REPUBLIC OF PERU

REPORT ON MINERAL EXPLORATION

IN

ISCAYCRUZ (OYON) AREA

CONSOLIDATED REPORT

SEPTEMBER 1985

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

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On the Revision of Tunnelling Survey Map in the Report of Mineral Exploration in the Iscaycruz Area Republic of Peru Phase I and Phase II.

In the Tunnelling Survey Map of Adit-N attached to the previous reports, an error was detected in its direction as a result of the check survey carried out in Phase III. Consequently, the plan of the Adit-N has been corrected in the Phase III and Consolidated Reports.

Please use, hereafter, the attached Maps of Phase III and Consolidated Reports.

PREFACE

The Government of Japan, in response to the request of the Government of the Republic of Peru, decided to conduct the mineral exploration composed of drilling and tunnelling surveys in the Iscaycruz (Oyon) Area in cooperation with Instituto Geologico, Minero, y Metalurgico (INGEMMET), and entrusted its execution to Japan International Cooperation Agency (JICA) and Metal Mining Agency of Japan (MMAJ).

The survey and investigation of the Iscaycruz Area were carried out over three years from 1982 to 1984 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 exploration 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.

August 1985

Keisuke Arita

Keisuke Arita
President
Japan International Cooperation Agency

Masayuki Nishiie

Masayuki Nishiie
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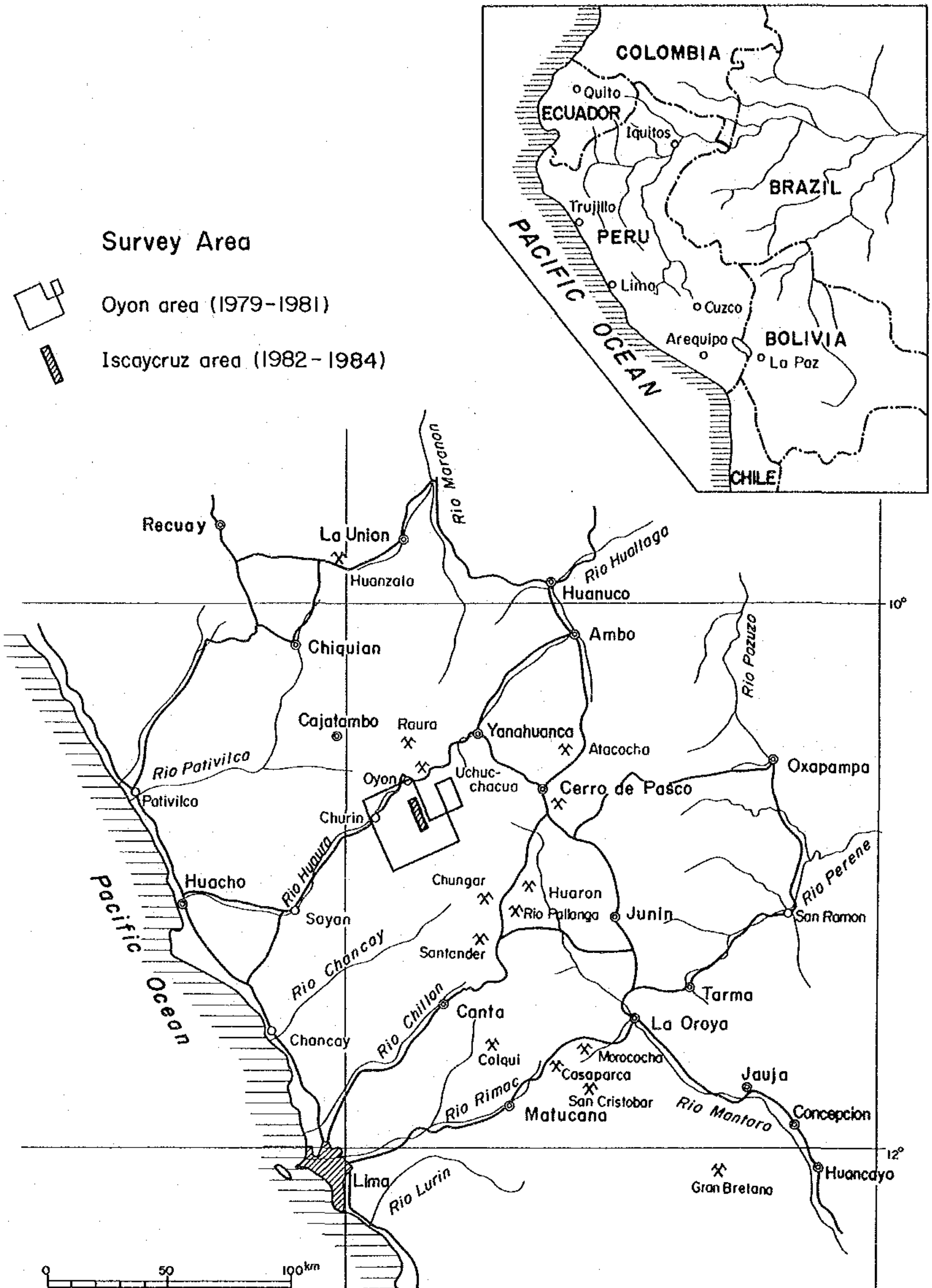

Fig. 1 Index Map

ABSTRACT

This report summarizes results of the exploration works of the progressive stage of the Mineral Exploration by means of drilling and tunnelling explorations carried out during the period of three years from 1982 to 1984 in the Iscaycruz Area (40 km^2), the Republic of Peru.

The Iscaycruz Area had been extracted as a favorable area where economic ore deposits would be expected to be emplaced, by the results of the early stage of the Mineral Exploration in the Oyon Area (860 km^2), which was carried out during the period of three years from 1979 to 1981.

The purpose of this project is to confirm the existence of economic ore deposits, in the selected areas of Limpe area and Limpe-South area in the Iscaycruz Area, through the implement of investigations such as tunnelling exploration and drilling exploration both on the surface and in the underground.

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

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

The cummulative amount of the investigation in this survey project is; as to the tunnelling exploration, 2,008 m is the total excavation length of the Adit-N (835 m, at 4,090 m above sea level) and of the Adit-S (1,173 m, at 4,570 m above sea level); and as to the drilling exploration, 4,110 m of 19 holes is the total length of the surface drilling (2,040 m, 9 holes) and the underground drilling (2,070 m, 10 holes).

Through the drilling exploration, indications of mineralization have been confirmed in all the holes; especially, in the 4 surface drill holes and in the 4 underground drill holes located in the Limpe area as well as in the 2 surface drill holes in the Limpe-South area, were confirmed high grade orebodies with the thickness over 10 m, the grade of which is as high as 20% Pb, Zn

and Cu combined. Also, in the tunnelling exploration, high grade orebodies have been confirmed at three localities and the conditions of the emplacement of the orebodies have been clarified.

Considering the results of these exploration works generally, it is estimated that the sizes of the orebodies in the Limpe area are 300 m in horizontal extension, over 150 m in vertical extension and 10 to 30 m in thickness. By the result of the ore reserve estimation by polygon method, the expected ore reserves in this area is estimated to be 3,250 thousand tons with the grade as high as 20% Pb and Zn combined.

As for the mineralization in the Limpe area, it would be necessary to conduct further detailed exploration works for the confirmation of the ore deposits, the ore reserves and possible extension of the orebodies at the depth. Also, it would be necessary to continue exploration for potentialities of mineral resources in the Limpe-South area, Limpe-North area and Kunsha Punta area.

As to the investigation of the next stage, it is recommended to carry out the survey for the planning of the development including every item in necessary fields for the investment to the development of mineral resources.

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CHAPTER 1 INTRODUCTION

1–1 Purpose of the Survey

The purpose of the survey is to comprehend geological structure in the area where the emplacement of ore deposits would be expected and to confirm lateral and vertical continuity of the mineralization zone by means of diamond drilling and tunnel exploration, in the Iscaycruz Area in the Republic of Peru.

1–2 Scope of the Survey

The survey constitutes a part of the Mineral Exploration by means of drilling and tunnelling explorations in the Iscaycruz Area. The Iscaycruz Area had been selected as a favorable area having high potentiality for possible emplacement of mineral ore deposits, according to the survey results of the early stage of the Mineral Exploration in the Oyon Area.

The Limpe area was extracted as a target area where high grade lead zinc ore deposits would be expected to be distributed, and such methods as tunnelling exploration and underground drilling in addition to surface drilling survey were employed for the prospecting. The actual prospecting works were carried out during the period of three years from 1982 to 1984.

The amount and the methods of the surveys in each year are shown in Table 1.

1–3 Members of the Survey Team

This survey was actually executed with the cooperation of the Instituto Geologico, Minero y Metalurtico; INGEMMET of the Republic of Peru.

The members participated in this survey project are listed in Table 2.

Table 1 Outline of the Survey

	Phase I (1982)	Phase II (1983)	Phase III (1984)	Total	Remarks
Drilling Exploration (m)					Surface Drilling in
Surface Drilling: Limpe Area	1,300 (5)	-	180 (1)	1,480 (6)	Oyon Project (1979-1981)
Tinyag Area	-	-	560 (3)	560 (3)	Limpe Area 840 (4)
Underground Drilling: Adit-N	-	440 (2)	680 (3)	1,120 (5)	Tinyag Area 230 (1)
Adit-S	-	470 (2)	480 (3)	950 (5)	Others 1,560 (7)
Total	1,300 (5)	910 (4)	1,900 (10)	4,110 (18)	Total 2,630 (12)
Tunnelling Exploration (m)					
Adit-N: Main Tunnel	310	200	-	510	Adit N: 4,689 mL
Crosscut-1	-	150	-	150	
Crosscut-2	-	-	175	175	
Adit-S: Main Tunnel	270	330	346	946	Adit S: 4,570 mL
Crosscut-1	-	-	141	141	
Crosscut-2	-	-	86	86	
Total	580	680	748	2,008	

( ) No. of holes

Table 2 Member List of the Survey Team

Division of Work	Phase I (1982)	Phase II (1983)	Phase III (1984)
Japan Side			
Planning, Negotiation and supervision	Toru Miura	Makoto Ishida	Toru Miura
	Makoto Ishida	Zenji Kita	Masao Tsuge
	Toshio Koizumi	Hideyuki Ueda	Makoto Ishida
	Zenji Kita		Sumihiro Fure
	Kazuhiko Uematsu		Takashi Kamiki
	Hideyuki Ueda		
	Hideaki Mukai		
	Tadaaki Ezawa		
	Takashi Ono		
Peru Side			
Planning and Negotiation	Fracisco Sotillo	Francisco Sotillo	Francisco Sotillo
	Gregorio Flores	Gregorio Flores	Gregorio Flores
	Augusto Zelaya	Augusto Zelaya	Augusto Zelaya
Japan Survey Team			
Leader	Jinichi Nakamura	Jinichi Nakamura	Jinichi Nakamura
Drilling exploration	Nobuhiko Yamamoto	Nobuhiko Yamamoto	Nobuhiko Yamamoto
	Yuji Katabe	Yuji Katabe	Hisashi Shimizu
	Tetsuo Yoshida	Yukio Kogita	Tsutomu Aoyama
	Saichi Ishii	Shintaro Horie	Tetsuo Yoshida
	Shuji Kurokawa		
	Yoriyuki Kogami		
	Tetsuo Sako		
	Hisashi Shimizu		
Tunnelling exploration	Ken Nakamura	Ken Nakamura	Kunihiko Tsukanaka
	Haruyoshi Ide	Hideo Morishita	Seiichi Furuyado
	Hideo Morishita		
Peruvian Survey Team			
Leader	Gregorio Flores	Gregorio Flores	Gregorio Flores
	Cesar Vilca	Luis Santalla	Hector Zarate
	Emilio Rojas	Emilio Rojas	Emilio Rojas
			Luis Santalla

CHAPER 2　OUTLINE OF THE SURVEYED AREA

2–1　Location and Accessibility

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

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

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, about 11 km west to the continental divide. 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. Relaitvely 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.

The Iscaycruz Area 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 ENE-WSW 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 divide. 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, Piriula, and Chapcha, grows at a mountainous place above 4,000 m.

2–4 Inhabitants and Industries

1) Inhabitants and Their Lives

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 slopes 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

Mordern metal mines such as Raura lead and zinc mine and Uchucchacua silver mine are operating in the neighboring area. Production rates of these mines are 1,600 t/d, and 800 t/d, and numbers of employees are 800 respectively. Each production scale is 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.

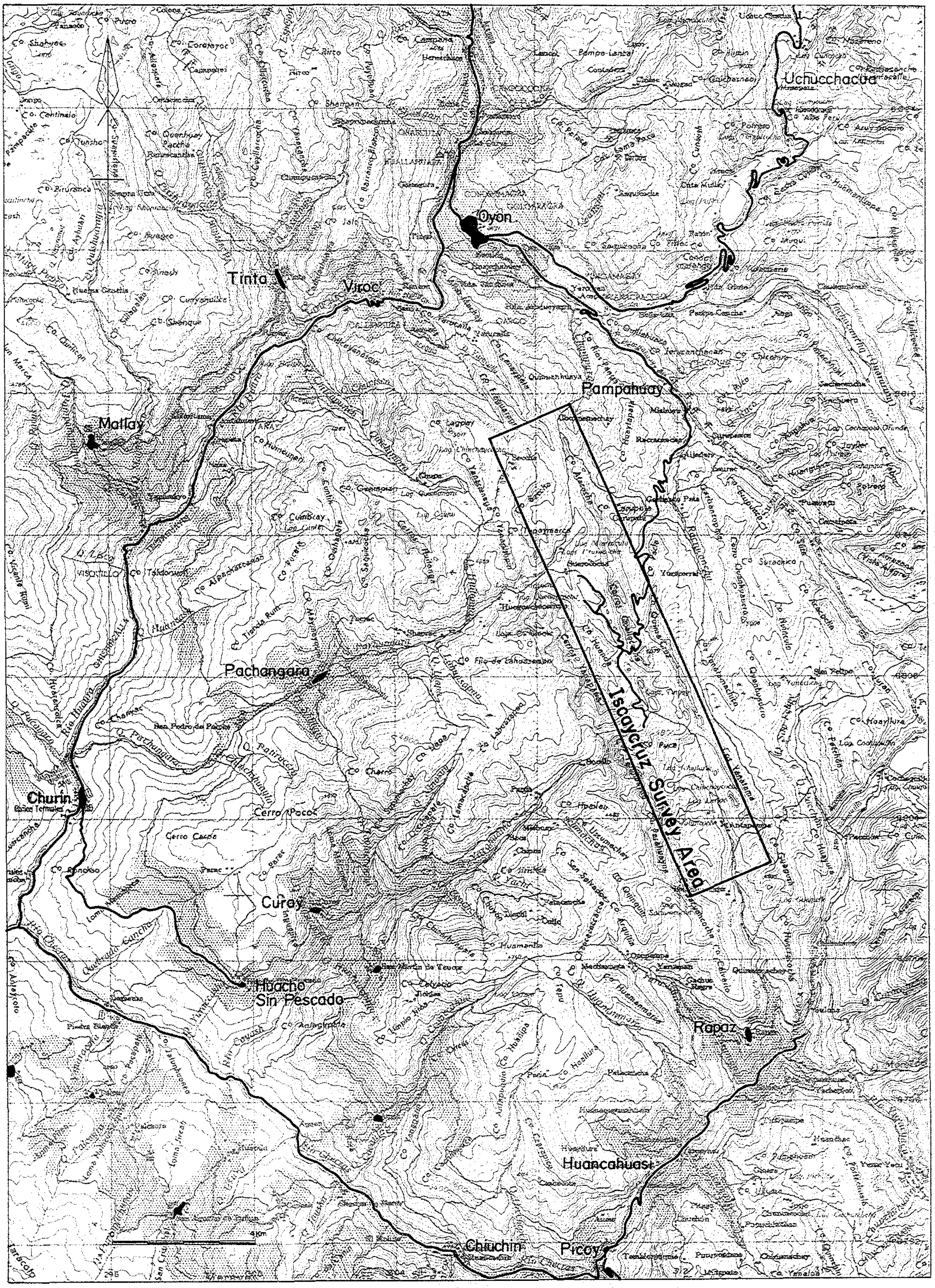
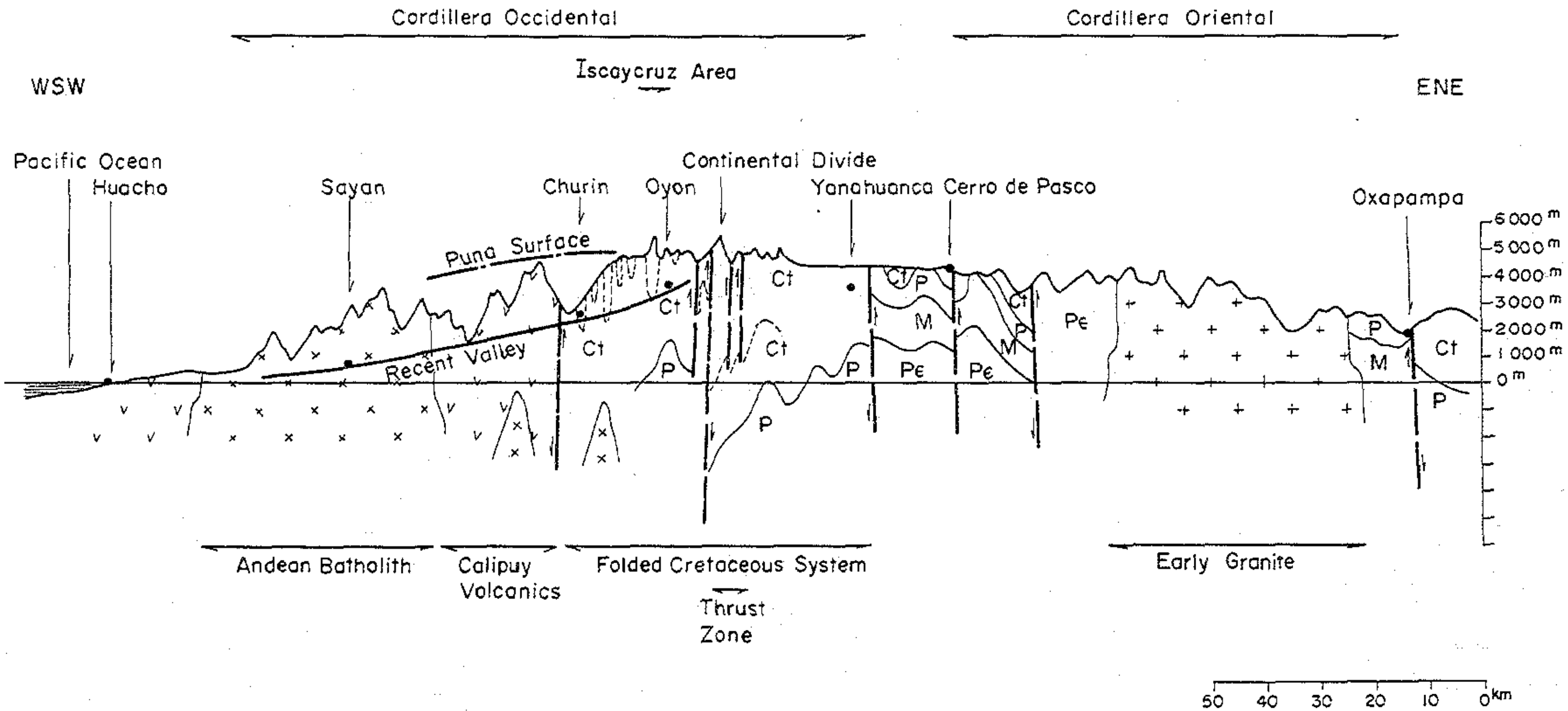


Fig. 2 Location and Access Map



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

Fig. 3. Schematic Profile of the Central Andes Area

CHAPER 3 SITUATION OF MINING INDUSTRY IN PERU

1) Outline

Peru is a well known country rich in mineral resources such as gold, silver, copper, lead, zinc, iron ores, etc., and the mining has been the main industry in this country.

The proportion of the production by the mining industry to the gross domestic production (GDP) is usually slightly less than 10 %, although it fairly changes according to the variation of the international metal prices and the movement of the consuming countries. The employment of the mining industry is a little less than 2 %. Indeed the proportion of the mining industry in the whole Peurvian economy is pretty low, viewing from such factors as GDP or the employment. However, the mining industry has played a great role in the balance of international payments of this country. Recently the amount of the export of the mineral products occupies as much as 45 % of the total amounts of the exports. If petroleum is included in the mineral products, the figure goes up to as high as 65 %. As the petroleum production is forecasted to be decreasing in future, and there would be no expectation of rapid expansion in the fishing, the agricultural and the manufacturing industries, the mining industry mainly of copper, silver, zinc and lead is thought to play increasingly greater role than ever, occupying heavier weight in the Peruvian economy (refer to the following table).

(1) Trade Balance of Peru and Export-Import by Items (Unit $1 million)

	1979	1980	1981	1982	1983
Export					
Marine products	256	195	141	202	
Agricultural products	328	226	170	218	
Mineral products	1,504	1,755	1,420	1,210	1,629
Oil products	652	792	689	715	
Others (Primary prod.)	126	103	128	126	
Others (Secondary prod.)	810	845	701	759	
Total	3,676	3,916	3,249	3,230	3,015
Import					
Consumption goods	155	410	603	495	
Raw material semiprocessed goods	905	1,149	1,376	1,290	
Capital goods	625	1,087	1,454	1,430	
Others	269	444	369	572	
Total	1,954	3,090	3,802	3,787	2,688
Trade balance	1,722	826	Δ 553	Δ 557	327

(2) **Export of Mineral Products from Peru (Unit $1 million)**

	1979	1980	1981	1982	1983
Copper	693	752	529	459	443
Iron ore	85	95	93	108	75
Lead	330	383	219	190	293
Silver	220	315	312	206	391
Zinc	174	210	267	247	307
Total	1,504	1,755	1,420	1,210	1,509

(3) **Quantity of Mineral Products Exported from Peru (Metal content, Unit Tx10^3, Mx10^6)**

		1979	1980	1981	1982	1983
Copper	(T–MT)	377	350	324	331	292
Iron ore	(M–LT)	5.7	5.7	5.3	5.7	4.3
Silver	(M–OZ)	23.8	16.0	28.1	26.0	32.7
Lead	(T–MT)	156	152	146	171	191
Zinc	(T–MT)	422	468	477	467	522
Oil	(M–BL)	24.1	22.5	19.9	22.6	

(from data of Banco Central de Reserva del Peru)

(4) **Mineral Production in Peru (Metal content, Unit x 1,000)**

		1978	1979	1980	1981	1982	1983
						(Ing./Blist/Conc.)	(Ing./Bist/Conc.)
Copper	(MT)	376	397	367	342	356(225/95/36)	322(191/101/30)
Silver	(Kg)	1,337	1,364	1,392	1,470	1,654(751/28/876)	1,728(676/30/1022)
Lead	(MT)	183	184	189	193	176(76/–/100)	205(64/–/141)
Zinc	(MT)	457	491	488	499	456(158/–/298)	553(154/–/399)
Iron ore	(MT)	3,275	3,622	3,780	4,007	5,597	4,225
Gold	(G)	3,361	4,191	4,074	4,820	4,305	4,260
Oil	(Bar)	55,060	69,952	71,369	70,431	71,211	62,600

(from Ministerio de Energia y Minas)

2) Mineral Production

The mineral production in Peru is shown in the above table. In addition to the Oroya copper-lead-zinc smelter, the recently constructed Iro copper smelter began its full scale operation and in 1981 the Cajamarquilla zinc smelter started its operation. Accordingly, as for the degree of processing, production ratio of finished or semi-finished goods such as ingot metal or blister has been increasing.

The production of copper increased rapidly in 1977, because of the development and the operation of the Cajone mine and the Cerro Verde mine. But the production of other metals has not been expanding. Generally, Peruvian mining industry has been supported by moderate to small scaled mines, except for some large scaled mines employing open pit mining method as are the cases with the Toquepala mine, the Cajone mine and the Cerro Verde mine, which are working porphyry copper type ore deposits, and the Cerro de Pasco mine, which is working lead-zinc massive sulphide ore deposits.

3) **Main Operating Mines in Peru (annual production in 1981–1982, Unit:MTx1000)**

(1) **Main Copper Mines (more than 2,500 t/y of Cu metal content)**

Cerro Verde	(31.5– 34.0)	Condestable	(2.4– 3.2)
Centromin	(25.8– 23.1)	Condoroma	(4.0– 2.7)
Southern	(227.7–259.3)	Nor–Peru	(2.8– 3.3)
Atalaya	(3.1– 3.0)	Pativilca	(4.5– 5.5)

(2) **Main Lead Mines (more than 5,000 t/y of Pb metal content)**

Centromin	(74.6– 72.6)	Huaron	(5.8– 6.3)
Arianza	(8.4– 6.6)	Milpo	(10.4– 14.1)
Atacocha	(13.3– 14.9)	Raura	(5.6– 10.9)
Del Madrigal	(6.0– 6.1)	Santa Luisa	(7.3– 11.0)

(3) **Main Zinc Mines (more than 15,000 t/y of Zn metal content)**

Centromin	(215.0–217.5)	S. Morococha	(40.1– 58.3)
Atacocha	(18.7– 19.1)	Santa Luisa	(18.3– 25.0)
Gran Bretana	(16.4– 17.5)	Santander	(26.2– 28.6)
Milpo	(24.1– 25.3)	Volcan	(21.4– 20.1)

(4) **Main Silver Mines (more than 50,000 kg/y of Ag metal content)**

Centromin	(421.4–425.6)	Buenaventura	(101.1–198.8)
Southern	(63.8– 71.9)	Castrovirreyna	(56.6– 46.9)
Arcata	(78.7– 89.1)	Huampar	(58.4– 63.6)
Arianza	(66.1– 53.9)	Milpo	(49.9– 67.8)

(from La Mineria en el Peru–83)

CHAPTER 4 OUTLINE OF THE SURVEY

4–1 Surveys in the Oyon Area (1979–1981)

In 1979, geological survey and geochemical survey were carried out in the Oyon Area, as the first stage of the Mineral Exploration, and some indications of lead zinc mineralization were confirmed in limestones of the Santa Formation, distributed in the Iscaycruz Area.

