Ministry of
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Ontario

Ontario Geological Survey
Open File Report 5881

Geology of the Casummit Lake Area, Kenora District (Patricia Portion)

1994

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ONTARIO GEOLOGICAL SURVEY

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By

G.P. Beakhouse

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Ontario Geological Survey

OPEN FILE REPORT

FOREWORD

Detailed geological mapping of the Casummit Lake area in northwestern Ontario was undertaken by the Precambrian Geoscience Section of the Ontario Geological Survey to identify the economic potential of the area.

The area is underlain by predominantly mafic metavolcanic and felsic plutonic rocks. Intermediate to felsic metavolcanic and metasedimentary rocks also occur but are not common.

The past-producing Jason Gold Mine is located on the east shore of Casummit Lake and the map area has potential for additional economic gold deposits and should also be explored for base metals and molybdenum.

John Wood
Director
Ontario Geological Survey

Critical reader P.C.Thurston, Subsection Manager. Manuscript approved for publication by B.O.Dressler, Section Chief, Precambrian Geoscience Section, February 3, 1994. This report is published with the permission of J.Wood, Director, Ontario Geological Survey.

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Abstract

This report describes the geology and mineral deposits of the Casummit Lake area. The area covers approximately 270 km2 and is located 110 km northeast of the Town of Red Lake. This area is underlain by a dominantly metavolcanic Archean supracrustal sequence that has been complexly deformed, metamorphosed and intruded by Archean intrusive rocks. The supracrustal rocks represent the northern portion of the Birch-Uchi metavolcanic-metasedimentary domain within the Uchi subprovince. The area was glaciated during the Pleistocene Epoch.

The supracrustal rocks are predominantly mafic metavolcanic rocks comprising massive and pillowed flows with minor associated autobrecciated facies. Intermediate to felsic metavolcanic rocks are primarily fragmental deposits although many of these are highly deformed and their origin is difficult to determine. Clastic metasedimentary rocks are a minor component of the belt and consist primarily of wacke and siltstone. Chemical metasedimentary rocks including chert and magnetite ironstone are a minor but widely distributed component of the belt.

The Mainprize Lake granitoid complex bounding the belt to the west is comprised almost entirely of microcline-megacrystic granodiorite. The belt is bounded to the east by the Shearstone Lake granitoid complex within which a similar granodiorite predominates but granitic, tonalitic

and quartz dioritic phases are locally abundant. The Mink Lake granodioritic stock post-dates most of the deformation. The metavolcanic and metasedimentary rocks have near vertical dips, are moderately to highly strained and have superimposed tectonic fabrics. These deformational features are interpreted to be a consequence of infolding and compression related to the emplacement of the surrounding granitoid complexes. The highest degrees of strain and most intense fabric development are associated with the margins of the belt and a broad zone adjacent to a major interface between a northern mafic-dominated sequence and a southern, more heterolithic sequence. This latter zone of intense deformation appears to have localized the migration of late fluids responsible for intense secondary alteration and veining related to gold mineralization.

The past-producing Jason Gold Mine is located at the east shore of Casummit Lake and between 1931 and 1952 produced about 102000 ounces of gold. The area has potential for the discovery of additional economic gold deposits and should also be explored for base metals and molybdenum.

Geology of the Casummit Lake Area
Kenora District, Patricia Portion

by

G.P. Beakhouse

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Introduction

The Casummit Lake area is located approximately 110 km northeast of the Town of Red Lake in the District of Kenora, Patricia Portion, and is in the Red Lake Mining Division. The area of detailed mapping covers approximately 270 km^2 and is approximately bounded by latitudes 51°27'10" and 51°34'30" and longitudes 92°10'E and 92°34'E.

The map-area is centred on the northern part of the Birch-Uchi greenstone belt in the Uchi subprovince. The area also includes portions of large granitoid complexes which bound the greenstone belt to the northeast and northwest.

Access

Access to the map-area is by float plane from Red Lake. Access within the map-area is hindered by the lack of interconnected waterways. Good to fair portages exist between Mink and Joneston Lakes, Mink and Birch Lakes, Joneston and Casummit Lakes and Casummit and Birch Lakes. In addition, Casummit Creek is navigable to small boats and canoes in periods of high water with only a few pullovers near Casummit Lake. In the northern part of the map-area, particularly north of Retter and Blondin Lakes, extensive areas of open muskeg and floating and string bog make access difficult. The most practical access to these areas is by helicopter.

Previous Geological Investigations

Previous geological investigations that cover portions of the map-area include those of Furse (1934), Horwood (1937) and Thurston (1986). The only detailed mapping was that of Horwood (1937) whose work was restricted to the area immediately around the Argosy Mine on Casummit Lake. The area to the south of the Casummit Lake area has been mapped in detail (Good 1988; Beakhouse 1989).

Present Geological Investigation

Field work was carried out during the summers of 1990-91. The field map was prepared at a scale of 1;15 840 (1 inch to 1/4 mile) on cronaflex base maps prepared by the Cartography Section, Surveys and Mapping Branch, Ontario Ministry of Natural Resources from maps of the Forest Resource Inventory. Field data were plotted on acetate overlays to aerial photographs at the same scale as the base maps.

Mapping was done by pace and compass traverses supplemented by examination of shoreline exposures. Based on prior examination of aerial photographs, traverses were designed to maximize outcrop coverage along lines run, where possible, at high angles to the strike of lithologic units. Prominent topographic features and outcrops visible on aerial photographs were used for control.

Acknowledgements

The author was capably assisted, through some rather trying times and experiences, by J. Egan, T. Fraser, M. Mainville and M. Wilson in 1990 and D. Besserer, D. Bouwman, M. Dehn and M. Wilson in 1991. Ms. Mainville and Mr. Wilson acted as senior assistants and are responsible for 50 to 60 percent of the mapping.

I thank the staff and management of Green Airways for providing safe and courteous transport into numerous lakes and puddles, efficient expediting services and extending many other courtesies to the field crews. I am also grateful to B. Atkinson and J. Parker of the Resident Geologists Office, Red Lake for the help and courtesies they extended during the course of the project.

Topography and Drainage

The map-area lies astride two major drainage systems, both of which are part of the arctic watershed. The souteastern portion of the map-area drains eastward to the Cat River system via either Birch Lake/Birch River or Kapikik River and thence into the Albany River system. The northwestern portion of the map area drains northwestward via the Berens River system to Lake Winnipeg.

The map-area can also be subdivided into two topographically distinct regions that broadly conform to the two drainage basins. The southern and eastern portions of the area are characterized by subdued relief (<70 metres) but with

locally rugged topography. Bedrock knobs and ridges are abundant thoughout much of this area and bedrock features exert a major control on topography and drainage.
Much of the Berens River drainage basin in the map-area is characterized by more subdued relief. Extensive areas are low lying spruce bog, open muskeg and string and floating bog with a few metres at most of relief. Many of the lakes in this area area shallow and the water almost opaque, rendering them hazardous to navigation and landings. Bedrock exposures are not abundant in this area. Pleistocene glacial deposits (drumlinoid ridges and DeGeer moraines) form distinctive topographic features locally. Both bedrock and Pleistocene deposits exert some control on drainage but, compared to other parts of the map area, this is not well developed.

General Geology

The map area is located at the northern end of the Birch-Uchi greenstone belt. The greenstone belt is assigned to the Uchi subprovince but the granitoid rocks in the area are difficult to assign to either the Uchi or Berens River subprovinces due to our inadequate understanding of this transition.
U - Pb geochronological investigations carried out in the southern portion of the Birch-Uchi greenstone belt have indicated a range of Late Archean ages from 2959 Ma to 2735

Ma. Although there is no geochronological data available for the map area and the Swain Lake deformation zone is a barrier to correlation into the northern portion of the greenstone belt (Beakhouse, 1989), all of the bedrock in the area is inferred to be of Late Archean age (Table 1).

Simple stratigraphic models such as have been applied in the past to various portions of the Birch-Uchi greenstone belt are inconsistent with more recent geological and geochronological observations (Beakhouse, 1989; Noble, 1989). Although lack of outcrop in critical areas, general poor quality of exposures and high degrees of strain conspire to make it difficult to identify the nature of the complexity, stratigraphic relationships with the map area are interpreted to be complex based on a number of observations. Firstly, some of the units interpreted to be in tectonic contact in the Birch Lake area (Beakhouse, 1989) extend into the map area where observations are consistent with those made to the south. Secondly, directions of younging, although these are only locally preserved, indicate that the stratigraphy cannot be deformed into simple monoclines or synclinoria. Small to large scale isoclinal folding may explain some of the reversals in younging direction but others that are lithologically assymetrical are interpreted to be faults.

Mafic metavolcanic rocks predominate within the greenstone belt and are particularly abundant in the northern part of the map area. The southern part of the map area is more heterolithic and include a significant proportion of intermediate metavolcanic rocks together with subordinate felsic metavolcanic rocks and metasedimentary rocks in addition to the mafic metavolcanic component.

Mafic intrusive rocks are widespread within the greenstone belt. Many of these are interpreted to be be closely related to the mafic metavolcanic rocks but others, particularly the larger masses in the western portion of Mink Lake and those north of Richardson Lake, might be discrete younger plutons.

Intermediate to felsic plutonic rocks include large granitoid complexes which bound the greenstone belt (Mainprize and Shearstone Lake complexes) and smaller plutons that are wholely or partially enveloped by the rocks of the greenstone belt (Mink Lake and Retter Lake stocks). All of these units are intrusive into the greenstone belt at the present level of exposure.

The structure of the greenstone belt is complex. This is interpreted to be due to the superposition of two tectonic processes each of which may itself involve numerous descrete deformational events. There is little evidence for the first stage, involving large scale faulting and perhaps folding leading to the tectonic assembly of disparate volcanic/sedimentary sequences, in the map area. The second tectonic process is interpreted to be related to the emplacement of the external granitoid complexes resulting in transposition of bedding into a near vertical orientation and the imposition of tectonic fabrics and low to high degrees of strain on the rocks of the greenstone belt. Pleistocene glacial and Recent deposits cover the bedrock throughout much of the map area.

Mafic Metavolcanic Rocks

Mafic metavolcanic rocks underlie more than one half of the greenstone belt and are especially abundant in the northern part of the belt. In the southern part of the map area they form thin units alternating with intermediate to felsic metavolcanic rocks but are otherwise similar to those occurring to the north. The most notable variations in field characteristics are related to variations in primary structures and texture, metamorphic grade, secondary alteration and intensity of fabric development and strain (Table 2).

The degree of preservation of primary structures and textures is highly variable across the map area. In some areas, notably east of the Jason Mine where they are well exposed by a recent burn, the rocks, though recrystallized to metamorphic mineral assemblages, are not highly strained and preserve many primary structures and textures (Photo 1). Throughout much of the area, moderate to high degrees of strain, in many cases coincident with zones of intense secondary alteration, have obliterated or significantly modified most primary structures and textures (Photos 2 and 3). Most of the observations presented here concerning primary features are based on the better preserved areas but there is no indication of any significant systematic variation in these features across the map area.

Massive and pillowed flows are approximately equally represented. All of the mafic metavolcanic rocks are typically fine to very fine grained but some of the massive flows have a grain size of up to approximately 1 millimeter and are difficult to distinguish from gabbro sills. Rarely, massive flows can be observed to grade upwards into pillowed varieties. In most cases the pillows form discrete entities that range from classical, relatively equant pillows to 'mattress' forms. Ameboid and interconnected pillow forms are rare. The selvages of pillows is typically 1 to 2 cm thick. Other features of pillows observed locally include radial and concentric fractures and concentration of radially disposed vesicles at the margins of the pillows (Photo 1). Pillows frequently display a concentric colour variation (lighter coloured on the outside) that is interpreted to be due differential alteration of the originally finer grained or glassy, more vesicular outer portion of the pillows.

Flow top breccias are associated with both massive and pillowed flows. Fragments are typically sub-rounded to angular and less than 30 cm in longest dimension. Some fragments have a discoloured rim due to alteration. In some cases, the colour zonation within pillow fragments is observed to be overprinted by the discolouration around the breccia fragment.

Amygdular structures are relatively common. Typical mineralogy within these gas cavities consists of various combinations of quartz, carbonate and chlorite. Concentric zonation, usually with a more quartz-rich core and carbonate-rich interior, is recognizable locally. One exceptional example, from a locally gossanous outcrop located approximately 800 metres southwest of Mink Lake Narrows, consists of closely packed 'spheres' of carbonate separated by fine grained chloritic material. The origin of this structure is unclear. One possibility is that it represents simple carbonate infilling of original extremely frothy pumice. An alternate possibility is that the carbonate is a late replacement of some other mineral (zeolites?) that occurred in spherical crystal aggregates. In either the case, the preservation of such delicate structures is remarkable and unusual for the Casummit Lake area.

