QUATERNARY GEOLOGY LAKE OF THE WOODS REGION NORTHWESTERN ONTARIO

PROGRESS REPORT FOR YEAR I

WABIGOON LAKE - GOLD ROCK AREAS

Prepared For:

GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF SUPPLY AND SERVICES
DSS FILE NO. 34SZ.23233-6-0158

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Contribution to Canada-Ontario
Mineral Development Agreement
1985 - 1989

March, 1987

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1.0 INTRODUCTION

This report briefly outlines progress to date on Year I activities of a four year project to study the surficial geology and till geochemistry of the Lake of the Woods Region of northwestern Ontario. This work is funded as part of the Canada-Ontario Mineral Development Agreement (COMDA) 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 Supply and Services (DSS File No. 34SZ.23233-6-0158). During Year I, work concentrated on the Wabigoon Lake (52F/NE) and Gold Rock (52F/SE) map areas (Fig. 1), approximately the eastern one-third of the project area (52F-Dryden, and 52E-Kenora).

1.1 Acknowledgements

Mr. D.R. Sharpe of the Geological Survey of Canada is the Scientific Authority for this project and Mr. Al Toren, Department of Supply and Services, the Contracting Officer. Both provided direction and assistance in a positive expeditious manner. 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 and local logistics suppliers. Laboratory services were supplied by Bondar-Clegg & Company Ltd. (Ottawa), Terramin Research Labs Ltd. (Calgary), D. Taplin Consultant Inc. (Calgary), Komex Consultants Ltd. (Calgary) and ERA Earth Resources Assessment Ltd. (Calgary). Field visits for information exchange and discussion were made by W. Coker and D. Sharpe of the Geological Survey of Canada and E. Sado and A. Bajc of the Ontario Geological Survey. Mr. Bim Waters carried out all computer applications. Each of the above mentioned contributed towards the progress of this project and their assistance is greatly appreciated.

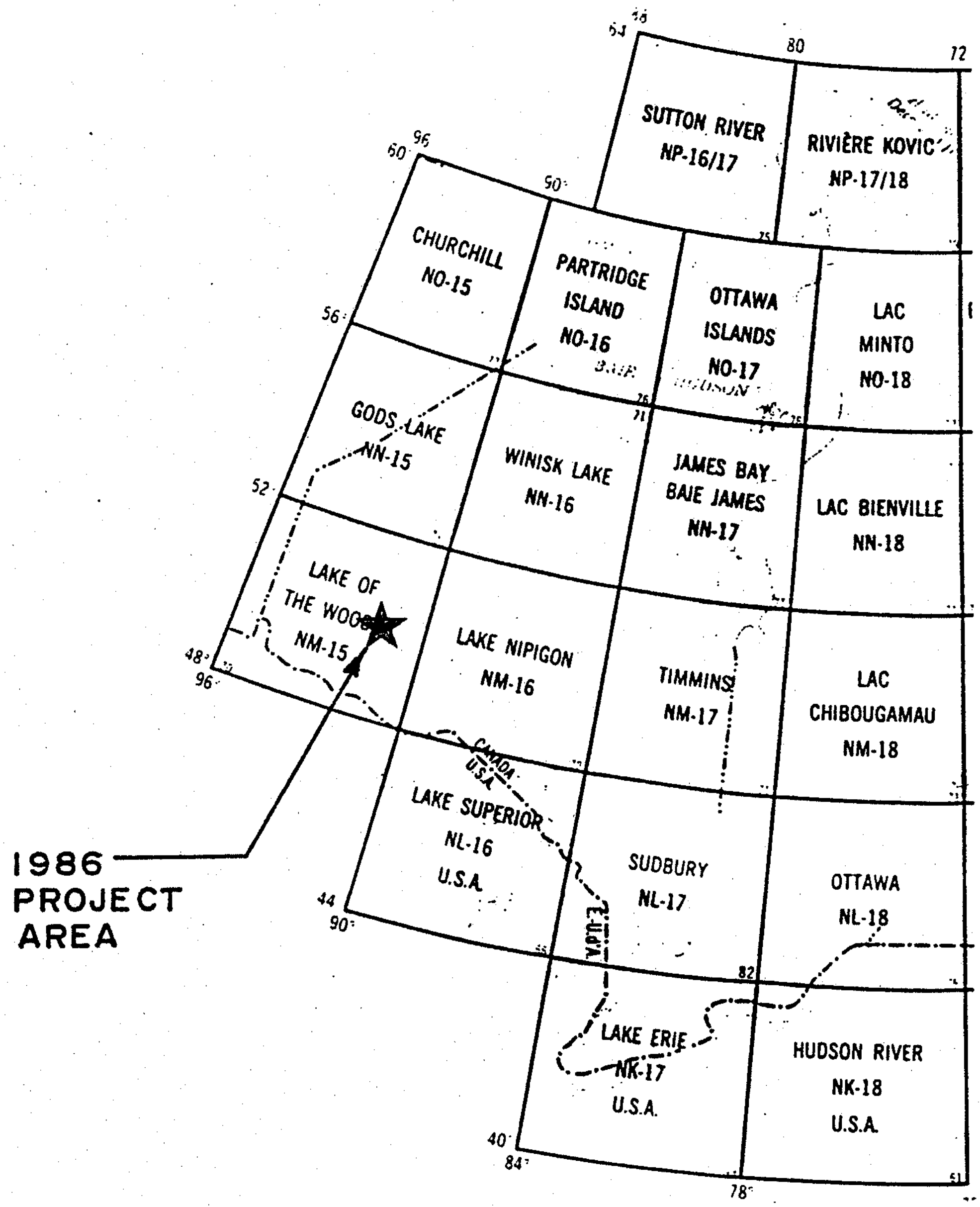

Figure 1: Location of 1986 study area

1.2 Field Work

Field work consisted of traversing most roads in the area which were passable in a 4 x 4 Dodge Ramcharger. Impassible situations consisted of washed-out bridges and culverts, deep water due to beaver ponding, or unexpected locked gates on operational forestry land. In addition, many old mineral exploration and logging roads are completely overgrown and offer little information through traversing due to zero visibility. Information was plotted on 1:50 000 and 1:60 000 (approximate) scale air photos taken about 10 years ago. More recent road locations were obtained from maps provided by the Ontario Ministry of Natural Resources in Kenora, Dryden, Fort Francis and Ignace, and from Great Lakes Forest Products Limited. These roads were replotted from generalized 1:100 000 or 1:63 360 maps to the photographs and traversed using the vehicle odometer for control. The locations from these traverses were upgraded using Landsat imagery, the odometer traverse data, and map measuring instruments.

In addition, most of the Wabigoon Lake shoreline was traversed by boat and brief aerial reconnaissance was carried out over Rowan Lake, Cameron Lake, and Upper and Lower Manitou Lakes which are all of economic interest with respect to gold mineralization. The aerial reconnaissance was primarily directed toward 1987 field work design.

Fifty five till samples were collected for laboratory analysis on an opportunistic basis due to the scattered distribution of potential sample sites. Laboratory analyses are described in subsequent sections.

1.3 Office-Laboratory Work

Office and laboratory work consisted of the preparation of surficial geology maps from air photographs; geochemical analysis of 55 till samples; petrographic analysis of heavy mineral separates of sand size materials, selected light mineral separates and pebble grade materials; major element and mineralogical analysis of clay samples; and the establishment of a computerized data bank for future manipulation of laboratory information. All analyses were carried out following standard laboratory procedures and results are presented in appendices to this report. As many of the results were acquired in very late stages of Year I, detailed interpretation of data will be presented in subsequent reports incorporating analyses of all field sampling carried out in Years II and III.

The computerized geological data base was initiated during Year I, despite a relatively small sample size, so that it could be built upon in subsequent years at little incremental cost. Work was carried out on an IBM compatible 640K personal computer using Lotus 1-2-3. Lotus 1-2-3- was selected after reviewing other data base packages and the requirements of this study.

2.0 BEDROCK GEOLOGY

2.1 Geology

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 predominantly metavolcanic and subordinate amounts of metasedimentary rocks, intruded by granitoid rocks, some of batholithic dimensions. It is bordered to the north and to the south by assemblages of predominantly metasedimentary rocks, their migmatic derivatives, and granitoid rocks that comprise portions of the English River and Quetico Subprovinces, respectively. Descriptions of the geology and mineralization of the area are given in recent papers by C.E. Blackburn et al. cited in the references. Useful mapped information is available 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.

2.2 Exploration Activity

The volcanic-sedimentary and immediately adjacent granitoid terrain is host to many small to medium scale gold deposits, the most important of which are estimated to contain 100,000 to 600,000 ounces of gold; there are dozens of other lesser but significant occurrences. Within the project area the current areas of "hot activity" are in the Wabigoon-Eagle Lakes, Manitou Lakes, Kakagi-Rowan Lakes, Shoal Lake, and Straw Lake areas (C.E. Blackburn*, pers comm. 1986). These are dispersed throughout the metavolcanic belts of the Subprovince and indicate no significant distribution preference between the Dryden East and West and Kenora portions of the project area. In addition to gold, zinc, lead-copper, zinc-gold, titanium, molybdenum and stibnite

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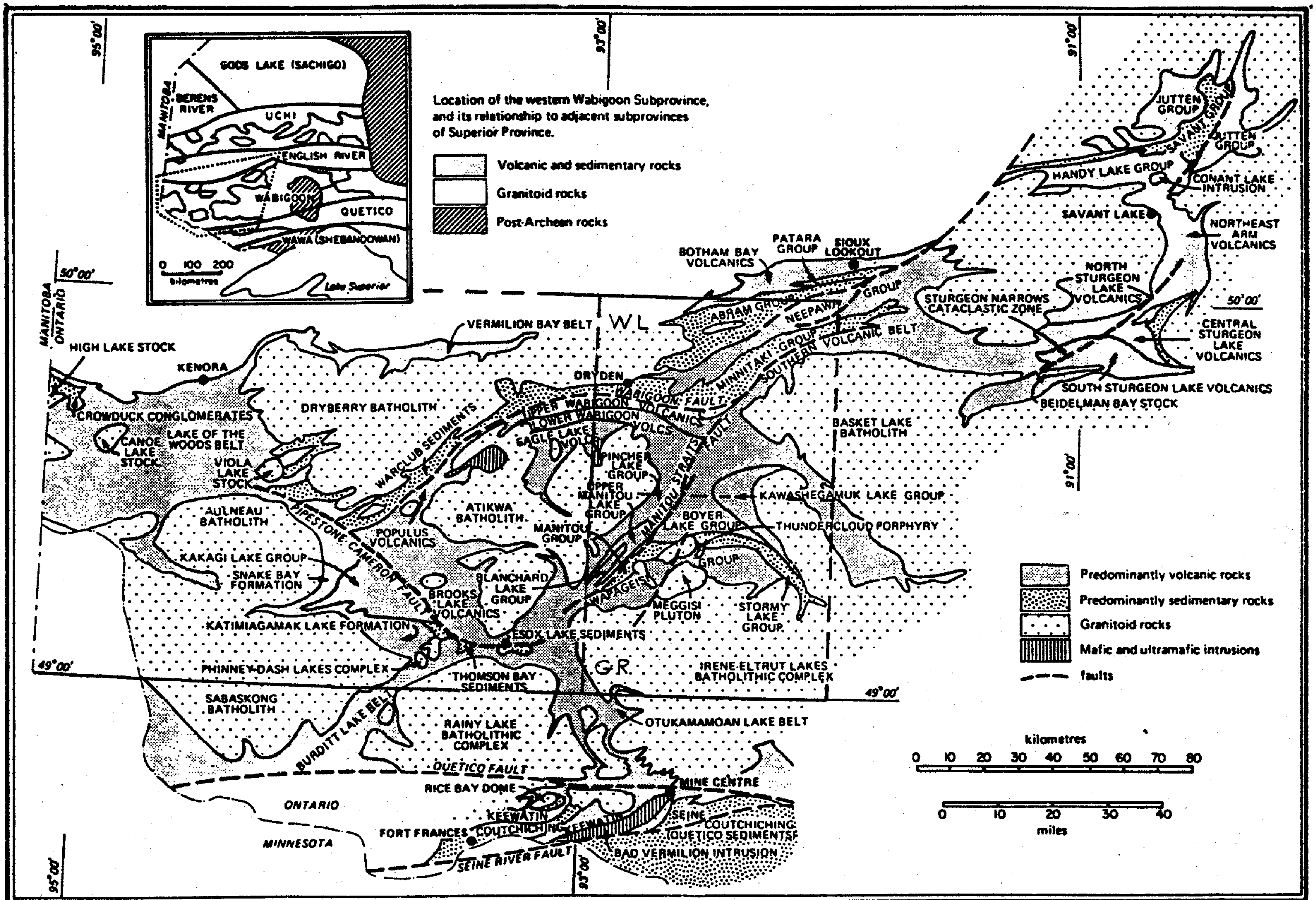

FIGURE 2: Stratigraphic units of the western Wabigoon Subprovince and its margins(from Blackburn et al. 1985b). WL indicates Wabigoon Lake area and GR Gold Rock area.

occurrences are presently undergoing or have recently undergone various degrees of exploration. Of current attention is the detailed underground exploration program of Nuinsco Resources on their Cameron Lake gold property (Northern Miner Dec. 8, 1986). Also, active exploration of a gold prospect at Flambeau Lake (near Dryden) is of immediate interest as are drilling programs being carried out by Van Horne Gold Exploration and International Platinum Corp. (Northern Miner - Dec. 8, 1986, April 20, 1987). The Quaternary geological and drift sampling aspects of this project are intended to contribute to exploration activity and enhance prospecting methodology for the area, especially in those areas with greater drift cover.

2.3 Bedrock Surface

Bedrock elevations within the project area range from less than 325m to more than 500m above sea level (a.s.l). However, the majority of the area has bedrock elevations between 350 and 450m a.s.l.. Major bedrock surface features are structural and air photo patterns are dominated by structurally and lithologically controlled elements. However, on the ground the dominiant impression is that of glacial modification in the form of rounded, polished, and striated stoss and lee rock forms; in only a few localities were rock forms not significantly glacially modified. The glacial features are primarily the result of direct glacier erosion with some overprinting due to basal glaciofluvial erosion. Ice-molded forms are generally small in scale (5-50m in long direction) and were usually larger in granitic terrain than in the generally more recessive metasedimentary and metavolcanic belts.

During the mapping of surficial materials, rock dominated areas were divided into two terrain types: 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 due to the presence of reindeer moss (Cladonia sp. lichen) on the very poor growth media provided or areas of very considerable structural control with sharp ridge and depression topography. Though not completely drift-free, these areas may be considered to be so from the point of view of construction or exploration planning; e.g., the northern segment of the Bending Lake Road (under construction) is almost entirely rock grade.

The second rock dominated terrain type is geomorphologically controlled by the rock with few or no landforms indicating the drift type. The drift may consist of thin discontinous till, a bouldery sand veneer, clay or sand and gravel. On air photos the differentation of materials is very difficult or impossible and where material types are shown it is frequently through extrapolation. This terrain type may be under-represented in places where the bedrock surface is of very low relief and rock forms are not very apparent on the air photos.

2.4 Glacially Striated Bedrock

Glacial striations are present on most fresh outcrops and are best preserved in volcanic sequences; they are usually missing on weathered, coarse-grained granitic rocks. Good stoss and lee relationships may be observed on well exposed outcrops. Striations commonly wrap-around polished outcrops with variations up to 20 degrees present on some sites. Crossed striations were rarely observed and no major significance was attributed to these, i.e., they were interpreted as representing different (e.g., early-late) phases of the same event. Striations measured ranged from 185-235 degrees in orientation with a mean value of 212 degrees for 102 direction determinations.

A histogram (Fig. 3) indicates a slightly westerly skewed distribution of values about the modal value of 210 degrees; 59 percent of all observations fell within the 205-215 degree range. This compares with an average value of 217° for 107 observations reported by Jack Satterly in 1943 for the Dryden-Wabigoon area. Early writers such as E.M. Burwash (1934), (following the work of J.B. Tyrell (1912)) suggested that more than one direction of glacial flow had affected the area. However, review of his work leads the writer to believe that flow around rock buttresses may account for the divergences he reported; Burwash (1934, Fig. 5) himself considered some of the variations in glacial flow directions to be the result of bedrock factors. Zoltai (1961) also suggested an early southerly flow and a later southwesterly flow, the latter perhaps radiating from an area between Hudson Bay and Lake Superior (Patricia Centre). From observations obtained during this survey it is suggested that the present glacial erosional features result from a major Lake Wisconsin southwesterly flow of ice from the Labrador Sector of the Laurentide ice sheet; within the literature, southwesterly flowing ice covering the region is frequently referred to as the Rainy Lobe.

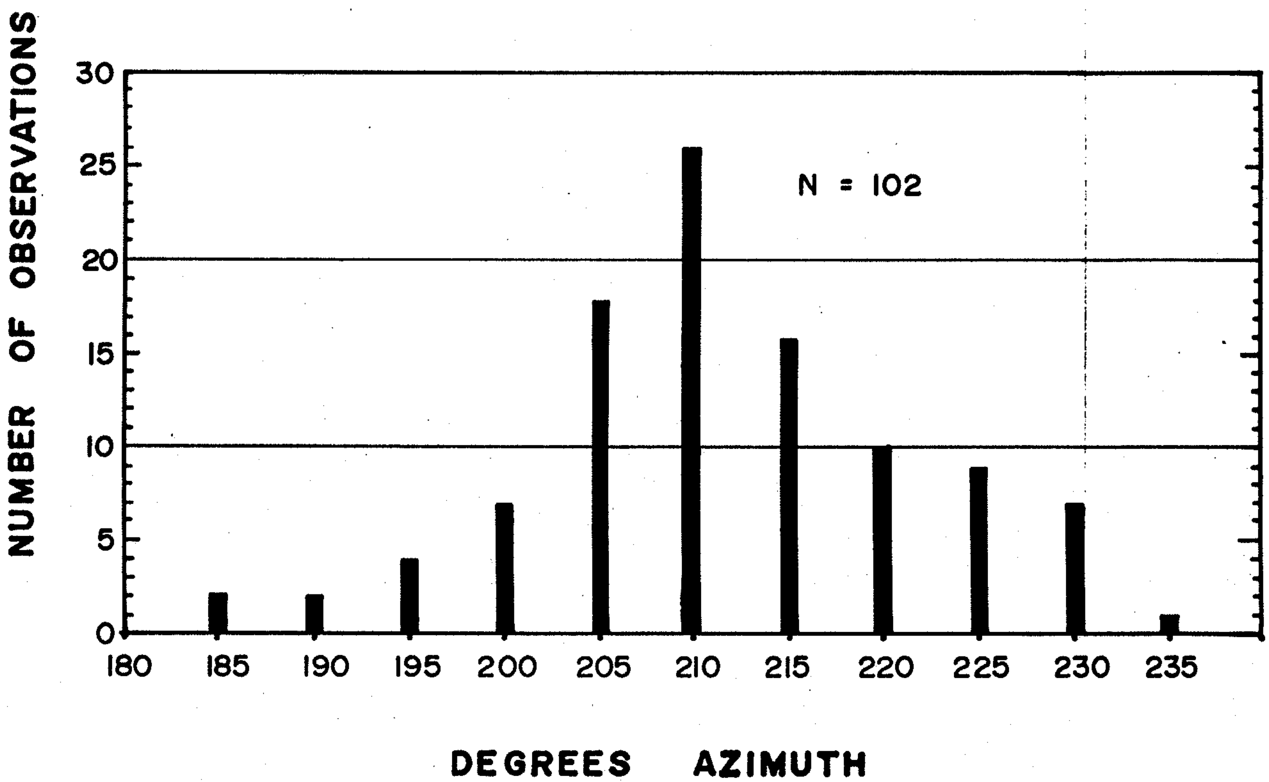

FIGURE 3: HISTOGRAM SHOWING DISTRIBUTION OF GLACIAL STRIATIONS

3.0 SURFICIAL MATERIALS

3.1 Introduction

This section describes Quaternary age surficial materials occurring within the 1986 study area.

