Report on Petrological studies of Rocks and the Mineralogy of Heavy Mineral Separates Claim Block Number 1151126 Thunder Bay Mining District

NTS 52 - A - 10

Peter MacMartin, B.Sc.
Gamah International Limited

October 3, 1995
Toronto, Ontario

Abstract

Eight unit claim block number 1151126 was staked in September 1993 to cover an area determined to have an airborne geophysical anomaly. The claims are located some 35 kilometres northeast of Thunder Bay, 15 kilometres east of Ontario Provincial Highway 527. In September 1993 a suite of samples of glacial till from the vicinity of the claims were collected and subjected to panning and heavy media separation to concentrate the heavy minerals. Subsequently these were examined by laboratory methods to determine their content and the potential for their origin to have been either kimberlitic or mafic/ultramafic with Ni, Cu, and PGE elements potential. During July and August 1995 a two person crew undertook reconnaissance of the claim block and determined that there was no significant extent of outcrop. Consequently mapping would not explain the reason for the magnetic anomaly.

The petrographic studies and heavy mineral work confirm the potential of this area to host ultramafic to mafic bodies and therefore further exploration for base metals and platinum group elements is warranted as is the search for kimberlites.

It is recommended that magnetic and electromagnetic ground geophysical surveys be undertaken to locate and delineate the extent of the airborne magnetic anomaly and search for conductors representing base metal concentrations.

Expenditures to date on the field and laboratory work applicable to the claim block amount to $7,629.18.

Table of Contents

1. Introduction

This report describes work which has been completed on and related to studies of the exploration potential of claim block #1151126 in the Thunder Bay Mining District, which work is being applied for assessment credit. The work completed included reconnaissance mapping of the claim block, collection of a suite of bulk samples from the area, heavy mineral separation therefrom, mineralogical and electron microscope analysis of the derivatives thereof and petrographic analysis of rock samples representative of the mafic and ultramafic hosts rocks found in the area.

2. Ownership of Claim Block

The mining claims investigated are an eight claim block:

Claim Block Number	Claim Block Anniversary Date
1151126	October 8, 1995

The mining claim block is held by Dr. Gerald Harper of 26 Orchard Crescent, Toronto, Ontario M8Z 3E1, MNDM Prospectors License: A47161 Exp. 16 May 1997 CLN 141927.

3. Location of and Access To Claim Block

Claim block #1151126 is in the Thunder Bay Mining District. Access to the claim block is via Highway 527, north for nearly 22 kilometres from its intersection with Highway 11/17 which is about 10 km northeast of Thunder Bay. See Figure 1. At this point a well used logging road extends eastwards following the watershed and height of land such as it is wherever possible. Sixteen and a half kilometres along this road, the west boundary line of claim block crosses the road. See Figure 2

4. Topography and Vegetation

The terrain is gently undulating, with moderate relief of less than 30 metres. See Figure 3. Off the claim block to the east, some 2 kilometres, the land drops sharply to an incised linear, north-south oriented valley likely controlled by a major geologic structure. The claim block is approximately bisected by the logging road which in this area has an orientation of 080°. Approximately 250 - 300 metres east along the road from the western claim line is a T junction with a side road extending due south. The area to the north of the main logging road has not been logged but 50 -60% of that south of the main road has been cut over. Both clear-cut and selective logging practices have been carried out. Much slash and damaged timber remains making walking difficult. Woodland trees include species of pine and spruce, white birch, poplar and minor tamarack. Beaver dammed lakes occur in the southeast corner of the claim block.

5. Regional Geology

The rock assemblages of the region north and northeast of Thunder Bay which encompasses the claim block area are predominantly composed of early Archean granitic and granodoioritic migmatites which in some areas include minor migmatic metasediments and minor metavolcanics. The structural trend of these rocks is predominantly of NE/SW orientation but superimposed thereon is the north-south feature mentioned above and which apparently offsets earlier NE linears. These Archean rocks were affected by Proterozoic rifting associated with the failed midcontinental rift zone to the immediate south. The geology of the mid-continent rift is characterized by voluminous tholeiitic magmatism. expressed in Keweenawan lava flows. diabase sills and dyke swarms. and discrete gabbroic to ultramafic intrusives (Smith and Sutcliffe. 1987; Sutcliffe. 1991) with interbedded bright red clastic sediments of the Sibley Formation.

There is very little outcrop in the area. and coarse boulder till and fluvio glacial material is common over extensive areas. Eskers. striae and other indications of glacial transport and direction suggesting a movement generally from the northeast. Float boulders. generally tens of centimetres to a few metres in diameter. include notable concentrations of various types of mafic-ultramafic rocks and red clastic sediments of the Sibley Formation. It is possible that these ultramafic/mafic float boulders are derived from the extensive Proterozoic diabases. gabbros and ultramafic rocks marked on regional maps some 20 - 30 kilometres to the north and continuing extensively over much of the area to the north and east encompassing Lake Nipigon. However they could also originate from ultramafic/mafic bodies of Archean age in the immediate area. of which a few are identified on regional geological maps and are likely more common as indicated by the amount and number of such bodies at Lac Des Iles. to the north where mining has exposed them.

Additional references to Ontario Geological Survey bedrock and surficial mapping work in this area include Hawley (1929). Mollard and Mollard (1983 and 1981). and Pye (1968).

6. Historical Claimstaking, Mining and Exploration Activity in the Area

The most important mining property in the region is the recently opened. 3.000 tpd Lac des Iles Platinum mine at Lac Des Iles. 30 kilometres north of the claims. This was discovered in the 1970s and the staking rush which accompanied its announcement has not led to other discoveries or prospects and consequently there is not a large area of retained claims in the vicinity.

Historically claimstaking in this area of the Thunder Bay Mining Division has not been very active. There are a small number of claim blocks in the immediate areas to the south and southwest of the claims that are the topic of this report but they do not follow any identifiable trend or be focused on one specific type of geology. The Thunder Bay area has historically been known for prominent amethyst showings but apart from that there has been little mining and consequently most of the area has not had any significant exploration. Silver. copper and gold have been discovered some distance to the south. near Shebandowan and the surrounding area. as has also. nickel which is being mined at Shebandowan and has a defined subeconomic defined resource at Great Lakes Nickel. south of Thunder Bay. Most of these showings are not in the same immediate rock units as those of the claim block.

Other historic activity in the region includes the famous. now abandoned Silver Islet silver mine on the Sibley Peninsula to the east in Lake Superior.

7. Regional Survey Work

The area of the claims has not been bedrock mapped at quadrangle scale by the Geological Survey of Canada nor the Ontario Geological Survey. However several of the nearby quadrangles have been mapped so extrapolation of geology combined with reconnaissance and aerial geophysical surveys interpretation allows for reasonably reliable geologic assumptions as to the conditions and potential.

The area has been flown by the Geological Survey of Canada aeromagnetic survey unit and results are available at 1" - 1 mile and 1" - 4 miles scales. In addition part of the area was flown by the Ontario Geological Survey with electromagnetic and magnetic surveys. These were released as a series of map sheets covering the "Shebandowan Area" at a scale of 1:20.000 in 1991.

Dr. Gerald Harper, the claim staker, became interested in the area as a result of studying the Ontario Geological Survey airborne geophysical maps and conducted regional reconnaissance in the area and claim staking in 1993. The regional work included sediment sampling of overburden tills, outwash gravels and stream sediments. Rock sampling from around the area was also carried out and petrographic work completed on these samples. Nine large (approximately 20kg) samples of glaciofluvial deposits were gathered as a part of a regional reconnaissance, with the intention of processing them for their heavy mineral content. In addition, three hand specimens of exposed bedrock were collected from the claims, and one sample of unusual float from the vicinity of Highway #527. (Wilson et.al. 1993). The nine bulk samples were gravity concentrated to extract heavy mineral suites and then examined by petrographic and electron scanning methods. The latter work was undertaken by Turnstone Geological Services Ltd. Detailed locations of the various samples collected are given in these reports with reference to the UTM grid.

The claim block is centred over an aeromagnetic high as shown on the map at 1:20,000 scale. The high is slightly elongated in an easterly orientation. At the time of the claim staking several days were spent prospecting and undertaking geological reconnaissance in the area but hardly any outcrops were found at all and of those that were none was in the area of the magnetic anomaly nor of a rock type capable of explaining such an anomaly. That prospecting work was undertaken by geologists Dr. Gerald Harper of 26 Orchard Crescent, Toronto, Ontario, M8Z 3E1, Dr. Francis T. Manns of 42 Highfield Road, Toronto, Ontario, M4L 2V1 and Dr. Graham C. Wilson of P. O. Box 130 Station "B" Toronto, Ontario, M5T 2T3.

Further regional geological reconnaissance and prospecting, along with the claim survey work were conducted between the dates of July 6, 1995 and July 21, 1995 by Peter MacMartin of 10 Oakmount Road, Toronto, Ontario M8X 1Y9 (E-33926) CLN 301253 and field assistant Lorraine Godwin, employees of Gamah International Limited on behalf of Gerald Harper and Minfocus International Inc. They spent six person days prospecting the claims one of them in conjunction with Dr. Graham Wilson of Turnstone Geological Services Ltd.

8. Claim Block Surveys

The claims have been prospected by four geologists for more than eight man days with no outcrop discovered. Consequently no grid was established as there was nothing to locate in detail with respect to it.

Efforts were focused on determining the nature of the rock types emanating from the area by till examination and analysis.

9. Property Geology

No outcrops were found on the claim block. The whole area is flat to gently undulating with the soil surface disturbed by large erratics within the till cover. The vast majority of these erratics are 1 - 2 metre diameter rounded granitic or granodioritic blocks. Their degree of rounding suggests very extensive transport. As mentioned earlier, where the till is exposed in profile such as in road ditches and uprooted tree root holes, it is striking what a high proportion of mafic and ultramafic appearing rock types are present in the smaller boulder size fractions. Systematic analysis of the till was initiated and specific techniques used and results achieved are described in detail in the three appended reports by the petrographer: Dr. Graham Wilson of Turnstone Geological Services of Toronto, Canada. The reports are:

- Exploration for Kimberlites and Diamonds in the Midcontinent Rift, Northwestern Ontario
- A Study of Heavy Mineral Fractions in the Nipigon Plate Region of Northwestern Ontario and
- Mineralogical Contribution to Exploration of Bedrock and Surficial Deposits in the Onion - Greenwich Lake Area of Northwestern Ontario

10. Recommendations for Further Work

Magnetic and electromagnetic ground geophysical surveys be should be undertaken to delineate the extent and exact location of the airborne magnetic anomaly while the electromagnetic survey would identify any major structures or conductors. The surveys should be run using lines oriented north-south.

After locating the magnetic anomaly consideration should be given to basal till sampling utilizing an appropriate manual or powered auger device to reach the necessary depths. Soil geochemistry is not considered a meaningful tool in this area of overburden cover. The ease of road access allows for the possibility of utilizing a back hoe or similar powered equipment if the overburden is determined not to be excessively deep. Such powered equipment would ensure reaching bedrock rather than simply erratic boulders.

Peter MacMartin

Peter MacMartin
Toronto, October 3, 1995

11. References

Hawley J E (1929) Thirty-eighth Annual Report of the Ontario Department of Mines. Toronto: 1930.

Mollard D G and Mollard J D (1983) Northern Ontario Engineering Geology Terrain Study 71. *Thunder Bay Area*, NTS 52A/SW. Ontario Geological Survey. Ministry of Natural Resources.

Mollard D G and Mollard J D (1981) Northern Ontario Engineering Geology Terrain Study 58. *Black Bay Area*, NTS 52A/NE and part of NTS 52A/SE. Ontario Geological Survey. Ministry of Natural Resources

Mollard D G and Mollard J D (1981) Northern Ontario Engineering Geology Terrain Study 57. *Kaministikwia Area*, NTS 52A/. Ontario Geological Survey. Ministry of Natural Resources

Pye E G (1968) *Geology of Lac des Iles Area*: Ontario Department of Mines. Geological Report 64. Toronto: 1968

Sutcliffe (1991)

Smith and Sutcliffe (1987)

Wilson G C (1993) *Exploration for kimberlites and diamonds in the Midcontinent Rift, northwestern Ontario*. Turnstone Geological Services Ltd. Confidential Report. TGSL Project 1993-11. to Minfocus International Inc., Toronto. 16pp.

Wilson G C (1995) *A study of heavy mineral fractions in the Nipigon Plate Region of northwestern Ontario*. Turnstone Geological Services Ltd. Confidential Report. TGSL Project 1995-02 to Minfocus International Inc.

Wilson G C (1995) *Mineralogical Contribution to Exploration of Bedrock and Surficial Deposits in the Union - Greenwich Lake Area of Northwestern Ontario*. Turnstone Geological Services Ltd. Confidential Report. TGSL Report 1995-25 to Minfocus International Inc., Toronto. 36 pp.

APPENDIX 1

Statement of Costs and Expenses

The field work on this claim block was combined with some regional reconnaissance work, some of which was undertaken during the period of field work when the claims were staked. In deriving the costs applicable to this claim block work, all costs incurred for prospecting, geological reconnaissance and sample collection during the period when the claims were staked has been excluded. Costs related to the laboratory and petrographic studies by Dr. Wilson have been included and some general expenses incurred during the field work in July 1995 and subsequent report writing have been prorated to reflect the proportion applicable to work completed on Claim Block 1151126 which is in the same area and had exploration undertaken on it during the same field work program. The particulars are detailed in the following table which itemizes the actual costs incurred.

Category of Expenses	Type of Expense Description	Total Value	Total Allocatable	
Transportation	Garnah Rental of Vehicle to Minfocus – 3100 km @ $0.35/km	$1,085.00	70 %	$759.50
Consultant Study	Research on Heavy Mineral Separates	$3,158.00	70 %	$2,210.60
Consultant	Field supervision	$1,000.00	70%	$700.00
Field	Expenses for trip (see itemized page attached)	$1,785.41	70 %	$1,249.79
	Rubbermaid containers	$55.08	70%	$38.56
	Office Place - supplies for field	$60.61	70%	$42.43
	Le Baron - field gear	$143.22	70%	$100.25
	Tent and Cooler	$145.80	70%	$102.06
	Wal-Mart - field gear	$108.18	70%	$75.73
	Field supplies	$131.10	70%	$91.77
	Field supplies	$61.49	70%	$43.04
	First Aid Kit	$45.31	70%	$31.72
	Canadian Tire - Field equipment	$49.06	70%	$34.34
	Sooters film for trip	$14.47	70%	$10.13
	Halltech Environmental	$91.80	70%	$64.26
Field Wages	Peter MacMartin $135/day for 3 days	$405.00	100 %	$405.00
Field Wages & data compilation, map preparation & report completion	Lorraine Godwin $105/day for 3 days	$315.00	100 %	$315.00
Office Wages, data compilation & report preparation	Gerald Harper $850.00/day for 1.0 day	$850.00	100 %	$850.00
Office Wages, report preparation	Brian Fenoulhet $400.00/day for 1.0 day	$400.00	100 %	$400.00
	Lorraine Godwin $105.00/day for 1 day	$105.00	100%	$105.00
TOTAL				**$7629.18**

Ck# 394.

GAMAH INTERNATIONAL LIMITED

Expenses of:__Peter Mac Martin/ Lorraine Godwin

For Period:___July, 1995___

Number of this page and total pages:__1____

CODE	DATE	ITEM	Rec#	AMOUNT	GST
93020	4-Jul	food for truck trip	NR	$ 45.00	
93020	5-Jul	Auto Fuel -Huntsville	R10628792	$ 53.00	$ 3.47
93020	5-Jul	Accomodation-Sudbury, Laurentian Uni.	A-7314	$ 40.32	$ 2.52
93020	5-Jul	Breakfast -- Laurentian University	NR	$ 9.00	
93020	5-Jul	Lunch and Food on trip(Sudbury to S.S.Marie)	NR	$ 19.00	
93020	5-Jul	Dinner- North Bay	26	$ 33.92	$ 2.06
93020	6-Jul	A&W White River	3	$ 8.61	$ 0.52
93020	6-Jul	Food- Sault Ste. Marie	no #-- calle	$ 7.16	$ -
93020	6-Jul	Parking in Sudbury	24	$ 1.00	$ -
93020	6-Jul	Hotel -- Wawa	NR	$ 63.25	$ 4.43
93020	7-Jul	Food for trip	4	$ 187.11	$ 2.84
93020	7-Jul	6 Pens -- White River	2.5	$ 4.07	$ 0.25
93020	7-Jul	Dinner T-Bay (Taco Time)	2	$ 17.17	$ 1.05
93020	7-Jul	Gas -- Conrad's Esso -- White River	x2	$ 44.00	$ 3.08
93020	8-Jul	Gas -- T.Bay	5	$ 62.91	$ 4.10
93020	10-Jul	Dinner, Swiss Chalet	7	$ 16.10	$ 0.98
93020	10-Jul	Bottled Water -- T.Bay	6	$ 5.07	
93020	10-Jul	Car Repair -- Power Steering		$ 127.00	
93020	11-Jul	Gas -- T. Bay -- 7-11	15	$ 55.55	
93020	11-Jul	Dinner -- T.Bay -- MacDonalds	NR	$ 20.00	
93020	13-Jul	Dustpan for Tent	8	$ 5.40	$ 0.33
93020	13-Jul	Stationary -- T.Bay	10	$ 3.43	$ 0.21
93020	13-Jul	Food-Safeway -- Graham et.al	9	$ 38.68	$ 0.45
93020	17-Jul	Car Repair -- MAP Sensor-- Goodyear	19	$ 144.21	$ 8.78
93020	18-Jul	Scale for weighing Sed Samples	12	$ 6.99	$ 0.49
93020	18-Jul	Food -- Thunder Bay	16	$ 44.83	$ 0.38
93020	18-Jul	Dinner -- T.Bay --	NR	$ 19.00	
93020	19-Jul	Gas -- Orr's Place -T.Bay	11	$ 28.00	
93020	21-Jul	Lunch -- T. Bay--	22	$ 6.19	
93020	21-Jul	MNDM (Assessement Reports)	mastercard	$ 15.42	
93020	21-Jul	Dinner -- Hojto Finnish Restaraunt	NR	$ 32.00	
93020	21-Jul	Shower in T Bay rec center		$ 8.30	
93020	22-Jul	Gas - Thunder Bay -- Esso	13	$ 65.01	
93020	22-Jul	Misc Food	NR	$ 5.00	
93020	22-Jul	Food Casey's T-Bay -- auto repair day	29	$ 35.97	$ -
93020	22-Jul	Venture Inn -- T-Bay Auto Repair trip	Mastercard	$ 68.00	$ -
93020	23-Jul	Car Repair -- Broken Driveshaft & U Joint	20	$ 145.00	
93020	24-Jul	Gas -- LongLac -- Esso	14	$ 60.00	
93020	24-Jul	Companion Hotel restaraunt-- Meal Stop on way	25	$ 18.74	
93020	25-Jul	Gas -- 25 July -- Kirkland Lake. C.Tire	17	$ 68.00	$ 4.45
93020	25-Jul	Laundry	NR	$ 30.00	
93020	25-Jul	Gas- Maple, Ontario	27	$ 50.00	$ -
93020	25-Jul	Kirkland Lake Comfort Inn	see recieps	$ 68.00	
		Total		**$ 1,785.41**	**$ 40.39**
Signed	Peter MacMartin				
Date:	9-Aug-95	Less advance		1,600.00	

balance owing 185.41

APPENDIX 2

Report by Turnstone Geological Services Ltd., TGSL Project 1993-11

Figure 1

Location of Claim Block #1151126 Relative to Major Geographic Elements

1 : 250, 000

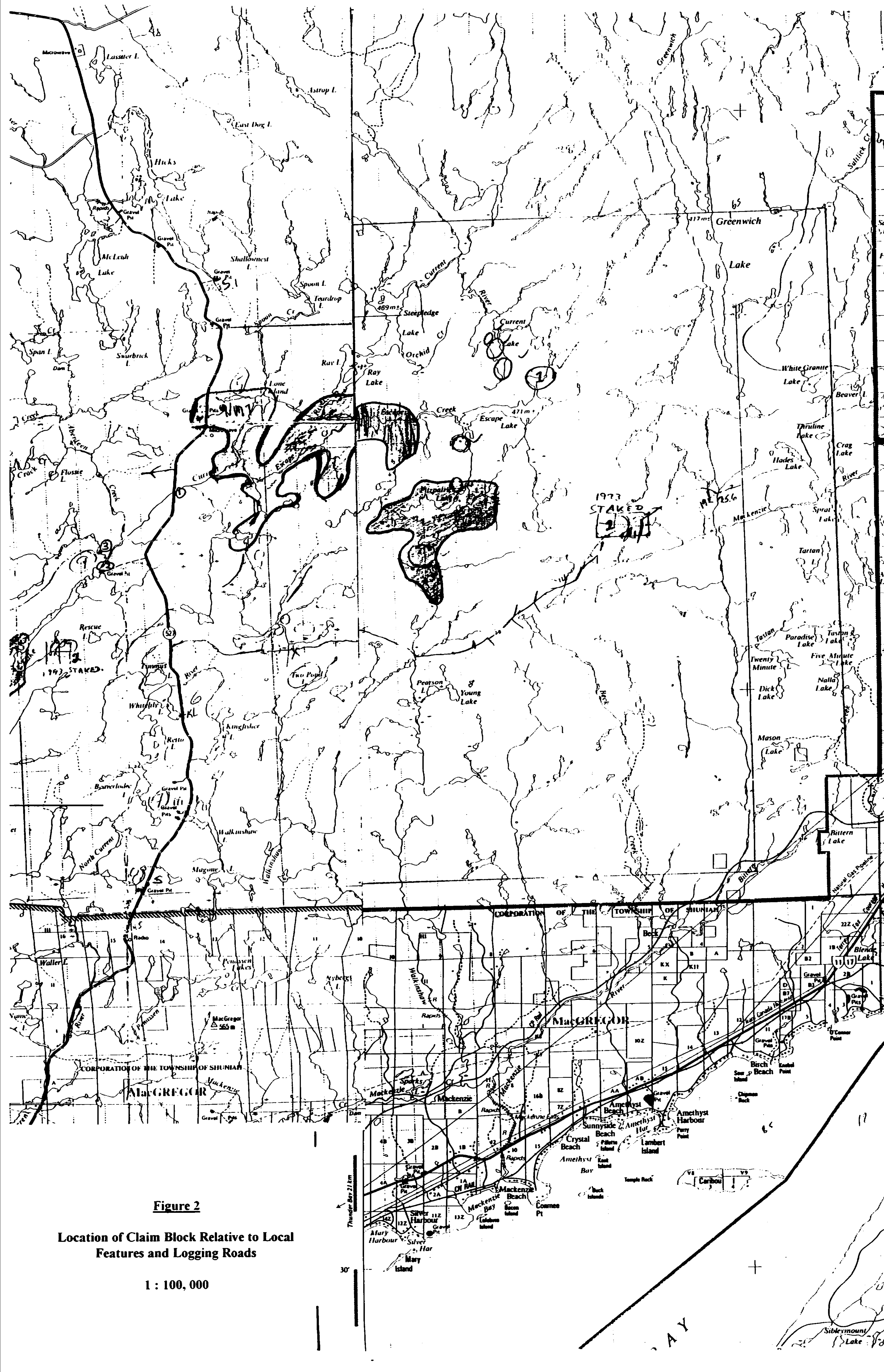


Figure 2

Location of Claim Block Relative to Local Features and Logging Roads

1 : 100, 000

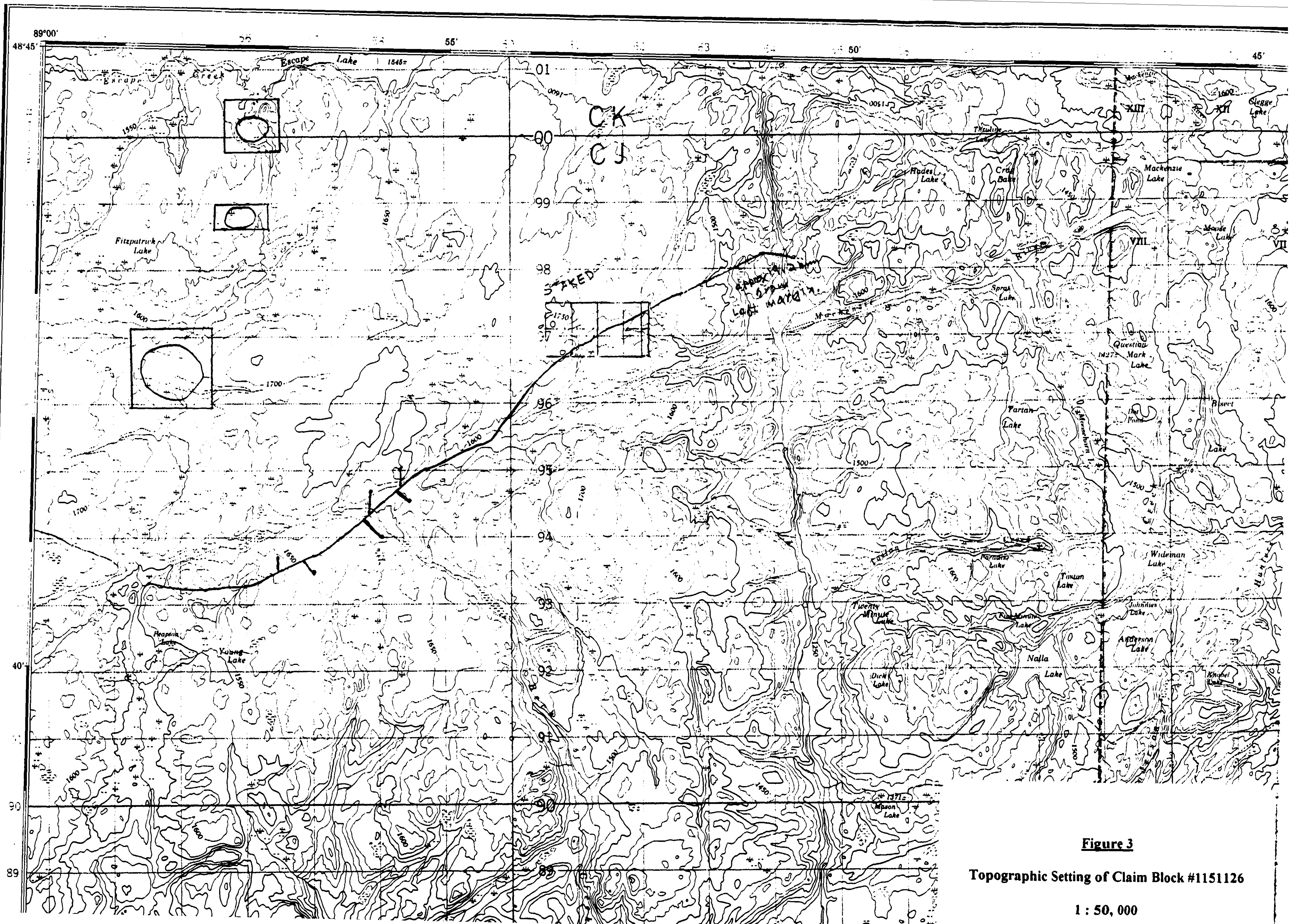


Figure 3

Topographic Setting of Claim Block #1151126

1 : 50, 000

APPENDIX 4

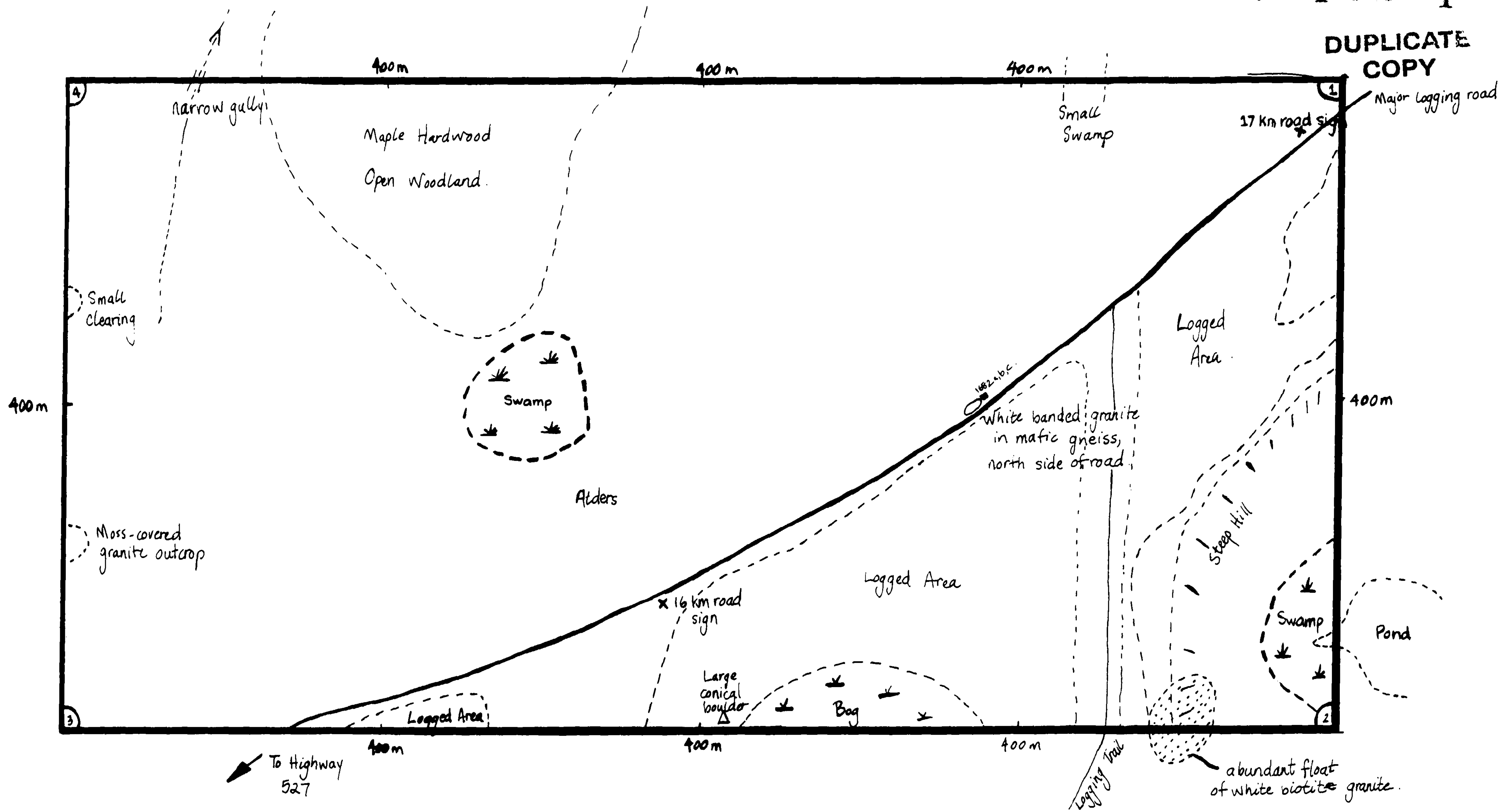
Report by Turnstone Geological Services Ltd., TGSL Project 1995-25

This report has not been included as a copy was forwarded as part of the Assessment Report for Claim Block #1151082. Please refer to that report.

APPENDIX 3

Report by Turnstone Geological Services Ltd., TGSL Project 1995-02

DUPLICATE COPY



Claim Block #1151126

Scale:
1:5,000

Report on Geological and Geochemical Surveys of Claim Block Number 1151082 Thunder Bay Mining District

NTS 52 - A - 11

RECEIVED

NOV 02 1995

MINING LANDS BRANCH

Peter MacMartin, B.Sc.
Gamah International Limited

October 3, 1995
Toronto, Ontario

Abstract

Four unit claim block number 1151082 was staked in September 1993 to cover an area determined to have an airborne geophysical anomaly. The claims are located some 25 kilometres north of Thunder Bay, 3 - 4 kilometres west of Ontario Provincial Highway 527. During July and August 1995 a two person crew established a grid over the claim block and completed geologic mapping and a geochemical soil survey. This report describes the results of that work.

The rocks occurring throughout most of this area are strongly foliated metaschists of mafic volcanic origin which in some places contain quartz stringers and fractures which occasionally deviate from the NE/SW foliation trend. Leucogranite and granodioritic rocks are found in a relatively small section of the northeast corner of the claim block.

The soil geochemical survey showed that the northwestern area of the claim block has some sporadic highs for the elements Cu, Zn, Ni and to a lesser extent, Au. However the predominantly anomalous highs are in the southeastern area. The zonal coincidence of anomalous highs in this area could indicate a possible subtle change of overall mineralization from the northwest to the southeast. There may be some structure running with the NE/SW trend, with geochemical highs existing to the east of it.

The soil survey should be extended to close off the significant open-ended anomalies. Geological mapping should be extended in conjunction therewith to aid in the subsequent geochemical interpretation.

It is also recommended that magnetic and electromagnetic ground geophysical surveys be undertaken to delineate the extent of the airborne magnetic anomaly in the north, locate the major NE/SW structure(s) if such exist(s) and also to determine any possible geophysical correlation of the high silver geochemical anomaly area.

Expenditures to date on the line cutting, physical work, geological and geochemical surveys of the claim block and the petrographic work in support thereof amount to $8564.77.

Table of Contents

1. Introduction

This report describes work which has been completed on claim block #1151182 in the Thunder Bay Mining District, which work is being applied for assessment credit. The work completed included line cutting and flagging, soil sampling, geological mapping, and sampling of rocks of interest. The soil samples were analyzed for Ag, Au, Cu, Ni, and Zn, with the results being drawn up on the accompanying maps. Selected rock samples were submitted for petrological identification and analysis. The results of this work are also contained in this report.

2. Ownership of Claim Block

The mining claims investigated are a four claim block:

Claim Block Number	Claim Block Anniversary Date
1151082	October 8, 1995

The mining claim block is held by Dr. Gerald Harper of 26 Orchard Crescent, Toronto, Ontario M8Z 3E1, MNDM Prospectors License: A47161 Exp. 16 May 1997 CLN 141927.

3. Location of and Access To Claim Block

Claim block #1151082 is in the Thunder Bay Mining District. Access to the claim block is via Highway 527, north for nearly 22 kilometres from its intersection with Highway 11/17 which is about 10 km northeast of Thunder Bay. An infrequently used logging trail, 21.3 km north of the Highway 527-11/17 intersection, provides rough but driveable access westwards, closer into the claim block area. Approximately 3.5 km of this old logging road should be driven, after which, 1.5 km of westerly bushwhacking on foot is required to reach the northeast corner of the claim block.

4. Topography and Vegetation

The terrain is gently undulating, with moderate relief of less than 50 metres, dropping down to the west to the valley of Current River and Onion Lake. The low rock ridges and gullies follow a dominantly northeast/southwest trend. Both clear-cut and selective logging practices have been carried out in the area., particularly in the area to the east of the claims and across the southeast corner of the claim block. Woodland trees include species of pine and spruce, white birch, poplar and minor tamarack. Beaver dammed lakes are very common.

5. Regional Geology

The rock assemblages of the region north and northeast of Thunder Bay which encompasses the claim block area are predominantly composed of early Archean granitic and granodoioritic migmatites which in some areas include minor migmatic metasediments and minor metavolcanics. The structural trend of these rocks is approximately in a NE/SW orientation. These Archean rocks were affected by Proterozoic rifting associated with the failed midcontinental rift zone to the immediate south. The geology of the mid-continent rift is characterized by voluminous tholeiitic magmatism, expressed in Keweenawan lava flows, diabase sills and dyke swarms, and discrete gabbroic to ultramafic intrusives (Smith and Sutcliffe, 1987; Sutcliffe, 1991) with interbedded bright red clastic sediments of the Sibley Formation. Some secondary NNW/SSE fracturing is also common in the area.

Additional references to Ontario Geological Survey bedrock and surficial mapping work in this area include Hawley (1929), Mollard and Mollard (1983 and 1981), and Pye (1968).

The local Archean bedrock, patchily displayed along road cuts, lake shores and in low, rounded woodland outcrops, has an overall exposure of less than 1%. Micaceous schist and gneiss, often biotite rich, enclosing boudinaged felsic segregations, are the most common rock type. White "bull" quartz and small pegmatitic segregations parallel to foliation are common in these supracrustal rocks, assumed to be of predominantly metasedimentary origin. Float boulders, generally tens of centimetres to a few metres in diameter, contain notable concentrations of mafic-ultramafic rocks and red clastic sediments of the Sibley Formation. It is possible that these ultramafic/mafic float boulders are derived from the Proterozoic diabases, gabbros and ultramafic rocks marked on regional maps some 20 - 30 kilometres to the north and continuing extensively over much of the area to the north and east encompassing Lake Nipigon.

Most of the overburdened cover in the area is till and fluvio glacial material, with eskers, striae and other indications of glacial transport and direction suggesting a movement generally from the northeast.

6. Historical Claimstaking, Mining and Exploration Activity in the Area

The most important mining property in the region is the recently opened, 3,000 tpd Lac des Iles Platinum mine at Lac Des Iles, 30 kilometres north of the claims. This was discovered in the 1970s and the staking rush which accompanied its announcement has not led to other discoveries or prospects and consequently there is not a large area of retained claims in the vicinity.

Historically claimstaking in this area of the Thunder Bay Mining Division has not been very active. There are a small number of claim blocks in the immediate areas to the south and southwest of the claims that are the topic of this report but they do not follow any identifiable trend or be focused on one specific type of geology. The Thunder Bay area has historically been known for prominent amethyst showings but apart from that there has been little mining and consequently most of the area has not had any significant exploration. Silver, copper and gold have been discovered some distance to the south, near Shebandowan and the surrounding area, as has also, nickel which is being mined at Shebandowan and has a defined subeconomic defined resource at Great Lakes Nickel, south of Thunder Bay. Most of these showings are not in the same immediate rock units as those of the claim block.

Other historic activity in the region includes the famous, now abandoned Silver Islet silver mine on the Sibley Peninsula to the east.

7. Regional Survey Work

The area of the claims has not been bedrock mapped at quadrangle scale by the Geological Survey of Canada nor the Ontario Geological Survey. However several of the adjacent quadrangles have been mapped so extrapolation of geology combined with reconnaissance and aerial geophysical surveys interpretation allows for reasonably reliable geologic assumptions as to the conditions and potential.

The area has been flown by the Geological Survey of Canada aeromagnetic survey unit and results are available at 1" - 1 mile and 1" - 4 miles scales. In addition part of the area was flown by the Ontario Geological Survey with electromagnetic and magnetic surveys. These were released as a series of map sheets covering the "Shebandowan Area" at a scale of 1:20,000 in 1991.

Gerald Harper, the claim staker, became interested in the area as a result of studying the Ontario Geological Survey airborne geophysical maps and conducted regional reconnaissance in the area and claim staking in 1993. The regional work included sediment sampling of overburden tills, outwash gravels and stream sediments. Rock sampling from around the area was also carried out and petrographic work completed on these samples. Nine large (approximately 20kg) samples of glaciofluvial deposits were gathered as a part of a regional reconnaissance, with the intention of processing them for their heavy mineral content. In addition, three hand specimens of exposed bedrock were collected from the claims, and one sample of unusual float from the vicinity of Highway #527 (Wilson et.al. 1993). The nine bulk samples were gravity concentrated to extract heavy mineral suites and then examined by petrographic and electron scanning methods. The latter work was undertaken by Turnstone Geological Services Ltd.

The northern part of the claim block covers an area shown on the aeromagnetic maps at 1:20,000 scale to be an area of relative high magnetic response.

Further regional geological reconnaissance and prospecting, along with the claim survey work were conducted between the dates of July 6, 1995 and July 21, 1995 by Peter MacMartin of 10 Oakmount Road, Toronto, Ontario M8X 1Y9 (E-33926) CLN 301253 and field assistant Lorraine Godwin, employees of Gamah International Limited on behalf of Gerald Harper and Minfocus International Inc.

8. Claim Block Surveys

Lines were cut flagged at 100 metre spacings across the claim block with north-south orientations. The north and south claim lines were relocated, brushed out and used baselines/tie lines for the grid control.

Geological mapping of the claim block was carried out using the grid lines as control. This entailed locating, mapping and logging occurrences of rocks, noting the types of vegetation, topography and terrain and the collection of rock samples of interest. Attempts were made to subdivide the rocks found into three types on the basis of hand specimens collected and attempts to correlate them with the regional stratigraphic sequence described on the 1" - 4 mile geologic compilation map. However, after the field data was plotted up, it was determined that the differences between lithological units were too small to merit three distinct divisions and hence only two are shown on the map of the claims area.

Geochemical surveying was completed by taking soil samples every 100m on all lines, with the exception of the most westerly North South line, thus resulting in seventy-two positions sampling sites. The soil samples were collected where available by pick and spade. Fifteen of the seventy-two sites were positioned in the middle of a lake, swamp or area of such high organic content as to be deemed not useful in the design of survey and therefore not collected. Every effort was made for each sample to be derived from the "B" horizon. In several cases the "A" horizon was all that was available. Depths of extraction ranged from 10-30 cm. A sample weighing approximately 500g was taken from each location and placed in kraft paper geochem bags.

9. Property Geology

The rocks of this area are strongly foliated metaschists of mafic volcanic origin which in some places contain quartz stringers and fractures which occasionally deviate from the NE/SW foliation trend. This is shown by the units 2a,b. Units 3a,b are leucogranite and granodioritic rocks. They are found in a relatively small section of the northeast corner of the claim block. An interpreted boundary dividing the two main units is projected crossing the north claim line along the eastern shore of the small lake on the property boundary line.

No measurable structures were observed in the outcrops but all evidence points to a dominant trend or grain oriented northeast - southwest. The steep sided gully occurring across the western claim boundary has such a trend and may be followed across the long axis of the open grassland area and then may influence the position of the southeast edge of the small lake on the northern claim boundary.

Rock samples were submitted to Dr. Graham Wilson of Turnstone Geological Services of Toronto, Canada for petrographic description and analyses. A report is appended which describes the results of this work.

Table of Rock Types:

1) Unit 1 was not observed in this claim block.

2) <u>Metavolcanics and Biotite schists</u>

a-Massive biotite schists, in some places quartz bearing.

In some outcrops heavy foliation was evident.

b-Mafic Metavolcanics and Metasediments, in some places, quartz bearing.

Sometimes observed as massive; other times, primary structures were observed, such as layering structures. Some of these units displayed minor visual secondary fracturing discordant to the major foliation direction.

3) <u>Granitoid rocks.</u>

a-Undifferentiated granites and granodiorites. High in K feldspar.

10. Geochemical Survey

The samples collected as described above were air dried and submitted to Chauncey Assay Laboratories in Toronto, Canada for geochemical analysis using aqua regia digestion analytical methods. The results were plotted up on the individual maps for each element tested contoured after statistical analysis of each sample population had been undertaken. The results of this work are displayed in table below and on the accompanying maps.

11. Determination of Anomalous Geochemical Values and Interpretation of Results

(Hawkes and Webb, 1962), suggest that for a single population background the best estimation of background is the median value of that population and that the threshold value is the value of points exceeded by 2.5 % of the values. We did not have a large population and hence in several cases the threshold values were taken as those quite obviously larger than those in the background. Values for contour lines drawn on Geochemical maps 93020-3 to 93020-7 were often taken as arbitrary round numbers near the threshold and higher. "Possibly anomalous" values were found by multiplying the standard deviation of the given population of readings for that element to the median value. Similarly, "probably anomalous" values were found by adding three times the standard deviation to the median value for that element. The statistics calculations for each of the elements tested for are listed below.

