Earth Sciences Report 2000-08

Diamond and Metallic-Mineral Potential of the Peerless Lake Map Area, North-Central Alberta

Alberta Energy and Utilities Board
Alberta Geological Survey

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August 2001

Acknowledgments

This study was funded entirely by the Canada-Alberta Western Economic Partnership Agreement (WEPA), a joint initiative between the Federal and Alberta governments that encourages regional economic development in Alberta. Such partnerships between the federal and Alberta governments continue to provide much-needed support for research on the geology of Alberta. Federal funding is provided through Western Economic Diversification; various Alberta government departments allocate the provincial funding.

Ashton Mining of Canada Inc. and Alberta Energy Company Ltd. are thanked for their cooperation during the 1998 field season.

The Saskatchewan Research Council is thanked for kimberlite-indicator processing, as is Tom Bonli, of the University of Saskatoon, for electron microprobe analysis. Alexander Rodinov, ASR consulting, is thanked for providing comments on kimberlite-indicator geochemistry during anonymous testing of a kimberlite-indicator reporting system; some results from anonymous testing of indicator grains from this report's dataset were incorporated into figures, tables and conclusions. David McIntyre, Manuka Palynologic Consulting, is thanked for the palynology contribution. Reg Olson, Alberta Geological Survey, provided advice and questions during internal editing. Finally, Bob Davies, RnD Technical is thanked for timely and efficient editing of the manuscript.

Alberta Energy and Utilities Board Alberta Geological Survey
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Published by
Alberta Energy and Utilities Board
Alberta Geological Survey
4th Floor, Twin Atria Building
4999 – 98th Avenue
Edmonton, Alberta
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Contents

Figures

Tables

Appendices

Abstract

A regional geochemical sampling program for diamond and metallic-mineral potential was completed during the summer of 1998 in the Peerless Lake map area, north-central Alberta. The area encompasses the 1997 discovery of diamondiferous kimberlites on the flanks of the Buffalo Head Hills by Ashton Mining of Canada Inc. and its co-venture's Alberta Energy Company Ltd. and Pure Gold Minerals Inc. The study is intended to provide reconnaissance-scale information from an area with known diamondiferous kimberlites.

The regional geochemical survey collected 184 samples, targeting a variety of sampling media: 88 stream-sediment heavy-mineral concentrates; 25 glaciofluvial, or sand and gravel samples; 70 glacial-deposit (till, glaciolacustrine, diamicton, and B/C horizon transition) samples; and 1 preglacial sand and gravel sample. More than 2000 silicate and oxide grains were recovered and 1500 picked (definite and possible) silicate minerals were plotted, regardless of chemistry, to study their distribution relationships. In total, 606 grains were selected for quantitative analysis of major- and trace-element chemistry using an electron microprobe.

The spatial distribution of silicate kimberlite-indicator minerals, particularly peridotitic garnet and olivine, clearly shows four areas with elevated grain counts. Three 'anomalous' areas occur in the northwestern and north-central parts of the map area, close to known kimberlite clusters. Heavy mineral sampling must therefore, be recognized as a valuable exploration tool in other areas of Alberta that are similarly covered with complex surficial deposits of glacial origin. A fourth anomalous area, located in the southwestern part of the area, is characterized by a wide distribution of elevated grain counts. While glaciofluvial samples contain a large number of indicator minerals, high indicator-mineral grain counts are generally independent of sample media. The distribution patterns of indicator grains in areas of known kimberlite occurrences are generally close to the kimberlite source.

With few exceptions, all indicators studied were derived from kimberlite. Based on the few samples analyzed, the sample mantle source is predominately lherzolitic, with minor harzburgitic and eclogitic/pyroxenitic constituents. The results of the geochemical survey show that the Peerless Lake map area in north-central Alberta has the potential to host a major diamond deposit.

The data in the current study represent one of the first regional indicator-mineral studies near a known diamondiferous kimberlite cluster in Alberta. The information will benefit exploration companies as they develop sampling strategies in other parts of Alberta. The quantitative and qualitative trends of kimberlite-indicator minerals from an area with known kimberlitic diatremes will enable better interpretation of possible indicator trains and future discoveries throughout Alberta.

1 Introduction

Alberta is in the early stages of exploration for volcanic-hosted commodities such as diamondiferous kimberlites. A complex veneer of glacial and glaciofluvial deposits hinders exploration in much of northern Alberta. The Peerless Lake map area (Figure 1), which is almost entirely covered by a thick cover of glacial surface deposits, represents one of the first areas where significant diamond deposits have been discovered in Alberta.

In 1997, Ashton Mining of Canada Inc. and its co-venture's Alberta Energy Company Ltd. and Pure Gold Minerals Inc., intersected "olivine-dominated fragmental and tuffaceous material" in two drillholes while testing positive aeromagnetic targets in the Peerless Lake area (Ashton Mining of Canada Inc., 1997a). Petrographic studies of core from K7B and K7C confirmed that the drillholes intersected kimberlites and identified indicator minerals, such as chromite and eclogitic garnets, and peridotitic garnets (Ashton Mining of Canada Inc., 1997b). To March 1, 2000, 32 kimberlite pipes has been discovered. Eighteen of these have been reported to be diamondiferous; five kimberlites with higher microdiamond counts, including K5, K6, K11, K14, and K91, have been mini-bulk sampled (Ashton Mining of Canada Inc., 1998a, 1999a). The discovery and subsequent exploration not only triggered a staking rush, but have also led to international exposure of a new commodity in the already oil- and gas-rich province of Alberta.

A heavy-mineral sampling strategy was selected for the Peerless Lake area. Heavy-mineral sampling is a widely practised, indirect exploration method that seeks to recover minerals that are 1) commonly associated with, but more abundant than, diamonds in the host rocks; and 2) resistant to chemical and physical degradation. The recovery of morphologically distinctive, chemically resistant, heavy minerals from the upper mantle has proven to be a beneficial diamond-exploration technique, virtually since 'kimberlite' was first recognized as a host for diamonds in South Africa. The minerals most commonly used to trace volcanic sources of diamonds include some varieties of garnet, chrome-rich spinel, orthopyroxene, clinopyroxene, ilmenite and, in special cases, olivine. Since these minerals are derived from the upper mantle and coexist with diamond, either in host xenoliths or as inclusions within diamonds themselves, their morphological and geochemical properties can provide significant information about the potential of the area.

A reconnaissance field program for diamond and metallic-mineral potential was completed by the Alberta Geological Survey during the summer of 1998 in the Peerless Lake map area of north-central Alberta. The regional study collected 184 samples, including stream-sediment heavy-mineral concentrates (HMC) and till, glaciofluvial, and B/C horizon transitional soil samples, from 171 separate locations. A variety of sampling media was collected to determine which would be most effective for indicator-mineral HMC sampling and targeting of indicator trains. The current study will report on the quantitative and qualitative trends of kimberlite-indicator minerals in an area with known kimberlitic diatremes. The data are intended to assist exploration companies in developing future sampling strategies for northern Alberta, and to provide background and anomalous values near known deposits.

2 Location and Access

The Peerless Lake map area is in north-central Alberta within National Topographic System (NTS) 1:250 000 map sheet 84 B, and is bounded by latitudes 56°N and 57°N, and by longitudes 114°W and 116°W (Figure 1). The map area is sparsely populated; the largest community is Red Earth Creek, located in the central part of the area. Other hamlets and localities include Loon Lake, Lubicon Lake, Peerless Lake and Trout Lake.

Much of the infrastructure in the Peerless Lake map area, including road networks where dry weather vehicle access is excellent, is the result of extensive oil exploration. Provincial Highway 88, running north-south through the west-central part of the map area, provides the main access. Highway 88 is paved as far north as the community of Red Earth Creek, where it becomes a loose, stabilized, all-weather road. Secondary Highways 986 and 686 provide access to the west-central and northeastern parts of the area, respectively. Other parts of the area can be accessed via improved roads including the Muskwa Lake road in the southeast, the Tepee Lake road in the east-central part, the Sawn Lake processing plant road in the northwest, and a road located north of the Gift Lake Métis settlement in the southwest.

3 Physiography

The Peerless Lake map area consists of three broad uplands, including the Peerless Uplands, Buffalo Head Hills and Birch Mountains, which are located more to the northeast (Figure 1). A broad area of low-relief known as the Loon River lowlands separates the upland regions and particularly the Buffalo Head Hills from the Peerless Uplands. Elevations range from less than 488 m above sea level (a.s.l.) in the floodplain of the Loon River to more than 793 m a.s.l. at Trout Mountain. The greatest overall relief is found in the Buffalo Head Hills uplands.

The Loon River and Muskwa River drain the area. Both rivers flow into the Wabasca River, a tributary of the larger Peace River drainage system. The lowland areas are characterized by an extensive network of preglacial channels, which approximately resembles the present-day drainage system. A major bedrock-channel thalweg, coincident with the Loon and Muskwa Rivers, trends north-south in the north-central part of the area and east-west in the southeastern part of the area (Pawlowicz and Fenton, 1995a). The lowlands near the Loon River form a flat to slightly depressed valley with occasional gently rolling ridges. An estimated 50-70 per cent of the area around Loon Lake is poorly drained and consists of moss and sedge bogs.

All lakes found in the map area are of glacial origin (Ceroici, 1979), and tend to be more numerous, larger, and deeper in the upland areas due to the rolling topography of ground moraine. Lakes found in the lowland areas, including Muskwa and Lubicon lakes, are generally shallow due to lack of relief on lacustrine plains.

4 Energy and Mineral Exploration History

The Peerless Lake area is typical of much of northern Alberta. Exploration has focused predominately on energy resources, while non-energy resources received very little attention. However, this changed dramatically in early 1997 when Ashton Mining of Canada Inc. released the results of petrographic studies of drill core from targets K7B and K7C in the northwestern part of the map area. The results confirmed the intersection of kimberlitic diatremes and the presence of kimberlite-indicator minerals such as chromite, eclogitic garnets, and peridotitic garnets. This section provides an overview of past energy, diamond, metallic-mineral, and aggregate exploration.

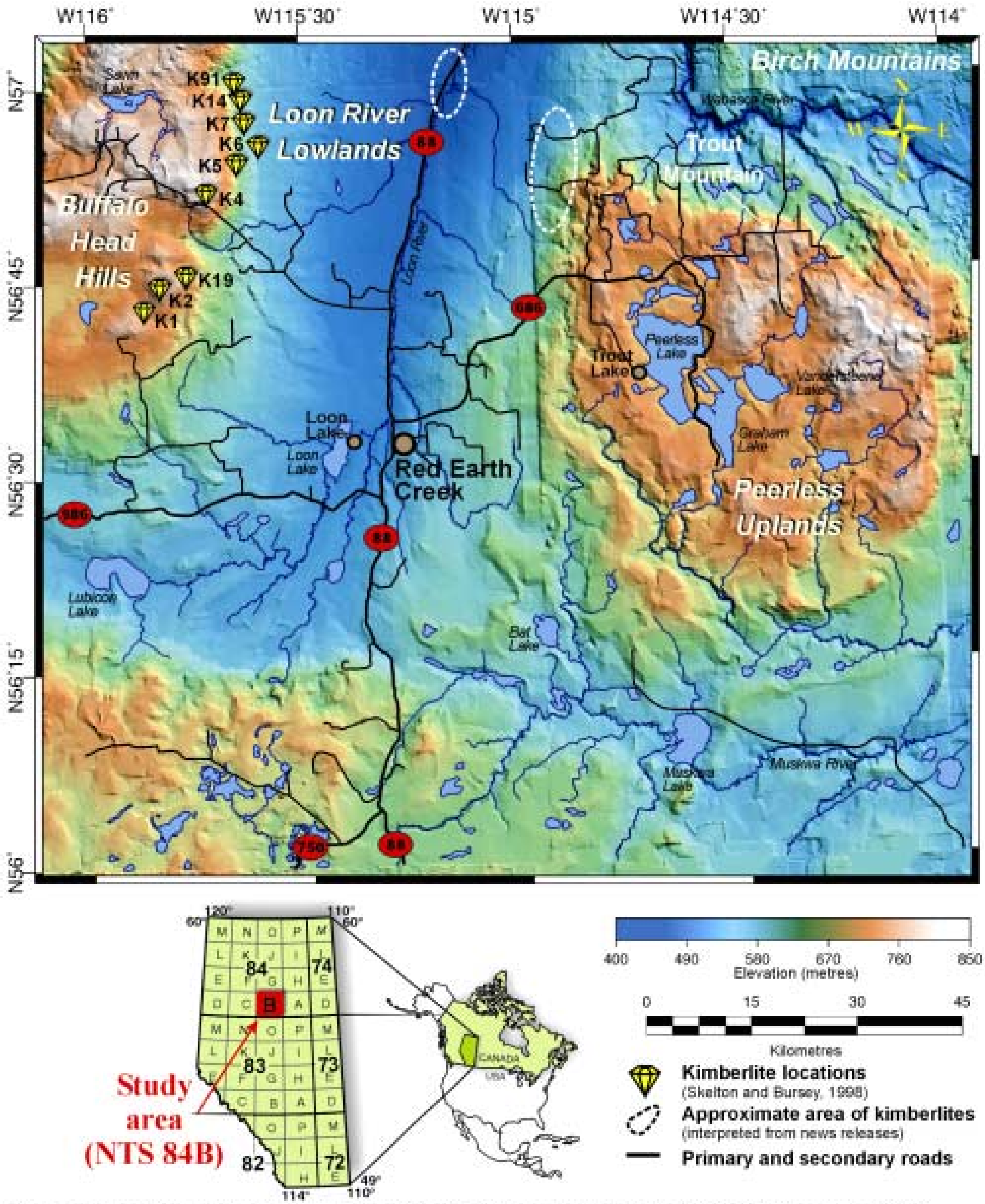


Figure 1. Location and physiography of the Peerless Lake map area (NTS 84B) north-central Alberta, with kimberlite locations.

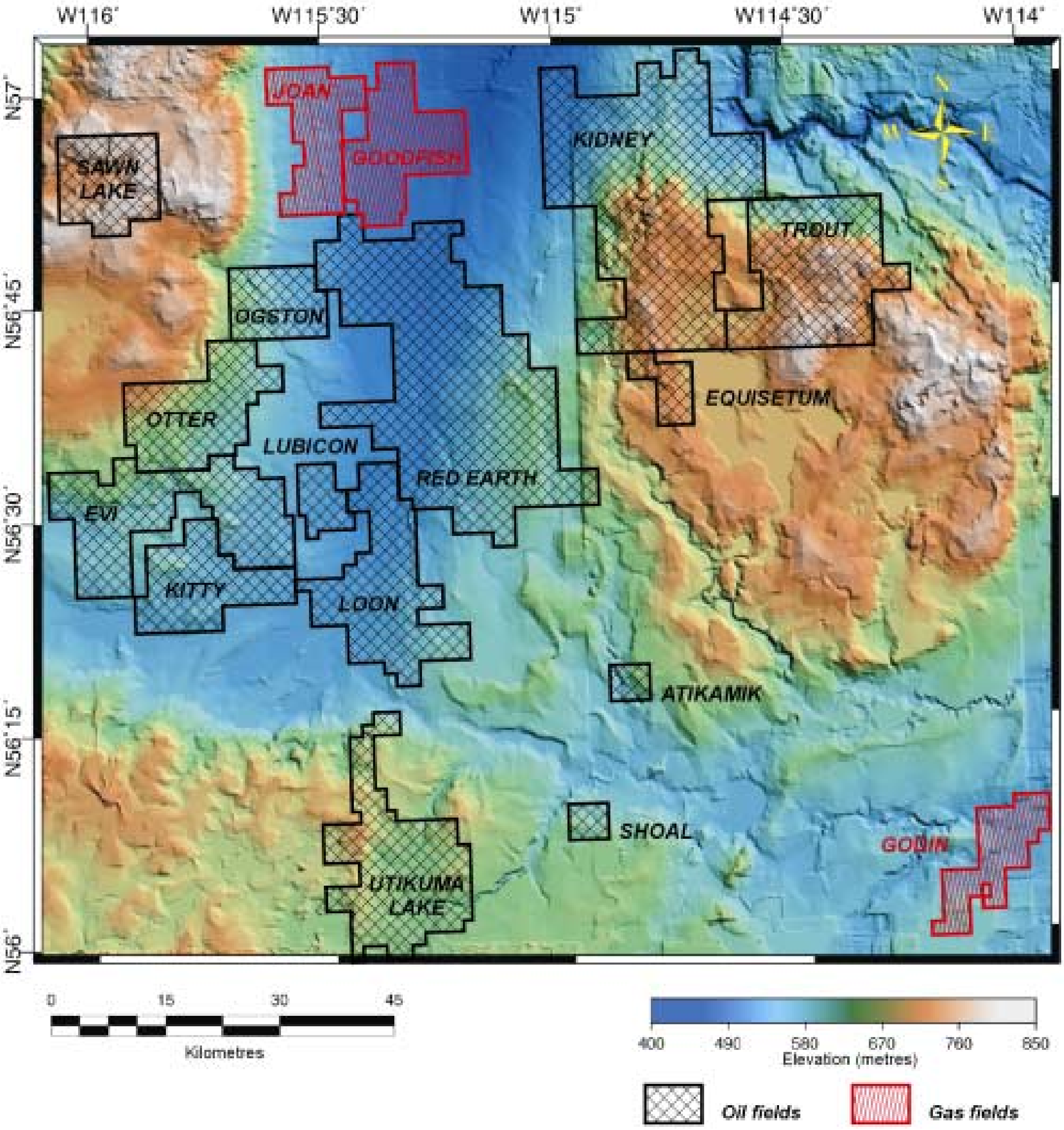


Figure 2. Oil and gas fields in the Peerless Lake area.

4.1 Oil and Gas

The Peerless Lake area is well known for its wealth of energy resources. The primary established reserves are 47,196.4 x 10^3 m^3 oil in twelve conventional fields and 808 x 10^6 m^3 gas in three fields (Figure 2; Table 1**)**. The geology of the Utikuma Lake Keg River Sandstone A and Red Earth Granite Wash A oil pools, the largest pools in the area, was outlined by Angus et al. (1989), who suggested that the pools are hosted by Granite Wash sandstone reservoirs. The Granite Wash Formation is composed of interbedded sandstone, siltstone, and shale, with minor amounts of dolostone and anhydrite (Greenwalt, 1956), and is thought to resemble a diachronous basal nonmarine to shallow marine clastic unit deposited farther from the Peace River Arch (Grayston et al., 1964). The oil is trapped in Granite Wash sandstone reservoirs that pinch out against or drape over numerous paleotopographic features on the Precambrian surface and are sealed by the overlying Muskeg Formation anhydrite.

4.2 Diamonds

4.2.1 Discovery

In September 1995, the Alberta Geological Survey recovered 152 possible pyrope garnets from a single 25 kg sample of dark greyish brown, silty clay till; the sample was collected northwest of Red Earth Creek (latitude 56° 50.834' N, longitude 115° 45.237' W; Fenton and Pawlowicz, 1997). Thirty-five garnet grains were analyzed by scanning electron microprobe, and 27 were classified as Group 9 (G9) garnets according to Gurney's (1984) CaO versus Cr_2O_3 plot (Figure 3). The same site was resampled in August 1996 and 176 possible pyrope grains were recovered, thus duplicating the high number of pyrope garnets initially recovered from this site.

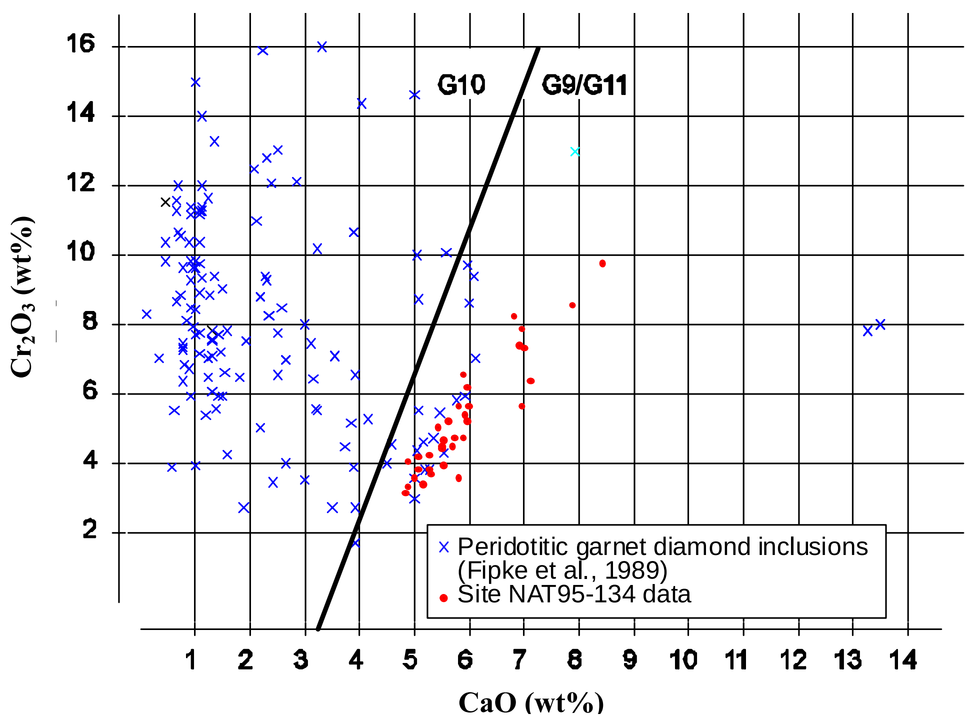


Figure 3. Scatter plot for the perioditic garnets from site NAT95-134 (Fenton and Pawlowicz, 1997).

Table 1. Primary reserves, cumulative production and remaining reserves of oil and gas pools in the Peerless Lake map area (Alberta Reserves, 1997, 1998).

Oil Field	Primary Established Reserves ($10^3 m^3$)	Cumulative Production to 1998 ($10^3 m^3$)	Remaining (1997) Established Reserves ($10^3 m^3$)
ATIKIAMIK	2.2	2.2	/
EQUISETUM	25.7	7.0	18.7
EVI	8175.8	6363.1	2180.9
KIDNEY	4506.8	3134.6	1355.2
KITTY	695.5	367.4	234.9
LOON	1831.6	1562.6	576.0
OGSTON	291.9	234.4	78.1
OTTER	3388.1	2408.0	959.2
RED EARTH	9916.8	9488.7	1623.2
SHOAL	12.6	12.6	/
TROUT	3053.4	2594.8	624.5
UTIKUMA LAKE	15296.0	13440.7	2054.7
TOTAL	47196.4	39616.1	9705.4
Gas Field	**Primary Established Reserves ($10^6 m^3$)**	**Net Cumulative Production to 1997 ($10^6 m^3$)**	**Remaining (1997) Established Reserves ($10^6 m^3$)**
GODIN	1100.0	266.0	834.0
GOODFISH	1048.0	451.0	597.0
JOAN	294.0	91.0	203.0
TOTAL	2442.0	808.0	1634.0

Alberta Energy Company Ltd. conducted a fixed-wing aeromagnetic survey over the Buffalo Head Hills in 1995. The survey identified 'dominant features' defined by several shallow, long-wavelength, high-frequency anomalies that also corresponded to very strong diffractions in the seismic profiles (Rob Pryde, personal communication, 1998; Carlson et al., 1998). In October 1996, an option agreement was signed by Ashton Mining of Canada Inc., Alberta Energy Company Ltd., and Pure Gold Minerals Inc. to investigate these anomalies.

In January 1997, Ashton Mining of Canada Inc. announced a drill program to test ten isolated geophysical anomalies in the Buffalo Head Hills area, approximately 35-45 km northwest of Red Earth Creek. The initial two drillholes, located on anomalies identified as 7B and 7C, penetrated "olivine-dominated fragmental and tuffaceous material" underlying glacial overburden at depths of 34.0 m and 36.6 m, respectively. The rock types were interpreted by Ashton to represent pipes (diatremes) that intruded from the basement through a thick column of overlying younger sedimentary rocks to the preglacial surface (Ashton Mining of Canada Inc., 1997a). Petrographic studies of core from K7B and K7C confirmed that the drillholes intersected kimberlites and identified indicator minerals such as chromite, eclogitic garnets, and peridotitic garnets (Ashton Mining of Canada Inc., 1997b). By March 1997, a total of 11 kimberlites within a 100 km^2 area had been discovered, 10 by drilling and one by bulldozer, including kimberlites K2, K4A, K4B, K4C, K5A, K5B, K6, K7A, K7B, K7C, and K14 (News release, 1997C). The first microdiamond analyses of samples collected from kimberlites K2, K4, and K14 were released in April 1997 and confirmed that the pipes are diamondiferous; more significantly, three samples totalling 152.5 kg from kimberlite K14 yielded significant numbers of diamonds, including 139 microdiamonds and 11 macrodiamonds (Ashton Mining of Canada Inc., 1997d). Geochemical analysis of kimberlite-indicator minerals from K2, K4, and K14 yielded G10 pyrope garnets and abundant chromites, with chromium and aluminium plotting in the diamond-inclusion field. These results, and ensuing headlines such as "Ashton Pulls Diamonds From Property in Alberta" (Northern Miner, 1997a), "Ashton, Pure Gold Find More Diamonds in Alberta" (Northern Miner, 1997b), "Forget Oil; Diamonds New Lure" (Calgary Herald, 1998), and "Alberta Has 'Tremendous Potential' for Diamonds" (Edmonton Journal, 1998), indicated that a new chapter in the history of the resource potential of Alberta was about to be written.

4.2.2 General Kimberlite Geology

The geological information in this section is credited to Carlson et al. (1998, 1999), who made public the first geoscientific information on the Buffalo Head Hills kimberlite province at the 7th International Kimberlite Conference, held in 1998 in Cape Town, South Africa.

To March 1, 2000, a total of 32 kimberlite pipes has been reported (Figure 1). Inferred sizes of the pipes, based on aeromagnetic signatures and drilling, range from less than 1 ha to approximately 45 ha. U-Pb perovskite dates of 86 ∀ 3 Ma and 88 ∀ 5 Ma on the pipes indicate that they were emplaced within sedimentary rocks of the Middle to Late Cretaceous (Cenomanian to Campanian) Smoky Group, Dunvegan Formation and, possibly, Shaftesbury Formation of the Western Canada Sedimentary Basin (WCSB; Table 2). These rocks, which form a sequence of alternating marine and nonmarine sandstone and shale, have limited exposure along the northern and eastern flanks of the Buffalo Head Hills, and are largely covered southeast of the Buffalo Head Hills by unconsolidated glacial deposits of variable thickness. While some of the pipes crop out or form topographic highs up to 60 m above the surrounding terrain, most are covered by variable thicknesses (up to 127 m) of fine- to coarse-grained glacial sediments.

Table 2. Table of Cretaceous formations, Peerless Lake area, north-central Alberta

ERA	SYSTEM	PEERLESS LAKE AREA		
MESOZOIC	CRETACEOUS		Wapiti	
MESOZOIC	CRETACEOUS	*SMOKY GROUP*	Puskwaskau	
MESOZOIC	CRETACEOUS	*SMOKY GROUP*	Bad Heart	
MESOZOIC	CRETACEOUS	*SMOKY GROUP*	Kaskapau	
MESOZOIC	CRETACEOUS		Dunvegan	
MESOZOIC	CRETACEOUS	*FORT ST. JOHN GROUP*	Shaftesbury	Belle Fourche
MESOZOIC	CRETACEOUS	*FORT ST. JOHN GROUP*	Shaftesbury	Fish Scales
MESOZOIC	CRETACEOUS	*FORT ST. JOHN GROUP*	Shaftesbury	Westgate
MESOZOIC	CRETACEOUS	*FORT ST. JOHN GROUP*	Peace River	Paddy/Cadotte
MESOZOIC	CRETACEOUS	*FORT ST. JOHN GROUP*	Peace River	Harmon
MESOZOIC	CRETACEOUS	*FORT ST. JOHN GROUP*	Spirit River	
MESOZOIC	CRETACEOUS	*BULLHEAD*	Bluesky/Gething	
PALEOZOIC	DEVONIAN — UPPER DEVONIAN		Wabamun	
PALEOZOIC	DEVONIAN — UPPER DEVONIAN			Graminia Silt
PALEOZOIC	DEVONIAN — UPPER DEVONIAN	*WINTERBURN GP*	Graminia	Blueridge
PALEOZOIC	DEVONIAN — UPPER DEVONIAN	*WINTERBURN GP*	Calmar	
PALEOZOIC	DEVONIAN — UPPER DEVONIAN	*WINTERBURN GP*	Nisku	

Preliminary petrographic examination of the kimberlites indicates that the pyroclastic-crater facies consists mainly of lapilli-bearing olivine crystal tuff, which is stratigraphically dominated by normally graded beds of coarse ash to coarse crystal tuff. Juvenile lapilli-rich beds have also been observed. Spherical or amoeboid lapilli, ovoid olivine macrocrysts up to 1 cm in length, and occasional mica laths up to 5 mm in length occur in a groundmass that generally consists of a fine-grained, sometimes segregational assemblage of serpentine, dolomite, calcite, and chlorite. Mica microphenocrysts show evolution from phlogopite toward aluminous phlogopite, and plot along Mitchell's (1995) kimberlite trend for Al_2O_3 versus TiO_2. Spinel microphenocrysts appear to exhibit magmatic trend 1, the compositional trend associated with Group I kimberlites (Mitchell, 1995).

Crustal xenoliths are typically shale of the Shaftesbury Formation, including blocky shale, shale with fish scales, and silty shale, which may represent Shaftesbury subformations defined as the Westgate, Fish Scales, and Belle Fourche, respectively. The mantle-derived xenolith population includes peridotitic (lherzolite, wehrlite, and harzburgite), pyroxenitic, eclogitic, and corundum-spinel-bearing rock types. Mantle xenolith textures vary from coarse granular, through coarse tabular and porphyroclastic sheared, to much rarer fluidal styles.

Kimberlite indicator minerals derived from mantle peridotite and pyroxenite include olivine, chrome pyrope, calcic knorringite, chrome diopside and augite, enstatite, and various chrome spinels (principally aluminous magnesium chromite). Kimberlites in the northern part of the Buffalo Head Hills Kimberlite Province contain subcalcic (G10) garnets with chromium contents of up to 17.8 weight per cent (wt %) Cr_2O_3, while the southern pipes contain only rare G10s. Aluminous magnesium chromites generally yield between 30 and 62 wt % Cr_2O_3, and the number of grains with diamond-inclusion chemistry is highly variable from one pipe to the next.

4.2.3 Preliminary Diamond Evaluation

To March 1, 2000, 18 kimberlites (out of 32) have been determined to be diamondiferous and, of these, five with higher microdiamond counts, including K5, K6, K11, K14, and K91, have been mini-bulk sampled (Ashton Mining of Canada Inc., 1998a, 1999a, b). The exploration, geochemical analysis, and reserve calculation of a kimberlite pipe are a lengthy process, hence publicly available information about the diamond quality are not yet available. Ashton's kimberlite evaluation sequence, as inferred from sequential news releases, involves the processing of

- 40-100 kg trench and core samples for microdiamond and macrodiamond counts;
- 1-19 tonne (t) mini-bulk samples of pit, drill-core, and reverse-circulation (RC) drill samples for diamonds greater than 0.8 mm in diameter and reserve estimates by carats per hundred tonnes (cpht);
- bulk sampling to recover approximately 450 t for diamond grade, quality, and consistency measurements.

Ashton's preliminary evaluation of selected pipes is in Tables 3 and 4, and highlights include:
- Microdiamond and macrodiamond counts
    - K5A yielded 43 microdiamonds from four samples totalling 196.9 kg.
    - K5B yielded 31 microdiamonds and one macrodiamond from two samples totalling 103.9 kg.
    - K6 yielded 53 microdiamonds and five macrodiamonds from 64 samples totalling 321.5 kg.
    - K11 yielded 106 microdiamonds and 14 macrodiamonds from two samples totalling 189.5 kg.
    - K14 complex yielded 667 microdiamonds and 107 macrodiamonds from eight samples totalling 371.1 kg, including one 89.0 kg sample that yielded 422 microdiamonds and 93 macrodiamonds.
    - K91 yielded 180 microdiamonds and 12 macrodiamonds from three samples totalling 117.0 kg.

- Mini-bulk sampling
  - K6 yielded a diamond content of 15.5 cpht from a 5.17 t drill-core sample.
  - K11 yielded a diamond content of 4.41 cpht from four RC holes totalling 18.68 t.
  - The average diamond content from RC drilling, pit, and drill-core samples from K14, K14B, and K14C ranges from 2 cpht to 43 cpht. RC (8.17 t) and drill-core (3.33 t) samples yielded diamond contents of 36 cpht and 43 cpht, respectively.
  - K91 yielded a high variability in diamond content between holes, with an indicated diamond content of 136 cpht from hole K91-1 and an average indicated content from all four core holes of 35 cpht.

- Bulk sampling:
  - A 479 t bulk sample from K14 yielded a total of 56.45 carats of diamonds, or an effective grade of 11.78 cpht. Most of the diamonds are clear or greyish in colour, with minor amounts of pale brown and rare yellow stones, and the two largest diamonds weigh 0.90 and 0.88 carats.

- Selected Diamonds:
  - A clear yellow stone weighing 0.76 carats was recovered from K6, indicating potential for commercial-size “fancy” stones in this kimberlite.
  - The largest diamonds recovered from K14 weigh 1.31, 0.60, 0.32, 0.30, 0.28, 0.21, and 0.18 carats; the 1.31 carat diamond is silver-grey.
  - K91 yielded stones weighing 0.13, 0.14, 0.41, and 0.45 carats.

The Buffalo Head Hills kimberlite province may have the potential to host economic diamond deposits due to 1) the large size of these kimberlites (up to 45 ha.), 2) minimal overburden (some pipes are outcropping), 3) readily accessible infrastructure from oil and gas development in the Red Earth Creek area, 4) broadly favourable indicator-mineral chemistry, and 5) the presence of diamonds in many of the pipes.

Table 3. Initial sample analyses from 32 kimberlites discovered in the Buffalo Head Hills area

Kimberlite	Size of geophysical anomaly(m)	Depth of overburden (m)	Number of samples	Total dry weight (kg)	Micro-diamonds (<0.05mm)	Macro-diamonds (>0.05mm)
K1A	350x240	30	3	135.2	1	0
K1B	320x180	18	2	88.1	1	2
K2	200x500	2.0	2	180.9	3	0
K3	650x500	29.0	2	180.2	0	0
K4A	250x300	24.7	4	194.7	2	1
K4B	350x400	8.5	4	197.3	4	0
K4C	200x250	43.9	5	299.9	0	0
K5A*	600x600	14.3	4	196.9	43	0
K5B*	150x450	50.3	2	103.9	31	1
K6	450x600	13.0	6	321.5	53	5
K7A	200x200	69.0	2	113.9	0	0
K7B	200x350	34.7	2	101.4	1	0
K7C	150x150	37.0	1	51.8	0	0
K10	150x150	127.0	2	99.1	4	0
K11	500x250	13.4	4	189.5	106	14
K14A**	K14 complex 300x200	7.0	4	204.1	190	12
K14B**			2	78.0	55	2
K14C**			2	89.0	422	93
K15	600x200	42.7	1	n/a	0	0
K19	200x100	5	1	51.3	0	0
K32	100x150	90.0	1	n/a	1	0
K91	400x100	14.0	3	117.0	180	12
K92	450x200	80.0	2	89.9	2	1
K93	350x150	79.0	1	n/a	0	0
K95	200x200	26.0	3	118.3	1	0
BH155	150x100	34.0	2	275.0	32	0
BH225	125x100	30.0	2	96.4	67	5

Table 3. Initial sample analyses from 32 kimberlites discovered in the Buffalo Head Hills area

Kimberlite	Size of geophysical anomaly(m)	Depth of overburden (m)	Number of samples	Total dry weight (kg)	Micro-diamonds (<0.05mm)	Macro-diamonds (>0.05mm)
BH229	n/a	74	n/a	n/a	n/a	n/a
BH230	n/a	39	2	176.4	1	0
LL07	n/a	114	1	26.2	0	0
LL08	n/a	n/a	n/a	n/a	n/a	n/a
BM2	n/a	n/a	n/a	n/a	n/a	n/a
BM3	n/a	n/a	n/a	n/a	n/a	n/a
BM16	n/a	124	n/a	n/a	n/a	n/a
WP	150x100	30.0	1	89.0	2	2

* K5 complex
** K14 complex
n/a not available

Table 4. Initial mini-bulk sample results (1997-98) from K5, K6, K11, K14A, K14B, K14C and K91

Kimberlite	Sampling method	Total dry weight (tonnes)	Stones >0.8mm (carats)	Carats/100 t (for stones >0.8 mm)	Largest diamond(s) (carats)
K5	Core	3.55	0	0	
K5	Pit	4.0	0.027	n/a	n/a
K6	RC	4.13	0.005	0.1	n/a
K6	Pit	4.65	0.067	1.4	n/a
K6	core	5.17	0.804	15.5	0.76
K11	4 RC holes	18.68	0.82	4.41	0.095, 0.094
K14A	RC	8.17	2.99	36	1.31
K14A	Pit	19.25	1.87	10	0.32
K14A	Core	4.38	0.94	21	n/a
K14B	Pit	7.03	0.51	7	n/a
K14B	Core	3.33	1.42	43	n/a
K14C	Core	2.71	0.06	2	0.0615
K91	Core	0.85	0.301	35.4	0.13, 0.14
K91	RC	17.48	1.77	10.1	n/a
K91	Core	2.47	0.378	15.3	0.41, 0.45
K91	Core	1.54	0.178	11.6	n/a
K91	RC	13.30	2.194	16.5	n/a
K91	RC	1.08	0.041	3.8	n/a

Bulk sample results (1998) from K-14.

K14	R/C	479	56.45	11.78	0.90, 0.88

4.3 Metallic Minerals

A provincial-scale metallogenic compilation by the Alberta Geological Survey (Olson et al., 1994) shows that there has been little or no documented metallic minerals exploration in the Peerless Lake map area. Only two occurrences of mineralization have been reported (Figure 4):

- **84B-1 (Zn):** Located in the northwestern corner of the map area east of Otter Lakes; Dubord (1987) noted the likely occurrence of sphalerite in drill cuttings from Loon River Well No. 4-23-89-12W5.
- **84C-1 (Cu):** In 1969, a 1110 m hole was drilled about 14 km north-northeast of Little Buffalo Lake to test for oil and gas; when pulled it was found to contain several pieces of native copper (Matheson, 1969). The pieces, up to 5 by 2.5 by 1.5 cm thick, assayed up to 99.15% Cu, with traces of Co, Fe, Ni, Pb, and S. A follow-up side wall coring program failed to locate additional mineralization.

4.4 Aggregate Sand and Gravel

Reconnaissance-level sand and gravel studies were completed in the Peerless Lake area by the Alberta Geological Survey to provide information on the distribution and characteristics of the resource (Scafe and Sham, 1986; Scafe et al., 1987). Sand and gravel in this area are distributed unevenly and are of variable quality (Figure 4).

Glaciofluvial deposits are the most widespread within the Peerless Lake area and are the major source of sand and gravel. Major glaciofluvial kame and esker features, in the southwest corner of the map area (at Whitefish Tower), are primary sources of aggregate material. Kame, esker, and meltwater channels occur in the northwest corner of the area, scattered throughout the eastern part, and concentrated along a line through Range 6 from Township 87 to 91. Meltwater channels and outwash deposits in the southeastern part of the area are potential sources of aggregate. A glaciolacustrine beach deposit of dirty, oxidized, gravelly sand lies north of an unnamed lake southeast of Kidney Lake. Recent sediments have little promise for aggregate exploitation.

Scafe and Sham (1986), noted that high-quality, quartzite-rich, preglacial sand and gravel deposits are commonly present at elevations greater than 1000 m south of the Peerless Lake map area near Marten Mountain Tower and Pelican Tower. A deposit of preglacial sand and gravel was discovered during this study on the southeast flank of the Buffalo Head Hills (Figure 4, sample site RE98-84B-164).

5 Geology

5.1 Introduction

The crystalline basement in the Peerless Lake area is composed dominantly of Proterozoic rocks formed between 2.32 and 2.9 Ga (Villeneuve et al., 1993) and has been documented by several authors including Burwash and Power (1990), Ross (1990), Ross et al. (1991), and Burwash et al. (1993, 1994). For a regional synthesis of the geological and structural history of the Peace River Arch the reader is referred to Cant (1988), O’Connell et al. (1990), and O’Connell (1994). These papers are discussed with respect to the Peerless Lake area by Eccles et al. (2000), which developed a structural emplacement model for the Buffalo Head Hills kimberlites.

Bedrock in the Peerless Lake map area is almost entirely covered by unconsolidated glacial deposits of variable thickness. Ceroici (1979) reported that the surficial deposits vary in thickness from less than 15 m to greater than 244 m in paleochannels. Bedrock exposure is predominantly limited to several sections along the Wabasca River, but at least two bedrock sections may be exposed along the southeast flanks of

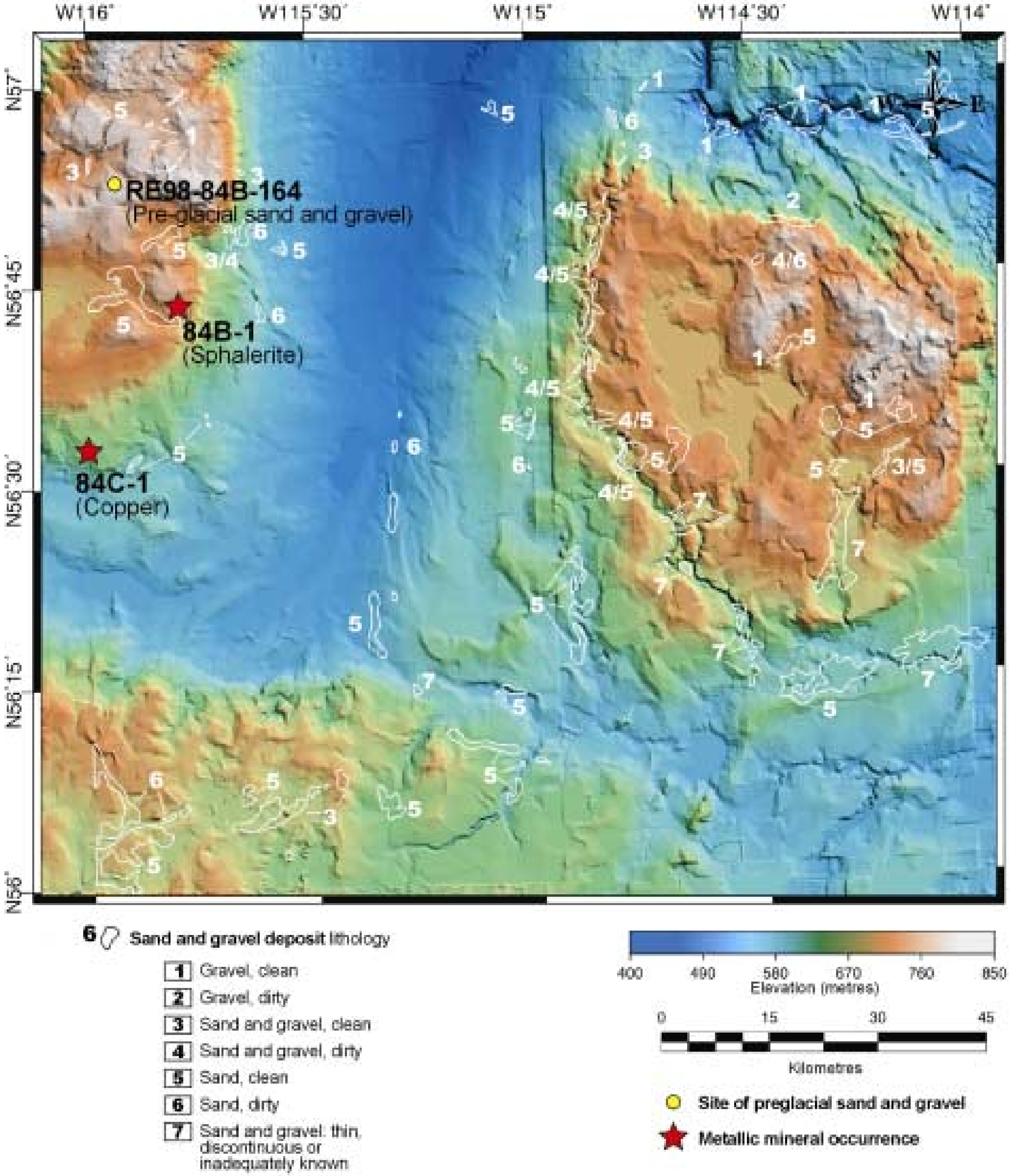


Figure 4. Location of sand and gravel deposits (Scafe and Sham, 1986; Scafe *et al*., 1987), and two metallic mineral occurrences (Olson *et al*., 1994) in the Peerless Lake area.

the Buffalo Head Hills in the northwest corner of the map area and are further discussed in Section 5.2. Green and Mellon (1970) correlated the geology from nearby bedrock sections with drill cores, and concluded that the Peerless Lake map area is underlain directly by nearly flat-lying sandstone and mudstone formations of Cretaceous age (Figure 5). The Cretaceous rocks (Table 2), which range in age from Albian (Shaftesbury Formation) to Campanian (Puskwaskau Formation), form a sequence of alternating marine and nonmarine sandstone and shale. Brief lithological descriptions of the Cretaceous units that are expected to underlie the surficial deposits are presented below.

Shaftesbury Formation: The oldest rocks, which are exposed on the banks of the Wabasca River, are Lower to mid-Cretaceous marine shale of the Albian Shaftesbury Formation. The Shaftesbury Formation has been subdivided into the Westgate, Fish Scales, and Belle Fourche subformations (Bloch et al., 1993), and consists of dark grey marine shale in the base of the section, bone beds and abundant fish scales in the Fish Scales subformation, and shale with an increasing percentage of laminated siltstone interbeds toward the top of the section.

Dunvegan Formation: The Upper Cretaceous (Cenomanian) Dunvegan Formation forms a wedge of carbonaceous, medium- to coarse-grained, cross-bedded sandstone with interbedded siltstone and mudstone interpreted to represent a stacked series of deltaic depositional systems (Battacharya and Walker, 1991). Ceroici (1979) reported that the Dunvegan occurs as a thin (<15 m) sandstone and is found primarily in the western part of the map area.

Smoky Group: The Smoky Group in the Peace River area (west of the map area) consists of the 1) Cenomanian to Turonian shallow-marine sandstone Kaskapau Formation; 2) Turonian to Coniacian Cardium Formation, known for its vast petroleum reserves in the Pembina field; 3) Middle to Late Coniacian Muskiki Formation mudstone; 4) Coniacian Bad Heart Formation, which separates the Kaskapau and Puskwaskau mudstones, and comprises a thin mappable unit consisting of oolitic ironstone; and 5) Santonian to Early Campanian Puskwaskau Formation, which comprises commonly silty, dark grey mudstone and lesser calcareous mudstone of marine origin.

5.2 Wapiti Formation Bedrock Discovery

Green and Mellon (1970) did not map the Upper Cretaceous Wapiti Formation, also known as the Brazeau Formation, in the Peerless Lake area. The Wapiti Formation is found mainly on the topographic highs of the plains region to the west (e.g., Clear Hills and near the margin of the folded belt) and to the south-southeast (e.g., Pelican Mountains) of the Peerless Lake area. In western Alberta, the lower Wapiti Formation lies stratigraphically above the Puskwaskau Formation and is composed of light grey, fine-grained, argillaceous, carbonaceous sandstone with interbedded siltstone, silty mudstone, and thin layers of coal and bentonite, and is locally conglomeratic. Interestingly, the siltstone and silty mudstone of the Wapiti Formation are invariably smectitic in nature and host the 69 Ma Mountain Lake diatreme (Wood et al., 1998).

