Field Examination, Sampling and Laboratory Testing on the Mattawan P Garnet Property,

Sudbury Mining District, Ontario, Canada

for:

IMPERIAL METALS CORPORATION
Suite 420 - 355 Burrard Street
Vancouver, B.C., Canada, V6C 2G8

by: 2. 19765

B.H. (Ben) Whiting, M.Sc., P.Geo.

Includes as an appendix the Report
"Point Count Study of Mattawan P Property Garnets"
by Katherina Ross, M.Sc.
Panterra Geoservices Inc.

January, 2000

WHITING RESOURCE MANAGEMENT
62 Quebec Street
Kingston, ON, Canada, K7K 1T7
Tel: (613) 531-9712
e-mail: whiting@geol.queensu.ca

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF PHOTOS

LIST OF APPENDICES

1. INTRODUCTION

In May 1999, the author conducted a geological property examination and Phase-I test sampling on the *Mattawan P* garnet property, on behalf of **Imperial Metals Corporation**. *Mattawan P* is an industrial minerals "almandine" garnet occurrence located 15 kilometres northwest of Mattawa, Ontario, Canada, on map sheet 31L/7.

There are two rock types on the property of interest for garnets, eclogite and garnetiferous amphibolite gneiss. Visually estimated grades on hand samples of 20-35% are present. These visual estimates correlate well with the binocular microscope point-count testing of the coarser grain size fraction (-20 to +42 mesh). Overall garnet grade, including the finer fractions, varies between 14% and 22%.

The rock sampling was divided into 'bucket samples' for mineralogical separation and corresponding 'hand samples' for rock description and thin section petrological studies. This report addresses the field examination, hand sample descriptions and point-count results, whereas the thin section studies will be conducted at a later time. Three bucket samples, between 26 and 32 kilograms each, were delivered to the laboratories of **Lakefield Research Ltd.** in Lakefield, Ontario. Tassos Grammatikopoulos, mineralogist for Lakefield, directed the crushing and filtering of the bucket samples into four sub-sample size fractions (-20 to +42, -42 to +100, -100 to +150, and -150 mesh). The sub-samples were then shipped to **Panterra Geoservices Inc.** in Surrey, British Columbia, for point-count mineralogical testing under the direction of mineralogist Katherina Ross, the results of which are presented in Appendix II.

It is concluded that this property shows ***"considerable promise"*** for the delineation of an economic almandine-rich garnet deposit. Further work, including geological mapping, relogging of old diamond drill core, and mineral separation testing of the properties is warranted, in conjunction with a industry market evaluation.

2. LOCATION, ACCESS AND INFRASTRUCTURE

The *Mattawan P* garnet property is located in the Mattawan Township, Sudbury Mining District in northeastern Ontario, Canada. The area is approximately 15 kilometres northwest of the town of Mattawa, which is at the meeting of the Mattawa and Ottawa Rivers. The project area is on N.T.S. map sheet 31L/7 at latitude 46° 23' N and longitude 78° 53' E. (Figure 1.) *Mattawan P* is on the west side of Highway #533, which follows along Harrington Creek.

Access to the property is excellent, with the paved Highway #533 passing within 400 metres of *Mattawan P*, from which there are gravel and dirt forestry haulage roads. There is also current logging being conducted in the *Mattawan P* area, thus expanding the access to the property.

The town of Mattawa, population 2,800, is the location of the nearest railway station for the Canadian Pacific Railway to Ottawa and the port of Montreal. Mattawa is also a potential harbour for barge traffic along the Ottawa River. The Trans-Canada Highway, also known as Highway #17 in this region, leads west from Mattawa 64 kilometres to North Bay, the nearest city, with a population of 58,000. A major power line corridor passes east-west approximately 2 kilometres south of the *Mattawan P* property. Thus, the infrastructure in this area is also considered excellent.

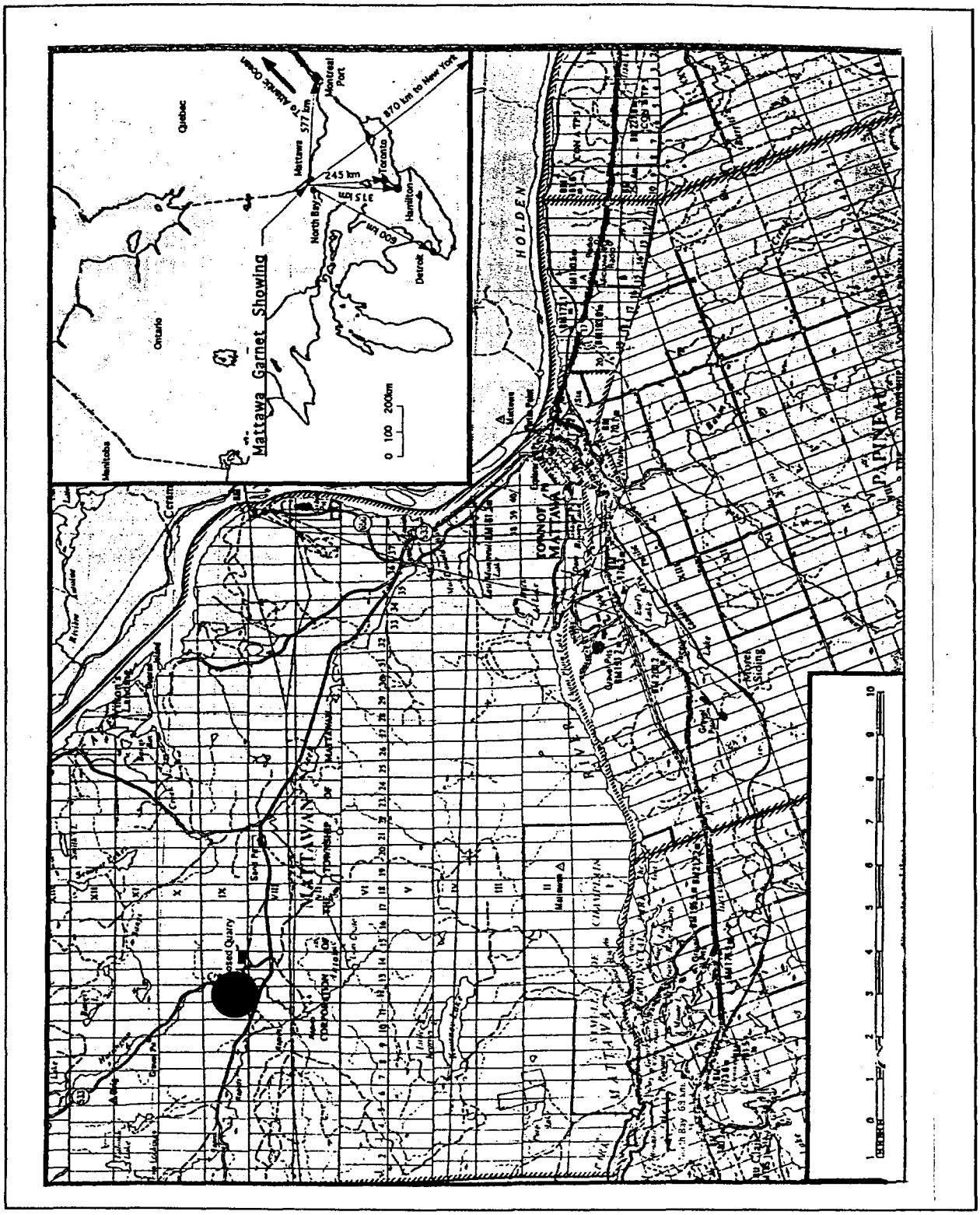


Figure 1. Location Map

3. PREVIOUS HISTORY

Government regional geological compilations by Harding (1944) and Lumbers (1976) covered this area for basic bedrock geology and Harrison (1971) for surficial geology. Lumbers described the area as containing feldspathic gneiss, gneissic tonalite, monzonitic to granitic rocks, plus gabbroic anorthosite and related mafic rocks.

In 1986-87, Hudson Bay Exploration and Development Co. Ltd. conducted an exploration program near the claim group, to the northeast of the *Mattawan P* showings. This was designed to target gold and consisted primarily of a VLF-EM survey, percussion overburden drilling to test the basal till samples, and three diamond drill holes (Davies, 1986; 1987). There was one area with anomalous gold, including 3 basal till samples exceeding 50 ppb Au, with a high of 345 ppb Au. Gold in stream sediments along Harrington Creek is likely to have been the initiating factor for this study. There is a possibility that the basal till gold is placer derived. However, Davies (1987) conclusion was as follows: *"The anomaly is too significant to write off without a little further effort."* It is not known whether additional testing was conducted.

In the report (Davies, 1986), the diamond drilling was located northwest of the old forestry tower site on the adjacent *Mattawan B* property. The drilling intersected significant thicknesses of *"garnetiferous amphibolite gneiss"*. The core is reportedly stored at the *Drill Core Library*, Cobalt, Ontario.

The most significant garnet-focused research work has been conducted by geologist Bob Komarechka on the adjacent *Mattawan B* property. Geological mapping, geophysical surveys (VLF and magnetometer), a garnet beneficiation study, and petrography of three thin sections have been performed (Komarechka, 1999, 1997, 1996, 1995, 1994; Stoness, 1995).

The **Ontario Geological Survey**, in conjunction with **Lakefield Research Ltd.**, have been examining five garnet properties in Ontario for soon to be released reports (Easton, 1999; Grammatikopoulos and MacDonald, 1999). These studies, include detailed laboratory work on

selected samples from the *Street*, *Dana*, *Papineau*, *Mattawan B* and *Mattawan P* deposits.

Physical work reports of outcrop scraping have been applied as assessment on the *Mattawan P* property (Shouinard, 1998). Line cutting and prospecting have also been conducted by the claim owners on the *Mattawan P* property. The results of this work has previously been filed for claims assessment.

4. GEOLOGY

REGIONAL GEOLOGY

The *Mattawan P* garnet property is in the Proterozoic Grenville Province of the Canadian Shield. The Grenville Province contacts the Archean Superior Province and Proterozoic Southern Province in a tectonic zone referred to as the Grenville Front. The Grenville Front Tectonic Zone (GFTZ) is a compressional transition zone, up to 30 kilometres across, separating a Central Gneissic Belt of the Grenville Province from the earlier cratons (Easton, 1992). Easton (1999) places the *Street* and *Dana* garnet deposits in the GFTZ and the *Papineau, Mattawan B* and *Mattawan P* deposits in the Central Gneissic Belt.

When dividing the Central Gneissic Belt, researchers have applied both lithological and tectonic classifications. These two approaches coincide in some regions, and diverge in other regions. The interpretation of metamorphosed mafic dyke rocks as parautochthonous (related to the earlier North American craton) and allochthonous (distinctly different assemblage from the craton) has lead to an interpreted crustal scale boundary called the Allochthon Boundary Thrust (ABT). Ketchum and Davidson (1999) will be presenting a revised interpretation of the crustal architecture of the Central Gneissic Belt in a future issue of the Canadian Journal of Earth Sciences.

A distinctive feature of the parautochthonous portion of the Central Gneissic Belt is the presence of metamorphosed mafic rocks chemically correlatable with the 1240 Ma Sudbury dyke swarms and similar aged mafic and felsic plutonic rocks. Mafic pods in the allochthonous portion are younger, ca. 1170 Ma, metagabbros and retrograde eclogites.

Lumbers (1976) conducted regional mapping in the Mattawan area. The garnetiferous occurrences in anorthosite, mafic gneisses, and eclogites correspond to units of calc-silicate gneiss on Lumbers' map. Fold interference patterns and later offset faulting are likely to be present. These rocks lie south of the ABT, in the same allochthonous panel as the *Papineau*

deposit (Easton, 1999).

From a geological model perspective, the eclogitic-hosted garnet occurrences may be considered as deep crustal wedges which have been thrust into their present position during the Grenville Orogeny. Proximity to the ABT, perhaps within 10 to 15 km, could be used as an exploration guideline. The larger gabbroic anorthosite bodies on the mapping of Lumbers (1976) have also been recommended as targets by Easton (1999).

PROPERTY GEOLOGY

The *Mattawan P* deposit occurs along a northwesterly trending ridge and small hills of high-grade metamorphic mafic units. Reddish-green eclogites and reddish-black garnetiferous amphibolites are present. Depending on the felsic mineral content and amount of metamorphic foliation, the rocks may be called gneisses (eg: garnet-hornblende-plagioclase gneiss). A massive appearing hand sample of rock may be given one name in the field and a different name from a thin section examination. Thus, the garnetiferous amphibolite in the field may be called a garnet-amphibole gneiss in a lab report. Refer to the Sampling section for more detailed field descriptions of the individual sample sites.

No systematic geological mapping has been conducted on the *Mattawan P* property, although extensive prospecting has located over 100 garnetiferous outcrops in a zone approximately 1,600m x 400m. Within this zone, there are separate members of eclogite and garnetiferous amphibolite that may be mappable as discrete units. Foliation strikes parallel to the ridge and dips steeply north or south, depending on the location. Overburden is shallow and outcrop exposures make up 5-10% of the main part of the property. Three bulk samples and six thin sections have been taken on this property for analyses.

Metamorphic petrology professor Dugald Carmichael examined one of the author's hand samples from the *Mattawan P* and stated that it was *"an excellent eclogite, with traces of retrograde textures as rims around the garnets"* (Carmichael, 1999 pers. com.)

Mineralogy of hand samples consists of reddish, duodecahedral garnets, black hornblende laths and pyroxene grains, and white to clear plagioclase and quartz. Lessor greenish-yellow olivine was also identified.

As to the quality of garnets, in a previous study **Lakefield Research Ltd.** analysed a sample from *Mattawan P* which yielded very few inclusions in the garnets, as illustrated by backscatter electron imaging (BSI viewed at Lakefield's laboratory), and had a composition of **Almandine exceeding Pyrope and Grossular** (A_{49-55}--P_{26-32}--G_{15-20}). **This sample is believed to** have come from the first clearing along the logging access road and was called a garnet-amphibole gneiss containing 30% by volume garnets. Recovery results for first and second pass mags were 35% and 94%, with an excellent quality index of 0.5/10 (Grammatikopoulos and MacDonald, 1999).

Outcrop on the hillsides is about 5-10%, but on the flat terrain to the south glacio-lacustrine deposits are encountered and represent considerable thicknesses of overburden. This is a part of a larger glacio-lacustrine system that drained in the waning stages of the last ice retreat (Harrison, 1971). **The last major ice direction, based on glacial striae, was from the** northeast.

The following photo series illustrates various outcrop patterns and rock textures observed during the property examination.

Photo 1. Mattawan P -- *"Discovery Outcrop"* garnetiferous eclogite; (l-r) Bob Komarechka, Guy Shouinard, and Ron Montreuil.

Photo 2. Mattawan P -- Hanging wall contact of garnet-rich eclogite and feldspathic gneiss (northeast side of deposit).

Photo 3. Mattawan P -- Convoluted banding textures in feldspathic gneiss.

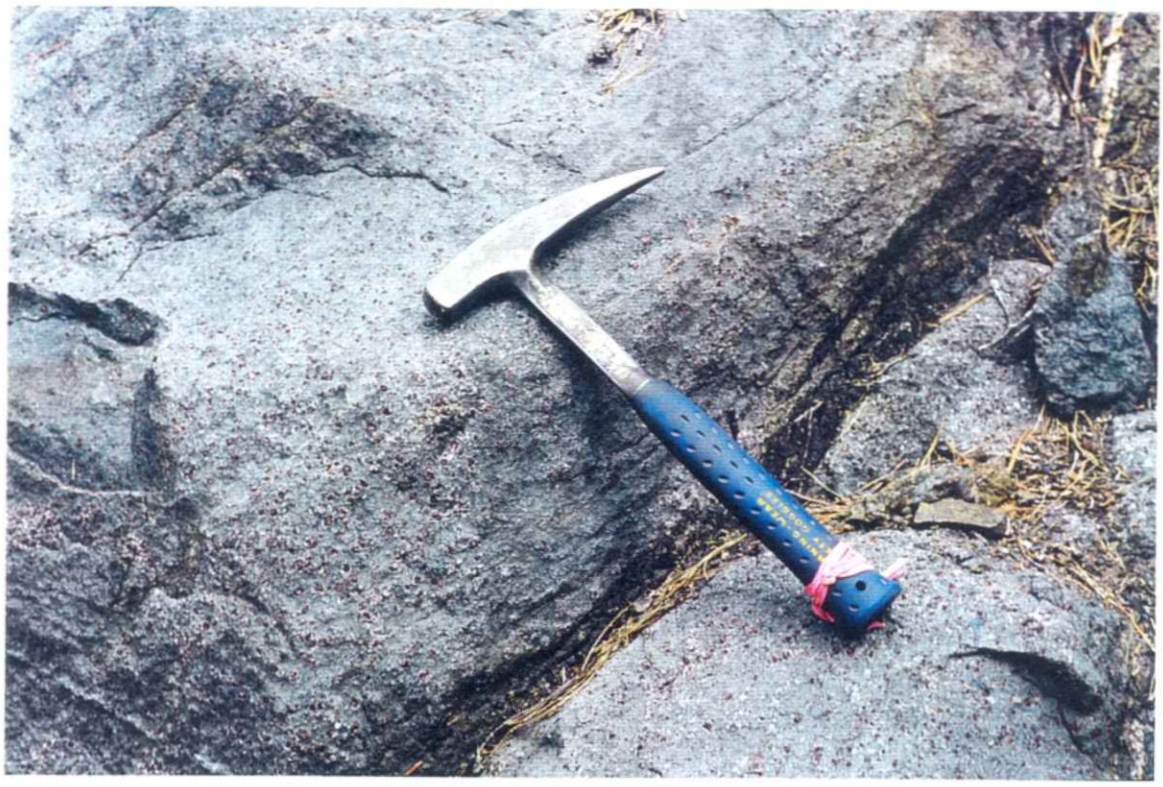


Photo 4. Mattawan P -- Massive garnet-rich eclogite (central-east high ground).

Photo 5. Mattawan P -- Coarsest garnet noted in a float block of eclogite.

Photo 6. Mattawan P -- Garnet-rich eclogite (northwest end of property).

Photo 7. Mattawan P -- Garnetiferous hornblende-plagioclase gneiss (at sample site MAT-W04).

Photo 8. Mattawan P -- Garnetiferous hornblende-plagioclase gneiss (at sample site MAT-W04).

Photo 9. Mattawan P -- Trench across garnet-rich amphibole-pyroxene-plagioclase gneiss. Note the change in garnet grain size with layering (at sample site MAT-W05).

Photo 10. Mattawan P -- Finer grained portion of the garnet-rich amphibole-pyroxene-plagioclase gneiss (at sample site MAT-W05).

Photo 11. Mattawan P -- Pegmatite vein cutting garnet amphibolite (at sample site MAT-W06).

Photo 12. Mattawan P -- Cut line 300-E and logging clearing (near sample site MAT-W06).

Photo 13. Mattawan P -- Log stacking area along access road.

Photo 14. Glacio-lacustrine overburden south of Mattawan P.

5. SAMPLING (This study)

The rock sampling has been divided into 'bucket samples' for mineralogical testing and 'hand samples' for thin section petrological studies (Figure 2). Rock names are field terms used during the property examination.

MINERALOGICAL TESTING

Three twenty-litre buckets of rock chips from outcrops were delivered to **Lakefield Research Ltd**. in Lakefield, Ontario, for sample preparation. Under the direction of mineralogist Tassos Grammatikopoulos, the buckets were divided into four mesh-size fractions (-20 to +42, -42 to +100, -100 to +150, and -150 mesh).

The 12 sub-samples were then sent to mineralogist Katherina Ross of Panterra Geoservices Inc. in Surrey, British Columbia. The details of further sample preparation and research are presented in Appendix II.

Table I. – Locations for Mineralogical Sample Sites

Sample No.	*Property*	*Northing*	*Easting*	*Comment*
MAT-W04	Mattawan P	5139811	662145	garnet-hbld-plag gneiss, o/c 20m x 2-3m
MAT-W05	Mattawan P	5139686	662374	garnet-hbld-plag gneiss, trench 18m x 2m
MAT-W06	Mattawan P	5139529	663427	garnet amphibolite, o/c 20m x 3m

PETROLOGICAL STUDIES

A box of eight large hand samples was sent to **Vancouver Petrographics Ltd.** for the preparation of eleven thin sections. Thin section results will be a part of a later phase of research and are not included herein. The following descriptions are solely from hand sample observation by the author.

The MAT-W04 hand sample and bucket sample come from prominent outcrops on the north side of a large log stacking road clearing on the west end of the *Mattawan P* property. It consists of garnet-hornblende-plagioclase gneiss. The garnets are orangy-red, 1-2mm in size and make up 30% of the rock. Next to minor pegmatite veinlets, the garnets are larger and more clustered, up to 6mm in size. The remainder of the rock consists of approximately 50% hornblende, 10% plagioclase, 5% quartz, 5% opaques (very weakly magnetic) and minor biotite. Foliation is weakly developed at 144°/60°NE, following the major trend of the ridge. It is expected that this sample material will have a moderate crushing strength for liberation of garnets.

Two thin sections have also been requested for MAT-W04, the first from a felsic portion of the gneiss and the second from 5 cm away in more mafic, garnetiferous material.

The MAT-W05 bucket sample and hand samples (two pieces of rock) come from a stripped trench 18 m long, north of the logging access road on the *Mattawan P* property. This outcrop contains reddish-black garnet-hornblende-plagioclase gneiss verging on garnetiferous amphibolite. In bands the garnet content exceeds visually estimated 60% reddish garnets, 0.5-2mm in size, with some garnet clusters up to 2 cm. Overall garnet content is visually estimated at 30%. There are crosscutting 1-5 cm thick pegmatitic veinlets at the north end of the trench. Hornblende is the dominant matrix, with 5% plagioclase, 3% opaques (very weakly magnetic) and minor quartz and biotite. This sample material will have a relatively easy crushing strength for liberation of garnets.

Two thin sections have also been requested for MAT-W05. The first thin section crosses the pegmatite veinlet/gneiss contact and the second thin section is from the high garnet sample.

The MAT-W06 bucket sample and hand sample come from a 20m x 3m outcrop on the south side of a logged-off area on the eastern part of the *Mattawan P* deposit. In this area, the claim holders have cut a new property grid and the sample site is adjacent to picket station 300E by 50N. The rock is a garnetiferous amphibolite similar to MAT-W05. The garnets are orangy-red, 1-3mm in size, for an estimated 30%. The remainder of the rock is 55% hornblende, 5% plagioclase, 5% opaques, and 5% biotite. As with the previous location, this site also contains minor pegmatitic veinlets, 1-6 cm thick, making up less than 2% of the total outcrop. This sample material will have a moderate to easy crushing strength for liberation of garnets.

Two thin sections have also been requested for MAT-W06. The first thin section crosses the pegmatite veinlet/amphibolite contact and the second thin section is from the garnetiferous amphibolite material.

Results of the *Mattawan P* thin section petrographic studies when available can be compared to those conducted by the **Ontario Geological Survey** (Grammatikopoulos and MacDonald, 1999) and those performed at **Laurentian University** on the adjacent *Mattawan B* property samples of Bob Komarechka (Stoness, 1995).

6. GEOPHYSICAL SURVEYS

No geophysical surveys were conducted on the Mattawan P property during this study. However, geophysics will be a useful method to delineate units in this geological setting.

AEROMAGNETICS

The ultramafic nature of the units of interest at the *Mattawan P* garnet deposit would be expected to stand out as positive anomalies relative to the more felsic country-rock feldspathic gneisses. This is the case on airborne magnetometer surveys. *AERODAT* survey maps for this region show an eastward opening horseshoe shaped magnetic anomaly on the 'total field', 'vertical gradient', and 'apparent susceptibility' magnetics. The *Mattawan P* deposit is on the south limb of this anomaly. This *AERODAT* survey was filed for assessment on properties to the north of Mattawan Township (Komarechka, 1997). Maps of this survey were observed by the author as posted in the downstairs rooms in Ron Montreuil's house in Mattawa.

GROUND GEOPHYSICS

On the adjacent *Mattawan B* property, a ground geophysical survey of VLF-electromagnetics, total field and vertical gradient magnetics was conducted in 1994. North of the *Mattawan B* deposit a VLF electromagnetics survey was conducted in 1987. This appears to have aided in delineating the highly magnetic troctolite from the lessor magnetic amphibolite and eclogite and the non magnetic feldspathic-quartz gneiss (Komarechka, 1995; Davies, 1987).

7. MINERAL CLAIM STATUS

Addresses for mineral claim holders for this area are as follows:

Guy Shouinard
P.O. Box 413
Temagami, Ontario
Canada, P0H 2H0

Ron Montreuil
P.O. Box 164
Mattawa, Ontario
Canada, P0H 1V0
tel: 705-744-2559

Figure 2 shows the locations of the mineral claims. These are summarized in Table II. The *Mattawan P* area is jointly held by Guy Shouinard and Ron Montreuil as 50-50 partners. The property at one time was optioned to Bernadette Teresa Berry, with the agreement registered around March, 1998. Having failed to meet the terms of the option agreement, the Berry option was cancelled. **Imperial Metals Corporation** has an option on the property.

Table II - Mining Claims Summary Table

MATTAWA P CLAIM LIST

TITLE #	TITLE NAME	UNITS	RECORD DATE	EXPIRY DATE	REQ'D EXP.	REMARKS
S1212158	N1/2 & S1/2 LOTS 19, 20, 21 CON.12	6	November 21, 1996	November 21, 1999	2,400.00	
S1212547	S1/2 LOT 17, CON. 13	1	November 21, 1996	November 21, 1999	400.00	Total reserve $482
S1212546	N1/2 LOT 17, CON. 12	1	November 21, 1996	November 21, 1999	400.00	
S1212548	S1/2 LOT 15 & 16 CON. 13 ET AL	4	December 30, 1996	December 30, 1999	1,600.00	
S1212566	S1/2 LOT 15 & 16, CON.12	2	April 3, 1997	April 3, 2000	800.00	
S1212549	S1/2 LOT 17, CON.12	1	April 3, 1997	April 3, 2000	400.00	
S1230848	S1/2 LOTS 12, 13 & 14, CON.12	3	September 18, 1998	September 18, 2000	1,200.00	
S1212159	S1/2 L18, C13 & N1/2 &S1/2 L18, C12	3	November 21, 1996	November 21, 2000	960.00	
S1212562	LOTS 13 & 14, CON.11	4	April 3, 1997	April 3, 2001	825.00	
S1212551	N1/2 & S1/2 LOTS 11,12 CON. 11	4	April 28, 1997	April 28, 2001	1,600.00	
S1224152	N1/2 LOT 7, CON. 10	1	May 15, 1998	May 15, 2001	400.00	
S1224153	N1/2 LOT 10, CON. 9	1	June 29, 1998	June 29, 2002	300.00	
S1229356	N1/2 LOT 9, CON. 4	1	October 1, 1998	October 1, 2002	300.00	
S1230850	S1/2 LOT 10, CON. 9	1	October 1, 1998	October 1, 2002	300.00	
S1212157*	N1/2 & S1/2 LOTS 11,12 CON.10	4	April 28, 1997	April 28, 2003	1,570.00	
S1230849*	S1/2 LOTS 8, 9, 10, CON. 10	3	May 15, 1998	May 15, 2003	615.00	

8. LAND CLAIM ISSUES

The province of Ontario has been undergoing a public review process called *"Lands for Life"*. This has been a contentious programme of consultation and negotiation between the provincial government, municipalities, environmental organizations, the forestry industry, and aboriginal groups in order to designate lands for specific uses. The lobbying efforts of the mining industry have been of limited success in preserving access to prospective lands. Many letters and editorials on this subject have appeared in the *Northern Miner* and in publications of the *Prospectors and Developers Association of Canada* (PDAC).

Fortunately, the *Mattawan P* garnet deposit falls in an area NOT covered by the *"Lands for Life"* designation. The area is crown land considered suitable for multiple use, including mining and quarrying.

While this area is crown land and mining friendly, it falls in a region of political influence of the Mattawa Band of the Algonquin people. The Algonquins would most likely be interested in jobs and training programs with any future mining/quarrying producer.

Potential archaeological sites are also significant in today's exploration planning. No signs of ancient habitation (eg: petroglyphs, rock circles, cave dwellings) were observed on the properties during the examination. The nearest known sites are over 25 kilometres to the southwest, in Champlain Park along the Mattawa River (Tyyskä and Burns, 1987).

9. ENVIRONMENTAL ISSUES

Environmental issues are not a significant topic for the *Mattawan P* deposit. There is no sulphide mineralization seen in the samples taken, and in all other areas observed the sulphide content was trace to zero. The Lakefield Research Ltd. study made a similar observation as follows: *"Generally, the garnet samples are devoid of sulphides although scarce pyrite is present."* (Grammatikopoulos and MacDonald, 1999). This means that Acid Mine Drainage (AMD) will not be a problem to address for the *Mattawan P* deposit.

To the northwest of Scooper Lakes, on the northern part of the property on claim unit 1212547, the property owners have identified a gabbro-peridotite containing *"a zone of fairly massive pyrrhotite [$Fe_{1-X}S$].. some pentlandite [$(Fe,Ni)_9S_8$] was also visible in the pyrrhotite at this location"* (Shouinard and Montreuil, 1998). If the garnet potential is to be evaluated in that region, then the sulphide potential for AMD would have to be considered.

Sports fishing and tourism are important local industries in this part of Ontario. Specific care would have to be exercised around the Harrington and Antoine Creeks. There is a 400 foot surface rights reservation around all lakes and rivers.

It is likely that the facilities for a future garnet quarrying operation could be constructed behind hills in such a manner that they would be mostly out of sight from tourists travelling along Highway #533.

10. CONCLUSIONS AND RECOMMENDATIONS

Observations from the property examination are ***"very encouraging"***. In particular, the garnetiferous amphibolite and eclogite units are the most promising to yield industrial grade garnets. Grades in the 20% to 35% almandine-rich garnet were expected from visual estimates and correspond well with the point-count testing of the coarse fraction -20 to +42 mesh. This is reduced to 14% to 22% in cumulative size fraction content.

The grade and quality of garnets are within the ranges of commercially produced deposits elsewhere in the world. Access and infrastructure are also excellent.

Further work, including geological mapping and mineral separation testing of the *Mattawan P* deposit is warranted, in conjunction with a industry market evaluation.

11. REFERENCES

Anderson, P. 1984, Mattawan Township, District of Nipissing, Ontario Geological Survey, Geological Data Inventory Folio 138, 20 p. Plus 2 maps.

Davies, R., 1987, VLF electromagnetic survey, overburden drilling and sampling on the Mattawa Claims to 1987. Hudson Bay Exploration and Development Co. Ltd. (Assessment report TR003).