The mineralogy of many of the mafic metavolcanic rocks is difficult to fully resolve under the petrographic microscope but they consist for the most part of feldspar, actinolite, chlorite, epidote, hornblende and opaques. Hornblende occurs primarily in proximity to the large external granitoid complexes.

The only mineral phase clearly identifiable as phenocrysts within the mafic metavolcanic rocks is plagioclase feldspar and this occurs as two distinct varieties. Smaller, subhedral to euhedral, tabular plagioclase phenocrysts that rarely display skeletal structure are less than 1 cm, and typically 2 to 3 millimeters, in longest dimension. They have a length to width aspect of 3:1 to 50:1 and, in some cases, form radiating crystal aggregates. They are comparatively fresh and unaltered. A second variety is much larger (1 to 5 cm diameter), equant and have a rounded, anhedral form. They are extensively altered to epidote and possibly other minerals that are too fine grained to be resolved under a petrographic microscope. Rarely, the two varieties of plagioclase phenocrysts occur together (Photo 4). These observations suggest that the smaller phenocrysts were in equilibrium with the melt but that the larger phenocrysts are relatively earlier and were resorbed and extensively reacted with the melt.

Rarely, hornblende or chlorite crystal aggregates up to 1 millimeter in diameter are recognized to be distinctly coarser than the matrix and may represent original mafic phenocrysts. No pyroxene is preserved and there is nothing in their form to indicate that the hornblende or chlorite is replacing pyroxene. Given their common occurrence in highly strained rocks and, in the case of hornblende, near the margins of the greenstone belt, it is difficult to discount the possibility that these might be porphyroblasts.

Notwithstanding regional variation in the intensity of strain, the primary textural/structural characteristics of the mafic metavolcanic rocks exert a major influence on the intensity of strain and the development of fabrics. In general, the coarser and more massive flows exhibit the least, and flow top breccias the most, strain and fabric development (Table 2). Where minor interflow chemical metasedimentary rocks are associated with the flow contacts, deformation is both intense and heterogeneous. Late alteration, veining and mineralization is concentrated in such zones (Photo 5).

Within two high strain zones of more regional extent, mafic metavolcanic rocks have distinctive characteristics as a consequence of the deformation and alteration/metamorphism. One of these zones corresponds to a prominent ridge that is immediately adjacent and parallel to the contact between the greenstone belt and the Mainprize Lake granitoid complex. The zone is up to 500 metres wide and extends from south of the map area to a point east of Blondin Lake. Within this zone mafic metavolcanics have been transformed to amphibolites. Evidence for high strain is seen within 'banded amphibolite' that alternates with more massive amphibolite. The banding is defined by alternating amphibolite (similar to massive variety), thin (< 1 cm), dark black mela-amphibolite and, less abundantly, greenish coloured epidote-rich amphibolite (Photo 3). These banded amphibolites alternate on a meter to decimeter scale with more massive fine to medium grained amphibolite and are rarely associated with thin chert or magnetite ironstone units. Rarely, adjacent mela-amphibolite bands are connected by tight closures at one or both ends, the latter case defining a flattened elliptical geometry. This observation, together with their overall setting and composition, suggests that these banded amphibolites represent original pillowed mafic flows. If this interpretation is correct, these rocks have undergone intense strain to produce length to width ratios on horizontal surfaces of at least 10:1 to 20:1. The nature of the exposure limits interpretation but the flattening aspect may be comparable in vertical section as well.

A second regional zone of intense deformation that gives rise to a distinctive variety of mafic metavolcanic rock is spatially associated with the contact between the northern mafic dominated portion of the greenstone belt and the southern more heterolithic portion of the greenstone belt. The characteristics of mafic metavolcanic rocks associated with this zone is not uniformly developed but rather is most obvious in discontinuous lenses. The most significant and extensive such zone occurs along the south shore of Casummit Lake. Here, mafic metavolcanic rocks are transformed to highly fissile chlorite schists with abundant carbonate and characterized by a deeply pitted weathered surface. All primary structures are obliterated within such zones and a mafic volcanic origin is inferred only from their setting and chlorite-rich composition.

Intermediate Metavolcanic Rocks

Intermediate metavolcanic rocks occur mainly in the southern part of the map area. These rocks are distinct from mafic metavolcanic rocks by virtue of their colour index, buff to grey colour and preponderance of feldspar both as a phenocryst and phenoclast but may form a compositional continuum with felsic metavolcanic rocks. In all cases where the original nature of the deposits could be deduced, intermediate metavolcanic rocks are interpreted to be fragmental deposits with no evidence for the presence of flows.

Intermediate metavolcanic rocks range from massive, poorly sorted tuff-breccia to thin, evenly bedded tuff. The coarsest deposits occur in the core of the regional fold north of Mink Lake. Here, poorly sorted, massively bedded tuff-breccias, with no associated tuff and only locally grading into lapilli-tuff, contains subrounded clasts with cross-sectional dimensions of up to 1 square meter. The clasts in this area are uniform in composition, consisting of abundant subhedral to euhedral plagioclase phenocrysts (1-3 millimeters in longest dimension) in a much finer grained matrix (predominantly quartzofeldspathic with up to 15 percent chlorite and minor opaques). The proportion of alteration (white mica, epidote) and secondary (quartz, carbonate, pyrite) minerals is generally low but variable. The matrix is somewhat more chloritic but is also characterized by abundant feldspar crystals that range from euhedral to angular, crystal fragments.

Lapilli-tuff (Photo 6) includes rocks spatially associated with the tuff-breccia described above and similar in all respects except clast size but, more typically, is more heterolithic and ranges from massive to moderately well bedded. Feldspar-phyric intermediate clasts and feldspar phenoclasts as described above are almost always present but significant (< 50%) aphyric intermediate and minor (<10%) mafic clasts are typically present.

Feldspar crystal-tuff, similar to the matrix described above, is common as massive to medium bedded units. Intermediate tuff without a significant feldspar phenoclast component is also common and frequently is associated with feldspar crystal-tuff. In this latter case, the two varieties of tuff are commonly thinnly interbedded and display sedimentary-type structures (graded bedding, scour marks) indicative of subaqueous deposition. Many of the finer grained tuffs may, in this case, be products of the hydrodynamic sorting of coarser deposits. Rarely these subaqueously deposited tuffs are associated with doubly graded tuff - lapilli-tuff that may represent pyroclastic flow deposits.

One possible interpretation of the concentration of very coarse, monolithic tuff-breccia in the core of the fold north of Mink Lake with these rocks passing along strike into finer grained, more heterolithic lapilli-tuff and tuff is a facies transition with the coarser deposits being more proximal. Features indicative of a central or vent facies (Easton and Johns, 1986) have not been recognized north of Mink Lake and, if the general model is correct, any vent was either removed by erosion or is buried in the subsurface. Although some of the tuffaceous units of the more distal facies were deposited subaqueously and are associated with possible pyroclastic flows, the depositional environment and mechanisms for the sequence as a whole remain uncertain. Rocks mapped as intermediate and felsic metavolcanic rocks to the east of Blondin Lake are particularly enigmatic due to poor and limited exposure, intense deformation and contact metamorphism. These rocks rarely contain lapilli-sized, feldspar-phyric fragments but are more commonly massive and devoid of any preserved primary strutures. Most commonly the rock is composed of abundant tectonized feldspar crystals (1-2 millimeters) in a much finer grained matrix consisting of quartzofeldspathic material along with up to 20 percent of either biotite or hornblende. In one locale, on the north side of the narrow lake between Retter and Brownstone Lake, garnet (~10%) coexists with biotite. Oblate, polycrystalline quartz aggregates approximately the same size as the feldspar grains are present locally but, in at least some cases, these appear to be disrupted veins. It is possible, however, that this unit could include a number of other highly deformed rock types including clastic metasedimentary and mylonitic felsic plutonic rocks.

Felsic Metavolcanic Rocks

Felsic metavolcanic rocks are not abundant. As a group, they are distinguished from intermediate metavolcanic rocks by a lower colour index, light grey to white colour, presence of quartz phenocrysts or aphanitic, glassy texture. They occur in a number of discrete units that are described separately below.

A thin, laterally persistent felsic metavolcanic unit located to the north of the west end of Mink Lake is comprized of tuff and lapilli-tuff. Equant, subhedral feldspar and rounded quartz crystals, both approximately 1 millimeter in diameter, are common as phenocrysts in lithic fragments and as phenoclasts in tuff and the matrix of lapilli-tuff. Other than these crystals, both rocks are extremely fine grained to aphanitic and have a characteristic ring and splintery fracture when struck with a hammer. Widespread, weak to moderate sericitic alteration imparts a greenish to yellowish tinge to these otherwise grey, white to buff weathering rocks. The original geometry of the clasts is masked by intense deformation and flattening. No evidence of internal bedding or other primary structures have been recognized within the unit and the environment and mechanism of deposition is unknown.

A number of thin, discontinuous felsic metavolcanic units occur within the dominantly intermediate metavolcanic sequence in the vicinity of Mink Lake and are distinguished from them on the basis of the presence of quartz phenocrysts and phenoclasts or the aphanitic, glassy texture characteristic of the felsic metavolcanic rocks elsewhere in the area. It is not clear if these rocks were derived from a discrete source or if they indicate intermittent variation in intermediate volcanic activity towards more evolved compositions.

Two lenses of felsic metavolcanic rocks occur within mafic metavolcanic rocks just to the south of the Jason Mine. Where their primary characteristics are evident, they are comprised of heterolithic tuff-breccia and lapilli-tuff with subrounded fragments along with minor, massive to thinnly bedded tuff. Clasts are predominantly grey, light grey weathering, fine grained to aphanitic, equigranular to porphyritic (quartz and/or feldspar) felsic metavolcanic rock. Distinctive pinkish grey clasts with abundant feldspar and minor quartz phenocysts are conspicuous locally. Minor mafic clasts as well as intensely sericitic/chloritic clasts that may represent collapsed pumice are widespread. At one locale within the northernmost lense, a few clasts with abundant green mica (fuchsite?) were noted.

A poorly exposed, intensely deformed and altered, felsic unit lying to the south of Casummit Creek is interpreted to be of felsic volcanic origin based on its composition. These rocks have been transformed to extremely fissile, fine grained sericite schist with abundant secondary alteration (carbonate, disseminated pyrite). Larger quartz and feldspar grains are interpreted to represent original phenocrysts or phenoclasts. Rare lithic fragments suggest a possible tuffaceous protolith but the origin of these rocks should be regarded as uncertain.

Clastic Metasedimentary Rocks

Clastic metasedimentary rocks including arenite, wacke, siltstone and conglomerate are a minor component of the greenstone belt. They occur primarily in three separate geographic areas that are described separately below.

Wacke and siltstone along with minor intercalated magnetite ironstone outcrops along parts of the north shore of Casummit Lake. Although these rocks are locally strongly deformed, particularly along the northwest shore of the lake, some primary sedimentary structures are preserved locally. Bedding thickness is quite variable but tends to be either massive to very thickly bedded wacke without associated siltstone or medium to thin (< 30 centimeters) bedded with wacke beds being thicker than siltstone beds and the latter often displaying fine laminations. Some graded bedding was noted locally in the more thinnly bedded variety but poor quality of exposure precluded obtaining enough determinations to be reliable as facing indicators.

Wacke, arenite, siltstone and conglomerate lying to the north, and along the western shore, of Mink Lake comprise a second occurrence of metasedimentary rocks. Arenite is restricted to the largest, northernmost of these lenses. It is thickly to (less commonly) thinly bedded and locally displays crude grading and scour. The arenite is feldspathic with moderately sericitized and epidotized plagioclase constituting approximately 90 percent of the framework grains that can be identified; the remainder are quartz and choritic, mafic, lithic fragments. The framework grains are typically subrounded and approximately 1 millimeter in diameter. The matrix is much finer grained and consists of quartzofeldspathic material along with minor sericite, chlorite and accessory minerals. The arenite is compositionally similar to the intermediate metavolcanic rocks that enclose this lense and are distinguished from these rocks by the degree of rounding and by the presence of quartz and sedimentary structures.

