CANADA

DEPARTMENT OF MINES AND RESOURCES

MINES AND GEOLOGY BRANCH

GEOLOGICAL SURVEY

PAPER 44-12

RARE-ELEMENT MINERALS IN PEGMATITES, YELLOWKNIFE-BEAULIEU AREA, NORTHWEST TERRITORIES

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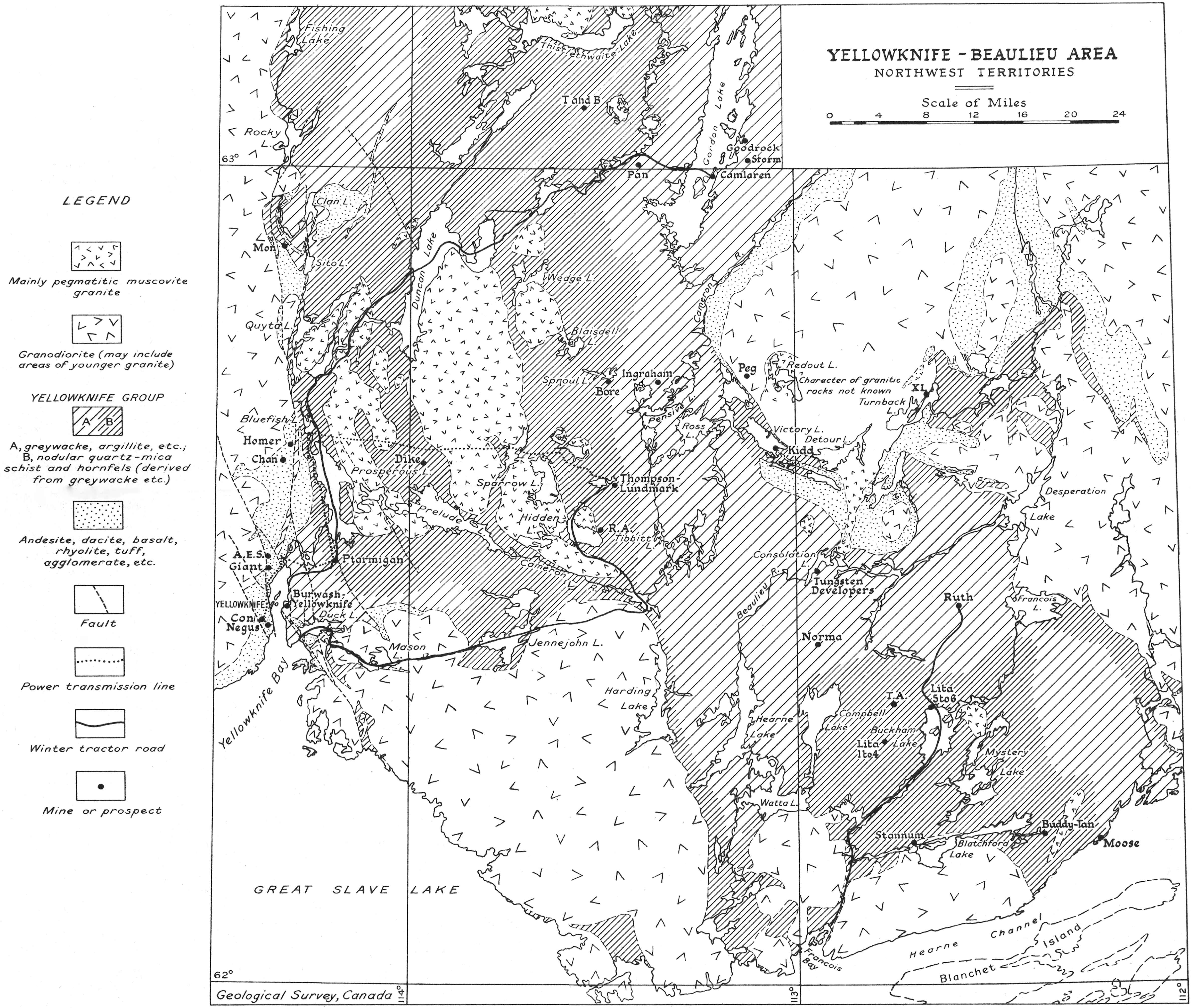
YELLOWKNIFE - BEAULIEU AREA
NORTHWEST TERRITORIES
Scale of Miles
0 4 8 12 16 20 24
LEGEND
Mainly pegmatitic muscovite granite
Granodiorite (may include areas of younger granite)
YELLOWKNIFE GROUP
A B
A, greywacke, argillite, etc.; B, nodular quartz-mica schist and hornfels (derived from greywacke etc.)
Andesite, dacite, basalt, rhyolite, tuff, agglomerate, etc.
Fault
Power transmission line
Winter tractor road
Mine or prospect
Fishing Lake
Thistlethwaite Lake
T and B
Rocky L.
Gordon Lake
Goodrock
Storm
Pan
Camlaren
63°
Clan L.
Mon
Sito L.
Duncan Lake
Wedge L.
Cameron R.
Quyta L.
Blaisdell L.
Peg
Redout L.
Character of granitic rocks not known
Sproul L.
Ingraham
Bore
XL
Turnback L.
Pensive L.
Bluefish L.
Ross L.
Victory L.
Detour L.
Homer
Chan
Dike
Kidd
Prosperous L.
Sparrow L.
Thompson-Lundmark
Desperation Lake
Prelude
Hidden L.
R.A.
Tibbitt L.
A.E.S.
Giant
Ptarmigan
Cameron R.
Consolation L.
Tungsten Developers
Burwash-Yellowknife
YELLOWKNIFE
Duck L.
Ruth
Francois L.
Con
Negus
Beaulieu R.
Norma
Mason L.
Jennejohn L.
Yellowknife Bay
Harding Lake
T.A.
Lita 5to6
Hearne Lake
Campbell Lake
Buckham Lake
Lita 1to4
Mystery Lake
Watta L.
Buddy-Tan
Moose
Stannum
Blatchford Lake
GREAT SLAVE LAKE
Hearne Channel
Island
Blanchet
Francois Bay
62°
Geological Survey, Canada
114°
113°
112°

FIGURE 1

RARE-ELEMENT MINERALS IN PEGMATITES,

YELLOWKNIFE-BEAULIEU AREA, NORTHWEST TERRITORIES

INTRODUCTION

Pegmatite dykes, sills, and stocks carrying tantalum, columbium, lithium, beryllium and tin minerals are widespread in Yellowknife-Beaulieu region. The area throughout which they are common probably exceeds 1,000 square miles and scarcely 1 per cent of the pegmatite bodies estimated to be present in the region have been closely prospected for such minerals. Although some of the tantalum and lithium deposits so far found may rank with the best known elsewhere, it seems improbable that the small fraction of pegmatites examined includes the best rare-element deposits in the area. Accordingly, this report is designed primarily to assist prospectors in the detection and evaluation of pegmatites carrying rare-element minerals. It is based mainly on the examination of nearly five hundred pegmatite bodies by the Geological Survey during the field season of 1943; this program could not have been carried out effectively without information concerning previous discoveries freely supplied by prospectors and companies active in the area -- particularly by W. L. McDonald and G. DeStaffany of Yellowknife, and by Consolidated Mining and Smelting Company of Canada, Limited. Capable field assistance was rendered by Messrs. Y. O. Fortier, W. R. Sproul, J. A. Woodard, D. B. McDougall, and J. R. Saunders.

Yellowknife-Beaulieu area comprises about 5,000 square miles on the north side of Great Slave Lake, 600 miles north of railhead at Waterways, Alberta. It may be reached in season by boat or by aircraft on floats or skis. Current freight rates by boat between Yellowknife and Waterways are $1.75 to $1.90 per hundredweight. Air freight is at 40 cents a pound. Aircraft based at Yellowknife and capable of carrying payloads of from 1,000 to 1,500 pounds may be chartered at from 65 to 85 cents a mile; the abundance of lakes in the region permit landing almost anywhere. All these rates may not apply to large shipments. Gold to a value of about $14,000,000 has been recovered from the area since production started late in 1938. At one time five properties were operating (Con-Rycon, Negus, Ptarmigan, Thompson-Lundmark, and Ruth; See Figure 1), but within the past year or so shortage in labour has stopped production at all except the Negus mine. Operating costs exclusive of depreciation lie within the range of $10 to $20 per ton milled. In addition, small mills have operated at various times on other properties, including Ingraham, Tungsten Developers, Goodrock, and Norma. Practically all prospecting has been for gold alone, except that since 1940 considerable search has been made for tungsten. Prior to 1943 about fifty intrusions of rare-element-bearing pegmatite had been found in the area. Of nearly 500 examined in 1943, tantalum-columbium was found in 100, lithium in 30, beryllium in 228, and tin in 22. It should be stressed that many of these pegmatite bodies could not be closely prospected and that altogether they represent only about 1 per cent of the pegmatites in the region; consequently, the rare-element possibilities should not be gauged on the basis of the described deposits.

GEOLOGY[1]

[1] This summary account may be supplemented by marginal notes on Geological Survey Maps 581A (Beaulieu River Area, 1941) and 709A (Yellowknife Bay Area, 1942) obtainable from the Bureau of Geology and Topography, Department of Mines and Resources, Ottawa.

The area is underlain wholly by rocks of Precambrian age and is characterized by a high proportion (perhaps 50 to 75 per cent) of exposed bedrock. The oldest known rocks are volcanic and sedimentary formations of the Yellowknife group (Archaean). The sedimentary members may be divided into relatively unaltered greywacke and slate, on the one hand, and their altered derivatives, nodular quartz-mica schist and sedimentary gneiss, on the other; these are known locally as "cool" and "hot" sediments respectively. As is implied by these terms, the "hot" sediments surround bodies of intrusive granitic rocks and grade outwards into "cool" areas. Different ages of granitic intrusions have long been suspected in the area and two are now definitely known to be present. The older is a granodiorite containing notable amounts of biotite or hornblende or both of these minerals. The younger is mainly a muscovite-biotite granite with tourmaline-bearing pegmatitic phases. In areas around bodies of the younger granite, pegmatite dykes and sills are much more common and the "hot" zone is much wider than around the older granodiorite. A large area of "hot" sediments around Buckham Lake suggests that the few stocks of younger granite present are offshoots from an underlying, extensive, younger granite batholith. The rare-element pegmatites of the region are all thought to be related to the younger granite, as are tourmaline-bearing gold-quartz veins such as those at Thompson-Lundmark mine. Diabase dykes cut all the above-mentioned rocks. Numerous faults trend north to northwest up Yellowknife River Valley. Rocks on the east side of each fault have been shifted relatively northwards for distances up to 5 miles. Many of the bedrock structures can be identified more readily on air photographs than on the ground. In addition, in areas underlain by sedimentary rocks cut by pegmatite bodies, a vertical air photograph will frequently serve as a detailed geological map[1].

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[1] Vertical air photographs are available for part of the area only. They may be obtained from the Chief, Bureau of Geology and Topography, Dept. of Mines and Resources, Ottawa. Accompanying the application should be a sketch map showing the area for which photographs are requir d, and a money order payable to the Receiver General of Canada covering the cost. For vertical photographs the cost averages about 30 cents per square mile. If these are not available and oblique photographs (which cost less) have to be substituted, the balance will be refunded. All the Yellowknife-Beaulieu area is covered with oblique photographs, which are less useful than the verticals but are still of considerable help in prospecting.

