MINERAL DEPOSITS OF THE TERRITORY OF AMAPÁ, BRAZIL

ALLUVIAL GOLD, CASSITERITE, AND COLUMBITE - TANTALITE IN THE AMAPARI RIVER REGION

By

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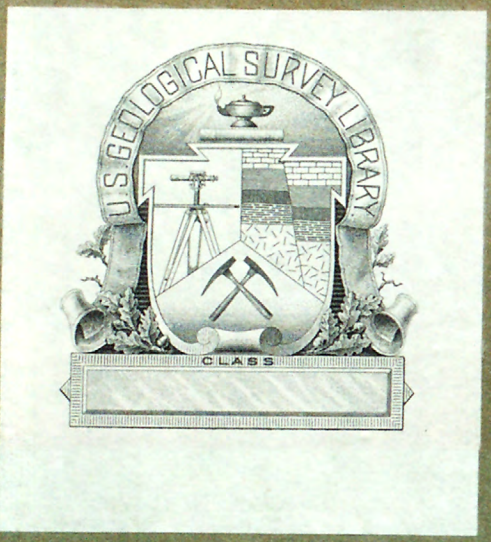
U. S. Geological Survey

and

Victor Dequech
Divisao de Fomento, Departamento Nacional da Produção Mineral

1945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1. Mineral deposits of the territory of Amapá, Brazil--alluvial gold, cassiterite, and columbite-tantalite in the Amapari River region, by M. R. Klepper and Victor Dequech. 31 p., 10 tables. Library, Departamento Nacional da Produção Mineral, Rio de Janeiro, Brazil.

2. Mineral deposits of the territory of Amapá, Brazil--gold, tantalite, and diamonds near Vila Santa Maria, by M. R. Klepper and Victor Dequech. 28 p., 5 tables. Library, Departamento Nacional da Produção Mineral, Rio de Janeiro, Brazil.

3. Geology and mineral deposits of the San Cristóbal district, Villa Martin Province, Potosi, Bolivia, by Herbert S. Jacobson, Carlos Murillo, Lorgio Ruiz, Oscar Tapia, Hugo Zapata, Hugo Alarcon, Edgar Delgadillo, and Carlos Velasco. 25 p., 2 pl. (1 in color), 7 figs.

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MINERAL DEPOSITS OF THE TERRITORY OF AMAPA, BRAZIL

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ABSTRACT

During the latter part of 1944 and the first half of 1945 cassiterite and columbite-tantalite were recognized in a number of gold placers in the Amapari River region of the Territory of Amapá, in the northeast corner of Brazil. In July 1945 the writers examined and sampled most of the known deposits. Samples were analyzed in the Laboratory of the Departamento Nacional da Produção Mineral at Campina Grande, Paraiba.

The Amapari River region, from the confluence of the Amapari River with the Araguari to Sete Ilhas, is hilly, jungle-covered terrain underlain by intensely metamorphosed schists and gneisses into which granitic and gabbroic bodies have been intruded. The placer deposits were formed by the concentrating action of running water after weathering had liberated the valuable minerals from their source rock, pegmatites for cassiterite and columbite-tantalite and probably quartz veins for gold.

During the second quarter of 1945 fifteen men produced a total of about 8,000 kilograms of cassiterite from the only two deposits being mined. In July 25 men were working, and the rate of production from these two deposits had increased to about 800 kilograms per week. No columbite-tantalite has been produced. The fourteen deposits examined are small, the largest containing

an estimated reserve of 16,000 kilograms of cassiterite in 1,400 cubic meters of gold tailings and gravel. The total reserve of cassiterite in 6 deposits is about 22,000 kilograms. The reserve of columbite-tantalite in 11 deposits is about 3,000 kilograms. Four deposits contain both cassiterite and columbite-tantalite. About one-third of the known reserve is in tailings which contain little or no recoverable gold; the remainder is in gravels that probably contain an average of about one gram of gold per cubic meter. The composition of the columbite-tantalite concentrate analyzed varies considerably, averaging about 45 percent Ta_2O_5, 35 percent Cb_2O_5.

Although the known reserves of cassiterite and columbite-tantalite are small, the writers believe that most of them can be extracted profitably by garimpeiros. It is likely that similar, and possibly larger, deposits will be found in the region. Systematic prospecting might also lead to the discovery of minable deposits in bedrock.

INTRODUCTION

During the latter part of 1944 cassiterite was recognized in gold-bearing gravels and in tailings from small-scale gold placer mining operations in the Amapari River region of the Federal Territory of Amapá. As a part of the program of cooperation between the Departamento Nacional da Produção Mineral and the U. S. Geological Survey, the writers visited this region during July 1945 in order to examine the known deposits, estimate reserves, and predict near-future production. One of the interesting findings was that although columbite-tantalite is present in many of the gold placers, it had never been recognized as such, and no effort had been made to recover it as a by-product of gold washing operations.

The Amapari region is in the central part of the Territory of Amapá, a rhomb-shaped area of 260,000 square kilometers* (a little larger than Wyoming), bounded on the northwest by French Guiana, on the northeast by the Atlantic Ocean, on the southeast by the Amazon River, and on the southwest by the Jarí River. Macapa, capitol of the Territory and a city of about 2,500 inhabitants, is a port on the Amazon River.

Supplies for most of the southern part of Amapá, including the Amapari region, are transported by river steamers and sailboats from Belem, capitol of the state of Para, to Macapa. Weekly plane service between Belem and Macapa is also available. Supplies for the Amapari region are hauled by truck from Macapa to Porto Grande on the Araguari River, a distance of 115 kilometers. Travel and distribution of supplies up-river from Porto Grande are by one to four-ton boats powered by outboard motors. A log of the writers' trip from Porto Grande to Sete Ilhas is given in Table 1. Foot trails lead from villages or landings along the river to inland settlements and placer workings.