Two small sections of possible bedrock were located during the reconnaissance program in the northwest corner of the map area, south of Sawn Lake (sample RE98-84B-165; UTM: 564559E, 6301509N, Zone 11) and near the Little Cadotte River (sample RE98-84B-166; UTM: 562657E, 6308807N, Zone 11), respectively (Figure 5). The rocks, which are in contact with overlying basal till, comprise brown to brownish grey, bioturbated, blocky, silty shale with layers of brown, rusty sandstone. The limited exposure makes it almost impossible to discern the geological rock unit by physical, field examination. Palynological assemblages from one section clearly suggest a Late Cretaceous age. The sample contains a

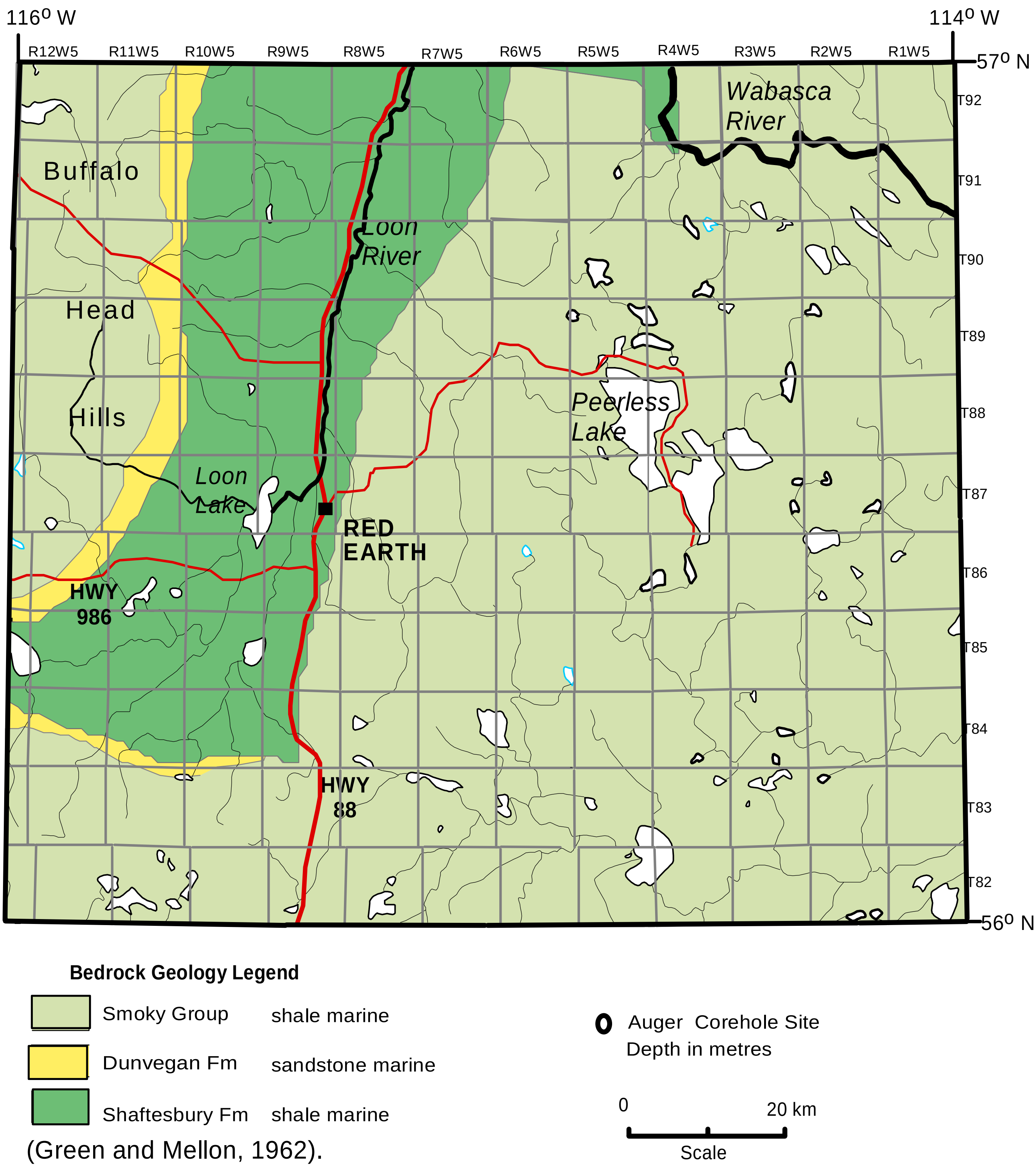


Figure 5. Bedrock geology of the Peerless Lake area.

rich and diverse pollen flora and a few dinoflagellates (Appendix 1). The many angiosperm species present indicate an Early Maastrichtian age, which is age equivalent to the Wapiti Formation. Since it is hard to imagine Wapiti Formation rocks being glacially 'rafted' to this location, the small sections are likely bedrock outcrop, especially since there are no indications of Wapiti Formation rocks north and northeast of the Peerless Lake area in the 'up-ice' glacial direction. However, further examination or coring is recommended to prove that the silty shale exposure is both in place and equivalent to the Wapiti Formation.

6 Surficial Geology

6.1 Introduction

The last ice sheets that covered north-central Alberta left a clear record of their presence and movement in the form of erosional and depositional landforms, and through deposition of glacial sediments. The Quaternary glacial deposits in Alberta are primarily Late Wisconsinan in age and were deposited by the Laurentide Continental and Cordilleran ice sheets between 18 000 and 9000 years ago (Fulton, 1989). Only the Laurentide Ice Sheet glacially modified the Peerless Lake map area, which is situated well east of the maximum eastern extension of the Cordilleran Ice Sheet. Modification by continental ice and post-glacial processes left extensive erosional features and depositional landforms throughout the Peerless Lake area, including glaciolacustrine, glaciofluvial, morainal, lacustrine, fluvial, eolian, and organic sediments (Figure 6; Gravenor and Bayrock, 1961; Fulton, 1995). Multiple Quaternary glaciations, interglaciations, and interstadials have resulted in a complex stratigraphic sequence of glacial and nonglacial sediments of different ages over the Alberta Interior Plains (Andriashek and Fenton, 1989; Barendregt et al., 1991). Seven auger holes drilled in the Red Earth Creek area during a recent till study by the Alberta Geological Survey showed the complexity of the glacial depositional system and numerous alternating layers of morainal, glaciofluvial, and glaciolacustrine deposits (Figure 7; Pawlowicz et al., 1998, 1999).

Most of the surficial deposits in northern Alberta have not been systematically mapped, so the type and thickness of the glacial and other surficial units are either unknown or poorly known. Previous work on the surficial geology of the Peerless Lake map area comprises a hydrogeology study completed by Ceroici (1979) and a preliminary airphoto interpretation map by Andriashek (1985). More recently, an airphoto interpretation was completed using 1:40 000 (1989) and 1:60 000 (1984) scale photographs (Balzer, 1998), to assist with sampling strategies for the current geochemical study. A ground-truth survey is currently being conducted by the Alberta Geological Survey, and a surficial geology map for the Peerless Lake area will be released in 2000 (Fenton et al., in preparation).

Since knowledge of the characteristics of the glacial deposits are crucial for heavy-mineral sampling, the observations from Ceroici (1979), Andriashek (1985), and Balzer (1998), and from fieldwork during the current study are summarized below.

6.2 Glacial Landscapes

The Peerless Lake map area consists of three broad highland uplands, including the Peerless Uplands, Birch Mountains, and Buffalo Head Hills. The landforms in the upland regions consist primarily of ground and hummocky disintegration moraine of variable relief, which encompass a wide range of irregular knobs of glacial sediment, resulting from ice stagnation and ablation. A series of parallel arcuate ridges in the northeast corner of the map area near Trout Mountain may represent an ice-thrusted, northwest-trending moraine.

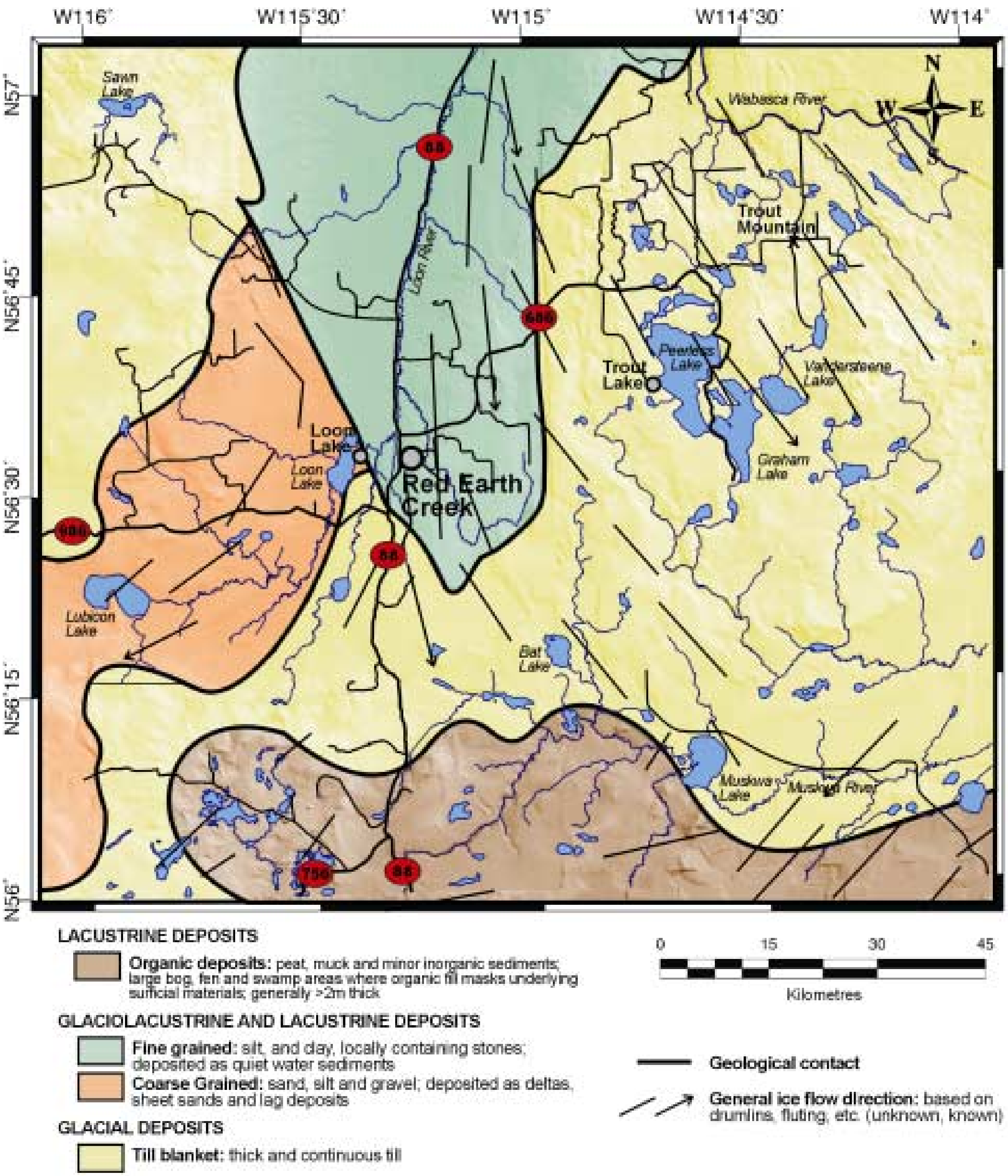


Figure 6. Surficial geology of the Peerless Lake area (Fulton, 1995).

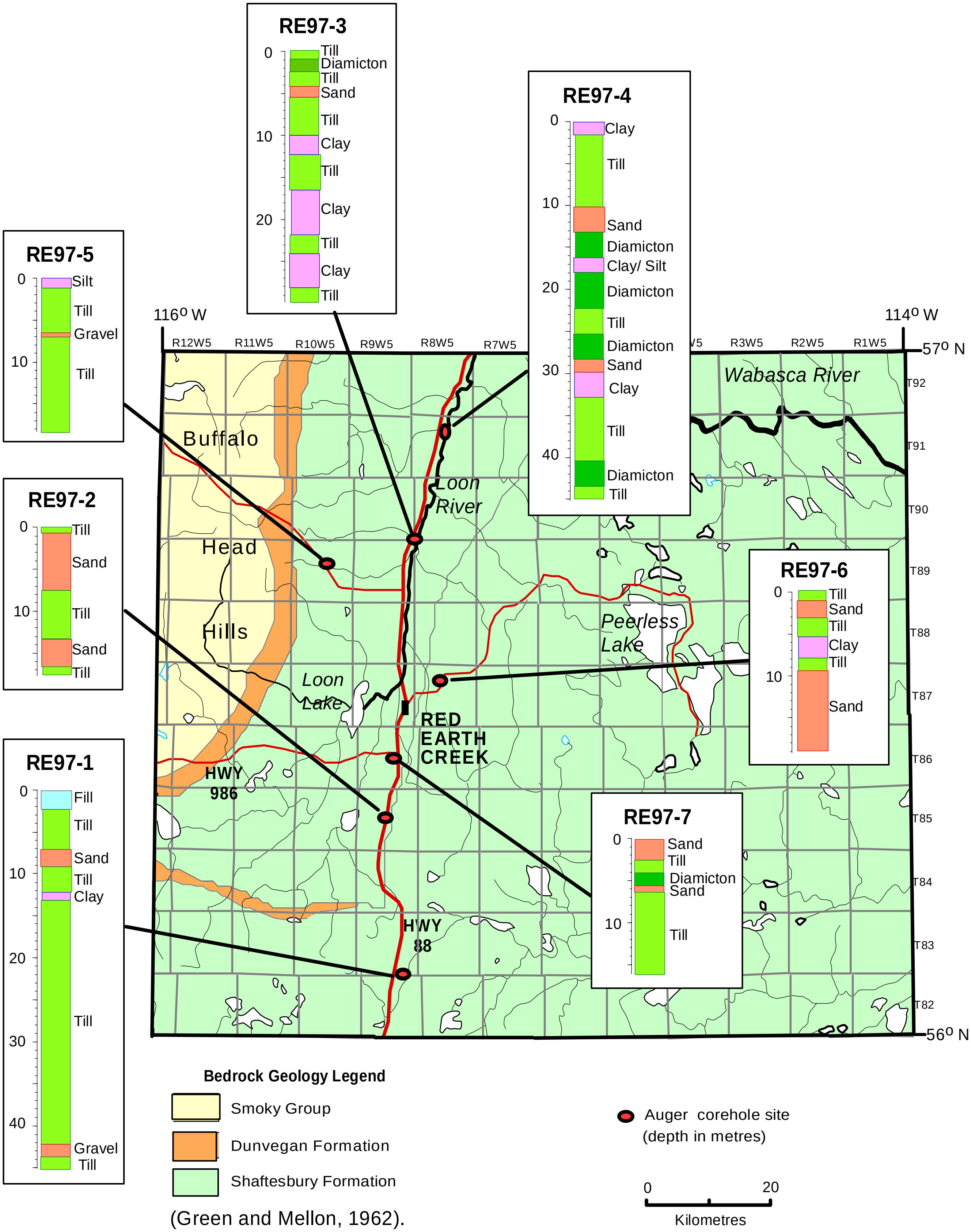


Figure 7. Auger core lithologs in the Peerless Lake area (Pawlowicz et al., 1999).

The upland regions, and particularly the Buffalo Head Hills, are separated by a broad, low-relief area, known as the Loon River lowlands. Low-relief hummocky terrain and ridges with extensive local ponding and organic deposits characterize the Loon River lowlands. Lakes within the streamlined regions show distinct elongation parallel to ice flow. Lineations, including flutes and grooves, occur transverse or parallel to ice flow and are most visible in the central and southeastern parts of the map area.

In places, glaciofluvial sand and gravel form conspicuous braided esker complexes and outwash plains. Several of the esker complexes have been reworked into strandlines by postglacial and Recent lacustrine processes. In the southwestern corner of the Peerless Lake map area, strandlines and extensive dune fields are formed by the modification of outwash plains by lacustrine and eolian processes.

6.3 Drift Thickness

The thickness of surficial deposits in the Peerless Lake map area varies widely, from less than 15 m to more than 244 m in the paleochannels (Ceroici, 1979). At the provincial scale, Pawlowicz and Fenton (1995a, b) showed that the areas of thickest drift (>150 m thick) follow major paleochannel thalwegs: 1) the Wabasca-Loon River (Loon River lowlands) paleovalley; 2) a northwest-trending Muskwa River paleovalley in the southern portion of the map area; and 3) the area east of Peerless Lake (Figure 8). Figure 8 also shows drift thicknesses from selected groundwater wells and petroleum wells in the map area. Drift thickness and bedrock topography will continue to be redefined, as new information becomes available from various private and government agencies. For example, the Alberta Geological Survey is conducting a study to determine the bedrock topography and drift thickness in the Peerless Lake area (Pawlowicz and Fenton, in press [a, b]).

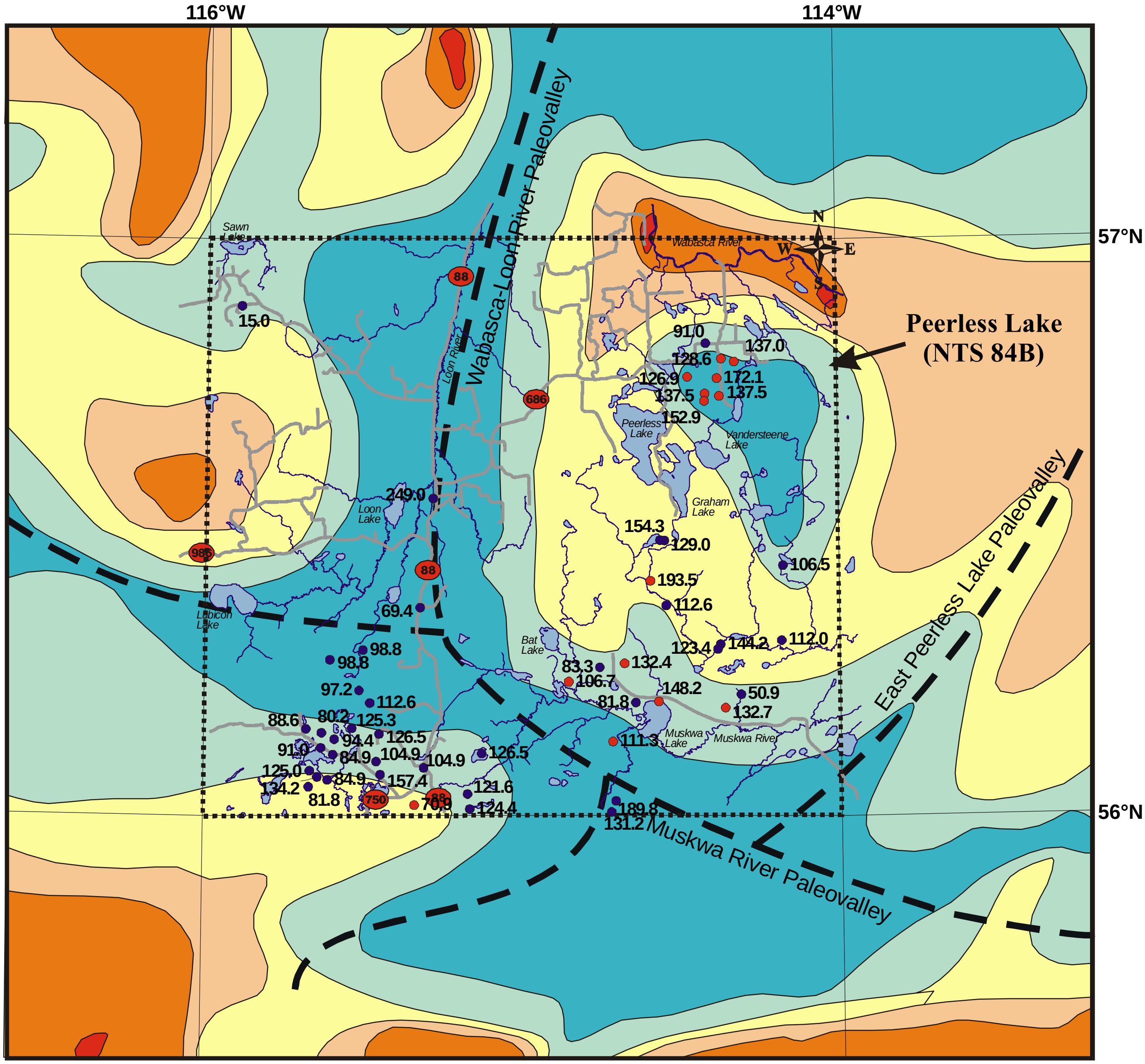
6.4 Ice Movement

Laurentide glacial ice-flow directions in Alberta were dominantly to the southwest, as evidenced by the distribution and orientation of erratics, drumlins, and flutes (Rutherford, 1928; Gravenor and Bayrock, 1955; Gravenor and Meneley, 1958; Gravenor and Bayrock, 1961; Shilts et al., 1979; Shetsen, 1987, 1990; Dyke and Prest, 1987a, b; Rains et al., 1993). In northern Alberta, however, major physiographic features also influenced the flow of ice. For example, southerly ice-movement direction occurs where ice was ‘channelled’ by major upland areas (Swan Hills, Buffalo Head Hills, Clear Hills, Naylor Hills, Mount Watt, and the Birch and Caribou Mountains) and in regions containing major lowland valleys (Peace River, Athabasca, and Wabasca-Loon River drainage systems).

In the Peerless Lake area, ice-flow directions change from mainly southerly, to southwest to southeast (Figure 6). That is, the ice was forced to flow predominantly south in the north and central parts of the map area due to the influence of the Buffalo Head Hills, Peerless Uplands, and Loon River lowlands. The ice flow appears to have split in the south part of the map area, possibly following the southern contours of the Buffalo Head Hills and Peerless Uplands, by veering southwest between Loon Lake and Lubicon Lake, and southeast near Bat Lake. Finally, other observations include the following: 1) glacial flutings, such as those in the southeast corner of the-area, suggest that ice movement was to the southwest; 2) on the west side of the Buffalo Head Hills and west half of the map area, flutes and grooves indicate a south-southeast flow; and 3) south to southeast orientated flute patterns wrap around Trout Mountain and join the dominant pattern of southwesterly ice-flow indicators south of the mountain.

6.5 Glacial Deposits

Surficial deposits of glacial origin in the Peerless Lake map area include glaciofluvial, glaciolacustrine, and glacial sediments. Ablation, englacial, and basal glacial deposits of variable thickness and topographic relief dominate the area. The three upland areas are characterized by hummocky till plains,



Contour Interval

- **0 m** (bedrock exposed)
- **>0 to 15 m**
- **>15 to 45 m**
- **>45 to 90 m**
- **>90 to 150 m**
- **>150 m**

0 25 50
Kilometres

Thalweg (from Pawlowicz and Fenton,1995a)
132.4 **Hydrogeological well site with a defined drift thickness (m)**
111.3 **Petroleum well site with a defined drift thickness (m)**

Figure 8. Drift thickness map of the Peerless Lake area (modified after Pawlowicz and Fenton, 1995b), with selected hydrogeological and petroleum well-site drift thickness measurements.

which are predominantly supraglacial in origin and consist of till that is often interbedded with local patches of organic deposits and fine- to coarse-grained glaciolacustrine deposits. The till plain is characteristic of the central, Loon River lowland, and consists of fine-grained, loamy- to clayey silt till that is mottled dark olive-brown (occasionally dark grey), often oxidized and slightly to strongly calcareous. The till is stony, containing clasts, of variable size and abundance, of igneous rocks, quartzite, limestone, black shale, and sandstone. The base of one individual till unit was observed along the Red Earth Creek airport road, and was locally marked by a granite boulder pavement or planar concentration of faceted, striated boulders.

Poorly sorted, coarse-grained silt, sand, and gravel deposits of glaciofluvial origin are widespread, but thickest in the southwest corner of the map area. The deposits, which include outwash plains, kames, kame moraines, and eskers, are often interbedded with fine-grained clay material that may be a mixture of till or lacustrine sediments. Ice-contact glaciofluvial features adjacent to the larger lakes have been reworked into strandlines and other beach-like deposits. Organic sediments of variable extent and thickness cover many of the outwash plains.

Glaciolacustrine clay, silt, and sand cover the lowland areas, such as the Loon River lowland and the southeastern part of the map area. The clay is often oxidized, orange-brown in colour, and varies greatly in thickness. Local lenses of clay are found within till throughout the map area (Figure 7). Strandlines on several larger lakes, such as Loon and Lubicon lakes, indicate former lake levels attributed to postglacial and Recent lacustrine processes.

6.6 Postglacial Deposits

Postglacial deposits of variable extent and thickness are present throughout the Peerless Lake region and include deposits of eolian, organic, fluvial, and lacustrine origin. Eolian deposits, in the form of parabolic to sinuous dunes, are located mainly in the west-central and southwestern parts of the map area. They consist mainly of reworked sand and silt that are likely eroded from glaciofluvial deposits.

Numerous bogs and fens cover the central part of the Peerless Lake. In places where the organic cover is greater than 2 m thick, the organics completely mask the underlying sediments. Organic sediments often ’blanket’ fluvial channels, depressions or other low-lying regions.

Alluvial sediments are present along major rivers and streams, and are often mixed with variable amounts of organic deposits. Comprising primarily silt and clay with minor sand, the fluvial deposits form floodplains and small channel bars. Colluvium is typically concentrated along the valley wall(s).

Lacustrine sediments occur primarily adjacent to current and former lakes. Exposed strandlines and beach deposits mark former shoreline levels. Lacustrine sediment deposition occurs mainly during spring run-off.

7 Sampling Methodology

Sampling was completed during the summer and fall of 1998. A mobile camp was used to target specific ‘corners’ of the 1:250 000 map area. Camps were based at Wabasca, Peerless Lake, Red Earth Creek, and at the Artisinn campsites (directly east of Highway 88 near the southern border of the map area). Most samples were collected in or near vehicle-accessible areas. Approximately 6 days of helicopter time were used to collect samples in areas that were not accessible by road. In total, 184 samples was collected from 171 sample sites. The geochemical survey targeted a variety of sampling media (Figure 9):

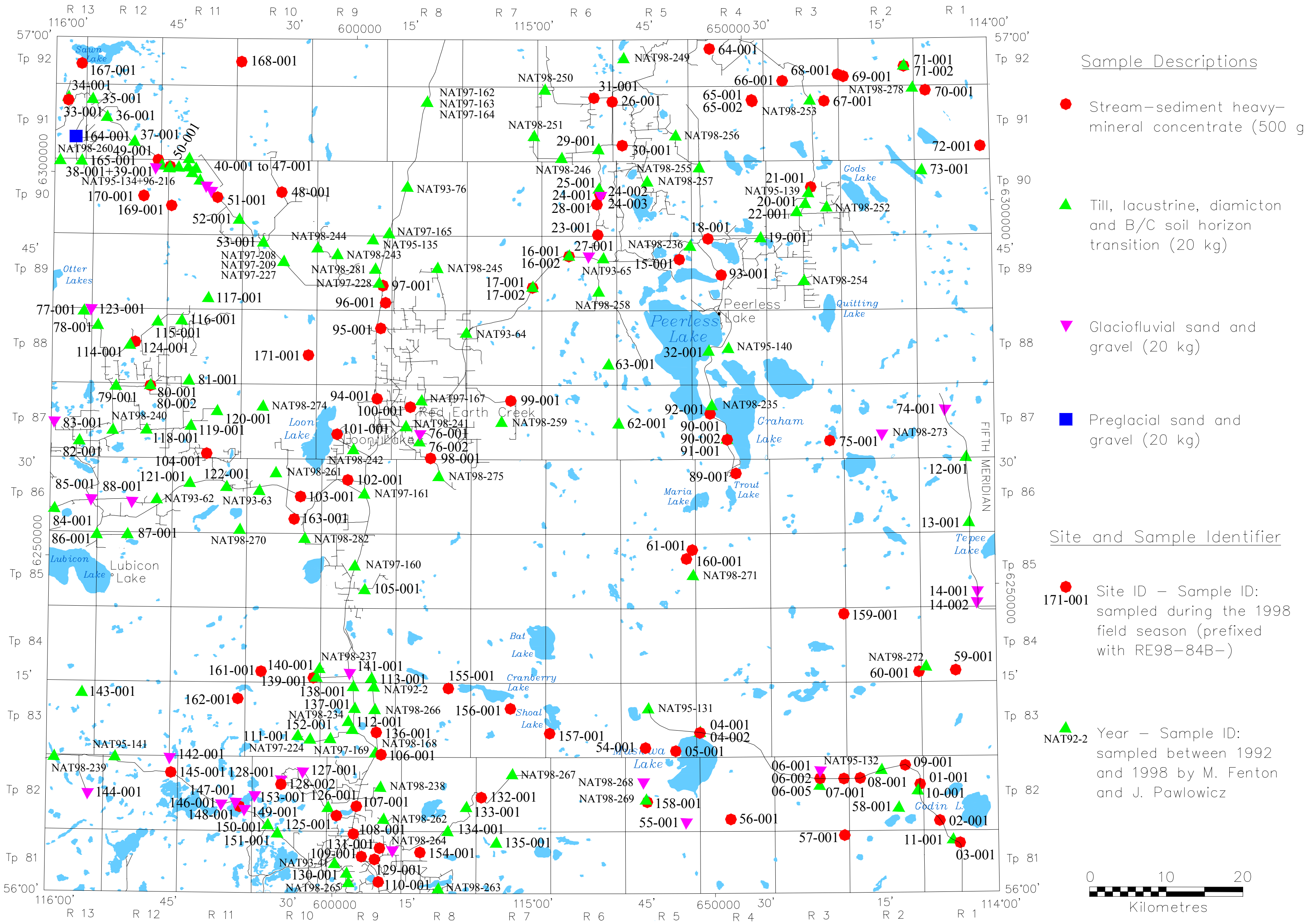


Figure 9. Location of stream sediment, till and glaciofluvial samples.

- 70 glacial-deposit samples, including good till, till, lacustrine, diamicton, and B/C soil horizon transition material
- 25 glaciofluvial samples, or sand and gravel
- one preglacial sand and gravel
- 88 stream-sediment heavy-mineral concentrate (HMC) samples

A variety of sampling media was collected to determine which would be most effective for the recovery of indicator-mineral grains and would display the largest indicator trains. The purpose of the study was to report on the results obtained, in an area with known kimberlitic diatremes, to help exploration companies in developing future sampling strategies for northern Alberta.

Two ‘test sites’ were selected for grid/transect sampling, in which a selected sample grid/transect was used to determine the range of kimberlite-indicator mobilization close to known kimberlite(s). A ‘detailed’ sampling transect, with a sample spacing of 1.0 km, was centred on kimberlite K4; the transect was oriented east-west in the west, then veering northwest-southeast in the east with the change in direction of the road. A less detailed grid, with a sample spacing of approximately 5 km, was completed in the area directly south of kimberlites K1, K2, and K19. Due to the variety of surficial material in the Peerless Lake area and at the test sites, it was not possible to select a single sample medium (e.g., a homogenous unit of good till). Hence, the sample media at the test sites include till, glaciofluvial, and stream-sediment HMC samples. Although, the purpose of this survey was to test multiple sample media; a more detailed sample grid using a homogeneous sample type is recommended for future studies.

Glacial till, glaciofluvial and preglacial sand and gravel samples were taken by collecting 25 kg from shallow hand-dug pits. The pits were dug to a depth of 1 m to ensure a representative sample of the deposited material. Attempts were made to sample unoxidized, relatively undisturbed material. No preconcentration of till samples was done in the field, although an attempt was made to remove most large pebbles and boulders by hand. Stream-sediment HMC samples were wet-sieved, by carefully shovelling sediment into a series of three stainless steel sieves resting in a large conical pan. The light fraction was panned off, and approximately 500 g of HMC (< 2 mm) were collected from each site. The samples were from a wide variety of physiographic fluvial environments, ranging from large sand and gravel bars in major rivers to minor sediment concentrations in rocky, narrow creeks. Except for major rivers and creeks with local elevated topography, many streams in the low-lying areas have poor water flow and are often part of low-lying fen deposits. Where possible, high-energy fluvial environments were selected for HMC samples, because they tend to yield the greatest concentration of heavy minerals.

A standard set of measurements was recorded at each stream and till/glaciofluvial sampling site, both to aid the collector and to record standards that may be of value in the interpretation phase of the survey. Stream-sediment sample descriptions (Appendix 2a) include sample number, location (UTM co-ordinates), fluvial trap location and description, material percentages and characteristics, water velocity, and overall field rating as designated by the sampler. Till and glaciofluvial sample descriptions (Appendix 2b) include sample number, location (UTM co-ordinates), colour, drainage, cobble descriptions, moisture, reaction to HCl, presence of organic material, coal, and stones, texture, and percentage of sand, silt, and clay.

Microscopic examination of the heavy-mineral concentrate samples for kimberlite-indicator minerals was completed by the Saskatchewan Research Council (SRC) within standard exploration grain sizes of 0.25-0.5 mm, 0.5-1.0 mm, and 1.0-2.0 mm. Summaries of the processing procedures are given in Swanson and Gent (1993). A simplified description of the lab procedure involves:

- separating the sample in order to work with the minus 2.0 mm fraction;
- permrolling the sample to separate the non-magnetic and quartz fractions from the paramagnetic and magnetic fractions;
- Frantz electromagnetic separation to generate distinct fractions (usually magnetic, paramagnetic, and nonmagnetic) based on variations in magnetic susceptibility;
- magstream to divide the nonmagnetic fraction into intermediate and heavy specific-gravity fractions; and
- microscopic examination of the heavy mineral concentrate to hand pick for selected kimberlite-indicator minerals.

Selected silicate and oxide mineral grains were submitted to the University of Saskatchewan, Department of Geological Sciences for quantitative analysis of major and trace elements using a scanning electron microprobe. The silicate grains were analyzed using an accelerator voltage of 15 kV, beam diameter of 10 femtometres (fm), beam current of approximately 10 nanoamperes (nA), and a maximum counting time for each element of 40 seconds. Oxide grains were analyzed using an accelerator voltage of 20 kV, beam diameter of 5 fm, beam current of approximately 10 nA, and a maximum counting time for each major cation of 40 seconds. Standards were run before and after the analysis to ensure the calibration remained stable during each run.

8 Indicator Mineral Distribution

The Saskatchewan Research Council picked 1549 definite and possible silicate minerals from the 184 samples collected in the Peerless Lake area. Due to limited funding, analysis of all grains by microprobe was not possible and only 606 grains were analyzed. Therefore, the mineral indicator picks, as documented by the Saskatchewan Research Council, were plotted, regardless of chemistry, to study their distribution relationships. The reader may therefore want to classify all grains used in this indicator-mineral distribution analysis as 'possible' kimberlite-indicator grains. Individual figures were created for each silicate indicator mineral and plotted according to the type of sample medium and the total number of definite and possible grains:

- 864 definite and 227 possible peridotitic garnets (Figures 10 and 11)
- one definite and 13 possible eclogitic garnets (Figure 12)
- 52 definite and 85 possible chrome diopsides (Figure 13)
- 307 possible olivines (Figure 14)

In order to analyze the most populated sampling density possible, indicator-mineral processing data from 69 till samples (451 possible silicate indicator minerals) were added to the data set from the present study. Mark Fenton and John Pawlowicz (Alberta Geological Survey) collected the 69 samples between 1992 and 1998. The samples are prefixed with "NAT" on Figure 9.

The spatial distribution of silicate kimberlite-indicator minerals, from all samples collected in the Peerless Lake area, clearly shows four areas with elevated grain counts, especially for peridotitic garnet and olivine (Figures 10 and 14). The areas, as defined by the sample with the greatest number of indicator minerals, are centred at

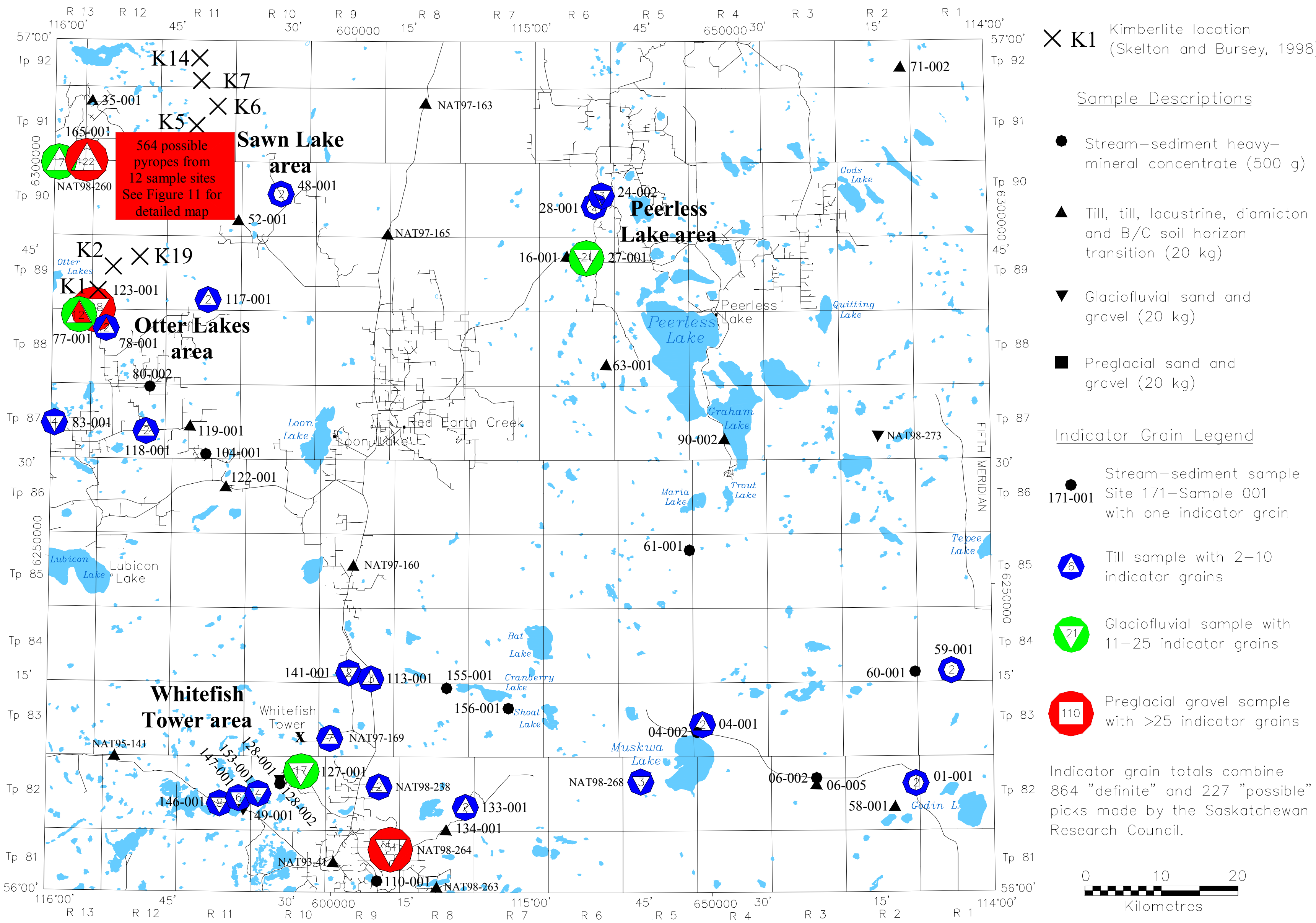


Figure 10. Spatial distribution of potential peridotitic garnet grains.

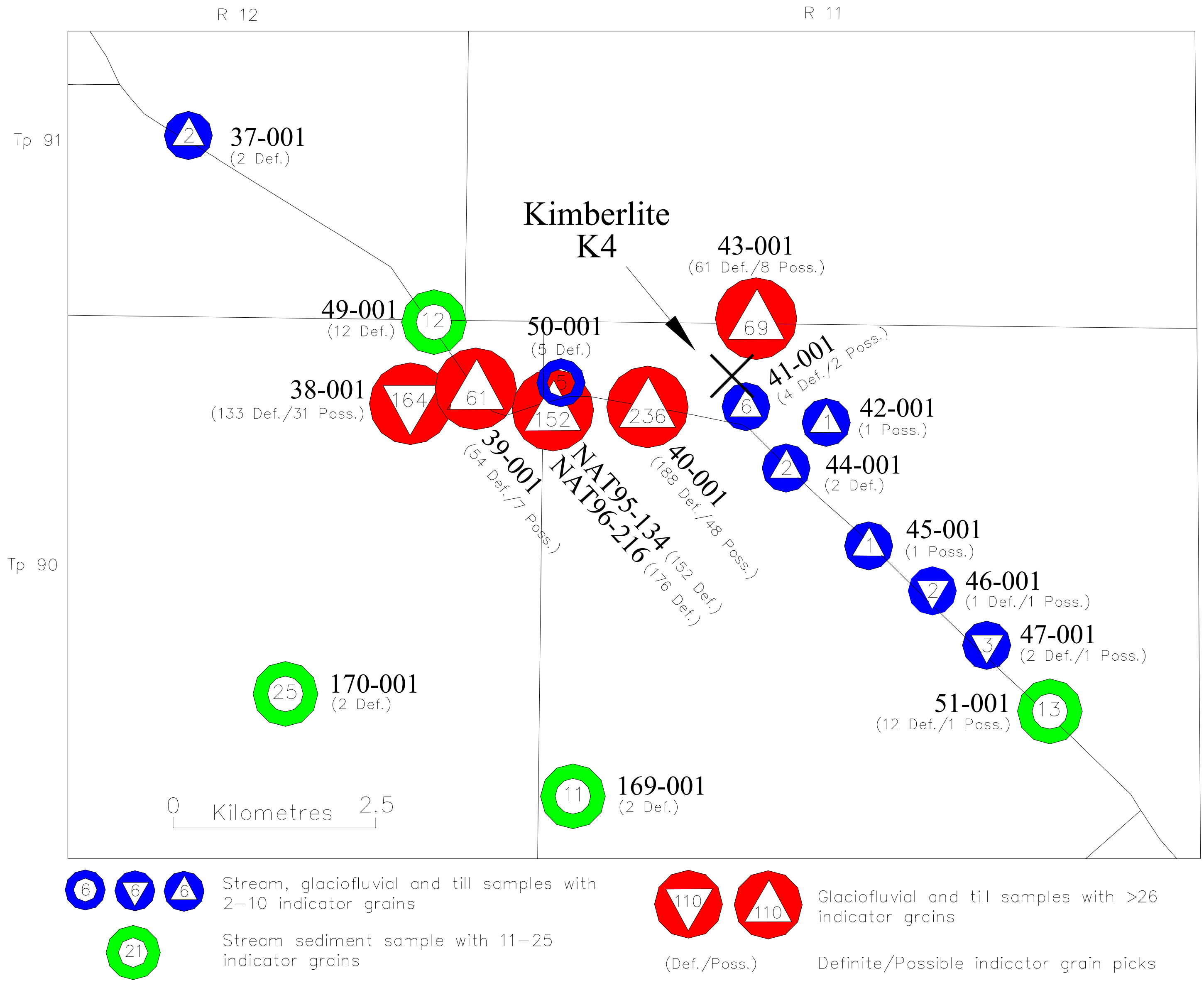


Figure 11. Detailed distribution of potential peridotitic garnets from samples collected adjacent to kimberlite K4 (see Figure 10).

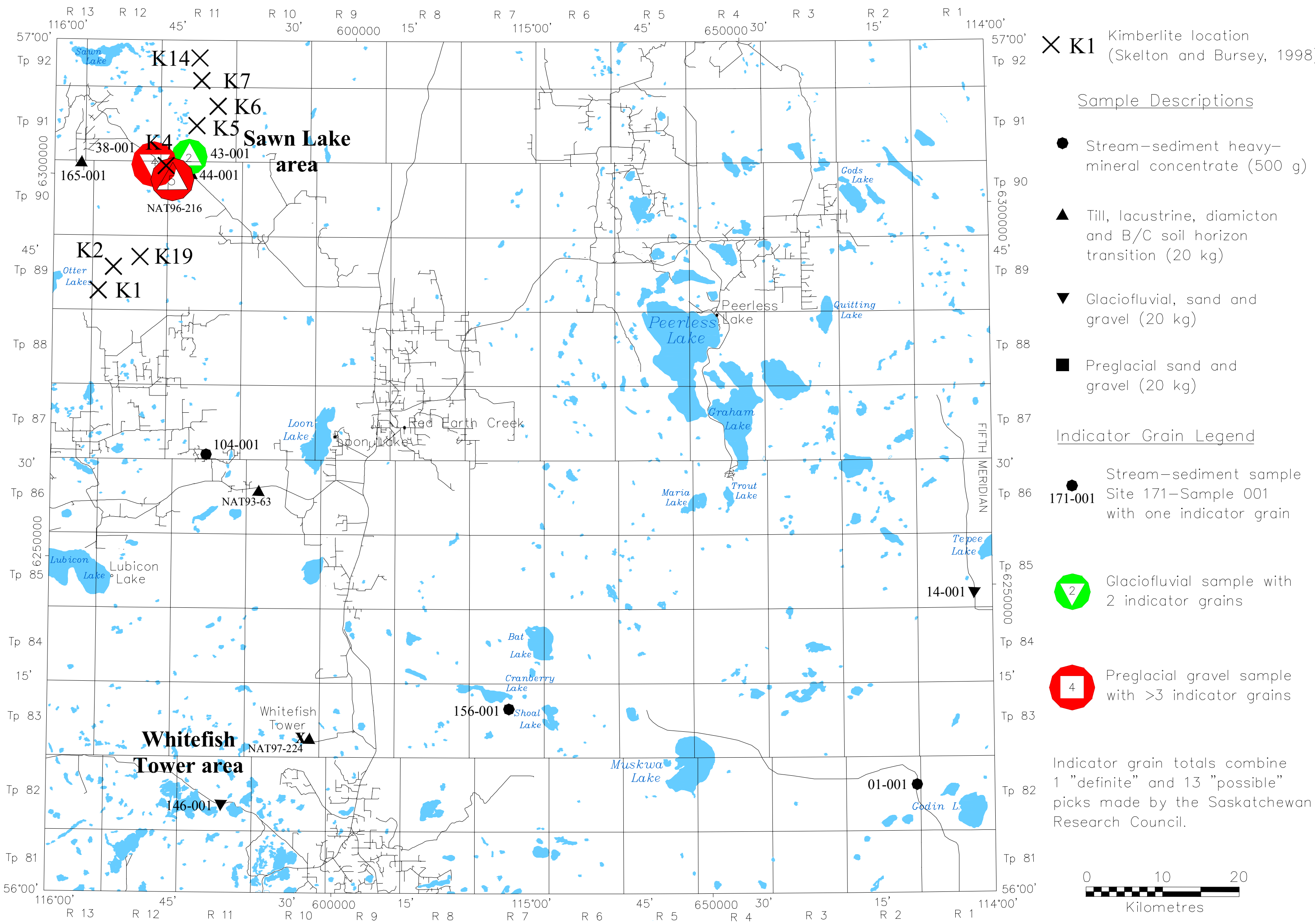


Figure 12. Spatial distribution of potential eclogitic garnet grains.

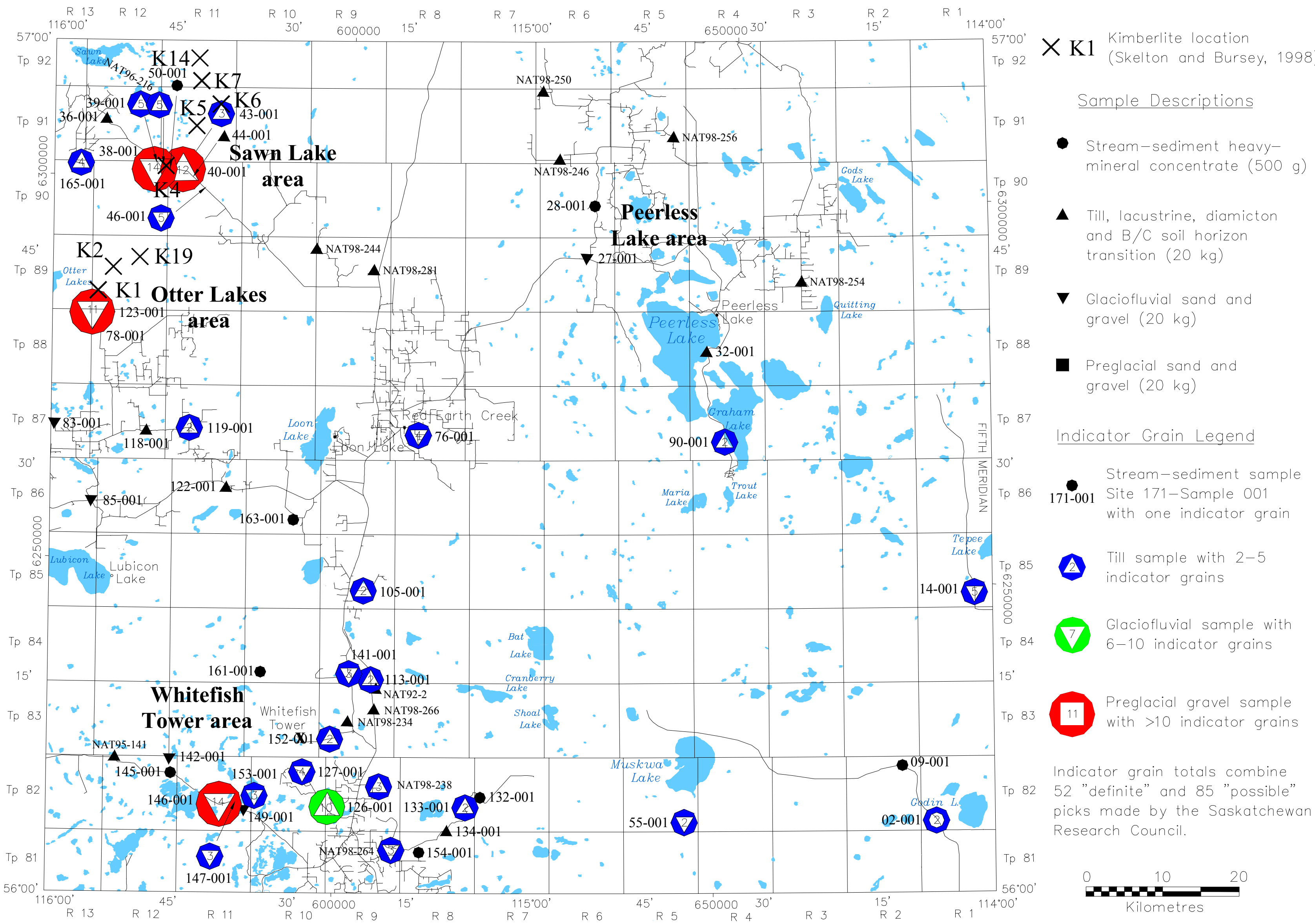


Figure 13. Spatial distribution of potential clinopyroxene (chrome diopside) grains.

