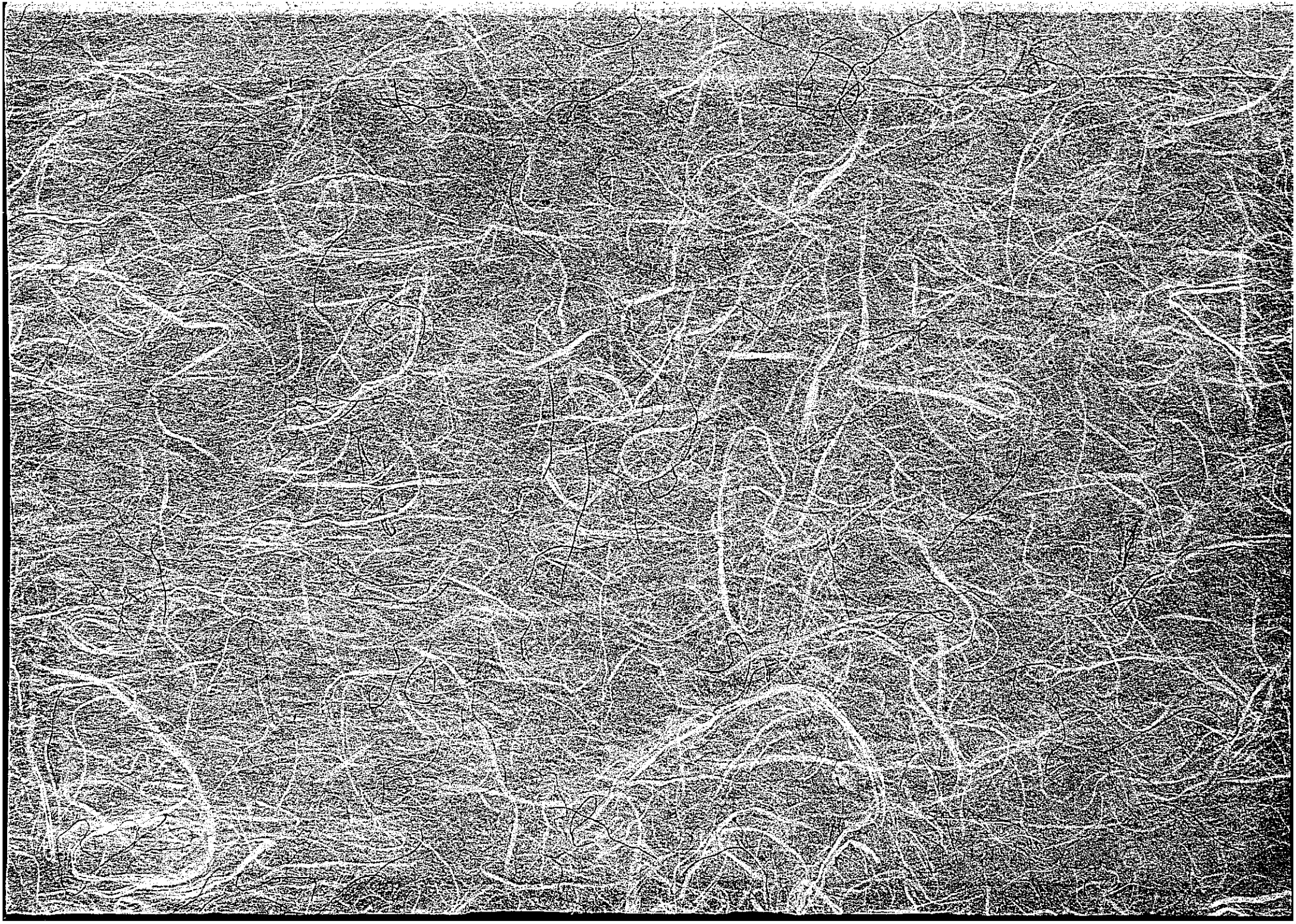
REPORT ON
GEOLOGICAL SURVEY FOR MINERAL RESOURCES DEVELOPMENT PLAN
OF
THE REPUBLIC OF VENEZUELA

September 1987

GOVERNMENT OF JAPAN



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国際協力事業団	
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Foreword

The Government of Japan, at the request of the Government of the Republic of Venezuela, has decided to undertake a basic survey for the Mineral Resources Development Plan in Venezuela, and entrusted the Overseas Technical Cooperation Agency of Japan with the task of implementing the field survey.

The Agency has dispatched to Venezuela a six-member survey team headed by Mr. Yutaka Eda, Mitsubishi Metal Mining Co., Ltd.

The survey team stayed in Venezuela for forty-five days, commencing its work on April 24, 1967, and successfully completed the field survey with the assistance and cooperation of the Venezuelan Government, resulting in the submission of this report.

The Agency, which is the executive organization of the overseas technical cooperation program taken up by the Japanese Government, sincerely hopes that the present report will prove to be a contribution toward the completion of the project.

In closing, the Agency hereby expresses its deepest sense of gratitude for the earnest support and cooperation extended by the Venezuelan Government Authorities.

September, 1967

S. Shibusawa

Shinich Shibusawa
Director General
Overseas Technical Cooperation Agency

Contents

I. Introduction

REPORT ON GEOLOGICAL SURVEY FOR MINERAL RESOURCES DEVELOPMENT PLANS OF THE REPUBLIC OF VENEZUELA

I. Introduction

For a period of forty-six days from April 24 to June 8, 1967, the "Survey Team for Mineral Resources in Venezuela, Government of Japan" carried out the geological survey of copper, lead and zinc mines in the Caribbean Coastal Mountains and the Venezuela Andes, Venezuela.

The mines surveyed by the team are as follows:

1. El Pao mine (Cu)
2. Santa Isabel mine (Cu, Zn)
3. Aroa mine (Cu)
4. Bailadores mine (Cu, Pb, Zn)
5. Seboruco mine (Cu)
6. Carúpano mine (Pb, Zn)

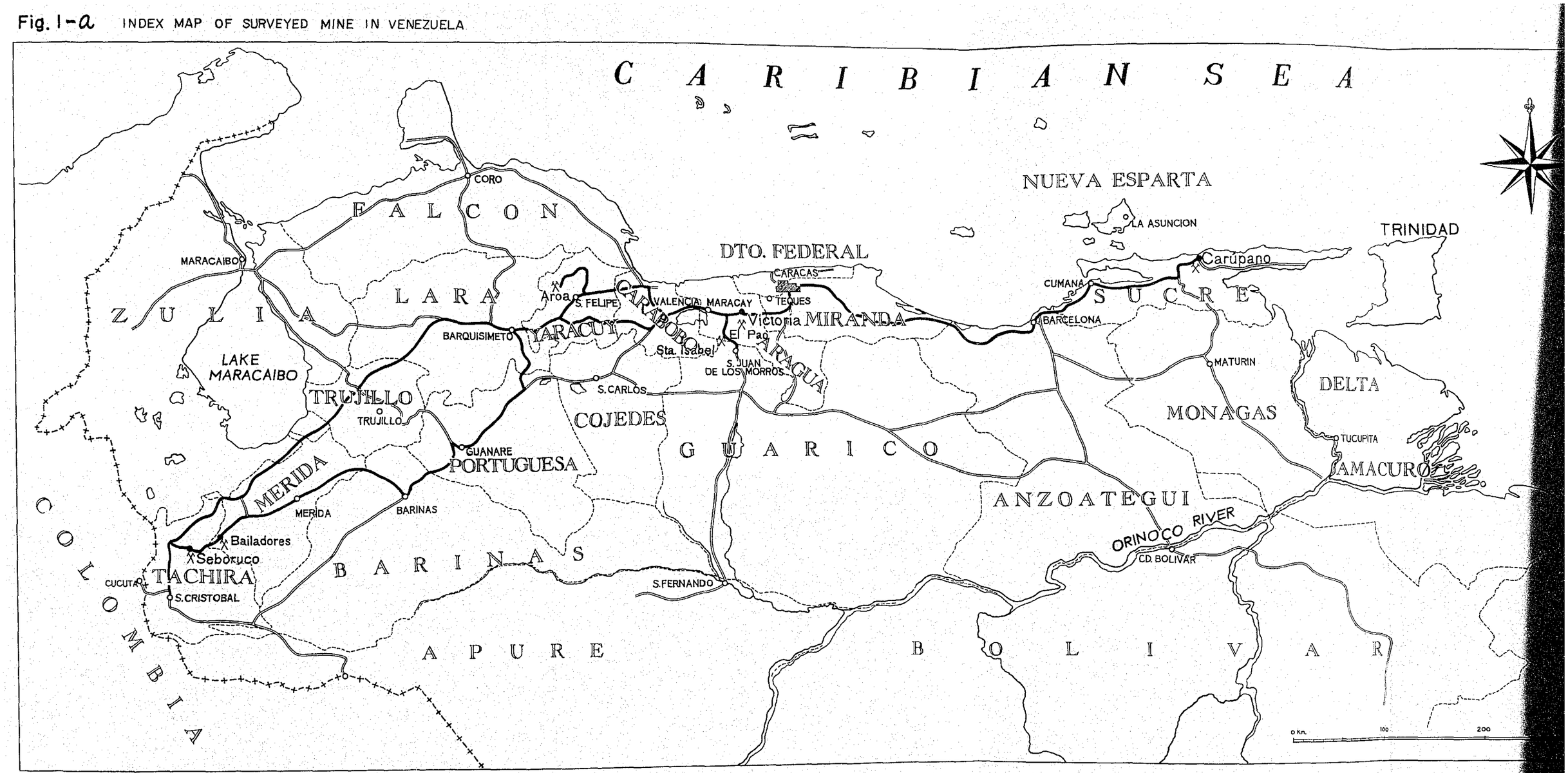
The members of the Survey Team are the following six geologists:

Yutaka Eda (Chief)	:	Mitsubishi Metal Mining Co., Ltd.
Hiroshi Hyakkoku	:	Nagoya International Trade and Industrial Bureau.
Den-ichi Sasaki	:	Toho Zinc Co., Ltd.
Atsushi Horita	:	Mitsui Mining & Smelting Co., Ltd.
Tomosaburo Ohsuga	:	Furukawa Mining Co., Ltd.
Yoichi Iwase	:	Overseas Mineral Resources Development Co., Ltd.

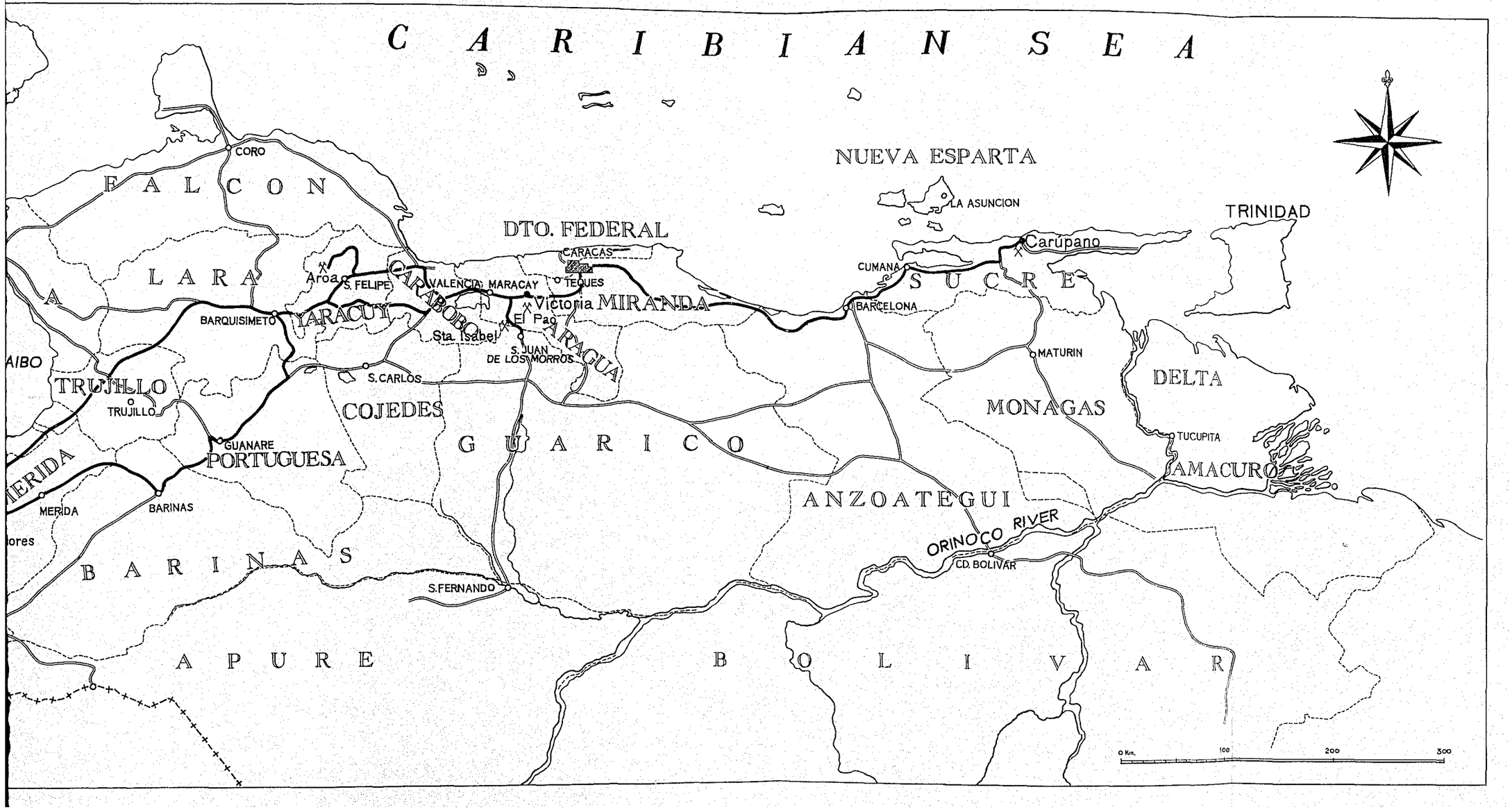
The survey was accomplished with the help of the Ministry of Mines and Hydrocarbons, Republic of Venezuela and the Embassy of Japan in Venezuela, to whom our heartfelt gratitude is expressed here.

The results of the survey of these mines are given in this report.

Fig. 1-a INDEX MAP OF SURVEYED MINE IN VENEZUELA



RVEYED MINE IN VENEZUELA



II. General Geology

II. General Geology

The Andes, one of the circum-Pacific mountain ranges, runs roughly north-south along the Pacific coast of South America between lat. 10° N and 55° S.

Stretching northward from Ecuador into Colombia the Andes forks into three ranges. The one on the west extends from Panama to Mexico; the central range enters the Caribbean Sea from the northern tip of Colombia, and forms the Windward Islands and other islands such as Puerto Rico, Dominica and Cuba.

The eastern range changes its trend in Venezuela from NE-SW to E-W and forms the coastal range of the country. It is inferred that an extension of this range is either submerged under the Atlantic Ocean after Trinidad Island, or is continuous through the Bahama Islands to the Miami Peninsula of North America.

The topography of Venezuela can be generally divided into the following four regions:

1. Western Andes (2,000 - 4,000 m above sea level)
2. Northern coastal mountains (500 - 2,500 m above sea level)
3. Orinoco River basin (200 m above sea level)
4. Guayana plateau (500 - 2,000 m above sea level)

General geology is closely related to the topography, so that the four topographic regions actually represent geologic divisions.

1. Western Andes region

The region is bounded by the Venezuela Andes on the south, and has the Maracaibo basin in the center. The Central Andes of Colombia borders the west side of this region.

Various kinds of gneisses, mica schist, quartzite and phyllites, which are widely distributed northeast to southwest of Merida City, constitute the basement of the Andes.

These rocks are strongly metamorphosed, and magmatic contamination and aplite injection are remarkable. In interfingering relation with these rocks, granites intrude in a northeast direction.

These basement rocks have been assigned to pre-Paleozoic age, but part of them may belong to the latest period of Paleozoic, although details remain

unknown.

Older rocks, whose age is known from the fossils contained therein, are weakly metamorphosed slates and sandstones of the Ordovician to Silurian period.

Occurrence of fossils is reported also from the Devonian system that is widely distributed to the north and south of Merida City.

Around the above-mentioned Paleozoic rocks, the Cretaceous system consisting chiefly of semi-schists is developed extensively in the northeastern part of Venezuela, that is, the Trujillo - Barquisimeto area on the northwest side of the Andes near the Colombian frontier.

The Tertiary system is developed on the northwestern and southeastern sides of the Andes, and consists of sedimentary rocks. Evidence of igneous activity is almost nonexistent.

In the area centering on Barquisimeto, where the Andes changes its trend from NE-SW to E-W, the Cretaceous rocks is markedly folded.

The basin with the Maracaibo Lake in the center is composed largely Tertiary to Recent sediments. Thickness of the sediments on the east side of the lake is supposed to exceed 10,000 m.

The oil production of Venezuela ranks the third in the world. Oil is yielded mostly from the Miocene series in the northeast of Maracaibo.

2. Northern coastal mountains

Near Barquisimeto east of the Maracaibo Lake, the Andes changes its NE-SW trend to E-W, and forms a coastal range along the Caribbean Sea.

Along with the change in the trend of the Andes, the geology also becomes quite different. Unlike the Western Andes region, the geology of this region is considered to be composed entirely of Cretaceous rocks. No occurrence of pre-Cretaceous rocks has been recorded.

Most of the Cretaceous rocks are mica schist, graphite schist, phyllite, chlorite schist, chert, limestone, gneiss and amphibolite. Metamorphism is relatively advanced, and folding is conspicuous in the central to western part of the region. Basic intrusive rocks, as well as acidic ones, are fairly abundant. On Margarita Island, intrusion of andesitic porphyrite is locally observed.

3. Orinoco River basin

This region is bounded by the Northern Coastal range, by the Western Andes,

and by the Guayana shield which is developed on the south.

In the central uplifted area the Tertiary system is developed, succeeding the Cretaceous system of the Northern coastal range. The Orinoco River basin is divided into the Orinoco delta basin in the east and the Apure basin in the west.

Except for the central uplifted area where the Tertiary system is developed, the whole region is composed of Quaternary beds and is covered with jungle. Thickness of the Tertiary to Recents sediments presumably attains to 12,000 m.

The Miocene series distributed from the central uplifted area to the Orinoco delta basin provides the second largest oil resources of Venezuela.

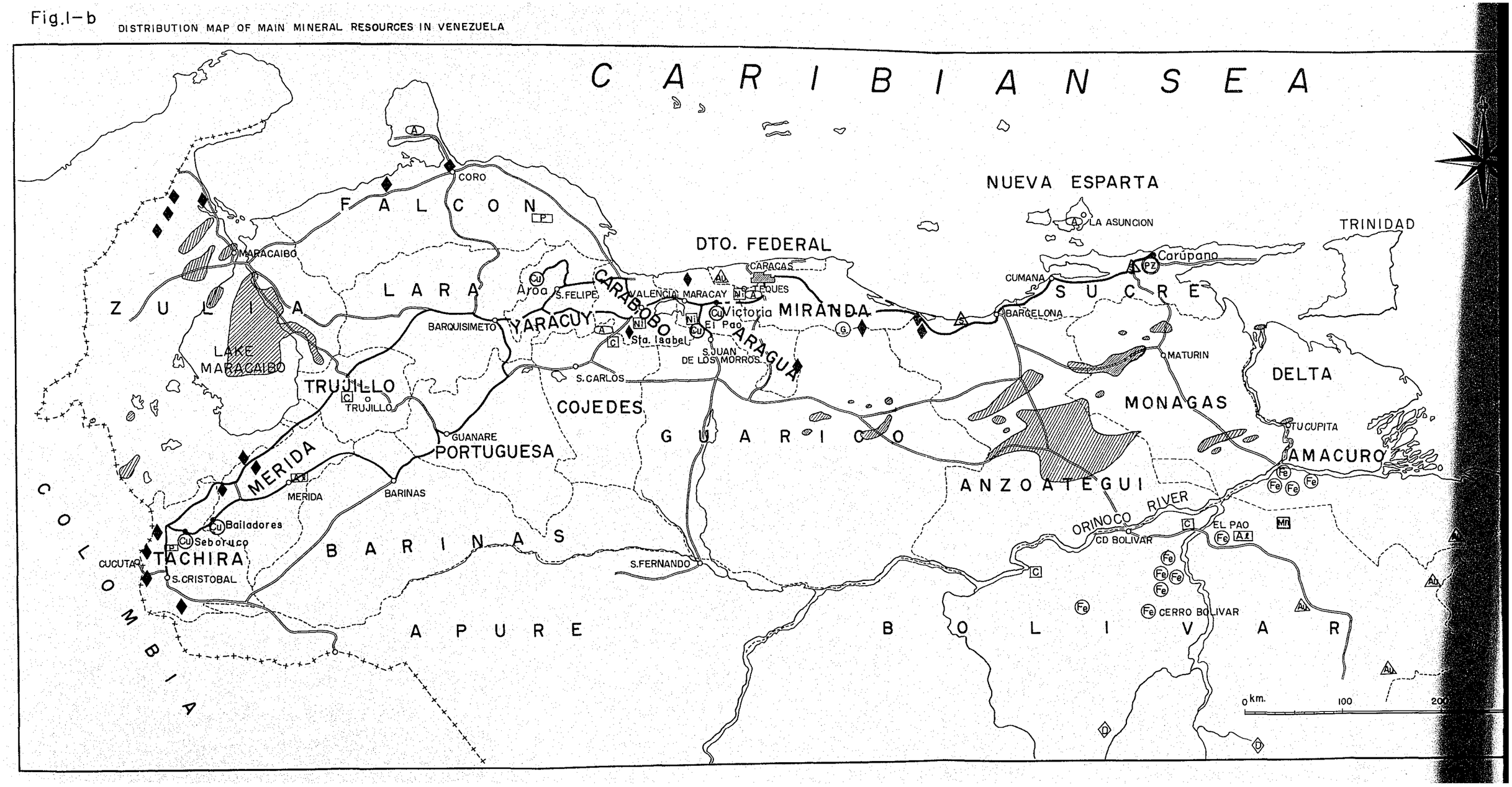
4. Guayana shield

The Guayana shield, composed of pre-Paleozoic rocks, is a land mass continuous to the Amazon River of Brazil. This shield is correlated with the so-called Brazilian shield forming the basement of Brazil.

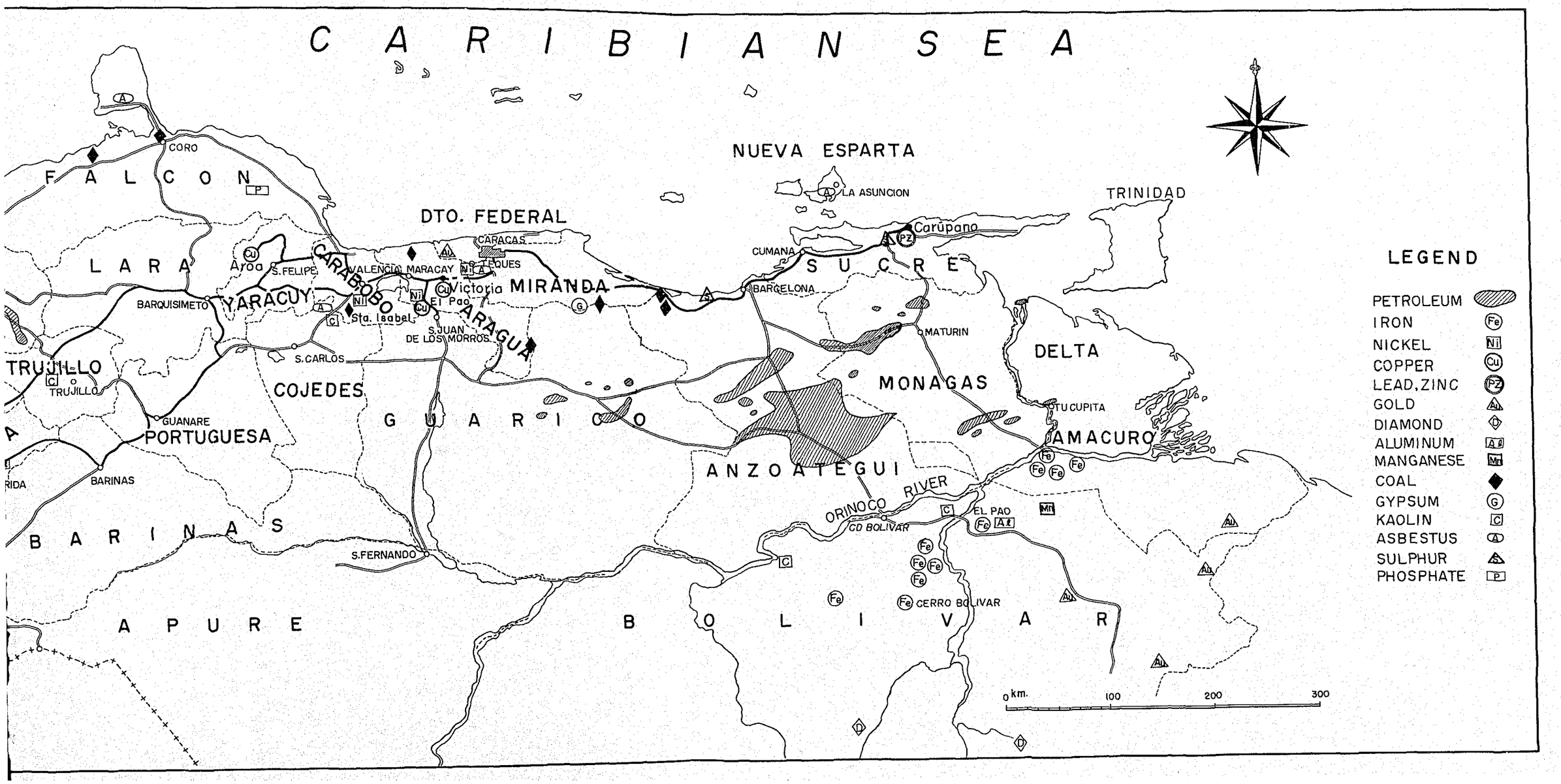
The Guayana shield is made up chiefly of granite gneiss, amphibole gneiss and mica schist. Development of ferruginous quartzite (Iron Ore Formation) is observed in the northern part of the shield. Placer deposits of gold and diamond are being worked in various places.