In 1980–1981, the following geophysical prospecting and drilling exploration were carried out in addition to the detailed geological survey.

(1) Detailed Geological Survey; area 40 km^2

(2) Geophysical Prospecting ; IP method 15 lines, totalling 35 km of line length
EM method 10 lines, totalling 13 km of line length

(3) Drilling Exploration ; 12 holes at 11 sites, total drilling length being 2,630 m.

By the results of the above surveys, high grade lead zinc mineralization was confirmed in the Limpe area, Limpe-South area and in some other areas. As the highest potentiality for the development of metal mineral resources would be expected in the Iscaycruz Area, more detailed surveys for the exploration were recommended to be carried out in this area.

4–2 The First Phase (1982)

The exploration program, setting the target on the confirmation and estimation of economic ore reserves was planned in the Iscaycruz Area, which was belonging to the stage of more detailed surveys in usual Mineral Exploration. It was determined that the detailed exploration program should include more precise exploration surveys with the combination of tunnelling exploration and underground drilling, in addition to the surface drilling.

As to the tunnelling exploration, it was decided to excavate main adits in the rocks belonging to the Chimu Formation and to extend crosscut tunnels from the main adits for the approach to the mineralization zone in the Santa Formation.

Underground drilling exploration was planned to prospect in the area between two crosscut tunnels and at the depth below the level of the tunnels.

As the time for the investigation was limited, two starting points (tunnel entrances) were established for the excavation of the tunnels with the approximate distance of 1,400 meters and with the difference of altitude of 120 meters, so that the center of the mineralization zone could be reached from north and from south in two levels.

	Location	Altitude
Entrance of Adit–N :	E = 310,357 N = 8809,095	4,689 m
Entrance of Adit–S :	E = 310,968 N = 8807,861	4,570 m

The amount of the tunnelling exploration in the Phase I of the surveys (1982) was total 580 meters ---- Adit–N main tunnel 310 m and Adit–S main tunnel 270 m.

As to the drilling exploration, the surface drilling was performed in 5 holes at 5 sites in the Limpe area, total length of which was 1,300 meters. Rich indication of copper lead zinc mineralization were caught in the drill hole IC–2.

In the Phase I of the survey, much time was spent on the preparation works including reconstruction and widening of the roads, change of the routes of the roads, temporary construction, mobilization of large scale machines, purchase and transportation of fuel, destruction of the existing roads, resulting in the traffic interruption, and the above-stated tunnelling exploration was delayed with such difficulties. The drilling exploration was also difficult in the Phase I, because of the bad weather and the brittle rocks encountered.

4–3 The Second Phase (1983)

Total excavated length of the tunnels in the Phase II (1983) was 680 meters ---- Adit–N main tunnel 200 m, Adit–N crosscut tunnels 150 m, and Adit–S main tunnel 330 m. Along the Adit–N crosscut tunnel, which was excavated about 80 meters into the mineralization zone found in the rocks belonging to the Santa Formation, an indication of zinc mineralization with the width of 12 meters was confirmed.

The drilling exploration in the underground was performed in 2 holes totalling 440 meters in the Adit–N as well as in 2 holes totalling 470 meters in the Adit–S, the total length of which was 910 meters.

In the Adit–S, highly acidic water (pH=1) sprang out of the drill holes (IC–8 and IC–9), which gave certain difficulties to the drill-works.

In the year of the Phase II, heavy rain, in addition to the snowslide due to the heavy snowfall, caused collapse and destruction of the existing roads again, resulting in the traffic interruption for a long time and the exploration works were faced to difficulties under such condition.

4–4 The Third Phase (1984)

Total excavated length of the tunnels in the Phase III (1984) was 748 meters ---- Adit–N No.2 crosscut tunnel 175 m, Adit–S main tunnel 346 m, Adit–S No.1 crosscut tunnel 141 m, and Adit–S No.2 crosscut tunnel 86 m. Indication of high grade lead zinc mineralization was caught along the Adit–S No.2 crosscut tunnel.

The drilling exploration of total length of 1,900 meters in 10 holes was carried out ---- 180 m in a hole on the surface in the Limpe area, 680 m in 3 holes in the Adit–N, 480 m in 3 holes in the Adit–S, and 560 m in 3 holes in the Limpe-South area. Indications of high grade mineralization were caught in 4 holes, that is, in 2 holes in the Adit–N (IC–11, IC–12), in a hole in the Adit–S (IC–14) and in a hole in the Limpe-South area (IC–18).

Along the Adit–S main tunnel, a brecciated zone was found parallel to the direction of the excavation of the tunnel, which lowered the efficiency of excavation to a degree. Also, large scaled hollow portion appeared and it was necessary to change the route of the tunnel. Along a crosscut tunnel of the Adit–S, highly acidic water (pH=1) sprang out and the machines and the equipments were damaged to a large extent. Replacement of the rails and the interruption of the exploration works were inevitable. In addition to the above-mentioned unfavorable conditions, disturbance of the public peace occurred in and after November, which resulted in the interruption of the whole works and loss of the efficiency. Prospecting works of both of the tunnelling exploration and the drilling exploration had considerably hard time and were delayed extremely. It was in June 1985 when the whole programmed works were completed.

CHAPTER 5 OUTLINE OF GEOLOGY

5–1 Regional Geology

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

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

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

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

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

5–2 Outline of Geology in the Iscaycruz Area

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

In the east of this area, an anticline is recognized with the axis running in NNW–SSE direction. The Oyon Formation, the lowest Cretaceous, composed mainly of sandstone and shale with coal measures and the oferlying Chimu Formation, 600 to 700 meters thick, composed of quartzite or quartzose sandstone are distributed along the axis of the anticline. They look dark grey to dark brown in color and form irregular rough mountain land. In the west of this area, a syncline is recognized with the axis in NNW–SSE direction, along which is distributed the upper Cretaceous Jumasha Formation composed of massive limestone of the thickness of almost 1,400 meters.

The limestone forms steep mountain land, brightly shining in grey color. Between the two mountain lands, topographically lower part has been formed in the area occupied by the Carhuaz Formation composed of the alternation of shale and sandstone, 500 to 700 meters thick.

In a narrow zone between the Chimu Formation and the Carhuaz Formation, the Santa Formation is distributed. The Santa Formation is as thick as 50 to 100 meters, composed of well-stratified bluish grey limestones. This formation constitutes the country rock of the mineralization in the Iscaycruz Area. Between the Carhuaz Formation and the Jumasha Formation, there are four other formations which are distributed zonally. They are Farrat Formation, about 100 meters in thickness, composed of quartzose sandstone and calcareous sandstone; Pariahuanca Formation, about 100 meters in thickness, composed of dark grey massive limestone; Chulec Formation, about 200 meters in thickness, composed mainly of light grey marlstone; and Pariatambo Formation, about 200 meters in thickness, composed of the alternation of thin layers of shale and dark grey to dark-colored limestone (refer to Fig. 4).

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

As for igneous rocks, dacitic porphyry is recognized near the axis of the syncline in the west of Cumbre de Iscaycruz (Iscaycruz pass) and also acidic dyke complex is found to have been active around the anticline axis near Cumbre de Cunsha Punta, in the middle to southern part of this area (refer to Fig. 6).

5–3 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 (refer to Fig. 3).

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 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 batholith 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.

The volcanic and plutonic activity has been continued from Jurassic to Quaternary age, and the center of the activity has been moving to the west from the coastal area to the axis zone of Western Andes. Most of metal ore deposits are considered to be formed resulted with the latest igneous activity after Tertiary age.

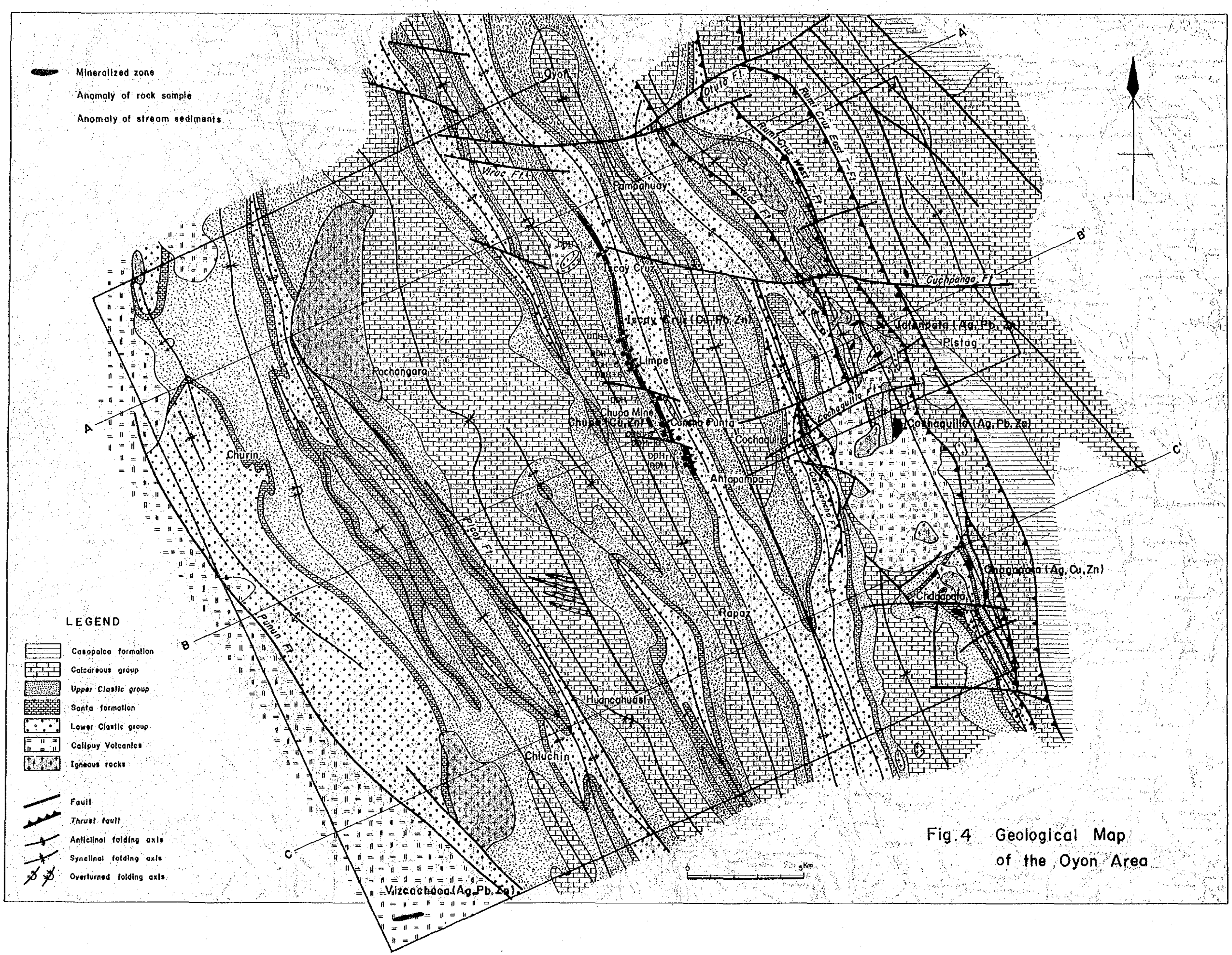
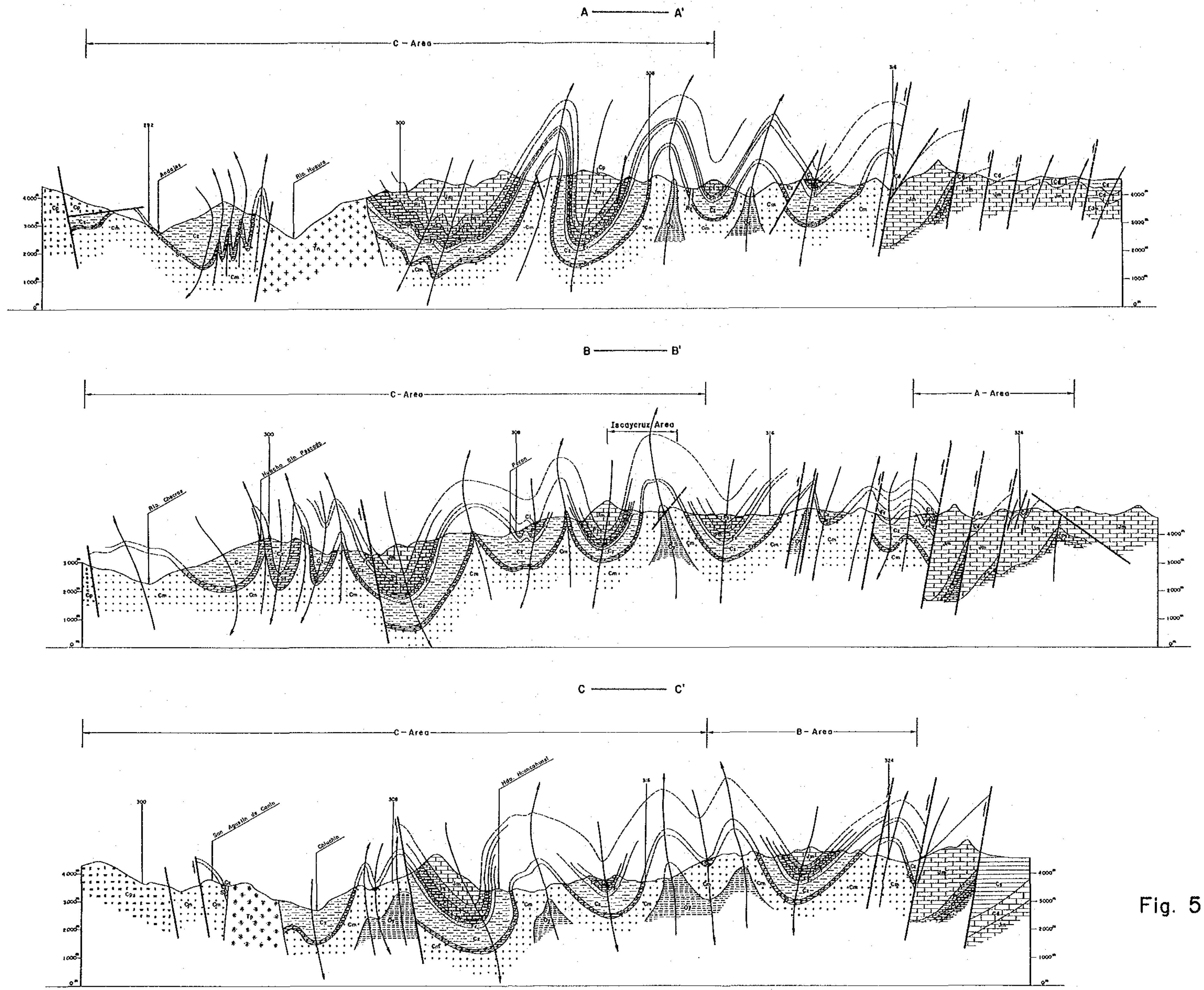


Fig. 4 Geological Map of the Oyon Area



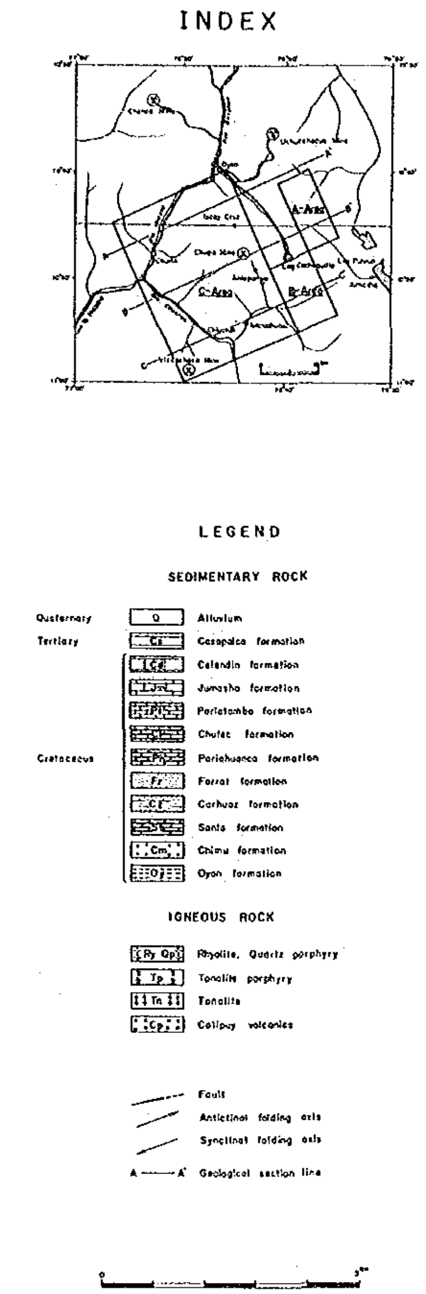


Fig. 5 Geological Profile of the Oyon Area

CHAPTER 6 OUTLINE OF ORE DEPOSITS

6–1 Outline

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

The ore deposits of the Oyon Area are classified as follows, according to the kind of ore, shape and genesis. Iscaycruz mineralized zone is characterized by the coexistence of contact metasomatism in the post-magmatic stage and hydrothermal replacement in the hydrothermal stage. Skarn minerals occured under high temperature condition had been suffured from regressive metamorphism.

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

6–2 Iscaycruz Mineralized Zone

The Iscaycruz mineralized zone is found in the limestone of the Santa Formation, and is distributed intermittently along the limestone in a distance of about 12 km from Canaypata, the northern end, to Antapama, the southern end. The indications of mineralization are found as dark-colored gossans bearing lead and zinc, massive pyrite orebodies associated with galena and sphalerite, skarn masses containing chalcopyrite and sphalerite, hematite masses disseminated with chalcopyrite and sphalerite, and disseminations in dolostones with galena and sphalerite (see Fig. 6).

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

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

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

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

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

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

6–3 Chupa Ore Deposit

Chupa ore deposit is located about 600 m west of Limpe-S skarn outcrop in the Iscaycruz 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.

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 Jumasha 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 direction is present, and the mineralization is strongly controlled by this fault system.

Approximate scale of orebody and assay result of 2 m channel samples taken at randum are as follows.

Level	Area of Orebody (m^2)	No. of Samples	Length of Sampling (m)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)
4,615 m	1,500	10	20	25	0.27	0.13	21.59
4,600 m		3	6	29	0.15	0.36	15.64
4,560 m	1,500	17	34	30	1.07	0.07	9.67

Skarn minerals are mainly composed of tremolite, hedenbergite, siderite, and quartz, accompanies by chlorite, epidote and lievrite. Ore minerals are mainly composed of sphalerite, pyrite and minor amounts of chalcopyrite, pyrrhotite, magnetite and bismuthinite.

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

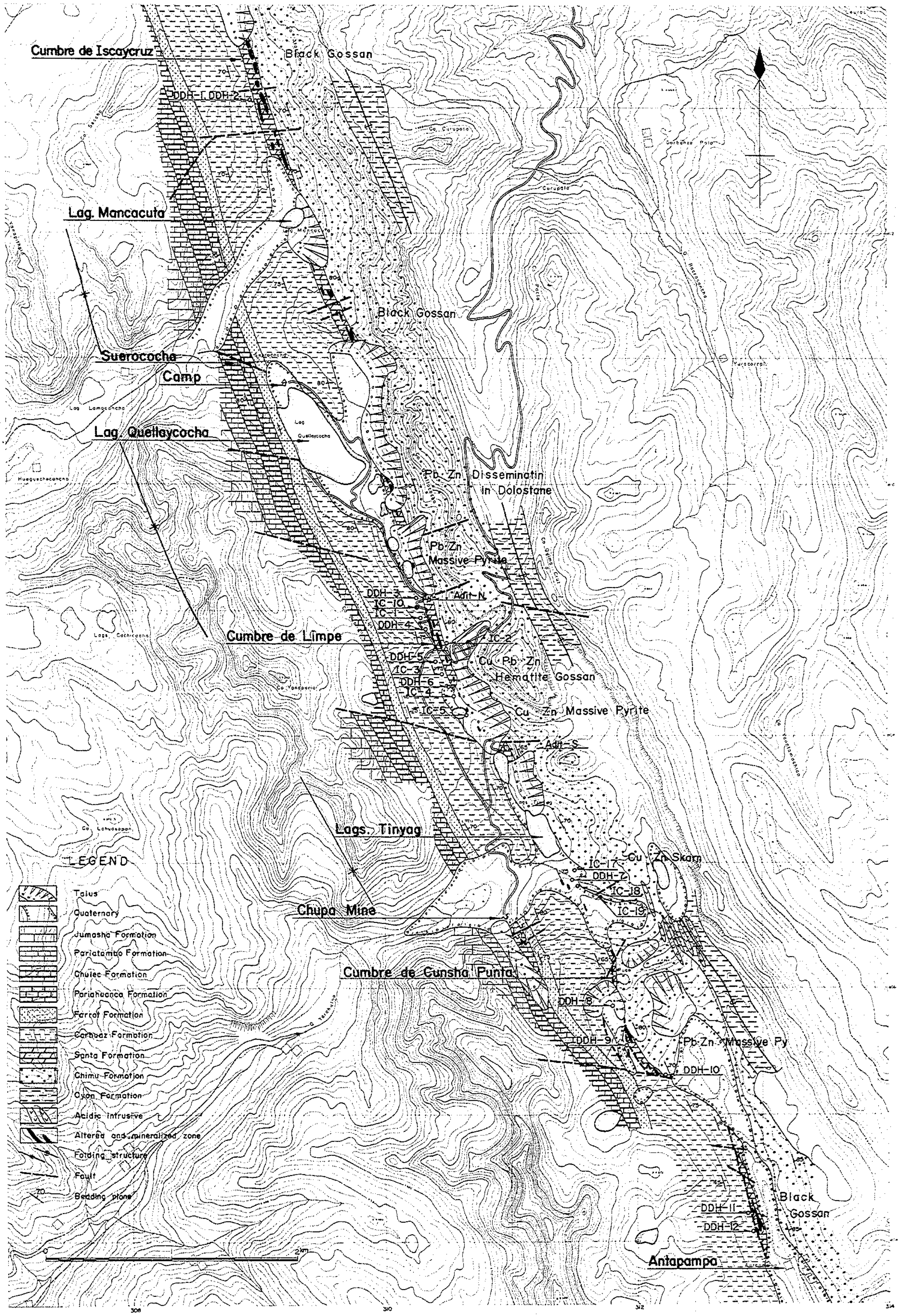


Fig. 6 Geological Map of the Iscaycruz Area

CHAPTER 7 OUTLINE OF THE SURVEY RESULTS

7–1 Drilling Exploration

The drilling exploration carried out in the Iscaycruz Area is shown as below.

	1980	1981	1982	1983	1984	Total
Limpe, Surface	150 (1)	690 (3)	1,300 (5)	–	180 (1)	2,320 (10)
Limpe, Underground	–	–	–	910 (4)	1,160 (6)	2,070 (10)
Limpe-S, Surface	–	230 (1)	–	–	560 (3)	790 (4)
Limpe-N, Surface	400 (2)	–	–	–	–	400 (2)
Cunsha-P, Surface	–	600 (3)	–	–	–	600 (3)
Antapampa, Surface	–	560 (2)	–	–	–	560 (2)
Total	550 (3)	2,080 (9)	1,300 (5)	910 (4)	1,900 (10)	6,740 (31)
Grand Total	2,630 (12)		4,110 (19)			6,740 (31)

(figures : meters, ( ) : number of holes)

Remarkable indications of mineralization have been confirmed in all the 31 drill holes, and high grade orebodies are caught in 11 of the 31 drill holes in this project. The main indications of mineralization in the Limpe area and in the Limpe-South (Tinyag) area are listed in the Table 4.

The lower horizon (D) and the upper horizon (U) of the Santa Formation are the ones which contain remarkably mineralized layers. The most remarkably mineralized portion of them is the one in the lower horizon and the sizes and the grade are as follows. The orebody is composed of the higher grade portion with the grade of 30 ~ 50% Pb and Zn combined and of the relatively lower grade portion with the grade of over 10% Pb and Zn combined.

Horizontal extension	approx. 300 m
Vertical extension	more than 150 m
Thickness	10 ~ 30 m
Average grade	Ag 65 g/t, Pb 2.6%, Zn 22%

The ore deposits along the upper horizon is emplaced intermittently over the length of more than 900 m. The thickness is 11 m at the most so far recognized and the grade is approximately 20% Pb and Zn combined.

7–2 Tunnelling Exploration

The total commulative amount of the tunnelling exploration carried out in the Limpe area is 2,008 m as shown in the following table.

