E R R A T A

Page	Line	Errors as appeared in the report	Correction
Table of Contents			
A-6	13th	Comperucho	Camperucho
7, 8	Figure	SANTANDLR	SANTANDER
"	"	Campotlorido	Campoflorido
"	"	Comperucho	Camperucho
2	11th	San Fransisco	San Francisco
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13	12th	malachite	malachite,
15	Figure	Azutite	Azurite
	"	Rocke	Rock
16	15th	deposite	deposit
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23	Figure	COMPERUCHO	CAMPERUCHO
26	12th	Provine	Province
27	Figure	RA	LA
33	"	Guesca	Guasca
34	2nd from the bottom	1,260	1,360
36	Figure	MINA	MINE
	5th from the bottom	deposite	deposit
37	Figure	strip	stripped
40	4th	Conslusion	Conclusion
41	11th	diamante	Diamante
46	3rd from the bottom	No.	No
49	3rd	feeruginous	ferruginous
50	12th	rugges	rugged
52	7th	enrighment	enrichment
53.54	Figure	Manganes	Manganese
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58.59	"	LAESPERANZA	LA ESPERANZA
60.61	"	CORVE	CURVE
65	11th	suposed	supposed
67	2nd	Medelline	Medellin
68	Figure	MIZO	MUZO
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REPORT ON THE INVESTIGATION OF ORE DEPOSITS IN COLOMBIA

MAY 1965

OVERSEAS TECHNICAL COOPERATION AGENCY
GOVERNMENT OF JAPAN

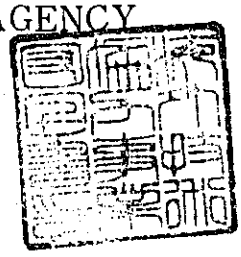


Table of Contents

REPORT OF THE 1965 JAPANESE MISSION TO COLOMBIA FOR MINERAL RESOURCES INVESTIGATION

I. Introduction

1. Circumstances and purpose of dispatch of the investigation mission

Investigations of mineral resources in the Republic of Colombia are now in progress, with a loan from the A. I. D. and technical aids of the U. S. Geological Survey. On a four-year program the basic investigations have just been commenced in four regions, and coal resources are scheduled to be investigated separately in the near future with an aid of Western Germany. Except for oil resources, almost no systematic survey has been made for geology and ore deposits of this country. However, judging from its geological setting the country is believed to have promising mineral resources in many places.

The Colombian Government, paying attention to these undeveloped resources, requested the Japanese Government in September 1964 for cooperation in investigating the possibility of development of such resources. To comply with the request, the Japanese Government asked the Overseas Technical Cooperation Agency to carry out basic investigations of mineral resources in the whole area of Colombia. Thereupon, the Agency has organized a mineral resources investigation mission to be dispatched to Colombia.

2. Organization of the investigation mission

Chief of the Mission	YOSHIKAZU HORIKOSHI Director of Overseas Mineral Resources Development Co.
Members of the Mission	NAOTAKA KANAO

Chief. Geological Survey Section of Overseas Mineral Resources Development Co.

TSUGUO NAKAMURA
Non-regular staff member of Overseas Mineral Resources Development Co.

YUTAKA KIKUCHI
Non-regular staff member of Oversea Mineral Resources Development Co.

3. Itinerary of the mission

Dec. 18 (Fri) Dec. 19 (Sat)	KANAO, TOKYO-SAN FRANSISCO-LOS ANGELS -BOGOTA (by plane) Visit to Japanese Embassy.
Dec. 20 (Sun) Dec. 21 (Mon)	Prearrangement for the plan of investigation.
Dec. 22 (Tue) Dec. 27 (Sun)	Collect the information about the investigating area and the data of mineral resources.
Dec. 28 (Mon) Dec. 29 (Tue)	Prepare a draft of itinerary of the mission.
Dec. 30 (Wed)	HORIKOSHI, NAKAMURA, and KIKUCHI arrive at BOGOTA.
Dec. 31 (Thu)	Visit Japanese Embassy to decide a final itinerary
Jan. 1 (Fri)	ibid.
Jan. 2 (Sat) Jan. 4 (Mon)	Study of the Colombian mines.
Jan. 5 (Tue)	Visit the Ministry of Mine and Petroleum. Have a conversation with Minister PARDO. Visit Colombia Geological Survey.
Jan. 6 (Wed)	Preparations of journey
Jan. 7 (Thu)	Visit the Central Bank to arrange the trip to emerald mine.
	Group 1: HORIKOSHI, KIKUCHI, BOGOTA-Cali Group 2: KANAO, NAKAMURA, Preparation of trip.

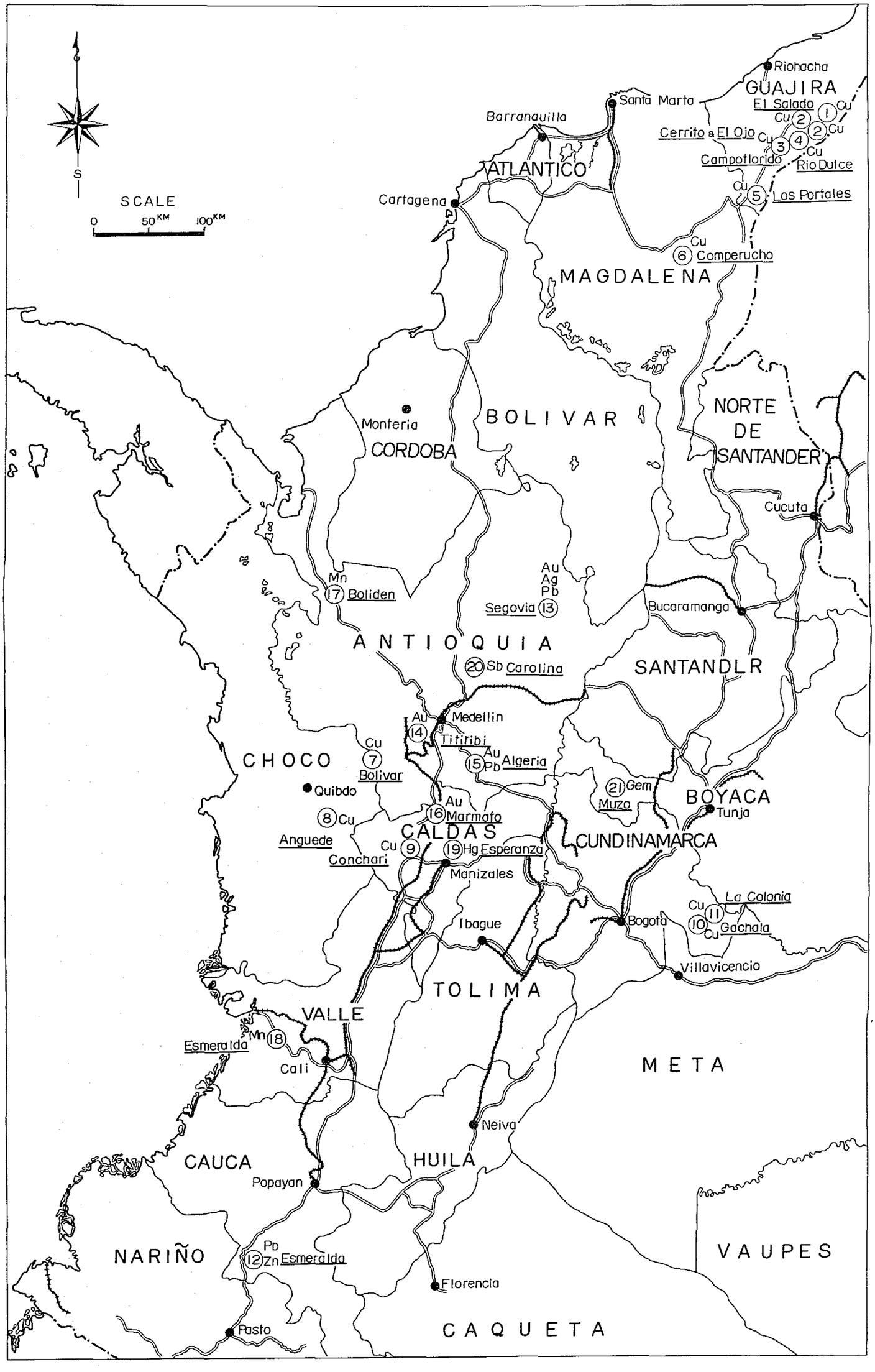
	Group 1	Group 2
Jan. 8 (Fri)	CALI-POPAYAN(by plane) put up at POPAYAN	BOGOTA-PEREIRA (by plane)-ARANZAZU (by car) put up at ARANZAZU
Jan. 9 (Sat)	POPAYAN-FLORENCIA(by plane)-ESMERALD(by horse)	ARANZAZU-LA ESPERANZA MINE(by car, horse) -ARANZAZU(by car, horse)
Jan. 10 (Sun)	Investigation of ESMERALDA MINE	Investigation of LA ESPERANZA MINE, ARANZAZU-MARMATO (by car)
Jan. 11 (Mon)	ESMERALDA-FLORENCIA -POPAYAN	Investigation of MARMATO MINE, MARMATO-SONSON(by car)
Jan. 12 (Tue)	POPAYAN-CALI(by plane)	SONSON-ARGELIA-ARGELIA MINE, investigation of DIAMANTE MINE
Jan. 13 (Wed)	CALI-ANCHICAYA(by car) -ESMERALDA MINE(by horse)	Investigation of ARGELIA MINE.
Jan. 14 (Thu)	Investigation of ESMERALDA MINE ESMERALDA MINE-CALI	ARGELIA-MEDELLIN -CAROLINA
Jan. 15 (Fri)	Investigation of ABSERNA	CAROLINA-GUADALUPE (by car) Investigation of Antimony Mine. GUADALUPE-MEDELLIN(by car)
Jan. 16 (Sat)	CALI-ANSERMA(by car) Prearrange with CONCHARI MINE Owner.	Arrange of mine's data
Jan. 17 (Sun)	Investigation of CONCHARI MINE, ANSERMA-MEDELLIN	Preparation of BOLIDEN MANGANESE MINE
Jan. 18 (Mon)	HORIKOSHI (Group 1) visit Mine Bureau of MEDELLIN	KANAO, NAKAMURA, KIKUCHI (Group 2), MEDELLIN-FRONTINO (by plane)-DABEIBA(by car)-BOLIDEN MINE.

Jan. 19 (Tue)	Visit the MEDELLIN UNIVERSITY	Investigation of BOLIDEN MINE, DABEIBA-FRONTION(by car)
Jan. 20 (Wed)	ibid.	FRONTINO-MEDELLIN (by plane)
Jan. 21 (Thu)	HORIKOSHI, NAKAMURA (Group 1) MEDELLIN-SEGOVIA(by plane)-SILENCIA MINE (by car)	KANAO, KIKUCHI (Group 2) MEDELLIN-TITIRIBI MINE(by car)-BOLIVAR (by car)
Jan. 22 (Fri)	Investigation of SILENCIA MINE, SEGOVIA-MEDELLIN	Investigation of BOLIVAR MINE
Jan. 23 (Sat)	MEDELLIN-BOGOTA(by plane)	
Jan. 24 (Sun)	Visit Japanese Embassy to report our journey. The Chief Secretary, ISHIKAWA draw up the plan of next investigation.	
Jan. 25 (Mon)	Preparation of journey.	
Jan. 26 (Tue)	BOGOTA-MUZO MINE, (by car) Investigation of MUZO MINE	
Jan. 27 (Wed)	MUZO MINE-BOGOTA (by car)	
Jan. 28 (Thu)	Rearrange the plan to change investigating project.	
Jan. 29 (Fri)	Group 1: HORIKOSHI, KANAO, study the data of investigated mine.	Group 2: NAKAMURA, KIKUCHI BOGOTA-GACHALA(by car)
Jan. 30 (Sat)	Visit Japanese Embassy to make report of investigated mine	Investigate the GACHALA MINE Camp
Jan. 31 (Sun)	Study the data of investigated mine	Camp-GACHALA(by horse)
Feb. 1 (Mon)	Visit Colombia Geological Survey	Investigation of LA COLONIA MINE
Feb. 2 (Tue)	BOGOTA-QUIBDO(by plane) Visit Mining Bureau of Department (CHOCO)	GACHALA-BOGOTA(by car)

Feb.	3 (Wed)	Visit the Governor of Department (CHOCO)	BOGOTA-MEDELLIN (by plane)
Feb.	4 (Thu)	KANAO, QUIBDO-BAGADO (by launch)	MEDELLIN-QUIBDO (by plane)
Feb.	5 (Fri)	HORIKOSHI, QUIBDO-BAGADO(by helicopter)-ANGUEDE-BAGADO, NAKAMURA, KIKUCHI, QUIBDO-BAGADO(by launch)	
Feb.	6 (Sat)	KANAO, KIKUCHI, Investigation of ANGUEDE MINE	
Feb.	7 (Sun)	BAGADO-QUIBDO(by launch)	
Feb.	8 (Mon)	HORIKOSHI, KANAO, QUIBDO-MEDELLIN (by plane)	NAKAMURA, KIKUCHI, Remain in QUIBDO on account of no plane seat.
Feb.	9 (Tue)	MEDELLIN-BOGOTA (by plane)	ibid.
Feb.	10 (Wed)	Prearrange the plan of next investigation.	ibid.
Feb.	11 (Thu)	Study the data of investigated mines.	
Feb.	12 (Fri)	ibid.	
Feb.	13 (Sat)	BOGOTA-BARRANQUILLA(by plane)-RIOHACHA (by plane)-BARRANCAS(by car)	
Feb.	14 (Sun)	Investigation of CAMPOFLORIDO and RIO DULCE MINE	
Feb.	15 (Mon)	Investigation of CERRITO and EL OJO MINE	
Feb.	16 (Tue)	Investigation of EL SALADO MINE	
Feb.	17 (Wed)	Investigation of CAMPERUCHO MINE	
Feb.	18 (Thu)	Investigation of URUMITA and LOS PORTALES MINE	
Feb.	19 (Fri)	BARRANCAS-RIOHACHA(by car)-BARRANQUILLA (by plane)-CARTAGENA(by car)	
Feb.	20 (Sat)	CARTAGENA-BOGOTA(by plane)	
Feb.	21 (Sun)	Arrange the data of investigated mines.	

Feb. 22 (Mon)	Visit Japanese Embassy to report the data of investigated mines.
Feb. 23 (Tue)	Meeting in J. E. betweens Colombian Minister and us.
Feb. 24 (Wed)	Study of the investigated mines.
Feb. 25 (Thu)	Meeting with Dr. LARA, Dr. IRVING, Dr. LUIS (Mining Bureau, Colombia Geological Survey.) Dr. WALTER, Dr. SANCHEZ (Interpreter)
Feb. 26 (Fri)	Visit Japanese Embassy, Ministry of Petroleum and Mine, and Colombia Geological Survey. Attend at the party of Japanese Embassy in the evening.
Feb. 27 (Sat)	BOGOTA-BUCARAMANGA(by plane)-CALIFORNIA MINE(by car)-BUCARAMANGA(by car) Observation study of CALIFORNIA MINE
Feb. 28 (Sun)	BUCARAMANGA-BOGOTA(by plane) Prepare to return to our conutry.
Mar. 1 (Mon)	BOGOTA-PANAMA-MEXICO-LOS ANGELS(by plane)
Mar. 2 (Tue)	Relaxation
Mar. 3 (Wed)	LOS ANGELS-HONOLULU-TOKYO(by plane)

Fig 1 INDEX MAP OF SURVEYED MINE



4. Acknowledgements

To enable the mission to accomplish the assigned task, the Colombian Government rendered every convenience through the Mining Bureau, Ministry of Petroleum and Mines, which served as the office in charge of this project. Without the immeasurable support of the government and people of Colombia, it would have been impossible for the mission to perform smooth and effective investigations covering the vast extension of the unfamiliar land and with time limited to only two months. Our sincere gratitude is expressed herewith.

We are especially indebted to the technical officials of the Colombian Government who accompanied us in field work, leading the way and helping our activity. In collecting referential materials and keeping contact with the field party, the mission enjoyed valuable assitance of the Japanese Embassy and Japanese people in Colombia, to whom our thanks are due.