In the southeastern part, the pre-Paleozoic formation is unconformably overlain by gently dipping Mesozoic beds of conglomerate, sandstone and shale.

Fig.I-b DISTRIBUTION MAP OF MAIN MINERAL RESOURCES IN VENEZUELA



INERAL RESOURCES IN VENEZUELA



III. MINES SURVEYED

III. Mines Surveyed

1. *El Pao Mines*

a. Location, transportation, topography

The El Pao mine is, in a straight distance, 65 km southwest of Caracas, in the district of Ricaurte, Aragua State. The mine concession is held by the government.

Access to the mine is quite easy. From Caracas to La Victoria it is 75 km on the highway, and 25 km from there to the mine. The climate is mild throughout the year.

The mine area shows a topography of old age. Situated at the northern end of the Andes, the area constitutes the coastal range running roughly east-west. It is about 1,000 m above sea level. The outcrop of the El Anitero ore deposit occurs at an altitude of 560 m.

b. Geology

The geology of the mine area is represented by the Los Naranjos Formation overlying the Tucutunemo Formation which is assigned to the upper part of Lower Cretaceous. Ore deposits occur in this Los Naranjos Formation which consists of meta-volcanics and crystalline schists, such as sericite schist, that have undergone regional metamorphism.

At 1 km southeast of the El Anitero deposit, serpentinized peridotite is found, intruding parallel to the general strike (N 30° - 60° E).

c. Ore deposits

1) El Anitero deposit

The El Anitero deposit, occurring in sericite schist along its schistosity plane (N 50° - 60° E, 20° - 30° N), is a lenticular, cupriferous pyrite deposit. Judging from the outcrop (Fig. 4) the deposit is of a small scale, being about 170 cm x 100 cm.

Ore minerals are minute grains of pyrite, irregularly intercalated with chalcopyrite of a small amount. The boundary of the ore body is somewhat obscure

due to contamination.

Analysis of samples taken from a high-grade portion revealed the following; Au 0.2 gr/t, Ag 30 gr/t, Cu 6.86%, Pb 0.04%, Zn 0.33% and S 39.74%.

ii) La Providencia deposit

The La Providencia deposit is about 1,700 m south of the El Anitero deposit.

Like the El Anitero deposit, this deposit occurs along the schistosity plane of sericite schist striking N 50° - 60° W and dipping 40° N, and is of a small scale.

The ascertained outcrop is about 6 m long, and is dotted with malachite and azurite within a width of 40 cm. The raw ore is supposed to be the so-called "gariko" (impregnated part of kieslager).

d. Status of prospecting

The status of prospecting enforced by the Ministry of Mines and Hydrocarbons is stated below.

i) Chemical prospecting and geophysical prospecting

Over the whole area of El Anitero and La Providencia, samples were collected at 30 m intervals on the traverse courses that are 100 m apart from one another, and chemical prospecting for Cu in these samples was carried out. The result revealed that high anomalies of 500 - 1,000 ppm occur at both El Anitero and La Providencia, and between El Anitero and La Providencia weak and continuous anomalies of 100 - 150 ppm are found, although these weak anomalies are not indicative of continuity of ore deposit but are attributable to the surface soil, which was derived from weathered deposit.

S.P. and magnetic prospecting were already performed. The result of S.P. showed no obvious anomalies, and the magnetic anomalies revealed only the existence of fault and peridotite, without any relation to the ore deposit.

ii) Prospecting by drilling

At El Anitero, prospecting is under way by four drillings (70 m, 18 m, 35 m and 50 m, totalling 173 m in length) in the direction of extension of the ore deposit. However, no noticeable indication of ore has been found so far.

At La Providencia, a 48 m long boring was drilled but ore indication was not detected.

iii) Gallery prospecting

No gallery prospecting was attempted at El Anitero. At La Providencia, Compania La Providencia carried out prospecting by driving a 15 - 20 m long

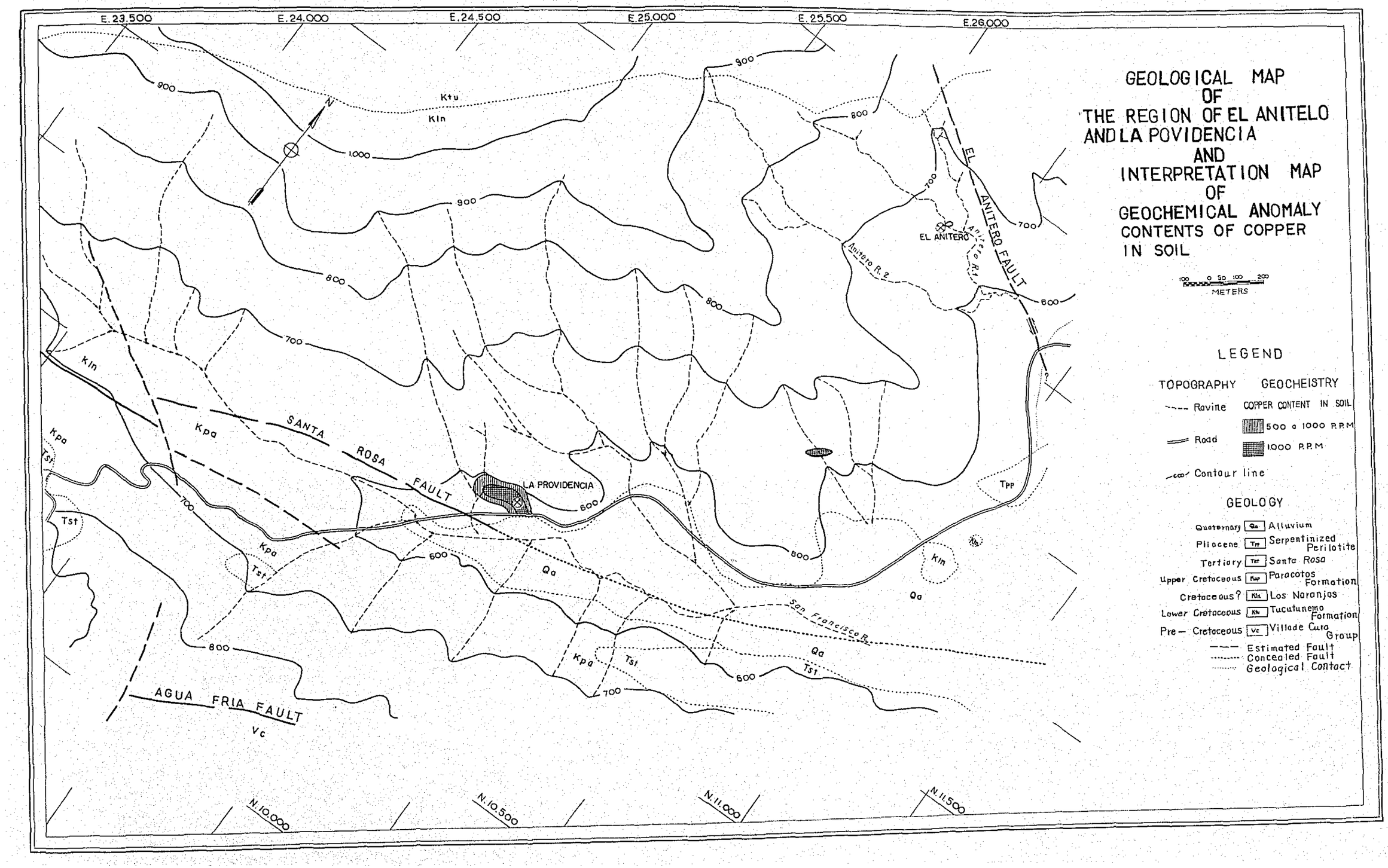
crosscut. Upon reaching ore, they seem to have performed drifting for winze prospecting, but details are unknown as the mine was closed about 10 years ago and is now filled with water.

e. Conclusion

i) The ore deposit is a lenticular, cupriferous pyrite deposit of a small scale, occurring along the schistosity plane of sericite schist. This deposit is considered to be of the so-called kieslager type.

ii) This ore deposit was investigated well by the Ministry of Mines and Hydrocarbons by means of geological survey, chemical and geophysical prospecting, as well as by drilling, and a conclusion has been reached already.

Fig.3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N.10.000
N.10.500
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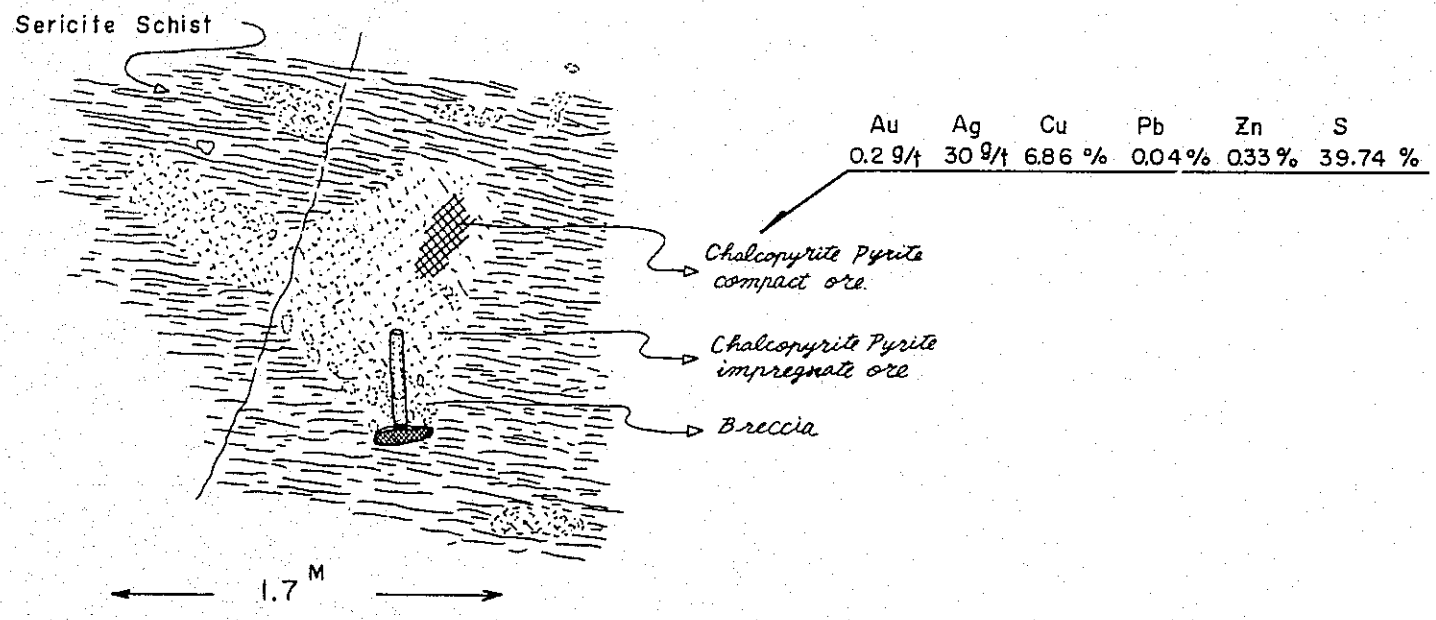
N.11.500
900
800
700
600
1.000
Ktu
Kln
Kpa
Tst
Qa
Tpp
Vc
SANTA ROSA FAULT
AGUA FRIA FAULT
EL ANITERO FAULT
LA PROVIDENCIA
EL ANITERO
Anitero R. 1
Anitero R. 2
San Francisco R.
GEOLOGICAL MAP
OF
THE REGION OF EL ANITELO
AND LA POVIDENCIA
AND
INTERPRETATION MAP
OF
GEOCHEMICAL ANOMALY
CONTENTS OF COPPER
IN SOIL
100 0 50 100 200
METERS
LEGEND
TOPOGRAPHY
Ravine
Road
Contour line
GEOCHEISTRY
COPPER CONTENT IN SOIL
500 a 1000 P.P.M
1000 P.P.M
GEOLOGY
Quaternary Qa Alluvium
Pliocene Tpp Serpentinized Perilotite
Tertiary Tst Santa Rosa
Upper Cretaceous Kap Paracotos Formation
Cretaceous? Kln Los Naranjos
Lower Cretaceous Kln Tucutunemo Formation
Pre-Cretaceous Vc Villade Cura Group
Estimated Fault
Concealed Fault
Geological Contact

Fig. 4

SKETCH OF OUTCROP
ANITERO, EL PAO
ARAGUA



2. *Santa Isabel Mines*

a. Location, transportation, topography, etc.

The Santa Isabel mine is located at San Juan de Los Morros in the Roscio district, Guarico State, near the border of Aragua.

The mine concession are owned by Sr. Nicolas Sosa. The mine concession is 288.6 ha in area. The mining operation is suspended at present.

At a point 138 km on the highway from Caracas there is the entrance to a plantation; from there a truck road runs, and after 7 km on this road the entrance of the Santa Isabel gallery is reached. By advancing on the highway farther south, without turning at the plantation entrance, one can get to San Juan De Los Morros after 7 km.

The Santa Isabel mine is located on the southwestern foot of a limestone mountain, Cerro El Picacho (1,068 m), which rises at the entrance to the Valencia basin in the upper reaches of Rio Guarico. The mine area is on a gentle slope 500 - 800 m above sea level. The altitude of the Santa Isabel gallery's entrance is 690 m.

The temperature is somewhat high, annual average being 27° - 28° C.

b. Geology

The geology of the area is composed, in descending order, of the Lower Cretaceous Grupo Villa de Cura Formation and Tucutunemo Formation; the former is subdivided into four formations, namely, Santa Isabel, El Carmen, El Chino and El Caño, in descending order.

The ore deposit occurs in the Santa Isabel Formation, which consists of graphite schist, mica schist and limestone, and strikes nearly E-W.

c. Ore deposits

i) Santa Isabel deposit

Rocks around the ore deposit are mostly sericite schist or graphite schist, intruded by a basic intrusive rock which is metamorphosed as is the former. The ore deposit occurs parallel to the schistosity plane of sericite schist, which strikes roughly E-W and dips 60° - 70° S. The deposit comprises small

lenticular ore bodies that are considerably pinching and swelling. Adjacent to the hanging wall of the ore deposit, the above-mentioned intrusive rock is observed.

The principal ore body in the upper gallery (690 m level) is 15 m long with maximum width 2.4 m, consisting of compact ore. The grade of residual ore near the wall is Au 3.0 gr/t, Ag 59 gr/t, Cu 1.03%, Pb 0.14%, Zn 4.12% and S 24.39%. The southwestern end of this ore body is cut by fault, and the ore becomes poor beyond the fault, though it is still traceable for about 20 m. The northeastern end pinches in a lenticular shape. (See Fig. 6)

In the lower gallery three layers of compact ore are found within a width of 15 m. They are lenticular and continue for about 50 m while pinching and swelling. Each of these ore bodies is small in scale, the maximum width being 60 cm and the maximum extension 10 m. The ore grade is Au 0.86 gr/t, Ag 72 gr/t, Cu 1.37%, Pb 0.20%, Zn 21.72% and S 19.23%. (See Fig. 5)

The sericite schist around the compact ore presents an appearance of low grade impregnation. The ore body in the upper gallery is continuous with the center drift of the lower gallery.

Pyrite is the principal ore mineral, accompanied by sphalerite and chalcopyrite, all occurring as very minute grains (see Photos. 1 and 2). According to literature of the Central University of Venezuela, tetrahedrite, tennantite, bornite, barite, etc., are also found.

ii) Arenilla deposit

The Arenilla deposit is located at about 3 km north of the Santa Isabel deposit.

The deposit occurs in sericite schist which is sandwiched between green schist. The maximum width of the ore deposit is 3 m. The sericite schist strikes N 85° E and dips 50° - 60° S. The ore deposit lies parallel to the schistosity of this rock, as in the case of the Santa Isabel deposit. Ore minerals are the same as those of the Santa Isabel deposit.

d. Status of prospecting

i) Santa Isabel deposit

Total extension of the upper gallery is 205 m and that of the lower gallery is 172 m. The interval of the two galleries is about 17 m.

The secondarily enriched oreshoot was worked between the outcrop and the

upper gallery, but no excavation was carried out in the lower gallery as the primary zone becomes rapidly poorer in ore grade.

From 1948 to 1949, 300 tons of oxide ore, with Cu 20 to 25%, was produced.

In November of 1966, 96.455 tons of dried ore (Au 6.1 gr/t, Ag 23.2 gr/t, Cu 11.62%) was sold to a Japanese smelter.

ii) Arenilla deposit

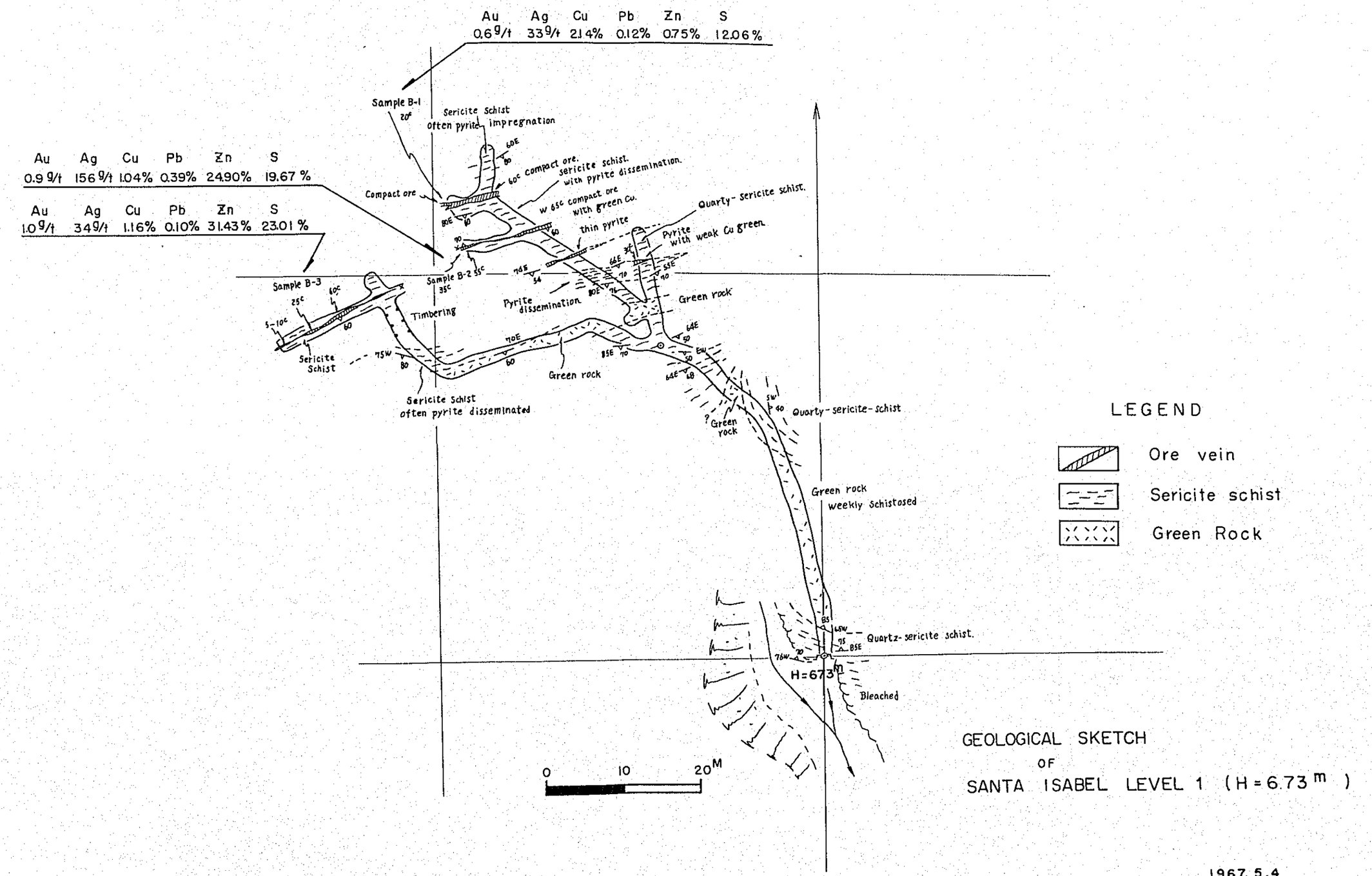
A 36 m long shaft was driven from the hanging wall side, and upon reaching the ore a drift exploration was made for 208 m westward. According to Sr. Sosa, owner of the mine concession, the ore was continuous. At present, the shaft is entirely inundated, so that the state of the ore deposit under the ground cannot be ascertained.

e. Conclusion

i) just like the E1 Pao mine, the ore deposit of this mine is a kieslager type deposit. Green schist is recognized in both hanging wall and foot wall.

ii) Ore bodies are of small scale. The mine once worked mainly oxides between the outcrop and the upper gallery. However, as the ore grade became lower when the excavation was proceeded into the primary zone of the lower gallery, mining operation was suspended.

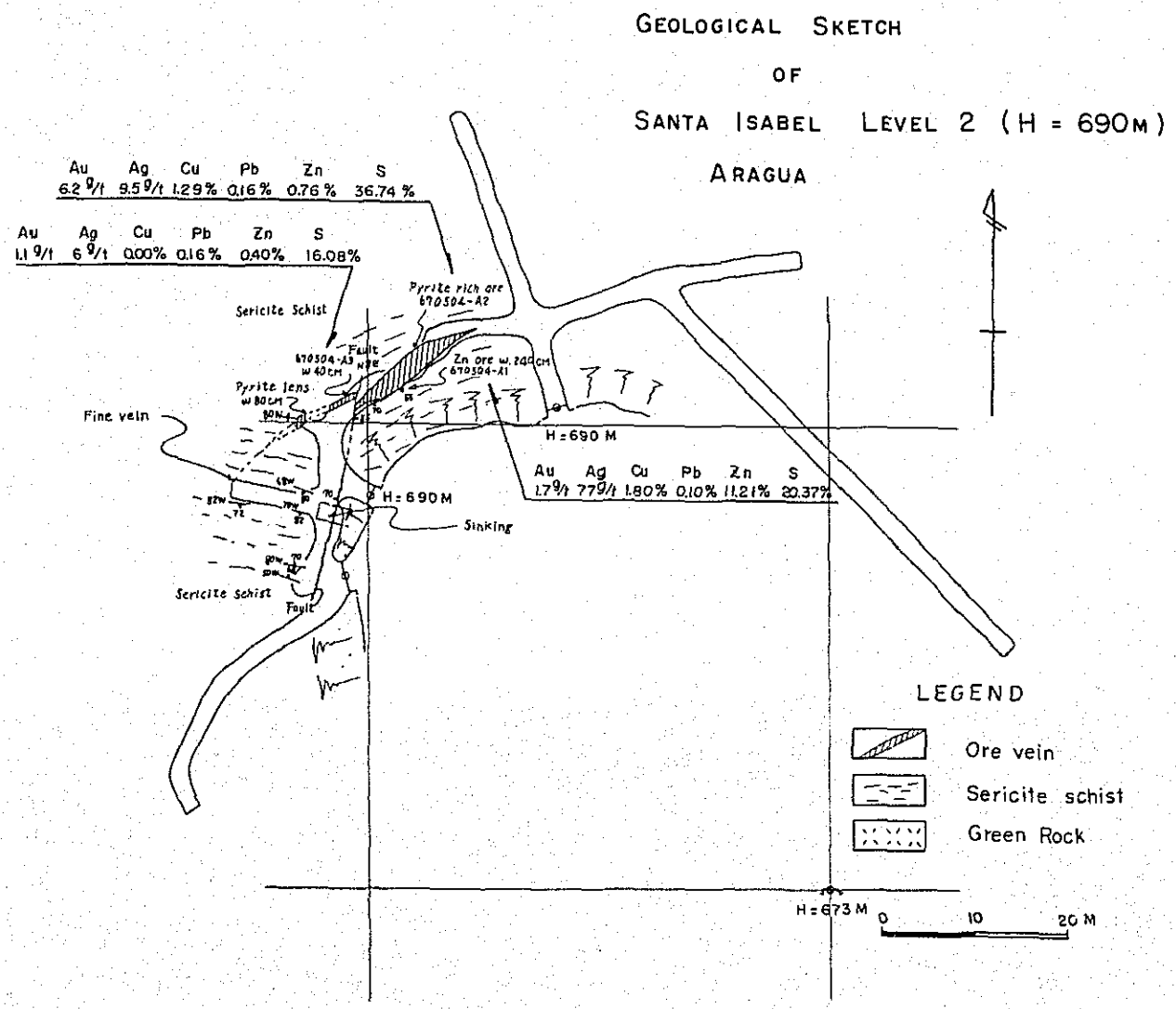
Fig. 5



GEOLOGICAL SKETCH
OF
SANTA ISABEL LEVEL 1 (H = 6.73 m)

1967. 5.4

Fig. 6


GEOLOGICAL SKETCH
OF
SANTA ISABEL LEVEL 2 (H = 690M)
ARAGUA
Au Ag Cu Pb Zn S
6.2 g/t 9.5 g/t 1.29% 0.16% 0.76% 36.74%
Au Ag Cu Pb Zn S
1.1 g/t 6 g/t 0.00% 0.16% 0.40% 16.08%
Sericite Schist
Pyrite rich ore
670504-A2
Fault
670504-A3
w 40cm
Zn ore w. 240cm
670504-A1
Pyrite lens
w 80cm
Fine vein
H=690 M
Au Ag Cu Pb Zn S
1.7 g/t 77 g/t 1.80% 0.10% 11.21% 20.37%
H=690M
Sinking
Sericite Schist
Fault
LEGEND
Ore vein
Sericite schist
Green Rock
H=673 M
0 10 20 M

3. Aroa Mines

a. Location, transportation, topography

The Aroa mine is located at 4 km east of Aroa village, Yaracuy State, about 220 km west of Caracas. The mine is possessed by IVP (Instituto Venezolano de Petroquimica).

It is 83 km from San Felipe, the capital of Yaracuy State, to the mine and takes about one hour and a half. Between Caracas and San Felipe a highway runs, and from San Felipe to Aroa there is a paved road, and from Aroa a 4 m wide truck road leads to the mine site.

