REPUBLIC OF PERU

REPORT ON GEOLOGICAL SURVEY

OF

ISCAYCRUZ (OYON) AREA

PHASE II

MAY 1984

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

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PREFACE

The Government of Japan, in response to the request of the Government of the Republic of Peru, decided to conduct collaborative mineral exploration, that is drilling and tunnelling surveys, in the Iscaycruz (Oyon) area and entrusted its execution to Japan Internatinal Cooperation Agency (JICA) and Metal Mining Agency of Japan (MMAJ).

Metal Mining Agency of Japan dispatched a survey team headed by Mr. Jinichi Nakamura to conduct the Phase II of the project. The survey had been started on 22 June, 1983 following the Phase I survey and accomplished on 12 March, 1984 under close cooperation with the Government of the Republic of Peru and its various authorities.

This report is a compilation of the survey of the Phase II, and after the completion of the project the consolidated report will be submitted to the Government of the Republic of Peru.

We wish to express our appreciation to all of the organizations and members who bore the responsibility for the project, the Government of the Republic of Peru, Instituto Geologico, Minero y Metalurgico, and other authorities and the Embassy of Japan in Peru.

April 1984

Keisuke Arita
President
Japan International Cooperation Agency

Masayuki Nishiie
President
Metal Mining Agency of Japan

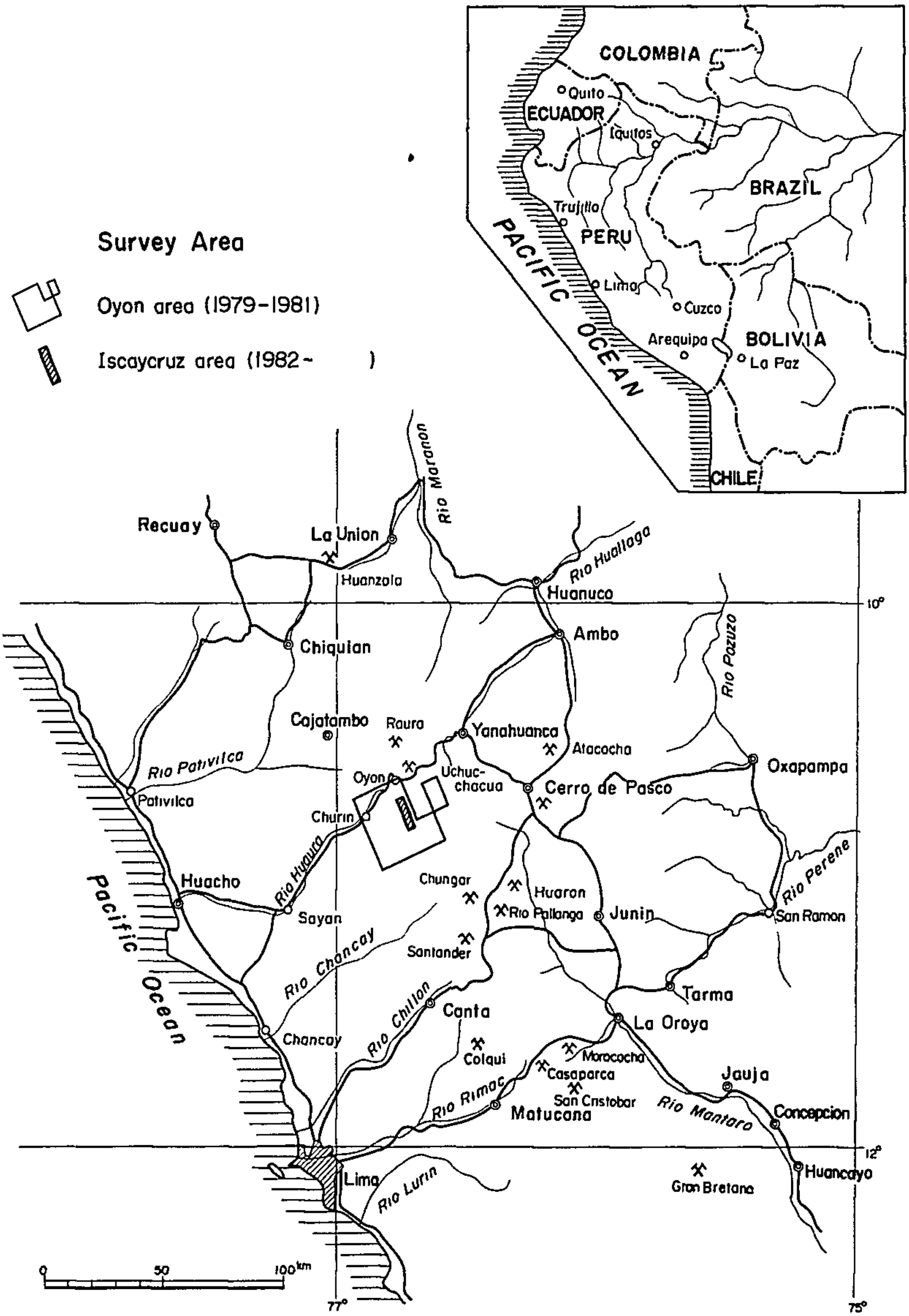

Fig. 1　Index Map

ABSTRACT

This report summarizes results of the second year's work of the Cooperative Basic Geological Survey for Development of Mineral Resources carried out in the Iscaycruz Area, the Republic of Peru.

The purpose of this project is to examine relationship between geological structure and mineralization, and to confirm lateral and vertical continuity of the mineralized zone, by means of drilling exploration and tunnelling exploration in this area.

The Iscaycruz Area had been extracted as a favorable area where economic ore deposits would be expected to be emplaced, by the results of the Cooperative Basic Geological Survey for Development of Mineral Resources in the Oyon Area, which was carried out during the period of three years from 1979 to 1981.

The Iscaycruz Area is located about 150 km north of Lima, in the backbone range of the West Andes. Geologically, Mesozoic sedimentary rocks are widely distributed in this area, forming remarkable composit folded structure due to tight forlding with the axes in the Andean direction, namely NNW–SSE.

The Iscaycruz mineralized zone is located approximately 7 km south-southeast of Oyon, in the high mountain at the altitude of 4,700 m above sea level. The mineralization occurs in the limestones of the Santa Formation, about 50 to 100 meters in thickness, and continues about 12 km along the strike. In this mineralized zone, ore deposits are divided roughly into two categories; the one is contact metasomatic skarn type ore deposits represented by copper-zinc skarn orebodies and the other is hydrothermal replacement ore deposits represented by copper-lead-zinc massive sulphide orebodies as well as by disseminated orebodies of lead and zinc in the siderite beds.

The investigations in the present year, following the works in the last year, the tunnelling exploration (Adit-N main tunnel, Adit-N crosscut, Adit-S main tunnel, total excavation length 680 m) and the underground diamond drilling (2 drill sites, 4 holes, total drill length 910 m) were carried out in the Limpe area in the central part of the Iscaycruz mineralization zone, where the emplacement of high grade copper-lead-zinc massive sulphide ore deposits would be expected most favorably in the Iscaycruz mineralization zone.

By the results of the tunnelling exploration, both main tunnels of Adit-N (4,690 meters above sea level) and Adit-S (4,570 meters above sea level) are located in quartzite of the Chimu Formation. The Santa Formation is recognized over 80 meters along the crosscut of the Adit-N and, in addition to the intense mineralization mainly of pyrite, indications of high grade zinc mi-

neralization of Zn 17.13% in average of the true width of 12 meters are confirmed on the horizon of the hanging-wall-side orebody.

By the results of the underground diamond drilling, heavy pyrite mineralization was recognized in 4 holes respectively. By the drill hole IC–6, which was located in the north of the crosscut of the Adit-N, indications of high grade zinc mineralization (core length 7.0 m , Cu 0.32%, Zn 21.59%) and copper disseminations in pyrite mass (core length 7.8 m, Cu 2.48%, Zn 0.46%) were recognized in the peripheral zone of the massive pyrite orebody along the horizon of the footwall-side orebody. And it has been clarified that there would be intimate relation between the pyrite mineralization and the copper-lead-zinc mineralization.

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CHAPTER 1 INTRODUCTION

1–1 Purpose of the Survey

The purpose of this survey is, in addition to the comprehension of the geological structure in relation to the mineralization in the Iscaycruz Area, to confirm lateral and vertical continuity of the mineralized zone, by means of drilling and tunnelling explorations and the analysis of the related geology.

The survey works have been completed with the cooperation of the Instituto Geologico, Minero y Metalurgico (INGEMMET).

1–2 Circumstances of the Survey

Cooperative Basic Geological Survey for the Development of the Mineral Resources was carried out for three years from 1979 to 1981 in the Oyon Area (860 km^2) including the Iscaycruz Area (40 km^2). In addition to geological mapping, geochemical survey and detailed geological survey, the following investigations were carried out in the Iscaycruz Area; geophysical prospecting by IP method (15 survey lines, total length 35.9 km); geophysical prospecting by EM method (10 survey lines, total length 13.0 km); diamond drilling (12 holes at 11 sites, total length 2,654 m).

By the results of these investigations, it was confirmed that the high grade copper-lead-zinc sulphide ore deposits and skarn ore deposits were emplaced in the Iscaycruz Area and also it was proved that high potentiality of the mineralization would be expected in this area for the development of mineral resources.

On the basis of the above results obtained through the Cooperative Basic Geological Survey in the Oyon Area, more detailed investigations by drilling and tunnelling explorations were recommended in Limpe area and in Tinyag area, where the most high grade lead-zinc ore deposits in the Iscaycruz Area were expected.

The Cooperative Basic Geological Survey for the Development of Mineral Resources in the Iscaycruz Area was scheduled to be carried out in three years' program on the basis of the Scope of Work signatured on May 11, 1982 between the Instituto Geologico, Minero y Metalurgico and the Metal Mining Agency of Japan. This year survey (1983) is the second year plan (Phase II).

1–3 Outline of the Survey

1) Drilling Exploration

In this year, underground drilling of 4 holes at 2 sites, 310 m point of Adit-N and 270 m point of Adit-S, was carried out (refer to Fig. 5).

2) Tunnelling Exploration

The purpose of the Tunnelling exploration is to confirm, along the tunnel wall passing through the orebodies, various factors as figures of orebodies, features and continuity of grade distribution and aspect of combinations of ore minerals, as well as to utilize the tunnel as the base for the underground drilling crosscutting the orebodies, which is the most effective for the confirmation of lateral and vertical continuity of the orebodies and the mineralized zone (refer to Fig. 5).

As the excavation and the maintenance of the tunnels were supposed to be difficult according to the results of the diamond drilling which revealed that the walls would be soft and weak in the mineralized zone, the main tunnel was excavated in the hard rock of quartzite of the Chimu Formation, from which the crosscut tunnels into the mineralized zone and underground drill chambers will be excavated.

As the time for the investigation was limited, two starting points were established for the excavation of the tunnels with the approximate distance of 1,400 m, so that the two faces, that are Adit-N and Adit-S, could be worked at the same time.

The length of tunnels excavated in the first year and this year is as follows:

	Phase I	Phase II	Total
Adit-N	310	200	510
Adit-N, Crosscut		150	150
Adit-S	270	330	600
Total	580	680	1,260

1–4 Organization of the Survey Team

Japan Side Planning, Negotiation, and Supervision

Makoto Ishida	MMAJ*
Zenji Kita	MMAJ
Hideyuki Ueda	MMAJ

Peru side Planning and Negotiation

Francisco Sotillo	INGEMMET**
Gregorio Flores	INGEMMET
Augusto Zelaya	INGEMMET

Japanese Survey Team

Jinichi Nakamura (Team Leader)	MINDECO[x]

Nobuhiko Yamamoto	(Leader of Drilling)	MINDECO
Yuji Katabe	(Drilling)	"
Yukio Kogita	"	"
Shintaro Horie	"	"
Ken Nakamura	(Leader of Tunnelling)	"
Hideo Morishita	(Tunnelling)	"
Peruvian Survey Team		
Gregorio Flores	(Team Leader)	INGEMMET
Luis Santalla	(Investigation)	"
Emilio Rojas	"	"

* Metal Mining Agency of Japan

**Instituto Geologico, Minero y Metalurgico

x Mitsui Mineral Development Engineering Co., Ltd.

CHAPTER 2 OUTLINE OF THE SURVEYED AREA

2–1 The Surveyed Area

The Iscaycruz Area is, on the administrative division, belonging to Provincia Cajatambo of Departamento Lima, and is located about 150 km north of Lima, the capital (see Fig. 1).

To reach the Area from Lima, it is necessary to come to Sayan through Chancay (137 km, about 3 hours by vehicle). From Sayan, running along a rough and bending road along the valley of the Rio Huaura, one can come to Oyon through Churin (93 km, about 3 hours). After passing through Pampahuay, an access road is available to pass over the range at the approximate altitude of 5,000 meters above sea level, to come to the Iscaycruz Area (approximately 30 km, about 2 hours, (see Fig. 2).

The surveyed area lies in the Cordillera Occidental, a main range of the Western Andes, and is situated in the source area of Rio Huaura which belongs to the drainage system of the Pacific coast, about 11 km west to the continental divide. The area forms steep mountaneous topographical feature. The elevation of the surveyed area is 4,600 ~ 4,700 meters above sea level.

The climate in this area belongs to what is called Andean highland climate. Daily variation of temperature is in fairly great range, and sometimes the temperature reaches over 20°C in daytime, while it goes down to less than 0°C in night time. To take annual variation of the climate, there are two seasons. The dry season is in the period from May to September, while the wet season is in the period from October to April. In the wet season, snowfall can be seen almost every day in the highland area at the altitude of more than 4,000 meters above sea level.

2–2 Outline of Geology

1) Regional Geological Setting

The Iscaycruz Area and the peripheral area belong stratigraphically to the zone of Cretaceous sedimentary basin (la Zona de la Cuenca Cretacea) by Cobbing (1973), and is structually situated in the folding-thrusting zone (la Zona de Pliegues y Sobreescurrimientos) by Wilson (1967).

Thick Cretaceous sedimentary rocks are widely distributed in this area. The lower part is composed mainly of clastic rocks such as siliceous sandstone and shale, and the upper part calcareous rocks associated with dolostone and shale, and the uppermost part red formation.

The clastic rocks of the lower part is divided into the Oyon, Chimu, Santa, Carhuaz and Farrat Formations, and the calcareous rocks of the upper part into the Pariahuanca, Chulec, Pariatambo, Jumasha, Celendin and the uppermost red Casapalca Formations in ascending order. These formations are unconformably covered by the Calipuy volcanics in Tertiary and are intruded by tonalites, dacites, granite porphyry and others (refer to Fig. 3 and Fig. 4).

The Cretaceous sedimentary rocks suffered intensely a structural movement in consequency of the Andean Orogeny to form composite folds with NNW–SSE trend. Anticlines and synclines appear at intervals of 2 to 3 km, sometimes several tens meters, so that the same stratum is repeatedly exposed at the surface. At the central part in the orogenic zone thrust faults parallel to the fold axis are developed.

On the east of this area the Eastern Andes consisting mainly of Paleozoic sedimentary rocks and Pre-Cambrian metamorphosed rocks runs, while on the west Tertiary volcanic rocks are continuously distributed and the Andean batholith intrudes into this volcanic rocks (refer to Fig. 3).

2) **Outline of Geology in the Iscaycruz Area**

The Iscaycruz Area is about 6 km to 18 km south-south-east of Oyon. Canaypata is at the north end of the area and Antapampa is at the south end (refer to Fig. 2).

In the east of this area, an anticline is recognized with the axis running in NNW–SSE direction. The Oyon Formation, the lowest Cretaceous, composed mainly of sandstone and shale with coal measures and the overlying Chimu Formation, 600 to 700 meters thick, composed of quartzite or quartzose sandstone are distributed along the axis of the anticline. They look dark grey to dark brown in color and form irregular rough mountain land. In the west of this area, a syncline is recognized with the axis in NNW–SSE direction, along which is distributed the upper Cretaceous Jumasha Formation composed of massive limestone of the thickness of almost 1,400 meters. The limestone forms steep mountain land, brightly shining in grey color. Between the two mountain lands, topographically lower part has been formed in the area occupied by the Carhuaz Formation composed of the alternation of shale and sandstone, 500 to 700 meters thick.

In a narrow zone between the Chimu Formation and the Carhuaz Formation, the Santa Formation is distributed. The Santa Formation is as thick as 50 to 100 meters, composed of well-stratified bluish grey limestones. This formation constitutes the country rock of the mineralization in the Iscaycruz Area. Between the Carhuaz Formation and the Jumasha Formation, there are four other formations which are distributed zonally. They are Farrat Formation, about 100 meters in thickness, composed of quartzose sandstone and calcareous sandstone; Pariahuanca Formation, about 100 meters in thickness, composed of dark grey massive limestone; Chulec Formation, about 200 meters in thickness, composed mainly of light grey marlstone; and Pariatambo Formation, about 200 meters in thickness, composed of the alternation of thin layers of shale and dark grey to dark-colored limestone.

The Santa Formation is situated on the wing of the fold structure. The dipping of the strata of this formation is almost vertical, as they constitute parts of the remarkable tight-folds. Overturned structures are observed to be developed in the Limpe area and Tinyag area in the central part of this area.

As for igneous rocks, dacitic porphyry is recognized near the axis of the syncline in the west of Cumbre de Iscaycruz (Iscaycruz pass) and also acidic dyke complex is found to have been active around the anticline axis near Cumbre de Cunsha Punta, in the middle to southern part of this area.

2–3 Outline of Ore Deposits

1) Outline

According to Bellido et al (1972), the Iscaycruz Area is located geologically in the Sub-Provincia Polimetalica del Altiplano in the Provincia Metalogenica Andina Occidental. In the vicinity of the survey area, there are many silver-lead-zinc mines in operation, such as Raura mine (Pb · Zn), Uchucchacua mine (Ag), Atacocha mine (Pb · Zn · Ag), Cerro de Pasco mine (Pb · Zn · Ag), Huaron mine (Pb · Zn · Ag), and Santander mine (Cu · Zn).

2) Iscaycruz Mineralized Zone

The Iscaycruz Mineralized zone is found in the limestone of the Santa Formation, and is distributed intermittently along the limestone in a distance of about 12 km from Canaypata, the northern end, to Antapama, the southern end. The indications of mineralization are found as dark-colored gossans bearing lead and zinc, massive pyrite orebodies associated with galena and sphalerite, skarn masses containing chalcopyrite and sphalerite, hematite masses disseminated with chalcopyrite and sphalerite, and disseminations in dolostones with galena and sphalerite (see Fig. 4).

Dark-colored gossans exposed widely on the surface are composed mainly of goethite, quartz and kaolinite, associated with manganese oxides and siderite. Most of the metal ingredients in the gossans are thought to be in the form of oxide or carbonate such as chalcophanite and smithsonite. It is inferred that the dark-colored gossans are the oxidation products of manganiferrous siderite.

Massive pyrite ore deposit, which is composed mainly of pyrite associated with pyrrhotite and marcasite, is occasionally enriched with galena and sphalerite. There occurs a lot of druses in pyrite orebody and hematite in the marginal places. In sphalerite, spotted small grains of chalcopyrite are contained.

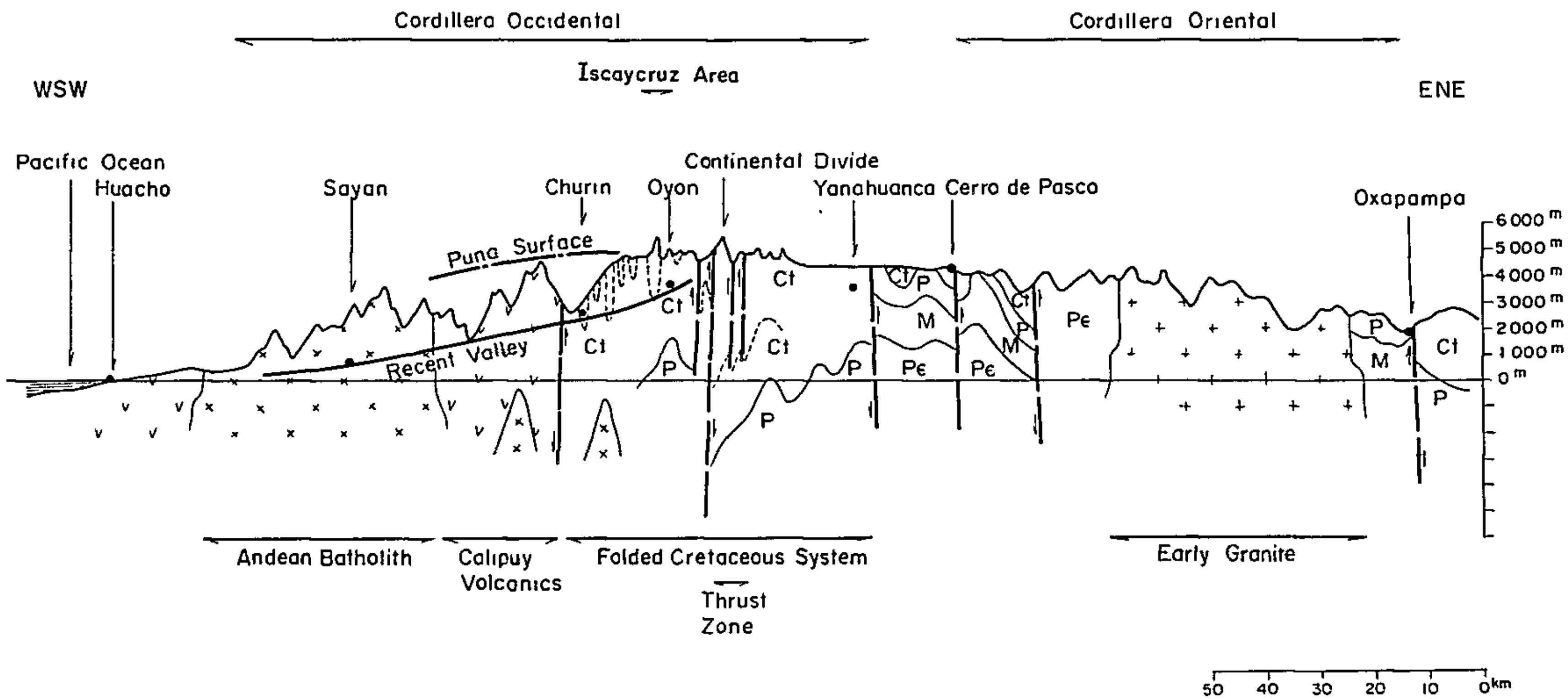
Main ore minerals of skarn ore deposit are chalcopyrite, sphalerite, pyrite, and magnetite, and main skarn minerals are tremolite, garnet, epidote, and quartz.

Silicification, sericitization, argillization, sideritization, dolomitization, and brecciation are remarkable alterations in the host rock of the ore deposits. The acidic dykes, which intruded into the Oyon and Chimu Formations around Cumbre de Cunsha Punta, are thought to have been related to the mineralization.

As for the fracture system, shear faults of WNW–ESE and NNE–SSW directions, both of which are oblique to the folding axis, tension fracture of ENE–WSW which shows right angle to the folding axis, and thrust fault and bedding fracture parallel to the folding axis are observed to be developed in this area.

The mineralized zone in the Iscaycruz Area is in a narrow zone about 12 km in length. The exposures of the mineral indications are intermittent and the features of concentration of the ore minerals are variable. Viewing the whole area at a glance, the skarn ore deposits containing copper and zinc minerals are recognized in the Tinyag area, nearest to the center of the activity of the acidic igneous rocks. It is thought these skarn ore deposits would occupy the area corresponding to the central portion of the mineralization in this area. Both in the Limpe area in the north of this central area, and the Cunsha Punta area in the south of it, massive sulphide ore deposits have been found, in places associated with lead and zinc minerals. In the outermost zone of the Cumbre de Iscaycruz area and the Antapampa area, dissemination type ore deposits of lead and zinc in the manganiferrous siderite layers are recognized. These ore deposits of various types are distributed in zonal arrangement, centered in the acidic igenous rocks, and they are thought to have been formed in a single mineralosphere by a series of mineralization as a whole.

Fig. 2 Location and Access Map



Ct Cretaceous

P Jurassic & Triassic (Pucara Group)

M Permian (Mitu Group)

Pe . Precambrian

Fig. 3. Schematic Profile of the Central Andes Area

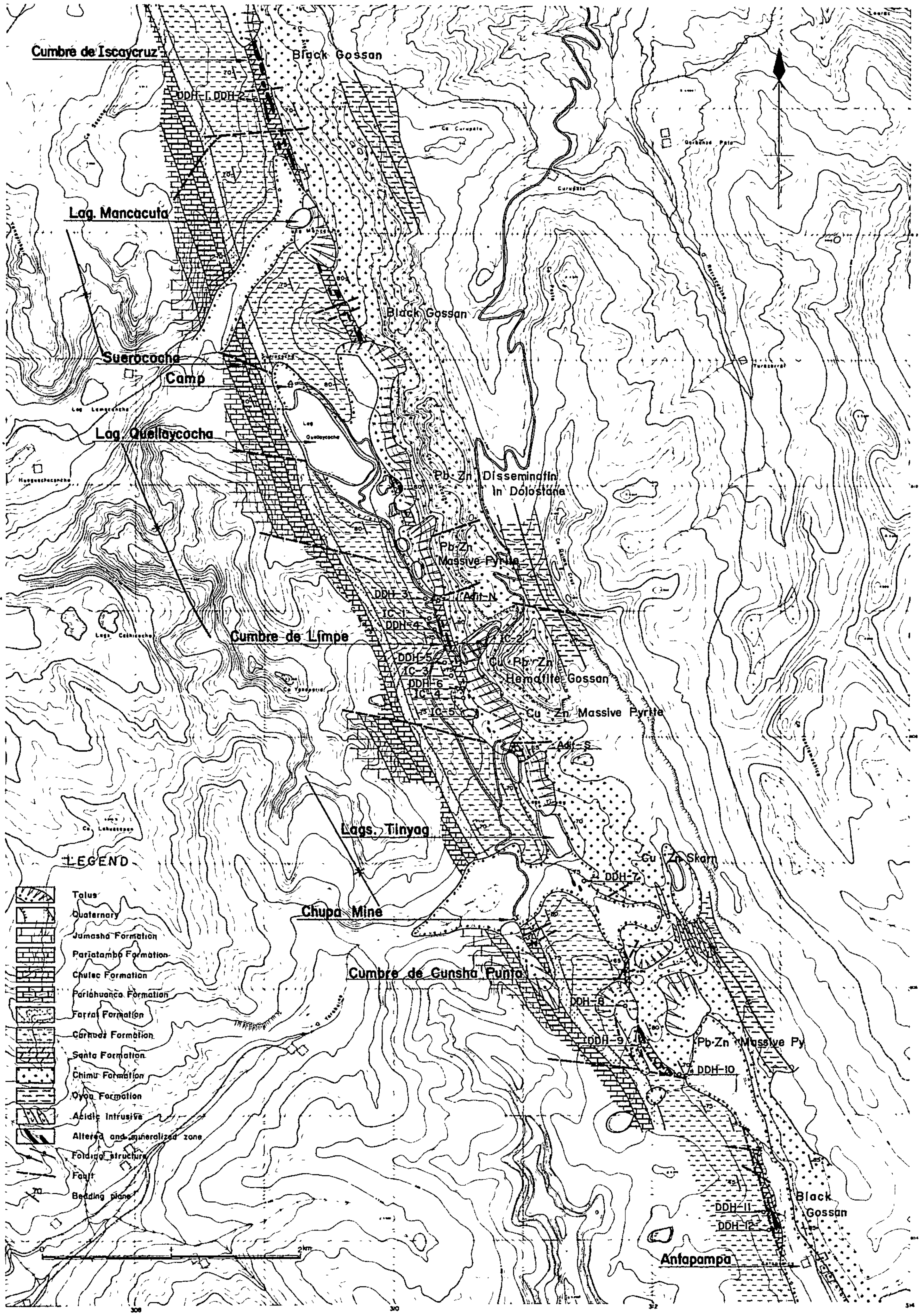


Fig.4 Geological Map of the Iscaycruz Area

CHAPTER 3 OUTLINE OF THE EXPLORATION RESULTS

3–1 Drilling Exploration

In the present year, underground diamond drilling of 4 holes, whose total length was 910 meters, was carried out in two drill sites in the tunnels of Adit-N and Adit-S.

1) IC–6 and IC–7

In the Adit-N, drilling of the holes IC–6 and IC–7 was carried out at the point of 310 meters from the gate of the adit, which was corresponding to the midway between the surface drill holes of DDH–4 and IC–2.

In the drill hole IC–6, the purpose of which was to investigate details of the massive pyrite orebody in the lowest part of the Santa Formation in contact with the Chimu Formation as well as to explore lower extention of the hanging wall-side zinc orebody caught by the drill hole DDH–4, high grade zinc ores are confirmed to have been emplaced in the peripheral zone of the massive pyrite orebody and it has also been confirmed that the pyrite orebody would contain copper minerals in parts. The results of the analysis of the mineralized portions caught in this hole are given as follows.

Hole	Depth (m)	Length (m)	Number of Samples	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)
IC–6	108.0 – 115.0	7.0	5	15	0.32	0.02	21 59
IC–6	115.0 – 122.8	7.8	4	23	2.48	0.02	0.46
IC–6	122.8 – 145.0	22.2*	5	15	1.04	0.02	0.23

* Core recovery was poor.

In the hole IC–7, the purpose of which was to do exploration in the deep part 100 ~ 200 m below the crosscut, pyrite orebody containing pyrrhotite was caught in the deep part below the foot-wall-side pyrite orebody and the hanging-wall-side zinc orebody.

2) IC–8 and IC–9

In the Adit-S, drilling of the holes IC–8 and IC–9 was carried out in the same bearing, at the point of 270 meters from the gate of the adit, for the purpose of the exploration for geological structure and mineralization in the area about 130 meters south of the surface drill hole IC–5. The target of the exploration by the drill hole IC–8 was at the level about 150 meters below surface while the target of the exploration by the hole IC–9 was at the level about 350 meters below surface.

By the results of the drilling of these two holes, it has been confirmed that the Santa Formation is as thick as 100 meters in this area, dipping 65° to the east, forming remarkable overturned structure, that the Santa Formation had been severely altered and mineralized, accompanying large scaled massive pyrite orebodies, and that copper minerals such as chalcopyrite and bornite are associated with hematite which is developed in the peripheral zone of the pyrite orebody. The results of the chemical analysis of the mineralized portions are shown as follows.

Hole	Depth (m)	Length (m)	Number of Samples	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)
IC–8	159.2 – 163.8	4.6	1	40	2.59	0.02	0.30
IC–8	174.5 – 178.1	3.6	3	23	2.43	0.11	0.11

3–2 Tunnelling Exploration

As the tunnelling exploration in this year, total 680 meters of tunnel excavation was carried out;

Adit-N (main tunnel)	200 m (cummulative total 510 m)
Crosscut of Adit-N	150 m
Adit-S (main tunnel)	330 m (cummulative total 600 m)

1) Adit-N (main tunnel)

Quartzite belonging to the Chimu Formation is recognized all along the adit. The strike of the quartzite is N15° ~ 20°W, and the dip is 80 ~ 85°E. Joints of WNW–ESE system are densely developed, which are almost rectangular to the bedding planes. At the point of 350 meters from the gate, fault fracture zone is recognized in the direction of NW–SE.

2) Crosscut of Adit-N

The crosscut of Adit-N was opened at the point of 310 meters from the gate in the main tunnel of the Adit-N. The location of this crosscut is in the midway of the surface drill holes of DDH–4 and IC–2. By the results of the excavation of this crosscut, remarkable indications of zinc mineralization have been confirmed in the true width of 12 meters.

To mention about the geology and the mineralization along the crosscut, the Chimu Formation composed mainly of quartzite is recognized to the 31 m point from the opening point, while the transitional zone of the Chimu Formation is found between 31 m point and the 70 m point from the opening point, comprising alternation of dolostone, shale, sandstone and quartzite.

The rocks of the Santa Formation are recognized in far side of the 70 m point. Within 9 meters of the width from the 70 m point to the 79 m point, alternation of marl and shale with the dissemination of sphalerite and pyrite is found, while, within 36 meters of the width from the 79 m point to the 115 m point, massive pyrite orebody is recognized with the dissemination, in parts, of chalcopyrite. Alternation of limestone, shale and dolostone, not mineralized, is found within 22 meters of the width from the 115 m point to the 137 m point.

Within 12 meters of the width, indications of zinc mineralization are recognized, in which sphalerite is concentrated in dissemination in the matrix of pyritic mass. Continuous channel sampling with 1 meter interval along both walls was carried out and by the result of the chemical analysis, as shown below, the ore grade was as high as Zn 17.1% in average of 24 samples. This result has shown that the mineralization in this crosscut is superior in the points of size and grade, compared to the indication caught by the drill hole DDH–4 (width of indication 14.8 m, true width 7.4 m, Zn 14. 49%) which is located about 70 meters north of this crosscut, and to the indication caught by the drill hole IC–2 (width of indication 16.4 m, true width 7.0 m, Pb 4.43%, Zn 9.39%) located about 130 meters south of this crosscut.

	Length (m)	Number of Samples	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)
Right wall (north side)	12	12	11	0.11	0.10	17.11
Left wall (south side)	12	12	5	0.08	0.04	17.16
Average	12	24	8	0.10	0.07	17.13

In the far side of the 149 m point, remarkably fractured shale is recognized, and it is thought that the working face of the crosscut entered into the area where the rocks of the Carhuaz Formation are distributed.

By the excavation of this crosscut, it has been confirmed that gentle dipping faults are well developed in the direciton of NW–SE, in addition to the steeply developed bedding plane faults of NNW–SSE system. The faults of NW–SE system are recognized at the 23 m point and at the 52 m point, where they are dipping 30° ~ 40° to the SW direction. It is estimated that dislocation of the beds is fairly large judging from the scale of the fractuation and the fault clay.

3) Adit-S

The Chimu Formation composed mainly of quartzite is recognized all along the Adit-S. The strike of the quartzite is N20°W, and the dip is 65° ~ 70°E, showing overturned structure. The quartzite is intensely silicified, and is massive, compact and hard, disseminated with pyrite. Joints of ENE–WSW system are remarkably developed. At the points of 319 m, 404 m and 500 m, respectively, faults of the ENE–WSW system are recognized. A fault zone composed of the faults of NNE–SSW system and those of ENE–WSW system is recognized between the 520 m point and the 537 m point. After passing this fault zone to the far side, alternation of marl, sandstone, shale and quartzite is observed to appear instead of monolith of quartzite.

CHAPTER 4 CONCLUSION AND RECOMMENDATION

4–1 Conclusion

The investigation works carried out in the present year were those in the second phase of the three years program of the Cooperative Basic Geological Survey for Development of Mineral Resources in the Iscaycruz Area.

Following the first year's investigation, the tunnelling exploration of the Adit-N and the Adit-S was carried out, and in addition, crosscut tunnel was excavated as to the Adit-N. Furthermore, exploration by the underground diamond drilling was commenced in the tunnels of Adit-N and Adit-S.

Both of the main tunnels of Adit-N and Adit-S are situated in the quartzite of the Chimu Formation. However, by the excavation of the rocks of the Santa Formation over 80 meters along the crosscut of the Adit-N, extensive indication of zinc mineralization (true width 12 m, Zn 17.13%) has been confirmed associated with the massive pyrite orebody, in addition to the copper-disseminated massive pyrite orebody (width 36 m). This indication of zinc mineralization is correspondent to the extension of the hanging-wall-side orebody caught by the two surface drill holes located about 70 meters north and about 130 meters south of the area where the crosscut is located, but the size and the ore grade are superior to the indications caught by these surface drilling.

As to the results of the underground diamond drilling, indications of high grade zinc mineralization (core length 7.0 m, Cu 0.32%, Zn 21.59%) and indications of copper dissemination in pyrite mass (core length 7.8 m, Cu 2.48%, Zn 0.46%) are confirmed by the drill hole IC–6 in the peripheral zone of the massive pyrite orebody in the northern and deeper portion below the crosscut. Although fairly intense indications of pyrite mineralization have been confirmed in the holes of IC–7, IC–8 and IC–9, respectively, only a small scaled indication of copper mineralization has been caught by the drill hole IC–8.

4–2 Recommendation

It is desirable to carry out the investigations by tunnelling and underground diamond drilling continuously in the Limpe area, where indications of intense mineralization have been recognized and emplacement of high grade copper-lead-zinc ore deposits would be expected.

As to the Adit-N, because the foot-wall-side orebody, which is thought to be the most superior indication of the mineralization, has not been caught in the tunnel, it is recommended; to excavate second crosscut in the area where the foot-wall-side orebody is expected, for the purpose to confirm figure of the orebody, characteristics and continuity of the ore grade distribution and difference of the composition of ore minerals; to carry out underground diamond drilling for the purpose to clarify the conditions in the mineralized zones.

As to the Adit-S, it is recommended to keep excavating the main tunnel toward the rich ore shoot of the grade of lead and zinc 30%, which was caught by the surface drill hole DDH–5 located in the south of Cumbre de Limpe, and to excavate crosscut tunnel in this mineralized part for the purpose to confirm the condition of the mineralization. It is also recommended to open crosscut tunnels and to carry out underground diamond drilling in such areas as around the drill hold DDH–6, by which indications of high grade zinc mineralization were caught,and in and around an unexplored area between the drill holes IC–4 and IC–5.

Beyond the reach of the tunnelling exploration, it is desirable to carry out investigations by surface diamond drilling in the Tinyag area in the south, for the purpose to clarify the extent of high grade copper and zinc orebody which was caught by the surface drill hole DDH-7.