Davies, R., 1986, Assessment work report Diamond Drill Holes 1, 2, 3, Mattawa Project. Hudson Bay Exploration and Development Co. Ltd. (Assessment report TR002).

Easton, R.M., 1999, Geologic setting of five garnet sample sites. Ontario Geological Survey, 6 p. (report in prep).

Easton, R.M., 1992, The Grenville Province. in Geology of Ontario, Chapter 19, Ontario Geological Survey, Special vol. 4, part 2, p. 713-904.

Grammatikopoulos T., and MacDonald, J., 1999, Mineralogical, geochemical, electron microprobe examination and beneficiation of garnet-bearing rocks, Ontario, Canada. Lakefield Research Limited, (report in prep).

Harding, W.D., 1944, Mattawan -- Olrig Area, District of Nipissing, Ontario, Ontario Department of Mines, Map no. 53d. (scale 1:63,360).

Harrison, J.E., 1971, Quaternary geology of the North Bay - Mattawa Region. Geological Survey of Canada, Paper 71-26, 37 p. plus maps.

Ketchum, J.W.F. and Davidson A., 1999, Crustal architecture and tectonic assembly of the Central Gneissic Belt, southwestern Grenville Province, Canada -- A new interpretation

Canadian Journal of Earth Sciences (in press - accepted).

Komarechka, B., 1999, The evaluation and extent of the eclogitic garnets in the East Highway Zone. OPAP Prospecting Proposal, 8 p.

Komarechka, B., 1997, Report on airborne magnetometer survey prepared for Marum Resources Inc. and Ditem Exploration Inc. Antoine Township and surrounding area. (Filed for assessment Antoine - SP001; overlaps Mattawan Township; 32 maps).

Komarechka, B., 1996, Final Report - OPAP #OP95-269 - Mattawan Township. Ontario Prospectors Assistance Plan, OP95-269, 29 p.

Komarechka, B., 1995, Area #1 - Mattawan Twp. Garnet study. Ontario Prospectors Assistance Plan, OP94-302, 8 p. plus 3 maps (in Assessment report TR005 and TR006).

Komarechka, B., 1994, Area #7 - Mattawan Twp. Garnet study. Ontario Prospectors Assistance Plan, OP93-685, 35 p. (in Assessment report TR005).

Lumbers, S.B., 1976, Mattawa -- Deep River Area (Western Half), District of Nipissing. Preliminary Map P-1196, Geological Series, Ontario Division of Mines (scale 1:63,360 or 1 inch = 1 mile).

Shouinard, G., 1998, Physical work - scraping of outcrops, Mattawan P property. 3 p. (Assessment report SP005).

Shouinard, G., and Montreuil, R., 1998, Prospecting and physical work report of claim unit 1212548. (Scooper Lakes area, Mattawan Twp. - Assessment report).

Shouinard, G., and Montreuil, R., 1997, Prospecting of claim unit 1212158. (Scooper Lakes - Smith Lake area, Mattawan Twp. - Assessment report SP002)

Stoness, J.A., 1995, Petrographic report on slides GAB, MO, and MP. *in* Komarechka, B., Mattawan Township Garnet Study, Ontario Prospectors Assistance Plan, OP94-302.

Tyyskä, A.E., and Burns, J.A., 1973, Archaeology from North Bay to Mattawa. Historical Sites Branch, Ontario Ministry of Natural Resources, Research Report no 2, 65 p.

Appendix I

STATEMENTS OF QUALIFICATIONS

CERTIFICATE OF QUALIFICATION

I, **Bernard Henry Whiting**, of Kingston, Ontario, Canada, do hereby certify that:

1. I am a consulting geologist with principal address at 62 Quebec Street, Kingston, Ontario, Canada, K7K 1T7.

2. I am a registered ***"Professional Geoscientist"*** of the Province of British Columbia; certificate number 19851. I am a Fellow of the Geological Association of Canada and a member of the Society of Economic Geologists, Association of Exploration Geochemists, and Canadian Institute of Mining, Metallurgy and Petroleum.

3. I hold a Bachelor of Science (1979) and a Master of Science (1989) in geological sciences from the University of British Columbia. I am a Ph.D. candidate in economic geology at Queen's University. I have 20 years experience as an exploration and mine geologist for Rio Tinto Canadian Expl. Ltd., Cassiar Asbestos Corp., Brinco Mining Ltd., and Lynx Geosystems Inc.. I have consulted for junior and senior resource companies and have geological experience in 16 countries on 5 continents. I have also taught university courses in ore reserve estimation, exploration geochemistry, and computer applications in geology.

4. I am the author of the report titled ***"The Mattawan Garnet Project, Sudbury Mining District, Ontario, Canada"***, which is based on a property examination conducted in May, 1999.

5. I have no direct or indirect interest in the Mattawan P and B properties, nor do I expect to receive any interest in these properties.

6. Permission is hereby granted for the use of this report for any legal purpose normal to the business of Imperial Metals Corporation.

DATED at Kingston, Ontario, Canada this 14th day of January, 2000.

B.H. (Ben) Whiting, M.Sc., P.Geo.

CERTIFICATE OF QUALIFICATIONS

I, Katherina V. Ross, of 14180 Greencrest Drive, Surrey, British Columbia, Canada, do hereby certify that:

1. I am a graduate of the University of Waterloo with an Honours B.Sc. (1988) in Applied Earth Sciences.

2. I am a graduate of the University of British Columbia with a M.Sc. (1993) in geology.

3. I have over 12 years experience in exploration and mining geology, and have practiced my profession continuously since graduation in 1988 in Canada, Australia, Mexico and the Philippines.

4. I am a partner of Panterra Geoservices Inc., an independent geological consulting firm incorporated in the Province of British Columbia.

5. I, or Panterra Geoservices Inc., do not own or expect to receive any interest (direct, indirect or contingent) in the property described herein nor in the securities of Imperial Metals Corp. or any of its affiliates.

Signed in Surrey, British Columbia on the 3rd day of June, 1999.

Respectfully submitted,

Katherina V. Ross, M.Sc.

Appendix II

"Point Count Study of Mattawan P Property Garnets"

by Katherina Ross, M.Sc.
Panterra Geoservices Inc.

PANTERRA
GEOSERVICES INC.
Applied geological studies for exploration and mining

14180 Greencrest Drive
Surrey, B.C., Canada
V4P 1L9
Phone/fax 604-536-4744

POINT COUNT STUDY OF MATTAWAN P PROPERTY GARNETS, ONTARIO

Prepared for

Imperial Metals Corporation
420-355 Burrard Street
Vancouver, B. C., Canada
V6C 2G8

By

Katherina V. Ross, M. Sc.

July 23, 1999

INTRODUCTION

The Mattawan P property, located in northern Ontario is currently being assessed by Imperial Metals Corp. for the potential to host an economic deposit of industrial garnets. The Fe-rich garnets occur in amphibolite gneisses (see petrographic report, K. Ross, June, 1999b). This report is part of an ongoing study of the Mattawan B and P, and Papineau properties. Other previous work by the author includes a petrographic report, and point count study on garnet samples from the Papineau property (Ross, March 1999, and June 1999a). Three samples, collected from the Mattawan P property (MAT W04, W05 and W06), were submitted to Panterra Geoservices by Mr. Patrick McAndless of Imperial Metals Corp. to order to undertake a point count study to better determine the volume percent of garnets in the host rocks. The methods used to determine a representative count, the results, and possible sources of error are discussed below.

SAMPLE PREPARATION

The samples consist of material collected from surface pits. Total sample weights ranged from 26-32 kilograms. The rock was crushed and screened by Lakefield Research Inc., in Ontario. The sample material was divided into -20 to +42, -42 to +100, -100 to +150, and -150 mesh sizes. Three fractions of -150 material are present; a clean sample with very uniform grain size, a small sample of impure dusty material, and a larger sample of -150 mesh, floury grey dust. The material was not divided into felsic and mafic fractions as the samples from the earlier Papineau property garnet point count study had been (Ross, 1999a). All of the sample material was shipped to Panterra Geoservices Inc. The samples are contained in individual plastic bags and there has been no cross contamination. Lakefield provided sample weights for the three coarser fractions, while the three -150 mesh fractions were re-weighed by the author of this report. The three coarser fractions, and the clean –150 mesh fraction were point counted. Approximately 30 grams of material was taken from each of the four countable fractions, resulting in four sub-samples per sample.

METHODS

The sample material was spread thinly on a 2 mm grid, and viewed under a binocular microscope. An electronic counter was used to tally the points. The first part of the study was to determine an appropriate count number to represent the true volume percent of garnet in the sample within each fraction. A point count of 400 was chosen for the earlier Papineau property study, based on multiple test counts to determine the best number. Because the material used for this study was not sub-divided into mafic and felsic fractions, the garnets are more diluted, and a larger number of points is necessary to accurately represent their numbers. A 600 point count was repeated 3 times on the 20 to +42 mesh of the first sample, followed a 700 point count, also repeated 3 times. Fresh sample material was spread out before each count. The average number of garnets for the 600 point count was 160.3 with a standard deviation of +/- 6.7% (10.7). The average count for 700 point count was 201.7 with a standard deviation of +/- 5.5% (11.2). Because the standard deviation was lower for 700 point count, this number was used on

the remaining samples. Second counts were randomly done to check the accuracy of the counting method. To simplify and expedite the counts no attempt was made to separately identify the mafic minerals, or quartz and feldspars. The grains were identified either as **i)** garnet, **ii)** mafic (hornblende, pyroxene, biotite, magnetite, olivine) or **iii)** felsic (quartz, feldspar). The garnet volume percent by fraction, and a calculated total garnet content for each sample is presented in Table 1. The actual point counts and comments on the sample material are presented in Table 2.

POSSIBLE SOURCES OF ERRORS

The 20 to +42 mesh count is considered by the author to be the most accurate count because there is good liberation of the garnets, and the crystals are coarse enough to be easily identified and counted. The -42 to +100 mesh fraction is a mixture of medium and fine-grained material. All of the mineral species are present in variable grain sizes, and a volumetrically representative count is difficult, therefore this count is probably the least accurate. The 100 to +150 and -150 mesh fractions are very uniform in grain size, but rather fine-grained to count on the binocular microscope. The eye is preferentially drawn to any coloured grains, and the clear feldspar and quartz grains are difficult to see, so the estimate of mafic minerals may be consistently slightly exaggerated.

No point counts were done on two of the -150 mesh fractions, the impure sample and the dust sized material, due to the grain size. The impure samples were small, constituting less than 2% of the overall weight of the sample, but the dust portion ranges from 7.4 to 17.3%, and the loss of material during sample preparation varies from 2.2 to 6.3% of the overall weight. The garnet content of these portions is unknown. The calculation of the overall garnet content is made on the combined weight of the four fractions that were counted, and therefore may vary from the true garnet content of the rock depending on the presence or absence of garnet in the uncounted fractions.

RESULTS

The main mineralogy of the samples consists of orange-red, often rounded garnets, black hornblende and pyroxene, and white to clear plagioclase, quartz and possibly K-feldspar. Biotite is uncommon and magnetite is present in trace amounts. Pale green-yellow olivine is present in one sample.

In the 20 to +42 mesh fraction composite grains of mafic, felsic and garnet crystals are present. The degree of mineral liberation varies between samples, depending on the primary crystal size, the coarser-grained the minerals the better the liberation. Generally the garnets tend to be well liberated, and the composite grains consist of plagioclase intergrown with hornblende or pyroxene. These composite grains are excluded from the counts. The liberation of all mineral species in the finer fractions is good. Garnet content between fractions of the same sample may vary by up to 15%. This appears to be a function of the naturally occurring size of the garnet crystals coinciding with a particular mesh size. In samples MAT W04, 05 and 06, garnets are most abundant in the

coarsest fraction, (20 to +42 mesh). The calculated garnet content of the three Mattawan P property samples ranges from 14.6% to 21.4%.

Table 1, Mattawan P property samples, volume % garnet by fraction, and calculation of total garnet content in each sample**.

Sample	Size Fraction (mesh)	Weight kilograms	Proportion of sample	Garnet Grade %	Check Count %	Weighted Volume %	Vol% Garnet Total sample
MAT W04	TOTAL	26.9	100.0%				**14.6**
	20-42	4.6	17.1%	19.0	18.5	3.7	
	42-100	15.7	58.4%	14.1		9.4	
	100-150	1.9	7.2%	10.7		0.9	
	-150	1.4	5.2%	10.1		0.6	
	-150 *	0.1	0.4%	-			
	-150 dust	2.1	7.8%	-			
	Loss	1.1	4.1%				
MAT W05	TOTAL	31.8	100.0%				**21.4**
	20-42	8.1	25.5%	30.2		8.6	
	42-100	17.1	53.8%	18.5	14.5	11.2	
	100-150	1.8	5.8%	13.0		0.8	
	-150	1.3	4.1%	16.2		0.7	
	-150 *	0.2	0.6%	-			
	-150 dust	2.5	7.9%	-			
	Loss	0.7	2.2%				
MAT W06	TOTAL	25.8	100.0%				**18.2**
	20-42	8.5	32.9%	28.2		10.7	
	42-100	11.5	44.6%	12.1	14.7	6.2	
	100-150	1.2	4.5%	11.2		0.6	
	-150	1.2	4.7%	13.0		0.7	
	-150 *	0.1	0.4%	-			
	-150 dust	1.9	7.4%	-			
	Loss	1.4	5.4%				

* impure sample, not counted

** calculated using the total weight of the four counted fractions

Table 2: Actual counts on each fraction.

MAT W04
700 points/count

Mesh size	20-42	20-42	42-100	100-150	-150
Garnet	133	130	99	75	71
Mafic	371	379	343	331	333
Felsic	196	191	258	294	296

20-42 mesh, poor to moderate separation of mafic-felsic minerals, but orange-red garnets are generally liberated, not magnetic.
42-100 mesh, good mineral separation but highly variable grain size, not magnetic.
100-150 mesh, homogeneous grain size, garnets distinctly pinkish.
-150 mesh, homogeneous grain size, but very fine-grained nature of the material makes it difficult to count.

MAT W05
700 points/count

Mesh size	20-42	42-100	42-100	100-150	-150
Garnet	212	102	130	91	114
Mafic	387	369	348	386	387
Felsic	101	229	222	223	199

20-42 mesh, moderate separation of mafic-felsic minerals, abundant orange-red garnets are generally liberated, not magnetic.
42-100 mesh, good mineral separation but highly variable grain size, not magnetic.
100-150 mesh, homogeneous grain size, garnets distinctly pinkish.
-150 mesh, homogeneous grain size, but very fine-grained nature of the material makes it difficult to count.

MAT W06
700 points/count

Mesh size	20-42	42-100	42-100	100-150	-150
Garnet	198	85	103	79	91
Mafic	367	383	392	419	424
Felsic	135	232	205	202	185

20-42 mesh, moderate separation of mafic-felsic minerals, abundant orange-red garnets are liberated, not magnetic.
42-100 mesh, good mineral separation but highly variable grain size, not magnetic.

100-150 mesh, homogeneous grain size, garnets distinctly pinkish.
-150 mesh, homogeneous grain size, but very fine-grained nature of the material makes it difficult to count.

REFERENCES:

Ross, K., March 19, 1999. Petrographic study, SEM and microprobe analysis of three garnet samples from Mattawa, Ontario. Internal company report, Imperial Metals Corp., 18 pages.

Ross, K., June 03, 1999a. Point count study of Mattawa garnets, Ontario. Internal company report, Imperial Metals Corp., 33 pages.

Ross, K., June 21, 1999b. Petrographic study, SEM and microprobe analysis of garnet samples from Mattawan Garnet Project, Ontario. Internal company report, Imperial Metals Corp., 41 pages.

LIST OF PHOTOGRAPHS TO ACCOMPANY REPORT

Sample material is laid out a 2 mm grid. The dark grid lines are spaced 1 cm apart, the red lines are spaced 2 mm apart. Black minerals are either hornblende, pyroxene, biotite or magnetite. White or clear minerals are feldspar and quartz. Garnet is bright orange-red and translucent.

1. MAT W04 +42 mesh, 6.4x magnification, garnet-rich sample.
2. MAT W04 +42 mesh, 16x magnification, not poor separation of plagioclase from hornblende/pyroxene.
3. MAT W04 -42 to +100 mesh, 16x magnification, note variable grain size.
4. MAT W04 -100 to +150 mesh, 16x magnification.
5. MAT W05 +42 mesh, 6.4x magnification, garnet-rich sample.
6. MAT W05 +42 mesh, 16x magnification, garnet-rich sample.
7. MAT W05 -42 to +100 mesh, 16x magnification, note variable grain size.
8. MAT W05 -100 to +150 mesh, 16x magnification.
9. MAT W05 -150 mesh, 16x magnification, note homogeneous grain size.
10. MAT W06 +42 mesh, 6.4x magnification, garnet-rich sample.
11. MAT W06 +42 mesh, 16x magnification, garnet-rich sample.
12. MAT W06 -42 to +100 mesh, 16x magnification, note variable grain size.
13. MAT W06 -100 to +150 mesh, 16x magnification, note homogeneous grain size.

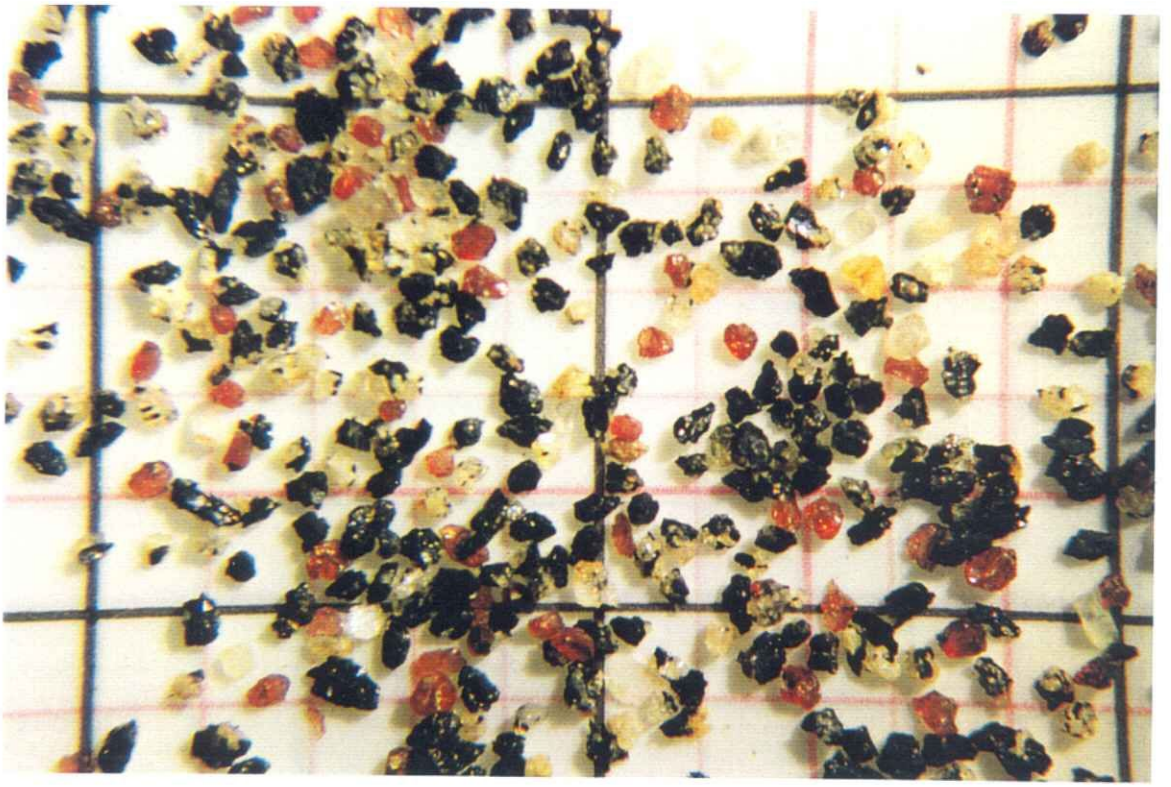


Photo 1. MAT-W04 +42 mesh., 6.4x magnification, garnet-rich sample.

Photo 2. MAT-W04 +42 mesh, 16x magnification, not poor separation of plagioclase from hornblende/pyroxene.

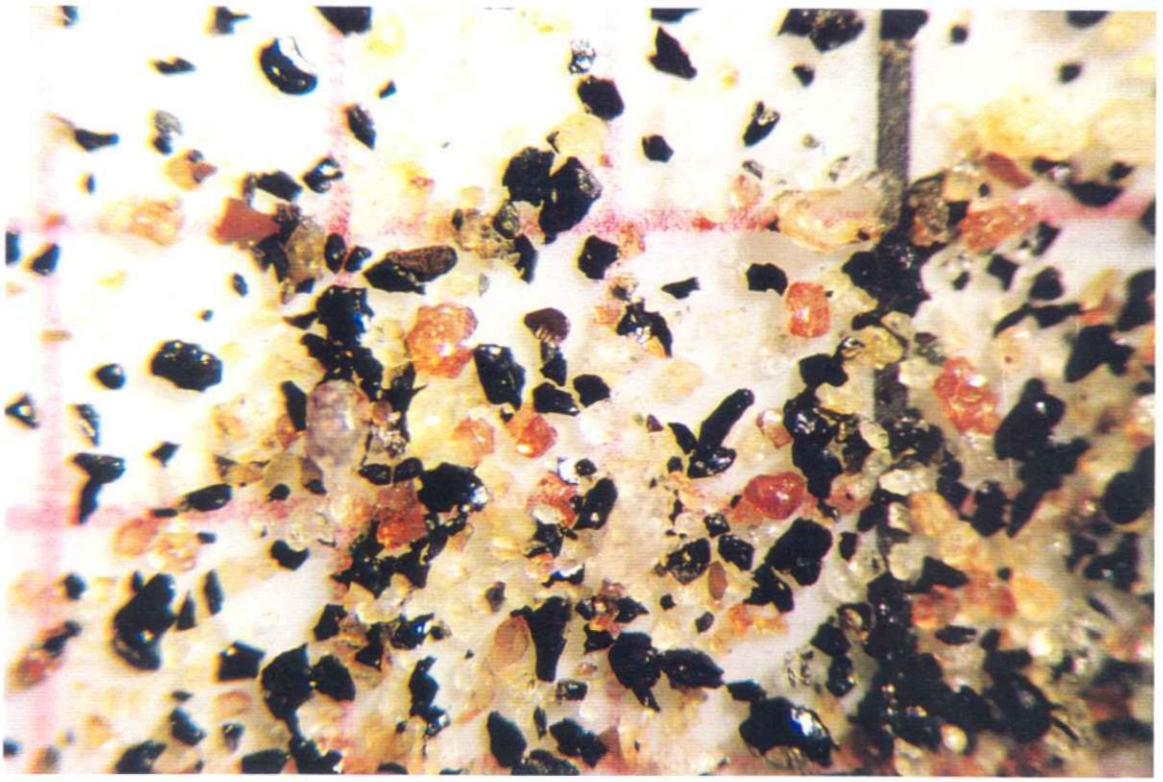


Photo 3. MAT-W04 -42 to +100 mesh, 16x magnification, note variable grain size.

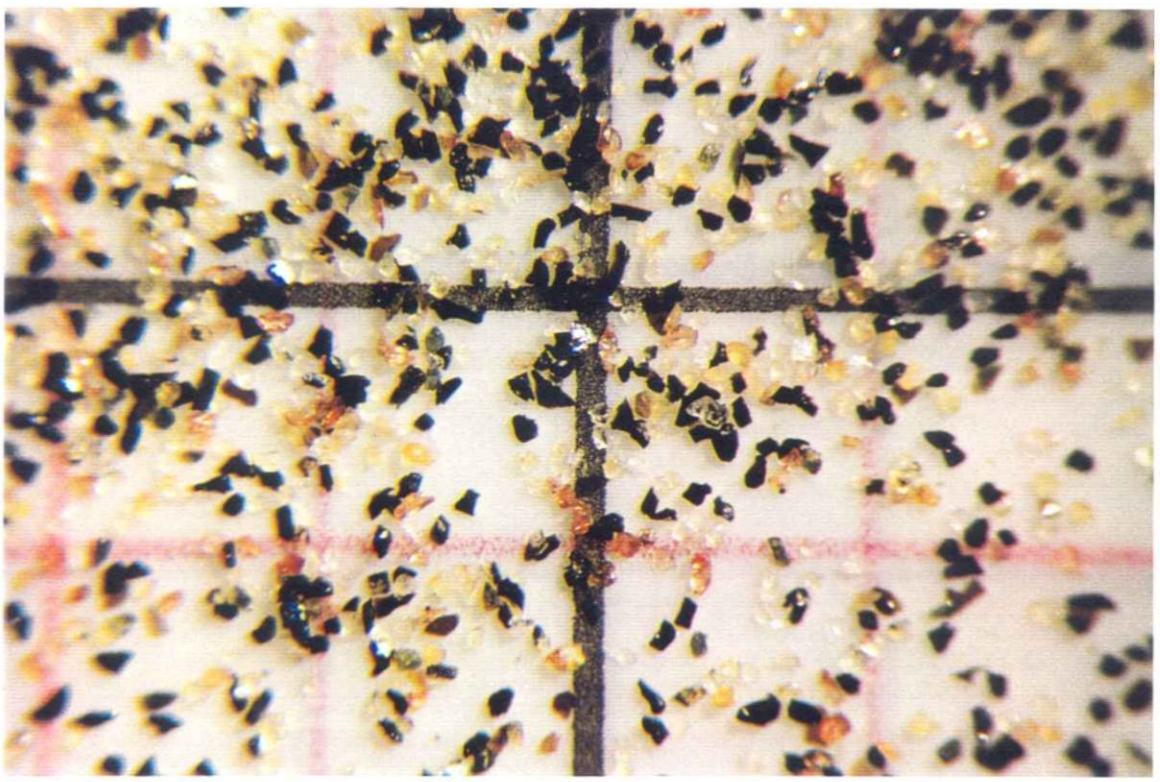


Photo 4. MAT-W04 -100 to +150 mesh, 16x magnification.

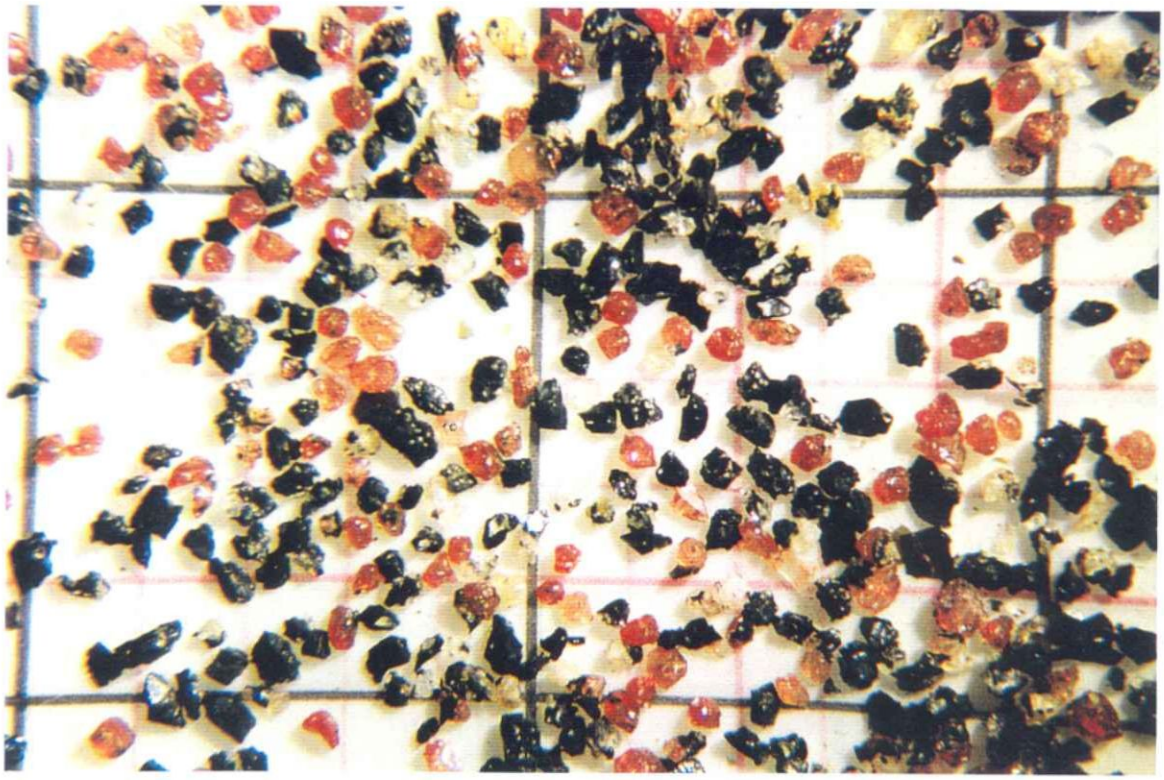


Photo 5. MAT-W05 +42 mesh, 6.4x magnification, garnet-rich sample.

Photo 6. MAT-W05 +42 mesh, 16x magnification, garnet-rich sample.

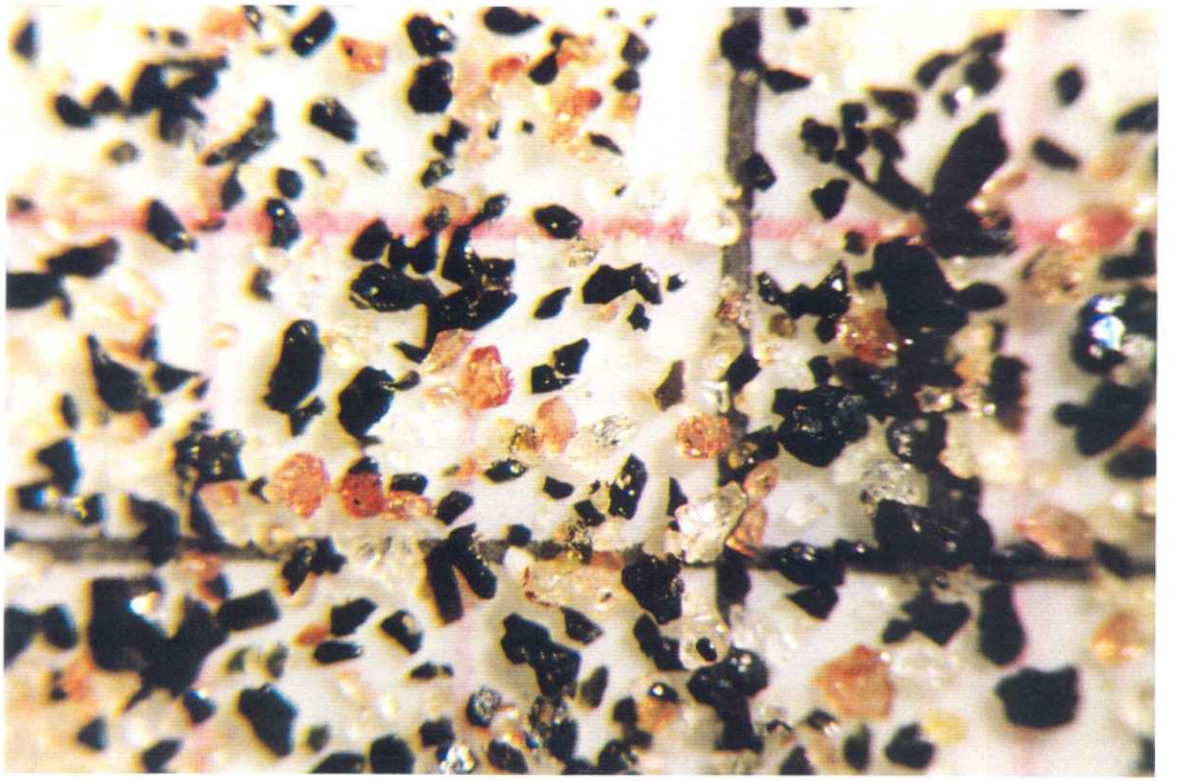


Photo 7. MAT-W05 -42 to +100 mesh, 16x magnification, note variable grain size..