With the exception of three end moraines which traverse the area, and thick glacial lake deposits in the vicinity of Dryden, the drift cover is thin and sporadic. Over much of the area, glacial sediment occurs only as shallow pockets in rock depressions or on the lee side of rock knobs. A dominant percentage of the drift is deglacial in nature and only a small fraction of the total drift in the area is basal till of lodgement or melt-out origin.

Deglaciation of the study area occurred generally between 11000 and 9500 radiocarbon years B.P..

3.2 End Moraines

Three major end moraines transect the area in a northwest-southeast direction: from west to east these are the Eagle-Finlayson Moraine, the Hartman Moraine and the Lac Seul Moraine (for dicussion of Moraine terminology, see Elson 1961, Zoltai 1961, and Prest 1963). The moraines are cored by glaciofluvial ice-contact stratified drift, much of which may be sub-aqueous outwash in origin, though bedrock knobs may occur. Sediments are sand dominant with local concentration of pebble and cobble gravel. As well, a soft sand diamicton is very common in some areas; this is interpreted as representing glacial debris deposited sub-aqueously with little or no modification during deposition. This diamicton is texturally similar to tills found within the region, the principal difference being the softness. Within all three moraines, interbedded till units have been found near or at the top of the stratified sequences. These usually demonstrate evidence of deposition within an aqueous environment and are considered to be normal occurrences within the fluvial ice-contact environment and do not represent glacier readvance or overriding. Zoltai (1961; pers comm. 1987) considered that surface till occurrences on the southeastern section of the Eagle-Finlayson Moraine represent later glacier overriding. To date the author has seen no significant evidence to indicate that the moraines represent glacier readvances; they are considered to represent still-stands during retreat within the area under study.

Moraine morphology appears to occur in three major modes. Firstly, all moraines were deposited in contact with Glacial Lake Agassiz and were considerably modified by wave action both on the face of the moraines and by overtopping. The Eagle-Finlayson Moraine has perhaps been most modified by wave action, in many places being flat-topped with shoreline features on it's upper surface. Secondly, sections of the moraines, particularly the Hartman Moraine, were deposited in a subaerial environment demonstrating original ice-contact topography, multiple ridges, and considerable associated pitted outwash. Thirdly, sections of all three moraines consist of very narrow linear ridges with concentrations of very large boulders along the crest line. Though these ridges have been previoulsy interpreted as eskers by Roed (1980a, 1980b), their original interpretation as moraines is adhered to in this study; in general they bear little or no resemblance to typical eskers. The origin of the boulder concentrations is of some interest as the majority of the drift within the moraines is not boulder-rich so that a first glance "winnowing out" does not seem plausible at this time. In some instances, the boulder concentrations are located immediately at the upper edge of the ice-contact slope. It is suggested that the concentrations represent a combination of primary deposition of supra-glacial and englacial boulders being transported to the ice marginal position and a winnowing effect of Lake Agassiz.

The origin of these end moraines deserves discussion and further study. Within the Agassiz Basin these moraines present remarkably long, curvilinear features with the previously mentioned narrow, boulder-crested ridges being somewhat unusual. Perhaps they are analogous with the arcuate Sakami Moraine of Nouveau-Quebec which Hillaire-Marcel (Hillaire-Marcel and Vincent, 1979) attributed to the grounding of a floating, calving ice margin. They referred to the Sakami Moraine as a "re-equilibration moraine", the almost perfect arc forming during retreat of a floating ice front and the grounding occurring during drainage of Glacial Lake Ojibway into the lower postglacial Tyrrell Sea. This analogy was previously suggested by the writer (Cowan, 1980) and will be pursued further during this project.

3.3 Till Deposits

Within the area mapped in 1986, till occurs in two principal modes: 1) as thin discontinuous patches of basal till in the rock dominated terrain; and 2) as thin beds or lenses within the uppermost sediments of end moraines. The latter were deposited in or near aqueous environments of Lake Agassiz. Though interpreted as till, these materials may grade laterally into sandy diamictons; they may contain sand lenses; and/or they may contain much dispersed free sand. Tills observed are generally of a sandy to sandy silt texture and olive-grey in colour when unoxidized. Calcium carbonate content varies from very low to sufficient to provide a strong reaction when treated with dilute HCl; the $CaCO_3$ is believed to be derived dominantly from volcanic assemblages within the greenstone belts as very little evidence of Paleozoic rock materials has been found to date by the writer though Zoltai (1961) reported well-worn pebbles of limestone, grey chert and mudstone from near Vermillion Bay and north of Dryden. Though previous mappers have mapped bedrock with patchy till as ground moraine (eg, Prest 1963; Zoltai 1965), this practice was not adhered to for this study as virtually all till areas obtain their morphology from underlying bedrock. No drumlins were observed in the area and only one small area was identified as fluted till.

No stratigraphic sections containing more than one till were found during the 1986 field studies. Till thickness varies from zero to perhaps six meters with greatest thicknesses occurring on protected slopes and the lee side of rock knobs. In general, till more than 1.5m thick is rare. Because most of the area was modified by the waters of Lake Agassiz, the till generally has a washed upper surface and in many instances has been washed completely away.

Size Composition

Till samples for the area were split into three fractions: plus #10 mesh; minus #10 - plus #230; and minus #230 mesh sieves; i.e., gravel, sand and fines (silt and clay). Gross compositon of tills for the area (excluding coarse gravel, cobbles and boulders is 22% gravel, 54% sand and 23% fines. Twenty five mechanical and hydrometer analyses were carried out on the minus 2mm (#10 mesh fraction) and the samples processed divided into three groups - those lying upon greenstone terrain; those lying upon granitic terrain; and those occurring as till units within end moraine features. Results are shown in Table 1 and Fig. 4. It is apparent that tills located on greenstone and granitic terrains are essentially similar in terms of grain size distribution whereas those samples obtained from end moraine sites contain more sand and less clay. Till samples obtained from the end morraines are considered to be flow tills or melt-out tills deposited in the presence of considerable meltwater or as slurries; this appears to have resulted in the winnowing or flushing out of 10-15% of the silt and clay size material.

Descriptively, the tills may be described as sand, sandy loam, loam, or sandy silt tills depending on the silt content.

TABLE I: GRAIN SIZE ANALYSIS OF TILL SAMPLES (-#10 MESH FRACTION)

Till Type	N	Sand		Silt		Clay		Md (mm)	
		Range	Mean	Range	Mean	Range	Mean	Range	Mean
Greenstone Terrain	10	59-81 ,	62	17-38 ,	33	2-7 ,	5	0.09-0.22 ,	0.121
Granitic Terrain	9	52-74 ,	60	25-40 ,	34	1-12 ,	6	0.066-0.22 ,	0.115
End Moraines	6	69-84 ,	76	14-28 ,	22	2-3 ,	2	0.16-0.28 ,	0.20
TOTAL SAMPLES	25	52-84 ,	64	14-40 ,	31	1-12 ,	5	0.066-0.28 ,	0.138

Gross composition of all till matrix, excluding cobbles and boulders, is 22% gravel, 54% sand, and 23% silt and clay.

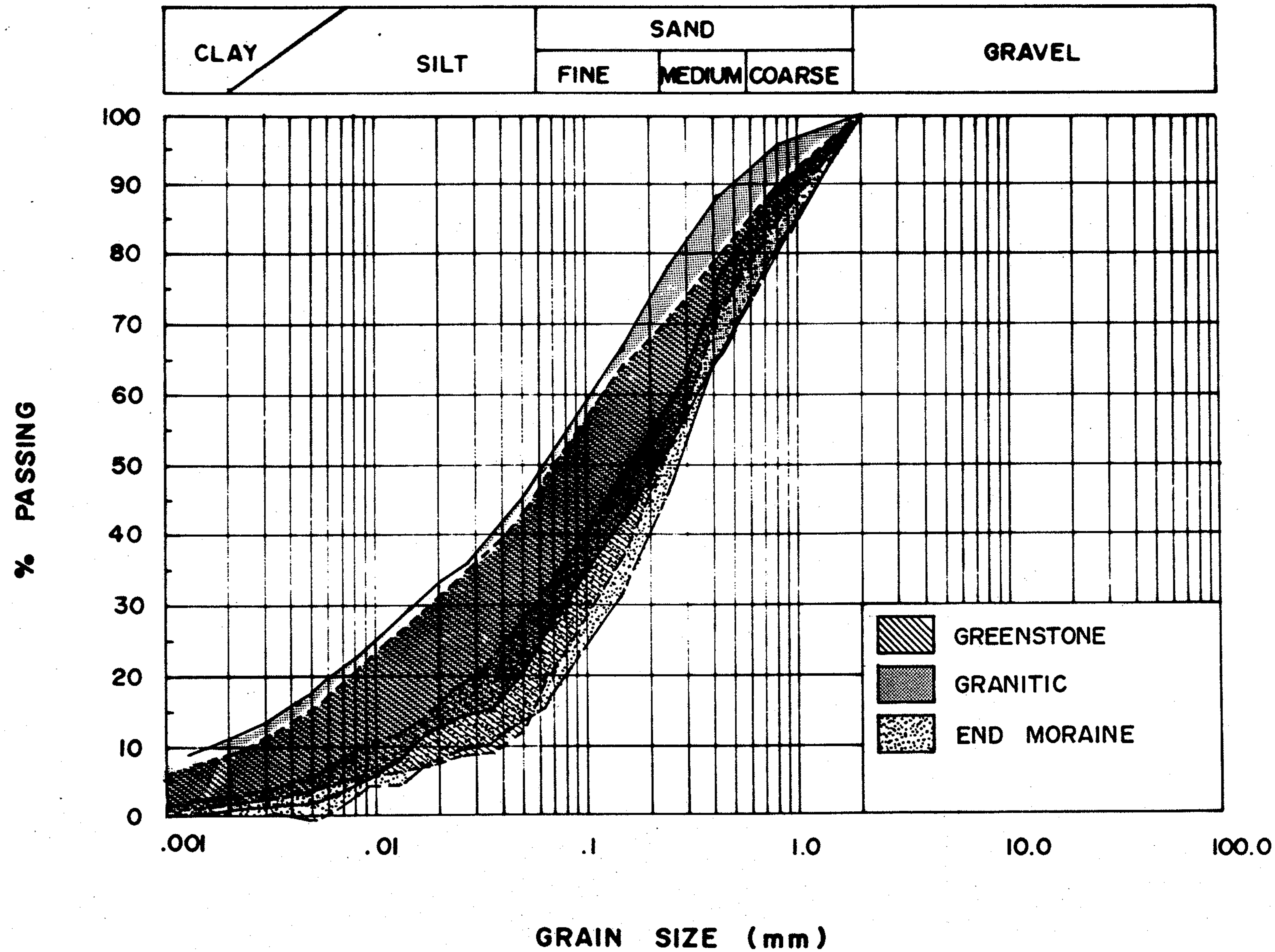

FIGURE 4 - GRAIN SIZE ENVELOPES FOR TILL SAMPLES COLLECTED FROM GRANITIC TERRANES, GREENSTONE TERRANES AND FROM END MORAINE DEPOSITS.

Pebble Lithology

Lithologic determinations on pebble grade material were made for all till samples collected. Raw data are presented in Appendix "C" and summary statistics are presented in Table 2. Determinations were generally made on pebbles in the 0.5 - 3 cm size range; however, for seven samples, where pebbles were not collected in the field, determinations were made on material retained on the #10 mesh sieve (2mm) during processing of the till samples.

Table 2 provides means, ranges and standard deviations for all samples as well as for sample groups for till overlying greenstone on 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 with a resultant overlapping of data. As anticipated, the granitic terrain samples contained statistically significant more granitoid rocks and less volcanic rocks than did the greenstone terrain. Pegmatite and ultramafic rocks are generally more common on granitic and greenstone terrains respectively, however, these rock types fluctuate greatly in occurrence.

Only one limestone pebble was found in the samples (sample 86D5), indicating little or no influx of Paleozoic material from the Hudson Bay Lowland. This observation is confirmed by light mineral analysis of sand size materials from till discussed in a later section. Only one fragment of iron formation was determined and no iron formation or Omarolluk Formation greywacke of Hudson Bay Region provenance were observed in samples or inthe field though this does not exclude their presence.

TABLE: 2

PEBBLE LITHOLOGY STATISTICS

	GR	PG	GN	MS	SS	AR	IF	MV	CM	FV	UM	LS	DS	QZ	GB	OTH	TOT	<Variable names
ALL DATA																		
Number >	55	55	55	55	55	0	55	55	55	55	55	55	55	55	55	55	55	<Number of valid data
Maximum >	94	6	30	14	17		2	75	9	47	14	1	0	6	11	0	100	<Maximum
Minimum >	3	0	0	0	0		0	2	0	0	0	0	0	0	0	0	100	<Minimum
Average >	41	1	5	4	3		0	32	0	12	1	0	0	1	0	0	100	<Average, arithmetic mean
Stan-Dev>	28	2	6	4	4		0	20	1	12	2	0	0	1	2	0	0	<Standard Deviation
Coef-Var>	69%	186%	118%	86%	111%		579%	62%	566%	98%	325%	735%	ERR	187%	445%	ERR	0%	<Coefficient of Variation = Std-Dev/Avg
GRANITE																		
Number >	23	23	23	23	23	0	23	23	23	23	23	23	23	23	23	23	23	<Number of valid data
Maximum >	94	6	18	8	9		0	58	0	47	7	0	0	2	0	0	100	<Maximum
Minimum >	18	0	0	0	0		0	2	0	0	0	0	0	0	0	0	100	<Minimum
Average >	60	1	8	3	2		0	18	0	7	0	0	0	0	0	0	100	<Average, arithmetic mean
Stan-Dev>	24	2	6	3	3		0	16	0	11	1	0	0	1	0	0	0	<Standard Deviation
Coef-Var>	41%	148%	79%	85%	116%		ERR	86%	ERR	165%	290%	ERR	ERR	209%	ERR	ERR	0%	<Coefficient of Variation = Std-Dev/Avg
GREENSTONE																		
Number >	32	32	32	32	32	0	32	32	32	32	32	32	32	32	32	32	32	<Number of valid data
Maximum >	83	4	30	14	17		2	75	9	38	14	1	0	6	11	0	100	<Maximum
Minimum >	3	0	0	0	0		0	6	0	1	0	0	0	0	0	0	100	<Minimum
Average >	27	0	4	5	4		0	41	0	16	1	0	0	1	1	0	100	<Average, arithmetic mean
Stan-Dev>	22	1	6	4	4		0	16	2	11	2	0	0	1	2	0	0	<Standard Deviation
Coef-Var>	82%	204%	162%	81%	100%		437%	39%	427%	68%	327%	557%		162%	333%		0%	<Coefficient of Variation = Std-Dev/Avg
SUMMARY																		
t test >	4.2	2.1	2.5	-1.7	-1.9		-1.1	-4.2	-1.1	-2.9	-0.4	-0.9		-1.7	-1.4			<Statistical test for similar averages
Sig .05 >	0	0	0	1	1		1	0	1	0	1	1		1	1			<If 1; then granite = greenstone, @ 95%
Sig .01 >	0	1	1	1	1		1	0	1	0	1	1		1	1			<If 1; then granite = greenstone, @ 99%
F test >	1.2	4.8	1.2	2.1	2.5		ERR	1.0	ERR	1.0	2.9	ERR		4.9	ERR			<Statistical test for similar std-dev
Sig .05 >	1	0	1	1	0		ERR	1	ERR	1	0	ERR		0	ERR			<If 1; then granite = greenstone, @ 95% approx
Sig .02 >	1	0	1	1	1		ERR	1	ERR	1	0	ERR		0	ERR			<If 1; then granite = greenstone, @ 98% approx
	GR	PG	GN	MS	SS	AR	IF	MV	CM	FV	UM	LS	DS	QZ	GB	OTH	TOT	<Variable names

<Long variable names

GRanitoid
PeGmatite
GNeiss & schist
MetaSeds (undivided)
SandStone & greywacke
ARgillite & siltstone
Iron Formation
Mafic Volcanics
Carbonatized Mafic volcanics
Felsic Volcanics
UltraMafics
LimeStone
DoloStone
QuartZ-vein
GaBbro
OTHer; none found
TOTal percent

Heavy Minerals

Heavy mineral separations were made for sand size materials using tetrabromoethane (S.G. 2.96). Three fractions were prepared: -10 to +40 mesh; -40 to +80 mesh; and -80 to +230 mesh. The -40 to +80 fraction was selected for microscopic determinations as the coarser fraction generally contained too much lithic material while the finer fraction was more difficult to assess due to small grain sizes. Ten fine samples were analyzed to compare with the -40 to +80 fraction. It was found that the mineralogy of the two size fractions is essentially the same and that there is no strong statistically significant difference between the mineral percentages from the finer fraction and those from the -40 to +80 mesh fraction.

Heavy minerals were counted with a binocular microscope with all grains being identified and counted in successive squares until the total of heavy minerals (minus unknown grains) was over 200. Some samples were heavily coated with an iron stained, clayey rind which made identification difficult, particularly with 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.

Raw data for heavy mineral analyses are presented in Appendix "D" while summary statistics are given in Table 3 for the total sample (55) and for grouped data for greenstone (32 samples) and granitic (23 samples) terrains. Heavy minerals in both terrains are dominated by hornblende which comprises about two-thirds of all samples within a range of 45-85 percent. Pyrite, tremolite-actinolite, and epidote form major components combining with the hornblende to form more than 90 percent of the heavy mineral composition of most samples.

