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PITCHBLENDE OCCURRENCES BETWEEN BEAVERLODGE AND HOTTAH LAKES, NORTHWEST TERRITORIES

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INTRODUCTION

GENERAL STATEMENT

The following report gives the results of field work done in 1945 in an area of some 10 square miles between Beaverlodge and Hottah Lakes in the Northwest Territories, about 100 miles south of Port Radium, Great Bear Lake. Several pitchblende occurrences were known in the area, and the purpose of the work was to examine these occurrences, to study the geology in detail, and to prospect thoroughly for pitchblende in the favourable areas or zones found in the course of the geological mapping.

Efficient assistance in the field work was given by R. W. Kirkland and Kenneth Hannigan. Thanks are due to R. Murphy and E. Walli of Eldorado Mining and Refining Limited for their many courtesies, and for providing air photographs of part of the area.

ACCESS

The area mapped is about 200 miles by air from Yellowknife on the north shore of Great Slave Lake, and 100 air-miles from Port Radium on the east shore of Great Bear Lake. In normal seasons aircraft on floats can operate between Yellowknife and Beaverlodge or Hottah Lake from the second week in June to the first week in October. Beaverlodge Lake may also be reached by canoe from Rae on the north arm of Great Slave Lake; this route is about 200 miles long and includes more than 40 portages. The canoe route between Beaverlodge and great Bear Lake via Camsell River is about 100 miles long, and includes only three short portages.

HISTORY

In the autumn of 1933 Indians found pitchblende on the ridge east of the narrows between the north and east arms of Beaverlodge Lake. D'Arcy Arden and E.H. Hargreaves staked the Tatee and Bee claims in January 1934 and at later dates. Later in the same year the WLO group of claims were staked by C.A. Watt and W.L. Olmstead to the northeast of the Arden-Hargreaves claims near Stairs Bay, Hottah Lake. Development of the Arden-Hargreaves claims was undertaken by Hottah Lake Mines, Limited, a company organized for that purpose. Work was started in the spring of 1934, and a pit put down on the original discovery (Occurrence No. 4 on maps). Pitchblende with hematite formed three lenses a few feet long, one above the other, in an 8-foot lens of chlorite schist in quartzite.[1]

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1 Kidd, D.F., Geol. Surv., Canada, Mem. 187, p. 27, 1936.

Another small lens of pitchblende was found 50 feet south of the original discovery. A shaft was sunk on this to a depth of 50 or 60 feet, but no pitchblende was found beneath the small lens at the surface.

The ore from the lenses was hand cobbed, and 1½ tons shipped to the Department of Mines at Ottawa where it was found to contain 40.5 per cent U_3O_8.[2] The shipment apparently included all the pitchblende from

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2 Op. cit., p. 27.

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the lenses, for only a negligible amount is left in the workings.

Another pitchblende showing (No. 10 on map) on the Arden-Hargreaves claims was found in 1934 about 1 mile northeast of the shaft. According to Kidd[3] "The pitchblende occurs at several places in a distance

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3 Op. cit., p. 28.

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of 100 feet, appearing as seams a fraction of an inch wide ...". Three large trenches were made in the showing.

Work on the Arden-Hargreaves claims was discontinued after sinking the shaft, and the ground reverted to the Crown. In April 1943 the claims were re-staked in part as the Cormac group of six claims.

In 1934 the WLO claims were staked northeast of the Arden-Hargreaves holdings southwest of Stairs Bay, Hottah Lake. The pitchblende occurs in small quartz-hematite veins in dykes of gabbro, intruding granite, and Kidd[4] reported "pitchblende in widely separated places on the claims".

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4 Op. cit., p. 29.

A sample from the best showing (probably occurrence No. 15 on map) was sent to the Mines Branch at Ottawa and ran 13.70 per cent U_3O_8.

The WLO group was abandoned in 1936, but was re-staked for the Tasman Syndicate in 1940 as the Bingo group of nineteen claims. Thirteen of the Bingo claims were taken over by Gold Uranium Exploration, Limited in 1947, and according to the Company some surface work and 3,700 feet of diamond drilling were done on the group in that year.

METHODS OF MAPPING AND PROSPECTING

A preliminary inspection of the known pitchblende occurrences revealed that they lay along or near two northeasterly trending belts of quartzite. It was, therefore, decided to map and prospect the area along these belts in detail, and a base line was cut along the strike, right angled offsets being made where necessary to keep the line near the quartzite. This base line, 26,000 feet long, was chained and stations marked at 100-foot intervals. The station at the extreme southwest end was marked A, the station 1,000 feet northeast of this B, etc. Intervening 100-foot stations between A and B were marked AE 100, AE 200, etc.; those between B and C, BE 100, BE 200, etc.; and so on. Blazed lines were run at right angles to the base line every 200 feet, using compass for direction. These lines were taped and stations marked at 100-foot intervals. Distances southeast of the base line were recorded as minus and those northwest as plus. Shores of lakes and the outcrops near them that were not covered by the surveyed lines were mapped by plane-table. The extension of the quartzite belt for 17,000 feet southwest of the narrows of Beaverlodge Lake was mapped by plane-table on a scale of 1 inch to 1,000 feet.

After surveying and geologically mapping an area it was prospected with Geiger-Muller counters. Along the belt containing most of the known occurrences the base line and offset lines were used for systematic Geiger-Muller counter traverses across the structure at 50-foot intervals. The Geiger counters were equipped with rate-meters in addition to earphones, and the rate-meter readings were recorded every 100 feet along the traverses. Between recordings the walking speed was kept slow enough to allow any significant rise in the count to be noted. In addition to the systematic Geiger survey of this area zones deemed especially favourable were covered in greater detail. Thus contacts between quartzite and porphyries and volcanic rocks, and all outcrops of small bodies of the older gabbro were gone over very thoroughly with the counters.

Areas mapped by plane-table southwest of the narrows of Beaverlodge Lake, along the shore of Beaverlodge Lake, and between Olmstead Lake and Stairs Bay were also prospected with the Geiger counter. However, although all outcrops were traversed, the traverses were not systematic or as closely spaced as in the area covered by the surveyed lines (See Northeast Sheet).