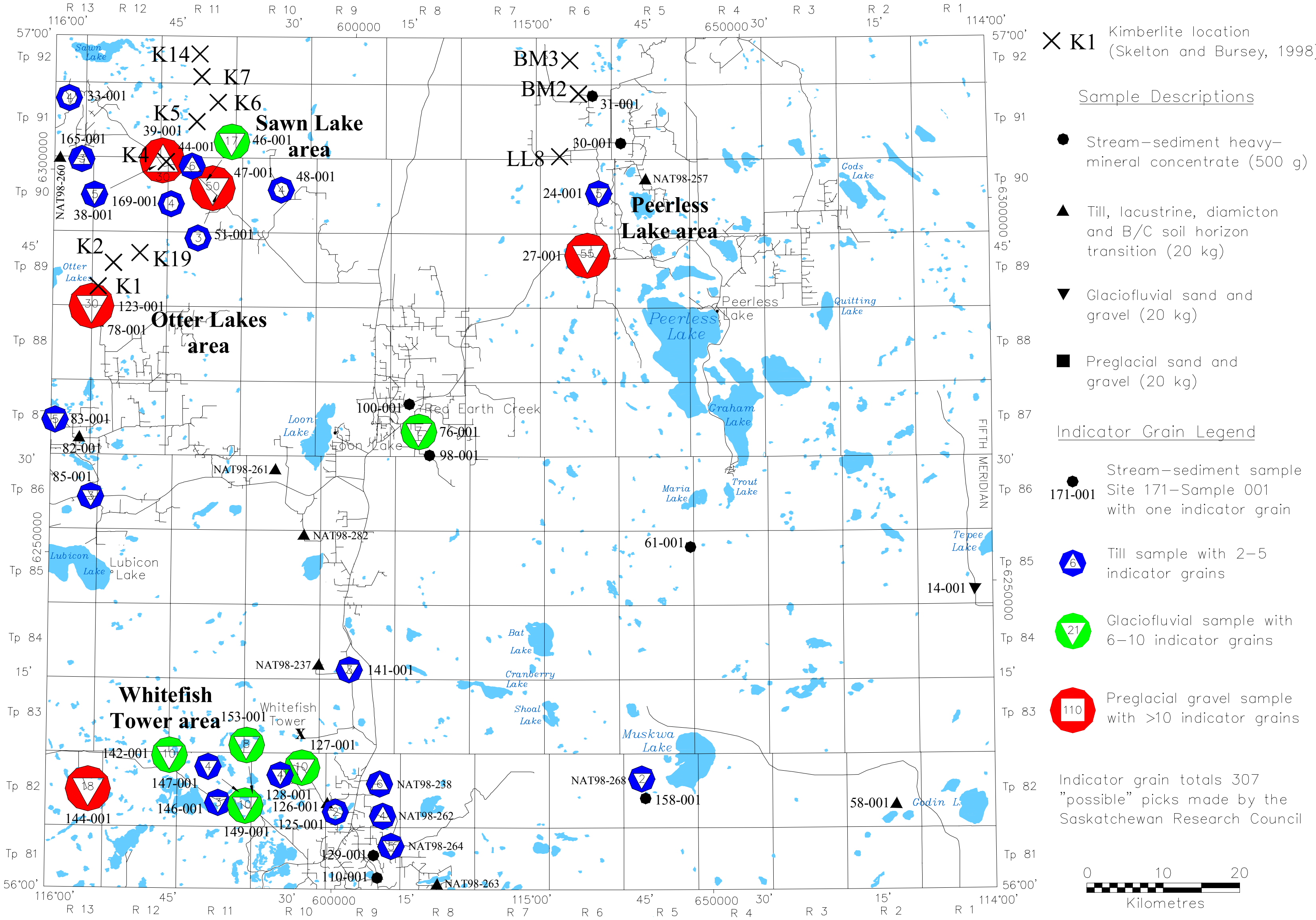


Figure 14. Spatial distribution of potential olivine grains.

- Peerless Lake area, sample RE98-84B-27-001, approximately 20 km northwest of settlement of Peerless Lake (township 89, range 6),
- Sawn Lake area, sample RE98-84B-40-001, approximately 15 km southeast of Sawn Lake (township 90, range 11),
- Otter Lakes area, RE98-84B-123-001, approximately 6 km southeast of Otter Lakes (townships 88 and 89, range 12), and
- Whitefish Tower area, sample RE98-84B-127-001, approximately 37 km southeast of the settlement of Lubicon Lake (township 82, ranges 9, 10, and 11).

Three of the four 'target' areas are close to known kimberlite(s). The indicator counts and distributions for each of the four areas are described below.

8.1 Peerless Lake area

Glaciofluvial sample, RE98-84B-27-001, is characterized by a fairly isolated occurrence of elevated grain counts: 21 peridotitic garnets, 1 chrome diopside, and 55 possible olivines. The sample site lies northwest of Goodfish and Peerless lakes, close to the approximate locations of kimberlites BM2, BM3, and LL8 (to date, the exact locations of these kimberlites have not been publicly released by Ashton, but their 'approximate locations' have been derived from news releases). Elevated grain counts also occur directly to the north in samples RE98-84B-24-001 (5 olivines in stream-sediment HMC), RE98-84B-24-002 (3 peridotitic garnets in glaciofluvial), and RE98-84B-28-001 (2 peridotitic garnets in stream-sediment HMC). Interestingly, till samples (good till, diamicton, and lacustrine samples) close to RE98-84B-27-001 did not yield any indicator minerals.

8.2 Sawn Lake area

A large cluster of very high grain counts occurs in the northwest corner of the map area, adjacent to kimberlite K4 (e.g., Figure 11). The anomaly, which is centred on sample site RE98-84B-40-001, contains up to 236 peridotitic garnets, 5 eclogitic garnets, 14 chrome diopsides, and 50 olivines. Although the elevated kimberlite-indicator grain counts are higher in glaciofluvial and till samples than in stream-sediment HMCs, the anomaly is really independent of sample medium. That is, till, glaciofluvial, and stream-sediment HMCs all yielded elevated grain counts. In addition, many of the stream-sediment HMC in this area were collected from stagnant water and very poor collection sites. A sampling transect, centred on RE98-84B-40-001 with a sample spacing of 1 km, showed that elevated grain counts continue both to the east and west of kimberlite K4 (Figure 11). The distribution of peridotitic garnets in the area is relatively widespread, and therefore, difficult to approximate direction or distances of transport (Figures 10 and 11). Conversely, the eclogitic garnets (Figure 12), chrome diopsides (Figure 13) and olivines (Figure 14) are all contained in samples that were collected relatively close to the K4 kimberlite. The spatial distribution of the peridotitic garnet grains (Figure 10) shows that the indicator mineral train may actually extend beyond the western border of the Peerless Lake map area. Because at least five kimberlite bodies (K4, K5, K6, K7 and K14) exist near or north of this sampling locale and some kimberlite locales are actually an assemblage of pipes (e.g., pipe K4 complex may include three separate pipes K4a, K4b and K4c), the current level of sample density makes it difficult to determine whether the indicator mineral grains are from a single or multiple kimberlite source. As well, the glacial transport history and surficial stratigraphy are not yet well understood in the Sawn Lake area.

8.3 Otter Lakes area

The third anomalous site, centred on sample RE98-84B-123-001, lies directly east of Otter Lakes and close to kimberlite K1 (kimberlites K2 and K19 also occur to the north and northeast). This glaciofluvial sample contains 198 peridotitic garnets, 11 chrome diopsides, and 30 olivines. Transitional B/C horizon soil to lacustrine till samples (RE98-84B-77-001 and RE98-84B-78-001) which were collected in the immediate vicinity, also yielded elevated indicator-grain counts (Figures 10, 13 and 14). No stream-sediment HMC samples were taken in the immediate area. A sample grid, which is located directly south of RE98-84B-123-001, and has a 5 km sample spacing, did not yield any significant concentrations of indicator grains to the south or east of this anomaly. As a general observation, samples containing from single grain to less than 5 grain anomalies were found in a southerly to southeasterly direction from RE98-84B-123-001 at maximum distances of 31 km for peridotitic garnets (RE98-84B-122-001), 40 km for chrome diopsides (RE98-84B-163-001), and 26 km for olivines (RE98-84B-85-001). Since the number of indicator grains south of RE98-84B-123-001 is minimal, it seems reasonable to conclude that elevated mineral-indicator grain counts are very close to source in this area.

8.4 Whitefish Tower area

A large area of high indicator-grain counts was discovered in the southwest part of the Peerless Lake map area. This anomaly is not currently associated with any known kimberlite cluster. Kimberlite-indicator mineral counts include up to 51 peridotitic garnets, 14 chrome diopsides, and 18 olivines from samples NAT98-264 (till), RE98-84B-146-001 (glaciofluvial), and RE98-84B-144-001 (glaciofluvial), respectively. In addition to these three samples, there exist at least one or more indicator minerals in 14 other till and 11 glaciofluvial samples at this locale. In contrast, only 6 stream sediment HMC samples had a maximum of 1 indicator mineral grain per sample. Given the number of indicator-mineral grain counts that occur in this area and the observed proximity of such grain counts to kimberlites in the northern part of the map area, the southwestern part of the Peerless Lake area should be given high priority for kimberlite exploration. However, the widespread occurrence of indicator minerals in this area may be related to large glaciofluvial kame and esker deposits that acted to facilitate grain dispersal. Further exploration should take this into consideration.

The available funding limited the indicator-mineral distribution analyses in this study to the silicate minerals. The cost of completely sorting and picking oxide-rich sample concentrates was too expensive for this projects budget. Therefore, no oxide indicator-mineral distribution maps were created.

9 Geochemical Results

In total, 606 grains out of 1549 silicate and an infinite number of oxide grains were selected for quantitative analysis of major and trace elements using an electron microprobe (Appendix 3). A ‘preliminary’ mineral ID is assigned in Appendix 3 using mineral identification programs written in QBASIC and provided by the SRC (Quirt, 1992a, b; Gent, 1993). The analyses confirmed the presence of indicator minerals picked by the SRC, including peridotitic and eclogitic garnet, chrome diopside, olivine, spinel (chromite), and ilmenite. A breakdown of the number of grains of each is provided in Table 5. The number of indicator grains per sample site is provided in Table 6. Further interpretations on the indicator grain data are discussed below.

Table 5. Total number of grains per indicator mineral

Mineral	Number
Garnet (total)	283
Peridotitic garnet	272
Eclogitic garnet	11
Clinopyroxene (chrome diopside)	121
Orthopyroxene	0
Olivine	119
Spinel	71
Ilmenite	12
TOTAL	606

Table 6. Distribution of indicator minerals selected for electron microprobe analysis per sample site

	Mineral ID							
Sample#	CHROMITE	G5	OLI	CPX	G9	G6	ILMENITE	Grand Total
RE98-84B-001-001		1		0	2			**3**
RE98-84B-002-001				2				**2**
RE98-84B-002-002					1			**1**
RE98-84B-003-001							1	**1**
RE98-84B-004-001					1			**1**
RE98-84B-006-001					1			**1**
RE98-84B-006-002	1							**1**
RE98-84B-006-005					1			**1**
RE98-84B-013-001	1							**1**
RE98-84B-014-001		1		5				**6**
RE98-84B-016-001	1				1			**2**
RE98-84B-016-002	1							**1**
RE98-84B-022-001					1			**1**
RE98-84B-023-001	1							**1**
RE98-84B-024-001							1	**1**
RE98-84B-024-003					1			**1**
RE98-84B-025-001	1				2			**3**
RE98-84B-026-001	1							**1**
RE98-84B-027-001	2		16	1	15			**34**
RE98-84B-028-001				1	1			**2**
RE98-84B-029-001					2		1	**3**
RE98-84B-030-001			1		2			**3**
RE98-84B-031-001				2	1		1	**4**
RE98-84B-032-001				1				**1**
RE98-84B-034-001				1				**1**
RE98-84B-035-001			9	6	42			**57**
RE98-84B-036-001				1				**1**
RE98-84B-037-001	1				2			**3**
RE98-84B-038-001	3	2	1	13	16			**35**
RE98-84B-039-001	5		1	3	25			**34**
RE98-84B-040-001	1			5	14	1		**21**
RE98-84B-041-001					3			**3**
RE98-84B-043-001	8	2		3	15			**28**
RE98-84B-044-001		1	5	1				**7**
RE98-84B-045-001	1							**1**
RE98-84B-046-001			12	5	1			**18**
RE98-84B-047-001					2			**2**
RE98-84B-048-001			3	1	2			**6**
RE98-84B-049-001	5				5			**10**
RE98-84B-050-001	1			1				**2**
RE98-84B-051-001			2		9			**11**

Table 6. Distribution of indicator minerals selected for electron microprobe analysis per sample site

	Mineral ID							
Sample#	CHROMITE	G5	OLI	CPX	G9	G6	ILMENITE	Grand Total
RE98-84B-052-001					1			**1**
RE98-84B-053-001				1				**1**
RE98-84B-055-001				2				**2**
RE98-84B-059-001	2				1			**3**
RE98-84B-060-001	1				1			**2**
RE98-84B-061-001			1		1			**2**
RE98-84B-063-001					1			**1**
RE98-84B-065-001				3				**3**
RE98-84B-065-002	1							**1**
RE98-84B-068-001	2							**2**
RE98-84B-071-001					1			**1**
RE98-84B-076-001			4	5				**9**
RE98-84B-077-001					8			**8**
RE98-84B-078-001				1				**1**
RE98-84B-080-002					1			**1**
RE98-84B-082-001			1					**1**
RE98-84B-083-001				3				**3**
RE98-84B-092-001	2							**2**
RE98-84B-093-001	1							**1**
RE98-84B-095-001	2							**2**
RE98-84B-097-001								**0**
RE98-84B-098-001			1					**1**
RE98-84B-103-001	1							**1**
RE98-84B-104-001		1						**1**
RE98-84B-105-001				2				**2**
RE98-84B-106-001							1	**1**
RE98-84B-110-001			1					**1**
RE98-84B-113-001				2			1	**3**
RE98-84B-118-001				1				**1**
RE98-84B-122-001				1				**1**
RE98-84B-123-001	2			8	11			**21**
RE98-84B-125-001	1		2				1	**4**
RE98-84B-127-001	1		10	4	6		1	**22**
RE98-84B-128-001	1		4				1	**6**
RE98-84B-129-001			1					**1**
RE98-84B-132-001				1				**1**
RE98-84B-133-001				2	2		1	**5**
RE98-84B-134-001				1	1			**2**
RE98-84B-135-001	1							**1**
RE98-84B-141-001			2	2	2			**6**
RE98-84B-142-001			5	1				**6**
RE98-84B-144-001			12	2				**14**

Table 6. Distribution of indicator minerals selected for electron microprobe analysis per sample site

	Mineral ID							
Sample#	CHROMITE	G5	OLI	CPX	G9	G6	ILMENITE	Grand Total
RE98-84B-145-001	1			1				**2**
RE98-84B-146-001		1	1	12	5			**19**
RE98-84B-147-001			4	3	6			**13**
RE98-84B-148-001	1							**1**
RE98-84B-149-001			9	1	1			**11**
RE98-84B-150-001							2	**2**
RE98-84B-152-001				2				**2**
RE98-84B-153-001			5	1	3			**9**
RE98-84B-154-001				1				**1**
RE98-84B-155-001					1			**1**
RE98-84B-156-001		1						**1**
RE98-84B-156-001					1			**1**
RE98-84B-157-001	1							**1**
RE98-84B-158-001			1					**1**
RE98-84B-160-001	1							**1**
RE98-84B-163-001	1							**1**
RE98-84B-163-001				1				**1**
RE98-84B-164-001	12							**12**
RE98-84B-165-001			2	1	26			**29**
RE98-84B-166-001				1				**1**
RE98-84B-169-001	1		3		9			**13**
RE98-84B-170-001	1				10			**11**
NAT98-264				3	5			**8**
Grand Total	**71**	**10**	**119**	**121**	**272**	**1**	**12**	**606**

G5 Group 5 garnet, magnesian almandine (eclogitic garnet) after Dawson and Stephens (1975)

OLI Olivine

CPX Clinopyroxene

G9 Group 9 garnet, chrome pyrope (peridotitic garnet) after Dawson and Stephens (1975)

G6 Group 6 garnet, pyrope-grossular-almandine after Dawson and Stephens (1975)

9.1 Peridotitic Garnets

Garnets are commonly reported as inclusions in diamond (Sobolev, 1977; Gurney, 1984), and in heavy-mineral indicator suites in which the mantle garnet suite may be derived from peridotites, eclogites, megacrysts, and crustal metamorphic rocks. A total of 272 peridotitic garnets was analyzed; their chemistry is summarized in Table 7.

Table 7. Geochemical summary of selected peridotitic garnet grains from the Peerless Lake area

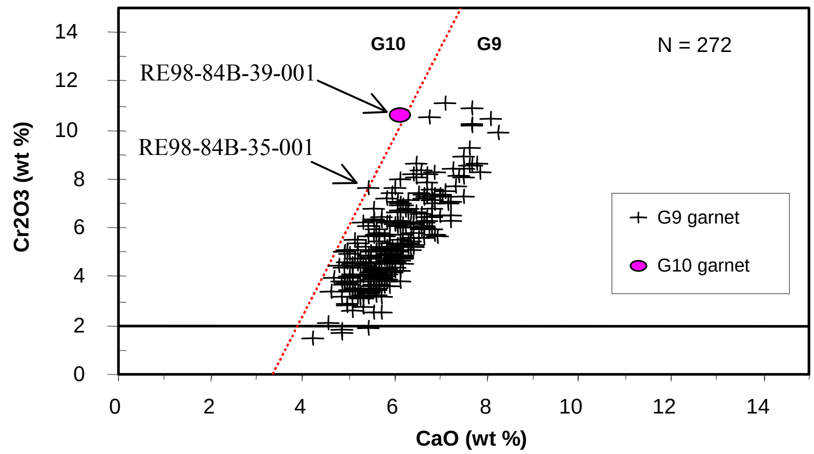
Parameter	Value	Unit
Total number (n)	272	
Minimum Cr_2O_3	1.52	wt %
Maximum Cr_2O_3	11.11	wt %
Maximum knorringite	19.44	mol %
Number of subcalcic garnets (Gurney, 1984)	1	
Percentage of subcalcic garnets (Gurney, 1984)	0.4	%
Number of low-Ti garnets	259	
Percentage of low-Ti garnets	95.2	%
Minimum TiO_2	0.00	wt %
Maximum TiO_2	0.88	wt %
Minimum FeO	6.00	wt %
Maximum FeO	11.38	wt %
Minimum CaO	4.20	wt %
Maximum CaO	8.26	wt %
Minimum Na_2O	0.00	wt %
Maximum Na_2O	0.14	wt %
Minimum Mg#	73.05	mol %
Maximum Mg#	85.66	mol %

Mg# = [100 x Mg (mol %) / Fe (mol %)] + Mg (mol %)

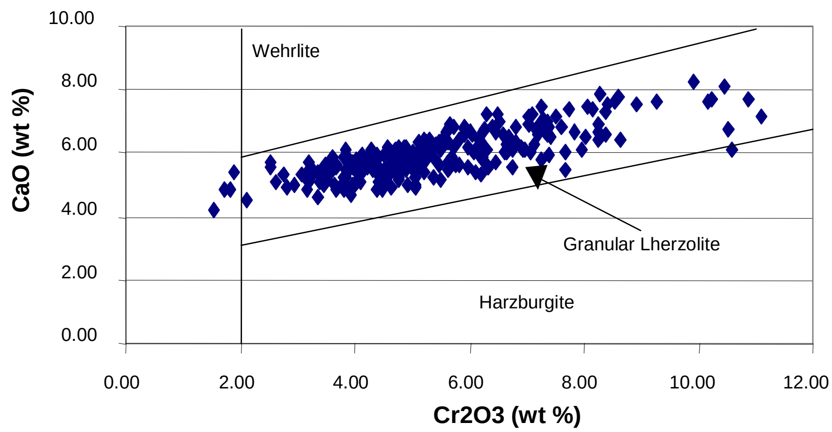
Garnets from kimberlite-hosted peridotite xenoliths generally belong to one of two parageneses: harzburgitic (olivine+orthopyroxene) or lherzolitic (olivine+orthopyroxene+clinopyroxene). Using hierarchical cluster analysis, Dawson and Stephens (1975) divided a large suite of garnets derived from xenoliths and heavy-mineral occurrences in kimberlites into 12 chemically distinct groups based on their TiO_2, Cr_2O_3, FeO, MgO, and CaO contents. Sobolev et al. (1973) reported that the most significant compositional factors indicative of potentially diamondiferous occurrences include the presence of peridotitic garnets that are CaO poor and Cr_2O_3 rich. Following the nomenclature of Dawson and Stephens (1975) and Gurney (1984), the term 'Group 9 (G9)' will be used for lherzolitic garnets, and the term 'Group 10 (G10)' will be used for for subcalcic/harzburgitic garnets. Gurney (1984) developed a CaO versus Cr_2O_3 diagram to identify G9 (lherzolitic) and G10 (harzburgitic) garnets (Figure 15A).

The distribution of most peridotitic garnet grains from the Peerless Lake area is tightly clustered around the lherzolitic trend (Figure 15A and 15B). Figure 15A shows that a single grain (from sample RE98-84B-39-001) is marginally of subcalcic G10 type (6.14 wt % CaO and 10.6 wt % Cr_2O_3). A single grain (from sample RE98-84B-35-001) plots on the G9-G10 boundary line. A relatively high knorringite ($Mg_3Cr_2Si_3O_{12}$) content (19.2 mol %) in this grain indicates a high pressure of equilibrium that could have fallen within the field of diamond stability, particularly if the high knorringite impurity in diamondiferous kimberlite pipes indicates deep-seated foci of kimberlite melts passing through the section of deep diamond-pyrope facies when moving upward (Sobolev et al., 1992). The G9 grain with the highest Cr_2O_3 content (11.11 wt % from sample RE98-84B-27-001) also has the highest knorringite content (19.44 mol %). Carlson et al. (1999) reported that kimberlites in the southern part of the Buffalo Head Hills cluster contain only rare subcalcic (G10) garnets, in contrast to those in the northern and central parts, which contain a larger concentration of G10 garnets. Although the current study found only one subcalcic G10 garnet within the Peerless Lake area, Carlson et al. (1999) noted that the Buffalo Head Hills kimberlites contain G10 garnets, some of which are strongly metameric (alexandritic) with exceptionally high chromium contents (up to 17.8 wt %). The additional chromic oxide in these garnets may result in a grass

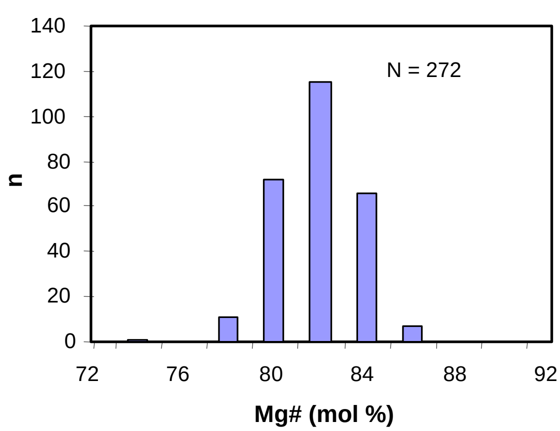
A) **Cr_2O_3 vs. CaO plot. Dashed line, G9-G10 boundary; solid line, Cr_2O_3 limit for megacrystic and eclogitic garnets (Gurney et al., 1993).**



B) **Garnet classification scheme (modified from Sobolev et al., 1973).**



C) **Histogram of Mg# distribution.**



D) **Cr_2O_3 vs. TiO_2 plot. Dashed line, sheared lherzolite field (after Ramsay, 1992).**

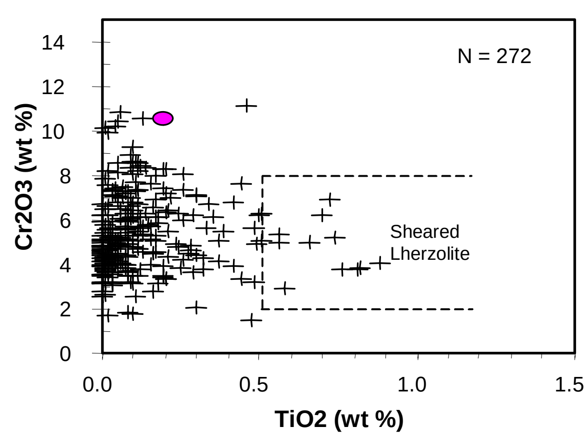


Figure 15. Scatter plots for selected peridotitic garnet grains.

green colour by daylight and should be considered by indicator mineral pickers and during microprobe grain selection.

Chromium contents of the G9 garnets vary from 1.52 to 11.11 wt % Cr_2O_3. Only a few grains contain either higher or lower Cr_2O_3. Four grains (RE98-84B-35-001, RE98-84B-38-001, RE98-84B-40-001, and RE98-84B-169-001) fall below the empirical boundary of 2 wt% Cr_2O_3 that divides megacrystic and eclogitic garnets from normal peridotitic (G9) garnets (Figure 15A), suggested by Gurney et al. (1993). These grains should be classified as megacrystic when applying this criterion. All four grains, however, contain low TiO_2 (0.02 to 0.10 wt %) and only one (RE98-84B-35-001) has an elevated FeO content (11.4 wt %), which is indicative of megacrystic magma.

Most (95.2%) of the grains identified as peridotitic (G9) are of the low-titanium type and contain less than 0.5 wt % TiO_2 (Table 7). Garnets exhibit Mg#s ranging from 73.05 to 85.66 mol % (Figure 15C) and indicative of garnets from garnet lherzolites, which typically range between 75 to 85 mol % (Meyer and Boyd, 1970, 1972; Sobolev et al., 1973). A low Mg# in about 5% of the grains, combined with an elevated TiO_2 content (greater than 0.5 wt %) and Cr_2O_3 values of 2.0-8.0 wt % (Figure 15D), indicate that a small proportion of the garnets are probably derived from sheared lherzolites and/or metasomatized peridotites. This suggests that parts of the garnet population were derived from high-temperature lherzolites generated closer to the primitive mantle (Boyd, 1973; Nixon and Boyd, 1973). These grains were discovered in samples RE98-84B-27-001 (three grains), RE98-84B-28-001 (one grain), RE98-84B-35-001 (two grains), RE98-84B-39-001 (two grains), and RE98-84B-149-001 (one grain).

In summary, the peridotitic garnet chemistry in the Peerless Lake area can be rated as being of moderate to high interest based on the presence of a G10 grain, a wide G9 range with high Cr and low Ca, and a relatively high knorringite content (15 grains, or about 6% of the total, are greater than 10 mol % $Mg_3Cr_2Si_3O_{12}$ and 3 grains, or about 1% of the total, are greater than 19 mol % $Mg_3Cr_2Si_3O_{12}$). In addition, Carlson et al. (1999) reported on the relationship between the G9 peridotitic garnet chemistry from the Buffalo Head Hills pipes and elevated diamond concentrations. They also noted the presence of high-Cr_2O_3, subcalcic garnets from kimberlite pipes located to the north of the current study area.

Table 8. Geochemical summary of selected eclogitic garnet grains from the Peerless Lake area

Parameter	Value	Unit
Total number (N)	11	
Minimum Cr_2O_3	0.00	wt %
Maximum Cr_2O_3	0.15	wt %
Minimum TiO_2	0.01	wt %
Maximum TiO_2	0.16	wt %
Minimum FeO	13.40	wt %
Maximum FeO	36.01	wt %
Minimum CaO	1.03	wt %
Maximum CaO	22.53	wt %
Minimum Na_2O	0.00	wt %
Maximum Na_2O	0.07	wt %
Minimum MnO	0.03	wt %
Maximum MnO	1.91	wt %
Minimum Mg#	0.0	mol %
Maximum Mg#	49.4	mol %

Mg# = [100 x Mg (mol %) / Fe (mol %)] + Mg (mol %)

9.2 Eclogitic Garnets

Only 11 grains (3.89% of the population) are classified as eclogitic garnets. Their chemistry is summarized in Table 8.

Although the classification of Dawson and Stephens (1975) works well for peridotitic garnets, classifications to evaluate eclogite garnet are constrained by the low abundance of eclogitic garnet xenocrysts in most kimberlites and the colour similarities between orange garnets from eclogites, Cr-poor megacryst garnets, and garnets from many crustal metamorphic rocks. Chemical characteristics, such as lower FeO (Schulze, 1997), moderate TiO_2, and elevated Na_2O (McCandless and Gurney, 1989; Gurney et al., 1993), can discriminate between eclogitic garnets derived from potentially diamondiferous kimberlite and those from crustal rocks and Cr-poor megacrysts.

The MgO versus FeO plot (Figure 16A) shows only three grains (one grain from RE98-84B-38-001 and two grains from RE98-84B-40-001) contain less than 22 wt % FeO, which is the cut-off proposed by Schulze (1997) to discriminate between eclogitic (<22 wt % FeO) and crustal (>22 wt % FeO) garnets. A single grain (RE98-84B-146-001) has a Na_2O content approaching the high-interest field boundary (0.07 wt % Na_2O; Figure 16B) suggested by Gurney et al. (1993); however, this grain contains 25.86 wt % FeO, which may indicate it is a crustal garnet. In addition, sample RE98-84B-40-001, which had the lowest concentration of FeO (13.4 wt %) also plots in the area of low interest with respect to Na_2O.

The 11 grains are divided into three compositional groups (designated as I, II, and III) on the CaO – FeO_{total} – MgO ternary plot (Figure 16C) and the grossularite+andradite – pyrope – almandine+spessartite ternary plot (Figure 16D). Group I consists of a single grain (RE98-84B-40-001) and is essentially grossular-almandine (68.1 mol % grossular and 31.7 mol % almandine). The group II grains (RE98-84B-38-001 and RE98-84B-40-001) are characterized by elevated CaO and moderate FeO contents (21.9 and 21.2 wt %). The remaining eight grains in group III (RE98-84B-14-001, RE98-84B-38-001, two grains from RE98-84B-43-001, RE98-84B-44-001, RE98-84B-104-001, RE98-84B-146-001, and RE98-84B-156-001) are characterized by relatively low CaO (1.03-4.26 wt %) and elevated but variable FeO (22.2-26.0 wt %). Four of the grains from group III may be further subdivided as almandine grains on Figure 16D.

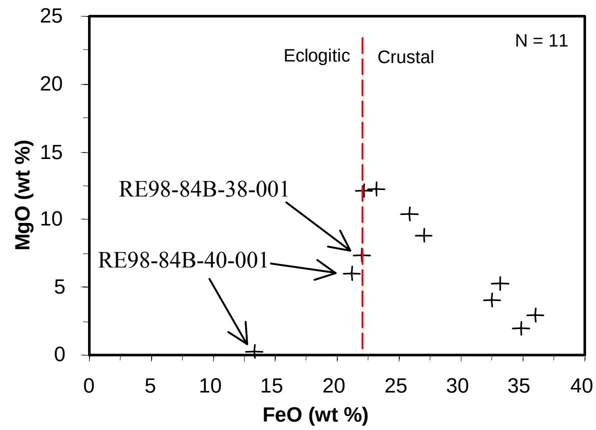
All three groups plot in the compositional fields (Figure 16D; after Coleman *et al*., 1965) for garnets in blueschist and high-pressure metamorphic terrains (Group C). No grains plot in the Coleman et al. (1965) compositional field for eclogitic garnets from kimberlite (Group A). However, the group II grains do plot in the diamond-inclusion field of Jerde *et al*. (1993) (Figure 16C) and the field for eclogitic garnets from worldwide kimberlite sources (Figure 16D). Relatively low TiO_2 and Na_2O, and high FeO in the garnet grains from groups I and III likely imply a source unrelated to kimberlites (i.e., they are probably metamorphic in origin).

In summary, the chemistry of the eclogitic garnets cannot be evaluated in terms of diamond potential due to insufficient data from this study (eclogitic garnets comprise only 11 grains or 3.84% of the total garnet population). Carlson et al. (1999) noted that eclogitic garnets from the Buffalo Head Hills kimberlites contain relatively low sodium (less than 0.07 wt.%) and that, to date, no grains show diamond-inclusion chemistry (or elevated Na_2O and TiO_2, after McCandless and Gurney (1989).

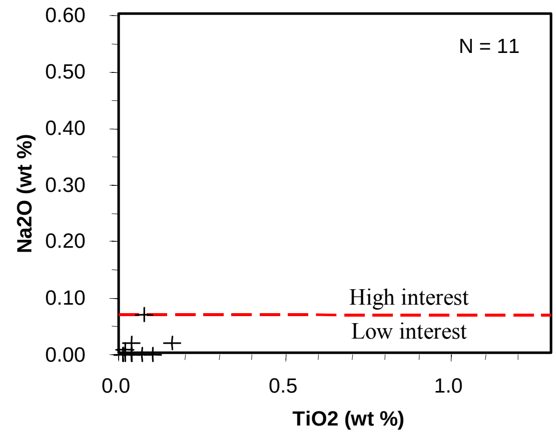
9.3 Clinopyroxene (Chrome Diopside)

Clinopyroxene, more specifically an emerald green, chrome-rich variety of diopside, is a useful visual pathfinder mineral for the location of kimberlite and/or lamproite diatremes. It can be present, as megacrysts and as a cognate phase, in both diamondiferous and nondiamondiferous eclogite and peridotite xenoliths.

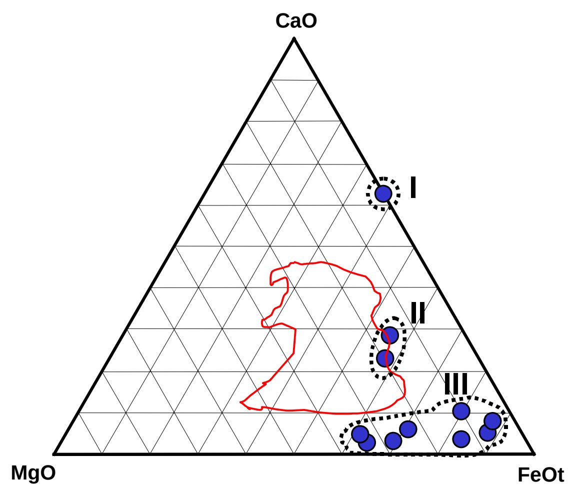
A) **MgO vs. FeO plot. Dashed line, boundary between eclogitic and crustal garnets (after Schulze, 1997)**



B) **Na_2O vs. TiO_2 plot. Dashed line, boundary between low and high interest garnets (after Gurney et al., 1993).**



C) **CaO - MgO - FeO (total) ternary plot. Solid contour, diamond inclusion field (after Fipke et al., 1989). Refer to text for discussion of groups I, II, and III.**



I - Essentially grossular-almandine (RE98-84B-40-001)

II - Within or proximal to the diamond inclusion field (RE98-84B-38-001 and RE98-84B-40-001)

III - Mainly almandine and/or spessartite garnets of probable crustal origin (RE-98-84B-14-001, RE-98-84B-38-001, RE-98-84B-43-001, RE-98-84B-44-001, RE-98-84B-104-001, RE-98-84B-146-001, and RE-98-84B-156-001)

D) **Grossularite+andradite - almandine+spessartite - pyrope ternary plot. Dashed lines, boundary between A, B, and C eclogite groups (Coleman et al., 1965); solid contour, eclogitic garnets from worldwide kimberlites (Jerde et al., 1993). Refer to text for discussion of groups I,II, and III.**

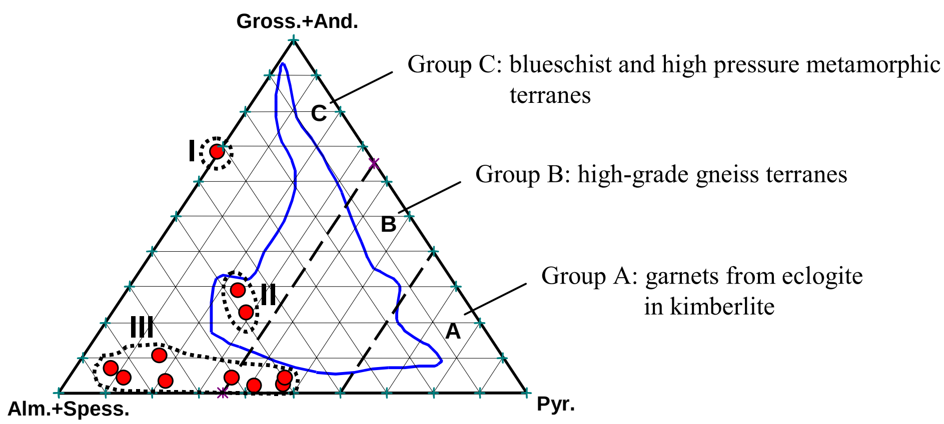


Figure 16. Scatter plots for selected eclogitic garnet grains.

A total of 121 possible clinopyroxene grains was analyzed from samples collected in the Peerless Lake area. Their chemistry is summarized in Table 9 and Figure 17.

Table 9. Geochemical summary of selected clinopyroxene (chrome diopside) grains from the Peerless Lake area

Parameter	Value	Unit
Total number (N)	121	
Minimum Cr_2O_3	0.00	wt %
Maximum Cr_2O_3	2.93	wt %
Minimum TiO_2	0.00	wt %
Maximum TiO_2	0.55	wt %
Minimum FeO	1.60	wt %
Maximum FeO	7.64	wt %
Minimum CaO	0.18	wt %
Maximum CaO	25.23	wt %
Minimum Na_2O	0.00	wt %
Maximum Na_2O	5.00	wt %
Minimum Al_2O_3	0.10	wt %
Maximum Al_2O_3	7.29	wt %
Maximum K_2O	1.53	wt %
Average K_2O > 0.08 wt %	15.7	%
Minimum Mg#	81.80	mol %
Maximum Mg#	94.91	mol %

Mg# = [100 x Mg (mol %) / Fe (mol %)] + Mg (mol %)

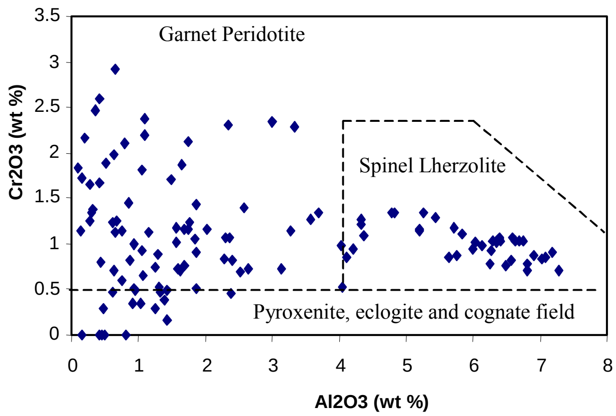
Stephens and Dawson (1977) carried out hierarchical cluster analysis on eclogitic and peridotitic clinopyroxenes, which occurred as inclusions in diamonds, and identified ten distinct groups. Most of the groups, however, contained grains derived from common mantle rock types, and many grains did not fall within the classification ranges of Stephens and Dawson, indicating that there was no unique clinopyroxene compositional group associated with diamond (e.g., equivalent to G10 garnet). Most diamond-associated clinopyroxenes appear to be either Cr_2O_3-rich peridotitic types or Na_2O-Al_2O_3-rich eclogitic types. At present, the only unique compositional characteristic suggested for determining diamond potential from clinopyroxene is the presence of eclogitic clinopyroxene (Na_2O-Al_2O_3-rich) with K_2O > 0.08 wt % (McCandless and Gurney, 1989).

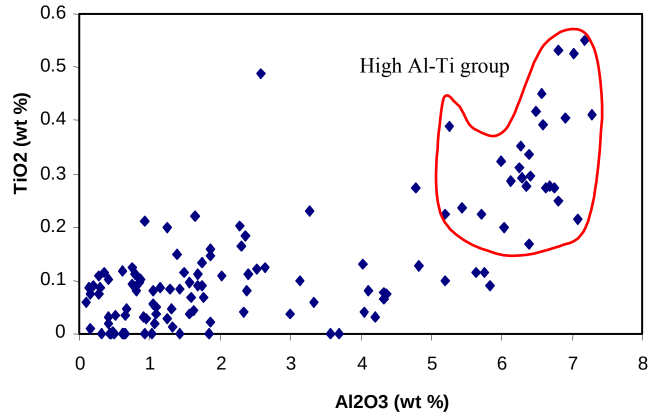
Clinopyroxene from the Peerless Lake area shows a broad compositional variation (Figure 17A). In general, it is characterized by relatively low Cr_2O_3 (maximum of 2.93 wt % and average of 1.13 wt %), and a large range of Al_2O_3 contents (0.10 to 7.29 wt % Al_2O_3). In general, the potential sources for clinopyroxenes range from garnet lherzolite (elevated Cr_2O_3, low Al_2O_3, high MgO), eclogite/pyroxenite (<0.5 wt % Cr_2O_3, high CaO and Na_2O), and spinel lherzolite (low Cr_2O_3, high Al_2O_3), using the nomenclature of Ramsay (1992). The high Al_2O_3 (greater than 5.0 wt %) clinopyroxene group is further distinguished by the presence of elevated TiO_2 (0.18 wt %, Figure 17B). A distinct group of 27 grains (Figure 17B) is characterized by greater than 5.0 wt % Al_2O_3 and greater than 0.18 wt % TiO_2. On the Cr_2O_3 versus Na_2O plot (Figure 17C), the Al_2O_3-poor clinopyroxenes show a positive trend and the Al_2O_3-rich clinopyroxenes a slightly negative trend.

On the Na_2O versus Al_2O_3 plot (Figure 17D), the upper positive trend is associated with clinopyroxenes collected near kimberlites K1 (Otter Lakes area) and K4 (Sawn Lake area) in the northwest corner of the map area. Two clinopyroxene grains from sample RE98-84B-39-001 contain the highest concentrations of Na_2O (4.78 and 5.00 wt %), intermediate Al_2O_3 contents (3.69 and 3.57 wt %), and also the highest K_2O values (1.52 and 1.40 wt %). Other sample sites that contain high Na_2O, Al_2O_3, and K_2O include RE98-84B-38-001, RE98-84B-40-001, and RE98-84B-123-001. These may be indicative of diamond potential, based on the criteria for eclogitic clinopyroxene by McCandless and Gurney (1989). Nineteen grains (15% of the total) contain more than 0.08 wt % K_2O. The lower positive trend is associated with the high Al-Ti group of grains observed on Figure 16B. In contrast, it is interesting to note that the plot of Cr_2O_3 versus CaO (Figure 17E) shows that most of the clinopyroxene grains plot in the diamond inclusion field after data from Fipke *et al*. (1989). Figure 17E also shows other potential groupings based on CaO content that may indicate rare types of clinopyroxene.

A) Cr_2O_3 vs. Al_2O_3 plot. Paragenetic fields after Ramsay (1992).

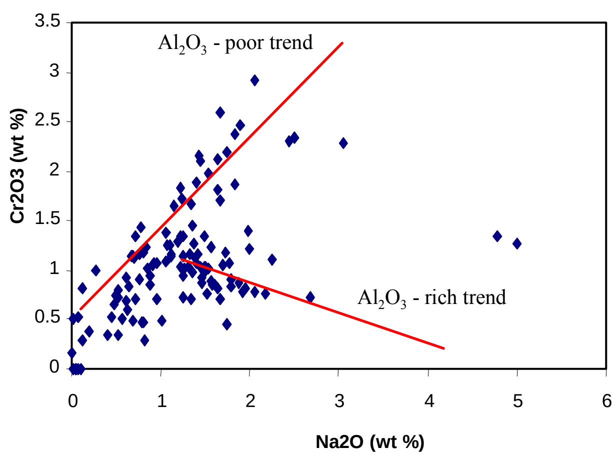
B) TiO_2 vs. Al_2O_3 plot.

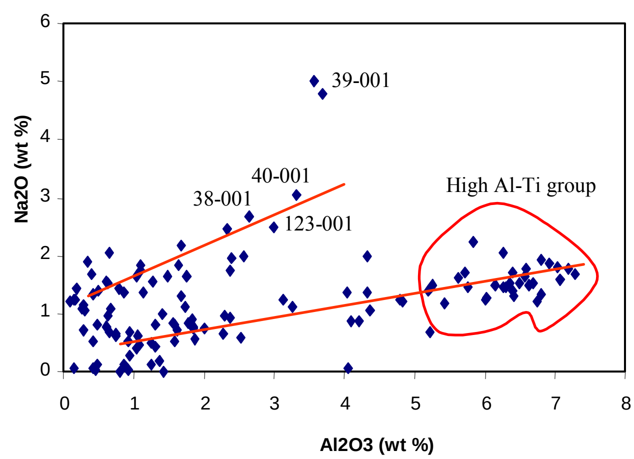




C) Cr_2O_3 vs. Na_2O plot.

D) Na_2O vs. Al_2O_3 plot.





E) Cr_2O_3 vs. CaO plot. Solid contour, diamond inclusion field after data from Fipke et al. (1989).

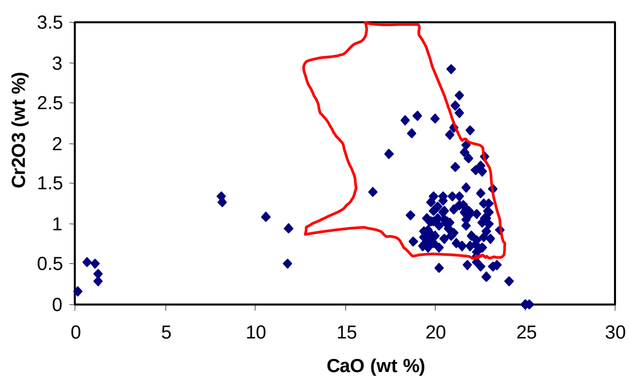


Figure 17. Scatter plots for selected clinopyroxene (chrome diopside) grains.

In summary, grains derived from garnet lherzolite (elevated Cr_2O_3, high MgO, low Al_2O_3), eclogite/pyroxenite (low Cr_2O_3, high Al_2O_3, high CaO and Na_2O), and spinel lherzolite sources can be identified. Overall, clinopyroxene chemistry is moderately favourable for diamond potential. The majority of the clinopyroxenes plot in the diamond inclusion field of Fipke et al. (1989). However, aluminous clinopyroxenes from spinel lherzolites indicate that mantle sampling has occurred at relatively shallow levels, and that the diamond stability field has not been sampled (Ramsay, 1992). Hence, overlapping compositional limits and the lack of clear clustering prevent reliable estimates of the proportions of different clinopyroxene types.

9.4 Olivine

Olivine is the least informative indicator mineral in terms of the parental rock type and equilibrium conditions. Since olivine with similar or even identical compositions can be derived from a range of other ultramafic rocks, it can be used as a direct kimberlite indicator only in areas known not to contain such rocks. Nonetheless, olivine commonly plays an indicator-mineral role due to its typical proximity to a kimberlite source, particularly when it occurs with other kimberlite indicator minerals.