The mine is about 600 m above sea level, situated on the northern foot of the E-W trending Andes. The topography of the mine area shows a mature stage and is somewhat rugged. As the climate is warm and humid, the area is thickly covered with jungle.

b. Condition of public peace

In recent years, Yaracuy State has been frequently disturbed by communist guerrilla activities. The Aroa road, in particular, has been troubled with many accidents this year, and is now under strict guard of the military. Without official permission no one can enter the mine.

c. History of the Aroa mine

The Aroa mine was discovered in 1605. Production was started in 1874. In 1907 the South American Copper Syndicates became the owner of the mine and the production increased rapidly. Since 1920, however, the output gradually lowered until 1936 when the mining operation was stopped. Since then, many mining companies explored the mine by drilling and other methods, and in 1957 IVP took possession of the mine as a possible source of sulphur for a factory at Morón owned also by IVP. From 1963 to 1964, the Ministry of Mines and Hydrocarbons carried out geological survey, geophysical prospecting and chemical prospecting in ore-bearing areas such as Aroa Principal, Titiara and San Antonio.

The total output of ore up to 1961 since the mine was opened is about 1,500,000 tons, and the ore grade ranges from Cu 12% (secondarily enriched ore)

to Cu 2.5% (primary ore).

d. Geology

Geology of the Aroa mine area is represented by Lower Cretaceous crystalline schists called Aroa Formation. The crystalline schists are mostly graphite schist, locally accompanied by crystalline limestone, sericite schist and green schist (amphibole schist), which occur either as intercalations or as lenses in the graphite schist.

The graphite schist generally strikes NNE and dips 20° - 40° W, but in the Richards crosscut of Aroa Principal the dip near the ore deposit is E, so that a local folding may be present.

So far as the field observation goes, the green schist is about 3 m thick and shows a conformable relation with the graphite schist.

The Aroa Formation yields no fossils but its age is assigned to Lower Cretaceous.

e. Ore deposits

Ore deposits of the Aroa mine are arranged in parallel with the schistosity plane of the country rock, so that they extend in the NNE direction for about 6 km. The ore deposits are, from the north, Mina Cunuragua, Titiara Norte, Mina Titiara, Zanjon Verde, Aroa Norte, Mina Aroa (Aroa Principal) and Mina San Antonio.

Gallery prospecting has been carried out for each of these deposits but, at present, only the Richards crosscut of Aroa Principal, which served as the main haulage level, can be entered.

The Richards crosscut, about 250 m in extension, reached the Aroa Principal deposit, and the drift is partly enterable. The greater portion of the ore body has been already worked out. In the remaining pillar on the foot wall side for about 10 m, the mode of occurrence of ore deposit is observed as follows:

i) Graphite schist, which is the country rock, strikes N-S and dips 40° E. The base of the ore body is entirely parallel to the schistosity plane of the country rock, and no evidence of faulting is recognized between them.

ii) The country rock shows no hydrothermal alteration or contamination. No skarn minerals are found in the ore body.

iii) The ore is compact and hard, showing irregular banding. The

ore minerals are fine grains of pyrite for the most part, associated with chalcopyrite, sphalerite, covelline and bornite; a small amount of galena, paragenetic with sphalerite, is also noticed. (See Photos. 3, 4 and 5). As for quartz, there are two kinds, one is microcrystalline quartz paragenetic with pyrite, and the other is of later crystallization occurring as patches and cutting the former kind.

iv) Analysis of samples revealed the following result; Au 0.5 gr/t, Ag 4 gr/t, Cu 4.51%, Pb 0.39%, Zn 1.09% and S 26.80%.

v) The basal part of the ore body is often brecciated, which is considered to have resulted from a fluidal movement of the mineral solution in the course of its solidification.

According to literature the Aroa Principal, which is the major deposit of the Aroa mine, has a strike extension about 80 m, the maximum thickness about 25 m and extension of shoot about 400 m.

Existence of limestone in the hanging wall has been reported but it cannot be ascertained at present.

The pitch of shoot is 10° - 15° to the north, which seems to coincide with the direction of the lineation of the country rock.

Above the Richards crosscut there are Penita, Santa Barbara and Pabao galleries, and in their upper levels the secondarily enriched ore bodies have been worked.

Below the Richards crosscut, eight levels, -10 m, -16 m, -22 m, -27 m, -33 m, -40 m and -50 m, have been driven.

Other ore deposits mentioned in literature are as follows:

i) Titiara deposit

The ore body occurs along the boundary between limestone and graphite schist. Green schist is found at 40 m above the ore body.

The ore body strikes N 15° E, dips 40° W, and is 150 m x 50 m x 10 m in dimensions. It has been worked out for the most part, but from the underground investigation the ore reserves have been estimated at 3,100 tons (with Cu 2.63%). The eastern end of the ore body is cut by a fault.

Eleven drillings have been driven for the purpose of prospecting, and three of them have encountered ore, although the ore grade is not known.

ii) San Antonio deposit

Like the above-mentioned one, the San Antonio deposit occurs along the boundary between limestone and graphite schist, and sometimes in limestone,

too. The strike is NNE and the dip is 60° W. The scope of the ore body is small, being 20 m to 60 m in strike extension and 1 m to 5 m in thickness. Secondarily enriched portion and high grade portion have been worked out.

f. Ore reserves

According to Wierzbicki, the ore reserves of the above-mentioned deposits are as follows:

i) Titiara deposit

3,100 t Cu 2.63%

ii) Aroa Principal deposit

135,000 t Cu 2.99%

iii) San Antonio deposit

(1) 2,320 t Cu 2.0%

(2) 6,080 t Cu 1.4%

(3) 9,730 t Cu 3.14%

Total 18,130 t Cu 2.41%

Sum total 156,230 t Cu 2.92%

g. Status of prospecting

i) Chemical prospecting

In the summer of 1964, Dr. R. C. Holman of the Geological Survey of Canada carried out chemical prospecting for Cu and Zn, but failed to get a satisfactory result as the ore-bearing area is contaminated.

ii) Geophysical prospecting

In 1964, Harold O. Siegel and Associates Ltd. carried out electro-magnetic prospecting (Turam method) and S. P., concurrently.

Magnetic prospecting was also attempted but any definite anomalies due to ore body were not detected, because the values were strongly affected by graphite.

No remarkable anomalies were found in the Aroa Principal deposit either.

h. Conclusion

i) The ore deposits of the Aroa mine are bedded cupriferous pyrite deposits (kieslager type) occurring parallel to the schistosity plane of crystalline schists with a general strike NNE and a dip 20° - 40° W.

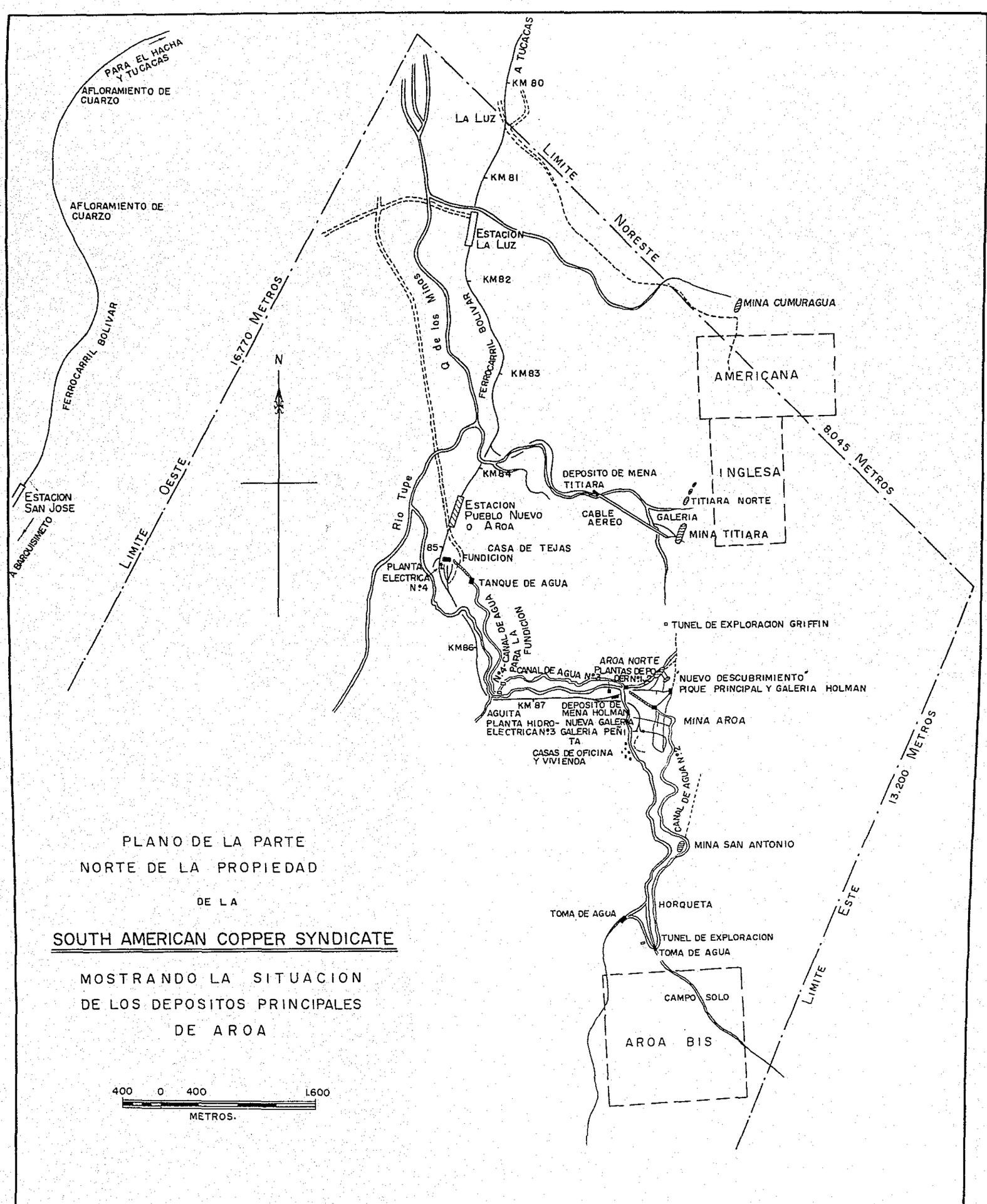
ii) The main deposit of this mine is Aroa Principal. Its scope is about 80 m in strike extension, about 25 m in maximum thickness and extension of shoot about 400 m. Since its discovery in 1605 up to the year of 1936 when the mining operation was suspended, about 1,300,000 tons (Cu 3.3%) of ore was exploited from the Aroa Principal and other deposits.

According to literature, the remaining reserves are 156,230 tons (Cu 2.92%), of which 135,000 tons (Cu 2.99%) remain in the Aroa Principal deposit.

iii) Even in Aroa Principal, the major deposit of the mine, not much can be expected from the reserves in the direction of downward extension. Besides, judging from the above-mentioned amount of remaining reserves, this deposit seems to have been already worked out.

iv) Based on the fact that the deposits of this mine are of kieslager type, future prospecting should depend on the result of fundamental geological survey for structural analysis.

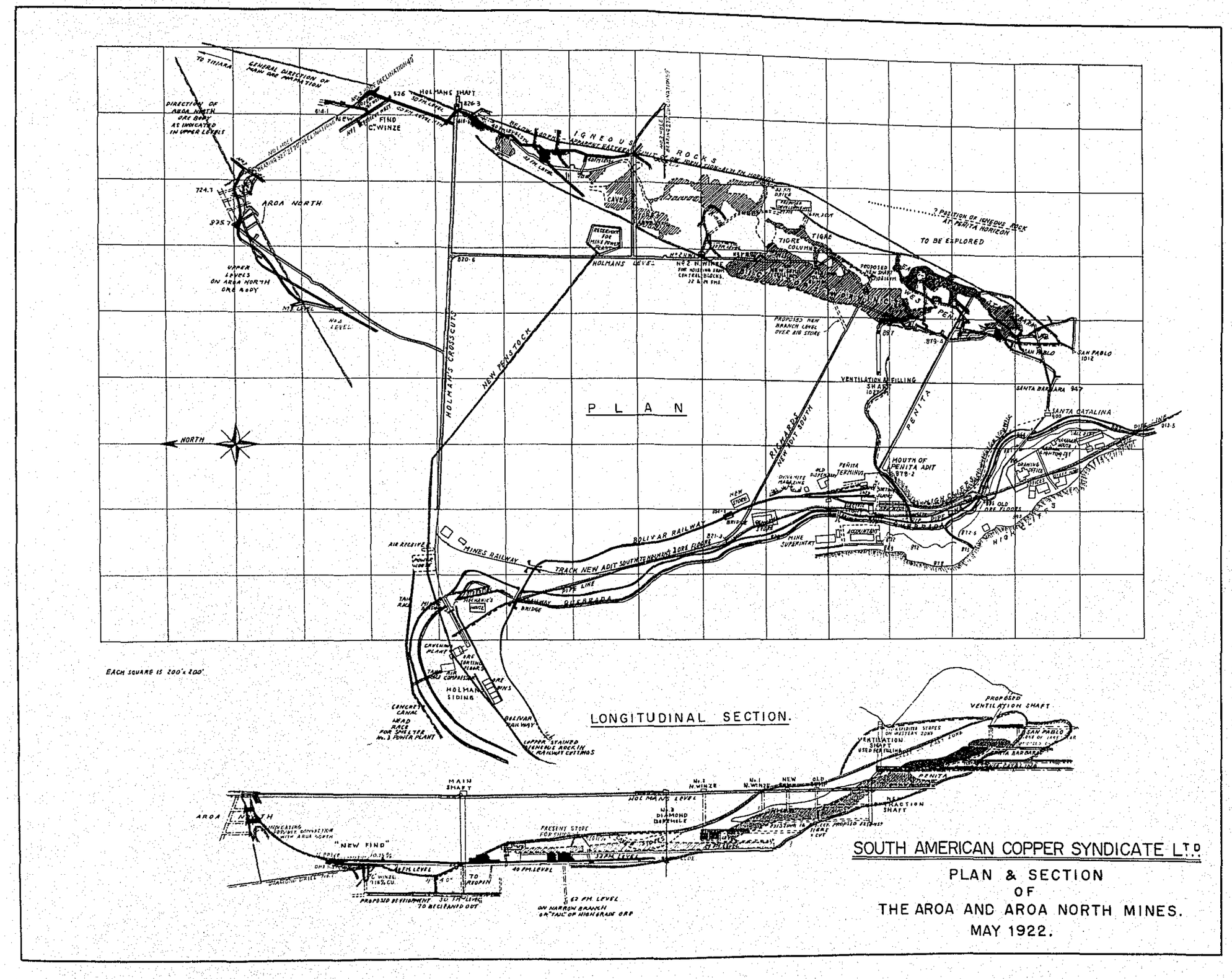
Fig.7



PLANO DE LA PARTE
NORTE DE LA PROPIEDAD
DE LA
SOUTH AMERICAN COPPER SYNDICATE
MOSTRANDO LA SITUACION
DE LOS DEPOSITOS PRINCIPALES
DE AROA

400 0 400 1600
METROS.

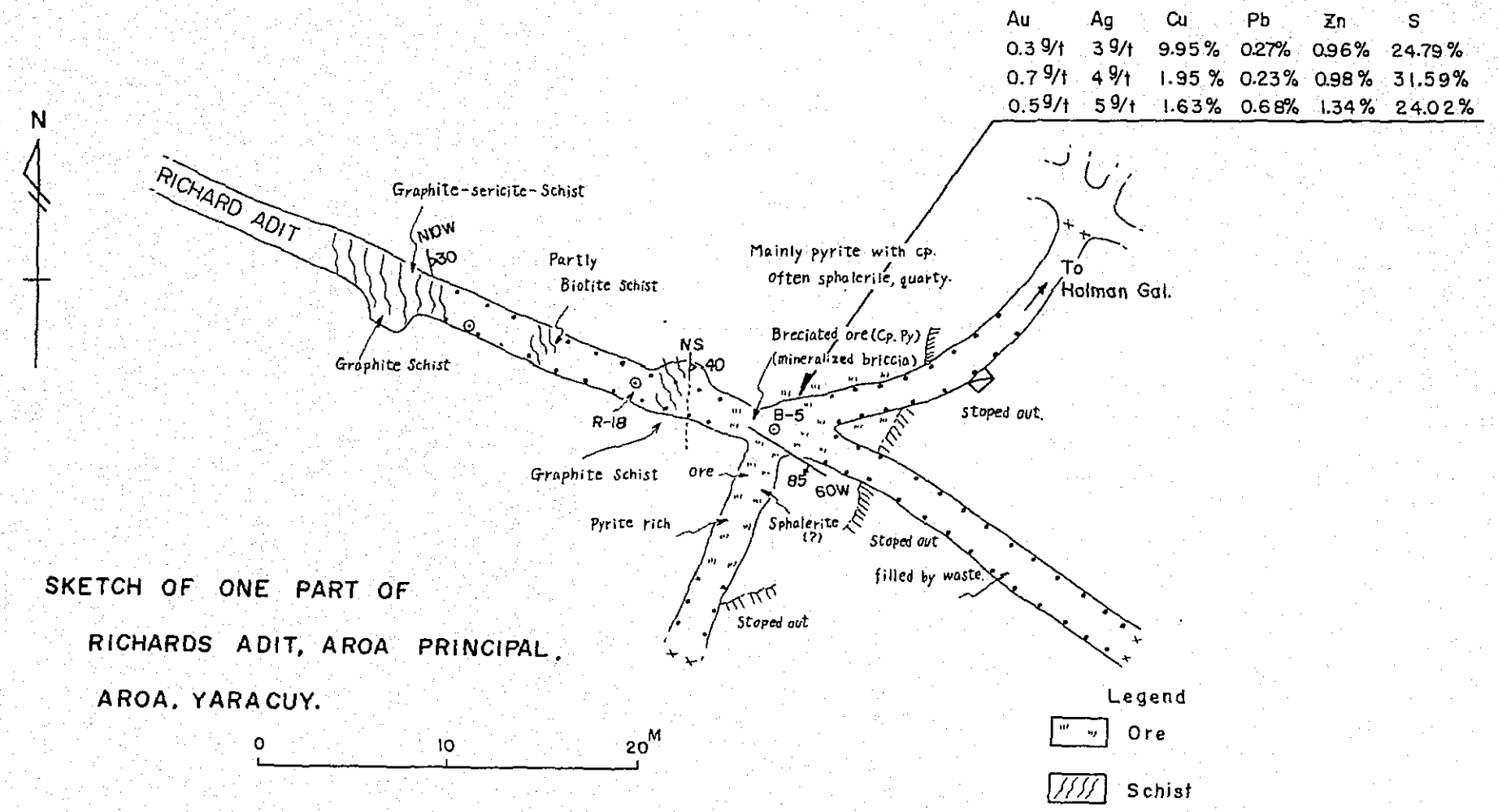
Fig.8



SOUTH AMERICAN COPPER SYNDICATE LTD.

PLAN & SECTION
OF
THE AROA AND AROA NORTH MINES.
MAY 1922.

Fig. 9


Au Ag Cu Pb Zn S
0.3 g/t 3 g/t 9.95 % 0.27% 0.96 % 24.79 %
0.7 g/t 4 g/t 1.95 % 0.23% 0.98 % 31.59 %
0.5 g/t 5 g/t 1.63 % 0.68% 1.34 % 24.02 %
N
RICHARD ADIT
Graphite-sericite-Schist
N10W
30
Partly
Biotite Schist
Graphite Schist
NS
40
R-18
Graphite Schist
ore
Pyrite rich
Sphalerite
(?)
Mainly pyrite with cp.
often sphalerite, quarty.
Brecciated ore (Cp. Py)
(mineralized briccia)
B-5
85
60W
Stoped out.
Stoped out
filled by waste.
Stoped out
To
Holman Gal.
SKETCH OF ONE PART OF
RICHARDS ADIT, AROA PRINCIPAL.
AROA. YARACUY.
0
10
20 M
Legend
Ore
Schist

4. Bailadores Mines

a. Location, transportation, topography

The Bailadores mine is located at about 600 km west-southwest of Caracas, or about 10 km southeast of the town of Bailadores, Merida State. The mine concession is held by the Ministry of Mines and Hydrocarbons.

In a straight distance the mine is about 90 km southwest of Merida, the capital of Merida State. From Merida to Bailadores, through La Victoria and Tovar, it takes 3 hours by car. From Bailadores to the mine site it is about 40 minutes by jeep.

The highway runs between Merida and La Victoria. From La Victoria a a paved road leads to Tovar and to Bailadores. The road between Bailadores and the mine site is partly paved but the rest is a truck road, 4 m wide, and as it nears the mine the road becomes a steep mountain path barely passable for a jeep.

In the mine area the outcrops are found between 2,390 m and 2,510 m in altitude.

The mine is in the Andes that trends NE-SW. The topography of the neighborhood shows a mature stage and is more or less rugged.

The climate is temperate and the growth of trees is luxuriant.

b. Geology

The mine area is composed largely of the so-called graphite schist, striking generally N 45° E and dipping 60° - 70° SE. The graphite schist is locally intercalated with green schist. Near the ore deposit, intrusion of small dykes of fine-grained compact hornblende porphyrite is observed.

At about 5 km west of the mine, biotite granite representing the igneous activity of the Andes is intruding. According to the Geological Map of Venezuela, this granite is distributed in a NE-SW direction. The granite turned the surrounding metamorphic rocks into hornfels. The age of these metamorphics is assigned to Paleozoic in the above-mentioned geological map. The age of the biotite granite is unknown, but it is highly possible that the granite intrustion took place in the closing period of the dynamo-metamorphism of the schists.

c. Ore deposits

The ore deposits of this mine are fissure-filling veins of mesothermal origin, occurring in faults of the above-mentioned metamorphics. Extension of of veins has been confirmed as 560 m between Galeria Monsilvenia and Calicata No. 6.

Constituent minerals are chiefly marmatite with subordinate pyrrhotite, accompanied by chalcopyrite, galena and pyrite. Gangue minerals are mostly quartz.

Alteration of the country rock is represented by sericitization, with occasional silicification and pyritization, but in any case the sphere of alteration is small, being limited to about 2 m in thickness along the walls.

The faults, which served as the stage of formation of ore deposits, are not much developed as shear zones. By their strike and dip these faults are grouped into two systems, one is N 30° E, 70° SE, and the other is N 60° E, 40° - 50° SE, and the latter system seems responsible for formation of ore shoots. The width of ore shoots is 2.5 m in maximum, 1.4 m on an average. Extension of ore shoots, within the observed range, is about 15 m.

Green schist is found directly beneath the veins or with an interval of several meters from the latter. The place where the ore deposits occur is considered to have been formed as a strike fault along the boundary between this green schist and the graphite schist.

d. Status of prospecting (see Figs. 10 - 18)

At present, the Ministry of Mines and Bydrocarbons is enforcing prospecting by means of trenching, reopening of old galleries, and drilling, with about 30 persons inclusive of two geologists.

i) Trenching

Trenching into outcrops at Calicata No. 1 - No. 6 has been carried out.

ii) Gallery prospecting

Prospecting has been done in Galeria Monsilvenia for a length of about 100 m, in Calicata No. 3 for about 30 m, and in Calicata No.4 for about 6 m. An old gallery near Calicata No. 1 is being reopened.

iii) Drilling

Bore hole No. 1 (N 50° W, -76,5°, 121.20 m) was driven from the hanging wall of the central part of the vein. At a depth of 90 m - 94 m, pyrite

contamination was regonized, which is supposed to be a lower part of the outcrop (Calicata No. 2).

Bore hole No. 2 is being driven at the same locality as No. 1, in the direction of N 45° W at an angle of 50°. It has encountered veins at depths of 65 m - 67 m and 72 m - 73 m.

iv) Geophysical prospecting

Geophysical prospecting by the S.P. method is under way.

v) Chemical prospecting

In the area upstream the Monsilvenia gallery and along the stream of Calicata No. 1, chemical prospecting by the rubeanic acid method has been done.

The result has revealed that anomalies occur in the lower reaches of the known deposits, but no anomalies are noticed in the upper reaches for a distance of about 300 m.

e. Ore reserve

On an assumption that the strike extension of vein is 560 m, probable depth 180 m, probable ratio of occurrence 43% (strike extension 320 x 30%; strike extension 240 m x 60%), dip of vein 60°, average width of vein 1.4 m (average horizontal width 1.4 m x 1.15) and specific gravity 3.2, the ore reserves are calculated as follows:

560 m x 180 m x 43% x 1.4 m x 1.15 x 3.2 = 223,308 t.

Thus the approximate ore reserves are 220,000 tons.

The mean grade of ore of 13 samples collected for analysis is as follows; Au 0.3 gr/t, Ag 88 gr/t, Cu 2.25%, Pb 6.55%, Zn 15.64% and S 21.13%. From this grade the metal contents are calculated as

Cu	5,024 t
Pb	14,627 t
Zn	34,925 t

f. Conclusion

i) The ore deposits are veins of mesothermal origin, occurring in faults of crystalline schists.

ii) The ascertained extension of veins is 560 m and the average vein width is 1.4 m, but the vein's driftward extension and downward continuation can be expected.

iii) Since prospecting of diamond drills are only two, available data are insufficient for discussing the lower part of the ore deposit.

iv) Judging from the above-mentioned points and the present situation of prospecting, the ore deposit has 220,000 tons of reserves that would become larger by future prospecting. Also, the ore is of high grade, as indicated by the contents of Cu, Pb and Zn, so that attention should be paid to the prospecting in progress by the Ministry of Mines and Hydrocarbons.

Fig.12

CROSS SECTION Ⓔ ~ Ⓕ
OF
TAPIAS NO.2, BAILADORES.
RIVAS DAVILA, MERIDA.