PEGMATITES

Pegmatites carrying rare-element minerals are most common in the "hot" sediments around bodies of younger granite. Some occur within the border phases of such bodies; they have also been found cutting older granodiorite between Ross and Redout Lakes. So far as is known they do not occur within the "cool" sediments. Most of them are tabular-shaped dykes or sills but some irregular bodies may be termed stocks.

The pegmatite intrusions consist chiefly of pink, white, and grey feldspar, milky quartz, and honey-yellow to colourless muscovite. The feldspar includes both microcline and cleavelandite, the latter a radiating, platy variety of albite. Other minerals identified are beryl, spodumene, amblygonite, lithiophilite, petalite, lepidolite, cassiterite, tantalite-columbite, tourmaline (including black, blue-green, and red varieties), garnet, gahnite (zinc spinel), graphite, lazulite, hornblende, fluorite, scheelite, molybdenite, arsenopyrite, pyrite, and ilmenite. Most of these minerals have a wide distribution, but a few have been found in one or two pegmatites only. The identities of several other minerals have not yet been established. Minerals were identified in the field by means of blowpipe, chemical, and specific gravity tests, supplemented by more complete investigations in Ottawa by H. V. Ellsworth of the Mineralogical Section of the Geological Survey. In view of the haste with which most of the pegmatites were examined in the field, other rare-element minerals may have been overlooked. At present, however, the only minerals of possible economic interest seem to be those containing tantalum, columbium, lithium, beryllium, and tin. The particular varieties of minerals carrying these elements in Yellowknife-Beaulieu pegmatites are described in order to assist in their identification by prospectors.

DESCRIPTIONS OF RARE-ELEMENT MINERALS

MINERALS CONTAINING TANTALUM AND COLUMBIUM

Tantalite-columbite

Composition: $(Fe,Mn)O.(Ta,Cb)_2O_5$ All gradations are possible between ferrotantalite ($FeO.Ta_2O_5$), mangantantalite ($MnO.Ta_2O_5$), ferrocolumbite ($FeO.Cb_2O_5$), and mangancolumbite ($MnO.Cb_2O_5$); small amounts of tin and titanium may be present.

Hardness: 6 to 7.

Specific Gravity: 5.2 to 8.2 (increasing with content of tantalum and iron).

Lustre: sub-metallic to metallic; opaque.

Colour: steel-grey (columbite) to purple-black (tantalite).

Colour of powdered mineral: dark brown to black.

Cleavage: one good.

Habit: well-formed crystals -- a high tantalum content is commonly associated with blocky, more or less equidimensional crystals, whereas high-columbium varieties seem to be characterized by thin, platy forms. The largest crystal of tantalite observed was in Dyke (1), Ross Lake area (See Figure 2), and measures 2 inches square by several inches long.

Minerals in Yellowknife-Beaulieu pegmatites that are most easily confused with tantalite-columbite include tourmaline and black alteration products of spodumene and lithiophilite, but all these give a white to grey powder and have specific gravities only about half that of tantalite-columbite. Cassiterite also resembles tantalite-columbite, but can be distinguished by the lighter colour of its powder, and by its reaction with zinc and hydrochloric acid (See under Tin). In some pegmatite bodies, black minerals are present in such tiny grains that ordinary field tests cannot be used; tantalite-columbite should be suspected in the case of those grains that are haloed by dark red feldspar; the haloes commonly extend less than a millimetre outwards from such grains.

Tantalite-columbite is a mineral of widely varying composition. As varieties rich in tantalum may command up to ten times the price of columbite ores, the worth of a tantalite-columbite deposit cannot be estimated until the average composition of the mineral present is known. Accurate chemical analysis of tantalite-columbite is a most difficult task and quite beyond the capabilities of most assayers. In consequence, producers of the mineral may have to rely on determinations made by the purchaser. However, the specific gravity of tantalite-columbite increases with the tantalum content, as is shown in Table I. Thus, if the specific gravity of the mineral is measured, its approximate composition can be determined by reference to the table.

Table I*

Relation of Specific Gravity to Composition in Tantalite-Columbite

* Prepared by H. V. Ellsworth, Geological Survey. The apparent discrepancies in the relationship may be due to the presence of gangue, variations in the iron and manganese content, or to other factors.

Specific Gravity	Ta_2O_5 %	Cb_2O_5 %	FeO %	MnO %	Impurities determined %	Total %
5.259	0.83	76.64	6.95	10.25	5.09	---
5.262	0.83	76.26	7.65	11.29	4.19	100.22
5.2726	11.33	63.77	11.38	8.79	4.37 (incl. 1.50 TiO_2)	99.64
5.32	5.26	72.37	15.04	5.97	1.25	99.89
5.32	5.87	71.38	15.86	5.33	1.48	100.04
5.383	2.74	73.45	11.32	9.70	1.96	---
5.395	----	77.97	17.33	3.28	1.34	99.92
5.396	19.72	62.80	11.16	2.85	1.28	97.81
5.52	12.60	64.60	15.00	7.30	0.40 SnO_2	99.90
5.65	17.86	60.59	14.82	4.73	1.93	99.93
5.65	9.22	68.99	16.80	3.65	1.61 (SnO_2 + WO_3)	100.27
5.661	22.12	56.48	8.07	12.45	0.71	99.83
5.73	18.95	60.95	12.86	7.07	----	99.83
5.73	19.44	60.46	12.95	7.00	----	99.85
5.74	16.25	62.64	13.06	6.11	2.24 (incl. 1.01 WO_3)	100.30
5.75	22.79	56.43	15.82	2.39	2.68 (incl. 1.07 WO_3)	100.11
5.780	19.71	60.52	12.64	7.51	0.09	100.47
5.804	18.93	61.72	11.21	8.67	0.25	100.78
5.890	18.20[1]	54.09[1]	11.21	7.07	0.31	90.88

[1] Possibly as much as 28.20 per cent Ta_2O_5 or 64.09 per cent Cb_2O_5

Specific Gravity	Ta_2O_5 %	Cb_2O_5 %	FeO %	MnO %	Impurities determined %	Total %
5.901	23.43	57.32	6.29	13.55	0.09	100.68
6.04	73.83	6.44	8.42	1.39	7.78 CaO, 0.62 MgO, 0.54 TiO_2, 0.72 SnO_2,	99.73[1]
6.082	42.15	40.21	16.00	1.07	0.18	99.61
6.151	28.55	51.53	13.54	4.55	2.02	100.19
6.170	34.27	47.22	1.89	16.25	0.32	99.95
6.181	34.04	47.05	11.15	7.80	0.30	100.34
6.211	23.97	49.56	9.86	11.98	3.92 (incl. 2.17 SnO_2, 0.96 WO_3)	99.29
6.232	40.19	41.69	9.88	8.70	0.11	100.57
6.245	35.14	46.59	7.44	10.94	0.18	100.29
6.26	30.58	48.87	15.70	2.95	1.45 (incl. 0.91 WO_3	99.55
6.311	49.64	29.27	13.77	2.88	3.24 (incl. 2.49 SnO_2+ WO_3)	98.80
6.373	44.87	37.29	6.87	11.02	0.09	100.14
6.376	41.14	40.37	8.28	9.09	1.01	99.89
6.393	44.55	37.91	6.70	11.05	0.09	100.30
6.445	42.09	40.28	6.70	11.23	0.19	100.49
6.469	44.48	37.28	9.29	8.68	0.16	99.89
6.515	42.96	39.94	8.59	8.82	0.01	100.31
6.565	42.92	40.07	9.73	7.24	0.20	100.16
6.59	52.29	30.16	0.43	15.58	0.37	98.83
6.592	57.60	24.40	14.46	2.55	1.14	100.15
6.612	47.11	35.11	8.37	9.26	0.35	100.20
6.707	52.49	31.31	6.10	10.71	0.09	100.70
6.750	53.28	29.78	6.11	10.40	0.13	99.70

[1] Calciotantalite from Wodgina

Specific Gravity	Ta_2O_5 %	Cb_2O_5 %	FeO %	MnO %	Impurities determined %	Total %
6.84	56.90	26.81	10.05	5.88	----	99.64
6.88	59.92	23.63	12.86	3.06	0.34	99.81
7.03	65.60	10.88	17.42		6.10 SnO_2	100.00
7.03	68.65	15.11	1.63	14.15	1.03 inc. 0.40 TiO_2	100.64
7.09	69.95	14.47	2.68	12.54	0.36 SnO_2	100.00
7.232	63.58	19.24	9.19	5.97	1.93	99.91
7.272	69.97	12.26	14.83		2.92 SnO_2	100.00
7.277	70.53	13.14	14.30	1.20	0.82 SnO_2	99.99
7.301	79.81	4.47	1.17	13.88	1.00	100.33
7.314	68.15	11.15	15.32	2.61	2.97	100.22
7.36	70.49	7.63	1.34	10.87	9.89 inc. 8.9 SnO_2	100.22
7.384	76.34	7.54	13.90	1.42	0.70 SnO_2	99.90
7.72	79.01	----	8.33	12.13	0.39 SnO_2	99.86
7.74	80.61	2.50	10.89	3.78	2.70 inc. 0.71 TiO_2	100.48
7.773	78.20	6.23	14.00	0.81	0.68 SnO_2	99.92
7.78	83.39	1.46	11.13	2.64	0.34 TiO_2 .03 SnO_2	98.99[1]
7.789	78.35	6.24	14.05	1.14	0.58	100.36
8.200	82.23	3.57	12.67	1.33	0.32	100.12

MINERALS CONTAINING LITHIUM

Spodumene

Composition: $Li_2O.Al_2O_3.4SiO_2$, theoretically equivalent to a content of 8.4 per cent lithium oxide; most varieties carry only 4 to 7 per cent.

Hardness: 6 to 7.

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1 Jemubi River Valley, Uganda Imp. Inst. analysis

Specific gravity: 3.1 to 3.2.

Lustre: pearly on cleavage faces; translucent.

Colour: light grey to greenish grey (apparently easily altered to a yellow, very fine-grained micaceous aggregate that retains the long prismatic outline of spodumene, or to a dark green to nearly black product that retains both the outline and cleavages of spodumene).

Colour of powder: white.

Cleavage: three good, all parallel to the length.

Habit: long, prismatic crystals; the largest seen are in the McDonald pegmatite where several crystals exceed 10 feet in length and range to more than 2 feet in thickness.

The only minerals that resemble spodumene in the Yellowknife-Beaulieu pegmatites are coarsely crystalline grey feldspar and amblygonite. The former is relatively rare (most feldspar is pink to cream coloured) and shows three cleavages at about right angles to each other, resulting in cubic or oblong shapes, whereas spodumene commonly breaks into long splintery forms not commonly characterized by faces at right angles. Amblygonite has a distinctive chalky appearance on the weathered surface and is in more or less equidimensional crystals as contrasted with the markedly elongated crystals of spodumene.

Amblygonite

Composition: $Al_2O_3.P_2O_5.2LiF$, corresponding to a theoretical content of 10.1 per cent lithium oxide; most varieties carry about 9 per cent.