The region is hot and humid. Rainfall averages about 300 centimeters per year, the greater part falling between November and June. Temperature normally varies between 21° C. and 32° C. The country between Macapa and Porto Grande is gently rolling grassland reaching a maximum elevation of 50 meters above sea level near Porto Grande. The region up-river from Porto Grande is covered by jungle growth which is very dense in low-lying areas but rather open on hill tops. Maximum relief is about 150 meters.

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*The metric system is used throughout this report.

Placer gold was discovered in tributaries of the Amapari River in 1935 or 1936 by prospectors working southward from the Calçoene-Cassipore region. Cassiterite was first identified in the latter part of 1944 and columbite-tantalite in July 1945. During the height of placer gold mining activity, from 1937 to 1940, the region was inhabited by 700 people, of whom at least half were miners or prospectors. In July 1945 about 100 out of a total of 250 inhabitants in the region were actively engaged in small-scale mining and prospecting for gold and cassiterite.

In 1945 most of the mining activity in the region was confined to five areas. In these areas placer deposits on 20 creeks were visited. Two of the deposits contained cassiterite with gold, four contained both cassiterite and columbite-tantalite* with gold, and eight contained columbite-tantalite with gold. Total production of cassiterite has been 8,000 kilograms; the current monthly rate is about 3,000 kilograms. Total production of gold is not known, but the current rate probably does not exceed 5 kilograms per month. No columbite-tantalite has been produced. Known deposits that contain cassiterite and/or columbite-tantalite are small, but some of them can be profitably exploited by garimpeiros**. More intensive prospecting will probably lead to discoveries of new placers and possibly also to deposits in bedrock.

The writers are indebted to the Territorial Government, and particularly to Captain January Gentil Nunes, Governor, and to Dr. Miranda Bastos, Chief of the Division of Production, for making available government-owned means of

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*The Ta_2O_5 : Cb_2O_5 ratio of the mineral from different deposits varies from 75:11 to 16:64. In the general sections of this report the mineral will be referred to as columbite-tantalite.

**Garimpeiros are prospectors or small-scale placer miners who work either singly or in small groups with hand implements (shovels, hoes, pans, Long Toms).

transportation and arranging for supplies. Dr. Fritz Ackermann, Geologist for the Territory, joined the field party and contributed to the discussions concerning the geology and mineral deposits of the region. Dr. Nelson Cardosa and Sr. Jose Nascimento, respectively Manager and Field Agent for Diamantes Tocantins Ltda., furnished transportation and lodging in the Indios Creek Area, and gave valuable information regarding production of cassiterite. Many miners and prospectors acted as guides and gave accounts of the history and production of different areas.

GEOLOGY

Although the Territory of Amapá is one of the least known parts of Brazil, the principal regions from which placer gold has been produced, the Oiapoque and the Calçoene-Cunany drainage systems, have been studied in reconnaissance fashion by geologists (1 and 2). Borges (3) made a reconnaissance map and described the rocks exposed along the Araguari and Amapari Rivers a few years before gold was discovered there. According to de Oliveira's Geologic Map of Brazil (4) most of the Territory is underlain by Archean rocks. A small belt

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(1) Vieina, Antonio Rodrigues, Jr., Ouro no Amapá, Ministeria da Agricultura, Industria e Commercio; Servico Geologico e Mineralogico, Boletim 8, 1924

(2) Moura, Pedro, Fisiographia e Geologia da Guiana Brasileira, Ministeria da Agricultura, Instituto Geologico e Mineralogico, Boletim 65, 1934.

(3) Borges, Josalfredo, Rio Araguari e Seu Maior Afluenti: Rio Mapari, Ministeria da Agricultura, D.N.P.M., S. G. e M., Boletim 87, Part II, 1937.

(4) de Oliveira, Avelino Ignacio, Mappa Geologico do Brasil e de Parte dos Paizes Visinhos, Ministeria da Agricultura, D.N.P.M., S.F.P.M., 1938.

of Tertiary and Middle Paleozoic rocks occurs in the southern corner of the Territory, and a narrow strip of Quaternary deposits borders the Amazon River and the Atlantic Ocean.

In the Amapari region a number of types of metamorphic and igneous rocks are exposed as ledges along the river, but the exposures are too few and too widely separated from one another to give a clear idea of the relationships between the different rock types. The assemblage, consisting of several varieties of gneisses and schists, amphibolite, metamorphosed quartzose breccia, gneissic granite, pegmatite, and gabbro, appears to represent intensely metamorphosed sedimentary and volcanic rocks cut by granitic and gabbroic intrusives. The area has been deeply weathered, and iron-rich laterite has formed in many places. The depth and degree of induration of the laterite are not known.

Concordance of hilltops at an altitude of about 200 meters, steep-sided hills, and depth of weathering suggest that the region was peneplaned and then, at a rather recent geologic date, uplifted. This 200-meter surface and the 100-meter surface in the vicinity of Vila Santa Maria to the south may be part of a single extensive peneplane, or they may be remnants of two less extensive erosion surfaces.

The placer deposits have formed as the result of liberation, by weathering, of the valuable minerals from the source rock, followed by concentration due to the action of running water. The source rock of the columbite-tantalite can be demonstrated at one locality, but the source of the gold and cassiterite can only be inferred from indirect evidence. Pegmatite which contains columbite-tantalite is exposed in the bed of Berilia Creek near Vila Antonio, and a

minable concentration of the mineral occurs for about 50 meters downstream from the outcrop. Nuggets of cassiterite with feldspar and muscovite adhering to them have been observed in several creeks, indicating that at least part of the cassiterite has been derived from pegmatites. Most of the placers have yielded quartz pebbles containing visible gold, but the surrounding hill slopes have never been prospected to discover the source of these pebbles. The writers believe that most, if not all, of the gold has been derived from quartz veins and stringers, even though the presence of gold in all of the known placers of cassiterite and columbite-tantalite suggests that all of these valuable minerals were derived from a single source.

PLACER DEPOSITS

Nature of the deposits.--Placer deposits in the smaller valleys range from a few meters up to ten meters in width, from a few centimeters up to a meter in thickness, and up to a kilometer in length. In some of the larger valleys, in which mining operations can be carried on only during the drier months of the year (August to November), placer deposits are as much as 1.5 meters thick, 40 meters wide, and a few kilometers long, but most of these deposits do not contain a high enough concentration of gold to be attractive to the garimpeiros.