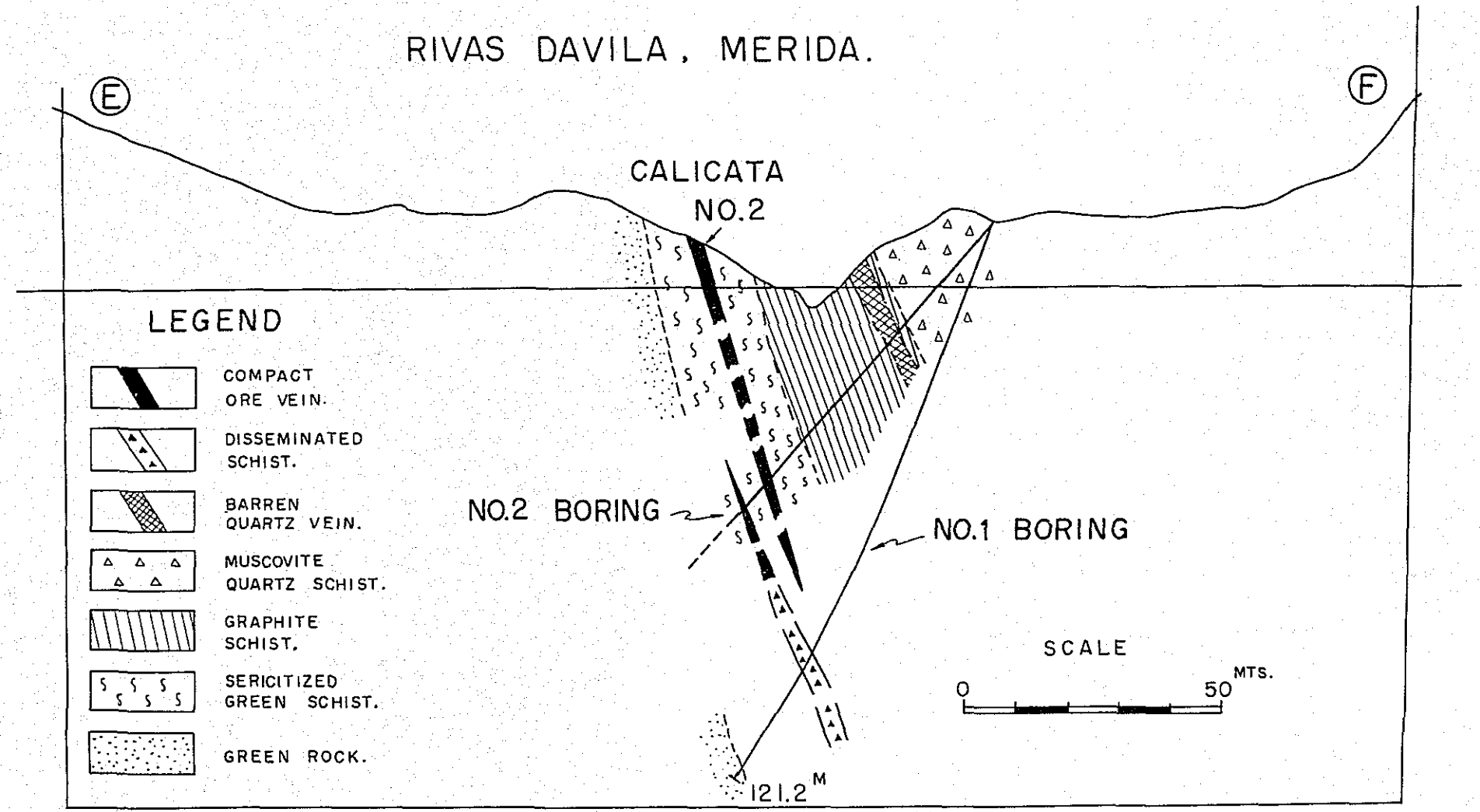
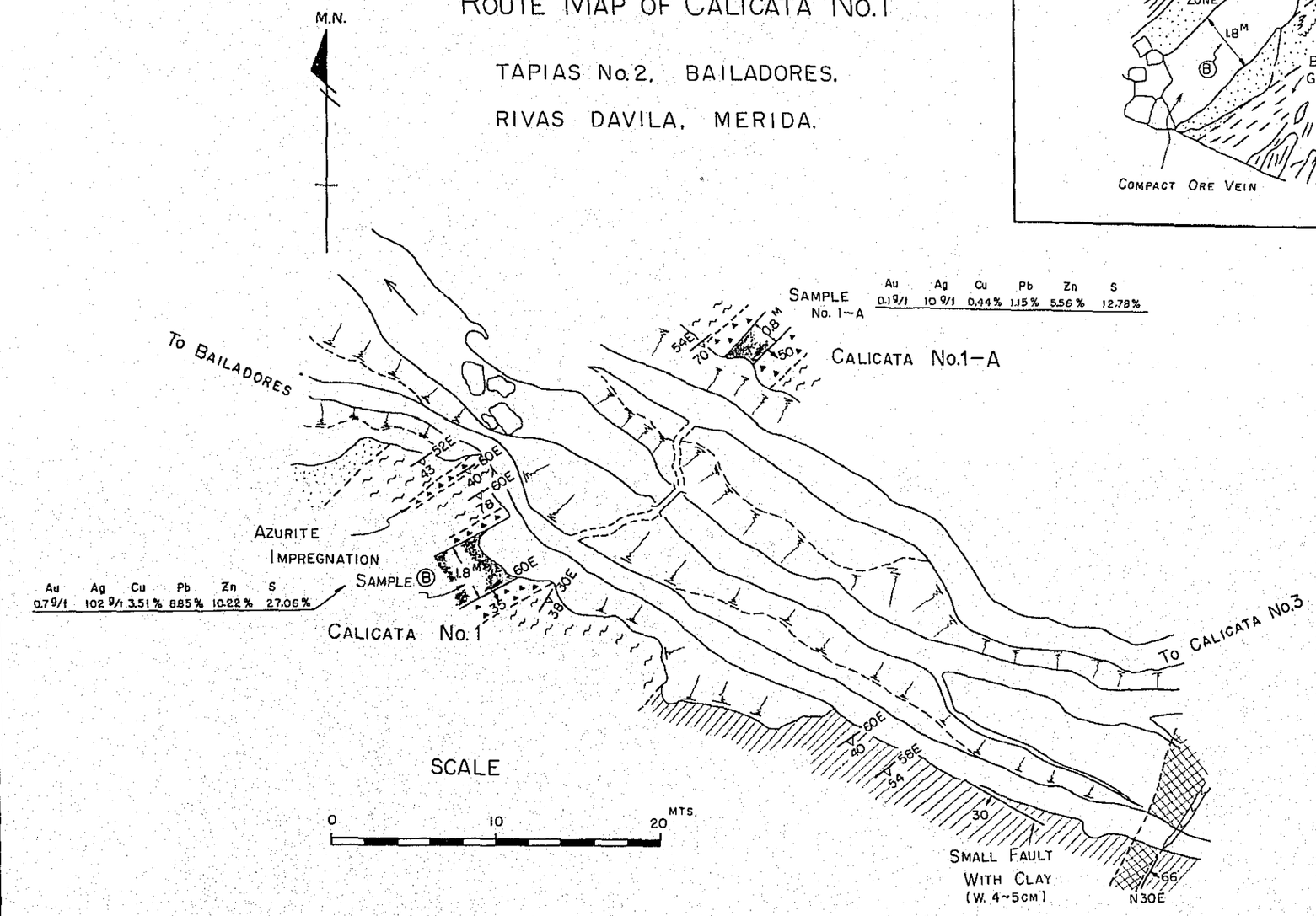


Fig.13

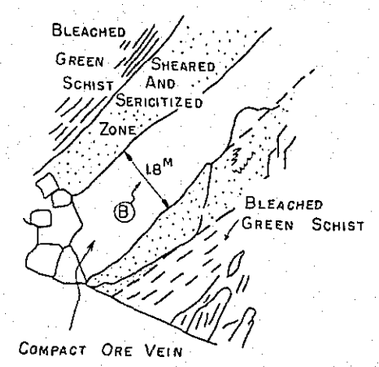
ROUTE MAP OF CALICATA No.1

TAPIAS No.2, BAILADORES.

RIVAS DAVILA, MERIDA.



SKETCH OF CALICATA No.1 (VERTICAL SECTION)



LEGEND

- Ore Vein (Zn, Cu, Pb)
- Quartz Vein (Barren)
- Alteration
- Hornblende Porphyrite
- Graphite Schist
- Green Schist (Schalstein)
- Green Schist (Basic Rock)
- Schistosity
- Fissure

Fig.14

GEOLOGICAL SKETCH
OF
CALICATA No.3

TAPIAS No.2, BAILADORES.

RIVAS DAVILA, MERIDA.

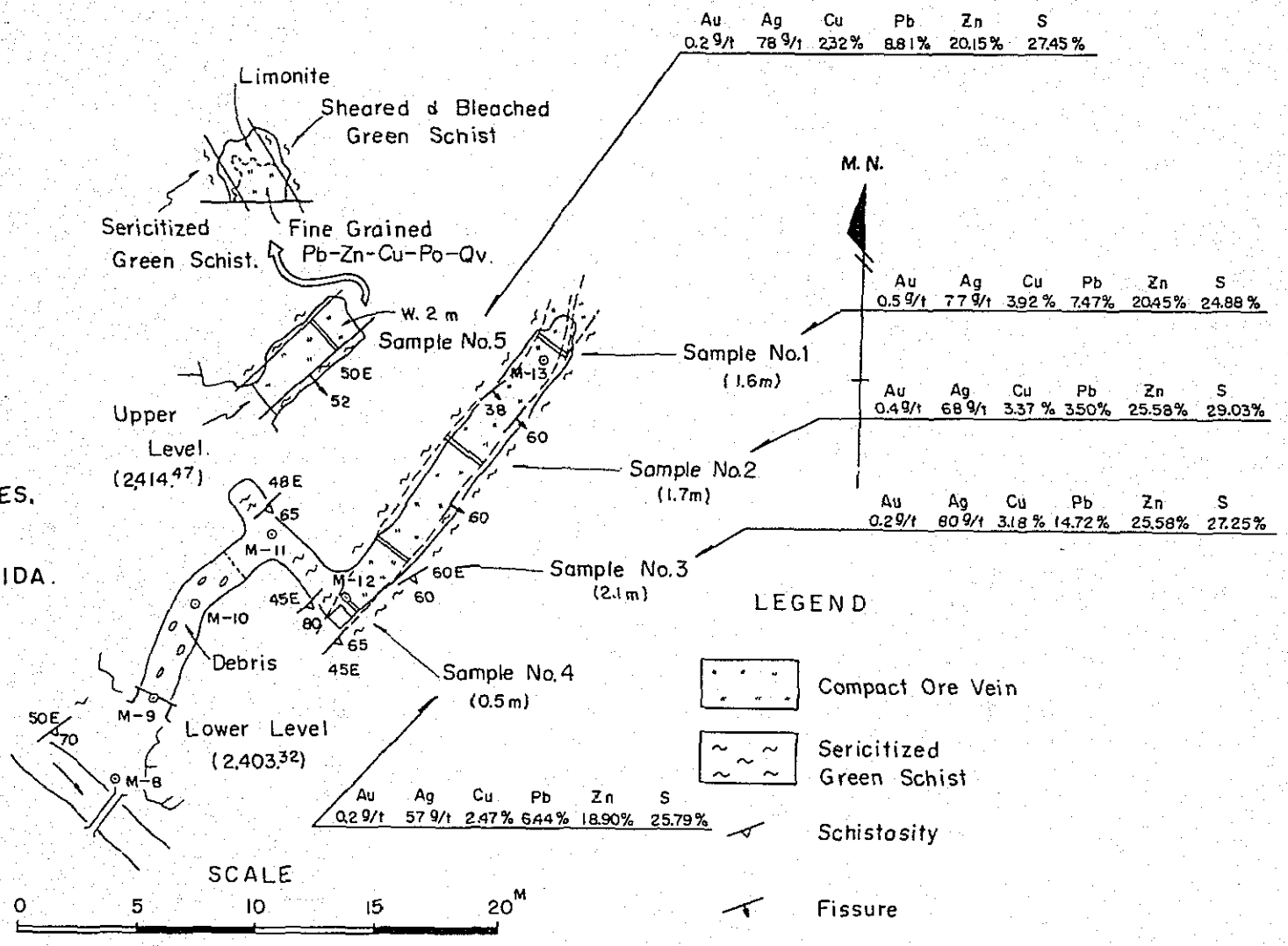


Fig. 15

GEOLOGICAL SKETCH

OF

CALICATA No. 4,

TAPIAS No. 2,

BAILADORES,

RIVAS DAVILA,

MERIDA

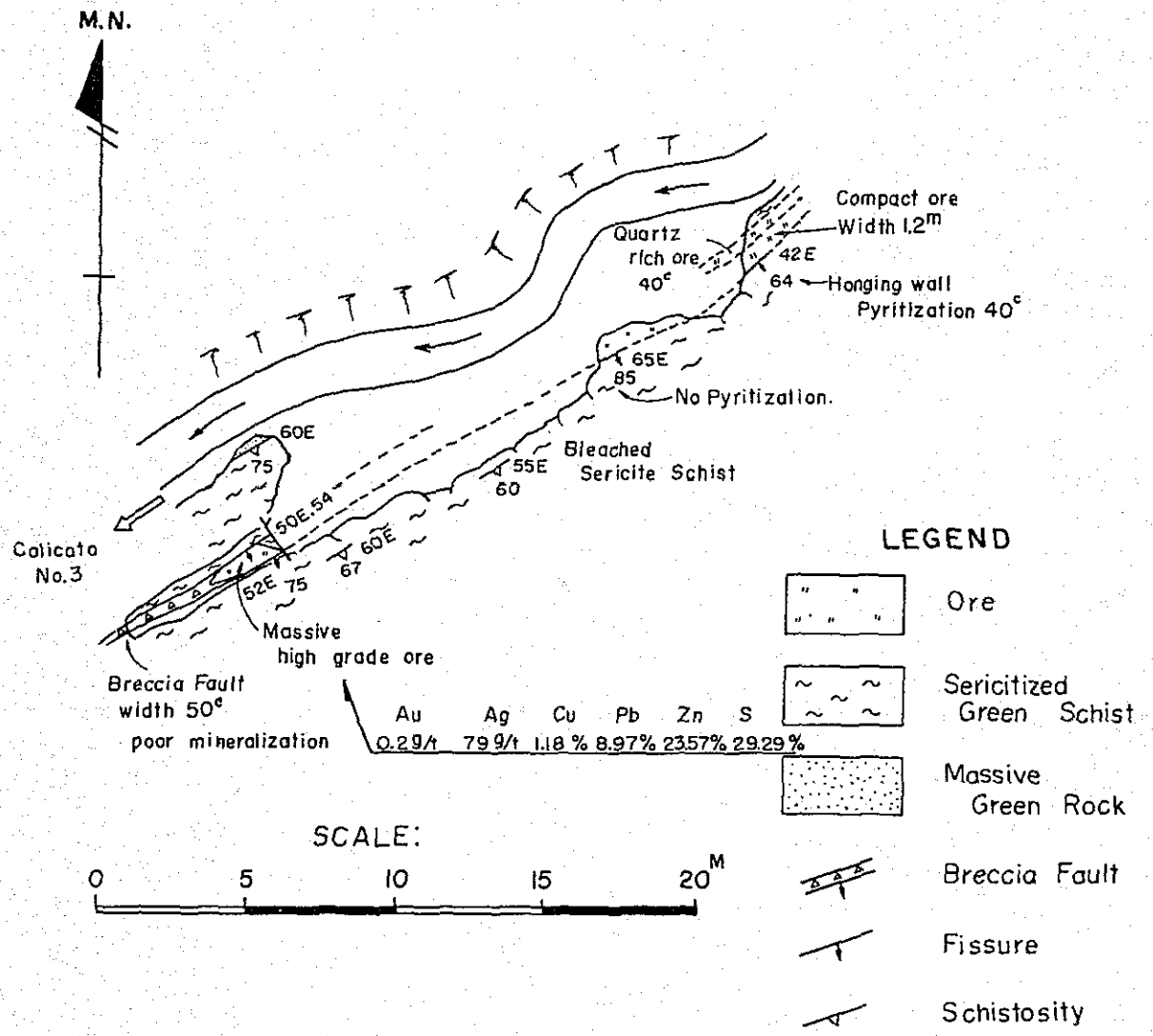


Fig. 16

GEOLOGICAL SKETCH OF GALLERY "MONSILVENIA."

TAPIAS No.2, BAILADORES, RIVAS DAVILA, MERIDA.

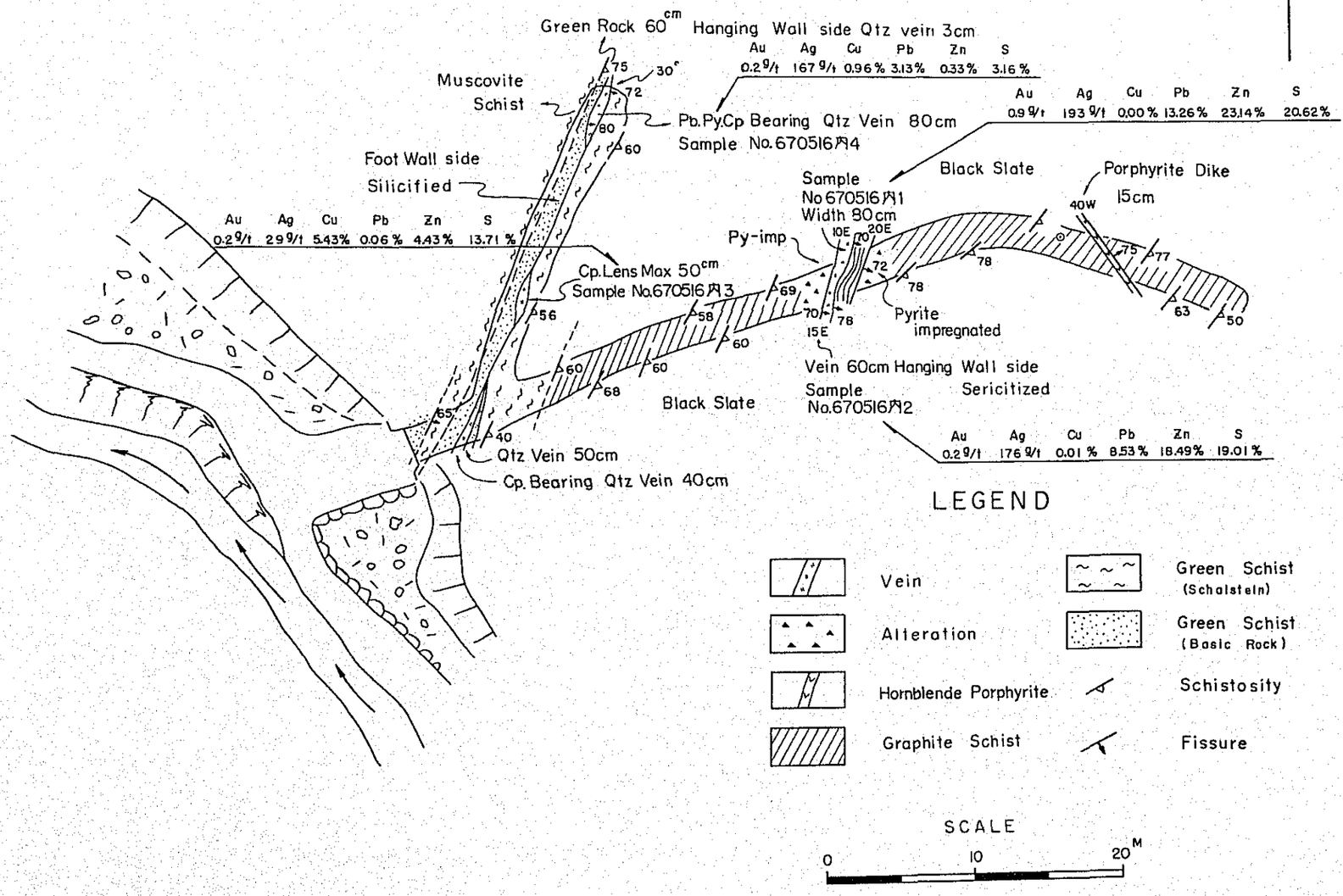


Fig. 17

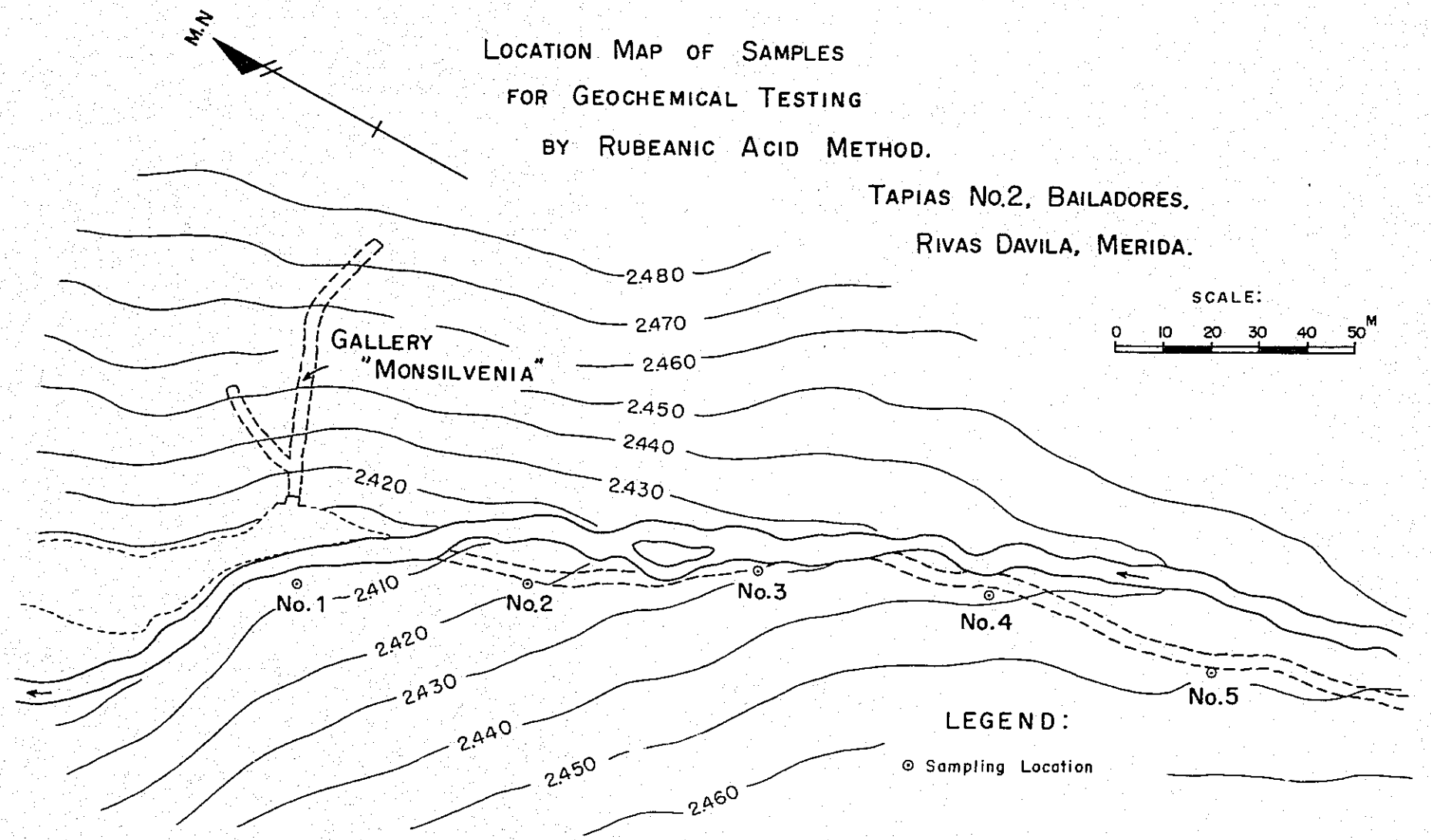
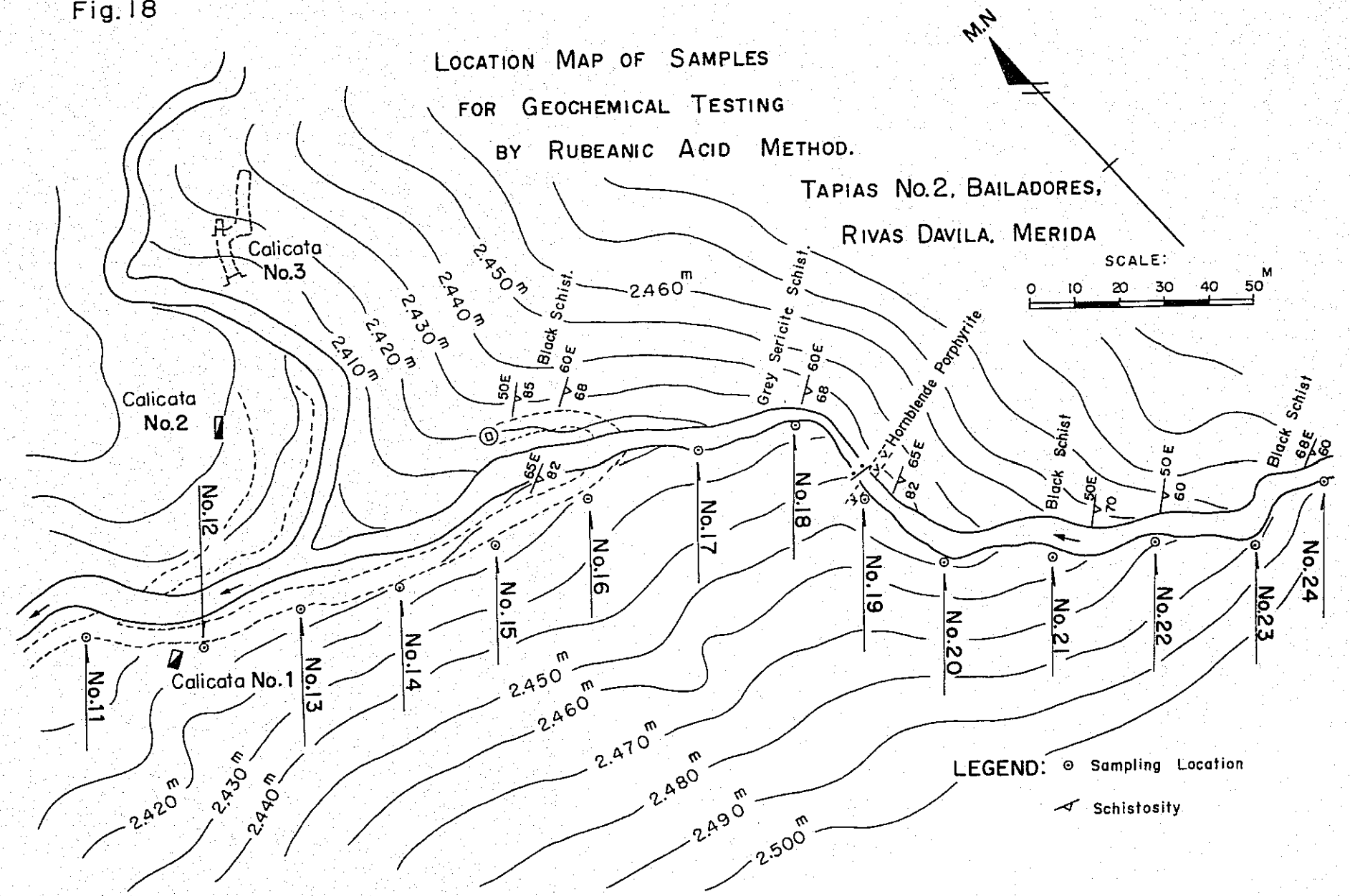

M.N
LOCATION MAP OF SAMPLES
FOR GEOCHEMICAL TESTING
BY RUBEANIC ACID METHOD.
TAPIAS No.2, BAILADORES,
RIVAS DAVILA, MERIDA.
SCALE:
0 10 20 30 40 50 M
GALLERY
"MONSILVENIA"
2480
2470
2460
2450
2440
2430
2420
2410
No. 1
No.2
No.3
No.4
No.5
LEGEND:
⊙ Sampling Location

Fig. 18


LOCATION MAP OF SAMPLES
FOR GEOCHEMICAL TESTING
BY RUBEANIC ACID METHOD.
TAPIAS No.2, BAILADORES,
RIVAS DAVILA, MERIDA
M.N
SCALE:
0 10 20 30 40 50 M
Calicata No.3
Calicata No.2
Calicata No.1
2.410 m
2.420 m
2.430 m
2.440 m
2.450 m
2.460 m
2.470 m
2.480 m
2.490 m
2.500 m
Black Schist.
Grey Sericite Schist.
Hornblende Porphyrite
Black Schist
Black Schist
50E 85
60E 68
60E 68
65E 82
65E 82
50E 70
50E 60
68E 60
No.11
No.12
No.13
No.14
No.15
No.16
No.17
No.18
No.19
No.20
No.21
No.22
No.23
No.24
LEGEND: ⊙ Sampling Location
Schistosity

5. *Seboruco Mines*

a. Location, transportation, topography

The Seboruco mine is located at about 40 km north-northeast of San Cristobal, the capital of Tachira State. The mine concession is held by the Ministry of Mines and Hydrocarbons. San Cristobal is about 750 km westnorthwest of Caracas.