Hardness: 6.

Specific gravity: 3 to 3.1

Lustre: greasy on some faces, pearly on others; translucent.

Colour of powder: white.

Cleavage: two good, at about 75 degrees.

Habit: more or less equidimensional crystals and aggregates; the largest observed are in the Moose dyke where aggregates exposed on the glaciated surface measure nearly 3 feet in diameter.

Spodumene is the only mineral apt to be confused with amblygonite; the chalky weathered surface and cleavage angle are diagnostic of the latter.

Lithiophilite

Composition: $Li_2O.2(Mn,Fe)O.P_2O_5$, equivalent to a lithium oxide content of about 9 per cent.

Hardness: 4 to 5 (can be scratched easily with a knife)

Specific gravity: about 3.5

Lustre: resinous; translucent when not altered.

Colour: yellow-brown in fresh specimens; alters readily to a dark brown to purple-black.

Colour of powder: light brownish grey to white.

Cleavage: three, good.

Habit: irregularly shaped aggregates; in the Prelude Lake pegmatites these are up to a foot across.

Some weathered crystals coated with manganese stain resemble cassiterite and tantalite, but are distinguished by their much lower specific gravity.

Petalite and Lepidolite

These minerals carry less than 5 per cent lithium oxide, and have been identified in one pegmatite each. The scarcity of lithia mica in pegmatites carrying abundant spodumene and amblygonite is noteworthy.

MINERALS CONTAINING BERYLLIUM

Beryl

Composition: $3BeO.Al_2O_3.6SiO_2$, equivalent to a theoretical content of 14 per cent beryllium oxide; natural varieties may carry as little as 11 per cent.

Hardness: 7.5 to 8 (scratches glass readily).

Specific gravity: about 2.7.

Lustre: vitreous; translucent.

Colour: various shades of green to white; also light blue and golden yellow.

Colour of powder: white.

Cleavage: poor or absent.

Habit: commonly in distinct six-sided prismatic crystals; occasionally barrel-shaped, that is, thicker in the middle than at either end.

The white variety resembles quartz but in most places shows sharp hexagonal crystal boundaries, whereas practically all the quartz in Yellowknife-Beaulieu pegmatites is massive with irregular outlines. The largest beryl seen is in a dyke near Blaisdell Lake where a basal section of two intergrown crystals measures 12 by 18 inches.

MINERALS CONTAINING TIN

Cassiterite

Composition: SnO_2, equivalent to 78.6 per cent tin.

Hardness: 6 (can just be scratched with a knife).

Specific gravity: 7.

Lustre: adamantine; almost opaque to translucent with red-brown internal reflections (resembles the "black jack" variety of sphalerite).

Colour: dark brown to black.

Colour of powder: grey to light brown.

Cleavage: one good (not common in cassiterite elsewhere).

Habit: more or less equidimensional aggregates; the largest seen measure about a cubic inch and are in the Sproul Lake dykes.

All cassiterite recognized so far in Yellowknife-Beaulieu area is brown-black and closely resembles tantalite-columbite. The colour of the powdered mineral is usually sufficient to distinguish the two minerals, that of cassiterite being much lighter than the dark brown to purple-black powder of tantalite-columbite. The best diagnostic test for cassiterite is obtained by placing the suspected mineral in contact with zinc and covering this with hydrochloric acid. Within a few minutes cassiterite will become coated with a dull grey film of metallic tin, which becomes bright on being rubbed.

TREATMENT AND DISPOSAL OF TANTALUM-COLUMBIUM, LITHIUM, BERYLLIUM, AND TIN ORES

Information concerning methods of milling and concentrating rare-element minerals may be obtained from the Bureau of Mines, Department of Mines and Resources, Ottawa. Current prices and lists of possible buyers of such concentrates may be had on application to this Bureau, or to the Metals Controller, Department of Munitions and Supply, Ottawa.

DESCRIPTIONS OF DEPOSITS

ROSS LAKE AREA

Peg. Jol. and Other Groups

In 1943, during the geological mapping of a granodiorite area east of Upper Ross Lake (45 miles northeast of Yellowknife), several hundred pegmatite dykes were found, in sixty of which a preliminary examination disclosed tantalite-columbite. The pegmatite bodies range to more than 500 feet in length and 40 feet in width, and traverse granodiorite cut by diorite dykes (See figure 2) that strike northwest and dip steeply east. They commonly trend southwest, dip about 50 degrees to the southeast, and are offshoots from a pegmatitic granite body that surrounds Redout Lake. This body is at least 5 miles in diameter and may extend east and southeast for 15 miles to join with a younger granite salient north of Consolation Lake. So far as is known, prospecting for rare-element minerals around this mass has been limited to about 10 square miles between

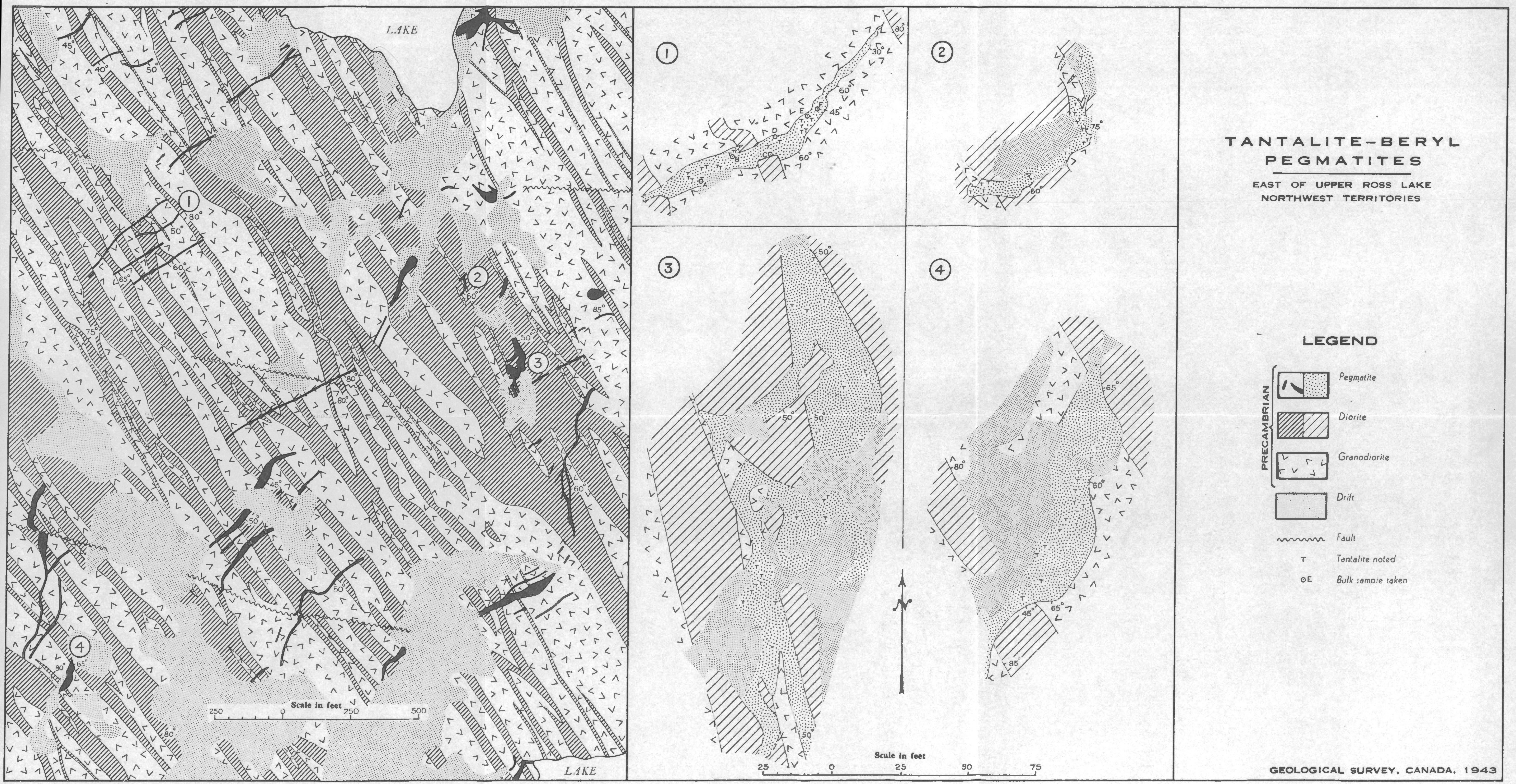
LAKE
LAKE
Scale in feet
250 0 250 500
Scale in feet
25 0 25 50 75
TANTALITE-BERYL PEGMATITES
EAST OF UPPER ROSS LAKE
NORTHWEST TERRITORIES
LEGEND
PRECAMBRIAN
Pegmatite
Diorite
Granodiorite
Drift
Fault
T Tantalite noted
⊙E Bulk sample taken
GEOLOGICAL SURVEY, CANADA, 1943

FIGURE 2

Upper Ross and Redout Lakes. Within this area, a preliminary examination indicates a rude zoning in the pegmatites extending outward from the younger granite body. Those nearest to it contain considerable graphic granite and few rare-element minerals other than beryl. The pegmatite intrusions lying between 1 and 2 miles from the granite contain most of the rare-element minerals, including the best tantalite-columbite concentrations seen. Beyond this, spodumene and, in one dyke, petalite, become prominent, but the content of beryl and tantalite-columbite diminishes. The description given below applies to pegmatites in the zone lying between 1 and 2 miles out from the main granite body.

Most of the area shown in Figure 2 is contained in the Peg group of four claims owned by J.R. Saunders of Yellowknife, N.W.T. Adjoining these on the east and south are the Jol claims staked on behalf of Radium Luminous Industries, Limited. Other claims are reported to have been staked in the vicinity.

The pegmatite bodies 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-columbite, tourmaline, lithiophilite, and lazulite.

Tantalite-columbite occurs in blocky crystals up to 2 inches square and several inches long (Dyke 1, Figure 2), and in plates up to 2 inches by 4 inches (Dyke 2, Figure 2). 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 4 inches across contain tantalite-columbite. Specific gravity determinations on samples of the mineral from various dykes shown in Figure 2 are given in Table II.

Table II

Specific Gravity of Tantalite-Columbite from Ross Lake Area

No.	Sp. Gr.		Dyke
1	7.2	(2)	No. 1.
2	7.6	(a)	No. 4.
3	7.22	(b)	150 feet northwest of No. 4.
4	7.52	(b)	250 feet northwest of No. 4.
5	7.80	(b)	No. 4; practically free from gangue.
6	7.87	(b)	No. 4; almost entirely free from gangue; preliminary chemical tests showed 1.5 per cent MnO, Ti not high, Cb doubtful, Sb and Bi nil.

No.	Sp. Gr.		Dyke
7	7.6320	(c)	No. 1; coarse concentrate from bulk sample A as received.
8	7.6562	(c)	No. 1; coarse concentrate from bulk sample A after partial removal of some of the gangue impurities; chemical test showed no tin.
9	7.5981	(c)	No. 1; coarse concentrate from bulk sample F as received.

(a) Measured in field on Westphal balance by Y. O. Fortier.
(b) Measured on Joly balance by H. V. Ellsworth.
(c) Measured in fused silica pyknometer by H. V. Ellsworth.

