REPUBLIC OF PERU

REPORT ON GEOLOGICAL SURVEY

OF

THE OYON AREA

CONSOLIDATED REPORT

MARCH 1982

METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

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

The survey and investigation of the Oyon area were carried out over three years from 1979 to 1981 and completed on schedule under close cooperation with the Government of the Republic of Peru and its authorities.

This report summarizes the results of the survey and investigation executed during three years.

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.

February 1982

Keisuke Arita
President
Japan International Cooperation Agency

Masayuki Nishiie
President
Metal Mining Agency of Japan

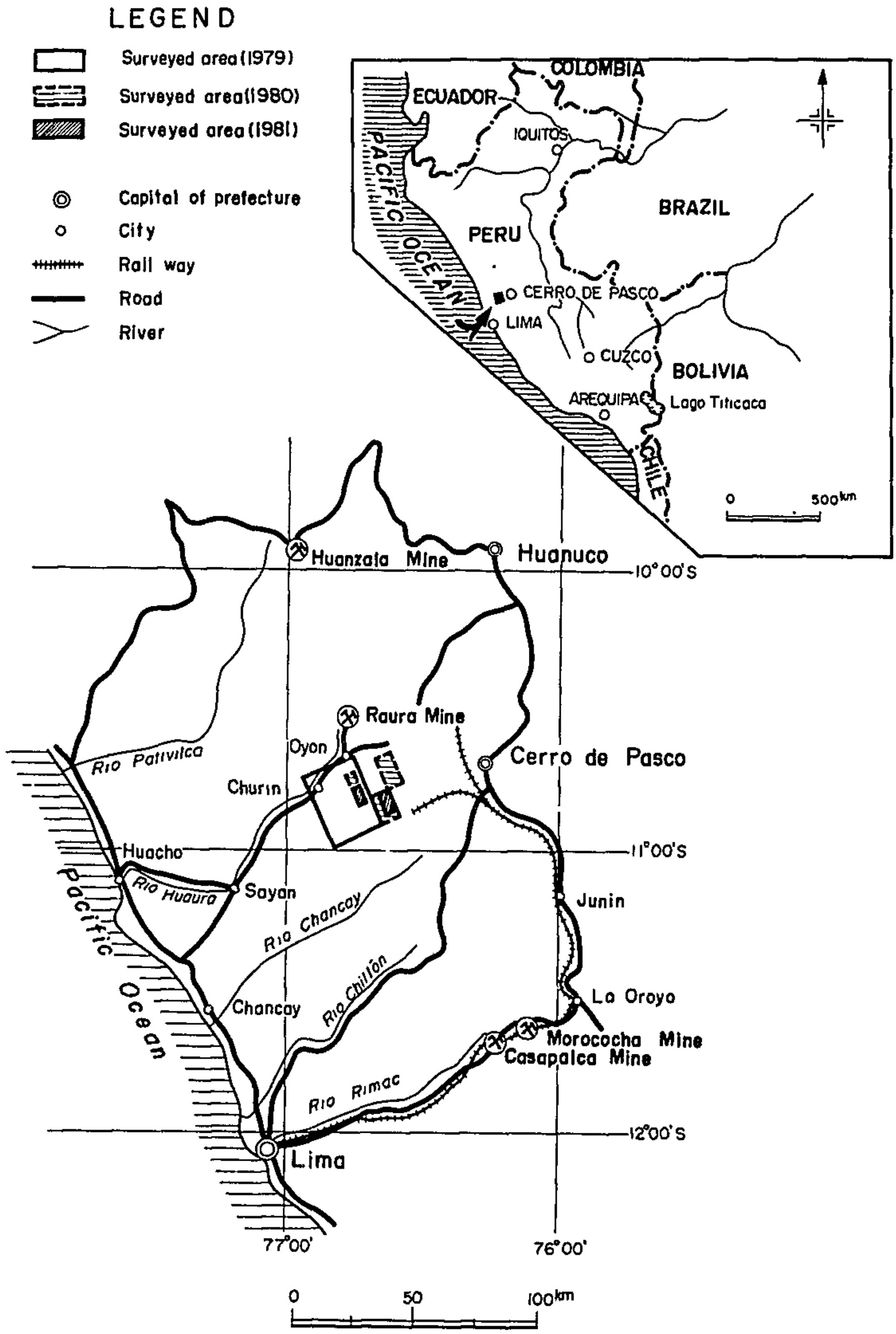

Fig. 1. Index Map

ABSTRACT

This report summarizes results of the part three year's work of basic geological survey for development of mineral respources in the Oyon area, the Republic of Peru. The work was carried out under the Japan-Peru co-operation project between 1979 and 1981. Purpose of this project is to examine relationship between geological structure and mineralization, hence to propose exploration criteria for further planning of exploration.

The Oyon area is situated at about 100 km north of Lima, capital of the country. It occupies backbone range of the West Andes in area of about 860 km². Geological survey was adopted step by step for the three years. To the selected, prosperous Iscay Cruz area for mineral potentiality, detail geological survey, geophysical prospecting, and drilling exploration were added. IP method was applied to 15 measuring lines totaling 35.9 km and EM method to 10 lines totaling 13.0 km. Drilling was done at 11 localities for 12 holes; the total length was 2,654 m.

In synthesizing results of above-mentioned works, stratigraphy, geological structure, nature of igneous activity, relationship between geological structure and mineralization, and characteristics of mineralized showing were established in the Oyon area. Distinct geophysical anomalies were discovered in Iscay Cruz area, which were followed up by drilling, and high-grade lead-zinc massive sulfide orebody and high-grade copper-zinc skarn orebody were detected.

The Oyon area is underlain by Mesozoic sedimentary rocks, which have a composite folded structure due to tight folding against the Andean, NNW-SSE axis. The Iscay Cruz mineralized zone is located at 7 to 19 km south-southeast of Oyon and in high mountains, 4,700 m above sea level. The mineralization occurs in the Santa formation of 40 to 80 m thick and continues to about 12 km along its strike. Two types are seen, namely contact metasomatic skarn deposit and hydrothermal replacement of lead-zinc massive sulfide deposit and lead-zinc disseminated siderite bed.

By the above-mentioned discoveries, the initial object of this project was accomplished in the Iscay Cruz area. Besides the high-grade ores, a large quantity of ore reserves is expected to exist in the area. More detail works to seek for feasibility of commercial level of development are recommended to this area.

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Chapter 1 Introduction

1–1 Purpose of the Survey

Purpose of this project is to establish relationship between geological structure and mineralization in the Oyon area, the Republic of Peru, which will serve useful parameters for future mineral exploration.

1–2 Scope of the Survey

The Oyon area is situated in the highest portion of the West Andes. The total area of 860 km^2 is grouped into A area (71 km^2), B area (89 km^2) and C area (700 km^2). The project was carried out under the Japan-Peru co-operation project for development of mineral resources from 1979 to 1981. Surveyed area of annual base and survey method adopted in individual years are listed in Table 1.

1–3 Members of the Survey Team

Field work and analysis of the results were done by the MESCO, Inc. (Engineering Division of Mitsui Mining & Smelting Co., Ltd.) with co-operation of Instituto Geologico, Minero y Metalurgico, (INGEMMET). The members joined in this project are listed in Table 2.

Table 1 Outline of the Survey

Survey Method	Phase I (1979)	Phase II (1980)	Phase III (1981)	Remarks
Geological Survey				
Regional survey (Km^2)	700	160		Oyon A, B and C areas
Detailed survey (Km^2)		40	40	Iscay Cruz and Cochaquillo areas
Detailed mapping (Km^2)			2	Iscay Cruz area
Study on aerial photograph (Km^2)	700	160		
Trenching (m)	200	200	200	
Geochemical survey (No. of samples)	464	164	157	
Geophysical Prospecting				Iscay Cruz area
IP method No. of survey lines		8	7	
Total surveyed length (Km)		25.4	10.5	
EM method No. of survey lines		2	8	
Total surveyed length (Km)		3.0	10.0	
Drilling Exploration				Iscay Cruz area
No. of drill holes		3	9	
Total length (m)		564	2,086	

Table 2 Member List of the Snrvey Team

担当業務		第1年次(1979)	第2年次(1980)	第3年次(1981)
日本側調査計画・折衝		坊城俊厚	齊藤顕	田所久造
		沢田賢治	沢田賢治	小泉俊夫
		名井鑾	米田一弘	北善次
		佐藤弘		及川準之助
ペルー側調査計画・折衝		Edgardo Ponzoni	Benjamin Morales	Francisco Sotillo
		Aurelio Cossio	Edgardo Ponzoni	Gregorio Flores
		Gregorio Flores	Gregorio Flores	Augusto Zelaya
日本側調査団	団長	佐藤弘	中村仁一	中村仁一
	地質調査	中村仁一	田上勇吉	田上勇吉
		沢田賢治	菅原一安	菅原一安
		田上勇吉		
		斉藤稔		
		菅原一安		
	物理探査		青山孝	田中栄治
			田島俊雅	立川三郎
			立川三郎	松久保和人
	試錐工事		山本延彦	山本延彦
			山下幸一	関口茂男
			関口茂男	津田孝行
			津田孝行	神成総二
			寺下吉雄	吉田徹男
				形部雄二
				中坪栄二
				谷川勝政
ペルー側調査団	団長	Oscar Palacios	Fernand Llosa	Fernand Llosa
	地質調査	Fernand Llosa	Cesar Vilca	Cesar Vilca
		Manuel Montoya	Guillermo Diaz	
		Zenen de la Cruz		
		Cesar Zedano		
	物理探査		Emilio Rojas	Emilio Rojas

Chapter 2 General Circumstances of the Surveyed Area

2–1 Location and Accessibility

The surveyed area lies 100 km north of Lima, the capital of the Republic of Peru.

There are 2 routes leading to the surveyed area from Lima, one is to pass through Huacho, and the other is a shortcut to attain directly Sayan through Chancay. The two-lane pavement road, the Pan-American High Way, is available from Lima to Huacho, and the road from Huacho beyond 15 km of Sayan is paved. The shortcut from Chancay, however, is not all paved. From Lima to Sayan, it is 178 km by the former route and 137 km by the latter. However, it takes almost same hours, 3 hours and 10 to 20 minutes, by the both routes.

From Sayan to Churin the road along Rio Huaura is rough and it takes about 2 hours to drive 61 km. From Churin to Oyon, it is 32 km and takes 1 hour and 20 minutes. To attain the Iscay Cruz area, on which the detailed surveys were carried out, the route from Oyon via Pampahuay is easiest. From Oyon to Pampahuay, it is 10 km and takes 30 minutes. From Pampahuay to Iscay Cruz, a new access road of 20 km distance passing through a pass about 5,000 m above sea level has been constructed, and it takes about 1 hour and 30 minutes by car, though it is dangerous because the road is not yet stable and it requires repair all the time.

2–2 Topography

The surveyed area lies in the Cordillera Occidental, a main range of the Western Andes, and is situated in the source of Rio Huaura which belongs to the drainage system of the Pacific coast. The area forms steep mountainous topographical feature.

The sea level ranges from 2,300 m at the lowest part of the valleys to 5,300 m at the summit of the highest mountain, attaining 3,000 m in the difference. Relatively flat plane named the Puna surface is developed from 4,200 m to 4,800 m, and the difference in topography is clearly observed bounded by this plane. The glacial topography consisting of steep peaks is formed above 4,800 m and the plane shows the stage of maturity, being deeply cut by valleys below 4,200 m (Fig. 2).

The detailed survey areas, both of Iscay Cruz and Cochaquillo, are located at uplands more than 4,600 m above sea level. All places above 4,800 m near the continental divide are covered by snow and glacier.

The topography and drainage system in this area reflect the geological structure: the

Jumasha formation consisting of massive limestone forms the highest peaks stretching in the NNW-SSE direction, then the Chimu formation of quartzite forms the mountains of intermediate height, and the Carhuaz formation composed of shale and sandstone forms lower cols. The drainage systems of NNW-SSE and ENE-WSW directions are well developed and cross to each other. The drainage system of NNW-SSE reflects the folding structure, distribution trend of the formations and thrust faults developing in parallel with the folding axes, while that of NNE-SSW reflects the fracture system.

2–3 Climate and Vegetation

1) Climate

The climate in the highland is so-called Andean highland climate. The temperature variation within a day is conspicuous. It rises over 20°C in the daytime and falls below 0°C at night.

The climate during a year is controlled by the seasonal wind from the Amazon side and is devided into two seasons, that are the dry season from May to September and the rainy season from October to April . In the rainy season rainfall, which turns to snowfall above 4,000 m, attains considerable amounts near the continental devide. As the height decreases toward west, the climate becomes dry and mild.

2) Vegetation

The kinds of plant in this area are limited owing to the dry and cold climate. A kind of cactus, such as Huacro, Chuco, and Viscayna, comes out at an upland from 3,000 m to 4,000 m above sea level. Only special alpine herbage, such as Ichu o Paja, Piriulla, and Chapcha, grows at a mountainous place above 4,000 m.

2–4 Inhabitants and Industries

1) Inhabitants and Their Lives

The area belongs to Provincia Cajatambo in Departamento Lima in the administrative organization. The inhabitants are mainly indio. They have settled villages in the basins along the valleys since Inca time, and are living in selfsuficient by old-fasioned farming and cattel breeding. The transportations between villages depend on horse and foot.

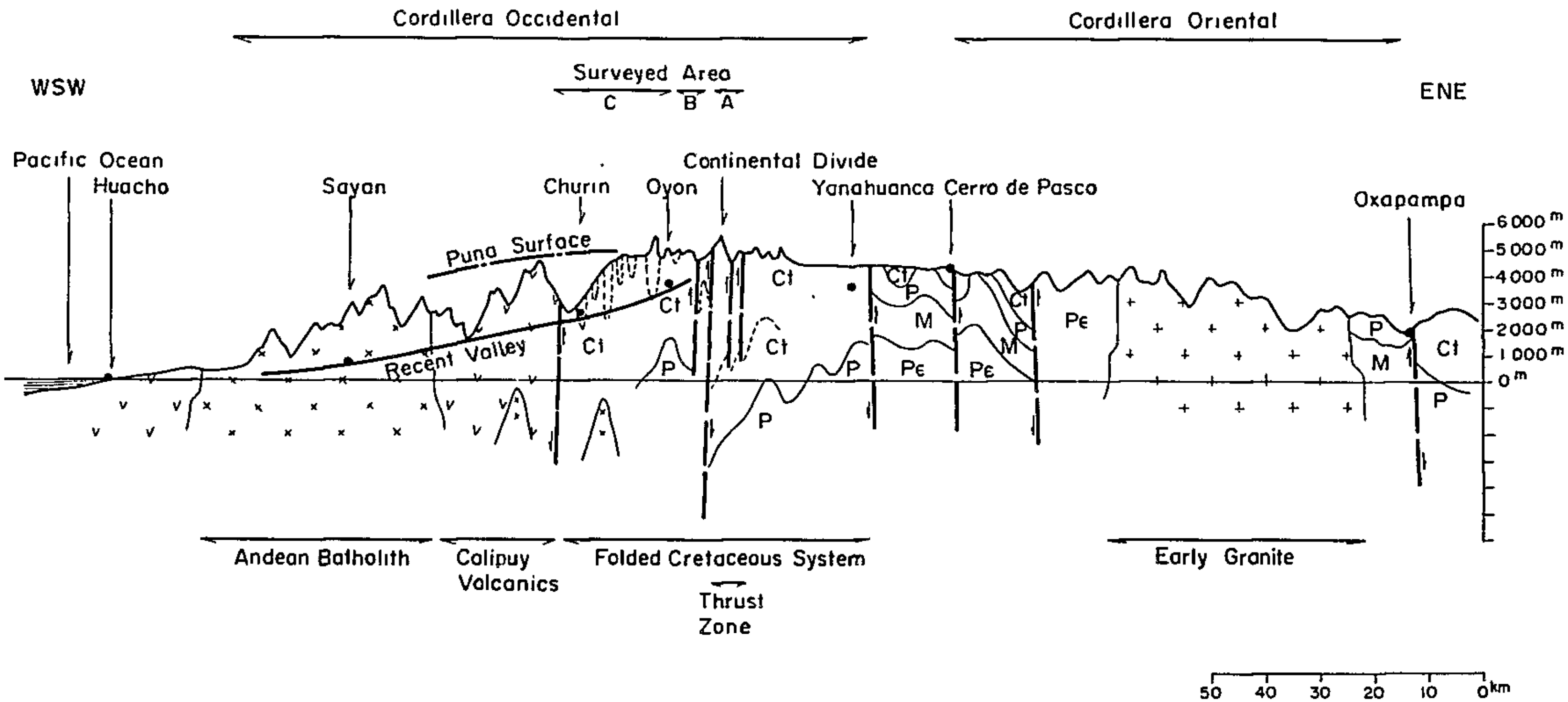
The area is steep in topography and has cold climate in the higher places and dry climate in the lower places, and therefore the lands suitable for farming are restricted. Small scale farming is engaged on the slops with water channels, which is limited by the elevation of 4,000 m. Grazing is only carried on the plateaus above 4,000 m.

2) Industries

Although there are no operating mines in the Oyon area, mordern metal mines such as Raura mine, Uchucchacua mine, and Chanca mine are operating in the neighboring area. Production rates of these mines are 1,100 t/d, 200 t/d (under an increase in production to 500 t/d), and 200 t/d, and numbers of employees are 800, 200, and 450 persons, respectively. Each production scale is small and moderate but more than 10,000 people including employees families are depending their lives on these mines.

Development of these mines is a core of industrial activity and brings a great impact and the most stable earnings to the communities which are located in the steep mountain range and depend on old-fasioned farming and grazing.

Coal mining has been carried since long time ago, but the scale is small remained a handicraft and the weight in the local economy is not high. There are hot springs at Churin and Chiuchin, and tourism is prospecting at these places as resort zone.



Ct Cretaceous
P Jurassic & Triassic (Pucara Group)
M Permian (Mitu Group)
Pє. Precambrian

Fig. 2 Schematic Profile of the Central Andes Area

Chapter 3 Outline of the Survey

3–1 The First Phase (1979)

During the first year, regional geological survey and geochemical survey were applied to the C area of 700 km^2 including Churin, Oyon, Iscay Cruz and Chiuchin. This work was able to outline regional structure of the Oyon area and to find good lead-zinc mineralized showing in Santa formation at Iscay Cruz area, 4,700 m above sea level.

3–2 The Second Phase (1980)

During the second year, regional geological survey and geochemical survey were carried out in the A and B areas of 160 km^2. Detail geological survey, geophysical prospecting and drilling exploration were adopted to the Iscay Cruz area.

1) Iscay Cruz Area

Mineralized showing of this area was seen in the Santa formation stretching to NNW-SSE direction, sporadically for about 12 km. It is shown as black gossan, which could be an oxidized manganiferous siderite, and is found mostly in the northern, Cumbre de Iscay Cruz area. In the central, Limpe area, there occur much hematite disseminating in silicified rocks, galena-sphalerite disseminating in dolostone and galena-sphalerite concentrating in massive pyrite orebody. Chalcopyrite-sphalerite disseminated skarn orebody is exposed in Tinyag area. In further south, Cunsha Punta area, sphalerite-pyrite-bearing outcrop is present. In the southernmost, Antapampa area, the showing is again black gossan.

During the second year, the whole Iscay Cruz area was covered by IP (induced polarization) method, and some parts were tested by EM (electromagnetic) method for reconnaissance study. The total measuring lines were 25.4 km of 8 lines for the IP method and 3 km of 2 measuring lines for the EM method. The results indicate distinct, high FE (frequency effect) anomaly and low AR (apparent resistivity) anomaly in the area to the south of Limpe.

Three holes were drilled at two places in Cumbre de Iscay Cruz and Limpe areas for the total length of 564 m. Lead-zinc disseminated deposit was discoverd in siderite bed of the Cumbre de Iscay Cruz area, and galena-sphalerite concentrated massive pyrite deposit was found in the Limpe area.

2) A and B Areas

The A area and B area are located on the eastern and western flanks of the watershed, and occupy areas of 71 km^2 and 89 km^2, respectively. Both the areas were examined by detail geological and geochemical surveys. Distinct mineralization showing for silver, copper, lead, zinc and iron was recognized in the B area.

3–3 The Third Phase (1981)

During the third year, detail geological survey of mineralized outcrops and geophysical prospecting were continued, and then systematic drilling was made in the Iscay Cruz area. In addition, detail geological survey was carried out in the Cohaquillo-Chagapata area of B area.

1) Iscay Cruz Area

By the outcrop survey, the following three points were clarified; close spatial relationship between Santa formation and mineralization showing, zonation of metals in the mineralization showing, and fault systems and dislocation of Santa formation.

In the southernmost, Antapampa area, IP method was applied on 7 cross measuring lines for the total of 10.5 km. It was found that concealed FE anomaly existed in N-S direction for more than 1,500 m which increased the depth toward the south. EM method was adopted on 8 measuring lines for total of 10 km in Tinyag – Cunsha Punta area, where the surface is completely covered by younger sediments. Santa formation is thought to be concealed in this area. Moreover, the response in the geophysics indicates that this formation could well be mineralized.

Drilling exploration for this year is 9 holes at 9 localities with the total length of 2,090 m. Three holes were drilled in Limpe area; all hit high-grade ores. DDH-5 is especially fruitful penetrating through 23 m thick orebody with 163 g/t Ag, 2.92 % Pb and 27.15 % Zn. DDH-7, which was drilled just below skarn outcrop in Tinyag area, caught skarn zone of 114 m thick. High grade ores were found at two places, and the total thickness of 26 m revealed average content of 2.38 % Cu and 19.58 % Zn. The other drill holes, three in Cumsha Punta area and two in Antapampa area, cut through strongly altered and mineralized zones, except for DDH-8.

2) Cochaquillo-Chagapata Area

By detail geological survey carried out in this area, it was found that the Cochaquillo deposit was a large-scale skarn type rich in silver and lead. However, its high grade portion is sporadic and small in scale, and the deposit is low grade as a whole.

·Chapter 4 Geology

4–1 Outline

4–1–1 Geologic Outline of Oyon Area

The Oyon area belongs 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 Plieques y Sobreescurrimientos) by Wilson (1967).

In this area thick Cretaceous sedimentary rocks are widely distributed. Their lithology is significantly different in the lower part and the upper part to each other; the lower part is composed mainly of clastic rocks such as siliceous sandstone and shale, the upper part calcareous rocks associated with dolostone and shale, and the uppermost part red formation. This sequence indicates an evolution of sedimentary basin in Cretaceous time and corresponds to a cycle in sedimentary environment, continental-marine-continental.

In the present report the stratigraphic classification and the name of the formations are referred to Cobbing (1973) and Wilson (1967). 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 (Fig. 3 and 5).

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. Usually the folds have acute angle at the axis. In many cases the upper strata are folded in between the lower strata, and the latter are interbedded in the former as plug. At the central part in the orogenic zone thrust faults parallel to the fold axis are developed. The total vertical displacement of the two main faults at intervals of about 2 km attain approximately 1,500 m. The west block thrusts onto the east block, and this part makes a continental divide. To the east of the thrusting fault, the faults belonging to the same system are developed at intervals of 1 to 2 km and make a imbricate structure (Fig. 3 and 4).

4–1–2 Geologic Outline of A, B and C Areas

1) A Area

The A area covers a part of the Rumi Cruz mountains (Cordillera Rumi Cruz) forming the continental divide and its eastern flanks, and the Jumasha and Celendin formations are distributed in this area. In the both sides of the Rumi Cruz mountains, a thrust fault divides the geologic structure of this area into two parts. This area is also situated in the western part of a great anticlinal structure, and therefore the both formations mentioned above dip west. The faults with NNW-SSE trend belonging to the same system as the thrust fault are developed regularly and make a imbricate structure.

2) B Area

The B area covers a part of the Rumi Cruz Mountains and the region on the west of the Callejon mountains (Cordillera Callejon) which is situated on the southern extension of the thrusting fault mentioned above. Cretaceous sediments from the Oyon formation to the Jumasha formations are distributed, forming a composite folded structure. The Calipuy volcanics covers unconformably both formations.

The thrust fault of NNW-SSE direction runs along the western edge of the Callejon mountains, and the western block composed of the lower Cretaceous formations such as Chimu and Carhuaz formations thrusts up to the eastern block composed of the upper Cretaceous Jumasha formation.

In the B area located to the west of the thrust zone, many ENE-WSW and E-W trending faults are developed, and many igneous bodies from granitic to dioritic composition in the forms of stock and dyke intrude into the Cretaceous sedimentary rocks. The intrusives are occasionally accompanied with silver, copper, lead, and zinc mineralization, and form several mineralized zones such as Cochaquillo and Chagapata.

3) C Area

The C area, occuping the greater part of the Oyon area, is located to the west of the thrust zone and the continental divide. The lead and zinc mineralized zone of Iscay Cruz is embedded in the Santa limestone located in the eastern part of the C area.

In this area, the Cretaceous system from the Oyon formation to the Jumasha formation is widely distributed and forms a composite folded structure trending to NNW-SSE direction. The Tertiary Calipuy volcanics appears in the western part by fault relation with the Cretaceous sedimenentary rocks. Intrusive rocks are mainly composed by tonalite, dacite, quartz porphyry, and porphyrite.

4–2 Sedimentary Rocks

4–2–1 Lower Clastic Group

The lowermost unit in the Oyon area is lowest Cretaceous, Oyon formation. It occurs along anticlinal axis. This formation is dark gray alternation of sandstone and shale, intercalating coal bed. Chimu formation, 600-700 m thick, consists of siliceous sandstone and quartzite. This unit is topographically distinct as it forms undulated, rough mountains. Santa formation is well stratified, bluish gray limestone. Having the thickness of 100-150 m, it is distributed in a narrow zone. Carhuaz formation is alternation of shale and sandstone, and the thickness varies from 500 m to 800 m. This unit forms a saddle in topography. Farrat formation is composed of siliceous sandstone and calcareous sandstone, and its thickness is 100-120 m (Fig. 5).

4–2–2 Upper Calcareous Group

Dark gray, massive limestone of Pariahuanca formation is 100-200 m thick, and cross out forming small knobs in a narrow belt. Chulec formation is dark gray or black alternation of thin limestone and shale beds. Jumasha formation is thick, more than 1,400 m, massive limestone, occurring along synclinal axis. It forms shinny, light gray ridge. Celendin formation is mainly composed of pale yellowish marl with the thickness of about 200 m, most of which have been eroded out.

4–2–3 Casapalca Formation

This formation is a red bed, consisting of conglomerate, sandstone, shale, marl and limestone. It is generally filled to occur graben. It overlies unconformably above Celendin or Jumasha formations of the lower unit, and is covered unconformably by Calipuy volcanic rocks.

4–3 Calipuy Volcanic Rocks

These rocks are distributed in wide area in the Pacific Ocean side of the West Andes, covering Cretaceous sedimentary rocks. However, the exposure in the Oyon area is limited to the western-edge part of the C area and also in the B area.

Calipuy volcanic rocks are largely lavas and pyroclastics of andesitic, dacitic and rhyolitic compositions. Agglomerate is seen in the lowermost horizon. The rock assemblage is various and differs in one place to another.

The volcanic rocks show a mild folding in contrast to severe folding in the Cretaceous sedimentary rocks. The thickness varies depending upon erosion surface of the basement sedimentary rocks, to which the volcanic rocks abut generally. They are 900 m thick in the B area, and the upper part appears to have been eroded; however, in the western-end part of the C area, the apparent thickness reaches about 3,000 m.

4–4 Intrusive Rocks

The main intrusive rocks of the Oyon area are tonalite to granodiorite, quartz porphyry to rhyolite, dacite and porphyrite. Radiometric age data are listed in Table 3. The ages range from 31.3 to 6.2 m.y. Normative quartz-orthoclase-plagioclase ratio, which is obtained from the bulk chemical analyses, is shown in Fig. 6. Most of the intrusive rocks are plotted in the granodiorite area classified by Bateman et al. (1975).

In MFA [MgO – ($FeO + Fe_2O_3$) – (Na_2O + K_2O)] diagram (Fig. 7) these rocks are plotted along a straight line, with a few exceptions. This fact indicates that the intrusive rocks differing in rock composition, mode of intrusion and age of intrusion may have been derived from the same magmatic source and experienced similar crystallization differentiation. The differentiation trend is consistent with that of typical calc-alkaline rock series. Ferric/ferrous (Fe_2O_3/FeO) ratio is usually higher than 0.5. This implies that the rocks belong to the magnetite-series of Ishihara (1977), which is suitable igneous rock series for base and precious metal-sulfide mineralization.

4–5 Geological Structure

The geological structure in this area is characterized by intrafolial fold, thrust fault parallel to the fold axis, conjugate shear faults oblique to the fold axis, and tension fault which cross with the fold axis at right angle. These are formed by the strong compressive force and emergence force of blocks produced through the Andean orogenic movement (Fig. 3 and 4).

4–5–1 Fold Structures

The Cretaceous sediments in this area make a composite fold structure with an axis of NNW-SSE direction, and the Chimu formation forms anticlinal part, while the Jumasha formation forms synclinal part.

The cycle of folding is usually 2 to 3 km, and sometimes it becomes several tens meters. The fold axis is horizontal, and according to Cobbing (1973), extends to 100 km. The dip of fold plane is usually 80° to 70° to the west and accasionally 80° to 70° to the east. The structure at the axial part usually show acute angle, and in such a case at the synclinal part the upper strata are folded in between the lower strata, while at the anticlinal part the lower strata are sandwiched in between the upper strata, showing plug shape.

In competent strata such as Chimu formation flexual-slip folds with faults parallel to bedding plane are developed. In this case fine-grained sandstones and sandy shales sandwiched between siliceous sandstones are considerably crushed, which may be caused by the bedding plane faults. On the other hand, in incompetent strata such as Pariatambo formation flexural-flow folds are developed and the thickness of strata varies considerably, depending on the shape of fold and the position at which the strata lie. The cycle of folding is in short range, and when the axial part has acute angle, thickness of strata varies considerably. Thickness of strata decreases usually at the wings of fold, while increases at the axial part.

4–5–2 Faults

In this area three fault systems are found: the first fault system with NNW-SSE trend is parallel to the fold axis; the second system with NE-SW and WNW-ESE trends crosses obliquely the first system; the last system with ENE-WSW trend crosses rectangularly the fold axis.

1) NNW-SSE System

In the westernmost part of the A area and the eastern part of the B area, two series of thrust faults, the west Rumi Cruz thrust and the east Rumi Cruz thrust, are running parallel to the Rumi Cruz and the Callejon mountains, both of which form the continental divides. The distance between the two thrusts is about 2 km and the vertical displacement attains approximately 1,500 m. The block of the west side to the faults, consisting of lower formations such as the Chimu formation, thrusts up to the upper formations consisting of the Jumasha, Celendin and Casapalca formations. On the both sides of the thrust faults, the faults beloinging to the same system of the thrust faults, such as the Ruco fault, the Cutacocha fault and the Picoy fault, are developed. In the area on the east of the east Rumi Cruz thrust, the faults of the same system are developed, forming imbricate structure.

2) NE-SW System and WNW-ESE System

The two fault systems, which cross obliquely the fold axis, are characterized by the horizontal displacement. The Shapra fault, about 10 km northwest of Oyon and the Otuto fault, about 5 km southeast of Oyon, are typical among the faults with NE-SW system. The Viroc fault to 3 km southwest of Oyon and the Cuchpange fault to the 13 km of Oyon belong to the WNW-ESE system. These faults are mainly characterized by horizontal displacement, and the block on the east is displaced toward west. Apparent displacement attains 1 km. The faults of both systems are typical conjugate fault, and have a close relation to the formation of the fold structure in this area. The Viroc fault forms echelon shape and the drags of strata are observed.

3) ENE-WSW System

This fault system is developed in echelon shape and crosses rectangularly fold axis. It has a characteristic of tension fracture, being randomly displaced. The Cochaquillo fault is a typical one. The fracture of this system is related to the intrusion of dikes and mineralization.

4) Bedding Fault

The strata are strongly folded, and at the part where flextural-slip folds are developed many bedding faults are formed. Although the displacement in each fault is small, it is considered that the displacement as a whole attains a considerably large amount. The folds, therefore, show saw-shape at the axial part. The dips of bedding fault are horizontal or very steep, and the fractures which are nearly horizontal and cross rectangularly the bedding faults occur at intervals of several tens to several hundreds meters. The strata are displaced to several meters by these fractures.

4–6 Geological History

The Oyon area is situated in the central zone of the Western Andes (Cordillera Occidental) and is composed mainly of intensely folded Cretaceous sedimentary rocks. 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 (Fig. 2).

In the Cretaceous time geological movements in this area reached a climax. A boat-shaped basin separated from ocean was developed at the western margin of the area, consisting of Paleozoic, Triassic and Cretaceous formations which have deposited to surround the South American Continent. In this basin the sediments with various lithology were formed. At the early stage of Cretaceous age a considerable amount of clastic material was brought from the land lying to the east of the basin, and clastic sediments containing coal beds were formed. At the middle stage of Cretaceous the transgression progressed and thick strata of limestone were formed. At the later stage of Cretaceous the retrogression proceeded and red formation was formed.

At the later stage of Cretaceous age the volcanic activity took place along the western margin of the basin and reached a climax in Tertiary. A large amount of andesitic lava and volcanic ash flow was erupted, and thus the volcanic arc was formed. These volcanic rocks are distributed from north to south in the Territory of Peru attaining 2,000 km. On the west of the volcanic arc, a large batholith crops out. The botholith is considered to form a spine of the Western Andes and to be a base of volcanic rocks, and was exposed by later erosion.

When the magma that brought about the volcanic activity on the surface is cooled in the crust, plutonic body is formed. The violent volcanic activity in Tertiary is a characteristic feature of the Andean Orogeny, and a large amount of lava was erupted and many plutonic bodies intruded. As a result, the crust was considerably expanded and strong compression and upheaval were produced. It is thus considered that these compression and upheaval caused the strong folding and uprising in the thick sediments in the Eastern and Western Andes. According to plate tectonic theory, the magma was continuously supplied by partial melting of subducting plate.

