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ONTARIO GEOLOGICAL SURVEY

Open File Report 5810

Quaternary Geology of the Shining Tree Area

By

P.W. Alcock

1991

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V.G. Milne

V.G. Milne, Director
Ontario Geological Survey

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ABSTRACT

The Quaternary deposits of the Shining Tree Area, located in Northeastern Ontario, are underlain by Archean aged metavolcanic and metasedimentary rocks of the Abitibi Greenstone Belt and Proterozoic aged sedimentary rocks of the Cobalt Group. The bedrock surface strongly controls the physiography of the study area and distribution of the Quaternary deposits.

The Pleistocene sediments observed are of Late Wisconsinan age with the oldest unit being a silty sand till deposited by ice advancing southward (180 +30). At a limited number of sites evidence of an earlier southwestward advance was present. Glaciofluvial deposits within the area consist of ice-contact stratified drift, mainly in the form of esker complexes, and outwash. Outwash deposits are the dominant sediment type in valley bottoms achieving widths of several kilometres. Sandy glaciolacustrine material, deposited in short lived proglacial lakes, occupies basins and topographic lows.

Recent deposits within the Shining Tree area include eolian sand dunes and organic and alluvial deposits.

Results of till geochemical sampling within the study area indicate that the drift exploration programs boulder tracing, surface till geochemical analysis and backhoe trenching are effective exploration methods where till is at or near the surface. Both the non-magnetic heavy mineral and silt-clay fraction may be used for unweathered till. In the case of weathered till, the choice of fraction to sample is dependent on the elements being sought.

Aggregate resources in the area, associated with ice-contact stratified drift and outwash, are abundant although no evenly distributed across the area.

THE QUATERNARY GEOLOGY OF THE SHINING TREE AREA

by

P.W. Alcock[1]

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INTRODUCTION

Location and Access

The Shining Tree project area includes three 1:50,000 N.T.S. map-sheet areas (Shining Tree 41 P/11; Sinclair Lake 41 P/14; and Gowganda 41 P/10) and is located within the Provincial Districts of Sudbury and Timiskaming (Figure 1). The area is located approximately 500 km north of Toronto, 140 km north of Sudbury and 80 km south of Timmins, Ontario. It is an L-shaped area bounded by latitudes 47° 30′ and 48° 00′ N and longitudes 80° 30′ and 81° 30′ W and encompasses approximately 3000 km^2 of land.

The settlements within the project area include the villages of Shining Tree and Gowganda. Other communities include Gogama, Matachewan, Elk Lake and a small part of the City of Timmins. The area is served by King's Highways 144, 560 and 566 and several secondary roads including; the Grassy Lake, Bay Lumber, Beauty Lake and Wicks roads. In addition to the public access roads, logging, mining and private secondary roads are present in many parts of the project area.

Present Geological Survey

The objectives of Quaternary mapping in th Shining Tree area are to: 1) determine the distribution and stratigraphy of the Quaternary sediments; and 2) expand the geological database for use in mineral exploration, forestry, and land use planning. This report summarizes information on the sedimentological, structural and geochemical properties of the Quaternary deposits and discusses their distribution, stratigraphy and

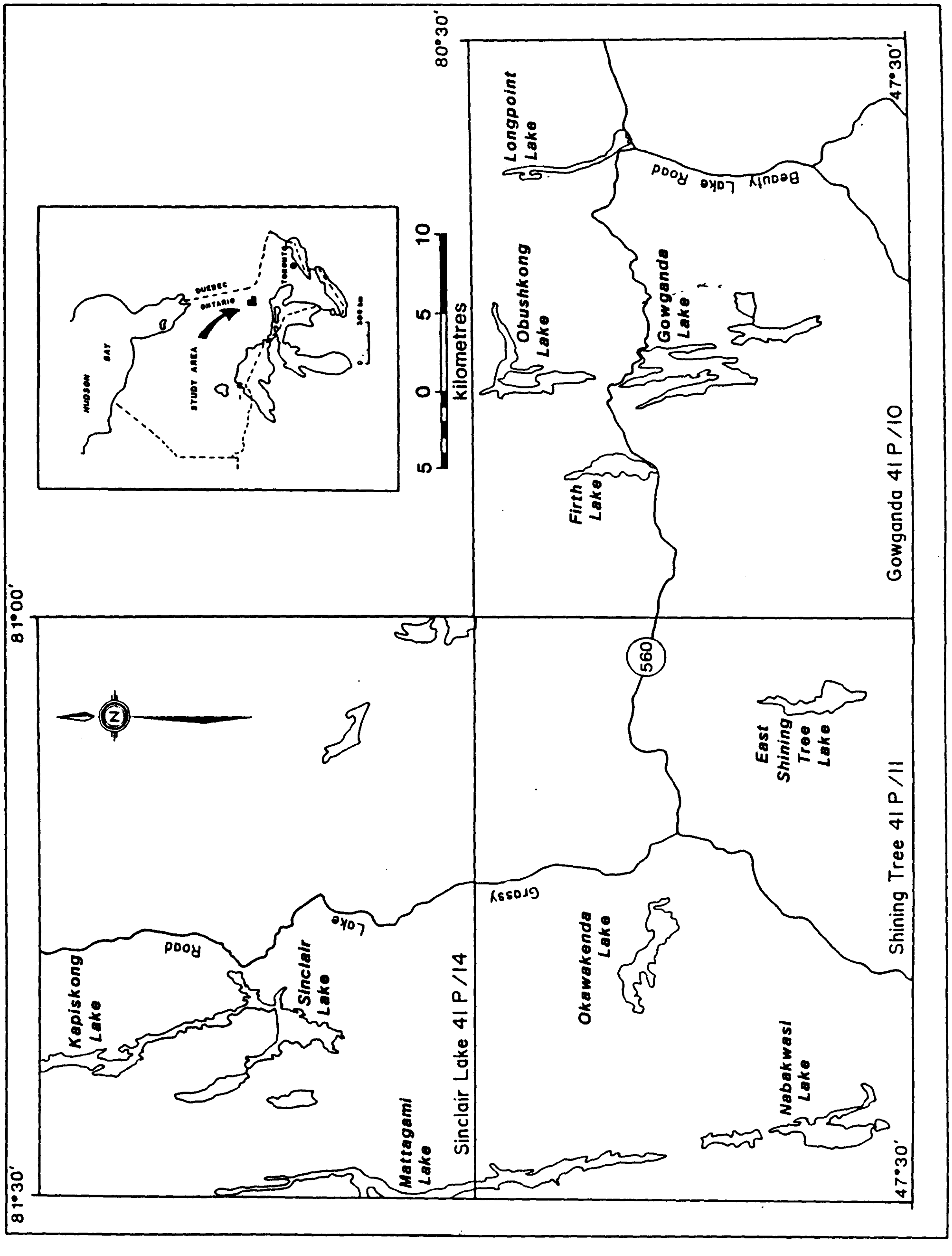

Figure 1. Location map.

depositional history. Three Quaternary geology maps have been prepared at 1:50,000 scale (Alcock and Miller, 1990a, 1990b).

Field work was conducted in the summers of 1986, 1987, 1988 and 1989. Trucks and all terrain vehicles were used to traverse highways, forestry and mining access roads, and power transmission line right-of-ways. Canoes with outboard motors were used for travel along lakes and rivers. Foot traverses were carried out in areas with no access.

The Quaternary deposits were initially examined and interpreted using air photographs at scales 1:15 840, 1:20,000 and 1:63 360 supplied by the Air Photo Library, Ontario Ministry of Natural Resources and the National Air Photo Library, Ministry of Energy, Mines and Resources, Canada. This was followed by examination of natural and man-made exposures along roads, river and lake shores, and in excavations. As much of the area lacked any exposures, hand augering and hand test pitting were used to examine and sample material down to about 1.5 m depth. A total of 32 backhoe trenches were excavated to a depth of about 3 m, in several areas in order to examine and sample deposits, usually thick till. All outcrops along traverses were examined for striations and other ice directional features. Field notes of E. V. Sado and W. A. Clarke were also used (see Sado and Clarke 1974).

The Quaternary deposits were delineated using 1:15,840 and 1:20,000 airphotos, field site observations and bedrock outcrop maps. Deposit morphology, vegetation cover, drainage characteristics, reflectivity of exposed sediments, presence of surface boulders and bedrock outcrops, and patterns of road and borrow pit development, were used to interpret the Quaternary deposits. In remote areas, using field relationships gained from areas with ground truth were used.

The units delineated on the maps represent areas where the indicated deposit type predominates. They may also include areas of other deposit types too small or too thin (less than 1 m) to map. For example, areas of till veneer over bedrock (Map Unit 2a) may also include areas of thick till (Unit 3) and organic deposits (Unit 8) and occasional thin surface veneers of lacustrine or eolian sediment. Many contacts between map units represent an arbitrary division of the gradual transition from one deposit type to another. Areas of bedrock-drift complex (2, 2a, 2b or 2c) have covers of surficial sediment over bedrock which are often 1 m or less in thickness, with frequent outcrops. All other units represent surficial sediment or organic material at least 1 m thick. Any site specific use of the surficial deposits maps should include an orientation survey to verify the sediment types, thicknesses and distribution locally.

Acknowledgements

Quaternary geological mapping and sampling of the Shining Tree map area (NTS 41 P/11) commenced in 1986 by P. Finamore, J. MacKenzie, A. Chippindale and C. Hibberd. Field mapping between 1987 and 1989 was completed by the author. Assistance in the field was provided by M. Miller, J. Aultman, V. Rammul, M. Schrader and K. O'Keefe.

The administrative and logistical assistance of the staff at the Gogama District Office and the Elk Lake Sub-office, Ontario Ministry of Natural Resources, is gratefully acknowledged. The author would like to thank Gary Naveau and the Mattagami Indian Band for their permission and co-operation in allowing access in 1987 to the Reserve lands (I.R. 71). The author would like to thank the many landowners and claimholders of the Shining Tree area who allowed access to their properties for fieldwork. Valuable discussions regarding the surficial deposits and mapping were held with staff of the Ontario Geological Survey.

Physiography and Drainage

The project area lies within the Abitibi Uplands and Cobalt Plain subdivisions of the James Physiographic Region (Bostock 1970; Shilts et al. 1987). The Abitibi Upland in the project area is underlain by Archean crystalline, metavolcanic and metasedimentary bedrock. The broad, rolling surface of this upland rises southwards at a low gradient. The Cobalt Plain is underlain by generally flat-lying Proterozoic clastic sedimentary rocks with hills formed by gabbroic sills or inliers of Archean crystalline rocks. In the northeastern and eastern parts of the project area, faulting and differential erosion of the beds in the Proterozoic sedimentary rocks have produced north oriented ridges and a stepped appearance to the edge of the large outlier.

The land surface rises generally southward from elevations of less than 335 m (1100 feet) in the north to elevations in excess of 580 m (1900 feet) in the south. The Sinclair Lake map area is generally a low relief lowland area while the Shining Tree map area is of higher local relief and higher elevation. The Gowganda map area has the highest and most rugged topography, with ridges and hills standing tens to hundreds of metres above the surrounding land surface. Local relief commonly ranges up to 50 m (165 feet) but steep rises in excess of 200 m do occur. Steep bedrock-controlled slopes occur near the boundaries of Proterozoic sedimentary rock areas.

The highest areas include hills in excess of 457 m (1500 feet) near Elephant Head Lake in Miramachi Township, in excess of 492 m (1600 feet) near Upper Grassy Lake in Natal Township and in excess of 580 m (1900 feet) east of Wallis Creek in Roadhouse Township. The topographic highs are generally underlain by Archean metavolcanic and felsic intrusive bedrock and diabase dikes in the Shining Tree and Sinclair Lake map areas, while in the Gowganda map area, the highs are formed of resistant ridges of Nipissing Diabase, Gowganda Formation conglomerate and Lorrain Formation sandstone. Most hills and ridges are glacially streamlined to some extent.

Valleys, which were important drainage route ways during deglaciation, are often underlain by major fault zones. In several locations, fault zones have been preferentially excavated by fluvial and glacial erosion, producing linear depressions. Ice-contact stratified drift deposits form local topographic highs.

The study area straddles the Hudson Bay-Great Lakes drainage divide which passes roughly northward through the Shining Tree map area and through the southeastern corner of the Sinclair Lake map area. The western parts of the Shining Tree and Sinclair Lake map areas drain westward via the Nabakwasi River, Opikinimika River, Claw Creek, Burrows Creek and Hassard Creek, into Mattagami Lake which in turn drains northward into the Mattagami River. Much of the central and eastern parts of the Sinclair Lake area drain northward by the Grassy River. The central and eastern parts of the Shining Tree area drain southward via the West Montreal River. Drainage in the Gowganda area is mainly northward by the West Montreal and Montreal Rivers and eastward by the Bear River. Most of the creeks and rivers have local base level controlled by bedrock sills. Little incision has occurred, resulting in few natural bank exposures of the Quaternary sediments.

In general, the lowland areas underlain by fine sand and silt of glaciolacustrine and eolian origin have poor drainage while the highland areas, mantled by sandy till, are somewhat better drained.

Drift Thickness and Bedrock Topography

Only in the major valleys and in some of the major areas of ice-contact deposits does the bedrock topography become subdued beneath the cover of Quaternary sediments. Drift thickness commonly ranges from less than 1 m to about 10 m over areas mapped as bedrock–drift complex. Thicknesses of more than 50 m are present in some of the areas of glaciofluvial ice-contact and outwash deposits and along major valleys infilled with glaciolacustrine deposits.

Previous Work

Previous reconnaissance Quaternary geology and engineering and terrain geology studies in the project area were completed by Boissonneau (1965, 1968), Roed (1979) and Roed and Hallett (1979a, 1979b). Quaternary geological mapping of parts of the project area was carried out by Sado and Clarke (1974). Closs and Sado (1982) undertook detailed bedrock and overburden geochemical investigations in vicinity of base metal occurrences in the Midlothian Lake and Natal Lake areas. Aultman (1988) completed a study of till sedimentology and structure and investigated the nature of gold dispersal down-ice of known gold occurrences in the Shining Tree area. The surficial deposits of the New Liskeard and Englehart areas, east of the project area, were mapped by Morton et al. (1979) and King and Morton (1979) respectively.

PRECAMBRIAN GEOLOGY

The project area lies within the west-central part of the Abitibi Greenstone Belt and the western part of the Cobalt Plate in the Superior Province of the Canadian Shield (McGlynn 1970). The regional bedrock geology has been compiled by Pyke et al. (1977) and MERQ-OGS (1987). A generalized geology map for the study area is presented as Figure 2.

Halliday, Midlothian, Moher, Semple and Hutt townships in the Sinclair Lake map area have been mapped by Bright (1970, 1984). Carter mapped all of the townships in the Shining Tree map area, with the exception of those included parts of Togo, Brunswick and Londonderry townships (Carter 1989). The bedrock geology of the Gowganda map area has been mapped by several workers. Chown, Lawson, Mickle and Roadhouse townships were mapped by MacKean (1968); Leith, Charters and Corkill townships by McIlwaine (1971); Van Hise, Milner, Haultain and Nichol townships by McIlwaine (1978); and Wallis Township by Card et al. (1973).

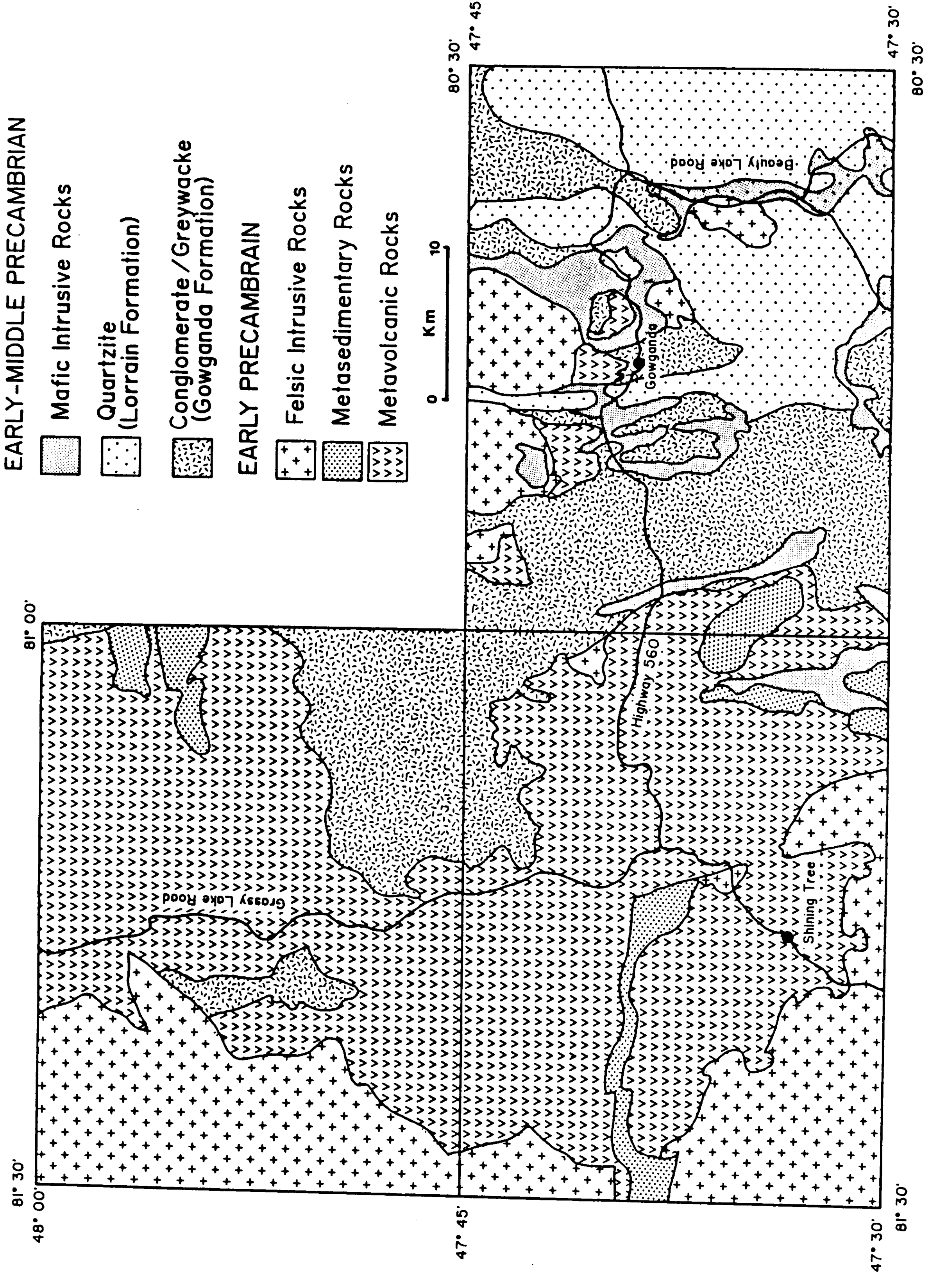

Figure 2. Generalized bedrock geology map.

In the Sinclair Lake map area, Archean rocks consist of a metavolcanic sequence with subordinate units of iron formation and metasedimentary rocks. Mafic and ultramafic sills and sill complexes intrude the metavolcanic sequence. During later regional folding, the northwestern portion of this map area was intruded by a granitic pluton. Late stage porphyritic monzonite, granodiorite and syenite stocks also intruded the metavolcanic rock succession.

In the Shining Tree area, Archean rocks comprise a felsic to mafic metavolcanic and metasedimentary rock sequence which was intruded by mafic and felsic plutonic rocks and diabase dikes.

In the Gowganda area, Archean felsic to mafic metavolcanic and metasedimentary rocks occur as inliers in younger Proterozoic sedimentary and mafic igneous rocks. The metavolcanic rocks were intruded by dunite bodies, felsic intrusive plutons and Matachewan-type diabase dikes.

After a period of erosion and tectonic activity, Cobalt Group sedimentary rocks were deposited over the Archean rocks during Proterozoic time. The basal formation of the Cobalt Group is the Gowganda Formation, consisting of two members, the Coleman Member and overlying Firstbrook Member. The Coleman Member consists of arenites, greywackes and paraconglomerates while the Firstbrook Member consists of laminated argillites. Overlying the Gowganda Formation are feldspathic to quartz arenites of the Lorrain Formation. Both the Gowganda and Lorrain Formations are relatively flat-lying throughout the study area and cover the Archean metavolcanic-metasedimentary rocks in the eastern portions of the Shining Tree and Sinclair Lake map areas and most of the Gowganda map area.

A number of dikes and sills of Nipissing diabase intruded the earlier metavolcanic and Cobalt Group sedimentary rocks. Northeast (Abitibi) and northwest (Sudbury) trending Proterozoic diabase dike swarms cut the previously emplaced units.

The mineral potential of the area has been evaluated by Springer (1977). The zones of high mineral potential, as determined from the distributions of known deposits, coincide with areas of bedrock-drift complex. Certain zones of medium mineral potential coincide with thicker surficial deposits of glaciofluvial ice-contact and outwash sediments and glaciolacustrine sediments. Areas underlain by Gowganda and Lorrain Formation bedrock are of medium to low mineral potential. Over the area, approximately 10 to 30% of the bedrock is exposed, although the percentage is much lower in areas of metavolcanic and metasedimentary bedrock in the Sinclair Lake map area.

Deposits and occurrences of silver, gold, bismuth, cobalt, copper, iron, molybdenum, nickel, lead, zinc, barite and asbestos occur in the project area (Bright 1970, 1984; Carter 1989; MacKean, 1968; McIlwaine 1971, 1978).

The geology, petrography and whole rock geochemistry of the silver deposits in the Gowganda area were reviewed and studied by Andrews et al. (1986). The paleo-placer gold potential of the Lorrain Formation in the Gowganda area was evaluated by Rice (1986). Geological Data Inventory Folios, published by the Ministry of Northern Development and Mines, are available for many of the townships in the project area.

QUATERNARY GEOLOGY

Glacial Deposits and Features

The unconsolidated deposits exposed at surface were probably deposited during the Late Wisconsinan and subsequent postglacial period. The surficial deposits and their constituent materials, diagnostic landforms and inferred depositional environments are summarized in Table I and are discussed below in greater detail.

The distribution of deposits is strongly topographically controlled, with till predominating at the highest elevations, glaciofluvial ice-contact and outwash deposits present in valleys oriented northward. Glaciolacustrine and organic deposits occupy many of the topographic lows with restricted drainage.

Ice Directional Features

The last dominant ice movement over the region was towards 180 30 ° as indicated by glacial striations, grooves, roches moutonnées and crag and tail features (Figure 3, Photo 1), till fabrics (Figure 4); and dispersion trends of bedrock and mineral indicators.

The bedrock surface commonly shows evidence of erosion by ice. Stoss sides of bedrock surfaces are usually glacially smoothed and striated; lee sides are smooth to

Table 1. Surficial deposits

Surficial Sediment Unit	Map Unit	Material	Landform	Depositional Environment
RECENT				
Man-emplaced	10	Fine sand and silt, broken rock, municipal and wood waste	Taings ponds, rock waste dumps, landfill sites	Human activity
Modern Alluvium	9	Silt, sand, gravel, minor organics	Point and channel bars, floodplains	Channels, floodplains
Organic deposits	8	Peat, muck and marl	Surficial blanket	Wet, poorly drained lows
Eolian	7	Silt and fine to medium sand	Dunes, surficial blanket	Subareial, strong winds, no vegetation cover
PLEISTOCENE				
Glacio-lacustrine (LK)	6	Massive, laminated silt and clay, fine to coarse sand, pebbly sand and gravel	Low relief plain, offshore bars, beaches, deltas	Lake centre and near-shore locations, proglacial ponds, beaches
Glaciofluvial Outwash (GF)	5	Silty fine sand to boulder gravel	Undulating blankets, raised kettled terraces, fans	Subaerial outwash fans and terraces, minor channel fill
Ice-contact Stratified Drift (ICSD)	4	Pebbly to bouldery sand and gravel, minor silt and till	Eskers, kames crevasse fillings, moraines, kame terraces, subaqueous fans	Englacial and immediately proglacial, subaqueous and subaerial environments
Till (thick: >1 m in thickness on average	3	sand to silt till with granule to boulder-sized clasts	Undulating sheets and hummocks	Sub-, supra- and proglacial environments
Bedrock Drift Complex				
a) thin till over bedrock	2a	As for till	Patchy venneer, hummocky, bedrock controlled	As above, plus possible later water or coluvial reworking
b) ICSD of GF over bedrock	2b	As for ICSF or GF	"	"
c) Glaciolacustrine or eolian sediments over bedrock	2c	As for LK or Eolian	"	"
Bedrock	1	Bedrock	Bare to 50% drift-covered bedrock knobs	Often meltwater or wave-washed

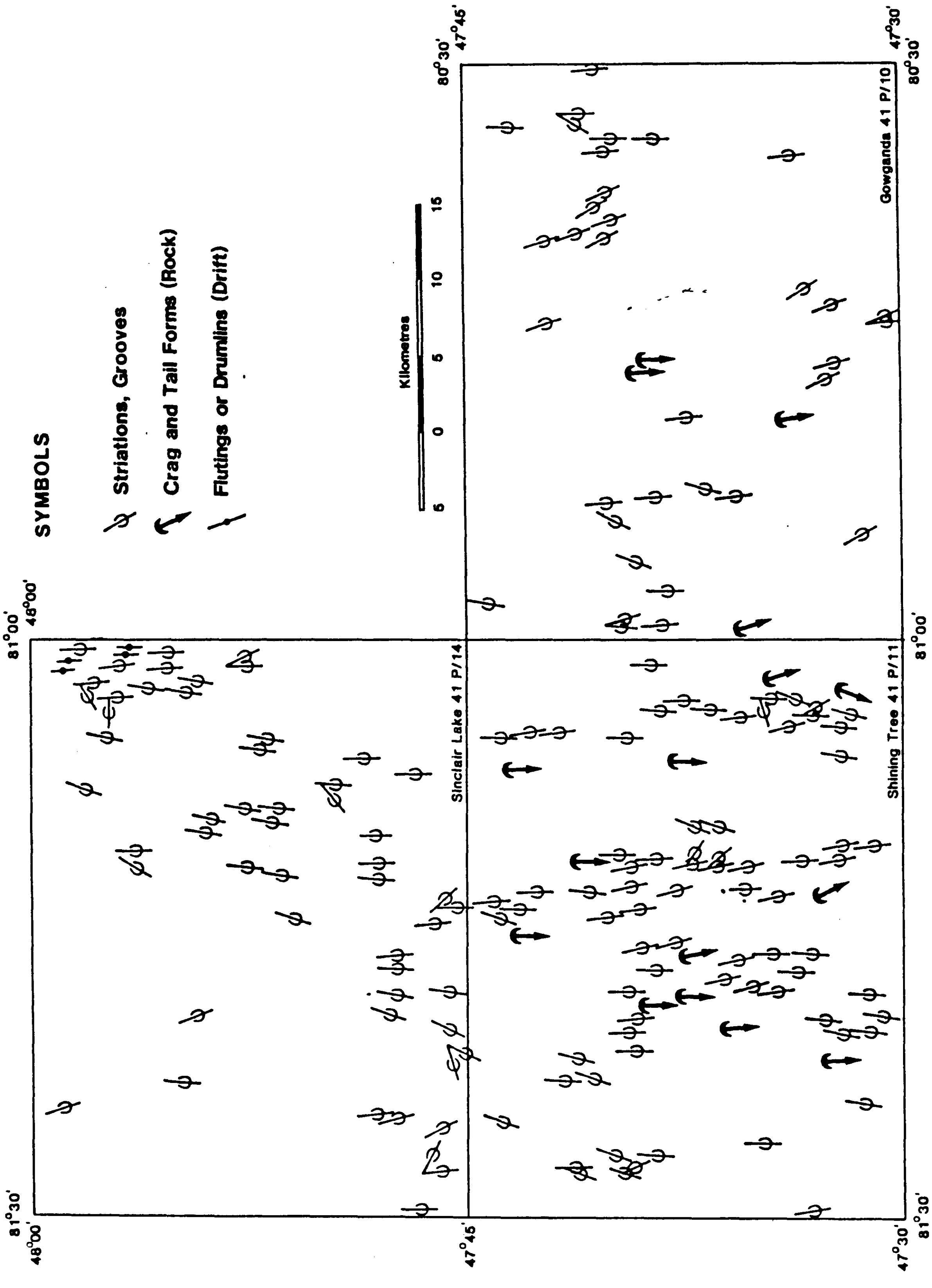

Figure 3. Ice directional indicator map.

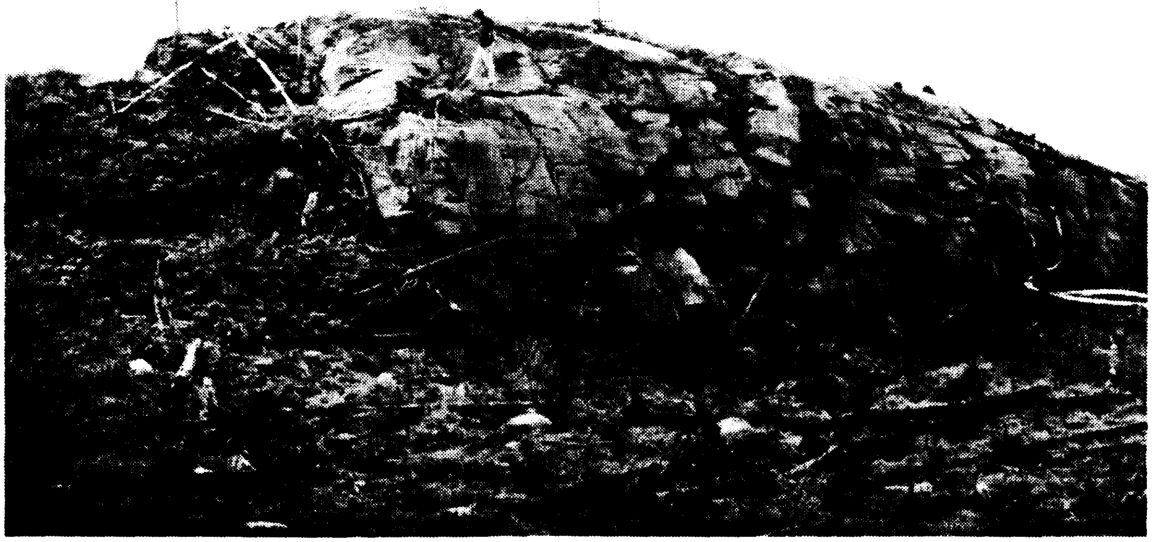

Photo 1. Roche moutoneé indicating southerly ice-flow.

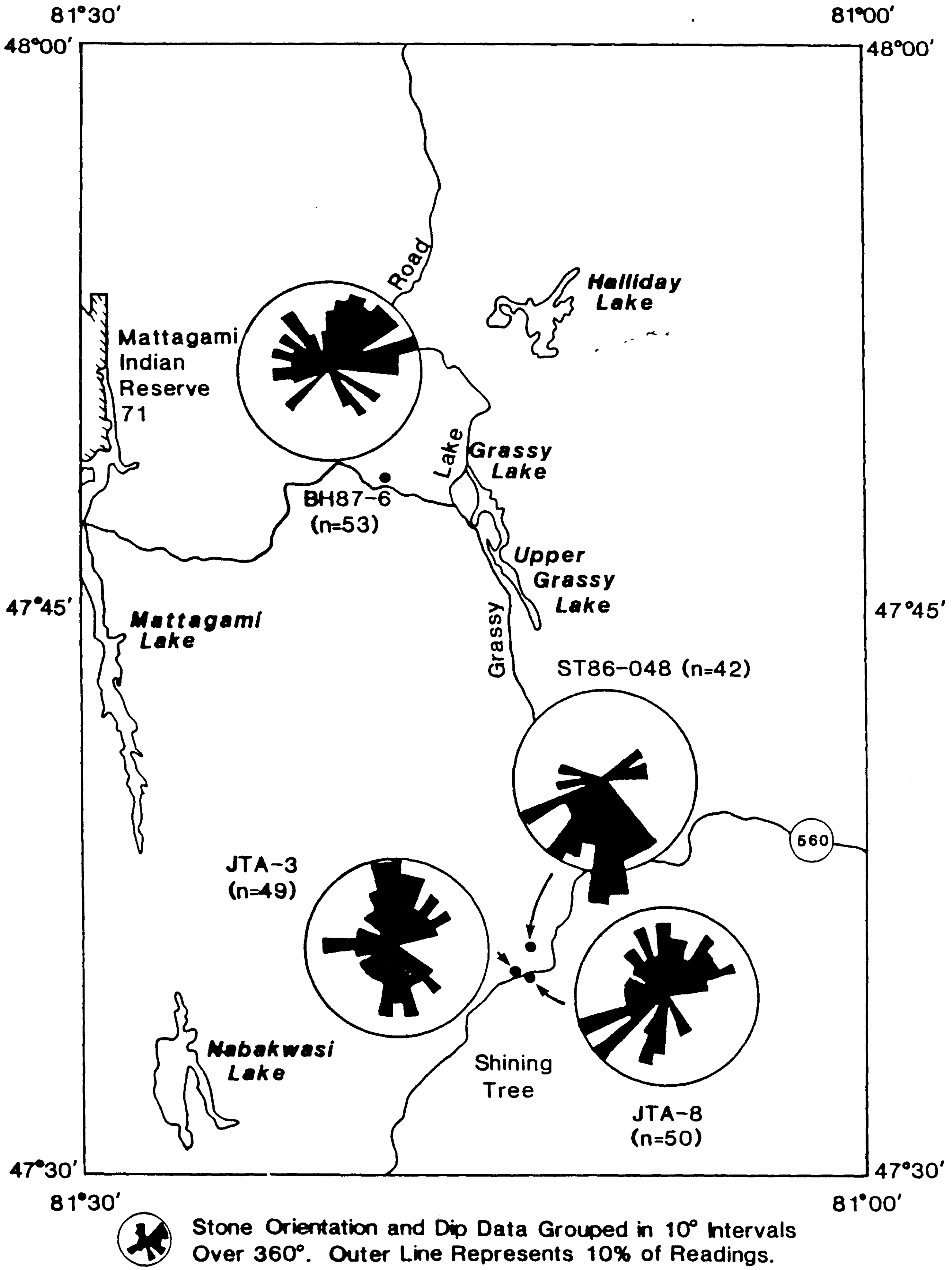

Figure 4. Till fabric diagrams.

jagged. Large exposures of bedrock commonly display whaleback or roche moutonnée forms. Ice flow was influenced by the rugged local bedrock topography.

Minor late-glacial shifts in ice direction due to the bedrock topography are indicated at a few sites, such as along Highway 560 east of Shining Tree, where fine 160° to 180° striations cross-cut an earlier set of well developed 140° to 160° striations. No areally consistent cross-cutting relationships were observed. Sites of cross-cutting glacial striae generally occur on the relatively soft, fine-grained metavolcanic and metasedimentary bedrock in the area (Photo 2). These rock types allow better formation and preservation of striations and grooves than the harder, coarsegrained granitic and gneissic bedrock in the region.

Boissonneau (1968) suggested that the cross-cutting striations found in the Shining Tree area indicated local ice readvances. It is considered here, however, that the presence of such cross-cutting striations is a function of the irregular local bedrock topography, which locally deflected the direction of the thinning ice sheet.

The clast lithological and heavy mineral composition of the till indicate southward ice flow and dispersal of rock debris and minerals. This is discussed in greater detail in the following sections on till composition.

Evidence for an earlier southwestward ice advance was occasionally observed on protected surfaces of large exposures of unweathered bedrock. On several roches moutonnées in the Shining Tree and Sinclair Lake map areas, striations, facets or

Photo 2. Striated outcrop with a set of 182° striations (pens at upper left) crosscutting a set of 147° striations (pens at lower right).

remnants of large grooves trending to the southwest are preserved on the lee (southern) sides. Southwesterly-oriented striations or grooves are crossed by southerly-oriented striations on several outcrops (Figure 3). This evidence supports the proposal for an early regional ice advance to the southwest, probably during Wisconsinan time, coincident with the advance documented by Veillette (1986a) in the Timmins, Matheson and Lake Timiskaming areas to the north and east of the project area.

No clear evidence of earlier ice flows was found in the Gowganda map area. To the south of the Gowganda map area, however, Card et al. (1973) recorded southwesterly-oriented striations in the area southeast of Lady Evelyn Lake. These are crosscut by later southerly-oriented striations.

Although striations and facets from an earlier ice advance are present, pervasive abrasion and plucking of the bedrock surface by the latest southerly ice advance has removed most evidence of the earlier advance.

Bedrock and Bedrock-Drift Complex

Where less than 50% of the land surface is covered by overburden, the surficial unit has been mapped as bedrock (Map Unit 1). In the Shining Tree and Sinclair Lake map areas, patches of bare bedrock are generally widely dispersed, with larger areas located near Claw Lake and Upper Grassy Lake. At these locations, postglacial lake wave washing has removed the Quaternary sediment cover from the bedrock knobs that were located in the foreshore area. In the Gowganda map area, large tracts of essentially bare bedrock occur on ridges and other topographic highs, near eskers and in meltwater channels. It is likely here, that subglacial and proglacial meltwaters removed the Quaternary sediment cover along their flow paths. Bedrock cliffs with talus accumulations from the spalling of large rock blocks occur in areas of Cobalt Group sedimentary rock at numerous locations in the eastern part of the project area.

Areas where thin patches of surficial sediment cover more than 50% of the bedrock surface have been defined as bedrock-drift complex deposits (Map Units 2). The bedrock-drift complex areas were delineated through airphoto interpretation on the basis of frequent bedrock outcrops, the presence of a rugged ground surface reflecting the bedrock topography and poor drainage.

The bedrock-drift complex units were separated, where possible, into: till veneers (Unit 2a); sand and gravel veneers (Unit 2b); and sand, silt and clay veneers (Unit 2c). In inaccessible areas, this separation was based mainly on vegetation types and patterns, drainage, relief, and proximity and topographic position with respect to esker and outwash systems and the shorelines of former proglacial lakes. Where the sedimentary nature of the surficial veneer could not be inferred, the unit was designated as undifferentiated drift over bedrock (Unit 2). The veneers of drift are often strongly weathered. The distribution and sedimentary characteristics of the Quaternary sediments forming the veneers are discussed in following sections of this report.

Till

Till is defined as sediment that has been transported and deposited by or from glacial ice with little or no sorting by water (Dreimanis 1982, 1988). It is the most widespread surficial deposit in the project area and generally occurs as a discontinuous sheet covering bedrock.

The till sheet in the map area represents a single lithostratigraphic unit and is the stratigraphic equivalent of the Matheson Formation (Hughes 1959) defined in the Cochrane, Timmins and Matheson areas. The till sheet may be stratigraphically equivalent to the Adam Till (Skinner 1973) defined in the Moose River Basin in the Hudson Bay Lowland.

The till has varying composition due to: 1) incor-poration of numerous bedrock lithologies of different physical characteristics into the ice; 2) deposition by a variety of glacial processes; and 3) postglacial chemical and physical weathering effects. The till was likely derived from both fresh and weathered bedrock and unconsolidated deposits. Some physical and chemical properties of till samples collected in the area are presented in the appendices (A, grainsize and carbonate content; B, heavy mineral concentrate and gold grain counts; C, heavy mineral grain counts; D, rock types of till pebbles; and E, F, G and H, results of geochemical analyses).

No till or other sedimentary units from pre-Late Wisconsinan glacial cycles have been recognized. If present, they are most likely preserved in the deeper valleys or in protected bedrock lows.

Till is commonly found as a veneer over bedrock (generally less than 1 m in thickness: Map Unit 2a) but thicknesses can exceed 4 m or more. Areas with till veneer have frequent bedrock outcrops and a surface morphology controlled by the underlying bedrock topography. Veneers of till are found over many bedrock hills and uplands and characteristically support a mixed forest of spruce, birch, balsam fir, poplar and pine.

Thicker deposits of till (Map unit 3, greater than 1 m) occur on the larger upland surfaces, in the lee of bedrock highs, and in low areas between bedrock knobs. Very few bedrock outcrops are found within the areas mapped as till. The vegetation pattern is similar to that in till veneer areas except that the stands are more homogeneous because of less variation in topography and surface moisture conditions.

In both the till veneer and till deposit areas, a thin covering of glaciolacustrine, and/or eolian sands and silts and occasionally glaciofluvial sand and gravel or organic deposits can occur.

It is likely that till underlies many deposits of glaciolacustrine and eolian sediment and organic materials mapped as Units 6, 7 or 8. Remnant patches of till are likely to underlie glaciofluvial outwash deposits (Unit 5) where aggradation, not erosion, predominated within meltwater channels. Till is not likely to underlie glaciofluvial ice-contact deposits where subglacial and proglacial meltwater streams were highly active. Valleys and topographic lows in which meltwater flow was restricted and water ponded, may have till deposits preserved at depth.

Facies interpretation of till in areas of coarse-grained bedrock, such as felsic intrusive bedrock or Lorrain Formation arenites, is hampered by its extremely coarse texture and strong degree of surface weathering. In areas of fine-grained bedrock, such as Archean metavolcanic-metasedimentary rock or Gowganda Formation greywackes, the original sedimentary structures in the till are preserved. Most exposures of till in the map area, are of subglacial till (Photo 3); few exposures of supraglacial till were observed.

Subglacial Till

Subglacially-deposited till is the predominant till type found in the project area. Lodgement, melt-out and flow varieties were identified using sedimentological and structural characteristics (Dreimanis 1982, 1989).

Lodgement till in the project area is commonly stony (10 to 50% clasts by volume), moderately to highly compact with a silty sand matrix. The presence of striated and glacially-faceted clasts, shear structures, fissility and compositional banding, indicate deposition from actively flowing ice. Rare silt and sand stringers and lenses were observed.

Melt-out till in the project area, has a silty sand matrix and is stony (10 to 50% clasts by volume), loose to moderately compact with occasional thin, deformed sand bands and lenses. Meltwater flow generated during the melting of stagnant debris-rich ice produced sand bands and lenses within the till. Meltwater movement around cobbles and boulders during melt-out produced pockets and thin layers of silt or sand surrounding these clasts.

Photo 3. Bouldery, silty sand till overlain by eolian sand.

Flow till units are often found as wedge-shaped bodies capping subglacial till on or between bedrock knobs. Deposited subglacially in lee-side cavities, or possibly supraglacially by flowage of former subglacial debris (Photo 4), this till type is commonly stony, moderately to loosely compacted with a sand matrix. Sand stringers and crude layering in flow units are common.

Till matrix colour is a product both of matrix composition and degree of weathering. Weathered subglacial till matrix colours ranged from red (2.5 Y 5/6; Munsell Colour 1973) to yellowish brown (10 YR 6/4) to dark yellowish brown (10 YR 4/4). Unweathered or slightly weathered tills were more gray in colour (10 YR 5/1). Gray or green coloured tills were produced from metavolcanic bedrock, gray to dark gray tills from Gowganda Formation greywackes, and light gray to pinkish gray tills were produced from felsic intrusive bedrock or Lorrain Formation arenites.

The grainsize and carbonate results from 181 samples of subglacial tills are listed in Appendix A and summarized in Table 2. The grainsize composition averages 65% sand, 33% silt and 2% clay and the average median grain size is 0.133 mm (fine sand). The common textural classes are silty sand to sandy silt. The proportions of sand, silt and clay and examples of the range of grainsize distributions present are displayed in Figure 5.

The till matrix (the less than 2 mm fraction of the till) is quite texturally variable, depending upon the source bedrock type and the depositional processes. As in the Kirkland Lake (Baker 1985) and Timmins areas, the sand content varies inversely to the

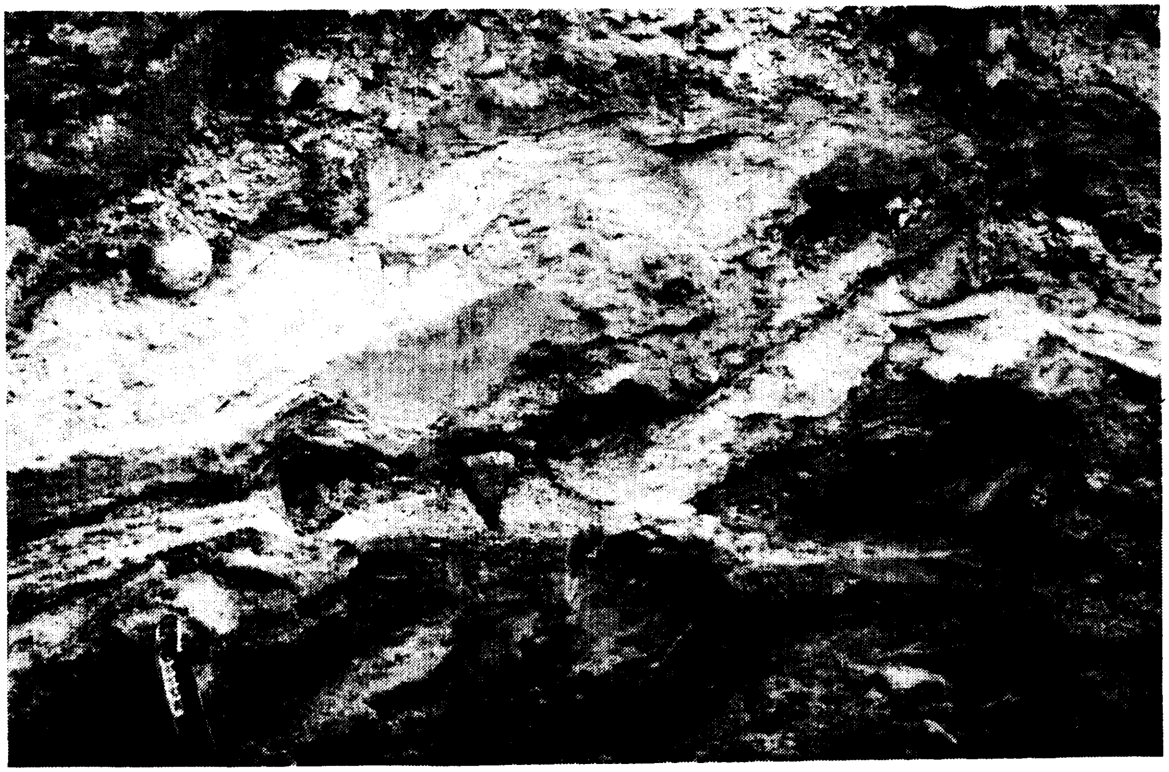

Photo 4. Intercalated flow till and water sorted sand layers.

Table 2. Summary of till grainsize and carbonate analyses.