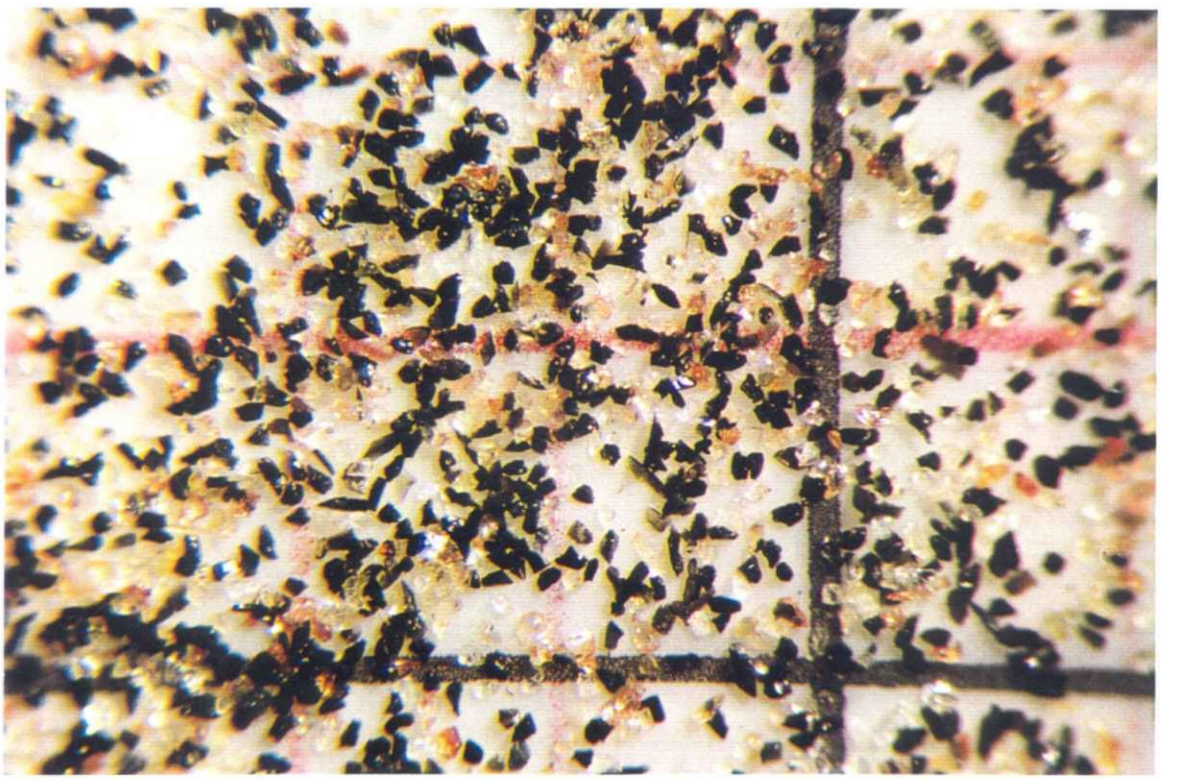


Photo 8. MAT-W05 -100 to +150 mesh, 16x magnification.

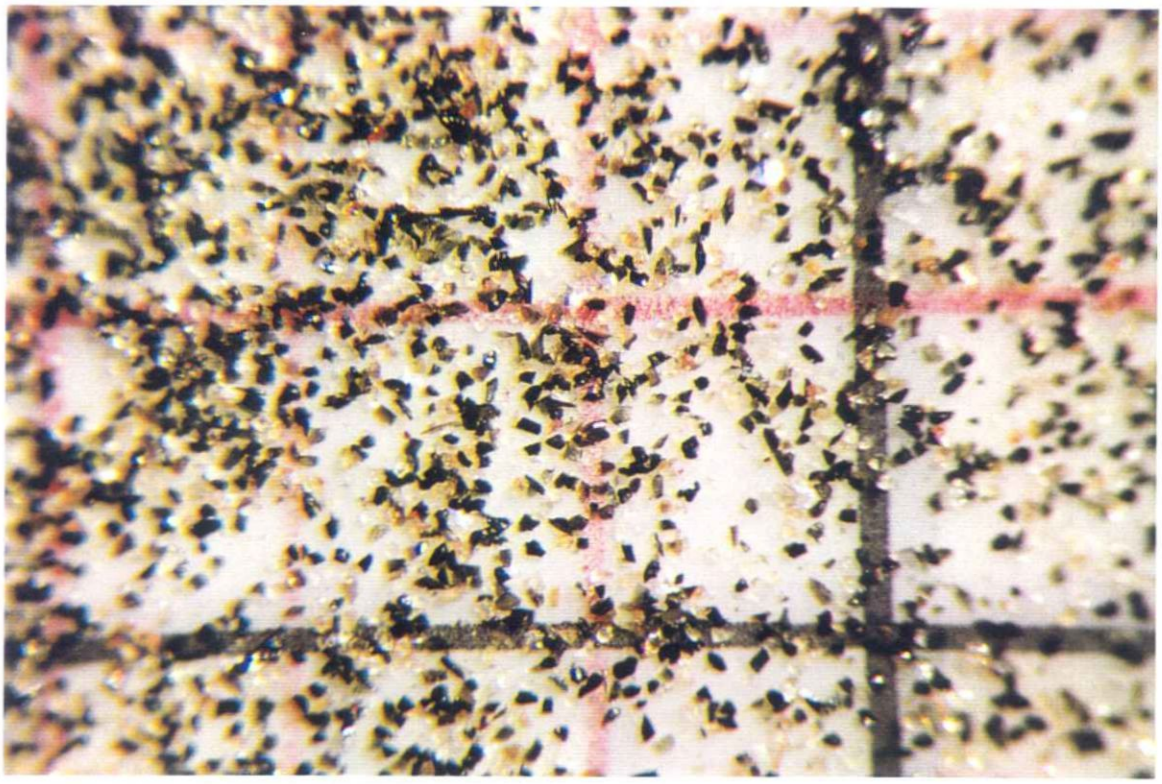


Photo 9. MAT-W05 -150 mesh, 16x magnification, note homogeneous grain size..

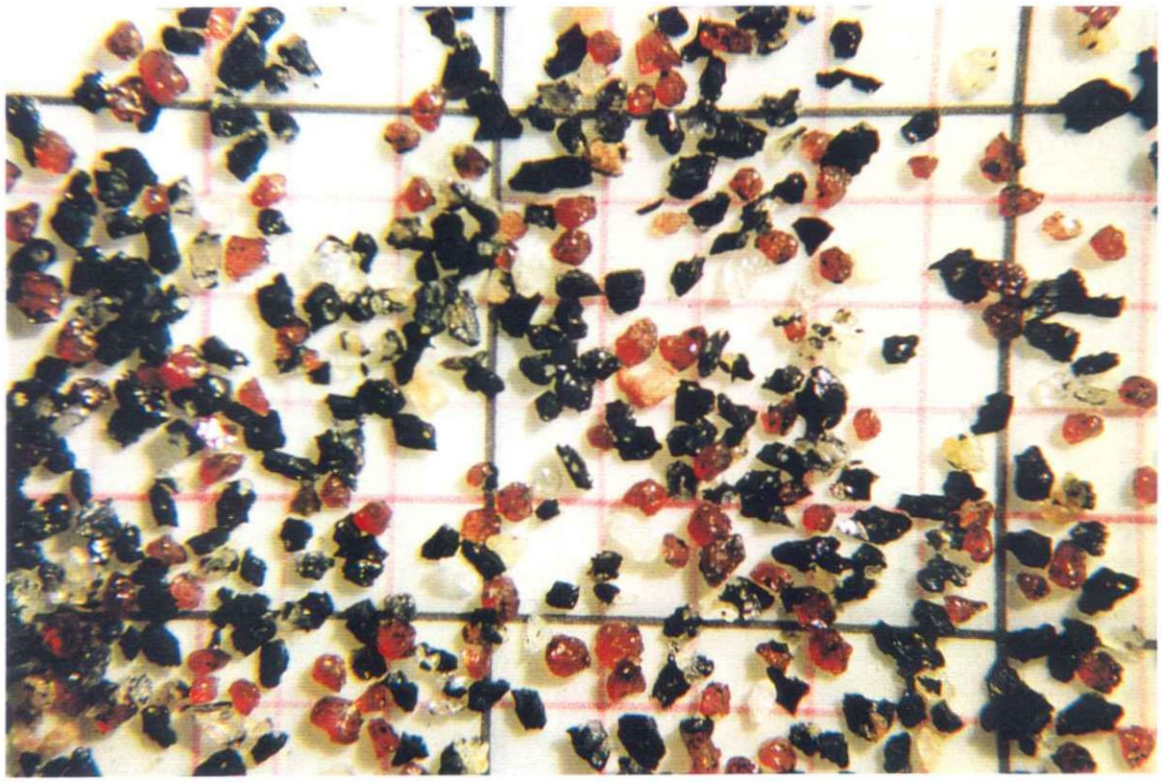


Photo 10. MAT-W06 +42 mesh, 6.4x magnification, garnet-rich sample.

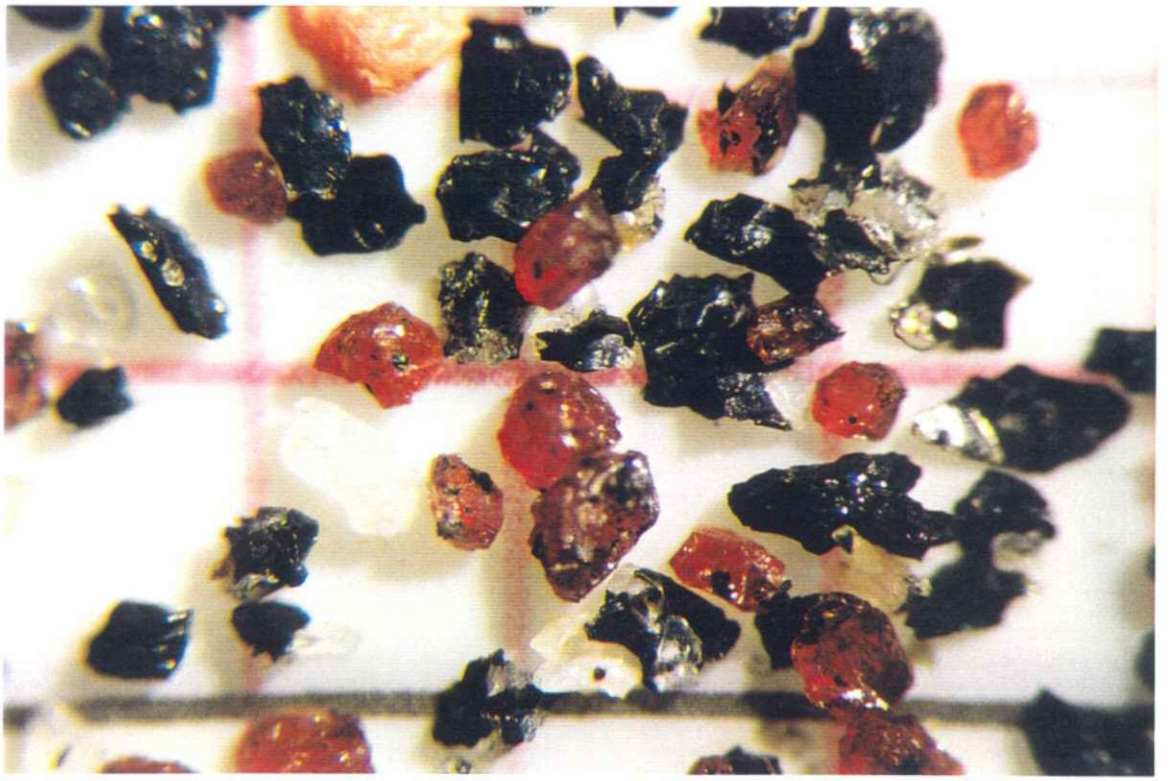


Photo 11. MAT-W06 +42 mesh, 16x magnification, garnet-rich sample.

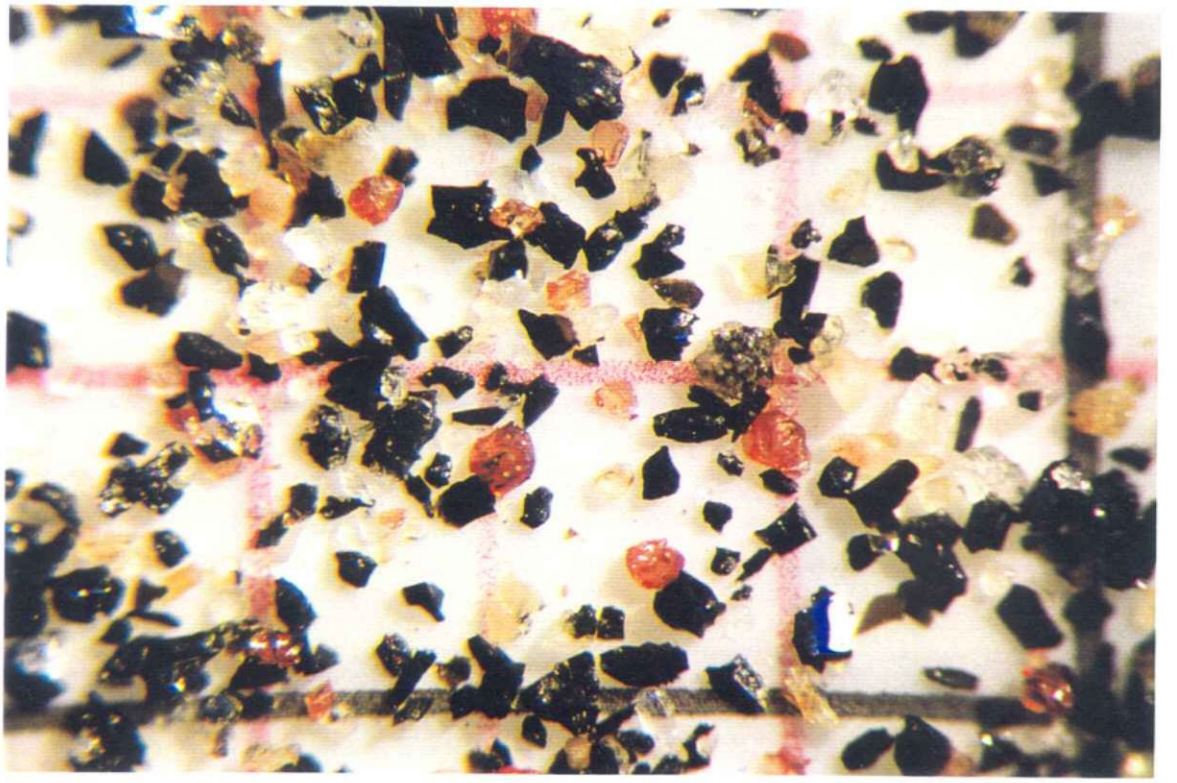


Photo 12. MAT-W06 -42 to +100 mesh, 16x magnification, note variable grain size.

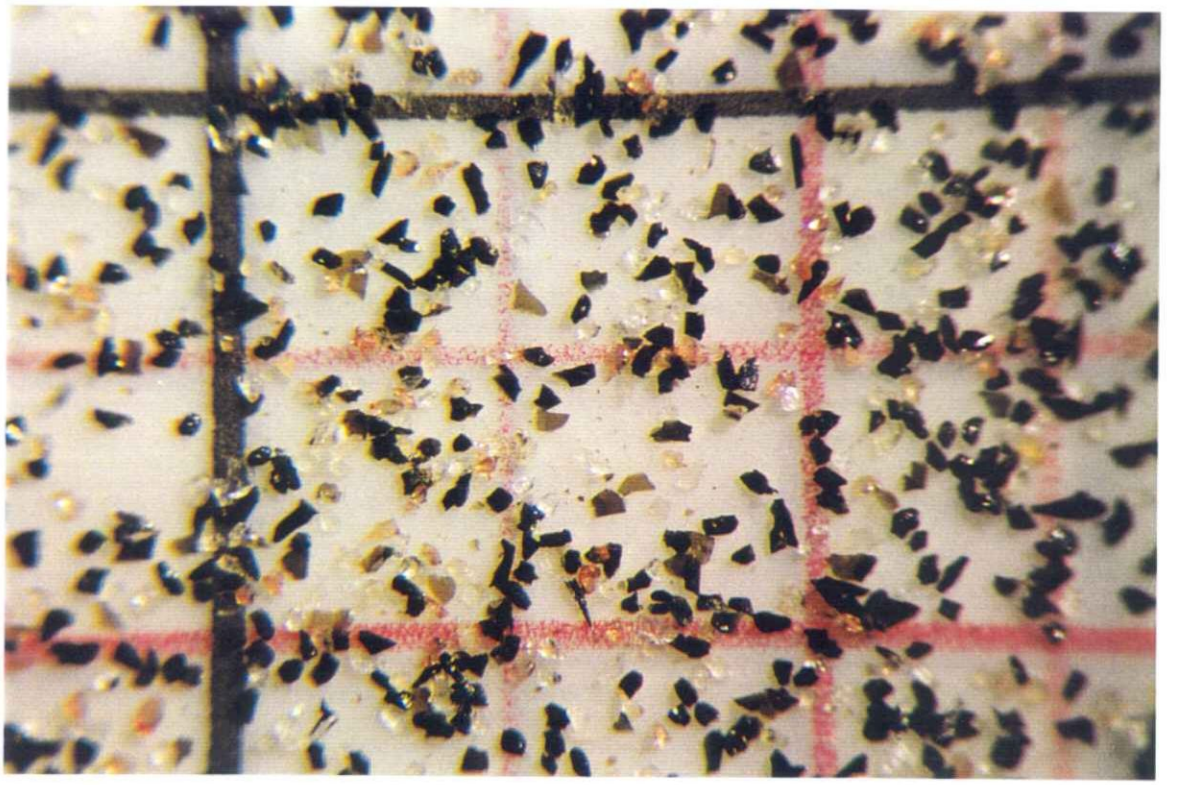


Photo 13. MAT-W06 -100 to +150 mesh, 16x magnification, note homogeneous grain size.

B.H. (BEN) WHITING, M.Sc., P.Geo.

62 Quebec Street
Kingston, Ontario
Canada, K7K 1T7
Tel: (613) 531-9712 ----- Fax: (613) 547-3199
E-mail: [illegible]

INVOICE – No. IMC-9901

Date: 14 June 1999

To: **Imperial Metals Corporation**

Re: **Mattawan Garnet Project** - during the period 19 May to 9 June 1999

PAID
JUN 21 1999

For: Geological Services of Ben Whiting
12.5 days at $400/day (time-sheet provided) ~~$ 5,000~~

Total Amount: ..... $ 5,000.
(243.45)

Please make payment to: Ben Whiting

at: 62 Quebec Street
Kingston, ON
Canada
K7K 1T7

pay $4756.55

If clarification is needed, please contact Ben Whiting at telephone (613) 531-9712 or e-mail: whiting@geol.queensu.ca

EXPENSE REPORT

Re: **Mattawan Garnet Project**

For the period: **May 18 to June 10, 1999**

Submitted by: **Ben Whiting**

Date	*Comment*	*Amount $*
May 18	Photocopying references, Queen's University	3.20
May 19	Fax receiving charges, Queen's University	14.50
May 20	Camera Film	22.96
	20 litre sample buckets, 6 at $4.50 ea.	27.00
May 21	Fuel for truck	52.00
	Food - lunch	5.78
	Parking - Sudbury	2.50
	MNDM-OGS copying claim search	28.62
	MNDM-OGS claim maps	9.66
	Food - Dinner	18.20
May 22	Food	10.30
May 23	Food	6.28
May 25	Food	4.75
	Field gear - cordage	3.42
	Field gear - tape	2.86
May 26	Accommodation, phone and food; Two Rivers Motel, Mattawa	355.83
	Fuel for truck	39.00
	Food - breakfast	1.90
	Food - lunch	5.97
	Food - dinner	12.21

May 27	Accommodation; Rest Haven, Sudbury	78.40
	Fuel for truck	40.29
	MNDM-OGS map	2.88
	MNDM-OGS assessment report copying	29.99
	Food - dinner	15.80
May 28	Fuel for truck	50.17
	Truck rental for 1 wee[redacted] mileage); Ace Rentals	515.28
May 31	Parcel post - rocks to Vancouver Petrographics Inc.	102.13
June 2	Food - lunch (Lakefield trip)	8.05
	Food - dinner	15.81
June 3	Truck rental for one day; Ace Rentals	102.55
	Fuel for truck	35.20
June 10	Final report copying	114.90
	Canada Post - reports sent to IMC in Vancouver	18.16
	$ Sub-total:	***1,756.55***
	Less expense advance	(2,000.00)
	$ Total:	***(243.45)***

LakefieldResearch

185 ConcessionStreet
Lakefield, ON
K0L 2H0 Canada
Phone: 705-652-2000
Fax: 705-652-8133

INVOICE

JUL 2 1

NO: 8837

July 15 99

IMPERIAL METALS CORPORATION
355 BURRARD STREET
SUITE 420
VANCOUVER, BC V6C 2G8
Attn: PATRICK MCANDLESS

G.S.T.Number 89921 6352RT
Terms: Net 30 days. 2% service charge per month on overdue accounts.

Our Project L.R. MP -228 : Charges for July
P.O. Number : Manager : MACDONALD, JAMES 1-630
A/R Code: IMC100

RE: MATTAWAN GARNET PROJ.: PHASE 1-SAMPLE PREPARATION

Charges as Per Agreement :	2,440.00
	2,440.00
GST @ 7%	170.80
Subtotal	2,610.80
*** PRE-PAYMENT CREDIT :	-1,220.00
CANADIAN FUNDS $	1,390.80

PAID
JUL 30 1999

PANTERRA GEOSERVICES INC.
Applied geological studies for exploration and mining

14180 Greencrest Drive
Surrey, B.C., Canada
V4P 1L9
Phone/fax 604-536-4744

INVOICE (#P99-16A)

Date: July 16, 1999

To: Mr. P. McAndless
Imperial Metals Corp.
Suite 420, 355 Burrard St.
Vancouver, B.C.
V6C 2G8

PAID AUG 12 1999

Re: Mattawan P-property garnet point count study, three samples, photo reprints and report modification.

Description	Total
Point counting, sample preparation and report preparation 8 hours @ $50.00/hour	$400.00
Modification of reports, 5 hours @50.00	$250.00
Subtotal	$650.00
7% GST on $650.00 (GST # 89642 6830)	$45.50
Expenses: 1. Duplication and binding of reports, 5 copies	$2.25
2. Photographs, and photo sheets	$10.55
3. Reprints of photographs (4 sets)	$34.00
4. Duplication of reports	$14.50
Grand Total	**$756.80**

Please make the cheque payable to Panterra Geoservices Inc. and mail to the above address.

Mattawan P

PANTERRA GEOSERVICES INC.
Applied geological studies for exploration and mining

14180 Greencrest Drive
Surrey, B.C., Canada
V4P 1L9
Phone/fax 604-536-4744

INVOICE (#P99-14A)

Date: June 21, 1999

PAID AUG 12 1999

To: Mr. P. McAndless
Imperial Metals Corp.
Suite 420, 355 Burrard St.
Vancouver, B.C.
V6C 2G8

Re: Mattawan Garnet Project, P-property petrography, SEM and Microprobe

Description		Total
Petrography, reflected and transmitted light, 6 samples @ $110.00/sample		$660.00
1.0 hours SEM operator time @ $50.00		$50.00
1.0 hours report preparation time @ $50.00		$50.00
12 microphotographs @4.00 /photo		$48.00
	Subtotal	$808.00
7% GST on $808.00 (GST # 89642 6830)		$56.56
Expenses: 1. Duplication and binding of reports, 2 copies (GST included)		$41.13
2. Rental time on SEM at UBC, 1.0 hours @ $100/hour (no GST)		$100.00
3. Microprobe operator Matti Raudsepp, 1 hours @ $60/hour (no GST)		$60.00
[redacted] time, 1 hours @ $80/hour (no GST)		$80.00
	Grand Total	$1145.69

Please make the cheque payable to Panterra Geoservices Inc. and mail to the above address.

Mattawan P

Mattawan P Garnet Project

Appendix III

"Petrographic Study, SEM and Microprobe Analyses Of Garnet Samples from the Mattawan Garnet project, Ontario"

By Katherina Ross, M.Sc.
Panterra Geoservices Inc.

PANTERRA GEOSERVICES INC.
Applied geological studies for exploration and mining

14180 Greencrest Drive
Surrey, B.C., Canada
V4P 1L9
Phone/fax 604-536-4744

PETROGRAPHIC STUDY, SEM AND MICROPROBE ANALYSES OF GARNET SAMPLES FROM THE MATTAWAN GARNET PROJECT, ONTARIO

Prepared for

Imperial Metals Corporation
420-355 Burrard Street
Vancouver, B. C., Canada
V6C 2G8

By

Katherina V. Ross, M.Sc.

June 21, 1999

6233/22/1

SUMMARY

Introduction

As part of an ongoing evaluation of the economic potential of the Mattawan Garnet Properties in Ontario, eleven samples of mafic, garnet-bearing rock were submitted to the author of this report for petrographic, scanning electron microscope (SEM,) and microprobe analysis to determine the composition of the garnets at the request of Mr. P. McAndless of Imperial Metals Corp. The samples were collected by Mr. B. Whiting on behalf of Imperial Metals Corp. Polished thin sections were prepared for each sample, and an offcut portion was stained with sodium cobaltinitrite to test for the presence of potassic feldspar. Polished sections were examined in reflected and transmitted light. Four of the samples, two from each property, were examined on the scanning electron microscope. Two of these samples were then examined on the microprobe. The microprobe analyses were done by M. Raudsepp, at the University of British Columbia. The petrography and SEM work was done by the author of this report. The oxide analyses from the microprobe data were recalculated to give proportions of end member compositions (see Table 1). Possible end member species are: almandine ($Fe_3Al_2Si_3O_{12}$), grossular ($Ca_3Al_2Si_3O_{12}$), andradite ($Ca_3Fe_2Si_3O_{12}$), pyrope ($Mg_3Al_2Si_3O_{12}$) spessartine ($Mn_3Al_2Si_3O_{12}$), and uvarovite ($Ca_3Cr_2Si_3O_{12}$).

Lithologies

The samples came from two properties, five from the Mattawan B property and six from the Mattawan P property. The B property samples consist of three samples of garnetiferous meta-gabbro, one peridotite (41% olivine) and one pyroxenite (70% clinopyroxene). Garnet content of the meta-gabbros ranges from 20-25 volume%. The peridotite contains approximately 5% garnet within irregularly shaped patches of unknown origin. These features are concentrically filled with a core of possible plagioclase that is rimmed by garnet followed by quartz. The pyroxenite contains approximately 8% garnet. Amphiboles in the meta-gabbro and peridotite are dark to medium brown. The P property samples consisted of three samples of garnetiferous amphibolite gneiss. Two polished sections were prepared from each of this samples, one consisting of the mafic material, and the second of the felsic, pegmatitic segregations or veins. The felsic portions lack garnets, while the mafic portions range from 12-50% garnet. Amphiboles in these samples are deep green in colour.

SEM Results

Samples MAT-W01 East and MAT-W01 West from the B property, and MAT-W05B and MAT-W06B from the P property were chosen for SEM analysis. In each sample three garnets were selected and 3 to 4 points across each garnet were analyzed. In addition, mineral inclusions in the garnets were identified, and several amphibole and biotite analyses were done to compare the compositions between properties. The garnets are homogeneous in composition, both within each garnet, and between samples. On the SEM spectra the Fe peak is distinctly higher than the Ca peak, indicating a high almandine garnet component (>50%). The samples from the B property have a small variation in Mn and Mg content. Were a small Mn component is present the Mg content is slightly lower. The P property samples did not have a Mn component. The garnets do not contain many mineral inclusions, but those identified consisted of apatite, rutile, ilmenite, zircon and possibly orthopyroxene.

The amphiboles from both properties contain K, Ti, and Na components, in addition to Fe, Mg, Ca, Si and Al. The brown amphiboles from the B property have slightly larger K, Ti, and Na contents than the green P property amphiboles. The brown amphibole may be oxyhornblende or kaersutite (Ti-bearing amphibole), based on its composition and distinct colour. The green amphibole is probably hornblende, with a kaersutite component. The biotite from both properties are similar, except that the B property biotite has a higher Ti content. Ilmenite in MAT-W01 East and West is pure ilmenite, while ilmenite in MAT-W05B and W06B is intergrown with magnetite lamella. Overall the B property rocks appear to have a higher Ti content than the P property rocks.

Microprobe Results

Two of samples, MAT-W01 West and MAT-W05B were selected for more detailed analyses on the microprobe. The same garnets that were analyzed on the SEM were re-analyzed on the microprobe. Eight points were analyzed on MAT-W01 West, and ten points on MAT-W05B. The proportions of end member garnet compositions were calculated from the microprobe results. The data are presented in Table 1.

The average almandine component of MAT-W01 West is 55.8%, with a range of 52.6 to 59.0%. There may be some enrichment of iron in the core of the garnets, but this is not clearly defined. The average grossular, pyrope and andradite components are 19.6%, 18.0%, and 4.15% respectively. The largest variation in these garnets is in the pyrope and spessartine components, which have an inverse relationship. This reflects variation in Mn and Mg composition within individual garnets. The average spessartine component is 2.42%, but ranges from 0.96 to 5.5 %.