GENERAL GEOLOGY

SUMMARY STATEMENT

The oldest rocks in the area are a series of interbedded volcanic and sedimentary rocks that are correlated with the Snare group of Proterozoic (Late Precambrian) age. They consist of feldspar and feldspar-quartz porphyries, fine-grained dacites, tuffs and agglomerates, and conglomerate, quartzite, slate, and cherty argillite. Some of the porphyry

is definitely extrusive, but a massive structureless phase may be in part intrusive. The thicker sedimentary belts consist of a fine-grained, very massive, white quartzite with conglomerate at the base. The quartzites grade into slates and fine-grained cherty argillites followed by more quartzite. There is evidence of an erosional unconformity between the volcanic and sedimentary rocks, but no evidence of a structural break or non-conformity was found. The rocks of the Snare group have been folded, cut by granitic intrusions, and altered in large part to schists. Dykes and large, sill-like bodies of gabbro cut both rocks of the Snare group and the granite. The youngest Precambrian rocks in the area are diabase dykes of gabbroic composition. Flat-lying conglomerate and sandstone of probable Ordovician age laid down on an irregular surface of deeply eroded Precambrian rocks underlie small areas southwest of the narrows of Beaverlodge Lake.

SNARE GROUP

Distribution and Structure

The volcanic and sedimentary rocks are correlated with the Snare group of the Snare River and Ingray Lake map-areas to the east.[1] The larger belts of sedimentary rocks lie stratigraphically above the volcanic rocks, but two narrow belts of quartzite and slate are interbedded with dacite flows southwest of the narrows of Beaverlodge Lake.

[1] Lord, C.S., Snare River and Ingray Lake Map-areas, Northwest Territories, Geol. Surv., Canada, Mem. 235 (1936).

The rocks of the Snare group form two narrow belts or roof pendants in the granite that vary from a few hundred to 3,000 feet in width and are more than 10 miles long. The southwesterly belt, which lies southwest of the narrows of Beaverlodge Lake, consists of a tight southwesterly plunging syncline of quartzites and slates and volcanic rocks. Only a small part of the northwestern flank of the structure is exposed, but the southeastern flank has been traced for more than 2 miles to the southwest and is up to 3,000 feet wide.

The northeasterly belt is cut off from the southwesterly belt by the granite at the narrows of Beaverlodge Lake. It has been traced northeast from the narrows for 6 miles to Olmstead Lake, but through the northeastern half of this distance it consists merely of a narrow belt of quartzite a few hundred feet wide that has escaped assimilation by the surrounding granite. North of the east arm of Beaverlodge Lake this belt consists of feldspar porphyry and dacite overlain by quartzite dipping steeply northwest. Two and a half miles northeast of the narrows the porphyry and dacite swing east and southeast, and the overlying quartzite thins out along strike and is replaced by cherty argillite with only a thin layer of quartzite at the base. Five hundred feet southeast of the main exposures of quartzite is the southeastern flank of a down-faulted syncline of the quartzite beyond which is an anticline and another well defined syncline of quartzite of which the southeastern limb can be traced east by three isolated quartzite outcrops to within 1,000 feet of Beaverlodge Lake.

A second band of quartzite first outcrops about 2½ miles northeast of the narrows of Beaverlodge Lake and 500 feet northwest of the lower quartzite band that rests on volcanic rocks. This upper quartzite band is 200 to 500 feet wide, and has been traced northeast for 4 miles to Olmstead Lake; throughout the greater part of this distance it is bounded on either side by intrusive granitic rocks.

Feldspar Porphyry, Dacite, Tuff and Agglomerate

Feldspar and feldspar-quartz porphyry outcrop southeast of the main belts of quartzite both southwest and northeast of the narrows of Beaverlodge Lake. Northeast of the narrows most of the porphyry is a massive, structureless, yellowish green to reddish, fine-grained, flinty rock with phenocrysts of feldspar up to an eighth of an inch in size scattered through it. The groundmass is a fine mosaic of highly sericitized feldspar, quartz, and some chlorite. The feldspar phenocrysts are altered, but are probably mostly oligoclase. A few, rounded quartz phenocrysts are generally present, and in places are as plentiful as the feldspar phenocrysts. The porphyries probably range from rhyolite to dacite in composition.

Some of the porphyry, particularly along and near the overlying quartzite, is fragmental, with rounded to subangular porphyry fragments, from a few inches to a foot or more in size, that are almost identical with the rock that encloses them. The fragmental phase of the porphyry with structures characteristic of extrusive rocks is particularly well developed southwest of the narrows of Beaverlodge Lake. There much of the porphyry is a red to purplish type with blebs of quartz, up to an inch in diameter, that are probably amygdules. Other rocks that are probably agglomerates and flow breccias contain fragments of cherty sediments, slates, and porphyries in a fine, porphyritic groundmass that in places shows ropy flow structures. Beds of tuff composed of fragments of porphyries, quartzites, and thinly bedded sediments in a matrix of smaller fragments occur associated with the fragmental porphyries.

The massive structureless porphyries that are devoid of flow structures and other characteristics of extrusive rocks may be of intrusive origin. The fragmental porphyries with associated tuffs, agglomerates, and fine-grained dacite flows that are widely developed southwest of the narrows of Beaverlodge Lake are almost certainly of extrusive origin.

Associated with the porphyritic rocks described above are dense, fine-grained lava flows ranging from green to dark purplish grey. Many of them contain irregular blebs of quartz up to 1 inch in diameter, that are probably amydules; ropy flow structures occur in places; and pillow structure is well developed in some of the more greenish types southwest of the narrows of Beaverlodge Lake. Tuffaceous and agglomeratic beds intercalated with the flows are common along and near the contact with the main band of quartzite southwest of the narrows of Beaverlodge Lake. For the most part the lavas are massive, but locally, as along the synclinal axis southwest of the narrows, they are highly sheared, dark blue-grey to green platy schists.