Between San Cristobal and Seboruco it is about 100 km by the highway and the paved road, and takes two hours and a half by car.

The ore deposit is exposed at an altitude of 1, 180 m, about 500 m south of the village of Seboruco. To reach there, one must walk a rugged mountain path for 1 km.

The mine is situated in the Andes and the topography of the neighborhood shows a mature stage. The climate is mild and trees are growing thick.

b. Geology

Geology of the area is composed of Jurassic and Cretaceous systems. The Jurassic system is called the La Quinta Formation and consists chiefly of red sandstone, accompanied by thin layers of cross-bedded shale and mudstone. The Cretaceous system is called the Tomon Formation and consists chiefly of white sandstone with sandy to siliceous shale. Fossil-bearing calcareous thin beds are found in the upper part. Conglomerate is developed at the base.

c. Ore deposits

The ore deposit is the so-called Corocoro type deposit (Bolivia) of sedimentary origin, occurring in the basal conglomerate that constitutes the lowermost part of the Tomon Formation.

The basal conglomerate is composed mostly of quartzite pebbles, some of which being ferruginous, accompanied by phyllite pebbles. So far as the field observation goes, most of the quartzite pebbles are 4 cm - 7 cm in diameter. Strike and dip of the basal conglomerate are N80° E and 42° N.

Principal ore mineral is malachite, associated with some azurite. Within the area surveyed, occurrence of native copper, bornite or atacamite was not

recognized.

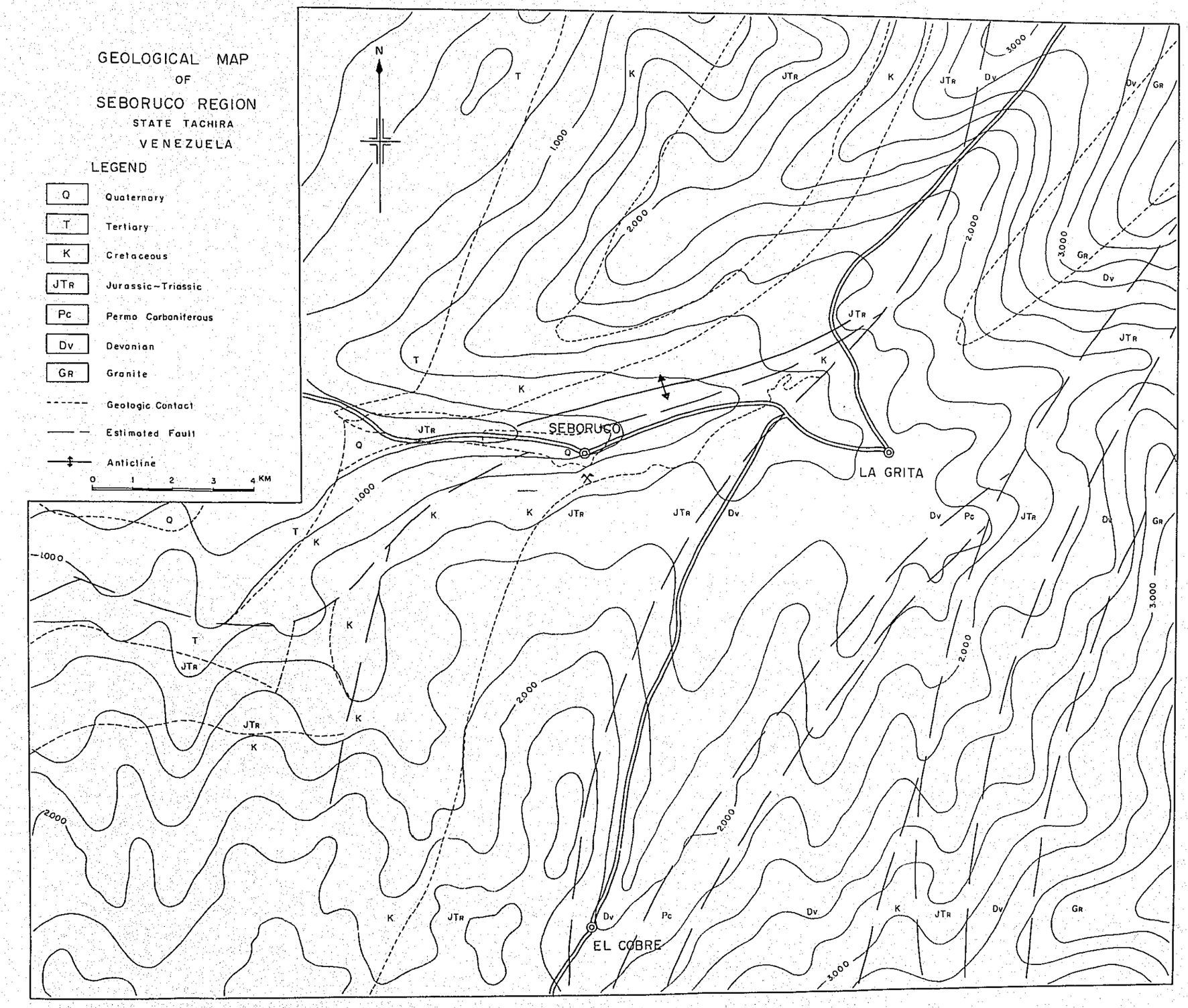
The ore deposit is about 40 cm thick in the basal part. There are two beds of ore, each being 25 cm thick, separated by a 3 m thick horse on the hanging wall side. The ore grade of the lower bed is, Au 0.3 gr/t, Ag 12 gr/t, total Cu 1.17%, soluble 1.15%, Pb 0.04%, Zn tr., and S 0.26%. According to literature, the footwall is composed of the same conglomerate for about 1 m thick, and this conglomerate rests unconformably on the red sandstone of the La Quinta Formation. It is also mentioned in literature that outcrops of this type of ore are found in several places within a range of 4 km.

d. Conclusion

i) The ore deposits is the so-called Corocoro type deposit and is of a small scale. It seems to have been deposited around the mouth of a river.

ii) As compared with the Corocoro type deposits that are being exploited in Bolivia, the deposit of this mine is smaller in scale and lower in ore grade, so that it is not worthy of prospecting.

Fig.19


GEOLOGICAL MAP
OF
SEBORUCO REGION
STATE TACHIRA
VENEZUELA
LEGEND
Q Quaternary
T Tertiary
K Cretaceous
JTR Jurassic-Triassic
Pc Permo Carboniferous
Dv Devonian
GR Granite
Geologic Contact
Estimated Fault
Anticline
0 1 2 3 4 KM
N
SEBORUCO
LA GRITA
EL COBRE
1,000
2,000
3,000

6. *Carúpano Mines*

a. Location, transportation

The Carúpano mine is located in the district of Bermúdez, south of Carúpano, Sucre State. The area is called the Carúpano - El Rincón area.

Between Caracas and Carúpano it is 557 km by the highway; the prospecting office of the Ministry of Mines and Hydrocarbons is about 6 km from Carúpano and can be reached by car. The Canchunchu gallery is near the office. Other localities of prospecting, such as Gran Pobre and El Encanto, can be reached through a forest road by jeep or on foot.

The area is 500 m - 600 m above sea level and shows a mature stage of topography.

b. Geology

The area is composed of Lower Cretaceous to Jurassic sedimentary rocks striking roughly E-W and gently dipping to N. The geology consists of the following formations in descending order:

Carúpano Formation	meta-volcanics, sericite phyllite or calcareous phyllite.
Macuro Formation	sericite phyllite or graphite phyllite, intercalated with limestone.
San Antonio Formation and Barranquin Formation ..	limestone.

Intrusion of dacite or dacite-porphyry is recognized, affecting at least the Macuro Formation. (See Photo. 7)

Ore deposits occur mostly in the Macuro Formation which is considerably folded and faulted.

c. Ore deposits

The Carúpano Formation contains thin veinlets of Cu-carbonate but these are out of question.

In the Macuro Formation two types of mineralization are observed.

i) One type is the veinlets in the sericite phyllite or graphite phyllite, as observed at Gran Pobre and Canchunchu. The veinlets consist of anglesite, galena, hematite and quartz, with a small amount of zincblende; those of Gran Pobre contain a considerable amount of Mn-oxide. Parallel to the veinlets, dykes of dacite-porphyry intruded and were brecciated, mineralized and chloritized. The mineralization may be ascribed to the post-activity of these dykes. The strike of veinlets is roughly N-S at both Gran Pobre and Canchunchu, but the dip is 40° - 50° W at the former and 70° - 80° E at the latter. The vein width is 10 cm - 80 cm. On the whole the ore grade is low, although it is partially high in Pb.

Analysis of samples taken from the high-grade part showed the following result:

	Vein width	Au	Ag	Cu	Pb	Zn	S
Canchunchu	30 cm	1.0 gr/t	119 gr/t	Tr.	20.82%	0.60%	4.15%
Gran Pobre	35 cm	0.4 gr/t	678 gr/t	Tr.	74.38%	0.10%	1.64%

ii) The other type is the metasomatic impregnation of galena, sphalerite and quartz, occurring along minor cracks of limestone, as observed at El Encanto. Impregnation is small, with the width about 20 cm and the extension only several meters, and is sporadically found in several places.

d. Status of prospecting

It is said that the prospecting of El Encanto and Gran Pobre was done in about 1870.

In 1957 - 1958, Compania Criolla Minera Y Metalurgica applied for the mine concession of the gallery of Canchunchu and did some excavation, but before long the operation was stopped and the mine was abandoned. In July of 1965, Canchunchu became the government-held mine concession, and the Ministry of Mines and Hydrocarbons started investigation and prospecting, and up to 1966 the topographic map compilation, survey of surface geology and investigation for reopening of the old gallery were carried out. In 1967, chemical prospecting was enforced, which revealed anomalies in two places other than the area of the old gallery. Geophysical prospecting (by the resistivity method) is

under way in the area of the old gallery. Reopening of the old gallery (Gran Pobre) is also being continued. Drilling has not been attempted as yet. About 30 persons, including two geologists, are engaged in the prospecting operation. Total extension of old galleries throughout the mine area is 2,600 m.

e. Conclusion

i) The vein type ore deposite are veinlets of a small scale and are not worthwhile prospecting.

ii) The mineral composition is Mn-oxide + Pb in the upper part, and Zn-mineral increases toward the lower part. There is a possibility of downward increase of Cu-mineral but, considering that the country rock is graphite schist, any noticeable development of fissures cannot be expected.

iii) The ore deposits of metasomatic impregnation type occurring in limestone are very small in scale and are quite out of question under the existing circumstances. However, a possibility of their thickening in the lower part must be ascertained.

Fig. 21

GEOLOGICAL SKETCH OF ESPERANSA A & B, CANCHUNCHU CARUPANO, SUCRE.

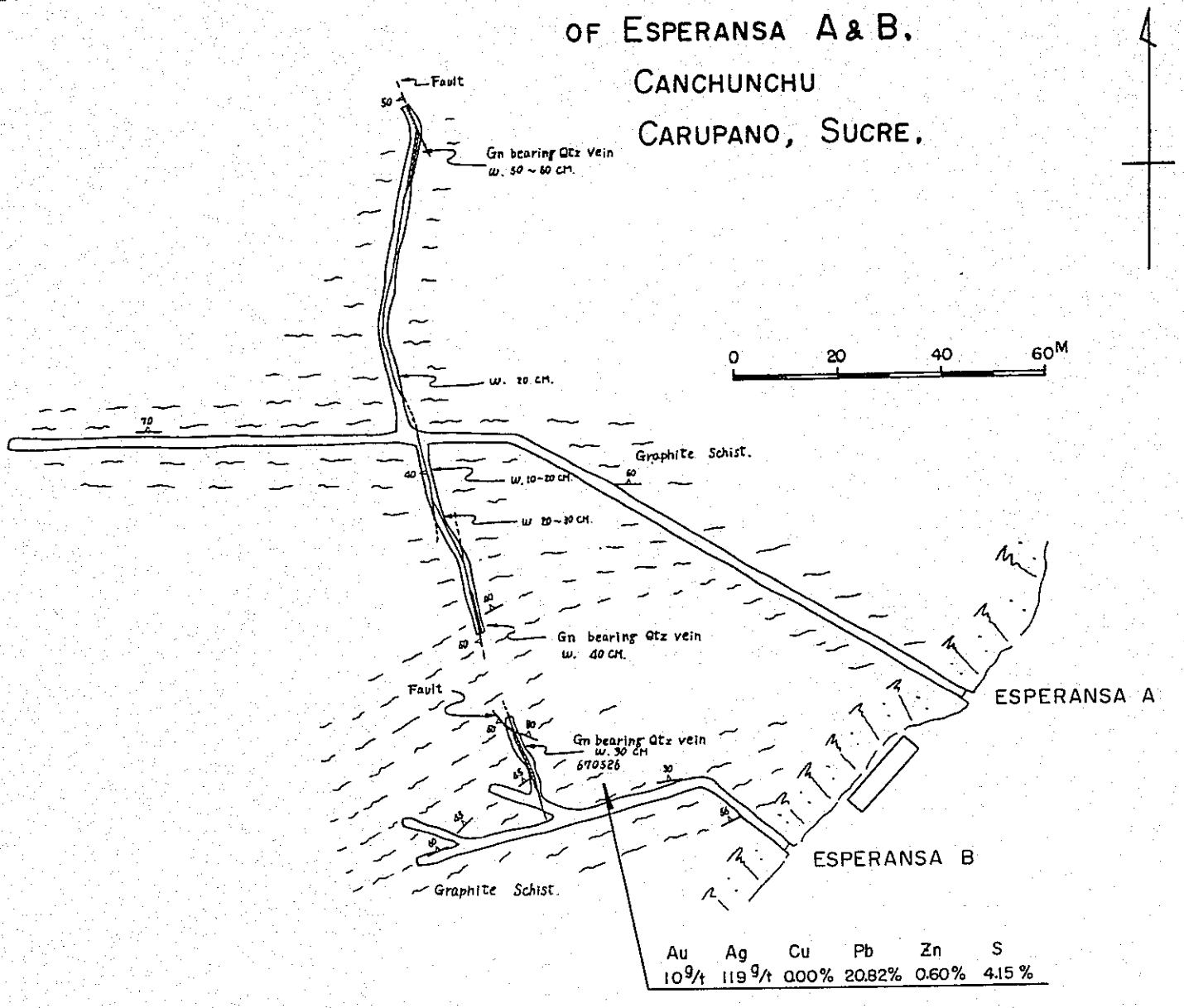
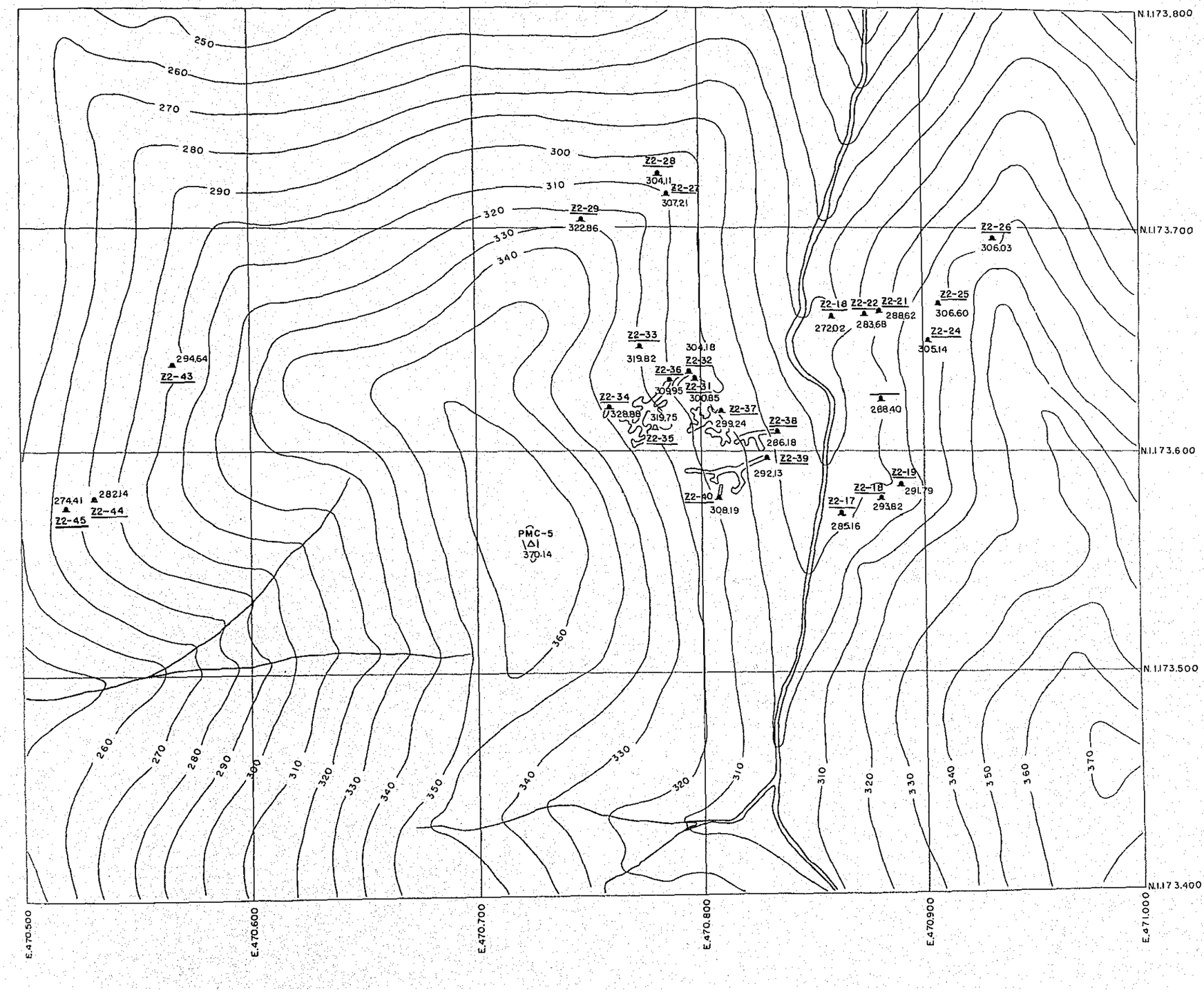


Fig.22



MAP
OF
DISTRICT EL ENCANTO

CARUPANO, BERMÚDEZ.

SUCRE, VENEZUELA.

SCALE

0 50 100 MTS.

▲ GALLERY.

Fig. 23

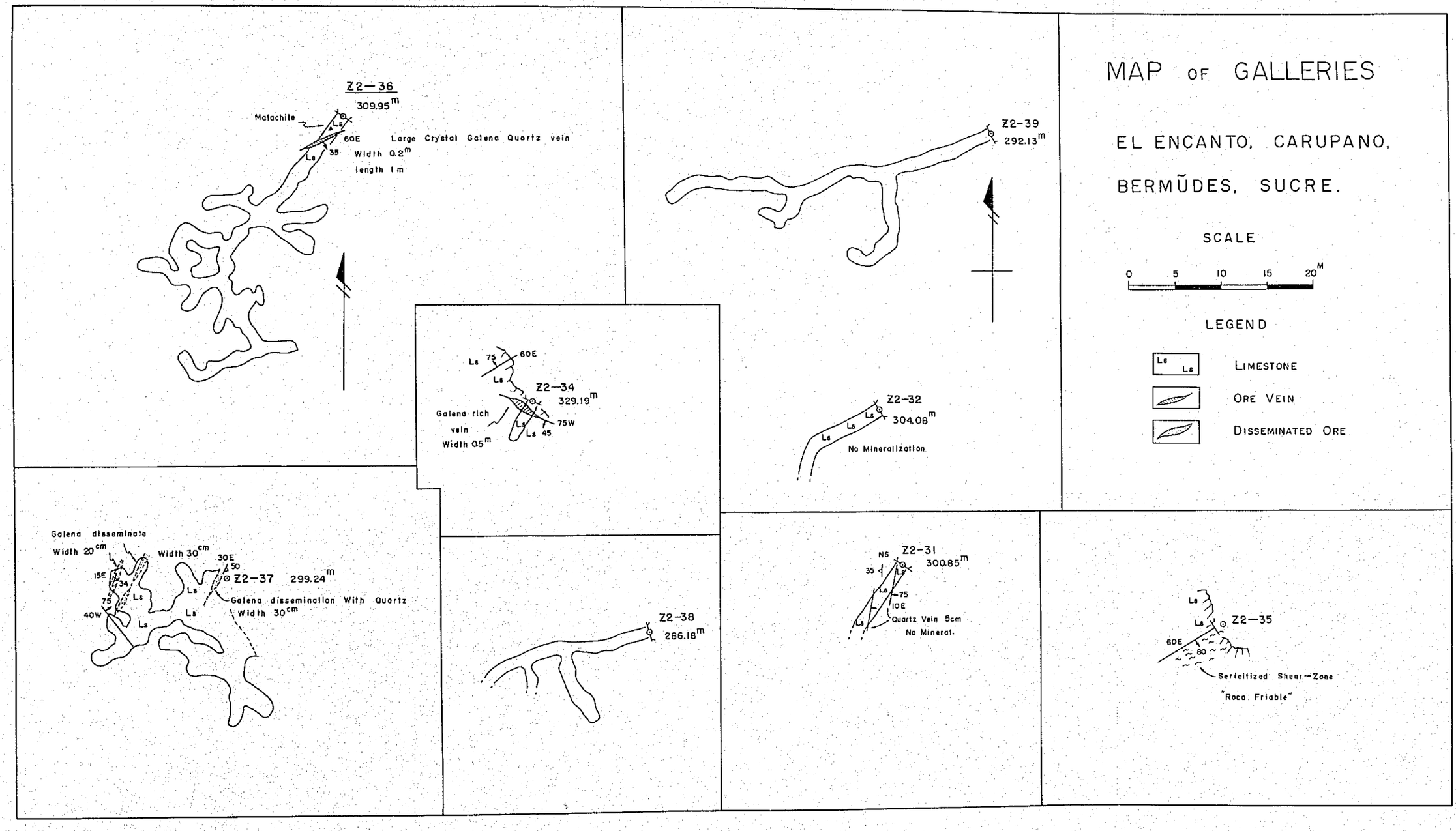
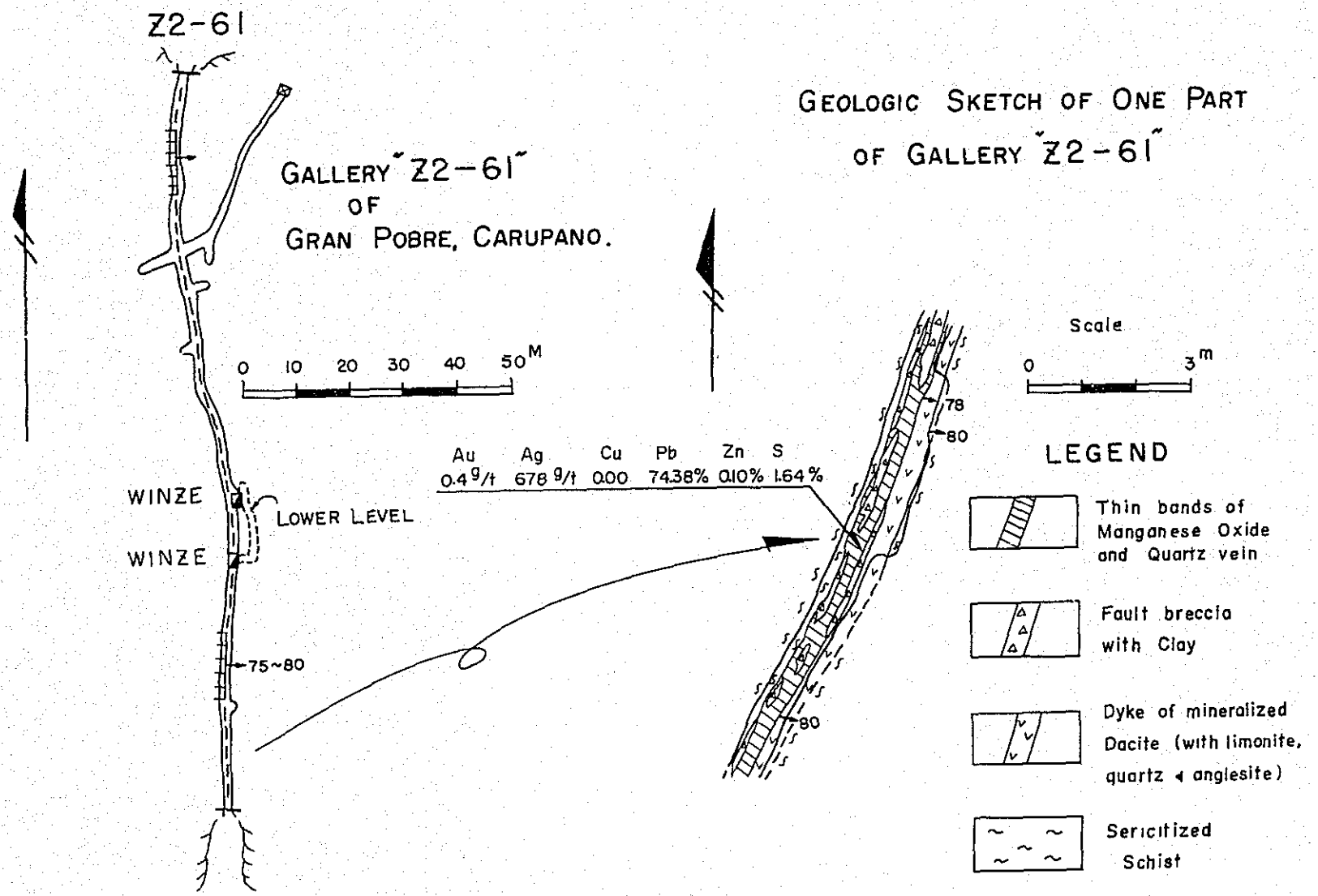

Z2—36
309.95m
Malachite
Ls
60E
35
Large Crystal Galena Quartz vein
Width 0.2m
length 1m
Z2-39
292.13m
MAP OF GALLERIES
EL ENCANTO, CARUPANO,
BERMÚDES, SUCRE.
SCALE
0 5 10 15 20M
LEGEND
Ls Ls LIMESTONE
ORE VEIN
DISSEMINATED ORE
Ls 75 60E
Z2—34
329.19m
Galena rich vein
Width 0.5m
75W
Ls 45
Z2-32
304.08m
No Mineralization
Galena disseminate
Width 20cm
Width 30cm
30E
50
Z2—37 299.24m
15E
34
75
40W
Galena dissemination With Quartz
Width 30cm
Z2-38
286.18m
NS
Z2-31
300.85m
35
75
10E
Quartz Vein 5cm
No Mineral.
Z2—35
60E
80
Sericitized Shear—Zone
"Roca Friable"

Fig. 24


Z2-61
GALLERY "Z2-61" OF GRAN POBRE, CARUPANO.
0 10 20 30 40 50 M
WINZE
LOWER LEVEL
WINZE
75~80
Au Ag Cu Pb Zn S
0.4 g/t 678 g/t 0.00 74.38% 0.10% 1.64 %
GEOLOGIC SKETCH OF ONE PART OF GALLERY "Z2-61"
Scale
0 3 m
78
80
80
LEGEND
Thin bands of Manganese Oxide and Quartz vein
Fault breccia with Clay
Dyke of mineralized Dacite (with limonite, quartz ◂ anglesite)
Sericitized Schist

IV. RECOMMENDATION ON PROSPECTING IN PRINCIPAL MINES

Ⅳ. Recommendation on Prospecting in Principal Mines

1. Aroa Mines

Analytical study of geological structure

So far as the observation in the Richards crosscut goes, the ore deposits of the Aroa mine are the so-called kieslager and are considered to be of a syngenetic origin. From this viewpoint, it is necessary to analyze the stratigraphic relations of the known several deposits centering on the Aroa Principal.

