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NORTHWEST DASSERAT TOWNSHIP, TEMISCAMINGUE COUNTY, QUEBEC

(REPORT AND MAP)

By

K. R. Dawson

OTTAWA

1950

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(Summary Account)

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Illustration

Preliminary map - Northwest Dasserat, Quebec.....In envelope

NORTHWEST DASSERAT TOWNSHIP, QUEBEC

INTRODUCTION

This report deals with the results of geological investigations made during the field seasons of 1948 and 1949 in the northwest quarter of Dasserat township, in Temiscamingue county, Quebec. The accompanying map, on a scale of 1 inch to 1,000 feet, covers an area of 25 square miles. Within this area traverses were made at intervals of 300 feet, sufficient, it is believed, to have made possible the mapping of all significant outcrops.

The area mapped is readily accessible by air from either Larder Lake, Ontario, or Noranda, Quebec. Within it are two large lakes, both suitable for aircraft landings. In addition, it can be reached by car from two directions: from Cheminis, Ontario, by driving north along the Bordulac mine road to Labyrinth Lake, or by driving north from the main Quebec highway (No. 59) at a point about 4 miles west of Arntfield, Quebec. Both of these roads terminate at landings from which one can travel by canoe into the area. Dasserat township is also accessible in the south by the Ontario Northland Railway, with stations at Cheminis and Arntfield.

All points of interest in the area can readily be reached from the shores of Lake Dasserat, Dasserat River, or Labyrinth Lake; consequently, travelling by canoe is the most economical method. Trails and cut-lines extend through much of the area, thus facilitating the examination of outcrops.

The northwest quarter of Dasserat township has possibilities as a gold mining area. The promising Bordulac deposit is already being developed, and mineralized shear zones have been prospected on several other properties. The common occurrence of such mineralized zones and of sulphide-bearing quartz veins, and the highly fractured nature of the rocks support this view. The ready accessibility of the area is a further inducement to prospecting and development.

The sand ridge that parallels the interprovincial boundary is an excellent source of materials for construction purposes as well as a first-rate site for a highway to facilitate mineral development.

The author gratefully acknowledges the valuable advice and assistance of Dr. C.H. Stockwell of the Geological Survey, under whose immediate supervision the field work was done, and of Mr. J.B. Currie, who was engaged in mapping an adjoining area in Ontario for the Geological Survey of Canada. Many thanks are due to the officers of Bordulac Mines Limited, Gilmont Mines Limited, and Dastur Gold Mines Limited, and especially to Messrs. T.W. MacDowell, President of Bordulac mine and Wm. Papke of Gilmont Mines, Limited. In addition, thanks are due to his senior assistants, S.E. Jenness and R.A. Forgrave, junior assistants H.A. Lee, T. Matthews, and A.E. Storey, and all others who contributed in any manner to this project.

The topography of northwest Dasserat is the product of numerous factors, including structural differences in the Keewatin and Cobalt formations and the effects of Pleistocene glaciation. The Keewatin rocks comprise steeply dipping lavas and agglomerates, and rest unconformably beneath gently dipping Cobalt sedimentary strata. Maximum relief is about 100 feet, both in areas underlain by the Cobalt and in those where the Cobalt is missing. Hilly topography is typical of the northwest and southeast corners of the map-area, but the central part is relatively flat, with a maximum relief of a few tens of feet. There, swamp conditions are prevalent, outcrops are scarce, and drill-holes on the Bordulac property have penetrated the overburden for as much as 180 feet without encountering bedrock. The quarter township is drained almost entirely by Kanasuta River, which forms part of the James Bay watershed. The divide separating this from the basin of Ottawa River lies near the east-west centre line of Dasserat township. Outcrops in the area all show the effects of glaciation, and the overburden is composed of varved clays and sands derived from the same source.

GENERAL GEOLOGY

Table of Formations

Era	Assemblage	Lithology
Proterozoic	Diabase dykes	Diabase and gabbro
	Intrusive contact	
	Cobalt sedimentary rocks	Greywacke Green argillite Conglomerate
	Unconformity	
Archaean	Post-Keewatin intrusions	Meta-diabase Pegmatitic facies Granophyre Meta-gabbro? Chlorite schist Mineralized facies Rhyolite porphyry Sericite schist Augite syenite Quartz-feldspar porphyry Feldspar porphyry Andesitic dyke rocks Mineralized types Amphibolite
	Intrusive contact	
	Keewatin volcanic rocks	Basaltic flows Agglomerate Interbedded tuffs and agglomerate Sheared agglomerate Rhyolite Sericite schist Green and grey intermediate flows Porphyritic facies Mineralized facies Spherulitic rock

Keewatin Volcanic Rocks

Spherulitic Rock. This rock (1)[1] is limited in occurrence

[1] Numbers in parentheses are those of map-units on accompanying map.

to a single narrow band along the north shore of the northwest arm of Lake Dasserat. It is not characterized by primary structures such as are typical of the other Keewatin lavas, but rather by a dark, glassy groundmass in which occur swarms of ovoid white patches. These patches are commonly very fine grained, and locally they have weathered sufficiently to show a radiating pattern. In thin section the rock was observed to consist of brown glassy material containing well-formed spherulites. Alteration has resulted in partial devitrification of the glass and the formation of grains of epidote and flakes of chlorite.

