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DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY.

GEOLOGICAL RECONNAISSANCE OF SOME URUGUAYAN IRON AND MANGANESE DEPOSITS IN 1962

By
Roberts M. Wallace, 1915-

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CONTENTS

LIST OF ILLUSTRATIONS

List of Illustrations (Continued) Page

THE VALENTINES IRON DEPOSIT, FLORIDA, URUGUAY

by

Roberts M. Wallace

ABSTRACT

This report is the result of a request by the Uruguayan Government for technical assistance in the field of geology by the U. S. Geological Survey under the auspices of the U. S. Agency for International Development and the Corps of Engineers, United States Army. Geological reconnaissance was made in the Departamentos (counties) of Florida, Tacuarembo, Rivera, and Cerro Largo from January 5-15, 1962.

The Valentines iron deposit is located about 261 km north of Montevideo, Uruguay. Exploration of the deposit was started about three years ago by Ingeniero Juan H. Caorsi and Q.I. Don Juan C. Goni of the Instituto Geologico del Uruguay. The deposit contains an estimated 23,500,000 tons of hematite-martite-magnetite iron ore that averages about 40 percent Fe. The ore occurs in highly metamorphosed itabirite of Precambrian age that is surrounded by coarse-grained metasomatized granite. The itabirite formation is about 50 meters thick and has been encountered down dip at a depth of 240 meters below its surface exposure. A few granite and amphibolite sills, commonly less than 1 m wide, lie within the itabirite. The deposit has been separated into three distinct parts along strike by small right-lateral slip faults or normal faults; the northern Apretado body, the central Aurora body, and the southern Esabella body. The orebody lies on the western flank of a gently plunging NNW-trending anticline. Mining of the ore and its transportation by railroad to Montevideo would present no special difficulties, but shipping by small barges should be investigated.

Location

The Valentines ore deposit is located about 6 km west of the small village of Valentine (pop. 250) in the extreme northeastern part of the Departamento (county) de Florida. The deposits are about 261 km north by rail from Montevideo. The Arroyo Valentines, a tributary of the Rio Yi, cuts through the center of the deposit.

History of the Valentine deposit

The deposits were first explored by Ingeniero Juan H. Caorsi and Q.I. Don Juan C. Goni of the Instituto Geologico del Uruguay. A nearby outcrop of hematite (Cerro Muliero) was mentioned by these authors (1958, p. 14). There is no available literature on the Valentine iron deposit (1962).

Description of the deposit

The Valentine itabirite iron deposit is separated into three ore bodies: the northern Apretado ore body, the central Aurora ore body and the southern Esabella (Fig. 1). The Apretado ore body crops out for about 1 km on top of a ridge (Figs. 2 and 3). The Aurora and Esabella deposits (Figs. 4 and 5) lie on the off-set southern extension of the Apretado ridge. The Aurora ore body crops out for about 300 meters in length and the Esabella ore body for about 500 meters. Itabirite crops out for another kilometer or more south of the known Esabella ore body (Fig. 5), but has not been systematically explored to date. The Arroyo Valentines passes between the Apretado and Aurora ore bodies (Fig. 6) and in some places has cut a canyon 12 to 15 meters deep through hard itabirite (Fig. 7).

Character of the rock:- The iron occurs in a hard, highly metamorphosed silica-rich Precambrian rock of sedimentary origin that is known in Brazil and elsewhere as itabirite. The rock has a banded appearance owing to the presence of alternating silica-rich and iron-rich layers (Fig. 8). In the Valentines deposits the itabirite is light brown to brownish gray in the quartz-rich layers, and medium gray to black in the iron-rich layers in the weathered surface rock. The layers average about 4 cm in thickness, but may range from less than 1 cm to more than 15 cm in thickness in some places. The rock weathers slowly in this temperate zone and breaks down to cobble and boulder sizes. No canga or "iron pan" is formed by weathering.

The weathering of the iron formation results in a distinctive topographic expression. It forms ridges that have a gentle slope on one side and a steep slope on the other (Figs. 3 and 4 above and Fig. 23). Granitic rocks that enclose all known deposits of itabirite throughout Uruguay, weather to ridges with gentle slopes on both sides. Also the steep slopes of the ridges containing iron formation commonly have a dark brown coloration, whereas the weathered granite is commonly buff colored or very light gray.

Character of the ore:- The ore occurs as coarse-grained hematite, martite, or magnetite interspersed with coarse-grained quartz. The average tenor of the ore is about 40-45 percent Fe. Dr. Caorsi has collected more than 2,000 specimens of the itabirite, chemical analyses of which range from 35 to 49 percent Fe. The rock weighs about 3.5 metric tons per cubic meter. There is only a slight variation of the itabirite in its iron content from place to place on the surface, and from the surface to the deepest penetration of the exploratory drilling (Max. 240 m).

There is a vertical zoning of the iron ore. Hematite (Fe_2O_3) lies within the top 30 m of the ore body in most places. The lower part of the ore body consists of magnetite (Fe_3O_4). A thin transition zone between the hematite and magnetite ores contain martite (a pseudomorph after magnetite with chemical formula of Fe_2O_3). The contact between the magnetite-rich ores and the hematite-rich ores appears to be very irregular, and pods of magnetite are enclosed in hematite-rich zones in some places. Dr. Caorsi believes the hematite is a weathering product of magnetite.

FIGURE 2. THE NORTHERN END OF THE APRETADO DEPOSIT AS SEEN FROM THE CRESTLINE LOOKING TOWARD THE NORTH.

FIGURE 3. THE SOUTHERN END OF THE APRETADO DEPOSIT IN THE VALENTINES DISTRICT AS SEEN IN A COMPOSITE PHOTOGRAPH LOOKING NORTH FROM THE NORTHERN END OF THE AURORA DEPOSIT. AN EXPLORATION TRENCH APPEARS AS A THIN DARK LINE AT THE TOP OF THE HILL. THE BUILDINGS ON THE LEFT ARE THE TEMPORARY QUARTERS OF THE EXPLORATION CREW.

FIGURE 4. IRON-RICH RUBBLE AND OUTCROPS OF ITABIRITE AS SEEN ON THE NORTHERN END OF THE AURORA DEPOSIT. THE APRETADO DEPOSIT IS IN THE BACKGROUND.