These specific gravities correspond to tantalites elsewhere that carry from 63 per cent to more than 80 per cent Ta_2O_5. (See Table I). Two samples of tantalite-columbite from the Ross Lake area, sent by J. R. Saunders to the Office of Economic Warfare, Washington, U. S. A., were forwarded to the Fansteel Metallurgical Corporation, North Chicago, Illinois, who reported "...the massive appearing mineral was found to contain from 68 per cent to 76 per cent Ta_2O_5, while the tabular mineral was found to contain only 14 per cent Ta_2O_5 and is undoubtedly columbite."[1]

[1] Personal communication from J. R. Saunders.

Apparently both high-tantalum and high-columbium varieties occur in the Ross Lake dykes, but, in view of the results presented in Table II, high-grade tantalite must be much the more common.

Preliminary field examination of the dykes shown in Figure 2 suggested that those numbered 1 to 4, inclusive, carry the most tantalite-columbite. Time and equipment available permitted sampling No. 1 dyke only. The samples represent material obtained from shallow blasts located at those places where minimum drilling was required; at the same time an endeavour was made to distribute the sampled areas so as to include both the borders and medial parts of the dyke and to avoid those places where tantalite-columbite concentrations were seen on the exposed surface (See Figure 2). The samples were treated at the Ore Dressing and Metallurgical Laboratories, Department of Mines and Resources, Ottawa.

> "The method used was to crush the sample to pass a 20-mesh screen. The ore was screened on 35- 48- and 65-mesh screens.... Each of the + 65 mesh products was then concentrated on a Wilfley table separately. A rougher concentrate was obtained which was recleaned. The middling and tailing were then reground to pass a 65-mesh screen and combined with the original -65 mesh ore. This -65 mesh fraction was then tabled. Four concentrates were thus obtained from each sample."[1]

[1] "Interim Report on Tin and Tantalum Ore from the Ross Lake Area, Northwest Territories", Investigation No. 1565, Report of the Ore Dressing and Metallurgical Laboratories, Ottawa; p. 5, January 6, 1944.

Table III

Concentration Tests on Tantalite-Columbite Ore, Ross Lake Area

Sample	Weight in pounds	Weight of concentrate in grams -20+35	-35+48	-48+65	-65	Total	Calculated weight of concentrate recovered per ton of ore, in pounds
A	29	86.0	41.0	23.8	54.0	204.8	31.14
B	22	0.4	0.3	0.3	2.2	3.2	0.64
C	22	0.3	0.3	0.4	0.8	1.8	0.36
D	22	4.7	3.0	2.3	7.9	17.9	3.59
E	22	2.1	0.5	0.8	2.4	5.8	1.16
F	35	53.2	19.5	18.0	51.2	141.9	17.88
					Mean		9.13

Pegmatites are noted for the erratic distribution of their mineral constituents, and No. 1 dyke is no exception. Sample F was taken nearly 5 feet from any tantalite-columbite visible on the surface, yet the heavy concentrate represents nearly 1 per cent of the head sample, and a specific gravity test shows that the concentrate, in the coarse fraction at least, is almost wholly tantalite-columbite (See 9, Table II). Conversely, sample B was taken at a place where tantalite-columbite was exposed yet carries only 0.03 per cent recoverable heavy concentrate. If the arithmetic mean of all the samples be accepted, the shoot will carry 9.13 pounds recoverable concentrate per ton for a length of 65 feet and an average width of 7 feet (equivalent to about 6 feet true width at a dip of 55 degrees). Such a shoot would contain about 38 tons of rock and 350 pounds of recoverable concentrate per vertical foot.

A weighted average sample from all the twenty-four fractions in the concentrate was prepared and analyzed [1].

[1] By H. V. Ellsworth, Geological Survey.

Table IV

Analysis of Tantalite-Columbite Concentrate, Ross Lake Area

	Per cent	
$(TaCb)_2O_5$	82.37	
TiO_2	1.59	
FeO	13.91	(1)
MnO	0.66	
SnO_2	0.14	(2)
WO_3	Not detected	
Insoluble	0.62	(3)

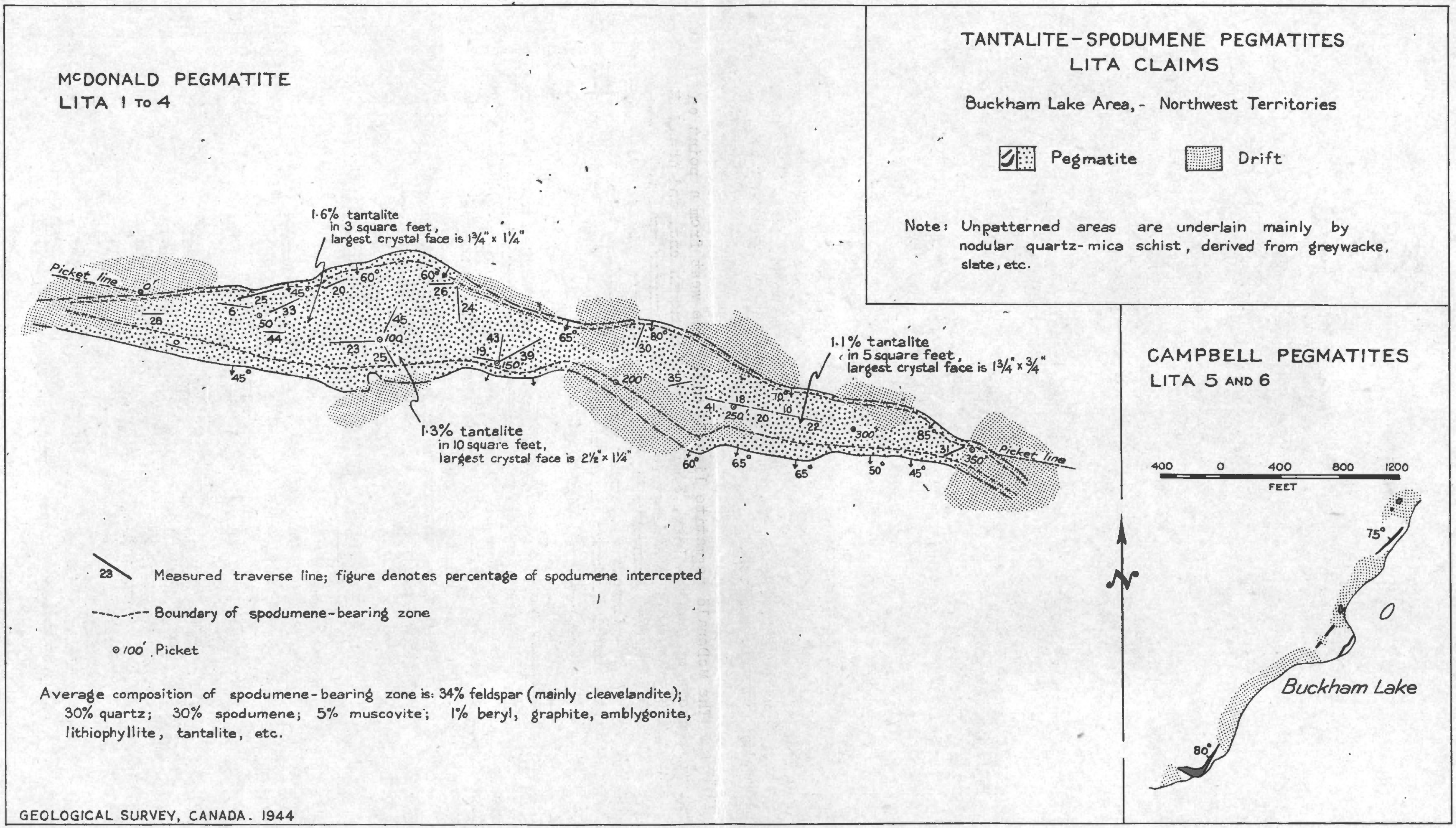
McDONALD PEGMATITE
LITA 1 TO 4
TANTALITE-SPODUMENE PEGMATITES
LITA CLAIMS
Buckham Lake Area, - Northwest Territories
Pegmatite
Drift
Note: Unpatterned areas are underlain mainly by nodular quartz-mica schist, derived from greywacke, slate, etc.
1·6% tantalite in 3 square feet, largest crystal face is 1¾" x 1¼"
1·3% tantalite in 10 square feet, largest crystal face is 2½" x 1¼"
1·1% tantalite in 5 square feet, largest crystal face is 1¾" x ¾"
Picket line
Picket line
CAMPBELL PEGMATITES
LITA 5 AND 6
400 0 400 800 1200
FEET
Buckham Lake
Measured traverse line; figure denotes percentage of spodumene intercepted
Boundary of spodumene-bearing zone
100' Picket
Average composition of spodumene-bearing zone is: 34% feldspar (mainly cleavelandite); 30% quartz; 30% spodumene; 5% muscovite; 1% beryl, graphite, amblygonite, lithiophyllite, tantalite, etc.
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FIGURE 3

Analytical Notes

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

(2) SnO_2 is possibly less than 0.14 per cent. A spectroscopic test by F. J. Fraser, Geological Survey, showed a very little tin and no tungsten.

(3) The insoluble material 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.

The above results, in conjunction with the high specific gravity values obtained on the concentrate, indicate that concentrate recovered will contain about 75 per cent Ta_2O_5 and that it will not contain sufficient tin and titanium oxides to exceed the 3 per cent commonly allowable without penalty.

BUCKHAM LAKE AREA

McDonald Pegmatite (Lits 1 to 4)

Mr. W. L. McDonald of Yellowknife reported to the Geological Survey in 1940 the discovery of a pegmatite dyke containing abundant large spodumene crystals. The deposit was examined on August 28 and 29, 1943, and has since been staked by Mr. McDonald on behalf of Frobisher Exploration Company, Limited.

The McDonald pegmatite lies 3½ miles due west from a point on the west shore of Buckham Lake, 3 miles from its north end, and about 50 miles slightly south of east from Yellowknife. A winter road from Ruth mine, 13 miles to the northeast, extends southwesterly from Buckham Lake about 20 miles to Francois Bay, where there are a dock and warehouse. (See Figure 1) Small aircraft might be able to land on lakes lying 2 miles west or a mile north of the deposit.

The pegmatite body strikes north 80 degrees west, has an average dip of 60 degrees to the south, and is apparently conformable with bedding in the enclosing nodular greywacke of the Yellowknife group. Its outcrop is nearly 400 feet long and 12 to 55 feet wide with a true average width for this length of about 25 feet (See Figure 3). At both ends the pegmatite body passes beneath drift that extends for 100 feet or more in either direction along the strike. No other pegmatite outcrops were seen.

Sections across the McDonald pegmatite show four main mineral zones, of which the two central ones are spodumene-bearing. Along either edge is a band consisting of quartz, feldspar, and light yellow muscovite in about equal proportions and with crystals uniformly about an inch across. The band along the footwall side is up to 3 feet wide, whereas that along the hangingwall is up to 8 feet. These pass gradationally into a spodumene-rich central section that may be divided into upper and lower parts of about equal width. In the upper (southern) half, the quartz and feldspar (mainly pink cleavelandite) occur commonly in discrete masses up to several feet across. Very little mica is present with these minerals, but "books" up to 6 inches across and 3 inches thick of golden yellow muscovite occur at intervals along and near the upper contact with the even-granular hangingwall zone. The lower (northern) half of the spodumene-rich section consists of intergrown quartz, cleavelandite, and a little muscovite up to several inches across. The crystal aggregates become smaller and the proportion of mica increases towards the footwall.