Colombian officials and persons who cooperated with the mission in accomplishing the investigations are listed below.

Minister, Ministry of Petroleum and Mine	ENRIQUE PARDO PARRA
Vice-minister, Ministry of Petroleum and Mine	AUGUSTRO GAITAN
Vice-chief Bureau of Mine	CARLOS LUIZ
Chief, Geological Survey	JESUS A. BUENO
Vice chief, Geological Survey	AURELIO LARA AGUDELO
Chief, A.I.D. in COLOMBIA	EARL M. IRVING
Mining Engineer, Bureau of Mine (MEDELLIN)	ARMANDO ESTRADA MEJIA
ibid.	PEDRO HERNANDES GUTIERREZ
ibid.	HERNAN RESTREPO A.
ibid.	NESTOR CASTRO Q.
Governor of Department (CHOCO)	RICARDO ELEAZAR VALENCIA
Professor, MEDELLIN University	GABRIEL TRUJILLO URIBE
ibid.	DARIO SUESECUN GOMEZ
Manager, MUZO Mine	MARIO VILLEGAS VAROSS
Manager, SILENCIA Mine	M.A. BURKE
Chief Engineer, SILENCIA Mine	ALEX A FRIDERICI

II. Mines Investigated by the Mission

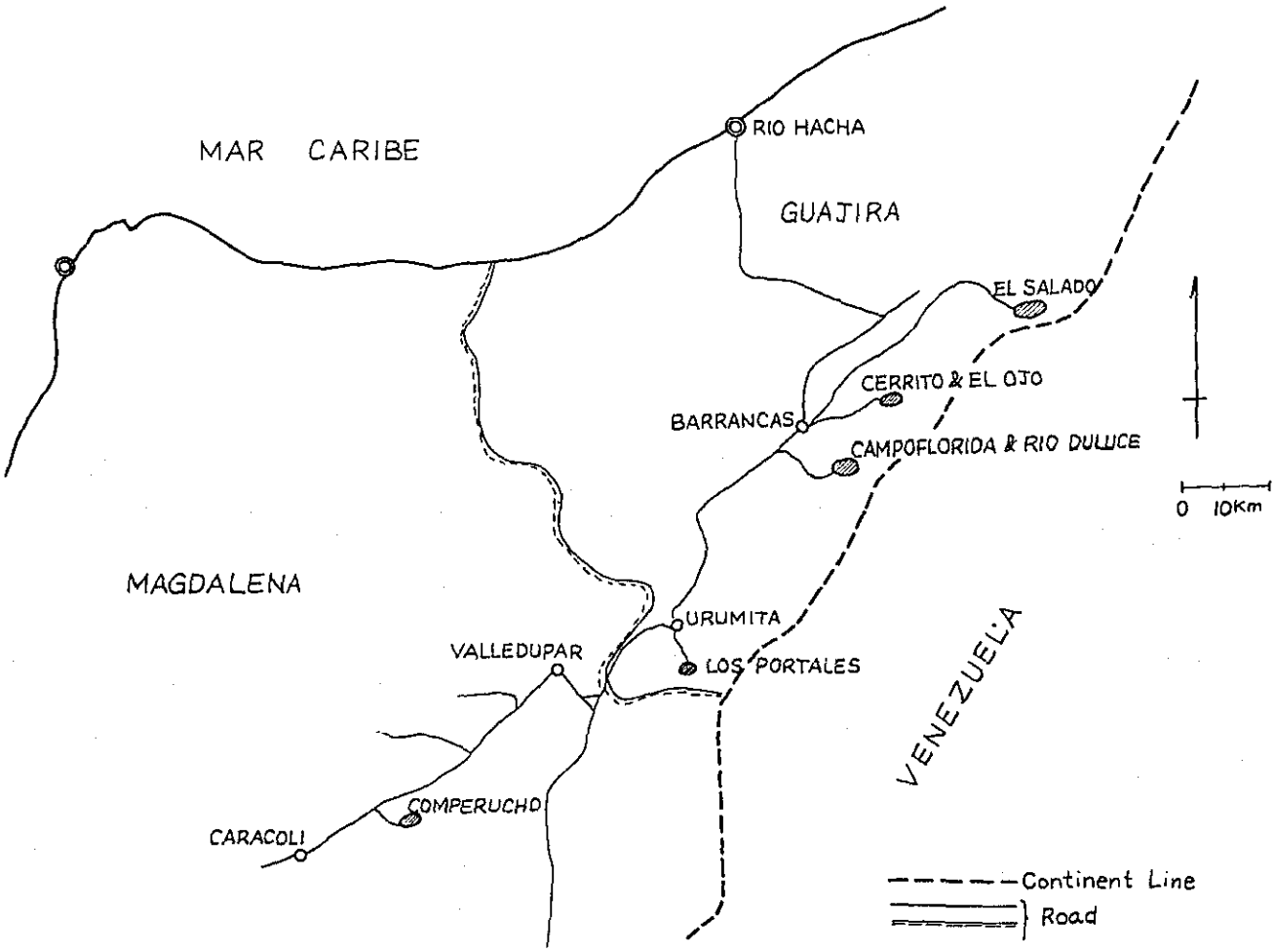
A. Copper Mines

General view on the region of Guajira Province and Magdalena Province

Along the eastern mountain range (Cordillera Oriental) of this region, a large number of outcrops of oxide copper ore are found, arranged in a NE-SW direction, but the outcrops, so far as we have investigated, are of a very

small scale and no ore deposit worthwhile development under the existing corci, stamces has been discovered. However, as the signs of mineralization, though weak, are widely distributed, workable deposits may be discovered by future investigations.

The ore deposits investigated by the present mission are described in the following paragraphs.



Location and transportation :

Riohacha --- (2.5 hours by car) --- Barrancas

Barrancas --- (2 hours by car) --- Urumita

Barrancas --- (5 hours by car) --- Caracoli

1. El Salado mine

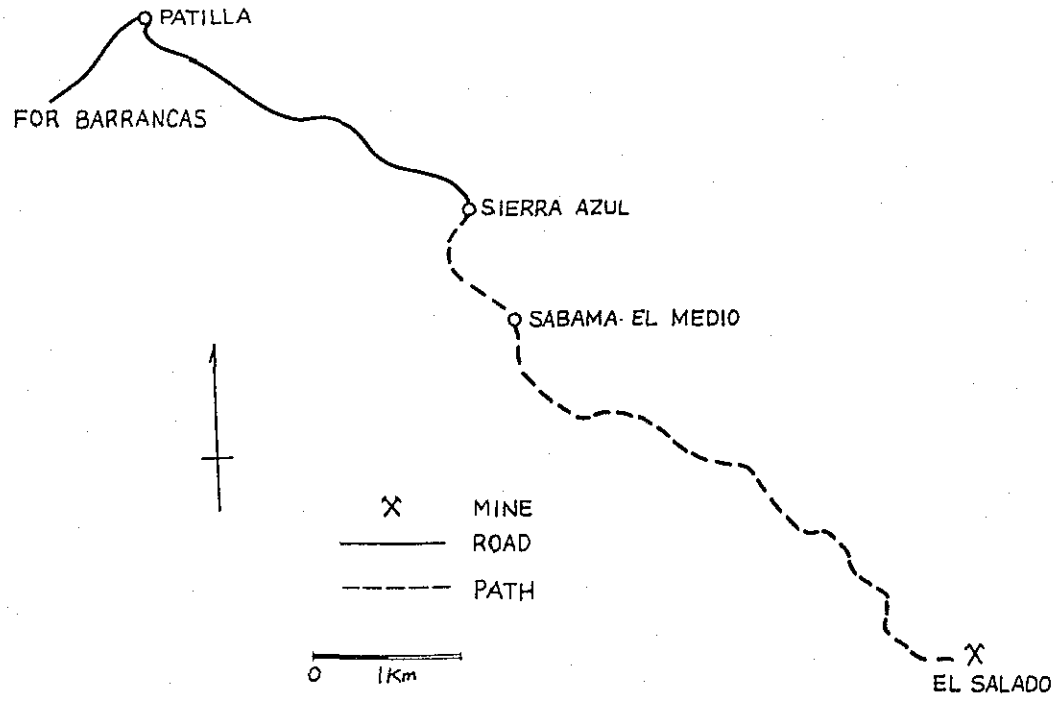
Sort of Ore : Cu

Location and transportation :

Elevation 400 m

Barrancas --- (1 hour and 40 minutes by car) --- Sierra Azul

Sierra Azul --- (2.5 hours on horseback, then 40 minutes on foot) --- El Salado



Geology :

The geology of the area is represented by a Mesozoic to Tertiary sedimentary complex consisting of red shale, sandstone and mudstone, striking generally N 70° E and dipping 40° NW.

Ore deposit:

The ore deposit occurs near a ridge several kilometers from the border of Venezuela. Due to the collapsed surface soil we were unable to ascertain the mode of occurrence of the deposit at the outcrop, but judging from a lump of ore, about 50 cm x 50 cm x 20 cm in size, which is supposed to have been taken from the outcrop, it can be interpreted that veinlets of chalcocite intruded the mudstone, forming such secondary minerals as malachite azurite and a small amount of native copper.

The dimensions of the ore deposit may not be much larger than 1 m x 1 m x 0.3 m at the most, as the surrounding rocks are hardly affected by mineralization.

As to the ore grade, Cu 2.5 to 3% is the average value of this lump ore.

Conclusion:

The ore deposit is not worthwhile prospecting, as it is too small in both scale and economic value.

2. Cerrito and El Ojo mines

Sort of ore : Cu

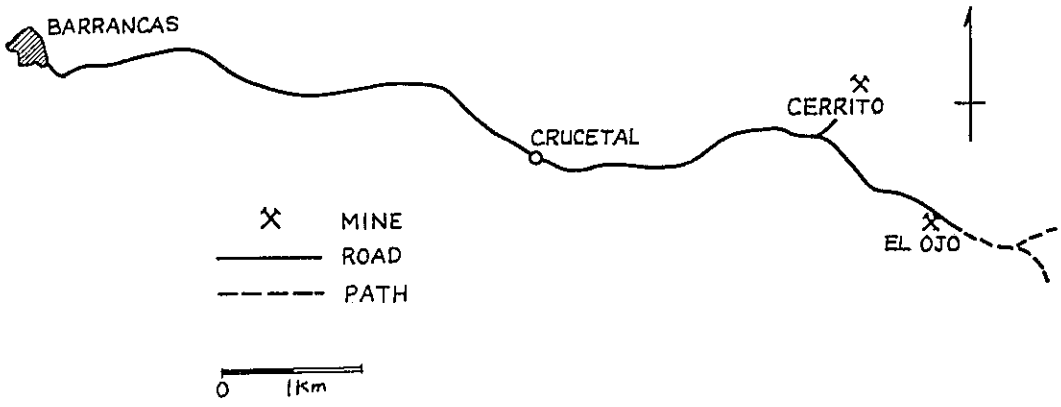
Location and transportation :

Elevation 250 - 450 m

Barrancas --- (40 minutes by small car) --- Cerrito

Cerrito --- (20 minutes by small car) --- El Ojo

(The road between Cerrito and El Ojo is very poor.)



Geology :

The principal rocks of the area are alternating sandstone, conglomerate and shale, intruded by a liparitic rock. The sedimentary rocks, with lithology suggesting Tertiary age, are striking N 45° E in the western part of the area and N 80° W in the eastern area, dipping 70° - 85° N in both areas. The rocks are slightly folded but show little disturbance by faulting or other causes. The liparitic rock is several to more than ten meters wide, and its extension is variable, ranging from 10 m to 150 m; it occurs mostly at high altitudes. The general strike of the rock bodies is N 80° and the dip is 75°N. This rock has a yellowish-green tint as a result of intensive silicivication and

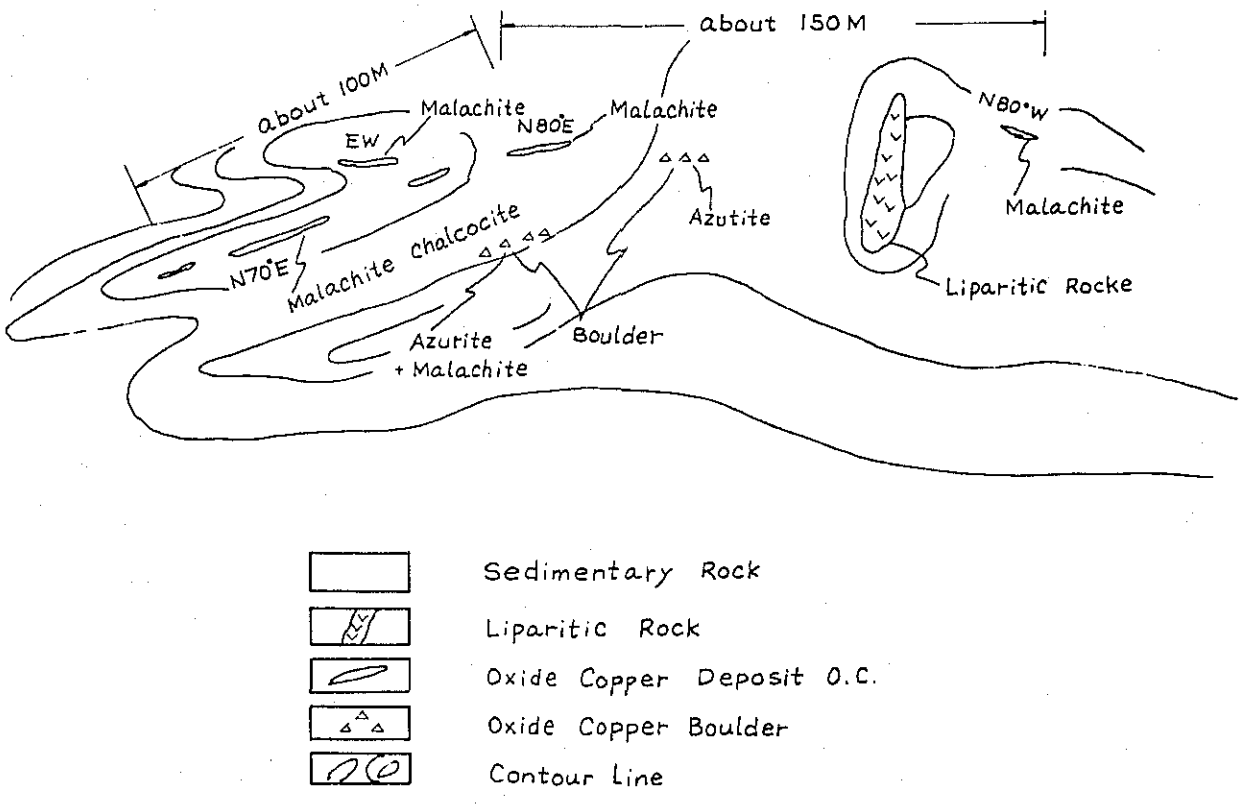
epidotization, but still retains distinct phenocrysts of quartz.

Ore deposit:

The ore is chiefly copper oxides which precipitated secondarily in the above-mentioned sedimentary rocks.

In the Cerrito area, outcrops are found in several places at intervals of several hundred meters. Of these outcrops, the most noticeable one (Cerrito No. 3 Deposit) is located at about 700 m east of the village of Cerrito. It reveals two zones of mineralization and a line of boulder ore occurring generally along the bedding plane of fine-grained sandstone or shale which strikes N 70° E or NE and dips 80° N. (Refer to Fig. 2)

Fig. 2



Extension of the ore deposit is about 250 m but the deposit is not continuous, as it is represented by intermittently occurring single outcrops, each being less than 10 m in length and 1 - 1.5 m in width. Secondary malachite is the principal constituent, locally accompanied by azurite and chalcocite. Chalcocite-bearing portions are partially intruded by fine veins of quartz, which suggests that mineralization attributable to igneous activity had taken place. However, the greater part of the ore deposit is occupied by secondary copper oxides that are supposed to have flowed down from the upper horizons and precipitated.

The ore grade of the best portion may be about Cu 0.7 - 0.8%.

Other outcrops than Cerrito No. 3 Deposit are a deposit of malachite which must have precipitated meagerly along the bedding plane of the finegrained sandstone or shale. They are one meter to several meters long, with a width 10 to 100 cm, and occur only sporadically.