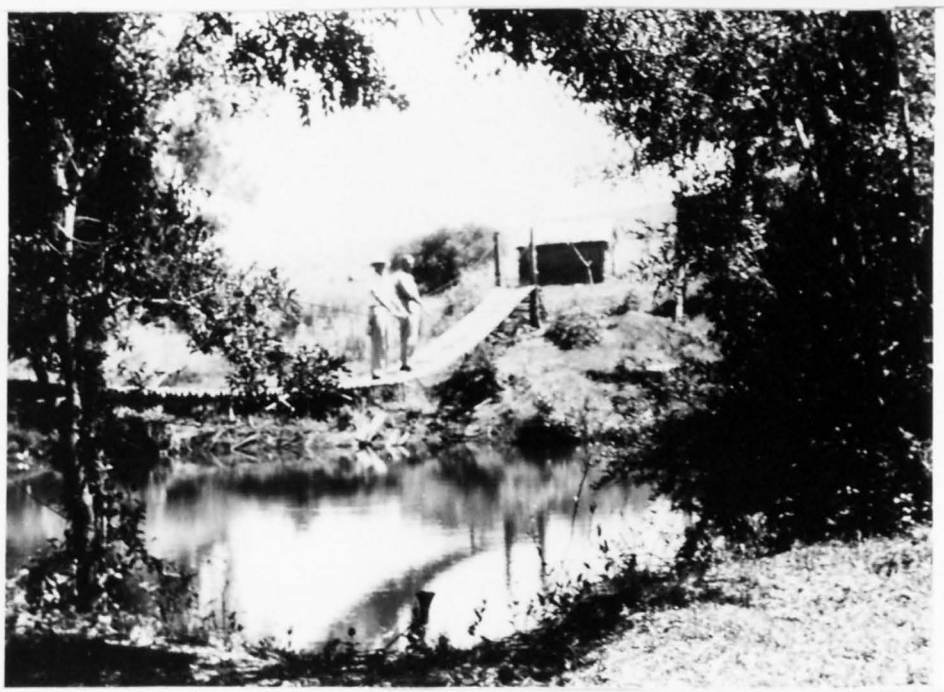


FIGURE 6. A FOOT BRIDGE ACROSS THE ARROYO VALENTINES. THE ARROYO IS MORE THAN TWO METERS DEEP AND 20 METERS WIDE AT THIS PLACE BETWEEN THE APRETADO AND AURORA DEPOSITS.

FIGURE 5. A COMPOSITE PHOTOGRAPH OF THE ESABELLA DEPOSIT AS SEEN FROM THE AURORA DEPOSIT. THE CAMERA FACES FROM WEST TO SOUTHWEST. MOST OF THIS DEPOSIT HAS NOT BEEN THOROUGHLY EXPLORED.

FIGURE 7. AN OUTCROP OF ITABIRITE AS SEEN IN THE BANKS OF THE ARROYO VALENTINES THAT FLOWS BETWEEN THE APRETADO AND AURORA DEPOSITS.

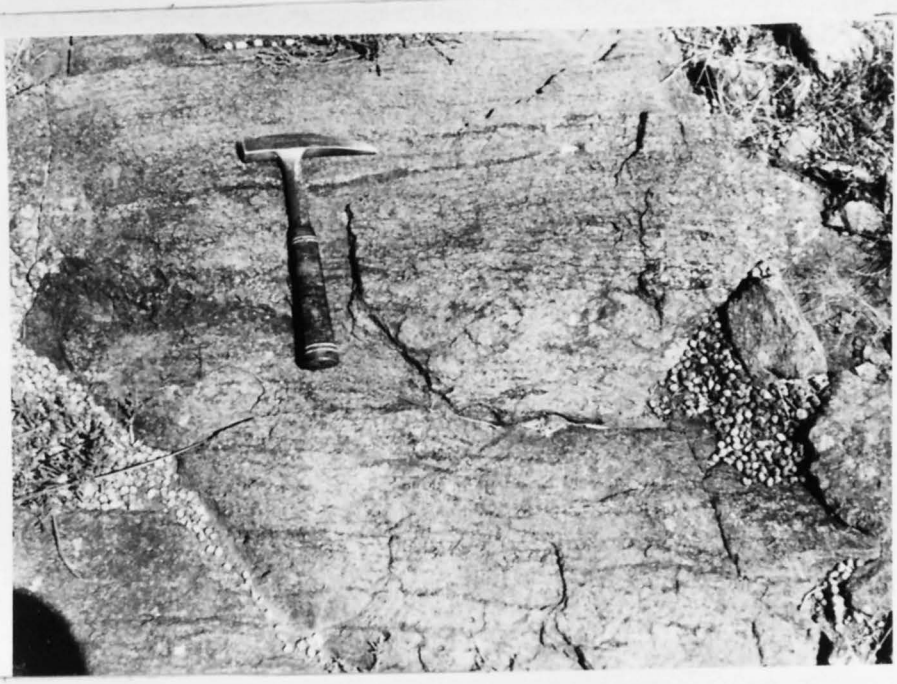


FIGURE 8. AN OUTCROP OF TYPICAL ITABIRITE AT APRETADO. HERE THE ROCK IS COMMONLY WIDELY BANDED, UNCONTORTED, AND IN PLACES CONTAINS IRREGULARLY SHAPED BODIES OF HEMATITE OR MAGNETITE IN THE IRON-RICH BANDS SUCH AS IS SHOWN AS A DARK MASS TO THE LEFT OF THE HAMMER HANDLE. THE IRON-RICH BAND LIES BETWEEN THE WHITE MARKINGS ON THE HAMMER HANDLE IN THIS PHOTOGRAPH. THE AVERAGE GRADE OF THIS ROCK IS 40 PERCENT FE.

Associated rocks:- Sills of granite and amphibolite as thick as 1 m occur in the itabirite in some places and lie above and below this formation. The sills that are included within the iron formation contain a maximum of 10 percent Fe. The contact rocks may contain from 1-5 percent Fe close to the contact, but are essentially barren of iron several meters away from this contact zone. In all places where the iron formation was trenched the contact between the granitic and amphibolitic rocks with the iron formation was sharp.