Beryl, amblygonite, and lithiophilite occur in the upper half of the central zone but together aggregate less than 1 per cent.

These differences in mineral content and grain size between the upper and lower halves of the central zone are not displayed by the spodumene. Both parts contain about 30 per cent spodumene by weight, and the crystals (which are commonly elongated at about right angles to the walls) are equally large in each. Just north of the 50-foot picket (See Figure 3) a crystal face of spodumene is exposed for a length of 9.7 feet and is up to 0.75 foot wide. Immediately south of the same picket another face measures 8 feet by 2.3 feet. Between the 250- and 300-foot pickets numerous large crystals extend to within a foot or two of either wall; the largest crystal face measures 10.7 feet by 1 foot. About twenty other spodumene crystals in both halves of the central zone approach these dimensions; from these upper limits the crystals range in size to some that are only about an inch across. By far the greater proportion of the spodumene is in crystals more than a foot long. The mineral contains less than 5 per cent visible impurities (chiefly quartz stringers), and none of the dull dark green or yellow micaceous alteration products, common in other spodumene-bearing dykes, is evident. A 5-pound sample of spodumene chips collected throughout the pegmatite was crushed and divided in a Jones sampler and analysed[1] with the following results:

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[1] By R. J. C. Fabry, Analyst, Mineralogical Section, Geological Survey.

Table V

Analysis of Composite Spodumene Sample, McDonald Pegmatite

	Per cent
SiO_2	64.09
Al_2O_3	27.06
FeO	1.25
CaO	0.51
MgO	0.27
Li_2O	5.70
Na_2O	1.59
K_2O	0.15
MnO	0.02
	100.64

Although lichens prevented close search, tantalite-columbite was found up to within 5 feet of either wall, and at intervals of less than 10 feet along the outcrop. The mineral appears to be more common and in larger crystals in the upper half of the spodumene-rich central zone. Three patches were seen containing tantalite-columbite up to 2¼ by 1¼ inches by 1 inch. Elsewhere in the pegmatite body several crystals averaging about a millimetre across may occur in each square foot throughout areas up to 50 square feet, as, for example, immediately south of the picket line between 25 and 45 feet, and between 250 and 270 feet. The larger crystals are more or less equidimensional; the smaller ones have a bladed habit. Most of them occur in cleavelandite. Two of the coarse clusters are associated with white beryl, spodumene, and amblygonite; the other with spodumene alone. Masses of pure quartz and pure cleavelandite up to several feet across are nearby in all cases. Specific gravity determinations were made on seven of the larger crystals of tantalite-columbite. The results ranged from 6.4 to 7.2535 and averaged 6.76. Most of the crystals contained some gangue.

The spodumene-bearing part of the pegmatite is about 400 feet long and averages 22 feet wide (about 19 feet true width at an average dip of 60 degrees). A body this size will contain about 750 tons per vertical foot. The mineral content of this part of the pegmatite was obtained by running a series of taped traverses, each 10 to 20 feet long and aggregating 290 feet, along which the intercepts of the various minerals were measured. No particular system could be followed in laying down these traverses, due to irregularities in the surface and in the moss and lichen cover. However, most of them were taken about parallel to the walls as most of the spodumene is elongated at about right angles to this direction; no traverse was measured in which the line followed the elongation of any large spodumene crystal. According to theory[1], the lineal

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1 Holmes, A.: "Petrographic Methods and Calculations"; Thomas Murby and Co., London; pp. 310, 311 (1930).

---

percentage of any mineral thus obtained is equal to the areal or volume percentage, from which the weight percentage can be calculated. The areal percentage of spodumene along traverse lines ranged from 6 per cent to 45 per cent and averaged 27 per cent. This is equivalent to 30.7 weight per cent spodumene.

No close estimate could be made of the tantalite-columbite content of the entire pegmatite mass. Three areas, totalling 18 square feet, were found that contain tantalite-columbite aggregates sufficiently coarse so that areal percentages could be measured. Assuming the mineral to have an average specific gravity of 6.8 (See Table V), the pegmatite represented by the 18 square feet would carry about 1.3 weight per cent of tantalite-columbite. Probably the rest of the deposit (about 95 per cent) would carry only a very small fraction of this amount, but this will not be known until large-scale bulk sampling is done.

Campbell Pegmatites (Lita 5 and 6)

Pegmatites carrying rare-element minerals were found at the north end of Buckham Lake several years ago by prospectors searching for gold. Information concerning one of these was obtained in 1942 from Dr. Neil Campbell[2] They were examined by the Geological Survey on August 27,

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2 Geologist, Consolidated Mining and Smelting Company of Canada, Ltd.

1943, and are now included in mining claims Lita 5 and 6, staked by W. L. McDonald on behalf of Frobisher Exploration Company, Limited.

Scattered exposures of pegmatite occur within an area extending southwesterly along the north shore of Buckham Lake for about 2,400 feet, and inland for less than 200 feet (See Figure 3). The country rock is nodular greywacke that strikes northeast and dips about 75 degrees northwest, parallel or nearly so to the pegmatite bodies. Some of the five pegmatites described separately below may be parts of the same body.

The northernmost pegmatite is represented by two outcrops 50 feet apart, up to 35 feet in diameter, and wholly surrounded by drift. One hundred and thirty feet south across the bedding a second sill begins in nodular greywacke and can be traced 250 feet southwest to where it ends in

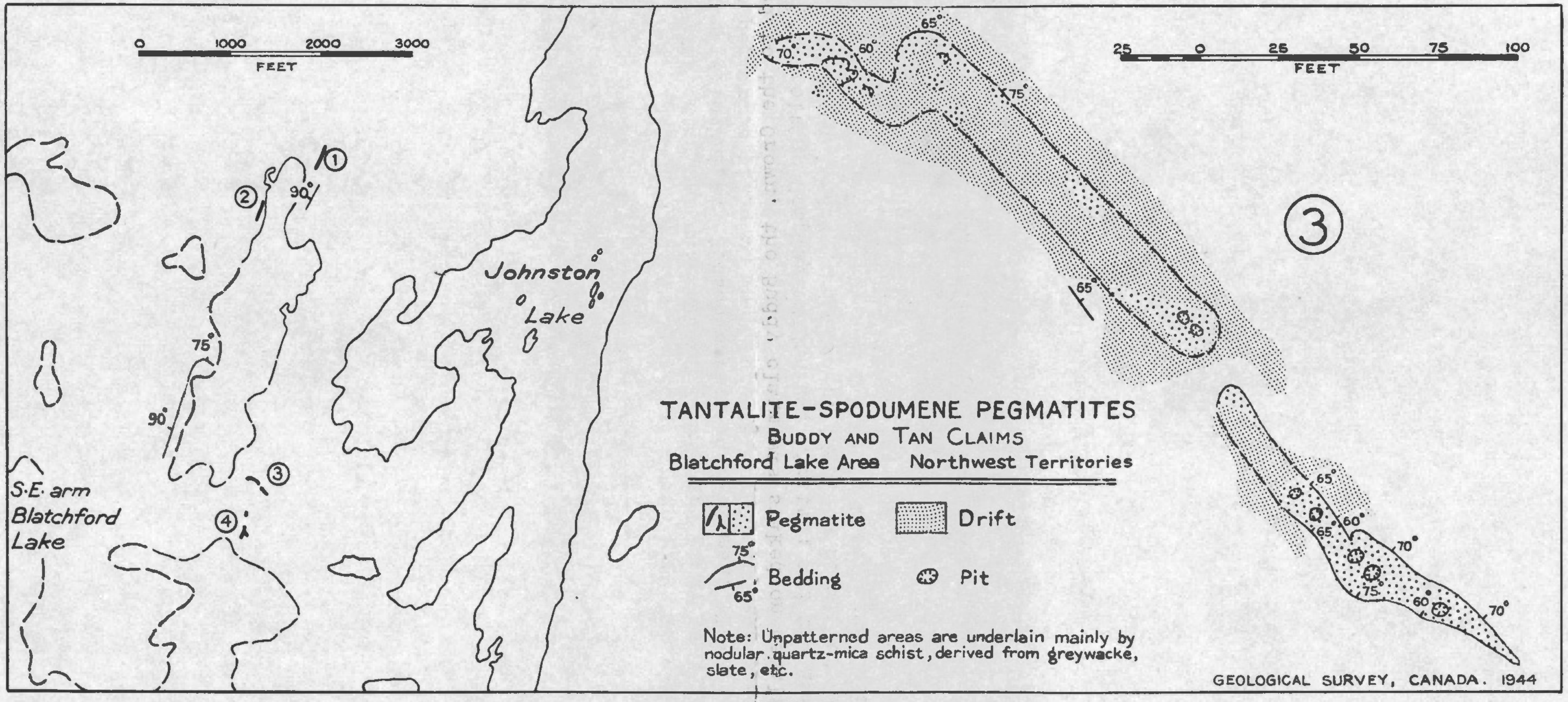

0 1000 2000 3000
FEET
S·E· arm
Blatchford
Lake
Johnston
Lake
25 0 25 50 75 100
FEET
TANTALITE-SPODUMENE PEGMATITES
BUDDY AND TAN CLAIMS
Blatchford Lake Area Northwest Territories
Pegmatite
Drift
Bedding
Pit
Note: Unpatterned areas are underlain mainly by nodular quartz-mica schist, derived from greywacke, slate, etc.
GEOLOGICAL SURVEY, CANADA. 1944

FIGURE 4

drift; in this distance it is up to 30 feet wide and averages 15 feet. Five hundred and fifty feet southwest across drift a third sill outcrops at intervals for a length of about 200 feet; it has an average width of $4\frac{1}{2}$ feet. Parallel to this, and 150 feet to the southeast, a fourth sill lies along the lake shore for 150 feet and averages 5 feet in width. About 900 feet farther southwest a fifth pegmatite body has an exposed length of 350 feet and is up to 50 feet wide, but tapers to about 10 feet at either end where it passes beneath drift.

The pegmatite bodies all carry about 50 per cent cleavelandite, 20 per cent quartz, 5 per cent muscovite, and variable amounts of coarse microcline-perthite. Spodumene occurs in crystals up to nearly 4 feet long and may comprise between 15 and 25 per cent of the rock. The distribution of spodumene is less regular than in the McDonald deposit. Other rare-element minerals present include amblygonite, lithiophilite, beryl, lazulite, and tantalite-columbite. In the four northern sills the tantalite-columbite occurs as scattered tiny blades up to $\frac{1}{4}$ inch long, chiefly within cleavelandite. In the southernmost pegmatite body it is present in crystals up to $1\frac{1}{2}$ inches by $\frac{1}{2}$ by 1/8 inch, one of which, containing some gangue, showed a specific gravity of 6.4 on a Westphal balance.

