O T T A W A  April 13th, 1944.

# R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1616.

## Concentration of Tantalum and Tin Ores from the Yellowknife-Beaulieu Area, Northwest Territories.

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Shipment:

The shipment consisted of some twenty samples of ore, taken from various pegmatite dykes in the Yellowknife-Beaulieu area in the Northwest Territories.

These were received on November 8th, 1943, and were submitted by Dr. A. W. Jolliffe, of the Geological Survey Division, Bureau of Geology and Topography, Department of Mines and Resources, Ottawa, Ontario.

These samples were taken by Dr. Jolliffe during the 1943 field season while making a geological survey in the area.

Purpose of the Investigation:

The samples were submitted to the Metallic Minerals Division ore dressing laboratories primarily for concentration. The concentrates were to be returned to the mineralogical section of the Geological Survey Division for examination which would include both physical and chemical tests. Certain samples were designated for analysis only.

All data on the concentrates are extracts from reports of Dr. H. V. Ellsworth, Mineralogical Section, Geological Survey Division.

Results of the Investigation:

Samples of tin and tantalite ores were received from the following properties: Peg Group, Bore Group, Tan Group, Stannum Group, and the T. and B. Group.

The results of concentration and chemical analysis indicate that the concentrate recovered from Peg Group ore contained the purest tantalite of the shipment, $(TaCb)_2O_5$ 82.37 per cent.

The tantalite recovered from the Bore Group contained about 30 per cent cassiterite. This concentrate would probably be unacceptable as an ore of tantalum.

The concentrate from the Tan Group was found to have a specific gravity of 7.3, which indicated a $Ta_2O_5$ content of about 70 per cent for iron tantalite.

These determinations were made by Dr. H. V. Ellsworth, mineralogist of the Mineralogical Section, Geological Survey Division.

LOCATION OF THE DEPOSITS:

A description of the deposits, minerals, and various locations was furnished by Dr. A. W. Jolliffe. The following descriptions were taken from his reports:

> Several hundred complex pegmatite dykes were found in a granodiorite area east of Upper Ross lake, Northwest Territories. In 60 of these a preliminary examination disclosed tantalite. Almost all of the tantalite-bearing dykes were found within an area of two square miles, which appears to be part of a favourable belt a mile wide extending northwesterly for at least five miles between Upper Ross and Redout lakes. The Peg Group occupies part of this area.
>
> Upper Ross lake lies 45 miles northeast of Yellowknife, Northwest Territories, and may be reached by air, winter road via Thompson-Lundmark mine, or by a canoe route. The canoe route is some 80 miles long, including 21 portages totalling about 2 miles, up the Yellowknife and Cameron rivers to Tibbitt lake and thence up the stream which drains Ross lake.
>
> More than three-quarters of the area consists of

(Location of the Deposits, cont'd) -

glaciated hummocky exposures of bedrock. Except for an abrupt rise of about 100 feet near the northeast shore of Upper Ross lake, the local relief is probably less than 30 feet. Scrub spruce and jackpine are common in the vicinity of the deposits.

Description of the Deposits of the Peg Group -

Pegmatite dykes up to more than 500 feet long and 40 feet wide cross granodiorite cut by diorite dykes. The latter strike northwest and dip steeply east. The pegmatites commonly trend southwest, dip about 50 degrees to the southeast, and are offshoots from a pegmatitic granite body at least five miles across surrounding Redout lake. Preliminary examination indicates a rude zoning in the pegmatites extending outward from this body. Those closest to it contain considerable graphic granite and few rare minerals other than beryl. The pegmatites lying between one and two miles distant from the granite contain most of the rare minerals, including the best tantalite concentrations seen. Beyond this, lithium minerals (chiefly spodumene and petalite) become prominent in the dykes, but the content of beryl and tantalite diminishes. The description given below applies to the pegmatites in the tantalite-rich zone lying between one and two miles out from the main granite body.

The pegmatites consist largely of feldspar, quartz and muscovite in irregular mixtures and intergrowths. Few of the dykes show any marked banding parallel to the walls, although quartz is quite common as a band or as disconnected lenses along and near the centre of a dyke. The feldspar includes both microcline perthite and albite. The former is in crystals up to more than a foot across, in part showing ragged, partly replaced borders. Albite is in smaller aggregates, some of which exhibit the radiating lamellar habit of cleavelandite. Rare element minerals identified with reasonable certainty include (in about their order of relative abundance): beryl, tantalite, tourmaline, lithiophyllite and lazulite.