Structural geology

The area contains a series of nearly parallel gently northwest plunging anticlines and synclines that trend about N. 20° W. to N. 30° W. (Fig. 1). The cores of these anticlines and synclines consist of granitic rocks. The lineation and foliation of the granitic rocks parallel the bedding in the itabirite in all known exposures. A N. 10°-30° E. cross-joint set is well developed in both the metasedimentary and granitic rocks. This joint set conforms with the linear trends of all Precambrian rocks of Uruguay.

Structures within the iron formation:- The iron formation on the flanks of the anticlines and synclines is about 50 m thick but thins to less than one meter on the crest and troughs. Small-scale folds appear in the itabirite in the flanks but folds apparently have been stretched into regular and unwarped bands on the noses and troughs. The small folds are commonly asymmetrical, show tight buckling in some exposures and gentle flextures in others (Figs. 9 and 10). The tighter buckles seem to indicate that the stress directions that formed them were parallel to the axes of the major anticlines and synclines. The stresses that caused the minor folds also may have produced the small right-lateral slip faults that separate the ore deposit into its three component parts. The faults do not cut the granitic rocks in the cores of the major structures, and may be interpreted to have been formed after the period of folding of the major anticlines and synclines.

Petrography and petrology

A complete description of the petrology and petrography of the Valentines deposit is in preparation by Sr. Jorge Bossi of the Instituto Geologico del Uruguay. It may be sufficient to state that the iron ore has all the characteristics of a highly metamorphosed iron-oxide facies itabirite; it includes such lime-silicates as diopside and other pyroxenes, amphiboles, and with minor microcline, biotite, and apatite.

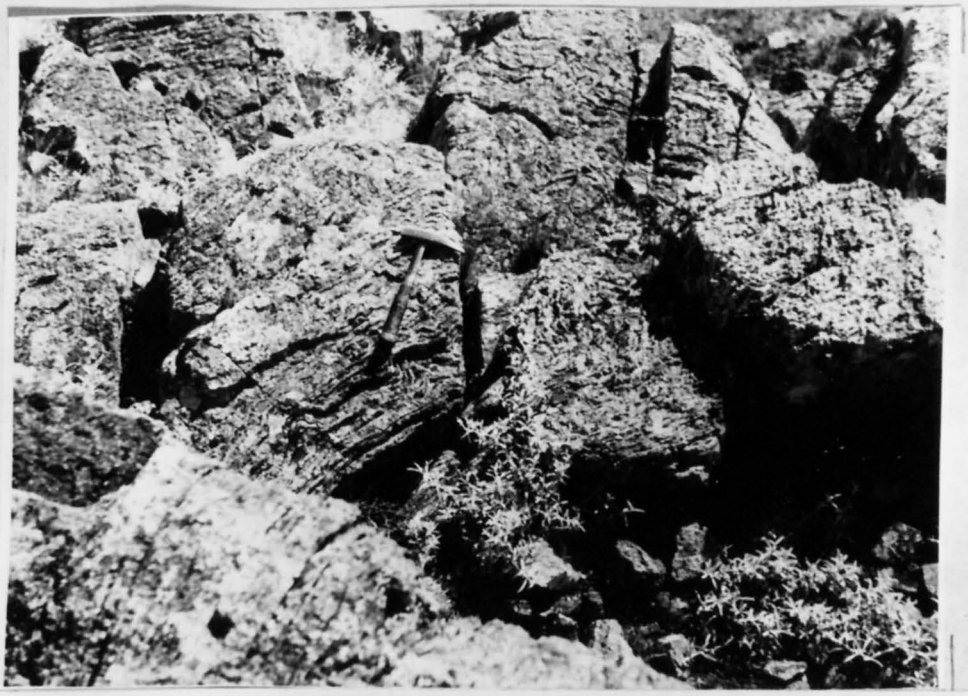


FIGURE 9. ITABIRITE DISPLAYING CRUMPLED BEDDING PLANES.

FIGURE 10. A CLOSE-UP VIEW OF CONTORTED BEDDING IN ITABIRITE.

ECONOMIC FACTORS

Statistics

(Note: The following computations are neither complete nor exact and can be verified or nullified by a complete exploration of deposit. Many of the data below are based on a quick glance that this writer had of an unpublished report by Ingeniero Caorsi to the Uruguayan Minister of Commerce ....)

If a conservative figure of about 1,500 meters is taken for the length of the Valentines deposit and the width of the iron formation is 50 meters then the following calculations can be made with reasonable assurance:

1,500 m x 50 m x 1 m x 3.5 (tons per m^3) = 260,000 tons of iron ore per meter of depth at 40 percent Fe.

The average depth of exploration by drilling, according to Dr. Caorsi, is about 90 m. Itabirite that averaged 40 percent Fe was encountered in all drill holes except where the drill penetrated through the steep-dipping footwall. The greatest depth of penetration as of January 1962 was 240 m and the drill encountered itabirite with an average of 40 percent Fe throughout this entire depth (Fig. 11).

If the above figure of 260,000 tons of iron ore per meter of depth is valid then the following tonnage may be predicted:

1,500 m x 50 m x 90 m x 3.5 (tons per m^3) = 23,500,000 tons of iron ore to a depth of 90 meters.

or:

1,500 m x 50 m x 240 m x 3.5 (tons per m^3) = 63,000,000 tons of iron ore if mining could reach 240 meters of depth throughout the entire deposit.

In addition it has been calculated that the iron rubble ore on top of the ridges is at least 300 meters wide and the trenches show that it is at least 1 m deep (Fig. 12). This is probably the best grade and easiest to recover with the least expense. It merely means breaking up the big blocks and loading it into cars. If a factor of 2.5 T/m^3 is used for the unconsolidated rubble ore, a very conservative estimate of the tonnage present is as follows:

1,500 m x 300 m x 1 m x 2.5 (tons per m^3) = 1,125,000 tons of iron ore available on the surface.

The annual iron consumption of Uruguay is expected to reach 100,000 tons of iron in the near future. A four and one-half year supply is readily available on the surface of this iron deposit.

FIGURE 11. ANTIQUE EXPLORATORY DRILL RIG. IN SPITE OF NUMEROUS MECHANICAL DIFFICULTIES THIS RIG DRILLED TO DEPTHS BELOW 240 METERS, BUT THE TIME CONSUMED TO ACCOMPLISH SUCH A FEAT IS PROHIBITIVE BY MODERN EXPLORATION STANDARDS.