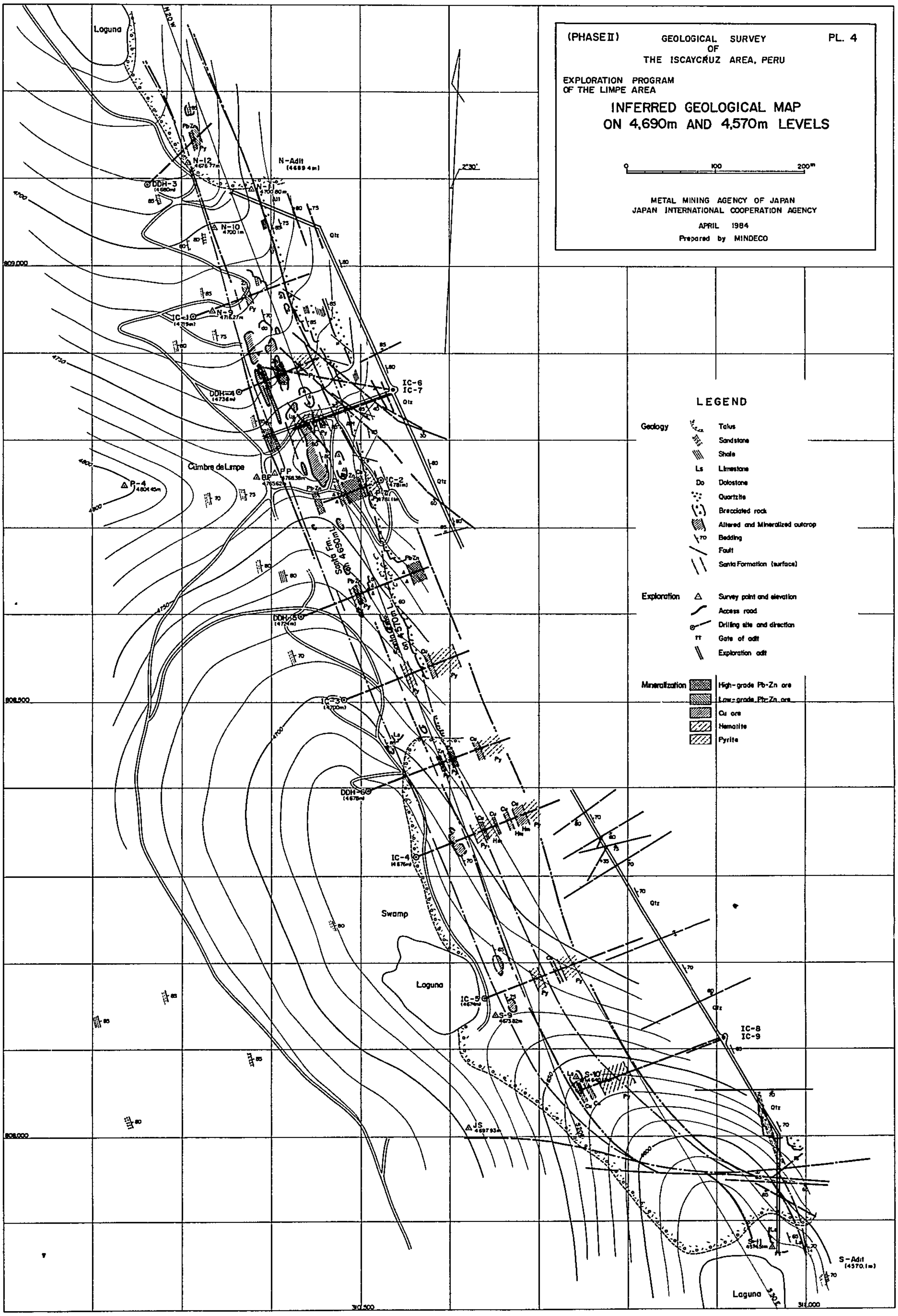


Fig. 5 Exploration Map of the Limpe Area

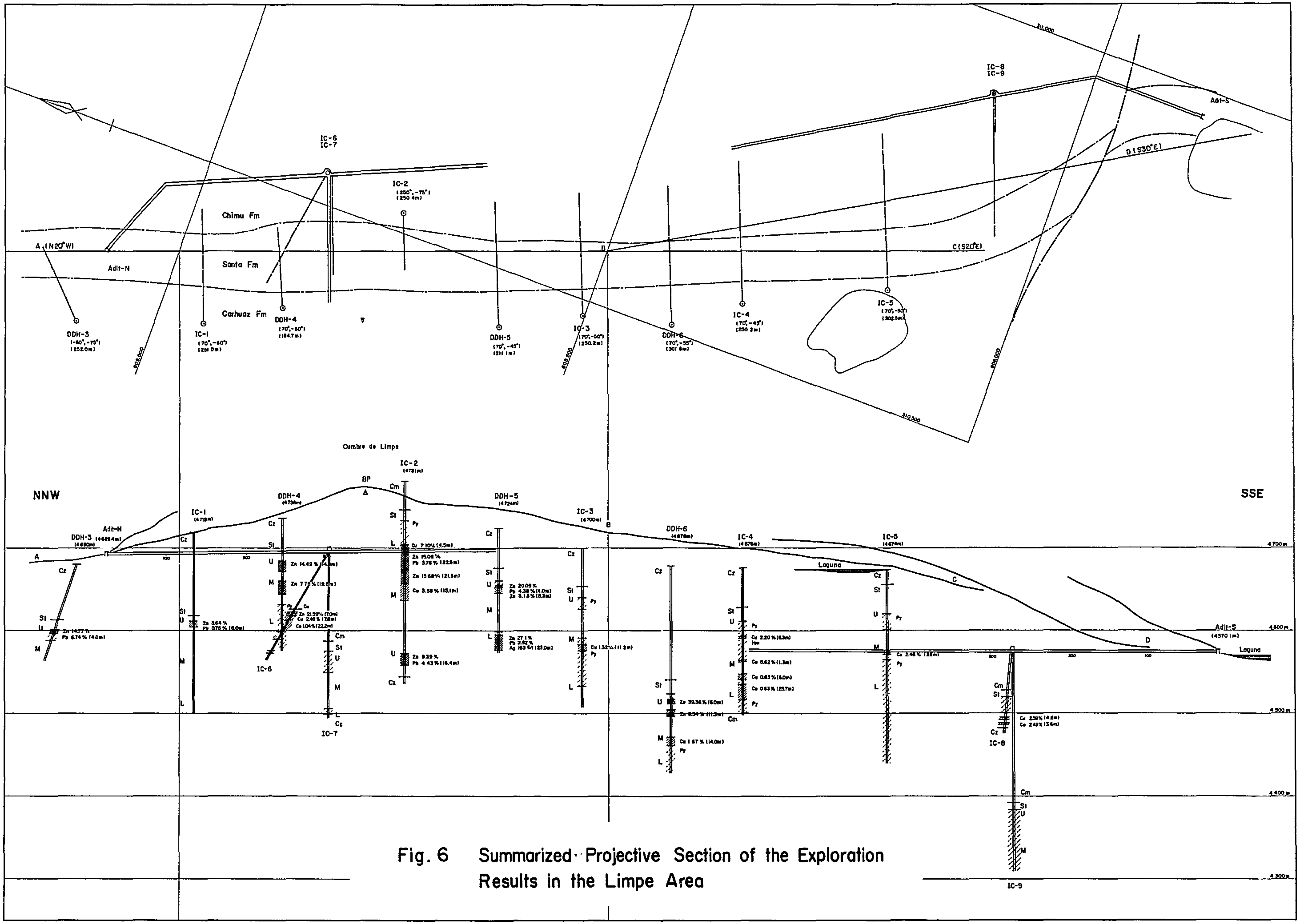


Fig. 6 Summarized Projective Section of the Exploration Results in the Limpe Area

REFERENCES

Bellido, B.E. (1969)
Sinopsis de la geologia del Peru.
Serv. Geol. Min., Peru, Bel. 22.

Bellido, B.E., Luis de Montreuil, D. y Girard, P.D. (1956)
Aspectos generales de la metalogenia del Peru.
Serv. Geol. Min., Peru.

Cobbing, J. (1973)
Geologia de los cuadrangulos de Barranca, Ambar, Oyon, Huacho, Huaral y Canta. Ser. Geol. Min., Peru, Bol.26.

Einaudi, M.T. (1977)
Environment of ore deposition at Cerro de Pasco, Peru.
Econ. Geol., v.72, p.893-924.

Fukahori, Y., Aikawa, K. and Kawasaki, M. (1980)
Geology and ore deposit of the Huanzala mine - Mineralogical Study (in Japanese). Min. Geol. Japan, v.30, p.103-118.

Horita, A., Oikawa, J. and Tagami, Y. (1973)
Geological features of the Huanzala ore deposits, Peru (in Japanese). Min. Geol. Japan, v.23, p.265-274.

James, D.E. (1971)
Plate tectonic model for the evolution of the Central Andes.
Geol. Soc. Amer. Bull., v.82, p.3325-3346.

Japan International Cooperation Agency and Metal Mining Agency of Japan (1980-1982), Report on geological survey of the Oyon area.
Phase I., Phase II., Phase III.

Japan International Cooperation Agency and Metal Mining Agency of Japan (1982), Consolidated report on geological survey of the Oyon area.

Japan International Cooperation Agency and Metal Mining Agency of Japan (1983), Report on geological survey of the Iscaycruz (Oyon) area. Phase I.

Jenks, W.F. (1956)
Peru, Handbook of South American Geology.
Geol. Soc. Amer., Memoir, 65, p.215-247.

Jenks W.F. (1979)
Geology of South America, Geology of the World (in Japanese).
Iwanami, Tokyo, p.143-172.

Miyashiro, A. (1979)
Orogenesis based on the plate tectonics, The Trasitional Earth (in Japanese). Iwanami, Tokyo, p.35-144.

Petersen, U. (1965)
Regional geology and major ore deposits of Central Peru.
Econ. Geol., v.60, p.407-475.

Petersen, U. (1970)
Metalogénetic provinces of South America.
Geol. Rundschau, v.59, p.834-897.

Sato, H. and Saito, N. (1977)
Pyrite zones and zonal distribution of Cu-Pb-Zn ores in Huanzala mine, Peru (in Japanese).
Min. Geol. Japan, v.27, p.133-144.

Wilson, J.J. (1963)
Cretaceous stratigraphy of Central Andes of Peru.
Amer. Assoc. Petrol. Geol. Bull., v.47, p.1-34.

PARTICULARS
PART I
DRILLING EXPLORATION

PART I DRILLING EXPLORATION

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CHAPTER 1 DRILLING EXPLORATION

1–1 Outline of the Exploration

1) Drilling Exploration

The drilling exploration in the present year was carried out in the underground of Adit-N and Adit-S. The total length of the drill holes was 916.00 m, of 4 holes at two drill sites.

Tunnel	Hole	Direction	Inclination	Depth (m)	Core Length (m)	Core Rec. (%)
Adit-N	IC–6	280°	–40°	200.30	165.10	82.4
Adit-N	IC–7	250°	–60°	242.80	201.40	82.9
Adit-S	IC–8	250°	–30°	202.80	190.00	93.7
Adit-S	IC–9	250°	–80°	270.10	251.35	93.1
Total				916.00	807.85	88.2

This drilling exploration in the underground was performed in the period of 134 days from September 20, 1983 to January 31, 1984.

The drill machine employed was TGM–3C (drilling capacity: NQ 510 m, BQ 660 m).

Location (grid coordinate) and altitude of each drill hole are as follows.

Tunnel	Hole	Longitude	Latitude	Elevation (m)
Adit-N	IC–6	310,528E	808,854N	4,692
Adit-N	IC–7	310,528E	808,854N	4,692
Adit-S	IC–8	310,904E	808,112N	4,573
Adit-S	IC–9	310,904E	808,112N	4,573

2) Core Logging and Analysis

All the cores of the drill holes were logged with regard to lithology and mineralization. The results of the logging were described in the geological logs of the scale of 1 to 200.

As for the mineralized parts of the cores, half-split pieces or quarterly-split pieces were collected to prepare samples for chemical analysis, which was completed with various elements such as silver, copper, lead, and zinc.

Also, as to the parts of the cores where mineralization and indications of mineralization were recognized, polished sections were prepared for microscopic observation. Some of the samples were provided for the identification of minerals by X-ray diffraction analysis.

Main contents and number of the analyses are given as follows.

(1) Chemical analysis of the mineralized parts of the cores (Ag, Cu, Pb, Zn) ..... 100 samples

(2) Microscopic observation of the polished sections of ores .... 10 pieces

(3) X-ray diffraction analysis .... 10 samples

1–2 Preparation

1) Transportation of Materials and Equipment

After the customs clearance, the materials and the equipments were transported on the two 11 t trucks from the storage at the Callao port on August 18, 1983 to the Pampahuay village on August 20, through the villages of Churin and Oyon. On the way from the Pampahuay to the Iscaycruz camp, the transportation was done by three 1 t pickup trucks.

2) Excavation of Drill Chambers

In the underground, each one drill chamber along the Adit-N and along the Adit-S, that is, total 2 underground drill chambers, were prepared by excavating walls of the tunnels.

3) Water Supply for Drilling

For the drill holes of IC–6 and IC–7, approximate 600 meters of pipe-line was established and the necessary water was supplied by pumping, from the lake located north of the Cumbre de Limpe.

For the drill holes of IC–8 and IC–9, approximate 800 meters of pipe-line was established and the necessary water was supplied by natural flowing from the lake located south of the Cumbre de Limpe.

4) Preparation Period

Totalling 28 days were needed for the preparation works, that is transportation of materials and equipment, temporary construction of electric cable and pipe-line and others.

1–3 Drilling Operations

HQ wire-line method was employed for the drilling. Casing pipes were sunk on necessity so that the final diameter of the hole should be BQ-size.

1) IC–6

Hole length	:	200.30 m
Core length	:	165.10 m
Core recovery	:	82.4 %
Date commenced	:	September 20, 1983
Date completed	:	October 23, 1983

0 m ~ 1.50 m :

By NQ wire-line diamond bits, using bentonite mud water, the hole was excavated in the rocks belonging to the Chimu Formation down to the depth of 1.50 meters, where, as the wall was recognized to be stable, HW casing pipes were sunk to the depth of 1.50 m after reaming the hole by HQ wire-line bits.

1.50 m ~ 52.20 m :

By NQ wire-line diamond bits, using bentonite mud water, the hole was excavated in quartzite to the depth of 52.20 meters.

In the portion at the depth between 35.00 m and 38.00 m, was recognized a clay fracture zone, where the insertion of rods was difficult and the hole was cemented. After reaming the hole by HQ wire-line bits, NW casing pipes were sunk to the depth of 49.00 meters.

52.20 m ~ 106.00 m :

By NQ wire-line diamond bits, using bentonite mud water, the hole was excavated in shale, sandstone and in dolostone with clay to the depth of 106.00 meters.

In the portion between the depth of 56.10 m and 60.00 m, was recognized a clay fracture zone in dolostone, where the hole condition was worse because of the wall-swelling. After reaming the hole by HQ wire-line bits, NW casing pipes were sunk to the depth of 74.00 meters.

106.00 m ~ 122.80 m :

By NQ wire-line diamond bits, using bentonite mud water, the hole was excavated in dolostone with clay and in sulphide ore zone to the depth of 122.80 meters.

This part of the hole was recognized to compose a clay fracture zone in dolostone. The hole condition was extremely poor owing to the wall-swelling. At the depth of 122.80 meters, jamming happened.

It took one day to recover from the jamming. After the recovery, NW casing pipes were sunk to the depth of 122.80 meters.

122.80 m ~ 133.30 m :

By NQ wire-line diamond bits, using bentonite mud water, the hole was excavated in clay fracture zone of sulphide ores to the depth of 133.30 meters. In the clay fracture zone of sulphide ore, the hole condition was poor owing to the wall-swelling. By reaming the hole with NW casing diamond shoe bit, NW casing pipes were sunk to the depth of 133.30 meters.

133.30 m ~ 157.60 m :

By NQ wire-line diamond bits, using bentonite mud water, the hole was excavated in clay fracture zone of sulphide ores as well as in clay beds to the depth of 157.60 meters.

This part of the hole was recognized to compose a clay fracture zone of sulphide ores and the hole condition was extremely poor owing to the wall-swelling. At the depth of 157.60 meters, jamming happened.

It took two days to recover from the jamming. After the recovery, NW casing pipes were sunk to the depth of 157.60 meters.

157.60 m ~ 200.30 m :

By BQ wire-line diamond bits, using bentonite mud water, the hole was excavated in dolostone beds, in sulphide zone to the depth of 200.30 meters, where the drilling was completed as the purpose of this hole was accomplished.

In the portion between 182.20 m and 186.25 m of the depth, zinc indications were caught and the mineralization was confirmed.

2) IC–7

Hole length	:	242.80 m
Core length	:	201.40 m
Core recovery	:	82.9 %
Date commenced	:	October 28, 1983
Date completed	:	December 15, 1983

0 m ~ 2.50 m :

By 116 mm diamond bit, using bentonite mud water, the hole was excavated in quartzite to the depth of 2.50 meters, where, as the wall was recognized to be stable, HW casing pipes were sunk to the depth of 2.50 meters.

2.50 m ~ 7.40 m :

By HQ wire-line diamond bits, using bentonite mud water, the hole was excavated in quartzite to the depth of 7.40 meters, where, as the wall rocks were recognized to be stable, NW casing pipes were sunk to the depth of 7.40 meters.

7.40 m ~ 138.80 m :

By NQ wire-line diamond bits, using bentonite mud water, the hole was excavated in the Chimu Formation composed of dolostone bed, shale, sandstone as well as in clay fracture zone to the depth of 138.80 meters.

In the portion of the depth between 135.80 m and 137.80 m, was recognized a clay fracture zone in dolostone, where the hole condition was poor because of the wall-swelling, and it was difficult to drill any further. By reaming the hole with BW casing carbide shoe bit, BW casing pipes were sunk down to the depth of 138.80 meters.

138.80 m ~ 171.10 m :

By BQ wire-line diamond bits, using bentonite mud water, the hole was excavated in sulphide ore zone with clay as well as in limestone to the depth of 171.10 meters. In the portion of the depth between 151.00 m and 167.20 m, were recognized clay fracture zones of sulphide ores and druses, where the hole condition was poor as the water circulation was mostly lost. By reaming the hole with BW casing carbide shoe bit, BW casing pipes were sunk to the depth of 171.10 meters.

171.10 m ~ 242.80 m :

By BQ wire-line diamond bits, using bentonite mud water, the hole was excavated in limestone, dolostone, sulphide ores, shale and in clay fractured zone, by cementing the hole in parts to get over jamming state down to the depth of 242.80 meters, where the drilling was completed as the purpose of this hole was accomplished.

3) IC–8

Hole length	:	202.80 m
Core length	:	190.00 m
Core recovery	:	93.7 %
Date commenced	:	December 20, 1983
Date completed	:	January 13, 1984

0 m ~ 0.50 m :

By HQ wire-line diamond bit, using bentonite mud water, the hole was excavated in quartzite to the depth of 0.50 meters, where, as the wall was recognized to be stable, HW casing pipes were sunk to the depth of 0.50 meters, by reaming the hole with HW casing diamond shoe bit.

0.50 m ~ 2.00 m :

By NQ wire-line diamond bits, using bentonite mud water, the hole was excavated in quartzite to the depth of 2.00 meters, where, as the wall was recognized to be stable, NW casing pipes were sunk to the depth of 2.00 meters, by reaming the hole with NW casing diamond shoe bit.

2.00 m ~ 115.40 m :

By NQ wire-line diamond bits, using bentonite mud water, the hole was excavated in the Chimu Formation composed of sandstone, dolostone and in fracture zones of sandy sulphide ores down to the depth of 115.40 meters.

In the portion of the depth between 99.10 m and 115.40 m, were recognized druses and fracture zone of sandy sulphide ores where water flew out (600 l/min, PH=2). Since the hole condition became poor there, the hole was reamed with BW casing diamond shoe bit and BW casing pipes were sunk to the depth of 115.40 meters.

115.40 m ~ 147.40 m :

By BQ wire-line diamond bits, the hole was excavated in fracture zones of sandy sulphide ores to the depth of 147.40 meters. In a fracture zone of sandy sulphide ores, where water flew out (600 l/min, PH=2), jamming state happened. By reaming the hole with BW casing diamond shoe bit, BW casing pipes were sunk to the depth of 147.40 meters.

147.70 m ~ 202.80 m :

By BQ wire-line diamond bits, the hole was excavated in fracture zones of sandy sulphide ores as well as in specularite bed, in dolostone bed and in shale bed to the depth of 202.80, where the drilling was completed as the purpose of the hole was accomplished.

4) IC–9

Hole length	:	270.10 m
Core length	:	251.35 m
Core recovery	:	93.1 %
Date commenced	:	January 18, 1984
Date completed	:	January 31, 1984

0 m ~ 1.00 m :

By 116 mm diamond bit, using bentonite mud water, the hole was excavated in quartzite to the depth of 1.00 meter, where, as the wall was recongnized to be stable, 112 mm casing pipe was sunk.

1.00 m ~ 1.50 m :

By NQ wire-line diamond bit, using bentonite mud water, the hole was excavated in quartzite to the depth of 1.50 meters, where, as the wall was recognized to be stable, NW casing pipes were sunk to the depth of 1.50 meters, by reaming the hole with NW casing diamond shoe bit.

1.50 m ~ 180.20 m :

By NQ wire-line diamond bits, using bentonite mud water, the hole was excavated in the Chimu Formation composed of sandstone, dolostone and shale with inserted clay layers, to the depth of 180.20 meters.

In a fracture zone of shale with clay insertions, where water flew out (50 l/min, PH=1), the hole condition was poor owing to the wall-swelling, and BW casing pipes were sunk to the depth of 180.20 meters.

180.20 m ~ 270.10 m :

By BQ wire-line diamond bits, the hole was excavated in dolostone, in specularite layers and in sulphide ore zones to the depth of 270.10 meters, where the drilling was completed as the purpose of this hole was accomplished.

1–4 Mobilization and Removal

1) Mobilization

The number of days used for mobilization is given as follows.

IC–7	:	3 days
IC–8	:	3 days
IC–9	:	3 days

2) Removal

As the climate was unfavorable and the condition of the roads for transportation was poor while removal of the equipment from the drill site of IC–9 (Adit-S), it was necessary to repair were adjusted and stored at the camp after transportation of 13 km distance. Three days were used for removal.

1–5 Performance of the Drilling

1) Drilling Efficiency

As shown A. 1–8, with regard to drill holes totalling 916.00 meters, the drill length per shift was 2.39 m/shift, and that of real drill works was 3.93 m/shift.

The drilling pace and the number of bit rotation are given as follows.

	Drilling Pace	Number of Bit Rotation
Hard rocks	1.0 ~ 1.5 cm/min	450 ~ 600 r.p.m.
Moderate rocks	1.5 ~ 2.0 cm/min	350 ~ 450 r.p.m.
Soft rocks	2.0 ~ 2.5 cm/min	250 ~ 350 r.p.m.

2) Core Recovery

As shown in A. 1–8, 807.85 meters of cores were recovered against 916.00 meters of the total length of the drill holes.

The average core recovery was 88.2%.

Fig I-1　PROGRESSIVE RECORD OF DIAMOND DRILLING IC-6

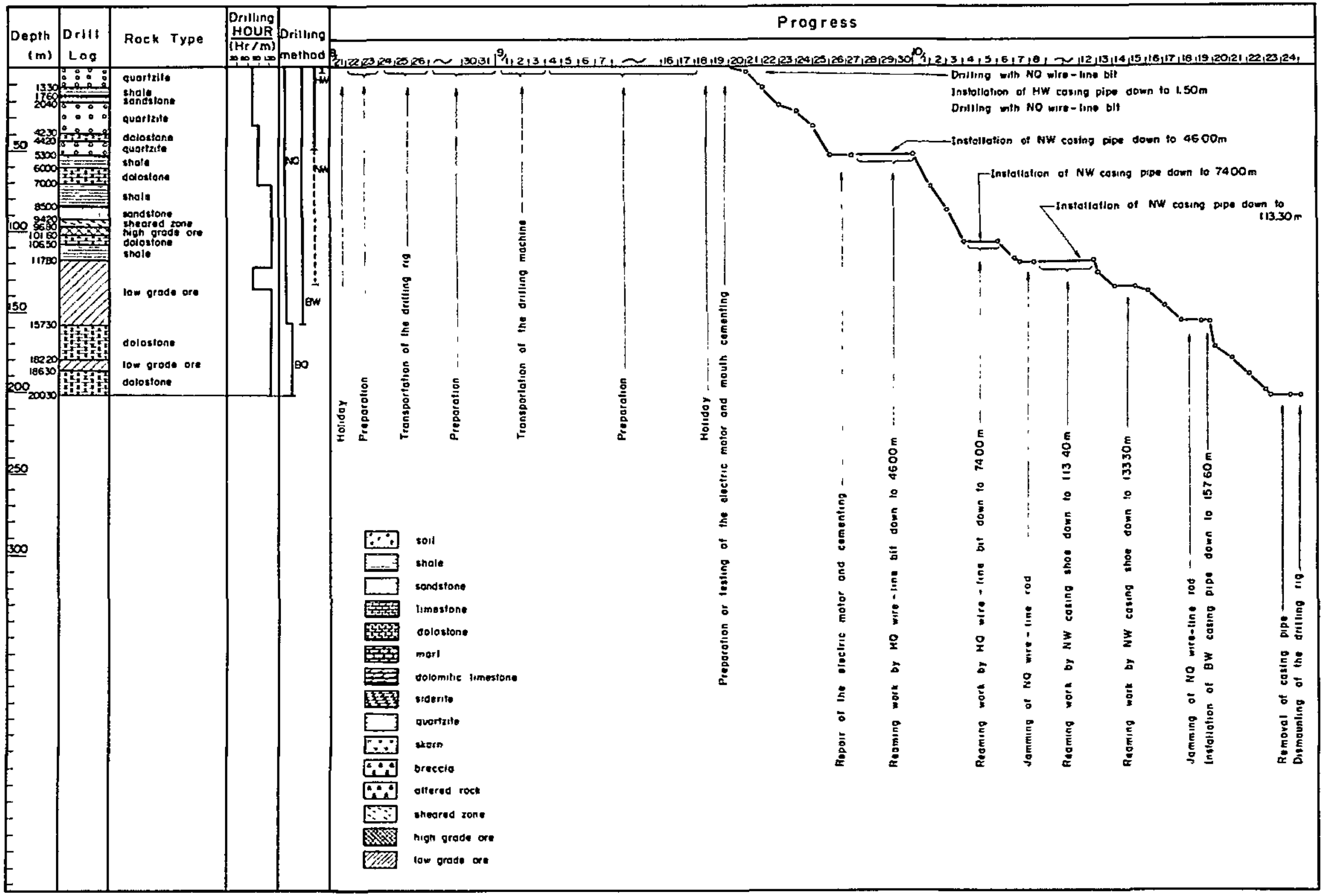


Fig. I-2 PROGRESSIVE RECORD OF DIAMOND DRILLING IC-7

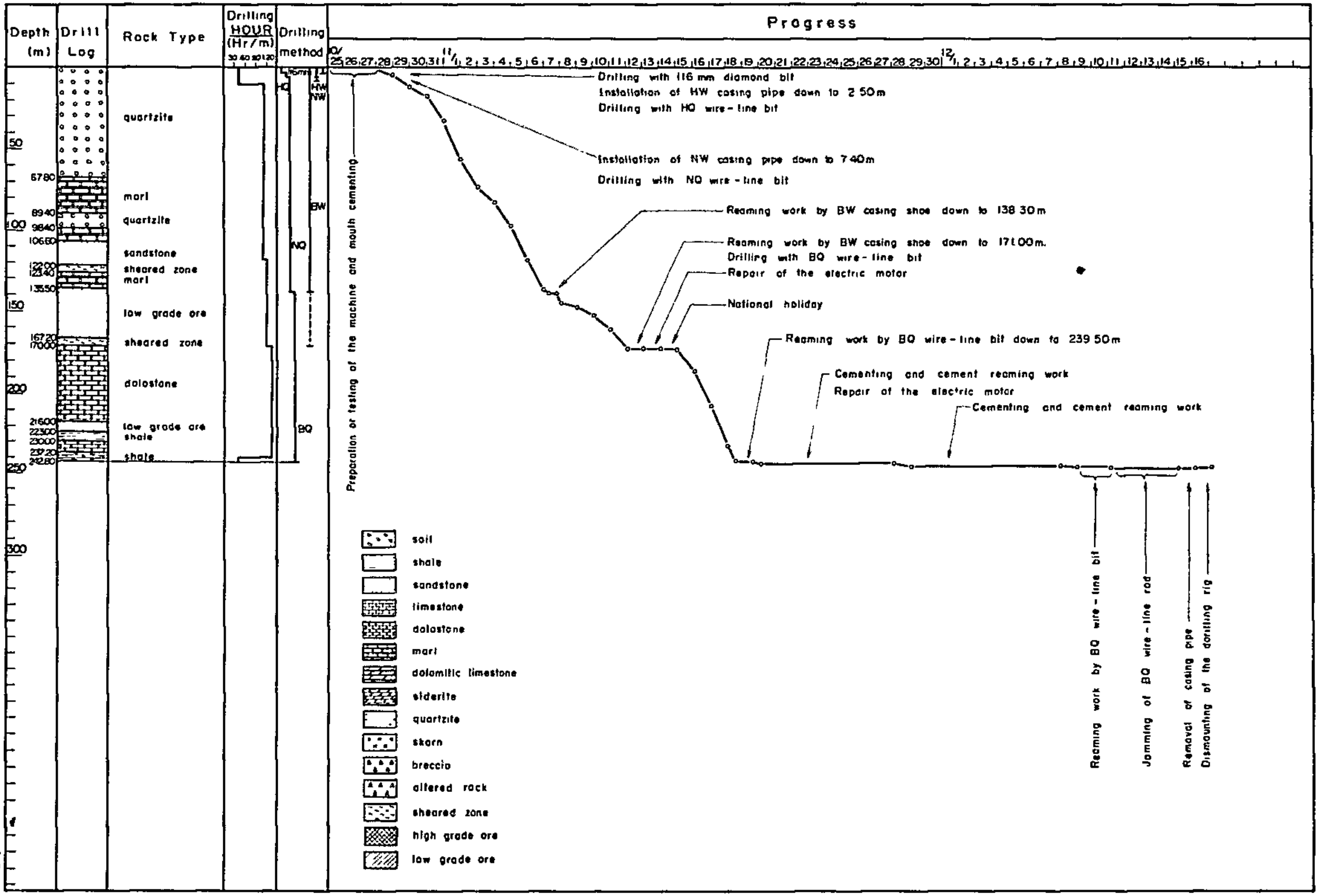


Fig. I-3 PROGRESSIVE RECORD OF DIAMOND DRILLING IC-8

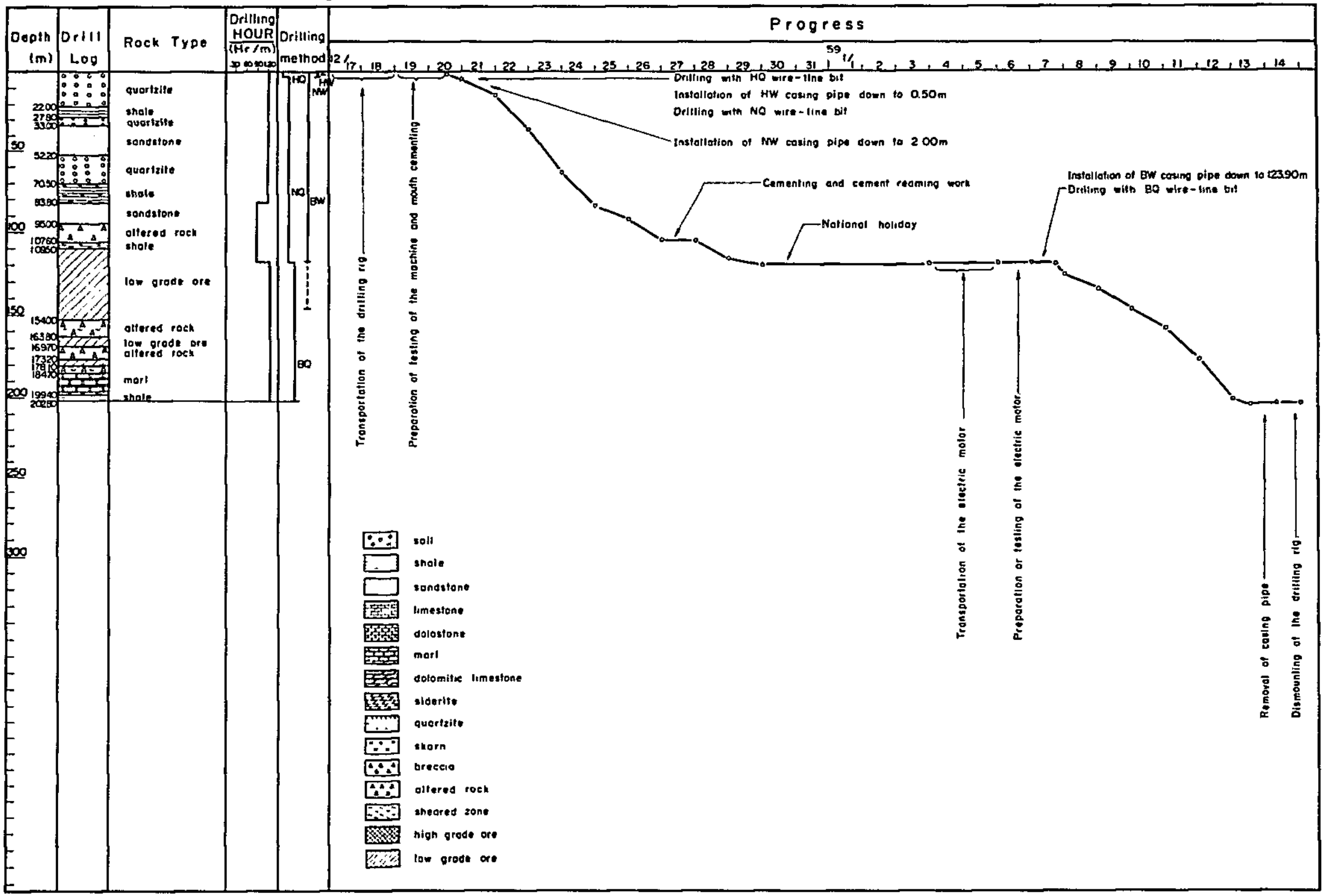
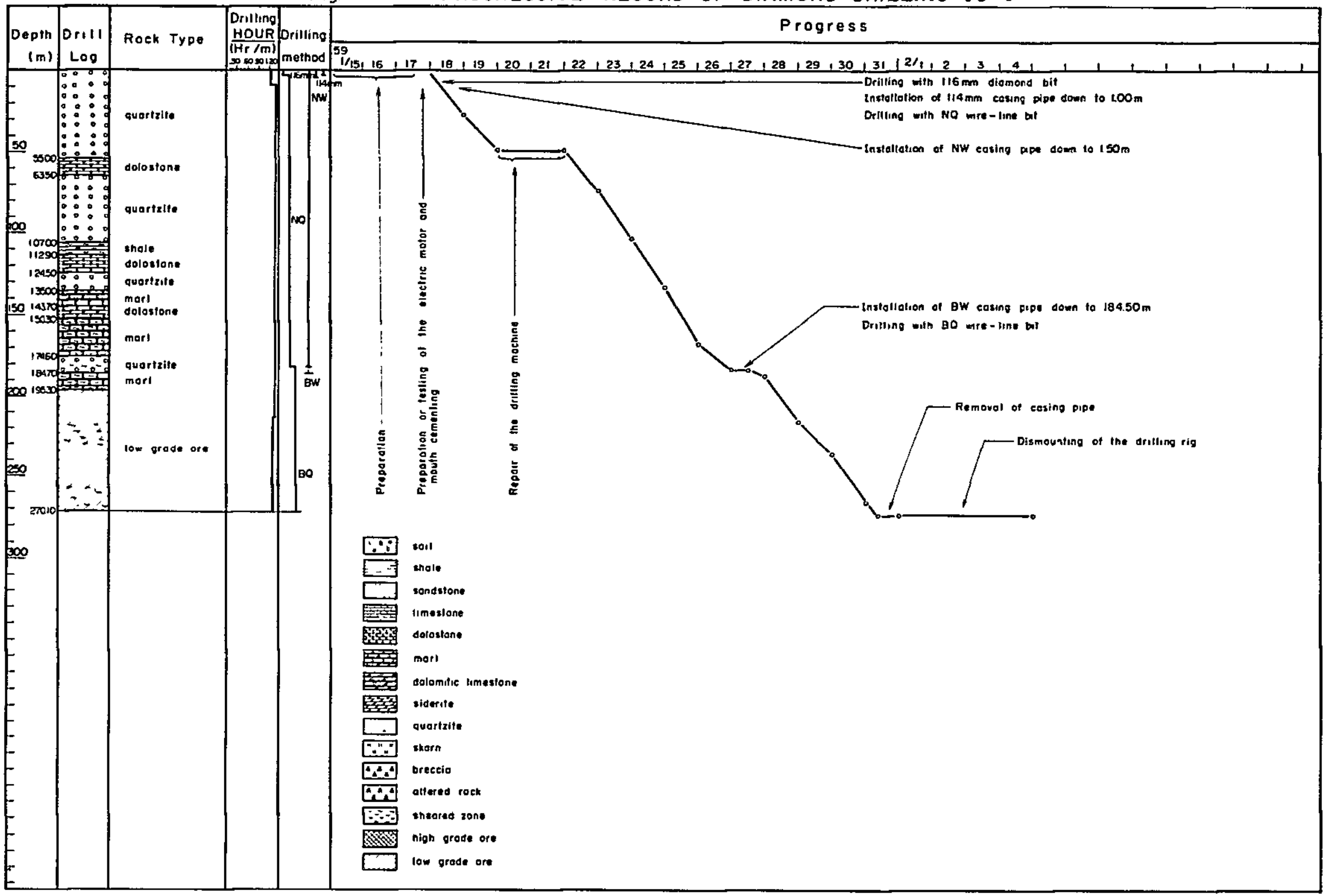


Fig. I-4 PROGRESSIVE RECORD OF DIAMOND DRILLING IC-9



CHAPTER 2 GEOLOGY AND MINERALIZATION IN THE DRILL HOLES

2–1 IC–6

(1) Purpose : The purpose of this hole was to explore mineralization along the lower extension of the hanging-wall-side orebody caught by the drill-hole DDH–4, as well as along the lower part of the Santa Formation, that is, along the boundary zone between the Santa Formation and the Chimu Formation.

(2) Location : At the point 310 m deep from the gate of the Adit-N, at the altitude of 4,692 meters above sea level. The bearing of the hole was 280°, and the inclination was –40°. The depth of the hole was 200.3 meters (Fig. 5, Fig. 6).

(3) Lithology : Down to the hole depth of 53.0 meters, the rocks were of the Chimu Formation which was composed mainly of quartzite with the inserted layers of shale, sandstone and dolostone.

To the hole depth of 94.2 meters, transitional zone of the Chimu Formation was recognized, comprising sandstone, dolostone, marl and shale.

Further down below the depth of 94.2 meters, the Santa Formation appeared. To the depth of 117.8 meters, alternation of dolomitic sandstone, dolostone and shale was found. Heavy dissemination of sphalerite, chalcopyrite and pyrite was recongnized in them. Down to the depth of 157.3 meters, massive pyrite was recognized associated with chalcocite and chalcopyrite. The matrix was clayey and the recovery was poor.

Below the depth of 157.3 meters, dolostone inserted with shale layers was recognized to the bottom of the hole, 200.3 meters. Dolomite was replaced by siderite in parts. Galena and sphalerite were disseminated in the siderite layers, where gypsum druses were also recognized. Sulphide layers composed of pyrrhotite and pyrite were developed in parts of the depth of 182.2 ~ 186.3 m (Fig. I–5, Pl. I–6).

(4) Mineralization and grade : The analysis results of the ore samples collected from the indications of mineralization and from the mineralized parts are given as follows.

Depth (m)	Length (m)	Number of Samples	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)
96.8 – 101.0	4.2	4	4	0.03	0.85	5.24
108.0 – 115.0	7.0	5	15	0.32	0.02	21.59
115.0 – 122.8	7.8	4	23	2.48	0.02	0.46
122.8 – 145.0	22.2*	5	15	1.04	0.02	0.23

* Core recovery was poor.

(5) Discussion : The massive pyrite orebody caught by this drill hole (depth : 117.8 ~ 157.3 m) was recognized to contain copper ores, as a whole. The principal copper minerals were chalcopyrite, associated with chalcocite and bornite. Pb-Bi minerals were recognized in chalcopyrite (A. III–2). This indication of copper mineralization is corresponding to the northern and lower extension of the massive pyrite orebody caught along the crosscut of the Adit-N. Along the peripheral zone of this massive pyrite orebody, that is, along the boundary with the Chimu Formation (depth 108.0 ~ 115.0 m), high grade zinc ores were recognized.

The bottom of this hole was still in the siderite zone of the Santa Formation. The siderite was leucocratic and of the species rich in Mn-component by X-ray diffraction (A. III–5).

2–2 IC–7

(1) Purpose : This hole was aimed to explore mineralization and to obtain geological information at the depth of the area where the Adit-N crosscut was located.

(2) Location : At the same point as the drill hole IC–6. The bearing of the hole was 250°, and the inclination was –60°. The depth of the hole was 242.8 meters (Fig. 5).

(3) Lithology : Down to the hole depth of 71.6 meters, the rocks were of the Chimu Formation which was composed mainly of quartzite, with the insertion of shale, sandstone and dolostone. Down to the depth of 122.0 meters, transitional zone of the Chimu Formation was recognized, comprising quartzite, sandstone, marl and shale. Below 1.4 meters of clay zone at the depth of 122.0 meters, the Santa Formation was recognized, which was composed of limestone, dolostone and marl inserted with thin layers of shale. The cores between 138.3 m and 167.2 m of the depth was mainly composed of pyrite, and the core recovery was poor. No cores were recovered between 154.9 m and 167.2 m of the depth, but it is estimated that this part would be represented by druses of pyrite or soft and weak clayey pyrite zone. Pyrrhotite and pyrite were recognized between 216.0 m and 223.0 m of the depth. Shale was predominant below the depth of 223.0 meters, and it is thought that the Carhuaz Formation appeared at the depth of 237.2 meters (Fig. I–6, PL. I–7).

(4) Mineralization and grade : No remarkable copper-lead-zinc mineralization was caught in and around pyrite orebody.

(5) Discussion : It was clarified by this drill hole that the size of the pyrite orebody would be smaller in the deep part below the crosscut of the Adit-N, and that the copper-lead-zinc mineralization would be less intense there.

2–3 IC–8

(1) Purpose : The purpose of this hole was to explore mineralization in the area south of the surface drill hole IC–5.

(2) Location : at the point 270 meters deep from the gate of the Adit-S. The altitude was 4,573 meters above sea level. The bearing of the hole was 250° and the inclination was −30°. The length of the hole was 202.8 meters. The area was corresponding to the portion below the small outcrop found in the area where talus deposits were accumulated (Fig. 5, Fig. 6).

(3) Lithology : To the depth of 70.5 meters, was recognized the Chimu Formation, which was composed mainly of quartzite, with the insertions of shale and sandstone. Transitional zone of the Chimu Formation was found to the depth of 95.0 meters, which was composed of sandstone, shale and marl.

The Santa Formation was recognized below the depth of 95.0 meters. The most of the Santa Formation found in the core of this drill hole was mineralized and altered to appear dark grey or greenish in color. Pyrite was recognized between 109.5 m and 148.3 m of the depth, but the matrix of this part was clayey and the cores were in powdered condition. Alternation of altered rocks and specularite-pyrite layers with chalcopyrite dissemination was found between 148.3 m and 184.7 m of the depth.

Below the depth of 184.7 meters, shale was predominant, and viewing from the fact that the sandstone insertions were recognized at around the depth of 200 meters, it was estimated that the rocks were belonging to the Carhuaz Formation.

