

GEOLOGICAL SURVEY OF CANADA

OPEN FILE 2080

**QUATERNARY GEOLOGY LAKE OF THE WOODS REGION
NORTHWESTERN ONTARIO**

**PROGRESS REPORT FOR YEAR III
RAT PORTAGE BAY — NORTHWEST ANGLE AREA**

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Gretchen Minning

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RAT PORTAGE BAY – NORTHWEST ANGLE AREA**

**Prepared For:
GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF SUPPLIES AND SERVICES
DSS FILE NO. 09SZ.23233-8-0725**

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1.0 INTRODUCTION

In June 1988, the Geological Survey of Canada, Ottawa, selected GVM Geological Consultants Limited of Calgary, Alberta, as the prime consultant to carry out Year III of a four year geological project in the Lake of the Woods Region of northwestern Ontario. Year I of this project (1986-1987) was carried out by Palliser Consultants Limited, Calgary, Alberta, and Year II (1987-1988) by GVM Geological Consultants.

This report describes the progress to date on Year III activities which included the study and mapping of surficial geology and the investigation of till geochemistry in the Lake of the Woods region. The project has been funded as part of the Canada-Ontario Mineral Development Agreement (COMDA) which was initiated to provide impetus to mineral exploration and development in the region, particularly with respect to gold. Work was carried out on behalf of the Geological Survey of Canada through the Department of Supplies and Services (DSS File No. 069SZ.23233-8-0725).

During Year III, mapping and sampling was concentrated in Rat Portage Bay (52E/NE) and Northwest Angle (52E/SE) map areas (Fig.1), approximately the western one-third of the project area (52F-Dryden and 52E-Kenora). Year II mapping was immediately to the east of Year III in the Blue Lake (52F/NW) and Rowan Lake (52F/SW) map areas. Mapping during Year I was done in the Wabigoon Lake (52F/NE) and Gold Rock (52F/SE) map areas to the east of the Blue Lake and Rowan Lake map sheets.

1.1 Acknowledgments

D.R. Sharpe of the Geological Survey of Canada is the Scientific Authority for this project and R.N. Finlayson, Department of Supply and Services, the Contracting Officer. Both provided competent direction and assistance in administration of the project. W.R. Cowan, formerly of Palliser Consultants Limited, and presently of the Ontario Ministry of Northern Development and Mines developed the framework for Year I of this study. C.E. Blackburn, M. Hailstone, J. Parker and Dr. P. Thurston of the Ontario Ministry of Northern Development and Mines provided information on bedrock geology, local logistics suppliers, and recent forestry road alignments.

Laboratory services were supplied by Bondar-Clegg & Company Ltd. (Ottawa, Ontario), Terramin Research Labs (Calgary, Alberta), Komex Consultants Ltd. (Calgary, Alberta), D. Taplin Consultant Inc. (Calgary, Alberta) and ERA Earth Resources Assessment Ltd. (Calgary, Alberta). Field visits were made with D.R. Sharpe Geological Survey of Canada.



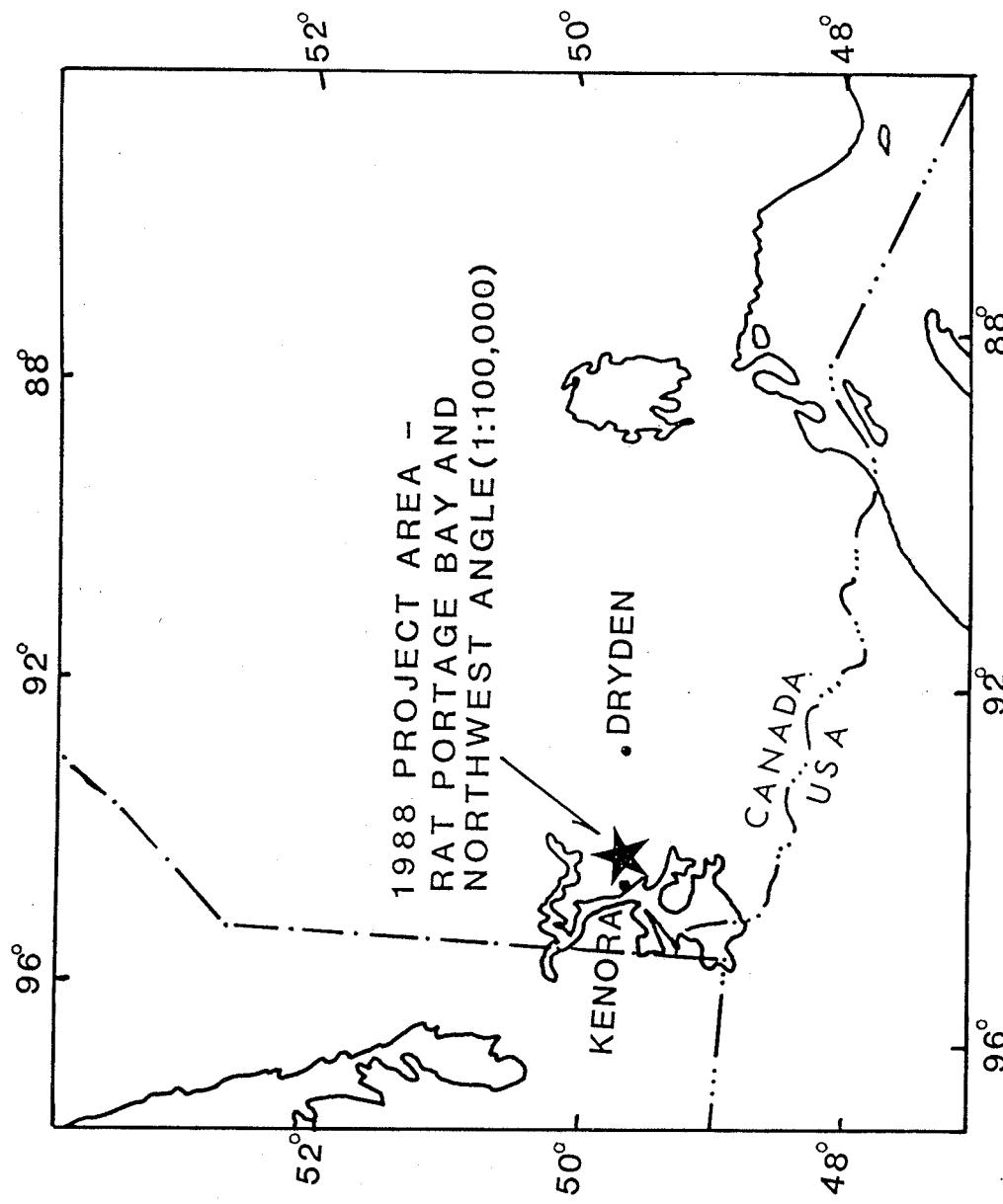


FIGURE 1: LOCATION OF 1988 STUDY AREA

Bim Waters (ERA Earth Resources Assessment Ltd.) carried out all petrographic analyses and prepared the computer data base. D.S. Evans (Geostrategic Consultants Ltd. (Calgary, Alberta)) carried out the preliminary geochemical assessment of the information contained in the data base.

GVM Geological Consultants Ltd. would like to thank all of the people mentioned above for their contributions toward the progress of this project.

1.2 Field Work

Field investigations were undertaken in July, August, and September of 1988. These investigations were undertaken by traversing most of the roads in the area in a half ton truck. Some of these roads do not appear on the 1:50,000 maps and their location and orientation were taken from recent airphotos (1982-1983) and forestry maps.

Impassible situations consisted of washed-out bridges and culverts, deep water related to beaver ponds, or unexpected locked gates on operational forestry land. In addition, many old mineral exploration and logging roads are completely overgrown and offer little information due to no visibility of exposures. Logging road access in the 1988 field area was more limited than in previous years, because land use in much of the study area near Lake of the Woods and Kenora is oriented toward recreational activities. A large part of the Rat Portage Bay and Northwest Angle map areas are inaccessible by road. Some of this area near Lake of Woods can be reached by boat. However, bedrock near Lake of the Woods for the most part has very little drift cover. This factor combined with limited time and funding has precluded field work in these inaccessible areas. Mapping is limited to airphoto interpretation in these areas.

Information was plotted on 1:50,000 (approximate) scale airphotos taken about 10 years ago and were supplied for this project from Year I. Airphotos in the Kenora area were taken when surface water levels were fairly high. In some cases, areas marked as swamps on maps appear to be lakes on the airphotos. The recent road locations taken from 1982-1983 airphotos and Ontario Ministry of Natural Resources resource road network base maps of Kenora, and Fort Francis were plotted on the project airphotos and on the 1:50,000 and 1:100,000 maps prepared during the study.

Geological traverses were made along roads using 1:50,000 topographic maps, airphotos, and the truck odometer. The location of approximately 701 observations were recorded on the 1:50,000 scale maps. Notes describing these observations were recorded in field notebooks. Photographs of exposures and other geologic features were made at some of the observation sites.



Samples were collected at 93 of the locations where field observations were made. Of these samples, 48 were submitted for grain size, geochemical, and petrographic analyses. Also 2 samples collected in the 1988 field area during 1987 were tested. The set of 50 tested samples have grain size, geochemical, and petrographic analyses. Laboratory and petrographic analyses will be described in subsequent sections.

1.3 Office Work

Office work consisted of analyzing and interpreting air photographs and transferring the surficial geology interpretation to 1:50,000 and 1:100,000 topographic map bases. The transfer from the 1:50,000 scale airphotos to the 1:50,000 scale maps was done visually. The 1:50,000 scale maps were then photographed at 1:100,000 scale and the transparencies produced were used to draw map boundaries on the 1:100,000 scale chronoflexes which are a final product of this study.

The original study for Year III (1988) covered eight 1:50,000 map sheets. However, during the field season the Year III mapping and sampling area was enlarged to include portions of four other 1:50,000 map sheets so that the final mapping would extend to the Manitoba border and would cover the entire 1:100,000 map sheets done for previous studies, e.g. Northern Ontario Engineering Geology Terrain Studies (Hallett and Roed, 1980a; 1980b).

Properties unique to each tested sample were tabulated on coding sheets so that they could form part of the data base. Information on these properties was obtained from field notes and from examination of the sample in the office. This information included a description of the geomorphic setting, lithology of the bedrock at the sample site, the presence of glacial striations, colour, acid reaction, field textures and structure, soil horizon, and any observations which might relate to the origin or character of the sample (See Appendix A).

Samples which were submitted for testing and formed part of the data base were renumbered from 1 to 50 and the new number was recorded along with the field number on the data sheets. The new sample numbers were also shown along with the sampling date designation at the appropriate location on the final 1:100,000 surficial geology map.

The data base for the samples was initiated during Year I, and included 52 samples. During Year II, the database was revised to handle the increased number of samples (98 complete analyses). After Year III (50 complete analyses), 200 complete analyses form the total database.



Work for the data base was carried out on an IBM compatible 640K personal computer using Lotus 1-2-3. Lotus 1-2-3 was selected in Year I after reviewing other data base packages and the requirements of this study.

Laboratory results for each sample were recorded in the data base along with the field properties. The data base was used to provide a summary of all factors related to each sample. Some simple statistics were prepared for this report from the data base.

1.4 Laboratory Work

Laboratory work was carried out on 50 of the 93 samples collected in the field. The laboratory work was designed to provide information on the chemical and physical properties of till from the study area. This information on till provides background data for drift prospecting in the Lake of the Woods region.

Laboratory analyses were carried out using standard procedures and results are presented in the Appendices of this report. Grain size analysis was carried out by Komex Consultants Ltd. on the 50 samples from 1988. The grain size analysis procedures in 1988 were slightly different from 1987 and 1986 in that no complete grain size analyses were carried out because of a reduced budget for the project in 1988. Previously in 1986 and 1987 two levels of grain size analysis were done 1) three sample splits (gravel, sand, and silt + clay) and 2) complete grain size analyses using mechanical and hydrometer methods to produce complete gradations and grain size curves. A total of 51 complete grain size analyses were done during 1986 and 1987. The remainder of the grain size analyses which appear in the database for 1986 and 1987 were carried out according to the three sample split mechanical analysis.

In Year III (1988) all samples were analyzed using the three sample split method. For this method sieves were used to mechanically separate till samples into three fractions (gravel-size fractions greater than #10 mesh, sand-size fractions between #10 and #230 mesh, and silt + clay-size fractions less than #230 mesh). For 20 of the 50 Year III samples tested, hydrometer analysis was used to obtain point values for silt and clay. The 20 samples chosen for this type of analysis represented till overlying several types of bedrock. These samples also had a fines content (silt + clay) which was greater than 10%. Results of all grain size work is presented in Appendix B and is summarized under the discussion of till deposits.



The sand size fractions obtained from the grain size analyses were submitted to Terramin Research Labs for heavy mineral separation into three fractions (-10 to +40 mesh; -40 to +80 mesh; and -80 to +230 mesh). Petrographic analysis was done on heavy and light minerals of these fractions, particularly the -40 to +80 fraction. Petrographic analysis was also carried out on the pebbles in the plus #10 grain size fraction. Information from the pebble and heavy and light mineral work is presented in Appendices C, D, and E.

Several types of geochemical analysis were carried out on the 50 till samples (See Appendix F). These included the following:

- 1) Atomic absorption measurements of Cu, Ni, Pb, Zn, Ag, Co, As, Mn, Fe, Cr, and Mo
- 2) Neutron activation measurements of gold and other heavy elements (Bondar Clegg's Gold + 33 multi-element INAA package with Option Two detection limits)
- 3) Determination of total carbon and calcium carbonate using the LECO direct combustion method
- 4) Determination of U using delayed neutron activation analysis
- 5) Determination of Ag using colorimetry

2.0 BEDROCK GEOLOGY

2.1 Geologic Setting

Most of the project area occurs within the Wabigoon Subprovince, a major subdivision of the Archean Superior Province (Fig. 2). Wabigoon Subprovince is a granite-greenstone terrain comprised of a supracrustal assemblage of predominately metavolcanic and subordinate amounts of metasedimentary rocks, intruded by granitoid rocks, some of batholithic dimensions. North and south of the Wabigoon Subprovince lies the English River and Quetico subprovinces respectively. These adjacent subprovinces consist of assemblages of predominately metasedimentary rocks, their migmatic derivatives, and granitoid rocks. Descriptions of bedrock geology and mineralization are given in recent publications by C.E. Blackburn et al.(1985a, 1985b), Parker et al.(1988), and Melling et al.(1988) cited in the references section of this report. Other useful information comes from Satterly (1943, 1960) and Ontario Geological Survey Map 2443 (Kenora-Fort Frances Compilation). Additional bedrock mapping is in progress as part of the COMDA program (See Summary of Fieldwork, Ontario Geological Survey, 1987 and 1988).



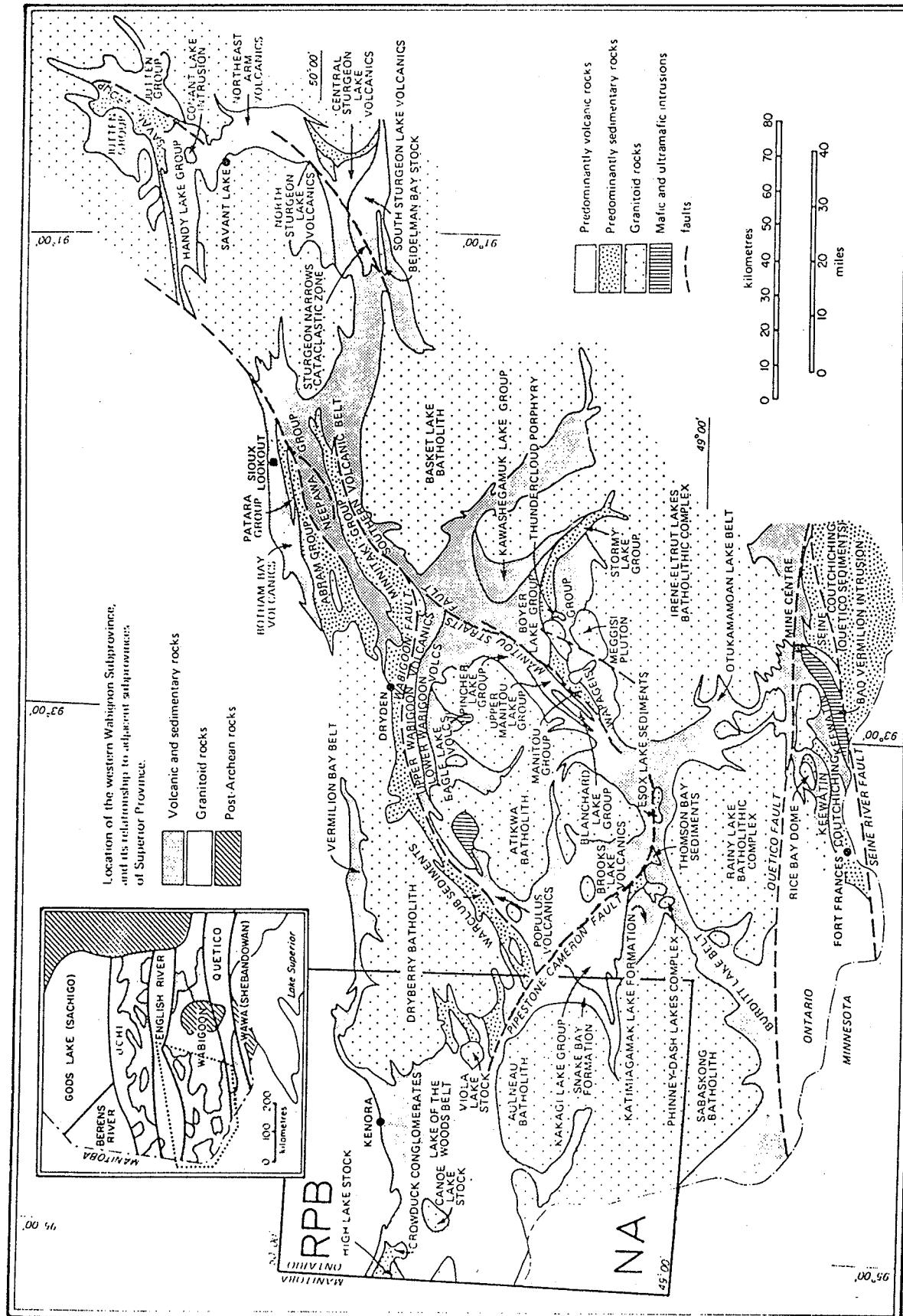


FIGURE 2: STRATIGRAPHIC UNITS OF THE WESTERN WABIGOON SUBPROVINCE AND ITS MARGINS (FROM BLACKBURN et al. 1985B). RPB indicates Rat Portage Bay area and NA indicates Northwest Angle area

2.2 Exploration Activity

The Kenora/Dryden area has a long history of prospecting and exploration for base metals, precious metals, and uranium. In recent years, exploration activities have largely been focused on massive sulphide (base and precious metals) deposits (late 1960's to present), uranium (late 1970's) and gold and silver (early 1980's to present).

Locating and developing gold and silver properties in the volcanic-sedimentary and adjacent granitoid terrain is currently underway. Gold deposits are small to medium scale and contain 100,000 to 600,000 ounces of gold in the more significant occurrences. Within the entire project area, the most active prospects are in the Wabigoon-Eagle Lakes, Manitou Lakes, Kakagi-Rowan Lakes, Shoal Lake and Straw Lakes areas (Blackburn, pers. comm. 1986; Cowan, 1987; Melling et al. 1988). The gold occurrences are dispersed throughout the metavolcanic belts of the Wabigoon Subprovince and are not concentrated at any one specific area in Dryden East, Dryden West, or Kenora.

In addition to gold, other minerals (zinc, lead-copper, zinc-gold, titanium, molybdenum, stibnite, and platinum) are undergoing active exploration.

Recent activity in the Kenora/Dryden area has been documented in the Northern Miner. Nuinsco Resources has a detailed underground exploration program on their Cameron Lake gold property (Northern Miner Dec. 8, 1986). The Flambeau Lake gold deposit (near Dryden) is being drilled by Van Horne Gold Exploration and International Platinum Corp. (Northern Miner Dec. 8, 1986, April 20, 1987). Also Contwoyto Goldfields Ltd. is investigating their Mulchay Lake property for Platinum Group Elements (Contwoyto Goldfields Ltd. Prospectus, 1987). A recent paper by Parker, Blackburn, and Perrault documents exploration in the Manitou-Stormy Lakes greenstone belt south of Dryden (Parker, Blackburn, and Perrault, 1988).

2.3 Bedrock Surface

Bedrock elevations range from less than 325 m to 480 m above sea level (a.s.l.). Most of the bedrock is from 350 to 450 m a.s.l. Major bedrock surface features are structural and bedrock patterns on airphotos are controlled by structural and lithological elements (Cowan, 1987). Field investigations indicate that the bedrock has been glacially modified and consists of rounded, polished, and striated stoss and lee rock forms.



The glacial features have resulted from direct glacier erosion with some overprinting by basal glaciofluvial erosion. Ice-moulded forms are generally small scale (5-50 m long) and are larger in granitic terrain. In the metasedimentary and metavolcanic terrain, the bedrock surface is more recessive and smoother.

Mapping during Year III, covered large sections of granitoid rock of the Dalles, Lount Lake, and Dryberry batholiths in the north and the Aulneau and Sabaskong batholiths in the south. Metavolcanic rock of the Lake of the Woods belt is common near Lake of the Woods shoreline and on islands in the lake. Also along the east central border of the Year III study area, Kakagi Lake Group metavolcanics outcrop. Metasedimentary rock occurs in close association with the metavolcanics along the east central border of the Year III study area near Yellow Girl Bay, near the north shoreline of Lake of the Woods, around Shoal Lake and on Big Narrows and adjacent islands in southern Lake of the Woods.

As with Year I and II mapping activities, rock dominated areas were divided into two major terrain units: 1) rock dominated terrain with little or no drift cover; and 2) rock dominated terrain with a thin discontinuous drift cover. The former areas consist of large rock bosses with little or no drift cover and high reflectance because of reindeer moss (*Cladonia* sp. lichen). In this type of terrain, the bedrock surface is mostly drift free and provides direct access for exploration programs.

The second type of rock-dominated terrain is controlled by the rock with few or no superimposed landforms indicating the origin of the drift. The drift may consist of thin discontinuous till, a bouldery sand veneer, clay, or sand and gravel. On airphotos it is difficult to differentiate these materials and mapping them is largely through extrapolation from existing known areas, e.g. along roads.

Forest cover in these areas with discontinuous drift is sometimes thicker, but not always so. This second type of rock dominated terrain is difficult to map in areas where the bedrock surface is of very low relief and rock forms do not show clearly on airphotos.



2.4 Glacially Striated Bedrock

Glacial striations are present on most fresh outcrops and are best preserved on volcanic sequences. They are usually missing on coarse-grained granitic rocks or are difficult to see in bright sunshine. Good stoss and lee relationships may be observed on well exposed outcrops. Striations wrap-around polished outcrops with variations of 20 degrees at some sites. Crossed striations were not observed on any of the outcrops where striations were measured during Year III.

Thirty-one striations were measured and ranged from 210 to 240 degrees with a mean value of 227 degrees (Table 1). A histogram (Fig. 3) combines the values for these striations with the values for the 129 striations from Years I and II. The histogram shows a slightly westerly skewed distribution. Year III mean value of 227 degrees was slightly higher than the Year II mean value of 219 degrees. Sixty-seven percent of all observations (160 total) fell within the 205 to 220 degree range.

Early workers Tyrell (1912) and Burwash (1934) suggested that more than one direction of glacial flow affected the area. Zoltai (1961) also suggested two flow directions, one south and the other southwesterly. Cowan (1987) feels that present glacial erosion features in the Dryden area (Year I of this study) have resulted from a major Late Wisconsin southwesterly flow of ice from the Labrador Sector of the Laurentide ice sheet. Within the literature, this southwesterly ice is frequently referred to as the Rainy lobe. Minning (1988) reported a similar southwesterly ice flow direction in the Vermillion Bay area (Year II study area). Field work during Year III, seems to agree with the interpretation of one southwesterly ice flow direction in the Rat Portage Bay map area. A similar ice flow direction is also evident in most of the Northwest Angle map area, except for the southeastern corner.

In the southeastern portion of the Northwest Angle map area, calcareous till was encountered near the town of Morson. A similar calcareous till has also been documented to the south in the Rainy River map area by Bajc and Gray (1987). These workers feel that the calcareous till was deposited by Keewatin ice flowing from the west. This ice is referred to as the St. Louis sublobe in northern Minnesota and its outer limit follows a northwestern trend which crosses the northeastern corner of the Rainy River map and extends into the Northwest Angle map area. The St. Louis sublobe moved east-northeast across the southeastern portion of the Northwest Angle map area after the southwesterly flow of the Rainy lobe.