The average almandine component of MAT-W05B is 52.15%, with a range of 50.6 to 53.92%. The average grossular, pyrope and andradite components are 14.0%, 27.5% and 5.44% respectively. The garnets have a consistently low spessartine component, with an average of 0.87%. These garnets are more compositionally homogeneous than MAT-W01 West garnets, with a lower Fe, Ca and Mn content, and a higher Mg content.

Table 1: Microprobe data and calculation of end member garnet components. (See pages 16 and 32 for SEM images of garnets and locations of analyses.)

MAT-W01 West

Analysis #	#1	#2	#3	#4	#5	#6	#7	#8
SiO_2	37.17	38.49	37.91	37.46	38.02	37.57	37.25	37.42
Al_2O_3	21.72	22.01	22.05	21.79	21.90	22.05	21.82	21.71
FeO	26.18	24.25	24.06	26.43	25.18	24.89	24.84	25.38
Fe_2O_3(c)	1.10	0.91	1.82	1.80	1.10	1.40	2.17	1.29
CaO	7.82	8.30	8.46	7.45	8.70	8.78	8.86	8.55
MgO	3.27	6.04	5.53	3.81	4.64	4.48	4.41	4.30
MnO	2.41	0.44	0.64	2.00	0.91	0.85	0.53	0.80
TiO_2	0.01	0.07	0.09	0.01	0.06	0.06	0.06	0.06
Cr_2O_3	0.00	0.00	0.03	0.00	0.01	0.05	0.01	0.02
Sum Ox%	99.69	100.51	100.58	100.75	100.53	100.13	99.96	99.53
End members								
Almandine	58.88	52.60	52.99	59.01	55.31	55.33	55.71	56.66
Andradite	3.22	2.60	5.14	5.16	3.15	4.00	6.19	3.75
Grossular	19.32	20.48	18.66	16.15	21.32	20.86	19.23	20.64
Pyrope	13.09	23.36	21.71	15.17	18.18	17.75	17.62	17.09
Spessartine	5.50	0.96	1.42	4.52	2.02	1.92	1.21	1.80
Uvarovite	0.00	0.00	0.08	0.00	0.03	0.14	0.04	0.06

MAT-W05B

Analysis #	#9	#10	#11	#12	#13	#14	#15	#16	#17	#18
SiO_2	38.04	38.21	37.89	38.39	38.73	37.98	37.96	38.19	37.99	38.30
Al_2O_3	21.94	22.16	22.20	22.08	22.08	22.19	22.19	22.02	21.93	22.09
FeO	24.00	24.58	23.44	24.19	24.97	24.06	23.46	23.15	23.16	23.18
Fe_2O_3(c)	2.46	2.14	1.75	1.52	1.04	1.65	2.37	2.14	2.17	2.09
CaO	6.54	6.48	7.37	7.02	6.37	6.37	6.66	7.82	7.51	7.36
MgO	7.13	6.95	6.77	6.93	7.17	7.22	7.28	6.84	6.94	7.19
MnO	0.40	0.42	0.39	0.41	0.39	0.39	0.46	0.34	0.33	0.38
TiO_2	0.00	0.02	0.05	0.04	0.01	0.07	0.04	0.06	0.07	0.02
Cr_2O_3	0.04	0.00	0.00	0.01	0.00	0.00	0.04	0.01	0.00	0.00
Sum Ox%	100.56	100.98	99.86	100.58	100.76	99.94	100.46	100.58	100.11	100.62
End Members										
Almandine	52.77	53.78	51.68	52.65	53.92	52.91	51.64	50.64	50.92	50.60
Andradite	6.90	6.00	4.94	4.31	2.97	4.67	6.62	6.01	6.13	5.87
Grossular	11.38	12.17	15.88	15.25	14.64	13.28	12.02	15.89	15.01	14.71
Pyrope	27.92	27.11	26.62	26.87	27.60	28.28	28.56	26.68	27.20	27.99
Spessartine	0.90	0.93	0.88	0.91	0.86	0.87	1.03	0.75	0.73	0.83
Uvarovite	0.13	0.01	0.01	0.02	0.00	0.00	0.13	0.02	0.00	0.00

PETROGRAPHIC DESCRIPTIONS OF SAMPLES, COLOUR PHOTOMICROGRAPHS, SEM SPECTRA, AND BLACK AND WHITE SEM IMAGES

SAMPLE: MAT-W01 EAST (Mattawan B property)

LITHOLOGY: Garnetiferous Meta-gabbro (Amphibolite-grade metamorphism)

Hand Sample Description: A medium grained, crystalline, mafic rock with a high specific gravity. It is comprised of approximately 20%sub-rounded, red garnet crystals 1-3.5 mm in diameter, in a groundmass of interlocking dark green-brown and black minerals. The overall texture and colour are homogeneous. Staining of the offcut with sodium cobaltinitrite indicates potassic feldspar forms hairline rims around some of the garnets. The rock is not magnetic, and is not foliated.

TRANSLUCENT MINERALS

Mineral	%	Distribution & Characteristics	Opt. Prop.
plagioclase	25	fine-grained, anhedral, occasionally as crystals with plagioclase twins, but mostly present intergrown with pyroxene forming groundmass to other crystals, often slightly clouded	1st order biref simple twinning
garnet	20	medium-grained, sub to euhedral, rounded crystals, colourless, high relief, abundant fractures, inclusions of other minerals	isotropic
pyroxene	20	fine-grained, anhedral, clouded but colourless, possibly with exsolution lamellae, some graphic intergrowths with plagioclase	2nd to 3rd order biref
amphibole	18	fine to medium-grained, up to 3 mm long maximum dimension, anhedral, ragged, pleochroic, pale yellow to intense brown-yellow, intergrown with and enclosing biotite and ilmenite, composition oxy-hornblende or kaersutite?	2nd-3rd order biref, masked by colour
biotite	08	medium-grained, up to 2 mm, platy, anhedral, intense red-brown to pale yellow pleochroic, intergrown with amphibole	masked high biref parallel extinction
K-feldspar	02	fine-grained, cloudy rims around garnet, identified by stain, possibly replacing original plagioclase rims	low 1st order biref.
apatite	minor	fine-grained, oval crystals, clear and colourless, high relief, enclosed in other minerals	1st order biref. parallel extinction
rutile	trace	very fine-grained, inclusions in garnet, identified by SEM	

OPAQUE MINERALS

Mineral	%	Distribution & Characteristics	Opt. Prop.
ilmenite	07	fine-grained, anhedral, throughout sample, intergrown with all other minerals	medium grey reflectance
Fe-oxides	trace	fine-grained rims pyrite	pale grey
pyrite	trace	fine-grained, disseminated	pale yellow

Thin Section Description:

The sample consists of medium-grained, subhedral garnet, anhedral amphibole, and biotite, and minor plagioclase crystals, in a groundmass of intergrown pyroxene-plagioclase with a graphic texture. Plagioclase to pyroxene content varies with one dominating over the other in different portions of the section. Scattered crystals of apatite, and anhedral ilmenite occur as accessory phases. With the exception of the garnet, the crystals are ragged and highly irregular in shape with no obvious preferred orientation. All minerals are intimately intergrown with one another. Both amphibole and biotite are intensely coloured, and the dark brown pleochroism indicates a high iron content. Garnet, amphibole and biotite appear fresh, whereas the pyroxene and plagioclase are often cloudy. Fine-grained brown amphibole partially replaces pyroxene. Biotite is often enclosed in amphibole. Staining of the offcut with

sodium cobaltinitrite indicates the plagioclase is partially replaced by K-feldspar. Some of the cloudiness of the plagioclase may also be due to surface weathering. Plagioclase/K-feldspar forms cloudy rims around the garnet, amphibole is stable in these rims. The garnets themselves contain a few fine-grained inclusions of cloudy plagioclase-pyroxene, ilmenite and apatite. There is no obvious alignment of minerals, however, the garnets are cut by an orthogonal set of fractures that have the same orientation throughout the section. These fractures are not present in the other minerals.

Scanning Electron Microscope Results

Four areas were examined on the SEM. Three of the points consisted of large garnet crystals. The third area enclosed an intergrowth of pyroxene, amphibole, biotite and plagioclase. Several analyses were made across each garnet, and any mineral inclusions in the garnets were also tested. The garnet spectra are very uniform in composition both within each garnet, and between garnets (Fig. 1). The Fe-peak is distinctly greater than the Ca-peak, indicating a high (>50%) almandine garnet component ($Fe_3Al_2Si_3O_{12}$). Minute mineral inclusions in the garnets consisted of Cl-bearing apatite, ilmenite, rutile and possibly orthopyroxene. The pyroxene is diopsidic with a small Na and Fe component (aegirine-augite). The amphibole spectra displays small Na, K, and Ti peaks. The presence of these components, as well as the brown pleochroic colours indicate an amphibole possibly intermediate between kaersutite and oxy-hornblende. The biotite spectra has a well defined Ti-peak.

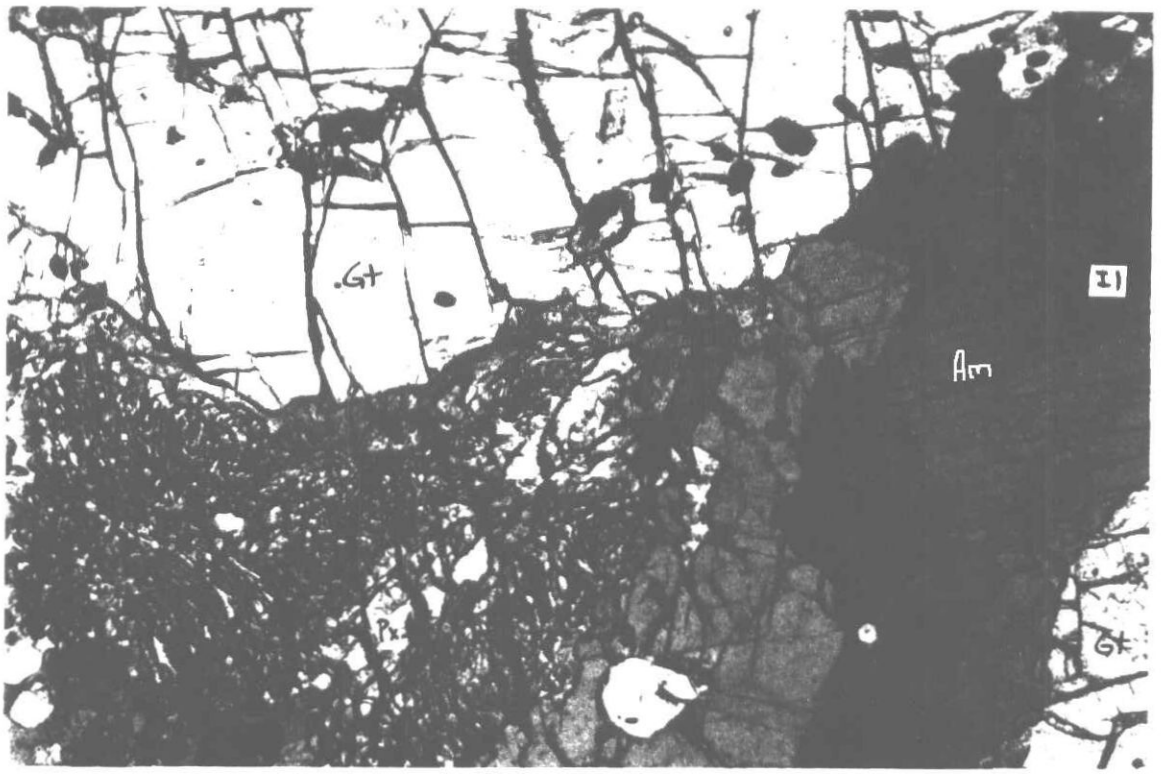


Photo 1A: MAT-W01 East. This view illustrates overall texture of the sample. Note the intense brown colour of both amphibole and biotite. The coarse-grained crystals occur in a groundmass of finely intergrown pyroxene and plagioclase (lower left). Note the slightly cloudy K-feldspar rim on the garnet. Gt-garnet, Am-amphibole, Bi-biotite, Px-pyroxene, Il-ilmenite, Kf-K-feldspar. Field of view 5.1 mm. Plane polarized light.

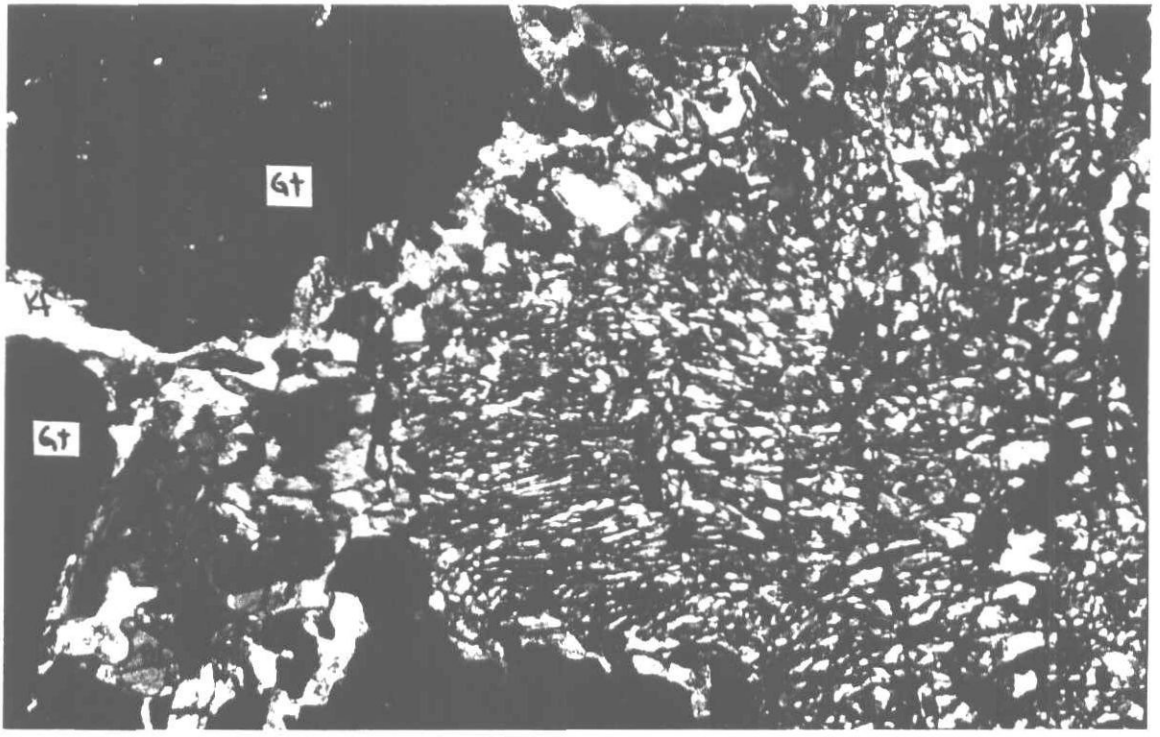


Photo 1B: MAT-W01 East. This view illustrates the graphic texture of the pyroxene-plagioclase intergrowth. The slightly cloudy K-feldspar rim on the garnet (black) is clearly visible. Gt-garnet, Bi-biotite, Px-pyroxene, Kf-K-feldspar. Field of view 5.1 mm. Cross polarized light.

A.

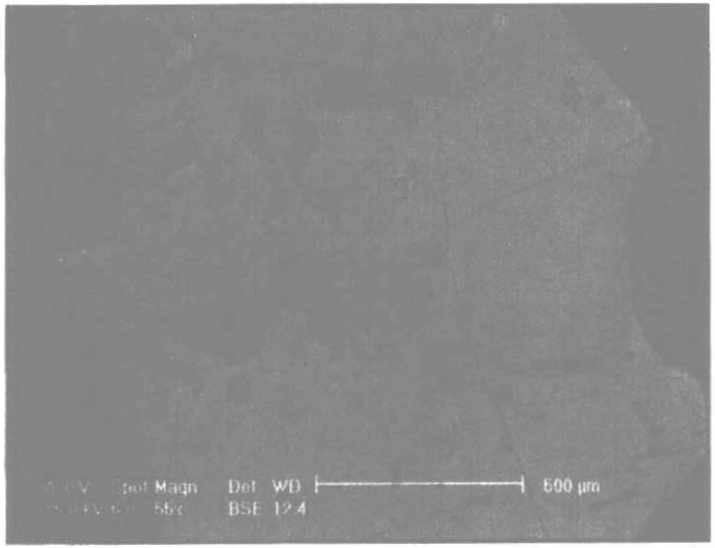


Photo 2A: MAT-W01 East, spot 1. SEM images, scale bar in microns in each photo. A homogeneous garnet crystal (gt) with inclusions of apatite (ap), plagioclase (pl), and amphibole (am).

B.

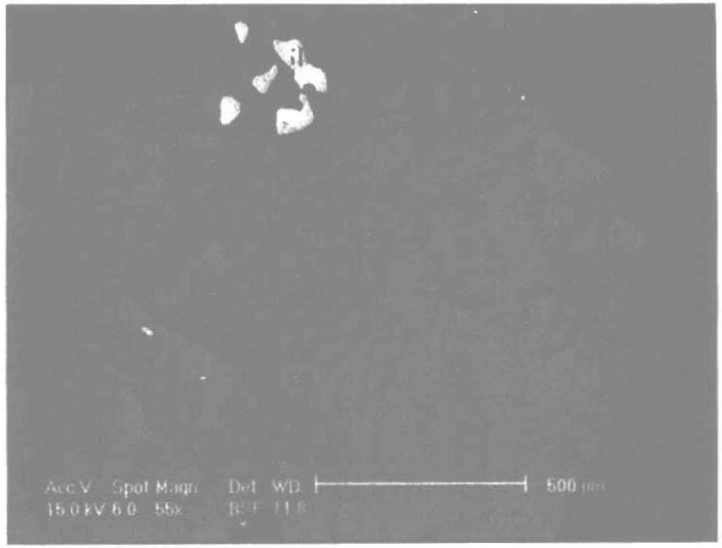


Photo 2B: MAT-W01 East, spot 2. A homogeneous garnet crystal (gt) with inclusions of ilmenite (il) and apatite (ap).

C.

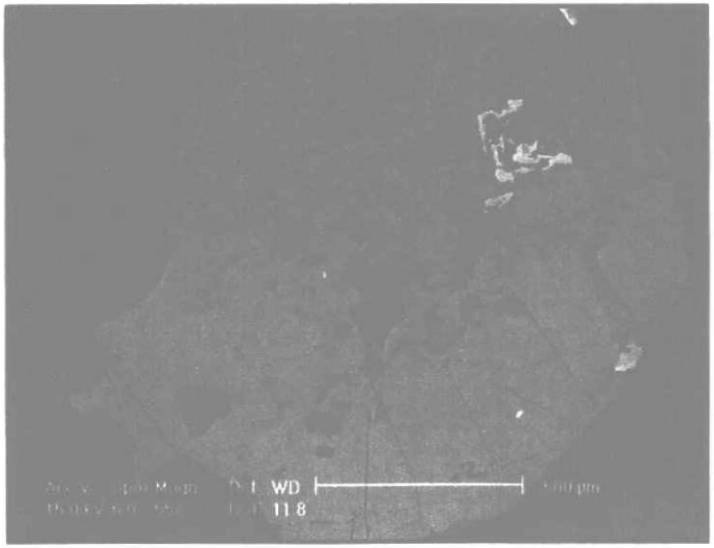


Photo 2C: MAT-W01 East, spot 3. A homogeneous garnet crystal (gt), with inclusions of ilmenite (il), apatite (ap) and silicates (dark grey).

D.

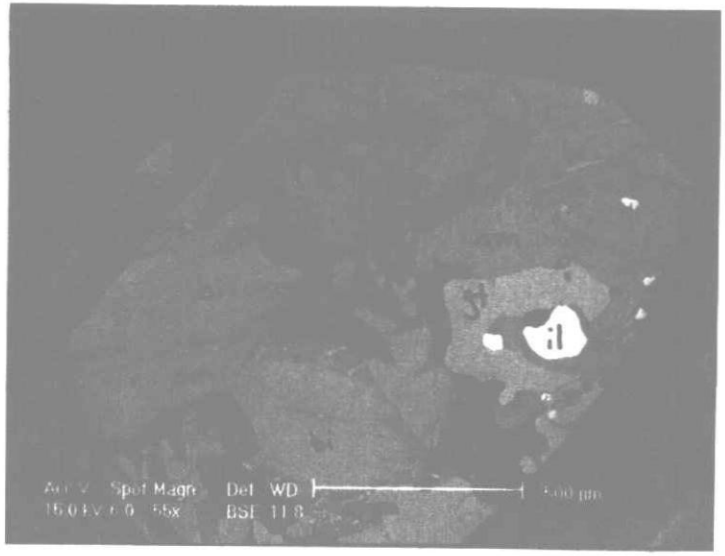
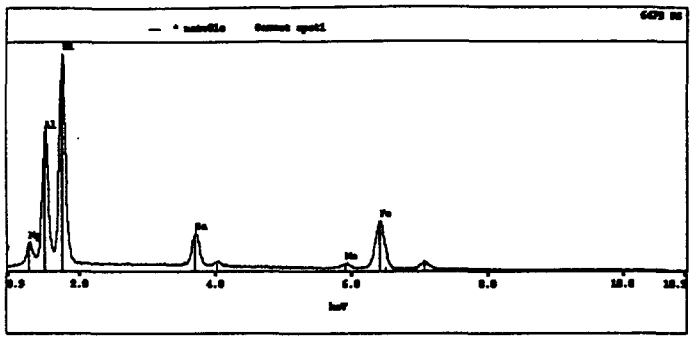
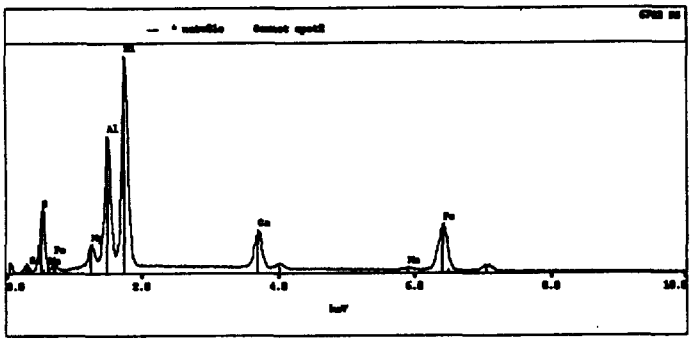


Photo 2D: MAT-W01 East, spot 4. An intergrowth of biotite (bi), garnet (gt), amphibole (am), plagioclase (pl) and ilmenite (il).

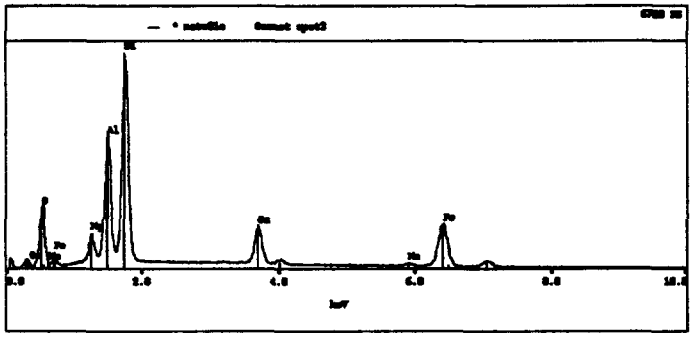
A.



B.



C.



D.

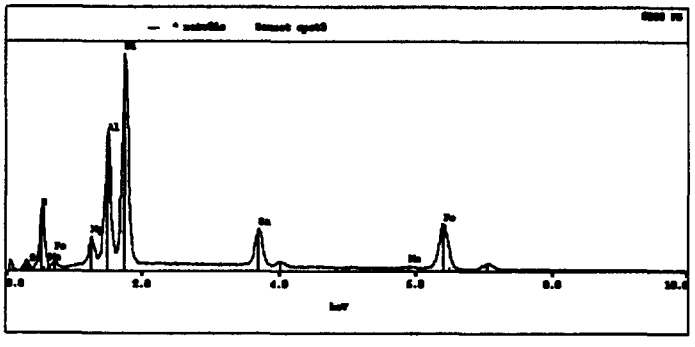
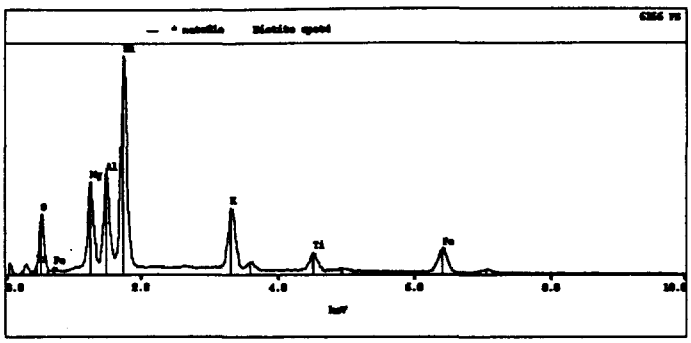
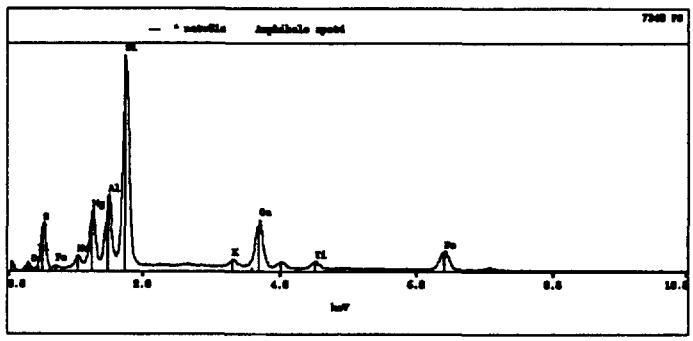


Figure 1. MAT-W01 East: Characteristic spectra of garnets, one analysis from the first two garnets analyzed, and two spectra from Spot3 to illustrate the slight difference in Mn component. Note the Fe peak is consistently larger than the Ca peak. No systematic variation across crystals from cores to rims was observed.

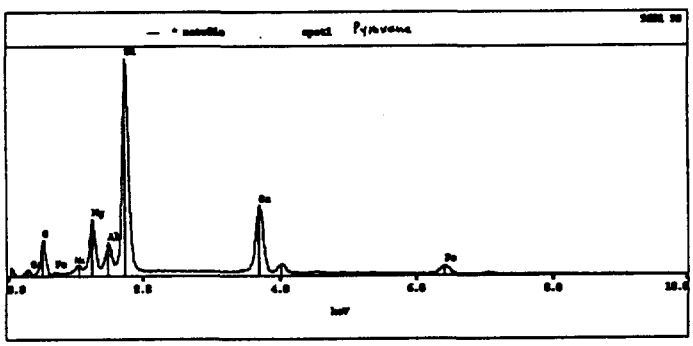
A.



B.



C.



D.

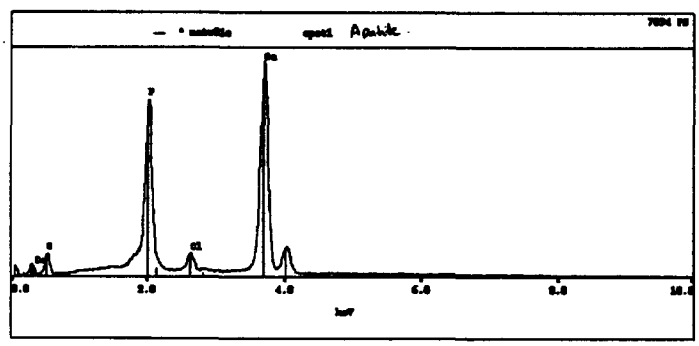


Figure 2. MAT-W01 East: Spectra of biotite, amphibole, pyroxene and apatite. Note the presence of Ti in both amphibole and biotite. The amphibole and the pyroxene both have an Na component. The apatite contains chlorine.

SAMPLE: MAT-W01 CENTRAL (Mattawan B property)

LITHOLOGY: Garnetiferous Meta-gabbro (Amphibolite-grade metamorphism)

Hand Sample Description: A medium-grained, crystalline, dense, mafic rock. The sample consists of swarms of rounded, red garnet crystals < 1.0 mm in diameter, in a greenish groundmass of crystals (amphibole/pyroxene) interspersed with irregularly shaped plagioclase crystals up to 7 mm across. Mineral distribution is more heterogeneous than in the previous sample (MAT-W01 east). The sample is not magnetic and unfoliated. Trace amounts of pyrite are present. The sodium cobaltinitrite stain on the offcut is weak, but minor amounts of K-feldspar appear to rim some garnets.

TRANSLUCENT MINERALS

Mineral	%	Distribution & Characteristics	Opt. Prop.
plagioclase	33	medium to coarse-grained, anhedral, clear, colourless, very coarse-grained in patches, polygonal crystals meet in triple point junctions, intergrown with pyroxene, and often enclosing other minerals	1st order biref albite twinning
garnet	25	medium-grained, sub-rounded 1 mm crystals, colourless, high relief, generally inclusion free	isotropic
pyroxene	15	fine-grained, anhedral, clouded but colourless, exsolution lamellae have a "herring-bone" pattern, graphic intergrowths with plagioclase	2nd to 3rd order biref
amphibole	15	medium to coarse-grained, anhedral, ragged, pleochroic, pale yellow to intense brown-yellow, interstitial to garnet with some large optically continuous crystals enclosing many garnets, also intergrown with and enclosing biotite and ilmenite, oxyhornblende or kaersutite?	2nd-3rd order biref, masked by colour
biotite	05	medium-grained, up to 1.5 mm, platy, anhedral, intense red-brown to pale yellow pleochroic, intergrown with amphibole and plagioclase	masked high biref parallel extinction
K-feldspar	minor	fine-grained, identified by stain, replacing plagioclase	low 1st order biref.
apatite	trace	fine-grained, oval crystals, clear and colourless, high relief	1st order biref.

OPAQUE MINERALS

Mineral	%	Distribution & Characteristics	Opt. Prop.
ilmenite	07	fine-grained, anhedral, generally enclosed in amphibole	grey reflectance
pyrite	trace	very fine-grained, rimmed with magnetite or Fe-oxides	pale yellow

Thin Section Description:

The sample consists of patches of coarse-grained polygonal plagioclase and intergrowths of plagioclase, pyroxene, garnet, amphibole, and biotite, with accessory ilmenite and apatite. Anhedral plagioclase crystals enclose the other mineral phases. The small extinction angle (<10°) of twins in the crystals indicates an albitic composition. Garnets are quite uniform is size ranging form 0.5-1.0 mm. They are generally separated from one another by the other minerals, but locally coalesce. They do not contain mineral inclusions. All other mineral phases are interstitial to garnet. Biotite and amphibole are intimately intergrown, and are both intensely brown and pleochroic. Large, (1 cm) optically continuous, skeletal amphibole crystals enclose numerous garnets. Ilmenite is also generally enclosed in amphibole. Much of the pyroxene has a distinct "herring-bone" texture, possibly caused by the exsolution of ortho and clinopyroxenes. These may originally have been large continuous crystals. Pyroxene without this texture is finer-grained, colourless and has the same relief as garnet in plane polarized light. Both pyroxene and amphibole are graphically intergrown with plagioclase. There is no alignment of minerals. The garnets are fractured, but not as intensely as in the previous sample, and the fractures appear more randomly oriented.