		1982	1983	1984	Total
Adit-N,	Main Tunnel	310	200	–	510
	Crosscut-1	–	150	–	150
	Crosscut-2	–	–	175	175
Adit-S,	Main Tunnel	270	330	346	946
	Cross	–	–	141	141
	Crosscut-2	–	–	86	86
Total		580	680	748	2,008

(figures : meters)

As the result of the tunnelling exploration, indications of mineralization have been confirmed at three localities. The sizes and the grade are listed below in addition to the correlation of the results obtained in the drilling exploration. Although there is a tendency that the results of the confirmation in the tunnelling exploration is comparatively better than those based on the data from the drilling exploration, it can be said that these two results are in approximate coincidence and that they are in fairly good correspondence.

	Horiz. Width (m)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Notes
NX-1 (U_3)	11.8	8	0.10	0.07	17.17	
DDH-4 (U_2)	9.5	13	0.07	0.04	14.49	70 m north
SX-2 (U_7)	15.0	182	0.16	3.80	30.10	
DDH-5 (D_6)	11.9	163	0.14	2.92	27.15	same locality
SX-2 (U_6)	6.0	26	0.08	2.63	11.75	
DDH-5 (U_5)	3.6	35	1.10	2.89	15.22	80 m upper

(upper lines: tunnelling, lower lines: drilling)

7–3 Statistical Analysis on the Grade of Ore

1) Introduction

For the purpose to examine the inter-relation of each ingredient (Ag, Cu, Pb and Zn) of the ore grade and to consider over the relation between the ore grade and the type and quality of the ore deposits, statistical analysis of the representative ore grades was carried out.

The data used for the analysis are as follows. Special care was given that the data should be distributed evenly as to the area and as to the quality of the ore deposits.

(a) Dissemination type (D-type)

51 data (DDH-1, DDH-2)

(b) Massive pyritic ore deposit type (M-type)

164 data (DDH-3, DDH-4, DDH-5, DDH-6, IC-2)

(c) Skarn ore type (S-type)

69 data (DDH-7)

2) **Result of the analysis**

(1) Average values

Type of Ore	No. of Samples	Mean (%)				Distribution Ratio (%)			
		Ag	Cu	Pb	Zn	Ag	Cu	Pb	Zn
(a) D-type	51	8.1	0.01	0.71	4.34	14.4	0.8	30.7	18.4
(b) M-type	164	42.5	0.54	1.56	11.98	75.8	44.6	67.5	50.4
(c) S-type	69	5.5	0.66	0.04	7.43	9.8	54.6	1.8	31.2
Av., Total	284	27.4	0.48	1.04	9.51	100	100	100	100

It is an obvious tendency that all of Ag, Cu, Pb and Zn are concentrated to the massive pyritic ore deposit type (M-type). Also, it has been recognized that Cu is apt to concentrate to the skarn ore type (S-type) and that Pb is apt to concentrate to the dissemination type (D-type).

(2) Correlation coefficient

		Ag	Cu	Pb	Zn
(a) D-type	Ag	1.000	0.322	0.128	0.569
	Cu	0.322	1.000	−0.166	0.308
	Pb	0.128	−0.166	1.000	0.296
	Zn	0.569	0.308	0.296	1.000
(b) M-type	Ag	1.000	−0.068	0.450	0.527
	Cu	−0.068	1.000	−0.162	−0.261
	Pb	0.450	−0.162	1.000	0.282
	Zn	0.527	−0.261	0.282	1.000
(c) S-type	Ag	1.000	0.527	−0.195	0.534
	Cu	0.527	1.000	−0.145	0.409
	Pb	−0.195	−0.145	1.000	−0.316
	Zn	0.534	0.409	−0.316	1.000

As for the data of the dissemination type (D-type), correlation is recognized between Ag and Zn, and it is estimated they have intimate relation each other, but no correlation has been recognized between Ag and Pb.

As for the data of the massive pyritic ore deposit type (M-type), correlation is recognized between Ag and Zn and between Ag and Pb.

As for the data of the skarn ore type (S-type), correlation is recognized between Cu and Zn, between Ag and Zn and between Ag and Cu.

(3) Factor analysis

		Factor 1	Factor 2	Factor 3	Factor 4
(a) D-type	Ag	0.598	0.453	−0.074	0.656
	Cu	0.228	0.683	0.684	−0.111
	Pb	0.673	0.693	0.238	0.087
	Zn	0.892	0.338	−0.218	−0.203
(b) M-type	Ag	0.724	0.101	0.086	0.676
	Cu	−0.217	0.594	0.771	−0.056
	Pb	0.685	0.560	−0.455	−0.093
	Zn	0.876	−0.412	0.217	−0.123
(c) S-type	Ag	0.722	0.140	0.017	0.676
	Cu	0.748	0.635	−0.114	−0.149
	Pb	−0.364	0.355	0.860	0.004
	Zn	0.895	−0.398	0.177	−0.088

In the dissemination type (D-type) and in the massive pyritic ore deposit type (M-type), Ag, Pb nd Zn have similarity, and in the skarn ore type (S-type), Ag and Cu have similarity.

To summarize the above results, it is estimated that there is a tendency for Ag to be concentrated by being accompanied with Zn or Cu.

7–4 Features of Ore

1) Outline

High grade zinc ore forming main orebody in the Limpe area is composed mainly of sphalerite, while the gangue minerals are, according to the X-ray diffraction analysis, mainly quartz associated with chlorite and siderite. It is megascopically characteristic that the ore is brecciated remarkably. Sphalerite has replaced the brecciated wall rocks. Also, sphalerite of other quality is found to have precipitated in spaces in brecciated ore mass, associated with pyrite and galena. Unmineralized breccias are included in some cases.

2) Occurrence of Sphalerite

The following three qualities of sphalerite are recognized in the subject ore.

a) Greenish dark grey sphalerite : Includes numerous very fine chalcopyrite and has exsolution structure. Composed almost solely of sphalerite and the ore grade reaches up to 40% or even to 50% of Zn.

b) Dark brown sphalerite: The sphalerite is found to include dots and aggregates of pyrite and galena. The ore grade reaches up to 30% or 40% of Zn.

c) Yellow ~ pale brown sphalerite: This type of sphalerite is usually pale and transparent in color, and is estimated to contain least Fe content. The sphalerite is recognized to occur in fine seams and dissemination.

3) Occurrence of Pyrite

As for the pyrite found in the ore, the following differences are recognized with the occurrences.

a) The brecciated pyrite. Along the cracks sphalerite is found to have been precipitated or to have replaced the pyrite.

b) The pyrite found in dots or in aggregates in massive sphalerite. The pyrite is recognized to have been corroded and replaced by the sphalerite.

c) The pyrite found in dendric aggregates in massive sphalerite.

d) The pyrite found in veinlets, associated with galena, sphalerite, chalcopyrite etc. This type of pyrite is euhedral in usual cases.

4) Consideration on the Genesis

From the viewpoints of the above-stated particularities of the ore minerals and ore deposits, it is thought that the followings are the characteristics of the subject ore deposits.

1) Remarkable structural movement would have been there during the period of the mineralization.

2) There must have been at least two or three stages as to mineralization.

3) It is thought to be likely that the ore minerals would have precipitated rapidly in a comparatively short period under the condition of relatively low temperature.

4) Brecciation and fracturing are closely related to the mineralization.

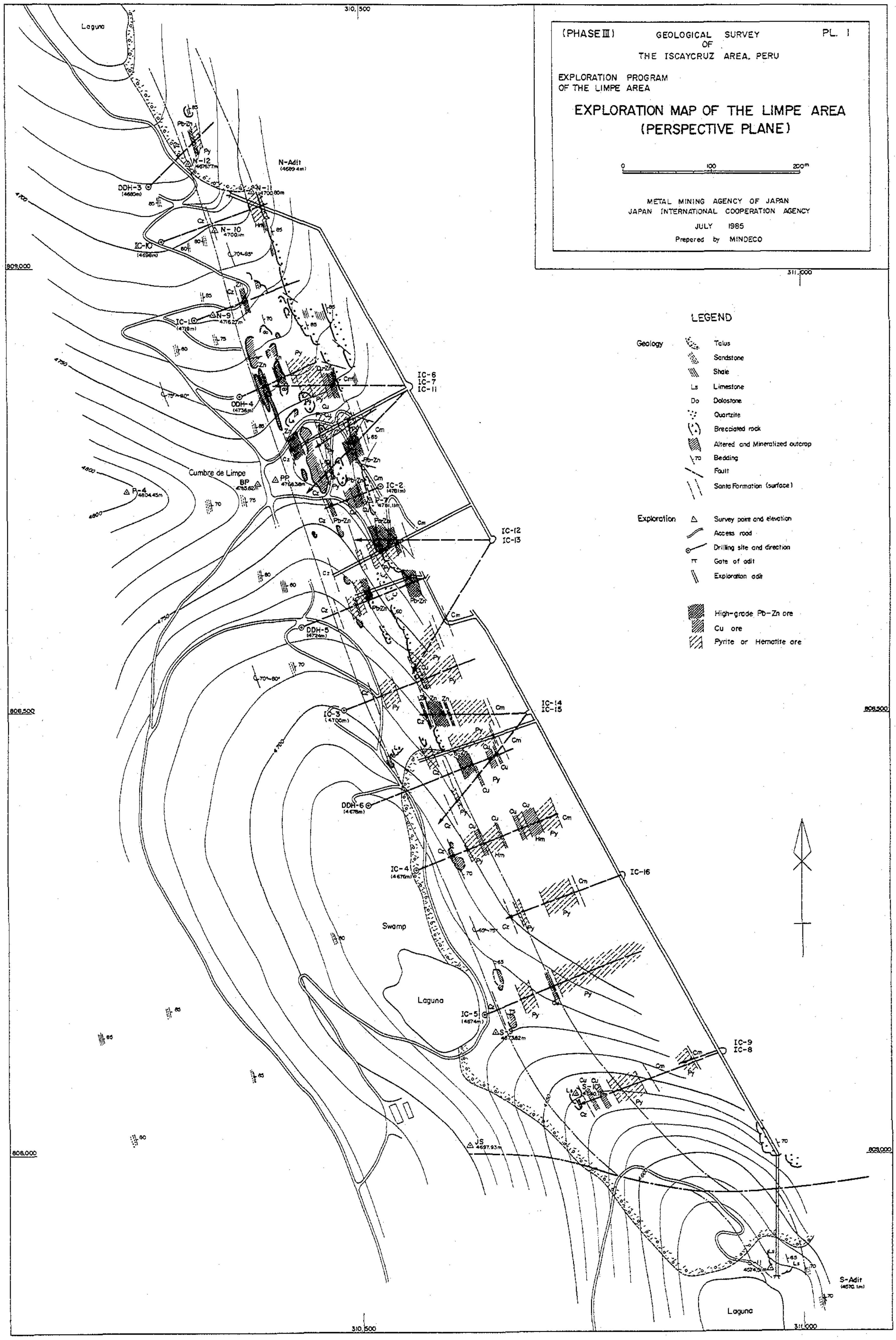


Fig. 7 Exploration Map of the Limpe Area

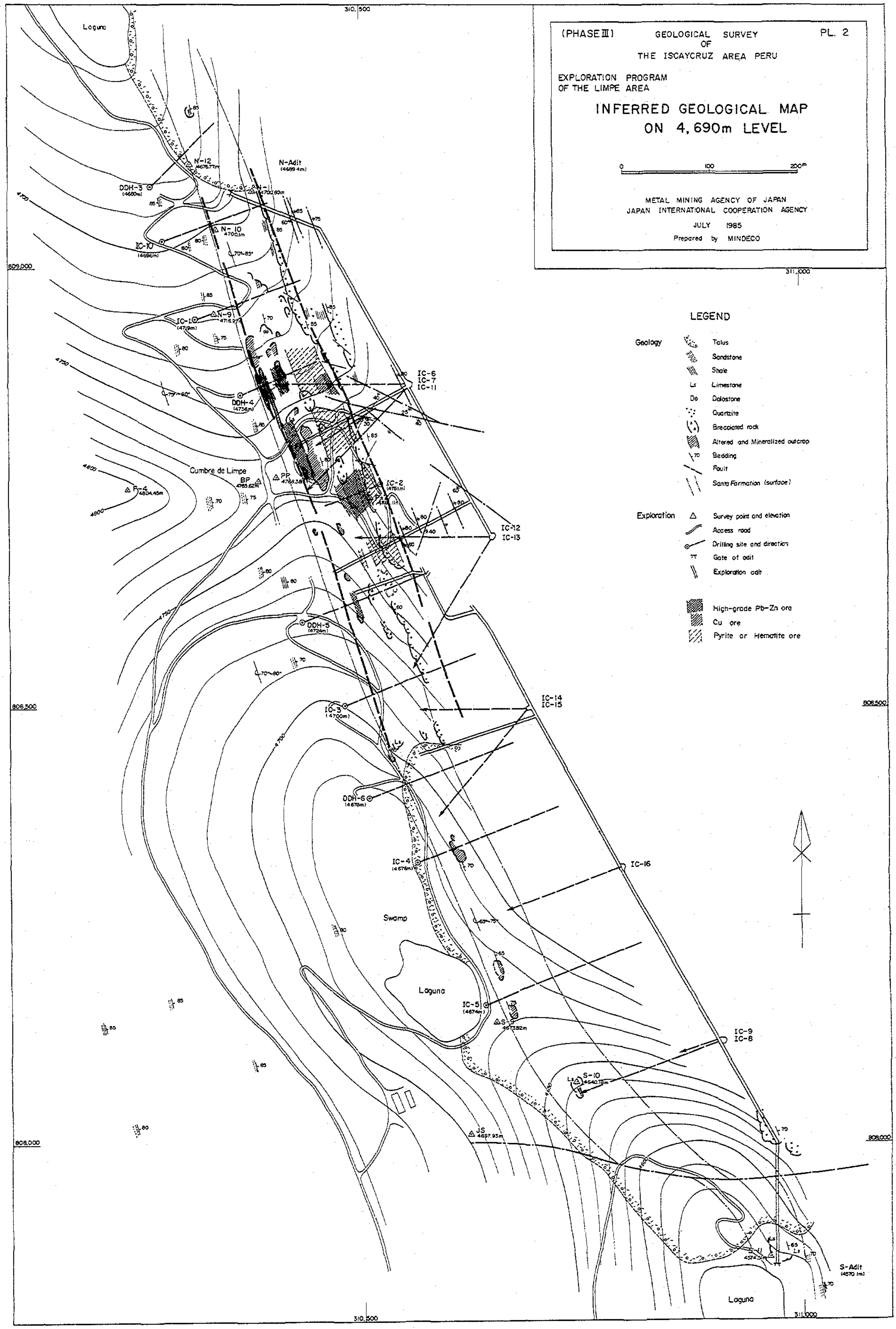


Fig.8 Inferred Geological Map on 4,690m Level

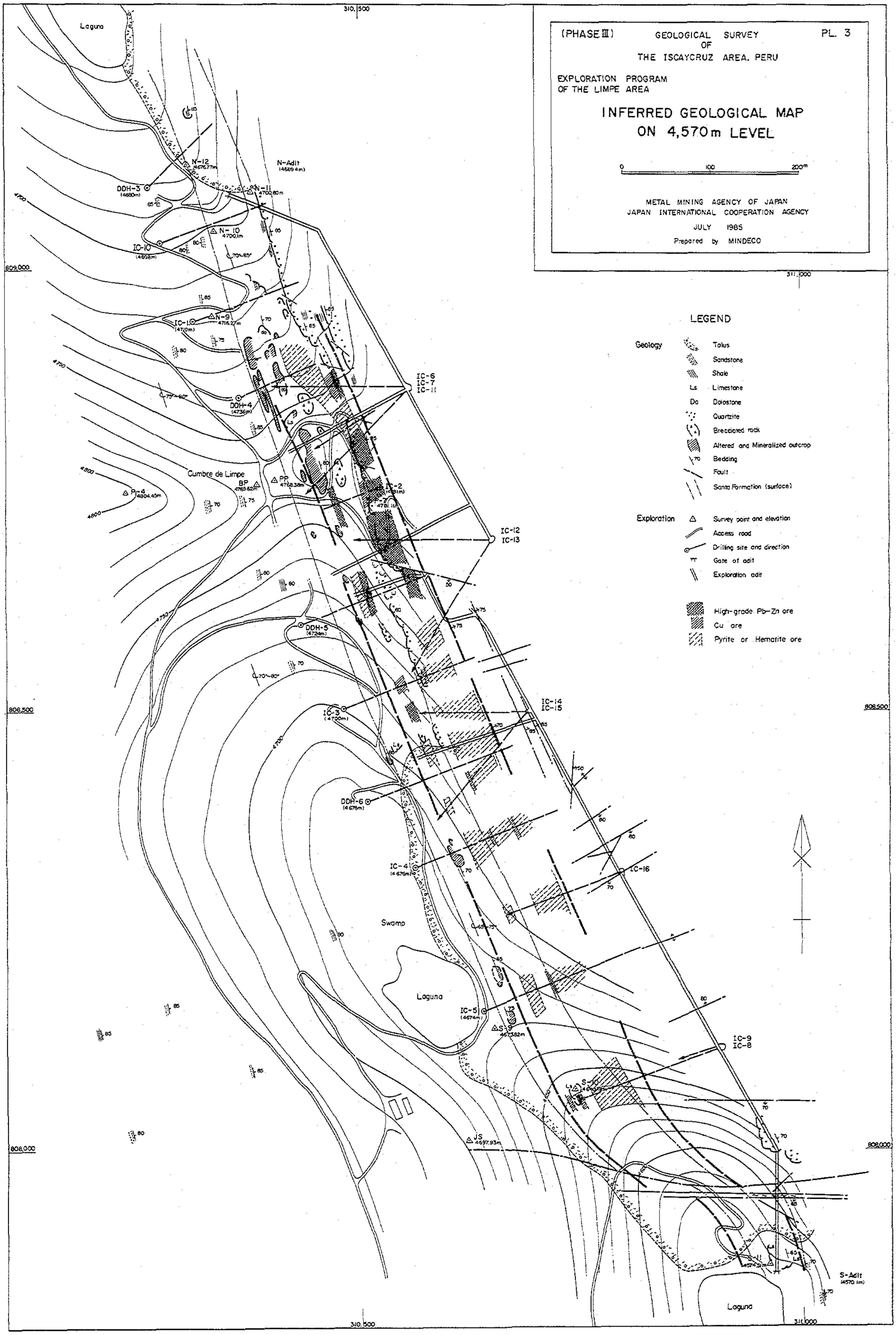


Fig. 9 Inferred Geological Map on 4,570m Level

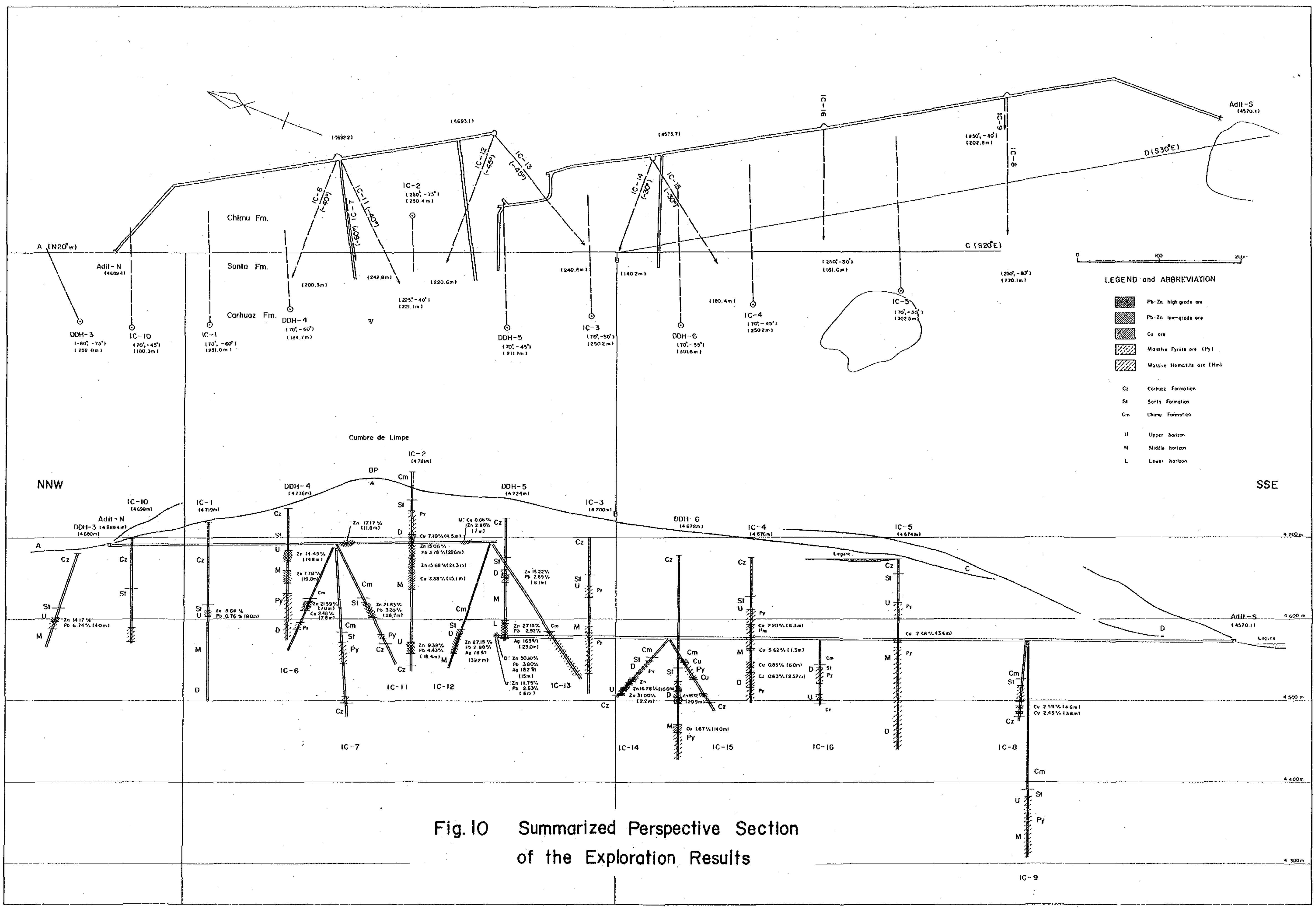


Fig. 10 Summarized Perspective Section of the Exploration Results

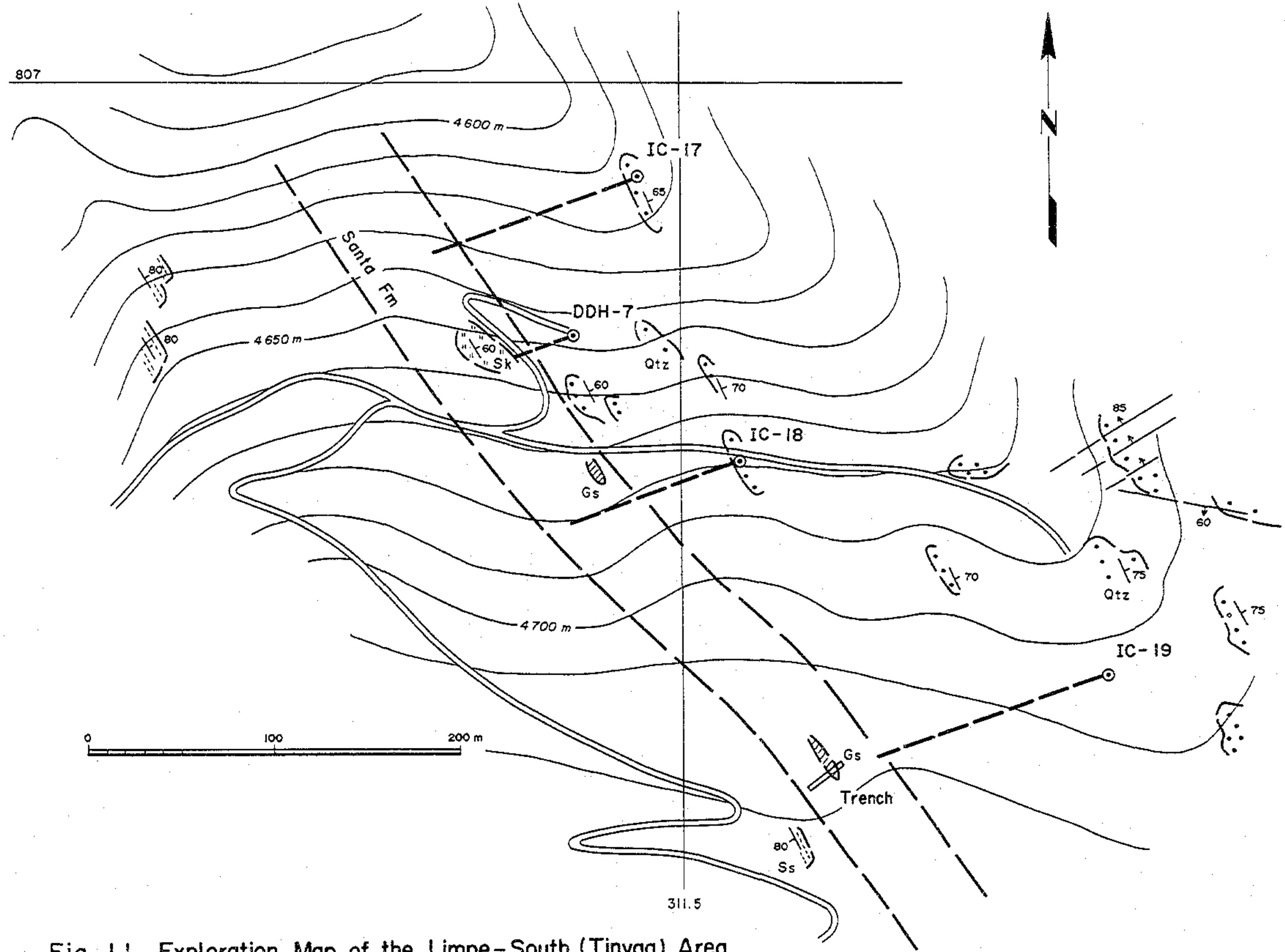


Fig. 11 Exploration Map of the Limpe-South (Tinyag) Area

Table 3 List of Drillings

Area	Drilling	Coordinate N	Coordinate E	Elevation (m)	Direction	Inclination	Depth (m)
Limpe Area	DDH- 3	809,093	310,262	4,680	60°	-50°	150
	IC -10	809,021	310,276	4,698	70°	-45°	180
	IC - 1	808,942	310,313	4,719	70°	-60°	250
	DDH- 4	808,856	310,364	4,736	70°	-60°	180
	IC - 2	808,755	310,523	4,781	250°	-75°	250
	DDH- 5	808,597	310,433	4,724	70°	-45°	210
	IC - 3	808,503	310,481	4,700	70°	-50°	250
	DDH- 6	808,396	310,508	4,678	70°	-55°	300
	IC - 4	808,322	310,562	4,676	70°	-45°	250
	IC - 5	808,158	310,639	4,674	70°	-50°	300
Adit-N	IC - 6	808,866	310,557	4,692	270°	-40°	200
	IC - 7	808,866	310,557	4,692	240°	-60°	240
	IC -11	808,868	310,558	4,692	225°	-45°	220
	IC -12	808,694	310,650	4,693	280°	-45°	220
	IC -13	808,692	310,654	4,693	210°	-45°	240
Adit-S	IC -14	808,497	310,687	4,576	270°	-30°	140
	IC -15	808,496	310,688	4,576	210°	-30°	180
	IC -16	808,315	310,796	4,594	250°	-30°	160
	IC - 8	808,113	310,909	4,573	250°	-30°	200
	IC - 9	808,113	310,909	4,573	250°	-80°	270
Tinyag Area	IC -17	806,960	311,480	4,620	250°	-45°	160
	DDH- 7	806,870	311,450	4,650	250°	-80°	230
	IC -18	806,800	311,500	4,680	250°	-60°	200
	IC -19	806,740	311,630	4,700	250°	-50°	200