According to the data at the Ministry of Mines and Hydrocarbons, the Aroa Principal ore body seems to be situated in the west wing of a synclinal structure of the country rock, which strikes generally NNE and dips W. The southern end of the ore body emerges on the ground surface, whereas its northern end is cut by a NE-trending normal fault and is dragged up onto the ground surface at Aroa Norte. It is probable that this up-dragged deposit may plunge into the ground again with a north pitch in the north of Aroa Norte, but it is somewhat questionable whether such a deposit can be correlated with the Zanjon Verde deposit.

In a relation similar to the above, can the Zanjon Verde be correlated with the Titiara deposit? Also, in the reverse direction, can the Aroa Principal be structurally continuous with the San Antonio deposit? These questions ought to be answered by analytical study of geological structure.

Another problem to consider is whether a synclinal structure controlling the Aroa Principal deposit may occur repeatedly in the east or west.

Analysis of such structures is requisite for finding room for prospecting in the Aroa area. For this purpose, reopening of appropriate old galleries will become necessary, and geologic drilling along the line connecting the known ore deposits, or into the both wings of the line, will prove effective.

2. *Bailadores Mines*

a. Enforcement of surface survey

i) Confirmation of continuity and extension of outcrops.

Extension of outcrops between the Monsilvenia gallery and Calicata No. 6 is 560 m, but in the distance of 320 m between Monsilvenia and Calicata No. 1 continuity of the veins has not been confirmed yet. The veins are expected to extend farther ahead the southwestern drift of the Monsilvenia gallery and ahead the northeastern drift of Calicata No. 6.

Therefore, continuity and extension of the veins should be confirmed first on the outcrops. Then, to know the ore grade and mode of occurrence of veins, trenching must be carried out at intervals of 30 - 50 m.

In the case of outcrops of oxidized and leached ore, as exemplified by Calicata No. 6, it is advisable to drive a 10 - 15 m long level for 3 to 4 trenches each, or to carry out drilling, so as to confirm the mineral composition (ore grade) of unoxidized parts of the ore.

ii) When the topographic map was completed, a detailed geological map at a scale of 1/5,000 to 1/10,000 would be prepared in order to clarify the relation between the occurrence of ore deposit and the geologic structure.

b. Geophysical and chemical prospecting

Along with the surface geological survey, including extensive chemical prospecting (with Cu as the index element) throughout the ore-bearing areas, exploration of parallel veins and branch veins should be made.

Geophysical prospecting would not be effective because of the rugged topography of the neighborhood and the widely distributed graphite schist.

c. Drilling

Drilling is effective for ascertaining downward continuation of veins, and deep drilling to a depth of 500 - 600 m is desirable.

When the exposed part of ore is oxidized and leached as mentioned above, drilling to a depth of 100 - 200 m would suffice to confirm the mineral composition of the lower part.

It is considered that the dip of veins is fairly steep in part. Accordingly, in carrying out drilling it would be better to bore inclined holes at an angle of 50° - 60° to the hanging wall, so that the ore is encountered at an angle of more than 40°, as has been actually done in bore holes No. 1 and No. 2.

As the country rock is markedly schistose, it must be kept in mind that bore holes are apt to curve in the direction perpendicular to the rock's schistosity. Therefore, the curvature of bore holes must be measured constantly.

d. Gallery prospecting

i) Reopening of an old gallery near Calicata No. 1 is in progress. This is highly effective to confirm the continuity and the mode of occurrence of veins between Calicata No. 1 and the Monsilvenia gallery. After the old gallery was reopened, it would be necessary to drive a drift toward the Monsilvenia gallery.

ii) Referring to the continuity of the vein on the ground surface and to the result of reopening of the old gallery, a new crosscut (350 m long) should be opened at a lower slope (2,340 m above sea level) to reach the vein, and then a drift must be driven along the extension of the vein.

iii) When the vein is confirmed to continue northeastward from Calicata No. 6, a drift for prospecting should be driven from this gallery as far as the vein extends in that direction.

3. Carúpano Mines

As to the Canchunchu and Gran Pobre deposits, the outline of their scope has been already revealed by the gallery prospecting and reopening of old galleries. To put the Carúpano mine on the industrial basis, it depends either on the development of the El Encanto deposit or on the finding of new deposits. Accordingly, prospecting of ore by the following methods is recommended.

a. Chemical prospecting, which is now in progress, will be continued along with a detailed geological survey. In the areas of ore indication thus revealed, drilling for prospecting will be carried out.

b. As to the El Encanto deposit, the structure of limestone and the distribution of mineralization must be studied well. Then, based on the obtained result, prospecting by drilling should be actively enforced to find the location of contact deposits.

In case these prospectings failed to bring about any noticeable results, development of the mine must be relinquished.

V. Summary and Conclusion

V. Summary and Conclusion

Non-ferrous metal deposits of Venezuela are widely distributed in the region of the Andes, which occupies the northern and southwestern parts of the country, and in the region of Guayana shield broadly stretching south of the Orinoco River.

Six members of the Survey Team travelled through the Andes region and surveyed six mine areas where copper, lead and zinc deposits are located.

Each of these areas has been described in the foregoing chapters. A summary of the surveyed mines will be given here as a conclusion of this report.

The mining industry of Venezuela has hitherto been dependent on the petroleum from the Tertiary system distributed in the Maracaibo Lake area in the northwestern part of the country and in the area north of the Orinoco River, and also on the iron ore deposite from the pre-Paleozoic system of the Guayana shield, with subordinate production of placer gold and placer diamond along the tributaries of the Orinoco.

However, despite the fact that the geology of Venezuela suggests existence of rich mineral resources as the Andes, which is the supplier of useful minerals in other South American countries, runs through this country for a distance as great as 1,200 km, the mining business in the Andes region has been entirely slack since 1936 when the operation of the Aroa mine was suspended.

From the results of our latest survey in the Andes region, we have come to the following conclusions:

1. The Andes of Venezuela is composed of pre-Paleozoic to Mesozoic metamorphic rocks. It is presumed that, because of the nature of these rocks, the formation of fracture zone was difficult even in the orogenic movement or in the process of faulting.

2. Acidic igneous activity was weak in the Tertiary period succeeding the Cretaceous period.

3. The northern coastal Andes is composed chiefly of Cretaceous metamorphic rocks, and discovery of bedded cupriferous pyrite deposits is possible in the area between Aroa and Caracas. Under the existing circumstances, however, none of the known deposits can become the object of mining business.

4. The prospecting in the Bailadores mine and Carúpano mine, being presently enforced by the Ministry of Mines and Hydrocarbons, is worthy of attention. If the result of the prospecting turned out promising, these mines could become the object of mining business. Especially about the prospecting of the Bailadores mine, we would like to keep in touch with the Ministry of Mines and Hydrocarbons and collect information, taking the grade of ore into consideration.

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VI. References

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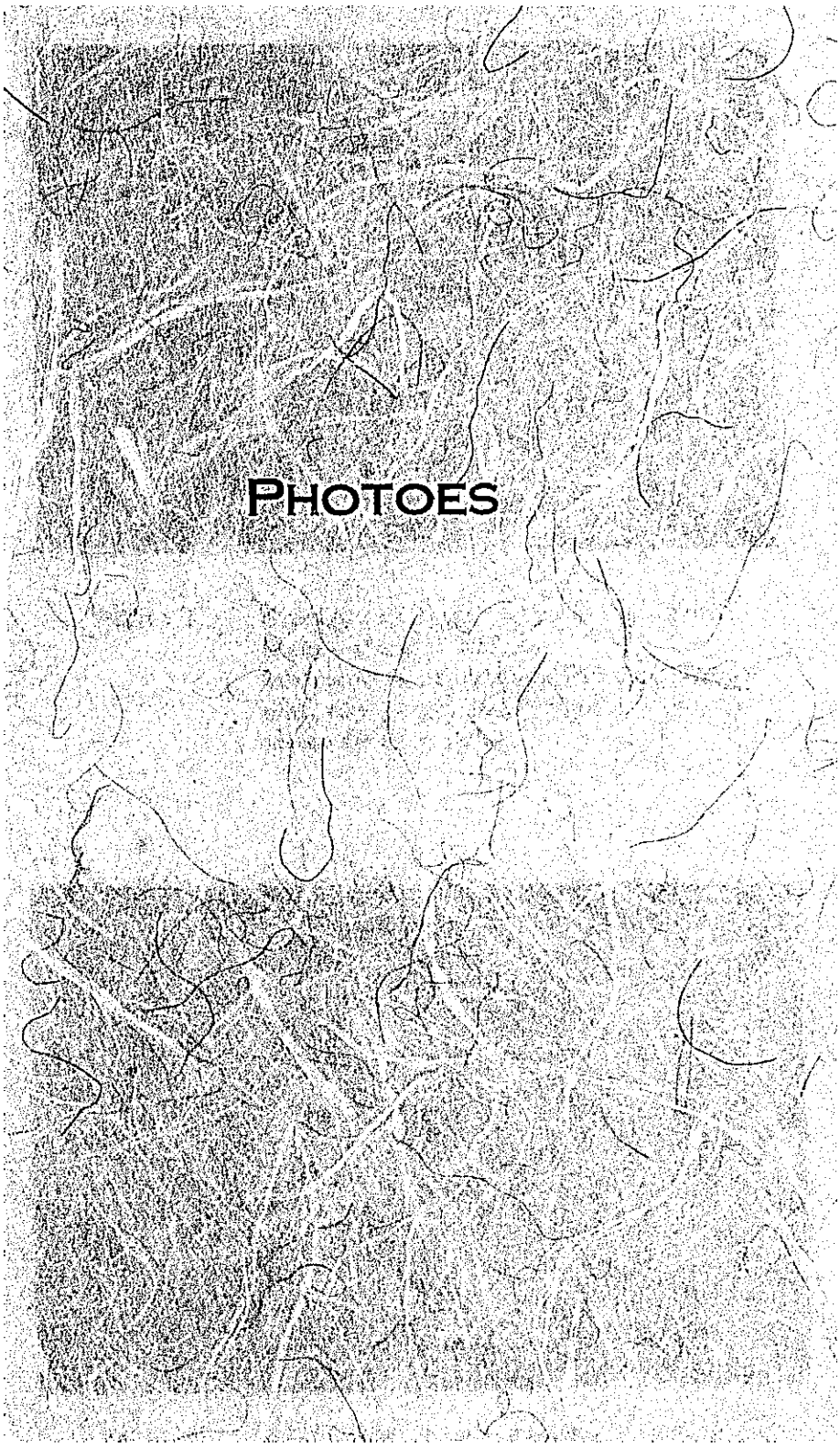

PHOTOES

Explanation of photographs

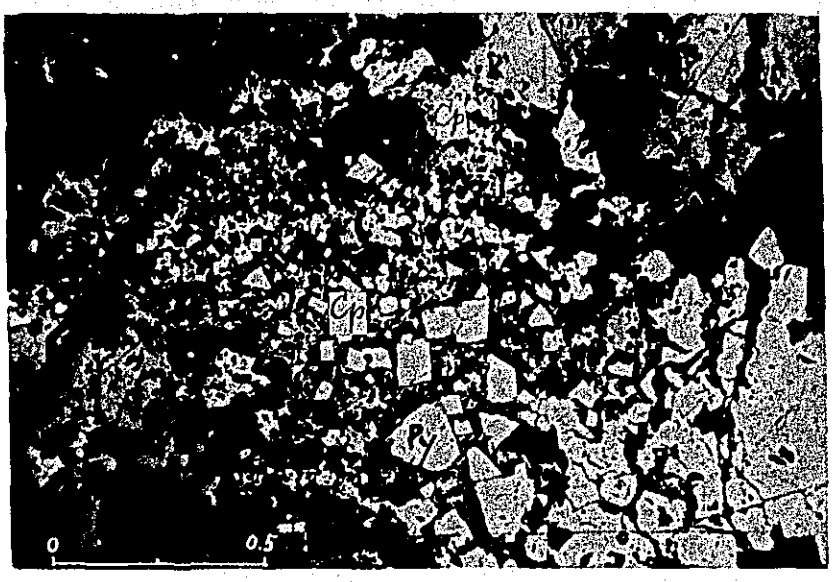


Photo 1. Kieslager type deposit of Santa Isabel mine. 7x6.
Interstices of pyrite (Py) are filled with chalcopyrite (Cp); pyrite abounds in cracks.

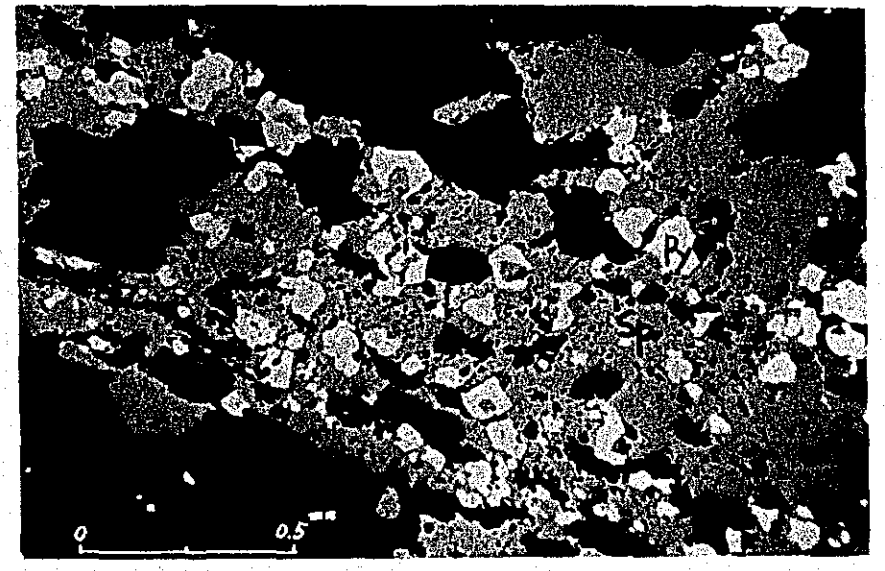


Photo 2. Kieslager type deposit of Santa Isabel mine. 7x6.
Idiomorphic to hypidiomorphic pyrite (Py) occurs as inclusions in sphalerite (Sp), or corroded and captured by the latter.

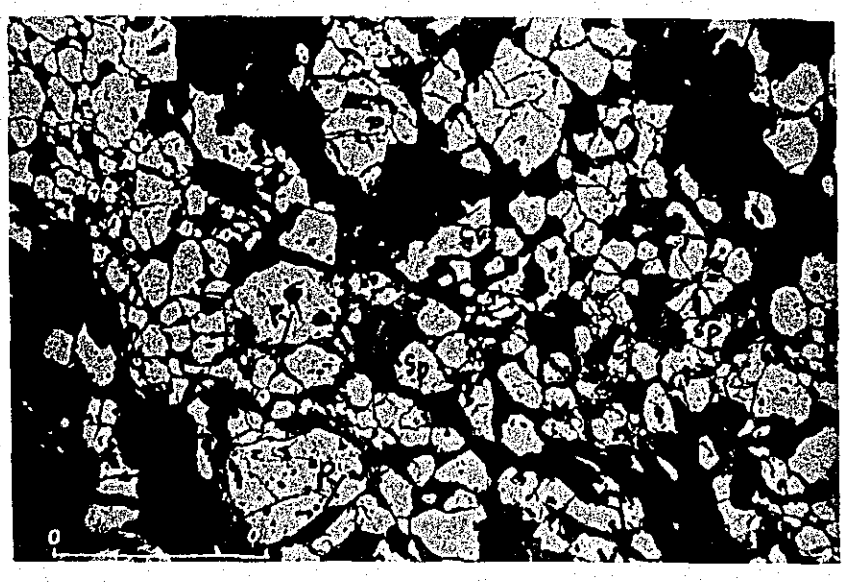


Photo 3. Kieslager type deposit of Aroa mine. 7x6.
Interstices of much-cracked pyrite (Py) are partially filled with sphalerite (Sp), chalcopyrite (Cp) and azurite (Cr).

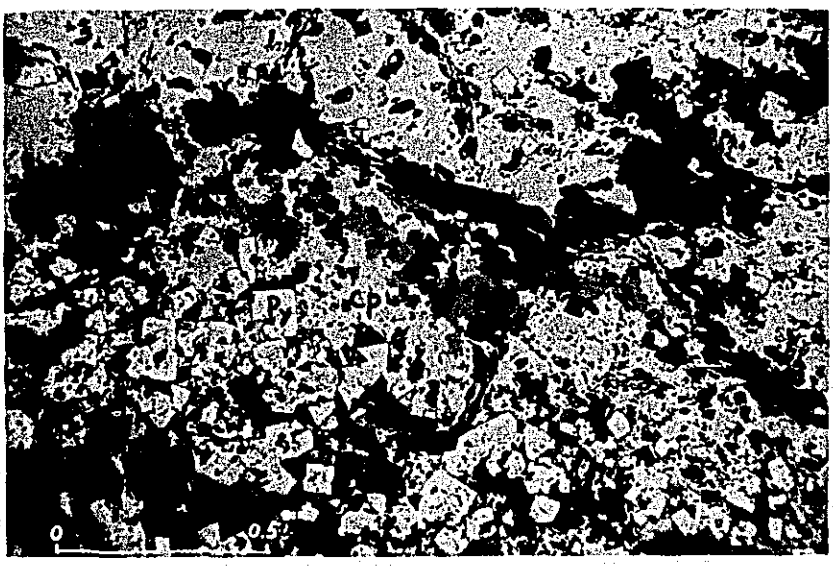


Photo 4. Kieslager type deposit of Aroa mine. 7x6.
Syngenetic chalcopyrite (Cp) and sphalerite (Sp) are seen to enclose hypidiomorphic to allotriomorphic pyrite (Py).

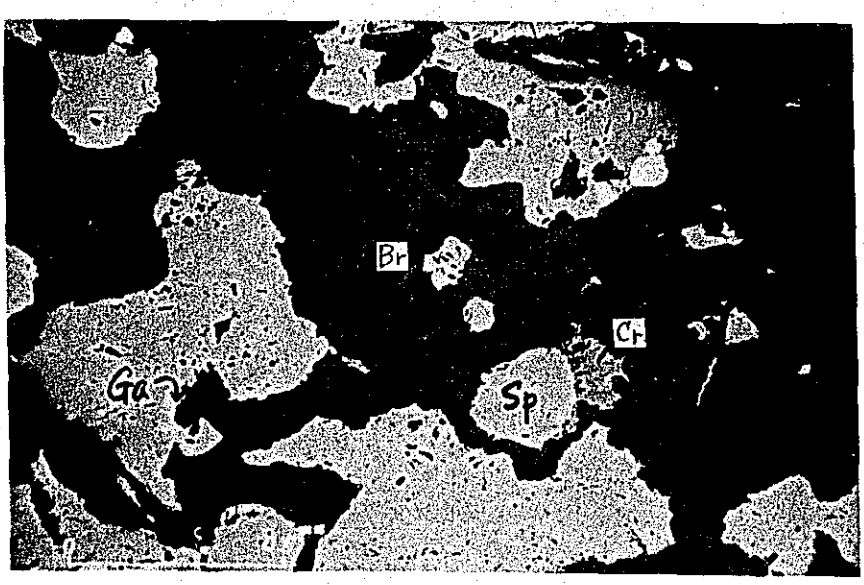


Photo 5. Kieslager type deposit of Aroa mine. 7x6.
Filling the interstices of pyrite (Py), abundant sphalerite (Sp) occurs with very little galena (Ga); bornite (Br) and azurite (Cr) are also noticed.

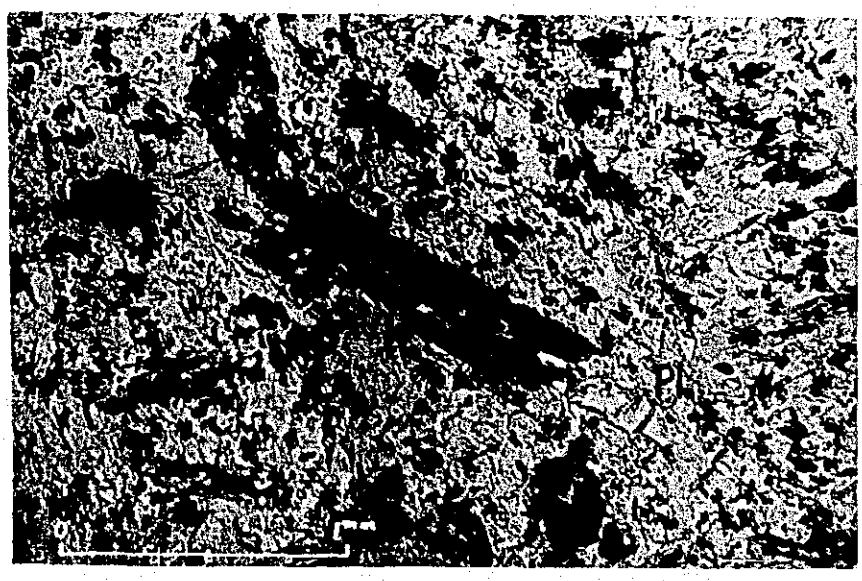


Photo 6. Hornblende porphyrite from Baila-dores mine. 7x4, + nicol.
It shows intergranular texture, with lath-shaped plagioclase (Pl); hornblende (H) is altered and closer to uralite in character. The rock is gabbroic.