Flows of Intermediate Composition. This series of lavas (2) is the most widespread in northwest Dasserat township, outcropping across the entire width of the area. The monotony of the sequence is broken by the other Keewatin rocks and the post-Keewatin intrusions.

The primary structures of these flows vary widely, as the group probably includes metamorphosed andesites, trachytes, and dacites. The porphyritic varieties, such as have been mapped in the northwest corner and near the Monarch mine, are typically pale green or grey, and are commonly pillowed. The pillows are exceptionally large, having thicknesses up to 6 feet and locally, where exposed in vertical cliffs, lengths in excess of 20 feet. The pillows show selvages more than 3 inches thick, banding in the core concentric with the selvages, phenocrysts both in the cores and in the selvages, and amygdules throughout composed of quartz, chlorite, and epidote. In addition to these flows, other pale grey and green lavas, which seldom show phenocrysts, are characterized by smaller pillows that are almost as distinctive. These pillows rarely exceed a length of 3 feet or their selvages more than an inch in thickness, and vesicles, which are quite abundant, are commonly filled by white calcite.

In thin sections, flows of intermediate composition show a wide variation in texture from porphyritic, through trachytic, to fine-grained granular. Almost without exception the original minerals have been altered to chlorite, sericite, epidote, and clinozoisite. Varying amounts of carbonate and yellow sulphides have been observed, and in some slides the feldspar is albite, which is also thought to be a secondary mineral. The mafic constituents originally present in these rocks have been completely altered to chlorite.

These flows are involved in major structures in the map-area, including the principal shear zones and the drag-fold north of the narrows in Labyrinth Lake. They lie in a south-facing, conformable series that extends across the map-area and includes the pyroclastic and other Keewatin rocks. Intruding it are the post-Keewatin intrusions, and overlying it unconformably the Cobalt sedimentary series.

Rhyolite Flows. These (3) are among the least significant of the Keewatin lavas, so far as volume is concerned. The flow outcropping north of the Bordulac mine is the thickest of those mapped; smaller flows were mapped at several places.

Megascopically, the most arresting feature of the rhyolite is the chalky white weathered surface, which on close inspection can be seen to be either pinkish or greenish, the latter shade due probably to sericitization of the original rock, and the former representing a less altered type. On fresh surfaces they are dense, honey-coloured rocks, rarely showing either quartz or feldspar phenocrysts. One occurrence north of Dasserat River features a dense black variety, and there, as in all of the other occurrences, a marked absence of flow banding or other primary structures that might suggest an extrusive origin.

Observed in thin section, the rhyolite appears as a dense mosaic of quartz and feldspar, with scattered coarser grains of quartz. The rock has undergone metamorphism to the extent that sericite has become one of the common mineral constituents.

The rhyolites behave structurally in a manner resembling that of the pyroclastic rocks. They appear to shear quite readily, and yield a columnar structure in which the elliptical columns are separated by pale yellow sericite films. Where fractured, the openings are commonly mineralized with quartz, specular hematite, and, more rarely, chalcopyrite. The flow mapped north of the Bordulac mine has undergone the same deformation and intrusive processes as the agglomerate in that area, and in addition it is intersected by two shear zones containing bands of sericite schist of varying widths.

Pyroclastic Rocks. The pyroclastic rocks (4) occupy two main belts, one north of Bordulac mine and the second south of the east arm of Labyrinth Lake. In addition, several smaller bands have been mapped at intervals across the quarter township. Of the Keewatin rocks, they are structurally the most confusing, as they are rarely sorted into distinguishable beds. Widths up to 2,000 feet have been mapped, as well as much narrower bands such as commonly separate the lava flows.

Megascopically, the pyroclastic rocks are generally seen to be composed of white, siliceous fragments, though some contain scoriaceous or even intrusive and extrusive material. The fragments are commonly embedded in a fine, dark green groundmass, which owes its colour to the chlorite that forms its major mineral constituent. The commonest pyroclastic rock is green and fine grained. Where the fragments are coarse the matrix is relatively scarce, and there is generally no evidence of bedding; this characteristic holds for the large area of agglomerate that lies directly north of the Bordulac mine, and also for the band between Labyrinth Lake and the area of Cobalt sedimentary rocks. The narrower bands, on the other hand, are commonly well sorted, a feature clearly indicated in the drag-fold north of Labyrinth Lake, where the beds show some crossbedding and channelling. Rhyolitic fragments are especially common in the larger occurrences, and some of the fragments in the poorly sorted

northern band have been observed to show flow banding. Owing to the intense shearing in evidence immediately north of Dasserat River, it has been found impossible to map what may be a rhyolite exposed in the outcrops immediately north of the river and east of the rapids.

The study of a few thin sections has shown that the more finely bedded material is pyroclastic in origin, consisting of fragments, and what appear to be patches, of isotropic to partly devitrified glass. These rocks have undergone the same alteration as the flows, with the production of chlorite, epidote, and carbonate.