Statistical Calculations

Element	Median	Standard Deviation	Min	Max	Count	Background	Threshold	Anomalous Possible	Anomalous Probable
Ag (ppm)	2.5	3.09	0.6	11	56	2.5	10	8.67	11.8
Au (ppb)	8	4.5	3	21	56	8	15	17	21.5
Cu (ppm)	18.5	7.27	6.2	34	56	18.5	30	33	40.3
Ni (ppm)	23	6.5	10	38	56	23	35	36	42.5
Zn (ppm)	36.5	16.4	14	85	56	36.5	60	69.2	85.6

Ag: The background value for Ag on this claim block was calculated as approx. 2.5 ppm. From the data, there is a trend of anomalous values roughly above 10 ppm which trends in a northerly direction. This is seen on accompanying map #93020-3. This anomalous zone appears very interesting because it lies in the statistically 'possible' anomaly category and the contained areas may have values in the 'probable' category. Further work should be done to delineate the extent of this anomaly off the claim to the south.

Au: The background value for Au was calculated from the data as 8 ppb. Anomalous values have been calculated as those above 15 ppb. The main high points for the Au were found in the southeastern section of the claim block. One of these high points coincides with the high point for the Ag anomaly. In general the gold values are spread in a generally irregular fashion over the southeastern section of the claim with a small unbounded area in the northeastern section and an even smaller anomalous area in the northwest corner of the claim.

Cu: The background value for Cu on this claim block is approximately 18 ppm. Two minor anomalous trends of copper values above 30 ppm are found. This pattern can be seen on accompanying map #93020-5. One of these zones was found in the southern section of the claim and the northern section of this anomalous trend seems to coincide spatially with that of the trend for Ag. In the upper middle right hand boundary of the claim block, another anomalous trend pattern is found which seems to line up with the southern trend angle.

Ni: The background value for Ni on this claim block is approximately 23 ppm. From the data collected, anomalous trend values for Ni are indicated for those values above 35 ppm. This pattern can be seen on accompanying map # 93020-6. The two main areas of interest are found on line #1W -- one in the southeastern corner of the claim and the other in the upper section of the line. These anomalies do not appear to have any link to the geological trend like the other two elements' maps do. However, a trend of Ni values bounded by the 30 ppm value do trend along the same area on the claim line as the copper anomaly. The presence of mafic/ultramafic float boulders and associated soils found in the area could imply that the Ni values are indicating high background values due to these boulders and associated developed soils.

Zn: The background value for Zn on this claim block is calculated as approximately 37 ppm Zn. The geochemical values in Appendix 3 have been mapped on diagram 93020-7. It is clear that there are two distinct bullseye anomalies found on the claim block. They both have similar areal extents and spatial variations with respect to concentration. The two bullseye targets are found in the northeast and southwest sections of the claim block. This NE/SW line is trending at approximately the same orientation as the major structural trends in the area namely approximately 55-60 degrees. These bullseye anomalies could be interpreted as two separate erratic showings with, as of yet, no identifiable origins. It could also possibly be interpreted as an offset fault on which the two minor Zn showing occur.

12. Recommendations for Further Work

By observing all of the geochemical maps together, one may observe that several areas of the claim block display recurring high values for certain elements. These points would probably indicate areas of higher prospectivity. Most of these points are found in the southeastern section of the claim block. The northwestern section has some sporadic highs for the elements Cu, Zn, Ni and to a lesser extent, Au. However the predominantly anomalous highs are in the southeastern area. This zonal coincidence of anomalous highs in this area could indicate a possible subtle change of overall mineralization from the northwest to the southeast. There may be some structure running with the NE/SW trend, with geochemical highs existing to the east of it.

In particular, some areas of interest include the anomalous highs of Au between lines 2 and 4, occurring 200-400m north of the south claim boundary. It is interesting to note that the most anomalous and significant high in the claim block is that of the significant Ag anomaly of values above 10 ppm which forms a northerly trending pattern running nearly halfway up the block. The anomalous values of above 10 ppm are well above the background of 2.5 ppm. There is also a gold peak of 20 ppb superimposed upon this silver anomaly.

The lineation of the Ni anomaly from the southwest to the northeast is not very high relative to the threshold but it does indicate some anomalous mineralisation which is parallel to the local structural trend.

The soil survey should be extended to close off the significant open-ended anomalies. Geological mapping should be extended in conjunction therewith to aid in the subsequent geochemical interpretation.

It is also recommended that magnetic and electromagnetic ground geophysical surveys be undertaken to delineate the extent of the airborne magnetic anomaly in the north, locate the major NE/SW structure(s) if such exist(s) and also to determine any possible geophysical correlation of the high silver geochemical anomaly area.

Peter MacMartin

Peter MacMartin
Toronto, October 3, 1995

13. References

Hawkes H E and Webb J S (1962) *Geochemistry in Mineral Exploration*. New York: 1962.

Hawley J E (1929) Thirty-eighth Annual Report of the Ontario Department of Mines. Toronto: 1930.

Mollard D G and Mollard J D (1983) Northern Ontario Engineering Geology Terrain Study 71. *Thunder Bay Area*. NTS 52A/SW. Ontario Geological Survey. Ministry of Natural Resources.

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Wilson G C (1995) *A study of heavy mineral fractions in the Nipigon Plate Region of northwestern Ontario*. Turnstone Geological Services Ltd. Confidential Report 1995-02 to Minfocus International Inc.

APPENDIX 1

Statement of Costs and Expenses

The field work on this claim block was combined with some regional reconnaissance work and therefore in deriving the costs applicable to this claim block work some general expenses have been prorated to reflect the proportion applicable to Claim Block 1151082. The particulars are detailed in the columns of the following table which itemizes the actual costs incurred.

Type of Expense	Category of Expenses Description	Total Value	Eligible Days	% for Claim	Total Claimable
Transportation	Auto - incidental expenses	$29.15		100	$29.15
Transportation	Gamah Rental of Vehicle to Minfocus – 3100 km @ $0.35 km	$1.085.00		30	$325.50
Consultant Study	Research on Heavy Mineral Separates	$3.158.00		30	$947.40
Consultant Study	Petrographic Report – Rock Samples	$4.675.36		75	$3.506.52
Consultant	Field Supervision	$300.00		100	$300.00
Field	Expenses for trip (see itemized page attached)	$1.785.41	6	30	$535.62
Field	Repair to Ford Truck	$100.00	20	100	$100.00
Supplies	Crown Registry	$6.48	0	100	$6.48
Supplies	Rubbermaid Containers	$55.08	6	30	$16.52
Supplies	Office Place – supplies for field office	$60.61	6	30	$18.18
Supplies	Le Baron – Field Gear	$143.22	6	30	$42.97
Supplies	Tent and Cooler	$145.80	6	30	$43.74
Supplies	Wal-Mart –field gear	$108.18	6	30	$32.45
Supplies	Field Supplies	$131.10	6	30	$39.33
Supplies	Field Supplies	$61.49	6	30	$18.45
Supplies	First Aid Kit	$45.31	20	30	$13.59
Supplies	Canadian Tire –field equipment	$49.06	6	30	$14.72
Supplies	Sooters Film for trip	$14.47	20	30	$4.34
Supplies	Halltech Environmental	$91.80	20	30	$27.54
Field Wages	Peter MacMartin $135 day for 6 days	$810.00	6	30	$243.00
Field Wages	Lorraine Godwin $105 day for 6 days	$630.00	6	30	$189.00
Office Wages (sample dispatch, drafting, report writing)	Peter MacMartin $135.00 day for 9 days	$1, 215.00	9	100	$1, 215.00
Office Supplies	Halltech Environmental	$32.69	20	100	$32.69
Office Supplies	Looseleaf paper	$3.63	20	100	$3.63
Printing	Photocopies of Artwork	$10.80		100	$10.80
Telephone	Telephone Charges	$18.46		100	$18.46
Assay Costs	Chauncey Assay Labs	$895.27		100	$895.27
	Project Total	$15.361.37	Total for Claim Block		$8564.77

Ck# 394.

GAMAH INTERNATIONAL LIMITED

Expenses of:__Peter Mac Martin/ Lorraine Godwin

For Period:___July, 1995___

Number of this page and total pages:__1_____

CODE	DATE	ITEM	Rec#	AMOUNT	GST
93020	4-Jul	food for truck trip	NR	$ 45.00	
93020	5-Jul	Auto Fuel -Huntsville	R10628792	$ 53.00	$ 3.47
93020	5-Jul	Accomodation-Sudbury, Laurentian Uni.	A-7314	$ 40.32	$ 2.52
93020	5-Jul	Breakfast -- Laurentian University	NR	$ 9.00	
93020	5-Jul	Lunch and Food on trip(Sudbury to S.S.Marie)	NR	$ 19.00	
93020	5-Jul	Dinner- North Bay	26	$ 33.92	$ 2.06
93020	6-Jul	A&W White River	3	$ 8.61	$ 0.52
93020	6-Jul	Food- Sault Ste. Marie	no #-- calle	$ 7.16	$ -
93020	6-Jul	Parking in Sudbury	24	$ 1.00	$ -
93020	6-Jul	Hotel -- Wawa	NR	$ 63.25	$ 4.43
93020	7-Jul	Food for trip	4	$ 187.11	$ 2.84
93020	7-Jul	6 Pens -- White River	2.5	$ 4.07	$ 0.25
93020	7-Jul	Dinner T-Bay (Taco Time)	2	$ 17.17	$ 1.05
93020	7-Jul	Gas -- Conrad's Esso -- White River	x2	$ 44.00	$ 3.08
93020	8-Jul	Gas -- T.Bay	5	$ 62.91	$ 4.10
93020	10-Jul	Dinner, Swiss Chalet	7	$ 16.10	$ 0.98
93020	10-Jul	Bottled Water -- T.Bay	6	$ 5.07	
93020	10-Jul	Car Repair -- Power Steering		$ 127.00	
93020	11-Jul	Gas -- T. Bay -- 7-11	15	$ 55.55	
93020	11-Jul	Dinner -- T.Bay -- MacDonalds	NR	$ 20.00	
93020	13-Jul	Dustpan for Tent	8	$ 5.40	$ 0.33
93020	13-Jul	Stationary -- T.Bay	10	$ 3.43	$ 0.21
93020	13-Jul	Food-Safeway -- Graham et.al	9	$ 38.68	$ 0.45
93020	17-Jul	Car Repair -- MAP Sensor-- Goodyear	19	$ 144.21	$ 8.78
93020	18-Jul	Scale for weighing Sed Samples	12	$ 6.99	$ 0.49
93020	18-Jul	Food -- Thunder Bay	16	$ 44.83	$ 0.38
93020	18-Jul	Dinner -- T.Bay --	NR	$ 19.00	
93020	19-Jul	Gas -- Orr's Place -T.Bay	11	$ 28.00	
93020	21-Jul	Lunch -- T. Bay--	22	$ 6.19	
93020	21-Jul	MNDM (Assessement Reports)	mastercard	$ 15.42	
93020	21-Jul	Dinner -- Hojto Finnish Restaraunt	NR	$ 32.00	
93020	21-Jul	Shower in T Bay rec center		$ 8.30	
93020	22-Jul	Gas - Thunder Bay -- Esso	13	$ 65.01	
93020	22-Jul	Misc Food	NR	$ 5.00	
93020	22-Jul	Food Casey's T-Bay -- auto repair day	29	$ 35.97	$ -
93020	22-Jul	Venture Inn -- T-Bay Auto Repair trip	Mastercard	$ 68.00	$ -
93020	23-Jul	Car Repair -- Broken Driveshaft & U Joint	20	$ 145.00	
93020	24-Jul	Gas -- LongLac -- Esso	14	$ 60.00	
93020	24-Jul	Companion Hotel restaraunt-- Meal Stop on way	25	$ 18.74	
93020	25-Jul	Gas -- 25 July -- Kirkland Lake. C.Tire	17	$ 68.00	$ 4.45
93020	25-Jul	Laundry	NR	$ 30.00	
93020	25-Jul	Gas- Maple, Ontario	27	$ 50.00	$ -
93020	25-Jul	Kirkland Lake Comfort Inn	see recieps	$ 68.00	
		Total		**$ 1,785.41**	**$ 40.39**
Signed	Peter Mac Martin				
Date:	9-Aug-95	Page 1 Less advance		1,600.00	

balance owing 185.41

TURNSTONE GEOLOGICAL SERVICES LTD

Dr G.C.Wilson

Box 130, Station "B", Toronto
Ontario, M5T 2T3 CANADA

Phone / Messages : (416)-466-3386

Tue 11-Jul-95
Ref: I-220-SFS
TGSL Project 1995-02

Your Ref: Indicator Minerals

To: Minfocus International Inc.,
Suite 707 - 1243 Islington Avenue,
Toronto, Ontario
Canada M8X 1Y9

c/o Dr Gerald Harper,
@ (416)-232-9114
Fax (416)-232-9120

INVOICE

For Research on Heavy Mineral Separates, Lake Superior Region

Item, unit costs	Amount
Sample polishing (2 PTS, $24)	48.00
Grain selection, mounting, microprobe set-up and operation, research and report preparation	2800.00
Electron microprobe rental (3 hrs)	270.00
Copying, binding, expediting	40.00
Subtotal	3158.00
Total due (in Canadian dollars)	* 3158.00 *

Payable to: `Turnstone Geological Services Ltd´. Prompt payment appreciated.
GST Account # 105424410
Terms: net, 30 days
1.5 percent service charge per month on overdue accounts

1 copy for head office, 2 copies for field camp,
top copy, 4 reserve copies available at Turnstone

TURNSTONE GEOLOGICAL SERVICES LTD

Dr G.C.Wilson

Box 130, Station "B", Toronto
Ontario, M5T 2T3 CANADA

Phone / Messages : (416)-466-3386

Sat 09-Sep-95
Ref: I-244-SFS
TGSL Project 1995-25

Your Ref: N.W. Ontario Project

Petrographic contracts only:
Sections ready Fri 18-08-95
Report completed: Sat 09-09-95

To: Minfocus International Inc.,
Suite 707 - 1243 Islington Avenue,
Toronto, Ontario
Canada M8X 1Y9

c/o Dr Gerald Harper,
@ (416)-232-9114
Fax (416)-232-9120

INVOICE

For Field Assessment of Claims, Follow-up Petrography and Report

Item, unit costs	Amount	GST included..
5 days field work	2000.00	
Air fare, Toronto-Thunder Bay	416.29	27.23
Other travel	31.70	2.07
Miscellaneous field expenses	27.02	1.64
Sample prep. (8 PTS, $21.40)	171.20	11.20
Petrographic descriptions (8 PTS, $70)	560.00	
Photographs (10, $20)	200.00	
Lac des Iles photos (6) - bonus	0.00	
Electron microprobe rental	180.00	
Microprobe operation, data reduction and report	1000.00	
Production costs	79.15	4.82
Expediting	10.00	
Subtotal	4675.36	

****
Total due (in Canadian dollars) * 4675.36 *
****

Payable to: `Turnstone Geological Services Ltd´. Prompt payment appreciated.
GST Account # 105424410
Terms: net, 30 days
1.5 percent service charge per month on overdue accounts

APPENDIX 2

Maps

Regional Map	Map # 93020-1
Geological Survey Map of Claim Block	Map # 93020-2
Geochemical Maps:	
Ag	Map # 93020-3
Au	Map # 93020-4
Cu	Map # 93020-5
Ni	Map # 93020-6
Zn	Map # 93020-7

APPENDIX 3

Geochemical Sediment Assays and Results

CHAUNCEY ASSAY LABORATORIES LTD.

33 Chauncey Avenue, Toronto, Ontario, M8Z 2Z2
Tel: (416) 239-3527 FAX: (416) 239-4012

CERTIFICATE OF ANALYSIS

RECEIVED FROM: **GAMAH INTERNATIONAL** DATE: AUGUST 17, 1995

REPORT NO.: MI-3573-01 SAMPLES OF: SOILS

DATE RECEIVED: AUGUST 14, 1995 ATTENTION: MR. GERALD HARPER

SAMPLE NO:	Ag ppm	Cu ppm	Ni ppm
93-A 0W-0N	6.0	10	20
0W-1N	10	15	22
0W-2N	8.0	20	23
0W-5N	11	19	18
** **0W-6N**	4.0	28	29
0W-7N	3.0	14	20
0W-8N	4.4	8.0	18
93-A 1W-0N	10	20	25
1W-2N	7.0	30	38
1W-3N	2.8	10	21
1W-5N	1.4	34	36
1W-6N	1.0	24	33
1W-7N	3.0	7.0	16
1W-8N	4.0	9.1	20
***93-A 2W-0N**	1.2	26	30
2W-1N	1.0	24	20
2W-2N	1.8	6.2	18
2W-3N	1.9	22	25
2W-4N	1.8	20	26
2W-5N	5.0	21	28
2W-6N	3.1	9.1	13

*** NOT LISTED**

**** LABELLED AS 0W-6N ON ONE SIDE AND 1W-0N ON THE OTHER, SO WE TOOK IT AS 0W-6N, BECAUSE THERE ALREADY WAS A 1W-0N**

J van Engelen Mgr.

CHAUNCEY ASSAY LABORATORIES LTD.

33 Chauncey Avenue, Toronto, Ontario, M8Z 2Z2
Tel: (416) 239-3527 FAX: (416) 239-4012

CERTIFICATE OF ANALYSIS

RECEIVED FROM: **GAMAH INTERNATIONAL** DATE: AUGUST 17, 1995

REPORT NO.: MI-3573-02 SAMPLES OF: SOILS

DATE RECEIVED: AUGUST 14, 1995 ATTENTION: MR. GERALD HARPER

SAMPLE NO:	Ag ppm	Cu ppm	Ni ppm
93-A 3W-0N	9.5	20	14
3W-1N	10	20	21
3W-2N	10	7.1	11
3W-3N	9.1	16	19
3W-4N	3.2	20	18
3W-6N	3.8	18	22
* **3W-7N**	4.4	28	28
93-A 4W-0N	7.5	21	30
4W-1N	10	23	24
4W-2N	1.7	13	25
4W-3N	2.5	29	30
* **4W-4N**	1.6	14	14
* **4W-6N**	1.7	11	24
* **4W-7N**	1.4	30	22
***93-A 5W-0N**	3.0	13	23
* **5W-1N**	1.0	12	21
5W-2N	1.1	20	31
5W-3N	.9	10	14
5W-4N	3.5	32	28
5W-7N	2.5	7.1	24
5W-8N	2.3	23	34

*** NOT LISTED**

J van Engelen Mgr.

CHAUNCEY ASSAY LABORATORIES LTD.

33 Chauncey Avenue, Toronto, Ontario, M8Z 2Z2
Tel: (416) 239-3527 FAX: (416) 239-4012

CERTIFICATE OF ANALYSIS

RECEIVED FROM: **GAMAH INTERNATIONAL** DATE: AUGUST 17, 1995

REPORT NO.: MI-3573-03 SAMPLES OF: SOILS

DATE RECEIVED: AUGUST 14, 1995 ATTENTION: MR. GERALD HARPER

SAMPLE NO:	Ag ppm	Cu ppm	Ni ppm
93-A 6W-1N	3.0	19	32
6W-2N	2.2	10	10
6W-3N	2.8	15	24
6W-4N	1.9	18	29
6W-6N	.9	14	23
6W-8N	1.8	9.2	20
93-A 7W-0N	1.6	19	34
7W-1N	.7	18	27
** 7W-3N	.6	11	23
7W-4N	1.0	23	20
7W-5N	.9	22	28
7W-6N	1.6	15	23
7W-7N	1.2	15	24
7W-8N	1.1	32	38
93-B 0W-6N	.9	28	31
2W-8N	1.3	24	30
3W-8N	2.8	10	5.1
4W-6N	1.9	21	30
4W-7N	.6	12	22
4W-8N	1.6	13	23
5W-8N	.6	7.1	15

****NOT LISTED, BUT IT LOOKS LIKE IT USED TO BE 7W-2N, AND THERE IS NO BAG 7W-2N, ALTHOUGH IT IS LISTED.**

J van Engelen Mgr.

CHAUNCEY ASSAY LABORATORIES LTD.

33 Chauncey Avenue, Toronto, Ontario, M8Z 2Z2
Tel: (416) 239-3527 FAX: (416) 239-4012

CERTIFICATE OF ANALYSIS

RECEIVED FROM: **GAMAH INTERNATIONAL** DATE: AUGUST 17, 1995

REPORT NO.: MI-3573-04 SAMPLES OF: SOILS

DATE RECEIVED: AUGUST 14, 1995 ATTENTION: MR. GERALD HARPER

SAMPLE NO:	Ag ppm	Cu ppm	Ni ppm
93-B 6W-8N	1.2	8.1	5.1
7W-8N	.8	20	18
8W-8N	1.0	10	12
9W-8N	1.3	6.2	14
10W-8N	.9	50	95
11W-8N	.5	18	20
95-III 12W-0.5N	1.1	10	25
12W-1N	.5	9.1	22
12W-1.5N	.3	10	8.1
12W-2N	.5	8.2	28
12W-2.5N	.6	18	34
12W-3N	.6	16	32
12W-3.5N	.4	18	23
12W-4.25N	.4	10	19
12W-4.5N	.3	6.1	12
12W-5N	.2	6.9	16
12W-5.5N	.8	8.0	20
12W-6N	2.6	5.2	14
12W-7.25N	1.3	43	35

J van Engelen Mgr.

CHAUNCEY ASSAY LABORATORIES LTD.

33 Chauncey Avenue, Toronto, Ontario, M8Z 2Z2
Tel: (416) 239-3527 FAX: (416) 239-4012

CERTIFICATE OF ANALYSIS

RECEIVED FROM: **GAMAH INTERNATIONAL** DATE: AUGUST 17, 1995

REPORT NO.: MI-3573-05 SAMPLES OF: SOILS

DATE RECEIVED: AUGUST 14, 1995 ATTENTION: MR. GERALD HARPER

SAMPLE NO:	Ag ppm	Cu ppm	Ni ppm
95-III OW-5.5N	1.1	14	32
OW-6N	.9	9.1	19
OW-6.5N	2.0	5.1	14
* **OW-7N**	1.4	5.0	8.0
OW-7.5N	3.1	16	30
OW-8N	.5	10	16
95-I			
* **LINE #1 150M S OF POST #1**	1.3	8.0	21

*** NOT LISTED**

J van Engelen Mgr.

CHAUNCEY ASSAY LABORATORIES LTD.

33 Chauncey Avenue, Toronto, Ontario, M8Z 2Z2
Tel: (416) 239-3527 FAX: (416) 239-4012

CERTIFICATE OF ANALYSIS

RECEIVED FROM: **GAMAH INTERNATIONAL** DATE: AUGUST 23, 1995

REPORT NO.: MI-3577-01 SAMPLES OF: SOILS

DATE RECEIVED: AUGUST 14, 1995 ATTENTION: MR. GERALD HARPER

SAMPLE NO:	Au ppb	Zn ppm
93-A 0W-0N	10	38
0W-1N	12	39
0W-2N	21	44
0W-5N	9	37
** **0W-6N**	11	38
0W-7N	8	36
0W-8N	10	80
93-A 1W-0N	12	65
1W-2N	15	54
1W-3N	< 5	48
1W-5N	< 5	64
1W-6N	10	64
1W-7N	8	48
1W-8N	< 5	40
***93-A 2W-0N**	11	53
2W-1N	< 5	42
2W-2N	9	33
2W-3N	10	34
2W-4N	7	68
2W-5N	11	80
2W-6N	10	26

*** NOT LISTED**

**** LABELLED AS 0W-6N ON ONE SIDE AND 1W-0N ON THE OTHER, SO WE TOOK IT AS 0W-6N, BECAUSE THERE ALREADY WAS A 1W-0N**

J van Engelen Mgr.

CHAUNCEY ASSAY LABORATORIES LTD.

33 Chauncey Avenue, Toronto, Ontario, M8Z 2Z2
Tel: (416) 239-3527 FAX: (416) 239-4012

CERTIFICATE OF ANALYSIS

RECEIVED FROM: **GAMAH INTERNATIONAL** DATE: AUGUST 23, 1995

REPORT NO.: MI-3577-02 SAMPLES OF: SOILS

DATE RECEIVED: AUGUST 14, 1995 ATTENTION: MR. GERALD HARPER

SAMPLE NO:	Au ppb	Zn ppm
93-A 3W-0N	9	16
3W-1N	21	24
3W-2N	11	14
3W-3N	< 5	20
3W-4N	< 5	56
3W-6N	< 5	21
* **3W-7N**	10	29
93-A 4W-0N	5	39
4W-1N	9	26
4W-2N	12	24
4W-3N	< 5	31
* **4W-4N**	5	23
* **4W-6N**	< 5	29
* **4W-7N**	< 5	31
***93-A 5W-0N**	< 5	33
* **5W-1N**	10	32
5W-2N	12	48
5W-3N	8	28
5W-4N	7	30
5W-7N	< 5	30
5W-8N	< 5	31

*** NOT LISTED**

J van Engelen Mgr.

CHAUNCEY ASSAY LABORATORIES LTD.

33 Chauncey Avenue, Toronto, Ontario, M8Z 2Z2
Tel: (416) 239-3527 FAX: (416) 239-4012

CERTIFICATE OF ANALYSIS

RECEIVED FROM: **GAMAH INTERNATIONAL** DATE: AUGUST 23, 1995

REPORT NO.: MI-3577-03 SAMPLES OF: SOILS

DATE RECEIVED: AUGUST 14, 1995 ATTENTION: MR. GERALD HARPER

SAMPLE NO:	Au ppb	Zn ppm
93-A 6W-1N	< 5	39
6W-2N	< 5	14
6W-3N	10	54
6W-4N	8	46
6W-6N	< 5	38
6W-8N	12	33
93-A 7W-0N	< 5	28
7W-1N	< 5	52
** 7W-3N	< 5	85
7W-4N	9	18
7W-5N	< 5	33
7W-6N	< 5	34
7W-7N	< 5	44
7W-8N	12	41

****NOT LISTED, BUT IT LOOKS LIKE IT USED TO BE 7W-2N, AND THERE IS NO BAG 7W-2N, ALTHOUGH IT IS LISTED.**

J van Engelen Mgr.

APPENDIX 4

Petrographic Report

Report has been filed as a separately bonded volume by Dr. G.C. Wilson (1995), entitled *Mineralogical Contribution to Exploration of Bedrock and Surficial Deposits in the Onion Lake-Greenwich Lake Area of Northwestern Ontario*, Turnstone Geological Services Ltd. Confidential Report 1995-25 to Minfocus International Inc.

MINERALOGICAL CONTRIBUTION TO EXPLORATION OF BEDROCK AND SURFICIAL DEPOSITS IN THE ONION LAKE-GREENWICH LAKE AREA OF NORTHWESTERN ONTARIO

On behalf of
Minfocus International Inc.,
Suite 707 - 1243 Islington Avenue,
Toronto, Ontario
Canada M8X 1Y9

Attn.: Dr Gerald Harper
Tel (416)-232-9114
Fax (416)-232-9120

By

Graham C. Wilson, PhD, FGAC
Turnstone Geological Services Ltd.
P.O. Box 130, Station "B", Toronto
Ontario CANADA M5T 2T3
(416)-466-3386

Fri 08-Sep-1995
TGSL Project 1995-25

(*With Petrographic Descriptions 1830-1837,
36 pages, 15 figures, 2 tables*)

Key features of samples are reviewed in the 'texture' and 'summary' sections of each description.
The details are presented in condensed form: a glossary of terms is appended.

ABSTRACT

This report contains detailed descriptions of eight grab samples of rocks from a little-explored district north of Thunder Bay, Ontario. Exposure in the region is generally poor, hence the samples include both in-situ and float lithologies. The samples represent mafic and felsic intrusions and their supracrustal country rocks. The latter include three examples of schistose metasediments and fragmental metavolcanics. Mafic-ultramafic float is common, hence the inclusion of one diabase cobble and, for comparison with the float, two rocks from the Lac des Iles Pd-Pt-Au-Cu-Ni-(Co-Rh) mine, located ≈ 70 km north of the target area. White leucogranites, often displaying intimate association of pegmatitic and aplitic facies, are common in float, roadcut and off-road outcrop. Pinkish to orangey-red garnet is common in these highly evolved granitoids, and two samples are described.

The exploration program on the claims and surrounding area is focused on locating at least three geological environments of potential economic interest: kimberlitic and related alkaline intrusions, mafic-ultramafic bodies and rare-metal pegmatites. The report contains selected 1995 field notes, and is illustrated with outcrop and thin-section photographs. Since one of the possible explanations for magnetic anomalies under the claims is the presence of buried mafic-ultramafic bodies, an appendix contains photographs and an extensive bibliography for the Lac des Iles intrusion and its PGE-Au-base metal mineralization.

In order to test the provenance of heavy mineral grains analysed by earlier electron microprobe work, garnets from the leucogranite suite (samples 1682c, P-1) and ilmenite from the diabase float (A-11) were also analysed by microprobe. 24 new analyses are compared with 14 of the heavy mineral grains. The results are clear-cut: Mn-rich garnets of probable magmatic origin, occurring in the leucogranites, match grains in surficial deposits. Ilmenites in diabase float match those in loose grains. However, coexisting Fe-Ti oxides and clinopyroxenes vary in composition, and it is still possible that some of these grains are derived from mafic bodies other than the diabase represented in the float.

The limited sampling conducted to date reveals no clear indication of kimberlitic or alkaline rocks in-situ or up-ice from the small surveyed fraction of the overall project area. There is no clear evidence for a gabbroic to ultramafic suite prospective for Ni-Cu-PGE. The abundant white granitoids are quite highly evolved, and there may be some potential for rare-element pegmatites or other granite-related mineralization. The garnets, which are zoned and enriched in Mn and (?) Y, the presence of greenish (?) zinnwaldite mica, and outcrops with pegmatite-aplite intercalations and unidirectional solidification textures, are all features consistent with high-level, apical facies granitoids, relatively volatile-rich and hence potentially capable of concentrating a range of elements. Due to poor exposure and a lack of firm evidence for the nature of associated geophysical anomalies, it is as yet too early to judge the local potential for discoveries of the three target types of economic interest.

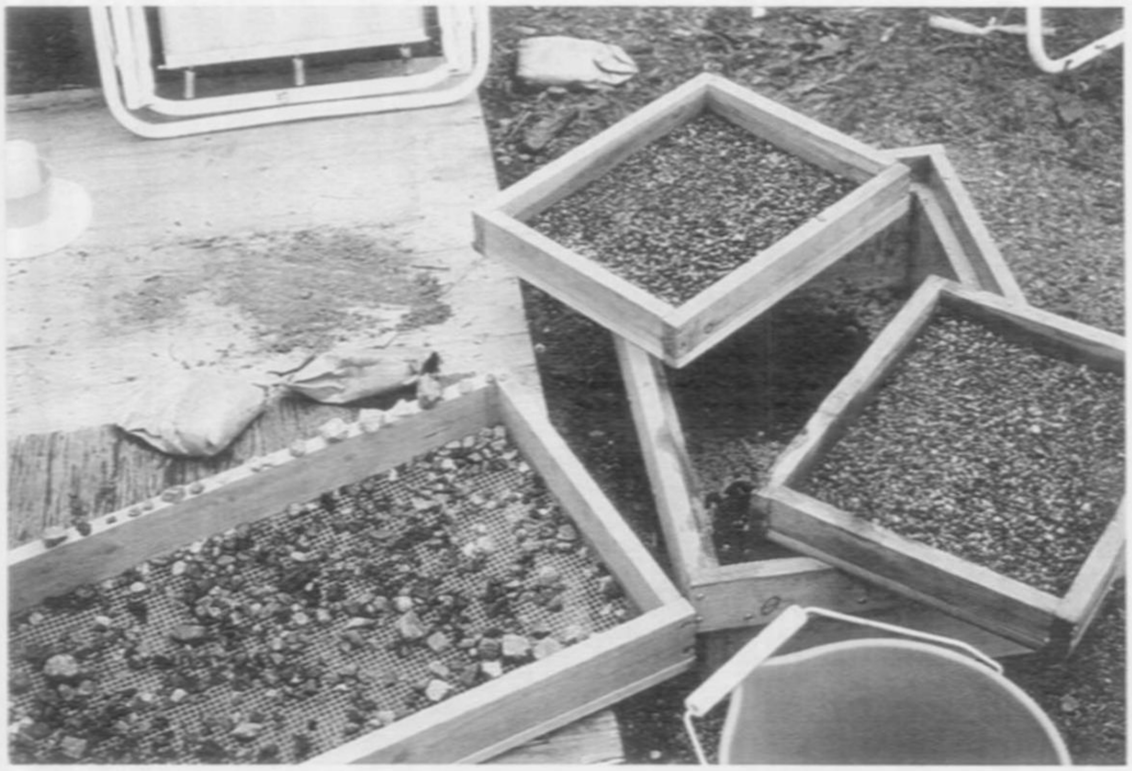
Note: This report is designed in modular fashion: the abstract and main text should provide the bulk of the essential information. Detailed sample descriptions can be scanned for increasingly specific levels of data. Within these, the mineral proportions, textural and summary data may be read first, and individual mineral data found as required.

N.B. Every effort has been made to provide an objective appraisal of the sample suite. This is a technical report, not a prospectus, yet for completeness the author would like to disclose a material interest in the project at hand.

Frontispiece:

Figure 1. Screens used in field processing of surficial deposits for heavy minerals, September 1993 and July 1995. The coarse (>5 mm) fraction is retained on the large screen at the left, while the fines (<1 mm) pass the smaller screens and are collected in the box. Fine and medium fractions are retained for laboratory processing, the coarse fraction is logged and discarded.

Figure 2. A magmatic garnet crystal in a pegmatitic to aplitic leucogranite body located beside the logging road crossing the 'East Claims'. The Mn-rich nature of the spessartine- almandine garnet was confirmed by electron microprobe analyses, and matches grains recovered from local stream sediments and gravel pits. Magnification 80x, long-axis field of view 1.4 mm, PPL, TL.



PREFACE

The 1995 field work on the target area follows on from the initial claim staking and field assessment (Wilson, 1993). Heavy mineral sampling was conducted in 1993 and 1995 (Fig. 1). The 1993 sample suite was processed and a selection of grains of garnet, pyroxene and other minerals were mounted, polished and analysed by electron microprobe (Wilson, 1995). The author joined the field crew for a 5-day visit in July 1995, and a synthesis of field observations, petrographic notes on grab samples, and fresh microprobe data is provided below. The laboratory work (Fig. 2) sheds light on the earlier heavy mineral sampling.

FIELD NOTES

The bedrock in the region, generally sparsely exposed, includes biotite schist (paragneiss), fragmental volcanic rocks, and conspicuous leucogranite intrusions. Minor intrusions are sparsely exposed, and include diabase dykes, which may be much more abundant beneath the overburden. Brief notes follow, and a list of 1995 hand specimens is provided (Appendix 1).

The supracrustal rocks typically exhibit a strong foliation. They are rich in biotite, plus plagioclase ± quartz, ± minor accessory phases such as amphiboles, epidote, sphene and pyrite. Coarse clots of biotite appear to preserve a relict texture consistent with a tuffaceous, volcaniclastic origin for some of the rocks, which display rough weathered faces (Fig. 3) and are interpreted as crystal tuffs, in contrast to smoother schists, thought to be *metasediments* derived from a greywacke protolith. Pronounced foliation, isoclinal folds, and ptygmatic folding of mm-scale felsic streaks are commonplace.

Leucogranite bodies are prominent in the region, both along the road sections and in off-road outcrop and float boulders. The white, massive to banded, quartz-feldspar-mica body on the 'East Claims' (Fig. 4) appears to be a sheet or series of sheets, individual exposures up to 3 m or more in thickness, with sharp contacts against the host rocks. Pegmatiic veins up to 30 cm thick are composed largely of white feldspar, including coarse megacrysts, grey quartz and a pale greenish 'muscovite' mica, possibly a Li-bearing species such as zinnwaldite or 'gilbertite'. Minor minerals include epidote and local concentrations of red to orange garnets. The largest exposure on the East Claims displays complex pegmatite-aplite textures, with finer material locally draped over the megacrysts. The latter are chalky-white, tabular in habit, up to 9x18 cm in section, enclosing blebs of grey quartz ≤ 1 cm in diameter.

Diabase dykes are seldom exposed in the area. Figure 5 shows a small example, 8 cm thick, in the country rock to the leucogranite on the East Claims. No coarse diabase or other substantial mafic-ultramafic intrusives were encountered during the brief roadside tours and traverses in the target area.

MINERALOGY OF GRAB SAMPLES

The samples are summarized in Table 1. The mineralogy of the suite is generally consistent with the greenschist facies of regional metamorphism. No garnets were observed in the schistose country rocks, and particular attention was paid to the garnets in the leucogranites, with a view to constraining the provenance of material in the heavy mineral separates.

TABLE 1. PETROGRAPHIC SAMPLE LIST ...6 samples from claims area, 2 from Lac des Iles

Descr.	*Sample*	*Suggested Identification*	*Figures*
1830	1682b	Foliated micaceous (?) crystal tuff	8
1831	1682c	Aplitic, garnetiferous leucogranite	2,11
1832	P-1	Garnetiferous, pegmatitic leucogranite	9,10,11
1833	A-10	Biotite schist	
1834	A-11	Coarse diabase	6,7
1835	1690	Foliated micaceous crystal tuff	3
1836	1687	Sulphidic melagabbro	14,15
1837	1688	Pyrite-bearing uralitized leucogabbro	

The electron microprobe analyses of selected grains from leucogranites 1682c and P-1, and from diabase float A-11, proved remarkably efficient at constraining the provenance of Mn-rich garnets and some of the other phases in the heavy mineral separates (Wilson, 1995). The data are presented in Table 2. The analyses were performed on the Cameca SX-50 microprobe at the Department of Geology, University of Toronto, using three wavelength-dispersive spectrometers.

The analytical strategy provides quantitative data for 8 elements (to save time, Na was omitted, except for rough estimates for pyroxene and feldspar). The 15 kV, 30 nA electron beam was rastered over square 15x15 μm target areas.

Garnets

The garnets from fine- and coarse-grained leucogranites (1682c, P-1) contain $\approx$20 and 8 wt.% MnO, respectively. Both may show degrees of zoning, from yellow cores to colourless rims. Yellow cores and patches contain slightly more MnO and less SiO_2 and FeO, and display lower totals than the colourless rims, but the major-element variations are quite subtle. The first three core and first three rim analyses for garnet in Table 2 are from the crystal (in sample 1682c, East Claims) depicted in Figure 2 (Frontispiece). Energy-dispersive spectra are displayed (Fig. 11) for the third core analysis for 1682c and for an area beside the first core analysis for P-1. The higher MnO content of 1682c is readily apparent.

The analyses are clearly quite good, but may be slightly low in general, perhaps reporting slightly low results for SiO_2. Whether the colour variation is attributable to the Mn content is uncertain. Another possibility is that the colour results from a species which was not analysed. A candidate is Y at a level of $\approx$1 wt.%: the tiny peaks in the EDS spectra at $\approx$1.9 keV may be the L_{α}^{1} line of Y (1.922 keV). This is discussed further in the last paragraph of this section. The yellow garnet in 1682c returned a mean oxide total of 97.57$\pm$0.40 (2σ), which is rather low for garnet, and low relative to the standard (reported analysis 99.16%). The colourless portions of the same grain averaged 98.66$\pm$0.70. Although the two means are barely distinguishable at the 2σ level, there is a consistent gap between totals for pairs of nearby yellow and clear areas, the yellow garnet averaging 1.08$\pm$0.68% (2σ) lower than the clear material.

The most Mn-rich garnets, analysed in grain-mount sites b-01, b-03 and b-04, are respectively derived from sites 9, 8 and 7 of Wilson (1993), which are the bed of the Current River just north of the West Claims and two gravel pits near Highway 527. Outcrops of white leucogranites occur on the highway between the target area and the Lac des Iles mine road, and such bodies are undoubtedly the source of the Mn-rich garnets in the surficial sediments.

The texture of the rocks suggests a magmatic origin for the garnets (which, in principle, could have entered the granites as xenocrysts, as magmatic components (phenocrysts $\pm$

overgrowths), or via subsolidus metamorphic re-equilibration. Magmatic garnets have been identified in a number of widely scattered localities, in rocks of Paleozoic to Tertiary age. They are generally in rocks of felsic to intermediate, commonly peraluminous composition, although they are also known from feldspathoidal syenites (in the latter case, as melanite garnet). Associated phases may include biotite, cordierite and epidote.

Harrison (1988) examined small, Mn-rich magmatic garnets from the Cairngorm granite in Scotland. The granite body is the largest of a series of post-tectonic, broadly calc-alkaline granitoids emplaced ≈55-25 My after the peak of regional metamorphism and deformation. The Cairngorm magmatic garnets are found in granite and a late aplite sheet, and contain up to 1.67 wt.% Y_2O_3 (see above). They are generally small (<2.5 mm) and subhedral, suggestive of equilibrium with the melt. They are not thought to have formed by assimilation, as there are no xenoliths, and the wallrocks are largely psammites. The garnet contains 13.43-22.62% MnO (13 analyses) and their postulated formation involves the magmatic crystallization of Mn-enriched, volatile-rich granite melt. The magmatic garnets of the Galway granite, Ireland, are also Mn-rich (Whitworth and Feely, 1994), with 25.71-35.50 wt.% MnO in 9 published analyses, Mn generally increasing from granite to aplite to pegmatite. There are zoned garnet crystals, with Mn and Ca-rich cores and Fe and Mg-rich margins, *exactly the situation in the Ontario garnets* (Table 2). Y is enriched in garnets in aplite and pegmatite, 0.48-1.85 wt.% Y_2O_3. The concensus appears to be that such garnets may form in localized, uncommon zones of Mn enrichment near the roof of a magma chamber. Aqueous fluids may have transported Mn, allowing low-pressure crystallization of the Mn-rich garnets.

Oxides

The Fe-Ti oxides in mineral separates and diabase float are relatively Mn-poor, ≤1.5 wt.% MnO. The ilmenites in separates and diabase are all quite close to pure $FeTiO_3$. Titanomagnetite coexisting with ilmenite in three separated grain intergrowths contains ≈14 wt.% TiO_2. In contrast, the diabase 'magnetite' appears to be quite variable in composition, possibly reflecting small-scale intergrowths. One 'magnetite' in the diabase is very Ti-rich, essentially a pure ulvospinel, Fe_2TiO_4. The others are (?) 'titanomagnetite' with 5-9 wt.% TiO_2. Typical intergrowths of hematite with ilmenite with not observed. Sparse oxides coexisting with Mn-rich garnets in granite (Harrison, 1988) may include coarse intergrowths of Mn-rich ilmenite with rather pure magnetite, which certainly suggests that the oxides in the heavy mineral separates are not of granitoid derivation. The provisional interpretation of the surficial oxide grains attributes their origins to unknown mafic intrusions up-ice of the target area.

Clinopyroxenes

The diabase pyroxene is augitic, but with a higher Mg number than augite-ferroaugite in the mineral separates. All examined pyroxenes have <0.3 wt.% Cr_2O_3. Derivation from mafic rocks is likely for most of the grains. Further work would be needed to refine this broad result for both oxides and pyroxenes. The Lac des Iles samples constitute a control group to compare with the abundant mafic float in the target area. An illustrated (Figs. 12-15) bibliography of the Lac des Iles area, the intrusion and associated mineralization is provided in Appendix 2.

CONCLUSIONS

The present findings complement the work of the field crew (Peter MacMartin and Lorraine Godwin) who conducted reconnaissance, mapping and sampling duties on the claims in July 1995. In addition, some aspects of the heavy-mineral chemistry of the surficial deposits have been clarified. The rock descriptions should also provide constraints on an essential (and ideally, the next) part of the project, a detailed geophysical assessment.

REFERENCES

HARRISON,TN (1988) Magmatic garnets in the Cairngorm granite, Scotland. Mineral.Mag. 52, 659-667.

WHITWORTH,MP and FEELY,M (1994) The compositional range of magmatic Mn-garnets in the Galway granite, Connemara, Ireland. Mineral.Mag. 58, 163-168.