Ore deposite of the El Ojo area are massive impregnations, several meters in longer diameter and 50 cm in shorter diameter, occurring in the liparitic rock. The ore contains a small amount of malachite with a negligible amount of bornite, and the grade is about Cu 0.2 - 0.3%.

Conclusion :

The ore deposits are very small in scale, low in grade, and little can be expected in the lower horizons, so that both economic value and exploration possibility are negative.

3. Campoflorido mine

Sort of ore : Cu

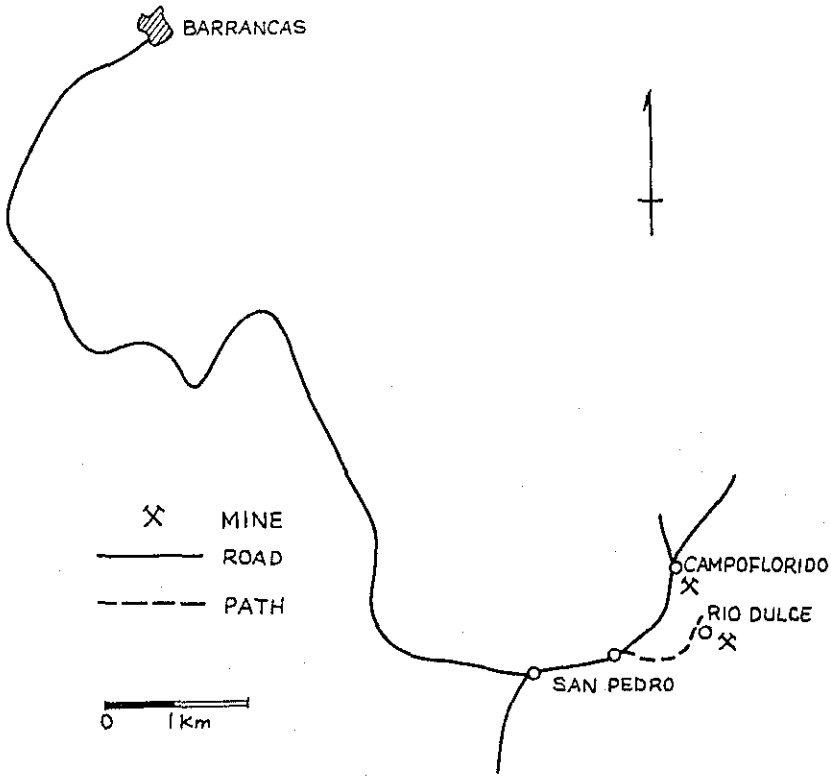
Location and transportation :

Elevation 300 m

Barrancas --- (1 hour by small car) --- Campoflorido

San Pedro --- (10 minutes by small car) --- Rio Dulce

(The road between San Pedro and Rio Dulce is very poor.)



Geology :

This area, including the village of Campoflorido, ahs many copper indications which are sporadically distributed along both sides of a zone trending NE-SW for a length of 30 km with an east-west width 2 - 3 km.

It is reported that occurrence of porphyry copper is possible in this area.

The neighborhood of Campoflorido is dotted with small isolated hills about 100 m in relative height. The geology is represented by andesitic rocks, partly andesitic lava, and dark-red schalstein. The rocks strike generally N 20° E, but small faults and shattered zones are abundant and the rocks are often crushed, with their strike and dip also disturbed. At about 500 m east of Campoflorido a zone of quartz porphyry begins, although its relation to the above-mentioned rocks is unknown. The geological age of these rocks has been assigned to Triassic to Jurassic, but their appearances suggest a younger age, probably Paleogene.

Ore deposit: (See Photo *1*)

The andesite near the village is reddish and locally limonitized. In places the andesite is argillized or silicified but such alterations are not so strong as to be attributable to mineralization. Green copper oxide ore is sporadically distributed within an area of 150 m x 30 m of the andesitic rock or its tuffaceous part. This copper ore, occurring as veinlets or as film in the minute cracks of the rock, is not worthwhile exploitation either on the whole or portionally.

Farther east boulders of quartz porphyry are found, often containing chalcocite, cuprite, malachite and chrysocolla, but the grade is low, being generally Cu 1 - 2%. Some outcrops of the quartz porphyry contain copper oxides and copper sulfides, as observed in the valley at about 500 m east of the above-mentioned locality, but their amounts are too small to deserve the name of ore deposit.

Conclusion:

This area has sporadic indications of copper ore but so far as the present investigation goes, the ore is low in grade and small in scale, and cannot be an objective of exploitation. Nevertheless, further investigation of the area is necessary as there are found many boulders of ore from unknown outcrops.

4. Rio Dulce mine

Sort of ore: Cu

Location and transportation: (See Fig. showing the location of Campoflorido)

The mine is located at about 1 km (in direct distance) south of the Campoflorido area.

Geology:

The geology of the mine area is represented by a formation consisting of red schalstein, intercalated with conglomerate which contains pebbles of red sandstone and porphyry, and black to gray slate. The formation strikes N 20° - 30° E, dips 20° - 30° E, and is intruded by younger liparitic dike rock on a small scale.

Ore deposit: (See Photo 2)

The ore deposit is a copper oxides deposit where malachite occurs as thin film in the shattered fissures of gray, fine-grained sandstone which is about 1.8 m thick, interbedded in black slate. The surrounding rocks are not affected by silicification and no sulfide minerals are found. Occurrence of copper oxides is limited to an area of about 2 m x 1 m along the bedding plane of the sandstone and about several tens of centimeters in the direction perpendicular to the bedding plane.

Conclusion :

The ore deposit was formed secondarily when the copper oxides had precipitated from the upper horizons, so its downward development is hardly possible. It is too small to be called ore deposit and has no economic value.

5. Los Portales mine

Sort of ore : Cu

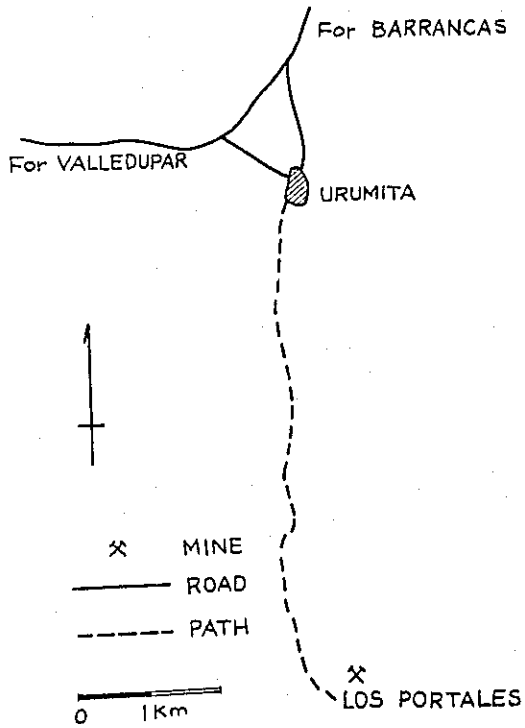
Location and transportation :

Elevation 700 m

Urumita --- (40 minutes by small car) --- X

(It is about 10 km in direct distance but the road is poor.)

X --- (1 hour and 20 minutes on horseback) --- Los Portales



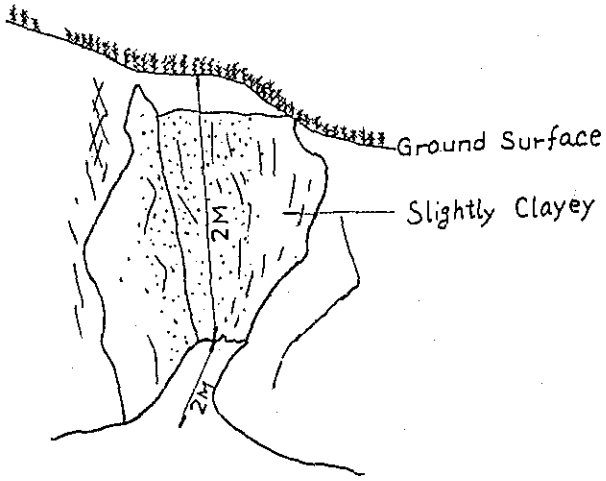
Geology :

The geology of this area is represented by an alternation of Tertiary ferruginous sandstone and shale, rarely intercalated with tuffaceous greenish shale. The beds strike N 20° W and dip less than 20° W. From a distance the conformable succession of the beds is distinctly observed.

Ore deposit :

Near the top of a hill west of the village of Los Portales occurs the tuffaceous greenish shale in which a site of old prospecting for copper is found. The prospecting was made by open cutting on the grass-covered slope, as the sketch below shows.

Fig. 3



The country rock is crushed and numerous cracks are developed in the direction of N 50° E or vertical. Green copper oxides ore occurs as

fine veins or thin film in these cracks. Also, the country rock has pisolitic spots of chlorite in places, thus presenting like an appearance of intensive mineralization.

The copper ore is characterized by predominance of azurite which is accompanied by malachite and chrysocolla. Very fine veins or pisolitic lumps of chalcocite are also found though rarely.

The impregnated part, Cu 3 - 5% in grade, is 60 cm thick in the upper part and about 20 cm in the lower part, and impregnation becomes weaker inward. As the distance from this cutting to the other side of the hill is about 30 m, there is no possibility of farther extension of the impregnation.

Two other indications of copper ore are found between this locality and the valley of Rio Marquesote, but they are no more than very scarce green copper minerals occurring in sandstone and green tuff, and cannot be regarded as ore deposits.

Conclusion :

As the area is a grassland, outcrops are very few. There is a possibility of discovering more hopeful copper indications, but the deposits so far known have no economic value nor prospecting possibility.

6. Camperucho mine

Sort of ore : Cu

Location and transportation :

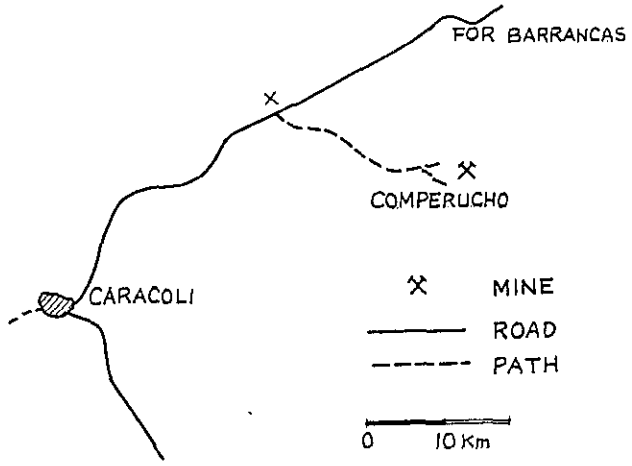
Elevation 100 m

Barrancas --- (5 hours by car) --- Caracoli

Caracoli --- (15 minutes by car) --- Camperucho

(From the X-marked point to Comperucho, it is

5 minutes by car, but the road is poor.)



Geology :

The area is composed of alternating black andesitic tuff and sandstone, probably Mesozoic in age. Strike and dip of the beds are not known, but judging from the sporadical small outcrops and old sites of prospecting in the flat grassland, a shattered zone seems to extend 2 km long in the direction of N 40° E.

Ore deposit :

The ore consists of malachite and other copper minerals which infiltrated into the cracks of the shattered zone.

At about 500 m north of the village of Camperucho, old pits and

trenches are recognized in more than ten places, arranged in a NE direction. The pits, supposedly about 2 m deep, are filled with collapsed soil. Around these old sites of excavation are scattered lumps of ore and waste, some containing more than 5% Cu. However, the ore occurs merely as aggregates of thin film or as meager infiltration, and the portions with grade higher than Cu 1% are very small.

Inside the pits almost no trace of ore is observed, except for rare occurrence of film of green copper oxides in the NE-trending cracks. It is most likely that the copper ore existed only near the ground surface.

At about 500 m and 1,000 m northeast of the above-mentioned locality, old sites of a deep prospecting well and a shaft are found, but the former is now filled with collapsed soil and the latter is submerged under water. Amount of copper minerals in these places is negligible.

Conclusion:

It is reported that prospecting of this area was attempted 80 years ago. The scope of the prospecting seems to have been fairly large. At any rate, this area is not worthy of prospecting because the copper oxides constituting the ore deposit are nothing but a transported material from upper horizons.

7. Boliden Bolivar mine (Carmen mine)

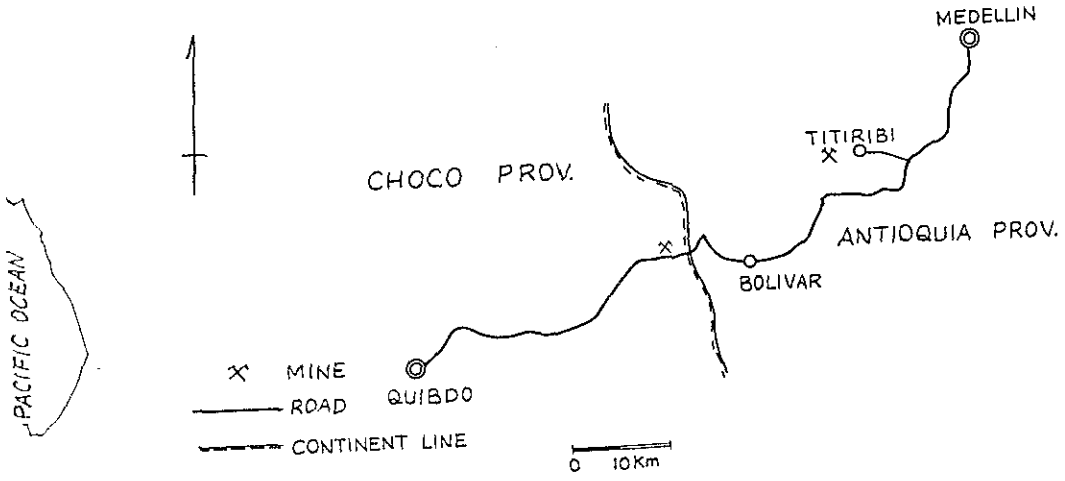
Sort of ore: Cu

Location and transportation: (See Fig.)

Elevation 1,800 m - 2,000 m

Medellin --- (5 hours by car) --- Bolivar

Bolivar --- (27 km, 1 hour by car) --- mine



Geology :

The mine area is composed of Mesozoic black slate and sandstone, intruded by a green rock, apparently diabase. The green rock is affected by weak pyritization.

Ore deposit:

The shattered zone of the diabase is intruded by chalcopyrite-bearing quartz-calcite veinlets, resulting in weak impregnation of chalcopyrite and pyrite near the veinlets. Secondarily-produced green copper oxides are also observed. The ascertained part of the deposit measures as follows: length about 150 m, width several to more than 10 cm, attaining to 2 m in maximum, and relative height about 50 m.

On the whole, the grade of chalcopyrite is Cu 0.2 - 0.3%, although there are some parts attaining to about Cu 3% with a width of 1 m.

Around this mineralized zone very weak pyritization is recognized.

Conclusion :

As the mineralization is very weak, the deposit has a very small possibility to be developed into a workable mine.

Besides, since the deposit occurs in a faulted zone, the surrounding rocks are extremely friable, which would cause technical difficulties in mining operation even when the ore grade becomes somewhat higher.

Consequently, economical development of this area seems to be difficult.