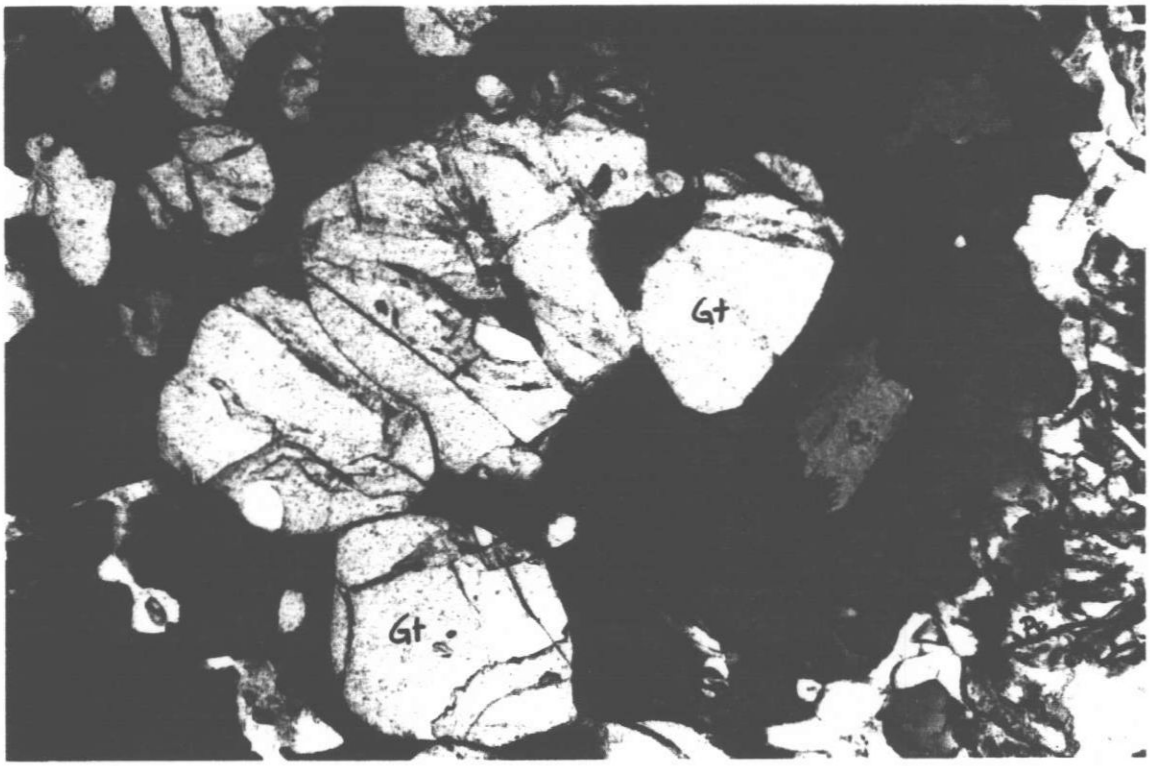


Photo 3A: MAT-W01 Central. Rounded garnets crystals and flakes of biotite are enclosed in brown amphibole. Gt-garnet, Am-amphibole, Bi-biotite, Px-pyroxene, Il-ilmenite, Field of view 5.1 mm. Plane polarized light.

Photo 3B: MAT-W01 Central. Garnets, rimmed with K-feldspar, occur in a groundmass of pyroxene-plagioclase. Gt-garnet, Am-amphibole, Px-pyroxene, Kf-K-feldspar. Field of view 5.1 mm. Plane polarized light.

SAMPLE: MAT-W01 WEST (Mattawan B property)

LITHOLOGY: Garnetiferous Meta-gabbro (Amphibolite-grade metamorphism)

Hand Sample Description: A medium-grained, crystalline, homogeneous, mafic rock. The sample is comprised of approximately 25% round, red garnet crystals, 1-2 mm in diameter in a dark green-grey groundmass. The garnets appear to be rimmed by a darker brown-grey mineral. Sodium cobaltinitrite staining of the offcut identifies hairline rims of K-feldspar around many garnets. The rock is not magnetic and is not foliated.

TRANSLUCENT MINERALS

Mineral	%	Distribution & Characteristics	Opt. Prop.
plagioclase	30	medium-grained, anhedral, clear, colourless, intimately intergrown with pyroxene, and often enclosing other minerals	1st order biref albite twinning
garnet	22	medium-grained, sub-rounded 1-2 mm crystals, colourless, high relief, generally inclusion free, fractured	isotropic
amphibole	20	medium-grained, anhedral, ragged, pleochroic, pale yellow to intense brown-yellow, interstitial to garnet, intergrown with and enclosing biotite and ilmenite, oxyhornblende or kaersutite?	2nd-3rd order biref, masked by colour
pyroxene	15	fine-grained, anhedral, clear, colourless, high relief, present only as graphic intergrowths with plagioclase	2nd to 3rd order biref
biotite	05	fine to medium-grained, platy, anhedral, intense red-brown to pale yellow pleochroic, intergrown with amphibole and plagioclase	masked high biref parallel extinction
K-feldspar	03	fine-grained, identified by stain, replacing plagioclase around garnets	low 1st order biref.
chlorite	trace	fine-grained, fibrous, alteration of garnet, greenish	1st order biref.
zircon/ monazite	trace	very fine-grained, rounded mineral inclusion in biotite, causing a pleochroic halo, very high relief	extreme biref.
apatite	trace	fine-grained, oval crystals, clear and colourless, high relief	1st order biref.

OPAQUE MINERALS

Mineral	%	Distribution & Characteristics	Opt. Prop.
ilmenite	05	fine-grained, anhedral, generally enclosed in amphibole	grey reflectance
pyrite	minor	fine-grained, disseminated, some enclosed in garnet	yellow

Thin Section Description:

The sample consists of an intergrowth of plagioclase, amphibole, pyroxene, garnet and biotite with accessory ilmenite and trace amounts apatite. All of the pyroxene is present as complex graphic intergrowths with plagioclase. Large plagioclase crystals also enclose all other minerals. Amphibole is anhedral and skeletal, enclosing garnet, biotite and ilmenite. It partially replaces pyroxene, and is itself intricately intergrown with plagioclase. Both biotite and amphibole are intensely brown and pleochroic, as in the previous two samples. The garnets are subrounded, and cut by randomly oriented, often conchoidal fractures. Minor amounts of chlorite? replacing the garnet, are associated with these fractures. Rounded inclusions of plagioclase are occasionally present in garnet crystals. Garnets may be rimmed by any of the other mineral phases present. The K-feldspar is visible as a slight clouding of the plagioclase, and lack of twinning. Ilmenite occurs throughout the sample, generally enclosed in amphibole.

Scanning Electron Microscope Results

Three garnets were examined on the SEM. Several points across the garnets, and various mineral inclusions were analyzed. In all of the garnet spectra the Fe peak is distinctly larger than the Ca peak, indicating a high almandine

garnet content. There is some slight variability in the Mn and Mg peaks (Fig. 2). Where there is a noticeable Mn peak, the Mg peak is smaller. Mineral inclusions in the garnet consist of apatite, ilmenite, and rutile. In addition the amphibole and biotite were analyzed. The spectra are identical to those for MAT-W01 East. The amphibole contains small amounts of Na, K and Ti. The biotite has a distinct Ti peak. What appeared to be a graphic intergrowth of pyroxene and plagioclase was examined, and was in fact an intergrowth of amphibole and plagioclase. The amphibole is the same composition as the larger amphibole crystals. The plagioclase has a large Na component. No pyroxene was analyzed in this sample.

Microprobe Results

This sample was selected for analyses on the microprobe. The same three garnets that were examined under the SEM were probed. Eight points were analyzed, and end member species were calculated. The results are presented in Table 1. Almandine is the dominant component, ranging from 52.6 to 59.0%. There is no distinct compositional zoning, however there is a difference of up to 6.4% in the almandine component of the garnet #1. The cores of the garnets may be enriched in iron. The second most abundant components are grossular garnet, which ranges from 16.16-21.32%, and pyrope garnet, which ranges from 13.09-23.36%. The andradite component ranges from 2.60 to 6.19%. The spessartine component ranges from 0.96 to 5.50%. The variation in pyrope and spessartine reflects the variability in the Mg versus Mn peaks observed during the SEM work, with the higher pyrope contents coinciding with low spessartine content, and vice versa. The average almandine component of this sample is 55.8%.

Almandine garnet - $Fe_3Al_2Si_3O_{12}$
Andradite garnet - $Ca_3Fe_2Si_3O_{12}$
Grossular garnet - $Ca_3Al_2Si_3O_{12}$
Pyrope garnet - $Mg_3Al_2Si_3O_{12}$
Spessartine garnet - $Mn_3Al_2Si_3O_{12}$
Uvarovite garnet - $Ca_3Cr_2Si_3O_{12}$

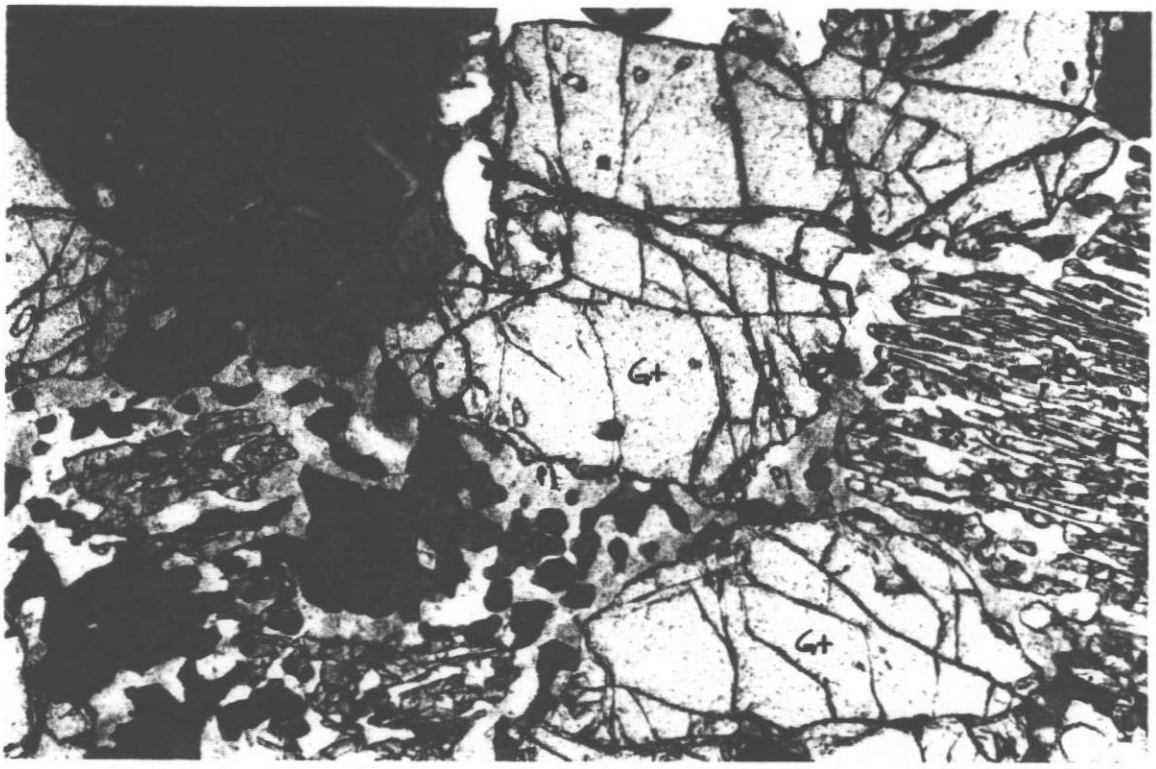


Photo 4A: MAT-W01 West. This view illustrates the overall texture of the sample. Coarse-grained garnet, amphibole and biotite occur in a groundmass of plagioclase, intergrown with pyroxene and lesser amounts of amphibole (right). Gt-garnet, Am-amphibole, Bi-biotite, Px-pyroxene, Il-ilmenite, Pl-plagioclase. Field of view 5.1 mm. Plane polarized light.

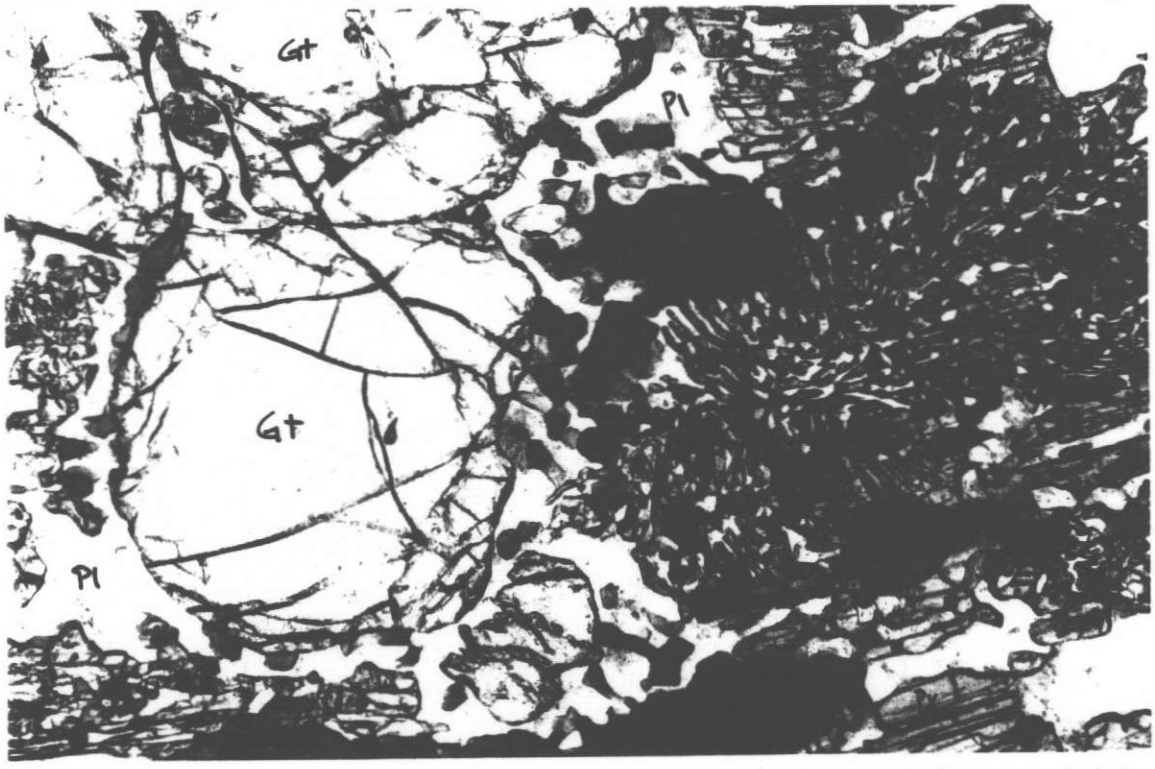


Photo 4B: MAT-W01 West. Another example of the texture of the rock, with intricately intergrown plagioclase, pyroxene and amphibole (right) and coarse-grained garnets (left). Gt-garnet, Am-amphibole, Bi-biotite, Px-pyroxene, Il-ilmenite, Pl-plagioclase. Field of view 5.1 mm. Plane polarized light.

A.

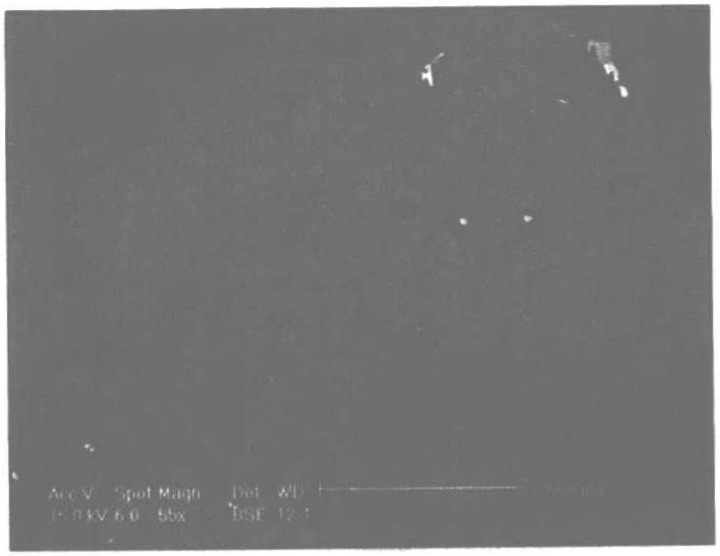


Photo 5A: MAT-W01 West, spot 1. SEM images, scale bar in microns in each photo. A homogeneous garnet crystal with inclusions of apatite (ap) and rutile (ru). Numbers indicate points analyzed on the microprobe.

B.

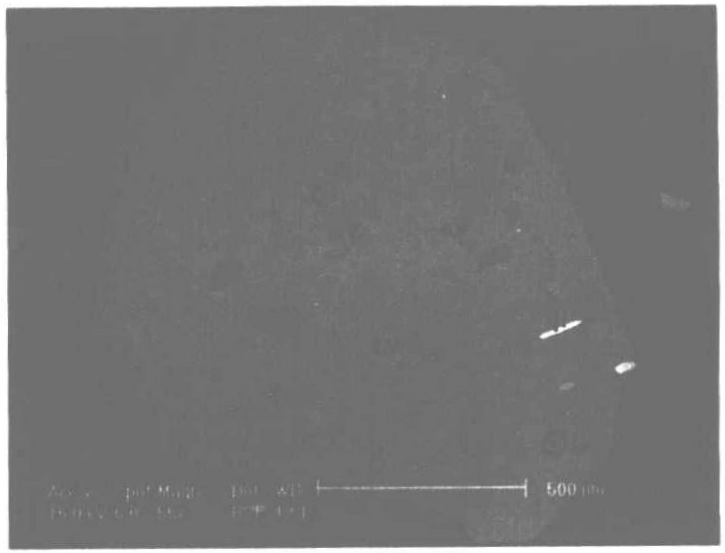


Photo 5B: MAT-W01 West, spot 2. A homogeneous garnet crystal (gt) with minute inclusions of apatite (ap) and ilmenite (il). Numbers indicate points analyzed on the microprobe.

C.

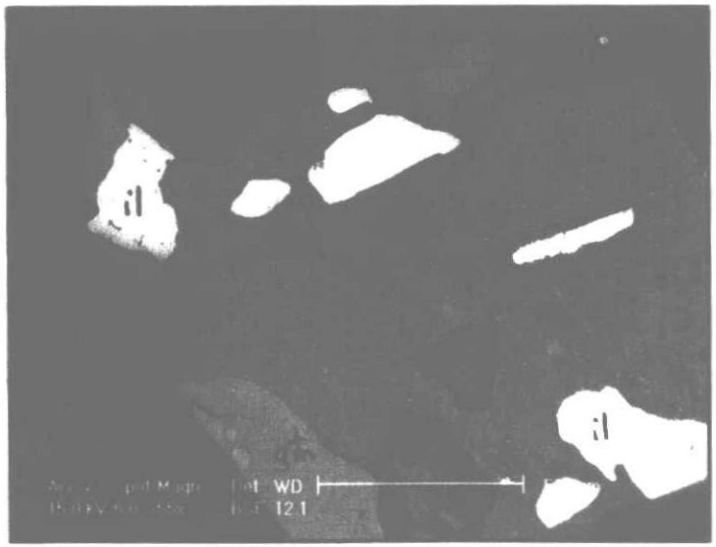


Photo 5C: MAT-W01 West, spot 3. An intergrowth of biotite (bi), amphibole (am), ilmenite (il) and plagioclase (pl).

D.

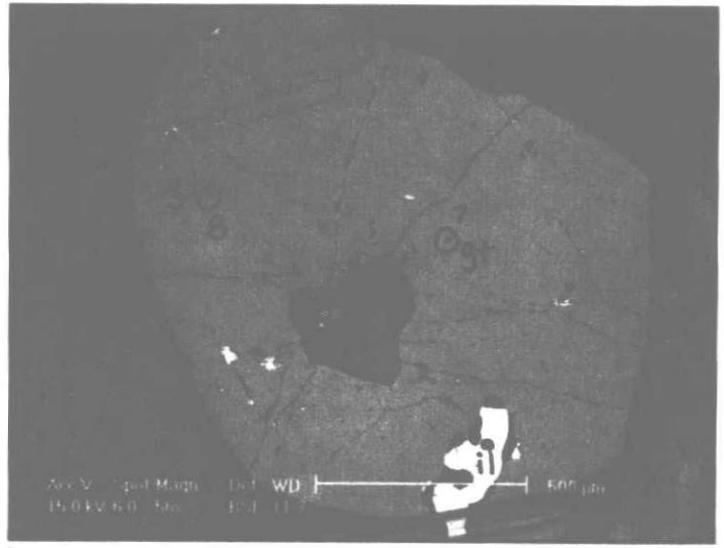
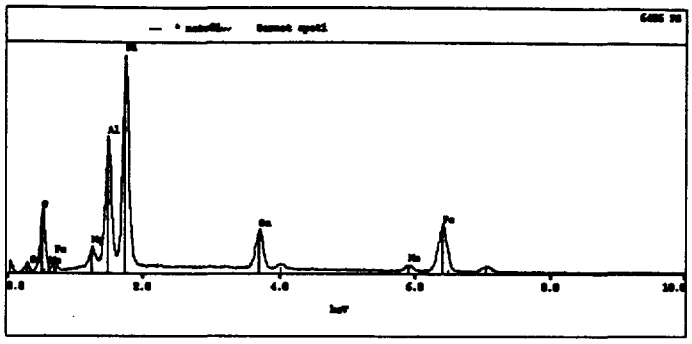
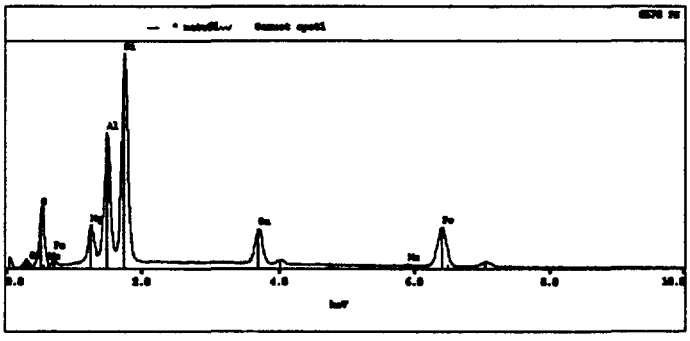


Photo 5D: MAT-W01 West, spot 4. A homogeneous garnet (gt) with silicate (dark grey) and ilmenite (il) inclusions. Numbers indicate points analyzed on the microprobe.

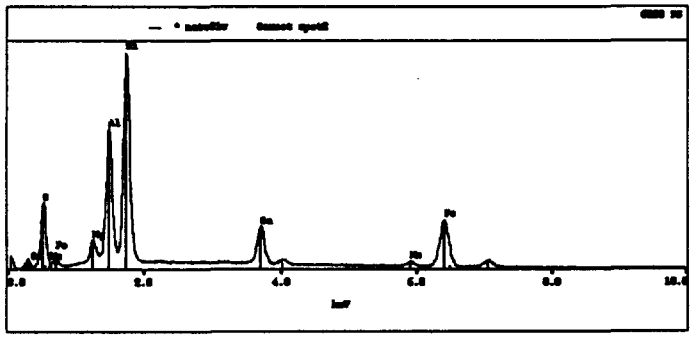
A.



B.



C.



D.

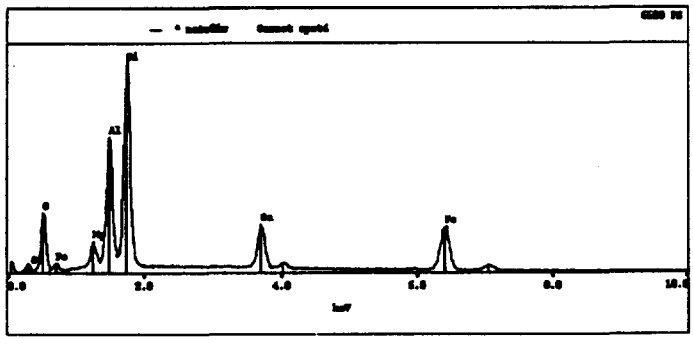
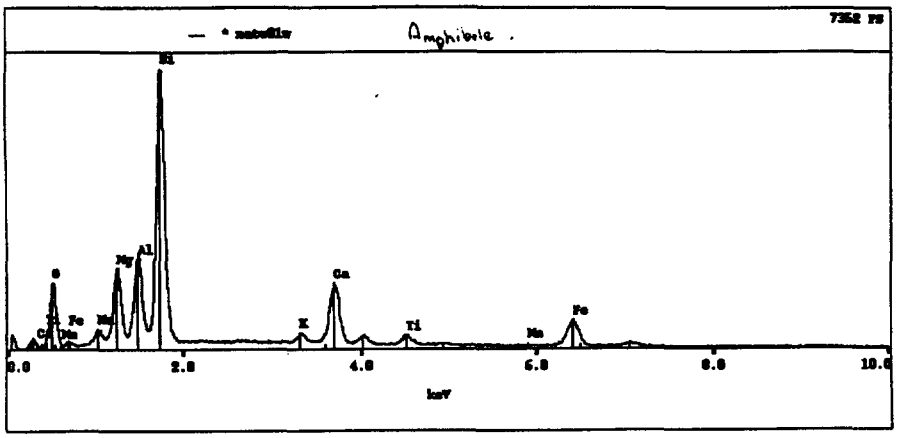
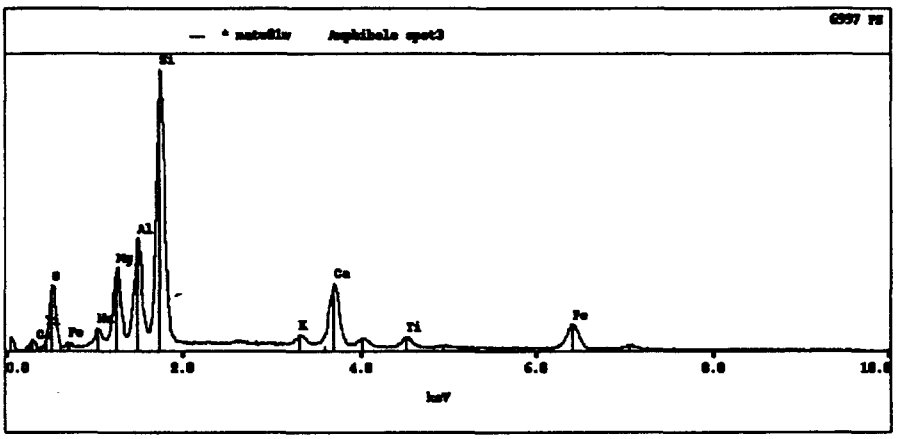


Figure 3. MAT-W01 West: Characteristic spectra of garnets, two analyses from the first garnet to illustrate the variation in Mn and Mg peaks, and one analyses each from two other garnets. There is slight variability in the proportions of the Fe and Ca peaks, however no systematic variation across crystals from cores to rims was observed.

A.



B.



C.

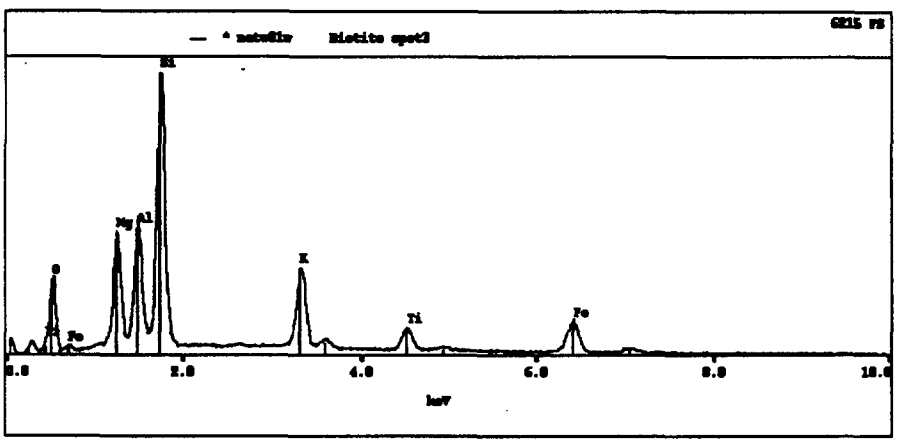


Figure 4. MAT-W01 West: Spectra of amphibole and biotite. The composition of these minerals is the same as those analyzed in MAT-W01 East (Fig. 2). Note the Ti peak in both minerals and the Na peak in the amphibole.

SAMPLE: MAT-W02 (Mattawan B property)

LITHOLOGY: Peridotite

Hand Sample Description: A fine to medium-grained, crystalline, mafic rock, with an overall dark grey-green colour. The rock is comprised of 15-20%, dark brown-black, rounded crystals in a paler groundmass, with interspersed, irregularly shaped greenish patches, up to 0.5 cm across. Staining of the offcut with sodium cobaltinitrite accentuates the texture, though there is no K-feldspar present. The rock is strongly magnetic. It is not foliated.

TRANSLUCENT MINERALS

Mineral	%	Distribution & Characteristics	Opt. Prop.
olivine	41	medium-grained, equant crystals, random fractures,	1st-2nd order biref.
plagioclase? or zeolite	12	medium-grained, anhedral, core of patches, clouded with minute inclusions of brown amphibole, dark green spinel?, colourless sericite? and possibly colourless isotropic garnet	low 1st order biref. vague twinning
spinel	10	fine-grained, anhedral, dark green to brown pleochroic, intergrown with and partially rimming magnetite, ?hercynite $FeAl_2O_4$	not isotropic
amphibole	10	fine-grained, anhedral, pleochroic pale brown to brown, encloses biotite and oxides	masked 1st to 2nd order biref.
quartz	05	very fine-grained, rims around the irregular patches, clear, colourless, encloses olivine	1st order biref.
garnet?	05	fine-grained, anhedral, clear, colourless, high relief, rims plagioclase	isotropic
serpentinite/ ? chlorophaetite	04	fine-grained, fibrous, filling fractures in olivine, olive green to yellowish	masked greenish biref.
biotite	03	fine-grained, platy, intensely pleochroic, red-brown to yellow, intergrown with brown amphibole	masked high biref.