Most of the gravel deposits examined are underlain by gray or bluish gray, decomposed mica schist or sericite phyllite. In some of the deposits the gravel is directly overlain by a mat of vegetation; in others sand and clay are interlayered in the upper part of the gravel, or overlie it. Generally about one meter of barren material must be stripped away in order to

expose material that is worth washing. In almost all of the deposits at least 95 percent of the pebbles and cobbles are quartz; the remainder are pegmatite, amphibolite, gneiss, schist, or gabbro. The following varieties of quartz, in varying amounts, were observed in most of the deposits: 1) massive clear and cloudy, 2) granular bluish and yellowish, and 3) massive smoky. Not uncommonly black tourmaline or mica is intergrown with the massive clear or cloudy quartz. In addition to the valuable minerals, Long Tom and pan concentrates generally contain black tourmaline, muscovite, a pale salmon-colored mineral that may be topaz and locally garnet. The gold varies in size from flakes barely visible in a pan to nuggets of several grams, but flakes weighing a fraction of a milligram predominate. A few nuggets weighing between 20 and 50 grams are reported to have been found. Fineness is reported to average about 970. At first glance it is difficult to distinguish between stream-worn pieces of cassiterite and columbite-tantalite, but on the basis of streak, pale yellowish brown for cassiterite and dark brown to black for columbite-tantalite, questionable specimens can rapidly be identified. Both minerals vary in size from barely visible grains to nuggets weighing 50 grams.

Tenor and Reserve.--Minable concentrations of cassiterite and columbite-tantalite occur in placer deposits with gold and in tailings from which most of the gold has been extracted. In order to form a basis for estimating tenor and reserve of known deposits of cassiterite and columbite-tantalite, pace and compass sketches were made, volumes of tailings suitable for rewashing were estimated, thicknesses of gravel and overburden were measured, and samples of gravels and tailings were panned. The concentrates recovered by panning were screened and weighed, and the quantity of cassiterite and columbite-tantalite in each was estimated by Dequech. Chemical analyses of some of the concentrates were made at the Laboratory of the D. N. P. M. at Campina Grande,

Paraiba. When possible, the production of gold and cassiterite from recently worked portions of deposits was ascertained and used in estimating tenor of reserves. The results of mechanical and chemical analyses, and estimates of the tenor of gravel in different deposits are in Tables 2 to 8. Estimates of reserve are in Table 9.

All of the known deposits are small, but some of them are rich. The cassiterite content of gravel and tailings varies up to 15 kilograms, but in most deposits is less than 1 kilogram. Gold content varies up to at least 3 grams per cubic meter and probably averages between 1 and 2. The combined indicated and inferred reserve in the deposits examined is estimated to be: cassiterite, about 22,500 kilograms; columbite-tantalite, about 2,600 kilograms; and gold, about 5,300 grams. The composition of the columbite-tantalite varies from 74 percent Ta_2O_5, 10 percent Cb_2O_5 to 16 percent Ta_2O_5, 64 percent Cb_2O_5, and averages about 45 percent Ta_2O_5, 35 percent Cb_2O_5.

The richest and most readily available portion of the known reserve of cassiterite and columbite-tantalite is in tailings, and can be recovered within a few months. The reserve in gravels that are being mined for gold and one or both of the other minerals will not be depleted as rapidly. Some deposits that heretofore were considered to be submarginal might now be mined for the combined content of gold with cassiterite and/or columbite-tantalite. It seems quite probable that other, and possibly larger, deposits of cassiterite and columbite-tantalite will be discovered, for the greater part of the region has not yet been carefully prospected for cassiterite and columbite-tantalite.

Mining and concentration.--Methods of mining and concentration are similar or identical to those described by Klepper and Dequesh (5).

Indians Creek area

Cassiterite-gold placer deposits occur in small tributaries of the Sentinella Creek and Grande Creek. Access to the region is by way of the sluggish, log-choked Indians Creek, which enters the Amapari River from the north, about 30 kilometers west of its junction with the Araguari River. Vila da Beira, a settlement of about 20 people and center of the cassiterite mining activity, is about 15 kilometers from the mouth of the creek. The trip from the mouth to the Vila in an 800-kilogram boat powered by a 4 hp Johnson motor requires about 3½ hours. From Vila da Beira jungle trails lead to the deposits.

Diamantes Tocantins Ltda., the only purchaser of cassiterite in the area during July 1945, maintained a field agent and three assistants at Vila da Beira, an 800-kilogram motor boat for travel on the Amapari and Araguari Rivers, and a storehouse in Porto Grande. The company buys cassiterite concentrate at Vila da Beira for 4 cruzeiros ($0.20) per kilogram. Up to July 18 a total of 7,500 kilograms had been purchased; unsold stocks in the region probably did not exceed 500 kilograms.

Grenat Creek.--The cassiterite-gold placer on Grenat Creek is about 3 kilometers east of Vila da Beira by steep jungle foot path. The miners have built a small thatch-hut settlement near the workings.

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(5) Klepper and Dequesh, Gold, Tantalite and Diamonds near Vila Santa Maria: U. S. Geol. Survey open-file rept. /1967/, 1945.

Gravels along this creek were worked for gold from 1939 to 1943. On April 26, 1945, four men commenced to rewash gold tailings to obtain cassiterite. By July 18 all of the tailings had been reworked, but 14 men were working in gravel. Production from April 26 to July 17 had been 6,500 kilograms of cassiterite, or about 9 kilograms per man-day. The cassiterite probably averaged 90 percent SnO_2 (Table 2). Production of gold during this period is not known.