KENORA-DRYDEN

TABLE: 3

HEAVY MINERAL STATISTICS

	L-10	HM-10	HN-10	L-40	HM-40	HN-40	L-80	HM-80	HN-80	LTOT	HMTOT	HNTOT	HTOT	TOTAL	HPC	HMPC	HRN	TRM	PYR	EPI	APA	BIO	MUS	GAR	TOU	SUL	UNK	OTH	TOT	<Variable names
ALL DATA																														
Number >	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	<Number of valid data
Maximum >	301.74	5.32	60.48	148.39	2.06	17.72	303.89	4.10	38.16	610.85	9.79	96.75	99.17	637.41	36.0	22.7	85	41	29	15	9	20	3	3	7	3	7	0	100	<Maximum
Minimum >	12.66	0.02	0.15	12.56	0.02	0.22	40.54	0.04	0.21	87.10	0.13	2.13	2.48	89.72	0.9	2.4	46	1	4	0	0	0	0	0	0	0	0	0	100	<Minimum
Average >	123.21	0.58	6.56	71.35	0.33	3.68	127.09	0.66	5.06	321.65	1.57	15.30	16.87	338.52	5.1	10.4	67	8	13	5	2	3	0	1	0	0	2	0	100	<Average, arithmetic mean
Stan-Dev>	57.60	0.82	9.42	27.66	0.32	3.38	57.16	0.69	6.24	120.92	1.63	16.71	17.92	124.90	5.4	4.2	10	7	5	4	2	4	1	1	1	0	2	0	0	<Standard Deviation
Coef-Var>	47%	142%	144%	39%	97%	92%	45%	104%	123%	38%	104%	109%	106%	37%	106%	41%	15%	84%	42%	78%	89%	138%	395%	111%	303%	384%	80%		0%	<Coefficient of Variation = Std-Dev/Avg
GRANITE																														
Number >	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	<Number of valid data
Maximum >	274.64	3.17	24.47	148.39	1.19	17.72	303.89	4.10	38.16	610.85	8.46	66.62	75.08	637.41	20.7	21.2	85	41	23	8	9	20	0	2	1	0	7	0	100	<Maximum
Minimum >	63.55	0.05	1.28	44.22	0.08	0.74	65.66	0.08	0.21	193.94	0.64	4.13	4.89	225.04	1.5	4.4	46	3	4	0	0	0	0	0	0	0	0	0	100	<Minimum
Average >	136.15	0.52	5.91	84.54	0.34	4.05	144.42	0.69	5.59	365.11	1.56	15.55	17.10	382.21	4.7	9.7	68	9	11	3	2	4	0	1	0	0	2	0	100	<Average, arithmetic mean
Stan-Dev>	51.66	0.62	4.67	28.55	0.25	3.47	61.04	0.78	7.84	113.13	1.58	14.00	15.39	116.35	4.2	3.8	9	9	5	2	2	5	0	1	0	0	2	0	0	<Standard Deviation
Coef-Var>	38%	119%	79%	34%	75%	86%	42%	113%	140%	31%	102%	90%	90%	30%	89%	39%	13%	107%	44%	63%	86%	125%	469%	137%	162%	ERR	89%		0%	<Coefficient of Variation = Std-Dev/Avg
GREENSTONE																														
Number >	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	<Number of valid data
Maximum >	301.74	5.32	60.48	98.32	2.06	14.59	262.18	2.64	23.09	589.37	9.79	96.75	99.17	608.50	36.0	22.7	83	17	29	15	7	6	3	3	7	3	7	0	100	<Maximum
Minimum >	12.66	0.02	0.15	12.56	0.02	0.22	40.54	0.04	0.25	87.10	0.13	2.13	2.48	89.72	0.9	2.4	46	1	6	0	0	0	0	0	0	0	0	0	100	<Minimum
Average >	113.91	0.61	7.03	61.86	0.32	3.42	114.63	0.64	4.69	290.41	1.57	15.13	16.70	307.11	5.4	10.9	66	7	14	5	2	2	0	1	0	0	2	0	100	<Average, arithmetic mean
Stan-Dev>	59.81	0.93	11.68	22.67	0.36	3.30	50.66	0.61	4.74	116.60	1.67	18.41	19.53	121.34	6.1	4.4	10	4	5	4	2	1	1	1	1	1	2	0	0	<Standard Deviation
Coef-Var>	53%	152%	166%	37%	112%	97%	44%	95%	101%	40%	106%	122%	117%	40%	114%	41%	15%	52%	39%	75%	89%	85%	311%	96%	291%	286%	73%		0%	<Coefficient of Variation = Std-Dev/Avg
SUMMARY																														
t test >	1.4	-0.4	-0.4	3.0	0.2	0.7	1.9	0.3	0.5	2.3	.0	0.1	0.1	2.2	-0.4	-1.0	0.8	0.6	-1.8	-2.2	1.2	2.4	-1.4	-1.6	-1.0	-1.6	-0.7			<Statistical test for similar averages
Sig .05 >	1	1	1	0	1	1	1	1	1	0	1	1	1	0	1	1	1	1	1	0	1	0	1	1	1	1	1			<If 1; then granite = greenstone, @ 95%
Sig .01 >	1	1	1	0	1	1	1	1	1	1	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 >	1.3	2.2	6.2	1.6	2.0	1.1	1.5	1.7	2.7	1.1	1.1	1.7	1.6	1.1	2.1	1.4	1.2	5.5	1.2	3.8	1.6	13.5	73.3	1.4	19.8	ERR	1.1			<Statistical test for similar std-dev
Sig .05 >	1	0	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	0	1	0	0	1	0	ERR	1			<If 1; then granite = greenstone, @ 95% a
Sig .02 >	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	0	1	0	0	1	0	ERR	1			<If 1; then granite = greenstone, @ 98% a
	L-10	HM-10	HN-10	L-40	HM-40	HN-40	L-80	HM-80	HN-80	LTOT	HMTOT	HNTOT	HTOT	TOTAL	HPC	HMPC	HRN	TRM	PYR	EPI	APA	BIO	MUS	GAR	TOU	SUL	UNK	OTH	TOT	<Variable names

-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

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

HoRNblende
TReMolite+actinolite
PYRoxene
EPIdote
APAtite
BIOtite
MUScovite
GARnet
TOUrmaline
SULfides
UNKnowns
OTHer; none found

TOTal percent
<Long variable names
<
<

Visual examination of samples taken from sites adjacent to mineral showings, trenches or old mine workings do not portray any major differences from average values for the most part. One possible exception is sample 11 (Flambeau Lake gold showing) which contained higher than average amounts of tourmaline, pyrite and unidentified sulphides; however, samples 12 and 13 from the same showing, while maintaining relatively high pyrite content, did not maintain high tourmaline and unidentified sulphide contents.

No gold grains were identified during examination of heavy minerals, probably due to the relatively small initial sample sizes. In the unknown category, nearly 5 percent of sample 41 is suggested as possibly corundum.

Light Minerals - Sand Fraction

A preliminary evaluation of the mineralogy of light minerals was carried out on ten selected samples, five from greenstone terrain and five from granitic terrain. Analysis was carried out on -40 to +80 mesh reject material from the heavy mineral separation. Two of the samples were cleaned within the -40 to +60 range due to coatings. Results shown in Table 4 indicate that quartz averages 90 percent of the total sample with feldspar and mica being more prominent in granitic terrain samples at the expense of quartz. No material identifiable as Paleozoic limestone was observed. Sparry crystals were present as a trace in all samples. These were non-caleareous, colourless, vitreous, transparent, and usually elongate with good parallel cleavage; these may have been celestite or, in part, quartz. No significant conclusions may be drawn from such a small sample size; however, the gross lithology of light minerals in the sand size materials is apparent.

TABLE 4: MINERALOGY OF LIGHT MINERALS FROM SAND SIZE MATERIALS IN TILL

TERRAIN	N	QUARTZ $\overline{X}$ (RANGE)	FELDSPAR $\overline{X}$ (RANGE)	MICA $\overline{X}$ (RANGE)	SPARRY CRYSTALS $\overline{X}$ (RANGE)
Greenstone	5	93 (90-86)	4 (2-6)	2 (0-7)	1 (0-1)
Granitic	5	87 (80-94)	6 (5-9)	6 (0-15)	1 (0-3)
TOTAL	10	90 (80-96)	5 (2-9)	4 (0-15)	1 (0-3)

Samples Used: Greenstone - 3, 4, 5, 31, 42;
Granitic - 28, 29, 34, 39, 45

Geochemical Analysis

Geochemical analysis of the 55 till samples was carried out by Bondar-Clegg & Company Ltd. of Ottawa using standardized procedures currently utilized by the G.S.C.. Raw data are provided in Appendix "E" under two title blocks - Atomic Absorption (AA) and Neutron Activation. Summary statistics for this data are provided in Tables 5 and 6. Within the atomic absorption tables all values were obtained by AA except Arsenic (colourmetric), Uranium (delayed neutron activation) and $CaCO_3$ equivalent (Leco carbon determinator). Analyses were carried out on the less than 2M m fraction. No interpretation of the data has been carried out by a geochemist to date. The following comments are very general.

Calcium carbonate equivalent shows a very wide range of values with the highest values being associated with gold mineralization in the Flambeau Lake-Larsen Bay area southwest of Dryden. Low values include some leached samples which had not been removed for this preliminary analysis. Though average $CaCO_3$ content for greenstone areas is higher than for the granitic terrain, the difference is difficult to assess due to the very high ranges within the greenstone area. The statistical treatment present in Table 5 indicates the difference is significant through analysis of variance but not through use of the 't' test. Most of the $CaCO_3$ is believed to be derived from volcanic sequences.

Visual inspection of Table 5 suggests that most elements occur within normal range limits for igneous and volcanic rocks. Statistical tests indicate that Cr, Fe, Ca, Pb, As, and U have significantly different concentrations between the granitic and greenstone terrains as might be expected. Several relatively high values for uranium are indicated for samples 29, 30, 41 and 52; all are from granitoid or gneissic terrain.

Table 6 provides geochemical statistics for neutron activation data provided in Appendix "E". As might be anticipated, numerous elements show statistical differences between the greenstone and granitic terrains, notably gold and uranium. Several samples indicate relatively high gold values - 10, 11, 13, 22, 14, 46 and 51. Of these, 11 and 13 are adjacent to the Flambeau Lake prospect; 22 is located east of the Gold Rock mining area; and 24 is located at a prospect near Avery Lake. Samples 10, 46 and 51 are all from thin till units within end moraine deposits and therefore present real challenges in terms of genetic interpretation. Sample 10 contains gold in a concentration of 34 PPB, approximately .1 ounce per ton.

As with the AA, samples 29, 30, 41 and 52 have relatively high uranium values; these are accompanied by high thorium values, especially samples 29 and 30 which are from granitic terrain of the White Otter Lake Pluton. Although both of these samples are obtained from close proximity of bedrock, they are also associated with the Eagle-Finlayson Moraine which may complicate any attempt to carry out drift prospecting interpretations.

TABLE: 5

GEOCHEMISTRY (ATOMIC ABSORBTION) STATISTICS

	CTOT	CORG	CIN	CEQ	Cr	Mn	Fe	Co	Ni	Cu	Zn	Mo	Ag	Pb	As	U	<Variable names
ALL DATA																	
Number >	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	<Number of valid data
Maximum >	11.00	4.00	7.00	58.31	220	1600	7.8	44	229	660	236	4.0	0.50	69	154	53.7	<Maximum
Minimum >	0.11	0.01	0.02	0.17	20	170	2.2	9	17	26	47	0.5	0.05	5	2	1.3	<Minimum
Average >	1.74	0.38	1.36	11.36	81	636	4.9	24	75	165	109	0.8	0.11	20	18	5.9	<Average, arithmetic mean
Stan-Dev>	1.94	0.70	1.31	10.89	33	345	1.4	9	39	128	31	0.8	0.10	11	23	8.7	<Standard Deviation
Coef-Var>	111%	186%	96%	96%	41%	54%	28%	35%	52%	77%	28%	96%	91%	58%	129%	146%	<Coefficient of Variation = Std-Dev/Avg
GRANITE																	
Number >	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	<Number of valid data
Maximum >	4.07	0.81	3.26	27.16	220	1200	7.7	38	129	250	209	4.0	0.30	69	26	53.7	<Maximum
Minimum >	0.22	0.01	0.14	1.17	20	240	2.2	9	17	42	47	0.5	0.05	5	2	1.3	<Minimum
Average >	1.26	0.17	1.09	9.09	74	560	4.2	21	63	122	103	0.8	0.09	22	10	9.4	<Average, arithmetic mean
Stan-Dev>	0.89	0.19	0.74	6.20	42	292	1.4	8	31	58	30	0.8	0.08	15	8	12.5	<Standard Deviation
Coef-Var>	71%	110%	68%	68%	56%	52%	33%	39%	50%	47%	29%	100%	85%	69%	80%	132%	<Coefficient of Variation = Std-Dev/Avg
GREENSTONE																	
Number >	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	<Number of valid data
Maximum >	11.00	4.00	7.00	58.31	128	1600	7.8	44	229	660	236	4.0	0.50	32	154	8.3	<Maximum
Minimum >	0.11	0.01	0.02	0.17	38	170	3.5	12	23	26	68	0.5	0.05	6	3	1.5	<Minimum
Average >	2.09	0.53	1.56	12.99	86	690	5.4	26	83	196	114	0.8	0.12	17	24	3.4	<Average, arithmetic mean
Stan-Dev>	2.37	0.88	1.56	13.02	25	369	1.1	8	41	153	30	0.8	0.11	6	28	1.5	<Standard Deviation
Coef-Var>	113%	165%	100%	100%	29%	54%	20%	32%	49%	78%	27%	93%	92%	36%	119%	43%	<Coefficient of Variation = Std-Dev/Avg
SUMMARY																	
t test >	-1.6	-1.9	-1.3	-1.3	-1.3	-1.4	-3.2	-1.9	-1.8	-2.1	-1.3	-0.2	-1.0	1.6	-2.2	2.5	<Statistical test for similar averages
Sig .05 >	1	1	1	1	1	1	0	1	1	0	1	1	1	1	0	0	<If 1; then granite = greenstone, @ 95%
Sig .01 >	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	<If 1; then granite = greenstone, @ 99%
F test >	7.0	22.5	4.4	4.4	2.9	1.6	1.6	1.0	1.7	7.0	1.0	1.0	1.9	5.9	12.5	69.4	<Statistical test for similar std-dev
Sig .05 >	0	0	0	0	0	1	1	1	1	0	1	1	1	0	0	0	<If 1; then granite = greenstone, @ 95% approx
Sig .02 >	0	0	0	0	0	1	1	1	1	0	1	1	1	0	0	0	<If 1; then granite = greenstone, @ 98% approx
	CTOT	CORG	CIN	CEQ	Cr	Mn	Fe	Co	Ni	Cu	Zn	Mo	Ag	Pb	As	U	<Variable names
	Carbon-TOTal	Carbon-ORGanic (C fix.)	Carbon-INorganic	CaCo3-EQuivalent	Chromium	Manganese	Iron	Cobalt	Nickel	Copper	Zinc	Molybdenum	Silver	Lead	Arsenic	Uranium	<Long variable names < <
	0.01	0.01	0.01	0.08	2	1	0.1	1	2	1	1	1	0.1	2	2	1	<Detection limit

KENORA-DRYDEN

TABLE: 6

GEOCHEMISTRY (NEUTRON ACTIVATION) STATISTICS

	Sc	Cr	Fe	Co	Ni	Zn	As	Se	Rb	Mo	Ag	Cd	Sb	Cs	Ba	La	Eu	Tb	Yb	Hf	Ta	W	Ir	Au	Th	U	WT	<Variable names
ALL DATA																												
Number >	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	<Number of valid data
Maximum >	82.8	400	13.0	65	270	330	207.0	7	260	12.0	2.0	<5	5.2	34.0	1000	93	5.0	2.6	9	7	2.8	7.0	<50	34	352.0	62.5	9.29	<Maximum
Minimum >	5.8	23	2.7	9	10	50	1.4	2	35	0.5	1.0	<5	0.2	2.8	270	19	0.5	0.2	1	2	0.2	0.5	<50	1	5.2	1.3	2.02	<Minimum
Average >	18.9	146	7.1	32	94	170	20.1	2	116	3.0	1.3	<5	0.8	8.9	632	45	1.1	0.8	2	5	1.2	2.0	<50	7	36.4	6.2	5.90	<Average, arithmetic mean
Stan-Dev>	11.1	64	2.3	13	48	70	30.2	1	47	1.8	0.3		0.8	4.8	172	18	0.9	0.4	1	1	0.5	1.5		8	51.5	9.9	1.43	<Standard Deviation
Coef-Var>	59%	44%	32%	41%	51%	42%	151%	33%	41%	61%	24%		105%	54%	27%	41%	80%	54%	56%	25%	46%	75%		104%	142%	159%	24%	<Coefficient of Variation = Std-Dev/Avg
GRANITE																												
Number >	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	<Number of valid data
Maximum >	30.6	400	11.0	52	160	280	34.0	7	260	5.0	2.0	<5	1.4	20.0	940	93	2.0	1.8	4	7	2.8	5.0	<50	16	352.0	62.5	7.74	<Maximum
Minimum >	5.8	23	2.7	9	10	50	1.4	2	59	0.5	1.0	<5	0.2	2.8	370	28	0.5	0.2	1	2	0.2	0.5	<50	1	8.5	1.3	2.02	<Minimum
Average >	15.5	130	6.1	27	80	155	10.2	2	135	2.4	1.3	<5	0.5	9.1	685	49	0.8	0.8	2	5	1.3	1.6	<50	4	55.1	10.1	5.47	<Average, arithmetic mean
Stan-Dev>	6.3	78	2.4	12	42	74	9.7	1	50	1.1	0.3		0.3	4.5	157	20	0.6	0.4	1	1	0.6	1.3		4	74.6	14.3	1.13	<Standard Deviation
Coef-Var>	40%	60%	39%	44%	52%	48%	95%	44%	37%	46%	23%		66%	49%	23%	40%	66%	48%	51%	25%	45%	77%		92%	135%	142%	21%	<Coefficient of Variation = Std-Dev/Avg
GREENSTONE																												
Number >	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	<Number of valid data
Maximum >	82.8	260	13.0	65	270	330	207.0	3	240	12.0	2.0	<5	5.2	34.0	1000	82	5.0	2.6	9	7	2.6	7.0	<50	34	43.4	9.1	9.29	<Maximum
Minimum >	7.8	73	3.8	16	37	50	2.2	2	35	0.5	1.0	<5	0.3	3.7	270	19	0.5	0.2	1	3	0.2	0.5	<50	1	5.2	1.3	2.71	<Minimum
Average >	21.4	157	7.8	35	104	180	27.2	2	103	3.4	1.3	<5	0.9	8.7	594	42	1.2	0.8	3	5	1.1	2.2	<50	9	22.9	3.5	6.20	<Average, arithmetic mean
Stan-Dev>	13.0	48	1.9	13	50	66	37.2	0	40	2.1	0.3		1.0	5.0	172	17	1.0	0.5	2	1	0.5	1.6		9	10.6	1.7	1.54	<Standard Deviation
Coef-Var>	61%	31%	24%	36%	48%	37%	137%	12%	39%	62%	24%		104%	58%	29%	40%	80%	57%	54%	24%	45%	71%		94%	47%	48%	25%	<Coefficient of Variation = Std-Dev/Avg
SUMMARY																												
t test >	-1.9	-1.5	-2.8	-2.1	-1.8	-1.3	-2.1	1.7	2.4	-2.1	0.1		-1.9	0.3	1.9	1.4	-1.7	-0.4	-2.2	-0.1	1.4	-1.5		-2.3	2.3	2.4	-1.9	<Statistical test for similar averages
Sig .05 >	1	1	0	0	1	1	0	1	0	0	1		1	1	1	1	1	1	0	1	1	1		0	0	0	1	<If 1; then granite = greenstone, @ 95%
Sig .01 >	1	1	0	1	1	1	1	1	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 >	4.3	2.7	1.6	1.1	1.4	1.3	14.8	18.9	1.6	3.8	1.1		7.8	1.3	1.2	1.3	3.1	1.6	2.2	1.0	1.4	1.6		4.6	49.2	73.5	1.9	<Statistical test for similar std-dev
Sig .05 >	0	0	1	1	1	1	0	0	1	0	1		0	1	1	1	0	1	0	1	1	1		0	0	0	1	<If 1; then granite = greenstone, @ 95% approx
Sig .02 >	0	0	1	1	1	1	0	0	1	0	1		0	1	1	1	0	1	1	1	1	1		0	0	0	1	<If 1; then granite = greenstone, @ 98% approx
	Sc	Cr	Fe	Co	Ni	Zn	As	Se	Rb	Mo	Ag	Cd	Sb	Cs	Ba	La	Eu	Tb	Yb	Hf	Ta	W	Ir	Au	Th	U	WT	<Variable names
	Scandium	Chromium	Iron	Cobalt	Nickel	Zinc	Arsenic	Selenium	Rubidium	Molybdenum	Silver	Cadmium	Antimony	Cesium	Barium	Lanthanum	Europium	Terbium	Ytterbium	Hafnium	Tantalum	Tungsten	Iridium	Gold	Thorium	Uranium	WeighT	<Long variable names
	0.2	20	0.2	5	20	100	0.5	5	5	1	2	5	0.1	0.5	50	2	1	0.5	2	1	0.5	1	50	2	0.2	0.2	0.01	<Detection limit

3.4 Glaciofluvial Deposits

Small glaciofluvial deposits are scattered throughout the study area whereas large deposits are primarily associated with the large end moraines described in a previous section.