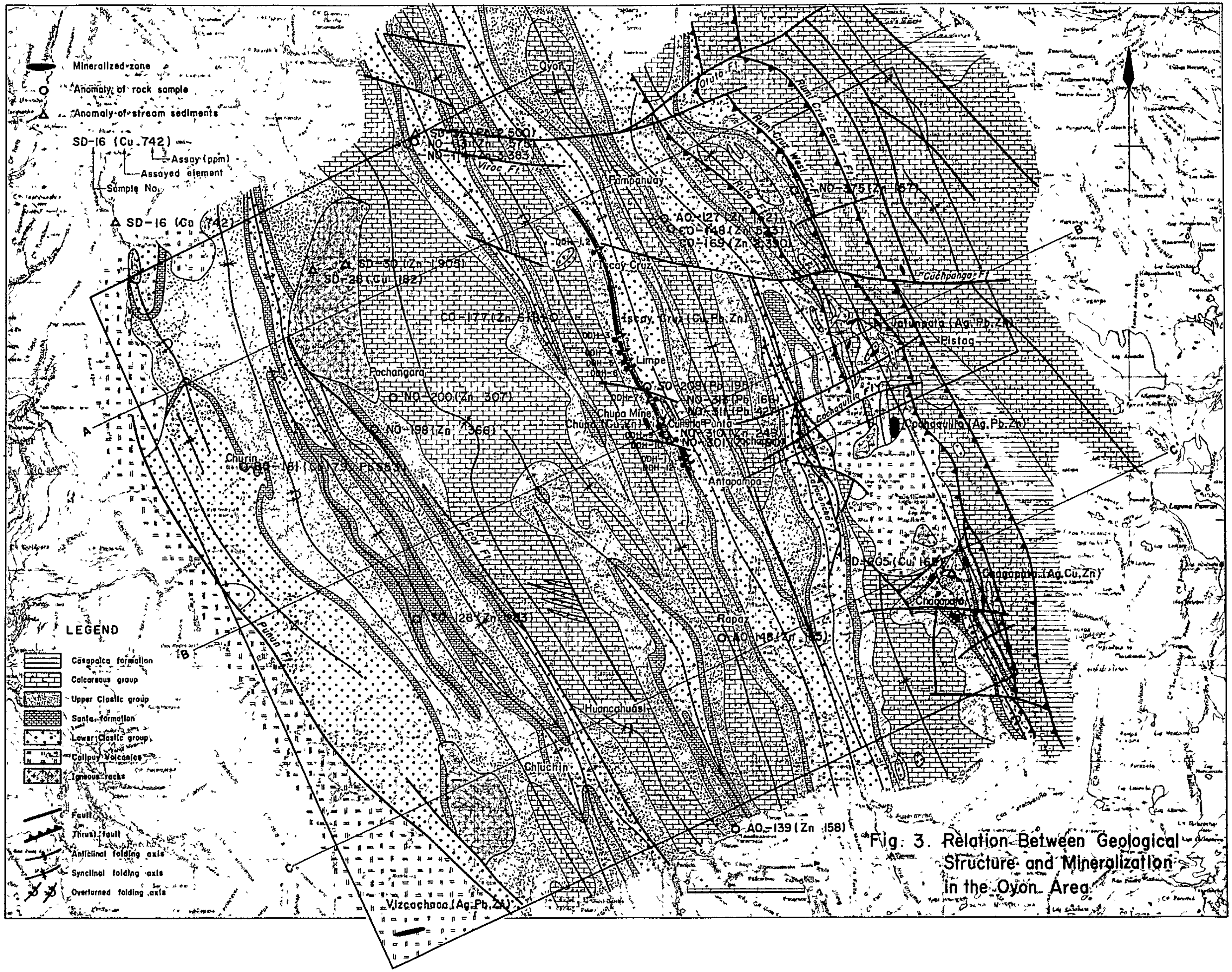


Fig. 3. Relation Between Geological Structure and Mineralization in the Oyon Area

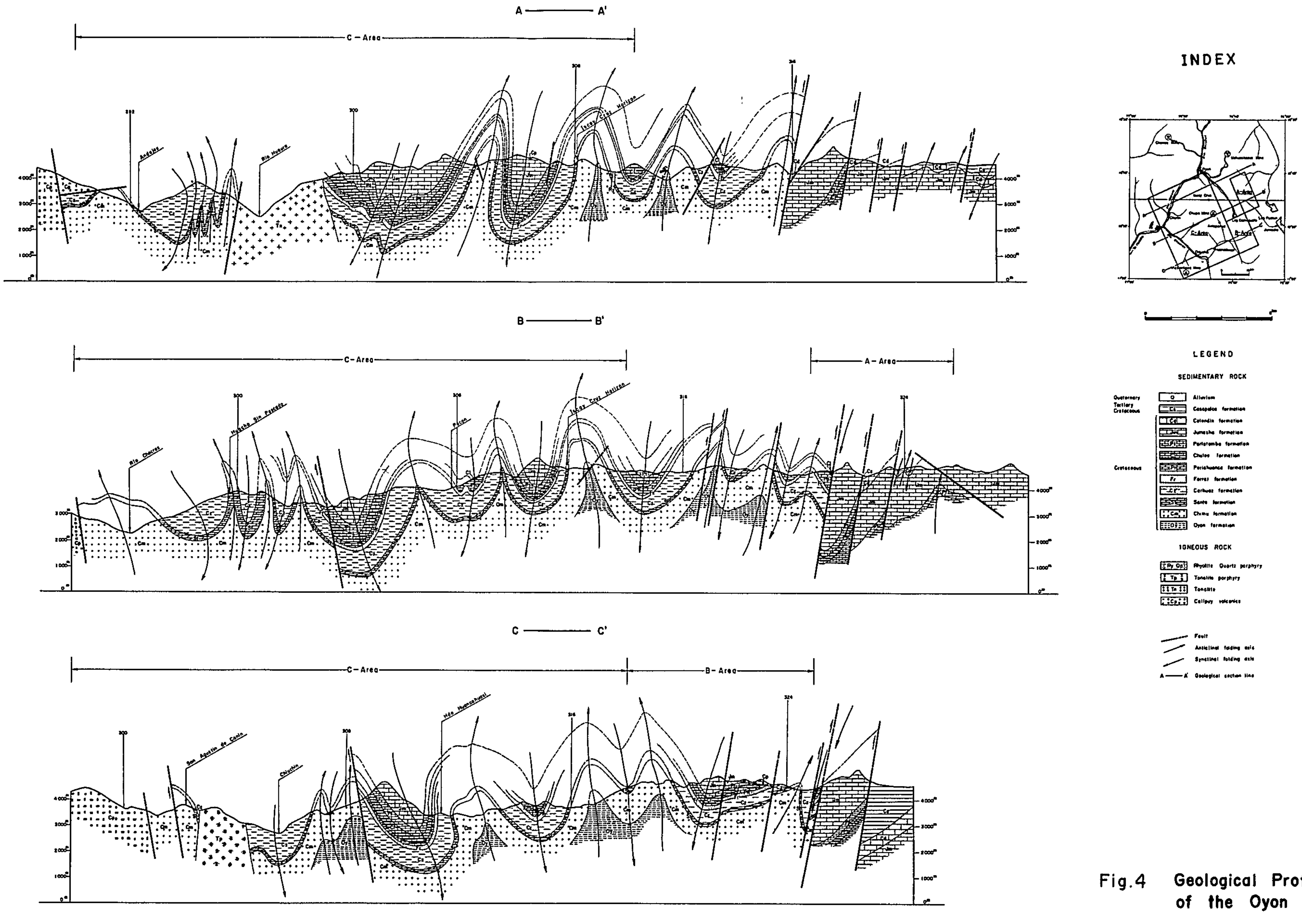


Fig.4 Geological Profile of the Oyon Area

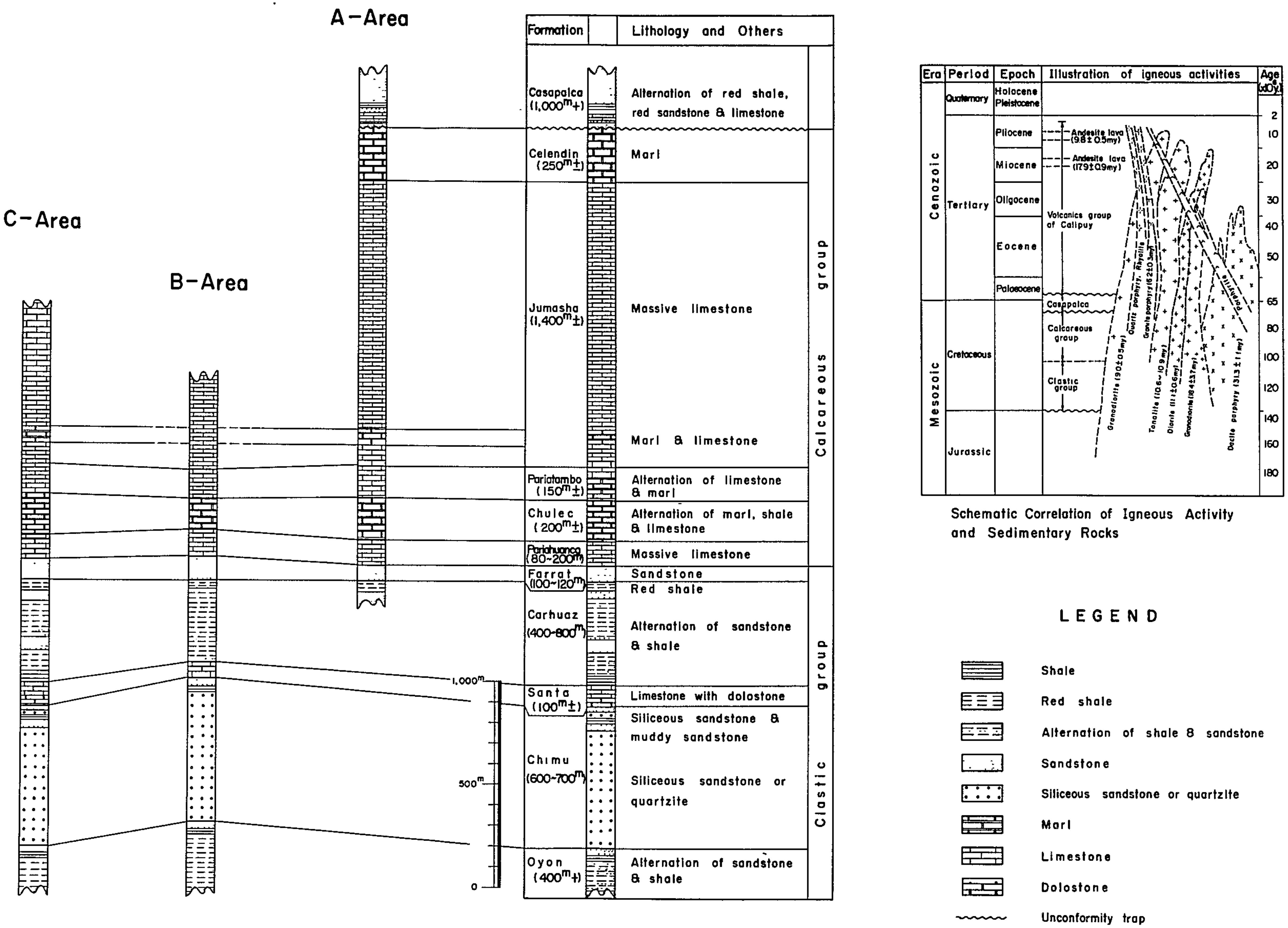


Fig. 5 Geological Column and Igneous Activity in the Surveyed Area

Table 3 Isotopic Age of Igneous Rocks

	Field No. (Rock Name)	Location	Mineral	Isotopic Age (m.y.)	$Ar^{40}/gm \times 10^{-5}$	$\%Ar^{40R}$	%K
1979	AO-116 (Andesite)	G3	whole rock	17.9±0.9	0.113 0.108	52.1 55.3	1.57 1.59
	CO-121 (Tonalite)	G1	biotite	10.9±0.5	0.215 0.225	43.8 51.0	5.17 5.16
	CO-122 (Tonalite)	G1	biotite	10.6±0.5	0.267 0.258	56.6 47.8	6.36 6.32
	SO-176 (Dacite por.)	G1	biotite	31.3±1.6	0.133 0.129	39.2 36.2	1.09 1.04
1980	NO-350 (Granodiorite)	G4	biotite	9.0±0.5	0.162 0.164	45.3 43.8	4.60 4.66
	NO-373 (Diorite)	G4	whole rock	11.1±0.6	0.101 0.102	31.9 35.8	2.33 2.35
	NO-376 (Granite por.)	G2	whole rock	22.4±1.1	0.457 0.463	75.2 72.2	5.24 5.28
	NO-334 (Rhyolite)	G4	whole rock	- *	-	-	-
1981	NO-625 (Andesite)	G4	whole rock	9.8±0.5	0.088 0.089	33.9 35.6	2.31 2.32
	NO-633 (Granodiorite)	G4	hornblende	18.4±3.7	0.037 0.038	14.8 9.1	0.52 0.52
	NO-652 (Granite por.)	G4	biotite	6.2±0.3	0.172 0.175	37.6 42.7	7.21 7.24

Constants used

$\lambda_\beta = 4.962 \times 10^{-10}$/year

$\lambda_\beta = 0.581 \times 10^{-10}$/year

$K^{40} = 1.167 \times 10^{-4}$/atom/K

Notes

Ar^{40R} : Radiogenic Ar^{40}

m.y. : million years

Analyses were performed by Teledyne Isotopes, Westwood, New Jersey, U.S.A.

* Cleaning remains are not enough for measurement.

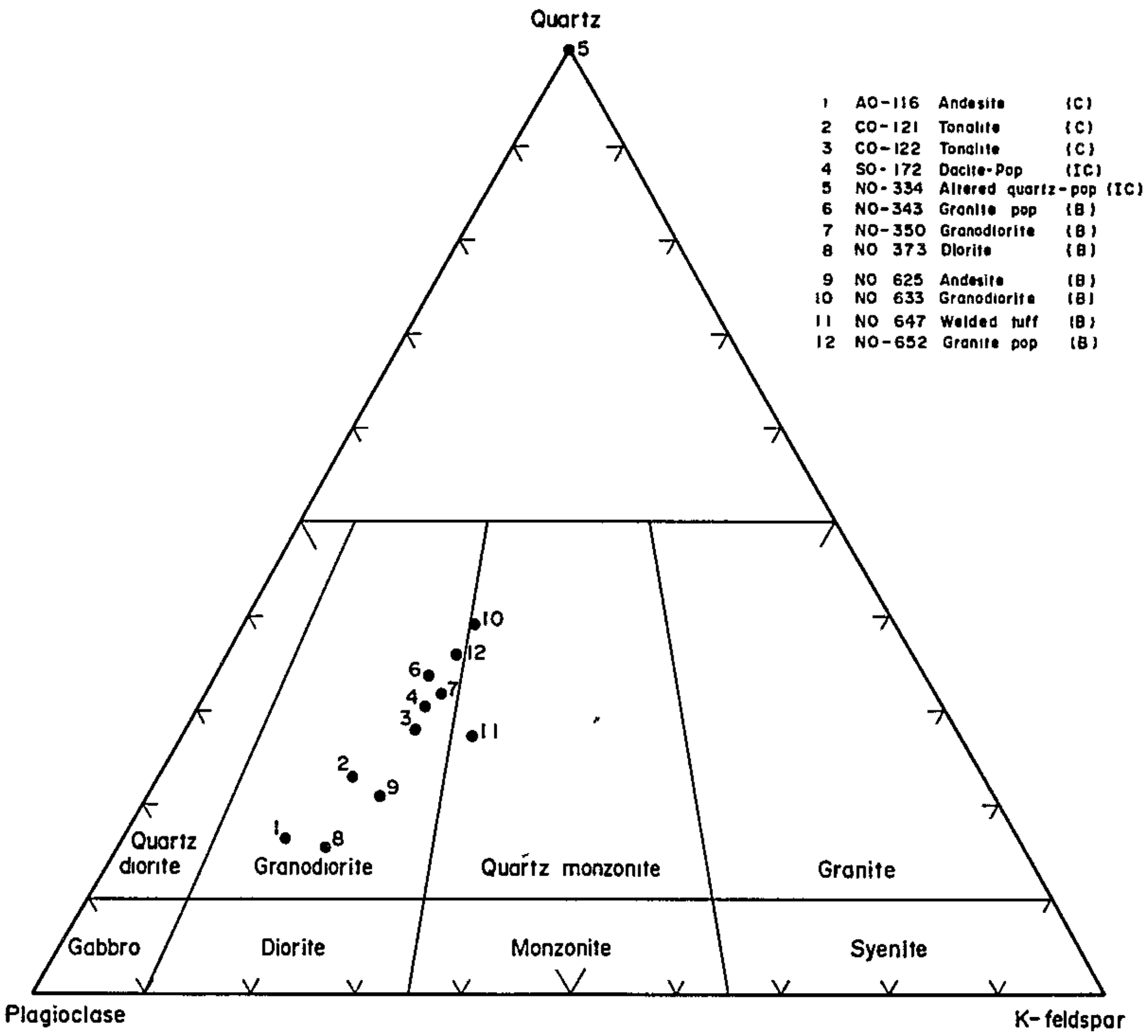


Fig. 6 Q-Kf-Pl Diagram for Normatic Composition of Igneous Rocks

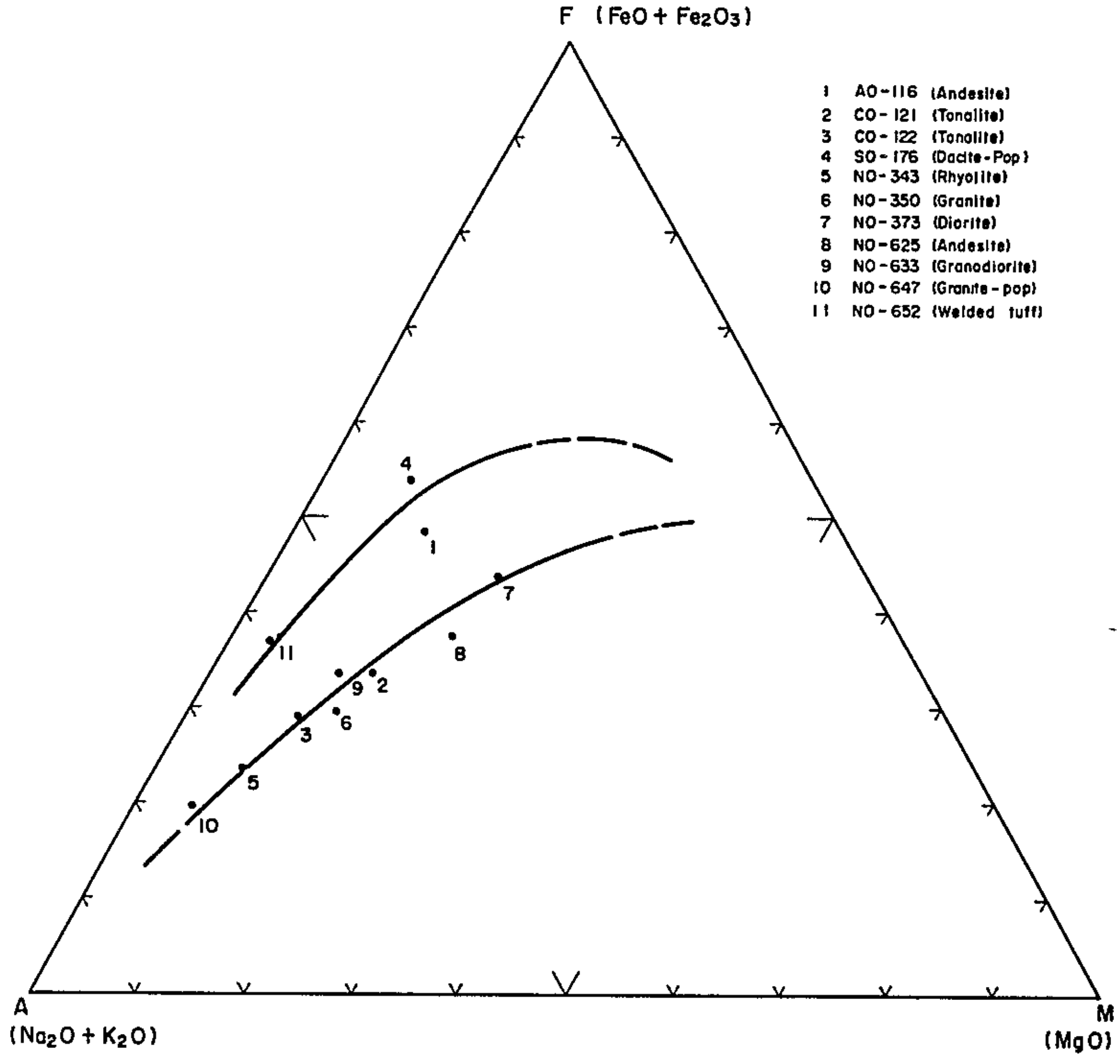


Fig. 7 MFA Diagram for Magmatic Differentiation of Igneous Rocks

Chapter 5 Ore Deposits

5–1 Outline

The Oyon area belonging to Polymetallic Sub-province of Andean Plateau (Sub-Provincia Polimetalica del Altiplane) in Metallogenetic Province of Western Andes (Provinca Metalogenica Andina Occidental) proposed by Bellido, et al. (1969), is surrounded by the mineral-rich areas. Many metal mines such as Huanzala and Raura mines to the north, Cerro de Pasco, Atacocha, and Vinchos mines to the east, and Huaron and Santander mines to the south are well known in the peripheral areas. Adjoining to the north of the surveyed area, three operating mines, namely Raura, Chanca, and Uchucchacua mines are in existence.

In the Oyon area, several mineralized zones and mineral indications, such as Iscay Cruz, Chupa, Cochaquillo, and Viscachaca, were discovered, however each of them are not still developed (see Table 4).

The ore deposits in the Oyon and adjoining areas are classified as follows, according to the kinds of ore, shape and genesis.

(1) Copper, lead and zinc contact metasomatic ore deposits in Cretaceous limestone.
Part of Raura, Chupa, part of Iscay Cruz, and Cochaquillo ore deposits.

(2) Silver, lead and zinc fissure-filling ore deposits in Cretaceous limestone.
Uchucchacua and part of Raura ore deposits.

(3) Silver, lead and zinc fissure-filling ore deposits in Tertiary volcanics and intrusives.
Chanca and part of Raura ore deposits.

(4) Lead, zinc and pyrite massive hydrothermal replacement ore deposits in Cretaceous limestone.
Iscay Cruz ore deposit.

5–2 Iscay Cruz Mineralized Zone

1) Outline

Mineralization indications of the Iscay Cruz area extend discontinuously about 12 km distance from Canaypata about 6 km south of Oyon to Antapampa about 18 km south of Oyon (see Fig. 8). Mineralization in this area occurs in calcareous rocks of the Santa formation, which constitutes a west wing of anticline whose axial part consists of the Oyon and Chimu formations.

The Santa formation is from 40 m to 80 m in thickness, and extends long and narrow in NNW-SSE direction usually in contact with steep cliff of Chimu quartzite formation. Dip of the Santa formation is almost vertical. It dips steeply west in the northern and southernmost parts, and steeply east in the central part forming an overturned structure.

Mineralization indications consist of black gossan containing Pb and Zn, galena and sphalerite concentration in massive pyrite bodies, sphalerite concentration within skarn, and dissemination of galena and sphalerite in dolostone. Talus and glacial sediments are widely distributed covering the surface in this area, and outcrops are exposed intermittently among these recent sediments.

As for the alteration of host rocks, silicification, sideritization, dolomitization, argilliza-tion, and brecciation are remarkable. Acidic intrusives such as quartz porphyry or rhyolite are suggested to be related to mineralization. Surrounding the intrusives, strong brecciation, pyritization, sericitization, and silicification are observed.

WNW-ESE trending faults, which are considered to be tension fault and related to mineralization, are densely developed oblique to the folding axis. Displacements by these faults are usually less than 20 m. Moreover, thrust faults and bedding plane faults are developed and effect the thickness of strata in this area.

2) Occurrence of Outcrop

Black gossan, which is distributed widely on the surface, is composed mainly of goethite, quartz and kaolinite carrying manganese oxides and siderite. Assays of black gossan taken at Cumbre de Iscay Cruz, the northern part of the mineralized zone, show about 1 % of Pb and 4 % – 6 % of Zn. Most of the metal elements in the black gossan are derived from oxide minerals such as chalcophanite, smithsonite, etc. It was proved by X-ray diffraction and chemical analysis that black gossan is an oxidation product of manganiferous siderite.

Limpe area located at the central part of the mineralized zone is characterized by large amounts of hematite disseminated in silicified rocks. In this area galena and sphalerite concentrated massive pyrite ore occurs occasionally. Pyrite coexists with pyrrhotite and marcasite, and sphalerite contains dots of chalcopyrite forming exsolution structure.

There appears skarn outcrop in Tinyag area. Skarn is composed mainly of tremolite, garnet, chlorite and quartz, and disseminated with chalcopyrite, sphalerite, pyrite and magnetite. Sphalerite and pyrite ore occurs in Cunsha Punta area as well as Limpe area. In the southernmost area black gossan comes out on the surface.

5–3 Chupa Ore Deposit

Chupa ore deposit is located about 600 m west of Tinyag skarn outcrop in the Iscay Cruz mineralized zone. It is a skarn deposit formed by replacement of a part of limestone belonging to the Pariahuanca formation and mainly accompanied by zinc and copper minerals. It was explored in the past with two levels of tunnels and high grade portion was encountered, but due to small reserves, it was abandoned (see Fig. 9).

The Pariahuanca formation, which is massive limestone with a thickness of about 100 m, is the host rock of deposit. It is located on the east wing of syncline formed by west side Jumusha formation as axis. Strike is NNW-SSE and dip is 75° to 85° to the east forming overturned structure. On the east side, Farrat sandstone occupies apparent upper position and on the west side Chulec marl and limestone occupy apparent lower position. Near the deposit, well developed fault system of ENE-WSW is present. It is of echelon formation, displacing beds few meters to each side. Near the deposit its strike is changed to E-W direction.

Mineralization is strongly controlled by this fault system. Ore deposit is also affected by stratigraphical structure and extends along bedding. However, high grade parts occur near the faults. Size of the orebody on the surface (elevation about 4,680 m) is about 20m x 70m, on upper level of elevation 4,615 m is about 80m x 20m, and on the lower level of elevation 4,560 m is about 18m x 90m. On 4,600 m level 100 m north of above main orebody, there is small orebody of about 10m x 20m.

Skarn minerals are mainly composed of tremolite, hedenbergite, siderite, and quartz, accompanied by chlorite, epidote and lievrite. Ore minerals are mainly composed of sphalerite, pyrite and minor amounts of chalcopyrite, pyrrhotite and magnetite. Observation of polish sections shows that sphalerite holds a large number of dots and lattice of chalcopyrite showing exsolution structure. Bismuthinite was identified by electron probe microanalysis. Assay results of 2-meters channel samples taken at randum on three levels are as follows:

Level	No. of Samples	Length of Sampling (m)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)
4615 m	10	20	25	0.27	0.13	21.59
4600 m	3	6	29	0.15	0.36	15.64
4560 m	17	34	30	1.07	0.07	9.67

Igneous rock is not found nearby but it is considered that mineralization belongs to the same type as the Iscay Cruz area, exactly due to the activity of acidic igneous rock.

5–4 Cochaquillo Ore Deposit

Cochaquillo ore deposit is skarn-type deposit situated at the northeastern part of B area, 4,800 m above sea level on the western slopes of the continental divide. The skarn zone is large scale about 300m x 500m.

The host rocks are mainly limestone of Pariahuanca formation and partly marlstone of Chulec formation. These formations occupy the eastern wing of a synclinal structure which forms overturned structure with strike of N-S direction and dip of 50° to 60° to the west. The lower siliceous sandstone of Farrat formation is apparently distributed at the upper part to the west side.

In the vicinity, fracture system of NE-SW and E-W trends are predominantly developed, resulting in several meters displacement to strata. Many acidic dykes of these direction are found.

The central part of the mineralization is of garnet skarn. Granet skarn is considerably disseminated with magnetite and pyrite. In general, there is a tendency that copper is rich in the part of abundant magnetite, while silver is rich in the part of abundant pyrite.

Green skarn of vein form occurs in the marginal part of garnet skarn zone and in the transitional part to unmineralized limestone to the north. In this green skarn, galena, sphalerite and pyrite are concentrated with high grade silver. Green skarn bodies are found in several places controlled by the acidic dykes. The skarn veins are NE-SW trend and extend about 100 m with 3 to 8 m width. Green skarn contains usually 6 to 8 % of Pb and Zn, and occasionally high grade lenses up to 15 % of Pb and Zn are found.

According to X-ray diffraction and microscopic observation, skarn minerals consist principally of hedenbergite tremolite, chlorite, epidote and quartz.

Assay values based on channel sampling on the outcrops are summarized as follows, which indicate high amounts of silver and lead in comparison with copper and zinc:

	No. of Samples	Total Length (m)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)
Green skarn	42	91	102	0.11	3.92	2.41
Py-garnet skarn	23	78	141	0.17	1.31	0.82
Mt-garnet skarn	32	116.5	56	0.23	0.20	0.13

Fig. 11 is a ternal diagram of Cu-Ag-(Pb+Zn) for mineralized outcrop whose assay values on channel sampling are given in Fig. 10. From this diagram, mineralized zone can be divided into three types as follows, based on the distributions of skarn minerals and grades of metal elements:

(1) Central zone; Cu is concentrated in magnetite-rich garnet skarn.

(2) Intermediate zone; Ag is concentrated in pyrite-rich garnet skarn.

(3) Outer zone; Ag, Pb, Zn are concentrated in green skarn.

Table 4 List of Mineralized Zones in the Survey Area

Area	Zone	Location	Kind of Orea	Host Rock Forma-tion	Host Rock Litho-logy	Type of Minera-lization	Mode of Occur-rence	Scale of Mineralized Zone	Scale of Unit Orebody Length	Scale of Unit Orebody Width	Direction	Grade of Ore	Ore Minerals	Gangue Minerals	Remarks
		IC-No.1	Pb,Zn	St	Ls,Do	rep	dis	1,200m	140m	25m	NNW-SSE	Cu 30ppm Pb 0.71% Zn 4.76%	Zn-Ox, Sp, Gl	Ge,Qt, Sid,Dm	Low grade Pb,Zn dis ore in siderite is confirmed by drilling
		IC-No.2	Pb,Zn	St	Ls,Do	rep	dis	650m	50m	23m	NNW-SSE	Cu 35ppm Pb 0.14% Zn 2.81%	Zn-Ox, Sp,Gl	Ge,Qt, Sid,Dm	
		IC-No.3	Pb,Zn	St	Ls,Do	rep	mas	800m	30m	5m	NNW-SSE	Cu 49ppm Pb 2.24% Zn 1.06%	Sp,Gl, Py,Po	Dm,Sid, Qt,Ge	High grade Pb,Zn ore is confirmed by drilling
		IC-No.4	Pb,Zn	St	Ls,Do	rep	mas	1,000m	80m	12m	NNW-SSE	Cu 0.20% Pb 0.13% Zn 2.17%	Sp,Gl, Py,Po	Hm,Sid, Qt,Ge	High grade Zn ore is confirmed by drilling
C	Iscay Cruz	IC-No.5	Pb,Zn	St	Ls	skarn	dis	100m	100m	20m	NNW-SSE	Cu 0.14% Pb 0.04% Zn 2.06%	Sp, Py,Mt	Tr,Ga, Qt	Cu,Zn dis in skarn mas is confirmed by drilling
		IC-No.6	Cu,Zn	St	Ls,Do	rep	mas	450m	100m	20m	NNW-SSE	Cu 0.65% Pb 0.18% Zn 1.94%	Cp,Sp, Py	Qt,Ge	Dislocation of St forma-tion by thrust is clarified
		IC-No.7	Pb,Zn	St	Ls,Do	rep	diss	300m	250m	24m	NNW-SSE	Cu 0.03% Pb 0.14% Zn 1.50%	Zn-Ox	Ge,Qt, Hm, Sid	Cu dis in Hm, Py and skarn bodies are con-firmed by drilling
		Chupa	Cu,Zn	Ph	Ls	skarn	mas	170m	90m	22m	NNW-SSE E-W	Cu 0.68% Pb 0.10% Zn 15.63%	Cp,Sp, Py,Po	Tr,Hd, Qt	Explored by tunnelling.
	Chiu-chin	Vizca-chaca	Ag, Pb,Zn	Cp	Volc	fr-fil	vein	100m	50m	1m	N80°E	Cu 0.05% Pb 7.6 % Zn 11.0 %	Gl,Sp	Qt	Abandoned
	Jatun-pata	Pirihuya	Ag, Pb,Zn	Ph	Ls	fr-fil	vein	110m	110m	0.5m	N-S	Ag 158g/t Pb 4.68% Zn 13.52%	Gl,Sp, Py	Qt,Cal	
		Yanacocha	Ag, Pb,Zn	Cz	Sh,Ss	fr-fil	vein	70m x 50m	70m	0.5m	ENE-WSW	Ag 73g/t Pb 2.81% Zn 5.51%	Gl,Sp, Py	Rdc,Qt	
		North	Ag, Pb,Zn	Ph(Cl)	Ls	skarn	mas, dis	200mx300m	100m	8m	NE-SW	Ag 102g/t Pb 3.92% Zn 2.41%	Gl,Sp, Py	Hd,Tr, Chl,Qt	Surveyed by pitting
B	Cocha-quillo	Middle	Ag, Pb,Zn	Ph(Cl)	Ls	skarn	mas, dis	100mx300m	100m	200m	N-S	Ag 141g/t Pb 1.31% Zn 0.82%	Gl,Sp, Py	Ga,Tr, Chl,Qt	
		South	Ag,Cu	Ph(Cl)	Ls	skarn	mas, dis	200mx300m	200m	200m	N-S	Ag 56g/t Cu 0.23% Pb 0.20%	Cp,Py, Mt	Ga	
	Chaga-pata	Chalgoac	Ag,Zn	St	Ls	skarn	mas	100m	20m	4m	NNE-SSW	Ag 50g/t Cu 0.36% Zn 9.77%	Sp,Py, Zn-Ox	Tr,Mus, Chl,Qt	
		Uchcu-machay	Ag,Pb	St	Ls	skarn	mas	300mx200m	20m	2m	N-S	Ag 627g/T Pb 7.15% Zn 1.78%	Gl,Sp, Py	Chl,Qt, Ga	

St: Santa
Cz: Carhuaz
Ph: Pariahuanca
Cl: Chulec
Cp: Calipuy

Ls: Limestone
Do: Dolostone
Sh: Shale
Ss: Sandstone
Volc: Volcanics

rep: replacement
fr-fil: fracture-filling
mas: massive orebody
dis: dissemination