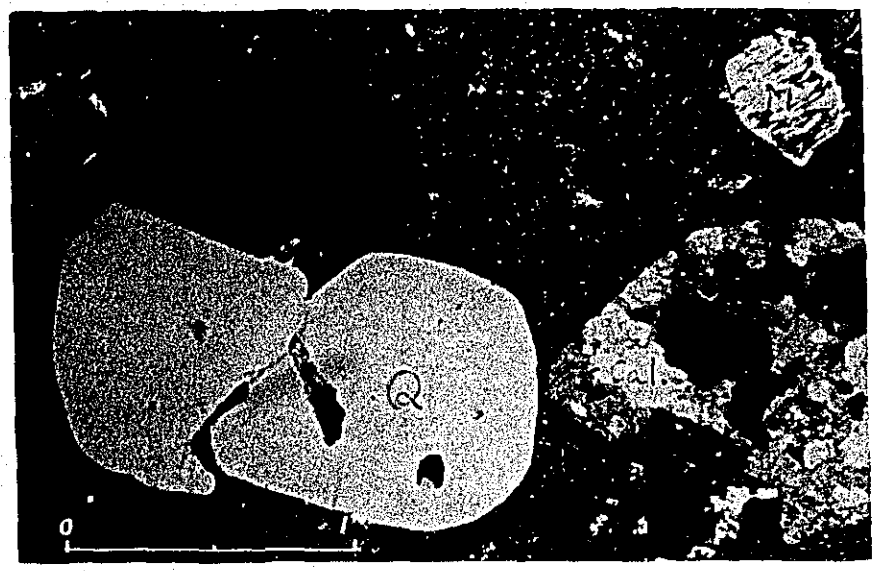
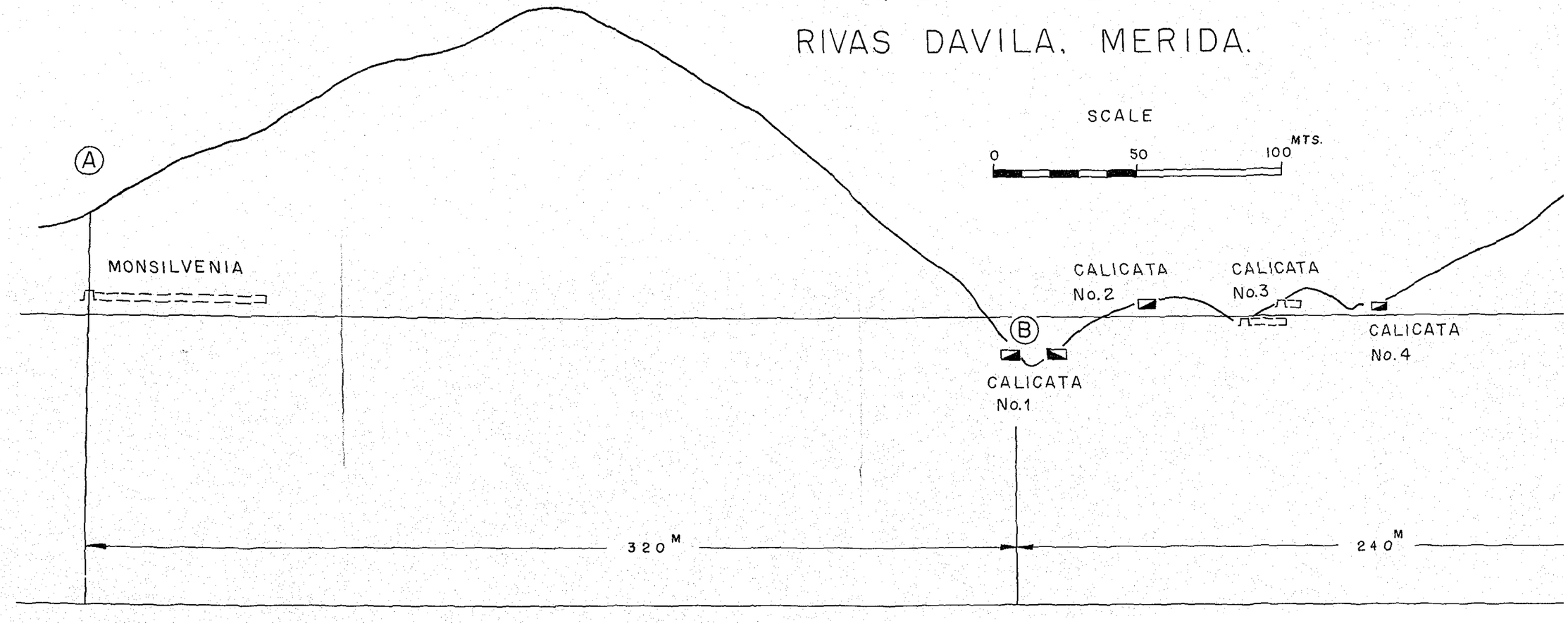


Photo 7. Dacite from Carúpano mine. 7x4, + nicol.
Cryptocrystalline, porphyritic texture, with phenocryst of corroded quartz (Q), carbonatized phenocryst (Cal) and altered mica (M); groundmass is vitreous.

Fig.11

LONGITUDINAL SECTION Ⓐ~Ⓑ~Ⓒ
OF
TAPIAS NO. 2. BAILADORES.
RIVAS DAVILA. MERIDA.



LONGITUDINAL SECTION Ⓐ~Ⓑ~Ⓒ
OF
TAPIAS NO. 2, BAILADORES.
RIVAS DAVILA, MERIDA.

SCALE
0 50 100 MTS.

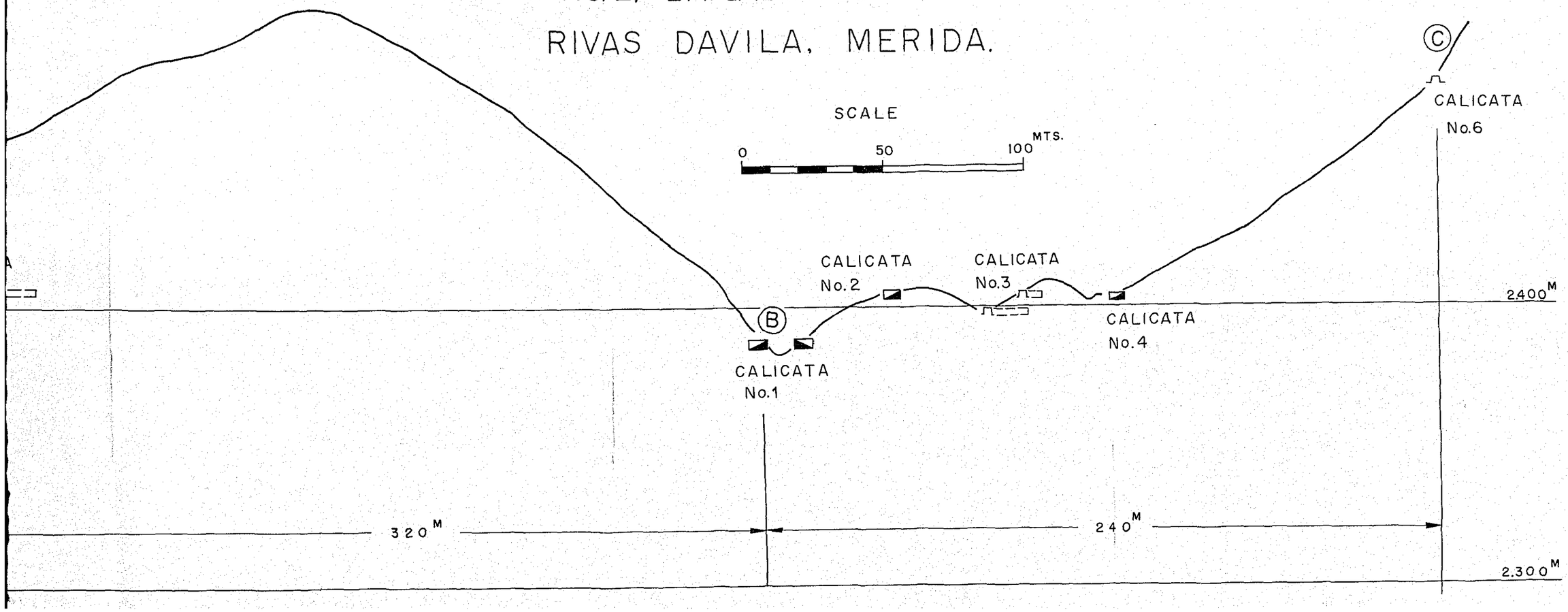
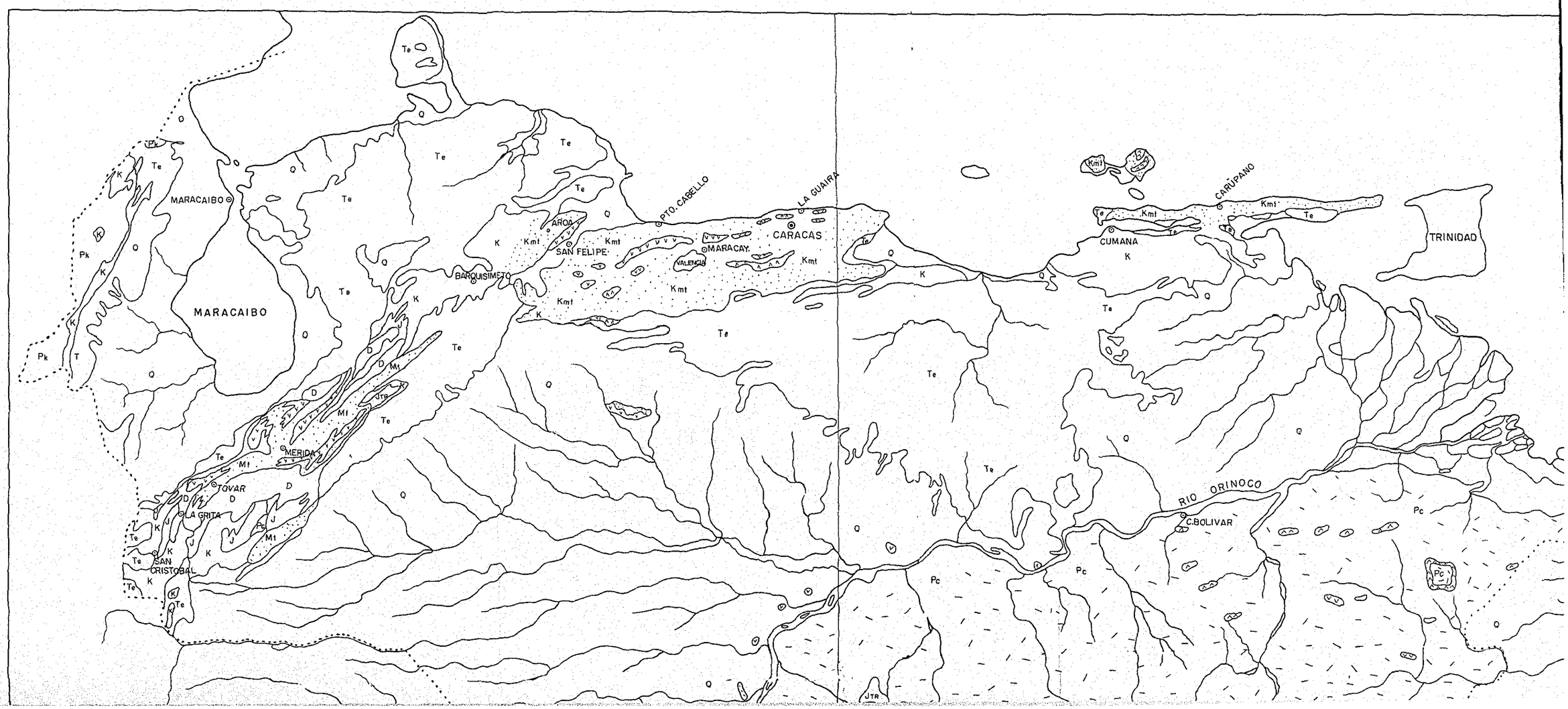
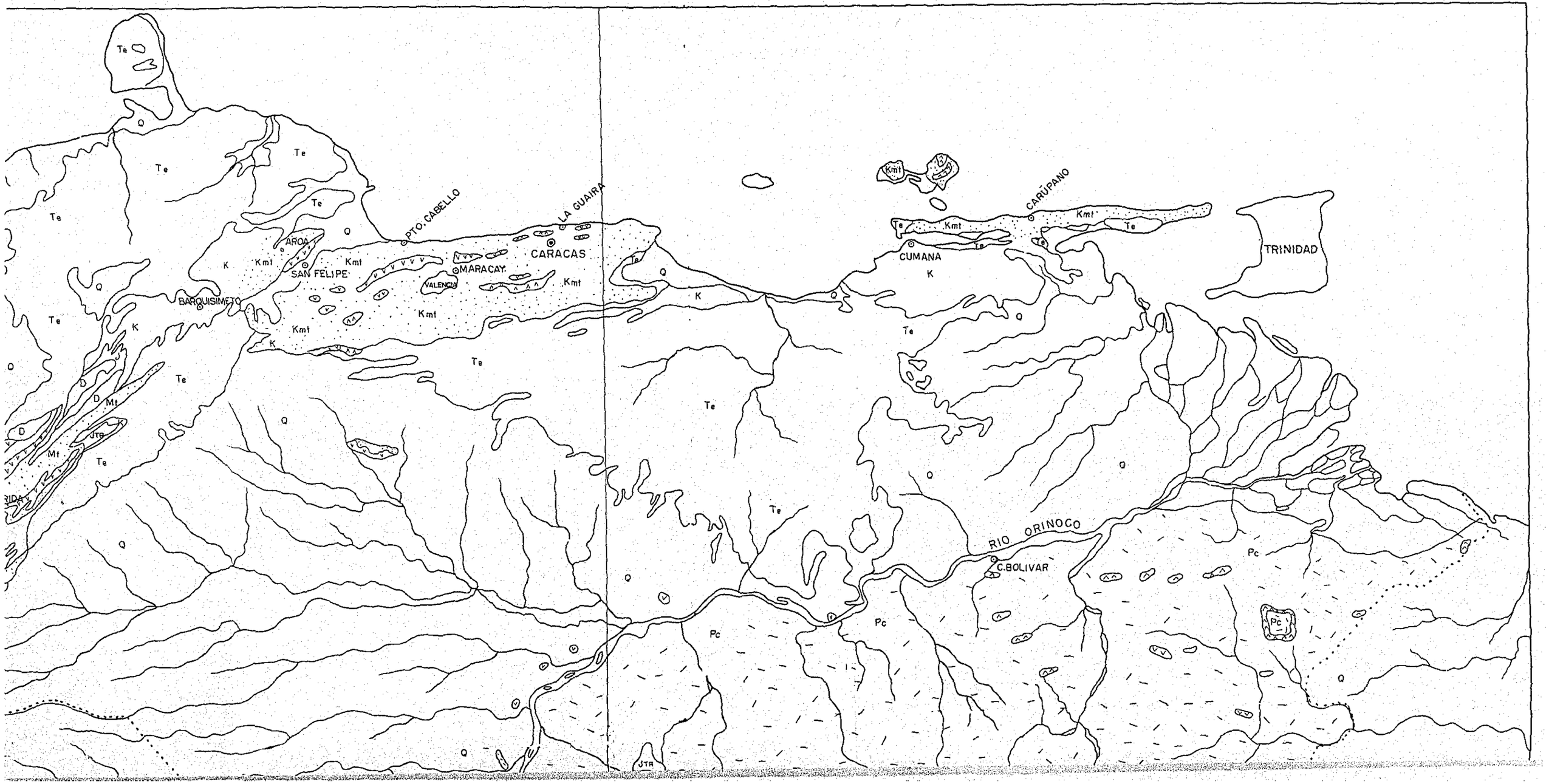


Fig.2


MARACAIBO
MARACAIBO
MERIDA
TOVAR
LA GRITA
SAN CRISTOBAL
BARQUISIMETO
AÑOA
SAN FELIPE
PTO. CABELLO
VALENCIA
MARACAY
CARACAS
LA GUAIRA
CUMANA
CARUPANO
TRINIDAD
C.BOLIVAR
RIO ORINOCO
Te
Pk
K
Kmt
Mt
D
J
Pc
Q
JTR


Te
Q
K
Kmt
Mt
D
Jtr
Pc
PTO. CABELLO
LA GUAIRA
CARACAS
MARACAY
VALENCIA
AROA
SAN FELIPE
BARQUISIMETO
CUMANA
CARÚPANO
TRINIDAD
RIO ORINOCO
C.BOLIVAR

LEYENDA

- Q — CUATERNARIO
- Te — TERCIARIO
- K — CRETACICO
- Km1 — CRET. METAMORFICO
- Pk — PRE CRETACICO
- JTR — JURACICO~TRIASICO
- J — JURACICO
- D — DEVONICO
- Pc — PRE CAMBRICO

EDAD SIN DIFERENCIAR

- M1 — METAMORFICAS
- V V V — IGNEAS ACIDAS
- ^ ^ ^ — IGNEAS BACICAS

TOVAR
LA GRITA
SAN CRISTOBAL
RIO ORINOCO
C.BOLIVAR

COLOMBIA

BARINAS

APURE

MAPA GEOLOGIC

DE LA REPUBLICA D

VENEZUELA

1955

ESCALA 1:2.000.000

0 50 100 KM

REPUBLICA DE VENEZUELA
MINISTERIO DE MINA E HIDROCA
DIRECCION DE GEOLOGIA

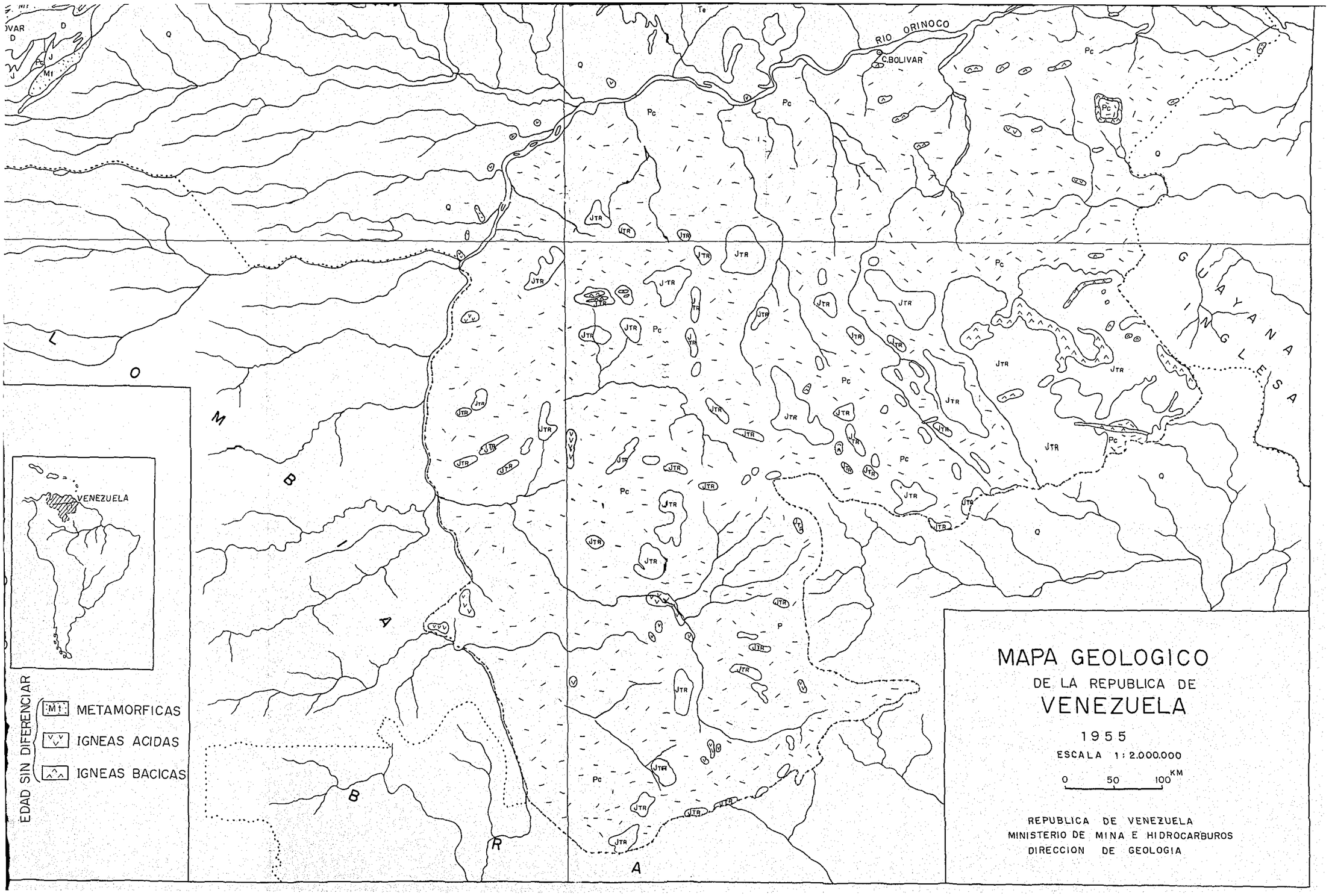
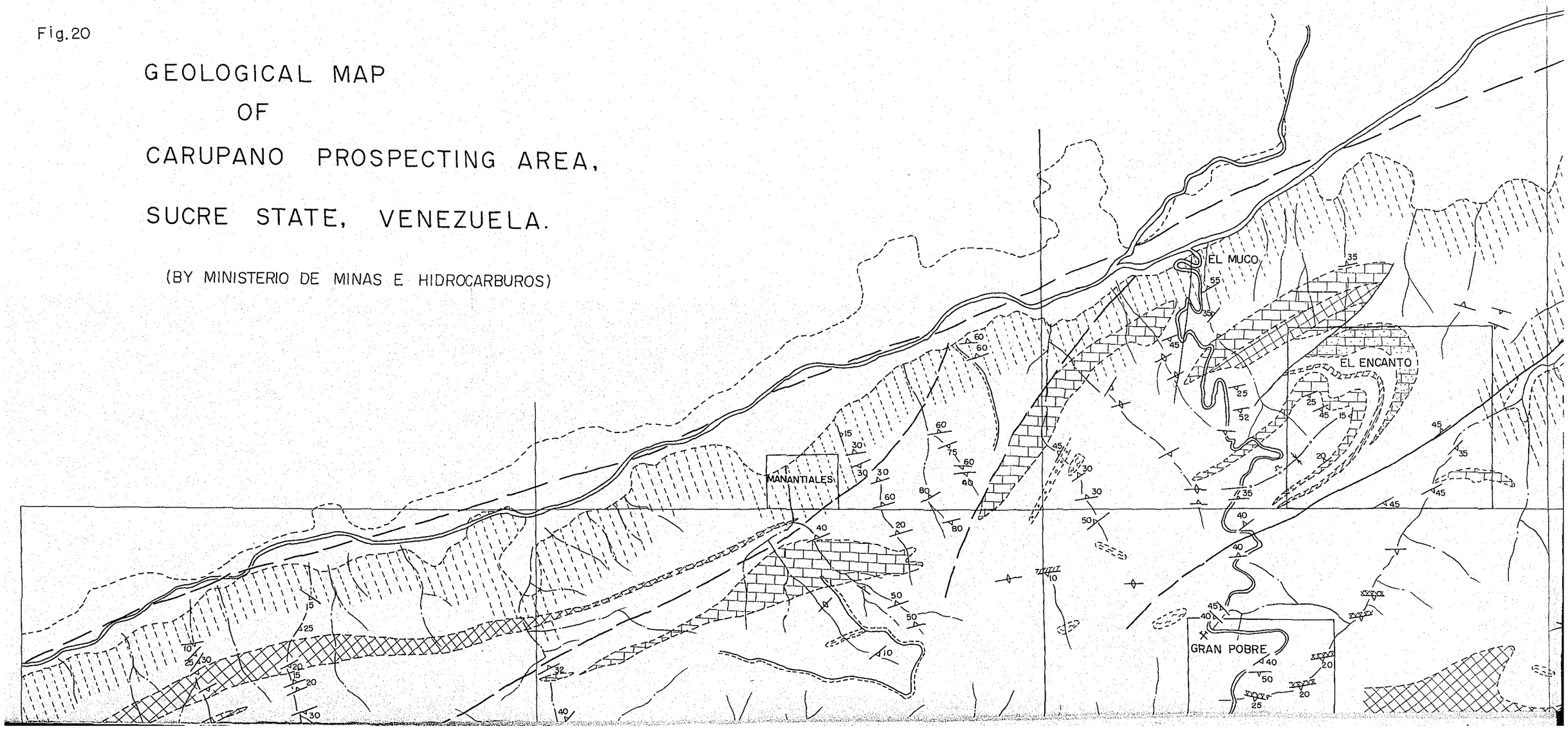

RIO ORINOCO
C.BOLIVAR
GUAYANA INGLESA
Q
Te
Pc
JTR
M
V
P
EDAD SIN DIFERENCIAR
METAMORFICAS
IGNEAS ACIDAS
IGNEAS BACICAS
VENEZUELA
MAPA GEOLOGICO
DE LA REPUBLICA DE
VENEZUELA
1955
ESCALA 1: 2.000.000
0 50 100 KM
REPUBLICA DE VENEZUELA
MINISTERIO DE MINA E HIDROCARBUROS
DIRECCION DE GEOLOGIA

Fig.20

GEOLOGICAL MAP
OF
CARUPANO PROSPECTING AREA,
SUCRE STATE, VENEZUELA.