FIGURE 12. TYPICAL IRON-RICH RUBBLE ORE THAT COVERS THE RIDGE LINE AND A PART OF THE FLANKS OF THE APRETADO DEPOSIT. IT IS ESTIMATED THERE IS A 4 1/2 YEAR SUPPLY OF IRON FOR URUGUAY PRESENT IN THE FORM OF THIS RUBBLE ORE IN THE THREE DEPOSITS IN THIS AREA.

MINING METHODS

Most iron ore deposits in the world are exploited by open pit bench methods. This would probably be the method used in the Valentines deposit. The surface rubble would first be stripped and then the open pit started.

TRANSPORTATION

The Valentines deposits are within 6 km of the railroad at the village of Valentines (km 261). The track from Montevideo to Valentines appears to be in excellent condition. It is a single track, standard gage (1.40 m) that lies on well-preserved wooden ties. The rails are medium weight. There are no sharp curves and the grades are very shallow except in a slightly hilly area in the vicinity of the village of Illescas. The bridges over the arroyos and rivers seem to be constructed strongly and in good condition, although the bridge over the Rio Santa Lucia, north of the town of San Ramon might bear inspection.

A spur to the vicinity of the Valentines deposit from Valentines could be constructed with a minimum of difficulty and maintain a grade of 1 percent easily.

The use of small barges on the Arroyo Valentines (Fig. 6), a tributary of the Rio Yi, for transportation of ore was not mentioned in any conversations with the Uruguayan authorities, but should be investigated. The Rio Yi flows into the Rio Negro, which in turn flows into the Rio Uruguay and the Rio de La Plata.

At the present the port facilities in Montevideo are not adequate for the handling of "raw" iron ore. The cost of transportation of run-of-mine ore because of the high quartz (waste material) content is prohibitive. The crux of their problem is that they probably will have to build a concentrating plant (crusher and separator) in Valentines and ship the iron concentrates to the sea ports for export. If the Uruguayan government wishes to smelt the iron for domestic use or for export purposes it will be necessary to import all fuels as Uruguay has no coal or petroleum. The question of the recovery of iron from the iron ore is of metallurgical nature and beyond the scope of this geological report.

GEOLOGICAL RECONNAISSANCE IN THE TACUAREMBO AND

RIVERA DEPARTAMENTOS, INCLUDING

CERRO DE PAPAGAYO AND CERRO IMAN, 1962

GEOLOGICAL RECONNAISSANCE IN THE TACUAREMBO AND RIVERA DEPARTAMENTOS

by

Roberts M. Wallace

ABSTRACT

Three mineralized areas lie in an area near the town of Minas de Corrales in the Departamento de Rivera; they are the Cerro Amelia, the Cerro de Papagayo, and the Cerro Iman. The Cerro Amelia is composed of small bands of iron-rich rock separated by an amphibolitic or mafic rock. Selective mining would be necessary to extract the 31,000 tons per meter of depth of iron-rich rock that ranges from 15 to 40 percent metallic iron.

The Cerro de Papagayo district contains many small, rich deposits of ferruginous manganese ore. The ratio of Mn to Fe varies widely within each small deposit as well as from deposit to deposit. Some ferruginous manganese ore contains 50-55 percent manganese dioxide. Although there are many thousands of tons of ore in this district, small-scale mining operations are imperative. One deposit, the Cerro Avestruz manganese mine, was visited. The manganese ore body lies within contorted highly metamorphosed itabirite that contains 40 percent Fe. The manganese ore body is zoned and contains both hard low grade and soft high grade ferruginous manganese ores estimated to average 40 percent Mn. About 38,000 tons of manganese ore is present in this deposit.

The Cerro Iman is a large block of itabirite that contains about 40 percent Fe. The grade is variable and probably runs from less than 35 percent Fe to more than 50 percent Fe. No exploration has been done on this deposit.

It is recommended that the Cerro de Iman area be geologically mapped in detail, and that a geological reconnaissance be made of the area that is between the Cuchilla de Corrales and the Cuchilla de Areycua/Cuchilla del Cerro Pelado area.

REPORT ON THE DEPOSIT AT CERRO AMELIA

Departamento Tacuarembo

The Cerro Amelia lies 1 km south of the small town of Minas de Corrales in the Departamento de Tacuarembo in the northern part of Uruguay. Here the tops of two small hills are covered by pebbles, cobbles, and boulders of dark reddish-brown to dark bluish-gray, hard, heavy structureless rubble that is highly magnetic. The rock somewhat resembles a hard-pan or canga in many

surface exposures (Figs. 13 and 14) but the larger blocks (maximum 3 m across) resemble fragments of magnetite-impregnated breccia.

The outcrop pattern of the surface rubble forms a lens 500 meters long with a maximum width of 35 meters. The lens lies within well foliated granite which becomes shattered and poorly foliated near the hidden contact zone. Rubble derived from amphibolitic dikes and quartz veins is found within the outcrop pattern of the iron-rubble lens and seems to lie in well defined lenslike patterns rather than to be scattered indiscriminantly.

The grade of the iron-rich rubble is unknown, but is extremely variable, probably varying from 15 to 40 percent Fe. Selective mining would be necessary to separate the iron rubble from the amphibolitic rubble or quartz vein rubble. Because of these factors the deposit probably has little or no commercial value as a source of iron ore.

SIERRA DE PAPAGAYO DISTRICT

Departamento de Rivera

There are many small but rich deposits of manganese minerals in the Sierra de Papagayo district that lies between the town of Minas de Corrales and the Arroyo Carpinteria in the Departamento de Rivera (Fig. 15). The manganese minerals (pyrolusite and psilomelane: identified by the Inst. Geol. de Uruguay) occur in elongated lenses in beds of highly metamorphosed itabirite surrounded by masses of granitic rocks. The iron minerals (Fe_2O_3) and magnetite (Fe_3O_4) are everywhere present with the manganese minerals.

Because of the association of manganese with the weather-resisting itabirite, the deposits are commonly found on the tops and steeper flanks of hills, although there are exceptions to this generalization.