Zn-Ox: Zn-Oxides
Sp: Sphalerite
Gl: Galena
Cp: Chalcopyrite
Py: Pyrite

Po: Pyrrhotite
Mt: Magnetite
Tet: Tetrahedrite
Hm: Hematite

Ge: Goethite
Qt: Quartz
Dm: Dolomite
Sid: Siderite
Chl: Chlorite

Tr: Tremolite
Hd: Hedenbergite
Ga: Garnet
Rdc: Rhodocrosite
Cal: Calcite

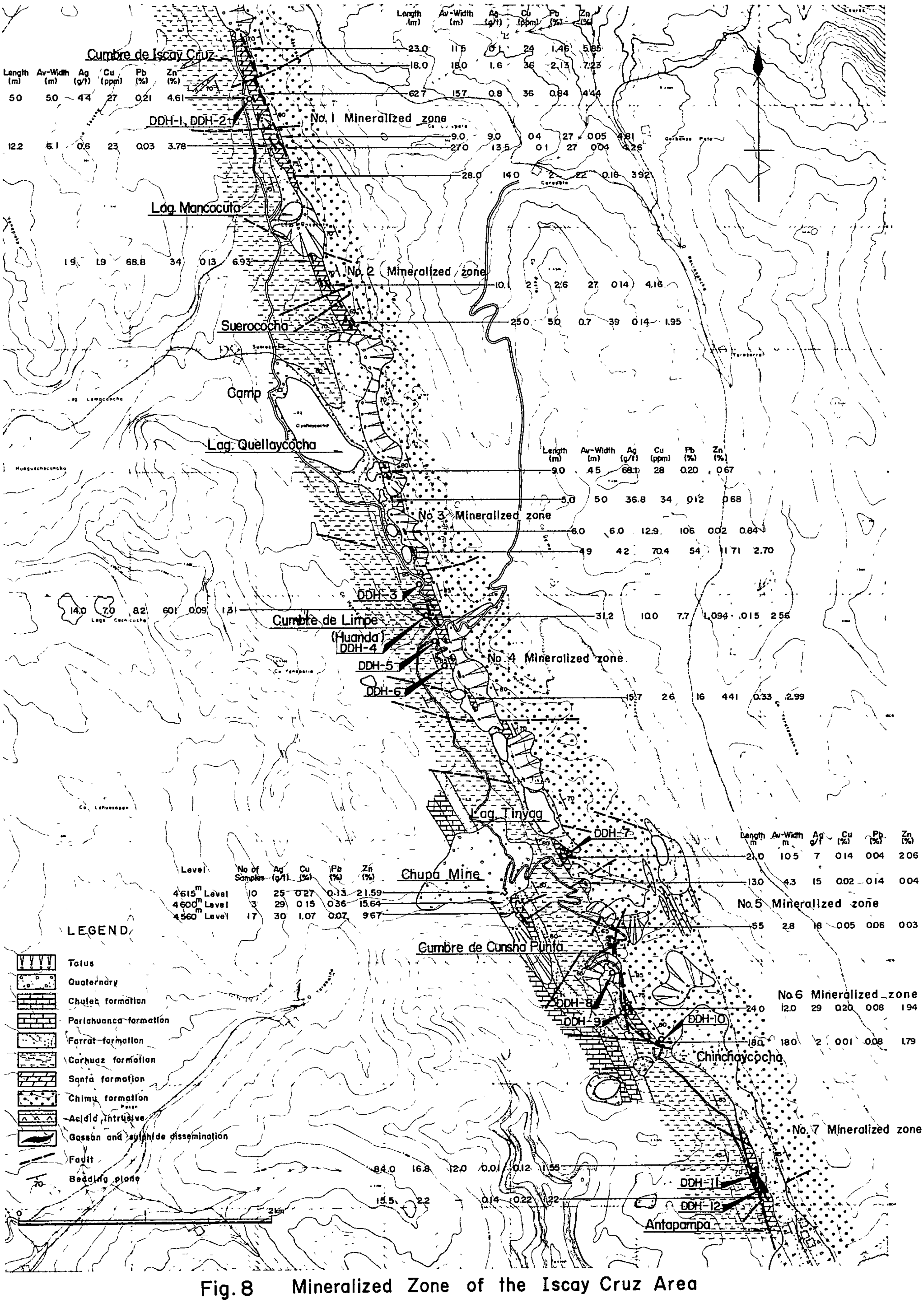


Fig. 8 Mineralized Zone of the Iscay Cruz Area

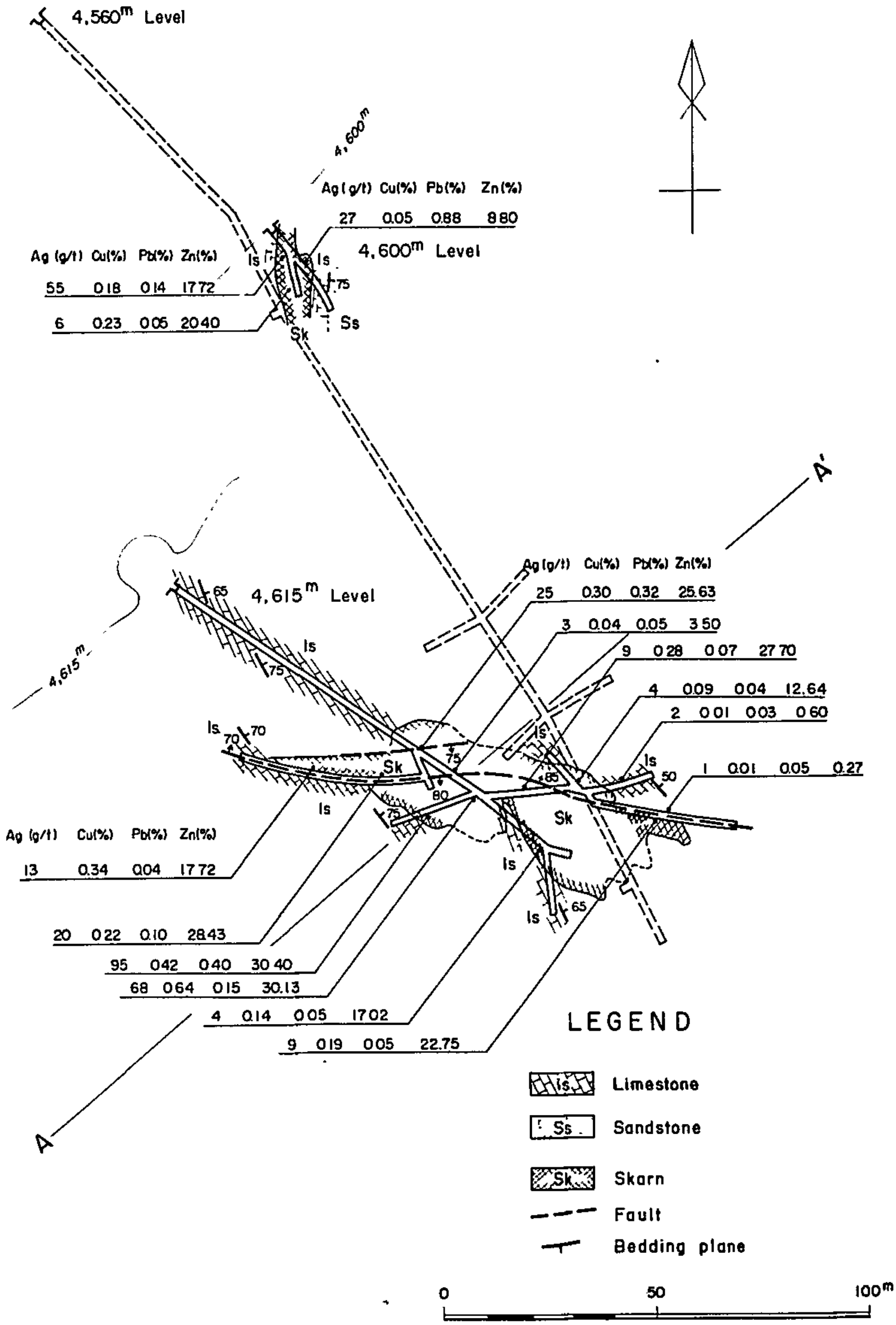


Fig. 9 Geological Survey Map of the Chupa Mine (1)

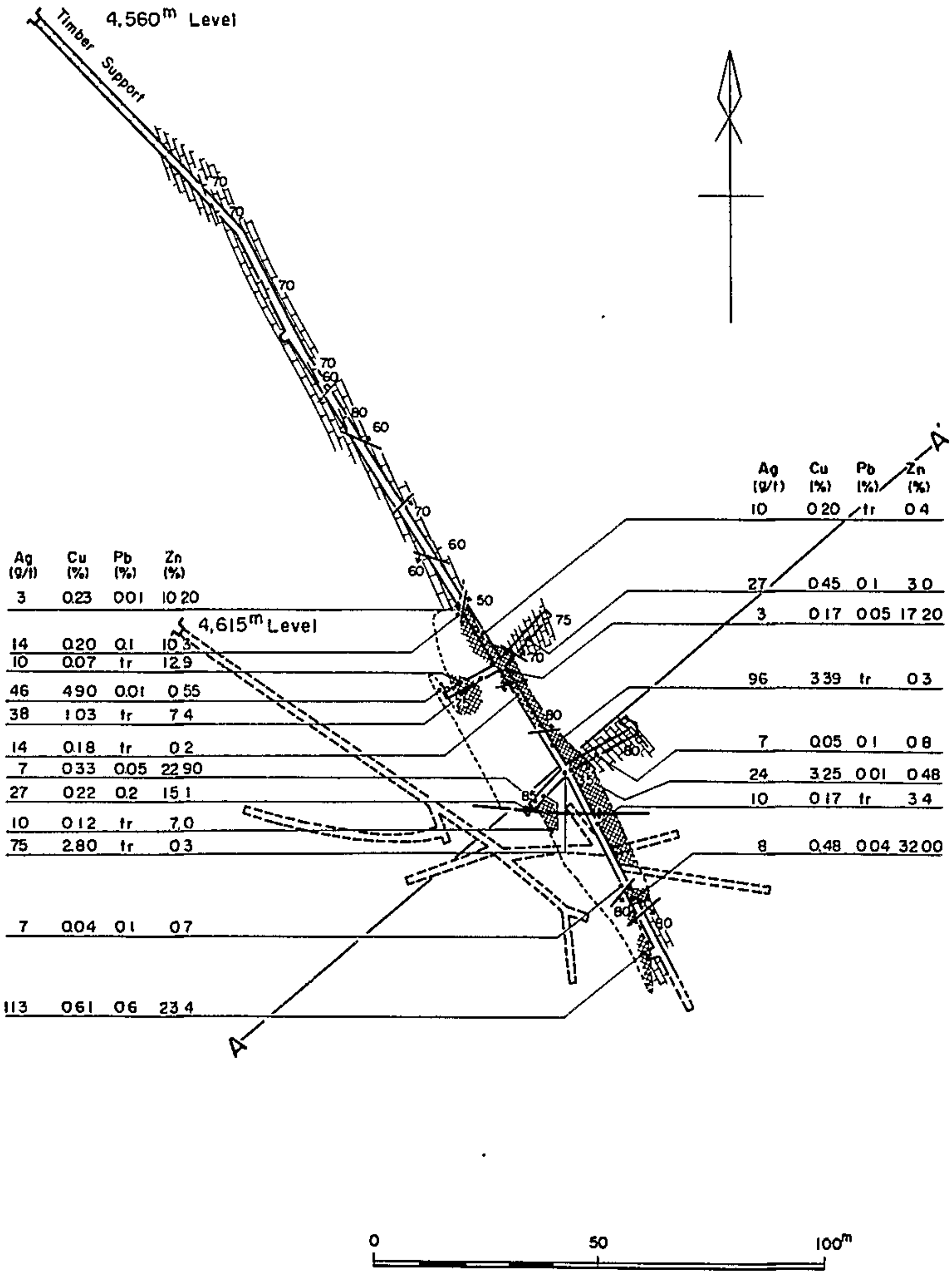


Fig. 9 Geological Survey Map of the Chupa Mine (2)

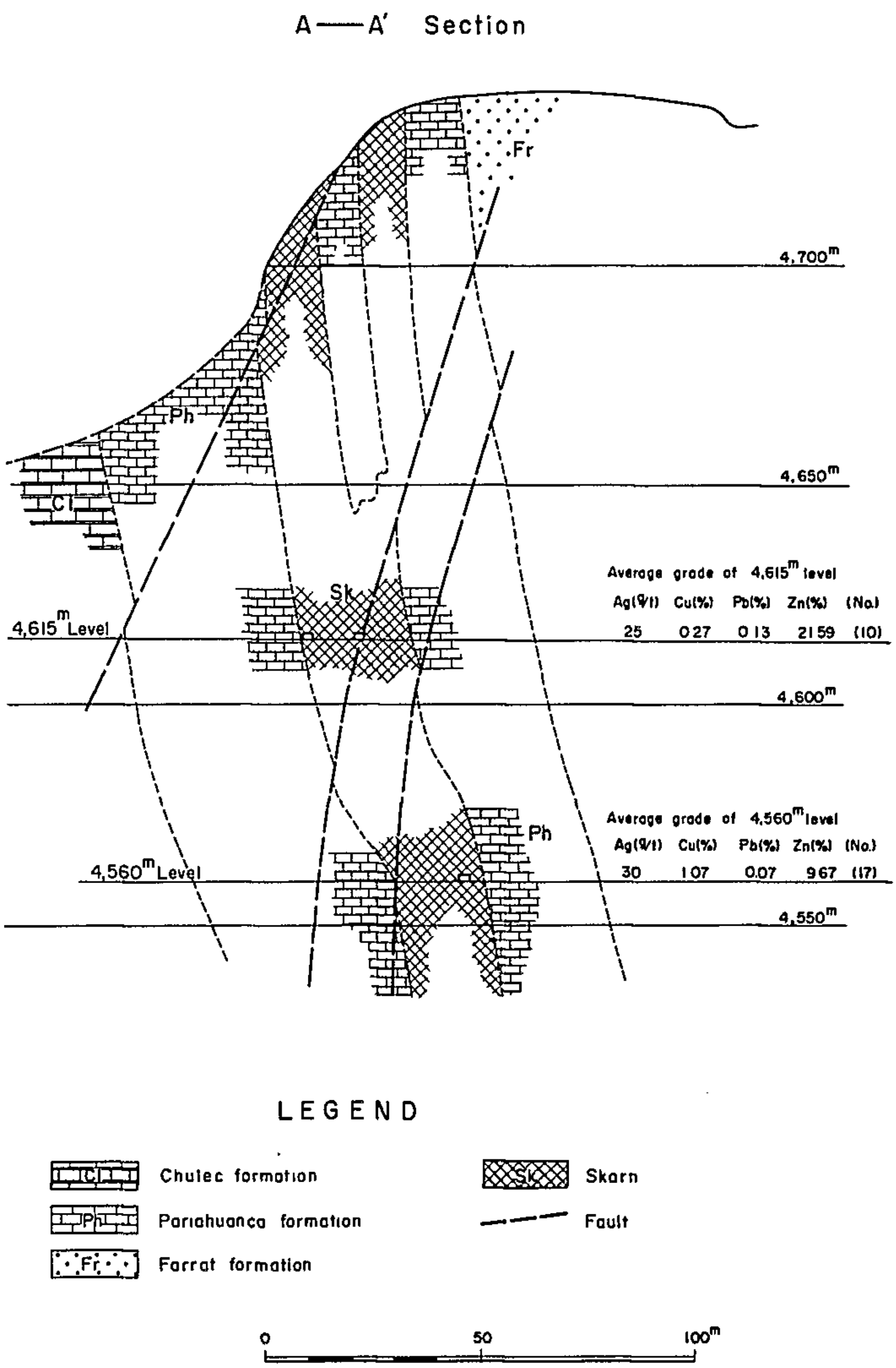


Fig. 9 Geological Survey Map of the Chupa Mine (3)

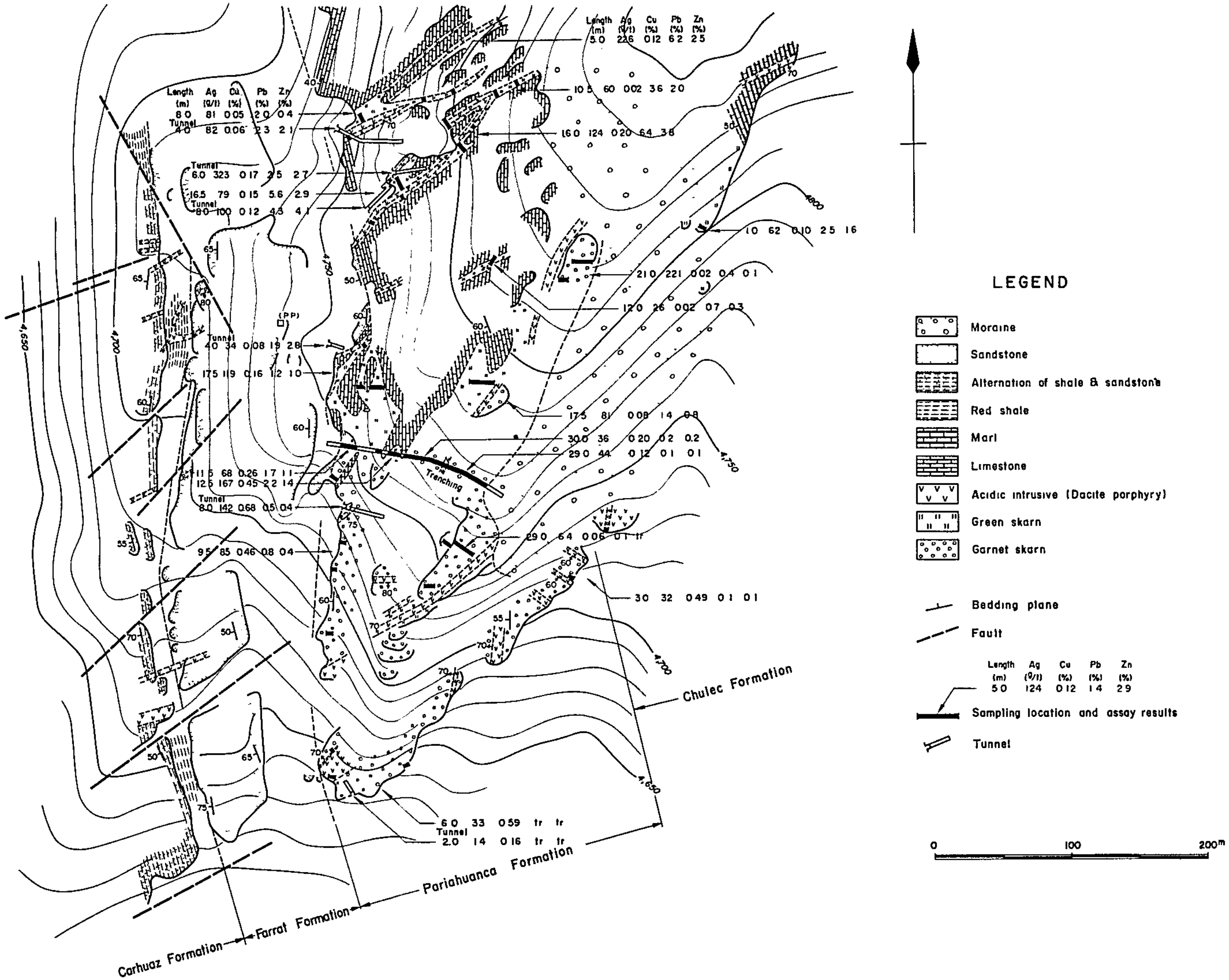
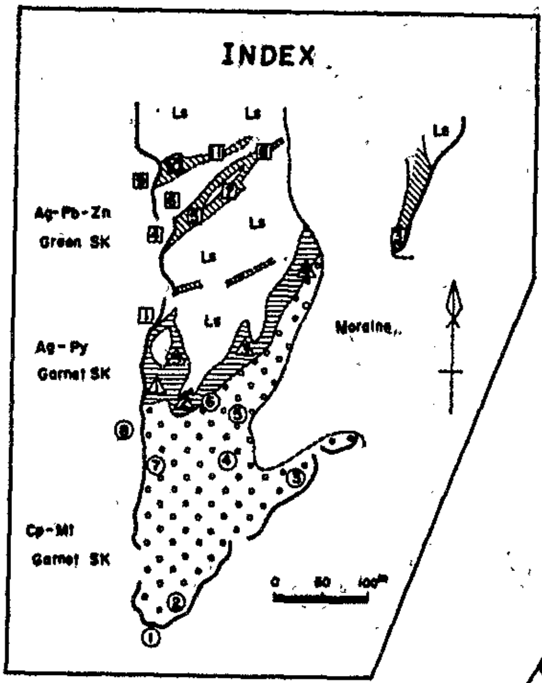


Fig. 10 Mineralized Zone of the Cochaquillo Area



Used data are from Fig. 10

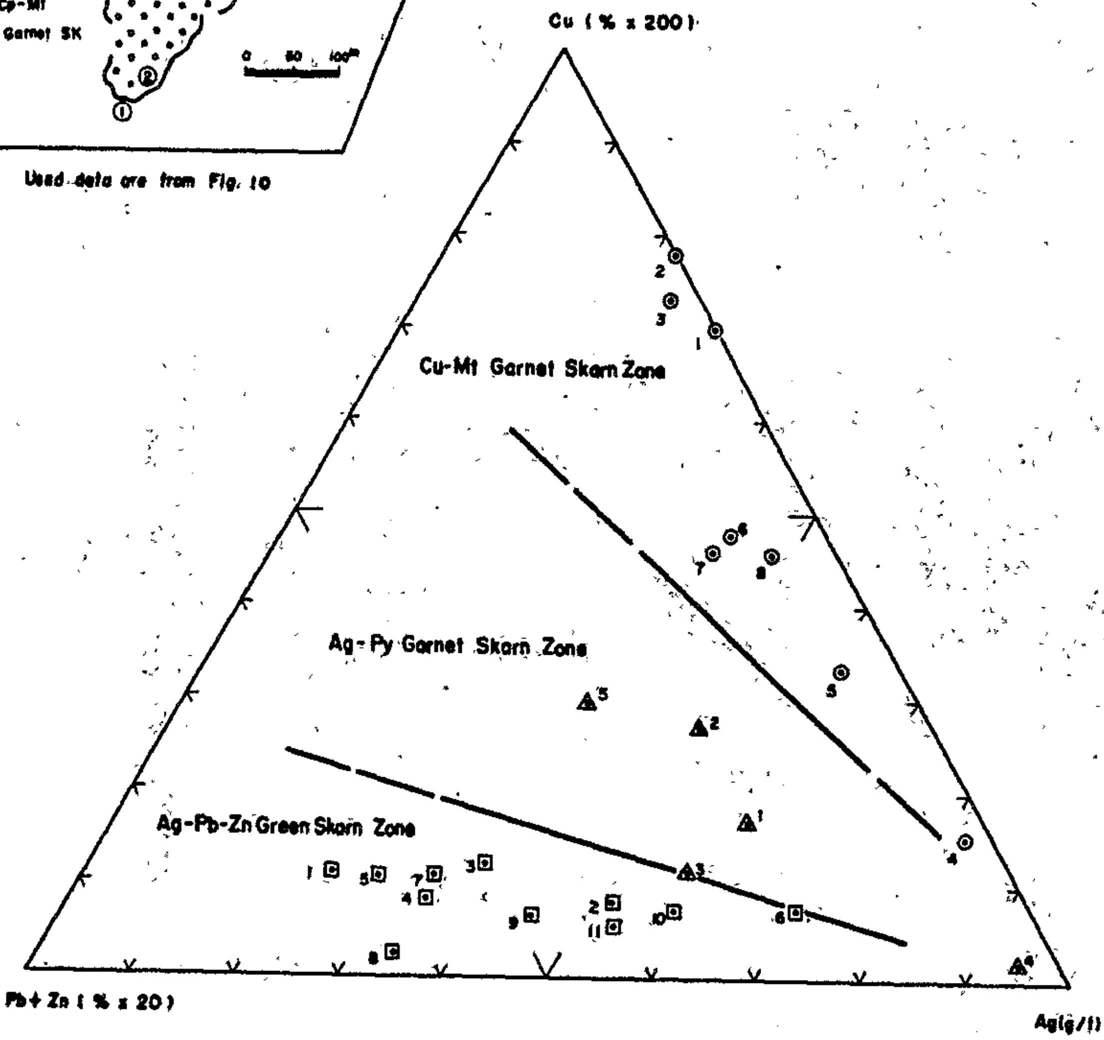


Fig. 11 Triangular Diagram for Cu-Ag-Pb-Zn Ratio in the Cochaquillo Area

Chapter 6 Outline of the Survey Result

6–1 Geological Survey

By the systematic geological surveys in the Oyon area over three years, stratigraphy, geological structure, the character of igneous activity and the zoning of mineralized zones are clarified. The details are described in Chapter 4, 5 and 7.

6–2 Geochemical Survey

Numbers of samples collected through the geochemical surveys of the first Phase and the second Phase are 304 rock samples, 210 gossans and 64 stream sediments. Three indicative elements, Cu, Pb and Zn were assayed. The results of statistical analysis on the assayed data treated by computer separately for each group and population are described as in the following (Table 5, Fig. 12 and Fig. 13).

Rock samples are classified according to geological groups and units. Background values are different in each rock type; lead is high in limestone and zinc tends to be high in igneous rocks; copper is constant at every rocks. The Santa formation is not particularly enriched in the three components.

15 geochemical anomalies among rock samples are found in the Santa and Pariahuanca formations in the neighborhood of acidic intrusives and fault zones. Among stream sediments, 5 anomalies are detected nearby the intrusives.

A factor analysis among Cu, Pb and Zn of three groups, rock, gossan and stream sediments, indicates that copper and lead has a high correlation in the rock samples, while lead and zinc are correlated in the gossan samples. Thus the metal concentration is different depending upon the genetic history of the analyzed materials.

6–3 Geophysical Prospecting

1) IP Method

High FE (frequency effect) anomaly and low AR (apparent resistivity) anomaly confirmed through IP method are limited to the south of Lag. Quellaycocha in the central and southern parts of the Iscay Cruz area. Specially distinct anomalies are discovered (1) in the vicinity of Cumbre de Limpe, (2) Antapamp area and (3) Chupa ore deposit and skarn outcrop area to the south of Lags. Tinyag.

(1) Strongest FE anomaly obtained by IP method in the Iscay Cruz area is located at the

Cumbre de Limpe where FE-values of 5 – 6.5 % and AR-values of 10 – 100 Ωm encircle the pass, and these anomalies extend to 600 – 850 m. Rocks around the pass which are of Santa formation contain abundant disseminated hematite and magnetite. Thus the high FE-values may be due to these oxide minerals, but sulfide orebody may also be expected at depth.

(2) In Antapampa area, high FE anomalies are observed below the black gossan and its northern and southern extension about 1,500 m where unmineralized limestone is expected. FE-values in this zone are 5 – 8 % and AR-values are 5 – 100 Ωm. Most of the anomaly zone lie concealed under the surface and hidden sulfide orebody under the gossan is considered.

(3) High FE-values and low AR-values found in the Chupa ore deposit and skarn outcrops to the east, are 4 – 6 % and 3 – 5 Ωm, respectively. These anomalies may be correlated to skarn deposits in the Santa formation, Chupa skarn deposit in the Pariahuanca formation and pyrite dissemination in the Carhuaz formation which occurs between the above two formations.

(4) Concealed FE anomalies are observed around the mineralized zone to the south of Cumbre de Cunsha Punta, AR-values are 200 – 300 Ωm and FE-values are 2 – 4 %.

(5) Low AR-values of 1 – 10 Ωm and the highest MF (metal factor) values were widely recognized around the Cumbre de Cunsha Punta and its northern slope. Since this area has thick talus deposits and horizon of the Santa formation is not clear, detailed study to clarify the cause of the anomaly is necessary.

(6) Low FE-values of 1 – 2 % and high AR-values of 150 – 500 Ωm were seen in the northern Iscay Cruz area between Canaypata and Lag. Quellaycocha. Thus large scale sulfide orebody cannot be expected here. This speculation was testified by DDH-1 and DDH-2 drillings.

2) EM Method

As for the second Phase survey, EM geophysical prospecting by means of VLF (very low frequency) and Induction methods was applied at Cumbre de Limpe and Tinyag skarn outcrop areas. The obtained data were corresponding well to the surface geology and also to the surveyed results by IP method, and high electric conductive bodies were found on the horizon equivalent to the Santa formation. It was proved that EM method is useful tool in this area where electric noise is small and recent cover of sediments is thick.

In the third Phase, EM prospecting by means of VLF method was carried out at

Tinyag-Cunsha Punta area where the surface is completely covered by recent sediments, and clear electromagnetic anomalies were observed on the horizon equivalent to the concealed Santa formation.

6–4 Drilling Exploration

Twelve drillings whose total length is 2,654 m, were performed at 11 localities in the northern Iscay Cruz, Limpe, Tinyag, Cunsha Punta and Antapampa areas. High grade ores were discovered in the Limpe and Tinyag areas; highly mineralized horizons were detected in the Cunsha Punta and Antapampa areas.

1) Northern Iscay Cruz Area

DDH-1 and DDH-2 were drilled at the northernmost part of the Iscay Cruz mineralized zone near Cumbre de Iscay Cruz. It was found that the lower part of black gossan is composed of manganiferous siderite and the siderite is disseminated with minute crystals of galena and sphalerite. Main lead and zinc disseminated parts are shown as follows.

	Depth (m)	Interval (m)	No. of Samples	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)
DDH-1	49.0 – 63.2	14.2	14	10	0.01	0.65	3.48
do.	67.0 – 78.7	11.6	7	8	0.01	0.58	4.18
do.	116.0 – 172.0	6.0	3	10	0.01	0.84	3.81
DDH-2	107.9 – 121.0	13.1	5	3	0.01	0.09	4.35
do.	124.9 – 130.8	5.9	2	6	0.02	0.19	4.51
do.	166.7 – 172.0	5.3	2	3	0.01	1.08	6.25
do.	220.9 – 231.7	10.8	5	5	0.01	1.06	4.46
do.	240.5 – 252.0	11.5	5	3	0.01	0.73	4.92
Weighted average		78.4	43	6	0.01	0.62	4.37

2) Limpe Area

Four drill holes, DDH-3, 4, 5 and 6 were set on storng FE anomalous zone in Limpe area, and all penetrated through high-grade lead-zinc ore. Analytical results of the major ore zones are given below.

	Depth (m)	Interval (m)	No. of Samples	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Net wid. (m)
DDH-3	104.6 – 108.6	4.0	4	89	0.03	6.74	14.17	2.57
DDH-4	61.3 – 76.1	14.8	15	13	0.07	0.04	14.49	7.40
do.	84.9 – 104.7	19.8	16	10	0.10	0.30	7.78	9.90
DDH-5	95.6 – 99.6	4.0	3	32	1.64	4.38	20.09	2.07
do.	181.0 – 204.0	23.0	23	163	0.14	2.92	27.15	11.91
DDH-6	194.4 – 200.4	6.0	6	29	0.33	0.03	39.36	3.01
do.	209.0 – 215.3	6.3	6	24	0.08	0.59	10.07	3.16
Weighted average based on individual holes		19.5	73	64	0.20	1.57	18.35	10.0

All the ores are sphalerite-rich massive pyrite, in which galena and chalcopyrite are locally disseminated.

3) Tinyag Area

DDH-7 was drilled to find lower extension of skarn outcrop exposed about 300 m south of Lags. Tinyag. Mineralized skarn was detected for 114 m. Almost all the skarn contain disseminated sphalerite, chalcopyrite, pyrite and magnetite. High grade portions and their assay are as follows.

	Depth (m)	Interval (m)	No. of Samples	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Net wid. (m)
DDH-7	56.0 – 63.0	7.0	5	5	0.21	0.01	19.71	4.43
do.	116.0 – 135.0	19.0	15	9	3.18	tr	19.53	12.03
Weighted average		26.0	20	8	2.38	tr	19.58	16.5

4) Cunsha Punta Area

In order to check lower extension of strongly mineralized outcrop of Santa formation, DDH-8, 9 and 10 were drilled in this area. All the holes encountered low-angle thrust fault, so that the Santa formation was not detected underneath the outcrop but Carhuaz formation. The Carhuaz formation is strongly mineralized by network-vein and disseminated manner of sphalerite and pyrite. This suggests that high potentiality would exist in near-by Santa formation which is possibly concealed below the Chimu formation, just east of the present site. Major mineralized zones of Carhuaz formation are listed below.

	Depth (m)	Interval (m)	No. of Samples	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)
DDH-9	9.5 – 11.1	1.6	1	10	0.05	0.1	3.90
DDH-10	59.2 – 64.2	5.0	3	11	0.04	0.06	3.11
do.	65.9 – 70.0	4.1	4	13	0.08	0.05	5.38

5) Antapampa Area

In order to explore lower extension of black gossan and to know character of subsurface FE anomaly, DDH-11 and DDH-12 were carried out in this area. According to DDH-11, rocks underneath the gossan are manganiferous siderite and dolostone. Therefore the black gossan is identified as oxidized products of these rocks. The manganiferous siderite and dolostone contain about 3 % Zn, due to dissemination of fine-grained sphalerite.

Through DDH-12, the following zonation was found from surface to the depth.

(upper) unmineralized limestone - dolomite·siderite - Zn·Cu·hematite
- pyrite - Cu·hematite·pyrite - Cu·skarn (lower)

The major mineralized zones have the following assay values, in high copper is dominant, especially in the deeper part, as compared with mineralization in other areas. Copper and zinc tend to occur with hematite.

