallow part from the surface to the depth of 132 m is subjected to intense argillization. Chloritization is weak in shallower part to the depth of 132 m, but intense chloritization is recognized in the deeper part of it. Fractures are remarkable between the depth of 27 m and 52 m, which are clay zone with some breccias.

(3) Mineralization

The soils down to the depth of about 14 m exhibit the zinc content of Zn 0.24%, and the underlying rock between the depth of 14 m and 30 m has shown assay result of Zn 0.28% in average. It is not certain whether the zinc minerals are oxides. Small amount of chalcopyrite dissemination is recognized at around the depth of 244 m.

Slight pyritization is observed at the depth from 133 m to 155 m but it is recognized in no other part of the cores.

3-2-7 Hole No. 54-7 (Length 300.20 m vertical)

(1) Rocks

From the mouth of the hole to the depth of 159.6 m, there are eluvial sediments, which are underlain by alternation of metamorphosed tuff, tuff breccia and shale in repetition of 6 to 20 m in length, distributed to the depth of 224.8 m. Thin layers of metamorphosed andesite are observed in

the metamorphosed tuff at around the depth of 203 m. Down from the depth of 224.8 m to the bottom, thick metamorphosed andesite is distributed.

The eluvial sediments to the depth of 102 m down below surface are composed mainly of grey to dark brown clay with fine to coarse grained sands and small pebbles of andesite and limestone 1 to 5 cm in diameter with small amount of coarse grained sands.

The tuff breccia has grey to white and fine to medium grained matrix with breccias of the same lithological rock as tuff, about 10 cm in diameter.

The metamorphosed andesite is pale green in color and fine to medium grained porphyritic rock with phenocrysts of feldspar and chlorite.

(2) Alteration

From the top of the basement rock at the depth of 159.5 m, to the bottom, silicification and chloritization are slightly recognized continuously. Sericitization and carbonatization are also observed at the depth from 159.5 m to 220 m, but weak.

(3) Mineralization

Moderate pyritization is recognized in the tuff breccia between the depth of 170 m and 188 m, but beneath that depth it is scarce. By the assay results, the cores from the depth of 158 m to 160 m reveal Zn 0.49% and those from the depth of 170 m to 176 m have shown Zn 0.28%. They are several calcite veins contained in a fracture zone about 5 cm wide in tuff breccia.

3-2-8 Hole No. 54-8 (Length 300.40 m, vertical)

(1) Rocks

From the mouth of the hole to the depth of 130.5 m, there are eluvial sediments. Two cycles of alternation of metamorphosed and tuff breccia, with the thickness of 20 to 54 m in core length are observed at the depth from 130.5 m to 268 m. Metamorphosed andesite is distributed from there

to the bottom.

The eluvial sediments are composed of clay, sands and pebbles in repetition of grading 4 to 20 m in core length. The clay is grey blue to grey brown in color. The sands are grey, green, dark brown in color and fine to coarse grained. The pebbles are sub-angular or sub-round, 1 to 10 cm in sizes. They are mainly andesite with minor amount of quartzite, limestone, tuff and shale.

(2) Alteration

From the top of the basement rock at the depth of 130.5 m, to the depth of 200 m, moderate silicification is recognized in the metamorphosed tuff and in the tuff breccia, but it is very weak in the deeper part. Sericitization and carbonatization are weakly recognized at the depth from 130 m to 230 m. Remarkable chloritization is observed in the deeper part than the depth of 242 m, where andesite is distributed.

(3) Mineralization

Pyritization is recognized slightly to the bottom from the depth of 130.5 m. As an indication of copper mineralization, chalcopyrite is found in the network veinlets about 90 cm in length down from the depth of 241 m. The assay result of the cores at the depth of 240 to 242 m has shown Cu 0.51%.

3-3 Indications of Mineralization in the Drill Holes (Refer to PL.II-3)

3-3-1 Indications of Copper Mineralization

The following 7 indications have been confirmed as those of copper mineralization.

Hole No.	Depth (m)	Length (m)	Assay (Cu%)
54-1	14 - 20	6	average 0.83
54-1	248 - 250	2	0.25
54-2	28 - 32	4	average 0.32
54-3	176 - 178	2	0.22
54-4	109 - 110	1	0.63
54-4	189.00 - 189.10	0.1	1.0 to 2.0
54-8	240 - 242	2	0.51

These indications of copper mineralization are roughly classified into two types --- one is dissemination type in the surface oxidation zone or in the secondary enrichment zone, and the other is vein type at the depth.

The indications of the dissemination type are found in the drill holes No. 54-1 (Depth 14 to 20 m) and No. 54-2 (Depth 28 to 32 m), both of which contain dissemination of oxidized dark-color minerals probably composed of chalcocite and pyrite. They are found in such zones as sericitization, carbonatization and argillization are remarkably developed, in the light brown, medium to coarse grained metamorphosed tuff or in the grey, medium grained metamorphosed welded tuff.

The indications of vein type are found in the deeper part than the depth of 110 m in the drill holes No. 54-1, No. 54-3, No. 54-4 and No. 54-8. They are usually in the network-like quartz veins 2 to 10 cm in width, containing chalcopyrite, pyrite and occasionally sphalerite.

The indication in the drill hole No. 54-1 is found in the core length of 1 m down from the depth of 247.8 m, which is contained in white, compact and fine grained metamorphosed tuff. Silicification is developed in this part.