Table 10. Geochemical summary of selected olivine grains from the Peerless Lake area

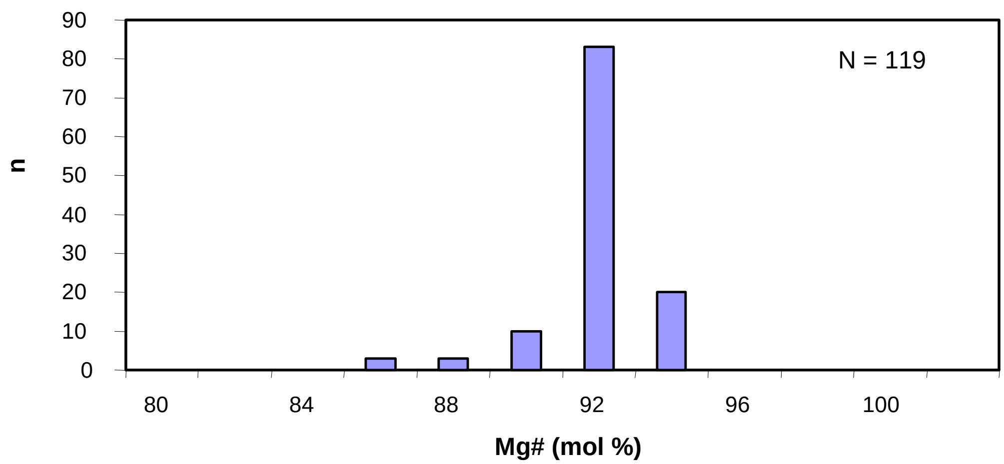
Parameter	Value	Unit
Total number (N)	119	
Minimum Cr_2O_3	0.00	wt %
Maximum Cr_2O_3	0.08	wt %
Minimum TiO_2	0.00	wt %
Maximum TiO_2	0.04	wt %
Minimum FeO	7.03	wt %
Maximum FeO	14.87	wt %
Minimum CaO	0.00	wt %
Maximum CaO	0.09	wt %
Minimum Mg#	84.46	mol %
Maximum Mg#	92.92	mol %

Mg# = [100 x Mg (mol %) / Fe (mol %)] + Mg (mol %)

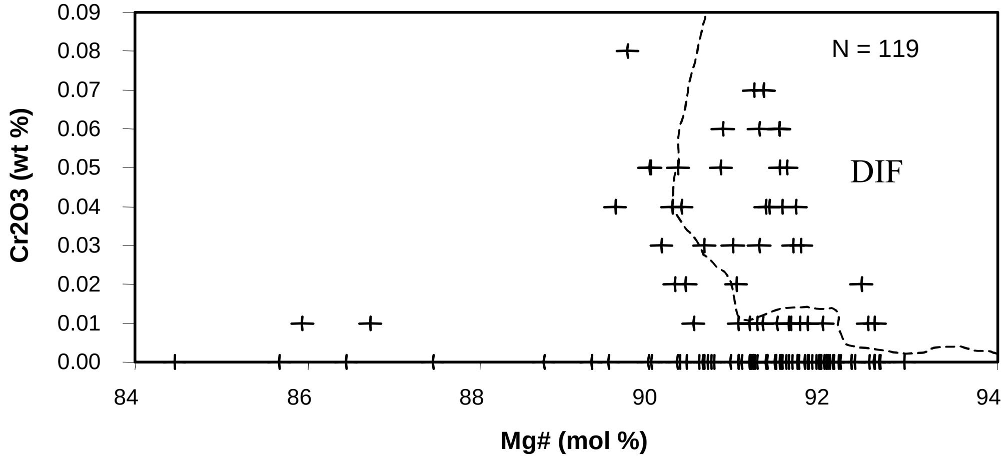
Olivine is well represented as an inclusion in diamonds from both kimberlites and lamproites, and characteristically is a highly magnesium-rich forsterite ($Fo_{90.2-96.6}$), with significant amounts of Ni (Fipke et al., 1995). All 119 olivine grains from the Peerless Lake area have a narrow range of Mg# (84.5-92.9 mol %) and an average of 91.2 mol % (Table 10; Figure 18A). Mitchell (1995) suggested that orangeites or Group II kimberlites (Fo_{91-93}) contain olivines that are higher in magnesium than those of most kimberlites (Fo_{88-90}), implying that their parental magmas were slightly more magnesian than kimberlite-forming magmas. Johnston (1973) showed that mineralogical differences are associated with textural distinctions; e.g., olivine in coarse-grained harzburgites exhibited Mg# of between 95.3 to 91.8 mol % while sheared peridotites exhibited Mg# of 91.6 to 86.4 mol %. Six grains, or 5% of the total olivine distribution, have Mg#s of less than 90 mol %, contain low to elevated Cr_2O_3 (up to 0.8 wt %) and TiO_2 (up to 0.3 wt %), and therefore, may be derived from either sheared lherzolite or megacrysts. The grains with the highest Mg#s (>92 mol %) are presumably derived from spinel lherzolites (16.8% of the total).

So far, attempts to correlate the minor-element concentrations in olivines with diamond potential have been unsuccessful. The Mg# is plotted against Cr_2O_3 and CaO (Figures 18B and 18C, respectively), and although olivine grains with high Mg# (> 90.3 mol %) and high Cr_2O_3 (> 0.01 wt %) plot within Fipke *et al*. (1995) diamond inclusion field, no conclusions are suggested.

A) Histogram of Mg# distribution.



B) Cr_2O_3 vs. Mg# plot. Dashed contour, diamond inclusion field (DIF) after Fipke et al. (1995).



C) CaO vs. Mg# plot.

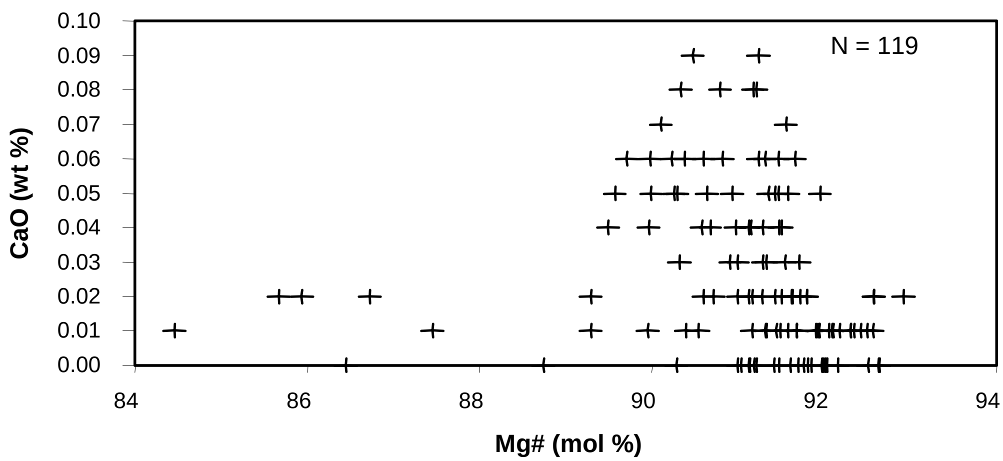


Figure 18. Scatter plots for selected olivine grains.

9.5 Chrome Spinel

Chrome spinel occurs as inclusions in diamond and in diamondiferous and non-diamondiferous mantle peridotites, crustal and mantle pyroxenites, and as cognate phases in mantle xenoliths. Chromite is a particularly useful indicator mineral due to its resistance to weathering and transportation. Microphenocrysts of atoll-textured chrome spinel from a variety of kimberlites in the Peerless Lake area were analyzed by Carlson et al. (1999) and plot along magmatic compositional trend 1, a trend diagnostic of kimberlite and often associated with group I kimberlites (Mitchell, 1995).

Table 11. Geochemical summary of selected chrome spinel grains from the Peerless Lake area

Parameter	Value	Unit
Total number (N)	71	
Minimum Cr_2O_3	31.34	wt %
Maximum Cr_2O_3	61.17	wt %
Average Cr_2O_3	48.92	wt %
Maximum TiO_2	4.95	wt %
Average TiO_2	0.64	wt %
Number with TiO_2 > 0.7 wt %	17	N
Percentage with TiO_2 > 0.7 wt %	23.94	%
Maximum Mg#	64.01	mol %
Average Mg#	41.93	mol %
Number with Zn > 0.25 wt %	6	n
Percentage with Zn > 0.25 wt %	8.45	%
Number of diamond inclusion-type spinels (Gurney et al., 1993)	0	n
Number of diamond inclusion-type spinels (Sobolev et al. 1992)	0	n

A total of 71 spinels, which were collected during this study from the Peerless Lake area, were analyzed by electron microprobe. The Cr_2O_3 content varies from 31.34 to 61.17 wt %, the TiO_2 content from 0.00 to 4.95 wt %, and the MgO content from 6.54 to 15.9 wt % (Table 11).

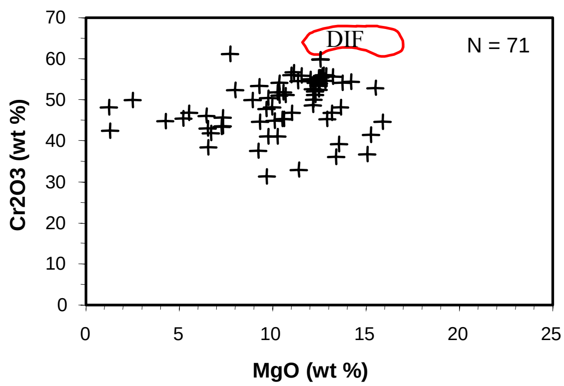
Geochemistry of chrome spinel from the Peerless Lake area is plotted on documented diamond-inclusion field plots of Cr_2O_3 versus MgO; Cr_2O_3 versus Al_2O_3; and Cr_2O_3 versus TiO_2 (Figures 19A to 19C, respectively). Not a single grain plots within the diamond-inclusion fields defined by Gurney et al. (1993) and Sobolev et al. (1992). Carlson et al. (1999), however, reported that the most common Buffalo Head Hills kimberlite spinels are aluminous magnesium chromites, which generally contain between 30 and 63.5 wt % Cr_2O_3, and that diamond-inclusion chromites are found throughout the Buffalo Head Hills kimberlite cluster, in both diamondiferous and barren kimberlites.

Although none of the 71 chrome spinel grains plot within the diamond-inclusion field, high-titanium spinels (i.e., >0.7 wt % TiO_2, after Sobolev et al., 1992) constitute 23.9% of the total population (Figure 19C and 19D). Such high-titanium and high-chromium (>42 wt % Cr_2O_3) spinels are unique to lamproites and kimberlites, including diamondiferous kimberlites (Fipke et al., 1995).

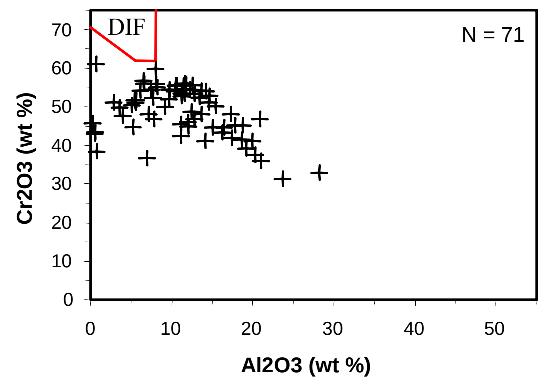
With respect to Zn content, the majority of the chrome spinels are of probable mantle origin, as shown by the inferred boundary between crustal and mantle spinels on Figure 19E. Only, six grains (8.45%) of the 71 spinels are identified as of probable crustal origin due to their elevated Zn content (grains from samples RE98-84B-16-002, RE98-84B-50-001, RE98-84B-59-001, RE98-84B-65-002, RE98-84B-128-001, and RE98-84B-135-001). The assumption that these are crustal spinels is confirmed by the low MgO content in these grains (1.22-6.45 wt %).

In summary, most of the chrome spinel grains from the Peerless Lake area contain a kimberlite chemical signature, defined by the presence of high TiO_2 with moderate to high Cr_2O_3 and low Zn content. However, the sample set is also characterized by some grains with low Cr_2O_3 values and an overall lack of spinels typical of diamond inclusion-type spinels.

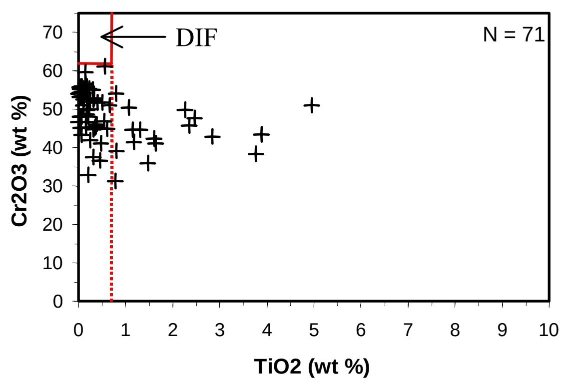
A) Cr_2O_3 vs. MgO plot. Solid contour, diamond inclusion field (DIF) after Gurney et al. (1993).



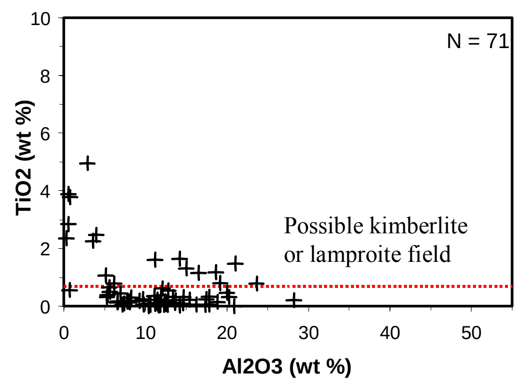
B) Cr_2O_3 vs. Al_2O_3 plot. Solid contour, DIF after Sobolev et al. (1992).



C) Cr_2O_3 vs. TiO_2 plot. Solid line, DIF; dashed line, low TiO_2 compositional limit after Sobolev et al. (1992).



D) TiO_2 vs. Al_2O_3 plot. Dashed line, same as figure 19c.



E) Zn vs. Ni plot. Dashed line, inferred boundary between crustal (>0.25 wt %) and mantle spinels.

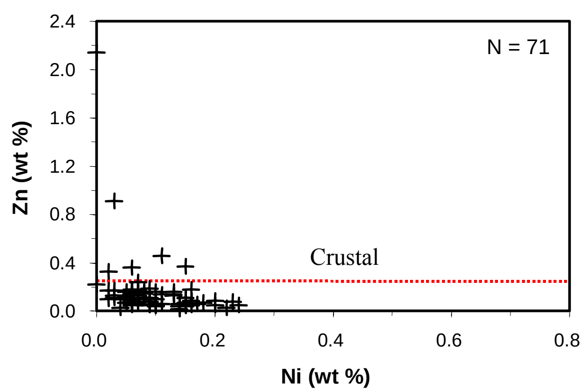


Figure 19. Scatter plots for selected chromite grains.

9.6 Ilmenite

Ilmenite is a common megacryst phase in many kimberlite localities, but also occurs in more 'crustal-derived' volcanic rocks with kimberlitic affinities, alkali basaltic breccia diatremes, carbonatites, and layered intrusive mafic rocks. Magnesium-rich ilmenite can occur in a variety of mineralogical associations and morphological types in kimberlitic rocks. It is generally a rare component of mantle xenoliths and occurs rarely as intergrowths or inclusions in diamond. Despite concerns that the presence of ilmenite may indicate diamond resorption in the upper mantle, Mg-rich ilmenite is still a commonly used heavy mineral in the exploration for diamondiferous rocks.

Only 12 ilmenite grains were analyzed from the Peerless Lake area; their chemistry is summarized in Table 12.

Table 12. Geochemical summary of selected ilmenite grains from the Peerless Lake area

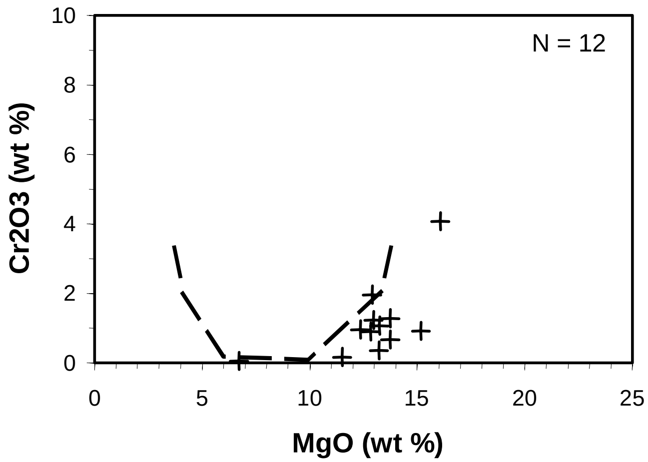
Parameter	*Value*	Unit
Total number (N)	12	
Hematite (<5%)	0.00	%
Hematite (5-10%)	16.67	%
Hematite (10-20%)	83.33	%
Hematite (>20%)	0.00	%
Cr_2O_3 (>0.5 wt %)	75.00	%
Geikielite (<10%)	0.00	%
Geikielite (10-20%)	0.00	%
Geikielite (20-30%)	8.33	%
Geikielite (30-50%)	25.00	%
Geikielite (>50%)	66.67	%
Minimum TiO_2	47.87	wt %
Maximum TiO_2	52.99	wt %
Average TiO_2	50.95	wt %
Minimum MgO	6.71	wt %
Maximum MgO	16.08	wt %
Average MgO	12.87	wt %
Maximum Cr_2O_3	4.08	wt %
Average Cr_2O_3	1.14	wt %
Maximum Al_2O_3	0.76	wt %
Average Al_2O_3	0.45	wt %

Haggerty (1975) first described a parabolic relationship between Cr_2O_3 and MgO in relatively coarse-grained ilmenites from kimberlites (Figure 20A). Moore and Gurney (1990) noted that the most significant characteristics of ilmenites in potentially diamondiferous areas is the presence of MgO-rich grains with elevated Cr_2O_3 and minimal Fe_2O_3 (low Fe^{3+}/Fe^{2+} ratio) contents. Figures 20A, B, and C show these compositional relationships for ilmenites from the Peerless Lake area.

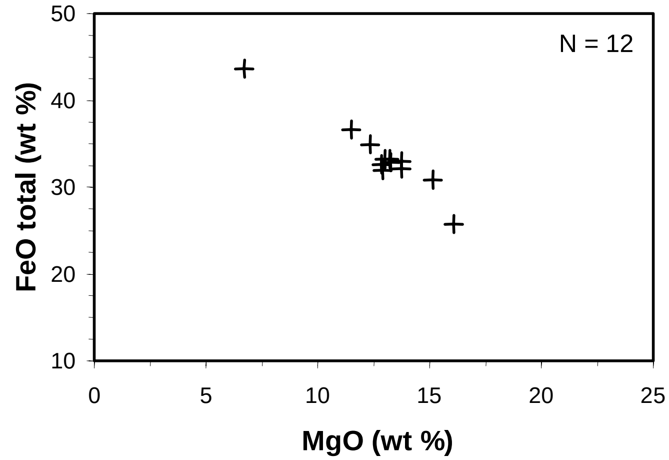
Elevated concentrations of MgO, combined with low Fe_2O_3 (assumed since high Fe^{3+} is associated with low MgO) and elevated Cr_2O_3 (75% of the grains have Cr_2O_3 content higher than 0.5 wt %), indicate that ilmenite grains from the map area have a high diamond-preservation potential. For example, Figure 20A shows a trend of increasing Cr_2O_3 with increasing MgO, that has been interpreted to be indicative of favourable conditions for diamond preservation. However, the elevated concentrations of Cr_2O_3 may be due to metasomatism of these grains, and more work is required to determine a suitable boundary between metasomatic and megacrystic ilmenite compositions. Nonetheless, the composition of ilmenite from the Peerless Lake area is generally consistent with reducing conditions, which in turn implies that diamond content will not be greatly affected by any resorption processes.

Finally, the compositional fields for kimberlitic ilmenite were plotted in the ternary systems geikielite ($MgTiO_3$)-ilmenite ($FeTiO_3$)-pyrophanite ($MnTiO_3$) and geikielite-ilmenite-hematite (Fe_2O_3) (Shee, 1984; Mitchell, 1995). Mitchell (1995) reported that kimberlitic groundmass ilmenites are members of the ilmenite-geikielite series (50-90 mol % $MgTiO_3$), that contain 5-10 mol % hematite. The bivariate diagram of MgO versus TiO_2 was used by Rodinov (1981) to measure the geikielite-hematite components of ilmenite. Figure 20D is such a plot, and shows that 11 of the 12 grains form a tight cluster in the MgO versus TiO_2 scatter plot, with a hematite component of approximately 8 to 14 mol %. A significant proportion of these grains (eight grains or 66.7%) has a geikielite component exceeding 50 mol %, which

A) Cr_2O_3 vs. MgO plot. Dashed line, parabolic curve from Haggerty (1975) for magnesian ilmenites from kimberlite.

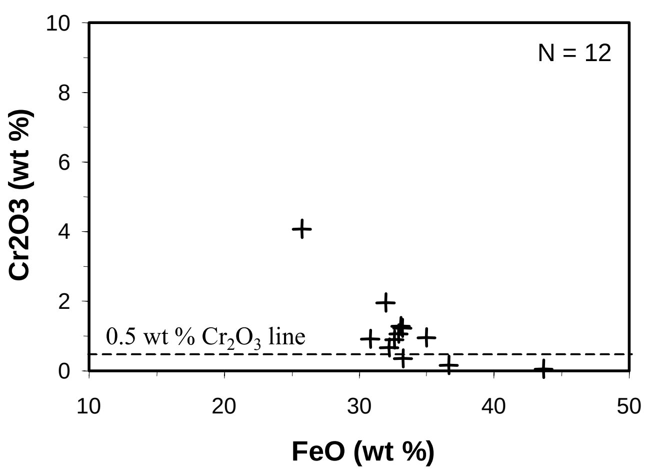


B) FeO (total) vs. MgO plot.



D) MgO vs. TiO_2 plot. Solid lines, hematite content grid (Fe_2O_3, mol %); dashed lines, geikielite content grid ($MgTiO_3$, mol %); IG50, 50% ilmenite and 50% geikielite composition point (modified from Rodinov, 1981)

C) Cr_2O_3 vs. FeO plot.



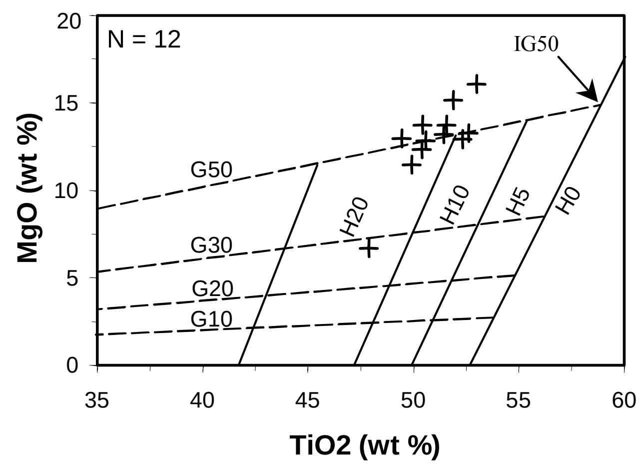


Figure 20. Scatter plots for selected ilmenite grains.

is considered indicative of a kimberlite origin. Only one single grain (RE98-84B-133-001) with the lowest MgO content has a compositional component that overlaps with ilmenite megacrysts from alkali basalts (Jones, 1984).

10 Indicator-Mineral Surface Morphology and Geochemical Comparisons

A variety of silicates (144) was examined under microbinoculars, including

- 54 peridotitic garnets (22 from stream sediment and 32 from till/glaciofluvial);
- 8 eclogitic garnets (3 from stream sediment and 5 from till/glaciofluvial);
- 60 chrome diopsides (10 from stream sediment and 50 from till/glaciofluvial); and
- 22 olivines (10 from stream sediment and 12 from till/glaciofluvial).

Their physical descriptions, including colour, clarity, lustre, shape, and surface characteristics, are presented in Appendix 4.

Selected peridotitic garnet and clinopyroxene grains were divided into 'groups' with common physical properties. These groups were marked and analyzed by electron microprobe to investigate the possibility that the physical features of the indicator grains may be indicative of geochemical properties. The geochemical results are presented by indicator mineral type on scatter plots, with a generalized physical description used for the specific grouping. The reader is referred to Appendix 4 for a more detailed description of the physical grouping.

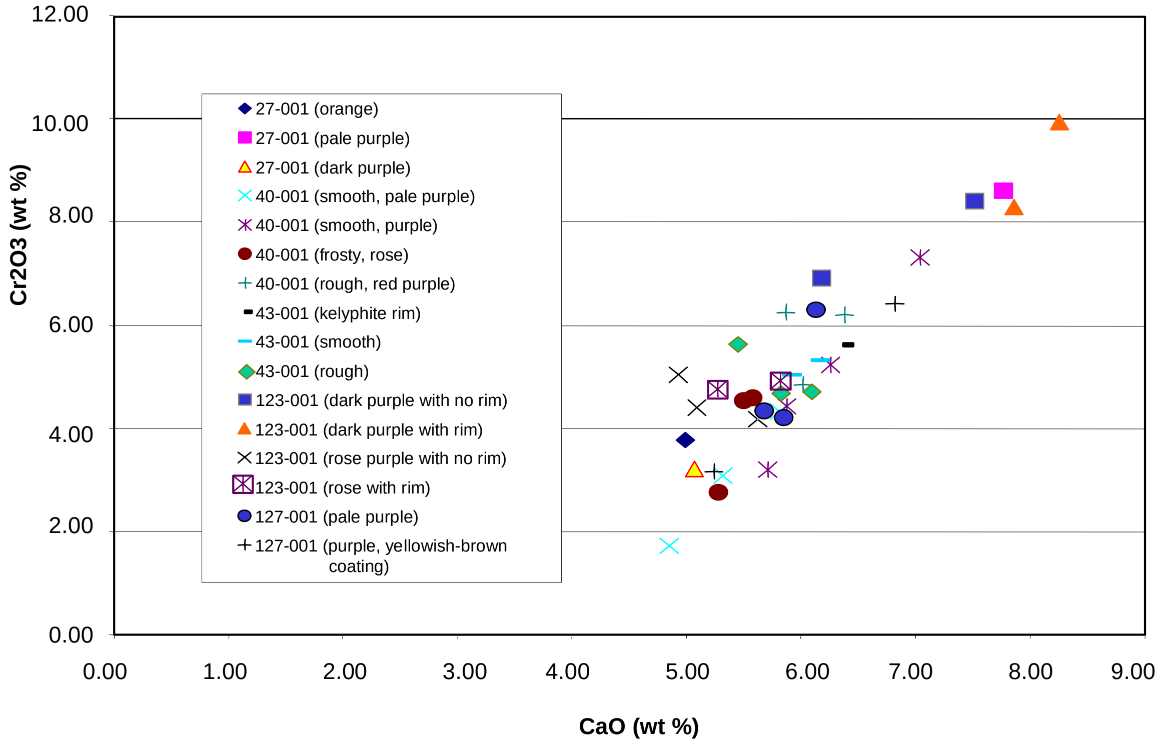
10.1 Peridotitic Garnets

The peridotitic (G9) garnets typically are various shades of purple, red, rose or pink, and brown, and with respect to their geochemistry are Cr- or Ti-bearing. The garnet grains habits are typically rhombic dodecahedral, often modified with form {110} and {211} being most prevalent. This habit is similar to those documented by Carlson et al. (1999) from the Buffalo Head Hills kimberlites. As well, the grains frequently have non-pristine surface features, such as pitting and/or fibrous kelyphite reaction rims.

Forty-one peridotitic garnets, from five sample sites, were grouped according to various physical attributes prior to analysis by microprobe. Three grains were selected from sample RE98-84B-27-001, and divided by colour into three groups: orange, pale purple, and dark purple. Fourteen grains were selected from sample RE98-84B-40-001, and divided by colour and surface characteristics into four groups: smooth and pale purple, smooth and purple, frosty and rose-purple, and rough and red-purple. Six grains were selected from sample RE98-84B-43-001 and divided into three groups based on surface texture: with kelyphite rim, smooth, and rough. Eleven grains from sample RE98-84B-123-001 were grouped by colour and the presence/absence of a kelyphite rim: dark purple with no rim, dark purple with a rim, rose purple with no rim, and rose purple with a rim. Seven grains were selected from sample RE98-84B-127-001 and grouped by the presence of a yellowish brown coating on dark purple grains.

Some previous studies to test the use of colorimetric properties of garnet in determining the source of the grains have concluded that there are no clear-cut associations the colour properties and the paragenesis of garnet (Manson and Stockton, 1981; Hearn and McGee, 1983). The Cr_2O_3 versus CaO plot (Figure 21A), showed a wide spread of G9 chemistry in the garnets selected for this test. A weak positive correlation was detected between the colour and composition of the peridotitic garnets in that dark purple peridotitic garnets are generally higher in Cr_2O_3. For example, grains from sample RE98-84B-123-001 show that the chromium content in the garnet influences the colour, with dark purple grains contain more than 8.0 wt %

A) Selected peridotitic garnets.



B) Selected clinopyroxenes.

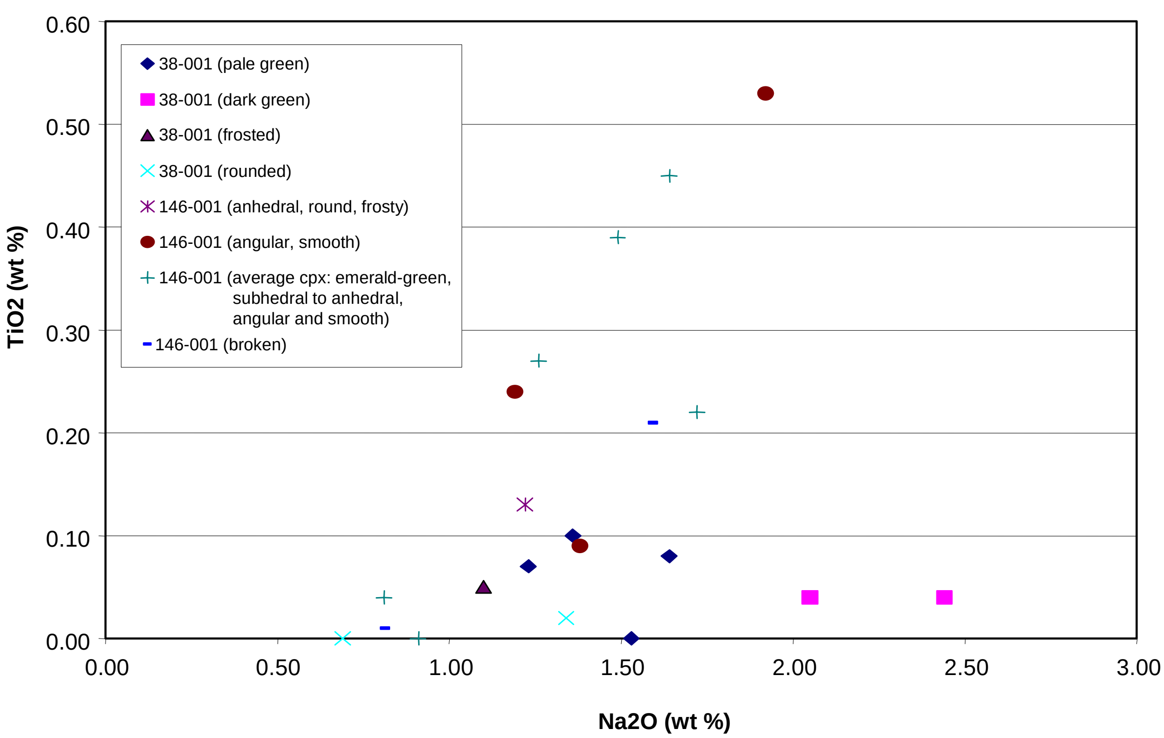


Figure 21. Geochemical comparisons between selected groups of peridotitic garnet and clinopyroxene grains that have similar physical and surface morphologies.

Cr_2O_3 and rose-coloured grains contain between 4.0 and 5.0 wt % Cr_2O_3. Grains from sample RE98-84B-40-001 also contain low Cr_2O_3 values (1.72-4.33 wt %) for pale purple garnets versus high Cr_2O_3 values (3.20-7.31 wt %) for dark purple grains. In contrast, however, grains from sample RE98-84B-27-001 show the opposite, where a pale purple grain contains 8.61 wt % Cr_2O_3 and a dark purple grain only 3.21 wt % Cr_2O_3. Thus, no definite or unequivocal correlation could be established between the physical character (colour and surface features) of the garnets from the Peerless Lake area with their chemistry.

10.2 Clinopyroxene (Chrome Diposide)

The clinopyroxene grains from the Peerless Lake area are typically light green to emerald green, rounded, transparent to translucent, vitreous, and commonly have etched terminations.

Twenty-four chrome diopsides were grouped according to their physical attributes from two sample sites prior to microprobe analysis. Ten grains were selected from sample RE98-84B-38-001 and grouped, on the basis of colour and surface characteristics, into faded green, dark green, frosted, and rounded. Fourteen grains were selected from sample RE98-84B-146-001 and grouped, by form, shape, and surface characteristics, into 1) anhedral, rounded, and frosty; 2) subhedral, angular, and smooth; 3) “average” chrome diopsides characterized by emerald-green colour, subeuhedral to anhedral, semi-angular to semirounded; and 4) angular or potentially broken. The geochemical distribution of the selected grains on the plot of TiO_2 versus Na_2O shows two distinct groups that are based more on the sample number (i.e., sample location) than on the surface morphology of the grains (Figure 21B). That is, grains from sample RE98-84B-38-001 contain higher concentrations of TiO_2 than those from sample RE98-84B-146-001, which also has a much wider Na_2O distribution.

11 Metallic-Mineral Potential

While the Peerless Lake map area is now known to be favourable for the emplacement of diamondiferous kimberlites, the metallic mineral potential is, at this time, poorly known. One could probably have reached the same conclusion about kimberlite potential as little as five years ago (i.e., prior to kimberlite discovery). The area is largely covered by a thick, complex veneer dominated by glacial and glaciofluvial deposits, which makes exploration very difficult because there are few outcrops available for prospecting or sampling. Except for bedrock exposures along the Wabasca River and a potential outcrop of Cretaceous sedimentary rocks in the northwest part of the map area, bedrock sampling during this reconnaissance ‘surface’ sampling survey was not possible.

All 184 samples, including stream-sediment HMC, till, and glaciofluvial samples, were evaluated for visible gold grains. Twenty-five samples, or about 14% of all samples, contain concentrations of microscopic gold (Figure 22; Table 13). Most samples contained only a single grain of gold, and only nine of the 184 samples contained two or three gold grains. As well, six till samples (out of 69 till samples) collected by the AGS contain visible gold grains (Mark Fenton and John Pawlowicz, personal communication, August, 1999). None of the gold grains exhibit a delicate surface morphology indicative of a proximal, local origin. Instead, the surface morphology of most grains are abraded and typical of placer type gold. In addition, the gold-grain concentrations are scattered throughout the Peerless Lake map area, making it difficult to suggest that any one area is more ‘anomalous’ than another.

Carlson et al. (1999) reported the occurrence of pyrite (up to 10%) in kimberlites associated with the K7 complex (kimberlites K7A, K7B, and K7C). The pyrite is present as disseminations in the total mineral assemblage, and as a replacement of olivine phenocrysts and various biogenic material. Chalcopyrite, ilmenite, rutile, sphalerite, millerite, and an unidentified Ca-rare earth element phosphate have also been

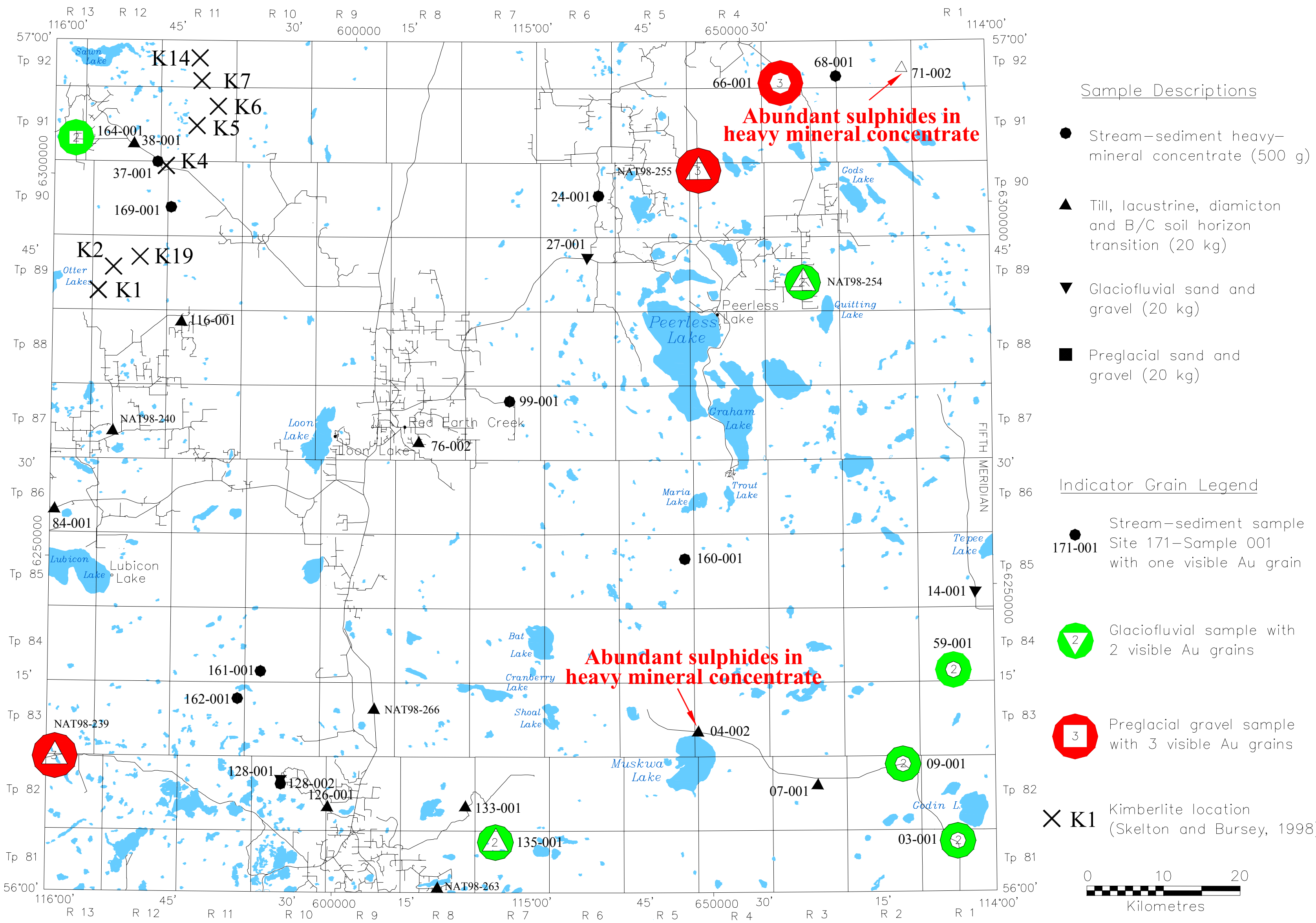


Figure 22. Visible gold grain counts from samples collected from the Peerless Lake area.

Table 13. Visible gold grain count and description.

Samples	Sample Type	Sample weight (g)	Number of Au grains	Largest grain Width x length (microns)	Average size Width x length (microns)	Grain description (# of grains - I, A)*
RE98-84B-03-001	Stream-sediment HMC	650.40	2	100x120	80x110	2 - A
RE98-84B-04-002	Stream-sediment HMC	391.60	1	140x240	140x240	1 - A
RE98-84B-07-001	Stream-sediment HMC	792.00	1	160x260	160x260	1 - A
RE98-84B-09-001	Stream-sediment HMC	459.60	2	200x200	160x160	2 - A
RE98-84B-14-001	Glaciofluvial (25 kg)	27.80	1	80x120	80x120	1 - A
RE98-84B-24-001	Stream-sediment HMC	24.70	1	60x140	60x140	1 - I
RE98-84B-27-001	Glaciofluvial (25 kg)	29.00	1	80x140	80x140	1 - A
RE98-84B-37-001	Diamicton (25 kg)	29.95	1	40x40	40x40	1 - A
RE98-84B-38-001	Glaciofluvial (25 kg)	21.95	1	80x160	80x160	1 - A
RE98-84B-59-001	Stream-sediment HMC	611.10	2	180x200	170x180	2 - A
RE98-84B-66-001	Stream-sediment HMC	659.80	3	240x320	130x180	3 - A
RE98-84B-68-001	Stream-sediment HMC	721.10	1	120x200	120x200	1 - A
RE98-84B-76-001	Glaciofluvial (25 kg)	30.90	1	20x80	20x80	1 - I
RE98-84B-84-001	B-C horizon-till (25 kg)	23.70	1	120x140	120x140	1 - I
RE98-84B-99-001	Stream-sediment HMC	478.30	1	100x100	100x100	1 - I
RE98-84B-128-002	Stream-sediment HMC	423.40	1	740x1040	740x1040	1 - A
RE98-84B-116-001	Till (25 kg)	28.85	1	100x140	100x140	1 - A
RE98-84B-126-001	B-C horizon-till (25 kg)	25.35	1	120x200	120x200	1 - A
RE98-84B-133-001	B-C horizon-till (25 kg)	29.45	1	140x300	140x300	1 - A
RE98-84B-135-001	Diamicton (25 kg)	26.75	2	280x380	220x290	2 - A
RE98-84B-160-001	Stream-sediment HMC	599.20	1	180x240	180x240	1 - A
RE98-84B-161-001	Stream-sediment HMC	790.00	1	400x420	400x420	1 - A
RE98-84B-162-001	Stream-sediment HMC	643.80	1	80x180	80x180	1 - A
RE98-84B-164-001	Preglacial S&G (25 kg)	37.25	2	120x220	110x220	2 - I
RE98-84B-169-001	Stream-sediment HMC	501.80	1	180x220	180x220	1 - A
NAT98-239	Till (25 kg)	29.10	3	60x160	40x80	3 - A
NAT98-240	Till (25 kg)	30.90	1	0x40	0x40	1 - A
NAT98-254	Till (25 kg)	32.60	2	100x120	60x110	2 - A
NAT98-255	Till (25 kg)	30.50	3	80x120	60x110	3 - I
NAT98-263	Till (25 kg)	31.50	1	40x60	40x60	1 - A
NAT98-266	Till (25 kg)	33.05	1	40x100	40x100	1 - I

* I = Irregular
A = Abraded (placer-type Au)

identified in trace amounts. From the current study, there is no direct correlation between elevated concentrations of sulphide minerals in the HMCs and the kimberlite locations, or the locations of samples that contain a significant number of indicator minerals. In fact, only two HMC samples contain elevated sulphide contents. Till HMCs from two sample sites (RE98-84B-04-002 and RE98-84B-71-002) in the eastern half of the Peerless Lake area contain abundant sulphide minerals (Figure 22).

A preliminary study of the stable isotope composition (carbon and oxygen) of carbonate minerals (calcite and dolomite) in the Paleozoic rocks in the subsurface was initiated in order to constrain temperatures of formation, which may indicate the impact of hydrothermal (potentially mineralizing) fluids. Negative deviations in the stable oxygen isotope composition ($\delta^{18}O$) from "normal" background values of the carbonate rocks (reflecting the processes of marine deposition and subsequent diagenesis during burial) can be generally attributed to the local influence of elevated temperatures and/or the involvement of fluids depleted in ^{18}O relative to seawater (i.e., meteoric water). The effect of temperature and fluid composition on the carbon isotope composition ($\delta^{13}C$) of carbonate rocks is less pronounced, due to the large quantity of carbon in the rock compared to that in the fluid (rock-buffering effect). However, carbon released as a result of biological and inorganic degradation of organic matter (i.e., during biochemical and thermochemical sulfate reduction, respectively) and incorporated into newly precipitated carbonate minerals will result in negative $\delta^{13}C$ values relative to marine carbonate.

Since the bedrock exposure in the Peerless Lake area is poor and drill core material of the Paleozoic carbonate rocks is scarce, subsurface drill cuttings from the Upper Devonian Winterburn Group were described and sampled in 12 wells. Bietting (2000), in conjunction with the AGS and University of Alberta, analyzed the $\delta^{18}O$ and $\delta^{13}C$ isotope composition of 5 calcite and 14 dolomite grains, which were hand-picked from three oil/gas wells located close to fault zones interpreted to propagate through Phanerozoic sedimentary rocks by Eccles et al. (2000). The faults are interpreted to act as ‘pathways’ for the emplacement of kimberlitic diatremes in the Peerless Lake area. The objective of the stable isotope study was to determine if there is any evidence of elevated temperatures in the Devonian dolomite. That is, could tectonic zones in the Phanerozoic strata act as conduits for other commodities (e.g., metalliferous penecontemporaneous synsedimentary ‘sedex’ type deposits or later epigenetic deposits).

Crystalline sucrosic dolomite, saddle dolomite and clear, inclusion-free calcite were reacted with phosphoric acid using the methodology of McCrea (1950); the resultant CO_2 was analyzed in a Finnigan-MAT 252 mass spectrometer a the University of Alberta. Matthias Grobe, AGS, using the equations below, recalculated the data presented by Bietting (2000), assuming possible endmember isotope compositions for the fluids (Faure, 1990). In general, subsurface fluids may have originated as meteoric water, seawater, formation waters, as well as metamorphic and magmatic waters or mixtures thereof. The data are presented in Table 14 and Figure 23. Since there is no other data available to constrain the temperature conditions and fluid compositions at this point in time, the results have to be considered preliminary.

Table 14. Calculated temperatures and fluid compositions from Peerless Lake Winterburn Formation calcite and dolomite d18O SMOW.