(4) Mineralization and grade : Apparent thickness of the pyrite orebody caught in this hole was as much as 39 meters, but the orebody was found to be mono-mineral orebody of pyrite. In case specularite should appear instead of pyrite, chalcopyrite dissemination was recognized. The main copper-mineralization was as follows.

Depth (m)	Length (m)	Number of Samples	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)
150.5 – 154.0	3.5	3	tr	0.50	0.02	0.93
159.2 – 163.8	4.6	1	40	2.59	0.02	0.30
174.5 – 178.1	3.6	3	23	2.43	0.11	0.11

(5) Discussion : Remarkable mineralization and alteration were recognized as a whole of this drill hole. Silicificaiton was intense in the quartzite of the Chimu Formation, which was extremely hard, associated with sericite.

In the shale of the Chimu Formation, pyrophyllite was identified by X-ray diffraction

(IC–8–026). In the specularite mass, talc was identified (IC–8–152). Under microscope, chalcopyrite in the specularite mass was associated with bornite and sphalerite, and around the specularite crystals, magnetite was found to be associated (IC–8–152).

2–4 IC–9

(1) Purpose : The purpose of this hole was to explore mineralization in the deep part below the drill hole IC–8.

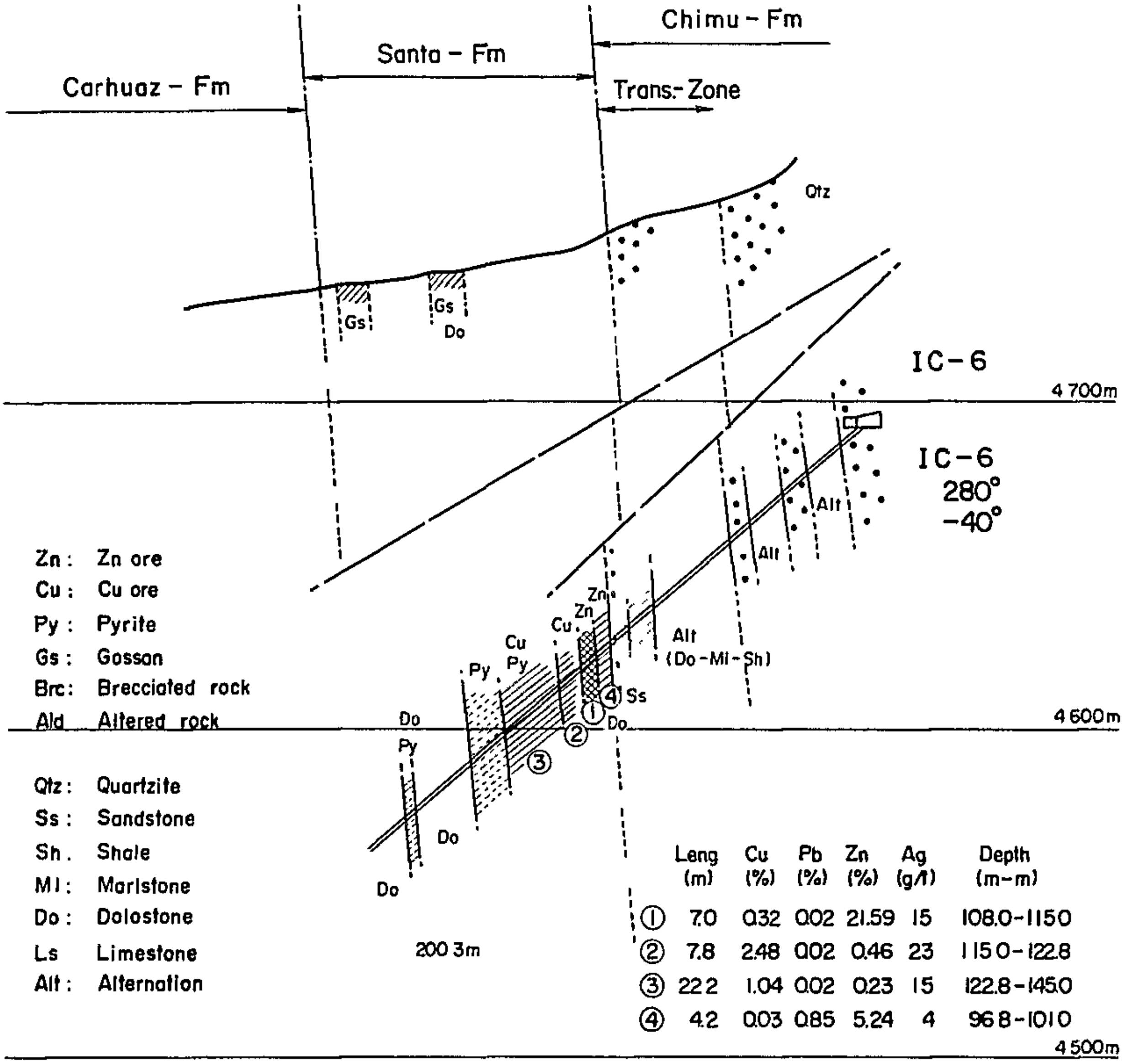
(2) Location : At the same site as the hole IC–8. The bearing of the hole was 250°, and the inclination was –80°. The length of the hole was 270.1 meters (Fig. 5).

(3) Lithology : To the depth of 138.2 meters, was recognized the Chimun Formation, which was composed mainly of quartzite with inserted layers of dolostone, shale, marl and sandstone. To the depth of 184.7 meters, transitional zone of the Chimu Formation was recognized, comprising quartzite, sandstone, dolostone, marl and pelitic altered rocks.

Below 0.7 meters of clay zone at the depth of 184.7 meters, the Santa Formation was recognized. To the depth of 195.3 meters, altered rocks were found disseminated with hematite, and from the depth of 195.3 meters to the bottom, massive pyrite orebody was recognized. Siliceous and argillaceous portions with residual banded structure were contained in this massive pyrite orebody. These portions were estimated to have been originated from shale (Fig. I–7, PL. I–9).

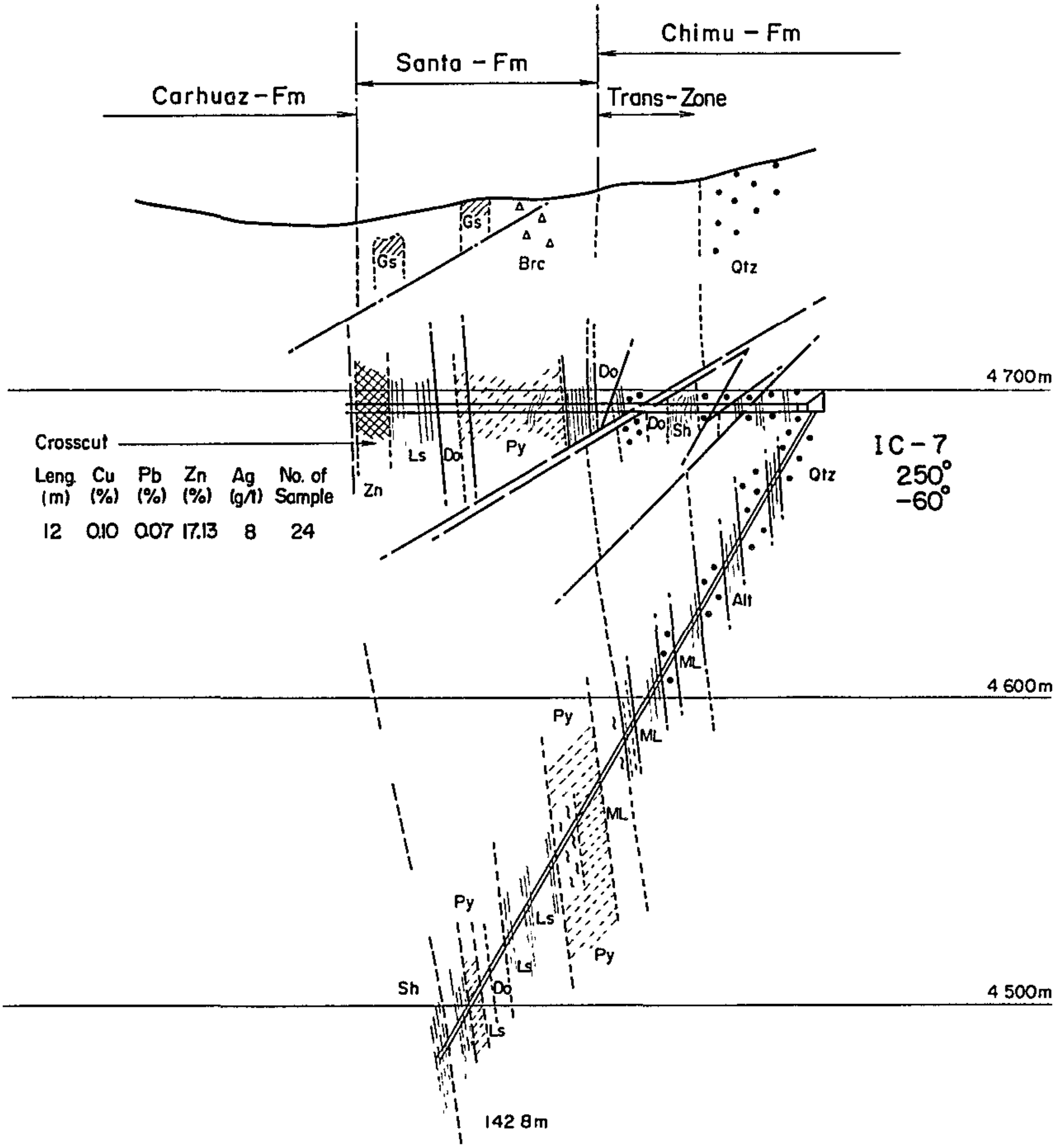
(4) Mineralization and grade : Intense mineralization and alteration were recognized in this hole as seen in the hole IC–8. The extension of the pyrite orebody was apparently more than 75 meters over most of the Santa Formation. However, the orebody was found to be monomineral orebody of pyrite.

(5) Discussion : Viewing the results of the geophysical exploration, the area where the holes of IC–8 and IC–9 were located was corresponding to the moderate anomaly of FE (Frequency Effect) value and to the high anomaly of AR(Apparent Resistivity) value, and some intense mineralization had been expected. However, by the results of the drilling of these two holes, it was large-scaled pyrite mono-mineral orebody that was caught. It is noted for future exploration that copper-lead-zinc concentration would be expected in the peripheral zone of pyrite orebody.



	Leng (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Depth (m-m)
①	7.0	0.32	0.02	21.59	15	108.0-115.0
②	7.8	2.48	0.02	0.46	23	115.0-122.8
③	22.2	1.04	0.02	0.23	15	122.8-145.0
④	4.2	0.03	0.85	5.24	4	96.8-101.0

Fig. I-5 Geological Section for IC-6



Leng. (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	No. of Sample
12	0.10	0.07	17.13	8	24

Fig. I - 6 Geological Section for IC-7 and Crosscut

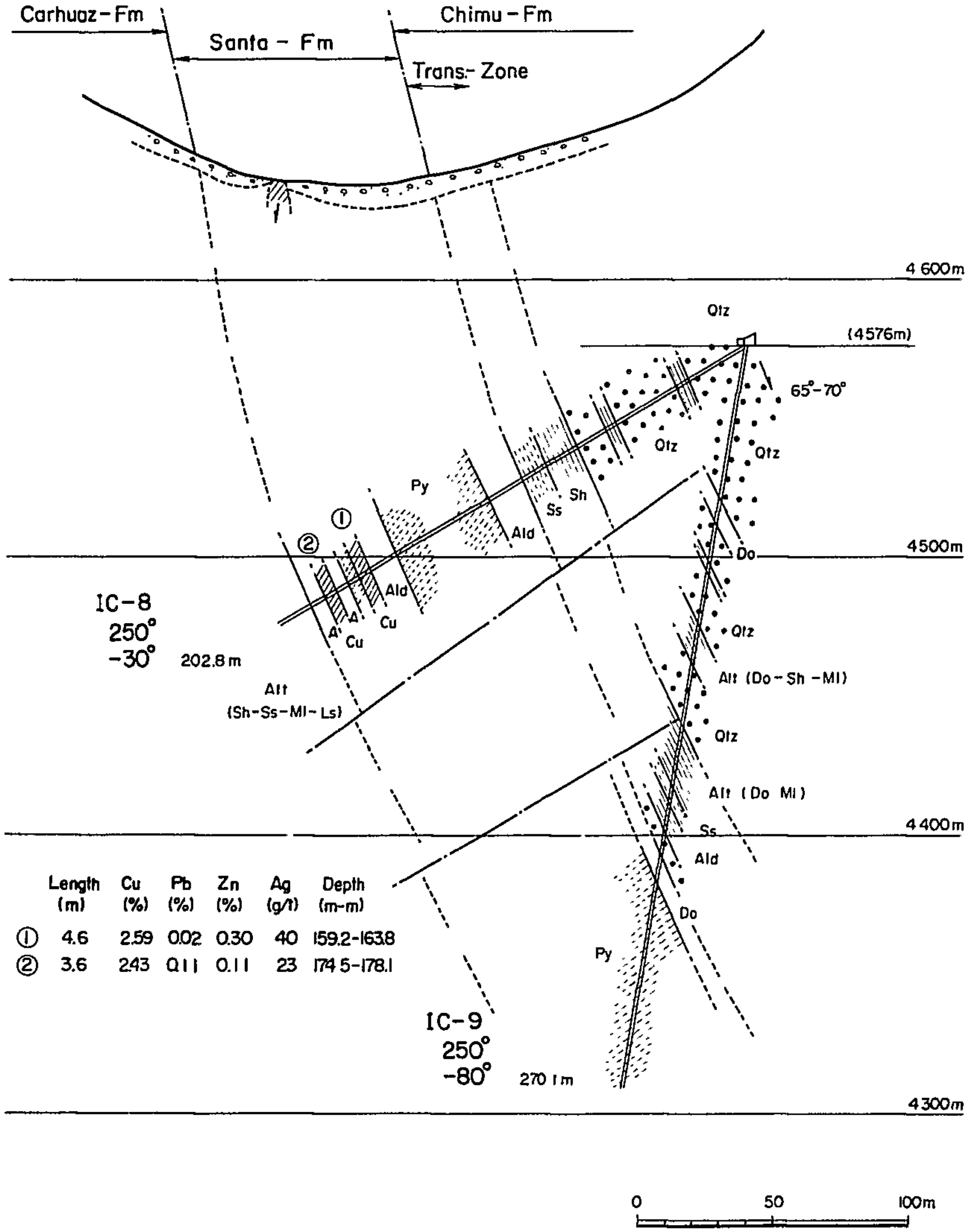


Fig. 1-7 Geological Section for IC-8 and IC-9

PARTICULARS
PART Ⅱ
TUNNELLING EXPLORATION

PART II TUNNELLING EXPLORATION

CONTENTS

LIST OF APPENDICES

CHAPTER 1 TUNNELLING EXPLORATION

1–1 Outline of the Exploration

Following the tunnelling exploration in the last year, 1982, the main tunnel was extended and the crosscut and the drilling chambers were excavated as to the Adit-N, while the main tunnel was extended and the drilling chamber was excavated as to the Adit-S, in the present year of 1983 (Fig. 5). It is noted that extra 20 meters of excavation was carried out for the crosscut of the Adit–N, considering the geological condition to the 130 m point.

The length and specifications of the tunnels and duration and other working conditions are as follows.

(1) Length of the tunnels

Name	Planned length (m)	Excavated length (m)
Adit-N	350.0	351.2
Adit-S	330.0	330.1
Total	680.0	680.3

(2) Specifications of the tunnels

Effective Section : 2.6 m x 2.5 m

Inclination : 1/100 ~ 1/200

Elevation of gate Adit-N : 4,689.37 m

Adit-S : 4,570.14 m

Direction of tunnels

Name	Length (m)	Direction
Adit-N (main tunnel)	200.4	160°
Adit-N, Crosscut	150.8	250°
Adit-S (main tunnel)	330.1	330°

(3) Term of exploration

Total days spent for excavation and its related work are 265 days from July 22, 1983 to March 12, 1984, as shown in the Table A. II–1.

Excavation began on July 27 for the Adit-N and on August 11 for the Adit-S, as the temporary works and the replacement of the machinery required the period until July 26, because it took quite a time to repair the bridge in Pampahuay which had been broken by the coal trucks and because it was unexpectedly difficult to cut open the new road and to widen narrow road, due to hard basement rocks around the ridge.

(4) Working System

The road construction and the temporary works were carried out for eight hours per one shift and one shift per day, and the tunnel excavation was carried out for eight hours per shift and three shifts per day.

(5) Number of Workers

Personnel worked for tunnel excavation including the road construction and the temporary works are as follows.

Japanese engineers	2 men per day
Peruvian engineers	6 men per day
Excavation labourers (including waste carrier and truck builder)	45 men per day
Surface labourers (storekeeper, mechanics and compressor operator)	5 men per day
Other labourers (road construction and temporary works)	10 men per day
Chauffeurs of Jeep and pick-up truck	3 men per day
Cook	4 men per day

(6) Topographical Survey

The results of survey in the tunnels are shown in Table A. II–9 · 10 · 11, and PL. II–1 · 2 · 3 are maps of the tunnels.

(7) Geological Survey in Tunnels

The tunnels were geologically surveyed on the scale of 1 to 200 with stress laid on clarifying lithology, geological structure, mineralization and dislocation by faults.

Contents and number of the assay and analysis works are shown as follows.

1) Chemical analysis of the mineralized portions (Ag, Cu, Pb, Zn) .... 40 samples
2) Microscopic observation of polished sections .... 10 pieces
3) X-ray diffraction analysis .... 5 samples

1–2 Road Construction

Following the construction in the last year, of the 16 km road section to Iscaycruz from the starting point of the construction about 1.4 km south of Pampahuay, 0.8 km was newly constructed, 2.4 km section was widened and whole of the section was repaired. The construction was carried out by one bulldozer (D7-17A) and manual labour.

1–3 Temporary Construction

An additional lodging house (50 m^2), with a galvanized sheet iron roofing was built.

In the vicinity of the gate of the Adit-N, ore pier was constructed in addition to waste pier.

Three fans were set in each tunnel of the Adit-N and the Adit-S for ventilation (Hitachi propeller 500). Temporary buildings with galvanized iron roofing were built for generater station (13 m^2), one each at every gate of the Adit-N and the Adit-S. For the doors (duplicated doors) of the underground magazine and the storage, two heavy locks were set for the outer doors and a lock for the inside doors. It is noted that an iron box (inside wooden) was fixed with anchor bolts to keep blasting cops inside in the storage. Lightning-conductor was prepared at the gate of the Adit-S and near the underground magazine.

Major machinery and major buildings constructed are listed in Table A. II–4.

1–4 Excavation

Personnel and working hours of excavation are as follows.

(1) Engineers

Adit-N : Hideo Morishita
Anibal Campos
Ernesto Sosa
Jorge Penasel

Adit-S : Ken Nakamura
Luis Manrique
Alejandro Cartolin
Emilio Guanhuayo

(2) Personnel

Excavation personnel for each adit is one Japanese engineer, three Peruvian engineers and 25 labourers, totaling 29 men. Excavation was carried out by one engineer and seven labourers per shift on three shifts per day.

(3) **Working Hours**

The first shift :	7:00 – 15:00
The second shift:	15:00 – 23:00
The third shift:	23:00 – 7:00

1–5 Adit-N Excavation

The figures shown are the distance from the gate. (excavated length in 1982 was 310.4 m)

1) Main Tunnel

310.4 m ~ 476.6 m :

Excavation was carried out following the last year's excavation. The rocks are quartzite. Remarkable joints and fractures of the NNW–SSE system are well developed and the excavation was difficult. At the 310.0 m point, a drilling chamber was prepared. Three fans were set and utilized for the deflation of smoke and gas after blasting, as well as for the air ventilation.

476.6 m ~ 496.6 m :

The rocks are still quartzite, but as there are many fractures of ENE–WSW system, total 5 timbers were required; 3 timbers in the section between 184.0 m and 186.2 m and 2 timbers in the section between 174.6 m and 176.0 m.

496.6 m ~ 510.8 m :

The rocks are quartzite, but fractures of ENE–WSW system are well developed and the excavation was difficult.

2) Crosscut

Opening ~ 33.0 m :

The rocks are those of the Chimu Formation composed mainly of quartzite. Remarkable joints are developed at around the 22.0 m point, and 5 timbers were required in the sections between 20.8 m and 23.2 m and between 31.7 m and 33.0 m.

33.0 m ~ 71.0 m :

The rocks are those of the transitional zone of the Chimu Formation composed of alternation of sandstone, shale and dolostone, which are brittle in parts. Total 13 timbers were required in the section between 33.0 m and 38.9 m, between 40.4 m and 51.3 m and between 63.7 m and 65.5 m.

71.0 m ~ 80.0 m :

The rocks are those of the Santa Formation, which are easily broken, and 2 timbers were required in the section between 77.8 m and 79.3 m.

80.0 m ~ 115.0 m :

The rocks are different and remarkable mineralization was observed, though the mineralization was composed mainly of pyrite in this area. In this mineralization zone, 5 timbers were required in the section between 113.2 m and 117.7 m.

115.0 m ~ 137.2 m :

After passing through the mineralization zone, the rocks are composed of alternation of dolostone, limestone and shale. No timbering was necessary in this section.

137.2 m ~ 149.2 m :

Another mineralization zone is recognized, which is orebody containing sphalerite and pyrite.

149.2 m ~ 150.8 m :

The rocks are shale (supposed to belong to the Carhuaz Formation), in which numerous joints are developed densely.

1–6 Adit-S Excavation

270.1 m ~ 518.1 m :

Lithologically, hard quartzite of the Chimu Formation appeared continuously, as was the case in the last year. Average drilling rate was 15 cm per minute and 48 to 52 drill holes were required for one blasting. Therefore, excavation was very slow and consumption of drilling bit became very heavy. In the section between 317.7 m and 318.4 m, fracture zone with clay was recognized and 2 timbers were required.

Three fans were set and utilized for the deflation of smoke and gas after blasting as well as for the air ventilation.

518.1 m ~ 600.2 m :

In the far side of the 518.1 m point, remarkable faults are recognized and the rocks are represented by alternation of shale, marl and sandstone. As there are extremely weak portions, total 33 timbers were required: 3 timbers in the section between 520.6 m and 523.9 m, 13 timbers in the section between 526.9 m and 545.4 m, 5 timbers in the section between 551.1 m and 557.1 m, and 12 timbers in the section between 560.5 m and 576.7 m.

CHAPTER 2 GEOLOGY AND MINERALIZATION IN TUNNELS

2–1 Adit-N (main tunnel)

The excavated length of the Adit-N (main tunnel) in the first year was 310 meters and that in the present year was 200 meters. The cummulative total length is 510 meters. The direction of this Adit-N is 160° (PL. I–3 · 4).

By the observation of the geology in the tunnel, quartzite of the Chimu Formation is recognized over whole of the length from the 310 m point, the starting point to the 510 m point, the ending point in the present year. The quartzite is leucocratic or light grey in color, and is fine to medium grained, massive, compact and hard. The strike is N15° ~ 20° W, and the dip is as steep as 80° ~ 85° to the east. The quartzite contains, in places, shale layers as thick as 5 ~ 10 cm with the spacing of several ten centimeters, and joints of the NNW–SSE system are well developed in this direction, parallel to the bedding planes. Also, in the direction almost rectangular to the bedding planes, joints of WNW–ESE system are densely developed, and in places they seem to be fracture zone (around the 490 m point). At around the 350 m point, a fault fracture zone of NW–SE system has recognized, dipping 25° ~ 35° to the southwest.

2–2 Adit-N, Crosscut

The opening of the crosscut of the Adit-N is at the 310 m point from the gate of the main tunnel. The direction of the crosscut is 250° and its length is 150 m (PL. I–3 · 5).

As to the geology along the crosscut of the Adit-N, the Chimu Formation is recognized to the 31 m point from the opening, composed mainly of quartzite with inserted layers of shale, dolostone and sandstone. The strike of the Chimu Formation is N15° ~ 25°W. and the dip is 75° ~ 90°E. In the comparatively soft layers of shale and dolostone in contact with the hard quartzite, fractured zone or faults are developed in many cases. At the 15 m point and at the 23 m point, faults of NW–SE system with the dip of 35° ~ 50°SW are developed.

Within 39 meters of the width from the 31 m point to the 70 m point, alternation of dolostone, shale, sandstone and quartzite is recognized, which is correspondent to the transitional zone of the Chimu Formation. Faults of NW–SE system are developed with the dip of 80°SW at the 48 m point, and with the dip of 30°SW at the 52 m point. These faults of NW–SE system are accompanying fault clay as wide as 10 ~ 20 cm and fracture zone as wide as several ten centimeters, and it is estimated that these faults have dislocated the beds in fair amount. Viewing from the fault clay and from the structure of the fracture zone, they are thought to be reverse fault. In the dolostone close to the Santa Formation, dissemination of sphalerite is recognized, and the,

	Length (m)	Number of Samples	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)
Right wall (north side)	12	12	11	0.11	0.10	17.11
Left wall (south side)	12	12	5	0.08	0.04	17.16
Average	12	24	8	0.10	0.07	17.13

This orebody is, as seen from the assay results, composed of simple ores mostly of sphalerite and pyrite. In the far part of this orebody in the crosscut, remarkably fractured shale is recognized. It is possible that they are belonging to the Carhuaz Formation.

2–3 Adit-S (main tunnel)

The Adit-S (main tunnel) was excavated in the first year in the length of 270 m, and the excavation length in this year is 330 m. The cummulative total is 600 meters. The direction of the tunnel is 330° (PL. II–4–2 · 3 · 4).

Geologically, the Adit-S is situated in the Chimu Formation as a whole from the 270 m point, the start in this year, to the 600 m point, the ending point.

To the 500 m point, is recognized quartzite, which is heavily silicified, leucocratic, massive, compact and hard. Pyrite is disseminated in this quartzite extensively. Where thin layers of shale and sandstone (usually the thickness is less than 5 cm) are inserted in the quartzite, bedding plane joints are well developed in parallel with these thin layers of shale and sandstone. The quartzite has the strike of N20°W and the dip of 65° ~ 70°E, showing overturned structure. Joints of ENE–WSW system are well developed almost rectangular to the bedding planes. At the points of 319 m and 404 m, faults of the ENE–WSW system (trend N70°E, dip 80° ~ 90°N, containing clay zones of the approximate width of 50 cm) are recognized. At the 500 m point, a fault fracture zone of the width of 1.2 meters is recognized in the direction of N55°E, dipping 60° ~ 80° to the south. Bounded by this fault, sandstone bed as thick as 0.8 meters is found in the far side. Fault zone is recognized in 17 meters from the 520 m point to the 537 m point. This fault zone is composed of the faults of NNE–SSW system and the faults of ENE- WSW system. Beyond this fault zone, alternation of marl, sandstone, shale and quartzite is observed. The marl is light brown, massive and soft. The sandstone is leucocratic and has fissilities. The shale is dark grey and has schistosity. The tunnel was totally timbered from the 520 m point, where the fault is located, to the 577 m point, where the alternation zone is distributed.

average grade of 5 samples collected in 9 meters along the wall is Cu 0.37%, Pb 0.11%, Zn 2.29% and Ag tr. The minerals composing this dolostone are mainly Fe-rich ankerite and quartz by the result of the X-ray diffraction (CN–5–20, A. III–5).

The Santa Formation is recognized in far side of the 70 m point. To the 79 m point, alternation of marl and shale is found, heavily altered and mineralized with the dissemination of sphalerite and pyrite. Banded structure is observed in green and white bands in this alternation. It has been clarified by the X-ray diffraction that the green bands are composed of great amount of chlorite (CN–6–30, A. III–5).

Within 36 meters of the width from the 79 m point to the 115 m point, massive pyrite orebody is recognized. The matrix of the pyrite orebody is clayey in some cases and is siliceous in other cases. In case of clay matrix, the ore is extremely soft and easily powdered. In this orebody, there are many druses over 1 meter in diameter. The average grade of 9 samples collected in this orebody is Cu 1.48%, Pb 0.08%, Zn 0.27% and Ag tr. In the central part of the pyrite orebody, only slight mineralization is observed as to any of copper, lead and zinc. It has been clarified that zinc is concentrated along the peripheral zone of the orebody while copper centration is in the inner zone of the periphery. As a whole, the general trend of this orebody is roughly N20°W with the dip of 85°E, but at around the 90 m point, gently-inclined structure with the dip of 20°W is developed, which is thought to be some partial peculiar structure blocked by faults.

From the 115 m point to the 137 m point, alternation of limestone, shale and dolostone is recognized, not mineralized. The limestone around the orebody is dolomitized. The fact that the orebody is in contact with unmineralized rocks with quite sharp boundary is thought to suggest that the mineralization would have been heavily controled by the bedding plane faults and the fracture zones developed in parallel with the bedding planes.

Within 12 meters of the width between the 137 m point and the 149 m point, there is an orebody of zinc mineralization. The matrix of this orebody is pyrite, and sphalerite is recognized in patches, in irregular veinlets and in dissemination in pyrite mass. The zinc grade of the ore is roughly Zn 15% in most cases, but there are some portions where the grade is as high as more than Zn 20%. The assay results of the samples collected by continuous channel sampling with 1 meter interval along both walls are shown below.

APPENDICES
PART I
DATA OF DRILLING

LIST OF APPENDICES

A. I-I List of the Used Equipment for Drilling

Item	Model	Quantity	Capacity, Type, and Specification
Drilling Machine	TCH-3C	1	Capacity NQ 510m, BQ 660m Inner Diameter of Spindle 93mm Weight (except engine) 2,300 kg
Pump	NAS-3C	1	Piston ϕ75mm Capacity 130, 72 39, 22 ℓ/min Pressure 26 ∿ 40 kg/cm^2
"	NAS-3B	1	Piston ϕ75mm Capacity 130, 72, 39, 22 ℓ/min Pressure 26 ∿ 40 kg/cm^2
"	MS-303	1	Piston ϕ25mm Capacity 25 ∿ 41 ℓ/min Pressure 35 kg/cm^2
Engine for pump	2T-90L	1	Diesel Engine 1,800 rpm/20 PS
"	NS-65C	1	Diesel Engine 1,800 rpm/5.5 PS
Electric Motor for Drilling Machine	NV180M4	1	Electric Motor 1,750 rpm/30 HP
Electric Motor for Drilling pump	NV132N4	1	Electric Motor 1,745 rpm/12 HP
Electric Motor for Mud Mixer	NV100LA4	1	Electric Motor 1,730 rpm/3.6 HP
Generator	SAR#76	1	115 kW, 1,800 rpm/220V, 60 Hz
Generator	TS-3.5S	2	8.5 kW, 1,800 rpm/220V, 60 Hz
Generator	YSG-3.5	2	3.5 KVA, 220V, 60 Hz
Engine for Generator	NS-65C	2	Diesel Engine 1,800 rpm/5.5 PS
Mud Mixer	MCE-200A	1	Volume 200 ℓ, 800∿1,000 rpm/min
Submersible Pump	KTV-22L	1	2.2 kW, 3P, 220V, 60 Hz, 0.6 m^3/min
Transformer	50KVA	4	50 KVA, 3P, 3,300 V/210V
Rod Holder	RH-85	1	Hand Type
Drill Rods	HQ-WL	10	3.00 m/PC

Item	Model	Quantity	Capacity, Type, and Specification
Drill Rods	HQ-WL	2	1.50 m/PC
"	NQ-WL	100	3.00 m/PC
"	"	2	1.50 m/PC
"	BQ-WL	100	3.00 m/PC
"	"	2	1.50 m/PC
Casing Pipes	112 mm	5	3.00 m/PC
"	"	4	1.00 m/PC
"	"	2	0.50 m/PC
"	HW	10	3.00 m/PC
"	"	4	1.00 m/PC
"	"	2	0.50 m/PC
"	NW	70	3.00 m/PC
"	"	5	1.00 m/PC
"	"	2	0.50 m/PC
"	BW	90	3.00 m/PC
"	"	6	1.00 m/PC
"	"	4	0.50 m/PC

A. I-2 Articles of Consumption and Drilling Parts

Item	Specification	Unit	Quantity			
			IC-6	IC-7	IC-8	IC-9
Light oil		ℓ	16,100	17,130	9,680	7,400
Gasoline		ℓ	214	295	140	130
Mobil oil		ℓ	164	305	105	140
Hydraulic oil		ℓ	40	10	-	10
Grease		kg	10	20	5	12
Bentonite	50kg/bag	kg	188	326	69	107
Libonite		kg	142	255	60	136
Tel-cellose		kg	39	80	11	31
Tel-stop		kg	6	264	-	-
Speeder-P		ℓ	65	45	-	-
Cement	40kg/bag	Bag	12	82	49	18
Metal crown	116mm	Pc	-	1	-	2
Single core tube	114mm x 0.5m	Set	-	-	-	1
Wire line core barrel	HQ x 1.50m	"	1	-	-	-
" "	NQ x 1.50m	"	-	1	-	1
" "	BQ x 1.50m	"	-	-	1	-
Inner tube assembly	HQ x 1.50m	"	-	-	-	1
" "	NQ x 1.50m	"	-	-	1	-
" "	BQ x 1.50m	"	-	1	-	-
Outer tube	HQ x 1.50m	Pc	-	-	-	-
"	NQ x 1.50m	Pc	-	-	-	1
"	BQ x 1.50m	"	-	-	-	-
Inner tube	HQ x 1.50m	"	-	-	-	-
"	NQ x 1.50m	"	-	-	1	-
"	BQ x 1.50m	"	-	-	-	1
Casing metal shoe	114mm	"	-	-	-	-
"	HW	"	1	-	-	-
"	NW	"	4	-	-	-
"	BW	"	1	2	-	-
Guide pipe	HQ	"	-	-	-	1
"	NQ	"	-	1	-	1
"	BQ	"	-	1	-	1
Guide coupling	HQ	"	-	1	-	1
"	NQ	"	-	1	-	1
"	BQ	"	-	1	-	1
Core lifter case	HQ	"	-	1	-	1
"	NQ	"	3	4	2	3
"	BQ	"	2	2	3	4
Core lifter	HQ	"	2	-	-	1
"	NQ	"	6	8	4	6
"	BQ	"	4	-	-	2
Water swivel packing		"	2	4	4	2
Water swivel spindle		"	-	-	1	-
Suction hose	50mm x 4.5m	"	-	1	-	1
Piston rod		"	2	2	-	2

Item	Specification	Unit	Quantity			
			IC-6	IC-7	IC-8	IC-9
Valve steel ball	38.1 φ	Pc	8	-	8	8
Pump packing		"	8	-	-	8
V-belt	TGM-3C	Set	1	-	-	1
"	NAS-3B	"	-	1	-	1
"	NAS-3Cx2T-90L	"	1	-	-	-
"	YSC-3.5xNS-65C	"	2	-	1	-
Core box	HQ	Pc	-	2	-	-
"	NQ	"	29	28	29	41
"	BQ	"	7	15	14	13
Wire	10#	kg	15	10	15	12
"	12#	"	10	8	9	10
Nail		"	10	8	12	6
Wire rope	6mm x 550m	Roll	-	1	-	1
"	12mm x 40m	"	-	1	-	-
Manila rope	18mm x 30m	"	1	-	1	-
Vinyl rope	8mm x 100m	"	-	1	-	0.5
Rag		kg	10	5	10	8

A. I-3 Preparation and Removal Records

Item	Hole No.	IC-6		IC-7		IC-8		IC-9					
Preparation and removal	In	21th Aug. '83		25th Oct. '83		17th Dec. '83		15th Jan. '84					
		19th Sep. '83		27th Oct. '83		19th Dec. '83		17th Jan. '84					
	Out	24th Oct. '83		16th Oct. '83		14th Jan. '84		1st Feb. '84					
		24th Oct. '83		16th Oct. '83		14th Jan. '84		4th Feb. '84					
		Days	Man-shifts	Days	Man-shifts	Days	Man-shifts	Days	Man-shifts	Days	Man-shifts	Days	Man-shifts
Preparation	Access road	-	-	-	-	-	-	-	-				
	Haulage	6	132	0.5	11	1	22	0.5	11				
	Installation	18	252	2	44	1	22	2	44				
	Water pipe	3	66	-	-	0.5	11	-	-				
	Test run, etc.	3	66	0.5	11	0.5	11	0.5	11				
	Total	30	516	3	66	3	66	3	66				
Removal	Dismantling	0.5	11	0.5	11	0.5	11	1	22				
	Pipe removal	0.5	11	0.5	11	0.5	11	0.5	11				
	Haulage	-	-	-	-	-	-	2	44				
	Road rein-statement	-	-	-	-	-	-	-	-				
	Others	-	-	-	-	-	-	0.5	11				
	Total	1	22	1	22	1	22	4	88				
Grand Total		31	538	4	88	4	88	7	154				

A. I-4 Operation Results of Drill Hole, IC-6

Working Period	Period	Number of Days	Actual Working Days	Day Off	Total Number of Workers
Preparation	21th Aug.'83∿19th Sep.'83	30	28	2	616
Drilling	20th Sep.'83∿23th Oct.'83	34	33	1	682
Removing	24th Oct.'83∿24th Oct.'83	1	1	-	22
Total	21th Aug.'83∿24th Oct.'83	65	62	3	1,320

Drilling Length			
Planned Length	200.00 m	Over-burden	- m
Increase or Decrease in Length	m	Core Length	165.10 m
Length Drilled	200.30 m	Core Recovery	82.4%

Working Time			
Drilling	195°00'	21.4%	19.6%
Hoisting & Lowering Rod	59°00'	6.5%	5.9%
Hoisting & Lowering I.T.	78°00'	8.6%	7.9%
Miscellaneous	566°00'	62.2%	57.1%
Repairing	12°00'	1.3%	1.2%
Others	-	- %	- %
Total	910°00'	100 %	91.7%
Removing: Preparation	40°00'	-	4.1%
Removing: Moving	42°00'	-	4.2%
G. Total	992°00'	-	100 %

Casing Pipe Inserted: Pipe Size & Meterage	Inserted Length / Drilling Length %	Recovery of Casing Pipe
HW 1.50 m	0.7 %	100 %
NW 133.30 m	66.6 %	79 %
BW 157.60 m	78.7 %	80 %

Core Recovery for each 100 m section

Depth of Hole	Section	Total
0∿100 m	93.7 %	93.7 %
100∿200.30m	69.8 %	82.4 %
m	%	%
m	%	%
m	%	%
m	%	%

Efficiency of Drilling

200.30m/Working Period	3.08m/day
200.30m/Working Days	3.23m/day
200.30m/Drilling Period	5.89m/day
200.30m/Net Drilling Days	6.07m/day
Total workers/200.30m	6.59 Man/m
Total Drilling Workers/200.30m	3.40 Man/m
Hoisting&Lowering Rod 47 Times	Hoisting&Lowering I.T. 239 Times

Remarks

G : Grand

I.T.: Inner Tube

A. I-5 Operation Results of Drill Hole, IC-7

Working Period

	Period	Number of Days	Actual Working Days	Day Off	Total Number of Workers
Preparation	25th Oct.'83~27th Oct.'83	3	3	-	66
Drilling	28th Oct.'83~15th Dec.'83	49	39	10	840
Removing	16th Dec.'83~16th Dec.'83	1	1	-	22
Total	25th Oct.'83~16th Dec.'83	53	43	10	928

Drilling Length

	m		m
Planned Length	240.00	Over-burden	-
Increase or Decrease in Length		Core Length	201.40
Length Drilled	242.80	Core Recovery	82.9%

Core Recovery for each 100 m section

Depth of Hole	Section	Total
0~100 m	96.7 %	96.7 %
100~200 m	67.4 %	81.1 %
200~242.80 m	93.5 %	82.9 %
m	%	%
m	%	%
m	%	%

Working Time

Drilling	202°00'	22.7%	21.5%
Hoisting & Lowering Rod	42°00'	4.7%	4.5%
Hoisting & Lowring I.T.	72°00'	8.1%	7.7%
Miscellaneous	551°00'	61.9%	58.7%
Repairing	23°00'	2.6%	2.5%
Others	-	- %	- %
Total	890°00'	100 %	94.9%
Removing: Preparation	36°00'	-	3.8%
Removing: Moving	12°00'	-	1.3%
G. Total	938°00'	-	100 %

Efficiency of Drilling

242.80 m/Working Period	4.58 m/day
242.80 m/Working Days	5.65 m/day
242.80 m/Drilling Period	4.96 m/day
242.80 m/Net Drilling Days	6.22 m/day
Total workers/242.80 m	3.82 Man/m
Total Drilling Workers/242.80 m	3.46 Man/m
Hoisting&Lowering Rod 42 Times	Hoisting&Lowering I.T. 244 Times

Casing Pipe Inserted

Pipe Size & Meterage	Inserted Length / Drilling Length %	Recovery of Casing Pipe
HW 2.50 m	1.0 %	100 %
NW 7.40 m	3.0 %	100 %
BW 171.00 m	70.4 %	88 %

Remarks

G : Grand

I.T.: Inner Tube

A. I-6 Operation Results of Drill Hole, IC-8

Working Period		Period	Number of Days	Actual Working Days	Day Off	Total Number of Workers
	Preparation	17th Dec.'83~19th Dec.'83	3	3	-	66
	Drilling	20th Dec.'83~13th Jan.'84	25	20	5	440
	Removing	14th Jan.'84~14th Jan.'84	1	1	-	22
	Total	17th Dec.'83~14th Jan.'84	29	24	5	528

Drilling Length		m		m
	Planned Length	200.00	Over-burden	-
	Increase or Decrease in Length		Core Length	190.00
	Length Drilled	202.80	Core Recovery	93.7%

Core Recovery for each 100 m section

Depth of Hole	Section	Total
0~100 m	96.0 %	96.0 %
100~202.80 m	91.3 %	93.7 %
m	%	%
m	%	%
m	%	%
m	%	%

Working Time				
	Drilling	180°00'	44.8%	36.6%
	Hoisting & Lowering Rod	46°00'	11.4%	9.3%
	Hoisting & Lowering I.T.	72°00'	17.9%	14.6%
	Miscellaneous	80°00'	19.9%	16.3%
	Repairing	-	- %	- %
	Others	24°00'	6.0%	4.9%
	Total	402°00'	100 %	81.7%
Removing	Preparation	36°00'	-	7.3%
Removing	Moving	54°00'	-	11.0%
	G. Total	492°00'	-	100 %

Efficiency of Drilling

202.80m/Working Period	6.99m/day
202.80m/Working Days	8.45m/day
202.80m/Drilling Period	8.11m/day
202.80m/Net Drilling Days	10.14m/day
Total workers/202.80m	2.60 Man/m
Total Drilling Workers/202.80m	2.16 Man/m
Hoisting&Lowering Rod 46 Times	Hoisting&Lowering I.T. 182 Times

Casing Pipe Inserted	Pipe Size & Meterage	Inserted Length / Drilling Length %	Recovery of Casing Pipe
	HW 0.50 m	0.3 %	100 %
	NW 2.00 m	1.0 %	100 %
	BW 147.40 m	72.7 %	67 %

Remarks

G : Grand

I.T.: Inner Tube

A. I-7 Operation Results of Drill Hole, IC-9

Working Period	Period	Number of Days	Actual Working Days	Day Off	Total Number of Workers
Preparation	15th Jan.'84~17th Jan.'84	3	3	-	66
Drilling	18th Jan.'84~31th Jan.'84	14	14	-	308
Removing	1st Feb.'84 ~4th Feb. '84	4	4	-	88
Total	15th Jan.'84 ~4th Feb.'84	21	21	-	462

Drilling Length			
Planned Length	250.00 m	Over-burden	- m
Increase or Decrease in Length	m	Core Length	251.35 m
Length Drilled	270.10 m	Core Recovery	93.1%

Core Recovery for each 100 m section

Depth of Hole	Section	Total
0∿100 m	100 %	100 %
100∿200 m	96.5 %	97.9 %
200∿270.10 m	79.2 %	93.1 %
m	%	%
m	%	%
m	%	%

Working Time			
Drilling	177°00'	54.6%	45.4%
Hoisting & Lowering Rod	26°00'	8.0%	6.7%
Hoisting & Lowering I.T.	32°00'	9.9%	8.2%
Miscellaneous	53°00'	16.4%	13.6%
Repairing	36°00'	11.1%	9.2%
Others	-	- %	- %
Total	324°00'	100 %	83.1%
Removing: Preparation	24°00'	-	6.1%
Removing: Moving	42°00'	-	10.8%
G. Total	390°00'	-	100 %

Efficiency of Drilling

270.10m/Working Period	12.86m/day
270.10m/Working Days	12.86m/day
270.10m/Drilling Period	19.29m/day
270.10m/Net Drilling Days	19.29m/day
Total workers/270.10 m	1.71 Man/m
Total Drilling Workers/270.10m	1.14 Man/m
Hoisting&Lowering Rod 43 Times	Hoisting&Lowering I.T. 258 Times

Casing Pipe Inserted: Pipe Size & Meterage	Inserted Length / Drilling Length %	Recovery of Casing Pipe
114mm 1.00m	0.37 %	100 %
NW 1.50m	0.55 %	100 %
BW 184.50m	68.30 %	100 %

Remarks

G : Grand

I.T.: Inner Tube

A. I-8 Summarized Operational Data of Each Drill Hole

Drill hole No.	Type of machine	Drilling period	Drilling length	Core		No. of drilling shift			Drilling speed		Remarks
				Length	Recovery	Drilling	Casing etc.	Total	* m/shift	** m/shift	
IC - 6	TGM-3C	20th Sep. '83 ∿ 23th Oct. '83	m 200.30	m 165.10	% 82.4	67	56	123	2.99	1.63	
IC - 7	TGM-3C	28th Oct. '83 ∿ 15th Dec. '83	242.80	201.40	82.9	74	74	148	3.28	1.64	
IC - 8	TGM-3C	20th Dec. '83 ∿ 13th Jan. '84	202.80	190.00	93.7	50	14	64	4.06	3.17	
IC - 9	TGM-3C	18th Jan. '84 ∿ 31th Jan. '84	270.10	251.35	93.1	42	7	49	6.43	5.51	
Total			916.00	807.85	88.2	233	151	384	3.93	2.39	

* Drilled per one shift covering net drilling operations.