Tantalite occurs in blocky crystals up to two inches square and several inches long, and in plates up to two inches by four inches. It occurs characteristically within albite near quartz lenses but was found in each of perthite, quartz, muscovite and beryl. It appears to be most common in the medial and upper parts of the dykes. Some dykes only four inches across contain tantalite.

Description of the Deposits of the Bore Group -

Tin and tantalum deposits, possibly of commercial size and grade, occur near the south side of Sproul lake, about 35 miles northeast of Yellowknife and 10 miles due north of the Thompson-Lundmark gold mine.

The tin-, tantalum-, and lithium-bearing pegmatite dykes cut nodular greywacke of the Yellowknife Group (archaen). The sedimentary rocks trend uniformly northeast, dip 65° to 70° to the northwest, and face southeast. The area is preponderantly outcrop with rounded bare rock knobs

(Location of the Deposits, cont'd) -

rising to elevations of 50 feet above Sproul lake. The dykes described in this report are contained in a belt up to 200 feet wide extending northwesterly for at least 1700 feet. They pass beneath Sproul lake to the northwest and beneath a wide muskeg to the southeast. A few other pegmatites seen within a radius of a half mile showed generally similar mineralogy but appeared to be narrower, or less continuous, or to contain smaller percentages of rare minerals. Individual dykes within the belt are up to 42 inches wide and are almost certainly continuous for as much as 500 feet. With one exception they strike northwesterly and dip to the southwest at angles ranging between 30° and 60°.

The mineral content varies considerably within a single dyke, or even within a single outcrop. Minerals identified with reasonable certainty, in about the order of relative abundance are: feldspar, including both microcline and cleavelandite (a platy variety of albite); quartz; muscovite; spodumene; amblygonite; beryl; cassiterite; tantalite; and triplite (manganese-iron phosphate).

Cassiterite and tantalite are the only minerals of possible present economic interest. They occur chiefly in cleavelandite in the medial and upper parts of the dykes, but were seen enclosed by several other minerals and in the lower part of the dykes as well. The cassiterite occurs as dark-brown to jet-black, more or less equidimensional, angular crystals or aggregates up to 1¼ to 3/8 inches, averaging probably slightly more than ¼ inch across.

The tantalite is in blue-black crystals having a distinctive bladed or tabular habit. The largest seen measured 1¼ x ⅝ x 3/16 inches; the average size would be slightly less than ¼ inch long. From these upper limits the crystals of both minerals range downwards to almost microscopic size. The two minerals appear much the same on the glaciated surfaces of the dykes and they have about the same hardness and weight. The chief distinguishing feature is the colour of the powdered mineral, that of cassiterite being light brown and that of tantalite very dark brown to black. The tabular habit is diagnostic of tantalite, as is the common occurrence of a very narrow pink or red halo.

Tan and Stannum Groups -

These are located at Blatchford lake, which is north of the Hearne channel of Great Slave lake. The samples from the Stannum Group were sent in for analysis for tin. The sample of the Tan Group was sent in for concentration of tantalite.

No description of these deposits was received.

T. and B. Groups -

This property of the Consolidated Mining and Smelting Company Limited is located some 20 miles north of Sproul lake.

The samples were submitted for the concentration of tantalite.

Sampling and Analysis:

The samples that were submitted for concentration of tantalite were not analysed or sampled. Several samples were submitted to determine the tin content. These were crushed and sampled by standard methods and a representative portion was analysed for tin.

The following is a list of the samples submitted for concentration and assay:

SAMPLES FROM THE PEG GROUP, ROSS LAKE:

Tantalum Ore

| Sample No. | | Weight, pounds |
|---|---|---|
| 48/1 | - | 29 |
| 48/2 | - | 22 |
| 48/3 | - | 22 |
| 48/4 | - | 22 |
| 48/6 | - | 22 |
| 48/7 | - | 35 |

SAMPLES FROM THE BORE GROUP:

Tantalum Ore

| Sample | Weight, pounds | Analysis |
|---|---|---|
| I | 66 | None required. |
| J | 52 | " " |
| K | 54 | " " |
| L | 58 | " " |
| A144 | 16 | " " |

Tin Ore

| | | |
|---|---|---|
| R | 53 | Sn, none detected. |
| S | 58 | Sn, " " |
| T | 57 | Sn, 0.41 per cent. |
| U | 53 | Sn, 0.06 " |

SAMPLE FROM THE TAN GROUP (Middle Dyke):

A171 23 pounds, tantalum ore.