The indication in the drill hole No. 54-3 is found in the metamorphosed

tuff near along the border to the metamorphosed tuff breccia. It is recognized in chalcopyrite-bearing calcite quartz veinlets over 50 cm in core length.

The indication of copper mineralization at the depth of 189 m of the drill hole No. 54-4 is found in a milky quartz vein (10 cm in width) bearing chalcopyrite, bornite and pyrite, in the metamorphosed welded tuff. Around this indication, silicification and carbonatization of moderate grade as well as weak sericitization are recognized.

The indication at the depth of 240 m of the drill hole No. 54-8 is found in the metamorphosed tuff breccia near the border to the metamorphosed andesite. There, dissemination of chalcopyrite and pyrite is recognized in network quartz vein over 70 cm in core length. This hole is located in the alluvial plain about 500 m east of the Vueltas del Rio hilly land. The area around this hole is covered with alluvium, and kinds of basement rocks and presence of mineralization had been uncertain. It has been confirmed by these drill holes No. 54-7 and No. 54-8 that the beds of the Vueltas del Rio Formation are distributed at depth in continuity, in east and west, from the Vueltas del Rio hilly land, and that copper mineralization is present though it is slight.

3-3-2 Indications of Gold Mineralization

The following two indications have been confirmed as those of gold mineralization.

Hole No.	Depth (m)	Length (m)	Assay (Au g/t)
No. 54-2	2 - 8	6	average 1.54
No. 54-4	10 - 12	2	3.24

The indications are found in the metamorphosed tuff and in the metamorphosed welded tuff. They are present in oxidation zone near surface

where rocks are reddish purple owing to remarkable limonitization and argillization.

The indication in the drill hole No. 54-2 is found around the axis of a syncline, where, it is thought, secondary gold enrichment zone in the shallow part has been formed by weathering and leaching of the gold veinlets developed in the northern hilly land.

The indication in the drill hole No. 54-4 is located along a tectonic line in the direction of east-north-east and west-south-west, and it is thought that the gold mineralization is related to the fault or fissures branched from the fault.

3-3-3 Indications of Zinc Mineralization

The following indications have been confirmed as those of zinc mineralization.

Hole No.	Depth (m)	Length (m)	Assay (Zn %)
No. 54-3	36 - 50	14	average 0.83
No. 54-3	58 - 78	20	" 0.43
No. 54-4	0 - 36	36	" 0.32
No. 54-4	62 - 80	18	" 0.31
No. 54-4	94 - 102	8	" 0.50
No. 54-6	0 - 30	30	" 0.26
No. 54-7	170 - 176	6	" 0.28

The indications include dissemination type in the shallow part near surface and vein type at depth.

The indications of the dissemination type are found in the drill holes No. 54-3, No. 54-4 and No. 54-6, where zinc mineralization is recognized in the secondary enrichment zone of the shallow part from the surface to the depth of 102 m. Ore minerals are sphalerite and pyrite with chalcocite.

In the drill hole No. 54-3, dissemination of fine grained sphalerite is observed in the white and medium grained metamorphosed tuff and grey green metamorphosed tuff breccia. At around the depth of 48 m, sphalerite-galena-chalcopyrite-bearing network quartz veins (0.1 to 0.55 mm in width) are recognized, which have shown the assay results of Zn 2.3% and Cu 0.22 % in the core length of 2 m.

The indications in the drill hole No. 54-4 are dissemination of fine grained sphalerite in the greyish white metamorphosed welded tuff and in the green metamorphosed tuff breccia, both of which are sericitized, carbonatized and chloritized. At around the depth of 32 m, sphalerite-chalcopyrite-bearing quartz calcite veinlets 2 to 5 cm in width are well recognized.

The indication in the drill hole No. 54-6 is dissemination of zinc minerals in the metamorphosed tuff, intensely argillized and limonitized in the shallow part from the surface to the depth of 30 m.

The vein type indication of zinc mineralization is found at the depth from 170 m to 176 m of the drill hole No. 54-7, which is sphalerite-pyrite-bearing calcite veinlets contained in the metamorphosed tuff breccia.

3-3-4 Summary of the Indications of Mineralization in This Area

Indications of mineralization in this area are summarized as follows;

a) Variation of mineralization --- Indications are mainly of copper and zinc mineralization with minor gold mineralization.

b) Type of mineralization --- There are dissemination type and vein type of mineralization. Most of the indications are of the type of dissemination, developed in surface oxidation zone or in secondary enrichment zone located in shallow part as from surface to the depth of about 100 m. Indications of the vein type mineralization are recognized in quartz calcite veinlets beneath the depth of 100 m.

c) Lithology --- Mineralization is found mostly in the metamorphosed tuff, tuff breccia and partly in the andesite, but no mineralization has been recognized in the dykes of andesite.

d) Alteration --- Indications of mineralization are frequently found in such zones of argillization, sericitization and fractuation. They are sometimes associated with carbonatization zone and chloritization zone. There is no particular relation between ore minerals and the difference of alteration.

e) Mineralization at depth and in the eluvial sediments --- By the diamond drilling of the holes No. 54-7 and No. 54-8 located along the Chamelecon River, it is confirmed that the beds of the Vueltas del Rio Formation is distributed at depth of the alluvial plain as an extension of those beds found on the western hills, and that there is an indication of copper mineralization in the beds covered with alluvial sediments. It has also been clarified that concentration of place gold would not be expected in the eluvial sediments on the surface.