Calcite	Well name	Location	General well cutting calcite/dolomite description	Sulphide/iron-staining	Calcite and corrected dolomite* $\delta^{18}O$ PDB	$\delta^{18}O$ SMOW (per mil)	Marine water scenarios: Calculated Temperature (°C) 0 per mil $\delta^{18}O$ SMOW**	Marine water scenarios: Calculated Temperature (°C) Minus 3 per mil $\delta^{18}O$ SMOW***	Magmatic water scenarios: Calculated Temperature (°C) 5.5 per mil $\delta^{18}O$ SMOW	Magmatic water scenarios: Calculated Temperature (°C) 10 per mil $\delta^{18}O$ SMOW***	Metamorphic water scenarios: Calculated Temperature (°C) 5 per mil $\delta^{18}O$ SMOW	Metamorphic water scenarios: Calculated Temperature (°C) 25 per mil $\delta^{18}O$ SMOW***
1-2100	Union Red Earth	8-6-91-8W5	Translucent calcite (4%)	Pyrite and marcasite (1%)/minor iron-staining	-6.59	24.120	48	31	86	131	82	903
1-2160	Union Red Earth	8-6-91-8W5	Translucent calcite (4%)	Pyrite and marcasite (1%)/minor iron-staining	-13.91	16.572	105	79	173	269	165	NC
1-2220	Union Red Earth	8-6-91-8W5	Translucent calcite (4%)	Pyrite and marcasite (1%)/minor iron-staining	-7.02	23.672	50	34	90	137	86	1061
1-2310	Union Red Earth	8-6-91-8W5	Translucent calcite (4%)	No sulphides visible	-5.00	25.760	38	23	73	113	70	600
1-2340	Union Red Earth	8-6-91-8W5	Translucent calcite (4%)	Pyrite (1%)	-7.35	23.338	52	35	93	141	89	1231
Dolomite												
1-2100Su	Union Red Earth	8-6-91-8W5	Grey-tan sucrosic xl'ine dolomite (95%)	Pyrite and marcasite (1%)/minor iron-staining	-6.54	23.562	71	51	116	165	115	1030
1-2160Su	Union Red Earth	8-6-91-8W5	Grey-tan sucrosic xl'ine dolomite (95%)	Pyrite and marcasite (1%)/minor iron-staining	-6.57	23.534	71	51	116	165	115	1040
1-2220Su	Union Red Earth	8-6-91-8W5	Grey-tan sucrosic xl'ine dolomite (95%)	Pyrite and marcasite (1%)/minor iron-staining	-6.90	23.201	74	53	119	169	119	1184
1-2280Su	Union Red Earth	8-6-91-8W5	Grey-tan sucrosic xl'ine dolomite (95%)	Pyrite and marcasite (1%)/minor iron-staining	-6.68	23.416	72	52	117	167	117	1086
1-2310Su	Union Red Earth	8-6-91-8W5	Brown, sucrosic xl'ine dolomite (90%)	No sulphides visible	-6.38	23.717	70	50	114	163	113	977
1-2340Su A	Union Red Earth	8-6-91-8W5	Tan, sucrosic xl'ine dolomite (90%); trace saddle dolomite	Pyrite (1%)	-6.09	24.011	68	48	112	159	110	893
1-2340Su B	Union Red Earth	8-6-91-8W5	Tan, sucrosic xl'ine dolomite (90%); trace saddle dolomite	Pyrite (1%)	-6.21	23.89	69	49	113	160	112	925
1-2400Su	Union Red Earth	8-6-91-8W5	Tan, sucrosic xl'ine dolomite (90%); trace saddle dolomite	Pyrite (1-2%)	-6.20	23.905	69	49	113	160	111	921
1-2460Su	Union Red Earth	8-6-91-8W5	Grey sucrosic xl'ine dolomite (45%); saddle dolomite (50%)	Pyrite blebs and marcasite/iron-staining	-6.16	23.939	68	49	112	160	111	912
1-2580Su	Union Red Earth	8-6-91-8W5	Grey-tan sucrosic xl'ine dolomite (85%); saddle dolomite (10%)	Pyrite and marcasite (1%)/minor iron-staining	-5.88	24.22	66	47	110	156	108	842
1-2640Su	Union Red Earth	8-6-91-8W5	Grey-tan sucrosic xl'ine dolomite (50%); saddle dolomite (15%)	Pyrite and marcasite (3%)/iron-staining	-7.27	22.831	77	56	123	174	123	1417
2-1330Sd	Reserve Gulf Mesa Sedex	10-18-91-2W5	Brown, sucrosic xl'ine dolomite (35%)	Pyrite and marcasite (5%), chalcopyrite/iron-staining	-14.97	15.13	157	120	227	346	254	NC
2-1340Su	Reserve Gulf Mesa Sedex	10-18-91-2W5	Brown, sucrosic xl'ine dolomite (35%)	Pyrite and marcasite (5%), chalcopyrite/iron-staining	-6.49	23.607	71	51	115	164	115	1014
3-620Su	Unocal Kidney	5-18-90-5W5	Brown, finely xl'ine dolomite (5%)	Pyrite and galena (1%)/prevasive iron staining	-10.69	19.412	106	80	160	231	168	NC

* using 0.82 as phosphoric acid fractionation correction (Sharma and Clayton, 1964)

** assuming normal marine seawater had a constant value of 0 per mil SMOW (Muehlenbachs and Clayton 1976)

*** assuming lower limit of oxygen isotope composition of Upper Devonian marine seawater was -3 per mil SMOW (Carpenter et al., 1991)

NC Not calculated

- calculated temperature (˚C) of calcite using the equation of Friedman and O'Neil (1977) for marine, magmatic and metamorphic water between 0˚ and 500˚C

$$1000 \ln\alpha_{\text{Calcite-water}} = 2.78 \times 10^6/T^2 - 2.89$$

- calculated temperature (˚C) of dolomite using the equation of Fritz and Smith (1970) for marine water between 25˚ and 78.6˚C

$$1000 \ln\alpha_{\text{Dolomite-water}} = 2.78 \times 10^6/T^2 + 0.11$$

- calculated temperature (˚C) of dolomite using the equation of Sheppard and Schwarcz (1970) for magmatic and metamorphic water between 100˚ and 650˚C

$$1000 \ln\alpha_{\text{Dolomite-water}} = 3.23 \times 10^6/T^2 - 3.29$$

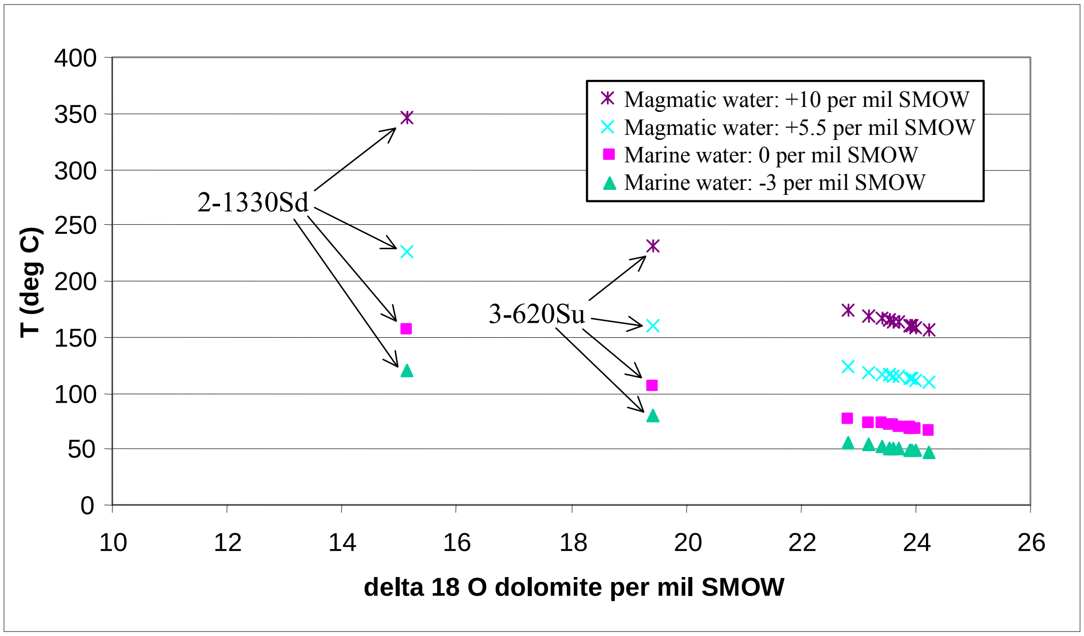
The majority (12 of 14, or 86% of the total) of the analysed dolomite samples have $\delta^{18}O$ values of between 22.831 and 24.011 ‰SMOW (Figure 23A and 23B). The average calculated temperature in marine, magmatic and metamorphic waters for these 12 closely grouped grains include:

- 71˚C for marine water with an assumed $\delta^{18}O$ value of 0 ‰ SMOW (Muehlenbachs and Clayton, 1976);
- 51˚C for Upper Devonian marine water with an assumed $\delta^{18}O$ value -3 ‰ SMOW (Carpenter et al., 1991);
- 115˚C for magmatic water with an assumed $\delta^{18}O$ value of 5.5 ‰ SMOW (Faure, 1990);
- 164˚C for magmatic water with an assumed fluid composition of 10 ‰ SMOW (Faure, 1990);
- 114˚C for metamorphic water with an assumed $\delta^{18}O$ value of 5 ‰ SMOW (note that the data for metamorphic water with an assumed $\delta^{18}O$ value of 25 ‰ SMOW are not reliable because the calculated temperatures fall outside of the validity range of the empirical equation; range of $\delta^{18}O$ values of metamorphic waters from Faure, 1990)

Samples 2-1330Sd and 3-620Su have anomalous $\delta^{18}O$ values of 15.13 and 19.412, respectively, suggesting the influence of elevated temperatures and/or the involvement of fluids depleted in ^{18}O. Sample 2-1330Sd, collected from Reserve Gulf Mesa Sedex (10-18-91-2W5), yields the highest temperature values. For example, assuming magmatic water with a $\delta^{18}O$ value of 10 ‰ SMOW, samples 2-1330Sd and 3-620Su yielded calculated temperatures of 346˚C and 231˚C, respectively. Sample 2-1330Sd also contains a highly negative $\delta^{13}C$ value of –23.256 ‰ PDB (Figure 23B), suggesting the influence of 'light' carbon as a result of the degradation of organic matter. Interestingly, the 'hot' samples (2-1330Sd and 3-620Su) also contain the highest volume of sulphides observed in the drill cuttings including pyrite, marcasite and even the occurrence of galena.

Although the temperature calculations are preliminary, the data suggests that the Devonian carbonates have been impacted by fluids with elevated temperatures, and hence, the potential does exist for metallic mineral commodities in the Peerless Lake area. Further research is recommended to further constrain temperatures of formation and fluid compositions using fluid inclusions and/or stable isotope work on the fluid inclusions, and to relate subsurface geochemical analysis to practical exploration techniques for industry.

A) Formation temperature scenarios



B) Bi-variate plot of $\delta^{13}C$ versus $\delta^{18}O$

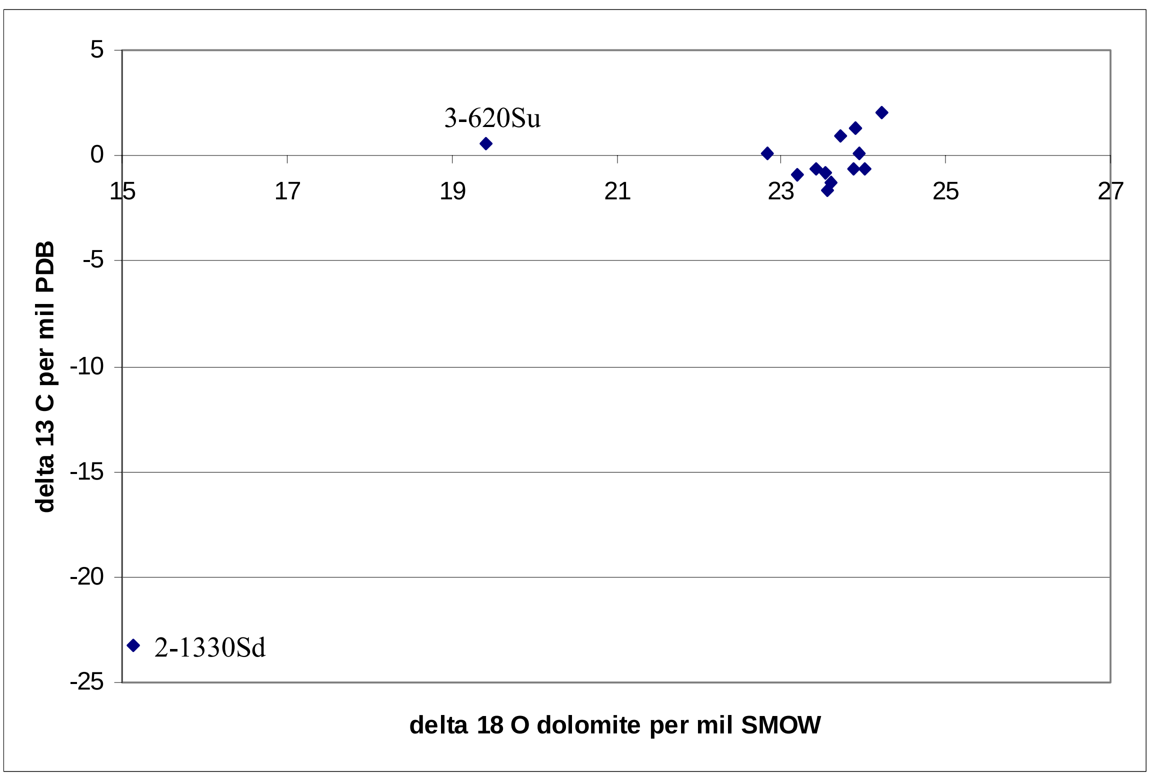


Figure 23. Geochemical comparisons of stable isotopes from the Peerless Lake.

12 Conclusions

More than 2000 silicate and oxide grains were recovered from the heavy-mineral concentrates (HMC) of 184 stream-sediment, glaciofluvial and glacial-deposit samples that were collected in the Peerless Lake area during 1998. The geochemical survey yielded some of the largest suites of kimberlite indicator minerals (for an individual sample) recovered to date by government sampling in Alberta. For example, an anomaly centred on sample site RE98-84B-40-001, in the northwest corner of the map area, yielded 236 peridotitic garnets, 5 eclogitic garnets, 14 chrome diopsides, and 50 olivines (all 'possible' indicator grains, prior to confirmation by electron microprobe analysis).

The spatial distribution of silicate kimberlite-indicator minerals, particularly peridotitic garnet and olivine grains, clearly show four areas with elevated grain counts exist in the Peerless Lake map area:

Peerless Lake area: northwest of Goodfish and Peerless lakes and believed to be in close proximity to the locations of more recent kimberlite discoveries (BM2, BM3, and LL8);

Sawn Lake area: the anomaly comprises a cluster of very high indicator grain counts in the northwest corner of the map area adjacent to kimberlite K4;

Otter Lakes area: located directly east of Otter Lakes and close to kimberlite K1 (kimberlites K2 and K19 also occur north and northeast of the sample); and

Whitefish Tower area: the anomaly comprises a large area of high indicator grain counts in the southwest part of the Peerless Lake map area that is not currently linked to any known kimberlite cluster.

In general, sample sites with elevated counts of indicator-mineral grains in the Peerless Lake map area are independent of the sample media used in this study. That is, high grain counts were observed in stream-sediment and glacial deposits of all types. Three of the four 'target' areas are close to known kimberlite(s). This may reflect: 1) a relatively proximal occurrence of indicator minerals to the kimberlite source, and/or 2) the concentration of indicator-mineral grains resulting from surficial processess (e.g., placer deposits in streams), but with the original source being distal. However, the fact that 3 of the 4 locales with abundant indicator-mineral grains (i.e., southeast of Sawn Lake, east of Otter Lakes and north of Peerless Lake), occur where there are known kimberlites, indicates that heavy mineral sampling conclusively works in the Peerless Lake area. Heavy mineral sampling must therefore, be recognized as a valuable exploration tool in other areas of Alberta that are similarly covered with complex surficial deposits of glacial origin. In addition, a widespread area of indicator minerals in the southwest part of the Peerless Lake map area (Whitefish Tower area), identified by the current study, may indicate this area is favourable for the existence of currently undiscovered kimberlite.

A total of 606 grains was selected for electron microprobe analysis. It is important to note that the data presented in the current study represent a reconnaissance study of the entire Peerless Lake 1:250 000 map area and include indicator minerals derived from only a few pipes. Hence, the data should in no way be interpreted to categorize the entire Buffalo Head Hills kimberlite cluster.

With few exceptions, most indicators studied were derived from kimberlite. Based on the few samples analyzed, the sampled mantle source is predominately lherzolitic, with minor harzburgitic and eclogitic/pyroxenitic constituents. Peridotitic garnet chemistry in the Peerless Lake area can be rated as being of moderate to high interest based on the presence of a G10 grain, a wide G9 range, and a relatively high knorringite component. Further studies are recommended to investigate a reported relationship by

Carlson et al. (1999) between the G9 chemistry from the Buffalo Head Hills pipes with elevated concentrations of diamond content.

In addition to the garnet data, clinopyroxene grains derived from garnet lherzolite, eclogite/pyroxenite, and spinel lherzolite sources can be identified. A distinct group of 28 grains is characterized by high Al_2O_3 (>5.0 wt %) and high TiO_2 (>0.18 wt %). Two clinopyroxene grains had high concentrations of Na_2O, Al_2O_3, and K_2O, which is considered indicative of diamond potential. Nineteen clinopyroxene grains (15%) contained more than 0.08 wt % K_2O. High TiO2 and moderate to high Cr_2O_3 characterize most of the chrome spinel grains in the Peerless Lake area. While these geochemical signatures are indicative of kimberlite chrome spinels, most grains also have low Cr_2O_3 contents and therefore do not resemble diamond inclusion-type spinels, such as those documented by Gurney et al. (1993) and Sobolev et al. (1992). Ilmenite grains from the Peerless Lake area contain elevated concentrations of MgO, combined with low a Fe_2O_3 and elevated Cr_2O_3 (75% of the grains contain more than 0.5 wt % Cr_2O_3), which is indicative of high diamond-preservation potential.

The results of the geochemical survey show that the Peerless Lake area in north-central Alberta has the potential to host a major diamond deposit or deposits. The data in the current study represent one of the first regional indicator-mineral studies close to a known diamondiferous kimberlite cluster in Alberta, hence the information will benefit exploration companies who are developing sampling strategies in other parts of Alberta. That is, quantitative and qualitative trends of kimberlite-indicator minerals from an area with known kimberlitic diatremes will enable better interpretation of possible indicator trains and enhance future discoveries throughout Alberta.

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Appendix 1

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Dinoflagellates, Pollen, Spores

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PALYNOLOGY OF ONE SAMPLE FROM BUFFALO HEAD HILLS

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Report prepared for R. Eccles, Alberta Geological Survey

One sample from the southeastern flank of the Buffalo Head Hills was examined for palynomorphs to determine the age. The sample contains a rich and diverse pollen flora and a few dinoflagellates. The assemblage is dominated by pollen of a few species of conifers which occur in the Cretaceous. Angiosperm pollen is common including the following species: *Aquilapollenites attenuatus*, *A. clarireticulatus*, *A. insignis*, *A. quadrilobus*, *A. reticulatus*, *A. rigidus*, *A. stelckii*, *A. trialatus uniformis*, *A. turbidus*, *Azonia cribrata*, *Cranwellia striata*, *Erdtmanipollis procumbentiformis*, *Fibulapollis scabratus*, *Quadripollis krempii*, *Mancicorpus calvus*. Among the few dinoflagellates present are *Chatangiella ditissima*, *Isabelidinium microarmum*, *Leberidocysta chlamydata*, *Laciniadinium arcticum*, *Senegalinium obscurum*, *Spongodinium delitiense*.

The palynological assemblage in the Buffalo Head Hills sample is clearly Late Cretaceous. The many angiosperm species present suggest an Early Maastrichtian age and there is no indication that the sample is as old as Late Campanian. The dinoflagellates provide agreement with the age determination. The determination of Early Maastrichtian suggests that the sample is not from the Puskwaskau Formation which is considered to be of Santonian age. The sample does not contain pollen species of Tertiary or younger age.

December 20,1998

Appendix 2a. Sample-site descriptions from stream- sediment heavy-mineral concentrate samples.

Sample Number	Location		Field Rating	Trap	Trap	Relation to Barrier		Material				Packing	Texture	Clast	Largest Clast		Water
	East	North		Location	Decscription	Horizontal	Vertical	Cobble	Pebble	Granule	Sand/Silt			Lithology %	Size (cm)	Lithology	Velocity
RE-84B-01-001	676260	6223569	Poor-Mod	Channel Bar	Channel Bar Near Bank	None	No Drop	50-20	<5	>50	20-50	Loose	Matrix Supported	Gr 70%	20	Granitic	Slow
RE-84B-02-001	678967	6218934	Mod-Good	Main Channel	Boulder Obstruction	Downstream	Drop <30 cm	<5	<5		>50	Slightly Loose	Matrix Supported	Gn30%/Gr60%/Q10%	80	Granitic	Slow
RE-84B-03-001	681721	6211610	Mod-Good	Main Channel	Boulder Obstruction	Downstream	No Drop	<5	20_5	20_5	>50	Loose	Matrix Supported	Ss5%/Gn5%/Gr35%/Q10%	650	Granitic	Slow
RE-84B-04-002	647351	6229341	Poor	Channel Edge Inside	Back of Creek	None	No Drop			20_5	>50	Slightly Loose	Matrix Supported		0	unknown	Inert
RE-84B-05-001	654261	6226910	Poor	Main Channel	No Real Trap	None	No Drop		<5	20_5	>50	Firm	Matrix Supported	Gr90%/Q10%	14	Granitic	Inert
RE-84B-06-002	663235	6223803	Mod-Good	Main Channel	Boulder Obstruction	Downstream	Drop >30 cm	20_5	20_5	20_5	>50	Firm	Intermediate	Gn10%/Gr80%/Q10%	90	Granitic	Slow
RE-84B-07-001	666300	6223957	Mod	Main Channel	Boulder Obstruction	Downstream	No Drop	20_5	50-20	20_5	20_5	Firm	Clast Supported	Ss5%/Gr30-50%/Q20%	50	Granitic	Slow
RE-84B-08-001	668415	6224100	Poor-Mod	Main Channel	Boulder Obstruction	Downstream	Drop <30 cm	20_5	20_5	50-20	50-20	Slightly Loose	Matrix Supported	Gn10%/Gr90%	50		Slow
RE-84B-09-001	674238	6225981	Poor	Main Channel	In Centre of Small Channel	Upstream	No Drop		20_5	50-20	>50	Loose	Matrix Supported	Ss10-20%/Gr30-50%/Q20-40%	25	Granitic	Slow
RE-84B-15-001	642809	6290940	Poor	Main Channel	Shallow Point	Between	No Drop	<5	50-20	20_5	20_5	Loose	Intermediate	Ss10%/Gn10%/Gr80%	25	Granitic	Slow
RE-84B-16-001	628427	6290905	Poor	Main Channel	Shallow Point	Between	No Drop	<5	20_5	20_5	>50	Loose	Matrix Supported	Gr100%	15	Granitic	Inert
RE-84B-17-001	623798	6286673	Mod-Good	Main Channel	Boulder Obstruction	Downstream	Drop <30 cm	20_5	20_5	50-20	50-20	Firm	Matrix Supported	Ss10%/Gn20%/Gr70%	75	Granitic	Fast
RE-84B-18-001	646471	6293740	Poor	Main Channel	Simply dig into Organic Base	Between	No Drop			20_5	>50	Loose	Matrix Supported				Slow
RE-84B-21-001	659647	6300918	Poor	Main Channel	No Real Trap	None	No Drop				>50	Loose	Matrix Supported				Slow
RE-84B-23-001	632086	6293811	Mod	Main Channel	Edge of Culvert (see notes)	Downstream	Drop >30 cm	50-20	20_5	20_5	20_5	Slightly Loose	Clast Supported	Ss15%/Gn25%/60%/	150	Granitic	Flood from Culvert
RE-84B-24-001	632210	6299080	Mod	River Edge	Deep Point or Pool	Between	No Drop	<5	<5	20_5	>50	Slightly Loose	Matrix Supported		1	Granitic	Slow
RE-84B-26-001	633445	6311212	Mod	Main Channel	Boulder Obstruction	Downstream	Drop <30 cm	<5	>50	20_5	20_5	Very Firm	Clast Supported	Ss35%/Gr45%/Q20%	85	Granitic	Fast
RE-84B-28-001	631862	6297774	Poor	River Edge	No Real Trap	None	No Drop				>50		Matrix Supported				Very Slow
RE-84B-30-001	634931	6305566	Mod	Main Channel	Boulder Obstruction	Downstream	Drop <30 cm	<5	20_5	20_5	>50	Loose	Matrix Supported	Gr100%	70	Granitic	Medium
RE-84B-31-001	631051	6311634	Poor-Mod	Main Channel	Tree Obstruction	Downstream	Drop <30 cm		<5	20_5	>50	Loose	Matrix Supported	Gr100%	8	Granitic	Slow
RE-84B-33-001	562585	6309417	Mod	Main Channel	Boulder Obstruction	Downstream	Drop <30 cm	50-20	20_5	20_5	20_5	Loose	Matrix Supported	Ss5-15%/Gr40-60%/Q20-30%	60	Granitic	Slow
RE-84B-48-001	590740	6298172	Mod-Good	Main Channel	Boulder Obstruction	Downstream	Drop <30 cm	20_5	20_5	20_5	20_5	Firm	Clast Supported	Ss20%/Gn15%/Gr60%/Q5%	100	Granitic	Medium
RE-84B-49-001	574509	6301936	Poor	River Edge	few locations in swampy fen	Between	No Drop				>50	Loose	Matrix Supported				Slow
RE-84B-50-001	576108	6301097	Poor	Main Channel	Shallow Point	Between	No Drop					Loose	Matrix Supported				Slow
RE-84B-51-001	582398	6297281	Mod	Main Channel	Shallow Point/ Tree Obstruction	Upstream	No Drop	<5	50-20	50-20	50-20	Slightly Loose	Matrix Supported	Gr100%	18		Slow
RE-84B-56-001	651727	6218187	Mod	Main Channel	Base of Rapids	Downstream	No Drop	20_5	20_5	20_5	20_5	Firm	Intermediate	Ss5%/Gn5%/Gr90%	90	Granitic	Medium
RE-84B-57-001	666631	6216590	Mod	Channel Edge Outside	Shallow Point	Between	No Drop		20_5	50-20	20_5	Firm	Matrix Supported	Gr100%	60	Granitic	Fast
RE-84B-59-001	680438	6238587	Mod	Channel Edge Inside	Base of Rapids	Downstream	Drop <30 cm	50-20	50-20	20_5	50-20	Firm	Intermediate	Ss30%/Gn20%/Gr50%	85	Granitic	Fast
RE-84B-60-001	675654	6238221	Poor-Mod	Main Channel	Shallow Point	Between	No Drop	50-20	20_5	20_5	50-20	Firm	Clast Supported	Ss15%/Gn25%/65%	50	Granitic	Medium
RE-84B-61-001	645638	6253121	Mod-Good	Channel Edge Inside	Boulder Obstruction	Downstream	Drop <30 cm	20_5	20_5	20_5	20_5	Firm	Intermediate	Ss20%/Gn30%/Gr40%/Q10%	65	Granitic	Medium
RE-84B-64-001	645896	6318509	Mod	Main Channel	Down Stream end of Sand Bar	Downstream	No Drop		<5	20_5	>50	Loose	Matrix Supported				Slow
RE-84B-65-001	651465	6312034	Mod-Good	Channel Edge Inside	Down Stream from Creek Confluence	Downstream	No Drop	20_5	20_5	20_5	50-20	Loose	Intermediate	Ss5%/Gn20%/Gr70%/Q5%	30	Granitic	Medium
RE-84B-65-002	651567	6312017	Poor-Mod	Main Channel	Tree Obstruction	Downstream	No Drop	20_5	20_5	20_5	50-20	Loose	Intermediate	Ss15%/Gn50%/Q25%	40	Granitic	Fast
RE-84B-66-001	655516	6314629	Mod-Good	Main Channel	Tree Obstruction	Downstream	Drop >30 cm		20_5	50-20	>50	Loose	Matrix Supported				Fast
RE-84B-67-001	661039	6312190	Mod-Good	Main Channel	Base of Rapids	Downstream	Drop <30 cm	20_5	50-20	50-20	50-20	Slightly Loose	Intermediate	Ss15%/Gn20%/Gr60%/Q5%	20	Granitic	Fast
RE-84B-68-001	662696	6315727	Poor-Mod	Main Channel	Shallow Point	Between	No Drop	<5	20_5	50-20	50-20	Slightly Loose	Matrix Supported	Ss5%/Gn5%/Gr75%/15%	18	Granitic	Slow
RE-84B-69-001	663456	6315478	Mod	Main Channel	Base of Rapids	Downstream	Drop <30 cm	20_5	20_5	20_5	50-20	Loose	Intermediate	Ss15%/Gr50%/Q15%	20	Granitic	Fast
RE-84B-70-001	674173	6314032	Mod	Channel Edge Inside	Base of Rapids	Downstream	No Drop	<5	20_5	50-20	>50	Loose	Clast Supported	Ss10%/Gn10%/Gr55%/Q25%	20	Quartzite	Fast
RE-84B-71-001	671270	6317074	Poor-Mod	Channel Edge Inside	Shallow Point	Between	No Drop	20_5	50-20	20_5	20_5	Firm	Clast Supported	Ss20%/Gr65%/Q15%	85	Sandstone	Fast
RE-84B-72-001	681543	6307007	Mod-Good	Channel Edge Inside	Tree Obstruction	Downstream	Drop >30 cm		20_5	50-20	>50	Loose	Matrix Supported				Medium
RE-84B-75-001	663131	6267946	Poor	Main Channel	Shallow Point	Between	No Drop	<5	20_5	20_5	>50	Loose	Matrix Supported	Ss20%/Gn20%/Gr50%/Q10%	70	Granitic	Slow
RE-84B-80-001	574364	6272503	Mod	Main Channel	Boulder Obstruction	Downstream	Drop <30 cm	20_5	50-20	20_5	50-20	Loose	Matrix Supported	Ss20%/Gn25%/Gr40%/Q15%	90	Granitic	Slow
RE-84B-89-001	651033	6263286	Mod	Main Channel	Boulder Obstruction	Downstream	No Drop	50-20	50-20	20_5	20_5	Loose	Clast Supported	Ss10%/Gr50%/Q25%	50	Granitic	Medium
RE-84B-90-001	649759	6267641	Poor-Mod	Main Channel	Boulder Obstruction	Downstream	No Drop	50-20	20_5	20_5	20_5	Loose	Clast Supported	Ss15%/Gn5%/Gr35%/Q25%	40	Granitic	Slow
RE-84B-91-001	647432	6270954	Poor	Channel Edge Outside	Shallow Point (See Notes)	Between	No Drop		<5	20_5	>50	Loose	Matrix Supported	Gr50%/Q50%	3	Granitic	Slow
RE-84B-92-001	648335	6289075	Mod-Good	Main Channel	Boulder Obstruction	Downstream	No Drop	50-20	50-20	20_5	20_5	Firm	Clast Supported	Ss10%/Gr40%/Q22.5%/Sh10%/Sl10%	70	Granitic	Fast
RE-84B-93-001	648651	6284119	Poor-Mod	Main Channel	Deep Point or Pool	Between	No Drop	20_5	50-20	50-20	>50	Slightly Loose	Intermediate	Ss15%/Gr50%/Q25%	25	Granitic	Slow
RE-84B-94-001	603970	6271611	Mod-Good	Main Channel	Boulder Obstruction	Downstream	No Drop	20_5	50-20	50-20	50-20	Slightly Loose	Intermediate	Ss10%/Gr40%/Q40%	70	Granitic	Slow
RE-84B-95-001	604172	6280807	Mod-Good	Main Channel	Boulder Obstruction	Downstream	No Drop	20_5	20_5	50-20	20_5	Loose	Matrix Supported	Ss10%/Gr60%/Q25%	80	Granitic	Slow
RE-84B-96-001	604700	6284160	Mod-Good	Main Channel	Boulder Obstruction	Downstream	No Drop	20_5	20_5	20_5	50-20	Loose	Matrix Supported	Ss20%/Gr40%/Q25%	40	Sandstone	Slow
RE-84B-97-001	604292	6286385	Mod-Good	Main Channel	Boulder Obstruction	Downstream	No Drop	20_5	20_5	20_5	50-20	Slightly Loose	Matrix Supported	Ss15%/Gr50%/Q25%	0.01	Granitic	Slow
RE-84B-98-001	611176	6264055	Poor	Main Channel	Side of Bank	Between	No Drop	<5	<5	<5	>50	Firm	Matrix Supported	Ss25%/Gr60%/Q25%	3	Granitic	Slow
RE-84B-99-001	621399	6271868	Poor	Main Channel	Downstream of Beaver Dam	Downstream	Drop >30 cm	20_5	20_5	20_5	50-20	Slightly Loose	Matrix Supported	Ss15%/Gr50%/Q25%	4	Granitic	
RE-84B-100-001	608337	6270658	Mod	Main Channel	Boulder Obstruction	Upstream	Drop <30 cm	20_5	20_5	20_5	50-20	Slightly Loose	Matrix Supported	Ss22.5%/Gn5%/Gr40%/Q25%	100	Granitic	Medium
RE-84B-101-001	598888	6266849	Poor	Main Channel	Boulder Obstruction	Downstream	No Drop	20_5	20_5	20_5	50-20	Slightly Loose	Matrix Supported	Ss20%/Gr50%/Q25%	25	Granitic	Slow
RE-84B-102-001	600463	6260915	Poor	Channel Edge Outside	Drop off from Bank	Between	No Drop	<5	<5	20_5	>50	Loose	Matrix Supported	Ss30%/Gr60%/Q10%	2	Sandstone	Slow
RE-84B-103-001	594375	6258588	Poor	Main Channel	Facies of Point Bar	Downstream	No Drop	<5	<5	20_5	>50	Slightly Loose	Matrix Supported	Ss10%/Gr80%/Q10%	1	Granitic	Slow
RE-84B-104-001	581961	6263872	Poor	Main Channel	Deep Point or Pool	Downstream	No Drop	<5	<5	20_5	>50	Loose	Matrix Supported	Ss15%/Gr60%/Q25%	2	Granitic	Inert
RE-84B-106-001	605864	6225257	Poor	Main Channel	Tree Obstruction	Downstream	No Drop	<5	<5	<5	>50	Firm	Matrix Supported	Ss15%/Gr70%/Q25%	2	Granitic	Slow
RE-84B-107-001	602839	6218431	Poor	Channel Edge Inside	Deep Point or Pool	Between	No Drop	<5	20_5	20_5	50-20	Loose	Matrix Supported	Ss15%/Gr50%/Q25%	25	Granitic	Slow

Appendix 2a. Sample-site descriptions from stream- sediment heavy-mineral concentrate samples.

Sample Number	Location		Field Rating	Trap	Trap	Relation to Barrier		Material				Packing	Texture	Clast	Largest Clast		Water
	East	North		Location	Decscription	Horizontal	Vertical	Cobble	Pebble	Granule	Sand/Silt			Lithology %	Size (cm)	Lithology	Velocity
RE-84B-108-001	602561	6214820	Poor	Main Channel	Deep Point or Pool	Between	No Drop	<5	20_5	20_5	50-20	Loose	Matrix Supported	Ss15%/Gr50%/Q25%	10	Granitic	Slow
RE-84B-109-001	603690	6211899	Poor	Main Channel	Deep Point or Pool	Between	No Drop	<5	<5	20_5	50-20	Loose	Matrix Supported	Ss15%/Gr50%/Q35%	2	Granitic	Slow
RE-84B-110-001	605976	6208657	Poor-Mod	Channel Edge Outside	Shallow Point	Between	No Drop	<5	<5	20_5	50-20	Loose	Matrix Supported	Ss15%/Gr50%/Q25%	5	Granitic	Slow
RE-84B-124-001	572219	6278164	Poor-Mod	Channel Edge Outside	Tree Obstruction	Downstream	No Drop			20_5	>50	Loose	Matrix Supported	Q85%/F5%/Ul10%	5	Granitic	Slow
RE-84B-125-001	600283	6217132	Poor	Main Channel	Boulder Obstruction	Downstream	No Drop	20_5	20_5	20_5	50-20	Loose	Matrix Supported	Ss15%/Gn12.5%/Gr50%/Q35%	30	Granitic	Slow
RE-84B-128-002	592930	6221015	Poor-Mod	Main Channel	Boulder Obstruction	Downstream	No Drop	<5	50-20	20_5	20_5	Loose	Clast Supported	Ss15%/Gn7.5%/Gr50%/Q35%	20	Granitic	Slow
RE-84B-129-001	605394	6211577	Poor-Mod	Channel Edge Inside	Facies of inside Bank	Downstream	No Drop	<5	20_5	20_5	50-20	Loose	Intermediate	Ss15%/Gr60%/Q25%	15	Sandstone	Medium
RE-84B-131-001	606011	6213067	Poor	Main Channel	Tree Obstruction	Downstream	No Drop	<5	<5	20_5	>50	Loose	Matrix Supported	Ss15%/Gn5%/Gr35%/Q35%	5	Granitic	Slow
RE-84B-132-001	619104	6220042	Poor-Mod	Main Channel	Facies of Bend (inside)	Downstream	No Drop	<5	20_5	20_5	>50	Loose	Matrix Supported	Ss20%/Gr60%/Q20%	4	Granitic	Slow
RE-84B-136-001	605151	6228140	Poor	Channel Edge Inside	Facies of Bend in stream	Between	No Drop	<5	<5	20_5	>50	Loose	Matrix Supported	Ss10%/Gr70%/Q20%	2	Granitic	Slow
RE-84B-139-001	596739	6235023	Poor-Mod	Main Channel	Boulder Obstruction	Downstream	No Drop	20_5	50-20	20_5	20_5	Slightly Loose	Clast Supported	Ss25%/Gn7.5%/Gr50%/Q35%	70	Granitic	Slow
RE-84B-145-001	578524	6222187	Poor-Mod	Main Channel	Tree Obstruction	Downstream	Drop <30 cm	<5	<5	20_5	>50	Loose	Matrix Supported	Ss20%/Gr70%/Q10%	10	Granitic	Slow
RE-84B-148-001	587594	6217972	Poor	Channel Edge Outside	Off Bank	Between	No Drop	20_5	50-20	20_5	20_5	Slightly Loose	Clast Supported	Ss15%/Gr50%/Q25%	25	Granitic	Slow
RE-84B-154-001	611309	6212649	Poor-Mod	Main Channel	Boulder Obstruction	Downstream	No Drop	20_5	20_5	20_5	50-20	Slightly Loose	Intermediate	Ss15%/Gn5%/Gr50%/Q30%	40	Granitic	Medium
RE-84B-155-001	614385	6234129	Mod	Channel Edge Inside	Tree Obstruction	Upstream	No Drop			50_20	>50	Loose	Matrix Supported	Ss20%/Gn10%/Gr60%/Q10%	5		Inert
RE-84B-156-001	622553	6231722	Poor	Main Channel	Shallow Point	Between	No Drop	<5	20_5	50-20	50-20	Loose	Intermediate	Ss20%/Gn15%/Gr50%/Q15%	10		Inert
RE-84B-157-001	627755	6228644	Poor-Mod	Main Channel	Tree Obstruction	Upstream	No Drop		20_5	50-20	>50	Loose	Intermediate	Ss30%/Gn10%/Gr50%/Q10%	50		
RE-84B-158-001	640765	6220095	Mod	Main Channel	Base of Rapids_Boulder Obstruction	Downstream	Drop <30 cm	50-20	20_5	20_5	20_5	Firm	Clast Supported	Ss20%/Gn20%/Gr50%/Q10%	100		Medium
RE-84B-159-001	665647	6245433	Mod	Main Channel	Boulder Obstruction	Downstream	Drop <30 cm	50-20	20_5	20_5	50-20	Slightly Loose	Intermediate	Ss20%/Gn10%/Gr60%/Q10%	80	Granitic	Slow
RE-84B-160-001	644905	6251937	Mod	Channel Edge Inside	Shallow Point	Between	Drop <30 cm	50-20	20_5	20_5	50-20	Slightly Loose	Intermediate	Ss20%/Gn15%/Gr35%/Q30%	25		Slow
RE-84B-161-001	589890	6235674	Poor-Mod	Main Channel	Shallow Point	Between	No Drop	20_5	50-20	20_5	20_5	Slightly Loose	Matrix Supported	Ss5%/Gn15%/Gr75%/Q5%	55		Slow
RE-84B-162-01	586964	6232039	Poor	Main Channel	Boulder Obstruction	Downstream	Drop <30 cm	<5	20_5	20_5	50-20	Slightly Loose	Intermediate	Ss50%/Gr50%	50	Sandstone	Inert
RE-84B-163-001	593622	6255643	Poor	Channel Edge Outside	Shallow Point	Downstream	No Drop	<5	20_5	20_5	>50	Loose	Matrix Supported	Ss10%/Gn30%/Gr60%	65	Granitic	Inert
RE-84B-167-001	564217	6314233	Mod-Good	Main Channel	Boulder Obstruction	Downstream	Drop <30 cm	20_5	20_5	20_5	50-20	Firm	Intermediate	Ss15%/Gn20%/Gr60%/Q5%	100	Granitic	Slow
RE-84B-168-001	585012	6315025	Poor	Main Channel	Beaver Obstruction	Between	No Drop		<5	20_5	>50	Loose	Matrix Supported				Inert
RE-84B-169-001	576434	6296035	Mod-Good	Main Channel	Boulder Obstruction	Downstream	Drop <30 cm	20_5	50-20	20_5	20_5	Firm	Matrix Supported	Ss10%/Gn15%/Gr60%/Q15%	70		Slow
RE-84B-170-001	572780	6297212	Mod-Good	Main Channel	Boulder Obstruction	Downstream	Drop >30 cm	20_5	20_5	20_5	20_5	Firm	Intermediate	Ss10%/Gn15%/Gr70%/Q5%	95	Gneis	Medium
RE-84B-171-001	594836	6277039	poor	Channel Edge Outside	No Barrier	Between	No Drop				>50	Loose	Matrix Supported				

Appendix 2b. Sample-site descriptions from till and glaciofluvial samples.