	Matrix Texture				Carbonate Content	
	% Sand	% Silt	% Clay	Md (mm)	Total %	Calcite/Dolomite Ratio
Mean (N=181	65	33	2	0.1333	1.54	0.89
Range	28-94	6-70	0-9	0.020-0.550	0.21-12.77	0-6.31
Sandard Deviation	10.6	10.0	1.5	0.068	1.62	0.79

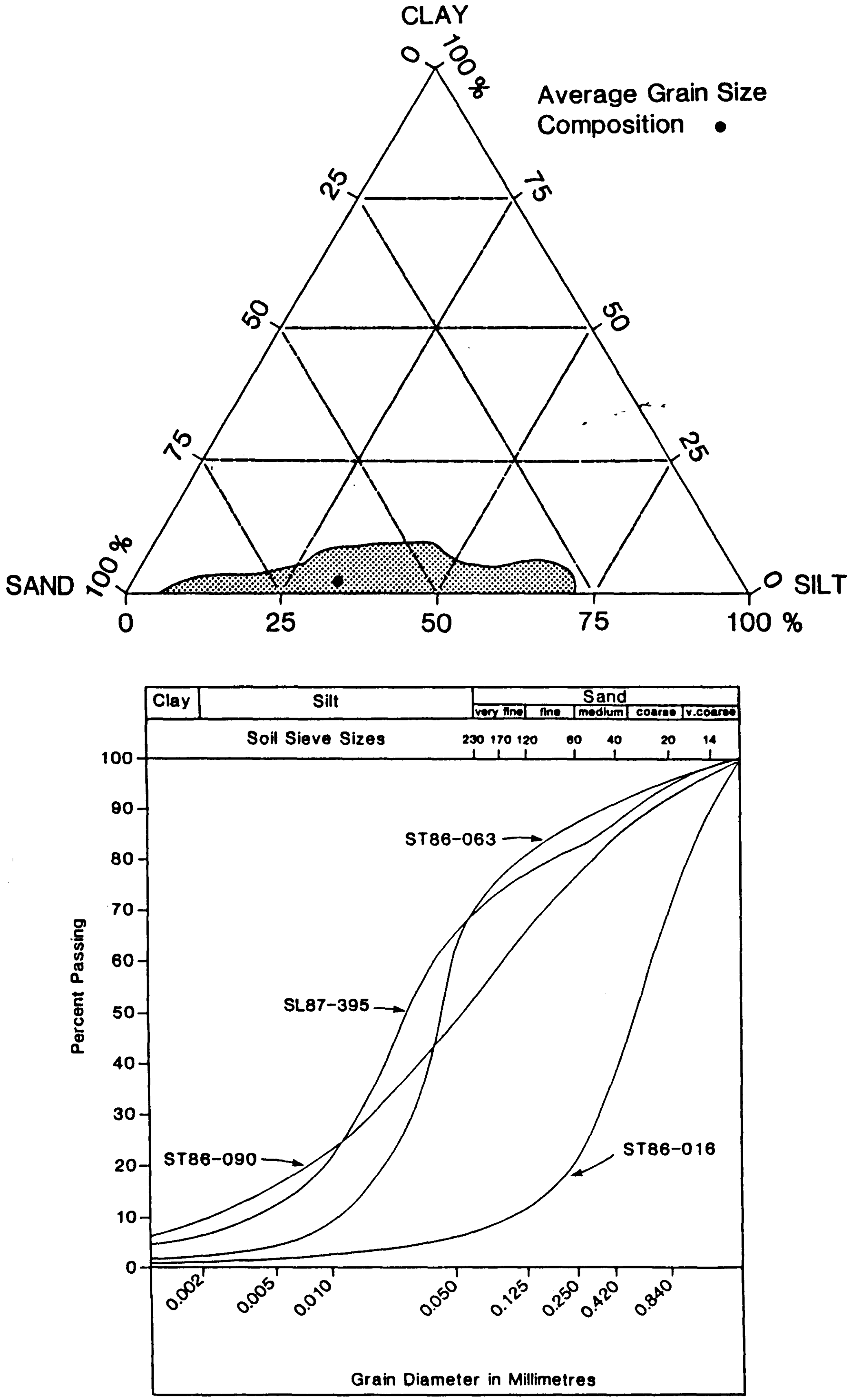

Figure 5. Textural variation in till samples a) proportions of sand, silt and clay, b) grainsize distribution curves.

silt content since the clay contents are consistantly low (less than 5%). The grainsize results are similar to the proportions and ranges obtained by Closs and Sado (1982) and Aultman (1988).

The till matrix is commonly low in total carbonates (average 1.5%, range 0.2% - 12.8%) and the calcite/dolomite ratio varies widely, indicating no predominance of either mineral species (Table 2, Appendix A). The total carbonate values reflect, in part, the effects of carbonate leaching in the near surface zone (less than 1 m depth). Backhoe pit samples collected below 1m depth contained total carbonate values ranging from 5 to 12.8%. This suggests that the original carbonate content of the till matrix was higher than indicated by the near surface samples. Precipitation of carbonates has also occurred in till in the weathering zone as indicated by: the presence of total carbonate values up to 11.3% in thin surface tills; cementation of the till matrix in these locations; and the rare presence of calcium carbonate rinds on the underside of till clasts.

Non-magnetic and magnetic heavy mineral concentrates of 143 till samples were separated by a combination of concentration on a shaker table, heavy liquid separation and magnetic separation by the method described by Averill et al. (1986). The results are listed in Appendix B. Eight additional till samples were processed as part of a gold dispersal case study (Aultman 1988; Appendix B).

The weight percentage of sand-sized non-magnetic heavy minerals (S.G. greater than 3.3) averages about 0.3% (n=144) and ranges from 0.08% to 0.8%; similar to the ranges from the Timmins and Matheson areas (Bloom and Steele 1989). These similar weight percentages of heavy minerals are likely due to the similar mix of bedrock lithologies in the three source areas, which are dominated by metavolcanic and felsic intrusive bedrock.

The weight percentage of magnetic heavy minerals averages 0.1% and ranges from 0.01% to 0.4%. The weight percentage of magnetic heavy minerals in till samples was not obviously higher over, or down-ice of, the thin iron formation bedrock units that occur in the area.

The most common mineral species in 100 point counts under a binocular microscope were: garnet and epidote with lesser amounts of pyroxene, horneblende, illmenite and hematite (see Appendix C). Few sulphide grains were observed.

The subglacial till facies contain variable amounts of clasts (10% to 50%), ranging from granules to boulders. Most are angular to subrounded in shape and often bear striations or facets. Some very large striated boulders (1 to 2 m long axis) were found during trenching and likely occur throughout the till. The hard, metavolcanic bedrock fragments, tend to form elongate, subangular clasts. The Gowganda Formation greywackes and siltstones, form elongate, subrounded clasts. The Lorrain Formation arenites commonly form plate and rectangular-shaped clasts, where the felsic intrusive bedrock fragments form spherical, subrounded clasts.

The tills are generally matrix supported and the clasts generally lie with their long axes oriented to the south or southwest. Till clast fabrics (Andrews 1971) were completed at four sites (Figure 4). The fabrics were done in backhoe trenches or roadcuts at depths of greater than 1.5 m.

The orientation and dip of clasts with a minimum clast a:b axis ratio of 2:1 were measured to the nearest 5° or better. The data was grouped in 10° intervals and plotted on 360° hemispheric grids for presentation as rose diagrams (Nemec 1988, Figure 4).

The fabrics obtained were of moderate strength with uni- to multi-modal trends and indicate subglacial deposition. The fabric directions support the range of southerly ice flow directions obtained from striations. Even the deflection of the ice flow around a local bedrock high produced a southwestward trending clast fabric similar to nearby 220° striations (Figure 4, site JTA-8; Aultman 1988).

The clast composition of the subglacial tills often strongly reflects the local bedrock lithologies (Appendix D). Clast composition results from samples along a transect in the eastern portion of the Sinclair Lake map area are shown in Figure 6. Metavolcanic or Huronian sedimentary bedrock fragments predominate in the clast lithological assemblage. Even a small outlier of sedimentary rock contributed a large amount of rock debris to the till. Till overlying bedrock in the project area reflects the composition of bedrock lithologies which occur locally and immediately up-ice; within several hundred to a few thousand metres. About 20% of the clasts in the till samples were composed of rock types of more distant derivation, such as durable felsic intrusive bedrock.

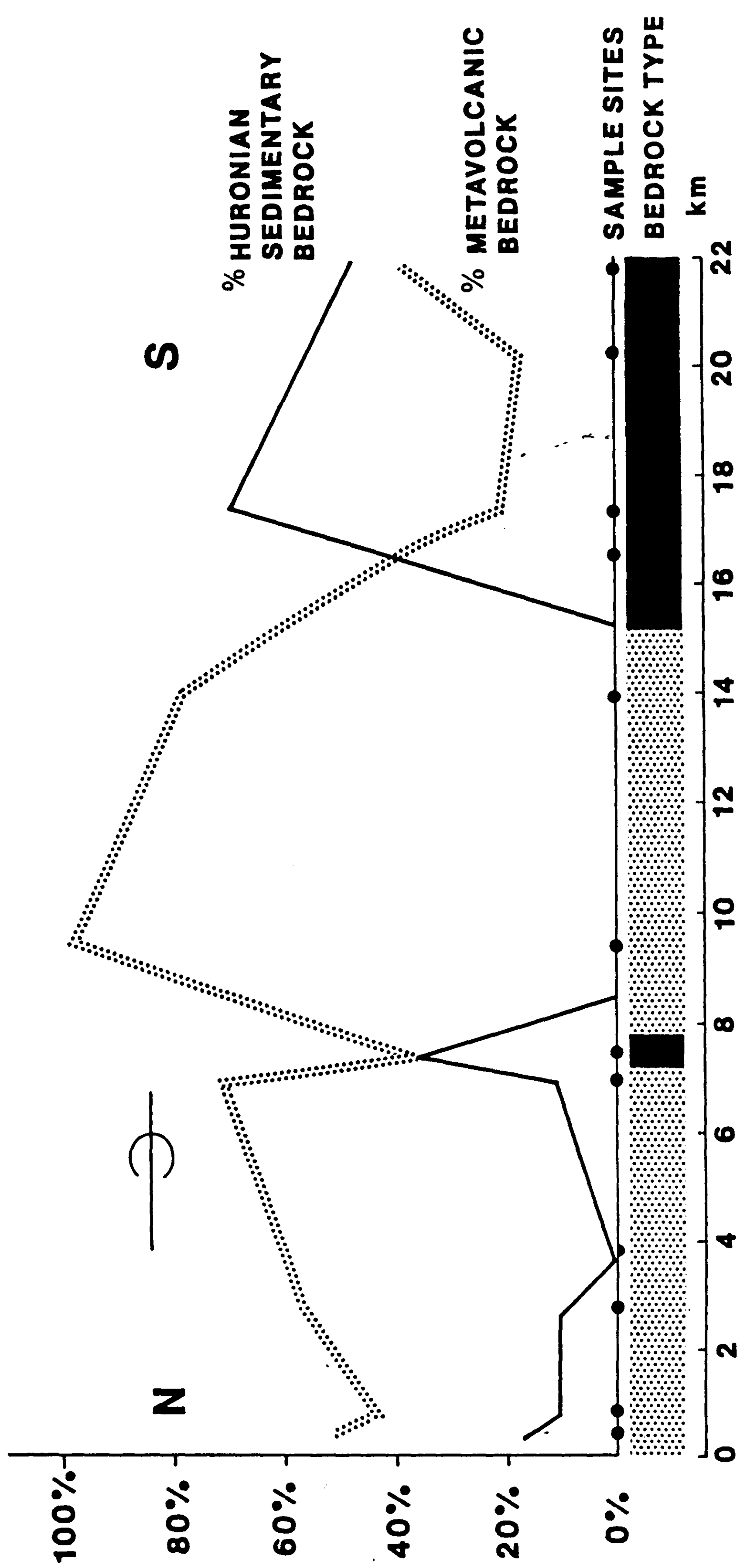

Figure 6. Clast lithological composition in subglacial tills, Sinclair Lake area.

Where clast lithology samples were taken from two levels in the same exposure, or from nearby sample sites, the percentages of rock types were similar, indicating lithological homogeneity, at least, over short distances.

In general, boulders of exotic indicator lithologies are very rare in the project area (see also Sado and Clarke 1974). Rare Paleozoic carbonate clasts, likely derived from the James Bay Lowlands, have been found in till and outwash deposits. The project area is south and east of the limit of carbonate drift as mapped by Karrow and Geddes (1987).

Supraglacial Till

Supraglacial till is usually found overlying subglacial till. It is commonly thin, loose and stony with a sand matrix containing frequent subrounded cobbles and boulders of distant provenance. This till type was deposited by supraglacial melt-out at the upper ice surface or by subsequent flowage of this debris.

Commonly, soil-forming processes have affected the entire thickness of the supraglacial till. Due to its restricted occurrence, limited thickness and highly weathered nature, supraglacial till was not sampled for grain size or carbonate analyses. In addition, as this type of till is not usually composed of locally-derived rock debris, it was not sampled for mineralogical or geochemical analyses.

Supraglacial flow tills occurs as thin, stony, silty sandy units often intercalated with esker or kame sediments (Photo 4). These flow till layers were deposited concurrently with waterlain sediments.

The composition of the supraglacial till usually reflects the local bedrock lithologies poorly. They are commonly derived from material carried long distances in the ice sheet in an englacial or supraglacial position.

Glaciofluvial Deposits and Features

Glaciofluvial deposits were separated into ice-contact (Unit 4) or outwash deposits (Unit 5) on the basis of internal structure, bedding and sedimentology, where sections were available. More commonly, however, deposit morphology, as observed on air photos, was used. Ice-contact stratified drift deposits are usually hummocky, have steep slopes related to deposition against ice walls and are commonly kettled. Ice-contact stratified drift deposits have a wide variety of sediment sizes (clay and silt to boulders) that were laid down in a range of ice-marginal fluvial, glaciolacustrine and colluvial environments.

Glaciofluvial outwash deposits commonly have gently sloping upper surfaces, some kettles and are composed of sorted, generally tabular beds of sand and gravel. Outwash deposits are formed in rivers and streams eminating from the glacier margin.

Hummocky, well- to variably-drained ice-contact deposits commonly support a mixed forest of white spruce, jackpine and poplar. The low relief, well drained outwash deposits commonly support very homogeneous stands of jackpine, with some white spruce and birch.

Few exposures were available in ice-contact or outwash deposits to determine detailed depositional environment or paleoflow direction. However, in eskers, ripples and cross beds indicated southward meltwater flow, against the regional topographic gradient. The flow direction of the eskers is the result of the hydraulic gradient within the ice during deposition.

Meltwater flow beyond the ice margin followed major valley systems and topographic lows. Paleoflow directions were generally southward away from the glacier margin.

The distribution of ice-contact and outwash deposits show no clear organization into belts or zones representing former ice-marginal positions in the map area. However, the Sultan Scarp, a major easterly trending ice-contact feature, occurs immediately south of the Shining Tree map area and along the southern edge of the Gowganda map area.

Ice-Contact Stratified Drift Deposits

Glaciofluvial ice-contact deposits (Unit 4) are laid down beneath, adjacent and on top of stagnant glacier ice, mainly by glaciofluvial and glaciolacustrine processes. Subsequent melting of the ice removes lateral and underlying support and causes faulting and disturbance of bedding. Dewatering and failure during and after rapid sedimentation may also caused disturbance of sedimentary structures. Ice-contact stratified drift deposits occur in eskers, kames, subaqueous fans, crevasse fillings and stagnant ice features. The deposits consist of pebbly to bouldery sand and sandy gravel.

Occasional blocks of ripped-up sediment, and some pods or layers of flow till may be present in ice-contact stratified drift deposits.

Esker Complexes

Several esker systems are present in the study area. They are parts of much longer systems which extend beyond the project area (Boissonneau 1965; Sado and Carswell 1987). The distribution of the eskers indicate a well-integrated drainage network existed in the ice sheet. The spacing, orientation, and distribution of eskers are strongly controlled by bedrock elevation and topography.

Large, discontinuous and occasionally compound or braided eskers, up to several hundred metres wide and 90 m high, occur along the sides of the main valleys and in topographic lows. These eskers commonly have a segmented or beaded form, especially near the large lakes, such as Kapiskong, Sinclair and Marne Lakes. They commonly consist of coalescing esker ridges and kames.

Small eskers, often continuous, single ridges, trend generally southward across higher elevation areas (Photo 5). The esker ridges range up to a few hundred metres across and up to 30 m high. These eskers display cores of cobbly to bouldery gravel which are overlain and flanked by beds of sand commonly contain small faults. The form and internal composition of these eskers indicates a change in depositional environment from closed conduit flow to open channel flow.

Some small eskers are remarkably straight where they follow fault-controlled bedrock valleys, such as north of Houston Lake in Macmurchy Township. In other locations, the orientation of small eskers is quite variable, especially where they connect lake basins or other topographic lows.

Ice Re-entrant Infillings

Several areas of hummocky and kettled ice—contact stratified drift occur in Connaught-Miramichi, Macmurchy-Fawcett, Fawcett-Leonard, Burrows-Cabot, and Sothman Townships. They form roughly inverted "V"-shaped deposits in plan view that are up to 7 km wide. These deposits probably formed in re-entrants along the ice margin which possibly formed due to the collapse of subglacial conduit roofs or preferential melting by meltwater streams focussed at the re-entrant.

The subglacial and proglacial meltwater streams deposited sediment around and on top of stagnant ice blocks. Upon melting of the supporting ice masses and buried ice blocks, steep ice-contact slopes and kettles were formed.

Although, the re-entrant infillings appear aligned along latitudinal belts, no definite ice-marginal positions have been distinguished. Similar deposits have been described in the Pamour map area (NTS 42 A/11) northeast of Timmins by Richard (1983).

Photo 5. Clast supported bouldery to cobbly gravel in a small esker.

Kames, Kettles and Minor Morainic Ridges

Large, isolated, well drained kames up to a few hundred metres across, are associated with the eskers of the area. They are thought to be deposited in crevasses or moulins in the ice by meltwater streams or by colluviation during ice wastage. Locally, small kames less than several tens of metres across are found in valleys among drift-veneered bedrock knobs. Many are too small to be differentiated and mapped at 1:50 000 scale.

The internal composition of these kames is highly variable and suggests deposition in a wide variety of low and high energy environments. In Asquith Township, 2 km north of the village of Shining Tree, a kame consisting of gravelly sands with contorted bedding was probably deposited in a low to medium energy fluvial environment. Along the Grassy Lake Road in northern Kemp Township, kames are made up of clast to matrix supported cobble and boulder gravels interlayered with coarse sand and were probably deposited in a high energy fluvial environment.

Kettles are common in ice-contact deposits and occur in a variety of forms and shapes. Some kettles are partially infilled with glaciolacustrine or eolian sediments or organic material. Many of the large, lowland lakes surrounded by ice-contact deposits, such as: Waonga, Ketchiwaboose, Fawcett, South Sandstrum, Cabot, Caribou, Marne, Sinclair, Beauty and Headwater lakes are likely coalesced kettle lakes. This suggests that very large ice blocks up to several hundred metres in diameter were left stranded in valleys upon deglaciation.

Minor morainic ridges were identified in Fawcett, Connaught and Corkill townships. They probably consist of glaciofluvial ice-contact sediment or till deposited at or near the ice edge. These ridges are linear features and given their well-drained appearance, likely do not contain much till.

Glaciofluvial Outwash Deposits

Glaciofluvial outwash deposits (Unit 5), were laid down in braided meltwater rivers beside and beyond the ice margin. These deposits consist of near horizontal beds of pebbly to gravelly sand and often flank eskers (Photo 6). Clasts are often imbricated and generally well rounded. Some beds are clast supported, with coarse sand and granules filling the interstices. Carbonate precipitation is common on the undersides of cobbles (Photo 7), forming rinds 1 to 3 mm thick. A few large boulders are found in these deposits, usually at the base of beds which fine upwards, and may represent major flood events.

The glaciofluvial outwash deposits are up to several kilometres in width and in places over 30 m thick. Large volumes of sediment were transported from the glacier and deposited in the meltwater streams of the area. Occasionally, outwash fans formed at the downstream ends of eskers. Many areas of outwash sediments probably had ice or proglacial lakes as the local base level control.

Extensive tracts of kettled and occasionally terraced outwash occupy large areas in: the southwestern, western and northwestern portions of the Shining Tree map area; the north, central and southeastern parts of the Sinclair Lake map area; and the southern

Photo 6. Bedded sands and gravels in a kettled outwash terrace.

Photo 7. Carbonate accumulations on cobbles.

parts of the Gowganda map area. The frequency of kettles in the outwash deposits indicates that large numbers of ice blocks were left stranded in the proglacial zone.

Veneers of glaciofluvial ice-contact and outwash sediments on bedrock (Unit 2b) are associated with both eskers and outwash systems. They generally occur on the saddles between topographic lows in areas of high relief, such as the areas underlain by Huronian sedimentary rock.

The sedimentary characteristics of two deep and laterally extensive glaciofluvial outwash sand deposits, just southeast of the project area in Westbrook and Garvey townships, have been investigated by Guillet (1983).

Glaciofluvial Meltwater Channels

Several of the major rivers in the area, such as the West Montreal, Grassy and Bear rivers, and Shining Tree Creek, occupy enlarged channels which were meltwater routes during deglaciation.

Meltwater channels were cut into drift between lake basins and between kettle holes in ice-contact and outwash deposits. Most of these meltwater channels are short, poorly developed and appear related to meltwater outflow from conduits at the ice edge. Boulder lag deposits on the floors of meltwater channels were noted in several locations (Photo 8). A distributary pattern of meltwater channels occurs on the outwash fan at the south end of Nabakwasi Lake.

Photo 8. Boulder lag accumulation in a meltwater channel.

Near Ember Lake, southeast of Ferris Lake, large terraces and scarps cut in drift and bedrock were produced during meltwater drainage through this confined valley. P-forms, thought to be produced by subglacial meltwater erosion, occur on the down-ice ends of outcrops where Highway 560 crosses Michiwakenda Lake. P-forms also occur on outcrops along Highway 560 approximately 1.5 km west of Longpoint Lake.

Glaciolacustrine Deposits

Glaciolacustrine deposits in the project area (Unit 6), consist of rhythmically laminated, rippled, or massive, silt and fine to medium sand, and laminated clay. Ripple drift cross-lamination and climbing ripple drift are common in the sandy deposits. Soft sediment deformation features such as folded clay beds and flamestructures, are present in a few exposures. Dropstones are rare. Faulting and slumping were noted at a few locations. There were very few exposures of silt and clay rhythmites in the area.

Glaciolacustrine deposits occur in the broad topographic low areas and major north trending valleys of the project area. They are well exposed along the shores of Mattagami and Kapiskong lakes (Photo 9). Locally, glaciolacustrine deposits are up to 15 m in thickness.

The bulk of the sediment was added to the proglacial lakes and ponds by meltwater streams. Sediment was also eroded from drift-covered hills, eskers and kames by waves and redistributed by lake processes.

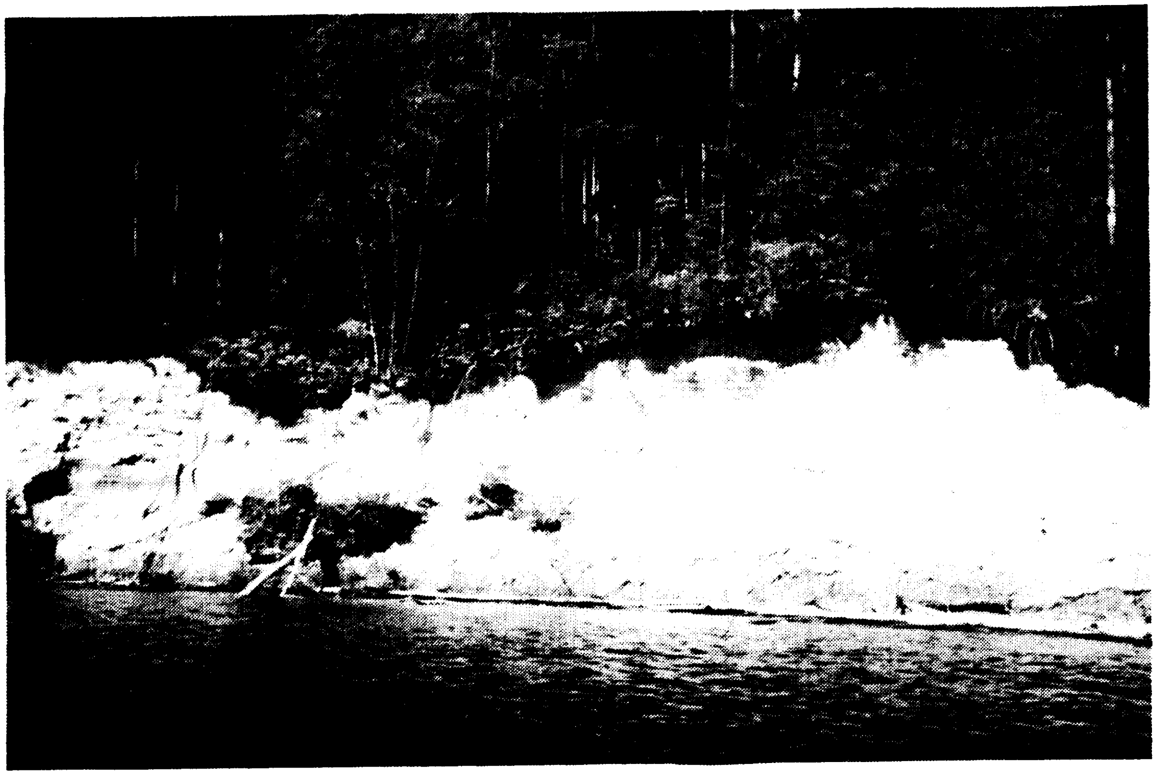

Photo 9. Rhythmically bedded glaciolacustrine sand exposed along the shores of Mattagami Lake.

The sandy glaciolacustrine deposits were deposited proximal to deltas and subaqueous fans in temporary proglacial lakes and ponds, primarily by density underflow currents. Broad sheets of nearshore sand were produced through wave erosion. Glaciofluvial deposits in topographic lows provided large quantities of sand to be eroded and distributed by proglacial lake waves and currents.

Glaciolacustrine silt to clay deposits are much less extensive. They were laid down primarily by suspension rainout and density underflow currents distal to deltas and subaqueous fans and in the central basins of the larger proglacial lakes. Rhythmically-bedded silt and clay found intercalated in kames are interpreted to represent periods of very low energy deposition in ice-contact environments.

Glaciolacustrine deposits can be quite extensive, covering up to tens of square kilometres. They are commonly wet and support a limited number of tree species, such as black spruce and cedar, in sparse, homogeneous forest stands. Veneers of glaciolacustrine sediment over bedrock knobs (Unit 2c) are found within and adjacent to the sites of former proglacial lake basins.

Few shoreline features have been identified. Most of the proglacial lakes were quite short-lived and had limited fetch. The upper extent of glaciolacustrine deposits and the occurrance of bare bedrock knobs define proglacial lakes with maximum lake levels of 366 to 381 m (1200 to 1250 ft). Beach deposits were found at an elevation of 343 m (1125 ft) in eastern Midlothian Township (Sado and Clarke 1974) and 373 m (1225 ft) on the Macmurchy-Natal township line, north of Houston Lake (E.V. Sado, field notes, 1974). Wave-washed till surfaces with boulder accumulations were found at 351 m (1150 ft) in Emerald Township along the power transmission line right-of-way.

A number of low-relief ridges less than 2 m high, interpreted as abandoned shoreline features or offshore bars have been identified at elevation 396 m (1300 ft) on the sand plains in the southwestern and southcentral parts of the Gowganda map sheet. The full extent of these proglacial lakes is unknown but they were probably controlled by topographic highs to the south in the Smoothwater Lake (NTS 41 P/7) map sheet.

A number of former proglacial lakes can be identified in the project area. The lakes appear to have formed as separate pondings with many islands, as opposed to a single, contiguous proglacial lake. They may, however, represent the initial stages of Lake Barlow—Ojibway over the region (see also Vincent and Hardy 1979). Proglacial lake shoreline elevations in the Shining Tree area are similar to beach levels reported south of Timmins (295 m, 315 m, and 335 m) and are probably those of glacial Lake Barlow-Ojibway.

Grainsize and carbonate contents of glaciolacustrine sediments were determined to characterize them and to provide information on their provenance (Figure 7). Two samples from silt and clay layers from near Firth Lake and Haines Creek had total carbonate contents of 16.7% and 19.1 % respectively. As these samples contain total carbonate values above those for unweathered till in the region, a distal sediment source must be considered. Silt and clay derived from the James Bay Lowlands would require long distance transport and connection of meltwater systems. In the Timmins area, glacial Lake Barlow-Ojibway silts and clays also have higher carbonate contents than till samples.

Eolian Deposits

Eolian deposits (Unit 7) consist of sorted, finely laminated to thinly bedded coarse silt to medium sand. They occur in large dune fields and as a widespread surficial veneer. Where this veneer overlies bedrock it is mapped as map unit 2c.

In the dune fields, parabolic and longitudinal forms are present. The dunes commonly range between 5 and 10 m in height, with some dunes exceeding 20 m in height (Photo 10). Coalescence of limbs has produced complex dune forms over 1 km in length. The form of the parabolic dunes and the dip directions of laminae and beds indicate that the dunes were deposited from a prevailing northwest wind.

The dune fields are located on and down–wind of glaciofluvial outwash and glaciolacustrine sand and silt deposits. The eolian reworking of waterlain deposits must have occurred in dry, non–vegetated conditions, after drainage of the proglacial lakes and lowering of the local groundwater level.

Grainsize results from four samples of dune sand have an average grainsize composition of 92% sand and 8% silt (Figure 7). The median diameter averaged 0.131 mm (fine sand) and the inclusive graphic standard deviation, a measure of sorting (Folk 1974), indicated the samples were only moderately to well sorted (0.43 phi to 0.88 phi). The lack of sorting is attributed to the immaturity of the eolian sediments.

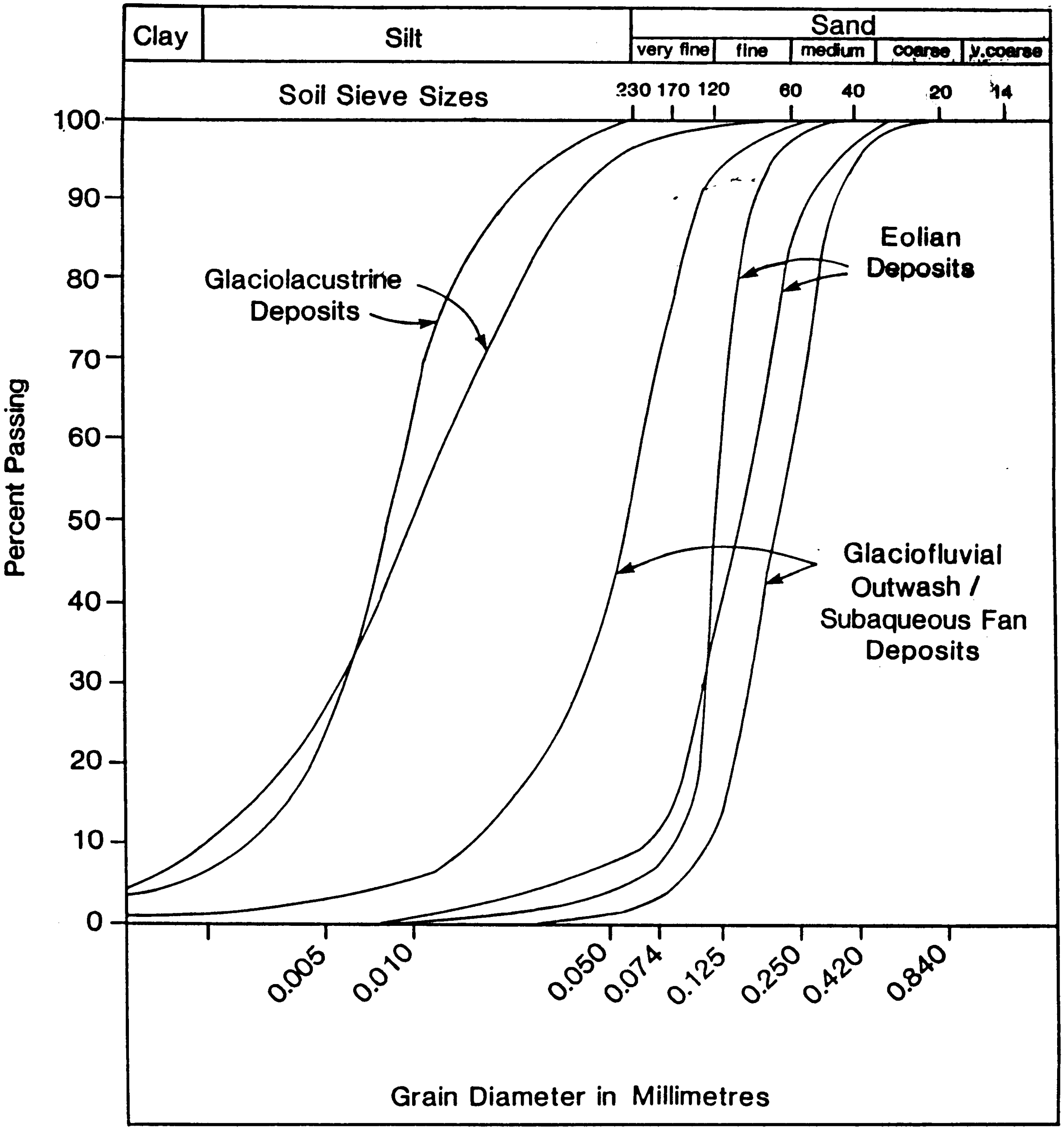

Figure 7. Glaciolacustrine and eolian grainsize distribution curves.

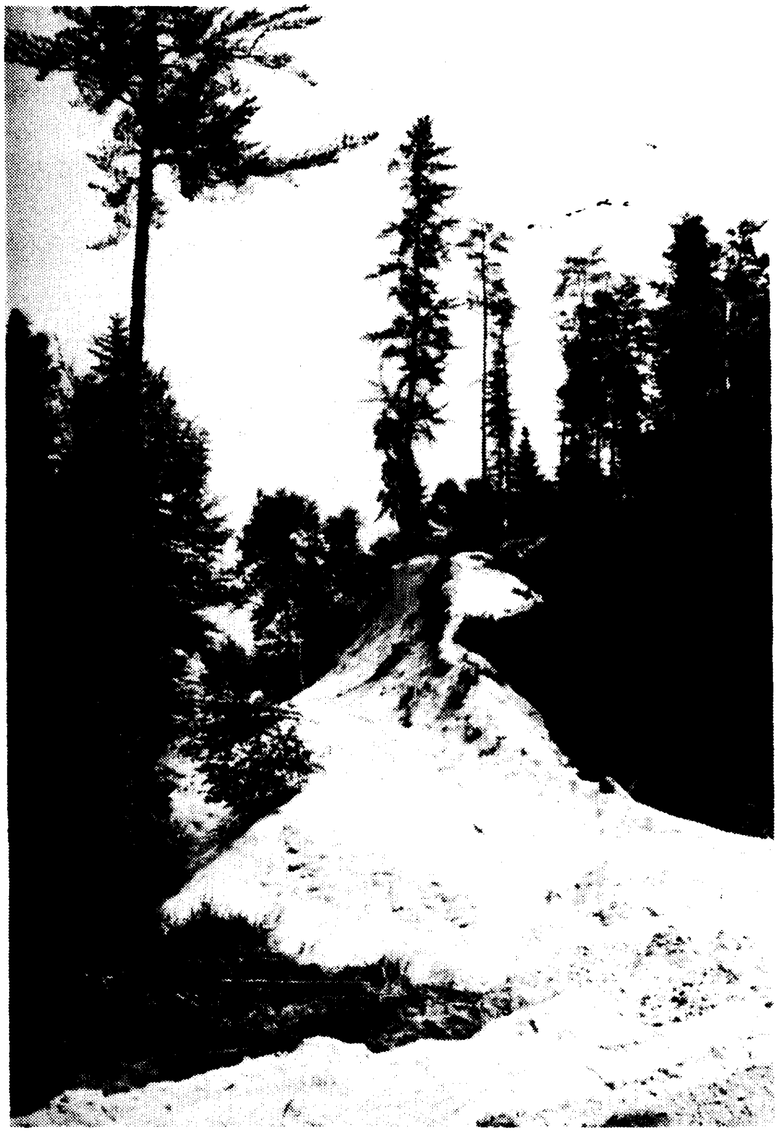

Photo 10. Large eolian dune.

Eolian sand and silt, less than 1 metre in thickness, covers other deposits, such as till, over extensive areas. The contact between the eolian sediment and the underlying deposit is commonly sharp with little evidence of mixing (Photo 11). Eolian sediment was differentiated from glaciolacustrine sand by its grainsize distribution, the lack of clay, the higher amount of void space and the tendency to be deposited on topographic highs versus lows. Roed and Hallet (1979b) have referred to these deposits as "blanket sand."

Organic Deposits

Deposits of peat, muck and marl (Unit 8) up to a few metres in thickness are found in bogs and swamps occupying local topographic depressions with poor drainage. These include areas between sand dunes, along small valleys, in flood plains beside the meandering streams and rivers and in kettle holes. Thin organic deposits occur over extensive areas on glaciolacustrine sand plains, such as between Nursey and Kapiskong lakes, and south of Hangingstone Lake. In most cases, thin organic deposits were underlain by silty fine sand or silt. Areas of organic deposits are commonly flat, wet, with few or no trees but some shrub growth. Black spruce, alder and tamarack trees have been observed to grow on organic deposits greater than 1 m in thickness. The organic deposits consist of woody to amorphous organic matter with some admixed mineral material.

An inventory of the region's peatland distribution shows only a few "individual or close groupings of peatlands" (Monenco Ontario Limited 1981, Plate A-8, p.153). An evaluation of the region's peat resources has shown that the typical small size and high

Photo 11. Till sample site.

water table in the peatlands and the distance to market generally preclude development of the peat resources for fuel or horticultural purposes and that any peatlands are best left as wildlife habitat (Monenco Ontario Limited 1981).

Alluvial Deposits

Alluvial deposits (Unit 9), consisting of sand, silt, gravel and some organic material, are found along the larger watercourses and are especially well developed in areas of glaciofluvial and glaciolacustrine deposits. The grainsize characteristics of the alluvium depend upon the parent material. Alluvial deposits are present along the Donnegana, Grassy, West Montreal, Montreal and Bear rivers and along Wapus and Calcite creeks. Most deposits are of very restricted areal extent and thickness, grade laterally into organic or other deposits and due to their limited size are not shown on the accompanying maps. Alluvium from abandoned streams and alluvium from modern streams are not differentiated on the map.

Man-Emplaced Deposits

Man—emplaced deposits (Unit 10) include mine development waste rock and tailings, lumber mill waste, municipal waste and fill. Small areas of mine waste rock and tailings are found near the following sites: the former Ronda Mine and other small workings just east of the village of Shining Tree; the former Tyranite Mine in Knight Township; the former United Asbestos and Stairs Mines in Midlothian Township; the former silver mines in Haultain and Nichol Townships; and the many small adits throughout the Gowganda map area. Lumber mill waste is found near Jess Lake in Macmurchy Township. Small deposits of municipal waste are found at public waste disposal sites located along the main roads. Considerable quantities of fill have been placed within the towns of Shining Tree and Gowganda and along Highway 560 but are too small to be mapped at 1:50,000 scale.

QUATERNARY HISTORY AND STRATIGRAPHY

The sequence of Quaternary events has been compiled from studies of the deposits, their superposition and depositional environments. As is typical for higher elevation areas in the Canadian Shield which had no extensive proglacial lake coverage, no sections with multiple tills or sequences of waterlain sediments were found and no organic materials suitable for dating or paleoenvironmental reconstruction were encountered.

The surficial sedimentary sequence records one glacial cycle, the main Wisconsinan ice advance and decay, late glacial and postglacial glaciofluvial and glaciolacustrine activity, and postglacial eolian, fluvial and biological activity.

The main (Late?) Wisconsinan ice advance removed most (if not all) of the former soil, unconsolidated deposits and the surface layer of fresh and weathered bedrock. Preferential excavation along faults and lineaments occurred, enlarging many valleys. The one till found in the project area likely correlates with the Matheson till found at or near surface in the Timmins and Matheson areas. Glacial erosion by the southwards flowing ice was pervasive and obliterated most traces of former ice flow events. Only a small number of striations, grooves and facets from a former (early to mid Wisconsinan?), southwesterly ice flow event are still present (Figure 4).

The ice cover melted from over the area about 10 000 years BP (Dyke and Prest 1987), leaving a widespread drift veneer over the irregular bedrock surface. Field evidence indicates that deglaciation over the region was characterized by stagnation and melting in place (Roed and Hallett 1979a; Finamore 1986; Alcock 1987, 1988, 1989), as opposed to the marginal retreat and readvance proposed by Boissonneau (1965, 1968). The only large or laterally extensive recessional moraine in the region is the Sultan Scarp. Ice readvances during deglaciation are not recognized.

The well-developed and integrated esker systems which stretch over considerable distances also provide evidence against readvances. If major readvances had occured, any exposed eskers in the proglacial zone would have been overridden, sheared and capped with reworked sediments, as occurs in the Timmins area within the zone of the Cochrane re-advance (Richard 1983).

The Sultan Scarp, located along the southern boundary of the project area, is recognized as a former ice-marginal position, the only major stillstand of the ice sheet in the project area (Roed and Hallett 1979a). The Sultan Scarp is a discontinuous, north-facing ice-contact slope. At this ice marginal position, eskers terminate in broad, coalescing fans of outwash sand and gravels which were deposited in subaerial and subaqueous environments. Temporary ponding of meltwater is indicated by glaciolacustrine deposits and the presence of raised beaches on the sand plain south of the Sultan Scarp. The sand plain is incised by meltwater channels in the southwestern part of the Shining Tree map area, indicating continued meltwater output (possibly in the form of periodic floods) after the major period of sediment aggradation.

The ice marginal position which formed the Sultan Scarp is likely correlative to the Chapleau II moraine position described by Boissonneau (1968) which he interpreted to have been deposited during a readvance. The Sultan Scarp may correlate with the Roulier Moraine in northwestern Quebec mapped by Veillette (1986a, b). The Roulier Moraine marks an ice-marginal position in glacial Lake Barlow (Veillette et al. 1989, Figure 20h, p.65). Little or no readvance of the ice margin is indicated.

These moraines represents a regional scale halt in the retreat of the ice sheet margin. The position of the ice sheet margin during this halt was topographically controlled at several locations where it was up against uplands, such as the southern end of the Beauty Lake esker. However, it was unconstrained by topography in the southwestern part of the Shining Tree map area. A single ice-marginal position is marked in many locations by the Sultan Scarp but in other places, the single scarp is replaced by an unorganized mix of hummocky ice-contact sediments which passes into generally flat-lying outwash sediments.

Sado and Clarke (1974) described two field sites near Campbell and Frank lakes which suggested to them that a late glacial readvance overrode previous deposited sediments. Evidence of ice readvance was not recognized in the rest of the project area. The sites of Sado and Clarke (1974) may be explained by normal ice-marginal processes, such as localized debris flows.

A few minor recessional moraines, commonly associated with ice-contact deposits, are found in the project area. Over much of the higher elevation terrain, little drift is present over the bedrock surface and no moraines were observed on the airphotos.

Upon deglaciation, most topographic lows were inundated by short–lived proglacial lakes into which deltas and subaqueous fans and glaciolacustrine sediments were deposited. Lake washing and winnowing of the drift–mantled hills and glaciofluvial deposits produced bare bedrock knobs, lag deposits of boulders over till at the upper reaches of wave influence, and blankets of nearshore sand.

Lake drainage was controlled by sills along the major valleys. Drainage of the proglacial lakes and subsequent subaerial exposure of waterlain sediments allowed extensive eolian reworking of these deposits. Formation and migration of sand dunes and deposition of a widespread veneer of loess resulted. Following cessation of eolian acitivity, soil development and vegetation growth began on these deposits.

Accumulation of organic material in poorly drained topographic lows and along watercourses has occurred since the revegetation of the landscape. Fluvial reworking of mainly waterlain sediments has built up minor accumulations of modern alluvial deposits along the major watercourses. Floodplain development has generally been hampered by bedrock outcrops and coarse-grained surficial deposits adjoining the watercourse.

Since about 1900, mining, logging and human occupation have produced a number of small deposits of waste rock, tailings, sawmill waste and municipal waste, usually near the major transportation routes.

ECONOMIC GEOLOGY

Aggregate Resources

Aggregate resources are locally abundant in vicinity of the main transportation corridors and are derived from eskers, kames and outwash deposits. In higher elevation, remote areas, supplies may be inadequate and till or glaciolacustrine or eolian sand may be used as a substitute for fill or borrow. Few rock types deleterious to aggregate quality, such as chert, foliated metamorphic rock types or fissile sedimentary rocks were noted in till clast lithological counts or surveys of gravel pit rock types.

Many potential sand and gravel deposits would require the stripping of veneers of glaciolacustrine or eolian silty fine sand.

Industrial Minerals

The industrial mineral potential of two deep and laterally extensive glaciofluvial sand deposits along Highway 560 in Westbrook and Garvey townships, immediately southeast of the project area, have been evaluated by Guillet (1983). Preliminary tests, including beneficiation by screening, attrition scrubbing and magnetic separation, were carried out on the raw material, an impure feldspathic sand. The results indicated a feldspathic sand could be produced which may be suitable for fiberglass and coloured container glass manufacture (Guillet 1983).

Mineral Exploration Utilizing Overburden Geochemistry

Introduction

In the Shining Tree area, deposits and occurrences of silver, gold, bismuth, cobalt, copper, iron, molybdenum, nickel, lead, zinc, barite and asbestos occur (Bright 1970, 1989; Carter 1989; MacKean, 1968; McIlwaine 1971, 1978). Within the project area, several mines were previously in operation. These include silver mines in the Gowganda map area (Castle No. 1 Mine, Castle Tretheway Mine, Rustex Mine, Mann Mine), gold mines in the Shining Tree and Sinclair Lake map areas (Ronda Mine, Stairs Mine) and an asbestos mine in Midlothian Township (United Asbestos Mine).

The mineral potential of the area has been evaluated by Springer (1977). Zones of high gold and silver potential coincide with areas of bedrock-drift complex near the former producing mines and most active properties.

Boyle (1968) reviewed the geochemistry of silver and its deposits, including those in the Gowganda area, and the results of geochemical prospecting in soils and tills. Previous studies in the Cobalt area (Boyle 1968, p.218-219) indicated that geochemical analyses of glaciolacustrine clay and the soil developed on them were not effective in detecting native silver mineralization. However, analyses of the less than 0.177 mm (-80 mesh) fraction of till which underlies the glaciolacustrine clay or sand, and overlie the bedrock surface, were effective in outlining broad dispersal trains.