LAKE OF THE WOODS (Year 3)

TABLE 1 - GLACIAL STRIATION STATISTICS

	Grid Reference				Sample		
	N.T.S.	EAST m	NORTH m	LITH	STRIAT deg	#	STATISTICS
Units ->							<Units of measurement
ALL DATA							ALL DATA
Number >	31	31	31	31	31	8	<Number of valid data
Maximum >	16	427350	5998200	45	240	46	<Maximum
Minimum >	8	347780	5460700	31	210	1	<Minimum
Average >					224		<Average or arithmetic mean
Stan-Dev>					8		<Standard Deviation
Coef-Var>					4%		<Coefficient of Variation = Std-Dev/Avg
GREENSTONE							DATA from over GREENSTONE BEDROCK
Number >	19	19	19	19	19	6	<Number of valid data
Maximum >	16	427350	5998200	45	240	46	<Maximum
Minimum >	8	347780	5460700	31	210	1	<Minimum
Average >					223		<Average or arithmetic mean
Stan-Dev>					8		<Standard Deviation
Coef-Var>					4%		<Coefficient of Variation = Std-Dev/Avg
GRANITE							DATA from over GRANITE BEDROCK
Number >	12	12	12	12	12	2	<Number of valid data
Maximum >	16	422600	5530650	39	238	38	<Maximum
Minimum >	9	371610	5493790	35	220	31	<Minimum
Average >					227		<Average or arithmetic mean
Stan-Dev>					7		<Standard Deviation
Coef-Var>					3%		<Coefficient of Variation = Std-Dev/Avg
SUMMARY							COMPARISON STATISTICS
t test >					1.1		<Statistical test for similar averages
Sig .05 >					1		<If 1; then granite = greenstone, @ 95%
Sig .01 >					1		<If 1; then granite = greenstone, @ 99%
F test >					1.4		<Statistical test for similar std-dev
Sig .05 >					1		<If 1; then granite = greenstone, @ ~95%
Sig .01 >					1		<If 1; then granite = greenstone, @ ~99%

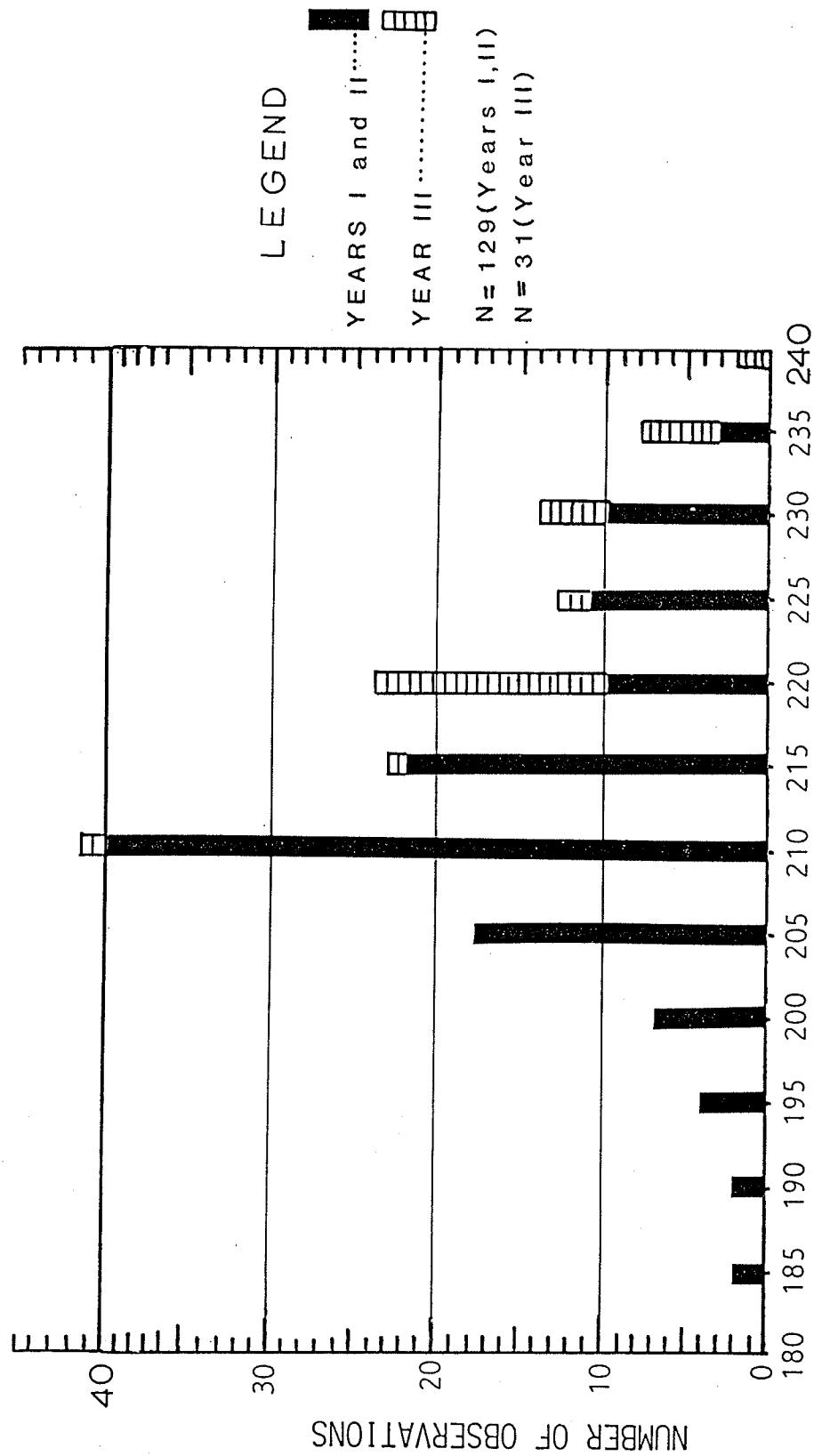


FIGURE 3: HISTOGRAM SHOWING DISTRIBUTION
OF GLACIAL STRIATIONS

3.0 SURFICIAL MATERIALS

3.1. Introduction

Quaternary materials within the 1988 study area are described in this section.

The drift cover is thin and sporadic except in 1) the north central portion of the Rat Portage Bay map area north of Kenora where thicker till, glaciofluvial, and glacial lake deposits are present, and in 2) the southern and western portions of the Northwest Angle map area where glacial lake deposits are fairly thick. Throughout most of the Rat Portage Bay and Northwest Angle map areas, glacial sediments occur only as shallow pockets in rock depressions or as patches of till plastered on the lee side of rock knobs. Most of the drift is deglacial in nature and only a fraction of the drift can be classified as lodgement till. Good exposures of lodgement till are limited. The best examples of lodgement till are found north of Kenora in several disturbed borrow pits.

Deglaciation of the study area occurred between 11,000 and 9,500 radiocarbon years B.P. (Clayton, 1983).

3.2 Moraines

No major end moraines cross the 1988 study area. A minor north-south trending moraine ridge was identified west of Highway 71 between Black Lake and Gibi Lake. Exposures in the moraine ridge showed two to three metres of bouldery sandy till with large boulders at the surface. The moraine ridge, like the major moraines to the east in the Vermillion Bay and Dryden areas, probably represents a still-stand during glacial retreat rather than a glacier readvance.

Landforms identified in previous studies as small moraine ridges (Hallet and Roed, 1980a; 1980b) have been mapped in this study mostly as patches of till and/or glaciofluvial material. In some cases these ridged features consist of bedrock with thin till cover.

3.3 Till Deposits

Till in the project area occurs in two principal modes: 1) as thin discontinuous patches of till in rock dominated terrain; and 2) as thin beds or lenses within the uppermost sediments of end moraines. The latter were deposited in near aqueous environments of Glacial Lake Agassiz. These till materials may grade laterally into sandy diamictons and may contain sand lenses or dispersed free sand.



Till deposits mapped in the Year III study area are generally of the first category described above. Tills of the second type are found mostly in association with the Lac Seul, Hartman, and Eagle-Finlayson Moraines mapped during Years I and II.

Tills sampled in Year III are variable in colour and include light and dark brown, yellow brown, grey brown, and olive brown. Colours were identified according to Munsell Color Charts in the laboratory on wet samples under a combination of fluorescent and incandescent light. Yellow brown tills were the most common and 71% of the samples were in this category. Dark brown and brown tills were 15% of the total and grey brown tills were 8%. Olive brown tills formed the remaining 6%.

The degree of oxidation and reaction of the sample to dilute hydrochloric acid was also determined during examination of the samples after they were unpacked at the laboratory. The samples ranged from unoxidized to strongly oxidized with 67% of the samples either unoxidized or slightly oxidized. The dark yellow brown and brown tills were the most oxidized. Of these more oxidized samples (either classified as partly oxidized (4), oxidized (5), or strongly oxidized (6)), approximately 54% were from metavolcanic terrain and 46% from granite terrain (see Appendix A).

Reaction to dilute hydrochloric acid varied from very low to weak. In 5 (11%) of 48 samples collected during Year III reaction to hydrochloric acid was recorded. Two samples collected during 1987 and analyzed during 1988 were not tested for acid reaction. Three of the 1988 samples that reacted (6%) were from the southeastern corner of the study area near Morson. These samples which had a very slight reaction to hydrochloric acid probably represent calcareous till of the St. Louis sublobe. The remaining 2 samples that reacted with acid were collected 1) in the southwestern corner of the study area and 2) north of Kenora. The southwestern sample is probably related to the St. Louis sublobe and the calcareous content in the matrix of the Kenora till which overlies granite gneiss has another origin, possibly related to the presence of fine fragments of weathered limestone concretions in greywacke pebbles of the Omarolluk Formation which were identified in the same sample G88-31 (Prest and Nielsen, 1987).

Analysis of pebbles from till samples collected during 1988, showed no individual limestone or dolomite pebbles. Limestone and dolomite pebbles were seen in gravelly beach deposits near Morson in the southeastern corner of the study area. These carbonate pebbles probably originated to the west and south and do not represent long distance transport from the Hudson Bay Lowlands.



Metasedimentary and greywacke pebbles in all samples were examined in detail to identify pebbles which were derived from the Omarolluk Formation of the Belcher Islands in southeastern Hudson Bay (Prest and Nielsen, 1987). These greywacke pebbles with limestone concretions and have been identified previously in the Dryden area (Manning, 1988). One Omarolluk pebble was identified in till sample G-88-31 (a sample from north of Kenora near Black Sturgeon River).

Visual textures were done on the samples before they were submitted for laboratory analysis of grain size. The tills were classified as sandy, sandy loam, loam, sandy silt, or silt till on the basis of their matrix (Elson, 1961). Most of the samples (78%) were classified as sandy till. Seven of the 1988 samples in the data base have also been classified as sandy gravel, sandy diamicton, and sandy gravelly diamicton because they may be outwash rather than till.

Previous mappers have shown bedrock with patchy till as ground moraine (Prest, 1963; Zoltai, 1965). This practice was not adhered to during Year I to III of this study because almost all till areas obtain their morphology from the underlying bedrock. No drumlins or areas of fluted till were observed in 1988.

No stratigraphic sections found during the 1988 field season contain more than one till. Till thickness varies from zero to 6 m with greater thicknesses occurring on protected slopes and the lea of rock knobs. The thickest till deposits were found north, northwest, and east of Kenora.

Till in the rest of the 1988 study area is generally no thicker than 1.5 m. Much of the area has been modified by Glacial Lake Agassiz, and as a result the till has a washed upper surface and in many cases it has been washed completely away.

3.3.1 Size Composition of Till

Till samples were split mechanically into three mesh fractions by Komex Consultants Ltd. These fractions were the plus #10 mesh (gravel), minus #10 mesh - plus #230 mesh (sand); and minus #230 mesh (silt and clay) sieves. Hydrometer analyses were then carried out on 20 of the samples to obtain point values for silt and clay. Samples chosen for this type of analysis represented tills overlying both granite and greenstone bedrock. In all cases the samples had greater than 10% fines.

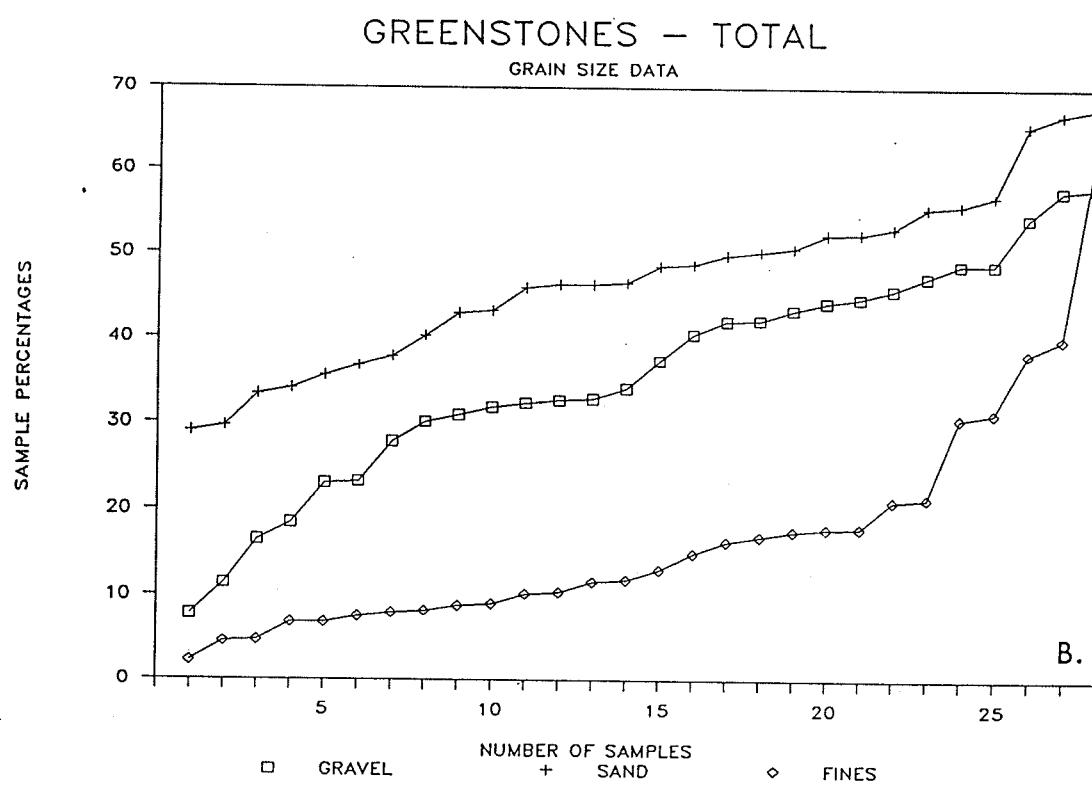
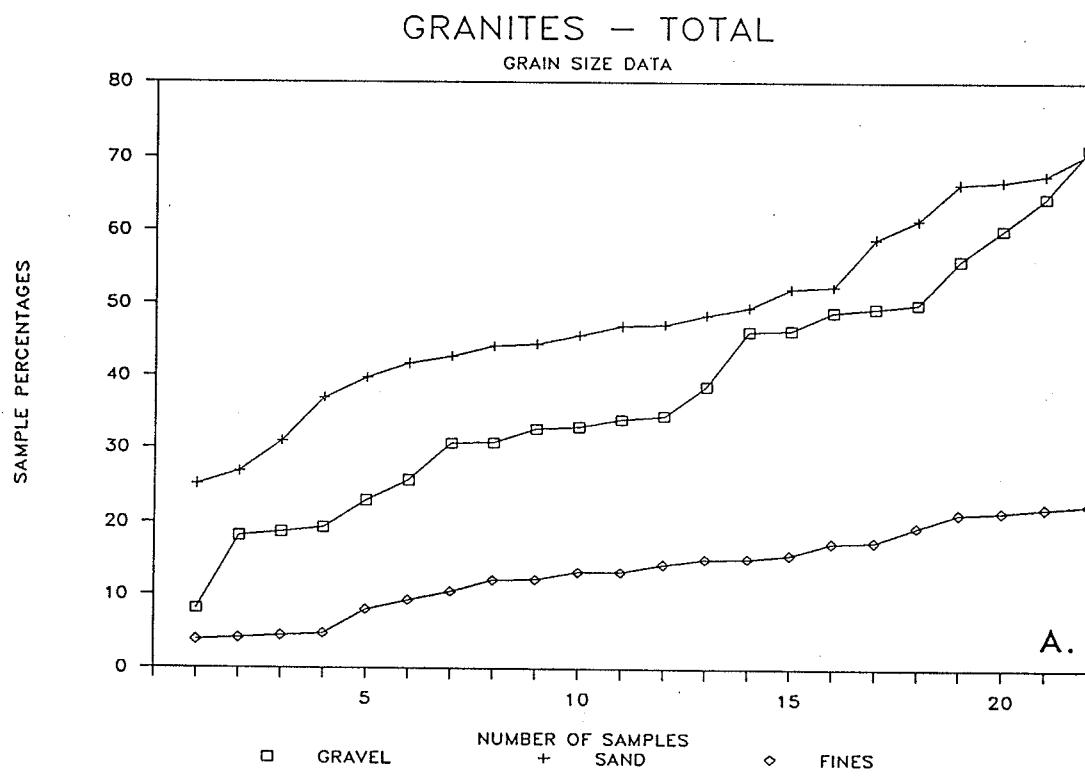


None of the 1988 samples were subjected to complete grain size analysis because of reduced funding. Also because there was no complete grain size analysis, no grain size curves were generated as was done in Years I and II. The gross composition of the till for the 1988 samples, excluding cobbles and boulders, is 37% gravel, 48% sand, and 15% silt and clay (see Appendix B).

Figure 4 illustrates the differences in grain size distribution for tills which overlie granites versus tills which overlie greenstones. On this figure percentages of gravel, sand, and fines in twenty-two samples of till overlying granite and in twenty-eight samples of till overlying greenstone are shown. The percentages of each grain size fraction are arranged in ascending order. It is apparent that the distributions of gravel and sand percentages between granite and greenstone tills are very similar. This is corroborated by the lack of any statistically significant difference between the mean values or between the standard deviations of the gravel and sand percentages between the granites and greenstones (see Grain Size Statistics-Appendix B). However, the distribution of sample percentages of the fines grain size split in the greenstone samples has a much wider range than that of the granite samples. Consequently, there is a significant statistical difference between the standard deviations (a measure of the 'spread' of the data distributions) of the percentages of fines in granites versus greenstones in spite of the fact that their means, or averages, are not significantly different (Grain Size Statistics - Appendix B).

The cause of the relatively wide spread of the percentages of fines in greenstone samples, as illustrated in Figure 4, may be explained in part by data related to the matrix of the till samples only as shown in Figure 5. Here, the percentages of sand, silt and clay are shown in ascending order for granite and greenstone till samples for the twenty samples in which silt and clay percentages were determined. Comparison of the graphs for granite and greenstone in Figure 5 reveals that the silt-sized, and, to a lesser extent, the sand-sized fractions of the greenstone samples have a much wider range or spread of percentages (see also Table 2). This is corroborated by the significant statistical differences between the standard deviations of the silt and sand fractions for granites versus greenstones in spite of the fact that their means are not significantly different (Grain Size Statistics - Appendix B). The clay size fraction percentages are statistically indistinguishable between granites and greenstones. This is apparent also on Figure 5.





**FIGURE 4: COMPARISON OF PERCENTAGES OF GRAVEL,
SAND AND FINES OF ALL TILL SAMPLES
ON GRANITE (4A) AND GREENSTONE (4B)**

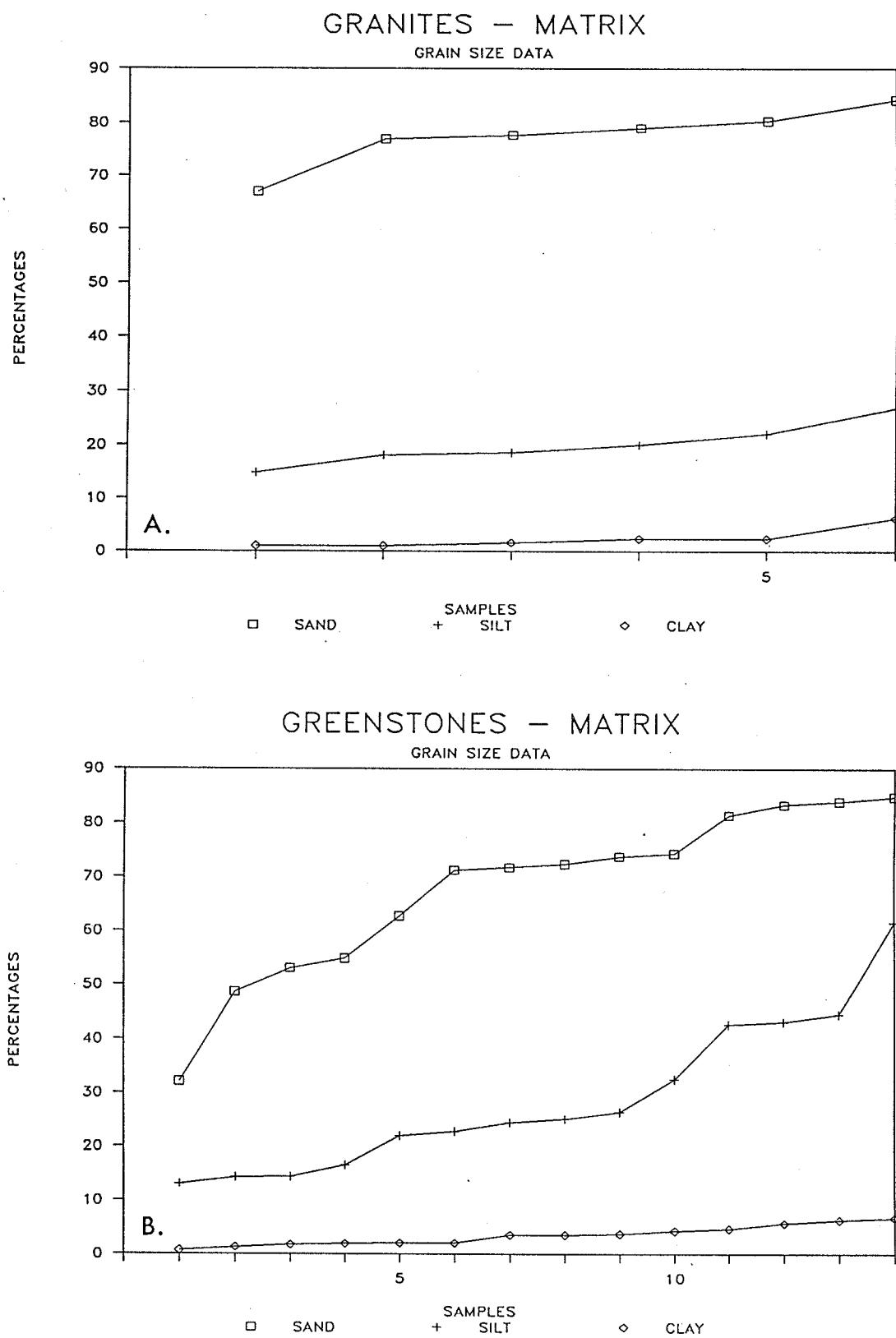


FIGURE 5: COMPARISON OF PERCENTAGES OF SAND, SILT AND CLAY OF THE MATRIX OF TILL SAMPLES ON GRANITES (5A) AND ON GREENSTONES (5B)

TABLE 2: GRAIN SIZE ANALYSIS OF TILL SAMPLES (-#10 MESH FRACTION)
AND ESTIMATED TOTAL SAMPLE MEDIAN

Till Type	N	Sand(%) ¹ Range	Silt(%) ¹ Mean	Clay (%) ¹ Range	Median (mm) ² Range, Mean
Greenstone Terrain	15	32-97, 69	13-62, 28	1-7, 3	0.035-10.00 ,2.6
Granitic Terrain	5	67-90, 77	15-27, 21	1-6, 3	0.400-20.00 ,2.9

¹ Nearest percent

² Estimates only

The median values cited in Appendix B are estimates only of the true sample medians. Complete grain size analyses and grain size curves are required for an accurate determination of these values. There appears to be no significant difference between the median averages of granites versus greenstones although there is an indication that the distribution of median values for granite samples is wider than that of the greenstones (Grain Size Statistics - Appendix B). This may, in part, reflect the slightly greater percentages of gravel present in granite samples and the presence of somewhat coarser material in some granite gravels (Table 2).