** Drilled per one shift covering total works conducted.

A. I-9 Working Time of Each Drill Hole

Drill hole No.	Drilling	Hoisting & lowering rod & I.T.		Miscellaneous			Repairs	Others	Moving Operation	Total
		Rod	Inner tube	Casing insertion	Hole reaming	Others				
IC – 6	195°00'	59°00'	78°00'	72°00'	156°00'	338°00'	12°00'	–	82°00'	992°00'
IC – 7	202°00'	42°00'	72°00'	18°00'	210°00'	323°00'	23°00'	–	48°00'	938°00'
IC – 8	180°00'	46°00'	72°00'	42°00'	30°00'	8°00'	–	24°00'	90°00'	492°00'
IC – 9	177°00'	26°00'	32°00'	18°00'	18°00'	17°00'	36°00'	–	66°00'	390°00'
Total	754°00'	173°00'	254°00'	150°00'	414°00'	686°00'	71°00'	24°00'	286°00'	2,812°00'
					1,250°00'					

A. I-10 Drilling Meterage of Diamond Bits

Item	Size	Type	Bit No.	Drilling meterage by drill hole. Unite meter					Total
				IC-6	IC-7	IC-8	IC-9		
				m	m	m	m		m
Bit	116mm	116mm	E-1293		2.00				2.00
			E-1294				0.30		0.30
			E-1295				0.50		0.50
			Total	-	2.00	-	0.80		2.80
	HX	HQ-WL	P-1022	(0.50)					(0.50)
			P-1023	(1.00)					(1.00)
			P-1024		1.10				1.10
			P-1025		1.30				1.30
			P-1026			0.50			0.50
			Total	(1.50)	2.40	0.50	-		2.90
	NX	NQ-WL	4513	20.60					20.60
			4514	19.80					19.80
			4515	9.60					9.60
			4516	22.10					22.10
			11007	19.80					19.80
			11008	21.50					21.50
			11009	23.90					23.90
			11010	20.30					20.30
			11011		19.40				19.40
			11012		21.10				21.10
			11013		22.10				22.10
			11014		17.80				17.80
			11015		23.60				23.60
			11016		21.10				21.10
			11017		8.80				8.80
			11018			12.60			12.60
			11019			10.20			10.20
			11020			9.70			9.70
			15312			4.80			4.80
			15313			15.70			15.70
			1030			9.20			9.20
			1031			20.10			20.10
			1032			8.60			8.60
			1033			11.20			11.20

Item	Size	Type	Bit No.	Drilling meterage by drill hol. Unite meter					Total
				IC-6	IC-7	IC-8	IC-9		
				m	m	m	m		m
Bit	NX	NQ-WL	1034			14.50			14.50
			1035			2.40			2.40
			1036				12.60		12.60
			1037				18.10		18.10
			1038				11.80		11.80
			1039				19.20		19.20
			1040				17.60		17.60
			1041				16.70		16.70
			1042				17.20		17.20
			1043				20.50		20.50
			1044				18.50		18.50
			1045				17.10		17.10
			1046				10.10		10.10
			Total	157.60	133.90	119.00	179.40		589.90
	BX	BQ-WL	P-1029	21.50					21.50
			P-1030	21.20					21.20
			P-1031		11.50				11.50
			P-1032		9.10				9.10
			P-1033		12.20				12.20
			P-1034		15.10				15.10
			P-1035		16.20				16.20
			P-1036		8.90				8.90
			P-1037		10.20				10.20
			A-47486		15.60				15.60
			471482		5.70				5.70
			471485			20.50			20.50
			471486			21.10			21.10
			D-1407			19.60			19.60
			D-7063			22.10			22.10
			E-7078				22.70		22.70
			E-7079				21.80		21.80
			E-7080				18.90		18.90
			E-7081				26.50		26.50
			Total	42.70	104.50	83.30	89.90		320.40

A. I-11 Specifications of Diamond Bits

Size	Type	Carats per bit	Matrix	Stones per carat	Water way	Number	Remark
116mm	116mm	42	X	1/30	6	E-1293	Reset
		42	X	1/30	6	E-1294	"
		42	X	1/30	6	E-1295	"
HX	HQ-WL	40	Z	1/30	6	P-1022	Reset
		40	Z	1/30	6	P-1023	"
		40	X	1/30	6	P-1024	"
		40	X	1/30	6	P-1025	"
		40	X	1/30	6	P-1026	"
NX	NQ-WL	30	X	1/30	4	4513	Reset
		30	X	1/30	4	4514	"
		30	X	1/30	4	4515	"
		30	X	1/30	4	4516	"
		30	T_1	1/30	4	11007	"
		30	T_1	1/30	4	11008	"
		30	T_1	1/30	4	11009	"
		30	T_1	1/30	4	11010	"
		30	T_1	1/30	4	11011	"
		30	T_1	1/30	4	11012	"
		30	T_1	1/30	4	11013	"
		30	T_1	1/30	4	11014	"
		30	T_1	1/30	4	11015	"
		30	T_1	1/30	4	11016	"
		30	T_1	1/30	4	11017	"
		30	T_1	1/30	4	11018	"
		30	T_1	1/30	4	11019	"
		30	T_1	1/30	4	11020	"
		30	X	1/30	4	15312	"
		30	X	1/30	4	15313	"
		30	X	1/30	4	1030	"
		30	X	1/30	4	1031	"
		30	X	1/30	4	1032	"
		30	X	1/30	4	1033	"

Size	Type	Carats per bit	Matrix	Stones per carat	Water way	Number	Remark
NX	NQ-WL	30	Y	1/30	4	1034	Reset
		30	Y	1/30	4	1035	"
		30	Y	1/30	4	1036	"
		30	Y	1/30	4	1037	"
		30	Y	1/30	4	1038	"
		30	Y	1/30	4	1039	"
		30	Z	1/30	4	1040	"
		30	Z	1/30	4	1041	"
		30	Z	1/30	4	1042	"
		30	Z	1/30	4	1043	"
		30	Z	1/30	4	1044	"
		30	Z	1/30	4	1045	"
		30	Z	1/30	4	1046	"
BX	BQ-WL	20	Z	1/30	4	P-1029	Reset
		20	Z	1/30	4	P-1030	"
		20	Z	1/30	4	P-1031	"
		20	Z	1/30	4	P-1032	"
		20	Z	1/30	4	P-1033	"
		20	Z	1/30	4	P-1034	"
		20	Z	1/30	4	P-1035	"
		20	Z	1/30	4	P-1036	"
		20	T_1	1/30	4	P-1037	"
		20	T_1	1/30	4	A-47486	"
		20	T_1	1/30	4	471482	"
		20	T_1	1/30	4	471485	"
		20	T_1	1/30	4	471486	"
		20	T_1	1/30	4	D-1407	"
		20	T_1	1/30	4	D-7063	"
		20	Y	1/30	4	E-7078	"
		20	Y	1/30	4	E-7079	"
		20	Y	1/30	4	E-7080	"
		20	Y	1/30	4	E-7081	"

APPENDICES
PART II
DATA OF TUNNELLING

LIST OF APPENDICES

A. II-1 Summary of Program

Item	1983 Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	1984 Jan.	Feb.	Mar.	Apr.
1 Mobilization (Tokyo ~ Lima ~ Site)	10 15		15 19								
2 Road Construction											
Restoration		11 24									
Construction		10	17								
Repair				18						8	
3 Equipment Moving in Provisional Works (with housing)		8 23									
4 Advance											
Adit-N 351.2 m		27						5			
Adit-S 330.1 m			11						18		
5 Equipment Moving out								10 11	25 28		
6 Demobilization (Site ~ Lima ~ Tokyo)										9 16	
7 Preparation of Report										17	10

A. II-2 Details of Employed Days for Advance

Adit Name	Moving in Moving out	Period of Advancing Work							Details of Working Period		Principal Accessory Works				
		Camping	No.of Days	Advance	No.of Days	Boring Chamber	No.of Days	Total	Work-ing Days	Suspend-ed Days	Construc-tion Re-pair of Road	No.of Days	Moving in Provision	No.of Days	Total No.of Days
	Accessory Works (Date) 10,Jul,83 8,Mar.84	(Date)	day	(Date)	day	(Date)	day	day	day	days	(Date) 10,Jul,83 8,Mar,84	day 180	(Date) 8,Jul,83 23,Jul,83	day 8	day 188
Adit-N		25,Jul,83 27,Jul,83	3	27,Jul,83 5,Jan.84	135	15,Aug,83 28,Aug,83	13	151	151						
Adit-S				11,Aug,83 18,Feb,84	140	31,Aug,83 29,Sept,83	19	159	140	19					
	Moving out 10,Jan,84 28,Feb.84													6	6
Total No. of Days			3		275		32	310	291	19		180		14	194

Note ; No. of days of each term signifies the No. of days in working term.

A. Ⅱ-3 Summary of Performance

Adit Name	Moving in Moving out	No. of Working Shift: No. of Shift of Advance	No. of Working Shift: Total No. of Shift	No. of Man-shift: Engineer	No. of Man-shift: Worker	No. of Hours for Each Work: Advance	Support	Besides Advance	Sub-Total	Camping Break up	Equipment Moving out	Others	Total
		(shift)	(shift)	(man-shift)	(man-shift)	(hrs.)	(hrs.)	(hrs.)	(hrs.)	(hrs.)	(hrs.)	(hrs.)	(hrs.)
(Accessory Works)	Road Restor.	0	9	9	86	-	-	-	-	-	-	86	86
	" Constr.	4	22	13	169	32	-	-	32	-	-	176	208
	" Repair	0	149	29.5	974	-	-	-	-	-	-	1,192	1,192
	Provision		25	21.5	163	94	-	-	94	96	-	-	190
Adit-N		435	468	552	3,813	2,731	112	325	3,168	24	-	-	3,192
Adit-S		463	512	667.5	4,350	2,863	200	341	3,404	-	-	-	3,404
	Equipment Moving out		23	28	68	-	-	-	-	-	36	60	96
Total		902	1,208	1,320.5	9,623	5,720	312	666	6,698	120	36	1,514	8,368

Note : Provisional works contain equipment moving in and camping etc.

A. II-4 List of the Used Equipment and Appratus for Tunnelling

Name of Equipment	Type and Specification	No., Q'ty	Remarks
Compressor	ATLAS COPCO XA 350 1/S	2	1 for N, 1 for S.
Loader	ATLAS COPCO LM 36	1	for N.
	ATLAS COPCO LM 56	1	for S.
Drifter	ATLAS COPCO BBC-16W	6	3 for N, 3 for S.
Tub	Side Dump Type, Hand Handling 1.0m^3		
Bit Grinder	ATLAS COPCO LSD-61	1	
Generator	YAMMER YSG-35N	1	
	CATERPILLAR SR-4 325 KVA	1	1 for S.
	CATERPILLAR SR-4 69 KVA	1	1 for N.
Ventilator	HITATHI 500ϕ 3.7 KW	6	3 for N, 3 for S.
Bulldozer	CATERPILLAR D7-17A	1	
Vehicle	TOYOTA LAND CRUISER FJ-55	1	
	TOYOTA HIGH LOOKS	1	
	TOYOTA LAND CRUISER FJ-40		
House	Storied House, Galvanized Iron 13 m^2	2	Generator. 1 for N, 1 for S
	Storied House, Galvanized Iron 50 m^2	1	Camp House.
	Storied House, Galvanized Iron 94 m^2	1	Camp House.
	Storied House, Galvanized Iron 80 m^2	1	Kitchen, Dinning Room.
	Storied House, Galvanized Iron 190 m^2	1	Camp House. Office.
	Storied House, Galvanized Iron 18 m^2	1	Warehouse
	Storied House, Galvanized Iron 18 m^2	2	Compressor Chamber 1 for N, 1 for S.
	Storied House, Galvanized Iron 18 m^2	2	Fuel Storage 1 for N, 1 for S.
Powder Magazine	Subterranean Type Powder Magazine	1	
	Subterranean Type Blasting Supplies		

A. II-5 Summary of Advance Works, Adit-N

Construction Period	Date of Starting Work		22, Jun, 1983					
	Date of Starting Advance		27, Jul, 1983					
	Date of Terminating Advance		5, Jan, 1984					
	Date of Finishing Work		11, Jan, 1984					

No. of Necessary Days			Until 5, Jan, 1984			Until 11, Jan, 1984			Remarks
			No.of Days	Per cent (%)		No.of Days	Per cent (%)		
	Working Days	Advance	days 148	84.1	84.1	days 148	83.1	83.1	
		Housing	-	-	-	-	-	-	
		Others	28 "	15.9	15.9	30 "	16.9	16.9	
	Sub-Total		176 "	100.0	100.0	178 "	100.0	100.0	
	Suspended Days		-	-	-	-	-	-	
	Total		176 "	-	100.0	178 "	-	100.0	

No. of Necessary Workers			Perforation	Preparation of Advance, Housing	Accessory Other Works	Remarks
	Staff	Interior	men 504	men -	men -	1 man=8 hrs/Shift
		Surface	-	6 "	42 "	
	Worker	Interior	3,598 "	-	-	
		Surface	-	29 "	186 "	
	Sub-Total	Interior	4,102 "	-	-	
		Surface	-	35 "	228 "	
	Total		4,102 "	35 "	228 "	G. Total 4,365 men

Efficiency		Until 5, Jan, 1984 (351.2 m)	Until 11, Jan, 1984 (351.2 m)	Remarks
	Advance m per 1 working day	1.995 m	1.973 m	
	Advance m per 1 actual Working day	2.373 m	2.373 m	
	Advance m per 1 necessary day	1.995 m	1.973 m	
	Advance m per 1 necessary worker	0.086 m	0.080 m	

Support				
	No. of Support	30 sets		
	Timbering Length (%)	30.1 m (8.6 %)		

A. II-6 Summary of Advance Works, Adit-S

Construction Period	Date of Starting Work	22, Jun, 1983
	Date of Starting Advance	11, Aug, 1983
	Date of Terminating Advance	18, Feb, 1984
	Date of Finishing Work	28, Feb, 1984

No. of Necessary Days			Until 18, Feb, 1984			Until 28, Feb, 1984			Remarks
			No.of Days	Per cent (%)		No.of Days	Per cent (%)		
Working Days	Advance		days 159	84.6	76.8	days 159	82.8	75.4	(*) Leg Drills, robbed 15-27,Aug,1983 Compressor trouble 19-24,Sept,1983 Loader trouble 18,Oct,1983
	Housing		-	-	-	-	-	-	
	Others		29 "	15.4	14.0	33 "	17.2	15.6	
Sub-Total			188 "	100.0	90.8	192 "	100.0	91.0	
Suspended Days (*)			19 "	-	9.2	19 "	-	9.0	
Total			207 "	-	100.0	211 "	-	100.0	

No. of Necessary Workers		Perforation	Preparation of Advance, Housing	Accessory Other Works	Remarks
Staff	Interior	men 644.5	men -	men -	1 man=8 hrs/Shift
	Surface	-	10 "	83 "	
Worker	Interior	3,985 "	-	-	
	Surface	-	30 "	335 "	
Sub-Total	Interior	4,629.5 "	-	-	
	Surface	-	40 "	418 "	
Total		4,629.5 "	40 "	418 "	G. Total 5,087.5 men

Efficiency		Until 18, Feb, 1984 (330.1 m)	Until 28, Feb, 1984 (330.1 m)	Remarks
	Advance m per 1 working day	1.756 m	1.719 m	
	Advance m per 1 actual working day	2.076 m	2.076 m	
	Advance m per 1 necessary day	1.595 m	1.564 m	
	Advance m per 1 necessary worker	0.071 m	0.065 m	

Support				
	No. of Support	35 sets		
	Timbering Length (%)	44.7 m (13.5 %)		

A. Ⅱ-7 Summary of Material Consumption

Name	Specification	Q'ty	Remarks
Petroleum		123,776 ℓ	
Gasoline		8,359 ℓ	
Drifter Oil		450.3 ℓ	
Engine Oil		1,619 ℓ	
Compressor Oil		3,916 ℓ	
Grease		80.8 kg	
Dynamite	DINASOL 7/8"x7"	15,054.6 kg	
Detonator	FULMESA No.6	29,049 nos	
Fuse	FULMESA	172,251.9 ft	
Insert Bit	COROMANT 22m/m Hex.	893 nos	
	Gauge 38m/m 1.8m		
Carbide		212.5 kg	
Timbering Wood		15.5 m^3	No includes Materials
Board		13.1 m^3	for Housing.
Sleeper		838 nos	
Supports		65 sets	

Note: Includes road construction etc.

A. II-8 Details of Material Consumption

Name	Specification	Q'ty		Remarks
		Adit-N	Adit-S	
Petroleum		60,570 ℓ	63,206	
Gasoline		3,452 ℓ	4,907	
Drifter Oil		200 ℓ	250.3	
Engine Oil		792 ℓ	827	
Compressor Oil		1,953 ℓ	1,963	
Grease		38 kg	42.8 kg	
Dynamite	7/8" x 7"	7,268.9 kg	7,785.7 kg	
Detonator	FULMESA No.6	14,253 nos	14,796 nos	
Fuse	FULMESA	85,743.1 ft	86,508,8 ft	
Insert Bit	COROMANT 22m/m Hex.	403 nos	490 nos	
	Gauge 38m/m 1.8m			
Carbide		119.5 kg	93 kg	
Timbering Wood	ϕ0.05 x 3.0m			
	ϕ0.10 x 3.0m			
	ϕ0.15 x 3.0m	11 m^3	4.5 m^3	
	ϕ0.20 x 3.0m			
	ϕ0.25 x 3.0m			
	ϕ0.30 x 3.0m			
Board	0.3mx0.05mx1.8m	6.3 m^3	6.8 m^3	
Sleeper	0.15mx0.15mx1.2m	397 nos	441 nos	
Supports		30 sets	35 sets	

A. II-9 Surveying Result, Adit-N

Survey Point	Direction	Horizontal Distance (m)	Coordinate (m)		Elevation (m)
			Longitude	Latitude	
N1	-	-	310,344.28	8,809,084.30	4,689.37
N1 -N2	111°40'30"	20.329	310,376.21	8,809,077.06	4,689.73
N2 -N3	112°31'41"	33.641	310,407.28	8,809,064.17	4,690.29
N3 -N4	112°38'18"	22.963	310,428.47	8,809,055.33	4,690.49
N4 -N5	112°29'21"	22.632	310,449.38	8,809,046.68	4,690.54
N5 -N6	128°31'16"	10.849	310,457.87	8,809,039.92	4,690.62
N6 -N7	158°21'26"	4.961	310,459.70	8,809,035.31	4,690.74
N7 -N8	173°29'56"	6.526	310,460.44	8,809,028.82	4,690.84
N8 -N9	159°56'06"	23.839	310,468.62	8,809,006.43	4,691.00
N9 -N10	159°59'31"	21.000	310,475.80	8,808,986.70	4,691.28
N10-N11	159°57'01"	26.255	310,484.803	8,808,962.037	4,691.578
N11-N12	159°54'11"	37.265	310,497.607	8,808,927.041	4,691.724
N12-N13	159°48'36"	23.576	310,505.743	8,808,904.914	4,691.719
N13-N14	159°44'56"	31.690	310,516.712	8,808,875.183	4,692.080
N14-N15	159°44'56"	24.488	310,525.188	8,808,852.209	4,692.231
N15-N16	159°49'46"	29.836	310,535.475	8,808,824.203	4,692.391
N16-N17	159°46'31"	22.620	310,543.294	8,808,802.978	4,692.491
N17-N18	159°46'31"	25.642	310,552.158	8,808,778.917	4,692.606
N18-N19	159°42'06"	30.309	310,562.672	8,808,750.491	4,692.797
N19-N20	159°32'06"	38.273	310,576.053	8,808,714.634	4,693.097
N20-N21	159°21'56"	28.736	310,586.179	8,808,687.742	4,693.305
N21-F		25.400			

A. Ⅱ-10 Surveying Result, Adit-N, Crssscut osscut

Survey Point	Direction	Horizontal Distance (m)	Coordinate (m)		Elevation (m)
			Longitude	Latitude	
N15			310,525.188	8,808,852.209	4,692.231
N15-CN4	248°02'06"	23.816	310,503.101	8,808,843.301	4,692.306
CN4-CN5	248°03'16"	24.249	310,480.610	8,808,834.239	4,692.564
CN5-CN6	247°57'51"	35.339	310,447.853	8,808,820.981	4,693.020
CN6-CN7	247°44'41"	31.479	310,418.720	8,808,809.059	4,693.413
CN7-CN8	247°43'01"	31.427	310,389.640	8,808,797.143	4,693.902
CN8-F		6.300			

A. Ⅱ-11 Surveying Result, Adit-S

Survey Point	Direction	Horizontal Distance (m)	Coordinate (m)		Elevation (m)
			Longitude	Latitude	
S1	-	-	310,968.25	8,807,260.34	4,570.14
S1 -S2	359°30'37"	20.421	310,968.08	8,807,881.36	4,570.20
S2 -S3	1°04'22"	31.541	310,968.67	8,807,912.90	4,570.44
S3 -S4	1°01'47"	24.693	310,969.11	8,807,937.59	4,570.76
S4 -S5	0°46'37"	19.689	310,969.377	8,807,957.273	4,570.91
S5 -S6	359°10'47"	33.582	310,968.90	8,807,990.85	4,571.21
S6 -S7	357°24'32"	8.190	310,968.53	8,807,999.03	4,571.33
S7 -S8	327°31'22"	26.245	310,954.44	8,808,021.17	4,571.572
S8 -S9	327°10'12"	21.519	310,942.769	8,808,039.254	4,571.852
S9 -S10	329°56'32"	29.518	310,927.985	8,808,064.802	4,572.241
S10-S11	330°53'42"	29.832	310,913.475	8,808,090.867	4,572.398
S11-S12	330°04'52"	23.450	310,901.779	8,808,111.191	4,572.496
S12-S13	330°01'02"	26.445	310,888.564	8,808,134.097	4,572.707
S13-S14	329°52'42"	35.288	310,870.856	8,808,164.619	4,573.225
S14-S15	329°54'02"	35.968	310,852.818	8,808,195.736	4,573.562
S15-S16	329°24'02"	38.090	310,833.429	8,808,228.521	4,573,587
S16-S17	329°15'37"	30.654	310,817.761	8,808,254.868	4,573.722
S17-S18	329°00'27"	38.379	310,797.999	8,808,287.767	4,574.209
S18-S19	329°38'32"	35.381	310,780.118	8,808,318.296	4,574.279
S19-S20	330°08'32"	31.319	310,764.526	8,808,345.457	4,574.437
S20-S21	329°54'57"	45.220	310,741.859	8,808,384.585	4,574.534
S21-F		15.100			

APPENDICES
PART Ⅲ
GEOLOGICAL DATA

LIST OF APPENDICES

A. Ⅲ-1 Assay Results (1) Drilling Core (1)

No.	Sample No.	Depth (m)	Length (m)	Rock Type	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)
001	IC-6-095	94.2- 95.5	1.3	Ald	0.09	0.02	0.80	nd
002	IC-6-096	95.5- 96.8	1.3	Ald	0.02	0.16	1.90	4
003	IC-6-097	96.8- 98	1.2	Ore	0.02	2.80	2.10	4
004	IC-6-098	98 - 99	1	Ore	0.02	0.12	4.85	4
005	IC-6-099	99 -100	1	Ore	0.01	0.05	2.41	4
006	IC-6-100	100 -101	1	Ore	0.08	0.02	12.34	4
007	IC-6-101	101 -102	1	Ore	0.02	0.02	2.11	4
008	IC-6-103	102.0-103.5	1.5	Ald	0.02	0.27	1.41	4
009	IC-6-104	103.5-105.0	1.5	Ald	0.03	0.02	1.30	tr
010	IC-6-105	105.0-106.5	1.5	Ald	0.20	0.02	3.61	tr
011	IC-6-107	106.5-108.0	1.5	Ald	0.02	0.02	0.25	4
012	IC-6-108	108.0-109.3	1.3	Ald	0.03	0.02	6.42	4
013	IC-6-110	109.3-110.5	1.2	Ald	0.03	0.03	30.21	20
014	IC-6-111	110.5-112.0	1.5	Ald	0.28	0.02	22.88	4
015	IC-6-113	112.0-103.5	1.5	Ald	0.62	0.02	29.10	4
016	IC-6-114	103.5-115.0	1.5	Ald	0.56	0.01	19.06	44
017	IC-6-116	115.0-116.4	1.4	Ald	3.43	0.02	1.20	112
018	IC-6-117	116.4-117.8	1.4	Ald	4.59	0.01	0.30	4
019	IC-6-119	117.8-120.3	2.5	Py	0.83	0.02	0.30	4
020	IC-6-121	120.3-122.8	2.5	Py	2.43	0.02	0.30	4
021	IC-6-124	122.8-126.4	3.6	Py	0.48	0.02	0.20	16
022	IC-6-127	126.4-130.4	4.0	Py	2.99	0.01	0.08	8
023	IC-6-131	130.4-135.9	5.5	Py	0.58	0.02	0.08	16
024	IC-6-136	135.9-140	4.1	Py	0.28	0.02	0.02	12
025	IC-6-140	140 -145	5	Py	1.00	0.03	0.70	20
026	IC-6-145	145 -150	5	Py	0.18	0.09	0.08	12
027	IC-6-150	150 -155	5	Py	0.74	0.02	0.03	36
028	IC-6-155	155 -160	5	Py	0.24	0.01	0.90	tr
029	IC-6-167	167.0-168.1	1.1	Sid	0.05	0.01	1.30	12
030	IC-6-181	180.9-182.2	1.3	Sid	0.04	0.02	3.51	4
031	IC-6-183	182.2-183.8	1.6	Py	0.04	0.02	0.20	20
032	IC-6-184	183.8-185.4	1.6	Py	0.03	0.03	0.30	tr
033	IC-6-186	185.4-186.3	0.9	Py	0.01	0.75	3.91	tr
034	IC-6-193	192.8-194.4	1.6	Sid	0.02	0.03	1.65	tr
035	IC-6-195	194.4-195.9	1.5	Sid	0.01	0.01	1.60	12
036	IC-6-197	195.9-198.7	4.8	Sh	0.01	0.01	0.30	4
037	IC-6-199	198.7-200.3	1.6	Sid	0.02	0.02	0.60	4
038	IC-7-138	138 -140	2	Py	0.13	0.06	0.36	4
039	IC-7-140	140 -142	2	Py	0.06	0.03	0.75	nd
040	IC-7-142	142 -144	2	Py	0.08	0.04	0.75	nd
041	IC-7-144	144 -146	2	Py	0.11	0.02	0.03	nd
042	IC-7-146	146 -148	2	Py	0.07	0.02	0.15	tr
043	IC-7-148	148 -150	2	Py	0.05	0.03	0.13	tr
044	IC-7-150	150 -152	2	Py	0.04	0.02	0.06	tr
045	IC-7-152	152 -154	2	Py	0.06	0.02	0.18	tr
046	IC-7-168	167.2-170.0	2.8	Do	0.05	0.04	0.90	tr
047	IC-7-179	178.4-179.5	1.1	Do	0.10	0.03	2.80	nd
048	IC-7-198	197.5-198.5	1.0	Do	0.01	0.02	0.30	nd
049	IC-7-207	206.5-207.8	1.3	Sid	0.02	0.02	0.90	tr
050	IC-7-215	214.7-216.0	1.3	Do	0.05	0.02	0.60	tr

(2)

No.	Sample No.	Depth (m)	Length (m)	Rock Type	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)
051	IC-7-216	216 -217	1	Py.Po	0.04	0.03	0.36	tr
052	IC-7-217	217 -218	1	Py.Po	0.03	0.02	0.08	4
053	IC-7-218	218 -219	1	Py.Po	0.05	0.02	0.25	tr
054	IC-7-219	219 -220	1	Py.Po	0.03	0.03	0.20	tr
055	IC-7-220	220 -221	1	Py.Po	0.03	0.05	0.12	tr
056	IC-7-221	221 -222	1	Py.Po	0.04	0.03	0.20	tr
057	IC-7-222	222 -223	1	Py.Po	0.05	0.02	0.20	tr
058	IC-8-110	109.5-113.8	4.3	Py	0.05	0.04	0.08	nd
059	IC-8-115	113.8-118.2	4.3	Py	0.04	0.02	0.15	nd
060	IC-8-119	118.2-122.7	4.5	Py	0.06	0.02	0.07	nd
061	IC-8-123	122.7-127.2	4.5	Py	0.06	0.01	0.08	nd
062	IC-8-128	127.2-131.6	4.4	Py	0.04	0.02	0.06	tr
063	IC-8-132	131.6-135.5	3.9	Py	0.04	0.02	0.07	tr
064	IC-8-136	135.5-138.8	3.3	Py	0.06	0.02	0.09	tr
065	IC-8-139	138.8-141.9	3.1	Py	0.06	0.02	0.06	tr
066	IC-8-142	141.9-145.1	3.2	Py	0.05	0.01	0.03	nd
067	IC-8-148	145.1-148.3	3.2	Py	0.04	0.01	0.10	nd
068	IC-8-149	148.3-150.5	2.2	Ald	0.06	0.01	0.90	tr
069	IC-8-151	150.5-151.6	1.1	Cu	0.24	0.02	0.70	tr
070	IC-8-152	151.6-152.8	1.2	Cu	0.87	0.01	1.51	tr
071	IC-8-153	152.8-154.0	1.2	Cu	0.36	0.02	0.55	nd
072	IC-8-154	154.0-156.8	2.8	Ald	0.12	0.02	2.46	nd
073	IC-8-157	156.8-159.2	2.4	Ald	0.07	0.02	2.31	tr
074	IC-8-160	159.2-163.8	4.6	Ald	2.59	0.02	0.30	40
075	IC-8-164	163.8-166.8	3.0	Py	0.12	0.01	0.25	tr
076	IC-8-167	166.8-169.7	2.9	Py	0.09	0.02	0.13	nd
077	IC-8-170	169.7-173.2	3.5	Ald	0.32	0.01	0.55	tr
078	IC-8-174	173.2-174.5	1.3	Spc	0.07	1.76	0.08	4
079	IC-8-175	174.5-175.8	1.3	Spc	0.74	0.23	0.20	32
080	IC-8-176	175.8-177.0	1.2	Cu	0.10	0.02	0.03	tr
081	IC-8-177	177.0-178.1	1.1	Cu	6.96	0.05	0.10	36
082	IC-8-179	178.1-180.3	2.2	Ald	0.03	0.02	0.15	tr
083	IC-8-181	180.3-182.5	2.2	Ald	0.02	0.02	0.03	tr
084	IC-8-183	182.5-184.2	1.7	Ald	0.01	0.02	0.85	nd
085	IC-9-185	184.7-190.0	5.3	Ald	0.08	0.03	0.04	tr
086	IC-9-190	190.0-195.3	5.3	Ald	0.10	0.02	0.03	4
087	IC-9-195	195.3-200	4.7	Py	0.02	0.02	0.01	tr
088	IC-9-200	200 -205	5	Py	0.02	0.02	0.01	nd
089	IC-9-205	205 -210	5	Py	0.05	0.01	0.08	4
090	IC-9-210	210 -215	5	Py	0.06	0.02	0.09	3
091	IC-9-215	215 -220	5	Py	0.06	0.01	0.01	nd
092	IC-9-220	220 -225	5	Py	0.03	0.01	0.01	4
093	IC-9-225	225 -230	5	Py	0.04	0.02	0.01	tr
094	IC-9-230	230 -235	5	Py	0.03	0.02	0.01	132
095	IC-9-235	235 -240	5	Py	0.04	0.01	0.01	3
096	IC-9-240	240 -245	5	Py	0.04	0.02	tr	tr
097	IC-9-245	245 -250	5	Py	0.05	0.02	tr	tr
098	IC-9-250	250 -255	5	Py	0.05	0.02	nd	2
099	IC-9-255	255 -260	5	Py	0.03	0.02	nd	4
100	IC-9-260	260 -270	10	Py	0.03	0.02	nd	tr

A. Ⅲ-1 Assay Results (2) Tunnelling Sample

No.	Sample No.	Depth (m)	Length (m)	Rock Type	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)
T01	CN-5-14	60 - 61	1	Ald	1.40	0.20	4.52	nd
T02	CN-5-16	62 - 63	1	Ald	0.12	0.07	1.61	nd
T03	CN-5-18	64 - 65	1	Ald	0.06	0.20	1.10	nd
T04	CN-5-20	66 - 67	1	Ald	0.24	0.07	1.72	nd
T05	CN-5-22	68 - 69	1	Ald	0.02	0.02	2.51	nd
T06	CN-5-29	75 - 76	1	Ald	0.12	0.05	0.60	4
T07	CN-5-33	79 - 80	1	Py	1.49	0.02	1.20	tr
T08	CN-6-02	83 - 84	1	Py	1.95	0.10	0.15	4
T09	CN-6-06	87 - 88	1	Py	0.07	0.05	0.15	tr
T10	CN-6-10	91 - 92	1	Py	0.06	0.05	0.20	nd
T11	CN-6-14	95 - 96	1	Py	0.06	0.05	0.08	nd
T12	CN-6-18	99 - 100	1	Py	0.08	0.07	0.12	nd
T13	CN-6-22	103 - 104	1	Py	0.18	0.10	0.10	tr
T14	CN-6-26	107 - 108	1	Py	9.10	0.07	0.15	tr
T15	CN-6-30	111 - 112	1	Py	0.32	0.20	0.30	tr
T16	CN-6-34	115 - 116	1	Py	0.06	0.01	1.15	nd
T17	CN-7-24N	137 - 138	1	Ore	0.24	0.05	19.57	nd
T18	CN-7-25N	138 - 139	1	Ore	0.04	0.03	5.72	8
T19	CN-7-26N	139 - 140	1	Ore	0.03	0.65	14.75	60
T20	CN-7-27N	140 - 141	1	Ore	0.08	0.20	5.52	4
T21	CN-7-28N	141 - 142	1	Ore	0.10	0.05	14.55	8
T22	CN-7-29N	142 - 143	1	Ore	0.08	0.03	8.03	4
T23	CN-7-30N	143 - 144	1	Ore	0.09	0.04	22.18	4
T24	CN-7-31N	144 - 145	1	Ore	0.14	0.03	28.60	tr
T25	CN-7-32N	145 - 146	1	Ore	0.10	0.05	24.49	16
T26	CN-7-33N	146 - 147	1	Ore	0.12	0.03	17.06	8
T27	CN-7-34N	147 - 148	1	Ore	0.19	0.04	27.09	12
T28	CN-7-35N	148 - 149	1	Ore	0.07	0.02	17.76	8
T29	CN-7-24S	137 - 138	1	Ore	0.09	0.07	12.85	4
T30	CN-7-25S	138 - 139	1	Ore	0.03	0.07	13.75	4
T31	CN-7-26S	139 - 140	1	Ore	0.04	0.02	4.82	16
T32	CN-7-27S	140 - 141	1	Ore	0.03	0.02	7.11	tr
T33	CN-7-28S	141 - 142	1	Ore	0.04	0.03	15.66	tr
T34	CN-7-29S	142 - 143	1	Ore	0.09	0.02	16.45	12
T35	CN-7-30S	143 - 144	1	Ore	0.14	0.03	23.68	4
T36	CN-7-31S	144 - 145	1	Ore	0.12	0.02	26.70	4
T37	CN-7-32S	145 - 146	1	Ore	0.12	0.03	27.66	tr
T38	CN-7-33S	146 - 147	1	Ore	0.10	0.04	20.05	8
T39	CN-7-34S	147 - 148	1	Ore	0.08	0.05	20.17	4
T40	CN-7-35S	148 - 149	1	Ore	0.12	0.05	16.96	4

Abbreviations

Ore : Pb.Zn ore
Cu : Cu ore
Py : Pyrite
Po : Pyrrhotite
Spc : Specularite

Ald : Altered rock
Sid : Siderite
Do : Dolomite
Sh : Shale

A. Ⅲ-2 Summary of Microscopic Observations

(1)