Samples of the A horizon of soils gave higher values and contrast than B horizon soil samples. In soils, the elements Ag, As, Sb and Mn and in certain locations Ni, Co and Hg were effective indicator elements. Cobalt area results should be generally applicable to the Gowganda area.

A case study of gold dispersion in till was conducted by Stewart and van Hees (1982) in the Matachewan area, northeast of the Sinclair Lake map area. The results, which are generally applicable to the project area, indicated that distinct dispersal trains from subcropping mineralized bedrock were present in a number of size fractions of surface till samples.

Aultman (1988) studied the nature of gold dispersal in till from several small gold occurrences in the Shining Tree area. The mineralization at these occurrences occurs as both free and sulphide-held gold over small subcrop areas (Carter 1980, p.65-69).

Results from the surface till samples collected up to several hundred metres down-ice of the known gold occurrences indicate gold grains are present in the sand-sized heavy mineral fraction (Figure 8). As well, anomalous gold geochemical values are present in the silt and clay and the heavy mineral concentrate fractions (Aultman 1988).

Several of the samples with higher gold grain counts and geochemical values near the source probably represent a simple subglacial dispersal train. The presence of other

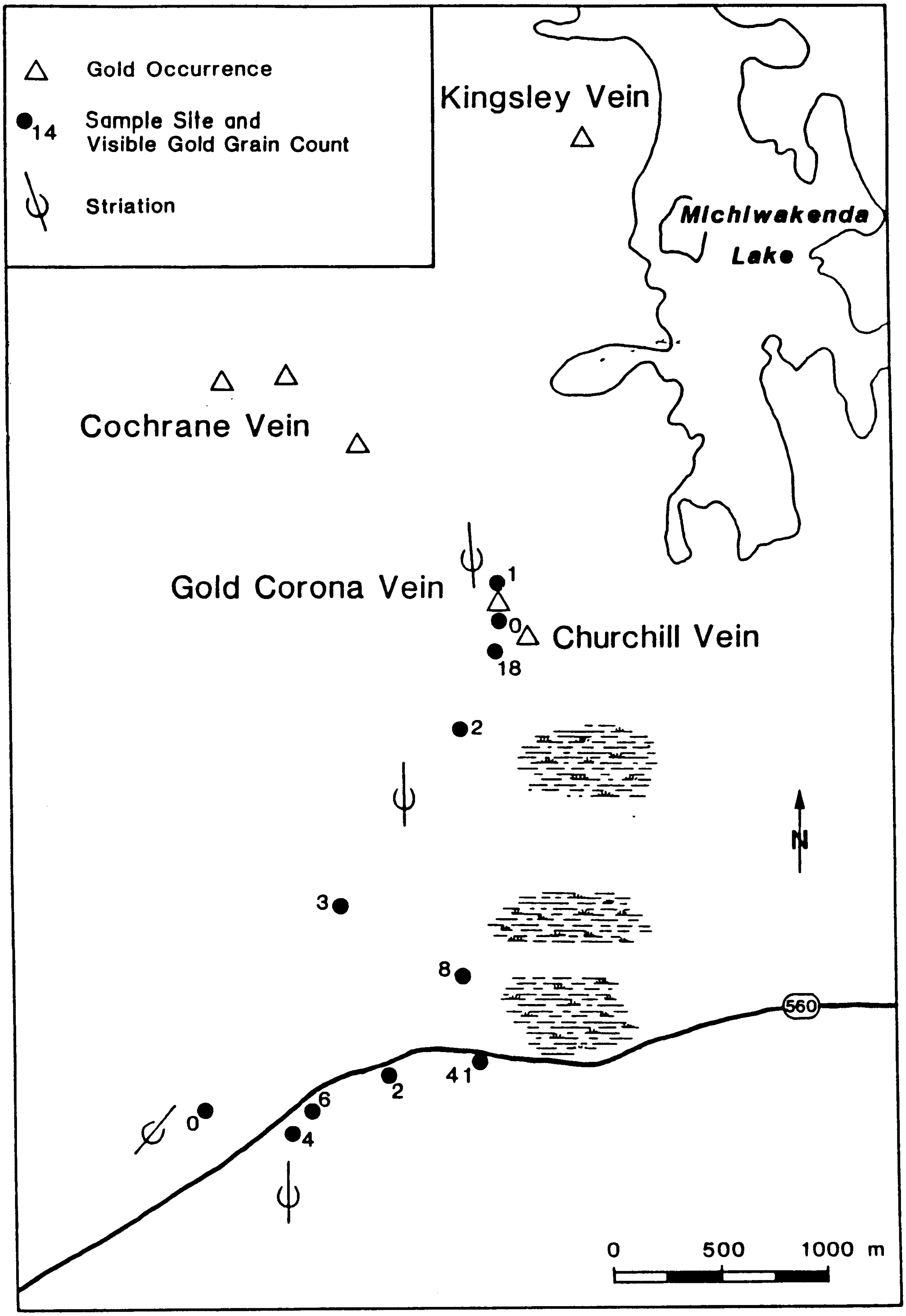

Figure 8. Distribution of gold grains in surface till samples, Beilby Lake Area, Churchill Township.

high values more than several hundred metres from source would suggest that some englacial transport also took place. It is believed that shearing within the glacier, caused by the irregular bedrock surface, distributed mineralized debris farther up into the ice; resulting in longer transport distances before deposition.

The Geological Survey of Canada has published results from a regional lake sediment geochemical sampling program which included the entire Shining Tree project area (Hornbrook and Friske 1988).

Present Survey

In order to develop a data base suitable for evaluating different methods of geochemical sampling and determine the background values in different sample media over certain bedrock types, a program of till sampling was carried out in conjuction with the Quaternary field mapping program.

Till samples were collected at approximately 1 km intervals where possible (Photo 11). Where weathered till was encountered, samples for geochemical analysis of the less than 0.063 mm (-230 mesh; silt and clay fraction) were collected from the C soil horizon. Where unweathered or partially weathered till was found, a bulk sample (approximately 10 kg) was collected for heavy mineral concentrate (S.G. greater than 3.3) preparation, visible gold grain counts (Photo 12) and heavy mineral grain counts. The heavy mineral concentrates were later geochemically analyzed. At sites where a bulk till sample was collected, a sample for geochemical analysis of the less than 0.063 mm fraction was also

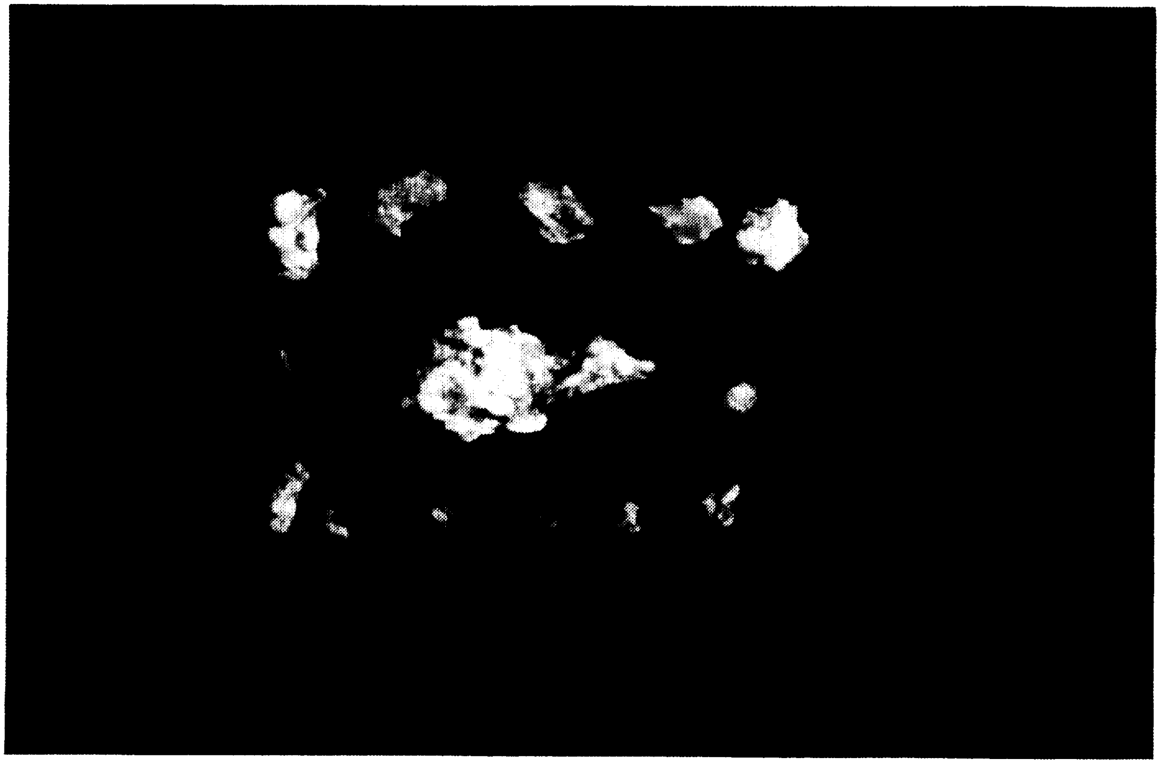

Photo 12. Visible gold grains recovered from sample.

collected for comparitive purposes. At selected till sample sites, approximately 100 clasts (2 to 15 cm a-axis) were collected and clast lithologies identified.

A total of 203 samples of weathered surface till were collected and the less than 0.063 mm fraction analysed for several major and trace elements. A total of 143 samples of slightly to unweathered till were collected for heavy mineral concentrate preparation and analyses.

The specific analyses performed include:

1) Atomic absorption (AA) analysis of the less than 0.063 mm (-230 mesh; silt and clay) fraction of weathered surface till;
2) Instrumental neutron activation analysis (INAA) for selected elements of the non-magnetic and magnetic fractions of the heavy mineral concentrate (S.G. greater than or equal to 3.3);
3) Fire assay analysis for selected elements of the non-magnetic and magnetic heavy mineral concentrate (S.G. as above);
4) Determination of the number, shape and size of visible gold grains in the heavy mineral concentrate produced by tabling of till samples;
5) Mineralogical identification of heavy mineral grains using 100 point counts under a binoccular microscope.

In weathered till samples, the silt and clay particles scavenge mobile metal cations released through weathering of sulphides or other mineral grains in the till. In unweathered samples, the original sulphide or native metal grains, derived from mineralized bedrock through erosion and crushing of rock debris, should be concentrated in the heavy mineral concentrate.

A geological data base, including sample number, UTM location, till matrix texture and carbonate content, silt and clay geochemistry, heavy mineral counts, heavy mineral geochemistry and till clast lithological results, compiled from laboratory and field results, is presented in the Appendices A to H. The sample results from Aultman (1988) are included in the Appendices B, E, F and G, but were not included in any of the summary statistical calculations at the end of each appendix. This was done so as not to bias the main group of geochemical or mineralogical results which were randomly collected from over the project area.

Geochemical results from the Gowganda map area are listed separately in the Appendices A to H and are not included in the geochemical summary statistics. These results are not directly comparable with 1986 and 1987 data due to a change in laboratory analytical techniques at the Ontario Geological Survey Geoscience Laboratories (see the appendix note pages for specific information). Gold grain count and mineralogical identification data from all years, however, can be compared.

Three types of geochemical landscapes can be defined in the project area: areas of thin and discontinuous drift covering bedrock (bedrock-drift complex); areas with thin glaciolacustrine or eolian deposits overlying till (commonly with less than 10 m of Quaternary sediments over bedrock); and areas where thick glaciofluvial and glaciolacustrine deposits occur (commonly with greater than 10 m of overburden). Effective drift prospecting stratagies are different in each of these areas.

Much of the higher elevation areas of Archean metavolcanic and felsic intrusive bedrock and Proterozoic sedimentary bedrock are covered by thin drift (bedrock-drift complex). In these areas, discontinuous patches of drift, often weathered till less than a few metres thick, are found. This landscape type is common in the northwestern, northeastern, south central and eastern portions of the project area. Mineral exploration using bedrock mapping and trenching, geophysics and till geochemistry, where sufficient drift is present, is best used in these areas.

Large portions of the metavolcanic-metasedimentary bedrock belt are overlain by a shallow but generally continuous blanket of till and/or glaciolacustrine or eolian deposits ranging from 1 to 10 m in thickness. Where till is covered by glaciolacustrine or eolian sediments, the area is suitable for till geochemical programs involving backhoe trenching or small drills.

In the areas of thick drift, till for sampling may be hard to find and interpretation of geochemical results may be difficult. Thick till is commonly in the form of hummocky disintegration moraine and is usually associated with glaciofluvial ice-contact and outwash deposits. Glaciolacustrine and eolian deposits may also form a thick cover over the till. In these areas, geochemical surveys must be carried out very selectively and only locally-derived, subglacial till should be sampled. Glaciofluvial, glaciolacustrine or eolian deposits are not of local deviation. In areas dominated by glaciofluvial sediments, it is rare for till to be preserved at depth. Till geochemical surveys are of limited use and geophysical surveys may be more suitable.

The sequence and directions of former ice flows is important to know for mineral indicator tracing. Striations are the primary ice directional indicator for the project area. These commonly ranged from 180° ± 30°. Crosscutting striations were noted at several locations and appear to indicate late shifts in the ice direction in response to local topographic influences. At a few locations, bedrock outcrops streamlined by southerly flowing ice were found with southwesterly oriented leeside facets or grooves. These facets likely represent preserved portions of large grooves from earlier ice flows. No tills or indicator dispersal patterns associated with the southwest flow have yet been found in the Shining Tree project area.

The irregular bedrock topography of the area may have caused eroded rock debris to be transported in an englacial position in the glacier. This may affect the size, shape and length of geochemical dispersal patterns. Bedrock ridges or valleys may also have deflected dispersal trains in the project area.

It would be expected that most dispersal patterns would be ribbon to fan shaped and be oriented generally southwards, in the direction of the most recent ice flow. As ice flow direction varies locally, indicator tracing programs should take into account local striation information.

Boulder tracing, surface till geochemical analysis and backhoe trenching are effective exploration methods in those areas with till at or near the surface. Tracing trains of mineralized or altered rock boulders would be a viable exploration technique in areas where subglacial till forms the surface material, as the boulders should be locally derived and form a distinct dispersal plume. Near the source subcrop, the mineralized boulders would be found at some depth in the till and so trenching would be required to locate the head of the boulder train.

Both the silt–clay fraction and the non–magnetic heavy mineral concentrate fraction (S.G.≥3.3) prepared from the less than 2 mm till matrix can be used for geochemical exploration. Where the surface till is weathered, the less than 0.063 mm fraction should be used; sulphide grains would be weathered and mobile elements, such as the base metals, would be attached to organic or clay particles. The heavy mineral fraction can be utilized for unweathered till or for those minerals such as gold and silver which do not weather rapidly in the surface environment.

As most of the bedrock-drift complex terrain has relatively thin drift and only restricted pockets of thicker (greater than 5 m) drift, backhoe trenching to expose bedrock and sample till is a workable technique. In areas of thick till or glaciofluvial or glaciolacustrine sand, small drills may be able to penetrate to the till-bedrock interface for geochemical or bedrock sampling.

The areas southeast of Wasapika Lake, and west of Porphyry Lake and Breeze Lake, which have potential for gold mineralization, are overlain by esker gravels.

Exploration should focus on bedrock trenching, geophysics and drilling as the local glacial drift will be distantly derived.

Traditional soil geochemical sampling would not be effective in those areas where thick or non-local glaciofluvial, glaciolacustrine or eolian deposits form the soil parent material. In these situations, plant roots may not have penetrated to a sufficient depth to remove metals or indicator elements from minerallized till or bedrock. Little or no transport of these elements to the leaves, branches and bark would have occurred and therefore vegetation litter and soil would not be enriched as a result of mineralization.

Geochemical prospecting in the Gowganda area should be carried out prudently due to the contamination present near old mine dumps, trenches and roadways (Boyle et al. 1967).

In the project area, there is no evidence as yet of multiple till sheets from different source areas or till of exotic provenance which would complicate interpretation of geochemical results. However, only the upper 4 to 5 m of the till sheet has been examined and sampled.

ENGINEERING GEOLOGY

Regional engineering geology terrain maps at scale 1:100 000 (Roed and Hallett 1979a; Roed 1979) are available for the project area. The irregular bedrock surface will adversely affect road building due to the need for blasting and the volume of fill required. This is particularly true in bedrock and bedrock-drift areas (Map units 1 and 2).

Where till is present at surface, it is commonly non–plastic, and sometimes compact and dense. It usually presents no major foundation problems. Large boulders, however, over 1 m in diameter, may be present and may make excavation difficult.

In areas where glaciolacustrine fine-grained sediments occur at surface, slope stability problems may occur. Road construction across areas of glaciolacustrine or eolian fine sands may encounter compaction problems. A cover of coarse, graded material may be required for the road bed in these areas. Thin organic deposits should be removed before a road bed is laid down as this material is prone to differential settling.

Along the shores of Mattagami Lake, a hydroelectric reservoir, steep shore bluffs have been eroded in the glaciolacustrine fine sand deposits by wave action as a result of changing water levels. Slumps and gully erosion can be expected to continue that may present hazards to cottage owners and boaters.

The groundwater potential in bedrock-drift complex deposit areas is low, but should be better in areas of glaciofluvial, lacustrine and eolian deposits. Many existing sanitary landfill sites are located in abandoned borrow pits in glaciofluvial ice-contact and outwash deposits. As these deposits ussually have high permeability, the migration rates of the resultant leachates could be high.

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APPENDIX A

Summary of Grainsize and Carbonate Results from Till Samples, Shining Tree Area

Notes:

1) All analyses were carried out by the Geoscience Laboratory, Ontario Geological Survey;

2) Sand-silt boundary is 0.063 mm; clay-silt boundary is 0.002 mm; Md. is median diameter in millimetres, determined graphically;

3) Grain diameters on cumulative frequency curves plotted as percent passing at mesh size;

4) 1986 and 1987 grainsize analyses utilized seiving and hydrometer methods; 1989 grainsize analyses utilized seiving and optical particle size analyzer;

5) Carbonate analyzes were carried out on material finer than 0.074 mm (-200 mesh) using the Chittick apparatus.

APPENDIX A. Summary of grainsize and carbonate results from till samples and listing of samples and sample locations of samples analyzed in appendices A to H

SAMPLE NUMBER	Eastings	Northing	Township	Sand (%)	Silt (%)	Clay (%)	Median (mm)	Percent Calcite	Percent Dolomite	Cal.+ Dol.	Cal./ Dol.
BH86-1	485700	5273900	Macmurchy	55.7	39.5	4.8	0.088	0.68	0.57	1.25	1.19
BH86-2	485750	5273400	Macmurchy	55.6	40.6	3.8	0.084	0.55	0.92	1.47	0.60
BH86-5	477800	5264250	Asquith	64.9	32.6	2.5	0.119	0.46	0.78	1.24	0.59
ST86-005	485800	5274000	Natal	57.3	39	3.7	0.095	0.75	1.38	2.13	0.54
ST86-006A	478400	5265300	Asquith	61.3	32.8	5.9	0.113	0.57	0.57	1.14	1.00
ST86-006B	478400	5265300	Asquith	64.9	33.8	1.3	0.105	0.43	1.24	1.67	0.35
ST86-009	482900	5288300	Kelvin	59.4	32.7	7.9	0.098	0.57	0.67	1.24	0.85
ST86-015	493400	5286000	Natal	61.6	35.3	3.1	0.115	0.57	0.67	1.24	0.85
ST86-016	495200	5276700	Tyrrell	93	6	1	0.55	0.43	0.9	1.33	0.48
ST86-021	486700	5275400	Macmurchy	74.2	24.1	1.7	0.3	0.57	0.78	1.35	0.73
ST86-024	493900	5278200	Macmurchy	65.5	31.4	3.1	0.15	0.46	0.67	1.13	0.69
ST86-027	496400	5276900	Tyrrell	63.8	33.1	3.1	0.124	0.68	0.67	1.35	1.01
ST86-030	499200	5277500	Tyrrell	78.7	20.1	1.2	0.2	0.57	0.67	1.24	0.85
ST86-033	496300	5268300	Leonard	62.9	36.2	0.9	0.125	0.5	0.46	0.96	1.09
ST86-037	485300	5273200	Macmurchy	55.2	40.4	4.4	0.082	0.57	0.57	1.14	1.00
ST86-039	496700	5263300	Leonard	31.9	65	3.1	0.033	0.5	0.46	0.96	1.09
ST86-042	483600	5270700	Churchill	84	14.8	1.2	0.4	0.5	0.57	1.07	0.88
ST86-043	482200	5270000	Churchill	52.9	44.6	2.5	0.07	0.68	0.57	1.25	1.19
ST86-048	483700	5271900	Churchill	56.4	38.5	5.1	0.1	0.68	0.57	1.25	1.19
ST86-049	483700	5271900	Churchill	69.4	25.8	4.8	0.27	0.68	0.57	1.25	1.19
ST86-057	466000	5286500	Cabot	68.3	30.2	1.5	0.147	0.57	0.78	1.35	0.73
ST86-059	488500	5275400	Macmurchy	85.5	13.5	1	0.233	0.43	0.9	1.33	0.48
ST86-060	485600	5276800	Macmurchy	62.4	32.8	4.8	0.145	0.34	0.67	1.01	0.51
ST86-063	464800	5278700	Brunswick	27.8	69.9	2.3	0.043	2.05	9.28	11.33	0.22
ST86-067	476200	5261000	Asquith	73.7	25.4	0.9	0.165	0.68	0.57	1.25	1.19
ST86-068	475100	5263800	Asquith	55	43.5	1.5	0.079	0.43	1.03	1.46	0.42
ST86-069	475600	5265600	Asquith	78.9	19.8	1.3	0.207	0.55	1.03	1.58	0.53
ST86-070	476300	5264100	Asquith	67.4	30.8	1.8	0.116	0.46	0.78	1.24	0.59
ST86-072B	479600	5270600	Churchill	57.4	41.7	0.9	0.085	0.43	0.9	1.33	0.48
ST86-072C	479600	5270600	Churchill	55	41.6	3.4	0.083	0.73	2.05	2.78	0.36
ST86-074	477700	5273000	Churchill	60.1	37.7	2.2	0.099	0.46	0.78	1.24	0.59
ST86-076	486000	5264900	Fawcett	61.1	36.9	2	0.118	0.68	0.8	1.48	0.85
ST86-077A	477400	5269900	Churchill	83.8	15	1.2	0.305	0.43	0.9	1.33	0.48
ST86-077B	477400	5269900	Churchill	54.8	41.4	3.8	0.081	0.43	0.9	1.33	0.48
T86-079	480400	5277500	Churchill	67.3	29.4	3.3	0.125	0.46	0.78	1.24	0.59
ST86-081	479800	5275800	Churchill	54.9	42.4	2.7	0.081	0.46	0.78	1.24	0.59
ST86-082	478400	5276900	Churchill	71.9	25.9	2.2	0.151	0.34	0.67	1.01	0.51
ST86-083	476600	5278300	Churchill	93.7	6.3	0	0.248	0.34	0.67	1.01	0.51
ST86-084	473900	5277700	Connaught	64.9	28.9	6.2	0.135	0.46	0.67	1.13	0.69
ST86-085	474600	5278900	Connaught	47.5	50.3	2.2	0.061	0.43	1.03	1.46	0.42
ST86-087	471800	5281400	Cabot	50.9	45.1	4	0.066	0.34	0.78	1.12	0.44
ST86-088	471800	5282900	Cabot	56.8	39.4	3.8	0.086	0.46	0.78	1.24	0.59

SAMPLE NUMBER	Eastings	Northing	Township	Sand (%)	Silt (%)	Clay (%)	Median (mm)	Percent Calcite	Percent Dolomite	Cal.+ Dol.	Cal./ Dol.
ST86-089	472300	5281000	Cabot	58.5	39	2.5	0.093	0.34	0.78	1.12	0.44
ST86-090	482600	5284200	Kelvin	46.4	44.4	9.2	0.055	0.68	0.57	1.25	1.19
ST86-100	479900	5266500	Asquith	65.6	32.6	1.8	0.125	0.66	1.13	1.79	0.58
ST86-101	479500	5266200	Asquith	81.4	17.3	1.3	0.02	0.43	1.03	1.46	0.42
ST86-102	492200	5264300	Fawcett	57.2	41.3	1.5	0.099	0.8	0.8	1.6	1.00
ST86-103	478100	5267800	Asquith	62.2	35.6	2.2	0.107	0.46	0.57	1.03	0.81
ST86-104	479700	5268100	Asquith	66.1	31.7	2.2	0.138	0.55	1.24	1.79	0.44
ST86-105	478800	5269200	Asquith	45.3	52.7	2	0.057	0.46	0.78	1.24	0.59
ST86-106	478500	5269800	Churchill	57.2	42.1	0.7	0.082	0.52	1.49	2.01	0.35
ST86-107A	461600	5267900	Londonderry	70.6	28.7	0.7	0.133	0.57	0.78	1.35	0.73
ST86-107B	461600	5267900	Londonderry	67.2	31.2	1.6	0.137	0.57	0.67	1.24	0.85
ST86-108A	462100	5263900	Londonderry	47.8	50.6	1.6	0.06	0.68	0.57	1.25	1.19
ST86-108B	462100	5263900	Londonderry	54	45.1	0.9	0.074	0.43	1.03	1.46	0.42
ST86-109	484400	5267500	Asquith	62.7	34.5	2.8	0.118	0.43	1.03	1.46	0.42
ST86-110	483000	5260400	Asquith	55.8	41.6	2.6	0.082	0.77	1.03	1.8	0.75
ST86-111	478200	5260100	Asquith	76.4	22.6	1	0.206	0.57	0.57	1.14	1.00
ST86-112	484800	5267600	Asquith	72.3	25.8	1.9	0.195	0.57	0.78	1.35	0.73
ST86-113	482800	5280000	Kelvin	51.3	45.7	3	0.116	0.34	0.78	1.12	0.44
ST86-114	483900	5275100	Churchill	70.8	27.3	1.9	0.206	0.43	1.13	1.56	0.38
ST86-115	482100	5278800	Churchill	46.6	50.8	2.6	0.057	0.46	0.78	1.24	0.59
ST86-116	481700	5280500	Kelvin	46.9	50.9	2.2	0.057	0.57	0.57	1.14	1.00
ST86-117	477200	5262300	Macmurchy	71.2	24.4	4.4	0.229	0.46	0.67	1.13	0.69
ST86-118	477500	5263400	Asquith	65.5	33.2	1.3	0.108	0.32	1.01	1.33	0.32
ST86-119	474900	5260200	Miramichi	56	42	2	0.082	0.43	1.03	1.46	0.42
ST86-120	474900	5260200	Miramichi	63	34.8	2.2	0.125	0.57	0.67	1.24	0.85
ST86-121	485700	5259600	Fawcett	69.5	27.7	2.8	0.147	0.43	1.03	1.46	0.42
ST86-122	485500	5259500	Fawcett	73.1	24.6	2.3	0.177	0.46	0.8	1.26	0.58
ST86-123	483500	5260500	Asquith	64.6	32.3	3.1	0.123	0.55	4.11	4.66	0.13
ST86-124	486800	5262900	Fawcett	76	22.1	1.9	0.202	0.57	0.57	1.14	1.00
ST86-125	489100	5273300	Macmurchy	83.2	14.5	2.3	0.239	0.32	0.92	1.24	0.35
BH87-1A	480000	5293500	Kemp	58	39	3	0.088	0.36	0	0.36	
BH87-1B	480000	5293500	Kemp	57	38	5	0.085	0.23	0	0.23	
BH87-2A	479200	5295300	Kemp	63	33	4	0.094	0.46	0.36	0.82	1.28
BH87-2B	479200	5295300	Kemp	47	48	5	0.056	1.43	4.36	5.79	0.33
BH87-3	478200	5297300	Kemp	58	38.5	3.5	0.093	0.46	0.36	0.82	1.28
BH87-4A	478500	5298300	Kemp	62	36	2	0.11	0.57	0.57	1.14	1.00
BH87-4B	478500	5298300	Kemp	51	44	5	0.067	0.64	1.72	2.36	0.37
BH87-5A	467100	5277100	Kemp	55	41	4	0.081	0.46	0.46	0.92	1.00
BH87-5B	467100	5277100	Kemp	61	34	5	0.108	0.55	1.03	1.58	0.53
BH87-6	477200	5294300	Kemp	66	31	3	0.145	1.2	2.93	44.13	0.41
BH87-7A	476500	5294500	Kemp	56	40.5	3.5	0.088	4.03	8.74	12.77	0.46
BH87-7B	476500	529400	Kemp	61.5	36	2.5	0.107	0.82	0.13	0.95	6.31
BH87-7C	476500	5294500	Kemp	56	40	4	0.079	0.82	0.23	1.05	3.57
BH87-9	480000	5300600	Sothman	73	24.5	2.5	0.185	0.59	0.1	0.69	5.9

SAMPLE NUMBER	Eastings	Northing	Township	Sand (%)	Silt (%)	Clay (%)	Median (mm)	Percent Calcite	Percent Dolomite	Cal.+ Dol.	Cal./ Dol.
BH87-10B	478000	53011700	Sothman	52.5	46	1.5	0.073	0.23	0	0.23	
BH87-11B	485100	5299200	Halliday	80.5	16.5	3	0.179	0.23	0.44	0.67	0.52
BH87-12A	480100	5294200	Kemp	61	35	4	0.107	0.46	0.36	0.82	1.28
BH87-12B	480100	529400	Kemp	54	40	6	0.077	0.34	0.34	0.68	1.00
BH87-13	481600	5291500	Kemp	66.5	31.5	2	0.137	2.55	4.42	6.97	0.58
BH87-14	483100	5285300	Kelvin	60	38	2	0.094	0.57	0.57	1.14	1.00
ST87-007	467100	5277100	Connaught	61.5	34	4.5	0.121	0.34	0.33	0.67	1.03
ST87-009	467100	5278900	Connaught	79.5	18.5	2	0.214	0.46	0.36	0.82	1.28
SL87-011	489000	5304500	Halliday	65	34	1	0.118	0.55	1.34	1.89	0.41
SL87-012	488500	5305300	Halliday	75	23.5	1.5	0.159	0.43	1.11	1.54	0.39
SL87-013	488400	5306400	Halliday	62	37	1	0.116	0.55	1.34	1.89	0.41
SL87-016	488800	5303200	Halliday	66	31	3	0.113	0.43	1.11	1.54	0.39
SL87-018	489600	5302500	Halliday	65	34	1	0.106	0.91	0.8	1.71	1.14
SL87-022	490300	5300000	Halliday	61.5	36.5	2	0.094	0.66	0.9	1.56	0.73
SL87-036	499500	5313300	Montrose	55.5	41.5	3	0.083	0.76	0.78	1.54	0.97
SL87-038	499000	5314800	Montrose	56	42	2	0.079	0.55	0.9	1.45	0.61
SL87-069	480100	5293200	Kemp	64	33.5	2.5	0.116	0.57	0.57	1.14	1.00
SL87-075	479800	5290600	Kemp	46	50	4	0.055	0.91	0.57	1.48	1.60
SL87-080	479400	5292700	Kemp	68	31	1	0.142	0.76	0.57	1.33	1.33
SL87-082	479700	5293400	Kemp	82	17.5	0.5	0.266	0.76	0.67	1.43	1.13
SL87-086	479100	5294200	Kemp	72	27	1	0.129	0.68	0.57	1.25	1.19
SL87-090	478400	5296000	Kemp	59	40	1	0.097	0.68	0.67	1.35	1.01
SL87-096	478200	5296500	Kemp	62	36	2	0.109	0.46	0.67	1.13	0.69
SL87-098	496400	5308300	Montrose	77	22	1	0.177	0.66	1.03	1.69	0.64
SL87-100	496500	5306600	Midlothian	62	36	2	0.103	0.66	1.13	1.79	0.58
SL87-102	464500	5316000	Gouin	68.5	28.5	3	0.16	0.66	0.92	1.58	0.72
SL87-105	466700	5316000	Moher	73	25.5	1.5	0.123	0.76	0.9	1.66	0.84
SL87-107	466800	5314900	Moher	72	27	1	0.134	0.76	0.9	1.66	0.84
SL87-132	469800	5309800	Moher	77.5	21	1.5	0.183	0.66	0.92	1.58	0.72
SL87-133A	469900	5309700	Moher	63	34.5	2.5	0.116	0.91	0.9	1.81	1.01
SL87-133B	469900	5309700	Moher	67	30	3	0.119	0.66	0.92	1.58	0.72
SL87-134	471600	5308900	Moher	73	26	1	0.177	0.82	0.57	1.39	1.44
SL87-136	471100	5309200	Kemp	67	31	2	0.142	0.82	0.78	1.6	1.05
SL87-141	480900	5291600	Kemp	61	37	2	0.103	0.68	0.69	1.37	0.99
SL87-157	497500	5310100	Montrose	71	27	2	0.119	0.82	0.57	1.39	1.44
SL87-161	488800	5296200	Mond	62	36	2	0.106	0.34	0.46	0.8	0.74
SL87-164	467000	5307700	Nursey	64.5	30	5.5	0.151	0.23	0.23	0.46	1.00
SL87-219A	477200	5294300	Kemp	68	30	2	0.164	0.36	0.1	0.46	3.6
SL87-219B	477200	5294300	Kemp	66.5	32.5	1	0.119	0.11	0.1	0.21	1.1
SL87-221	476500	5294300	Kemp	62	35	3	0.119	0.91	1.24	2.15	0.73
SL87-229	476000	5293200	Kemp	76	21	3	0.151	0.34	0.46	0.8	0.74
SL87-272	467900	5291000	Burrows	62	35	3	0.109	0.43	0.92	1.35	0.47
SL87-290	469400	5293700	Burrows	73.5	25	1.5	0.146	0.46	0.36	0.82	1.28
SL87-322	475700	5306200	Sothman	75	23	2	0.213	0.48	0.21	0.69	2.29

SAMPLE NUMBER	Eastings	Northing	Township	Sand (%)	Silt (%)	Clay (%)	Median (mm)	Percent Calcite	Percent Dolomite	Cal.+ Dol.	Cal./ Dol.
SL87-353	484400	534400	Semple	62	29	9	0.129	0.46	0.44	0.9	1.05
SL87-356	490400	5297300	Mond	62	32	6	0.097	0.46	0.44	0.9	1.05
SL87-357	490500	5296400	Mond	63.5	34	2.5	0.109	0.32	0.67	0.99	0.48
SL87-358	490800	5294600	Mond	67	30.5	2.5	0.125	0.32	0.57	0.89	0.56
SL87-359	491000	5293600	Mond								
SL87-361	491400	5292100	Mond	68	30.5	1.5	0.138	0.57	0.67	1.24	0.85
SL87-363	487700	5275100	Macmurchy	83	16	1	0.138	0.46	0.67	1.13	0.69
SL87-364	487700	5275000	Macmurchy	66	32	2	0.133	0.46	0.67	1.13	0.69
SL87-383	471900	5313100	Mond	64	33.5	2.5	0.125	0.34	0.57	0.91	0.60
SL87-394	492600	5295600	Mond	65.5	31	3.5	0.119	0.34	0.67	1.01	0.51
SL87-395	494200	5295000	Mond	31	63	6	0.035	0.2	0.57	0.77	0.35
SL87-411	464800	5291900	Mattagami	73	26	1	0.195	0.34	0.44	0.78	0.77
SL87-412	463100	5292500	Mattagami	74	24	2	0.201	0.2	0.46	0.66	0.43
SL87-415	464600	5298700	Emerald	63.5	35.5	1	0.125	0.43	0.9	1.33	0.48
SL87-416	465100	5296400	Mattagami	79	20.5	0.5	0.195	0.18	0.92	1.1	0.20
SL87-418	471900	5297100	Burrows	52.5	41.5	6	0.069	0.48	0.1	0.58	4.80
SL87-423	480200	5296500	Kemp	57	40.5	2.5	0.106	0.46	0.67	1.13	0.69
SL87-439	495800	5302800	Midlothian	66	30.5	3.5	0.13	1.57	7.96	9.53	0.20
SL87-440	496100	5302200	Midlothian	70	27	3	0.164	0.34	0.33	0.67	1.03
SL87-450	463500	5309600	Gouin	80	19	1	0.156	0.68	0.36	1.04	1.89
SL87-451	463900	5305300	Emerald	57.5	40.5	2	0.097	0.93	0.33	1.26	2.82
SL87-452	464700	5298200	Mattagami	63	36	1	0.114	0.93	0.33	1.26	2.82
SL87-458	482900	5288400	Kelvin	64.5	33	2.5	0.107	3.89	6.68	10.57	0.58
SL87-461	498100	5304300	Midlothian	75	23	2	0.235	0.82	0.44	1.26	1.86
SL87-513	463100	5311600	Gouin	61	37.5	1.5	0.091	0.46	0.46	0.92	1.00
SL87-514	463400	5310800	Gouin	49.5	49	1.5	0.063	0.2	0.69	0.89	0.29
SL87-517	464100	5312700	Gouin	67	29	4	0.151	0.2	0.57	0.77	0.35
SL87-518	463800	5311900	Gouin	77	22	1	0.195	0.34	0.67	1.01	0.51
SL87-521	483000	5309300	Semple	58	39.5	2.5	0.088	0.34	0.57	0.91	0.60
SL87-527	484700	5309500	Semple	62.5	35.5	2	0.109	0.43	0.96	1.39	0.45
SL87-528	463500	5290300	Mattagami	72.5	25.5	2	0.188	0.93	0.33	1.26	2.82
SL87-546	485300	5313800	Hutt	65.5	32.5	2	0.118	0.82	0.33	1.15	2.48
SL87-547	486800	5313100	Hutt	64.5	34.5	1	0.11	0.48	0.21	0.69	2.29
SL87-548	487000	5310900	Hutt	64	34	2	0.108	0.46	0.36	0.82	1.28
SL87-551	488200	5306800	Halliday	68.5	29.5	2	0.141	0.59	0.23	0.82	2.57
SL87-552	488400	5305600	Halliday	78.5	20.5	1	0.156	0.34	0.33	0.67	1.03
SL87-555	481800	5298600	Sothman	78.5	20.5	1	0.228	0.68	0.46	1.14	1.48
SL87-559	499400	5310000	Montrose	48	46.5	5.5	0.059	0.34	0.33	0.67	1.03
SL87-560	499200	5307700	Midlothian	59	39	2	0.099	0.46	0.56	1.02	0.82
SL87-561	498100	5304300	Midlothian	60.5	36.5	3	0.11	0.46	0.46	0.92	1.00
GW89-004	501500	5273800	Tyrrell								
GW89-008	500100	5270300	Tyrrell	61.5	35.5	3	0.11	0.43	1.13	1.56	0.38
GW89-011	500000	5278500	Tyrrell								
GW89-30A	507700	5278500	Milner								

SAMPLE NUMBER	Eastings	Northing	Township	Sand (%)	Silt (%)	Clay (%)	Median (mm)	Percent Calcite	Percent Dolomite	Cal.+ Dol.	Cal./ Dol.
GW89-030B	507700	5278500	Milner	87.5	10.5	2	0.37	0.43	1.34	1.77	0.32
GW89-048	512700	5275800	Milner								
GW89-057	519200	5281800	Haultain								
GW89-071	534100	5281900	Chown	74	24	2	0.161	0.43	1.03	1.46	0.42
GW89-085	537600	5261900	Corkill								
GW89-095	501500	5287700	Knight								
GW89-115	519500	5277600	Nichol	77	21.5	1.5	0.292	0.66	0.92	1.58	0.72
GW89-117	519200	5278600	Nichol	75	22	3	0.25	0.43	1.13	1.56	0.38
GW89-119	521500	5277300	Nichol								
GW89-127	528100	5278700	Lawson	86.5	11.5	2	0.272	0.43	1.03	1.46	0.42
GW89-128	509000	5282400	Van Hise								
GW89-138	515900	5286800	Haultain								
GW89-151	519200	528055	Haultain								
GW89-159	526850	5268350	Corkill	79	18	3	0.25	0.43	0.9	1.33	0.48
GW89-172	533350	5283199	Chown	61	37	2	0.114	0.55	1.03	1.58	0.53
GW89-185	515850	5273350	Milner								
GW89-195	516200	5260950	Charters								
GW89-196	514200	5260200	Leith								
GW89-200	518650	5263200	Charters	68	30	2	0.132	0.43	1.01	1.44	0.43
GW89-218	527450	5263050	Corkhill								
GW89-228	500600	5276550	Tyrrell	57	40	3	0.083	0.55	1.03	1.58	0.53
GW89-229	500700	5277850	Tyrrell	80	17	3	0.243	0.66	1.03	1.69	0.64
GW89-230	500250	5277600	Tyrrell								
GW89-238	533000	5276350	Lawson								
SL89-246	496350	5305600	Midlothian	65	33	2	0.114	0.66	1.03	1.69	0.64
SL89-247	496350	5305650	Midlothian								
COUNT				181	181	181	181	181	181	181	181
AVERAGE				64.7	32.8	2.6	0.13	0.59	0.95	1.54	0.91
MAXIMUM				93.7	69.9	9.2	0.55	4.03	9.28	12.77	6.31
MINIMUM				27.8	6.0	0.0	0.02	0.11	0.00	0.21	0.00
STD. DEV.				10.6	10.0	1.5	0.07	0.45	1.24	1.62	0.85

AULTMAN SAMPLES, CHURCHILL TOWNSHIP

Sample Number	Eastings	Northing	Township
JTA-1	483640	5271980	Churchill
JTA-2	483670	5272060	Churchill
JTA-3B	483090	5270540	Churchill
JTA-7	483120	5270620	Churchill
JTA-8A	482870	5270620	Churchill
JTA-9	483370	5270700	Churchill
JTA-11	483240	5271160	Churchill
JTA-12	483570	5271670	Churchill
JTA-14	483650	5271880	Churchill
JTA-17	483590	5270970	Churchill

APPENDIX B

Heavy Mineral Concentrate and Gold Grain Count Results

Notes:

1) Heavy mineral concentrates were prepared by Overburden Drilling Management Ltd., Nepean, Ontario (Averill et al, 1986). The -2.00 mm (-10 mesh) fraction from bulk till samples was passed over a shaker table and the heavy fraction further concentrated using methylene iodide (S.G. > 3.3). This heavy fraction was separated into magnetic and non-magnetic heavy mineral concentrates.

   During Tabling, if 2 or more visible gold grains were seen, the sample was hand panned and examined under a binocular microscope, and the gold grains, or any other economic or indicator minerals, were counted and sized.