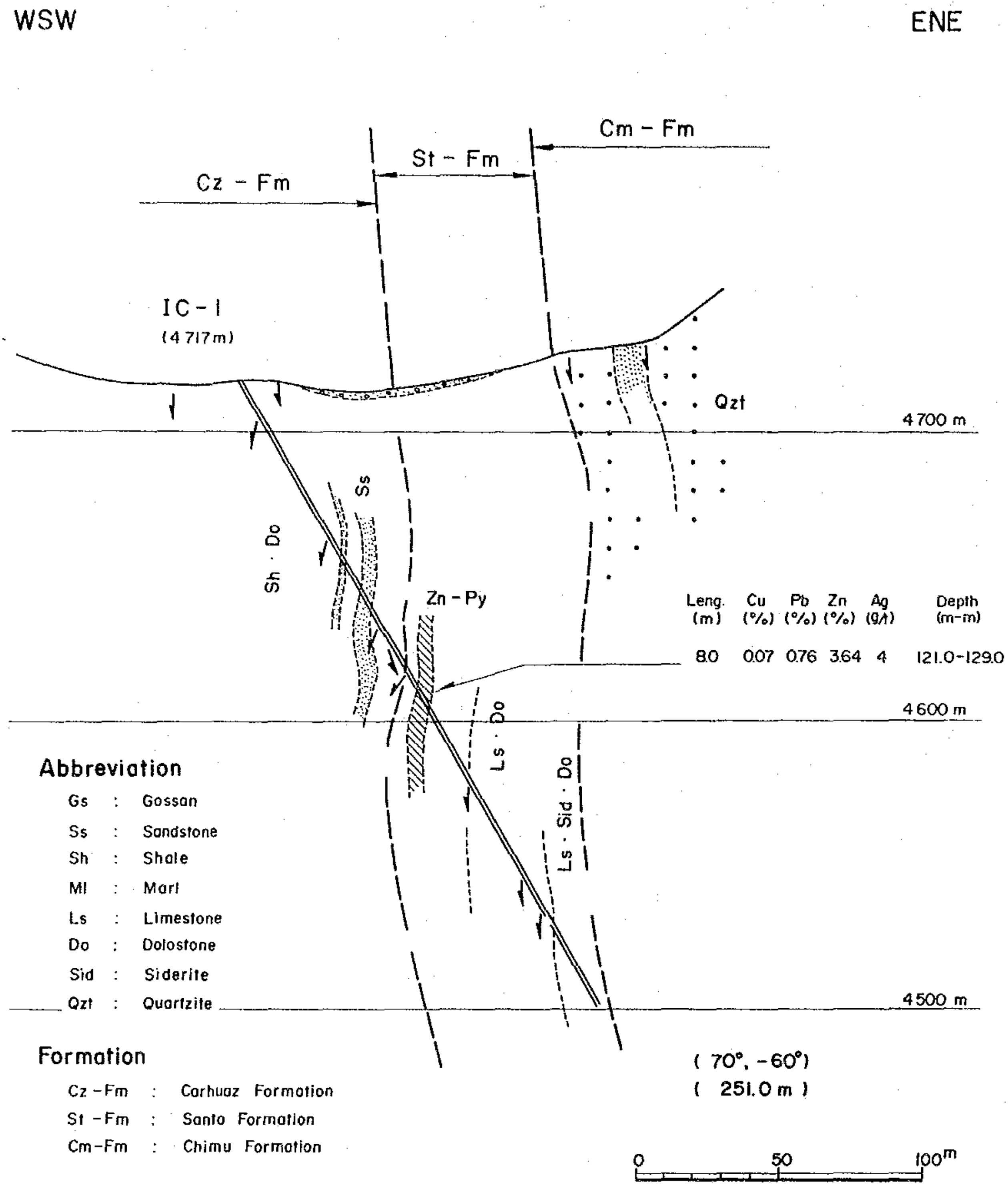


Fig. 13 - 1 Geological Section for IC - 1

(S70°W - N70°E)

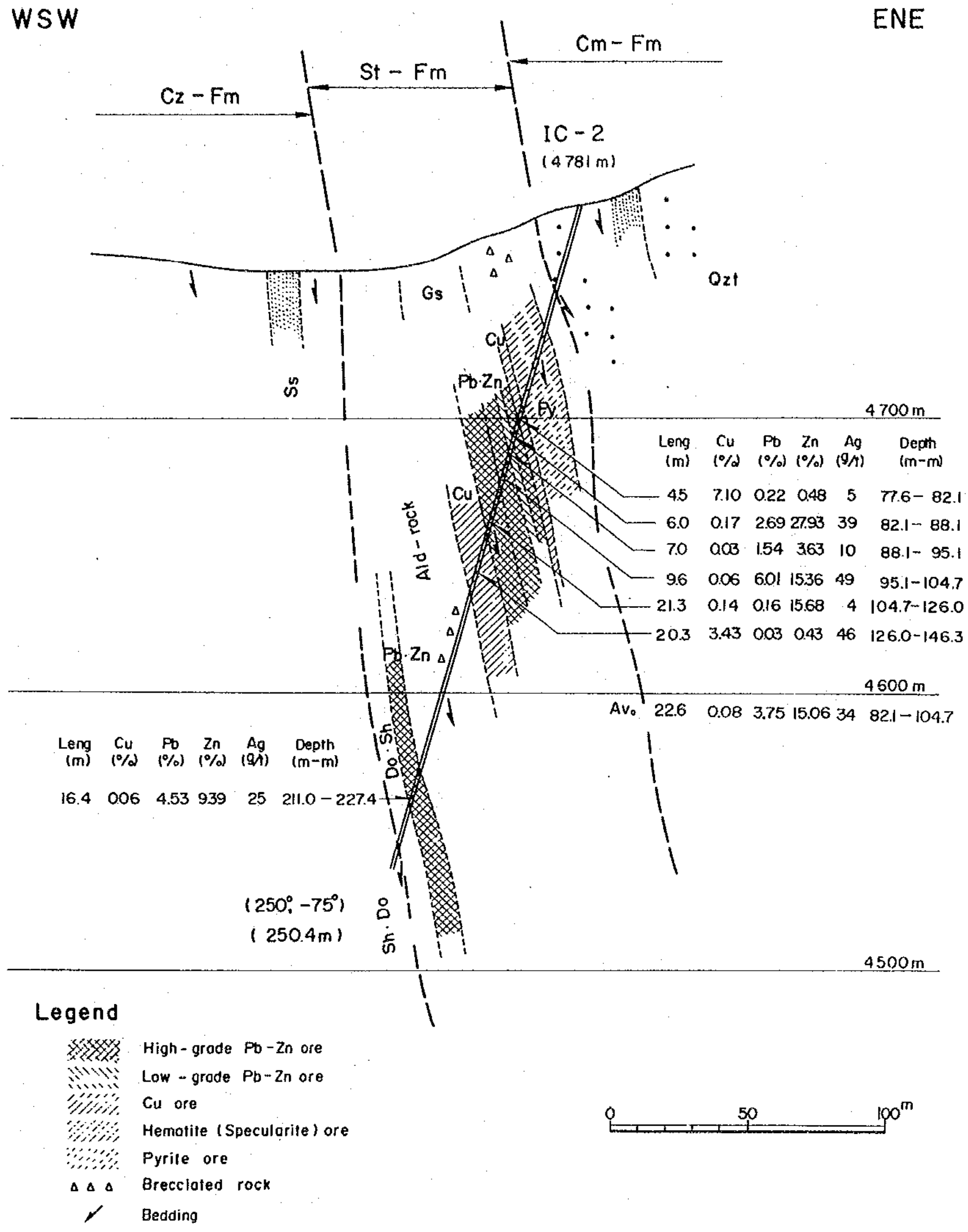


Fig. 13 - 2 Geological Section for IC - 2

(S70°W - N70°E)

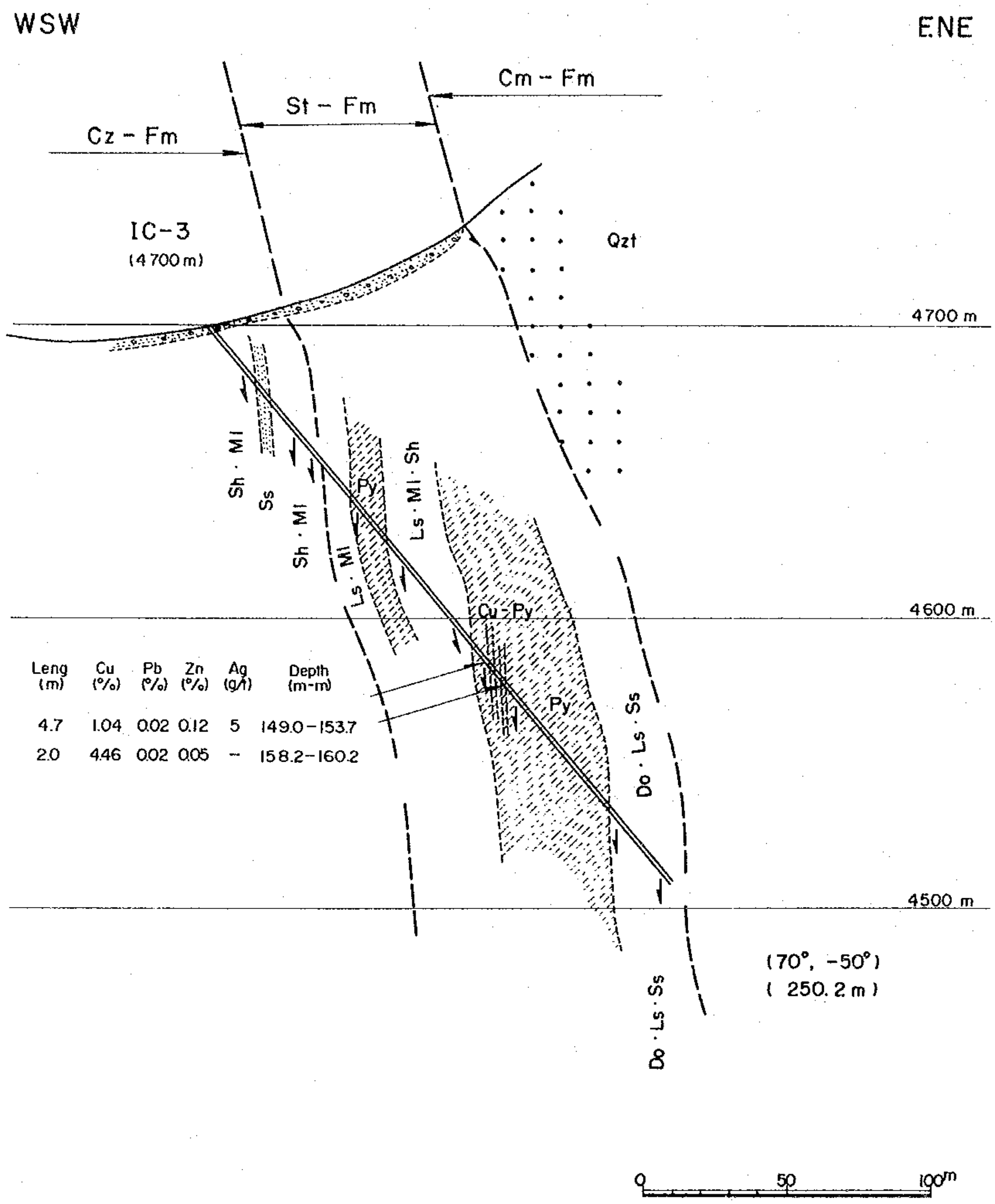


Fig. 13− 3 Geological Section for IC−3

(S70°W − N70°E)

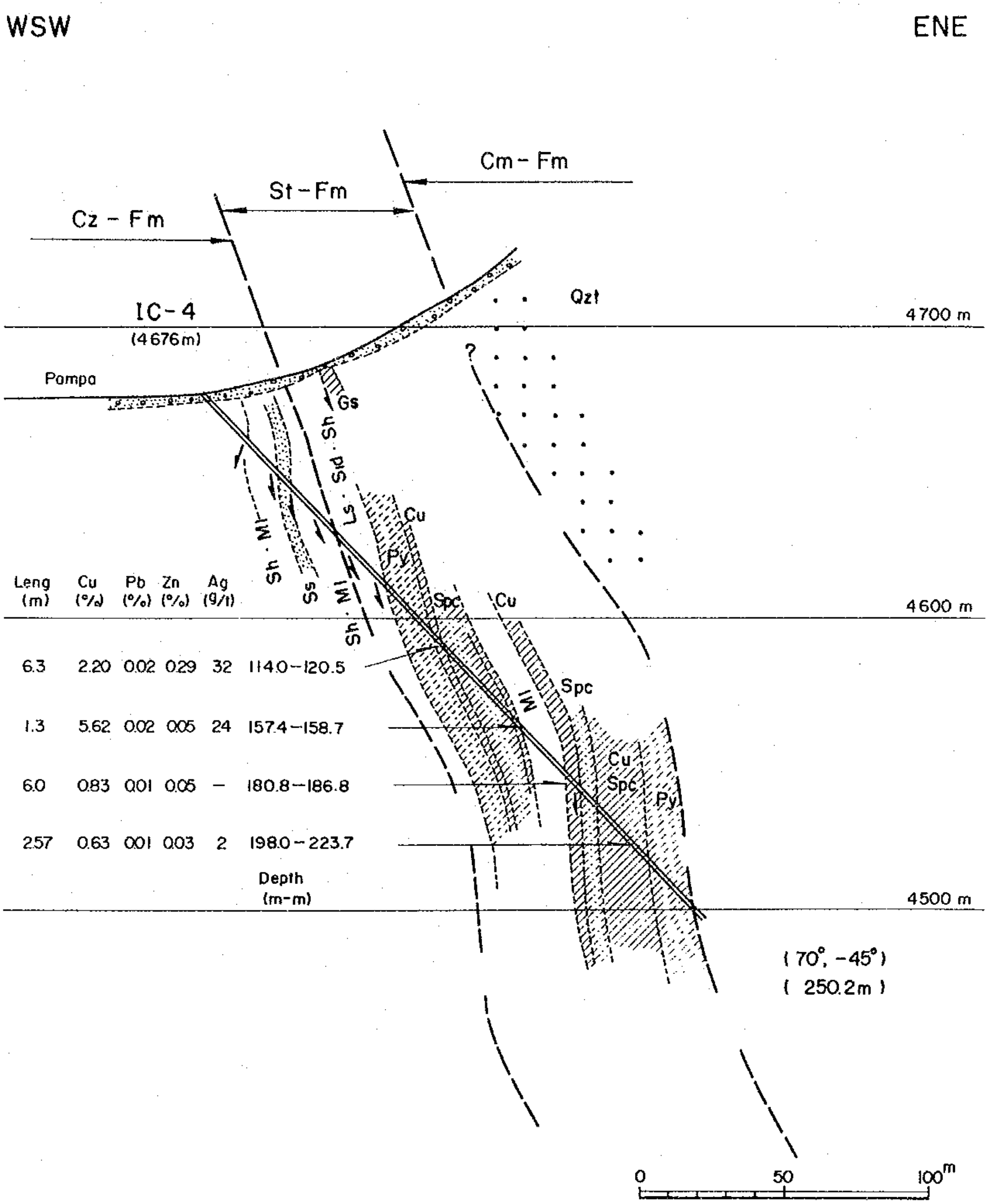


Fig. 13-4 Geological Section for IC-4

(S70°W - N70°E)

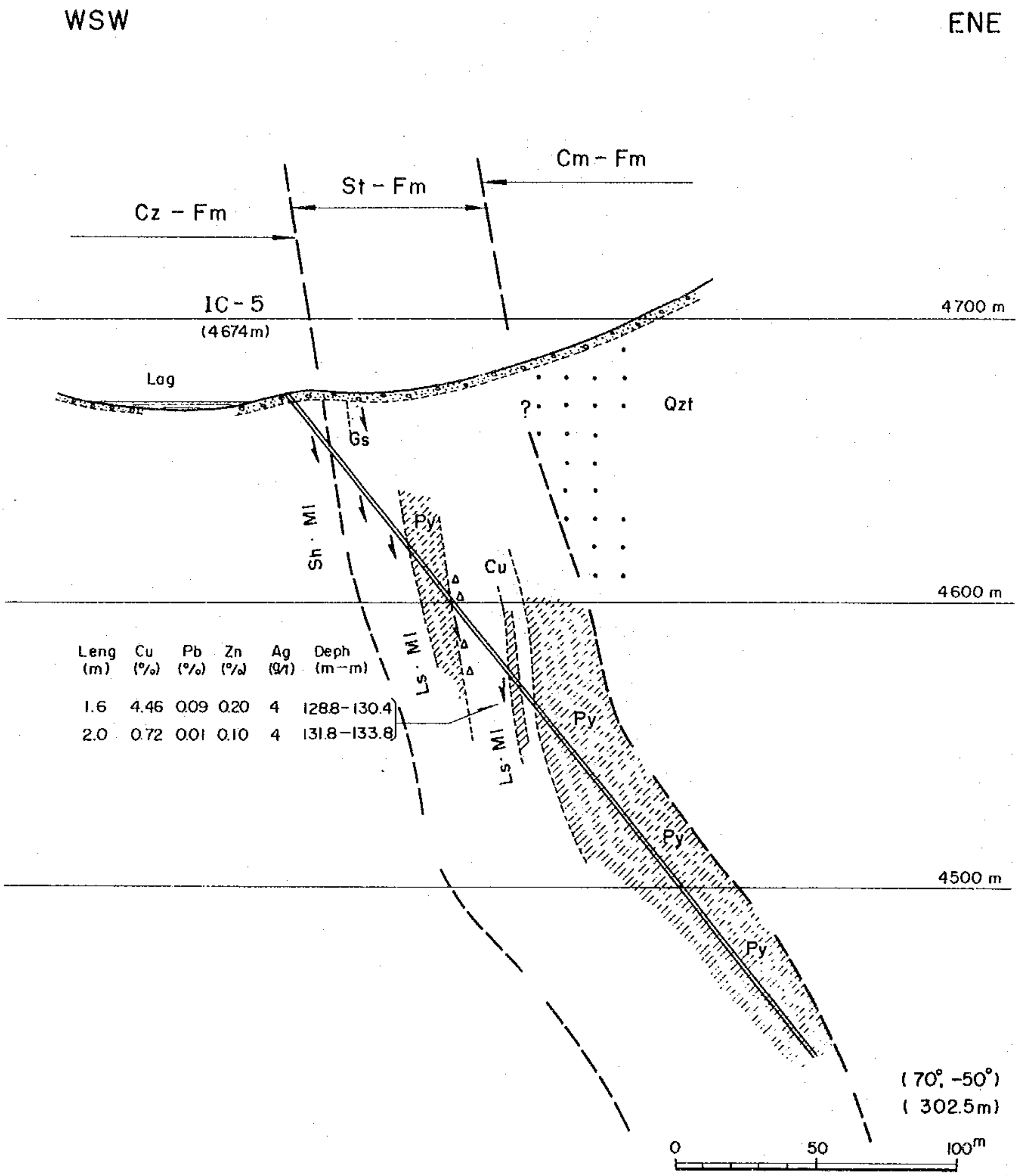


Fig. 13-5 Geological Section for IC-5

(S70°W - N70°E)