	Depth (m)	Interval (m)	No. of Samples	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)
DDH-12	122.8 – 128.1	5.3	2	12	0.12	0.10	4.89
do	137.4 – 141.6	4.2	2	16	0.52	0.15	3.35
do	142.4 – 144.8	2.4	1	34	1.89	tr	0.20
do	237.5 – 247.2	9.7	5	94	3.08	0.01	0.33
do	281.2 – 285.4	4.2	2	35	2.73	tr	0.40

Table 5 Results of Statistical Analysis on the Geochemical Samples

	Population	Number of Samples	Cu (ppm)		Pb (ppm)		Zn (ppm)	
			Mean	Mean+2σ	Mean	Mean+2σ	Mean	Mean+2σ
1	Type of Samples							
	Rock	304	5.4	26	20.8	162	28.8	153
	Gossan	210	61.0	3,055	968.3	21,478	11,091.8	358,922
	Stream Sediment	64	20.2	110	30.8	455	114.8	445
2	Rock Samples Classified by Group							
	Upper calcareous rocks (Cd,Jm,Pt, Cl,Ph)	93	5.6	16	28.4	49	31.4	131
	Upper clastic rocks (Fr, Cz)	27	6.8	49	9.8	96	33.6	220
	Lower calcareous rocks (St)	141	5.1	15	26.9	125	24.5	123
	Lower clastic rocks (Cm, Oy)	16	5.9	186	11.6	423	23.8	192
	Igneous rocks (Cp, Ig)	27	5.3	76	5.4	114	48.3	283
3	Rock Samples Classified by Formation							
	Celendin formation (Cd)	1	13.0	13	63.0	63	100.9	101
	Jumasha formation (Jm)	18	4.0	8	28.3	43	25.8	150
	Pariatambo formation (Pt)	22	5.5	17	24.3	35	29.7	99
	Chulec formation (Cl)	21	7.2	26	28.4	47	36.2	155
	Pariahuanca formation (Ph)	31	5.6	12	31.0	58	32.1	121
	Farrat formation (Fr)	7	3.6	36	4.5	121	10.2	39
	Carhuaz formation (Cz)	20	8.6	45	12.9	63	50.8	169
	Santa formation (St)	141	5.1	15	26.9	125	24.5	123
	Chimu formation (Cm)	14	5.8	233	16.5	413	25.1	231
	Oyon formation (Oy)	2	6.7	15	1.0	7	16.5	33
	Calipuy volcanics (Cp)	12	3.1	38	5.5	63	47.2	171
	Intrusive rocks (Ig)	15	8.2	104	5.3	185	49.2	409

Mean ; Geometric mean

σ ; Standard deviation

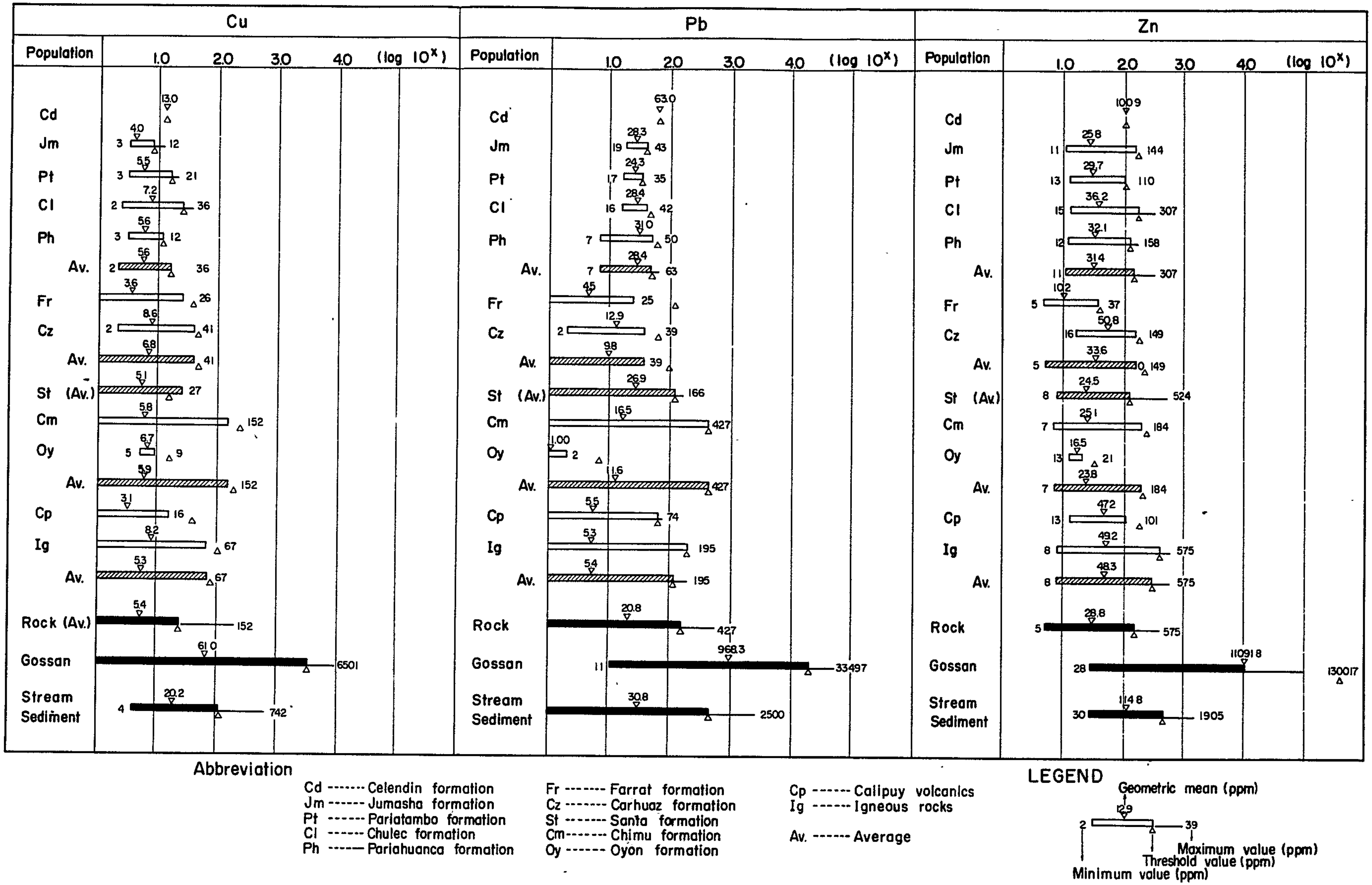


Fig. 12. Value Dispersion of Geochemical Samples in the Surveyed Area

Fig.13 Histogram and Cumulative Frequency Curve for Cu, Pb and Zn contents of Geochemical Samples
(1) Rock Samples

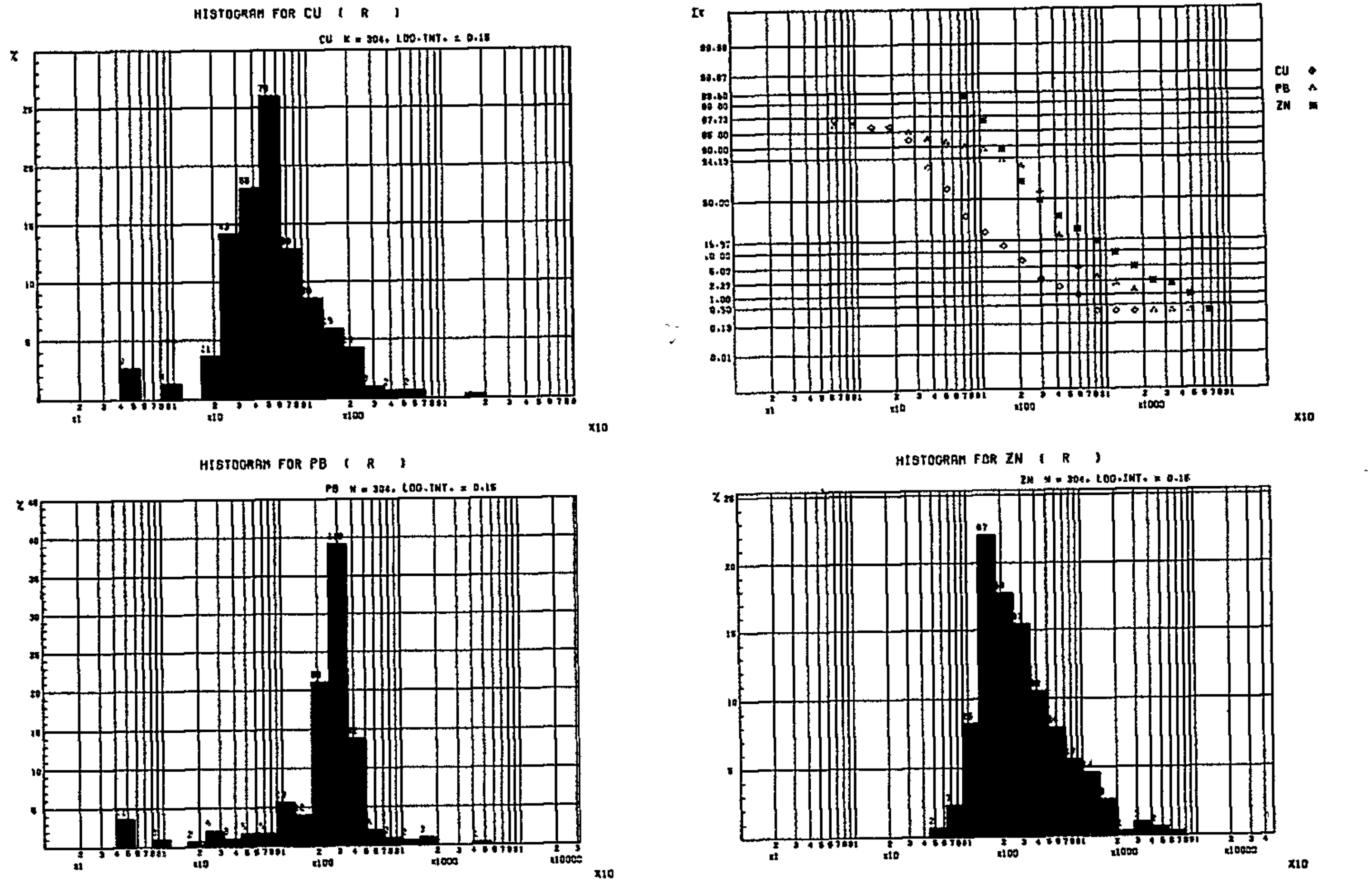
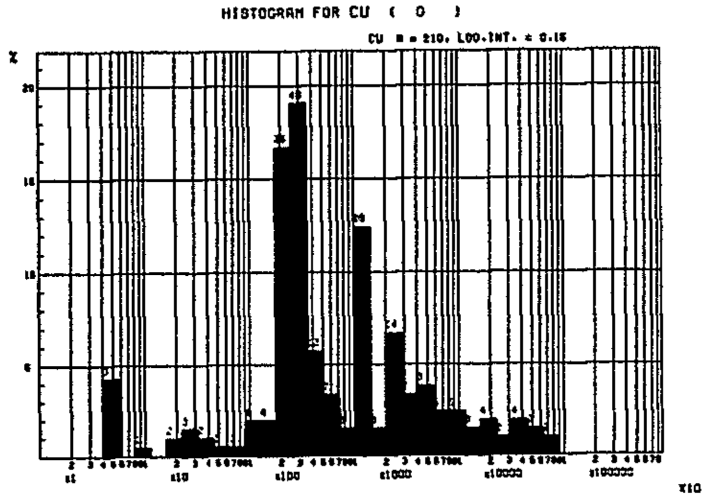
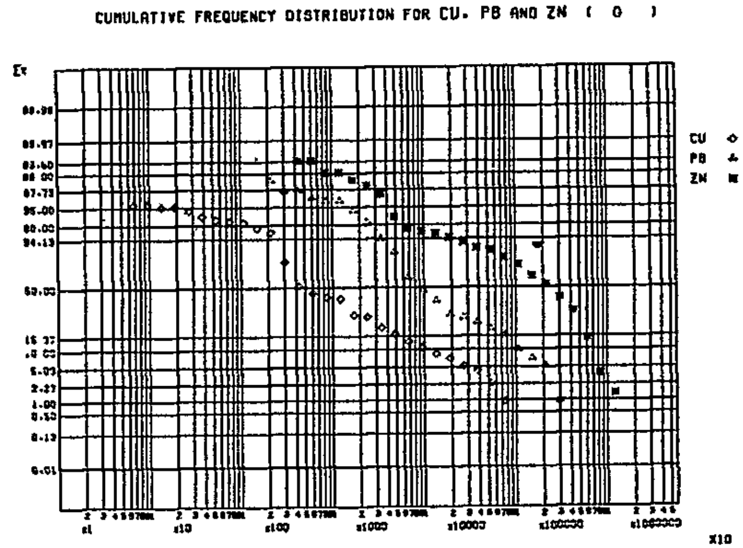
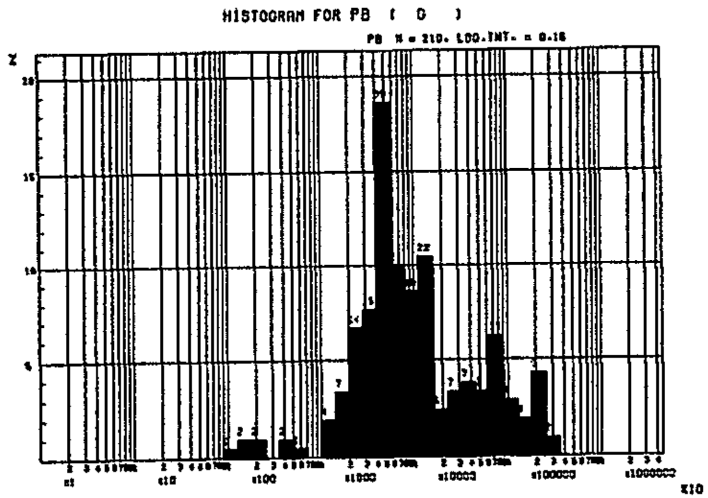


Fig. 13 Histogram and Cumulative Frequency Curve for Cu, Pb and Zn contents of Geochemical Samples (2) Gossan Samples







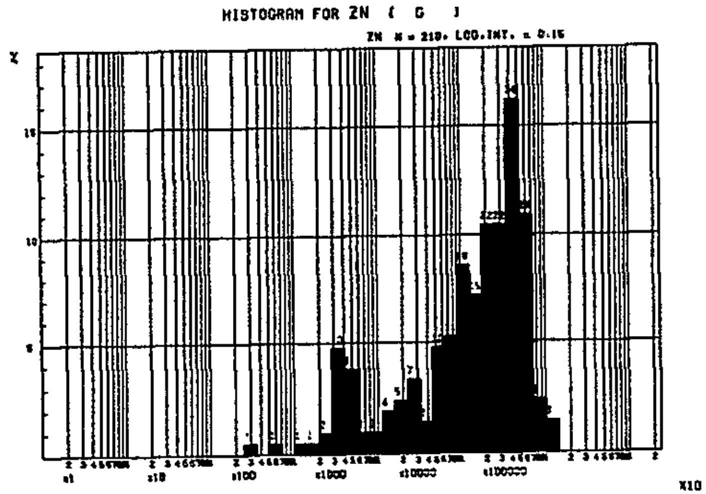
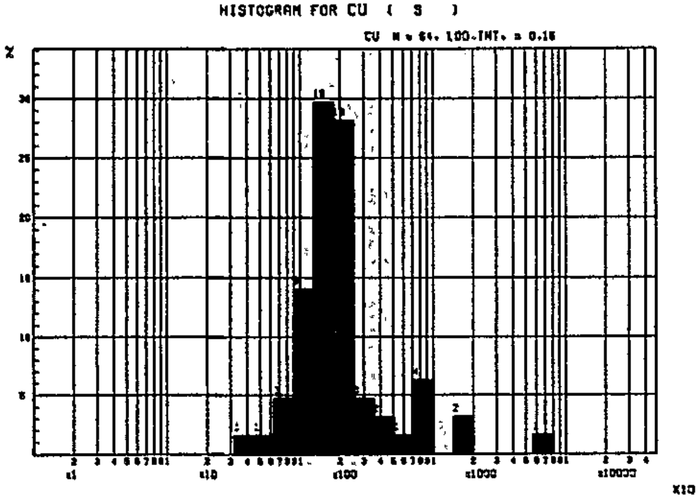
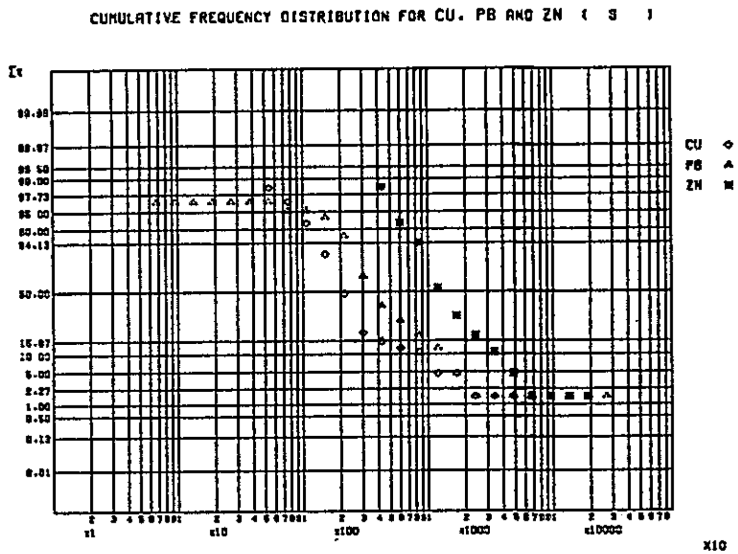
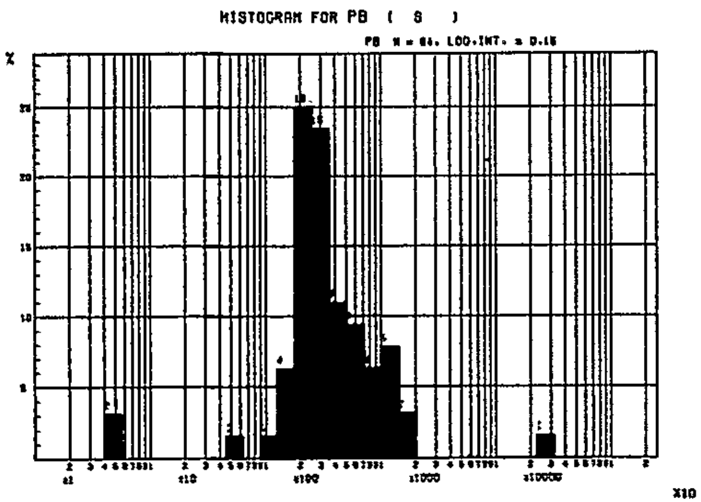
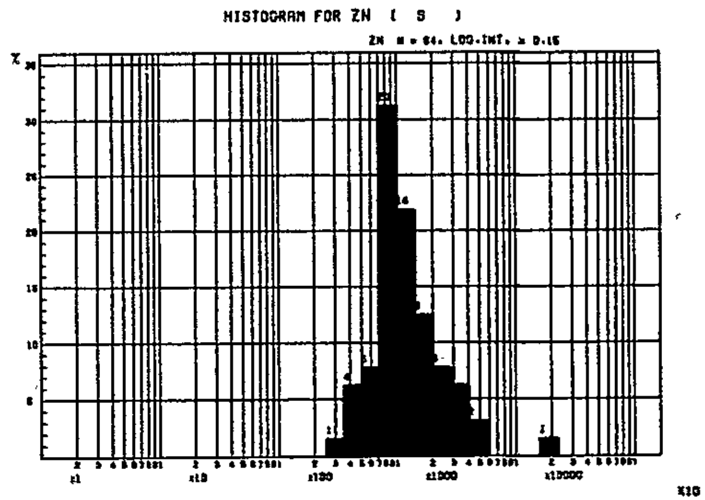


Fig.13 Histogram and Cumulative Frequency Curve for Cu, Pb and Zn contents of Geochemical Samples (3) Samples of Stream Sediments









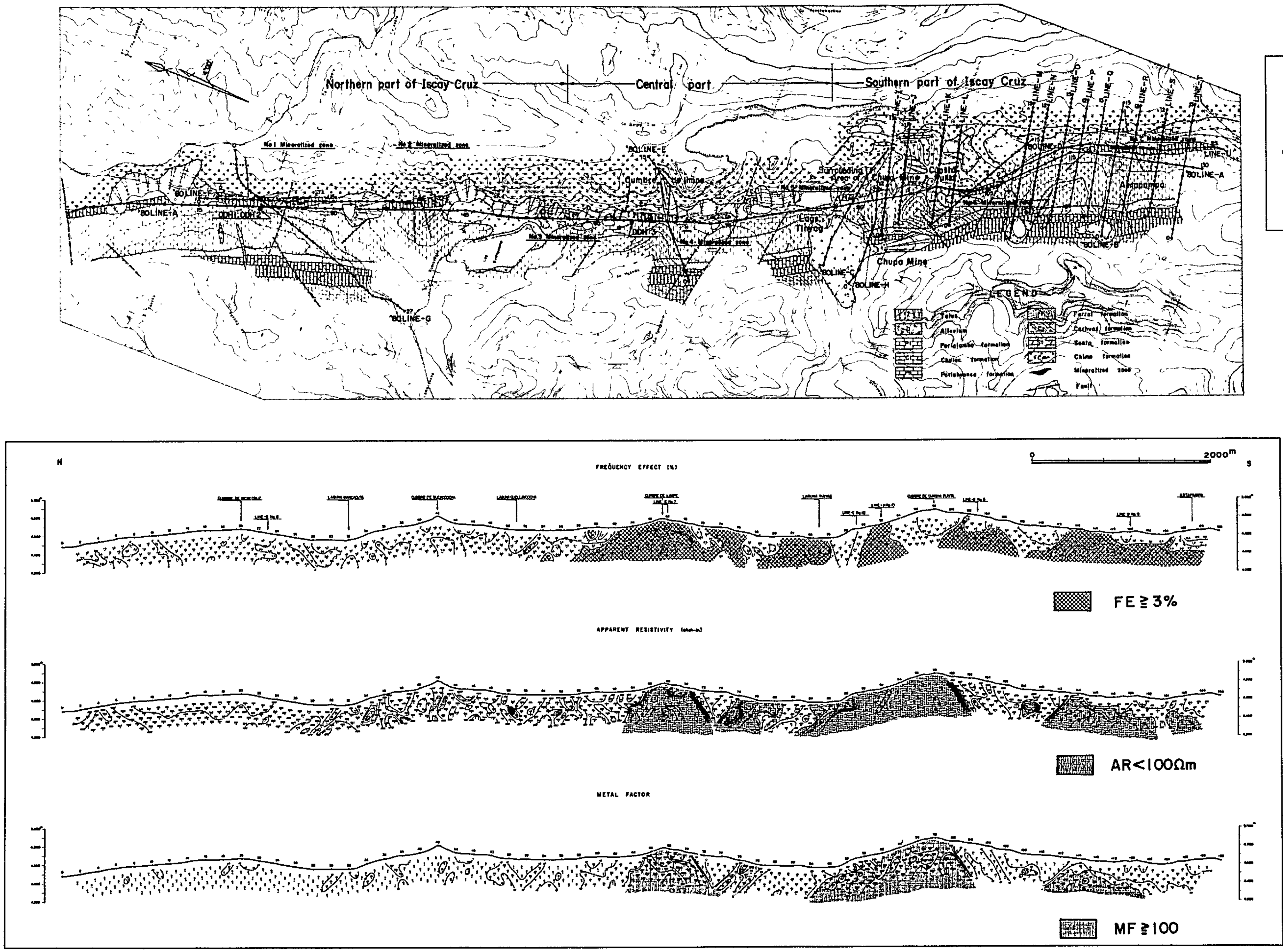
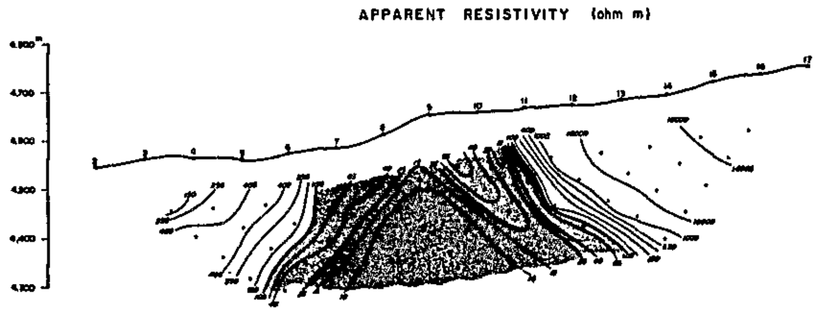
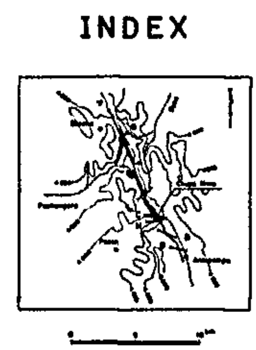
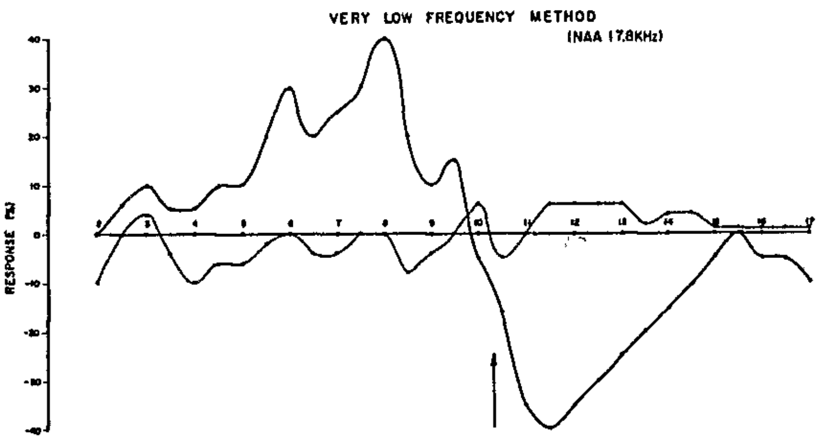
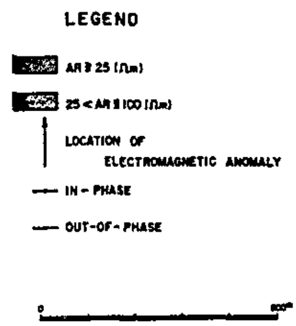


Fig. 14 Summarized Map of IP Anomalies









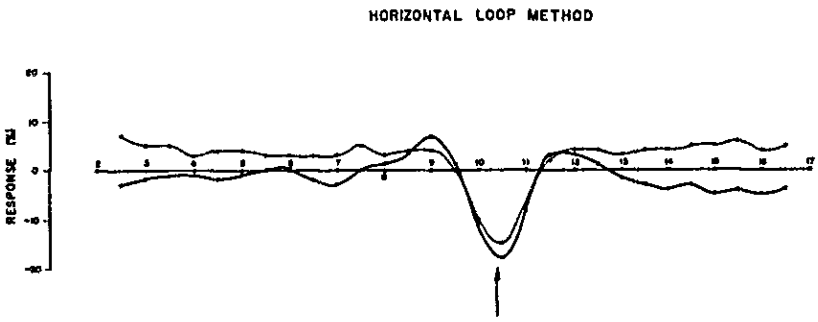


Fig.15 EM Component Curve (I) Line-C

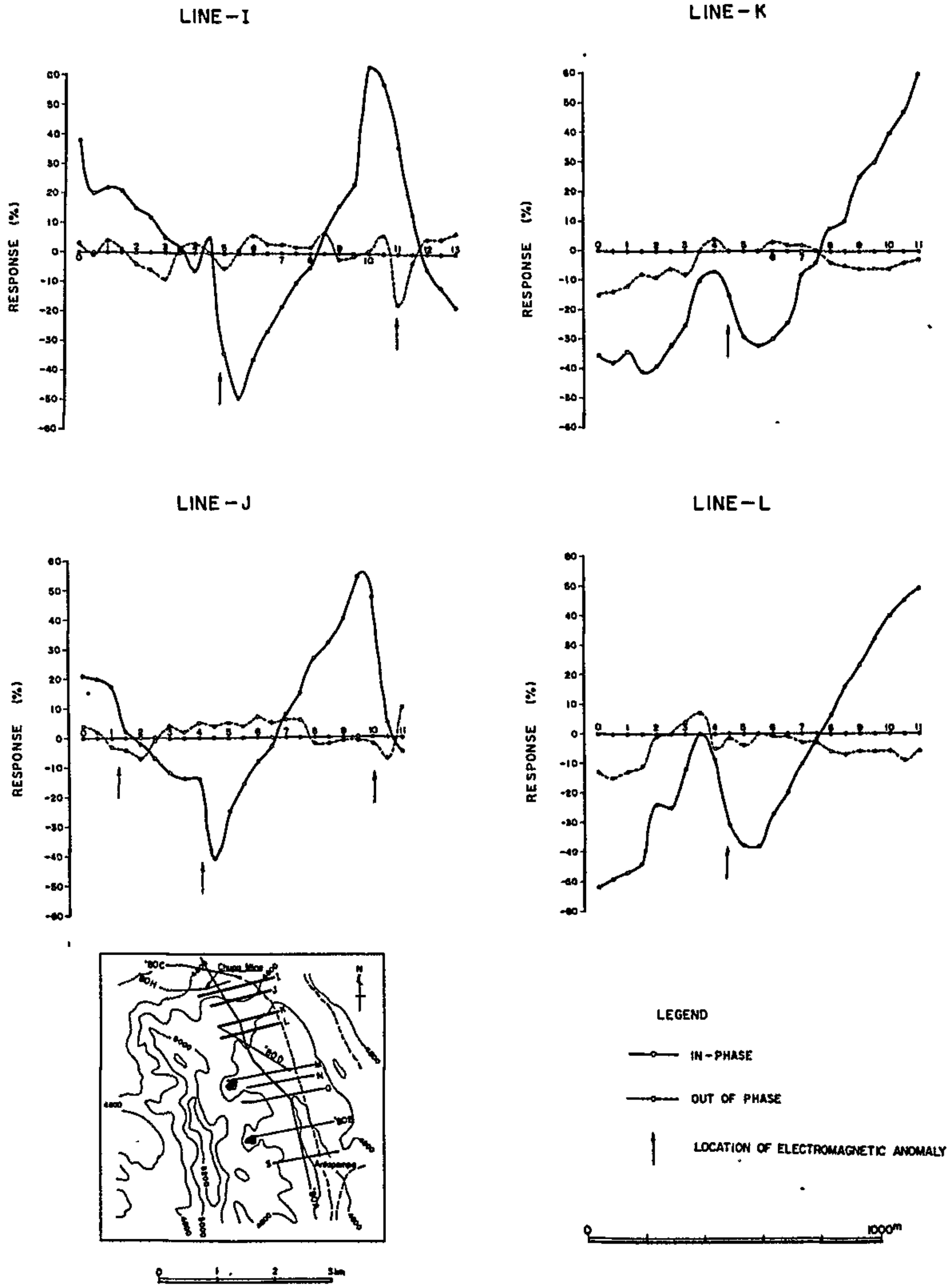
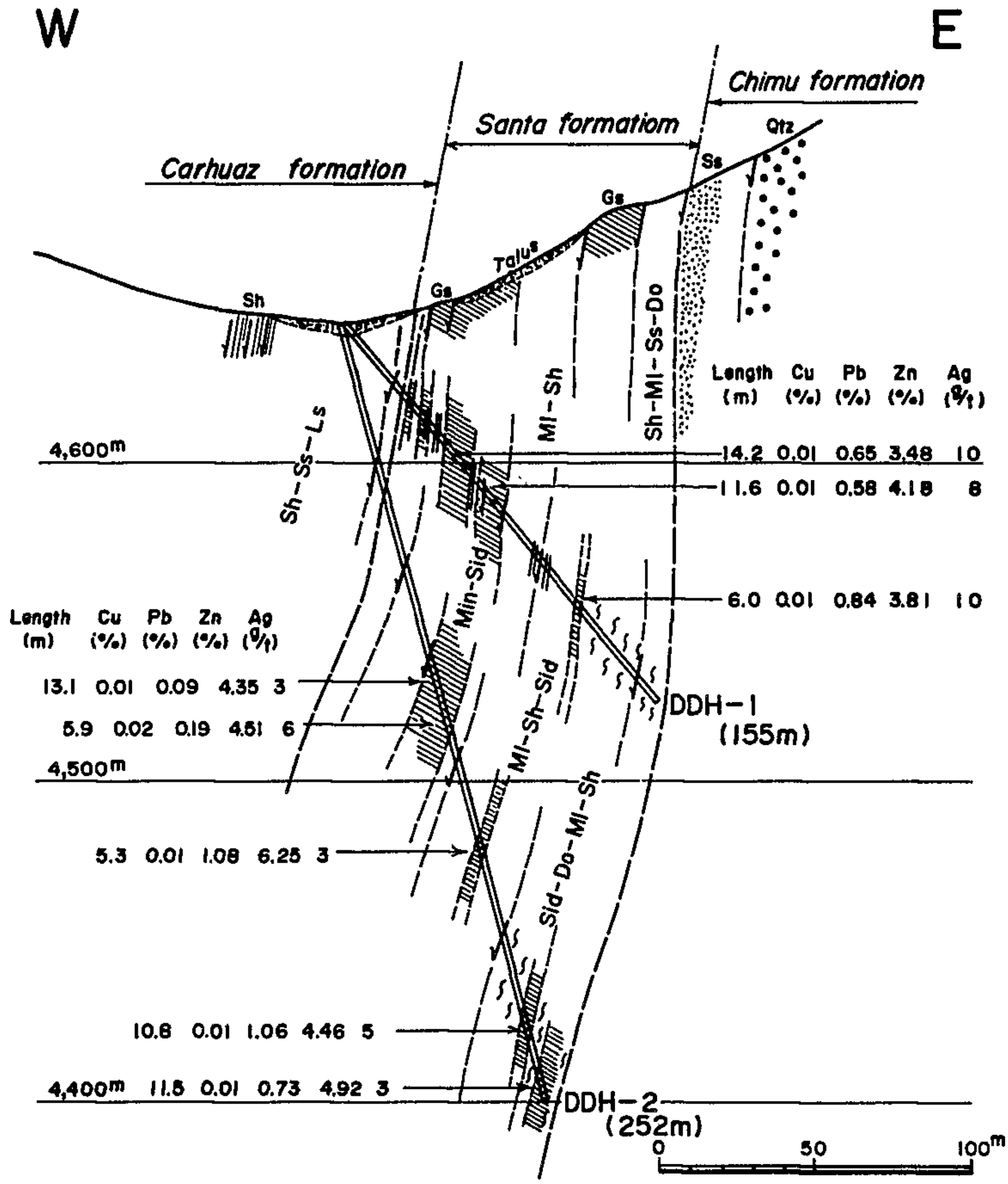


Fig. 15 EM Component Curve
(2) Lines-I, J, K and L by VLF Method

Table 6 List of Drilling

	Coordinate		Elevation	Direction	Inclination	Depth
	N	E	(m)			(m)
DDH-1	813.070	309.040	4,643	80°	-50°	155.0
DDH-2	813.070	309.040	4,643	80°	-75°	252.0
DDH-3	809.120	310.310	4,695	60°	-48°	157.0
DDH-4	808.870	310.400	4,758	70°	-60°	184.7
DDH-5	808.610	310.460	4,742	70°	-45°	211.1
DDH-6	808.410	310.540	4,696	70°	-55°	301.6
DDH-7	806.870	311.450	4,646	250°	-80°	230.8
DDH-8	805.860	311.780	4,810	70°	-60°	200.3
DDH-9	805.540	311.930	4,774	70°	-70°	200.8
DDH-10	805.310	312.200	4,701	285°	-60°	200.4
DDH-11	804.250	312.880	4,606	0°	-90°	250.5
DDH-12	804.120	312.910	4,600	70°	-85°	310.5



Abbreviation

Sh ------ Shale	Qtz -------- Quartzite
Ss ------ Sandstone	≈≈ ------ Sheared zone
Ml ------ Marl	Gs -------- Gossan
Ls ------ Limestone	Min-Sid ---- Mineralized Siderite
Do ------ Dolostone	/ -------- Bedding

Fig. 16 Geological Section for DDH−1 and DDH−2 (S80°W — N80°E)

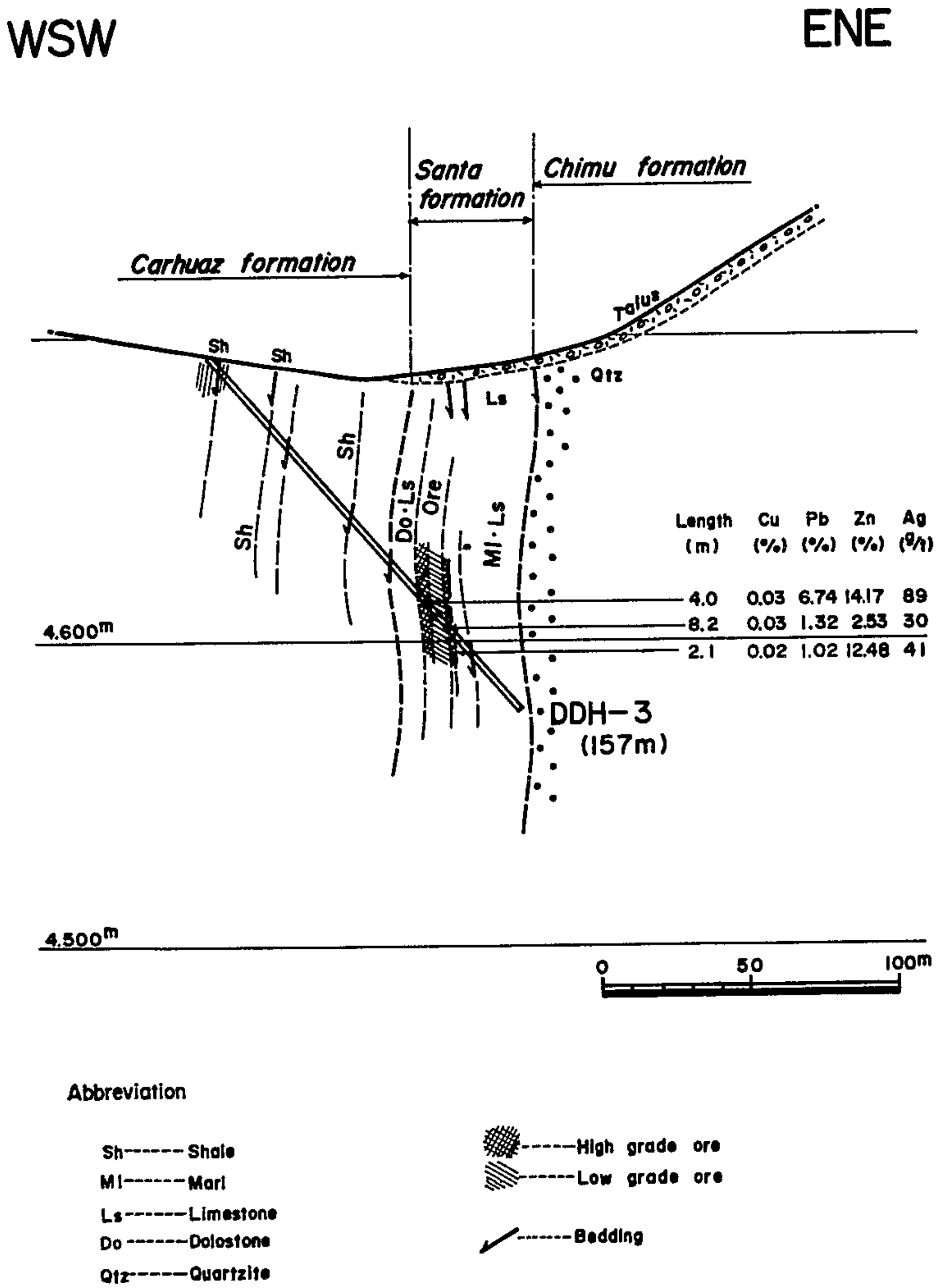
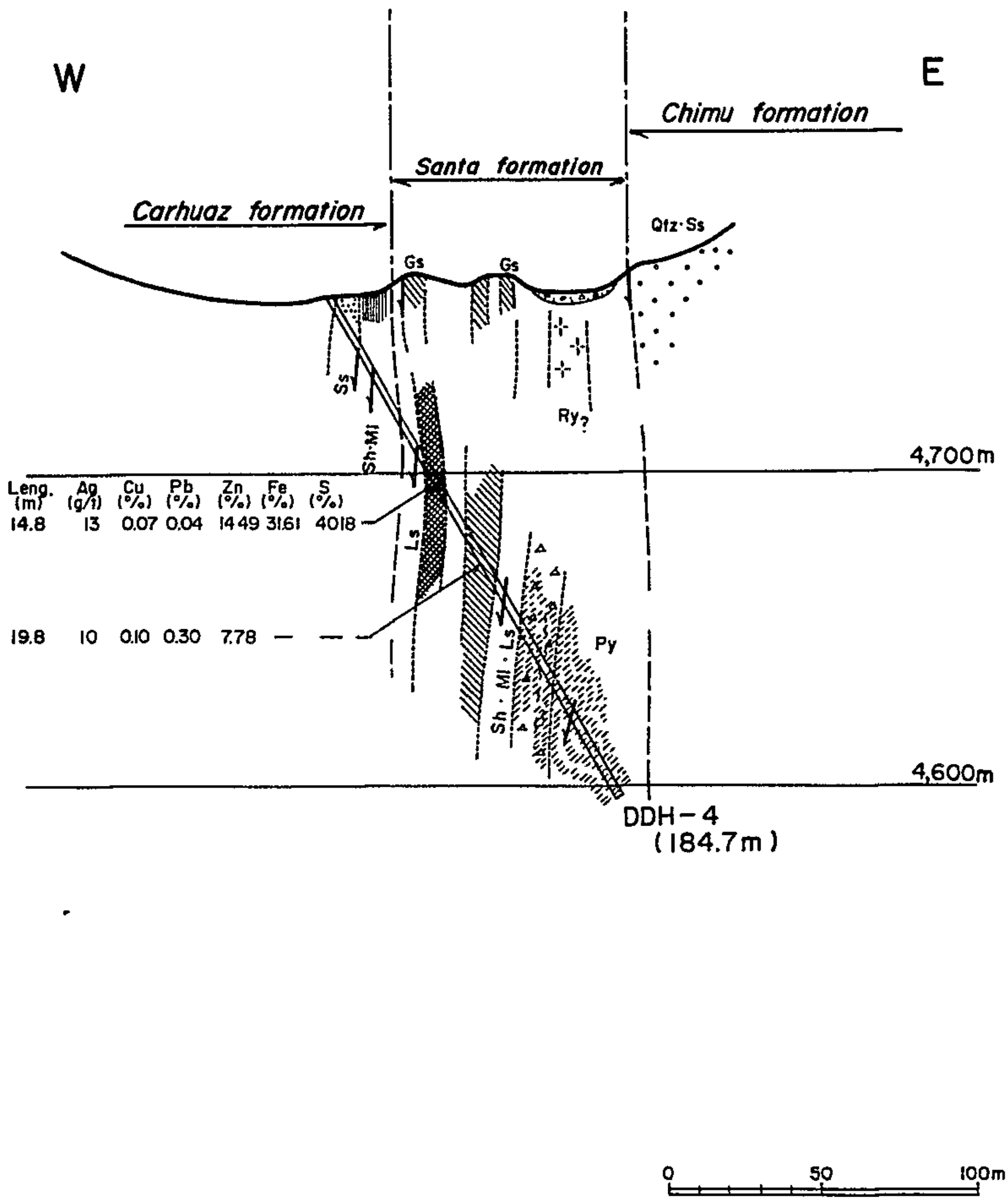