APPENDIX B. Heavy mineral concentrate and gold grain count results

	Weight (kg wet)			Weight (grams dry)					Au		Weight % of Heavy Fraction		Normalized Au Grains		
						M.I. Concentrate									
Sample Number	Table Split	+10 Chips	Table Feed	Table Conc.	M.I. Lights	Conc. Total	Non Mag.	Mag.	No. V.G.	Calc. ppb	Non Mag	Mag	Per 10 g HMC	Per 10 kg Feed	Conc. Factor
BI 186-1	12.3	3.3	9.0	110.8	88.5	22.5	15.8	6.7	0	0	0.176	0.074	0.00	0.0	400
BI 186-2	11.2	3.1	8.1	90.1	66.7	23.6	17.1	6.5	0	0	0.211	0.080	0.00	0.0	343
BI 186-5	13.1	2.9	10.2	87.8	59.7	28.1	18.7	9.4	0	0	0.183	0.092	0.00	0.0	363
ST86-005	11.8	4.2	7.6	141.3	122.1	19.2	12.7	6.5	1	118	0.167	0.086	0.52	1.3	396
ST86-006A	11.3	2.8	8.5	150.0	126.5	23.5	17.3	6.2	0	0	0.204	0.073	0.00	0.0	362
ST86-006B	4.1	0.9	3.2	106.3	89.9	16.4	12.4	4.0	0	0	0.388	0.125	0.00	0.0	195
ST86-009	10.7	3.6	7.1	145.9	126.9	19.0	14.0	5.0	0	0	0.197	0.070	0.00	0.0	374
ST86-015	11.2	4.8	6.4	121.1	101.3	19.8	14.3	5.5	5	147	0.223	0.086	2.53	7.8	323
ST86-016	10.8	5.6	5.2	197.9	165.8	32.1	22.1	10.0	3	2330	0.425	0.192	0.93	5.8	162
ST86-021	10.6	8.5	2.1	126.1	114.9	11.2	7.3	3.9	2	209	0.348	0.186	1.79	9.5	188
ST86-024	12.5	8.0	4.5	166.4	149.0	17.4	11.8	5.6	0	0	0.262	0.124	0.00	0.0	259
ST86-027	13.1	5.4	7.7	133.6	110.0	23.6	15.2	8.4	3	613	0.197	0.109	1.27	3.9	326
ST86-030	12.8	6.8	6.0	122.9	93.0	30.1	18.9	11.2	4	332	0.315	0.186	1.33	6.7	199
ST86-033	9.0	4.3	4.7	148.4	137.9	10.5	6.7	3.8	0	0	0.143	0.081	0.00	0.0	448
ST86-037	9.7	4.9	4.8	119.9	101.1	18.8	13.5	5.3	5	365	0.281	0.110	2.66	10.4	255
ST86-039	9.3	2.9	6.4	130.7	120.1	10.6	6.0	4.6	0	0	0.094	0.072	0.00	0.0	604
ST86-042	10.8	8.6	2.2	126.9	111.0	15.9	9.9	6.0	41	7082	0.450	0.273	25.79	186.4	138
ST86-043	8.6	2.1	6.5	131.9	109.2	22.9	15.5	7.4	7	2137	0.238	0.114	3.06	10.8	284
ST86-048	9.9	3.3	6.6	151.9	135.2	116.7	11.1	5.6	0	0	0.168	0.085	0.00	0.0	395
ST86-049	8.9	6.0	2.9	134.9	125.4	9.5	6.2	3.3	0	0	0.214	0.114	0.00	0.0	305
ST86-057	8.7	4.3	4.4	193.1	141.9	51.2	32.6	18.6	24	3943	0.741	0.423	4.69	54.5	86
ST86-059	10.5	6.6	3.9	162.9	133.7	29.2	20.6	8.6	0	0	0.528	0.221	0.00	0.0	134
ST86-060	10.2	5.5	4.7	122.2	111.0	11.2	10.4	0.8	3	493	0.221	0.017	2.68	6.4	420
ST86-063	9.0	2.8	6.2	152.4	138.2	14.2	9.4	4.8	3	1860	0.152	0.077	2.11	4.8	437
ST86-067	9.4	2.2	7.2	226.7	189.4	37.3	28.9	8.4	0	0	0.401	0.117	0.00	0.0	193
ST86-068	8.2	3.9	4.3	128.4	110.0	18.4	11.9	6.5	0	0	0.277	0.151	0.00	0.0	234
ST86-069	9.9	4.7	5.2	169.4	141.7	27.7	19.1	8.6	0	0	0.367	0.165	0.00	0.0	188
ST86-070	9.1	3.2	5.9	144.2	115.6	28.6	20.7	7.9	3	484	0.351	0.134	1.05	5.1	206
ST86-072B	8.2	1.9	6.3	157.8	143.5	14.3	10.1	4.2	2	508	0.160	0.067	1.40	3.2	441
ST86-072C	11.0	1.8	9.2	163.6	143.1	20.5	14.4	6.1	0	0	0.157	0.066	0.00	0.0	449
ST86-074	9.2	2.5	6.7	158.6	132.5	26.1	18.7	7.4	4	1092	0.279	0.110	1.53	6.0	257
ST86-076	8.9	4.2	4.7	146.3	132.0	14.5	10.8	3.7	6	1639	0.230	0.079	4.14	12.8	324
ST86-077A	10.9	5.6	5.3	216.2	152.1	64.1	42.0	22.1	7	254	0.792	0.417	1.09	13.2	83
ST86-077B	9.7	1.3	8.4	180.5	153.1	19.3	19.1	8.5	4	141	0.227	0.101	2.07	4.8	435
ST86-079	9.2	2.0	7.2	203.0	174.7	28.3	19.6	8.7	2	81	0.272	0.121	0.71	2.8	254
ST86-081	8.8	2.7	6.1	168.5	147.5	19.6	14.3	5.3	0	0	0.234	0.087	0.00	0.0	311
ST86-082	9.8	2.9	6.9	192.4	169.2	23.2	19.0	4.2	3	166	0.275	0.061	1.29	4.3	297
ST86-083	8.0	2.4	5.6	277.4	233.8	43.6	31.4	12.2	6	1261	0.561	0.218	1.38	10.7	128
ST86-084	9.7	6.3	3.4	136.9	115.2	21.7	15.1	6.6	6	6046	0.444	0.194	2.76	17.6	157

	Weight (kg wet)		Weight (grams dry)						Au		Weight % of Heavy Fraction		Normalized Au Grains		
						M.I. Concentrate									
Sample Number	Table Split	+10 Chips	Table Feed	Table Conc.	M.I. Lights	Conc. Total	Non Mag.	Mag.	No. V.G.	Calc. ppb	Non Mag	Mag	Per 10 g HMC	Per 10 kg Feed	Conc. Factor
ST86-085	8.6	3.3	5.3	87.8	67.9	19.9	13.4	6.5	0	0	0.253	0.123	0.00	0.0	266
ST86-087	10.4	3.1	7.3	132.8	111.8	21.0	16.0	5.0	9	956	0.219	0.068	4.29	12.3	348
ST86-088	12.7	3.7	9.0	158.3	120.3	38.0	23.5	14.5	7	864	0.261	0.161	1.84	7.8	237
ST86-089	11.3	4.4	6.9	207.1	167.3	39.8	27.2	12.6	12	1182	0.394	0.183	3.02	17.4	173
ST86-090	9.0	3.2	5.8	178.5	168.7	9.8	7.8	2.0	0	0	0.134	0.034	0.00	0.0	592
ST86-100	6.9	2.2	4.7	158.9	139.3	19.6	14.7	4.9	0	0	0.313	0.104	0.00	0.0	240
ST86-101	8.3	2.3	6.0	160.1	129.1	31.0	22.0	9	0	0	0.367	0.150	0.00	0.0	194
ST86-102	5.7	1.8	3.9	137.1	116.4	20.7	15.6	5.1	3	359	0.400	0.131	1.45	7.7	188
ST86-103	12.4	2.2	10.2	202.3	170.0	32.3	23.2	9.1	8	621	0.227	0.089	2.48	7.8	316
ST86-104	8.9	2.1	6.8	123.5	94.6	28.9	20.5	8.4	2	610	0.301	0.124	0.69	2.9	235
ST86-105	10.4	0.8	9.6	79.5	56.7	22.8	16.1	6.7	0	0	0.168	0.070	0.00	0.0	421
ST86-106	4.4	0.8	3.6	61.1	47.9	13.2	9.7	3.5	0	0	0.269	0.097	0.00	0.0	273
ST86-107A	10.1	1.7	8.4	105.6	65.9	39.7	27.5	12.2	0	0	0.327	0.145	0.00	0.0	212
ST86-107B	5.2	1.5	3.7	89.5	66.1	23.4	16.9	6.5	0	0	0.457	0.176	0.00	0.0	158
ST86-108A	9.7	2.0	7.7	99.9	75.6	24.3	16.8	7.5	6	102	0.218	0.097	2.47	7.8	317
ST86-108B	4.6	1.0	3.6	68.2	50.0	18.2	13.5	4.7	0	0	0.375	0.131	0.00	0.0	198
ST86-109	8.5	3.0	5.5	82.0	61.6	20.4	13.5	6.9	4	104	0.245	0.125	1.96	7.3	270
ST86-110	11.4	3.4	8.0	120.6	97.2	23.4	14.9	8.5	4	313	0.186	0.106	1.71	5.0	342
ST86-111	11.3	4.5	6.8	121.2	86.3	34.9	22.3	12.6	11	1335	0.328	0.185	3.15	16.2	195
ST86-112	8.8	4.5	4.3	156.9	136.8	19.8	13.3	6.5	0	0	0.309	0.151	0.00	0.0	217
ST86-113	9.2	4.8	4.4	112.4	101.6	10.8	8.2	2.6	0	0	0.186	0.059	0.00	0.0	407
ST86-114	9.5	2.0	7.5	170.2	155.0	15.2	10.9	4.3	0	0	0.145	0.057	0.00	0.0	493
ST86-115	7.2	3.0	4.2	62.4	58.8	3.6	3.4	0.2	0	0	0.081	0.005	0.00	0.0	1167
ST86-116	7.2	3.4	3.8	62.3	56.4	5.9	4.1	1.8	0	0	0.108	0.047	0.00	0.0	644
ST86-117	5.1	2.2	2.9	123.8	114.6	9.2	6.3	2.9	0	0	0.217	0.100	0.00	0.0	315
ST86-118	5.9	0.6	5.3	142.5	115.1	27.4	19.7	7.7	5	200	0.372	0.165	1.82	9.4	193
ST86-119	2.8	0.8	2.0	84.5	72.7	11.8	8.7	3.1	0	0	0.435	0.155	0.00	0.0	169
ST86-120	5.1	0.5	4.6	137.3	116.7	20.6	14.4	6.2	0	0	0.313	0.135	0.00	0.0	223
ST86-121	12.9	4.8	8.1	153.2	124.4	28.6	18.6	10.2	0	0	0.230	0.126	0.00	0.0	281
ST86-122	12.2	4.3	7.9	82.1	49.7	32.4	21.2	11.2	0	0	0.268	0.142	0.00	0.0	244
ST86-123	11.9	2.7	9.2	174.2	144.9	29.3	19.6	9.7	0	0	0.213	0.105	0.00	0.0	314
ST86-124	11.8	3.8	8.0	146.8	116.2	30.6	21.6	9	0	0	0.270	0.112	0.00	0.0	261
ST86-125	8.9	4.1	4.8	130.7	107.8	22.9	16.9	6	4	2888	0.352	0.125	1.75	8.3	210
BH87-1B	11.5	2.0	9.5	202.4	175.1	27.3	15.6	8.8	0	0	0.164	0.093	0.00	0.0	348
BH87-2B	11.9	1.7	10.2	130.1	109.3	20.8	14.3	6.5	0	0	0.140	0.064	0.00	0.0	490
BH87-4B	12.3	1.7	10.6	120.9	90.8	30.1	20.8	9.3	0	0	0.196	0.088	0.00	0.0	352
BH87-5B	15.0	3.2	11.8	139.7	107.1	32.6	19.2	9.6	0	0	0.163	0.081	0.00	0.0	362
BH87-6	13.3	2.5	10.8	139.4	111.4	28.0	18.1	9.9	0	0	0.168	0.092	0.00	0.0	386
BH87-7A	12.4	1.1	11.3	55.7	29.0	26.7	18.2	8.5	0	0	0.161	0.075	0.00	0.0	423
BH87-9	16.7	5.4	11.3	182.2	103.7	78.5	48.8	29.7	22	13314	0.432	0.263	2.80	19.5	144
BH87-10B	11.7	3.1	8.6	99.0	72.8	26.2	17.6	8.6	7	116	0.205	0.100	2.67	8.1	328

	Weight (kg wet)		Weight (grams dry)			M.I. Concentrate			Au		Weight % of Heavy Fraction		Normalized Au Grains		
Sample Number	Table Split	+10 Chips	Table Feed	Table Conc.	M.I. Lights	Conc. Total	Non Mag.	Mag.	No. V.G.	Calc. ppb	Non Mag	Mag	Per 10 g HMC	Per 10 kg Feed	Conc. Factor
BH87-11B	8.3	4.3	4.0	129.7	88.2	41.5	27.9	13.6	10	2713	0.698	0.340	2.41	25.0	96
BH87-12A	12.4	1.7	10.7	136.8	122.1	14.7	8.5	6.2	5	288	0.079	0.058	3.40	4.7	728
BH87-12B	12.4	1.7	10.7	102.8	75.9	26.9	17.9	9	0	0	0.167	0.084	0.00	0.0	398
BH87-13	15.1	8.7	6.4	131.6	122.9	8.7	6.0	2.7	2	13662	0.094	0.042	2.30	3.1	736
SL87-011	12.5	5.5	7.0	96.0	69.0	27.6	18.0	9.6	4	5453	0.257	0.137	1.45	5.7	254
SL87-012	11.5	1.7	9.8	114.7	92.3	22.4	15.2	7.2	0	0	0.155	0.073	0.00	0.0	438
SL87-013	14.2	6.3	7.9	135.0	108.3	26.7	17.4	9.3	5	23621	0.220	0.118	1.87	6.3	296
SL87-016	13.5	2.1	11.4	153.5	119.7	33.8	21.6	12.2	2	31	0.189	0.107	0.59	1.8	337
SL87-018	11.8	2.5	9.3	216.3	186.0	30.3	20.5	9.8	7	4388	0.220	0.105	2.31	7.5	307
SL87-022	13.4	2.0	11.4	121.2	85.6	35.6	22.4	13.2	5	450	0.196	0.116	1.40	4.4	320
SL87-036	12.5	3.5	9.0	158.6	137.8	20.8	14.3	6.5	2	28	0.159	0.072	0.96	2.2	433
SL87-038	13.5	1.5	12.0	185.3	151.7	33.6	23.8	9.8	5	82	0.198	0.082	1.49	4.2	357
SL87-069	13.2	2.4	10.8	170.4	127.4	43.0	29.8	13.2	8	48	0.276	0.122	1.86	7.4	251
SL87-075	12.5	1.4	11.1	90.4	65.1	25.3	17.5	7.8	10	1953	0.158	0.070	3.95	9.0	439
SL87-080	12.6	2.7	9.9	57.6	28.9	28.7	18.7	10.0	4	38	0.189	0.101	1.39	4.0	345
SL87-082	13.1	4.5	8.6	78.3	29.4	48.9	29.1	19.8	16	2262	0.338	0.230	3.27	18.6	176
SL87-086	11.5	2.4	9.1	62.5	32.4	30.1	19.6	10.5	7	3074	0.215	0.115	2.33	7.7	302
SL87-090	12.6	2.8	9.8	63.3	39.6	23.7	15.8	7.9	0	0	0.161	0.081	0.00	0.0	414
SL87-096	11.2	2.4	8.8	56.3	36.0	20.3	13.1	7.2	5	890	0.149	0.082	2.46	5.7	433
SL87-098	12.9	4.5	8.4	217.6	187.4	30.2	20.0	10.2	10	5066	0.238	0.121	3.31	11.9	278
SL87-100	12.9	4.5	8.4	120.5	94.9	25.6	18.7	6.9	7	816	0.223	0.082	2.73	8.3	328
SL87-102	14.2	4.3	9.9	106.9	55.6	51.3	33.9	17.4	6	1133	0.342	0.176	1.17	6.1	193
SL87-105	15.9	3.0	12.9	190.2	112.2	78.0	55.4	22.6	5	407	0.429	0.175	0.64	3.9	165
SL87-107	14.7	4.1	10.6	181.9	89.4	92.5	67.8	24.7	0	0	0.640	0.233	0.00	0.0	115
SL87-132	13.9	2.9	11.0	227.7	151.5	76.2	54.3	21.9	0	0	0.494	0.199	0.00	0.0	144
SL87-134	12.9	3.2	9.7	242.7	172.5	70.2	48.9	22.2	0	0	0.504	0.229	0.00	0.0	138
SL87-141	12.2	2.8	9.4	88.1	54.8	33.3	23.5	9.8	4	670	0.250	0.104	1.20	4.3	282
SL87-157	13.7	5.0	8.7	101.4	51.2	50.2	37.4	12.8	0	0	0.430	0.147	0.00	0.0	173
SL87-161	13.1	3.8	9.3	66.3	39.5	26.8	18.7	8.1	6	343	0.201	0.087	2.24	6.5	347
SL87-164	15.2	6.4	8.8	99.1	64.4	34.7	22.7	12.0	0	0	0.258	0.136	0.00	0.0	254
SL87-219A	12.8	4.5	8.3	123.1	88.0	35.1	24.5	10.6	0	0	0.295	0.128	0.00	0.0	236
SL87-229	13.2	5.1	8.1	145.6	93.9	51.7	37.1	14.6	0	0	0.458	0.180	0.00	0.0	157
SL87-272	18.3	4.2	14.1	149.4	100.3	49.1	33.1	16.0	4	1757	0.235	0.113	0.81	2.8	287
SL87-290	14.6	4.6	10.0	212.9	128.7	84.2	56.8	27.4	10	401	0.568	0.274	1.19	10.0	119
SL87-322	12.9	4.7	8.2	143.9	108.8	35.1	25.3	9.8	0	0	0.309	0.120	0.00	0.0	234
SL87-353	14.7	2.8	11.9	78.3	48.3	30.0	21.0	9.0	4	115	0.176	0.076	1.33	3.4	397
SL87-356	14.1	1.2	12.9	82.4	50.3	32.1	22.2	9.9	6	200	0.172	0.077	1.87	4.7	402
SL87-357	17.0	3.2	13.8	117.6	74.6	43.0	29.4	13.6	0	0	0.213	0.099	0.00	0.0	321
SL87-358	13.4	3.0	10.4	67.1	39.9	27.2	18.6	8.6	3	371	0.179	0.083	1.10	2.9	382
SL87-359	13.3	3.8	9.5	103.3	65.8	37.5	24.5	13.0	7	121	0.258	0.137	1.87	7.4	253
SL87-361	14.3	4.2	10.1	135.4	97.3	38.1	25.8	12.3	9	448	0.255	0.122	2.36	8.9	265

	Weight (kg wet)		Weight (grams dry)						Au		Weight % of Heavy Fraction		Normalized Au Grains		
						M.I. Concentrate									
Sample Number	Table Split	+10 Chips	Table Feed	Table Conc.	M.I. Lights	Conc. Total	Non Mag.	Mag.	No. V.G.	Calc. ppb	Non Mag	Mag	Per 10 g HMC	Per 10 kg Feed	Conc. Factor
SL87-363	13.0	4.5	8.5	105.1	70.3	34.8	21.4	13.4	0	0	0.252	0.158	0.00	0.0	244
SL87-364	14.2	6.8	7.4	61.6	37.7	23.9	15.2	8.7	8	1193	0.205	0.118	3.35	10.8	310
SL87-394	16.2	3.2	13.0	89.7	50.2	39.5	26.9	12.6	6	146	0.207	0.097	1.52	4.6	329
SL87-411	12.3	3.6	8.7	189.1	134.7	54.4	36.5	17.9	2	33	0.420	0.206	0.37	2.3	160
SL87-412	16.0	5.3	10.7	280.0	219.3	60.7	38.6	22.1	0	0	0.361	0.207	0.00	0.0	176
SL87-415	13.4	5.6	7.8	219.5	161.5	58.0	37.2	20.8	0	0	0.477	0.267	0.00	0.0	134
SL87-439	13.6	2.4	11.2	126.9	88.1	38.8	28.3	10.5	2	45	0.253	0.094	0.52	1.8	289
SL87-440	17.6	5.0	12.6	158.8	121.3	37.5	30.8	6.7	4	216	0.244	0.053	1.07	3.2	336
SL87-521	13.4	2.4	11.0	167.8	123.2	44.6	32.9	11.7	0	0	0.299	0.106	0.00	0.0	247
SL87-527	13.7	2.2	11.5	165.6	118.6	47.0	35.6	11.4	0	0	0.310	0.099	0.00	0.0	245
SL87-546	12.5	2.4	10.1	140.8	99.9	40.9	29.0	11.9	3	51	0.287	0.118	0.73	3.0	247
SL87-547	12.8	1.8	11.0	170.5	119.1	51.4	37.8	13.6	0	0	0.344	0.124	0.00	0.0	214
SL87-548	10.8	2.2	8.6	64.4	39.5	24.9	16.5	8.4	2	114	0.192	0.098	0.80	2.3	345
SL87-551	12.3	3.6	8.7	113.5	86.8	26.7	17.6	9.1	0	0	0.202	0.105	0.00	0.0	326
SL87-560	13.6	2.0	11.6	104.3	79.3	25.0	17.6	7.4	4	163	0.152	0.064	1.60	3.4	464
GW89-008	13.2	3.5	9.7	227.6	198.1	29.5	20.1	9.4	0	0	0.207	0.103	0.00	0.0	329
GW89-030B	14.8	7.1	7.7	139.9	108.2	31.7	23.8	7.9	1	207	0.309	0.097	0.32	1.3	243
GW89-117	13.5	5.0	8.5	197.0	156.4	40.6	24.4	16.2	0	0	0.287	0.052	0.00	0.0	209
GW89-159	13.3	5.0	8.3	224.9	151.1	73.8	45.5	28.3	1	299	0.548	0.029	0.14	1.2	112
GW89-228	14.1	2.5	11.6	118.2	87.2	31.0	21.3	9.7	0	0	0.184	0.120	0.00	0.0	374
GW89-229	15.1	7.3	7.8	95.9	77.7	18.2	12.4	5.8	0	0	0.159	0.134	0.00	0.0	429
SL89-246	13.5	4.3	9.2	184.2	145.5	38.7	27.8	10.9	33	523	0.302	0.084	8.53	35.9	238
Average	11.4	3.5	7.9	138.0	107.4	30.6	21.0	9.6	3	889	0.277	0.117	1.21	5.6	301
Maximum	18.3	8.7	14.1	280.0	233.8	92.5	67.8	29.7	41	23621	0.792	0.423	25.79	186.4	1167
Minimum	2.8	0.5	2.0	55.7	28.9	3.6	3.4	0.2	0	0	0.079	0.000	0.00	0.0	83
Std.Dev.	2.8	1.7	2.7	46.9	41.8	15.9	10.9	5.4	6	2715	0.128	0.069	2.45	16.7	139

AULTMAN SAMPLES, CHURCHILL TOWNSHIP

	Weight (kg wet)		Weight (grams dry)			M.I. Concentrate			Au		Weight % of Heavy Fraction		Normalized Au Grains		
Sample Number	Table Split	+10 Chips	Table Feed	Table Conc.	M.I. Lights	Conc. Total	Non Mag.	Mag.	No. V.G.	Calc. ppb	Non Mag	Mag	Per 10 g HMC	Per 10 kg Feed	Conc. Factor
JTA-1	14.77	5.49	9.28	54.6	37.3	28.2	26.0	2.2	0	0	0.280	0.024	0.00	0.0	329
JTA-2	15.43	6.19	9.24	46.5	30.2	46.5	41.7	4.8	1	13912	0.451	0.052	0.22	1.1	199
JTA-3B	10.0	3.0	7.0	131.6	107.4	24.2	16.0	8.2	4	27	0.229	0.117	1.65	5.7	289
JTA-7	9.8	3.8	6.0	105.5	87.8	17.7	11.6	6.1	6	130	0.193	0.102	3.39	10.0	339
JTA-8A	5.9	1.7	4.2	91.5	75.4	16.1	11.1	5.0	0	0	0.264	0.119	0.00	0.0	261
JTA-9	5.7	2.0	3.7	67.7	59.3	8.4	6.3	2.1	2	115	0.170	0.057	2.38	5.4	440
JTA-11	9.9	3.2	6.7	138.8	115.7	23.1	14.7	8.4	3	1519	0.219	0.125	1.30	4.5	290
JTA-12	7.7	2.8	4.9	100.0	83.9	16.1	11.0	5.1	2	36	0.224	0.104	1.24	4.1	304
JTA-14	10.7	5.5	5.2	127.9	115.5	12.4	8.6	3.8	18	472	0.165	0.073	14.52	34.6	419
JTA-17	9.0	3.3	5.7	95.8	81.0	14.8	9.7	5.1	8	136	0.170	0.089	5.41	14.0	385
Average	9.9	3.7	6.2	96	79.4	20.8	15.7	5.1	4.4	1634.7	0.237	0.086	3	7.9	325.6

APPENDIX C

Heavy Mineral Grain Counts

A 100 point count of the heavy mineral concentrate was carried out using the line scan method, with an inspection of the entire sample for the presence of indicator or accessory minerals. The mineral abbreviations are as follows:

GT	Garnet
EP	Epidote
PX	Pyroxine
HB	Hornblende
IL	Ilmenite
HM	Hematite
PY	Pyrite
RT	Rutile
ZR	Zircon
SE	Sphene
SR	Staurolite
GO	Goethite
KY	Kyanite
QF	Quartz, Feldspar

APPENDIX C: Heavy mineral grain counts, Shining Tree area

Sample	GT	EP	PX	HB	IL	HM	PY	RT	ZR	SE	SR	GO	KY	QF	Remarks From Tabling, Panning and Microscopic Examination
BI186-1	27	35	13	11	4	10	-T	T		-T					
BI186-2	24	44	15	7	4	6		-T		T					
BI186-5	23	31	18	7	6	14		1		-T					
ST86-005	28	34	11	17	2	6				2				5	No Sulphides
ST86-006A	27	31	10	27	0	4		-T	1	-T				3	
ST86-006B	22	52	10	13	1	1			-T	1	-T			2	
ST86-009	35	37	11	13	1	2		1		-T					
ST86-015	22	42	17	15	0	4		-T		-T				3	No Sulphides
ST86-016	21	36	21	15	1	6	-T	-T		-T	-T			1	No Sulphides
ST86-021	16	47	12	19	0	5		1		-T		T		2	No Sulphides
ST86-024	37	35	9	13	1	4		1		T	-T			2	
ST86-027	25	48	8	15	2	2		-T		-T	-T			6	No Sulphides
ST86-030	26	48	14	6	0	5		1		-T				1	No Sulphides
ST86-033	18	58	6	17	0	1	-T							1	
ST86-037	28	31	16	18	1	5		1		-T	-T				No Sulphides
ST86-039	29	34	19	16	0	1	-T	1			-T			9	
ST86-042	28	38	17	8	2	7			-T		T				No Sulphide
ST86-043	24	45	12	15	1	3		-T		-T	-T			4	No Sulphides
ST86-048	26	41	15	15	1	2		-T						1	
ST86-049	26	46	12	12	0	3		1		-T	-T				
ST86-057	15	61	8	15	0	1								1	No Sulphides
ST86-059	27	42	15	14	0	1		-T		1				2	
ST86-060	21	42	20	12	1	4				-T	-T			1	No Sulphides
ST86-063	28	41	15	11	1	2	1	-T		1				1	
ST86-067	16	48	18	14	1	3								2	
ST86-068	7	70	8	12	0	3		-T		-T				2	
ST86-069	13	54	15	17	0	T		1						1	
ST86-070	19	50	11	15	0	4		1						1	No Sulphides
ST86-072B	7	68	12	12	0	1		-T							No Sulphides
ST86-072C	34	30	18	13	2	3		-T		-T	-T			7	
ST86-074	22	43	14	18	1	2		T		-T				2	No Sulphides
ST86-076	22	53	10	10	2	3		-T						1	No Sulphides
ST86-077A	37	36	13	12	1	1		-T			-T				No Sulphides
ST86-077B	32	32	21	10	1	3		1		T				1	No Sulphides
ST86-079	25	32	12	21	3	6		1						1	No Sulphides
ST86-081	32	35	9	18	0	5				1				3	
ST86-082	21	48	15	13	0	2		1							No Sulphides
ST86-083	22	44	14	17	1	2		-T		-T					No Sulphides
ST86-084	28	46	10	12	1	3	T								No Sulphides
ST86-085	18	54	12	14	0	1	-T		1						

Sample	GT	EP	PX	HB	IL	HM	PY	RT	ZR	SE	SR	GO	KY	QF	Remarks From Tabling, Panning and Microscopic Examination
ST86-087	21	35	18	18	4	4			-T	-T					No Sulphides
ST86-088	20	47	13	15	3	2		-T		-T	-T			3	No Sulphides
ST86-089	19	54	11	14	0	2								1	No Sulphides
ST86-090	20	39	6	27	1	7	T			-T				1	
ST86-100	15	51	18	12	2	2		-T		-T					
ST86-101	20	40	21	14	2	3		T	-T					2	
ST86-102	28	32	21	10	3	6		-T		-T	-T			2	No Sulphides
ST86-103	20	50	8	11	6	4		1		-T				4	No Sulphides
ST86-104	12	53	11	15	1	8		T						1	No Sulphides
ST86-105	26	32	19	13	1	9		T		-T				3	
ST86-106	6	63	12	14	1	4		-T							
ST86-107A	21	34	24	15	1	3		1		1	-T			4	
ST86-107B	19	46	20	14	0	1				-T				1	
ST86-108A	23	40	18	11	3	5		T		T				8	No Sulphides
ST86-108B	22	45	21	9	1	2				T				5	
ST86-109	31	45	9	10	1	4		T						4	No Sulphides
ST86-110	26	34	16	18	1	3		1		1				3	No Sulphides
ST86-111	20	38	17	21	1	3		-T		-T	-T			5	No Sulphides
ST86-112	20	45	20	5	2	7	1			-T					
ST86-113	13	61	14	8	0	4		-T							
ST86-114	29	31	18	8	5	9		-T		-T	T				
ST86-115	3	75	6	13	0	3		-T		-T					
ST86-116	14	64	7	11	1	2	T	1	-T						
ST86-117	17	48	24	10	0	1	-T	-T	-T					5	
ST86-118	19	46	19	11	1	4		T				-T			No Sulphides
ST86-119	20	45	22	7	1	5		-T			-T				
ST86-120	29	26	19	14	3	9				T					
ST86-121	23	47	16	11	0	3				-T					
ST86-122	34	28	13	10	6	8				1	-T				
ST86-123	32	33	21	9	1	2		-T	1	1					
ST86-124	12	48	14	18	3	5		-T							
ST86-125	28	37	17	13	2	3		-T		-T					No Sulphides
BI I87-1B	33	24	10	17	4	9		T	T	3				15	
BI I87-2B	33	22	8	12	9	12		1	1	2				15	
BI I87-4B	42	25	7	12	5	7		T	T	3			1	15	
BI I87-5B	29	21	15	13	10	10		1	T	1				20	
BI I87-6	37	24	4	11	7	10		3	2	2		T		16	
BI I87-7A	39	30	5	5	9	8		1	T	3				9	
BI I87-9	25	22	12	15	9	11		3	1	2				10	No Sulphides
BI I87-10B	33	31	7	7	9	11		1	T	1				13	No Sulphides
BI I87-11B	37	20	10	14	5	10		3	T	1				6	No Sulphides

Sample	GT	EP	PX	HB	IL	HM	PY	RT	ZR	SE	SR	GO	KY	QF	Remarks From Tabling, Panning and Microscopic Examination
BH87-12A	40	25	12	6	9	6		1	T	1		T		17	No Sulphides
BH87-12B	43	19	8	11	6	10		1	T	2				17	
BH87-13	27	21	18	12	7	11		2	1	1		T		10	No Sulphides
SL87-011	39	26	10	10	3	8	-T	2	2	T		-T		7	No Sulphides
SL87-012	30	29	9	12	6	9		3	T	2				9	
SL87-013	30	26	14	9	7	11		1	1	1		T		11	No Sulphides
SL87-016	44	23	11	6	6	9		T	1	T				15	No Sulphides
SL87-018	37	31	9	10	5	6		1	T	1				25	No Sulphides
SL87-022	41	20	10	9	6	9		1	1	2	1			13	No Sulphides
SL87-036	41	18	13	8	6	12		T	1	1				14	No Sulphides
SL87-038	39	16	21	5	12	7		T	T	T				15	No Sulphides
SL87-069	31	26	11	8	9	11		2	T	2				10	No Sulphides
SL87-075	38	28	7	2	10	10		3	T	2	T			11	No Sulphides
SL87-080	35	20	7	9	8	16		1	3	1				10	No Sulphides
SL87-082	41	20	8	5	11	11		1	T	3				6	No Sulphides
SL87-086	32	23	15	8	10	7		1	1	3				5	No Sulphides
SL87-090	22	29	8	17	9	11		2	1	1				8	
SL87-096	41	23	6	10	11	7		T	1	1	T			10	No Sulphides
SL87-098	24	31	6	5	9	18		3	2	1	1			12	No Sulphides
SL87-100	37	31	9	6	9	5		1	T	2		T		10	No Sulphides
SL87-102	27	33	9	17	5	5		2	T	2				12	No Sulphides
SL87-105	35	34	3	11	8	5		T	2	2				10	No Sulphides
SL87-107	26	45	8	11	3	3		2	T	2				11	
SL87-132	33	21	11	14	8	12		T	T	1				11	
SL87-134	29	34	19	4	3	5		2	1	2	1			7	
SL87-141	31	29	7	11	11	9		1	1	T				11	No Sulphides
SL87-157	24	19	15	5	10	11		T	T	2	14			15	
SL87-161	40	29	10	5	8	6		2	T	T		T		11	No Sulphides
SL87-164	29	33	12	7	5	8		3	1	2	T			12	
SL87-219A	29	27	8	13	5	14		2	1	1				13	
SL87-229	31	30	12	10	8	9		T	T	T	T			10	
SL87-272	32	28	11	7	12	6		T	1	3	T			10	No Sulphides
SL87-290	29	35	17	13	2	3		T	1	T	T	T		13	No Sulphides
SL87-322	25	31	22	5	4	9		1	T	3				9	
SL87-353	30	20	13	17	6	11		3	-T	T	T			12	No Sulphides
SL87-356	32	17	10	19	7	9		2	T	4	T	T		11	No Sulphides
SL87-357	32	20	17	17	5	8		1	T	T	T			10	
SL87-358	36	24	5	7	9	13		T	2	3	T	1		11	No Sulphides
SL87-359	35	29	12	5	8	8		1	T	1	1			8	No Sulphides
SL87-361	38	26	10	9	7	8		2		T				11	No Sulphides
SL87-363	40	36	6	4	3	10		1	T	T	T			8	

Sample	GT	EP	PX	HB	IL	HM	PY	RT	ZR	SE	SR	GO	KY	QF	Remarks From Tabling, Panning and Microscopic Examination
SL87-364	42	34	8	5	7	4		T	T	T				10	
SL87-394	42	21	11	5	8	9		3	T	1	T	T		11	No Sulphides
SL87-411	21	45	13	8	2	5		1	T	4	1			6	No Sulphides
SL87-412	29	43	9	7	3	7				2				14	
SL87-415	16	46	16	8	2	4		3	1	3	1			12	
SL87-439	40	20	12	5	7	10		3	1	1	1			11	No Sulphides
SL87-440	32	21	12	8	9	11		1	2	4				9	No Sulphides
SL87-521	36	22	13	12	5	9		2	T	1		T		11	
SL87-527	40	27	11	12	2	6		T	1	T	1			14	
SL87-546	38	20	14	10	6	8		T	T	4	T			12	No Sulphides
SL87-547	33	26	6	8	7	16		T	1	2	1			10	
SL87-548	37	26	5	4	7	11		6	T	4				6	No Sulphides
SL87-551	35	20	12	11	6	11		2	1	2				12	
SL87-560	33	26	6	11	5	15		2	1	1				9	No Sulphides
SL89-246	33	26	21	5	7	7		T	T			1		1	See * Below
GW89-008	21	40	14	5	13	4		-T	2	1		-T		-T	
GW89-030B	18	12	52	1	9	6			2	-T				1	
GW89-117	8	28	43	6	6	5		1	2	1				-T	
GW89-159	20	24	19	9	12	15			1	T				1	
GW89-228	18	26	30	3	7	13			3		-T			3	
GW89-229	27	22	28	7	7	7			2		-T			1	
AVERAGE	27.4	35.1	13.5	11.2	4.18	6.39	0.16	0.88	0.66	0.99	0.51	0.18		7.47	
MANIMUM	44	75	52	27	13	18	1	6	3	4	14	1		25	
MINIMUM	3	12	3	1	0	0	0	0	0	0	0	0		0	
STD. DEV.	8.74	12.3	6.52	4.65	3.55	3.85	0.37	1.07	0.79	1.15	2.07	0.39			
* Est. 0.5% Limonitized Pyrite, Sample Oxidized															
Aultman Samples, Churchill Township															
JTA-3B	40	37	6	6	1	10				T	T			4	no sulphides
JTA-7	40	36	6	4	5	8		T		1				1	trace limonite from py.
JTA-8A	37	35	12	4	2	5		2		T		3			trace specular hematite
JTA-9	21	42	11	8	2	15						1		1	no sulphides
JTA-11	36	37	6	8	3	10				T				3	no sulphides
JTA-12	37	35	10	6	3	7				1	1			2	no sulphides
JTA-14	35	31	13	7	2	11		1		T	T			4	no sulphides
JTA-17	39	32	9	4	4	12		T		T	T			3	no sulphides
AVERAGE	35.6	35.6	9.12	5.87	22.75	9.75		0.75		0.28	0.25	2		2.57	
MAXIMUM	40	42	13	8	5	15		2		1	1	3		4	
MINIMUM	21	31	6	4	1	5		0		0	0	1		1	
STD. DEV.	5.78	3.15	2.66	1.61	1.19	2.9		0.82		0.45	0.43	1		1.17	

APPENDIX D

Clast Lithological Composition of Till Samples

Clast lithology types were identified for approximately 100 clasts with long axis > 2 cm. The clasts were collected from till sample sites, washed and examined for glacial abrasion features and the constituent rock type. As the geologists identifying the clasts were different in each year, and the identification of small rock fragments is tentative, this data should only be used for general information on the till composition.

APPENDIX D: Clast lithology compositional data, Shining Tree area

Sample	Total Count	Felsic Intrus.	Int.-Maf Intrus.	Mafic Metavolc.	Fel.-Int. Metavolc.	Breccia-Tuff	Schistic	Archean Metaseds.	Quartz-ite	Banded Iron FM.	Sand-stone	Siltstone Mudstone	Shale Slate	Conglom.	Chert	Lime-stone	Vein Quartz	Wthd. Pebbles	Other
BH86-1	100	2.0	10.0	16.0	58.0	0.0	0.0	0.0	8.0	0.0	2.0	1.0	0.0	0.0	2.0	0.0	0.0	1.0	0.0
ST86-005	108	3.7	22.2	19.4	45.4	0.0	3.7	0.0	1.9	0.0	0.0	0.9	1.9	0.0	0.0	0.0	0.0	0.9	0.0
ST86-006B	98	4.0	14.3	25.5	28.6	2.0	5.1	0.0	2.0	0.0	0.0	3.0	3.0	0.0	0.0	0.0	0.0	12.2	0.0
ST86-009	101	3.0	10.9	26.7	21.8	7.9	0.0	0.0	1.0	0.0	3.0	4.0	5.9	0.0	0.0	0.0	0.0	15.8	0.0
ST86-015	99	6.0	12.1	22.2	24.2	1.0	0.0	0.0	13.1	0.0	0.0	2.0	15.0	0.0	0.0	0.0	0.0	3.0	1.0
ST86-016	105	4.8	18.0	31.4	17.1	1.9	0.0	0.0	10.5	0.0	1.0	0.0	9.5	0.0	0.0	0.0	1.0	4.8	0.0
ST86-021	80	2.5	20.0	20.0	43.8	1.3	1.3	0.0	6.3	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	3.8	0.0
ST86-024	100	7.0	10.0	17.0	29.0	1.0	0.0	0.0	9.0	0.0	0.0	2.0	13.0	1.0	0.0	0.0	0.0	11.0	0.0
ST86-027	91	5.5	20.9	20.9	27.5	0.0	0.0	0.0	1.0	0.0	6.6	1.0	15.4	1.0	0.0	0.0	0.0	0.0	0.0
ST86-030	100	2.0	0.0	6.0	76.0	2.0	5.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0
ST86-033	98	1.0	5.1	4.1	26.5	34.7	0.0	0.0	7.1	0.0	1.0	2.0	9.0	0.0	0.0	0.0	0.0	9.0	0.0
ST86-037	92	2.2	15.1	28.0	28.0	1.0	1.0	0.0	1.0	0.0	1.0	7.2	6.0	0.0	0.0	0.0	0.0	9.7	0.0
ST86-039	102	2.0	17.6	28.4	18.6	1.0	0.0	0.0	16.7	0.0	1.0	1.0	5.9	1.0	0.0	1.0	0.0	5.9	0.0
ST86-042	99	3.0	16.0	24.0	36.0	2.0	3.0	0.0	1.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	0.0	7.0	0.0
ST86-043	101	5.9	13.9	36.6	23.8	4.0	1.0	0.0	2.1	0.0	0.0	3.1	3.1	0.0	0.0	0.0	0.0	7.0	0.0
ST86-048	97	6.2	6.2	26.8	30.9	4.1	6.2	0.0	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	1.0	10.3	5.1
ST86-049	103	2.9	9.7	16.5	33.0	1.9	5.8	0.0	2.9	0.0	0.0	4.9	4.9	0.0	0.0	0.0	1.9	12.6	2.9
ST86-057	95	63.2	16.8	5.3	2.1	0.0	9.5	0.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0
ST86-059	102	1.0	38.2	39.2	5.9	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.7	0.0
ST86-060	102	3.9	21.6	10.8	20.6	0.0	2.9	0.0	2.9	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	35.3	0.0
ST86-063	100	70.0	17.0	0.0	1.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0
ST86-067	87	43.7	17.2	10.3	17.2	0.0	2.3	0.0	1.1	2.3	0.0	1.1	3.4	0.0	0.0	0.0	0.0	1.1	0.0
ST86-068	97	34.0	37.1	11.8	8.2	0.0	3.1	0.0	2.1	0.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0	2.1	0.0
ST86-069	103	5.8	15.5	31.1	34.0	0.0	3.9	0.0	0.0	2.9	0.0	1.0	0.0	0.0	0.0	0.0	1.9	3.9	0.0
ST86-070	101	28.7	13.9	13.9	29.7	1.0	7.9	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	2.0	0.0
ST86-072B	91	13.2	12.1	19.8	31.9	0.0	7.7	0.0	3.3	0.0	0.0	1.1	2.2	0.0	0.0	0.0	0.0	8.8	0.0
ST86-072C	100	13.0	10.0	31.0	28.0	0.0	3.0	0.0	1.0	2.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	10.0	0.0
ST86-074	104	13.5	4.8	7.7	20.2	26.0	0.0	0.0	7.7	0.0	0.0	1.0	6.8	0.0	0.0	0.0	0.0	12.5	0.0
ST86-076	108	5.6	9.3	37.0	18.5	0.0	9.3	0.0	0.0	0.0	0.0	0.0	4.6	0.0	0.0	0.0	1.0	14.8	0.0
ST86-077A	102	18.6	7.8	21.6	36.3	0.0	1.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.8	0.0
ST86-079	98	14.3	7.1	34.7	25.5	0.0	3.1	0.0	2.0	0.0	1.0	0.0	4.1	0.0	0.0	0.0	1.0	7.1	0.0
ST86-081	102	13.7	8.8	34.3	23.5	0.0	4.9	0.0	1.0	0.0	0.0	0.0	3.9	0.0	0.0	0.0	0.0	9.8	0.0
ST86-082	98	20.4	12.2	23.4	22.4	1.0	4.1	0.0	2.0	0.0	1.0	0.0	2.0	0.0	0.0	0.0	0.0	11.2	0.0
ST86-083	101	10.9	8.9	31.7	36.6	1.0	1.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	7.0	0.0
ST86-084	96	9.5	14.7	12.6	35.8	0.0	6.3	0.0	0.0	0.0	0.0	1.0	2.1	0.0	0.0	0.0	0.0	18.9	0.0
ST86-085	99	4.0	1.0	3.0	81.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.1	0.0
ST86-087	100	3.0	10.0	16.0	56.0	0.0	1.0	0.0	1.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	7.0	0.0
ST86-088	107	9.3	12.1	17.8	47.7	0.0	1.0	0.0	0.0	1.9	0.0	0.0	2.8	1.0	0.0	0.0	1.0	5.6	0.0
ST86-089	106	12.3	8.5	25.5	45.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	5.7	0.0
ST86-101	116	12.9	17.2	15.5	34.5	0.0	4.3	0.0	0.9	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.9	0.9
ST86-103	98	19.4	8.2	20.4	41.8	0.0	1.0	0.0	1.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	6.1	0.0
ST86-104	99	11.1	17.2	13.1	23.2	2.0	9.1	0.0	3.0	0.0	1.0	0.0	2.0	0.0	0.0	0.0	1.0	15.2	2.0
ST86-105	105	17.1	17.0	14.3	16.2	1.0	13.3	0.0	6.7	0.0	0.0	0.0	5.7	0.0	0.0	0.0	1.0	7.6	0.0
ST86-107B	101	49.5	11.9	9.9	9.9	0.0	13.9	0.0	1.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0	2.0	0.0	0.0
ST86-108A	101	53.4	24.8	6.9	2.0	1.0	6.9	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.0	0.0
ST86-109	93	6.4	17.2	29.0	21.5	1.1	4.3	0.0	0.0	0.0	1.1	1.1	6.4	0.0	0.0	0.0	0.0	11.8	0.0