Crudely bedded, clast supported, polymictic pebble conglomerate is interbedded with arenite and intermediate tuff in one outcrop at the eastern end of the lense described above. Clasts are well rounded. Clast types include not only aphyric and feldspar-phyric intermediate metavolcanic clasts similar to those occurring in the adjacent intermediate metavolcanic sequence, but also significant felsic and mafic metavolcanic and minor cherty, sedimentary material.

Wacke and siltstone predominate within the metasedimentary units on the west shore of Mink Lake. Where they are not highly strained, wacke and siltstone from this area preserve thin to medium bedding with grading and scour indicating tops to the west. These wackes, like the arenite to the north, are feldspathic but quartz is more abundant (<30%) in the wacke.

A third area underlain by clastic metasedimentary rocks occurs along the eastern margin of the greenstone belt to the southeast of Graham Lake. These rocks are not exposed in the map area and are known from diamond drilling and along strike extrapolation from the Birch Lake area (Good, 1988). The drill core from a series of holes which provide a complete section across this unit is stored in Balmertown, Ontario and was re-examined through the courtesy of Paul Burchell and Placer-Dome Inc.. Wacke and siltstone predominate and range from thickly bedded to laminated but are mainly thin to medium bedded. Grading and scour are common and consistently indicate tops towards the collar of the drill holes (i.e. to the northeast). The finer grained top portion of graded beds commonly displays delicate parallel laminations. The wackes are feldspathic with up to 25% of the framework grains being quartz along with minor lithic fragments. The matrix to the wackes as well as the siltstone contains quartzofeldspathic material along with chlorite, biotite and accessory minerals. The only other rock types present in this metasedimentary sequence are a number of thin gabbroic to dioritic sills and several magnetite-rich zones. The latter are associated with fine grained wacke and siltstone. In one such zone, up to 30% magnetite is associated with grunerite and minor garnet.

Chemical Metasedimentary Rocks

Chemical metasedimentary rocks include chert, ferruginous chert and magnetite ironstone. These are a minor but widespread component of the greenstone belt and occur in several different associations. The most common variety consists of thin (< 2 meter), discontinuous units occurring at flow contacts in mafic metavolcanic sequences. These zones are typically strongly deformed (Photo 5) and some of the discontinuity may be a function of tectonic disruption. Even tectonically disrupted interflow chemical metasedimentary rocks, however, commonly preserve delicate, thin bedding. Chert and magnetite ironstone are both well represented and commonly are interbedded but both also occur alone in some examples. Ferruginous chert is less abundant. A second chemical metasedimentary association is represented by the occurrence of magnetite ironstone layers with wacke and siltstone. The latter commonly display grading from a wacke base to a siltstone top and the magnetite layers occur at the top of these beds and are interpreted to reflect background sedimentation that is interrupted by the deposition of detritus deposited from density currents. The only relatively thick, laterally continuous chemical metasedimentary unit within the map area occurs at the metasedimentary-metavolcanic contact to the north of the eastern portion of Casummit Lake. This unit is interpreted to have a strike length of at least 1000 metres and a thickness of up to 20 meters. It shares some of the characteristics of each of the two associations discussed above. It is intercalated with wacke-siltstone, especially near the southern contact of the unit, but much of it consists of delicated laminated to thinnly bedded chert-magnetite ironstone. This unit may record a significant hiatus in volcanism and clastic sedimentation.

Mafic Intrusive Rocks

Gabbro, along with subordinate diorite, is a widely distributed, minor component of the greenstone belt. Many occur as sills within mafic metavolcanic rocks and are distinguished with difficulty from the medium grained variety of the latter. Gabbro sills also occur within intermediate metavolcanic rocks (e.g. east of Mink Lake) and metasedimentary rocks (southeast of Graham Lake) but these are far less common. A number of the larger masses of gabbro/diorite (e.g. west end of Mink Lake and north of Richardson Lake) are more irregular in shape and although they are spatially related to mafic metavolcanic rocks these larger masses also occur in proximity to felsic intrusive rocks. Regardless of their setting, representatives of this unit exhibit remarkably uniform textural and compositional characteristics.

The color of these rocks on both fresh and weathered surfaces ranges from black and greenish-black (gabbros) to dark grey (diorites). Medium grained (mostly 1 to 3 millimeters), equigranular textures predominate. Narrow, finer grained chilled margins were observed in a fewe localities. Superimposed tectonic fabrics that are well developed within adjacent metavolcanic rocks are either not recognized in the gabbros or are much more weakly developed. Gabbro and diorite, properly distinguished on the basis of their plagioclase composition (Streckeisen, 1976), are used here as field terms to distinguish two intergradational rock types. The predominant minerals in both rock types are plagioclase feldspar (variously altered to epidote, white mica and carbonate) and mafic phases including hornblende, actinolite and chlorite. Minor biotite is restricted to rocks referred to as diorites. Opaque minerals, which frequently display skeletal crystal forms, are a ubiquitous minor phase. Gabbro and diorite were distinguished in the field on the basis of the lower color index and presence of biotite in the latter. Examination of several thin sections indicates that the plagioclase compositional distinction required to properly assign these names are met in some cases.

Fine-Grained Intermediate to Felsic Intrusive Rocks

A wide variety of fine-grained, aphyric to porphyritic, intermediate to felsic intrusive rocks are a minor rock type in the map area. Many are poorly exposed. Some have the form of dikes discordant to bedding and are clearly deformed but it is not clear to what extent all of the rocks included in this category are temporally and/or genetically related. There is no apparent pattern to their distribution. Feldspar and rare amphibole phenocrysts tend to be subhedral to euhedral whereas quartz phenocrysts are typically anhedral, rounded quartz 'eyes'. Most rocks assigned to this unit are too fine grained for their composition to determined in outcrop but they are likely intermediate to felsic based on their light color and the predominance of feldspar and/or quartz as phenocryst phases.

Internal Intermediate to Felsic Intrusive Rocks

Mink Lake Stock

The Mink Lake stock outcrops on the shores, and south of, Mink Lake in the southwestern portion of the map area. A small portion of the pluton, which hosts a significant Mo-Au occurrence, lies south of the map area and has been described elsewhere (Beakhouse, 1989). The stock has been studied in some detail by Burrows (1984) and Burrows and Spooner (1987).

The predominant phase within the stock is a granodiorite that, on a megascopic scale, is fairly uniform throughout the stock. This phase is typically grey, pink weathering, equigranular to weakly porphyritic, homogeneous, biotite granodiorite. The porphyritic aspect is due to the occurrence of rounded, anhedral quartz crystals up to 5 millimeters in diameter that contrasts with the more typical 2-3 millimeter grain size of the bulk of the rock. Biotite occurs both as finer grained 'shreds' and as larger plates with hexagonal outlines. With the exception of plagioclase feldspar which typically displays weak alteration to white mica, most of the minerals are relatively fresh and unaltered. Except for a few narrow, discrete sheared zones there is little evidence for the presence of a superimposed tectonic fragment.

A number of other rock types are minor components of the stock. Small (<20 centimeters long), disc-shaped mafic inclusions are a minor but widespread feature. These have been interpreted to be entrained cumulates related to the earlier stages of crystallization of the stock (Burrows, 1984). Where a number of mafic inclusions occur together they are oriented parallel to one another and approximately parallel to the margins of the pluton suggesting that the planar fabric defined by their orientation is a primary flowage fabric related to the emplacement of the stock.

Dikes and veins that cut the granodiorite are a minor but locally conspicuous feature of the stock. Most of the dikes are granitic aplite to pegmatite. A number of examples of zoned dikes with aplitic margins and pegmatitic cores were noted. The pegmatitic dikes are gradational into quartz veins that in some cases contain minor K-feldspar. Mo-Au mineralization in the southern portion of the stock is related to these late veins, suggesting that the mineralization may also be magmatically derived.

External Intermediate to Felsic Intrusive Rocks

Mainprize Lake Granitoid Complex

The Mainprize Lake granitoid complex bounds the greenstone belt to the west. This unit is continuous with that described previously to the south (Beakhouse, 1989) and reconnaissance investigations indicate that it extends at least as far west as Wavell Lake and as far north as Upper Goose Lake.

The predominant rock type is a grey, medium grained, massive to weakly foliated, hornblende-biotite granodiorite that is characterized by the presence of subhedral to euhedral microcline megacrysts. The modal proportions of minerals are relatively uniform except that within 200 metres of the contact with the greenstone belt hornblende is more abundant and quartz less abundant, locally resulting in quartz monzodioritic compositions. Inclusions of country rock (these are distinct from more widespread mafic enclaves discussed below) are restricted to the immediate vicinity of the contact with the greenstone belt.

The most conspicuous megascopic feature of these rocks are microcline megacrysts but their development is highly variable. Most commonly, the megacrysts are subhedral to anhedral masses that are 2-3 centimetres long with a length to width aspect of 1.5:1 to 2:1. They are perthitic and poikilitically enclose small inclusions of quartz, plagioclase and mafic minerals. They are commonly twinned according to the Carlsbad Law. The variation in their development is reflected both by their form (locally subhedral to euhedral and size (from 8 centimetres long down to the grain size of the matrix.

Another conspicuous feature of this unit is the widespread occurrence of small (typically < 20 centimetres), disc-shaped mafic enclaves. These enclaves are composed primarily of plagioclase (~40-60%), hornblende (~30-40%), biotite (~10-30%) and quartz (~0-10%) but locally contain microcline megacrysts, either entirely within them or developed across their contact with adjacent granodiorite. In several localities located on Wavell Lake (approximately 8 kilometres west of the northwest corner of the map area), the enclave material forms dike-like forms that are back-veined by megacrystic granodiorite. These observations suggests that these dikes and enclaves represent mafic magmas that were coeval with and emplaced along with the granodioritic magma.

Shearstone Lake Granitoid Complex

The Shearstone Lake granitoid complex is located to the east of the greenstone belt. The complex consists of three segments which contain similar rock types in somewhat

different proportions and are separated by linear, strongly deformed, more heterolithic zones. One of these zones, located north and northeast of Retter Lake and extending to the central portion of Brownstone Lake consists of strongly foliated, fine to medium grained tonalite with abundant inclusions and tabular units of amphibolitic, mafic metavolcanic rock. These tonalites are intruded by relatively little deformed granodiorites and granites.
A second linear zone extends from the west shore of Brownstone Lake in a generally westerly direction to the Whitefish River, beyond which its extent is obscured by extensive Pleistocene and Recent deposits. It differs in several important respects from the zone occuring to the northeast of Retter Lake. Metavolcanic inclusions are more diverse, including intermediate and felsic metavolcanic rocks in addition to mafic metavolcanic rocks. Although both zones are strongly deformed, the zone to the south of Retter Lake is characterized by cataclastic fabrics indicative of more brittle deformation. Unlike the zone to the north, the granodiorite (and granite?) is not intrusive into the more strongly deformed rocks but rather appears to be deformed itself. These observations suggest that the zone to the south of Retter Lake may have developed later and in a more brittle regime than the zone to the north.
The boundary between the Shearstone Lake granitoid complex and the greenstone belt is poorly exposed but is interpreted

to be sharp based on examination of drill core from southeast of Graham Lake.

The Shearstone Lake granitoid complex is comprised of predominant granodiorite, suborbinate granite and minor tonalite and quartz diorite to diorite. The predominant granodioritic rocks are mainly microcline megacrystic granodiorites that are similar in most respects to those occurring in the Mainprize Lake granitoid complex, except that very weakly megacrystic to equigranular varieties are better represented.

Fine to medium grained, equigranular hornblende and/or biotite tonalite is a minor constituent of the complex and occurs primarily within the strongly deformed zones referred to above. Field relationships indicate that the tonalite was emplaced and, in some cases, deformed prior to the emplacement of the granodiorites and granite.

Medium to coarse grained, equigranular to pegmatitic/aplitic leuco-granite is widespread and locally predominant. Where intrusive relationships are established, the granite invariably intrudes the granodiorite. The granite is composed of subequal abundances of quartz, plagioclase and microcline that together comprise 90->99% of the rock. Most of the remainder consists of biotite or, in the most leucocratic varieties, biotite + white mica. Medium and, less commonly, coarse grained equigranular varieties are most common. Pegmatitic variants occur primarily as narrow (< 1 metre) dikes that frequently are zoned from quartzþkfeldspar (core) through pegmatitic granite to aplitic granite (margin).

Fine to medium grained, equigranular, hornblende diorite to quartz diorite is a minor constituent of this granitoid complex. Disc-shaped mafic enclaves, similar to those occurring in the Mainprize Lake granitoid complex, are widespread in the granodioritic phases of the Shearstone Lake complex.