Sample No.	Type \ Minerals	Sphalerite	Sphalerite ※	Galena	Chalcopyrite	Pb-Bi mineral	Bornite	Covelline		Pyrite	Pyrrhotite	Arsenopyrite	Marcasite	Hematite	Magnetite	Pb-As mineral	Ti mineral	Graphite		Remarks
IC-6-090	Do-Ss	•			•					•										dis
IC-6-098	Do-Ss	o		o						o										dis
IC-6-100	Sp dis Sh		○	o	o					○										Gl is fgd in Sp
IC-6-112	Sp-Gl dis Sh		○	o	o					o										Gl is fgd in Sp
IC-6-129	Cp-v		○	•	◎	•	•			o		•		•						Bi and Bn are in Sp
IC-6-168	Sid			•						o							•			
IC-6-181	Sp-Gl dis Sid	o	•	o	•					o										dis
IC-6-182	Sp-Po-Py-ore	o		o						o	◎									Sp in Po
IC-7-106	Do	•								o								•		
IC-7-143	Py-ore									◎										Py aggregation
IC-7-207	Sid									o										
IC-7-217	Po-Py-ore	•								◎	◎									Py is auhedral
IC-8-116	Py-ore	•								◎										
IC-8-152	Hm-ore	•	•		o		o							○	○	•				
IC-8-160	Hm-ore				•		•							○						Bn is with Cp
IC-8-163	Py-ore				○					○		•		○	○					
IC-8-167	Py-ore	•			•			•		◎										Cp is fgd in Py
IC-8-170	Py-ore				•					○				o						Cp is in Py and around Py
IC-8-177	Cp-Hm-ore				•									○	○					
IC-8-189	Py-ore	•			•		•			o				•						Bn is with Cp,Cp is vs in Py

v: vein　　dis: disseminated　　※ Sphalerite with chalcopyrite dots

◎ abundant　　○ common　　o fairly　　• rare

(2)

Sample No.	Type	Sphalerite	Sphalerite ※	Galena	Chalcopyrite	Pb-Bi mineral	Bornite	Covelline		Pyrite	Pyrrhotite	Arsenopyrite	Marcasite	Hematite	Magnetite	Pb-As mineral	Ti mineral	Graphite		Remarks
CN-5-20	Do	∘									•		•					∘		
CN-6-24	Py-dis ore	•		•	•					○				•						Gl and Cp are fgd in Py
CN-7-17	Py-ore	•			•		•			◎	•									dis in Py
CN-7-24	Sp-Hm-ore	◎	∘	•	•									∘						Gl is fgd in Sp
CN-7-26	Sp-Py-ore	○	∘	•	•					○										dots of Cp in Sp
CN-7-28	Sp-drs	◎	∘	•	•					∘										Gl is fgd in Sp
CN-7-29	Sp-Py-ore		∘		•					◎										
CN-7-31	Sp-Py-ore	∘	•		•					◎	•									Gl is fgd in Sp
CN-7-33	Sp-Py-ore	○	•	•	•					○										
CN-7-35	Sp-Py-ore	○	•	•	•					○										

v: vein   dis: disseminated   ※: Sphalerite with chalcopyrite dots

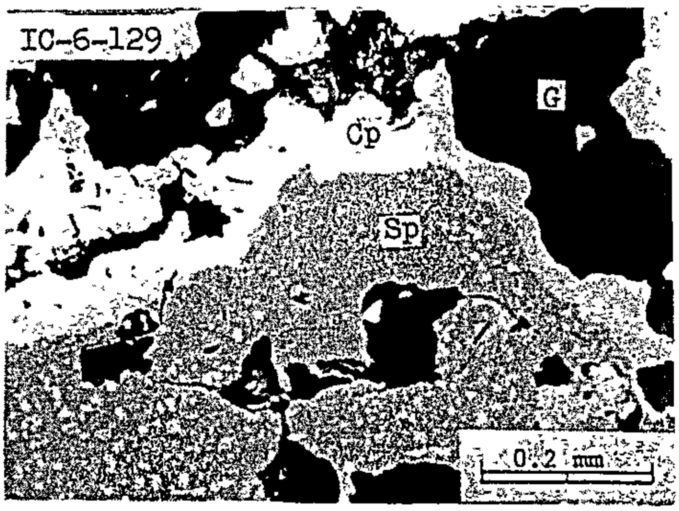
◎ abundant   ○ common   ∘ fairly   • rare

A. Ⅲ-3 Microscopic Observations of Polished Section (1)

Sample No.	Rock Type	Microscopic Observations
IC-6-091	Dolomite	Ore minerals recognized in this section are slight amount of pyrite and very slight amount of sphalerite and chalcopyrite. Pyrite is anhedral and is found disseminated. Sphalerite does rarely contain dots of chalcopyrite and is scatteringly disseminated. Only a grain of chalcopyrite was recognized in this section. It is noted that unidentified minerals which could be taken as graphite are recognized.
IC-6-098	Dolomitic sandstone (Zn diss.)	Ore minerals recognized in this section are slight amount of pyrite, sphalerite and galena. Pyrite is euhedral-anhedral and is found to be scatteringly disseminated. Sphalerite rarely contains dots of chalcopyrite and is recognized to be scatteringly disseminated. Galena is also recognized to be scatteringly disseminated.
IC-6-101	Dolomitic sandstone (Zn diss.)	Ore minerals recognized in this section are large amount of pyrite and sphalerite with small amount of galena and chalcopyrite. Pyrite is euhedral - anhedral and is recognized in form of dissemination or in porphyritic texture. Sphalerite contains dots of chalcopyrite and is recognized to be disseminated or to occur around pyrite grains. Chalcopyrite is recognized to occur in dots contained in sphalerite. Galena is found to be fine grained, contained in sphalerite.
IC-6-112	Zn-Py ore	Ore minerals recognized in this section are large amount of sphalerite with small amount of pyrite, chalcopyrite and galena. Sphalerite contains dots of chalcopyrite and is found to occur in network. Chalcopyrite is recognized to occur in dots contained in sphalerite. Pyrite is euhedral - anhedral and is recognized to be scattered in sphalerite or in gangues. Galena is fine grained (several 10 μm), and is recognized to occur contained in sphalerite grains.
IC-6-129	Cu ore in vein	Ore minerals recognized in this section are very large amount of chalcopyrite and large amount of sphalerite with small amount of pyrite, although slight amounts of hematite, galena, azurite, Pb-Bi series (?) minerals and arsenopyrite are recognized. Chalcopyrite is found to be massive and in some cases it is recognized to occur surrounding sphalerite. Sphalerite contains dots of chalcopyrite and is found to be contained in chalcopyrite. Pyrite is euhedral and is found to be contained in chalcopyrite in many cases. Hematite is also found to be contained in chalcopyrite. Galena, azurite and Pb-Bi series (?) minerals are found to be fine grained (under 100 μm) and are recognized to be contained in sphalerite and chalcopyrite (see photograph).
IC-6-168	Siderite	Ore minerals recognized in this section are small amount of pyrite and slight amount of Ti minerals (?) with very slight amount of galena. Pyrite is euhedral - anhedral and is found to be scatteringly disseminated. Ti minerals (?) are also found to be fine grained (several 10 μm) and is recognized to be scatteringly disseminated. Only one grain of galena has been found in this section in an approximate diameter of 100 μm. It is noted that the Ti minerals (?) could possibly be identified as sphalerite.
IC-6-181	Siderite (Zn diss.)	Ore minerals recognized in this section are small amount of sphalerite, galena and pyrite with slight amount of chalcopyrite. Sphalerite contains dots of chalcopyrite in parts, and is recognized to be disseminated and to occur in porphyritic texture or along veinlets. The occurrence of galena is similar to that of sphalerite. Pyrite is euhedral - anhedral and is found to be scatteringly disseminated.
IC-6-182	Zn-Po-Py ore	Ore minerals recognized in this section are very large amount of pyrrhotite and large amount of pyrite with small amount of sphalerite and galena. Pyrrhotite is found to be massive and includes pyrite, sphalerite and galena in some cases, while it is recognized to be surrounding them in other cases. Sphalerite rarely contains dots. Pyrite is euhedral in most cases. It is noted that pyrrhotite has been marcasitized along cracks or along the peripheral parts in contact with pyrite. It is thought that the order of the crystallization would have been pyrite → sphalerite and galena → pyrrhotite → marcasitization (see photograph).
IC-7-106	Dolomite	Ore minerals recognized in this section are small amount of pyrite and slight amount of sphalerite. Pyrite is euhedral - anhedral and is recognized to be scatteringly disseminated. Sphalerite rarely contains dots of chalcopyrite, and is found to be scatteringly disseminated. It is noted that there are some other minerals which seem to be graphite.
IC-7-143	Py massive ore	Ore minerals recognized in this section are very large amount of pyrite. Pyrite is euhedral - anhedral and is recognized to be aggregated or massive.

Sample No.	Rock Type	Microscopic Observations
IC-7-207	Siderite	Ore minerals recognized in this section are small amount of pyrite. Pyrite is euhedral - anhedral and is found to be disseminated or aggregated.
IC-7-217	Po-Py ore	Ore minerals recognized in this section are very large amount of pyrite and pyrrohtite with slight amount of sphalerite. Pyrite is euhedral, and pyrrohtite is found to occur filling spaces among pyrite grains. Sphalerite rarely contains dots of chalcopyrite, and is found around pyrite. Pyrrhotite is found to occur surrounding sphalerite. Therefore, it is thought that the order of the crystallization would have been pyrite → sphalerite → pyrrhotite.
IC-8-116	Py siliceous ore	Ore minerals recognized in this section are very large amount of pyrite and slight amount of sphalerite. Pyrite is euhedral - anhedral, and massive. Sphalerite rarely includes dots of chalcopyrite. It is fine grained (under 200 μm) and is recognized to occur in and around pyrite.
IC-8-152	Hematite ore	Ore minerals recognized in this section are large amount of hematite and magnetite with small amount of chalcopyrite and bornite, although slight amounts of sphalerite and Pb-As series (?) minerals are recognized. Chalcopyrite is associated with bornite and they are recognized to be disseminated or in porphyritic texture. Sphalerite includes dots of chalcopyrite partly, and is included in chalcopyrite. Pb-As series (?) minerals are found included in bornite and along boundaries between chalcopyrite and bornite. It is possible that these minerals of Pb-As series (?) would belong to minerals of Pb-Bi series or Pb-Sb series. Hematite is recognized to occur in needel-like crystals, in forms of dissemination or aggregation. Magnetite is found to occur around hematite (see photograph).
IC-8-161	Hematite ore	Ore minerals recognized in this section are large amount of hematite with slight amount of chalcopyrite, bornite and sphalerite. Hematite is found to occur in needle-like crystals. Chalcopyrite is found to be associated with bornite in some cases, while it is associated with sphalerite in other cases.
IC-8-163	Py siliceous ore	Ore minerals recognized in this section are large amount of chalcopyrite, pyrite, magnetite, hematite and slight amount of arsenopyrite. Chalcopyrite is found to be disseminated or to occur around pyrite. Pyrite is euhedral in many occasions. Magnetite and hematite are also recognized around chalcopyrite. Accordingly, it is thought that the order of crystallization would have been chalcopyrite → pyrite → magnetite → hematite.
IC-8-167	Py massive ore	Ore minerals recognized in this section are very large amount of pyrite and slight amount of chalcopyrite with very slight amount of sphalerite and azurite. Pyrite is found to be massive. Chalcopyrite and sphalerite are fine grained and are recognized to be contained in pyrite. Azurite is also found to be included in pyrite.
IC-8-170	Py diss. ore	Ore minerals recognized in this section are large amount of pyrite and small amount of hematite and sphalerite with slight amount of chalcopyrite. Chalcopyrite is euhedral and is found to be disseminated or in porphyritic texture. Sphalerite is recognized to contain dots of chalcopyrite in parts, and is found to occur in and around pyrite. Chalcopyrite is also found in and around pyrite.
IC-8-177	Cu-Spc ore	Ore minerals recognized in this section are large amount of magnetite and hematite with slight amount of chalcopyrite. Magnetite is recognized in characteristic succaroidal form which seems to have replaced parts of certain gangue minerals, while hematite is found to occur in needel-like crystals. Chalcopyrite is recognized to be scatteringly disseminated in gangues.
IC-8-178	Py ore	Ore minerals recognized in this section are small amount of pyrite and slight amount of hematite and chalcopyrite with very slight amount of sphalerite. Pyrite is euhedral and is recognized to occur in seams or disseminated. Chalcopyrite is found in veinlets and in dots contained in pyrite. Sphalerite is found to occur in dots contained in pyrite.

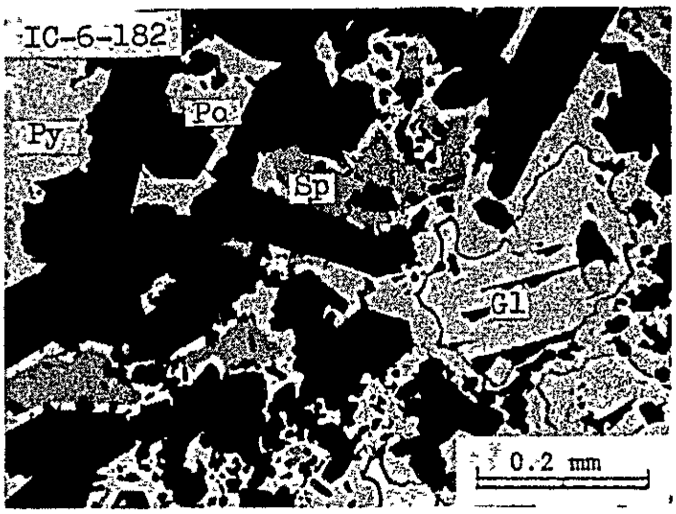
Sample No.	Rock Type	Microscopic Observations
CN-5-20	Dolomite	Ore minerals recognized in this section are small amount of sphalerite and very small amount of pyrrhotite, marcasite (?) and graphite-like mineral. Sphalerite is found to be fine grained (under 100 μm) and is recognized to be scatteringly disseminated. Only one grain of pyrrhotite has been recognized, in this section, which is associated with marcasite(?).
CN-6-24	Altered rock (Py diss.)	Ore minerals recognized in this section are large amount of pyrite and slight amount of hematite, chalcopyrite and sphalerite with very slight amount of galena. Pyrite is found to be massive or in porphyritic texture. Chalcopyrite, galena and hematite are fine grained and are recognized to be contained in pyrite. Sphalerite is found to be fine grained (under 100 μm) and is recognized to be associated with gangue minerals.
CN-7-17	Py massive ore	Ore minerals recognized in this section are very large amount of pyrite and slight amount of sphalerite, chalcopyrite, azurite and phrrhotite (?). Pyrite is found to be massive. Other minerals as sphalerite (including no dots of chalcopyrite), chalcopyrite, azurite and pyrrhotite (?) are recognized to occur in dots contained in pyrite.
CN-7-24	Zn-Spc ore	Ore minerals recognized in this section are very large amount of sphalerite and small amount of hematite with slight amount of chalcopyrite and galena. Sphalerite contains dots of chalcopyrite in parts, and is recognized to be massive. Hematite is found to occur in needle-like crystals and is found to be contained in sphalerite. Chalcopyrite is recognized to be in dots included in sphalerite. Galena is also recognized to occur in dots contained in sphalerite.
CN-7-26	Zn diss. ore	Ore minerals recognized in this section are large amount of sphalerite and pyrite with slight amount of galena and chalcopyrite. Sphalerite contains dots of chalcopyrite in parts and is recognized to be in porphyritic texture or in form of dissemination. Pyrite is euhedral and is recognized to be disseminated in and around sphalerite as well as in gangues. Galena is recognized to be in diameter of 500 μm to several 10 μm, included in sphalerite. Chalcopyrite is recognized to occur in dots contained in sphalerite. It is characteristic in this specimen that pyrite is found to occur surrounding sphalerite, and it is thought that the order of the crystallization would have been sphalerite → pyrite (see photograph).
CN-7-28	Zn drusy ore	Ore minerals recognized in this section are very large amount of sphalerite and small amount of pyrite with slight amount of galena and chalcopyrite. Sphalerite contains dots of chalcopyrite in parts and is recognized to exist in porphyritic texture. Pyrite is euhedral - anhedral and is found to be contained in sphalerite. Galena and chalcopyrite are recognized to occur in dots included in sphalerite.
CN-7-29	Zn-Py ore	Ore minerals recognized in this section are very large amount of pyrite and small amount of sphalerite with slight amount of chalcopyrite. Pyrite is recognized to be in porphyritic texture and in form of dissemination. Sphalerite contains dots of chalcopyrite and is recognized to occur surrounding pyrite and filling spaces among pyrite grains. Chalcopyrite is found to occur in dots contained in sphalerite.
CN-7-31	Zn-Py ore	Ore minerals recognized in this section are very large amount of pyrite and small amount of sphalerite with slight amount of chalcopyrite and pyrrhotite (?). Pyrite is found to be massive. Sphalerite contains dots of chalcopyrite in parts, and is recognized to occur in and around pyrite. Chalcopyrite is found to be in dots contained in sphalerite. Pyrrhotite is recognized to be in dots contained in pyrite. It is noted that pyrite has been marcasitized as a whole.
CN-7-33	Zn-Py ore	Ore minerals recognized in this section are large amount of pyrite and sphalerite with slight amount of chalcopyrite, thought very slight amount of galena is recognized. Sphalerite contains dots of chalcopyrite in very small parts, and is found to be associated with pyrite. Chalcopyrite is recognized to be in dots contained in sphalerite. Galena is in diameter of 20 - 30 μm and is found to be contained in sphalerite, though no more than 2 or 3 grains of galena are recognized.
CN-7-35	Zn-Py ore	Ore minerals recognized in this section are large amount of pyrite and sphalerite with slight amount of chalcopyrite and galena. Sphalerite contains dots of chalcopyrite partly and is recognized to occur surrounding pyrite and filling spaces among pyrite grains. Chalcopyrite is recognized to be in dots contained in sphalerite. Galena is found in a diameter of several 10 μm and contained in sphalerite (see photograph).



Sample No. IC-6-129

Type of Ore : Cp Ore

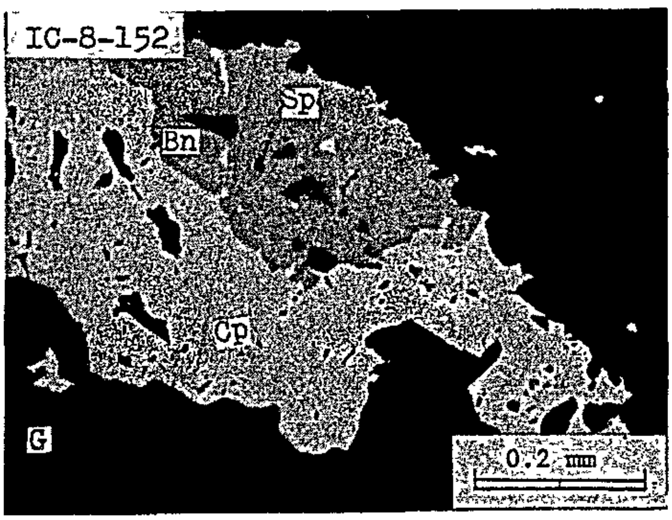
Cp : chalcopyrite
Sp : sphalerite
G : gangue minerals



Sample No. IC-6-182

Type of Ore : Gl-Sp-Po-Py Ore

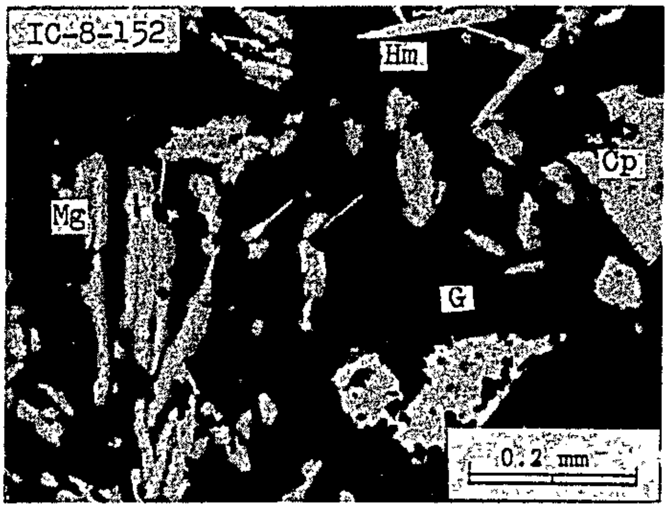
Gl : galena
Po : pyrrhotite



Sample No. IC-8-152(1)

Type of Ore : Cp-Hm Ore

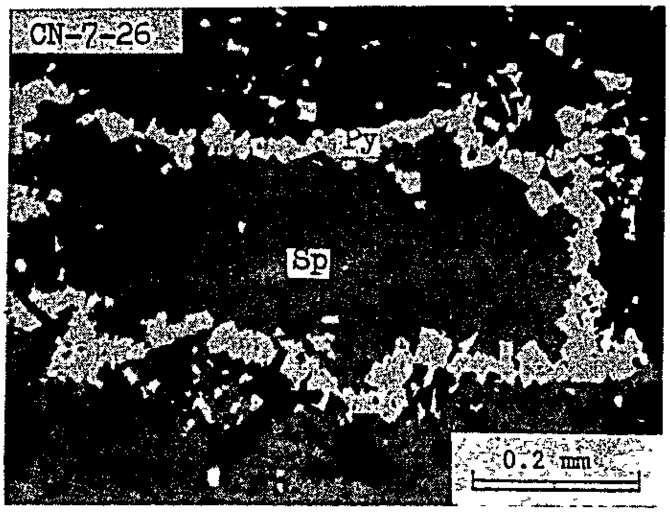
Bn : bornite
Hm : hematite



Sample No. IC-8-152(2)

Type of Ore : Cp-Mg-Hm Ore

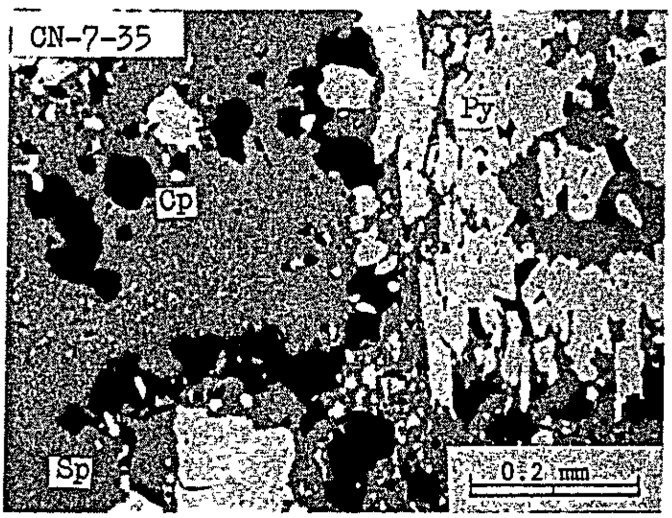
Cp : chalcopyrite
Mg : magnetite
Hm : hematite
G : gangue minerals



Sample No. CN-7-26

Type of Ore : Sp-Py Ore

Sp : sphalerite
Py : pyrite



Sample No. CN-7-35

Type of Ore : Sp-Py Ore

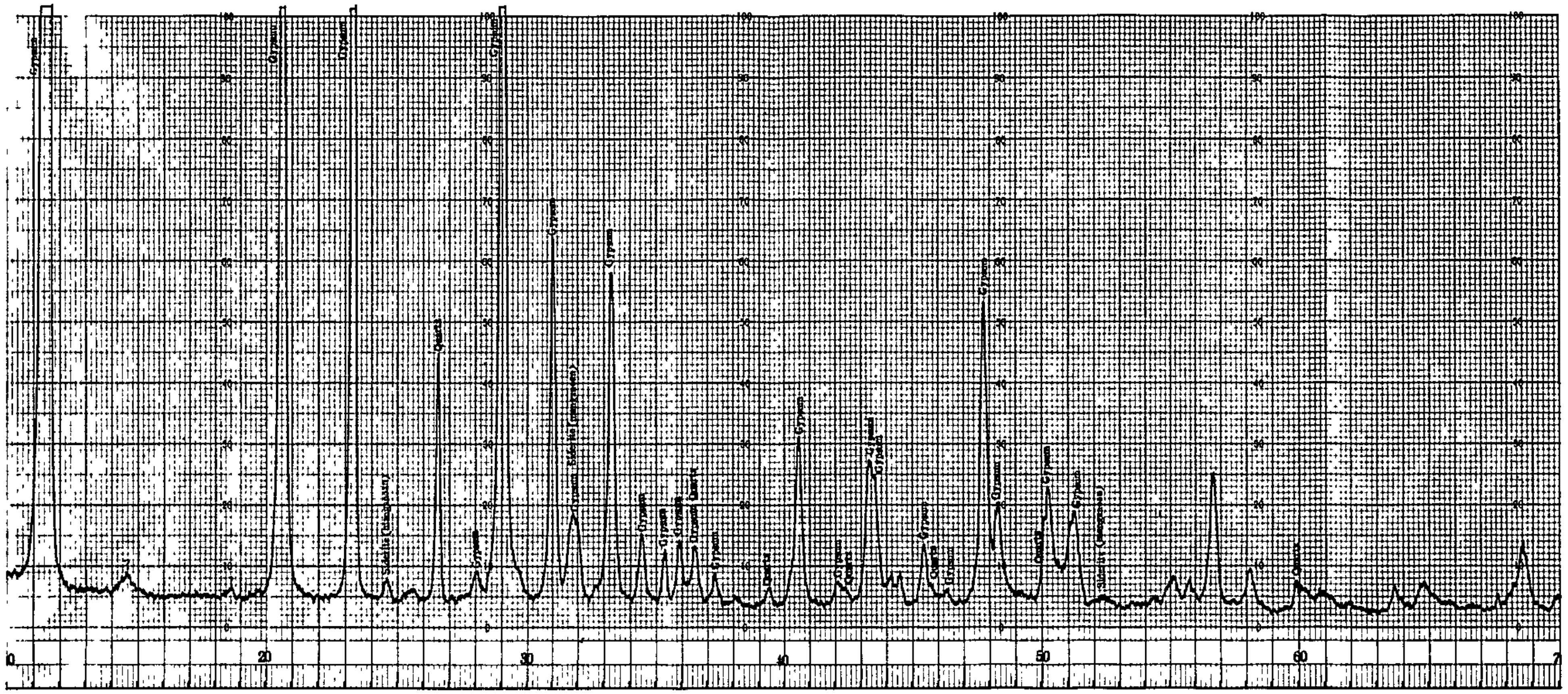
A. Ⅲ-5 Summary of X-Ray Diffraction Analysis

Sample No.	Type	Quartz	Calcite	Ankerite	Dolomite	Siderite	Mn-Siderite	Biotite	Pyrophyllite	Talc	Chlorite	Sericite	Gypsum	Rutile	Anatase		Sphalerite	Galena	Chalcopyrite	Smithsonite	Plumbogumnite	Pyromorphite	Pyrite	Pyrrhotite	Magnetite		Remarks
IC-6-181	Gyp-v	∘					•						◎														
IC-6-185	Sid						◎																•	∘			
IC-6-194	Sid-v	•					◎										•						•				
IC-7-106	Ss	◎										∘			•								•				
IC-7-136	Do	∘	∘	◎													•	•									
IC-7-146	Py-drs	◎																					◎				
IC-7-209	Do-v	○	◎		◎																						
IC-8-026	Sh	◎							∘			•		•													
IC-8-133	Py-ore	◎																	•			•	○				
IC-8-152	Ald	◎			∘	•		•		◎	•						◎		○	○							
CN-5-15	Wht-v	◎															◎	•									Cly-ms
CN-5-20	Do	◎		◎						•	•						•	•									
CN-6-30	Ald	◎									◎												○				
CN-7-21	Ald	◎																					○				
CN-7-31	Sp-ore	•															◎						○				

v: vein   drs: druse   Ald: altered rock and gangue minerals in ore

◎ abundant   ○ common   ∘ fairly   • rare

A. Ⅲ-6 X-Ray Diffraction Chart (1)

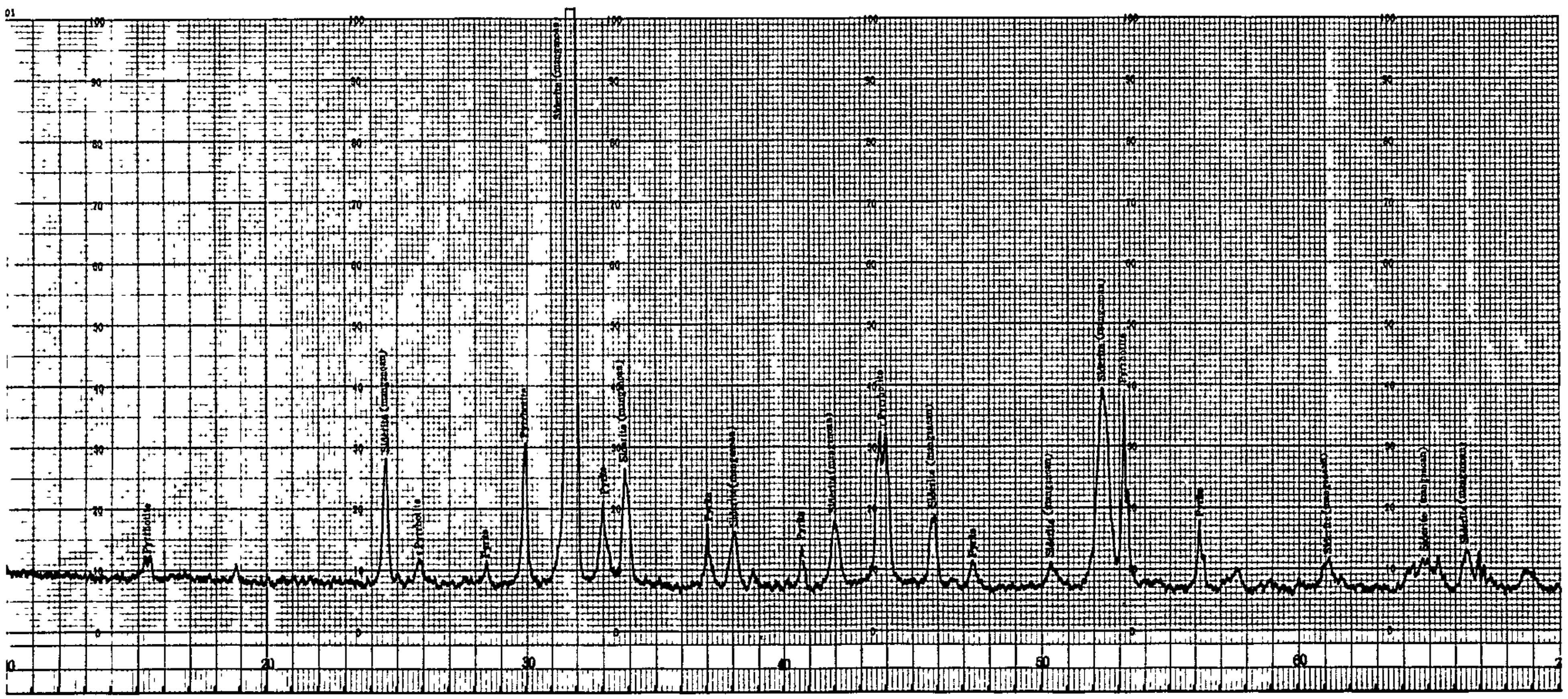


Sample No IC-6-181

Target	Cu
G, Monochro	
Voltage	40 kv
Current	150 mA
Full Scale Range	4000 cps
Time Constant	0.5 sec
Scanning Speed	4 °/min
Chart Speed	4 cm/min
Divergency	1 °
Receiving Slit	0.15 mm
Detector	S.C
Date	3 1984
Diffractometer	Rotaflex RU-200

MINDECO

A. Ⅲ-6 X-Ray Diffraction Chart (2)

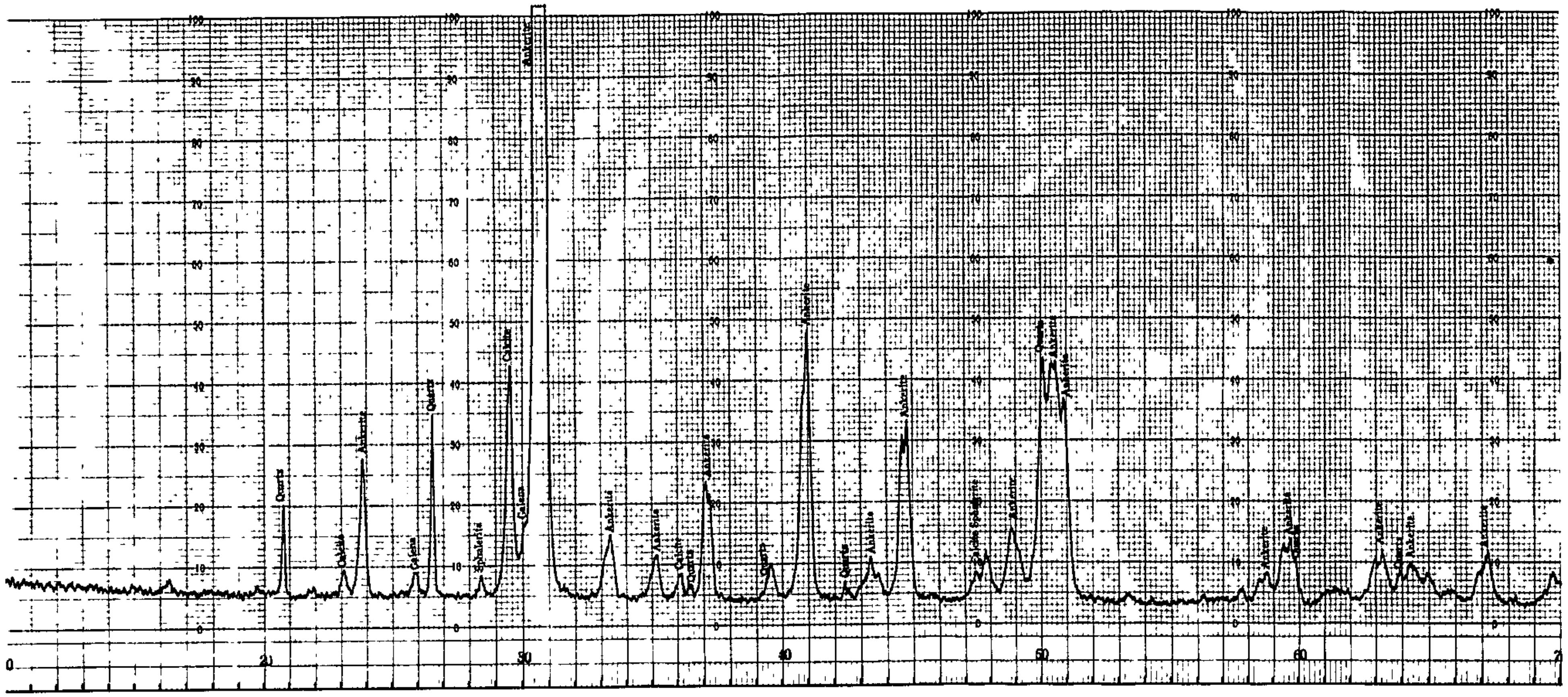


Sample No IC-6-185

Target	Cu
G, Monochro	
Voltage	40 kv
Current	150 mA
Full Scale Range	4000 cps
Time Constant	0.5 sec
Scanning Speed	4 °/min
Chart Speed	4 cm/min
Divergency	1 °
Receiving Slit	0.15 mm
Detector	S.C
Date	3 1984
Diffractometer	Rotaflex RU-200

MINDECO

A. III-6 X-Ray Diffraction Chart (3)

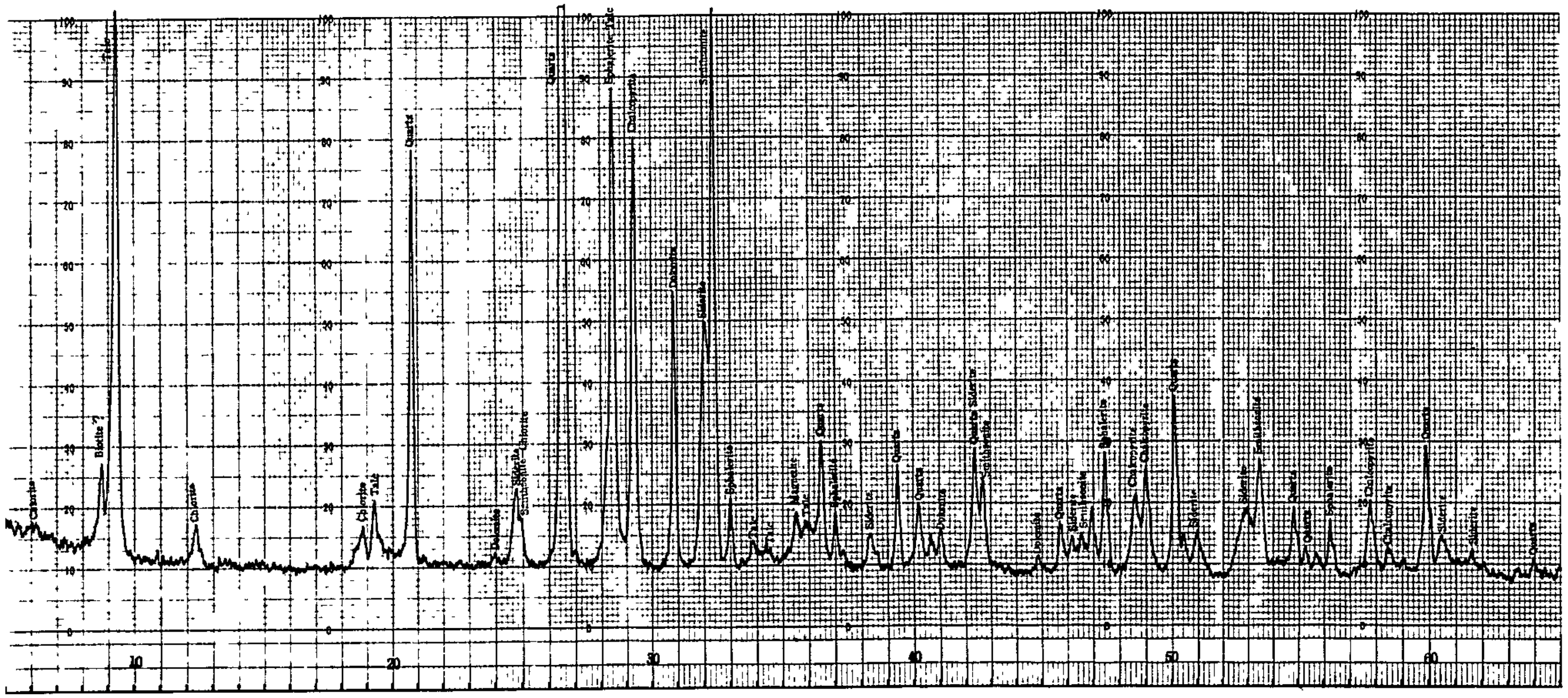


Sample No. IC-7-136

Target	Cu
G. Monochro	
Voltage	40 kv
Current	150 mA
Full Scale Range	4000 cps
Time Constant	0.5 sec
Scanning Speed	4 °/min
Chart Speed	4 cm/min
Divergency	1 °
Receiving Slit	0.15 mm
Detector	SC
Date	3 1984
Diffractometer	Rotaflex RU-200

MINDECO

A. III-6 X-Ray Diffraction Chart (4)



Sample No IC-8-152

Target	Cu
G. Monochro	
Voltage	40 kv
Current	150 mA
Full Scale Range	4000 cps
Time Constant	0.5 sec
Scanning Speed	4 °/min
Chart Speed	4 cm/min
Divergency	1 °
Receiving Slit	0.15 mm
Detector	SC
Date	3 1984
Diffractometer	Rotaflex RU-200