The origin of the slight, but discernible, differences between the grain size percentages of the granites and greenstones may reflect the lithologic character and weathering characteristics of these bedrock types. Many of the greenstones are themselves silty metasediments or finely fragmental metavolcanics. Weathering and erosion of these rocks could be expected to release large and variable quantities of silt and fine sand for incorporation in overlying tills by erosion and deposition during glaciation. Granites might in turn be expected to release more uniform and slightly smaller amounts of silt and fine sand and larger, more variable quantities of gravel.



3.3.2 Pebble Lithology

Lithologic determinations on pebble size material were made on the 50 samples that were submitted for laboratory analyses. Pebble identifications were done on the grain size fraction that has been partially cleaned and sieved to +2 mm. Each of these samples was further cleaned and sieved to +1 cm. Then all pebbles larger than 1 cm were identified and counted. Identification was done using general colour, mineralogy and texture (primary grain size). Finally, the raw counts were entered into a Lotus 1-2-3 spread sheet and statistically analyzed. Raw data on pebble lithology including raw counts and percentages are presented in Appendix C and summary statistics appear in Table 3.

Table 3 provides means, ranges and standard deviations for all sample groups as well as for sample groups of till overlying greenstone or granitic terrain. No attempt has been made during this phase of the project to account for glacial dispersion from one terrain to another. Therefore, there are considerable edge effects and overlapping data.

The following paragraphs describe some of the observations made during the petrographic analyses of the pebbles. Granites, including all granitoids, are considered to represent a single lithology. Granites are sometimes over-represented as a result of breakage during the cleaning process. Generally the granitoids are pink, but they are occasionally white to medium grey. They are medium grained and are sometimes weathered. Samples from granitic terrain showed a slightly greater granite content, but this was not as statistically significant as in the 1987 data (see Table 3). Grains recorded as pegmatites consisted of fragments of quartz, feldspar, or porphyritic granite.

The category gneiss includes schist and phyllite and is highly variable in lithology. The gneiss category may be overrepresented in some samples as a result of breakage during cleaning. In some cases, where the fragments have compositional banding, the gneiss category may be underrepresented in fragments larger than pebble size (1 cm to about 5 cm). Undivided meta-sediments may include some volcanics, especially agglomerates. The meta-sediments have been so thoroughly metamorphosed that they are difficult to identify.

The mafic volcanics are medium or dark green to greenish grey; generally fine grained and occasionally schistose. Felsic volcanics were separated from the mafic variety using colour. The felsic volcanics are much paler; light green to sometimes light grey; always fine grained and often schistose. Agglomerates are included with volcanics except in a few cases where they were so thoroughly metamorphosed that they were grouped with metasediments.



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TABLE 3 - PEBBLE LITHOLOGY STATISTICS (Percentages)

Units ->	GRAN	PEGM	GNSS	MSTD	SS	IF	MVLC	CMVLC	FVLC	UM	LS	DS	QTZ	GFB	OTH	TOT	STATISTICS
ALL DATA	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	#	<Units of measurement
Number	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	ALL DATA
Maximum	94	4	52	8	9	0	80	0	15	7	0	0	11	14	7	249	<Number of valid data
Minimum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	<Maximum <Minimum
Average	63	0	14	1	1	0	16	0	2	0	0	0	1	2	0	75	<Average or arithmetic mean
Stan-Dev	22	1	9	2	2	0	17	0	4	1	0	0	2	3	1	45	<Standard Deviation
Coef-Var	36%	309%	65%	195%	249%	106%	144%	285%					311%	186%	290%	60%	<Coefficient of Variation = Std-Dev/Avg
GREENSTONE																	
Number	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	DATA from over GREENSTONE BEDROCK
Maximum	94	4	52	8	6	0	80	0	15	7	0	0	7	8	7	138	<Number of valid data
Minimum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	<Maximum <Minimum
Average	56	0	16	1	1	0	20	0	3	1	0	0	0	1	0	75	<Average or arithmetic mean
Stan-Dev	22	1	10	2	1	0	18	0	4	1	0	0	1	2	1	36	<Standard Deviation
Coef-Var	39%	286%	61%	170%	245%	92%	131%	216%					339%	169%	277%	48%	<Coefficient of Variation = Std-Dev/Avg
GRANITE																	
Number	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	DATA from over GRANITE BEDROCK
Maximum	93	4	20	5	9	0	41	0	8	0	0	0	11	14	3	249	<Number of valid data
Minimum	27	0	3	0	0	0	0	0	0	0	0	0	0	0	0	12	<Maximum <Minimum
Average	74	0	10	1	1	0	9	0	2	0	0	0	1	2	0	76	<Average or arithmetic mean
Stan-Dev	19	1	5	1	2	0	11	0	3	0	0	0	3	4	1	57	<Standard Deviation
Coef-Var	26%	339%	51%	249%	232%	122%	163%						258%	164%	276%	75%	<Coefficient of Variation = Std-Dev/Avg
SUMMARY																	
t test	2.7	0.1	-2.4	-1.4	0.9	-2.1	-1.3	-1.9	-1.3	-1.9	-1	-1	1.1	-0.7	0.1	<Statistical test for similar averages	
Sig .05	0	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	<if 1; then granite = greenstone, @ 95%
Sig .01	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	<if 1; then granite = greenstone, @ 99%
F test	1.4	1.6	3.8	3.0	2.9	2.5	2.1	2.1	4.3	5.3	3.9	3.9	2.6	<Statistical test for similar std-dev			
Sig .05	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	<if 1; then granite = greenstone, @ 95%	
Sig .01	1	1	0	1	1	1	1	1	0	0	0	0	1	1	1	<if 1; then granite = greenstone, @ 99%	

Gabbros were separated from mafic volcanics on the basis of crystal size. Metamorphism may have recrystallized some volcanics into the crystal size range of gabbro.

The sandstone and greywacke category includes quartzite, arkose, and some siltstone. Some of these greywackes which consist of well rounded pebbles of what appears to be unmetamorphosed brownish grey, fine grained greywacke were found in 12 of the samples (G-88-3, G-88-4, G-88-6, G-88-10, G-88-17, G-88-24, G-88-31, G-88-33, G-88-34, G-88-39, G-88-48, and G-88-49). Only one of the samples G-88-31 had a greywacke pebble with a limestone concretion that is typical of the Omarolluk Formation of the Hudson Bay Lowlands (Prest and Nielsen, 1987). The other greywacke pebbles could be from 1) the Omarolluk Formation and could represent the rock mass between the concretions, 2) other greywacke locations in the Hudson Bay Lowlands, or 3) lightly metamorphosed greywackes from the greenstone belts in the study area (10 of the 12 samples were from greenstone belts).

Iron formation and oolitic jasper were not found during examination of the 1988 samples. Some ferrous fine grained sediments were included with the siltstone. No argillite was found during examination of the pebbles. All siltstone was included with the greywacke or metasediments depending upon whether or not it was metamorphosed. Vein quartz was mono to poly-crystalline, usually milky and rarely clear.

No limestone or dolomite was found in the 1988 samples.

3.3.3 Heavy Minerals

Heavy mineral separations were made by Terramin Research Labs on the sand size material (minus #10-plus #230 fraction) using tetrabromoethane (S.G. 2.96). Three fractions were prepared from the sand: -10 to +40 mesh; -40 to +80 mesh; and -80 to +230 mesh. The -40 to +80 mesh fraction (non-magnetic) was selected for microscopic determinations of heavy and light minerals because the coarser fraction contained too much lithic material and the finer fraction was more difficult to assess because of the smaller grains. During 1986, ten samples of the fine fraction (-80 to +230) were analyzed and compared with the -40 to +80 fraction. It was found that the mineralogy of the two size fractions was essentially the same (see Appendix G - Minning, 1988 for the 1986 results). For this reason, counting of the fine fraction (-80 to +230) was not carried out on the 1987 or 1988 samples.



Heavy minerals listed in the database of this report were identified and counted by ERA Earth Resources Assessments Ltd using a binocular microscope. For each sample, the contractor spread a small amount of the sample on a dish under the microscope. All the grains were identified and counted in successive squares until the total of heavy minerals (minus unknown grains) was over 200. The reference standard of mineral grains (cemented on a micro-slide) which was prepared for the 1986 samples was used to keep identifications uniform. In 1986, 1987 and 1988 the reference heavy minerals were identified in accordance with Ontario Geological Survey Geosciences Laboratory procedures (Pitts, 1979). Observations were made using colour, lustre and shape (crystal habit, cleavage, etc.). Only appropriate grains were counted; that is any light minerals were excluded when heavy minerals were counted and mineral aggregates were never included. Unknown minerals were also excluded from the count. Statistics for the heavy mineral analyses appear in Table 4.

Some samples were heavily coated with an iron stained, clayey, slightly calcareous rind which made identification difficult, particularly for the paler minerals: tremolite, epidote, and apatite. However, an attempt was made to include coated minerals in the total so as not to bias the results. Finally, the raw counts were entered into a Lotus 1-2-3 spread sheet and analyzed statistically.

The following paragraphs summarize the results of the heavy mineral analyses which are also shown on Tables 4 and 5 and in Appendix D. Hornblende was by far the most abundant heavy mineral, consisting of 50% to 90% of the grains. It was black to very dark green, with a dull vitreous luster and opaque, with amphibole cleavage (60 and 120 degrees), subhedral to anhedral and often bladed or elongate.

Pyroxene was the second most common mineral forming 5% to 15% of the grains. No attempt was made to separate the clinopyroxenes from the orthopyroxenes. Pyroxenes were black to very dark green, dull vitreous and opaque, with pyroxene cleavage (90 degrees), subhedral to anhedral and usually equant.

Diopside was abundant (40%) in G-88-4. It was uniformly pale greenish grey, fibrous, vitreous lustre, opaque, anhedral and slightly elongate.

Tremolite and actinolite were counted together and usually account for 5% to 10% of the sample. They were very pale to dark green, bright vitreous lustre, and transparent to translucent, coarsely fibrous, occasionally showing amphibole cleavage, subhedral to rarely anhedral, and usually elongate.



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TABLE 4 - HEAVY MINERAL STATISTICS (Percentages)

Units ->		HORNBL	TREM	PYROX	EPID	APAT	BIOT	GARN	TOUR	SULF	OTHR	TOTAL	STATISTICS
ALL DATA		%	%	%	%	%	%	%	%	%	#	<Units of measurement	
Number		50	50	50	50	50	50	50	50	50	50	50	ALL DATA
Maximum		95	82	22	5	10	13	4	0	2	42	293	<Maximum
Minimum		17	0	1	0	0	0	0	0	0	0	200	<Minimum
Average		80	7	7	1	2	2	1	0	0	1	225	<Average or arithmetic mean
Stan-Dev		14	12	5	1	2	2	1	0	0	6	21	<Standard Deviation
Coef-Var		17%	185%	67%	123%	122%	128%	96%	398%	448%	693%	10%	<Coefficient of Variation = Std-Dev/Avg
GREENSTONE													
Number		31	31	31	31	31	31	31	31	31	31	31	DATA from over GREENSTONE BEDROCK
Maximum		95	82	22	5	10	6	4	0	2	0	272	<Maximum
Minimum		17	0	1	0	0	0	0	0	0	0	200	<Minimum
Average		78	9	7	1	2	1	1	0	0	0	221	<Average or arithmetic mean
Stan-Dev		15	15	5	1	2	1	1	0	0	0	16	<Standard Deviation
Coef-Var		19%	164%	68%	125%	124%	115%	94%	381%	399%	7%	12%	<Coefficient of Variation = Std-Dev/Avg
GRANITE													
Number		19	19	19	19	19	19	19	19	19	19	19	DATA from over GRANITE BEDROCK
Maximum		95	6	16	2	6	13	2	0	0	42	293	<Maximum
Minimum		44	0	2	0	0	0	0	0	0	0	206	<Minimum
Average		83	3	7	1	1	3	1	0	0	2	232	<Average or arithmetic mean
Stan-Dev		11	2	5	1	1	3	1	0	0	9	27	<Standard Deviation
Coef-Var		13%	68%	65%	100%	103%	115%	96%	424%	424%	420%	12%	<Coefficient of Variation = Std-Dev/Avg
SUMMARY													
t test	1.0	-1.8	0.0	-1.0	-0.9	2.0	-0.9	-0.2	-0.8	1.3	1.7	1.7	<Statistical test for similar averages
Sig .05	1	1	1	1	1	1	1	1	1	1	1	1	<If 1; then granite = greenstone, @ 95%
Sig .01	1	1	1	1	1	1	1	1	1	1	1	1	<If 1; then granite = greenstone, @ 99%
F test	2.0	76.7	1.1	3.3	3.0	4.2	1.6	1.2	12.1	2.8	2.8	2.8	<Statistical test for similar std-dev
Sig .05	1	0	1	0	0	0	1	1	0	0	0	0	<If 1; then granite = greenstone, @ 95%
Sig .01	1	0	1	0	1	0	1	1	0	1	1	1	<If 1; then granite = greenstone, @ 99%

Apatite was present in most samples at a trace to 5%. It was always 'bottle' green, with a bright vitreous lustre and transparent, usually fractured, anhedral and equant.

Epidote was present in almost all samples as a trace. It was the characteristic 'pistachio' green with good cleavage.

Biotite was present in some samples as a trace to 5%. The biotite was black with dark brown edges, bright vitreous and opaque, always tabular and often partly hexagonal.

Garnet showed as a trace in most of the samples. It was reddish brown to brown, with a dull vitreous lustre, translucent to opaque, with a conchoidal fracture and equant.

Tourmaline was present as a few traces in a few samples. It has a dull vitreous lustre and is opaque and black in colour and has a rounded triangular cross section and longitudinal striations.

Sulfides were very rare, and only one or two grains were found in a couple of samples. It was not possible to identify the mineral because it occurred as a lump of rust with some metallic material in the center.

No gold flakes were found in the portions of the samples inspected. It may be present, but a much larger portion of each sample would have to be inspected to be certain of its presence or absence. One copper flake was found in G-88-27.

Some unknown minerals were found as a trace in some samples. They are assumed to be a heavy mineral since they were not quartz or feldspar. They were usually medium grey, dull vitreous lustre and translucent with no cleavage or crystal habit and well rounded in shape. They could represent a microcrystalline aggregate.

Table 5 lists the location, sample number, and mineral percentages of some unusual heavy mineral occurrences. Most of these occurrences are in the greenstone terrain and fall on the Kenora map-sheet (52E/16).

3.3.4 Light Minerals - Sand Fraction

A preliminary evaluation of the mineralogy of light minerals was carried out on 20% of all samples (10 samples total). These samples represented granite and greenstone terrain and were spread throughout the Year III study area. Analysis was carried out on the -40 to +80 mesh reject from the heavy mineral separation. Results from this work are shown in Tables 6 and 7. There was no overall statistical difference between the total average percentages of light minerals in granite and greenstone terrains.



TABLE 5: UNUSUAL HEAVY MINERAL OCCURRENCES IN TILL

SAMPLE NO.	LOCATION	MINERAL (%)
G-88-4	NE corner Kenora map (52E/16); south of East Lake (Granite)	Diopside (42)
G-88-9	NE corner Sioux Narrows map (52E/8); between Long Bay and Regina Bay (Greenstone)	Apatite (6)
G-88-12	East side Kenora map (52E/16); east side Silver Lake (Granite)	Apatite (5)
G-88-18	SE corner Kenora map (52E/16); south of Silver Lake (Granite)	Apatite (6)
G-88-24	SW corner Kenora map (52E/16); near Black Sturgeon Lakes (Greenstone)	Apatite (6)
G-88-25	West side Morson map (52E/1); north of town of Morson (Granite)	Garnet (4)
G-88-26	SW corner Kenora map (52E/16); near Kenora airport (Greenstone)	Apatite (10)
G-88-27	NW corner Kenora map (52E/16); east of Corn Lake (Granite)	Copper (trace)
G-88-30	SW corner Kenora map (52E/16); north of Laurensons Lake (Greenstone)	Apatite (6)
G-88-42	NW corner Clearwater Bay map (52E/10); near Woodchuck Bay (Greenstone)	Tremolite (82)
G-88-47	East side Falcon Lake map (52E/11); near Crowdock Lake (Greenstone)	Garnet (3)

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TABLE 6 - LIGHT MINERAL STATISTICS (Percentages)

		QUARTZ			FELDSPAR			MICA			TOTAL		STATISTICS	
Units ->		FRACT	FROST	%	%	%	%	%	%	%	#	<Units of measurement		
ALL DATA												ALL DATA		
Number >	10	10	10	10	10	10	10	10	10	10	10	<Number of valid data		
Maximum >	79	73	26	1	1	5	5	5	5	293	293	<Maximum		
Minimum >	20	11	2	0	0	0	0	0	0	200	200	<Minimum		
Average >	63	26	8	1	1	3	3	3	3	227	227	<Average or arithmetic mean		
Stan-Dev>	18	17	7	0	0	1	1	1	1	24	24	<Standard Deviation		
Coef-Var>	28%	68%	77%	73%	73%	59%	59%	59%	59%	11%	11%	<Coefficient of Variation = Std-Dev/Avg		
GREENSTONE		DATA from over GREENSTONE BEDROCK			DATA from over GREENSTONE BEDROCK			DATA from over GREENSTONE BEDROCK			DATA from over GREENSTONE BEDROCK		DATA from over GREENSTONE BEDROCK	
Number >	6	6	6	6	6	6	6	6	6	6	6	<Number of valid data		
Maximum >	79	73	26	1	1	5	5	5	5	232	232	<Maximum		
Minimum >	20	11	2	0	0	0	0	0	0	208	208	<Minimum		
Average >	61	27	9	1	1	3	3	3	3	221	221	<Average or arithmetic mean		
Stan-Dev>	21	21	8	0	0	2	2	2	2	8	8	<Standard Deviation		
Coef-Var>	34%	78%	90%	57%	57%	60%	60%	60%	60%	4%	4%	<Coefficient of Variation = Std-Dev/Avg		
GRANITE		DATA from over GRANITE BEDROCK			DATA from over GRANITE BEDROCK			DATA from over GRANITE BEDROCK			DATA from over GRANITE BEDROCK		DATA from over GRANITE BEDROCK	
Number >	4	4	4	4	4	4	4	4	4	4	4	<Number of valid data		
Maximum >	78	38	10	1	1	4	4	4	4	293	293	<Maximum		
Minimum >	47	16	3	0	0	1	1	1	1	200	200	<Minimum		
Average >	66	23	8	0	0	2	2	2	2	236	236	<Average or arithmetic mean		
Stan-Dev>	12	9	3	0	0	1	1	1	1	35	35	<Standard Deviation		
Coef-Var>	18%	37%	37%	102%	102%	57%	57%	57%	57%	15%	15%	<Coefficient of Variation = Std-Dev/Avg		
SUMMARY		COMPARISON STATISTICS			COMPARISON STATISTICS			COMPARISON STATISTICS			COMPARISON STATISTICS		COMPARISON STATISTICS	
t test >	0.5	-0.4	-0.3	-0.8	-0.8	-0.4	-0.4	-0.4	-0.4	1.0	1.0	<Statistical test for similar averages		
Sig .05 >	1	1	1	1	1	1	1	1	1	1	1	<if 1; then granite = greenstone, @ 95%		
Sig .01 >	1	1	1	1	1	1	1	1	1	1	1	<if 1; then granite = greenstone, @ 99%		
F test >	3.0	6.0	7.9	1.4	1.4	1.5	1.5	1.5	1.5	19.3	19.3	<Statistical test for similar std-dev		
Sig .05 >	1	1	1	1	1	1	1	1	1	0	0	<if 1; then granite = greenstone, @ ~95%		
Sig .01 >	1	1	1	1	1	1	1	1	1	1	1	<if 1; then granite = greenstone, @ ~99%		

Also, there are no statistically significant differences between the average percentages of individual light minerals between granite and greenstone terrains. This may, in part, be due to the smaller number of samples examined for 1988 compared with that (20 samples) examined for light minerals in 1987.

Results shown in Table 6 indicate that quartz averages 89% in all the samples. Quartz grains formed the major part of all the samples and it has been divided into clear and frosted quartz varieties. The clear form (two-thirds of the quartz) was colourless, transparent, fractured and angular and generally appeared fresh. The frosted quartz was colourless to pale yellow, pink or green, transparent to translucent, subrounded to well rounded and partly to completely frosted.

Feldspar, 5% to 20% of the samples, contained both plagioclase and K-spar. These were not separated from each other. The feldspars were white to pale shades of cream or pink, dull vitreous luster, occasionally cleaved and usually not as equant as quartz.

Mica accounted for 1% to 5% of the samples. It was mostly muscovite and phlogopite. The muscovite was very pale to translucent, bright vitreous luster and in very thin plates. The phlogopite was similar, but medium brown and a little thicker. The amount of heavier micas may have been due to a variation in the density of the liquid.

Sparry crystals occurred as a trace in some samples. They were non-calcareous, colourless, vitreous, transparent with good parallel cleavage and usually elongate. They looked like celestite but some may have been quartz.

TABLE 7: MINERALOGY OF LIGHT MINERALS
FROM SAND SIZE MATERIAL IN TILL

TERRAIN	N	CLEAR QUARTZ \bar{X} (Range)	FROSTED QUARTZ \bar{X} (Range)	FELDSPAR \bar{X} (Range)	MICA \bar{X} (Range)	SPARRY CRYSTALS \bar{X} (Range)
GREEN-STONE	6	61(20-79)	27(11-73)	9(2-26)	3(0-5)	1(0-1)
GRANITE	4	66(47-78)	23(16-38)	8(3-10)	2(1-4)	0(0-1)
TOTAL	10	63(20-79)	26(11-73)	8(2-26)	3(0-5)	1(0-1)



3.3.5 Geochemical Analysis

Geochemical analysis of 50 till samples was carried out by Bondar-Clegg & Company Ltd. of Ottawa using standardized procedures currently employed by the Geological Survey of Canada. Raw geochemical data are provided in Appendix F under three title blocks - Geochemistry by Atomic Absorption Data, Geochemistry by Neutron Activation (Light Elements) Data, and Geochemistry by Neutron Activation (Heavy Elements) Data. Summary statistics for this data are provided in Tables 8, 9, and 10 of the text. Within the atomic absorption data reported in the tables and appendices all values were obtained by AA except arsenic (As) which was determined colorimetrically, uranium (U) which was determined by delayed neutron activation, and organic and inorganic carbon which were determined on a Leco carbon determinator. Analyses were carried out on the less than 2 micron fraction. A wide suite of elements were analyzed by neutron activation (Tables 9 and 10), including the elements gold (Au), silver (Ag), and uranium (U).

Duplicate analyses for several elements were performed by different geochemical techniques. Silver (Ag), chromium (Cr), iron (Fe), cobalt (Co), nickel (Ni), zinc (Zn), and molybdenum (Mo) were each analyzed by atomic absorption and neutron activation. Arsenic (As) was determined both colorimetrically and by neutron activation and uranium (U) was determined both from neutron activation and delayed neutron activation techniques. Duplicate results for these elements appear to all coincide at least to within an order of magnitude, but there are some major discrepancies between analytical techniques for some elements. For example, although the average values of some elements analyzed by atomic absorption such as iron and cobalt, agree very closely with their average values as determined from neutron activation, other important elements such as molybdenum and silver display major differences between types of analyses for their average values of up to 178%. Arsenic determinations are more discrepant, with their average values differing by 270%, based on the percent difference between colorimetric determination and neutron activation determinations. Such differences are perhaps understandable in light of the fundamentally different character of these techniques. For example, in atomic absorption analysis, the sample must undergo a total dissolution in strong acid whereas neutron activation analysis is performed on the original unaltered sample.