Fig. 17 Geological Section for DDH – 3
(S60°W – N60°E)

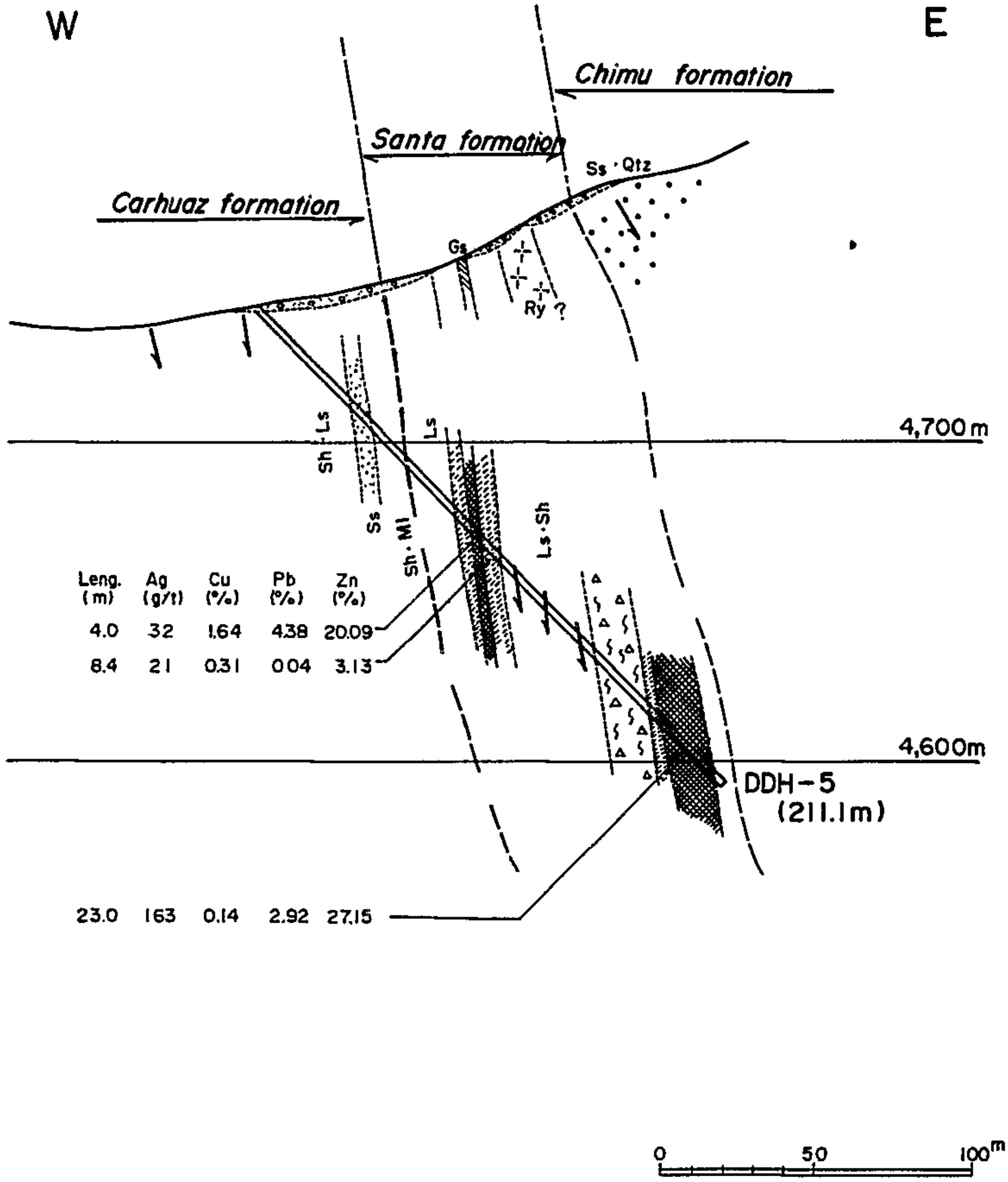


Abbreviation

Sh ------ Shale
Ss ------ Sandstone
Ml ------ Marl
Ls ------ Limestone
Do ------ Dolostone
Qtz ------ Quartzite
Ry ------ Rhyolite

------ High grade ore
------ Low grade ore
------ Pyrite
Gs ------ Gossan
------ Sheared zone
------ Brecciated zone
------ Bedding

Fig. 18 Geological Section for DDH-4
(S70°W-N70°E)



Abbreviation

Sh ------ Shale
Ss ------ Sandstone
Ml ------ Marl
Ls ------ Limestone
Do ------ Dolostone
Ry ------ Rhyolite

------ High grade ore
------ Low grade ore
------ Pyrite
Gs ------ Gossan
------ Sheared zone
ΔΔ ------ Brecciated zone
------ Bedding

Fig. 19 Geological Section for DDH-5
(S70°W - N70°E)

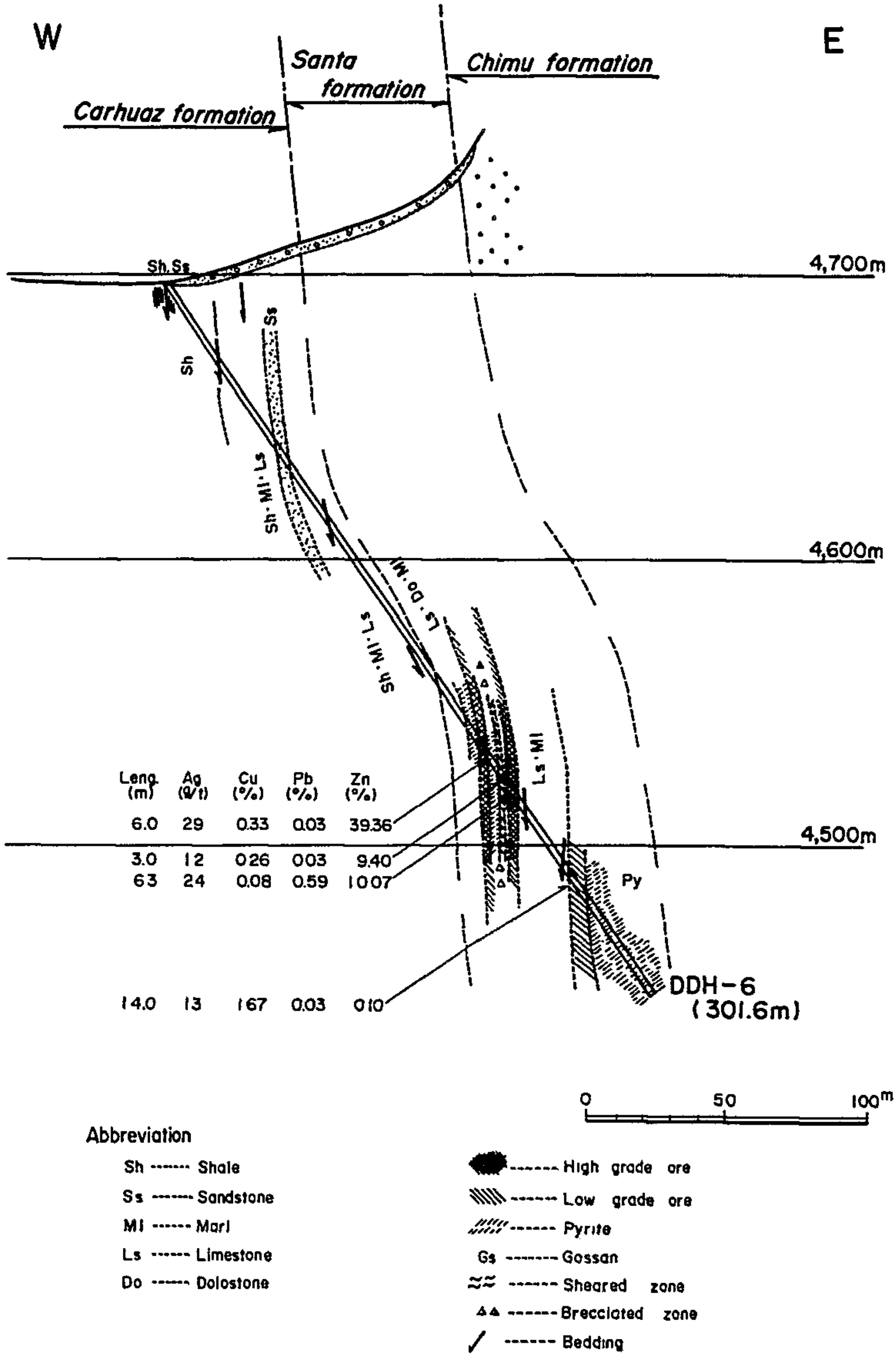


Fig.20 Geological Section for DDH - 6
(S70°W - N70°E)

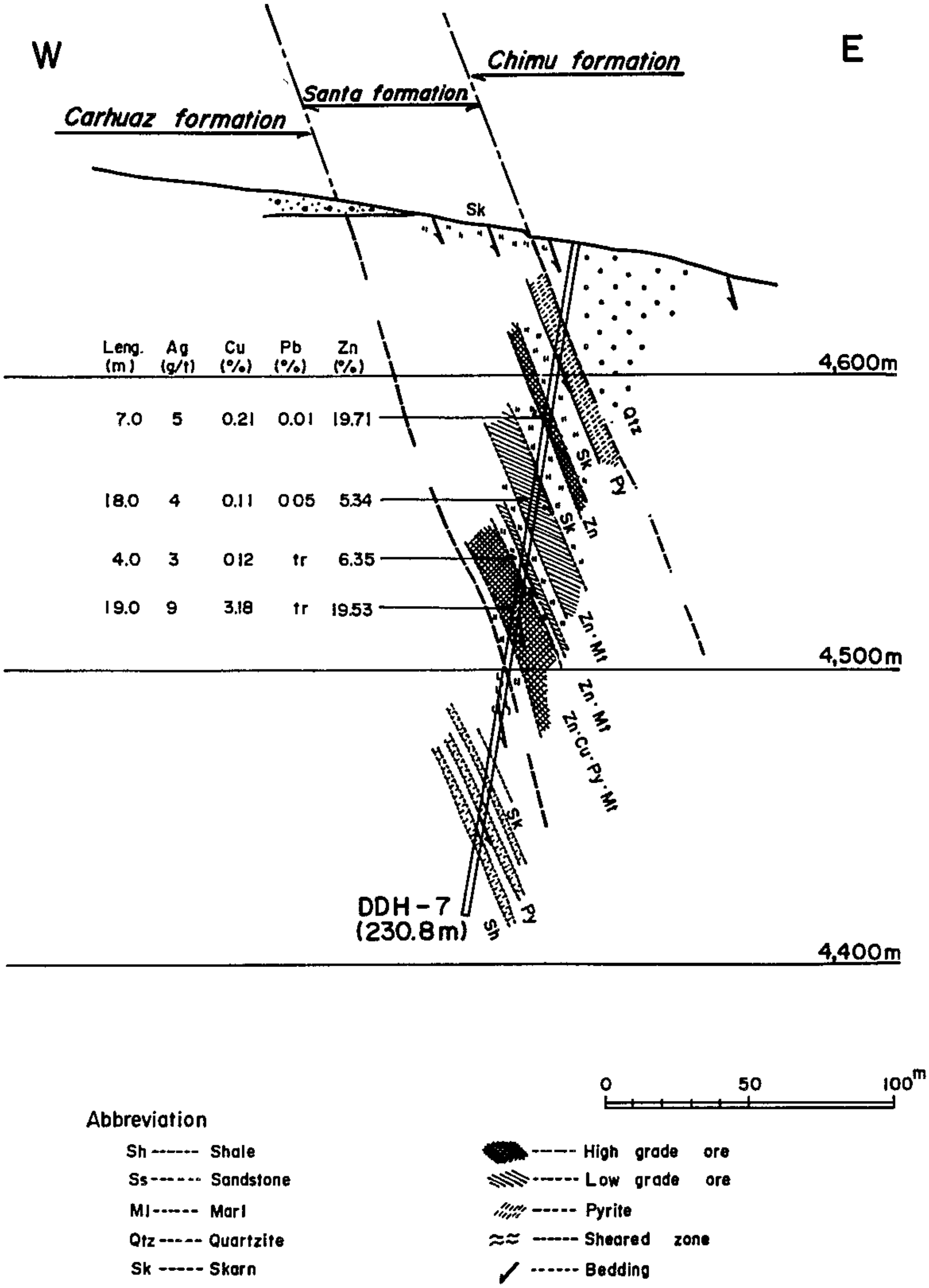


Fig.21 Geological Section for DDH-7 (S70°W-N70°E)

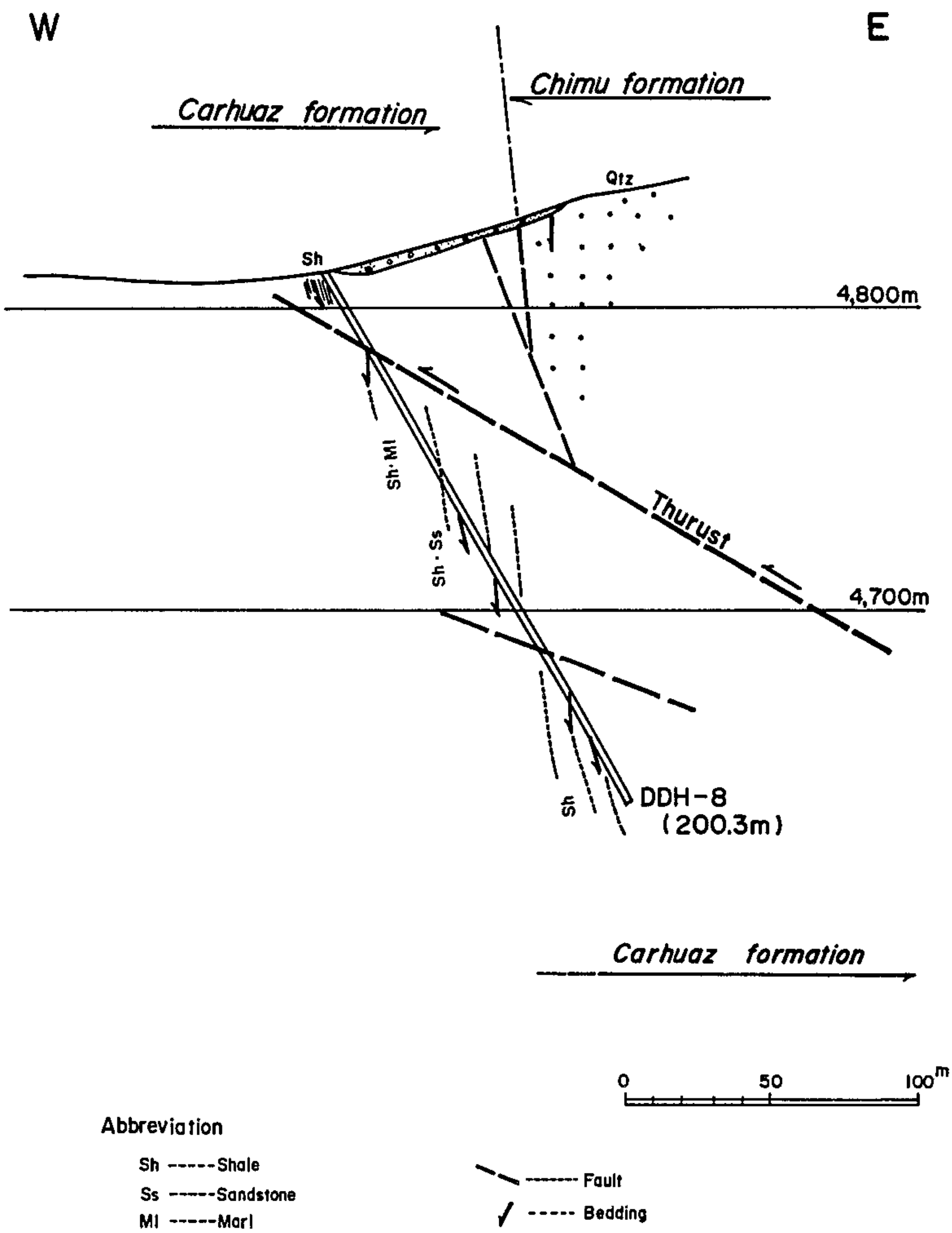
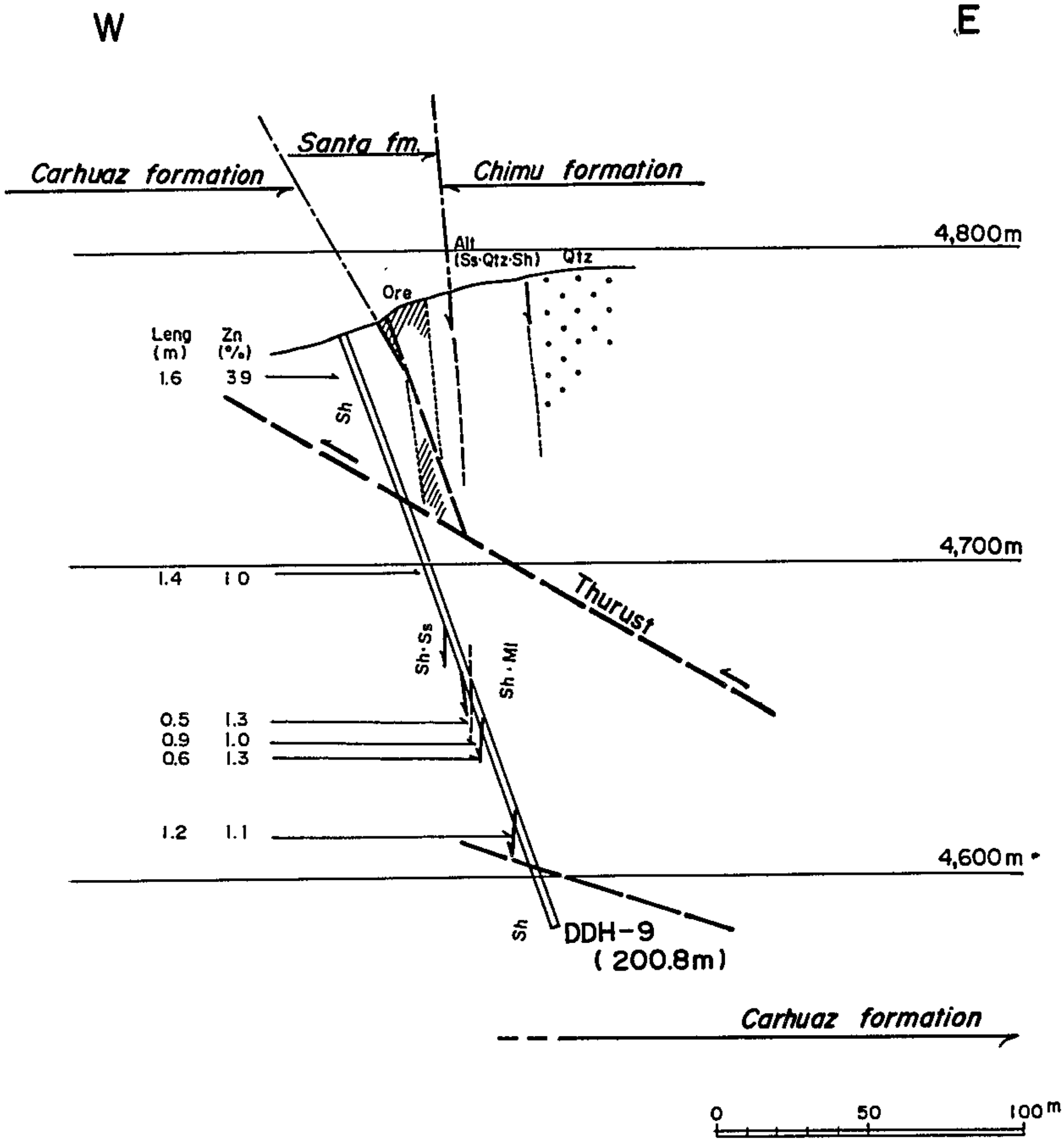


Fig. 22 Geological Section for DDH-8
(S70°W-N70°E)



Abbreviation

Sh ----- Shale
Ss ----- Sandstone
Ml ----- Marl
Ls ----- Limestone
Qtz ----- Quartzite
Do ----- Dolostone
Gs ----- Gossan
----- Fault
----- Bedding

Fig.23 Geological Section for DDH-9 (S70°W-N70°E)

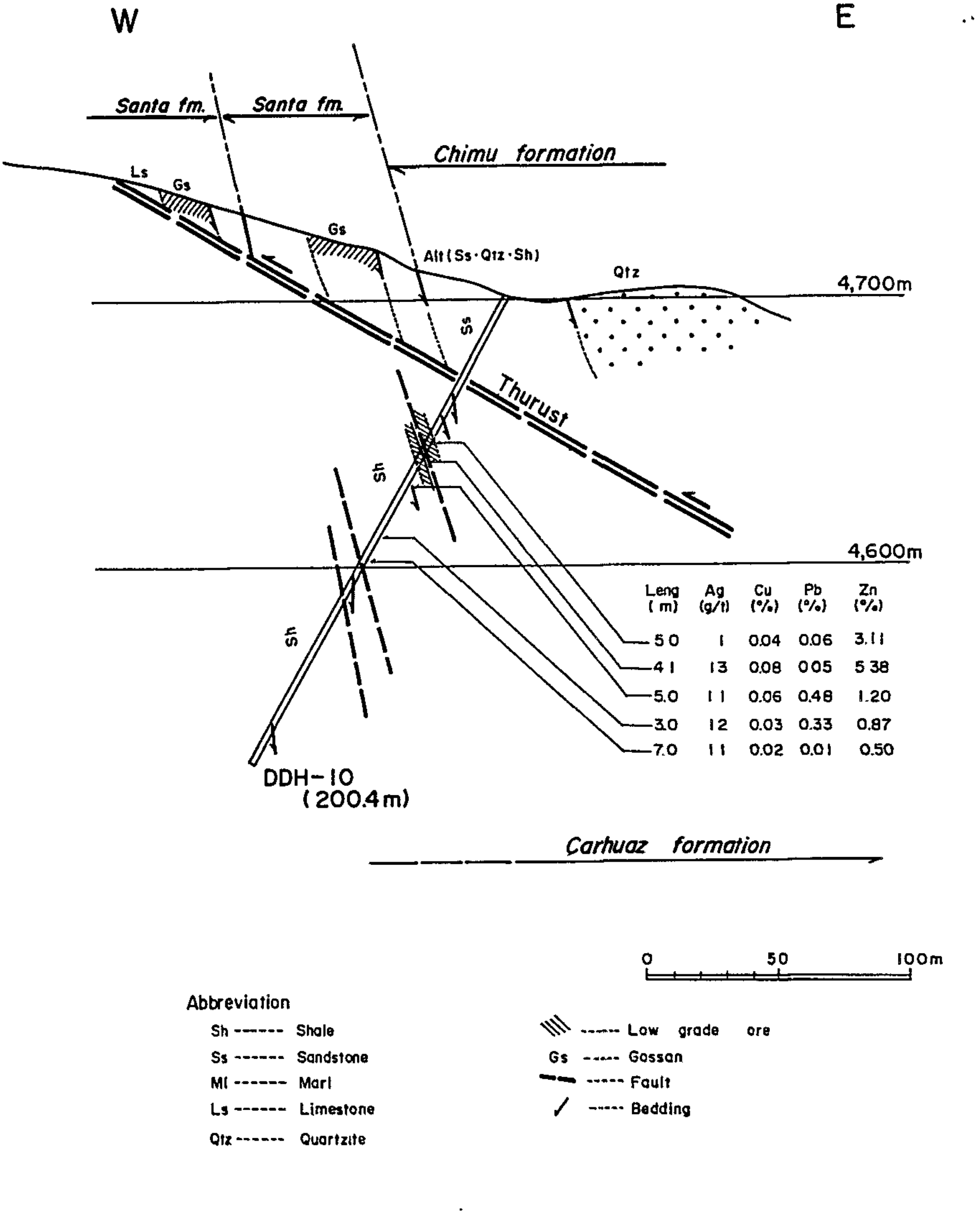
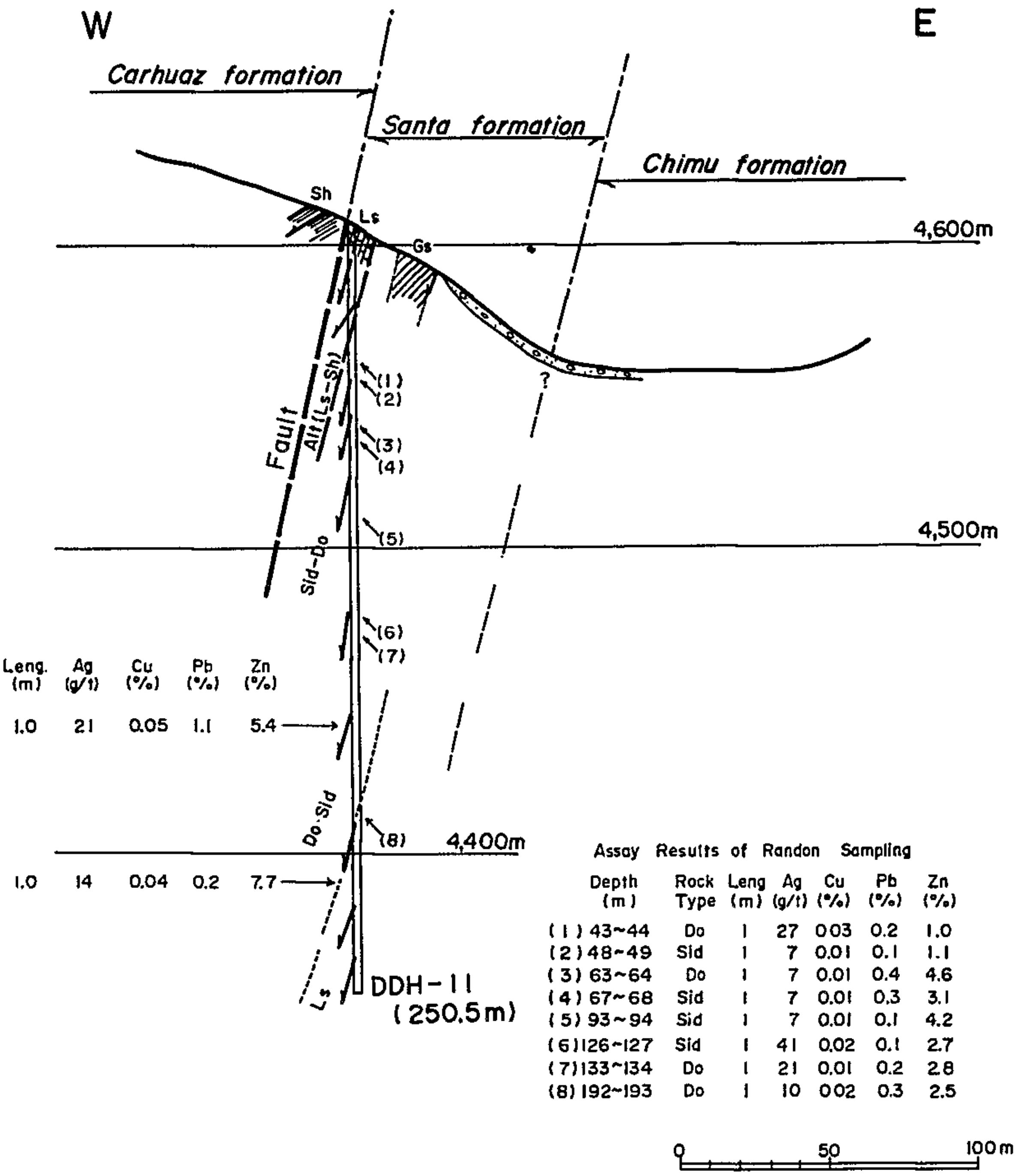


Fig. 24 Geological Section for DDH - 10
(S 75°E - N 75°W)



Assay Results of Randon Sampling

Depth (m)	Rock Type	Leng (m)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)
(1) 43~44	Do	1	27	0.03	0.2	1.0
(2) 48~49	Sid	1	7	0.01	0.1	1.1
(3) 63~64	Do	1	7	0.01	0.4	4.6
(4) 67~68	Sid	1	7	0.01	0.3	3.1
(5) 93~94	Sid	1	7	0.01	0.1	4.2
(6) 126~127	Sid	1	41	0.02	0.1	2.7
(7) 133~134	Do	1	21	0.01	0.2	2.8
(8) 192~193	Do	1	10	0.02	0.3	2.5

Abbreviation

Sh ----- Shale
Ml ----- Marl
Ls ----- Limestone
Do ----- Dolostone
Sid ----- Siderite
Gs ----- Gossan
≈ ----- Sheared zone
----- Fault
----- Bedding

Fig.25 Geological Section for DDH-11

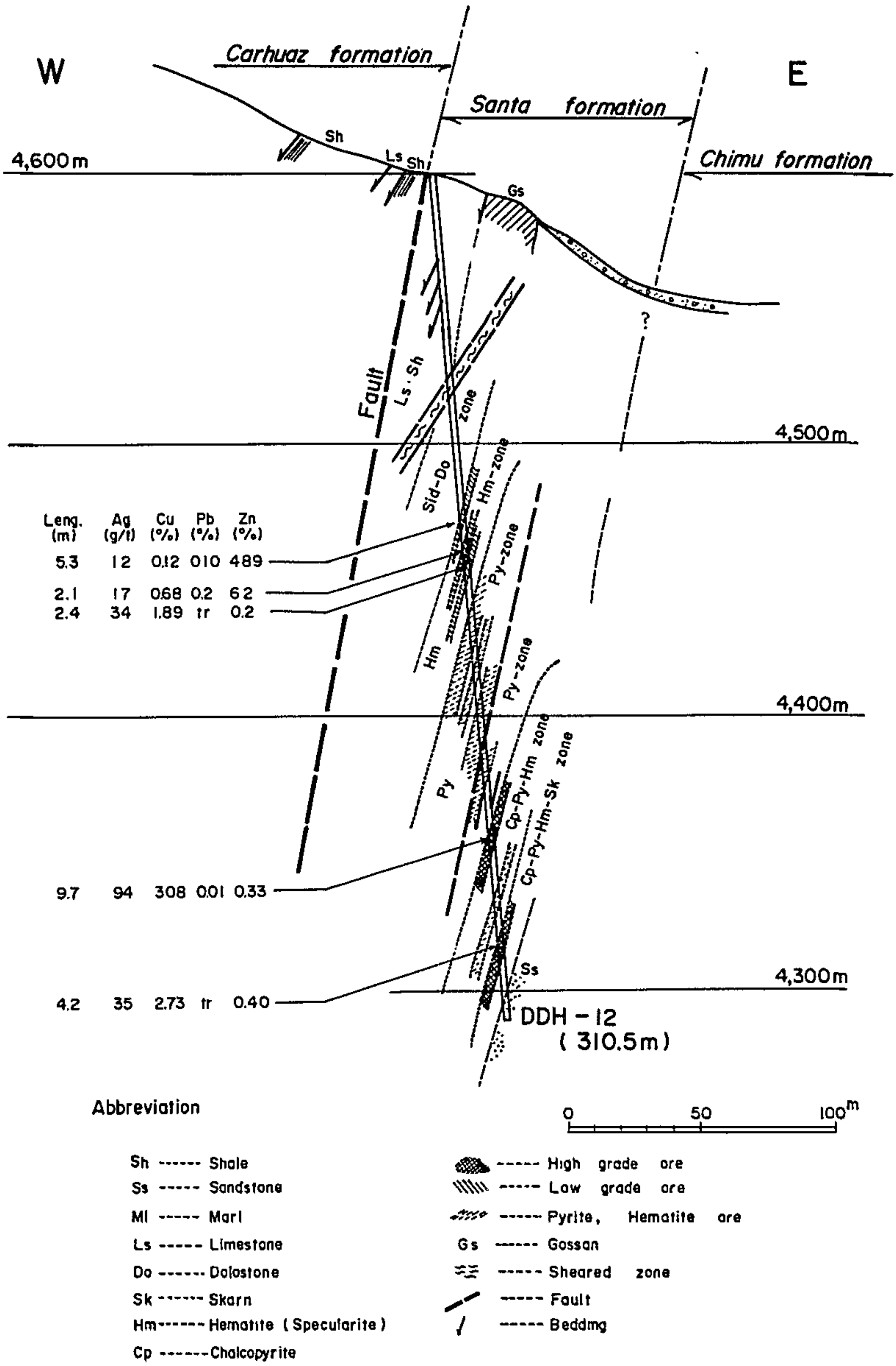


Fig.26 Geological Section for DDH - 12
(S70°W - N70°E)

Chapter 7 Synthetic Discussion on the Iscay Cruz Mineralized Zone

7–1 Geologic Structure and Mineralization

Mineralization in this area occurs in calcareous rocks of the Santa formation. This formation constitutes wing of folded sedimentary rocks. Because of tight folding, however, the dip here is nearly vertical and partly overturned. The thickness varies from 40 m to 80 m.