The valley of the creek is from 15 to 20 meters wide, and the zone known to contain cassiterite is about 400 meters long and 10 meters wide. Within this zone rich, low-grade, and barren streaks occur. In 12 pits the thickness of gravel varies from 20 centimeters to 90 centimeters, averaging 65. Bluish clay, probably decomposed phyllite or fine-grained sericite schist, underlies the gravel. Overburden averages 65 centimeters in thickness. The gravel is composed of about 95 percent subangular to subrounded quartz pebbles and cobbles and 5 percent pegmatite, amphibolite and schist. The heavy mineral concentrate consists predominantly of cassiterite, a pink cleavable mineral (topaz?),and black tourmaline. Data summarized in Table 3 indicate that in the explored area the gravel contains an average of at least 10 kilograms of cassiterite and 1.5 grams of gold per cubic meter.

In this deposit, the largest and richest yet discovered in the Amapari region, a reserve of about 16,000 kilograms of minable cassiterite is indicated and inferred in a 400-meter long zone. The concentration of cassiterite in the gravels progressively decreases to the north, and the northernmost workings are probably near the end of the workable zone. Only a small reserve is anticipated in the 60-meter interval between the southernmost working and the head of the creek.

Virgilio Creek.--The cassiterite-gold placer on Virgilio Creek is about 5 kilometers by canoe and 3 kilometers by jungle foot-trail north of Vila da Beira. A small thatch-hut settlement, at which most of the miners live, has been built near the workings.

The creek was worked for gold during 1942. Between June 4 and July 18, 1945 from 2 to 12 men engaged in rewashing tailings recovered a total of 1,500 kilograms of cassiterite, or about 6 kilograms per man-day. The reserve in tailings will probably be exhausted by the end of August. Recently dug workings and test pits indicate that the zone of minable gravel is about 175 meters long, 4 meters wide, and 40 centimeters thick. The indicated and inferred reserve in this zone is about 3,250 kilograms of cassiterite and 30 grams of gold.

The gravel consists of about 95 percent quartz, 4 percent quartz with intergrown muscovite and black tourmaline, and 1 percent amphibolite. Very few of the cassiterite fragments are larger than 6 millimeters in diameter (Table 4); a few are subrounded, but most are subangular or have partial crystal form.

Tavares Creek.--Sr. Tavares of Vila da Beira submitted a sample of tantalite-cassiterite concentrate from gold tailings along a creek 2 or 3 kilometers by trail north of the Virgilio Creek deposit. Partial chemical analysis of this sample is shown in Table 4-B.

Jornal gold-cassiterite-tantalite area

At one time or another during the past eight years gold has been mined from most of the creeks within a 5 kilometer radius of Vila Jornal, a settlement on the north shore of the Amapari River about 88 kilometers west of its confluence with the Araguari. In July 1945 8 persons lived in the village and 6 in the interior near the placers they were exploring. Only those

placers which were reported to yield appreciable quantities of cassiterite-tantalite were visited.

In both Renale Creek and Cecilon Creek two men were working gravel deposits from which they were recovering between 1.5 and 2 grams of gold per cubic meter. Sampling indicated that the gravels being worked contain between 1 and 3 kilograms of black concentrate per cubic meter, of which about 80 percent is cassiterite and 20 percent tantalite. Locally the tailings from former gold washing operations contain as much as 15 kilograms of concentrate per cubic meter, but the total reserve of tailings that could be rewashed profitably probably does not exceed 100 cubic meters. Results of mechanical and partial chemical analyses are in Table 5; estimates of reserves are in Table 10.

Three men were washing gravels along the somewhat larger Bruno Creek. Examination in the field and analysis of one sample suggest that each cubic meter of gravel in this deposit contains between 1 and 2 grams of gold and between 1 and 2.5 kilograms of black concentrate, of which about 80 percent is cassiterite and 20 percent tantalite. An estimate of reserve is given in Table 10.

Santa Terezinha gold-cassiterite-tantalite area

The only cassiterite-tantalite deposit thus far discovered in the area is in an unnamed creek about 1 kilometer by jungle trail north of Vila Santa Terezinha, a settlement on the north shore of the Amapari River, 100 kilometers northwest of its confluence with the Araguari. The placer was explored for gold for several months and abandoned.

Six samples of tailings from a 100 meter long cassiterite-tantalite-bearing zone at the head of the creek contained an average of 2.4 kilograms of concentrate per cubic meter. Mechanical and chemical analyses (Table 6)

of the samples indicate that the concentrate consisted of 60 percent cassiterite and 40 percent tantalite. The tantalite contained 65 percent Ta_2O_5. Two samples of gravels contained only about 1.0 kilogram of concentrate per cubic meter. Total reserve (Table 10), of which about half is in tailings, is calculated to be about 450 kilograms of cassiterite and 300 kilograms of tantalite. One or two hundred grams of gold might be recovered in mining this reserve.

Antonio-Panel gold-tantalite area

The Antonio-Panel area is the most active gold mining area in the Amapari region. About 130 persons, of which at least 50 are actively engaged in placer mining, live in the principal villages of Panel, Antonio, Marboef, Cabrito and two or three smaller settlements.

The writers examined all of the placers in which columbite-tantalite had been observed.

Berilia Creek.--A small deposit at the head of Berilia Creek, about 2 kilometers by trail northwest of Vila Antonio, was very carefully sampled. Three pits were dug in kaolinized pegmatite and fifteen samples of tailings were taken at 10-meter intervals along the creek (Tables 7A and 7B). Two 30-liter samples from the kaolinized pegmatite yielded 1.5 and 2.0 grams of very fine grained tantalite and colors of gold. Whether the gold was a constituent of the pegmatite or a contamination from the overlying eluvial material is not known. The tailings contain measurable quantities of tantalite for a length along the stream of only 50 meters, and the rich concentration (8 kilograms per cubic meter) is only 20 meters long. It is rather surprising

that practically all of this fine-grained tantalite has been concentrated within such a very short distance of the source. The reserve in tailings is about 600 kilograms of tantalite. Unworked gravels might yield 100 or 200 kilograms of tantalite and 100 grams of gold.