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TABLE 8 - GEOCHEMISTRY by ATOMIC ABSORPTION STATISTICS

Carbon										STATISTICS									
Units	C _{TOT}	C _{ORG}	C _{IN}	C _{EQ}	Cr	Mn	Fe	Co	Ni	Cu	Zn	Mo	Ag	Pb	As	U	STATISTICS		
ALL DATA	%	%	%	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	<Units of measurement		
Number	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	ALL DATA		
Maximum	16.66	16.50	0.16	1.33	563	1010	7.4	33	208	288	243	9.0	0.80	40	44	11.3	<Maximum		
Minimum	0.44	0.44	-0.05	-0.42	43	135	1.8	4	15	23	36	0.5	0.05	8	2	1.7	<Minimum		
Average	4.88	4.85	0.03	0.21	100	366	3.7	15	56	84	105	2.5	0.20	22	12	4.3	<Average or arithmetic mean		
Stan-Dev	3.12	3.10	0.03	0.26	101	206	1.0	6	42	59	38	1.6	0.19	8	8	2.0	<Standard Deviation		
Coef-Var	64%	64%	122%	122%	102%	56%	27%	43%	75%	70%	36%	63%	99%	39%	68%	46%	<Coefficient of Variation = Std-Dev/Avg		
GREENSTONE																			
Number	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	DATA from over GREENSTONE BEDROCK		
Maximum	10.75	10.72	0.10	0.83	563	1010	6.0	31	208	288	243	5.0	0.70	40	44	7.9	<Maximum		
Minimum	0.44	0.44	0.00	0.00	43	147	1.8	9	18	32	60	0.5	0.05	10	4	2.1	<Minimum		
Average	4.62	4.59	0.03	0.21	118	414	3.7	16	66	100	117	2.3	0.18	22	12	3.9	<Average or arithmetic mean		
Stan-Dev	2.52	2.51	0.02	0.19	125	219	0.9	6	47	67	41	1.2	0.16	8	8	1.4	<Standard Deviation		
Coef-Var	55%	55%	87%	87%	106%	53%	25%	40%	72%	67%	35%	52%	86%	37%	68%	34%	<Coefficient of Variation = Std-Dev/Avg		
GRANITE																			
Number	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	DATA from over GRANITE BEDROCK		
Maximum	16.66	16.50	0.16	1.33	103	805	7.4	33	129	124	9.0	0.80	37	32	11.3	<Maximum			
Minimum	1.18	1.18	-0.05	-0.42	43	135	1.9	4	15	23	36	0.5	0.05	8	2	1.7	<Minimum		
Average	5.30	5.28	0.03	0.21	70	289	3.8	13	40	59	87	2.9	0.22	21	11	4.8	<Average or arithmetic mean		
Stan-Dev	3.86	3.84	0.04	0.35	16	156	1.2	6	24	27	23	2.1	0.24	9	7	2.6	<Standard Deviation		
Coef-Var	73%	73%	165%	165%	22%	54%	31%	45%	59%	45%	27%	72%	111%	42%	67%	55%	<Coefficient of Variation = Std-Dev/Avg		
SUMMARY																			
t test	0.8	0.8	-0.0	-0.0	-1.6	-2.1	0.3	-1.9	-2.1	-2.4	-2.7	1.2	0.6	-0.7	-0.5	1.5	COMPARISON STATISTICS		
Sig .05	1	1	1	1	1	0	1	1	0	0	0	1	1	1	1	1	<Statistical test for similar averages		
Sig .01	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	<If 1; then granite = greenstone, @ 95%		
F test	2.3	2.3	3.5	3.5	62.1	2.0	1.7	1.3	4.0	6.4	3.1	2.9	2.3	1.1	1.2	3.7	<Statistical test for similar std-dev		
Sig .05	1	1	0	0	0	1	1	1	0	0	0	0	1	1	0	0	<If 1; then granite = greenstone, @ ~95%		
Sig .01	1	1	0	0	0	0	1	1	0	0	1	1	1	1	0	0	<If 1; then granite = greenstone, @ ~99%		

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TABLE 9 - GEOCHEMISTRY by NEUTRON ACTIVATION STATISTICS (Light Elements)

Units ->		Na	Sc	Cr	Fe	Co	Ni	Zn	As	Se	Br	Rb	Zr	Mo	Ag	Cd	Sn	Sb	Te	STATISTICS
ALL DATA		%	ppm	%	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	<Units of measurement
Number	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	ALL DATA	
Maximum	3.52	23.6	590	7.7	54.0	220	390	11.00	2.5	29.0	130	940	3.0	1	2.5	50	50	50	<Number of valid data	
Minimum	1.60	5.5	37	2.0	2.5	10	50	0.25	2.5	1.0	35	100	0.5	1	2.5	50	0.05	5	<Maximum	
Average	2.55	10.4	121	3.6	15.2	44	155	3.24	2.5	5.7	78	375	0.9	1	2.5	50	0.19	5	<Average or arithmetic mean	
Stan-Dev	0.44	3.4	111	1.2	9.7	41	79	2.42	0.0	5.6	19	226	0.8	0	0.0	0	0.12	1	<Standard Deviation	
Coef-Var	17%	32%	92%	33%	63%	94%	51%	75%	0%	97%	25%	60%	84%	0%	0%	0%	61%	22%	<Coefficient of Variation = Std-Dev/Avg	
GREENSTONE																				
Number	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	DATA from over GREENSTONE BEDROCK	
Maximum	3.32	23.6	590	7.7	54.0	220	390	11.00	2.5	18.0	130	940	3.0	1	2.5	50	0.50	13	<Number of valid data	
Minimum	1.60	5.5	42	2.3	6.0	10	50	0.25	2.5	1.0	50	100	0.5	1	2.5	50	0.05	5	<Maximum	
Average	2.48	11.1	150	3.9	18.1	55	161	3.44	2.5	5.0	82	366	0.9	1	2.5	50	0.23	5	<Average or arithmetic mean	
Stan-Dev	0.42	3.7	130	1.3	10.5	48	85	2.30	0.0	3.9	19	239	0.7	0	0.0	0	0.12	1	<Standard Deviation	
Coef-Var	17%	33%	87%	33%	58%	87%	53%	67%	0%	79%	23%	65%	84%	0%	0%	0%	53%	27%	<Coefficient of Variation = Std-Dev/Avg	
GRANITE																				
Number	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	DATA from over GRANITE BEDROCK	
Maximum	3.52	15.0	140	4.7	20.0	53	260	11.00	2.5	29.0	100	730	3.0	1	2.5	50	0.30	5	<Number of valid data	
Minimum	1.80	5.9	37	2.0	2.5	10	50	0.50	2.5	1.0	35	100	0.5	1	2.5	50	0.05	5	<Maximum	
Average	2.67	9.1	73	3.1	10.5	26	147	2.91	2.5	7.0	71	391	0.9	1	2.5	50	0.14	5	<Average or arithmetic mean	
Stan-Dev	0.45	2.3	27	0.8	5.3	15	67	2.57	0.0	7.4	18	201	0.8	0	0.0	0	0.09	0	<Standard Deviation	
Coef-Var	17%	25%	37%	26%	51%	56%	45%	89%	0%	105%	26%	52%	84%	0%	0%	0%	65%	0%	<Coefficient of Variation = Std-Dev/Avg	
SUMMARY																				
t test	1.5	-2.0	-2.4	-2.2	-2.7	-0.6	-0.8	-1.3	-2.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	-2.6	-0.8	<Statistical test for similar averages	
Sig .05	1	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	1	<If 1; then granite = greenstone, @ 95%	
Sig .01	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	<If 1; then granite = greenstone, @ 99%	
F test	1.2	2.7	23.2	2.5	3.9	10.6	1.6	1.3	3.6	1.1	1.4	1.0	3.6	1.1	1.4	1.0	1.8	1	<Statistical test for similar std-dev	
Sig .05	1	0	0	0	0	0	0	1	1	0	1	1	1	1	1	1	1	1	<If 1; then granite = greenstone, @ ~95%	
Sig .01	1	1	0	1	0	1	0	1	1	0	1	1	1	1	1	1	1	1	<If 1; then granite = greenstone, @ ~99%	

LAKE OF THE WOODS (Year 3)

TABLE 10 - GEOCHEMISTRY by NEUTRON ACTIVATION STATISTICS (Heavy Elements)

Units ->	Cs	Ba	La	Ce	Sm	Eu	Tb	Lu	Hf	Ta	W	Ir	Au	Th	U	WT	STATISTICS
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppb	ppm	ppm	g	<Units of measurement
ALL DATA	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	ALL DATA
Number	12	1300	77	150	8.6	3.0	1.10	3	0.3	15	1.20	2.0	25	110	29.1	4.7	<Number of valid data
Maximum	1	270	16	31	1.4	0.5	0.25	1	0.1	4	0.25	0.5	25	1	3.5	1.0	<Maximum
Minimum																	<Minimum
Average	3	670	33	74	4.4	1.0	0.48	1	0.2	9	0.72	0.6	25	5	13.8	2.2	<Average or arithmetic mean
Stan-Dev	2	172	12	30	1.3	0.7	0.25	1	0.1	2	0.24	0.2	0	15	5.7	0.7	<Standard Deviation
Coef-Var	74%	26%	36%	41%	29%	69%	52%	41%	57%	26%	34%	43%	0%	325%	41%	29%	<Coefficient of Variation = Std-Dev/Avg
GREENSTONE																	
Number	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	DATA from over GREENSTONE BEDROCK
Maximum	8.1	920	56.0	150	6.3	3.0	0.90	3	0.3	12	1.20	2.0	25	110	28.9	3.4	<Number of valid data
Minimum	1.2	270	16.0	31	1.4	0.5	0.25	1	0.1	4	0.25	0.5	25	1	3.5	1.1	<Maximum
Average	3.3	629	31.8	75	4.2	1.0	0.44	1	0.2	9	0.72	0.6	25	6	13.3	2.1	<Average or arithmetic mean
Stan-Dev	1.9	127	10.1	29	1.2	0.7	0.22	1	0.1	2	0.27	0.3	0	19	5.0	0.5	<Standard Deviation
Coef-Var	56%	20%	32%	39%	28%	72%	49%	45%	57%	26%	37%	50%	0%	309%	38%	24%	<Coefficient of Variation = Std-Dev/Avg
GRANITE																	
Number	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	DATA from over GRANITE BEDROCK
Maximum	12.0	1300	77.0	150	8.6	2.0	1.10	2	0.3	15	1.00	0.5	25	10	29.1	4.7	<Number of valid data
Minimum	0.7	420	19.0	38	3.1	0.5	0.25	1	0.1	6	0.25	0.5	25	1	4.7	1.0	<Maximum
Average	2.3	737	35.1	73	4.9	1.1	0.54	1	0.2	10	0.72	0.5	25	2	14.8	2.4	<Average or arithmetic mean
Stan-Dev	2.4	212	14.1	31	1.3	0.7	0.28	0	0.1	2	0.20	0.0	0	2	6.6	0.8	<Standard Deviation
Coef-Var	106%	29%	40%	43%	28%	63%	52%	34%	56%	22%	27%	0%	0%	104%	45%	34%	<Coefficient of Variation = Std-Dev/Avg
SUMMARY																	
t test	-1.6	2.2	1.0	-0.2	1.9	0.2	1.4	-0.5	-0.0	2.5	0.0	-1.6	-0.9	0.9	1.3	1.2	<Statistical test for similar averages
Sig .05	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	<If 1; then granite = greenstone, @ 95%
Sig .01	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	<If 1; then granite = greenstone, @ 99%
F test	1.7	2.8	1.9	1.1	1.3	1.2	1.7	2.0	1.1	1.0	1.8	-65.3	1.7	2.5	1.3	1.3	<Statistical test for similar std-dev
Sig .05	1	0	1	1	1	1	1	1	1	1	1	0	1	0	1	1	<If 1; then granite = greenstone, @ ~95%
Sig .01	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	<If 1; then granite = greenstone, @ ~99%

However, it is surprising that the uranium analyses by neutron activation and delayed neutron activation display a difference of 95% between their average values in view of the basic similarity between these techniques. In years 1 and 2 of this study the difference between the average uranium values determined by these techniques is less than 10%. These discrepancies will be investigated further in future studies in year IV.

The total carbon content (CTOT) averaged 4.85% for all samples with maximum value of 16.5%. As with the 1987 data, granites have a slightly, but not significantly higher CTOT content than the greenstones. Almost all of the CTOT is present as organic carbon (CORG), which is consistent with the lack of reaction of the till samples with 10% HCL acid.

As with the 1987 data, most elements occur within the normal range limits for igneous and volcanic rocks in general. The pattern of abundances of elements in tills overlying greenstone versus tills overlying granites for 1988 is similar to those of 1987. Overall, tills overlying greenstones are more enriched in metals (Mn, Ni, Cu, Zn, Sc, Cr, Fe, Sb, and Co) (see Tables 8 and 9). However, the relative degree of enrichment for any particular metal varies according to the analytical method. For example the concentration of iron and cobalt are not indicated to be significantly greater in greenstone terrain according to atomic absorption analysis (Table 8), but neutron activation analysis indicates significantly higher iron and cobalt concentrations in tills overlying greenstones at a 95% level of significance (Table 9).

Unlike the 1987 data, heavy elements show no preferred affinity for tills overlying granites or greenstones. Neither gold (Au) or uranium (U) occur preferentially in granite or greenstone terrain (Table 10). The lack of definitive correlation between the abundance of heavy elements and their occurrence in tills of granite or greenstone terrain may be a consequence of the smaller 1988 data base.

Geochemical "anomalies" have been identified for specific sample sites at locations where the concentrations of given elements exceed values equal to the overall arithmetic means of these elements plus two standard deviations above their means. These results are reported by Dave Evans (geochemist) in Table 11 which was compiled from the data set listed in the "Geochemistry by Atomic Absorption Data" section of Appendix F. These data were used because they incorporate analyses of elements such as Cu and Zn which are not included in the neutron activation results but which are most readily related to the geochemistry of known and inferred mineral occurrences as outlined on Geological Series Map 2443 (Blackburn, 1981).



TABLE 11: SUMMARY OF GEOCHEMICAL ANOMALIES 1988 DATA
RAT PORTAGE BAY/NORTHWEST ANGLE MAP-SHEETS

ELEMENT	M ¹	SD ²	M+2SD ³	Cv ⁴	ANOMALOUS SITES
Gold	2.5	2.2	7	88	10,15,28,33
Nickel	56	42	140	75	19,33,42
Copper	84	59	202	70	10,19,24
Zinc	105	38	181	38	25,47
Molybdenum	2.5	1.6	5.7	63	22,37
Silver	0.20	0.19	0.58	99	7,18,20,39
Lead	22	8	38	39	39,44
Arsenic	12	8	28	68	7,45,47,49
Uranium	4.3	2.0	8.3	46	31,43

1 = Arithmetic Mean (All elements in PPM except gold in PPB)

2 = Standard Deviation

3 = Mean plus two standard deviations

4 = Coefficient of Variation

Geochemically anomalous locations are scattered across the samples area and no clear patterns are evident (Table 11). Many of these anomalies are weak enrichments of metals in relation to normally expected background abundance values; and, this may imply that the majority of base and precious metals mineralization is highly localized in the 1988 study area in and around Lake of the Woods; and, overall potential may be less than in the adjacent 1987 study area to the east (Blue Lake and Rowan Lake map areas) where geochemical anomaly groupings better confirmed and/or defined known and inferred areas of base and precious metals mineralization. However, additional factors to consider may be either that the more irregular sampling distribution and/or the smaller number of samples analyzed during 1988 (50 samples) versus 1987 (110 samples) may be responsible to the lack of definitive trends.

In general, the elemental associations in the 1988 study area (Kenora-Lake of the Woods) are similar to those in the 1987 study area (Blue Lake-Rowan Lake areas) described in Minning (1988). Minor enrichments of molybdenum and uranium occur in association with the large granitic batholiths and complexes and the smaller stocks. The chalcophilic group of elements (Cu, Pb, Zn, Ag, Ni, Au, and As) are associated with the metavolcanic sequences or at/near the contact with mafic or granitic stocks and complexes.

The low density of sampling has resulted in poor isolation and definition of anomalies and enrichments, but some till sample sites are deserving of discussion (see Table 11). At site G-88-10, south of Black Lake on Highway 71, a copper-gold anomaly occurs in an area of Cu-Zn mineralization associated with volcanic rocks north of the Pipestone-Cameron Fault. Further north and west near Andrew Bay on Lake of the Woods at site G-88-19, Cu and Ni enrichments are found in an area of ultramafic and basic metavolcanic rock. These rocks host numerous occurrences of gold, silver, copper, and zinc. Intermediate and basic metavolcanic rock extends in a band from High Lake near the Manitoba border eastward to Clearwater Bay and Kenora. This band of rock has weak to moderate enrichments of As, Ag, Zn, Pb, and Au. Till sample site G-88-33 falls within the area underlain by the metavolcanic rock and has highly anomalous gold occurring in association with anomalous nickel and geochemically elevated Cu and Cr. This sample site is near the formerly producing Kenrica mine (Au, Ag).

Geochemical results in both 1987 and 1988 seem to indicate that drift is fairly local in origin and has not been transported from great distances. Till from greenstone belts seems to contain many of the metals present in the underlying bedrock.



3.4 Glaciofluvial Deposits

Small to large-sized glaciofluvial deposits are scattered throughout the study area. The largest deposits are found on the east side of Kenora, north of Shoal Lake between West Hawk Lake and Granite Lake, along the east side of Lake of the Woods near Highway 71 from Gibi Lake southward to Black Lake, on the east side of Lake of the Woods near Sioux Narrows, and in the southeastern portion of the study area along Highway 71 near Kakagi Lake and Sabaskong Bay (Minning, 1988).

3.4.1 Ice Contact Deposits

Glaciofluvial ice contact deposits are largely associated with the major end moraines which were described previously in Years I and II. In the moraines which were deposited in contact with Glacial Lake Agassiz, e.g. the Eagle-Finlayson Moraine near Vermillion Bay, much of the outwash seems to be subaqueous in origin and to a lesser degree ice contact deltaic sediments (Cowan, 1987). Glaciolacustrine fine grained sediments are associated with these glaciofluvial materials. These materials are dominated by sand with lesser quantities of pebble to boulder gravel. Sandy diamicton is common and flow tills are locally present in the upper part of the moraines. No major ice contact deposits of the type mapped near the end moraines in Years I and II were mapped in the 1988 study area.

3.4.2 Outwash Deposits

Small to large outwash plain deposits are located throughout the Rat Portage Bay and Northwest Angle map areas. The five larger glaciofluvial complex deposits mentioned previously have been classified as outwash plain deposits during field investigations. These deposits are sand dominated, but have large zones of pebble gravels. The northeast-southwest trending deposit on the east side of Kenora is the largest continuous outwash deposit and is Kenora's primary source of sand and gravel. Many pits have been opened in this deposit. The Kenora deposit also underlies the airport and is the location of the principal landfill for the town.

The deposit north of Shoal Lake between West Hawk Lake and Granite Lake consists of a series of outwash plain deposits interrupted by rock knobs. The outwash plain complex extends from West Hawk Lake in a south and southeast trending band toward Shoal Lake and Granite Lake. Highway 17 crosses portions of this deposit and many of the pits along the highway exploit its sand and gravel. In topographic lows, outwash sand and gravel is overlain to some degree by organic material.



The outwash complex that is located on the east side of Lake of the Woods along Highway 71 between Gibi Lake and Black Lake trends in a northwest-southeast direction. It is also discontinuous in nature and is interrupted by rock knobs. The primary material in the deposit is sand, but minor gravel is present. Pits along Highway 71 and on secondary roads near the highway are located in this deposit.

South of Black Lake, another outwash complex is crossed by Highway 71. This discontinuous deposit extends southward toward Snake Bay on the south side of Sioux Narrows. Pits in this deposit show sand and gravelly sand. In some pits the glaciofluvial deposits are 5 to 9 m thick.

In the southeastern corner of the Northwest Angle map area, near Kakagi Lake and Sabaskong Bay another sandy outwash complex lies along Highway 71. This deposit extends to the east into the Rowan Lake map area (Manning, 1988).

In addition to the larger outwash complexes described above, smaller individual outwash bodies are scattered throughout the study area. These deposits are frequently located on the lee side of rock knobs. Many borrow pits on primary and secondary roads throughout the study area are located in these smaller outwash deposits. Some of these deposits consist of reworked till and it is sometimes difficult to distinguish the outwash phase from the till phase in certain of these deposits.

3.5 Glaciolacustrine Sediments

Glaciolacustrine sediments are widespread in small to large topographic lows (below 350 m) throughout the study area. North and northwest of Kenora in the Rat Portage Bay map area and in the southeastern and southwestern corners of the Northwest Angle map area larger deposits of these sediments overlie bedrock and older glacial deposits.

These glaciolacustrine sediments were deposited within Glacial Lake Agassiz approximately 11,000 to 9000 radiocarbon years B.P. and perhaps up until about 8,500 B.P. (Clayton, 1983). The abundant sediment sources for the larger glaciolacustrine deposits north and northwest of Kenora include the thicker till deposits and the larger glaciofluvial deposits which are found in the same area. Sediments in the glaciolacustrine deposits in the southeastern and southwestern corners of the Northwest Angle map area were derived from sandy silt till of the Rainy Lobe of the Labrador Sector of the Laurentide ice sheet, the more recent clay till of the St. Louis sublobe of Keewatin ice, and glaciofluvial deposits within the area.



3.5.1 Fine Grained Sediments

Laminated to rhythmically bedded (possibly varved) clay, silt and fine sand representing low energy sedimentation is the most common type of glaciolacustrine deposit. These occupy low areas (below 350 m) and range from a few centimetres to several metres in thickness. In rolling bedrock areas, these sediments are draped over the rock surface with bedding generally conformable with the bedrock topography. In some topographic lows the fine grained glaciolacustrine sediments overlie glaciofluvial and/or till deposits. The varved clay deposits are mostly the grey clay component in the Kenora area. Several locations with red clay were found, e.g., north of Kenora near Black Sturgeon Lakes, but the red clay component is not as evident as in the Dryden area to the east where it was described in detail by Cowan (1987) and earlier workers. A detailed research program on the sedimentology and origin of these thick glaciolacustrine varved sequences near Dryden, is being carried out by Tim Warman, University of Manitoba.

3.5.2 Coarse Grained Sediments

Coarse grained sediments related to Glacial Lake Agassiz include shore-face pebbly sands and gravels and shallow water off-shore sands, fine sands and silts. Exposures of shore face materials are generally not good, but can be seen at some localities particularly in the southeastern corner of the Northwest Angle map sheet near Morson, and between Shoal Lake and Echo Bay. Most outcrops display a crude reworking of glaciofluvial and till materials and are well sorted, open work sediment. Beach deposits occur at or below the 350 m contour line. Near Morson these deposits are calcareous because they were derived from the surface till sheet of the St. Louis sublobe.

Shorelines have not been studied in detail and the lack of end moraines and the superimposed shoreline features makes it difficult to document the position of the uppermost water plane in the Kenora area. Shoreline features in the 1988 study area occur at or near 350 m.

Off-shore sediments are dominantly fine sands, but have some coarse sands and silt. These sediments are best developed west of Keewatin near Lulu Lake, around Shoal Lake, in topographic lows on peninsulas and islands in Lake of the Woods, and south of Morson. Some of these sediments are probably present beneath organic materials in the low lying areas.



3.6 Organic Terrain

Organic terrain occurs throughout the area as small depressional fills 1-2 m thick. These consist primarily of fibrous sphagnum and sedge peat. Large areas of organic terrain vary from heavily treed muskegs to floating fens and string muskegs with complex hydrological regimes. Thicknesses are generally 1-2 m, and are sometimes up to 3 or 4 m. Organic deposits often overlie fine grained glaciolacustrine materials and sandy outwash deposits.

3.7 Eolian Sediments

These sediments were found in 1986 in an area between Dyment and Revell where Glacial Lake Agassiz sediments had been reworked by the wind. No eolian areas were found during the 1987 and 1988 mapping activities.

3.8 Alluvial Sediments

Alluvial sediments occur along rivers and streams throughout the project area. However, they are best developed in areas underlain by low relief sands and clays deposited in Glacial Lake Agassiz. Alluvium consists of fine sand and silt and includes organic material in meander belts where muskeg development is concurrent with alluvial erosion and sedimentation due to surface or near surface water tables. Alluvium is in the order of 1-2 m thick and associated organic terrain can be up to 3 m thick.

3.9 Modern Beach Deposits

Modern beach deposits occur on the shores of present day lakes. However, for the most part these deposits are too small to appear on the 1:100,000 scale final map. Some of the more visible modern beach deposits occur as fine shoreline features on the western side of Shoal Lake.