WILSON,GC (1993) Exploration for kimberlites and diamonds in the Midcontinent Rift, northwestern Ontario. TGSL Report 1993-11, for the American Rift Project, Toronto, 16pp.

WILSON,GC (1995) A study of heavy mineral fractions in the Nipigon Plate region of northwestern Ontario. TGSL Report 1995-02 for Minfocus International Inc., Toronto, 45pp.

TABLE 2. ELECTRON MICROPROBE DATA

Sample	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Total	Identification	Class[1]
Garnets in Granitoid Samples											
1682c	34.529	0.055	20.257	0.020	22.838	18.902	0.539	0.292	97.471	Yellow garnet core	non-kim:peg
1682c	34.933	0.060	20.095	0.000	23.243	18.505	0.544	0.319	97.699	Yellow garnet core	non-kim:peg
1682c	34.749	0.063	20.189	0.001	23.170	18.896	0.526	0.256	97.859	Yellow garnet core	non-kim:peg
1682c	34.585	0.017	20.380	0.018	23.341	18.057	0.692	0.318	97.422	Deep yellow garnet zone	non-kim:peg
1682c	34.653	0.088	20.540	0.044	23.337	17.575	0.743	0.371	97.411	Deep yellow garnet zone	non-kim:peg
1682c	35.475	0.002	20.639	0.019	24.218	17.822	0.630	0.234	99.066	Clear garnet rim	non-kim:peg
1682c	35.517	0.000	20.790	0.000	24.716	16.995	0.652	0.259	98.929	Clear garnet rim	non-kim:peg
1682c	35.350	0.030	20.779	0.000	24.539	16.956	0.703	0.228	98.629	Clear garnet rim	non-kim:peg
1682c	35.487	0.013	20.705	0.000	24.649	16.596	0.743	0.246	98.439	Clear garnet rim	non-kim:peg
1682c	35.186	0.000	20.527	0.000	24.520	16.955	0.783	0.245	98.216	Clear garnet rim	non-kim:peg
P-1	35.746	0.098	20.686	0.010	30.900	8.340	2.189	0.340	98.366	Yellow garnet core	non-kim:peg
P-1	35.543	0.082	21.105	0.000	30.938	8.820	2.235	0.313	99.036	Yellow garnet core	non-kim:peg
P-1	35.905	0.000	21.128	0.000	31.277	8.208	2.192	0.312	99.038	Clear garnet rim	non-kim:peg
P-1	36.146	0.027	21.243	0.025	31.465	8.544	2.096	0.306	99.955	Clear garnet rim	non-kim:peg
Selected Garnets in Heavy Mineral Samples (MnO>4%)											
h-04a	36.215	0.040	20.501	0.000	19.019	21.558	1.461	0.410	99.204	Almandine-spessartine	non-kim
h-01a	36.277	0.000	21.462	0.000	31.555	8.508	2.391	0.423	100.616	Mn-rich almandine	non-kim
h-03a	36.501	0.007	21.190	0.000	28.852	8.778	3.416	0.651	99.395	Mn-rich almandine	non-kim
h-04b	36.767	0.005	21.228	0.001	32.344	4.297	3.106	1.506	99.254	Almandine	non-kim
h-04c	36.833	0.000	21.410	0.004	31.299	5.413	3.532	1.153	99.644	Almandine	non-kim
Standard											
Pyr STD	41.460	0.470	23.730	0.000	10.680	0.280	18.510	5.170	100.300	Pyrope garnet	STD 'book'
PyropKsx1 STD	40.881	0.444	23.550	0.057	10.405	0.329	18.452	5.008	99.165	Pyrope garnet	non-kim

Notes:
[1]This page includes a total of 19 'unknown' plus 1 standard analyses, performed by wavelength-dispersive electron microprobe. All values in weight percent oxide, all Fe expressed as FeO. Rapid analysis schedule, omitting Na_2O and P_2O_5.

Sample	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Total	Identification	Class[1]
Oxides in Diabase Float Sample											
A-11	0.000	50.402	0.030	0.000	47.573	1.296	0.056	0.000	99.383	Rounded ilmenite	ilm
A-11	0.000	50.619	0.028	0.072	47.676	1.393	0.022	0.034	99.844	Nearby rounded ilmenite	ilm
A-11	0.000	50.162	0.023	0.044	47.466	1.476	0.035	0.028	99.234	Tabular ilmenite	ilm
A-11	0.000	49.543	0.009	0.004	47.466	1.472	0.050	0.041	98.585	Ilmenite	ilm
A-11	0.569	32.264	0.350	0.108	60.643	1.513	0.121	0.259	95.854	Magnetite on ilmenite	Ulvospinel
A-11	0.227	9.002	0.385	0.075	81.506	0.332	0.071	0.052	91.661	Pitted magnetite grain	Ti mag (?)
A-11	0.060	6.493	0.385	0.140	84.385	0.163	0.000	0.048	91.704	Magnetite on rim of ilmenite	Ti mag (?)
A-11	0.101	5.192	0.438	0.110	85.539	0.161	0.020	0.106	91.689	Magnetite on rim of ilmenite	Ti mag (?)
Fe-Ti Oxide Pairs in Heavy Mineral Samples											
a-07b	0.896	13.995	0.780	0.056	78.566	0.457	0.158	0.036	94.944	Titanomagnetite	Ti mag
a-07a	0.000	50.795	0.038	0.000	47.345	1.374	0.000	0.011	99.563	Low-Mn ilmenite	ilm
a-17b	0.101	14.707	1.260	0.174	77.982	0.351	0.121	0.000	94.696	Titanomagnetite	Ti mag
a-17a	0.000	51.785	0.032	0.000	47.896	0.571	0.320	0.001	100.605	Low-Mn ilmenite	ilm
a-19b	0.064	14.629	2.577	0.130	75.598	0.609	0.368	0.001	93.976	Titanomagnetite	Ti mag
a-19a	0.000	51.289	0.064	0.058	46.161	0.588	1.230	0.010	99.400	Low-Mn ilmenite	ilm
Clinopyroxene in Diabase Float Sample											
A-11	48.700	0.984	3.613	0.285	11.530	0.185	13.571	18.989	98.111	Clinopyroxene: augite	cpx:aug*
A-11	49.230	0.893	2.893	0.123	12.359	0.260	13.545	18.409	98.044	Clinopyroxene: augite	cpx:aug*
Clinopyroxenes in Heavy Mineral Samples											
a-06	48.916	0.617	1.190	0.015	24.774	0.557	9.290	13.813	99.172	Clinopyroxene: ferroaugite	cpx:aug
a-08a	47.519	0.512	0.988	0.000	27.338	0.531	4.708	17.392	98.988	Clinopyroxene: ferroaugite	cpx:aug
a-11	49.402	0.657	1.289	0.004	22.089	0.528	11.936	13.325	99.230	Clinopyroxene: augite	cpx:aug

Notes:

[1]This page includes a total of 19 'unknown' analyses, performed by wavelength-dispersive electron microprobe. All values in weight percent oxide, all Fe expressed as FeO (hence low values for magnetite, ideally near 95%, Fe as FeO).

*these pyroxene totals include 0.2-0.3 wt.% estimated Na_2O.

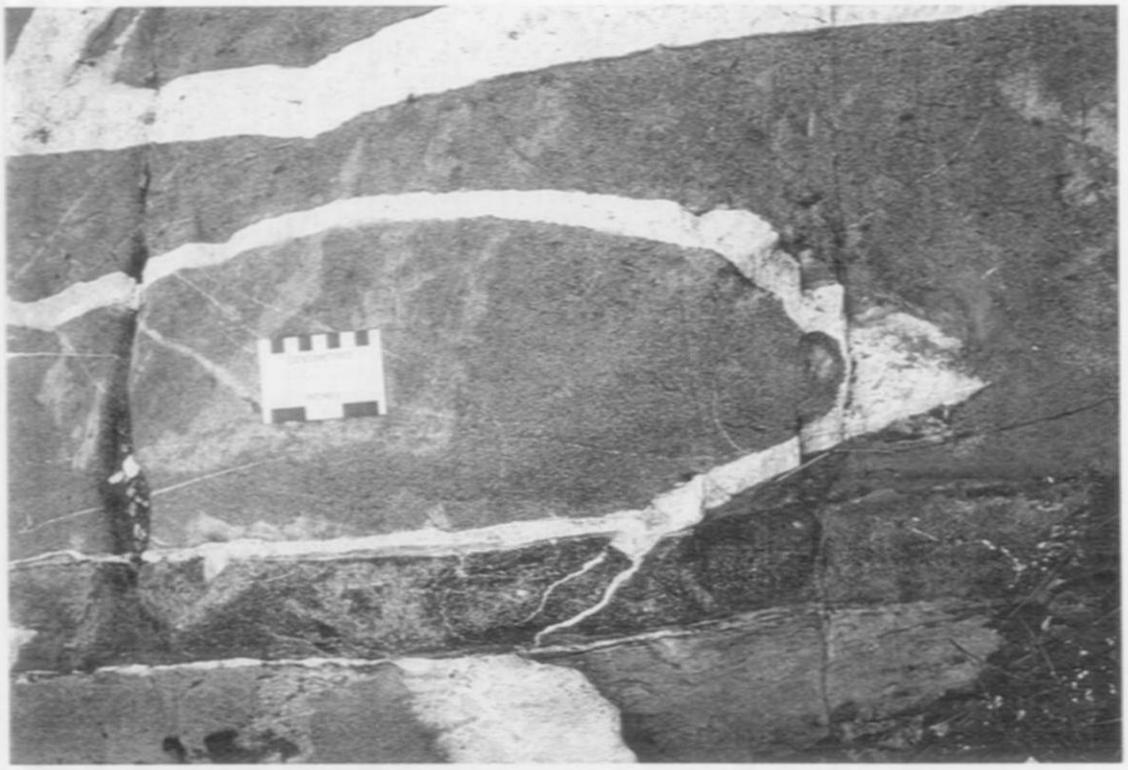
=== NOTES ===

Figure 3. Biotite-rich (?) volcaniclastic layer, interpreted as crystal tuff interbedded on a ≈30-cm scale with greywacke (schist) in an outcrop on the east side of Highway 527, on the south side of the access road at the north end of Walkinshaw Lake. Site of sample 1690. The outcrop is cut by minor intrusions, biotite granodiorite and aphanitic diabase. Both felsic and mafic intrusives contain trace pyrite, which in the granodiorite occurs on low-angle quartz veinlets.

Figure 4. Leucogranite sheet cutting a biotite-rich (?) tuffaceous host rock on the north side of the major logging road cutting the 'East Claims'. Site of samples 1682b,c.

Figure 5. Located on the East Claims at ≈675W+650N, a thin, dark, (?) biotite- and chlorite-altered diabase sheet lies within the foliation of the host schists. A felsic sheet, identical in appearance to a nearby, larger leucogranite body, underwent recumbent folding in the same dominant fabric prior to diabase emplacement. Minor rheomorphism accompanied the injection of mafic magma, partly remelting the granite, from which felsic veinlets penetrate the diabase.

Figure 6. Unusually sulphide-rich area of diabase A-11. Pale brownish ilmenite associated with bright pyrite and angular yellow chalcopyrite, all enveloped in bluish-grey secondary goethite, hosted by pyroxene and plagioclase. Magnification 160x, long-axis FOV 0.7 mm, PPL, RL.



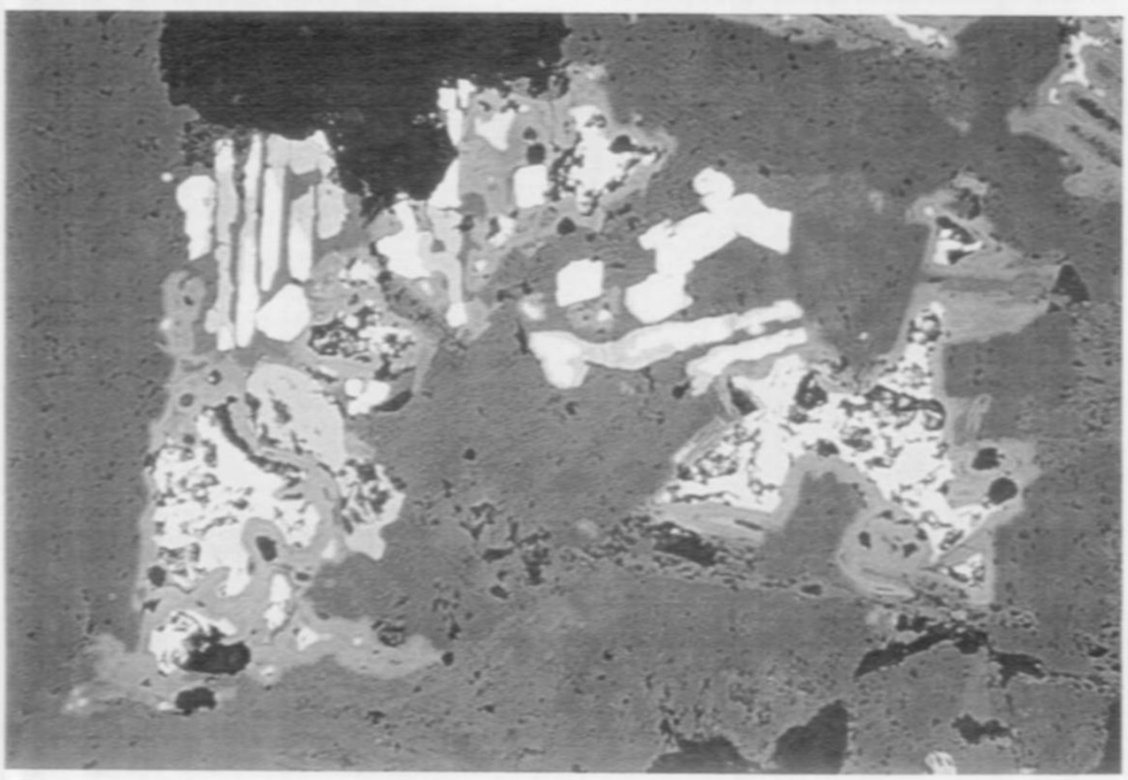
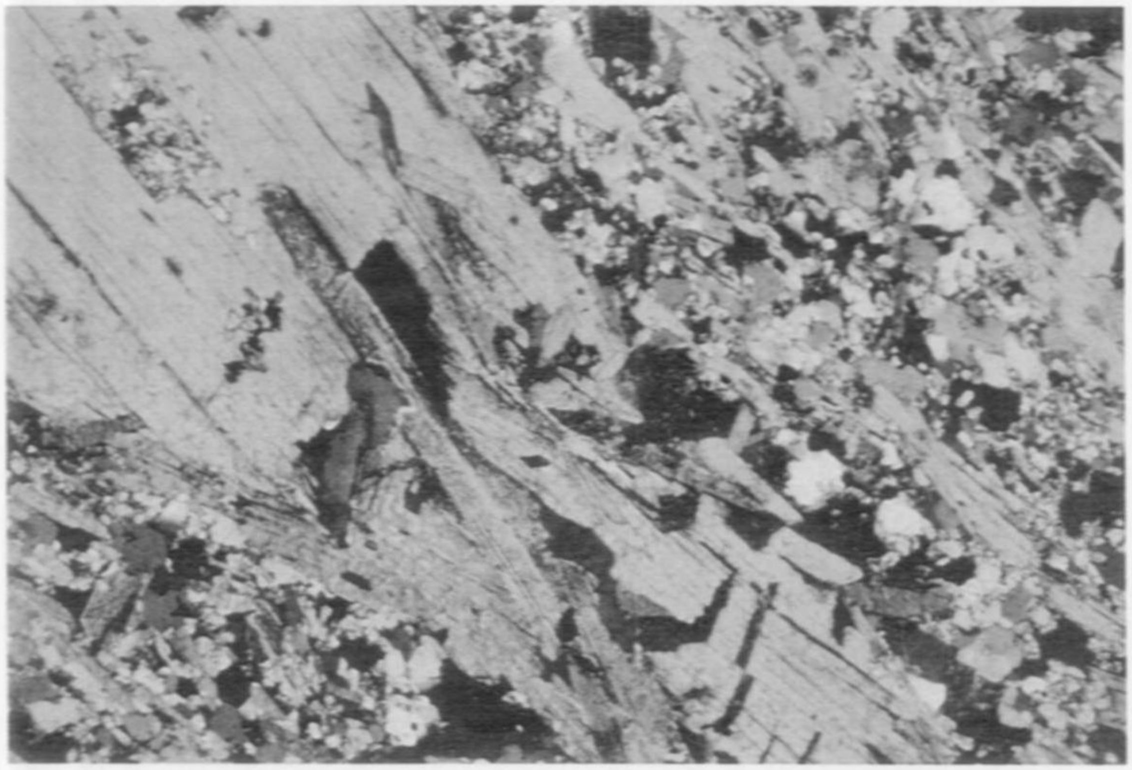


Figure 7. A typical view of diabase A-11, displaying ophitic texture of plagioclase laths enveloped by augitic clinopyroxene. Magnification 40x, long-axis FOV 2.8 mm, XP, TL.

Figure 8. Foliated micaceous (?) crystal tuff, sample 1682b, host rock to leucogranites on the East Claims (Fig. 4). Note the presence of both coarse and fine biotite mica with small pleochroic haloes. Magnification 40x, long-axis FOV 2.8 mm, XP, TL.

Figure 9. Coarse leucogranite P-1. The view is dominated by plagioclase feldspar, with a small rounded garnet (isotropic, thus black) at top right, partly mantled by bright muscovite mica partly replaced by fibrous (?) sillimanite. Magnification 40x, long-axis FOV 2.8 mm, XP, TL.



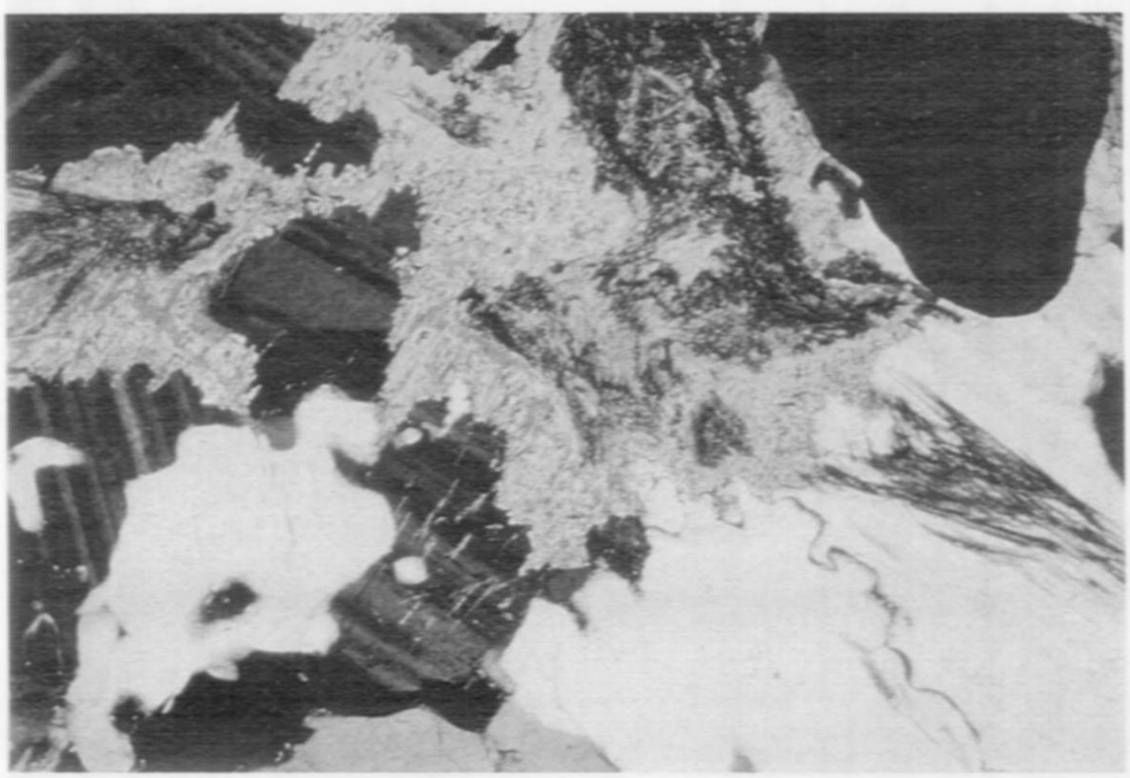
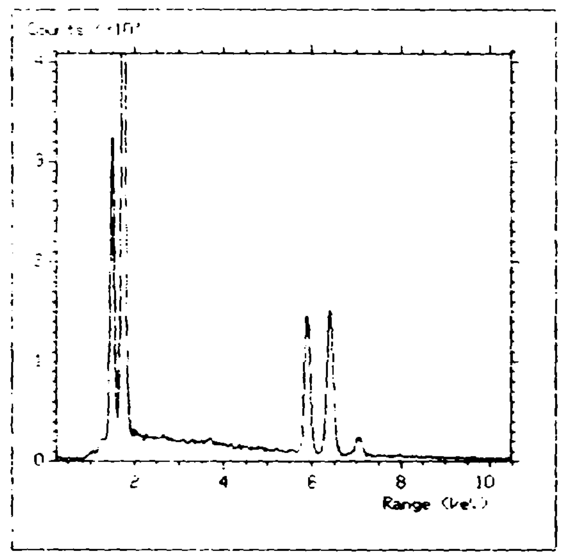


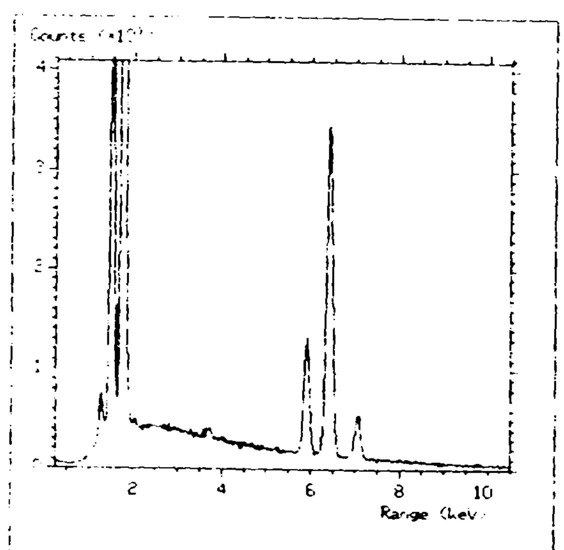
Figure 10. Coarse leucogranite P-1. Close-up of Figure 9, displaying fibrous (?) sillimanite in muscovite mantling garnet (black, at right). Magnification 80x, long-axis FOV 1.4 mm, XP, TL.

Figure 11. Energy-dispersive spectra of yellow (core) garnet from relatively fine-grained (1682c) and pegmatitic (P-1) leucogranite samples. Eight peaks can be seen in P-1: small blips of Mg and (?) Y flank major Al and Si at 1-2 keV, to the right of which is the small peak of Ca, a large Mn Kα peak at 5.9 keV, and two Fe peaks. The relative peak heights of the various elemental x-ray lines are significant: note the high Mn content (relative to Fe) in 1682c.

1682c



P-1



APPENDIX 1: CATALOGUE OF HAND SPECIMENS FROM NORTHWESTERN ONTARIO, JULY 1995

A note on terminology: (1) in situ means collected directly from outcrop, as far as can be ascertained. (2) effectively in situ refers to a sample collected loose from an outcrop of apparently identical rock type. (3) loose refers to all other samples, whether or not there is any obvious connection with local outcrop, if any. This listing is derived from the SAMPA database.

1681
Leucogranite
Northern Ontario
loose from the 'East Claims', north of Thunder Bay, Ontario. North side of logging road. See 1558 (S.W. end of same outcrop, ≈100 m long, marked by a perched erratic of red Sibley siltstone with greenish reduction spots).
15 Jul 1995
A leucogranite with a white feld (albite?) megacryst, ≈9x4 cm, containing small blebs of grey qz. The groundmass is mostly aplitic, locally pegmatitic, with white plag, grey qz, greenish-yl mica (zinn?) and a trace of fgr red gar. Not appreciably magnetic. In outcrop, drapes of fgr matrix appear to have 'settled' around such megacrysts.
HS
FNB, pp.3-25
Late Archean.

1682
Garnet leucogranite cuts hb crystal tuff
Northern Ontario
in situ from the 'East Claims', north of Thunder Bay, Ontario. North side of logging road. Just east of site of 1681, 1711.
15 Jul 1995
One large HS (A) shows contact between leucogranite and hb crystal tuff. 2 smaller HS of tuff (B), 3 of leucogranite (C). Not appreciably magnetic. The foliation in the tuff, marked by dark amph clots, is cut at shallow angle by contact of qz-plag-zinn-gar granite, which varies from aplitic (PTS, with gar) to pegmatitic in texture.
6 HS
2 PTS
FNB, pp.3-25
Late Archean.

1683
Altered diabase dyke
Northern Ontario
effectively in situ from the 'East Claims', north of Thunder Bay, Ontario. North side of logging road, as 1682.
15 Jul 1995
An altered (biotite- and chlorite-bearing) dark and aphanitic diabase dyke ≈8 cm thick, injected parallel to foliation and earlier folded leucogranitic veining (which has to a minor degree a rheomorphic relationship to the diabase). Not appreciably magnetic.
HS
FNB, pp.3-25
Late Archean.

1684
Varitextured gabbro
Lac des Iles mine site, northern Ontario
north of Thunder Bay, Ontario. Site reached by Hwy 527 (≈92.7 km north of Hwy 11/17) and access road (mine office ≈15.8 km west of Hwy 527). Loose from notch at top of the north end of open pit mine.
16 Jul 1995
The 'varitextured gabbro': mostly greasy grey plag and grn (?) uralitized cpx. Massive and cgr, silicate gs≈3-12 mm, with 1-2% disseminated sulphides (rich in py, + chalc, pyrr). Minor alteration of plag to epi. Not appreciably magnetic.
HS
FNB, pp.3-25
Late Archean.

1685
Epidote-veined gabbro
Lac des Iles mine site, northern Ontario
north of Thunder Bay, Ontario. Loose from notch at top of the north end of open pit mine.
16 Jul 1995
A mgr (2-4 mm) gabbro (probably the leucogabbro of mine parlance, but with a much higher colour index than some samples). Plag and cpx, trace sulphide and oxide, cut by thin, bright yl-grn epidote veining with dark uralitized selvages. Not appreciably magnetic.
HS
FNB, pp.3-25
Late Archean.

1686
Varitextured gabbro / granite dyke
Lac des Iles mine site, northern Ontario
north of Thunder Bay, Ontario. Loose from notch at top of the north end of open pit mine.
16 Jul 1995
Varitextured gabbro, with disseminated sulphide rich in chalc, pyrr, py (possibly ore: Cu and Ni values likely, but PGE and Au not necessarily of high grades). Not appreciably magnetic. Sharp contact against a white, foliated granitic intrusion, probably a thin leucogranite dyke, at least 4 cm thick, composed of qz, feld and chl, with chloritic selvage.
HS
FNB, pp.3-25
Late Archean.

1687
Pyroxenitic ore
Lac des Iles mine site, northern Ontario
north of Thunder Bay, Ontario. Loose from (just south of the centre of the west side of) the open pit on 66 level (datum in feet with reference to arbitrary 10,000 datum).
16 Jul 1995
Dark, massive pyroxenite or melagabbro, most probably constituting ore, with 1-2% disseminated sulphide (chalc and pyrr). Locally strongly magnetic on sulphide/oxide grains. 1-5 mm gs.
HS
PTS FNB, pp.3-25
Late Archean.

1688
Leucogabbro
Lac des Iles mine site, northern Ontario
north of Thunder Bay, Ontario. Loose from south end of the open pit (which was constructed to access the Roby Zone mineralization) on 66 level, near the 'Pyroxenite Shear'.
16 Jul 1995
The leucogabbro facies of the deposit, gs ≈ 3-4 mm, colour index ≈ 35%, traces of disseminated sulphide and oxide, not appreciably magnetic. Minor yl-grn epi.
HS
PTS FNB, pp.3-25
Late Archean.

1689
Steel rod
Lac des Iles mine site, northern Ontario
north of Thunder Bay, Ontario. A metallurgical curiosity from a waste bin of the mill.
16 Jul 1995
A remnant of one of the long steel rods (originally ≈ 2.5" / 63.5 mm in diameter) used in the rolling mill. 90-mm length, now oblate in section, 28x18 mm. The steel balls in the ball mills undergo similar attrition, and replacements are added every few days. The mill is currently producing a ≈ 1% concentrate from ≈ 2,000-2,200 T/day ore.
HS
FNB, pp.3-25
(-).

1690
Hornblende crystal tuff
Northern Ontario
north of Thunder Bay, Ontario. In situ from immediately east of the southeast corner of '95-2 claims', on the east side of Hwy 527, a prominent low outcrop on the south side of the access road at the north end of Walkinshaw Lake.
17 Jul 1995
The lithology tentatively identified in outcrop as hb crystal tuff. In outcrop, displays banding on ≈ 30-cm scale, a coarser rock with finer bands and clasts, and traces of cross-bedding in fine bands. Not appreciably magnetic. Strikes 80°, dip 75° to north.
HS
PTS FNB, pp.3-25
Late Archean.

1711
Leucocratic pegmatite cuts mica schist
Northern Ontario
effectively in situ from the 'East Claims', north of Thunder Bay, Ontario. North side of logging road. Same outcrop as 1681. Collected by Peter MacMartin, ≈ 18 July, presented 11 August.
18 Jul 1995
Sharp contact between white leucocratic pegmatite and ironstained mica schist. The pegmatite (gs 5-25 mm) is composed of white feld, grey qz and greenish silvery (?) zinn / musc mica. The schist is fgr, muscovitic, and ironstained.
HS
Late Archean.

=== NOTES ===

APPENDIX 2:
BIBLIOGRAPHY OF THE LAC DES ILES PGE-Au-Cu-Ni DEPOSIT AND SURROUNDING AREA

Turnstone Geological Services Ltd,
P.O. Box 130, Station 'B', Toronto M5T 2T3

July 18, 1995

(80 items selected from 33,010 entries in MINLIB)
Search Code 'Lac des Ile' - covers topic
Fields searched: TKK

<u>References</u>:

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WILSON,GC, KILIUS,LR and RUCKLIDGE,JC (1995) Precious metal contents of sulfide, oxide and graphite crystals: determinations by accelerator mass spectrometry. Econ.Geol. 90, 255-270.

****

Figure 12a,b. The Lac des Iles mine is now readily accessed from Highway 527. The initial open pit mine development focused on the Roby zone, the start-up plan calling for mining to a cut-off depth of 500 feet. Reserves for the project (Northern Miner, 14 March 1994, p.2) were estimated at 7.4 MT grading 0.18 oz/T PGE, 0.01 oz/T Au, 0.1% Cu and 0.1% Ni.

Figure 13a,b. A view of the mill site, and (below) a close-up of the flotation concentrate at an advanced stage of preparation. The mill began operating full-time on 30 November 1993. At the time of the visit, the milling rate was near 2,200 T/day. The target rate is 3,000 T/day, with forecast annual production (ibid.) of 120,000 oz Pd, 6,000 oz Pt, 12,000 oz Au, 1.5 million lb Cu and 1 million lb Ni.

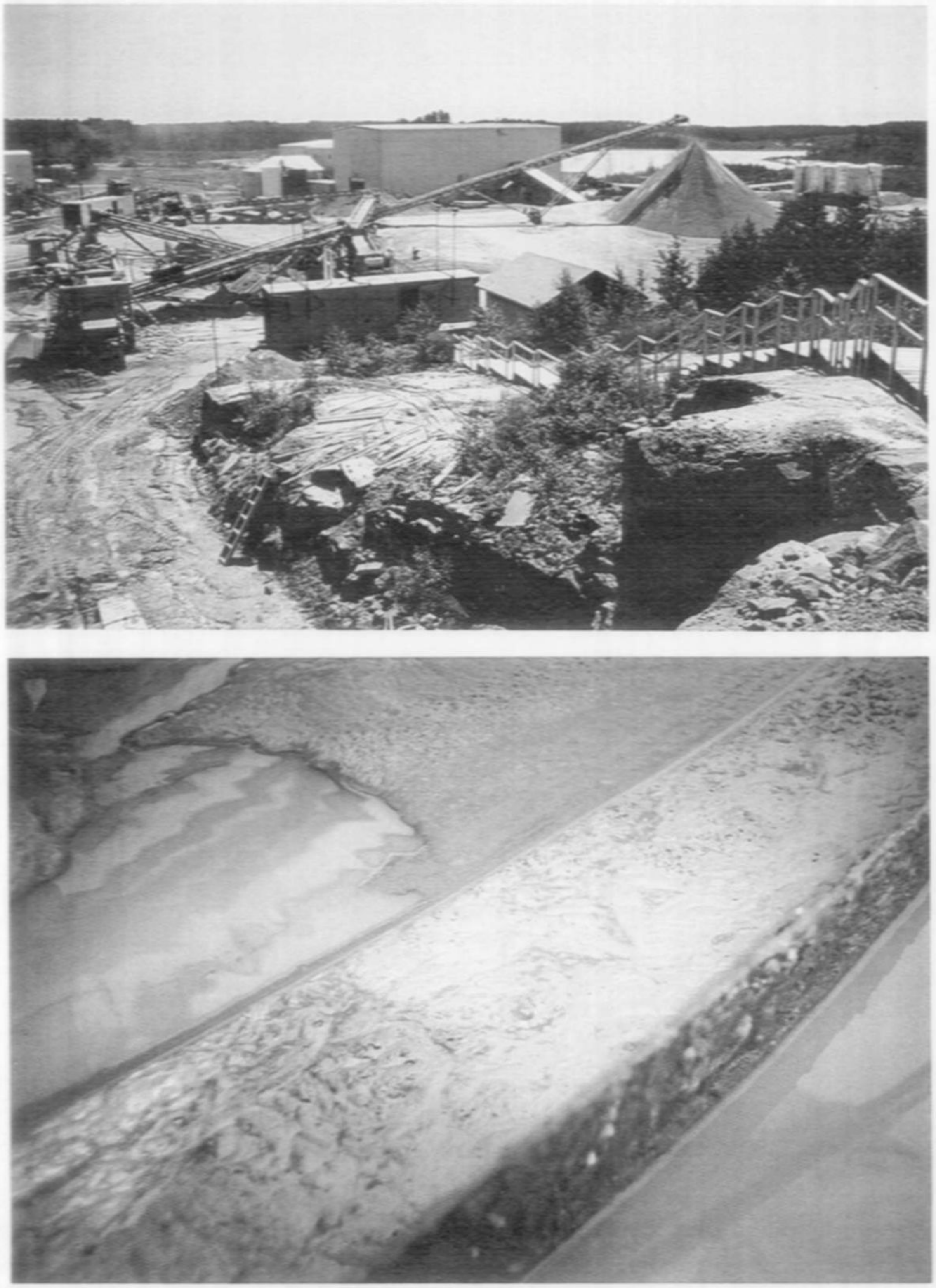
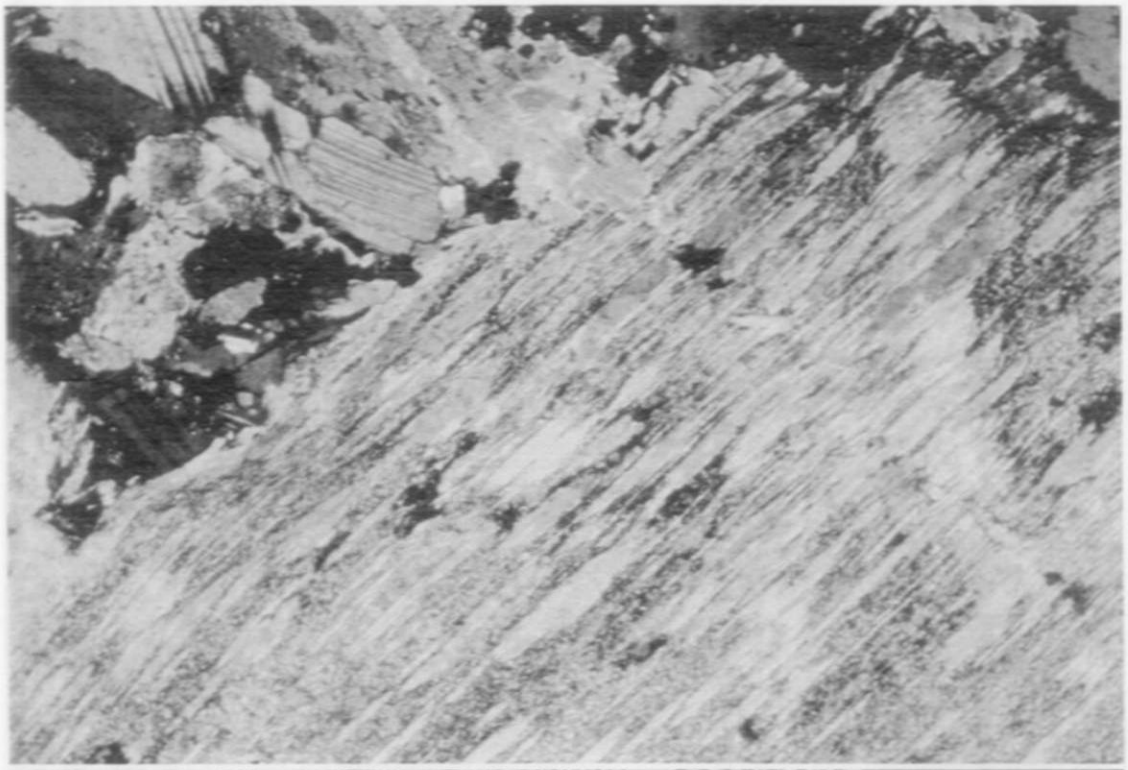
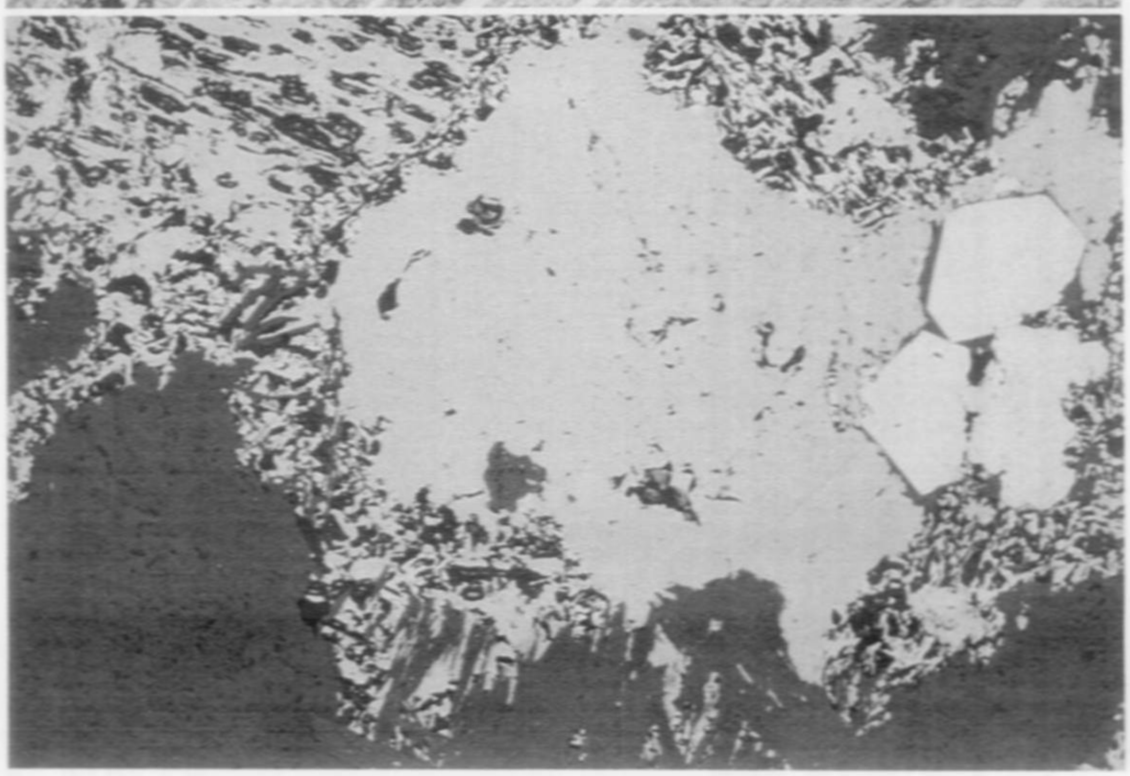


Figure 14. Sample 1687, a sulphidic, orthopyroxene-bearing melagabbro, from the Lac des Iles mine. The coarse opx is partly altered to a fine-grained talc-like sheet silicate. Albite-twinned plagioclase rims the opx. Magnification 40x, long-axis FOV 2.8 mm, XP, TL.

Figure 15. The sulphide assemblage in 1687. The centre of the field is coarse pyrrhotite, partly enclosing three euhedra of bright pyrite. A pitted intergrowth of pyrrhotite and chalcopyrite overgrows the pyrrhotite. Note the intergrowth of Cu-rich sulphide and late hydrous silicate (chlorite, lower left). Magnification 80x, long-axis FOV 1.4 mm, PPL, RL.





PETROGRAPHIC DESCRIPTIONS

A glossary of terms is appended

TURNSTONE **PETROGRAPHIC DESCRIPTION** **Status; CONFIDENTIAL**

Sample ; 1682B **Description ; 1830**
TGSL Project; 1995-25

Client/job ; Minfocus International, Toronto / "Midcontinent Rift".
Locality ; Northwestern Ontario - Area accessed from Highway 527, north of Thunder Bay, on the 'East Claims'.

Collection details; HS, in situ, the country rock hosting an invading pegmatitic to aplitic leucogranite body.

Format ; PTS - 31 μm - by Geoplastech Inc., Whitby, Ont
Hand specimen data; A dark bi schist with dark (?) amph standing proud on rusty weathered surfaces: strongly foliated crystal tuff (?). HS, 1 chip, 1 offcut. Not appreciably magnetic, no eff in dil HCl.

Major Minerals;
* Biotite- Strongly pleo brn mica flakes, notable for large numbers of small pleo haloes. Large flakes (≈12% of rock, mostly ≥1.5 mm in size, max gs 2.0x1.3 mm) occur in the same foliation as smaller flakes, generally <0.75 mm long (≈40% of rock). Uniaxial -ve figure. LS, str ext, bright 3rd-o int colours. 52%.
* Quartz- Granular qz, max gs 500x300 μm, generally <200 μm in dia. Mostly equant, unstrained, with few inclusions. 30%.
* Plagioclase feldspar and alteration products- Granular feld, max gs ≈250x100 μm, largely altered to vfgr, scaly aggregates of sericitic mica with bright int colours. 16%.

Minor and Accessory Minerals (2%);
* Sphene- Granular brn sphene, sometimes strongly pleo, max absorption normal to polarizer (c.f. bi) in pleo haloes in bi. Pale to medium grey and quite well polished in RL. Max gs 200x80 μm, very high relief and bir. 2%.
* Ilmenite- A 120x70 μm rounded grey relict grain encircled by granular, secondary sphene. Aniso, pale relative to the alteration rim, probably the Fe Ti oxide. Tr.
* Apatite- Colourless, high relief phase: 80x60 μm euh, isot, hexagonal section. Rare Tr.

Texture; Strongly foliated rock, fabric defined by oriented biotite flakes. The mica seems to occur in a bimodal size distribution, with coarse flakes entrained in the same fabric as the smaller, more abundant mica flakes. Both may contain pleochroic haloes. Some of the coarser mica may be cut by thin kink bands.