Pleistocene and Recent Deposits

Unconsolidated Pleistocene and Recent deposits unconformably overlie the Archean bedrock throughout the map area. In some areas, notably in the north-central part of the map area, they form extensive deposits that cover most of the bedrock. Elsewhere, they occur in depressions between outcrop ridges and knobs.

The Pleistocene deposits are related to a Late Wisconsin glaciation. Bouldery till forms extensive deposits that mantle the bedrock throughout much of the map area. There is little evidence of stratification within these deposits. There is commonly a close correspondance between boulder populations and local (within ~500 metres) bedrock and exotic boulders such as Paleozoic sedimentary rocks were not noted, suggesting local derivation. Similar types of material also form topographically prominent drumlinoid ridges, the most notable of these being located between Mink and Blondin Lakes and south of Retter Lake.

Low, generally northward trending, ridges comprized of unstratified bouldery material similar to that described above occur to the north of Blondin Lake and locally elsewhere in the map area. They are locally (e.g., north of Mink Lake) superimposed on drumlinoid ridges. Although only a few metres high and less than 10 metres wide, the are nevertheless clearly recognizable both on the ground and in aerial photographs(especially in areas of limited relief located to the north of Blondin Lake). Individual ridges can be traced for up to 1 kilometre. They tend to occur as clusters with individual ridges being subparallel and spaced 100-200 metres apart. These deposits are interpreted to be DeGeer (annual recessional) moraines.

Pleistocene sand deposits with little or no associated bouldery till occur in an area of subdued relief to the north of the Whitefish River. These sands are well sorted, clean and, at least locally, stratified. They may represent outwash deposits but their uncertain stratigraphic relationship with respect to DeGeer moraines which also occur in this area make this interpretation problematical.

The orientation of drumlinoid ridges and glacial straie (ENE) and DeGeer moraines (NNW-NNE) suggests that ice advanced from the east-northeast and retreated towards the east.

Recent deposits include sand and clay deposits that represent lacustrine and fluvial reworking of unconsolidated Pleistocene deposits, as well as organic material rich mud and swamp deposits. The later are particularly common to the northwest of Retter Lake where there are extensive areas of open muskeg, floating bog and string bog.

Metamorphism

The rocks of the greenstone belt have undergone regional metamorphism. Peak metamorphic conditions are poorly constrained. Mafic mineral assemblages in mafic metavolcanic rocks include various combinations of chlorite, tremolite-actinolite and epidote throughout most of the greenstone belt. Within 500 metres of the contact with the external granitoid complexes and within the narrow mafic units in the Shearstone Lake granitoid complex, mafic metavolcanics have been transformed to hornblende-plagioclase schists. In the later case, the plagioclase is recrystallized and fresh in contrast to lower grade assemblages where it is variably but typically highly altered to epidote, white mica and carbonate. These mineral assemblages suggest upper greenschist to amphibolite grade metamorphism.

Structural Geology

The greenstone belt is structurally complex due to the heterogeneous superposition of two or more deformational 'events'. On a mesoscopic scale, this complexity is evident from the deformation of, and superposition of later tectonic structures on, an early, generally bedding-parallel, foliation and flattening fabric. On a map scale, this complexity is reflected in the regional scale folding of bedding and schistosity in a pattern mimicing the outline of the greenstone belt.

Minor Structures

Most of the metavolcanic and metasedimentary rocks have a superimposed tectonic mineral foliation and/or lineation. Purely foliated rocks and foliated rocks with a lineation in the plane of the foliation are both well represented. Purely lineated rocks are rare, the best examples being located in the vicinity of the large island in Brownstone Lake. Platy, tabular and acicular minerals that define these structures include chlorite, biotite, muscovite and amphibole.

In addition to a mineral foliation, many rocks display a parallel to subparallel flattening fabric. Primary structures that may display this flattening include clasts, pillows, amygdules, varioles and individual grains and crystals.

A spaced fracture cleavage, or rarely a penetrative planar fabric, transects the regionally dominant penetrative fabric locally. The cleavage, which is parallel to the axial surfaces of open folds that deform the earlier fabric, is typically oriented within 20 degrees of north and is vertically or very steeply dipping. These features are most conspicuous where they occur at a high angle to the penetrative foliation and flattening fabric.

The earlier, bedding-parallel fabric corresponds to the D_2 fabric described for the area to the south (Good, 1988; Beakhouse, 1989) and the subsequent folding and transecting fabrics are related to the the D_3 deformation described for the northern Birch Lake area (Beakhouse, 1989).

Small scale shear zones accommodating displacements of up to several metres are relatively common in parts of the map area, notably in the vicinity of Joneston Lake and south of Richardson Lake. Most of these shears are generally northwest trending and a high proportion display a dextral sense of displacement.

Major Fold Structures

The most noteworthy regional scale fold occurs to the north of Mink Lake where both bedding and a foliation(D_2) are deformed into an open to close fold plunging steeply to the north-north-west. The fold tightens to the north with the interlimb angle decreasing from approximately 90 degrees just north of Mink Lake to approximately 30 degrees to the west of Blondin Lake. A second (D_3) fabric (fracture cleavage or penetrative foliation) observed to cut the earlier folded foliation locally, is oriented approximately parallel to the axial surface of the regional scale fold. The gentle folding of bedding and an earlier foliation in the vicinity of Joneston Lake may be related to the fold described above. The folding in this area is evident on a number of scales ranging from the gentle flexures in the mafic metavocanic - intermediate metavolcanic contact to mesoscopic scale folds. A sharply discordant fracture cleavage that is approximately parallel to the axial surface of the folds is also recognized locally in this area. Both these and the aforementioned fold north of Mink Lake are interpreted to be manifestations of the D_3 deformation described in the northern part of the Birch Lake area (Beakhouse, 1989)

Major Faults

No compelling evidence for the presence of significant faults was uncovered during the course of mapping the Casummit Lake area. Several faults are suspected to be present based on extrapolation from outside the map-area and limited data within the map-area. A limited number of facing indicators at the west end of Mink Lake are consistent with observations made to the south of the map area that suggest that the intermediate metavolcanic/clastic metasedimentary sequence at the western end of Mink Lake is in a back to back facing relationship with the mafic metavolcanic/gabbroic sequence to the south. This relationship was interpreted to be due to early (pre-infolding of the greenstone belt) thrust faulting (Beakhouse, 1989). A similar relationship may exist between this same intermediate metavolcanic dominated sequence and the mafic metavolcanic sequence lying to the north of it based on limited facing information. The limited data and especially the absence of reliable facing indicators in the mafic metavolcanic rocks within a few hundred metres of the contact render this possibility speculative.

Deformation Zones

Deformation zones (mappable zones of high strain characterized by strong fabric development) are recognized in several parts of the map-area. One such zone occurs within mafic metavolcanic rocks located within 300 metres of the western contact of the greenstone belt with the Mainprize Lake granitoid complex and extends from south off to at least near the northern boundary of the map-area. Within this zone, massive, fine to medium grained mafic metavolcanic rocks are interbanded with more fissile, banded mafic rocks. Units of each of these variants range in thickness from one to severals tens of metres. All are composed of amphibole and plagioclase with subordinate epidote and magnetite. The banded variety consists of alternating bands (<2 cm thick) of more and less mafic rock and, less abundantly, epidote-rich rock (Photo 3). These banded rocks are interpreted to be highly deformed pillowed mafic flows on the basis of; 1)rare cases where mafic bands can be determined to define highly attenuated elliptical shapes, 2) resemblance of the epidote-rich layers to epidote-rich pods associated with less deformed pillow lavas and 3) rare associated with thinnly bedded chemical metasedimentary rocks. Based on the rare cases where full elliptical shapes can be defined, the flattening ratio is in the range of 20:1 to 50:1. The proximity of this zone to the contact with the granitoid complex suggests that it is likely a contact strain effect related to the emplacement of the complex.

A second regional scale deformation zone is spatially associated with the contact between mafic and intermediate to felsic metavolcanic rocks and extends from the nose of the fold north of Mink Lake in a southeasterly direction to Birch Lake in the southeastern corner of the map-area. A narrow zone of high strain associated with the northeasterly trending metasedimentary unit on the northwest shore of Casummit Lake may be a splay related to this zone. The intensity of fabric development and deformation is not uniformly developed within this broad belt. Zones of extreme flattening and/or fissility occur within variably, but generally strongly deformed rock (Table 3) within 500 metres of the main lithological contact. In some areas, notably in the vicinity of the Blondin and Alcon occurrences and along the south shore of, and southeast of, Casummit Lake, zones of intense fissility are also intensely altered. A feature informally referred to as the Retter Lake cataclastic zone extends in a westerly direction from the mouth of the creek entering the northwest corner of Brownstone Lake to a point southwest of Retter Lake. The zone is up to 500 metres wide, narrows to the east and extends for at least 5000 metres. Within this zone, predominant granodiorite-tonalite together with subordinate entrained intermediate and mafic volcanic rocks have been intensely deformed, culminating in the development of cataclastic and mylonitic textures. The development of cataclastic textures is most readily apparent in the originally medium to coarse grained granodiorites and tonalites. The rocks display a continuum as follows:

- weakly deformed
- moderately deformed with a pervasive fabric and spaced, discrete, intensely foliated zones
- rounded or augen shaped feldspars with intensely flattened (~10:1) polycrystalline quartz
- mylonite with 10-20% rounded feldspars set in an aphanitic matrix

Consistent, diagnostic indicators of the sense of movement were not identified but the deflection of foliation trajectories and the mafic unit at Brownstone Lake suggests a sinistral transcurrent component. The possible extension of this zone beyond the extent described above is difficult to evaluate because of lack of exposure. It is possible that the zone deflects in a northwesterly direction along the poorly exposed eastern margin of the greenstone belt to the northeast of Blondin Lake. Prominent east-north-east trending topographic linears, of which the Kapikik River form a part, suggest a possible eastward extension but within the map area the rocks along this linear are late granitic rocks that show little evidence of deformation.

Economic Geology

History of Exploration

The earliest mineral exploration in the map-area apparently shortly post-dated the discovery of gold at Red Lake in 1926 (Furse, 1933). A period of extensive mineral exploration with gold mineralization as the primary focus occurred in the early to mid-1930's. This work was concentrated in the area of Casummit Lake and lead to the discovery of one significant producer located at the northeast corner of the lake. This deposit (Jason Mine) was developed intermittently over a period of 20 years and to date has yielded 101875 ounces of gold and 9788 ounces of silver. Other occurrences discovered near this time that ultimately saw limited, small scale mining development include the Richardson Lake occurrence (1126 ounces gold and 102 ounces silver) and the McIntyre occurrence (approximately 200 ounces gold).

The next period of intensive mineral exploration activity followed the discovery in 1968 by Selco Exploration Company Limited of the South Bay Cu-Zn deposit. This work consisted of several regional scale airborne geophysical surveys that led to some follow up ground geophysics but comparatively little diamond drilling is reported.
Another interval of very active mineral exploration, with gold again the primary focus, commenced in the early 1980's. Much of the work carried out at this time focussed on reexamination of some of the gold occurrences identified during the earlier exploration activity.

Description of Properties

Information on mineral occurrences in the area are presented in table 4. This information is taken from earlier published reports on the area (Furse, 1933 and Horwood, 1937) as well as unpublished information acquired from the files of the Resident Geologist's Office, Red Lake. Specific observations relevant to mineralization on these occurrences made during the course of the current survey are also reported here. Some of the information concerning the Jason Mine is also presented in figure 1.

Recommendations for Future Mineral Exploration

Base Metal Mineralization

No major occurrences of base metal mineralization are known within the area but it is not clear that all conductive or geologically favourable areas have been thoroughly investigated. Minor base metal mineralization is reported from the Angela Lake, International Obaska Mines Ltd, and Joneston Lake occurrences. With the possible exception of the International Obaska Mines Ltd occurrence, which is poorly understood and occurs in a thin, strongly tectonized septum off the main greenstone belt, these occurrences are situated at or near major lithological contacts. Future base metal exploration should focus special attention on geophysically anomalous zones located near major lithological contacts.

Molybdenum Mineralization

Disseminated molybdenum mineralization with associated gold mineralization is known to occur within the Mink Lake stock just to the south of the map-area (Beakhouse, 1989). There is the potential for the discovery of additional deposits of this type elsewhere within this stock.