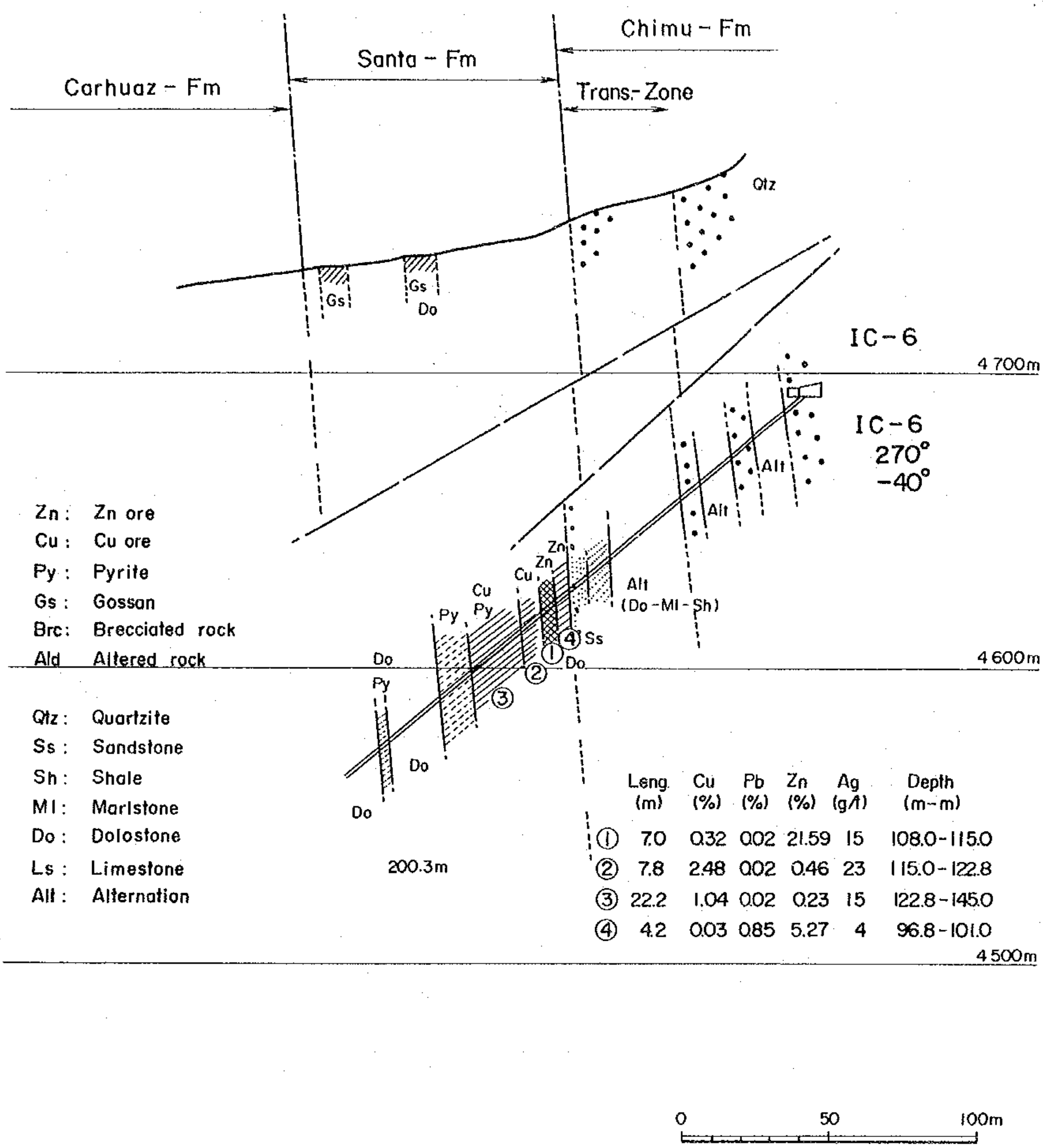


Fig. 13-6 Geological Section for IC-6

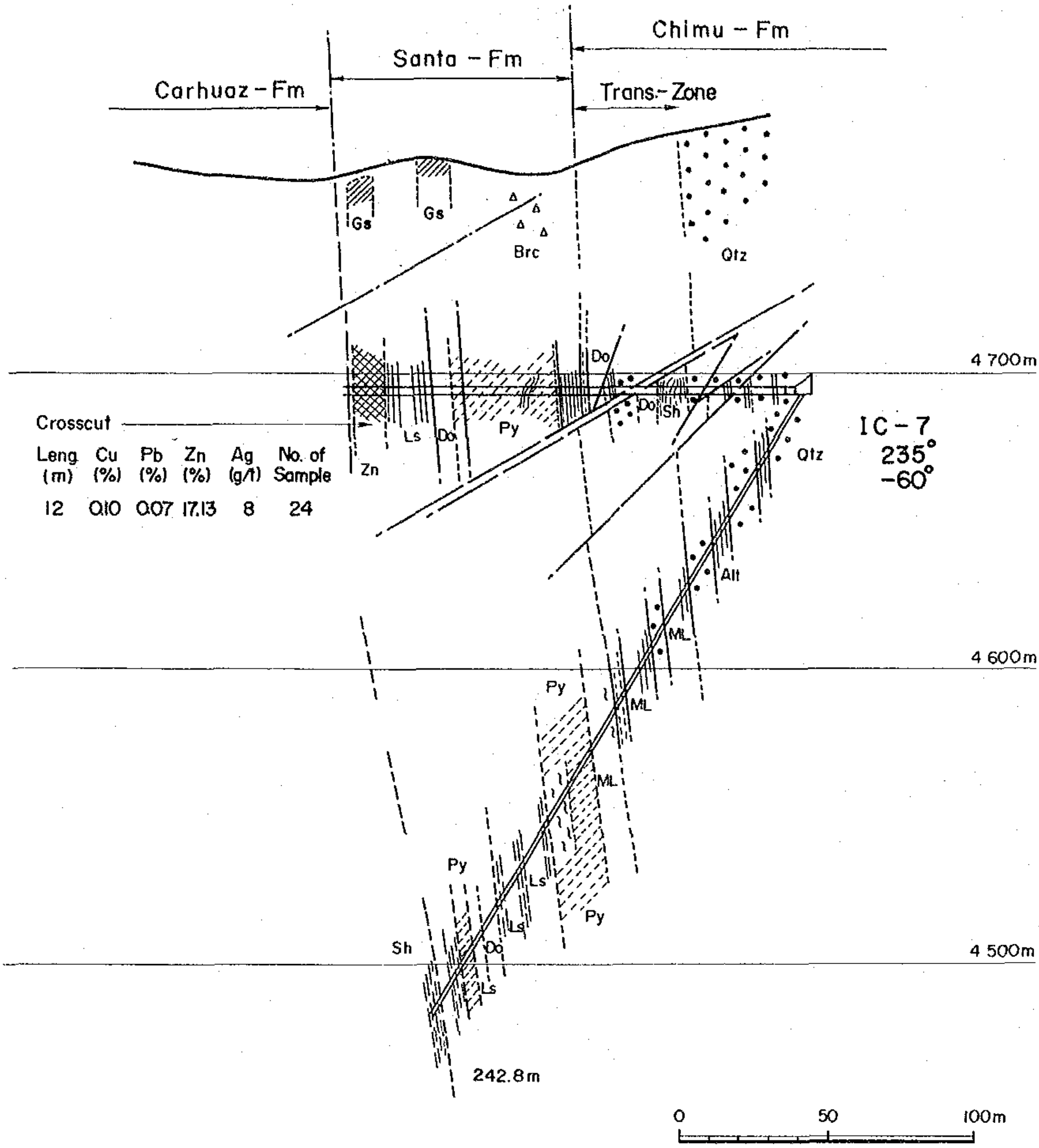
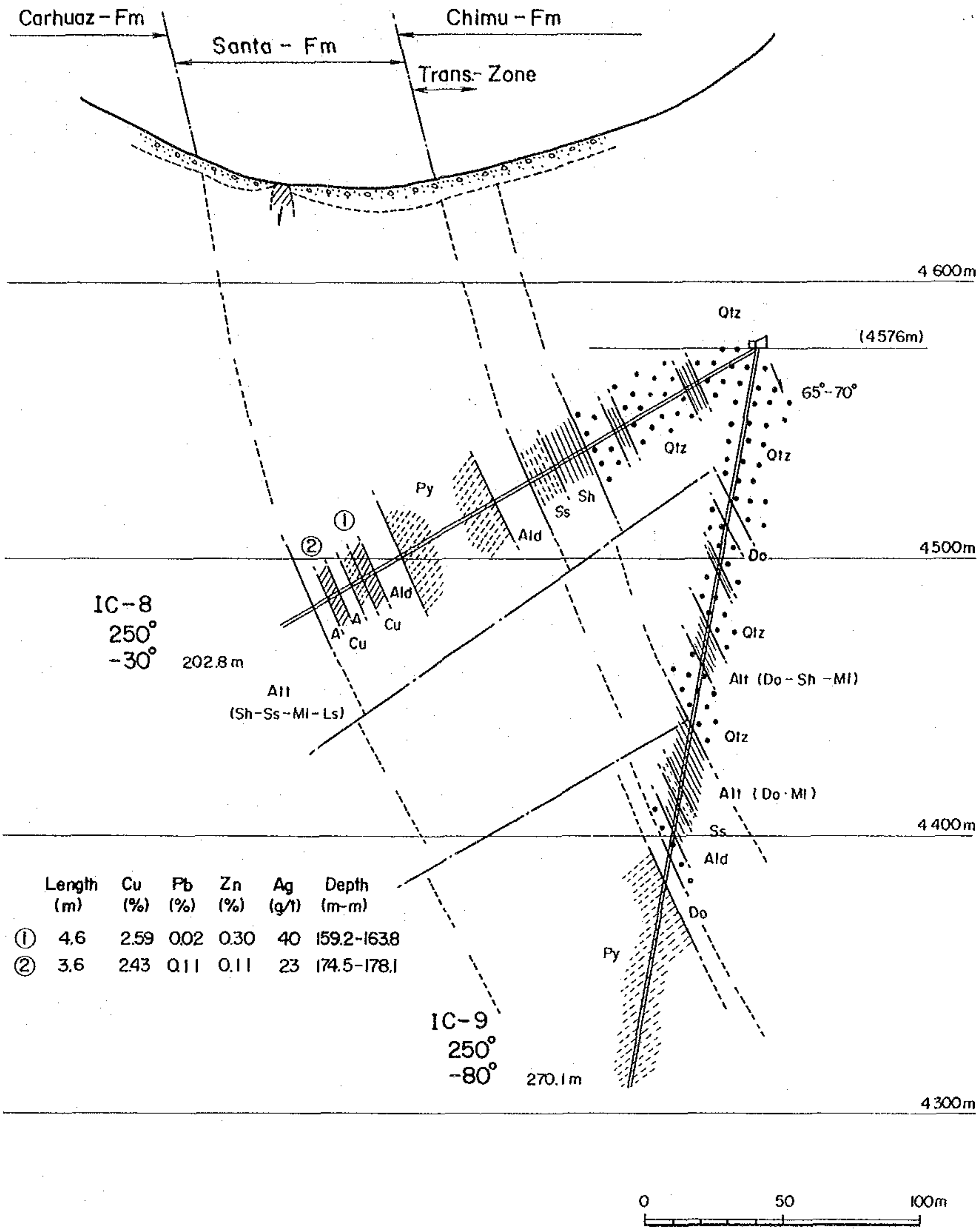


Fig. 13-7 Geological Section for IC-7 and Crosscut, NX-1



	Length (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Depth (m-m)
①	4.6	2.59	0.02	0.30	40	159.2-163.8
②	3.6	2.43	0.11	0.11	23	174.5-178.1

Fig. 13- 8 Geological Section for IC - 8 and IC - 9

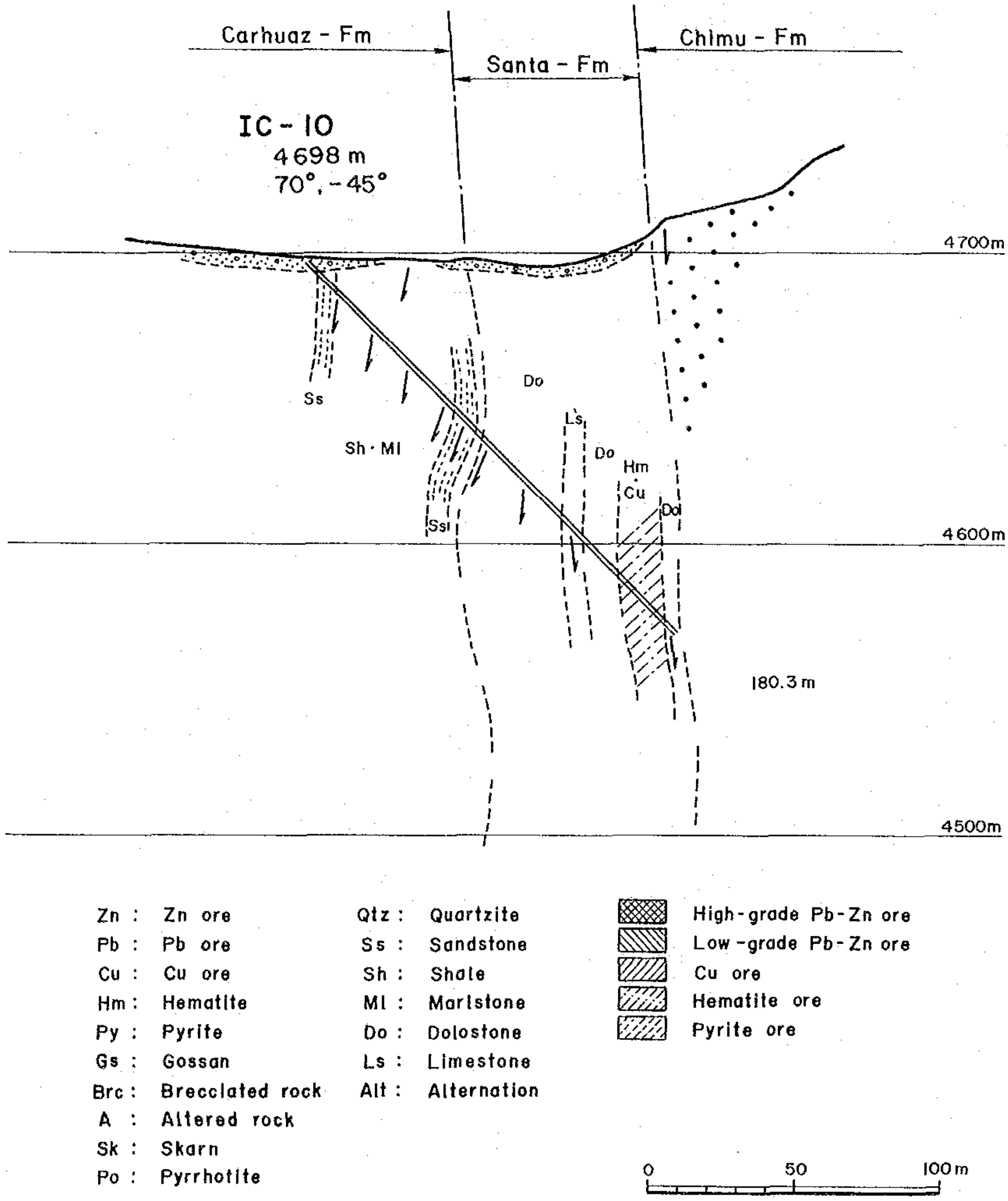
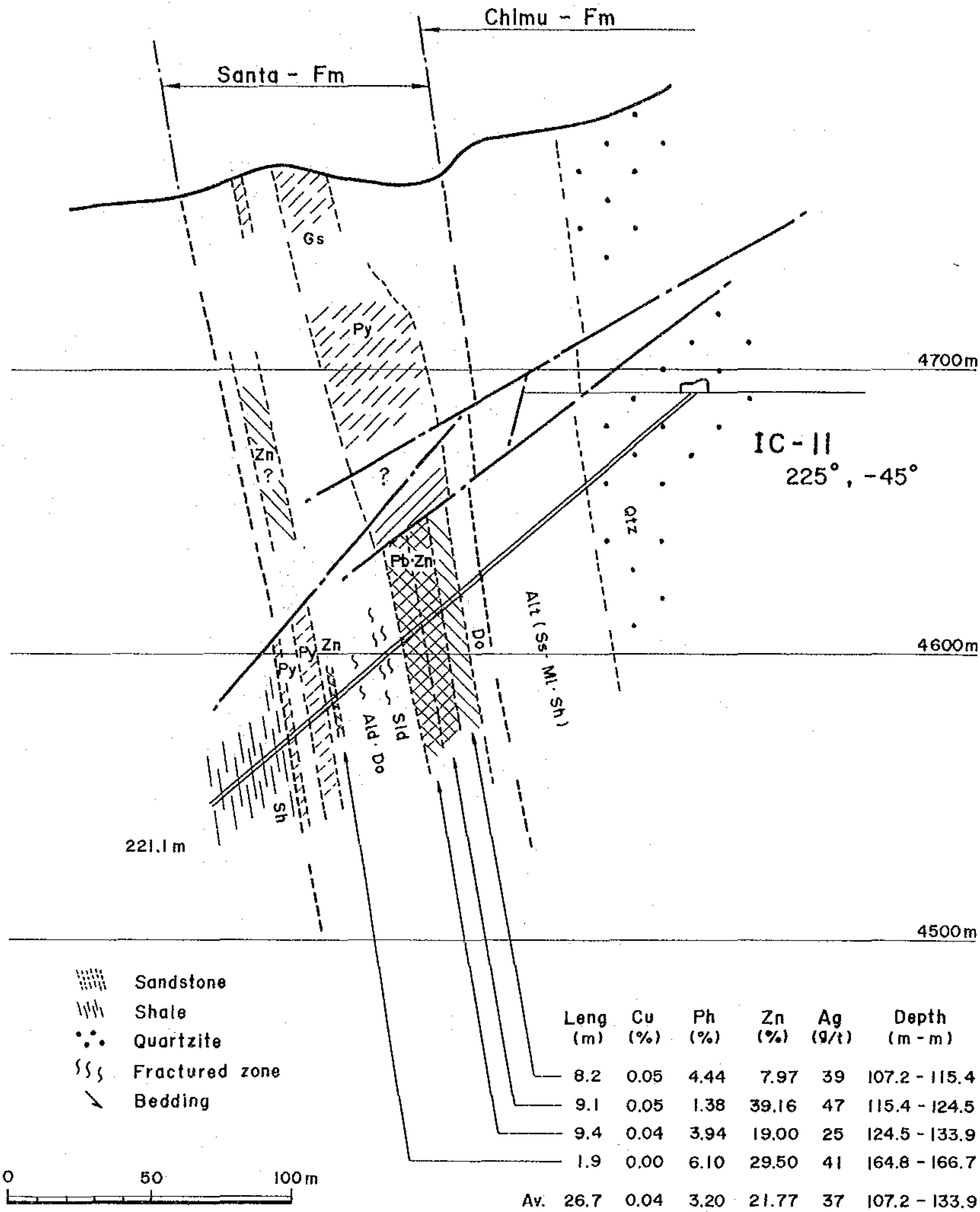
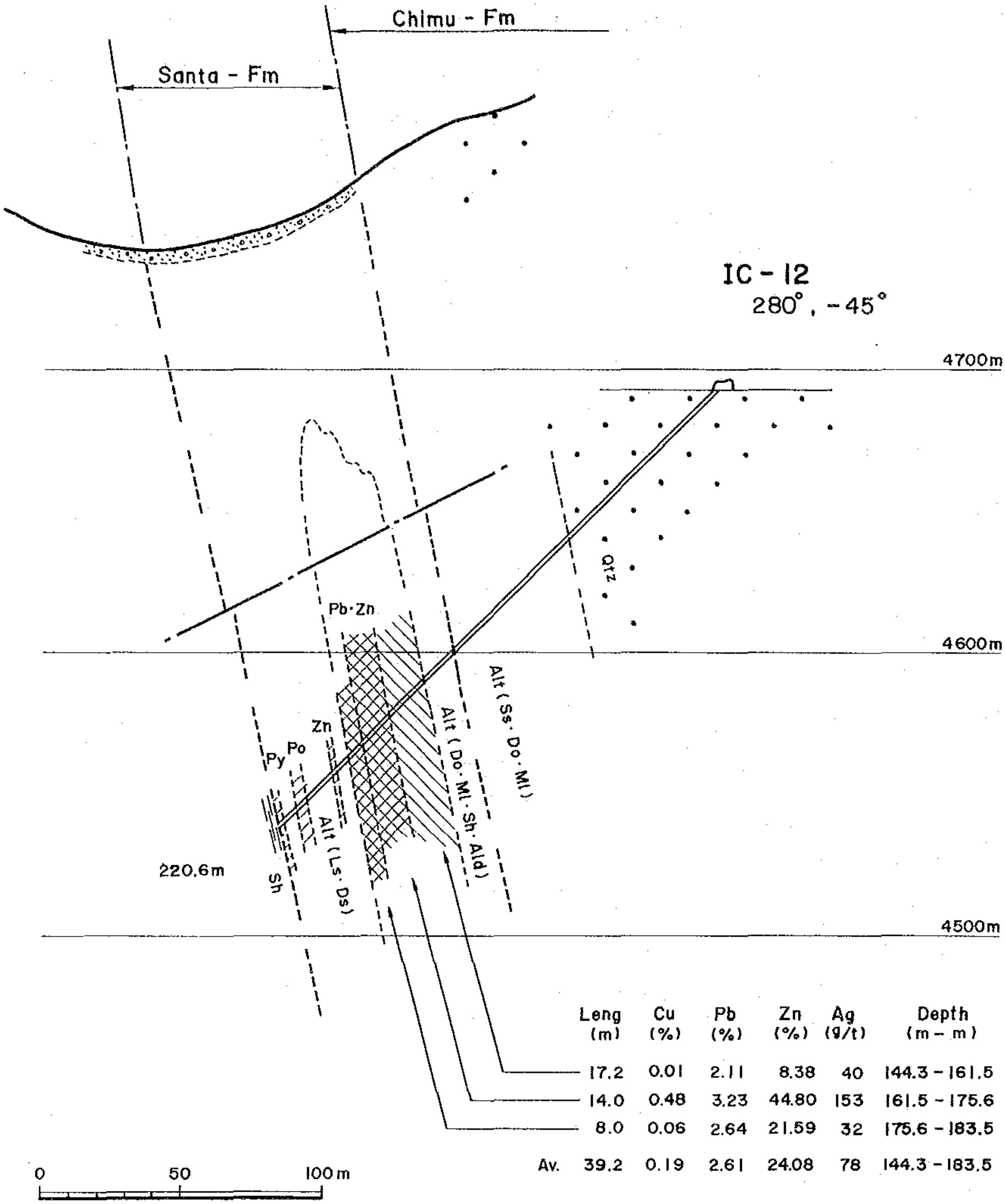


Fig. 13-9 Geological Section for IC-10



Leng (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Depth (m-m)
8.2	0.05	4.44	7.97	39	107.2 - 115.4
9.1	0.05	1.38	39.16	47	115.4 - 124.5
9.4	0.04	3.94	19.00	25	124.5 - 133.9
1.9	0.00	6.10	29.50	41	164.8 - 166.7
Av. 26.7	0.04	3.20	21.77	37	107.2 - 133.9

Fig. 13-10 Geological Section for IC-11



	Leng (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Depth (m - m)
	17.2	0.01	2.11	8.38	40	144.3 - 161.5
	14.0	0.48	3.23	44.80	153	161.5 - 175.6
	8.0	0.06	2.64	21.59	32	175.6 - 183.5
Av.	39.2	0.19	2.61	24.08	78	144.3 - 183.5

Fig. 13-11 Geological Section for IC-12

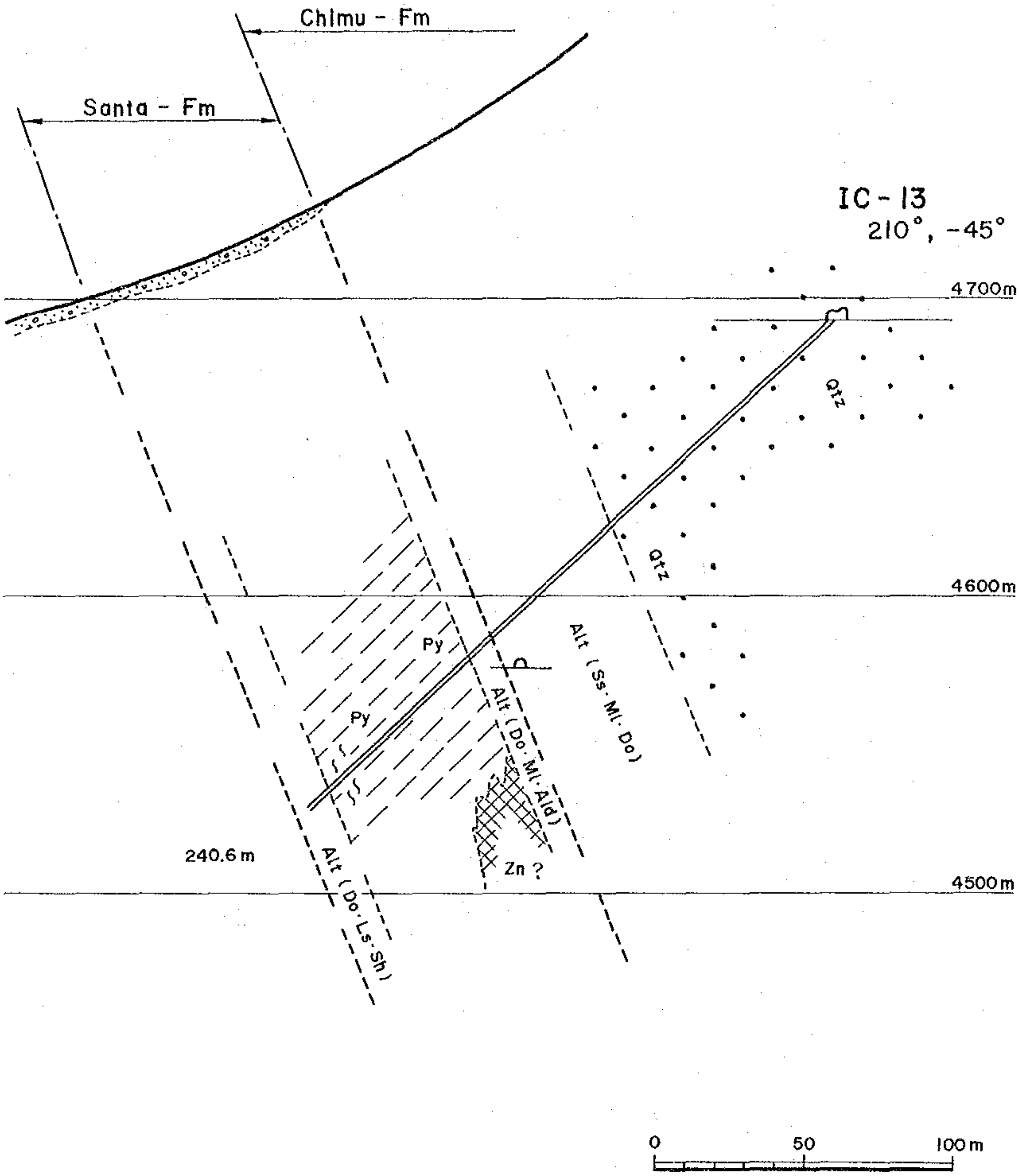
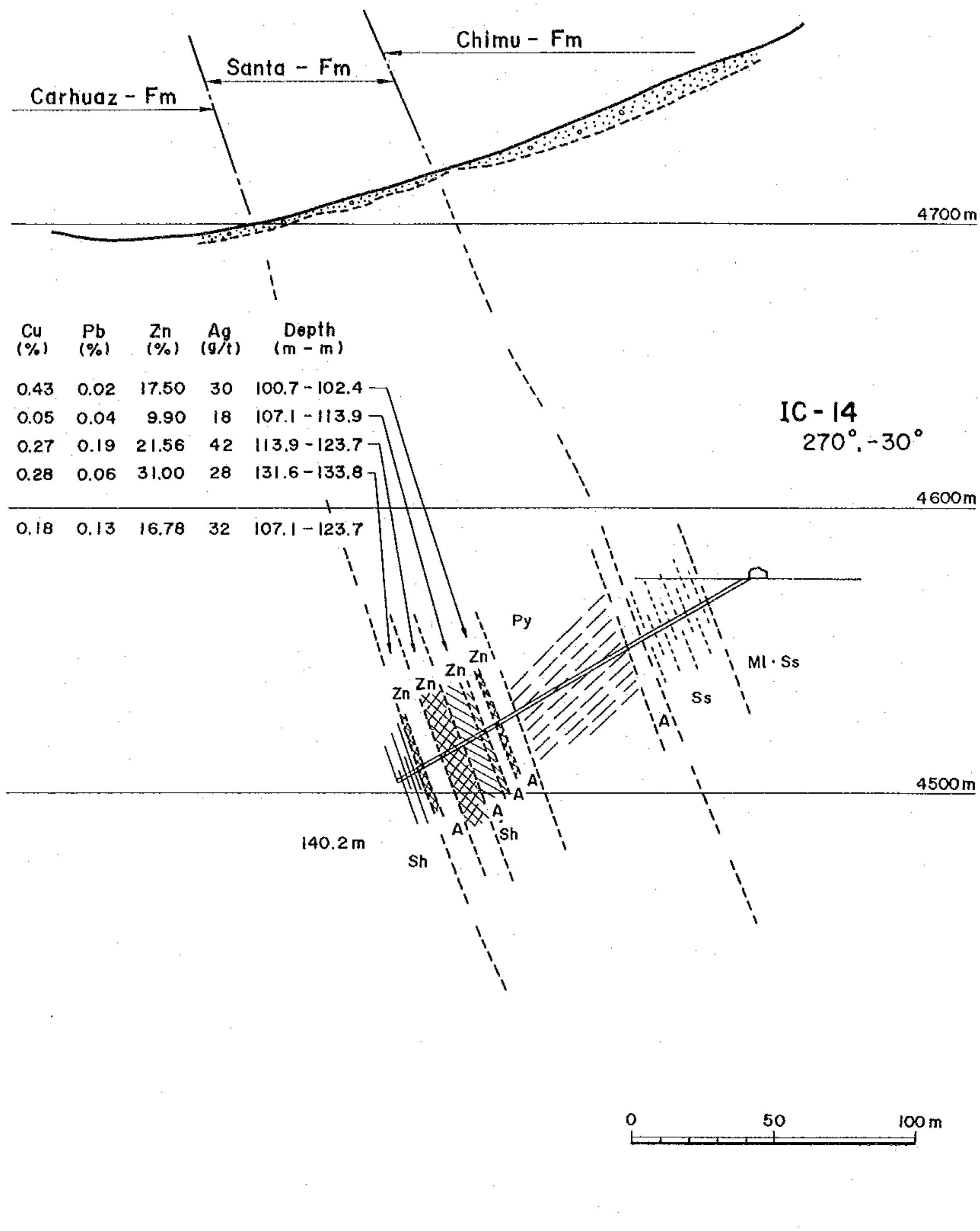