3-4 Relation of Geology of the Drill Holes to Geological Structure

Outline of geology in this area is illustrated in a profile (Refer to PL. I-1 and PL. I-2), based on the informations acquired in the various surveys carried out in the present year, in addition to the data of the geology and the results of the diamond drilling obtained in the last year and before.

a) Although it is difficult to correlate the beds of the metamorphosed tuff and the metamorphosed tuff breccia found in the drill holes, it has been confirmed by taking the metamorphosed andesite as a key bed that these beds comprise a synclinorium with axis of east-north-east and west-south-

west, in this area. The data are as follows;

The drill holes No. 54-3, No. 54-5 and No. 54-6 are located in the southern part of the area, where the beds of the metamorphosed tuff and the metamorphosed tuff breccia are trending east and west with the dip to the north. The metamorphosed andesite is conformably inserted in them. This metamorphosed andesite is almost horizontal in the drill hole No. 54-2, which is thought to be corresponded with the fact that its location is along the axis of syncline. In the drill hole No. 54-1 located in the north of the above hole, the dip of the beds is to the south. In the northern side of this hole, the beds are dipping to the north. In the north of the drill hole No. 53-5 the beds are recognized to appear again in south dipping.

Thus the idea that there is a synclinorium has been confirmed.

b) Considering the geology on the east-west profile, it has become evident that the beds belonging to the Vueltas del Rio Formation are extended from the western hilly land to the deep part of the eastern alluvial plain and that the axis of the synclinorium is plunging to the east gently.

c) In the subject area, sheared fissures of the direction of east-north-east and west-south-west are developed remarkably, and other fissures of east and west are also predominant, branched from the former. Also, there are north-south fissures. The contain limonitized quartz veinlets. It is considered that intimate relation would be there between the fissures of east and west on the surface and the indications of copper mineralization at the depth of 104 m of the drill hole No. 53-3 completed in the last year as well as those at the depth of 109 m and 189 m of the drill hole No. 54-4 performed in the present year.

d) In many places from the surface to the depth of 150 to 200 m, alterations as argillization, sericitization and carbonatization are recognized while silicification is observed all through the core though weak.

Chloritization is found remarkably developed beneath the depth of about 150 m, where the metamorphosed andesite appears.

Table II—1 Drilling Machines Used and Materials Consumed Drilling Machines: TGM-5A

Item	Model	Quantity	Capacity, Type, and Specification
Drilling Machine	TGM-5A	2	Capacity NQ510m BQ660m Inner Diameter of Spindle 93m/m Weight (excl. engine) 1,600kg
Engine for Drill	F3L-912	2	Diesel Engine 1,800rpm/40PS ∿ 1,500rpm/33.5PS
Pump	NAS-3C NAS-3B	2 2	Piston ϕ75m/m Capacity 130, 72, 39, 22 ℓ/min Pressure 26 ∿ 40 kg/cm²
Engine for Pump	TS-155C	4	Diesel Engine 2,200rpm/12PS
Generator	YSG-3S	1	3KVA 100∿110V
Engine for Generator	TS-60C	1	Diesel Engine 2,200rpm/5.5PS
Derrick	DCP9-9	2	Steel structural derrick (Vertical, inclination) Weight 12 ton lifting 6m height
Mud Mixer	MCE-200-A	2	Volume 200ℓ 800∿1,000rpm/min
Rod Holder	CH-60A	2	Hydraulic type
Drill Rods	HQ NQ BQ	115 220 330	3.00 m/pc 3.00 m/pc 3.00 m/pc
Casing Pipes	HW NW BW	25 110 300	3.00 m/pc 3.00 m/pc 3.00 m/pc

Table II—2 Consumables Used

Description	Specification	Unit	Quantity							
			54-1	54-2	54-3	54-4	54-5	54-6	54-7	54-8
Light oil		ℓ	700	650	650	700	750	700	700	700
Mobil oil		ℓ	48	48	24	48	48	24	72	72
Hydraulic oil		ℓ	60	60	10	5	5	10	20	15
Grease		kg	15	15	10	10	10	10	30	30
Bentonite		Bag	93	31	55	70	86	122	168	78
Libonite		kg				50	80		450	275
Tel-cellose		kg	11.6	13.3	13	8	10	5	13	10
Mud seal		kg	5	3	3	4	5	4	10	3
Tel-stop		kg	25	2	3	5	3	5	60	12
Emale 20C		ℓ	10	15	10	8	8	10	18	18
Metal crown	116m	Pcs	2	3	2	2	2	2	2	4
Single core tube	114mm x 0.5m	Set	1	1						
Double core tube	114mm x 1.5m	"	1	1						1
Wire line core barrel	HQ x 3.00m	"	1	1						
" "	NQ x 3.00m	"	1	1						
" "	BQ x 3.00m	"	1	1						
Inner tube assembly	HQ x 3.00m	"	1	1						
" "	NQ x 3.00m	"	1	1						
" "	BQ x 3.00m	"	1	1						
Outer tube	HQ x 3.00m	Pcs				1		1		
"	NQ x 3.00m	"				1		1		
"	BQ x 3.00m	"				1	1		1	1
Inner tube	HQ x 3.00m	"			2		1	1	2	2
"	NQ x 3.00m	"			1	1	1	1	1	1
"	BQ x 3.00m	"			2	2	2	2	2	2
Casing metal shoe	HW	"	1	1	1	1	1	1	1	1
"	NW	"	1	1	1	1	1	1	1	1
"	BW	"	1	1	1	1	1	1	1	1
Rag		kg	5	5	4	3	3	4	6	6
Core box		Pcs	34	34	34	35	34	33	38	31
Wire	10#	kg	10	8	5	5	7	6	12	12
"	12#	"	3	2	2	3	3	2	4	4
Nail		"	10	10	5	5	5	5	20	20
Wire rope	6mm x 550m	Roll	1	1					1	1
"	12mm x 40m	"	1	1						