Summary; A foliated, micaceous (?) crystal tuff, apparently with two generations of biotite mica. The coarser grains are all biotite, without the amphibole which had been tentatively recognized in the hand specimen. Plausibly an airfall tuff / volcaniclastic sediment of intermediate to felsic composition, with abundant accessory Fe-Ti oxide, now altered to granular sphene.

Age; Late Archean
Petrography; GCW, Turnstone Geological Services Ltd, TO
Sep 3 1995

TURNSTONE **PETROGRAPHIC DESCRIPTION** **Status; CONFIDENTIAL**

Sample ; **1682C**

Description ; 1831
TGSL Project; 1995-25

Client/job ; Minfocus International, Toronto / "Midcontinent Rift".
Locality ; Northwestern Ontario - Area accessed from Highway 527, north of Thunder Bay. As 1682B.

Collection details; HS

Format ; PTS - 33 μm - by Geoplastech Inc., Whitby, Ont
Hand specimen data; Fine-grained (aplitic, saccharoidal) facies of pegmatitic to aplitic granitoid. Grey qz, white feld, silvery musc/zinn mica, scattered 1-mm red garnets. Sharp contact with host rock (not in PTS). HS, 1 chip, 1 offcut. Not appreciably magnetic, no eff in dil HCl.

Major Minerals;
* Plagioclase feldspar- Simple and albite twinned, M-L MEA 15° (range 13-15°, 5 determinations, RI<qz) => An_7 albite. Max gs 1.4x0.4 mm, variable ser plus kaol alteration. 70%.
* Quartz- Often quite strained. Variable gs, max gs 2.4x2.0 mm, anh, commonly coarser than plag. In a few of the larger grains, planes of partial recrystallization may be marked by dark lines of minute inclusions, including fluid inclusions up to 10 μm in dia. 18%.
* Muscovite- Musc/zinn 'white mica' flakes. LS, str ext, bright 3rd-o int colours. Max gs 1100x500 μm. In such rocks, Li-rich species such as lepidolite or zinnwaldite often occur. The silvery colour in HS rules out the former, but without analysis it is hard to demonstrate whether the mica is of a common musc composition or Li -enriched. 5%.

Minor and Accessory Minerals (7%);
* Garnet- May be zoned from a pinkish or orangey core to a colourless rim. Rounded, isot, often with cracks infilled by vfgr, brightly bir musc. Max gs 1100x800 μm. 4%.
* K-feldspar- Max gs 1.6x1.0 mm. Microcline with tartan twinning, sometimes turbid with a moderate kaol alteration. 3%.
* Goethite- Small colloform masses of secondary Fe oxide, max size 90x60 μm. Opaque to orange-red, with strong red internal reflections. Tr.

Texture; A fine-grained, massive leucogranite of allotriomorphic seriate to saccharoidal texture, speckled with coarser, anhedral quartz grains and rounded 1-mm-size garnet crystals in a fine, feldspathic groundmass.

Summary; An aplitic, garnetiferous leucogranite, colour index ≈4 percent, QAP mode ≈20-3-77 (in IUGS terms, a trondhjemite [leucotonalite]).

Age; Late Archean
Petrography; GCW, Turnstone Geological Services Ltd, TO
Sep 3, 1995

TURNSTONE **PETROGRAPHIC DESCRIPTION** **Status; CONFIDENTIAL**

Sample **; P-1** **Description ; 1832**
TGSL Project; 1995-25

Client/job ; Minfocus International, Toronto / "Midcontinent Rift".
Locality ; Northwestern Ontario - Area accessed from Highway 527, north of Thunder Bay. Collected by Peter MacMartin from leucogranitic granite-pegmatite outcrops on roadside north of claim area ('drive shaft locality').

Collection details; HS

Format ; PTS - 35 μm - by U. of T. DOG, Toronto, Ont
Hand specimen data; Pale, coarse to pegmatitic leucogranite, largely smokey qz, white feld and red to orange-red garnet plus minor biotite. Minor grn-yl (?) epidotization of feld. Minor red alteration on cracks. 3 HS, 1 sawn, with one chip and one offcut. Not appreciably magnetic, no eff in dil HCl.

Major Minerals;
* Quartz- Variable gs, often strained. Primary fluid inclusions, 2-10 μm in dia. Max gs 8.5x2.8 mm. 60%.
* Plagioclase feldspar- Low relief, colourless feldspar, thin albite twins, twin planes sometimes bent. Minor pericline twinning. M-L test MEA 12° (5 determinations, range 9-12°, RI<qz) => An_{10}, albite. Quite fresh, may be enclosed in qz, max gs 3.5x3.0 mm. Minor ser+kaol alteration. 24%.
* Garnet- Isot gar, high relief. Rounded, max gs 5.5x5.5 mm, many rounded inclusions of qz (generally not in optical continuity, as might have been expected if the gar were a late metamorphic overgrowth of magmatic qz and other phases). Minor included musc flakes. Fractured, pale pinkish, the cracks sometimes showing anomalous aniso behaviour. 7%.
* K-feldspar- Microcline, tartan twinning prominent. Minor ser+kaol alteration. RI<qz. Max gs 1.7x1.2 mm. 6%.

Minor and Accessory Minerals (3%);
* Sillimanite- Brownish sheaves of fibrous prisms, max size 2.5x0.4 mm, LS, str ext, $\delta \approx 0.020$, max int colour a 2nd-o bl. Assoc with / enclosed by musc. 1%.
* Muscovite- Colourless mica, high bir. Patches to 1.3x1.0 mm, enclosed by qz and plag and (?) undergoing replacement by sill. 1%.
* Biotite- Very dark brn, strongly pleo mica, max gs 2.8x0.5 mm. 1%.
* Fe oxide- Fracture-related limonitic oxide may be assoc with vfgr mica. Tr.
* Zircon- Irregular, 270x120 μm grain, very high relief, bright bir, LS, essentially str ext, pale pinkish-brn body colour. Rare Tr.

Texture; A coarse rock of granitic texture, subhedral to anhedral grains intergrown, lacking the coarsest (cm-scale) feldspar of the hand specimen. Patches of muscovite with sillimanite, up to 2.8x2.0 mm in section, display mica sheets in optical continuity, apparently replaced by fibrous sheaves of aluminosilicate. Ferromagnesian inclusions are conspicuously absent in the garnet: no clear evidence for replacement of a specific parent phase. Garnet, like quartz, feldspars, micas and accessory zircon, may be a magmatic phase.

Summary; Garnetiferous, pegmatitic leucogranite, estimated QAP mode ≈66-7-27, colour index ≈9 percent, a quartz-rich granitoid of granodioritic to tonalitic affinity. Notably high garnet content is arguably an 'S-type granitoid' signature indicative of appreciable crustal contamination of the felsic magma. Sillimanite may be an equally strong indicator of assimilation of metapelites encountered by the magma during its rise and emplacement.

Age; Late Archean
Petrography; GCW, Turnstone Geological Services Ltd, TO
Aug 29, 1995

TURNSTONE **PETROGRAPHIC DESCRIPTION** **Status; CONFIDENTIAL**

Sample **; P-1** **Description ; 1832**
TGSL Project; 1995-25

Client/job ; Minfocus International, Toronto / "Midcontinent Rift".
Locality ; Northwestern Ontario - Area accessed from Highway 527, north of Thunder Bay. Collected by Peter MacMartin from leucogranitic granite-pegmatite outcrops on roadside north of claim area ('drive shaft locality').

Collection details; HS

Format ; PTS - 35 μm - by U. of T. DOG, Toronto, Ont
Hand specimen data; Pale, coarse to pegmatitic leucogranite, largely smokey qz, white feld and red to orange-red garnet plus minor biotite. Minor grn-yl (?) epidotization of feld. Minor red alteration on cracks. 3 HS, 1 sawn, with one chip and one offcut. Not appreciably magnetic, no eff in dil HCl.

Major Minerals;
* Quartz- Variable gs, often strained. Primary fluid inclusions, 2-10 μm in dia. Max gs 8.5x2.8 mm. 60%.
* Plagioclase feldspar- Low relief, colourless feldspar, thin albite twins, twin planes sometimes bent. Minor pericline twinning. M-L test MEA 12° (5 determinations, range 9-12°, RI<qz) => An_{10}, albite. Quite fresh, may be enclosed in qz, max gs 3.5x3.0 mm. Minor ser+kaol alteration. 24%.
* Garnet- Isot gar, high relief. Rounded, max gs 5.5x5.5 mm, many rounded inclusions of qz (generally not in optical continuity, as might have been expected if the gar were a late metamorphic overgrowth of magmatic qz and other phases). Minor included musc flakes. Fractured, pale pinkish, the cracks sometimes showing anomalous aniso behaviour. 7%.
* K-feldspar- Microcline, tartan twinning prominent. Minor ser+kaol alteration. RI<qz. Max gs 1.7x1.2 mm. 6%.

Minor and Accessory Minerals (3%);
* Sillimanite- Brownish sheaves of fibrous prisms, max size 2.5x0.4 mm, LS, str ext, $\delta \approx 0.020$, max int colour a 2nd-o bl. Assoc with / enclosed by musc. 1%.
* Muscovite- Colourless mica, high bir. Patches to 1.3x1.0 mm, enclosed by qz and plag and (?) undergoing replacement by sill. 1%.
* Biotite- Very dark brn, strongly pleo mica, max gs 2.8x0.5 mm. 1%.
* Fe oxide- Fracture-related limonitic oxide may be assoc with vfgr mica. Tr.
* Zircon- Irregular, 270x120 μm grain, very high relief, bright bir, LS, essentially str ext, pale pinkish-brn body colour. Rare Tr.

Texture; A coarse rock of granitic texture, subhedral to anhedral grains intergrown, lacking the coarsest (cm-scale) feldspar of the hand specimen. Patches of muscovite with sillimanite, up to 2.8x2.0 mm in section, display mica sheets in optical continuity, apparently replaced by fibrous sheaves of aluminosilicate. Ferromagnesian inclusions are conspicuously absent in the garnet: no clear evidence for replacement of a specific parent phase. Garnet, like quartz, feldspars, micas and accessory zircon, may be a magmatic phase.

Summary; Garnetiferous, pegmatitic leucogranite, estimated QAP mode ≈66-7-27, colour index ≈9 percent, a quartz-rich granitoid of granodioritic to tonalitic affinity. Notably high garnet content is arguably an 'S-type granitoid' signature indicative of appreciable crustal contamination of the felsic magma. Sillimanite may be an equally strong indicator of assimilation of metapelites encountered by the magma during its rise and emplacement.

Age; Late Archean
Petrography; GCW, Turnstone Geological Services Ltd, TO
Aug 29, 1995

TURNSTONE **PETROGRAPHIC DESCRIPTION** **Status; CONFIDENTIAL**

Sample ; A-10 **Description ; 1833**
TGSL Project; 1995-25

Client/job ; Minfocus International, Toronto / "Midcontinent Rift".
Locality ; Northwestern Ontario - Area accessed from Highway 527, north of Thunder Bay. The 'West Claims'.

Collection details; HS

Format ; PTS - 29 μm - by U. of T. DOG, Toronto, Ont
Hand specimen data; A dark, fgr hb-bi schist cut by coarse, clear cm-scale qz veining (not in PTS). Traces of (?) gar, py and chl in wallrock near the veinlets. HS, 1 chip, 1 offcut. Not appreciably magnetic, no eff in dil HCl.

Major Minerals;
* Biotite mica- Many vfgr flakes of an intensely pleo brn mica, darkened by numerous tiny pleo haloes. Max gs ≈650x200 μm. LS, str ext, uniaxial -ve figure. The mica flakes have a mottled appearance at the ext position. The inclusions in the haloes are often invisible: they may include sphene, max gs 40x20 μm, the haloes up to 30 μm in radius. 65%.
* Plagioclase feldspar- Colourless, low relief, between mica flakes. Generally fresh, local vfgr sericitic alteration. A few grains display simple or albite twinning. Mostly equant, max gs 300x160 μm. 35%.

Minor and Accessory Minerals (Tr.);
* Andalusite (?)- In a dense band of oriented bi flakes, a thin lens is composed mostly of a colourless, prismatic phase, fairly high relief, max gs 250x60 μm, 1st-o orange int colour. LF, str ext, orientation suggestive of andalusite. Tr.
* Sphene- Granular brn translucent mineral, grey and of moderate refl in RL. May be elongated within cleavage planes in flakes of biotite. A secondary, rather pale metamorphic sphene. Tr.
* Apatite- Colourless, high relief, tiny squat prisms, max gs 70x35 μm, LF, str ext. Tr.
* Pyrite- Tiny sulphide blebs, max gs 8x5 μm. Rare Tr.

Texture; A strongly foliated, fine-grained biotite schist. Strong fabric defined by alignment of the mica flakes, sometimes in near-monomineralic bands up to 1.1 mm thick. Trace of prismatic (?) andalusite is entrained within the fabric.

Summary; Biotite schist. The section does not sample the quartz veining in the hand specimen, and (remarkably) the section appears free of quartz, hornblende, garnet and chlorite. Very simple mineralogy, colour index 65 percent, and very fine-grained, most crystals <500 μm in maximum dimension.

Age; Late Archean
Petrography; GCW, Turnstone Geological Services Ltd, TO
Sep 2, 1995

TURNSTONE **PETROGRAPHIC DESCRIPTION** **Status; CONFIDENTIAL**

Sample **; A-11** **Description ; 1834**
TGSL Project; 1995-25

Client/job ; Minfocus International, Toronto / "Midcontinent Rift".
Locality ; Northwestern Ontario - Area accessed from Highway 527, north of Thunder Bay. The 'West Claims'.

Collection details; HS, cobble of mafic float.

Format ; PTS - 30 μm - by U. of T. DOG, Toronto, Ont
Hand specimen data; Massive, holocrystalline mafic intrusive rock, greenish-black with orange weathering crust. Red (?) 'gar' on broken faces appears on sawn faces to be bright red goethite. HS, 2 chips, 1 offcut. Not appreciably magnetic, no eff in dil HCl. A coarse diabase with intergrown feld + px.

Major Minerals;
* Plagioclase feldspar- Variable sericitization, some laths clear, others thoroughly altered to vfgr micaceous masses. Simple and albite twinning. Elongate, simple-twinned and mostly fresh laths are the main plag habit enclosed by cpx, max gs 2.0x0.3 mm. Beyond the cpx, plag is generally more equant, max gs 800x700 μm, and more pervasively sericitized. 58%.
* Actinolite- Grn to bl-grn to colourless pleo, alteration product of cpx, may be simple twinned like the cpx. Max gs 1.8x1.6 mm, turbid relative to precursor cpx, may contain small bi flakes. 22%.
* Clinopyroxene- Pale brownish to colourless cpx, clear, fairly high relief, bright 2nd-o int colours, highly incl ext, max gs 4.2x1.2 mm. Biaxial +ve figure, 2V≈60°, on grain with px cleavage traces (≈90°) and 1st-o grey int colour. 13%.

Minor and Accessory Minerals (7%);
* Fe-Ti oxides- Largely brn-grey aniso ilmenite. Angular, max gs 500x300 μm. EPM confirms ilm, and also Ti magnetite ± Ti hematite (*oxide totals ≈100, 95, 90+% respectively, see Table 2*). 4%.
* Olivine and alteration products- Extensive alteration to yl-brn iddingsite. Max gs 600x350 μm, mostly the rich brn iddingsite with high bir visible through the strong body colour. Fresh grains with bright int colours, max gs 350x200 μm. 3%.
* Pyrite- Pale yl sulphide, largely in a 1200x300 μm granular aggregate, partly swathed by act. Tr.
* Biotite- Small flakes in secondary amph, strong brn-colourless pleo, max gs 150x120 μm. Tr.
* Chalcopyrite- Fgr yl sulphide. Tr.
* Goethite- Red internal reflections, may be translucent. Bl-grey in RL, unlike paler, brownish-grey ilm. Tr.

Texture; Massive, holocrystalline intrusive rock. Subophitic to ophitic texture, with some plagioclase laths partly or wholly enclosed within larger crystals of clinopyroxene. Moderate alteration (sericitization and uralitization) leaving fresh grains of all primary phases.

Summary; A relatively coarse diabase, with subophitic to ophitic texture and appreciable sericitization of tabular plagioclase laths. Colour index ≈42 percent, with minor ilmenite and olivine. In hand specimen terms, this dense sample, with a rugose, orange-brown weathering rind, is typical of much of the rounded mafic float cobbles seen throughout the area.

Age; Proterozoic (?)
Petrography; GCW, Turnstone Geological Services Ltd, TO
Sep 3, 1995

TURNSTONE **PETROGRAPHIC DESCRIPTION** **Status; CONFIDENTIAL**

Sample **; 1690** **Description ; 1835**
TGSL Project; 1995-25

Client/job ; Minfocus International, Toronto / "Midcontinent Rift".
Locality ; Northwestern Ontario - Area accessed from Highway 527, north of Thunder Bay. On east side of Hwy 527, at north end of Walkinshaw Lake, near southeast corner of the '95-2 Claims'.

Collection details; HS

Format ; PTS - 33 μm - by Geoplastech Inc., Whitby, Ont
Hand specimen data; A (?) hb crystal tuff, fgr dark bi schist, speckled with dark crystals on both sawn and ironstained, weathered faces. Cut by two sets of thin bluish-grey (?) feld±qz-dominated veinlets. 1 large HS, 1 chip, 1 offcut. Not appreciably magnetic, no eff in dil HCl.

Major Minerals;
* Biotite- Mostly small flakes of strongly pleo dark brn to colourless mica. A few flakes are relatively cgr, max gs 600x200 μm. LS, str ext. 45%.
* Quartz- Fgr granular qz. Mostly equant, unstrained, <250 μm in size. A minor volume of coarser, somewhat strained grains occur in thin qz veinlets and late granitoid veining, max gs 1000x700 μm to 450x250 μm. 30%.
* Sericitic alteration after plagioclase- Vfgr scaly aggregates with bright int colours, after plag, max size of these patches is at least 1.5x1.0 mm. Anh, with inclusions of qz, bi, epi and hb. Individual mica flakes 5-20 μm in size. 17%.

Minor and Accessory Minerals (8%);
* Epidote after plagioclase- Granular epi, high relief and bright bir. A few prisms, max gs 80x20 μm, LF, str ext. 3%.
* Actinolitic hornblende- Deep grn to bl-grn pleo amph, max gs 700x250 μm. Symm ext on basal sections. 3%.
* Pyrite- Pale yl sulphide, high refl, max gs 220x80 μm, a few of the grains subh-euh (with square outlines). 2%.
* Pyrrhotite- Aniso, brn sulphide, max gs 550x150 μm, ± chalc. Smaller pyrr grains may be plated onto py, max gs 100x60 μm. Tr.
* Sphene- Pale brn, high relief, extreme bir, max gs 300x150 μm, in dark pleo halo in bi mica. Tr.
* Chalcopyrite- On edge of pyrr, yl sulphide, max gs 80x30 μm. Tr.

Texture; The coarsest biotite and hornblende flakes and grains, ~500-750 μm in length, are aligned with the strong foliation defined by innumerable smaller mica flakes. Two sets of cross-cutting, quartz-rich lenses and veinlets lie at low angles to the fabric: the wider set offsets the thinner. The early, thin set is quartz veining: the later, wider set contains quartz, sericitized feldspar and mica, with the overall composition of a biotite granite.

Summary; As in the case of sample 1682B, the origin of the coarser grains of ferromagnesian minerals is central to the evolution of the whole rock. A similar origin (foliated micaceous crystal tuff) seems plausible for samples 1682B and 1690.

Age; Late Archean
Petrography; GCW, Turnstone Geological Services Ltd, TO
Sep 3, 1995

TURNSTONE **PETROGRAPHIC DESCRIPTION** **Status; CONFIDENTIAL**

Sample ; **1687** **Description ; 1836**
TGSL Project; 1995-25

Client/job ; Minfocus International, Toronto / "Midcontinent Rift".
Locality ; Northwestern Ontario - Area accessed from Highway 527, north of Thunder Bay. The Lac des Iles Pd-Pt-Au-Ni-Cu -(Co-Rh) mine.

Collection details; HS

Format ; PTS - 32 μm - by Geoplastech Inc., Whitby, Ont
Hand specimen data; Dark massive pyroxenite or melagabbro with 1-2% disseminated sulphides (pyrr, py and chalc), gs 1-7 mm. HS, 1 offcut. Sulphides may be strongly magnetic, no eff in dil HCl.

Major Minerals;
* Clinopyroxene and alteration products- Pale cpx, highly incl ext, often with 2nd-o int colours. Max gs 6.6x2.4 mm. Often (like opx) partly altered to a vfgr, highly bir sheet silicate. There is also minor (≈5%) patchy alteration to pale bl-grn to colourless pleo amph of actinolitic composition. 75%.
* Plagioclase feldspar and alteration products- Commonly albite-twinned, twin planes often deformed: also displays simple and pericline twin laws. Max gs 3.5x2.8 mm, with strained, fragmented margins. More often as smaller, tabular laths interstitial to px grains, max dimension commonly ≤1 mm. Quite fresh, minor kaol alteration, fractures infilled by chl. M-L MEA 33° (wide range, 20-33°, 7 determinations) =>An_{59}, labradorite. 14%.
* Orthopyroxene and alteration products- Max gs at least 4.0x2.6 mm, max int colour is 1st-o yl-or. Str ext on cleavage traces. Commonly partially altered to a vfgr, talc-like sheet silicate. 6%.

Minor and Accessory Minerals (5%);
* Chlorite- Grn to colourless pleo, max absorption parallel to polarizer, the only strongly coloured mineral. LF, str ext. Chl variety ripidolite. Irregular patches to at least 3.0x1.2 mm. 3%.
* Pyrrhotite- Well-polished sulphide, max dia 650 μm, in anh, pyrr-rich masses of sulphides up to 4.5x1.0 mm. 2%.
* Chalcopyrite- Late yl sulphide, max gs 600x300 μm, in subh masses. Abundant Tr.
* Pyrite- Small inclusions in pyrr, max gs 220x180 μm. Tr.
* Magnetite- Isot grey Fe oxide grains, max gs 1100x400 μm. May be plated by pyrr and chalc. Sometimes cracked, the fractures lined by chalc. Tr.
* Biotite- Assoc with chl, minor secondary bi, medium brn to colourless pleo, max absorption parallel to polarizer, max size ≈600x150 μm. Tr.

Texture; Massive mafic intrusive rock with minor cores of orthopyroxene mantled by abundant, coarse (often ≈5 mm) clinopyroxene, interstices largely filled by smaller plagioclase laths and disseminated magmatic sulphides. The accessory oxide is often mantled by sulphide. Sulphides are often intergrown with the late, dark sheet silicate, chlorite.

Summary; A sulphidic, orthopyroxene-bearing melagabbro, colour index 86 percent.

Age; Late Archean
Petrography; GCW, Turnstone Geological Services Ltd, TO
Sep 4, 1995

TURNSTONE **PETROGRAPHIC DESCRIPTION** **Status; CONFIDENTIAL**

Sample **; 1688** **Description ; 1837**
TGSL Project; 1995-25

Client/job ; Minfocus International, Toronto / "Midcontinent Rift".
Locality ; Northwestern Ontario - Area accessed from Highway 527, north of Thunder Bay. The Lac des Iles Pd-Pt-Au-Ni-Cu -(Co-Rh) mine.

Collection details; HS

Format ; PTS - 30 μm - by Geoplastech Inc., Whitby, Ont
Hand specimen data; An attractive speckled grey leucogabbro, mostly pale grey feld and black cpx, gs 2-4 mm, with trace sulphides (disseminated py), cut by a thin fracture coloured by yl-grn epidote, colour index ≈35%. HS, 1 offcut. Not appreciably magnetic, no eff in dil HCl.

Major Minerals;
* Plagioclase feldspar and alteration products- Often albite-twinned. Patchy, locally intense sheet silicate alteration, to kaol plus lesser ser. Minor epi alteration. May contain tiny blebs of sulphide (chalc). M-L MEA 36° (range 18-36°, 4 determinations) => An_{64}, labradorite. A combined Carlsbad-albite twin in suitable orientation yields EAs of 20+33°, also => An_{64}. Max gs 4.2x2.8 mm. 67%.
* Actinolite- Pale grn to colourless pleo pseudomorphs after px. Max gs at least 3.0x3.0 mm, composed of thin domains of secondary amph, incl ext, bright 2nd-o int colours. 30%.

Minor and Accessory Minerals (3%);
* Chlorite- Very pale grn flaky masses of secondary chl. Greenish in XP, LF, str ext, chl variety ripidolite. Anh patches to at least 2.5x0.6 mm, may enclose granules of epi, also infills fractures in plag. 2%.
* Epidote- Granular, high relief, pale yl body colour, brilliant int colours. Max gs 750x500 μm, may be simple-twinned. Str ext, (?) LF. 1%.
* Pyrite- Irregular pale yl sulphide, variable gs, max gs 500x350 μm. Round, isot masses may display a parting. The largest lie in pale amph pseudomorphs after px. Abundant Tr.
* Chalcopyrite- A vfgr sulphide, separate from py, max gs ≈20x10 μm. Tr.

Texture; Massive, equigranular leucogabbro, composed largely of strongly uralitized pyroxene and partly altered labradorite. The feldspar may be altered preferentially along albite twin planes and cross-cutting fractures. Accessory sulphide (largely pyrite) is found as fine-grained disseminations. Late silicate alteration products include chlorite and epidote.

Summary; A pyrite-bearing, uralitized, equigranular leucogabbro, colour index ≈33 percent. Undoubtedly a waste rock, whereas melagabbro 1687 appears likely to be of Cu-Ni±PGE±Au ore grade.

Age; Late Archean
Petrography; GCW, Turnstone Geological Services Ltd, TO
Sep 4, 1995

GLOSSARY OF ABBREVIATIONS USED IN PETROGRAPHIC DESCRIPTIONS

By **Graham C. Wilson,**
Turnstone Geological Services Ltd,
Box 130, Station "B", Toronto,
Ontario, CANADA M5T 2T3
Telephone (416)-466-3386

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The following are often obvious, but for the record all regular abbreviations are given below, with some additional notes on procedures. This system has been evolved for detailed, standardised descriptions, in both handwritten and database formats. This version of the glossary is intended for use with Turnstone numbered descriptions, #401 onwards. Summaries of all descriptions (>1,650) are stored in the **PETSUM** database, and complete descriptions (#976 on) are now created in the **PETDAT** database. In this later work, textural and summary sections are written 'in full', but shorthand forms are generally retained for detailed information on each mineral.

An earlier (1986), Spanish-annotated edition of this glossary is available: two relevant works in Spanish are: Anon (1981), Williams *et al.* (1968). Specifics of unusual rock names and mineralogy may be clarified in references cited in individual descriptions. Plutonic rock nomenclature generally follows the modal classification of Streckeisen (1976), summarized in Hyndman (1972, pp.31-41). See also Le Maitre *et al.* (1989) and Sharma (1992).

Colour

bl	blue
brn	brown
grn	green
or	orange
yl	yellow

General

anh	anhedral
assoc	associated
balsam	mounting medium: balsam or glue of similar RI.
DDH	diamond drill hole (drill core samples). Sizes: X-Ray (19.0 mm, 0.75"), A (27.0 mm, 1.06"), B (36.5 mm, 1.44"), N (47.6 mm, 1.87"), and H9 (63.5 mm, 2.50") / HQ (63.0 mm, 2.48").
dia	diameter
EDS	energy-dispersive spectrometry (of EPM)
eff in HCl	effervescence in (cold) dilute (10%) hydrochloric acid
EPM	electron microprobe analysis
esp	especially
euh	euhedral
HS	hand specimen
magnetism	magnetic samples, rich in ore minerals such as mag and magnetic pyrr, identified in HS descriptions. High concentrations of these phases yield an extremely magnetic sample, in which an offcut slice (say 45x25x5 mm) of the rock can be lifted with a small magnet.
max/min	maximum/minimum

PGE	Platinum Group Elements (Os, Ir, Ru, Rh, Pt and Pd)
PGM	Platinum Group Minerals (major proportions of one or more PGE)
rel	relatively (or 'relief': discontinued)
staining	K-feld staining involves the HF-sodium cobaltinitrate test (Sclar and Fahey, 1972; Hayes and Klugman, 1959), leaving a bright yellow stain on the feldspar. For carbonate staining a variety of methods can distinguish, e.g., calcite, dolomite, ankerite and magnesite, the most important carbonates to identify when outlining gold-related alteration assemblages. See Friedman (1959), and Hutchison (1974).
symm	symmetric(ally)
tr	trace
WDS	wavelength-dispersive spectrometry (of EPM)

Grainsize

dia	diameter
gs	grain size - NB: section orientation influences apparent size of tabular and acicular minerals (e.g., micas and tourmalines respectively).
...fgr	fine-grained
...mgr	medium-grained
...(v)cgr	(very) coarse-grained
mm	1 mm=0.03937 inch
µm	1 micron=0.001 mm

Minerals (74 species and groups of minerals: see also Fleischer and Mandarino, 1991)

ab	albite	
act	actinolite	
amph	amphibole	
an	anorthite	
and	andradite	- Ca-Fe garnet, in context
anth	anthophyllite	
ap	apatite	
asp	arsenopyrite	
aug	augite	
bi	biotite	
cal	calcite	
carb	carbonate	
chalc	chalcopyrite	
chl	chlorite	
chr	chromite	
clzo	clinozoisite	
cord	cordierite	
cpx	clinopyroxene	
ctoid	chloritoid	
cumm	cummingtonite	
di	diopside	- Mg-Ca cpx
dol	dolomite	
en	enstatite	
epi	epidote	
fa	fayalite	- Fe oliv
fo	forsterite	- Mg oliv

foid	feldspathoid	- sodalite, nepheline, etc
fstilp	ferrostilpnomelane	
gal	galena	
gar	garnet	- common end-members include pyrope, almandine, spessartine, uvarovite, grossularite and andradite
go	goethite	
gro	grossularite	- Al-Ca garnet
grp	graphite	
hb	hornblende	
hed	hedenbergite	- Fe-Ca cpx
hem	hematite	
hyp	hypersthene	
ilm	ilmenite	
joh	johannsenite	- Mn cpx
kaol	kaolinite	
K-feld	alkali feldspars	- Kfeld: orthoclase, microcline, perthite, sanidine
ky	kyanite	
lim	limonite	
ma	marialite	- sodic scapolite (δ=0.009)
mag	magnetite	
marc	marcasite	
me	meionite	- calcic scapolite (δ=0.036)
moly	molybdenite	
musc	muscovite	
neph	nepheline	
of	orthoferrosilite	- pyroxene Fe-rich endmember
oliv	olivine	
opx	orthopyroxene	
pent	pentlandite	
phlog	phlogopite	
plag	plagioclase feldspar	
px	pyroxene	
py	pyrite	
pyrr	pyrrhotite	
qz	quartz	
rieb	riebeckite	
rut	rutile	
ser	sericite	
serp	serpentine	
sill	sillimanite	
sphal	sphalerite	
sphen	sphene	- more properly, titanite
staur	staurolite	
stilp	stilpnomelane	
tour	tourmaline	- common varieties are schorl, dravite and elbaite
ves	vesuvianite	- alias idocrase
woll	wollastonite	- (in abbreviated formulae of pyroxenes, 'Wo', e.g., $En_{75}Of_{10}Wo_{15}$)
zir	zircon	
zo	zoisite	

Miscellaneous

C-A	Carlsbad-Albite twinning in plagioclase
QAM	Quartz- Ankerite- Mariposite rock (distinctive green alteration assemblage, as in the Mother Lode: also known as 'listwanite')
QAP	Quartz - Alkali-feldspar - Plagioclase estimated modes in a rock, normalized to 100% (see Streckeisen, 1976).
QFP	Quartz-Feldspar-Porphyry

Mode

A rough visual estimate. Accessory phases <1% are annotated 'Tr.' (trace): subdivisions are 'Abundant tr.' and 'Rare tr.'. An attempt is made to counteract the common tendency to overestimate the frequency of the dark phases. Minerals are described in order of decreasing modal abundance.

Optical Properties

aniso	anisotropic/anisotropy
bir	birefringence - relative retardation is often written in shorthand, e.g., 1st-o yl = first-order yellow. The maximum birefringence is estimated from the thickness (calculated from colours of dependable minerals, such as quartz) and the highest colours seen in the section.
birl	bireflectance
ext	extinction. May be 'str' (straight, parallel to length) or 'clean', meaning that the whole grain goes dark at once, c.f. strained quartz.
int	interference
LF/LS	orientation: length fast/slow
MEA	Maximum Extinction Angle (degrees) in the Michel-Levy test of plagioclase composition. Where possible, at least six suitable grains are used. MEA is also used for other minerals. For intermediate -calcic plagioclase, note that the M-L test often gives results which are rather more sodic than the the actual composition, as determined by either the Carslbad-Albite (C-A) test or by EPM (seldom noted, but see Finn, 1981). If both are available, a C-A number is generally preferred to a M-L value. In the case of albite and oligoclase below An_{20}, unless a perfectly oriented section is found, the estimate may be too calcic. This is unlikely to be a major obstacle in interpretation, although in one case plag estimated at An_8 (M-L test) and An_5 (C-A test) was found by EPM to be An_1, nearly pure albite.
PH	polishing hardness: see Uytenbogaardt and Burke (1971, pp.17-21)
Pleo	pleochroism
PPL	plane polarized light
refl	reflectance
RI	refractive index
RL	reflected light
'RL'	obliquely-incident light, sometimes employed on CTS
ST	sensitive tint plate (orientation and optic sign work)
TL	transmitted light
XP	cross-polarized light: usually with exact alignments of polarizer and analyser. In RL one is often offset (rotated) a few degrees in order to emphasise anisotropy / bireflectance. Some properties (pleochroism and relief), are described relative to the orientation of the polarizer (the 'vibration plane of the lower nicol' is equivalent to the polarizer).

Ore Microscopy

For optical properties in reflected light see Craig and Vaughan (1981) or Spry and Gedlinske (1987), which each contain descriptions of about 100 opaque minerals. Properties such as scratch and polishing hardness, bireflectance and reflection pleochroism are also briefly discussed (Craig and Vaughan, 1981, pp.36-43). Descriptions of ore minerals are also listed in Uytenbogaardt and Burke (1971), Ineson (1989) and the classic work of Ramdohr (1980).

Photomicrographs and Figures

Colour	Photomicrographs are made by either (a) using daylight- balanced colour film and a blue filter, or (b)using film balanced for tungsten lighting, without a blue filter. Photos taken in RL may thus have bluish-grey backgrounds (method (a)) or brownish backgrounds (method (b), mostly in early descriptions). Intermediate colour renditions can also be achieved with daylight film, and no blue filter. Slide film is used for maximum flexibility and quality control: 2-3 (or more) slides are taken per subject due to high rejection rates.
FOV	Field of view in mm (long axis of photo): the primary scale indicator, as magnification (for a given FOV) is dependent on equipment used. FOV is approximate: prints often show only 95% of so of the FOV on the original slide. Quoted FOV may sometimes be reduced from that of the original by extra enlargement and/or cropping of the print.

Sample Format

CTS	covered thin section, nominal thickness 30 μm.
(D)PTS(C)	(doubly-) polished thin section (C=> circular, in 25 mm diameter form for microprobe work: some rectangular PTS are also microprobe-compatible). Used in reflected light study. For high -current ion beam analyses, such glass-backed mounts have been prepared with a thickness of about 500 μm or more: 'ThPTS(C)', now generally supplanted by the PRS methods noted below.
PM	polished mount, for reflected light microscopy, also microprobe-compatible unless qualified. Generally circular, $\approx$10 mm thick.
PRS	polished rock slice, often an offcut of PTS preparation (see below).
Thickness	of CTS and PTS, gauged by interference colour of quartz or other phases. Excludes the slide margins, which commonly taper somewhat.

Sections (including the glass backing slide) are $\approx$1 mm thick: normal CTS and PTS are 46x27 mm in plan. Large sections (75x50 mm) are especially useful for structural geology, often with oriented samples. In the case of PM ('ore mounts') it is probably better to prepare smaller mounts than the older samples commonly found in teaching and museum collections. While some of these (e.g., 30 mm wide and 18 mm deep) may fit into electron microscope sample chambers, maximum compatibility with microprobe systems is achieved with circular mounts 25 mm wide and (say) 10 mm thick. Modern PM are mostly 25 mm in diameter, but larger (40 mm) PM may be useful for examining large volumes of mill products. Most of the volume is usually the epoxy mounting medium: the sample can be a few sub-mm grains, mm-scale flakes or drill chips, or a rock slice up to 25 mm wide and a few mm thick.

Special Formats include grain mounts, which typically contain 20 or more mineral grains or metal shards. These are used especially for EPM of diamond indicator minerals such as garnets (the PM format can also be used for this purpose). A novel type of mount is a polished offcut (PRS), ideally the complement of a prepared PTS, used in Accelerator Mass Spectrometry for ultra-trace element analysis (e.g., detection levels of parts per billion for gold and PGE). In this technique, 'minicores' 4 mm in diameter are often drilled from a number of PRS, and mounted in sets of 12 within a 25-mm aluminium mount, suitable for a full range of in-situ microanalytical techniques.

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A STUDY OF HEAVY MINERAL FRACTIONS IN THE NIPIGON PLATE REGION OF NORTHWESTERN ONTARIO

On behalf of
Minfocus International Inc.,
Suite 707 - 1243 Islington Avenue,
Toronto, Ontario
Canada M8X 1Y9

Attn.: Dr Gerald Harper
Tel (416)-232-9114
Fax (416)-232-9120

By
Graham C. Wilson, PhD, FGAC
Turnstone Geological Services Ltd.
P.O. Box 130, Station "B", Toronto
Ontario CANADA M5T 2T3
(416)-466-3386

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ABSTRACT

A suite of till, river gravel and outwash samples collected in the target area (Wilson, 1993) has been processed and scanned for kimberlitic indicator minerals. The project appears timely, as junior firms such as Indicator Minerals and Rhonda are searching in southeast Manitoba, encouraged by reports that De Beers has discovered 2 or 3 kimberlites across the border in Minnesota, USA (Kryzanowski, 1994). Also, other claims have been staked in the target region in 1995. Nine samples were divided into four separates (medium-grained light and heavy and fine-grained light and heavy, Table 1) and examined under a binocular microscope, picking interesting grains for subsequent electron microprobe analysis. As a 'control', light and heavy separates were prepared from a sample of the Lake Ellen (Michigan) kimberlite, collected by the writer in 1994. The Michigan kimberlite is very rich in red and orange garnets and ilmenite. The fine heavy fractions ($\approx$250-1000 μm, plus a few obvious grains $\leq$1500 μm) proved the most efficient sampling medium, in terms of abundance of relevant heavy minerals.

Heavy minerals found in 36 separates from the target area were provisionally identified by their appearance as pink to (rarely) red and also orange garnets, staurolite, zircon and ilmenite, plus dark pyroxenes, olivine and magnetite (presumably from local mafic-ultramafic inclusions). Also noted were traces of pink (?) spodumene and pale greenish (?) diopside and beryl. To date, the presence of the underlined minerals has been confirmed by microprobe analysis.

In general, it is reasonable to infer that most of the garnets are of regional metamorphic origin, with augitic pyroxenes derived from mafic intrusions and diopside (?) from skarns. These identities are consistent with some of the associated lithic fragments, described in Table 2. The nature of these grains is important for further work in the region, as some garnets and ilmenites are diamond indicator minerals. A suite of grains was mounted, polished, and analysed by electron microprobe using a rapid 8-element protocol. This method omits sodium, but is efficient and produces good analyses for mineral characterization. The results (Table 3) include a range of good-quality analyses of garnets, pyroxenes and Fe-Ti oxides. The occurrence of metamorphic (probably metapelite) garnets of almandine-dominant and less- abundant spessartine-rich (pegmatitic?) compositions is notable. So are the grains of Ti-magnetite with exsolved Mn-poor ilmenite, possibly of gabbroic intrusive provenance. One olivine grain of intermediate composition was analysed. Plagioclase feldspar is generally of intermediate composition: semi-quantitative analyses suggest a range from oligoclase through andesine to sodic labradorite. Apatite was found as one discrete grain, and as an inclusion in a plagioclase-oxide intergrowth. Associated phases include quartz and biotite, often as blebs in the almandines, consistent with metapelite origins. Clinopyroxene grains are mostly augitic, ranging from diopside to augite to ferroaugite. These preliminary data are interpreted to confirm a hinterland containing both greenschist to amphibolite facies supracrustal rocks, as well as plutonic bodies of probable granitic to gabbroic compositions. No clear indicators for either alkaline (kimberlite- lamproite-lamprophyre) nor peraluminous pegmatitic suites have been identified so far.

N.B. Every effort has been made to provide an objective appraisal of the sample suite. This is a technical report, not a prospectus, yet for completeness the author would like to disclose a material interest in the project at hand.

METHODOLOGY OF SAMPLE PROCESSING

Nine samples were split into 4 fractions (respectively, 'lights' and 'heavies' of fine- and medium seived portions, the coarse fraction having been logged and discarded at the collection sites; Wilson, 1993). Light and heavy separates were made of a sample from the Lake Ellen kimberlite in Michigan, as a control, for a total of 38 sub-samples. The heavy liquid employed was methylene iodide ("MI"). For reference, a table of specific gravities is given below:

Mineral / rock / compound	*S.G.*
Common indicator minerals and components: (range 3.20-5.00)	
Diopside	3.20-3.38
Diamond	3.52
Pyrope	3.70
Almandine	3.90-4.20
Chromite	4.50-4.80
Ilmenite	4.50-5.00
Other phases: (range 2.50-5.18)	
Serpentine	2.50-2.60
Microcline K-feldspar	2.56
Plagioclase, An_{0-10} (albite)	2.60-2.62
Quartz	2.65
Plagioclase, An_{50-70} (labradorite)	2.67
Biotite	2.70-3.10
Tourmaline	2.98-3.20
Hornblende	3.00-3.47
Olivine, Fo_{100} (forsterite)	3.20
Augite	3.20-3.50
Olivine, Fo_{90} (calc.)	3.31
Staurolite	3.70
Olivine, Fo_{0} (fayalite)	4.30
Zircon	4.70
Pyrite	4.80-5.10
Magnetite	5.18
Rocks, Compounds:	
Methylene iodide (di-iodo methane)	3.325
Metabasites	3.06-3.10

The grains were sorted in a petri dish, internal diameter 13.7 cm. A metal probe and a pair of fine-tipped tweezers proved adequate for grain sorting. The zoom binocular microscope employed for the task, a Wild Leitz M7 S, was mostly used at the lowest magnification. Fields of view for the instrument are:

Magnification	*Field (mm)*
6	34
10	21
12	17
20	11
31	6.5

Grains considered representative of either (a) indicator minerals or (b) selected metamorphic and igneous heavy minerals were mounted on glass slides for polishing. The second group include grains which are either of intrinsic interest or which appear similar to kimberlitic phases.

A NOTE ON INDICATOR MINERALS

The catalyst for the exploration program was the perceived opportunity for kimberlite occurrences in a hitherto unexplored terrain. The core of the North American continent is one of the cratons underlain by Archean basement ('archons') to which kimberlitic primary diamond deposits of economic size appear to be restricted (Fig. 1). The examination of fractions of the $\approx$200 kg of sand and gravel samples collected in late 1993 (Wilson, 1993; Table 1) permits a refined appraisal of the provenance of surficial deposits in the area.