Fig. 13-12 Geological Section for IC-13



Leng (m)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Depth (m - m)
1.7	0.43	0.02	17.50	30	100.7 - 102.4
6.8	0.05	0.04	9.90	18	107.1 - 113.9
9.8	0.27	0.19	21.56	42	113.9 - 123.7
2.2	0.28	0.06	31.00	28	131.6 - 133.8
Av. 16.6	0.18	0.13	16.78	32	107.1 - 123.7

Fig. 13-13 Geological Section for IC-14

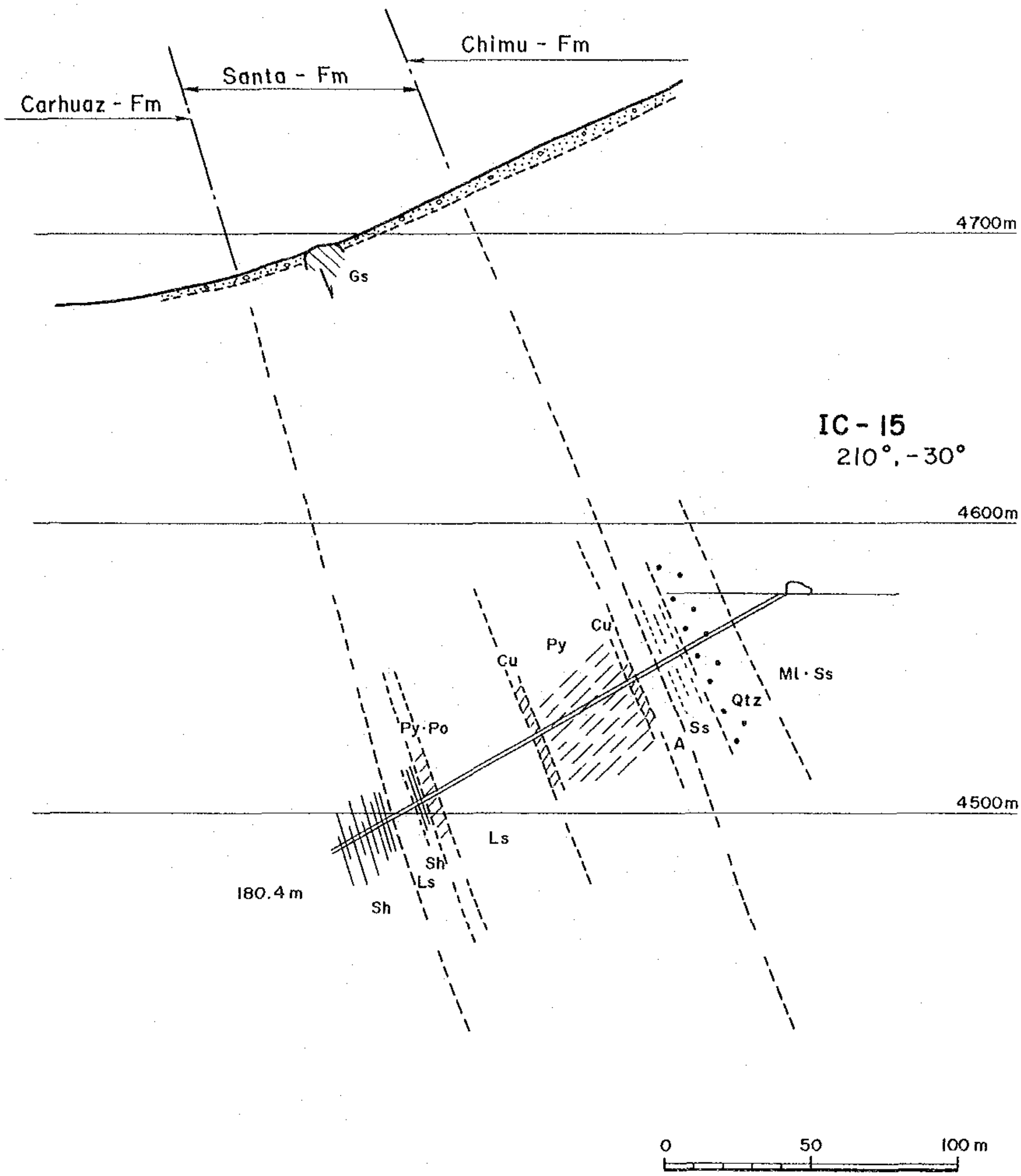


Fig. 13—14 Geological Section for IC-15

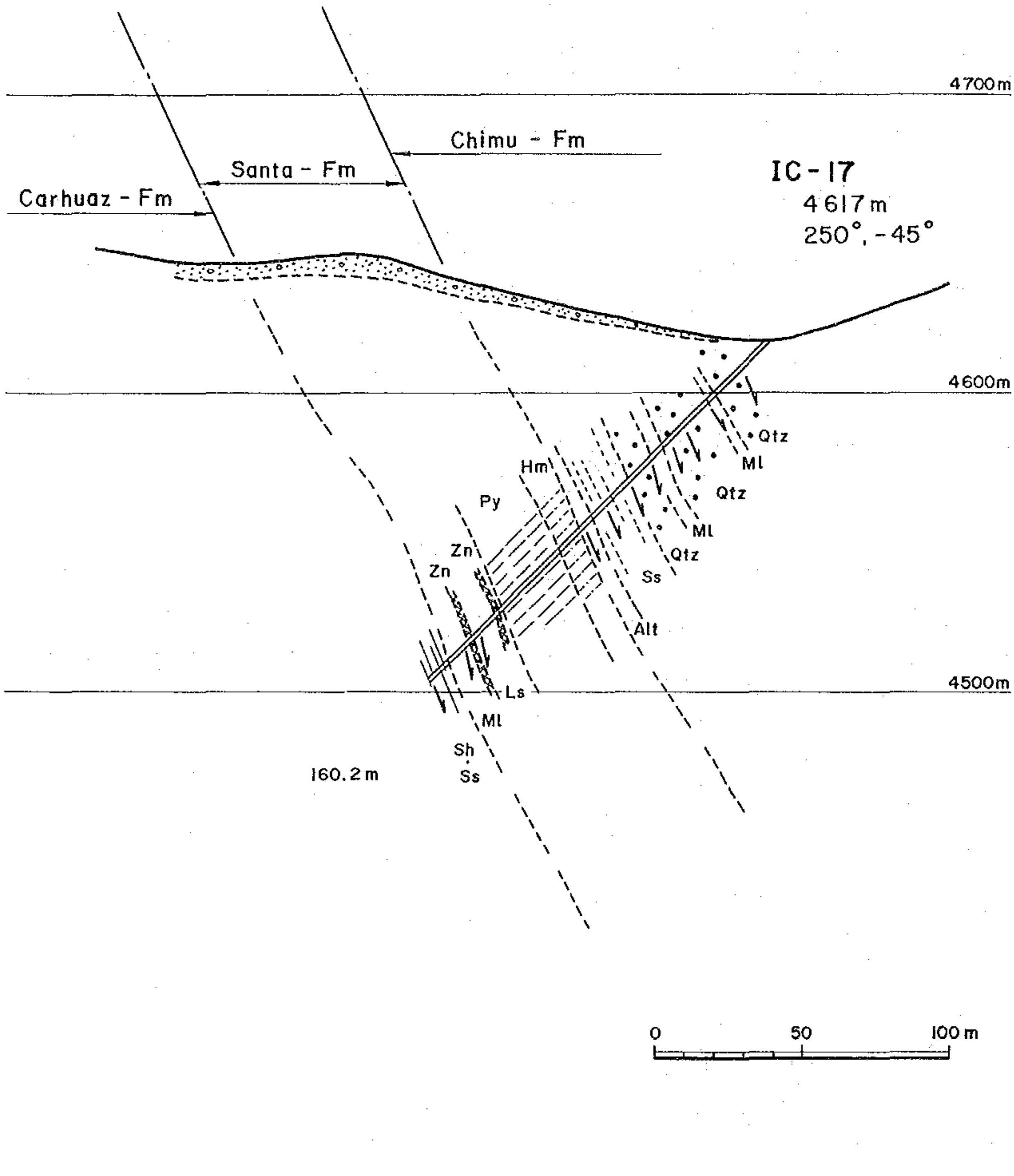


Fig. 13-16 Geological Section for IC-17

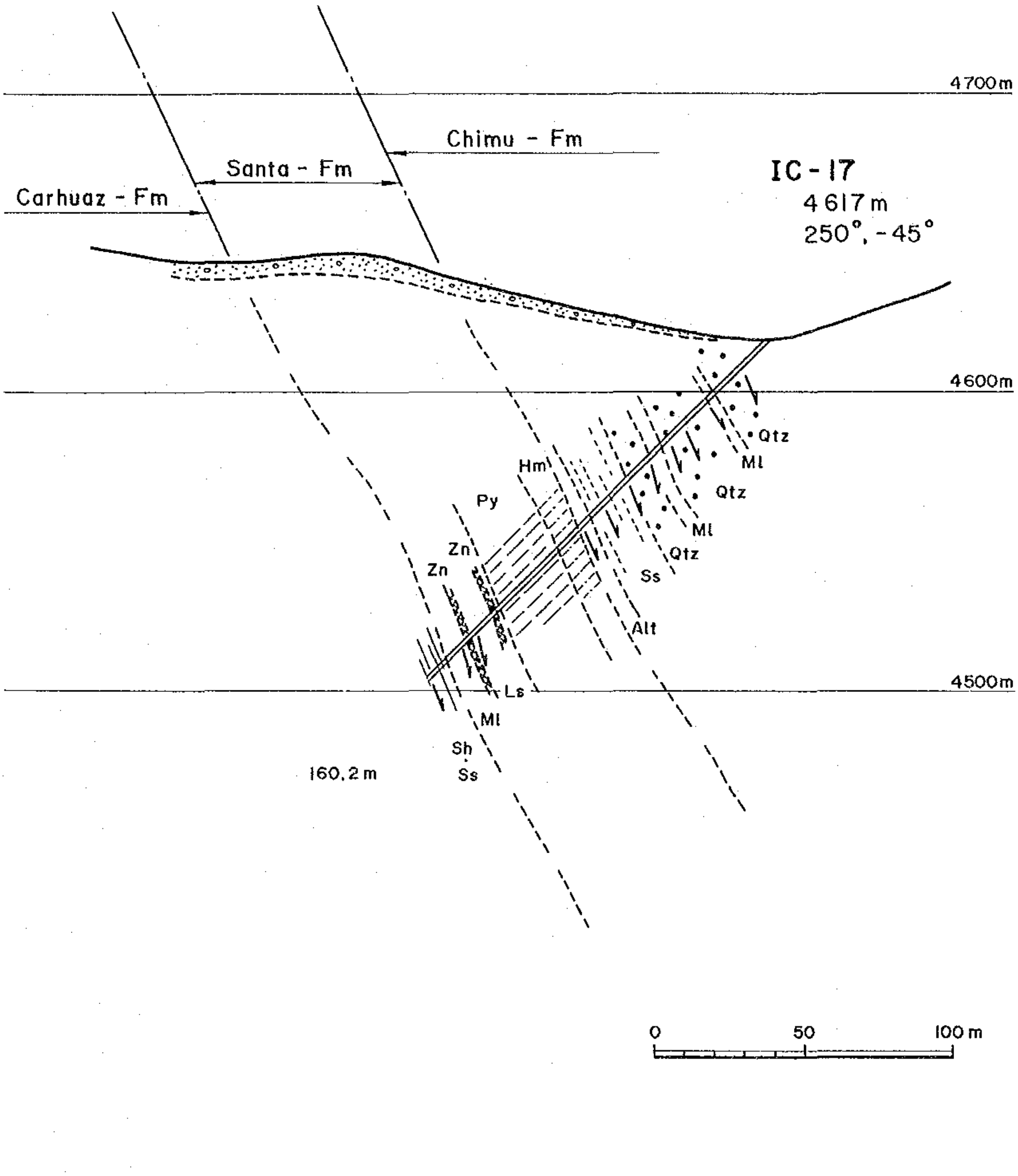


Fig. 13-16 Geological Section for IC-17

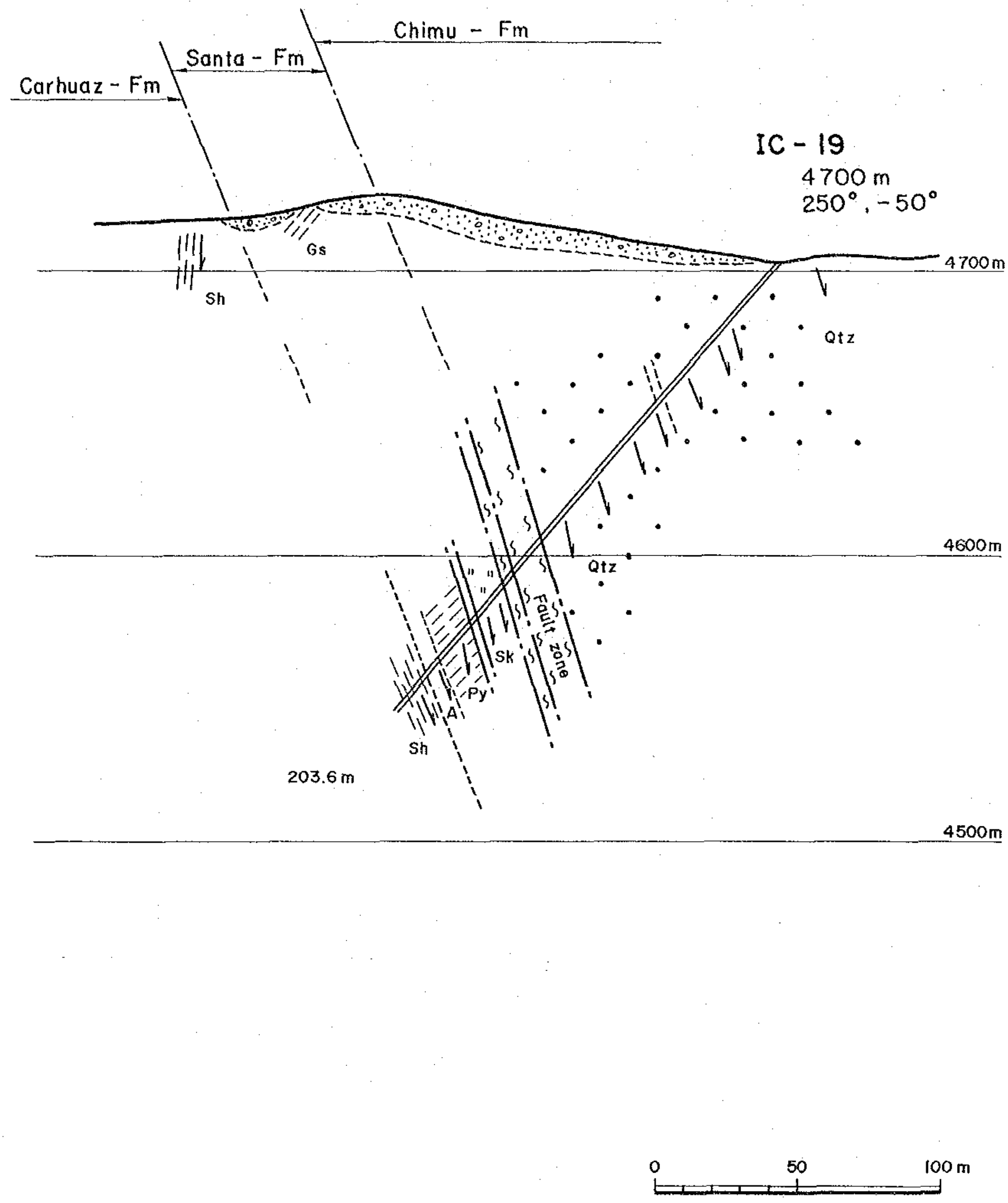


Fig. 13-18 Geological Section for IC-19

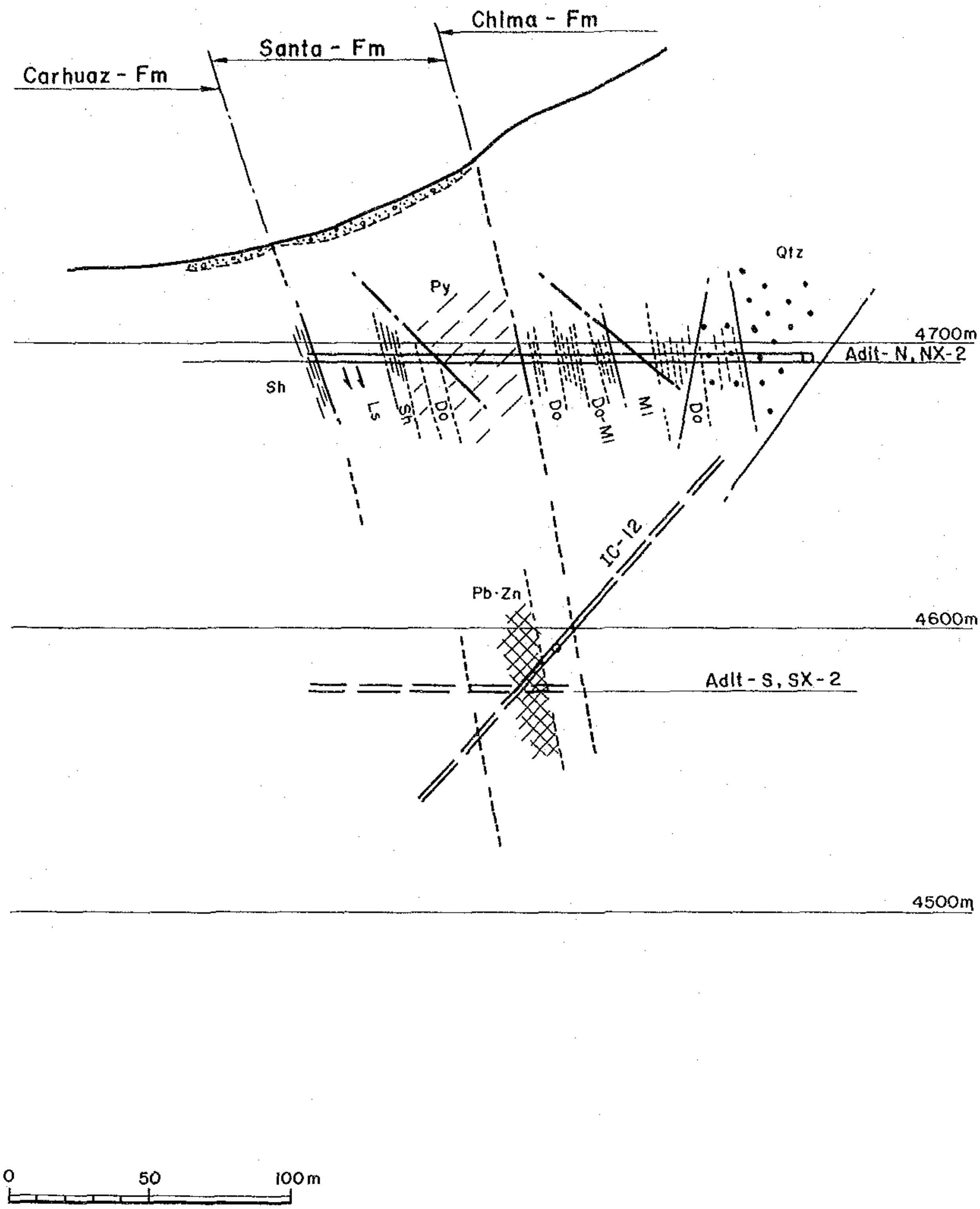


Fig. 14 - 1 Geological Section for Crosscut, NX-2

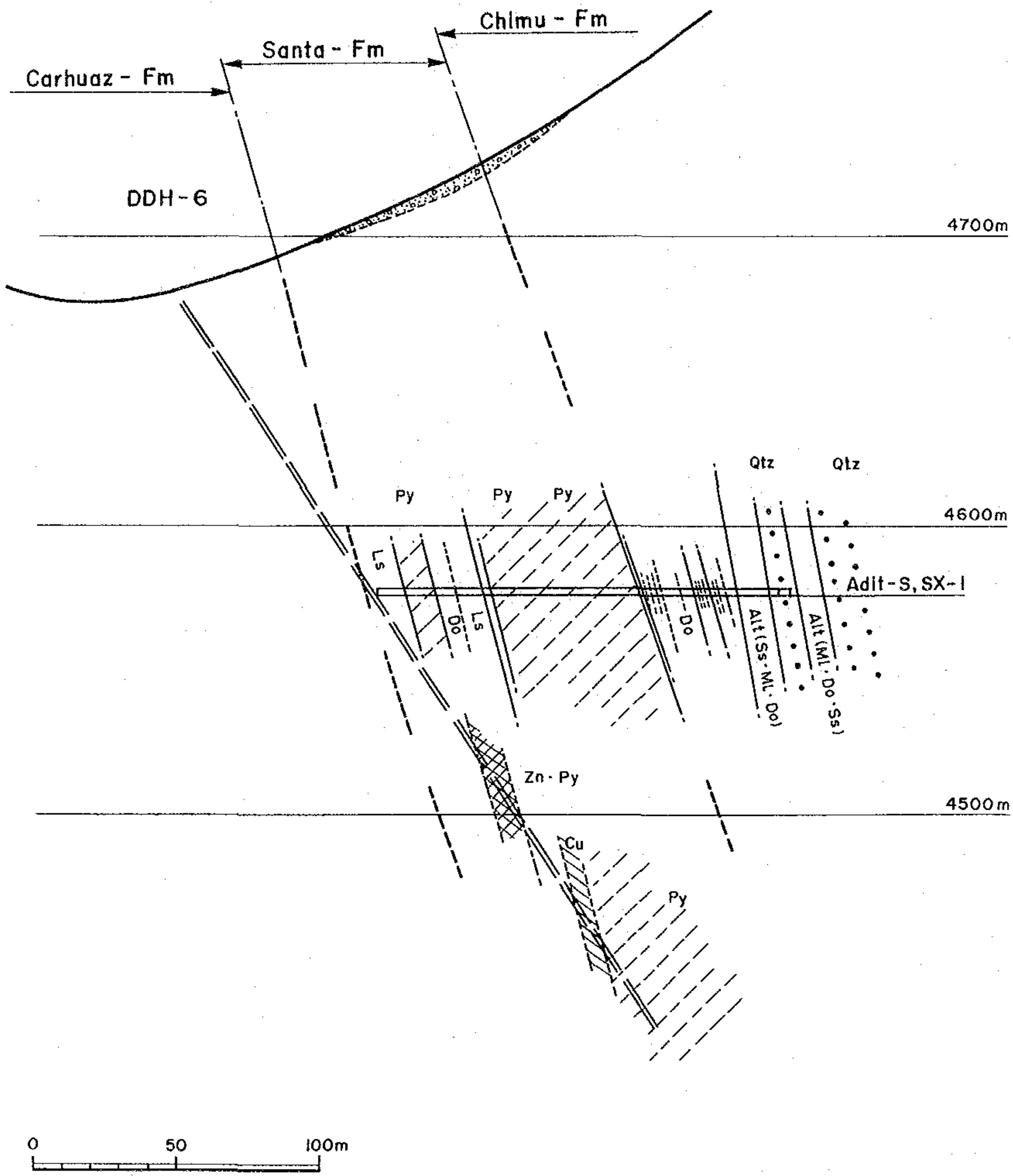


Fig. 14-2 Geological Section for Crosscut, SX-1

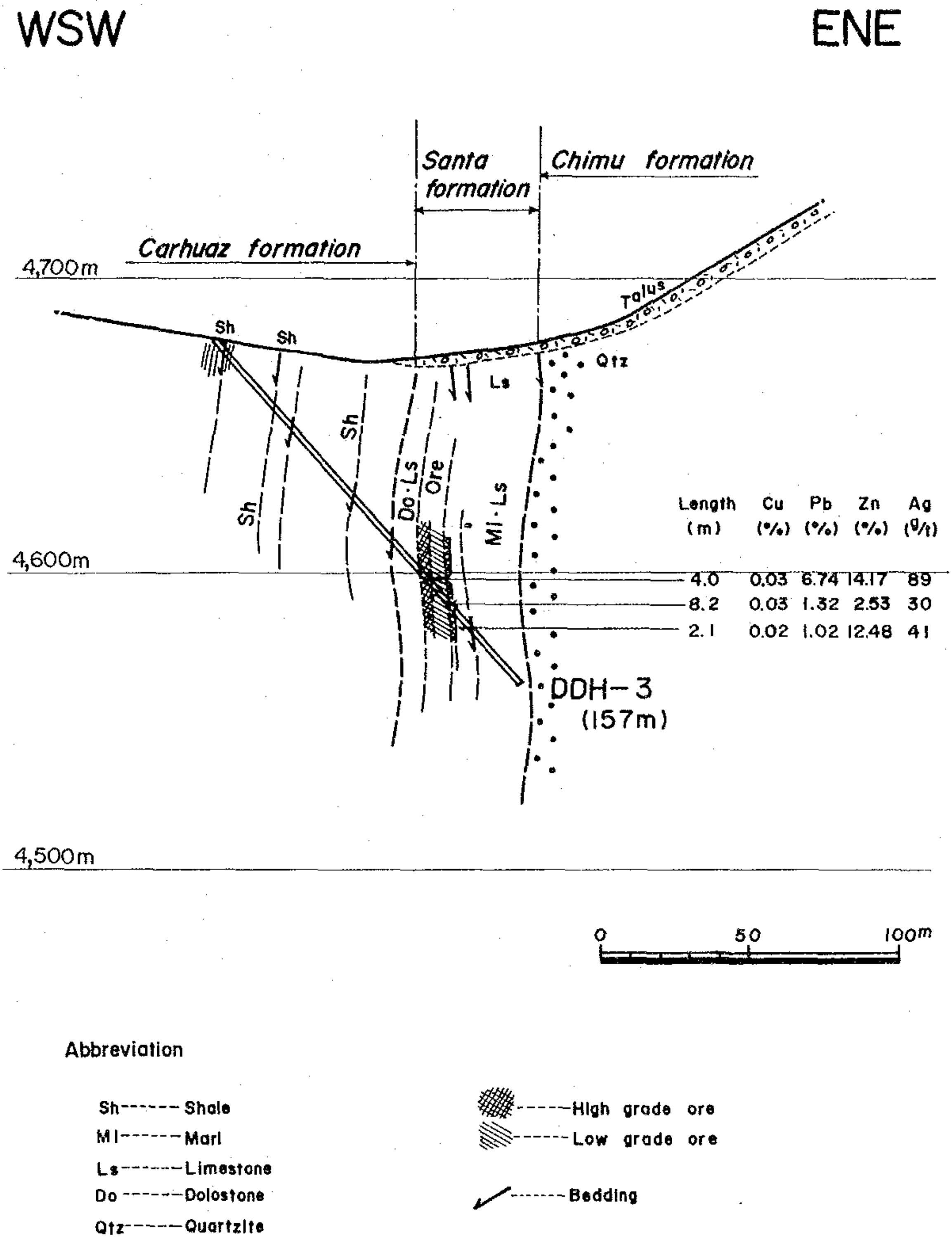
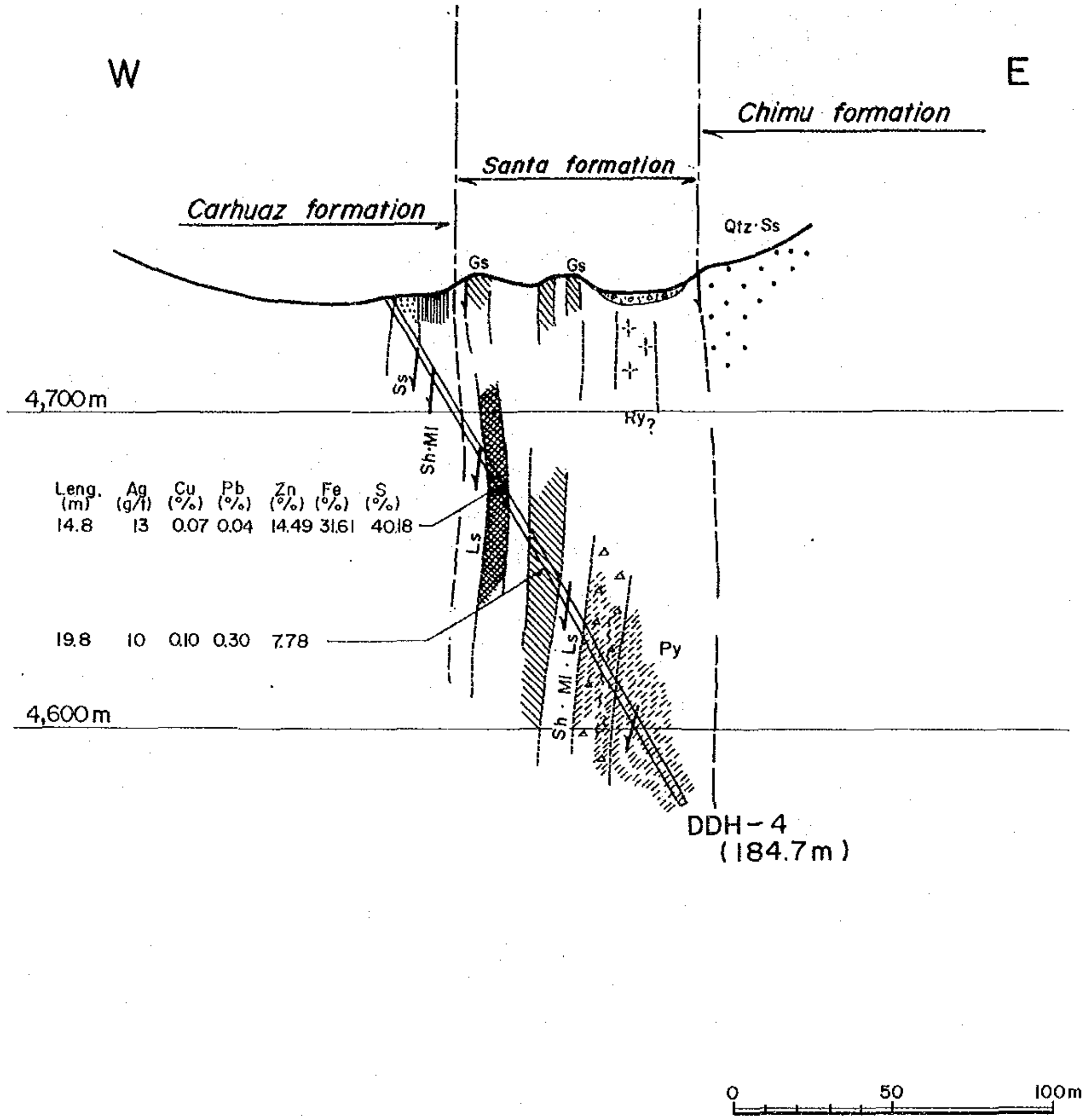


Fig. 15 − 1 Geological Section for DDH − 3
(S60°W — N60°E)

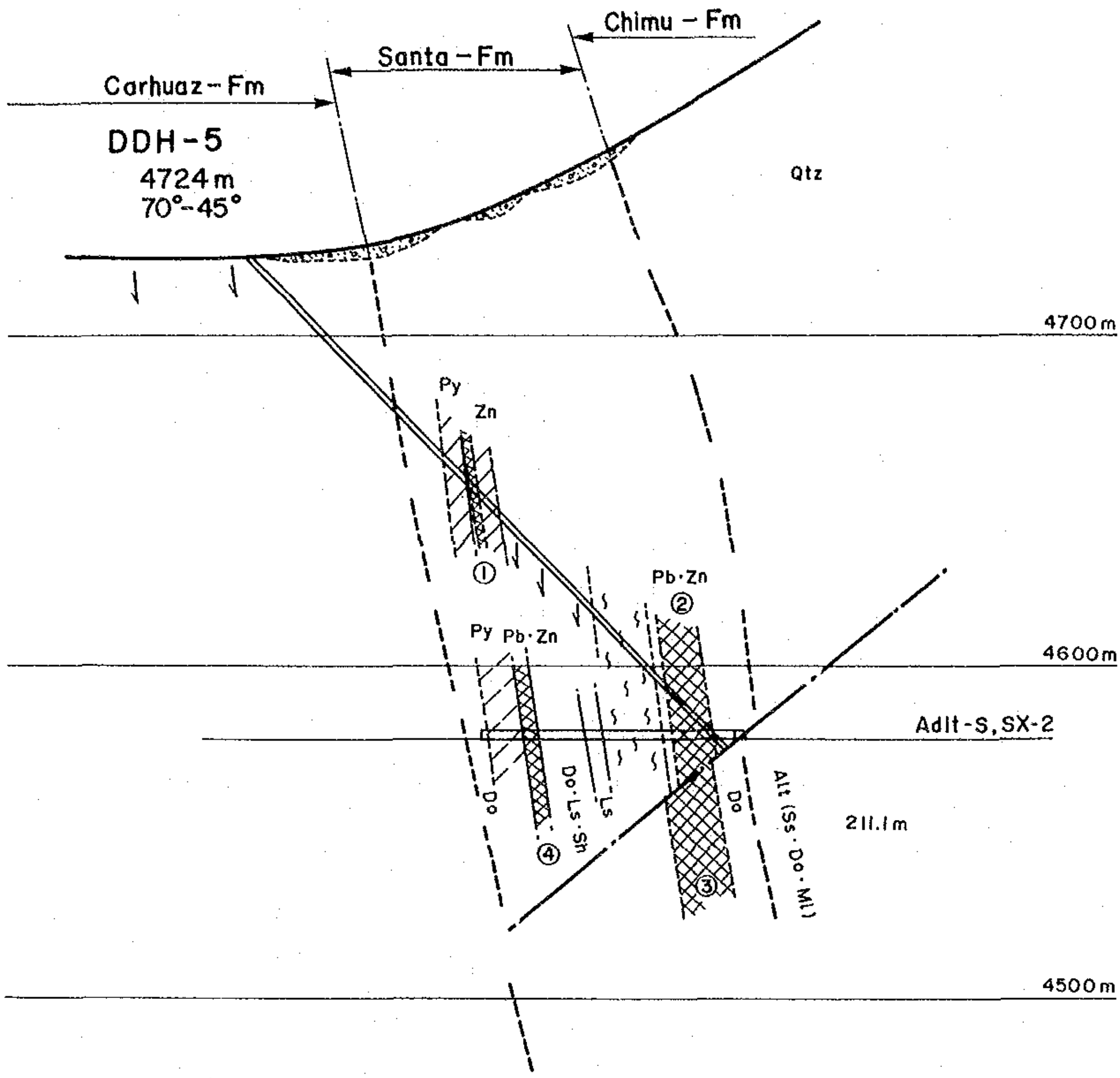


Abbreviation

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. 15－2 Geological Section for DDH－4 (S70°W－N70°E)



	Depth (m–m)	Length (m)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	
DDH-5	95.6–101.7	6.1	35	1.10	2.89	15.22	①
〃	181.10–204.0	23.0	163	0.14	2.97	27.15	②
SX-2	3.0–21.0	15.0	182	0.16	3.80	30.10	③
〃	58.0–65.0	6.0	26	0.08	2.63	11.75	④

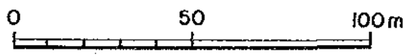


Fig. 15 – 3 Geological Section for DDH-5 and SX-2

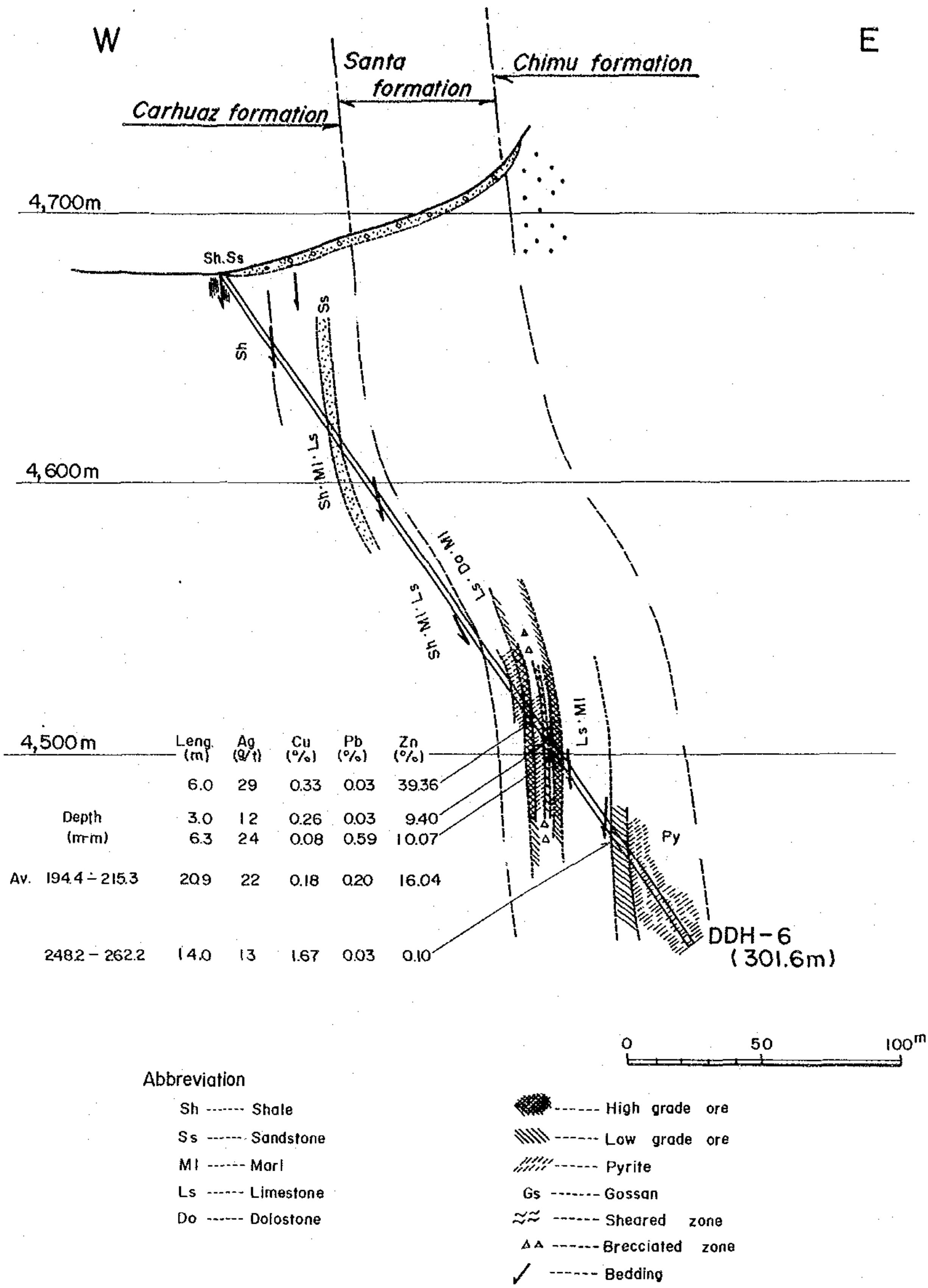


Fig. 15 – 4 Geological Section for DDH – 6
(S70°W – N70°E)

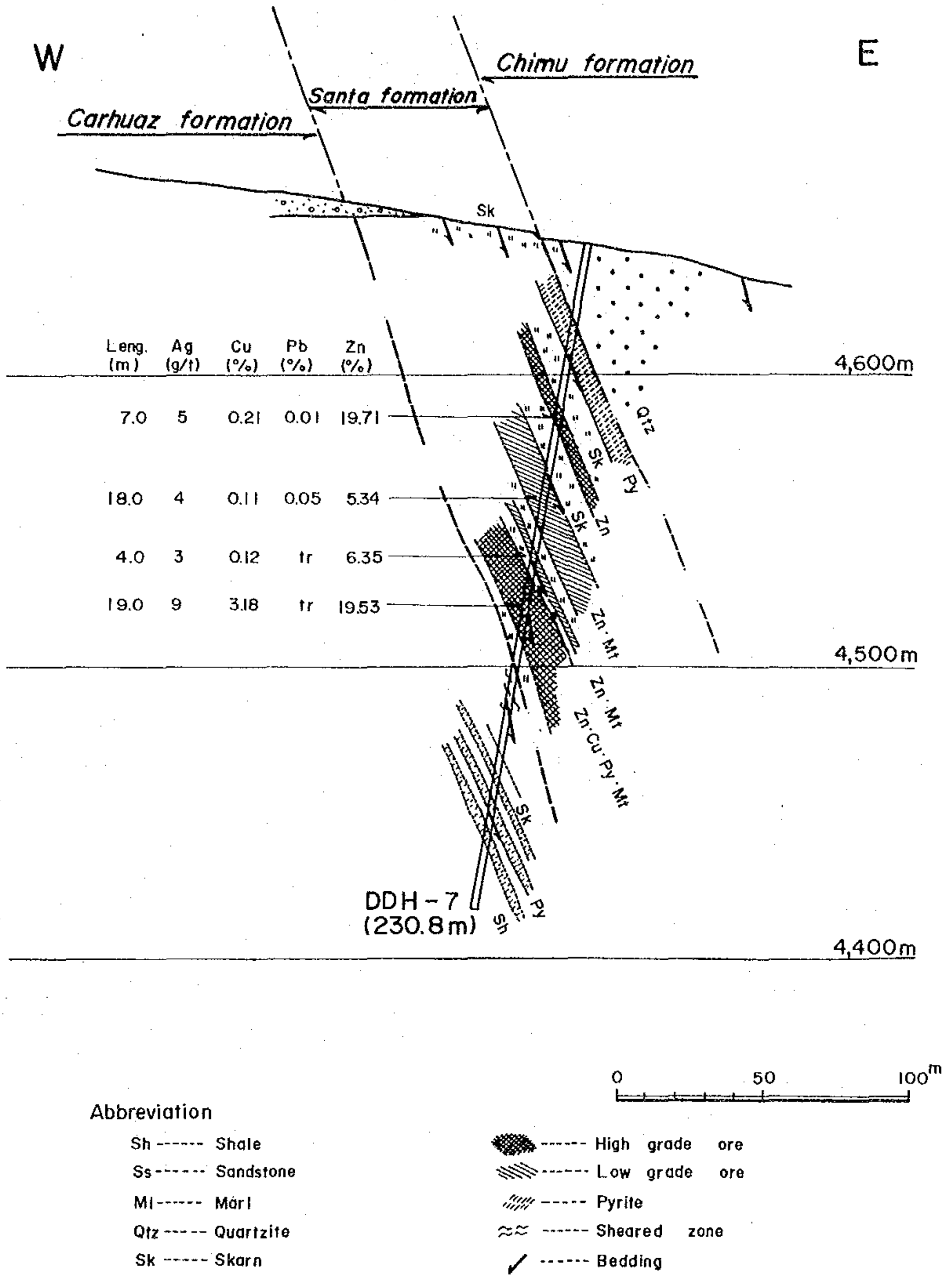


Fig. 15 – 5 Geological Section for DDH – 7 (S70°W – N70°E)

CHAPTER 8 ORE RESERVE ESTIMATION (TENTATIVE CALCULATION)

8–1 Methods of Calculation

The mineralization in the Limpe area, which is the main object of the surveys, is represented by irregular massive ore deposits formed by the replacement of limestones. Viewing from the survey results, it seems that the shapes and the sizes of the orebodies might have variation to a considerable extent and that the distribution of ore grades might be inhomogeneous. For such undeterminable orebodies, it is impossible to insist that the exploration works carried out by this stage would have been enough in amount for the delineation of precise properties of the orebodies by this stage, because only four crosscut tunnels have been excavated within such a distance of 1,400 meters and the drilling exploration has been done merely with the spacing of every 100 meters. It is not appropriate to say that now is the right stage when ore reserve estimation by any means expecting certain accuracy could be possible.

By the tunnelling and drilling explorations, more than ten indications of high grade mineralization have been confirmed. It is thought that they are related intimately to the pyritization and to the brecciation, and it is estimated that they have continuity to some extent, being controlled by the structure of the limestone. Therefore, it would be possible only on such basis to execute tentative ore reserve estimation for rough assumption of the ore reserve and the ore grade.

As to the method of calculation Polygon Method was employed, which is thought to be the most simple and objective way of ore reserve estimation.

8–2 Process and Basis of the Calculation

(1) The indications involved in the estimation are those having thickness of more than 2 meters and having grade of more than 10 % of Pb+Zn. In case of copper ore, indications having grade of more than 2 % of Cu are employed. However, any indications which are composed of only one sample satisfying the above conditions have been excluded.

(2) Center points of each of the indications caught are projected on a perspective section, which is established parallel to the extension of the mineralization zone (N20°W–S20°E).

(3) After real thickness of each of the indications is obtained based on the angle between the direction of the drill hole and the boundary plane of the wall rocks and the ore deposit or the plane structure of the ore deposit, its width on the horizontal plane is calculated according to the inclination of the ore deposit or the wall rocks. (see Table 4).

(4) The area of the calculation in both strike and vertical directions is taken not to exceed five times of the horizontal width of the indications and is limited to be less than 50 meters at the

maximum.

(5) The area down to the depth of 30 meters below surface is not included in the ore reserve estimation due to the possibilities of oxidized and/or leached zone.

(6) In case the distance between any two center points of the indications is within 5 times of the total of the two horizontal width of the indications, and the continuity of the mineralization is expected geologically, they are regarded to be within one single orebody.