Little Panel Creek.--During July Sr. Yago and two helpers, opening a new placer in Little Panel Creek 400 meters south-southeast of Vila Panel, were recovering between 4 and 5 grams of gold and 1 and 2 kilograms of tantalite per day from about 4 cubic meters of gravel. A vertical section along the wall of the pit consists of (1) 50 centimeters overburden, (2) 20 centimeters quartz sand with fine tantalite, (3) 65 centimeters white clay with quartz pebbles and cobbles, gold and tantalite; and (4) decomposed gray sericite schist. The minable gravel zone is at least 7 meters wide and contains about 150 cubic meters with 2 grams of gold and 0.6 kilogram of tantalite (43 percent Ta_2O_5) per cubic meter indicated, and 300 cubic meters of the same tenor inferred. More intensive prospecting may reveal a larger reserve along this creek.

Other Creeks.--Sr. Cenac and two associates, working in Panel Creek 1 kilometer southeast of Vila Panel, were recovering from 2 to 4 grams of gold per cubic meter of gravel washed. Each cubic meter contained only a few tenths of a kilogram of tantalite. The reserve of unworked gravel is at least 300 cubic meters (Tables 8 and 10). A vertical section in the pit now being opened is (1) 65 centimeters of clayey overburden, (2) 5 centimeters of sand, (3) 60 centimeters of clay, (4) 20-25 centimeters of gravel, (5) decomposed gray schist with recoverable gold in the upper 5 centimeters.

A 75-liter sample taken from tantalite-bearing tailings along Saramaca Creek, 1 kilometer by trail southwest of Vila Panel, indicates that about 275 cubic meters contain between 1.5 and 4.0 kilograms of columbite concentrate per cubic meter. This placer was inactive in July 1945.

Samples taken on Blackwater Creek and a small tributary, about 2.5 kilometers north-northeast of Vila Antonio, indicate a reserve in tailings and gravels of about 250 kilograms of tantalite. Average tenor is about 1 kilogram per cubic meter. Several miners were working in this area, but none were recovering tantalite.

Sete Ilhas gold-tantalite area

The Sete Ilhas area, inactive in 1945, is about 155 kilometers northwest of the confluence of the Amapari River with the Araguari. A few years ago at least 20 miners were living in Yago Village and Porto Sete Ilhas and operating gold placer operations in nearby creeks.

Old placer workings on Anta, Marimbonda, Ambrosia, and Yago Creeks were examined. No tantalite was identified in tailings along Yago Creek, and tailings along Marimbonda Creek yielded only a very small amount. A few hundred cubic meters of tailings containing 0.5 kilogram of columbite-tantalite per cubic meter occur along Anta and Ambrosia Creeks (Tables 9 and 10).

Summary

(1) The known placer deposits of cassiterite and tantalite are small, the largest having an indicated and inferred reserve of only about 16,000 kilograms of cassiterite; only three of the deposits have a combined reserve of cassiterite and tantalite of more than 1,000 kilograms.

(2) Gold is present in all of the known deposits of cassiterite and/or columbite-tantalite.

(3) The ratio of cassiterite to columbite-tantalite decreases progressively from the southeastern to northwestern part of the region. In Grenat and Virgilio Creek (Indians Creek Area) columbite-tantalite is a negligible constituent of the concentrate; in the Jornal Area the proportion of cassiterite to tantalite in the concentrate is about 7 to 1; in the Santa Terezinha Area the proportion is about 3 to 2; in the Antonio-Panel and Sete Ilhas Area cassiterite is a negligible constituent.

(4) The concentration of cassiterite in virgin gravels sampled varies up to 21 kilograms per cubic meter; concentration of columbite-tantalite varies up to about four kilograms. In gravels containing both cassiterite and columbite-tantalite up to 1.4 kilograms of cassiterite and 0.7 kilogram of columbite-tantalite were found.

(5) The composition of the columbite-tantalite concentrate analyzed varies from 16 percent Ta_2O_5, 64 percent Cb_2O_5 to 74.4 percent Ta_2O_5, 9.6 percent Cb_2O_5, averaging about 45 percent Ta_2O_5, 35 percent Cb_2O_5. The few samples analyzed suggest that the variation of composition within an area is as great as the variation from one area to another.

(6) The richest and most easily recoverable reserve of cassiterite and tantalite is in gold tailings. The gravels contain a lower concentration of cassiterite and tantalite and are more difficult to mine, but in most places they contain at least 1 gram of gold.

(7) The cassiterite and tantalite have been liberated from pegmatites by weathering. Most of the gold has probably been liberated from quartz veins.

(8) The Amapari Region is covered by dense jungle growth, and consequently intensive prospecting has been confined to a rather narrow belt bordering the river. No attempt has been made to discover deposits in bedrock. The writers believe that many other small placer deposits of columbite-tantalite and cassiterite, and possibly some larger ones, occur in the region. Some of these can be located by examining tailings along creeks that have already been worked for gold; others by panning gravels in creeks that have not yet been worked. The Berilia Creek deposit suggests that it may not be difficult to locate the source of many of the placer deposits. For example, the hillslopes at the head of the Grenat and Virgilio deposits should be trenched to determine the source of these two principal cassiterite deposits.

(9) The present system of individual small-scale mining and concentration by hand appears to be the best method of operation for the known deposits.

To fully explore the potentialities of the region, a campaign of scientific prospecting and sampling under the direction of a geologist would be necessary. Such a campaign might lead to the discovery of workable deposits of gold, cassiterite or tantalite in bedrock or of more extensive placer deposits in some of the larger stream valleys.

(10) Most of the richer gold-bearing gravels in small streams near the Amapari have already been mined, and during the few years prior to 1945 activity and production have been declining. If substantial concentrations of cassiterite and/or tantalite are found in enough creeks, interest in mining in this region may be restimulated.