OPAQUE MINERALS

Mineral	%	Distribution & Characteristics	Opt. Prop.
magnetite	10	fine-grained, anhedral, rimmed in spinel? and amphiboles	dull grey
pyrite	trace	fine-grained, intergrown with pyrrhotite, chalcopyrite	pale yellow
chalcopyrite	trace	fine-grained, intergrown with pyrrhotite	bright yellow
pyrrhotite	trace	fine-grained, intergrown with chalcopyrite, minor pyrite	biref. creamy white

Thin Section Description:

The rock is comprised dominantly of olivine. The dark spots visible in the hand sample consist of a core of magnetite, rimmed by dark green-brown spinel?, biotite and amphibole. Brown amphibole always forms the outermost halo. These irregular spots occur throughout the sample and are generally 0.5 mm across. They occur in a groundmass of equant, subrounded olivine crystals. Olivine is cut by numerous randomly oriented fractures. A green-yellow mineral replaces olivine along these fractures. It may be serpentine or chlorophaetite, a mixture of chlorite, limonite, and serpentine. The irregular greenish patches may have been vesicles. They are cored by a clear, low birefringent mineral. Faint simple twinning is visible in cross polarized light. This may be plagioclase, or possibly be a zeolite, based on the optical properties. The plagioclase? is clouded with abundant mineral inclusions, often aligned on crystal planes. These inclusions consist of dominantly of dark green, often cubic crystals (spinel?), but brown amphibole and colourless inclusions are also present. This core is completely rimmed by colourless, isotropic garnet, which is in turn completely rimmed by fine-grained quartz. The quartz rim is very sharp, whereas the garnet rim is not. Isolated crystals of olivine within the plagioclase? domains are surrounded by quartz with an outer rim of garnet.

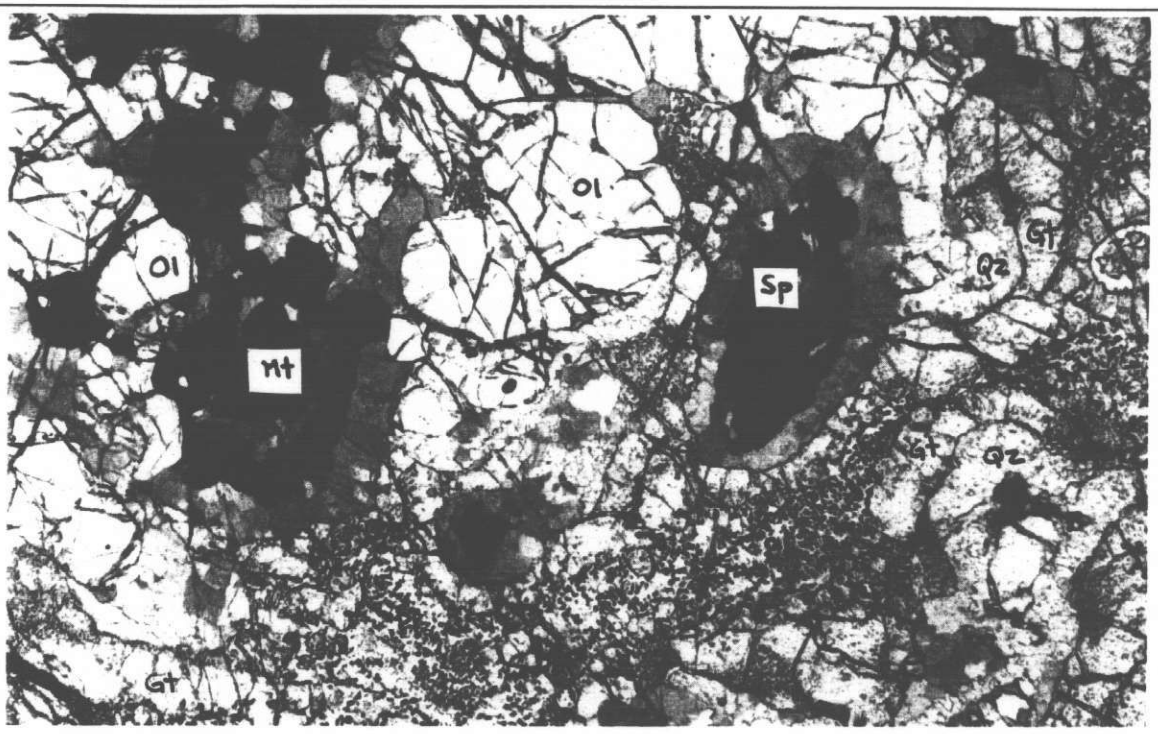


Photo 6A: MAT-W02. This view illustrates the two main features of the sample. Crystals of magnetite form circles or rings which are in turn surrounded by brown amphibole and biotite. A dark green mineral (spinel?) is intergrown with, and also partially rims magnetite. The colourless, rounded crystals are olivine. Below the magnetite spots in this view, is a one of the irregular patches (vesicles?) filled with plagioclase?, quartz and garnet. The numerous tiny green mineral inclusions are visible in the plagioclase. Ol-olivine, Gt-garnet, Am-amphibole, Bi-biotite, Pl-plagioclase, Qz-quartz, Mt-magnetite, Sp-spinel. Field of view 5.1 mm. Plane polarized light.

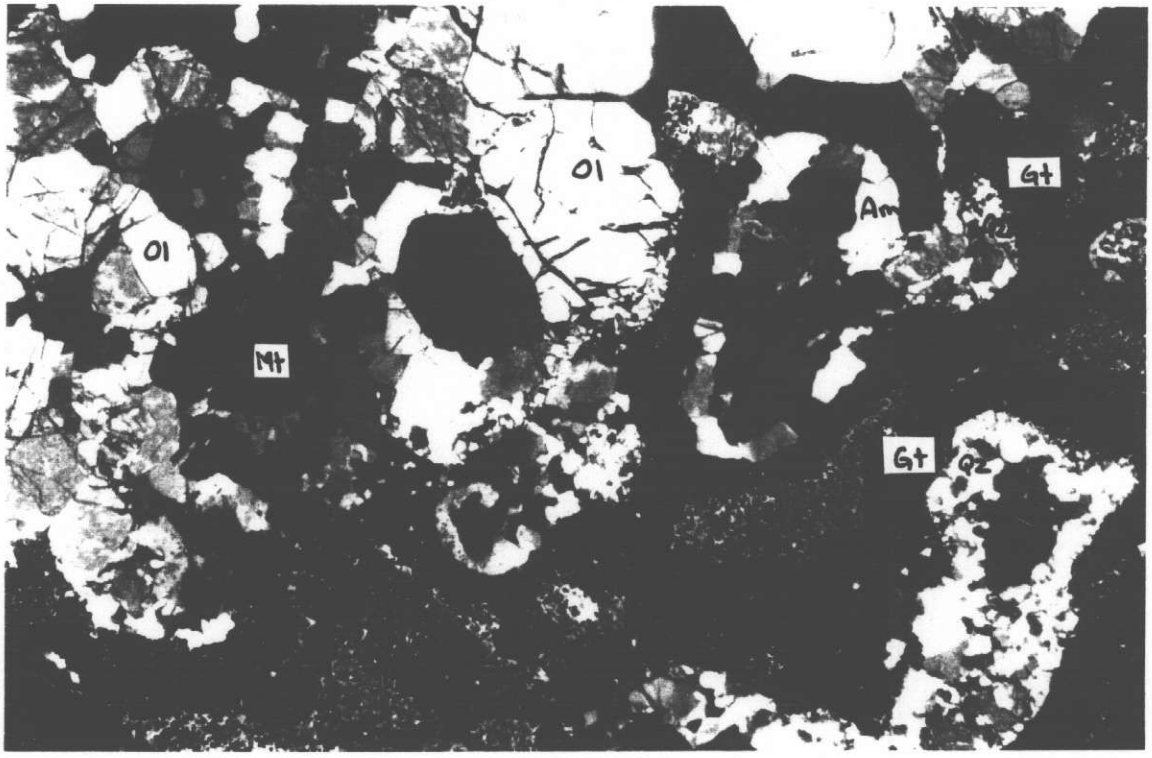


Photo 6B: MAT-W02. Same view as above, in cross polarized light. Faint twinning is visible in the plagioclase? that cores the irregular patch or vesicle, it is rimmed by an isotropic mineral, probably garnet, which is rimmed by quartz. Ol-olivine, Gt-garnet, Am-amphibole, Bi-biotite, Pl-plagioclase, Qz-quartz, Mt-magnetite. Field of view 5.1 mm.

SAMPLE: MAT-W03 (Mattawan B property)

LITHOLOGY: Pyroxenite

Hand Sample Description: A fine to medium-grained, dense, crystalline, black-green rock with a weak foliation defined by the elongation of minerals. The rock is comprised dominantly of interlocking black pyroxene and greenish olivine, with scattered streaks of red garnet. The streaks of garnet are generally 1 mm thick and several mm long, aligned with the foliation. The rock is strongly magnetic. No K-feldspar is present.

TRANSLUCENT MINERALS

Mineral	%	Distribution & Characteristics	Opt. Prop.
pyroxene - augite?	70	fine to medium-grained, anhedral, but often equant to slightly elongate, pleochroic pale brown to paler brown, 87° cleavage, no twinning or lamellae, no alteration, intergrown with olivine and biotite	1st order biref. asymmetric extinction, 20°
olivine	14	medium-grained, equant to slightly elongated, anhedral, clear, colourless, fractured, high relief	1st to 2nd order biref.
garnet	08	fine to medium-grained, anhedral, elongate parallel to foliation, clear, colourless, high relief	isotropic
chlorophaetite ?serpentine	04	alteration of olivine, orangey-green, fibrous	masked biref.
biotite	minor	medium-grained, elongate flakes, pleochroic, pale brown to nearly colourless	high biref.
spinel?	minor	fine-grained, dark green, intergrown with magnetite	isotropic

OPAQUE MINERALS

Mineral	%	Distribution & Characteristics	Opt. Prop.
magnetite	04	fine-grained, anhedral crystals, throughout sample, aligned with garnet	dull grey
pyrrhotite	trace	very fine-grained, disseminated	creamy beige

Thin Section Description:

The sample consists dominantly of interlocking pyroxene and olivine. Both of these minerals are equant and rounded or blocky, to slightly elongate. The olivine is colourless, while the pyroxene is weakly pleochroic brown. The composition of the pyroxene is not known, the low birefringence suggests augite. Pyroxene is unaltered, while an orangey-green mineral locally replaces olivine. There may be weakly developed compositional banding, with pyroxene-only and mixed pyroxene-olivine bands, on a <0.5 cm scale. Magnetite is somewhat irregularly disseminated throughout the rock and is distinctly aligned. Garnet is the most distinctly lineated mineral. In the plane of the thin section it occurs as thin (<1 mm) discontinuous bands or streaks that may be 0.5 cm long. It is oriented in the same direction as the magnetite. In plane polarized light it looks like the olivine, but can be distinguished easily in crossed polarized light by its isotropic nature.

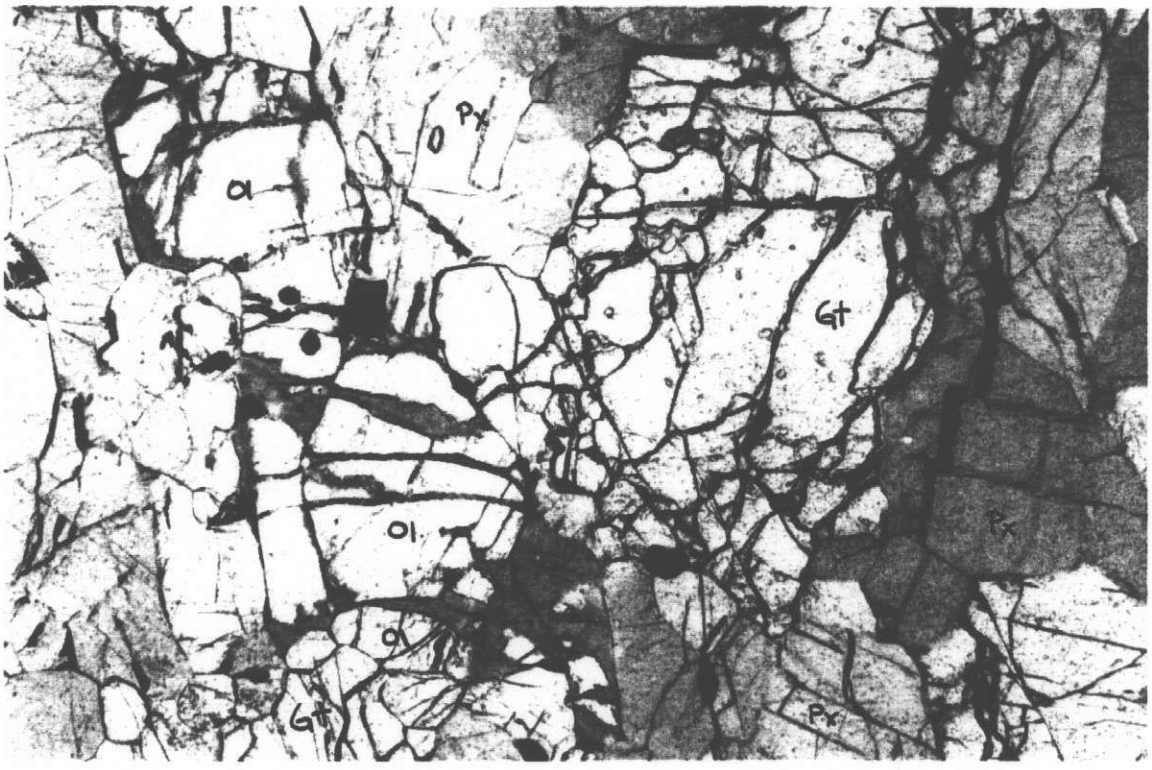


Photo 7A: MAT-W03. This view illustrates the overall texture of the sample. In plane polarized light, olivine can be distinguished from garnet by the presence of an orangey alteration mineral that replaces it along fractures. The pyroxene is a pale brown and slightly pleochroic. Ol-olivine, Gt-garnet, Mt-magnetite. Field of view 5.1 mm. Plane polarized light.

Photo 7B: MAT-W03. Same view as above, in cross polarized light. The garnet is isotropic, while the olivine has bright birefringence colours (purple-red). Pyroxene has low birefringence (grey and pale yellow). Ol-olivine, Gt-garnet, Px-pyroxene. Field of view 5.1 mm.

SAMPLE: MAT-W04A (Mattawan P property)

LITHOLOGY: Garnet Amphibolite Gneiss

Hand Sample Description: A fine-grained, crystalline, weakly foliated, mafic rock. The overall colour is dominantly black, with about 20% total volume, streaky, pink felsic segregations. The foliation is slightly oblique to the compositional banding. Approximately 15% of the rock is round, red garnet crystals, <0.5-2.0 mm in diameter, which occur mainly in the dark portions of the rock. The rock is not magnetic. The offcut is stained with sodium cobaltinitrite. The felsic segregations do not contain K-feldspar.

TRANSLUCENT MINERALS

Mineral	%	Distribution & Characteristics	Opt. Prop.
amphibole	40	fine to coarse-grained, (0.5 cm), anhedral, oriented, intensely pleochroic pale yellow to olive green, hornblende	masked 2nd order biref.
quartz	30	medium-grained, anhedral but equant crystals, clear, colourless	1st order biref.
plagioclase	17	fine to medium-grained, anhedral, clear, colourless, intergrown with quartz in felsic segregations	1st order biref. albite twinning
garnet	10	medium-grained, anhedral to subhedral rounded crystals, mostly around 1 mm in diameter, clear, colourless, trace mineral inclusions	isotropic
biotite	minor	fine-grained, elongate flakes, pleochroic orange-brown to pale brown, intergrown with amphibole	high masked biref
apatite	trace	fine-grained, rounded inclusions, high relief, clear, colourless	1st order biref.

OPAQUE MINERALS

Mineral	%	Distribution & Characteristics	Opt. Prop.
ilmenite	03	fine-grained, anhedral, intergrown with amphibole, sometimes surrounded by an unidentified, orange-brown alteration product	dull grey reflectance
pyrite	minor	fine-grained, rimmed with Fe-oxides	pale yellow

Thin Section Description:

The mafic portions of the sample consist of dark green amphibole intergrown with ilmenite, and minor amounts biotite. The dark green colour of the amphibole is consistent with a hornblende composition. It occurs as large, elongate, anhedral crystals with a preferred orientation. Biotite is not obviously aligned. The felsic segregations consist of unoriented, interlocking quartz and plagioclase. Fine-grained rounded crystals of plagioclase and quartz are included in the larger plagioclase-quartz crystals, giving the felsic domains a "spotted" appearance in crossed polarized light. Colourless garnet occurs as anhedral to rounded crystals in both the mafic and felsic portions of the sample. Size varies from < 0.4 mm to 2 mm,. with the larger crystals being more irregularly shaped. A few crystals of biotite, apatite and quartz are observed in garnets, but they are generally inclusion free. The ilmenite generally appears to be in equilibrium with the amphibole and biotite, however in several spots, the ilmenite is surrounded by a orange-brown alteration product. This may be a mixture of Fe-oxides and chlorite. There are no apparent fractures or veinlets controlling this alteration. Minerals in the rest of the sample are pristine.

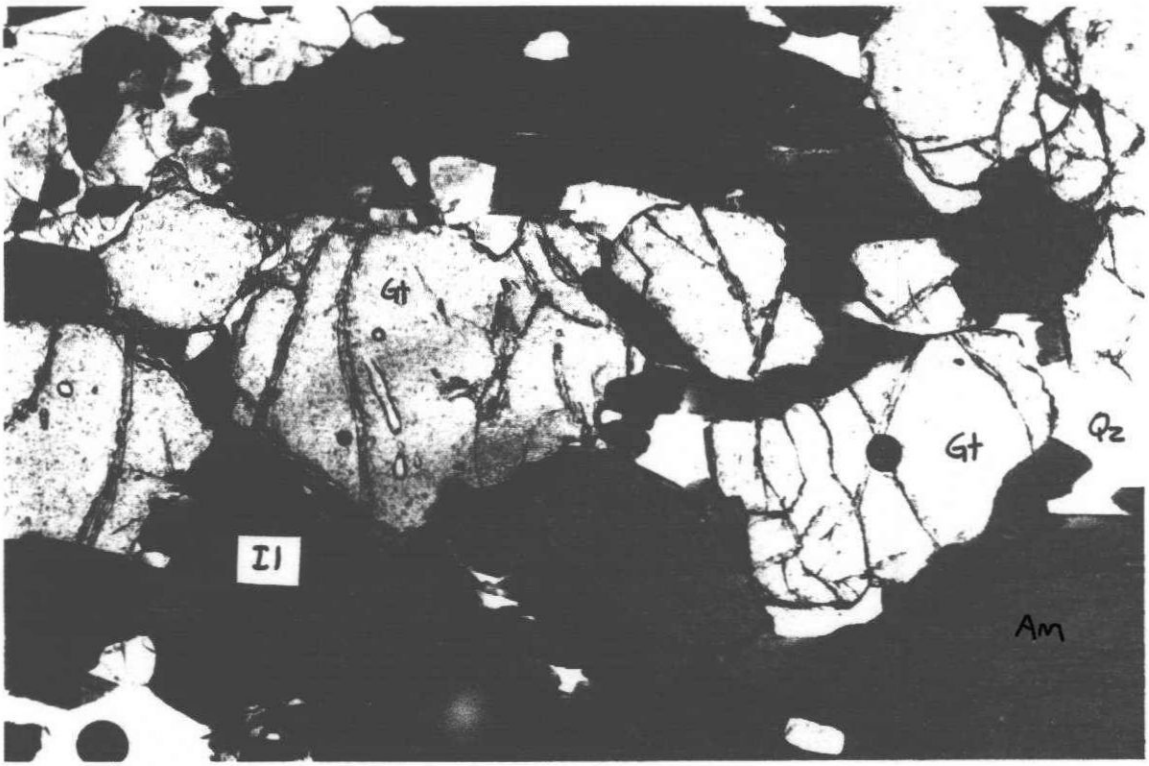


Photo 8A: MAT-W04A. This view illustrates the overall texture of the sample. Coarse-grained garnet, and amphibole are intergrown with fine-grained quartz and plagioclase. Am-amphibole, Gt-garnet, Il-ilmenite, Qz-quartz. Field of view 5.1 mm. Plane polarized light.

Photo 8B: MAT-W04A. Similar view. The garnet is isotropic, while the hornblende has bright birefringence colours. Albite twinning is visible in the plagioclase, quartz is white to pale grey. Am-amphibole, Gt-garnet, Pl-plagioclase, Qz-quartz. Field of view 5.1 mm. Cross polarized light

SAMPLE: MAT-W04B (Mattawan P property)

LITHOLOGY: Garnet Amphibolite Gneiss (Mafic portion)

Hand Sample Description: This sample is the same one as the previous sample, but the polished section is cut from the mafic rich portion, avoiding the felsic bands. There is a slightly higher garnet content in this part of the sample. Garnets are generally very fine-grained, <0.5 mm, with a few scattered garnets up to 2 mm. There is no K-feldspar.

TRANSLUCENT MINERALS

Mineral	%	Distribution & Characteristics	Opt. Prop.
amphibole	45	fine to coarse-grained, (0.5 cm), anhedral, intensely pleochroic pale yellow to olive green, hornblende	masked 2nd order biref.
quartz	17	medium-grained, anhedral but equant crystals, clear, colourless	1st order biref.
plagioclase	15	fine to medium-grained, anhedral, clear, colourless, intergrown with quartz in felsic segregations	1st order biref. albite twinning
garnet	12	medium-grained, anhedral to subhedral rounded crystals, mostly around 1 mm in diameter, clear, colourless, trace mineral inclusions	isotropic
biotite	05	medium-grained, elongate flakes, pleochroic orange-brown to red-brown, intergrown with amphibole	high masked biref
pyroxene	03	fine-grained, anhedral, pale blue-green	2nd order biref.
apatite	minor	fine-grained, rounded inclusions, high relief, clear, colourless	1st order biref.

OPAQUE MINERALS

Mineral	%	Distribution & Characteristics	Opt. Prop.
ilmenite	03	fine-grained, anhedral, irregularly distributed throughout sample, intergrown mainly with amphibole	
pyrite	minor	fine-grained, rimmed with Fe-oxides	

Thin Section Description:

The sample consists of interlocking amphibole, biotite, garnet, plagioclase, quartz and pyroxene with accessory apatite and ilmenite. Amphibole is the dominant, and coarsest-grained phase. Some prismatic amphibole crystals are present, but all the minerals are generally anhedral. Quartz and plagioclase are evenly dispersed throughout the section. Garnets are subrounded, but more irregularly shaped than in the previous samples. They contain few mineral inclusions. The pyroxene is slightly cloudy, and is partially altered by the amphibole. The other minerals are stable. The ilmenite generally appears to be in equilibrium with the other minerals, but a few crystals are surrounded by the same rusty alteration product that is present in the previous sample, MAT-W04A. Minerals are not obviously oriented in the plane of this section.

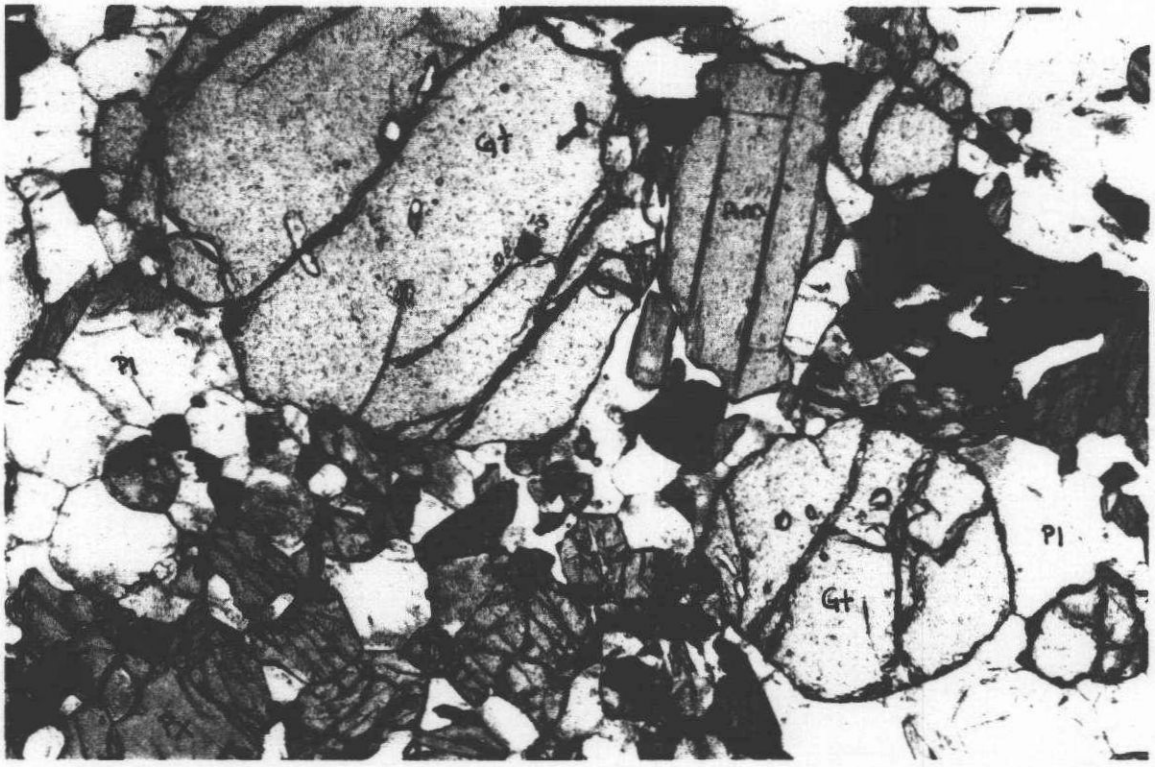


Photo 9A: MAT-W04B. This view illustrates the overall texture of the sample, consisting of rounded garnets, intergrown with green amphibole, pyroxene, quartz and plagioclase. Am-amphibole, Gt-garnet, Px-pyroxene, Il-ilmenite, Qz-quartz. Field of view 5.1 mm. Plane polarized light.

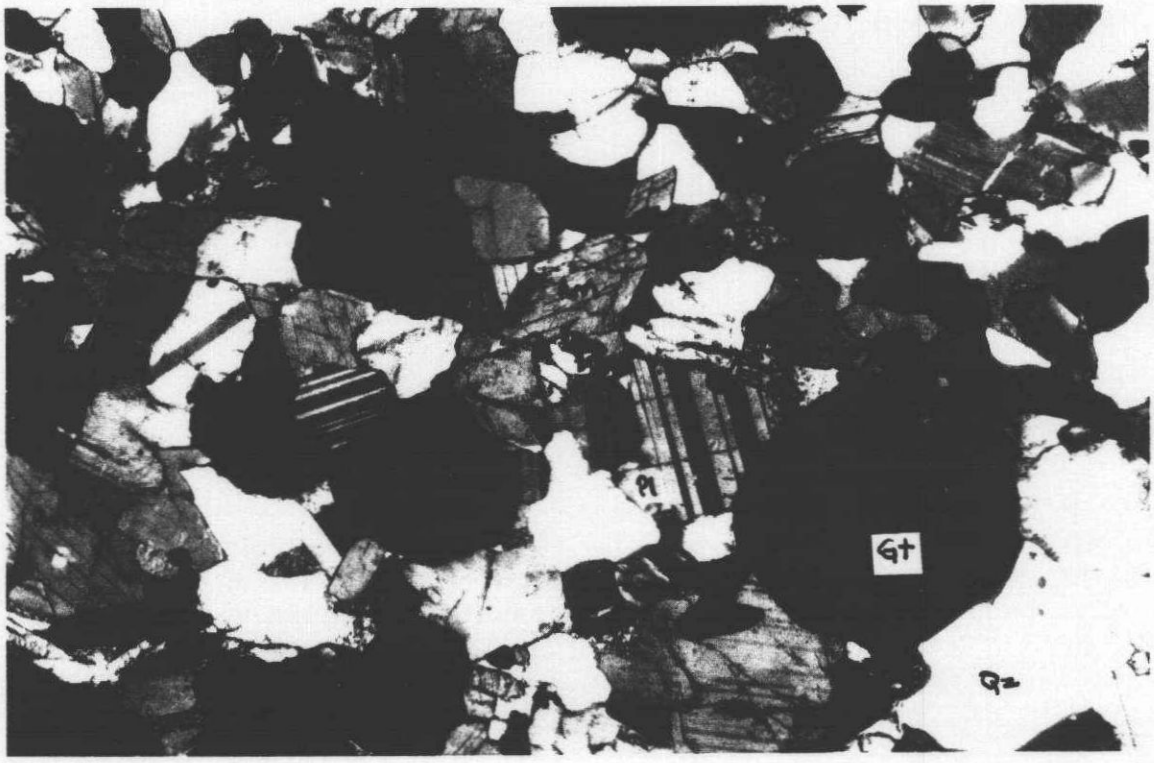


Photo 9B: MAT-W04B. Similar view. The garnet is isotropic, while the amphibole has bright birefringence colours. Albite twinning is visible in the plagioclase, quartz is white to pale grey. Am-amphibole, Gt-garnet, Pl-plagioclase, Qz-quartz. Field of view 5.1 mm. Cross polarized light

SAMPLE: MAT-W05A (Mattawan P property)

LITHOLOGY: Garnet Amphibolite Gneiss

Hand Sample Description: The sample consists of a fine-grained, well foliated, black crystalline rock, cut by pink and white pegmatitic veins, up to 3 cm wide in the hand sample. The veins cut across foliation and are not foliated themselves. Contacts are irregular but sharp. The foliation is defined by the sparkling crystal faces of the black minerals that are the dominant component of the rock. Fine-grained red garnets are abundant in the mafic portion of the rock, but absent from the pegmatite veins. The polished section consists of 2/3 vein and 1/3 mafic rock. The stained offcut indicates that K-feldspar is present, but occurs mainly along fractures replacing coarse-grained plagioclase crystals. The sample is not magnetic. The sample is partially disintegrating into sand.

TRANSLUCENT MINERALS

Mineral	%	Distribution & Characteristics	Opt. Prop.
plagioclase	40	fine to coarse-grained, anhedral, colourless, slightly clouded with K-feldspar alteration	1st order biref. albite twinning
quartz	34	fine to coarse-grained, anhedral, clear, colourless	1st order biref.
biotite	10	fine-grained, elongate flakes, pleochroic pale-brown to red-brown, a few pleochroic halos	high masked biref
amphibole	07	medium-grained, anhedral, ragged, intensely pleochroic pale yellow to olive green, hornblende	masked 2nd order biref.
garnet	07	medium-grained, anhedral to subhedral rounded crystals, mostly around 1 mm in diameter, clear, colourless, trace mineral inclusions	isotropic
K-feldspar	02	alteration of plagioclase, identified by stain, cloudy	low biref.
sericite/ muscovite	minor	very fine-grained, alteration of plagioclase, along crystal planes	bright biref.
apatite	minor	fine-grained, rounded inclusions, high relief, clear, colourless	1st order biref.