Throughout prominent mineralized zones in the Limpe area, Cunsha Punta area and Chupa ore deposit, the host formation is overturned, and the lower unit of the Chimu formation, which is arenaceous sandstone of the Farrat formation in the case of Chupa deposit, is distributed in the apparent hanging wall side. Chemically inert sandstone seems to have acted as shattered rock against chemically reactive limestone of the host horizon where the ore minerals are concentrated.

In the Iscay Cruz area, shear faults and fractures are densely developed in ENE-WSW direction which is diagonal to the folding axis. Mineralization of the Chupa ore deposit is strongly controlled by the diagonal fracture system. These fractures are considered to be important as channel way of the ore solution and also as the place of precipitation of the ore minerals. The fractures as well as NNW-SSE faults may effect extension of mineralized zone.

7–2 Igneous Activity and Mineralization

Dacite porphyry intrudes as stock at about 1 km west of the Cumbre de Iscay Cruz. This stock is only weakly altered and skarnization in the surrounding limestone is also faint. Thus the intrusion may not be related to the mineralization. Andesitic porphyry dike is recognized in this area, which is later than the mineralization.

In the Oyon and Chimu formations to the east of Cumbre de Cunsha Punta, present are more than ten dikes of acidic compositions. These dikes themselves and the intruded wall rocks are both intensely altered hydrothermally, and the original minerals are converted to quartz, sericite and pyrophyllite. Pyrite and limonite are disseminated in the altered rocks. Distinct brecciation is seen at margin of these dikes, and breccia dike or vein is formed in some places. These dikes are distributed, though sporadically, in the entire Iscay Cruz area along the anticlinal axis, and in the Cumbre de Limpe area, they intrude into the Santa formation. The strong alteration as well as spatial relationship of the dikes with mineralized zones suggests that the acidic dikes are most closely related igneous activity to the mineralization in the surveyed area. Because of the intense alteration, the original composition of the dikes is hardly identified. Yet they are assumed originally a quartz porphyry, for the remaining phenocrysts of quartz and feldspars.

7–3 Wall Rock Alteration

Host rocks of the known mineralized zones are limestone of the Santa formation which intercalates tuffaceous siltstone and shale. The limestone in this area appears to be clayey, as compared with limestones in the other areas. It is not clear, however, whether this character is due to the original impure nature or due to later alteration such as silicification, dolomitization and sideritization.

To the north of Cumbre de Cunsha Punta, skarn occurs with disseminated chalcopyrite and sphalerite. In the massive sulfide orebody recognized to the north of Cumbre de Limpe, a large amount of pyrite and pyrrhotite replace limestone. Horse stone in the orebody and the surrounding wall rocks are distinctly silicified, sericitized, sideritized and dolomitized. In the vicinity of Cumbre de Iscay Cruz, silicified siderite is seen widely and is disseminated with galena and sphalerite. The surrounding rocks of shale and marlstone are pyrite disseminated. Brecciation of the host rocks is distinct in the high grade part. Prominent alterations related to the mineralization are sideritization and silicification. Chemically, iron, manganese and silica are added. This addition is considered due to hydrothermal alteration.

Fig. 27 is a graph showing variation of major components of unaltered limestone of the Santa formation in the Iscay Cruz area, and dolostone and siderite bed occurring around the orebodies, which may indicate migration of these components during hydrothermal alteration. This figure reveals that the limestone is composed of highly pure $CaCO_3$ but in the dolostone about 50 percent of calcium has been leached out and replaced by magnesium, iron and manganese. In the siderite bed, calcium has been completely leached out and replaced by iron and manganese; silicon has been also added.

7–4 Zonal Distribution of Ore and Gangue Minerals

The mineralization tends to occur along the Santa formation for about 12 km in length, and concentration of the ore minerals is sporadic within this horizon. However, an overall view indicates a regional zonation of the ore minerals. In the place like north of Cumbre de Cunsha Punta which is very close to the center of acidic igneous activities, present are skarn deposits containing chalcopyrite, sphalerite, magnetite, pyrite and pyrrhotite.

To the north and south flanks of this mineralized zone, i.e., around Cumbre de Limpe and to the south of Cumbre de Cunsha Punta, massive sulfide orebody is formed. Galena and sphalerite are disseminated in the massive pyrite and pyrrhotite orebody. In the outermost zone like the vicinity of Cumbre de Iscay Cruz and Antapampa area, only galena and sphalerite are disseminated in manganiferous siderite mass. This lateral variation on type of mineralization and on kind of ore minerals is considered to have resulted in a series of mineralized solution brought up from the acidic igneous center just mentioned above.

Fig. 28 is a ternary diagram of copper, lead and zinc of mineralized outcrop whose assay values on the channel sampling are given in Fig. 8. Since abundance of copper and lead is relatively low to that of zinc, copper and lead are multiplied by the factors of 100 and 10, respectively. The figure indicates that the Cu-Pb-Zn ratio differs depending upon locality of the outcrop; thus showing a regional zonation. The Iscay Cruz area constitutes Pb-Zn-rich, outer zone; the Limpe area is Cu-Pb-Zn intermediate zone; and the Antapampa area and the Chupa ore deposit appear to be a transitional zone of the two zones mentioned above, and finally the Cunsha Punta area including Tinyag is characterized by high copper, inner zone. This zonation of the ore metals may be attributed to evolution of the ore solution and different physicochemical conditions that occurred in the Santa formation during formation for these minerals.

7–5 Discussion on the Geophysical Results

(1) IP prospecting covering all the Iscay Cruz area reveals a clear contrast in the northern and southern areas, which is separated at Lag. Quellaycocha. The northern area is shown by low FE and high AR values which are not promising a large-scale pyrite orebody. This interpretation was proved to be valid by DDH-1 and DDH-2 drillings.

(2) High FE and low AR anomalies are located in the Limpe area and further to the south. The anomalies are particularly distinct in the Limpe area, which is nearly the center of the mineralized zone. The anomalies were interpreted to imply concealed lead-zinc-pyrite orebodies, and the interpretation was tested to be true by DDH-3 and three other drill holes.

(3) The next ranked, high FE and low AR anomaly is seen in the southernmost, Antapampa area. The anomaly is mainly concealed and plunges southward. DDH-11 and DDH-12 confirmed that anomaly was caused by copper-bearing hematite-pyrite orebody occurring in siderite bed.

(4) The third class, high FE anomaly is observed in the Cunsha Punta area, Tinyag skarn outcrop area and the area around Lags. Tinyag. Among them, the Cunsha Punta amonaly is concealed, possibly due to the measurement lines set up at distant from the orebody. FE anomaly around the Tinyag skarn outcrop is rather weak. This may be due to the fact that the skarn contains only a little pyrite but is rich in magnetite and sphalerite, in addition to unproper distance between the measurement lines and the orebody. High FE anomaly around Lags. Tinyag may possibly caused by limonite deposited at margin of lake. Besides, low AR zone and the highest and the widest MF (metal factor) anomaly were obtained in the area from Lags. Tinyag to Cunsha Punta pass.

(5) As stated above, IP prospecting provided very useful information on exploration of base metals in the surveyed area.

7–6 Discussion on the Drilling Results

Twelve drill holes were made from the last year to this year. Nearly all drilling, except DDH-8, detected orebody and mineralized zones. Fig. 29 illustrates copper-lead-zinc ratio of the main orebodies discovered by the drilling. Here, copper and lead are multiplied by 50 and 10, respectively.

According to this figure, the ores from DDH-1, 2 and 3 located in the north are relatively rich in lead which constitute the outer zone, and zinc-rich ores from the Limpe area represent the intermediate zone.

It is reasonable that skarn ores of DDH-7 is plotted in copper-zinc-rich field which demonstrates the inner zone. However, the ores of DDH-12 are also plotted in the same field. These ores imply also a center of the mineralization. Thus minor centers of the mineralization might have existed in the deep south, besides the main center.

7–7 Occurrence of Outcrop and Mineralization

It was confirmed by drilling that high-grade lead-zinc pyrite orebodies concealed widely in the Limpe area. In spite of the intense mineralization, pyrite mineralization in the outcrop is weak and small in scale. The surface manifestation is shown by hematite dissemination in silicified rocks, black gossan oxidized from manganiferous siderite and weak dissemination of galena and sphalerite in dolostone. The hematite and black gossan, which are exposed widely on the surface, cannot be considered as oxidized products of the hidden pyrite orebody. Thus these outcrop materials are different primarily from the orebody, and may be an upper manifestation of low temperature mineralization and alteration of the hidden lead-zinc pyrite.

7–8 Consideration on the Genesis

The skarn deposit is tentatively considered as contact metasomatic deposit of a post-magmatic stage and limestone replacement deposit is product of a hydrothermal stage mineralization. The siderite-hosted deposit may have been formed at much lower temperature stage. Co-existence of the variety of mineralization is characteristic in this surveyed area, and is in accord with the Cordilleran type of ore deposits by Petersen (1965).

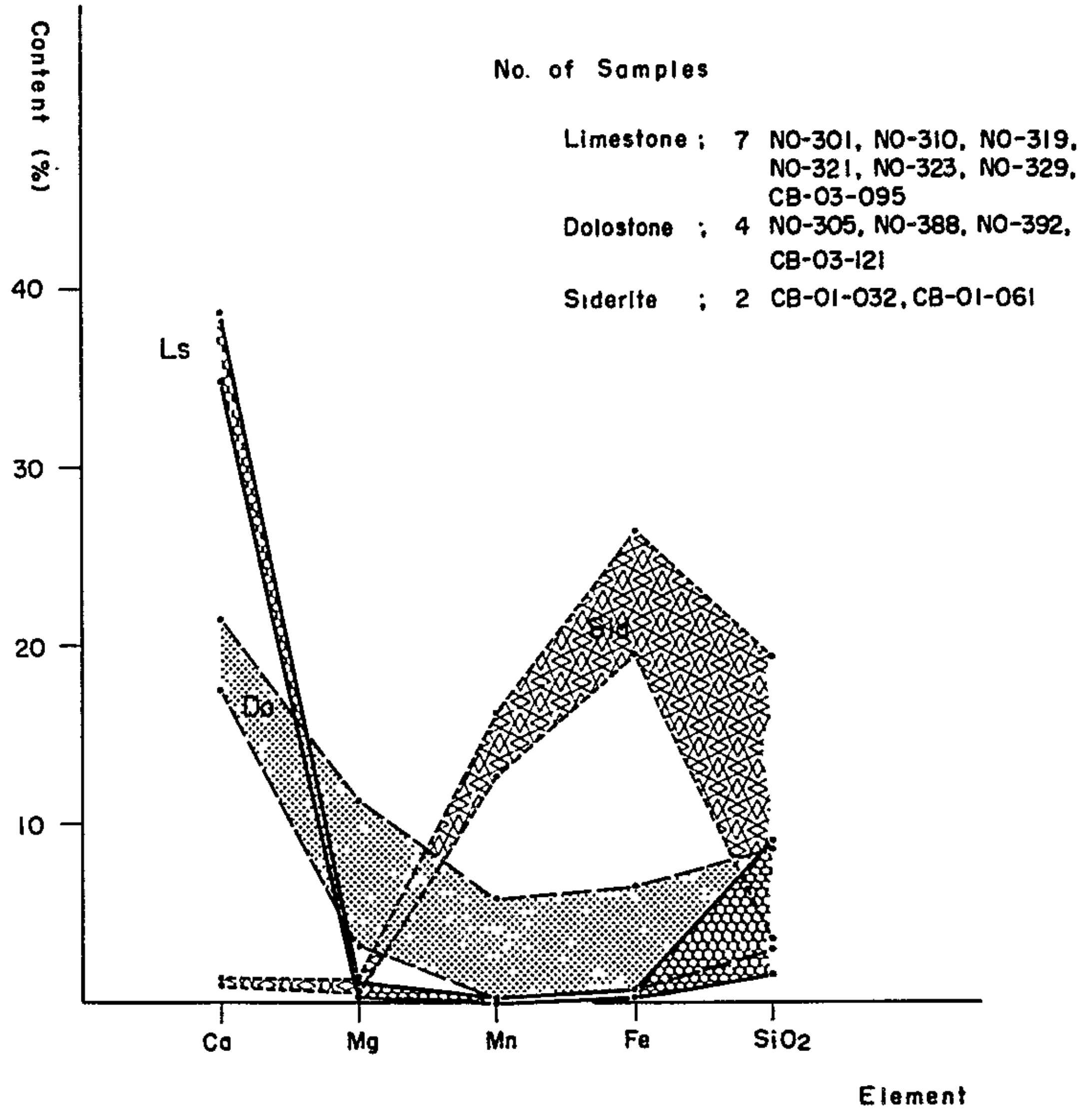


Fig. 27 Variation Diagram for Chemical Components of the Carbonate Rocks of the Santa Formation in the Iscay Cruz Area

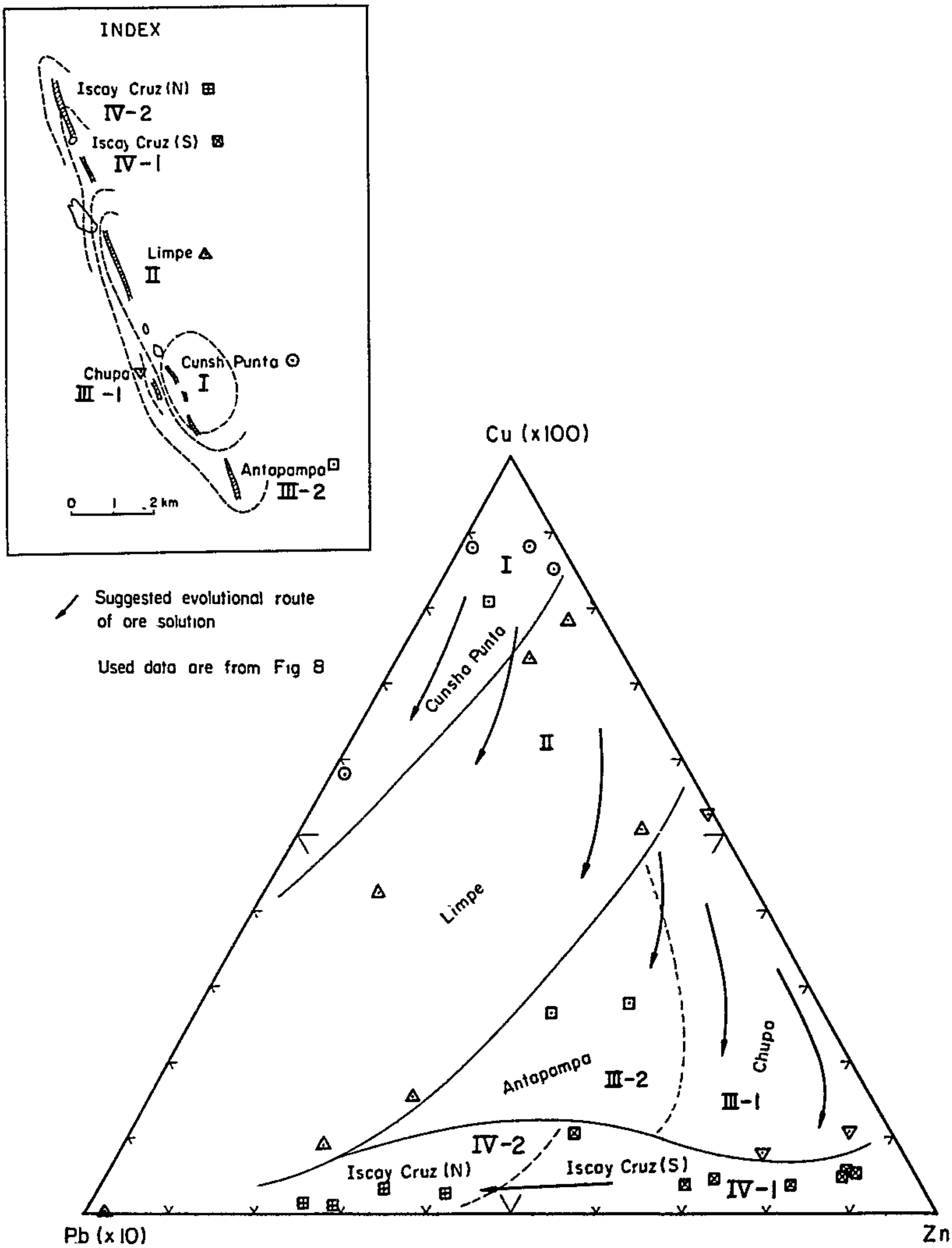


Fig. 28 Triangular Diagram for Cu-Pb-Zn Ratio in the Iscay Cruz Area

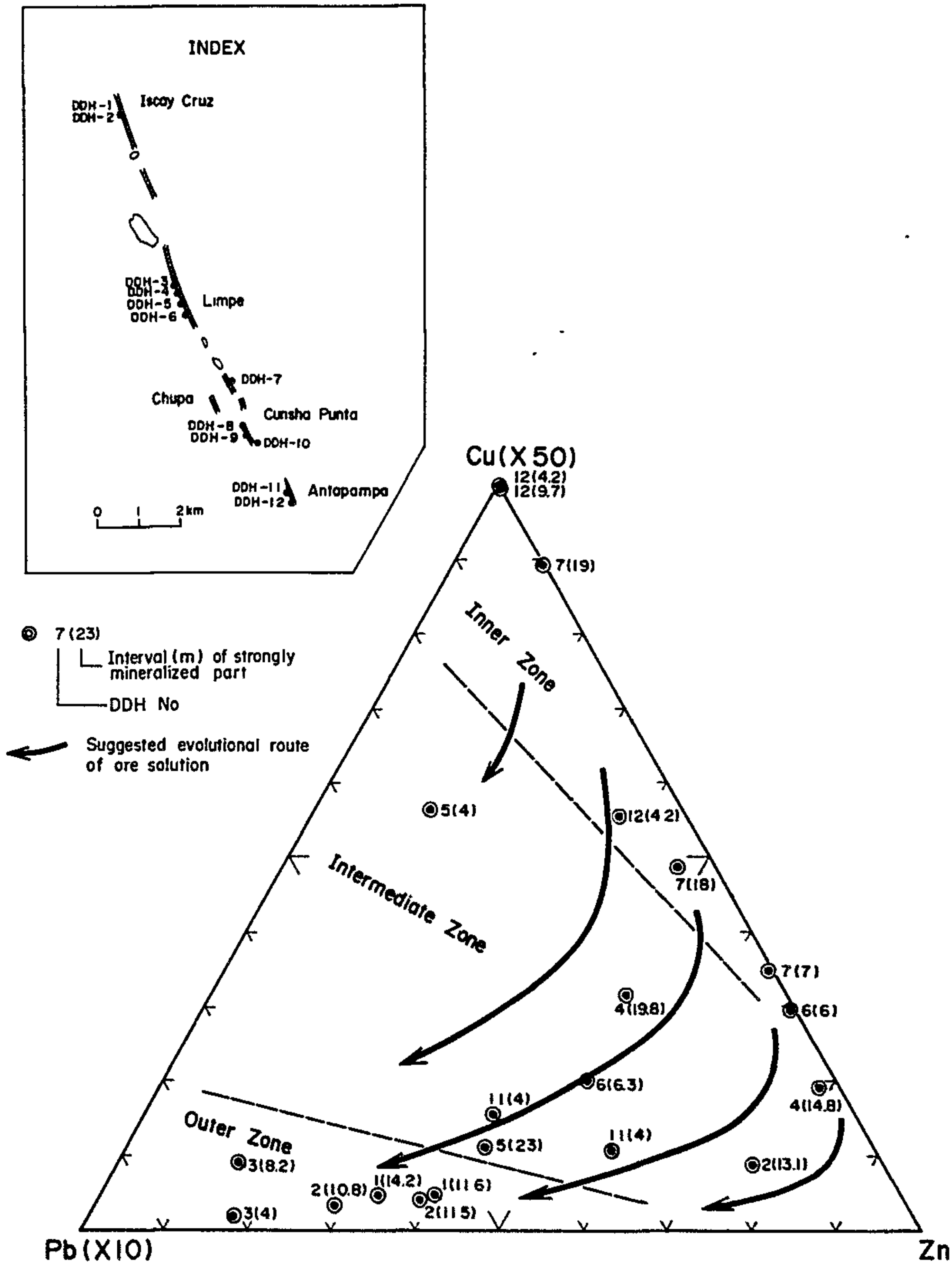


Fig. 29 Triangular Diagram for Cu-Pb-Zn Ratio in the Drilled Core

Chapter 8 Conclusions and Future Outlook

8–1 Conclusions

(1) By the systematic geological studies for the Oyon area, mineralized zones in Iscay Cruz, Cochaquillo and others were discovered, and relationship between the mineralization and geological structure and characteristics and potentiality of the mineralized zones were clarified.

(2) Geophysical prospecting and drilling exploration were applied to the Iscay Cruz area which was selected as the most prosperous area for further exploration. Distinct geophysical anomalies were detected and the following drilling was able to detect concealed, high-grade copper-lead-zinc orebodies.

(3) Cochaquillo deposit was selected as the next potential area to the Iscay Cruz area. This deposit is characterized by large-scale skarns, and high-grade silver-lead ores are limited to certain portions.

8–2 Future Outlook

(1) The initial object was accomplished in the Iscay Cruz area by finding high-grade ores. Besides the high grade, a large quantity of ore is expected in this area. A more detail geological survey and exploration work aiming at commercial level of development for mine are recommended to this area.

(2) About Cochaquillo deposit, increase of the ore grade is expected in the lower part of the fringe zone of the known orebody. Thus exploration of the deeper parts should be considered in future.

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GEOLOGIC DRILL LOG
OYON PROJECT

Coordinate N 813.07, E 309.04; Elevation 4643.3m

DDH No. 1; Direction 80°; Inclination -50°; Total Depth 155m

Assays (columns 1–5)

Len (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)
1.4	.006	2.50	7.05	10
1.4	.005	1.60	5.40	5
1.2	.008	1.20	6.25	7
1.9	.012	2.20	6.15	12
1.0	.014	2.00	4.80	26
1.0	.008	0.24	0.85	10
1.0	.007	0.61	2.80	3
1.0	.007	0.95	3.40	15
1.0	.008	0.72	4.70	7
1.0	.005	0.40	4.20	5
1.0	.008	0.42	2.60	7
1.0	.008	0.60	2.70	10
1.0	.008	0.92	2.00	9
1.0	.007	0.86	4.00	6
1.0	.006	0.28	3.50	5
1.0	.008	0.29	4.20	8
1.0	.005	0.35	3.40	2
1.2	.009	0.48	5.20	27
1.5	.007	0.13	4.10	7
1.5	.005	0.10	3.80	2
2.0	.006	0.20	6.40	16
1.9	.004	0.31	3.40	6
1.9	.005	0.73	4.00	9
1.4	.006	2.50	3.40	9
1.4	.015	0.40	1.80	8
1.9	.005	0.45	3.00	8
1.3	.006	0.56	3.00	4
1.3	.008	0.75	3.80	10
3.4	.010	0.96	4.20	13
1.6	.007	0.34	1.80	18
3.6	.025	0.42	13.90	59

Depth and Occurrence (columns 6, 9–16)

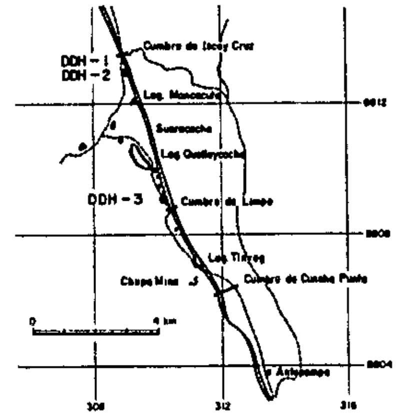
Depth (m)	Str.	Rock	Oxd.	Alt.	Min.	Color	Fract.	Observations
0–7.3		Peb						Talus deposit
7.3–11.2		Ss		do-v		d-gry		Cal-Ss (Cz); 11.1 cal-v
11.2–14.3	∠30°	Cal-Sh		cly	Py	l-gry	shd	Sh with calcareous part
14.3–19.5	∠30°	Cal-Sh		cly sil	Py	l-gry		19.3 calcareous part 20cm w
19.5–21.5		Sh			Py	blk		Sh of phyllitic str
21.5–24.2	∠35°	Ls				gry		Ls with alt thin beds
24.2–26.5		Sh		cly	Py	gry		Sh (Cz) of phyllitic str with Py diss along bedding & Do-vs (26.2)
26.5–29.7	∠30°	Sh		cly	Py	blk		
29.7–32.5		Sid	oxd	sid sil	Oxd Py	blk	shd brc	Oxidized & mineralized Sid (Sr) with diss of Galena & Zn-oxide & with brownish, soft & sandy appearance
32.5–33.7		Do	oxd	cly		d-gry	F	
33.7–34.5		Sh	oxd	cly		d-gry	F	
34.5–37.4	∠40°	Ml		do sil cly	Py	gry		Ml (Sr)
37.4–38.1		Sh		cly		blk	shd	
38.1–39.3		Sid	oxd	sid-v	Pb Zn	gry	brc	Mineralized Sid (Sr) with a lot of fine-grained Galena & sid-vs
39.3–41.2	∠45°	Sid	oxd	sid cly	Pb Py	d-gry	shd	druses
41.2–44.0	∠55°, ∠65°	Sh	oxd	cly do	Py	blk	shd	Sh
44.0–46.0		Sh		cly	Py	blk	shd	
46.0–48.0		Ml		cly	Py	blk	F	Ml
48.0–63.2		Sid		sid sil	Pb Zn Py	l-gry	brc	Mineralized Sid with a lot of wht sid-vs & druses & diss of fine-grained Galena. Zn is supposed to occur as forms of oxides
63.2–64.5		Ml		cly		d-gry	F	Ml
64.5–67.0	∠50°	Sh		sil do		blk		Sh
67.0–71.3		Sid	oxd	sid sil cly	Oxd	gry	shd brc	Mineralized – Sid with a lot of sid vs & druses
72.0–	∠50°	Ml	oxd	do		d-gry		Ml with shaly parts
–75.0		Sid	oxd	sid		brn-d-gry	brc	Oxidized Sid of brownish, soft & sandy appearance
75.0–76.5		Sh						
76.5–78.7		Sid		sid	Pb Zn	d-gry	brc	Mineralized Sid with a lot of sid-vs & druses
78.7–82.5	∠40°	Ml		do sil		l-gry		Ml
82.5–84.4	∠40°	Sh				l-gry		Sh
84.4–88.0		Do-Ls		do		gry		Dolomitic Ls
88.0–91.3	∠45°	Ml		do		d-gry		Ml
91.3–94.3	∠40°	Ml		do-v cly		d-gry		
94.3–95.8	∠30°	Sh				blk		Sh of phyllitic str
95.8–97.7		Sid	oxd	do sil	Oxd	gry	shd brc	Sid
97.7–102.8	∠45°	Sh		cly sil	Py	wht-l-gry		Sh of saccharoidal texture; with gray patchs of diss of Py
102.8–105.2	∠40°	Sh		sil		d-gry		Sh
105.2–		Sid	oxd	sid cly sil		l-gry	shd	Oxidized Sid with brownish-color, soft & sandy appearance
–111.6		Sid		sid cly sil		l-gry		
111.6–113.8		Sid		sid sil	Oxd	l-gry	brc	Mineralized Sid with sid-vs & druses
113.8–117.2		Sid		sid cly	Oxd	l-gry	shd	
117.2–124.5		Do (?)		cly sid sil		l-gry	shd	
124.5–130		Do (?)	oxd	cly sid sil		blk-d-gry	brc shd	Oxidized Do with very soft & sandy appearance; core recovery is very bad
150–	∠40°				Py			diss of fine-grained Py
–155.0		Do (?)	oxd	sil cly				Sludge only
155.0								155.0m end

PL. II-1

GEOLOGICAL SURVEY OF THE OYON AREA, PERU
PHASE II

DRILLING EXPLORATION IN THE ISCAY CRUZ AREA

GEOLOGIC DRILL LOG
DDH – 1



METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

FEBRUARY 1982

prepared by MESCO, Inc

LEGEND and ABBREVIATION

No.	Item	Term	Abbreviation
10	Rock,	Pebble	Peb
		Shale	Sh
		Sandstone	Ss
		Calcareous shale	Cal-Sh
		Calcareous sandstone	Cal-Ss
		Marl	Ml
		Limestone	Ls
		Dolomitic limestone	Do-Ls
		Dolostone	Do
		Quartzite	Qtz
		Ore, high grade	
		Ore low grade	
		Fault & fracture	
		Intrusive, intermediate	
		Siderite	
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
14	Color,	light	l-
		dark	d-
		grey	gry
		black	blk
		white	wht
		brown	brn
15	Fracture,	Fault	F
		sheared	shd
		brecciated	brc
16	Observations,	dissemination	diss
		veins	vs

GEOLOGIC DRILL LOG
OYON PROJECT

Coordinate N 813.07, E 309.04; Elevation 4643.3m

DDH No. 2; Direction 80°; Inclination -75°; Total Depth 252.0m

Leng (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Dep (m)	Str	Rock	Oxd	Alt	Min	Color	Fract	Observations
1	2	3	4	5	6	9	10	11	12	13	14	15	16
					0.85		Peb						
							Sludge						
					3.8		Peb						
						∠70°, ∠70°	Ss			Py	l-gry	brd	Ss (Cz), fng to mdg, alternation of massive texture & laminated
					10, 10.8	∠60°	Sh			Py	blk		Sh, phyllitic
					12.5		Ls			Py	l-gry		Ls, mdg, porous
							Do			Py	d-gry		Do, fng, mas
					13.9	∠80°	Sh			Py	d-gry		Sh, with cal-lamina
							Sh				blk		
					19.0, 20	∠35°	Do			Py	d-gry		Do, fng, massive with calcite vts
					21.7		Ls		cly		blk	brd	Ls, fng, massive with calcite vts
					28.3				cly				
					30		Po		chl		greenish-gry		Porphyrite dyke feldspar phenocryst with calcite vts
					32.5		Do		cly	Py	d-gry	brc	
						∠70°	Sh			Py	blk		Sh, phyllitic
					40								
					44.4	∠70°	Ls			Py	d-gry		Ls, fng to mdg with calcite vts
					47.2, 50	∠80°	Cal-Sh			Py	blk		Calcareous Sh (Cal), with cal-lamina
					52.9		Ls			Py	blk		Ls (Sh) fng, massive, with calcite vts
					56.0		Cal-Sh				d-gry	brd	Cal-Sh with cal-lamina
					57.2		Ls				d-gry		Ls, fng massive with calcite vts
					60, 61.0	∠60°	Ls				gry		
							Ls				l-gry		Ls, mdg, massive with calcite vts
					63.8		Sid				gry		Sid, fng, with cal-lamina
					66.9	∠60°	Ls			Py	d-gry		Ls, fng, massive with sh film with calcite vts
					70		Cal-Sh			Py	gry		Cal-Sh, with cal-lamina
					71.4		Sid				gry		Sid, fng, massive
							Ml			Py	grn-gry		Ml, fng to mdg massive sandy
						∠50°	Ml			Py	grn-gry		Ml, fng, massive
					76.3		Cal-Sh			Py	gry		Cal-Sh, with cal-lamina
					80	∠55°	Sh				blk		Sh, phyllitic
							Cal-Sh			Py	blk		Cal-Sh, with cal-lamina
					90	∠60°	Cal-Sh		cly	Py	gry		
							Sh				blk	brd	Sh, phyllitic
					96.6	∠30	Sid				l-gry		Sid, fng, massive
					98.0		Cal-Sh				blk		Cal-Sh, phyllitic
					99.7								

Leng (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Dep (m)	Str	Rock	Oxd	Alt	Min	Color	Fract	Observations
1	2	3	4	5	6	9	10	11	12	13	14	15	16
					100.6		Sid				d-gry		Sid, fng, massive
							Ml				gry		Ml, massive
							Sh			Py	blk		Sh, phyllitic
					103.3		Sid	oxd	sid		d-gry	brc	Sid, porous
							Ml				gry		Ml, fng, massive
					105.7	∠40°	Cal-Sh			Py	d-gry		Cal-Sh, phyllitic
					107.9								
3.1	0.01	0.11	4.49	1	110		Sid	oxd	cly, sid	Ga	d-gry	brc	Mineralized-Sid with a lot of wht do-vs & druses & diss of fine-grained Galena. Zn is supposed to occur as forms of oxides
3.0	0.01	0.07	4.30	2									
3.0	0.01	0.10	3.88	2									
2.0	0.01	0.11	4.80	2									
2.0	0.01	0.08	4.70	?	120								
					121.0	∠50°	Sh			Py	blk		Sh, phyllitic
							Sid	oxd	sid	Ga	d-gry	brc	Mineralized Sid, porous
							Sh			Py	blk		Sh, phyllitic
					123.7		Sid	oxd	sid	Ga	d-gry		Mineralized Sid, porous
2.9	0.03	0.08	4.20	2			Sid	oxd	sid, cly	Ga	d-gry	brc	Mineralized Sid, with a lot of wht do-vs & druses & diss of fine-grained Galena
1.0	0.02	0.30	4.80	10	130								
							Do-Sh				blk		Do-Sh, with do-lamina
						∠35°	Sid			Py	l-gry		Sid, fng, massive
					134.1		Sh			Py	blk		Sh, fng, massive
							Do-Sh			Py	d-gry		Do-Sh, with do-lamina
							Do-Sh	oxd		Py	blk		
					138.8, 140		Ls			Py	gry		Ls, fng, massive
							Cal-Sh			Py	blk		Cal-Sh, with foraminiferous lamina
					142.2	∠80°	Ls			Py	d-gry		Ls, fng, massive
					144.7								
3.6	0.02	0.22	1.50	2			Ls			Py, Ga	d-gry		Mineralized Ls, porous with diss of fine grained Galena & Sh lamina
							Sh			Py	blk		Sh, phyllitic
					150	∠70°	Sid			Py	d-gry		Sid, fng, massive
					152.3		Sh			Py	blk		Sh, phyllitic
							Sid			Py	gry		Sid, fng, massive
							Sh		cly	Py	gry	shd	Sh, massive
							Sid				gry		Sid, massive
							Sh		cly	Py	blk		Sh, phyllitic
					158.8		Sid			Py	l-gry		Sid, fng, massive
					160, 161.5	∠50°	Ml		cly	Py	bluish l-gry		Ml, massive
					165.2		Sh		cly		d-gry	shd	Sh
					166.7								
2.3	0.01	1.05	7.40	2			Sid		cly	Ga	d-gry	brc, shd	Mineralized Sid, porous with diss of fine-grained Galena
3.0	0.01	1.10	5.36	3	170								
					173.0		Sid		cly		brn-gry	brc	Sid, fng porous
							Sh			Py	d-gry	shd	Sh
							Sid	oxd	cly		brn-gry	shd	Oxidized-Sid
					179.6, 180		Sh	oxd	cly		d-gry	shd	Sh
					190		Sid	oxd, ml	cly		l-brn	shd	Oxidized-Sid, Mdg, porous
					196.1	∠55°	Sh			Py	gry		Sh, phyllitic
					199.8		Sid	oxd	cly	Py, Ga	l-brn	shd	Mineralized Sid