Table II-2 Consumable used (continued)

Description	Specification	Unit	Quantity							
			54-1	54-2	54-3	54-4	54-5	54-6	54-7	54-8
Manila rope	18mm x 30m	Pcs	1	1					1	1
Vinyl rope	8mm x 100m	"	1	1		1	1			
Pump packing		"	4	4	4	4	4	4	8	8
Valve steel ball	38.1ϕ				8		8		8	8
Piston rod		"	2	2					2	2
Guide pipe	HQ	"					1	1		
"	NQ	"			1	1				
	BQ	"			1	1				
Guide coupling	HQ	"	1	1						
"	NQ	"	1	1						
"	BQ	"	1	1						
Suction hose	50mm x 4.5m	"	1	1		1		1		
Water swivel packing		"	3	3	3	3	3	3	3	3
Water swivel spindle		"	1	1	1	1	1	1	1	1
V-belt	TGM-5xP3L912	Sets			1			1	1	1
"		Pcs		1			1		1	1
Core lifter	HQ	"	2	2	1	1	1	1	1	1
"	NQ	"	3	3	2	2	3	3	2	2
"	BQ	"	3	3	2	2	2	4	2	2
Core lifter case	HQ	"	2	2		2	2		2	2
"	NQ	"	2	2	2	2	1	3	2	2
"	BQ	"	2	2	2	2	2	2	2	2

Table II—3 Preparation and Removal

Item \ Hole No.		54-1		54-2		54-3		54-4		54-5		54-6		54-7		54-8	
Preparation and removal	In	1st Jun '79		1st Jun '79		4th Jun '79		4th Jun '79		3rd Jun '79		2nd Jun '79		23rd Jul '79		25th Jul '79	
		12th Jun '79		12th Jun '79		2nd Jul '79		17th Jul '79		17th Jul '79		29th Jun '79		4th Aug '79		4th Aug '79	
	Out	29th Jun '79		26th Jun '79		4th Jun '79		30th Jul '79		31st Jul '79		13th Jul '79		19th Aug '79		18th Aug '79	
				27th Jun '79		14th Jul '79		31st Jul '79		1st Aug '79		14th Jul '79		28th Aug '79		28th Aug '79	
		Days	Man-shifts	Days	Man-shifts	Days	Man-shifts	Days	Man-shifts	Days	Man-shifts	Days	Man-shifts	Days	Man-shifts	Days	Man-shifts
Preparation	Access road	2	35	2	31.5	1	6.5	2	8.5	1	10	1	4	2	12	2	10
	Haulage	2	26	2	26	0.5	6	0.5	13	0.5	8	0.5	12	2	26	1.3	20
	Installation	4	88.5	3.5	83	1.2	34	1.5	35	1.3	33	1	30	1.8	58	1.5	43.5
	Water pipe			0.5	5	0.3	3			0.2	4	0.5	8	0.2	4	0.2	4
	Test run, etc.																
	Total	8	149.5	8	145.5	3	49.5	4	56.5	3	55	3	54	6	100	5	77.5
Removal	Dismantling	1	21.5	1.5	40	1.7	44	1.5	37	1.3	37	2	45	1	21	2	46
	Pipe removal			0.5	5	0.3	3			0.2	4						
	Haulage													3	75	3	72
	Road reinstatement																
	Others													4	96	4	96.5
	Total	1	21.5	2	45	2	47	1.5	37	1.5	41	2	45	8	192	9	214.5
Grand total		9	171	10	190.5	5	96.5	5.5	93.5	4.5	96	5	99	14	292	14	292

Table II—4 Operational Results by Drill Hole No. 54-1

		Period	Number of Days	Actual Working Days	Day Off	Total Number of Workers
Working Period	Preparation	1st Jun'79∿12th Jun'79	12	8	4	149.5
	Drilling	13th Jun'79∿28th Jun'79	16	14	2	303
	Removing	29th Jun'79	1	1	-	21.5
	Total	1st Jun'79∿29th Jun'79	29	23	6	474