Sample ID	Easting	Northing	From (m)	To (m)	Type	Colour	Drainage	Rotten Clasts	Consistency	Moisture	Reaction to HCl	Ca	Fe	Mn	Organic	Coal	Crystals	Stoney	Modifier	Texture	Sand (%)	Silt (%)	Clay (%)	s
RE98-84B-04-001	647135	6229341	1.0	1.5	Lacustrine	Rusty Brown	imperfect	few	friable	dry	none		Y					2	1	2	5	40	50	Rusty modaling,Granitic cobble, massive,slity cloviate
RE98-84B-06-001	663196	6223885	3.0	3.5	Glacial Fluvial	Brown	rapid	few	soft/sticky	moist	none		Y		Y	Y	Y	2	3	2	40	30	30	Out crope on cutbank south of road on eastside of creek, mica schist, varred at upper portion of exp
RE98-84B-06-005	663196	6223885	9.0	9.3	Till	Gray	well	none	very hard	dry	none		Y		Y	Y	Y	2	2	3	30	40	30	
RE98-84B-10-001	676000	6222676	0.5	0.7	Lacustrine	Light Brown	well	none	hard	dry	none						Y		3	3	40	40	20	
RE98-84B-11-001	680728	6216432	1.0	1.2	Lacustrine	Light Brown	poor	none	soft/sticky	dry	none		Y		Y			1	1	2	20	40	20	massive,Few (rare) Granitic pebbles + very rare cobbles -size material
RE98-84B-12-001	680945	6266329	1.5	2.0	B-C Horizon to Till	Light Brown	poor	none	friable	moist	none	Y	Y	Y	Y	Y	Y	1	2	1		25	75	Dug into a roadside bank, best site.
RE98-84B-13-001	681600	6257859	3.0	3.3	Till	Dark Brown	poor	none	friable	moist	none	Y	Y				Y	2	2	1		30	70	Vayered beach deposites on top, alternating Ss +Mudstone. Potential dunvegan Ss Bowlder @ bas
RE98-84B-14-001	682940	6247996	1.0	1.5	Glacial Fluvial	Sandy	poor	few	loose	dry	none													1m section of sand (mainly Qtz0 with some layers of Granitic pebbles (up to 2cm) for D.I.
RE98-84B-14-002	682940	6247996	5.0	5.3	Glacial Fluvial	Sandy	poor	few	loose	moist	none			Y				1	1	2		50	50	Finely laminated silty sand, silt and clay (some snady layers). -immed below sand unit in a gravel pi
RE98-84B-16-002	628472	6290905	1.0	1.3	Lacustrine	Light gray	poor	none	soft/sticky	dry	none		Y					1	2	1				Fresh slump on Roadside next to strean sed. Sample 001. -Clay-silt (F.G.) laminated lacustrine till.
RE98-84B-17-002	623798	6286673	2.0	2.5	Diamicton	Light gray	imperfect	none	very hard	dry	moderate	Y	Y					2	3	2	30	60	10	Hardest till sample to date, homogeneous, pooly sorted with cobbles up to 8cm, also, 1st to effervis.
RE98-84B-19-001	653307	6294026	0.6	1.5	Till	Dark Brown	poor	none	soft/sticky	moist	none		Y			Y	Y	2	3	2				Shield pebbles up to 10cm, Mainly granitic, no sorting.
RE98-84B-20-001	658999	6298675	1.8	2.8	Till	Dark Brown	imperfect	none	friable	dry	none		Y						1	2	10	60	30	Good setion, homenous, poorly sorted to nonsorted, Granitic cobble (up to B23)
RE98-84B-22-001	657922	6297568	0.8	1.3	Till	Dark Brown	poor	none	soft/sticky	moist	none		Y				Y	2	1	2	20	50	30	
RE98-84B-24-002	632210	6299080	0.8	1.3	Glacial Fluvial	Sandy	well	none	loose	dry	none									3	100			Med- to crs-grained sand, Matbe stratified, Minor pebbles (Qtz + Grantic), Nice beach sand.
RE98-84B-24-003	632210	6299080	1.0	1.5	Glacial Fluvial	Sandy	well	none	loose	dry	none									3				Sandy cobble till, More cobbles here then 002, Granitic + Qtz, up to 10cm.
RE98-84B-25-001	632080	6299746	1.0	1.5	Diamicton	Dark Brown	imperfect	none	loose	moist	none		Y					3	2	3	70	20	10	Glacial fluvial sandy till, stratified, fus, Granitic, Qtz, Gneiss + Ss (Dunvegan cobble), up to 20cm.
RE98-84B-27-001	631075	6290850	2.0	4.0	Glacial Fluvial	Sandy	well	few	loose	dry	none		Y	Y				3		3	100			Channel sample through several glacial fluvial events over 2m.
RE98-84B-29-001	631858	6304860	1.2	1.4	Diamicton	Dark Brown	poor	none	friable	dry	none		Y					2	3	1				lacustrine till, interlayered clay + Ss, Granitic stones up to 10cm, sample from a fresh slump.
RE98-84B-32-001	646981	6279047	0.9	1.1	Till	Dark Brown	imperfect	none	friable	moist	none							2	1	2	10	60	30	Homogeneous clayey, silty till with granitic boulders up to 20cm immediately below finely laminated
RE98-84B-34-001	562604	6309730	1.1	1.3	Lacustrine	Gray + Brown	imperfect	3	soft/sticky	moist	none		Y				y		1	2	10	60	30	Finely to moderaterly laminated clay + clayey silt till
RE98-84B-35-001	565764	6309574	1.0	1.3	Till	Dark Brown	imperfect	none	soft/sticky	moist	moderate		Y					2	1	2	5	70	25	\
RE98-84B-36-001	567710	6307283	0.8	1.1	Till	Dark Brown	well	none	soft/sticky	moist	strong		Y					2	1	2	5	70	25	
RE98-84B-37-001	571356	6304176	1.1	1.5	Diamicton	Dark Brown	poor	none	soft/sticky	moist	moderate		Y					2	1	2	5	60	35	Cleared forestry area.
RE98-84B-38-001	574293	6300929	1.0	1.3	Glacial Fluvial	Sandy gravel	well	none	loose	moist	none									3	100			
RE98-84B-39-001	574993	6301161	1.0	1.3	Till	Dark Brown	imperfect	none	soft/sticky	moist	none				Y			2	2	3	55	40	5	
RE98-84B-40-001	577201	6300986	1.0	1.3	Till	Dark Brown	imperfect	none	soft/sticky	moist	moderate		Y						1	2	10	60	30	
RE98-84B-41-001	578462	6301026	1.0	1.5	Till	Brown	imperfect	none	soft/sticky	moist	none		Y					2	1	2	15	60	25	
RE98-84B-42-001	579465	6300876	1.0	1.3	B-C Horizon to Till	Buff	imperfect	none	hard	dry	none								3	2	30	60	10	
RE98-84B-43-001	578555	6302112	1.0	1.3	B-C Horizon to Till	Dark Brown	imperfect	none	soft/sticky	moist	none		Y					2	2	1				
RE98-84B-44-001	578995	6300303	1.0	1.3	Till	Dark Brown	imperfect	none	soft/sticky	moist	moderate		Y					2	1	2	10	60	30	
RE98-84B-45-001	580040	6299356	1.0	1.3	Till	Dark Brown	imperfect	none	hard	dry	slight		Y					2		2	10	80	10	
RE98-84B-46-001	580906	6298617	1.0	1.3	Glacial Fluvial	Sand	well	few	loose	dry	none							1		3	100			
RE98-84B-47-001	581570	6298003	1.0	1.3	Glacial Fluvial	Sand + Gravel	well	few	loose	dry	none							3		3				Gravel Pit
RE98-84B-52-001	585320	6294402	1.5	2.0	B-C Horizon	Grayish-Brown	imperfect	none	soft/sticky	moist	none		Y					2	1	2	20	50	30	
RE98-84B-53-001	588540	6291521	2.5	3.0	Till	Dark Brown	poor	few	soft/sticky	moist	strong		Y					2	1	2	15	55	30	
RE98-84B-55-001	645945	6217477	0.8	1.2	Glacial Fluvial	Sandy	well	none	loose	dry	none		Y					2		3	90	10		
RE98-84B-57-001	666631	6216590	1.0	1.5	Lacustrine	Dark Brown	imperfect	none	soft/sticky	moist	none													
RE98-84B-58-001	673586	6220360	0.7	1.4	Lacustrine	Dark Brown	imperfect	none	soft/sticky	moist	none							1	3	2		60	40	Swompy area close to topigraphcal high
RE98-84B-62-001	635552	6269185	1.0	1.3	Lacustrine	Dark Brown	imperfect	none	soft/sticky	moist	none							1	1	2	10	60	30	
RE98-84B-63-001	634001	6276867	0.6	1.0	B-C Horizon to Till	Buff gray	imperfect	few	hard	dry	slight		Y					2	2	3	50	30	20	Very fined grained siltstone
RE98-84B-71-002	671270	6317074	3.0	3.5	Till	Dark Brown	imperfect	none	friable	moist	none						Y	2	1	2	25	45	30	Good till unit appaers homogeneous though out. 40m thick.
RE98-84B-73-001	674021	6303543			B-C Horizon to Till	Tan to light buff	poor	none	soft/sticky	wet	none		Y					2	2	3	50	40	10	
RE98-84B-74-001	677960	6272381	2.6	3.0	Glacial Fluvial	Sandy	well	3	loose	dry	none		Y	Y				3		3	100			Sand and gravel pit, many large cobbles/boulders, very poorly sorted, many rotten clasts, 800*500m
RE98-84B-76-001	609671	6266684	6.0	6.5	Glacial Fluvial	Sandy	well	none	loose	dry	none		Y					3		3				Poorly sorted, boulder sand + gravel, gravel unit~ 8m thick beneath a silt clay till.
RE98-84B-76-002	609671	6266684	1.3	1.6	Till	Dark Brown	imperfect	few	loose	moist	none		Y						2	3	60	30	10	Sample taken at a boulder pavement; clay till above boulder and silty sand immed around and below
RE98-84B-77-001	565431	6281969	0.8	1.1	B-C Horizon to Lac.	Dark Brown	imperfect	none	soft/sticky	moist	slight							1	1	2		60	40	Sample from a small trench ~ 3*28m
RE98-84B-78-001	567290	6280153	0.5	0.7	B-C Horizon to Lac.	Brown	imperfect	none	soft/sticky		none	Y	Y					2	3	2	20,30	50,60	20,30	
RE98-84B-79-001	569881	6272306	1.0	1.5	Till	Dark Brown	imperfect	few	loose	moist	strong		Y					2	1	2	5	60	35	
RE98-84B-80-001	574369	6272503	1.0	1.3	Till	Sandy brown	poor	few	friable	dry	none	Y	Y						3	2	35	60	5	Large pebbles of chark
RE98-84B-81-001	579362	6273259	1.0	1.5	Diamicton	Dark Brown	poor	few	soft/sticky	moist	strong		Y						1	2	10	60	30	
RE98-84B-82-001	565322	6265048	0.6	0.8	Till	Brown	well	none	very hard	dry	strong		Y					2	3	2	30	60	10	
RE98-84B-83-001	561977	6267472	0.8	1.2	Glacial Fluvial	sandy	well		loose	dry			Y					1		3				Glacial Fluvial sand from roadside cat.
RE98-84B-84-001	562327	6256122	1.0	1.3	B-C Horizon to Lac.	Gray- tann brown	imperfect	none	soft/sticky	moist	none		Y						2	1	5	35	50	
RE98-84B-85-001	567053	6257664	0.7	1.0	Glacial Fluvial	Gray/Brown	well	none	loose	moist	none		Y					1						Sand Glacial fluvial
RE98-84B-86-001	567943	6252898	0.8	1.0	B-C Horizon to Lac.	Grayish-Brown	poor	none	soft/sticky	wet	none							1		1		10	90	Poor site- old slump
RE98-84B-87-001	571963	6253001	0.6	0.9	B-C Horizon to Lac.	Grayish-Brown	imperfect	none	soft/sticky	moist	none		Y					1	2	1		35	65	Old slump
RE98-84B-88-001	572391	6257349	0.5	0.8	Glacial Fluvial	Brown	well	none	loose	moist	none		Y					3		3	90	10		Sand with numerous cobbles to boulders.
RE98-84B-90-002	649759	0667641	3.0	3.5	Till	Brown	well		soft/sticky	dry	none		Y					2	2	3	40	50	10	Homogeneous, hight 6m
RE98-84B-105-001	603091	6246635	0.7	1.0	Diamicton	Dark Brown	poor	few	friable	moist	none		Y		Y			2	3	2	20	40	40	Homogeneous through out with small sand units 1 to 10cm in size.
RE98-84B-111-001	594935	6227349	1.0	1.4	Lacustrine	Dark Gray	well	none	friable		none							1	3	2		20,40	40,70	
RE98-84B-112-001	602037	6228352	0.5	1.0	Till	Brown	well	none	soft/sticky	moist	none		Y					2	2	3	5,10	40,60	30,40	
RE98-84B-113-001	604315	6235084	0.5	1.0	Till	Dark Brown	well	none	friable	dry								2	2	3	40	30	30	
RE98-84B-114-001	571557	6277701	1.3	1.6	Till	Dark Gray		3	soft/sticky	moist	strong	Y	Y					2	1	2	20	50	30	Good till, modaled.
RE98-84B-115-001	575083	6280824	1.5	1.8	Till	Dark Gray		few	friable	moist	strong	Y	Y					2	1	2	20	50	30	
RE98-84B-116-001	578214	6281056	1.8	2.0	Till	Dark Gray	well	few	friable	moist	none	Y	Y					2	3	2	40	30	30	cobbles up to 20cm.
RE98-84B-117-001	581586	6284077	4.0	4.2	Till	Dark Brown	imperfect	few	soft/sticky	moist	strong		Y		Y									
RE98-84B-118-001	574034	6266708	1.5	1.8	Till	Dark Gray	imperfect	few	friable	moist	strong	Y	Y					2	1	2	20	50	30	
RE98-84B-119-001	579787	6267368	5.0	5.5	Till	Dark Brown	imperfect	few	friable	moist	moderate	Y	Y					2	3	1	30	20	50	Strongly oxided, boulders up to 1m
RE98-84B-120-001	583177	6269394	5.0	5.5	Till	Dark Gray	imperfect	few	hard	moist	moderate	Y	Y					2	2	1	20	30	50	Oxidized fractures rotten limestone, very good dense till.
RE98-84B-121-001	579904	6259920	3.0	3.5	Till	Dark Brown	imperfect	none	friable	moist	strong	Y	Y					2	3	1	30	20	50	
RE98-84B-122-001	584697	6259540	2.0	2.5	Till	Dark Gray	imperfect	3	friable	moist	strong		Y						3	1	30	20	50	Dark blocky till, Fe stained on block faces
RE98-84B-123-001	566241	6282101	1.0	1.2	Glacial Fluvial	Dark Gray	imperfect	none	loose	moist	none	Y	Y					2	2	3	60	10	30	very clayey sand + small gravel, no large clast visable.
RE98-84B-126-001	599141	6218102	1.0	1.3	B-C Horizon to Lac.	Dark Gray	well	none	friable	dry	none		Y					1	3	2	30	50	20	
RE98-84B-127-001	595694	6222732	1.0	1.5	Glacial Fluvial	Brown	rapid	none	loose	dry	none							2	3	3				Gravel pit not in uses.
RE98-84B-128-001	592930	6221015	6.0	6.4	Glacial Fluvial	Gray/Brown	rapid	few	loose	dry	none													
RE98-84B-130-001	601806	6209600	2.0	2.5	Till	Brown	imperfect	few	soft/sticky	moist	moderate		Y						3	2	30	50	20	
RE98-84B-133-001	617195	6218632	1.5	1.7	B-C Horizon to Till	Dark Brown	well	few	soft/sticky	moist	moderate		Y					2	3	2	30	50	20	exposed bank at side of road.
RE98-84B-134-001	614855	6215426	2.0	2.5	B-C Horizon to Till	Dark Brown	rapid	none	soft/sticky	dry	none		Y					2	3	2	40	60	20	
RE98-84B-135-001	621231	6214098	1.0	1.4	Diamicton	Dark Brown	well	none	soft/sticky	moist	moderate		Y					2	2	3	40	30	30	sample taken 30m down slope of clear cut.
RE98-84B-137-001	602254	6231115	1.0	1.2	B-C Horizon to Lac.	Brown	imperfect	none	hard	dry	none								3	3	80	10	10	Diamicton
RE98-84B-138-001	601979	6233953	1.0	1.5	B-C Horizon to Lac.	Light Brown	imperfect	none	soft/sticky	moist	none								3	3	70	20	10	Diamicton
RE98-84B-140-001	597156	6235037	0.5	1.0	Till	Dark Gray	well	few	soft/sticky	moist	slight		Y			Y		2	3	2	30	40	20	
RE98-84B-141-001	601483	6235778	0.5	0.7	Glacial Fluvial	Brown	well	none	loose	moist	none							1	2	3	60	20	20	Diamicton
RE98-84B-142-001	578360	6223977	1.0	1.5	Glacial Fluvial	Brown	rapid	none	loose	dry	none								3	3	100			Massive sand.
RE98-84B-143-001	566613	6232255	0.5	0.7	Lacustrine	Grey	imperfect	none	hard	dry	none		Y					1	2	3	50	30	20	Diamicton
RE98-84B-144-001	567666	6219155	2.0	2.5	Glacial Fluvial	Gray/Brown	rapid	none	loose	moist	none							3	3	3	80	10	10	Gravel
RE98-84B-146-001	585242	6218218	2.0	2.5	Glacial Fluvial	Brown	well	none	loose	dry	none		Y					2	3	3	100			sand
RE98-84B-147-001	587086	6218371	4.0	4.5	Glacial Fluvial	Brown	rapid	none	very hard	dry	none							3	2	3	60	30	10	Hard gravel ridge.
RE98-84B-149-001	588160	6217598	1.0	1.5	Glacial Fluvial	Brown	rapid	none	very hard	dry	none													
RE98-84B-150-001	591357	6215657	0.7	1.0	B-C Horizon to Lac.	Light Brown	well	none	loose	dry	slight							1	3	3	70	20	10	Sand
RE98-84B-151-001	592642	6214570	0.5	0.7	B-C Horizon to Lac.	Brown	well	none	soft/sticky	moist	none		Y					1	2	3	40	30	30	
RE98-84B-152-001	599192	6227088	1.0	1.3	B-C Horizon to Lac.	Brown	well	none	friable	dry	none		Y					2	3	2	20	60	20	
RE98-84B-153-001	589495	6219403	1.0	1.4	Glacial Fluvial	Brown	well	none	loose	dry	none		Y					2	3	3	100			Sand
RE98-84B-164-001	563871	6304538	1.0	2.0	Pre-glacial S&G	sand+Gravel	poor	none	loose	dry	none		Y					3			100			Preglacial sand and gravel
RE98-84B-165-001	564559	6301509	0.7	1.7	Basal Till	Grayish-Brown	imperfect	few	loose	dry	strong							2	1	2	15	50	35	Sample taken immediately above contact with blocky, brownish gray silty shale interlayered with fine

Appendix 3. Summary of geochemical analyses of silicate and oxide indicator grains.

SILICATES

Peridotitic Garnets														
Sample#	Easting	Northing	TiO2	Cr2O3	FeO	MgO	Ca0	SiO2	Al2O3	Na2O	MnO	K2O	Total	Min ID-(Gent, 1993)*
RE98-84B-001-001	676260	6223569	0.211	5.510	7.440	19.970	5.140	42.080	18.840	0.103	0.387	0.028	99.709	CHROME-PYROPE_>ONE_S.D.
RE98-84B-002-002	678967	6218934	0.020	3.900	8.060	18.910	5.460	42.040	20.670	0.000	0.457	0.000	99.517	CHROME-PYROPE_>ONE_S.D.
RE98-84B-004-001	647351	6229341	0.422	3.960	6.650	20.850	5.030	42.420	19.720	0.055	0.327	0.000	99.433	TITANIUM_PYROPE_>ONE_S.D.
RE98-84B-006-001	663193	6223885	0.200	3.350	7.440	19.430	5.410	42.050	20.680	0.079	0.364	0.049	99.051	CHROME-PYROPE
RE98-84B-006-005	663193	6223885	0.029	4.710	7.470	19.320	5.460	41.540	19.740	0.081	0.382	0.044	98.776	CHROME-PYROPE_>ONE_S.D.
RE98-84B-016-001	628427	6290905	0.000	4.280	7.870	18.800	6.140	41.760	20.000	0.036	0.595	0.000	99.481	CHROME-PYROPE_>ONE_S.D.
RE98-84B-022-001	657922	6297568	0.209	4.380	7.530	20.450	4.880	42.250	19.760	0.056	0.452	0.000	99.967	CHROME-PYROPE
RE98-84B-024-003	632210	6299080	0.092	3.250	8.770	19.020	5.300	41.900	20.850	0.097	0.438	0.024	99.741	CHROME-PYROPE
RE98-84B-025-001	632080	6299746	0.066	4.030	7.830	19.220	5.550	41.540	20.220	0.000	0.377	0.000	98.833	CHROME-PYROPE
RE98-84B-025-001	632080	6299746	0.066	3.970	7.500	19.270	5.520	41.680	20.290	0.066	0.420	0.004	98.786	CHROME-PYROPE
RE98-84B-027-001	631075	6290850	0.083	5.320	8.610	18.030	6.390	41.290	19.450	0.024	0.481	0.000	99.677	CHROME-PYROPE_>ONE_S.D.
RE98-84B-027-001	631075	6290850	0.069	6.000	8.810	17.370	6.650	41.020	18.720	0.084	0.468	0.026	99.217	CHROME-PYROPE_>ONE_S.D.
RE98-84B-027-001	631075	6290850	0.558	5.020	7.270	19.940	5.710	41.260	18.560	0.054	0.282	0.022	98.676	TITANIUM_PYROPE_>ONE_S.D.
RE98-84B-027-001	631075	6290850	0.563	5.370	7.550	20.050	5.220	41.510	17.880	0.131	0.221	0.037	98.531	TITANIUM_PYROPE_>ONE_S.D.
RE98-84B-027-001	631075	6290850	0.105	7.260	8.740	17.380	7.000	41.180	17.340	0.000	0.470	0.105	99.580	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-027-001	631075	6290850	0.127	5.370	7.580	19.160	5.890	41.690	19.560	0.079	0.437	0.029	99.923	CHROME-PYROPE
RE98-84B-027-001	631075	6290850	0.458	11.110	6.810	18.420	7.110	40.930	13.990	0.031	0.287	0.087	99.233	UNKNOWN
RE98-84B-027-001	631075	6290850	0.205	8.270	8.340	17.150	6.880	40.730	15.860	0.047	0.415	0.000	97.897	UNKNOWN
RE98-84B-027-001	631075	6290850	0.088	7.030	8.520	17.020	7.150	40.910	17.670	0.000	0.528	0.047	98.964	CHROME-PYROPE_>ONE_S.D.
RE98-84B-027-001	631075	6290850	0.000	3.590	7.780	19.190	5.490	41.960	20.880	0.039	0.556	0.015	99.499	CHROME-PYROPE_>ONE_S.D.
RE98-84B-027-001	631075	6290850	0.106	7.730	8.580	16.810	7.350	40.460	17.240	0.035	0.493	0.004	98.807	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-027-001	631075	6290850	0.200	7.250	7.330	19.380	5.820	41.150	17.660	0.002	0.340	0.019	99.151	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-027-001	631075	6290850	0.761	3.770	7.760	20.040	4.990	41.940	19.060	0.011	0.244	0.000	98.576	TITANIUM_PYROPE_>ONE_S.D.
RE98-84B-027-001	631075	6290850	0.105	8.610	8.600	16.150	7.770	40.600	16.680	0.019	0.467	0.000	99.000	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-027-001	631075	6290850	0.000	3.210	7.870	19.490	5.070	42.180	21.470	0.000	0.598	0.029	99.917	CHROME-PYROPE_>ONE_S.D.
RE98-84B-028-001	631862	6297774	0.878	4.050	7.820	20.310	5.330	42.180	18.360	0.060	0.256	0.000	99.243	HIGH-TITANIUM_PYROPE_>ONE_S.D.
RE98-84B-029-001	631858	6304860	0.010	4.260	7.220	18.930	5.740	41.840	20.250	0.049	0.504	0.000	98.804	CHROME-PYROPE_>ONE_S.D.
RE98-84B-029-001	631858	6304860	0.270	4.530	8.030	19.040	5.180	41.480	19.550	0.136	0.464	0.020	98.699	CHROME-PYROPE
RE98-84B-030-001	634931	6305566	0.053	5.140	7.540	18.460	5.950	41.590	19.640	0.049	0.499	0.000	98.921	CHROME-PYROPE_>ONE_S.D.
RE98-84B-030-001	634931	6305566	0.055	4.770	7.240	19.810	5.130	41.740	19.960	0.026	0.405	0.052	99.187	CHROME-PYROPE_>ONE_S.D.
RE98-84B-031-001	631051	6311634	0.078	3.530	8.320	18.850	5.120	41.410	20.850	0.000	0.420	0.004	98.582	CHROME-PYROPE
RE98-84B-035-001	565764	6309574	0.202	6.350	8.020	18.650	5.530	41.460	17.750	0.090	0.325	0.000	98.377	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.011	7.830	7.510	18.480	6.680	41.120	16.870	0.045	0.373	0.000	98.919	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.719	6.950	7.530	19.070	6.110	41.100	16.770	0.007	0.291	0.000	98.547	UVAROVITE-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.030	5.260	7.860	19.100	5.800	41.850	19.590	0.037	0.411	0.000	99.938	CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.018	5.280	8.070	18.330	6.190	41.490	19.370	0.000	0.497	0.029	99.274	CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.010	3.830	7.790	19.930	5.030	42.240	20.690	0.024	0.559	0.000	100.102	CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.213	6.460	7.250	19.370	5.740	41.380	18.210	0.035	0.339	0.007	99.004	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.745	5.210	7.890	20.220	5.370	41.630	18.070	0.070	0.275	0.000	99.481	TITANIUM_PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.108	6.750	6.930	19.120	6.250	41.310	18.060	0.031	0.334	0.048	98.940	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.253	3.850	7.640	19.650	5.440	41.020	20.560	0.038	0.353	0.007	98.811	CHROME-PYROPE
RE98-84B-035-001	565764	6309574	0.011	5.400	7.640	18.700	6.260	41.680	19.550	0.000	0.597	0.000	99.838	CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.120	6.170	7.410	18.790	6.400	41.370	18.580	0.043	0.360	0.000	99.242	CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.351	6.110	8.380	18.580	6.140	40.840	18.100	0.000	0.361	0.000	98.862	CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.146	7.670	7.210	19.340	5.440	41.320	17.260	0.054	0.340	0.000	98.781	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.162	2.806	8.690	19.690	4.940	42.110	21.210	0.089	0.422	0.000	100.118	CHROME-PYROPE
RE98-84B-035-001	565764	6309574	0.088	8.940	8.190	16.780	7.520	40.320	15.670	0.019	0.521	0.000	98.048	UNKNOWN
RE98-84B-035-001	565764	6309574	0.475	5.650	6.930	20.080	5.530	41.660	17.980	0.031	0.315	0.044	98.695	TITANIUM_PYROPE_>ONE_S.D.

Appendix 3. Summary of geochemical analyses of silicate and oxide indicator grains.

SILICATES

Sample#	Easting	Northing	TiO2	Cr2O3	FeO	MgO	Ca0	SiO2	Al2O3	Na2O	MnO	K2O	Total	**Min ID-(Gent, 1993)***
RE98-84B-035-001	565764	6309574	0.100	8.070	8.670	17.350	7.490	40.940	16.960	0.062	0.535	0.000	100.177	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.000	4.770	7.430	18.750	6.100	41.860	19.920	0.000	0.483	0.022	99.335	CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.094	6.810	8.570	17.800	6.790	40.970	17.750	0.041	0.420	0.018	99.263	CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.424	6.800	7.130	18.970	6.310	41.270	17.750	0.046	0.334	0.000	99.034	UVAROVITE-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.200	3.390	7.870	19.820	5.080	41.070	20.500	0.031	0.341	0.059	98.361	CHROME-PYROPE
RE98-84B-035-001	565764	6309574	0.116	3.820	7.780	19.880	4.870	42.140	20.660	0.030	0.360	0.000	99.657	CHROME-PYROPE
RE98-84B-035-001	565764	6309574	0.001	3.540	8.100	19.100	5.580	41.840	20.690	0.008	0.486	0.088	99.433	CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.167	5.260	7.760	19.110	6.380	41.910	19.160	0.035	0.395	0.000	100.177	CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.181	6.160	7.030	19.030	6.160	41.620	18.510	0.019	0.282	0.007	99.000	CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.177	3.160	8.880	19.250	4.860	41.620	20.320	0.000	0.427	0.000	98.694	CHROME-PYROPE
RE98-84B-035-001	565764	6309574	0.043	4.020	7.100	20.610	5.070	42.410	19.390	0.028	0.271	0.011	98.953	CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.082	1.892	11.380	17.310	5.400	41.520	21.580	0.104	0.588	0.000	99.856	CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.281	4.850	8.370	18.870	5.770	41.620	18.850	0.053	0.456	0.000	99.120	CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.035	5.600	7.530	18.940	6.320	41.570	19.130	0.012	0.454	0.000	99.591	CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.082	4.790	7.590	19.050	5.990	41.500	19.350	0.061	0.449	0.000	98.861	CHROME-PYROPE
RE98-84B-035-001	565764	6309574	0.055	3.840	7.860	19.860	5.210	41.860	20.370	0.064	0.516	0.000	99.635	CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.076	5.170	7.460	19.490	5.690	41.650	18.860	0.048	0.325	0.037	98.805	CHROME-PYROPE
RE98-84B-035-001	565764	6309574	0.098	6.170	7.000	19.400	6.050	41.320	18.570	0.000	0.393	0.000	99.001	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.188	3.440	8.050	19.840	5.000	42.150	20.640	0.050	0.384	0.055	99.798	CHROME-PYROPE
RE98-84B-035-001	565764	6309574	0.662	5.010	7.660	19.880	5.460	41.700	17.940	0.060	0.308	0.000	98.680	TITANIUM_PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.107	3.500	7.520	19.300	5.530	41.330	20.510	0.000	0.333	0.000	98.130	CHROME-PYROPE
RE98-84B-035-001	565764	6309574	0.005	5.120	7.600	18.890	6.320	41.560	19.160	0.072	0.339	0.000	99.065	CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.065	7.030	8.690	17.630	7.170	40.630	17.830	0.019	0.448	0.026	99.538	CHROME-PYROPE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.105	5.060	7.020	19.770	5.210	41.640	19.540	0.000	0.370	0.121	98.837	CHROME-PYROPE
RE98-84B-035-001	565764	6309574	0.585	2.926	7.680	20.860	4.980	42.280	19.970	0.037	0.328	0.000	99.645	TITANIUM_PYROPE_>ONE_S.D.
RE98-84B-037-001	571356	6304176	0.027	3.670	7.910	18.970	5.550	42.040	20.700	0.021	0.629	0.000	99.516	CHROME-PYROPE_>ONE_S.D.
RE98-84B-037-001	571356	6304176	0.009	3.800	7.980	18.910	5.840	42.020	20.660	0.015	0.535	0.000	99.768	CHROME-PYROPE_>ONE_S.D.
RE98-84B-038-001	574293	6300929	0.469	1.517	7.810	20.360	4.200	42.820	21.730	0.116	0.353	0.082	99.457	TITANIAN_PYROPE
RE98-84B-038-001	574293	6300929	0.063	4.000	8.500	18.400	5.670	42.050	19.960	0.048	0.496	0.000	99.187	CHROME-PYROPE
RE98-84B-038-001	574293	6300929	0.099	4.820	7.870	19.110	5.490	41.920	19.210	0.099	0.400	0.000	99.018	CHROME-PYROPE
RE98-84B-038-001	574293	6300929	0.011	6.520	8.060	17.590	6.960	41.130	18.270	0.000	0.548	0.000	99.089	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-038-001	574293	6300929	0.024	4.370	7.420	18.700	5.990	41.970	19.980	0.005	0.562	0.000	99.021	CHROME-PYROPE_>ONE_S.D.
RE98-84B-038-001	574293	6300929	0.053	4.520	7.820	18.440	5.960	41.810	20.060	0.046	0.510	0.085	99.304	CHROME-PYROPE_>ONE_S.D.
RE98-84B-038-001	574293	6300929	0.093	6.640	8.350	18.070	6.260	40.850	18.190	0.043	0.458	0.004	98.958	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-038-001	574293	6300929	0.013	4.040	7.810	18.990	5.760	42.560	20.530	0.062	0.469	0.008	100.242	CHROME-PYROPE_>ONE_S.D.
RE98-84B-038-001	574293	6300929	0.078	4.960	8.220	18.400	5.960	41.960	19.430	0.049	0.481	0.073	99.610	CHROME-PYROPE
RE98-84B-038-001	574293	6300929	0.072	3.890	9.360	17.760	5.790	42.190	20.140	0.022	0.434	0.000	99.657	CHROME-PYROPE_>ONE_S.D.
RE98-84B-038-001	574293	6300929	0.000	5.010	7.570	18.380	6.050	41.750	19.720	0.055	0.540	0.053	99.127	CHROME-PYROPE_>ONE_S.D.
RE98-84B-038-001	574293	6300929	0.046	4.920	8.200	18.660	5.920	41.790	19.360	0.073	0.389	0.000	99.358	CHROME-PYROPE_>ONE_S.D.
RE98-84B-038-001	574293	6300929	0.046	4.130	8.160	18.880	5.510	41.910	20.480	0.000	0.471	0.000	99.587	CHROME-PYROPE_>ONE_S.D.
RE98-84B-038-001	574293	6300929	0.000	4.890	8.430	18.360	6.180	42.020	19.830	0.000	0.537	0.000	100.247	CHROME-PYROPE_>ONE_S.D.
RE98-84B-038-001	574293	6300929	0.002	4.140	7.730	18.460	5.950	42.240	20.160	0.021	0.455	0.000	99.157	CHROME-PYROPE_>ONE_S.D.
RE98-84B-038-001	574293	6300929	0.035	4.070	8.040	18.640	5.700	41.980	20.250	0.010	0.419	0.000	99.143	CHROME-PYROPE_>ONE_S.D.
RE98-84B-039-001	574993	6301161	0.000	6.740	7.370	19.370	6.110	41.890	18.340	0.046	0.406	0.077	100.348	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-039-001	574993	6301161	0.024	6.620	7.330	19.580	6.040	41.920	18.450	0.009	0.439	0.000	100.413	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-039-001	574993	6301161	0.819	3.830	8.160	19.140	6.100	41.780	19.620	0.107	0.350	0.077	99.983	TITANIUM_PYROPE_>ONE_S.D.
RE98-84B-039-001	574993	6301161	0.441	7.670	6.820	19.790	6.000	41.270	16.190	0.044	0.255	0.000	98.480	UVAROVITE-PYROPE_>ONE_S.D.
RE98-84B-039-001	574993	6301161	0.510	6.320	8.640	18.910	5.560	40.480	17.840	0.047	0.429	0.000	98.735	UVAROVITE-PYROPE_>ONE_S.D.
RE98-84B-039-001	574993	6301161	0.005	2.616	8.070	19.940	5.070	42.170	21.930	0.018	0.502	0.000	100.322	CHROME-PYROPE_>ONE_S.D.
RE98-84B-039-001	574993	6301161	0.005	4.130	7.530	19.510	5.800	42.110	20.530	0.010	0.440	0.000	100.065	CHROME-PYROPE_>ONE_S.D.

Appendix 3. Summary of geochemical analyses of silicate and oxide indicator grains.

SILICATES

Sample#	Easting	Northing	TiO2	Cr2O3	FeO	MgO	Ca0	SiO2	Al2O3	Na2O	MnO	K2O	Total	Min ID-(Gent, 1993)*
RE98-84B-039-001	574993	6301161	0.093	3.160	9.410	18.180	5.400	41.480	20.710	0.028	0.481	0.000	98.942	CHROME-PYROPE_>ONE_S.D.
RE98-84B-039-001	574993	6301161	0.061	7.530	8.680	17.690	7.110	40.950	17.570	0.066	0.484	0.025	100.166	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-039-001	574993	6301161	0.191	10.600	7.160	19.310	6.140	41.300	14.840	0.057	0.255	0.015	99.867	UNKNOWN
RE98-84B-039-001	574993	6301161	0.106	5.480	7.910	17.970	6.340	41.800	18.960	0.111	0.503	0.000	99.181	CHROME-PYROPE_>ONE_S.D.
RE98-84B-039-001	574993	6301161	0.127	5.740	8.650	18.080	6.160	41.710	18.860	0.055	0.438	0.056	99.876	CHROME-PYROPE_>ONE_S.D.
RE98-84B-039-001	574993	6301161	0.037	7.430	7.320	18.740	6.520	41.180	17.790	0.010	0.405	0.000	99.432	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-039-001	574993	6301161	0.141	5.760	8.620	18.450	5.610	41.430	18.560	0.055	0.452	0.000	99.078	CHROME-PYROPE_>ONE_S.D.
RE98-84B-039-001	574993	6301161	0.054	10.450	7.410	16.960	8.080	40.500	15.120	0.000	0.367	0.000	98.941	UNKNOWN
RE98-84B-039-001	574993	6301161	0.089	6.090	7.360	18.750	6.030	41.810	18.700	0.022	0.468	0.000	99.319	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-039-001	574993	6301161	0.264	8.040	7.720	17.650	6.480	40.950	16.590	0.052	0.459	0.000	98.205	UVAROVITE-PYROPE_>ONE_S.D.
RE98-84B-039-001	574993	6301161	0.008	10.170	7.210	17.570	7.650	40.990	15.390	0.028	0.412	0.000	99.427	UNKNOWN
RE98-84B-039-001	574993	6301161	0.037	10.240	7.310	17.430	7.670	40.780	15.460	0.019	0.446	0.000	99.392	UNKNOWN
RE98-84B-039-001	574993	6301161	0.137	8.390	7.780	17.300	7.280	41.120	16.240	0.030	0.390	0.000	98.667	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-039-001	574993	6301161	0.020	3.620	8.040	18.600	5.680	42.020	20.520	0.059	0.548	0.000	99.106	CHROME-PYROPE_>ONE_S.D.
RE98-84B-039-001	574993	6301161	0.000	3.910	8.030	18.460	5.830	41.640	20.250	0.000	0.565	0.077	98.762	CHROME-PYROPE_>ONE_S.D.
RE98-84B-039-001	574993	6301161	0.180	5.830	8.650	18.150	5.660	41.370	18.580	0.124	0.581	0.000	99.125	CHROME-PYROPE_>ONE_S.D.
RE98-84B-039-001	574993	6301161	0.059	5.220	8.560	17.970	6.390	41.670	18.900	0.000	0.473	0.000	99.243	CHROME-PYROPE_>ONE_S.D.
RE98-84B-039-001	574993	6301161	0.386	5.500	8.370	18.030	6.130	41.200	18.680	0.061	0.458	0.000	98.815	CHROME-PYROPE_>ONE_S.D.
RE98-84B-040-001	577201	6300986	0.000	3.170	8.140	19.450	5.270	42.050	21.190	0.000	0.507	0.000	99.777	CHROME-PYROPE_>ONE_S.D.
RE98-84B-040-001	577201	6300986	0.017	4.840	8.390	18.060	6.020	41.850	19.600	0.026	0.437	0.000	99.240	CHROME-PYROPE_>ONE_S.D.
RE98-84B-040-001	577201	6300986	0.000	6.200	7.920	18.190	6.380	41.610	18.600	0.014	0.383	0.000	99.296	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-040-001	577201	6300986	0.498	6.250	8.840	18.240	5.870	41.430	18.150	0.116	0.429	0.040	99.863	UVAROVITE-PYROPE_>ONE_S.D.
RE98-84B-040-001	577201	6300986	0.030	3.080	7.940	19.310	5.320	41.590	21.350	0.000	0.472	0.096	99.188	CHROME-PYROPE_>ONE_S.D.
RE98-84B-040-001	577201	6300986	0.035	4.330	7.850	18.860	5.810	41.750	20.400	0.000	0.481	0.000	99.516	CHROME-PYROPE_>ONE_S.D.
RE98-84B-040-001	577201	6300986	0.021	1.724	7.710	19.970	4.850	42.000	22.300	0.039	0.504	0.000	99.118	CHROME-PYROPE_>ONE_S.D.
RE98-84B-040-001	577201	6300986	0.019	4.420	7.580	18.660	5.880	41.410	19.720	0.077	0.535	0.000	98.301	CHROME-PYROPE_>ONE_S.D.
RE98-84B-040-001	577201	6300986	0.012	3.200	7.800	18.840	5.710	41.660	21.140	0.000	0.561	0.082	99.005	CHROME-PYROPE_>ONE_S.D.
RE98-84B-040-001	577201	6300986	0.020	5.230	8.480	18.030	6.260	40.950	19.440	0.026	0.503	0.080	99.019	CHROME-PYROPE_>ONE_S.D.
RE98-84B-040-001	577201	6300986	0.033	7.310	7.980	17.590	7.040	40.990	17.650	0.079	0.453	0.015	99.139	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-040-001	577201	6300986	0.134	4.590	8.160	18.940	5.580	42.060	19.490	0.071	0.396	0.000	99.421	CHROME-PYROPE
RE98-84B-040-001	577201	6300986	0.167	4.540	8.480	18.680	5.500	40.930	19.700	0.026	0.510	0.000	98.533	CHROME-PYROPE
RE98-84B-040-001	577201	6300986	0.000	2.760	7.740	19.440	5.280	41.980	21.550	0.021	0.494	0.000	99.265	CHROME-PYROPE_>ONE_S.D.
RE98-84B-041-001	578462	6301026	0.076	5.920	8.300	17.630	6.830	41.440	18.640	0.000	0.567	0.032	99.435	CHROME-PYROPE_>ONE_S.D.
RE98-84B-041-001	578462	6301026	0.097	8.640	7.310	18.720	6.450	41.170	16.500	0.023	0.421	0.039	99.370	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-041-001	578462	6301026	0.077	5.990	8.360	17.990	6.230	41.810	18.490	0.030	0.489	0.000	99.465	CHROME-PYROPE_>ONE_S.D.
RE98-84B-043-001	578555	6302112	0.003	4.880	7.660	18.830	5.830	42.220	19.920	0.011	0.509	0.000	99.863	CHROME-PYROPE_>ONE_S.D.
RE98-84B-043-001	578555	6302112	0.052	8.160	7.890	16.930	7.400	41.390	16.860	0.000	0.426	0.000	99.108	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-043-001	578555	6302112	0.000	3.130	7.960	19.420	5.250	42.480	21.090	0.038	0.596	0.000	99.964	CHROME-PYROPE_>ONE_S.D.
RE98-84B-043-001	578555	6302112	0.115	4.730	8.400	18.800	5.660	42.010	19.500	0.000	0.428	0.060	99.704	CHROME-PYROPE
RE98-84B-043-001	578555	6302112	0.000	4.870	8.120	17.830	6.180	41.520	19.440	0.004	0.549	0.024	98.537	CHROME-PYROPE_>ONE_S.D.
RE98-84B-043-001	578555	6302112	0.032	4.830	7.940	18.630	6.040	42.300	19.680	0.000	0.548	0.004	100.004	CHROME-PYROPE_>ONE_S.D.
RE98-84B-043-001	578555	6302112	0.027	3.590	8.200	18.700	5.760	42.170	20.610	0.006	0.491	0.093	99.646	CHROME-PYROPE_>ONE_S.D.
RE98-84B-043-001	578555	6302112	0.107	7.350	8.310	17.740	6.610	41.690	17.740	0.001	0.420	0.000	99.968	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-043-001	578555	6302112	0.026	7.340	7.420	18.140	6.720	41.590	17.640	0.037	0.379	0.000	99.292	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-043-001	578555	6302112	0.082	5.620	7.860	18.040	6.370	41.610	19.190	0.000	0.534	0.000	99.306	CHROME-PYROPE_>ONE_S.D.
RE98-84B-043-001	578555	6302112	0.111	5.320	8.060	18.350	6.170	41.910	19.170	0.053	0.450	0.000	99.594	CHROME-PYROPE_>ONE_S.D.
RE98-84B-043-001	578555	6302112	0.003	5.040	7.250	19.250	5.920	42.040	19.910	0.048	0.563	0.064	100.088	CHROME-PYROPE_>ONE_S.D.
RE98-84B-043-001	578555	6302112	0.119	5.630	8.340	18.380	5.450	41.850	18.890	0.088	0.440	0.000	99.187	CHROME-PYROPE_>ONE_S.D.
RE98-84B-043-001	578555	6302112	0.024	4.670	7.430	18.660	5.830	41.630	19.840	0.000	0.500	0.112	98.696	CHROME-PYROPE_>ONE_S.D.
RE98-84B-043-001	578555	6302112	0.030	4.700	7.450	18.480	6.100	41.930	19.800	0.043	0.526	0.076	99.136	CHROME-PYROPE_>ONE_S.D.

Appendix 3. Summary of geochemical analyses of silicate and oxide indicator grains.

SILICATES

Sample#	Easting	Northing	TiO2	Cr2O3	FeO	MgO	Ca0	SiO2	Al2O3	Na2O	MnO	K2O	Total	Min ID-(Gent, 1993)*
RE98-84B-046-001	580906	6298617	0.058	5.120	7.780	18.650	5.920	41.940	19.530	0.039	0.572	0.000	99.609	CHROME-PYROPE_>ONE_S.D.
RE98-84B-047-001	581570	6298003	0.445	3.370	7.480	20.430	4.610	42.380	20.120	0.070	0.273	0.000	99.178	TITANIUM_PYROPE_>ONE_S.D.
RE98-84B-047-001	581570	6298003	0.158	4.470	7.340	20.450	4.810	42.240	19.670	0.000	0.352	0.004	99.494	CHROME-PYROPE
RE98-84B-048-001	590740	6298172	0.033	4.860	7.690	18.520	6.050	41.820	19.620	0.033	0.534	0.000	99.160	CHROME-PYROPE_>ONE_S.D.
RE98-84B-048-001	590740	6298172	0.077	3.680	7.450	20.210	4.880	42.390	20.020	0.074	0.315	0.000	99.095	CHROME-PYROPE
RE98-84B-049-001	574509	6301936	0.262	5.970	7.420	19.400	5.580	41.650	18.710	0.065	0.424	0.000	99.481	CHROME-PYROPE_>ONE_S.D.
RE98-84B-049-001	574509	6301936	0.000	2.543	8.990	18.360	5.520	41.740	21.390	0.000	0.553	0.000	99.096	CHROME-PYROPE_>ONE_S.D.
RE98-84B-049-001	574509	6301936	0.031	5.220	7.740	18.980	6.120	41.850	19.630	0.000	0.552	0.000	100.123	CHROME-PYROPE_>ONE_S.D.
RE98-84B-049-001	574509	6301936	0.334	5.640	8.130	18.580	5.750	41.370	18.640	0.050	0.455	0.004	98.953	CHROME-PYROPE_>ONE_S.D.
RE98-84B-049-001	574509	6301936	0.044	5.110	7.830	19.250	5.600	41.510	19.220	0.036	0.457	0.000	99.057	CHROME-PYROPE_>ONE_S.D.
RE98-84B-051-001	582398	6297281	0.000	4.630	8.010	18.140	6.020	41.900	19.830	0.078	0.529	0.012	99.149	CHROME-PYROPE_>ONE_S.D.
RE98-84B-051-001	582398	6297281	0.054	7.040	7.520	17.690	6.890	41.200	17.730	0.004	0.523	0.020	98.672	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-051-001	582398	6297281	0.025	5.040	8.430	18.130	5.870	41.760	19.570	0.000	0.418	0.000	99.243	CHROME-PYROPE_>ONE_S.D.
RE98-84B-051-001	582398	6297281	0.062	6.060	8.170	17.660	6.620	41.700	18.610	0.036	0.521	0.101	99.540	CHROME-PYROPE_>ONE_S.D.
RE98-84B-051-001	582398	6297281	0.008	3.680	7.760	18.920	5.630	41.730	20.730	0.000	0.498	0.000	98.956	CHROME-PYROPE_>ONE_S.D.
RE98-84B-051-001	582398	6297281	0.061	4.080	7.530	19.970	5.070	42.270	20.600	0.071	0.503	0.000	100.154	CHROME-PYROPE
RE98-84B-051-001	582398	6297281	0.003	4.780	7.360	18.660	6.180	42.020	19.770	0.080	0.440	0.000	99.292	CHROME-PYROPE_>ONE_S.D.
RE98-84B-051-001	582398	6297281	0.034	7.160	8.020	17.710	6.780	41.110	17.460	0.000	0.407	0.000	98.681	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-051-001	582398	6297281	0.000	4.560	8.610	18.170	6.190	41.710	19.880	0.069	0.530	0.000	99.719	CHROME-PYROPE_>ONE_S.D.
RE98-84B-052-001	585321	6294402	0.219	6.970	7.720	18.500	6.120	41.670	17.130	0.054	0.369	0.000	98.751	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-059-001	680438	6238587	0.490	4.920	8.300	19.590	5.010	41.390	18.900	0.047	0.430	0.000	99.076	TITANIUM_PYROPE_>ONE_S.D.
RE98-84B-060-001	675654	6238221	0.509	5.050	8.260	19.530	4.890	41.700	19.000	0.107	0.459	0.000	99.506	TITANIUM_PYROPE_>ONE_S.D.
RE98-84B-061-001	645638	6253121	0.696	6.230	6.000	20.110	5.800	42.070	17.560	0.093	0.256	0.000	98.816	UVAROVITE-PYROPE_>ONE_S.D.
RE98-84B-063-001	634001	6276867	0.188	3.940	7.490	20.560	4.650	42.490	20.140	0.057	0.406	0.000	99.920	CHROME-PYROPE
RE98-84B-071-001	671270	6317074	0.173	5.060	7.060	20.290	4.980	42.460	19.650	0.097	0.326	0.000	100.097	CHROME-PYROPE
RE98-84B-077-001	565431	6281969	0.109	4.680	7.410	19.270	5.930	41.600	19.700	0.017	0.385	0.000	99.101	CHROME-PYROPE
RE98-84B-077-001	565431	6281969	0.102	9.280	7.820	16.970	7.600	40.200	15.860	0.000	0.431	0.000	98.263	UNKNOWN
RE98-84B-077-001	565431	6281969	0.134	10.540	6.620	18.710	6.760	40.570	14.130	0.000	0.361	0.000	97.825	UNKNOWN
RE98-84B-077-001	565431	6281969	0.056	10.880	8.280	16.370	7.700	40.060	14.690	0.104	0.500	0.012	98.652	UNKNOWN
RE98-84B-077-001	565431	6281969	0.116	8.240	8.540	17.540	6.400	40.340	16.710	0.002	0.396	0.000	98.284	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-077-001	565431	6281969	0.106	6.170	6.010	19.700	5.980	41.720	18.460	0.069	0.225	0.000	98.440	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-077-001	565431	6281969	0.192	3.500	7.210	19.940	5.080	42.060	20.570	0.058	0.329	0.012	98.950	CHROME-PYROPE
RE98-84B-077-001	565431	6281969	0.299	7.070	7.480	18.390	6.030	40.590	16.890	0.065	0.383	0.000	97.197	UVAROVITE-PYROPE_>ONE_S.D.
RE98-84B-080-002	574369	6272503	0.063	4.890	7.960	18.870	5.440	41.380	19.190	0.022	0.337	0.049	98.200	CHROME-PYROPE
RE98-84B-097-001	604292	6286385	0.024	0.054	3.120	0.122	0.000	36.630	56.960	0.006	2.255	0.000	99.171	UNKNOWN
RE98-84B-123-001	566241	6282101	0.000	6.240	8.040	18.360	6.650	41.420	18.900	0.000	0.483	0.000	100.093	CHROME-PYROPE_>ONE_S.D.
RE98-84B-123-001	566241	6282101	0.020	8.240	6.470	19.350	6.670	41.270	16.020	0.079	0.211	0.000	98.330	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-123-001	566241	6282101	0.173	6.910	6.680	19.850	6.180	41.460	18.160	0.033	0.324	0.000	99.770	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-123-001	566241	6282101	0.122	8.410	8.240	16.970	7.520	40.800	16.620	0.019	0.439	0.022	99.162	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-123-001	566241	6282101	0.020	9.930	8.070	16.140	8.260	39.400	15.600	0.009	0.580	0.000	98.009	UNKNOWN
RE98-84B-123-001	566241	6282101	0.192	8.290	8.320	17.000	7.860	40.570	16.690	0.066	0.507	0.000	99.495	UVAROVITE-PYROPE_>ONE_S.D.
RE98-84B-123-001	566241	6282101	0.296	4.400	7.610	20.130	5.090	41.690	19.750	0.000	0.374	0.000	99.340	CHROME-PYROPE_>ONE_S.D.
RE98-84B-123-001	566241	6282101	0.370	5.040	7.500	20.200	4.930	41.670	18.930	0.044	0.372	0.011	99.066	CHROME-PYROPE_>ONE_S.D.
RE98-84B-123-001	566241	6282101	0.262	4.180	6.910	20.020	5.620	42.030	20.070	0.000	0.373	0.011	99.475	CHROME-PYROPE
RE98-84B-123-001	566241	6282101	0.244	4.760	7.550	20.000	5.270	41.890	19.770	0.102	0.379	0.062	100.028	CHROME-PYROPE
RE98-84B-123-001	566241	6282101	0.229	4.920	8.220	18.950	5.820	41.640	19.440	0.000	0.364	0.000	99.583	CHROME-PYROPE
RE98-84B-127 001	595694	6222737	0.139	6.300	7.930	18.570	6.130	41.420	18.300	0.022	0.461	0.000	99.272	CHROME-PYROPE_>ONE_S.D.
RE98-84B-127-001	595694	6222737	0.020	3.620	8.200	19.090	5.470	41.800	20.960	0.046	0.496	0.000	99.702	CHROME-PYROPE_>ONE_S.D.
RE98-84B-127-001	595694	6222737	0.005	4.210	8.180	18.610	5.850	41.510	20.090	0.055	0.558	0.000	99.068	CHROME-PYROPE_>ONE_S.D.
RE98-84B-127-001	595694	6222737	0.013	4.340	7.650	19.070	5.680	41.790	20.510	0.045	0.473	0.000	99.571	CHROME-PYROPE_>ONE_S.D.

Appendix 3. Summary of geochemical analyses of silicate and oxide indicator grains.