Under the microscope these rocks show a fine-grained mat of secondary sericitic mica, quartz, feldspar, and some chlorite and leucoxene. Finely disseminated magnetite grains occur throughout the sections. The flows probably range in composition from about dacite or latite to acid andesite.

Contacts between the massive feldspar porphyries and dacite flows are commonly marked by coarse agglomerates or flow breccias. Thus along the contact northeast of the narrows (C-1100) a coarse breccia 20 to 100 feet thick is developed between massive structureless feldspar porphyry and a dark blue-purple weathering fine-grained lava with good flow structures and amygdules. The breccia consists of angular to subangular fragments of feldspar porphyry up to 2 feet in size, but averaging 2 to 4 inches, in a fine-grained, dark blue-purple groundmass. The porphyry fragments are practically identical with the main porphyry body to the southeast. The breccia is probably a flow breccia formed as a result of blue-purple lava

engulfing blocks of the underlying porphyry. No dykes of feldspar porphyry were found intruding the dacitic flows here or at any other place in the area. The presence of fragmental volcanic rocks along contacts of porphyries and dacite flows, and the lack of porphyry dykes in the dacite suggest that the porphyries are, in large part, extrusive in origin.

Quartzite, Conglomerate, Slate, and Cherty Argillite

The quartzites are for the most part very pure, siliceous, fine-grained rocks. The colour is generally white to light green, but in places the rock has a light pinkish caste. It is very homogeneous, and bedding is difficult to recognize, except where impure beds, now altered to slates and fine, sericitic schists, occur. Ripple-marks are fairly common, and are usually best developed in the impure, more argillaceous beds. Gradation in grain may be observed in some beds, and is useful for determining the top of steeply inclined strata. A representative section measured across the large outcrop northwest of the shaft is as follows:

Description	Feet
Beds strike N 40° E and dip 70° to 80° NW	
Quartzite, pure, white; thick, massive beds	60
Slates and sericite schist, thin-bedded	20
Quartzite, pure, white, fine-grained, beds 1 to 3 feet thick	20
Sericite schist and slate, thin-bedded	10
Quartzite, pure, white; beds ½ to 6 feet thick, with a few slaty interbeds	80
Sericite schist and slate, green to grey, thin-bedded; beds show gradation in grain and are ripple marked	40
Quartzite, pure, white; beds are 4 to 8 feet thick	50
Quartzite, interbedded pure white quartzite in beds 1 to 6 inches thick and light green sericitic quartzite in beds ¼ to 1 inch thick	15
Quartzite, massive, white to greenish, ripple marked in places	105
Breccia, fragments of porphyry 2" to 12" in diameter in quartzite	1 to 2
Underlying rock - feldspar porphyry	

Thin beds of grit and conglomerate are interbedded with the quartzite in places, particularly along or near the base of the quartzites near contacts with the underlying volcanic rocks. Thus, 1 mile southwest of the narrows of Beaverlodge Lake the quartzite is underlain by a 1- to 2-foot layer of conglomerate resting on a purple-red schistose feldspar porphyry flow. The conglomerate consists of pebbles of quartz, red slate, and several different types of porphyry in a gritty quartzite matrix. The pebbles are up to 3 inches in size, but

average ½ to 1 inch and for the most part are well rounded. The conglomerate grades up into a coarse, gritty quartzite composed mainly of large quartz grains and with beds of conglomerate 1 to 2 inches thick. This, in turn, grades into massive, pure, fine-grained white quartzite. Many other excellent exposures of the volcanic sedimentary contact may be observed along the southeast flank of this syncline.

Northeast of the narrows of Beaverlodge Lake, in the vicinity of the shaft, the porphyry-quartzite contact is marked by a zone, 1 to 2 feet wide, composed of fragments of porphyry in the quartzite. The angular to subangular porphyry fragments are 2 to 12 inches in diameter, with quartzite filling the interstices.

Another bed of conglomerate was noted in the main band of quartzite 1 mile southwest of Stairs Bay (UE 500-700) immediately south of two large trenches. There the conglomerate bed, which is 1½ feet thick, outcrops over a length of 50 feet, and is composed of pebbles of jasper, chert, quartz, and porphyry in a coarse matrix of smaller fragments. The pebbles are angular to subangular, and are poorly sorted. The conglomerate is associated with red jaspery quartzites and grits that grade to the southeast into massive, pure white, fine-grained quartzite.

Other conglomeratic beds in the quartzite are exposed in the trenches at pitchblende occurrence No. 10, along the shore of Olmstead Lake, and in the large hook-shaped quartzite inclusion in the granite 2,500 feet southwest of Stairs Bay and 500 feet northwest of the main quartzite band (TE 800+650).

The quartzites in places are fractured, and the fractures are filled with quartz veinlets. Most of the veinlets are only a few inches wide, but large irregular masses of vein quartz several feet in width are fairly common. Contacts between the vein quartz and quartzite are sharp and distinct; some veinlets include fragments of quartzite and these are angular and well defined. Most of the vein quartz is coarsely crystalline, with well developed comb structure. Terminated quartz crystals along the vuggy centres of the veinlets are commonly coated with hematite (specularite).

The vein quartz in the quartzite is irregular in distribution. In places only a few small stringers are present, whereas at other places a stockwork of vein quartz may make up as much as 10 to 15 per cent of the whole. The quartzite band in the granite southwest of Stairs Bay contains much more vein quartz than the quartzites in other parts of the area. The quartzite of the band is a fine-grained, cherty, pink to white rock that is cut by a multitude of small quartz veins and stringers running in all directions. The quartz veins and veinlets of the stockwork cut one another, and are apparently of several generations, but the youngest veins are coarsely crystalline comb quartz with vuggy centres. The granite bordering the quartzite for several hundred feet is also cut by a stockwork of quartz veins that make up as much as 50 per cent of the whole.

The quartzite also occurs as inclusions in the granite. These are particularly numerous northwest of the main quartzite band near Stairs Bay. For the most part they are pure white or greenish cherty quartzites cut by a multitude of quartz veinlets. Contacts with the granite are commonly well defined, although the granite nearby is cut by much vein quartz. In the large, hook-shaped, quartzite inclusion 2,500 feet southwest of Stairs Bay a 3-foot bed of conglomerate is present. It is composed of fragments of chert, quartz, and light grey porphyry as much as 1½ inches in diameter in a coarse fragmental matrix.