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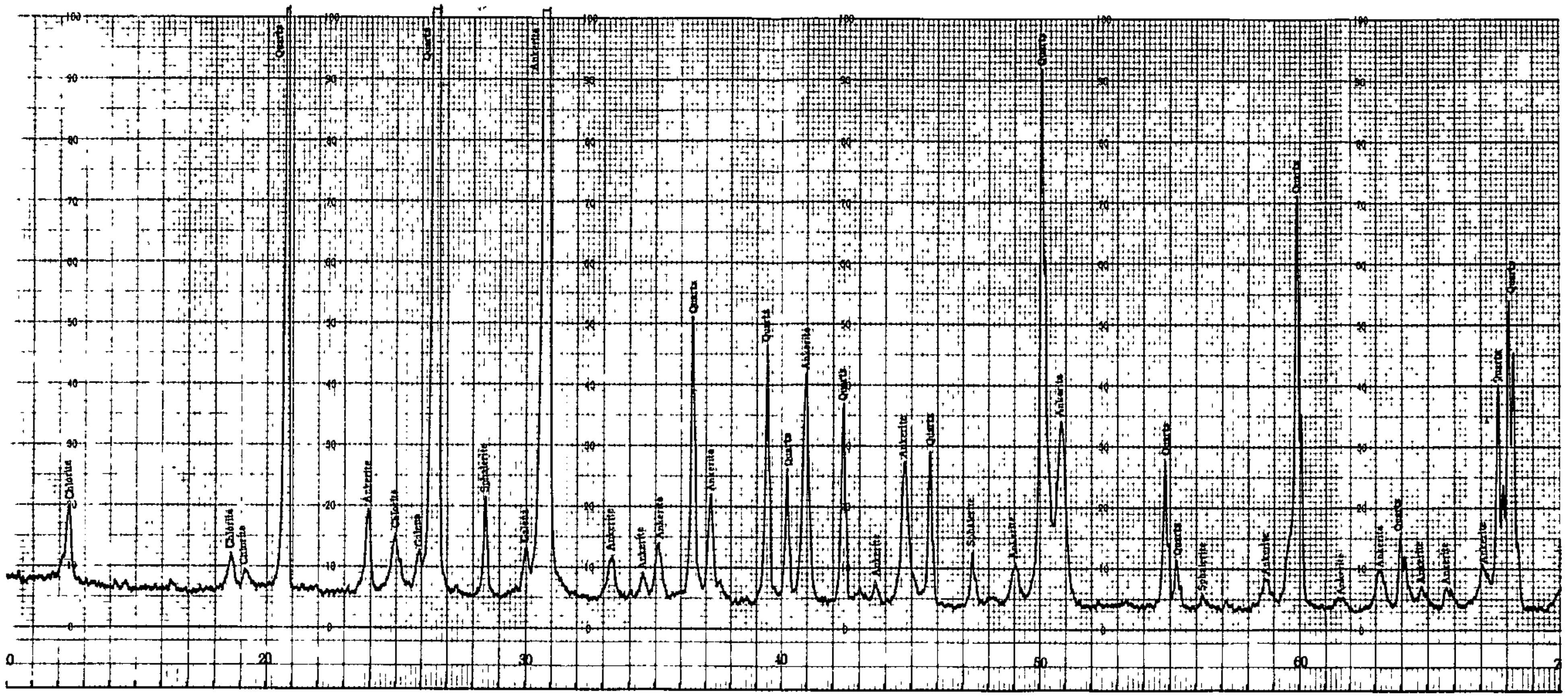
A. II-6 X-Ray Diffraction Chart (5)



Sample No. CN-5-20

Target	Cu
G.Monochro	
Voltage	40 kv
Current	150 mA
Full Scale Range	4000 cps
Time Constant	0.5 sec
Scanning Speed	4 °/min
Chart Speed	4 cm/min
Divergency	1 °
Receiving Slit	0.15 mm
Detector	S.C
Date	3 1984
Diffractometer	Rotaflex RU-200

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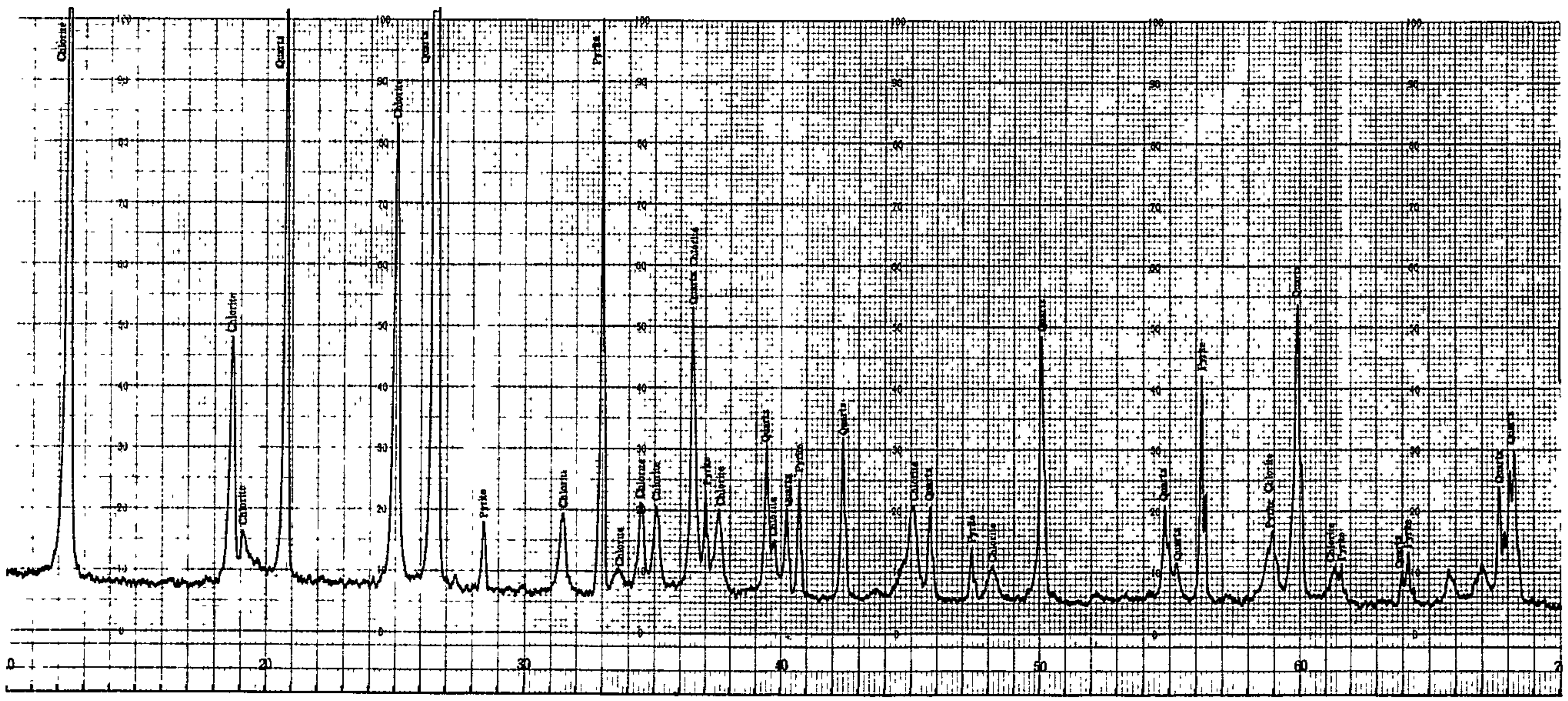
A. II-6 X-Ray Diffraction Chart (6)



Sample No CN-6-30

Target	Cu
G.Monochro	
Voltage	40 kv
Current	150 mA
Full Scale Range	4000 cps
Time Constant	0.5 sec
Scanning Speed	4 °/min
Chart Speed	4 cm/min
Divergency	1 °
Receiving Slit	0.15 mm
Detector	S.C
Date	3 1984
Diffractometer	Rotaflex RU-200

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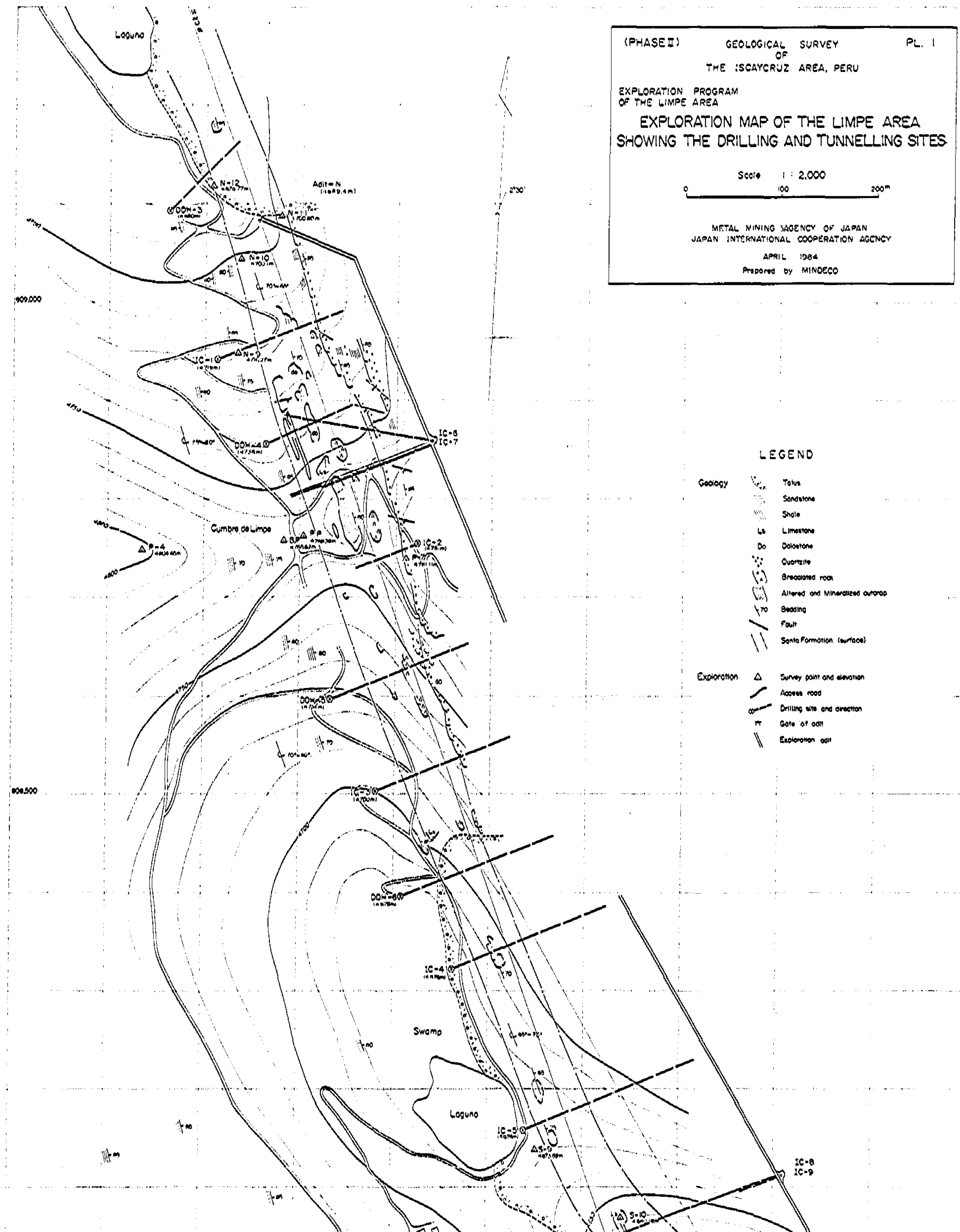
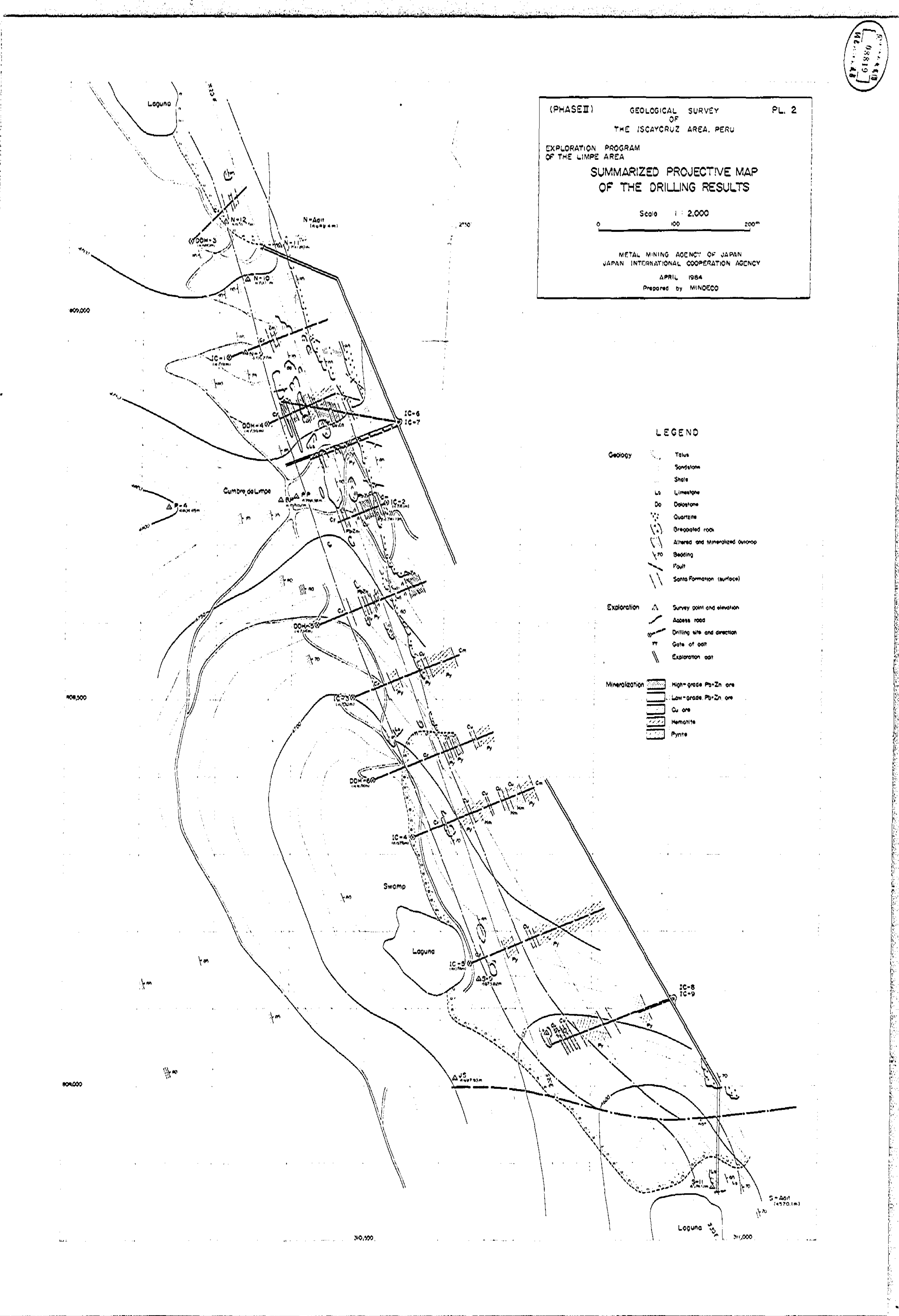
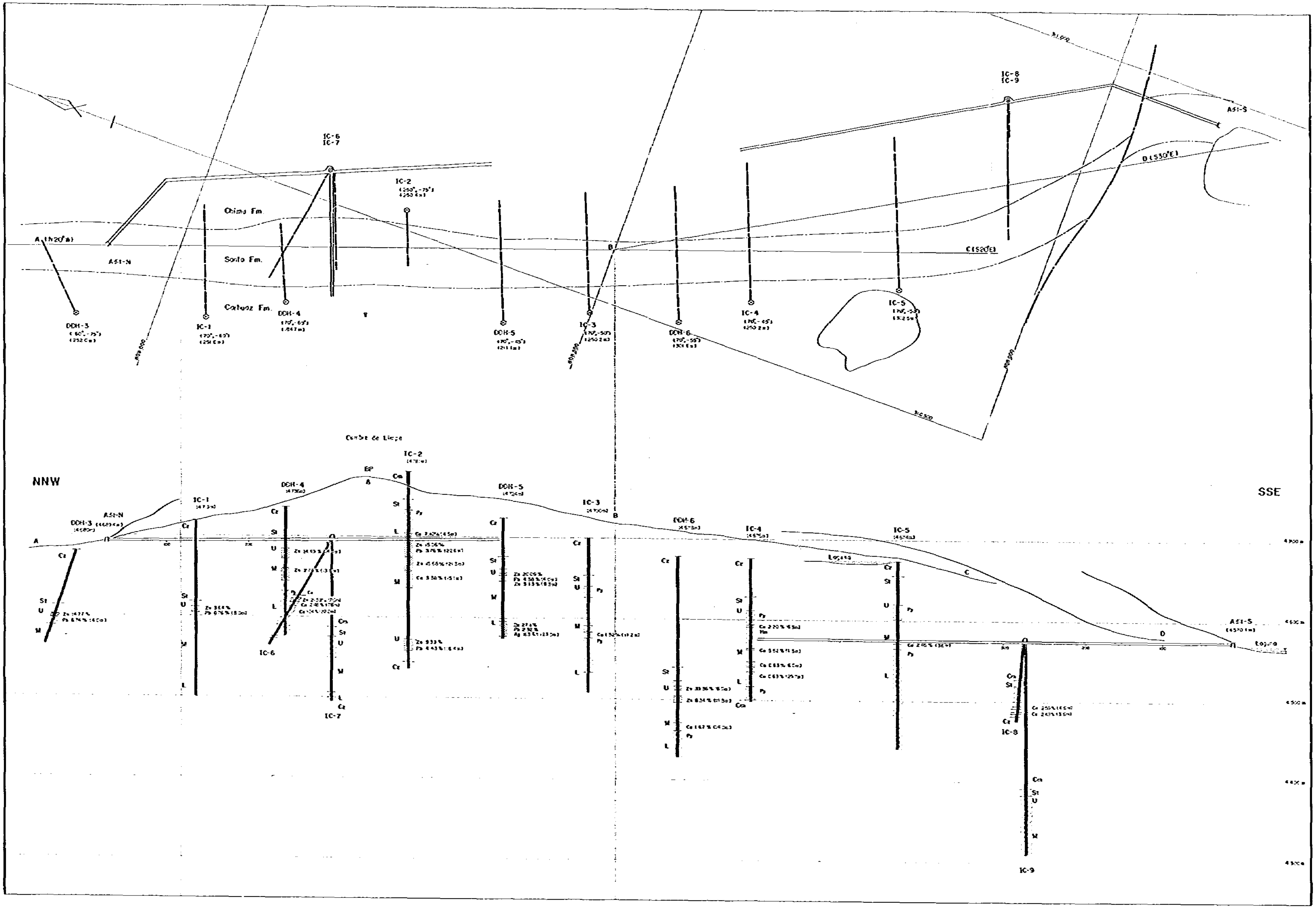
LIST OF PLATES


(PHASE II)
GEOLOGICAL SURVEY OF THE ISCAYCRUZ AREA, PERU
PL. I
EXPLORATION PROGRAM OF THE LIMPE AREA
EXPLORATION MAP OF THE LIMPE AREA SHOWING THE DRILLING AND TUNNELLING SITES
Scale 1 : 2,000
0
100
200m
METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY
APRIL 1984
Prepared by MINDECO
LEGEND
Geology
Talus
Sandstone
Shale
Ls Limestone
Do Dolostone
Quartzite
Brecciated rock
Altered and Mineralized outcrop
Bedding
Fault
Santa Formation (surface)
Exploration
Survey point and elevation
Access road
Drilling site and direction
Gate of adit
Exploration adit
Laguna
Adit-N
N-12
DDH-3
N-11
N-10
IC-1
N-2
DDH-4
IC-6
IC-7
Cumbre de Limpe
P-4
IC-2
DDH-5
IC-3
DDH-6
IC-4
Swamp
Laguna
IC-5
IC-8
IC-9
S-10
Adit-S
Laguna
909,000
908,500
908,000
310,500
311,000

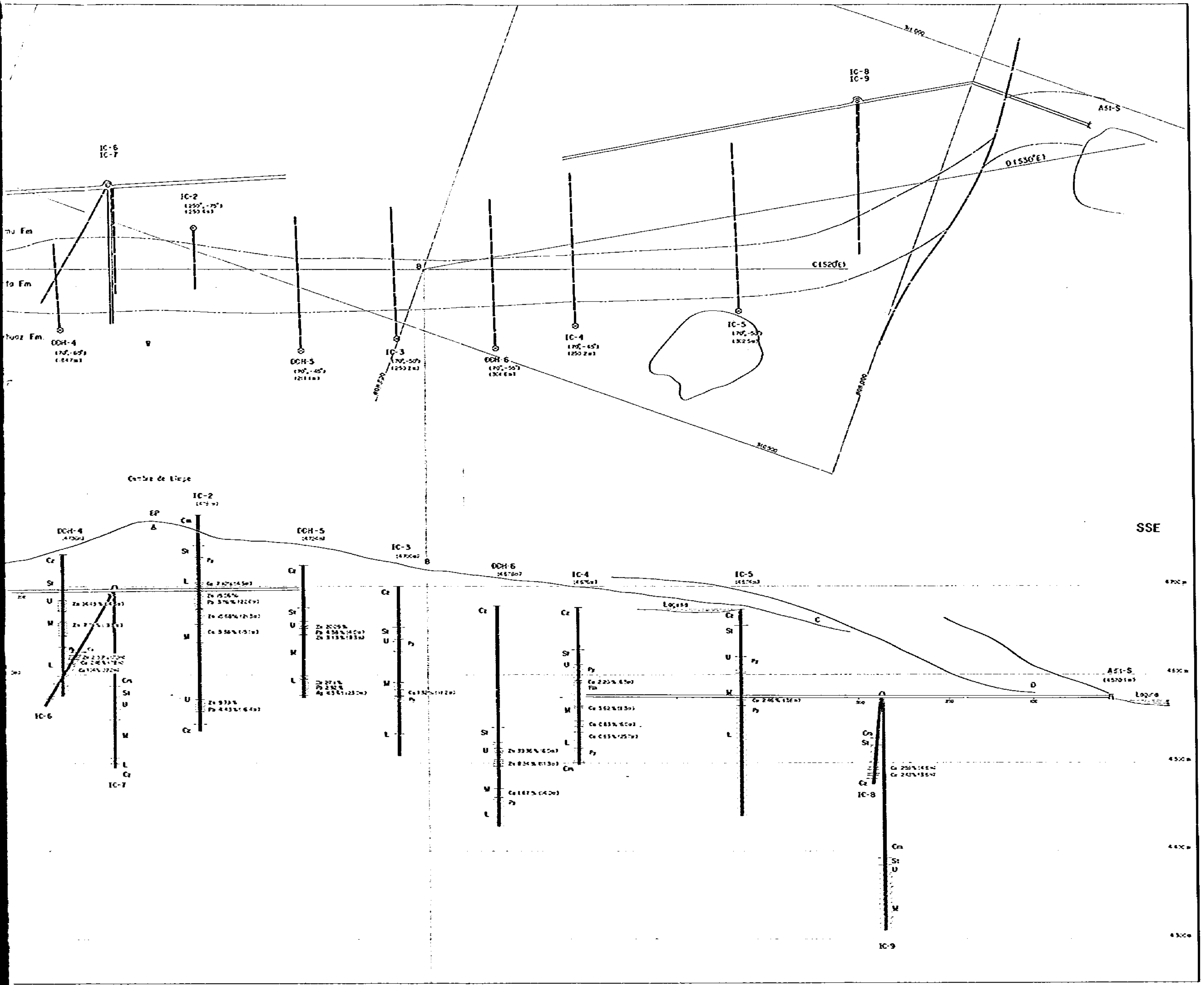

(PHASE II)
GEOLOGICAL SURVEY OF THE ISCAYCRUZ AREA, PERU
PL. 2
EXPLORATION PROGRAM OF THE LIMPE AREA
SUMMARIZED PROJECTIVE MAP OF THE DRILLING RESULTS
Scale 1 : 2,000
0
100
200m
METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY
APRIL 1984
Prepared by MINDECO
LEGEND
Geology
Talus
Sandstone
Shale
Limestone
Dolostone
Quartzite
Brecciated rock
Altered and Mineralized outcrop
Bedding
Fault
Santa Formation (surface)
Exploration
Survey point and elevation
Access road
Drilling site and direction
Gate of adit
Exploration adit
Mineralization
High-grade Pb-Zn ore
Low-grade Pb-Zn ore
Cu ore
Hematite
Pyrite
Laguna
N-Adit
N-12
DDH-3
N-11
N-10
IC-1
DDH-4
IC-6
IC-7
Cumbre de Limpe
IC-2
DDH-5
IC-3
DDH-6
IC-4
Swamp
Laguna
IC-5
IC-8
IC-9
S-Adit (4570.1m)
S-11
Laguna
310,500
311,000



(PHASE II)

EXPLORATION
OF THE LIMP

SUM



PL. 3

GEOLOGICAL SURVEY
OF
THE ISCAYCRUZ AREA, PERU

EXPLORATION PROGRAM
OF THE LIMPE AREA

SUMMARIZED PROJECTIVE SECTION OF THE DRILLING RESULTS

Scale 1 : 2,000

0 100 200m

METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

APRIL 1984

Prepared by MINDECO

LEGEND and ABBREVIATION

Pb-Zn high-grade ore

Pb-Zn low-grade ore

Cu ore

Massive Pyrite ore (Py)

Massive Hematite ore (Hm)

Cr Carhuaz Formation

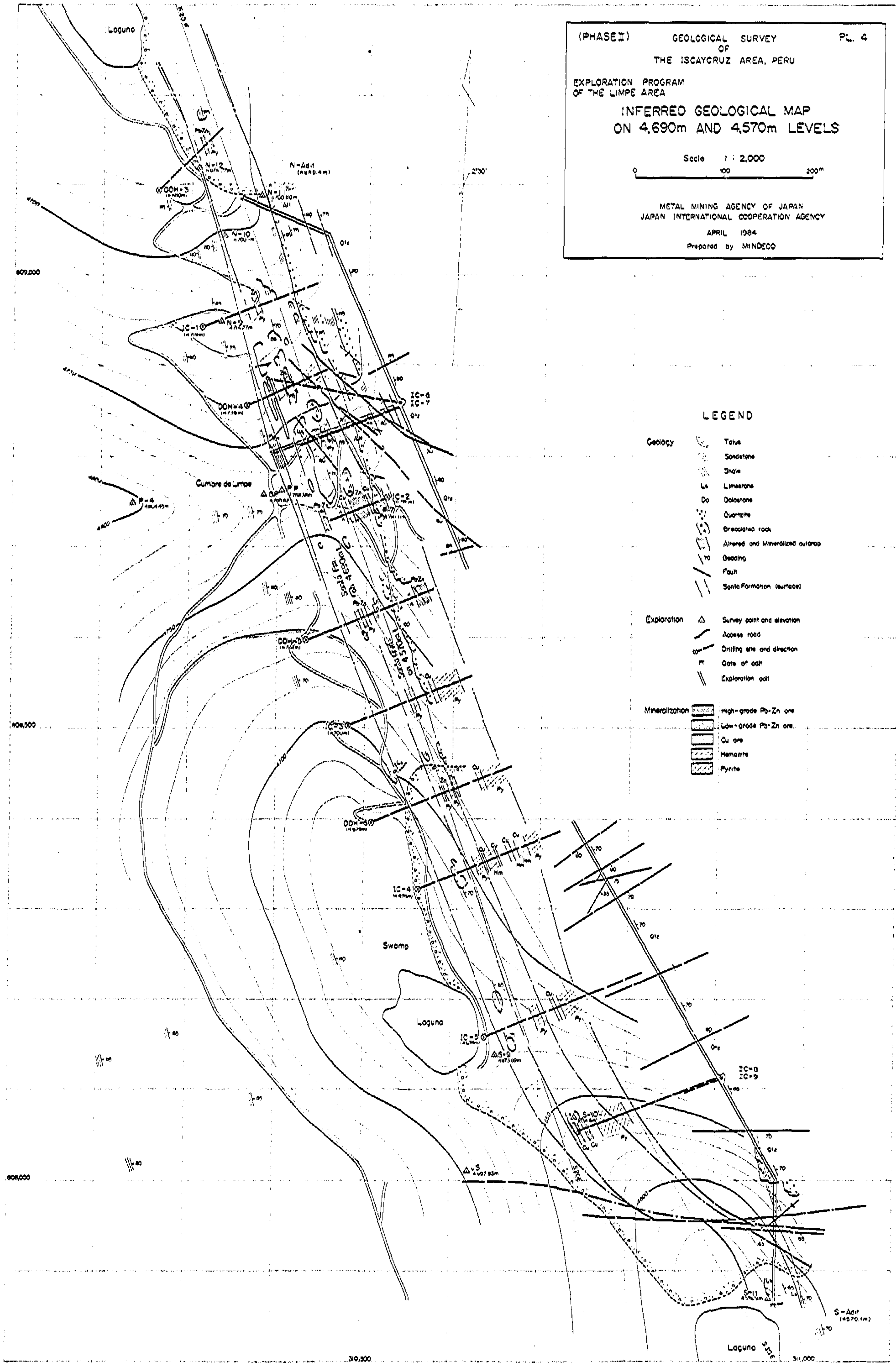
St Santa Formation

Cm Chimu Formation

U Upper Horizon

M Middle Horizon

L Lower Horizon



(PHASE II)
GEOLOGICAL SURVEY OF THE ISCAYCRUZ AREA, PERU
PL. 4
EXPLORATION PROGRAM OF THE LIMPE AREA
INFERRED GEOLOGICAL MAP ON 4,690m AND 4,570m LEVELS
Scale 1 : 2,000
0
100
200m
METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY
APRIL 1984
Prepared by MINDECO
LEGEND
Geology
Talus
Sandstone
Shale
Ls Limestone
Do Dolostone
Quartzite
Brecciated rock
Altered and Mineralized outcrop
Bedding
Fault
Santa Formation (surface)
Exploration
Survey point and elevation
Access road
Drilling site and direction
Gate of adit
Exploration adit
Mineralization
High-grade Pb-Zn ore
Low-grade Pb-Zn ore.
Cu ore
Hematite
Pyrite
Laguna
N-Adit
Cumbre de Limpe
Swamp
Laguna
S-Adit (4570.1m)
Laguna

GEOLOGIC DRILL LOG
ISCAYCRUZ PROJECT

Coordinate N 8808.854 E 310.528
Elevation 4692m

DDH No. IC-6
Direction 280°
Inclination -40°
Total Depth 242.8m

Drill log (part 1)

Int (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)
13	009	002	090	—
13	002	016	130	4
12	002	280	2.0	4
10	002	012	485	4
10	001	005	241	4

Rock	Oxd	Alt	M.A.	Color	Frac	Observations
Qz	Lm	sil ser	Py	l-gy wh		
Ss (Sd)			Py	bk		Sandy Sh, pyritic
Qz (Ss)			Py	l-gy		Fgd, ...
Sh			Py	bk		Sandy sh
Ss (Qz)			Py	gy		
Sh			Py	bk		With Ss patches
Qz (Ss)			Py	wh		Mgd-fgd
						271-273: Sh
Sh			Py	bk		Transitional zone; Pyritic, flaky; 334-345: dolomite; 347-365: cly
Ss		cly		l-gy		379-380: F-cly
At						At (Sh, Ss)
Do				bk		432, 433, 434: ... 02m
Qz	Lm		Py	wh l-gy		Limonite along ...
At			Py	d-gy		At (Sh-Do-Ss)
Sh		cly sil		l-gy	shd	
Ml (Ss)		cly		l-gy		Very soft
Do				gy		Limestone of ...
Ss (Ml)				l-gy		
Do			Py	bk		Fgd, cryst; Bedding sh
Sh				bk		
Ml (Ss)		cly		l-gy		
Ss (Ca)		do		gy		Fgd, dolomitic
						892-895: Sh
						930-934: Sh; Cu-Fe
At		cly	Py Sp	bk	shd	At (Sh Ca); Sr-Fe
Zn-Ore		sil	Py Sp	d-gy		Zn diss ore (Dolomitic Ss); Soft, cryst, cgd; Av. 42 003 085 527 4

Drill log (part 2)

Int (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)
10	008	005	234	4
10	002	002	218	4
15	002	027	141	4
15	003	002	150	tr
15	020	002	361	tr
15	002	002	025	4
13	003	002	642	4
12	003	003	3021	20
15	028	002	2288	4
15	062	002	290	4
15	066	001	505	64
14	343	002	120	112
14	459	001	030	4
25	053	002	030	4
25	243	002	030	4
36	043	002	020	16
42	293	001	008	8
55	058	002	008	16
41	028	002	002	12
50	100	003	070	20
50	018	009	008	12
50	074	002	003	36
50	024	001	090	tr
11	005	001	130	12
13	004	002	351	4
16	004	002	020	20
16	003	003	030	tr
39	001	075	331	tr
16	002	003	165	tr
15	001	001	160	12
45	001	001	030	4
16	002	002	060	4

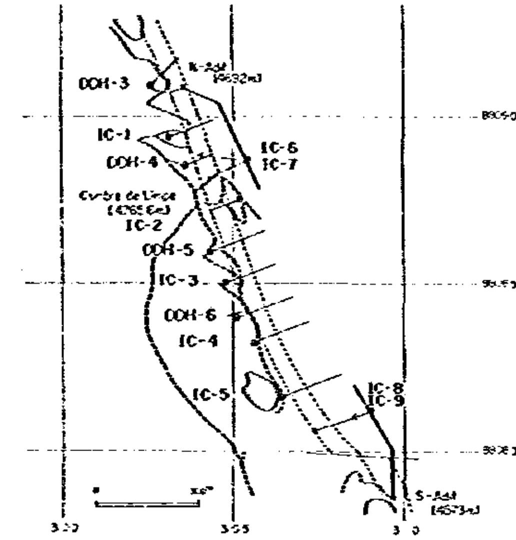
Rock	Oxd	Alt	M.A.	Color	Frac	Observations
						100.7-102.0: Ss, dolomitic
Ss		sil	Sp	l-gy		Dolomitic
Do (Ml)		do chl	Py Sp	p-gy		
Sh		sil cal	Py Sp	p-gy	shd	108-112m: Sh, cly; Int (m) Cu (%) Pb (%) Zn (%) Ag (g/t)
Zn-Ore Sh (Ss)	Mn	cly sil	Py Cp Cc Sp	bk	shd brc	Carboniferous ?; Manganiferous ?; Very soft; Av. 70 032 002 2.59 15
Cu-Ore Ss (Ad)	Mn	cly	Py Cp Cc	bk		
Cu-Py-Ore		sil cly	Py Cp Cc	d-yel		Int (m) Cu (%) Pb (%) Zn (%) Ag (g/t); Av. 78 248 002 045 23
						125m: Cu conc = 100m, 40
						Int (m) Cu (%) Pb (%) Zn (%) Ag (g/t); Av. 222 104 002 023 15
Py		cly	Py	d-yel		Py powder ore
At		cly	Py	wh		
Py-Ore		cly sil	Py Cp Cc	d-yel		Py powder ore; Py diss in wh clay mtx.; Core recovery is low.
						152.5-152.8: Hm.
Zn-Ore				gy-Sk		
Ls		do		l-gy		157.3-157.5: Do
Sh, Sh		do		gy		
Sp		do		gy		
Do		do sil		l-gy		Partly remained Ls; Do network, vs, patches
Sd		sd	Py Sp	l-gy		167.0-167.1: Sh; 168.0: Gyp v
Do		do		l-gy		
						Wd Do
At		do		l-gy bk		At (Do-Sh)
Sh		do		bk		
Do		do		gy		
Sd		do	Pb Sp	l-gy		Wd-Sd network
Zn-Ore		sd		d-brn		Gypsum is detected (8m); Pyritic, massive ore; Existence of Sd is confirmed by X-ray; Sd vs S ... (185m)
Py-Ore		sd	Py Sp	yel		Zn diss
At						Fine-At (Do-Ss); 10-20-80cm ...
Sd		sd	Py Sp	l-gy		Sd is determined by X-ray/Sd-ml
Sh			Cu	bk		Native Cu diss
Sd		sd	Py Sp	l-gy		200.3m end

GEOLOGICAL SURVEY OF THE ISCAYCRUZ AREA, PERU PHASE II

PL I-6

DRILLING EXPLORATION IN THE LIMPE AREA (UNDERGROUND)

GEOLOGIC DRILL LOG DDH - IC-6



METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

APRIL 1984
Prepared by MINDECO

Scale 1 : 200
0 4 8 12 16 20m

LEGEND and ABBREVIATION

10. Rock:
- Pebble, sand, clay — Peb
- Sandstone — Ss
- Shale — Sh
- Marl — Ml
- Limestone — Ls
- Dolomitic limestone — Do-Ls
- Dolostone — Do
- Siderite — Sd
- Quartzite — Qz
- Ore, high grade
- Ore, low grade
- Pyrite ore — Py
- Hematite ore — Hm
- Skarn — Sk
- Brecciated rock — Brc
- Altered rock — A
- Fault, fracture — F

11. Oxidation: oxidized — oxd; limonitized — lim

12. Alteration: dolomitization — do; calcitization — cal; argillization — cly; silicification — sil; sericitization — ser

13. Mineralization: Pyrite — Py; Pb-minerals — Pb; Zn-minerals — Zn; Oxide minerals — Oxd; Chalcopyrite — Cp; Chalcocite — Cc; Hematite — Hm, Spc; Magnetite — Mt

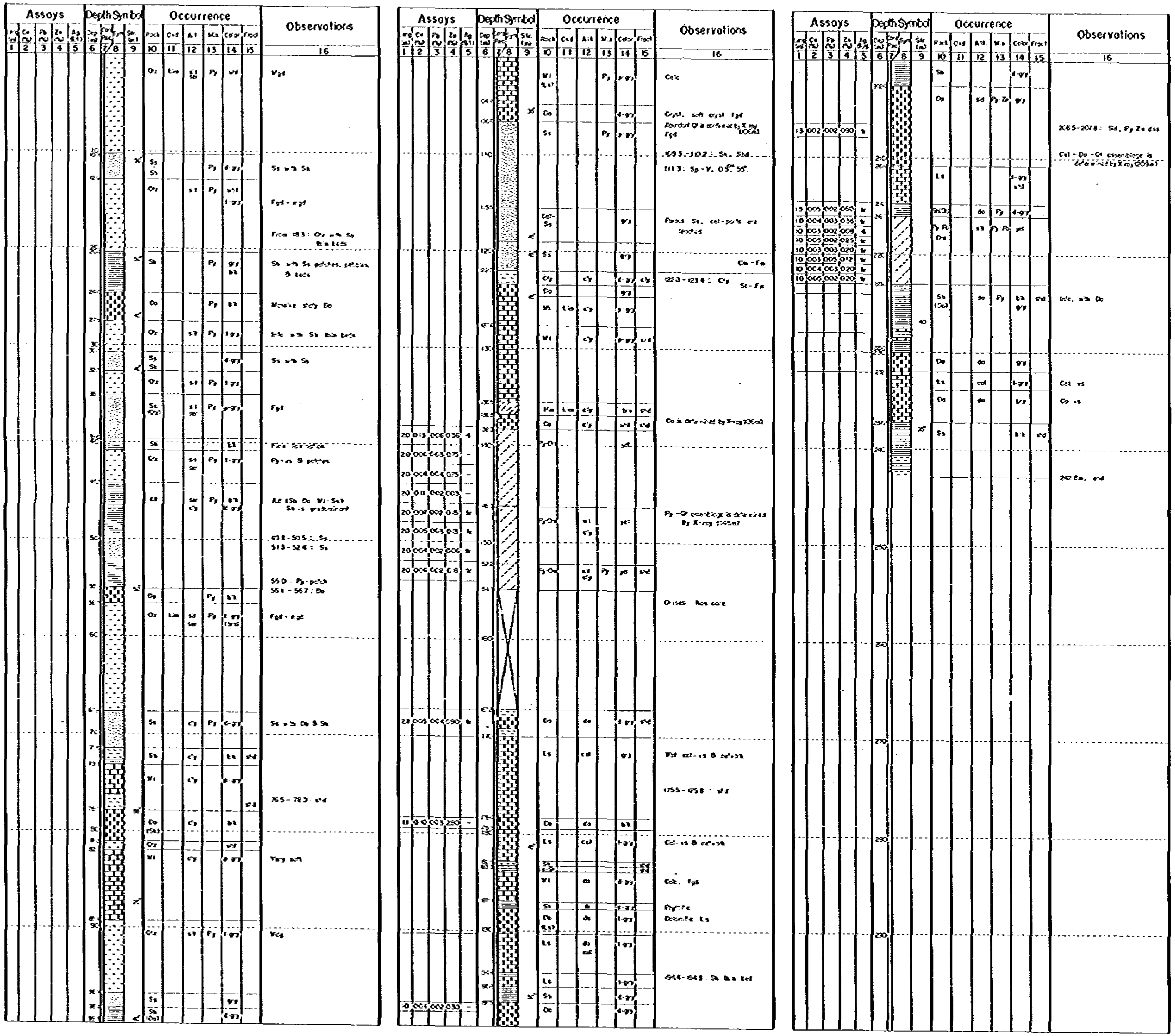
14. Color: light — l-; dark — d-; grey — gy; black — bk; white — wh; brown — brn

15. Fracture: Fault — F; sheared — shd; brecciated — brc

16. Observations: dissemination — diss; veins — vs; veinlets — vls

GEOLOGIC DRILL LOG
ISCAYCRUZ PROJECT

Coordinate	N 8808,654	DDH No.	IC-7
	E 310,528	Direction	250°
Elevation	4,692m	Inclination	-60°
		Total Depth	242.8m