TABLE 1

Travel time and Approximate Distances

Porto Grande to Porto Sete Ilhas

1500 Kilo Boat Powered by 4-HP Penta Motor

FROM		TO	ASCENDING Hours	ASCENDING Mins.	DESCENDING Hours	DESCENDING Mins.	Approx. Distance in Kilometers
Porto Grande	-	Mouth of Amapari	2	10	-	-	18
Mouth of Amapari	-	Ig. dos Indios	3	40	-	-	32
Ig. dos Indios	-	Ilha do Cancao	3	45	(		32
Ilha do Cancao	-	Vila Jornal	2	35	(3 (	32	23
Vila Jornal	-	Vila Terezinha	1	25	0	43	12
Vila Terezinha	-	Vila Antonio	4	30	2	17	33
Vila Antonio	-	Porto Panel	1	30	0	43	10
Porto Panel	-	Porto 7 Ilhas	1	35	0	47	12
		TOTAL	21	10			172

TABLE 2

Grab samples from stocks of cassiterite concentrates purchased from miners at Village de Beira by Diamantes Tocantins Ltda.

A - From IGARAPÉ DO GRENAT (GRENAT CREEK)

Mesh	Weight in grams	Percent of total weight	Percent SnO_2
Over 10	449.	21.1	90.6
10 to 20	1028.	48.2	91.4
Under 20	654.	30.7	89.5
TOTAL	2131.	100.0	90.65

B - From IGARAPÉ DO VIRGILIO (VIRGILIO CREEK)

Mesh	Weight in grams	Percent of total weight	Percent SnO_2
Over 10	1106.	57.4	91.6
Under 10	821.	42.6	90.4
TOTAL	1927.	100.0	91.09

C - From IGARAPÉ DOS INDIOS AREA: submitted to D. N. P. M. for analysis by Governor of Amapá.

SnO_2 - 92.8 percent

TABLE 3

IGARAPE DOS INDIOS (Indians Creek) AREA

IGARAPE DO GRENAT (Grenat Creek)

Mechanical Analyses of concentrates panned from four 33-liter samples of gravels in zone being mixed.

Sample No.	Mesh	Weight in Grams	Estimated Percent Cassiterite	Est. Weight Cassiterite in Grams	Kilos of Cassiterite per M^3 gravel --approx.
G - 1	Over 20	109	95	103.5	3.1
	20 to 50	34	50	17	0.5
	Subtotal	143		120.5	3.6
G - 2	Over 10	525	100	525.	15.7
	10 to 20	161	95	153.	4.6
	20 to 50	36	90	32.	1.0
	Subtotal	722		710.	21.3
G - 3	Over 10	354	95	336	10.1
	10 to 20	108	90	97	2.9
	20 to 50	38	20	8	0.2
	Subtotal	500		441	13.2
G - 4	Over 20	46	95	44	1.3
	20 to 50	24	90	22	.7
	Subtotal	70		66	2.0
	TOTAL			1,337.5	-
	Average of 4 samples			334.4	10.0

TABLE 4

IGARAPÉ DOS INDIOS (Indians Creek) AREA

A - IGARAPÉ DO VIRGILIO (Virgilio Creek)

Mechanical Analyses of concentrates panned from 33-liter samples of gravels near head of Igarapé in zone not yet explored.

Sample No.	Mesh	Weight in grams	Estimated percent Cassiterite	Est. Weight Cassiterite in grams	Kilos of Cassiterite per m^3 gravel --approx.
V - 1	Over 20	12	90	11	0.3
	Under 20	0			
V - 2	Over 20	48	85	41	1.2
	20 to 50	29	80	23	0.7
	Subtotal	77		64	1.9
V - 3	Over 10	172	90	155	4.6
	10 to 20	48	90	43	1.3
	20 to 50	33	75	25	0.8
	Subtotal	253		223	6.7
V - 4	Over 20	25	95	24	0.7
	20 to 50	6	50	3	0.1
	Subtotal	31		27	0.8
	TOTAL			325	-
	Average of 4 samples			81.2	2.4

B - IGARAPÉ DO TAVARES (Tavares Creek)

Chemical Analysis of Sample of concentrate panned from gold tailings by Sr. Tavares.

Sample No.	Mesh	Weight in grams	Percent Ta_2O_5	Percent Nb_2O_5	Percent SnO_2	Percent TiO_2
T - 1	Over 10	200	65.0	16.6	4.2	0.6
	Under 10	1	-	-	-	-

TABLE 5

JORNAL AREA

A - Mechanical Analyses of concentrates panned from gravels and Long-Tom discharge piles.

Sample No.	Igarapé	Mesh	Weight in grams	Estimated weight Cassiterite in grams	Kilos Cassiterite per M_3 material - approx.	Estimated weight Tantalite in grams	Kilos Tantalite per M_3 material - approx.
J-2	Renale (1)	Over 20	53	50	?	2	?
		20 to 50	18	15	?	2	?
		Subtotal	71	65		4	
J-3	Renale (2)	Over 10	221	176	5.3	42	1.2
		10 to 20	62	52	1.6	6	0.2
		20 to 50	61	51	1.5	6	0.2
		Subtotal	344	279	8.4	54	1.6
J-4	Renale (3)	Over 20	11	8.5	0.25	1.5	0.05
J-5	Cecilon (2)	Over 10	125	112	3.4	12	0.4
		10 to 20	196	166	5.0	19	0.6
		20 to 50	224	178	5.3	32	0.9
		Subtotal	545	456	13.7	63	1.9
J-6	Cecilon (3)	Over 20	7	6	0.2	1	0.03
		20 to 50	3	2.5	0.1	0.5	0.02
		Subtotal	10	8.5	0.3	1.5	0.05
J-7	Bruno (3)	Over 20	30	28	0.8	1	0.03
		20 to 50	12	6	0.2	5	0.15
		Subtotal	42	34	1.0	6	0.18

(1) Sample from stock of concentrate recovered from clean-up of Long-Tom.
(2) Concentrate from 33-liter sample of Long-Tom discharge.
(3) Concentrate from 33-liter sample of gravel.