Gold Mineralization

The presence of a past-producing gold mine, numerous gold occurrences and the extent of alteration and deformational features related to gold mineralization all point to considerable potential for the discovery of economic gold mineralization. The most favourable area is included within a triangluar shaped area with apeces located near the Blondin, Richardson Lake and Boylen (East Group) occurrences. This area includes most of the known gold occurrences in the map-area and straddles a major lithological boundary zone in which most of the favourable alteration and deformational features interpreted to be related to the gold mineralization are located.

The general characteristics of gold deposits in the Casummit Lake area, based on observations summarized elsewhere in this report, can be summarized as follows. Most gold mineralization is closely associated with sulphides (especially arsenopyrite) that occur most commonly within and marginal to quartz and quartz/carbonate veins and less commonly as disseminations in intensely deformed zones with iron carbonate alteration. These two styles of sulphide mineralization are often spatially related and tend to occur in and adjacent to strongly deformed, schistose rocks. These zones of strong deformation that have been subsequently altered and mineralized appear to develop preferentially at lithological contacts within the triangular shaped area referred to above. This stratigraphic control of late tectonic structures is developed on a variety of scales ranging from the association of a broad, imprecisely and irregularly bounded domain of generally more intense deformation with the prominent mafic-intermediate metavolcanic contact north of Mink and Joneston Lake to narrow, well defined zones localized at flow contacts and interflow metasedimentary horizons within this larger deformational domain. Zones of extreme ductility contrast, such as commonly occurs associated with chemical metasedimentary units, are particularly susceptible to intense, heterogeneous deformation. These stratigraphically influenced late tectonic structures are interpreted to have focussed the migration of late fluids responsible for alteration and gold mineralization, although the source of the gold itself remains problematical.

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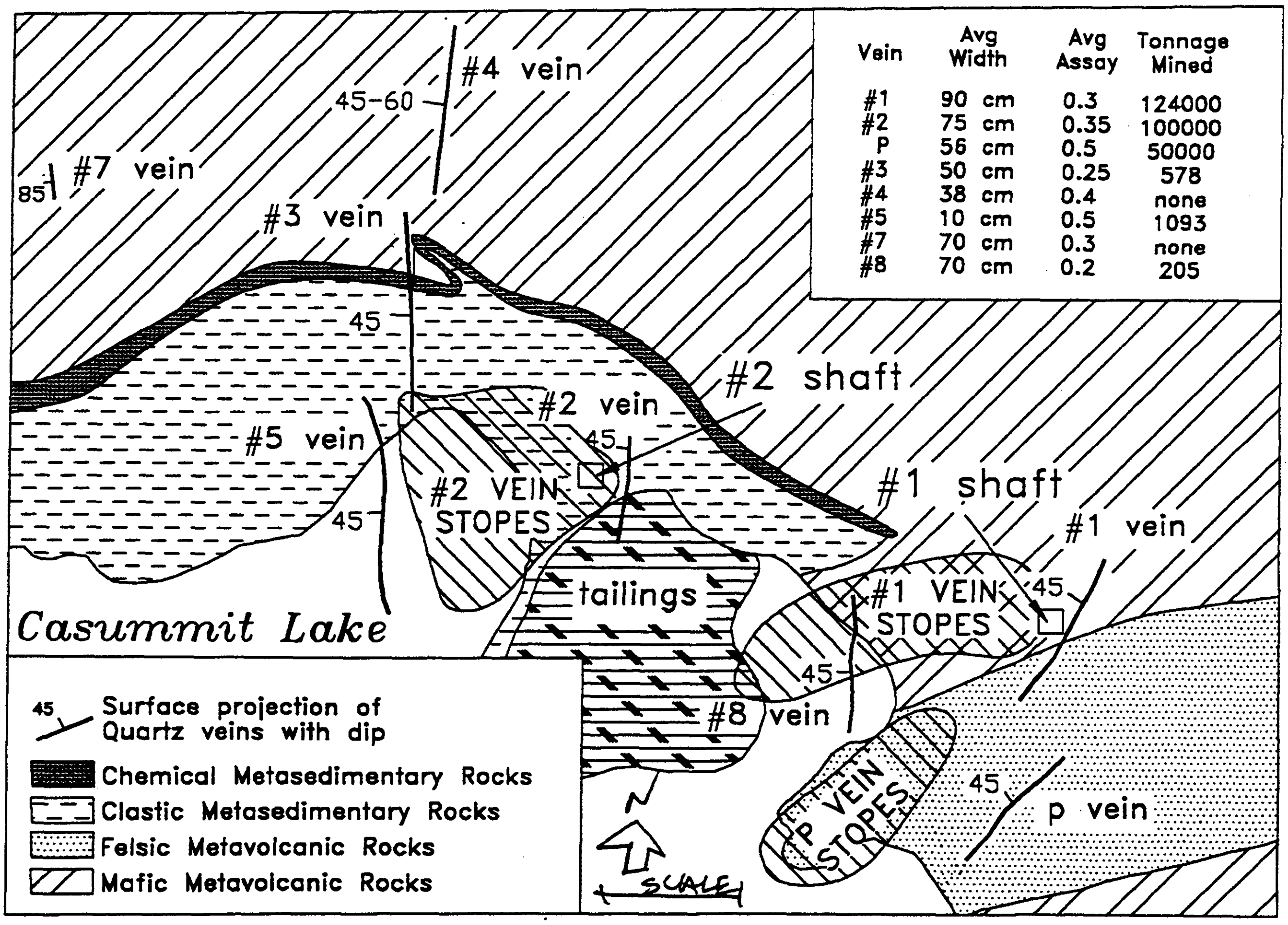
Figure 1. Geological map of the Jason Mine area illustrating the location and attitude of veins, production statistics and the vertical projection of the areas of underground development. The figure is based largely on unpublished data taken from the files of the Resident Geologists Office, Red Lake.



Vein	Avg Width	Avg Assay	Tonnage Mined
#1	90 cm	0.3	124000
#2	75 cm	0.35	100000
P	56 cm	0.5	50000
#3	50 cm	0.25	578
#4	38 cm	0.4	none
#5	10 cm	0.5	1093
#7	70 cm	0.3	none
#8	70 cm	0.2	205

Table 1. Table of lithologic units for the Casummit Lake area.

PHANEROZOIC
  CENOZOIC
    QUATERNARY
      PLEISTOCENE AND RECENT
   Glacial, swamp, lake and stream deposits

      Unconformity

PRECAMBRIAN
  LATE ARCHEAN
    FELSIC TO INTERMEDIATE INTRUSIVE ROCKS (EXTERNAL TO GREENSTONE BELT)
   Hornblende-biotite tonalite, hornblende-biotite granodiorite, hornblende-biotite granodiorite with microcline megacrysts, leuco-granite, biotite granite, hornblende diorite to quartz diorite, hornblende quartz monzodiorite

    FELSIC TO INTERMEDIATE INTRUSIVE ROCKS (FINE TO MEDIUM GRAINED) (INTERNAL TO GREENSTONE BELT)
   Granodiorite, porphyritic (quartz phenocrysts) granodiorite

    FELSIC TO INTERMEDIATE INTRUSIVE ROCKS (APHANITIC TO FINE GRAINED) (INTERNAL TO GREENSTONE BELT)
   Quartz porphyry, feldspar porphyry, quartz-feldspar porphyry, felsite

    MAFIC INTRUSIVE ROCKS
   Diorite, gabbro

      Intrusive Contact

    CHEMICAL METASEDIMENTARY ROCKS
   Chert, ferruginous chert, magnetite ironstone

    CLASTIC METASEDIMENTARY ROCKS
   Arenite, wacke, siltstone, conglomerate

    FELSIC METAVOLCANIC ROCKS
   Tuff, lapilli-tuff, tuff-breccia, sericite schist

    INTERMEDIATE METAVOLCANIC ROCKS
   Tuff, feldspar-crystal tuff, lapilli-tuff, tuff-breccia

    MAFIC METAVOLCANIC ROCKS
   Massive flow, pillowed flow, flow breccia, pillow breccia, porphyrytic flow, variolitic flow, amygdaloidal flow, medium to coarse grained flow, chlorite schist

Table 2. Summary of characteristics of mafic metavolcanic rocks in the Casummit Lake area

Colour (Weathered)
- dark green, black, green, buff

Colour (Fresh)
-dark greenish black (least altered, lower grade varieties)
-black (hornblende-bearing varieties near contact with granitoid plutons)
-light to medium green-grey (altered varieties- epidote, carbonate, silicification)

Texture
-commonly fine grained, equigranular
-variations include:
-coarse plagioclase phenocrysts ($>$10 mm); typically equant
-small plagioclase phenocrysts; typically lath-shaped with length:width $\sim$2:1 to 3:1 and 2-5 mm long
-bimodal (both of the above) sized plagioclase phenocrysts
-rare mafic phenocrysts?
-rare varioles (spherical, 3-7 mm diameter)
-fine to medium grain size (1-2 mm)

Structures
-(inferred primary characteristics- does not consider highly deformed varieties)
-massive, fine to medium grained flows
-pillowed flows- pillow shapes range from simple spherical to weakly ellipsoidal forms (most common) to multi-lobate, irregular forms
-pillow selvages are $\sim$1 cm thick and locally have associated hyaloclastite, chert, carbonate or magnetite ironstone
-radial vesicles near pillow margins
-radial and concentric fractures, often with secondary quartz
-calc-silicate pods with abundant epidote and carbonate
-amygdules- mostly narrow diameter ($<$3 mm)
-quartz and/or carbonate filling- lesser chlorite

Alteration/ Deformation
-primary textural/structural varieties display a generally increasing susceptibility to deformation and alteration in the order; med gr flows $<$ f gr, massive flows $<<$ pillowed flows $<<$ flow tops $<$ flow tops with associated interflow metasedimentary rocks
-banded (amphibolite + mela-amphibolite + calc-silicate) amphibolite alternating with massive amphibolite near contact with Mainprize Lake granitoid complex
-strongly deformed chloritic mafic rocks of indeterminate origin with abundant secondary carbonate and pitted weathered surface

Table 3. Contrasting characteristics of intensely deformed zones (e.g. Blondin occurrence) within strongly deformed zones

Feature	zones of intense deformation	outside of these zones
Fabric	weak to well developed penetrative foliation	strongly schistose; often with well developed fissility
Carbonate alteration	brick-red, iron-rich	white, calcitic to dolomitic
Sulphides	fine grained, disseminated pyrite and/or arsenopyrite	coarser grained, often euhedral pyrite
Veining	polymineralic (quartzþFe-rich carbonateþ suphides	simple quartz veins (barren)
Other features	may be graphitic, auriferous; commonly with extensive sulphides in adjacent wall rock	

Table 4. Summary of information on mineral occurrences in the Casummit Lake area. Abbreviations as follows; arsenopyrite= asp, carbonate/carbonatization= carb, chalcopyrite= cp, galena= gn, graphite= gf, iron-rich carbonate/carbonatization= Fe-carb, pyrite= py, pyrrhotite= po, quartz= qz, quartz vein= qv, quartz-carbonate vein= qcv, scheelite= shee, sericite/sericitization= ser, silicification= sil, sphalerite= sp, tourmaline= tour.

Work Performed	Remarks
Alcon Occurrence (1) {1.5 km west of Joneston Lake)	
Dome Exploration Company (1973)	
diamond drilling	Widespread, minor (0.5-1%) py along with minor, local shee, sp, gn, cp are reported to be associated with widespread qv and qcv in strongly schistose rock.
Noranda Exploration Company Ltd. (1981)	
geological mapping and 2 diamond drill holes	Py and asp with minor gn mineralization is reported to be associated with qv oriented parallel to a strong foliation. Report indicates gold associated with qz-py-asp and, less commonly, with qz-py-gn veins although assay results were reported to be low, the best being 0.03 oz/ton Au over 1.5 m..
Rand Hodgson (1985)	
geological mapping and sampling	Reports widespread sulphide mineralization, especially associated with qv, along with assays up to 0.18 oz/ton Au from old pits on the occurrence.
Golden Terrace Resources Corporation (1986)	
ground magnetic survey	Work carried out over one claim revealed no significant anomalies.
Esso Resources Canada Limited (1987-88)	
geological mapping, ground magnetic survey, soil and rock sampling	Au is reported to be associated with py in both qv and host, strongly foliated, metavolcanic/metasedimentary, rocks. The best assay from a veined interval is 1.46 oz/ton Au over 0.61m. whereas the best assay from vein-free, pyritic host is 0.24 oz/ton Au. Magnetic and soil geochemical anomalies are associated with the mineralized area.
This survey	Mineralization and alteration is concentrated in strongly schistose rock along the southern margin of a thin mafic metavolcanic unit within a thick sequence of intermediate fragmental and associated metasedimentary rocks. Alteration within this zone includes qv and qcv, Fe-carb and disseminated py. Py is concentrated within and marginal to qv and qcv and in strongly schistose zones.
Angela Lake Occurrence (2) {southeast of Graham Lake}	
Amax Exploration, Inc (1973)	
mag-em survey	This survey indicates strong, long conductive zones with associated strong magnetic anomalies

Dome Exploration (Canada) Ltd (1967)

diamond drilling to test geophysics anomalies	Magnetic anomalies are attributed to magnetite ironstone and conductive zones to narrow zones of stringer and massive sulphide mineralization. Assays reported indicate minor Cu and Zn, low Ag and nil to trace Au.