Ice-Contact Deposits

Glaciofluvial ice-contact sediments are largely associated with the end moraines which have mainly been mapped as ice-contact stratified drift. As the moraines were generally deposited in contact with Glacial Lake Agassiz, much of the sediments appear to consist of subaqueous outwash and, to a lesser degree, ice-contact deltaic sediments. Glaciolacustrine fine-grained sediments are frequently intimately associated with the fluviatile materials. These materials are sand dominated 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.

Small, isolated sand and gravel deposits occur throughout the area, frequently on the lee side of rock knobs. These have been largely mapped as ice-contact deposits and are believed to be of subglacial origin in many instances.

Outwash Deposits

Major sub-aerial outwash deposits in the study area are associated with the Hartman Moraine in the Sandybeach Lake-Basket Lake area. These are largely up-glacier from the moraine itself and contain numerous kettle holes and other ice-contact features. Though the sediments are sand dominated, large zones of pebble gravel occur; these have not been sub-divided in most instances due to insufficient information.

Minor outwash deposits are present elsewhere in the study area. These too are dominantly sand in composition.

3.5 Glaciolacustrine Sediments

Glaciolacustrine sediments are widespread in the Gold Rock-Wabigoon Lake area though they are most common in the Wabigoon Basin and throughout the Wabigoon Lake map area. Here sediment sources, related to deposition of the major end moraines, were apparently most abundant. The sediments were deposited within Glacial Lake Agassiz approximately 11000 to 9000 radiocarbon years B.P. and perhaps up until about 8500 B.P.. Based on unmodified ice-contact topography on the Hartman Moraine southwest of Basket Lake, maximum water plane elevations were in the order of 425-430m a.s.l. in this area with some variation from southwest to northeast due to isostatic effects.

Fine-Grained Sediments

Laminated to varved clay, silt and fine sand representing off-shore sedimentation is common throughout the northern two-thirds of the area. These occupy lower areas in general and range from a few centimeteres to up to 6 m in thickness. In rolling bedrock areas these sediments are draped over the rock surface with bedding generally conformable with the bedrock topography. This relationship is highlighted in roadcut sections by a sequence of clay-dominant, reddish-brown varves which Rittenhouse (1934) described in considerable detail at McKeevers Point, about one and one-half miles (2.4 km) southwest of the Town of Dinorwic. He termed these as "abnormal varves" due to the considerable thickness of the winter clay component. They occurred within the following sequence: "(1) a lower 300-year series of varves diminishing in thickness and recording ice retreat from the region; (2) a 140-year series increasing in thickness; (3) a 24-year series of very thick varves with very thick, dark chocolate-red winter fractions; and (4) an upper series of diminishing thickness, signifying a resumption of normal retreat conditions. The upper division passes by degrees into homogeneous, thinly laminated, non-varved clay" (Rittenhouse 1934, p. 110). Following much discussion Rittenhouse (1934) concluded that the abnormal varves were due to an influx of material from a distant source to the east which furnished material fairly high in carbonate and ferric iron. He inferred that the abnormal varves were contemporaneous with deposition of the Hartman Moraine; Zoltai (1961) confirmed this relationship during regional mapping of the area (Zoltai, 1965a). The interrelationships of these varves with the ice-contact glaciofluvial sediments related to the Hartman Moraine may be observed in borrow pits north of Dryden. Current thinking attributes the source of the reddish-brown clay to a readvance of the Lake Superior lobe to the Marks Moraine near Thunder Bay; during this event iron-rich debris was eroded from the Lake Superior Basin and carried westward into a rising phase (Emerson) of Glacial Lake Agassiz. This glacial event is referred to as the Marquette Readvance and is closely dated at 9900 radiocarbon years B.P. (Clayton, 1983; Nielsen et al, 1982); at this time the Rainy Lobe apparently stood at the Hartman and Dog Lake moraine positions (Nielsen et al, 1982).

Though the above interpretation of the origin of the reddish-brown "abnormal" varves is plausible, there are points of discussion which require further clarification. Firstly, if the ice was standing at the Hartman Moraine position, it is difficult to fully account for thick clay-rich units of distant provenance being intimately associated with the sediments of the moraine, i.e., have sediments from nearby ice been displaced? Secondly, do the reddish-brown and grey clays have a different provenance or is the color difference due to environmental conditions during deposition?

Examination of the second question has been initiated by the writer and requires more evaluation by others.

Table 7 provides information on the chemistry of red and grey clays from shore bluffs on Wabigoon Lake. The data from Anderson Island indicates that Fe_2O_3 is more common in the red clay than the grey.

TABLE 7: MAJOR ELEMENT CHEMISTRY OF CLAYS FROM WABIGOON LAKE SHORE BLUFFS

	Sample	SiO2 %	Al2O3 %	CaO %	MgO %	Na2O %	K2O %	Fe_2O_3 %	MnO %	TiO2 %	LOI %
1) Anderson Island	Red Clay	46.8	13.4	7.457	4.792	1.186	2.518	7.78	0.120	0.62	13.60
2) Anderson Island	Grey Clay	54.5	12.8	7.499	3.283	2.278	2.169	5.08	0.098	0.50	10.65
3) Contact Bay	62-519*			8.53				6.77			5.77
4) Wabigoon Lake	62-518*			8.55				7.13			11.51

1) Red varved clay, Anderson Island, Wabigoon Lake, Dryden
2) Grey varved clay, Anderson Island, Wabigoon Lake, Dryden
3) Brown varved clay, Contact Bay, Wabigoon Lake
4) Red varved clay, Contact Bay, Wabigoon Lake
* from Guillet, 1977

Similarily, data provided by Guillet (1977) from Contact Bay, Wabigoon Lake shows that this red clay is also richer in Fe_2O_3 than the grey. Chemical data provided by Guillet (1977) indicates that red clays from Dog Lake, Pine Bay, and Finmark near Thunder Bay contain an average of 7.54% Fe_2O_3 within a range of 6.59- 7.96%; grey clays invariably contain lower Fe_2O_3 percentages. From this, one may infer that these clays become brownish in color at about 6.5% Fe_2O_3 and may be quite red at Fe_2O_3 percentages somewhat above this (allowing for minor differences in field observations and laboratory procedures). Thus the color difference appears to be due to iron content. The question remains though, is the red clay derived from a specific provenance as suggested by Nielsen et al, 1982, or does it reflect depositional conditions in part? Data from Guillet (1977) suggests that red clays elsewhere in Ontario may contain considerably less Fe_2O_3 than those of the study area.

Mineralogical examination of the two samples collected from Anderson Island in Wabigoon Lake was carried out by Dr. D. Taplin of D. Taplin Consultant Inc., Calgary. The findings of this work are summarized below.

Powdered samples of red and grey clay were analyzed for mineralogical composition using a Phillips X-ray Diffractometer with Cobalt-K radiation source. The diffractogram recorded between 2 and 140 degrees 20 at a scan rate of 1 deg/min. Automatic analysis of the main peak intensities was achieved using a Phillips PW171/000 microprocessor control system.

Table 8 presents a summary of the major d-spacings with accompanying intensity values and corresponding mineral type. In general, the mineralogical composition of both clays was identical. A total of 62 peaks were cross-correlated. The composition of the samples were found to be mainly quartz with lesser amounts of albite, calcite, dolomite, illite, hornblende, kaolinite and chlorite. Also, there is some indication of the presence of muscovite and plagioclase. The presence of hematite was not confirmed from the diffractogram.

TABLE 8.

SUMMARY OF X-RAY DIFFRACTION ANALYSIS

D-SPACING (A)		INTENSITY		MINERALOGY
RED	GREY	RED	GREY	
14.3892	14.245	156	n/a(30)	*Chlorite
p	14 050	n/a	n/a	
10.0495	10.0732	64	50	*Illite, *Muscovite
8.4923	8.4429	42	57	*Hornblende
7.1501	7.0894	46	48	*Kaolinite, Chlorite
p	6.4024	n/a	40	
p	5.9134	n/a	n/a	
p	4.9135	n/a	n/a	
4.5016	4.4924	58	37	Illite, Chlorite, Muscovite
4.2563	4.2553	87	193	Quartz
4.0453	4.0363	69	154	Albite
3.8647	3.8584	52	55	Calcite
3.7761	3.7728	63	89	Albite
p	3.7120	n/a	60	
3.6754	3.6681	58	84	Albite
3.4810	3.4866	54	63	
3.3481	3.3456	333	927	*Quartz, *Muscovite
p	3.2914	n/a	67	Illite
3.2433	3.2440	79	84	Albite
3.1991	3.1991	119	240	*Albite
3.1429	3.1568	49	66	Albite, Hornblende
3.0365	3.0331	252	220	*Calcite
p	2.9401	n/a	65	Albite
2.8932	2.8911	85	136	*Dolomite
p	2.8567	n/a	38	
2.7081	2.7133	n/a	39	Hornblende
p	2.5566	n/a	54	Kaolinite, Muscovite
2.4943	2.4918	57	43	Calcite
2.4594	2.4563	61	85	Quartz
2.3913	2.4067	37	35	
2.2842	2.2816	78	96	Quartz, Calcite
p	2.2364	n/a	40	Quartz
2.1929	2.1936	34	42	Dolomite
p	2.1629	n/a	34	Hornblende
2.1304	2.1284	32	62	
2.0939	2.0922	47	42	Calcite
p	2.0176	n/a	38	Dolomite
p	1.9800	n/a	38	Quartz
1.9115	1.9113	43	47	Calcite
1.8736	1.8730	44	38	Calcite

... (Cont'd)

TABLE 8. (Cont'd)

SUMMARY OF X-RAY DIFFRACTION ANALYSIS

D-SPACING (A)		INTENSITY		MINERALOGY
RED	GREY	RED	GREY	
p	1.8506	n/a	27	
1.8188	1.8182	52	53	
p	1.8032	n/a	107	Dolomite(?)
p	1.7856	n/a	48	Dolomite
1.6719	1.6719	28	39	
1.6031	1.6019	33	29	Calcite
1.5426	1.5417	41	88	Quartz
p	1.5248	n/a	28	Illite
p	1.4537	n/a	26	Quartz, Hornblende
1.3831	1.3820	25	65	Quartz
1.3742	1.3732	34	44	Quartz
p	1.2563	n/a	40	Quartz
p	1.2003	n/a	30	Quartz
p	1.1844	n/a	38	Quartz
p	1.1807	n/a	32	Quartz
p	1.1532	n/a	28	Quartz
p	1.0819	n/a	29	Quartz
p	1.0479	n/a	28	Quartz
p	1.0151	n/a	28	Quartz
p	0.9898	n/a	24	Quartz
p	0.9608	n/a	28	Quartz

p = peak present, but not evaluated during run.
n/a = not available.
* = 0,0,1 reflections.

Table 9 presents the estimated composition of various minerals. The percentage values have been calculated based upon the intensity values measured at the 0,0,1 reflections.

The values given in Table 9 are for discussion purposes only. X-ray diffraction is not a quantitative technique. Intensity values can only be used to give compositional weighting. Examination of thse two compositions indicate that the red clay has a significantly lower quartz content and a higher dolomite and chlorite content. Nevertheless, these mineral composition differences cannot explain the color difference. Alternative reasons for the color difference could be the presence of amorphous coatings on the mineral surfaces, or differences in environmental conditions during deposition. The amount of amorphous material can be determined by the method of selective dissolution.

Concretions locally occur in great numbers within the clays and appear to be absent elsewhere, perhaps due to differing environmental site histories, e.g., difference in groundwater chemisty or flow regimes. At eroded lake sections, shingle beaches consisting entirely of concretions may be observed. Fenwick (1976) examined such concretions in some detail and determined that the concretions form without nuclei in most cases; most contain evidence of summer and winter bands; most concretions consist of the upper part of the clay winter layer and the lower part of the overlying summer layer with the latter comprising a greater part of the concretion; and, finally, the concretions are a result of local cementation of the varve with calcium carbonate.

Stratigraphic relationships of the Lake Agassiz clays are complex in ice-contact environments where they are interbedded with fluvial deposits such as subaqueous outwash. Elsewhere, the clays commonly rest conformably on bedrock with intervening till or fluvial sediment seemingly quite rare; Satterly (1943, p.44) also noted that on Wabigoon and Dinorwic lakes that varved clays most commonly rest directly on bedrock and only rarely on till. Where younger materials overlie the clays, it is most frequently sand or muskeg.

TABLE 9: MINERALOGICAL COMPOSITION

MINERAL TYPE	PERCENTAGE	
	RED CLAY	GREY CLAY
Quartz	30	56
Albite	11	15
Calcite	23	13
Dolomite	8	8
Illite	6	3
Hornblende	4	3
Kaolinite	4	3
Chlorite	14	2

Erosion of the varved clay on the banks of Wabigoon and Dinorwic Lakes is and will continue to be something of a problem to landowners in the area. Typically, the clay erodes back until bedrock is encountered and the bank becomes rock-defended. Though this process has undoubtedly continued over the last several thousand years, it was perhaps accerlerated in 1900 when the power dam was constructed on Wabigoon River at Dryden.

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 in the area due to the present low level of granular materials extraction for construction purposes. Most outcrops observed displayed a crude reworking of glaciofluvial morainic materials and well-sorted, open-work, swash bar gravels were only observed in a few instances. Beacause of the nature of the area, most beach features are developed on the major end moraines. A few examples of erosional bluffs in clay deposits were also observed.

Though shorelines have not been considered in any detail to date, the uppermost water plane appears to have been at about 425 to 430m a.s.l. in the northeastern-most part of the area. Additional shore features appear to be common at levels between 380 and 400m a.s.l. in the Borups Corners - Dryden area.

Off-shore sediments are dominatly fine sands but range to coarse sand or silt. These are best developed on the distal slopes of the end moraines, the largest features fronting the Hartman Moraine. A large area near Dyment has been mapped as off-shore fine sands. The unit includes some clay which usually underlies the sand in an off-lap sequence; however, in a few instances thin clay, including the reddish-brown facies, has been observed overlying the sands.

3.6 Organic Terrain

Organic terrain occurs throughout the area as small depressional fills 1-2m thick. These consist primarily of fibrous sphagnum and sedge peat. Large areas of organic terrain, such as in Revell Township, vary from heavily treed muskegs to floating fens and string muskegs with complex hydrological regimes. Thicknesses are generally 1-2m, rarely exceeding 3 or 4m in deeper sections.

One organic deposit located near Dryden has been drained and is apparently being used for limited production of agricultural peat for local use.

3.7 Eolian Sediments

Eolian fine to very fine sands occur in the area between Dyment and Revell swamp where sand dunes are common, some indicating growth into the organic terrain. The eolian sand is reworked from the Lake Agassiz off-shore and near shore sands. Satterly (1960) observed dunes with rock cores; it is presumed that these are developed on the lee (east) side of rock knobs in most instances. Though no direct measurements have been made, it is assumed that the eolian sands are generally less than 3m in thickness.

3.8 Alluvial Sediments

Alluvial sediments occur along streams throughout the project area. However, they are best developed in areas underlain by low relief clay and sands deposited in Lake Agassiz. Here, meander belts are well developed and may be quite broad. Alluvium consists mainly of fine sand and silt and includes considerable organic material in broad meander belts where muskeg development is concurrent with alluvial erosion and sedimentation due to surface or near surface water tables. In such instances the materials are mapped as compound Alluvium/Organic Terrain units.

Beaver impoundments along most streams of small dimension have resulted in development of some organic terrain along virtually all of these streams.

Most alluvium is in the order of 1 or 2m in thickness. Associated organic terrain may be up to 3m thick.

3.9 Modern Beach Deposits

Areally small modern beach deposits have been mapped on the shores of several lakes. These consist of small beaches, bars, spits, and tombolos. Sediments are dominantly fine to coarse sand with minor gravel and peat. As mentioned previously, occasional shingle beaches have been observed which are dominated by calcareous concretions.

4.0 SUMMARY

The following comments summarize significant observations or conclusions drawn during Year I of this project:

1) All glacial sediments appear to be of Late Wisconsinan age and are primarily deglacial in nature.

2) The bedrock surface is heavily polished and striated with a mean glacial direction of about 212 degrees; no conclusive evidence for more than one direction of glaciation has been found to date.

3) Till composition is dominated by local lithologies. No significant input of distant lithologies from the Hudson Platform or Belcher Islands region has been observed.

4) Major end moraines consist primarily of fluvial sands with lesser components of gravel, boulders and till. No evidence was found to indicate that the moraines indicate readvances rather than still-stands.

5) Glaciolacustrine clay sediments deposited in Lake Agassiz are commonly draped directed on the bedrock surface with only infrequent intervening till or fluvial sediments. This has considerable implications for potential overburden drilling programs as the potential for encountering till between the clay and the rock surface is quite limited.

6) The origin of the "abnormal" red clay bands in the Lake Agassiz sediments remains a question in our opinion. It is suggested that environmental conditions during deposition may well account for the red colouring rather than provenance. The red colouring may be due to amorphous coatings on mineral grains rather than mineralogical composition.

7) Though detailed examination of Lake Agassiz shorelines has not been carried out to date, shoreline elevation groupings appear to indicate major water plane levels at about 425-430m a.s.l. and 380-400m a.s.l..

8) Results of till geochemical analyses indicate a few occurrences of above average gold and uranium-thorium values. Some of the gold values are related to known gold occurrences while others need further investigation. Curiously, several of the higher gold values occur within till beds high up in end moraine deposits. Two of the more interesting uranium-thorium values are from till samples located within the White Otter Lake Pluton area; these may warrant further investigation.