Some of the attenuated, narrow zones of quartzite in the granite, such as those southwest of the narrows of Beaverlodge Lake, are difficult to distinguish from a quartz-vein stockwork. In fact they were

considered to be such until the quartz bodies in the granite southwest of Stairs Bay were found to be quartzite. In detail they are zones of elongated quartzite bodies surrounded by granite. The larger masses are white to greenish, fine-grained quartzite cut by a stockwork of white, coarser grained quartz veins that also cut the adjoining granite. Under the microscope the quartzite of these zones is similar to that of the main quartzite bands, but is cut by a network of fine quartz veinlets.

The cherty argillites underlie a considerable area northwest of the east arm of Beaverlodge Lake. They are buff weathering, dark greenish-grey on fresh fracture, very fine-grained, cherty rocks with conchoidal fracture. Bedding is difficult to distinguish, and where present is a series of fine laminations visible only on a clean weathered surface. A few thin beds of quartzite, coarse grit, and fine conglomerate occur in them.

In thin section the cherty argillite is a fine-grained mat of quartz, sericitic mica, and chlorite. In many of the sections there are small lens-like areas with more chlorite and specks of magnetite. No bedding is apparent in the thin sections examined.

Relation of Sedimentary to Volcanic Rocks

Contacts between the volcanic rocks and the quartzite southwest of the narrows of Beaverlodge Lake are marked by coarse grits and conglomerates that grade upwards into massive, fine-grained cherty quartzites. In detail the contact is most irregular, with prongs of volcanic rocks projecting 10 to 20 feet into the sedimentary rocks. Evidently the conglomerate and quartzite were laid down on a very irregular surface. Northeast of the narrows the same conditions are present along the contact, although the conglomerates are not as well developed. The dacite near the small lakes southwest of the shaft seems to be bevelled by the overlying quartzite, but this may be due to the uneven nature of the volcanic flows. The presence of conglomerates and, possibly, some bevelling of the flows by the quartzite suggests erosional intervals of some duration between the periods of vulcanism and sedimentation. There is, however, no evidence of any structural break or non-conformity between them.

GRANITE, GRANODIORITE, AND ALLIED ROCKS

The granitic rocks vary considerably in composition and texture, but pink to red-brown granite is probably the most common type. All bodies intrude the volcanic and sedimentary rocks of the Snare group, and are believed to be Proterozoic in age.

The intrusions southwest of the narrows of Beaverlodge Lake are medium- to rather coarse-grained, pink weathering, massive granites averaging about 30 per cent quartz, 60 to 70 per cent orthoclase and plagioclase feldspar, and 5 to 10 per cent chlorite pseudomorphic after biotite. The feldspars appear fresh, but under the microscope show considerable sericitic alteration. The quartz grains are cloudy grey, and in places somewhat opalescent in appearance.

North of the east arm of Beaverlodge Lake the granitic rocks vary in composition from granite to granodiorite. They are massive, red-brown weathering, medium-grained rocks averaging 20 to 25 per cent quartz, 60 to 70 per cent feldspar ($\frac{1}{2}$ to 2/3 orthoclase) and 10 to 20 per cent chlorite pseudomorphic after biotite. Along contacts with the quartzite and cherty argillite, and for 500 to 600 feet southeast of them the granitic rocks are more basic in composition and variable in texture than normal. Several dykes and small bodies of light pink to yellowish, fine-grained, aplitic granite cut the main mass southeast of the quartzite near Stairs Bay.

The younger aplitic granite is believed to be a phase of the older intrusion.

The granitic rock northwest of the quartzite southwest of Stairs Bay containing many conclusions of quartzite is a very coarse-grained, pink to reddish, porphyritic, altered granite. It is cut by many quartz stringers, and tends to break along slip surfaces coated with chloritic minerals. The quartz occurs as white to opalescent blebs up to $\frac{1}{4}$ inch in size that stand out prominently on the weathered surface. The reddish orthoclase phenocrysts, $\frac{1}{2}$ to $\frac{3}{4}$ inch in size, are waxy and altered. In places, as southwest of the cabins on Stairs Bay, the quartz content is low, and the rock approaches a syenite porphyry in composition.

GABBRO

The largest gabbro body lies north of the east arm of Beaverlodge Lake. It appears to conform, in general, with the anticlinal and synclinal structures of the porphyry and volcanic and sedimentary rocks that it intrudes and is probably sill-like in form. This form is also suggested by two large outcrops near the shore that rise abruptly with cliff-like faces 200 feet above the lake. Porphyry outcrops along the base of these gabbro cliffs, and the contact dips toward the cliff face at 20 to 25 degrees.

The gabbro is a rusty to greenish weathering rock of medium grain. It is dark green on fresh fracture, and much of it has large ghost-like poikilitic green crystals up to an inch in length recognizable by their glistening cleavage faces. The rock is massive for the most part, but in places is jointed and fractured, with light green weathering epidote filling many of the fractures. Under the microscope, the feldspars, which make up 50 to 60 per cent of the whole, are highly altered to sericite and saussurite. Green, pleochroic hornblende, partly altered to chlorite, makes up the remainder of the slides, along with many grains of magnetite. The rock has a well developed poikilophitic texture.

In addition to the large, sill-like gabbro bodies described above, numerous gabbro dykes and small irregular masses intrude the granitic rocks; they are assumed to be related to the large gabbro body. They are most irregular in outline; some are sill-like, with gently dipping contacts with the granite, whereas others are dykes with vertical contacts. Apophyses that are too small to map extend into the granite from some of them. The smaller gabbro bodies are rusty brown weathering, reddish green, fine- to medium-grained rocks, with a well developed ophitic texture. They are composed of 50 to 60 per cent saussuritized plagioclase and 40 to 50 per cent hornblende. Titanite and leucoxene are also present, as well as abundant specularite, the latter being developed mainly in the hornblende crystals along cleavage cracks. The margins of the gabbro are commonly highly sheared and altered to chlorite, but the central parts are massive.