An outstanding structural feature of the pyroclastic bands is the development of wide shear zones, with central parts of sericite schist flanked on either side by less altered pyroclastic rock. In addition, these bands, which are believed to be conformable with the lavas, reflect deformations analogous to that exhibited by the lavas. The pyroclastic rocks are believed to be products of the same period of eruptions as the lavas because they have been intruded by most of the post-Keewatin intrusions.

Basaltic Flows. These lavas (5) outcrop over a limited area of range VI near the Monarch mine shaft and on the south side of the east arm of Labyrinth Lake. Those near the shaft have not been traced west along their strike beyond the shore of Lusko Lake, and towards the east only as far as Lake Dasserat. Locally, other flows are of about the same colour as the basalts, but primary structures and, generally, specific gravity determinations have indicated that they are all of intermediate composition.

The basalts exhibit two main primary structures: amydules and pillows. The former are generally not as common as the latter, nor are they as characteristic. The pillows seldom exceed 2 feet in length, and the selvage is rarely as much as an inch thick. No concentric banding has been observed between the core and the selvage. Specific gravity determinations average 3.00, a value

typical for basalts. In addition, these flows have pyroclastic partings between them, a feature that has only been rarely observed in lavas of intermediate composition, even where well exposed. The massive black basalts might be confused with fine-grained intrusions of diabase, but lack prominent chilled margins.

In thin sections, the basalts show well-defined plagioclase laths, which have a tendency to radiate from common centres. The groundmass is composed of finely disseminated chlorite and minor amounts of granular epidote. Slides from massive flows much resemble those from fine-grained, intrusive diabase.

These flows are believed to lie in a conformable sequence facing south in both occurrences mapped. Two faults are assumed to cut across them near Lake Dasserat, and one small shear has been detected near their contact with feldspar porphyry on the east shore of Lusko Lake. Information available suggests that these flows are among those at the top of the Keewatin section exposed in the map-area. It appears that all the lavas have been folded. Mostly they form the north limb of a large syncline the axis of which lies south of the area. The abrupt change in strike near the Monarch mine may be due in part to proximity to the axis, and in part to faulting in that vicinity.

With the exception of their intrusive contact with the feldspar porphyry, nothing is known about the relationship of those flows to the remainder of the post-Keewatin intrusions. In addition, no actual data are available on the nature of the contact between these lavas and the Cobalt sedimentary strata, though it is assumed that it would be unconformable as it is for the Keewatin volcanic rocks.

Post-Keewatin Intrusive Rocks

Amphibolite. This rock (6) outcrops in two small areas on the west flank of the ridge of Cobalt conglomerate northeast

of Little Maron Lake. It is possible that the rocks of the two areas are parts of one intrusive mass, as they are lithologically similar, but there are no surface exposures to support this view. No other occurrences of this particular rock type have been mapped in the area.

In hand specimens, the rock is uniformly medium coarse grained, showing no prominent primary structures. The mafic constituents exhibit cleavages visible to the naked eye, but the feldspars are difficult or impossible to detect, probably as a result of the extensive formation of chlorite in the saussurite pseudomorphs after the original feldspar .

In thin sections, the amphibolite is composed of about 55 per cent mafic minerals (biotite, chlorite, and uralite), 35 per cent plagioclase, 7 per cent quartz, and the balance of accessory sphene and leucoxene. The original plagioclase has been largely replaced by saussurite pseudomorphs rimmed by clear twinned plagioclase believed to be albite. The saussurite is composed of a mixture of clinozoisite and chlorite, in aggregates that retain a lath-like outline, possibly inherited from the original feldspar. Small amounts of this saussurite join with angular patches of quartz in a pattern very suggestive of granophyre. The uralitic hornblende occurs in poikilitic plates, within which are flakes of chlorite and occasional groups of pale green biotite flakes. These textures and minerals are believed to indicate that the original rock has undergone extensive alteration. The presence of important amounts of hornblende led to the naming of the rock as an amphibolite.

The amphibolite is of interest structurally, as it supplies evidence to prove that the pre-Cobalt land surface had a fair amount of relief, at least locally. In the cliff at the west side of the ridge of Cobalt conglomerate the contact between the amphibolite and the conglomerate rises to where it reaches an elevation of more than 50 feet above the low ground to the west. Farther south along the

same ridge, the conglomerate outcrops down to the bottom of the cliff. The contact does not appear to be intrusive, as no tongues of amphibolite invade the conglomerate; instead, some black pebbles in the overlying conglomerate may have been derived from the amphibolite.

Andesitic Dyke Rocks. These rocks (7) are almost as widely distributed as the meta-diabase dykes and sills (10). They occur most commonly as dykes, ranging from a few inches to 20 or 30 feet in width, in the Keewatin volcanic rocks, and are most readily recognizable in the agglomeratic bands from which they differ noticeably in texture and colour.

Without exception these rocks are almost completely altered to chlorite-carbonate schists. Their most conspicuous primary structure is their chilled contacts against adjacent rocks.