Drilling Length	Planned Length	m 250.00	Over-burden	m 7.50	Core Recovery for each 100m section	
	Increase or Decrease in Length	m	Core Length	m 236.00	Depth of Hole	Section / Total
	Length Drilled	m 250.20	Core Recovery	94.3 %	0∿107.20m	90.1 % / 90.1 %
					107.20∿204.70m	97.4 % / 93.6 %
					204.70∿250.20m	97.6 % / 94.3 %
Working Time	Drilling	120°00'	30.1 %	26.6 %		
	Hoisting & Lowering Rod		%	%	m	% / %
					m	% / %
	Hoisting & Lowering I.T.				m	% / %
	Miscellaneous	109°00'	27.3 %	24.1 %	Efficiency of Drilling	
	Repairing	6°00'	1.5 %	1.3 %	250.20m/Working Period	8.63m/day
	Others	164°00'	41.1 %	36.3 %	250.20m/Working Days	10.88m/day
	Total	399°00'	100 %	88.3 %	250.20m/Drilling Period	15.64m/day
	Removing Preparation	33°00'		7.3 %	250.20m/Net Drilling Days	17.84m/day
	Removing Moving	20°00'		4.4 %	Total workers/ 250.20 m	1.89 Man/m
	G. Total	452°00'		100 %	Total Drilling Workers/250.20m	1.21 Man/m

Casing Pipe Inserted	Pipe Size & Materage	Inserted Length / Drilling Length %	Recovery of Casing Pipe
	HW 19.50 m	7.8 %	100 %
	NW 60.00 m	24.0 %	100 %
	BW 132.00 m	25.8 %	100 %

Remarks

G : Grand

I.T.: Inner Tube

Table II—5 Operational Results by Drill Hole No. 54-2

Working Period

	Period	Number of Days	Actual Working Days	Day Off	Total Number of Workers
Preparation	1st Jun'79∿12th Jun'79	12	8	4	145.5
Drilling	13th Jun'79∿25th Jun'79	13	11	2	243.5
Removing	26th Jun'79∿27th Jun'79	2	2	-	45
Total	1st Jun'79∿27th Jun'79	27	21	6	434

Drilling Length

Planned Length	250.00 m	Over-burden	10.00 m
Increase or Decrease in Length	m	Core Length	245.20 m
Length Drilled	250.30 m	Core Recovery	98.0 %

Working Time

Drilling	109°30'	32.0 %	27.4 %
Hoisting & Lowering Rod		%	%
Hoisting & Lowering I.T.			
Miscellaneous	84°00'	24.6 %	21.1 %
Repairing	30'	0.1 %	0.1 %
Others	148°00'	43.3 %	37.1 %
Total	342°00'	100 %	85.7 %
Removing: Preparation	33°00'		8.3 %
Removing: Moving	24°00'		6.0 %
G. Total	399°00'		100 %

Core Recovery for each 100m section

Depth of Hole	Section	Total
0∿97.50 m	97.2 %	97.2 %
97.50∿197.70m	98.1 %	97.7 %
197.70∿250.30m	99.0 %	98.0 %
m	%	%
m	%	%
m	%	%

Efficiency of Drilling

250.30m/Working Period	9.27m/day
250.30m/Working Days	11.92m/day
250.30m/Drilling Period	19.25m/day
250.30m/Net Drilling Days	22.75m/day
Total workers/ 250.30 m	1.73 Man/m
Total Drilling Workers/ 250.30	0.97 Man/m

Casing Pipe Inserted

Pipe Size & Materage	Inserted Length / Drilling Length %	Recovery of Casing Pipe
HW 26.80 m	10.7 %	100 %
NW 60.00 m	24.0 %	100 %
BW 128.80 m	51.5 %	100 %

Remarks

G : Grand

I.T.: Inner Tube

Table II--6 Operational Results by Drill Hole No. 54-3

Working Period

	Period	Number of Days	Actual Working Days	Day Off	Total Number of Workers
Preparation	4th Jun'79~2nd Jul'79	29	3	26	49.5
Drilling	3rd Jul'79~12th Jul'79	10	9	1	207.5
Removing	13th Jul'79~14th Jul'79	2	2	-	47
Total	4th Jun'79~14th Jul'79	41	14	27	304

Drilling Length

Planned Length	250.00 m	Over-burden	7.00 m
Increase or Decrease in Length	m	Core Length	246.40 m
Length Drilled	250.70 m	Core Recovery	98.3 %

Working Time

Drilling	99°00'	36.8 %	33.1 %
Hoisting & Lowering Rod		%	%
Hoisting & Lowering I.T.			
Miscellaneous	72°00'	26.8 %	24.1 %
Repairing	2°00'	0.7 %	0.7 %
Others	96°00'	35.7 %	32.1 %
Total	269°00'	100 %	90.0 %
Removing: Preparation	16°00'		5.3 %
Removing: Moving	14°00'		4.7 %
G. Total	299°00'		100 %

Core Recovery for each 100m section

Depth of Hole	Section	Total
0~91.00m	95.7 %	95.7 %
91.00~212.50m	99.7 %	98.0 %
212.50~250.70m	100 %	98.3 %
m	%	%
m	%	%
m	%	%

Efficiency of Drilling

250.70m/Working Period	6.11m/day
250.70m/Working Days	17.91m/day
250.70m/Drilling Period	25.07m/day
250.70m/Net Drilling Days	27.86m/day
Total workers/250.70 m	1.21Man/m
Total Drilling Workers/250.70m	0.83Man/m

Casing Pipe Inserted

Pipe Size & Materage	Inserted Length / Drilling Length %	Recovery of Casing Pipe
HW 12.00 m	4.8 %	100 %
NW 57.00 m	22.7 %	100 %
BW 129.00 m	51.5 %	100 %