SAMPLES FROM THE STANNUM GROUP:

A177 Pegmatitic material from shaft. Sn, none detected.
A178 Greisen " " " " " "

(Continued on next page)

(Sampling and Analysis, cont'd) -

SAMPLES FROM THE T. AND B. GROUP (C.M. & S. Co.):

Trench 4 - 12.5 pounds.
Trench 5 - 11.0 "

INVESTIGATIVE PROCEDURE:

The tin ore from the Bore Group consisted of four samples, R, S, T, and U. Each was first crushed and sampled, after which the four were combined and concentrated as one sample.

Each of the samples which were to be concentrated for tantalite or tin was crushed to pass a 20-mesh screen. The ore was then screened on 35-, 48-, and 65-mesh screens. This resulted in four products (-20+35 mesh, -35+48 mesh, -48+65 mesh, and -65 mesh). Each of the plus 65 mesh products was concentrated separately on the Wilfley table. A rougher concentrate was obtained, which was recleaned on the Haultain superpanner. The Wilfley table middlings and tailings were combined with the superpanner tailing and crushed through 65 mesh. This minus 65 mesh product was combined with the original minus 65 mesh ore. This minus 65 mesh fraction was then tabled.

Four concentrates were thus obtained from each sample. These were kept separate for examination by Dr. H. V. Ellsworth, who determined the specific gravities of the minerals by his precision method. A chemical analysis was made on the Peg Group composite concentrate.

(Continued on next page)

(Investigative Procedure, cont'd) -

Results of Concentration:

TANTALUM ORE, PEG GROUP, ROSS LAKE.

| Sample No. | Weight of ore, pounds | Weight of concentrate, in grams -20+35 | -35+48 | -48+65 | -65 | Total | Calculated weight of concentrate, lb./ton of ore |
|---|---|---|---|---|---|---|---|
| 48/1 | 29 | 86.0 | 41.0 | 23.8 | 54.0 | 204.8 | 31.14 |
| 48/2 | 22 | 0.4 | 0.3 | 0.3 | 2.2 | 3.2 | 0.64 |
| 48/3 | 22 | 0.3 | 0.3 | 0.4 | 0.8 | 1.8 | 0.36 |
| 48/4 | 22 | 4.7 | 3.0 | 2.3 | 7.9 | 17.9 | 3.59 |
| 48/6 | 22 | 2.1 | 0.5 | 0.8 | 2.4 | 5.8 | 1.16 |
| 48/7 | 35 | 53.2 | 19.5 | 18.0 | 51.2 | 141.9 | 17.88 |

TANTALUM ORE, BORE GROUP, SPROUL LAKE.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I | 66 | 14.0 | 4.5 | 1.8 | 16.4 | 36.7 | 2.45 |
| J | 52 | 1.8 | 1.6 | 2.1 | 5.7 | 11.2 | 0.95 |
| K | 54 | 1.3 | 0.8 | 1.2 | 9.4 | 12.7 | 1.04 |
| L | 58 | 2.6 | 1.0 | 0.8 | 12.4 | 16.8 | 1.28 |
| A144 | 16 | 7.2 | 4.3 | 4.2 | 15.2 | 30.9 | 8.51 |

TIN ORE, BORE GROUP, SPROUL LAKE.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| R) S) T) U) | 211.0 | 68.5 | 37.0 | 28.7 | 72.4 | 206.6 | 4.32 |

TANTALUM ORE, MIDDLE DYKE, TAN GROUP, BLATCHFORD LAKE.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A171 | 23 | 5.5 | 3.4 | 3.3 | 20.4 | 32.6 | 6.25 |

TANTALUM ORE, T. AND B. GROUP (C.M. & S. CO. PROPERTY).

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Trench 4 | 12.5 | 0.1 | 0.2 | 0.2 | 0.2 | 0.7 | 0.25 |
| Trench 5 | 11.0 | 0.5 | 0.1 | 1.2 | 0.1 | 1.9 | 0.76 |

RESULTS OF CHEMICAL AND PHYSICAL TESTS:

PEG GROUP, ROSS LAKE.