SILICATES

Sample#	Easting	Northing	TiO2	Cr2O3	FeO	MgO	Ca0	SiO2	Al2O3	Na2O	MnO	K2O	Total	Min ID-(Gent, 1993)*
RE98-84B-127-001	595694	6222737	0.096	6.410	8.420	17.890	6.820	41.190	17.970	0.039	0.511	0.044	99.389	CHROME-PYROPE_>ONE_S.D.
RE98-84B-127-001	595694	6222737	0.030	3.160	7.710	19.310	5.240	41.980	20.960	0.018	0.561	0.056	99.025	CHROME-PYROPE_>ONE_S.D.
RE98-84B-133-001	617195	6218632	0.169	6.110	7.140	19.840	5.400	41.440	18.540	0.095	0.398	0.000	99.132	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-133-001	617195	6218632	0.082	4.370	8.080	19.540	5.430	42.250	19.840	0.003	0.384	0.000	99.979	CHROME-PYROPE
RE98-84B-134-001	614855	6215426	0.319	4.320	6.700	20.270	5.510	42.090	19.660	0.039	0.255	0.000	99.163	CHROME-PYROPE_>ONE_S.D.
RE98-84B-141-001	601483	6235778	0.324	3.820	7.730	19.770	4.930	41.930	20.110	0.050	0.307	0.000	98.971	CHROME-PYROPE_>ONE_S.D.
RE98-84B-141-001	601483	6235778	0.082	7.260	8.360	17.320	7.500	41.270	17.650	0.000	0.573	0.000	100.015	CHROME-PYROPE_>ONE_S.D.
RE98-84B-146-001	585242	6218218	0.084	6.280	8.220	17.790	6.720	41.210	18.390	0.000	0.602	0.000	99.295	CHROME-PYROPE_>ONE_S.D.
RE98-84B-146-001	585242	6218218	0.190	7.400	7.250	19.220	5.970	41.690	17.230	0.062	0.438	0.000	99.449	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-146-001	585242	6218218	0.090	8.380	6.890	18.640	6.570	41.430	15.860	0.034	0.305	0.000	98.199	UNKNOWN
RE98-84B-146-001	585242	6218218	0.077	6.640	7.540	18.630	6.060	41.360	18.170	0.012	0.461	0.024	98.974	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-146-001	585242	6218218	0.050	6.760	7.030	19.810	5.560	41.890	18.080	0.078	0.326	0.101	99.685	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-147-001	587086	6218371	0.112	7.390	7.710	17.830	6.850	41.200	17.820	0.009	0.511	0.081	99.513	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-147-001	587086	6218371	0.029	5.060	8.250	18.400	5.900	41.790	19.590	0.001	0.525	0.000	99.545	CHROME-PYROPE_>ONE_S.D.
RE98-84B-147-001	587086	6218371	0.476	3.190	6.860	20.320	5.170	42.320	20.540	0.079	0.281	0.000	99.236	TITANIUM_PYROPE_>ONE_S.D.
RE98-84B-147-001	587086	6218371	0.027	4.220	7.300	19.610	5.560	42.130	20.340	0.026	0.391	0.000	99.603	CHROME-PYROPE_>ONE_S.D.
RE98-84B-147-001	587086	6218371	0.000	4.710	7.700	19.060	5.760	41.750	19.830	0.000	0.306	0.103	99.219	CHROME-PYROPE_>ONE_S.D.
RE98-84B-147-001	587086	6218371	0.102	2.537	9.350	18.150	5.690	41.680	21.260	0.000	0.639	0.000	99.408	CHROME-PYROPE_>ONE_S.D.
RE98-84B-149-001	588160	6217598	0.810	3.820	7.840	19.920	5.230	41.900	18.760	0.015	0.264	0.000	98.559	TITANIUM_PYROPE_>ONE_S.D.
RE98-84B-153-001	589495	6219403	0.172	7.980	6.880	18.730	6.140	41.520	17.170	0.013	0.349	0.000	98.953	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-153-001	589495	6219403	0.072	5.460	7.320	19.880	5.630	41.950	19.080	0.000	0.382	0.000	99.773	CHROME-PYROPE_>ONE_S.D.
RE98-84B-153-001	589495	6219403	0.000	3.470	7.520	19.000	5.430	42.070	20.790	0.060	0.469	0.000	98.809	CHROME-PYROPE_>ONE_S.D.
RE98-84B-155-001	614385	6234129	0.289	6.200	7.240	19.380	5.310	41.540	17.840	0.083	0.396	0.000	98.278	CHROME-PYROPE_>ONE_S.D.
RE98-84B-156-001	622553	6231722	0.033	5.910	8.630	17.480	6.730	41.090	18.440	0.025	0.515	0.032	98.886	CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.295	2.100	8.620	19.160	4.540	42.360	21.570	0.047	0.424	0.000	99.115	CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.022	5.660	8.450	17.430	6.920	41.460	18.780	0.000	0.541	0.100	99.364	CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.034	4.280	7.830	18.220	5.990	42.020	20.290	0.000	0.567	0.069	99.300	CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.076	3.620	8.290	18.140	5.910	41.630	20.540	0.000	0.573	0.068	98.847	CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.034	3.220	8.800	18.490	5.570	42.010	20.860	0.033	0.552	0.036	99.606	CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.148	5.110	8.090	19.250	5.570	41.780	19.030	0.000	0.385	0.000	99.363	CHROME-PYROPE
RE98-84B-165-001	564559	6301509	0.339	6.680	8.810	17.500	6.490	41.210	17.640	0.083	0.371	0.000	99.123	UVAROVITE-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.034	4.450	7.580	19.170	5.340	41.590	20.080	0.028	0.656	0.052	98.979	CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.024	6.210	7.710	18.170	6.320	41.890	18.420	0.036	0.450	0.036	99.266	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.148	5.700	8.260	18.370	5.880	41.760	18.830	0.043	0.473	0.036	99.500	CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.038	5.010	8.340	18.760	5.880	41.840	19.810	0.017	0.455	0.000	100.150	CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.369	4.170	8.640	18.410	5.610	41.490	19.490	0.089	0.436	0.000	98.703	CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.062	6.470	7.780	17.570	6.700	41.510	18.420	0.050	0.534	0.000	99.096	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.023	4.740	8.290	18.080	6.150	41.780	19.600	0.000	0.551	0.000	99.214	CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.000	4.640	7.650	18.510	5.870	42.260	20.170	0.053	0.512	0.000	99.664	CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.000	3.960	8.080	18.570	5.730	42.210	20.380	0.047	0.509	0.061	99.546	CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.000	4.410	7.470	19.230	5.580	41.820	20.260	0.000	0.534	0.000	99.304	CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.050	8.550	8.640	16.610	7.640	41.000	16.820	0.000	0.524	0.080	99.914	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.005	5.040	7.560	18.600	5.840	42.020	19.640	0.006	0.548	0.000	99.258	CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.065	5.590	8.130	17.400	6.640	41.440	19.020	0.000	0.544	0.000	98.829	CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.293	3.660	8.640	18.820	5.020	41.880	20.150	0.144	0.475	0.000	99.082	CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.072	7.190	7.720	18.110	6.610	41.550	17.700	0.010	0.491	0.000	99.454	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.067	7.320	7.220	18.600	6.680	41.600	17.810	0.000	0.435	0.000	99.732	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.280	4.630	7.280	20.640	4.960	42.420	20.020	0.015	0.298	0.000	100.542	CHROME-PYROPE
RE98-84B-165-001	564559	6301509	0.076	5.740	8.450	17.410	6.860	41.150	18.730	0.019	0.531	0.000	98.966	CHROME-PYROPE_>ONE_S.D.
RE98-84B-165-001	564559	6301509	0.013	5.820	7.730	18.130	6.400	41.660	19.270	0.069	0.522	0.000	99.613	CHROME-PYROPE_>ONE_S.D.

Appendix 3. Summary of geochemical analyses of silicate and oxide indicator grains.

SILICATES

Sample#	Easting	Northing	TiO2	Cr2O3	FeO	MgO	Ca0	SiO2	Al2O3	Na2O	MnO	K2O	Total	Min ID-(Gent, 1993)*
RE98-84B-169-001	576434	6296035	0.003	5.280	7.860	18.640	6.040	41.990	19.750	0.031	0.563	0.000	100.158	CHROME-PYROPE_>ONE_S.D.
RE98-84B-169-001	576434	6296035	0.044	4.750	8.220	18.200	5.840	42.110	19.710	0.002	0.444	0.000	99.320	CHROME-PYROPE_>ONE_S.D.
RE98-84B-169-001	576434	6296035	0.260	7.360	8.110	17.390	6.990	40.030	17.260	0.000	0.445	0.004	97.849	UVAROVITE-PYROPE_>ONE_S.D.
RE98-84B-169-001	576434	6296035	0.067	6.300	8.240	16.980	7.210	41.270	18.250	0.000	0.524	0.064	98.905	CHROME-PYROPE_>ONE_S.D.
RE98-84B-169-001	576434	6296035	0.000	3.980	7.680	18.920	5.700	42.070	20.590	0.075	0.551	0.000	99.566	CHROME-PYROPE_>ONE_S.D.
RE98-84B-169-001	576434	6296035	0.000	4.890	8.090	18.620	5.910	42.000	19.930	0.048	0.550	0.065	100.103	CHROME-PYROPE_>ONE_S.D.
RE98-84B-169-001	576434	6296035	0.059	6.490	7.920	17.480	7.230	41.170	18.490	0.022	0.537	0.032	99.430	CHROME-PYROPE_>ONE_S.D.
RE98-84B-169-001	576434	6296035	0.103	1.807	7.900	19.430	4.840	42.480	22.200	0.031	0.561	0.000	99.353	CHROME-PYROPE
RE98-84B-169-001	576434	6296035	0.155	4.000	9.930	18.140	5.030	41.510	20.190	0.090	0.378	0.041	99.463	CHROME-PYROPE_>ONE_S.D.
RE98-84B-170-001	572780	6297212	0.100	3.480	9.020	18.130	5.600	41.700	20.600	0.000	0.446	0.000	99.076	CHROME-PYROPE_>ONE_S.D.
RE98-84B-170-001	572780	6297212	0.244	6.270	8.750	18.020	5.710	41.470	18.340	0.071	0.432	0.000	99.307	CHROME-PYROPE_>ONE_S.D.
RE98-84B-170-001	572780	6297212	0.023	5.580	7.970	18.100	6.520	41.400	18.940	0.062	0.514	0.000	99.109	CHROME-PYROPE_>ONE_S.D.
RE98-84B-170-001	572780	6297212	0.159	6.590	8.210	17.870	6.590	41.290	18.340	0.040	0.499	0.000	99.588	CHROME-PYROPE_>ONE_S.D.
RE98-84B-170-001	572780	6297212	0.108	8.590	8.260	16.680	7.670	40.690	16.470	0.044	0.490	0.000	99.002	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
RE98-84B-170-001	572780	6297212	0.082	3.470	8.450	19.590	5.160	41.800	20.370	0.000	0.379	0.000	99.300	CHROME-PYROPE
RE98-84B-170-001	572780	6297212	0.014	3.410	8.610	18.370	5.500	41.640	20.900	0.018	0.461	0.000	98.924	CHROME-PYROPE_>ONE_S.D.
RE98-84B-170-001	572780	6297212	0.298	7.130	8.320	17.930	6.260	41.410	17.400	0.046	0.488	0.028	99.309	UVAROVITE-PYROPE_>ONE_S.D.
RE98-84B-170-001	572780	6297212	0.000	5.910	8.080	17.650	6.580	41.480	18.900	0.000	0.472	0.000	99.072	CHROME-PYROPE_>ONE_S.D.
RE98-84B-170-001	572780	6297212	0.041	7.100	8.350	17.220	7.210	41.350	17.300	0.000	0.419	0.000	98.990	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
NAT98-264	613335	5988941	0.000	4.610	8.020	19.060	5.290	41.460	20.370	0.048	0.529	0.000	99.386	CHROME-PYROPE_>ONE_S.D.
NAT98-264	613335	5988941	0.018	7.600	7.340	18.290	6.790	41.260	17.440	0.015	0.421	0.000	99.174	LOW-CALCIUM_CHROME-PYROPE_>ONE_S.D.
NAT98-264	613335	5988941	0.073	4.450	7.590	19.370	5.250	41.990	19.920	0.081	0.330	0.000	99.054	CHROME-PYROPE
NAT98-264	613335	5988941	0.000	4.160	7.440	18.800	5.500	41.860	20.340	0.074	0.549	0.000	98.724	CHROME-PYROPE_>ONE_S.D.
NAT98-264	613335	5988941	0.000	4.500	7.560	19.060	5.460	41.870	20.370	0.067	0.574	0.012	99.473	CHROME-PYROPE_>ONE_S.D.
Eclogitic Garnet														
Sample#	Easting	Northing	TiO2	Cr2O3	FeO	MgO	Ca0	SiO2	Al2O3	Na2O	MnO	K2O	Total	Min ID-(Gent, 1993)*
RE98-84B-001-001	676260	6223569	0.163	0.062	21.230	6.010	10.960	38.770	21.220	0.017	0.448	0.000	98.879	CALCIC_PYROPE-ALMANDINE_>ONE_S.D.
RE98-84B-014-001	682940	6247996	0.039	0.034	23.130	12.200	1.029	39.690	22.140	0.000	0.674	0.000	98.936	MAGNESIAN_ALMANDINE_>ONE_S.D.
RE98-84B-038-001	574293	6300929	0.103	0.061	21.940	7.410	8.800	39.150	21.620	0.000	0.646	0.000	99.730	CALCIC_PYROPE-ALMANDINE_>ONE_S.D.
RE98-84B-038-001	574293	6300929	0.037	0.075	27.040	8.800	2.278	39.070	21.390	0.000	0.843	0.000	99.533	MAGNESIAN_ALMANDINE_>ONE_S.D.
RE98-84B-043-001	578555	6302112	0.018	0.000	36.010	2.912	2.044	37.510	20.690	0.014	1.080	0.000	100.277	ALMANDINE
RE98-84B-043-001	578555	6302112	0.044	0.013	32.480	4.090	4.260	37.600	20.900	0.021	0.504	0.000	99.911	ALMANDINE
RE98-84B-044-001	578995	6300303	0.065	0.063	33.150	5.320	1.468	37.970	21.120	0.000	0.625	0.000	99.780	ALMANDINE
RE98-84B-104-001	581961	6263872	0.006	0.000	34.900	1.935	3.090	37.180	20.300	0.000	1.906	0.000	99.318	ALMANDINE
RE98-84B-146-001	585242	6218218	0.078	0.031	25.860	10.400	1.236	39.510	21.660	0.074	0.585	0.000	99.434	MAGNESIAN_ALMANDINE_>ONE_S.D.
RE98-84B-156-001	622553	6231722	0.022	0.150	22.230	12.190	1.662	38.170	21.700	0.000	0.833	0.000	96.957	MAGNESIAN_ALMANDINE_>ONE_S.D.
RE98-84B-040-001	577201	6300986	0.008	0.000	13.400	0.002	22.530	37.220	21.350	0.000	0.028	0.000	94.538	FERRO-MAGNESIAN_GROSSULAR_>ONE_S.D.
Clinopyroxene														
Sample#	Easting	Northing	TiO2	Cr2O3	FeO	MgO	Ca0	SiO2	Al2O3	Na2O	MnO	K2O	Total	Min ID-(Gent, 1993)*
RE98-84B-002-001	678967	6218934	0.109	1.155	2.849	15.920	22.930	53.360	2.016	0.757	0.100	0.000	99.196	CPX-CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-002-001	678967	6218934	0.183	1.062	3.160	15.110	22.870	53.440	2.368	0.923	0.075	0.060	99.251	CPX-CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-014-001	682940	6247996	0.158	1.436	2.055	15.880	23.250	53.440	1.859	0.777	0.038	0.108	99.001	CPX-CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-014-001	682940	6247996	0.229	1.143	3.060	15.130	21.970	53.140	3.270	1.117	0.089	0.008	99.155	CPX-CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-014-001	682940	6247996	0.029	0.735	4.690	16.000	22.260	53.650	1.248	0.485	0.181	0.000	99.277	UNKNOWN CPX
RE98-84B-014-001	682940	6247996	0.000	0.345	3.540	16.280	22.880	54.260	1.038	0.396	0.073	0.054	98.866	UNKNOWN CPX

Appendix 3. Summary of geochemical analyses of silicate and oxide indicator grains.

SILICATES

Sample#	Easting	Northing	TiO2	Cr2O3	FeO	MgO	Ca0	SiO2	Al2O3	Na2O	MnO	K2O	Total	Min ID-(Gent, 1993)*
RE98-84B-014-001	682940	6247996	0.126	1.139	3.010	18.180	20.420	54.600	0.755	0.665	0.082	0.062	99.038	UNKNOWN CPX
RE98-84B-027-001	631075	6290850	0.336	1.045	2.524	14.860	20.520	52.310	6.400	1.703	0.098	0.000	99.796	CPX-_CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-028-001	631862	6297774	0.031	0.939	2.904	21.060	11.870	54.590	4.210	0.878	0.165	0.413	97.059	UNKNOWN CPX
RE98-84B-031-001	631051	6311634	0.225	1.153	2.403	15.570	20.530	52.880	5.200	1.411	0.075	0.031	99.479	CPX-CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-031-001	631051	6311634	0.113	0.754	5.570	14.050	19.930	54.320	1.688	2.174	0.057	0.042	98.699	UNKNOWN CPX
RE98-84B-032-001	647011	6279047	0.096	1.018	3.000	16.340	22.610	54.730	1.561	0.847	0.126	0.012	100.340	CPX-CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-034-001	562604	6309730	0.220	1.876	3.140	17.560	17.420	55.050	1.644	1.830	0.069	0.102	98.909	CPX-_CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-035-001	565764	6309574	0.200	0.290	5.990	33.540	1.280	56.670	1.260	0.120	0.110	0.000	99.460	UNKNOWN CPX
RE98-84B-035-001	565764	6309574	0.150	0.380	5.960	33.730	1.280	56.770	1.380	0.200	0.140	0.006	99.996	UNKNOWN CPX
RE98-84B-035-001	565764	6309574	0.000	0.510	5.090	34.570	1.110	56.650	0.930	0.020	0.120	0.013	99.013	UNKNOWN CPX
RE98-84B-035-001	565764	6309574	0.487	1.395	4.070	17.790	16.510	54.730	2.576	1.975	0.073	0.012	99.618	UNKNOWN CPX
RE98-84B-035-001	565764	6309574	0.116	1.705	4.130	15.200	21.160	54.560	1.496	1.661	0.124	0.000	100.152	UNKNOWN CPX
RE98-84B-035-001	565764	6309574	0.111	0.821	4.100	14.820	20.510	54.090	2.393	1.949	0.137	0.000	98.932	CPX-DIOPSIDE_>ONE_S.D.
RE98-84B-036-001	567710	6307283	0.125	0.720	4.640	14.210	19.290	54.640	2.650	2.682	0.122	0.000	99.078	UNKNOWN CPX
RE98-84B-038-001	574293	6300929	0.000	1.969	1.996	16.210	21.750	55.020	0.639	1.535	0.022	0.035	99.175	UNKNOWN CPX
RE98-84B-038-001	574293	6300929	0.081	1.810	1.800	16.390	21.900	55.010	1.043	1.642	0.020	0.000	99.696	CPX-CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-038-001	574293	6300929	0.074	1.720	1.882	16.740	22.520	55.060	0.168	1.232	0.038	0.000	99.433	UNKNOWN CPX
RE98-84B-038-001	574293	6300929	0.097	1.454	2.056	16.360	21.710	54.840	0.860	1.361	0.119	0.000	98.858	UNKNOWN CPX
RE98-84B-038-001	574293	6300929	0.035	2.926	2.251	15.630	20.890	54.970	0.653	2.051	0.018	0.000	99.424	UNKNOWN CPX
RE98-84B-038-001	574293	6300929	0.041	2.310	2.289	15.390	19.990	54.800	2.347	2.441	0.051	0.016	99.674	CPX-UREYITIC_DIOPSIDE
RE98-84B-038-001	574293	6300929	0.047	1.246	1.818	16.720	22.990	54.520	0.674	1.098	0.067	0.008	99.186	UNKNOWN CPX
RE98-84B-038-001	574293	6300929	0.000	1.117	1.795	17.550	22.340	54.950	0.665	0.695	0.000	0.078	99.190	UNKNOWN CPX
RE98-84B-038-001	574293	6300929	0.018	1.660	2.147	16.530	22.230	55.130	0.419	1.340	0.044	0.000	99.519	UNKNOWN CPX
RE98-84B-038-001	574293	6300929	0.103	2.600	2.424	16.160	21.370	55.420	0.410	1.669	0.100	0.108	100.364	UNKNOWN CPX
RE98-84B-038-001	574293	6300929	0.145	0.908	3.270	15.970	22.850	54.270	1.864	0.755	0.062	0.000	100.094	CPX-CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-038-001	574293	6300929	0.000	0.713	2.366	16.680	22.600	55.200	0.643	0.957	0.108	0.142	99.408	UNKNOWN CPX
RE98-84B-038-001	574293	6300929	0.000	0.476	2.583	16.620	23.270	55.020	0.614	0.782	0.104	0.120	99.588	UNKNOWN CPX
RE98-84B-039-001	574993	6301161	0.000	1.337	2.328	21.210	8.110	52.630	3.690	4.780	0.031	1.526	95.642	UNKNOWN CPX
RE98-84B-039-001	574993	6301161	0.001	1.274	2.398	21.550	8.170	53.260	3.570	5.000	0.029	1.401	96.654	UNKNOWN CPX
RE98-84B-039-001	574993	6301161	0.119	1.228	2.630	16.430	21.330	55.300	0.612	1.570	0.084	0.047	99.350	UNKNOWN CPX
RE98-84B-040-001	577201	6300986	0.100	1.135	2.628	14.790	23.040	51.930	5.210	0.683	0.115	0.054	99.685	CPX-CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-040-001	577201	6300986	0.107	1.243	2.302	16.590	22.680	54.530	0.271	1.079	0.056	0.000	98.858	UNKNOWN CPX
RE98-84B-040-001	577201	6300986	0.038	2.194	2.065	15.810	21.050	54.730	1.099	1.748	0.029	0.000	98.762	CPX-CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-040-001	577201	6300986	0.048	2.368	2.166	15.420	21.330	54.770	1.101	1.826	0.066	0.028	99.122	CPX-CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-040-001	577201	6300986	0.061	2.279	2.447	14.480	18.360	54.630	3.330	3.050	0.038	0.097	98.771	CPX-UREYITIC_DIOPSIDE
RE98-84B-043-001	578555	6302112	0.000	1.370	1.644	17.050	22.550	55.400	0.313	1.062	0.036	0.074	99.498	UNKNOWN CPX
RE98-84B-043-001	578555	6302112	0.120	0.683	3.820	15.700	22.490	53.290	2.526	0.604	0.124	0.000	99.357	UNKNOWN CPX
RE98-84B-043-001	578555	6302112	0.069	0.731	5.840	14.940	21.990	53.030	1.585	0.519	0.218	0.000	98.922	UNKNOWN CPX
RE98-84B-044-001	578995	6300303	0.080	0.455	5.180	14.660	20.230	54.620	2.378	1.746	0.000	0.027	99.375	CPX-DIOPSIDE_>ONE_S.D.
RE98-84B-046-001	580906	6298617	0.099	0.730	4.680	14.520	21.520	53.380	3.140	1.246	0.113	0.124	99.552	CPX-DIOPSIDE_>ONE_S.D.
RE98-84B-046-001	580906	6298617	0.204	0.826	3.500	15.490	22.680	53.960	2.283	0.645	0.133	0.000	99.720	UNKNOWN CPX
RE98-84B-046-001	580906	6298617	0.212	1.002	2.874	17.480	23.030	54.070	0.938	0.269	0.095	0.000	99.970	UNKNOWN CPX
RE98-84B-046-001	580906	6298617	0.249	0.702	2.780	15.340	20.240	51.950	6.810	1.335	0.122	0.109	99.636	UNKNOWN CPX
RE98-84B-046-001	580906	6298617	0.273	1.033	2.881	15.680	19.770	51.810	6.630	1.493	0.119	0.035	99.724	CPX-_CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-048-001	590740	6298172	0.080	0.000	1.820	16.980	25.230	53.100	0.810	0.010	0.070	0.018	98.118	UNKNOWN CPX
RE98-84B-050-001	576108	6301097	0.090	1.154	1.599	16.720	21.910	54.530	1.689	1.319	0.089	0.070	99.170	CPX-CHROME_DIOPSIDE
RE98-84B-053-001	588540	6291521	0.068	1.242	4.410	15.700	21.570	53.790	1.772	0.828	0.170	0.000	99.549	CPX-DIOPSIDE_>ONE_S.D.
RE98-84B-055-001	645945	6217477	0.002	0.286	4.080	15.350	24.110	54.600	0.478	0.816	0.162	0.000	99.884	UNKNOWN CPX
RE98-84B-055-001	645945	6217477	0.029	0.494	3.610	15.970	23.480	54.580	0.948	0.685	0.155	0.000	99.951	UNKNOWN CPX
RE98-84B-065-001	651567	6312017	0.082	0.855	2.014	15.990	22.040	53.220	4.100	0.885	0.086	0.000	99.272	CPX-CHROME_DIOPSIDE_>ONE_S.D.

Appendix 3. Summary of geochemical analyses of silicate and oxide indicator grains.

SILICATES

Sample#	Easting	Northing	TiO2	Cr2O3	FeO	MgO	Ca0	SiO2	Al2O3	Na2O	MnO	K2O	Total	Min ID-(Gent, 1993)*
RE98-84B-065-001	651567	6312017	0.272	1.040	2.671	15.050	20.650	51.930	6.750	1.227	0.108	0.000	99.698	UNKNOWN CPX
RE98-84B-065-001	651567	6312017	0.323	0.948	2.609	15.220	20.740	52.190	6.000	1.257	0.084	0.000	99.371	CPX-DIOPSIDE_>ONE_S.D.
RE98-84B-076-001	609671	6266684	0.000	0.000	1.690	17.340	25.040	54.440	0.460	0.040	0.060	0.010	99.080	UNKNOWN CPX
RE98-84B-076-001	609671	6266684	0.030	0.000	2.490	16.730	25.020	54.400	0.420	0.050	0.230	0.017	99.387	UNKNOWN CPX
RE98-84B-076-001	609671	6266684	0.083	0.880	4.150	15.640	21.030	54.920	1.281	1.558	0.190	0.000	99.732	CPX-DIOPSIDE_>ONE_S.D.
RE98-84B-076-001	609671	6266684	0.031	0.340	4.080	16.190	22.860	54.970	0.921	0.528	0.166	0.000	100.085	UNKNOWN CPX
RE98-84B-076-001	609671	6266684	0.526	0.827	2.799	14.870	19.380	52.480	7.030	1.790	0.139	0.109	99.949	UNKNOWN CPX
RE98-84B-078-001	567290	6280153	0.393	1.073	2.671	14.660	20.130	52.600	6.590	1.775	0.089	0.000	99.981	CPX-_CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-083-001	561977	6267472	0.040	0.520	5.590	33.090	0.640	54.780	4.050	0.070	0.130	0.028	98.938	UNKNOWN CPX
RE98-84B-083-001	561977	6267472	0.079	1.265	2.654	16.330	19.780	52.910	4.320	1.367	0.115	0.217	99.036	CPX-CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-083-001	561977	6267472	0.091	1.101	2.539	15.120	18.660	53.370	5.840	2.246	0.073	0.066	99.106	CPX-CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-105-001	603091	6246635	0.035	1.887	1.943	16.450	21.680	54.870	0.510	1.404	0.020	0.000	98.798	UNKNOWN CPX
RE98-84B-105-001	603091	6246635	0.088	1.337	3.250	17.390	21.330	55.020	0.294	0.718	0.038	0.062	99.527	UNKNOWN CPX
RE98-84B-113-001	604315	6235084	0.550	0.915	2.638	14.450	19.430	51.900	7.180	1.786	0.156	0.004	99.008	UNKNOWN CPX
RE98-84B-113-001	604315	6235084	0.074	1.097	4.240	21.340	10.620	53.860	4.370	1.055	0.148	0.000	96.804	UNKNOWN CPX
RE98-84B-118-001	574034	6266708	0.083	0.486	5.200	15.220	21.820	54.210	1.420	1.006	0.157	0.000	99.601	UNKNOWN CPX
RE98-84B-122-001	584697	6259540	0.351	0.919	2.650	15.410	19.630	52.200	6.270	1.459	0.169	0.078	99.134	CPX-_CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-123-001	566241	6282101	0.111	2.111	2.157	16.810	20.850	54.690	0.786	1.440	0.071	0.000	99.027	UNKNOWN CPX
RE98-84B-123-001	566241	6282101	0.089	1.159	2.556	17.500	19.930	54.490	1.745	1.122	0.080	0.054	98.725	CPX-CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-123-001	566241	6282101	0.089	2.155	2.134	16.160	21.970	54.820	0.192	1.429	0.073	0.000	99.023	UNKNOWN CPX
RE98-84B-123-001	566241	6282101	0.073	1.657	2.079	16.370	22.660	55.150	0.285	1.146	0.080	0.000	99.499	UNKNOWN CPX
RE98-84B-123-001	566241	6282101	0.115	2.461	2.782	15.580	21.130	54.920	0.355	1.897	0.044	0.000	99.284	UNKNOWN CPX
RE98-84B-23-001	566241	6282101	0.037	2.331	2.433	15.340	19.010	54.810	2.993	2.497	0.091	0.136	99.677	CPX-UREYITIC_DIOPSIDE
RE98-84B-123-001	566241	6282101	0.134	2.131	2.982	17.160	18.700	54.520	1.751	1.639	0.086	0.000	99.103	CPX-CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-123-001	566241	6282101	0.087	1.136	3.590	15.910	21.630	54.410	0.146	1.243	0.104	0.000	98.257	UNKNOWN CPX
RE98-84B-127-001	595694	6222737	0.311	0.774	3.180	15.300	18.810	52.740	6.260	2.048	0.113	0.012	99.548	CPX-_CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-127-001	595694	6222737	0.094	0.599	5.390	15.850	22.310	54.560	0.748	0.623	0.139	0.015	100.329	UNKNOWN CPX
RE98-84B-127-001	595694	6222737	0.043	0.702	3.170	16.180	22.630	53.870	1.619	0.718	0.058	0.000	98.989	CPX-CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-127-001	595694	6222737	0.000	0.794	3.400	16.760	22.320	54.460	0.431	0.524	0.067	0.000	98.755	UNKNOWN CPX
RE98-84B-132-001	619104	6220042	0.022	0.509	3.800	21.560	11.790	56.390	1.869	0.570	0.087	0.032	96.627	CPX-_SUB-CALCIC_DIOPSIDE_>ONE_S.D.
RE98-84B-133-001	617195	6218632	0.287	0.988	2.504	15.430	20.200	51.650	6.140	1.495	0.047	0.000	98.740	CPX-_CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-133-001	617195	6218632	0.277	1.018	2.443	15.070	20.590	51.650	6.350	1.529	0.069	0.000	98.995	CPX-_CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-134-001	614855	6215426	0.292	1.028	2.872	15.480	19.740	52.600	6.300	1.447	0.131	0.000	99.889	CPX-_CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-141-001	601483	6235778	0.167	1.075	2.709	15.610	19.520	52.290	6.400	1.405	0.102	0.082	99.360	CPX-_CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-141-001	601483	6235778	0.296	1.040	2.638	15.070	19.910	52.030	6.410	1.307	0.080	0.027	98.808	CPX-_CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-142-001	578360	6223977	0.418	0.761	2.462	14.450	21.210	52.400	6.500	1.524	0.031	0.058	99.814	CPX-_CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-144-001	567666	6219155	0.000	0.000	1.740	17.150	25.010	54.730	0.490	0.110	0.110	0.019	99.359	UNKNOWN CPX
RE98-84B-144-001	567666	6219155	0.010	0.000	3.640	15.990	25.000	54.310	0.160	0.070	0.170	0.014	99.364	UNKNOWN CPX
RE98-84B-145-001	578524	6222187	0.411	0.699	2.981	14.600	19.590	51.620	7.290	1.667	0.098	0.051	99.006	UNKNOWN CPX
RE98-84B-146-001	585242	6218218	0.128	1.337	2.397	16.170	20.430	52.860	4.830	1.217	0.058	0.000	99.427	CPX-CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-146-001	585242	6218218	0.237	1.292	2.543	15.570	20.480	51.670	5.430	1.191	0.049	0.000	98.462	CPX-_CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-146-001	585242	6218218	0.088	1.126	2.283	16.080	21.980	54.980	1.148	1.378	0.071	0.000	99.134	CPX-CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-146-001	585242	6218218	0.531	0.788	2.545	14.750	19.540	51.870	6.810	1.918	0.080	0.175	99.007	UNKNOWN CPX
RE98-84B-146-001	585242	6218218	0.224	1.180	2.266	14.290	21.030	52.600	5.720	1.720	0.089	0.000	99.119	CPX-CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-146-001	585242	6218218	0.273	1.339	2.105	15.600	20.960	52.410	4.790	1.256	0.036	0.008	98.776	CPX-CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-146-001	585242	6218218	0.389	1.340	2.562	15.460	19.930	52.720	5.260	1.487	0.089	0.016	99.253	CPX-_CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-146-001	585242	6218218	0.001	1.045	4.410	15.020	21.740	53.380	1.842	0.913	0.111	0.000	98.461	CPX-DIOPSIDE_>ONE_S.D.
RE98-84B-146-001	585242	6218218	0.036	1.180	3.790	15.980	21.760	53.760	1.576	0.805	0.175	0.000	99.062	CPX-_DIOPSIDE_>ONE_S.D.
RE98-84B-146-001	585242	6218218	0.451	0.817	2.697	15.040	19.820	52.130	6.570	1.645	0.040	0.000	99.210	UNKNOWN CPX
RE98-84B-146-001	585242	6218218	0.214	0.860	2.648	14.690	20.000	51.840	7.080	1.583	0.104	0.039	99.058	UNKNOWN CPX

Appendix 3. Summary of geochemical analyses of silicate and oxide indicator grains.

SILICATES

Sample#	Easting	Northing	TiO2	Cr2O3	FeO	MgO	Ca0	SiO2	Al2O3	Na2O	MnO	K2O	Total	Min ID-(Gent, 1993)*
RE98-84B-146-001	585242	6218218	0.012	0.480	4.150	15.410	22.570	54.450	1.323	0.802	0.151	0.023	99.372	UNKNOWN CPX
RE98-84B-147-001	587086	6218371	0.405	0.864	2.587	14.670	19.740	52.200	6.910	1.869	0.062	0.062	99.369	UNKNOWN CPX
RE98-84B-147-001	587086	6218371	0.114	0.869	2.748	15.270	20.980	53.120	5.750	1.460	0.100	0.027	100.438	CPX-CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-147-001	587086	6218371	0.019	0.656	3.950	16.080	22.300	54.060	1.081	0.472	0.148	0.008	98.774	UNKNOWN CPX
RE98-84B-149-001	588160	6217598	0.277	1.038	2.870	15.220	19.700	51.860	6.690	1.511	0.106	0.035	99.306	UNKNOWN CPX
RE98-84B-152-001	599192	6227088	0.055	0.926	3.700	14.790	23.620	53.810	1.059	0.612	0.761	0.000	99.333	UNKNOWN CPX
RE98-84B-152-001	599192	6227088	0.198	1.009	2.641	15.040	20.830	52.510	6.030	1.273	0.020	0.062	99.613	CPX-DIOPSIDE_>ONE_S.D.
RE98-84B-153-001	589495	6219403	0.000	0.170	7.640	33.800	0.180	56.900	1.430	0.000	0.140	0.004	100.264	UNKNOWN CPX
RE98-84B-154-001	611309	6212649	0.066	1.215	2.361	15.490	20.130	53.390	4.330	2.001	0.080	0.156	99.218	CPX-CHROME_DIOPSIDE_>ONE_S.D.
RE98-84B-163-001	593622	6255643	0.104	0.815	2.444	17.650	23.080	54.580	0.868	0.116	0.111	0.101	99.868	UNKNOWN CPX
RE98-84B-165-001	564559	6301509	0.060	1.829	2.128	16.750	22.800	55.120	0.103	1.228	0.060	0.058	100.134	UNKNOWN CPX
RE98-84B-166-001	562657	6308807	0.047	0.526	4.610	15.970	22.340	53.420	1.314	0.445	0.135	0.000	98.807	UNKNOWN CPX
NAT98-264	613335	5988941	0.116	0.853	2.276	15.050	20.870	52.970	5.630	1.613	0.116	0.000	99.493	CPX-CHROME_DIOPSIDE_>ONE_S.D.
NAT98-264	613335	5988941	0.132	0.987	4.090	14.310	21.760	52.600	4.030	1.359	0.096	0.101	99.465	UNKNOWN CPX
NAT98-264	613335	5988941	0.164	1.062	2.957	15.200	22.770	53.640	2.308	0.954	0.082	0.000	99.136	CPX-CHROME_DIOPSIDE_>ONE_S.D.
Olivine														
Sample#	Easting	Northing	TiO2	Cr2O3	FeO	MgO	Ca0	SiO2	Al2O3	Na2O	MnO	K2O	Total	Min ID-(Gent, 1993)*
RE98-84B-027-001	631075	6290850	0.020	0.000	10.960	48.470	0.000	40.140	0.010	0.010	0.170	0.001	99.781	OLIVINE_Fo_#
RE98-84B-027-001	631075	6290850	0.000	0.000	7.320	51.150	0.010	40.860	0.000	0.010	0.100	0.003	99.453	OLIVINE_Fo_#
RE98-84B-027-001	631075	6290850	0.000	0.000	7.840	50.710	0.000	40.610	0.010	0.010	0.120	0.032	99.332	OLIVINE_Fo_#
RE98-84B-027-001	631075	6290850	0.000	0.000	7.830	51.110	0.010	40.840	0.000	0.000	0.100	0.025	99.915	OLIVINE_Fo_#
RE98-84B-027-001	631075	6290850	0.000	0.000	8.360	50.470	0.010	40.750	0.020	0.000	0.110	0.010	99.730	OLIVINE_Fo_#
RE98-84B-027-001	631075	6290850	0.020	0.010	7.370	50.950	0.010	41.020	0.000	0.010	0.090	0.012	99.492	OLIVINE_Fo_#
RE98-84B-027-001	631075	6290850	0.030	0.000	10.470	48.990	0.010	40.250	0.000	0.020	0.140	0.006	99.916	OLIVINE_Fo_#
RE98-84B-027-001	631075	6290850	0.010	0.000	8.510	50.250	0.010	40.490	0.010	0.000	0.140	0.016	99.436	OLIVINE_Fo_#
RE98-84B-027-001	631075	6290850	0.000	0.030	8.130	50.560	0.020	40.510	0.020	0.010	0.130	0.017	99.427	OLIVINE_Fo_#
RE98-84B-027-001	631075	6290850	0.020	0.000	8.850	50.140	0.030	40.610	0.000	0.000	0.110	0.015	99.775	OLIVINE_Fo_#
RE98-84B-027-001	631075	6290850	0.010	0.050	9.030	49.980	0.080	40.690	0.030	0.030	0.110	0.001	100.011	OLIVINE_Fo_#
RE98-84B-027-001	631075	6290850	0.000	0.000	8.720	50.260	0.000	40.580	0.010	0.010	0.060	0.005	99.645	OLIVINE_Fo_#
RE98-84B-027-001	631075	6290850	0.000	0.040	9.580	49.650	0.060	40.530	0.000	0.020	0.110	0.014	100.004	OLIVINE_Fo_#
RE98-84B-27-001	631075	6290850	0.020	0.000	8.670	49.940	0.000	40.670	0.020	0.030	0.140	0.000	99.490	OLIVINE_Fo_#
RE98-84B-027-001	631075	6290850	0.010	0.000	8.860	50.270	0.000	40.810	0.000	0.010	0.120	0.015	100.095	OLIVINE_Fo_#
RE98-84B-030-001	634931	6305566	0.020	0.050	9.780	49.200	0.040	40.540	0.020	0.000	0.100	0.023	99.773	OLIVINE_Fo_#
RE98-84B-035-001	565764	6309574	0.000	0.010	7.320	51.180	0.020	40.700	0.010	0.020	0.090	0.044	99.394	OLIVINE_Fo_#
RE98-84B-035-001	565764	6309574	0.000	0.060	8.380	50.400	0.060	40.570	0.040	0.010	0.110	0.014	99.644	OLIVINE_Fo_#
RE98-84B-035-001	565764	6309574	0.030	0.000	13.160	47.080	0.000	39.850	0.030	0.000	0.150	0.020	100.320	OLIVINE_Fo_#
RE98-84B-035-001	565764	6309574	0.000	0.000	7.030	51.800	0.020	40.960	0.000	0.000	0.090	0.024	99.924	OLIVINE_Fo_#
RE98-84B-035-001	565764	6309574	0.000	0.060	9.010	50.000	0.060	40.590	0.030	0.040	0.110	0.004	99.904	OLIVINE_Fo_#
RE98-84B-035-001	565764	6309574	0.000	0.000	7.570	50.980	0.010	40.980	0.000	0.010	0.120	0.000	99.670	OLIVINE_Fo_#
RE98-84B-035-001	565764	6309574	0.010	0.080	10.020	49.000	0.060	40.400	0.020	0.030	0.110	0.020	99.750	OLIVINE_Fo_#
RE98-84B-035-001	565764	6309574	0.000	0.000	8.090	51.160	0.000	40.840	0.000	0.000	0.130	0.012	100.232	OLIVINE_Fo_#
RE98-84B-035-001	565764	6309574	0.000	0.060	8.370	50.320	0.050	40.780	0.030	0.030	0.100	0.006	99.746	OLIVINE_Fo_#
RE98-84B-038-001	574293	6300929	0.000	0.000	8.380	50.630	0.020	40.450	0.000	0.000	0.100	0.002	99.582	OLIVINE_Fo_#
RE98-84B-039-001	574993	6301161	0.010	0.000	8.420	50.380	0.050	40.530	0.020	0.020	0.110	0.006	99.546	OLIVINE_Fo_#
RE98-84B-044-001	578995	6300303	0.000	0.020	9.440	49.760	0.060	40.650	0.010	0.040	0.090	0.014	100.084	OLIVINE_Fo_#
RE98-84B-044-001	578995	6300303	0.000	0.000	8.120	50.960	0.020	40.810	0.020	0.000	0.100	0.003	100.033	OLIVINE_Fo_#
RE98-84B-044-001	578995	6300303	0.020	0.010	8.330	50.880	0.050	40.690	0.030	0.000	0.100	0.006	100.116	OLIVINE_Fo_#
RE98-84B-044-001	578995	6300303	0.020	0.000	7.940	50.910	0.050	40.560	0.020	0.010	0.090	0.001	99.601	OLIVINE_Fo_#

Appendix 3. Summary of geochemical analyses of silicate and oxide indicator grains.

SILICATES

Sample#	Easting	Northing	TiO2	Cr2O3	FeO	MgO	Ca0	SiO2	Al2O3	Na2O	MnO	K2O	Total	Min ID-(Gent, 1993)*
RE98-84B-044-001	578995	6300303	0.020	0.010	8.700	50.110	0.040	40.490	0.040	0.020	0.110	0.000	99.540	OLIVINE_Fo_#
RE98-84B-046-001	580906	6298617	0.020	0.010	8.190	50.790	0.030	40.430	0.020	0.050	0.090	0.011	99.641	OLIVINE_Fo_#
RE98-84B-046-001	580906	6298617	0.000	0.000	8.570	50.610	0.030	40.300	0.000	0.030	0.100	0.009	99.649	OLIVINE_Fo_#
RE98-84B-046-001	580906	6298617	0.010	0.040	8.460	50.120	0.050	40.680	0.030	0.000	0.090	0.026	99.506	OLIVINE_Fo_#
RE98-84B-046-001	580906	6298617	0.000	0.000	9.790	49.390	0.050	40.380	0.010	0.020	0.100	0.011	99.751	OLIVINE_Fo_#
RE98-84B-046-001	580906	6298617	0.000	0.020	8.870	50.150	0.040	40.510	0.000	0.000	0.080	0.000	99.670	OLIVINE_Fo_#
RE98-84B-046-001	580906	6298617	0.020	0.000	9.510	49.570	0.000	40.610	0.000	0.010	0.120	0.022	99.862	OLIVINE_Fo_#
RE98-84B-046-001	580906	6298617	0.030	0.030	8.910	50.130	0.050	40.530	0.030	0.010	0.090	0.011	99.821	OLIVINE_Fo_#
RE98-84B-046-001	580906	6298617	0.000	0.030	9.210	49.800	0.060	40.480	0.020	0.000	0.110	0.012	99.722	OLIVINE_Fo_#
RE98-84B-046-001	580906	6298617	0.030	0.000	10.310	49.270	0.040	40.280	0.030	0.020	0.080	0.023	100.083	OLIVINE_Fo_#
RE98-84B-046-001	580906	6298617	0.000	0.010	8.470	50.780	0.010	40.640	0.020	0.010	0.100	0.003	100.043	OLIVINE_Fo_#
RE98-84B-046-001	580906	6298617	0.000	0.010	8.090	50.830	0.020	40.780	0.050	0.030	0.110	0.002	99.922	OLIVINE_Fo_#
RE98-84B-046-001	580906	6298617	0.030	0.000	9.190	50.180	0.040	40.410	0.000	0.000	0.100	0.004	99.954	OLIVINE_Fo_#
RE98-84B-048-001	590740	6298172	0.040	0.000	8.690	50.180	0.040	40.340	0.010	0.010	0.090	0.019	99.419	OLIVINE_Fo_#
RE98-84B-048-001	590740	6298172	0.010	0.010	8.800	49.890	0.020	40.370	0.020	0.030	0.090	0.010	99.250	OLIVINE_Fo_#
RE98-84B-048-001	590740	6298172	0.020	0.040	8.300	50.140	0.040	40.770	0.010	0.030	0.110	0.009	99.469	OLIVINE_Fo_#
RE98-84B-051-001	582398	6297281	0.020	0.000	9.100	49.430	0.050	40.600	0.010	0.030	0.090	0.016	99.346	OLIVINE_Fo_#
RE98-84B-051-001	582398	6297281	0.020	0.030	9.660	49.380	0.070	40.550	0.030	0.040	0.100	0.025	99.905	OLIVINE_Fo_#
RE98-84B-061-001	645638	6253121	0.010	0.000	9.810	49.260	0.010	40.440	0.020	0.000	0.130	0.000	99.680	OLIVINE_Fo_#
RE98-84B-076-001	609671	6266684	0.040	0.050	9.490	49.540	0.050	40.150	0.030	0.020	0.110	0.007	99.487	OLIVINE_Fo_#
RE98-84B-076-001	609671	6266684	0.010	0.000	14.870	45.350	0.010	39.450	0.010	0.000	0.180	0.019	99.899	OLIVINE_Fo_#
RE98-84B-076-001	609671	6266684	0.020	0.000	8.680	50.510	0.000	40.710	0.000	0.020	0.160	0.017	100.117	OLIVINE_Fo_#
RE98-84B-076-001	609671	6266684	0.020	0.050	9.790	49.290	0.060	40.220	0.020	0.010	0.110	0.004	99.574	OLIVINE_Fo_#
RE98-84B-082-001	565322	6265048	0.040	0.000	9.100	49.240	0.020	40.740	0.010	0.010	0.110	0.030	99.300	OLIVINE_Fo_#
RE98-84B-098-001	611176	6264055	0.000	0.000	8.140	50.860	0.000	40.400	0.000	0.000	0.130	0.019	99.549	OLIVINE_Fo_#
RE98-84B-110-001	605976	6208657	0.010	0.000	12.160	47.580	0.010	39.840	0.020	0.020	0.220	0.015	99.875	OLIVINE_Fo_#
RE98-84B-125-001	600283	6217132	0.020	0.000	8.160	50.480	0.010	40.620	0.010	0.000	0.100	0.014	99.414	OLIVINE_Fo_#
RE98-84B-125-001	600283	6217132	0.000	0.000	7.920	50.430	0.010	40.940	0.000	0.000	0.100	0.012	99.412	OLIVINE_Fo_#
RE98-84B-127-001	595694	6222737	0.000	0.000	7.940	50.830	0.010	40.640	0.000	0.030	0.130	0.013	99.593	OLIVINE_Fo_#
RE98-84B-127-001	595694	6222737	0.000	0.000	9.500	49.750	0.030	40.680	0.020	0.000	0.160	0.028	100.168	OLIVINE_Fo_#
RE98-84B-127-001	595694	6222737	0.010	0.000	8.220	50.860	0.010	40.700	0.000	0.010	0.100	0.001	99.911	OLIVINE_Fo_#
RE98-84B-127-001	595694	6222737	0.000	0.000	8.360	50.360	0.000	40.940	0.020	0.010	0.090	0.011	99.791	OLIVINE_Fo_#
RE98-84B-127-001	595694	6222737	0.000	0.000	7.930	51.070	0.000	40.640	0.000	0.000	0.100	0.009	99.749	OLIVINE_Fo_#
RE98-84B-127-001	595694	6222737	0.030	0.000	10.480	49.000	0.020	40.610	0.010	0.000	0.140	0.029	100.319	OLIVINE_Fo_#
RE98-84B-127-001	595694	6222737	0.010	0.000	7.330	51.310	0.020	40.890	0.000	0.000	0.110	0.016	99.686	OLIVINE_Fo_#
RE98-84B-127-001	595694	6222737	0.020	0.000	7.940	50.770	0.010	40.810	0.010	0.000	0.110	0.024	99.694	OLIVINE_Fo_#
RE98-84B-127-001	595694	6222737	0.000	0.040	9.450	49.550	0.080	40.660	0.030	0.020	0.120	0.012	99.962	OLIVINE_Fo_#
RE98-84B-127-001	595694	6222737	0.020	0.070	8.580	50.430	0.030	40.720	0.020	0.020	0.090	0.026	100.006	OLIVINE_Fo_#
RE98-84B-128-001	592930	6221015	0.000	0.000	8.430	50.350	0.000	40.690	0.010	0.020	0.140	0.004	99.644	OLIVINE_Fo_#
RE98-84B-128-001	592930	6221015	0.000	0.000	8.900	49.940	0.030	40.520	0.000	0.000	0.090	0.014	99.494	OLIVINE_Fo_#
RE98-84B-128-001	592930	6221015	0.000	0.030	8.580	50.110	0.090	40.510	0.020	0.000	0.110	0.032	99.482	OLIVINE_Fo_#
RE98-84B-128-001	592930	6221015	0.000	0.040	8.140	50.210	0.060	40.820	0.030	0.020	0.100	0.016	99.436	OLIVINE_Fo_#
RE98-84B-129-001	605394	6211577	0.020	0.060	8.560	49.990	0.060	40.830	0.040	0.030	0.110	0.009	99.709	OLIVINE_Fo_#
RE98-84B-141-001	601483	6235778	0.020	0.000	7.850	51.050	0.010	41.110	0.030	0.000	0.110	0.027	100.207	OLIVINE_Fo_#
RE98-84B-141-001	601483	6235778	0.010	0.000	9.290	49.070	0.010	40.880	0.000	0.010	0.120	0.006	99.396	OLIVINE_Fo_#
RE98-84B-142-001	578360	6223977	0.000	0.000	7.720	51.080	0.010	40.900	0.000	0.000	0.110	0.012	99.832	OLIVINE_Fo_#
RE98-84B-142-001	578360	6223977	0.000	0.000	7.580	51.000	0.010	41.080	0.000	0.000	0.110	0.012	99.792	OLIVINE_Fo_#
RE98-84B-142-001	578360	6223977	0.000	0.000	13.810	46.320	0.020	39.970	0.020	0.030	0.170	0.006	100.346	OLIVINE_Fo_#
RE98-84B-142-001	578360	6223977	0.030	0.000	8.350	50.720	0.030	40.850	0.010	0.000	0.090	0.000	100.080	OLIVINE_Fo_#
RE98-84B-142-001	578360	6223977	0.000	0.000	7.300	51.410	0.000	40.890	0.000	0.000	0.080	0.001	99.681	OLIVINE_Fo_#

Appendix 3. Summary of geochemical analyses of silicate and oxide indicator grains.