Remarks

G : Grand

I.T.: Inner Tube

Table II—7 Operational Results by Drill Hole No. 64-4

Working Period

	Period	Number of Days	Actual Working Days	Day Off	Total Number of Workers
Preparation	4th Jun'79~17th Jul'79	44	4	40	56.5
Drilling	18th Jul'79~30th Jul'79	12.5	10.5	2	243
Removing	30th Jul'79~31st Jul'79	1.5	1.5	-	37
Total	2nd Jun'79~31st Jul'79	58	16	42	336.5

Drilling Length

Planned Length	250.00 m	Over-burden	0 m
Increase or Decrease in Length	m	Core Length	248.70 m
Length Drilled	250.40 m	Core Recovery	99.3 %

Working Time

Drilling	123°00'	39.2 %	35.2 %
Hoisting & Lowering Rod		%	%
Hoisting & Lowering I.T.			
Miscellaneous	85°00'	27.1 %	24.4 %
Repairing	2°00'	0.6 %	0.6 %
Others	104°00'	33.1 %	29.8 %
Total	314°00'	100 %	90.0 %
Removing — Preparation	28°00'		8.0 %
Removing — Moving	7°00'		2.0 %
G. Total	349°00'		100 %

Core Recovery for each 100m section

Depth of Hole	Section	Total
0~103.70m	98.7 %	98.7 %
103.70~187.70m	99.5 %	99.1 %
187.70~250.40m	100 %	99.3 %
m	%	%
m	%	%
m	%	%

Efficiency of Drilling

250.40m/Working Period	4.32m/day
250.40m/Working Days	15.65m/day
250.40m/Drilling Period	20.03m/day
250.40m/Net Drilling Days	23.85m/day
Total workers/ 250.40 m	1.34Man/m
Total Drilling Workers/ 250.40m	0.97Man/m

Casing Pipe Inserted

Pipe Size & Materage	Inserted Length / Drilling Length %	Recovery of Casing Pipe
HW 15.00 m	6.0 %	100 %
NW 60.00 m	24.0 %	100 %
BW 129.00 m	51.5 %	100 %

Remarks

G : Grand

I.T.: Inner Tube

Table II—8 Operational Results by Drill Hole No. 54-5

Working Period

	Period	Number of Days	Actual Working Days	Day Off	Total Number of Workers
Preparation	3rd Jun'79～17th Jul'79	45	3	42	55
Drilling	18th Jul'79～31st Jul'79	13.5	11.5	2	248.5
Removing	31st Jul'79～ 1st Aug'79	1.5	1.5	-	41
Total	3rd Jun'79～ 1st Aug'79	60	16	44	344.5

Drilling Length

Planned Length	250.00 m	Over-burden	0 m
Increase or Decrease in Length	m	Core Length	241.10 m
Length Drilled	250.30 m	Core Recovery	96.3 %

Working Time

Drilling	140°00'	41.8 %	38.2 %
Hoisting & Lowering Rod		%	%
Hoisting & Lowering I.T.			
Miscellaneous	83°00'	24.8 %	22.6 %
Repairing		%	%
Others	112°00'	33.4 %	30.5 %
Total	335°00'	100 %	91.3 %
Removing: Preparation	24°00'		6.5 %
Removing: Moving	8°00'		2.2 %
G. Total	367°00'		100 %

Core Recovery for each 100m section

Depth of Hole	Section	Total
0～ 97.80m	94.1 %	94.1 %
97.80～187.50m	96.2 %	95.1 %
187.50～250.30m	100 %	96.3 %
m	%	%
m	%	%
m	%	%

Efficiency of Drilling

250.30m/Working Period	4.17m/day
250.30m/Working Days	15.64m/day
250.30m/Drilling Period	18.54m/day
250.30m/Net Drilling Days	21.77m/day
Total workers/ 250.30 m	1.38 Man/m
Total Drilling Workers/250.30m	0.99 Man/m

Casing Pipe Inserted

Pipe Size & Materage	Inserted Length / Drilling Length %	Recovery of Casing Pipe
HW 11.85 m	4.7 %	74.7 %
NW 62.90 m	25.1 %	100 %
BW 131.90 m	52.7 %	100 %

Remarks

G : Grand

I.T.: Inner Tube

Table II—9 Operational Results by Drill Hole No. 54-6

Working Period

	Period	Number of Days	Actual Working Days	Day Off	Total Number of Workers
Preparation	2nd Jun'79∿29th Jun'79	28	3	25	54
Drilling	30th Jun'79∿12th Jul'79	13	11	2	243.5
Removing	13th Jul'79∿14th Jul'79	2	2	-	45
Total	4th Jun'79∿14th Jul'79	43	16	27	342.5

Drilling Length

Planned Length	m 250.00	Over-burden	m 17.80
Increase or Decrease in Length	m	Core Length	m 226.40
Length Drilled	m 250.20	Core Recovery	90.5 %

Core Recovery for each 100m section

Depth of Hole	Section	Total
0∿104.70m	92.6 %	92.6 %
104.70∿187.30m	93.1 %	92.8 %
187.30∿250.20m	83.5 %	90.5 %
m	%	%
m	%	%
m	%	%

Working Time

Drilling	119°00'	33.7 %	31.1 %
Hoisting & Lowering Rod		%	%
Hoisting & Lowering I.T.			
Miscellaneous	126°00'	35.7 %	32.9 %
Repairing		%	%
Others	108°00'	30.6 %	28.2 %
Total	353°00'	100 %	92.2 %
Removing: Preparation	22°00'		5.7 %
Removing: Moving	8°00'		2.1 %
G. Total	383°00'		100 %