Sample	Total Count	Felsic Intrus.	Int.-Maf Intrus.	Mafic Metavolc.	Fel.-Int. Metavolc.	Breccia-Tuff	Schistic	Archean Metaseds.	Quartz-ite	Banded Iron FM.	Sand-stone	Siltstone Mudstone	Shale Slate	Conglom.	Chert	Lime-stone	Vein Quartz	Wthd. Pebbles	Other
ST86-110	96	9.4	17.7	11.4	33.3	0.0	12.5	0.0	5.2	0.0	0.0	0.0	4.2	0.0	0.0	0.0	0.0	6.3	0.0
ST86-111	101	36.6	19.8	12.9	12.9	1.0	10.9	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	4.0	0.0
ST86-112	109	2.8	11.0	23.9	33.0	0.0	6.4	0.0	1.8	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	19.3	0.0
ST86-113	116	3.4	7.8	20.7	50.9	0.0	0.0	0.0	0.0	5.2	0.0	0.0	1.7	0.0	0.0	0.0	3.4	6.9	0.0
ST86-114	102	9.8	3.9	30.4	40.2	0.0	1.0	0.0	0.0	1.0	0.0	0.0	2.0	0.0	0.0	0.0	2.0	9.8	0.0
ST86-115	99	1.0	29.3	26.3	18.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.3	0.0
ST86-116	98	5.1	11.2	27.6	33.7	0.0	0.0	0.0	0.0	0.0	0.0	1.0	4.1	0.0	0.0	0.0	0.0	17.3	0.0
ST86-118	93	18.3	20.4	22.6	14.0	2.2	11.8	0.0	1.0	0.0	1.1	5.4	2.2	0.0	0.0	0.0	1.1	0.0	0.0
ST86-121	101	4.0	18.8	24.8	21.8	0.0	5.9	0.0	4.0	0.0	3.0	4.0	10.9	0.0	0.0	0.0	0.0	3.0	0.0
ST86-122	94	13.8	22.3	19.1	21.3	0.0	7.4	0.0	4.3	1.1	3.2	0.0	5.3	0.0	0.0	0.0	0.0	2.2	0.0
ST86-123	114	19.1	25.2	19.1	19.1	0.9	3.5	0.0	2.6	0.0	0.0	2.6	0.9	0.0	0.0	0.0	0.9	5.2	0.9
ST86-124	98	7.5	15.3	19.4	29.6	0.0	21.4	0.0	1.0	0.0	0.0	0.0	3.0	0.0	0.0	1.0	1.0	0.0	0.0
ST86-125	95	5.3	16.8	21.0	23.2	0.0	0.0	0.0	6.3	0.0	1.0	6.4	2.1	0.0	1.0	0.0	0.0	16.8	0.0
BH87-1A	116	21.6	7.8	30.2	19.8	0.9	0.0	0.0	0.0	0.0	2.6	14.7	0.0	0.0	0.9	0.0	0.9	0.9	0.0
BH87-1B	136	16.9	6.6	35.3	33.1	1.5	0.0	0.0	0.0	0.0	3.7	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BH87-2A	98	20.4	18.4	10.2	22.4	1.0	0.0	0.0	0.0	0.0	8.2	19.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BH87-2B	116	24.1	9.5	25.0	14.7	4.3	0.0	0.0	0.0	0.0	14.7	6.0	0.0	0.0	0.0	0.9	0.0	0.9	0.0
BH87-3	111	9.9	3.6	16.2	9.0	1.8	0.0	0.0	3.6	0.0	18.9	36.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BH87-4B	109	17.4	11.9	15.6	16.5	0.0	0.0	0.0	0.0	0.0	16.5	17.4	2.8	0.0	0.0	0.0	1.8	0.0	0.0
BH87-5A	113	6.2	10.6	23.9	22.1	0.0	0.0	0.0	0.0	0.0	9.7	26.5	0.0	0.0	0.0	0.0	0.9	0.0	0.0
BH87-5B	106	8.5	6.6	17.9	16.0	0.9	0.0	0.0	0.0	0.0	5.7	29.2	0.9	14.2	0.0	0.0	0.0	0.0	0.0
BH87-6	83	12.0	6.0	10.8	6.0	0.0	0.0	0.0	0.0	0.0	18.1	32.5	13.3	1.2	0.0	0.0	0.0	0.0	0.0
BH87-7A	107	17.8	6.5	24.3	20.6	5.6	0.9	0.0	6.5	0.0	4.7	7.5	0.0	5.6	0.0	0.0	0.0	0.0	0.0
BH87-7B	79	13.9	10.1	3.8	12.7	0.0	0.0	0.0	0.0	0.0	21.5	19.0	0.0	16.5	1.3	0.0	0.0	1.3	0.0
BH87-7C	101	8.9	3.0	5.0	9.9	0.0	0.0	0.0	0.0	0.0	9.9	53.5	4.0	5.9	0.0	0.0	0.0	0.0	0.0
BH87-9	105	41.0	0.0	18.1	27.6	0.0	1.0	0.0	1.0	0.0	2.9	6.7	1.0	0.0	1.0	0.0	0.0	0.0	0.0
BH87-10B	115	10.4	9.6	19.1	38.3	5.2	0.0	0.0	0.0	0.0	0.9	13.9	0.0	0.0	0.0	0.0	0.9	1.7	0.0
BH87-11B	114	14.0	4.4	15.8	62.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0
BH87-12A	100	12.0	19.0	12.0	24.0	4.0	0.0	0.0	0.0	0.0	11.0	18.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BH87-12B	99	18.2	10.1	21.2	24.2	4.0	0.0	0.0	0.0	0.0	15.2	0.0	5.1	0.0	0.0	1.0	1.0	0.0	0.0
BH87-13	95	2.1	0.0	3.2	43.2	13.7	0.0	0.0	0.0	0.0	17.9	0.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0
ST87-007	133	18.0	19.5	21.8	25.6	0.0	1.5	0.0	0.0	0.0	3.8	7.5	0.0	0.0	0.0	0.0	0.0	2.3	0.0
ST87-009	111	12.6	11.7	28.8	33.3	0.0	10.8	0.0	0.0	0.0	1.8	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SL87-011	105	1.9	78.1	6.7	11.4	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SL87-013	91	12.1	17.6	22.0	12.1	0.0	0.0	0.0	36.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SL87-069	102	23.5	13.7	29.4	20.6	0.0	0.0	0.0	0.0	0.0	0.0	3.9	8.8	0.0	0.0	0.0	0.0	0.0	0.0
SL87-075	88	20.5	13.6	20.5	3.4	0.0	0.0	0.0	6.8	0.0	0.0	35.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SL87-080	94	26.6	10.6	28.7	2.1	0.0	0.0	0.0	5.3	25.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0
SL87-082	100	22.8	0.0	30.7	21.8	0.0	0.0	0.0	0.0	0.0	0.0	14.9	8.9	0.0	0.0	0.0	0.0	0.9	0.0
SL87-086	109	16.5	7.3	34.9	35.8	0.0	0.0	0.0	0.0	0.0	0.0	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SL87-090	104	14.4	12.5	13.5	12.5	0.0	0.0	0.0	31.7	1.9	2.9	6.7	1.0	0.0	0.0	0.0	0.0	2.9	0.0
SL87-096	91	17.6	4.4	13.2	51.6	2.2	0.0	0.0	0.0	0.0	1.1	5.5	4.4	0.0	0.0	0.0	0.0	0.0	0.0
SL87-098	87	0.0	16.1	27.6	35.6	13.8	0.0	0.0	0.0	0.0	0.0	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SL87-100	99	17.2	8.1	13.1	52.5	2.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0
SL87-102	169	55.0	23.7	10.1	5.3	0.0	1.2	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.0	0.0
SL87-105	103	46.6	30.1	15.5	0.0	0.0	0.0	0.0	7.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SL87-107	108	39.8	40.7	11.1	4.6	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	1.9	0.0	0.0
SL87-132	97	26.8	10.3	14.4	17.5	0.0	0.0	0.0	26.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1	0.0
SL87-133A	101	52.5	7.9	15.8	22.8	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Sample	Total Count	Felsic Intrus.	Int.-Maf Intrus.	Mafic Metavolc.	Fel.-Int. Metavolc.	Breccia-Tuff	Schistic	Archean Metaseds.	Quartz-ite	Banded Iron FM.	Sand-stone	Siltstone Mudstone	Shale Slate	Conglom.	Chert	Lime-stone	Vein Quartz	Wthd. Pebbles	Other
SL87-134	91	51.6	24.2	19.8	1.1	0.0	0.0	0.0	0.0	0.0	2.2	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SL87-136	110	44.5	20.9	24.5	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7
SL87-141	94	14.9	8.5	8.5	51.1	6.4	0.0	0.0	0.0	0.0	0.0	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SL87-157	92	4.3	3.3	4.3	5.4	81.5	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SL87-164	101	74.3	14.9	3.0	7.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SL87-219A	93	7.5	8.6	14.0	29.0	2.2	1.1	0.0	24.7	0.0	1.1	5.4	6.5	0.0	0.0	0.0	0.0	0.0	0.0
SL87-219B	100	21.0	0.0	13.0	31.0	1.0	0.0	0.0	0.0	0.0	0.0	30.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0
SL87-221	96	9.4	8.3	10.4	5.2	0.0	1.0	0.0	5.2	0.0	24.0	33.3	0.0	0.0	0.0	2.1	0.0	1.0	0.0
SL87-229	97	9.3	7.2	8.2	11.3	4.1	0.0	0.0	1.0	0.0	24.7	23.7	0.0	10.3	0.0	0.0	0.0	0.0	0.0
SL87-272	92	29.3	2.2	21.7	29.3	3.3	1.1	0.0	0.0	0.0	7.6	1.1	4.3	0.0	0.0	0.0	0.0	0.0	0.0
SL87-290	106	37.7	18.9	12.3	14.2	0.0	3.8	0.0	6.6	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.9	3.8	0.0
SL87-322	86	33.7	9.3	34.9	7.0	0.0	5.8	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	8.1	0.0
SL87-353	108	22.2	13.0	36.1	22.2	0.9	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0
SL87-356	93	16.1	1.1	19.4	14.0	5.4	0.0	0.0	1.1	0.0	10.8	30.1	0.0	0.0	0.0	0.0	0.0	1.1	1.1
SL87-357	111	9.0	14.4	9.0	27.9	2.7	1.8	0.0	12.6	0.0	2.7	15.3	0.0	0.0	0.0	0.0	0.0	4.5	0.0
SL87-358	111	18.0	8.1	16.2	36.0	3.6	0.0	0.0	0.0	0.0	4.5	12.6	0.0	0.0	0.0	0.0	0.0	0.9	0.0
SL87-361	111	10.8	6.3	13.5	17.1	1.8	1.8	0.0	16.2	0.0	5.4	18.9	1.8	5.4	0.0	0.0	0.0	0.9	0.0
SL87-383	106	75.5	15.1	9.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SL87-394	93	2.2	7.5	8.6	9.7	1.1	0.0	0.0	0.0	0.0	30.1	34.4	0.0	0.0	0.0	0.0	0.0	1.1	5.4
SL87-395	98	6.1	6.1	3.1	23.5	0.0	0.0	0.0	0.0	0.0	19.4	35.7	0.0	5.1	1.0	0.0	0.0	0.0	0.0
SL87-411	89	78.7	1.1	5.6	12.4	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0
SL87-412	108	70.4	12.0	5.6	5.6	0.0	0.0	0.0	3.7	0.0	0.0	0.9	0.0	0.9	0.0	0.0	0.0	0.9	0.0
SL87-415	102	77.5	13.7	4.9	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SL87-416	80	87.5	6.3	1.3	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SL87-418	103	51.5	25.2	10.7	6.8	0.0	0.0	0.0	0.0	0.0	4.9	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
SL87-439	101	11.9	4.0	38.6	35.6	2.0	0.0	0.0	0.0	0.0	5.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SL87-440	107	14.0	5.6	24.3	48.6	0.0	0.0	0.0	0.0	0.0	0.9	5.6	0.0	0.0	0.0	0.0	0.0	0.9	0.0
SL87-517	124	47.6	13.7	12.1	16.9	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	2.4	0.8	0.0
SL87-518	111	55.0	16.2	6.3	11.7	0.0	0.0	0.0	0.0	0.0	9.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0
SL87-521	116	13.8	17.2	20.7	28.4	0.0	0.9	0.0	0.0	0.0	4.3	9.5	0.0	0.0	0.0	0.0	0.0	5.2	0.0
SL87-527	102	26.5	10.8	12.7	0.0	47.1	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
SL87-528	111	84.7	9.9	2.7	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0
SL87-546	103	21.4	7.8	24.3	26.2	0.0	0.0	0.0	0.0	0.0	10.7	6.8	0.0	0.0	0.0	0.0	0.0	2.9	0.0
SL87-547	93	32.8	14.0	18.3	23.7	1.1	1.1	0.0	0.0	0.0	4.3	4.3	1.1	0.0	0.0	0.0	0.0	0.0	0.0
SL87-548	101	23.8	6.9	4.0	33.7	19.8	2.0	0.0	2.0	0.0	5.9	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
SL87-551	104	14.4	9.6	44.2	20.2	0.0	0.0	0.0	0.0	0.0	1.9	0.0	7.7	0.0	0.0	0.0	0.0	1.9	0.0
SL87-560	99	8.1	8.1	16.2	27.3	0.0	0.0	0.0	0.0	0.0	11.1	27.3	0.0	0.0	0.0	0.0	0.0	2.0	0.0
GW89-008	118	8.5	3.4	28.0	24.6	18.6	16.1	0.9	0.0										
GW89-030	114	1.8	2.6	0.9	3.5	86.8	4.4	0.0	0.0										
GW89-085	112	0.9	3.6	0.9	0.0	2.7	89.3	0.0	2.7										
GW89-095	106	3.8	8.5	12.3	0.9	45.3	25.5	2.8	0.9										
GW89-117	107	14.0	54.2	11.2	4.7	13.1	2.8	0.0	0.0										
GW89-138	116	11.2	11.2	7.8	3.5	56.9	9.5	0.0	0.0										
GW89-159	112	11.6	31.3	5.4	0.0	13.4	38.4	0.0	0.0										
GW89-172	111	0.9	3.6	0.9	0.9	77.5	16.2	0.0	0.0										
GW89-196	105	4.8	33.3	13.3	0.0	39.1	8.6	0.0	1.0										
GW89-228	128	2.3	12.5	10.2	2.3	46.1	26.6	0.0	0.0										
GW89-229	124	4.0	1.6	0.0	0.0	83.9	10.5	0.0	0.0										

APPENDIX E

Geochemical Analyses of -0.063 mm (-230 mesh; Silt and Clay) Fraction

Notes:

1) All sample analyses were carried out by the Geoscience Laboratory, Ontario Geological Survey

2) Trace element analyses carried out on the -0.063 mm (-230 mesh) fraction obtained by seiving;

3) In 1986 and 1987, the following analytical techniques were used:

Element	Technique	Detection Limit (ppm)
Ag	AAS Flame	2
As	AAS Hydride	1
Au	AAS Furnace	0.002
Ba	AAS Flame	10
Cd	AAS Flame	2
Co	AAS Flame	5
Cr	AAS Flame	10
Cu	AAS Flame	5
Fe	AAS Flame	5
Li	AAS Flame	3
Mo	AAS Flame	3
Ni	AAS Flame	5
Pb	AAS Flame	10
Pd	AAS Furnace	0.001
Pt	AAS Furnace	0.001
Rb	XRF	5
Sb	AAS Hydride	0.1
Sr	XRF	5
Zn	AAS Flame	10

In 1989, the following analytical techniques were used:

Element	Technique	Detection Limit (ppm)
Ag	AAS Flame	2
As	AAS Hydride	1
Au	AAS Furnace	0.002
Ba	AAS Flame	10
Be	ICP/OES	1
Bi	AAS Hydride	0.05
Co	ICP/OES	5
Cr	AAS Furnace	10
Cu	ICP/OES	5
Fe	AAS Flame	5
Li	AAS Flame	3
Mn	AAS Flame	5
Mo	ICP/OES	10
Ni	ICP/OES	5
Pb	AAS Flame	10
Pd	AAS Furnace	0.001
Pt	AAS Furnace	0.001
Sb	AAS Hydride	0.1
Sc	AAS Hydride	0.1
Sr	ICP/OES	5
V	ICP/OES	5
Y	ICP/OES	5
Zn	ICP/OES	5

4) Blind duplicate samples were submitted in 1987 and 1989. The results showed satisfactory duplication of analytical results.

APPENDIX E: Geochemical analysis of -0.063 mm (-230 mesh) silt and clay fraction

Note: for analytical techniques used and elements analysed see appendix cover page

Sample	Ag ppm	As ppm	Au ppb	Ba ppm	Cd ppm	Co ppm	Cr ppm	Cu ppm	Fe %	Li ppm	Mn ppm	Mo ppm	Ni ppm	Pb ppm	Pd ppb	Pt ppb	Rb ppm	Sb ppm	Sr ppm	Zn ppm
BI186-1	-2	5.5	4	525	-2	14	118	105	2.88	15	635	-3	67	5	N/A	N/A	0	0.3	305	61
BI186-2	-2	8.0	3	510	-2	14	122	78	2.76	14	550	-3	68	10	N/A	N/A	48	0.3	299	62
BI186-5	-2	3.5	2	510	-2	10	94	46	2.27	10	438	-3	55	10	N/A	N/A	50	0.2	315	41
ST86-005	-2	10.5	3	508	-2	11	110	85	3.11	13	453	-3	61	10	N/A	N/A	47	0.3	298	56
ST86-006A	-2	10.0	13	472	-2	17	140	108	3.64	15	725	-3	81	13	N/A	N/A	52	0.3	282	63
ST86-006B	-2	4.0	12	534	-2	9	85	41	2.15	8	510	-3	43	11	N/A	N/A	48	0.1	321	34
ST86-009	-2	20.0	1	525	-2	22	118	86	3.84	28	1040	-3	70	12	N/A	N/A	50	5.0	261	122
ST86-015	-2	3.5	2	544	-2	12	96	49	2.45	13	465	-3	50	13	N/A	N/A	54	0.2	295	37
ST86-016	-2	105.0	37	436	-2	65	304	450	6.00	17	2275	-3	250	34	N/A	N/A	47	0.7	288	119
ST86-021	-2	13.0	12	529	-2	17	106	63	3.25	13	800	-3	58	17	N/A	N/A	50	0.5	300	47
ST86-024	-2	32.5	17	525	-2	20	176	47	3.55	15	745	-3	95	14	N/A	N/A	55	0.6	280	44
ST86-027	-2	6.0	3	569	-2	12	124	54	2.59	11	400	-3	81	12	N/A	N/A	52	0.1	288	39
ST86-030	-2	18.0	35	505	-2	20	135	113	4.03	13	900	-3	85	19	N/A	N/A	53	0.3	310	50
ST86-033	-2	8.0	7	470	-2	14	100	67	2.92	14	360	-3	58	14	N/A	N/A	48	0.2	263	36
ST86-037	-2	8.0	3	510	-2	15	110	41	3.22	15	655	-3	72	12	N/A	N/A	49	0.3	300	46
ST86-039	-2	5.5	17	535	-2	10	84	42	2.53	13	500	-3	46	13	N/A	N/A	54	-0.1	307	36
ST86-042	-2	73.0	130	460	-2	41	168	163	5.50	17	1380	-3	115	29	N/A	N/A	46	2.2	287	139
ST86-043	-2	7.5	20	485	-2	14	150	50	3.09	12	490	-3	85	10	N/A	N/A	46	0.4	302	41
ST86-048	-2	12.5	12	480	-2	20	139	68	3.52	18	675	-3	89	10	N/A	N/A	49	0.7	281	67
ST86-049	-2	45.0	65	505	-2	37	148	138	5.05	20	1680	-3	106	17	N/A	N/A	54	1.5	268	84
ST86-057	-2	3.5	2	505	-2	16	109	37	3.28	17	570	-3	50	14	N/A	N/A	44	0.1	318	47
ST86-059	2	36.5	3	505	-2	34	144	265	4.65	16	1640	-3	97	27	N/A	N/A	49	0.9	325	85
ST86-060	-2	7.0	3	480	-2	16	125	105	3.59	20	500	-3	71	14	N/A	N/A	52	0.4	272	63
ST86-063	-2	1.5	1	490	-2	8	77	30	2.37	12	525	-3	36	10	N/A	N/A	46	-0.1	342	39
ST86-067	-2	2.5	28	490	-2	10	82	31	2.60	14	480	-3	41	11	N/A	N/A	51	0.2	317	35
ST86-068	-2	2.5	14	532	-2	13	83	45	3.03	14	535	-3	42	15	N/A	N/A	50	0.1	308	40
ST86-069	-2	8.0	9	483	-2	19	99	72	3.44	13	500	-3	58	13	N/A	N/A	45	0.2	296	40
ST86-070	-2	4.0	7	557	-2	14	85	44	3.00	18	525	-3	48	14	N/A	N/A	54	0.1	300	54
ST86-072B	-2	6.5	14	438	-2	9	83	34	3.25	13	355	-3	40	10	N/A	N/A	43	0.3	275	31
ST86-072C	-2	14.0	6	542	-2	11	115	62	2.55	15	540	-3	67	11	N/A	N/A	53	0.4	302	45
ST86-074	-2	3.5	6	522	-2	13	105	29	2.73	13	455	-3	60	10	N/A	N/A	49	0.3	308	34
ST86-076	-2	9.0	13	487	-2	20	171	84	4.15	20	645	-3	96	13	N/A	N/A	43	0.4	271	51
ST86-077A	-2	16.0	6	487	-2	23	130	84	4.01	15	810	-3	77	16	N/A	N/A	45	0.5	305	46
ST86-077B	-2	4.5	5	518	-2	12	110	45	2.84	12	550	-3	59	5	N/A	N/A	46	0.2	305	39
ST86-079	-2	6.5	14	513	-2	15	132	56	2.94	14	580	-3	71	13	N/A	N/A	52	0.4	304	47
ST86-081	-2	6.0	3	528	-2	12	105	35	2.68	13	495	-3	59	5	N/A	N/A	48	0.6	307	36
ST86-082	-2	12.0	7	482	-2	16	112	37	3.14	15	480	-3	68	11	N/A	N/A	45	0.5	278	55
ST86-083	-2	6.0	2	510	-2	11	96	14	2.64	9	370	-3	31	11	N/A	N/A	51	0.2	325	27
ST86-084	-2	19.0	12	583	-2	24	146	70	5.35	22	1440	-3	85	12	N/A	N/A	64	2.0	279	75
ST86-085	-2	4.0	18	536	-2	12	94	31	2.78	14	460	-3	43	10	N/A	N/A	56	0.3	305	36
ST86-087	-2	2.5	5	542	-2	14	158	62	3.18	13	610	-3	82	5	N/A	N/A	47	0.1	306	42
ST86-088	-2	4.0	7	510	-2	19	199	110	3.70	13	740	-3	103	11	N/A	N/A	45	0.1	305	53

Note: for analytical techniques used and elements analysed see appendix cover page

Sample	Ag	As	Au	Ba	Cd	Co	Cr	Cu	Fe	Li	Mn	Mo	Ni	Pb	Pd	Pt	Rb	Sb	Sr	Zn
	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppb	ppb	ppm	ppm	ppm	ppm
ST86-089	-2	3.0	4	526	-2	17	164	43	3.24	13	505	-3	86	5	N/A	N/A	49	0.1	297	40
ST86-090	-2	110.0	16	408	-2	56	980	308	7.80	22	1360	-3	555	24	N/A	N/A	53	8.9	181	1490
ST86-100	-2	5.5	18	512	-2	17	108	39	2.60	10	535	-3	59	10	N/A	N/A	48	0.3	308	37
ST86-101	-2	4.0	1	502	-2	14	104	49	2.82	10	610	-3	62	11	N/A	N/A	46	0.3	300	38
ST86-102	-2	3.0	10	552	-2	13	101	30	2.58	11	530	-3	48	10	N/A	N/A	54	0.1	322	35
ST86-103	-2	2.0	3	502	-2	12	100	41	2.21	10	460	-3	50	5	N/A	N/A	48	0.1	318	34
ST86-104	-2	6.0	8	507	-2	16	114	37	2.63	12	570	-3	57	5	N/A	N/A	49	0.4	299	39
ST86-105	-2	2.0	8	507	-2	10	85	17	1.84	8	375	-3	37	5	N/A	N/A	43	0.2	270	27
ST86-106	-2	3.5	23	502	-2	13	94	18	2.38	11	330	-3	44	5	N/A	N/A	48	0.2	295	29
ST86-107A	-2	2.5	1	512	-2	10	63	31	2.10	10	420	-3	26	10	N/A	N/A	47	0.1	342	35
ST86-107B	-2	4.5	5	512	-2	13	69	35	2.65	13	510	-3	31	10	N/A	N/A	45	0.1	324	45
ST86-108A	-2	0.5	1	581	-2	8	58	28	1.97	10	398	-3	23	5	N/A	N/A	48	0.1	302	35
ST86-108B	-2	1.0	1	576	-2	10	63	27	2.25	14	445	-3	31	10	N/A	N/A	54	-0.1	316	41
ST86-109	-2	9.5	8	478	-2	16	114	52	3.02	13	635	-3	66	5	N/A	N/A	46	0.5	295	48
ST86-110	-2	5.0	2	522	-2	14	109	71	2.75	12	545	-3	62	5	N/A	N/A	48	0.3	307	49
ST86-111	-2	6.5	23	533	-2	15	102	54	3.08	13	530	-3	58	5	N/A	N/A	47	0.3	304	45
ST86-112	-2	28.0	6	569	-2	22	112	54	3.77	17	690	-3	65	12	N/A	N/A	53	0.5	269	48
ST86-113	-2	25.5	24	468	-2	38	375	62	4.08	23	830	-3	265	12	N/A	N/A	43	2.5	254	106
ST86-114	-2	11.5	7	512	-2	15	118	59	2.57	14	545	-3	61	10	N/A	N/A	47	0.5	296	47
ST86-115	-2	3.0	6	438	-2	15	139	36	3.48	22	388	-3	61	10	N/A	N/A	36	0.5	246	51
ST86-116	-2	11.0	2	510	-2	20	144	31	2.93	18	705	-3	76	10	N/A	N/A	52	0.5	263	56
ST86-117	-2	9.0	13	555	-2	20	162	180	4.15	19	710	-3	105	17	N/A	N/A	55	0.3	283	81
ST86-118	-2	3.5	1	510	-2	10	82	33	2.08	8	430	-3	39	10	N/A	N/A	46	0.1	315	30
ST86-119	-2	3.5	1	553	-2	11	79	40	2.51	11	443	-3	46	11	N/A	N/A	50	0.1	312	40
ST86-120	-2	3.0	4	553	-2	10	78	37	2.42	11	425	-3	39	12	N/A	N/A	55	0.1	328	40
ST86-121	-2	7.5	6	510	-2	15	121	67	2.93	12	545	-3	65	12	N/A	N/A	44	0.4	303	80
ST86-122	-2	12.0	7	528	-2	15	117	88	3.29	12	665	-3	70	10	N/A	N/A	48	0.5	313	71
ST86-123	-2	7.0	4	472	-2	12	91	66	2.70	10	475	-3	49	10	N/A	N/A	46	0.3	307	49
ST86-124	-2	6.5	1	492	-2	17	139	71	3.42	12	620	-3	72	10	N/A	N/A	45	0.2	298	51
ST86-125	-2	12.5	12	482	-2	28	131	197	4.50	18	1180	-3	72	14	N/A	N/A	50	0.5	302	72
BH87-1A	-2	2.5	5	540	N/A	14	126	34	2.62	13	475	-3	68	5	-1	-1	N/A	-0.1	N/A	37
BH87-1B	-2	2.0	3	505	N/A	14	128	31	2.86	13	455	-3	77	5	-1	2	N/A	-0.1	N/A	39
BH87-2A	-2	2.5	2	556	N/A	13	114	23	2.71	13	435	-3	60	5	-1	-1	N/A	-0.1	N/A	34
BH87-2B	-2	1.5	1	510	N/A	12	119	25	2.59	16	440	-3	64	10	-1	-1	N/A	-0.1	N/A	39
BH87-3	-2	2.0	9	594	N/A	15	113	68	2.47	19	400	-3	53	11	-1	-1	N/A	-0.1	N/A	38
BH87-4A	-2	2.0	3	567	N/A	11	96	22	2.27	12	365	-3	50	10	-1	-1	N/A	-0.1	N/A	28
BH87-4B	-2	2.0	13	546	N/A	11	116	33	2.48	14	390	-3	67	5	-1	-1	N/A	-0.1	N/A	35
BH87-5A	-2	2.0	4	551	N/A	11	100	18	2.32	13	355	-3	45	10	-1	-1	N/A	-0.1	N/A	29
BH87-5B	-2	4.0	5	541	N/A	17	151	47	3.18	17	500	-3	87	11	-1	-1	N/A	0.1	N/A	45
BH87-6	-2	3.5	7	523	N/A	10	84	28	2.25	12	355	-3	41	12	-1	-1	N/A	0.1	N/A	29
BH87-7A	-2	2.5	15	508	N/A	11	94	21	2.13	14	420	-3	56	5	-1	-1	N/A	-0.1	N/A	33
BH87-7B	-2	2.5	6	543	N/A	8	71	24	1.92	10	305	-3	35	10	-1	-1	N/A	-0.1	N/A	24
BH87-7C	-2	2.0	7	518	N/A	11	89	17	2.15	11	365	-3	49	12	-1	-1	N/A	0.1	N/A	27

Note: for analytical techniques used and elements analysed see appendix cover page

Sample	Ag ppm	As ppm	Au ppb	Ba ppm	Cd ppm	Co ppm	Cr ppm	Cu ppm	Fe %	Li ppm	Mn ppm	Mo ppm	Ni ppm	Pb ppm	Pd ppb	Pt ppb	Rb ppm	Sb ppm	Sr ppm	Zn ppm
BH87-9	-2	7.5	13	518	N/A	17	101	28	2.76	12	430	-3	78	5	-1	-1	N/A	0.1	N/A	35
BH87-10B	-2	3.5	4	508	N/A	13	97	19	2.33	11	380	-3	72	5	-1	-1	N/A	-0.1	N/A	32
BH87-11B	-2	4.5	2	539	N/A	14	91	28	2.74	12	485	-3	55	13	-1	-1	N/A	-0.1	N/A	40
BH87-12A	-2	2.0	3	570	N/A	12	107	19	2.40	12	400	-3	59	10	-1	-1	N/A	-0.1	N/A	29
BH87-12B	-2	2.0	2	539	N/A	13	125	26	2.75	15	440	-3	81	11	-1	-1	N/A	-0.1	N/A	41
BH87-13	-2	6.0	3	505	N/A	13	82	33	2.46	15	405	-3	40	14	-1	-1	N/A	0.2	N/A	36
BH87-14	-2	3.5	4	552	N/A	12	103	22	2.19	13	370	-3	53	12	-1	-1	N/A	0.1	N/A	40
ST87-007	-2	3.0	5	498	N/A	14	99	48	2.81	11	445	-3	48	10	-1	-1	N/A	0.1	N/A	39
ST87-009	-2	13.0	4	473	N/A	17	88	28	2.78	11	450	-3	46	10	-1	-1	N/A	0.3	N/A	39
SL87-011	-2	7.0	3	493	N/A	21	134	53	2.54	10	485	N/A	127	14	-1	-1	N/A	-0.1	N/A	96
SL87-012	-2	3.5	1	478	N/A	13	105	21	2.33	9	485	N/A	55	14	-1	-1	N/A	-0.1	N/A	31
SL87-013	-2	5.0	12	457	N/A	14	93	42	2.58	11	580	N/A	52	11	-1	-1	N/A	0.1	N/A	30
SL87-016	-2	4.0	2	493	N/A	13	118	33	2.51	10	510	N/A	73	10	-1	-1	N/A	-0.1	N/A	44
SL87-018	-2	8.5	4	475	N/A	12	76	15	2.30	9	450	N/A	38	11	-1	-1	N/A	0.2	N/A	24
SL87-022	-2	2.0	1	475	N/A	10	83	20	2.13	9	425	N/A	38	11	-1	-1	N/A	-0.1	N/A	27
SL87-036	-2	2.0	2	542	N/A	12	90	36	2.17	13	430	N/A	41	13	-1	-1	N/A	-0.1	N/A	27
SL87-038	-2	1.5	5	527	N/A	9	78	14	1.84	10	360	N/A	32	11	-1	-1	N/A	-0.1	N/A	23
SL87-069	-2	2.5	4	492	N/A	13	116	23	2.56	11	460	N/A	73	12	-1	-1	N/A	-0.1	N/A	30
SL87-075	-2	2.0	6	492	N/A	10	88	20	2.08	9	410	N/A	46	11	-1	-1	N/A	-0.1	N/A	24
SL87-080	-2	2.0	18	513	N/A	8	76	13	1.89	8	370	N/A	35	11	-1	-1	N/A	-0.1	N/A	21
SL87-082	-2	4.0	7	497	N/A	13	86	15	2.30	9	475	N/A	43	11	-1	-1	N/A	-0.1	N/A	25
SL87-086	-2	5.0	1	508	N/A	11	79	18	2.30	7	395	N/A	42	11	-1	-1	N/A	-0.1	N/A	23
SL87-090	-2	2.0	7	438	N/A	10	78	13	1.98	7	375	N/A	40	11	-1	-1	N/A	-0.1	N/A	23
SL87-096	-2	2.5	2	463	N/A	11	88	16	2.05	8	440	N/A	48	12	-1	-1	N/A	-0.1	N/A	24
SL87-098	-2	12.0	3	429	N/A	14	75	24	2.28	6	460	N/A	38	11	-1	-1	N/A	0.1	N/A	22
SL87-100	-2	6.5	2	498	N/A	14	93	32	2.45	8	435	N/A	54	12	-1	-1	N/A	-0.1	N/A	26
SL87-102	-2	1.5	6	557	N/A	11	57	33	2.26	13	390	N/A	29	10	-1	-1	N/A	-0.1	N/A	36
Sl87-105	-2	2.0	2	502	N/A	11	66	24	2.22	10	415	N/A	32	13	-1	-1	N/A	-0.1	N/A	57
SL87-107	-2	1.5	1	483	N/A	11	56	17	2.32	13	420	N/A	24	11	-1	-1	N/A	-0.1	N/A	31
SL87-132	-2	3.5	7	483	N/A	14	85	33	2.44	11	455	N/A	45	11	-1	-1	N/A	-0.1	N/A	39
SL87-133A	-2	2.5	11	564	N/A	14	100	54	3.14	16	480	N/A	61	12	-1	-1	N/A	-0.1	N/A	54
SL87-133B	-2	2.0	1	539	N/A	12	88	38	2.69	12	435	N/A	41	13	-1	-1	N/A	-0.1	N/A	41
SL87-134	-2	1.5	1	579	N/A	12	56	22	2.03	7	360	N/A	28	12	-1	-1	N/A	-0.1	N/A	42
SL87-136	-2	1.5	3	629	N/A	12	62	22	2.22	9	390	N/A	29	14	-1	-1	N/A	-0.1	N/A	31
SL87-141	-2	2.0	1	516	N/A	10	84	17	2.00	9	340	N/A	43	11	-1	-1	N/A	-0.1	N/A	23
SL87-157	-2	4.0	6	547	N/A	14	68	20	2.48	10	520	N/A	33	12	-1	-1	N/A	0.1	N/A	35
SL87-161	-2	2.5	2	511	N/A	14	99	24	2.44	9	495	N/A	48	10	-1	1	N/A	-0.1	N/A	32
SL87-164	-2	2.0	33	715	N/A	15	86	66	3.34	23	505	N/A	47	11	-1	-1	N/A	-0.1	N/A	71
SL87-219A	-2	3.5	3	476	N/A	13	99	35	2.28	8	393	N/A	45	11	-1	1	N/A	-0.1	N/A	28
SL87-219B	-2	3.5	2	469	N/A	10	79	23	2.02	7	345	N/A	38	11	-1	-1	N/A	-0.1	N/A	23
SL87-221	-2	4.0	11	510	N/A	13	96	32	2.22	10	430	N/A	50	10	-1	1	N/A	-0.1	N/A	29
SL87-229	-2	5.0	5	472	N/A	20	126	27	3.11	11	600	-3	70	10	-1	1	N/A	0.2	N/A	31
SL87-272	-2	2.0	10	482	N/A	11	67	27	2.54	10	480	-3	36	5	4	3	N/A	0.1	N/A	29

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Sample	Ag ppm	As ppm	Au ppb	Ba ppm	Cd ppm	Co ppm	Cr ppm	Cu ppm	Fe %	Li ppm	Mn ppm	Mo ppm	Ni ppm	Pb ppm	Pd ppb	Pt ppb	Rb ppm	Sb ppm	Sr ppm	Zn ppm
SL87-290	-2	2.0	2	514	N/A	13	78	65	3.27	9	525	-3	35	5	2	-1	N/A	0.1	N/A	37
SL87-322	-2	5.0	3	498	N/A	22	213	37	3.90	16	710	-3	92	17	-1	-1	N/A	0.1	N/A	67
SL87-353	-2	3.5	1	535	N/A	17	142	41	3.55	15	610	-3	95	5	-1	-1	N/A	0.1	N/A	43
SL87-356	-2	2.5	5	477	N/A	13	98	27	2.81	12	510	-3	61	5	-1	-1	N/A	0.1	N/A	30
SL87-357	-2	2.5	5	477	N/A	9	70	23	2.43	8	435	-3	40	5	-1	-1	N/A	0.1	N/A	24
SL87-358	-2	3.0	2	467	N/A	12	69	18	2.38	8	438	-3	41	5	-1	-1	N/A	0.1	N/A	22
SL87-361	-2	2.5	16	467	N/A	11	76	24	2.16	8	430	-3	48	11	-1	-1	N/A	0.1	N/A	22
SL87-363	-2	2.0	2	420	N/A	22	101	76	3.85	14	1105	-3	58	5	-1	-1	N/A	0.4	N/A	36
SL87-364	-2	6.5	10	462	N/A	12	90	250	2.98	12	700	-3	52	10	-1	-1	N/A	0.3	N/A	34
SL87-383	-2	1.0	1	745	N/A	14	65	37	2.85	10	490	-3	30	10	-1	-1	N/A	0.1	N/A	50
SL87-394	-2	1.5	8	493	N/A	14	112	32	2.54	11	485	-3	72	5	-1	-1	N/A	0.1	N/A	29
SL87-395	-2	1.5	1	522	N/A	7	52	8	1.91	13	295	-3	22	10	-1	-1	N/A	0.1	N/A	25
SL87-411	-2	1.5	2	513	N/A	12	67	23	2.57	11	540	-3	34	5	-1	-1	N/A	0.1	N/A	32
Sl87-412	-2	1.0	1	478	N/A	11	60	42	2.71	11	433	-3	29	5	-1	-1	N/A	0.1	N/A	37
SL87-415	-2	1.0	1	485	N/A	10	51	32	2.91	11	428	-3	25	5	-1	-1	N/A	0.1	N/A	42
SL87-416	-2	1.5	4	475	N/A	11	52	17	2.53	8	380	-3	26	5	-1	-1	N/A	0.1	N/A	28
SL87-418	-2	1.5	3	540	N/A	10	60	27	2.08	14	280	-3	27	12	-1	-1	N/A	-0.1	N/A	29
SL87-423	-2	3.5	1	516	N/A	20	86	25	2.48	20	510	-3	63	11	-1	-1	N/A	0.1	N/A	33
SL87-439	-2	1.5	10	478	N/A	13	78	22	2.09	11	430	-3	39	10	1	-1	N/A	0.1	N/A	25
SL87-440	-2	2.0	26	478	N/A	10	75	16	2.21	13	340	-3	37	10	-1	-1	N/A	0.1	N/A	30
SL87-450	-2	1.0	1	556	N/A	11	65	18	2.45	14	415	-3	25	12	-1	-1	N/A	-0.1	N/A	31
SL87-451	-2	1.0	1	600	N/A	12	62	20	2.30	16	370	-3	28	13	-1	-1	N/A	-0.1	N/A	34
SL87-452	-2	6.0	1	575	N/A	11	50	20	3.06	9	350	-3	21	5	-1	-1	N/A	-0.1	N/A	37
SL87-458	-2	2.5	1	585	N/A	11	81	16	2.32	14	410	-3	37	5	-1	-1	N/A	0.1	N/A	36
SL87-461	-2	2.0	1	610	N/A	32	108	99	4.80	17	760	-3	52	13	-1	-1	N/A	-0.1	N/A	59
SL87-513	-2	2.0	1	466	N/A	11	59	23	2.26	16	335	-3	32	11	-1	-1	N/A	0.1	N/A	27
Sl87-514	-2	1.0	1	532	N/A	9	51	23	1.91	13	390	-3	21	5	-1	-1	N/A	0.1	N/A	25
Sl87-517	-2	3.0	5	556	N/A	13	70	47	2.59	14	520	-3	42	10	-1	-1	N/A	0.1	N/A	40
SL87-518	-2	2.0	70	525	N/A	14	67	30	2.56	15	555	-3	42	11	-1	-1	N/A	0.1	N/A	36
SL87-521	-2	2.0	5	488	N/A	14	114	21	2.53	10	555	-3	91	5	-1	-1	N/A	0.1	N/A	27
SL87-527	-2	2.0	1	494	N/A	12	90	12	2.11	9	435	-3	51	10	-1	-1	N/A	0.1	N/A	23
SL87-528	-2	1.0	2	640	N/A	13	54	17	2.52	12	350	-3	26	5	-1	-1	N/A	-0.1	N/A	41
SL87-546	-2	2.5	13	610	N/A	13	88	25	2.24	10	375	-3	53	10	-1	-1	N/A	-0.1	N/A	28
SL87-547	-2	1.0	1	537	N/A	10	78	11	1.96	9	350	-3	36	11	-1	-1	N/A	-0.1	N/A	24
SL87-548	-2	2.0	1	513	N/A	12	85	13	2.15	9	340	-3	44	10	-1	-1	N/A	-0.1	N/A	24
SL87-551	-2	2.5	1	598	N/A	14	105	47	3.00	11	455	-3	67	11	-1	-1	N/A	-0.1	N/A	39
SL87-552	-2	1.5	5	613	N/A	10	76	11	2.02	7	365	-3	46	10	-1	-1	N/A	-0.1	N/A	22
SL87-555	-2	3.0	38	613	N/A	14	103	20	2.62	10	510	-3	54	10	-1	-1	N/A	-0.1	N/A	31
SL87-559	-2	2.0	4	607	N/A	10	78	18	2.00	14	300	-3	40	13	-1	-1	N/A	0.1	N/A	35
SL87-560	-2	2.0	4	548	N/A	13	85	25	2.52	15	390	-3	41	13	-1	-1	N/A	0.1	N/A	34
SL87-561	-2	28.0	6	443	N/A	19	105	46	3.60	17	560	-3	59	11	-1	1	N/A	0.7	N/A	45

Note: for analytical techniques used and elements analysed see appendix cover page

Sample	Ag ppm	As ppm	Au ppb	Ba ppm	Cd ppm	Co ppm	Cr ppm	Cu ppm	Fe %	Li ppm	Mn ppm	Mo ppm	Ni ppm	Pb ppm	Pd ppb	Pt ppb	Rb ppm	Sb ppm	Sr ppm	Zn ppm
AVERAGE		7.1	8.2	518		15	107	47	2.80	13		533		60	11		49		297	50
MAXIMUM		110	130	745		65	980	450	7.80	28		2275		555	34		64		342	1490
MINIMUM		0.5	1	408		7	50	8	1.84	6		280		21	5		36		181	21
STD.DEV.		13.8	14	48		7.3	78	51	0.818	4		259		49	4		4.1		23.7	113
No.below detection limit		1	34											20						

APPENDIX E: Gowganda area sample results

Note: for analytical techniques used and elements analysed see appendix cover page

Sample	Ag ppm	As ppm	Au ppb	Ba ppm	Be ppm	Bi ppm	Co ppm	Cr ppm	Cu ppm	Fe %	Li ppm	Mn ppm	Mo ppm	Ni ppm	Pb ppm	Pd ppb	Pt ppb	Sb ppm	Sc ppm	Sr ppm	V ppm	Y ppm	Zn ppm
GW89-004	-2	2.5	6	427	-1	100	10	84	25	1.91	9	635	-10	39	10	-1	-1	0.2	8	287	51	9	26
GW89-008	-2	13.0	6	463	1	160	17	115	39	1.91	10	840	-10	78	13	-1	1	2.4	11	276	57	10	35
GW89-011	-2	4.0	20	448	1	120	14	86	20	2.14	11	705	-10	52	13	-1	-1	0.2	8	253	51	10	30
GW89-030A	-2	5.5	17	419	1	220	20	90	32	2.72	18	935	-10	41	12	-1	-1	0.3	10	238	72	9	40
GW89-030B	-2	6.0	2	392	1	180	23	157	74	3.10	18	1180	-10	60	18	-1	1	0.5	15	255	102	11	61
GW89-048	-2	4.5	2	459	1	130	13	80	37	2.30	11	850	-10	32	16	-1	-1	0.2	9	314	64	9	37
GW89-057	-2	3.0	20	407	-1	100	11	65	30	1.89	8	720	-10	24	-10	-1	-1	0.1	8	327	56	9	29
GW89-071	-2	4.5	4	410	1	250	16	96	27	2.73	28	740	-10	40	-10	3	5	0.5	11	171	82	10	45
GW89-085	-2	2.0	2	223	-1	70	2.5	28	8	0.85	5	220	-10	9	-10	-1	-1	0.1	4	142	24	6	8
GW89-095	-2	3.5	4	428	1	120	11	82	21	1.56	10	485	-10	50	10	-1	-1	1.1	8	265	47	8	20
GW89-115	-2	4.0	5	304	-1	80	33	231	75	4.03	20	1880	-10	99	14	-1	1	0.3	24	235	142	12	75
GW89-117	-2	7.5	1	500	1	210	20	173	70	2.63	16	1070	-10	50	25	-1	-1	2.2	13	328	85	12	72
GW89-119	-2	16.0	5	427	-1	1500	17	90	33	2.91	9	985	-10	33	22	-1	-1	0.5	11	359	78	11	39
GW89-127	-2	6.0	7	552	1	170	7	91	11	1.90	10	240	-10	-10	20	-1	-1	3.9	4	89	39	6	12
GW89-128	-2	2.5	1	446	1	130	10	74	17	2.02	13	570	-10	31	11	-1	-1	0.2	8	282	51	8	25
GW89-138	-2	2.5	8	489	1	110	13	101	30	2.53	16	650	-10	46	13	-1	-1	0.2	9	266	58	9	36
GW89-151	-2	20.0	29	439	1	170	18	102	77	2.81	15	730	-10	59	74	-1	-1	0.3	9	256	57	11	134
GW89-159	-2	2.5	2	467	-1	260	10	219	41	1.77	10	640	-10	24	15	-1	-1	0.4	8	292	69	10	35
GW89-172	-2	5.0	10	362	1	150	10	110	41	1.88	12	580	-10	23	-10	-1	-1	0.3	8	219	54	8	24
GW89-185	-2	5.5	1	535	1	130	22	86	39	3.21	19	730	-10	44	21	-1	2	0.2	11	202	87	11	35
GW89-195	-2	2.0	2	482	-1	90	8	58	9	1.65	11	645	-10	23	11	-1	11	0.05	8	291	47	9	26
GW89-196	-2	3.0	11	470	1	170	12	62	23	1.91	9	725	-10	25	14	-1	2	0.3	8	297	53	9	27
GW89-200	-2	1.5	3	443	-1	150	9	129	29	1.69	9	570	-10	22	-10	-1	-1	0.2	7	233	50	7	23
GW89-218	-2	2.0	2	447	-1	100	9	56	18	1.97	9	575	-10	21	12	-1	2	0.2	8	273	54	9	23
GW89-228	-2	2.5	2	454	1	220	10	170	28	1.63	9	630	-10	33	13	-1	-1	0.3	8	277	50	9	25
GW89-229	-2	3.5	1	481	1	220	13	194	38	2.04	17	750	-10	44	-10	-1	-1	0.3	9	266	56	10	32
GW89-230	-2	3.5	5	446	1	140	14	80	23	1.97	12	705	-10	45	12	-1	-1	0.3	8	265	52	8	26
GW89-238	-2	3.0	1	435	1	150	6	43	10	1.44	8	365	-10	17	-10	-1	-1	0.3	5	184	38	7	14
SI.89-246	-2	15.0	1	450	-1	260	12	210	22	1.88	9	810	-10	52	-10	-1	-1	0.3	9	309	53	9	25
SI.89-247	-2	19.0	5	452	-1	70	15	86	25	2.25	10	890	-10	49	10	-1	-1	0.5	8	285	58	9	23
AVERAGE		5.8	6	439	198	13	108	32	2.17	12	735	40		0.6	9	258	61	9	35				
MAXIMUM		20.0	29	552	1500	33	231	77	4.03	28	1880	99		3.9	24	359	142	12	134				
MINIMUM		1.5	1	223	70	3	28	8	0.85	5	220	9		0.05	4	89	24	6	8				
STD.DEV.		5.1	7	61	248	6	52	19	0.62	5	297	19		0.8	4	56	22	2	24				
No.below detection limit			6			1						1.0											

Aultman Samples, Churchill Township

Sample	Ag ppm	As ppm	Au ppb	Ba ppm	Cd ppm	Co ppm	Cr ppm	Cu ppm	Fe %	Li ppm	Mn ppm	Mo ppm	Ni ppm	Pb ppm	Pd ppm	Pt ppb	Rb ppb	Sb ppm	Sr ppm	Zn ppm
JTA-1A	-2	19.0	23	533	N/A	20	129	55	3.16	16	650	-10	72	10	-1	7	N/A	0.8	N/A	56
JTA-1B	-2	28.0	21	549	N/A	31	123	75	3.71	18	1015	-10	73	10	-1	-1	N/A	0.9	N/A	60
JTA-2	-2	55.0	19	462	N/A	50	132	104	3.93	18	1230	-10	86	10	-1	7	N/A	1.2	N/A	65
JTA-3A	-2	16.0	3	462	N/A	19	134	45	2.90	14	620	-10	81	12	-1	-1	N/A	0.5	N/A	75
JTA-3B	-2	13.0	5	431	N/A	21	132	69	2.83	14	670	-10	74	10	-1	1	N/A	0.4	N/A	80
JTA-4	-2	47.0	36	411	N/A	36	166	82	5.05	16	1165	-10	85	22	-1	1	N/A	1.1	N/A	78
JTA-5	-2	14.0	21	492	N/A	19	133	52	3.01	15	640	-10	69	13	-1	1	N/A	0.5	N/A	63
JTA-6	-2	16.0	19	517	N/A	15	120	72	2.84	15	565	-10	62	12	-1	-1	N/A	0.4	N/A	54
JTA-7	-2	9.0	6	492	N/A	26	170	76	3.44	17	830	-10	108	16	-1	2	N/A	0.7	N/A	120
JTA-8A	-2	15.0	5	451	N/A	24	137	46	3.22	14	790	-10	68	13	1	1	N/A	0.7	N/A	73
JTA-9	-2	18.0	3	447	N/A	19	159	38	3.16	17	615	-10	93	10	-1	-1	N/A	0.6	N/A	105
JTA-11	-2	22.0	8	427	N/A	25	144	71	3.34	13	790	-10	84	10	-1	-1	N/A	0.7	N/A	106
JTA-12	-2	16.0	13	481	N/A	20	127	65	2.94	13	695	-10	66	10	-1	-1	N/A	0.6	N/A	73
JTA-14	-2	17.0	200	532	N/A	25	111	57	3.36	15	1075	-10	56	5	-1	-1	N/A	0.7	N/A	50
JTA-16	-2	21.0	27	491	N/A	29	134	57	3.75	18	1090	-10	75	5	-1	-1	N/A	0.7	N/A	67
JTA-17	-2	11.0	5	501	N/A	19	121	57	2.60	16	665	-10	70	5	-1	-1	N/A	0.6	N/A	60
AVERAGE		21.1	26	480		25	136	64	3.33	16	819		76	8				0.7		74
MAXIMUM		55.0	200	549		50	170	104	5.05	18	1230		108	22				1.2		120
MINIMUM		9.0	3	411		15	111	38	2.60	13	565		56	5				0.4		50
STD.DEV.		12.2	46	40		8	16	16	0.57	2	214		12	4				0.2		20
No.below detection limit														3						