The findings have implications for continued exploration in the region. Picking representative heavy minerals from whole samples generally takes about 10 minutes for light samples, 25-30 minutes for heavies. A more or less quantitative separation of indicator mineral and other phases is much more labour intensive, and can easily take 90 minutes, including weighing the separated fractions. The first generalization of the distribution of garnets and other interstsing phases is that the majority occur in the heavies, as might be expected; indeed, a "fast-track" appraisal might be conducted using the fine heavies alone. This observation echoes an interesting appraisal of indicators around the Kirkland Lake district;

> A recent study of the C14 and Diamond Lake kimberlite pipes in the Kirkland Lake area of Ontario, Canada (Averill and McLenaghan, 1994) is quite instructive. That area contains green crustal andradite-uvarovite garnet and low-Cr diopside. The garnets can be distinguished from kimberlitic Cr diopside by their cloudy appearance, microcolloform texture and presence of platy serpentine intergrowths. Low-Cr diopside is harder to separate from the kimberlitic mineral - each kg of kimberlite may have yielded as many as 5000 Cr diopside fragments to the ice. <1% of the Cr pyrope fragments are larger than 1 mm: *economical exploration may be conducted using only the <1 mm fraction*. The small Cr pyropes are angular, with fresh conchoidally fractured surfaces more abundant than rounded, resorbed faces with kelyphitic rims - most of the soft kelyphite is removed in the first few hundred m, but subkelyphite matte and orange peel textures may survive over 10 km of transport. A caveat on colour sorting of garnets is that red-purple garnets may change to blue-purple during glacial transport. Only picroilmenite, which occurs as larger grains, has appreciably fragmented in transport - leucoxene coatings are removed in a few hundred m, but resorption features are well preserved.

Eskers may provide mineral trains which are quite narrow, no more than 2-3 km wide, yet tens of km in length (Beaumier *et al.*, 1993). In this study from Quebec, sampling involved the collection of large (≈60 kg) samples, prepared by sieving, the use of jigs, magnetic separation, heavy liquids (methylene iodide) and a Frantz separator, searching for chromite and pyrope garnet, Cr diopside and Mg ilmenite, olivine and zircon. Green and mauve garnets were found.

Low indicator mineral counts do not necessarily mean the absence of subjacent kimberlites, depending on local geometric factors such as the depth of drift above bedrock.

> A recent heavy mineral survey for kimberlite indicator minerals in the Michipicoten River- Wawa area (Morris *et al.*, 1994) involved collection of 250 alluvium samples, each weighing at least 10 kg, screened to exclude pebbles >10 mm in size. 4 G10 garnets and 4 Cr-rich chromites were recovered and identified. 37 G9 garnets and 9 Cr diopside grains were also found in the region, where 2-3 diamonds have recently been discovered, probably in a point bar in the Dead River.

The nine samples from the project area yield contrasting mineral assemblages (Table 2). Potential indicator minerals plus a number of other heavy minerals in the samples are outlined in **bold** type. Representative grains were electron probed for positive identification and to produce a database of 'real' and 'fake' indicator mineral compositions in the target area. In summary, a range of garnet, pyroxene, oxide and plagioclase compositions were estimated by electron microprobe (below, Table 3), and the identities of other grains and inclusions (apatite, olivine, quartz) were confirmed. The 1926-g sample from Lake Ellen, as one might expect, yielded an interesting range of red and orange garnets, some of which were analysed as part of this study. A Lake Ellen synopsis will be presented elsewhere (Wilson, 1994, revised version).

ELECTRON MICROPROBE WORK

A recent study using the OGS Cameca SX-50 (Morris *et al.*, 1994) employed a 2-5 μm electron beam (15 kV, 20 nA) for analysis of Na, Mg, Al, Si, Cr, Mn, Fe, Ni, K, Ca, Ti and Nb. They quote detection limits of 110 ppm Na_2O, 350 ppm Cr_2O_3 and 210 ppm TiO_2 in garnet, 260 ppm MgO in chromite, and 240 ppm MgO and 540 ppm MnO in ilmenite, comparable to results from a similar machine at the University of Toronto, employed in the present study.

A total of 61 analyses were carried out on grains of interest, plus 4 analyses of a pyrope garnet standard. As an economy measure, a pared-down suite of eight elements (Mg, Fe, Al, Si, Ti, Mn, Cr and Ca) was analysed with 3 wavelength-dispersive spectrometers, permitting quantitative analysis of garnets, pyroxenes and oxides and semiquantitative analysis and identification of other mineral species. Grains are commonly identified by inspection of energy-dispersive spectra (Fig. 2). 25 analyses were made of the 20 coarse grains, and 36 more points were analysed on 33 of the 49 fine grains on the second polished mount. The 15 keV electron beam was rastered over a 15x15 μm area on each grain. Reduced peak count times of 10-20 s per element enabled the time per analysis (exclusive of system set-up, calibration and point selection!) to be limited to 2 minutes. High-quality analyses are presented for garnet (Table 3A) and other phases (Table 3B). A technical problem reduced the quality of the data later in the run: these results are preserved in a database, and serve for mineral identification, but are not listed here. Notes on all 65 analyses (41 on garnet, 24 on other phases), with brief descriptions and chemical identifications, are listed in Table 3C. The a-series of samples are on the relatively coarse "medium" fraction grain mount, the b-series on the "fine" mount.

A NOTE ON THE REGIONAL GEOLOGY

Details of the initial targets may be found in Wilson (1993). The immediate Archean bedrock lies within the Archean metasediment-rich Quetico subprovince, but nearby to the east lie the volcanics and sediments (including distinctive Sibley sandstones) of the Proterozoic Nipigon plate (embayment), and to the north outcrops the 900-km-long Wabigoon subprovince, running eastwards from Kenora to Geraldton. The Wabigoon is an Archean granite-greenstone subprovince incorporating a diversity of lithologies, including metavolcanics, pyroclastics and metasediments (tholeiite, komatiite, hyaloclastite, metapelite, conglomerate, BIF, etc; Blackburn *et al.*, 1991). There are internal granitoids (batholiths of tonalite, trondhjemite, granodiorite, quartz monzonite and granite), synvolcanic batholiths and a range of mafic-ultramafic rocks (see Fig. 3). The latter include sills of Bigstone Bay, Kakagi Lake, Katimiagamak Lake, Bad Vermilion Lake and Grassy Portage, the Mulcahy Lake gabbroic layered intrusion, the Lac des Iles complex, Tib gabbro and Chrome Lake- Puddy Lake sill. Other mafic bodies near Lac des Iles include Legris Lake, Shelby Lake, Wakinoo Lake and Demars Lake; Dunning (1979, p.129) suggested that the latter three may be comagmatic with the western gabbro at Lac des Iles, perhaps forming a continuous sill-shaped body, and that 'a thorough search of these bodies for PGE seems justified'. A number of the mafic intrusions, such as Lac des Iles and Crystal Lake, lie along the Quetico fault (Lavigne *et al.*, 1992).

Ford (1994) described the Quaternary geology of the Rinker Lake area, north of Dog Lake, and immediately east of Lac des Iles. The bedrock units include upper greenschist to lower amphibolite facies rocks of the Wabigoon subprovince, and, in limited outcrop, of Proterozoic Sibley Group sediments (red shale with distinctive pale reduction spots is probably part of the Kama Hill Formation). Quaternary features include eskers and esker-kame complexes, and the drift cover varies from zero to >40 m, but is generally <3 m. The two most prominent ice flow directions are 220° and 240° (younger), roughly parallel to the strike of the supracrustal bedrocks: other striae record directions of 180° and 265°.

SIGNIFICANCE OF THE FINDINGS FOR REGIONAL EXPLORATION

At least three target types are under consideration for the region. Bearing in mind the small size of sampling (9 samples of aggregate mass 197.2 kg, of which only ≈5.6 kg of fines and 19.6 kg of the medium fraction were processed), no firm conclusions can be drawn, but the preliminary results are suggestive.

Mafic-Ultramafic Intrusions

The Lac des Iles complex is dated at 2740 Ma. Both gabbroic and ultramafic rocks carry PGE, although only the Roby zone in the gabbro is of economic importance. Rock types include wehrlite, clinopyroxenite, websterite, peridotite, norite, gabbronorite, gabbro and anorthosite; the interaction of the lithologies is intricate, especially in the vicinity of the ore zone. The high-grade mineralization in the centre of the gabbroic complex is associated with pegmatitic and pyroxenitic facies, with strong enrichment of Au, Pt and Pd relative to Ir and Os. High volatile content of the residual magma may have triggered partial remelting of gabbro cumulates (constitutional zone refining); the matrix of the 'varitextured' zone is interpreted as the residuum of this melting process, whereas pegmatoids, pegmatites and quartz-bearing dykes may be final crystallization products of the partial melt (Brugmann *et al.*, 1990).

> The principal known metal resource in the region is the Pd-rich Pd-Pt-Au-Ni-Cu deposit in the Lac des Iles intrusion. The mineralization has been known for many years, and the host igneous complex is well-documented in the literature, with 80 citations in the MINLIB database, 1963-1995. Reserves (Anon, 1994) have been estimated at 7.4 MT grading 0.18 oz/T PGE, 0.01 oz/T Au, 0.1% Cu and 0.1% Ni. The mill began full-time operation on 30 November 1993. The initial phase of mining is within the Roby zone, which will be mined by open pit to cut-off depth of 500 feet, with a scheduled production rate of 3000 T/day. Annual production is predicted at 120,000 oz Pd, 6,000 oz Pt, 12,000 oz Au, 1.5 million lb Cu and 1 million lb Ni.

Microprobe data for rock-forming minerals at Lac des Iles are summarized in Sweeny and Edgar (1987) and Sutcliffe *et al.* (1989). The occurrence of Cl-bearing apatite with ≈1.5 wt.% Cl is interesting. However, olivine ($\approx Fo_{80}$) and clinopyroxenes have much higher Mg/Fe ratios than the limited data collected from the grain mounts. As might be expected, the plagioclases at Lac des Iles are generally more calcic (An_{55-77}) than the results in Table 3C.

Kimberlites and Lamproites

The garnet analyses were compared with the oft-cited southern African classification of Dawson and Stephens (1975, 1976). The Lake Ellen kimberlite contains a compositional range of garnets, including some G9 chrome pyropes. The Ontario garnets are almandine-dominated, although some are strongly manganiferous. A few grains correspond more or less to the 'magnesian almandine' or G5 of Dawson and Stephens (1976). It is suggested here that while G5s from southern Africa have been found as constituents of kimberlite and eclogite and as diamond inclusions; (1) this composition elsewhere may easily be confused with regional metamorphic garnets, and (2) this more conservative if less exciting conclusion is almost certainly the case if other classes of diagnostic garnet, with or without other indicator minerals, are not found in association. A recent till sampling project in northern Alberta (Fenton and Pawlowicz, 1995) found that the most common diamond indicator minerals were relatively low-Fe and high-Mg almandines, identified as G3 and G5 garnets. Perhaps these are from kimberlites, but (as noted elsewhere) until proven, caution should be exercized in transporting the S.African mineral classification to other cratons.

> A collection of 194 10-kg samples from hand-dug pits in the Lac de Gras area of the Slave craton (Ward *et al.*, 1995) was processed to yield non-ferromagnetic fractions of specific gravity >3.2, seived to 0.25-0.5 and 0.5-1.0 mm. The findings in this area of known diamondiferous kimberlites are revealing: concentrations of picked indicator minerals ranged from 0 to >1000 grains/sample, and most grains were found in the 0.25-0.5 mm fraction. In the fine fraction 91/194 samples contain confirmed indicator minerals, whereas in the coarser fraction only 20 samples contained indicators. Overall, the indicators are dominated by pyrope garnets (73%) and Cr diopside (>1% Cr_2O_3, 24%: unfortunately not all kimberlite provinces have this distinctive green indicator in abundance!). Kelyphite rims were present on garnets of 4 samples, and were <1 km to >30 km from known pipes, perhaps suggesting that such rims can survive transport over substantial distances.

Murray (1995) has worked on heavy mineral characterization in the Wawa area. She noted that some magnesian ilmenites have reaction rims of TiO_2 polymorphs and low-Mg ilmenite, akin to kelyphitic rims on some of the garnets, perhaps indicative of a nearby source. On the plot of Cr_2O_3 (y axis) as a function of MgO content in ilmenite (for grains with >0.09 wt.% Cr_2O_3), the data fall into a rhomb-shaped field from ≈2 to 14% MgO and 0-4% Cr_2O_3, with MgO in individual grains rising from core to rim.

More generally, GSC studies (McClenaghan, 1994) indicate that the non-ferromagnetic fraction, 250-1000 μm in size, constitute the most cost-efficient samples for indicator mineral studies. In the Kirkland Lake area, the presence of hundreds of indicator mineral grains and retention of kelyphitic rims on garnets are signs that material has been transported only a few hundred m from a kimberlitic source (but note the above inference on possible survival of such rims). The garnets survive subsequent transport well, whereas the size of Cr diopside (the most abundant indicator mineral in the C14 pipe near Kirkland Lake) decreases exponentially down-ice from the kimberlite.

The physical properties of kimberlites and lamproites have been recently reviewed (Hoover and Campbell *in* Heran, 1994; Macnae, 1995). reviewed: most of the structures are relatively small, 400-1000 m in diameter, ranging from <1 to almost 150 ha in size. Magnetic highs may or may not be present, depending on contrast with host rocks. Gravity, resistivity and seismic velocity anomalies are generally lows over diatremes, due to serpentinization and weathering effects. The geophysical signature differs from carbonatites in the reduced amplitude of the magnetic anomaly and the small negative gravity anomaly (c.f. the large positive anomaly of carbonatites).

Felsic Pegmatite Fields

Although their occurrence would not be especially surprising (Wilson, 1993), no definite indicators of evolved pegmatites, with their potential for mineralization in rare metals (Nb, Ta, Y, REE, Cs, Li, Be, etc) have been identified to date. A recent study of the dispersion pattern around a Be-rich pegmatite (Robitaille, 1994) noted that the beryl content of the heavy mineral fraction was relatively low, but garnet (almandine) was 5-20% of the heavy minerals in till samples. The small Umfreville Lake granite pegmatite dyke contains coarse garnet, muscovite and biotite, smoky quartz and plagioclase feldspar, plus beryl and cassiterite. The till separates were dominated by amphiboles (71-94 wt.%) plus garnet (3-20%) in the heavies (methylene iodide separation, specific gravity 3.3), plus quartz, plagioclase, orthoclase K-feldspar and (<2%) beryl in the light fraction.

Tom Morris of the Ontario Geological Survey (pers.commun., 1995; work in progress) considers the following minerals a short list for heavy-mineral prospecting for pegmatites: tantalite, cassiterite, beryl and gahnite, spodumene, Li tourmaline and holmquistite (Li amphibole), spessartine garnet, scheelite and ilmenite. He suggests that a till geochemical exploration package would analyse for the following elements: Li, Be, Cs, Rb, Sn, Ta, Sc, Nb, Hf, U, Th and REE. It is possible that a new examination of the probe data in the present report may reclassify some of the garnets (the Mn-rich variants) as of pegmatitic rather than metamorphic provenance.

CONCLUSION

Although staking activity has been moderate to low in the Midcontinent Rift region, Ashton Mining continues its extensive program targeting diamonds in Michigan, Wisconsin and Illinois. A diamondiferous ultramafic lamprophyre of 20 ha surface extent has been found 400 km from the nearest previously-known diamondiferous body, with low to moderate microdiamond content indicated in preliminary findings (Ashton Mining of Canada, 1995). A careful assessment of new geochemical, float and bedrock samples collected in the summer 1995 field program, combined with locations of known intrusions and ice-flow directions, will guide a more informed appraisal of the mineral potential of this little-explored region.

As an aid to informed exploration with kimberlites in view, two appendices are presented. Appendix 1 is a revised and expanded bibliography for diamonds and kimberlites in Ontario. Appendix 2 is an annotated bibliography of a new volume on diamonds and diamond exploration (Griffin, 1995). At the time of writing, the MINLIB database contained 1,019 references on the theme of diamonds and their host rocks. It may be fair to suggest that Griffin's expert assemblage of 18 papers constitutes a practical tool overshadowing most of the previous 1,000 publications!

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Figure 1. World distribution of diamondiferous terrains (from Kaminsky *et al.*, 1995).

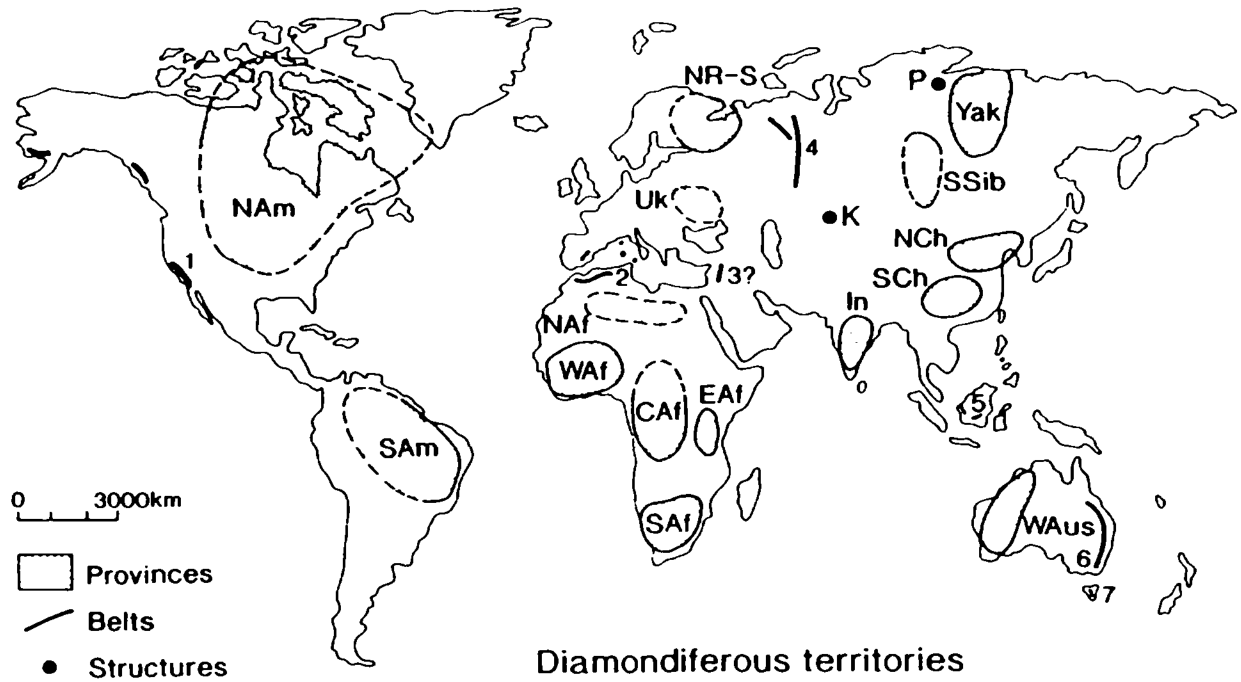
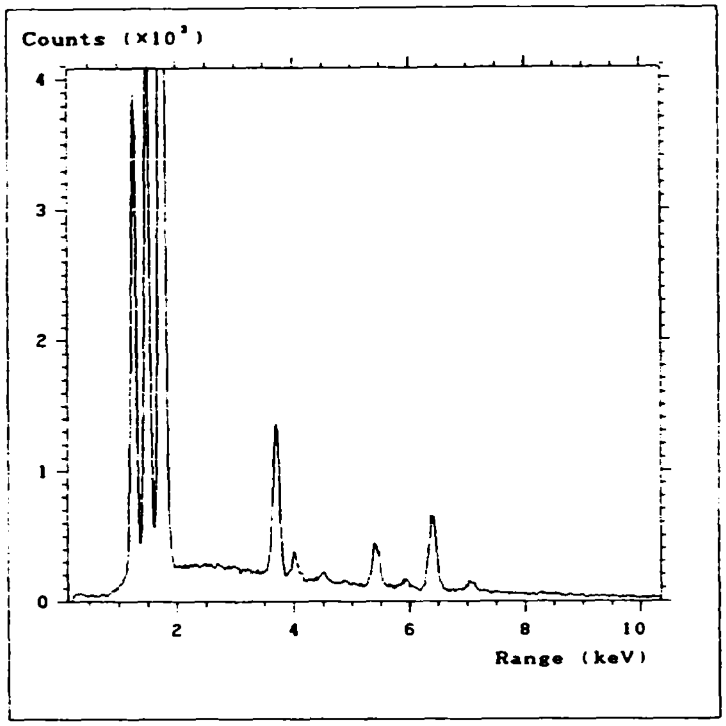


Fig. 1. Diamondiferous territories of the World. Provinces: NAm — North American, SAm — South American, NR-S — Northern Russian-Scandinavian, Uk — Ukrainian, Yak — Yakutian, SSib — Southern Siberian, NCh — Northern Chinese, SCh — Southern Chinese, In — Indian, NAf — Northern African, WAf — Western African, CAf — Central African, EAf — Eastern African, SAf — South African, WAus — West Australian. Belts: 1 — Western Pacific, 2 — Western Mediterranean, 3 — Eastern Mediterranean, 4 — Ural–Timan, 5 — Kalimantan, 6 — Eastern Australia, 7 — Tasmania. Structures: K — Kokchetav (metamorphic), P — Popigai (impact). After Janse (1994b) with some new data.

Figure 2. Energy-dispersive x-ray spectra of selected grains:

Upper: G9 garnet from Lake Ellen, site a13, analysis 3132. Abundant Mg, Al, Si, then Ca (doublet), trace Ti, appreciable Cr, trace Mn and appreciable Fe (doublet).

Lower: A 'G5' magnesian almandine from the target area, site b2a, analysis 3145. Minor Mg, abundant Al, Si, then Ca (doublet), essentially no Ti and Cr, appreciable Mn and strong Fe (doublet).



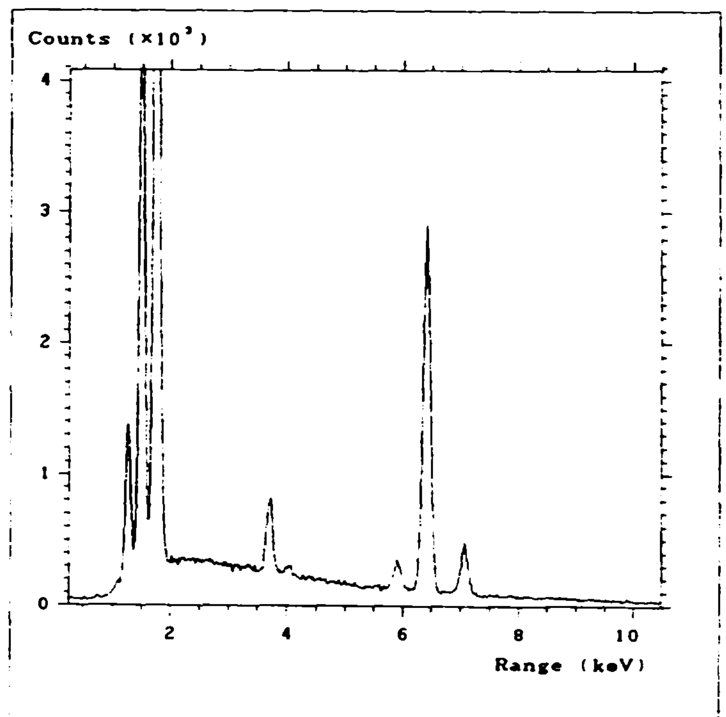


Figure 3. Location map for some of the known mafic-ultramafic intrusions near the project area (from Sweeny and Edgar, 1987).

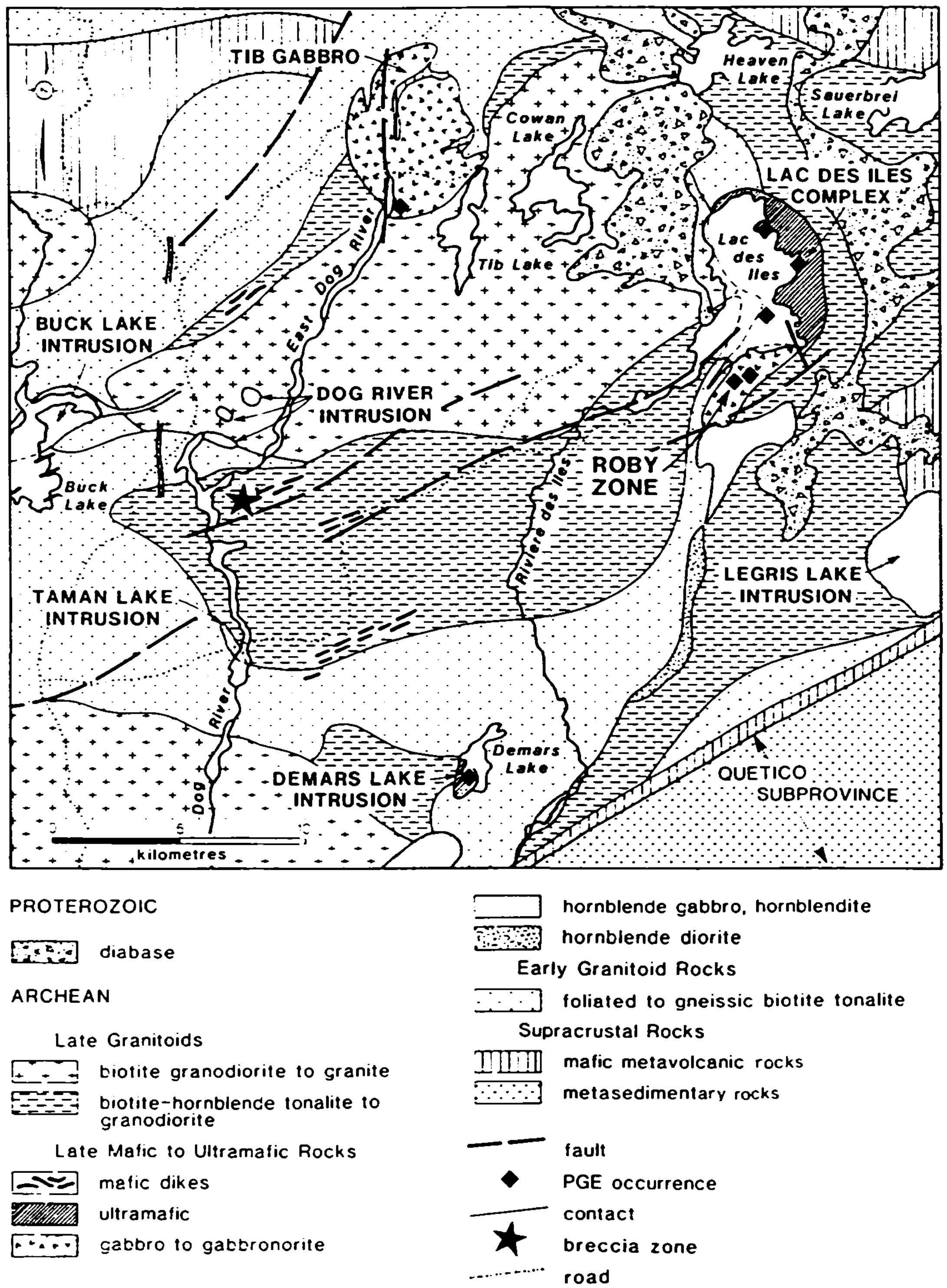


TABLE 1. HEAVY MINERAL SAMPLES, FINE AND MEDIUM FRACTIONS

Sample	*gs*	*Lot*	*Mass*	*TabCon*	MI_{seps}	*Px*	*Sibley*	*Granite*	*Oxides*	*Gar/CrDi*	*Unclassified*	*Total*
FINE LIGHT AND HEAVY FRACTIONS						PRACTICAL CONSTRAINTS LIMITED COMPLETION OF THIS TABLE TO ONE FULL ENTRY						
1	FL	2432	529.6	6.09	1.25							
	FH				4.73							
2	FL	2433	610.8	18.87	9.42							
	FH				8.96							
3	FL	2434	484.1	24.05	16.54							
	FH				6.94							
4	FL	2435	542.9	39.88	18.23							
	FH				21.81							
5	FL	2436	613.9	12.77	3.88							
	FH				8.85							
6	FL	2437	616.3	15.14	7.78							
	FH				7.32							
7	FL	2438	686.6	27.03	11.79							
	FH				15.34							
8	FL	2439	618.7	19.07	10.93							
	FH				8.26							
9	FL	2440	912.6	9.35	7.66							
	FH				1.55							

Sample	*gs*	*Lot*	*Mass*	*TabCon*	MI_{seps}	*Px*	*Sibley*	*Granite*	*Oxides*	*Gar/CrDi*	*Unclassified*	*Total*
MEDIUM LIGHT AND HEAVY FRACTIONS												
1	ML2441		2221.7	73.01	3.48							
	MH				70.12							
2	ML2442		1646.1	26.85	1.73							
	MH				25.26							
3	ML2443		1499.4	83.31	1.53	0.7220	0.0087	0.0084	0.0117	0.0	0.7099	1.4607
						49.4%	0.6%	0.6%	0.8%	0	48.6%	
						132	5	9	4	0	?	
	MH				82.25							
4	ML2444		2692.6	49.72	6.11							
	MH				43.78							
5	ML2445		1707.0	125.99	2.68							
	MH				124.67							
6	ML2446		2620.1	65.09	2.21							
	MH				63.47							
7	ML2447		2600.0	81.10	1.69							
	MH				79.78							
8	ML2448		1974.5	95.05	1.42							
	MH				94.55							
9	ML2449		2612.4	99.86	0.61							
	MH				99.95							
‘10’	-L	2450	1926.0	84.74	15.46							
‘10’	-H				73.57							

Notes. In each case, the data commence with the field sample number, fraction (screened in the field into Coarse, Medium and Fine), the lot number at the processing laboratory, and the mass received at the lab. Lab values are then provided for the masses of table concentrates, and for light and heavy fractions separated by methylene iodide heavy liquid treatment (specific gravity of "MI" is 3.32). In the case of samples which were examined quantitatively the weight, percentage of weight, and number of grains is given for each distinct grain group. Samples 1-9 from target area; '10' is the Lake Ellen sample.

The diversity of the grains is exemplified by sample 2443-MH:

Pyroxenes
Dark igneous pyroxene, presumably from one or more mafic-ultramafic intrusions located up-ice / upstream, representing such lithologies as clinopyroxenite and gabbro. A few grains display attached (?) plagioclase, phlogopite or olivine.

Sibley Group
Distinctively red, rounded, fine-grained siltstone.

Granitic Components
A small proportion of the MI lights are of likely granitic pegmatite origin. This includes a few grains of white quartz, pinkish feldspars, pale pink rose quartz (?), and shiny, pinkish-orange (?) zircon with myriad dark inclusions (one in 2443MH).

Oxides
Relatively coarse ilmenite and magnetite, as recognized by eye. Coarse ilmenite may be worth probing.

Garnet and Chrome Diopside
Not recognized to date in this suite. Should be probed where found with promising colour.

Unclassified
Largely medium- to fine-grained pyroxenes plus very fine-grained green to dun-coloured olivine. The latter apparently fragments far more readily than the pyroxene. Its presence confirms the presence of mafic-ultramafic intrusions in the area.

The fractions were all examined (Table 2) and then grains from fine fractions of all 9 Ontario samples and medium fractions from six of the Ontario samples plus the Lake Ellen material were microprobed (Table 3).

TABLE 2. NOTES ON INDIVIDUAL FRACTIONS (samples 1-9, as collected in the field, plus Lake Ellen sample 1625)

SAMPLE 1

2441	ML	Milky quartz, pink feldspar, red and grey Sibley siltstones, white granite (± muscovite), white calcite and diabase.
2441	MH	Contains pyroxene, magnetite and olivine, plus **pale to strong pink garnet**, rare **orange garnet**, **ilmenite**, magnetite and Sibley siltstone. 18 garnets sampled (mostly pinkish) plus one ilmenite.
2432	FL	Clear and milky quartz, pink Sibley siltstone, red feldspar, chlorite and muscovite. Contains orange to red spheroidal waxy agglutinates, probably friable, shiny droplets of conifer resin. Samples pyroxene and one **pale orange rounded (?) garnet**.
2432	FH	Contains **pink garnets**, some equant with faces suggestive of small porphyroblasts grown in regional metamorphism of pelitic sediments. Also **pale pinkish-orange (?) zircon**. Olivine and pyroxene. Samples include ≈ 16 garnets, including one **orange garnet** and perhaps some zircon.

SAMPLE 2

2442	ML	Gabbroic chips, tabular-plagioclase diabase (1 chip sampled), garnet schist and gneiss (1 sampled), white quartz, pink Sibley siltstone, pink granite, pink feldspar, muscovite and diabase.
2442	MH	Magnetite, pyroxene and clear quartz. Pale to medium **pink garnets**. **Ilmenite**, white feldspar, calcite and rare sulphide (pyrite). Sampled ≈ 10 pinkish garnets and 3 oxide grains.
2433	FL	Milky quartz and clear quartz, calcite and pink Sibley sediment. Pink and red feldspars. Diabase.
2433	FH	Magnetite, ilmenite and diabase. Pale pink garnets, generally angular. Minor **orangey garnet** and pink Sibley sediment. Sample 12 **pinkish garnets** and one **ilmenite**.

SAMPLE 3

2443	MH	The most abundant phase is pyroxene (49.4 wt.%: see above), but Sibley sediment, granite and Fe-Ti-(Cr) oxides also occur, including magnetite and fairly coarse **ilmenite**. Also olivine, white quartz, pink feldspar, **pink rose quartz / garnet** and pinkish-orange (?) **zircon**.
2443	ML	Pink Sibley siltstone, pink biotite granite, white granite ± muscovite, colourless and ironstained quartz, a biotite-speckled siltstone (contact aureole rock?), fine-grained biotite schist, diabase and a chip of a mafic-ultramafic rock, plus grains of pyroxene and tabular calcite.
2434	FL	Much clear quartz. Red and grey Sibley siltstone (more rarely a pale greenish colour), traces of biotite and smoky quartz and pink feldspar. A grain of olivine and one unusually well-rounded quartz grain.
2434	FH	Contains pyroxene, olivine and much oxide (magnetite plus trace ilmenite). 15 **pinkish** (almandine?) **to pale orangey garnets** were sampled, plus 3 (?) **ilmenite** crystals. Trace muscovite, clear to white quartz, and Sibley siltstone. A good example of a sample where the fine heavies may yield better samples of potential indicator minerals than the coarser (medium) heavy fraction.

SAMPLE 4

2444 ML Pink and white granites, colourless and white quartz ('rock crystal' and 'milky quartz'), Sibley siltstone, including pink and grey examples, and one piece of purple siltstone with pink spots (sampled). Biotite schist ± **orangey garnet** (sampled). Fgr gabbroic chip (sampled). Pink, red (sampled) and white feldspar grains. Some of the granite is gneissic with muscovite flakes.

2444 MH At least 8 phases, although dark grn pyroxene, dun olivine and fgr black magnetite predominate. Pale **pink rose quartz** (felsic pegmatites?) / **garnet** / **zircon** are quite abundant. Minor white quartz and shiny black ilmenite. Trace (1 grain) of rounded green (?) Cr diopside. Trace colourless, cleaved (?) calcite. Left intact, after removal of 20 grains: 14 **pale pink quartz/garnet**, one **dull red garnet**, 3 **orangey garnet** (one coarse, with quartz attached), one large ilmenite, and a calcite 920 grains: the one (?) **Cr diopside** was misplaced).

2435 FL Fine-grained, except for two mysteriously large (3 mm) white leucogranite chips. Much pale quartz. Some olivine and pyroxene. Sibley siltstone, **ilmenite**, trace of **pale pink garnet**. Trace of very **pale green or bluish green diopside and/or beryl**, generally elongate prism fragments.

2435 FH Contains olivine, pyroxene and pale pink garnet. Sampled grains include 28 **pinkish to orangey garnets**, one **red garnet**, one **ilmenite** and 2 olivines. Garnets are variably rounded. Orange grains may be hessonite (grossular)? Minor oxide (ilmenite). Some small pink shards might be **spodumene** (kunzite?), suggestive of a felsic, most probably peraluminous pegmatitic source.

SAMPLE 5

2445 ML Pink and grey Sibley sediments. Colourless and milky quartz. White and pink granites. Cream-coloured and pink feldspars. Gabbroic material, biotite, biotite schist, chloritized mica. Also one sampled chip of (?) diabase with abundant bladed white feldspar laths.

2445 MH Cleaved black pyroxene and relatively fine-grained dun-coloured olivine. Also traces of Sibley sediments and milky quartz.

2436 FL Contains pyroxene, olivine and clear quartz. Also salmon-pink feldspar. Traces of very fine-grained **orange garnet** and magnetite / **ilmenite**. Also a few anomalously large pebbles (pink granite, etc).

2436 FH Abundant fine magnetite. Abundant pale pink garnet, and lesser **orange garnet**. Garnets mostly angular, some are rounded. Sampling of ≈35 grains, mostly **pinkish garnet**. Also a few anomalously large pebbles (Sibley siltstone, etc).

SAMPLE 6

2446 ML A rather clay-rich sample. White quartz, pink and white feldspars and white and pink granite. Tabular-plagioclase diabase (2 chips sampled), calcite, gabbroic material, garnet-biotite schist (1 sampled), purple and pink Sibley sediment and a coarser grit, pink in colour, pink feldspar and grey quartz (sampled). Biotite, hornblende and pyroxene.

2446 MH Pyroxene, olivine, magnetite and clear quartz. Pink feld with attached muscovite (felsic pegmatite), ilmenite and trace of pink Sibley siltstone. Also pale to medium pink garnet, sometimes rounded, and coarse angular aggregates of orange garnet. 12 sampled grains (mostly **orange garnet**, some **pink garnet** and **ilmenite**).

2437 FL Clear quartz, pyroxene, pink feldspar, diabase, small **pink garnets**, Sibley sediment, and (sampled) a pale blue prism of (?) **beryl**.

2437 FH Magnetite, pyroxene and olivine. Also **pink garnet** and **orange garnet** (≈ 17 grains sampled, mostly pinkish garnet).

SAMPLE 7

2447 ML Milky quartz, white and red granites, Sibley siltstone, salmon-pink feldspar, diabase, biotite schist and white calcite.

2447 MH Grains of pyroxene plus minor gabbroic material, quartz, Sibley siltstone, trace olivine. Also hackly, white-coated grey metal, (?) oxidized bullet lead fragments.

2438 FL White plus ironstained quartz, Sibley siltstone, pyroxene, muscovite and white granite.

2438 FH Contains olivine and pyroxene, **pale pink garnet** (11 grains sampled), **orange garnet / staurolite** (5 grains). Some of the pink garnets are quite rounded.

SAMPLE 8

2448 ML White quartz, biotite schist, pink and grey Sibley siltstones, white, grey and red granites, diabase, pink feldspar, muscovite, clear calcite, and gabbroic chips.

2448 MH Red Sibley siltstone, milky quartz, pyroxene, olivine and gabbroic chips, grey phyllite.

2439 FL Colourless to milky quartz, Sibley siltstone, diabase, pink feldspar, muscovite, biotite and colourless to pinkish calcite.

2439 FH Abundant magnetite, olivine and pyroxene, plus milky quartz and traces of Sibley sediment and pale **pink garnet** (4 tiny samples).

SAMPLE 9

2449 ML Abundant pink to purple Sibley sediments, ± white spots. White and pink granites, ± muscovite. Pink and clear quartz. Diabase and muscovite schist. Calcite and salmon-coloured feldspar. Sampled pieces of hornblende mica schist, **rose quartz**, (?) pink feldspar and coarse muscovite.

2449 MH Oxides, diabase, pyroxene, calcite, milky quartz, muscovite phyllite and schist. **Rose quartz**, pink feldspar and (?) gypsum. Trace of Sibley sediment (sampling of 4 quartz, 1 **ilmenite**, 1 feldspar and 1 gypsum?).

2440 FL Clear quartz, red feldspar, magnetite and pyroxene, pink and orange garnets. Oddly, contains 20 assorted ≈ 3 mm pebbles: pink Sibley sediment, white and pink granites, milky quartz and muscovite schist. Sampled: 5 **pink garnets and orange garnets**.

2440 FH Magnetite, pyroxene, **ilmenite**, and very abundant pale **pink and orange garnets**. These include angular shards, equant (?) porphyroblasts and rounded, apparently long-transported grains. Sampled: >40 orange to pink garnets and ≈ 10 oxides.

LAKE ELLEN SAMPLE 1625

2450 ML Contains a number of **red** and lesser **orange garnets**, plus **ilmenite**, often enclosed in or attached to the pale grn, less-dense kimberlitic matrix. Also platy, pale greenish orthopyroxene and chloritized mica. Sample 0.78 g of indicators plus matrix, leaving 68.25 g.

2450 MH A partial separation was effected, yielding 2856 mg of indicator minerals. These included **ilmenite** (170 grains, 1879 mg, mean mass 11.1 mg), **red garnet** (150 grains, 598 mg, mean mass 4.0 mg), and **orangey garnet** (110 grains, 379 mg, mean mass 3.45 mg). Particularly for ilmenite and red garnet, a few large grains skew the mean masses: median values would be significantly less. Total sample weight was 15.37 g: abundant indicator grains are left in the remaining 81% of the sample.

TABLE 3A. ELECTRON MICROPROBE DATA: GARNETS

Sample	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Total	Identification	Class[1]
Garnets											
a-01	40.577	0.083	23.297	0.048	17.063	0.262	14.563	5.065	100.958	Calcic pyrope-almandine	G3
a-02	41.871	0.527	22.927	0.807	9.007	0.411	20.118	4.350	100.018	Titanian pyrope	G1/SEG(?)
a-03	40.014	0.105	23.004	0.067	15.868	0.252	11.439	9.537	100.286	Pyrope-almandine	G3-G4
a-04	40.162	0.113	23.337	0.075	15.219	0.222	12.722	8.436	100.286	Pyrope-almandine	G3-G4
a-05	39.270	0.097	21.942	0.091	23.593	0.400	10.036	5.115	100.544	Magnesian almandine	G5
a-12	39.922	0.130	22.337	0.057	20.083	0.351	13.270	4.269	100.419	Calcic pyrope-almandine	G3
a-13	42.297	0.420	21.124	2.955	7.218	0.243	20.853	5.185	100.295	Cr pyrope	G9
a-14	41.762	0.087	21.746	2.787	8.415	0.398	19.899	5.146	100.240	Cr pyrope	G9
a-09	37.434	0.000	22.031	0.003	33.688	1.030	5.560	1.216	100.962	Magnesian almandine	G5/non-kim
a-10	37.107	0.000	21.258	0.070	35.492	0.329	2.453	4.396	101.105	Almandine	non-kim
a-18	37.856	0.040	21.884	0.044	30.163	1.703	6.104	2.892	100.686	Magnesian almandine	G5/non-kim
a-20	36.951	0.017	21.347	0.082	36.159	0.821	3.564	1.622	100.563	Almandine	non-kim
b-01a	36.277	0.000	21.462	0.000	31.555	8.508	2.391	0.423	100.616	Mn-rich almandine	non-kim
b-01b	36.362	0.017	21.103	0.000	39.044	0.770	1.638	1.304	100.238	Almandine	non-kim
b-02a	37.768	0.050	21.769	0.060	29.341	1.825	6.829	2.114	99.756	Magnesian almandine	G5/non-kim
b-02b	37.284	0.000	21.804	0.054	33.739	1.622	5.119	0.686	100.308	Almandine	non-kim
b-02c	37.103	0.000	21.468	0.001	33.489	2.535	4.474	0.908	99.978	Almandine	non-kim
b-02d	37.043	0.005	21.478	0.000	34.483	1.201	3.909	1.615	99.734	Almandine	non-kim
b-02e	37.766	0.055	21.942	0.000	30.218	1.117	6.888	0.916	98.902	Magnesian almandine	G5/non-kim
b-03a	36.501	0.007	21.190	0.000	28.852	8.778	3.416	0.651	99.395	Mn-rich almandine	non-kim
b-03b	37.413	0.000	21.884	0.000	32.367	0.976	5.932	1.076	99.648	Magnesian almandine	G5/non-kim
b-04a	36.215	0.040	20.501	0.000	19.019	21.558	1.461	0.410	99.204	Almandine-spessartine	non-kim
b-04b	36.767	0.005	21.228	0.001	32.344	4.297	3.106	1.506	99.254	Almandine	non-kim
b-04c	36.833	0.000	21.410	0.004	31.299	5.413	3.532	1.153	99.644	Almandine	non-kim
Pyr STD	41.460	0.470	23.730	0.000	10.680	0.280	18.510	5.170	100.300	Pyrope	STD 'book'
Pyr STD-01	41.090	0.424	23.513	0.086	10.369	0.331	18.183	5.106	99.102	Pyrope	STD
Pyr STD-02	41.424	0.437	23.711	0.039	10.643	0.329	18.467	5.164	100.214	Pyrope	STD
Pyr STD-03	41.420	0.445	23.819	0.136	10.527	0.316	18.564	5.170	100.397	Pyrope	STD
Pyr STD-04	41.796	0.439	23.811	0.088	10.831	0.236	18.639	5.187	101.027	Pyrope	STD

Notes:
[1]This page includes a total of 24 unknown plus 4 standard analyses, performed by wavelength-dispersive electron microprobe. All values in weight percent oxide, all Fe expressed as FeO. Rapid analysis schedule, omitting Na_2O and P_2O_5.