Noranda Exploration Limited (1981)

airborne mag-em survey	long conductors with associated mag anomaly

Dome Exploration (Canada) Ltd (1983)

mag survey	positive northwest trending, regional magnetic anomalies

Golden Maverick Resources Corporation (1985)

airborne mag/em survey	Survey located northwest trending conductors with associated magnetic anomalies.

Dome Exploration (Canada) Ltd (1985)

13 diamond drill holes	Widespread py, local po and minor shee along with qv and qcv and alteration (sil, carb and ser) are reported. The best assay reported is 4.1 g/ton Au (0.3m.),with most others being <1 g/ton Au.

This survey

The area of reported geophysical anomalies and mineralization broadly coincides with a major metavolcanic/metasedimentary interface in an area of little or no outcrop.

Blondin Occurrence (3) {north of the east end of Mink Lake)

Selco Exploration Company Limited (1970)

ground mag/em survey	This survey identified a number of conductive zones, some with associated magnetic anomalies, in the vicinity of the x-shaped lake located to the northwest of Mink Lake.

Rand Hodgson (1985)

geological mapping and sampling	Reports barren qv and one assay of metavolcanic rock that returned 675 ppb Au.

Gold Fields Canadian Mining Ltd (1985-88)

mag/EM and IP surveys, humus geochem and diamond drilling (one hole filed at time of writing but more carried out)	The geophysical surveys identified a number of discontinuous magnetic anomalies and no conductors. Mention is made in the diamond drill results of a weak IP anomaly in the area drilled but the results of this survey were not available at the time of writing. The drill hole was designed to test an extensive deformation/alteration zone from which "anomalous surface samples" were collected. Widespread qcv and py (<3%) are reported but no assay data are available.

This survey

A number of overgrown trenches were located at the west end of the small east-south-east trending lake. The rocks exposed here are interpreted to be strongly deformed and altered (disseminated Fe-carb, py and perhaps gf) metasedimentary rocks cut by numerous pyritic qcv. Assays of host rock and veins returned assays of 60 and 200 ppb Au, respectively.
The results of this survey and the assessment file data suggest that a relatively narrow zone of strong deformation parallel to bedding and regional foliation acts as a locus for alteration and complex veining and is, at least locally, anomalously enriched in gold. This zone is poorly exposed and has a negative topographic expression but is interpreted to be 100-200 meters wide. The length of the zone is not well constrained but extends at least from the vicinity of the trenches, in an ESE direction beneath the small lake to the area of the diamond drilling. This zone is 'on strike' with the Alcon and Finn occurrences and could be even more laterally continuous.

Blondin Lake Occurrence (4) {south shore of Blondin Lake)

Amax Exploration, Inc (1973)

ground mag/EM survey follow-up to airborne survey — Numerous, NNW-trending conductive and magnetic zones were identified, the most continuous of which is a conductor that can be traced be traced for at least 900 meters and is coincident along part of its length with a strong magnetic anomaly.

This survey

Lack of outcrop precluded determination of the source of individual anomalies. The area is generally underlain by mafic metavolcanic rocks which, although they contain minor disseminated, euhedral py, show no evidence of alteration, veining or economically significant sulphide mineralization. Thin units of chert, with or without magnetite ironstone, are locally interlayered with the mafic metavolcanic rocks and are the likely source of the magnetic anomalies. The nature of the conductive zones is not clear.

Boylen (East Group) Occurrence (5) {north of McIntyre Bay)
McIntyre Occurrence (20) {north of McIntyre Bay)

*these occurrences were originally distinguished by Furse (1933) but have subsequently been evaluated together and consequently are described together.

Furse (1933)

This report describes a number of vein systems associated with sheared and/or rusty zones in metavolcanic rock and iron formation. The veins, some of which are auriferous, are reported to be composed of qz, asp and py with local carb, cp and tour.

Historical Exploration and Mining Activity

unpubl report by W.H. Thorpe based on otherwise unavailable files	This report, based in part on otherwise unavailable company files, indicates that mineralization was first discovered in 1928 by Jack Miller, a prospector working for McIntyre, and extensive prospecting and trenching during the following year lead to the discovery of numerous veins. Five diamond drill holes totalling 1954 feet were drilled in 1931. An intersection of 0.38 ounces Au/ton over 13 feet is reported from one of these holes. In 1934, the property was leased to Cooper and Barry and development work carried out included the sinking of a 90 foot vertical shaft, 155 feet of drifting at the 50 foot level and the erection of a 20 ton mill. At least 200 ounces of gold was produced from an estimated 1200 tons of mill feed. Most of the mill feed was inferred to have come from the surface workings. Approximately 2000 feet of diamond drilling carried out in 1935 apparently was discouraging and the property was returned to McIntyre. In 1940, McIntyre completed 7 diamond drill holes testing the previously known veins which intersected erratic gold mineralization which could not be correlated from hole to hole.

Cominco Ltd. (1979)

Geological map and report including summary of earlier, otherwise undocumented work	Earlier (1950's and 60's) work included trenching and drilling. The focus of most of this effort was apparently testing sulphide zones associated with ironstone units. Some of these were reported to be auriferous but no assay data are available. Mapping carried out by Cominco, Ltd confirmed the presence of numerous, thin chert - magnetite ironstone units.

Noranda Exploration Ltd (1981)

airborne mag/EM survey	This work identified a weak conductor on the flanks of a small magnetic anomaly in the area where the earlier work identified ironstone units.

Bert Crawford (1985)

mag/EM survey	This survey, carried out over part of the occurrence, located a number of discontinuous magnetic anomalies but no conductors.

Dome Exploration (Canada) Ltd (1985)

mag/EM survey	The survey identified several strong magnetic anomalies, some of which have an electromagnetic response. The anomalies were interpreted to reflect the presence of "iron formation".

St Joe Canada Inc. (1987)

mag/EM survey	This survey, over a relatively larger area than the previous surveys identified numerous conductors (most with associated magnetic anomalies). In the vicinity of this occurrence, the anomalies trend W to WNW.

Carmac Resources Ltd. (1983-84)

geological report, 12 diamond drill holes and historical overview from unpubl reports	Report suggests that qv and Au are localized within a 600-700 foot wide conformable shear zone. The first two drill are described to have intersected ore grade rock over mineable widths (one intersection is reported to have a true width of 11.8 feet assaying 0.506 ounces Au/ton, cut to 1 ounce Au/ton). These holes were drilled east of, and along strike from, the old workings. The ten subsequent holes were less encouraging; the best assays being 0.67 oz/ton Au over 30 cm, 0.27 oz/ton Au over 20 cm and .132 oz/ton Au over 45 cm with the remainder of the assays being 0.1 oz/ton Au over narrow widths. The assay results reported suggest that gold mineralization is closely associated with asp which is in turn associated with py and qv and qcv.

This survey

The occurrence is underlain primarily by mafic metavolcanic rocks that contain thin, bedded magnetite ironstone - chert units. No evidence for broad shear zones was observed, but many of the flow contacts, especially where interflow chemical metasedimentary units occur, are strongly deformed over widths of up to 3 m. These zones appear to localize qv and weak alteration (carb). Most qv are irregular and parallel to foliation but others are more regular, occurring in vertically dipping, 050 degree trending, en echelon sets. Py and asp occur within and marginal to the qv. Au assays for grab samples from the area of the shaft as follows; 0.04 oz/ton and <2 ppb for pyritic, schistose mafic metavolcanic rocks; 0.03 oz/ton for an asp-bearing qv, 20 ppb for a py-bearing qv and 0.02 oz/ton for a sample of vein-free, sulphide-poor magnetite ironstone.

Boylen (West Group) Occurrence (6) {south of Casummit Creek)

Furse (1933)

This author describes a vein zone exposed for 1000 feet in a series of trenches to the north of the round swampy lake near the outlet of Casummit Creek. The vein zone is described as trending approximately 105 degrees with individual quartz stringers being parallel to a host rock schistosity trending east and dipping steeply to the north. Mineralization reported includes asp and py both within and marginal to the quartz veins.

This study

The area of the reported trenching and mineralization is heavily overgrown and only a few of the trenches could be located. Quartz veins 1 to 5 cm wide occur within a highly schistose, strongly sericitized rock with local Fe carb. Minor py and asp are associated with the veins.

Brengold Mines Ltd Occurrence (7) {west of Casummit Lake)

Furse (1933)

This author reports that exploration ongoing at the time uncovered qv with associated py and Au near the west and south shore of Casummit Lake.

Floregold Red Lake Mines Ltd (1949-50)

4 diamond drill holes — Drilling is reported to have intersected strongly deformed chloritic schist. Best assays indicate $4.20 (~0.12 ounces, assuming $35 gold) Au/ton over 1 foot and $1.40 (~0.04 ounces) Au/ton over 3 feet.

Esso Resources Canada Ltd (1987-88)

geological map and report, mag survey — This survey over a larger area did not identify any significant anomalies or mineralization in the vicinity of this occurrence. A number of assays of grab samples reported for the general area of the occurrence all returned trace Au.

This survey

The general area of this occurrence is very poorly exposed. Most outcrops in the area are chloritic or sericitic schists and are characterized by intense fabric development, alteration (carb) and minor disseminated py. The only noteworthy vein mineralization encountered is exposed in a pit along the west shore, just to the west of the large island in Casummit Lake. Here, a 10-15 cm wide, crack and seal quartz vein with 1-2% py returned an assay of 1.07 oz/ton Au.

Brownstone Lake Occurrence (8) {south shore Brownstone Lake)

Selco Mining Corporation Ltd (1976)

mag/EM survey — This survey detected a weakly conductive zone corresponding to a broad positive magnetic anomaly located beneath the waters of Brownstone Lake.

Golden Maverick Resources Corporation (1985)

airborne mag/EM survey — This survey identified a number of conductive zones with a weak magnetic response located near the southeast corner of Brownstone Lake.

Tanqueray Resources Ltd (1988)

airborne mag/EM survey — This survey identified a number of conductive zones, some with associated magnetic anomalies.

This survey

During the coarse of this survey a heavily gossanous outcrop was located along the shore near the southeast corner of Brownstone Lake. It is difficult to ascribe an origin to these rocks with any degree of certainty due to nature of the outcrop and alteration, but both medium grained mafic metavolcanic rocks and graphitic, cherty metasedimentary rocks are interpreted to be present. Sulphide minerals include py and asp. Five grab samples were selected for assay but these all indicated background or very low values; Au <20 ppb, Cu <400 ppm and Zn <210 ppm

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Casey Mountain Operating Syndicate Occurrence (9) {north end Casummit Lake)

Horwood (1937)

This author reports the occurrence of a narrow, irregular quartz vein with ore grade assays and visible gold.

This study

This vein was not located during the present survey. Rocks exposed in the area are mafic metavolcanic rocks with minor disseminated py. The area where the vein is reported from is generally along strike with a strongly schistose metasedimentary unit occurring to the southwest.

Finn Occurrence (10) {northwest of Joneston Lake)

Furse (1933)

This author reports numerous narrow qcv with associated py and minor sp, cp and gn from within schistose rock.

Noranda Exploration Ltd (1981)

airborne mag/EM survey	This survey indicates a magnetically noisy zone in the vicinity of the veins reported by Furse (1937).

Esso Resources Canada Ltd (1987-88)

geological map and report, mag survey	This report indicates the presence of qz-tour-gn veins within altered (Fe carb), pyritic wall rock. A number of assays of grab and channel samples are reported with the best being 0.12 oz/ton Au and most returning only a trace.

This survey

The veins were not encountered during the present survey. The area where they are reported to occur lies within moderately strongly deformed mafic metavolcanic rocks just to the north of a major contact. No noteworthy alteration or mineralization was encountered in this area.

Graham Occurrence (11) {on peninsula in Joneston Lake)

Furse (1933)

This author reports sheared, rusty rock with numerous qv with associated py. Gold was reportedly panned from some of the veins.