In thin section, chlorite, untwinned feldspar, leucoxene, and carbonate are seen to be the major constituents. White mica is common as fine grains in the groundmass. One section exhibited a rude porphyritic texture; another appeared as a complex mat of minerals.

Augite Syenite. The main occurrence of augite syenite (8) has been mapped on the peninsula north of the Flynn-Ber cabin. A smaller area of a more acidic rock has been mapped on islands in Lake Dasserat south of the outlet of the lake. The exposures of both intrusive bodies occupy only a few acres at the most.

The augite syenite is characterized by a pink to dark green weathered surface, which north of the Flynn-Ber cabin shows stumpy augite crystals, and on the islands in Lake Dasserat is almost indistinguishable from that of the meta-diabase immediately to the east. The augite-bearing type carries considerable pink feldspar, whereas the other is more even textured, with the mafic constituents uniformly distributed.

In thin sections, the syenite from north of the Flynn-Ber cabin is seen to be composed of about 75 per cent sodic oligoclase,

2 to 3 per cent quartz, 15 per cent uralitic hornblende, and the balance of accessory sphene, apatite, and magnetite, plus such alteration products as white mica, chlorite, and brown iron oxides. Biotite may have been an original constituent, but is now represented by chlorite and some of the sphene. The plagioclase shows the effects of alteration in the presence of white mica near the cores of the grains. The uralitic hornblende commonly shows a prominent poikilitic texture, and the chlorite appears as ragged flakes or laths, probably pseudomorphous after the biotite.

The syenite outcropping on the islands in the northwest arm of Lake Dasserat has not been examined in thin section. It appears to be a siliceous rock, and as it is somewhat brecciated it may be the contact phase of either a syenite or a granodiorite cupola.

Because of limited exposures, little is known of the structural behaviour of these syenitic rocks except that they are known to intrude the Keewatin rocks. The relationship of the augite syenite to the metadiabase is obscure owing to the similarity of the two rocks in the field.

Only two small dykes of quartz-feldspar porphyry (8a) have been mapped in the area, one on an island near the west end of the northwest arm of Dasserat Lake, the other on the west side of the outlet of the lake. They are characterized by coarse quartz and feldspar, appearing somewhat pegmatitic.

Feldspar porphyry dykes (8b) are limited in their occurrence to the east end of range VI near the north-south centre line of the township. They have been found to intrude the Keewatin basaltic flows and pyroclastic rocks in that vicinity, and have well-defined walls. They are characterized by bright red euhedral feldspar crystals that commonly show both zoning and twinning striae, which are apparent in hand specimens. The groundmass has a somewhat reddish cast, and is suspected to carry considerable feldspar.

Rhyolite Porphyry. This rock (9) comprises two elongated bodies that extend from near the first rapids on Dasserat River to the west end of Lake Dasserat and thence to the north edge of the township. It is normally pale green or pinkish on weathered surfaces and amber coloured on fresh surfaces. Flow structures have not been observed, but the rock carries a fair number of euhedral quartz 'eyes' and scattered feldspar phenocrysts. Thin sections of the rock indicate that it is composed of a fine mosaic of quartz and feldspar, with phenocrysts of both minerals and varying amounts of sericite.

The rock is commonly undeformed, but is traversed by two shears along which sericite schist has formed. One of these lies north of the rapids on Dasserat River, and the second strikes north 70 degrees west from south of the mouth of Clericy Creek. The only other structure of interest in the porphyry is locally developed columnar jointing.

The rhyolite porphyry strikes across the regional trend of the Keewatin volcanic rocks. It is intrusive into the lavas and agglomerate, but little is known of its relationship to the post-Keewatin intrusions.

Meta-diabase. Altered diabasic rocks (10) comprise the largest intrusive group in the area. They compose both dykes and lenticular, sill-like bodies, and may exceed 3 miles in length and $\frac{1}{4}$ mile in width. The larger intrusions include the Dastur meta-gabbro, which forms the south shore of the northwest arm of Lake Dasserat; the Bordulac intrusion, which extends northeasterly from the narrows of Labyrinth Lake; and the meta-diabases and gabbros that form the complex at the east end of this lake. In addition, many smaller bodies are widely distributed across the map-area.

The Dastur intrusion is somewhat longer than the Bordulac mass, and lies in an en échelon position to the northeast of it. The two bodies differ texturally and mineralogically, the former being almost completely altered, though retaining remnants of poikilitic augite containing saussurite pseudomorphs after the original plagioclase. This feldspar has been reduced to clinozoisite, chlorite, and albite, and the augite is in the process of being reduced to uralitic hornblende and chlorite. Magnetite has been identified only in the pegmatitic phase of the rock (10a) and appears to have been mainly a titaniferous variety that has been reduced to the common leucoxene skeletons observed in thin sections. A little quartz has been identified in angular interstitial patches among the saussurite laths.