SILICATES

Sample#	Easting	Northing	TiO2	Cr2O3	FeO	MgO	Ca0	SiO2	Al2O3	Na2O	MnO	K2O	Total	Min ID-(Gent, 1993)*
RE98-84B-144-001	567666	6219155	0.010	0.000	7.870	50.940	0.000	40.520	0.000	0.000	0.100	0.029	99.469	OLIVINE_Fo_#
RE98-84B-144-001	567666	6219155	0.000	0.000	9.130	50.010	0.020	40.580	0.010	0.000	0.120	0.017	99.887	OLIVINE_Fo_#
RE98-84B-144-001	567666	6219155	0.020	0.070	8.670	50.230	0.080	40.720	0.010	0.040	0.110	0.029	99.979	OLIVINE_Fo_#
RE98-84B-144-001	567666	6219155	0.010	0.010	8.530	50.030	0.020	40.690	0.020	0.010	0.090	0.009	99.419	OLIVINE_Fo_#
RE98-84B-144-001	567666	6219155	0.040	0.000	8.700	50.320	0.020	40.790	0.000	0.000	0.120	0.006	99.996	OLIVINE_Fo_#
RE98-84B-144-001	567666	6219155	0.000	0.000	8.140	51.230	0.000	40.920	0.000	0.000	0.120	0.016	100.426	OLIVINE_Fo_#
RE98-84B-144-001	567666	6219155	0.040	0.000	9.320	50.050	0.010	40.870	0.010	0.010	0.130	0.006	100.446	OLIVINE_Fo_#
RE98-84B-144-001	567666	6219155	0.000	0.010	7.920	50.960	0.000	40.860	0.010	0.000	0.120	0.019	99.899	OLIVINE_Fo_#
RE98-84B-144-001	567666	6219155	0.010	0.000	7.750	51.090	0.000	40.860	0.010	0.000	0.110	0.014	99.844	OLIVINE_Fo_#
RE98-84B-144-001	567666	6219155	0.000	0.000	9.260	49.940	0.040	40.900	0.000	0.000	0.150	0.014	100.304	OLIVINE_Fo_#
RE98-84B-144-001	567666	6219155	0.010	0.000	7.770	50.830	0.010	41.070	0.000	0.000	0.110	0.016	99.816	OLIVINE_Fo_#
RE98-84B-144-001	567666	6219155	0.030	0.040	10.080	48.560	0.050	40.540	0.010	0.010	0.110	0.022	99.452	OLIVINE_Fo_#
RE98-84B-146-001	585242	6218218	0.010	0.000	7.550	51.080	0.010	40.730	0.010	0.000	0.090	0.009	99.489	OLIVINE_Fo_#
RE98-84B-147-001	587086	6218371	0.030	0.010	13.650	46.830	0.020	39.850	0.020	0.000	0.200	0.023	100.633	OLIVINE_Fo_#
RE98-84B-147-001	587086	6218371	0.000	0.010	8.290	50.740	0.000	40.810	0.000	0.000	0.150	0.000	100.000	OLIVINE_Fo_#
RE98-84B-147-001	587086	6218371	0.000	0.000	8.220	50.910	0.000	40.680	0.000	0.010	0.160	0.000	99.980	OLIVINE_Fo_#
RE98-84B-47-001	587086	6218371	0.020	0.000	8.640	50.130	0.000	40.740	0.000	0.000	0.130	0.003	99.663	OLIVINE_Fo_#
RE98-84B-149-001	588160	6217598	0.000	0.040	8.530	50.320	0.060	40.740	0.030	0.050	0.100	0.006	99.876	OLIVINE_Fo_#
RE98-84B-149-001	588160	6217598	0.010	0.000	7.950	50.810	0.010	40.710	0.000	0.000	0.090	0.019	99.599	OLIVINE_Fo_#
RE98-84B-149-001	588160	6217598	0.030	0.030	8.180	50.290	0.020	40.940	0.020	0.020	0.090	0.012	99.632	OLIVINE_Fo_#
RE98-84B-149-001	588160	6217598	0.000	0.000	7.360	51.490	0.020	41.260	0.000	0.000	0.100	0.022	100.252	OLIVINE_Fo_#
RE98-84B-149-001	588160	6217598	0.010	0.020	7.480	51.180	0.010	40.920	0.000	0.020	0.110	0.018	99.768	OLIVINE_Fo_#
RE98-84B-149-001	588160	6217598	0.000	0.000	8.540	50.370	0.010	40.550	0.000	0.010	0.120	0.009	99.609	OLIVINE_Fo_#
RE98-84B-149-001	588160	6217598	0.000	0.000	8.680	49.990	0.020	40.860	0.000	0.010	0.150	0.010	99.720	OLIVINE_Fo_#
RE98-84B-149-001	588160	6217598	0.000	0.000	7.410	51.390	0.000	40.890	0.000	0.030	0.110	0.007	99.837	OLIVINE_Fo_#
RE98-84B-149-001	588160	6217598	0.000	0.010	8.610	50.170	0.080	40.780	0.030	0.000	0.110	0.031	99.821	OLIVINE_Fo_#
RE98-84B-153-001	589495	6219403	0.000	0.010	12.940	47.470	0.020	40.140	0.020	0.010	0.140	0.007	100.757	OLIVINE_Fo_#
RE98-84B-153-001	589495	6219403	0.000	0.000	7.270	51.360	0.000	40.900	0.010	0.000	0.120	0.007	99.667	OLIVINE_Fo_#
RE98-84B-153-001	589495	6219403	0.000	0.000	8.760	50.710	0.010	40.600	0.000	0.000	0.150	0.000	100.230	OLIVINE_Fo_#
RE98-84B-153-001	589495	6219403	0.020	0.010	9.320	49.670	0.090	40.630	0.050	0.000	0.110	0.003	99.903	OLIVINE_Fo_#
RE98-84B-153-001	589495	6219403	0.000	0.050	8.380	50.500	0.040	40.830	0.000	0.000	0.100	0.000	99.900	OLIVINE_Fo_#
RE98-84B-158-001	640765	6220095	0.000	0.000	8.770	49.940	0.000	40.650	0.020	0.010	0.160	0.004	99.554	OLIVINE_Fo_#
RE98-84B-165-001	564559	6301509	0.000	0.000	8.240	50.560	0.020	40.830	0.020	0.010	0.120	0.011	99.811	OLIVINE_Fo_#
RE98-84B-165-001	564559	6301509	0.000	0.000	8.410	50.300	0.020	40.900	0.000	0.010	0.090	0.021	99.751	OLIVINE_Fo_#
RE98-84B-169-001	576434	6296035	0.000	0.020	9.510	49.460	0.050	40.630	0.020	0.040	0.100	0.004	99.834	OLIVINE_Fo_#
RE98-84B-169-001	576434	6296035	0.000	0.070	8.540	50.190	0.040	40.620	0.000	0.000	0.100	0.015	99.575	OLIVINE_Fo_#
RE98-84B-169-001	576434	6296035	0.000	0.000	8.320	50.750	0.010	40.710	0.000	0.000	0.080	0.005	99.875	OLIVINE_Fo_#

***** See report for interpretation subsequent to Min-ID

Appendix 3. Summary of geochemical analyses of silicate and oxide indicator grains.

OXIDES

Ilmenites

Sample#	Easting	Northing	TiO2	Cr2O3	FeO	MgO	CaO	SiO2	Al2O3	Na2O	MnO	Total	K2O	ZrO2	Nb2O5	NiO	ZnO	Ni	Zn	Min ID-(Gent, 1993)*
RE98-84B-03-001	681712	6216107	51.57	0.67	32.20	13.74	0.00	0.00	0.33	0.00	0.36	99.23	0.00	0.06	0.22	0.05	0.03	0.04	0.02	PICRO_ILMENITE
RE98-84B-24-001	632210	6299080	51.43	0.36	33.27	13.20	0.00	0.02	0.55	0.00	0.25	99.24	0.00	0.03	0.05	0.06	0.01	0.04	0.01	PICRO_ILMENITE
RE98-84B-29-001	631858	6304860	50.39	0.96	34.97	12.34	0.00	0.05	0.46	0.00	0.31	99.84	0.00	0.08	0.22	0.05	0.03	0.04	0.02	PICRO_ILMENITE
RE98-84B-31-001	631051	6311634	51.88	0.92	30.82	15.16	0.00	0.00	0.76	0.00	0.20	100.31	0.00	0.07	0.22	0.21	0.08	0.16	0.06	PICRO_ILMENITE
RE98-84B-106-001	605864	6225257	52.99	4.08	25.74	16.08	0.00	0.04	0.60	0.00	0.33	100.25	0.00	0.03	0.06	0.26	0.04	0.20	0.03	UNKNOWN
RE98-84B-113-001	604315	6235084	49.91	0.17	36.63	11.49	0.00	0.04	0.51	0.00	0.23	99.17	0.00	0.04	0.15	0.00	0.00	0.00	0.00	PICRO_ILMENITE
RE98-84B-125-001	600283	6217132	50.42	1.29	33.04	13.73	0.00	0.00	0.50	0.00	0.15	99.44	0.00	0.07	0.16	0.10	0.00	0.08	0.00	PICRO_ILMENITE
RE98-84B-127-001	595694	6222737	52.60	1.07	32.88	13.26	0.00	0.06	0.13	0.00	0.28	100.58	0.00	0.01	0.19	0.09	0.00	0.07	0.00	PICRO_ILMENITE
RE98-84B-128-001	592930	6221015	52.32	1.96	31.95	12.91	0.00	0.00	0.13	0.00	0.34	100.05	0.00	0.06	0.22	0.12	0.03	0.09	0.03	PICRO_ILMENITE
RE98-84B-133-001	617195	6218632	47.87	0.06	43.64	6.71	0.00	0.00	0.48	0.00	0.37	99.23	0.00	0.06	0.01	0.00	0.04	0.00	0.04	PICRO_ILMENITE
RE98-84B-150-001	591357	6215617	50.58	0.90	32.62	12.85	0.00	0.00	0.42	0.00	0.21	97.90	0.00	0.04	0.20	0.07	0.00	0.06	0.00	PICRO_ILMENITE
RE98-84B-150-001	591357	6215617	49.43	1.24	33.21	12.98	0.00	0.03	0.49	0.00	0.30	97.98	0.00	0.00	0.15	0.15	0.00	0.12	0.00	PICRO_ILMENITE

Chromites

Sample#	Easting	Northing	TiO2	Cr2O3	FeO	MgO	CaO	SiO2	Al2O3	Na2O	MnO	Total	K2O	ZrO2	Nb2O5	NiO	ZnO	Ni	Zn	Min ID-(Gent, 1993)*
RE98-84B-06-002	663193	6223885	0.20	32.99	26.13	11.39	0.00	0.00	28.23	0.00	0.25	99.66	0.00	0.04	0.05	0.16	0.20	0.13	0.16	SUB_PICRO_CHROMITE
RE98-84B-13-001	681600	6257859	0.31	37.63	30.64	9.23	0.00	0.03	20.25	0.00	0.40	98.83	0.00	0.03	0.00	0.14	0.17	0.11	0.14	SUB_PICRO_CHROMITE
RE98-84B-16-001	628427	6290905	2.47	47.76	33.53	9.66	0.00	0.00	3.97	0.00	0.30	98.02	0.00	0.00	0.00	0.19	0.14	0.15	0.11	UNKNOWN
RE98-84B-16-002	628427	6290905	0.06	43.41	30.99	7.28	0.00	0.01	16.22	0.00	0.41	98.99	0.00	0.02	0.05	0.08	0.45	0.06	0.36	UNKNOWN
RE98-84B-23-001	632086	6293811	0.78	31.34	32.98	9.70	0.00	0.00	23.62	0.00	0.29	99.08	0.00	0.00	0.06	0.21	0.11	0.16	0.09	SUB_PICRO_CHROMITE
RE98-84B-25-001	632080	6299746	1.47	36.02	27.22	13.39	0.00	0.00	21.02	0.00	0.28	99.76	0.00	0.11	0.00	0.20	0.06	0.16	0.05	SUB_PICRO_CHROMITE
RE98-84B-26-001	633445	6311212	0.06	54.51	22.55	12.04	0.00	0.04	9.72	0.00	0.27	99.38	0.00	0.00	0.01	0.12	0.05	0.10	0.04	UNKNOWN
RE98-84B-27-001	631075	6290850	0.47	41.15	27.29	9.76	0.00	0.01	19.98	0.00	0.37	99.38	0.00	0.01	0.06	0.09	0.20	0.07	0.16	UNKNOWN
RE98-84B-27-001	631075	6290850	2.35	45.78	40.30	7.33	0.00	0.00	0.26	0.00	0.50	96.89	0.00	0.00	0.00	0.26	0.11	0.20	0.09	UNKNOWN
RE98-84B-37-001	571356	6304176	0.24	52.08	25.06	12.26	0.00	0.03	9.63	0.00	0.36	100.16	0.00	0.03	0.14	0.16	0.16	0.13	0.13	UNKNOWN
RE98-84B-38-001	574293	6300929	0.31	52.51	19.71	12.47	0.00	0.03	13.37	0.00	0.37	98.96	0.00	0.00	0.00	0.13	0.06	0.10	0.05	UNKNOWN
RE98-84B-38-001	574293	6300929	0.65	51.04	30.00	10.35	0.00	0.00	5.53	0.00	0.52	98.31	0.00	0.01	0.00	0.13	0.07	0.10	0.06	UNKNOWN
RE98-84B-38-001	574293	6300929	0.50	51.79	29.74	10.28	0.00	0.08	5.59	0.00	0.41	98.58	0.00	0.02	0.00	0.12	0.06	0.09	0.05	UNKNOWN
RE98-84B-39-001	574993	6301161	0.00	54.09	21.37	12.29	0.00	0.00	10.43	0.00	0.38	98.89	0.00	0.00	0.00	0.13	0.20	0.10	0.16	UNKNOWN
RE98-84B-39-001	574993	6301161	2.84	43.00	43.47	6.52	0.00	0.00	0.52	0.00	0.46	97.22	0.00	0.00	0.01	0.29	0.10	0.23	0.08	UNKNOWN
RE98-84B-39-001	574993	6301161	0.11	54.19	16.34	13.74	0.00	0.00	13.66	0.00	0.26	98.53	0.00	0.01	0.00	0.07	0.14	0.05	0.12	UNKNOWN
RE98-84B-39-001	574993	6301161	0.04	53.35	21.66	12.46	0.00	0.00	11.55	0.00	0.30	99.67	0.00	0.00	0.02	0.11	0.18	0.08	0.15	UNKNOWN
RE98-84B-39-001	574993	6301161	0.11	52.68	22.31	12.18	0.00	0.00	11.25	0.00	0.32	99.04	0.00	0.00	0.03	0.03	0.14	0.03	0.11	UNKNOWN
RE98-84B-40-001	577201	6300986	0.09	55.48	20.51	12.47	0.00	0.00	10.44	0.00	0.22	99.37	0.00	0.00	0.00	0.07	0.10	0.06	0.08	UNKNOWN
RE98-84B-43-001	578555	6302112	3.89	43.48	41.07	7.33	0.00	0.00	0.57	0.00	0.38	97.07	0.00	0.00	0.03	0.28	0.04	0.22	0.03	UNKNOWN
RE98-84B-43-001	578555	6302112	0.08	54.61	17.43	12.79	0.00	0.04	11.76	0.00	0.27	97.19	0.00	0.03	0.01	0.08	0.08	0.06	0.06	UNKNOWN
RE98-84B-43-001	578555	6302112	0.79	54.13	26.21	10.37	0.00	0.00	6.14	0.00	0.37	98.22	0.00	0.00	0.02	0.12	0.06	0.10	0.05	UNKNOWN
RE98-84B-43-001	578555	6302112	0.56	61.17	27.25	7.73	0.00	0.00	0.66	0.00	0.52	98.26	0.00	0.02	0.00	0.12	0.23	0.09	0.19	UNKNOWN
RE98-84B-43-001	578555	6302112	0.30	55.09	22.73	12.04	0.00	0.00	8.22	0.00	0.36	99.09	0.00	0.04	0.04	0.09	0.17	0.07	0.13	UNKNOWN
RE98-84B-43-001	578555	6302112	0.06	56.00	17.36	12.72	0.00	0.00	11.57	0.00	0.31	98.32	0.00	0.00	0.02	0.06	0.20	0.05	0.16	UNKNOWN
RE98-84B-43-001	578555	6302112	0.02	55.91	17.49	12.65	0.00	0.00	11.67	0.00	0.30	98.25	0.00	0.00	0.00	0.11	0.10	0.09	0.08	UNKNOWN
RE98-84B-43-001	578555	6302112	0.04	55.83	17.32	12.86	0.00	0.01	11.75	0.00	0.31	98.33	0.00	0.00	0.05	0.03	0.13	0.02	0.10	UNKNOWN
RE98-84B-45-001	580040	6299356	0.03	53.33	22.54	9.30	0.00	0.03	12.76	0.00	0.33	98.64	0.00	0.00	0.04	0.00	0.28	0.00	0.22	UNKNOWN
RE98-84B-49-001	574509	6301936	3.77	38.43	45.17	6.57	0.00	0.01	0.75	0.00	0.39	95.41	0.00	0.01	0.00	0.25	0.06	0.20	0.05	UNKNOWN
RE98-84B-49-001	574509	6301936	1.07	50.49	31.24	9.76	0.00	0.01	5.11	0.00	0.41	98.48	0.00	0.01	0.04	0.19	0.14	0.15	0.11	UNKNOWN
RE98-84B-49-001	574509	6301936	0.09	54.47	24.98	11.35	0.00	0.00	7.38	0.00	0.37	98.93	0.00	0.00	0.03	0.13	0.12	0.10	0.10	UNKNOWN
RE98-84B-49-001	574509	6301936	0.14	56.75	22.92	11.14	0.00	0.03	6.50	0.00	0.36	98.11	0.00	0.00	0.02	0.11	0.13	0.09	0.11	UNKNOWN

Appendix 3. Summary of geochemical analyses of silicate and oxide indicator grains.

OXIDES

Sample#	Easting	Northing	TiO2	Cr2O3	FeO	MgO	CaO	SiO2	Al2O3	Na2O	MnO	Total	K2O	ZrO2	Nb2O5	NiO	ZnO	Ni	Zn	Min ID-(Gent, 1993)*
RE98-84B-49-001	574509	6301936	0.16	56.04	24.09	10.99	0.00	0.00	6.60	0.00	0.28	98.38	0.00	0.00	0.01	0.11	0.10	0.09	0.08	UNKNOWN
RE98-84B-50-001	576108	6301097	0.31	44.80	41.43	4.26	0.00	0.00	5.26	0.00	0.52	97.29	0.00	0.00	0.00	0.13	0.57	0.11	0.46	UNKNOWN
RE98-84B-59-001	680438	6238587	0.06	48.14	39.15	1.22	0.00	0.02	7.19	0.00	0.60	97.56	0.00	0.02	0.00	0.04	1.13	0.03	0.91	UNKNOWN
RE98-84B-59-001	680438	6238587	0.15	46.76	36.32	5.53	0.00	0.00	7.75	0.00	0.40	97.39	0.00	0.00	0.09	0.09	0.30	0.07	0.24	UNKNOWN
RE98-84B-60-001	675654	6238221	0.07	53.54	21.73	12.45	0.00	0.00	11.19	0.00	0.34	99.47	0.00	0.00	0.01	0.08	0.07	0.06	0.05	UNKNOWN
RE98-84B-65-002	651567	6312017	0.35	45.51	35.18	5.24	0.00	0.00	11.13	0.00	0.50	98.67	0.00	0.10	0.01	0.19	0.46	0.15	0.37	UNKNOWN
RE98-84B-68-001	662696	6315727	0.04	55.47	20.29	12.52	0.00	0.03	10.63	0.00	0.30	99.50	0.00	0.00	0.01	0.07	0.11	0.06	0.09	UNKNOWN
RE98-84B-68-001	662696	6315727	1.60	42.42	40.47	1.30	0.00	0.00	11.18	0.00	0.56	97.72	0.00	0.00	0.02	0.09	0.08	0.07	0.06	UNKNOWN
RE98-84B-92-001	647432	6270954	0.04	48.12	19.37	13.62	0.00	0.00	17.32	0.00	0.32	99.15	0.00	0.09	0.00	0.08	0.18	0.06	0.15	UNKNOWN
RE98-84B-92-001	647432	6270954	0.45	36.76	37.48	15.06	0.00	0.00	6.93	0.00	0.29	97.36	0.00	0.00	0.01	0.31	0.07	0.24	0.05	UNKNOWN
RE98-84B-93-001	648335	6289075	0.25	41.96	32.09	6.70	0.00	0.04	17.46	0.00	0.66	99.25	0.00	0.00	0.02	0.05	0.04	0.04	0.03	UNKNOWN
RE98-84B-95-001	604172	6280807	0.32	52.96	15.53	15.50	0.00	0.03	14.67	0.00	0.20	99.44	0.00	0.00	0.00	0.19	0.04	0.15	0.04	UNKNOWN
RE98-84B-95-001	604172	6280807	0.09	51.10	22.55	10.70	0.00	0.01	14.57	0.00	0.35	99.56	0.00	0.00	0.00	0.04	0.16	0.03	0.13	UNKNOWN
RE98-84B-103-001	594373	6258588	0.05	45.27	24.77	10.54	0.00	0.00	17.79	0.00	0.33	99.05	0.00	0.00	0.04	0.03	0.22	0.03	0.17	UNKNOWN
RE98-84B-123-001	566241	6282101	0.07	55.64	17.20	13.22	0.00	0.00	12.55	0.00	0.30	99.29	0.00	0.00	0.02	0.11	0.19	0.08	0.15	UNKNOWN
RE98-84B-123-001	566241	6282101	0.16	48.75	24.80	12.18	0.00	0.06	12.40	0.00	0.35	98.92	0.00	0.01	0.00	0.14	0.07	0.11	0.06	UNKNOWN
RE98-84B-125-001	600283	6217132	0.00	46.76	18.53	13.16	0.00	0.00	20.91	0.00	0.25	99.98	0.00	0.03	0.04	0.07	0.22	0.06	0.18	PICRO_CHROMITE
RE98-84B-127-001	595694	6222737	1.15	44.62	21.17	15.90	0.00	0.03	16.48	0.00	0.22	100.05	0.00	0.00	0.23	0.18	0.05	0.14	0.04	UNKNOWN
RE98-84B-128-001	592930	6221015	0.18	49.94	32.78	2.50	0.00	0.00	9.24	0.00	1.19	98.55	0.00	0.00	0.06	0.00	2.66	0.00	2.14	UNKNOWN
RE98-84B-135-001	621231	6214098	0.38	46.07	32.09	6.45	0.00	0.01	11.95	0.00	0.47	97.92	0.00	0.04	0.04	0.03	0.41	0.02	0.33	UNKNOWN
RE98-84B-145-001	578524	6222187	2.26	49.92	32.64	8.92	0.00	0.02	3.59	0.00	0.51	98.31	0.00	0.03	0.01	0.21	0.22	0.16	0.18	UNKNOWN
RE98-84B-148-001	587594	6217972	0.22	55.43	19.31	12.55	0.00	0.01	11.42	0.00	0.27	99.49	0.00	0.00	0.00	0.07	0.21	0.06	0.17	UNKNOWN
RE98-84B-157-001	627755	6228644	0.61	44.96	30.03	10.09	0.00	0.03	12.06	0.00	0.38	98.41	0.00	0.02	0.00	0.09	0.12	0.07	0.10	UNKNOWN
RE98-84B-160-001	644905	6251937	0.04	54.43	17.17	14.19	0.00	0.03	12.27	0.00	0.26	98.62	0.00	0.03	0.04	0.07	0.09	0.05	0.07	UNKNOWN
RE98-84B-163-001	593622	6255643	4.95	51.09	26.23	12.28	0.00	0.01	2.88	0.00	0.32	98.11	0.00	0.02	0.02	0.23	0.08	0.18	0.07	UNKNOWN
RE98-84B-164-001	563871	6304538	0.80	39.20	26.77	13.56	0.00	0.00	19.15	0.00	0.25	100.07	0.00	0.00	0.01	0.16	0.17	0.13	0.14	UNKNOWN
RE98-84B-164-001	563871	6304538	0.34	45.29	24.83	10.60	0.00	0.01	17.80	0.00	0.22	99.42	0.00	0.00	0.03	0.09	0.22	0.07	0.17	UNKNOWN
RE98-84B-164-001	563871	6304538	0.20	48.19	25.94	9.97	0.00	0.00	13.72	0.00	0.34	98.73	0.00	0.05	0.09	0.06	0.16	0.05	0.13	UNKNOWN
RE98-84B-164-001	563871	6304538	0.01	54.05	18.21	12.51	0.00	0.00	14.20	0.00	0.31	99.67	0.00	0.06	0.08	0.03	0.21	0.02	0.17	UNKNOWN
RE98-84B-164-001	563871	6304538	1.17	41.53	22.53	15.28	0.00	0.04	18.61	0.00	0.17	99.64	0.00	0.00	0.00	0.22	0.08	0.17	0.06	UNKNOWN
RE98-84B-164-001	563871	6304538	1.30	44.66	26.36	9.33	0.00	0.00	15.02	0.00	0.22	97.15	0.00	0.00	0.00	0.18	0.08	0.14	0.06	UNKNOWN
RE98-84B-164-001	563871	6304538	0.15	45.25	21.94	12.92	0.00	0.00	18.81	0.00	0.29	99.63	0.00	0.00	0.03	0.11	0.13	0.08	0.11	UNKNOWN
RE98-84B-164-001	563871	6304538	0.54	46.87	26.51	11.04	0.00	0.03	12.81	0.00	0.26	98.24	0.00	0.00	0.00	0.12	0.06	0.09	0.05	UNKNOWN
RE98-84B-164-001	563871	6304538	1.64	41.13	30.03	10.25	0.00	0.00	14.18	0.00	0.31	97.77	0.00	0.03	0.00	0.18	0.03	0.14	0.02	UNKNOWN
RE98-84B-164-001	563871	6304538	0.23	50.10	21.29	12.20	0.00	0.02	15.40	0.00	0.27	99.78	0.00	0.02	0.00	0.07	0.18	0.06	0.14	UNKNOWN
RE98-84B-164-001	563871	6304538	0.18	52.34	28.42	8.00	0.00	0.00	7.73	0.00	0.41	97.42	0.00	0.00	0.04	0.10	0.20	0.08	0.16	UNKNOWN
RE98-84B-164-001	563871	6304538	0.14	59.76	16.04	12.56	0.00	0.00	7.98	0.00	0.38	97.10	0.00	0.00	0.03	0.08	0.13	0.07	0.11	UNKNOWN
RE98-84B-169-001	576434	6296035	0.4	51.78	29.15	10.58	0	0.07	5.37	0	0.37	98.01	0	0	0.01	0.19	0.08	0.15	0.07	UNKNOWN
RE98-84B-170-001	572780	6297212	0.16	55.89	23.52	11.57	0	0	8.06	0	0.34	99.74	0	0	0	0.07	0.12	0.05	0.1	UNKNOWN

* See report for interpretation subsequent to Min-ID

Appendix 4. Surface morphologies of selected silicate grains.

Sample No.	Grain# (for (probing)	Grain Type	Colour	Clarity*	Lustre**	Form***	Shape+	Surface++	Remarks+++
Chrome Diopside: Stream (def)									
RE98-84B-02 - 001		C.D. (def)	pale em-grn	TRNSP	VIT	SUBH	SANG	SMOOTH	prismatic on one end
RE98-84B-50 - 001		C.D. (def)	EM-GREEN	TRNSP	VIT	ANH	SANG	SMOOTH	
RE98-84B-66 - 001		C.D. (def)	EM-GREEN	TRNSP-SL	VIT	ANH	RND	SMOOTH	
Chrome Diopside: Stream (poss)									
RE98-84B-02 - 001		C.D. (poss)	EM-GREEN	TRNSP	VIT	ANH	RND	SMOOTH	
RE98-84B-28 - 001		C.D. (poss)	EM-GREEN	TRNSP	VIT	EUN	ANG-SANG	SMOOTH	PRISMATIC XLS
RE98-84B-37 - 001		C.D. (poss)	EM-GREEN	TRNSL	VIT	ANH	RND	SMOOTH	
RE98-84B-57 - 001		C.D. (poss)	EM-GREEN	TRNSP-SL	VIT	SUBH	SANG	SMOOTH	
RE98-84B-161 - 001		C.D. (poss)	EM-GREEN	TRNSL	VIT	SUBH	srnd-sang	SMOOTH	
RE98-84B-163 - 001		C.D. (poss)	EM-GREEN	TRNSP	VIT	EUH	SANG	SMOOTH	VERY SMALL
RE98-84B-09 - 001		C.D. (poss)	EM-GREEN	TRNSP	VIT	ANH	RND	SMOOTH	
Chrome diopside: Till (def)									
RE98-84B-38 - 001		C.D. (def)							
RE98-84B-38 - 001	a,b,c,d	C.D.(def)	pale em-grn	TRNSP	VIT	EUH-SUBH	ANG	SMOOTH	"FADED" C.D.'s
RE98-84B-38 - 001	e,f,g	C.D.(def)	dark em-grn	TRNSL	VIT	SUBH	SANG	SMOOTH	"DARK" C.D.'s
RE98-84B-38 - 001	h	C.D.(def)	EM-GREEN	TRNSL	VIT	SUBH	sang-srnd	FROSTY	"FROSTY" C.D.'s
RE98-84B-38 - 001	i,j	C.D.(def)	EM-GREEN	TRNSL	VIT	ANH	RND	SMOOTH	"ROUNDED" C. D.'s
RE98-84B-39 - 001		C.D. (def)							
RE98-84B-40 - 001		C.D. (def)							
RE98-84B-43 - 001		C.D. (def)	EM-GREEN	TRNSP	VIT	ANH	SANG	SMOOTH	VERY CLEAR
RE98-84B-85 - 001		C.D. (def)	EM-GREEN	TRNSL	VIT	SUBH	SANG	ROUGH	
RE98-84B-105 - 001		C.D. (def)							
RE98-84B-122 - 001		C.D. (def)	pale em-grn	TRNSP	VIT	EUH	ANG	SMOOTH	MAY BE BROKEN
RE98-84B-123 - 001		C.D. (def)							
RE98-84B-127 - 001		C.D. (def)							
RE98-84B-141 - 001		C.D. (def)							
RE98-84B-146 - 001		C.D. (def)							
RE98-84B-146-001	a	C.D. (def)	EM-GREEN	TRNSL	DULL	ANH	RND	FROSTY	"RND AND FROSTED"
RE98-84B-146-001	b,c,d	C.D. (def)	EM-GREEN	TRNSP	VIT	SUBH	ANG	SMOOTH	"BROKEN" C.D.'s
RE98-84B-147 - 001		C.D. (def)							
RE98-84B-165 - 001		C.D. (def)	EM-GREEN	TRNSL	VIT	SUBH	SANG	SMOOTH	FRACTURED
Chrome diopside: Till (poss)									
RE98-84B-14 - 001		C.D.(poss)							
RE98-84B-17 - 001		C.D.(poss)	EM-GREEN	TRNSP	VIT	SUBH	SRND	SMOOTH	
RE98-84B-32 - 001		C.D.(poss)	GREEN	TRNSL	VIT	IRREG	SRND	ROUGH	fractured (grossular?)
RE98-84B-35 - 001		C.D.(poss)							
RE98-84B-36 - 001		C.D.(poss)	EM-GREEN	TRNSP	VIT	EUH	ANG	SMOOTH	two prismatic xl's
RE98-84B-38 - 001		C.D.(poss)							
RE98-84B-40 - 001		C.D.(poss)							
RE98-84B-43 - 001		C.D.(poss)							
RE98-84B-44 - 001		C.D.(poss)	EM-GREEN	TRNSP	VIT	SUBH	SRND	SMOOTH	
RE98-84B-46 - 001		C.D.(poss)							
RE98-84B-55 - 001		C.D.(poss)							

Appendix 4. Surface morphologies of selected silicate grains.

Sample No.	Grain# (for (probing)	Grain Type	Colour	Clarity*	Lustre**	Form***	Shape+	Surface++	Remarks+++
RE98-84B-76 - 001		C.D.(poss)							
RE98-84B-78 - 001		C.D.(poss)	pale L-GRN	TRNSL	VIT	SUBH	SRND	SMOOTH	garnet? Dodecahedron ?
RE98-84B-83 - 001		C.D.(poss)							
RE98-84B-113 - 001		C.D.(poss)							
RE98-84B-118 - 001		C.D.(poss)	LT-GREEN	TRNSP	VIT	SUBH	SANG	SMOOTH	MAY BE BROKEN
RE98-84B-119 - 001		C.D.(poss)							
RE98-84B-127 - 001		C.D.(poss)							
RE98-84B-133-001		C.D.(poss)							
RE98-84B-134-001		C.D.(poss)	EM-GREEN	TRNSL	VIT	ANH	RND	FROST	
RE98-84B-141-001		C.D.(poss)	EM-GREEN	TRNSL	VIT	SUBH	SANG	ROUGH	VERY SMALL
RE98-84B-142-001		C.D.(poss)	GREEN	TRNSL	VIT	ANH	RND	FROST	
RE98-84B-146 - 001		C.D.(poss)							
RE98-84B-146-001	e,f,g,h	C.D.(poss)	EM-GREEN	TRNSP-SL	VIT	SUBH-ANH	sang-srnd	smth-rgh	THE "AVERAGE" C.D's
RE98-84B-146-001	i,j,k,l	C.D.(poss)	EM-GREEN	TRNSP-SL	VIT	SUBH-ANH	sang-srnd	smth-rgh	THE "AVERAGE" C.D's
RE98-84B-146-001	m,n	C.D.(poss)	EM-GREEN	TRNSP	VIT	ANH	ANG	SMOOTH	BROKEN (?)
RE98-84B-147 - 001		C.D.(poss)							
RE98-84B-149-001		C.D.(poss)	olive green		VIT	EUH	SANG	SMOOTH	
RE98-84B-152-001		C.D.(poss)							
RE98-84B-153-001		C.D.(poss)							
RE98-84B-165 - 001		C.D.(poss)							
Eclogite Garnet: Stream (def)									
RE98-84B-104-001		ECL. (def)	BRN-ORNG	TRNSP	VIT	EUH-SUBH	ANG-SANG	SMOOTH	DODECAHEDRON
Eclogite Garnet: Stream (poss)									
RE98-84B-01-001		ECL. (poss)	Pale brn-orn	TRNSP	VIT	EUH	ANG-SANG	SMOOTH	dodec. Concoidal fracture
RE98-84B-156-001		ECL. (poss)	Pale brn-orn	TRNSP	VIT	EUH	ANG	SMOOTH	DODECAHEDRON
Eclogite Garnet: Till (poss)									
RE98-84B-14-001		ECL. (poss)	ORANGE	TRNSP-SL	VIT-DULL	EUH-SUBH	sang-srnd	SMTH-FRST	amalgamated grains
RE98-84B-38-001		ECL. (poss)	ORANGE	TRNSP	VIT	EUH-SUBH	ANG-SANG	SMOOTH	
RE98-84B-44-001		ECL. (poss)	pink-orange	TRNSL	VIT	SUBH	SANG	PITTED	rounded pitted dodeca
RE98-84B-146-001		ECL. (poss)	pale brn-orn	TRNSP	VIT	ANH	ANG	SMOOTH	BROKEN GRAIN
RE98-84B-165-001		ECL. (poss)	CL-BRONZE	TRNSP	VIT	ANH	ANG	SMOOTH	BROKEN (?)
Olivine: Stream (poss)									
RE98-84B-33-001		OLIVINE(poss)	pale apple-g	TRNSP-SL	DULL	ANH	RND	SMOOTH	dipyramid ends of xl's
RE98-84B-48-001	4 GRAINS	OLIVINE(poss)	pale yell-grn	TRNSP-SL	VIT	SUBH-EUH	SANG	SMTH-RGH	
RE98-84B-61-001		OLIVINE(poss)	CLEAR-YEL	TRNSP	VIT	ANH	SRND	STEPPED	cl. Centres-yel grn edges
RE98-84B-98-001		OLIVINE(poss)	CLEAR	TRNSL	VIT	SUBH-EUH	SANG	GRANULAR	
RE98-84B-100-001		OLIVINE(poss)	YEL-BR-GR	TRNSP	VIT	SUBH-EUH	SANG	SMOOTH	nice clear peridote
RE98-84B-110-001		OLIVINE(poss)	CLEAR	TRNSP	VIT	ANH	ANG	SMOOTH	olivine ?
RE98-84B-125-001		OLIVINE(poss)	CLEAR	TRNSP-SL	VIT	SUBH-ANH	SRND	SMTH-GRN	waxy appearance
RE98-84B-129-001		OLIVINE(poss)	CLEAR	TRNSP-SL	VIT	SUBH-ANH	SANG	SMOOTH	
RE98-84B-158-001		OLIVINE(poss)	CLEAR	TRNSP	VIT	ANH	SRND	SMTH-GRN	
RE98-84B-169-001	4 GRAINS	OLIVINE(poss)	CLEAR TO	TRNSP-SL	VIT-DULL	EUH-SUBH	SANG-RND	SMTH-GRN	
			YEL-BR-GR						

Appendix 4. Surface morphologies of selected silicate grains.

Sample No.	Grain# (for (probing)	Grain Type	Colour	Clarity*	Lustre**	Form***	Shape+	Surface++	Remarks+++
Olivine: Till (poss)									
RE98-84B-14-001		OLIVINE(poss)	YELL-GRN	TRNSP	VIT	SUBH-EUH	SANG	SMOOTH	VERY SMALL
RE98-84B-27-001	a,b,c,d,e,f	OLIVINE(poss)	CLEAR	TRNSP	VIT	SUBH-EUH	SANG-ANG	SMOOTH	
RE98-84B-27-001	g to q	OLIVINE(poss)	YEL-BR-GR	TRNSP-SL	VIT	SUBH-ANH	sang-srnd	gran-etched	
RE98-84B-39-001		OLIVINE(poss)	clear-paley	TRNSP	VIT	ANH	SRND	conchoidal	conchoidal fractures
RE98-84B-58-001		OLIVINE(poss)	clear-paley	TRNSP-SL	VIT	SUBH	SANG	GRANULAR	corundum inclusions
RE98-84B-78-001		OLIVINE(poss)	YELL-GRN	TRNSL	VIT	ANH	sang-srnd	fractured	
RE98-84B-82-001		OLIVINE(poss)	YELL-GRN	TRNSL	DULL	ANH	SRND	FROST	
RE98-84B-118-001		OLIVINE(poss)	clear-pale gr	TRNSP	VIT	EUH	SANG	SMOOTH	
RE98-84B-126-001		OLIVINE(poss)	YELL-GRN	TRNSL	DULL	SUBH	SRND	FROST	
RE98-84B-144-001	18 GRAINS	OLIVINE(poss)	clear-y-b-gr	TRNSP-SL	VIT	SUBH-ANH	SANG-RND	SMTH-FRST	SRND>SANG
RE98-84B-153-001	8 GRAINS	OLIVINE(poss)	clear to y-gr	TRNSP-SL	VIT-DULL	SUBH-ANH	ANG-RND	SMTH-FRST	ANG>SRND/RND
RE98-84B-155-001	3 GRAINS	OLIVINE(poss)	YELL-GRN	TRNSL	VIT	SUBH	sang-srnd	GRANULAR	FROSTED
Pyrope Garnet: Stream (def)									
RE98-84B-01-001A		PYROPE(def)	PALE PUR	TRNSP	VIT	SUBH-ANH	ANG	SMOOTH	BROKEN ?
RE98-84B-01-001B		PYROPE(def)	PURPLE	TRNSP	VIT	SUBH	SANG	SMOOTH	
RE98-84B-06-002		PYROPE(def)	PURPLE	TRNSP	VIT	SUBH	ANG-SANG	SMOOTH	conchoidal fracture
RE98-84B-28-001	a	PYROPE(def)	PURPLE	TRNSL	VIT	SUBH	SANG	SMTH-GRN	(O.P.)
RE98-84B-28-001	b	PYROPE(def)	RED	TRNSP	VIT	EUH	ANG	SMOOTH	
RE98-84B-104-001		PYROPE(def)	PURPLE	TRNSP	VIT	SUBH	sang-srnd	SMOOTH	
RE98-84B-110-001		PYROPE(def)	PURPLE	TRNSP	VIT	EUH	SANG	SMOOTH	DODECAHEDRON
RE98-84B-128-001		PYROPE(def)	DARK PUR	TRNSP	VIT	EUH-SUBH	SANG	SMOOTH	GEM QUALITY
RE98-84B-48-001		PYROPE(def)	ROSE PUR	TRNSL	VIT	SUBH	SANG	SMTH-PITT	also very small faded prp
RE98-84B-59-001		PYROPE(def)	ROSE PUR	TRNSP	VIT	ANH	ANG	SMOOTH	BROKEN VERY ANG.
RE98-84B-60-001		PYROPE(def)	PURPLE	TRNSP	VIT	EUH	SANG	SMOOTH	DODECAHEDRON
RE98-84B-61-001		PYROPE(def)	reddish purp	TRNSL	VIT-DULL	ANH	RND	FROSTY	
RE98-84B-80-002		PYROPE(def)	PALE PUR	TRNSP	VIT	SUBH-ANH	ANG-SANG	SMTH-GRN	
RE98-84B-155-001		PYROPE(def)	PURPLE	TRNSP	VIT	ANH-SUBH	ANG-SANG	SMOOTH	conchoidal fracture
RE98-84B-156-001		PYROPE(def)	PALE PUR	TRNSL	VIT	SUBH	SANG	PITTED	
RE98-84B-169-001		PYROPE(def)	rose-D. purp	TRNSP-SL	VIT	EUH-SUBH	ANG-SRND	SMOOTH	1 ref. Sample pitted/gran
Pyrope Garnet: Stream (poss)									
RE98-84B-04-002		PYROPE(poss)	clr-pale purp	TRNSP	VIT	EUH	SANG	SMOOTH	VERY SMALL
RE98-84B-09-001		UVAR.(pos)	EM-GREEN	TRNSP	VIT	EUH	SANG	SMOOTH	UVAR. OR C.D. ?
RE98-84B-15-001		UVAR.(pos)	EM-GREEN	TRNSP-SL	VIT	SUBH-ANH	sang-srnd	SMOOTH	C.D. ?
RE98-84B-51-001		UVAR.(pos)	dark em-grn	TRNSL	VIT	ANH	ANG	SMOOTH	concoidal fracturing
RE98-84B-57-001		UVAR.(pos)	dark em-grn	TRNSL	VIT	SUBH-ANH	SRND	SMOOTH	WITH ORANGE PEEL
RE98-84B-59-001		PYROPE(poss)	PALE RED	TRNSP	VIT	ANH	ANG-SANG	smooth-step	ECLOGITE ?
Pyrope Garnet: Till (def)									
RE98-84B-40-001	d,e,f,g,	PYROPE(def)	PURPLE	TRNSP	VIT	EUH	ANG	SMOOTH	
RE98-84B-40-001	h,i,j,k,	PYROPE(def)	ROSE PUR	TRNSL	VIT	SUBH-ANH	ANG-SANG	FROST	
RE98-84B-40-001	l,m,n	PYROPE(def)	reddish purp	trnsl-opaque	VIT	ANH	SANG	ROUGH	
RE98-84B-43-001	a	PYROPE(def)	PURPLE	TRNSP-SL	VIT	SUBH	ANG-SANG	STH-KELY	
RE98-84B-43-001	b,c,	PYROPE(def)	PURPLE	TRNSP	VIT	EUH	ANG	SMOOTH	
RE98-84B-43-001	d,e,f	PYROPE(def)	ROSE PUR	TRNSL	VIT	ANH-SUBH	SANG	ROUGH	
RE98-84B-123-001	a,b,	PYROPE(def)	DARK PUR	TRNSP	VIT	SUBH	ANG	SMOOTH	NO REACTION RIM

Appendix 4. Surface morphologies of selected silicate grains.

Sample No.	Grain# (for (probing)	Grain Type	Colour	Clarity*	Lustre**	Form***	Shape^{+}	Surface^{++}	Remarks^{+++}
RE98-84B-123-001	c,d,e,f,	PYROPE(def)	DARK PUR	TRNSP-SL	VIT	SUBH	sang-srnd	SMTH-PITT	pitted kelyphite rims-ol-sp
RE98-84B-123-001	g,h,i,	PYROPE(def)	ROSE PUR	TRNSL	VIT	SUBH	SANG	SMTH-PITT	NO REACTION RIM
RE98-84B-123-001	j,k	PYROPE(def)	ROSE PUR	TRNSL	VIT	SUBH	SANG	SMTH-PITT	pitted kelyphite rims-olv
RE98-84B-27-001	a	PYROPE(def)	ORANGE	TRNSP	VIT	ANH	ANG-SANG	SMOOTH	orange peel eclogite?
RE98-84B-27-001	b	PYROPE(def)	pl. pink-purp	TRNSP	VIT	SUBH	ANG	SMOOTH	
RE98-84B-27-001	c	PYROPE(def)	DARK PUR	TRNSP	VIT	ANH	sang-srnd	SMOOTH	ORANGE PEEL
RE98-84B-127-001	a,b,c,d,	PYROPE(def)	PURPLE	TRNSP	VIT	EUH-ANH	ANG-SANG	SMOOTH	
RE98-84B-127-001	e,f,g	PYROPE(def)	PURPLE	TRNSP-SL	VIT	SUBH	ANG-SANG	SMOOTH	yell-brn coating on 50%
RE98-84B-117-001		PYROPE(def)	PURPLE	TRNSP	VIT	ANH-SUBH	ANG-SANG	SMOOTH	
RE98-84B-118-001		PYROPE(def)	PALE PUR	TRNSP	VIT	EUH-SUBH	SANG	SMOOTH	
RE98-84B-119-001		PYROPE(def)	PALE PUR	TRNSP	VIT	SUBH	SANG	SMOOTH	VERY SMALL
RE98-84B-134-001		PYROPE(def)	ROSE PUR	TRNSP	VIT	EUH	SRND	SMOOTH	
RE98-84B-149-001		PYROPE(def)	pl.orang-red	TRNSP	VIT	SUBH	sang-srnd	SMOOTH	
Pyrope Garnet: Till (poss)									
RE98-84B-24-002		UVAR.(pos)	EM-GREEN	TRNSL	VIT	ANH	sang-srnd	CHIP	conchoidal fracture
RE98-84B-27-001		UVAR.(pos)	EM-GREEN	TRNSL	VIT	SUBH	sang-srnd	SMTH-STP	
RE98-84B-40-001	a,b,c,	PYROPE(poss)	cl-pale purp	TRNSP	VIT	SUBH-EUH	ANG	SMOOTH	
RE98-84B-46-001		PYROPE(poss)	PALE-PUR	TRNSL	VIT	ANH	ANG-SANG	ROUGH	
RE98-84B-47-001		PYROPE(poss)	orng-red-brn	TRNSP	VIT	EUH	SANG	SMOOTH	dodecahedron (eclogite?)
RE98-84B-55-001		UVAR.(pos)	EM-GREEN	TRNSL	VIT-DULL	ANH	SRND-RND	rgh ornpeel	
RE98-84B-75-001		UVAR.(pos)	EM-GREEN	TRNSP-SL	VIT	SUBH	SANG	SMOOTH	conchoidal fracture
RE98-84B-122-001		PYROPE(poss)	CLEAR	TRNSP	VIT	EUH	SANG	SMTH-CHP	BROKEN
RE98-84B-128-001		PYROPE(poss)	ROSE	TRNSP	VIT	EUH	SANG	SMOOTH	DODECAHEDRON
RE98-84B-146-001		PYROPE(poss)	PALE-ROS	TRNSP	VIT	EUH	sang-srnd	SMOOTH	VERY SMALL
RE98-84B-146-001		UVAR.(pos)	EM-GREEN	TRNSP	VIT	SUBH	SANG	SMOOTH	VERY SMALL
RE98-84B-153-001		UVAR.(pos)	EM-GREEN	TRNSL	VIT	ANH	sang-srnd	frst-orpeel	

Legend

Clarity*	Lustre**	Form***	Shape^{+}	Surface^{++}	Remarks^{+++}
TRNSP (transparent)	VIT (Vitreous)	EUH (euhedral)	ANG (angular)	KELY (kelyphite)	Miscellaneous remarks
TRNSL (translucent)	DULL	SUBH (subeuhedral)	SANG (subangular)	ORPEEL (orange peel)	including cleavage,
OPAQ (opaque)	EARTHY	ANH (anhedral)	SRND (subrounded)	FROST	fracture patterns, unique
	MET (metallic)	IRREG (irregular)	RND (rounded)	SMOOTH	crustal/mantle observations
				ROUGH	
				CHIP	
				PIT	
				STEP	