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APPENDIX "A"

SUMMARY FIELD DATA FOR TILL SAMPLES*

* Note: Samples 9 and 10 are located in 52F/NW and sample 2 is located slightly north of the map area.

KENORA-DRYDEN Location & Field Data

YR D SMP 10 2 1 EAST NORTH YR D SMP HUE V C A LTH STR PR SEC ST M T O HZ COMMENTS

Data type:	LOCATION			FIELD DATA														
Var group:	N.T.S.	Grid_Ref.		Sample	Munsel Colour						Texture							
Variable>:	10 2 1	EAST	NORTH	YR D #	HUE	V	C	A	LTH	STR	PR	SEC	ST	M	T	O	HZ	COMMENTS_FIELD_DATA
86 D 1 :	52 F/NE	5106	55316	86 D 1	10YR	5.0	6.0	0	35	200	3	4	-1	-1	-1	-1	-1	10% pebbles
86 D 2 :	52 F/NE	5100	55390	86 D 2	10YR	5.0	2.0	5	35	-1	2	3	M	-1	-1	-1	-1	massive to fissile
86 D 3 :	52 F/NE	5325	55066	86 D 3	2.5Y	5.0	2.0	-1	22	-1	3	4	-1	-1	-1	-1	-1	30% coarse clasts
86 D 4 :	52 F/NE	5382	55100	86 D 4	10YR	5.0	2.0	0	41	205	2	3	-1	-1	-1	-1	-1	
86 D 5 :	52 F/NE	5167	55081	86 D 5	2.5Y	5.5	2.0	5	21	215	3	4	-1	-1	-1	-1	-1	very stony
86 D 6 :	52 F/NE	5040	55068	86 D 6	2.5Y	5.0	3.0	0	21	205	2	3	-1	-1	-1	4	-1	str=225 also, 10YR5/5 when oxidized
86 D 7 :	52 F/NE	5044	54993	86 D 7	2.5Y	5.0	3.0	0	31	205	3	6	-1	-1	-1	1	-1	
86 D 8 :	52 F/NE	5025	54982	86 D 8	2.5Y	5.0	3.0	5	21	-1	2	3	-1	-1	-1	-1	-1	
86 D 9 :	52 F/NW	4959	54941	86 D 9	2.5Y	5.0	3.0	0	35	-1	3	5	-1	-1	-1	3	-1	
86 D 10 :	52 F/NW	4912	55117	86 D 10	2.5Y	5.0	3.0	0	41	-1	2	3	-1	E	-1	-1	-1	stony
86 D 11 :	52 F/NE	5045	55072	86 D 11	2.5Y	5.0	2.0	0	-1	215	3	-1	-1	-1	-1	-1	-1	: down-ice from Flambeau Lake Au deposit
86 D 12 :	52 F/NE	5046	55072	86 D 12	2.5Y	5.5	2.0	0	-1	220	2	3	-1	-1	-1	5	C	: down-ice from Flambeau Lake Au deposit
86 D 13 :	52 F/NE	5046	55072	86 D 13	10YR	5.0	6.0	0	-1	220	2	3	-1	-1	-1	-1	B	: down-ice from Flambeau Lake Au deposit
86 D 14 :	52 F/NE	5093	55012	86 D 14	2.5Y	5.5	3.0	0	35	-1	2	3	-1	-1	-1	-1	-1	20% pebbles - boulders
86 D 15 :	52 F/NE	5179	54956	86 D 15	2.5Y	5.5	3.0	0	35	-1	2	3	-1	-1	-1	-1	-1	diorite
86 D 16 :	52 F/NE	5231	54957	86 D 16	10YR	5.0	5.0	0	21	225	3	4	-1	-1	-1	-1	B	loam, diamicton, weathered B horizon
86 D 17 :	52 F/NE	5182	54912	86 D 17	2.5Y	5.5	4.0	0	35	230	2	3	-1	-1	-1	5	C	
86 D 18 :	52 F/NE	5184	54877	86 D 18	2.5Y	5.5	2.5	0	35	-1	2	3	F	-1	-1	5	C	
86 D 19 :	52 F/NE	5218	54899	86 D 19	2.5Y	5.5	3.0	0	21	-1	2	3	-1	-1	-1	5	C	:
86 D 20 :	52 F/NE	5218	54899	86 D 20	2.5Y	7.0	6.0	0	21	-1	2	3	-1	-1	-1	-1	B	:
86 D 21 :	52 F/NE	5249	54833	86 D 21	2.5Y	5.5	5.0	5	21	215	2	3	-1	-1	-1	-1	-1	some rusty weathered rock
86 D 22 :	52 F/SE	5263	54780	86 D 22	2.5Y	5.5	5.0	0	21	210	3	-1	-1	-1	-1	-1	-1	pillow lavas nearby
86 D 23 :	52 F/NE	5438	55051	86 D 23	2.5Y	5.5	4.0	0	21	205	2	3	-1	-1	-1	-1	-1	: str=220 also, east of road
86 D 24 :	52 F/NE	5438	55051	86 D 24	2.5Y	5.0	2.0	0	23	-1	2	3	S	-1	-1	-1	-1	: next to exploration trenches
86 D 25 :	52 F/NE	5370	55016	86 D 25	2.5Y	5.5	3.0	5	23	210	3	-1	-1	-1	-1	-1	-1	rusty weathered rock
86 D 26 :	52 F/SE	5675	54832	86 D 26	2.5Y	6.5	4.0	-1	23	-1	3	2	-1	-1	-1	-1	-1	diamicton, hard, very few pebbles
86 D 27 :	52 F/SE	5666	54796	86 D 27	2.5Y	6.0	2.0	0	35	210	3	2	-1	-1	-1	-1	-1	diamicton, hard, few pebbles, ss parting
86 D 28 :	52 F/SE	5567	54490	86 D 28	2.5Y	6.0	2.0	0	39	215	3	-1	-1	-1	M	-1	-1	
86 D 29 :	52 F/SE	5600	54363	86 D 29	2.5Y	6.0	3.0	0	35	210	3	4	-1	-1	L	-1	-1	
86 D 30 :	52 F/SE	5622	54338	86 D 30	2.5Y	6.5	2.0	0	35	225	3	-1	-1	E	-1	-1	-1	
86 D 31 :	52 F/SE	5002	54301	86 D 31	5Y	5.0	3.0	0	21	205	2	3	-1	-1	-1	-1	-1	pyrite in rock
86 D 32 :	52 F/SE	5008	54364	86 D 32	5Y	5.5	3.0	0	23	205	3	-1	-1	-1	-1	-1	-1	secondary CaCO3 on rock fractures
86 D 33 :	52 F/SE	5023	54386	86 D 33	2.5Y	6.0	3.0	0	21	-1	2	3	-1	-1	-1	-1	-1	lth=granitic also
86 D 34 :	52 F/SE	5051	54446	86 D 34	2.5Y	6.0	3.0	0	35	210	2	3	-1	-1	-1	-1	-1	
86 D 35 :	52 F/SE	5127	54508	86 D 35	2.5Y	5.5	2.0	0	35	-1	3	4	L	-1	-1	-1	-1	surface pebbles 60% mafic
86 D 36 :	52 F/SE	5189	54535	86 D 36	2.5Y	6.5	3.0	0	21	210	2	3	-1	-1	-1	-1	-1	weak carbonatized, rust weather, pyrite
86 D 37 :	52 F/SE	5218	54566	86 D 37	-1	-1.0	-1.0	-1	21	215	2	4	F	-1	-1	-1	-1	mottled gy-brn, weak etc as for 86 D 36
86 D 38 :	52 F/SE	5241	54623	86 D 38	2.5Y	6.0	2.0	0	22	210	2	3	-1	-1	-1	-1	-1	mottled 2.5Y6/2 - 10YR5/8
86 D 39 :	52 F/SE	5257	54680	86 D 39	2.5Y	5.5	4.0	0	35	-1	2	3	F	-1	-1	-1	-1	weak fissility
86 D 40 :	52 F/NE	5196	55192	86 D 40	2.5Y	6.0	2.0	0	35	-1	2	3	-1	H	W	-1	-1	
86 D 41 :	52 F/SE	5261	54686	86 D 41	10YR	6.0	5.0	0	35	215	2	3	-1	-1	-1	6	-1	
86 D 42 :	52 F/NE	5092	55073	86 D 42	10YR	5.5	4.0	0	26	-1	2	3	-1	-1	-1	-1	-1	next to old mine workings
86 D 43 :	52 F/NE	5678	54972	86 D 43	2.5Y	6.0	2.0	0	35	-1	2	3	-1	-1	O	-1	-1	dispersed free sand
86 D 44 :	52 F/NE	5616	54983	86 D 44	2.5Y	7.0	3.0	0	35	-1	3	2	-1	H	F	-1	-1	diamicton, soft
86 D 45 :	52 F/NE	5681	55208	86 D 45	5Y	5.5	2.0	0	35	225	2	3	F	-1	M	-1	-1	fissile in part, ss stringers
86 D 46 :	52 F/NE	5694	55158	86 D 46	2.5Y	6.0	2.0	0	35	-1	2	3	-1	L	F	-1	-1	laminated at base
86 D 47 :	52 F/NE	5573	55063	86 D 47	2.5Y	6.5	4.0	0	35	195	2	3	F	-1	L	-1	-1	str=225 also
86 D 48 :	52 F/NE	5383	54841	86 D 48	2.5Y	5.5	4.0	0	23	220	2	1	-1	-1	-1	-1	B	colour B horizon, sticky
86 D 49 :	52 F/SE	5395	54716	86 D 49	2.5Y	5.5	2.0	0	26	-1	2	3	-1	-1	-1	-1	-1	
86 D 50 :	52 F/SE	5393	54699	86 D 50	2.5Y	6.0	4.0	0	21	230	2	3	-1	-1	-1	5	C	BC is 10YR5/5
86 D 51 :	52 F/SE	5416	54606	86 D 51	5Y	5.0	2.0	0	21	-1	2	3	-1	E	F	-1	-1	
86 D 52 :	52 F/SE	5400	54504	86 D 52	2.5Y	5.0	4.0	0	45	-1	3	-1	-1	-1	-1	-1	-1	mottled, lth=pegmatite also

```
  YR D SMP   10 2 1    EAST NORTH   YR D SMP  HUE   V     C    A  LTH  STR   PR  SEC  ST   M    T    O    HZ  COMMENTS

* 86 D  53 :  52 F/SE   5599 54568  * 86 D  53 2.5Y  6.0  4.0   0   35   -1    2    3 S      -1   -1   -1   -1                                 *
* 86 D  54 :  52 F/NE   5402 54990  * 86 D  54 2.5Y  6.0  5.0   0   21  210    2    3 F      -1   -1   -1   -1 some free ss in matrix          *
* 86 D  55 :  52 F/NE   5513 54767  * 86 D  55 2.5Y  6.0  2.0   0   21  215    3   -1   -1   -1   -1   -1   -1 lee side of outcrop             *
*          :                        *                                                                                                       *
* 86 D   0 :  52 F/NE   9999 99999  * 86 D   0 2.5Y  5.0  0.0   0    0   -1    2    3   -1   -1   -1   -1   -1 <-- Data pattern to copy       *
*          :                        *                                                                                                       *
*++++++++++:+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
* STATS    : SUM STATS for Location * SUMMARY STATISTICS for Field data                                                                     *
*..........:.................................................................................................................................
* Variable>:  10 2 1    EAST NORTH  * YR D   #  HUE   V     C    A  LTH  STR   PR  SEC  ST   M    T    O    HZ                                 *
* Units -->:               m     m  * Units ->                            deg                                <Units                         *
*          :                        *                                                                                                       *
* Number ->:              55    55  * Number >  54   54    54   52   52   31   55   47   10    6    9    9    9 <Number of valid data          *
*          :                        *                                                                                                       *
* Maximum >:            5694 55390  * Maximum>       7.0  6.0    5       230    3    6                   6      <Maximum                       *
* Minimum >:            4912 54301  * Minimum>       5.0  2.0    0       195    2    1                   1      <Minimum                       *
*          : Range ->    782  1089  *                                                                                                       *
* Average >:                        * Average>       5.6  3.2    0       213    2    3                   4      <Average, arithmetic mean      *
* Stan-Dev>:                        * Stan-Dev       0.5  1.2    1         8    0    1                   1      <Standard Deviation            *
* Coef-Var>:                        * Coef-Var         9%  37% 307%        4%  20%  24%                 33%     <Coefficient of Variation = Std-Dev/Avg *
*----------:-----------------------------------------------------------------------------------------------------------------------------------
* SELECTION: SELECTION for Location * SELECTION CRITERIA for Field data                                                                     *
*..........:.................................................................................................................................
* Variable>:  10 2 1    EAST NORTH  * YR D   #  HUE   V     C    A  LTH  STR   PR  SEC  ST   M    T    O    HZ                                 *
* Criteria>:                        *                                                                        <Enter selection criteria      *
* Spare    :                        *                                                                                                       *
* Spare    :                        *                                                                                                       *
*----------:-----------------------------------------------------------------------------------------------------------------------------------
* VARIABLES: NAMES for Locations    * VARIABLE NAMES for Field data                                                                         *
*..........:.................................................................................................................................
* Names -->:            EASTing     * YeaR Sample No.                    STRiations                                                         *
*       ->:  1:1,000,000    NORTH   *          HUE   Value                     Texture-PRimary                                              *
*        >:     1:250,000           *                      Chroma                   Texture-SECondary                                       *
*         :       1:100,000         *                           Acid reaction            STructure                                          *
*         :                         *                              LiTHology                  Moraine                                       *
*         :                         *                                                             Till facies                               *
* Det.limit:                        *                                                                  Oxidation                            *
* Method ->:                        *                                                                       HoriZon (soil)                  *
*          :                        *                                                                                                       *
*----------:-----------------------------------------------------------------------------------------------------------------------------------
* CODES    :                        * CODE TRANSLATION for Field data                                                                       *
*..........:.................................................................................................................................
* Names -->:                        *  -1 = Missing               ACID REACTION   Blanks and nulls cause problems for the macros            *
*                                                                                          : = same location as adjacent sample             *
*       ->:                         *   (all data)                0=None                                                                    *
*        >:                         *                             3=Weak                                   ss = sand                      ***
*         : ************************                              5=Strong                                                                  *
* -1 =    :                         *                                                                                                       *
*   Missing:                        *                                                                                                       *
                                    *                                LITHOLOGY                                                              *
                                    *                                10=Sedimentary (undivided)                                             *
                                    *                                                                                                       *
                                    *                                                                                                       *
                                    *                                20=Volcanic (undivided)                                                *
                                    *                                21=Mafic volcanic                                                      *
                                    *                                22=Pillow basalt                                                       *
                                    *                                23=Carbonatized mafic volcanic
```

YR D SMP HUE V C A LTH STR PR SEC ST M T O HZ COMMENTS

25=Felsic volcanic
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

TEXTURE (primary & secondary)
1=Clay
2=Silt
3=Sand
4=Gravel
5=Cobble
6=Boulder

STRUCTURE
M=Massive
F=Fissile
L=Loose
S=Stiff

MORAINE
E=Eagle-Finlayson
H=Hartman
L=Lac Seul

TILL FACIES
L=Lodgement
W=Water-lain
F=Flow
B=Basal
O=Melt-out
M=Basal-melt-out

OXIDATION
0=Unoxidized
1=Slightly
3=Weakly
4=Partly
5=Oxidized
6=Strongly

APPENDIX "B"

GRAIN SIZE ANALYSIS DATA

YR D SMP GRV SND FN SD SLT CLY MD COMMENTS

GRAIN SIZE ANALYSIS

Sample			Gross			Matrix				
YR	D	#	GRV	SND	FN	SD	SLT	CLY	MD	COMMENTS_GRAIN_SIZE
86	D	1	25	56	20	-1	-1	-1	-1.000	
86	D	2	3	78	19	52	36	12	0.066	
86	D	3	23	52	24	67	31	2	0.120	
86	D	4	10	62	28	62	33	5	0.100	
86	D	5	35	45	20	59	34	7	0.110	
86	D	6	18	59	23	-1	-1	-1	-1.000	
86	D	7	40	54	6	81	17	2	0.220	
86	D	8	23	66	11	-1	-1	-1	-1.000	
86	D	9	26	59	15	-1	-1	-1	-1.000	
86	D	10	20	69	11	84	14	2	0.280	
86	D	11	11	54	35	-1	-1	-1	-1.000	
86	D	12	5	52	43	-1	-1	-1	-1.000	
86	D	13	1	76	23	-1	-1	-1	-1.000	
86	D	14	26	51	23	-1	-1	-1	-1.000	
86	D	15	15	56	28	-1	-1	-1	-1.000	
86	D	16	44	45	11	-1	-1	-1	-1.000	
86	D	17	24	57	19	-1	-1	-1	-1.000	
86	D	18	33	50	17	-1	-1	-1	-1.000	
86	D	19	35	49	17	-1	-1	-1	-1.000	
86	D	20	30	43	27	-1	-1	-1	-1.000	
86	D	21	25	51	24	-1	-1	-1	-1.000	
86	D	22	24	55	21	51	40	9	0.070	
86	D	23	17	53	30	-1	-1	-1	-1.000	
86	D	24	24	53	23	-1	-1	-1	-1.000	
86	D	25	19	56	25	-1	-1	-1	-1.000	
86	D	26	4	56	40	-1	-1	-1	-1.000	
86	D	27	4	61	35	55	40	5	0.072	
86	D	28	18	58	24	69	30	1	0.110	
86	D	29	39	34	10	74	25	3	0.220	
86	D	30	28	51	21	72	26	2	0.190	
86	D	31	21	47	32	60	35	5	0.090	
86	D	32	25	51	24	-1	-1	-1	-1.000	
86	D	33	26	56	18	-1	-1	-1	-1.000	
86	D	34	22	43	35	55	39	6	0.085	
86	D	35	26	47	27	-1	-1	-1	-1.000	
86	D	36	29	47	24	58	38	4	0.100	
86	D	37	2	40	58	-1	-1	-1	-1.000	
86	D	38	35	39	26	60	33	7	0.130	
86	D	39	35	53	12	62	29	9	0.200	
86	D	40	22	61	17	74	24	2	0.180	
86	D	41	18	64	18	-1	-1	-1	-1.000	
86	D	42	-1	-1	-1	57	38	5	0.140	
86	D	43	26	57	17	-1	-1	-1	-1.000	
86	D	44	17	67	16	77	21	2	0.190	
86	D	45	17	63	20	58	36	6	0.091	
86	D	46	36	48	16	78	20	2	0.200	
86	D	47	17	54	29	60	36	4	0.100	
86	D	48	30	53	17	-1	-1	-1	-1.000	
86	D	49	22	43	35	-1	-1	-1	-1.000	
86	D	50	22	48	30	-1	-1	-1	-1.000	
86	D	51	38	43	19	69	28	3	0.160	
86	D	52	20	54	26	57	38	5	0.090	

YR	D	SMP	GRV	SND	FN	SD	SLT	CLY	MD	COMMENTS
* 86	D	53	17	55	27	-1	-1	-1	-1.000	*
* 86	D	54	14	68	18	-1	-1	-1	-1.000	*
* 86	D	55	24	49	26	62	35	3	0.125	*
*										*
* 86	D	0	0	0	0	-1	-1	-1	-1.000	<-- Data pattern to copy *
*										*