8. Anguede mine lot of Bagado area

Sort of ore : Cu

Location and transportation :

Bagado, Choco Provine (See Photo)

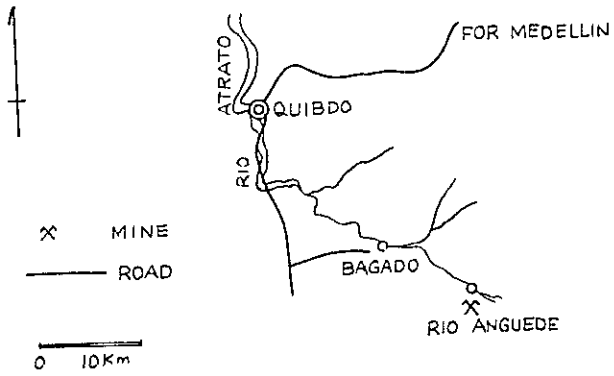
Elevation 200 m

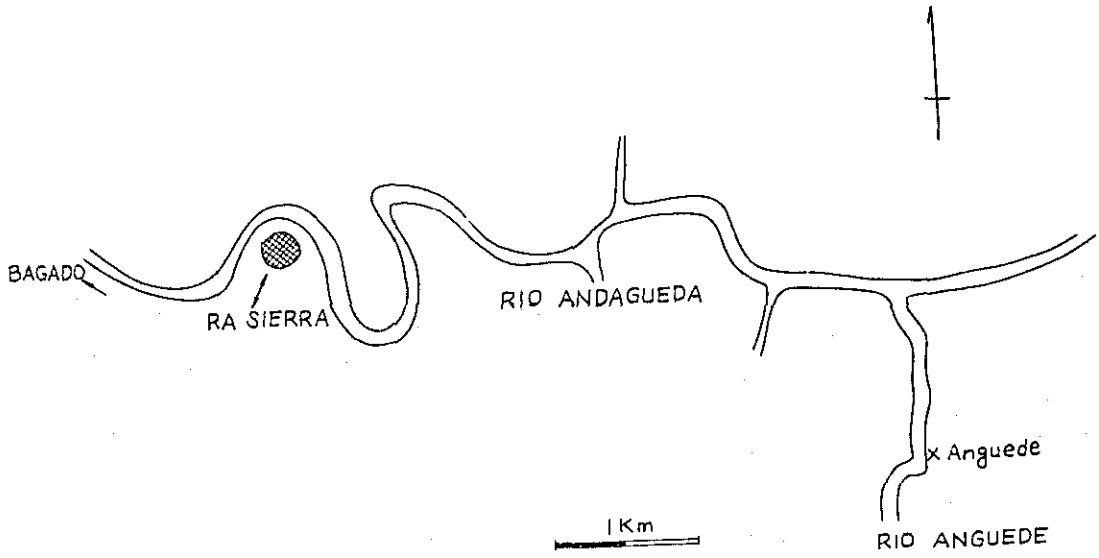
Quibdo --- (4 hours by launch, or 40 minutes by helicopter) --- Bagado

Bagado --- (6 hours by canoe) --- Anguede

(From Bagado to Anguede, it becomes navigable by launch when the river water rose.)

Rio Anguede's entrance --- (1 hour on foot) --- mine lot





Geology :

Observation of the Anguede outcrop and vicinity has revealed that the country rock is a slightly chloritized dacite or quartz porphyry, in which run three rows of fissures. Veins of pyrite and chalcopyrite occur along these fissures.

Ore deposit: (See Photos 3, 4)

One of such veins has been investigated this time. It occurs in

the cliff 8 m above the river bed. The vein, striking N 35° E and dipping 35° E, is a chalcopyrite-pyrite-bearing quartz vein, filling a small fissure. The vein has a width of 3 - 5 cm, showing often some swelling and pinching, and is observed to extend only 4 or 5 m in the strike direction. Chalcopyrite is more abundant than pyrite, and the vein grade may be Cu 5 - 8%.

We were informed that another ore vein occurs farther upstream and an outcrop of pyrite impregnation on the river-bed below the opposite bank, but we could not confirm either of them.

Conclusion :

So far as the outcrop we have investigated is concerned, the scale of ore deposit seems to be small and mineralization weak. However, as it is understood that there are 20 outcrops in this area, basic investigation of those outcrops should be carried out and their relativity and other features should be studied. Difficulties to be involved in the field work would be ascribed chiefly to the area's inconvenient location and to the dense cover of vegetation.

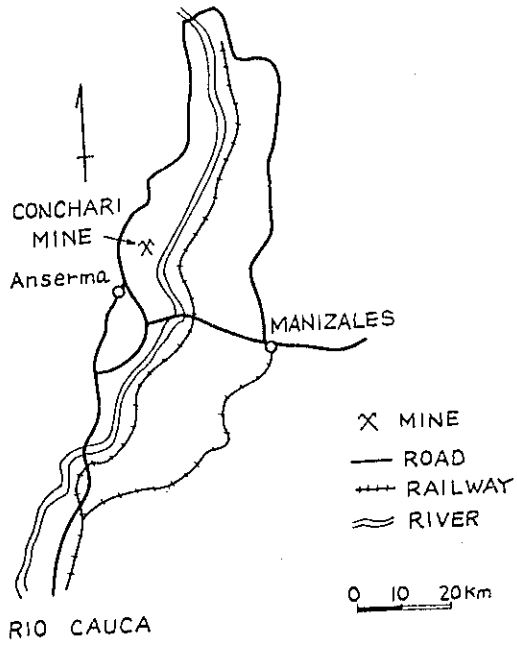
9. Conchari mine

Sort of ore : Cu

Location and transportation :

Anserma --- (5 km by car) --- X

X --- (10 km, 2.5 hours on horseback) --- mine site



Geology :

The neighborhood of the mine is a grass-covered pasture. Details of geological setting of the area are not known, but several rock exposures and boulders suggest a granitic rock region.

Ore deposit :

A mound, probably an old waste heap, and several outcrops of ore deposit are observed along a small valley. According to the observation of the outcrops, the ore deposit appears to be a cupriferous calcite-quartz vein intruding aplitic granite. Copper minerals are mostly malachite and chalcocite of secondary origin, although some boulders of ore contain a fair amount of chalcopyrite. As the ore observed here occurs mainly as boulders, precise features of the ore vein are not known, but judging from the topography the vein may be extending N-S. We heard that

there was another copper ore deposit, but we could not find it as even our guide had no knowledge of its location.

We were also informed that placer gold was collected previously from a nearby stream, and that boulders of molybdenite ore were often found. The source of these metals may be the quartz veins intruding the granitic rock.

Conclusion:

The present state of the area, as mentioned above, enables no means of investigation. The owner of the mine should attempt some exploration at least by trenching.

10. Gachala mine

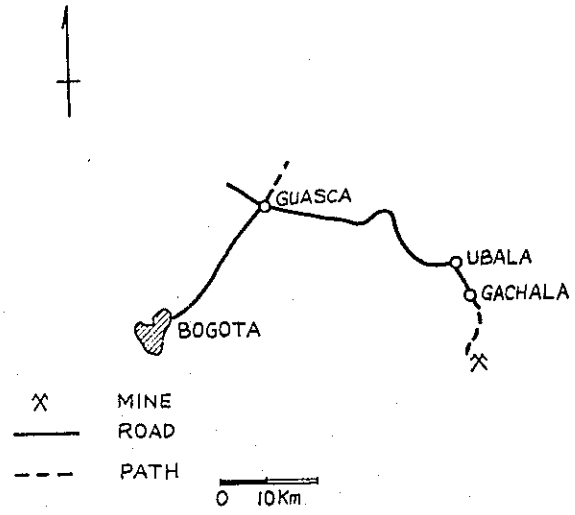
Sort of ore : Cu

Location and transportation :

Elevation 2,640 m

Bogota --- (4 hours by car) --- Gachala

Gachala --- (5 hours on horseback) --- mine site



Geology :

The geology of this area is represented by a complex of apparently Paleozoic age, consisting of red sandstone, dark-gray slate, gray sandstone and schalstein or tuffaceous slate. The complex has a nearly horizontal or gently inclined structure, striking N-S and dipping about 5° or less to E.

Ore deposit :

The ore deposit is a bedded impregnation deposit, about 2 m thick, of fine grains of pyrite, chalcopyrite and bornite, imbedded in the schalstein or tuffaceous slate which contacts the red sandstone footwall. In this footwall, intrusion of quartz veinlets in network is faintly observed. The impregnated part of the copper minerals shows slight silicification and rarely tourmalinization.

Ore reserves :

Under the existing circumstances the extension of the ore deposit cannot be traced. It has been ascertained only that the outcrop is 15 - 20 m long in the strike direction. However, we were told that a similar deposit occurring in a corresponding horizon is exposed with a strike length of 2,000 m, at a place beyond the pass about 2,000 m east of the above-mentioned outcrop. Should these two outcrops be continuous, an areal extension of the ore deposit would amount to about 2,000 m x 2,000 m. Consequently, the inferred reserves may be

2,000 m x 2,000 m x 2 m (width) x 2.6 (specific gravity)

$\fallingdotseq$ 20,000,000 tons.

Nevertheless, so far as the observation of the outcrop goes, the

ore grade is not uniform, ranging from Cu 1% or less in good parts to Cu 0.3 - 0.5% in inferior parts, and deterioration of grade is noticed on the west side of the outcrop. Hence, the entire area of 2,000 m x 2,000 m cannot be considered to represent the reserves. Even if the average grade at the outcrop was estimated at Cu 0.7 - 0.8%, it would be risky to apply this value to the whole reserves.

Conclusion :

Since the ore deposit is an only 2 m thick horizontal bed, some technical difficulties are expected in exploitation. Supposing the prospecting is carried out by test boring, it must face the problems of the 200 - 400 m thick overburden and the unfavorable geographical situation. Before the ore reserves can be ascertained, the expenses of the prospecting would become enormous. Therefore, under the present conditions, prospection and development of this mine seem difficult.

11. La Colonia mine

Sort of ore : Cu

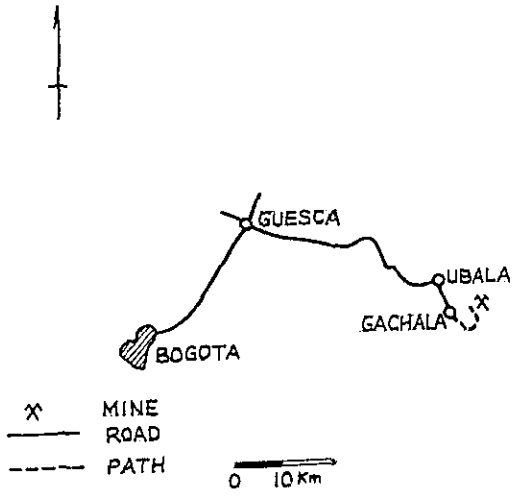
Location and transportation :

Elevation 1,450 m

Bogota --- (160 km, 4 hours by car) --- Gachala

Gachala --- (20 km, 30 minutes by car, or 2 ours on horseback)

--- mine site



History :

The mine was discovered in about 1926 by a Swiss named Peter Alig. Later, seven cross-cuts were made by the Sheel Company. From 1955 to 1958, the mine was operated by another company with a British capital, and during this period the mine was provided with dressing facilities. Afterwards, the operation was suspended. In 1959, the Choco Pacifico Company carried out prospecting by 4 or 5 test borings, obtaining poor results. At present the mine remains closed.

Geology :

Limestone and gray slate, probably Paleozoic in age, are distributed in the mine area. Strike and dip are variable, but the general strike is NE or NNE and the dip is steep or gentle to W.

Ore deposit :

Near the ore deposit the limestone and the slate are in fault contact, and formation of the ore deposit is related to this fault. The ore deposit was formed by mineral solution which ascended along subordinate faults or shattered zone in the limestone and replaced the wall rock; the solution also

invaded the limestone in a network pattern.

The ore body strikes N 30° E and dips 88° W. Its upper part has become an oxidation zone, forming secondary ore-shoots of malachite, bornite, etc. Its scale is about 15 m in extension, 2.5 m in maximum width and several meters in depth. An average grade may amount to Cu 5 - 6%.

The lower part is intruded by network of calcite and quartz veinlets; chalcopyrite, bornite and a very small amount of pyrite are observed along the veinlets or replacing the limestone. The size of these cupriferous parts is about 20 m in extension, 2 - 2.5 m in width and about 10 m in depth. Inferred grade of ore is about Cu 3%.

The lowermost part, which was explored by a cross-cut, does not show any noticeable signs of mineralization, hence no expectation can be placed on the parts farther below.

The ore reserves are estimated as follows :

a) Upper secondarily-enriched zone

15 m (length) x 2 m (width) x 5 m (depth) x 2.4 (sp. gr.) = 360 tons

Exploited amount ..... approximately 100 tons

Remaining reserves .... approximately 260 tons (with Cu 6%)

b) Lower sulphurized zone

20 m (length) x 2 m (width) x 10 m (depth) x 2.5 (sp. gr.) = 1,000 tons (with Cu 3%)

Total 1,260 tons (with Cu about 3.6%)

Conclusion :

If the enriched parts alone are mined selectively on a small scale the business might be paid, when the copper price is high. Judging from the nature of the ore deposit, however, future development of the mine is hopeless since no expectation can be placed on the parts farther below.

According to the guide who led our way, similar deposite are found at about 10 localities around this deposit, but they are probably all very small.

Consequently, this mine is too small to be taken into consideration as an object of enterprise.

B. Lead-zinc Mines

12. Esmeralda mine

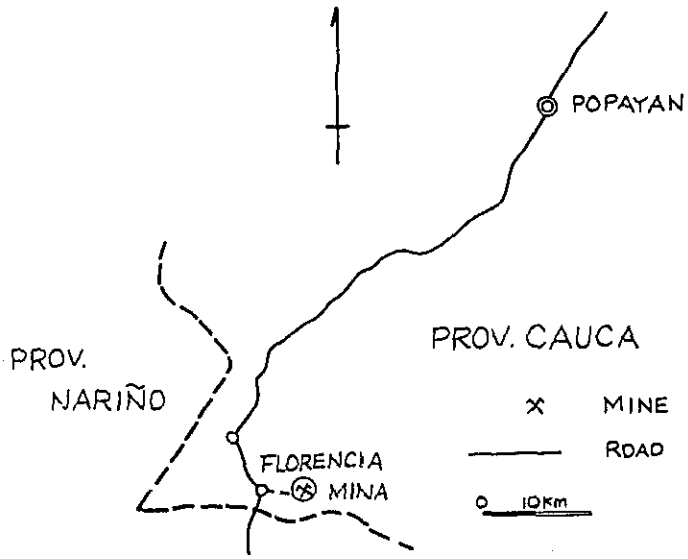
Sort of ore : Pb, Zn

Location and transportation :

Elevation 1,800 m

Popayan --- (5.5 hours by car) --- Florencia

Florencia --- (12 km, 3.5 hours on horseback) --- mine



Geology :

Conglomerate, sandstone and shale, which appear to be Tertiary in age, are intruded by andesite and quartz porphyry that constitute the higher part of this area. The lead-zinc mineralization occurs mainly in the conglomerate around the intrusive rocks. The mineralization, however, is weak, showing silicification and kaolinization accompanied by pyrite, zincblende, galena and chalcopyrite.

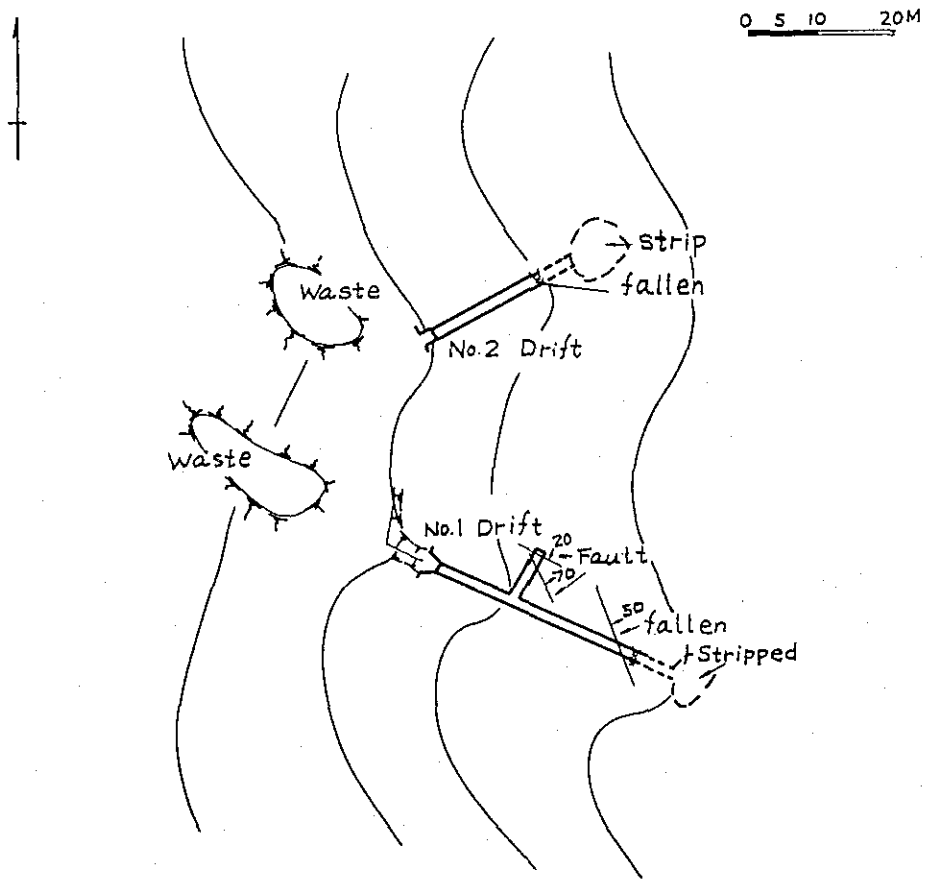
Ore deposite :

Principal sites of old prospecting are found in the conglomerate bed where the mineralization is more or less concentrated along faults and shattered zones. Ore minerals, chiefly zincblende, occur as lumps, less than 10 cm in diameter, scattered in a clay zone, or as a cementing material

of fault breccia. The ore zone is not defined well, but the grade is less than Zn 10% even in the good parts. Nodules of lead-zinc ore are noticed only sporadically. Pyrite is thinly and widely disseminated. None of these minerals is worthy of prospecting.