BLATCHFORD LAKE AREA

Buddy and Tan Claims

In 1938 prospectors staked the Jade group of claims on several gold showings near the east end of Blatchford Lake, 67 miles east-southeast from Yellowknife. Subsequently, rare-element minerals were found in four pegmatite sills on the property. In 1942, the Jade group having reverted to the Crown, the Buddy claim was staked on behalf of Consolidated Mining and Smelting Company of Canada, Limited; and the Tan group of three claims was staked in July and August, 1943, on behalf of DeStaffany Tungsten-Gold Mines, Limited. So far as is known, the Buddy and Tan holdings include the four pegmatite sills examined by the Geological Survey on August 16, 21, and 22, 1943.

The northernmost sill (No. 1 on Figure 4) was traced for 265 feet and shows an average width, where exposed, of 5 feet. It strikes north 20 degrees east, has a vertical dip, and is parallel to bedding in the enclosing nodular greywacke. Altered spodumene up to a foot long, and tantalite-columbite in crystals up to 3/8 inch across, are sparsely and irregularly distributed.

Sill No. 2 is exposed at intervals for 225 feet and maintains a constant width of about 10 feet. It strikes north 20 degrees east, dips steeply west, passes under muskeg and lake to the north, and to the south disappears beneath drift that extends for several hundred feet. Cleavelandite, quartz, and muscovite, are the common constituents together with some grey feldspar in crystals up to a foot across, which show a ragged outline. Spodumene and amblygonite are common in crystals up to 18 and 8 inches long, respectively; the former may constitute about 1 per cent of the sill. A few small aggregates of blue lazulite are also present. Tantalite-columbite and cassiterite are comparatively evenly distributed throughout the pegmatite, even to within an inch or two of the walls; the majority of freshly broken surfaces show either or both minerals. Tantalite-columbite is in tabular crystals up to $\frac{3}{4}$ inch long and appears more abundant than cassiterite, which is in more or less equidimensional aggregates up to $\frac{1}{4}$ inch across.

Sill No. 3 probably averages 10 feet wide, trends northwesterly for about 300 feet, and dips about 70 degrees to the northeast (See Figure 4). It is separated by a 15-foot wedge of nodular sedimentary rocks into a southeastern part, which is almost continuously exposed for 125 feet, and a northwestern part, which is exposed at intervals for about 160 feet.

Ten shallow pits have been sunk in the sill at irregular intervals. The common minerals present are cleavelandite, microcline (in crystals up to 16 by 17 by 12 inches), quartz, and muscovite. Rare-element minerals include spodumene, amblygonite, beryl, lithiophilite, lazulite, tantalite-columbite, and cassiterite. In addition, one crystal of pyrite was noted; graphite is common in seams within and bordering the microcline, and tourmaline-rich selvages less than an inch thick border the walls of the sill. There are probably other minerals that were not identified. Tantalite-columbite and cassiterite are rather evenly distributed throughout the pegmatite; on the average, one crystal or aggregate up to an inch across of either or both minerals can be seen per square foot of naturally exposed surface. The pegmatite material exposed in the pits does not appear to be of a higher grade than elsewhere in the sill. A sample weighing 23 pounds, considered to be representative of the pegmatite, was obtained from dumps at the various pits and was concentrated in Ottawa. The procedure followed is the same as that for the Ross Lake tantalite.

Table VI

Concentration Tests on Tantalite Ore, Sill No.3, Buddy and Tan Claims[1]

[1] "Interim Report on Tin and Tantalum Ore from the Ross Lake Area, North-west Territories"; Investigation No.1565, Report of the Ore Dressing and Metallurgical Laboratories, Ottawa, p.6, (January 6, 1944).

Weight of head sample	23 pounds	
Weight of concentrate:		
+-20 -35	5.5 grams	
+-35 -48	3.4 "	
+-48 -65	3.3 "	
-65	20.4 "	
Total		32.6 grams
Calculated weight of concentrate recovered:		6.25 pounds/ton

Some of the concentrate has been tested by H.V. Ellsworth of the Mineralogical Section of the Geological Survey, who reports[2]:

[2] Personal communication, February 2, 1944.

In the -20 -35 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 grams of sample as received gave 11.6% cassiterite by weight. However, not all the grains weighed were entirely 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 concentrate both as minute crystals and as intergrowths with the tantalite. Some of the tiny crystals are quite perfectly formed...... Specific gravity of sample as received, using the whole lot of 5.5 grams was 7.055(2). After picking out under the binocular microscope reduced cassiterite, gangue, pyrite, and all grains showing attached gangue or intergrown cassiterite, the specific gravity of the remaining 0.73 grams was 7.31(8). Evidently the cassiterite compensated for some of the lighter impurities present. A specific gravity of 7.3 would indicate a Ta_2O_5 content around 70 per cent for iron tantalite".

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

An analysis of a weighted average sample of concentrate by H.V. Ellsworth showed 66.70 per cent $(Ta, Cb)_2O_5$, 15.96 per cent SnO_2, and 0.20 per cent TiO_2.

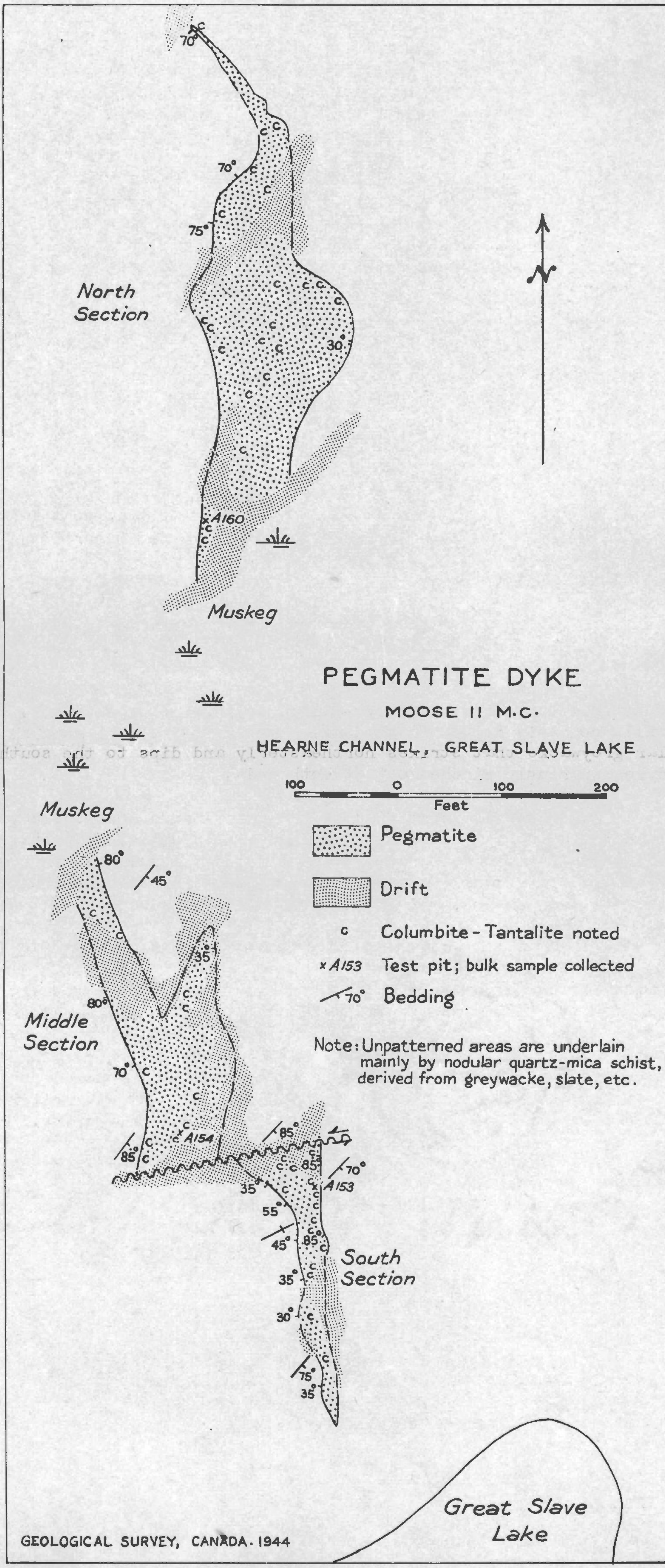

North Section
Muskeg
Muskeg
Middle Section
South Section
Great Slave Lake
A160
A154
A153
PEGMATITE DYKE
MOOSE II M.C.
HEARNE CHANNEL, GREAT SLAVE LAKE
100 0 100 200
Feet
Pegmatite
Drift
c Columbite - Tantalite noted
x A153 Test pit; bulk sample collected
70° Bedding
Note: Unpatterned areas are underlain mainly by nodular quartz-mica schist, derived from greywacke, slate, etc.
GEOLOGICAL SURVEY, CANADA. 1944

FIGURE 5

Sill No. 4 consists of scattered exposures along a line trending about north 25 degrees east for a total length of about 120 feet. About 150 feet farther north on strike a small outcrop of pegmatite in drift may represent a continuation of this sill. Furthermore, limited geological mapping in the vicinity suggests that sills No. 3 and No. 4 may be parts of the same pegmatite exposed on opposite limbs of an anticlinal fold cresting north; if this is so, the body would approach 1,000 feet in length. In those places where both walls can be seen, sill No. 4 is from 10 to 20 feet wide and dips about 60 degrees west. The mineralogy is similar to that in sill No. 3. Tantalite-columbite occurs in crystals up to $\frac{3}{4}$ inch long. One small fragment largely free from gangue showed a specific gravity of 7.54[1].

[1]Measured by H. V. Ellsworth.

Moose Dyke

In July 1942 Moose 1 and 2 were staked on behalf of DeStaffany Tungsten Gold Mines, Limited, to cover scheelite showings on the north side of Hearne Channel, in the east arm of Great Slave Lake, 72 miles east-southeast from Yellowknife. The following year the group was enlarged to include two pegmatite dykes carrying rare-element minerals. An examination of what appeared to be the better dyke was made by the Geological Survey, August 17 to 19, 1943.

The dyke extends for about 1,400 feet north from a point less than 150 feet from (and about 60 feet above) Great Slave Lake (See Figure 5). Its outcrop is up to 200 feet wide and is interrupted about midway of its length by a muskeg 400 feet across, and, in its southern half, by an east-west fault that causes a left-hand displacement of 120 feet. The dyke walls commonly dip 30 to 85 degrees to the west. The country rock is nodular greywacke that strikes northeasterly and dips to the southeast. The dyke apparently pinches out at both ends.

Minerals identified in the dyke include microcline, cleavelandite, quartz, muscovite, spodumene, amblygonite, graphite, beryl, tantalite-columbite, cassiterite, tourmaline, and lazulite. The only minerals that are sufficiently abundant to be of possible economic interest are tantalite-columbite, and the lithium minerals spodumene and amblygonite.

Tantalite-columbite is found throughout the dyke (See Figure 5) but in widely varying amounts. It occurs chiefly in very thin radiating plates that are up to 3½ inches across. The greatest concentration seen extends south from the fault for about 100 feet along and near the footwall (east side) of the dyke, and averages about 5 feet wide. Bulk sample A153 may be about representative of this section; other bulk samples were taken from the central (A154) and northern (A160) sections of the dyke. Each represents material obtained from a single blast. All were concentrated at the Ore Dressing and Metallurgical Laboratories, Ottawa.