(7) In case there are more than two points of the indications within a single orebody, polygons are established with each of the points of the indications to be the centers. Boundaries of the polygons are taken so that any neighbouring two points could have equal distance to the boundary between them. Unmineralized points in the mineralized horizon are also considered to decrease ore reserve tonnage. Tetragon is drawn with such orebody with only one point.

(8) After area and volume of each of the polygons are obtained, the ore reserves and the ore grade are calculated. Specific gravity is decided to be 3.4, considering the amount of 12 % of the porosity of the orebodies over 3.83, the measured value of the specific gravity.

(9) It is the known tendency of the polygon method that the ore reserve would be estimated excessively especially along the margin of each polygon when the density of the survey elements is rough or when the variation of thickness and shapes of the orebody is fairly big. Considering such characteristics of the polygon method, in addition to the fact that the figures of the horizontal widths of the orebodies are obtained only as the estimated values, it may be safer to infer actual ore tonnage, if an assesment factor of around 90 % to 75 % was adopted.

(10) As for ore grade calculation, a safety factor of 95 % is adopted.

8–3 Sampling and Analysis

1) Sampling Methods of the Drill Cores

(1) High grade ore

Sampling interval is 1 meter as a rule. Core is cut equally into two half pieces along the axis by diamond cutter and the half of the core is further cut into two equal pieces in the same way. Thus, one fourth of the core is employed as a sample.

(2) Moderate grade ore

Sampling interval is 2 meters as a rule. With core splitter core is split into two pieces to employ half of the core as a sample. On necessity, cores are broken in site and are reduced to make one sample by sample reducer.

(3) Low grade ore

Sampling interval is free up to 10 meters in maximum. With hammer, one sample is prepared by collecting small pieces continuously.

2) Sampling Methods in the Tunnels

(1) High grade ore

Continuous channel sampling on both walls with the interval of every 1 meter at a level of 1 meter above the bottom of the tunnel.

(2) Moderate grade ore

Channel sampling of the length of 1 meter with the interval of every 2 meters either in zig-zag way on both walls or along a wall on one side.

(3) Low grade ore

Channel sampling of the length of 1 meter with the interval of 4 meters on a wall.

3) Analysis

(1) Analysis of Ore Samples

The analysis of ore samples were carried out at the laboratory of INGEMMET as a rule, but some of the samples were sent to the Plenge Laboratory for the analysis. The ingredients for the analysis are Ag, Cu, Pb and Zn.

The laboratory of INGEMMET employs the Atomic Absorption Spectrochemical Analysis. In the third year, some samples show very high grade more than 40% up to 50% in zinc. The Wet Chemical Analysis is more suitable method to such high grade ore samples. Therefore, all samples of high grade ore more than 30% of zinc content were sent to the Plenge Laboratory and re-analysed by the Wet Chemical Analysis, and the assay values of the Plenge Laboratory were adopted for the ore reserves calculation.

(2) Analysis of Composit Samples

Three composit samples were analysed for the contents of minor elements, and the results of the analysis are shown as follows.

	Length (m)	Depth (m)	Cu (%)	Pb (%)	Zn (%)	Bi (%)	Cd (g/t)	Sn (%)	W (%)
IC–11	26.7	107.2–133.9	0.05	2.92	18.17	0.10	270	0.32	Nd
IC–12	29.1	151.4–180.5	0.51	1.82	20.39	0.23	15	0.35	Nd
IC–14	9.8	113.9–123.7	0.19	0.02	17.90	0.13	54	0.38	Nd

	Sb (%)	Hg (%)	Fe (%)	As (%)	S (%)	Au (g/t)	Ag (g/t)
IC–11	0.09	0.01	21.30	0.43	27.46	Nd	32
IC–12	0.09	0.14	24.62	0.10	28.36	Nd	58
IC–14	0.09	0.03	29.16	0.11	34.72	Tr	52

4) **Measurement of Specific Gravity**

Apparent specific gravity was measured with 37 samples, collected in the main mineralized parts of the drill cores. The samples for the measurement of specific gravity had been dried in the temperature of 60°C in 24 hours before measurement and the surface of the samples were coated with paraffine. The results of the measurement are shown in Table 5. The average value of the specific gravity measured with 26 samples of pyritized ore in the Limpe area is 3.83, while the average value measured with 7 samples of skarnized ore in the Limpe-South area is 3.61. As druses or other hollow parts are developed in the actual orebodies in situ, it is necessary to give consideration on the porosity of ore for the specific gravity in situ. Assuming the value of such porosity to be 12% with the pyritized ore and to be 6% with the skarnized ore, the apparent specific gravity in situ common to both types of ore is calculated to be 3.4.