On the western slope of the mountain on which stands the village of Esmeralda, two drifts, No. 1 and No. 2, are found at about 500 m south of the village. The sketch map is given below.

Fig. 4 SKETCH MAP OF ESMERALDA Pb. Zn. MINE



Besides the above, there are several sites of excavation, cutting the cliff on the reverse side of the mountain, but the exposures reveal merely the existence of metallic minerals,none of which deserves the name of ore deposit.

Conclusion :

The lead-zinc ore of the Esmeralda mine is of low grade. It is possible that such low grade ores are widely scattered throughout the area, but no good deposits can be expected. Even if ore reserves of a considerable amount were ascertained, the economic value would be small because of the inconvenient location and the low grade of ore. In addition, it must be noted that the zincblende contains much iron and is presumably marmatitic. Thus, there is no hope of the mine's future development.

C. Gold, Silver and Copper Mines

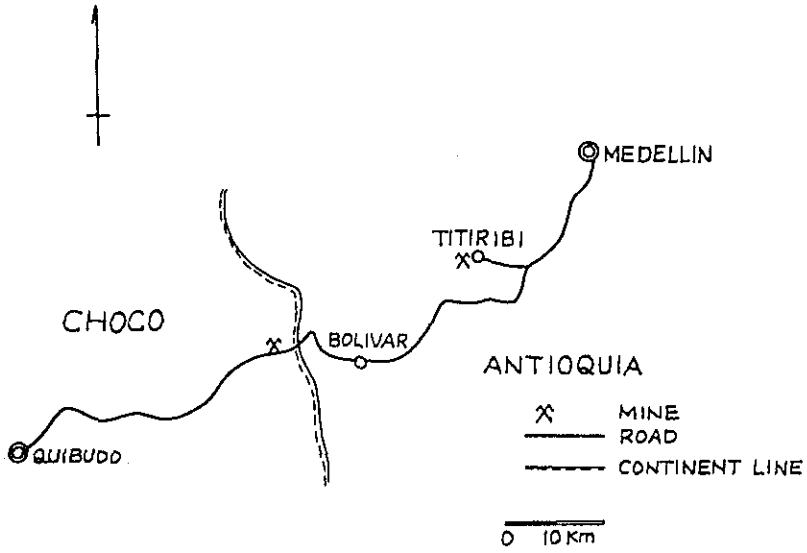
13. Titiribi mine

Sort of ore : Au

Location and transportation :

Elevation 600 m

Medellin --- (2 hours by car) --- Titiribi



Geology :

The geology of the area consists of Tertiary sandstone and conglomerate, intruded by propylite. The sandstone and conglomerate are both highly silicified, and in propylite are seen silicification and slight pyritization.

Ore deposit :

Owing to collapse of the tunnel, we could not enter it. According to a native guide, the daily production of gold ore some 30 years ago was around 500 tons totalling the outputs of the neighboring 10 mines. However, the waste in the dump at the adit contains no vein quartz buy consists only of highly silicified rock, so the possibility of existence of a promising gold ore deposit is negative.

In the mine investigated, it is said that exploration was made by adit and inclined shaft for a length of 300 - 400 m, and that an auriferous a

vein with 2 cm in width and an ore body called "Manto" were encountered. But, the ore grade remains unknown, and even when such deposits are really existent, they cannot be an object of exploitation under the present conditions.

Conslusion :

In view of the scale and the ore grade, there is no deposit to be called a gold ore deposit, and no further exploration is warranted.

14. San Andres and Diamante mines

Sort of ore : Au, Ag

Location and transportation :

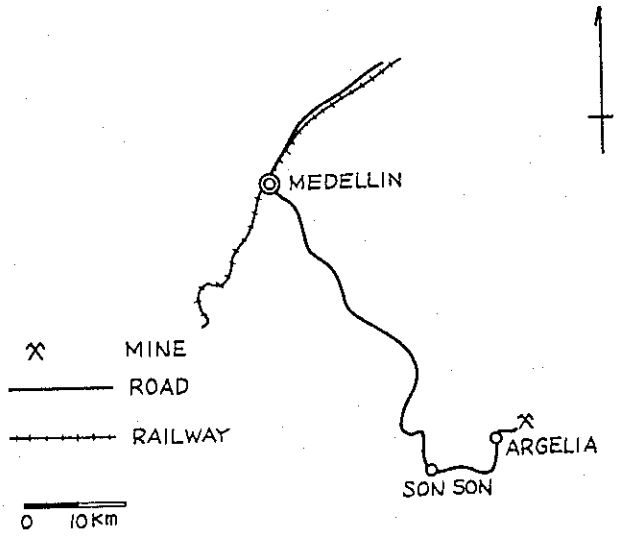
Argelia, Antioguia Province

Elevation 1,500 m

Medellin --- (111 km by car) --- Son Son

Son Son --- (25 km by car) --- Argelia

Argelia --- (4 km by horse) -- mine site



History :

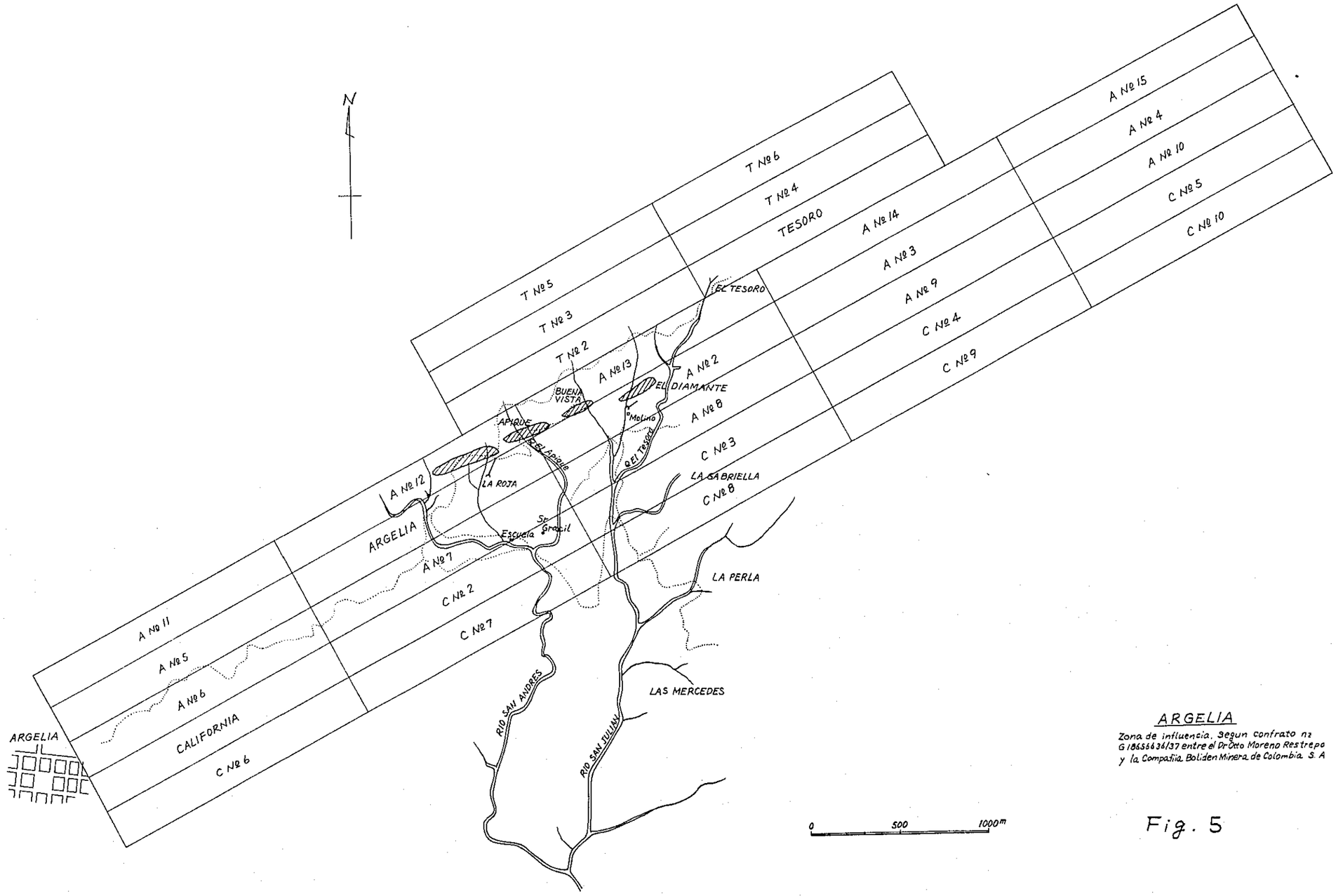
The lease of one and the same deposit is held by two companies, separating it into two portions, San Andres and Diamante.

The San Andres deposit is said to have been worked by the San Andres Mining Company as early as 1890 - 1917. At the present time, however, investigation is nearly impossible either on the underground working or on the surface outcrop. From the information obtained, the rich ore above the main adit level appears to have been mined out. The ore below this level also seems to have been exploited to some extent by a shaft, although the details are not known.

In the diamante deposit, old excavations are seen along the outcrop. All the adits have collapsed, but the one 10 m above the dressing plant level has been cleared and the remaining ore is now being mined, yielding 4 - 5 tons per day, using a water-mill type stamp.

Geology :

The area is situated in the drainage basin of Quebrada Tesoro, a tributary of Rio San Julian, and Quebrada El Apique, a tributary of Rio San Andres. It constitutes a part of the granite batholith which is widely distributed (50 km east-west and 130 km north-south) to the east of Medellin, Antioquia Province.



ARGELIA

Zona de influencia. Segun contrato nº G 1865636/37 entre el Dr Otto Moreno Restrepo y la Compañia Boliden Minera de Colombia S. A

Fig. 5

Ore deposit:

The deposit of the Diamante mine is a lode containing gold, silver and lead with quartz gangue, filling the granite's fissure, striking roughly east-west and dipping 60° - 70° S. It is a deposit of chimney or lens type. The outcrop is on a ridge 1,650 m above sea level and is separated by a "horse" into two parts, having the width 20 cm to the hanging wall and 60 cm to the foot wall. It is composed of quartz gangue with pyrite, galena and a minor amount of zincblende. The grade of the outcrop averages Au 20 g/t, Ag 300 g/t, Pb 4 - 5% and Zn 0.5%. The deposit, however, might be of small scale, as it is not persistent in strike direction.

Conclusion:

So far as the San Andres mine is concerned, no definite knowledge can be gained on the mode of occurrence of the deposit, its grade and other details. The outcrop has been obscured, and even the accurate location of the adit entrance is not known. Judging from the observations at the Diamante mine, we cannot expect much from this deposit.

In the Diamante mine also, observations were limited due to the collapse of most of the old adits. At any rate, the mine cannot be very promising as the deposit is small and the lenses of ore are few.

15. Maramato mine

Sort of ore: Au, Ag

Location and transportation: (Photo 7)

Marmato, Caldas Province

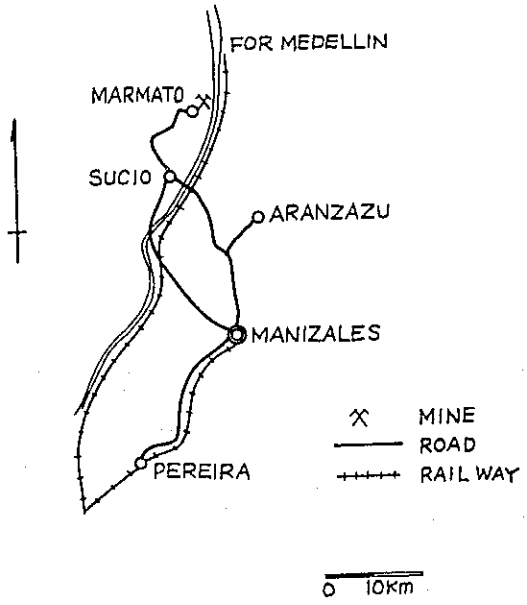
Elevation 1,340 m

Bogota --- (1 hour by air) --- Pereira

Pereira --- (213 km by car) --- Marmato

Sucio (railway station) --- (75 km by car) --- Marmato

(Between Marmato and the mine site, bus services are available.)



History :

It appears that the mine has been worked for a long time and a large scale exploitation was carried out before the mine was placed under the government management. Most of the underground workings and portals have collapsed. In spite of the government's efforts for reconstruction of

the mine, the present conditions are no better than those of a closed mine.

Geology :

The area is occupied by Tertiary granite extending 50 km north-south and 15 km east-west. The Marmato mine is nearly in the center of this rock body.

Ore deposit :

The deposit is of the fissure-filling type, consisting chiefly of gold-and silver-bearing quartz, associated with pyrite, galena, zincblende and chalcopyrite as accessory minerals. There are more than ten veins extending in a NW-SE direction, with a maximum length of 800 m. The veins are divided into three groups, North, Central and South, at intervals of 250 m and 50 m respectively. Details of the ore veins are not known, as the underground workings are almost inaccessible, and no technical experts are at the mine. A cross-cut was opened at about 800 m below the outcrop but the operation is now suspended.

Production :

Crude ore	80 t/day
Grade	Au 10 g/t, Ag 15 - 20 g/t
Employee	Approximately 500

Mining is now carried out at about five faces, most of which are dealing only with the ore remnants. At the mine site there is no technical experts but a supervisor serving as a caretaker. No reliable calculation of ore reserves has been made. No. exploration is being undertaken at present.

Conclusion and recommendation :

1. The number of the mine employees is quite large. In addition to the difficulty in personnel reduction, the mine is pressed by the payment of unemployment insurance. Mining operation is extremely inefficient. Relevant countermeasures must be taken immediately.

2. Owing to the paucity of available information on vertical changes of mineral assemblage, vein width and fluctuation of ore grade, etc., a reasonable appraisal of the deposit is difficult.

However, since the mining operation including exploration of the lower horizons has been proceeded to a considerable extent, it is advisable that the government sends the technical experts to the mine to carry out overall reinvestigations of the ore deposit before any practical plans are made.