APPENDIX F

INA Analyses of Non-Magnetic and Magnetic Fractions of HMC Samples

Instrumental Neutron Activation Analysis (INA Analysis) of the entire unground non-magnetic or magnetic heavy mineral concentrate was carried out by Bondar-Clegg & Co. Ltd., Ottawa, Ontario. Detection limits for the various elements are as follows:

Ag	Silver	5 ppm
As	Arsenic	1 ppm
Au	Gold	5 ppb
Ba	Barium	100 ppm
Br	Bromine	1 ppm
Cd	Cadmium	10 ppm
Ce	Cerium	10 ppm
Co	Cobalt	10 ppm
Cr	Chromium	50 ppm
Cs	Cesium	1 ppm
Eu	Europium	2 ppm
Fe	Iron	0.5 percent
Hf	Hafnium	2 ppm
Ir	Iridium	100 ppm
La	Lanthanum	5 ppm
Lu	Lutetium	0.5 ppm
Mo	Molybdenum	2 ppm
Na	Sodium	0.05 percent
Ni	Nickel	20 ppm
Rb	Rubidium	10 ppm
Sb	Antimony	0.2 ppm
Sc	Scandium	0.5 ppm
Se	Selenium	10 ppm
Sm	Samarium	0.2 ppm
Sn	Tin	200 ppm
Ta	Tantalum	1 ppm
Tb	Terbium	1 ppm
Te	Tellurium	20 ppm
Th	Thorium	0.5 ppm
U	Uranium	0.5 ppm
W	Tungsten	2 ppm
Yb	Ytterbium	5 ppm
Zn	Zinc	200 ppm
Zr	Zirconium	500 ppm

APPENDIX F: INA Analysis of non-magnetic HMC samples, Shining Tree Area

Sample	Ag	As	Au	Ba	Ce	Co	Cr	Eu	Fe	Hf	La	Lu	Mo	Na	Ni	Sb	Sc	Se	Sm	Sn	Ta	Tb	Th	U	W	Yb	Zn	Zr	Wt
Number	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	pct	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	g
BH86-1	-5	4	731	-100	720	40	2500	5	20	203	350	3.3	-2	0.29	39	0.5	94.4	-10	59.8	-200	12	7	151	19	6	26	-200	8800	16.07
BH86-2	-5	6	190	-100	550	46	2600	4	20	180	270	3.2	-2	0.27	21	0.6	96	-10	50.4	-200	9	6	109	16	6	23	-200	7000	17.15
BH86-5	-5	4	1020	-100	920	41	1900	-2	20	228	460	3.6	-2	0.25	-20	0.3	92.4	-10	73.8	-200	12	8	210	23	7	26	-200	9200	18.44
ST86-005	-5	3	120	-100	760	41	2400	5	21	218	350	3.3	-2	0.32	-20	0.5	98.5	-10	60.9	-200	10	6	156	19	6	27	-200	9300	12.46
ST86-006A	-5	5	1690	-100	850	41	1900	5	19	212	410	3.2	-2	0.3	-20	0.5	94	-10	66.7	-200	12	6	180	22	-6	26	-200	8200	17.05
ST86-006B	-5	3	62	130	780	43	1700	6	19	230	350	3.1	-2	0.26	59	0.4	95.8	-10	63.9	-200	13	7	147	22	-6	26	-200	8800	12.12
ST86-009	-5	1	39	-100	1190	34	2100	4	19	259	606	2.9	-2	0.16	-20	0.7	88.5	-10	86	-200	13	7	227	28	12	25	-200	12000	13.76
ST86-015	-5	6	991	-100	690	37	2400	4	18	210	350	2.9	-2	0.3	23	0.4	84.3	-10	64.1	-200	11	7	166	21	-6	22	-200	9200	14.31
ST86-016	-5	29	1160	-100	390	81	10400	3	20	94	180	2.7	-2	0.23	120	1.8	86.3	-10	38	-200	8	5	73.7	10	10	19	-200	4400	21.99
ST86-021	-5	7	200	-100	540	54	1300	4	21	130	230	2.5	-2	0.34	27	0.8	90.6	-10	44	-200	9	5	93.7	13	6	20	-200	5200	7.34
ST86-024	-5	14	840	-100	700	53	4100	5	19	201	310	3.5	-2	0.25	45	0.8	101	-10	55	-200	10	6	128	18	22	28	-200	7800	11.63
ST86-027	-5	5	778	-100	740	45	5380	3	20	237	350	3.7	-2	0.35	-20	1.3	102	-10	57.8	-200	12	6	158	20	-6	28	-200	9500	14.93
ST86-030	-5	7	558	-100	530	47	3900	6	18	200	250	3.2	-2	0.3	21	0.7	96.2	-10	47	-200	9	5	97.4	16	19	25	-200	8500	18.7
ST86-033	-5	8	240	-100	600	53	6290	6	20	222	270	3.3	-2	0.24	36	0.6	97.7	-10	45	-200	10	5	107	17	-6	25	-200	8800	6.64
ST86-037	-5	4	290	-100	640	48	2500	5	21	200	300	3.2	-2	0.19	23	0.6	100	-10	52.2	-200	10	6	126	17	-6	25	-200	8300	13.11
ST86-039	-5	12	190	-100	610	56	3600	3	19	180	270	2.6	-2	0.34	50	0.8	91.1	-10	46	-200	8	5	111	16	-7	19	-200	7100	5.58
ST86-042	-5	24	7800	-100	430	67	2000	4	20	120	190	2.1	-2	0.2	57	1.9	81.2	-10	40	-200	6	5	80.3	11	12	18	-200	5200	9.74
ST86-043	-5	6	1140	-100	600	46	2400	4	18	217	290	2.7	-2	0.31	-20	1	87.8	-10	54.9	-200	10	6	138	20	-6	21	-200	9700	15.48
ST86-048	-5	11	92	-100	460	67	2300	4	22	150	200	2.6	-2	0.29	72	1.1	86.7	-10	37	-200	8	4	83.1	12	-6	20	-200	6400	11
ST86-049	-5	27	1490	-100	460	49	2200	3	20	130	210	2.7	-2	0.24	60	2.3	90	-10	36	-200	7	5	90.9	12	-6	21	210	4800	6.5
ST86-057	-5	1	1740	-100	1060	37	1400	5	21	216	539	4.2	-2	0.39	-20	0.3	107	-10	87.2	-200	15	8	234	26	18	30	-200	9000	32.29
ST86-059	-5	5	190	-100	720	43	2100	7	20	190	330	3.4	-2	0.2	-20	0.7	103	-10	59.5	-200	10	6	141	18	-6	26	-200	7300	20.58
ST86-060	-5	5	270	-100	650	41	4200	3	21	204	290	3.5	-2	0.25	35	0.6	109	-10	48	-200	11	6	124	16	12	25	-200	8200	10.37
ST86-063	-5	0.5	1040	-100	800	38	870	12	18	180	340	3.4	-2	0.12	-20	0.4	97.7	-10	82.8	-200	11	9	126	20	-6	27	-200	7000	9.3
ST86-067	-5	0.5	44	-100	700	33	1600	5	19	190	330	3.5	-2	0.3	-20	0.2	100	-10	58.4	-200	11	6	140	19	-6	26	-200	7900	28.67
ST86-068	-5	0.5	260	-100	730	40	1400	6	19	246	340	3.1	-2	0.23	23	0.4	96.1	-10	57.4	-200	9	6	142	21	-6	25	-200	10000	11.56
ST86-069	-5	5	51	-100	580	43	2200	5	21	180	250	3.3	-2	0.32	24	0.4	98.9	-10	46	-200	10	6	109	15	-6	23	-200	7400	18.65
ST86-070	-5	2	400	-100	810	39	1500	4	19	262	390	3.3	-2	0.2	39	0.3	93.3	-10	66	-200	11	7	172	25	-7	26	-200	10000	20.44
ST86-072B	-5	5	693	-100	720	41	2000	4	21	238	340	3.2	-2	0.26	-20	0.6	96.7	-10	55.6	-200	11	6	153	20	18	25	-200	9500	10.06
ST86-072C	-5	1	320	-100	1040	42	1700	6	21	253	506	3.7	-2	0.35	-20	0.4	96.7	-10	79.8	-200	13	7	222	26	-7	29	-200	10000	14.4
ST86-074	-5	1	1220	-100	790	38	1900	5	21	237	380	3.5	-2	0.2	41	0.4	104	-10	61.8	-200	12	6	164	22	-7	28	-200	9500	18.35
ST86-076	-5	3	1320	-100	660	44	3000	5	21	201	310	3	-2	0.27	27	0.5	103	-10	51.1	-200	9	6	128	18	9	25	-200	8300	10.47
ST86-077A	-5	5	220	-100	610	42	2200	4	22	130	300	3.5	-2	0.26	31	0.5	95.9	-10	54	-200	11	5	126	14	-6	23	-200	5600	42.49
ST86-077B	-5	2	120	-100	830	41	2100	5	21	227	400	3.6	-2	0.28	-20	0.4	100	-10	68.5	-200	12	7	166	22	8	28	-200	9000	18.95
ST86-079	-5	5	200	-100	830	41	2100	5	21	227	410	3.5	-2	0.24	-20	0.5	98.4	-10	68.5	-200	12	7	178	21	9	27	-200	9500	19.26
ST86-081	-5	3	29	-100	780	40	1600	3	20	213	370	3.2	-2	0.35	44	0.5	98.4	-10	62.3	-200	10	7	157	19	-7	26	-200	8700	14.09
ST86-082	-5	4	250	-100	740	42	2900	3	21	200	360	3.7	-2	0.31	-20	0.5	104	-10	60.1	-200	11	6	149	20	-7	26	-200	8400	19.17
ST86-083	-5	7	620	-100	610	46	1700	4	20	140	280	3	-2	0.21	-20	0.4	99.2	-10	53.3	-200	10	5	113	16	-7	22	-200	5800	31.08
ST86-084	-5	10	2710	-100	660	65	1100	6	18	190	300	2.9	-2	0.21	43	0.6	87.6	-10	63.5	-200	11	7	137	22	-7	23	-200	8600	15.01
ST86-085	-5	5	250	-100	890	40	1700	3	18	248	440	2.6	-2	0.33	29	0.7	83.6	-10	72.9	-200	10	7	208	27	-7	25	200	10000	13.44
ST86-087	-5	1	260	-100	690	39	2900	6	19	212	330	3.2	-2	0.12	-20	0.3	96.9	-10	60.2	-200	10	6	136	19	-7	26	-200	9000	16.14
ST86-088	-5	1	697	-100	800	37	2300	6	20	214	400	3.5	-2	0.22	-20	0.3	95.7	-10	66.4	-200	11	7	171	22	-7	25	-200	9200	23.27
ST86-089	-5	3	350	-100	730	54	1900	6	21	200	350	3.5	-2	0.26	-20	0.3	95.8	-10	60.4	-200	10	7	137	20	-7	25	-200	7700	27.27
ST86-090	-5	124	210	-100	1020	340	5770	15	25	140	480	2.4	-2	0.25	390	18	80.1	-10	76	-200	8	6	83.1	11	-8	21	450	6100	7.64
ST86-100	-5	3	91	-100	710	39	1500	5	18	202	340	3	-2	0.26	27	0.5	95	-10	59.3	-200	10	7	139	19	-5	24	-200	8500	14.84
ST86-101	-5	3	170	-100	790	35	1600	5	19	220	380	3.3	-2	0.23	35	0.6	91.8	-10	66.5	-200	12	7	164	21	6	25	-200	9000	21.9
ST86-102	-5	2	360	540	710	37	2000	3	17	200	350	3	-2	0.22	36	0.4	91.8	-10	60.6	-200	10	6	148	20	-5	22	-200	8200	15.65
ST86-103	-5	3	470	-100	880	35	2200	5	20	255	450	3.7	-2	0.25	-20	0.3	91.8	-10	77.4	-200	14	7	201	26	-5	26	-200	11000	22.56
ST86-104	-5	3	410	-100	710	37	1800	4	19	190	350	2.8	-2	0.21	-20	0.6	88.5	-10	66.2	-200	11	7	170	21	27	21	-200	8400	20.34
ST86-105	-5	0.5	160	-100	900	36	1900	3	21	253	440	2.9	-2	0.25	27	0.3	97.2	-10	73.9	-200	13	7	206	26	9	27	-200	10000	15.87
ST86-106	-5	3	310	-100	810	36	1900	4	20	259	390	3.3	-2	0.14	-20	0.4	98.1	-10	59.5	-200	10	6	166	23	6	26	-200	11000	9.75
ST86-107B	-5	4	35	-100	420	42	1300	7	17	190	180	2.9	-2	0.27	-20	0.3	98.3	-10	44	-200	10	5	66.3	15	7	22	-200	7600	16.52
ST86-108A	-5	2	93	-100	700	38	1200	6	18	213	340	3.4	-2	0.33	-20	0.1	95	-10	60.5	-200	11	6	131	20	-5	24	-200	8000	16.85

Sample Number	Ag ppm	As ppm	Au ppb	Ba ppm	Ce ppm	Co ppm	Cr ppm	Eu ppm	Fe pct	Hf ppm	La ppm	Lu ppm	Mo ppm	Na ppm	Ni ppm	Sb ppm	Sc ppm	Se ppm	Sm ppm	Sn ppm	Ta ppm	Tb ppm	Th ppm	U ppm	W ppm	Yb ppm	Zn ppm	Zr ppm	Wt g
ST86-108B	-5	0.5	628	-100	690	34	840	6	17	216	310	3.4	-2	0.3	37	0.2	103	-10	57.9	-200	11	7	118	20	7	23	-200	9000	13.14
ST86-109	-5	7	130	-100	660	44	2300	6	20	190	300	3.6	-2	0.25	-20	0.9	99.4	-10	53.4	-200	10	6	125	17	-5	25	-200	7300	13.45
ST86-110	-5	3	450	-100	820	42	2000	5	20	230	400	3.5	-2	0.3	-20	0.5	92.3	-10	64.3	-200	12	7	172	21	-5	26	-200	8800	14.69
ST86-111	-5	3	999	-100	780	45	1600	6	21	213	380	3.6	-2	0.3	-20	0.3	100	-10	61.5	-200	12	6	165	21	-6	27	-200	9400	22.6
ST86-112	-5	12	52	-100	480	59	2300	4	19	140	240	2	-2	0.25	62	0.9	77.3	-10	47	-200	12	5	121	14	12	17	-200	6000	13
ST86-113	-5	13	430	-100	490	52	7450	3	18	150	240	2.6	-2	0.21	60	2.8	90.1	-10	44	-200	11	5	104	14	8	21	-200	6200	8.07
ST86-114	-5	8	310	-100	610	43	2500	4	19	190	300	2.9	-2	0.22	33	0.8	91.7	-10	49	-200	10	6	130	17	10	22	-200	7900	10.76
ST86-115	-5	2	525	-100	680	42	6370	3	17	283	320	3.4	-2	0.16	32	0.9	90.5	-10	49	-200	10	6	136	21	-5	26	240	11000	3.66
ST86-116	-5	23	62	-100	800	64	3600	5	22	267	360	3.1	-2	0.26	36	2.2	94.2	-10	57	-200	9	7	155	22	-5	26	-200	10000	3.82
ST86-117	-5	13	793	-100	380	44	2800	2	19	84	170	2.4	-2	0.32	-20	0.7	82.8	-10	32	-200	8	4	74.6	8.5	7	17	-200	3400	6.49
ST86-118	-5	4	230	-100	700	46	1600	5	20	214	330	3.4	-2	0.27	-20	0.9	93.2	-10	59.7	-200	10	6	143	20	-4	24	-200	8400	19.58
ST86-119	-5	3	59	-100	760	43	1400	7	19	217	360	3.2	-2	0.24	-20	0.4	99.4	-10	62.5	-200	10	7	154	21	9	26	-200	9200	8.42
ST86-120	-5	3	140	-100	660	42	1500	7	19	150	310	3.2	-2	0.27	24	0.3	98.5	-10	58.2	-200	10	6	136	18	7	24	-200	6500	14.32
ST86-121	-5	5	320	-100	670	47	1900	4	18	180	320	2.5	-2	0.37	52	0.5	81.4	-10	59.7	-200	10	6	155	19	6	22	-200	7600	18.21
ST86-122	-5	4	370	-100	710	42	1900	5	19	208	350	2.8	-2	0.35	30	0.5	81.1	-10	69.2	-200	14	7	181	22	-5	23	-200	9200	21.18
ST86-123	-5	5	210	-100	610	55	2100	5	19	190	300	2.7	-2	0.38	38	0.9	90.7	-10	56.6	-200	11	6	124	17	7	22	-200	7600	19.49
ST86-124	-5	4	300	-100	710	41	2000	3	20	222	360	3.7	-2	0.27	30	1	97.9	-10	63.8	-200	11	7	150	21	7	25	-200	9100	21.16
ST86-125	-5	8	813	-100	510	48	2100	5	22	140	240	2.7	-2	0.24	35	0.8	91.9	-10	46	-200	10	5	95.8	13	-4	20	-200	5500	16.63
BH87-1B	-5	4	76	-100	740	47	1700	5	21	170	380	3.1	-2	0.19	-20	0.3	102	-10	62.8	-200	11	7	172	21	10	29	-200	7600	15.2
BH87-2B	-5	2	2.5	-100	760	39	1400	3	22	150	390	3.2	-2	0.27	-20	0.1	103	-10	63.1	-200	10	7	178	18	-6	29	-200	6300	13.88
BH87-4B	-5	0.5	200	-100	760	39	1500	5	20	180	400	3.1	-2	0.28	-20	0.2	98.5	-10	62.6	-200	9	6	167	20	6	28	-200	8200	20.64
BH87-5B	-5	2	20	-100	720	38	1900	3	21	150	370	3	-2	0.18	-20	0.3	98.7	-10	58.6	-200	10	6	159	17	-6	27	-200	6300	19.15
BH87-6	-5	3	669	-100	720	36	1600	-2	21	170	370	2.8	-2	0.17	-20	0.3	100	-10	59.1	-200	10	6	166	19	-6	25	-200	7700	17.77
BH87-7A	-5	0.5	77	-100	710	31	1500	4	19	170	370	2.8	-2	0.14	-20	0.2	97	-10	63.8	-200	11	6	182	20	6	28	-200	7200	18.05
BH87-9	-5	4	8130	-100	550	44	1800	3	20	130	340	3.3	-5	0.21	-20	0.2	91.4	-10	60.8	-200	13	5	147	18	24	21	200	6600	48.55
BH87-10B	-5	4	350	170	700	44	2300	2	19	213	390	3	-2	0.29	-20	0.5	96.2	-10	60.7	-200	11	6	170	22	-6	26	-200	9100	17.39
BH87-11B	-5	0.5	1860	-100	740	36	1500	-2	21	150	410	3.6	-2	0.24	-20	0.1	108	-10	66.3	-200	11	7	174	20	9	29	220	7100	27.51
BH87-12A	-5	3	320	-100	450	37	1800	-2	20	81	230	2.3	-2	0.47	-20	0.2	89.4	-10	34	-200	7	5	115	10	7	22	-200	3600	8.13
BH87-12B	-5	3	130	-100	840	34	1300	4	20	206	470	3.2	-2	0.26	-20	0.3	97.8	-10	70.1	-200	13	7	201	23	11	29	-200	9300	18.07
BH87-13	-5	10	330	1800	660	48	2000	4	18	242	320	2.8	-2	0.22	-20	0.9	96.2	-10	54.6	-200	9	6	119	20	10	27	-200	10000	5.79
SL87-011	-5	4	2310	-100	910	39	1900	5	21	244	460	4	-2	0.25	-20	0.3	101	-10	67.3	-200	15	7	205	24	-8	30	210	9300	17.59
SL87-012	-5	3	55	-100	880	41	1600	3	20	298	480	3.7	-2	0.21	-20	0.3	96.2	-10	67.3	-200	11	8	217	28	-4	32	-200	13000	15.49
SL87-013	-5	3	5760	-100	740	48	1700	3	21	223	410	3.3	-2	0.28	-20	0.3	104	-10	59.8	-200	13	7	182	22	8	27	-200	9200	17.18
SL87-016	-5	3	250	-100	760	40	1800	4	20	227	410	3.5	-2	0.24	-20	0.3	98.9	-10	62.3	-200	14	7	190	22	-4	29	-200	10000	21.25
SL87-018	-5	2	2230	-100	720	33	1600	-2	18	200	390	2.8	-2	0.2	-20	0.1	94.8	-10	64.5	-200	10	7	184	22	-4	27	-200	9200	20.13
SL87-022	-5	0.5	250	-100	970	41	1500	-2	20	306	606	3.9	-4	0.26	-20	0.2	91.4	-10	94.3	-200	15	8	295	36	6	31	-200	15000	21.87
SL87-036	-5	4	240	-100	680	37	1500	3	19	228	360	3	-2	0.19	-20	0.4	102	-10	61.2	-200	11	7	164	23	-4	28	-200	10000	14.09
SL87-038	-5	0.5	95	-100	650	33	1200	-2	18	180	380	3.3	-2	0.24	-20	0.2	98.7	-10	60	-200	10	6	158	20	-2	27	-200	7800	24.05
SL87-069	-5	3	90	-100	690	38	1500	3	20	190	400	3.4	-2	0.26	-20	0.2	103	-10	61.9	-200	11	6	163	21	5	28	-200	8200	29.66
SL87-075	-5	2	808	-100	810	34	1700	4	20	270	480	3.5	-2	0.17	-20	0.3	100	-10	68.3	-200	12	7	202	27	5	29	-200	13000	17.18
SL87-080	-5	0.5	110	-100	740	37	1700	-2	22	220	440	3.4	-2	0.15	-20	0.3	99.1	-10	64.1	-200	14	7	194	22	-4	28	-200	10000	18.3
SL87-082	-5	0.5	1280	-100	930	40	1900	-2	25	244	655	4.3	-5	0.18	-20	0.1	101	-10	84.5	-200	16	6	267	29	-6	36	-200	12000	28.91
SL87-086	-5	0.5	1320	-100	700	32	1600	2	20	222	410	3.2	-2	0.18	-20	0.1	100	-10	61.5	-200	11	6	184	22	-4	28	-200	9700	19.42
SL87-090	-5	2	300	-100	810	42	1600	3	21	251	460	3.1	-2	0.19	-20	0.3	100	-10	68	-200	12	6	205	25	-4	27	-200	11000	15.54
SL87-096	-5	0.5	440	-100	810	38	1700	-2	21	229	460	2.6	-2	0.15	-20	0.3	98.1	-10	64.5	-200	11	6	218	23	-5	25	-200	10000	12.82
SL87-098	-5	10	2410	-100	590	43	2100	2	17	160	320	2.4	-2	0.19	-20	0.4	84.1	-10	54.7	-200	14	6	165	19	-4	23	-200	7500	19.78
SL87-100	-5	7	1010	-100	510	46	2000	2	18	160	270	1.9	-2	0.2	21	0.5	85.4	-10	52.1	-200	10	6	141	18	-2	22	-200	7200	18.29
SL87-102	-5	0.5	1440	-100	450	34	730	3	16	200	250	2.6	-2	0.26	-20	0.2	95.7	-10	53	-200	10	5	98	16	7	20	-200	9500	33.24
SL87-105	-5	2	502	-100	560	34	830	-2	18	170	330	3.5	-2	0.28	-20	0.1	108	-10	61.5	-200	10	5	121	18	6	25	220	8600	54.87
SL87-107	-5	0.5	410	-100	300	26	550	3	14	150	180	2.8	-2	0.25	-20	0.1	108	-10	43	-200	7	4	55.5	12	24	16	220	7000	67.36
SL87-132	-5	2	90	-100	510	33	920	3	18	140	330	3.3	-2	0.2	-20	0.1	95.8	-10	54.7	-200	11	5	114	17	13	22	220	6900	54.04
SL87-134	-5	0.5	160	-100	410	39	770	4	18	110	210	2.7	-2	0.19	-20	0.1	96.5	-10	47	-200	9	5	71.7	12	6	19	-200	5100	48.7
SL87-141	-5	3	635	-100	630	37	1300	3	19	200	360	3.1	-2	0.23	-20	0.4	98	-10	60.8	-200	10	6	154	20	-4	26	-200	9100	23.14
SL87-157	-5	6	97	-100	320	86	990	2	21	100	170	1.6	-2	0.22	60	0.3	66.7	-10	34	-200	6	4	66.4	11	-2	13	-200	4400	37.27
SL87-161	-5	2	240	-100	690	43	1900	3	20	207	370	3.2	-2	0.19	-20	0.3	99	-10	58.6	-200	12	6	167	21	5	27	-200	9800	18.45
SL87-164	-5	1	330	-100	360	33	760	4	16	120	180	1.9	-2	0.26	-20	0.1	89.7	-10	42	-200	11	5	70.4	12	-2	19	-200	5200	22.44

Sample Number	Ag ppm	As ppm	Au ppb	Ba ppm	Ce ppm	Co ppm	Cr ppm	Eu ppm	Fe pct	Hf ppm	La ppm	Lu ppm	Mo ppm	Na ppm	Ni ppm	Sb ppm	Sc ppm	Se ppm	Sm ppm	Sn ppm	Ta ppm	Tb ppm	Th ppm	U ppm	W ppm	Yb ppm	Zn ppm	Zr ppm	Wt g
SL87-219A	-5	2	150	-100	540	37	1400	2	18	150	300	2.2	-2	0.19	-20	0.3	85.7	-10	58.4	-200	11	6	141	18	9	21	200	6800	24.24
SL87-229	-5	2	66	-100	540	41	1600	3	19	140	290	2.9	-2	0.17	-20	0.3	96.5	-10	55.1	-200	10	6	116	16	-4	22	-200	6700	36.81
SL87-272	-5	0.5	717	-100	700	35	1100	4	20	209	400	3.5	-2	0.19	-20	0.3	100	-10	72.7	-200	11	7	151	22	-5	26	-200	9900	32.97
SL87-290	-5	0.5	370	-100	400	39	750	4	16	120	210	2.2	-2	0.32	-20	0.1	84.5	-10	49	-200	8	4	66.5	13	6	18	-200	5500	56.43
SL87-322	-5	2	110	-100	420	40	1100	4	17	130	220	2.4	-2	0.21	-20	0.2	81.6	-10	47	-200	7	5	85.3	16	11	19	-200	6300	25.23
SL87-353	-5	2	200	-100	750	31	1900	2	22	208	420	3.1	-2	0.18	-20	0.3	97.3	-10	62.7	-200	11	6	191	21	5	27	-200	9400	20.92
SL87-356	-5	0.5	400	-100	870	36	1800	6	20	217	511	3.6	-2	0.17	-20	0.3	98	-10	77.3	-200	13	7	221	25	9	32	-200	9600	21.99
SL87-357	-5	0.5	500	-100	810	35	1800	-2	20	202	490	3.7	-2	0.13	-20	0.1	96.5	-10	77.4	-200	12	6	204	24	5	31	-200	9200	29.27
SL87-358	-5	3	280	-100	740	38	2300	-2	20	222	400	3.3	-2	0.18	-20	0.3	100	-10	61.5	-200	12	6	183	23	7	29	240	9900	18.5
SL87-359	-5	2	150	-100	680	38	1900	-2	21	210	380	3.3	-2	0.17	-20	0.3	102	-10	60.7	-200	12	6	172	21	-5	29	-200	9300	24.34
SL87-361	-5	3	795	-100	620	36	1600	2	19	170	350	2.9	-2	0.21	-20	0.3	97	-10	57.8	-200	10	6	158	18	-5	27	-200	7400	25.78
SL87-363	-5	6	270	120	650	40	2000	3	22	210	360	3.1	-2	0.18	-20	0.6	106	-10	57.8	-200	12	7	172	20	-5	27	-200	9400	21.07
SL87-364	-5	8	4500	-100	750	37	1900	4	21	234	410	3.6	-2	0.17	-20	0.5	104	-10	62.4	-200	12	6	183	23	7	28	-200	11000	15.07
SL87-394	-5	0.5	170	-100	900	32	2200	5	21	237	537	4.1	-2	0.21	-20	0.3	105	-10	80.5	-200	13	7	221	28	-6	35	270	10000	26.81
SL87-411	-5	0.5	55	-100	380	32	670	4	15	110	200	2.5	-2	0.24	-20	0.1	90.4	-10	66	-200	10	7	63.9	13	-4	21	-200	4700	36
SL87-412	-5	0.5	42	-100	410	26	660	5	15	120	220	2.7	-2	0.2	-20	0.1	92.7	-10	50.3	-200	8	5	66.3	13	7	21	-200	6000	38.45
SL87-415	-5	0.5	33	-100	210	34	410	4	14	97	110	2.2	-2	0.31	24	0.1	87.1	-10	30	-200	7	4	27	8.2	-2	18	-200	4300	37.25
SL87-439	-5	0.5	75	-100	670	30	1600	2	18	150	370	3.6	-2	0.13	-20	0.2	100	-10	61.6	-200	11	6	144	19	-5	28	220	7000	28
SL87-440	-5	0.5	150	-100	730	29	2100	2	21	160	400	3.8	-2	0.19	-20	0.3	109	-10	68	-200	12	7	163	20	10	30	-200	7000	30.73
SL87-521	-5	3	42	-100	610	37	1200	4	18	150	330	3.2	-2	0.2	-20	0.3	98.5	-10	56.8	-200	9	5	133	18	-5	24	-200	6700	32.49
SL87-527	-5	3	48	-100	560	37	1200	3	18	140	310	3.2	-2	0.21	-20	0.3	97.9	-10	55.5	-200	9	5	126	17	-5	25	-200	6500	35.13
SL87-546	-5	0.5	150	-100	620	33	1200	4	19	150	340	2.9	-2	0.18	-20	0.2	90.5	-10	62.5	-200	11	7	160	20	5	25	-200	7000	28.71
SL87-547	-5	0.5	120	-100	590	30	1000	-2	18	170	340	3	-2	0.19	-20	0.3	91	-10	67.3	-200	11	7	154	22	-5	24	220	8100	37.54
SL87-548	-5	0.5	270	-100	750	40	1800	3	21	211	410	3.6	-2	0.15	-20	0.1	103	-10	63.8	-200	12	7	204	23	-6	29	-200	9300	16.24
SL87-551	-5	2	140	-100	660	43	2000	-2	21	212	350	3.1	-2	0.24	-20	0.3	99.2	-10	54.8	-200	10	6	163	20	-5	30	-200	9600	17.24
SL87-560	-5	2	160	-100	840	34	1500	5	20	211	450	3.6	-2	0.24	-20	0.3	103	-10	68.4	-200	12	7	202	23	-6	31	-200	9500	17.23
		5	644		680	44	2030		20	193	349	3.1		0.24		0.6	95.6		59.5		11	6	149	19		25		8270	20.56
		124	8130		1190	340	10400		25	306	655	4.3		0.47		18.0	109.0		94.3		16	9	295	36		36		15000	67.36
		0.5	2.5		210	26	410		14	81	110	1.6		0.12		0.1	66.7		30.0		6	4	27	8		13		3400	3.66
		11	1184		161	27	1287		2	45	93	0.5		0.06		1.6	7.0		11.2		2	1	45	4		4		1915	10.87

Aultman Samples, Churchill Township

Sample Number	Ag ppm	As ppm	Au ppb	Ba ppm	Ce ppm	Co ppm	Cr ppm	Eu ppm	Fe pct	Hf ppm	La ppm	Lu ppm	Mo ppm	Na ppm	Ni ppm	Sb ppm	Sc ppm	Se ppm	Sm ppm	Sn ppm	Ta ppm	Tb ppm	Th ppm	U ppm	W ppm	Yb ppm	Zn ppm	Zr ppm	Wt g
JTA-3B	-5	12	1240	-100	520	46	2500	3	20	150	260	2.7	-2	0.3	39	1.3	101	-10	44	-200	9	5	98.8	13	-6	23	-200	6300	15.75
JTA-7	-5	9	140	-100	500	43	2500	4	21	140	250	2.7	-2	0.26	-20	1.2	97.2	-10	42	-200	10	5	106	13	-6	23	-200	6100	11.39
JTA-8A	-5	12	100	-100	480	44	2400	4	20	140	230	2.2	-2	0.22	33	1.3	97.1	-10	41	-200	8	5	92.2	12	-6	22	-200	5900	11
JTA-9	-5	7	2.5	-100	460	44	3100	5	20	140	220	2.1	-2	0.22	55	0.9	95.5	-10	39	-200	8	5	93.9	12	10	22	220	6100	6.02
JTA-11	-5	7	575	-100	450	41	2200	3	19	150	230	2.3	-2	0.18	-20	1.2	88	-10	41	-200	8	5	106	13	10	19	-200	5900	14.27
JTA-12	-5	8	110	-100	460	38	1900	2	17	170	240	2.1	-2	0.26	35	1.1	87.3	-10	46	-200	9	6	108	15	6	20	-200	7400	11
JTA-14	8	18	1620	-100	420	48	2000	3	19	130	200	2.1	-2	0.18	27	1.9	90	-10	39	-200	8	5	79.9	11	-6	20	-200	5400	8.71
JTA-17	-5	9	160	-100	520	46	2700	4	21	170	260	2.4	-2	0.23	-20	1.2	98.6	-10	41	-200	11	5	115	14	-6	23	-200	6800	9.35
		10	493		476	44	2413	4	20	149	236	2.3		0.23		1.3	94		42		9	5	100	13		22		6238	10.94

Control Samples: INA analysis of non-magnetic fraction of HMC (Klip control)

Sample Number	Ag ppm	As ppm	Au ppb	Ba ppm	Ce ppm	Co ppm	Cr ppm	Eu ppm	Fe pct	Hf ppm	La ppm	Lu ppm	Mo ppm	Na ppm	Ni ppm	Sb ppm	Sc ppm	Se ppm	Sm ppm	Sn ppm	Ta ppm	Tb ppm	Th ppm	U ppm	W ppm	Yb ppm	Zn ppm	Zr ppm	Wt g
ST86-100B	-5	-1	-5	160	590	40	250	6	21	304	290	4.9	-2	0.38	-20	-0.2	76.5	-10	66.2	-200	9	8	54.8	25	-5	33	-200	13000	25.62
ST86-017	-5	2	-5	-100	630	35	240	7	21	322	280	4.3	-2	0.32	-20	-0.2	74.1	-10	59.6	-200	8	8	58.8	24	-5	35	-200	13000	8.17
ST86-071	-5	-1	-5	-100	560	38	250	4	18	310	260	3.2	-2	0.34	-20	-0.2	66.2	-10	64.1	-200	8	8	59.3	26	-6	28	-200	13000	14.65
ST86-091	-5	2	-5	-100	660	40	230	7	22	329	310	5.1	-2	0.39	21	0.2	79	-10	66.7	-200	9	9	58.4	26	-7	36	-200	13000	24.99
SL87-083	-5	-1	-5	140	510	37	200	5	21	297	270	4	-2	0.36	-20	-0.2	77.6	-10	58.1	-200	9	8	54.7	25	-2	33	-200	13000	16.91
SL87-165	-5	-1	-5	-100	470	35	210	4	18	276	230	2.3	-2	0.34	-20	-0.2	66.7	-10	50.7	-200	7	8	52.1	22	-5	27	-200	11000	5.21
SL87-417	-5	-1	-5	-100	480	35	190	4	20	262	250	4.2	-2	0.3	-20	-0.2	74.7	-10	55.3	-200	8	7	47	22	-4	31	-200	11000	26.91
BH87-3B	-5	-1	-5	-100	520	32	200	4	21	277	260	4.3	-2	0.28	-20	-0.2	77.3	-10	52.4	-200	8	7	50	21	-5	34	-200	12000	13.91
JTA-4	-5	-1	-5	-100	530	37	200	3	21	304	280	4.1	-2	0.33	-20	-0.2	76.1	-10	57.5	-200	8	8	54.3	24	-5	34	-200	14000	22.68

APPENDIX F. INA Analysis of magnetic fraction of HMC samples, Shining Tree Area

Sample Number	Ag ppm	As ppm	Au ppb	Ba ppm	Ce ppm	Co ppm	Cr ppm	Eu ppm	Fe pct	Hf ppm	La ppm	Lu ppm	Mo ppm	Na pct	Ni ppm	Sb ppm	Sc ppm	Se ppm	Sm ppm	Sn ppm	Ta ppm	Tb ppm	Th ppm	U ppm	W ppm	Yb ppm	Zn ppm	Zr ppm
BH86-1	-5	5	-5	-100	-10	8360	75	-2	63.7	4	8	-0.5	-2	0.11	230	0.4	19	-10	2.1	-200	2	-1	1.7	0.6	-2	-5	410	-500
ST86-05	-5	5	-5	-100	-10	8710	71	-2	64.8	3	12	-0.5	-2	0.13	190	0.3	19	-10	2.9	-200	2	-1	2.4	0.7	-2	-5	290	-500
ST86-015	-5	4	-5	-100	-10	7600	71	-2	69.3	3	6	-0.5	-2	0.15	190	-0.2	17	-10	1.4	-200	2	-1	1.8	-0.5	-2	-5	310	-500
ST86-016	-5	12	-5	-100	-10	13500	79	-2	55.3	3	10	-0.5	-2	0.22	240	0.9	26	-10	2.8	-200	2	-1	2.2	0.7	-2	-5	220	-500
ST86-021	-5	8	-5	-100	33	5360	73	-2	55.7	7	26	-0.5	-2	0.22	140	1.2	32	-10	7.1	-200	3	1	4.8	1.5	2	-5	260	-500
ST86-027	-5	4	-5	-100	-10	21900	110	-2	65.6	5	11	-0.5	-2	0.1	440	-0.2	16	-10	2.4	-200	1	-1	3.2	0.6	-2	-5	300	-500
ST86-030	-5	6	-5	-100	-10	10600	70	-2	56.3	5	14	-0.5	-2	0.2	180	0.3	29	-10	3.5	-200	2	-1	2	0.8	-2	-5	280	-500
ST86-033	-5	5	-5	-100	-10	11800	63	-2	58.3	5	14	-0.5	-2	0.31	180	0.6	29	-10	3.2	-200	2	-1	3.3	1.1	3	-5	290	-500
ST86-037	-5	5	-5	-100	-10	10300	73	-2	63	3	10	-0.5	-2	0.14	230	0.5	27	-10	3.2	-200	2	-1	2.2	0.6	-2	-5	370	-500
ST86-042	-5	10	-5	-100	-10	5410	67	-2	48	6	13	-0.5	-2	0.21	190	1.4	27	-10	4.6	-200	2	-1	1.9	1	-2	-5	300	-500
ST86-043	-5	5	-5	-100	-10	11000	77	-2	64.5	4	9	-0.5	-2	0.1	240	0.5	20	-10	2.4	-200	2	-1	2.3	0.6	-2	-5	310	-500
ST86-048	-5	6	-5	-100	-10	7320	92	-2	59.3	5	13	-0.5	-2	0.18	160	0.7	30	-10	3.6	-200	2	-1	2.4	0.8	-2	-5	330	-500
ST96-049	-5	8	-5	-100	-10	7770	75	-2	56.4	5	12	-0.5	-2	0.21	180	1.1	27	-10	3.5	-200	2	-1	3.2	0.6	-2	-5	350	-500
ST86-057	-5	3	-5	-100	-10	8690	57	-2	66	3	9	-0.5	-2	0.09	200	-0.2	14	-10	1.9	-200	1	-1	2.6	0.7	-2	-5	310	-500
ST86-059	-5	7	-5	-100	-10	8410	74	-2	64.4	4	11	-0.5	-2	0.12	170	0.5	23	-10	2.9	-200	2	-1	2.8	0.7	-2	-5	330	-500
ST86-063	-5	4	-5	-100	-10	4000	58	-2	59.7	4	12	-0.5	-2	0.13	110	-0.2	25	-10	3.4	-200	2	-1	3.2	1.2	-2	-5	350	-500
ST86-074	-5	4	-5	-100	-10	9080	70	-2	71.1	3	6	-0.5	-2	0.08	210	-0.2	15	-10	1.4	-200	1	-1	2.3	-0.5	-2	-5	350	-500
ST86-076	-5	7	-5	-100	-10	6890	60	-2	54.9	5	11	-0.5	-2	0.23	140	0.7	31	-10	3.7	-200	2	-1	2.1	1	-2	-5	370	-500
ST86-077A	-5	4	-5	-100	-10	7390	68	-2	62.3	4	7	-0.5	-2	0.1	170	0.2	19	-10	1.9	-200	2	-1	1.8	-0.5	-2	-5	290	-500
ST86-077B	-5	4	52	-100	-10	8930	71	-2	70.2	4	7	-0.5	-2	0.06	170	0.3	16	-10	1.8	-200	1	-1	2.2	0.7	-2	-5	340	-500
ST86-079	-5	4	-5	-100	-10	9650	71	-2	68.3	3	8	-0.5	-2	0.06	210	-0.2	14	-10	1.7	-200	1	-1	2.4	-0.5	-2	-5	330	-500
ST86-081	-5	4	-5	-100	-10	9000	69	-2	66.1	4	8	-0.5	-2	0.1	230	0.3	16	-10	1.9	-200	1	-1	2.3	0.6	-2	-5	340	-500
ST86-082	-5	4	-5	-100	-10	8710	68	-2	58.3	3	7	-0.5	-2	0.15	160	0.3	21	-10	2	-200	2	-1	2.2	0.6	-2	-5	400	690
ST86-083	-5	4	21	-100	-10	7580	64	-2	63	4	7	-0.5	-2	0.1	180	0.3	20	-10	1.9	-200	2	-1	1.5	0.5	-2	-5	320	-500
ST86-084	-5	4	10	-100	-10	5180	58	-2	64.2	4	7	-0.5	-2	0.15	120	0.3	20	-10	2.2	-200	2	-1	2.1	0.8	-2	-5	380	-500
ST86-087	-5	2	-5	-100	-10	10400	69	-2	61	4	9	-0.5	-2	0.13	200	-0.2	20	-10	2.4	-200	2	-1	1.9	-0.5	-2	-5	400	-500
ST86-088	-5	3	8	-100	-10	9980	65	-2	61	5	7	-0.5	-2	0.09	210	-0.2	16	-10	2.2	-200	2	-1	2.1	-0.5	-2	-5	320	-500
ST86-089	-5	3	-5	-100	-10	7950	64	-2	55.5	3	6	-0.5	-2	0.11	190	-0.2	16	-10	1.9	-200	2	-1	1.5	-0.5	-2	-5	340	-500
ST86-103	-5	3	-5	-100	-10	9310	66	-2	71.4	2	5	-0.5	-2	0.025	220	0.3	13	-10	1.2	-200	1	-1	1.5	-0.5	-2	-5	330	-500
ST86-108A	-5	3	-5	-100	-10	3200	52	-2	62.6	4	11	-0.5	-2	0.16	85	-0.2	25	-10	2.5	-200	2	-1	1.8	-0.5	-2	-5	380	-500
ST86-109	-5	7	7	-100	-10	8950	72	-2	61.9	5	12	-0.5	-2	0.17	210	0.9	26	-10	3.5	-200	2	-1	2.3	0.8	-2	-5	240	-500
ST86-111	-5	4	-5	-100	-10	6290	61	-2	67.1	5	8	-0.5	-2	0.12	130	-0.2	18	-10	1.8	-200	2	-1	2.6	0.9	-2	-5	330	-500
ST86-112	-5	9	-5	-100	-10	6150	68	-2	52	4	8	-0.5	-2	0.18	180	1.9	22	-10	2.6	-200	2	-1	2.5	0.7	7	-5	250	-500
ST86-114	-5	6	-5	-100	-10	8490	75	-2	63.9	3	10	-0.5	-2	0.14	230	0.6	24	-10	2.8	-200	2	-1	2	0.6	-2	-5	320	-500
ST86-118	-5	4	-5	-100	-10	8840	73	-2	69.4	4	8	-0.5	-2	0.09	200	0.2	16	-10	1.8	-200	2	-1	2.2	0.6	2	-5	280	-500
ST86-125	-5	7	-5	-100	-10	6460	75	-2	62.7	4	12	-0.5	-2	0.13	140	0.6	29	-10	3.2	-200	3	-1	1.8	0.8	-2	-5	380	-500
BH87-4BM	-5	4	-5	-100	-10	9580	79	-2	68.5	6	19	-0.5	-2	0.1	180	-0.2	16	-10	3.8	-200	2	-1	8.7	0.7	-2	-5	360	-500
BH87-9M	-5	6	-5	-100	-10	10700	140	-2	63.1	4	10	-0.5	-2	0.06	380	0.3	16	-10	2.2	-200	2	-1	2.3	0.9	-2	-5	270	-500
BH87-10BM	-5	7	-5	-100	-10	11800	130	-2	65.2	5	13	-0.5	-2	0.07	440	0.3	17	-10	2.6	-200	2	-1	3.6	0.7	-2	-5	310	-500
SL87-353M	-5	4	-5	-100	-10	8580	77	-2	70	3	11	-0.5	-2	0.025	160	-0.2	13	-10	1.9	-200	2	-1	4.5	0.7	-2	-5	360	-500
SL87-521M	-5	4	-5	-100	-10	10700	75	-2	67.1	4	14	-0.5	-2	0.09	200	-0.2	15	-10	2.7	-200	2	-1	5.9	0.8	-2	-5	270	-500
SL87-527M	-5	4	-5	-100	-10	8800	74	-2	68.4	5	11	-0.5	-2	0.08	200	-0.2	17	-10	2.4	-200	2	-1	6.4	0.7	-2	-5	320	-500
AVERAGE		5				8793	74		62.8	4	10			0.13	200		21		2.6		2		2.7				324	
MAXIMUM		12				21900	140		71.4	7	26			0.31	440		32		7.1		3		8.7				410	
MINIMUM		2				3200	52		48	2	5			0.03	85.0		13		1.2		1		1.5				220	
STD.DEV.		2				2918	17		5.40	1	3.7			0.06	70.5		5.5		1.0		0		1.4				43.9	
No.below detection limit		2												2														

APPENDIX G

Fire Assay Analysis of Non-Magnetic and Magnetic Fractions of HMC Samples

Fire Assay (FA), Directly Coupled Plasma (DCP), Atomic Absorption (AA) or a combination of methods was used on 15 g or less portions of the non-magnetic or magnetic heavy mineral concentrate. The analyses were carried out by Bondar-Clegg & Company, Ottawa, Ontario.