B - Chemical Analyses

Sample No.	Description	PERCENT SnO_2	Ta_2O_5	Nb_2O_5	TiO_2
J - 2	Samples J-2 and J-3 above analyzed after	86.6	...Not determined...		
J - 3	mechanical analysis.	85.0	...Not determined...		
J - 2 to 7	Tantalite for analysis separated from concentrate by hand.	4.5	43.8	33.2	4.3

TABLE 6 SANTA TEREZINHA AREA

Sample No.	Mesh	Weight in grams	Estimated weight Cassiterite in grams	Kilos Cassiterite per M_3 of gravel - approx.	Estimated weight Tantalite in grams	Kilos Tantalite per m^3 of gravel - approx.
A - Mechanical analyses of concentrates panned from two 33-liter samples of gravel taken near head of an unnamed creek.						
ST - 1	Over 20	63	40	1.2	22	0.6
	20 to 50	9	6	0.2	2	0.1
	Subtotal	72	46	1.4	24	0.7
ST - 2	Over 20	1	0.75	0.02	0.25	0.01
	20 to 50	0	-			
	TOTAL	73	46.75	--	24.25	--
	Average of 2 samples.	36.5	23.4	0.7	12.1	0.35
B - Mechanical analyses of concentrates panned from six 22-liter samples of tailings from Long-Toms along same creek.						
ST - 3	Over 20	78	39	1.8	39	1.8
	20 to 50	0				
ST - 4	Over 20	4	2.5	0.11	1.5	0.07
	20 to 50	1	0	--	0	--
	Subtotal	5	2.5	0.11	1.5	0.07
ST - 5	Over 10	50	17	0.8	32	1.4
	10 to 20	59	39	1.8	19	0.9
	20 to 50	82	57	2.5	24	1.1
	Subtotal	191	113	5.1	75	3.4
ST - 6	Over 20	9	5	0.2	4	0.2
	20 to 50	12	7	0.3	5	0.2
	Subtotal	21	12	0.5	9	0.4
ST - 7	Over 50	23	15	0.7	8	0.4
ST - 8	Over 50	8	3	0.14	3	0.14
	TOTAL	326	184.5	--	135.5	--
	Average of 6 samples.	54.3	30.7	1.4	22.6	1.0

C - Chemical Analyses

Sample No.	Description	PERCENT SnO_2	Ta_2O_5	Nb_2O_5	TiO_2
ST - 1 to 8	Tantalite for analysis picked from samples by hand.	5.4	67.4	10.8	0.6
ST - 1 to 8	(20) - Mixture of material over 20 mesh in samples above.	40.1	44.7	8.0	0.3

TABLE 7 - A

ANTONIO - PANEL AREA

IGARAPÉ DA BERILIA (Berilia Creek)

A - Mechanical Analyses of concentrates panned from Long-Tom tailings along Igarapé.

Sample No.	Liters Panned	Mesh	Weight in Grams	Estimated Weight of Tantalite, Grams.	Kilos Tantalite Per Cu. Meter Tailings -- approx.
A - 1	33	--	18	15	0.5
A - 2	33	--	13	10	0.3
A - 3	33	Over 20	294	290	8.7
		Under 20	98	95	2.8
		Subtotal	392	385	11.5
A - 4	33	Over 20	65	64	1.9
		Under 20	92	90	2.7
		Subtotal	157	154	4.6
A - 5	33	--	9	Trace	--
A - 7	11	--	16	Trace	--
A - 8 to 15	11	--	--	Trace	--
Average of samples A -1 to 5 (tailings along west branch of Igarapé)					3.4

TABLE 7-B

ANTONIO - PANEL AREA

IGARAPÉ DA BERILIA (Berilia Creek)

B - Chemical Analyses

Sample No.	Weight in Grams	Percent SnO_2	Percent Ta_2O_5	Percent Nb_2O_5	Percent TiO_2
A - 1 and 2 (mixed)	31	Not det.	25.9	5.2	Not det.
A - 3 (+ 20)	294	1.9	74.4	9.6	1.5
A - 21 (1)	109	Not det.	16.0	62.8	Not det.
A - 23 (2)	100	Not det.	7.7	5.1	Not det.

(1) 109-Gram sample of concentrate from Blackwater Creek given by Sr. Felix.

(2) 100-Gram sample of pannings from workings of Sr. Antonio on Blackwater Creek and an unnamed tributary entering from east.

C - Spectographic Analyses

Elements listed in order of decreasing abubdance.

A - 23(see above)	Ti, Fe, Mg, Ta, Zn, Sn, Mn, Bi
A - 24(3)	Ti, Fe, Mn, Bi, Sn
A - 25(4)	Ti, Mn, Bi, Fe, Sn

(3) 2 Grams of concentrate panned from 30 liters of kaolinized pegmatite. Upper one-third of exposure in pit.

(4) 1.5 Grams of concentrate panned from 30 liters of kaolinized pegmatite. Lower two-thirds of exposure in pit.

TABLE 8

ANTONIO - PANEL AREA

A - Mechanical Analyses of concentrates from some of the principal placer workings.

Sample No.	Igarapé	Description	Mesh	Weight in Grams	Estimated Weight Tantalite in Grams	Kilos Tantalite per M^3 material - approx.
P - 1	Panel	11-liter sample of gravel from Cenac workings.	Over 20 Under 20 Subtotal	4.5 1.5 6.0	4 0 4	0.2 0 0.2
P - 2	Saramaca	75-liter sample of Long-Tom tailings.	Over 10 10 to 20 Under 20 Subtotal	110 59 150 319	108 57 135 300	1.4 0.8 1.8 4.0
P - 3	Little Panel	22-liter sample from sand overlying gravel. Yago workings.	10 to 20 Under 20 Subtotal	7 10 17	7 7 14	0.3 0.3 0.6
P - 4	Little Panel	33-liter sample of gravel. Yago workings.	Under 20	24	20	0.6
P - 5	Panel	Hand-picked sample from Long-Tom Tails. Given by Sr. Yago.	Over 50	58	58	-
P - 6	Little Panel	Concentrate recovered by 3 men in 7 hours from Yago workings.	Over 20	175	170	0.6

B - Chemical Analyses

Sample No.	Igarapé	Description	Percent Ta_2O_5	Percent Nb_2O_5	Percent SnO_2	Percent TiO_2
P - 2 (10 to 20)	Samaraca	As above	11.3	44.7	Not determined	
P - 2 (under 20)	Samaraca	As above	1.6	9.7	Not determined	
P - 6 (over 20)	Little Panel	As above	42.7	38.2	Trace	1.4

TABLE 9

SETE ILHAS AREA

A - Mechanical analysis of concentrates from some of principal placer workings.