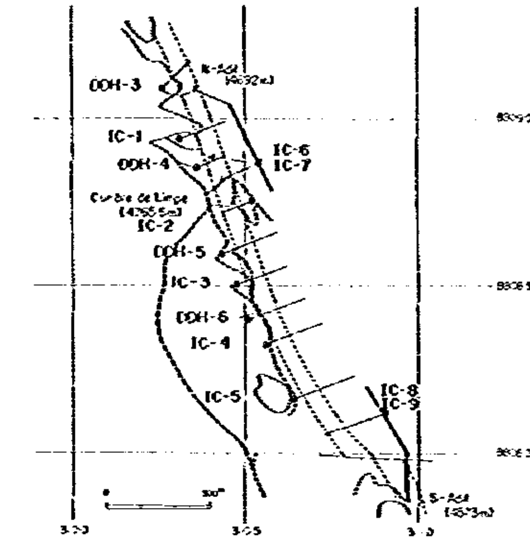


PL 1-7

GEOLOGICAL SURVEY
OF
THE ISCAYCRUZ AREA, PERU
PHASE II

DRILLING EXPLORATION
IN THE LIMPE AREA (UNDERGROUND)

GEOLOGIC DRILL LOG
DDH - IC-7



METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

APRIL 1984
Prepared by MINDECO

Scale 1 : 200

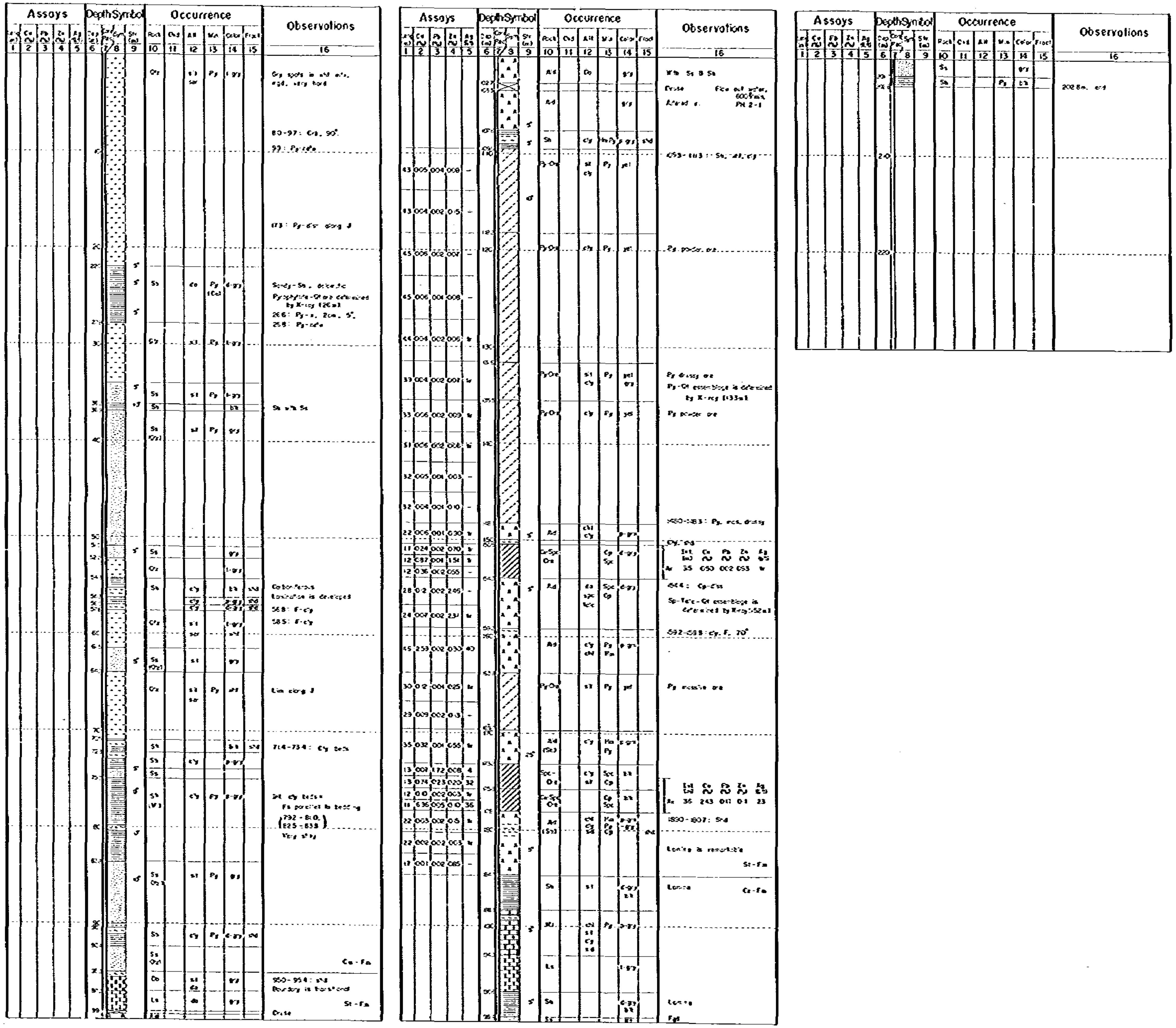
LEGEND and ABBREVIATION

10. Rock:	Pebble, sand, clay	Peb			
	Sandstone	Ss			
	Shale	Sh			
	Marl	Ml			
	Limestone	Ls			
	Dolomitic limestone	Do-Ls			
	Dolostone	Do			
	Siderite	Sd			
	Quartzite	Qz			
	Ore, high grade				
	Ore, low grade				
	Pyrite ore	Py			
	Hematite ore	Hm			
	Skarn	Sk			
	Brecciated rock	Brc			
	Altered rock	A			
	Fault, fracture	F			
11. Oxidation:	oxidized	oxd			
	limonitized	lim			
12. Alteration:	dolomitization	do			
	calcitization	cal			
	argillization	cly			
	silicification	sil			
	sericitization	ser			
13. Mineralization:	Pyrite	Py	Chalcopyrite	Cp	
	Pb-minerals	Pb	Chalcocite	Cc	
	Zn-minerals	Zn	Hematite	Hm	Spc
	Oxide minerals	Oxd	Magnetite	Mt	
14. Color:	light	lt-	black	blk	
	dark	d-	white	wht	
	grey	gry	brown	brn	
15. Fracture:	Fault		F		
	sheared		shd		
	brecciated		brc		
16. Observations:	dissemination		diss		
	veins		vs		
	veinlets		vls		

GEOLOGIC DRILL LOG
ISCAYCRUZ PROJECT

Coordinate N 8808.112
E 310.904
Elevation 4,573m

DDH No. IC-8
Direction 250°
Inclination -30°
Total Depth 202.8m

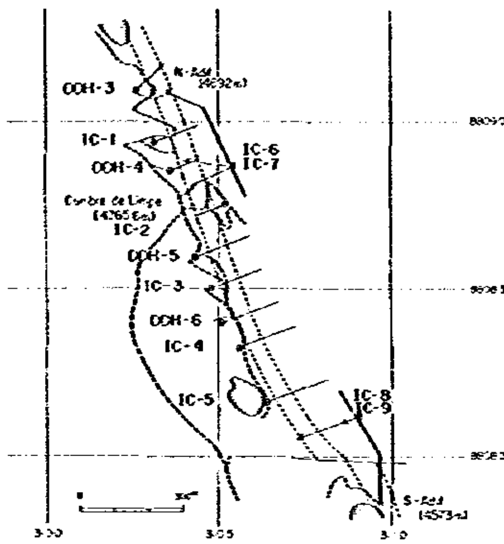


PL. I-8

GEOLOGICAL SURVEY
OF
THE ISCAYCRUZ AREA, PERU
PHASE II

DRILLING EXPLORATION
IN THE LIMPE AREA (UNDERGROUND)

GEOLOGIC DRILL LOG
DDH - IC-8



METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

APRIL 1984
Prepared by MINDECO

Scale 1 : 200

0 4 8 12 16 20m

LEGEND and ABBREVIATION

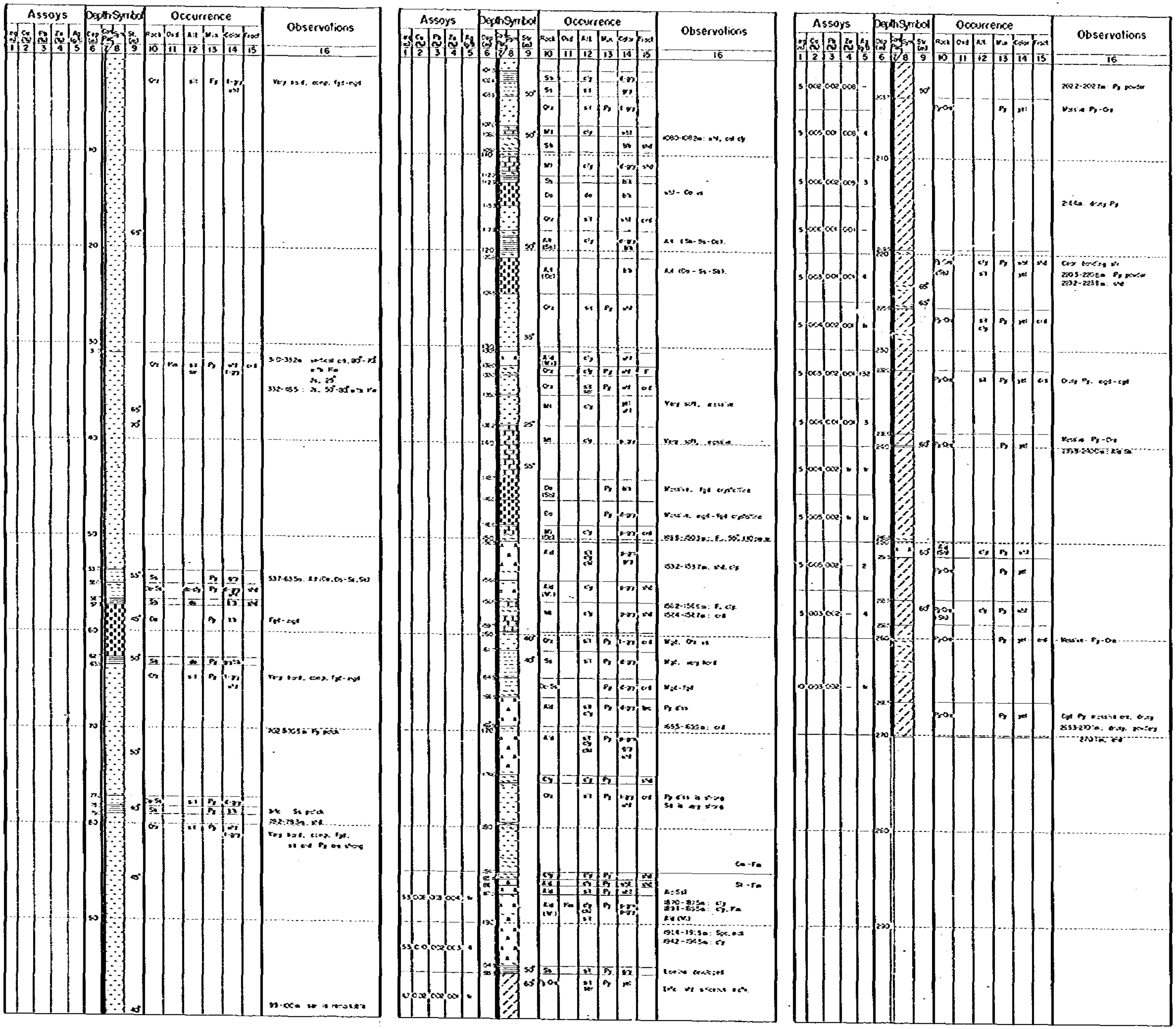
10. Rock	Pebble, sand, clay	Peb	
	Sandstone	Ss	
	Shale	Sh	
	Marl	Ml	
	Limestone	Ls	
	Dolomitic limestone	Do-Ls	
	Dolostone	Do	
	Siderite	Sd	
	Quartzite	Qz	
	Ore, high grade		
	Ore, low grade		
	Pyrite ore	Py	
	Hematite ore	Hm	
	Skarn	Sk	
	Brecciated rock	Brc	
	Altered rock	A	
	Fault, fracture	F	
11. Oxidation :	oxidized	oxd	
	limonitized	lim	
12 Alteration :	dolomitization	do	
	calcitization	cal	
	argillization	cly	
	silicification	sil	
	sericitization	ser	

13 Mineralization :	Pyrite Py	Chalcopyrite	Cp	
	Pb-minerals Pb	Chalcocite	Cc	
	Zn-minerals Zn	Hematite	Hm Spc	
	Oxide minerals Oxd	Magnetite	Mt	
14 Color :	light l-	black	blk	
	dark d-	white	wht	
	grey gry	brown	brn	
15. Fracture :	Fault	F		
	sheared	shd		
	brecciated	brc		
16 Observations :	dissemination	dss		
	veins	vs		
	veinlets	vls		

GEOLOGIC DRILL LOG
ISCAYCRUZ PROJECT

Coordinate N 8808112
E 310900
Elevation 4,573m

DDH No. IC-9
Direction 250°
Inclination -80°
Total Depth 270.1m

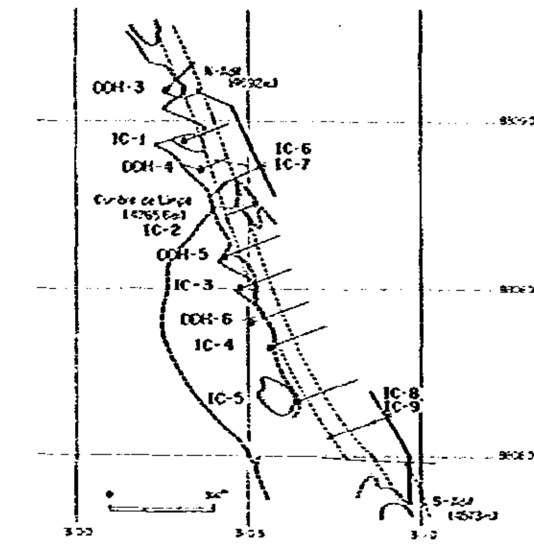


PL. 1-9

GEOLOGICAL SURVEY
OF
THE ISCAYCRUZ AREA, PERU
PHASE I

DRILLING EXPLORATION
IN THE LIMPE AREA (UNDERGROUND)

GEOLOGIC DRILL LOG
DDH - IC-9



METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

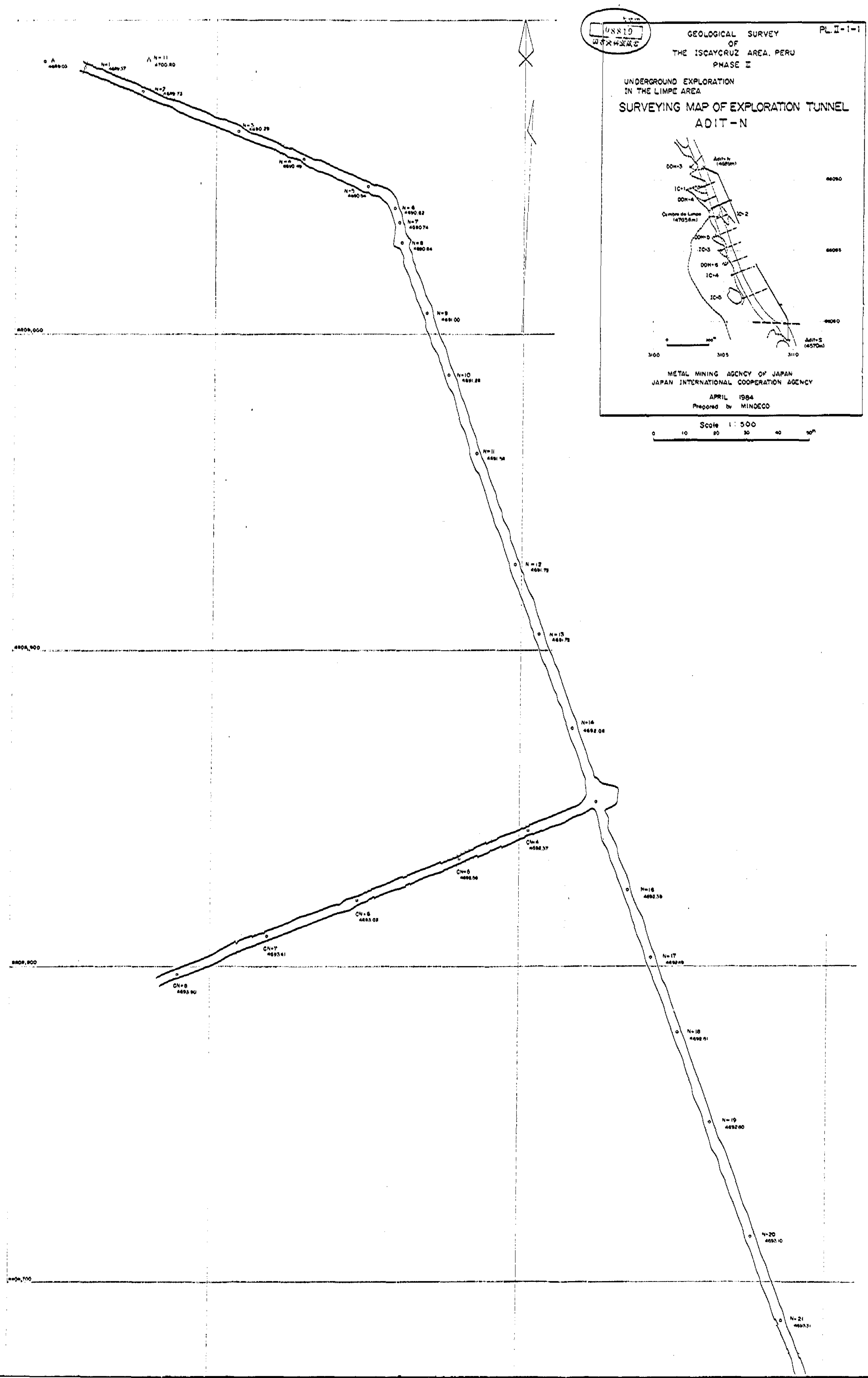
APRIL 1984
Prepared by MINDECO

Scale 1 : 200

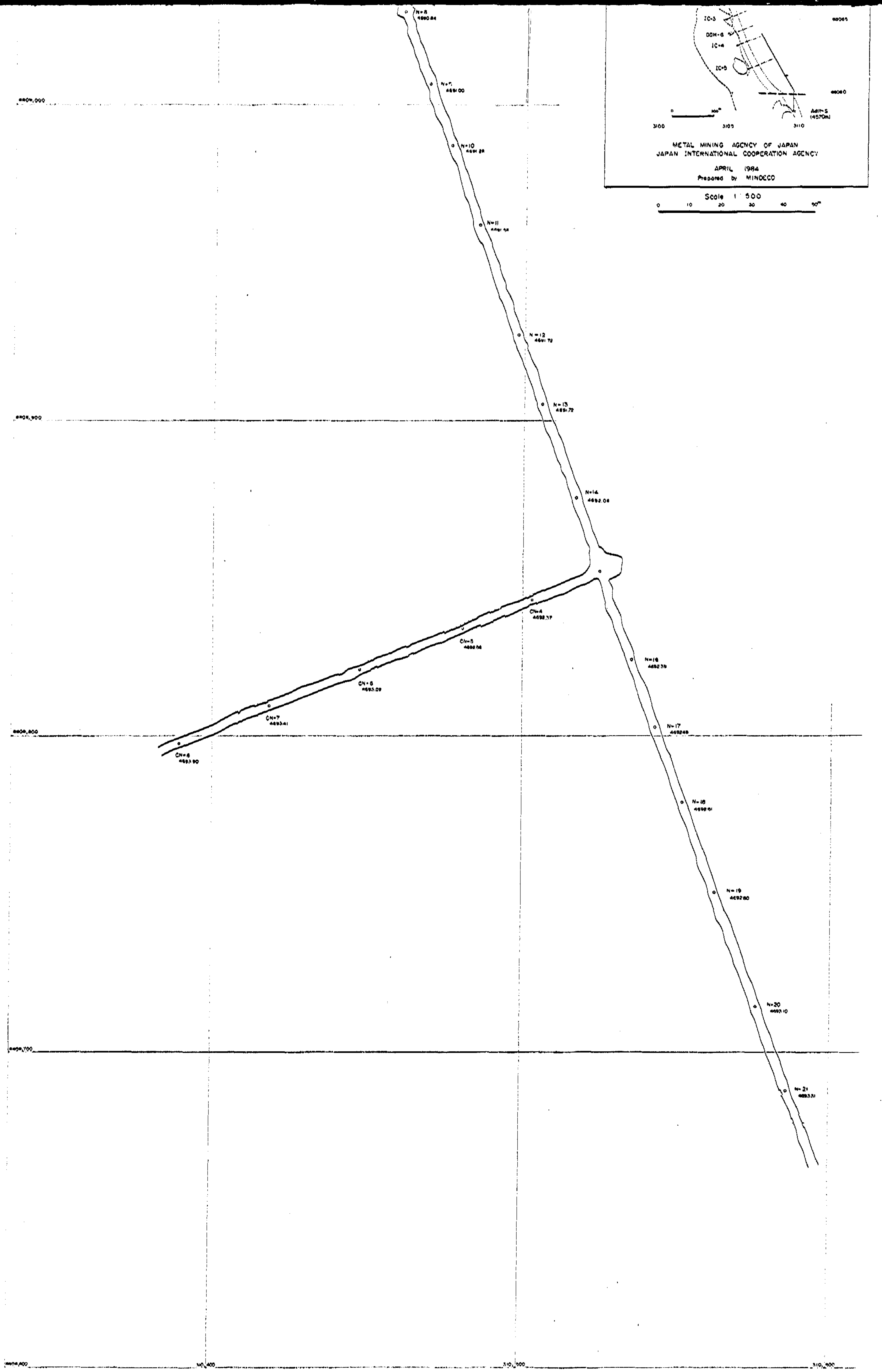
0 4 8 12 16 20m

LEGEND and ABBREVIATION

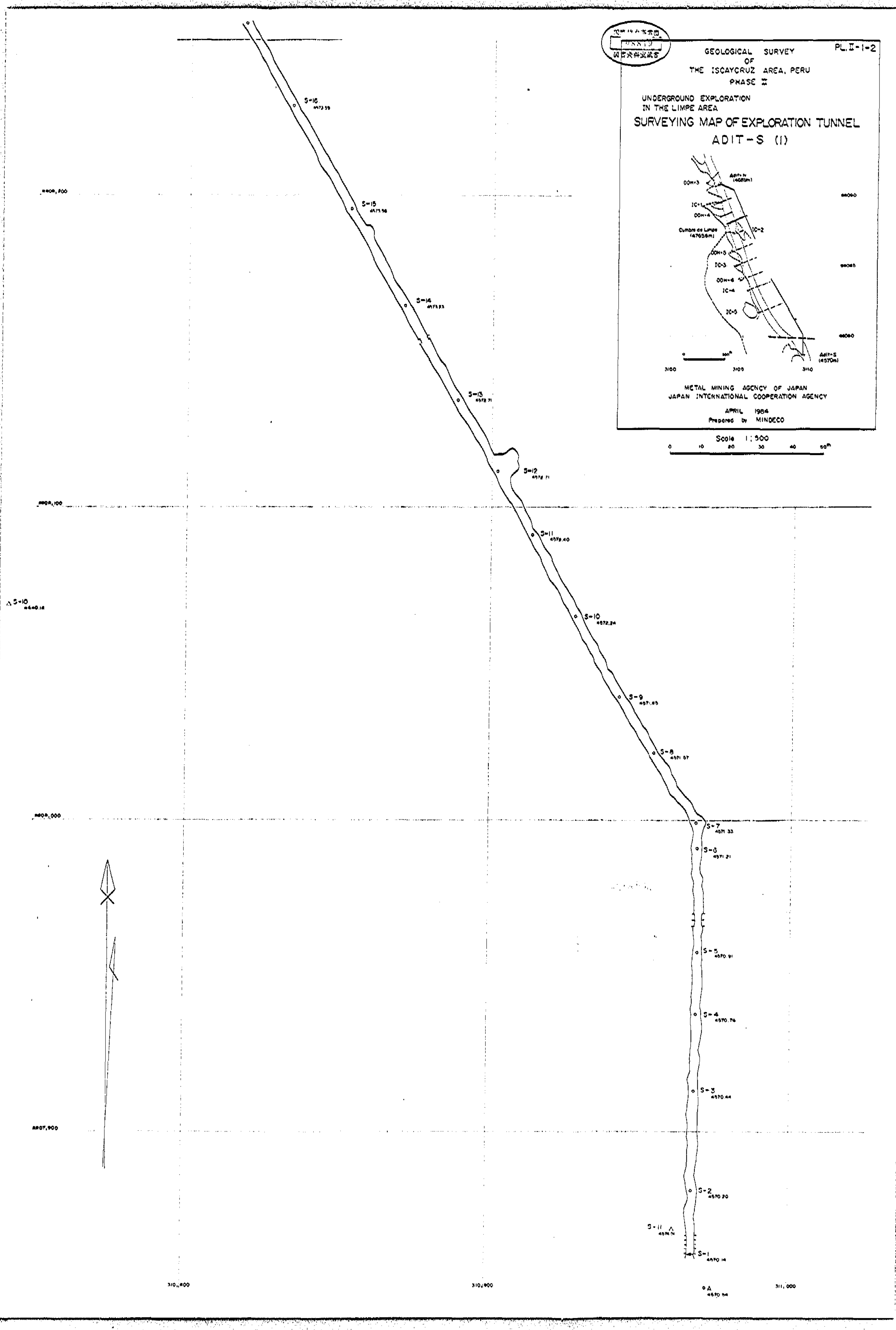
10. Rock:	Pebble, sand, clay	Peb			
	Sandstone	Ss			
	Shale	Sh			
	Marl	Ml			
	Limestone	Ls			
	Dolomitic limestone	Do-Ls			
	Dolostone	Do			
	Siderite	Sd			
	Quartzite	Qz			
	Ore, high grade				
	Ore, low grade				
	Pyrite ore	Py			
	Hematite ore	Hm			
	Skarn	Sk			
	Brecciated rock	Brc			
	Altered rock	A			
	Fault, fracture	F			
11. Oxidation:	oxidized	oxd			
	limonitized	lim			
12. Alteration:	dolomitization	do			
	calcification	cal			
	argillization	cly			
	silicification	sil			
	sericitization	ser			
13. Mineralization:	Pyrite	Py	Chalcopyrite	Cp	
	Pb-minerals	Pb	Chalcocite	Cc	
	Zn-minerals	Zn	Hematite	Hm Spc	
	Oxide minerals	Oxd	Magnetite	Mt	
14. Color:	light	l-	black	blk	
	dark	d-	white	wht	
	gray	gry	brown	brn	
15. Fracture:	Fault	F			
	sheared	shd			
	brecciated	brc			
16. Observations:	dissemination	dss			
	veins	vs			
	veinlets	vls			

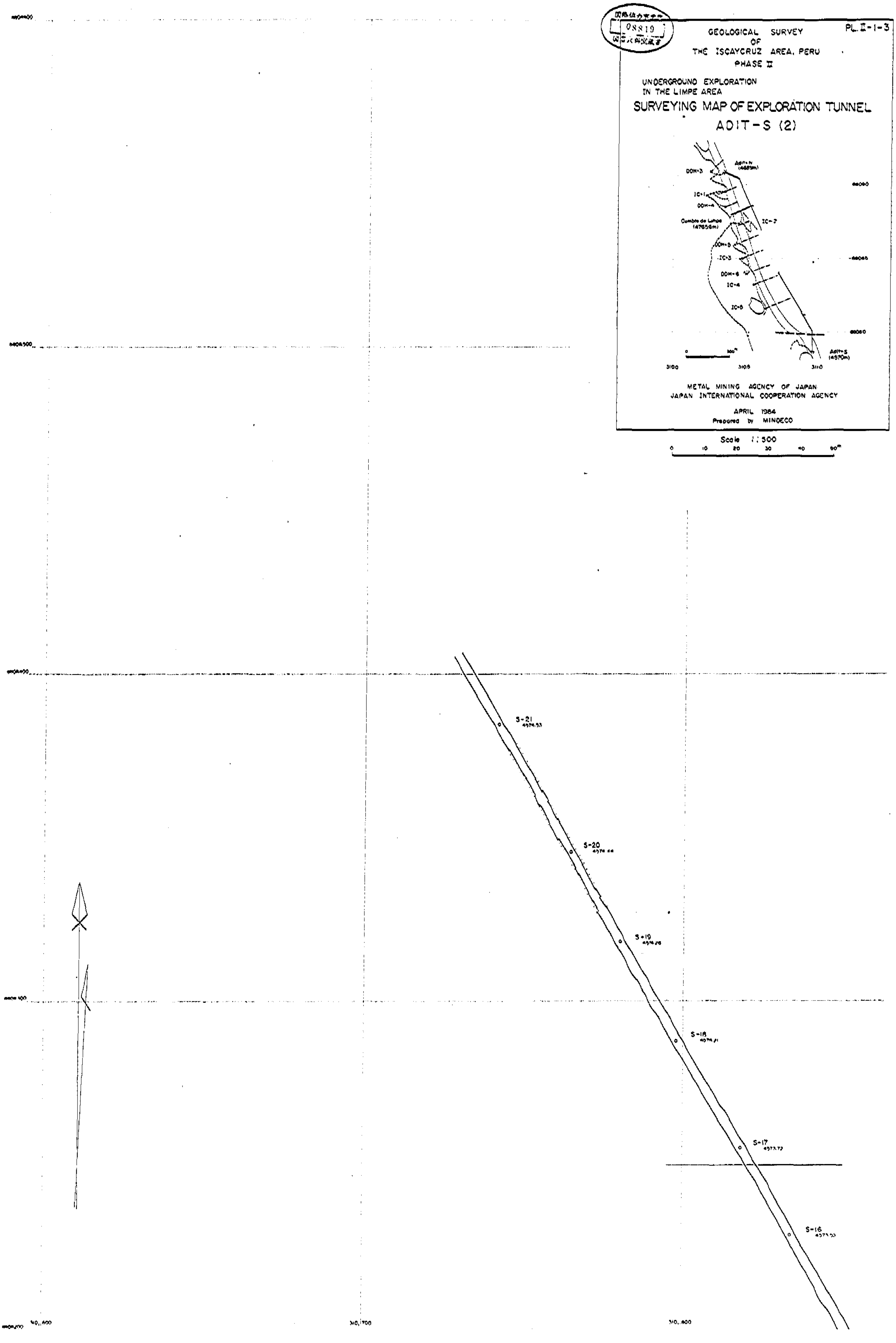


08819
PL. II-1-1
GEOLOGICAL SURVEY
OF
THE ISCAYCRUZ AREA, PERU
PHASE II
UNDERGROUND EXPLORATION
IN THE LIMPE AREA
SURVEYING MAP OF EXPLORATION TUNNEL
ADIT-N
Adit-N
DDH-3
IC-1
DDH-4
Cumbre de Limpe
IC-2
DDH-5
IC-3
DDH-6
IC-4
IC-5
Adit-S
(4570m)
3100
3105
3110
METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY
APRIL 1984
Prepared by MINDECO
Scale 1 : 500
0
10
20
30
40
50m

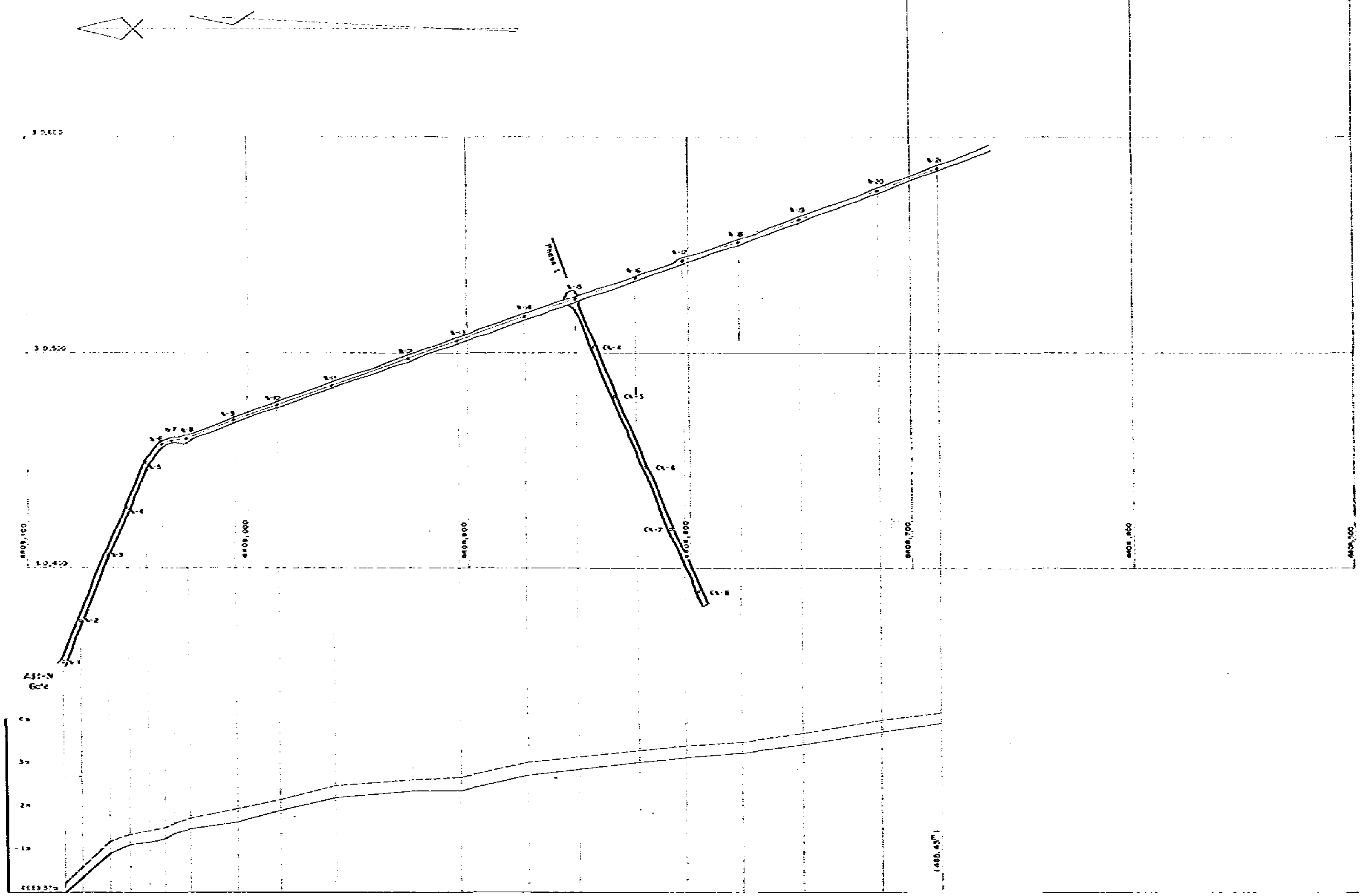


IC-3
DDH-6
IC-4
IC-5
Adit-5
(4570m)
3100
3105
3110
N-9
N-10
N-11
N-12
N-13
N-14
N-16
N-17
N-18
N-19
N-20
N-21
CN-4
CN-5
CN-6
CN-7
CN-8
METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY
APRIL 1984
Prepared by MINDECO
Scale 1 : 500
0 10 20 30 40 50m


PL. II-1-2
GEOLOGICAL SURVEY
OF
THE ISCAYCRUZ AREA, PERU
PHASE II
UNDERGROUND EXPLORATION
IN THE LIMPE AREA
SURVEYING MAP OF EXPLORATION TUNNEL
ADIT-S (1)
Adit-N
DDH-3
IC-1
DDH-4
Cumbre de Limpe
IC-2
DDH-5
IC-3
DDH-6
IC-4
IC-5
Adit-S
(4570m)
METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY
APRIL 1984
Prepared by MINDECO
Scale 1 : 500
0 10 20 30 40 50m
S-16
S-15
S-14
S-13
S-12
S-11
S-10
S-9
S-8
S-7
S-6
S-5
S-4
S-3
S-2
S-1
A



PL. II-1-3
GEOLOGICAL SURVEY
OF
THE ISCAYCRUZ AREA, PERU
PHASE II
UNDERGROUND EXPLORATION
IN THE LIMPE AREA
SURVEYING MAP OF EXPLORATION TUNNEL
ADIT-S (2)
METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY
APRIL 1984
Prepared by MINDECO
Scale 1:500
0 10 20 30 40 50m
S-21
S-20
S-19
S-18
S-17
S-16



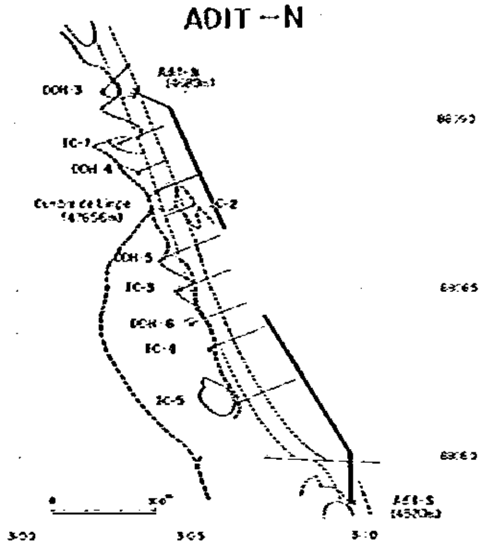
Survey Point	Horizontal Distance (m)	Elevation (m)	Difference of Elevation (m)	Accumulative Difference (m)
Gate No.1	0	4689.37	0	0
N-2	20.329	4689.73	0.36	0.36
N-3	33.641	4690.29	0.56	0.92
N-4	22.963	4690.49	0.20	1.12
N-5	22.632	4690.54	0.05	1.17
N-6	10.849	4690.62	0.08	1.25
N-7	4.961	4690.74	0.12	1.37
N-8	6.526	4690.84	0.10	1.47
N-9	23.659	4691.00	0.16	1.63
N-10	21.000	4691.28	0.28	1.91
N-11	24.255	4691.58	0.30	2.21
N-12	37.265	4691.72	0.14	2.35
N-13	25.676	4691.72	0.00	2.35
N-14	31.690	4692.08	0.36	2.71
N-15	24.449	4692.23	0.15	2.86
N-16	29.836	4692.39	0.16	3.02
N-17	22.620	4692.49	0.10	3.12
N-18	25.842	4692.61	0.12	3.24
N-19	30.300	4692.80	0.19	3.43
N-20	38.275	4693.10	0.30	3.73
N-21	28.736	4693.31	0.21	3.94