The manganese-rich rocks occur in two distinct forms: (1) a hard, dense, brittle rock that contains a high ratio, 1:10 in places, of Fe to Mn, and (2) a soft spongy porous rock that appears to be considerably richer in psilomelane and pyrolusite and may have a Mn:Fe ratio of 5:2. The hard variety commonly has a dark steel-gray color and breaks with a conchoidal fracture. This rock is highly magnetic and commonly forms the bulk of the manganese-rich lenses.

The soft variety is dull black and porous. Bands of this material commonly lie near the center of the manganese-bearing lens, but have no systematic distribution pattern in most places. This type of rock may contain 50-55 percent MnO_2 in some places, has very little visible quartz, and iron may be low.

The origin of the manganese-rich lenses is not clear. It is this writer's opinion that the ores were derived from the weathering of amphibolitic sills and dikes rich in manganiferous minerals. Dikes of this aspect have been encountered in the vicinity of the deposits. A highly or deeply weathered dike of perhaps amphibolitic composition lies within the manganese-rich lens at the Cerro Avestruz deposit described below.

FIGURE 13. OUTCROPS OF MAGNETITE-RICH ROCK (NON-ITABIRITE TYPE ORE) IN THE CERRO AMELIA, 1 KILOMETER SOUTH OF MINAS DE CORRALES IN THE DEPARTAMENTO TACUAREMBO. THE CAMERA FACES NORTH FROM THE TOP OF SOUTH HILL.

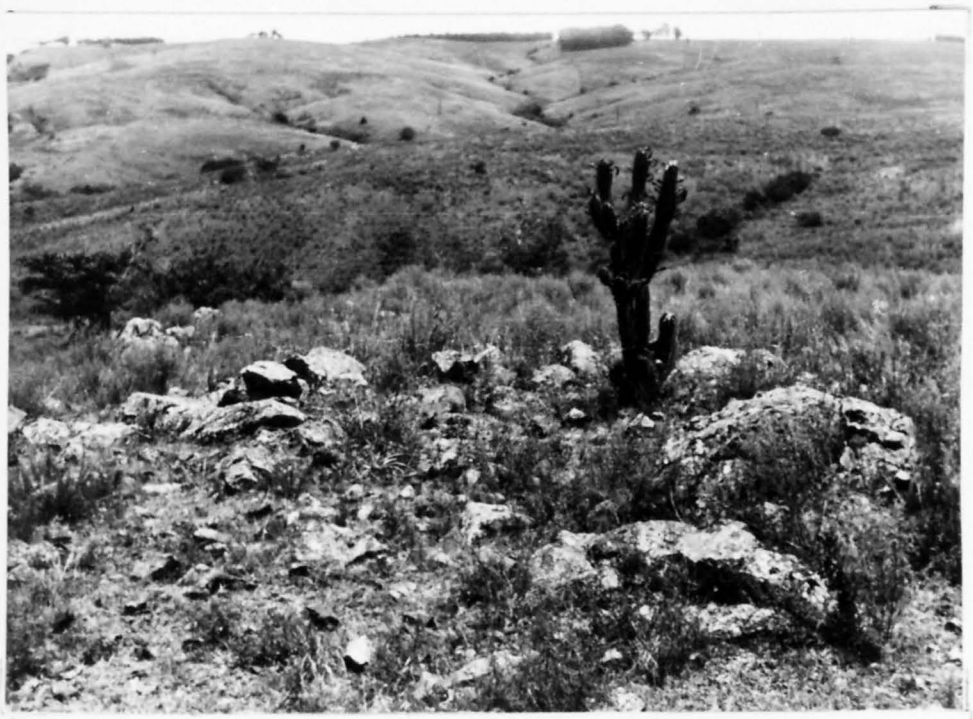


FIGURE 14. SAME AS FIGURE 13. THE CAMERA FACES SOUTH FROM THE TOP OF SOUTH HILL.

FIGURE 15. AERIAL VIEW OF THE CERRO DA PAPAGAYO, ABOUT 40 KILOMETERS EAST SOUTHEAST OF MINAS DE CORRALES IN THE DEPARTAMENTO DE RIVERA. THE LIGHT GRAY COLORED ROCKS IN THE UPPER PART OF THE PHOTOGRAPH ARE OUTCROPS OF IRON FORMATION. THE CAMERA IS POINTED TO THE SOUTHEAST FROM AN ALTITUDE OF ABOUT 4,000 FEET.

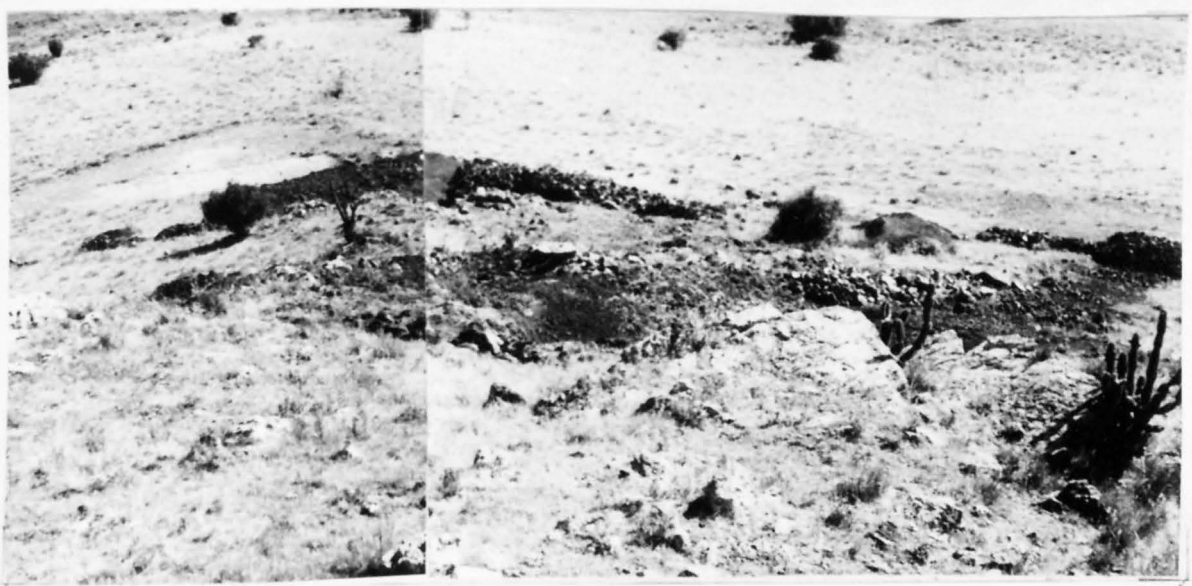


FIGURE 16. A COMPOSITE PHOTOGRAPH OF A MANGANESE OPEN PIT MINE IN THE CERRO AVESTRUS WHICH IS A PART OF THE SIERRA DE PAPAGAYO. THIS DEPOSIT IS ABOUT 18 KILOMETERS SOUTHEAST OF THE TOWN OF MINAS DE CORRALES. IT IS ESTIMATED THAT ABOUT 38,000 TONS OF MANGANESE ORE ARE PRESENT IN THIS DEPOSIT.