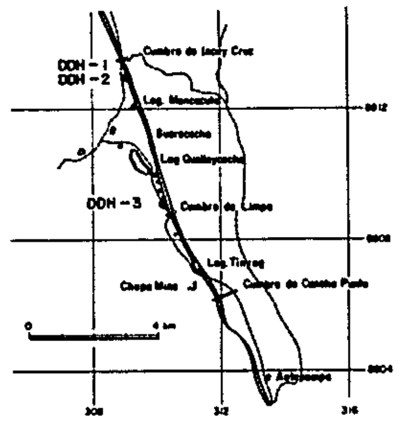
Leng (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Dep (m)	Str	Rock	Oxd	Alt	Min	Color	Fract	Observations
1	2	3	4	5	6	9	10	11	12	13	14	15	16
							Sid	oxd	cly	Py, Ga	l-brn	shd	Mineralized Sid
					204.0		Sh		cly	Py	d-gry	shd	Sh, phyllitic
					207.7								
					210		Do ?	oxd	cly		l-brn	shd	
							Sh				d-gry	shd	Sh
					220		Do ?	oxd	cly		l-brn	brd	
					220.9								
2.0	0.01	1.18	4.38	1			Sid	oxd	cly	Ga	l-brn	shd	Mineralized Sid, with diss of fine-grained Galena & druses filled with dolomite crystals
2.0	0.02	0.70	4.38	2									
2.0	0.01	1.16	4.29	6									
2.0	0.02	1.30	4.80	8									
							Sh				blk		Sh, phyllitic
					228.9								
2.0	0.01	0.96	4.48	8	230		Sid	oxd	cly	Ga	l-brn	shd	Mineralized Sid
					231.7		Sh		cly	Py	gry		Sh, phyllitic
					233.4	∠70°	Sid	oxd	cly		l-brn		Sid, massive
					236.0		Sid	oxd	cly		d-gry	brc	Sid, porous
					238.0		Sh		cly	Py	d-gry	shd	Sh, phyllitic
							Sh			Py	l-gry		Sh, massive
					240, 241.0								
2.5	0.01	0.79	4.26	3			Sid	oxd	cly	Ga	gry	brc	Mineralized Sid, with diss of fine-grained Galena & druses filled with dolomite crystals
3.0	0.01	1.40	6.20	6	245.0								
2.0	0.02	0.62	4.80	2									
2.0	0.01	0.10	4.46	1									
2.0	0.01	0.38	4.29	1	250, 251.7								
													252.0m end
					260								
					270								
					280								
					290								

PL III-2

GEOLOGICAL SURVEY OF THE OYON AREA, PERU PHASE II

DRILLING EXPLORATION IN THE ISCAY CRUZ AREA

GEOLOGIC DRILL LOG DDH – 2



METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

FEBRUARY 1982

prepared by MESCO, Inc

LEGEND and ABBREVIATION

No.	Item	Term	Abbreviation
10	Rock,	Pebble	Peb
		Shale	Sh
		Sandstone	Ss
		Calcareous shale	Cal-Sh
		Calcareous sandstone	Cal-Ss
		Marl	Ml
		Limestone	Ls
		Dolomitic limestone	Do-Ls
		Dolostone	Do
		Quartzite	Qtz
		Ore, high grade	
		Ore, low grade	
		Fault & fracture	
		Intrusive, intermediate	
		Siderite	
11	Oxidation,	oxidized	oxd
		limonitized	lim
12	Alteration,	dolomitization	do
		calcilization	cal
		argillization	cly
		silicification	sil
		sericitization	ser
13	Mineralization,	Pyrite	Py
		Pb-minerals	Pb
		Zn-minerals	Zn
		Oxide-minerals	Oxd
14	Color,	light	l-
		dark	d-
		grey	gry
		black	blk
		white	wht
		brown	brn
15	Fracture,	Fault	F
		sheared	shd
		brecciated	brc
16	Observations,	dissemination	diss
		veins	vs

GEOLOGIC DRILL LOG
OYON PROJECT

Coordinate N 809.12, E 310.31 — Elevation 4694.5m

DDH No. 3 — Direction 60° — Inclination −48° — Total Depth 157m

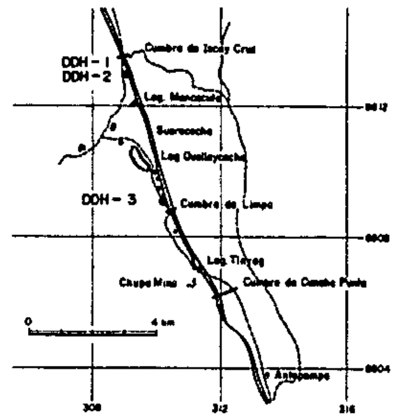
Lng (m) 1	Cu (%) 2	Pb (%) 3	Zn (%) 4	Ag (g/t) 5	Dep (m) 6	Str 9	Rock 10	Oxd 11	Alt 12	Min 13	Color 14	Fract 15	Observations 16
					0.9		Peb						Talus deposit
						∠40°	Sh	lim	cal-qt-v	Py	gry		Sh (Cs) Lim diss along joints; Cal-Qt vs develope; Py diss in the sil parts
					5.6		Sh	lim	cal qt-v	Py	l-gry		
					10				sil	Py			aggregation of Py patch
					13.9	∠40°	Red-Sh				red		Red-Sh
					17.4	∠40°	Sh		sil	Py	l gry		Sh
					20		Sh		sil	Py	gry		
					23.4		Sh			Py	blk	crsh	23.4~23.6 Fault cly; Sh
					26.6		Ls				blk		Ls nodules in blk-Sh with fossils
					27.3	∠30°	Cal-Sh			Py	gry		Cal-Sh
					30								
					33.0	∠40°	Sh		sil	Py	l-gry		33.6~33.7 Fault cly; Banded-Sh fine alt of sh and sandy sh
					40								41.2 Do v, 3cm w 40°
					41.5	∠40°	Sh				blk		Banded-Sh
					45.0		Sh		sil		d-gry		Banded-Sh
					49.0		Sh				blk		
					50								51.2~51.6 Fault cly
					51.6		Sh		cly do-v		gry	crsh	Sh many do-vs
					55.4		Cly		cly		gry	F	Fault or sheared zone
					58.x		Sh		cly	Py	d-gry	shd	Sheared zone with cal & do vs
					60								
					63.0	∠40°	Sh		cly	Py	blk		63.0 Py v, 2cm w
					64.8		Cal-Ss		cal-v		l-gry		Cal-Ss
05	.010	.001	.003	2	66.8	∠35°	Alt				gry		Alt (cal-ss & sh)
					68.4		Sh			Py	blk	phy	Phylline-Sh
					70	∠35°							68.6 Py diss along bed; 70.7 cly 5cm
					73.7	∠40°	Sh		sil	Py	l-gry	brc	Sandy-Sh massive and brecciated partly (76.5~77.5); 75.0 cal-v 1cm w
					78.5	∠45°	Sh				blk	phy	Sh
					80								
					81.x		Cal Ss		sil cly	Py	l-gry	shd	Cal-Ss with Sh thin beds; 83.0 cly 30cm
					89.x	∠45°	Sh		sil cly	Py	blk	shd	Sh (Cs)
					90								Arg-Carb-Sh 91.8~92.21
					92.1		Ls		cal-v do		l-gry		Ls (St) with cal-vs & do-druse
					96.3		Sh		do-v cly		gry		Sh; 93.3 cly 30cm
05	.008	.080	0.42	8	96.0		Do		do	Pb-Zn Py	l-gry		Do with do-vs & druse; Pb-Zn diss in do-druse (98.0~)
					00.7		Ml		do-sil	Py	gry	brc	Ml
08	.010	035	058	12	03.0		Do-Ml		do-sil	Py Pb-Zn	l-gry	brc	do-druse, Pb-Zn diss
08	.009	186	230	27	04.8								
10	.030	825	1800	118	05.4				sil	Pb-Zn	gry		Pb-Zn high grade, diss ore
10	.042	1100	1636	95					druse	Pb-Zn Py	yel		Pb-Zn high grade, Py porous ore
10	.026	550	1785	75									
10	.023	220	440	68	08.2								
10	.029	070	130	30									
10	.024	110	210	26	110				sil	Pb-Py	yel		Pb-Zn low grade,
10	.020	100	180	20					sd	Pb-Zn	brn		Py-Pb massive ore
10	.014	165	360	32									
10	.018	200	330	30	12.5				sil	Pb-Zn Py-Pb	yel brn		Pb-Zn medium grade, Py-Pb massive ore
10	.093	210	270	32									
11	.010	152	340	35	15.4								
11	.012	050	200	30	16.7					Pb-Py Pb-Zn	yel brn		Pb-Zn low grade, Py-Pb mas ore
11	.030	135	1229	38	17.9				sil	Pb-Zn Py-Pb	yel	brc	Pb-Zn medium grade, Pb-Py brc ore
10	.008	065	1269	45	18.9		Sh			Pb-Zn	d gry	shd	Pb-Zn Py diss ore
12	.012	007	175	4	19.2		Sh						
12	.008	055	250	6	120		Do		sil		gry	brc	121.0 do-v 3cm w
					21.3		Ls		cal-v		l-gry	brc	Ls
					23.3								
05	.008	001	001	4	25.0		Do		cal-v	Py	gry	brc	Do (St) with cal-vs
							Ml		cal-do	Py	d-gry		Ml
					130								
					31.3	∠60°							31.3~32.3 cal-spots
					32.0	∠60°	Ml		cal-do-v	Py	gry		Ml
							Ls		cal-v		l-gry		Ls (St) with cal-vs
					140								
					43.3		Do-Ls		sil-do	Py	l-gry		Do-Ls
					46.4		Ml		cal cal-v		d-gry		Ml with cal-vs
					150								
					52.5		Ls		cal-v		gry		Ls with cal-vs
					55.7	∠30°	Sh				blk	shd	Sh
					157.0								157.0m end
					160								
					170								
					180								
					190								
					210								
					220								
					230								
					240								
					250								
					260								
					270								
					280								
					290								

PL III-3

GEOLOGICAL SURVEY OF THE OYON AREA, PERU PHASE II

DRILLING EXPLORATION IN THE ISCAY CRUZ AREA

GEOLOGIC DRILL LOG DDH – 3



METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

FEBRUARY 1982

prepared by MESCO, Inc

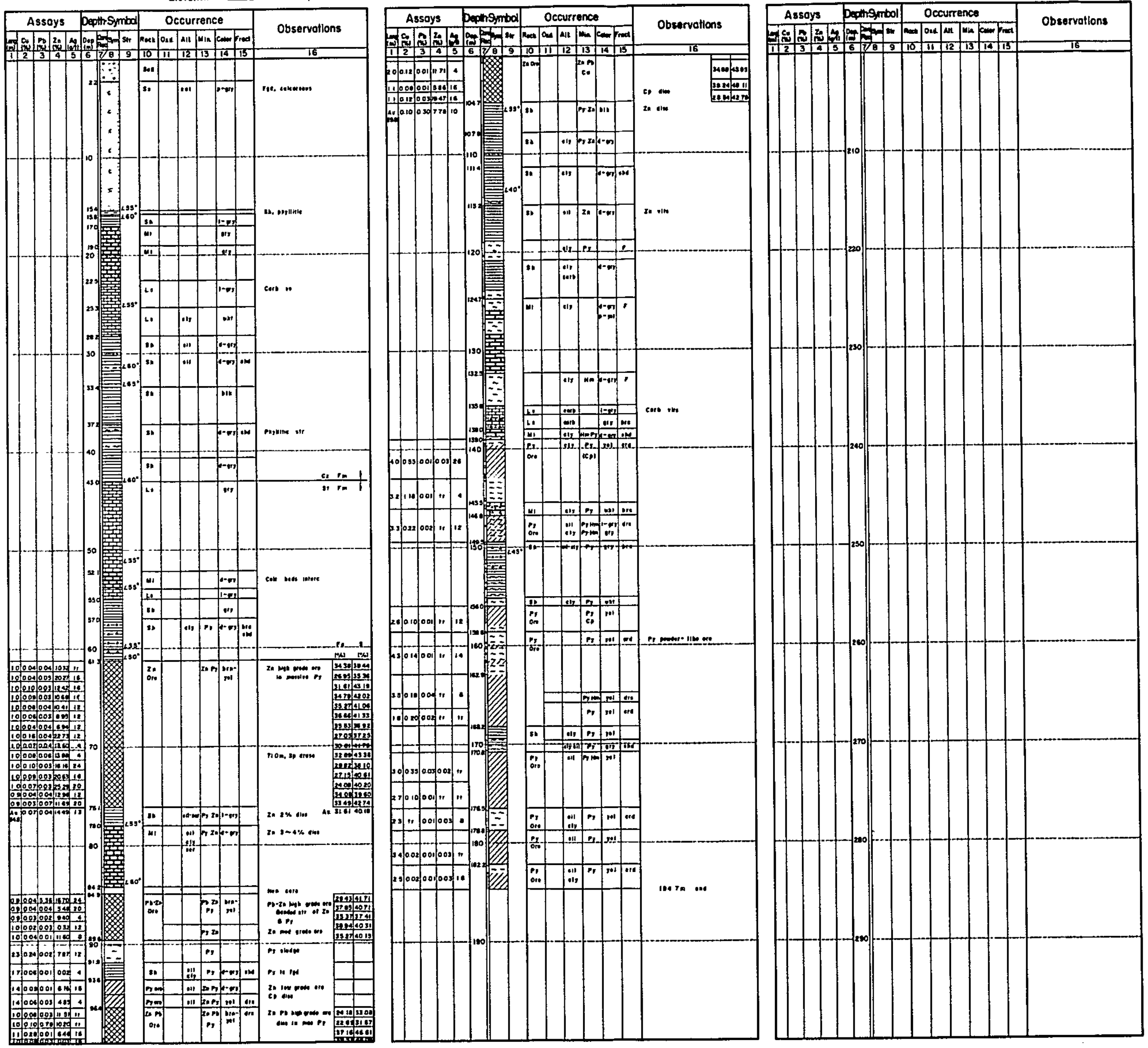
LEGEND and ABBREVIATION

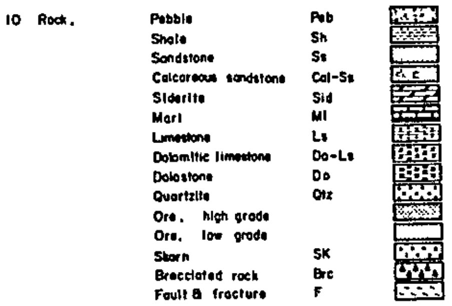
10	Rock,	Pebble	Peb
		Shale	Sh
		Sandstone	Ss
		Calcareous shale	Cal-Sh
		Calcareous sandstone	Cal-Ss
		Marl	Ml
		Limestone	Ls
		Dolomitic limestone	Do-Ls
		Dolostone	Do
		Quartzite	Qtz
		Ore, high grade	
		Ore, low grade	
		Fault & fracture	
		Intrusive, intermediate	
		Siderite	
11	Oxidation,	oxidized	oxd
		limonitized	lim
12	Alteration,	dolomitization	do
		calcilization	cal
		argillization	cly
		silicification	sil
		sericitization	ser
13	Mineralization,	Pyrite	Py
		Pb- minerals	Pb
		Zn- minerals	Zn
		Oxide- minerals	Oxd
14	Color,	light	l-
		dark	d-
		grey	gry
		black	blk
		white	wht
		brown	brn
15	Fracture,	Fault	F
		sheared	shd
		brecciated	brc
16	Observations,	dissemination	diss
		veins	vs

GEOLOGIC DRILL LOG
OYON PROJECT

Coordinate N 808 870, E 310 400; Elevation 4757.5m

DDH No. 4; Direction 70°; Inclination -60°; Total Depth 184.7m



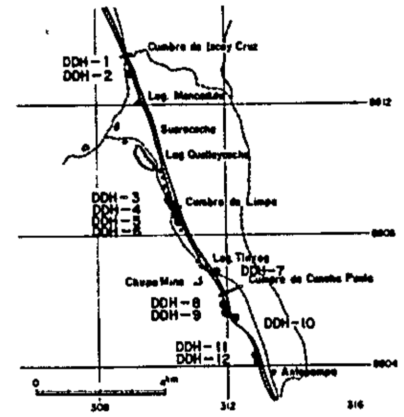


PL. II-4

GEOLOGICAL SURVEY
OF
THE OYON AREA, PERU
PHASE II

DRILLING EXPLORATION
IN THE ISCAY CRUZ AREA

GEOLOGIC DRILL LOG
DDH − 4



METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

FEBRUARY 1982

prepared by MESCO, Inc

LEGEND and ABBREVIATION

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

GEOLOGIC DRILL LOG
OYON PROJECT

Coordinate N 808 610, E 310 460 — Elevation 4742.2m

DDH No. 5 — Direction 70° — Inclination -45° — Total Depth 211.1m

Columns: Assays (1 Leng. (m), 2 Cu (%), 3 Pb (%), 4 Zn (%), 5 Ag (g/t)); Depth Symbol (6 Dep. (m), 7 Core Rec., 8 Sym., 9 Str); Occurrence (10 Rock, 11 Oxd., 12 Alt., 13 Min., 14 Color, 15 Fract); 16 Observations

Assays (86.7 – 99.6 m)

Leng. (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)
0.9	0.09	0.03	tr	tr
1.0	0.08	0.01	0.01	tr
1.0	0.04	0.04	0.03	36
1.0	0.20	0.05	0.18	tr
1.0	0.04	0.03	0.01	20
1.0	0.04	0.01	0.07	4
1.0	0.08	0.03	0.08	tr
1.0	0.06	0.04	0.04	tr
1.0	0.40	0.03	0.05	tr
1.2	5.14	0.04	0.29	60
1.4	0.24	1.30	23.82	40
1.4	0.04	11.19	33.32	tr

Assays (99.6 – 108.0 m)

Leng. (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)
1.0	0.04	0.04	5.86	44
1.1	0.08	0.06	6.06	40
1.1	0.04	0.04	2.73	tr
1.3	0.16	0.03	0.40	tr
1.3	0.18	0.06	0.38	32
1.3	0.40	0.04	1.89	tr
1.3	1.12	0.03	5.61	36

Assays (174.8 – 199.4 m)

Leng. (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)
4.4	1.00	0.41	0.32	tr
1.0	0.04	0.04	0.29	32
1.0	0.12	0.24	42.00	600
1.0	0.16	0.10	43.43	340
1.0	0.08	0.03	34.73	284
1.0	0.06	2.01	35.24	200
1.0	0.12	0.03	31.29	160
1.0	0.08	0.03	27.88	8
1.0	0.12	0.04	22.31	80
1.0	0.08	2.30	1.63	48
1.0	0.08	2.79	15.04	96
1.0	0.20	0.10	38.08	8
1.0	0.14	0.03	32.31	88
1.0	0.28	0.03	18.17	88
1.0	0.48	0.02	33.72	80
1.0	0.36	0.06	31.71	124
1.0	0.20	0.03	25.05	88
1.0	0.16	0.35	29.80	112
1.0	0.18	6.39	35.35	324
1.0	0.18	8.90	38.79	248
1.0	0.04	11.98	18.10	124

Assays (199.4 – 204.0 m)

Leng. (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)
1.0	0.04	3.00	8.38	72
1.0	0.08	10.10	37.57	308
1.0	0.02	6.10	20.96	196
1.0	0.04	4.79	10.00	116

Observations

Talus & soil

Phyllitic

Sludge

Brecciated gouge & stone

Phyllitic

Py patch diss (31.0~32.5m)

Interc. with shaly part

Zn Py diss

Cz Fm / Sr Fm

brc Zone

Brecciation is strong

	Int (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)
Av	(8.9)	0.11	0.03	0.05	7

Py subhedral cryst (2cm x 2cm)

	Int (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)
Av	(4.0)	1.64	4.38	20.09	32
Av	(8.4)	0.31	0.04	3.13	21

Brecciated zone

Cal vs

Altered ? probably changed from Ml

Brecciation is remarkable

Non core

Non core

Zn, Py low grade ore

High grade Zn ore

Banded str

	Int (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)
Av	(23.0)	0.14	2.92	27.19	163

Druse, non core

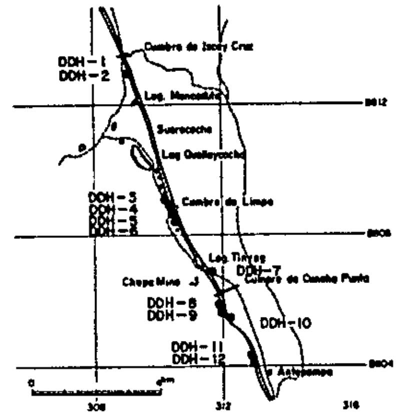
211.1m end

PL II-5

GEOLOGICAL SURVEY OF THE OYON AREA, PERU PHASE II

DRILLING EXPLORATION IN THE ISCAY CRUZ AREA

GEOLOGIC DRILL LOG DDH – 5



METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

FEBRUARY 1982

prepared by MESCO, Inc

LEGEND and ABBREVIATION

10 Rock.
- Pebble — Peb
- Shale — Sh
- Sandstone — Ss
- Calcareous sandstone — Cal-Ss
- Siderite — Sid
- Marl — Ml
- Limestone — Ls
- Dolomitic limestone — Do-Ls
- Dolostone — Do
- Quartzite — Qtz
- Ore, high grade
- Ore, low grade
- Skarn — SK
- Brecciated rock — Brc
- Fault & fracture — F

11 Oxidation.
- oxidized — oxd
- limonitized — lim

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

13 Mineralization.
- Chalcopyrite — Cp
- Hematite — Hm or Spc
- Magnetite — Mt
- Skarn — Sk
- Pyrite — Py
- Pb-minerals — Pb
- Zn-minerals — Zn
- Oxide minerals — Oxd

14 Color.
- light — l-
- dark — d-
- grey — gry
- black — blk
- white — wht
- brown — brn

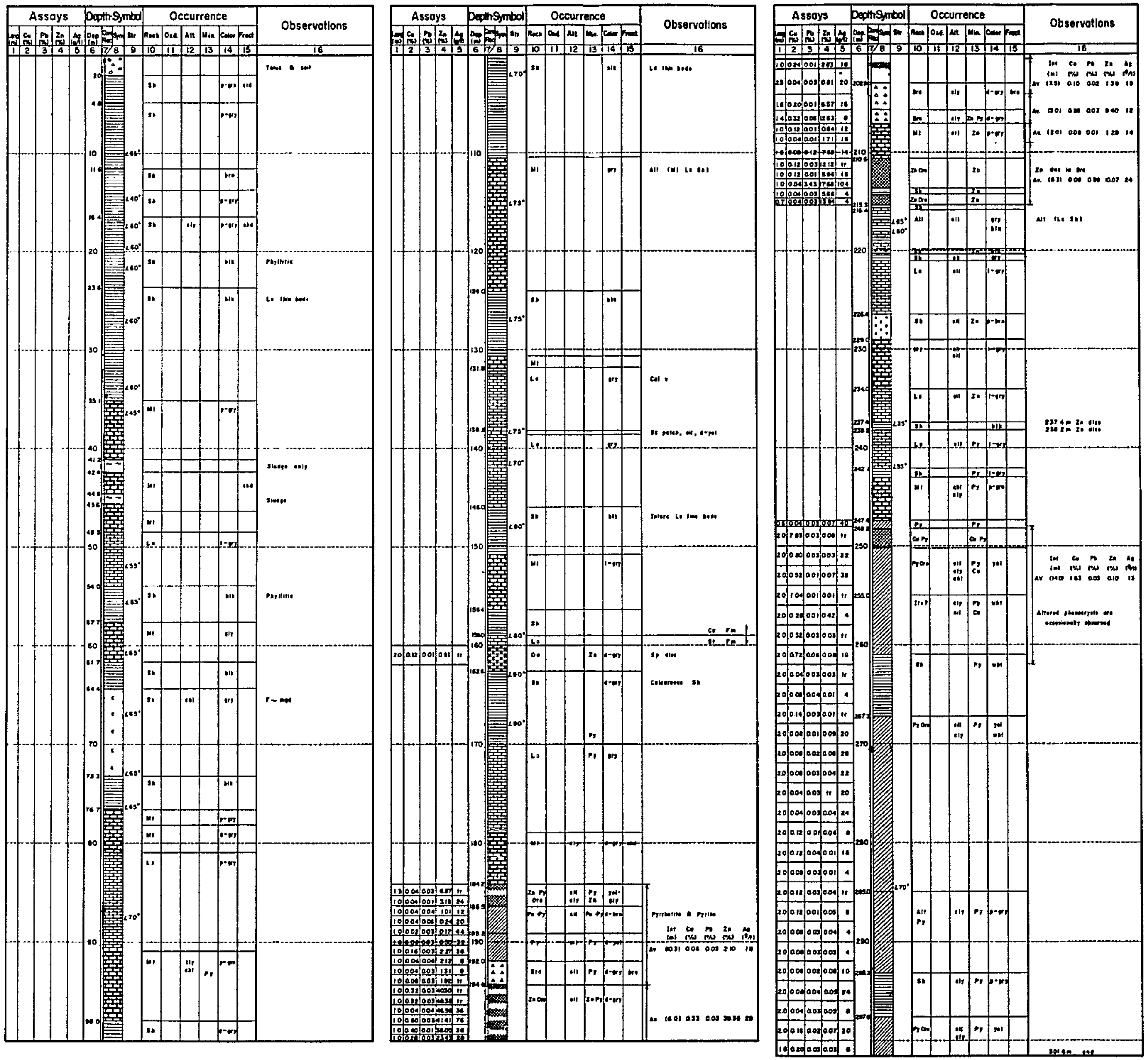
15 Fracture.
- Fault — F
- sheared — shd
- brecciated — brc

16 Observations.
- dissemination — diss
- veins — vs

GEOLOGIC DRILL LOG
OYON PROJECT

Coordinate N 808 410, E 310 540
Elevation 4696.1m

DDH No. 6
Direction 70°
Inclination -55°
Total Depth 301.6m

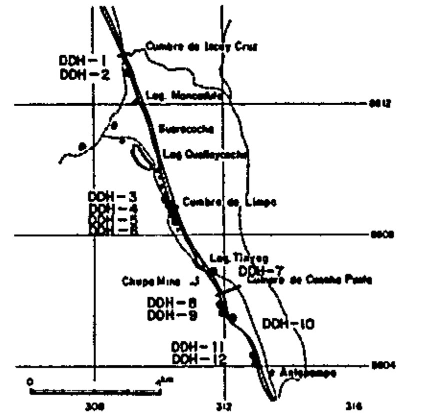


PL. II - 6

GEOLOGICAL SURVEY
OF
THE OYON AREA, PERU
PHASE III

DRILLING EXPLORATION
IN THE ISCAY CRUZ AREA

GEOLOGIC DRILL LOG
DDH – 6



METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

FEBRUARY 1982

prepared by MESCO, Inc

LEGEND and ABBREVIATION

No.	Item	Term	Abbr.	Term	Abbr.
10	Rock,	Pebble	Peb		
		Shale	Sh		
		Sandstone	Ss		
		Calcareous sandstone	Cal-Ss		
		Siderite	Sid		
		Marl	Ml		
		Limestone	Ls		
		Dolomitic limestone	Do-Ls		
		Dolostone	Do		
		Quartzite	Qtz		
		Ore, high grade			
		Ore, low grade			
		Skarn	SK		
		Brecciated rock	Brc		
		Fault & fracture	F		
11	Oxidation ;	oxidized	oxd		
		limonitized	lim		
12	Alteration,	dolomitization	do		
		calcilization	cal		
		argillization	cly		
		silicification	sil		
		sericitization	ser		
13	Mineralization ,	Chalcopyrite	Cp	Pyrite	Py
		Hematite	Hm or Spc	Pb-minerals	Pb
		Magnetite	Mt	Zn-minerals	Zn
		Skarn	Sk	Oxide minerals	Oxd
14	Color ,	light	l-		
		dark	d-		
		grey	gry		
		black	blk		
		white	wht		
		brown	brn		
15	Fracture ,	Fault	F		
		sheared	shd		
		brecciated	brc		
16	Observations ,	dissemination	diss		
		veins	vs		

GEOLOGIC DRILL LOG
OYON PROJECT

Coordinate N 806.870, E 311.450 — Elevation 4645.5m

DDH No. 7 — Direction 250° — Inclination −80 — Total Depth 230.8m

Columns: Assays (1 Leng (m), 2 Cu (%), 3 Pb (%), 4 Zn (%), 5 Ag (g/t)); Depth-Symbol (6 Dep. (m), 7 Core Rec., 8 Sym, 9 Str); Occurrence (10 Rock, 11 Oxd, 12 Alt, 13 Min., 14 Color, 15 Fract); 16 Observations

Assays (sheet 1)

Leng (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)
2.0	0.33	0.1	0.9	10
2.0	0.22	0.1	0.5	7
2.0	0.06	tr	0.1	3
2.0	0.12	tr	0.1	3
2.0	0.24	tr	0.1	3
2.0	0.90	0.1	0.3	7
2.0	0.18	0.1	1.0	7
2.0	1.58	tr	0.5	17
2.0	1.06	0.1	0.5	14
2.0	0.83	tr	0.4	14
2.0	0.18	tr	0.8	7
2.0	0.04	0.1	0.3	3
2.0	0.21	0.1	1.2	3
2.0	0.14	tr	14.8	3
2.0	0.22	tr	28.3	7
1.0	0.22	tr	13.9	3
1.0	0.20	tr	21.0	7
1.0	0.36	0.1	14.9	7
1.0	0.19	0.1	0.7	3
2.0	0.04	0.3	1.0	3
2.0	0.07	0.1	0.4	3
2.0	0.07	0.1	1.2	3
2.0	0.05	0.1	1.3	3
2.0	0.03	0.1	0.8	3
2.0	0.08	0.1	0.3	3
2.0	0.03	tr	0.1	3
2.0	0.14	0.1	0.1	3
1.0	0.14	0.1	0.8	7
1.0	0.05	0.1	12.7	3
1.0	0.04	0.1	0.3	3
1.0	0.07	0.1	5.5	3
1.0	0.13	0.1	8.9	7
1.0	0.05	0.1	1.1	3
1.0	0.05	0.1	1.1	3
1.0	0.18	0.1	14.2	7
1.0	0.09	tr	5.9	3
1.0	0.04	tr	1.0	3
1.0	0.02	0.1	0.3	3
1.0	0.03	0.1	1.0	3
1.0	0.17	tr	4.9	3
1.0	0.07	tr	1.3	3
1.0	0.21	tr	0.3	3
1.0	0.13	tr	1.2	3
1.0	0.40	tr	17.3	7
1.0	0.09	tr	11.6	3
1.0	0.14	tr	7.5	3
1.0	0.07	tr	0.6	3

Depth, Symbol and Occurrence (sheet 1)

Dep. (m)	Str	Rock	Oxd	Alt	Min.	Color	Fract	Observations
0		Soil						
		Qtz	Lim	ser sil	Py	wht brn		
6.5	∠65°	Sh	Lim	cly chl	Py	p-grn	F	Sh & [illegible] ss
8.2		Qtz		ser cly	Py	wht gry		
10.7		Qtz	Lim	cly	Py	wht brn	shd	
12.3		Qtz	Lim	ser cly	Py	brn wht		
28.2	∠45° ∠50°	Ss	Lim	cly ep chl	Py Mt	wht	shd	Cm Fm
30		Sh		cly	Py	d-gry wht	shd	Sr Fm
31.4		Py		cly	Py	d-gry wht		Py powder
		Py		sil	Py	yel		Massive Py
41.2		Sh	Hm	cly		wht		
		SK		chl cly	Mt	p-grn		
		Sh		cly	Py	p-gry		
44.7		SK	Lim	cly	Mt Py Cu	d-brn		
50		SK		cly	Py Mt	p-gry		
52.6		Sh		cly	Mt	p-gry		
57.0		Cly			Py Zn	wht		Int (m) 7.0, Cu (%) 0.21, Pb (%) 0.01, Zn (%) 19.71, Ag (g/t) 5 (Av)
60		Zn SK		cal	Zn Mt Py	p-gry		Zn Mt ore
63.0		SK		ep chl	Mt Py	d-grn		
80	∠65° ∠60°							
81.0		Zn SK			Zn Mt			
		SK Ore		chl ep cal	Mt Py Zn	p-grn		Ss Act-Ep Chl SK Zn Ore; Int (m) 18.0, Cu (%) 0.11, Pb (%) 0.05, Zn (%) 5.34, Ag (g/t) 4 (Av)
89.0		Chl Ore		chl ep cal	Zn	d-grn p-grn		Ep-Chl-SK Zn Ore
98.4		Mt-SK		chl	Mt	p-grn		

Assays (sheet 2)

Leng (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)
2.0	0.05	tr	1.2	3
2.0	0.08	tr	1.2	3
2.0	0.18	tr	0.8	3
2.0	0.17	tr	8.1	3
2.0	0.07	tr	4.6	3
2.0	0.07	tr	1.3	3
2.0	0.16	tr	0.9	3
2.0	0.08	tr	0.9	3
2.0	0.17	tr	10.7	3
2.0	0.39	tr	14.5	7
1.0	0.10	tr	8.1	3
1.0	0.32	tr	8.6	7
1.0	0.74	tr	34.9	14
1.0	0.56	tr	41.3	17
1.0	0.17	tr	15.6	3
1.0	0.31	tr	19.8	7
1.0	0.84	tr	26.3	10
1.0	0.43	tr	15.8	7
1.0	0.57	tr	12.7	7
1.0	0.40	tr	16.2	7
1.0	1.21	tr	4.9	3
2.0	14.9	tr	36.0	21
2.0	12.0	tr	21.8	10
2.0	1.04	tr	0.7	3
2.0	0.77	tr	1.1	7
2.0	0.50	tr	0.5	14
2.0	0.84	tr	0.4	7
[illegible]	0.29	tr	0.1	7
2.5	0.08	tr	0.1	3
2.0	0.05	tr	0.1	3
1.6	0.18	tr	tr	3
2.5	0.08	tr	0.1	3

Depth, Symbol and Occurrence (sheet 2)

Dep. (m)	Str	Rock	Oxd	Alt	Min.	Color	Fract	Observations
		Mt SK		chl	Mt	p-gry		Act Ep Mt SK; Mt band
105.8		Sh		chl		p-grn		
106.4		Zn Mt SK		chl cly cal	Mt Zn	d-gry		Act SK; Int (m) 4.0, Cu (%) 0.12, Pb (%) tr, Zn (%) 8.38, Ag (g/t) 3 (Av)
109.0	∠50°	SK		ep chl cly	Mt	p-gry		
115.0		Sh		cly			shd	
116.0	∠50°	Zn-SK		chl	Py Mt Zn Cu	p-grn		118.4 Cu patch; Hd ~ Diop SK
120								Zn diss ore
121.0		Zn SK		chl	Zn Py	d-grn		
		Zn Ore			Zn Py	d-brn		Zn high grade ore
				chl ep	Mt	d-grn		Av (19.0) 3.18 tr 19.33 9
		Zn Ore			Zn Mt	d-brn		
128.6	∠60°	SK Ore		cly	Mt Py Zn	p-gry wht		
131.8		Zn Spc Ore			Spc Py Zn Cu	blk	shd	Bornite and chalcocite?
135.8		Py				yel		Py sludge
138.0		Py Mt SK		sil	Py Mt	d-yel		Av (18.0m) 0.79 tr 0.63 8
140		SK		cly	Py	d-gry		
143.0								St Fm
144.0		Ss		sil	Py	p-gry		Cr Fm
							F	
		Py			Py	yel	shd	Py sludge
147.6		Ss		sil ser cly	Py	wht		
154.0		Ml		chl ep	Py	d-gry		
156.0	∠70°	Sh		cly sil	Py	p-gry		
160.8		Ml		chl ep	Py Mt	d-gry		
162.8			Lim			d-brn		Gouge
164.6		Sh		sil cly	Py	p-gry	crd	
168.0		Sh Cly		cly		brn-gry	F	
171.1		Sh		cly	Py	wht		
177.5		SK		chl ep	Py Mt	d-grn		
182.3		SK		cly chl	Py	d-grn	shd	
185.0		Py		sil ser	Py	yel		
187.0		Sh		cly sil ser	Py	wht		
194.3	∠55°	SK Ore		chl	[illegible]	gr-gry		Sp & Cp diss in green sh
195.2		Sh			Py	wht		
195.8		Py		cly	Py	yel-gry		
198.3	∠50°	Sh		cly	Py	p-gry		