PL. II-2-1

GEOLOGICAL SURVEY OF THE ISCAYCRUZ AREA, PERU PHASE II

UNDERGROUND EXPLORATION IN THE LIMPE AREA

SURVEYING MAP SHOWING LOCATION AND LEVEL OF EXPLORATION TUNNEL ADIT - N



METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

APRIL 1984
Prepared by MINDECO

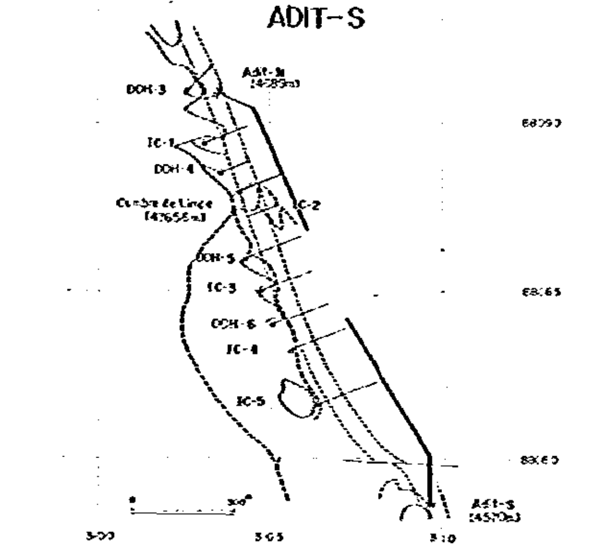
Scale 1:1000

PL. II-2-2

GEOLOGICAL SURVEY
OF
THE ISCAYCRUZ AREA, PERU
PHASE II

UNDERGROUND EXPLORATION
IN THE LIMPE AREA

SURVEYING MAP SHOWING LOCATION AND LEVEL OF EXPLORATION TUNNEL ADIT-S

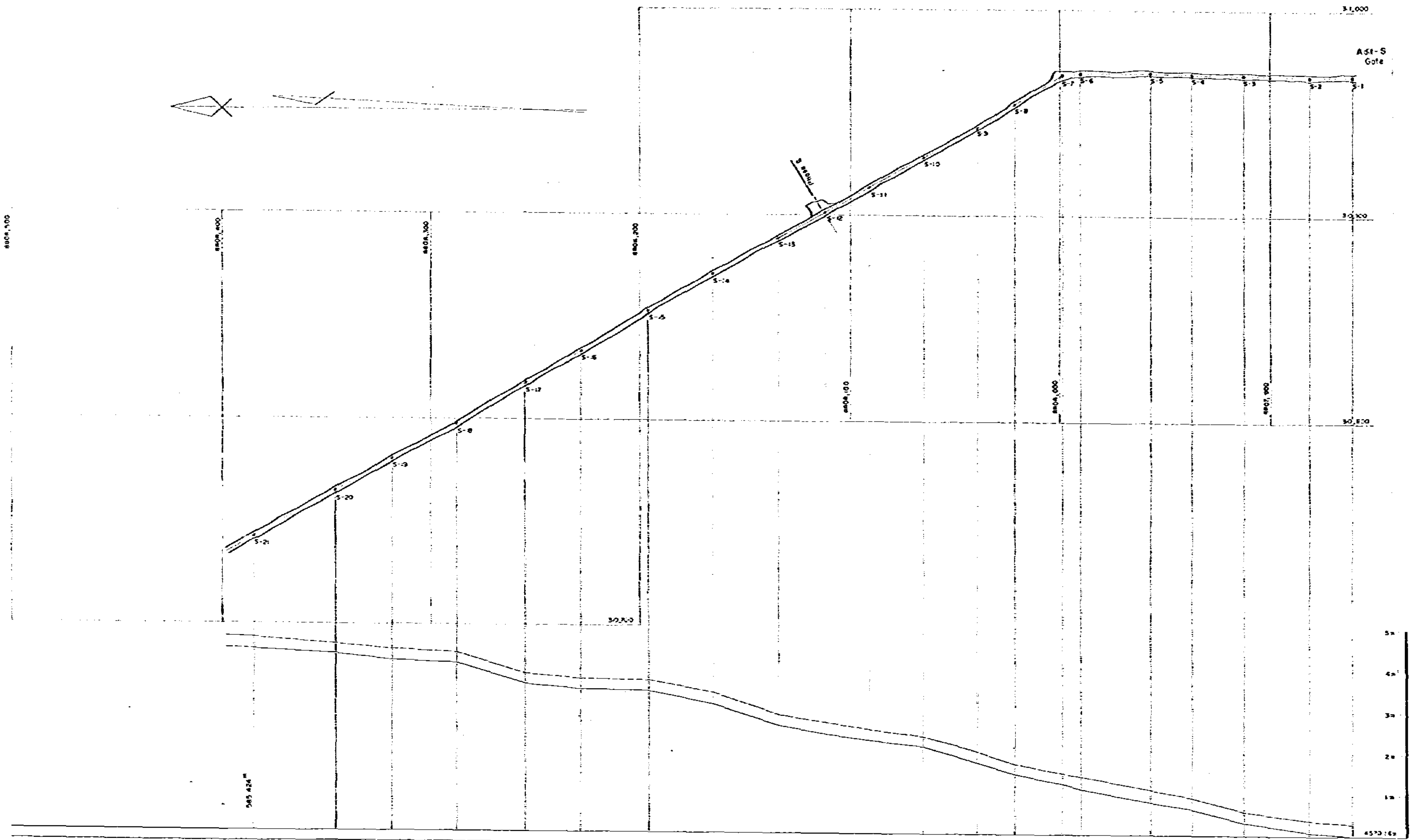


METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

APRIL 1984
Prepared by MINDECO

Scale 1:1000

0 20 40 60 80 100m



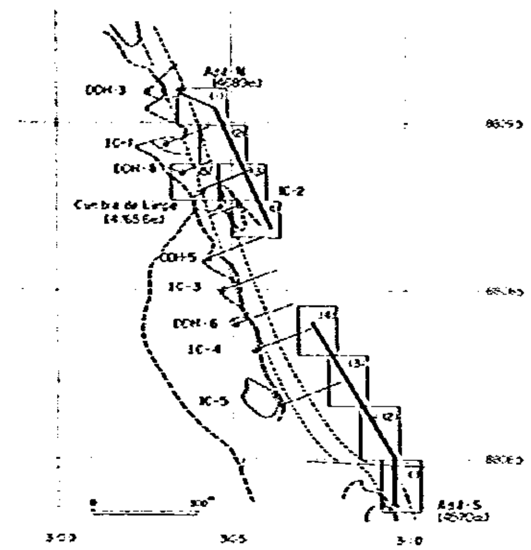
Survey Point	Horizontal Distance (m)	Elevation (m)	Difference of Elevation (m)	Accumulated Difference (m)
S-21	45.270	4574.55	0.09	4.39
S-20	31.319	4574.44	0.16	4.30
S-19	35.881	4574.28	0.07	4.14
S-18	38.379	4574.21	0.46	4.07
S-17	30.656	4573.72	0.15	3.58
S-16	36.000	4573.59	0.03	3.45
S-15	35.948	4573.56	0.33	3.42
S-14	35.288	4573.23	0.52	3.09
S-13	26.445	4572.71	0.21	2.57
S-12	23.400	4572.50	0.10	2.36
S-11	25.832	4572.40	0.16	2.26
S-10	29.918	4572.24	0.38	2.10
S-9	21.919	4571.85	0.28	1.71
S-8	26.240	4571.57	0.24	1.45
S-7	8.190	4571.33	0.12	1.19
S-6	36.942	4571.21	0.30	1.07
S-5	19.669	4570.91	0.15	0.77
S-4	24.695	4570.76	0.32	0.62
S-3	31.941	4570.44	0.24	0.30
S-2	20.421	4570.20	0.06	0.06
Gate S-1	0	4570.14	0	0

PL Ⅱ-3-3

GEOLOGICAL SURVEY
OF
THE ISCAYCRUZ AREA, PERU
PHASE Ⅱ

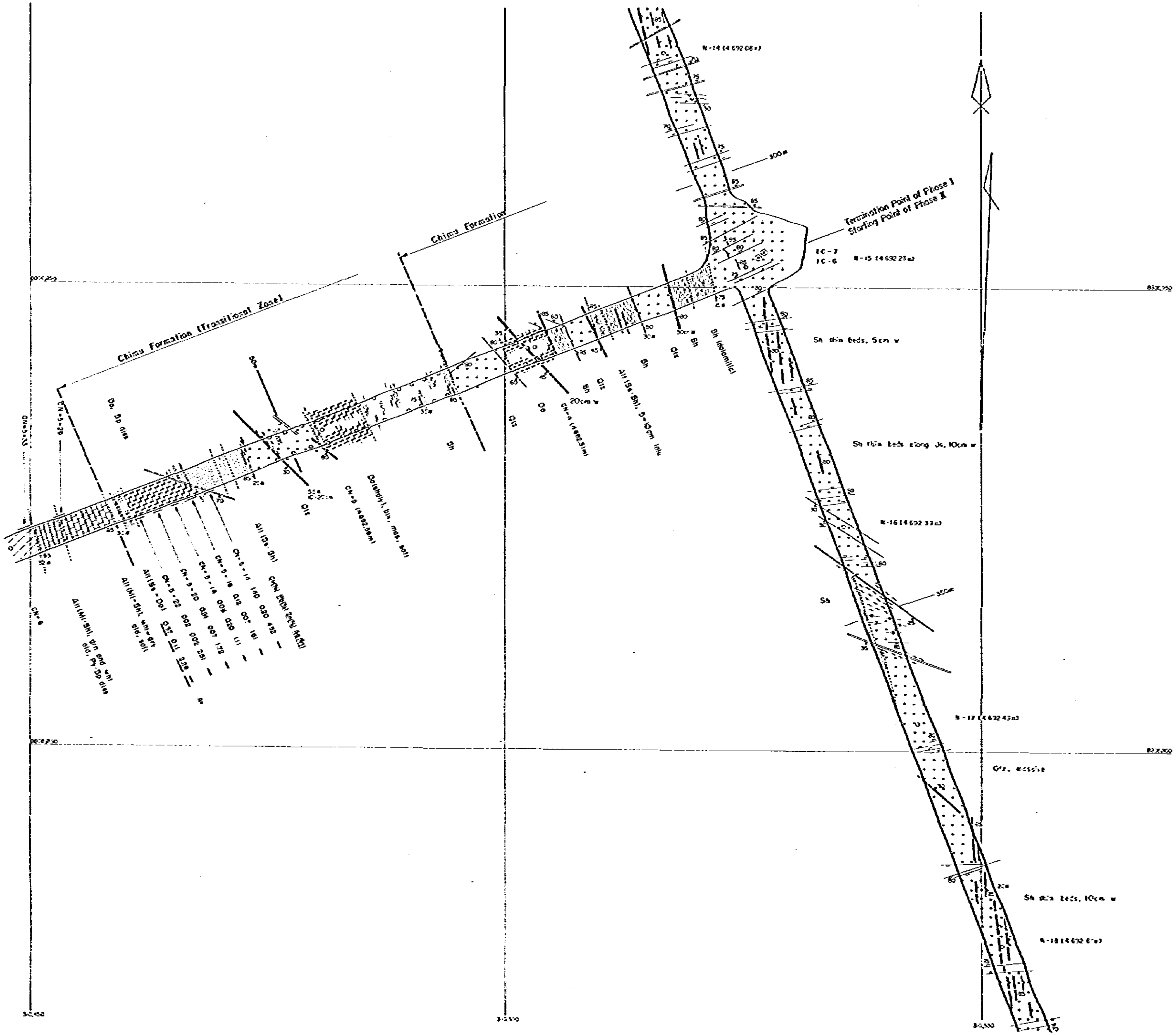
UNDERGROUND EXPLORATION
IN THE LIMPE AREA

GEOLOGICAL SKETCH ADIT - N (3)



METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

APRIL 1984
Prepared by MINDECO



Scale 1 : 200

LEGEND and ABBREVIATION

Rock:

Pebble, sand, clay	Pb	
Sandstone	Ss	
Shale	Sh	
Marl	Ml	
Limestone	Ls	
Dolomitic Limestone	Do-Ls	
Dolostone	Do	
Siderite	Sd	
Quartzite	Qz	
Ore, high grade		
Ore, low grade		
Pyrite ore	Py	
Hematite ore	Hm	
Skarn	Sk	
Brecciated rock	Bx	
Altered rock	A(cl)	
Sheared zone	Shd	
Fault	F	
Fracture and joint	J	
Bedding		

Alteration:

dolomitization	do
calcification	cal
argillization	cly
silicification	si
sericitization	ser

Mineralization:

Pyrite	Py	Magnetite	Mt
Galena	Gl	Hematite	Hm Spc
Sphalerite	Sp	Chalcocite	Cc
Chalcopyrite	Cp	Limonite	Lim
Quartz	Qt	Oxide minerals	Oxd
Calcite	Cal		

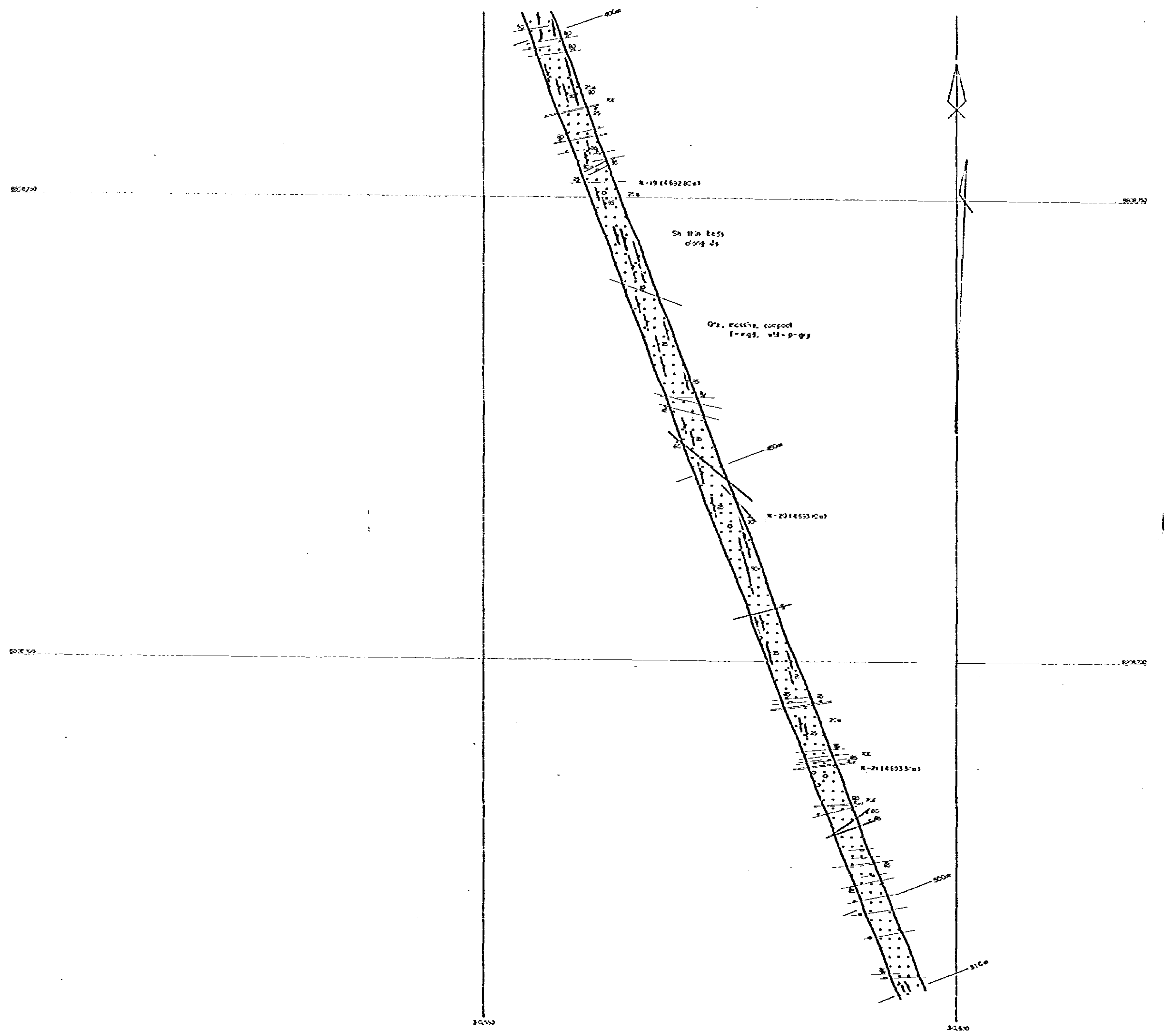
Color:

light	l-	black	bk
dark	d-	white	wh
grey	gry	brown	bn

Other:

fine-grained	fgd	vein	v
medium-grained	mgd	veinlet	vt
coarse-grained	cgd	dissemination	diss
intercalated	intc	Alteration	Alt

Sampling location and assay result — Nr-01

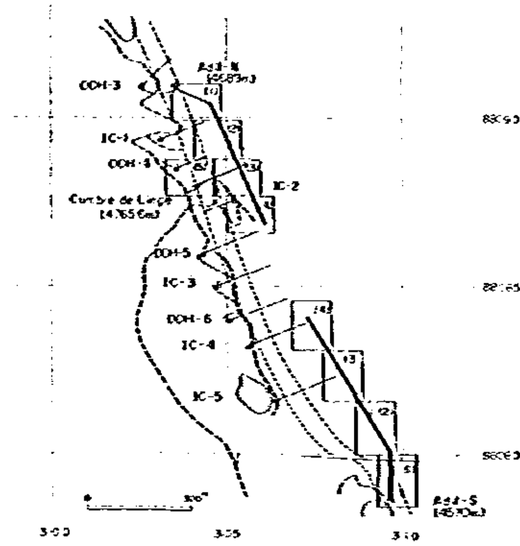


PL.Ⅱ-3-4

GEOLOGICAL SURVEY
OF
THE ISCAYCRUZ AREA, PERU
PHASE Ⅱ

UNDERGROUND EXPLORATION
IN THE LIMPE AREA

GEOLOGICAL SKETCH
ADIT - N (4)



METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

APRIL 1984
Prepared by MINDECO

Scale 1:200

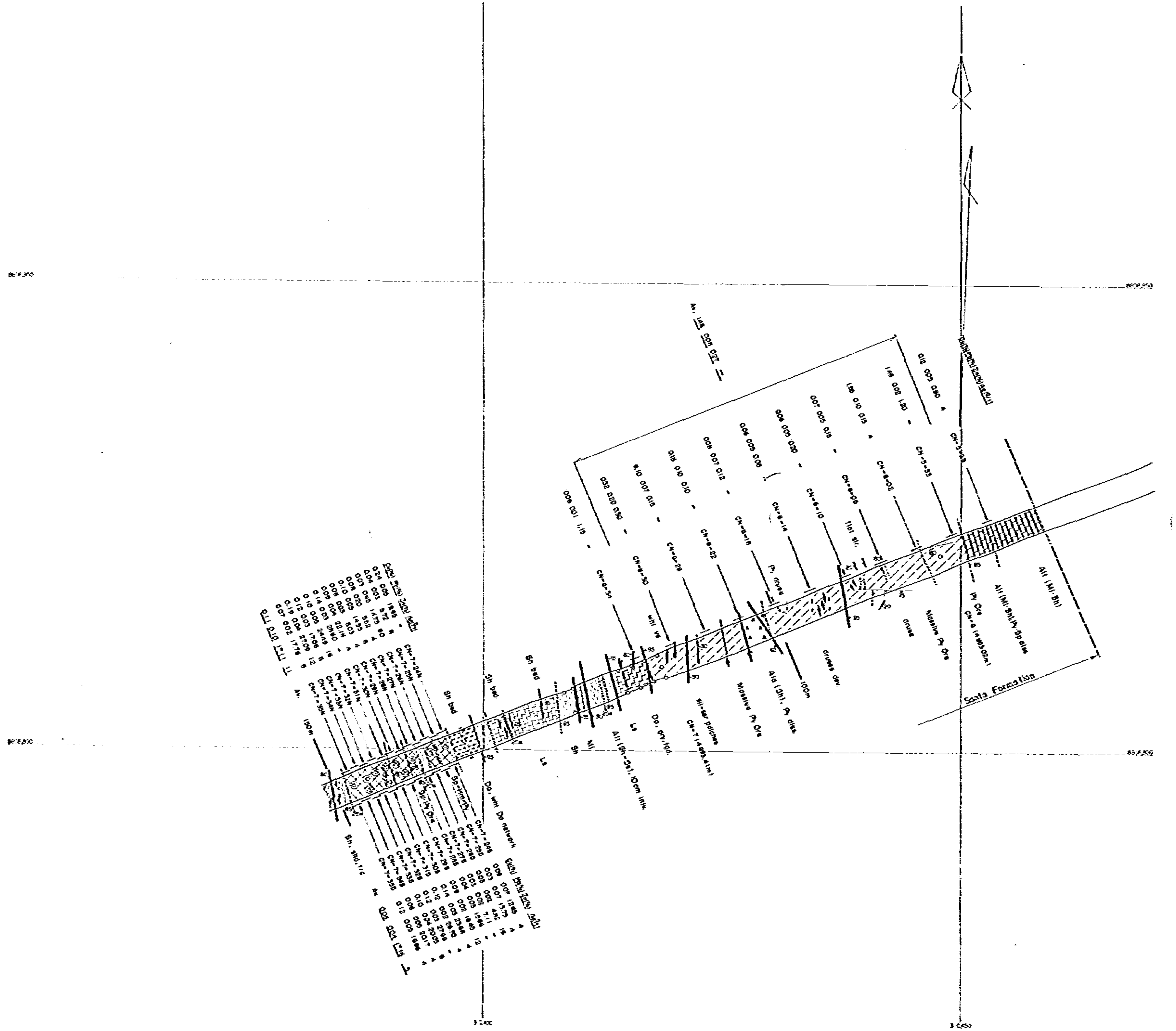
0 4 8 12 16 20m

LEGEND and ABBREVIATION

Rock:	Pebble, sand, clay	Peb
	Sandstone	Ss
	Shale	Sh
	Marl	Ml
	Limestone	Ls
	Dolomitic limestone	Do-Ls
	Dolostone	Do
	Siderite	Sd
	Quartzite	Qz
	Ore, high grade	
	Ore, low grade	
	Pyrite ore	Py
	Hematite ore	Hm
	Skarn	Sk
	Brecciated rock	Bc
	Altered rock	Alt'd
	Sheared zone	Shd
	Fault	F
	Fracture and joint	J
	Bedding	
Alteration:	dolomitization	do
	calcitization	cal
	argillization	cly
	silicification	si
	sericitization	ser

Mineralization:	Pyrite	Py	Magnetite	Mt
	Galena	Gl	Hematite	Hm Spe
	Sphalerite	Sp	Chalcocite	Cc
	Chalcopyrite	Cp	Limonite	Lim
	Quartz	Qz	Oxide minerals	Oxd
	Calcite	Cal		
Color:	light	l-	black	bk
	dark	d-	white	wht
	grey	gy	brown	brn
Other:	fine-grained	fgd	vein	v
	medium-grained	mgd	veinlet	vlt
	coarse-grained	cgd	dissemination	diss
	intercalated	intc	Alteration	Alt

Sampling location and assay result — M-01



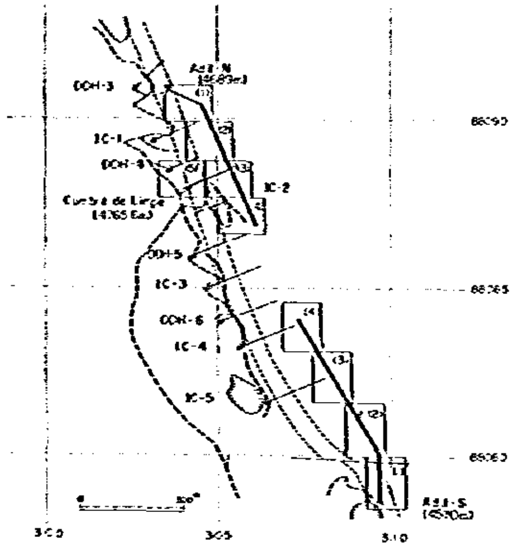
GEOLOGICAL SURVEY OF THE ISCAYCRUZ AREA, PERU

PHASE II

PL II-3-5

UNDERGROUND EXPLORATION IN THE LIMPE AREA

GEOLOGICAL SKETCH ADIT - N (5)



METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

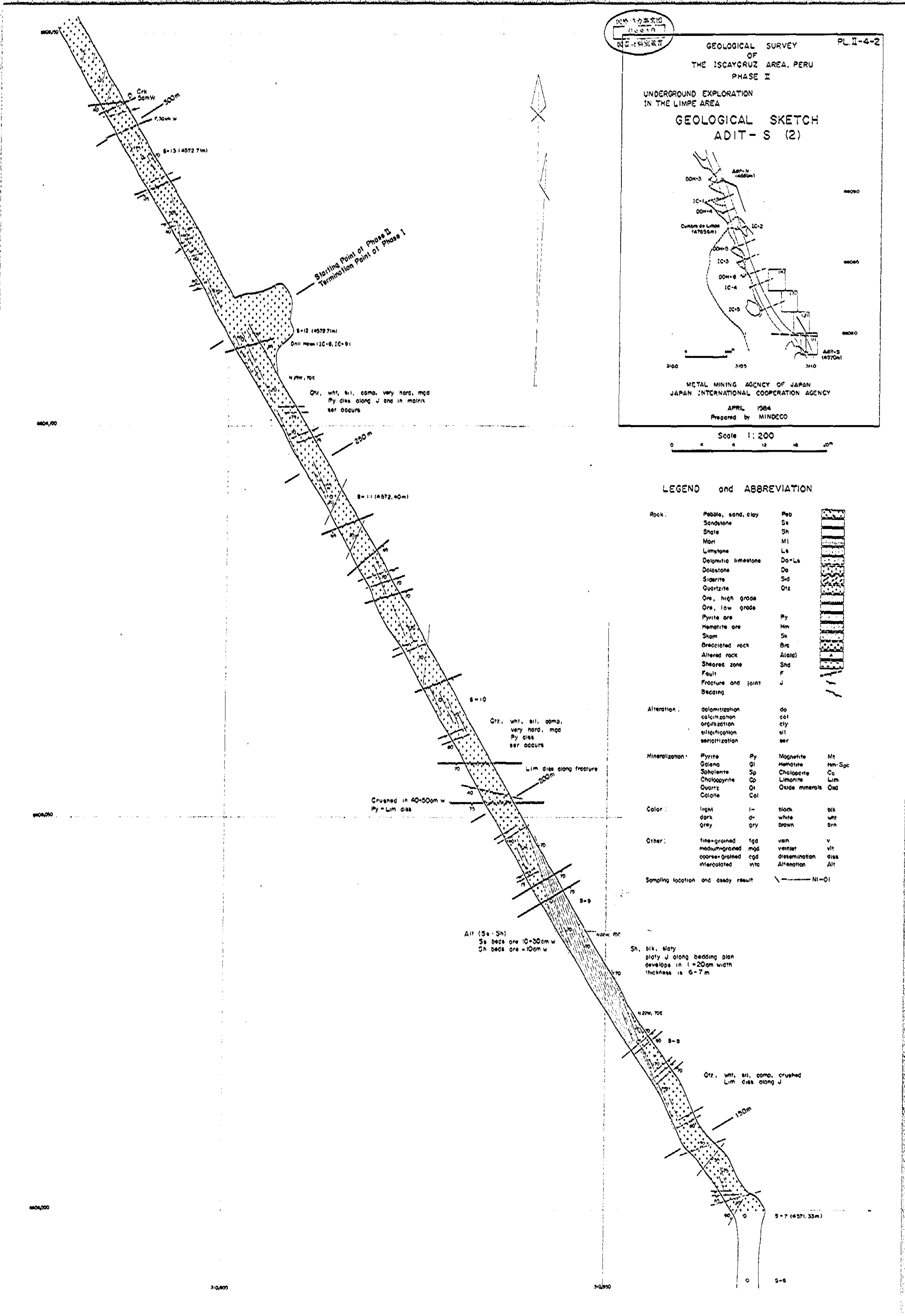
APRIL 1984
Prepared by MINDECO

Scale 1: 200

LEGEND and ABBREVIATION

Rock:	Pebble, sand, clay	Pbs		
	Sandstone	Ss		
	Shale	Sh		
	Marl	Ml		
	Limestone	Ls		
	Dolomitic limestone	Do-Ls		
	Dolostone	Do		
	Siderite	Sd		
	Quartzite	Qtz		
	Ore, high grade			
	Ore, low grade			
	Pyrite ore	Py		
	Hematite ore	Hm		
	Skarn	Sk		
	Brecciated rock	Brc		
	Altered rock	Alt(d)		
	Sheared zone	Shd		
	Fault	F		
	Fracture and joint	J		
	Bedding			
Alteration:	dolomitization	do		
	calcification	cal		
	argillization	aly		
	silicification	sil		
	sericitization	ser		
Mineralization:	Pyrite	Py	Magnetite	Mt
	Galena	Gl	Hematite	Hm Spc
	Sphalerite	Sp	Chalcocite	Cc
	Chalcopyrite	Cp	Limonite	Lim
	Quartz	Qz	Oxide minerals	Oxd
	Calcite	Cal		
Color:	light	l-	black	bk
	dark	d-	white	wh
	grey	gy	brown	bn
Other:	fine-grained	fgd	vein	v
	medium-grained	mgd	veinlet	vt
	coarse-grained	cgd	dissemination	diss
	intercalated	intc	Alteration	Alt

Sampling location and assay result — N-01


PL. II-4-2
GEOLOGICAL SURVEY
OF
THE ISCAYCRUZ AREA, PERU
PHASE II
UNDERGROUND EXPLORATION
IN THE LIMPE AREA
GEOLOGICAL SKETCH
ADIT- S (2)
Adit-N (4685m)
DDH-3
IC-1
DDH-4
Cumbre de Limpe (4705.6m)
IC-2
DDH-5
IC-3
DDH-6
IC-4
IC-5
Adit-S (4570m)
METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY
APRIL 1984
Prepared by MINDECO
Scale 1 : 200
LEGEND and ABBREVIATION
Rock : Pebble, sand, clay Peb
Sandstone Ss
Shale Sh
Marl Ml
Limestone Ls
Dolomitic limestone Do-Ls
Dolostone Do
Siderite Sid
Quartzite Qtz
Ore, high grade
Ore, low grade
Pyrite ore Py
Hematite ore Hm
Skarn Sk
Brecciated rock Brc
Altered rock A(ald)
Sheared zone Shd
Fault F
Fracture and joint J
Bedding
Alteration : dolomitization do
calcinzation cal
argillization cly
silicification sil
sericitization ser
Mineralization : Pyrite Py
Galena Gl
Sphalerite Sp
Chalcopyrite Cp
Quartz Qt
Calcite Cal
Magnetite Mt
Hematite Hm-Spc
Chalcocite Cc
Limonite Lim
Oxide minerals Oxd
Color : light l-
dark d-
grey gry
black blk
white wht
brown brn
Other : fine-grained fgd
medium-grained mgd
coarse-grained cgd
intercalated intc
vein v
veinlet vlt
dissemination diss
Alteration Alt
Sampling location and assay result NI-01
Crk 5cmW
300m
F, 30cm w
S-13 (4572.71m)
Starting Point of Phase II
Termination Point of Phase I
S-12 (4572.71m)
Drill Holes (IC-8, IC-9)
N 29W, 70E
Qtz, wht, sil, comp, very hard, mgd
Py diss along J and in matrix
ser occurs
250 m
S-11 (4572.40m)
S-10
Qtz, wht, sil, comp,
very hard, mgd
Py diss
ser occurs
Lim diss along fracture
200m
Crushed in 40-50cm w
Py - Lim diss
S-9
Alt (Ss · Sh)
Ss beds are 10-30cm w
Sh beds are - 10cm w
N22W, 70E
Sh, blk, slaty
platy J along bedding plan
develops in 1-20cm width
thickness is 6-7 m
N 22W, 70E
S-8
Qtz, wht, sil, comp, crushed
Lim diss along J
150m
S-7 (4571.33m)
S-6

PL.II-4-3

GEOLOGICAL SURVEY
OF
THE ISCAYCRUZ AREA, PERU
PHASE II

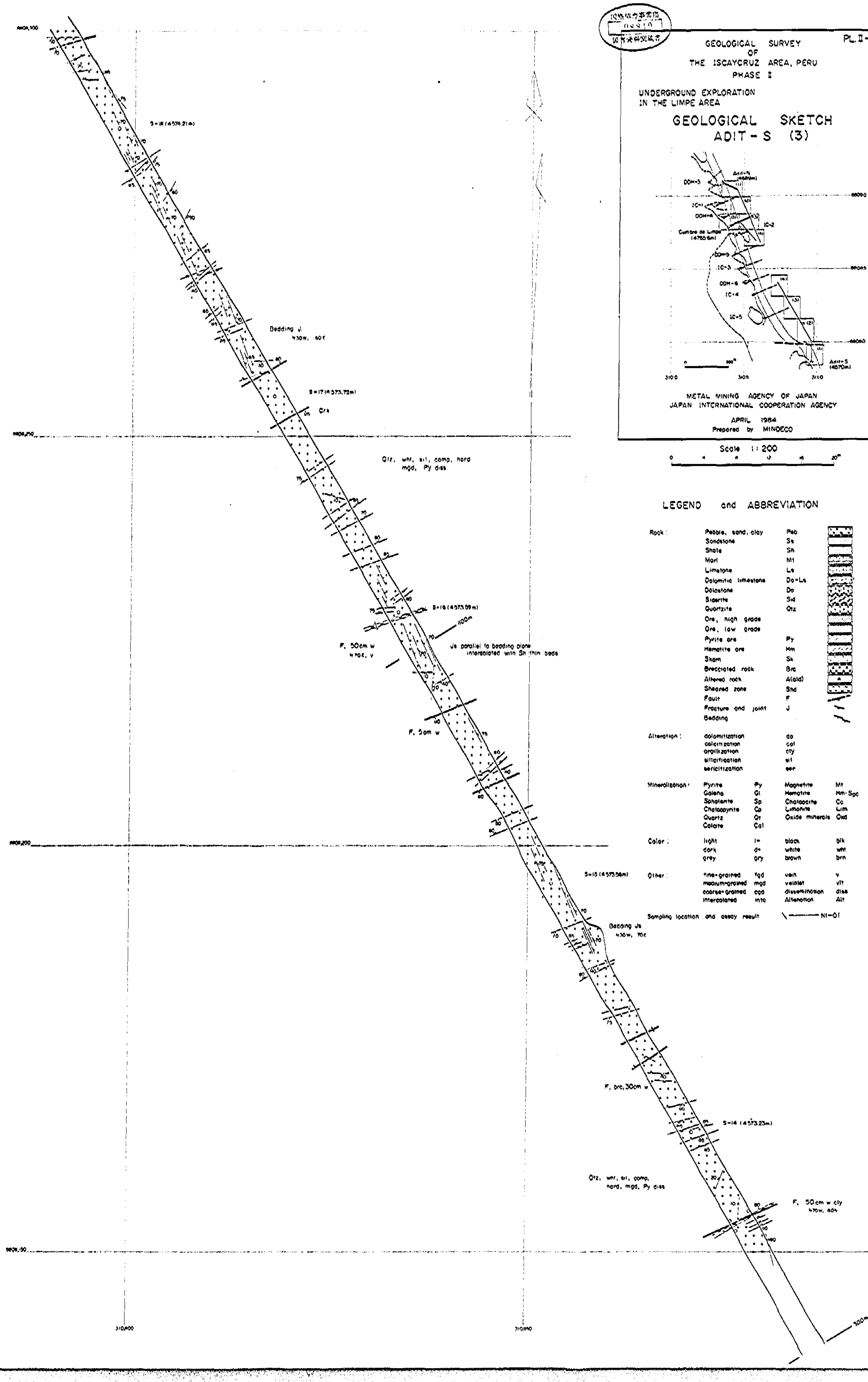
UNDERGROUND EXPLORATION
IN THE LIMPE AREA

GEOLOGICAL SKETCH
ADIT - S (3)

METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

APRIL 1984
Prepared by MINDECO

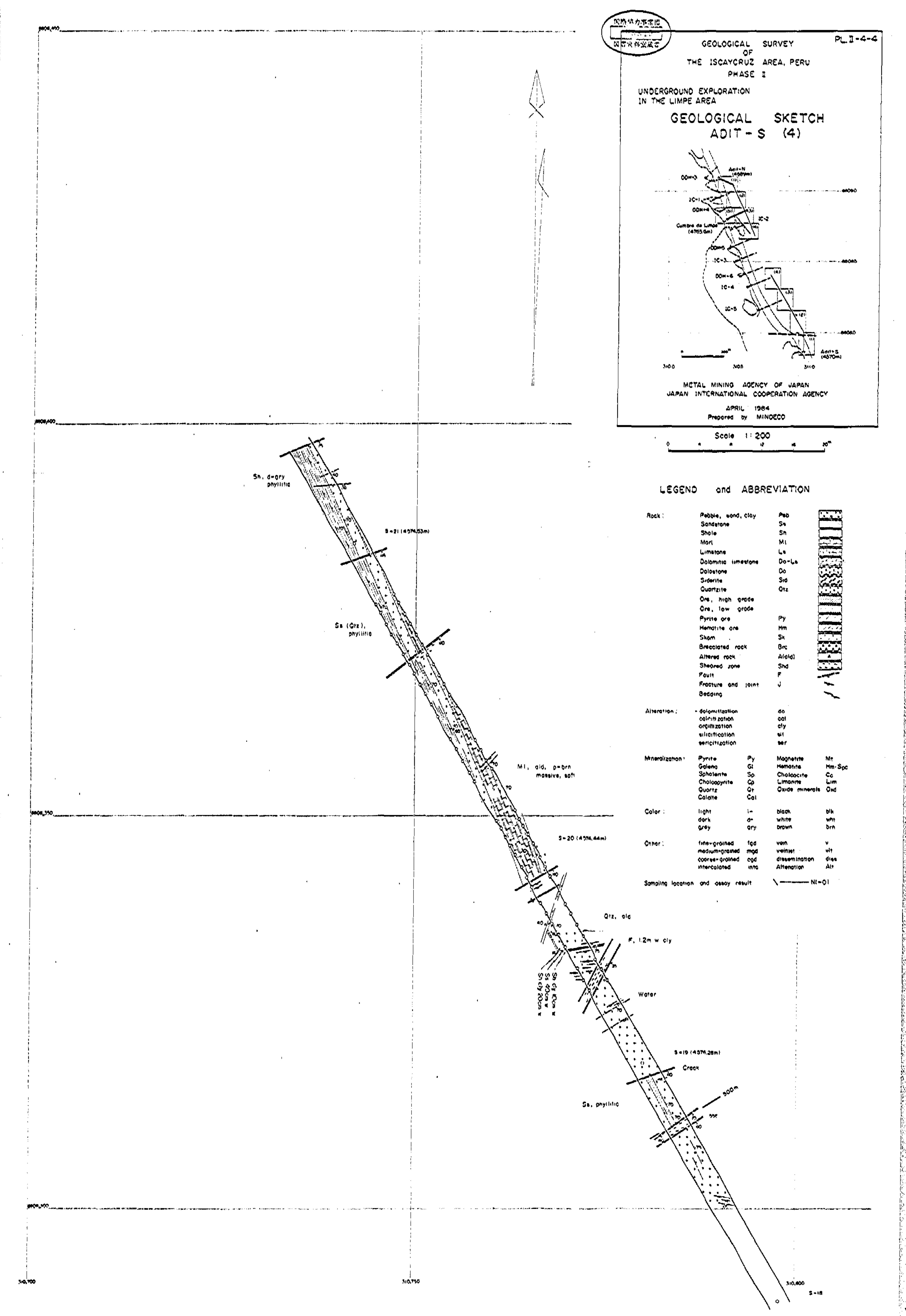
Scale 1 : 200
0 4 8 12 16 20m



LEGEND and ABBREVIATION

Rock :	Pebble, sand, clay	Peb		
	Sandstone	Ss		
	Shale	Sh		
	Marl	Ml		
	Limestone	Ls		
	Dolomitic limestone	Do-Ls		
	Dolostone	Do		
	Siderite	Sid		
	Quartzite	Qtz		
	Ore, high grade			
	Ore, low grade			
	Pyrite ore	Py		
	Hematite ore	Hm		
	Skarn	Sk		
	Brecciated rock	Brc		
	Altered rock	A(ald)		
	Sheared zone	Shd		
	Fault	F		
	Fracture and joint	J		
	Bedding			
Alteration :	dolomitization	do		
	calcitization	cal		
	argillization	cly		
	silicification	sil		
	sericitization	ser		
Mineralization :	Pyrite	Py	Magnetite	Mt
	Galena	Gl	Hematite	Hm·Spc
	Sphalerite	Sp	Chalcocite	Cc
	Chalcopyrite	Cp	Limonite	Lim
	Quartz	Qt	Oxide minerals	Oxd
	Calcite	Cal		
Color :	light	l-	black	blk
	dark	d-	white	wht
	grey	gry	brown	brn
Other :	fine-grained	fgd	vein	v
	medium-grained	mgd	veinlet	vlt
	coarse-grained	cgd	dissemination	diss
	intercalated	inte	Alteration	Alt

Sampling location and assay result —— N1-01


PL. II-4-4
GEOLOGICAL SURVEY
OF
THE ISCAYCRUZ AREA, PERU
PHASE II
UNDERGROUND EXPLORATION
IN THE LIMPE AREA
GEOLOGICAL SKETCH
ADIT - S (4)
METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY
APRIL 1984
Prepared by MINDECO
Scale 1 : 200
LEGEND and ABBREVIATION
Rock : Pebble, sand, clay Peb
Sandstone Ss
Shale Sh
Marl Ml
Limestone Ls
Dolomitic limestone Do-Ls
Dolostone Do
Siderite Sid
Quartzite Qtz
Ore, high grade
Ore, low grade
Pyrite ore Py
Hematite ore Hm
Skarn Sk
Brecciated rock Brc
Altered rock A(ald)
Sheared zone Shd
Fault F
Fracture and joint J
Bedding
Alteration ; dolomitization do
calcitization cal
argillization cly
silicification sil
sericitization ser
Mineralization : Pyrite Py Magnetite Mt
Galena Gl Hematite Hm-Spc
Sphalerite Sp Chalcocite Cc
Chalcopyrite Cp Limonite Lim
Quartz Qr Oxide minerals Oxd
Calcite Cal
Color : light l- black blk
dark d- white wht
grey gry brown brn
Other : fine-grained fgd vein v
medium-grained mgd veinlet vlt
coarse-grained cgd dissemination diss
intercalated intc Altenation Alt
Sampling location and assay result Nl-01
Sh, d-gry phyllitic
S-21 (4574.53m)
Ss (Qtz), phyllitic
Ml, ald, p-brn massive, soft
S-20 (4574.44m)
Qtz, ald
F, 1.2m w cly
Water
S-19 (4574.28m)
Crack
Ss, phyllitic
500m
310,700
310,750
310,800
S-18