TABLE 3B. ELECTRON MICROPROBE DATA: GARNETS

Sample	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Total	Identification	Class[1]
Clinopyroxenes											
a-06	48.916	0.617	1.190	0.015	24.774	0.557	9.290	13.813	99.172	Clinopyroxene: ferroaugite	cpx:aug
a-08a	47.519	0.512	0.988	0.000	27.338	0.531	4.708	17.392	98.988	Clinopyroxene: ferroaugite	cpx:aug
a-11	49.402	0.657	1.289	0.004	22.089	0.528	11.936	13.325	99.230	Clinopyroxene: augite	cpx:aug
Olivine											
b-4d	33.660	0.000	0.023	0.098	43.889	0.578	20.253	0.192	98.693	Olivine, $\approx Fo_{45}$	oliv
Fe-Ti Oxide Pairs											
a-07b	0.896	13.995	0.780	0.056	78.566	0.457	0.158	0.036	94.944	Titanomagnetite	Ti mag
a-07a	0.000	50.795	0.038	0.000	47.345	1.374	0.000	0.011	99.563	Low-Mn ilmenite	ilm
a-17b	0.101	14.707	1.260	0.174	77.982	0.351	0.121	0.000	94.696	Titanomagnetite	Ti mag
a-17a	0.000	51.785	0.032	0.000	47.896	0.571	0.320	0.001	100.605	Low-Mn ilmenite	ilm
a-19b	0.064	14.629	2.577	0.130	75.598	0.609	0.368	0.001	93.976	Titanomagnetite	Ti mag
a-19a	0.000	51.289	0.064	0.058	46.161	0.588	1.230	0.010	99.400	Low-Mn ilmenite	ilm

Notes:
[1]This page includes a total of 10 'unknown' analyses, performed by wavelength-dispersive electron microprobe. All values in weight percent oxide, all Fe expressed as FeO (hence the low values for magnetite, ideally near 95%, Fe as FeO). Other minerals did not yield analyses of this quality, largely due to exclusion of major elements (e.g., Na in feldspar).

Origins of all grains: refer back to Tables 1-2 for details (with a few exceptions, the two mounts are divided into the 'coarse' medium "a1-20" and fine "b1-16" grain fractions, each of the 36 locations containing 1-6 grains):
1 (2432)FH: b15 - 1 (2441)MH: b16.
2 (2433)FH: b13 - 2 (2442)MH: b14.
3 (2434)FL: b12 *and* FH: b11 - 3 (2443)MH: a6-8,11,19,20.
4 (2435)FL: b10 *and* FH: b9 - 4 (2444)MH: a17,18.
5 (2436)FH: b8.
6 (2437)FL: b6 ('beryl') *and* FH: b5 - 6 (2446)MH: a10 *and* b7.
7 (2438)FH: b4.
8 (2439)FH: b3.
9 (2440)FL: b2 *and* FH: b1 - 9 (2449)ML: a15 *and* MH: a9,16.
10 (2450)MH (Lake Ellen): a1-4 ('orange garnet'), a-5,12-14 ('red garnet').

TABLE 3C. ANALYST'S NOTES ON THE TARGET GRAINS

Analysis	*Sample*	*Summary*	*Notes*
3118	a-01	Calcic pyrope-almandine	See first Lake Ellen data, analyses 2858-2862. **a1-5,12-14 are Lake Ellen**.
3119	a-02	Titanian pyrope	3118-3121 are pale orange in HS, colourless in PTS.
3120	a-03	Pyrope-almandine	See Lake Ellen analysis 2860.
3121	a-04	Pyrope-almandine	Conchoidal fracture well-displayed.
3122	a-05	Magnesian almandine	Embayed, red in HS but distinctly orange in PTS. Early suspicion in data: G5 is easiest S.African label to assign a non-kim garnet (?).
3123	a-06	Cpx: ferroaugite	Highly incl ext.
3124	a-07a	Low-Mn ilmenite	Pale oxide, intergrown with Ti mag (3125).
3125	a-07b	Titanomagnetite	Brown oxide.
3126	a-08a	Cpx: ferroaugite	Intergrown with albite-twinned plag (3127).
3127	a-08b	Plagioclase (andesine)	Low total as Na not analysed. $\approx An_{40}$.
3128	a-09	Magnesian almandine	Rounded qz inclusions abundant. Very pale pink.
3129	a-10	Almandine	Orange in PTS.
3130	a-11	Cpx: augite	With chalc inclusions. Highly incl ext.
3131	a-12	Calcic pyrope-almandine	Red in HS, embayed orange (in PTS) garnet.
3132	a-13	Cr pyrope	Large (1.6x1.1 mm) rectangular, pale pink.
3133	a-14	Cr pyrope	Rounded pale pink, 1.1x0.9 mm.
3134	a-15	Quartz	Odd result - sample looks like a sheet silicate (bi?)!
3135	a-16	Plagioclase (olig-and)	LF, str ext, bright int colours (thick PTS), colourless, extensively sericitized, EDS = > Na peak (lower than Ca) + minor K.
3136	a-17a	Low-Mn ilmenite	Coarse oxide intergrowth - pale oxide.
3137	a-17b	Titanomagnetite	Brown oxide, intergrown with ilm.
3138	a-17c	Plagioclase (oligoclase)	Rounded 500x300 μm inclusion in oxide intergrowth. At one end (between plag and oxide) is 75x60 μm equant apatite inclusion, EDS = >Cl-bearing. $\approx An_{25}$.
3139	a-18	Magnesian almandine	Pale gar with rounded qz inclusions.
3140	a-19a	Low-Mn ilmenite	Pale oxide, with Ti mag and trace (?) plag.
3141	a-19b	Titanomagnetite	Intergrown darker brn oxide.
3142	a-20	Almandine	Pink gar with minor qz and (pleo brn) bi mica inclusions.
3143	b-01a	Mn-rich almandine	Pale pinkish 600x550 μm gar.
3144	b-01b	Almandine	Pale pinkish 500x400 μm gar.
3145	b-02a	Magnesian almandine	Largest of 5 small, pale pink gar. 600x550 μm.
3146	b-02b	Almandine	2nd-largest of 5 small pale pink gar, 600x300 μm.
3147	b-02c	Almandine	Small pink gar. 350x300 μm.
3148	b-02d	Almandine	Small pink gar. Qz inclusion on margin. 400x200 μm.
3149	b-02e	Magnesian almandine	Small pink gar. 350x300 μm.

3150	b-03a	Mn-rich almandine	Clear patch in 900x300 μm mottled grain.
3151	b-03b	Magnesian almandine	Yellowish patch in 600x500 μm gar, akin to grain in 3150.
3152	b-04a	Almandine-spessartine	Pale pink gar. 500x400 μm, unusual distinct partings separated by $\approx 70°$.
3153	b-04b	Almandine	Irregular, 600x450 μm pale pinkish gar, qz plus minor (?) bi inclusions, partings visible.
3154	b-04c	Almandine	Rounded pale pinkish gar, 900x650 μm, small qz inclusions.
3155	b-4d	Olivine, $\approx Fo_{45}$	Pale 600x160 μm sliver, high bir, (?) slightly incl ext.
3156	b-05a	Almandine	Very pale pinkish gar, 600x200 μm. Low totals in 3156-3177 due to microscope failure, hence poor focusing (sample positioning using SEM imagery only).
3157	b-05b	Mn-rich almandine	Very pale pinkish gar, 450x450 μm, with bi inclusions.
3158	b-06	Apatite	EDS = >Ca phosphate. No data on Cl and other volatiles. 550x300 μm prism, low bir, str ext, LF, easily recognized in PTS.
3159	b-07a	Almandine	700x600 μm, pale pink gar with small qz inclusions.
3160	b-07b	Almandine	Square 700x700 μm gar. Pale pink with yellowish patches.
3161	b-08a1	Plagioclase (olig-and)	120x60 μm plag inclusion, with larger (?) bi in gar.
3162	b-08a2	Almandine	800x550 μm fractured gar host of 3161 feld and bi.
3163	b-08b	Almandine	Small, 350x250 μm garnet.
3164	b-08c	Almandine	Rectangular 700x600 μm garnet, near 60 μm round qz inclusion.
3165	b-09a1	Titanomagnetite	Rounded 900x700 μm oxide with (?) bi inclusion at one end. Centre of grain, which also encloses exsolved ilm blades.
3166a	b-09a2	Low-Mn ilmenite	Relatively squat example of 2 exsolved ilm blades in mag.
3166b	b-09b	Almandine	Large pale pink 1050x900 μm gar.
3167	b-10a	Cpx: diopside	450x250 μm grain, very pale grn, apparently high bir and highly incl ext .
3168	b-11a	Almandine	Rhombohedral section, 750x600 μm, showing interfacial angle of $\approx 70°$. Very pale pinkish.
3169	b-12a1	Cpx: augite	Sample included a round qz (EDS checked, 700 μm dia, uniaxial +ve). Target grain is angular, 800x600 μm, pale brownish, highly incl ext, bright bir, intergrown with plag grains.
3170	b-12a2	Plagioclase: labradorite	Simple-twinned 280x160 μm plag grain intergrown with cpx. Probably a sodic plag. $\approx An_{55}$.
3171	b-13a	Almandine	Pale pink 1000x600 μm grain.
3172	b-14a	Almandine	Small rounded gar, pale pink, 500x400 μm, with tiny (10-80 μm) blebs of qz or plag.
3173	b-15a	Mn-rich almandine	Pale pinkish 500x400 μm small rounded gar shard.
3174	b-16a	Titanomagnetite	Ragged 950x350 μm grain.
3175	b-16b	Plagioclase: oligoclase	Partly sericitized simple-twinned plag, 750x700 μm. $\approx An_{30}$.
3176	b-16c	Clinopyroxene: augite	Pale clove-coloured 750x550 μm grain intergrown with fgr plag.
3177	b-16d	Almandine	A pale pink 800x600 μm grain with small inclusion of pale grn (?) diopsidic cpx.
STD	pyropKsx1	STD-02	Pyrope garnet
STD	pyropKsx1	STD-03	Pyrope garnet
STD	pyropKsx1	STD-04	Pyrope garnet
STD	pyropKsx1	STD-01	Pyrope garnet

NOTES

APPENDIX 1.

BIBLIOGRAPHY OF DIAMONDS IN ONTARIO

Second Edition

Turnstone Geological Services Ltd,
P.O. Box 130, Station 'B', Toronto M5T 2T3

July 8, 1995

(73/88 items selected from 32,768 entries in MINLIB)
Search Code 'Ontario / DKL' - covers topic
Fields searched: 2 logicals

N.B. The previous search (30 September 1993), produced 39 items from 49 hits. The current list was produced from reappraisal of the expanded database: the vibrant upsurge of interest and consequent research in the subject are evident.

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The 1970s (7)

FERGUSON,SA and FREEMAN,EB (1978) Ontario Occurrences of Float, Placer Gold, and Other Heavy Minerals. OGS MDC 17, 214pp.

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The 1960s (4)

BROWN,LC (1969) Kirkland Lake - the golden years. Can.Geographic (July 1969) / MS, 15pp., MNR, 4th edition.

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Pre-1960 (2)

BLUE,A (1900) Are there diamonds in Ontario? OBM Report 9, 119-124.

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NOTES

APPENDIX 2.

ANNOTATED BIBLIOGRAPHY: LISTING OF PAPERS IN THE JOURNAL OF GEOCHEMICAL EXPLORATION DIAMOND VOLUME, 1995

Turnstone Geological Services Ltd,
P.O. Box 130, Station 'B', Toronto M5T 2T3

July 10, 1995

(19 items selected from 32,770 entries in MINLIB)
Search Code 'J.Geoc../DKL/1995' - covers topi
Fields searched: R + D + 1 logical

THE VOLUME:

Griffin,WL (editor)
Diamond Exploration: Into the 21st Century.
J.Geochem.Explor. 53 nos.1-3, 1-367 (1995).
Geochemical exploration - diamond exploration - multiauthor review volume (18/18 papers in MINLIB) - the formation and occurrence of diamonds in the mantle - a catalogue of diamond and kimberlite occurrences - area selection (3 papers, including tectonic controls, structural geology and geophysical exploration) - diamond indicator minerals - the geophysics of kimberlite and lamproite - mechanisms of emplacement - placer diamond exploration - the petrography, mineral chemistry, litho-geochemistry, sampling and statistical evaluation of materials in diamond exploration.

THE 18 PAPERS, IN AUTHOR-ALPHABETICAL ORDER:

Bulanova,GP
The formation of diamond.
J.Geochem.Explor. 53, 1-23 (1995).
On peridotitic and eclogitic diamonds from Yakutia - the formation of macrodiamonds in kimberlitic rocks - diamond growth in kimberlites of Yakutia (Siberia, Russia, former USSR) - zoned crystals revealed by infrared microscopy and cathodoluminescence - inclusion paragenesis - crystal habit - internal structures suggest that individual diamond crystals formed by layer-by-layer growth around nucleation centres, phases such as sulphide and native Fe and wustite and monocrystalline graphite - beautiful colour photographs of diamonds - N aggregation - EPM analyses of eclogitic garnet and clinopyroxene inclusions, and of chromite from Udachnaya - useful review in a special volume on diamonds - petrography - many references.

Golubev,YK
Diamond exploration in glaciated terrain: a Russian perspective.
J.Geochem.Explor. 53, 265-275 (1995).
Geochemical exploration - diamond exploration - the Arkhangelsk (Archangel) and Middle Timan areas of the North Russian craton - USSR - glacial geology - Quaternary geology - prospecting in glaciated terrain - short-range haloes may be found in diamond indicator minerals in basal tills, 1-3 km from pipes, and in glaciofluvial sediments of alluvial stream facies - these haloes are hard to find - long-range trains may extend up to 50-70 km from source, and are found in glaciofluvial sediments such as esker deposits - pyrope garnet and chromite grains may develop surface features indicating the distance of transport from the source - maps - Karpinsky and Vodorazdelnaya pipes - grain morphologies - SEM images - 8 references.

Griffin,WL and Ryan,CG
Trace elements in indicator minerals: area selection and target evaluation in diamond exploration.
J.Geochem.Explor. 53, 311-337 (1995).
Geochemical exploration - diamond exploration - trace elements in diamond indicator minerals - geochemical analysis by PIXE - the geothermometer based on Cr pyrope, in which the Ni content of garnet equilibrated with mantle olivine rises as a function of temperature - Cr geobarometer based on partition of Cr between garnet and orthopyroxene - PIXE analyses of garnets from Udachnaya (Siberia, Russia, USSR) and Canada, chromites from Wesselton and ilmenites from Frank Smith, ** S.Africa - the mantle geotherm - calibration of the Ni thermometer - Kaapvaal craton - garnet geotherm for concentrate from the Batty kimberlite, Somerset Island, NWT, Arctic Canada - kimberlites from Tanzania - Prairie Creek lamproite, Arkansas, USA - the Four Corners area of the Colorado plateau - W.Australia - Udachnaya and Mir - China - Zr and Y in Cr pyrope garnets (p.325) - mantle chemistry and layering - the Ω parameter, a broad estimate of the diamond potential of a kimberlite pipe (p.327), defined as the percentage of garnets in the 'diamond window' minus the percentage of garnets with the Ni geothermometer estimate above the diamond window - all pipes known to be barren have $\Omega < 10$, while all pipes in the data set with grades >30 carats/100 T have $\Omega > 40$ - Cr Ni Ga in chromites - Zn thermometry, based on chromite- Cr pyrope garnet pairs - mineral chemistry - Zr and Nb in chromites - Nb Ni Zr in ilmenite - valuable review of specialized microanalytical field.

Gurney,JJ and Zweistra,P
The interpretation of the major element compositions of mantle minerals in diamond exploration.
J.Geochem.Explor. 53, 293-309 (1995).
Geochemical exploration - diamond exploration - diamond indicator minerals - application of EPM data - macrocrysts - rules for Group I and Group II kimberlites are not identical - Ca Cr plots for pyrope garnets - examples from ** S.Africa and Botswana - G9 and G10 garnets - peridotitic and eclogitic sources - Finsch has abundant G10 garnets, and is high-grade, with predominantly peridotitic diamonds - Premier is medium-grade, with both peridotitic and eclogitic diamonds - Koffiefontein, Orapa (the latter high-grade, mainly eclogitic) and the very low-grade Colossus (mostly G9 garnets) - Cr Mg plots for chromite from diamondiferous kimberlites: Sover, Sloan (Colorado, USA), Bultfontein, Driekoppies, Koffiefontein and Argyle (W.Australia) - petrography - Na Ti plot for eclogitic garnets (0.0-0.2 wt.% Na_2O

on x axis, versus 0.0 to 1.2% TiO_2) - the sodic eclogitic garnets are mostly distinct, with higher Na and the same or lower Ti than megacryst garnets - resorption of diamonds.

Helmstaedt,HH and Gurney,JJ
Geotectonic controls of primary diamond deposits: implications for area selection.
J.Geochem.Explor. 53, 125-144 (1995).
On diamond exploration - diamondiferous mantle roots - structural geology - age dates on diamondiferous materials - mantle structure - plate tectonics and mineralization - the Kaapvaal craton of ** S.Africa and adjacent states - geophysics - seismology - positive shear wave velocity perturbations under USA, Canada and * Greenland - subduction processes - survival of mantle roots - the Slave province, NWT - the MacKenzie dyke swarm - the Colorado-Wyoming kimberlite province - Saskatchewan - depth of origin of kimberlites - first-order controls on primary diamond deposits are the sites of source rocks in the lithospheric roots of Archean cratons - source rocks are mainly garnetiferous peridotites (mainly low-Ca garnet harzburgites) and subordinate eclogites that are generally much older than host kimberlites and lamproites - exploration should target areas in which diamondiferous lithospheric roots may be preserved, or at least where such roots were present at the time of kimberlite emplacement - more local structural controls on the intrusives are still not well understood - useful review.

Janse,AJA and Sheahan,PA
Catalogue of world wide diamond and kimberlite occurrences: a selective and annotative approach.
J.Geochem.Explor. 53, 73-111 (1995).
A review of diamond and kimberlite occurrences worldwide - many references - some 5000 kimberlite occurrences are known, of which 500 are said to be diamondiferous, 50 have been or are being mined and 15 are large active mines - Clifford's rule is valid, in that large economic kimberlites are limited to old cratons with Archean basement (archons), whereas some economic lamproites occur on 'protons' (Proterozoic mobile belts adjacent to archons) - archons are found in 12 potentially diamond-producing regions on 7 continents - the regional sections include notes on the history of mining - maps - local geology - S.America - placer diamonds have been found in 7 of the 25 states of Brazil - Guyana - Venezuela - USA and Canada (pp.78-84) - BC, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, Labrador (Newfoundland: ultramafic dykes of alnoite and aillikite) - NWT - Africa - ** S.Africa - Lesotho - Swaziland - Namibia, S.W. Africa - Botswana - Zimbabwe and Zaire - Angola - Central African Republic - Tanzania - Sierra Leone, Liberia, Guinea, Ivory Coast and Mali - Ghana - Europe - Siberia (Russia, USSR) - India (pp.97-99) - China - Indonesia - Borneo - Australia - table of world mining and prospecting areas, with latitudes and longitudes (pp.104-105).

Jennings,CMH
The exploration context for diamonds.
J.Geochem.Explor. 53, 113-124 (1995).
Geochemical exploration - diamond exploration - world diamond production in 1993 is estimated at 104-110 million carats - only 7 major (>3 million carats/year) mines have been found since 1950: Argyle (W.Australia), Orapa and Jwaneng (Botswana, Africa) and Venetia (** S.Africa) and Jubilee, Udachnaya and Mir (Siberia, Russia, USSR) - review of mineral economics - world diamond production figures (1985-1992, and 1993-1995 estimates) - ratio of actually or potentially productive pipes to total pipes in some kimberlite clusters (e.g., 5/68 in the Group I cluster at Kimberley) - there appear to be about 4000 known kimberlites worldwide, including 900 in the former USSR, 600 in Tanzania, 550 in S.Africa, 300 in Angola, 200 in Australia, 140 in Botswana and 25 in India - area, grade and value (per carat and per tonne) of selected kimberlites - preliminary bulk data from the 3.1 ha Panda pipe (NWT, Canada) indicate a grade of 118 carats/100 T, of mean value $US 127/carat or 150/T - brief notes on exploration methods - geophysical exploration - electromagnetic and magnetic methods - conductivity contrasts - the author has drilled assorted excellent 'bullseye' magnetic targets in areas like the sandy Kalahari of Botswana, only to find that gabbro plugs, banded ironstone outliers and serpentinites may all yield magnetic signatures identical to kimberlite.

Kaminsky,FV, Feldman,AA, Varlamov,VA, Boyko,AN, Olofinsky,LN, Shofman,IL and Vaganov,VI
Prognostication of primary diamond deposits.
J.Geochem.Explor. 53, 167-182 (1995).
Useful review - diamond exploration - kimberlite and lamproite intrusions in cratons are usually localized in zones of 'high magmatic permeability, as defined by the repeated intrusion of various types of igneous rocks' - neat sketch map of worldwide diamond occurrences (p.168) - long-lived, deep-seated mobile zones may be marked by widespread intrusive and volcanic rocks, with sharply contrasting, elongate magnetic and gravity anomalies - the mobile zones may be divided into transcurrent intracratonic mobile zones (Halls Creek zone, W.Australia) and rift-related zones (Belomorian system, northern Russian craton) - maps of kimberlite fields in former USSR - Zimni Bereg field, Arkhangelsk region - Zolotitsa kimberlite cluster - lack of correlation between Moho depth and kimberlite location - geophysical exploration - gravity data - Little Botuobiya kimberlite field, Yakutia - seismology - structural geology - Daldyn-Alakit region, Yakutia.

Macnae,J
Applications of geophysics for the detection and exploration of kimberlites and lamproites.
J.Geochem.Explor. 53, 213-243 (1995).
Geophysical exploration - diamond exploration - airborne magnetics have been most cost-effective - a major contribution to kimberlite and lamproite magnetic anomalies is often remanent magnetization - local anomalies may be of normal or reversed polarity relative to a non-magnetic background - examples in Australia and Canada often have reversed polarity - many kimberlites in ** S.Africa are of Triassic to Cretaceous age, coinciding with a long period of mostly normal polarity - airborne electromagnetic methods are a factor of three more expensive, but are especially useful for finding weathered or crater facies pipes - paleomagnetism - Ellendale and Argyle in W.Australia - the Sheoak area of S.Australia - examples of ground magnetic contours - example from NWT, Canada - Sirotem profiles over lamproites - seismology - gravity - seismic reflection - comparisons between techniques - summary of properties of kimberlite and lamproite (p.240) - useful review.

Marshall,TR and Baxter-Brown,R
Basic principles of alluvial diamond exploration.
J.Geochem.Explor. 53, 277-292 (1995).
Geochemical exploration - placer diamond exploration - geomorphology - tectonic setting - structural geology - post-depositional modification of alluvial sediments - paleotopography - sedimentology - fluvial geomorphology - remote sensing (p.286) - case study from southwestern Transvaal, ** S.Africa - maps.

Mitchell,RH
The role of petrography and lithogeochemistry in exploration for diamondiferous rocks.
J.Geochem.Explor. 53, 339-350 (1995).
The role of petrography and lithogeochemistry in diamond exploration - brief review - rock classification - optical petrography - BSE SEM images - textures of carbonate segregation of the Benfontein kimberlite, ** S.Africa - orangeite from Swartruggens - lamproite from Oscar, West Kimberley, W.Australia - lamprophyre of the Male dyke, Swartruggens - initial assessment of diamond potential (p.344) - summary of mineralogy of kimberlite, orangeite, lamproite, minette and ultramafic lamprophyres (p.345) - mica mineral chemistry (cartoon, p.346) - rock definitions (pp.348-349) - 34 references.

Morgan,P
Diamond exploration from the bottom up: regional geophysical signatures of lithosphere conditions favorable for diamond exploration.
J.Geochem.Explor. 53, 145-165 (1995).
Geophysical exploration - diamond exploration - search for areas of lithosphere suitable for diamond genesis and preservation - areas of low heat flow (<40-45 mW/m2) and lithospheric thicknesses >150 km are appropriate - Clifford's Rule - geotherms - surface heat flow - heat flow estimates based on groundwater silica content (example, USA) - gravity, specific gravity and elevation considerations - electrical and magnetic studies - Magsat data for Australia - seismology - shear wave velocity-depth profiles - regional geophysical properties.

Muggeridge,MT
Pathfinder sampling techniques for locating primary sources of diamond: recovery of indicator minerals, diamonds and geochemical signatures.
J.Geochem.Explor. 53, 183-204 (1995).
Geochemical exploration - diamond exploration - it appears that placer diamonds were known in India as long ago as 800 B.C., and that by 400 B.C. they were being actively traded there, implying an equally long history for prospecting of placer deposits - heavy mineral sampling - exploration flowchart (p.186) - cartoon of matchstick and the size and number of indicator grains leading to the Argyle lamproite / diamond discovery in W.Australia (27 lamproitic chromites and 11 diamonds, 0.4 to 1.0 mm in diameter, from 3 drainage samples, the most distant 10 km from the pipe: *see next page*) - stream sediment and other samples - river trap sites for diamond indicators (with cartoon, p.194) - tabulation of indicator minerals (pp.192-193) - loam sampling - biogeochemistry - field processing of samples.

Nixon,PH
The morphology and nature of primary diamondiferous occurrences.
J.Geochem.Explor. 53, 41-71 (1995).
Useful review - primary diamond occurrences - volcanism associated with diamond pipes (kimberlites and lamproites) - volcanic landforms include pyroclastic cones or aprons (Saskatchewan, Canada), craters (Tanzania and Zaire, Africa) and diatremes (W.Australia, southern Africa) - hypabyssal intrusions are also prospective, either for diamonds or for their proximity to larger pipes - less 'traditional' sources of diamonds are also mentioned - map showing worldwide association of diamonds with cratons - age dates of kimberlite and lamproite, extending back as far as 2000-1700 Ma - geomorphology - maar and tuff ring structures - kimberlitic tuff from Fort a la Corne, Saskatchewan - the Mbuji Mayi kimberlites of Zaire - kimberlite root zones in ** S.Africa - Wesselton and Monastery - Ramatseliso kimberlite in Lesotho - kimberlitic dykes (Bellsbank, S.Africa and the Guaniamo area of Venezuela, S.America) - possible diamond associations with lamprophyre, nephelinite and carbonatite (pp.56-58) - diamonds in ultramafic massifs (pp.58-62) - Tibetan ophiolites - graphitized diamonds in garnet pyroxenites such as Beni Bousera (Morocco, N. Africa) and Ronda (southern Spain, Europe) - SEM images of diamonds from the Donqiao and Luobusa ophiolite massifs - metadunites (Burkina Faso, west Africa) - diamonds in metamorphic terrain (Kazakhstan, USSR) - Kumdikol diamond province (tectonic melange with eclogite blocks) - other eclogite facies occurrences in Dabie Shan (China) and in Norway, Scandinavia - polycrystalline diamond (carbonado) may contain phosphate inclusions of crandallite -type minerals such as florencite - diamonds in meteorites (p.66) - many references.

Rombouts,L
Sampling and statistical evaluation of diamond deposits.
J.Geochem.Explor. 53, 351-367 (1995).
Mineral economics - diamond exploration - evaluation of diamond deposits - sampling and sample treatment - stone size distributions - lognormal size distributions - Mwadui kimberlite, Tanzania, east Africa - Gbenko placer diamonds, Guinea - loghyperbolic distributions - grade distributions - geostatistics - block definition and local estimation - use of microdiamond counts in grade estimation - value estimation - 27 references.

Spetsius,ZV
Occurrence of diamond in the mantle: a case study from the Siberian platform.
J.Geochem.Explor. 53, 25-39 (1995).
Daldyn-Alakit region - Udachnaya, Sytykanskaya, Mir - studies of diamond crystals in xenoliths and kimberlite pipes of Yakutia (Siberia, Russia, USSR) - photoluminescence and infrared light absorption of diamonds from mantle xenoliths - most if not all diamonds in kimberlites were derived from mantle peridotite and eclogite 'and were liberated into the kimberlite by the disaggregation of such xenoliths' - diamond crystal habit - SEM images - photoluminescence spectra - kyanite eclogite - bimineralic eclogite - diamondiferous eclogite nodules are generally small, ≈20x30 mm, varying from 5x15 mm to 40x80 mm - petrography - infrared absorption - octahedral and rhombododecahedral habits - chemistry of ultramafic xenoliths: olivinite, dunite, harzburgite, lherzolite, wehrlite, clinopyroxenite, websterite, orthopyroxenite - evidence for lateral heterogeneity in the upper mantle - occurrence of coated diamonds and rare cubic diamonds in most

kimberlites in the region is correlated with the occurrence of kyanite eclogites and other highly aluminous rocks.

Towie,NJ and Seet,LH
Diamond laboratory techniques.
J.Geochem.Explor. 53, 205-212 (1995).
Geochemical exploration - diamond exploration - sample processing for heavy minerals (diamond indicator mineral grains >0.1 mm in size) - visual recognition of the grains is the key factor, 'which is labour intensive and can affect total analysis time by a factor of ten' - mineral separation - cartoon laboratory flowsheet (p.207) - description of heavy liquid separation media (p.209) - 4 references on heavy liquid and magnetic separation methods.

White,SH, de Boorder,H and Smith,CB
Structural controls of kimberlite and lamproite emplacement.
J.Geochem.Explor. 53, 245-264 (1995).
On diamond exploration - structural geology - mechanisms of emplacement - kimberlite and lamproite - regional structures - sketch maps - W.Australia - S.Australia - Russia, USSR - Kola Peninsula - the Archangel kimberlite fields - Ellendale - faults and shear zones - the Lucapa Corridor in Angola, Africa - the Halls Creek mobile zone, northwest Australia - kimberlite fields of ** S.Africa - west Africa - Yengema area, Sierra Leone.

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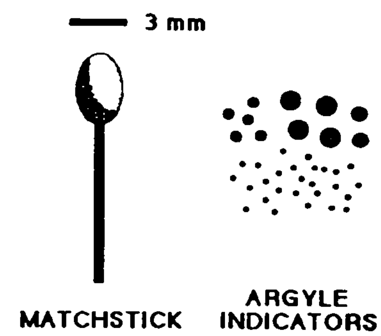
Size and number of indicator grains leading to the discovery of the Argyle diamond mine (Muggeridge, 1995):



The following 5 pages are taken from Muggeridge (1995, pp.186, 192-193, 194) on program design, river site sampling and indicator minerals, and from Macnae (1995, p.240) on the physical properties of kimberlites and lamproites.

From Muggeridge (1995):

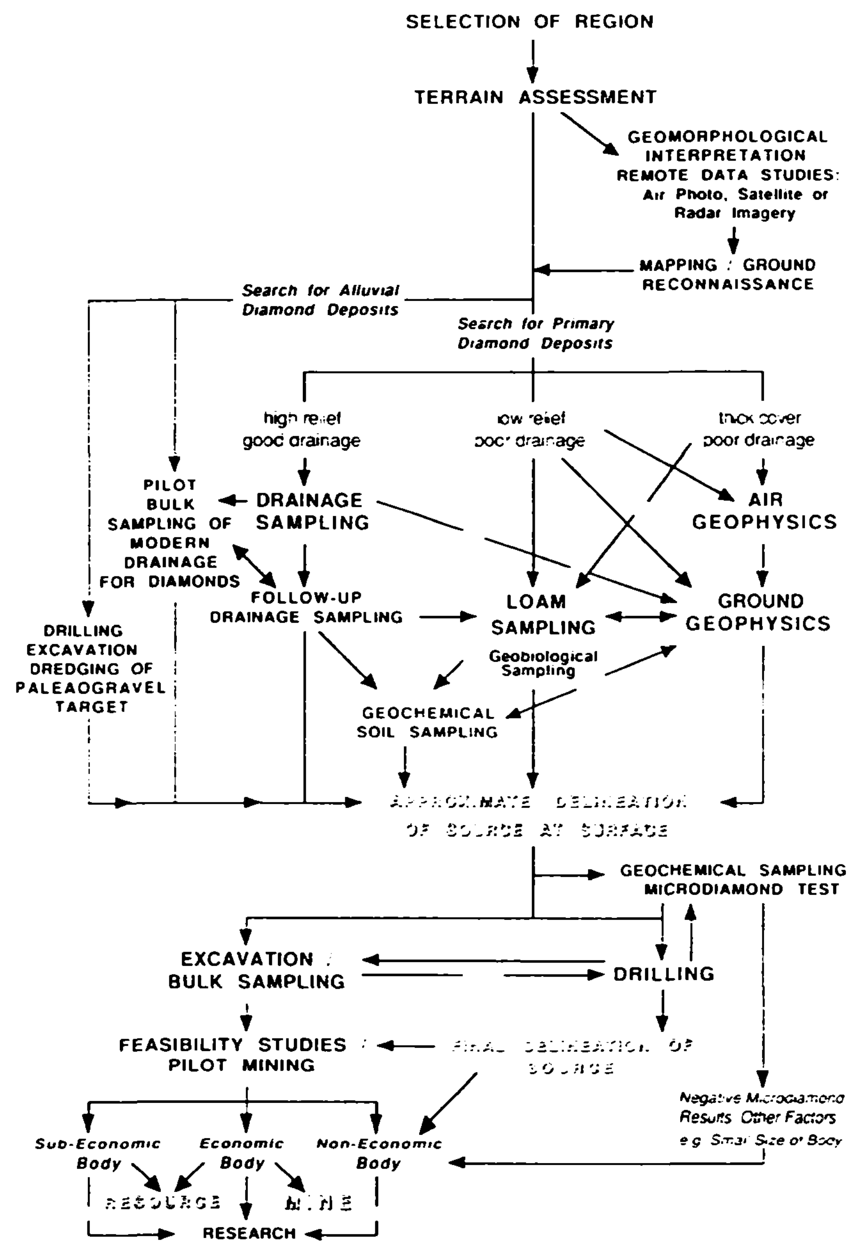


Fig. 2. Locating diamond deposits: exploration flowchart.

From Muggeridge (1995):

Table 1
Characteristics of important pathfinder minerals from kimberlitic rocks (Mitchell and Bergman, 1991, Deer et al., 1966; Dana, 1932)

Mineral	Composition [a]	Crystal system	Kimberlitic macro-phase [b]	Maximum grain size range (cm) normal–rare	Response to hand magnet
Pyrope garnet	Mg Al silicate, *Fe, Ca, Cr, Ti*	Isometric	Megacryst, macrocryst, ?phenocryst [c]	1–15 [c]	None to very weak
Picroilmenite	Mg Fe Ti oxide, *Cr, Mn, Al, Si*	Trigonal	Megacryst, macrocryst	2–10 [c]	Medium to strong (ferromagnetic)
Chrome diopside (clinopyroxene)	Ca Mg silicate, *Fe, Cr, Al, Na*	Monoclinic	Megacryst, macrocryst	2–15	None to very weak
Diopside (clinopyroxene)	Ca Mg silicate, *Fe, Al, Na, Ti, Cr*	Monoclinic	Megacryst, macrocryst, phenocryst	2–15 [c]	None to very weak
Chrome spinel	Mg Fe Cr Al oxide, *Mn, Ti*	Isometric	Macrocryst, phenocryst	0.2–0.8	Weak to medium (paramagnetic)
Phlogopite (mica)	Al Mg silicate, *K, Fe, Ti, Cr*	Monoclinic	Megacryst, macrocryst, phenocryst	1–10 [c]	Very weak to weak
Forsteritic olivine	Mg silicate, *Fe, Ni, Mn*	Orthorhombic	Megacryst, macrocryst, phenocryst	2–15 [c]	None to very weak
Enstatite/bronzite (orthopyroxene)	Mg silicate, *Fe, Al, Ca, Ti*	Orthorhombic	Megacryst, macrocryst	2–17 [c]	Weak (paramagnetic)
Zircon	Zr silicate, *Hf (diagnostic low U, Th [c])*	Tetragonal	Megacryst, macrocryst	1–4	None
Potassic richterite/magnesio katophorite (amphibole)	Mg K Ti silicate, *Fe, Ca, Na*	Monoclinic	Phenocryst	0.05–1.5 [c]	None
Priderite	Fe Ba K titanate (hollandite group)	Tetragonal	Phenocryst	0.05–0.4 [c]	None to very weak
Diamond	C native (*N, B*)	Isometric	Xenocryst	1–3 (Cullinan: ~8 cm!)	None

Colour	Specific gravity	Hardness (Moh)	Visible diagnostic features of kimberlitic minerals [d]	Main source rocks
Purple, red, crimson, mauve, orange, yellow	3.51	7.5	Anhedral, rounded shape; kelyphite rim (reaction corona); certain characteristic colours	Peridotite, kimberlite, lamproite, lamprophyre, carbonatite, (Certain basic volcanics)
Black	4.5–5	5–6	Anhedral shape (rounded or blocky); characteristic surface pitting; leucoxene coating	Kimberlite, (Certain basic volcanics, carbonatite)
Emerald-green	3.3–3.6	5–6	Anhedral, blocky (usual: in kimberlites); prismatic form (usual: in lamproites); cream-white surface alteration; characteristic colour	Kimberlite, lamproite, carbonatite
Bright green	3.3–3.6	5–6	Anhedral, rounded (in kimberlites) (cream-white surface alteration); prismatic form (lamproites and kimberlites); certain characteristic colours	Metamorphic rocks, picrites, lamprophyre, kimberlite, lamproite, akaline basic volcanics
Black	4.3–4.57	5.5	Grain surface morphology: e.g. satin-like sheen and fine layering, matte pitted surface, edge bevelling, smooth glossy surface	Lamproite, kimberlite, various ultramafic and basic rocks
Bronze, reddish-brown, green	2.78–2.85	2.5–3	Characteristic colour; rounded crystal edges	Ultrabasic rocks, metamorphosed limestones, lamproite, kimberlite, lamprophyre
Yellow–green	3.2–3.33	6–7	Characteristic colour; irregular crystal apices, vermiform etching	Peridotite, carbonatite, kimberlite, lamproite
Olive-green, brown	3.1–3.3	5.5	Characteristic colour; prismatic form, characteristic cleavage and striae	Peridotite, kimberlite
Colourless, grey, yellow, honey-brown, pink, reddish-brown	4.68–4.7	7.5	Anhedral, blocky shape; characteristic colour; characteristic surface pitting and "frosting"; fluorescence	Plutonic igneous rocks, kimberlite, high grade metamorphics, carbonatite
Rose-red, pinkish-brown	3.09	5–6	Characteristic colour, plate-like or tabular form	Lamproite (certain peridotitic xenoliths in kimberlite, lamprophyre)
Brownish-red	3.86	~6	Characteristic colour; adamantine lustre, basal cleavage or acicular form	Lamproite (carbonatite, kimberlite)
Colourless, pale colours (especially yellows and browns)	3.52	10	Adamantine lustre; characteristic crystal forms; resorption features; step layering	Kimberlite, lamproite (certain lamprophyres, certain high grade metamorphics)

[a] Roman type: essential, Italics: minor–trace.
[b] Terminology: non-genetic categories; megacryst 1–20 cm [c], macrocryst 0.5–10 mm [c].
[c] Mitchell (1986)
[d] By naked eye, hand lens, binocular microscope or ultra-violet lamp.

From Muggeridge (1995):

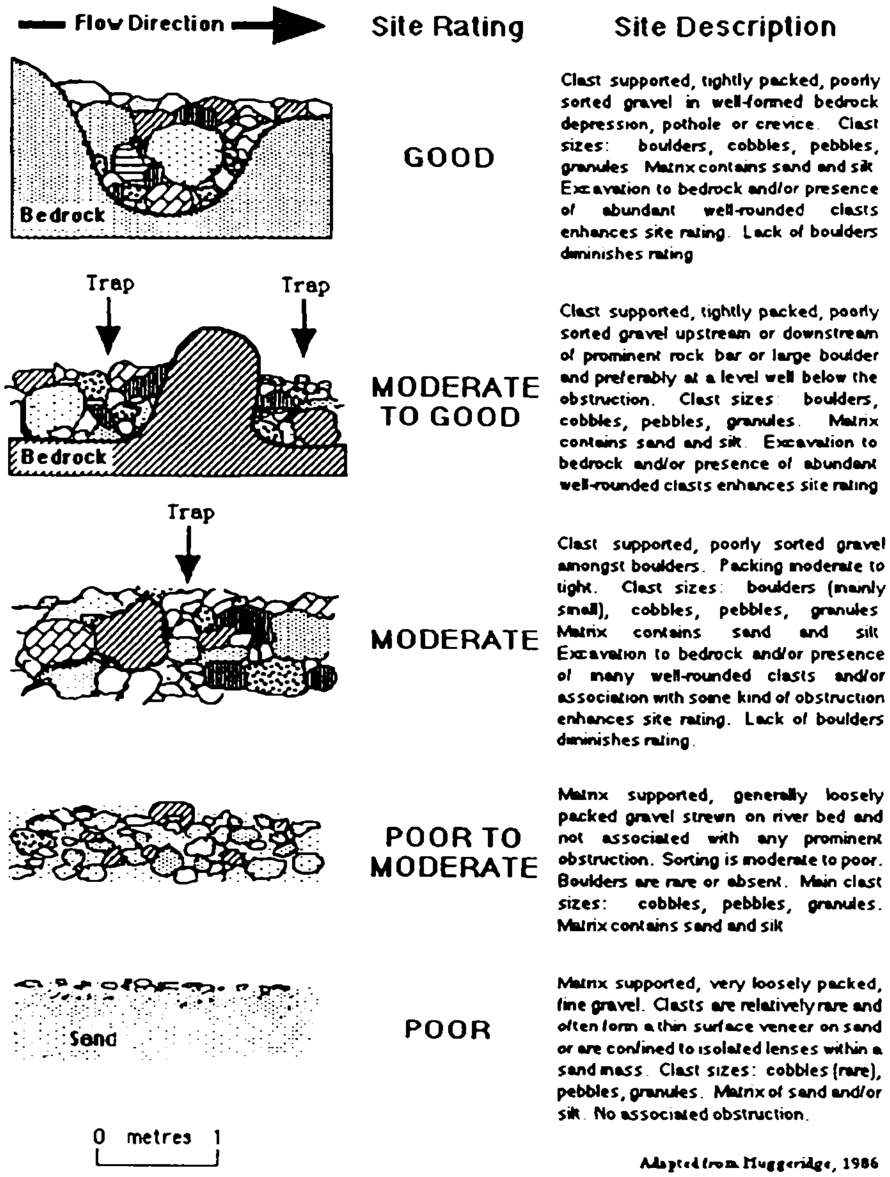


Fig. 5. River sample site classification.