D. Manganese Mines

16. Boliden mine

Sort of ore : Mn

Location and transportation :

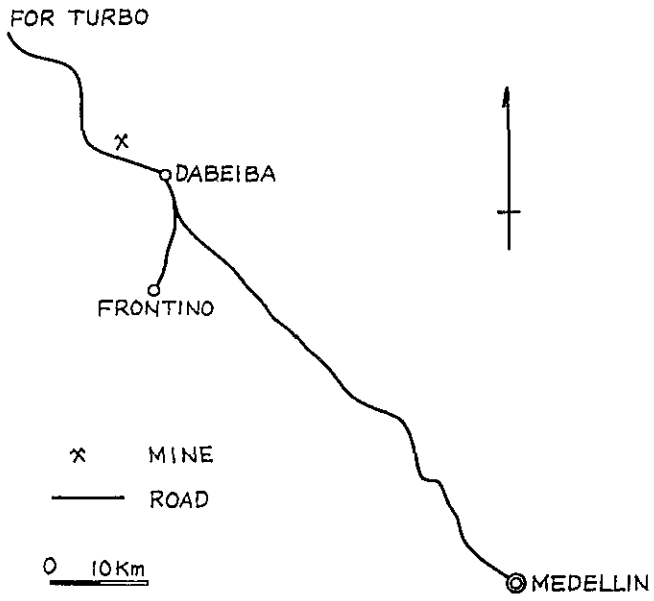
Medellin --- (about 200 km, by large car) --- Dabeiba

Medellin --- (50 minutes by small plane) --- Frontino

Frontino --- (2 hours by car) --- Dabeiba

Dabeiba --- (1 hour by car) --- mine site

Elevation of the mine site 170 m



History :

Exploration of the mine was started in 1962 by the Boliden Mineria de Colombia (a Swedish company), who carried out trenching and stripping of the outcrop and four drillings. Topographical and geological surveys were also made. The drillings have confirmed the existence of an ore body extending to the 65 m level. To explore further in the direction of the extension and in the downward direction, four drilling machines, two are of a 400 m capacity and two of 200 m, are being prepared at Dabeiba.

Geology :

The geology of the area consists of a series of schalstein, limestone, conglomerate, slate and quartzite which are thought to be of Jurassic or Cretaceous age. Though markedly folded, the rocks strike generally N-S

to N 20° E and dip either steeply or gently to the east.

Ore deposit:

The ore deposit is a feeruginous manganese bed occurring in the schalstein; rich ore bodies have been formed along the folding axis of the host rock.

There are two main ore bodies, (A) near the mining hut and (B) at 1.5 km north of the former, both being 30 - 40 m in length and 1.5 - 2 m in width, attaining a maximum width of 3.5 m. Ore body (A) has been confirmed by drilling down to the level of 65 m below the outcrop, and the ore intersection of the core is reported to attain to 8 m.

The superficial part of the outcrop is composed chiefly of secondary pyrolusite which is occasionally associated with a mineral that seems to be polianite

The ore grade is generally higher on the surface as a result of secondary enrichment, partly as high as MnO_2 75%. The grade begins to lower at several meters below the ground surface, so little expectation can be placed in lower horizons. We were not informed of the result of the drilling, but is is most likely that the ore grade of the deeper parts was lower than that of the superficial part.

Away from the axial zone of the folding, ore bodies deteriorate rapidly, turning into ore streaks, but the ore-bearing horizon is still traceable.

Ore reserves:

Since the down-dip continuation of the ore bed was ascertained by drilling, considerably large reserves are talked about, but so far as the

present state reveals, the total amount of reserves of two ore bodies would be around several ten thousand tons.

Conclusion :

Although the manganese ore is locally fairly high in grade, the scale of the deposit is small and the greater portion of the reserves occur below the river level. Therefore, some technical problems would arise in mining, and a large scale development of this mine would be difficult.

17. Esmeralda mine

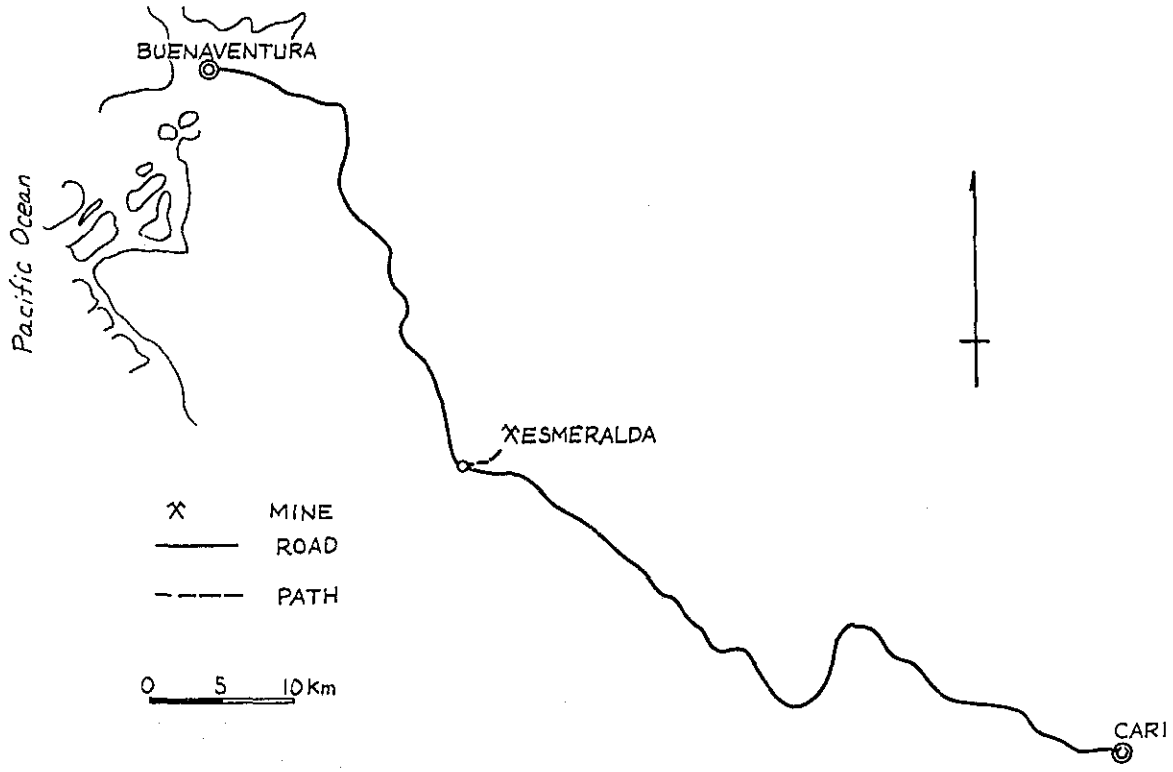
Sort of ore : Mn

Location and transportation :

Cali --- (90 km, 2.5 hours by car) --- Anchicaya

Anchicaya --- (8 km, 4 hours on foot; road is rugges and muddy) --- mountain hut

Elevation of mountain hut	200 m
Elevation of outcrop	400 m



Geology :

Dioritic rock occupies a wide area around the Anchicaya village. In the vicinity of the mine are widely distributed phyllite and iron-bearing red schalstein which are probably Paleozoic or Early Mesozoic in age.

Ore deposit :

The iron-bearing red schalstein contains manganese in a certain horizon, and this manganese has formed an ore bed of secondary manganese dioxide. The manganese-bearing zone is recognized as an outcrop which strikes N 50° E, dips 58° SE, with a strike length of several hundred meters and a width several meters. But, the portion valuable as a manganese ore

is limited to a very small part of the surface, occurring either as lenses of less than several meters in length and several to ten centimeters in width, or thin coating along the joint plane of the country rock. The grade would decrease with depth. Accordingly, only about 1% of the so-called manganese deposit would deserve the name of true manganese ore. In other words, the manganese deposit of this area is composed of manganese dioxide resulting from the manganese-bearing rock by secondary enrighment, so there is no hope for future development.

Conclusion:

Economic value of this mine is very small, as the so-called ore deposit is composed of small lumps of ore which are scattered over a very inconveniently located area.

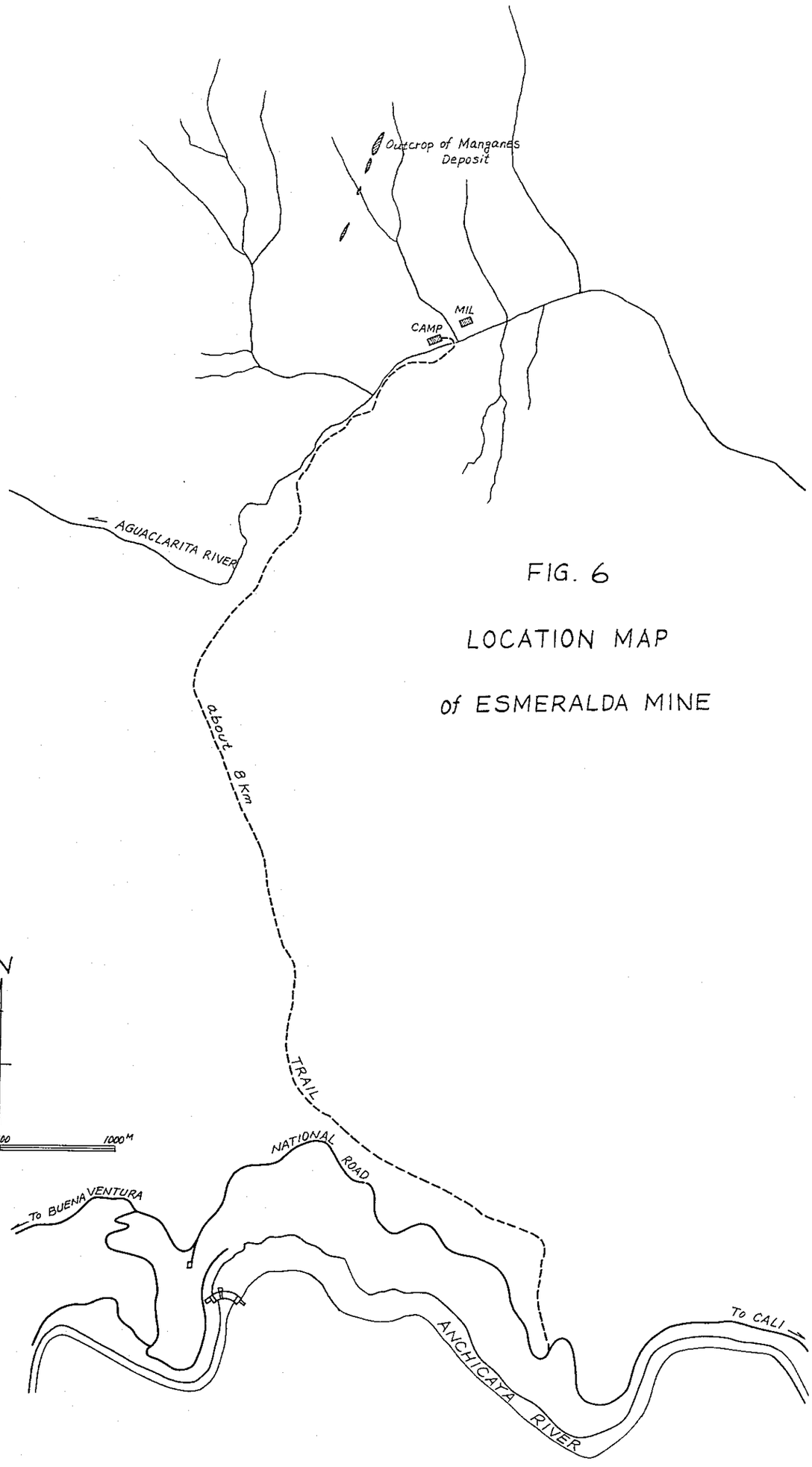


FIG. 6

LOCATION MAP

of ESMERALDA MINE

E. Mercury Mine

18. La Esperanza mine

Sort of *ore* : Hg

Location and transportation :

Aranzazu, Caldas Province

Elevation 1,950 m

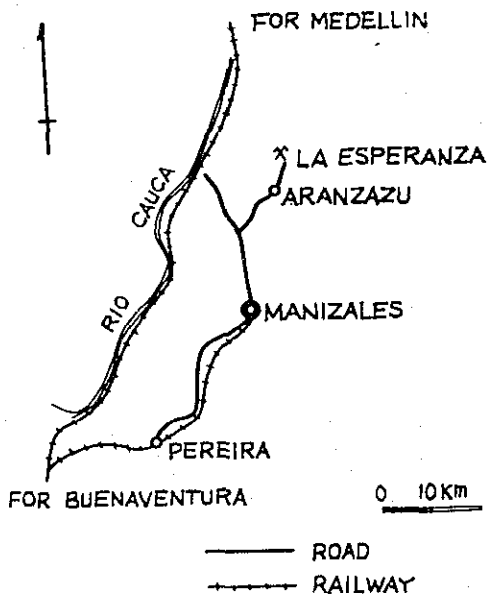
Bogota --- (1 hour by plane) --- Pereira

Pereira --- (50 km by car) --- Manizales

Manizales --- (58 km by car) --- Aranzazu

Aranzazu --- (10 minutes by car, or 1 hour on horseback) --- La Esperanza

(A railway runs from Manizales to Buenaventura, a port on the Pacific coast.)



History :

The ore deposit was discovered in about 1948 and was developed in 1954. Underground exploration was started in 1955, but the full-scale investigation was carried out in 1958 by J. Vermeiren. During the period of 1961 - 1963, the mine was operated by the Choco Pacifico Company. After that, the operation has been continued under the joint managment of the Consorcio Minero Colombiano and Mr. Americo Maran.

Geology :

The vicinity of the mine is composed of gray, light green and black slates (locally phyllitic) of pre-Cretaceous age. The beds form an anticlinal structure with the axis extending along the Rio Chupadera in the direction roughly north-south. The La Esperanza murcury deposit occurs on the slope above the Rio Chupadera draining the east limb of the anticline.

Ore deposit:

The deposit was formed in the shear zone of the slate constituting the east limb of the anticline; the shear zone extends along the bedding plane of the rock, striking roughly N-S and dipping 50° - 60° E. The ore occures chiefly within a width of 5 - 20 m adjacent to the hanging wall. Mercury occurs mainly as natural mercury in the form of grain (0.5 - 0.15 mm in diameter) in fissures, and very rarely as cinnabar. Where quartz or calcite veinlets occur near the deposit, mercury is associated with pyrite and rarely with chalcopyrite. Mercury is found also in the clay, 4 - 5 cm wide, of the shear zone.

Underground situation :

Adit No. 4 has encountered ore vein at about 100 m from the portal.

On the face, the vein is about 50 cm in width and dips 45° E, consisting of rich and poor zones; the zone rich in natural mercury is 4 - 5 cm wide, with the Hg content several percents, occurring along both the hanging and foot walls, and the poor zone with less than 0.5% Hg is found in between them. The average grade of the vein is approximately 1% Hg. The rich ore zone adjacent to the hanging wall is composed of clay which contains natural mercury, while that adjacent to the foot wall is composed of black slate, which is phyllitic and appears to have suffered considerable shearing, and natural mercury occurs in the cracks, rarely accompanied by cinnabar. Besides the clayey part, a few quartz veinlets, several millimeters wide, occur rarely containing pyrite.