The Bordulac intrusion, on the other hand, shows a slightly different mineral composition, and also a distinctly different texture. No augite has, for instance, been identified in the thin sections examined, as the principal mafic constituent is now uralitic hornblende. The original plagioclase has been altered to clinozoisite, epidote, and albite, and locally the rock takes on the bright green shade of the abundant epidote. The feldspars have been altered, but the saussurite pseudomorphs retain an ophitic texture, which is apparent even in hand specimens, a feature that has yet to be observed in the Dastur meta-gabbro. Granophyric patches (10b) have been observed in the Bordulac intrusion but not in the Dastur intrusion, another point of difference between the two.

Both of these intrusive masses are associated with a coarse pegmatitic rock, which occurs in patches and dykes, and is composed of blocky plagioclase, augite, hornblende, and magnetite. The first two minerals show the same high degree of alteration that characterizes

the meta-diabase. Accessory minerals are magnetite, quartz, and apatite, as in the finer grained phase.

Accompanying the Bordulac intrusion is a small outcrop area near the narrows on Labyrinth Lake, which has been mapped as a granophyric facies (10b) of the meta-diabase. It ranges from pink to grey, depending upon the preponderance of either plagioclase or quartz. The mafic constituents of the rock are limited to a few per cent, consisting mainly of chlorite, uralitic hornblende, with carbonate, and accompanied by the same accessory minerals as occur in the meta-diabase.

The granophyric phases of the meta-diabase commonly react to shearing by the formation of quartz-chlorite schists (10d), and such mineral occurrences of economic interest (10e) as have been found in these intrusive rocks are commonly associated with such schists.

The meta-diabase, meta-gabbro, and associated rock types contain within themselves the same pattern of faulting and shearing as has been observed in the Keewatin rocks. Some of the smaller dykes are offset by faults, but generally there is little evidence of any major folds affecting these intrusive rocks. Field evidence indicates that they intrude the Keewatin rocks but fails to show their relationship to the other post-Keewatin intrusions. They are not considered to be Proterozoic intrusions because they have, without exception, undergone extensive regional metamorphism. On the other hand, they have not been found in contact with the Cobalt sedimentary rocks, so the conclusion that they are all Archaean is far from certain.

Earlier workers in this area have classified these rocks as quartz diorites, but the author has chosen to discard this term as inaccurate and in its place uses the terms meta-diabase and meta-gabbro. The results obtained from a dozen partial chemical

analyses have indicated that the silica content of these rocks seldom exceeds 50 per cent, which is more typical of diabases and gabbros than of diorites. On the other hand, the rocks do not have the mineralogical composition of fresh diabase and gabbro, as they have undergone extensive metamorphism. As a result, such original minerals as the basic plagioclase, augite, and possibly some hornblende have been altered and recrystallized as saussurite, uralite, and minor amounts of albite, thus producing meta-diabases and meta-gabbros.

Cobalt Series

Conglomerate. Conglomerate (11) is the most prevalent rock type in the area underlain by the Cobalt sedimentary series. It outcrops in a triangular area in ranges V1 and V11, extending from the north end of Lusko Lake south along its west shore and west to Little Maron Lake.

This rock has the most striking appearance of those in the Cobalt series, as it carries a wide variety of coloured detritus, ranging in size from coarse sand to blocks 5 feet or more across. The fragments are cemented by a sandy matrix composed of quartz, feldspar, and a few scattered grains of mafic minerals. Sandy strata occur locally in the conglomerate, but are rarely large enough to map separately. They, are, however, useful in determining the attitude of the conglomerate.

Stratigraphically, the conglomerate forms the basal and an intermediate member of the series, as a narrow band of green argillite (12) is interbedded with it. In addition, a major unconformity separates the conglomerate from the underlying Keewatin rocks, the contact being exposed at several points around the edge of the Cobalt area. Also, the cliff immediately

west of Lusko Lake, at the eastern margin of the syncline, shows a faulted contact between porphyritic, green Keewatin lava and the conglomerate. At this point, a narrow zone of gouge separates the two rocks, and the surfaces have been striated suggesting a fault contact in place of the more normal unconformity.

Argillite. The Cobalt argillite (12) has a wider distribution than the greywacke, though it doesn't occur in as great volume. It has been mapped above the basal conglomerate (11, in part) at points around much of the area underlain by the Cobalt series.

The argillite is generally a pale green, fine-grained rock, exhibiting abundant fine-bedding lamellae wherever exposed, and has, consequently, proved particularly useful in structural interpretations. Locally, the bedding planes have been disrupted by pebbles. The argillite is both underlain and overlain by conglomerate in the conformable sequence.

Greywacke. Greywacke (13) has been mapped in that part of range V1 that lies between Lusko and Little Maron Lakes. There it forms the top of the sedimentary series in a syncline that plunges southwest. The rock is generally black or dark grey, and is fine to medium coarse grained, locally carrying some pebbles.

The syncline, of which the greywacke forms a part, trends southwesterly, and is undisturbed except by the Milky Creek fault, which is thought to follow the first creek valley west of Lusko Lake. It is probable that the east ridge of the syncline has moved up with respect to the western part, thus exposing more greywacke than would otherwise be expected. Available evidence indicates that the greywacke conformably overlies conglomerate (11, in part).