Rand Hodgson (1985)

geological map and report and assays	Anomalous gold values are reported for qcv (0.1 to 0.52 oz/ton) and altered (ser, carb, py) host rock (<860 ppb).

Esso Resources Canada Ltd (1987-88)

geological map and report, mag survey	Additional stripping of the older trenches is reported to reveal qv with associated alteration (Fe carb, sil). Py occurs in both veins and host rock but all assay data returned only trace Au.

This survey

This survey confirmed the presence of numerous qv and qcv cutting strongly foliated intermediate metavolcanic rocks. Very minor py occurs in both veins and host rock. A grab sample of a narrow (~2 cm) qv containing Fe carb and very minor py returned an assay of 0.07 oz/ton Au whereas another from one of the more prominent wider (~1 m), Fe-carb free veins returned only 12 ppb Au.

Hatch (Mink Lake Group) Occurrence (12) {Mink Lake narrows)

Furse (1933)

This author describes a number of qv with associated py from the general area of the narrows in Mink Lake and the island filled bay to the southwest.

This study

Only one of the veins (at Mink Lake narrows) described by Furse was examined during the course of this survey. Where examined, this 1 meter wide qv is barren of sulphides.

Hatch (Joneston Lake Group) Occurrence (13) {west of Joneston Lake)

Furse (1933)

This report describes a narrow, laterally extensive qv in chloritic schist. Py occurs within and marginal to the vein which is locally auriferous.

Rand Hodgson (1985)

geological map and report and assays — Sulphide mineralization is reported to be common as disseminations and occur less abundantly as a "massive bedded variety". Sulphides are especially abundant in association with qv and sericite schist. A number of anomalous gold assays are reported for grab samples from the general area of the occurrence; 0.172 oz/ton from pyritic schist adjacent to qv and 0.058 oz/ton from a narrow qz-py-po-sp-gn vein.

Esso Resources Canada Ltd (1987-88)

geological map and report, mag survey — A narrow, laterally extensive qv (presumably the same one described by Furse, 1933) is reported to contain chlorite and tour. Grab samples of the vein and schistose wall rock returned gold assays of up to 0.04 oz/ton but most returned only trace.

This survey

A narrow qv cuts mafic metavolcanic rock which is more chloritic, schistose and pyritic adjacent to the vein.

Hewitt - Ziyone Occurrence (14) {east of Casummit Lake)

Horwood (1937)

This author reports that a number of narrow auriferous qv with associated py and asp occur in sheared zones and at lithological contacts.

A. Kostynuk (1969)

3 drill holes — Disseminated py and asp are reported.

Golden Terrace Resources Corporation (1986)

geological maps and report and soil geochemistry — Mineralization is described as consisting of a stockwork of qz-carb-asp-Au veins for which Au assays of 0.70, 0.02, 0.14 and 0.69 oz/ton are reported. A humus geochemistry survey indicates anomalies related to either known areas of mineralization or old mine (Jason Gold Mine) development.

This survey

No observations directly bearing on the mineralization reported for this area were made during the course of this survey.

International Obaska Mines Ltd Occurrence (15) {west of Brownstone Lake)

International Obaska Mines Ltd (1971)

2 drill holes — This drilling intersected a wide variety of rock types as well as some intervals that were interpreted to represent possible faults. Up to 10% sulphides (py with minor po and cp) are reported with the best assays being 0.17% Ni over 3 feet and 0.12% Cu over 3 feet.

Selco Mining Corporation Ltd (1976)

mag/EM survey	Several anomalies were detected but these were not deemed to be worthy of additional follow-up.

This survey

The area of previous exploration activity broadly coincides with the Retter Lake deformation zone but no significant mineralization or alteration was recorded in this area during this survey.

Jason Gold Mine (16) {east shore Casummit Lake)

Furse (1933)

This report describes some of the results of the earliest exploration and development work in the area. All of the gold mineralization is reported to be associated with qv and sulphides (py and asp and, less commonly, cp and gn).

Horwood (1937)

The information presented in this report is based primarily on the results of the initial mining development on the property. The close spatial association of high grade gold mineralization across narrow widths with qv and sulphides (py, asp, po, cp, sp and gn) is noted. It is further indicated that there is an especially strong spatial association between gold and asp as well as between the highest grade mineralization and veins hosted in metasedimentary rock.

Grand Bay Explorations Ltd. (1976)

Report and geological map

This report is largely a summary of otherwise unavailable data on previous mining development and exploration. The report indicates that total production amounting to 276573 tons yielding 101875 ounces of gold and 9788 ounces of silver occurred at various times between 1931 and 1952. The map indicates the vertical projection of the areas of mine development (figure xx)

Noranda Exploration Company Ltd. (1980-86)

geological map and report, mag survey, diamond drilling and tailings evaluation

This extensive exploration focused on the known mineralization associated with quartz veining and also addressed potential stratigraphic control of mineralization. The work reconfirmed the association of high grade mineralization with qv and adjacent, narrow zones of sulphidized wall rock with numerous assays in excess of 1 ounce/ton over narrow widths. An association of gold with asp is also apparent from this work. Some of the best results are reported for those veins (eg. veins #3 and #4) on the western part of the occurrence that saw no extensive development during the earlier mining activity. The best mineralization is reported to be associated with qv where they intersect iron-rich chemical metasedimentary rocks. Subsequent investigation of the chemical metasedimentary rocks themselves revealed no economically significant mineralization.
A sampling program on the mine tailings led to the conclusion that 300000 tons of tailings contained less than 2800 ounces of gold.

This survey

Most of the veins reported from the earlier exploration and development work were examined briefly during the course of this investigation. No significant additional veins were discovered and the noteworthy alteration and mineralization is restricted to the veins and immediately adjacent wall rock. Several assays of approximately 0.1 oz/ton and observations of visible gold suggest that gold is most commonly present i) in association with sulphides occurring at the edges of veins and along the edges of wall rock inclusions in veins and ii) in association with asp.

Johnson Dynes Occurrence (17) {at bend in Casummit Creek)

Furse (1933)

This report describes asp and py mineralization from strongly schistose rocks associated with barren quartz veins.

Gold Fields Canadian Mining Ltd (1988-89)

3 diamond drill holes — This drilling is reported to have intersected strongly foliated rocks hosting widespread alteration including qv, qcv and sil as well as up to 5% py + asp mineralization. No assays are reported but reference is made to anomalous gold values from the first hole drilled.

this study

The area of this outcrop is poorly exposed and no observations were made in the area of the reported mineralization. Regionally, the reported mineralization appears to be near a strongly deformed mafic/intermediate metavolcanic contact.

Joneston Lake Occurrence (18) {north of Joneston Lake)

Selco Mining Corporation Ltd (1976)

mag/EM survey — This work identified a weak conductor corresponding to a weak magnetic low.

Noranda Exploration Ltd (1981)

airborne mag/EM survey — This survey identified two conductors, one associated with a mag low and the other with a positive magnetic anomaly.

Dome Exploration Canada Ltd (1967)

1 diamond drill hole — This drilling is reported to have intersected a heterolithic zone that includes cherty and graphitic intervals with up to 10% po and py and traces of cp. The best assays returned 0.11% Cu and 0.25% Zn.

this survey

The area of the reported mineralization corresponds to a linear topographic depression. Outcrops adjacent to this valley are very strongly foliated mafic metavolcanic rocks that contain minor disseminated py.

Lundberg Group Occurrence (19) {west of Richardson Lake)

Horwood (1937)

Trenching is reported to have exposed narrow qv but no information on mineralization is presented.

this survey

Little outcrop and no evidence of the veining or trenches was found in the area of the reported mineralization. The area is underlain by mafic metavolcanic rocks along with minor chert-magnetite ironstone.

McIntyre Occurrence (20) {north of McIntyre Bay)

see Boylen (East Group) occurrence

Moran Occurrence (21) {south of Richardson Lake)

Horwood (1937)

This report describes numerous mineralized (py, asp, cp, Au) quartz veins located along the north shore of, and west of, the small lake to the northeast of the Jason Mine.

this survey

Several of the veins described by Horwood were located during the present survey. 700 meters to the west of the small lake, narrow qv mineralized with py, asp and cp cut mafic metavolcanic rocks. Along the north shore of the small lake, extensive alteration (Fe carb, qv) and mineralization (asp, py) occurs within a narrow heterolithic (chert-magnetite ironstone, wacke and mafic flow rocks) zone within the dominantly mafic metavolcanic sequence. Several samples were assayed for gold with results as follows; 0.04 oz/ton for wacke with disseminations and veins of asp, 0.03 oz/ton for an asp-rich qv, 60 ppb for pyritic chert-magnetite ironstone, 24 ppb for a pyritic qv, and 14 ppb for a chert-magnetite breccia with no visible sulphides. These results suggest that gold content is strongly correlated with that of asp. A number of recent diamond drill locations that were apparently testing this zone at depth were seen in the field but the results of this drilling was not available at the time of writing.

Richardson Lake Occurrence (22) {north shore of Richardson Lake)

Furse (1933)

This report describes a number of qv with a variety of sulphide minerals concentrated within and marginal to the veins. A number of these veins are reported to be auriferous.

Horwood (1937)

This report restates the observations made by Furse (1933) and provides some general information on gold assays with reports of 0.04 to 0.628 oz/ton over 0.9 to 5.3 feet.

Golden Terrace Resources Corporation (1984-86)

summary of earlier exploration and development, geological map and report, mag/EM/IP surveys, 10 diamond drill holes

This report summarizes otherwise unavailable results of earlier exploration on the occurrence that includes mapping, geophysical surveys, trenching and in excess of 30 drill holes. It also reports results of a small-scale mining operation carried out on the property between 1963 and 1966 which includes the sinking of a 50 foot shaft and approximately 100 feet of drifting. It is reported that 577 tons of rock were mined and hand cobbed to concentrate vein material for milling with production totalling 1126 ounces Au and 102 ounces Ag.

This work identified a number of auriferous zones that are related to either qv with associated sulphides (asp, py, sp, gn) or sulphide-bearing alteration zones. Assay data suggests that the vein-related mineralization is lower grade (<0.18 ounces Au/ton) whereas that from the vein-free, sulphidized rock is more erratic but locally higher grade (6 grab samples of vein-free, sulphidized rock from the dump at the shaft are reported to range from 0.087 ounces Au/ton to 1.7 ounces Au/ton and average 0.75 ounces Au/ton). Both types of mineralization are reported to be concentrated in strongly deformed rocks coincident with thin chemical metasedimentary units in the dominantly mafic metavolcanic stratigraphy.

this survey

Few exposures were located in the vicinity of the reported mineralization. Trenches near the north shore of Richardson Lake expose locally pyritic qv cutting mafic metavolcanic rocks. A single grab sample from the pyritic margins of one of these veins returned only a trace of gold.

Whitefish River Occurrence (23) {east of Blondin Lake)

Amax Exploration, Inc. (1973)

mag/EM survey — This work identified a lengthy conductor and numerous discontinuous strongly magnetic zones, all of which trend approximately 315 degrees.

this survey

The area of the geophysical anomalies corresponds to the approximate position of the poorly exposed contact between a thick sequence of mafic metavolcanic rocks and a narrow, highly deformed, intermediate to felsic unit near the margin of the greenstone belt. The only sulphide mineralization noted within the area, other than ubiquitous disseminated py, are several small, weakly pyritic qz-tour veins that returned only a trace of gold.

Figure Captions

Figure 1. Geological map of the Jason Mine area illustrating the location and attitude of veins, production statistics and the vertical projection of the areas of underground development. The figure is based largely on unpublished data taken from the files of the Resident Geologists Office, Red Lake.

Photo Captions

Photo 1. Pillowed mafic flow with radial vesicles concentrated near the margin of individual pillows. Such low degrees of strain and well preserved primary structures are not typical of the map-area and are largely restricted to the area to the east of the Jason Mine. This photo is taken from an outcrop located approximately 1300 metres ESE of the Jason Mine.

Photo 2. Flattened pillows in mafic flow. Comparable degrees of strain are common within the map area. This photo is taken from an outcrop located approximately 1700 metres west of the south end of the western arm of Blondin Lake.

Photo 3. Banded amphibolite interpreted to represent a very highly strained pillowed mafic flow. These highly strained rocks are common within several hundred metres of the contact with the Mainprize Lake granitoid complex. This photo is taken from an outcrop located approximately 2500 metres WSW of the south end of the western arm of Blondin Lake.