OPAQUE MINERALS

Mineral	%	Distribution & Characteristics	Opt. Prop.
		no opaques	

Thin Section Description:

The polished section intersects one of the pegmatite veins and a portion of the mafic rock. Observing the section with the naked eye the vein makes up approximately 2/3 of the section. The contact is defined in the mafic rock by an irregular, 1 mm wide band of dark green amphibole crystals, intergrown with plagioclase and quartz. Several amphibole crystals also lie within the vein. Behind the amphiboles lies a finer-grained, 2 mm wide band of biotite intergrown with plagioclase and quartz. Biotite appears to be aligned with the contact. Beyond this zone, biotite, garnet, amphibole, plagioclase and quartz are intergrown. The garnets are subhedral and generally equant. Biotite flakes penetrate garnet crystals, and do not wrap around them. Garnet contains minor amounts of biotite, amphibole and plagioclase or quartz, as inclusions. There appears to be a thin (4 mm) reaction zone around the pegmatite veins in which garnets are not stable.

The pegmatite vein is comprised of coarse-grained quartz and plagioclase, with patches of medium-grained, polygonal plagioclase crystals, indicating there has been some recrystallization. The K-feldspar is visible as cloudy alteration of plagioclase. There is also minor sericite alteration of plagioclase. The plagioclase is not well twinned either in the vein, or in the mafic rock. Several cloudy corroded crystals in the vein may have been amphibole crystals.

Photo 10A: MAT-W05A. This view illustrates the contact of pegmatite vein (right) and mafic rock (left). Green amphibole is abundant at the contact. Oriented biotite, quartz and plagioclase form a second rim behind the amphibole. Am-amphibole, Gt-garnet, Bi-biotite, Qz-quartz., Pl-plagioclase. Field of view 5.1 mm. Plane polarized light.

Photo 10B: MAT-W05A. In the mafic rock, beyond the reaction rim on the vein, garnet is intergrown with the other minerals. Am-amphibole, Gt-garnet, Bi-biotite, Pl-plagioclase, Qz-quartz. Field of view 5.1 mm. Plane polarized light

SAMPLE: MAT-W05B (Mattawan P property)

LITHOLOGY: Garnet Amphibolite Gneiss (Mafic portion)

Hand Sample Description: This sample is the same as the previous one. The polished section was cut from the mafic portion of sample, avoiding the pegmatitic veins. The offcut is extremely rich in garnets, containing approximately 50%, rounded red garnet crystals in weakly defined bands several mm in width. There is no K-feldspar present.

TRANSLUCENT MINERALS

Mineral	%	Distribution & Characteristics	Opt. Prop.
garnet	50	medium-grained, subhedral rounded crystals, 0.5-2.0 mm in diameter, clear, colourless, trace mineral inclusions	isotropic
amphibole	20	fine to medium-grained, anhedral, intensely pleochroic pale yellow to olive green, interstitial to garnets, hornblende composition	masked 2nd order biref.
plagioclase	15	fine-grained, anhedral, colourless	1st order biref. albite twinning
quartz	10	fine-grained, anhedral, clear, colourless	1st order biref.
biotite	minor	fine-grained, elongate to stubby flakes, pleochroic pale-brown to dark-brown	high masked biref
hematite	minor	very fine-grained, alteration of garnet along fractures	translucent red
apatite	minor	fine-grained, rounded inclusions, high relief, clear, colourless	1st order biref.

OPAQUE MINERALS

Mineral	%	Distribution & Characteristics	Opt. Prop.
ilmenite	05	fine-grained, anhedral, disseminated, with lamella of magnetite	dull grey
magnetite	minor	intergrown with ilmenite	bluish grey

Thin Section Description:

The sample is dominated by rounded, colourless garnet crystals. There is a weak compositional banding defined by garnet content. Garnet-rich bands consist of garnet crystals with interstitial amphibole and ilmenite, and minor amounts of plagioclase and quartz. Garnet-poor bands consist of coarser-grained amphibole, intergrown with plagioclase, quartz and ilmenite, and only scattered garnet crystals. Garnet-rich material predominates in the sample. Ilmenite occurs as inclusions in some garnets, but they are generally inclusion free. A orange-red translucent mineral (hematite?) occurs along fractures in a few garnet crystals. The garnets are cut by a tightly spaced, parallel set of fractures.

Scanning Electron Microscope Results

Three garnets were analyzed. The composition of the garnets appears to be very similar to those in MAT-W01 East and West. The Fe peak is larger than the Ca peak, indicating a high almandine garnet component. There is no Mn component. The analyses across individual garnets, and between different garnets are virtually identical. Rutile and zircon were identified as mineral inclusions in the garnets. Several analyses were also done on the green amphibole to compare its composition to the brown amphibole. The spectra are very similar. The amphibole in this sample has slightly smaller K, Ti and Na peaks, than the brown amphibole in MAT-W01. It may be hornblende with a kaersutite component.

Microprobe Results

This sample was selected for further analyses on the microprobe. The same three garnets that were examined under the SEM were probed. Ten points were analyzed, and end member species were calculated. The results are presented in Table 1. Almandine is the dominant component, ranging from 50.6 to 53.92%. Pyrope is the second most abundant component ranging from 26.62 to 28.56%. The grossular component ranges from 11.38 to 15.89%. The andradite component ranges from 2.97 to 6.9%, and the spessartine component is 0.73 to 1.03%. There is no obvious compositional zoning within the garnets. The average almandine component of this sample is 52.15%.

Almandine garnet - $Fe_3Al_2Si_3O_{12}$
Andradite garnet - $Ca_3Fe_2Si_3O_{12}$
Grossular garnet - $Ca_3Al_2Si_3O_{12}$
Pyrope garnet - $Mg_3Al_2Si_3O_{12}$
Spessartine garnet - $Mn_3Al_2Si_3O_{12}$
Uvarovite garnet - $Ca_3Cr_2Si_3O_{12}$

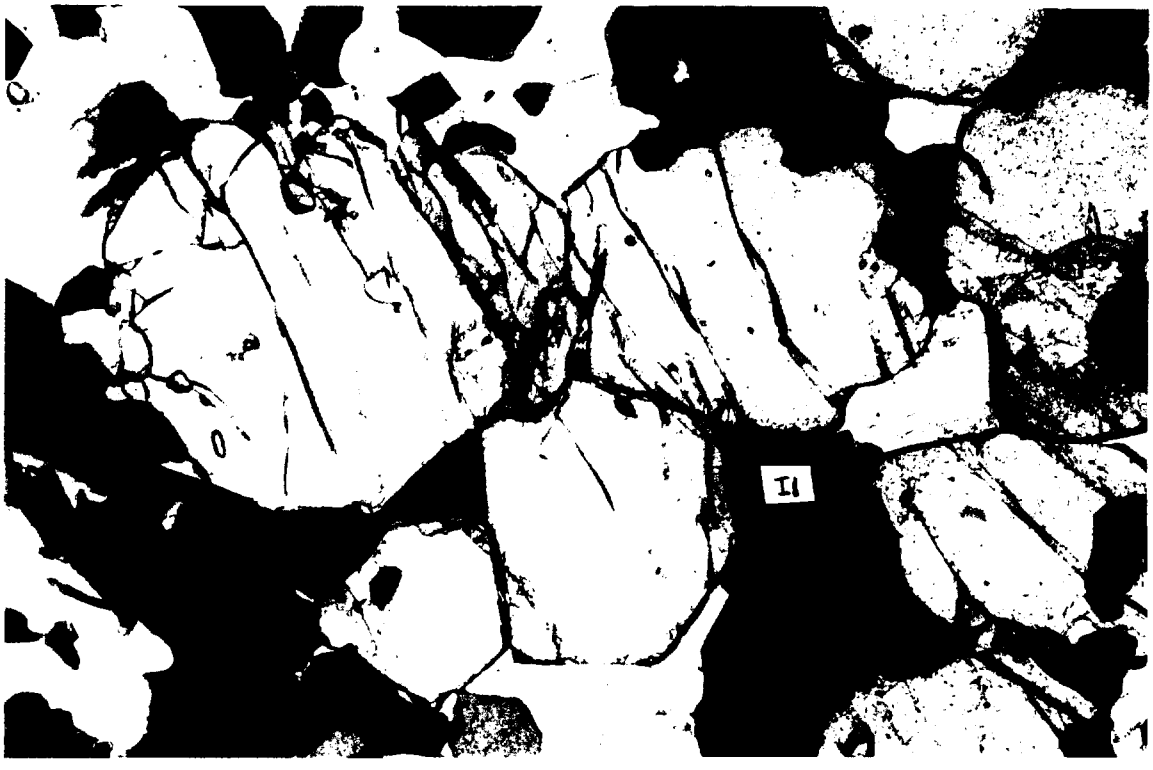
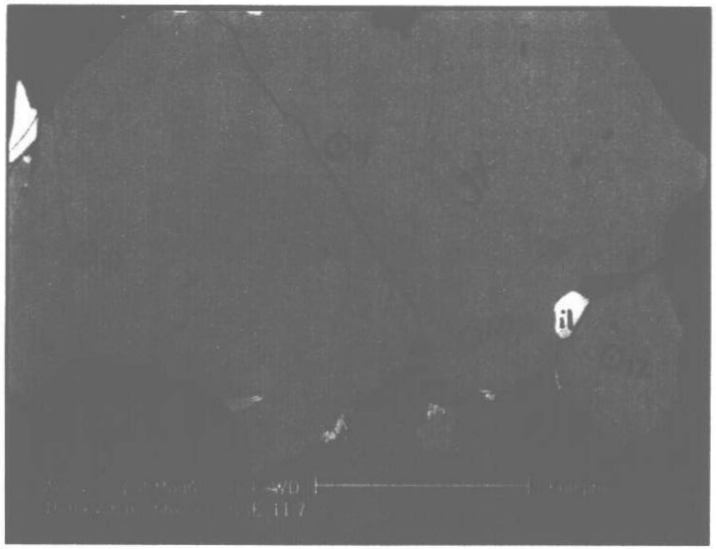


Photo 11A: MAT-W05B. This sample contains abundant subhedral garnets, intergrown with intensely green pleochroic amphibole. Opaques consist of ilmenite with lamella of magnetite. Am-amphibole, Gt-garnet, Pl-plagioclase, Il-ilmenite. Field of view 5.1 mm. Plane polarized light.

Photo 11B: MAT-W05B. Flakes of biotite are intergrown with the amphibole. Garnet contains small inclusions of ilmenite/magnetite. Am-amphibole, Gt-garnet, Bi-biotite, Pl-plagioclase. Field of view 5.1 mm. Plane polarized light

A.



B.

C.

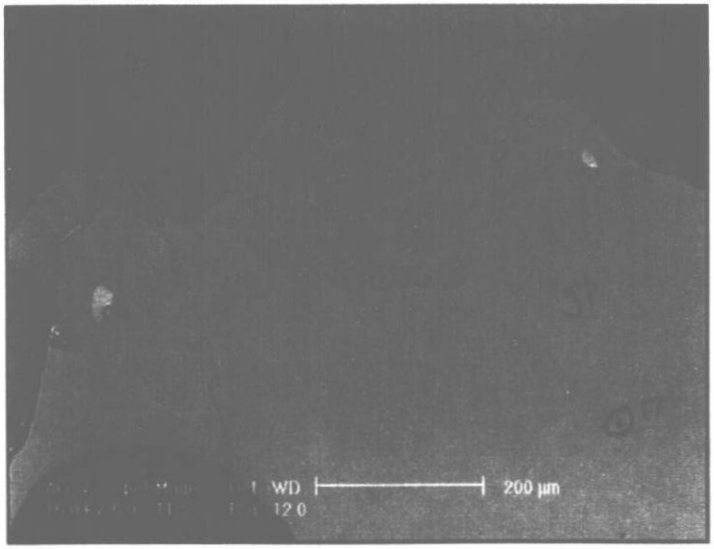
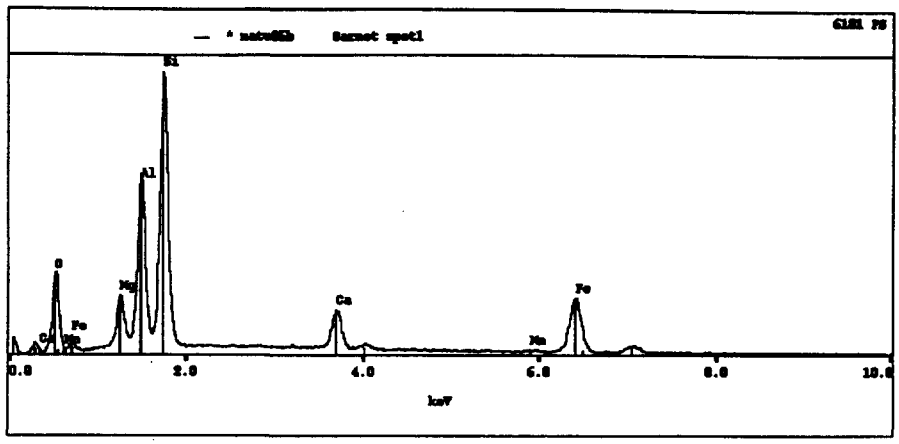


Photo 12A: MAT-W05B, spot 1. SEM images, scale bar in microns in each photo. Homogeneous garnet crystals (gt) with plagioclase (pl), amphibole (am) and ilmenite (il) on crystal margins. The garnets in this sample are very inclusion free. Numbers indicate points analyzed on the microprobe.

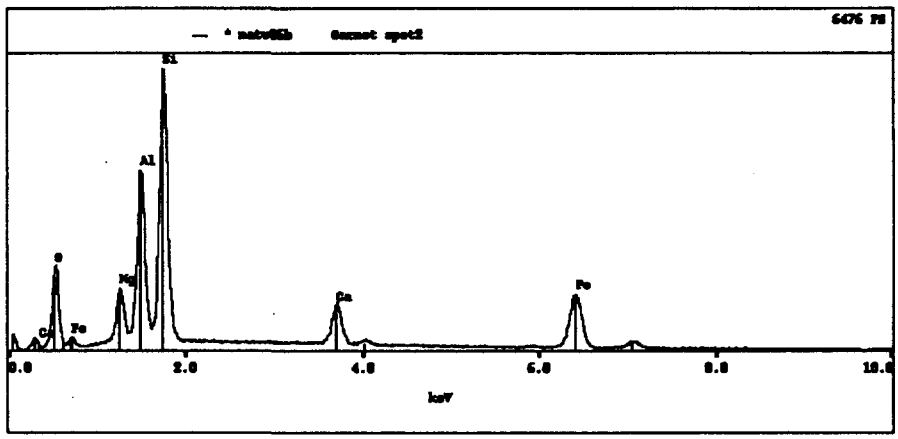
Photo 12B: MAT-W05B, spot 2. A homogeneous garnet crystal (gt) with minute inclusions of rutile (ru) and zircon (z). Numbers indicate points analyzed on the microprobe.

Photo 12C: MAT-W05B, spot 3. A large homogeneous garnet crystal (gt), surrounded by amphibole (am), with minute ilmenite inclusions (il). Numbers indicate points analyzed on the microprobe.

A.



B.



C.

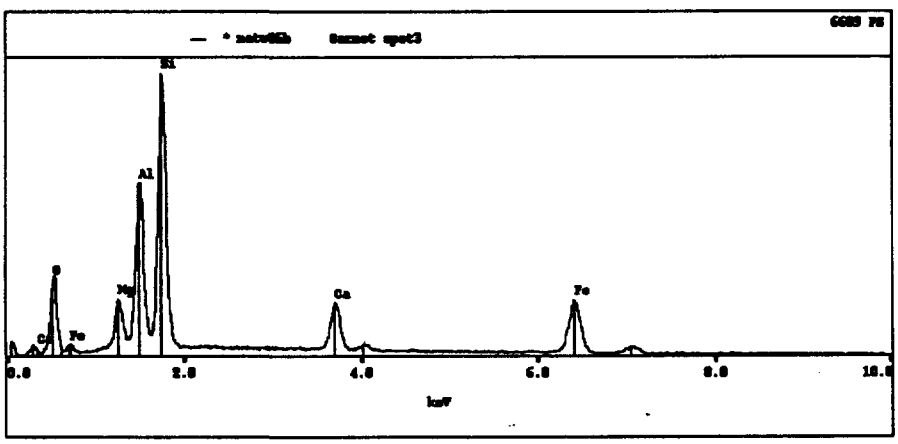
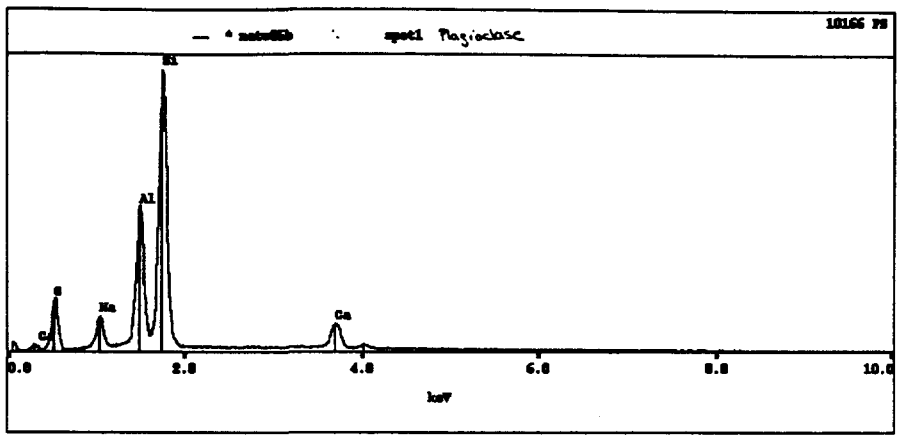
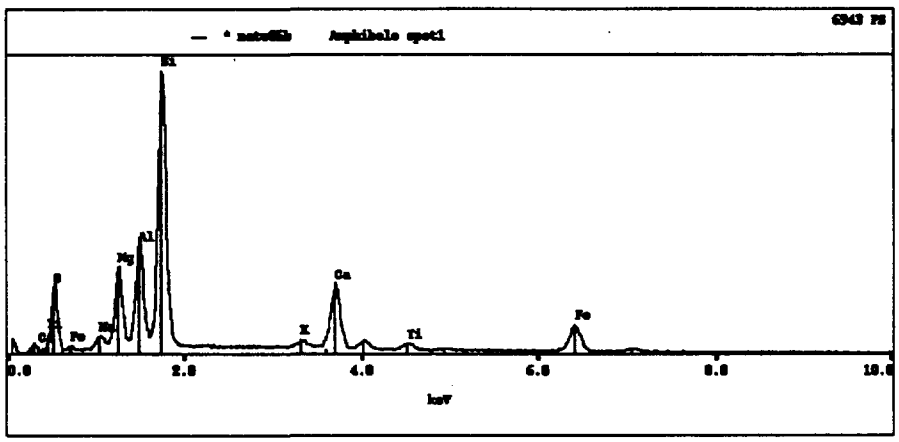


Figure 5. MAT-W05B. Characteristic spectra of garnets, one analysis from each of the three spots analyzed. These garnets have no significant Mn component. There is slight variability in the proportions of the Fe and Ca peaks, though Fe peak is always larger, however no systematic variation across crystals from cores to rims was observed.

A.



B.



C.

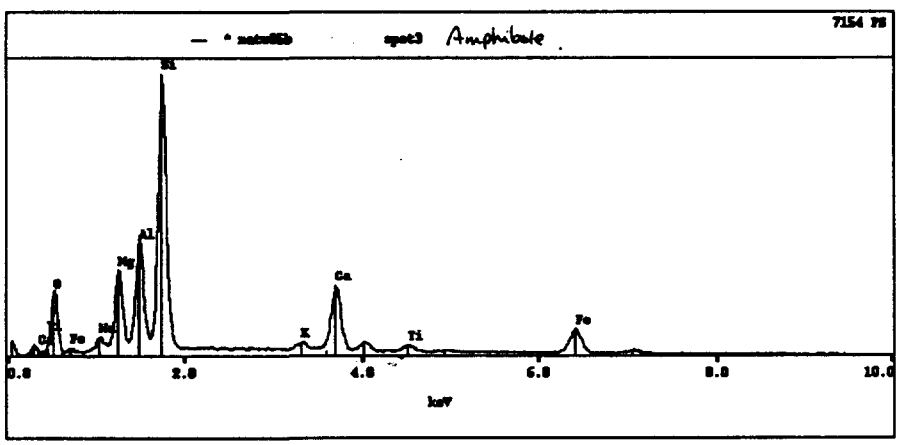


Figure 6. MAT-W05B. Spectra of amphibole and plagioclase. The plagioclase has a large Na component.The amphibole has Ti , K and Na peaks, though these are slightly smaller than the amphiboles analyzed in MAT-W01 East and West (compare to Figs. 2 and 4).

SAMPLE: MAT-W06A (Mattawan P property)

LITHOLOGY: Garnet Amphibolite Gneiss (Pegmatite vein)

Hand Sample Description: The sample is very similar to MAT-W05A. It consists of a fine-grained, well foliated, garnet-rich mafic rock, cut by pink pegmatitic veins. The foliation is defined by the alignment of crystal faces of the amphibole and biotite. Total garnet content is approximately 30-40%. The garnets are fine-grained and red, and there is weak compositional banding of garnet-rich and amphibole-rich layers on a mm scale. The veins are pinkish in colour, but staining with sodium cobaltinitrite identifies only minor amounts of K-feldspar present along fractures and crystal planes in coarse-grained plagioclase crystals. The rock is not magnetic. This polished section consists almost entirely of vein material.

TRANSLUCENT MINERALS

Mineral	%	Distribution & Characteristics	Opt. Prop.
plagioclase	68	medium to coarse-grained, anhedral, colourless to cloudy	1st order biref. albite twinning
quartz	20	coarse-grained, anhedral, clear, colourless	1st order biref.
amphibole	08	fine to medium-grained, anhedral, intensely pleochroic pale yellow to olive green, hornblende	masked 2nd order biref.
biotite	04	fine to medium-grained, elongate flakes, pleochroic pale-brown to dark-brown	high masked biref
K-feldspar	minor	alteration of plagioclase, identified by stain, cloudy	low biref.
sericite	minor	very fine-grained, minute flakes, replacing plagioclase	bright biref.
apatite	minor	fine-grained, rounded inclusions, high relief, clear, colourless	1st order biref.

OPAQUE MINERALS

Mineral	%	Distribution & Characteristics	Opt. Prop.
ilmenite	minor	fine-grained, anhedral, with lamella of magnetite	dull grey
magnetite	trace	fine-grained, intergrown with ilmenite	medium grey

Thin Section Description:

The vein consists of coarse-grained plagioclase and quartz, with areas of recrystallized, polygonal feldspar. Some of the plagioclase is clear and unaltered, other crystals are cloudy with sericite and some K-feldspar alteration. The contact of the wall rock with the vein consists of intense green amphibole, intergrown with dark brown flakes of biotite, plagioclase, quartz and minor amounts of ilmenite. No garnet is present. In this sample only 3 mm of wall rock is present on either side of the vein. The biotite flakes are generally subparallel to the contact.

Photo 13A: MAT-W06A. This is a view of the contact between the pegmatite vein (right) and the mafic wall rock (left). Green pleochroic amphibole occurs right at the contact, and coarse-grained flakes of biotite are oriented parallel to the contact. Plagioclase and quartz in the veins are very coarse-grained. Am-amphibole, Bi-biotite, Pl-plagioclase. Field of view 5.1 mm. Plane polarized light.

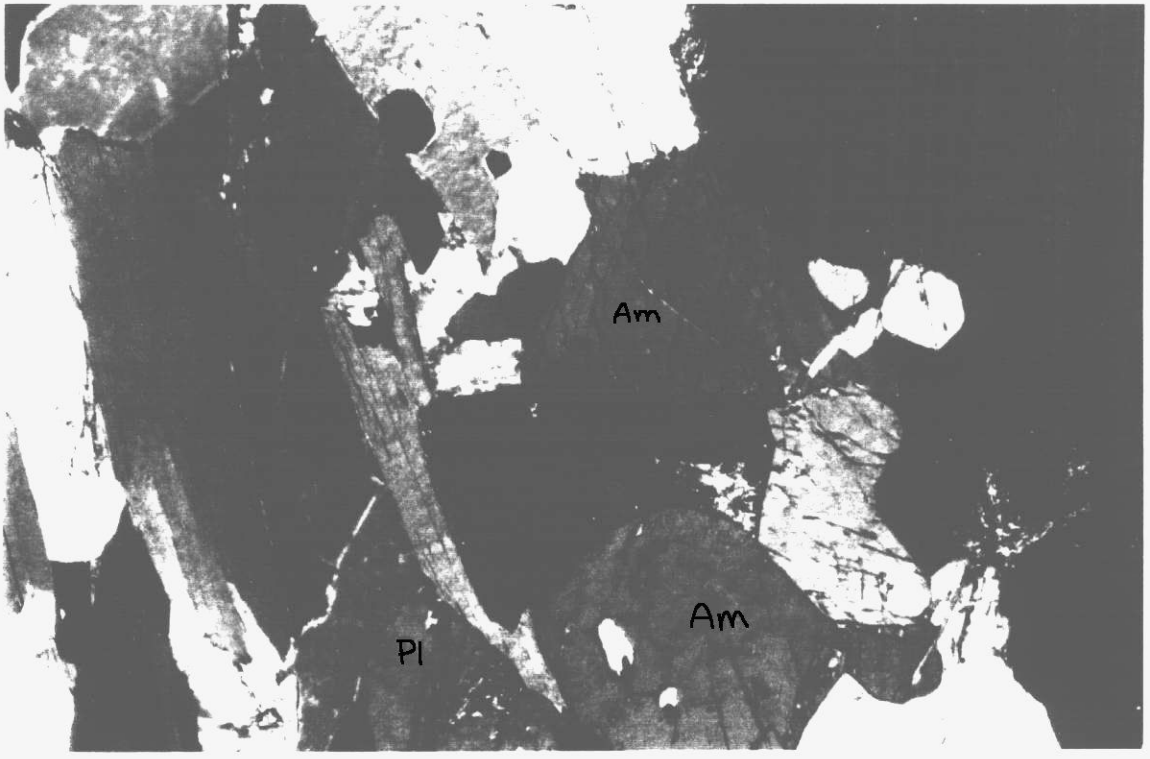


Photo 13B: MAT-W06A. Same view in cross polarized light. Note twinning in plagioclase. Am-amphibole, Bi-biotite, Pl-plagioclase. Field of view 5.1 mm.

SAMPLE: MAT-W06B (Mattawan P property)

LITHOLOGY: Garnet Amphibolite Gneiss (Mafic portion)

Hand Sample Description: This is the same sample as the previous one, but the polished section was cut from the mafic portion of the rock, avoiding the pegmatitic veins. The offcut contains approximately 30% fine-grained, red, round garnets. There is a weak discontinuous banding of the garnets that cuts diagonally across the section. The minerals are not obviously oriented in the plane of this section. Staining of the offcut with sodium cobaltinitrite indicates that there is some K-feldspar alteration of plagioclase in the groundmass.

TRANSLUCENT MINERALS

Mineral	%	Distribution & Characteristics	Opt. Prop.
garnet	35	medium-grained, subhedral rounded crystals, 0.5-2.0 mm in diameter, clear, colourless, some opaque inclusions	isotropic
amphibole	31	fine to medium-grained, anhedral, intensely pleochroic pale yellow to olive green, intergrown with garnets, hornblende	masked 2nd order biref.
plagioclase	25	fine-grained, anhedral, colourless to slightly cloudy with K-feldspar alteration	1st order biref. albite twinning
biotite	05	fine to medium-grained, elongate flakes, pleochroic pale-brown to dark-brown	high masked biref
K-feldspar	minor	alteration of plagioclase, identified by stain, cloudy	low biref.
apatite	minor	fine-grained, rounded inclusions, high relief, clear, colourless	1st order biref.

OPAQUE MINERALS

Mineral	%	Distribution & Characteristics	Opt. Prop.
ilmenite	04	fine-grained, disseminated, with lamella of magnetite	dull grey
magnetite	minor	intergrown with ilmenite	medium grey

Thin Section Description:
This sample is very similar to MAT-W05B. It consists of an interlocking garnet, amphibole, plagioclase, biotite and ilmenite/magnetite. Amphibole-rich and garnet-rich zones define a weak compositional banding. There is no obvious mineral orientation in this sample. Ilmenite is disseminated throughout the sample and occasionally occurs as inclusions in garnet. The subrounded garnets are often in contact with one another, with no interstitial minerals. A set of sub-parallel fractures cut the garnets, but are not as well defined as in the previous sample.

Scanning Electron Microscope Results
Three garnets were analyzed, as well as several amphibole and biotite crystals for comparison with previous samples. The garnets were homogeneous, with the Fe peak larger than the Ca peak, as in the previous samples, indicating a high almandine content. The garnets contained a few minute ilmenite and rutile inclusions, but are generally inclusion free. The amphibole is indistinguishable from that in MAT-W05B, with small Na, K and Ti peaks. The biotite has a smaller Ti peak than the biotite analyzed in MAT-W01 West.