From Macnae (1995):

Table 1
Summary of important physical properties of kimberlite and lamproite pipes

Feature	Property	Notes
"Diameter" of a pipe	< 1.5 km; > 100 m detectable from airborne geophysics	> 300 m minimum of economic interest?
Shape of pipe in plan	Circular to elliptical; multiple intrusions common	Coalescence of elliptical shapes if multiple
Shape of pipe in section	Cylindrical to carrot shaped diatreme; flatter conical vent	Erosion will remove material from original ~ 2 km depth of diatreme
Sediments in crater facies	Very conductive; non-magnetic; low density	Conductivity depends mainly on groundwater salinity and clay content
Weathered diatreme ("yellow ground" in kimberlites)	Conductive; non-magnetic; low density; weathers more easily than host	Conductivity from clays and groundwater in porous matrix
Partially weathered ("blue ground" in kimberlites)	Usually magnetic; intermediate conductivity; located at depths below host regolith development	Depth of weathering and physical properties vary significantly between intrusions
Unweathered diatreme facies	Magnetic; moderately resistive; high density	Magnetisation can be small
Sediment hosted at shallow depths	Uniform non-magnetic background at surface favourable	Conductive background expected
Unweathered Precambrian host	Pipes often associated with structure seen on regional magnetics, detectability depends on host magnetic properties	Conductivity at top detectable even in recently glaciated terrain
Weathered host	Magnetic sources in pipe deeper and anomalies smaller; possible surficial maghemite patches cause problems	Top of pipes usually more conductive than other regolith developments
Unconformably covered	Both magnetic and conductive pipe sources deeper by amount of cover	Conductive pipe material easily detectable through resistive cover such as carbonates, sand or snow and ice
Kimberlite magnetisation	Remanent 0.01 to 10 A/m; induced 0.001 to 0.5 A/m; viscous not quantified	Anomaly at magnetic source: remanent 12 to 12,000 nT, induced 1 to 600 nT
Lamproite (and mangeite) magnetisation	Factor of 10 smaller than kimberlite above	Factor of 10 smaller than kimberlite above
Typical airborne magnetic anomaly at 100 m altitude	Kimberlite 0–500 nT; lamproite 0–50 nT	Most anomalies at smaller end of the range

NOTES

14 -07- 1995

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MINLIB keyword summary:

The processing, sorting, classification and electron microprobe analysis (EPM, EDS spectra) of heavy mineral separates from the Nipigon Plate region - Ontario, Canada - nine samples were processed, plus a sample from the Lake Ellen kimberlite (Michigan, USA) - the non-magnetic, fine (250-1000 μm, 1500 μm at maximum) heavy fractions are the best for grain picking, although some good grains may also occur in the coarser 'medium' fractions - brief notes on diamond indicator minerals, EPM analysis and regional geology (Archean Quetico and Wabigoon subprovinces and Proterozoic Nipigon plate) - significance of the findings for three possible targets of geochemical exploration: mafic-ultramafic intrusions (such as Lac des Iles), kimberlites and felsic pegmatites - with 27 references and 3 tables detailing the petrography of the mineral separates, with 24 good-quality analyses of garnets and 10 analyses of other phases - Fe Ti oxide pairs are abundant: intergrown Ti magnetite and low- Mn ilmenite (0.6-1.4% MnO) - clinopyroxenes are ferroaugite to augite to diopside - garnets are almandine-rich, although some are also rich in spessartine (6/24 grains with >2% MnO, one with 21.6% MnO) - some of the local almandines are magnesian, nominally akin to the kimberlitic G5 type - 8 analyses of Lake Ellen garnets are provided, including G1 (or sodic eclogitic garnet? - Na_2O was not analysed), G3-G4, G5 and G9 garnets - other species noted in EDS spectra and semiquantitative / partial analyses (not included) are Cl -bearing apatite, olivine ($\approx Fo_{45}$), plagioclase feldspars ($\approx An_{20-55}$) and quartz - the mineral chemistry, and inclusions of quartz and biotite, suggest a regional metamorphic (metapelite) origin for most of the garnets, although the Mn-rich variants may be derived from felsic pegmatites - no kimberlitic grains were noted in the Ontario region, unless some of the garnets are G5s (more likely metamorphic?) - oxides and some other grains may have gabbroic provenance - bibliography of 73 items on diamonds and kimberlites in Ontario, 1899-1995, and an annotated bibliography of Griffin (1995), the J.Geochem.Explor. v.53 special issue on diamond exploration.

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EXPLORATION FOR KIMBERLITES AND DIAMONDS IN THE MIDCONTINENT RIFT, NORTHWESTERN ONTARIO

On behalf of
The American Rift Project

In association with:

Dr Gerald Harper,
Gamah International Ltd,
26 Orchard Crescent,
Toronto, Ontario M8Z 3E1

Tel (416)-232-9114/1881
Fax (416)-232-9254

and

Dr Francis T. Manns,
Artesian Mineral Services,
42 Highfield Road,
Toronto, Ontario M4L 2V1

Tel (416)-469-0609

By

Graham C. Wilson, PhD, FGAC
Turnstone Geological Services Ltd.
P.O. Box 130, Station "B", Toronto
Ontario CANADA M5T 2T3

Tel (416)-466-3386

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TGSL Project 1993-11

ABSTRACT

An initial collection of notes on exploration for kimberlites and diamonds in the Ontario portion of the late Proterozoic Midcontinent Rift. The following is an interim compilation of information, for the use of participants in the "American Rift Project" in the compilation of a market prospectus. The exploration program includes the identification of promising geophysical targets, and regional geochemical testing involving diamond 'indicator minerals'.

The initial data comprise (a) field notes relevant to claim staking in September, 1993; (b) the locations and sizes of all samples collected during the fieldwork; and (c) a first selection of relevant references in the geological literature. Projected follow-up work includes the separation and characterization of diamond indicator minerals, and planning of optimal ground-based geophysical surveying on the claims, to be carried out as soon as possible after the completion of line-cutting on the targets, and constitutes a prerequisite for a program of drill testing.

INTRODUCTION: TARGET LOCATIONS

The following information refers to field work conducted for the American Rift Project, 19-26 September 1993. The field area lies within NTS sheet 52A. Access to the region is very straightforward, via Highway 17 (the Trans-Canada Highway) northeast of Thunder Bay, and Highway 527, which runs from the Trans-Canada for 240 km north to Armstrong. The development of a system of logging roads allows seasonal 2-wheel-drive access to the East claims, while the West claims are reached by ≈2 km of bushwacking from starting points on the west side of Highway 527. The East claims are located about 7 km SSW of the south end of Greenwich Lake, in the northern drainage of the Mackenzie River. The West claims are located east of the south end of Dog Lake, between Rescue Lake and the northern end of Onion Lake (a part of the Current River), 2-3 km west of Highway 527.

The terrain is gently undulating, with moderate relief, slight rock ridges and gullies commonly following a dominant northeast- southwest trend. Both clear-cut and selective logging practices have been carried out in the area. Woodland trees include species of pines and spruce, white birch, poplar and minor tamarack. Beaver-dammed lakes are very common. Other mammals include moose, black bear and porcupine.

The exploration concept for the Project was developed by Gerald Harper. Airborne magnetic and electromagnetic data on the region provided the initial stimulus for exploration in the present context. Under favourable circumstances, interpretations of the origins of anomalies can be derived even in the presence of conductive overburden (Ghosh, 1972). The local magnetic maps reveal more detail than the intriguing regional maps for the entire province (Gupta, 1991). Circular magnetic anomalies, with or without coincident EM anomalies, occur in the area (Anon, 1962; Ontario Geological Survey, 1991a,b,c). The target area has better geophysical coverage today than in the recent past (Ontario Geological Survey, 1991d). In the East claims, the target magnetic anomaly is about 250 gamma above the 59110 gamma base level. In the West claims, the anomaly is 210 gamma above the 59030 gamma base level. The elongate ENE-WSW anomaly immediately to the north, 160 gamma above the base level, disturbs a compass strongly at ground level: the local effect is suspected to stem from a suite of buried en echelon diabase dykes. Lineament analysis based on satellite remote sensing data for the region reveals a number of promising intersections within the target area (Mussakowski and Trowell, 1992).

Notes on the location of the two claim blocks, made during the marking of the perimeter lines, are given in Appendix I. Magnetic interference on compass bearings was not appreciable during the staking of the two claim blocks, although serious interferences attend the elongate ENE-WSW anomaly to the north of the West claims, as noted above.

LOCAL GEOLOGY AND SAMPLE DESCRIPTIONS

While detailed studies are few, the region is covered by a number of publications, both for Archean and Proterozoic bedrock geology (Macdonald, 1939; Pye and Fenwick, 1965; Ayres et al., 1971) and Quaternary geology (Burwasser, 1981; Mollard and Mollard, 1981a,b). The geology of the Midcontinent Rift is characterized by voluminous tholeiitic magmatism, expressed in Keweenawan lava flows, diabase sills and dyke swarms, and discrete gabbroic to ultramafic intrusives (Smith and Sutcliffe, 1987; Sutcliffe, 1991).

The local Archean bedrock, patchily displayed along road cuts, lake shores and in low, rounded woodland outcrops, has an overall exposure of ≈ 1 percent. Micaceous schist and gneiss, frequently biotite-rich, enclosing boudinaged felsic segregations, are the most common rock type. White 'bull' quartz and small pegmatitic segregations parallel to foliation are common in the supracrustal rocks, assumed to be of predominantly metasedimentary origin. Granitoid blocks and outcrops are common, and are notably rich in leucogranitic and pegmatitic material, generally with abundant muscovite and plagioclase. Such material is typical of S-type granitoids, and may reflect the magmatism of the Georgia Lake pegmatite field in the region of Lake Nipigon (Pye, 1965). Float boulders, generally tens of cm to a few m in diameter, contain notable concentrations of mafic-ultramafic rocks and red clastic sediments. The latter are derived from the Proterozoic Sibley Group (Moorhouse, 1957; Pye, 1965; Sutcliffe, 1991). Some vein Ag occurrences and amethyst deposits near Lake Superior both appear to be associated with the Archean- Proterozoic unconformity, with veins in fault and breccia zones separating Archean granitoids and Proterozoic Sibley Group sediments (Scott, 1985; Garland, 1992). The ultramafic materials may be derived from igneous complexes to the north and northeast, such as the Lac des Iles complex and the Beardmore ring dyke (Sutcliffe, 1991).

Sampling program

Nine large ($\approx$20 kg) samples of glaciofluvial deposits were gathered as part of a regional reconnaissance, with the intention of processing them for their heavy mineral content. In addition, three hand specimens of exposed bedrock were collected from the claims, and one sample of unusual float from the vicinity of Highway 527. Sample descriptions are appended, for sand and gravel samples (Tables 1-2) and hand specimens (Table 3). The coarse fraction is dominated by lithic clasts, 5-30 mm in diameter. The persistence of pebble-sized materials (Table 2) is obviously a reflection of mechanical resistance to abrasion, hence the abundant red siltstones of the Sibley Group are mostly a few mm in maximum dimension, as opposed to common cm-size pebbles of granitoids. The nine samples totalled 197.2 kg, averaging 21.9 ± 4.8 kg, the medium size fraction after washing totalling 42.5 kg (averaging 21% of the total, varying from 7 to 33 weight percent of each sample). Some samples were very clean (3,4,7,8) whereas others contained much sticky clay (1,2). For the record, the NTS locations of the nine sand samples are listed below (UTM zone 16, NTS sheet 52A/NE [1-4] or 52A/NW [5-9]):

Sample	Coordinates	Notes
1	642981	Mackenzie River valley
2	506936	Logging road
3	492936	Logging road
4	444963	The 'camp site' gravel pit, Current River
5	487014	Highway 527
6	471916	Highway 527
7	469884	Highway 527
8	453860	Highway 527
9	445963	Current River

DIAMONDS AND KIMBERLITIC ROCKS IN ONTARIO

The occurrence of diamonds has long been noted in the northern Midwestern states such as Wisconsin, Michigan and Ohio (Hobbs, 1899). The late nineteenth-century finds in glacial float and in stream gravels led Archibald Blue to speculate on the possibility of finding diamonds in Ontario (Blue, 1900). Hobbs described 17 macroscopic diamonds found in the Great Lakes region of the USA in the last quarter of the last century. Small diamonds in Plum Creek (Rock Elm township, Pierce county, Wisconsin) were found in well-worn gravel, and said to be associated with garnets, gold and platinum. The largest stone was the pale yellow Kohlsville diamond, 20x13x10 mm, found in kettle moraine on a farm in Wisconsin. Hobbs wrote a section on "the ancestral home of the diamond" and noted (p.384) that "the material from which the diamonds were derived must clearly have been to the northward beyond the lakes, in the wilderness of Canada".

In Ontario, carbonatites and kimberlites represent five intrusive events, age dated at 2700-2500 Ma, 1850-1700 Ma, 1250-900 Ma, 650-450 Ma and ≈150 Ma (Sage, 1991). Structural controls are evident in many alkaline intrusives in eastern Canada (ibid., p.687). Although diamond exploration in Ontario has been something of a footnote to the past century's mining of gold, base metals and uranium, a significant body of published information is available on the subject of kimberlitic rocks and diamonds in the province. This is indicated by the selected bibliography compiled in Appendix II.

FUTURE PROGRAM

Our sampling program can be compared to other recent North American exploration efforts in terms of sample size and screening (c.f., Swanson and Gent, 1992). The glaciofluvial samples will be subjected to further processing, including flotation techniques and magnetic separation (Hutchison, 1974, pp.116-120), as required to liberate desired heavy minerals. Garnets, Cr diopside and oxide phases (ilmenite, magnetite, chromite, etc) will be sought. Once suitable grains are identified, 40-50 will be mounted on a glass slide and prepared as a polished thin section for microprobe analysis.

Subject to funding, line-cutting and a detailed ground geophysical survey of the aeromagnetic anomalies will be conducted as soon as possible.

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TABLE 1. DATA ON SAND AND GRAVEL SAMPLES

Sample	Coarse	Medium	Fine	Clay	Other Loss	Total
1	3.2	6.0	8.7	0.2	0.1	18.2
2	1.1	2.2	8.4	3.2	0.3	15.2
3	0.4	1.5	16.2	2.0	0.4	20.5
4	2.8	9.2	16.4	2.0	0.5	30.9
5	7.3	6.0	10.8	4.0	0.0	28.1
6	3.0	5.2	11.3	0.6	0.1	20.2
7	0.4	5.0	15.1	0.2	1.1	21.8
8	0.4	4.2	18.2	0.0	-0.6	22.2
9	2.0	3.2 (min)	14.9 (max)	?	?	20.1

All weights quoted in kg. Values are approximate, weighed in the field using a 20-kg spring balance, corrected for weight of plastic sample buckets. Field sample preparation is as follows:

(a) The coarse material is nominally >5 mm in grainsize (0.25" mesh, 12 holes per 3"). This material was dry-screened, washed in the river and weighed. Roots and other contaminants (such as four Cu or Pb bullets found in gravel pits used as shooting ranges) were removed. The residue was then examined to yield a crude estimate of modal proportions (Table 2) and discarded.
(b) The medium and fine fractions, nominally separated at 1 mm grain size, were also dry-screened, the most time-consuming part of the process. Mesh size here averages very slightly >1 mm (≈45 holes per 3", mean hole+wire width ≈1.6 mm). A small bag of the fines was saved for lab analysis. All the medium fraction was saved, after the river washing which caused the loss of adhering fines (the 'clay'). Weighing inaccuracies are reflected by the 'other loss' column, and the quoted total is the sample weight prior to treatment.

Geographic notes:

1. Poorly-sorted coarse fluvial outwash in bank on N side of logging road, 20 m W of south-flowing arm of the Mackenzie River, 2.4 km E from the #1 post of the East claims. No suitable fines found in river bed here. Sample above present river level.
2. Fine deposits above rock outcrop on S side of logging road, 4.0 km E of Highway 527.
3. Gravel pit, N side of logging road, 2.8 km E of Highway 527. Bedded materials, remains of an esker.
4. NW corner of gravel pit near Project's camp site, E side of Current River, NE of Onion Lake, some 1.3 km W of Highway 527 on S side of access road to logging camp 46 (this turn to the logging camp on W side of 527 is ≈25.9 km north of the Trans-Canada).
5. Further north, in area of microwave tower E of Highway 527. The NMT (northern microwave tower) site. Next 3 sites are further south:
6. Esker at Whitelily Lake turn, E side of Highway 527.
7. Gravel pit on W side of Highway 527, the more northerly of 2 pits shown on local topographic map.
8. From quarry S of sample 7 site, on W side of Highway 527.
9. E side of Current River by camp site, near SW corner of gravel pit of sample 4. Mixture of fine stream sediments in back-eddy of river with greyer, fine bank sands. Sampled wet, hard to handle, needed wet screening, hence modified statistics given above (medium + fine incompletely separated).

TABLE 2. MODAL PROPORTIONS, COARSE FRACTIONS

Sample	Granitoids	MV/MS	M-UM	Sibley	Etc
1	40	40	-	20	-
2	30	30	10	30	Tr.
3	40	25	-	35	-
4	35	50	-	15	-
5	60	15	10	15	-
6	50	35	5	10	-
7	75	20	-	5	Tr.
8	50	25	Tr.	25	Tr.
9	60	25	Tr.	15	-

Granitoid pebbles include all granitic intrusives plus grains of quartz and feldspars and (more rarely) mica flakes. The dark pebbles of fine-grained material include massive to foliated 'metavolcanics' (basalt ± diabase) and metasediments (phyllites). Coarse mafic-ultramafic rocks (often found as boulders on roadsides) are catalogued separately. The red clastic sediments of the Sibley Group are very distinctive. Other notable lithologies flagged in the last column include banded iron formation (BIF, sample 2) and (?) chloritoid schist (samples 7,8). The volcanics in sample 5 included a large pebble of strikingly coarse feldspar-phyric diabase, phenocrysts mostly tabular, ≈5 mm in size. An ultramafic pebble in sample 8 is composed largely of fibrous asbestos. In sample 3, 10% out of the 25% MV/MS may be grey Sibley sediment. Grey phyllites in sample 9 displayed foliation and a striking amount of rather coarse muscovite flakes, suggesting a relatively proximal source.

TABLE 3. HAND SPECIMEN NOTES

Hand specimens, 1556-1559, records from Turnstone's **SAMPA** database.

1556 — Biotite schist

Small cliff of bedrock, in situ, 440 m north on W line of the 'West claims' (1151082), between Onion Lake and Rescue Lake, north of Thunder Bay, in the Current River drainage west of Hwy 527, southwest of Lake Nipigon. UTM 16, NTS sheet 52/A, ≈428941.
22 Sep 1993.
Biotite schist with foliation-parallel lenticles of granular quartz. Not appreciably magnetic, no eff in dil HCl.
HS. FNB, p.134. Archean.

1557 — K-feldspar muscovite granite

Moss-covered bedrock outcrop, in situ, 200 m north on W line of the 'East claims' (1151126), west of the Mackenzie River, north of Thunder Bay, just north of a major logging road east of Hwy 527, southwest of Lake Nipigon. UTM 16, NTS sheet 52/A, ≈604970.
23 Sep 1993.
Massive, salmon pink K-feldspar-muscovite granite, not appreciably magnetic, no eff in dil HCl.
HS. FNB, p.143. Archean.

1558 — Banded leucogranite

From striking bedrock outcrop, loose, north side of logging road in the 'East claims' (1151126), west of the Mackenzie River, north of Thunder Bay, east of Hwy 527, southwest of Lake Nipigon. UTM 16, NTS sheet 52/A, ≈616972.
23 Sep 1993.
From spectacular outcrop of S-type leucogranite with BUSTs (banded unidirectional solidification textures à la Macdonald) over tens of cm, adjacent to dark gneiss host rock. White pegmatite-aplite banding. 24x11x10 cm sample displays mm-cm-scale bands of albite, quartz, muscovite (zinnwaldite?) and dark garnet/sphene. Not appreciably magnetic, no eff in dil HCl.
HS. FNB, p.145. Archean.

1559 — Mafic nodular block (?)

Loose float boulder, near Highway 527, north of Thunder Bay, southwest of Lake Nipigon. UTM 16, NTS sheet 52/A.
24 Sep 1993.
Mafic-ultramafic(?) block displays nodular weathering (the bulk of the ≈20 cm block resides in Anne and Gerry Harper's garden in Toronto!). Found by Fran and Gerry. Unusual rock, fgr matrix seems talcose, thought to be an odd serpentinite with (?) orthopyroxene clots standing proud on the rusty-weathering exterior. Not appreciably magnetic, no eff in dil HCl.
HS. Archean.

APPENDIX I.
NOTES ON CLAIM LINES

The West claims (4 in total, a 2x2 block, 800x800 m, 22 September):

Claim tag 1151082

Metres	*Notes*
East side	
0	#1 Post (NE corner)
225	Hill crest
250	Bog
325	Low mossy ridge trends NE-SW
480	North edge of clear-cut area
550	Low outcrops in next 50 m (grey gneiss, small boudins, strike 250°)
700	Bog
740	South edge of clear-cut
800	#2 post (SE corner) on N side of elongate bog trending NE-SW
South side	
60	Back into clear-cut
130	Gneiss outcrop
150	Leave clear-cut (which ends just to the south?)
195	Low outcrops for 15 m
300	Alder thicket
310	Line rises out of bog
475	Little valley
640	Gully
645	Rock ridge
800	#3 post (SW corner)
West side	
50	Large upstanding rock outcrop
200	Low, NE-striking rocky hummock
255	Another hummock, rivulet in gully on N side
270	Line crosses ridge for 25 m
305	Small ridge
340	S edge of steep gorge
370	Centre of gorge strikes 60°
390	Steep N wall of gorge
440	Small cliff - sample 1556, in situ
500	Pleasant flat forest floor, 50 m
800	#4 post (NW corner), easy going to east

Metres	*Notes*
North side	
250	On right side, steep slope down to S and SE
300	Lake, 100 m wide, crossed to north via 2 beaver dams and small island
540	Lake, 110 m wide, bypassed to N. Shore outcrops of black gneiss/quartz veins
650	Line just north of pile of granite boulders on shore. 50 m of thickets to E
720	Small rivulet flows northwards
750	Small N-S outcrop of red granite
800	#1 post: on line with northern line: closure error only 30 m.

The East claims (8 in total, a 4x2 block, long axis runs E-W, 1600x800 m, 23-24 September):
Claim tag 1151126

East side	
0	#1 post (NE corner) in small bog on north side of major logging road
20	Logging road
110	Unburnt forestry slash for 30 m
200	Boulders of mafic biotite schist
250	Forestry slash trends 60°, for 60 m
275	Small outcrop
300	Small outcrop: milky ('bull') quartz in chloritic schist
335	Slope down to S
350	Lake to E, for 200 m
390	Small bog, open to lake to E
670	Between 2 large boulders
725	White blocks of quartz-feldspar-muscovite pegmatite
800	#2 post (SE corner)
South side	
240	A logging road
400	Open bog
750	Large conical boulder, above W edge of the large boggy area
1360	The main logging road which passes the #1 post
1600	#3 post (SW corner)

Metres	*Notes*
West side	
50	A blow-down, small natural clearing in the woods
120	Mossy slope, slight declivity to E
200	Extensive mossy outcrop of pink muscovitic leucogranite, epidote on fractures - site of sample 1557, in situ. Open woodland
250	Small clearing down to E
350	Mossy boggy forest floor for 50 m
550	Small clearing
700	Deep thicket
800	#4 post (NW corner)
North side	
80	Entering small bog
150	Centre of narrow slough trending 20°
200	Higher ground to S, small bog to N, good bush to E
400	Placed substantial flagging in this area
800	Side post at this point is near white granitoid boulders
1010	Shallow gully, trending 320°, small swamp to N
1100	Open woodland, sometimes boggy underfoot, for 50 m
1255	Small N-S swamp for 40 m
1490	17 km sign on logging road on south side. Winter camp site by road
1600	#1 post

Note that, in each claim block, line posts are placed every 400 m around the perimeter. Favourable spacing of obstacles such as lakes obviated the need for witness posts. The claims occupy 64 ha (West) and 128 ha (East), a total of 192 ha (1.92 km^2, 475 acres, 0.74 mi^2). Magnetic bearing (1985) was ≈2°15' W.

APPENDIX II.
BIBLIOGRAPHY OF THE OCCURRENCE OF DIAMONDS, KIMBERLITES AND LAMPROITES IN ONTARIO

Turnstone Geological Services Ltd,
P.O. Box 130, Station 'B', Toronto M5T 2T3
Output from the MINLIB database,

September 30, 1993

(39 items selected from 49 hits, 4 pages, from 26,139 entries in MINLIB)
Search Code 'DKL/ONT' - covers the subject matter
Fields searched: 2 logicals

N.B. A few items are confidential, not for general distribution

ANON (1992a) Sudbury Contact price jumps with diamond find at Kirkland Lake. Northern Miner 78 no.5, 1-2.

ANON (1992b) Diamond fever at Kirkland Lake. Northern Miner 78 no.14, B1-2.

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Not part of report...

GCW accounting notes.

1. Elapsed time:

19-26 Sep	Travel, staking, sampling, sample processing	8.0 days
29 Sep	Report processing	1.0 days
Grand Total		9.0 days

2. Inclusive Costs:

18 Sep	Food	4.71
19 Sep	Food	13.40
20 Sep	Food	4.27
20 Sep	Travel (gas)	35.00
20 Sep	Food	4.00
20 Sep	Travel (gas,oil)	44.87
25 Sep	Food	26.48
Subtotal		132.73 (includes 5.72 GST)
28 Sep	Books and maps	75.90 (includes 4.83 GST)
Grand Total		208.63

****

Gerry and Fran notes also required, to form basis of costs recoverable in any option agreement / filing of assessment work.

*****

Note for Gerry

SPRINGER,JS (1985) Colour clues to concentration of iron pigments and gold at the Paleozoic-Precambrian unconformity. OGS Misc.Pap. 126, 253-256.

Ontario, Canada - Grenville - Hastings County - pigments - hematite-rich 'red earths' in area locally represent supergene Au enrichments above sulphide ores - Cordova Mine - remote sensing - Paleozoic carbonate karst.

Ministry of Northern Development and Mines
Ontario

Report of Work Conducted After Recording Claim

Mining Act

Transaction Number: W9540.274

Claim Block 1151126

ersonal information collected on this form is obtained under the authority of the Mining Act. This information will be used for correspondence. Questions about this collection should be directed to the Provincial Manager, Mining Lands, Ministry of Northern Development and Mines, Fourth Floor, 159 Cedar Street, Sudbury, Ontario, P3E 6A5, telephone (705) 670-7264.

2.16251

nstructions:
- Please type or print and submit in duplicate.
- Refer to the Mining Act and Regulations fo ... work or consult the Mining Recorder.
- A separate copy of this form must be com
- Technical reports and maps must accomp
- A sketch, showing the claims the work is a

52A10NW0017 2 16251 TARTAN LAKE

900

Recorded Holder(s)		Client No.
Dr. Gerald Harper		CLN 141927
Address		**Telephone No.**
26 Orchard Crescent, Toronto, Ontario. M8Z 3E1		416-232-1881
Mining Division	**Township/Area**	**M or G Plan No.**
Thunder Bay	See report for location	G2706
Dates Work Performed From: 8 October 1993	To: 3 October 1995	

Work Performed (Check One Work Group Only)

	Work Group	Type
X	Geotechnical Survey	Geological and geochemical.
	Physical Work, Including Drilling	
	Rehabilitation	
	Other Authorized Work	
	Assays	
	Assignment from Reserve	

RECEIVED NOV 02 1995 MINING LANDS BRANCH

Total Assessment Work Claimed on the Attached Statement of Costs $ 6774.~~52~~

Note: The Minister may reject for assessment work credit all or part of the assessment work submitted if the recorded holder cannot verify expenditures claimed in the statement of costs within 30 days of a request for verification.

Persons and Survey Company Who Performed the Work (Give Name and Address of Author of Report)

Name	Address
Peter MacMartin (Author)	10 Oakmount Road, Toronto, Ontario. M6P 2M4
Lorraine Godwin Dr. Graham Wilson	
Gamah International Limited	
Turnstone Geological Services Ltd.	

(attach a schedule if necessary)

RECEIVED NOV 02 1995 MINING LANDS BRANCH

Certification of Beneficial Interest * See Note No. 1 on reverse side

I certify that at the time the work was performed, the claims covered in this work report were recorded in the current holder's name or held under a beneficial interest by the current recorded holder.	Date: 3 October 1995	Recorded Holder or Agent (Signature): [signature]

Certification of Work Report

I certify that I have a personal knowledge of the facts set forth in this Work report, having performed the work or witnessed same during and/or after its completion and annexed report is true.

Name and Address of Person Certifying: Peter MacMartin, 10 Oakmount Road, Toronto, Ontario. M6P 2M4

Telephone No.	Date	Certified By (Signature)
416-763-1901	3 October 1995	Peter MacMartin

For Office Use Only

Total Value Cr. Recorded	Date Recorded	Mining Recorder	Received Stamp
6774		[signature]	RECEIVED OCT - 5 1995 A.M. 7 8 9 10 11 12 1 2 3 4 5 P.M.
	Deemed Approval Date: Jan 3/96	Date Approved	
	Date Notice for Amendments Sent		

Work Report Number for Applying Reserve	Claim Number (see Note 2)	Number of Claim Units	Value of Assessment Work Done on this Claim	Value Applied to this Claim	Value Assigned from this Claim	Reserve: Work to be Claimed at a Future Date
	1151126	8	~~$6773.52~~ $6774	$6400.00	~~$373.52~~	~~$373.52~~ $374
	Total Number of Claims: 1		Total Value Work Done: ~~$6773.52~~ $6774	Total Value Work Applied: $6400.00	Total Assigned From: $373.52	Total Reserve: ~~$373.52~~ $374

Credits you are claiming in this report may be cut back. In order to minimize the adverse effects of such deletions, please indicate from which claims you wish to priorize the deletion of credits. Please mark (✓) one of the following:

1. ☐ Credits are to be cut back starting with the claim listed last, working backwards.
2. ☐ Credits are to be cut back equally over all claims contained in this report of work.
3. ☐ Credits are to be cut back as priorized on the attached appendix.

In the event that you have not specified your choice of priority, option one will be implemented.

Note 1: Examples of beneficial interest are unrecorded transfers, option agreements, memorandum of agreements, etc., with respect to the mining claims.

Note 2: If work has been performed on patented or leased land, please complete the following:

I certify that the recorded holder had a beneficial interest in the patented or leased land at the time the work was performed.	Signature	Date

Ministry of Northern Development and Mines
Ontario

Ministère du Développement du Nord et des mines

Statement of Costs for Assessment Credit
État des coûts aux fins du crédit d'évaluation

Mining Act/Loi sur les mines

Transaction No./N° de transaction: W9540.274

Claim Block 1151126

2.16251

Personal information collected on this form is obtained under the authority of the **Mining Act**. This information will be used to maintain a record and ongoing status of the mining claim(s). Questions about this collection should be directed to the Provincial Manager, Minings Lands, Ministry of Northern Development and Mines, 4th Floor, 159 Cedar Street, Sudbury, Ontario P3E 6A5, telephone (705) 670-7264.

Les renseignements personnels contenus dans la présente formule sont recueillis en vertu de la **Loi sur les mines** et serviront à tenir à jour un registre des concessions minières. Adresser toute question sur la collecte de ces renseignements au chef provincial des terrains miniers, ministère du Développement du Nord et des Mines, 159, rue Cedar, 4e étage, Sudbury (Ontario) P3E 6A5, téléphone (705) 670-7264.

1. Direct Costs/Coûts directs

Type	Description	Amount Montant	Totals Total global
Wages Salaires	Labour Main-d'oeuvre	720.00	
	Field Supervision Supervision sur le terrain	700.00	1420.00
Contractor's and Consultant's Fees Droits de l'entrepreneur et de l'expert-conseil	Type: Research on heavy mineral separates	2210.60	
	Report preparation	1355.00	3565.60
Supplies Used Fournitures utilisées	Type: Field expenses	659.00	
	RECEIVED		659.00
Equipment Rental Location de matériel	Type: NOV 02 1995		
	MINING LANDS BRANCH		
		Total Direct Costs Total des coûts directs	5644.60

2. Indirect Costs/Coûts indirects

** **Note:** When claiming Rehabilitation work Indirect costs are not allowable as assessment work.
Pour le remboursement des travaux de réhabilitation, les coûts indirects ne sont pas admissibles en tant que travaux d'évaluation.

Type	Description	Amount Montant	Totals Total global
Transportation Transport	Type: Vehicle rental	759.50	
	Vehicle expense	632.58	
	RECEIVED		1392.08
Food and Lodging Nourriture et hébergement	NOV 02 1995	592.49	592.49
Mobilization and Demobilization Mobilisation et démobilisation	MINING LANDS BRANCH		
		Sub Total of Indirect Costs Total partiel des coûts indirects	1984.57
		Amount Allowable (not greater than 20% of Direct Costs) Montant admissible (n'excédant pas 20 % des coûts directs)	1128.92
		Total Value of Assessment Credit (Total of Direct and Allowable Indirect costs) Valeur totale du crédit d'évaluation (Total des coûts directs et indirects admissibles)	6773.52

Note: The recorded holder will be required to verify expenditures claimed in this statement of costs within 30 days of a request for verification. If verification is not made, the Minister may reject for assessment work all or part of the assessment work submitted.

Note : Le titulaire enregistré sera tenu de vérifier les dépenses demandées dans le présent état des coûts dans les 30 jours suivant une demande à cet effet. Si la vérification n'est pas effectuée, le ministre peut rejeter tout ou une partie des travaux d'évaluation présentés.

Filing Discounts

1. Work filed within two years of completion is claimed at 100% of the above Total Value of Assessment Credit.
2. Work filed three, four or five years after completion is claimed at 50% of the above Total Value of Assessment Credit. See calculations below:

Total Value of Assessment Credit		Total Assessment Claimed
	× 0.50 =	

Remises pour dépôt

1. Les travaux déposés dans les deux ans suivant leur achèvement sont remboursés à 100 % de la valeur totale susmentionnée du crédit d'évaluation.
2. Les travaux déposés trois, quatre ou cinq ans après leur achèvement sont remboursés à 50 % de la valeur totale du crédit d'évaluation susmentionné. Voir les calculs ci-dessous.

Valeur totale du crédit d'évaluation		Évaluation totale demandée
	× 0,50 =	

Certification Verifying Statement of Costs

I hereby certify:
that the amounts shown are as accurate as possible and these costs were incurred while conducting assessment work on the lands shown on the accompanying Report of Work form.

that as Agent (Recorded Holder, Agent, Position in Company) I am authorized to make this certification

Attestation de l'état des coûts

J'atteste par la présente :
que les montants indiqués sont le plus exact possible et que ces dépenses ont été engagées pour effectuer les travaux d'évaluation sur les terrains indiqués dans la formule de rapport de travail ci-joint.

Et qu'à titre de ____ (titulaire enregistré, représentant, poste occupé dans la compagnie) je suis autorisé à faire cette attestation.

Signature	Date
D. Truscott	3 October 1995

0212 (04/91)

Nota : Dans cette formule, lorsqu'il désigne des personnes, le masculin est utilisé au sens neutre.

Ministry of Northern Development and Mines
Ontario

Report of Work Conducted After Recording Claim

Mining Act

Transaction Number: W9540.275

Claim Block 1151082

2.16251

Personal information collected on this form is obtained under the authority of the Mining Act. This information will be used for correspondence. Questions about this collection should be directed to the Provincial Manager, Mining Lands, Ministry of Northern Development and Mines, Fourth Floor, 159 Cedar Street, Sudbury, Ontario, P3E 6A5, telephone (705) 670-7264.

Instructions:
- Please type or print and submit in duplicate.
- Refer to the Mining Act and Regulations for requirements of filing assessment work or consult the Mining Recorder.
- A separate copy of this form must be completed for each Work Group.
- Technical reports and maps must accompany this form in duplicate.
- A sketch, showing the claims the work is assigned to, must accompany this form.

Recorded Holder(s): Dr. Gerald Harper		Client No.: CLN 141927
Address: 26 Orchard Crescent, Toronto, Ontario. M8Z 3E1		Telephone No.: 416-232-1881
Mining Division: Thunder Bay	Township/Area: See report for location	M or G Plan No.: G2706
Dates Work Performed From: 8 October 1993	To: 3 October 1995	

Work Performed (Check One Work Group Only)

	Work Group	Type
X	Geotechnical Survey	Geological and geochemical.
	Physical Work, Including Drilling	RECEIVED
	Rehabilitation	
	Other Authorized Work	NOV 02 1995
	Assays	MINING LANDS BRANCH
	Assignment from Reserve	

Total Assessment Work Claimed on the Attached Statement of Costs $ 8565.77

Note: The Minister may reject for assessment work credit all or part of the assessment work submitted if the recorded holder cannot verify expenditures claimed in the statement of costs within 30 days of a request for verification.

Persons and Survey Company Who Performed the Work (Give Name and Address of Author of Report)

Name	Address
Peter MacMartin (Author)	10 Oakmount Road, Toronto, Ontario. M6P 2M4
Lorraine Godwin Dr. Graham Wilson	
Gamah International Limited	
Turnstone Geological Services Ltd.	

(attach a schedule if necessary)

Certification of Beneficial Interest * See Note No. 1 on reverse side

I certify that at the time the work was performed, the claims covered in this work report were recorded in the current holder's name or held under a beneficial interest by the current recorded holder.	Date: 3 October 1995	Recorded Holder or Agent (Signature): [signature]

Certification of Work Report

I certify that I have a personal knowledge of the facts set forth in this Work report, having performed the work or witnessed same during and/or after its completion and annexed report is true.

Name and Address of Person Certifying: Peter MacMartin, 10 Oakmount Road, Toronto, Ontario. M6P 2M4

Telephone No.: 416-763-1901	Date: 3 October 1995	Certified By (Signature): Peter MacMartin

For Office Use Only

Total Value Cr. Recorded	Date Recorded	Mining Recorder	Received Stamp
8565		M.G. Werner	RECEIVED OCT - 5 1995 A.M. 7 8 9 10 11 12 1 2 3 4 5 P.M.
	Deemed Approval Date: Jan 3/96	Date Approved	
	Date Notice for Amendments Sent		

2-1 (03/91)

Work Report Number for Applying Reserve	Claim Number (see Note 2)	Number of Claim Units	Value of Assessment Work Done on this Claim	Value Applied to this Claim	Value Assigned from this Claim	Reserve: Work to be Claimed at a Future Date
	1151082	4	$856~~4.77~~ 5	$3200.00	~~$5364.77~~	$536~~4.77~~ 5
	Total Number of Claims: 1		Total Value Work Done: $856~~4.77~~ 5	Total Value Work Applied: $3200.00	Total Assigned From: ~~$5364.77~~	Total Reserve: $536~~4.77~~ 5

Credits you are claiming in this report may be cut back. In order to minimize the adverse effects of such deletions, please indicate from which claims you wish to priorize the deletion of credits. Please mark (✓) one of the following:

1. ☐ Credits are to be cut back starting with the claim listed last, working backwards.
2. ☐ Credits are to be cut back equally over all claims contained in this report of work.
3. ☐ Credits are to be cut back as priorized on the attached appendix.

In the event that you have not specified your choice of priority, option one will be implemented.

Note 1: **Examples of beneficial interest are unrecorded transfers, option agreements, memorandum of agreements, etc., with respect to the mining claims.**

Note 2: ***If work has been performed on patented or leased land, please complete the following:***

I certify that the recorded holder had a beneficial interest in the patented or leased land at the time the work was performed.	Signature	Date

Northern Development and Mines
Ontario

Ministère du Développement du Nord et des mines

Statement of Costs for Assessment Credit

État des coûts aux fins du crédit d'évaluation

Mining Act/Loi sur les mines

Transaction No./N° de transaction: W9540-275

Claim Block 1151082

2.16251

Personal information collected on this form is obtained under the authority of the **Mining Act**. This information will be used to maintain a record and ongoing status of the mining claim(s). Questions about this collection should be directed to the Provincial Manager, Minings Lands, Ministry of Northern Development and Mines, 4th Floor, 159 Cedar Street, Sudbury, Ontario P3E 6A5, telephone (705) 670-7264.

Les renseignements personnels contenus dans la présente formule sont recueillis en vertu de la Loi sur les mines et serviront à tenir à jour un registre des concessions minières. Adresser toute quesiton sur la collece de ces renseignements au chef provincial des terrains miniers, ministère du Développement du Nord et des Mines, 159, rue Cedar, 4e étage, Sudbury (Ontario) P3E 6A5, téléphone (705) 670-7264.

1. Direct Costs/Coûts directs

Type	Description	Amount Montant	Totals Total global
Wages Salaires	Labour Main-d'oeuvre	432.00	
	Field Supervision Supervision sur le terrain	300.00	732.00
Contractor's and Consultant's Fees Droits de l'entrepreneur et de l'expert-conseil	Type: Heavy mineral	947.40	
	~~Petrographics~~	~~3506.52~~	
	Assays	895.27	
	~~Report prep.~~	~~1215.00~~	6564.19
Supplies Used Fournitures utilisées	Type: Field expenses	288.90	
			288.90
Equipment Rental Location de matériel	Type		
	Total Direct Costs Total des coûts directs		7585.09

2. Indirect Costs/Coûts indirects

** Note: When claiming Rehabilitation work Indirect costs are not allowable as assessment work.
Pour le remboursement des travaux de réhabilitation, les coûts indirects ne sont pas admissibles en tant que travaux d'évaluation.

Type	Description	Amount Montant	Totals Total global
Transportation Transport	Type: Vehicle rental	325.5	
	Vehicle expense	400.25	
			725.75
Food and Lodging Nourriture et hébergement		253.93	253.93
Mobilization and Demobilization Mobilisation et démobilisation			
	Sub Total of Indirect Costs Total partiel des coûts indirects		979.68
	Amount Allowable (not greater than 20% of Direct Costs) Montant admissible (n'excédant pas 20 % des coûts directs)		1517.02
	Total Value of Assessment Credit (Total of Direct and Allowable Indirect costs) Valeur totale du crédit d'évaluation (Total des coûts directs et indirects admissibles)		8564.77

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Note: The recorded holder will be required to verify expenditures claimed in this statement of costs within 30 days of a request for verification. If verification is not made, the Minister may reject for assessment work all or part of the assessment work submitted.

Note : Le titulaire enregistré sera tenu de vérifier les dépenses demandées dans le présent état des coûts dans les 30 jours suivant une demande à cet effet. Si la vérification n'est pas effectuée, le ministre peut rejeter tout ou une partie des travaux d'évaluation présentés.

Filing Discounts

1. Work filed within two years of completion is claimed at 100% of the above Total Value of Assessment Credit.
2. Work filed three, four or five years after completion is claimed at 50% of the above Total Value of Assessment Credit. 'See calculations below:

Total Value of Assessment Credit		Total Assessment Claimed
	x 0.50 =	

Remises pour dépôt

1. Les travaux déposés dans les deux ans suivant leur achèvement sont remboursés à 100 % de la valeur totale susmentionnée du crédit d'évaluation.
2. Les travaux déposés trois, quatre ou cinq ans après leur achèvement sont remboursés à 50 % de la valeur totale du crédit d'évaluation susmentionné. Voir les calculs ci-dessous.

Valeur totale du crédit d'évaluation		Évaluation totale demandée
	x 0,50 =	

Certification Verifying Statement of Costs

I hereby certify:
that the amounts shown are as accurate as possible and these costs were incurred while conducting assessment work on the lands shown on the accompanying Report of Work form.

that as Agent (Recorded Holder, Agent, Position in Company) I am authorized to make this certification

Attestation de l'état des coûts

J'atteste par la présente :
que les montants indiqués sont le plus exact possible et que ces dépenses ont été engagées pour effectuer les travaux d'évaluation sur les terrains indiqués dans la formule de rapport de travail ci-joint.