DIABASE AND GABBRO

Diabase and gabbro occur as dykes that cut the Snare rocks, granite, and older gabbro, and are the youngest known Precambrian rocks in the area. They are rusty brown weathering, fresh, black to greenish rocks, of fine to medium grain depending on the size of the dyke. Contacts with adjacent rocks are sharp, and they have chilled borders against them. They are composed of about 50 per cent plagioclase (commonly labradorite) and 50 per cent pyroxene that is partly altered to amphibole and chlorite in some dykes. Grains of magnetite are scattered through the rock, and a little brown mica may be present.

Most of the dykes are vertical or inclined at steep angles, although some have been injected along the bedding of the quartzite near Olmstead Lake and are sill-like in form. Some of the small, east-west striking dykes southwest of Stairs Bay may have come in along small faults.

PALAEOZOIC CONGLOMERATE AND SANDSTONE

Nearly flat-lying conglomerate and sandstone that is probably Palaeozoic in age forms many of the outcrops southwest of the narrows of Beaverlodge Lake. The old Precambrian erosion surface on which these sediments were deposited must have had a relief of at least 700 feet, because sandstone outcrops along the shore of the lake 700 feet below the hill of Precambrian quartzite to the northwest. The conglomerate and sandstone were observed resting on both Precambrian granite and quartzite.

The conglomerate occurs as a number of large, cliff-like outcrops on the southeast side of the quartzite hill some 300 to 400 feet above the elevation of the lake, whereas the sandstone forms low outcrops along the shore of the lake to the southeast. At the base, near the old erosion surface, the conglomerate is composed of great angular blocks of quartzite, up to 15 to 20 feet long, in a coarse matrix of smaller fragments from a foot to a fraction of an inch in size. Toward the top of the cliff-like outcrops the fragments become smaller, averaging 1 to 2 feet, and are more rounded, but there is little or no sorting, and the larger fragments are angular. A remarkable feature of the conglomerate is that it is composed almost entirely of quartzite fragments even where resting on granite. It is apparently a talus conglomerate derived from and formed along the sides and base of the high hill of quartzite to the northwest. Many of the quartzite blocks and cobbles in the conglomerate are cut by vuggy comb quartz veinlets, indicating that the comb quartz veinlets in the quartzite are pre-conglomerate in age.

The sandstones form low outcrops along and near the shore of the lake. They are almost flat lying, poorly consolidated, medium- to rather coarse-grained white to maroon quartzitic sandstones that weather readily to sand and outcrop as loosely piled slabs a few inches thick. Thin pebble-beds with well rounded pebbles up to 2 inches in diameter occur in places, and crossbedding is fairly common. The sandstone is composed of well rounded quartz grains in a cement of silica and hematite.

The sandstone is similar to that described by Lord[1] along

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[1] Lord, C.S.: op. cit., p. 37.

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the west side of Marian Lake some 125 miles to the southeast, where it is overlain by fossiliferous Ordovician sandy dolomite.

ECONOMIC GEOLOGY

GENERAL STATEMENT

Thirty-eight occurrences of radioactive minerals were mapped. Of these, between eleven and fifteen are probably new discoveries found in the course of the field work; the remainder had been picked at or trenched, and evidently were discovered originally by earlier prospectors.

Where the radioactive mineral is present in sufficient quantity to be identified it is pitchblende closely associated with hematite. Most of the occurrences are in quartz-hematite veinlets that occur: (1) in quartzite along or near steeply dipping, disconformable contacts with

underlying volcanic flows and porphyries, and (2) along joints in gabbro dykes and sill-like bodies that intrude granitic rocks.

Nine deposits (Nos. 2 to 10 on accompanying maps) are in quartzite along or near the contact with the underlying porphyries and dacites. Deposits No. 3 and No. 4 have been mined out. They were in the form of small lenses of pitchblende and hematite in quartzite, and probably the $1\frac{1}{4}$-ton sample sent to the Mines Branch at Ottawa in 1934 included most of the ore from these deposits. Deposit No. 10 occurs in gritty quartzite associated with a 3-foot bed of conglomerate. It consists of a vein-zone of quartz stringers up to 14 inches wide carrying some pitchblende, and is exposed for a length of 35 feet. The vein zone dies out along the strike in both directions. The other occurrences in the quartzite are small and unimportant.

Twenty-six pitchblende occurrences are in quartz veinlets in gabbro sills and dykes intruding granitic rocks. These include deposit No. 1 and deposits numbered 11 to 36 on accompanying maps. Most of these veinlets are a fraction of an inch wide, and can be traced for only a few feet. The largest deposit, No. 15, occurs in a quartz-hematite vein in an irregular sill-like body of gabbro. The vein varies from 2 to 8 inches in width and can be traced for 85 feet. A trench 40 feet long has been blasted out along the radioactive part of the vein. Of the vein exposed in the trench about 25 feet is strongly radioactive, and the remaining 15 feet is only feebly so. A 12-foot length of the vein at the eastern end of the trench contains some small lenses of hematite and pitchblende. A picked sample sent to the Mines Branch at Ottawa in 1934[1]

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[1] Kidd, D.F.: "Rae to Great Bear Lake, Mackenzie District, N.W.T." Geol. Surv. Canada, Mem. 187, p. 29.

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that assayed 13.70 per cent U_3O_8 probably came from this section of the trench.

DESCRIPTION OF PITCHBLENDE OCCURRENCES

In the following detailed descriptions of the pitchblende occurrences the Geiger-Muller counter referred to is Model GP_9 with rate-meter graduated from 1 to 50. The instrument was adjusted so that the normal background count gave a reading on the meter between 18 and 28.

The occurrences are described in order from No. 1 to No. 38 beginning at the southwest and working northeast.

No. 1 This occurrence is in a small, irregular shaped gabbro body about 3 feet from the granite contact. The gabbro is sheared, altered, and cut by a network of quartz stringers, some of which are of comb quartz. A little uranium stain occurs in one of the small quartz stringers. The rate-meter needle on the Geiger counter goes off the dial when held directly over one part of the stringer, but radioactivity is limited to length of less than 2 feet.