Undifferentiated Sedimentary Rocks. Within this group (14) is included some of all of the Cobalt sedimentary rocks of the map-area. The separate rock types have not been differentiated, as the full details of their mutual relations have not been deciphered.

Late Precambrian Dykes

Late Precambrian quartz diabase and gabbro (15) comprise a few small dykes scattered across the map-area. One has been mapped where it crosses the southern contact of the Bordulac intrusion, and two others of less definite age have been mapped respectively in the agglomerate north of the Bordulac mine and in contact with Cobalt strata south of range line V1-V11.

These rocks show chilled margins against adjacent rocks, and ophitic textures are generally visible in hand specimens. The age determinations that serve to separate these rocks from the meta-diabases (10) are based upon their intrusive relationships and the presence of basic feldspar and augite preserved in them.

STRUCTURAL GEOLOGY

Structures in Keewatin Rocks

The Keewatin lavas and agglomerates outcropping in northwest Dasserat township exhibit very few noticeable structures; the drag-fold north of the Bordulac property and such minor folds as those observed south of Labyrinth Lake and east of Lusko Lake are those most readily apparent. On the basis of top determinations, it appears that the greater part of the area is underlain by a south-facing conformable sequence of lavas. This monoclinal structure is most apparent along the west side of Lake Dasserat.

Drag-fold. This structure is exposed near the inter-provincial boundary, in ranges VIII, IX, and X of Dasserat township, and is the most prominent structure mapped. The main rock types involved are lavas of intermediate composition, pyroclastic rocks, a few rhyolite flows, and such intrusive rocks as the rhyolite porphyry and meta-diabase.

The drag-fold itself is an S-shaped structure, with both northern and southern components plunging west. The presence of the structure is well supported by the attitude of the rocks in its immediate vicinity as well as by those farther to the south and north. Immediately to the east, the structure is obscured by the two largest meta-diabase intrusions in the area and, possibly, by a major fault zone.

The northern member of the drag-fold is well outlined by both lavas and the band of pyroclastic rocks. With the exception of several small faults in the north limb and an assumed shear in the south limb, these rocks have been folded without causing significant shearing in the Keewatin volcanic rocks.

In the southern component of the drag-fold the lavas and unsorted agglomerate show more effects of distortion than do their counterparts to the north, possibly due to the fact that the fold must be considerably tighter than the northern one. The south component is generally highly sheared, and shear zones are common in both the lavas and the agglomerate. The agglomerate has been forced west into the drag-fold north of the falls on Dasserat River and to a lesser degree to the south, thus destroying any original linear nature it had. As mapped, a horseshoe-shaped mass of agglomerate appears to tail off to the east both north and south of Dasserat River. Lavas of intermediate composition fit conformably

on the outside of this structure, with agglomerate and rhyolite and then intermediate lava within it in that order. This would suggest the existence of an anticlinal structure south of the river, but top determinations and such complicating factors as the intrusions and the assumed fault make this improbable. The author is of the opinion that the drag-fold hypothesis best fits the available facts.

The Monocline. The eastern half of the map-area, extending from the north township line south to the vicinity of range line V1-V11, has been mapped as a uniformly south-dipping sequence of lavas and pyroclastic rocks, interrupted only by meta-diabase dykes. Top determinations do not indicate either anticlinal or synclinal axes anywhere in the sequence.

This monoclinal structure is complicated by several faults along the south shore of the northwest arm of Lake Dasserat and on the islands and on the mainland west of the lake. The scarcity of outcrops makes their interpretation speculative, but it does seem probable that the Milky Creek fault, on its extension, cuts across the monocline, and that the only possible path for it to follow without a major bend would be the low ground along the west sides of the two small lakes north of Lusko Lake. The movement appears to have been east side north with respect to the west side, as the porphyritic flow has been offset in such a fashion for a distance of roughly a mile. Judging from the offset observed in one of the meta-diabase dykes, movement since its intrusion has been sufficient to offset it 2,500 feet.

Minor Folds. One minor fold involving two rather abrupt changes in strike is exposed near Little Maron Lake in a succession of intermediate flows, agglomerate, and at least one basic flow.

South of Labyrinth Lake, the lavas trend about south 75 degrees east and maintain this strike to just west of Little Maron Lake where the trend changes to northeast, roughly parallel with the Cobalt-Keewatin contact. As the same rocks near the east end of Labyrinth Lake they bend towards the east normal to the direction of the Cobalt-Keewatin contact. The reasons for these sinuous changes in strike are not readily apparent. The unsorted agglomerate in the sequence is sheared much as it is in the drag-fold, and probably as a result of the same forces. The Milky Creek fault, to which reference has already been made, lies immediately to the east of the above-described fold, so it is possible that movement along the fault has been largely responsible for the fold. For example, the fold south of the east bay of Labyrinth Lake is believed to reflect the movement that carried the east wall of the Milky Creek fault north with respect to the west wall. The lack of the buttressing effects of any large intrusive bodies in these folds would permit them to react in the manner suggested. The effect of the meta-diabase intrusions north of the east arm of the lake does not appear to have been important as a deterrent in the deformation of these rocks.