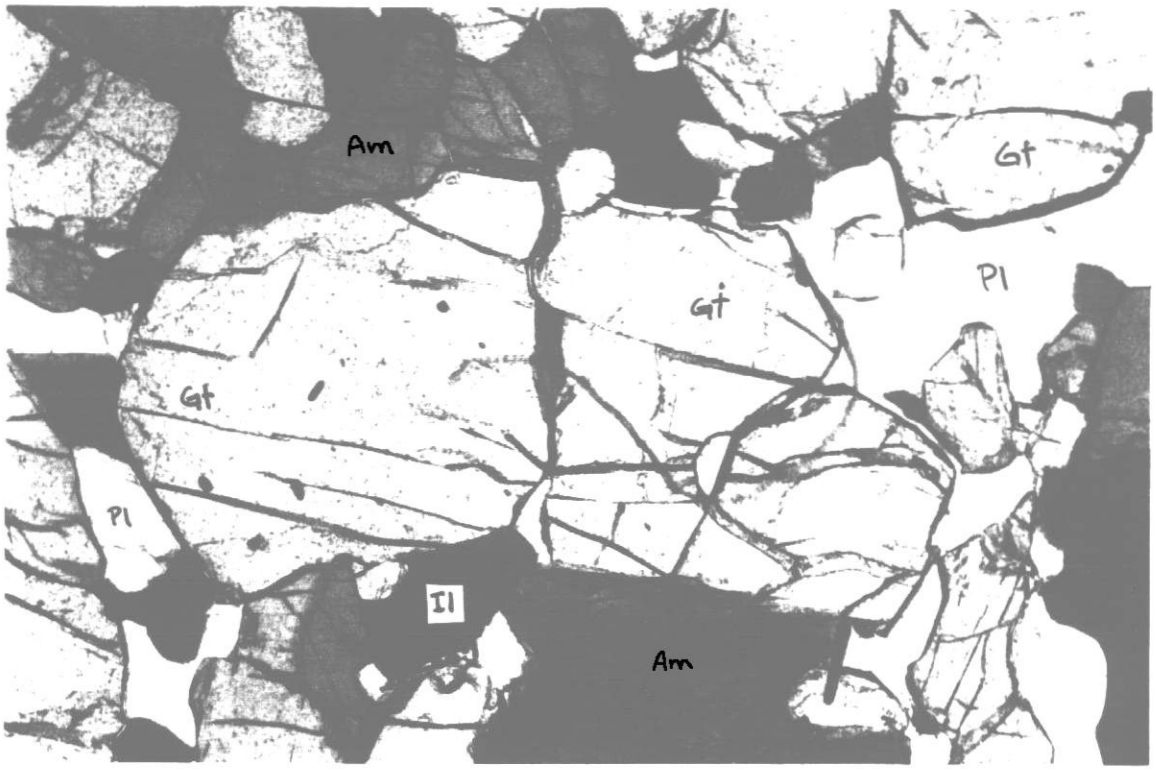


Photo 14A: MAT-W06B. This is a view of the overall texture of the sample. Coarse-grained garnets are intergrown with green pleochroic amphibole, plagioclase, biotite and ilmenite/magnetite. Am-amphibole, Bi-biotite, Pl-plagioclase, Il-ilmenite. Field of view 5.1 mm. Plane polarized light.

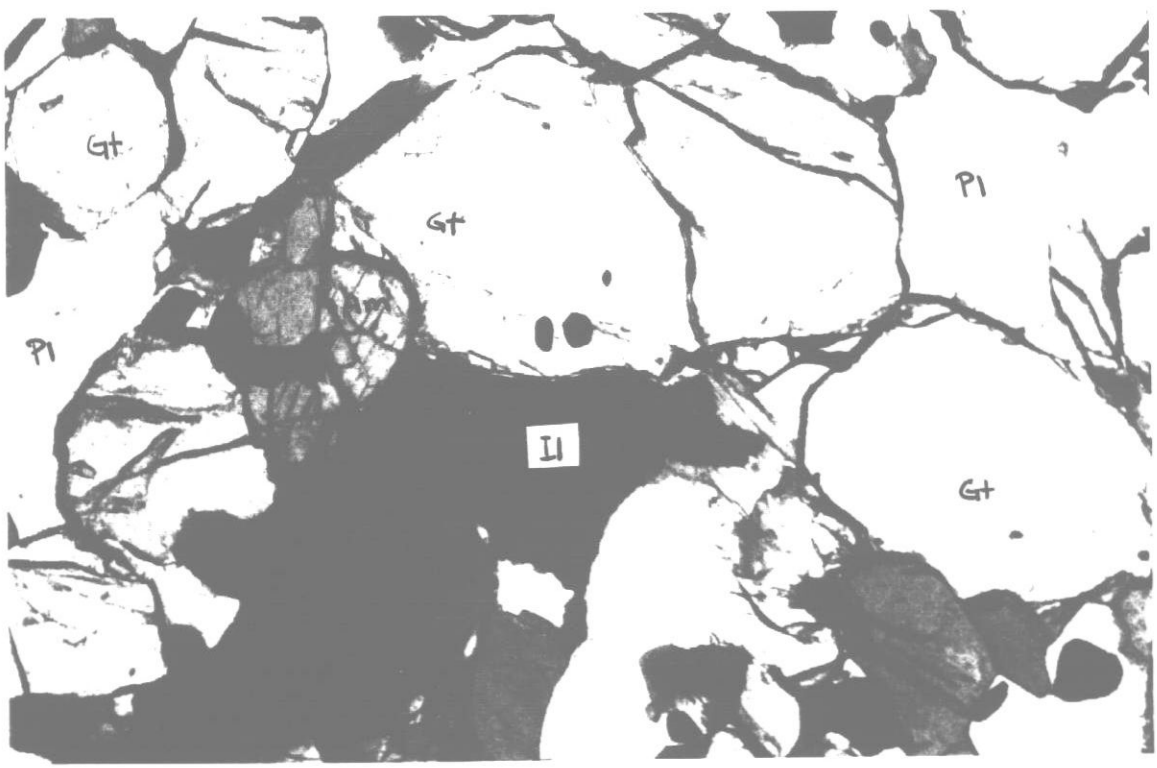
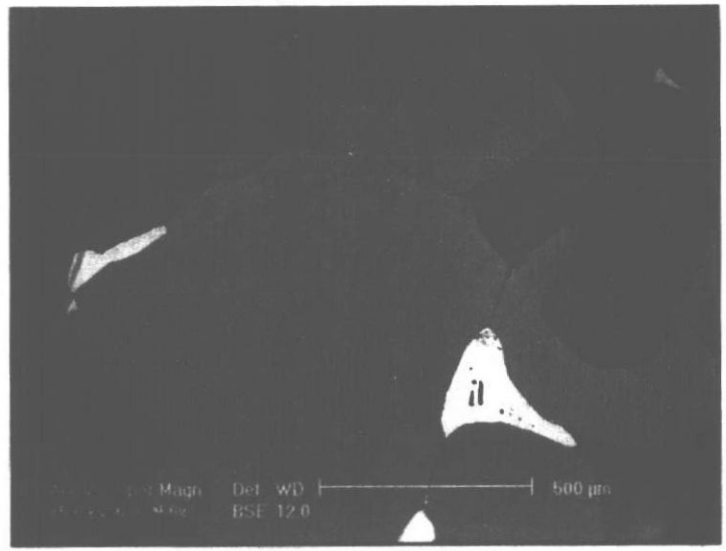


Photo 14B: MAT-W06B. Different view, overall texture. Note the inclusion-free nature of the garnets. Am-amphibole, Bi-biotite, Pl-plagioclase, Il-ilmenite. Field of view 5.1 mm. Plane polarized light.

A.

B.



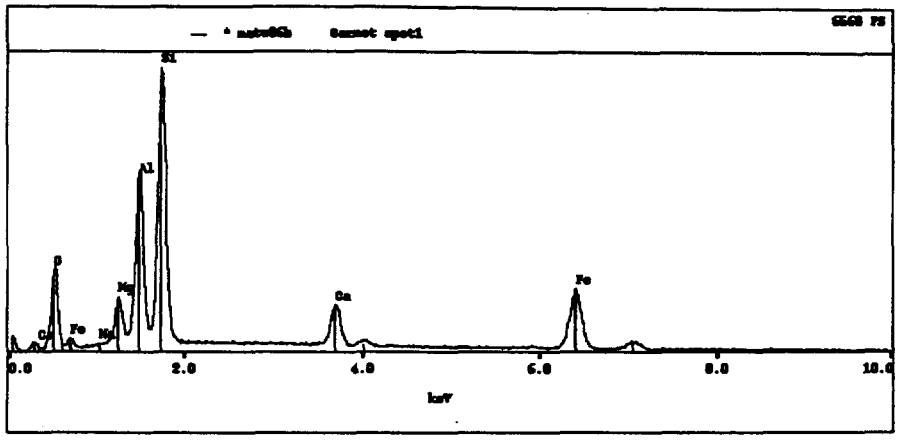
C.

Photo 15A: MAT-W06B, spot 1. SEM images, scale bar in microns in each photo. Homogeneous garnet crystals (gt) with minute inclusions of ilmenite (il), intergrown with amphibole (am).

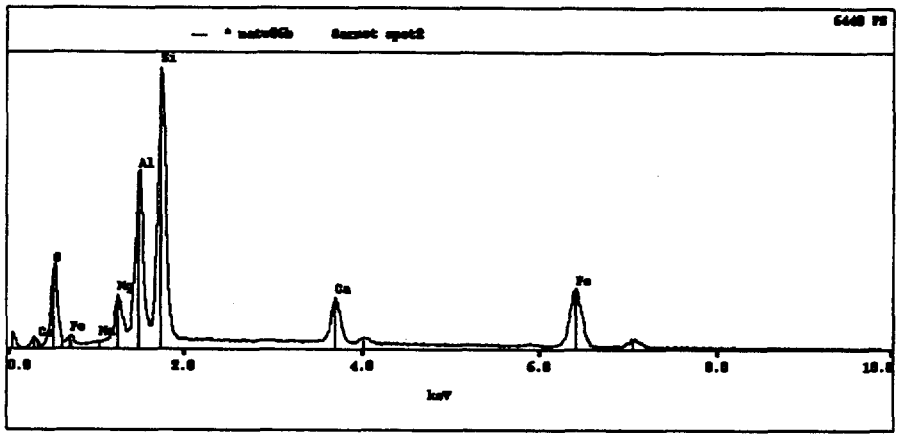
Photo 15B: MAT-W06B, spot 2. Homogeneous garnet crystals (gt) intergrown with ilmenite (il) and amphibole (am).

Photo 15C: MAT-W06B, spot 3. Homogeneous garnet crystals (gt) with rutile inclusions (ru), intergrown with ilmenite (il), biotite and amphibole (am).

A.



B.



C.

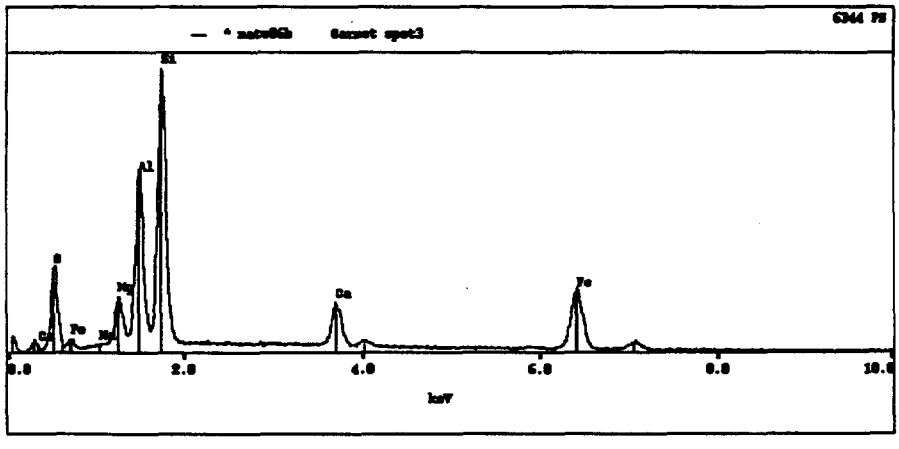
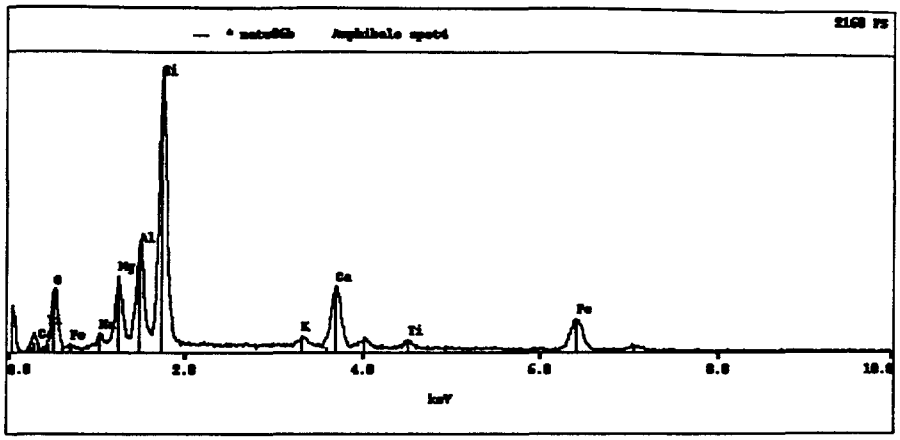


Figure 7. MAT-W06B. Characteristic spectra of garnets, one analysis from each of the three spots analyzed. The Fe peaks is consistently higher than the Ca peak. Note the lack of a Mn peak.

A.



B.

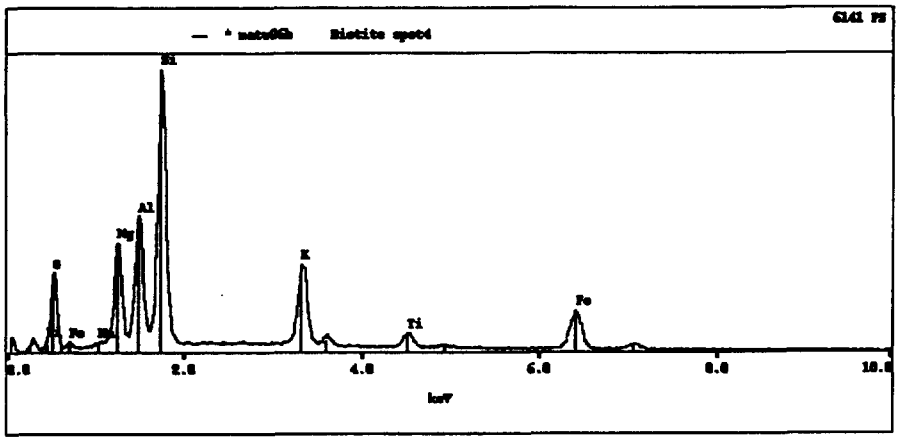


Figure 8. MAT-W06B. Spectra of amphibole and biotite. These are very similar to the analyses in MAT-W05B (Fig. 7). The Ti, K and Na peaks are lower than MAT-W01 East and West (Figs. 2 and 4). Overall the samples from the Mattawan P property appear to have a lower Ti content than the Mattawan B property samples (MAT-W01).

Final revised

Ontario Ministry of Northern Development and Mines

Declaration of Assessment Work Performed on Mining Land

Mining Act, Subsection 65(2) and 66(3), R.S.O. 1990

Transaction Number (office use)
W9970.00302
Assessment Files Research Imaging

of subsection 65(2) and 66(3) of the Mining Act. Under section 8 of the Mining Ac
he assessment work and correspond with the mining land holder. Questions abo
of Northern Development and Mines, 3rd Floor, 933 Ramsey Lake Road, Sudbur

31L07NW2008 2.19765 MATTAWAN 900

Instructions: - For work performed on Crown Lands before recording a claim, use form 0240.
- Please type or print in ink.

1. Recorded holder(s) (Attach a list if necessary)

Name: HIGH G MINERALS CORPORATION	Client Number: 304102
Address: 420-355 BURRARD STREET	Telephone Number: (604) 669-2959
VANCOUVER, B.C. V6C 2G8	Fax Number: (604) 687-4030
Name: MONTREUIL RONALD ARMAND	Client Number: 302870
Address: P.O. BOX 164	Telephone Number: (705) 744-2559
MATTAWA, ON P0H 1V0	Fax Number: (705) 744-3529

2. Type of work performed: Check (✓) and report on only ONE of the following groups for this declaration.

Geotechnical: prospecting, surveys, assays and work under section 18 (regs) ✓ | Physical: drilling stripping, trenching and associated assays | Rehabilitation

Work Type: GEOTECHNICAL (GEOLOGICAL EXAMINATION, ROCK SAMPLING)	Office Use
	Commodity
	Total $ Value of Work Claimed: $6,586
Dates Work Performed: From Day 25 Month 05 Year 1999 To Day 09 Month 06 Year 1999	NTS Reference
Global Positioning System Data (if available) — Township/Area: MATTAWAN; M or G-Plan Number: G-1633	Mining Division: SUDBURY; Resident Geologist District: SUDBURY

Please remember to:
- obtain a work permit from the Ministry of Natural Resources as required;
- provide proper notice to surface rights holders before starting work;
- complete and attach a Statement of Costs, form 0212;
- provide a map showing contiguous mining lands that are linked for assigning work;
- include two copies of your technical report.

3. Person or companies who prepared the technical report (Attach a list if necessary)

Name: B.H. (BEN) WHITING	Telephone Number: (613) 531-9712
Address: 62 QUEBEC STREET, KINGSTON, ON K7K 1T7	Fax Number: (613) 574-3199
Name:	Telephone Number:
Address:	Fax Number:
Name:	Telephone Number:
Address:	Fax Number:

RECEIVED
2:30
OCT 01 1999
GEOSCIENCE ASSESSMENT OFFICE

OCT 01 1999

4. Certification by Recorded Holder or Agent

I, RAD PESALJ (Print Name), do hereby certify that I have personal knowledge of the facts set forth in this Declaration of Assessment Work having caused the work to be performed or witnessed the same during or after its completion and, to the best of my knowledge, the annexed report is true.

Signature of Recorded Holder or Agent: Rad. Pesalj		Date: SEP. 28, 1999
Agent's Address: 420-355 BURRARD ST. VANCOUVER, BC V6C 2G8	Telephone Number: (604) 488-2663	Fax Number: (604) 687-4030

0241 (03/97)

RECEIVED
JAN 20 2000
GEOSCIENCE ASSESSMENT OFFICE

5. Work to be recorded and distributed. Work can only be assigned to claims that are contiguous (adjoining) to the mi land where work was performed, at the time work was performed. A map showing the contiguous link must accompany form.

W9970.00302 Final revised

Mining Claim Number. Or if work was done on other eligible mining land, show in this column the location number indicated on the claim map.		Number of Claim Units. For other mining land, list hectares.	Value of work performed on this claim or other mining land.	Value of work applied to this claim.	Value of work assigned to other mining claims.	Bank. Value of w to be distributed at a future date
eg	TB 7827	16 ha	$26,825	N/A	$24,000	$2,825
eg	1234567	12	0	$24,000	0	0
eg	1234568	2	$ 8,892	$ 4,000	0	$4,892
1	S1224153 •	1	$2,195	N/A	$2,000	$195
2	S1212157 •	4	$2,196	N/A	$2,000	$196
3	S1230849 •	3	$2,195	N/A	$2,000	$195
4	S1212158	6	0	$2,400	0	0
5	S1212547	1	0	$ 400	0	0
6	S1212546	1	0	$ 400	0	0
7	S1212548	4	0	$1,600	0	0
8	S1212566	2	0	$ 800	0	0
9	S1212549	1	0	$ 400	0	0
10						
11						
12						
13						
14						
15						
	Column Totals	23	$6,586	$6,000	$6,000	$586

I, RAD PESALJ (Print Full Name), do hereby certify that the above work credits are eligible un subsection 7 (1) of the Assessment Work Regulation 6/96 for assignment to contiguous claims or for application to the claim where the work was done.

Signature of Recorded Holder or Agent Authorized in Writing	Date
Rad. Pesalj	January 19, 2000

6. Instruction for cutting back credits that are not approved.

Some of the credits claimed in this declaration may be cut back. Please check (✓) in the boxes below to show how you wist prioritize the deletion of credits:

- ☐ 1. Credits are to be cut back from the Bank first, followed by option 2 or 3 or 4 as indicated.
- ☐ 2. Credits are to be cut back starting with the claims listed last, working backwards; or
- ☐ 3. Credits are to be cut back equally over all claims listed in this declaration; or
- ☐ 4. Credits are to be cut back as prioritized on the attached appendix or as follows (describe):

Note: If you have not indicated how your credits are to be deleted, credits will be cut back from the Bank first, followed by option number 2 if necessary.

For Office Use Only

Received Stamp	Deemed Approved Date	Date Notification Sent
	Date Approved	Total Value of Credit Approved
	Approved for Recording by Mining Recorder (Signature)	

0241 (03/97)

RECEIVED
JAN 20 2000
GEOSCIENCE ASSESSMENT OFFICE

Ontario Ministry of Northern Development and Mines

Statement of Costs for Assessment Credit

Transaction Number (office use)

Personal information collected on this form is obtained under the authority of subsection 6 (1) of the Assessment Work Regulation 6/96. Under section 8 of the Mining Act, this information is a public record. This information will be used to review the assessment work and correspond with the mining land holder. Questions about this collection should be directed to a Provincial Mining Recorder, Ministry of Northern Development and Mines, 3rd Floor, 933 Ramsey Lake Road, Sudbury, Ontario, P3E 6B5.

Work Type	Units of work Depending on the type of work, list the number of hours/day worked, metres of drilling, kilometres of grid line, number of samples, etc.	Cost Per Unit of work	Total Cost
FIELD EXAMINATION AND	B. WHITING, 6.25 DAYS		
ROCK SAMPLING	@ $ 400/DAY		$ 2,500.00
SAMPLE PREPARATION	LAKEFIELD RESEARCH		1,305.40
MINERALOGICAL WORK	K. ROSS		1,902.49
Associated Costs (e.g. supplies, mobilization and demobilization).			
FIELD SUPPLIES			122.50
COMMUNICATIONS			7.25
SHIPPING			60.37
Transportation Costs			
TRUCK RENTAL, 4 DAYS			308.92
FUEL			108.33
Food and Lodging Costs			
ACCOMODATION & FOOD			270.67
		Total Value of Assessment Work	$ 6,585.93

Calculations of Filing Discounts:

1. Work filed within two years of performance is claimed at 100% of the above Total Value of Assessment Work.
2. If work is filed after two years and up to five years after performance, it can only be claimed at 50% of the Total Value of Assessment Work. If this situation applies to your claims, use the calculation below:

TOTAL VALUE OF ASSESSMENT WORK	x 0.50 =	Total $ value of worked claimed.

Note:
- Work older than 5 years is not eligible for credit.
- A recorded holder may be required to verify expenditures claimed in this statement of costs within 45 days of a request for verification and/or correction/clarification. If verification and/or correction/clarification is not made, the Minister may reject all or part of the assessment work submitted.

Certification verifying costs:

I, RAD PESALJ (please print full name), do hereby certify, that the amounts shown are as accurate as may reasonably be determined and the costs were incurred while conducting assessment work on the lands indicated on the accompanying Declaration of Work form as AGENT (recorded holder, agent, or state company position with signing authority) I am authorized to make this certification.

Signature	Date
Rad. Pesalj	JAN 19, 2000

0212 (03/97)

Ministry of
Northern Development
and Mines

Ministère du
Développement du Nord
et des Mines

Ontario

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

Telephone: (888) 415-9845
Fax: (877) 670-1555

Visit our website at:
www.gov.on.ca/MNDM/MINES/LANDS/mlsmnpge.htm

January 27, 2000

Rad Pesalj
HIGH G MINERALS CORPORATION
420-355 BURRARD STREET
VANCOUVER, B.C.
V6C-2G8

Dear Sir or Madam:

Submission Number: 2.19765

Subject: Transaction Number(s):		**Status**
	W9970.00302	Approval After Notice

We have reviewed your Assessment Work submission with the above noted Transaction Number(s). The attached summary page(s) indicate the results of the review. WE RECOMMEND YOU READ THIS SUMMARY FOR THE DETAILS PERTAINING TO YOUR ASSESSMENT WORK.

If the status for a transaction is a 45 Day Notice, the summary will outline the reasons for the notice, and any steps you can take to remedy deficiencies. The 90-day deemed approval provision, subsection 6(7) of the Assessment Work Regulation, will no longer be in effect for assessment work which has received a 45 Day Notice. Allowable changes to your credit distribution can be made by contacting the Geoscience Assessment Office within this 45 Day period, otherwise assessment credit will be cut back and distributed as outlined in Section #6 of the Declaration of Assessment work form.

Please note any revisions must be submitted in DUPLICATE to the Geoscience Assessment Office, by the response date on the summary.

If you have any questions regarding this correspondence, please contact BRUCE GATES by e-mail at bruce.gates@ndm.gov.on.ca or by telephone at (705) 670-5856.

Yours sincerely,

ORIGINAL SIGNED BY
Blair Kite
Supervisor, Geoscience Assessment Office
Mining Lands Section

Correspondence ID: 14531
Copy for: Assessment Library

Work Report Assessment Results

Submission Number: 2.19765

Date Correspondence Sent: January 27, 2000 **Assessor:** BRUCE GATES

Transaction Number	First Claim Number	Township(s) / Area(s)	Status	Approval Date
W9970.00302	1212158	MATTAWAN	Approval After Notice	January 22, 2000

Section:
17 Assays BENEF
18 Other MICRO

The revisions outlined in the Notice dated December 08, 1999, have been corrected. Accordingly, assessment work credit has been approved as outlined on the AMENDED Declaration of Assessment Work Form accompanying this submission.

Correspondence to:

Resident Geologist
Sudbury, ON

Assessment Files Library
Sudbury, ON

Recorded Holder(s) and/or Agent(s):

Rad Pesalj
HIGH G MINERALS CORPORATION
VANCOUVER, B.C.

RONALD ARMAND MONTREUIL
MATTAWA, ONTARIO

Correspondence ID: 14531

REFERENCES

AREAS WITHDRAWN FROM DISPOSTION

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

	Description	Order No.	Date	Disposition	File
R1	SEC. 34 / 80	W.2/82	15/4/82	M & S.	57876
R2	CROWN RESERVE			S.R.O.	151867
R3	WITHDRAWAL	W-8-55/86	02/08/86	M & S	196150

R4 SEC 35 W-LL-P148/99 ONT MAY 14/99 M&S

R5 SEC35 W-LL-P131/99 ONT MAY 14/99 M&S
200 METERS FROM THE WATER'S EDGE.

R6 SEC 35 W-LL-P123/99 ONT MAY 15/99 M&S

MINING CLAIMS STAKED IN THIS TOWNSHIP ARE SUBJECT TO SEC. ~~54~~ 48 OF THE MINING ACT, R.S.O. 1970.

3(R-6912 (L... PR.126 Pt 1)

See Calvin Township Land ... File for Plan of Prov. Park

JUNE 1ST. OPENING
ONTARIO GAZETTE VOL.123-13
MARCH 31, 1990 AND VOL.123-18 MAY 5, 1990
PT. LOT 37, CONC.V MRO

31L07NW2008 2.19765 MATTAWAN 200

REFERENCES

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

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)
LAND USE PERMITS FOR COMMERCIAL TOURISM, OUTPOST CAMPS	

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)

ACRES 40 HECTARES 16

TOWNSHIP

MATTAWAN

M.N.R. ADMINISTRATIVE DISTRICT

NORTH BAY

MINING DIVISION

SUDBURY

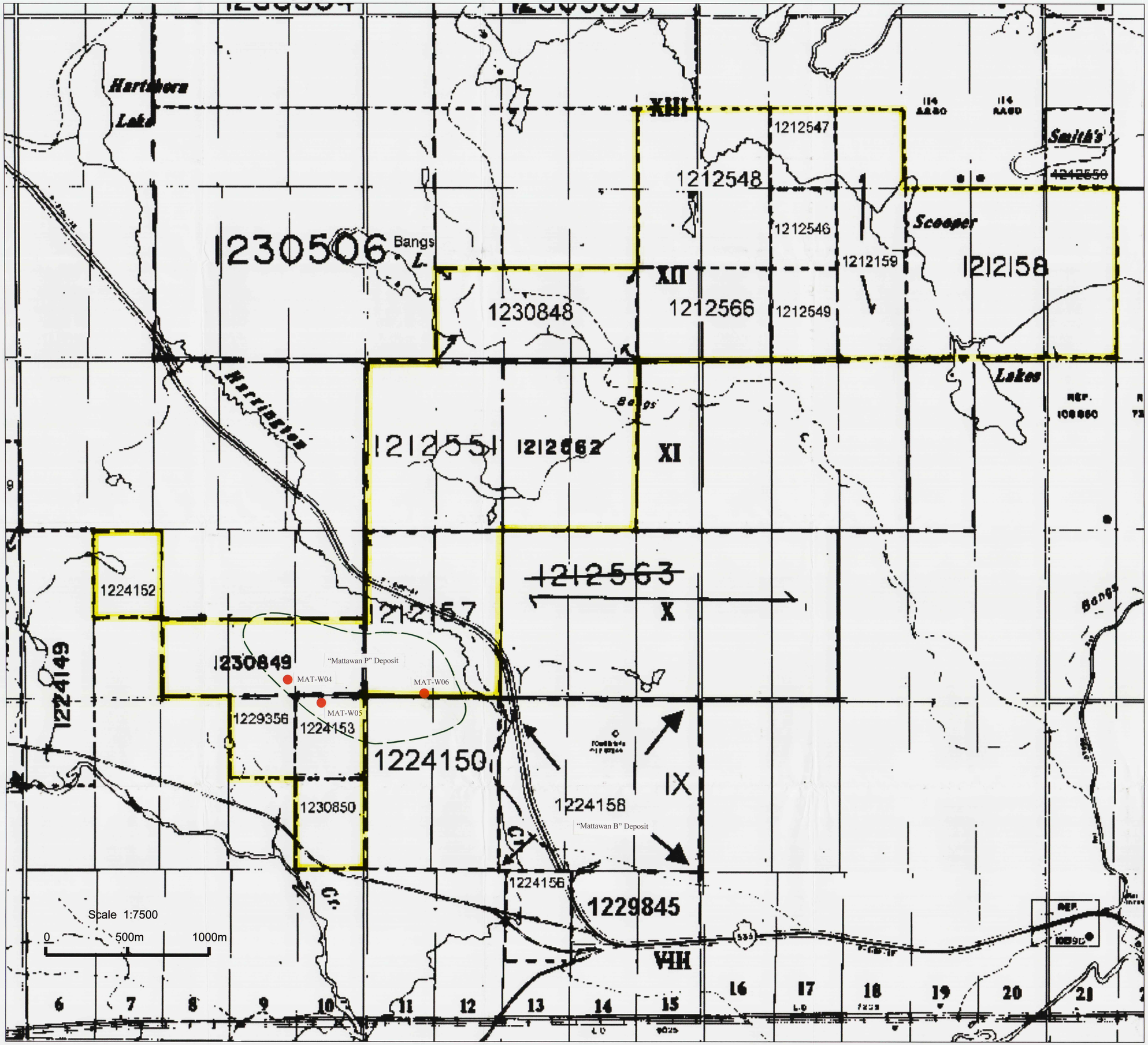
LAND TITLES / REGISTRY DIVISION

NIPISSING

Ministry of Natural Resources
Ontario
Land Management Branch

Date OCTOBER 1984

Number G-1633



MAT-W04 Rock Sample Location

Area of Garnetiferous Outcrops for the "Mattawan P" Deposit.

1230848 Mineral Claim Boundary

IMPERIAL METALS CORPORATION

Mattawan P Deposit

Claim Map and Sample Locations

Mattawan Township, Ontario, Canada N.T.S. 31L/7

Date: 14 January 2000 Figure #2