All deposits inspected by this writer were lens-shaped. The long axes of these lenses lie conformable to the general lineation of the rocks in the area and no crosscutting lenses of manganese-rich rocks, nor crosscutting dikes of mafic composition, were seen.

Conclusions

From limited observations, the manganese deposits in the Sierra de Papagayo district are estimated to contain a total of many thousands of tons of manganese-rich rocks. The deposits are small and scattered and will necessarily have to be worked as small-scale mining operations. No large-scale mining operations, using heavy equipment, is indicated at the present. Most of the deposits are several kilometers from roads and lie on hill tops or on the steep flanks. Haulage of ore will be restricted to small loads by truck, working during the dry season, until all-weather roads can be constructed.

THE CERRO AVESTRUZ (OSTRICH HILL) DEPOSIT

(MANGANESE)

The Cerro Avestruz deposit is located about 18 km southeast of the town of Minas de Corrales in the Sierra de Papagayo. It is a typical deposit of manganese that forms a lens within the borders of a thick band of itabirite (Fig. 16). The long axis of this lens of manganese ore is parallel to the N. 10° E. strike of the bedding of the surrounding itabirite host rock. The lens of manganese-rich rock contains an estimated average of about 40 percent MnO_2 in the form of pyrolusite and psilomelane. The lens contains both the hard and soft varieties of ore.

A light-brown to cream-colored weathered sill that is conformable with the constant 80° E. dip of the nearby itabirite beds occurs in the center of the manganese-rich lens (Fig. 17). There appears to be crude zoning of the manganese ores on either side of this sill: spongy ore lies adjacent to the sill and grades laterally into the hard variety of ore. In this mine the spongy variety is about 1-2 m thick, the transition zone into hard manganese-rich material is about 5 to 10 cm thick, and the bands of hard material about 10 m thick. The hard variety grades into manganese-rich itabirite, and commonly within 3 m or less, the itabirite apparently contains only a small percentage of manganese minerals (Figs. 18 and 19).

In one open cut at the northern end of this mine, one-meter thick bands of spongy ore are found irregularly distributed throughout the 21-meter face of hard manganese ore.

FIGURE 17. WEATHERED AMPHIBOLITIC (?) SILL IN THE CENTER OF A MANGANESE-RICH LENS IN THE CERRO AVESTRUZ MINE. NOTICE THE SHARP CONTACT BETWEEN THE BARREN AND WEATHERED SILL (LIGHT GRAY) AND THE SPONGY VARIETY MANGANESE ORE (BLACK) JUST BELOW THE BASE OF THE HAMMER HANDLE, AND ALSO ON THE LEFT SIDE OF THE PHOTOGRAPH. NO HARD VARIETY ORE IS SHOWN.

FIGURE 18. A PART OF THE OPEN PIT MINE AT THE CERRO AVESTRUZ. THE BLACK ROCK IN THE LEFT HALF OF THE PHOTOGRAPH IS MANGANESE ORE. THE WELL JOINTED MEDIUM GRAY ROCK IN THE CENTER AND RIGHT HALF OF THE PHOTOGRAPH IS MANGANIFEROUS ITABIRITE (IRON ORE). THE HAMMER LIES ON ITABIRITE THAT CONTAINS ONLY A SMALL AMOUNT OF MANGANESE MINERALS.

FIGURE 19. A CLOSE-UP VIEW OF THE MANGANESE-RICH ROCKS SHOWN IN FIGURE 18.

FIGURE 21. AERIAL PHOTOGRAPH OF THE CERRO IMAN, LOCATED ABOUT 19 KILOMETERS EAST OF THE TOWN OF MINAS DE CORRALES IN THE DEPARTAMENTO DE RIVERA. THE IRON DEPOSIT IS NEAR THE CENTER OF THE PHOTOGRAPH AND IS SEEN AS AN ISOLATED ROUGH-TOPPED HILL. THE CAMERA LOOKS TO THE SOUTHWEST FROM AN ALTITUDE OF ABOUT 4,000 FEET ABOVE SEA LEVEL.

An estimated tonnage of manganese ore present in this deposit may be calculated as follows:

length, 100 meters

average width, 25 meters

average thickness, 5 meters

specific gravity , (average) 3.0

100 m x 25 m x 5 m x 3.0 = 37,500 tons of manganese ore

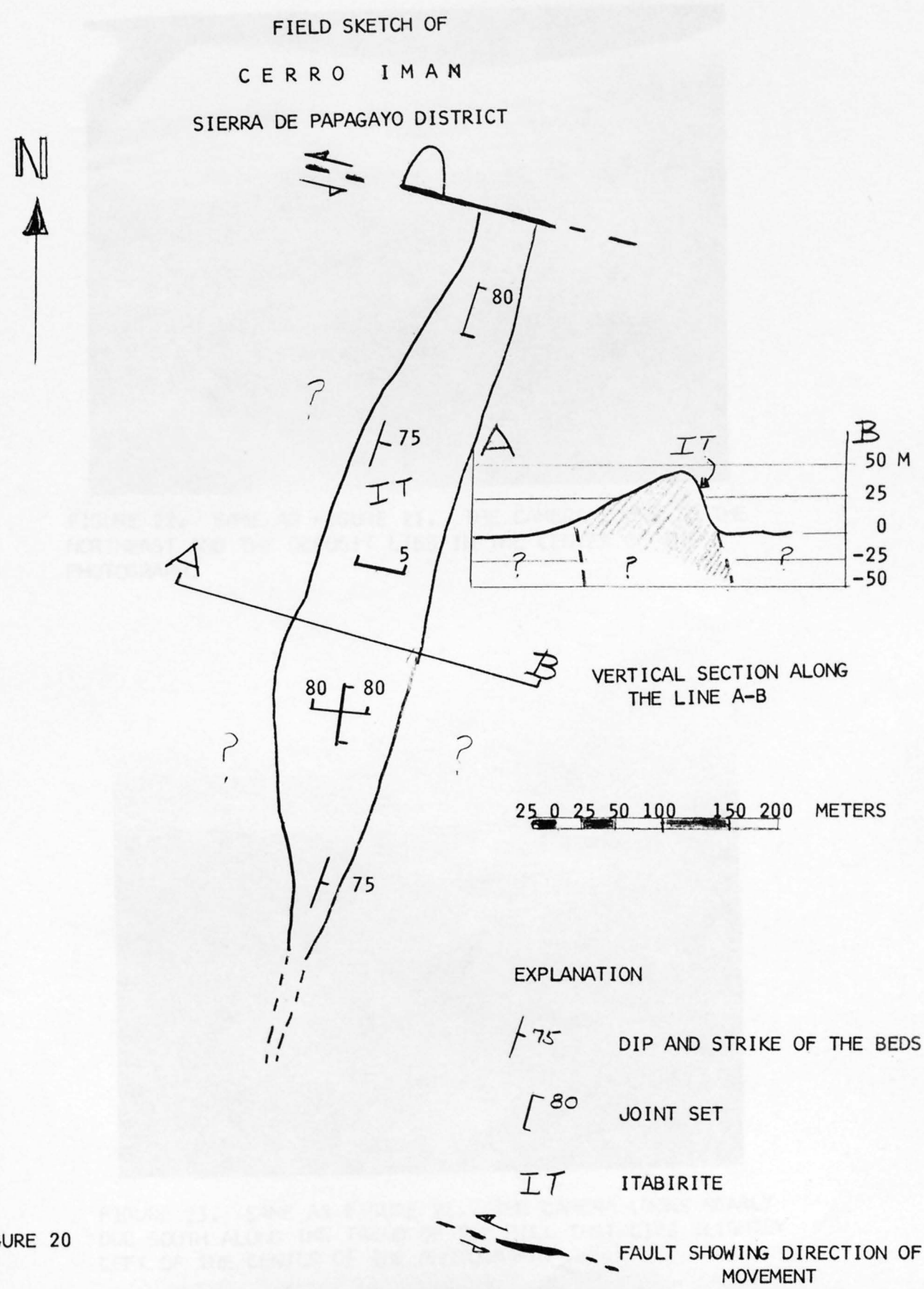
In addition to the manganese ore lens, there is present an estimated 100,000 tons of itabirite adjacent to the manganiferous lens.

CERRO IMAN IRON DEPOSIT

The Cerro Iman (Magnet Hill) iron deposit is located on a hill about 5 km (by air) from the small village of Rapucay, or 19 km east of Minas de Corrales (Fig. 20). This hill trends about N. 10° E. and appears as a nearly vertical block of rock, jutting about 40 meters above the surrounding gently rolling topography (Figs. 21, 22, and 23). The hill is about 600 m long and has a maximum width of 100 m at its base and about 55 m on its nearly flat top (Fig. 24). The entire hill is composed of itabirite which weathers to a typical light gray. Some surface exposures show highly contorted laminae in the itabirite. The itabirite is highly magnetic and the iron-rich lenses contain coarse-grained magnetite and hematite. A well developed joint system is present throughout the entire area. One joint set conforms to the regional N.-10°-E. joint set and the trend of the hill, and a cross-joint set is at right angles to the trend of the hill. A well developed, nearly horizontal joint set also is present in most places.

In the brief time that this writer had to visit this deposit it was noted that some of the lenses of itabirite, that measured a maximum of 2 m thick, apparently contain less iron minerals than others. These quartz-rich lenses could be traced for only a few tens of meters laterally, but contained perhaps less than 35 percent Fe (estimated by heft in hand specimen sizes). Other lenses contained an estimated 50 percent or more Fe. It was estimated that the average grade would be about 40 percent Fe. The rock is similar in most respects to that now being prospected in the Cerro Valentines in the Departamento de Florida. No manganese minerals were seen in the rock nor were lenses of manganese seen in the outcrop surface, but manganese "float" was noticed in the rubble on the western slopes.

A nearly vertical cliff forms the northern end of this deposit. A small outcrop of itabirite crops out about 50 meters northwest of the base


FIELD SKETCH OF
CERRO IMAN
SIERRA DE PAPAGAYO DISTRICT
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ITABIRITE
FAULT SHOWING DIRECTION OF
MOVEMENT

FIGURE 20

FIGURE 22. SAME AS FIGURE 21. THE CAMERA LOOKS TO THE NORTHEAST AND THE DEPOSIT LIES IN THE CENTER OF THE PHOTOGRAPH.

FIGURE 23. SAME AS FIGURE 21. THE CAMERA LOOKS NEARLY DUE SOUTH ALONG THE TREND OF THE HILL THAT LIES SLIGHTLY LEFT OF THE CENTER OF THE PHOTOGRAPH.

FIGURE 24. A COMPOSITE PHOTOGRAPH OF THE CERRO IMAN LOOKING TOWARD THE WEST. ABOUT 500 METERS OF OUTCROP OF ITABIRITE IS SHOWN IN THIS PHOTOGRAPH. THIS ITABIRITE CONTAINS APPROXIMATELY 2,000,000 TONS OF IRON ORE VISIBLE IN THE PHOTOGRAPH.

of the cliff and may be an extension of the formation that is offset by a left-lateral slip fault. The southern end of the deposit forms a steeply plunging nose. Here a few scattered boulders of itabirite continue along trend for about 150 meters.

An estimate of the tonnage of iron ore in this hill of itabirite may be computed as follows:

600 m x 40 m x 20 m x 3.5 = about 1,700,000 tons of ore as indicated reserves

As the eastern side of the hill forms a dip slope that dips about 75° E., and this side of the hill rises about 40 m above the iron rubble at its foot, it is estimated that the iron formation continues down at least to the foot and probably several tens of meters further underground. If mining of the deposit would continue 10 meters below the present foot of the hill, then the average width of the ore deposit may be increased by 10 meters or more and an additional tonnage of inferred ore may be estimated as:

600 m x 50 m x 30 m x 3.5 = 3,150,000 tons of inferred iron ore present in this deposit of itabirite

Other deposits

The writer had the opportunity to visit briefly several small deposits of manganese in the Cerro del Manganeso and Cerro Bonito areas. Each deposit contained a few thousand of tons of manganese material in small stock piles near the mine areas. The rocks recovered were similar in all respects to those described in the section concerned with the Cerro Avestruz mine.