Efficiency of Drilling

250.20m/Working Period	5.82m/day
250.20m/Working Days	15.62m/day
250.20m/Drilling Period	19.25m/day
250.20m/Net Drilling Days	22.75m/day
Total workers/ 250.20 m	1.37 Man/m
Total Drilling Workers/250.20m	0.97 Man/m

Casing Pipe Inserted

Pipe Size & Materage	Inserted Length / Drilling Length %	Recovery of Casing Pipe
HW 27.00 m	10.8 %	100 %
NW 59.50 m	23.8 %	100 %
BW 135.20 m	54.0 %	100 %

Remarks

G : Grand

I.T.: Inner Tube

Table II—10 Operational Results by Drill Hole No. 54-7

Working Period

	Period	Number of Days	Actual Working Days	Day Off	Total Number of Workers
Preparation	23rd Jul'79~ 4th Aug'79	13	6	7	100
Drilling	5th Aug'79~18th Aug'79	14	12	2	279
Removing	19th Aug'79~28th Aug'79	10	8	2	192
Total	23rd Jul'79~28th Aug'79	37	26	11	571

Drilling Length

Planned Length	300.00 m	Over-burden	130.40 m
Increase or Decrease in Length	m	Core Length	279.60 m
Length Drilled	300.20 m	Core Recovery	93.1 %

Working Time

Drilling	126°00'	34.3 %	29.0 %
Hoisting & Lowering Rod		%	%
Hoisting & Lowering I.T.			
Miscellaneous	97°00'	26.4 %	22.4 %
Repairing		%	%
Others	144°00'	39.3 %	33.2 %
Total	367°00'	100 %	84.6 %
Removing — Preparation	40°00'		9.2 %
Removing — Moving	27°00'		6.2 %
G. Total	434°00'		100 %

Core Recovery for each 100m section

Depth of Hole	Section	Total
0~108.00m	86.9 %	86.9 %
108.00~188.00m	93.9 %	89.8 %
188.00~300.20m	98.7 %	93.1 %
m	%	%
m	%	%
m	%	%

Efficiency of Drilling

300.20m/Working Period	8.11m/day
300.20m/Working Days	11.55m/day
300.20m/Drilling Period	21.44m/day
300.20m/Net Drilling Days	25.02m/day
Total workers/ 300.20 m	1.90 Man/m
Total Drilling Workers/300.20m	0.93 Man/m

Casing Pipe Inserted

Pipe Size & Materage	Inserted Length / Drilling Length %	Recovery of Casing Pipe
HW 8.80 m	2.9 %	100 %
NW 84.00 m	28.0 %	100 %
BW 165.00 m	55.0 %	100 %

Remarks

G : Grand

I.T.: Inner Tube

Table II--11 Operational Results by Drill Hole No. 54-8

Working Period

	Period	Number of Days	Actual Working Days	Day Off	Total Number of Workers
Preparation	25th Jul'79~ 4th Aug'79	11	5	6	77.5
Drilling	5th Aug'79~17th Aug'79	13	11	2	256.5
Removing	18th Aug'79~28th Aug'79	11	9	2	214.5
Total	25th Jul'79~28th Aug'79	35	25	10	548.5

Drilling Length

Planned Length	300.00 m	Over-burden	133.70 m
Increase or Decrease in Length	m	Core Length	272.10 m
Length Drilled	300.40 m	Core Recovery	90.6 %

Working Time

Drilling		112°00'	33.9 %	27.9 %
Hoisting & Lowering Rod			%	%
Hoisting & Lowering I.T.				
Miscellaneous		82°00'	24.9 %	20.4 %
Repairing			%	%
Others		136°00'	41.2 %	33.8 %
Total		330°00'	100 %	82.1 %
Removing	Preparation	34°00'		8.5 %
	Moving	38°00'		9.4 %
G. Total		402°00'		100 %

Core Recovery for each 100m section

Depth of Hole	Section	Total
0~ 85.90m	87.5 %	87.5 %
85.90~205.60m	86.5 %	86.9 %
205.60~300.40m	98.5 %	90.6 %
m	%	%
m	%	%
m	%	%

Efficiency of Drilling

300.40m/Working Period	8.58m/day
300.40m/Working Days	12.02m/day
300.40m/Drilling Period	23.11m/day
300.40m/Net Drilling Days	27.31m/day
Total workers/ 300.40 m	1.83 Man/m
Total Drilling Workers/300.40m	0.85 Man/m

Casing Pipe Inserted

Pipe Size & Materage	Inserted Length / Drilling Length %	Recovery of Casing Pipe
HW 22.00 m	7.3 %	100 %
NW 111.60 m	37.2 %	100 %
BW 149.80 m	49.9 %	100 %