"The smaples were crushed to pass a 20-mesh screen, and then were screened on 48- and 65-mesh screens, giving the following products: -20+48, -48+65, and -65 mesh. The plus 65 mesh fractions were concentrated on a Wilfley table. The table middlings and tailings were reground to pass a 65-mesh screen. The minus 65 mesh products were then concentrated on a Wilfely table.

The cleaned concentrates were screened on 28-, 35-, 48- and 65-mesh screens and the various products were examined microscopically. The plus 48 mesh products carried considerable gangue attached to mineral, indicating that a concentrate free of attached gangue could not be made at a grind coarser than 48-mesh. The -48+65 mesh concentrate showed some attached gangue but the amount was relatively small.

The final tantalite concentrates contained some sulphides, a light brown mineral, and a little free quartz, the light brown particles being more abundant than the sulphides. This brown mineral could not be eliminated from the tantalite concentrate. Later tests showed that this mineral was cassiterite.

Some magnetic material was removed from each concentrate by means of a hand magnet. This included magnetite and metallics from the grinding mill"[1]

Table VII[1]

[1]"Concentration of Tantalite Ore from the Moose Property (DeStaffany Tungsten Gold Mines, Limited), Yellowknife Area, Northwest Territories"; Report of the Ore Dressing and Metallurgical Laboratories, Investigation No. 1554, pp. 3, 4 (December 14, 1943)

Concentration Tests on Tantalite-columbite Ore, Moose Dyke

Sample no.	A153	A154	A160
Original feed	125.5 lb.	67 lb.	55 lb.
Magnetics from concentrates	10.2 gm.	2.2 gm.	3.0 gm.
- 48 + 65 mesh concentrate (1)	80.0 gm.	11.9 gm.	1.9 gm.
- 65 + 100 " " (1)	59.2 "	6.0 "	3.0 "
-100 + 150 " " (1)	52.3 "	7.1 "	2.5 "
-150 + 200 " " (1)	45.5 "	8.0 "	1.8 "
-200 " " (1)	54.7 "	11.7 "	3.2 "
- 65 + 100 mesh concentrate (2)	2.7 gm.	4.3 gm.	0.6 gm.
-100 + 150 " " (2)	7.5 "	8.3 "	3.5 "
-150 + 200 " " (2)	5.0 "	3.8 "	2.2 "
-200 " " (2)	11.0 "	8.7 "	2.8 "
Total concentrate -	317.9 gm.	69.8 gm.	21.5 gm.
Calculated weight of concentrate per ton of ore -	11.2 lb. /ton	4.6 lb. /ton	1.7 lb. /ton

(1) Original concentrates.
(2) Concentrates from reground middlings.

After cutting out the head sample from each shipment, the remainder was the original feed for each test, as indicated.

The -48+65 concentrate for each sample was examined by H. V. Ellsworth, and the following is a summary of his findings:

A153 contains the following impurities: quartz and feldspar in individual grains and attached to tantalite-columbite, scheelite (?), pyrite, iron, pale bluish phosphate (?), and cassiterite.

Specific gravity[2] of concentrate as received 5.7719
Specific gravity after cleaning with acids and repanning . 5.8072

From the specific gravity the concentrate appears to be chiefly columbite carrying about 20 to 25 per cent Ta_2O_5. Chemical tests indicate that this is chiefly iron columbate; titanium and rare earths are absent; no radioactivity; a small amount of tin is present; tungsten was not detected.

[2] All specific gravity determinations made on Moose dyke concentrate were measured by H. V. Ellsworth in a fused silica pyknometer.

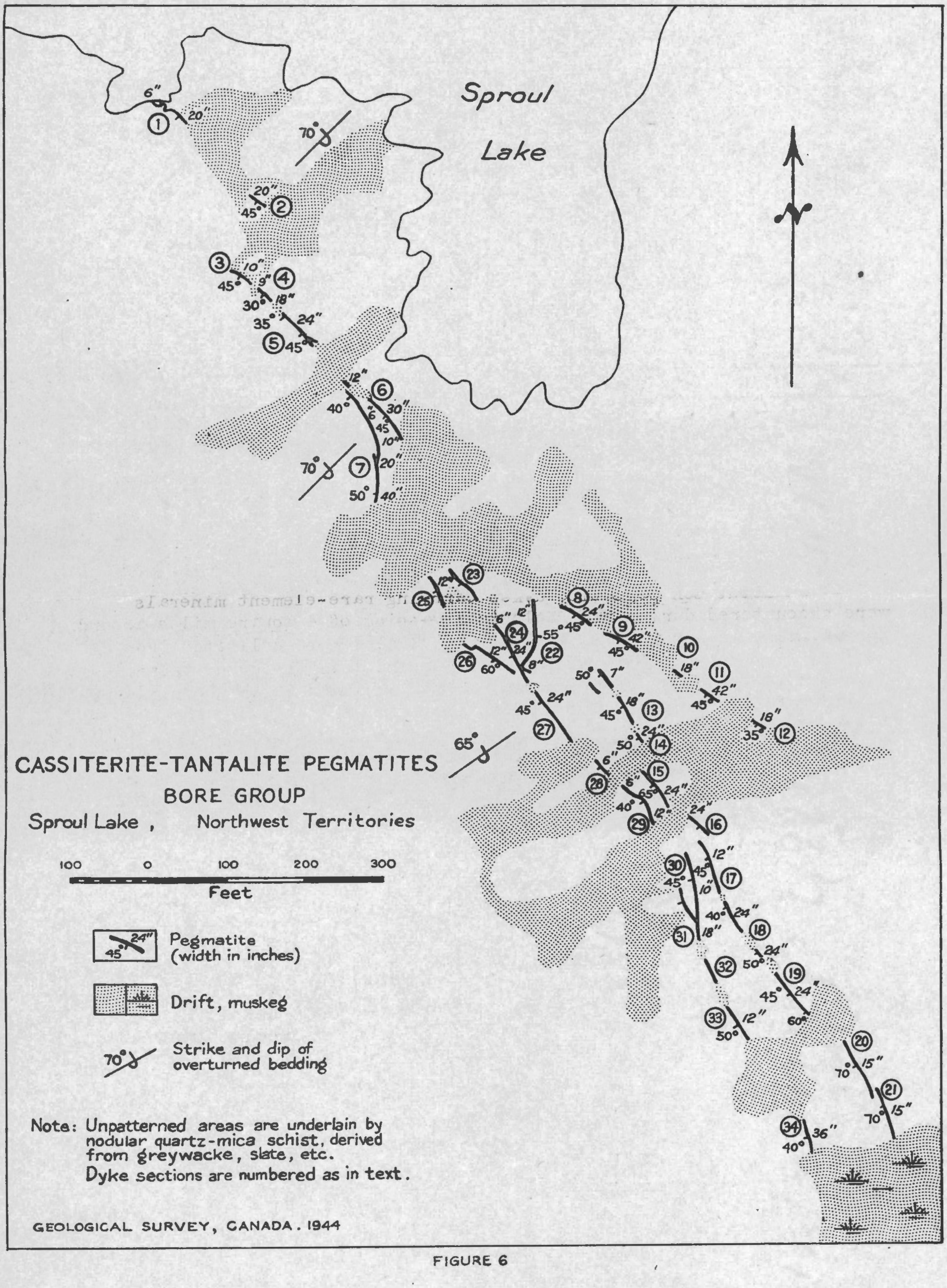

Sproul Lake
CASSITERITE-TANTALITE PEGMATITES
BORE GROUP
Sproul Lake, Northwest Territories
100 0 100 200 300
Feet
Pegmatite (width in inches)
Drift, muskeg
Strike and dip of overturned bedding
Note: Unpatterned areas are underlain by nodular quartz-mica schist, derived from greywacke, slate, etc.
Dyke sections are numbered as in text.
GEOLOGICAL SURVEY, CANADA. 1944

FIGURE 6

A154 contains the same impurities as A153.

Specific gravity of concentrate as received 6.1918

Specific gravity after cleaning with acids and repanning ... 6.2651

A zinc reduction test shows about 8 per cent of the grains to be cassiterite. Assuming these to have a specific gravity of 6.9, the corrected specific gravity of the tantalite-columbite present in the concentrate is about 6.21, equivalent to a content of 30 to 40 per cent Ta_2O_5.

A160 Specific gravity[1] of concentrate as received ... 5.7962

[1] All specific gravity determinations made on Moose dyke concentrate were measured by H. V. Ellsworth in a fused silica pyknometer.

Lithium minerals are erratically distributed throughout the Moose dyke, but time did not permit evaluation of these. In the middle section (between the fault and muskeg) bands up to 50 feet long and 5 feet wide carry more than 25 per cent spodumene. Amblygonite is likewise an important constituent of the dyke. The largest crystal face of spodumene seen measured 2 by 4 feet, and of amblygonite, 2 by 3 feet. These were observed in the northern section where lichens and moss prevented close examination. Both appear to be parts of still larger crystals. One specimen of each of spodumene and amblygonite on analysis[2] showed

[2] by R. J. C. Fabry, Mineralogical Section, Geological Survey

3.65 per cent and 4.68 per cent lithium oxide, respectively.

SPROUL LAKE AREA

Bore group

About ten pegmatite dykes carrying rare-element minerals were encountered during the geological mapping of 4 square miles around Sproul Lake, August 2 to 9, 1943. Bulk samples were collected from some of the dyke sections on September 12 and 13. The dykes shown in Figure 6 lie south of the lake and are now included in the Bore group, owned by Radium Luminous Industries, Limited.

Sproul Lake lies 35 miles northeast of Yellowknife and 10 miles due north of Thompson-Lundmark mine (See Figure 1). The nearest good landing for large aircraft is Upper Pensive Lake, 2½ miles to the southeast. A canoe route between the two lakes includes three portages totalling nearly a mile.

With one exception, the dykes described here strike northwesterly and dip between 30 and 70 degrees to the southwest.(See Figure 6). They are contained in a belt up to 200 feet wide and more than 1,700 feet long, which passes beneath Sproul Lake to the northwest and beneath a wide muskeg to the southeast. Individual dykes within the belt are up to 3½ feet wide and are almost certainly continuous for as much as 500 feet. The dykes cross nodular greywacke that strikes northeast and has an overturned dip of 65 to 70 degrees northwest.

The mineral content varies considerably within a single dyke, or even within a single outcrop. Rare-element minerals identified are spodumene, amblygonite, beryl, cassiterite, tantalite-columbite, lithiophilite, and indicolite (blue-green tourmaline).