A second minor fold, on the Monarch property east of Lusko Lake, is represented by a single, rather abrupt bend from the direction of the regional strike to another more southerly strike as mapped. This change in strike is very apparent in the pillowed basalts south of the shaft, but north and west of Lusko Lake it is difficult to detect due to scarcity of outcrops. Lack of outcrops also prevents any positive determination of the effects of the assumed extension of the Milky Creek fault.

Within the folded lavas on the Monarch property at least two shears parallel the strike: one outcrops on the shore of

Lusko Lake at the contact with the feldspar porphyry, the other in the exposures south of the lake. These may have acted as bedding plane shears, as they are almost conformable with the regional strike. In addition, two cross-faults are assumed to cut the lava sequence on the lake shore east of the shaft; their presence is suggested by the apparent offsets suffered by a red porphyry dyke and the basalt-porphyritic dacite contact in those positions.

Faults. The map-area has undergone extensive faulting and shearing, probably during two or more periods of Precambrian time, and it is equally probable that intermittent movement has occurred along such structures as the Milky Creek fault. Such a series of movements is suggested by the displacement of the Keewatin lavas, the meta-diabase dyke in range V11, and the Cobalt sedimentary strata.

Faults and shears mapped have the following, four common orientations: northwest, north 20 degrees west to north 20 degrees east, north 60 degrees east, and east. All of these, with the exception of those of the second group, occur as shear zones occupied by chlorite or sericite schist and, commonly, mineralized by quartz and carbonates, with minor sulphides. Those of the second group have been observed in the workings of the Bordulac mine, where they are gouge-filled fractures of varying width, with strongly striated walls. The direction indicated by the fault striae would suggest that the principal displacement along these faults has been vertical, and it has been observed that horizontal displacement has been sufficient to offset other structures a few tens of feet. Little is known of the relative movement along the shear zones, due to lack of outcrops along their strike.

Structures in Post-Keewatin Intrusions

The post-Keewatin intrusive rocks that range in composition from meta-diabase to rhyolite porphyry do not appear to have been folded but, rather, have reacted to the orogenic forces by faulting and shearing. This might be due to their size and homogeneity as compared with the flows.

Shears are especially common, perhaps in part due to the ubiquitous chlorite, which would aid in their formation. The sinuous east-west group is well represented, and here, as has often been found elsewhere, gold has been detected. Shears striking about north 60 degrees east are common, but little is known regarding movement along them. The one that lies beneath the narrows of Labyrinth Lake has been found to carry gold.

Faults do not appear to be as numerous as the shears, and only one set, striking north 20 degrees west to north 20 degrees east, has been recognized. Those faults are best displayed by the workings of the Bordulac mine in the meta-diabase. The Milky Creek fault, on its extension north of the area underlain by the Cobalt sedimentary rocks, has been found to offset the meta-diabase it crosses.

Structure of Cobalt Sedimentary Rocks

The Cobalt series appears, on good evidence, to have been deposited in a trough on top of the underlying Keewatin flows. It forms a southerly plunging syncline, complicated by the Milky Creek fault and by a fault along its eastern contact with porphyritic Keewatin lava. The Cobalt strata do not show the effects of horizontal displacement, because they are relatively flat lying, but there does seem to have been movement in a vertical direction, with the east side of the trough uplifted with respect

to the west side. No folding has been observed within the sedimentary series, so it has been concluded that there has been no significant orogeny in that area since the consolidation of the Cobalt beds.

Structure of Post-Cobalt (Keweenawan?) Diabase

The dykes considered to be of post-Cobalt age are generally narrow, and as, with one exception, they do not intrude rocks younger than the meta-diabase, their age is assumed on the basis of the insignificant alteration undergone by the original mineral constituents. One dyke in range Vl has been found in contact with the lowest strata of the Cobalt series, but even there the evidence supporting intrusive relationships is not conclusive.

ECONOMIC GEOLOGY

Gold Deposits

Bordulac Mine. The Bordulac property comprises a large block of claims extending east from the interprovincial boundary for nearly 3 miles in range Vlll. Most of it is occupied by the Bordulac meta-diabase, though towards the east the claims are underlain along their north sides by the Dastur meta-diabase and to the south by intermediate lavas, minor agglomerate, and rhyolite flows.

Gold has been found to accompany a persistent east-west shear that has been traced for more than 7,000 feet. Drill logs have indicated another shear striking roughly north 60 degrees east and dipping about 65 degrees southeast from its position beneath the narrows of Labyrinth Lake. This shear is thought to continue northeast along the low ground and to the southwest into the Natjo property in Ossian township, Ontario. Surface lineaments suggest that another, parallel shear may occur in the vicinity of the mine

camp, but to date no clear evidence has been found to support this opinion. The main, east-west shear has been followed by drifts on the 150-foot level, where it shows numerous offsets due to faults that strike from north 20 degrees west to north 20 degrees east. These faults seldom offset the mineralized zone more than a few tens of feet. They are not mineralized, but consist of gouge-filled fractures with strongly striated walls; movement along them appears to have been mainly vertical. The mineralized shear has been traced through the various phases of the meta-diabase, including the granophyre and the pegmatitic facies, with fairly consistent values. It would appear that they have acted as a fairly competent homogeneous mass that kept this shear zone open during periods of mineralization.