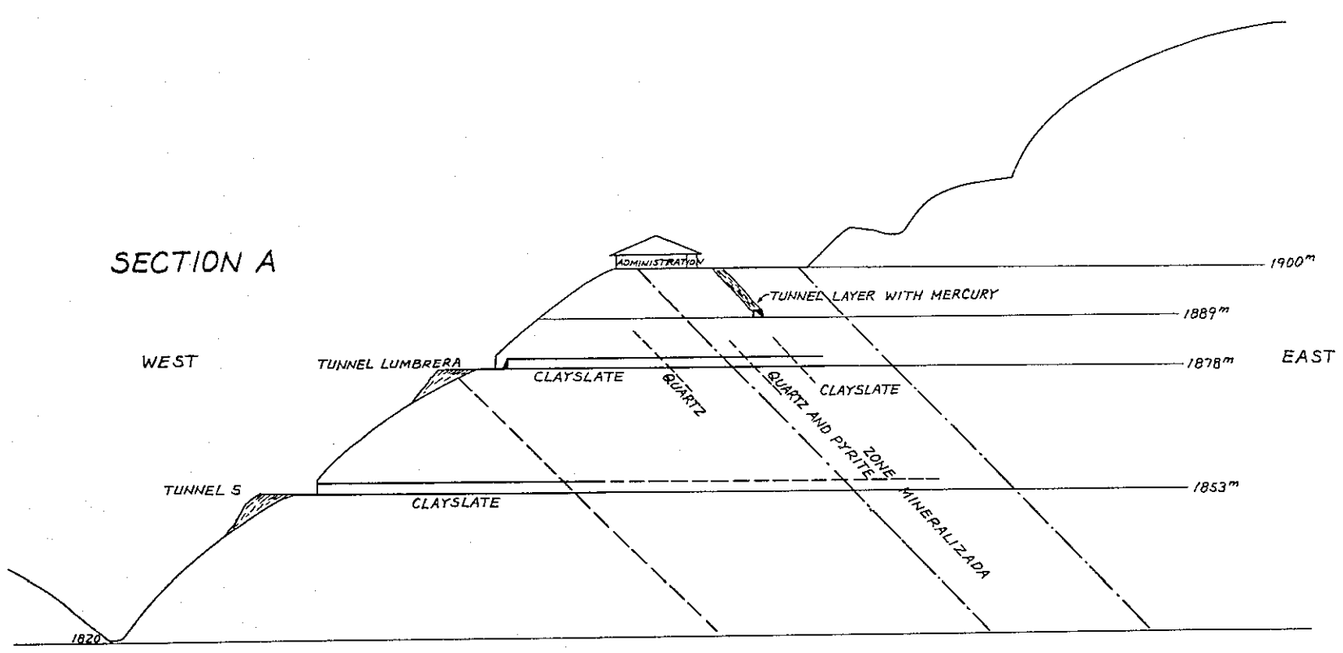
Ore reserves :

Proved ore reserves were calculated in 1957 as shown below. This calculation is supposed to have been made for the ore above the level of Adit No. 4, although we do not know for sure, as no ore reserve maps are available. The greater part of the reserves must have been worked out, leaving only a small amount of remaining ore. However, if Adit No. 5 which is now being driven could encounter the ore vein, ore reserves might be expected as far as Rio Chupadera.

FIG. 7

MINA de MERCURIO "LAESPERANZA"

ARANZAZU - (CALDAS)



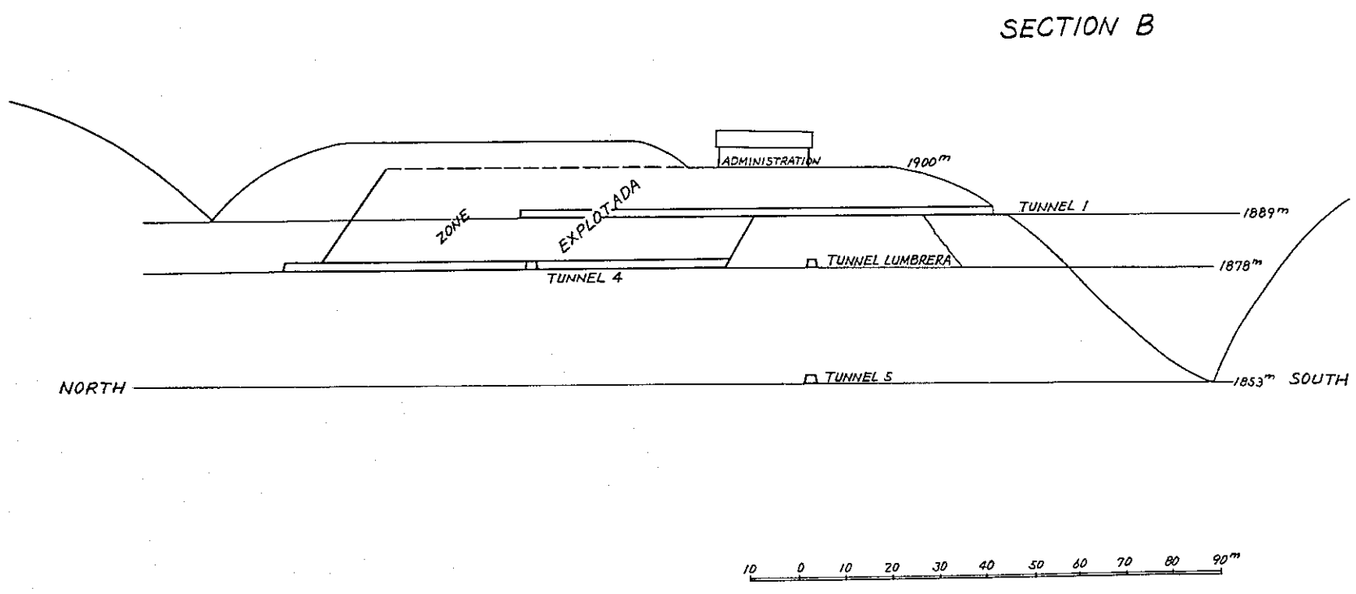
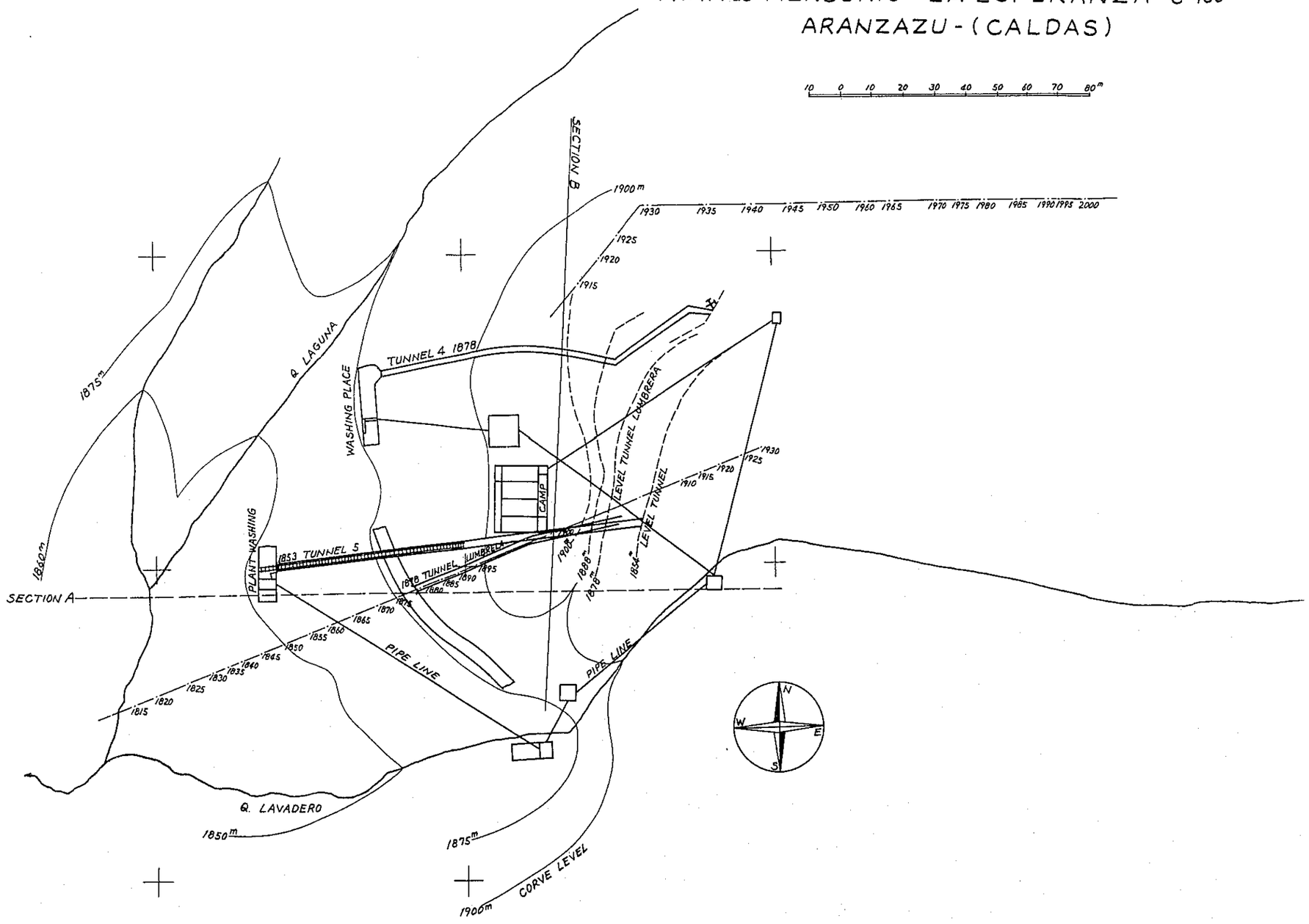


Fig. 8

MINA de MERCURIO "LA ESPERANZA" c 960

ARANZAZU - (CALDAS)



Ore reserves calculated in 1957

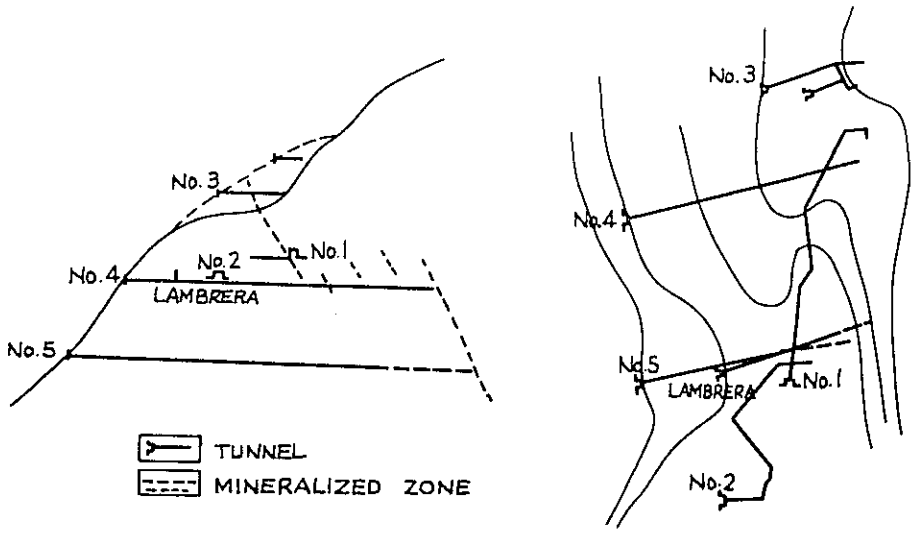
	Strike length		Height		Vein width		Sp. gr.		Tonnage	Grade(Hg)
I.	35 m	x	10 m	x	1.5 m	x	2.5	=	1,312	
II.	40 m	x	16.5 m	x	2.5 m	x	2.5	=	4,125	
III.	75 m	x	5 m	x	2 m	x	2.5	=	1,875	
Total									7,312	0.5% (3,656 kg)

Reserves expected from Adit No. 5

100 m x 60 m x 3 m x 2.5 = 45,000 tons Hg 0.5% (22,500 kg)

Prospecting:

Ore on the levels of Adits No. 1, No. 2 and No. 3 seem to have been mined out already (investigation was impossible as all the adits had collapsed). On the level of Adit No. 4, too, mining is made only for the remaining ore. Therefore, no more reserves can be expected in the levels above it. A cross-cut, Adit No. 5, is being driven from a point 25 m below Adit No. 4, and is expected to encounter the ore vein after driving 50 m more. Another cross-cut is also in progress on the same level as Adit No. 4, for the purpose of confirming the remaining ore below Adit No. 1.

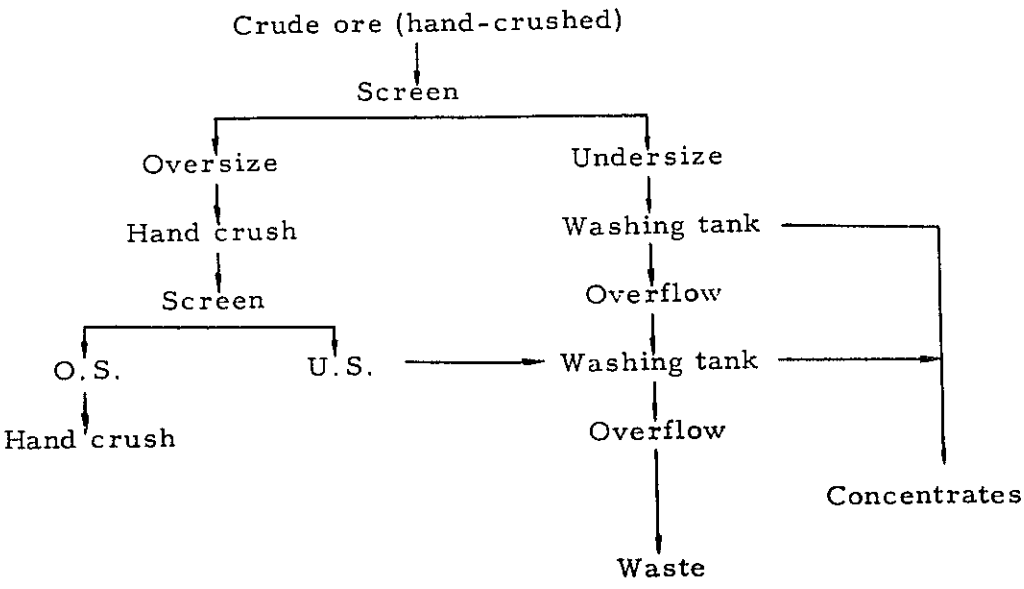


Mining :

The present mining face is in Adit No. 4, where the ores left by the Choco Pacifico Company are being extracted by hand. The ores, in the amount of 5 to 6 tons a day, are carried by mono-wheel hand-cart. Ventilation of the tunnel is very poor as there is only one adit.

Beneficiation : (Photos 15, 16, 17)

The crude ore carried out of the adit by hand-cart is crushed by hand on the earth floor; then it is placed on the screen above the washing tank and is stirred by a scoop so that the undersize is collected in the tank. The oversize ore is crushed again and washed with water. This process is repeated usually twice The tails are rejected as waste.



Production :

Crude ore	150 t/month
Grade	±0.7% Hg
Natural mercury	100 - 110 kg/month

Personnel and wages :

Supervisor	1	
Miner	4	
Ore-dresser	4	
Explorer	3	
Others	4	
Total	16	
Mining	25	₱/day
Transportation	16	₱/day
Washing	16	₱/day
Assistant	10	₱/day
Adit Driving	300	₱/meter

Conclusion and Recommendation :

1. The geographical situation of the mine is relatively favorable (with regard to communication, transportation, climate electricity etc.). The mine is presently working, though on a small scale, and is proceeding with exploration, too.

Mining work is going on in blind adits, mostly dealing with clearance of old adits and excavation of remaining ore. Ventilation of the adits is very poor, which would endanger the miners with oxygen shortage. There is also a fear of mine gas. Therefore, appropriate consideration should be taken on better ventilation.

2. The present method of beneficiation is suposed to have very poor recovery in yielding concentrates. Equipments should be mechanized step by step; even small size machinery would serve the purpose.

Since the histroy of the mine is rather young, mining has been performed only near the ground surface, and no prospecting has been attempted for the ores in depth.

From the foregoing points, it is recommended that the deeper parts of this mine and the mineralized zone in the vicinity are to be explored. Referring to the aspects of the vein which will be disclosed by Adit No. 5, plannings are to be taken for increase of production and for mechanization of the operation. Then, this mine would become a very interesting mine although it cannot be of a large scale.

F. Antimony Mine

19. Carolina mine

Sort of ore : Sb

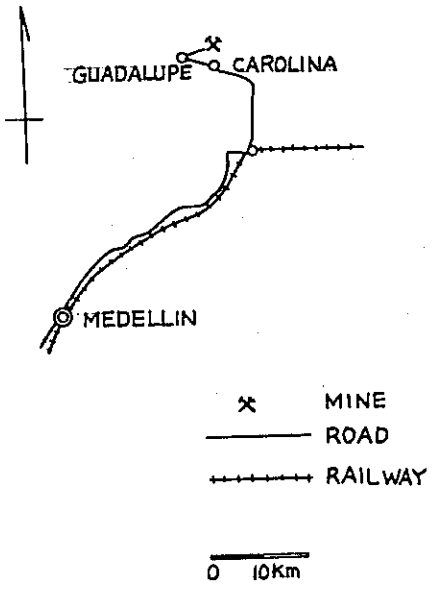
Location and transportation :

Carolina, Antioquia Province

Elevation 2,000 m

Medellin --- (151 km by car) --- Carolina

(Distance from Carolina to the nearest railway station is 39 km. Between Carolina and Medellin, bus services are available.)