Et qu'à titre de ______ (titulaire enregistré, représentant, poste occupé dans la compagnie) je suis autorisé à faire cette attestation.

Signature	Date
[signature]	3 October 1995

? (04/91)

Nota : Dans cette formule, lorsqu'il désigne des personnes, le masculin est utilisé au sens neutre.

Ontario

Ministry of
Northern Development
and Mines

Ministère du
Développement du Nord
et des Mines

Geoscience Approvals Office
933 Ramsey Lake Road
6th Floor
Sudbury, Ontario
P3E 6B5

Telephone: (705) 670-5853
Fax: (705) 670-5863

January 30, 1996

Our File: 2.16251
Transaction #: W9540.00274
.00275

Mining Recorder
Ministry of Northern Development & Mines
435 James Street South, Suite B003
Thunder Bay, Ontario
P7E 6E3

Dear Sir:

Subject: APPROVAL OF ASSESSMENT WORK CREDITS ON MINING CLAIMS TB.1151126 & 1151082 IN THE TARTAN LAKE AND ONION LAKE AREAS

The deficiencies in the original submission have been rectified.

Assessment work credits have been approved as outlined on the original submission. The credits have been approved under Section 12, Geology and Section 17, Assays, Mining Act Regulations for W9540.00274. Credits have been approved under Section 12, Geology and Section 13, Geochemical, Mining Act Regulations for W9540.00275.

The approval date is January 22, 1996.

.../2

January 30, 1996
Mining Recorder, Thunder Bay, Ontario

If you have any questions regarding this correspondence, please contact Lucille Jerome at (705) 670-5858.

Yours Sincerely,
ORIGINAL SIGNED BY:

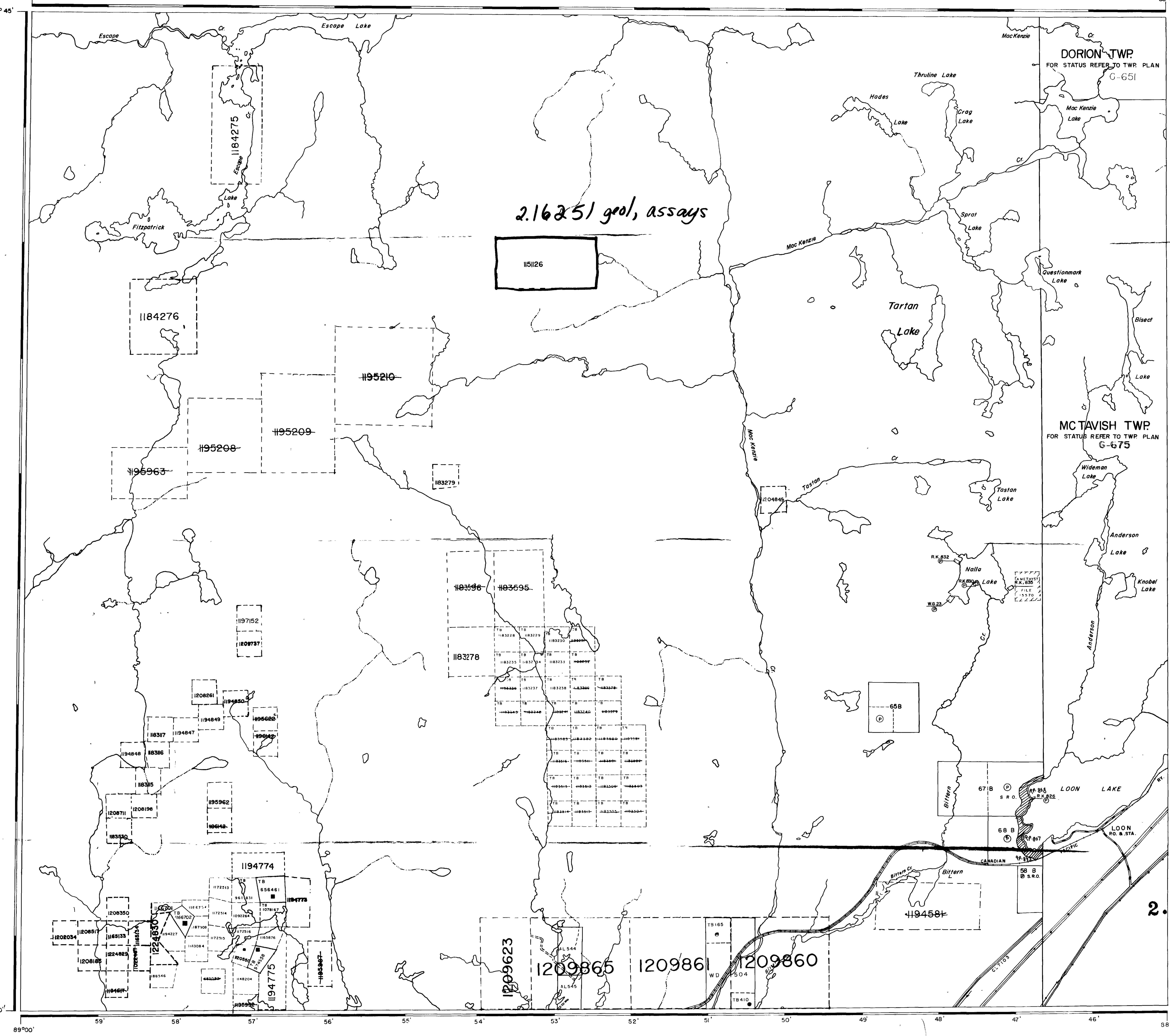
Ron C. Gashinski
Senior Manager, Mining Lands Section
Mining and Land Management Branch
Mines and Minerals Division

LJ/jl
Enclosure:

cc: Resident Geologist
Thunder Bay, Ontario

Assessment Files Library
Sudbury, Ontario

G-2705



NOTICE:

The information that appears on this map has been compiled from various sources, and accuracy is not guaranteed. Those wishing to stake mining claims should consult with the Mining Recorder, Ministry of Northern Development and Mines, for additional information on the status of the lands shown hereon.

LEGEND

PATENTED LAND	(P)
CROWN LAND SALE	C.S.
LEASES	(L)
LOCATED LAND	Loc.
LICENSE OF OCCUPATION	L.O.
MINING RIGHTS ONLY	M.R.O.
SURFACE RIGHTS ONLY	S.R.O.
ROADS	
IMPROVED ROADS	
KING'S HIGHWAYS	
RAILWAYS	
POWER LINES	
MARSH OR MUSKEG	
MINES	
CANCELLED	C.
LAND USE PERMITS FOR COMMERCIAL TOURISM, OUTPOST CAMPS	

REFERENCES

AREAS WITHDRAWN FROM DISPOSITION

M.R.O. – MINING RIGHTS ONLY
S.R.O. – SURFACE RIGHTS ONLY
M.+ S. – MINING AND SURFACE RIGHTS

Description	Order No.	Date	Disposition	File

SCALE: 1 INCH = 40 CHAINS

AREA

TARTAN LAKE

M.N.R. ADMINISTRATIVE DISTRICT
THUNDER BAY
MINING DIVISION
THUNDER BAY
LAND TITLES / REGISTRY DIVISION
THUNDER BAY

2.16251

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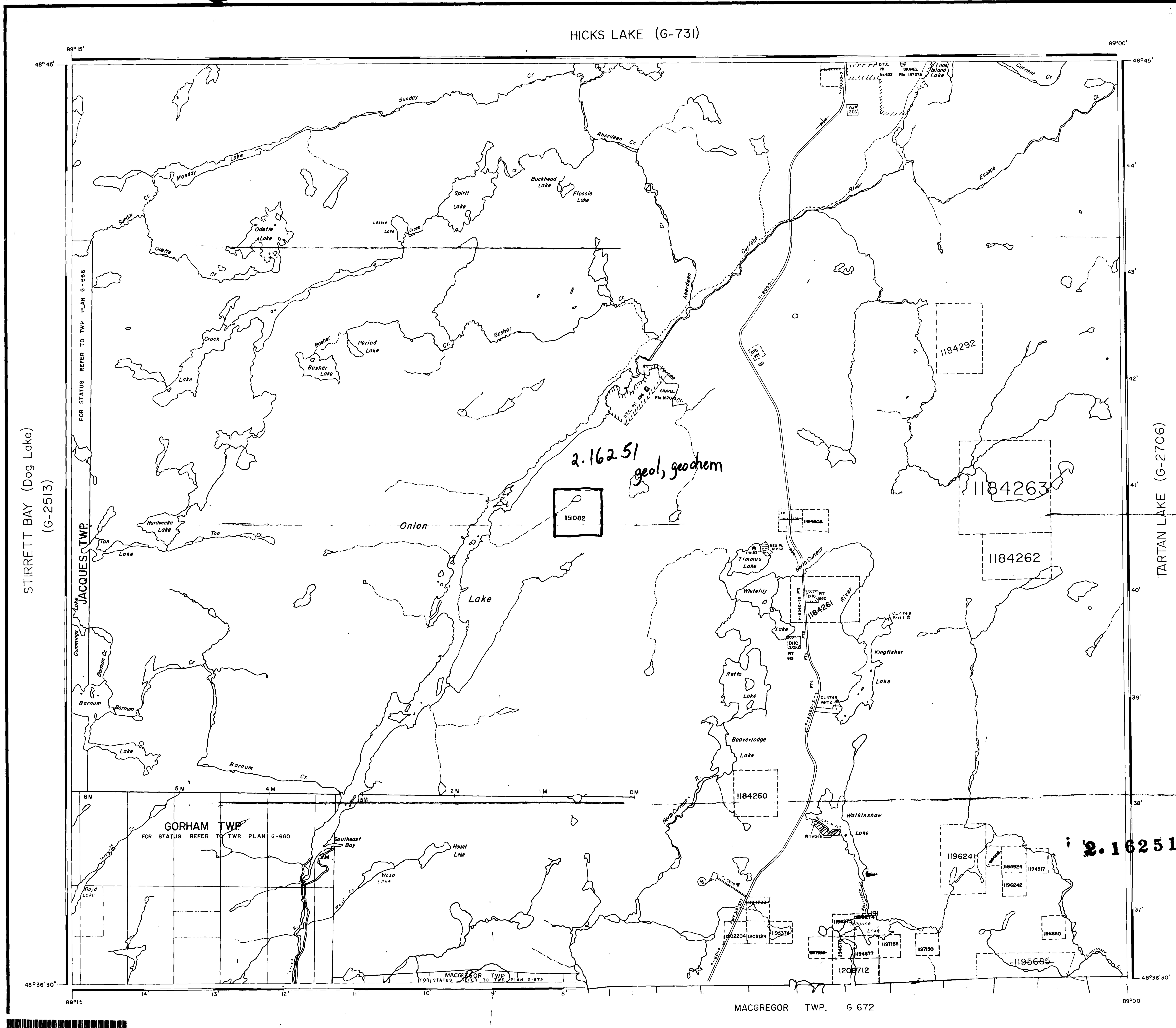
Ontario — Ministry of Natural Resources — Ministry of Northern Development and Mines

Date JULY, 1991
In Service July 23/93.

G-2706

52A10NW0017 2.16251 TARTAN LAKE 200



REFERENCES

AREAS WITHDRAWN FROM DISPOSITION

M.R.O. – MINING RIGHTS ONLY
S.R.O. – SURFACE RIGHTS ONLY
M.+ S. – MINING AND SURFACE RIGHTS

Description	Order No.	Date	Disposition	File
(RI)	W-TB-109/88 NWR		SEE MACGREGOR LANDROLL	

LEGEND

- HIGHWAY AND ROUTE No.
- OTHER ROADS
- TRAILS
- SURVEYED LINES:
  - TOWNSHIPS, BASE LINES, ETC
  - LOTS, MINING CLAIMS, PARCELS, ETC
- UNSURVEYED LINES
  - LOT LINES
  - PARCEL BOUNDARY
  - MINING CLAIMS ETC
- RAILWAY AND RIGHT OF WAY
- UTILITY LINES
- NON-PERENNIAL STREAM
- FLOODING OR FLOODING RIGHTS
- SUBDIVISION OR COMPOSITE PLAN
- RESERVATIONS
- ORIGINAL SHORELINE
- MARSH OR MUSKEG
- MINES
- TRAVERSE MONUMENT

DISPOSITION OF CROWN LANDS

TYPE OF DOCUMENT	SYMBOL
PATENT, SURFACE & MINING RIGHTS	●
" , SURFACE RIGHTS ONLY	◒
" , MINING RIGHTS ONLY	◓
LEASE, SURFACE & MINING RIGHTS	■
" , SURFACE RIGHTS ONLY	⬒
" , MINING RIGHTS ONLY	⬓
LICENCE OF OCCUPATION	▼
ORDER-IN-COUNCIL	OC
RESERVATION	(R)
CANCELLED	⊗
SAND & GRAVEL	(S)

NOTE: MINING RIGHTS IN PARCELS PATENTED PRIOR TO MAY 6, 1913, VESTED IN ORIGINAL PATENTEE BY THE PUBLIC LANDS ACT, R.S.O. 1970, CHAP 380, SEC 63, SUBSEC 1.

SCALE: 1 INCH = 40 CHAINS

FEET 0 1000 2000 4000 6000 8000
METRES 0 200 1000 (1 KM) 2000 (2 KM)

THE INFORMATION THAT APPEARS ON THIS MAP HAS BEEN COMPILED FROM VARIOUS SOURCES, AND ACCURACY IS NOT GUARANTEED. THOSE WISHING TO STAKE MINING CLAIMS SHOULD CONSULT WITH THE MINING RECORDER, MINISTRY OF NORTHERN DEVELOPMENT AND MINES, FOR ADDITIONAL INFORMATION ON THE STATUS OF THE LANDS SHOWN HEREON.

2.16251

AREA

ONION LAKE

M.N.R. ADMINISTRATIVE DISTRICT
THUNDER BAY

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MINING DIVISION
THUNDER BAY

LAND TITLES / REGISTRY DIVISION
THUNDER BAY

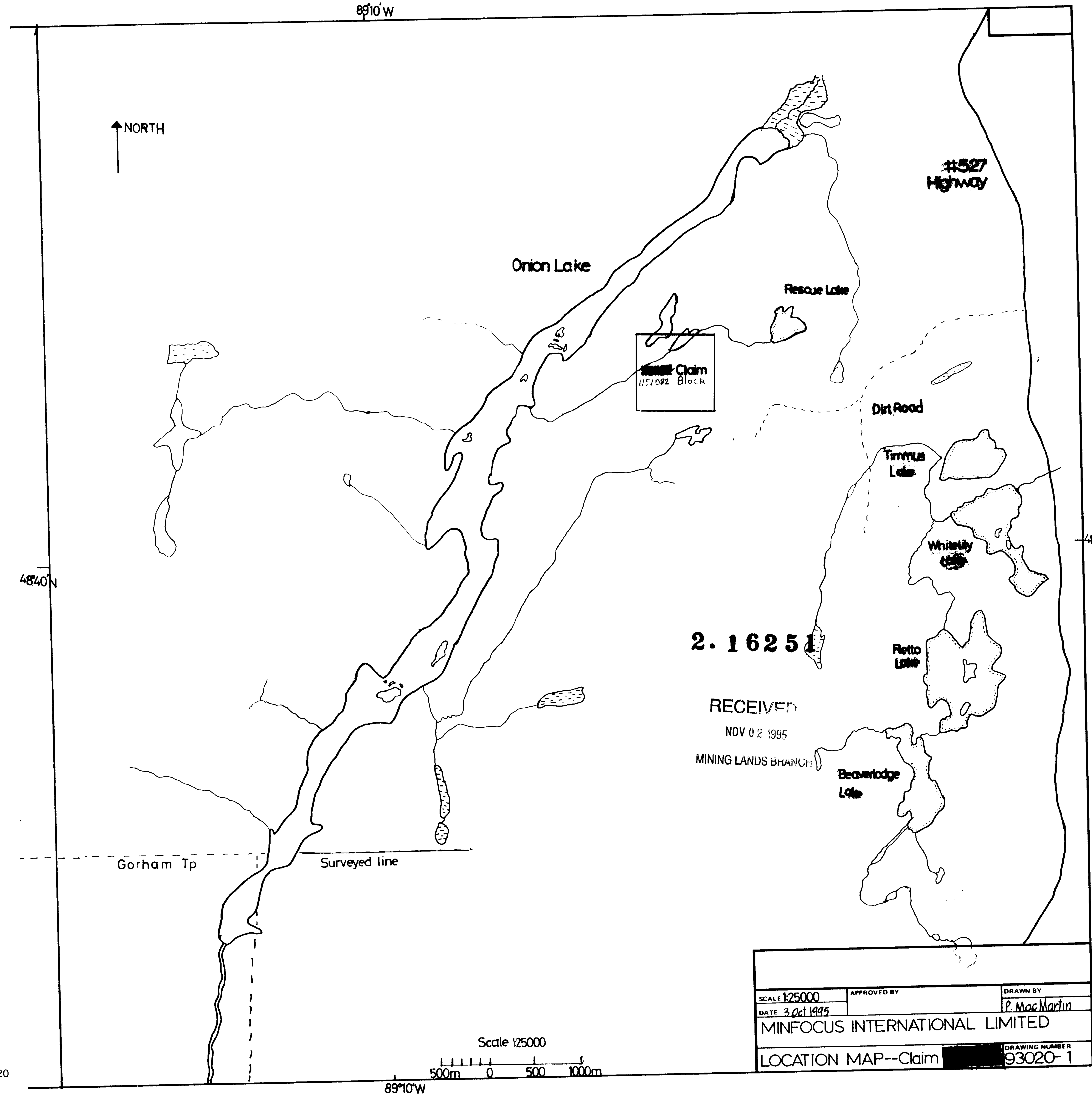
Ministry of Natural Resources — Land Management Branch
Ontario
In service since Sept. 10/92

Date JULY 1991
In service July 1992

Number G-747

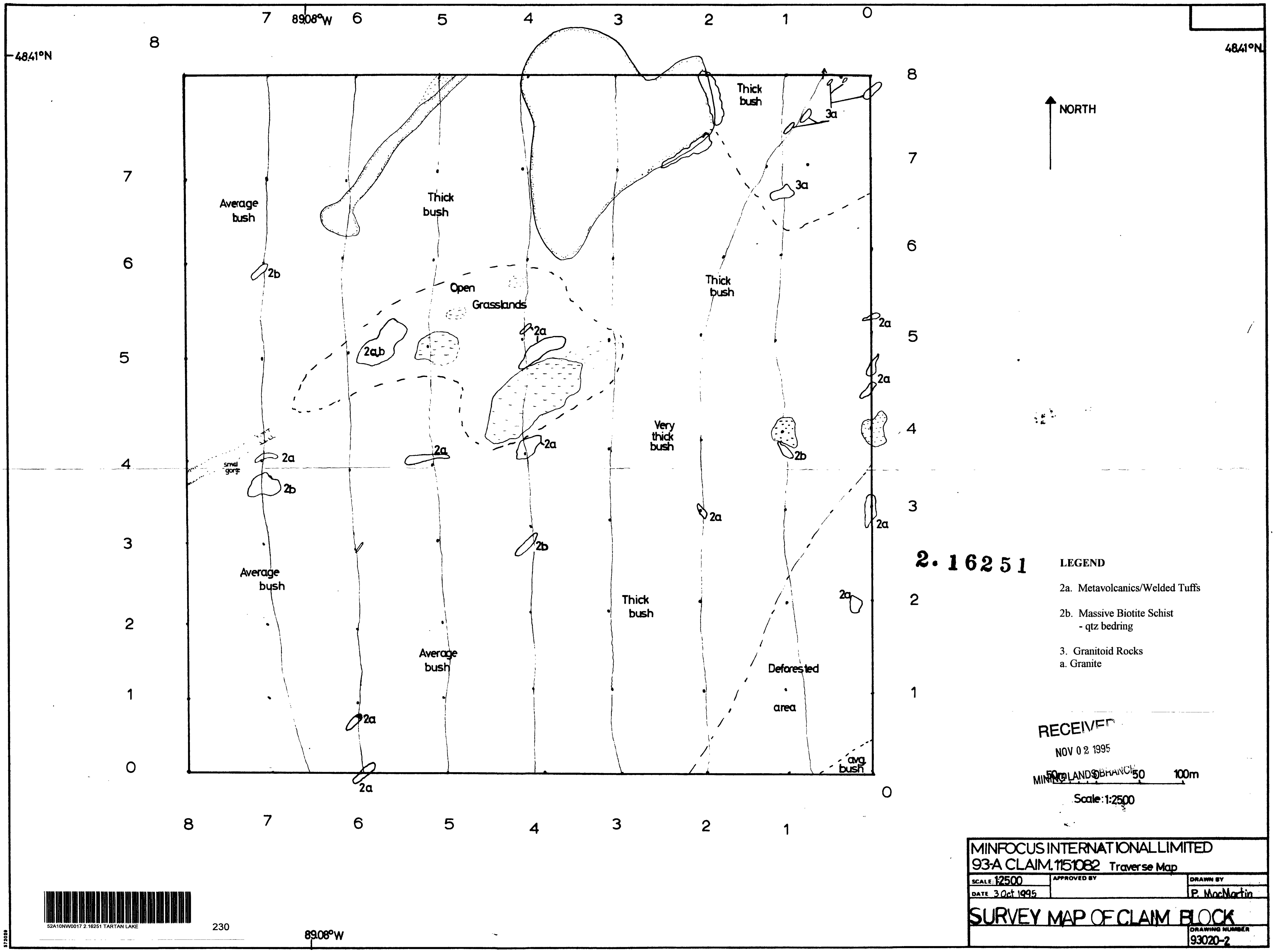
52A10NW0017 2.16251 TARTAN LAKE

210



52A10NW0017 2 16251 TARTAN LAKE

220



48.41°N
89.08°W
NORTH
Average bush
Thick bush
Open Grasslands
Very thick bush
Thick bush
Average bush
Average bush
Thick bush
Deforested area
avg. bush
small gorge
2a
2b
2a,b
3a
2.16251
LEGEND
2a. Metavolcanics/Welded Tuffs
2b. Massive Biotite Schist - qtz bedring
3. Granitoid Rocks
a. Granite
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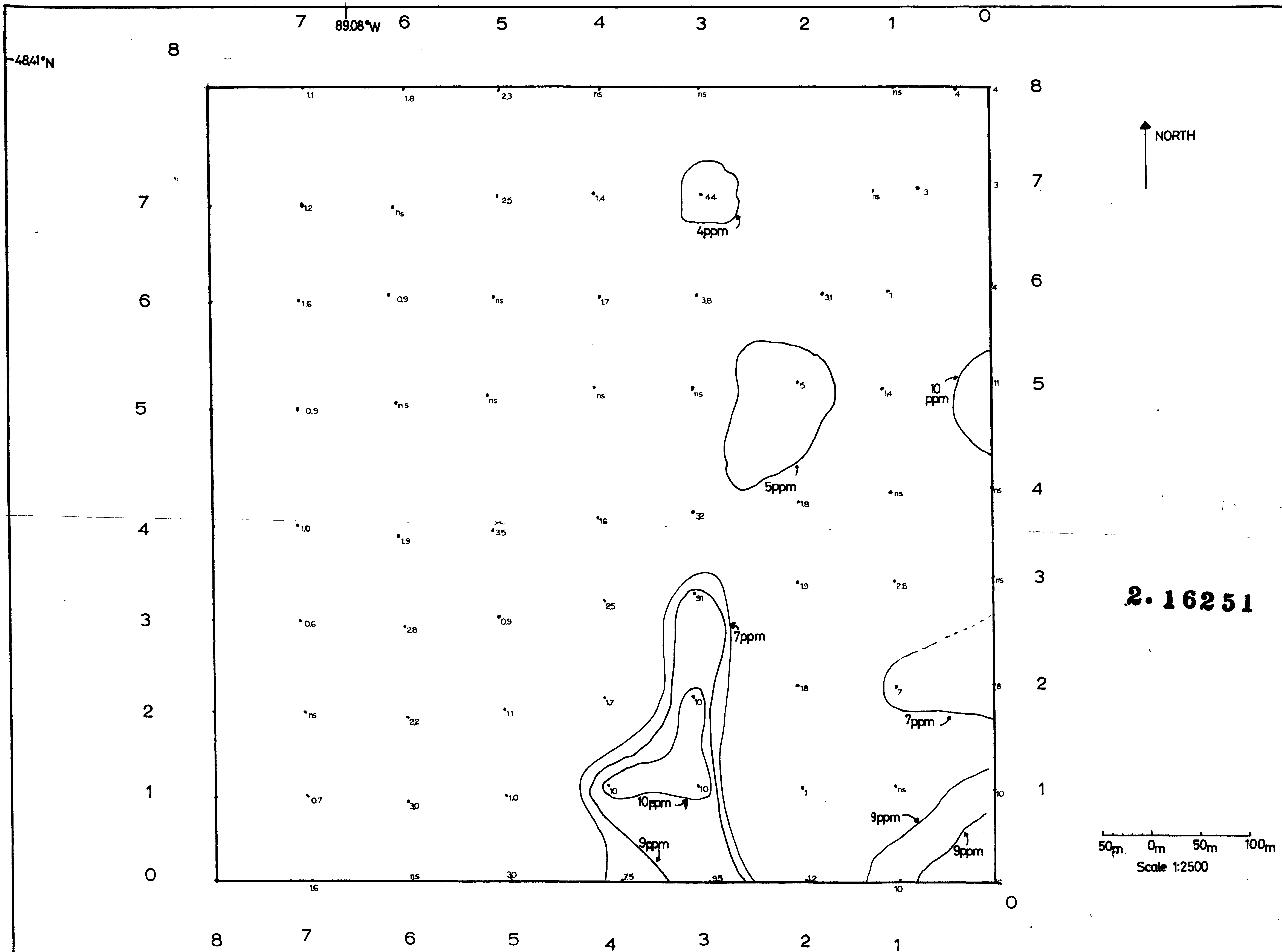
MINING LANDS BRANCH
50 0 50 100m
Scale: 1:2500
MINFOCUS INTERNATIONAL LIMITED
93-A CLAIM 1151082 Traverse Map
SCALE: 1:2500
DATE 30 Oct 1995
APPROVED BY
DRAWN BY
P. MacMartin
SURVEY MAP OF CLAIM BLOCK
DRAWING NUMBER
93020-2
52A10NW0017 2.16251 TARTAN LAKE
230



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MINING LANDS BRANCH

52A10NW0017 2.16251 TARTAN LAKE 240

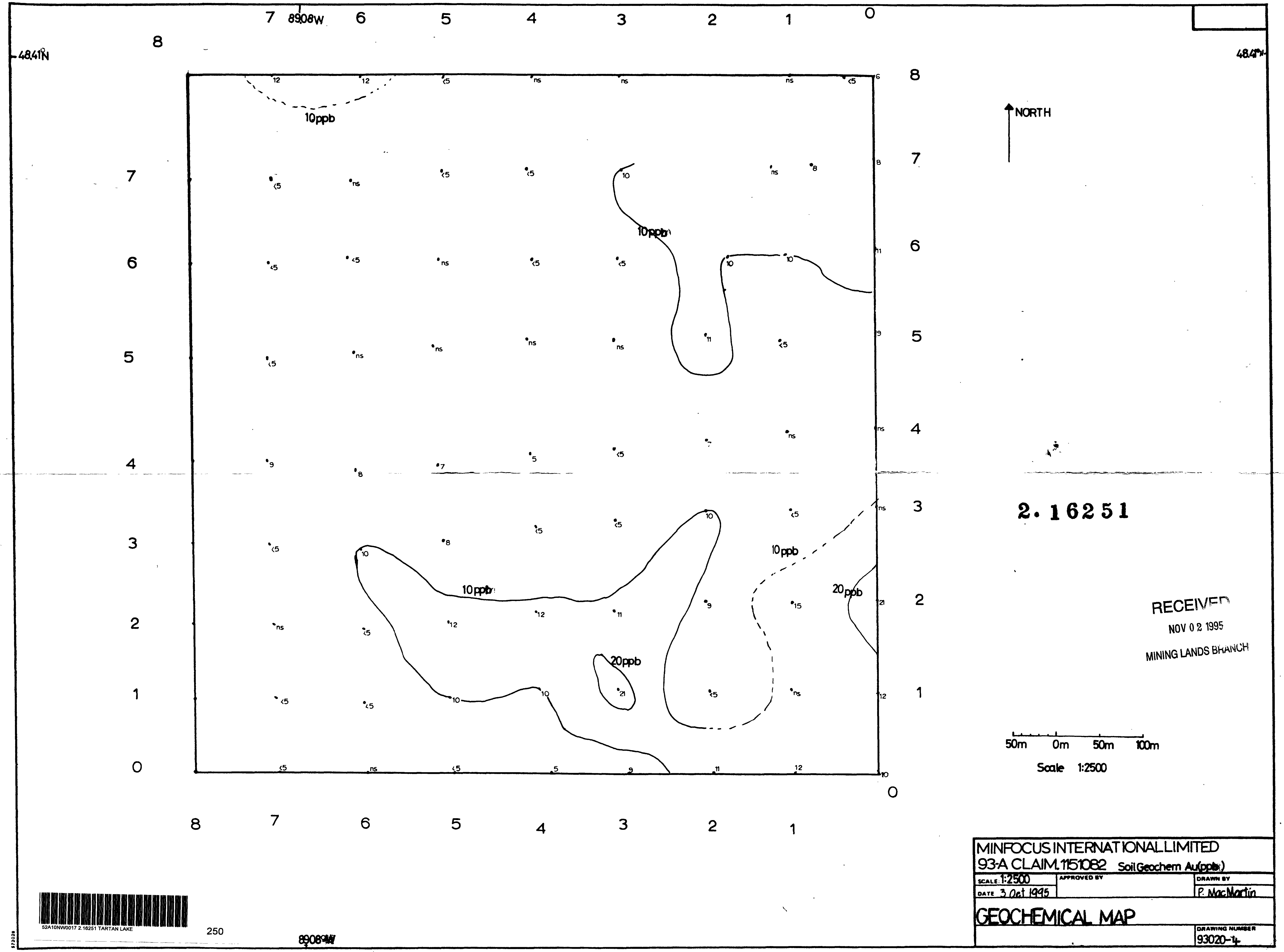
89.08°W

MINFOCUS INTERNATIONAL LIMITED
93-A CLAIM 1151082 Soil Geochem -- Ag(ppm)

SCALE: 1:2500	APPROVED BY	DRAWN BY
DATE 30 Oct 1995		P. MacMartin

GEOCHEMICAL MAP

DRAWING NUMBER 93020-3



89°08'W
48°41'N
NORTH
10ppb
20ppb
2.16251
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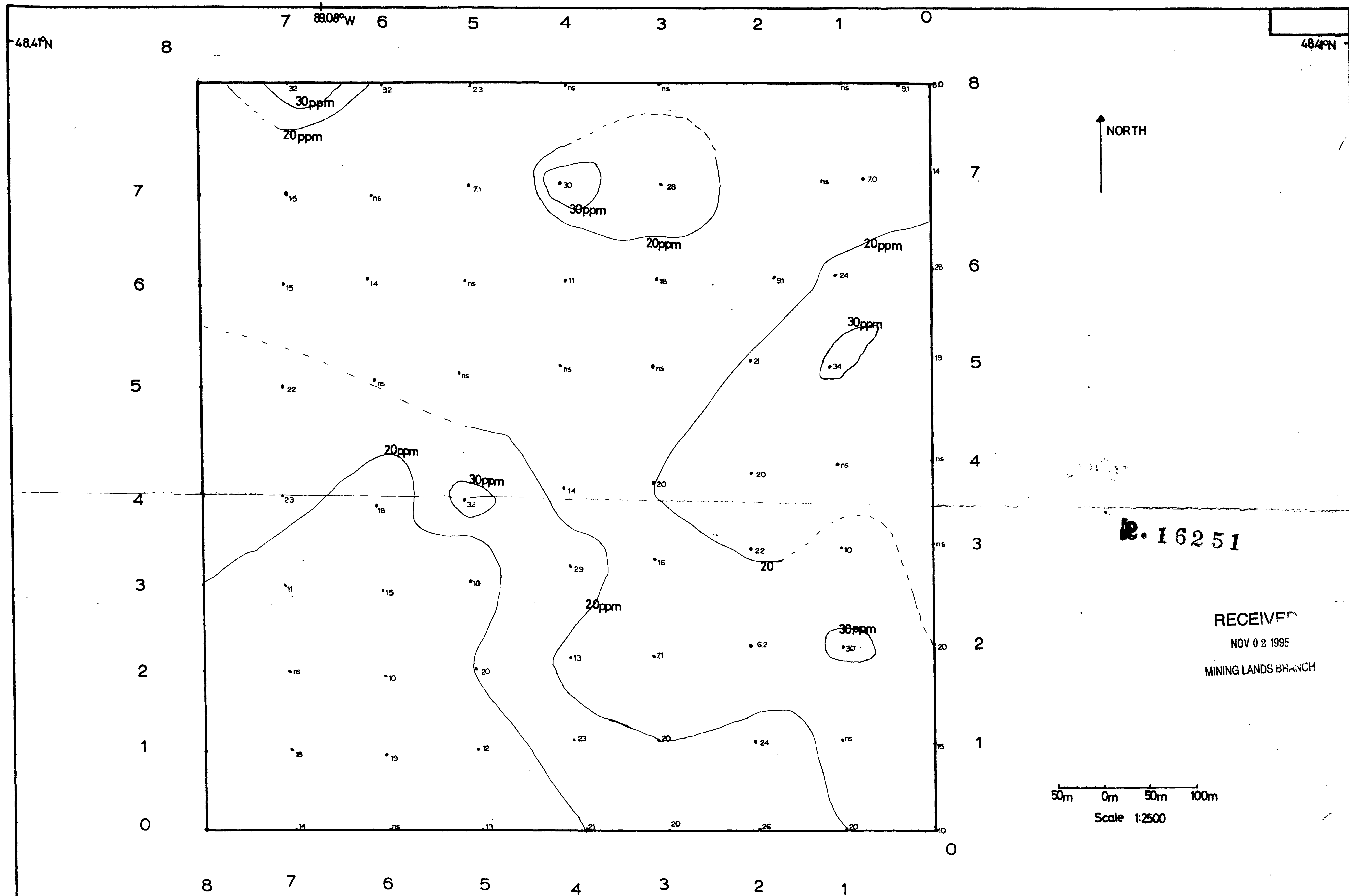
NOV 02 1995
MINING LANDS BRANCH
50m 0m 50m 100m
Scale 1:2500
MINFOCUS INTERNATIONAL LIMITED
93-A CLAIM 1151082 Soil Geochem Au(ppb)
SCALE: 1:2500
APPROVED BY
DRAWN BY
P. MacMartin
DATE 3 Oct 1995
GEOCHEMICAL MAP
DRAWING NUMBER
93020-4
52A10NW0017 2.16251 TARTAN LAKE
250



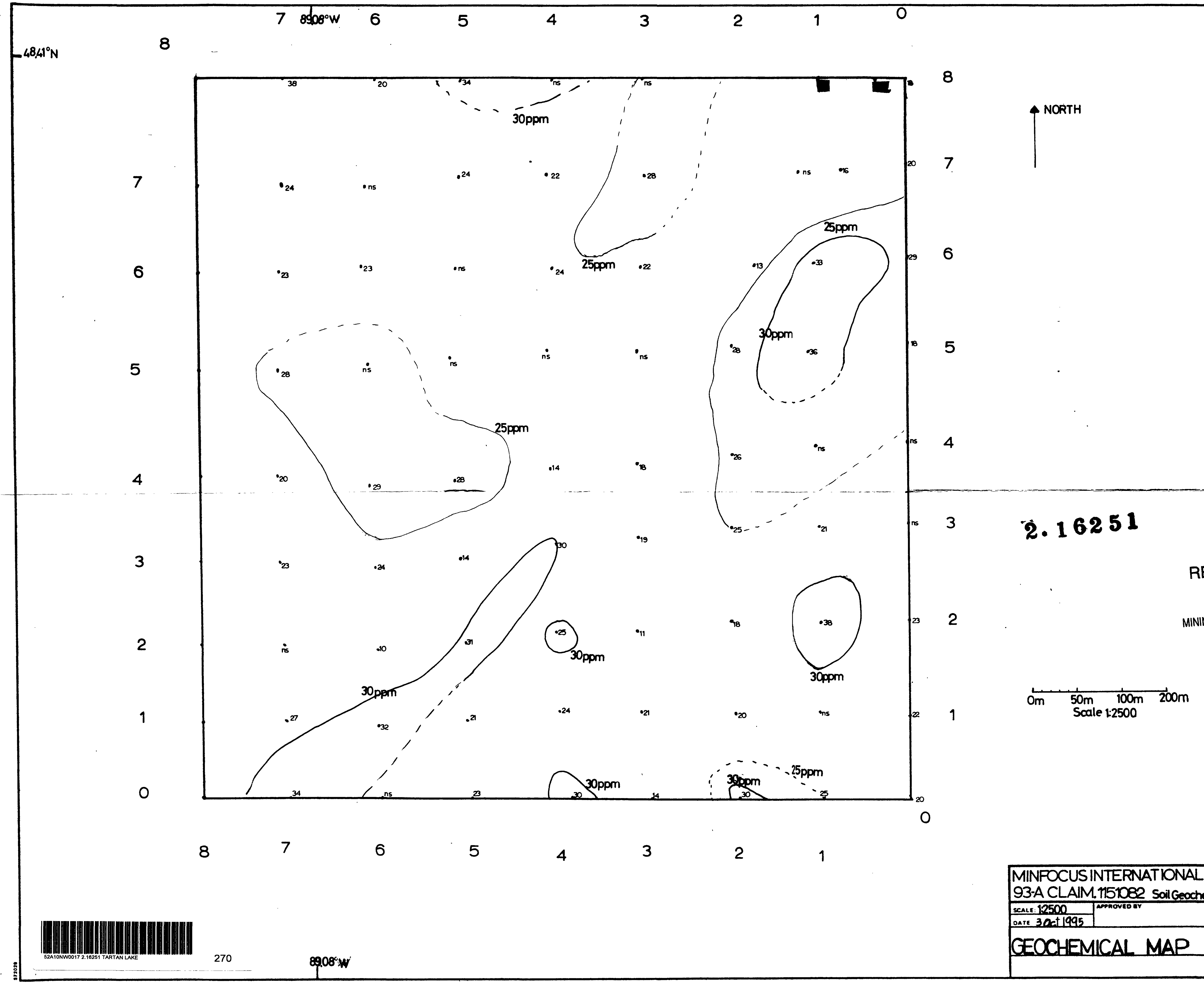
MINFOCUS INTERNATIONAL LIMITED
93-A CLAIM. 1151082 Soil Geochem--Cu(ppm)

SCALE: 1:2500	APPROVED BY	DRAWN BY
DATE 30ct 1995		P. MacMartin

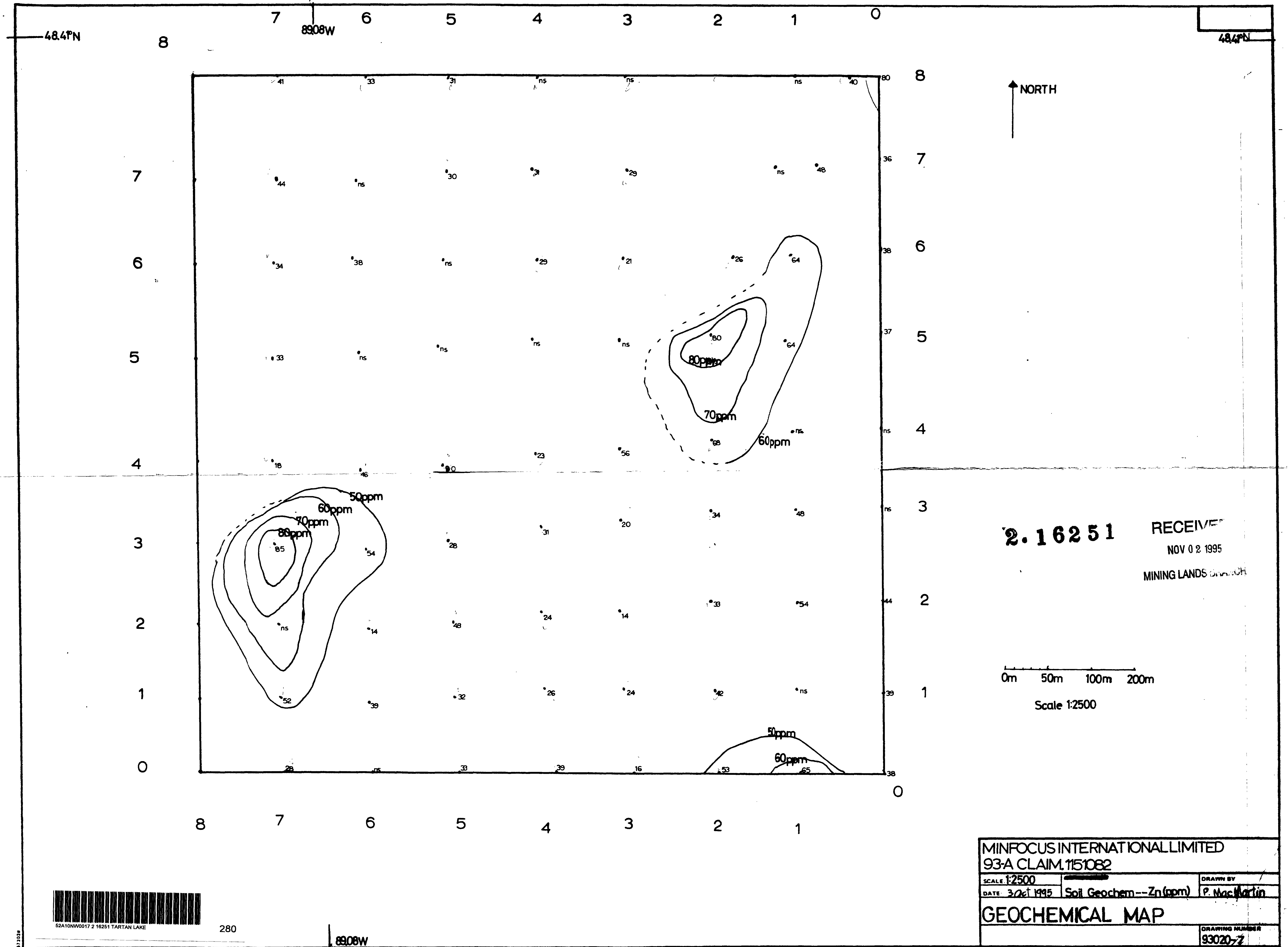
GEOCHEMICAL MAP

DRAWING NUMBER 93020-5

89.08°W



MINFOCUS INTERNATIONAL LIMITED 93-A CLAIM 1151082 Soil Geochem--Ni(ppm)		
SCALE: 1:2500	APPROVED BY	DRAWN BY P. MacMartin
DATE 3 Oct 1995		
GEOCHEMICAL MAP		DRAWING NUMBER 93020-6


48.4°N
89.08W
NORTH
80ppm
70ppm
60ppm
50ppm
2.16251
RECEIVED
NOV 0 2 1995
MINING LANDS BRANCH
0m 50m 100m 200m
Scale 1:2500
MINFOCUS INTERNATIONAL LIMITED
93-A CLAIM 1151082
SCALE 1:2500
DATE 3 Oct 1995
Soil Geochem--Zn (ppm)
DRAWN BY P. MacMartin
GEOCHEMICAL MAP
DRAWING NUMBER 93020-7
52A10NW0017 2 16251 TARTAN LAKE
280