The elements analyzed, the extraction techniques utilized, the methods of analysis and the lower detection limits are listed in the following table:

Ag	Silver	HCL-HNO3, (3:1)	AA	0.1 ppm
Au	Gold	Aqua Regia	FA/DCP	1 ppb
Ba	Barium	Borate Fusion	DCP	1 ppm
Co	Cobalt	HCL-HNO3, (3:1)	AA	1 ppm
Cr	Chromium	Borate Fusion	DCP	1 ppm
Cu	Copper	HCL-HNO3, (3:1)	AA	0.5 ppm
Mo	Molybdenum	HCL-HNO3, (3:1)	AA	1 ppm
Ni	Nickel	HCL-HNO3, (3:1)	AA	1 ppm
Pb	Lead	HCL-HNO3, (3:1)	AA	2 ppm
Pd	Palladium	Aqua Regia	FA/DCP	1 ppb
Pt	Platinum	Aqua Regia	FA/DCP	5 ppb
Zn	Zinc	HCL-HNO3, (3:1)	AA	0.5 ppm

APPENDIX G. Fire assay analysis of magnetic fraction of HMC, Shining Tree Area.

Sample Number	Ag ppm	Au ppb	Ba ppm	Co ppm	Cr ppm	Cu ppm	Mo ppm	Ni ppm	Pb ppm	Pd ppb	Pt ppb	Zn ppm	Weight g
BH86-1	-0.1	-4	44	29	6930	15.2	2	120	10	-4	-19	75.4	4
ST86-005	-0.1	-4	21	27	6720	17.6	2	117	8	-4	-19	73.2	4
ST86-015	-0.1	-5	21	26	5480	21.6	2	123	9	-5	-25	76.5	3
ST86-016	-0.1	4	66	34	11470	46.5	3	173	13	-2	-9	83.1	8
ST86-021	-0.1	-5	54	35	4630	35.7	2	103	45	-5	-26	95.9	2.9
ST86-027	-0.1	-3	25	46	17280	22.8	1	321	11	-3	-13	69.7	6
ST86-030	-0.1	3	58	27	9730	48.5	1	102	14	-2	-8	70.7	9
ST86-033	-0.1	-8	78	25	9920	32.1	2	127	16	-8	-38	82.7	2
ST86-037	-0.1	-8	40	27	7660	21.2	1	113	11	-8	-38	85.9	2
ST86-042	-0.1	4	80	32	5710	35.8	2	106	11	-4	-19	116.5	4
ST86-043	-0.1	-3	27	28	9170	20.7	1	145	9	-3	-15	81.2	5
ST86-048	-0.1	5	58	42	5910	34.5	2	118	9	-5	-25	182.7	3
ST86-049	-0.1	-6	53	33	6720	40.2	2	115	10	-6	-30	118.4	2.49
ST86-057	-0.1	1	5	21	7630	14.3	2	95	13	-1	-5	62.6	15
ST86-059	-0.1	-3	75	30	6940	42.6	2	130	11	-3	-13	100.7	6
ST86-063	-0.1	-8	101	25	3330	36	3	74	14	-8	-38	86.5	2
ST86-074	-0.1	-3	42	29	7100	17.8	2	132	9	-3	-15	87.8	5
ST86-076	-0.1	-6	55	28	6280	32.9	2	115	13	-6	-30	100.5	2.49
ST86-077A	-0.1	-1	25	32	6630	18.5	2	127	9	-1	-5	99	15
ST86-077B	-0.1	68	81	30	7310	17.7	2	139	9	-3	-13	86.7	6
ST86-079	-0.1	-3	21	30	8290	15.7	2	150	8	-3	-13	80.7	6
ST86-081	-0.1	-5	30	31	7660	17.5	2	137	8	-5	-25	86.1	3
ST86-082	-0.1	-8	42	31	7940	14.9	2	122	14	-8	-38	103.8	2
ST86-083	-0.1	42	34	27	6360	15	2	109	11	12	-8	77.6	10
ST86-084	-0.1	-5	64	23	4300	17.4	2	91	10	-5	-25	75.7	3
ST86-087	-0.1	12	47	30	8450	26	2	135	11	-6	-30	86.2	2.5
ST86-088	-0.1	4	47	28	8790	28	2	120	10	11	-6	71.6	12
ST86-089	-0.1	3	72	29	8340	17.5	2	123	9	-2	-8	86.6	10
ST86-103	-0.1	-2	32	24	8360	17.4	1	118	8	69	-11	67.4	7
ST86-108A	-0.1	-3	60	22	2910	24.3	2	62	10	-3	-15	73.3	5
ST86-109	-0.1	-4	72	26	8070	15.8	2	126	28	-4	-19	71.8	4
ST86-111	-0.1	-2	33	23	5340	19.6	1	82	10	-2	-8	72.5	9
ST86-112	-0.1	10	84	30	6950	21.5	2	127	102	-5	-25	88.1	3
ST86-114	-0.1	-8	44	27	7000	21.4	2	131	11	-8	-38	76.4	2
ST86-118	-0.1	3	64	26	7400	13.7	2	119	10	-3	-15	74.3	5
ST86-125	-0.1	-4	52	34	5860	34.5	3	91	11	-4	-19	118.8	4
BH87-4B	-0.1	4	64	31	7880	16.6	2	148	11	-2	-11	83.3	7
BH87-9	-0.1	2	46	75	9860	23.6	2	346	12	11	-5	90.4	15
BH87-10B	-0.1	3	23	65	8940	21.7	2	387	10	-3	-13	91.6	6
SL87-353	-0.1	5	38	32	7170	13.9	2	111	9	15	-13	77.3	6
SL87-521	-0.1	-2	34	30	8440	15	2	145	8	2	-8	69.7	9
SL87-527	-0.1	2	68	28	7370	12.2	1	121	10	10	-8	76.3	9

AVERAGE			50	31	7482	23.7	2	136	14			86.6	6
MAXIMUM			101	75	17280	48.5	3	387	102			182.7	15
MINIMUM			21	21	2910	12	1	62	8			63	2
STD.DEV.			20	10	2285	9.6	0	64	15			20.1	4

Aultman Samples, Churchill Township

Sample Number	Ag ppm	Au ppb	Ba ppm	Co ppm	Cr ppm	Cu ppm	Mo ppm	Ni ppm	Pb ppm	Pd ppb	Pt ppb	Zn ppm	Weight g
JTA-3B	-0.1	3	87	33	7400	25.9	2	125	11	10	-13	89.2	6
JTA-7	-0.1	-5	60	31	7150	22.7	3	128	11	10	-25	99.1	3
JTA-8A	-0.1	-6	60	33	7900	19.4	2	126	10	-6	-30	94.3	2.5
JTA-9	-0.1	-15	78	31	7300	25.4	2	126	16	31	-76	116.5	0.98
JTA-11	-0.1	-3	60	35	7040	30.9	2	122	10	-3	-13	94.6	6
JTA-12	-0.1	-8	69	33	6910	30.4	2	129	12	-8	-38	90.3	2
JTA-14	-0.1	12	74	31	7430	22.7	3	129	10	-6	-29	90.2	2.59
JTA-17	-0.1	-6	78	34	7760	29.4	2	123	10	6	-30	100.9	2.5
AVERAGE			71	33	7361	25.9	2	126	11			96.9	3
MAXIMUM			87	35	7900	30.9	3	129	16			116.5	6
MINIMUM			60	31	6910	19.4	2	122	10			89.2	1

Control samples: fire assay analysis of magnetic fraction of HMC (Fort Frances Control)

Sample Number	Ag ppm	Au ppb	Ba ppm	Co ppm	Cr ppm	Cu ppm	Mo ppm	Ni ppm	Pb ppm	Pd ppb	Pt ppb	Zn ppm	Weight g
BH86-2	-0.1	-3	60	44	1760	20.5	4	124	18	-3	-25	75.8	3
ST86-038	-0.1	-3	40	44	1670	28.6	4	125	17	-3	-13	80.3	6
ST86-086	-0.1	11	60	52	1680	20.1	4	88	15	17	-11	81.1	7
JTA-4BM	-0.1	-2	55	38	1650	34.3	6	96	26	-2	-11	81.5	7

APPENDIX G: Fire assay analysis of non-magnetic fraction of HMC, Shining Tree Area

Sample Number	Ag ppm	Au ppm	Ba ppm	Co ppm	Cr ppm	Cu ppm	Mo ppm	Ni ppm	Pb ppm	Pd ppb	Pt ppb	Zn ppm	Weight g
BI 186-1	0.1	833	46	6	2800	29.6	2	18	30	5	6	33.9	12
BI 186-2	0.1	232	18	7	2870	25.4	2	17	24	16	-6	32.8	13
BI 186-5	-0.1	4581	33	4	2220	15.3	1	12	33	5	-6	26.1	13
ST86-005	-0.1	62	61	6	2400	29.8	2	14	25	-2	-8	38.6	10
ST86-006A	0.1	5674	58	7	1880	18.8	1	15	30	2	7	29.4	13
ST86-006B	-0.1	91	50	6	1610	19.6	2	13	24	-2	-8	28.5	10
ST86-009	-0.1	71	65	6	2560	16.7	1	14	31	-1	-7	33.8	11
ST86-015	-0.1	2073	42	8	2690	25.1	1	17	28	-1	-6	32.4	12
ST86-016	0.2	2762	73	32	11290	47.8	2	78	25	1	-5	63.4	14
ST86-021	0.1	294	59	17	1150	44.4	2	27	24	-3	-15	55.1	5
ST86-024	0.2	1595	51	14	3780	17	2	26	24	-2	-8	29.3	9
ST86-027	0.2	1558	65	6	5050	17.3	1	20	28	-1	-6	24.4	13
ST86-030	0.5	536	42	11	3860	29.8	2	22	24	-1	-5	26	14
ST86-033	0.2	474	73	10	5880	136.4	2	24	27	-3	-15	33.5	5
ST86-037	0.1	428	54	12	2470	25	2	17	25	-1	11	27.5	11
ST86-039	-0.1	206	64	14	3570	29.1	2	34	26	-4	-19	32.4	4
ST86-042	0.6	13063	64	28	2030	46.5	3	44	25	6	21	69.2	8
ST86-043	0.3	2421	52	11	2590	14.2	2	22	26	3	-6	27	12
ST86-048	0.1	110	79	29	2190	24.6	2	38	18	-2	-8	80.1	9
ST86-049	1.8	2381	55	18	2210	29.5	3	27	25	-4	-19	45.3	4
ST86-057	-0.1	2947	58	6	1390	8	2	9	42	2	-6	25.9	13
ST86-059	0.1	288	47	11	1930	23.9	2	17	37	-1	-5	25.4	14
ST86-060	-0.1	300	44	3	3800	12.4	2	13	25	-2	-11	21.9	7
ST86-063	-0.1	2436	34	4	831	17	2	16	28	-2	11	24.9	7
ST86-067	0.1	3	44	2	1880	5.6	1	11	26	-1	-5	19.9	14
ST86-068	0.1	384	59	8	1330	13	2	15	33	-2	-8	26	10
ST86-069	0.1	86	47	7	2120	20.8	2	20	22	-1	-5	27.2	15
ST86-070	0.1	166	40	6	1340	9.8	1	15	14	-1	-6	17.7	13
ST86-072B	-0.1	2033	62	10	2120	6.7	2	16	30	-2	-9	22.6	8
ST86-072C	0.2	351	62	6	1710	8.4	1	16	30	-1	-6	20.8	12
ST86-074	0.1	249	54	5	1780	7.7	1	13	24	-1	-5	16.3	15
ST86-076	0.6	2808	51	8	3030	19.7	1	18	27	2	-8	26.4	9
ST86-077A	0.1	91	54	9	2550	11.8	1	19	26	-1	-5	27.7	15
ST86-077B	0.2	49	51	6	2240	11.1	1	15	25	-1	-5	20.5	15
ST86-079	-0.1	447	57	6	2310	9.6	1	17	25	-1	-6	22.7	13
ST86-081	-0.1	36	54	7	1750	7.9	1	15	24	-1	-6	22.1	12
ST86-082	-0.1	241	51	4	3220	13.2	1	17	29	-1	7	27.5	15
ST86-083	1	1919	57	10	1920	8.6	1	16	24	1	-5	21.9	15
ST86-084	-0.1	4749	37	30	1230	16.5	3	23	21	3	11	22.8	12
ST86-085	-0.1	475	40	8	2100	11.8	2	14	27	-1	-7	22.4	11
ST86-087	0.1	623	59	5	3220	12.8	3	13	24	-1	-6	21.8	12
ST86-088	-0.1	878	43	3	2660	15.5	2	14	22	-1	9	17.7	15

Sample Number	Ag ppm	Au ppm	Ba ppm	Co ppm	Cr ppm	Cu ppm	Mo ppm	Ni ppm	Pb ppm	Pd ppb	Pt ppb	Zn ppm	Weight g
ST86-089	-0.1	691	56	16	2080	12.1	2	25	22	1	7	29.5	15
ST86-090	0.6	200	47	199	6000	174.6	3	670	30	5	15	646.5	6
ST86-100	-0.1	43	65	6	1650	24.3	1	14	24	13	11	32.6	12
ST86-101	-0.1	348	44	7	1910	23.6	2	16	18	1	11	30.2	11
ST86-102	-0.1	1039	572	4	2090	27.2	1	14	26	3	9	33.6	12
ST86-103	-0.1	1381	52	3	2400	15.5	1	10	29	2	10	22.6	15
ST86-104	-0.1	1214	49	6	2030	17.9	2	13	32	-1	-5	29.7	13
ST86-105	0.4	359	44	4	2210	9.8	1	10	31	-1	-5	27.7	13
ST86-106	0.1	639	62	7	2100	20.4	2	14	32	-2	19	33.7	7
ST86-107B	-0.1	51	44	8	1240	18.4	1	13	16	-1	-6	27.2	12
ST86-108A	0.6	90	67	5	1150	16.5	1	11	23	-1	-6	29.4	12
ST86-108B	0.3	1394	39	3	872	26.7	1	9	22	-1	-7	36.8	11
ST86-109	-0.1	134	47	9	2180	19.9	2	17	22	-1	-7	36.5	11
ST86-110	-0.1	950	105	7	2040	30	1	16	28	-1	-6	36.4	12
ST86-111	-0.1	1343	47	11	1780	27.3	1	14	28	2	-5	32	15
ST86-112	1.2	32	33	23	2730	37.9	1	24	32	2	-8	40.5	N/A
ST86-113	1.5	1158	28	12	8700	20.1	1	40	26	-3	-13	47.2	6
ST86-114	0.1	368	26	8	2830	22.8	1	17	26	-2	-9	35.7	8
ST86-115	0.3	80	36	7	7500	50	2	13	59	-10	-50	80.8	1.5
ST86-116	0.2	3	33	24	3460	38.5	2	38	33	-6	-30	51	2.5
ST86-117	-0.1	1658	49	12	3350	50.3	2	22	27	4	-19	55.2	4
ST86-118	0.4	550	33	9	1850	16.5	1	16	25	-1	-6	30.9	13
ST86-119	-0.1	85	52	4	1320	21.6	1	12	28	-3	-13	30.3	6
ST86-120	0.1	248	27	5	1590	21	1	11	24	1	-6	29.9	12
ST86-121	-0.1	575	39	13	2230	46	1	40	28	1	-5	45	14
ST86-122	0.2	498	52	9	2690	38.6	1	26	31	1	-6	38.9	13
ST86-123	0.1	600	42	14	2180	56	1	57	22	2	6	41	14
ST86-124	-0.1	682	20	9	2220	22.2	1	16	28	2	6	30.2	14
ST86-125	3	156	15	14	2200	48.6	2	16	23	2	8	45.9	13
BH87-1B	-0.1	88	38	13	1830	19.4	3	22	26	2	8	28.3	13
BH87-2B	0.2	0.5	65	8	1550	13.1	2	18	22	3	11	28	12
BH87-4B	0.1	508	62	5	1720	14.2	2	18	26	-1	-6	22.5	12
BH87-5B	-0.1	20	42	7	2200	21.4	2	23	30	-1	-7	33	11
BH87-6	-0.1	593	69	7	1850	22.4	2	19	28	-1	-7	31.2	11
BH87-7A	0.1	145	39	5	1690	10.8	2	25	26	-1	-7	20.5	11
BH87-9	-0.1	+20000	39	9	2480	12	2	21	20	4	24	24.4	18
BH87-10B	1.7	327	47	10	2690	14.2	2	33	28	-1	-7	28.9	11
BH87-11B	0.1	2520	51	6	1760	19.3	2	22	23	-1	8	32.6	11
BH87-12A	0.1	273	79	5	1770	21.4	2	19	24	-3	-15	42.7	5
BH87-12B	0.1	168	43	3	1440	9.8	2	13	29	-1	-6	22.1	12
BH87-13	-0.1	735	1730	20	2230	215.1	3	30	39	-8	-38	37.8	2
SL87-011	20.2	2999	28	11	2140	13	3	28	34	2	9	40.1	13
SL87-012	0.1	57	31	7	1900	8.2	2	18	33	-1	8	19.1	11
SL87-013	-0.1	173	50	12	1780	12.3	2	13	27	-1	-6	23.8	12

Sample Number	Ag ppm	Au ppm	Ba ppm	Co ppm	Cr ppm	Cu ppm	Mo ppm	Ni ppm	Pb ppm	Pd ppb	Pt ppb	Zn ppm	Weight g
SL87-016	0.1	199	41	8	2130	8.9	2	15	29	-1	-5	19.5	14
SL87-018	-0.1	10914	72	7	2030	10	3	14	29	-1	7	23.7	13
SL87-022	0.1	376	58	4	2130	7.4	3	11	43	-1	-5	21.8	15
SL87-036	-0.1	250	41	10	1740	12.9	3	13	32	-1	-6	23.8	12
SL87-038	-0.1	234	69	3	1470	6.9	3	11	30	-1	-5	17.5	15
SL87-069	-0.1	145	76	8	1790	8.2	3	17	30	-1	-6	23.9	12
SL87-075	-0.1	347	52	5	2100	6.9	3	13	33	-1	-6	20.8	13
SL87-080	0.1	110	58	6	2170	6.6	2	13	31	-1	-6	19.9	13
SL87-082	-0.1	601	61	6	2600	6.5	2	11	40	-1	-7	21.1	11
SL87-086	-0.1	3220	29	6	1900	7.9	2	13	30	1	-5	19.1	15
SL87-090	0.2	470	50	6	1860	6.2	2	13	31	-1	-6	18.8	12
SL87-096	-0.1	978	32	5	2150	11.1	2	12	26	421	-7	21.9	11
SL87-098	0.3	6773	40	14	2970	18	2	19	33	3	-6	24.8	13
SL87-100	0.2	1144	83	14	2770	20.2	2	22	26	1	-5	31.5	14
SL87-102	-0.1	4320	58	7	998	15.7	2	13	18	3	-5	21.3	15
SL87-105	-0.1	173	60	7	1030	11.2	2	12	28	-1	8	30.6	15
SL87-107	-0.1	122	32	6	774	11.4	2	12	18	-1	-5	21.3	15
SL87-132	-0.1	61	53	6	1320	9.9	2	13	25	-1	-5	21.6	15
SL87-134	-0.1	114	39	7	1000	15.6	2	13	20	-1	-5	24.9	15
SL87-141	-0.1	1194	53	6	1640	10.9	2	13	27	-1	-5	24.4	15
SL87-157	-0.1	241	46	48	1390	16.7	2	75	21	-1	-5	137.1	14
SL87-161	0.1	478	42	10	2460	10.5	2	14	28	-1	-5	26.1	14
SL87-164	0.1	629	35	8	990	17.2	2	15	20	1	-5	30.3	15
SL87-219A	0.2	176	37	5	2020	12.4	2	123	28	3	-5	21.7	15
SL87-229	0.1	122	22	5	2060	10.1	2	16	24	-1	-5	21.7	15
SL87-272	-0.1	2420	51	3	1290	11.6	3	14	25	2	5	22	15
SL87-290	0.2	769	51	7	1030	32	2	17	17	-1	-5	28.2	15
SL87-322	-0.1	185	48	10	1430	13.3	2	18	30	-1	-6	29.9	12
SL87-353	0.1	78	44	6	2280	8.5	2	14	30	-1	-6	25.4	13
SL87-356	-0.1	846	59	3	2280	13.1	2	13	33	-1	-5	47.3	14
SL87-357	-0.1	107	33	7	2320	13.6	2	14	30	-1	-6	26.3	13
SL87-358	-0.1	697	77	6	2760	18.9	2	14	31	-1	-5	31.1	13
SL87-359	0.1	256	42	8	2340	15	2	15	32	-1	-5	27.2	15
SL87-361	0.4	1844	42	7	1930	17	1	17	27	-1	-5	22.6	15
SL87-363	-0.1	382	35	8	2470	18.7	2	15	30	-1	-5	24.7	14
SL87-364	0.5	13333	38	6	2130	55.1	2	14	32	3	9	26	12
SL87-394	0.3	267	65	0.5	2630	9	2	11	34	-1	-5	20.2	15
SL87-411	-0.1	32	58	2	825	12.7	2	12	19	-1	-5	23.9	15
SL87-412	-0.1	28	58	2	740	17.6	2	11	17	-1	-5	22.5	15
SL87-415	0.2	0.5	38	6	521	21.1	2	13	13	-1	-6	33.1	13
SL87-439	-0.1	76	36	0.5	2060	9	2	14	26	-1	6	22	15
SL87-440	-0.1	3	44	4	2580	7.7	3	12	30	1	6	24	13
SL87-521	0.1	75	44	12	1580	31.6	2	20	30	1	-5	39.6	15
SL87-527	0.1	106	60	7	1560	9.1	2	13	25	2	7	27.8	13

Sample Number	Ag ppm	Au ppm	Ba ppm	Co ppm	Cr ppm	Cu ppm	Mo ppm	Ni ppm	Pb ppm	Pd ppb	Pt ppb	Zn ppm	Weight g
SL87-546	0.1	266	76	5	1620	17.4	2	16	28	3	8	32.3	12
SL87-547	0.1	49	28	2	1480	10.8	2	12	28	1	5	24.7	15
SL87-548	-0.1	496	36	10	2140	19.5	2	15	35	1	8	34.3	11
SL87-551	-0.1	162	42	10	2250	16.9	2	15	22	2	9	27.8	13
SL87-560	0.1	336	42	1	1740	9.5	2	10	31	1	8	19.7	13
AVERAGE		1055	65	10	2271	22	2	24	27		35	12	
MAXIMUM		+20000	1730	199	11290	215.1	3	670	59		647	18	
MINIMUM		0.5	15	1	521	5.6	1	9	13		16	1.5	
STD.DEV.		2075	151	18	1352	26	1	57	6		55	3.3	

Aultman Samples, Churchill Township

Sample Number	Ag ppm	Au ppm	Ba ppm	Co ppm	Cr ppm	Cu ppm	Mo ppm	Ni ppm	Pb ppm	Pd ppb	Pt ppb	Zn ppm	Weight g
JTA-3B	-0.1	2748	47	10	2640	26.3	2	23	19	-1	-6	37.5	12
JTA-7	-0.1	227	84	11	2740	24.9	2	22	21	-2	-9	37.2	8
JTA-8A	-0.1	152	28	10	2660	16.4	3	21	15	-2	-9	32.1	8
JTA-9	-0.1	2.5	48	7	3320	12.8	2	20	20	-5	35	36.3	3
JTA-11	-0.1	1043	40	11	2660	19.4	3	27	20	-1	11	37	11
JTA-12	-0.1	176	40	10	2320	21.8	2	24	22	-2	17	31.9	7
JTA-14	0.6	2112	56	15	2230	25.4	3	29	20	-3	30	29.3	5
JTA-17	-0.1	203	56	10	2840	20	2	20	22	-3	15	31.3	6
AVERAGE		833	50	11	2676	20.9	2	23	20			34.1	8
MAXIMUM		2748	84	15	3320	26.3	3	29	22			37.5	12
MINIMUM		2.5	28	7	2230	12.8	2	20	15			29.3	3
No.Below detection limit		1											

Control results: fire assay analyses of non-magnetic fraction of HMC (Klip Control)

Sample Number	Ag ppm	Au ppm	Ba ppm	Co ppm	Cr ppm	Cu ppm	Mo ppm	Ni ppm	Pb ppm	Pd ppb	Pt ppb	Zn ppm	Weight g
SL87-165H	0.7	5	70	5	225	16.8	3	9	10	-5	-25	46.2	3
SL87-417H	-0.1	-2	43	5	231	7.4	3	7	10	-2	-8	33.7	10
BH87-3BH	-0.1	-2	65	6	208	12.6	3	9	10	-2	-8	42.7	10
JTA-4H	-0.1	-1	55	5	227	11.2	2	10	10	-1	-5	35.7	14

APPENDIX H: Trace element analysis (trace 2) of non-magnetic and magnetic fractions of HMCs, Gowganda Map Area

Sample	Ba ppm	Be ppm	Co ppm	Cr ppm	Cu ppm	Fe pct	Mo ppm	Ni ppm	Pb ppm	Sc ppm	Sr ppm	V ppm	Y ppm	Zn ppm
Non-Magnetic HMC														
GW89-008	90	-1	25	1430	22	16.9	-10	82	32	74	510	295	125	86
GW89-030	640	-1	52	810	20	14.7	-10	116	14	50	260	340	69	82
GW89-117	1240	-1	32	820	28	13.8	-10	94	38	62	738	362	83	82
GW89-159	2240	-1	34	804	51	27	-10	45	52	62	355	384	106	71
GW89-228	620	-1	22	900	20	18.5	-10	46	46	77	449	298	130	82
GW89-229	720	-1	24	1510	21	19.6	-10	39	46	83	434	297	148	95
SL89-246	1020	-1	37	796	30	20.8	-10	146	44	77	439	254	145	91
Magnetic HMC														
GW89-008	520	-1	50	7960	27	52.1	-10	244	-10	7	44	1594	12	264
GW89-030	460	-1	36	1730	33	46.7	-10	121	-10	15	57	2766	15	274
GW89-117	590	-1	30	1800	47	45.8	-10	88	42	16	47	2237	21	265
GW89-159	590	-1	37	1610	44	51	-10	75	30	15	36	2571	19	270
GW89-228	190	-1	71	9000	26	57	-10	270	-10	7	31	1866	12	286
GW89-229	280	-1	68	11000	32	53.2	-10	223	-10	6	23	1606	10	278
SL89-246	340	-1	54	5900	19	58.9	-10	124	-10	5	25	1620	11	318

Control Results from Gowganda Area Non-Magnetic and Magnetic HMC Analysis: KLIP Control

Sample	Ba ppm	Be ppm	Co ppm	Cr ppm	Cu ppm	Fe pct	Mo ppm	Ni ppm	Pb ppm	Sc ppm	Sr ppm	V ppm	Y ppm	Zn ppm
Non-Magnetic HMC														
GW89-003H	100	-1	17	360	8	20.6	-10	23	-10	59	78	342	193	148
GW89-303H	880	-1	16	342	9	21	-10	20	-10	59	81	351	196	147
Magnetic HMC														
GW89-003M	590	-1	70	1980	22	63.5	-10	161	-10	-2	16	1137	9	140
GW89-303M	340	-1	76	2320	26	63.3	-10	138	-10	-2	17	1142	11	134

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^2	0.155 0	square inches	1 square inch	**6.451 6**	cm^2
1 m^2	10.763 9	square feet	1 square foot	**0.092 903 04**	m^2
1 km^2	0.386 10	square miles	1 square mile	2.589 988	km^2
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
			VOLUME		
1 cm^3	0.061 02	cubic inches	1 cubic inch	**16.387 064**	cm^3
1 m^3	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m^3
1 m^3	1.308 0	cubic yards	1 cubic yard	0.764 555	m^3
			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.

41 P/14 1:50,000 **CANADA** EDITION 2 41 P/14

SINCLAIR LAKE
ONTARIO

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Copies may be obtained from the Canada Map Office, Department of Energy, Mines and Resources, Ottawa, or your nearest map dealer.

Roads:	Routes:		
loose or stabilized surface, all weather...	gravier aggloméré, toute saison...	2 lanes or more 2 voies ou plus	less than 2 lanes moins de 2 voies
loose surface, dry weather and unclassified streets...	de gravier, temps sec et rues hors classe...		
cart track...	de terre...		
trail, cut line or portage...	sentier, percée ou portage...		

FOR COMPLETE REFERENCE SEE REVERSE SIDE POUR UNE LISTE COMPLÈTE DES SIGNES, VOIR AU VERSO

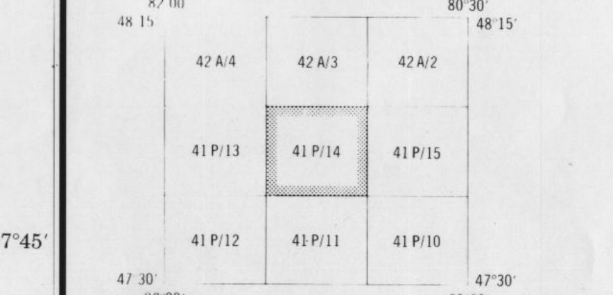
Scale 1:50,000 Échelle

Miles 1 0 1 2 3 Milles
Metres 1000 0 1000 2000 3000 4000 Mètres
Yards 1000 0 1000 2000 3000 4000 Verges

CONTOUR INTERVAL 50 FEET
Elevations in Feet above Mean Sea Level
North American Datum 1927
Transverse Mercator Projection

ÉQUIDISTANCE DES COURBES 50 PIEDS
Élévations en pieds au-dessus du niveau moyen de la mer
Système de référence géodésique nord-américain, 1927
Projection transverse de Mercator

TABLEAU D'ASSEMBLAGE DU SYSTÈME NATIONAL DE RÉFÉRENCE CARTOGRAPHIQUE



INDEX TO ADJOINING MAPS OF THE NATIONAL TOPOGRAPHIC SYSTEM

Établie par la DIRECTION DES LEVÉS ET DE LA CARTOGRAPHIE, MINISTÈRE DE L'ÉNERGIE, DES MINES ET DES RESSOURCES. Mise à jour à l'aide de photographies aériennes prises en 1974. Vérification des ouvrages en 1975. Renseignements à jour en 1975.

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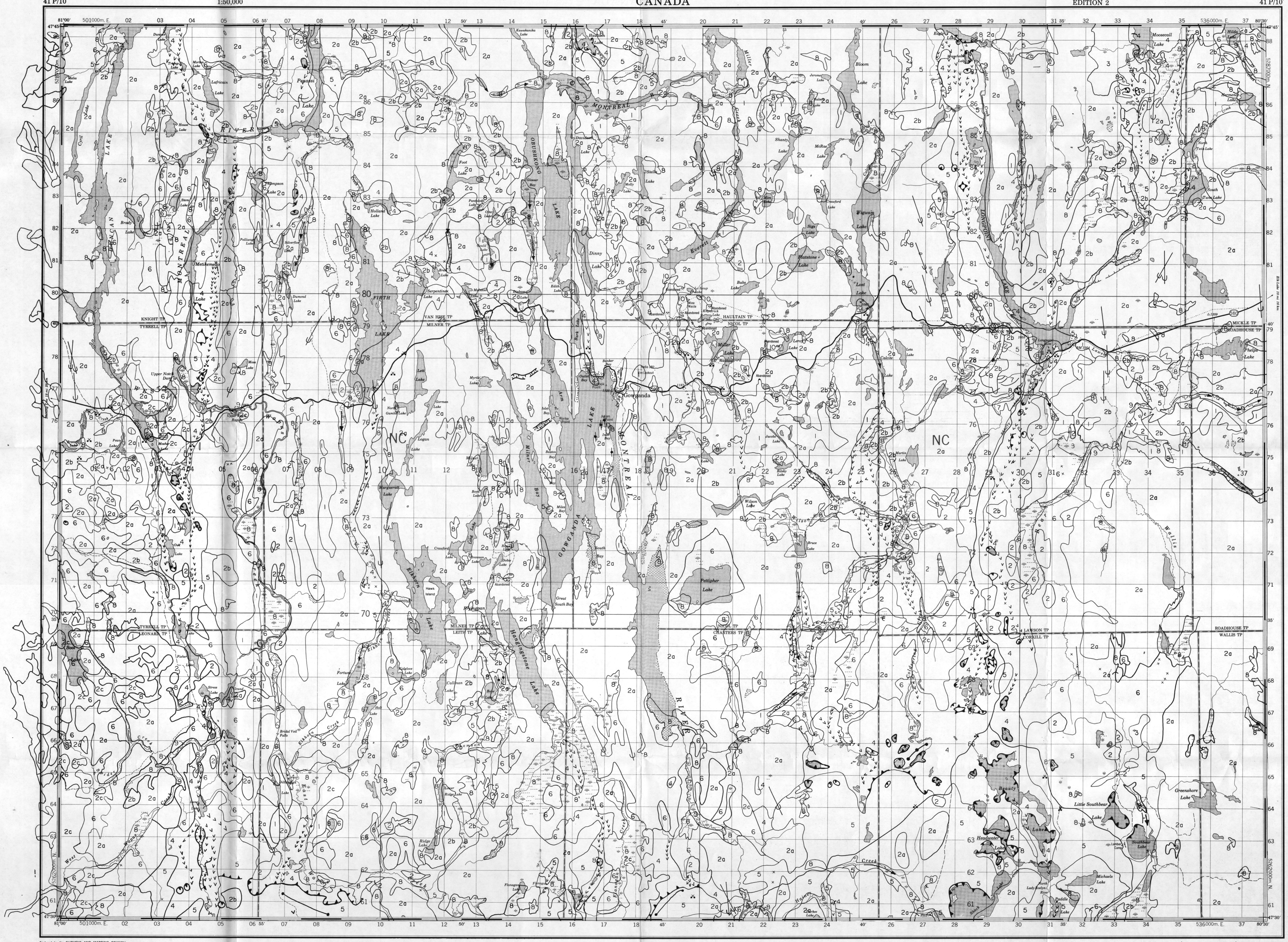
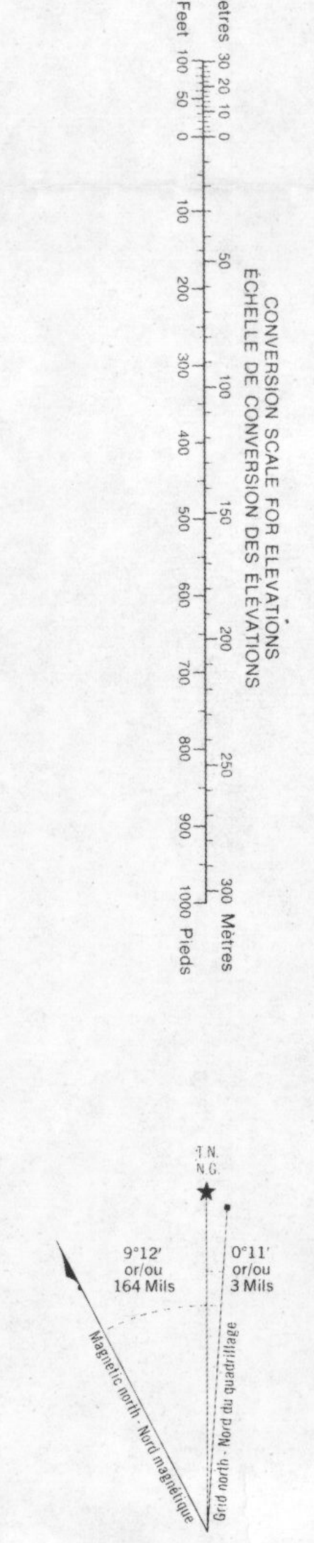
SINCLAIR LAKE
41 P/14
EDITION 2

41 P/10 1:50,000 **CANADA** EDITION 2 41 P/10

Military users, refer to this map as: Référence de cette carte pour usage militaire:	SERIES A 751 SÉRIE MAP 41 P/10 CARTE EDITION 2 MCE ÉDITION





Use diagram only to obtain numerical values
APPROXIMATE MEAN DECLINATION 1976
FOR CENTRE OF MAP
Annual change decreasing 0.1'

N'utiliser le diagramme que pour obtenir les valeurs numériques
DÉCLINAISON MOYENNE APPROXIMATIVE
AU CENTRE DE LA CARTE EN 1976
Variation annuelle décroissante 0.1'

ONE THOUSAND METRE
UNIVERSAL TRANSVERSE MERCATOR GRID
ZONE 17
QUADRILLAGE DE MILLE MÈTRES
TRANSVERSE UNIVERSEL DE MERCATOR

GRID ZONE DESIGNATION: DÉSIGNATION DE LA ZONE DU QUADRILLAGE:	100,000 M. SQUARE IDENTIFICATION IDENTIFICATION DU CARRÉ DE 100,000 M.
17 T	NC

EXAMPLE OF METHOD USED
TO GIVE A REFERENCE TO NEAREST 100 METRES
EXEMPLE DE LA MÉTHODE EMPLOYÉE
POUR FIXER DES REPÈRES À 100 MÈTRES PRÈS

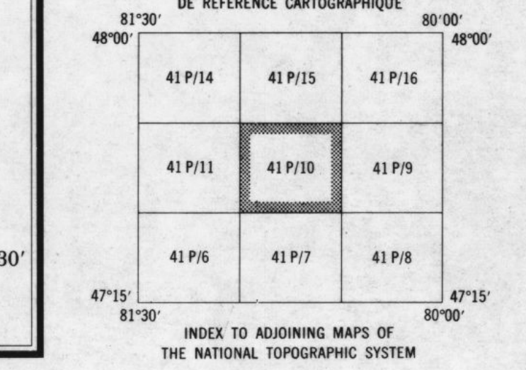
REFERENCE POINT / POINT DE REPÈRE CHURCH - ÉGLISE (as above) (ci-dessus)

EASTING: Read number on grid line immediately to left of point:
LONGITUDE EST: Noter le chiffre de la ligne du quadrillage immédiatement à gauche du repère: 97
Estimate tenths of a square from this line eastward to point:
Estimer le nombre de dixièmes du carré entre cette ligne et le repère en direction est: 5
975

NORTHING: Read number on grid line immediately below point:
LATITUDE NORD: Noter le chiffre de la ligne du quadrillage immédiatement en-dessous du repère: 98
Estimate tenths of a square from this line northward to point:
Estimer le nombre de dixièmes du carré entre cette ligne et le repère en direction nord: 4
984
GRID REFERENCE:
RÉFÉRENCE AU QUADRILLAGE: 975984

Nearest similar grid reference 100,000 metres (about 63 miles)
La prochaine référence similaire est à 100,000 mètres (environ 63 milles)

TABLEAU D'ASSEMBLAGE DU SYSTÈME NATIONAL DE RÉFÉRENCE CARTOGRAPHIQUE



INDEX TO ADJOINING MAPS OF THE NATIONAL TOPOGRAPHIC SYSTEM

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Roads:	Routes:		
hard surface, all weather	pavée, toute saison	dual highway 2 chaussées séparées	more than 2 lanes plus de 2 voies
hard surface, all weather	pavée, toute saison	2 lanes 2 voies	less than 2 lanes moins de 2 voies
loose or stabilized surface, all weather	gravier aggloméré, toute saison	2 lanes or more 2 voies ou plus	less than 2 lanes moins de 2 voies
loose surface, dry weather and unclassified streets	de gravier, temps sec et rues hors classe		
cart track	de terre		
trail, cut line or portage	sentier, percée ou portage		

FOR COMPLETE REFERENCE SEE REVERSE SIDE POUR UNE LISTE COMPLÈTE DES SIGNES, VOIR AU VERSO

GOWGANDA
ONTARIO
TIMISKAMING DISTRICT
Scale 1:50,000 Échelle

Miles 1 0 1 2 3 Milles
Metres 1000 0 1000 2000 3000 4000 Mètres
Yards 1000 0 1000 2000 3000 4000 Verges

CONTOUR INTERVAL 50 FEET
Elevations in Feet above Mean Sea Level
North American Datum 1927
Transverse Mercator Projection

ÉQUIDISTANCE DES COURBES 50 PIEDS
Élévations en pieds au-dessus du niveau moyen de la mer
Système de référence géodésique nord-américain, 1927
Projection transverse de Mercator

Établie par la DIRECTION DES LEVÉS ET DE LA CARTOGRAPHIE, MINISTÈRE DE L'ÉNERGIE, DES MINES ET DES RESSOURCES. Mise à jour à l'aide de photographies aériennes prises en 1974. Vérification des ouvrages en 1975. Renseignements à jour en 1975.

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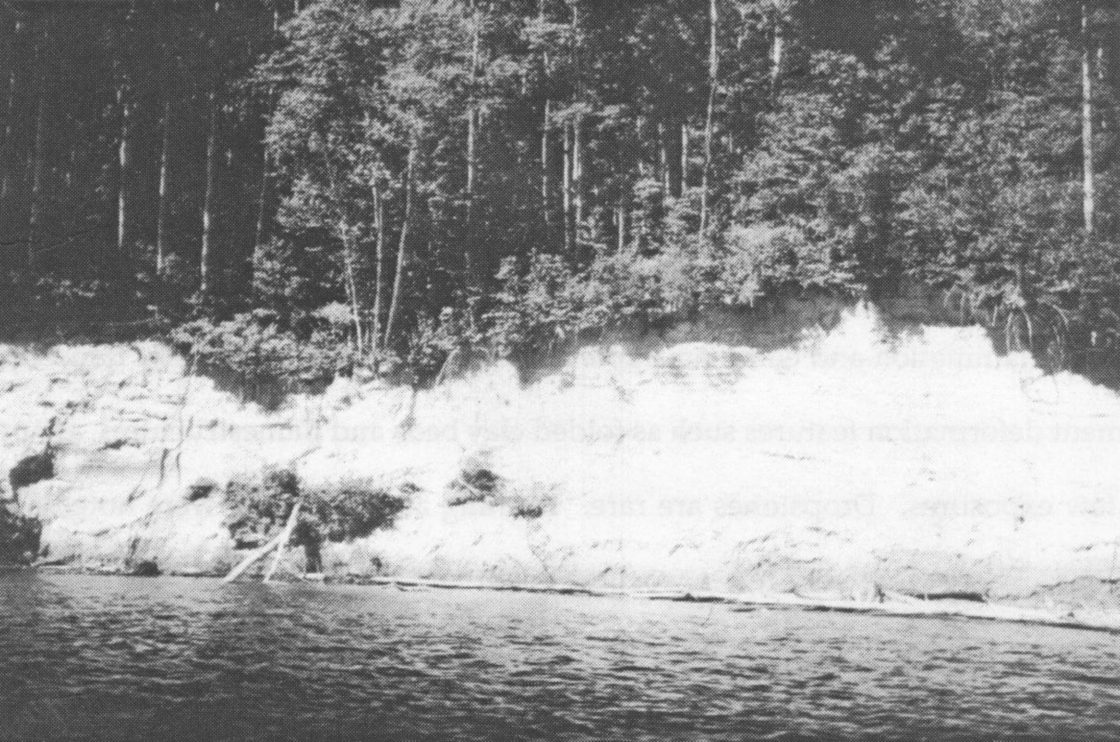
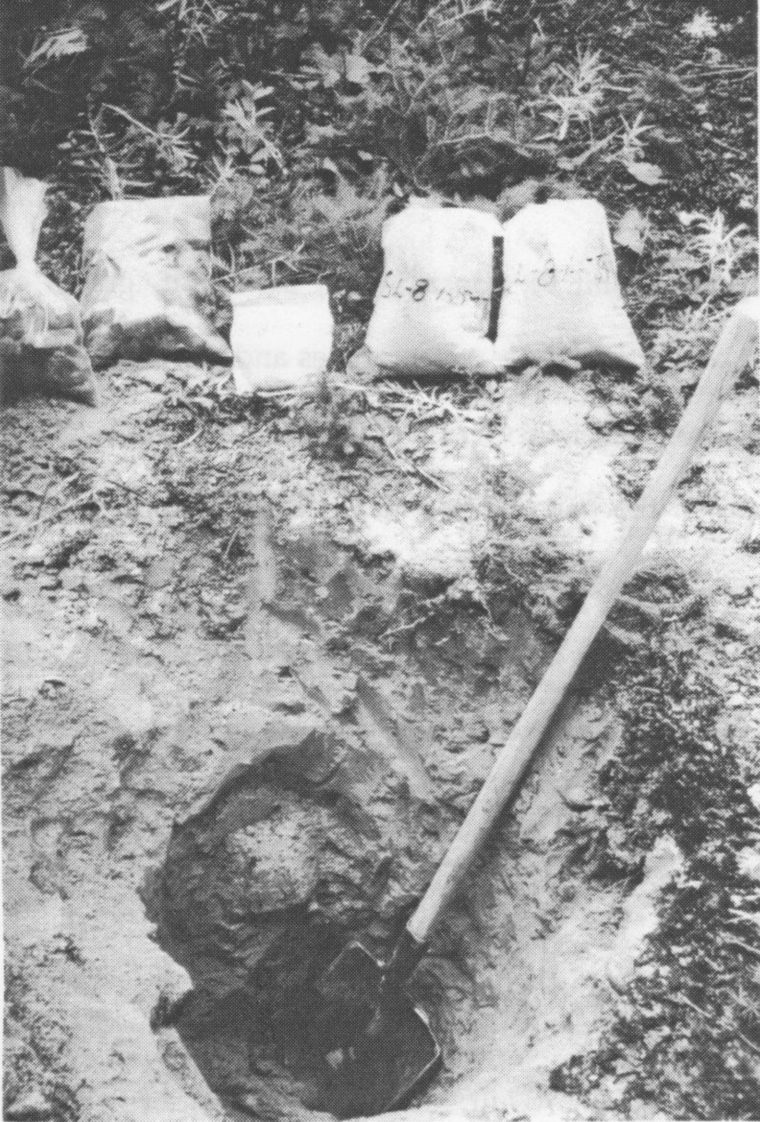
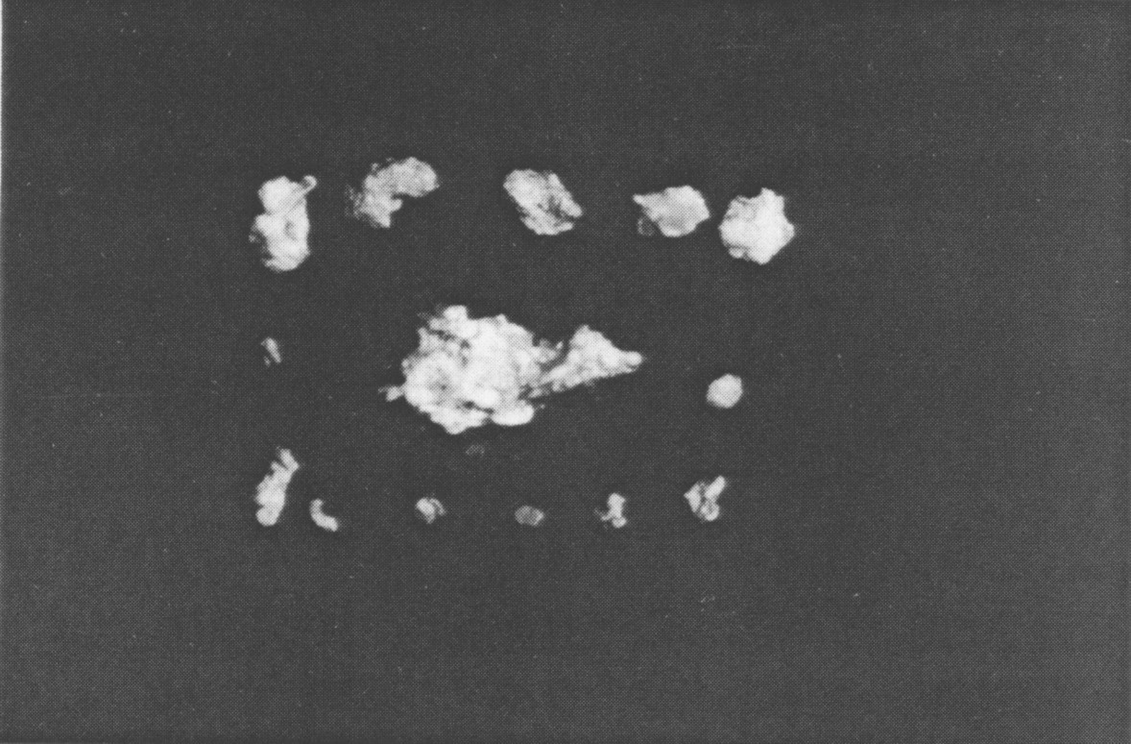
GOWGANDA
41 P/10
EDITION 2







MARGINAL NOTES

INTRODUCTION

The Quaternary geology of the Shining Tree area (NTS 41P/11) was mapped during the 1986 field season (Finamore 1986), with further work in 1987 and 1988 (Alcock 1987, 1988). The Sinclair Lake map area (NTS 41P/14), immediately to the north, has also been mapped (Alcock and Miller 1990).