Photo 4. Bimodal size distribution of feldspar phenocrysts in mafic flow. This photo is taken from an outcrop located approximately 1200 metres ESE of the Jason Mine.

Photo 5. Cherty chemical metasedimentary rocks at mafic flow contact. The sedimentary horizon and immediately adjacent parts of the mafic volcanic rocks have been strongly deformed and are a locus for alteration and quartz veining. This photo is taken from an outcrop located 400 metres north of the lake immediately to the west of Joneston Lake.

Photo 6. Highly strained and kink banded, heterolithic intermediate lapilli-tuff. This photo is taken from an outcrop located on the point northwest of the small island in Joneston Lake.

Photo 1. Pillowed mafic flow with radial vesicles concentrated near the margin of individual pillows. Such low degrees of strain and well preserved primary structures are not typical of the map-area and are largely restricted to the area to the east of the Jason Mine. This photo is taken from an outcrop located approximately 1300 metres ESE of the Jason Mine.

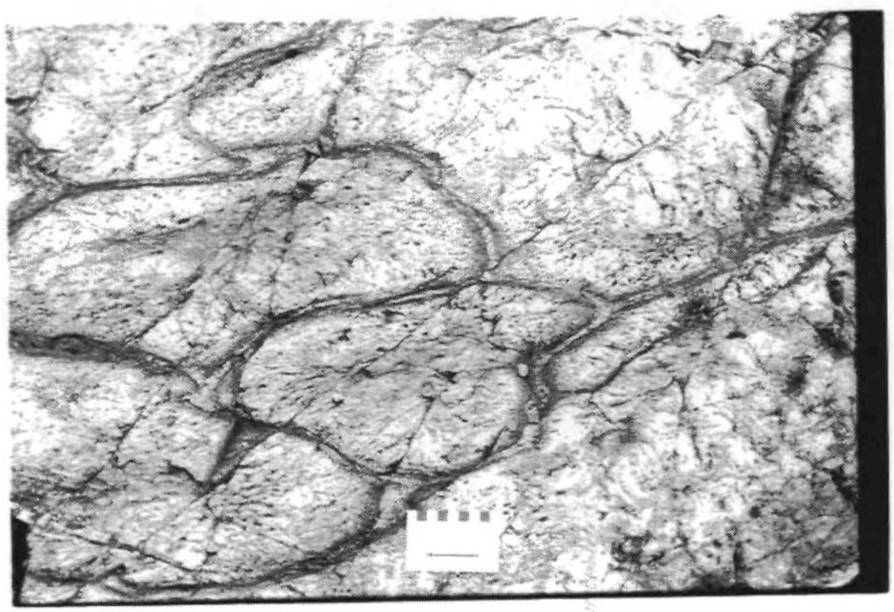

Photo 2. Flattened pillows in mafic flow. Comparable degrees of strain are common within the map area. This photo is taken from an outcrop located approximately 1700 metres west of the south end of the western arm of Blondin Lake.

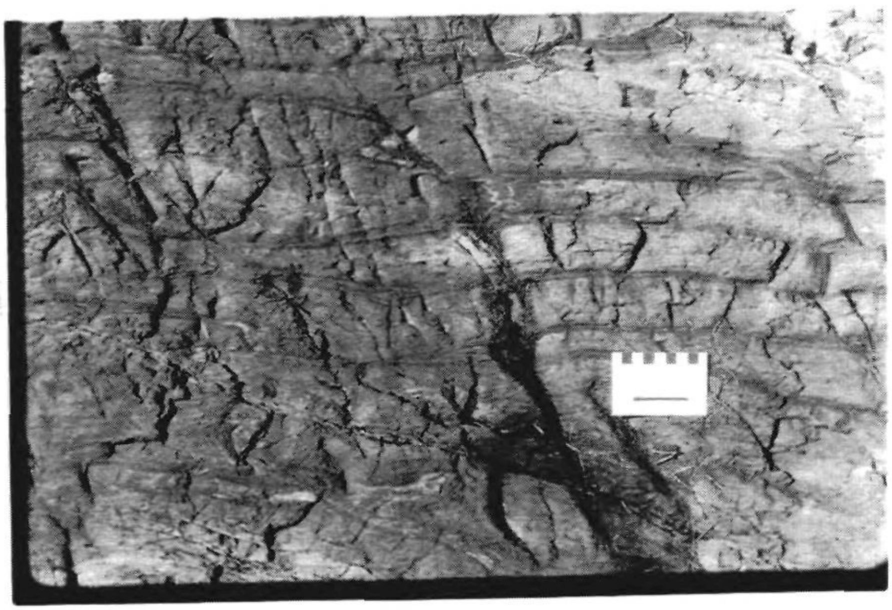

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Photo 4. Bimodal size distribution of feldspar phenocrysts in mafic flow. This photo is taken from an outcrop located approximately 1200 metres ESE of the Jason Mine.

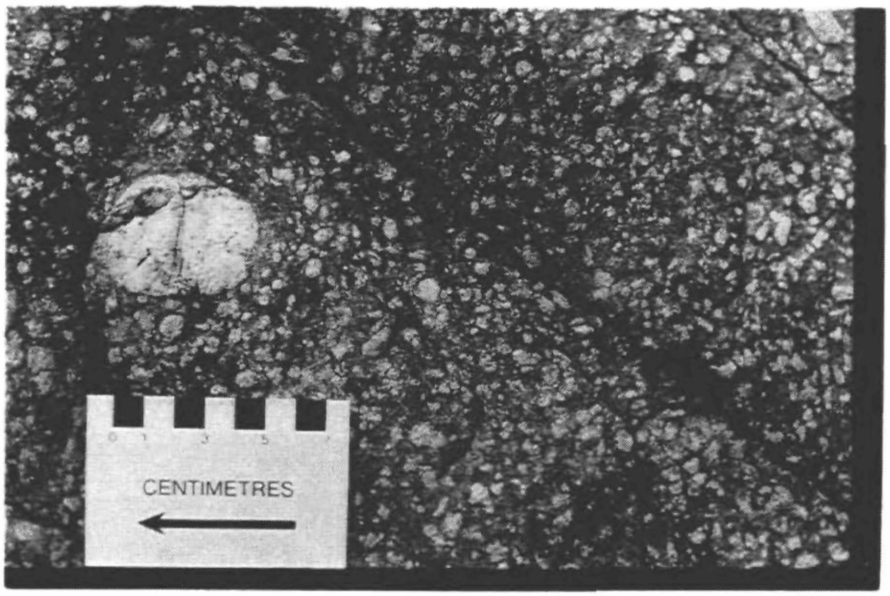


Photo 5. Cherty chemical metasedimentary rocks at mafic flow contact. The sedimentary horizon and immediately adjacent parts of the mafic volcanic rocks have been strongly deformed and are a locus for alteration and quartz veining. This photo is taken from an outcrop located 400 metres north of the lake immediately to the west of Joneston Lake.

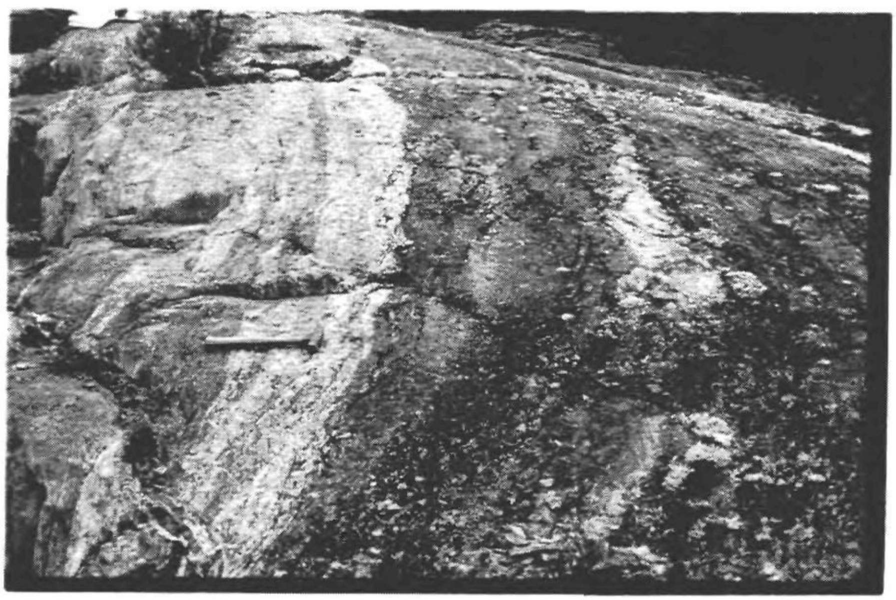
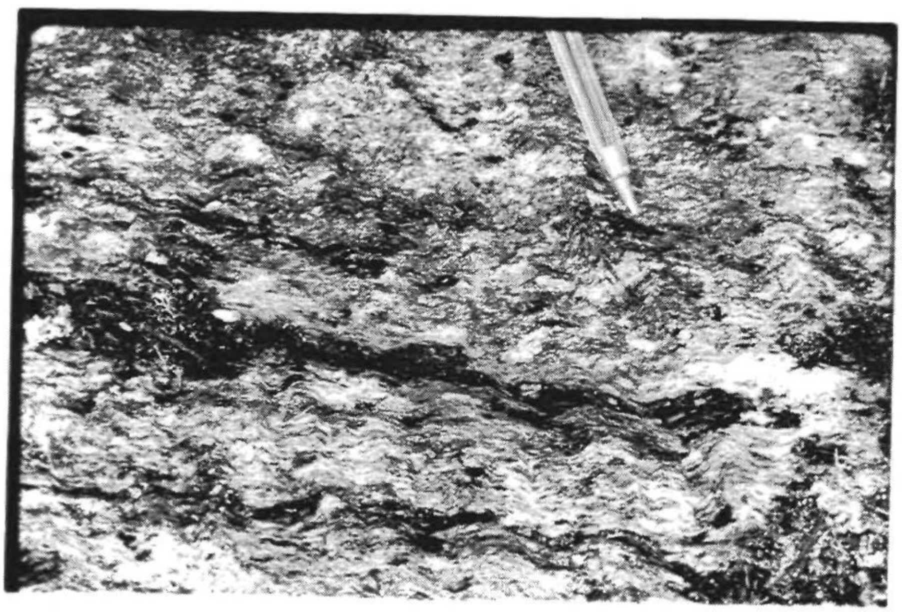


Photo 6. Highly strained and kink banded, heterolithic intermediate lapilli-tuff. This photo is taken from an outcrop located on the point northwest of the small island in Joneston Lake.



CONVERSION FACTORS FOR MEASUREMENTS IN ONTARIO GEOLOGICAL SURVEY PUBLICATIONS

Conversion from SI to Imperial			**Conversion from Imperial to SI**		
SI Unit	*Multiplied by*	*Gives*	*Imperial Unit*	*Multiplied by*	*Gives*
			LENGTH		
1 mm	0.039 37	inches	1 inch	**25.4**	mm
1 cm	0.393 70	inches	1 inch	**2.54**	cm
1 m	3.280 84	feet	1 foot	**0.304 8**	m
1 m	0.049 709 7	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	**1.609 344**	km
			AREA		
1 cm@	0.155 0	square inches	1 square inch	**6.451 6**	cm@
1 m@	10.763 9	square feet	1 square foot	**0.092 903 04**	m@
1 km@	0.386 10	square miles	1 square mile	2.589 988	km@
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
			VOLUME		
1 cm#	0.061 02	cubic inches	1 cubic inch	**16.387 064**	cm#
1 m#	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m#
1 m#	1.308 0	cubic yards	1 cubic yard	0.764 555	m#
			CAPACITY		
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	**4.546 090**	L
			MASS		
1 g	0.035 273 96	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 75	ounces (troy)	1 ounce (troy)	**31.103 476 8**	g
1 kg	2.204 62	pounds (avdp)	1 pound (avdp)	**0.453 592 37**	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	**907.184 74**	kg
1 t	1.102 311	tons (short)	1 ton (short)	**0.907 184 74**	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	**1016.046 908 8**	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	**1.016 046 908 8**	t
			CONCENTRATION		
1 g/t	0.029 166 6	ounce (troy)/ ton (short)	1 ounce (troy)/ ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ ton (short)	1 pennyweight/ ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

	Multiplied by	
1 ounce (troy) per ton (short)	20.0	pennyweights per ton (short)
1 pennyweight per ton (short)	0.05	ounces (troy) per ton (short)

Note: Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries, published by the Mining Association of Canada in co-operation with the Coal Association of Canada.

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