Table VIII

Mineral Distribution in Pegmatites, Bore Group, Sproul Lake

Dyke section	Cassiterite	Tantalite-columbite	Spodumene	Amblygonite	Beryl
1	c	c		c	
2	b	b		b	
3	a	b			
4	c	b			c
5	c	a		c	c
6	b	c			
7	b	c	b	b	
8	c	c		c	
9	c	a	a	b	
10	b	b	b	c	
11	c	b	b	c	c
12	b	b		c	c
13	b	b			
14	c	c			
15	c	b	c	c	c
16	c		c		
17			c		
18	b	c	c		
19	b	b		c	c
20	a				
21	b				
22		c	c		
23					
24		c	c	c	
25		c			c
26			c	c	
27	b	c		c	c
28	a	c			
29	b	b		c	c
30	c		c		
31	c	c			
32	c	c			
33	c	c		c	c
34	c		c		

a - relatively abundant
b - present
c - minor occurrence

Spodumene occurs in rudely radiating columnar crystals up to a foot long within the central parts of certain dyke sections. Much of it, particularly the smaller crystals, is altered to a very fine-grained, yellow-green, micaceous aggregate. Amblygonite is commonly concentrated near the hangingwall and occurs in equidimensional crystals up to 8 inches across, but averages less than an inch. Over lengths of 10 to 15 feet the two lithium minerals may constitute as much as a quarter of the dyke area. Beryl occurs sparingly in a few sections as white to light green crystals up to 2 inches across. Muscovite constitutes less than 5 per cent of most dykes and occurs chiefly along the borders; less commonly it is present as medium-grained aggregates up to a foot long within quartz along the central parts of the dykes. Lithiophilite was found in sections (7), (12), and (29). Tiny blue-green crystals of indicolite occur in muscovite along the dyke margins; black bands less than an inch wide in the bordering sedimentary rocks may represent introduced tourmaline.

Cassiterite and tantalite-columbite are the only minerals of possible present economic interest. They occur chiefly in cleavelandite in the middle and upper parts of the dykes, but were seen enclosed by several other minerals and in the footwall as well. Cassiterite occurs as dark brown to jet-black irregular aggregates up to 1¼ inches by 1 by 3/8 inch. Tantalite-columbite is in blue-black crystals having a distinctive bladed or tabular habit up to 1¼ inches by ¾ by 3/16 inch. From these upper limits the crystals of both minerals range downwards to almost microscopic size.

Bulk samples were taken from the dyke sections showing most cassiterite on the weathered surface (18, 19, 20, and 21, on Figure 6), and those showing most tantalite (9, 10, 11, and 12). The samples represent material obtained from several shallow blasts along each dyke section, and were tested in Ottawa.

Table IX

Analysis and Concentration Tests on Bulk Samples,
Bore Group, Sproul Lake[1]

Sample	Weight in pounds	Tin content
(18)	53	None detected
(19)	58	" "
(20)	57	0.41 per cent
(21)	53	0.06 " "

Sample	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
(18) (19) (20) (21)	211.0	68.5	37.0	28.7	72.4	206.6	4.32
(9)	66	14.0	4.5	1.8	16.4	36.7	2.45
(10)	52	1.8	1.6	2.1	5.7	11.2	0.95
(11)	54	1.3	0.8	1.2	9.4	12.7	1.04
(12)	58	2.6	1.0	0.8	12.4	16.8	1.28

Examination of the coarser fractions of the concentrate from samples (9), (10), (11), and (12) reveals that about 30 per cent is cassiterite, the remainder being largely tantalite-columbite of undetermined composition.

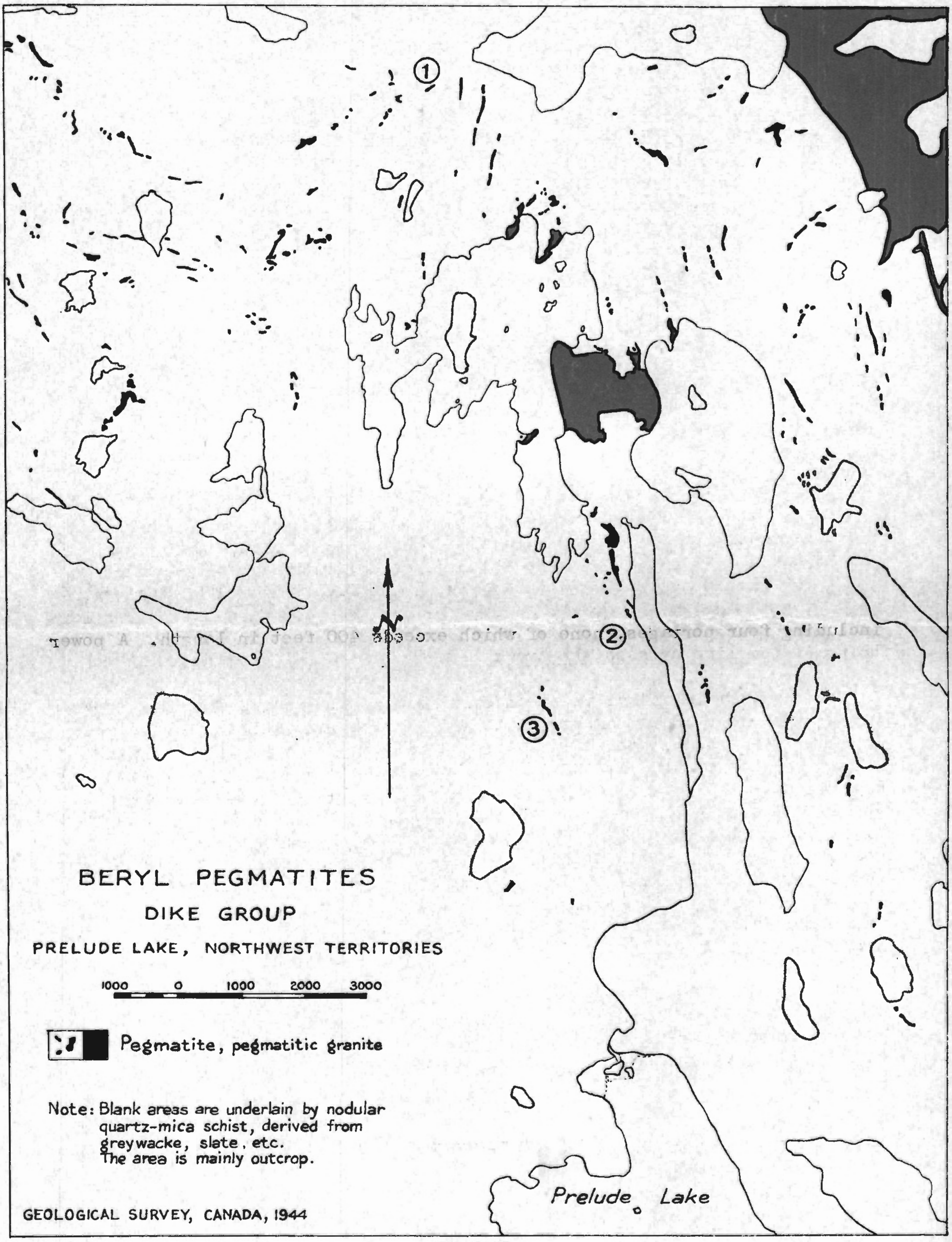
[1]"Interim Report on Tin and Tantalum Ore from the Ross Lake Area, Northwest Territories"; Report of the Ore Dressing and Metallurgical Laboratories; Ottawa; Investigation No. 1565, pp. 2, 6 (January 6, 1944).

BLAISDELL LAKE AREA

Blaisdell Lake lies 34 miles northeast of Yellowknife and is most conveniently reached by air. Beryl was first reported from the district by a Geological Survey field party in 1937. Brief examinations were made between July 25 and 31, 1943, of some of the pegmatite bodies lying within a mile or two of the lake.

The area is underlain by nodular sedimentary rocks intruded by two bodies of younger granite. One of these is less than a mile across and forms most of the peninsula on the north side of the lake; the other extends 5 miles northwest from the lake. Pegmatite dykes and sills cut these bodies and the surrounding sedimentary rocks.

Of nearly fifty dykes examined, beryl with tantalite-columbite (and/or cassiterite) were found in twelve, and a further twenty were found to contain beryl alone. Most of the pegmatites carry tourmaline; minor occurrences of lithiophilite, molybdenite, arsenopyrite, and pyrite, were noted.



1
2
3
BERYL PEGMATITES
DIKE GROUP
PRELUDE LAKE, NORTHWEST TERRITORIES
1000 0 1000 2000 3000
Pegmatite, pegmatitic granite
Note: Blank areas are underlain by nodular quartz-mica schist, derived from greywacke, slate, etc.
The area is mainly outcrop.
GEOLOGICAL SURVEY, CANADA, 1944
Prelude Lake

FIGURE 7

The beryl-bearing dykes are up to 2,000 feet long and 10 feet wide. The best concentration seen is in a dyke cutting granite a few feet west of the granite-sediment contact, three-quarters of a mile north of Blaisdell Lake. The dyke strikes north-northwest parallel to the contact, dips 75 degrees to the west, and was followed for 700 feet. Two sections, each about 30 feet long and 7 feet wide, carry about 4 per cent beryl (estimated by measuring areas of beryl crystals exposed on the glaciated surface). The intervening dyke section is 180 feet long, 7 feet wide, and contains some beryl and tantalite-columbite. Over a total length of 240 feet the dyke should average close to 1.5 per cent beryl across 7 feet. The mineral is in distinct pale greenish yellow crystals averaging more than an inch across by several inches long. Within the southern high-grade shoot, a basal section of two intergrown beryl crystals measures 12 by 18 inches. As most beryl crystals in this dyke and elsewhere have lengths measuring three to four times their maximum widths, it is probable that these two crystals will aggregate nearly half a ton.

PRELUDE LAKE AREA

In 1937 a Geological Survey student assistant on an exploratory traverse north of Prelude Lake reported crossing a pegmatite 180 feet wide estimated to contain 5 per cent beryl. This is the dyke about 1,000 feet north of (2) on Figure 7. Subsequent investigation indicated that this estimation must have been made on a local concentration of beryl within the dyke.

An area of about 10 square miles immediately north of Prelude Lake was prospected for beryl by a Geological Survey field party between June 18 and 28, 1943. The area includes the Dike group, which had been staked on behalf of Frobisher Exploration Company, Limited. It lies 17 miles northeast of Yellowknife and may be reached by a canoe route about 25 miles long including four portages, none of which exceeds 400 feet in length. A power transmission line crosses the area.

The area is underlain by closely folded, altered, sedimentary rocks cut by irregular bodies of pegmatite and pegmatitic granite. In general, the larger the body, the greater the proportion of granite. Beryl was found in fifty-six of the one hundred pegmatites examined and displays crystal faces up to 7 inches wide and 17 inches long. Minerals common to all pegmatites are grey and pink feldspar, quartz, muscovite, and black tourmaline. The beryl-rich sections commonly occupy medial positions in the pegmatites, and in places contain, in addition to the above-mentioned minerals, minor amounts of green and red tourmaline, lithiophilite, tantalite-columbite (specific gravity 5.94 on one specimen from dyke No. 1, Figure 7), with crystal faces up to $\frac{1}{4}$ inch by $1\frac{1}{4}$ inches, lazulite, gahnite (zinc spinel), and several unknown minerals.

The three most important beryl concentrations seen are in dykes 1, 2, and 3 (See Figure 7). An estimation of their content was obtained by measuring the areas of beryl crystals exposed and calculating therefrom the areal and weight per cent of visible beryl.

Table X

Dyke	True dimensions beryl-rich shoot	Weight per cent beryl
1	50 feet by 5 feet	2
2	110 5	0.5
3	200 10	0.3