No. 2 (GE 820-90) - A pit about 12 feet by 7 feet and 5 to 6 feet deep has been made in pure, massive white quartzite striking north 48 degrees east and dipping 70 to 75 degrees northwest. The quartzite has been fractured, and vuggy comb quartz veinlets with associated hematite (specularite) fill the fractures. The quartz veinlets are seldom more than a fraction of an inch wide and make up only 5 to 10 per cent of the whole.

No uranium stain was observed but the rate-meter on the Geiger counter rises 10 to 15 points in the pit, with the highest count in the northwest corner.

No. 3 A shaft has been sunk in quartzite about 6 feet northwest of the contact with the porphyry. The needle of the rate-meter is driven off the dial in the neighbourhood of the shaft, although no stain is evident.

According to Jolliffe[1], who visited the property when the

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1 Jolliffe, Fred - "Pitchblende in a Giant Quartz Vein, Beaverlodge Lake, Northwest Territories", Unpublished Thesis, Princeton University 1935, p. 93.

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shaft was being sunk "a small amount of secondary uranium minerals prompted the location" and "an irregular compound pitchblende lens (was) exposed in the west wall of the pit ---- The maximum dimension of this lens exposed in cross-section during the development work measured slightly over six feet. Throughout this length there were three swells with intervening pinches. The top swell at its widest portion measured 6 inches across, the middle 8 inches, and the bottom one 7 inches".

The shaft is reported to have been sunk to a depth of 50 feet. No pitchblende was found beneath the lens described above.

No. 4 (GE 930-50) A pit about 25 by 20 feet at the surface and 12 to 15 feet deep, with the bottom covered by water, has been sunk in the quartzite. In the northeast bottom corner of the pit a 3-inch seam of chlorite lies between two massive quartzite beds. It occurs only in the bottom of the pit as it pinches out before it reaches the surface, but patches of it can be seen along the northwest wall of the pit where it has not been mined out. The quartzite near the chlorite patches on this wall of the pit is coated with uranium stain.

The chlorite has apparently been introduced along a crush zone parallel to the bedding, for the quartzite along the chlorite seam on the northwest wall is fractured. There is practically no pitchblende left in this pit, although the Geiger counter needle is driven off the dial near it, due in large part to the abundance of loose pieces of ore lying in the vicinity.

Jolliffe[1] describes the lenses that were mined out of this

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1 op. cit., p. 91

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pit as follows: "Three rudely lenticular pockets were located containing pitchblende and hematite disseminated through quartz---- In view of the transitional character of the borders of these lenses the following measurements are only approximate. The pocket nearest the surface was more or less equi-dimensional and about 2 feet across. In the same vertical line were found two other lenses of which the upper had a maximum width of about 3 feet and was only a few inches deep. The bottom lens measured about 1 foot across its largest dimension. Intervening barren vein material separated these lenses."

No. 5 (HE 780-160) The radioactive area is less than a square foot, and is in a chloritic lens in the quartzite about 8 inches from the contact with the underlying porphyry. By standing over the radioactive area the Geiger needle rises 5 to 10 points, and by setting the instrument on the spot will rise about 30 points.

No. 6 (HE 950-80) At the contact of porphyry and quartzite there are numerous veinlets of comb quartz and hematite. One small area is radioactive, and the Geiger needle rises 10 points, or the needle will leave the dial if the instrument is placed in contact with the ground.

No. 7 (I 20-85) A crush zone in quartzite with comb quartz and hematite some 20 feet from contact with porphyry has a small radioactive area. The rate-meter on the Geiger counter registers a rise of 10 to 20 points above normal when standing over it. The radioactive area has a length of less than 3 feet.

No. 8 (LE 570-100) - A shallow pit has been made on the contact of quartzite and porphyry at a point where an irregularity on the old erosion surface causes the porphyry to project some 20 feet into the quartzite. Where the quartzite rests on the projection it dips gently northwest, and is coarse grained with grains an eighth of an inch or more in size. The quartzite is fractured along the contact, and hematite and associated pitchblende, with some quartz, have been introduced along the fractures over an area of 2 to 3 square feet. The gritty quartzite seems to have been particularly susceptible to impregnation by hematite with pitchblende. Veinlets of chlorite are associated with the hematite and cut it. Much of the hematite is covered with uranium stain, and the needle of the Geiger rate-meter is driven off the dial over it. The radioactivity is limited, however, to the small area of hematite exposed in the pit.

No. 9 (LE 900-15) - This is a small occurrence of uranium stain in a crack in the quartzite about 10 feet from the contact with porphyry. The Geiger rate-meter rises 5 to 10 points above normal when over it. The radioactive area cannot be traced in any direction.

No. 10 (ME 700-550) - The pitchblende occurs along a zone of quartz stringers in quartzite, conglomerate, and argillite that strikes northeast and dips 55 to 60 degrees northwest. Three large trenches and a small pit have been dug across the zone in a length of 70 feet. The conglomerate bed, which is about 4 feet thick, is composed of quartz and porphyry pebbles up to 1½ inches in diameter in a coarse, gritty quartzitic matrix. The conglomerate grades upward into a coarse, gritty quartzite containing a few scattered pebbles, and the vein zone containing the pitchblende is in the gritty quartzite but, to the southwest, angles off into an overlying, greenish, thinly bedded argillite, and breaks up into a network of quartz stringers containing no pitchblende.

The small southwesterly pit is in the vein zone after it has passed into the argillite, and the Geiger counter gives no appreciable reaction either in it or to the southwest of it. The large trench, 5 feet to the northeast, is 12 by 5 feet at the surface, and 6 feet deep, with the longer dimension along the vein zone. The vein zone is exposed at both ends, and lies between the 4-foot conglomerate bed to the southeast and the 1-foot bed of coarse, gritty quartzite succeeded by argillaceous sediments to the northwest. The vein zone, which consists of stringers of comb quartz with some associated hematite and pitchblende along the walls of the stringers, is 4 to 6 inches wide, increasing in width to 14 inches at the northeast end of the trench. There is much uranium stain along the vein zone, and the Geiger counter needle is driven off the dial in this trench.