4.0 SUMMARY

The following is a summary of significant observations compiled during Year III of this project:

- 1) Quaternary geology mapping activities, comparable to Year I and Year II, have outlined similar map units.
- 2) All glacial sediments appear to be of Late Wisconsinan age and are deglacial in nature.
- 3) The bedrock is polished and striated and glacial directions average 227 degrees slightly higher than the average of 219 degrees for the 1987 data and with 67% of all observations (160 for Years I to III) falling within the 205 to 220 degree range. Striations indicate the major ice flow direction was from northeast to southwest. No striations indicate a second ice flow direction.
- 4) Calcareous till deposits in the southeastern and southwestern corners of the Northwest Angle map area indicate a second more recent ice flow direction from the west that has also been documented by Bajc and Gray (1987) in the Rainy River map area immediately to the south.
- 5) No major end moraines were mapped as in Years I and II. A small moraine ridge was mapped near Highway 71 north of Black Lake.
- 6) Till deposits are fairly thin and are dominated by local lithologies. Only minor input from the Hudson Platform or Belcher Islands region was observed.
- 7) Five fairly large glaciofluvial outwash complexes lie within the Year III study area. These complexes consist mostly of sand, but also contain some gravel.
- 8) Glaciolacustrine sediments deposited in Glacial Lake Agassiz are common throughout the study area and occupy topographic lows below 350 m. Larger and thicker deposits of these sediments are found north and northwest of Kenora in the Rat Portage Bay map area and in southwestern and southeastern portions of the Northwest Angle map area near Shoal Lake and Morson respectively. For the most part, glaciolacustrine sediments are draped directly on the bedrock with infrequent intervening till or glaciofluvial sediments. Near Morson and Shoal Lake, till(s) and glaciofluvial materials may lie between the glaciolacustrine cover and the bedrock. Overburden drilling programs would be most effective in these areas with thicker Quaternary cover.



- 9) Detailed investigation of Glacial Lake Agassiz has not been carried out to date. Field work in the 1988 study area indicates shoreline features at around 350 m.
- 10) Heavy and light mineral analyses of tills have indicated several areas in both granite and greenstone terrain near Kenora with some unusual mineral occurrences.
- 11) Geochemical analyses on 1988 till samples have indicated molybdenum and uranium associations in tills overlying granitic batholiths.
- 12) Geochemical analyses on 1988 till samples have indicated chalcophilic elements (Cu, Pb, Zn, Ag, Ni, Au, As) associated with tills overlying metavolcanics or at/near the contact with mafic or granitic stocks or complexes.
- 12) Three areas with noticeable geochemical anomalies are:
 - a) south of Black Lake near G-88-10 sample site on Highway 71,
 - b) near sample site G-88-19 and Andrew Bay on Lake of the Woods, and
 - c) between the Manitoba border and Kenora along Highway 17 and near sample site G-88-33.



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APPENDIX A

SUMMARY FIELD DATA FOR TILL SAMPLES

Units ->	N.T.S.	Grid Reference			LITH	STRIAT deg	Sample #	STATISTICS
		EAST m	NORTH m	LITH				
ALL DATA								<Units of measurement
Number >	31	31	31	31	31	31	8	<Number of valid data
Maximum >	16	427350	5998200	45	240		46	<Maximum
Minimum >	8	347780	5460700	31	210		1	<Minimum
Average >						224		<Average or arithmetic mean
Stan-Dev>						8		<Standard Deviation
Coef-Var>						4%		<Coefficient of Variation = Std-Dev/Avg
GREENSTONE								DATA from over GREENSTONE BEDROCK
Number >	19	19	19	19	19	19	6	<Number of valid data
Maximum >	16	427350	5998200	45	240		46	<Maximum
Minimum >	8	347780	5460700	31	210		1	<Minimum
Average >						223		<Average or arithmetic mean
Stan-Dev>						8		<Standard Deviation
Coef-Var>						4%		<Coefficient of Variation = Std-Dev/Avg
GRANITE								DATA from over GRANITE BEDROCK
Number >	12	12	12	12	12	12	2	<Number of valid data
Maximum >	16	422600	5530650	39	238		38	<Maximum
Minimum >	9	371610	5493790	35	220		31	<Minimum
Average >						227		<Average or arithmetic mean
Stan-Dev>						7		<Standard Deviation
Coef-Var>						3%		<Coefficient of Variation = Std-Dev/Avg
SUMMARY								COMPARISON STATISTICS
t test >					1.1			<Statistical test for similar averages
Sig .05 >					1			<If 1; then granite = greenstone, @ 95%
Sig .01 >					1			<If 1; then granite = greenstone, @ 99%
F test >					1.4			<Statistical test for similar std-dev
Sig .05 >					1			<If 1; then granite = greenstone, @ ~95%
Sig .01 >					1			<If 1; then granite = greenstone, @ ~99%

LAKE OF THE WOODS (Year 3)

FIELD DATA

	N.T.S.	Grid Reference EAST NORTH m m	Munsell Colour HUE VAL CHR	ACID	LITH deg	STR PRIM SEC STRCT OXY	CLSS	GRVL	FIELD	STATISTICS
Units ->								%	#	<Units of measurement
ALL DATA	50	50 50	48 48 48	47	50 45	50 240 4	48	50	50	<Number of valid data
Number >	50	50	48	48	47	50	50	50	50	ALL DATA
Maximum >	16	426750 5538500	6.0 6.0	3	45 240	4 4	6	71.1	888	<Maximum
Minimum >	1	349935 5429260	3.0 2.0	0	22 218	2 2	0	7.8	14	<Minimum
Average >			3.9 4.4	0		226 3 3	2	36.9		<Average or arithmetic mean
Stan-Dev >			0.9 1.3	1		9 1 1	2	14.5		<Standard Deviation
Coef-Vari >			22% 30%	334%		4% 15% 20%	105%	39%		<Coefficient of Variation = Std-Dev/Avg

GREENSTONE

Number >	31	31	30 30	30	31	6 31	29	30	31	<Number of valid data
Maximum >	16	426750 5538500	5.0 6.0	1	45	240 4	4	6	58.0	<Maximum
Minimum >	1	349935 5439450	3.0 2.0	0	22	218 2	2	0	7.8	<Minimum
Average >			3.7 4.2	0		226 3 3	2	36.9		<Average or arithmetic mean
Stan-Dev >			0.7 1.2	0		9 1 1	2	12.8		<Standard Deviation
Coef-Vari >			20% 28%			4% 16% 21%	100%	35%		<Coefficient of Variation = Std-Dev/Avg

GRANITE

Number >	19	19	18 18	17	19	2 19	18	18	19	<Number of valid data
Maximum >	16	423450 5536320	6.0 6.0	3	39	238 4	4	6	71.1	<Maximum
Minimum >	1	350440 5429260	3.0 2.0	0	35	220 3	2	0	8.1	<Minimum
Average >			4.3 4.8	0		229 3 3	2	36.9		<Average or arithmetic mean
Stan-Dev >			0.9 1.5	1		9 0 1	2	16.9		<Standard Deviation
Coef-Vari >			20% 31%	208%		4% 14% 20%	110%	46%		<Coefficient of Variation = Std-Dev/Avg

SUMMARY

t test >	2.5	1.6	2.2	0.5	0.5	0.0	0.3	-0.0		COMPARISON STATISTICS
Sig .05 >	0	1	0	1	1	1	1	1		<If 1; then granite = greenstone, @ 95%
Sig .01 >	1	1	1	1	1	1	1	1		<If 1; then granite = greenstone, @ 99%
F test >	1.4	1.6		1.1	1.2	1.1	1.5	1.7		<Statistical test for similar std-dev
Sig .05 >	1	1		1	1	1	1	1		<If 1; then granite = greenstone, @ ~95%
Sig .01 >	1	1		1	1	1	1	1		<If 1; then granite = greenstone, @ ~99%

Page

FIELD #	N.T.S.	Grid Reference			Sample			
		EAST	NORTH	LITH	STRIAT	YR	#	COMMENTS
5	52 E/ 9	407410	5508825	35	230	88 G		
9	52 E/ 9	409175	5508425	35	235	88 G		
10	52 E/ 9	410060	5508320	35	220	88 G	1-2 m till	
30	52 E/ 9	412420	5501760	35	230	88 G	5 m outwash	
35	52 E/ 9	420260	5498480	35	235	88 G	Till, reworked	
59	52 E/ 9	410750	5494200	42	235	88 G		
68	52 E/ 9	422820	5998200	42	230	88 G	<1 m till	
69	52 E/ 9	422270	5495025	42	220	88 G	2 m outwash	
71	52 E/ 9	418840	5499050	31	220	88 G	14 Organics, Granite/gabbro contact	
73	52 E/ 9	422310	5500020	42	215	88 G		
75	52 E/ 9	422540	5496450	41	220	88 G	6	
77	52 E/ 9	422600	5493790	35	220	88 G		
98	52 E/ 8	423130	5482400	41	220	88 G	5	
108	52 E/ 8	427350	5476175	42	210	88 G		
110	52 E/ 8	426750	5480160	42	218	88 G	1 Organic content	
115	52 E/ 9	404350	5508780	35	230	88 G	Poor quality	
124	52 E/16	402210	5511900	42	220	88 G	Spalton pit	
129	52 E/ 9	394282	5509425	42	220	88 G		
154	52 E/ 9	405560	5503300	35	220	88 G		
220	52 E/15	371610	5527520	39	238	88 G	38	
252	52 E/15	382170	5512120	45	235	88 G	32	
378	52 E/16	394480	5530650	39	220	88 G	31 Gravelly	
403	52 E/16	397600	5527300	45	220	88 G	Clay/gneiss	
448	52 E/16	393470	5521020	35	220	88 G		
527	52 E/ 9	410010	5508700	35	220	88 G	Outwash	
551	52 E/10	356500	5510060	42	240	88 G	46	
572	52 E/14	347780	5514525	42	235	88 G		
574	52 E/ 8	422500	5482260	41	225	88 G		
575	52 E/ 8	426960	5479300	42	220	88 G		
602	52 E/ 8	425850	5460700	31	210	88 G		
671	52 E/11	351920	5503900	42	228	88 G		

VARIABLE NAMES

FIELD number	EASTing	Northing	YeAr	Sample No.
1:1,000,000				
1:250,000			LITHology	
1:100,000			STRIATIONS	
Units ->	m	m	deg	<Units of measurement

CODE TRANSLATION

LITHOLOGY
 10=Sedimentary (undivided)
 20=Volcanic (undivided)
 30=Plutonic (undivided)
 31=Gabbro
 35=Granitoid
 40=Metamorphic (undivided)
 41=Metasedimentary (undivided)
 42=Metavolcanic (undivided)
 45=Gneiss

LAKE OF THE WOODS (Year 3)

FIELD DATA

Page:

88 G 36	52 E/10	373100	5508320	2.5Y	4.0	4.0	0	42		4	3	L	1	ST	57.6	319 Gravelly
88 G 37	52 E/15	372050	5519680	10YR	3.0	6.0	0	39		3	4	L	6	ST	18.7	695 Organic content
88 G 38	52 E/15	371610	5527520	10YR	5.0	3.0	0	39	238	4	3	L	0	ST	46.3	220
88 G 39	52 E/10	369850	5506500	10YR	3.0	4.0	0	42		3	4	L	1	ST	42.1	318 Washed, Large boulders
88 G 40	52 E/15	366730	5526090	10YR	5.0	3.0	0	39		3	2	L	0	ST	19.3	217
88 G 41	52 E/15	364470	5520450	10YR	5.0	4.0	0	39		3	4	L	0	ST	32.9	697
88 G 42	52 E/10	364120	5505720	10YR	4.0	4.0	0	42		2	3	F	3	LT	7.8	303
88 G 43	52 E/10	362170	5510420	10YR	5.0	6.0	0	39		3	4	L	1	ST	30.6	292
88 G 44	52 E/10	359550	5503320	10YR	4.0	6.0	0	42		3	4	L	5	SGD	34.0	295 Outwash
88 G 45	52 E/10	359560	5499300	10YR	4.0	6.0	0	42		3	4	L	4	ST	32.3	288
88 G 46	52 E/10	356500	5510060	10YR	4.0	4.0	0	42	240	4	3	L	1	ST	48.8	551
88 G 47	52 E/11	351090	5503200	10YR	5.0	4.0	0	42		3	4	L	0	SGD	32.8	561 Outwash
88 G 48	52 E/11	350850	5510780	10YR	3.0	3.0	0	42		4	3	L	3	ST	58.0	555
88 G 49	52 E/ 6	350440	5463100	10YR	4.0	6.0	3	35		4	3	L	5	ST	55.9	680 Boulders
88 G 50	52 E/14	349935	5512750	10YR	3.0	4.0	0	42		3	4	L	1	ST	42.2	568

LAKE OF THE WOODS (Year 3)

FIELD DATA

Page 2

Sample	YR #	N.I.S.	Grid Reference	Munsell Colour						Texture						Field #	COMMENTS
				HUE	VAL	CHIR	ACID	LITH	STR	PRIM	SEC	STRET	OXY	CSS	GRVL		
88 G 1	52 E/ 8	426750	5480160	10YR	4.0	4.0	0	42	218	3	2	L	1	SST	11.4	110 Organic content	
88 G 2	52 E/ 8	425860	5458750					42		3	2			SST	18.5	855 1987 sample	
88 G 3	52 E/ 8	424900	5464320	2.5Y	4.0	4.0	0	42		3	4	L	0	ST	32.6	601	
88 G 4	52 E/16	423450	5534700	10YR	5.0	2.0	0	35		4	3	L	0	ST	49.3	510	
88 G 5	52 E/ 8	423130	5482400	10YR	3.0	6.0	0	41	220	3	4	L	5	ST	30.1	98	
88 G 6	52 E/ 9	422540	5496450	10YR	3.0	6.0	0	41	220	3	4	L	6	ST	37.3	75	
88 G 7	52 E/ 9	422850	5464930	10YR	4.0	6.0	0	35		3	2	L	6	SD	8.1	83 Outwash	
88 G 8	52 E/ 8	422240	5471960	10YR	4.0	4.0	0	22		3	4	L	0	SGD	44.3	588 Outwash?	
88 G 9	52 E/ 8	421700	5475500	10YR	5.0	2.0	0	22		3	2	L	0	SLT	16.5	582	
88 G 10	52 E/ 1	421410	5448260	10YR	3.0	4.0	0	42		3	4	L	0	SGD	45.8	606 Outwash	
88 G 11	52 E/ 1	421400	5431150					35		3	4			ST	33.9	888 1987 sample	
88 G 12	52 E/16	421010	5327200	10YR	5.0	6.0	0	42		3	4	L	1	ST	30.9	497	
88 G 13	52 E/16	419100	5512780	10YR	4.0	4.0	0	35		4	3	L	1	ST	60.0	531 Gravelly	
88 G 14	52 E/ 9	418840	5499050	10YR	3.0	6.0	0	31	220	3	4	L	5	ST	23.2	71 Organics, Granite/gabbro contact	
88 G 15	52 E/ 1	417075	5433750	10YR	3.0	4.0	0	35		3	4	L	1	SGD	46.1	617 Outwash?	
88 G 16	52 E/ 1	415680	5429260	2.5Y	4.0	4.0	1	35		3	4	L	0	ST	34.4	608	
88 G 17	52 E/ 9	414380	5496460	10YR	3.0	4.0	0	42		3	4	L	3	ST	44.8	54 Metavolcanic/granite contact	
88 G 18	52 E/16	413180	5520950	10YR	4.0	6.0	0	35		3	4	L	5	ST	32.6	488 Disturbed site	
88 G 19	52 E/ 9	412200	5494450	10YR	3.0	6.0	0	42		4	3	L	1	ST	54.3	57 Gravelly	
88 G 20	52 E/16	410425	5534540	10YR	5.0	6.0	0	35		4	3	L	5	ST	64.4	521 Gravelly	
88 G 21	52 E/ 9	410720	5492860	10YR	4.0	4.0	0	42		3	4	L	5	ST	27.8	65 Cobbly	
88 G 22	52 E/ 9	409920	5506280	10YR	3.0	6.0	0	35		3	4	L	5	ST	18.2	14	
88 G 23	52 E/ 9	407940	5498480	10YR	4.0	4.0	0	42		4	3	L	1	ST	48.8	640 Organics	
88 G 24	52 E/16	402500	5520300	10YR	5.0	2.0	0	26		4	3	L	0	ST	47.3	471 Sand veneer	
88 G 25	52 E/ 1	402900	5439450	10YR	3.0	4.0	1	45		4	3	L	1	ST	48.8	640 Organics	
88 G 26	52 E/16	400200	5516580	10YR	4.0	4.0	0	42		3	4	L	1	ST	31.8	475 Old mine	
88 G 27	52 E/16	399730	5336320	10YR	3.0	6.0	0	35		3	4	L	1	ST	25.6	396	
88 G 28	52 E/ 9	399500	5511360	10YR	3.0	3.0	0	42		4	3	L	1	ST	43.4	536 Organic content	
88 G 29	52 E/ 1	398800	5429620	2.5Y	6.0	2.0	1	35		3	4	L	0	ST	30.7	618	
88 G 30	52 E/16	395730	5514490	10YR	5.0	3.0	0	41		3	4	L	0	SGD	23.0	549 Outwash?	
88 G 31	52 E/16	394480	5530650	10YR	5.0	6.0	3	39	220	4	3	L	1	ST	71.1	378 Gravelly	
88 G 32	52 E/15	382170	5512120	10YR	3.0	4.0	0	45	235	4	3	L	5	ST	49.9	252	
88 G 33	52 E/10	379500	5510840	10YR	3.0	3.0	0	26		4	2	L	1	ST	40.5	259 Organic content	
88 G 34	52 E/15	375930	53358500	10YR	3.0	3.0	0	45		3	4	L	1	ST	38.5	236	
88 G 35	52 E/15	375550	5517980	10YR	5.0	6.0	0	39		3	4	L	1	ST	22.9	694	

FIELD DATA

VARIABLE NAMES FOR FIELD DATA

卷之三

LITHOLOGY	
10=Sedimentary (undivided)	
20=Volcanic (undivided)	
22=Pillow basalt	
26=Fragmental felsic volcanic	
30=Plutonic (undivided)	
31=Gabbro	
35=Granitoid	
39=Granite gneiss	
40=Metamorphic (undivided)	
41=Metasedimentary (undivided)	
42=Metavolcanic (undivided)	
45=Gneiss	

STRUCTURE
F=Fissile
| El nose

APPENDIX B

GRAIN SIZE ANALYSIS DATA

LAKE OF THE WOODS (Year 3)

GRAIN SIZE ANALYSIS

Page

	Gross						Matrix						MEDIAN mm	STATISTICS <Units of measurement
	GRAVEL %	SAND %	FINES %	SILT %	CLAY %		SND %	FNS %	SIL %	CLY %				
Units ->														
ALL DATA														
Number	50	50	50	20	20	50	50	20	20	61.6	6.8	48	ALL DATA	
Maximum	71.1	70.7	62.6	56.8	5.8	96.7	67.9	20	20	61.6	6.8	20.0	<Number of valid data	
Minimum	7.8	25.1	2.3	0.0	0.5	32.1	3.3	13.1	0.7	0.7	0.0	0.0	<Maximum <Minimum	
Average	36.9	47.7	15.3	18.4	2.2	76.8	23.2	26.2	3.1	2.7	<Average or arithmetic mean			
Stan-Dev	14.5	11.3	10.6	12.6	1.4	11.9	11.9	12.4	1.9	3.4	<Standard Deviation			
Coef-Var	39%	24%	69%	68%	67%	15%	51%	47%	60%	124%	<Coefficient of Variation = Std-Dev/Avg			
GREENSTONE														
Number	31	31	31	15	15	31	31	15	15	31	6.8	31	DATA from over GREENSTONE BEDROCK	
Maximum	58.0	67.6	62.6	56.8	5.8	96.7	67.9	61.6	6.8	10.0	<Maximum			
Minimum	7.8	29.0	2.3	0.0	0.5	32.1	3.3	13.1	0.7	0.0	<Minimum			
Average	36.9	46.9	16.1	20.1	2.4	75.9	24.1	28.1	3.3	2.6	<Average or arithmetic mean			
Stan-Dev	12.8	9.9	12.6	13.9	1.5	14.0	14.0	13.6	1.9	2.5	<Standard Deviation			
Coef-Var	35%	21%	78%	69%	65%	18%	58%	48%	56%	94%	<Coefficient of Variation = Std-Dev/Avg			
GRANITE														
Number	19	19	19	5	5	19	19	5	5	5	5	17	DATA from over GRANITE BEDROCK	
Maximum	71.1	70.7	22.4	20.3	2.5	90.0	33.3	26.8	6.2	20.0	<Maximum			
Minimum	8.1	25.1	3.8	7.5	0.5	66.7	10.0	14.8	1.0	0.4	<Minimum			
Average	36.9	49.0	14.1	13.2	1.5	78.2	21.8	20.5	2.6	2.9	<Average or arithmetic mean			
Stan-Dev	16.9	13.2	5.9	4.2	0.7	7.1	7.1	4.0	1.9	4.6	<Standard Deviation			
Coef-Var	46%	27%	42%	32%	48%	9%	32%	19%	73%	159%	<Coefficient of Variation = Std-Dev/Avg			
SUMMARY														
t test	-0.0	0.6	-0.7	-1.1	-1.2	0.7	-0.7	-1.2	-0.7	-0.7	-0.7	0.2	<Statistical test for similar averages	
sig .05	1	1	1	1	1	1	1	1	1	1	1	1	<If 1; then granite = greenstone, @ 95%	
sig .01	1	1	1	1	1	1	1	1	1	1	1	1	<If 1; then granite = greenstone, @ 99%	
F test	1.7	1.8	4.6	10.8	4.9	3.9	3.9	11.8	1.1	1.1	1.1	3.4	<Statistical test for similar std-dev	
sig .05	1	1	0	0	0	0	0	0	0	0	0	0	<If 1; then granite = greenstone, @ ~95%	
sig .01	1	1	0	0	0	0	0	0	0	0	0	0	<If 1; then granite = greenstone, @ ~99%	

LAKE OF THE WOODS (Year 3)

GRAIN SIZE ANALYSIS

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Sample	YR	#	Gross				Matrix				MEDIAN	COMMENTS	
			GRAVEL	SAND	FINES	SILT	CLAY	SND	FNS	SIL	CLY		
88 G 1	88	G 1	11.4	48.6	40.0	38.2	1.8	54.9	45.1	43.1	2.0	0.180	
88 G 2	88	G 2	18.5	43.3	38.2	34.7	3.5	53.1	46.9	42.6	4.3	0.300	1987 sample
88 G 3	88	G 3	32.6	46.4	21.0			68.8	31.2			1.000	
88 G 4	88	G 4	49.3	42.7	8.0	7.5	0.5	84.2	15.8	14.8	1.0	4.300	
88 G 5	88	G 5	30.1	56.9	13.0	11.6	1.4	81.4	18.6	16.6	2.0	1.100	
88 G 6	88	G 6	37.3	52.3	10.4		2.2	83.4	16.6	13.1	3.5	1.800	
88 G 7	88	G 7	8.1	70.7	21.2	20.3	0.9	76.9	23.1	22.1	1.0	0.400	
88 G 8	88	G 8	44.3	48.8	6.9			87.6	12.4			3.300	
88 G 9	88	G 9	16.5	52.4	31.1	27.1	4.0	62.8	37.2	32.5	4.7	0.350	
88 G 10	88	G 10	45.8	46.6	7.6			86.0	14.0			3.000	
88 G 11	88	G 11	33.9	44.1	22.0			66.7	33.3			1.000	1987 sample
88 G 12	88	G 12	30.9	66.8	2.3			96.7	3.3			1.500	
88 G 13	88	G 13	60.0	26.8	13.2	10.7	2.5	67.0	33.0	26.8	6.2	20.000	
88 G 14	88	G 14	23.2	55.5	21.3	16.9	4.4	72.3	27.7	22.0	5.7	0.650	
88 G 15	88	G 15	46.1	41.7	12.2			77.4	22.6			3.000	
88 G 16	88	G 16	34.4	48.4	17.2			73.8	26.2			1.400	
88 G 17	88	G 17	44.8	46.4	8.8			84.1	15.9			3.000	
88 G 18	88	G 18	32.6	52.3	15.1	13.5	1.6	77.6	22.4	20.0	2.4	1.300	
88 G 19	88	G 19	54.3	36.7	9.0			80.3	19.7			7.000	
88 G 20	88	G 20	64.4	30.9	4.7			86.8	13.2				
88 G 21	88	G 21	27.8	67.6	4.6			93.6	6.4			1.400	
88 G 22	88	G 22	18.2	67.5	14.3			82.5	17.5			0.670	
88 G 23	88	G 23	48.8	43.0	8.2	7.3	0.9	84.0	16.0	14.3	1.7	4.000	
88 G 24	88	G 24	47.3	37.8	14.9	13.9	1.0	71.7	28.3	26.4	1.9	3.800	
88 G 25	88	G 25	48.8	47.1	4.1			92.0	8.0			4.300	
88 G 26	88	G 26	31.8	50.7	17.5	16.7	0.8	74.3	25.7	24.4	1.3	1.000	
88 G 27	88	G 27	25.6	58.8	15.6	13.8	1.8	79.0	21.0	18.6	2.4	0.800	
88 G 28	88	G 28	43.4	40.3	16.3	14.2	2.1	71.2	28.8	25.1	3.7	2.800	
88 G 29	88	G 29	30.7	46.9	22.4			67.7	32.3			1.600	
88 G 30	88	G 30	23.0	65.4	11.6	11.1	0.5	84.9	15.1	14.4	0.7	0.800	
88 G 31	88	G 31	71.1	25.1	3.8			86.9	13.1				
88 G 32	88	G 32	49.9	36.9	13.2			73.7	26.3			4.800	
88 G 33	88	G 33	40.5	29.0	30.5	26.5	4.0	48.7	51.3	44.5	6.8	1.400	
88 G 34	88	G 34	38.5	49.4	12.1	11.1	1.0	80.3	19.7	18.1	1.6	1.800	
88 G 35	88	G 35	22.9	66.6	10.5			86.4	13.6			0.900	

LAKE OF THE WOODS (Year 3)

GRAIN SIZE ANALYSIS

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88 G 36	57.6	35.5	6.9				
88 G 37	18.7	66.3	15.0				
88 G 38	46.3	44.4	9.3				
88 G 39	42.1	53.1	4.8				
88 G 40	19.3	61.3	19.4				
88 G 41	32.9	45.6	21.5				
88 G 42	7.8	29.6	62.6	5.8			
88 G 43	30.6	52.0	17.4				
88 G 44	34.0	55.8	10.2				
88 G 45	32.3	49.9	17.8	15.5	2.3		
88 G 46	48.8	33.3	17.9				
88 G 47	32.8	50.3	16.9				
88 G 48	58.0	34.0	8.0				
88 G 49	55.9	39.7	4.4				
88 G 50	42.2	46.0	11.8				

VARIABLE NAMES and NOTES for Grain Size analyses

Year Sample No.