++

* SUMMARY STATISTICS for Grain Size Analyses *

* YR D #	GRV	SND	FN	SD	SLT	CLY	MD	
* Units ->	%	%	%	%	%	%	mm	<Units *
*								*
* Number >	54	54	54	25	25	25	25	<Number of valid data *
*								*
* Maximum>	44	78	58	84	40	12	0.280	<Maximum *
* Minimum>	1	34	6	51	14	1	0.066	<Minimum *
*								*
* Average>	22	54	23	65	31	5	0.138	<Average, arithmetic mean *
* Stan-Dev	10	9	9	9	7	3	0.056	<Standard Deviation *
* Coef-Var	45%	16%	38%	14%	23%	59%	41%	<Coefficient of Variation *

* SELECTION CRITERIA for Grain Size analyses *

* YR D #	GRV	SND	FN	SD	SLT	CLY	MD	
*								<Enter selection criteria *
*								*
*								*

* VARIABLE NAMES for Grain Size analyses *

* YeaR Sample No. — SanD (2.0 - 0.063mm) *
* GRaVel — SiLT (0.063 - 0.002mm) *
* SaND — CLaY (<0.002mm) *
* FiNes — Median-Diameter (mm) *

* Gravel, sand and fines should total approximately 100% *

* Sand, silt and clay should total approximately 100% *

* CODE TRANSLATION for Grain Size analyses *

* -1 or -1.000 = Missing *
* (all data) *
* Blanks and nulls cause problems for the macros, use -1 *

APPENDIX "C"