Assays (sheet 3)

Leng (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)
3.6	0.05	tr	0.1	3

Depth, Symbol and Occurrence (sheet 3)

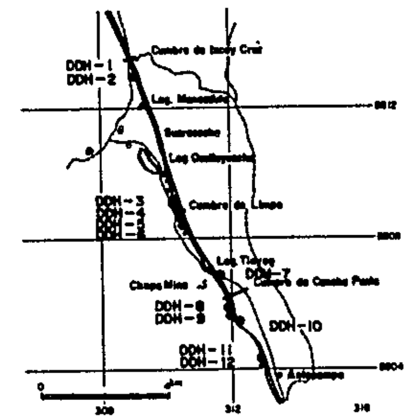
Dep. (m)	Str	Rock	Oxd	Alt	Min.	Color	Fract	Observations
		Sh		cly sil chl	Py	wht		
204.6		Py		sil wht ser	Py	yel		
208.2	∠55°	Sh		sil ser cly ch	Py	l-gry		
218.3								Py v.
220		Sh		sil chl ch	Py	l-gry		
	∠60°							
230								230.8m end

PL. II-7

GEOLOGICAL SURVEY
OF
THE OYON AREA, PERU
PHASE II

DRILLING EXPLORATION
IN THE ISCAY CRUZ AREA

GEOLOGIC DRILL LOG
DDH − 7



METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

FEBRUARY 1982

prepared by MESCO, Inc

LEGEND and ABBREVIATION

Item	Term	Abbreviation	Term	Abbreviation
10 Rock.	Pebble	Peb		
	Shale	Sh		
	Sandstone	Ss		
	Calcareous sandstone	Cal-Ss		
	Siderite	Sid		
	Marl	Ml		
	Limestone	Ls		
	Dolomitic limestone	Do-Ls		
	Dolostone	Do		
	Quartzite	Qtz		
	Ore, high grade			
	Ore, low grade			
	Skarn	SK		
	Brecciated rock	Brc		
	Fault & fracture	F		
11. Oxidation;	oxidized	oxd		
	limonitized	lim		
12. Alteration;	dolomitization	do		
	calcitization	cal		
	argillization	cly		
	silicification	sil		
	sericitization	ser		
13. Mineralization.	Chalcopyrite	Cp	Pyrite	Py
	Hematite	Hm or Spc	Pb-minerals	Pb
	Magnetite	Mt	Zn-minerals	Zn
	Skarn	Sk	Oxide minerals	Oxd
14 Color;	light	l-		
	dark	d-		
	grey	gry		
	black	blk		
	white	wht		
	brown	brn		
15. Fracture;	Fault	F		
	sheared	shd		
	brecciated	brc		
16. Observations;	dissemination	diss		
	veins	vs		

GEOLOGIC DRILL LOG
OYON PROJECT

Coordinate N 805.860, E 311.780
Elevation 4810.2m

DDH No. 8
Direction 70°
Inclination -60°
Total Depth 200.3m

Columns: Assays — 1 Leng (m), 2 Cu (%), 3 Pb (%), 4 Zn (%), 5 Ag (g/t); Depth/Symbol — 6 Dep (m), 7 Core Rec, 8 Sym, 9 Str; Occurrence — 10 Rock, 11 Oxd, 12 Alt, 13 Min, 14 Color, 15 Fract; 16 Observations

Dep (m)	Leng (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Str	Rock	Oxd	Alt	Min	Color	Fract	Observations
0 – 1.5													Talus dep., mainly Qtz
1.5 – 18.0						∠80°	Ml	Lim	cly		l-gry		
18.0 – 21.4							Sh	Lim	cly chl	Py	brn d-gry		Tuffaceous appearance
21.4 – 25.0						∠70°	Ml		cly		l-gry wht		Banding str
25.0 – 27.8													
27.8						∠30°	cly					F	
27.8 – 34.9							Ml		cly		p-gry	F	
34.9							cly					F	
34.9 – 36.3							Sh		cly		p-gry	shd	
36.3 – 39.3							Ml		cly hm		p-gry	shd	
39.3 – 47.2						∠65°	Sh		cly hm		p-gry brn blk	shd	
47.2 – 55.0	1.0	0.06	0.1	0.1	3		Sh		hm		brn		Red sh
55.0 – 63.4						∠60°	Ml		cly sil		l-gry wht		
60 – 63.4							Sh		hm		brn		
63.4 – 71.8							Sh		cly		p-gry	shd	
71.8 – 75.6							Ml		chl cly sil		gry		Partly skarnized
75.6 – 77.2							Ss				gry		Banding str
77.2 – 80							Sh		cly		d-gry	shd brc	
80 – 89.0						∠75°	Sh		sil cly		p-gry		
89.0 – 99.5						∠75°	Sh		sil cal		p-gry		Dotted pattern is observed
99.5 – 110	1.0	0.06	0.1	0.1	7		Ss				p-gry		Cal vs
110 – 120						∠70°	Sh		sil cal	Py	wht l-gry		Py Qt vlts
120 – 126.2							Sh				blk		
126.2 – 134.0						∠75°	Ss		cal		gry		Very fgd ss
134.0 – 141.4							Sh		cal		p-gry		
141.4 – 142.8							Sh		cly		p-gry		
142.8 – 143.6							cly		cly			F	
143.6 – 146.4							Ss		cal		d-gry		
146.4 – 174.6	1.0	0.03	0.1	tr	3	∠70° ∠80°	Sh		sil cly		p-gry		153m Qt v 0.5cm ∠80°
174.6 – 180							Sh		sil cly		p-gry	crd	
180 – 200.3						∠85°	Sh		cal		d-gry		200.3m end

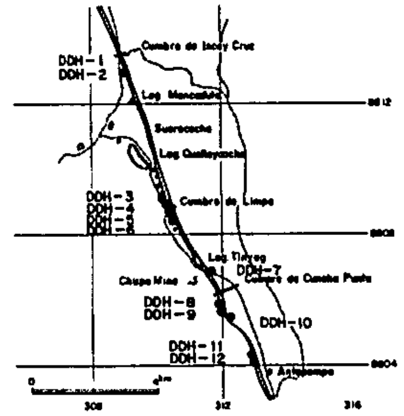
Dep (m)	Leng (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Str	Rock	Oxd	Alt	Min	Color	Fract	Observations
210													
220													
230													
240													
250													
260													
270													
280													
290													

PL Ⅲ - 8

GEOLOGICAL SURVEY
OF
THE OYON AREA, PERU
PHASE Ⅲ

DRILLING EXPLORATION
IN THE ISCAY CRUZ AREA

GEOLOGIC DRILL LOG
DDH – 8



METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

FEBRUARY 1982

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LEGEND and ABBREVIATION

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

GEOLOGIC DRILL LOG
OYON PROJECT

Coordinate N 805.540 E 311.930 Elevation 4773.9m

DDH No. 9 Direction 70° Inclination -70° Total Depth 200.8m

Leng (m) 1	Cu (%) 2	Pb (%) 3	Zn (%) 4	Ag (g/t) 5	Dep. (m) 6	Str 9	Rock 10	Oxd. 11	Alt 12	Min. 13	Color 14	Fract 15	Observations 16
					1.2		Talus	Lim			brn		
							Ss	Lim	sil		l-gry		
					4.2	∠45° -70°	Sh				bk	brc	Phyllitic Sh
1.6	0.05	0.1	3.8	10	10		Sh		cly	Zn	d-gry	brc	
1.9	0.05	0.1	1.1	10	11.1								Sludge only
					13.0		Sh				d-gry	brc	Massive & sandy sh
					19.8 / 20		Sh				d-gry	crd	
					21.2	∠50°	Sh				d-gry	brc	Ss patch is contained occasionally
					22.5		Sh		cly		b-gry		
1.0	0.03	tr	tr	3	25.5		Sh		cly		b-gry	shd	
					30	∠50°							
					33.6		Sh		sil		gry		34.3m, cal v, 1cm w, ∠25° Py diss Massive & sandy sh
					34.0		Sh		cly		b-gry	shd	
					40		Sh	Lim	cly		brn		
1.0	0.02	0.1	0.1	7	50	∠35°							
					54.9	∠30°	Sh		cly	Py Zn	b-gry	brc	
					56.3		Cly					F	
					58.0		Ml		cal		gry	brc	Cal vs
					59.7 / 60		Sh				d-gry	shd	
					63.2		Ss		cal		l-gry		Cal vs
					66.0	∠70°	Ss				l-gry		Sh free beds are contained
					70	∠75°							Py diss
1.0	0.14	0.1	tr	7	75.5		Ss				wht		
1.4	0.09	0.2	1.0	10	78.6		Ss		sil	Zn	wht		Zn diss along joints
					80		Sh				blk	shd	
1.6	0.05	0.3	0.4	7	83.0		Ml		chl	Zn Pb	b-gry		Sp sil network
1.6	0.06	0.1	0.2	7									84.5m, Sp Gl v ∠45° 0.5cm
					86.2		Sh				blk	shd	
					88.6		Ss		cal		l-gry		Fgd Ss with Cal-vs
					90 / 90.6		Sh				d-gry		
					92.6	∠70°	Ss		cly		wht		Fgd
					96.0		Ss		sal cly		wht		
					99.0		Sh		cal		gry		

Leng (m) 1	Cu (%) 2	Pb (%) 3	Zn (%) 4	Ag (g/t) 5	Dep. (m) 6	Str 9	Rock 10	Oxd. 11	Alt 12	Min. 13	Color 14	Fract 15	Observations 16
1.0	0.04	tr	0.1	7									
					101.5		Ls				l-gry		
					104.0	∠85°	Ss				l-gry		With shaly beds
					110								
					117.0		Sh				blk		
					120 / 121.0		Sh		sil	Py	l-gry		Py diss, cal vlts
1.0	0.09	0.3	0.3	10		∠70°							
	0.10	0.3	1.3	14	127.8		Ml		chl	Zn Py	d-gry		Zn Py Qt vs network
					128.4 / 130		Ml		sil cly		gry		
							Ss		cly		l-gry	crd	
					134.6							F	
0.9	0.06	0.4	1.0	21	135.2		Ml		chl	Zn	b-gry		
					136.3		Sh		cal		gry	shd	
0.6	0.10	0.3	1.3	21	138.2		Ml		chl	Zn	gry		Zn vs network
					138.8 / 140		Sh				gry	shd	
					142.0		Sh		cal		gry		Intercalated with Ml partly
1.0	0.04	0.2	0.3	17	150 / 150.5	∠75°	Ml		sil	Zn	gry		
					153.3		Sh		cly		gry		
					160	∠70°	Ml				l-gry		
							Sh		cly		l-gry		
1.2	0.05	0.2	1.1	14	166.2		Sh		cly	Zn Py	grn-gry	shd	Zn Py diss
1.3	0.05	0.2	0.3	10									
					168.7							F	
					170		Sh		cly	Py	d-gry	shd	
												F	
					171.7		Sh		cly	Py	d-gry	shd	
1.0	0.04	tr	0.1	7									
					176.9							F	
					180	∠40°	Cly		cly		grn-gry	F	
							Sh		sil chl cly	Py	grn-gry	shd	
					190								190m, Py vs
					192.0		Sh		sil		l-gry		
													200.8m end

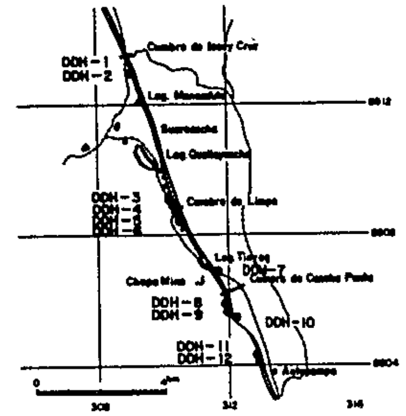
Leng (m) 1	Cu (%) 2	Pb (%) 3	Zn (%) 4	Ag (g/t) 5	Dep. (m) 6	Str 9	Rock 10	Oxd. 11	Alt 12	Min. 13	Color 14	Fract 15	Observations 16
					210								
					220								
					230								
					240								
					250								
					260								
					270								
					280								
					290								

PL. II - 9

GEOLOGICAL SURVEY OF THE OYON AREA, PERU PHASE II

DRILLING EXPLORATION IN THE ISCAY CRUZ AREA

GEOLOGIC DRILL LOG DDH — 9



METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

FEBRUARY 1982

prepared by MESCO, Inc

LEGEND and ABBREVIATION

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

GEOLOGIC DRILL LOG
OYON PROJECT

Coordinate N 805 310, E 312 200
Elevation 4700.9m

DDH No. 10
Direction 285°
Inclination -60°
Total Depth 200.4m

Log (Depth Symbol / Occurrence / Observations)

Dep. (m)	Str (9)	Rock (10)	Oxd (11)	Alt (12)	Min (13)	Color (14)	Fract (15)	Observations (16)
0–1.0		Soil						
1.0		Qtz		sil				
1.0–9.2		Qtz	Lim			wht		
9.2–12.5	∠55°	Ss				gry		Siliceous ss, f~mgd
12.5–15.4		Sh		sil		gry		
15.4–17.3							F	Sludge only
17.3–22.6		Sh		cly	Py	gry		
22.6–35.6	∠15°	Ss				gry		Cm Fm
35.6–	∠25°	Cly		cly	Py		F	Brc
–36.8	∠30°	Sh		cly	Py	p-gry	F	
36.8–		Cly		cly	Py		F	
		Sh		cly		d-gry	F	
–43.0	∠55°	Sh				blk	shd	Cz Fm
43.0–		Sh		sil	Py	gry		
–52.0	∠40°	Arr				gry		Fine-alt of sh & ss showing banded str
52.0–58.2	∠40°	Sh			Py	blk gry		
58.2–60		Ss		sil	Py Zn	l-gry		Py Zn diss
60–61.4	∠30°	Cly		cly	Py		F	
61.4–62.8	∠30°	Ss		sil	Py Zn		shd	
62.8		Cly		cly	Py		F	
–68.0		Sh		cly chl	Zn Py	p-grn gry		63.5m Zn Qt vs; Zn Py network ore; 65.0
68.0–69.0		Sh		sh	Zn Py	grn		Contained abundant Zn
69.0–72.6		Sh		sil chl	Py Zn	l-grn ~gry		Cu (%) Pb (%) Zn (%) Ag (g/t): 70.0m: 0.08 0.05 5.98 15 (1.4m)
72.6–74.0		Sh		sil		d-gry		
74.0–74.8		Ml		cal		p-gry		
74.8–76.2	∠45°	Sh	Lim		Py	brn	shd	
76.2–81.3	∠40°	Sh		sil	Zn Py	gry		76.6m, Zn Qt v 1cm; Interc of ss
81.3–90	∠45°	Sh		sil		l-gry		
90–95.3		Sh		cly		d-gry	shd	
95.3–98.8		Sh		cly cal		gry		97m, Cal vlts
98.8–102.0		Ml		sil	Zn-Py	l-gry		
102.0–110		Sh		cly chl		p-grn ~gry		
110–116.4		Sh		cly sil	Zn Py	p-gry	shd	109.5m, Zn Py Qt vs 0.8cm w
116.4–122.0	∠70°, ∠60°	Sh				l-gry		
122.0–127.4		Sh		cal		d-gry		Interc with Ml
127.4–128.4	∠30°	Cly		cly			F	
128.4–140		Sh				d-gry		
140–141.3							F	
141.3–143.6		Sh				gry	shd	
143.6–	∠40°	Sh			Zn	d-gry		151.5m Sp Qt v, 1cm w
–154.0		Ss				p-gry		
154.0–166.6		Sh		cly chl		p-gry		
166.6–178.2		Sh				d-gry		
178.2–180	∠35°	Ss		chl		p-grn -gry		
180–196.3	∠50°	Sh				d-gry		Special bedding pattern is observed
193.3–194.1							F	
196.3–200.4	∠60°	Sh		cly	Py Hm	d-gry	F	200.4m end

Depth marks: 10, 12.5, 15.4, 17.3, 20, 22.6, 30, 35.6, 36.8, 40, 43.0, 50, 52.0, 58.2, 60, 61.4, 62.8, 68.0, 69.0, 70, 72.6, 74.0, 74.8, 76.2, 80, 81.3, 90, 95.3, 98.8, 102.0, 110, 116.4, 120, 122.0, 127.4, 128.4, 130, 140, 141.3, 143.6, 150, 154.0, 160, 166.6, 170, 178.2, 180, 190, 193.3, 194.1, 196.3, 197.3, 198.0; 210, 220, 230, 240, 250, 260, 270, 280, 290 (blank panel).

Assays

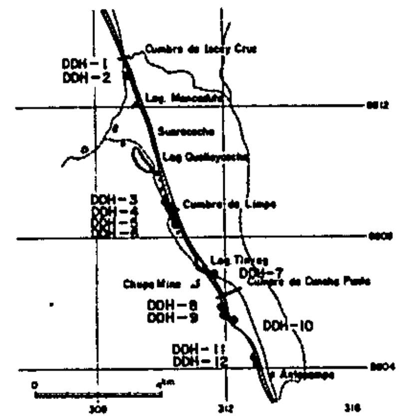
Leng (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)
1.0	0.08	tr	0.3	10
2.2	0.04	tr	4.4	10
1.4	0.04	0.1	1.0	10
1.4	0.05	0.1	3.2	14
1.1	0.03	tr	0.9	7
1.1	0.07	0.1	5.7	14
1.0	0.10	tr	5.5	10
1.0	0.11	0.1	5.8	17
1.0	0.03	tr	4.5	10
1.0	0.02	0.1	0.4	10
1.0	0.04	0.1	0.1	10
1.0	0.20	2.2	4.5	21
1.0	0.02	tr	0.1	7
1.0	0.02	tr	0.9	7
1.0	0.02	0.2	0.8	10
1.0	0.04	0.8	1.3	17
1.0	0.02	0.3	0.4	10
1.0	0.02	0.1	0.1	10
1.0	0.02	tr	0.7	10
1.0	0.01	0.1	0.2	10
1.0	0.01	0.1	0.6	7
1.0	0.02	0.2	0.9	10
1.0	0.01	0.1	0.3	10
1.0	0.02	0.1	0.7	17

PL. II-10

GEOLOGICAL SURVEY
OF
THE OYON AREA, PERU
PHASE II

DRILLING EXPLORATION
IN THE ISCAY CRUZ AREA

GEOLOGIC DRILL LOG
DDH – 10



METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

FEBRUARY 1982

prepared by MESCO, Inc

LEGEND and ABBREVIATION

No.	Item	Term	Abbreviation	Term	Abbreviation
10	Rock,	Pebble	Peb		
		Shale	Sh		
		Sandstone	Ss		
		Calcareous sandstone	Cal-Ss		
		Siderite	Sid		
		Marl	Ml		
		Limestone	Ls		
		Dolomitic limestone	Do-Ls		
		Dolostone	Do		
		Quartzite	Qtz		
		Ore, high grade			
		Ore, low grade			
		Skarn	SK		
		Brecciated rock	Brc		
		Fault & fracture	F		
11.	Oxidation,	oxidized	oxd		
		limonitized	lim		
12	Alteration,	dolomitization	do		
		calcitization	cal		
		argillization	cly		
		silicification	sil		
		sericitization	ser		
13	Mineralization,	Chalcopyrite	Cp	Pyrite	Py
		Hematite	Hm or Spc	Pb-minerals	Pb
		Magnetite	Mt	Zn-minerals	Zn
		Skarn	Sk	Oxide minerals	Oxd
14	Color,	light	l-		
		dark	d-		
		grey	gry		
		black	blk		
		white	wht		
		brown	brn		
15	Fracture,	Fault	F		
		sheared	shd		
		brecciated	brc		
16	Observations,	dissemination	diss		
		veins	vs		

GEOLOGIC DRILL LOG
OYON PROJECT

Coordinate N 804.250 E 312.880 — Elevation 4605.6m

DDH No. 11 — Direction 0° — Inclination -90° — Total Depth 250.5m

Len (m) 1	Cu (%) 2	Pb (%) 3	Zn (%) 4	Ag (g/t) 5	Dep. (m) 6	Str 9	Rock 10	Oxd 11	Alt 12	Min 13	Color 14	Fract 15	Observations 16
					2.5		Ml		cal		d-gry		Cal vs
					7.6	∠75°	Sh				blk	crd	
					10								
					12.8	∠70°	Ls				gry		With Sh thin bed Cal dots
					20		Sh				d-gry	crd	
					23.2		Ls				gry		
					30								
					31.4	∠60°	Sh				blk	shd	
					33.2		Ls				d-gry	shd	
					35.8		Cly		cly do		blk	F	
					40		Ls		cal do		gry		
							Sh		do		blk	shd	
					42.0		Do				d-gry		
1.0	0.03	0.2	1.0	27									
					46.2		Sh				blk	shd	
							Sid		sid		p-gry		Sid druses
1.0	0.01	0.1	1.1	7									
					50	∠85°	Sh		cly		d-gry	shd	
					55.0		Cly		cly		d-gry	shd	
					56.5		Do		cly		d-gry	shd	
							Sh		cly		blk		
					60	∠80°							
1.0	0.01	0.4	4.6	7			Do				gry		
					66.6		Sid		sid			drs brc	Whit sid vs & druses
1.0	0.01	0.3	3.1	7									
					70	∠45°	Do				gry	shd	
					72.8	∠30°	Sh		cly		blk	shd	
					75.8		Ls				l-gry		
					78.0		Sh						
					80	∠80°							
					84.0		Ls				l-gry	brc	
					86.0		Sh				blk	shd	
					90		Ml		do		d-gry	shd	
					92.4		Sid				l-gry	drs	Sid network
1.0	0.01	0.1	4.2	7									
					98.0		Do				d-gry		
					1098								

Len (m) 1	Cu (%) 2	Pb (%) 3	Zn (%) 4	Ag (g/t) 5	Dep. (m) 6	Str 9	Rock 10	Oxd 11	Alt 12	Min 13	Color 14	Fract 15	Observations 16
							Ml		do		blk	shd	
					103.6		Sh		do sid		blk	shd	
					110								
					111.6		Do		cal		gry		
					119.0		Sid		sid		l-gry	drs	
					119.8								
					120	∠85°	Do		sil		gry	shd	
					122.6		Sh				blk	shd	
1.0	0.02	0.1	2.7	4.1	126.4		Sid		sid		gry		Wht Sid network & druses
					130								
1.0	0.01	0.2	2.8	21	132.2		Do		sid		gry		
					140								
					143.2		Do		sid		d-gry	shd	
					145.0		Sh				blk	shd	
					147.3		Do		sid		gry		
					150		Sh		do	Py	d-gry		
					154.4		Do		sid		d-gry		Porous Ton Sid vs & druses
										Py			
					160	∠75°							
1.0	0.05	1.1	5.4	21						Py			163.2~164.2m Py diss
					170								Sid druses
					180		Do					shd	
							Do		do		d-gry	shd crd	
					185.0		Do		sid		d-gry		
					190								
1.0	0.02	0.3	2.9	10	191.6		Do		do		blk	brc	Originally to be sh
							Do		do		d-gry	shd	
					197.0		Ls						
					198.2		Ls		sil		blk		Cal network

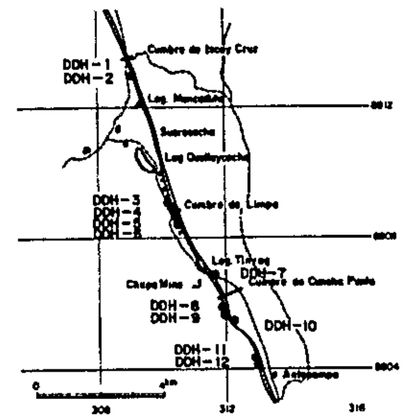
Len (m) 1	Cu (%) 2	Pb (%) 3	Zn (%) 4	Ag (g/t) 5	Dep. (m) 6	Str 9	Rock 10	Oxd 11	Alt 12	Min 13	Color 14	Fract 15	Observations 16
						∠80°	Ls		cal		d-gry		Cal vs
							Ls		cal		gry		Cal network
					210								
1.0	0.04	0.3	7.7	14	213.2		Sh		sil	Py	d-gry		Py network
					216.7		Sh		sil		d-gry		
					217.7		Ml		sil		p-gry		
					220								
					222.0	∠70°	Ls		cal		gry		Cal vs
					230								
					231.4		Ml				blk	shd	
					237.2		Ls				gry	shd	
					240	∠85°							
					242.2		Ls				gry		Cal vs
					250								250.5m end
					260								
					270								
					280								
					290								

PL. II-11

GEOLOGICAL SURVEY OF THE OYON AREA, PERU PHASE II

DRILLING EXPLORATION IN THE ISCAY CRUZ AREA

GEOLOGIC DRILL LOG
DDH – 11



METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

FEBRUARY 1982

prepared by MESCO, Inc

LEGEND and ABBREVIATION

10	Rock,	Pebble		Peb		
		Shale		Sh		
		Sandstone		Ss		
		Calcareous sandstone		Cal-Ss		
		Siderite		Sid		
		Marl		Ml		
		Limestone		Ls		
		Dolomitic limestone		Do-Ls		
		Dolostone		Do		
		Quartzite		Qtz		
		Ore, high grade				
		Ore, low grade				
		Skarn		SK		
		Brecciated rock		Brc		
		Fault & fracture		F		
11	Oxidation,	oxidized		oxd		
		limonitized		lim		
12	Alteration,	dolomitization		do		
		calcilization		cal		
		argillization		cly		
		silicification		sil		
		sericitization		ser		
13	Mineralization,	Chalcopyrite	Cp	Pyrite	Py	
		Hematite	Hm or Spc	Pb-minerals	Pb	
		Magnetite	Mt	Zn-minerals	Zn	
		Skarn	Sk	Oxide minerals	Oxd	
14	Color,	light		l-		
		dark		d-		
		grey		gry		
		black		blk		
		white		wht		
		brown		brn		
15	Fracture,	Fault		F		
		sheared		shd		
		brecciated		brc		
16	Observations,	dissemination		diss		
		veins		vs		

GEOLOGIC DRILL LOG
OYON PROJECT

Coordinate N 804.120 E 312.910 — Elevation 4599.9m

DDH No. 12 — Direction 70° — Inclination -85° — Total Depth 310.5m

Leng (m) 1	Cu (%) 2	Pb (%) 3	Zn (%) 4	Ag (g/t) 5	Dep. (m) 6	Str 9	Rock 10	Oxd. 11	Alt. 12	Min. 13	Color 14	Fract 15	Observations 16
					3.0		Sm	Lim		[illegible]	d-brn		
					3.8		Sh		cly		d-gry	shd	
					10								
					12.9		Sh		cly		p-gry		
							Ls		cal		gry		Cal vs
					20								
					21.0		Ml				blk		
					24.0		Sh		cly		blk	shd	
					27.5		Ls		cal		d-gry		Cal vs
					29.3 / 30		Ml		sil		blk		
					31.0	∠60°	Ls		cal		d-gry blk		
					39.0	∠70°							
					40	∠70°	Ls		cal		d-gry gry		Cal vs
					49.6 / 50		Cly		cly		blk	F	
					51.0		Ls				p-gry		
					52.0		Sh				blk		
					55.0		Ls		cal		d-gry		
					60								
					63.5		Sh		do		p-gry		
					66.0		Ls				gry	shd	
					68.0		Sh		cly do		d-gry	shd	
					70								
					72.0		Cly		cly		d-gry	F brc	Fault zone
					77.0		Do		cly		d-gry	shd	
					80		Cly		cly		d-gry	F	
					82.0		Do		do sid		d-gry		Wht Sid vlts & druses
					90								

Leng (m) 1	Cu (%) 2	Pb (%) 3	Zn (%) 4	Ag (g/t) 5	Dep. (m) 6	Str 9	Rock 10	Oxd. 11	Alt. 12	Min. 13	Color 14	Fract 15	Observations 16
					101.8		Do		do		p-gry		
							Sid		sid		d-gry	shd	
					104.8		Sid		sid		blk & wht	brc	Pinkish-wht sid network Brecciated
2.4	0.01	0.1	0.4	14									
2.4	0.03	0.1	1.3	14									
2.5	0.02	0.1	1.2	14	110					Py Sd Cp			Py-Sps-Cp-diss
2.8	0.02	0.1	0.7	17									
					114.4		Cly		sid cly		d-gry	F	
					118.6 / 120		Do		cly do		d-gry	shd	
					122.8		Sps	Hm		Sps Sp	brn & blk		
2.6	0.21	0.1	2.8	17									
2.7	0.03	0.1	6.9	7									
					128.1		Sh	Hm	do-cly	Sps	d-gry		
					130		Sps	Hm		Sps	brn blk		
					131.0		Cly	Hm	cly		d-brn-gry	F	
					133.0		Sid		sid		d-gry	brc	
					137.4		Sps	Hm		Sps Sp Cp	brn & blk		
2.1	0.68	0.2	6.2	17									
2.1	0.35	0.1	0.5	14	140								
					141.6		Ml		do		d-gry		
					142.4		Sps	Hm		Sps Cp-Sp	blk		
2.4	1.89	tr	0.2	34	144.6								
2.4	0.16	tr	0.1	7	146.8		Do	Hm	sil do	Sps Cp	red & p-gry		Reddish-brn spots diss in do Cp vlts & patches
					150								
					153.0		Do		do sil	Py	d-gry		Py diss
					157.8		Py		sil	Py	yel		
2.0	0.06	0.1	0.5	17									
2.0	0.04	0.1	0.7	27	160								
2.0	0.06	0.1	0.8	34									
1.9	0.03	0.1	0.8	31	163.8		Do		do	Py	yel-gry		
2.3	0.02	0.1	0.4	24	165.5		Py		sil do	Py	yel		
2.3	0.03	0.1	0.8	17									
2.3	0.03	0.1	0.7	17	170								
2.2	0.02	tr	0.3	14									
					174.6		Do		sil cly	Py	yel-gry		
					177.1		Sh?		cly	Py	d-gry	shd	
					178.2		Py		sil	Py	yel		
2.6	0.03	tr	0.6	34	180								
2.7	0.04	tr	0.8	58									
					183.9		Sh?		cly	Py	yel-wht	shd	
					185.8		Sh?		cly	Py	yel-gry	shd	
					187.7		Ml		sil cly	Py	p-gry		
					190								
					192.7		Py		sil do ser	Py	yel	drs	Many druses with Sid & large cryst of Py
2.0	0.02	tr	0.8	38									
2.0	0.04	tr	1.0	48									
2.0	0.03	tr	1.1	58									Sid druse
					199.0		Py						

Leng (m) 1	Cu (%) 2	Pb (%) 3	Zn (%) 4	Ag (g/t) 5	Dep. (m) 6	Str 9	Rock 10	Oxd. 11	Alt. 12	Min. 13	Color 14	Fract 15	Observations 16
2.0	0.03	tr	0.9	45			Py		sil ser	Py	yel	drs	Large cryst of Py
2.0	0.02	tr	0.8	34									
2.0	0.02	tr	0.4	14									
2.0	0.02	tr	0.7	17									
					207.7		Sh		cly do		p-gry		
					210		Cly		cly do		wht	F brc	
					212.9		Py			Py	yel		
							Do		do cly	Py	p-gry		
					215.6		Py		sil do cly	Py	yel		
2.1	0.03	tr	0.7	21									
2.1	0.02	0.3	1.1	21									
2.1	0.02	tr	0.7	34	220								
2.1	0.03	tr	1.1	31									
2.0	0.07	tr	1.2	117									
					226.0	∠75°	Sh		do sil	Py	p-gry		
					228.0 / 230		Py		sil	Py	yel		
3.6	0.07	0.1	2.7	82									
					232.6	∠75°	Ml	Hm	sil	Py	brn & p-gry		
					236.8		Ml		sil	Py Cp	yel-blk		
1.3	5.02	0.1	1.3	151	237.8		Cp-Py	Hm		Cp-Py	yel-blk		237.5 Cu Py ore
2.1	0.52	tr	0.4	31	238.6		Cp-Py	Hm		Sps	brn		Cu Specularite ore
2.1	4.87	tr	0.1	206	240		Ore			Cp	brn		Cu (%) Pb (%) Zn (%) Ag (g/t)
2.1	0.94	tr	0.1	27									Av. 3.08 0.01 0.33 94 (8.7m)
2.1	4.74	tr	0.1	75									
2.0	0.49	tr	0.1	14									247.2
					248.3 / 250		Cly	Hm	cly	Sps	d-gry	shd	
							Ml		do sil cly	Sps	p-gry		
					260								
					262.4		Py		sil do	Py	yel		
2.9	0.03	tr	0.2	7									
2.9	0.13	0.1	0.9	31									
2.8	0.02	tr	0.2	7	270								
2.9	0.03	tr	0.2	7									
					274.0		Ml		do	Py	p-gry		
					275.8		Ls		do		gry		Do vs
					279.8 / 280		Ml		do		p-gry		
2.1	0.71	tr	0.5	14	281.8		Cp Hm	Hm	sil	Cp-Hm	d-brn-gry		Cu Hm ore
2.1	4.75	tr	0.3	35			Ss		sil	Py			
					285.4		Ml		sil		d-gry		
					290	∠60°							
					292.6		Sh		sil		p-gry		
0.8	1.91	tr	0.9	38	294.6		Sh?						Cp Py Hm ore (Sk)
					296.1		Ss		sil	Py	gry		
					298.8		Ss		sil	Py			

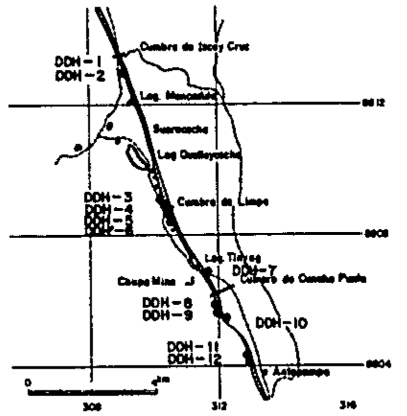
Leng (m) 1	Cu (%) 2	Pb (%) 3	Zn (%) 4	Ag (g/t) 5	Dep. (m) 6	Str 9	Rock 10	Oxd. 11	Alt. 12	Min. 13	Color 14	Fract 15	Observations 16
							Ss		sil	Py	d-gry		St Fm
					302.8		Ss		sil		gry		Cm Fm
					310								310.5m end

PL. II-12

GEOLOGICAL SURVEY
OF
THE OYON AREA, PERU
PHASE II

DRILLING EXPLORATION
IN THE ISCAY CRUZ AREA

GEOLOGIC DRILL LOG
DDH – 12



METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY

FEBRUARY 1982

prepared by MESCO, Inc

LEGEND and ABBREVIATION

10	Rock,	Pebble	Peb
		Shale	Sh
		Sandstone	Ss
		Calcareous sandstone	Cal-Ss
		Siderite	Sid
		Marl	Ml
		Limestone	Ls
		Dolomitic limestone	Do-Ls
		Dolostone	Do
		Quartzite	Qtz
		Ore, high grade	
		Ore, low grade	
		Skarn	SK
		Brecciated rock	Brc
		Fault & fracture	F
11	Oxidation :	oxidized	oxd
		limonitized	lim
12	Alteration,	dolomitization	do
		calcitization	cal
		argillization	cly
		silicification	sil
		sericitization	ser