The surficial sediments were examined at natural and man-made exposures along road and water traverses, and through hand augering, test pitting and backhoe trenching. Access to much of the area is poor. The road system is limited to a few main gravel-surfaced roads and a network of minor bush roads maintained for forestry and recreational purposes. Rivers and lakes allowed access to many remote areas.

Surficial units were delineated through airphoto interpretation using 1:15 840 and 1:50 000 scale airphotos. Deposit morphology, vegetation cover, drainage characteristics and reflectivity of exposed sediments were used to interpret the surficial deposits in remote areas. The distribution of deposits is strongly topographically controlled. Till predominates in the upland areas. Glaciofluvial ice-contact and outwash deposits are present in north-south oriented valleys and glaciolacustrine and organic deposits occupy topographic lows with restricted drainage.

Any map unit represents a composite area, with the indicated deposit type predominating and minor areas of other deposit types. For example, within the bedrock-drift complex, most areas of till veneer (<1 m thickness) over bedrock also include small areas of thick till (>1 m thickness) and organic deposits. Many contacts between map units represent an arbitrary division of the gradual transition from one deposit type to another, for example, the transition from glaciofluvial outwash to wave-reworked outwash to lacustrine sands. The bedrock-drift complex areas have covers of drift over bedrock which average 1 m or less in thickness. All other units represent drift or organic material at least 1 m thick. Any site specific use of the surficial deposits map should include an orientation survey to locally verify the sediment types, thickness and distribution.

The present study provides additional detail and local control to the regional mapping of Boissonneau (1965, 1968) and the terrain study of Roed and Hallet (1979) and expands upon the areas initially mapped by Closs and Sado (1982). Reference was made to 1:31 680 scale bedrock maps (Carter 1981; Bright 1970, 1984) for verifying areas of bedrock-drift complex.

The authors wish to acknowledge the administrative and logistical assistance of the staff at the Gogama District Office, Ontario Ministry of Natural Resources. Competent assistance during mapping was provided by J. MacKenzie, A. Chippindale C. Hibberd, J. Aultman and V. Rammul and M. Schrader.

BEDROCK GEOLOGY

In the Shining Tree map area, Early Precambrian (Archean) rocks consist of a metavolcanic-metasedimentary sequence which are intruded by mafic and felsic plutonic rocks and diabase dikes. Middle Precambrian (Proterozoic) rocks include generally flat-lying clastic and chemical sedimentary rocks of the Quirke Lake and Cobalt groups. These unconformably overlie the Early Precambrian bedrock, and Nipissing-type intrusive diabase sills and dikes. Late Precambrian diabase dikes cut all formations (Carter 1981).

Deposits and occurrences of gold, silver, cobalt, copper, zinc, lead, molybdenum, nickel, iron, and asbestos occur in the study area (Carter 1981; Bright 1970, 1984). Over the area, approximately 10 to 30 percent of the bedrock is exposed.

PLEISTOCENE HISTORY

The last late Wisconsinan ice advance, and postglacial glaciolacustrine and eolian activity, are represented by the surficial sedimentary sequence. Glacially streamlined and striated bedrock outcrops, till fabrics and dispersion trends of lithologic indicators demonstrate that the last dominant ice movement was towards 180±30° azimuth. Minor late-glacial shifts in ice direction, due to bedrock topographic influences, are indicated by 160 to 180° striations cross-cutting an earlier set of 140 to 160° striations. Where exposed, the bedrock surface is often glacially smoothed, striated and displays whaleback forms.

Certain *roches moutonnées* preserve facets or remnants of grooves oriented southwest-northeast on their lee (southern) sides. On rare outcrops, such as near the south end of Bobtail Lake in Fawcett Township, southwesterly oriented striations are crossed by southerly oriented ones. This evidence suggests an earlier southwesterly ice advance, perhaps equivalent to that documented by Veillette (1986) in the Timmins, Matheson and Lake Timiskaming areas to the north and east of the project area.

Ice retreated from the area about 10 000 years BP (Dyke and Prest, 1987), leaving a widespread drift veneer over the bedrock surface. Very few ice constructional features, such as drumlins or minor morainic ridges, are present. Several north-south-trending belts and ice re-entrant infills of glaciofluvial ice-contact and outwash sediments were deposited in the area. Upon deglaciation, most topographic lows were inundated by short-lived proglacial lakes. Washing and winnowing of the drift-mantled hills and glaciofluvial deposits produced bare bedrock knobs, wave-cut benches in eskers and blankets of nearshore sand stretching out from sediment sources. Accumulations of boulders on till are found over the range of glaciolacustrine wave influence.

Meltwater drainage was controlled by the location and elevation of the major bedrock valleys such as those occupied by the West Montreal and Grassy rivers and by Nabakwasi, Mattagami, Bigfour and Pigeon lakes. Drainage of the proglacial lakes and subsequent subaerial exposure of waterlain sediments allowed extensive eolian reworking of the coarse-grained deposits, deposition of dunes and a widespread veneer of eolian sediment.

Drift thickness in areas of bedrock-drift complex commonly ranges from less than 1 m to in excess of 10 m. Extreme thicknesses of more than 50 m are present in areas of ice-contact deposits and in the major infilled valleys.

Only rare clasts of carbonate lithologies have been found in till or outwash deposits, indicating that the project area is south and east of the limit of carbonate drift as mapped by Karrow and Geddes (1987).

SURFICIAL GEOLOGY

TILL

Till is frequently found as a veneer over bedrock (Unit 2a) but ranges up to 4 m or more in thickness in areas of thick till (Unit 3). Till veneer areas (average thickness <1 m) have frequent bedrock outcrops and a surface morphology controlled by the underlying bedrock topography. Veneers of till are found over many bedrock hummocks and uplands. Deposits of thick till are found on the larger upland surfaces and in the lee of bedrock highs.

The till sheet found at surface represents one lithostratigraphic unit with varying composition. The variation is due to the incorporation of various bedrock lithologies and different modes of deposition. All surface till, to a depth of at least 1 to 2 m, has been affected by soil forming processes, including oxidation and translocation of matrix carbonate and iron.

Both subglacial and supraglacial tills were identified using sedimentological and structural characteristics. Subglacially deposited tills are common at or near surface in areas of bedrock-drift complex and thick till. Lodgement till is commonly moderately to highly compact, stony (10 to 50 percent clasts by volume) and has a silty sand matrix. This till type occasionally displays shear structures, and may overlie striated bedrock. Subglacial melt-out till is loose to moderately compact, stony (10 to 50 percent clasts by volume), with a silty sand matrix and has thin deformed sand bands. The subglacial till facies contain frequent striated and facetted clasts ranging in size from granules to boulders. The composition of these tills often strongly reflects the local bedrock lithologies.

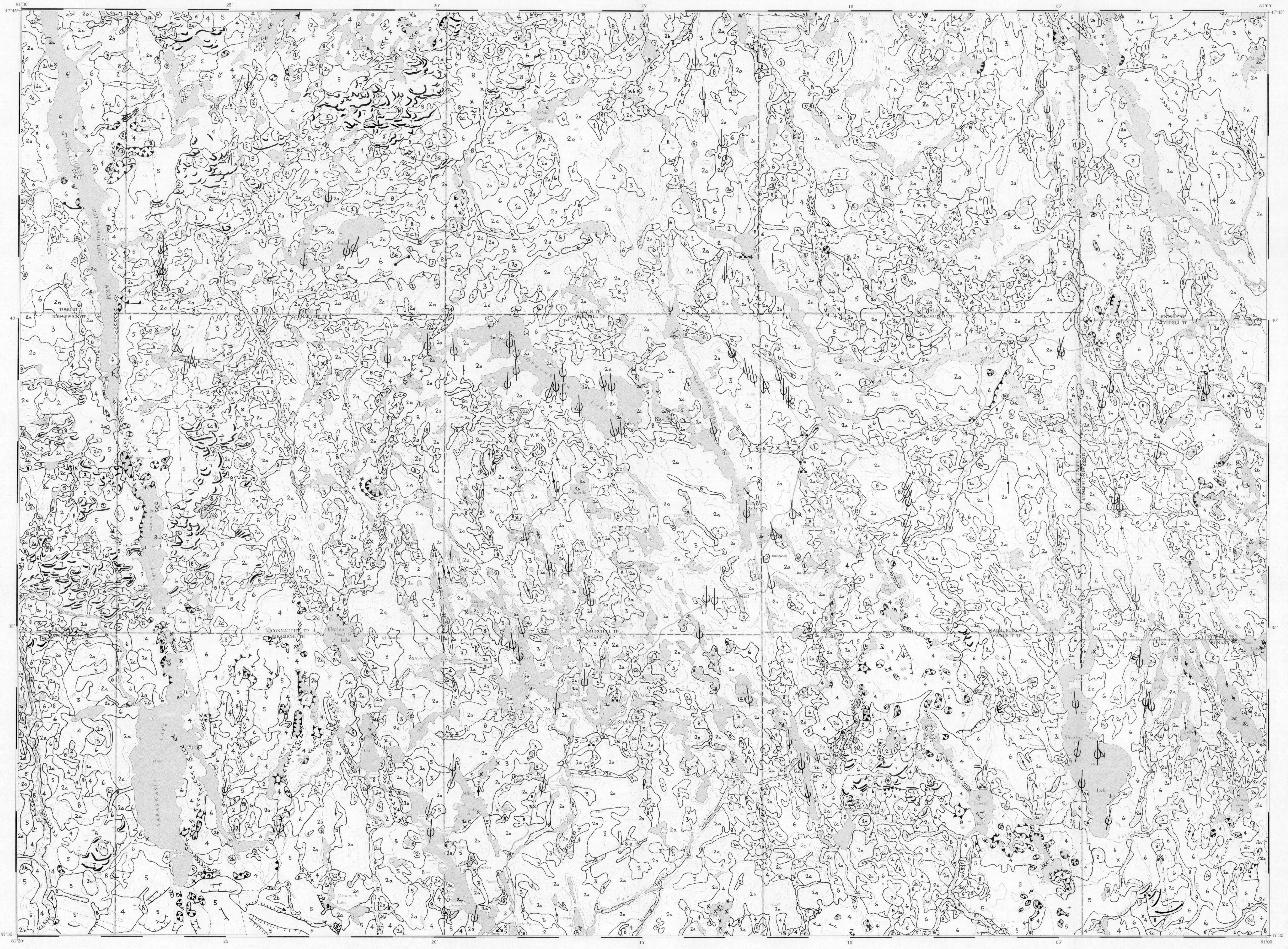
Supraglacial tills likely represent englacial or subglacial derived debris sheared or emplaced onto the ice surface and then deposited. The supraglacial tills are often found as thin units overlying subglacially deposited facies. Supraglacially derived flow till is often found on or between bedrock knobs, or as intercalated units in kames or eskers. This till type is moderately to loosely compacted with a stony sand matrix. In the flow units, sorted sand stringers and crude banding or layering are common. Supraglacial melt-out (ablation) till is commonly thin, loosely compacted with a stony sand matrix and frequent subrounded cobbles and boulders of distant provenance. The composition of the supraglacial tills often poorly reflects the local bedrock lithologies.

ICE-CONTACT STRATIFIED DRIFT

Glaciofluvial ice-contact deposits (Unit 4) occur as eskers, kames, subaqueous outwash fans and other stagnant ice features. These deposits consist of cobbly to bouldery sand and gravel, frequently with disturbed and faulted bedding. Several esker systems cross the study area. The smaller eskers, often of continuous, single ridge form, trend generally southwards across the areas of higher elevation. On the edges of the major valleys and in the broad topographic lows, large, discontinuous and occasionally compound esker complexes occur.

Areas of hummocky and highly kettled ice-contact deposits, up to a few kilometres across, occur in Miramichi, Cabot and Fawcett townships. These deposits probably represent sediment deposition over and between ice blocks in ice sheet re-entrants by meltwater streams and sediment gravity flows.

Many lowland area lakes, such as Waonga, Ketchiwaboose, Fawcett and South Sandstrum lakes, are partially surrounded by ice-contact deposits and have sections of lakeshore which are steep ice-contact slopes. These lakes are thus likely, in part, kettle lakes, suggesting that very large ice blocks up to several hundred metres in diameter were left stranded upon deglaciation.



Kames are commonly found in valleys among drift-veneered bedrock knobs. Many are too small to be differentiated and mapped at 1:50 000 scale.

GLACIOFLUVIAL OUTWASH DEPOSITS

Glaciofluvial outwash deposits (Unit 5), consisting of horizontal beds of pebbly to gravelly sand, often flank the esker systems. Occasionally, fans of outwash sediments are found at the downstream ends of eskers. Extensive areas of kettled, and occasionally terraced outwash, occupy large tracts in the southwestern portion of the map area. The frequency of kettles in the outwash deposits indicates that large numbers of ice blocks were left stranded in the proglacial zone. Minor glaciofluvial deposits occur in smaller valleys as terraces.

Glaciofluvial ice-contact and outwash sediment veneers on bedrock (Unit 2b) are associated with esker and outwash systems, generally along the saddles between topographic lows.

GLACIOLACUSTRINE DEPOSITS

Glaciolacustrine deposits (Unit 6), consist of rhythmically stratified, to rippled, to massive silt and fine to medium sand and occasional laminated clay. The sandy glaciolacustrine deposits were laid down in proglacial lake deltas by traction flows and density undercurrents. Wave erosion of glaciofluvial deposits and drift-veneered hills also produced broad sheets of nearshore sand. The occurrence of glaciofluvial deposits in topographic lows provided large quantities of easily erodible sand.

The glaciolacustrine deposits occupy broad topographic lows and the margins of the major north-south valleys. Glaciolacustrine deposits are well exposed along the shores of Mattagami Lake and locally range up to 15 m in thickness. Thin (probably <3 m) but extensive glaciolacustrine deposits occupy separate former shallow proglacial lake basins near Nabakwasi, Mattagami, Claw, Granite and East Shining Tree lakes. Few definite shoreline features have been identified on the airphotos, suggesting that the glacial lakes were quite short-lived and the fetch lengths were not great. The upper extent of glaciolacustrine deposits and wave-washed bedrock knobs suggests lake levels of 366 to 381 m (1200 to 1250 feet). These proglacial lakes likely occurred as separate pondings between a drainage outlet to the south and the retreating ice margin to the north. These lakes were not part of a single, extensive proglacial lake which would represent an early phase of Lake Barlow–Ojibway (Vincent and Hardy 1979).

EOLIAN DEPOSITS

Eolian deposits (Unit 7) consist of well-sorted, finely stratified to thinly bedded coarse silt to fine sand. These deposits occur as dunes in large fields and as a widespread surficial veneer over bedrock-drift complex, till and glaciofluvial deposits. Parabolic and longitudinal sand dunes up to 20 m in height are common. Coalescence of limbs has produced complex dunes over 1 km in length.

Dune fields are located on and downwind (southeast) from parent deposits of glaciofluvial outwash and glaciolacustrine sands. The eolian reworking of waterlain deposits occurred during dry conditions with limited vegetation present, after drainage of the proglacial lakes.

Veneers of glaciolacustrine and eolian sediment over bedrock knobs (Unit 2c) are found within and adjacent to the sites of former proglacial lakes and the dune fields.

ORGANIC DEPOSITS

Deposits of peat, muck and mud (Unit 8) up to a few metres in thickness are found in bogs and swamps occupying topographic depressions with poor drainage. These include areas between sand dunes, in small valleys and along the meandering streams and rivers. Thin organic deposits occur over extensive areas on glaciolacustrine sand plains.

ALLUVIAL DEPOSITS

Alluvial deposits (Unit 9), consisting of sand, silt, gravel and some organic material, are found along those larger watercourses which cut through glaciofluvial deposits. Alluvium is present along the Donnegana River and the West Montreal River. Most deposits are of very restricted areal extent and thickness and cannot be mapped at the current scale.

MAN-EMPLACED DEPOSITS

Man-emplaced deposits (Unit 10) include: 1) mine-waste and tailings, found near the former Ronda Mine and other small workings just east of the village of Shining Tree, and in Knight Township north of the former Tyranite Mine; and 2) lumbermill waste found near Jess Lake.

ECONOMIC GEOLOGY

APPLIED GEOLOGY

A till sampling program was carried out to create a geochemical data base and determine how overburden sampling could be effectively used as a mineral exploration technique in the study area. A total of 170 samples of weathered surface till were collected and the silt and clay fraction (<0.063 mm; -250 mesh) analysed for a suite of elements. About 150 samples of slightly to unweathered till were collected for heavy mineral concentrate preparation (sg ≥ 3.3), gold grain and heavy mineral counts and geochemical analysis.

The results of the field investigations and overburden geochemical sampling program indicate that surface till geochemical and mineralogical analyses as well as boulder tracing, are effective exploration methods in those areas with till at or near the surface. Both the silt and clay fraction and the non-magnetic heavy mineral concentrate fraction, prepared from the <2 mm till matrix, can be utilized for geochemical exploration. As the surface till is weathered to a depth of 1 to 3 m, the silt and clay fraction should be utilized for the more labile mineral species, such as base metal sulphides. The heavy mineral fraction can be utilized for unweathered till or for those minerals which do not weather in the surface environment (e.g., native gold). Surface geochemical sampling would not be effective in those areas where non-local glaciofluvial, glaciolacustrine or eolian sediment forms the surficial material.

Aultman (1988) completed a study on the nature of gold dispersal in till in the Shining Tree area. Results from surface till samples collected up to several hundred metres down-ice of known gold occurrences indicate gold grains are present in the sand-sized heavy mineral fraction. Further work has also indicated anomalous gold geochemical values in the silt and clay fraction of these samples.

A case study of gold dispersion in till was conducted by Stewart and van Hees (1982) in the Matachewan area, northeast of the Shining Tree area. The results indicated that distinct dispersal trains from subcropping mineralized bedrock were present in the surface till in a number of size fractions.

The Geological Survey of Canada has recently published results from a regional lake sediment geochemical sampling program which included the Shining Tree area (Hornbrook and Friske 1988).

AGGREGATE RESOURCES

Aggregate resources are locally abundant and adequate for current needs in the vicinity of the main transportation corridors and settlements. Supplies are mainly derived from the esker, kame and outwash deposits beside highways. In higher elevation areas, supplies may be inadequate and till may be used as a substitute for fill or borrow.

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Ministry of
Northern Development
and Mines
Ontario

Mines and Minerals Division
Ontario Geological Survey

MAP P.3165

QUATERNARY GEOLOGY

SHINING TREE AREA

Scale 1:50 000
1000 m 0 1 2 km

NTS Reference: 41 P/11

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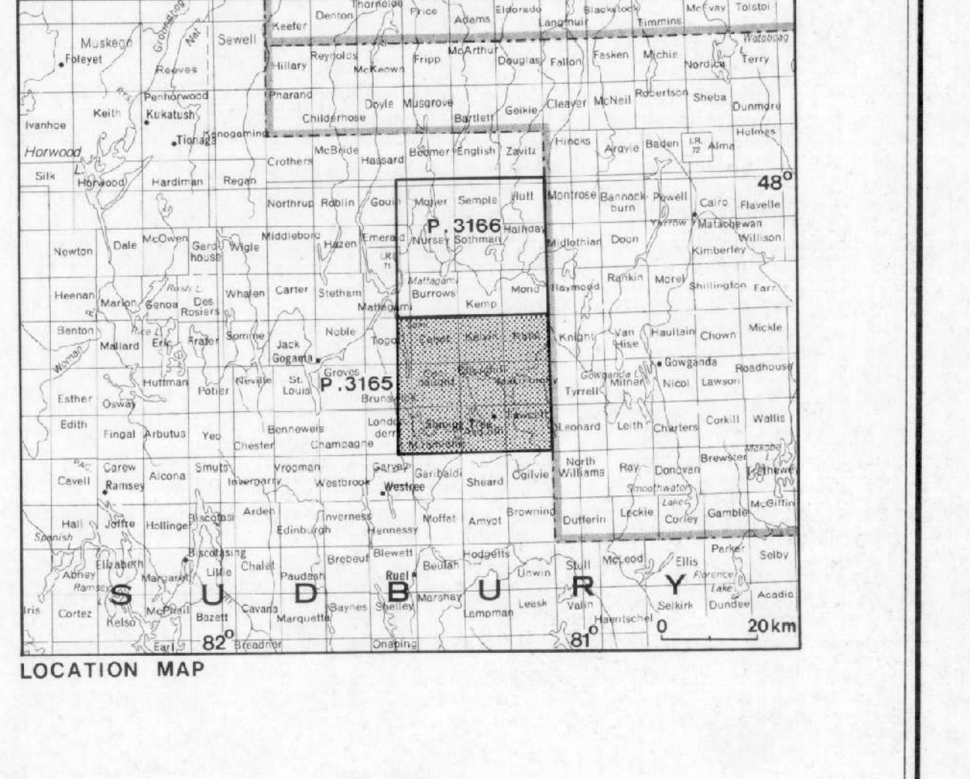
CANADA ONTARIO Mineral Development Exploitation Minérale

This project is part of the five-year Canada–Ontario 1985 Mineral Development Agreement (COMDA), a subsidiary agreement to the Economic and Regional Development Agreement (ERDA) signed by the governments of Canada and Ontario.



LOCATION MAP

LEGEND

PHANEROZOIC
CENOZOIC
QUATERNARY
RECENT

10	**Man-Emplaced Deposits:** mine tailings, waste rock, wood waste
9	**Modern Alluvium:** silty sand to cobble gravel
8	**Organic Deposits:** peat, muck, mud

PLEISTOCENE

7	**Eolian Deposits:** coarse silt, fine- to medium-grained sand
6	**Glaciolacustrine Deposits:** silty sand to coarse sand, minor clay and silt
5	**Glaciofluvial Outwash Deposits:** fine-grained sand to boulder gravel
4	**Ice-Contact Stratified Drift:** silt, sand and gravel, boulders, minor flow till
3	**Till:** silt to sand matrix with granule to boulder-sized clasts
2	**Bedrock-drift complex:** thin (<1 m) and discontinuous drift (sedimentary character as indicated) over bedrock

2 Undifferentiated drift veneer over bedrock
2a Till veneer over bedrock
2b Coarse-grained ice-contact stratified drift or glaciofluvial outwash sands and gravels over bedrock
2c Glaciolacustrine or eolian sediments over bedrock

UNCONFORMITY

EARLY TO LATE PRECAMBRIAN

1	**Bedrock:** (>50% exposure), with minor undifferentiated drift cover.

SYMBOLS

- Geologic Boundary (Approximate)
- × Small Bedrock Outcrop
- Glacial Striation (Single; Multiple; Sequential: Younger Direction Crosscuts Older)
- Streamlined Bedrock or Till Form
- Minor Morainic Ridge
- Esker (Direction Known; Unknown)
- Kame
- Kettle; Ice-Contact Slope
- Meltwater Channel (Inferred Flow Direction Indicated)
- Fluvial Terrace
- Dune Crest (Major Forms Only)
- Beach Berm or Bar
- Gravel Pit

SOURCES OF INFORMATION

Base map derived from Map 41 P/11 of the National Topographic System, scale 1:50 000.

Aerial photography by the Ontario Ministry of Natural Resources.

Contour interval: 50 feet (15.24 m).

Magnetic declination approximately 8°20′W in 1989.

Geology not tied to surveyed lines.

CREDITS

Geology by P. Finamore and J. MacKenzie, 1986; P.W. Alcock, M.J. Miller and J. Aultman, 1987, 1988.

To enable rapid dissemination of data, this map has received only a cursory edit. Discrepancies may occur for which the Ontario Geological Survey does not assume liability.

Issued 1990.

Information from this publication may be quoted if credit is given. It is recommended that reference to this map be made in the following form:

Alcock, P.W. and Miller, M.J. 1990. Quaternary geology, Shining Tree area; Ontario Geological Survey, Preliminary Map P.3165, scale 1:50 000.

MARGINAL NOTES

INTRODUCTION

The Quaternary geology of the Sinclair Lake map area (NTS 41 P/14) was mapped during the 1987 field season, with some further work in 1988 (Alcock 1987, 1988). The Shining Tree map area (NTS 41 P/11), immediately to the south, has also been mapped (Alcock and Miller 1990).

The surficial sediments were examined at natural and man-made exposures along roads and water courses, and through test-pitting, hand augering and backhoe trenching. Access to much of the area is poor. The road system is limited to a few main gravel surfaced roads and a network of minor bush roads maintained for forestry and recreational purposes. Rivers and lakes allowed access to many remote areas.

Surficial units were delineated through airphoto interpretation using 1:15 840 and 1:50 000 scale airphotos. Deposit morphology, vegetation cover, drainage characteristics and reflectivity of exposed sediments were used to interpret the surficial deposits in remote areas. The distribution of deposits is strongly topographically controlled. Till predominates in upland areas. Glaciofluvial ice-contact and outwash deposits are present in north-south oriented valleys and glaciolacustrine and organic deposits occupy topographic lows with restricted drainage.

Any map unit represents a composite area, with the indicated deposit type predominating plus minor areas of other deposit types. For example, within the bedrock-drift complex, most areas of till veneer (<1 m thickness) over bedrock also include small areas of thick till (>1 m thickness) and organic deposits. Many contacts between map units represent an arbitrary division of the gradual transition from one deposit type to another, for example the transition from glaciofluvial outwash to wave-reworked outwash to glaciolacustrine sands. The bedrock-drift complex areas have a cover of drift over bedrock which averages 1 m or less in thickness, with frequent outcrops. All other units represent drift or organic material at least 1 m thick. Any site specific use of this surficial geology map should include an orientation survey to locally verify the sediment types, thickness and distribution.

The present study provides additional detail and local control to the regional mapping of Boissonneau (1965, 1968) and the terrain study of Roed and Hallet (1979) and expands upon the areas initially mapped by Closs and Sado (1982). Reference was made to bedrock maps (Bright 1970, 1984; Carter 1981) for verifying areas of bedrock-drift complex.

The authors wish to acknowledge the administrative and logistical assistance of the staff at the Gogama District Office, Ontario Ministry of Natural Resources. Competent assistance in the field was provided by J. Aultman, V. Rammul and M. Schrader.

BEDROCK GEOLOGY

In the Sinclair Lake map area, Early Precambrian rocks consist of a metavolcanic sequence with subordinate units of iron formation and metasediments (Bright 1970, 1984; Carter 1981). Mafic and ultramafic sills and sill complexes intrude the metavolcanic sequence. During later regional east-west folding, the northwestern portion of the map area was intruded by a granitic pluton. Late porphyritic monzonite, granodiorite and syenite stocks were emplaced in the metavolcanic succession. Generally flat-lying Middle Precambrian (Proterozoic) clastic and chemical sedimentary rocks of the Quirke Lake and Cobalt Groups unconformably overlie the Archean rocks in the eastern portion of the map area. Early to Late Precambrian diabase dikes cut the previously emplaced units.

Deposits and occurrences of gold, silver, cobalt, copper, zinc, lead, molybdenum, nickel, iron and asbestos occur in the project area (Bright 1970, 1984; Carter 1981). Over the area, approximately 10 to 30% of the bedrock is exposed.

PLEISTOCENE HISTORY

The last late Wisconsinan ice advance, and postglacial glaciolacustrine and eolian activity, are represented by the surficial sedimentary sequence. Glacially streamlined and striated bedrock outcrops, till fabrics and dispersion trends of lithologic indicators demonstrate that the last dominant ice movement was towards 180±30° azimuth. Minor late-glacial shifts in ice direction, due to bedrock topographic influences, are indicated by 160 to 180° striations crosscutting an earlier set of 140 to 160° striations. Where exposed, the bedrock surface is often glacially smoothed and striated and displays whaleback forms.

Certain *roches moutonnées* preserve facets or remnants of grooves oriented southwest-northeast on their lee (southern) sides. On rare outcrops, such as on Ferris Lake in Mond Township and in Gouin Township just west of the map area, southwesterly oriented grooves are crossed by southerly oriented striations. This evidence suggests an earlier southwesterly ice advance, similar to that documented by Veillette (1986) in the Timmins, Matheson and Lake Timiskaming areas to the north and east of the project area.

Ice retreated from the area about 10 000 years BP (Dyke and Prest 1987), leaving a widespread drift veneer over the bedrock surface. Very few ice constructional features, such as drumlins or minor morainic ridges, are present. Several north-south-trending belts and ice re-entrant infills of glaciofluvial ice-contact and outwash sediments were deposited in the area. Upon deglaciation, most topographic lows were inundated by short-lived proglacial lakes. Washing and winnowing of the drift-mantled hills and glaciofluvial deposits produced bare bedrock knobs and blankets of nearshore sand stretching out from the sediment sources. Accumulations of boulders on till are found over the range of glaciolacustrine wave influence.

Melt-water drainage was controlled by the major valleys such as those occupied by the Grassy River, Ferris Lake and Little Seganku Lake. Drainage of the proglacial lakes and subsequent subaerial exposure of waterlain sediments allowed extensive eolian reworking of these coarse-grained deposits, deposition of dunes and a widespread veneer of eolian sediment.

In areas of bedrock-drift complex, drift thickness commonly ranges from less than 1 m to in excess of 10 m. Extreme thicknesses of more than 50 m are present in areas of ice-contact deposits and in the major infilled valleys.

Only rare clasts of carbonate lithologies have been found in till or outwash deposits, indicating that the project area is south and east of the limit of carbonate drift as mapped by Karrow and Geddes (1987).

SURFICIAL DEPOSITS

TILL

Till is frequently found as a veneer over bedrock (Unit 2a) but ranges up to 4 m or more in thickness in areas of thick till (Unit 3). Till veneer areas (average thickness <1 m) have frequent bedrock outcrops and a surface morphology controlled by the underlying bedrock topography. Veneers of till are found over many bedrock hummocks and uplands. Deposits of thick till are found on the larger upland surfaces and in the lee of bedrock highs.

The till sheet found at surface represents one lithostratigraphic unit with varying composition. The variation is due to the incorporation of various underlying bedrock lithologies and different modes of deposition. All till at surface, to a depth of at least 1 to 2 m, has been affected by soil forming processes, including oxidation and translocation of matrix carbonate and iron.

Both subglacial and supraglacial tills were identified using sedimentological and structural characteristics. Subglacially deposited tills are common at or near surface in areas of bedrock-drift complex and thick till. Lodgement till is commonly moderately to highly compact, stony (10 to 50% clasts by volume) and has a silty sand matrix. This till type occasionally displays shear structures, and may overlie striated bedrock. Subglacial melt-out till is loose to moderately compact, stony (10 to 50% clasts by volume), with a silty sand matrix and has thin deformed sand bands. The subglacial till facies contain frequent striated and facetted clasts ranging in size from granules to boulders. The composition of these tills often strongly reflects the local bedrock lithologies.

Supraglacial tills likely represent englacial or subglacial debris sheared-up or emplaced onto the ice surface and then deposited. The supraglacial tills are often found as thin units overlying subglacial tills. Supraglacially derived flow till is often found on or between bedrock knobs, or as intercalated units in kames or eskers. This till type is moderately to loosely compacted, with a stony sand matrix. In the flow units, sorted sand stringers and crude banding or layering are common. Supraglacial melt-out (ablation) till is commonly thin, loose, and has a stony sand matrix and frequent subrounded cobbles and boulders of distant provenance. The composition of the supraglacial till types often poorly reflects the local bedrock lithologies.

ICE-CONTACT STRATIFIED DRIFT

Glaciofluvial ice-contact deposits (Unit 4) occur as eskers, kames, subaqueous outwash fans and stagnant ice features. These deposits consist of cobbly to bouldery sand and gravel, frequently with disturbed and faulted bedding. Several esker systems cross the study area. The smaller eskers, often of continuous, single ridge form, trend generally southwards across areas of higher elevation. On the edges of the major valleys and in the broad topographic lows, large, discontinuous and occasionally compound esker complexes occur.

Areas of hummocky and highly kettled ice-contact deposits, up to a few kilometres across, occur in Burrows, Sothman and Semple townships. These deposits probably represent sediment deposition over and between ice blocks in ice sheet re-entrants by meltwater streams and sediment gravity flows.

Many lowland area lakes, such as Cabot, Caribou, Marne and Sinclair lakes, are partially surrounded by ice-contact deposits and have sections of lakeshore which are steep ice-contact slopes. These lakes are thus likely, in part, kettle lakes, suggesting that very large ice blocks up to several hundred metres in diameter were left stranded upon deglaciation.

Kames are commonly found in valleys among drift-veneered bedrock knobs. Many are too small to be differentiated and mapped at 1:50 000 scale.

GLACIOFLUVIAL OUTWASH DEPOSITS

Glaciofluvial outwash deposits (Unit 5), consisting of horizontal beds of pebbly to gravelly sand, often flank the esker systems. Occasionally, fans of outwash sediments are found at the downstream ends of eskers. Extensive tracts of kettled, and occasionally terraced, outwash occupy large portions of the north and central parts of the map area. The frequency of kettles in the outwash deposits indicates that large numbers of ice blocks were left stranded in the proglacial zone. Minor glaciofluvial deposits occur in local valleys as terraces.

Glaciofluvial ice-contact and outwash sediment veneers on bedrock (Unit 2b) are associated with esker and outwash systems, generally along the saddles between topographic lows.

Meltwater drainage was controlled by the location and elevations of several valleys, especially those occupied by the Grassy River, and by Ferris and Little Seganku lakes. Near Ember Lake just southeast of Ferris Lake, large terraces and scarps in drift were produced through powerful erosion during meltwater drainage through the confined valley.

GLACIOLACUSTRINE DEPOSITS

Glaciolacustrine deposits (Unit 6), consist of rhythmically stratified, to rippled, to massive silt and fine to medium sand and occasional laminated clay. The sandy glaciolacustrine deposits were laid down in proglacial lake deltas by traction flows and density undercurrents. Wave erosion of glaciofluvial deposits and drift-veneered hills has also produced broad sheets of nearshore sand. The occurrence of glaciofluvial deposits in topographic lows provided large quantities of easily erodible sand.

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Dune fields are located on and downwind (southeast) from parent deposits of glaciofluvial outwash and glaciolacustrine sands. The eolian reworking of waterlain deposits occurred during dry conditions with limited vegetation present, after drainage of the proglacial lakes.

Veneers of glaciolacustrine and eolian sediment over bedrock knobs (Unit 2c) are found within and adjacent to the sites of former proglacial lakes and the dune fields.

ORGANIC DEPOSITS

Deposits of peat, muck and mud (Unit 8) up to a few metres in thickness are found in bogs and swamps occupying topographic depressions with poor drainage. These include areas between sand dunes, in small valleys, and along meandering streams and rivers. Thin organic deposits occur over extensive areas on glaciolacustrine sand plains.

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MAN-EMPLACED DEPOSITS

Man-emplaced deposits (Unit 10) include mine-waste and tailings, found near the former United Asbestos Mine and the former Stairs Mine in Midlothian Township.

ECONOMIC GEOLOGY

APPLIED GEOLOGY

A till sampling program was carried out to create a geochemical data base and determine how overburden sampling could be effectively used as a mineral exploration technique in the study area. A total of 170 samples of weathered surface till were collected and the silt and clay fraction (<0.063 mm; -250 mesh) analysed for a suite of elements. About 150 samples of slightly to unweathered till were collected for heavy mineral concentrate preparation, gold grain and heavy mineral counts and geochemical analysis.

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AGGREGATE RESOURCES

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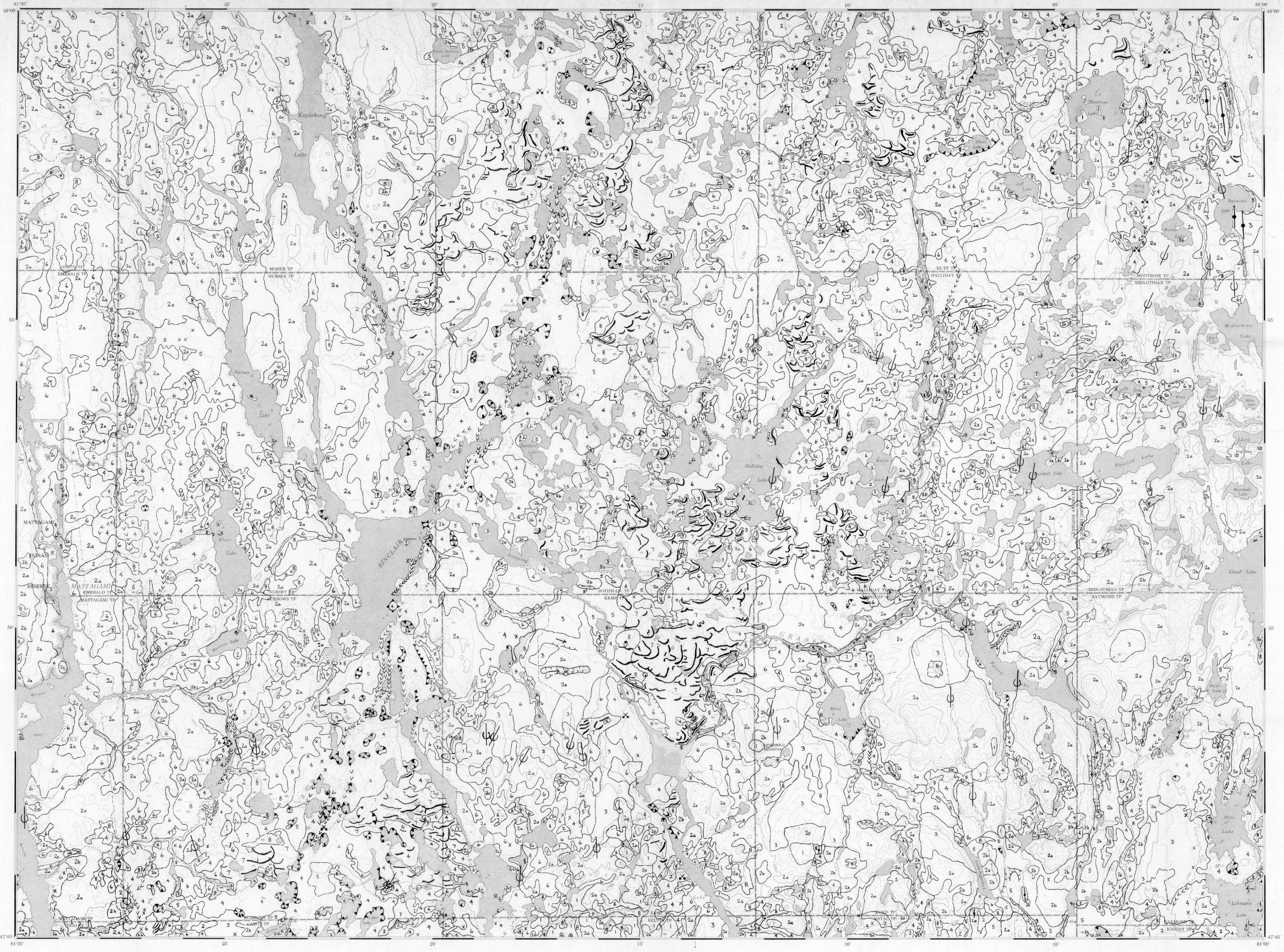

Ministry of Northern Development and Mines
Ontario

Mines and Minerals Division
Ontario Geological Survey

MAP P.3166

QUATERNARY GEOLOGY

SINCLAIR LAKE AREA

Scale 1:50 000

1000 m 0 1 2 km

NTS Reference: 41 P/14

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CANADA ONTARIO Mineral Development Exploitation Minérale

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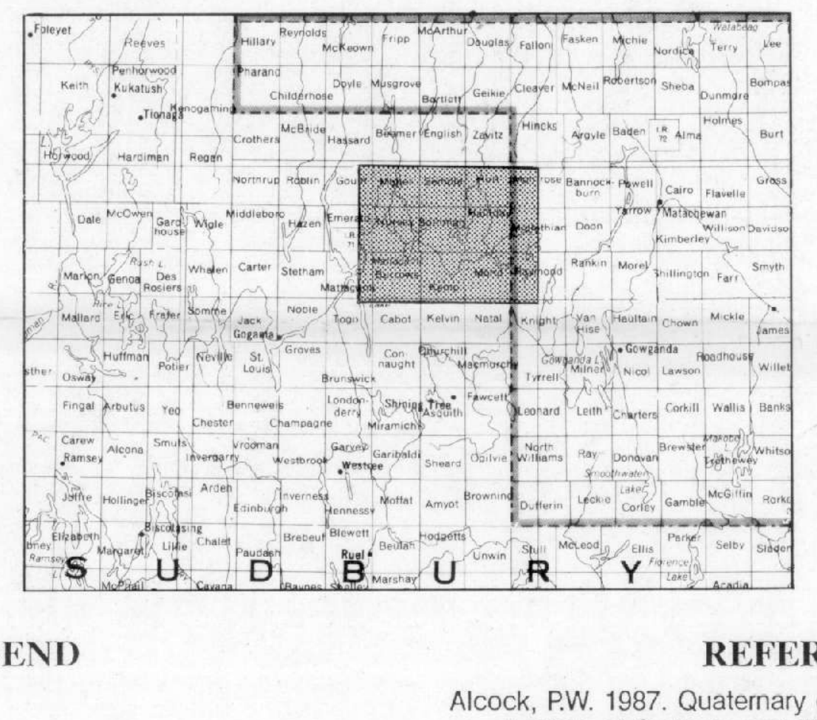

LEGEND

PHANEROZOIC
CENOZOIC
QUATERNARY
RECENT

10	**Man-Emplaced Deposits:** mine tailings, waste rock, wood waste
9	**Alluvial Deposits:** silty sand to cobble gravel
8	**Organic Deposits:** peat, muck, mud

PLEISTOCENE

7	**Eolian Deposits:** coarse silt, fine to medium-grained sand
6	**Glaciolacustrine Deposits:** silty sand to coarse sand, minor clay and silt
5	**Glaciofluvial Outwash Deposits:** fine-grained sand to boulder gravel
4	**Ice-Contact Stratified Drift:** silt, sand and gravel, boulders, minor flow till
3	**Till:** silt to sand matrix with granule- to boulder-sized clasts
2	**Bedrock-drift complex:** thin (<1 m) and discontinuous drift (sedimentary character as indicated) over bedrock

2	Undifferentiated drift veneer over bedrock
2a	Till veneer over bedrock
2b	Coarse-grained ice-contact stratified drift or glaciofluvial outwash sands and gravels over bedrock
2c	Glaciolacustrine or eolian sediments over bedrock

UNCONFORMITY

EARLY TO LATE PRECAMBRIAN

1	**Bedrock:** (>50% exposure), with minor undifferentiated drift cover

SYMBOLS

Geologic Boundary (Approximate)
Small Bedrock Outcrop
Glacial Striation (Single; Multiple; Sequential: Younger Direction Crosscuts Older)
Streamlined Bedrock or Till Form
Minor Morainic Ridge
Esker (Direction of Flow Indicated)
Kame
Kettle; Ice-Contact Slope
Meltwater Channel (Inferred Flow Direction Indicated)
Fluvial Terrace
Dune Crest (Major Forms Only)
Beach Berm or Bar
Gravel Pit

SOURCES OF INFORMATION

Base map derived from map 41 P/14 of the National Topographic System, scale 1:50 000.

Aerial photography by the Ontario Ministry of Natural Resources.

Magnetic declination approximately 8°25′W in 1989.

Contour interval: 50 feet (15.24 m).

Geology not tied to surveyed lines.

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CREDITS

Geology by P.W. Alcock, M.J. Miller and J. Aultman, 1987 and 1988.

To enable the rapid dissemination of information, this map has received only a cursory edit. Discrepancies may occur for which the Ontario Geological Survey does not assume liability. Users should verify critical information.

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Information from this publication may be quoted if credit is given. It is recommended that reference to this map be made in the following form:

Alcock P.W. and Miller M.J. 1990. Quaternary geology, Sinclair Lake area; Ontario Geological Survey, Preliminary Map P.3166, scale 1:50 000.