Sample 48/1, -20+35 Mesh Concentrate -

This concentrate (86.0 grams) as received was probably the purest so far examined, being at least free from steel, solder, etc., and with relatively little gangue. A test for cassiterite by reduction in a zinc dish did not reveal a single grain of cassiterite.

Specific gravity of Sample 48/1, -20+35 mesh as received, is 7.632(0) at 21.32° C.

After picking over, under the binocular microscope, the same concentrate gave specific gravity 7.656(2) at 21.27° C.

Sample 48/7, -20+35 Mesh Concentrate -

51.2 grams as received gave specific gravity of 7.598(1) at 22.60° C.

These were the main concentrates of the Peg Group by weight.

A weighted average sample of all the 24 concentrates of the Peg Group was prepared, the small concentrates of fractional gram weight and up to 2 or 3 grams being combined for this purpose. This sample was ground and analysed, with the following results:

| | | Per cent |
|---|---|---|
| $(TaCb)_2 O_5$ | = | 82.37 |
| $TiO_2$ | = | 1.59 |
| FeO | = | 13.91(1) |
| MnO | = | 0.66 |
| $SnO_2$ | = | 0.14(2) |
| $WO_3$ | = | None detected. |
| Insol. | = | 0.62(3) |
| | | 99.29 |

1. Includes iron from pyrite and any steel particles present.

2. $SnO_2$ not exceeding 0.14 per cent, possibly less. A spectroscopic test showed very little tin, no tungsten.

3. The insoluble does not represent quite the total amount of gangue minerals present, as feldspar and mica are more or less completely decomposed by the fusions, and only their constituent silica may appear in the insoluble.

(Results of Chemical and Physical Tests, cont'd) -

BORE GROUP, SPROUL LAKE.

Tantalite concentrate -20+35 mesh, weight 14.1420 grams, used half for specific gravity 6.609 at 20.45° C. as received.

This concentrate showed a considerable amount of impurities, plenty of small grains of quartz and feldspar, a little mica, steel particles, and little metal balls about 1/3 mm. in diameter and bun-shaped rolls of a soft, more or less corroded metal, possibly solder. Many tantalite grains have attached quartz or feldspar. A very few fluorescent grains were also seen, resembling scheelite in appearance. None of the little metallic balls and rolls was attached to mineral grains, all were free.

Of the above concentrate, 1,000 grams as received was reduced in a zinc dish to identify cassiterite. A count gave 31.20 per cent and a weighing, 29.10 per cent cassiterite.

As the material appeared to be probably unacceptable for a tantalum ore, no further work was done.

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TAN GROUP, BLATCHFORD LAKE.

Sample A171, -20+35 mesh tantalite concentrate. - Grains of quartz, feldspar and pyrite were present and a zinc reduction test showed cassiterite present. The reduced grains collected under the binocular microscope from 0.5000 gram of sample, as received, gave 11.6 per cent cassiterite by weight. However, not all the grains weighed were cassiterite and, on the other hand, cassiterite intergrown with tantalite is probably not reduced unless the cassiterite happens to actually touch the zinc. The cassiterite occurs in the concentrates both as minute crystals and as intergrowths with the tantalite. Some of the tiny crystals are quite perfectly formed. They

(Results of Chemical and Physical Tests, cont'd) -

appear to be identical in habit with those from Stoneham, Me., represented by Figure 1, page 234, Dana, with pyramidal faces s(111) and e(101). Those seen were about $\frac{3}{4}$ mm. in diameter.

The minus 65 mesh concentrate, weight 20.4 grams, which is the main one in this lot, was also tested for tin and showed a considerable quantity.

The specific gravity of Sample A171, -20+35 mesh, tantalite concentrate as received, using the whole lot of 5.5 grams, was 7.055(2) at 19.65° C.

After picking out, under the binocular microscope, reduced cassiterite, gangue, pyrite, and all grains showing attached or intergrown cassiterite, the specific gravity of the 0.73 gram thus obtained was 7.31(8) at 19.75° C. Evidently the cassiterite compensated for some of the lighter impurities present.

Specific gravity of 7.3 would indicate a $Ta_2O_5$ content of around 70 per cent for iron tantalite.

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CONCLUSIONS:

The investigation discloses that the ore lends itself to gravity concentration of the heavy minerals present. Cassiterite is present in some of the tantalite concentrates and is not amenable to mechanical separation from tantalite; thus, it was included in the tantalite concentrate.

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