8–4 Calculation Result

1) **Limpe Area**

The perspective sections for ore reserve estimation are shown in the Fig. 16 and the calculation table is shown in the Table 6. The result of the ore reserve calculation by the polygon method in the mineralization zone in the Limpe area is as follows.

Type of Ore	Ore Reserve (1,000 ts)	Grade of Ore			
		Ag (g/t)	Cu (%)	Pb (%)	Zn (%)
Pb-Zn ore	3,250	48	0.13	1.95	18.99
Cu ore	100	32	2.84	0.03	0.39

2) **Limpe-South Area**

The exploration is at the preliminary stage where mineralization has been confirmed in only two drill holes spaced about 100 m each other. If the horizontal width of the orebody is taken to be 19.1 m, horizontal extension to be 200 m, vertical extention to be 150 m, specific gravity to be 3.4 and the index of existence of the orebodies to be 75%, total 1,460 thousand tons of ore reserves are expected according to the following calculation.

$$19.1 \text{ m} \times 200 \text{ m} \times 150 \text{ m} \times 3.4 \times 0.75 = 1{,}461{,}150 \text{ t}$$

The weighted average of the ore grade of the orebodies confirmed in the two drill holes is Ag 10 g/t, Cu 1.85%, Pb 0.01% and Zn 19.59%.

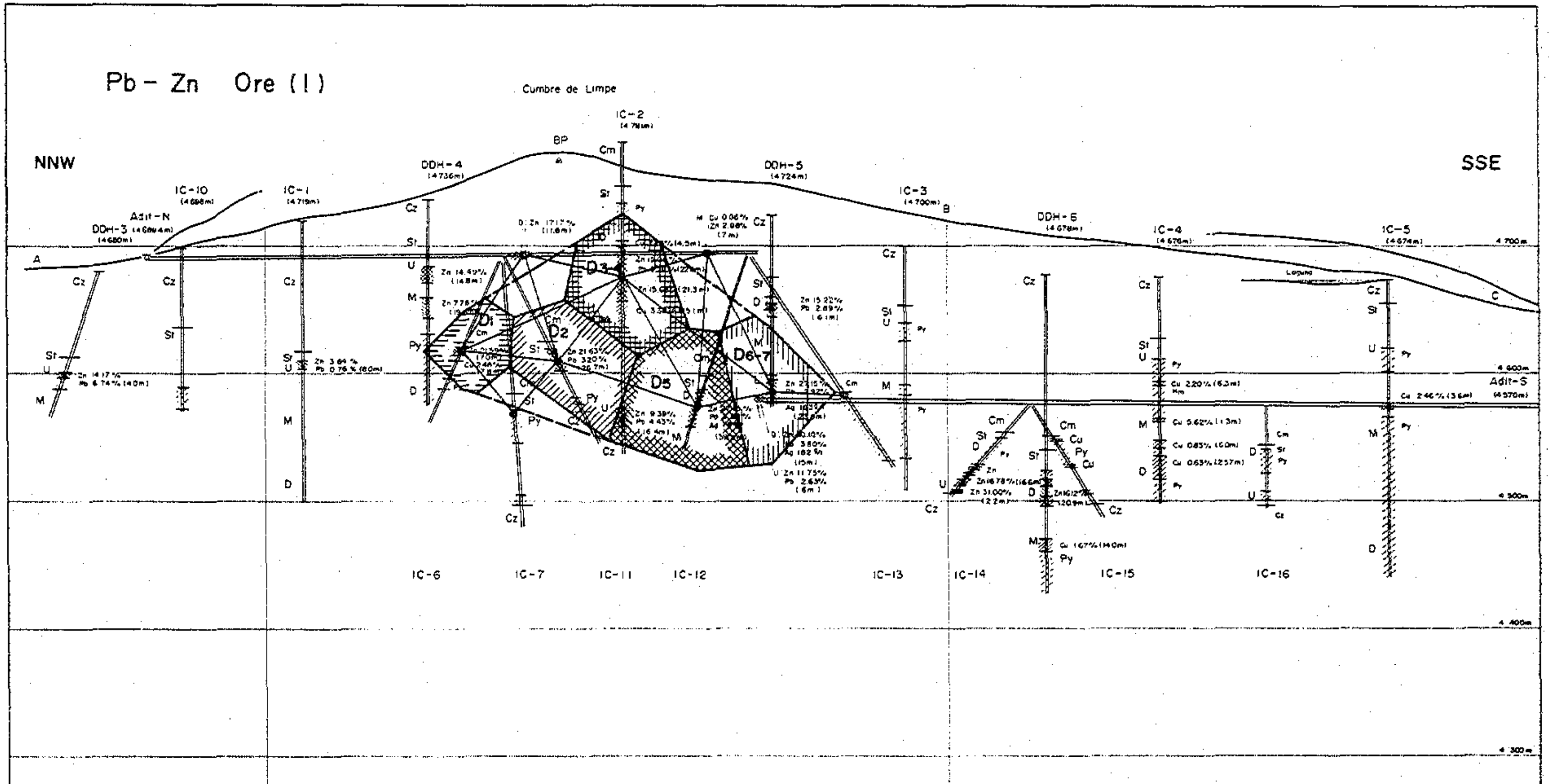


Fig. 16 Perspective Section for Ore Reserve Calculation (I) Lower Horizon

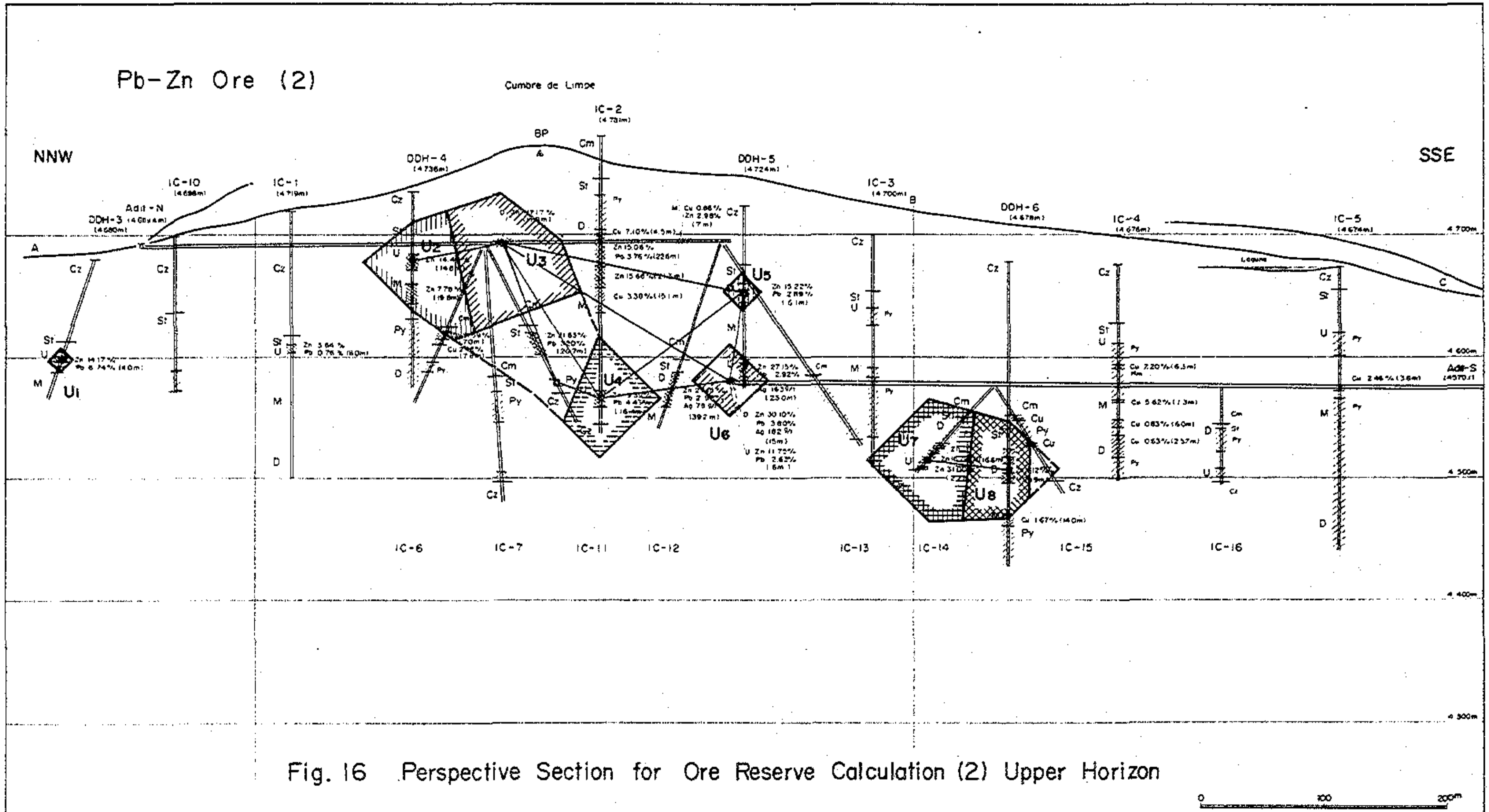


Fig. 16 Perspective Section for Ore Reserve Calculation (2) Upper Horizon

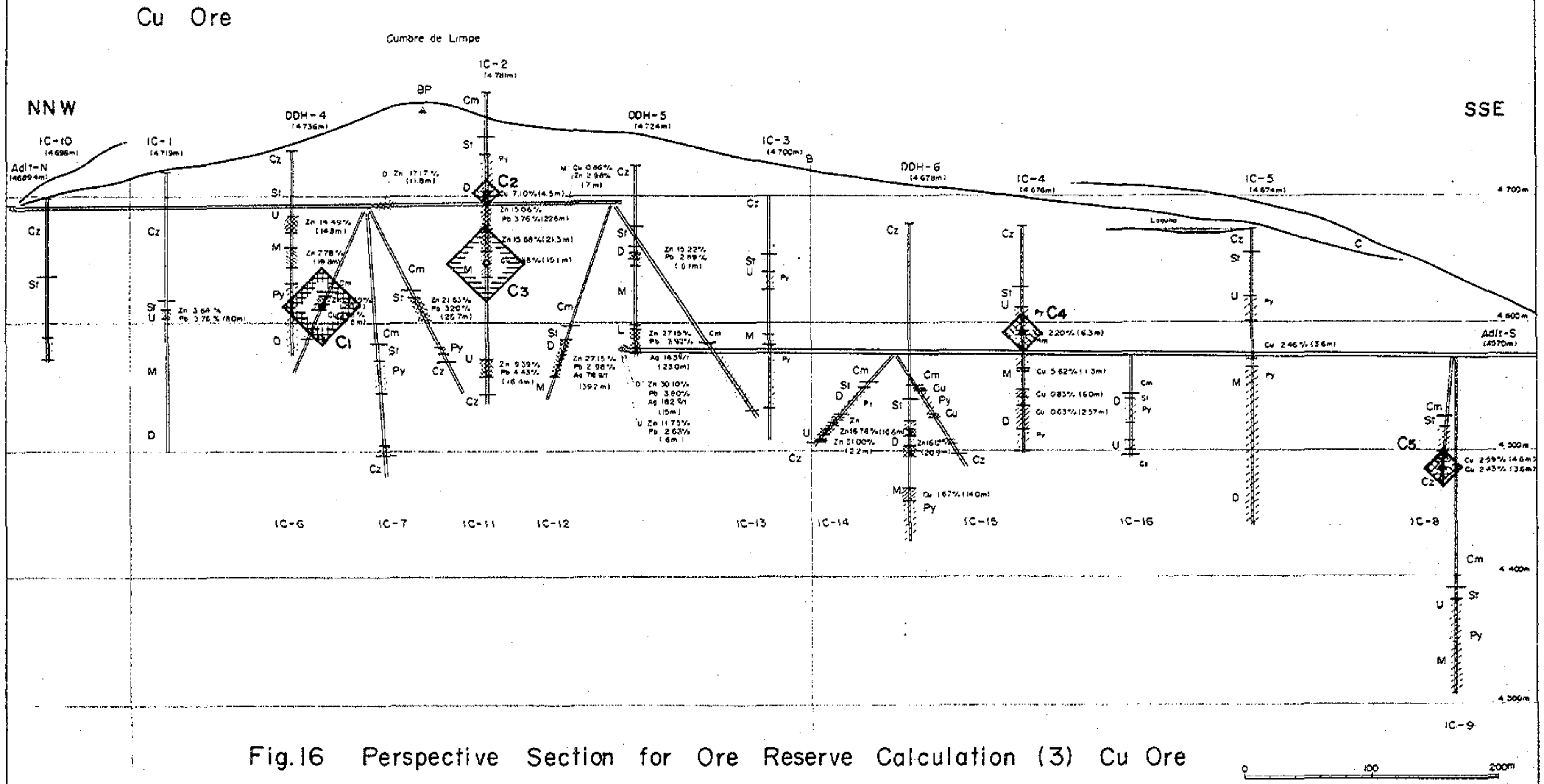


Fig.16 Perspective Section for Ore Reserve Calculation (3) Cu Ore

Table 4 List of the Confirmed High Grade Mineralized Parts

Area	DDH	Depth m	Interval m	No. of Sample	Ag g/t	Cu %	Pb %	Zn %	Angle (Comp.)	Inc.	Real Thick m	Horiz. Width m	Orebody
Limpe	DDH-3	104.6-108.6	4.0	4	89	0.03	6.74	14.17	55°	90°	2.29	2.3	U_1
	DDH-3	108.6-118.9	10.3	10	32	0.03	1.26	4.56	55°	90°			
	IC-10												
	IC-1	121.0-129.0	8.0	4	4	0.07	0.76	3.64	40°	90°			
	DDH-4	61.3- 76.1	14.8	15	13	0.07	0.04	14.49	50°	90°	9.51	9.5	U_2
	DDH-4	84.9-104.7	19.8	16	10	0.10	0.30	7.78	55°	90°			
	IC-6	96.8-101.0	4.2	4	4	0.03	0.85	5.27	40°	85°			
	IC-6	108.0-115.0	7.0	5	15	0.32	0.02	21.59	30°	85°	6.06	6.1	D_1
	IC-6	115.0-122.8	7.8	4	23	2.48	0.02	0.46	30°	85°	6.75	6.8	C_1
	IC-7												
	NX-1		6.0	6	17	1.42	0.04	0.30	10°				
	NX-1		12.0	24	8	0.10	0.07	17.13	10°			11.8	U_3
	IC-11	107.2-133.9	26.7	19	38	0.04	3.16	22.69	40°	85°	20.45	20.5	D_2
	IC-2	77.6- 82.1	4.5	2	5	7.10	0.22	0.48	50°	80°	2.89	2.9	C_2
	IC-2	82.1-104.7	22.6	19	34	0.08	3.75	15.06	60°	75°	11.30	11.7	D_3
	IC-2	104.7-126.0	21.3	4	4	0.14	0.16	15.68	60°	75°	10.65	11.0	D_4
	IC-2	126.0-146.3	15.3+	5	46	3.43	0.03	0.43	60°	80°	7.65	7.8	C_3
	IC-2	211.0-227.4	16.4	8	25	0.06	4.53	9.39	45°	80°	11.60	11.8	U_4
	NX-2		7	8	32	0.86	0.31	2.98	10°				
	IC-12	144.3-183.5	39.2	38	78	0.19	2.61	24.08	35°	75°	32.11	33.2	D_5
	DDH-5	95.6-101.7	6.1	5	35	1.10	2.89	15.22	55°	80°	3.50	3.6	U_5
	DDH-5	181.0-204.0	23.0	23	163	0.14	2.92	27.15	60°	75°	11.50	11.9	D_6
	SX-2		15.0	31	182	0.16	3.84	30.11	0°			15.0	D_7
	SX-2		6.0	12	26	0.08	2.63	11.75	0°			6.0	U_6
	IC-13												
	IC-3												
	IC-14	107.1-123.7	16.6	13	32	0.18	0.13	16.78	40°	75°	12.72	13.2	U_7
	IC-14	131.6-133.8	2.2	2	28	0.28	0.06	31.00	45°	75°	1.56	1.6	
	SX-1												
	DDH-6	194.4-215.3	20.9	18	22	0.18	0.20	16.04	65°	85°	8.83	8.9	U_8
	DDH-6	248.2-262.2	14.0	7	13	1.67	0.03	0.10	60°	85°			
	IC-4	114.0-120.3	6.3	3	32	2.20	0.02	0.29	60°	80°	3.15	3.2	C_4
	IC-16												
	IC-5												
	IC-8	174.5-178.1	3.6	3	23	2.43	0.11	0.11	10°	65°	3.55	3.9	C_5
Tinyag	DDH-7	56.0- 63.0	7.0	5	5	0.21	0.01	19.71	60°	65°	3.50	3.9	T_1
	DDH-7	81.0- 99.0	18.0	18	4	0.11	0.05	5.34	60°	65°			
	DDH-7	116.0-135.0	19.0	15	9	3.18	-	19.53	55°	65°	10.90	12.0	T_2
	IC-18	96.9-125.5	28.6	22	8	1.32	0.01	19.79	45°	65°	20.22	22.3	T_3

* In principle, listed up ore parts above 5% in Pb+Zn and above 1.5% in Cu averaging more than 2 samples.

\+ Excluded of non-core part.

NX and SX marks show Tunnels.

$$\text{Real Thickness (m)} = \text{Interval (m)} \times \sin(90° - \text{Angle})$$

$$\text{Horiz. Width (m)} = \text{Real Thickness (m)} \times \frac{1}{\cos(90° - \text{Inc.})}$$

Table 5 Measurement Results of Specific Gravity

Sample No.	Type of Ore	Wa (g)	Wp (g)	Ww (g)	D
BC-03-107	Gl-Sp-Py ore	70.40	71.70	53.25	4.13
BC-04-064	Sp-Py ore	182.15	185.45	138.90	4.24
BC-04-068	Sp-Py ore	115.90	117.50	88.15	4.19
BC-04-076	Sp-Py ore	141.50	143.50	107.30	4.16
BC-04-087	Sp-Py ore	124.95	126.90	96.00	4.34
BC-04-104	Sp-Py ore	79.30	80.60	59.80	4.08
BC-05-099	Gl-Sp-Py ore	65.45	66.50	48.60	3.90
BC-05-183	Sp-Py ore	62.40	63.70	47.40	4.19
BC-05-190	Sp-Py ore	61.05	62.30	45.30	3.90
BC-05-192	Sp-Py ore	64.25	65.45	47.00	3.74
BC-05-195	Sp-py ore	75.50	77.00	56.35	3.97
BC-05-199	Gl-Sp-Py ore	71.05	72.90	52.90	3.95
IC-02-083	Sp-Py ore	131.0	133.2	96.5	3.81
IC-02-089	Sp diss ore	67.6	69.2	44.9	2.99
IC-02-099	Gl-Sp-Py ore	133.6	136.3	98.6	3.84
IC-02-103	Sp-Py ore	145.5	148.2	108.3	3.93
IC-02-118	Sp diss ore	100.6	102.7	64.2	2.77
IC-02-225	Sp-Py ore	75.6	77.2	55.1	3.71
IC-11-119	Sp-Py ore	87.2	89.5	64.3	3.84
IC-11-123	Sp ore	112.6	114.7	83.3	3.86
IC-12-164	Gl-Sp ore	114.4	116.7	82.6	3.62
IC-12-172	Sp ore	159.8	163.0	122.5	4.32
IC-12-175	Sp ore	98.2	100.3	72.6	3.86
IC-12-183	Sp ore	72.0	73.8	45.5	2.73
IC-14-117	Sp-Py ore	124.7	127.2	91.3	3.76
IC-14-133	Sp-Py ore	114.8	117.1	82.9	3.62
Av. of Massive Sp-Py ore					3.83
BC-07-085(A)	Sk ore	152.35	154.30	107.90	3.43
BC-07-085(B)	Sk ore	108.50	110.30	73.35	3.10
BC-07-123	Sp Sk ore	104.50	105.85	78.65	4.05
BC-07-126	Sp Sk ore	104.60	106.40	70.50	3.08
BC-07-127	Sp-Mt Sk ore	80.30	81.50	59.70	3.91
IC-18-121	Sp Sk ore	58.7	59.9	41.0	3.33
IC-18-125	Sp-Py ore	128.4	130.7	98.9	4.38
Av. of Skarn ore					3.61

$$D = \frac{Wa \times Dw}{Wp - Ww - (Wp - Wa)/Dp}$$

D : Apparent specific gravity
Wa: Weight of dried sample in the air
Wp: Weight of paraffin coated sample in the air
Ww: Weight of paraffin coated sample in the water
Dp: Specific gravity of paraffin (=0.9)
Dw: Specific gravity of water (=0.997)

Table 6 Table for Ore Reserves Calculation

Zone	Body	Area (m^2)	Wid. (m)	Volume (m^3)	Tonnage* (t)	Grade Ag g/t	Grade Cu %	Grade Pb %	Grade Zn %	Metal Value Ag kg	Metal Value Cu t	Metal Value Pb t	Metal Value Zn t
D	D_1	3,200	6.1	19,520	66,300	15	0.32	0.02	21.59	994	212	13	14314
	D_2	6,500	20.5	133,250	453,000	38	0.04	3.16	22.69	17214	181	14314	102785
	D_{3-4}	6,600	22.7	149,820	509,300	20	0.11	2.01	15.36	10186	560	10236	78228
	D_5	8,400	33.2	278,880	948,100	78	0.19	2.61	24.08	73951	1801	24745	228302
	D_{6-7}	5,500	13.4	73,700	250,500	172	0.15	3.38	28.63	43086	375	8467	71717
Subtotal					2,227,200	65	0.14	2.59	22.24	145431	3129	57775	495347
U	U_1	200	2.3	460	1,500	89	0.03	6.74	14.17	133	0	101	212
	U_2	5,000	9.5	47,500	161,500	13	0.07	0.04	14.49	2099	113	64	23401
	U_3	7,600	11.8	89,680	304,900	8	0.10	0.07	17.13	2439	304	213	52229
	U_4	3,900	11.8	46,020	156,400	25	0.06	4.53	9.39	3910	93	7084	14685
	U_5	450	3.6	1,620	5,500	35	1.10	2.89	15.22	192	60	158	837
	U_6	1,800	6.0	10,800	36,700	26	0.08	2.63	11.75	954	29	965	4312
	U_7	5,600	13.2	73,920	251,300	32	0.18	0.13	16.78	8041	452	326	42168
	U_8	3,700	8.9	32,930	111,900	22	0.18	0.20	16.04	2461	201	223	17948
Subtotal					1,029,700	19	0.12	0.89	15.13	20229	1252	9134	155792
Zn-Pb Ore Total					3,256,900	51	0.13	2.05	19.99	165660	4381	66909	651139
Adjusted Total**					3,256,900	48	0.13	1.95	18.99	157377	4161	63563	618582
Cu	C_1	1,800	6.8	12,240	41,600	23	2.48	0.02	0.46	956	1031	8	191
	C_2	200	2.9	580	1,900	5	7.10	0.22	0.48	9	134	4	9
	C_3	1,800	7.8	14,040	47,700	46	3.43	0.03	0.43	2194	1636	14	205
	C_4	450	3.2	1,440	4,800	32	2.20	0.02	0.29	153	105	0	13
	C_5	450	3.9	1,755	5,900	23	2.43	0.11	0.11	135	143	6	6
Cu Ore Total					101,900	34	2.99	0.03	0.42	3447	3049	32	424
Adjusted Total**					101,900	32	2.84	0.03	0.39	3274	2896	30	402

* Specific gravity in situ : 3.4

** Safety factor of ore grade : 0.95

CHAPTER 9 CONCLUSION AND RECOMMENDATION

9–1 Conclusion

1) The Limpe area in the Iscaycruz Area was selected as a promising area bearing the highest potentiality for the emplacement of high grade lead zinc mineral ore deposits, and the tunnelling exploration and the drilling exploration on the surface and in the underground were conducted in the Limpe area during the period of three years from 1982 to 1984. Also, some surface drilling was carried out in the Limpe-South (Tinyag) area.

2) Through the exploration works as above-stated, the existence of high grade lead-zinc orebodies has been confirmed in the Limpe area. It is estimated that the sizes of the orebodies in the Limpe area are 300 m in horizontal extension, over 150 m in vertical extension and 10 to 30 m in thickness.

3) By the result of the ore reserve estimation of the ore deposit in the Limpe area by the polygon method, the expected ore reserves are as follows;

Ore reserve ; 3,250 thousand tones

Grade ; Ag 48 g/t, Cu 0.13%, Pb 1,95%, Zn 18.99%

4) Existence of high grade copper zinc mineralization has been confirmed in the Limpe-South area, too.

9–2 Recommendation

1) For the development of the mineral resources in the Iscaycruz Area, it is recommended, as the investigation of the next stage, to carry out the survey for the planning of the development including every item in necessary fields for the investment to the development of mineral resources.

2) As for the mineralization in the Limpe area, it would be necessary to conduct further detailed exploration works for the confirmation of the ore deposits, the ore reserves and possible extension of the orebodies at the depth. Also, it would be necessary to conduct exploration for potentialities of mineral resources in the Limpe-South area, Limpe-North area and Kunsha Punta area.

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