PEBBLE LITHOLOGY DATA

KENORA-DRYDEN Pebble Lithologies

YR D SMP GR PG GN MS SS AR IF MV CM FV UM LS DS QZ GB TOT COMMENTS

PEBBLE LITHOLOGY

YR	D	Sample #	GR	PG	GN	MS	SS	AR	IF	MV	CM	FV	UM	LS	DS	QZ	GB	OTH	TOT	COMMENTS_PEBBLES
86	D	1	58	0	0	0	1	-1	0	2	0	1	0	0	0	0	0	0	62	
86	D	2	46	4	10	1	5	-1	0	6	0	1	0	0	0	0	0	0	73	
86	D	3	62	1	4	3	2	-1	0	32	0	4	2	0	0	1	0	0	111	
86	D	4	55	0	1	0	2	-1	0	6	0	2	0	0	0	0	0	0	66	
86	D	5	8	0	9	5	0	-1	0	46	0	30	0	1	0	0	0	0	99	
86	D	6	13	0	4	10	0	-1	0	48	0	24	0	0	0	0	0	0	99	
86	D	7	31	4	13	3	4	-1	0	37	0	3	0	0	0	1	12	0	108	
86	D	8	52	1	9	0	1	-1	0	14	0	3	0	0	0	1	0	0	81	
86	D	9	46	2	6	2	0	-1	0	10	0	1	0	0	0	0	0	0	67	
86	D	10	19	0	23	8	2	-1	0	22	0	2	0	0	0	0	0	0	76	
86	D	11	23	2	0	3	26	-1	1	59	0	35	0	0	0	7	0	0	156	Pebbles retained on #10
86	D	12	7	0	1	3	12	-1	0	32	0	22	0	0	0	3	0	0	80	Pebbles retained on #10
86	D	13	2	0	0	4	6	-1	0	29	0	26	0	0	0	0	1	0	68	Pebbles retained on #10
86	D	14	41	0	7	4	0	-1	0	12	0	8	0	0	0	0	0	0	72	
86	D	15	48	0	1	1	0	-1	0	14	0	3	0	0	0	0	0	0	67	
86	D	16	16	0	2	5	2	-1	0	73	0	37	0	0	0	1	0	0	136	
86	D	17	21	0	8	5	0	-1	0	67	0	13	2	0	0	0	0	0	116	
86	D	18	24	1	14	0	0	-1	0	58	0	9	1	0	0	1	0	0	108	
86	D	19	8	0	1	6	2	-1	0	75	0	8	0	0	0	0	0	0	100	
86	D	20	58	0	0	5	19	-1	0	201	0	48	1	0	0	0	6	0	338	Pebbles retained on #10
86	D	21	7	0	1	7	1	-1	0	76	11	18	1	0	0	0	0	0	122	
86	D	22	11	1	0	4	2	-1	0	43	0	25	0	0	0	1	9	0	96	
86	D	23	304	2	3	6	13	-1	0	135	0	23	1	0	0	6	1	0	494	Pebbles retained on #10
86	D	24	17	0	0	1	3	-1	0	55	0	11	1	0	0	3	0	0	91	
86	D	25	2	0	3	3	0	-1	0	30	2	15	2	0	0	1	0	0	58	
86	D	26	174	6	1	0	20	-1	0	28	0	2	0	0	0	15	0	0	246	Pebbles retained on #10
86	D	27	17	1	2	2	2	-1	0	3	0	0	0	0	0	0	0	0	27	
86	D	28	64	6	17	0	1	-1	0	14	0	1	1	0	0	1	0	0	105	
86	D	29	90	0	2	0	1	-1	0	3	0	0	0	0	0	0	0	0	96	
86	D	30	80	4	6	1	0	-1	0	3	0	0	0	0	0	0	0	0	94	
86	D	31	34	0	6	12	4	-1	0	38	0	8	0	0	0	2	0	0	104	
86	D	32	10	0	1	2	5	-1	1	24	0	8	0	0	0	0	0	0	51	
86	D	33	46	0	2	1	3	-1	0	44	0	12	0	0	0	0	0	0	108	
86	D	34	34	0	2	7	2	-1	0	31	0	25	0	0	0	2	0	0	103	
86	D	35	23	0	2	5	8	-1	0	31	0	11	6	0	0	1	0	0	87	
86	D	36	79	1	1	4	5	-1	0	100	0	17	2	0	0	1	0	0	210	Pebbles > 1/2 cm
86	D	37	14	1	1	3	4	-1	0	7	0	6	0	0	0	0	0	0	36	
86	D	38	16	0	0	1	5	-1	0	47	0	7	0	0	0	0	0	0	76	
86	D	39	24	0	1	3	3	-1	0	35	0	16	0	0	0	0	0	0	82	
86	D	40	95	2	3	4	0	-1	0	7	0	1	0	0	0	0	0	0	112	
86	D	41	15	0	1	6	2	-1	0	18	0	37	0	0	0	0	0	0	79	
86	D	42	11	0	3	1	0	-1	0	37	0	20	0	0	0	0	0	0	72	
86	D	43	70	1	11	1	0	-1	0	2	0	0	0	0	0	0	0	0	85	
86	D	44	25	0	7	3	2	-1	0	1	0	0	0	0	0	0	0	0	38	
86	D	45	51	0	9	2	1	-1	0	10	0	0	0	0	0	0	0	0	73	
86	D	46	87	0	1	1	3	-1	0	15	0	2	1	0	0	0	0	0	110	
86	D	47	82	0	4	0	4	-1	0	2	0	0	0	0	0	0	0	0	92	
86	D	48	4	0	0	4	1	-1	0	33	0	23	0	0	0	1	0	0	66	
86	D	49	16	0	1	12	1	-1	0	28	0	26	0	0	0	0	0	0	84	
86	D	50	10	0	2	8	9	-1	0	38	0	15	0	0	0	0	0	0	82	
86	D	51	8	0	9	9	3	-1	0	57	0	9	15	0	0	0	0	0	110	
86	D	52	45	4	15	2	0	-1	0	13	0	2	0	0	0	2	0	0	83	

```
 YR D SMP    GRV    SND     FN     SD     SLT     CLY   MD      COMMENTS

* 86 D  53    17     55     27     -1     -1      -1 -1.000                             *
* 86 D  54    14     68     18     -1     -1      -1 -1.000                             *
* 86 D  55    24     49     26     62     35       3  0.125                             *
*                                                                                       *
* 86 D   0     0      0      0     -1     -1      -1 -1.000 <-- Data pattern to copy    *
*                                                                                       *
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
* SUMMARY STATISTICS for Grain Size Analyses                                            *
.........................................................................................
* YR D    #   GRV    SND     FN     SD     SLT     CLY   MD                             *
* Units ->     %      %      %      %       %       %    mm    <Units                   *
*                                                                                       *
* Number >    54     54     54     25     25      25       25 <Number of valid data     *
*                                                                                       *
* Maximum>    44     78     58     84     40      12  0.280 <Maximum                    *
* Minimum>     1     34      6     51     14       1  0.066 <Minimum                    *
*                                                                                       *
* Average>    22     54     23     65     31       5  0.138 <Average, arithmetic mean   *
* Stan-Dev    10      9      9      9      7       3  0.056 <Standard Deviation         *
* Coef-Var    45%    16%    38%    14%    23%     59%     41%<Coefficient of Variation  *
-----------------------------------------------------------------------------------------
* SELECTION CRITERIA for Grain Size analyses                                            *
.........................................................................................
* YR D    #   GRV    SND     FN     SD     SLT     CLY   MD                             *
*                                                          <Enter selection criteria    *
*                                                                                       *
*                                                                                       *
-----------------------------------------------------------------------------------------
* VARIABLE NAMES for Grain Size analyses                                                *
.........................................................................................
* YeaR Sample No.                       SanD (2.0 - 0.063mm)                            *
*             GRaVel                        SiLT (0.063 - 0.002mm)                      *
*                   SaND                         CLaY (<0.002mm)                        *
*                          FiNes                      Median-Diameter (mm)              *
*                                                                                       *
*                   Gravel, sand and fines should total approximately 100%              *
*                                                                                       *
*                   Sand, silt and clay should total approximately 100%                 *
*                                                                                       *
-----------------------------------------------------------------------------------------
* CODE TRANSLATION for Grain Size analyses                                              *
.........................................................................................
*  -1 or -1.000 = Missing                                                               *
*   (all data)                                                                          *
*   Blanks and nulls cause problems for the macros, use -1                              *
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APPENDIX "D"

HEAVY MINERAL ANALYSES

KENORA-DRYDEN Heavy Minerals

YR D SMP L-10 HM-10 HN-10 L-40 HM-40 HN-40 L-80 HM-80 HN-80 LTOT HMTOT HNTOT HTOT TOTAL HPC HMPC HRN TRM PYR EPI APA BIO MUS GAR TOU SUL UNK OTH TOT COMMENTS

*	HEAVY MIN		-10+40			-40+80			-80+230			Total					Percent		Heavy Minerals													
* Sample		Light	Heavy		Light	Heavy		Light	Heavy		Light	Mag.	Non-m	Heavy	Grand	Heavy	Mag.															
* YR D	#	L-10	HM-10	HN-10	L-40	HM-40	HN-40	L-80	HM-80	HN-80	LTOT	HMTOT	HNTOT	HTOT	TOTAL	HPC	HMPC	HRN	TRM	PYR	EPI	APA	BIO	MUS	GAR	TOU	SUL	UNK	OTH	TOT	COMMENTS_HEAVY_MINERALS
* 86 D	1	147.67	0.55	3.46	119.41	0.77	4.25	179.94	1.40	9.88	447.02	2.72	17.59	20.31	467.33	4.3	13.4	149	8	35	5	6	3	0	1	0	0	9	0	216	
* 86 D	2	105.09	0.20	1.63	107.10	0.24	2.10	200.64	0.67	3.58	412.83	1.11	7.31	8.42	421.25	2.0	13.2	163	8	35	6	7	0	0	3	0	0	5	0	227	carbonate(?) coated
* 86 D	3	42.70	0.08	2.15	24.64	0.14	0.98	48.94	0.57	3.56	116.28	0.79	6.69	7.48	123.76	6.0	10.6	127	22	36	15	1	7	0	3	0	0	5	0	216	
* 86 D	4	125.25	0.21	1.57	72.23	0.33	1.79	121.80	1.35	6.34	319.28	1.89	9.70	11.59	330.87	3.5	16.3	138	11	40	13	2	2	0	2	0	0	2	0	210	
* 86 D	5	153.17	0.66	10.32	74.64	0.29	3.64	134.39	1.02	5.45	362.20	1.97	19.41	21.38	383.58	5.6	9.2	130	27	34	21	2	5	8	2	1	0	9	0	239	carbonate(?) coated
* 86 D	6	80.82	0.34	1.46	49.54	0.27	1.03	98.92	0.56	3.88	229.28	1.17	6.37	7.54	236.82	3.2	15.5	113	25	37	22	3	4	7	3	0	0	6	0	220	carbonate(?) coated
* 86 D	7	85.55	0.43	6.17	63.37	0.48	3.71	64.94	1.04	6.39	213.86	1.95	16.27	18.22	232.08	7.9	10.7	132	16	48	8	1	4	0	0	1	0	5	0	215	
* 86 D	8	105.77	0.31	4.06	98.32	0.33	2.24	262.18	0.80	2.91	466.27	1.44	9.21	10.65	476.92	2.2	13.5	110	12	62	7	4	10	1	0	3	0	3	0	212	carbonate(?) coated
* 86 D	9	213.18	0.38	4.80	122.61	0.58	4.27	181.67	0.81	3.55	517.46	1.77	12.62	14.39	531.85	2.7	12.3	128	12	49	12	3	7	1	0	0	0	2	0	214	
* 86 D	10	125.17	0.59	1.64	78.32	0.35	1.37	70.18	0.60	2.22	273.67	1.54	5.23	6.77	280.44	2.4	22.7	123	26	26	14	10	13	0	5	3	2	6	0	228	
* 86 D	11	25.00	0.12	0.27	16.13	0.09	0.33	70.18	0.27	1.53	111.31	0.48	2.13	2.61	113.92	2.3	18.4	115	6	40	11	2	5	0	1	15	6	6	0	207	carbonate(?) coated
* 86 D	12	12.66	0.02	0.16	12.56	0.02	0.22	61.88	0.20	2.00	87.10	0.24	2.38	2.62	89.72	2.9	9.2	99	30	33	32	3	8	0	2	2	0	8	0	217	
* 86 D	13	24.26	0.05	0.15	70.80	0.14	1.50	51.82	0.48	2.31	146.88	0.67	3.96	4.63	151.51	3.1	14.5	141	11	56	37	4	0	0	0	0	0	0	0	249	carbonate(?) coated
* 86 D	14	138.42	0.37	5.02	75.75	0.20	3.57	164.13	0.35	2.17	378.30	0.92	10.76	11.68	389.98	3.0	7.9	135	10	42	14	4	5	0	2	0	0	2	0	214	
* 86 D	15	108.25	0.27	3.44	62.64	0.24	3.62	208.07	0.28	1.29	378.96	0.79	8.35	9.14	388.10	2.4	8.6	132	12	27	17	5	17	0	0	0	0	4	0	214	
* 86 D	16	112.89	0.27	3.58	51.71	0.35	2.88	83.37	0.67	4.93	247.97	1.29	11.39	12.68	260.65	4.9	10.2	148	3	29	17	3	5	3	0	0	0	6	0	214	carbonate(?) coated
* 86 D	17	93.76	0.56	7.05	61.58	0.28	3.60	128.21	0.22	1.47	283.55	1.06	12.12	13.18	296.73	4.4	8.0	135	10	45	16	6	15	0	1	2	0	4	0	234	
* 86 D	18	169.06	0.81	5.85	94.93	0.77	6.26	158.58	0.73	4.01	422.57	2.31	16.12	18.43	441.00	4.2	12.5	104	74	25	5	6	5	0	1	2	0	2	0	224	
* 86 D	19	132.39	0.60	6.38	69.23	0.51	3.96	112.74	0.82	4.33	314.36	1.93	14.67	16.60	330.96	5.0	11.6	126	10	42	12	14	0	0	0	0	0	9	0	213	
* 86 D	20	57.07	0.17	2.31	32.85	0.22	1.83	55.02	0.51	4.03	144.94	0.90	8.17	9.07	154.01	5.9	9.9	136	6	44	9	12	1	0	2	1	0	3	0	214	carbonate(?) coated
* 86 D	21	138.19	0.78	3.84	74.52	0.23	2.05	181.72	0.07	0.25	394.43	1.08	6.14	7.22	401.65	1.8	15.0	138	5	35	15	9	3	0	6	0	0	6	0	217	
* 86 D	22	216.69	0.38	3.79	64.46	0.19	2.24	128.18	0.11	0.90	409.33	0.68	6.93	7.61	416.94	1.8	8.9	128	22	25	14	5	1	0	7	0	1	4	0	207	carbonate(?) coated
* 86 D	23	122.62	0.26	4.24	82.09	0.11	3.40	152.22	0.04	2.13	356.93	0.41	9.77	10.18	367.11	2.8	4.0	159	10	18	5	3	5	0	3	1	0	9	0	213	carbonate(?) coated
* 86 D	24	140.95	0.61	5.61	65.73	0.11	2.66	155.02	0.08	2.14	361.70	0.80	10.41	11.21	372.91	3.0	7.1	170	31	17	6	2	3	0	4	1	0	2	0	236	
* 86 D	25	131.28	0.62	6.87	96.55	0.36	4.15	155.32	0.48	2.83	383.15	1.46	13.85	15.31	398.46	3.8	9.5	172	14	13	13	5	2	0	1	0	0	9	0	229	
* 86 D	26	63.76	0.11	2.04	63.15	0.13	1.90	133.99	0.49	6.69	260.90	0.73	10.63	11.36	272.26	4.2	6.4	199	17	21	1	2	5	0	2	0	0	1	0	248	
* 86 D	27	85.43	0.10	2.36	85.96	0.15	2.25	151.96	0.43	3.82	323.35	0.68	8.43	9.11	332.46	2.7	7.5	151	10	22	5	11	4	0	0	1	0	5	0	209	
* 86 D	28	145.79	3.17	10.74	135.57	1.19	17.72	280.97	4.10	38.16	562.33	8.46	66.62	75.08	637.41	11.8	11.3	109	84	10	0	0	2	0	1	0	0	0	0	206	
* 86 D	29	133.02	0.07	1.51	52.51	0.17	0.74	76.21	0.52	1.88	261.74	0.76	4.13	4.89	266.63	1.8	15.5	141	19	13	6	1	37	0	0	0	0	4	0	221	
* 86 D	30	219.09	0.29	2.70	95.26	0.31	1.04	136.45	1.00	2.21	450.80	1.60	5.95	7.55	458.35	1.6	21.2	125	15	9	4	6	42	0	0	1	0	6	0	208	
* 86 D	31	125.49	0.26	4.59	85.00	0.35	4.32	194.69	2.64	18.14	405.18	3.25	27.05	30.30	435.48	7.0	10.7	154	18	22	1	1	7	0	1	0	0	4	0	208	
* 86 D	32	129.57	1.13	11.53	76.96	0.54	7.52	149.34	0.76	3.60	355.87	2.43	22.65	25.08	380.95	6.6	9.7	160	11	27	2	6	2	0	0	0	0	6	0	214	
* 86 D	33	185.15	1.63	14.00	83.36	0.55	8.49	159.73	0.42	1.78	428.24	2.60	24.27	26.87	455.11	5.9	9.7	171	3	21	2	4	0	0	1	0	0	3	0	205	carbonate(?) coated
* 86 D	34	129.47	0.62	6.07	56.47	0.39	4.26	95.95	0.72	5.71	281.89	1.73	16.04	17.77	299.66	5.9	9.7	161	15	28	3	10	6	0	0	0	0	3	0	226	carbonate(?) coated
* 86 D	35	63.55	1.12	24.47	44.22	0.33	8.95	86.17	0.76	14.99	193.94	2.21	48.41	50.62	244.56	20.7	4.4	174	7	19	2	6	4	0	1	0	0	1	0	214	
* 86 D	36	188.80	5.32	37.91	84.54	2.06	14.59	133.98	2.41	11.15	407.32	9.79	63.65	73.44	480.76	15.3	13.3	163	12	21	0	0	2	0	2	0	0	1	0	201	carbonate(?) coated
* 86 D	37	51.69	0.02	0.83	31.37	0.04	0.87	127.56	0.07	0.65	210.62	0.13	2.35	2.48	213.10	1.2	5.2	181	8	17	1	4	3	0	3	1	0	0	0	218	carbonate(?) coated
* 86 D	38	301.74	1.06	5.56	94.90	0.79	6.26	192.73	0.69	4.77	589.37	2.54	16.59	19.13	608.50	3.1	13.3	140	17	14	32	3	1	0	2	0	0	5	0	214	
* 86 D	39	274.64	0.55	8.43	96.66	0.33	3.24	117.68	0.22	1.26	488.98	1.10	12.93	14.03	503.01	2.8	7.8	165	6	28	3	1	2	0	4	0	0	0	0	209	heavy carbonate(?) coated
* 86 D	40	89.71	0.18	3.11	47.01	0.16	1.39	77.85	0.58	5.05	214.57	0.92	9.55	10.47	225.04	4.7	8.8	130	19	18	2	19	15	0	0	1	0	0	0	204	
* 86 D	41	216.88	0.34	9.18	91.63	0.19	3.18	118.85	0.14	0.64	427.36	0.67	13.00	13.67	441.03	3.1	4.9	151	9	22	11	2	3	0	5	0	0	10	0	213	Unk = corundum? carb coat
* 86 D	42	65.87	0.14	2.42	28.42	0.10	0.87	40.54	0.08	1.24	134.83	0.32	4.53	4.85	139.68	3.5	6.6	167	11	24	4	0	0	0	0	0	0	0	0	206	carbonate(?) coated
* 86 D	43	135.05	0.29	5.17	84.97	0.20	2.41	94.50	0.37	2.51	314.52	0.86	10.09	10.95	325.47	3.4	7.9	178	8	25	12	0	3	0	0	0	0	3	0	229	
* 86 D	44	93.00	0.16	3.76	89.11	0.22	2.88	89.32	0.58	4.78	271.43	0.96	11.42	12.38	283.81	4.4	7.8	166	20	16	8	4	4	0	0	0	0	2	0	220	
* 86 D	45	158.57	0.38	5.43	148.39	0.28	3.78	303.89	0.08	0.21	610.85	0.74	9.42	10.16	621.01	1.6	7.3	173	18	21	11	4	4	0	0	0	0	12	0	243	
* 86 D	46	99.03	0.22	5.55	49.87	0.15	1.70	65.66	0.39	3.01	214.56	0.76	10.26	11.02	225.58	4.9	6.9	155	15	17	4	5	16	0	3	1	0	2	0	218	
* 86 D	47	115.33	0.05	1.28	70.50	0.08	0.84	128.70	0.51	2.17	314.53	0.64	4.29	4.93	319.46	1.5	13.0	170	11	12	8	4	4	0	4	1	0	16	0	230	
* 86 D	48	151.36	0.31	1.18	53.92	0.10	0.71	74.03	0.06	0.31	279.31	0.47	2.20	2.67	281.98	0.9	17.6	153	16	27	5	1	5	0	1	1	2	0	0	211	carbonate(?) coated
* 86 D	49	90.65	1.41	3.76	46.53	0.15	2.51	74.04	0.23	4.03	211.22	1.79	10.30	12.09	223.31	5.4	14.8	127	38	28	13	1	2	0	1	0	0	16	0	226	
* 86 D	50	139.76	0.86	5.36	63.74	0.17	3.26	113.62	0.40	4.66	317.12	1.43	13.28	14.71	331.83	4.4	9.7	138	31	25	17	3	2	0	0	0	0	9	0	225	
* 86 D	51	64.86	0.40	60.48	42.74	0.44	13.18	68.70	1.58	23.09	176.30	2.42	96.75	99.17	275.47	36.0	2.4	143	24	20	15	7	2	0	4	0	1	0	0	216	
* 86 D	52	120.74	0.49	8.39	98.31	0.26	5.55	173.65	0.31	3.17	392.70	1.06	17.11	18.17	410.87	4.4	5.8	149	27	23	10	1	1	0	0	0	0	5	0	216	

YR D SMP L-10 HM-10 HN-10 L-40 HM-40 HN-40 L-80 HM-80 HN-80 LTOT HMTOT HNTOT HTOT TOTAL HPC HMPC HRN TRM PYR EPI APA BIO MUS GAR TOU SUL UNK OTH TOT COMMENTS

	YR	D	SMP	L-10	HM-10	HN-10	L-40	HM-40	HN-40	L-80	HM-80	HN-80	LTOT	HMTOT	HNTOT	HTOT	TOTAL	HPC	HMPC	HRN	TRM	PYR	EPI	APA	BIO	MUS	GAR	TOU	SUL	UNK	OTH	TOT	COMMENTS
*	86	D	53	76.63	0.89	6.62	54.07	0.27	5.45	102.59	0.79	12.97	233.29	1.95	25.04	26.99	260.28	10.4	7.2	189	8	15	4	3	1	0	0	0	0	2	0	222	
*	86	D	54	87.00	0.33	4.92	57.20	0.16	2.32	88.71	0.50	4.93	232.91	0.99	12.17	13.16	246.07	5.3	7.5	166	18	29	19	1	0	0	1	0	0	6	0	240	
*	86	D	55	167.02	0.15	5.66	70.15	0.10	2.50	107.70	0.49	6.89	344.87	0.74	15.05	15.79	360.66	4.4	4.7	158	15	24	4	3	4	0	1	0	1	11	0	221	
*																																	
*	86	D	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	ERR	ERR	0	0	0	0	0	0	0	0	0	0	0	0	0	<-- Data pattern to copy
*																																	

* SUMMARY STATISTICS for Heavy Minerals

*	YR D	#	L-10	HM-10	HN-10	L-40	HM-40	HN-40	L-80	HM-80	HN-80	LTOT	HMTOT	HNTOT	HTOT	TOTAL	HPC	HMPC	HRN	TRM	PYR	EPI	APA	BIO	MUS	GAR	TOU	SUL	UNK	OTH	TOT	
*	Units ->		g	g	g	g	g	g	g	g	g	g	g	g	g	g	%	%	#	#	#	#	#	#	#	#	#	#	#	#	#	<Units
*																																
*	Number >		55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	<Number of valid data
*																																
*	Maximum>		301.74	5.32	60.48	148.39	2.06	17.72	303.89	4.10	38.16	610.85	9.79	96.75	99.17	637.41	36.0	22.7	199	84	62	37	19	42	8	7	15	6	16	0	249	<Maximum
*	Minimum>		12.66	0.02	0.15	12.56	0.02	0.22	40.54	0.04	0.21	87.10	0.13	2.13	2.48	89.72	0.9	2.4	99	3	9	0	0	0	0	0	0	0	0	0	201	<Minimum
*																																
*	Average>		123.21	0.58	6.56	71.35	0.33	3.68	127.09	0.66	5.06	321.65	1.57	15.30	16.87	338.52	5.1	10.4	147	17	27	10	4	6	0	2	1	0	5	0	219	<Average, arithmetic mean
*	Stan-Dev		57.60	0.82	9.42	27.66	0.32	3.38	57.16	0.69	6.24	120.92	1.63	16.71	17.92	124.90	5.4	4.2	22	14	12	8	4	8	1	2	2	1	4	0	11	<Standard Deviation
*	Coef-Var		47%	142%	144%	39%	97%	92%	45%	104%	123%	38%	104%	109%	106%	37%	106%	41%	15%	83%	42%	80%	87%	136%	401%	110%	294%	378%	81%	ERR	5%	<Coefficient of Variation

* SELECTION CRITERIA for Heavy Minerals

*	YR D	#	L-10	HM-10	HN-10	L-40	HM-40	HN-40	L-80	HM-80	HN-80	LTOT	HMTOT	HNTOT	HTOT	TOTAL	HPC	HMPC	HRN	TRM	PYR	EPI	APA	BIO	MUS	GAR	TOU	SUL	UNK	OTH	TOT	
*																																<Enter selection criteria
*																																
*																																

* VARIABLE NAMES for Heavy Minerals

* YeaR Sample No. -10+40 mesh -40+80 mesh -80+230 mesh HoRNblende MUScovite TOTal number of grains
* Light mineral TOTal TReMolite+actinolite GARnet
* L = Light minerals Heavy Magnetic mineral TOTal PYRoxene TOUrmaline
* HM = Heavy-Magnetic minerals Heavy Nonmagnetic mineral TOTal EPIdote SULfides
* HN = Heavy-NonMagnetic minerals Heavy mineral TOTal APAtite UNKnowns
* grand TOTAL BIOtite OTHer, identified in the comments
* -10 = -10+40 mesh Heavy mineral PerCent
of (light+heavy)
* -40 = -40+80 mesh Heavy Magnetic
PerCent of heavy minerals
* -80 = -80+230 mesh

* CODE TRANSLATION for Heavy Minerals

* -1 = Missing LTOT = L-10 + L-40 + L-80
* (all data) Carbonate coating reduces
* Blanks and nulls cause problems for the macros, use -1 HMTOT = HM-10 + HM-40 + HM-80 the accuracy of the
*** counts,
* HNTOT = HN-10 + HN-40 + HN-80 specially pale minerals.
*
* HTOT = HMTOT + HNTOT
*
* TOTAL = LTOT + HTOT
*
* HPC = 100 * HTOT /
TOTAL
*
* HMPC = 100 * *
HMTOT / HTOT
****

APPENDIX "E"

GEOCHEMICAL ANALYSES

GEOCHEMISTRY by ATOMIC ABSORPTION

Sample YR	D	#	Carbon CTOT	CORG	CIN	CEQ	Cr	Mn	Fe	Co	Ni	Cu	Zn	Mo	Ag	Pb	As	U	COMMENTS_GEOCHEM_AA