GRAVEL (>2.0 mm)	SAND (2.0 - 0.07 mm)	Sand (2.0 - 0.07mm)	
	FINES (<0.07 mm)	FINeS (<0.07 mm)	
	SILT (0.07 - 0.003 mm)	SiLT (0.07 - 0.003mm)	
	CLAY (<0.003 mm)	ClAy (<0.003 mm)	
			MEDIAN-Diameter (mm)

Units ->	Gravel, sand and fines total 100%			Sand and fines total 100%		
	%	%	%	%	%	%

APPENDIX C

PEBBLE LITHOLOGY DATA

LAKE OF THE WOODS (Year 3)

PEBBLE LITHOLOGIES (Raw Counts)

1

Units ->												STATISTICS																																						
ALL DATA												<Units of measurement																																						
Number			PEGM			GNSS			MTSD			SS			IF			MVLC			CMVLC			FVL C			UM			LS			DS			QTZ			GBB			OTH			TOT			ALL DATA		
Maximum			50			50			50			50			50			50			50			50			50			50			50			<Number of valid data														
Minimum			0			0			0			0			0			0			0			0			0			<maximum			249			<minimum														
Average			49			0			11			1			0			11			0			2			0			0			0			1			0											
Stan-Dev			37			1			8			1			0			11			0			3			1			0			1			2			1											
Coef-Var			77%			271%			79%			194%			226%			105%			154%			268%			260%			195%			264%			60%														

DATA FROM SATELLITE SURVEY

		Number of valid data			Number of invalid data			Number of total data			Number of total data		
		<maximum			<minimum			<maximum			<minimum		
		Average			Standard Deviation			Coefficient of Variation			Average		
Lumber	Number	31	31	31	31	31	31	31	31	31	31	31	31
Maximum	92	2	38	5	3	0	45	0	8	4	0	1	3
Minimum	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	44	0	13	1	0	0	13	0	2	1	0	0	1
Stand-Dev	25	1	9	2	1	0	12	0	3	1	0	0	1
Coeff.-Var	58%	26.4%	77.9%	145%	21.9%	0%	47.8%	200%	100%	33.3%	0%	0%	100%

CONTINUATION

Comparison statistics		<Statistical test for similar averages						<Statistical test for similar std-dev					
t test	F test	1.2	0.2	-2.2	-1.8	1.1	-1.9	-0.7	-2.1	1.6	1.6	-0.4	0.1
Sig .05		1	1	0	1	1	1	1	0	1	1	1	1
Sig .01		1	1	1	1	1	1	1	1	1	1	1	1
		4.0	2.0	3.2	5.9	3.9	1.7	1.0	9.6	9.4	2.2	2.6	
Sig .05		0	1	0	0	0	1	1	0	0	1	0	
Sig .01		0	1	0	0	0	1	1	0	0	1	1	

LAKE OF THE WOODS (Year 3)

PEBBLE LITHOLOGIES (Percentages)

Page 1

	GRAN	PEGM	GNSS	MTSD	SS	IF	MVLC	CMVLC	FVLC	UM	LS	DS	QTZ	GBB	OTH	TOT	STATISTICS
Units ->	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	#	<Units of measurement
ALL DATA	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	ALL DATA
Number	94	4	52	8	9	0	80	0	15	7	0	0	11	14	7	249	<Number of valid data
Maximum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	<Maximum
Minimum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<Minimum
Average	63	0	14	1	1	0	16	0	2	0	0	0	1	2	0	75	<Average or arithmetic mean
Stan-Dev	22	1	9	2	2	0	17	0	4	1	0	0	2	3	1	45	<Standard Deviation
Coef-Var	36%	309%	65%	195%	249%	106%	144%	285%					311%	186%	290%	60%	<Coefficient of Variation = Std-Dev/Avg

SUMMARY

t test	2.7	0.1	-2.4	-1.4	0.9	-2.1	-1.3	-1.9									COMPARISON STATISTICS
Sig .05	0	1	0	1	1	0	1	1									<Statistical test for similar averages
Sig .01	1	1	1	1	1	1	1	1									1 <if 1; then granite = greenstone, @ 95%
F test	1.4	1.6	3.8	3.0	2.9	2.5	2.1										1 <if 1; then granite = greenstone, @ 99%
Sig .05	1	1	0	0	0	0	1										<Statistical test for similar std-dev
Sig .01	1	1	0	1	1	1	1										0 <if 1; then granite = greenstone, @ 95%

DATA from over GREENSTONE BEDROCK

	GREENSTONE	Number	31	31	31	31	31	31	31	31	31	31	31	31	31	31	DATA from over GREENSTONE BEDROCK
Units ->	%	Maximum	94	4	52	8	6	0	80	0	15	7	0	0	7	8	<Number of valid data
Number	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	<Maximum
Maximum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<Minimum
Minimum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Average	56	0	16	1	1	0	20	0	3	1	0	0	0	1	0	75	<Average or arithmetic mean
Stan-Dev	22	1	10	2	1	0	18	0	4	1	0	0	1	2	1	36	<Standard Deviation
Coef-Var	39%	286%	61%	170%	245%	92%	131%	216%					339%	169%	277%	48%	<Coefficient of Variation = Std-Dev/Avg

DATA from over GRANITE BEDROCK

	GRANITE	Number	19	19	19	19	19	19	19	19	19	19	19	19	19	19	DATA from over GRANITE BEDROCK
Units ->	%	Maximum	93	4	20	5	9	0	41	0	8	0	0	0	11	14	<Number of valid data
Number	27	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3	<Maximum
Maximum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<Minimum
Minimum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Average	74	0	10	1	1	0	9	0	2	0	0	0	0	1	2	0	<Average or arithmetic mean
Stan-Dev	19	1	5	1	2	0	11	0	3	0	0	0	0	3	4	1	<Standard Deviation
Coef-Var	26%	339%	51%	249%	232%	122%	163%							258%	164%	276%	75% <Coefficient of Variation = Std-Dev/Avg

COMPARISON STATISTICS

t test	2.7	0.1	-2.4	-1.4	0.9	-2.1	-1.3	-1.9									COMPARISON STATISTICS
Sig .05	0	1	0	1	1	0	1	1									<Statistical test for similar averages
Sig .01	1	1	1	1	1	1	1	1									1 <if 1; then granite = greenstone, @ 95%
F test	1.4	1.6	3.8	3.0	2.9	2.5	2.1										<Statistical test for similar std-dev
Sig .05	1	1	0	0	0	0	1										0 <if 1; then granite = greenstone, @ 95%
Sig .01	1	1	0	1	1	1	1										1 <if 1; then granite = greenstone, @ 99%

APPENDIX D

HEAVY MINERAL ANALYSES

HEAVY/LIGHT MAGNETIC SPIN IT

HEAVY/LIGHT MAGNETIC SPIRIT

1

HEAVY/LIGHT/MAGNETIC SPLIT

		-10+40			-40+80			-80+230			Total			Percent			
		Light		Heavy	Light		Heavy	Light		Heavy	Light		Mag.	Non-M	Heavy	Grand	HeavMag.
		L-10	HM-10	HN-10	L-40	HM-40	HN-40	L-80	HM-80	HN-80	L-TOT	HM-TOT	H-TOT	TOTAL	HPC	HMPC	STATISTICS
units ->	LL DATA	g	g	g	g	g	g	g	g	g	g	g	g	g	%	%	<Units of measurement
number	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	ALL DATA
maximum	801.30	66.40	31.50	531.40	8.18	25.00	573.00	31.70	50.60	1473.30	71.40	93.90	112.41	1503.03	15	65	<Maximum
minimum	61.50	0.11	0.49	28.00	0.14	1.45	90.00	0.32	4.19	331.80	0.64	8.94	12.94	387.48	2	1	<Minimum
average	444.28	3.31	9.73	225.01	1.74	8.67	261.20	4.03	16.63	930.49	9.08	35.02	44.10	974.59	5	21	<Average or arithmetic mean
tan-dev	175.14	9.31	8.15	94.41	1.47	5.19	102.30	4.46	10.24	256.96	11.48	19.00	23.41	257.68	3	13	<Standard Deviation
ref-var	39%	282%	84%	42%	84%	60%	39%	111%	62%	28%	126%	54%	53%	26%	66%	65%	<Coefficient of Variation = Std-Dev/Avg

GREENSTONE BEDROCK										GRANITE										
Number			Mean			Standard Deviation			Coefficient of Variation			Number			Mean			Standard Deviation		
Maximum	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	
Minimum	801.30	66.40	31.50	438.40	8.18	21.50	487.50	31.70	50.60	1473.30	71.40	78.90	109.82	1503.03	15	65	<Maximum	<Number of valid data	<Maximum	
Average	455.99	3.86	11.01	210.76	1.73	8.26	254.61	4.35	17.04	921.36	9.94	36.30	46.24	967.60	5	20	<Average or arithmetic mean	<Number of valid data	<Standard Deviation	
Standard Deviation	200.96	11.57	7.97	86.45	1.50	4.70	93.15	5.28	10.55	278.46	13.94	16.74	22.67	278.34	3	14	<Standard Deviation	<Number of valid data	<Coefficient of Variation = Std-Dev/Avg	
Coefficient of Variation	44%	300%	72%	41%	87%	57%	37%	12%	62%	30%	140%	46%	49%	29%	65%	68%	<Coefficient of Variation = Std-Dev/Avg	<Number of valid data	<Maximum	
DATA from over GREENSTONE BEDROCK										DATA from over GRANITE										
Number	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
Maximum	692.50	11.20	27.30	531.40	5.92	25.00	573.00	8.54	41.60	1368.30	21.31	93.90	112.41	1411.10	11	50	<Maximum	<Number of valid data	<Maximum	
Minimum	243.40	0.19	0.49	95.50	0.19	3.34	90.00	0.32	5.17	507.30	0.70	12.27	18.10	525.94	2	3	<Minimum	<Number of valid data	<Maximum	

Average

COMPAGNIA STATISTICA

LAKE OF THE WOODS (Year 3)

HEAVY/LIGHT/MAGNETIC SPLIT

Page 2

Sample	YR #	-10+40				-40+80				-80+220				Total				Percent	
		Light	Heavy	HM-10	HN-10	Light	Heavy	HM-40	HN-40	Light	Heavy	HM-80	HN-80	LTOT	HMTOT	HTOT	TOTAL	HPC	HMPC
88 G 1	110.0	0.36	1.25	213.3	0.70	1.45	487.4	3.80	12.20	810.70	4.86	14.90	19.76	830.46	2.4	24.6			
88 G 2	385.6	1.39	18.10	220.7	0.57	9.14	487.5	1.33	24.10	1093.80	3.29	51.34	54.63	1148.43	4.8	6.0	1987 sample		
88 G 3	374.9	1.21	14.20	172.1	0.73	4.92	278.4	2.37	11.40	825.40	4.31	30.52	34.83	860.23	4.0	12.4			
88 G 4	433.5	6.85	0.49	258.1	5.92	8.61	246.0	8.54	16.40	937.60	21.31	25.50	46.81	984.41	4.8	45.5			
88 G 5	332.7	0.65	2.57	171.8	0.73	2.18	260.4	2.62	4.19	764.90	4.00	8.94	12.94	777.84	1.7	30.9			
88 G 6	445.6	1.26	8.91	307.4	1.33	8.86	215.3	3.95	15.60	968.30	6.54	33.37	39.91	1008.21	4.0	16.4			
88 G 7	263.9	0.64	3.02	531.4	2.72	10.20	573.0	7.62	18.60	1368.30	10.98	31.82	42.80	1411.10	3.0	25.7			
88 G 8	801.3	1.82	15.60	298.9	2.06	5.56	152.2	5.59	8.31	1252.40	9.47	29.47	38.94	1291.34	3.0	24.3			
88 G 9	165.9	0.59	3.05	172.2	0.72	2.54	395.6	4.75	8.97	733.70	6.06	14.56	20.62	754.32	2.7	29.4			
88 G 10	603.9	66.40	6.92	279.3	1.92	16.20	203.7	3.08	15.30	1086.90	71.40	38.42	109.82	1196.72	9.2	65.0			
88 G 11	462.9	2.34	26.50	187.0	1.74	22.70	321.5	1.85	30.70	971.40	5.93	79.90	85.83	1057.23	8.1	6.9	1987 sample		
88 G 12	661.1	2.91	15.50	371.9	2.02	12.10	288.7	7.06	14.30	1321.70	11.99	41.90	53.89	1375.59	3.9	22.2			
88 G 13	243.4	0.77	2.69	124.3	1.30	4.33	139.6	1.57	7.98	507.30	3.64	15.00	18.64	525.94	3.5	19.5			
88 G 14	344.7	0.96	4.76	186.7	1.27	11.40	390.1	3.95	34.80	921.50	6.18	50.96	57.14	978.64	5.8	10.8			
88 G 15	424.2	5.33	27.30	299.6	5.05	25.00	193.3	8.13	41.60	917.10	18.51	93.90	112.41	1029.51	10.9	16.5			
88 G 16	356.1	1.69	10.90	195.1	1.67	14.10	259.5	2.31	21.50	810.70	5.67	46.50	52.17	862.87	6.0	10.9			
88 G 17	703.7	0.88	4.53	318.7	1.09	7.56	282.1	2.21	15.70	1304.50	4.18	27.79	31.97	1336.47	2.4	13.1			
88 G 18	299.5	1.48	5.25	205.4	2.47	9.50	277.0	5.58	22.80	781.90	9.53	37.55	47.08	828.98	5.7	20.2			
88 G 19	562.6	3.33	28.60	196.1	3.32	6.69	224.2	6.01	13.10	982.90	12.66	48.39	61.05	1043.95	5.8	20.7			
88 G 20	460.5	0.75	3.76	152.2	1.57	3.34	158.7	3.51	5.17	771.40	5.83	12.27	18.10	789.50	2.3	32.2			
88 G 21	655.1	1.48	17.30	438.4	0.99	9.87	245.0	4.78	18.60	1338.50	7.25	45.77	53.02	1391.52	3.8	13.7			
88 G 22	692.5	1.09	4.92	342.6	1.82	6.23	319.7	3.69	5.30	1354.80	6.60	16.45	23.05	1377.85	1.7	28.6			
88 G 23	440.0	0.80	2.52	145.4	1.22	2.85	159.6	2.77	8.52	745.00	4.79	13.89	18.68	763.68	2.4	25.6			
88 G 24	440.2	2.65	16.10	127.0	1.28	5.85	204.4	4.06	15.40	771.60	7.99	37.35	45.34	816.94	5.5	17.6			
88 G 25	608.5	4.24	31.50	271.3	1.52	21.50	288.4	1.33	25.90	1168.20	7.09	78.90	85.99	1254.19	6.9	8.2			
88 G 26	273.9	10.80	9.35	186.7	8.18	5.52	220.3	31.70	29.70	680.90	50.68	44.57	95.25	776.15	12.3	53.2			
88 G 27	645.9	0.56	3.54	351.5	1.39	5.13	266.0	6.42	6.80	1263.40	8.37	15.47	23.84	1287.24	1.9	35.1			
88 G 28	256.3	1.30	8.60	173.9	1.79	9.98	236.0	4.30	23.00	666.20	7.39	41.58	48.97	715.17	6.8	15.1			
88 G 29	369.3	1.90	21.10	229.9	0.86	13.10	359.8	3.98	25.20	959.00	6.74	59.40	66.14	1025.14	6.5	10.2			
88 G 30	736.9	1.48	3.03	259.5	1.73	3.71	269.5	8.41	5.24	1265.90	11.62	11.98	23.60	1289.50	1.8	49.2			
88 G 31	593.6	1.35	8.51	132.8	1.20	6.04	111.2	2.43	6.26	837.60	4.98	20.81	25.79	863.39	3.0	19.3			
88 G 32	264.0	1.43	21.40	100.3	0.77	7.46	114.6	1.53	12.60	478.90	3.73	41.46	45.19	524.09	8.6	8.3			
88 G 33	201.2	1.74	6.41	111.7	2.76	18.10	167.2	5.10	50.60	480.10	9.60	75.11	84.71	564.81	15.0	11.3			
88 G 34	567.7	2.07	26.30	170.6	1.23	4.97	239.3	3.41	9.74	977.60	6.71	41.01	47.72	1025.32	4.7	14.1			
88 G 35	416.6	0.47	2.37	367.7	1.18	5.81	346.2	3.49	14.00	1130.50	5.14	22.18	27.32	1157.82	2.4	18.8			

LAKE OF THE WOODS (Year 3)

HEAVY/LIGHT/MAGNETIC SPLIT

Page 3

Sample No.	Year	-10+40 mesh	-40+80 mesh	-80+230 mesh	Light mineral TOTAL	Heavy Magnetic mineral TOTAL	Heavy Nonmagnetic mineral TOTAL	Heavy mineral TOTAL	grand TOTAL	Heavy mineral Percent of (light+heavy)	Heavy Magnetic Percent of heavy minerals
88 G 36	442.8	1.15	16.30	143.2	0.99	10.60	215.6	2.56	15.90	801.60	4.70
88 G 37	330.7	6.45	0.51	336.6	0.54	13.20	437.5	1.61	25.80	1104.80	8.60
88 G 38	549.4	1.50	7.42	234.8	1.63	5.08	175.9	2.45	9.87	960.10	5.58
88 G 39	681.9	3.21	9.61	233.6	4.93	5.41	141.9	1.93	7.95	1057.40	10.07
88 G 40	406.6	0.19	5.48	204.9	0.19	6.05	230.0	0.32	10.70	841.50	0.70
88 G 41	404.4	0.31	6.03	219.8	0.39	7.22	317.5	0.70	14.50	941.70	1.40
88 G 42	61.5	0.11	1.24	28.0	0.14	10.60	242.3	0.39	43.20	331.80	0.64
88 G 43	404.0	0.70	4.49	95.5	0.84	5.57	344.8	1.57	13.60	844.30	3.11
88 G 44	738.4	1.10	6.66	332.7	1.79	5.94	402.2	3.54	10.70	1473.30	6.43
88 G 45	253.9	0.55	3.51	145.1	0.68	3.37	232.0	2.82	8.38	631.00	4.05
88 G 46	265.0	0.59	9.58	134.6	0.99	12.10	193.1	1.77	23.20	592.70	3.35
88 G 47	573.3	0.99	6.04	220.9	1.36	5.02	231.0	2.73	8.29	1025.20	5.08
88 G 48	658.2	1.16	12.80	136.1	2.53	12.10	118.4	1.72	14.90	912.70	5.41
88 G 49	321.2	11.20	1.09	247.8	1.13	6.05	90.0	0.96	6.41	659.00	13.29
88 G 50	525.0	1.07	8.98	265.4	2.18	12.50	306.4	3.26	18.30	1096.80	6.51

VARIABLE NAMES for Heavy-Light Split

Year Sample No. -10+40 mesh -40+80 mesh -80+230 mesh

L = Light minerals
 HM = Heavy-Magnetic minerals
 HN = Heavy-Nonmagnetic minerals

-10 = -10+40 mesh
 -40 = -40+80 mesh
 -80 = -80+230 mesh

Units -> g g g g g g g g g g g % % % % <Units of measurement

NOTES and CODE TRANSLATION for Heavy-Light Split

$$LTOT = L-10 + L-40 + L-80$$

$$HMTOT = HM-10 + HM-40 + HM-80$$

$$HNTOT = HN-10 + HN-40 + HN-80$$

$$HTOT = HMTOT + HNTOT$$

$$TOTAL = LTOT + HTOT$$

$$HPC = 100 * HTOT / TOTAL$$

$$HMPC = 100 * HMTOT / HTOT$$

LAKE OF THE WOODS (Year 3)

HEAVY MINERALS (Raw Counts)

Page 1

Units ->	HORNBL	TREM	PYROX	EPID	APAT	BIOT	GARN	TOUR	SULF	OTHR	TOTAL	STATISTICS
ALL DATA	#	#	#	#	#	#	#	#	#	#	#	<Units of measurement
Number	50	50	50	50	50	50	50	50	50	50	50	ALL DATA
Maximum	278	191	44	10	24	29	10	1	4	95	293	<Maximum
Minimum	40	0	3	0	0	0	0	0	0	0	200	<Minimum
Average	180	15	16	2	4	4	2	0	0	2	225	<Average or arithmetic mean
Stan-Dev	38	28	10	2	5	5	2	0	1	13	21	<Standard Deviation
Coef-Var	21%	190%	64%	120%	126%	127%	100%	396%	452%	693%	10%	<Coefficient of Variation = Std-Dev/Avg
GREENSTONE												
Number	31	31	31	31	31	31	31	31	31	31	31	DATA from over GREENSTONE BEDROCK
Maximum	248	191	44	10	24	15	10	1	4	0	272	<Maximum
Minimum	40	1	3	0	0	0	0	0	0	0	200	<Minimum
Average	173	20	16	2	4	3	2	0	0	0	221	<Average or arithmetic mean
Stan-Dev	37	34	10	3	6	3	2	0	1	0	16	<Standard Deviation
Coef-Var	21%	170%	65%	123%	128%	116%	101%	381%	403%	7%	12%	<Coefficient of Variation = Std-Dev/Avg
GRANITE												
Number	19	19	19	19	19	19	19	19	19	19	19	DATA from over GRANITE BEDROCK
Maximum	278	16	35	5	15	29	6	1	1	95	293	<Maximum
Minimum	99	0	5	0	0	0	0	0	0	0	206	<Minimum
Average	192	6	16	2	3	6	2	0	0	0	5	<Average or arithmetic mean
Stan-Dev	37	4	10	1	3	7	2	0	0	21	27	<Standard Deviation
Coef-Var	19%	71%	63%	96%	110%	113%	97%	424%	424%	420%	12%	<Coefficient of Variation = Std-Dev/Avg
SUMMARY												
t test	1.7	-1.8	0.3	-0.9	-0.8	2.1	-0.6	-0.2	-0.8	1.3	1.7	<Statistical test for similar averages
Sig .05	1	1	1	1	1	0	1	1	1	1	1	<If 1; then granite = greenstone, @ 95%
Sig .01	1	1	1	1	1	1	1	1	1	1	1	<If 1; then granite = greenstone, @ 99%
F test	1.0	68.2	1.0	3.3	2.5	4.2	1.6	1.2	12.2	2.8	2.8	<Statistical test for similar std-dev
Sig .05	1	0	1	0	0	0	1	1	0	0	0	<If 1; then granite = greenstone, @ ~95%
Sig .01	1	0	1	0	1	0	1	1	0	1	1	<If 1; then granite = greenstone, @ ~99%

LAKE OF THE WOODS (Year 3)

HEAVY MINERALS (Raw Counts)