Geology :

The area is situated in the drainage basin of the Rio Guadalupe,

and constitutes part of the granite batholith which is widely distributed to the east of Medelline, Antioquia Province.

Ore deposit:

In a valley on the immediate east of the Guadalupe village occures a quartz vein carrying a very small amount of stibnite. This vein extends in a direction of N 75° W and stands vertically, along which an adit has been driven for about 10 m. The vein varies in width, averaging about 1 m, and locally contains good ore having an average vein grade less than 1% Sb.

The quartz vein itself extends for about several tens of meters in the direction of both strike and dip, but it consists for the most part of barren quartz.

Conclusion:

In the present situation the deposit looks far from promising.

G. Emerald Mine

20. Muzo mine

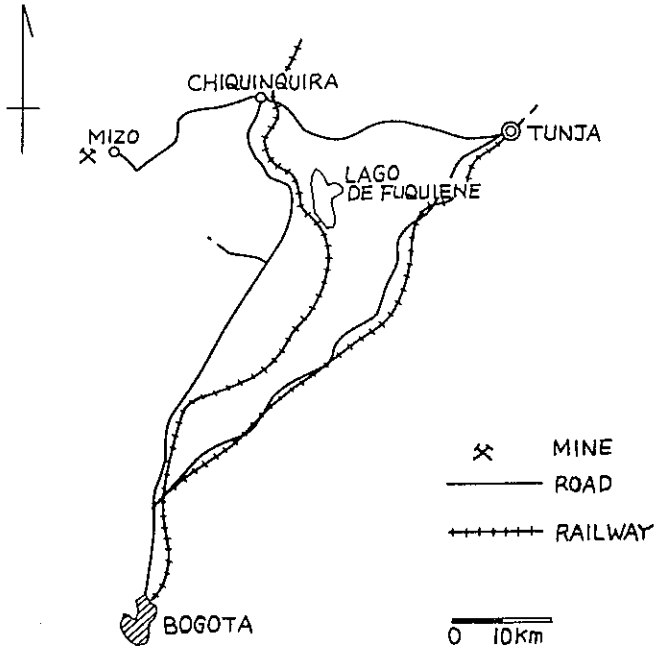
Sort of ore: Emerald

Location and transportation:

Muzo, Boyaca Province

Elevation 750 m

Bogota --- (7 hours by car) --- Muzo



Geology :

The rocks exposed in this area are Jurassic sandstone and a Cretaceous series consisting of calcareous slate, coaly shale and limestone. The rocks are folded into an anticline whose axis extends in a direction of roughly NNW-SSE. At the crest of the anticline are recognized injection of calcite veinlests and pyritization. The trend of the calcite veinlets is variable, some extending nearly horizontal, some being almost vertical with the strike either N-S or E-W, and some obliquely intersecting the others; their distribution is very sparse. Width of individual veinlets ranges generally from several millimeters to several centimeters, occasionally as wide as several tens of centimeters.

The calcite veinlets are divided into two types; one is associated

with pyrite and the other with emerald which occurs in druses. In this mine the two types are considered to be genetically different.

Ore deposit:

Emerald occurs very sparsely in the calcite veins which penetrate the coaly shale mentioned above, so the mineral is found only once in 15 to 20 days at each mining face. At the time of our investigation, therefore, we could not observe the mode of its occurrence. Some parts of the limestone were suffered from remarkable pyritization, and partially present an appearance of impregnated ore of bedded deposit.

Mining: (Photos 11, 12)

Mining is carried out by open-cut. The faces are inclined at an angle of 45° and the benches are 1 m in height as well as in width. At present, the mining area is divided into three section, Tequendama, Agua Adiente and Banco, each section having 3 - 4 mining places. The mining object is emerald, so that it is very difficult to locate its precise occurrence. One mining place consists of 2 - 5 benches of 1 m x 1 m (actual height and width are about 50 cm x 70 cm), and each face is about 10 m wide. Mining is carried out by scraping the face by hand using a lever or a pick searching for the mineral emerald and the crude materials are dropped down to the lowest place (50 m or more below the bench) to be hand-sorted there. Waste is pushed out into the river by a bulldozer. There is a dam in the upper reaches and a large quantity of water discharged from this dam carries the waste away.

However, the actual mining place consists of very irregular benches, and the faces tend to become steeper. Usually 10 to 15 men are

working on a narrow bench as high as several tens of meters, using no safety-ropes, so the mining is very dangerous.

Equipments :

Compressor	4 (75 HP)
Compressor	2 (30 HP)
Bulldozer	3
Picks, jackhammers, etc.	

Production :

30,000 ct/month

Personnel :

Mining	80
Others	100
Total	180

(All personnel, including the chief, are living in the assigned quarters. Their families are not with them.)

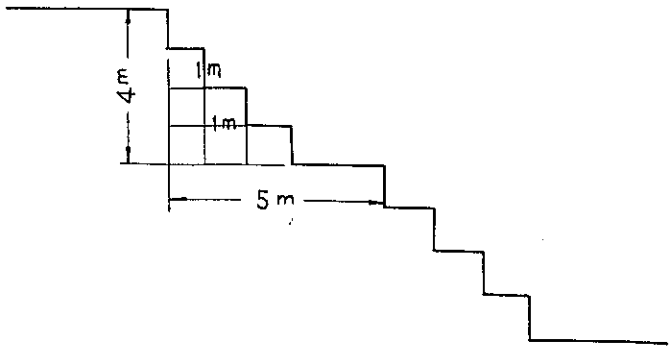
Stationary troop 30 (As the guard to prevent steal-mining and burglary.)

Conclusion :

1. Unless the open-cut mining is systematically planned and performed, the mining benches would become too steep to be safe, as presently observed, and the workers have to work at very high places endangering themselves. For safety precaution, more attention should be paid to these points.

2. For example safer mining can be performed by widening each step of benches to 5 m, with a height about 4 m, and making minor benches,

1 m x 1 m, in each of the widened benches. Thus, sorting of ore can be done on each step (at vertical intervals of 4 m). Also, utilization of the dam water in washing the ore can be taken into consideration.



3. In blasting the surface materials and country rocks, the explosives now in use are all right, but the nature of the country rocks suggests that ANFO explosives will do as well and will be more economical.

4. The present benches are very narrow and crowded with workers. Such situation may be for the purpose of mutual surveillance among the workers, but it is markedly degrading the efficiency. The working area per man should be more expanded.

III. Conclusions and Recommendations on the Mining Industry of Colombia

Four members of the investigation mission have surveyed mines and surface indications of ore deposits in various parts of Colombia. Conclusions and recommendations reached by the members are summarized below.

The mining industry of this country has been heretofore represented by the oil production from the northern plain region and the placer gold and platinum mining along the central rivers. The production of emerald has also been known to the world. However, other kinds of mining industry are still undeveloped and production of various minerals is very small. Geologically speaking, the Andes, which contains abundant mineral resources of South America, forks out into three branch ranges running N-S in the western part of this country. Many kinds of strata of Tertiary and older ages, are distributed between these ranges in association with various intrusive and extrusive rocks, thus presenting geologic structures hopeful of occurrence of ore deposits. Reasons for the belated mining industry of this country, in spite of the possibility of its containing rich mineral resources, must be contemplated now.

Based on the results of our investigations, we conclude as follows : Although we could not confirm very promising mines in the areas investigated this time, we are sure that the future of mining industry of Colombia is hopeful, and it is most likely that useful mineral deposits and promising mines will be discovered one after another. The reasons of the scarcity of good mines and the underdevelopment of mining industry are enumerated

below.

(1) The physical features are unfavorable, as the greater part of the country is covered either with jungle or grass as in the pastures, and communication and transportation are made only along the rivers, thus limiting the opportunity of discovering outcrops of ore deposits.

(2) The people in general lack interest or enthusiasm in mining industry and do not realize the importance of the industry.

(3) Some of the outcrops examined this time are of no economic value, but others can be properly appraised at a small cost and with a little labor if the owners are eager to develop them. Unfortunately, the owners regard such mining claim merely as their assets, and make no effort to develop them into workable mines even when there is a possibility. This state of things must be improved through an appropriate mining policy of the government.

The most important thing under the existing circumstances is to arouse people's interest in the mining industry, but this is a problem of the national policy so we would not discuss it here. From the technical point of view, preparation of fundamental geologic maps is essential, as it will reveal the areas that are geologically most likely to contain mineral resources. We are pleased to know that geological survey, with the aids of America and Germany, is in progress in a certain area of the country, and we hope that the survey will eventually cover wider portions. Some parts of the country are still untrodden by men (such as the Province of Choco, the eastern provinces and the high mountainous regions). It is desired that the geological survey in order to determine important areas is carried out as soon as

possible, and for this purpose, even a preliminary geologic mapping at a scale about 1/500,000 will do.

It is also desired that the government encourages and supports the operation of the mines if they are more or less promising, and proceeds with further survey and exploration of ore deposits. So far as our investigations are concerned, the Aranzazu mercury mine and the California gold mine can be the objects of the government support.

To materialize the aboe-mentioned policy for development of the nation-wide mineral resources, however, the shortage of mining and geological experts is keenly felt. Therefore, it is a pressing necessity that the country improves her facilities of training specialists and at the same time accepts the assistance of foreign experts.

We sincerely hope that;the Japanese Government helps Colombia in developing mineral resources by dispatching as many specialists as possible.

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Photo. 1. Outcrops at Campoflorido.

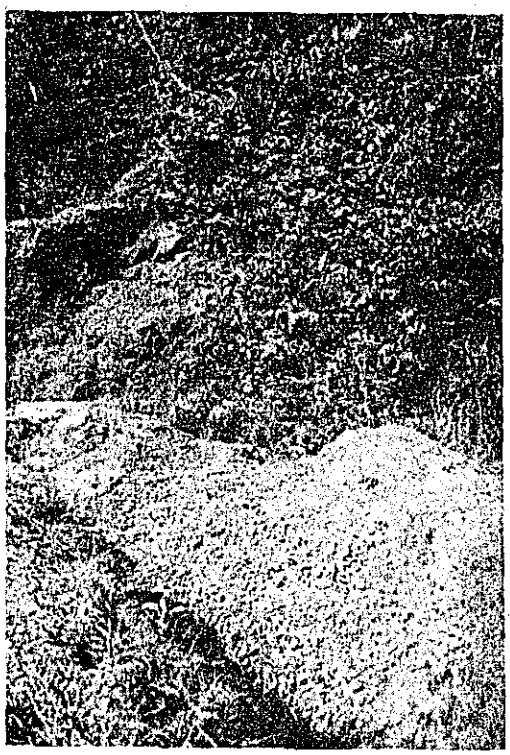

Photo. 2. Outcrops at Rio Dulce.

Photo. 3.

Outcrops at Anguede mine-lot.

(dotted line shows outcrops,

approx. 8 m. above the river)

Photo. 5. *Rio Atrato, Choco Province.*

Photo. 6. Ferry at Quibdo City,

Choco Province.

Photo. 4. Heliport at the mouth of Rio Anguede.

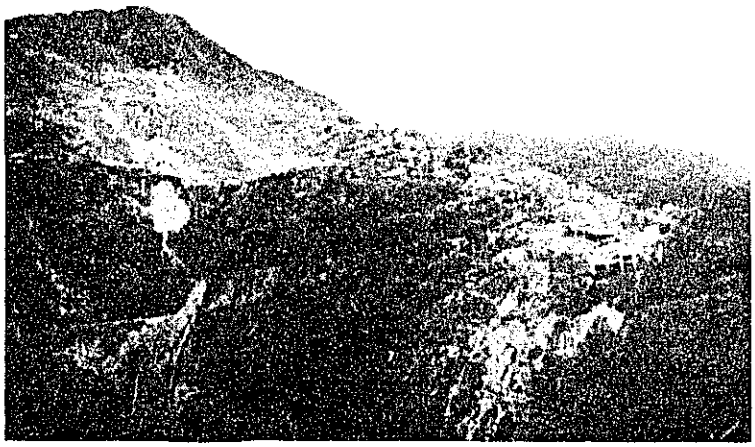

Photo. 7. Marmato Mine.

Photo. 8. Hand picking scene at Esperanza Mine.

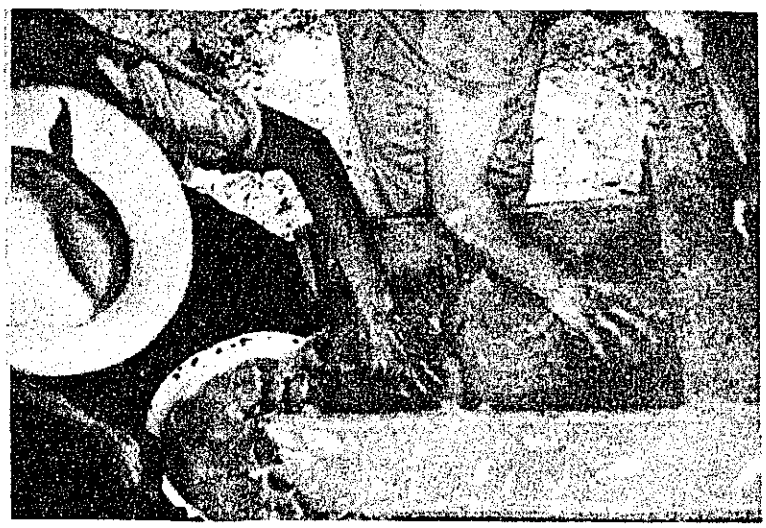

Photo. 9. Hand picking scene at Esperanza Mine

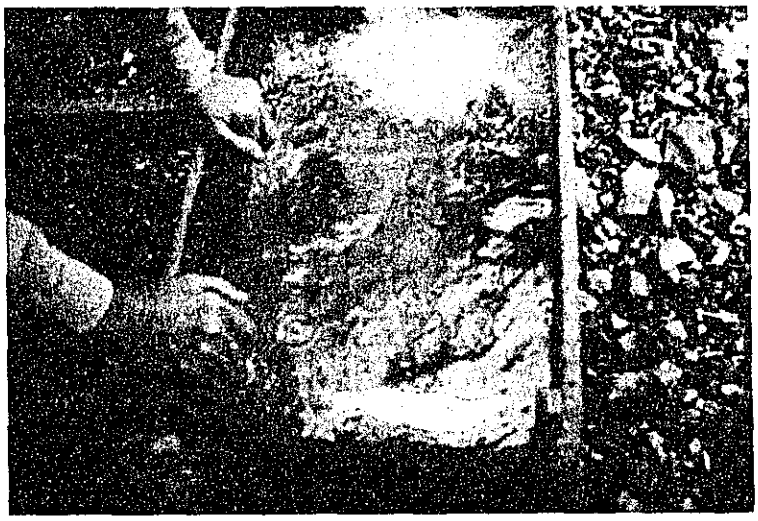

Photo. 10. Collected native Mercury, La Esperanza Mine.

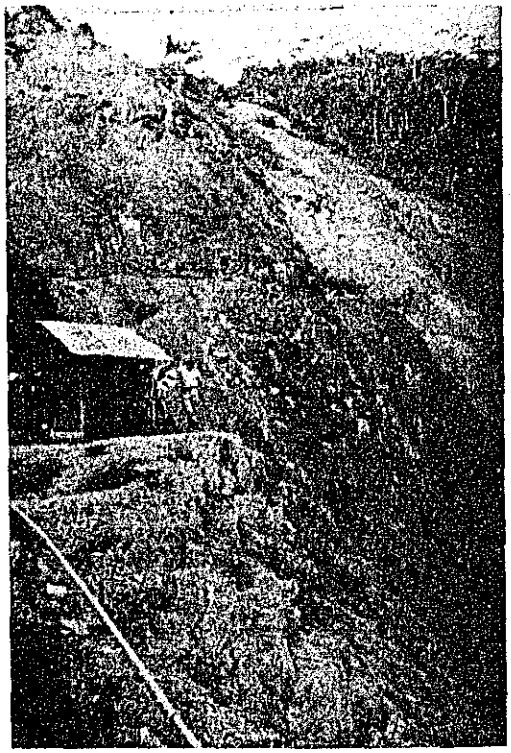

Photo. 11. View of Muzo mine.

Photo. 12. *Pit face at Muzo mine.*