The shear zone is composed mainly of chlorite schist, which has been mineralized by brown and white carbonate, scheelite, pyrite - commonly in pyritohedrons - quartz, and gold. Small pockets of chalcopyrite occur locally. The sulphides grade out into the chloritic wall-rock. The gold occurs locally in fine veinlets through the sulphides or in the quartz.

Monarch Mine. This property comprises a group of claims in range V1 between Lusko and Dasserat Lakes. It is underlain, from north to south, by agglomerate, prophyritic dacite, and basaltic flows. Near the contact between the first two rock types is a persistent dyke of red feldspar porphyry that strikes almost parallel with the enclosing flows. Underground work has been confined to two shafts sunk into this red porphyry.

The rock on this property commonly carries a more than normal amount of sulphides, this being especially true of the porphyritic dacite. Nothing, however, is known of the structural

control of the mineral deposits, but the porphyry dyke has been drilled along its strike from the shaft to Lake Dasserat, and so it is assumed that the original vein was found associated with it. In addition, a shear has been investigated near range V11, another at the contact between the red dyke and the basaltic flows on the shore of Lusko Lake, and a third has been trenched in the southern part of the property. Apparently assay returns did not warrant further investigation.

Dastur Property. This property consists of a block of claims in range V111 extending west from the centre line to the small lakes south of the northwest arm of Lake Dasserat. It is underlain by lavas of intermediate composition, the Dastur meta-diabase, and a few small beds of agglomerate.

The property has been extensively trenched, and a small shear at the north contact of the meta-diabase has been trenched and drilled, with indifferent results. Shears exposed at points on the lake shore and inland were previously investigated by trenching, but little of economic interest seems to have been uncovered.

Flynn-Ber Property. This property comprises a block of claims in range V1 on the peninsula that juts into the southern side of Labyrinth Lake. Within the area of these claims, augite syenite and a large dyke of meta-diabase have intruded a volcanic series that includes, from north to south, intermediate lava, agglomerate, intermediate lava, and, finally, a wide band of unsorted agglomerate.

The volcanic rocks underlying the area immediately north of the cabin have been strongly sheared and carbonatized along a zone that, to the east, disappears beneath low ground. Similarly sheared and altered lava is again visible in outcrops immediately to the east of the meta-diabase and a few hundred feet north of the

projected strike of the shear zone. These altered zones seem to afford the best prospecting ground on the property.

SUMMARY AND CONCLUSIONS

(1) The complex structure in the Keewatin rocks north of the Bordulac camp is thought to be a drag-fold rather than a combined syncline and anticline. The distribution of the various rock types, and attitude determinations within the structure itself and to the north and south tend to support this view.

(2) The Milky Creek fault is believed to cross the eastern part of the quarter township, as indicated by horizontal displacements in the Keewatin rocks and post-Keewatin meta-diabase intrusions and by the vertical displacement exhibited by the Cobalt strata.

(3) The dark-coloured intrusive dykes and sills in northwest Dasserat township are quartz-bearing meta-diabases and meto-gabbros rather than quartz diorites. Evidence to support this is to be found in textural features, in the metamorphic mineral suite that now characterizes these rocks, and in chemical analyses.

(4) Two, possibly three, ages of basic intrusive rocks are represented in the area. Two intrusive groups show the effects of intensive, low-grade metamorphism, whereas the third, which is thought to be Proterozoic, is relatively fresh and unaltered. The two older groups can be separated on the basis of the presence or absence of magnetite and a strongly developed ophitic texture. In at least one instance a magnetite-bearing intrusion cuts across a non-magnetic mass.

(5) There are two, separate, sill-like basic intrusions in range VIII rather than a single one as mapped formerly. This is borne out by textural and chemical dissimilarities, and in addition one is found to be much more magnetic than the other.

(6) Known gold occurrences accompany sulphides and carbonate in the sinuous east-west shears, as indicated on the Bordulac, Flynn-Ber, and Dastur properties and on one or two other mineralized showings. Consequently, it would appear that such shears as the one on the shore of Labyrinth Lake, near its outlet, the shears on the large south island in that lake, and the shears west of Little Maron Lake may carry gold.

(7) The pre-Cobalt land surface in northwestern Dasserat was one with appreciable local relief, as indicated by the irregularity of the amphibolite-Cobalt contact.

(8) The Keewatin-Cobalt contact is not everywhere an unconformity, but in places, as on the west side of Lusko Lake, is represented by a gouge-filled fault fracture.

(9) The predominant lava type in the map-area is not basaltic but rather a quartz andesite or dacite, which may or may not be porphyritic. A study made of a dozen thin sections, chosen to represent the whole series of flows in the area, revealed the almost universal presence of free quartz with intermediate plagioclase. Textural details, colours, and specific gravity determinations are believed to lend support to this view.