Recommendations for future geological work

Cerro Iman might be mapped in detail and some subsurface probing done. This block may prove to be a large low-grade iron deposit.

A complete coverage by aerial photographs and subsequent topographic maps could well be made in an area between the Cuchilla de Corrales and the Cuchilla de Areycua-Cuchilla de Cerro Pelado area. This could be followed by a geological reconnaissance mapping project. It might be well to have mapping completed before the railroad is extended into this area, as the maps might have a bearing on the best route for the railroad extension.

NOTES ON THE IRON DEPOSIT NEAR THE CERRO DE LAS CUENTES

DEPARTAMENTO DE CERRO LARGO, January 7, 1962

The Cerro de las Cuentas, Departamento de Cerro Largo, is of no commercial value as an iron deposit, and can be considered as of academic interest only; no further action can be taken until a complete analysis of the iron-rich surface material is made.

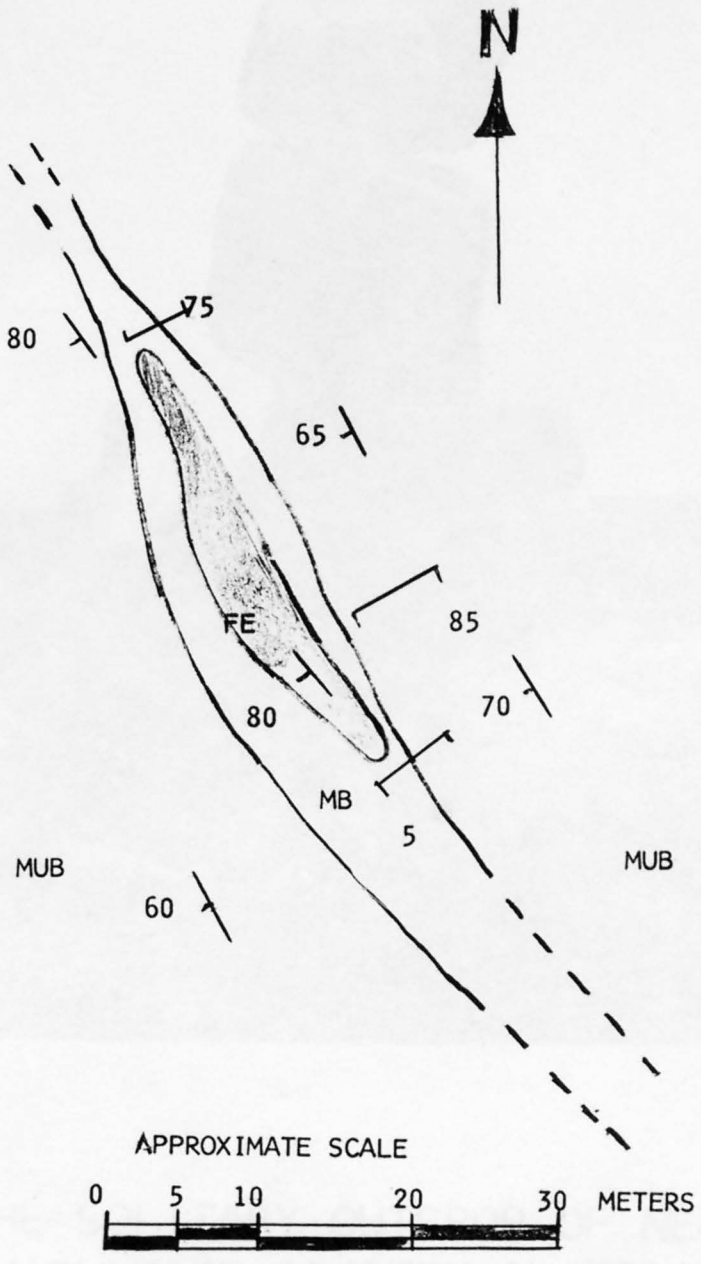
The deposit is located about 18 kilometers by road directly west of the railroad station at Cerro de las Cuentes 363 km north of Montevideo, at a place known as "Iron Hill" (translation), in the Departamento de Cerro Largo.

Description of the deposit

The iron-bearing lens crops out within a mass of marble (a metamorphosed limestone or other calcareous rock) of unknown size, has a surface exposure of about 32 meters long, an average width of 2.5 meters, and extends 5 meters above the ground in the center of the lens (Figs. 25 and 26). It lies conformable with the bedding of the marble and has a strike of N. 10°-30° W. and dips 65°-80° W. It is composed of one solid mass of nearly pure specular hematite and magnetite; quartz is extremely rare and appears as angular blebs within the iron mass.

The surrounding marble is crudely banded or zoned; rock close to the iron lens is bleached to shades of yellow and brown, whereas rock further away is medium gray to dark gray. The zoning suggests that the origin of the iron lens is hydrothermal. A large mass of granite lies abut 880 meters ESE of this iron lens.

FIGURE 25. IRON OUTCROP NEAR CERRO DE LAS CUENTES, DEPARTAMENTO DE CERRO LARGO, URUGUAY.



EXPLANATION

FE..... LENS OF NEARLY PURE HEMATITE AND MAGNETITE
MB..... BLEACHED MARBLE ZONE
MUB.... UNBLEACHED MARBLE
GR..... GRANITIC ROCKS

/ 70 DIP AND STRIKE OF THE BEDS

⌊ 85 JOINTS SHOWING DIP OF THE FRACTURE PLANES

FIGURE 26. THE SOLITARY OUTCROP OF NEARLY PURE HEMATITE AND MAGNETITE AS SEEN IN "IRON HILL," 18 KILOMETERS WEST OF CERRO DE LAS CUENTES IN THE DEPARTAMENTO DE CERRO LARGO. THE DEPOSIT IS OF N COMMERCIAL VALUE.