86	D	1	1.85	0.19	1.66	13.83	74	375	5.3	16	51	66	91	0.5	0.05	20	6	4.2	
86	D	2	2.07	0.01	2.06	17.16	62	580	3.2	12	31	42	83	0.5	0.10	10	4	1.3	
86	D	3	1.82	0.25	1.57	13.08	76	960	3.9	35	82	250	124	0.5	0.10	24	12	4.0	
86	D	4	0.64	0.02	0.62	5.16	60	420	3.5	16	59	104	117	0.5	0.05	15	8	3.9	
86	D	5	1.74	0.01	1.73	14.41	80	1400	5.0	25	69	174	128	2.0	0.20	12	10	2.6	
86	D	6	1.77	0.32	1.45	12.08	86	1400	5.8	33	81	196	110	2.0	0.30	27	33	6.1	
86	D	7	0.45	0.12	0.33	2.75	118	590	5.2	26	136	370	137	0.5	0.05	26	15	6.4	
86	D	8	1.60	0.01	1.59	13.24	84	960	4.2	16	61	76	116	0.5	0.10	16	4	3.6	
86	D	9	0.69	0.14	0.55	4.58	92	490	4.5	22	62	90	105	0.5	0.05	19	9	3.4	
86	D	10	0.52	0.04	0.48	4.00	110	505	4.8	38	161	235	177	0.5	0.20	32	8	8.3	
86	D	11	4.86	2.52	2.34	19.49	42	360	6.2	12	23	28	126	2.0	0.50	25	15	2.6	
86	D	12	3.32	1.40	1.92	15.99	56	370	4.0	21	38	32	102	0.5	0.40	26	13	3.7	
86	D	13	9.28	2.48	6.80	56.64	60	430	7.6	19	44	78	112	0.5	0.20	26	47	2.2	
86	D	14	0.55	0.13	0.42	3.50	90	520	5.2	25	76	80	129	4.0	0.05	22	17	4.6	
86	D	15	0.50	0.10	0.40	3.33	60	550	7.7	30	62	200	100	0.5	0.10	6	3	1.7	
86	D	16	1.33	0.29	1.04	8.66	84	380	4.7	26	69	128	94	0.5	0.20	18	17	3.2	
86	D	17	2.41	0.33	2.08	17.33	100	1100	5.6	38	106	130	115	0.5	0.30	21	25	2.9	
86	D	18	0.92	0.12	0.80	6.66	92	760	5.0	28	95	210	119	0.5	0.20	25	18	3.9	
86	D	19	0.92	0.16	0.76	6.33	84	760	5.4	40	109	176	98	0.5	0.10	19	29	3.9	
86	D	20	2.88	0.87	2.01	16.74	82	410	5.8	28	82	74	97	0.5	0.05	18	24	2.8	
86	D	21	1.08	0.04	1.04	8.66	84	1200	6.8	28	84	184	128	0.5	0.05	11	76	1.7	
86	D	22	1.37	0.22	1.15	9.58	96	1600	7.8	44	120	420	151	0.5	0.10	12	154	4.7	
86	D	23	1.37	0.36	1.01	8.41	76	170	4.2	23	58	58	68	0.5	0.05	14	5	2.1	
86	D	24	1.30	0.37	0.93	7.75	84	360	4.0	19	66	110	98	0.5	0.05	14	5	2.4	
86	D	25	1.49	0.02	1.47	12.25	76	1200	5.6	30	85	134	106	0.5	0.10	9	36	1.5	
86	D	26	1.76	0.18	1.58	13.16	52	430	3.7	15	43	96	97	0.5	0.05	20	3	4.4	
86	D	27	0.67	0.10	0.57	4.75	46	240	2.8	11	36	82	76	0.5	0.05	19	3	7.7	
86	D	28	1.38	0.08	1.30	10.83	220	1200	5.2	32	129	140	103	0.5	0.05	16	26	3.3	
86	D	29	1.79	0.10	1.69	14.08	28	360	2.5	11	26	76	113	0.5	0.05	69	3	53.7	
86	D	30	0.61	0.02	0.59	4.91	20	440	2.4	9	17	52	123	0.5	0.05	58	2	18.4	
86	D	31	0.71	0.15	0.56	4.66	108	570	5.6	25	76	260	79	0.5	0.05	13	8	2.9	
86	D	32	0.57	0.04	0.53	4.41	112	840	5.4	27	121	540	130	0.5	0.05	12	19	2.9	
86	D	33	0.60	0.08	0.52	4.33	128	1000	5.5	28	94	260	108	0.5	0.05	19	19	5.7	
86	D	34	0.70	0.02	0.68	5.66	128	1000	5.6	29	99	250	107	0.5	0.05	20	17	5.0	
86	D	35	0.22	0.08	0.14	1.17	56	285	2.3	15	60	178	47	0.5	0.05	5	10	2.3	
86	D	36	0.21	0.01	0.20	1.67	120	1050	6.2	35	138	500	236	0.5	0.05	14	17	2.8	
86	D	37	0.11	0.09	0.02	0.17	96	480	5.8	22	80	104	106	1.0	0.10	11	9	2.2	
86	D	38	0.88	0.17	0.71	5.91	120	460	6.4	25	74	200	88	0.5	0.05	13	21	3.9	
86	D	39	2.20	0.50	1.70	14.16	80	370	4.7	29	71	114	82	1.0	0.05	20	22	5.5	
86	D	40	1.24	0.17	1.07	8.91	84	880	4.4	29	104	200	209	0.5	0.30	44	4	8.9	
86	D	41	0.88	0.14	0.74	6.16	76	1100	5.6	29	65	136	95	0.5	0.05	12	23	39.5	
86	D	42	11.00	4.00	7.00	58.31	50	210	6.0	12	34	38	110	4.0	0.05	16	14	3.0	
86	D	43	0.66	0.02	0.64	5.33	30	330	2.2	11	25	68	82	0.5	0.05	19	3	6.2	
86	D	44	2.18	0.42	1.76	14.66	66	240	3.6	18	49	80	75	2.0	0.20	32	8	11.7	
86	D	45	0.22	0.01	0.21	1.75	42	430	3.5	14	42	90	128	0.5	0.05	5	3	1.4	
86	D	46	0.73	0.08	0.65	5.41	44	580	3.4	22	49	148	111	0.5	0.10	8	4	2.6	
86	D	47	1.74	0.24	1.50	12.50	22	320	2.6	13	23	48	113	0.5	0.05	18	3	6.7	
86	D	48	2.55	0.71	1.84	15.33	38	360	7.0	12	31	26	103	0.5	0.05	7	18	1.6	
86	D	49	2.54	0.44	2.10	17.49	112	390	5.4	25	69	96	83	0.5	0.05	23	39	2.5	
86	D	50	2.28	0.50	1.78	14.83	124	600	6.1	34	90	200	96	2.0	0.05	25	50	4.1	
86	D	51	0.56	0.06	0.50	4.17	104	680	3.9	37	229	660	115	0.5	0.05	6	7	2.1	
86	D	52	0.69	0.06	0.63	5.25	92	460	4.0	22	64	157	75	0.5	0.05	25	8	17.0	
YR	D	SMP	CTOT	CORG	CIN	CEQ	Cr	Mn	Fe	Co	Ni	Cu	Zn	Mo	Ag	Pb	As	U	COMMENTS

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  YR D SMP  CTOT  CORG  CIN   CEQ      Cr    Mn    Fe    Co    Ni    Cu    Zn    Mo    Ag    Pb    As     U  COMMENTS

* 86 D  53  4.07  0.81  3.26 27.16    102   280   4.7    28   118   172    82   1.0  0.05    24     7   4.9                   *
* 86 D  54  4.47  0.85  3.62 30.15     76   640   4.6    29    84   240    93   0.5  0.10    17    14   2.5                   *
* 86 D  55  0.91  0.19  0.72  6.00     62   880   5.4    25    64   230   113   0.5  0.20    19    10   3.9                   *
*                                                                                                                           *
* 86 D   0  0.00  0.00  0.00  0.00      0     0   0.0     0     0     0     0   0.5  0.05     0     0   0.0 <-- Data pattern  *
*                                                                                                                           *
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
* SUMMARY STATISTICS for Geochemistry by Atomic Absorbtion                                                                   *
.............................................................................................................................
* YR D    #  CTOT  CORG  CIN   CEQ     Cr    Mn    Fe    Co    Ni    Cu    Zn    Mo    Ag    Pb    As     U                   *
* Units ->    %     %     %     %     ppm   ppm    %    ppm   ppm   ppm   ppm   ppm   ppm   ppm   ppm   ppm <Units            *
*                                                                                                                           *
* Number >    55    55    55    55     55    55    55    55    55    55    55    55    55    55    55    55 <Number of valid  *
*                                                                                                                           *
* Maximum> 11.00  4.00  7.00 58.31    220  1600   7.8    44   229   660   236   4.0  0.50    69   154  53.7 <Maximum          *
* Minimum>  0.11  0.01  0.02  0.17     20   170   2.2     9    17    26    47   0.5  0.05     5     2   1.3 <Minimum          *
*                                                                                                                           *
* Average>  1.74  0.38  1.36 11.36     81   636   4.9    24    75   165   109   0.8  0.11    20    18   5.9 <Average, arithmetic *
*                                                                                                                           *
* Stan-Dev  1.94  0.70  1.31 10.89     33   345   1.4     9    39   128    31   0.8  0.10    11    23   8.7 <Standard Deviation *
* Coef-Var  111%  186%   96%   96%    41%   54%   28%   35%   52%   77%   28%   96%   91%   58%  129%  146%<Coefficient of   *
-----------------------------------------------------------------------------------------------------------------------------
* SELECTION CRITERIA for Geochemistry by Atomic Absorbtion                                                                  *
.............................................................................................................................
* YR D    #  CTOT  CORG  CIN   CEQ     Cr    Mn    Fe    Co    Ni    Cu    Zn    Mo    Ag    Pb    As     U                   *
*                                                                                                       <Enter selection    *

*                                                                                                                           *
*                                                                                                                           *
-----------------------------------------------------------------------------------------------------------------------------
* VARIABLE NAMES for Geochemistry by Atomic Absorbtion                                                                      *
.............................................................................................................................
* YeaR Sample No.                                   Iron                                 Molybdenum                         *
*          Carbon-TOTal                   Chromium       Cobalt                               Silver                        *
*                Carbon-ORGanic (C fix.)     Manganese        Nickel                               Lead                     *
*                      Carbon-INorganic                             Copper                             Arsenic              *
*                            CaCo3-EQuivalent                             Zinc                               Uranium        *
*                                                                                                                           *
*          0.01  0.01  0.01  0.08      2     1   0.1     1     2     1     1     1   0.1     2     2     1 <---- Detection  *
*                                      AA    AA    AA    AA    AA    AA    AA    AA    AA    AA Colourimeter<- Measurement  *
*                                                                                                   Delayed NA              *
-----------------------------------------------------------------------------------------------------------------------------
* CODE TRANSLATION for Geochemistry by Atomic Absorbtion                                                                    *
.............................................................................................................................
*  -1 = Missing        CIN = CTOT - CORG       For Molybdenum and silver, if the measurement is less than the detection limit  *
*   (all data)               CEQ = CIN * 8.33                          then the data value entered is 1/2 the measurement   *
*   Blanks and nulls cause problems for the macros, use -1                                                                  *
*****************************************************************************************************************************
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KENORA-DRYDEN Geochemistry (NA)

YR D SMP Sc Cr Fe Co Ni Zn As Se Rb Mo Ag Cd Sb Cs Ba La Eu Tb Yb Hf Ta W Ir Au Th U Wt COMMENTS

GEOCHEMISTRY by NEUTRON ACTIVATION

Sample

YR	D	#	Sc	Cr	Fe	Co	Ni	Zn	As	Se	Rb	Mo	Ag	Cd	Sb	Cs	Ba	La	Eu	Tb	Yb	Hf	Ta	W	Ir	Au	Th	U	WT	COMMENTS_GEOCHEM_NA
86	D	1	13.0	140	6.9	22	63	50	7.9	3	100	3.0	1.5	<5	0.4	4.9	840	79	1.0	1.8	3	4	1.2	1.0	<50	1	48.2	4.7	5.58	
86	D	2	12.0	110	3.7	14	51	210	2.2	2	130	2.0	1.0	<5	0.3	3.7	850	51	0.5	0.8	3	3	1.2	0.5	<50	1	17.0	1.3	6.00	
86	D	3	14.0	120	5.5	40	95	330	15.0	2	93	4.0	2.0	<5	0.7	6.7	810	51	1.0	0.8	2	3	1.4	1.0	<50	8	43.4	4.3	2.75	
86	D	4	12.0	100	5.0	20	73	290	10.0	2	120	1.0	1.5	<5	0.4	7.0	1000	68	2.0	0.9	1	4	0.7	2.0	<50	1	31.0	4.4	4.74	
86	D	5	17.0	180	6.5	32	85	240	13.0	2	130	4.0	1.0	<5	0.5	7.1	790	61	2.0	0.9	4	6	0.9	1.0	<50	5	18.0	2.9	6.58	
86	D	6	18.0	140	9.1	51	120	210	41.0	2	120	5.0	1.5	<5	1.1	8.3	590	39	3.0	1.0	4	7	1.2	5.0	<50	6	37.2	7.3	5.29	
86	D	7	21.3	200	7.6	34	180	240	20.0	2	160	2.0	1.5	<5	0.7	14.0	780	62	0.5	1.1	3	4	1.8	2.0	<50	8	39.3	6.0	6.10	
86	D	8	15.0	120	5.2	19	83	150	6.0	2	190	2.0	1.0	<5	0.4	12.0	920	82	2.0	1.3	2	4	1.2	2.0	<50	1	25.0	3.7	7.19	
86	D	9	17.0	160	6.8	30	77	130	11.0	2	190	1.0	1.0	<5	0.5	13.0	730	38	2.0	0.2	1	4	1.4	2.0	<50	1	26.7	3.8	7.74	
86	D	10	17.0	160	6.6	53	200	230	9.0	3	240	4.0	1.5	<5	0.5	34.0	840	53	0.5	0.9	1	3	2.6	7.0	<50	34	39.3	9.1	3.45	
86	D	11	13.0	94	10.0	17	37	300	18.0	2	59	5.0	1.0	<5	1.0	6.2	350	25	0.5	0.2	3	5	1.4	4.0	<50	27	10.0	3.0	9.29	
86	D	12	16.0	130	6.6	33	54	250	21.0	2	92	5.0	1.0	<5	0.8	11.0	490	26	0.5	0.2	3	6	1.6	3.0	<50	12	9.2	3.7	7.29	
86	D	13	12.0	82	12.0	25	47	220	62.3	3	63	12.0	2.0	<5	1.6	6.3	390	22	1.0	0.6	2	6	1.4	2.0	<50	24	13.0	3.0	2.71	
86	D	14	20.0	170	9.1	34	120	210	18.0	7	140	5.0	1.5	<5	0.5	17.0	630	44	2.0	1.0	3	5	1.6	3.0	<50	10	39.5	4.9	5.58	
86	D	15	15.0	81	11.0	39	84	180	2.4	2	150	3.0	1.5	<5	0.2	5.2	630	50	0.5	0.8	1	4	1.0	3.0	<50	7	17.0	1.6	4.94	
86	D	16	14.0	170	8.2	37	89	150	21.0	2	92	6.0	1.0	<5	0.6	7.6	620	34	0.5	0.7	2	5	1.5	2.0	<50	1	30.0	3.7	7.49	
86	D	17	18.0	160	8.8	52	140	270	28.0	2	110	3.0	1.5	<5	0.6	13.0	540	32	2.0	1.0	2	5	1.5	5.0	<50	7	26.9	3.1	4.92	
86	D	18	19.0	160	8.3	38	130	130	20.0	2	160	2.0	1.0	<5	0.5	11.0	770	43	0.5	1.0	2	5	1.0	2.0	<50	4	42.3	3.6	5.85	
86	D	19	15.0	140	8.5	64	150	150	31.0	2	89	3.0	1.5	<5	0.8	9.4	480	32	0.5	0.6	2	5	1.4	2.0	<50	6	36.0	3.7	5.90	
86	D	20	13.0	130	8.1	40	120	140	29.0	2	94	4.0	1.5	<5	0.8	7.9	490	22	0.5	0.8	2	5	1.3	3.0	<50	4	23.9	2.9	5.68	
86	D	21	29.7	170	9.4	36	110	190	90.3	2	110	2.0	1.5	<5	5.2	5.3	640	31	2.0	0.6	3	6	0.5	1.0	<50	11	11.0	1.4	6.00	
86	D	22	82.8	200	13.0	65	150	150	207.0	2	87	3.0	1.5	<5	3.6	9.0	490	57	5.0	2.6	9	6	1.1	0.5	<50	22	19.0	4.7	8.85	
86	D	23	14.0	150	7.4	32	81	150	5.7	2	88	3.0	1.0	<5	0.4	6.9	540	19	1.0	0.2	2	3	1.1	2.0	<50	1	11.0	2.0	7.86	
86	D	24	25.7	160	7.0	28	110	130	7.4	2	120	3.0	1.0	<5	0.3	10.0	920	46	1.0	1.3	4	4	1.4	2.0	<50	29	22.1	2.5	7.58	
86	D	25	27.6	160	7.8	38	77	230	42.0	2	110	2.0	1.0	<5	1.9	5.4	610	38	0.5	0.7	3	5	0.8	0.5	<50	4	14.0	1.3	6.90	
86	D	26	11.0	84	3.8	16	47	170	2.2	2	120	2.0	1.0	<5	0.4	6.8	580	25	2.0	0.9	3	4	0.9	1.0	<50	9	35.2	4.7	4.84	
86	D	27	15.0	79	4.4	12	47	170	3.3	2	110	2.0	1.0	<5	0.4	5.6	690	32	0.5	0.8	1	4	1.4	0.5	<50	1	62.7	8.9	6.14	
86	D	28	24.2	400	8.1	47	160	50	34.0	2	150	2.0	1.5	<5	1.4	15.0	750	48	0.5	0.2	2	5	1.3	0.5	<50	9	28.5	4.2	5.98	
86	D	29	8.9	23	3.6	13	29	260	2.0	2	220	2.0	1.0	<5	0.2	8.9	810	93	0.5	0.8	1	7	1.2	0.5	<50	1	213.0	62.5	4.84	
86	D	30	7.6	45	2.7	9	10	210	1.5	3	260	2.0	1.0	<5	0.2	8.2	930	91	0.5	0.9	2	5	0.2	0.5	<50	1	352.0	16.0	5.00	
86	D	31	32.6	200	9.3	36	110	50	7.8	2	58	0.5	1.0	<5	0.6	8.4	420	57	2.0	1.1	6	5	0.9	4.0	<50	11	20.2	2.6	8.60	
86	D	32	28.9	200	8.2	37	150	50	19.0	2	100	2.0	1.5	<5	1.0	10.0	620	66	2.0	1.2	3	5	0.9	4.0	<50	11	22.9	2.9	5.80	
86	D	33	25.4	210	8.6	34	110	150	19.0	2	96	3.0	1.0	<5	1.0	8.3	610	70	1.0	1.1	3	4	1.2	3.0	<50	7	26.5	5.4	7.10	
86	D	34	28.9	240	10.0	38	130	130	20.0	2	110	3.0	1.5	<5	1.0	9.1	720	80	2.0	0.8	4	6	1.1	2.0	<50	9	28.9	5.8	6.55	
86	D	35	20.0	180	5.1	28	110	140	8.0	2	59	1.0	1.0	<5	0.5	2.8	620	40	0.5	0.6	3	3	0.6	1.0	<50	9	13.0	1.9	7.50	
86	D	36	29.8	240	10.0	46	160	220	14.0	2	85	2.0	1.5	<5	0.6	7.3	580	47	2.0	0.8	3	5	0.9	1.0	<50	6	23.5	2.5	4.88	
86	D	37	31.7	200	8.3	29	95	50	9.1	2	91	5.0	1.5	<5	0.5	9.4	710	52	2.0	0.2	4	4	0.6	0.5	<50	1	17.0	2.1	6.51	
86	D	38	26.6	230	9.3	32	92	150	21.0	2	98	3.0	1.5	<5	0.8	9.4	570	49	0.5	0.7	3	5	0.8	2.0	<50	7	29.1	3.6	5.66	
86	D	39	17.0	140	7.2	37	92	50	22.0	2	74	3.0	1.5	<5	1.0	6.9	520	37	1.0	0.8	3	6	1.5	0.5	<50	6	30.0	6.3	4.54	
86	D	40	15.0	140	5.9	34	110	280	3.3	3	210	1.0	1.5	<5	0.5	20.0	910	73	0.5	1.0	1	3	1.6	2.0	<50	1	66.4	10.0	4.28	
86	D	41	30.6	170	8.5	35	91	50	24.0	2	110	3.0	1.5	<5	1.4	8.9	570	37	0.5	0.8	2	5	1.0	1.0	<50	7	16.0	45.5	6.56	
86	D	42	7.8	73	7.1	16	39	210	12.0	2	35	7.0	1.0	<5	0.8	4.8	270	19	0.5	0.2	1	3	0.7	2.0	<50	5	10.0	2.7	4.77	
86	D	43	8.7	52	2.8	11	29	210	1.6	2	180	0.5	1.0	<5	0.2	14.0	810	31	0.5	0.8	3	4	2.8	0.5	<50	1	32.4	6.9	5.20	
86	D	44	13.0	78	4.2	19	62	200	7.0	3	110	5.0	2.0	<5	0.8	9.1	390	57	1.0	1.0	4	6	2.1	2.0	<50	2	56.9	11.0	2.02	
86	D	45	10.0	67	4.4	17	47	170	1.4	2	94	2.0	1.0	<5	0.2	2.9	620	28	0.5	0.2	1	4	0.2	0.5	<50	2	8.5	1.3	5.98	
86	D	46	10.0	79	4.0	22	43	160	3.7	2	100	2.0	1.0	<5	0.3	4.3	600	34	0.5	0.2	1	4	0.7	0.5	<50	16	22.9	2.3	5.25	
86	D	47	5.8	41	2.8	13	21	200	2.0	2	160	2.0	1.0	<5	0.3	10.0	940	36	0.5	0.2	1	5	1.3	4.0	<50	1	32.2	6.4	4.71	
86	D	48	21.5	160	7.7	16	50	150	17.0	2	160	3.0	1.0	<5	0.5	6.8	520	29	0.5	0.2	2	6	0.6	0.5	<50	1	5.2	1.4	6.26	
86	D	49	16.0	170	6.6	30	81	140	35.0	2	90	3.0	1.0	<5	0.8	7.7	510	27	1.0	0.6	1	5	0.6	2.0	<50	1	16.0	2.4	5.67	
86	D	50	19.0	190	8.4	40	110	140	47.0	2	76	3.0	1.0	<5	0.7	9.1	460	34	0.5	0.6	2	4	0.9	2.0	<50	7	29.0	3.7	7.47	
86	D	51	27.4	260	8.0	55	270	220	5.3	2	53	2.0	1.0	<5	0.3	5.1	400	32	0.5	0.8	3	3	0.2	1.0	<50	17	10.0	2.1	6.47	
86	D	52	16.0	140	6.2	29	74	50	5.8	2	110	2.0	1.0	<5	0.4	9.4	520	34	1.0	0.8	1	5	2.1	2.0	<50	1	47.1	15.0	5.52	

YR D SMP Sc Cr Fe Co Ni Zn As Se Rb Mo Ag Cd Sb Cs Ba La Eu Tb Yb Hf Ta W Ir Au Th U Wt COMMENTS

YR	D	SMP	Sc	Cr	Fe	Co	Ni	Zn	As	Se	Rb	Mo	Ag	Cd	Sb	Cs	Ba	La	Eu	Tb	Yb	Hf	Ta	W	Ir	Au	Th	U	Wt	COMMENTS
86	D	53	11.0	140	5.6	32	130	50	5.4	2	59	3.0	1.0	<5	0.4	6.2	370	39	0.5	0.9	1	2	1.2	3.0	<50	4	40.2	4.4	5.23	
86	D	54	16.0	100	5.6	33	86	150	8.6	2	65	1.0	1.0	<5	0.4	3.7	460	24	0.5	0.7	3	3	0.2	0.5	<50	3	15.0	1.7	6.20	
86	D	55	13.0	100	6.6	28	73	170	4.0	2	110	3.0	1.0	<5	0.4	10.0	560	41	0.5	1.0	2	3	1.5	6.0	<50	7	39.4	3.5	6.62	
86	D	0	0.0	0	0.0	0	0	0	0.0	2	0	0.0	1.0	<5	0.0	0.0	0	0	0.5	0.0	0	0	0.0	0.5	<50	0	0.0	0.0	0.00	<-- Data pattern to copy

* SUMMARY STATISTICS for Geochemistry by Neutron Activation

YR D	#	Sc	Cr	Fe	Co	Ni	Zn	As	Se	Rb	Mo	Ag	Cd	Sb	Cs	Ba	La	Eu	Tb	Yb	Hf	Ta	W	Ir	Au	Th	U	WT	
Units ->		ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppb	ppm	ppm	g	<Units
Number >		55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	<Number of valid data
Maximum>		82.8	400	13.0	65	270	330	207.0	7.0	260	12.0	2.0	0	5.2	34.0	1000	93	5.0	2.6	9	7	2.8	7.0	0	34.0	352.0	62.5	9.29	<Maximum
Minimum>		5.8	23	2.7	9	10	50	1.4	2.0	35	0.5	1.0	0	0.2	2.8	270	19	0.5	0.2	1	2	0.2	0.5	0	1.0	5.2	1.3	2.02	<Minimum
Average>		18.9	146	7.1	32	94	170	20.1	2.2	116	3.0	1.3	0	0.8	8.9	632	45	1.1	0.8	2	5	1.2	2.0	0	7.3	36.4	6.2	5.90	<Average, arithmetic mean
Stan-Dev		11.1	64	2.3	13	48	70	30.2	0.7	47	1.8	0.3	0	0.8	4.8	172	18	0.9	0.4	1	1	0.5	1.5	0	7.5	51.5	9.9	1.43	<Standard Deviation
Coef-Var		59%	44%	32%	41%	51%	42%	151%	33%	41%	61%	24%	ERR	105%	54%	27%	41%	80%	54%	56%	25%	46%	75%	ERR	104%	142%	159%	24%	<Coefficient of Variation

* SELECTION CRITERIA for Geochemistry by Neutron Activation

YR D	#	Sc	Cr	Fe	Co	Ni	Zn	As	Se	Rb	Mo	Ag	Cd	Sb	Cs	Ba	La	Eu	Tb	Yb	Hf	Ta	W	Ir	Au	Th	U	WT	
																													<Enter selection criteria

* VARIABLE NAMES for Geochemistry by Neutron Activation

YeaR Sample No.	Sc	Cr	Fe	Co	Ni	Zn	As	Se	Rb	Mo	Ag	Cd	Sb	Cs	Ba	La	Eu	Tb	Yb	Hf	Ta	W	Ir	Au	Th	U	Wt	
	Scandium	Chromium	Iron	Cobalt	Nickel	Zinc	Arsenic	Selenium	Rubidium	Molybdenum	Silver	Cadmium	Antimony	Cesium	Barium	Lanthanum	Europium	Terbium	Ytterbium	Hafnium	Tantalum	Tungsten	Iridium	Gold	Thorium	Uranium	WeighT	
	0.2	20	0.2	5	20	100	0.5	5	5	1	2	5	0.1	0.5	50	2	1	0.5	2	1	0.5	1	50	2	0.2	0.2	0.01	<---- Detection limit

* CODE TRANSLATION for Geochemistry by Neutron Activation

* -1 = Missing
* (all data)
* Blanks and nulls cause problems for the macros, use -1

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

This occurs for: Nickel, Zinc, Selenium, Molybdenum, Silver,
Europium, Terbium, Ytterbium, Tantalum, Tungstem, Gold.