Sample No.	Igarapé	Description	Mesh	Weight in grams	Estimated weight Tantalite in grams	Kilos Tantalite per cu. meter material --approx.
SI - 1	?	Coarse concentrate from hut - Yago village.	Over 10	237	230	--
SI - 2	Anta	11 liters from Long-Tom tails	Over 10	1	1	0.09
			10 to 50	1	0.5	0.04
			Subtotal	2	1.5	0.13
SI - 3	Anta	33 liters from Long-Tom tails	Over 10	13	13	0.4
			10 to 50	19	17	0.5
			Subtotal	32	30	0.9
SI - 4	Ambrosia	33 liters from Long-Tom tails	Over 10	1	1	--
			10 to 50	12	10	0.3
			Subtotal	13	11	0.3

B - Chemical Analyses

Sample No.	Igarapé	Description	Percent Ta_2O_5	Percent Nb_2O_5	Percent SnO_2	Percent TiO_2
SI - 1	?	As above	43.0	38.1	Trace	1.2
SI - 3 (over 10)	Anta	As above	37.0	43.2	Not determined	
SI - 3 (under 10)	Anta	As above	16.1	15.7	Not determined	
SI - 1 to 4	Mixed sample	As above	42.7	39.2	Not determined	

TABLE 10

GRADE AND RESERVE OF THE KNOWN PRINCIPAL CASSITERITE - TANTALITE PLACERS IN THE AMAPARI REGION

AREA	CREEK (Igarape)	CLASS*	OVERBURDEN Average Thickness (m)	GRAVEL (meters) Aver. Thick.	Aver. Length	Aver. Width	Cubic Meters	TAILINGS (m^3)	CASSITERITE kg/m^3	CASSITERITE Reserve kg	TANTALITE kg/m^3	TANTALITE Reserve Kilos	TANTALITE Percent Ta_2O_5: Nb_2O_5	GOLD g/m^3	GOLD Gms. Reserve	MINERS WORKING JULY 1945
Igarape des Indios	Grenat	Meas.-Ind.	0.65	0.65	275	4	715	0	15	10,725	0	0	0	1.5	1,073	
		Inferred	0.70	0.60	200	6	720	0	7.5	5,400	0	0	0	1.5	405	
		Subtotal					1,435			16,125					1,478	30
	Virgilio	Meas.-Ind.	0.5	0.4	100	3.5	175	150	10	2,250	0	0	0	1.5	262	
		Inferred	0.5	0.4	75	5	150	0	6.7	1,000	0	0	0	1.5	225	
		Subtotal					325			3,250					487	12
		Total					2,215	150		19,375					1,965	42
Jornal	Renale	Meas.-Ind.	0.5	0.4	25	5	50	150	4.5	900	0.8	160		2	100	
		Inferred	0.5	0.4	100	5	200	0	2.5	500	0.4	80		1.5	300	
		Subtotal					250	150		1,400		240			400	3
	Cecilon	Meas.-Ind.	--	--	--	--	--	60	7.0	420	1.0	60		--	--	
		Inferred	0.5	0.3	100	4	120	0	2.0	240	0.33	80		1.5	180	
		Subtotal					120	60		680		140			180	2
	Bruno	Meas.-Ind.	--	--	--	--	--	50	2.5	125	0.3	15		--	--	
		Inferred	0.6	0.4	150	5	300	--	1.0	300	0.15	45		2.0	600	
		Subtotal					300	50		425		60			600	3
		Total					670	260		2,505		440	45.5:34.5		1,180	8
Santa Terezinha	Unnamed	Meas.-Ind.	--	--	--	--	--	200	1.4	280	1.0	200		--	--	
		Inferred	0.35	0.35	125	5	220		0.7	155	0.35	77		1.0	220	0
		Total					220	200		435		277	65:11		220	0
Antonio-Panel	Berilia	Subtotal	--	--	--	--	--	180	--	--	3.4	612	71:10	--	--	0
	Blackwater	Meas.-Ind.	--	--	--	--	--	100	--	--	1.5	150				
		Inferred	0.5	0.5	60	5	150	--	--	--	0.75	113		1.5	225	
		Subtotal					150	100				263	32:48		225	6
	Little Panel	Meas.-Ind.	0.65	0.75	30	6	135	--	--	--	0.6	80		2.0	270	
		Inferred	0.65	0.67	70	6	280	--	--	--	0.5	140	43:38	1.5	420	
		Subtotal					415					220			690	3

TABLE 10 (Continued)

	Panel	Meas.-Ind.	1.2	0.4	15	10	60	200	--	--	0.2	52		3	180	
		Inferred	1.2	0.3	40	20	240	--	--	--	0.2	48		2	480	
		Subtotal					300	200				100			660	4
	Saramava	Meas.-Ind.	--	--	--	--	--	75	--	--	4.0	300		-	--	
		Inferred	0.6	0.4	100	5	200	--	--	--	1.5	300	16:64	1	200	
		Subtotal					200	75				600			200	0
		Total					1,065	555				1,795			1,775	13
Sete	Anta	Meas.-Ind.	--	--	--	--	--	150	--	--	0.5	75				
Ilhas		Inferred	0.6	0.4	75	5	150	--	--	--	0.2	30		1	150	
		Subtotal					150	150				105	38:42		150	0
	Ambrosia	Subtotal	--	--	--	--	--	100	--	--	0.3	30		-	--	0
		Total					150	250				135	43:39		150	0
		GRAND TOTAL					3,865	1,415		22,315		2,647			5,290	63

* In the Meas.-Ind. column, most of the reserve in tailings is measured and most of the reserve in gravel is indicated.