In the next trench to the northeast, which is 15 feet long, 3 feet wide, and 3 feet deep, with its longer dimension normal to the structure, the vein zone is exposed at the southeast end. It is not as well defined as in the last-described trench, but there are a few quartz stringers with much stain and a little pitchblende, and the Geiger counter needle is driven off the dial.

The next trench is 30 feet northeast of the one last described, and is about 20 feet long, 3 feet wide, and 3 feet deep and normal to the rock structure. The trench is in conglomerate and gritty quartzite, but there is no well defined vein exposed in it although one 2-inch quartz veinlet at the southeast end of the trench contains a little uranium stain. The Geiger counter needle rises 30 to 40 points above normal in this trench.

In summary the best part of this showing is exposed in the two southwesterly trenches, where a zone of quartz stringers 4 to 14 inches wide carrying pitchblende is exposed over a length of 35 feet. This zone dies out to the southwest, where it passes into slaty argillite, and apparently also to the northeast, where it has not been picked up in the most northeasterly trench.

No. 11 (VE 260-215) - A small amount of uranium stain occurs in a quartz veinlet in gabbro, striking south 40 to 50 degrees east and dipping 45 degrees southwest. The veinlet is ½ inch to 1 inch wide, and can be traced for 10 feet. The Geiger needle goes off the dial when over the stain, and rises about 15 to 25 points for 2 feet on either side along strike - that is, the veinlet is radioactive along a length of 4 feet.

No. 12 (VE 245-270) - A little stain shows along a 1/8-inch quartz veinlet in gabbro, striking south 60 degrees east and dipping 55 degrees northeast. The stain is exposed for a length of 1 foot along the veinlet, and the Geiger needle goes off the dial when standing over the stain and rises 20 to 25 points for 5 feet along strike on either side of it; that is, the veinlet is radioactive for a length of 10 feet.

Another veinlet of about the same width is exposed 8 feet northeast of that described above. It is radioactive for a length of about 8 feet.

No. 13 (VE 390-175) - A little stain occurs in places along a 1/8- to ¼-inch veinlet in gabbro striking south 25 degrees east and dipping 40 degrees northeast. For a length of 10 feet along the veinlet the Geiger needle rises 10 to 30 points above normal.

Another veinlet in the gabbro, up to 3 inches wide, and about 10 feet southeast of the other, strikes north 15 degrees east and dips 35 degrees southeast; it can be traced about 75 feet to the southwest. The Geiger needle rises 20 to 30 points at one place over some stain, and 15 to 20 points for 10 feet on either side of the stain along the veinlet.

No. 14 (VE 345-270) - A quartz veinlet in gabbro ¼ to ½ inch wide can be traced for 12 feet. It strikes south 75 degrees east, dips 45 degrees southwest, and contains a little stain at one place that raises the Geiger needle about 15 points when standing directly over it. The veinlet is radioactive over a length of 2 feet or less.

No. 15 (VE 300-350) - This is the largest pitchblende deposit occurring in gabbro. A trench 40 feet by 5 feet by 3½ feet deep has been blasted out along a quartz vein. The vein strikes east to a little south of east, dips 45 degrees north, and ranges in width from 2 inches at the west end of the trench to 8 inches at the east end. It can be traced 30 feet beyond the eastern end and 15 feet beyond the western end of the trench for a total length of 85 feet. The vein is composed of quartz and hematite, and much of the hematite is crystalline specularite. The hematite and specularite are generally concentrated along the margin of the vein, with comb quartz and some flakes of specularite in the centre, but in places the vein is composite, with bands of hematite and quartz repeated twice or more. Of the vein exposed in the trench the eastern 25 feet is strongly radioactive, with much uranium stain present. The Geiger counter responds

strongly, and the needle is driven off the dial. The western 15 feet of the vein in the trench is feebly radioactive, with a little stain exposed in places, and the Geiger needle rises only 10 to 15 points. Beyond the trench to the east and west the vein is not radioactive.

A small pile of hand-cobbed earthy hematite with pitchblende lies near the trench. It probably came from a 12-foot section of the vein at the eastern end of the trench, where some small pods or lenses of similar material up to ½ inch wide occur in the vein. The sample sent to the Mines Branch at Ottawa[1] that assayed 13.70 per cent U_3O_8 probably came from this trench.

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1 Kidd, D.F.: "Rae to Great Bear Lake, Mackenzie District, N.W.T." Geol. Surv. Canada, Mem. 187, p. 29.

No. 16 (VE 360-340) - A small quartz veinlet in the gabbro strikes north 75 degrees east and dips 35 degrees north. It is radioactive over a length of 3 feet, raising the meter reading of the Geiger counter 20 to 25 points when held over the veinlet and driving the needle off the dial when held in contact.

No. 17 (VE 400-370) - A narrow quartz veinlet in the gabbro strikes south 25 degrees east and dips 30 degrees southwest. Uranium stain covers an area 2 inches by 10 inches on the wall of the veinlet. The Geiger needle rises 15 to 20 points when standing over the stain.

Fifteen feet to the southwest some stain occurs in another veinlet striking north 75 degrees east and dipping 30 degrees northwest. The Geiger needle rises 10 to 15 points over the stain.

No. 18 (VE 410-390) - A quartz veinlet less than 1 inch wide, striking east and dipping north, has a strong reaction on the Geiger counter, driving the needle off the dial over a length of 8 feet along the strike of the veinlet and for 3 feet on either side. This occurrence has not been opened up, but is probably one of the better showings in the gabbro.

No. 19 (VE 540-400) - A quartz-hematite veinlet in gabbro striking north 25 degrees east and dipping vertically, can be traced for 11 feet. Some uranium stain occurring along 1 foot of the veinlet raises the Geiger needle 10 to 15 points when standing over it.