Page 2

Sample	YR #	HORNBL	TREM	PYROX	EPID	APAT	BIOT	GARN	TOUR	SULF	OTHR	TOTAL	COMMENTS
88 G 1	187	27	3	1	4	4	2	0	0	0	0	228	
88 G 2	202	28	13	2	4	2	0	0	0	0	0	251	1987 sample
88 G 3	135	10	44	10	4	0	0	0	0	0	0	203	
88 G 4	99	7	8	0	1	10	4	0	0	0	95	224	Other = diopside
88 G 5	200	5	15	7	8	4	3	0	0	0	0	242	Heavy carbonate-clay coating
88 G 6	193	4	12	0	0	0	1	0	0	0	0	210	Heavy carbonate-clay coating
88 G 7	182	3	24	1	8	0	0	0	0	0	0	218	
88 G 8	151	12	28	6	3	1	1	0	0	0	0	202	
88 G 9	143	22	36	4	13	1	1	1	0	0	0	221	
88 G 10	176	17	19	8	1	1	2	0	0	0	0	224	Carbonate-clay coating
88 G 11	229	16	16	1	3	4	0	0	0	0	0	269	1987 sample, Heavy carbonate-clay coating
88 G 12	167	1	25	4	11	0	0	0	0	0	0	208	
88 G 13	170	4	8	0	2	29	3	0	0	0	0	216	
88 G 14	172	29	10	0	1	0	0	0	0	0	0	212	Carbonate-clay coating
88 G 15	183	11	13	1	1	2	0	0	0	0	0	211	
88 G 16	189	4	6	2	3	5	1	0	0	0	0	210	
88 G 17	183	6	14	0	0	0	3	0	0	0	0	206	carbonate-clay coating
88 G 18	195	11	35	2	15	0	4	0	0	0	0	262	
88 G 19	182	7	14	1	2	6	2	0	0	0	0	214	
88 G 20	171	13	27	3	1	5	4	0	0	0	0	224	
88 G 21	180	17	8	2	1	2	2	0	0	0	0	212	
88 G 22	199	5	8	1	0	5	2	0	1	0	0	221	
88 G 23	178	3	20	1	2	3	1	0	0	0	0	208	
88 G 24	176	2	20	3	14	15	1	0	0	0	0	231	
88 G 25	248	2	10	0	1	1	10	0	0	0	0	272	
88 G 26	140	46	17	3	24	2	3	0	0	0	0	235	
88 G 27	213	4	10	2	4	14	6	0	0	0	1	254	Other = copper?
88 G 28	202	6	13	1	6	0	2	0	0	0	0	230	
88 G 29	278	5	8	0	0	0	2	0	0	0	0	293	
88 G 30	167	15	28	4	14	2	5	0	0	0	0	235	
88 G 31	195	1	5	0	0	10	3	0	0	0	0	214	
88 G 32	103	51	38	3	8	1	0	1	0	0	0	205	
88 G 33	160	32	13	0	1	3	2	0	0	0	0	211	
88 G 34	177	3	14	5	1	3	4	0	2	0	0	209	
88 G 35	249	3	8	1	2	12	2	0	0	0	0	277	
88 G 36	138	53	12	0	3	10	0	0	0	0	0	216	

Year Commencement

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ACCIDENTAL TO THE EGYPTIANS,

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LAKE OF THE WOODS (Year 3)

HEAVY MINERALS (Percentages)

Page 1

STATISTICS									
Units ->	%	%	%	%	%	%	%	%	#
ALL DATA									
Number	50	50	50	50	50	50	50	50	50
Maximum	95	82	22	5	10	13	4	0	42
Minimum	17	0	1	0	0	0	0	0	293
Average	80	7	7	1	2	2	1	0	1
Stan-Dev	14	12	5	1	2	2	1	0	225
Coef-Var	17%	185%	67%	123%	122%	128%	96%	396%	<Average or arithmetic mean
									<Standard Deviation
									<Coefficient of Variation = Std-Dev/Avg
GREENSTONE									
Number	31	31	31	31	31	31	31	31	31
Maximum	95	82	22	5	10	6	4	0	272
Minimum	17	0	1	0	0	0	0	0	200
Average	78	9	7	1	2	1	1	0	221
Stan-Dev	15	15	5	1	2	1	1	0	<Standard Deviation
Coef-Var	19%	164%	68%	125%	124%	115%	94%	381%	<Coefficient of Variation = Std-Dev/Avg
GRANITE									
Number	19	19	19	19	19	19	19	19	19
Maximum	95	6	16	2	6	13	2	0	42
Minimum	44	0	2	0	0	0	0	0	293
Average	83	3	7	1	1	3	1	0	232
Stan-Dev	11	2	5	1	1	3	1	0	<Standard Deviation
Coef-Var	13%	68%	65%	100%	103%	115%	98%	424%	<Coefficient of Variation = Std-Dev/Avg
SUMMARY									
t test	1.0	-1.8	0.0	-1.0	-0.9	2.0	-0.9	-0.2	1.3
Sig .05	1	1	1	1	1	1	1	1	1.7
Sig .01	1	1	1	1	1	1	1	1	<Statistical test for similar averages
F test	2.0	76.7	1.1	3.3	3.0	4.2	1.6	1.2	12.1
Sig .05	1	0	1	0	0	1	1	0	<If 1; then granite = greenstone, @ 95%
Sig .01	1	0	1	0	1	0	1	1	<If 1; then granite = greenstone, @ 99%

LAKE OF THE WOODS (Year 3)

HEAVY MINERALS (Percentages)

Page 2

Sample	YR	#	HORNBL	TREM	PYROK	EPID	APAT	BIOT	GARN	TOUR	SULF	OTHR	TOTAL	COMMENTS
88 G 1		82	12	1	0	2	2	1	0	0	0	0	228	
88 G 2		80	11	5	1	2	1	0	0	0	0	0	251	1987 sample
88 G 3		67	5	22	5	2	0	0	0	0	0	0	203	
88 G 4		44	3	4	0	0	4	2	0	0	0	0	42	224 Other = diopside
88 G 5		83	2	6	3	3	2	1	0	0	0	0	242	Heavy carbonate-clay coating
88 G 6		92	2	6	0	0	0	0	0	0	0	0	210	Heavy carbonate-clay coating
88 G 7		83	1	11	0	4	0	0	0	0	0	0	218	
88 G 8		75	6	14	3	1	0	0	0	0	0	0	202	
88 G 9		65	10	16	2	6	0	0	0	0	0	0	221	
88 G 10		79	8	8	4	0	0	0	1	0	0	0	224	Carbonate-clay coating
88 G 11		85	6	6	0	1	1	0	0	0	0	0	269	1987 sample, Heavy carbonate-clay coating
88 G 12		80	0	12	2	5	0	0	0	0	0	0	208	
88 G 13		79	2	4	0	1	13	1	0	0	0	0	216	
88 G 14		81	14	5	0	0	0	0	0	0	0	0	212	Carbonate-clay coating
88 G 15		87	5	6	0	0	1	0	0	0	0	0	211	
88 G 16		90	2	3	1	1	2	0	0	0	0	0	210	
88 G 17		89	3	7	0	0	0	1	0	0	0	0	206	Carbonate-clay coating
88 G 18		74	4	13	1	6	0	2	0	0	0	0	262	
88 G 19		85	3	7	0	1	3	1	0	0	0	0	214	
88 G 20		76	6	12	1	0	2	2	0	0	0	0	224	
88 G 21		85	8	4	1	0	1	1	0	0	0	0	212	
88 G 22		90	2	4	0	0	2	1	0	0	0	0	221	
88 G 23		86	1	10	0	1	1	0	0	0	0	0	208	
88 G 24		76	1	9	1	6	6	0	0	0	0	0	231	
88 G 25		91	1	4	0	0	0	4	0	0	0	0	272	
88 G 26		60	20	7	1	10	1	1	0	0	0	0	235	
88 G 27		84	2	4	1	2	6	2	0	0	0	0	254	Other = copper?
88 G 28		88	3	6	0	3	0	1	0	0	0	0	230	
88 G 29		95	2	3	0	0	0	1	0	0	0	0	293	
88 G 30		71	6	12	2	6	1	2	0	0	0	0	235	
88 G 31		91	0	2	0	0	5	1	0	0	0	0	214	
88 G 32		50	25	19	1	4	0	0	0	0	0	0	205	
88 G 33		76	15	6	0	1	0	1	0	0	0	0	211	
88 G 34		85	1	7	2	0	0	1	0	0	0	0	209	
88 G 35		90	1	3	0	1	4	1	0	0	0	0	277	
88 G 36		64	25	6	0	1	5	0	0	0	0	0	216	

APPENDIX E

LIGHT MINERAL ANALYSES

LAKE OF THE WOODS (Year 3)

LIGHT MINERALS (Raw Counts)

Page 1

<u>QUARTZ</u>						<u>MICA</u>						<u>STATISTICS</u>											
Units ->	FRACT	FROST	#	#	FELDSP	'SPAR'	#	#	MICA	TOTAL	#	<Units of measurement	ALL DATA	Number	10	10	10	10	10	10	<Number of valid data	ALL DATA	
ALL DATA														Maximum	214	169	57	2	12	293	<Maximum		
Number	10	10	10	10										Minimum	46	24	4	0	1	200	<Minimum		
Maximum	214	169	57	2										Average	143	58	19	1	6	227	<Average or arithmetic mean		
Minimum	46	24	4	0										Stan-Dev	44	41	15	1	3	24	<Standard Deviation		
Coef-Var	31%	70%	76%	73%																11% <Coefficient of Variation = Std-Dev/Avg			
<u>GREENSTONE</u>																							
Number	6	6	6	6										Maximum	179	169	57	2	12	232	<Maximum		
Maximum	179	169	57	2										Minimum	46	24	4	0	1	208	<Minimum		
Minimum	46	24	4	0										Average	133	61	20	1	6	221	<Average or arithmetic mean		
Stan-Dev	44	50	18	1										Coef-Var	33%	82%	90%	56%	59%	8	<Standard Deviation		
Coef-Var	33%	82%	90%	56%																4% <Coefficient of Variation = Std-Dev/Avg			
<u>GRANITE</u>																							
Number	4	4	4	4										Maximum	214	84	28	2	9	293	<Maximum		
Maximum	214	84	28	2										Minimum	104	35	6	0	2	200	<Minimum		
Minimum	104	35	6	0										Average	157	54	19	1	5	236	<Average or arithmetic mean		
Stan-Dev	39	18	8	1										Coef-Var	25%	34%	43%	100%	55%	35	<Standard Deviation		
Coef-Var	25%	34%	43%	100%																15% <Coefficient of Variation = Std-Dev/Avg			
<u>SUMMARY</u>																							
t test	0.9	-0.3	-0.1	-0.6										Sig .05	1	1	1	1	1	1	1 <If 1; then granite = greenstone, @ 95%		
Sig .01	1	1	1	1										F test	1.3	7.5	4.7	1.8	1.4	1	1 <If 1; then granite = greenstone, @ 99%		
F test	1.3	7.5	4.7	1.8										Sig .05	1	1	1	1	1	0 <If 1; then granite = greenstone, @ ~95%	19.3 <Statistical test for similar std-dev		
Sig .01	1	1	1	1															1 <If 1; then granite = greenstone, @ ~99%				

COMPARISON STATISTICS

1.0 <Statistical test for similar averages
 1 <If 1; then granite = greenstone, @ 95%
 1 <If 1; then granite = greenstone, @ 99%
 19.3 <Statistical test for similar std-dev
 0 <If 1; then granite = greenstone, @ ~95%
 1 <If 1; then granite = greenstone, @ ~99%

LAKE OF THE WOODS (Year 3)

LIGHT MINERALS (Raw Counts)

Page 2

Sample	QUARTZ			'SPAR'	MICA	TOTAL	COMMENTS
	FRACT	FROST	FELDSP				
88 G 6	150	65	4	1	4	224	Heavy carbonate-clay rind
88 G 7	156	35	6	0	3	200	
88 G 9	165	37	8	0	5	215	
88 G 24	179	24	22	1	1	227	
88 G 25	46	169	10	2	5	232	
88 G 37	155	49	19	0	7	230	
88 G 43	214	47	28	2	2	293	
88 G 47	149	32	17	2	8	208	
88 G 49	104	84	23	2	9	222	
88 G 50	110	39	57	2	12	220	

VARIABLE NAMES for Light Minerals

Year Sample No.

Units ->	#	#	#	#	#	#	<Units of measurement
FRACTured quartz							
FROSTed quartz							
FELDSPar							
'SPAR'ry mineral							
MICA (Muscovite & Phlogopite)							
TOTAL number of grains counted							

Clay+carbonate coating reduces the accuracy
of the counts

FELDSPar

'SPAR'ry mineral

MICA (Muscovite & Phlogopite)

TOTAL number of grains counted

LAKE OF THE WOODS (Year 3)

LIGHT MINERALS (Percentages)

30-Mar-89 Page 1

<u>QUARTZ</u>						TOTAL	STATISTICS
Units ->	FRACT	FROST	FELDSP	'SPAR'	MICA	%	# <Units of measurement
ALL DATA							ALL DATA
Number >	10	10	10	10	10	10	10 <Number of valid data
Maximum >	79	73	26	1	5	293	<Maximum
Minimum >	20	11	2	0	0	200	<Minimum
Average >	63	26	8	1	3	227	<Average or arithmetic mean
Stan-Dev>	18	17	7	0	1	24	<Standard Deviation
Coef-Var>	28%	68%	77%	73%	59%	11%	<Coefficient of Variation = Std-Dev/Avg
 GREENSTONE							
Number >	6	6	6	6	6	6	DATA from over GREENSTONE BEDROCK
Maximum >	79	73	26	1	5	232	<Maximum
Minimum >	20	11	2	0	0	208	<Minimum
Average >	61	27	9	1	3	221	<Average or arithmetic mean
Stan-Dev>	21	21	8	0	2	8	<Standard Deviation
Coef-Var>	34%	78%	90%	57%	60%	4%	<Coefficient of Variation = Std-Dev/Avg
 GRANITE							
Number >	4	4	4	4	4	4	DATA from over GRANITE BEDROCK
Maximum >	78	38	10	1	4	293	<Maximum
Minimum >	47	16	3	0	1	200	<Minimum
Average >	66	23	8	0	2	236	<Average or arithmetic mean
Stan-Dev>	12	9	3	0	1	35	<Standard Deviation
Coef-Var>	18%	37%	37%	102%	57%	15%	<Coefficient of Variation = Std-Dev/Avg
 SUMMARY							
t test >	0.5	-0.4	-0.3	-0.8	-0.4	1.0	COMPARISON STATISTICS
Sig .05 >	1	1	1	1	1	1	<Statistical test for similar averages
Sig .01 >	1	1	1	1	1	1	<if 1; then granite = greenstone, @ 95%
F test >	3.0	6.0	7.9	1.4	1.5	19.3	<if 1; then granite = greenstone, @ 99%
Sig .05 >	1	1	1	1	1	0	<Statistical test for similar std-dev
Sig .01 >	1	1	1	1	1	1	<if 1; then granite = greenstone, @ 95%
							<if 1; then granite = greenstone, @ 99%

LAKE OF THE WOODS (Year 3)

LIGHT MINERALS (Percentages)

30-Mar-89 Page 2

Sample	QUARTZ			FELDSP	'SPAR'	MICA	TOTAL	COMMENTS
	FRACT	FROST	FROST					
88 G 6	67	29	2	0	0	2	224	Heavy carbonate-clay rind
88 G 7	78	18	3	0	0	2	200	
88 G 9	77	17	4	0	0	2	215	
88 G 24	79	11	10	0	0	0	227	
88 G 25	20	73	4	1	1	2	232	
88 G 37	67	21	8	0	0	3	230	
88 G 43	73	16	10	1	1	1	293	
88 G 47	72	15	8	1	4	4	208	
88 G 49	47	38	10	1	4	4	222	
88 G 50	50	18	26	1	5	5	220	

VARIABLE NAMES for Light Minerals

Year Sample No.

Units ->	%	%	%	%	%	#	<Units of measurement
FRACTURED quartz							
FROSTed quartz							
FELDSPar							
'SPAR'ry mineral							
MICA (Muscovite & Phlogopite)							
TOTAL number of grains counted							

Clay+carbonate coating reduces the accuracy
of the counts

'SPAR'ry mineral

MICA (Muscovite & Phlogopite)

TOTAL number of grains counted

APPENDIX F
GEOCHEMICAL ANALYSES

LAKE OF THE WOODS (Year 3)

GEOCHEMISTRY by ATOMIC ABSORPTION

Page 1

Carbon

Units	CTOT	CORG	CIN	CEQ	Cr	Mn	Fe	Co	Ni	Cu	Zn	Mo	Ag	Pb	As	U	STATISTICS
ALL DATA	%	%	%	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ALL DATA
Number	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	<Number of valid data
Maximum	16.66	16.50	0.16	1.33	563	1010	7.4	33	208	288	243	9.0	0.80	40	44	11.3	<Maximum
Minimum	0.44	0.44	-0.05	-0.42	43	135	1.8	4	15	23	36	0.5	0.05	8	2	1.7	<Minimum
Average	4.88	4.85	0.03	0.21	100	366	3.7	15	56	84	105	2.5	0.20	22	12	4.3	<Average or arithmetic mean
Stan-Dev	3.12	3.10	0.03	0.26	101	205	1.0	6	42	59	38	1.6	0.19	8	8	2.0	<Standard Deviation
Coef-Var	64%	64%	122%	122%	102%	56%	27%	43%	75%	70%	36%	63%	99%	39%	68%	46%	<Coefficient of Variation = Std-Dev/Avg

GREENSTONE

Number	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	DATA from over GREENSTONE BEDROCK
Maximum	10.75	10.72	0.10	0.83	563	1010	6.0	31	208	288	243	5.0	0.70	40	44	7.9	<Maximum
Minimum	0.44	0.44	0.00	0.00	43	147	1.8	9	18	32	60	0.5	0.05	10	4	2.1	<Minimum
Average	4.62	4.59	0.03	0.21	118	414	3.7	16	66	100	117	2.3	0.18	22	12	3.9	<Average or arithmetic mean
Stan-Dev	2.52	2.51	0.02	0.19	125	219	0.9	6	47	67	41	1.2	0.16	8	8	1.4	<Standard Deviation
Coef-Var	55%	55%	87%	87%	106%	53%	25%	40%	72%	67%	35%	52%	86%	37%	68%	34%	<Coefficient of Variation = Std-Dev/Avg

GRANITE

Number	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	DATA from over GRANITE BEDROCK
Maximum	16.66	16.50	0.16	1.33	103	805	7.4	33	129	124	129	9.0	0.80	37	32	11.3	<Maximum
Minimum	1.18	1.18	-0.05	-0.42	43	135	1.9	4	15	23	36	0.5	0.05	8	2	1.7	<Minimum
Average	5.30	5.28	0.03	0.21	70	289	3.8	13	40	59	87	2.9	0.22	21	11	4.8	<Average or arithmetic mean
Stan-Dev	3.86	3.84	0.04	0.35	16	156	1.2	6	24	27	23	2.1	0.24	9	7	2.6	<Standard Deviation
Coef-Var	73%	73%	165%	165%	22%	54%	31%	45%	59%	45%	27%	72%	111%	42%	67%	55%	<Coefficient of Variation = Std-Dev/Avg

SUMMARY

t test	0.8	0.8	-0.0	-0.0	-1.6	-2.1	0.3	-1.9	-2.1	-2.4	-2.7	1.2	0.6	-0.7	-0.5	1.5	COMPARISON STATISTICS
Sig .05	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	<Statistical test for similar averages
Sig .01	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	<If 1; then granite = greenstone, @ 95%
F test	2.3	2.3	3.5	3.5	62.1	2.0	1.7	1.3	4.0	6.4	3.1	2.9	2.3	1.1	1.2	3.7	<Statistical test for similar std-dev
Sig .05	1	1	0	0	0	1	1	1	0	0	0	1	1	1	1	1	<If 1; then granite = greenstone, @ ~95%
Sig .01	1	1	0	0	0	1	1	1	0	0	1	1	1	1	1	1	<If 1; then granite = greenstone, @ ~99%

LAKE OF THE WOODS (Year 3)

GEOCHEMISTRY by ATOMIC ABSORPTION

Sample	YR #	Carbon						Sulfur						Trace Elements					
		CTOT	CORG	CIN	CEQ	Mn	Cr	Fe	Ni	Cu	Zn	Mo	Ag	Pb	As	U	Comments		
88 G 1	9.48	9.44	0.04	0.33	94	289	2.9	13	65	70	122	3.0	0.30	33	8	4.0			
88 G 2	1.44	1.44	0.00	0.00	98	364	4.5	22	45	106	70	1.0	0.30	10	4	3.4 1987 sample			
88 G 3	2.50	2.49	0.01	0.08	121	571	4.4	23	94	185	125	2.0	0.10	14	22	3.2			
88 G 4	3.19	3.18	0.01	0.08	86	530	3.5	33	129	124	117	3.0	0.10	21	7	3.2			
88 G 5	10.75	10.72	0.03	0.25	51	164	3.3	10	31	82	93	5.0	0.20	34	8	4.8			
88 G 6	5.04	5.00	0.04	0.33	63	231	4.0	13	37	140	106	4.0	0.20	25	12	3.4			
88 G 7	9.84	9.89	-0.05	-0.42	86	382	4.3	15	59	89	129	4.0	0.60	37	32	5.0			
88 G 8	2.10	2.09	0.01	0.08	63	217	3.2	16	44	46	96	1.0	0.05	18	7	2.8			
88 G 9	1.58	1.58	0.00	0.00	78	304	3.8	12	39	105	90	1.0	0.05	15	13	4.3			
88 G 10	1.70	1.69	0.01	0.08	101	757	4.2	27	96	244	115	1.0	0.05	19	26	3.2			
88 G 11	7.82	7.84	-0.02	-0.17	66	212	4.8	15	41	63	82	3.0	0.50	13	11	4.6 1987 sample			
88 G 12	5.71	5.67	0.04	0.33	57	411	4.3	23	90	84	90	3.0	0.50	32	10	3.7			
88 G 13	5.34	5.32	0.02	0.17	43	214	3.9	9	29	30	100	3.0	0.20	28	10	3.3			
88 G 14	5.92	5.82	0.10	0.83	128	211	3.5	11	35	46	94	2.0	0.05	14	12	2.1			
88 G 15	2.17	2.17	0.00	0.00	85	171	3.2	14	52	94	83	1.0	0.05	14	13	2.1			
88 G 16	1.34	1.34	0.00	0.00	91	347	3.5	18	50	77	106	0.5	0.05	12	6	1.7			
88 G 17	6.19	6.15	0.04	0.33	47	147	2.6	11	23	59	70	3.0	0.05	19	8	3.0			
88 G 18	4.86	4.81	0.05	0.42	50	317	4.0	11	26	35	121	2.0	0.70	22	7	4.0			
88 G 19	1.99	1.98	0.01	0.08	515	813	6.0	31	198	288	107	2.0	0.10	25	17	4.8			
88 G 20	6.43	6.39	0.04	0.33	60	190	4.0	14	39	56	70	3.0	0.80	20	10	3.8			
88 G 21	2.95	2.87	0.08	0.67	112	538	3.1	13	55	41	84	2.0	0.05	17	7	2.7			
88 G 22	16.66	16.50	0.16	1.33	56	205	4.6	7	15	43	62	9.0	0.10	20	15	3.9			
88 G 23	6.17	6.12	0.05	0.42	44	157	2.6	9	18	43	60	4.0	0.05	19	11	7.1			
88 G 24	0.44	0.44	0.00	0.00	75	523	3.6	15	80	253	133	0.5	0.05	22	5	4.8			
88 G 25	4.29	4.26	0.03	0.25	71	284	3.6	16	41	69	227	1.0	0.20	18	6	3.3			
88 G 26	6.81	6.77	0.04	0.33	126	230	3.3	15	58	143	68	4.0	0.05	13	8	7.9			
88 G 27	3.51	3.49	0.02	0.17	58	410	3.4	15	36	54	104	2.0	0.20	34	8	8.1			
88 G 28	4.18	4.16	0.02	0.17	64	511	3.8	16	42	64	125	3.0	0.10	32	9	5.2			
88 G 29	1.18	1.18	0.00	0.00	63	202	2.4	10	33	35	65	1.0	0.05	8	5	2.3			
88 G 30	4.99	4.95	0.04	0.33	78	544	4.0	26	91	131	111	3.0	0.30	17	11	4.7			
88 G 31	5.26	5.24	0.02	0.17	59	230	2.8	11	37	95	107	3.0	0.05	30	10	10.4			
88 G 32	5.18	5.16	0.02	0.17	122	335	2.1	12	74	32	98	2.0	0.05	17	7	3.1			
88 G 33	2.50	2.49	0.01	0.08	372	1010	5.5	31	179	158	3.0	0.30	17	7	2.8				
88 G 34	7.56	7.54	0.02	0.17	43	839	1.8	9	32	37	120	1.0	0.40	14	10	3.1			
88 G 35	2.92	2.90	0.02	0.17	70	319	3.5	12	38	59	83	2.0	0.10	26	7	4.7			