Remarks

G : Grand

I.T.: Inner Tube

Table II—12 Summary Operational Data by Drill Holes

Drill hole No.	Type of machine	Drilling period	Drillings length	Core		No. of drilling shift			Drilling speed		Remarks
				Length	Recovery	Drilling	Casing etc.	Total	* m/shift	** m/shift	
			m	m	%						
54-1	TGM-5A	13th Jun. '79 ∿ 28th Jun. '79	250.20	236.00	94.3	31	2	33	8.07	7.58	
54-2	"	13th Jun. '79 ∿ 25th Jun. '79	250.30	245.20	98.0	23	2	25	10.88	10.01	
54-3	"	3rd Jul. '79 ∿ 12th Jul. '79	250.70	246.40	98.3	22	1	23	11.40	10.90	
54-4	"	18th Jul. '79 ∿ 30th Jul. '79	250.40	248.70	99.3	27	1.5	28.5	9.27	8.79	
54-5	"	18th Jul. '79 ∿ 31st Jul. '79	250.30	241.10	96.3	29.5	2	31.5	8.48	7.95	
54-6	"	30th Jun. '79 ∿ 12th Jul. '79	250.20	226.40	90.5	29	2	31	8.63	8.07	
54-7	"	5th Aug. '79 ∿ 18th Aug. '79	300.20	279.60	93.1	28.5	1.5	30	10.53	10.01	
54-8	"	5th Aug. '79 ∿ 17th Aug. '79	300.40	272.10	90.6	24.5	1.5	26	12.26	11.55	
Total			2,102.70	1,995.50	94.9	214.5	13.5	228	9.80	9.22	

* Drilled per one shift covering net drilling operations.
** Drilled per one shift covering total works conducted.

Table II—13 Working Time by Drill Hole

Drillhole No.	Drilling	Hoisting & lowering rod & I.T.		Miscellaneous			Repairs	Others	Moving operation	Total
		Rod	Inner tube	Casing insertion	Hole reaming	Others				
54-1	120°00'			16°00'		93°00'	6°00'	164°00'	53°00'	452°00'
54-2	109°30'			16°00'		68°00'	30'	148°00'	57°00'	399°00'
54-3	99°00'			8°00'		64°00'	2°00'	96°00'	30°00'	299°00'
54-4	123°00'			12°00'		73°00'	2°00'	104°00'	35°00'	349°00'
54-5	140°00'			16°00'		67°00'		112°00'	32°00'	367°00'
54-6	119°00'			16°00'		110°00'		108°00'	30°00'	383°00'
54-7	126°00'			12°00'		85°00'		144°00'	67°00'	434°00'
54-8	112°00'			12°00'		70°00'		136°00'	72°00'	402°00'
Total	948°00'			108°00'		630°00'	10°30'	1,012°00'	376°00'	3,085°00'
				738°00'						

Table II—14 Drilling Meterage of Diamond Bits

Item	Size	Type	Bit No.	Drilling meterage by drill hole. Unite meter								Total
				54-1	54-2	54-3	54-4	54-5	54-6	54-7	54-8	
Bit	HX	HQ-WL	H- 537	30.90								30.90
			H- 538	20.10								20.10
			F-1012		16.40							16.40
			F-1013		16.80							16.80
			02			20.30						20.30
			03			24.70						24.70
			H- 535				28.30					28.30
			H- 536				16.70					16.70
			H- 31					30.40				30.40
			H- 32					20.65				20.65
			01						14.50			14.50
			04						18.40			18.40
			F-1011							29.70		29.70
			H- 33							22.60		22.60
			H- 34							19.90		19.90
			F-1010								33.60	33.60
			05								31.50	31.50
			Total	51.00	33.20	45.00	45.00	51.05	32.90	72.20	65.10	395.45
	NX	NQ-WL	F-1016	27.80								27.80
			F-1017	21.40								21.40
			F-1018	22.80								22.80
			E-2520		36.70							36.70
			E-2521		32.10							32.10
			N- 2			40.90						40.90
			N- 3			31.10						31.10
			E-2523				43.70					43.70
			F-1019				25.30					25.30
			010					27.50				27.50
			011					19.10				19.10
			N- 4					22.40				22.40
			012						30.20			30.20
			013						26.30			26.30
			E-2524						18.80			18.80
			E-2525							33.10		33.10
			F-1020							23.80		23.80
			F-1021							27.10		27.10
			N- 5								35.40	35.40
			014								28.50	28.50
			Total	72.00	68.80	72.00	69.00	69.00	75.30	84.00	63.90	574.00

Table II-14 Drilling meterage of diamond bits (continued)

Item	Size	Type	Bit No.	Drilling meterage by drill hole. Unite meter								Total
				54-1	54-2	54-3	54-4	54-5	54-6	54-7	54-8	
		BQ-WL	H- 541	24.60								24.60
			H- 542	20.10								20.10
			H- 543	11.60								11.60
			H- 841	31.80								31.80
			H- 842	30.10								30.10
			F-1030		34.40							34.40
Bit			F-1031		26.60							26.60
			H- 843		31.90							31.90
			H- 844		28.60							28.60
	BX		H- 544			43.70						43.70
			H- 545			40.20						40.20
			H- 546			37.80						37.80
			H- 845				45.30					45.30
			F-1032				40.10					40.10
			F-1033				36.00					36.00
			174565					39.50				39.50
			174566					42.80				42.80
			174567					36.10				36.10
			F-1034						28.70			28.70
			F-1035						31.20			31.20
			H- 846						35.30			35.30
			H- 847						19.80			19.80
			H- 547							47.60		47.60
			H- 548							42.10		42.10
			H- 549							45.50		45.50
			H- 550								42.50	42.50
			H- 848								36.80	36.80
			H- 849								39.00	39.00
			H- 850								32.30	32.30
			Total	118.20	121.50	121.70	121.40	118.40	115.00	135.20	150.60	1,002.00