No. 20 (WE 160-410) - Uranium stain occurs along the selvages of a number of quartz-hematite stringers, none of which is more than ½ inch wide, in a gabbro dyke. The main veinlet strikes north 35 degrees east and dips 40 degrees northwest. A small pit has been dug, and the stain is exposed for 4 feet along, and for 2½ feet down the dip of the veinlet. When standing directly over the stain the Geiger needle goes off the dial, and there is a feeble reaction for 3 to 4 feet around the pit - probably due to fragments from the pit.

No. 21 (WE 200-410) - Uranium stain occurs along the selvage of a 1½-inch quartz veinlet in the gabbro. The veinlet strikes north 30 degrees east and dips 45 degrees northwest. The Geiger needle rises 10 to 15 points over the stain, but shows no reaction elsewhere along the veinlet.

No. 22 (WE 120+35) - A quartz veinlet 1/8 inch wide along the gabbro-granite contact is coated with uranium stain. The Geiger needle rises 20 to 25 points over it, but the radioactivity is confined to a small area.

No. 23 (WE 180+6) - A $1\frac{3}{4}$-inch quartz veinlet in a gabbro dyke and striking parallel to it is heavily mineralized with specularite with some uranium stain along the walls. The veinlet can be traced 6 feet to the southwest, and is covered with drift to the northeast. The Geiger needle rises 20 to 25 points over the 6-foot length that is exposed.

A parallel veinlet $\frac{1}{2}$ inch wide is exposed 6 feet to the south. It can be traced for 8 feet, and is radioactive over a length of 3 feet, raising the Geiger needle 10 to 15 points.

No. 24 (WE 235+15) - A little uranium stain occurs along a veinlet in the gabbro 2 feet from the granite contact. It causes a rise of 15 to 20 points in the Geiger reading over a length of 10 feet.

No. 25 (WE 730+375) - A quartz veinlet in gabbro 4 feet from contact with granite is radioactive over a length of 2 feet or less. The radioactive area is covered with about a foot of loose rock and dirt, but the surrounding bare rock is not radioactive, so its dimensions are small. The radioactivity is sufficiently strong to drive the Geiger needle off the dial.

No. 26 (XE 540+275) - Of several small quartz veinlets in gabbro exposed in a small pit, one veinlet about $\frac{1}{2}$ inch wide contains some uranium stain. By standing in the pit the needle on the Geiger counter rises 10 to 20 points above normal.

No. 27 (XE 725+235) - A small pit has been dug along the gabbro-granite contact. No stain was observed, but the Geiger counter needle rises 10 to 15 points above normal in the pit.

No. 28 (XE 950+200) - Two small pits have been dug along the gabbro-granite contact. No uranium stain was observed, but there is a rise of 5 to 10 points in the Geiger reading in the pits.

No. 29 (XE 125 - 40) - A quartz-hematite veinlet $\frac{1}{2}$ inch or less wide in gabbro strikes south 30 degrees east and dips steeply southwest. It has some uranium stain along the walls, and the Geiger reading rises 10 to 15 points directly over the stained part of veinlet.

No. 30 (YE 630+700) - A small quartz veinlet is confined to a 2-foot gabbro dyke cutting the granite. Some uranium stain in the veinlet raises the Geiger reading about 10 points above normal.

No. 31 (YE 660+690) - A small quartz veinlet is confined to a 2-foot gabbro dyke cutting the granite. A little stain along the veinlet raises the Geiger reading 10 to 15 points above normal.

No. 32 (YE 700+700) - A dykelet of gabbro about 2 feet wide contains a $\frac{1}{4}$-inch quartz veinlet with some uranium stain. The Geiger reading rises 10 to 15 points above normal when standing directly over the stain.

Thirty feet to the south of the above occurrence another, 1-foot, gabbro dyke cutting the granite contains a small quartz veinlet with some uranium stain.

No. 33 (YE 775+750) - An irregular shaped pit about 12 by 15 feet and 1 to 3 feet deep has been blasted in a vertical gabbro dyke. At the east end, near the surface, is a small area of uranium stain about 3 inches by 9 inches. No other stain was observed in place in this pit.

The uranium stain occurs along a veinlet of hematite and fine cherty quartz $\frac{1}{2}$ inch or less in width. The veinlet lies along a joint in the gabbro striking north 80 degrees east and dipping 45 degrees north. It cannot be traced along the strike or down the dip. By standing with the Geiger counter directly over the stain the needle is driven off the dial. By standing on the dump of rock from the pit or in the pit itself the needle rises 5 to 10 points above normal.

Twenty feet west of the main pit some joint cracks in the gabbro dyke have been opened up with a pick, and in places are coated with uranium stain. The joints are on the strike and have the same dip as the veinlet in the large pit. Veinlets of hematite and cherty quartz have come in along the joints, and it is along them that the uranium stain occurs. The needle on the rate-meter rises 5 to 10 points when standing directly over the stain, or if the instrument be set on the stain the needle is driven off the dial.

No. 34 (YE 775+350) - On the eastern edge of a small area of drift are two, 2-foot gabbro dykes in the granite. A small quartz veinlet in one of them contains a little stain, and the Geiger reading rises 10 to 15 points over it.

No. 35. A small veinlet cutting across a $2\frac{1}{2}$-foot gabbro dyke in the granite contains a little uranium stain. The Geiger reading rises about 10 points above normal when standing over it.

No. 36. A little uranium stain occurs along the foot-wall of a 2-foot gabbro dyke cutting the granite and striking north 45 degrees east and dipping 55 degrees northwest. The stain covers an area of about $1\frac{1}{2}$ by 2 feet, and raises the Geiger reading 10 to 15 points when standing directly over it.

Nos. 37 and 38. These two occurrences are along joints or cracks in the granite. A thin film of vein quartz can be seen along the joints with some uranium stain in places. The massive salmon-red granite is a deeper red along and near the joints. Occurrence No. 37 is along a joint or crack striking north 70 degrees east and dipping 60 degrees northwest. It is radioactive over a length of 7 feet, and along the central part the Geiger needle is driven off the dial. Occurrence No. 38 is along a joint or crack striking east, and may dip about 50 degrees south. It is radioactive over a length of 20 feet, sending the Geiger needle off the dial when over the central part.