(BY MINISTERIO DE MINAS E HIDROCARBUROS)



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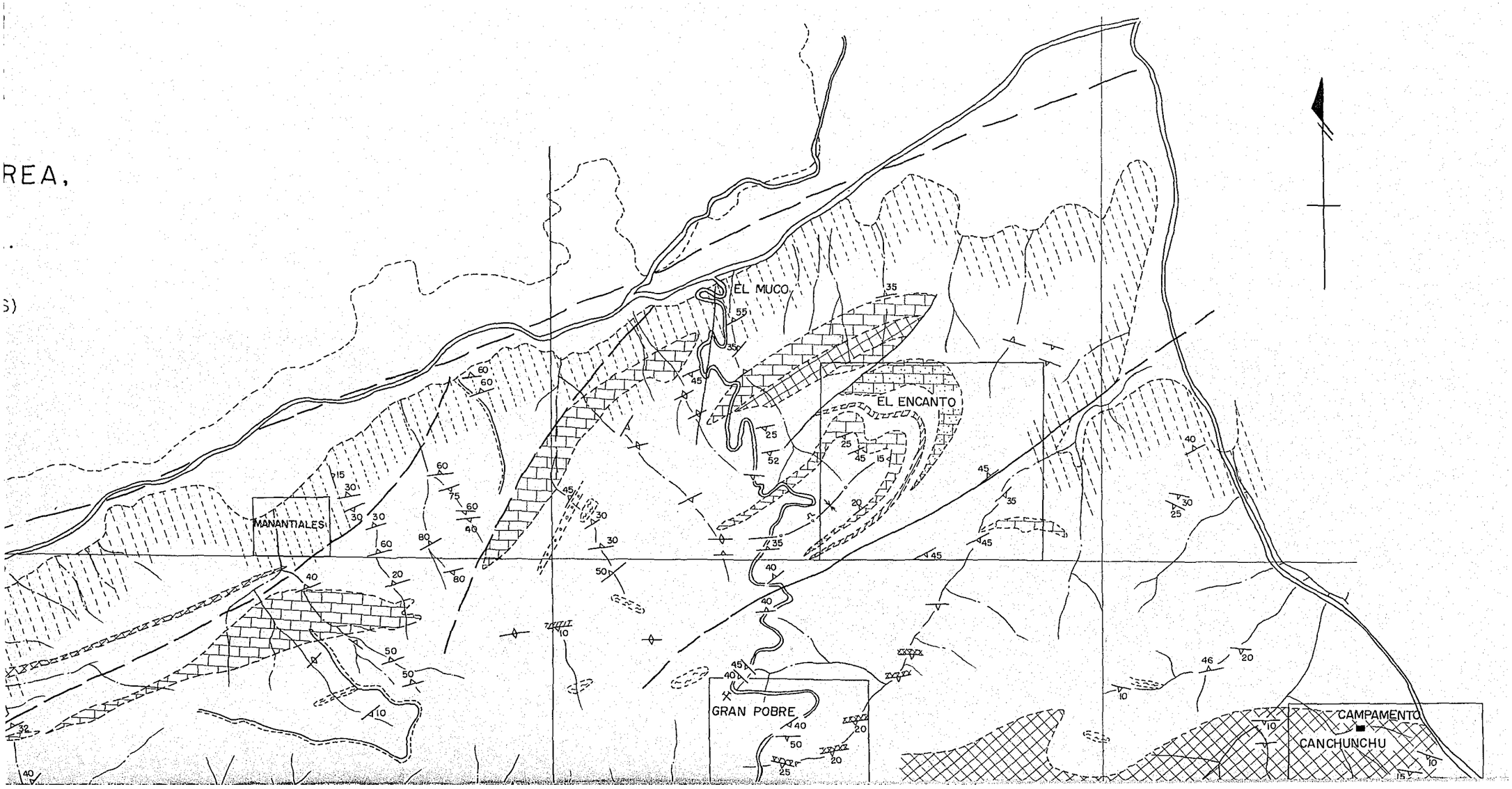
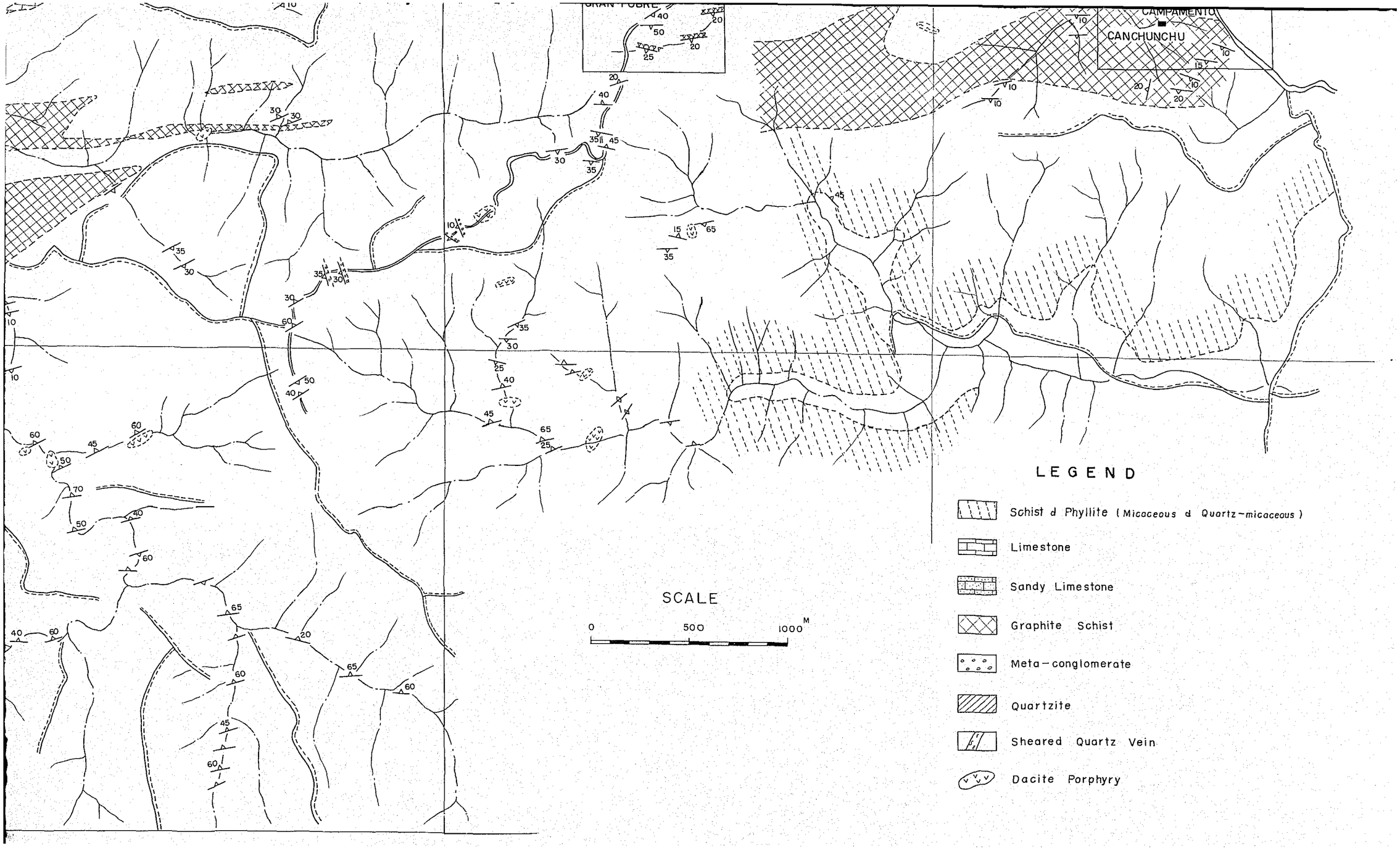

EL MUCO
EL ENCANTO
MANANTIALES
GRAN POBRE
CAMPAMENTO
CANCHUNCHU

GRAN POBRE

SCALE

0 500 1000 M


CAMPAMENTO
CANCHUNCHU
SCALE
0
500
1000 M
LEGEND
Schist & Phyllite (Micaceous & Quartz-micaceous)
Limestone
Sandy Limestone
Graphite Schist
Meta-conglomerate
Quartzite
Sheared Quartz Vein
Dacite Porphyry

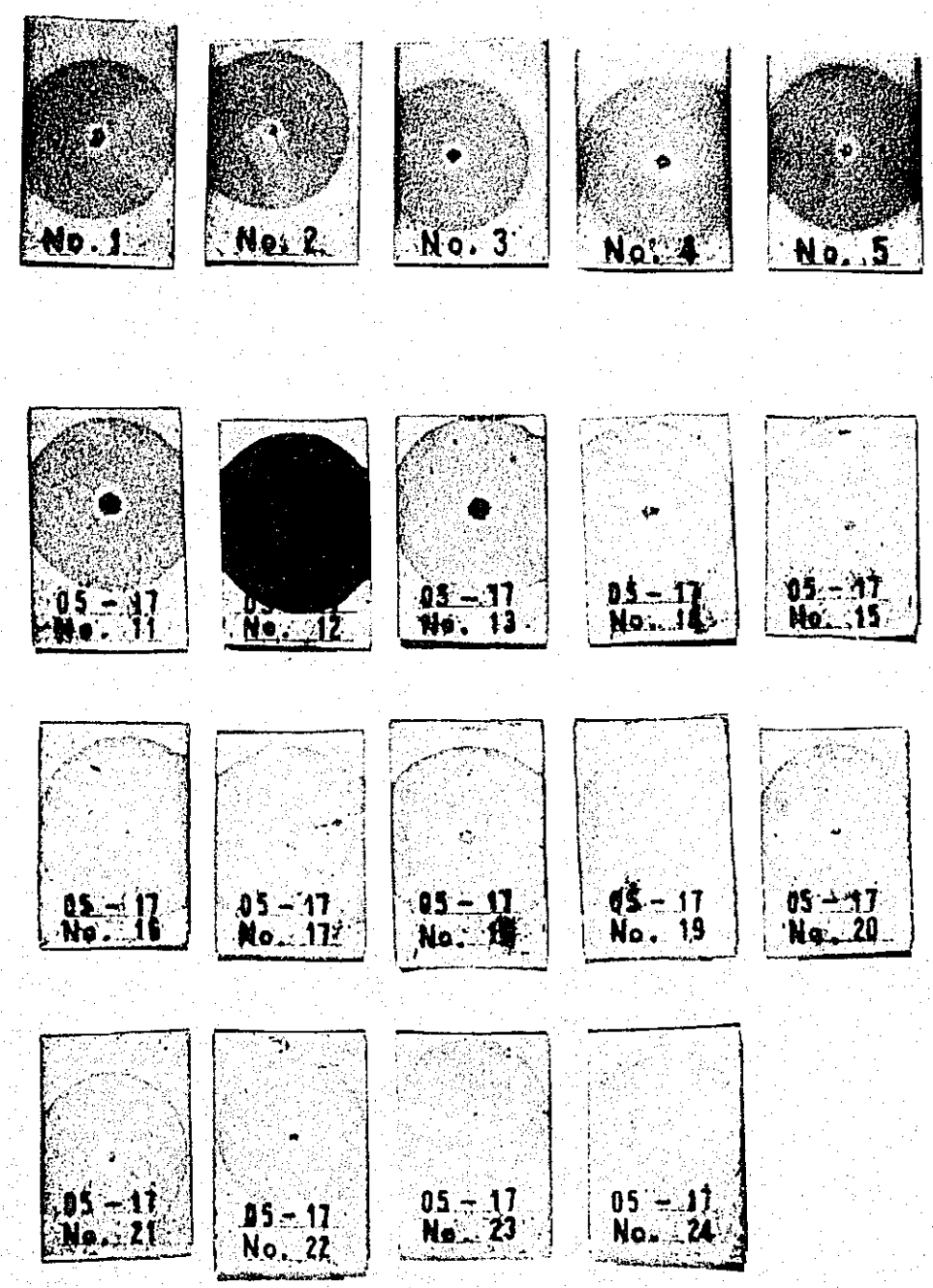
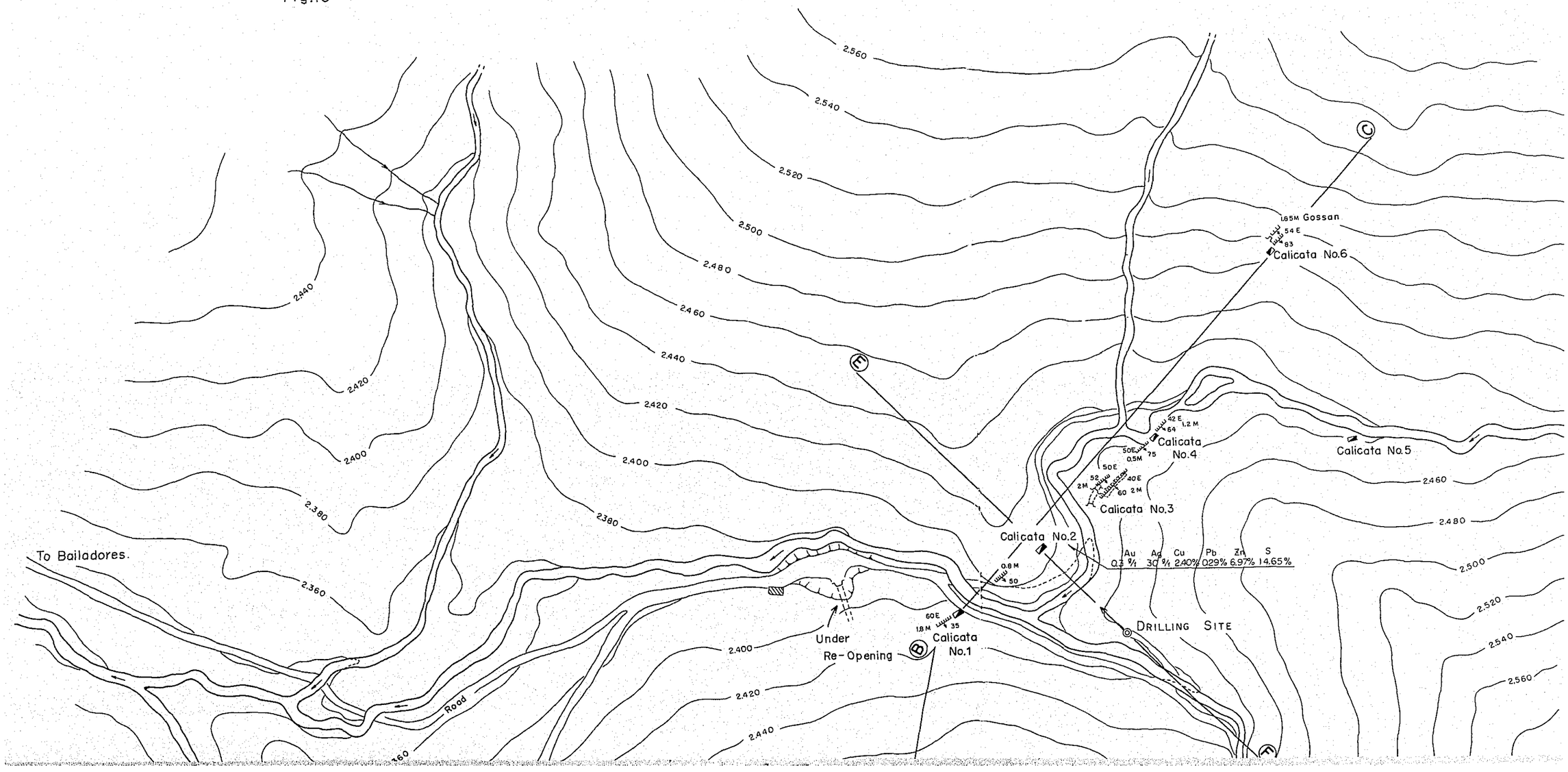
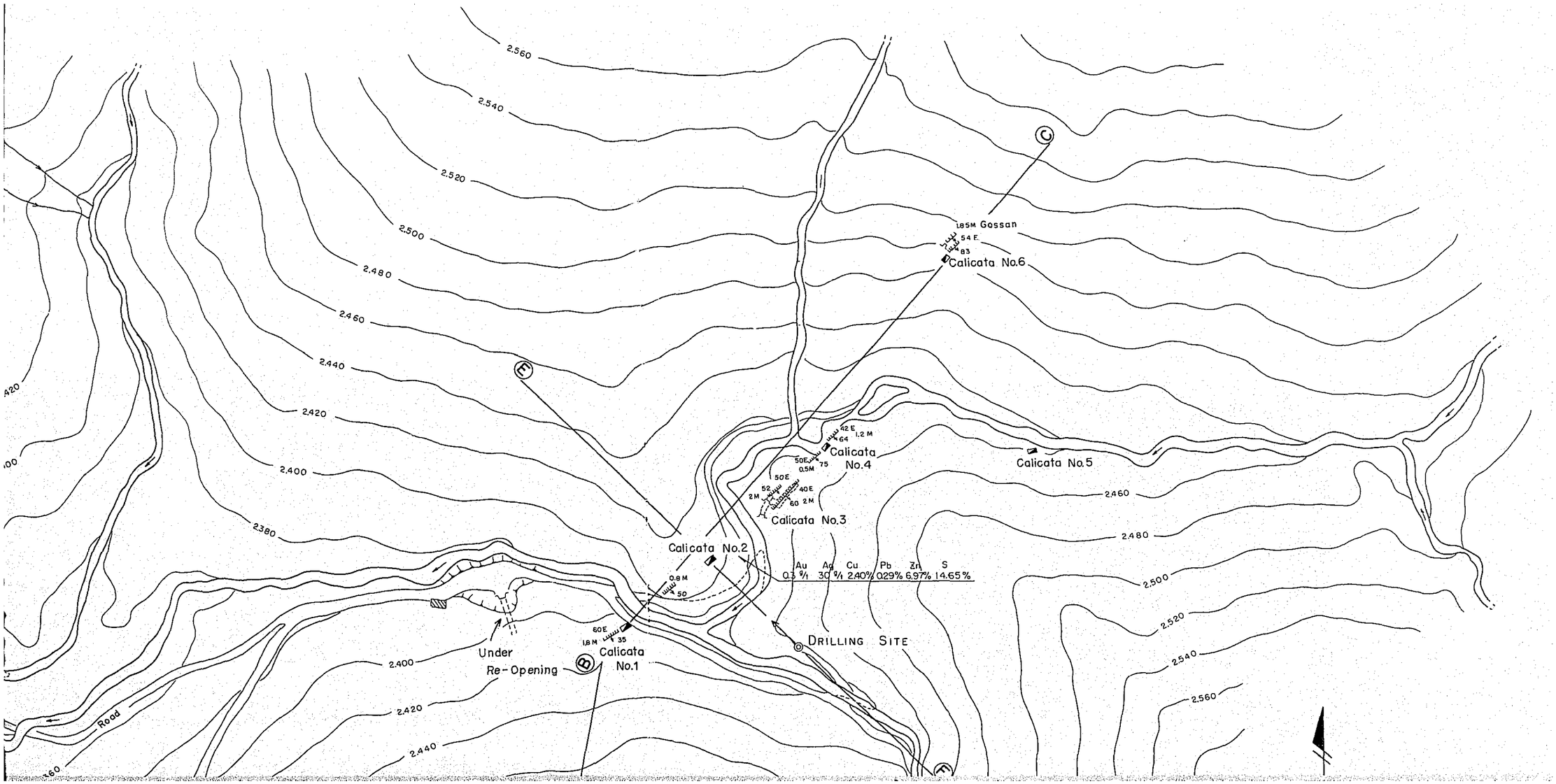
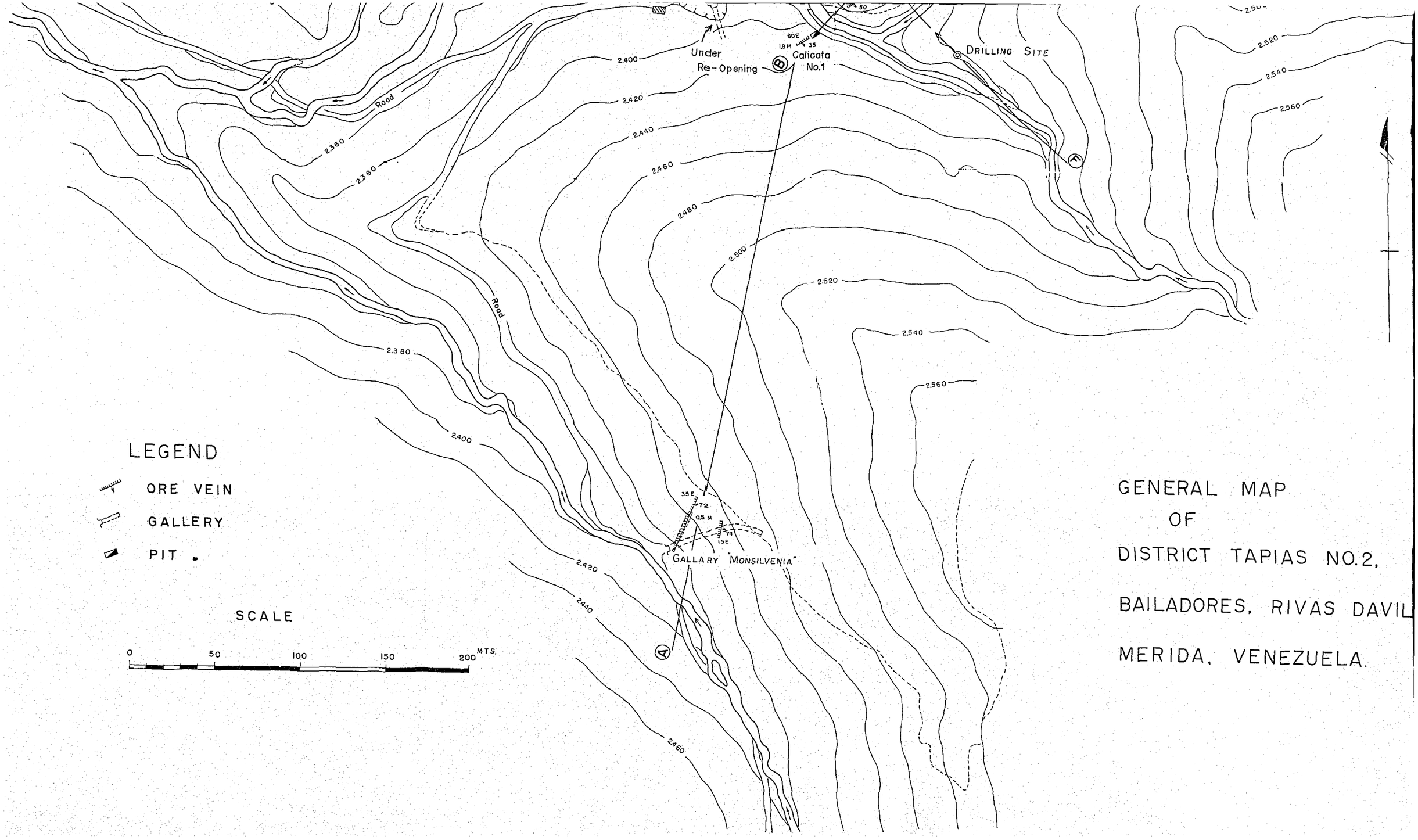


Photo 8. Rubeanic Acid Test at Bailadores Project

Fig.10


2.560
2.540
2.520
2.500
2.480
2.460
2.440
2.420
2.400
2.380
2.360
2.440
2.420
2.400
2.380
2.360
2.400
2.420
2.440
2.460
2.480
2.500
2.520
2.540
2.560
To Bailadores.
Road
Under Re-Opening
Calicata No.1
Calicata No.2
Calicata No.3
Calicata No.4
Calicata No.5
Calicata No.6
165M Gossan
DRILLING SITE
Au Ag Cu Pb Zn S
0.3 % 30 % 2.40% 0.29% 6.97% 14.65%

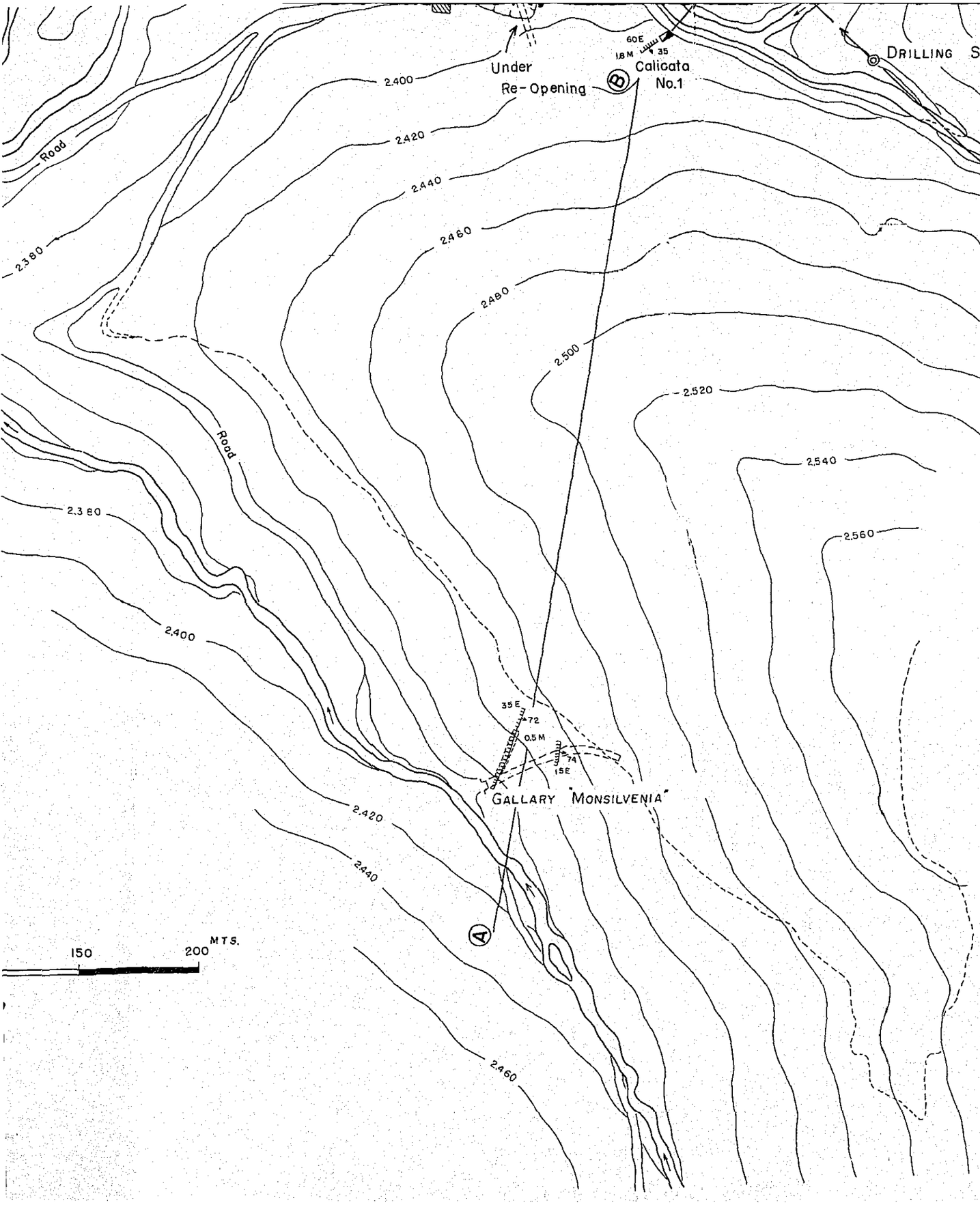

2.560
2.540
2.520
2.500
2.480
2.460
2.440
2.420
2.400
2.380
185M Gossan
54 E
83
Calicata No.6
Calicata No.5
42 E
64
1.2 M
Calicata
No.4
50E
0.5M
75
50E
52
2M
40E
60
2M
Calicata No.3
Calicata No.2
Au Ag Cu Pb Zn S
0.3 % 30 % 2.40% 0.29% 6.97% 14.65%
0.8 M
50
60E
1.8 M
35
Under
Re-Opening
Calicata
No.1
DRILLING SITE
Road



GENERAL MAP OF DISTRICT TAPIAS NO.2.

BAILADORES. RIVAS DAVIL

MERIDA. VENEZUELA.



GENERAL MAP OF DISTRICT TAPIAS NO.2, BAILADORES, RIVAS DAVILA, MERIDA, VENEZUELA.