88	G	36	6.70	6.66	0.04	0.33	75	209	2.4	10	55	134	83	4.0	0.05	24	12	4.7
88	G	37	10.52	10.49	0.03	0.25	103	135	7.4	4	40	57	86	1.0	0.05	22	16	4.9
88	G	38	1.99	1.97	0.02	0.17	62	203	1.9	12	61	73	125	2.0	0.70	40	8	5.6
88	G	39	4.98	4.96	0.02	0.17	110	520	4.0	11	27	23	84	1.0	0.05	12	6	3.0
88	G	40	1.46	1.44	0.02	0.17	57	158	2.6	11	30	29	86	1.0	0.10	12	2	3.8
88	G	41	2.12	2.11	0.01	0.08	86	248	3.1	10	66	122	2.0	0.20	11	5	3.1	
88	G	42	2.82	2.81	0.01	0.08	563	434	5.1	26	208	61	4.0	0.05	19	9	11.3	
88	G	43	6.44	6.39	0.05	0.42	86	207	3.6	8	44	83	120	4.0	0.30	38	19	6.1
88	G	44	5.98	5.96	0.02	0.17	78	341	4.3	13	41	66	168	1.0	0.40	30	2.2	4.3
88	G	45	3.39	3.38	0.01	0.08	65	384	3.3	20	47	103	3.0	0.10	32	8	2.9	
88	G	46	3.80	3.79	0.01	0.08	67	205	3.5	12	43	114	243	1.0	0.20	27	44	4.3
88	G	47	0.98	0.98	0.00	0.00	69	667	4.0	15	32	163	1.0	0.10	29	13	3.0	
88	G	48	6.76	6.74	0.02	0.17	49	323	4.1	12	35	65	68	5.0	0.05	32	29	7.7
88	G	49	7.68	7.60	0.08	0.67	71	805	5.3	13	37	127	2.0	0.10	31	11	7.1	

VARIABLE NAMES for Coacahomilotepehu Atomic Attributions

SOMA TRAUMATIQUE ET CINÉMATOGRAFIE

CIN = CTOT - CORG

If the measurement is less than the detection limit, then the data value is 1/2 the measurement (rounded down if necessary)

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Units ->		Na	Sc	Cr	Fe	Co	Ni	Zn	As	Se	Br	Rb	Zr	No	Ag	Cd	Sn	Sb	Te	STATISTICS
ALL DATA		%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	<Units of measurement	
Number	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50 <Number of valid data	
Maximum	3.52	23.6	590	7.7	54.0	220	390	11.00	2.5	29.0	130	940	3.0	1	2.5	50	0.50	13 <Maximum		
Minimum	1.60	5.5	37	2.0	2.5	10	50	0.25	2.5	1.0	35	100	0.5	1	2.5	50	0.05	5 <Minimum		
Average	2.55	10.4	121	3.6	15.2	44	155	3.24	2.5	5.7	78	375	0.9	1	2.5	50	0.19	5 <Average or arithmetic mean		
Stan-Dev	0.44	3.4	111	1.2	9.7	41	79	2.42	0.0	5.6	19	226	0.8	0	0.0	0	0.12	1 <Standard Deviation		
Coef-Var	17%	32%	92%	33%	63%	94%	51%	75%	0%	97%	25%	60%	84%	0%	0%	0%	61%	22% <Coefficient of Variation = Std-Dev/Avg		
GREENSTONE																				
Number	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31 <Number of valid data		
Maximum	3.32	23.6	590	7.7	54.0	220	390	11.00	2.5	18.0	130	940	3.0	1	2.5	50	0.50	13 <Maximum		
Minimum	1.60	5.5	42	2.3	6.0	10	50	0.25	2.5	1.0	50	100	0.5	1	2.5	50	0.05	5 <Minimum		
Average	2.48	11.1	150	3.9	18.1	55	161	3.44	2.5	5.0	82	366	0.9	1	2.5	50	0.23	5 <Average or arithmetic mean		
Stan-Dev	0.42	3.7	130	1.3	10.5	48	85	2.30	0.0	3.9	19	239	0.7	0	0.0	0	0.12	1 <Standard Deviation		
Coef-Var	17%	33%	87%	33%	58%	87%	53%	67%	0%	79%	23%	65%	84%	0%	0%	0%	53%	27% <Coefficient of Variation = Std-Dev/Avg		
GRANITE																				
Number	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19 <Number of valid data		
Maximum	3.52	15.0	140	4.7	20.0	53	260	11.00	2.5	29.0	100	730	3.0	1	2.5	50	0.30	5 <Maximum		
Minimum	1.80	5.9	37	2.0	2.5	10	50	0.50	2.5	1.0	35	100	0.5	1	2.5	50	0.05	5 <Minimum		
Average	2.67	9.1	73	3.1	10.5	26	147	2.91	2.5	7.0	71	391	0.9	1	2.5	50	0.14	5 <Average or arithmetic mean		
Stan-Dev	0.45	2.3	27	0.8	5.3	15	67	2.57	0.0	7.4	18	201	0.8	0	0.0	0	0.09	0 <Standard Deviation		
Coef-Var	17%	25%	37%	26%	51%	56%	45%	89%	0%	105%	26%	52%	84%	0%	0%	0%	65%	0% <Coefficient of Variation = Std-Dev/Avg		
SUMMARY																				
t test	1.5	-2.0	-2.4	-2.2	-2.7	-2.4	-0.6	-0.8	-1.3	-2.0	0.4	0.0	-2.6	-0.8	<Statistical test for similar averages					
Sig .05	1	0	0	0	0	0	1	1	1	1	1	1	0	1	1	1	1	1 <if 1; then granite = greenstone, @ 95%		
Sig .01	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1 <if 1; then granite = greenstone, @ 99%		
F test	1.2	2.7	23.2	2.5	3.9	10.6	1.6	1.3	3.6	1.1	1.4	1.0	1.8	1.8	1.8	1.8	1.8	1.8 <Statistical test for similar std-dev		
Sig .05	1	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1 <if 1; then granite = greenstone, @ 99%		
Sig .01	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1 <if 1; then granite = greenstone, @ 99%		

LAKE OF THE WOODS (Year 3)

GEOCHEMISTRY by NEUTRON ACTIVATION (Light Elements)

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Sample	YR	#	Na	Sc	Cr	Fe	Co	Ni	Zn	As	Se	Br	Rb	Zr	Mo	Ag	Cd	Sn	Sb	Te	COMMENTS
88 G 1	2.78	6.1	100	2.3	6.0	44	120	1.60	2.5	4.8	100	100	0.5	1	2.5	50	0.05	5			
88 G 2	2.20	9.3	68	2.8	13.0	27	120	1.60	2.5	2.3	53	100	1.0	1	2.5	50	0.20	5	1987 sample		
88 G 3	2.81	12.0	91	3.7	17.0	44	190	6.70	2.5	2.9	88	380	2.0	1	2.5	50	0.30	5			
88 G 4	3.52	9.4	67	3.8	19.0	29	50	1.10	2.5	2.2	66	730	0.5	1	2.5	50	0.05	5			
88 G 5	2.59	5.5	42	2.9	13.0	10	120	2.80	2.5	15.0	99	100	0.5	1	2.5	50	0.10	5			
88 G 6	2.14	15.0	110	5.9	27.0	39	50	3.20	2.5	5.2	67	430	0.5	1	2.5	50	0.30	5			
88 G 7	2.93	5.9	44	2.0	2.5	10	240	1.50	2.5	12.0	83	100	0.5	1	2.5	50	0.10	5			
88 G 8	2.14	9.1	90	3.3	13.0	40	310	3.30	2.5	4.1	91	100	0.5	1	2.5	50	0.30	5			
88 G 9	3.32	6.3	52	2.3	7.0	10	160	2.90	2.5	1.0	120	430	0.5	1	2.5	50	0.10	5			
88 G 10	2.32	16.0	170	5.6	28.0	79	290	3.10	2.5	3.1	100	100	2.0	1	2.5	50	0.20	5			
88 G 11	1.80	11.0	100	3.8	20.0	42	230	4.00	2.5	14.0	46	280	0.5	1	2.5	50	0.30	5	1987 sample		
88 G 12	3.21	10.0	78	4.1	13.0	33	170	1.40	2.5	3.2	66	940	0.5	1	2.5	50	0.10	13			
88 G 13	2.17	8.7	57	3.1	12.0	28	120	2.90	2.5	5.9	78	490	0.5	1	2.5	50	0.20	5			
88 G 14	1.80	15.0	250	6.3	25.0	65	150	4.80	2.5	5.8	75	100	0.5	1	2.5	50	0.20	5			
88 G 15	2.72	15.0	140	4.6	20.0	53	170	3.20	2.5	3.5	35	390	1.0	1	2.5	50	0.10	5			
88 G 16	3.03	13.0	110	3.6	12.0	51	220	1.60	2.5	1.0	48	390	0.5	1	2.5	50	0.10	5			
88 G 17	2.24	9.4	75	3.7	16.0	24	140	3.40	2.5	7.7	75	430	0.5	1	2.5	50	0.30	5			
88 G 18	3.10	7.6	49	3.2	9.0	10	150	1.50	2.5	2.5	85	650	0.5	1	2.5	50	0.10	5			
88 G 19	2.27	23.6	590	6.4	47.0	220	190	5.00	2.5	2.7	77	600	0.5	1	2.5	50	0.30	5			
88 G 20	3.05	7.3	47	2.9	10.0	20	50	1.20	2.5	2.9	58	610	0.5	1	2.5	50	0.05	5			
88 G 21	2.55	15.0	210	5.0	25.0	64	100	3.90	2.5	6.9	84	100	0.5	1	2.5	50	0.20	5			
88 G 22	2.10	9.1	86	3.7	10.0	41	130	6.90	2.5	29.0	49	200	1.0	1	2.5	50	0.20	5			
88 G 23	2.47	11.0	66	3.9	16.0	24	130	3.60	2.5	12.0	65	100	0.5	1	2.5	50	0.20	5			
88 G 24	3.30	12.0	100	3.1	12.0	26	120	0.25	2.5	1.0	80	830	0.5	1	2.5	50	0.05	5			
88 G 25	2.45	13.0	110	4.6	19.0	31	390	2.80	2.5	4.6	100	520	3.0	1	2.5	50	0.30	5			
88 G 26	3.03	12.0	220	3.8	18.0	43	140	1.80	2.5	8.2	61	560	0.5	1	2.5	50	0.10	5			
88 G 27	2.84	8.1	37	2.9	7.0	28	110	1.60	2.5	2.8	77	630	0.5	1	2.5	50	0.05	5			
88 G 28	3.04	9.3	83	3.0	8.0	21	110	1.30	2.5	3.2	91	570	0.5	1	2.5	50	0.20	5			
88 G 29	2.81	12.0	100	2.9	12.0	32	150	1.60	2.5	1.0	75	410	1.0	1	2.5	50	0.20	5			
88 G 30	2.79	8.1	76	2.9	18.0	25	50	1.90	2.5	4.3	74	620	0.5	1	2.5	50	0.05	5			
88 G 31	2.52	8.5	65	2.5	2.5	10	50	3.50	2.5	19.0	84	460	0.5	1	2.5	50	0.20	5			
88 G 32	1.70	16.0	470	4.2	28.0	140	200	2.70	2.5	6.7	66	100	0.5	1	2.5	50	0.20	5			
88 G 33	2.25	16.0	410	7.7	54.0	180	160	1.50	2.5	2.1	130	100	0.5	1	2.5	50	0.30	5			
88 G 34	2.24	8.5	88	2.9	13.0	26	100	3.20	2.5	5.0	110	480	0.5	1	2.5	50	0.30	5			
88 G 35	2.93	7.2	44	2.1	5.0	20	170	1.00	2.5	1.0	69	630	1.0	1	2.5	50	0.05	5			

LAKE OF THE WOODS (Year 3)

GEOCHEMISTRY by NEUTRON ACTIVATION (Light Elements)

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88 G 36	2.34	12.0	3.5	18.0	65	130	3.20	2.5	18.0	50	690	0.5	1	2.5	50	0.20	5	
88 G 37	2.18	6.9	74	4.1	9.0	23	230	6.70	2.5	14.0	52	470	3.0	1	2.5	50	0.30	5
88 G 38	2.72	9.4	62	2.8	14.0	10	100	1.90	2.5	3.2	100	420	0.5	1	2.5	50	0.10	5
88 G 39	2.73	10.0	140	3.3	16.0	56	110	1.60	2.5	3.5	70	410	0.5	1	2.5	50	0.20	5
88 G 40	2.94	8.7	70	2.4	10.0	10	50	1.80	2.5	1.0	100	100	0.5	1	2.5	50	0.05	5
88 G 41	2.58	7.3	64	2.0	8.0	20	170	0.50	2.5	2.8	85	100	1.0	1	2.5	50	0.05	5
88 G 42	2.73	9.4	350	3.3	26.0	130	50	1.10	2.5	1.0	55	100	0.5	1	2.5	50	0.05	5
88 G 43	3.00	7.7	57	2.3	2.5	10	140	1.70	2.5	5.8	67	100	0.5	1	2.5	50	0.10	5
88 G 44	2.22	7.7	98	3.1	10.0	62	50	8.50	2.5	3.1	66	240	0.5	1	2.5	50	0.40	5
88 G 45	2.51	9.1	85	2.8	12.0	38	140	7.70	2.5	1.0	72	410	0.5	1	2.5	50	0.50	5
88 G 46	2.49	10.0	92	3.6	12.0	32	200	3.00	2.5	4.5	86	370	2.0	1	2.5	50	0.20	5
88 G 47	2.31	9.2	68	3.4	9.0	34	260	11.00	2.5	1.0	94	540	2.0	1	2.5	50	0.50	5
88 G 48	1.60	11.0	74	4.3	15.0	44	370	4.90	2.5	6.5	90	260	3.0	1	2.5	50	0.40	5
88 G 49	1.80	11.0	110	4.7	15.0	50	260	11.00	2.5	10.0	88	260	3.0	1	2.5	50	0.30	5
88 G 50	2.30	8.7	71	2.9	8.0	24	160	2.80	2.5	3.2	90	540	1.0	1	2.5	50	0.20	5

VARIABLE NAMES for Geochemistry by Neutron Activation (Light elements)

Year Sample No.	Sodium	Scandium	Chromium	Iron	Nickel	Zinc	Arsenic	Selenium	Bronine	Rubidium	Cadmium	Tin	Antimony	Tellurium	<----- Detection limit		
0.02	0.2	20	0.2	5	20	100	0.5	5	0.5	5	200	1	2	5	100	0.1	10

If the measurement is less than the detection limit, then the data value is 1/2 the measurement (rounded down)

This occurs for: Cobalt, Nickel, Zinc, Selenium, Zirconium, Molybdenum, Silver, Cadmium, Tin

Units -> % ppm <Units of measurement

LAKE OF THE WOODS (Year 3)

GEOCHEMISTRY by NEUTRON ACTIVATION (Heavy Elements)

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Units ->	Cs	Ba	La	Ce	Sm	Eu	Tb	Yb	Lu	Hf	Ta	W	Ir	Au	Th	U	WT	STATISTICS
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppb	ppm	ppm	g	<units of measurement
ALL DATA	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	ALL DATA
Number	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	<Number of valid data
Maximum	12	1300	77	150	8.6	3.0	1.10	3	0.3	15	1.20	2.0	25	110	29.1	4.7	15.44	<Maximum
Minimum	1	270	16	31	1.4	0.5	0.25	1	0.1	4	0.25	0.5	25	1	3.5	1.0	6.83	<Minimum
Average	3	670	33	74	4.4	1.0	0.48	1	0.2	9	0.72	0.6	25	5	13.8	2.2	10.44	<Average or arithmetic mean
Stan-Dev	2	172	12	30	1.3	0.7	0.25	1	0.1	2	0.24	0.2	0	15	5.7	0.7	1.78	<Standard Deviation
Coef-Var	74%	26%	36%	41%	29%	69%	52%	41%	57%	26%	34%	43%	0%	325%	41%	29%	17%	<Coefficient of Variation = Std-Dev/Avg

DATA from over GREENSTONE BEDROCK

GREENSTONE	Number	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	
	Maximum	8.1	920	56.0	150	6.3	3.0	0.90	3	0.3	12	1.20	2.0	25	110	28.9	3.4	14.15	<Maximum
	Minimum	1.2	270	16.0	31	1.4	0.5	0.25	1	0.1	4	0.25	0.5	25	1	3.5	1.1	6.83	<Minimum
Average	3.3	629	31.8	75	4.2	1.0	0.44	1	0.2	9	0.72	0.6	25	6	13.3	2.1	10.20	<Average or arithmetic mean	
Stan-Dev	1.9	127	10.1	29	1.2	0.7	0.22	1	0.1	2	0.27	0.3	0	19	5.0	0.5	1.66	<Standard Deviation	
Coef-Var	56%	20%	32%	39%	28%	72%	49%	45%	57%	26%	37%	50%	0%	309%	38%	24%	16%	<Coefficient of Variation = Std-Dev/Avg	

DATA from over GRANITE BEDROCK

GRANITE	Number	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
	Maximum	12.0	1300	77.0	150	8.6	2.0	1.10	2	0.3	15	1.00	0.5	25	10	29.1	4.7	15.44	<Maximum
	Minimum	0.7	420	19.0	38	3.1	0.5	0.25	1	0.1	6	0.25	0.5	25	1	4.7	1.0	8.63	<Minimum
Average	2.3	737	35.1	73	4.9	1.1	0.54	1	0.2	10	0.72	0.5	25	2	14.8	2.4	10.81	<Average or arithmetic mean	
Stan-Dev	2.4	212	14.1	31	1.3	0.7	0.28	0	0.1	2	0.20	0.0	0	2	6.6	0.8	1.92	<Standard Deviation	
Coef-Var	106%	29%	40%	43%	28%	63%	52%	34%	56%	22%	27%	0%	0%	104%	45%	34%	18%	<Coefficient of Variation = Std-Dev/Avg	

SUMMARY

t test	-1.6	2.2	1.0	-0.2	1.9	0.2	1.4	-0.5	-0.0	2.5	0.0	-1.6	-0.9	0.9	1.3	1.2	<statistical test for similar averages	
Sig .05	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	<If 1; then granite = greenstone, @ 95%
Sig .01	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	<If 1; then granite = greenstone, @ 99%
F test	1.7	2.8	1.9	1.1	1.3	1.2	1.7	2.0	1.1	1.0	1.8	1.3	65.3	1.7	2.5	1.3	<Statistical test for similar std-dev	
Sig .05	1	0	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	<If 1; then granite = greenstone, @ ~95%
Sig .01	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	<If 1; then granite = greenstone, @ ~99%

LAKE OF THE WOODS (Year 3)

GEOCHEMISTRY by NEUTRON ACTIVATION (Heavy Elements)

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Sample	YR	#	Cs	Ba	La	Ce	Sm	Eu	Tb	Lu	Yb	Hf	Ta	W	Ir	Au	Th	U	WT	COMMENTS
88 G 1	1.3	630	32	75	2.8	0.5	0.50	1	0.1	8	0.60	0.5	25	1	18.0	2.2	11.15			
88 G 2	3.1	490	19	40	4.3	0.5	0.25	1	0.1	6	0.60	0.5	25	6	7.7	1.6	8.55	1987 sample		
88 G 3	2.6	580	22	81	4.2	0.5	0.60	1	0.3	7	1.00	0.5	25	6	11.0	1.6	10.49			
88 G 4	0.7	1100	77	150	8.6	2.0	1.10	2	0.1	13	0.80	0.5	25	1	20.9	2.1	14.71			
88 G 5	2.4	640	36	66	3.2	1.0	0.25	1	0.1	10	0.60	0.5	25	2	22.0	3.2	10.43			
88 G 6	7.8	640	26	56	3.2	2.0	0.25	2	0.1	7	1.10	1.0	25	2	10.0	1.9	11.10			
88 G 7	1.2	700	33	67	5.9	2.0	0.60	1	0.1	12	0.25	0.5	25	1	22.8	2.8	10.91			
88 G 8	4.0	590	28	57	4.3	0.5	0.25	1	0.3	8	0.90	0.5	25	3	14.0	2.3	9.07			
88 G 9	1.7	700	39	69	5.1	0.5	0.60	1	0.3	11	0.60	0.5	25	2	20.4	2.1	10.92			
88 G 10	5.5	540	20	46	4.0	0.5	0.25	3	0.3	7	1.00	1.0	25	8	9.1	1.7	8.82			
88 G 11	2.6	450	24	51	4.7	1.0	0.25	1	0.1	6	0.90	0.5	25	4	6.6	1.9	9.24	1987 sample		
88 G 12	1.2	770	51	100	5.4	2.0	0.90	1	0.1	11	0.25	0.5	25	1	18.0	2.0	11.70			
88 G 13	3.0	730	28	57	3.1	0.5	0.50	1	0.1	8	0.80	0.5	25	3	11.0	2.4	11.14			
88 G 14	5.0	530	28	49	3.7	0.5	0.25	1	0.1	7	0.80	0.5	25	5	7.9	1.8	10.10			
88 G 15	1.2	420	20	44	4.5	0.5	0.25	1	0.3	9	0.80	0.5	25	10	6.2	1.3	10.45			
88 G 16	1.2	470	20	48	4.4	2.0	0.25	1	0.3	9	0.80	0.5	25	1	4.7	1.0	11.50			
88 G 17	4.5	640	28	49	3.1	0.5	0.50	1	0.1	7	0.25	0.5	25	1	11.0	2.3	8.88			
88 G 18	1.9	1300	39	83	6.5	2.0	0.80	1	0.1	12	1.00	0.5	25	1	13.0	2.4	12.66			
88 G 19	7.5	390	38	130	4.6	2.0	0.70	1	0.1	5	0.80	0.5	25	3	11.0	2.3	9.46			
88 G 20	0.8	810	42	82	4.1	0.5	0.60	1	0.1	11	0.70	0.5	25	1	23.5	2.0	15.44			
88 G 21	3.8	660	30	79	3.7	1.0	0.25	1	0.1	5	0.60	0.5	25	2	12.0	2.1	10.58			
88 G 22	2.6	680	37	71	4.1	0.5	0.70	1	0.1	7	0.25	0.5	25	5	16.0	2.5	9.21			
88 G 23	2.4	660	41	72	3.9	0.5	0.25	1	0.1	7	0.25	0.5	25	1	13.0	3.3	9.65			
88 G 24	3.1	820	49	87	5.9	0.5	0.70	1	0.1	11	0.90	0.5	25	1	16.0	1.9	13.54			
88 G 25	8.1	650	35	69	6.3	0.5	0.25	2	0.3	10	1.00	0.5	25	1	10.0	2.2	7.47			
88 G 26	1.5	690	56	95	5.2	3.0	0.60	1	0.1	10	0.80	0.5	25	2	16.0	2.3	14.15			
88 G 27	1.6	840	42	100	5.0	0.5	1.10	2	0.1	15	0.60	0.5	25	2	22.9	2.8	13.06			
88 G 28	2.8	920	44	93	5.5	2.0	0.60	1	0.1	12	0.80	0.5	25	8	14.0	2.4	12.28			
88 G 29	3.3	670	19	38	4.0	1.0	0.60	1	0.2	9	0.70	0.5	25	1	4.8	1.2	10.02			
88 G 30	1.4	760	32	83	4.1	0.5	0.60	1	0.1	10	0.80	0.5	25	2	14.0	1.8	13.06			
88 G 31	2.0	780	53	110	5.8	0.5	1.00	1	0.1	10	0.90	0.5	25	6	29.1	4.7	10.30			
88 G 32	3.7	580	25	48	2.8	0.5	0.25	1	0.1	8	0.80	0.5	25	1	12.0	2.0	8.34			
88 G 33	3.7	390	16	42	1.7	0.5	0.25	1	0.1	4	0.25	0.5	25	110	4.4	1.1	10.07	Gold anomalous?		
88 G 34	2.4	710	49	100	5.3	2.0	0.90	3	0.1	11	1.20	1.0	25	1	28.9	3.4	8.49			
88 G 35	1.3	770	27	73	5.0	2.0	0.50	2	0.3	14	0.80	0.5	25	1	14.0	2.2	10.22			

