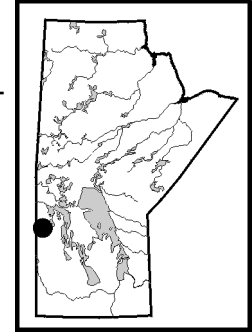


**KIMBERLITE INDICATOR MINERALS FROM WEST-CENTRAL
MANITOBA — 2002 UPDATE (NTS 63C AND 63K)
by J.D. Bamburak and M.A.F. Fedikow¹**



Bamburak, J.D. and Fedikow, M.A.F. 2002: Kimberlite indicator minerals from west-central Manitoba — 2002 update (NTS 63C and 63K); *in* Report of Activities 2002, Manitoba Industry, Trade and Mines, Manitoba Geological Survey, p. 287-294.

SUMMARY

Follow-up investigations of kimberlite indicator minerals (KIM) in west-central Manitoba, released in 2001, have been conducted. The additional sampling was done later that year; and the results of analyses were received early in 2002. This work confirmed that the northern half of the Porcupine Hills contains anomalous quantities of KIM compared to the southern half. The common headwater location of the Little Woody, Rice and Steeprock rivers and of the Homestead and Little Rice creeks appears to be the source area. The KIM are not derived from the Cretaceous Swan River Formation, but may have been eroded from younger Cretaceous beds or from the multiple till sheets that are draped over the Porcupine Hills.

INTRODUCTION

A total of 23 sand and gravel samples (Table GS-34-1) from west-central Manitoba were analyzed for KIM. This work was done as a follow-up to investigations of KIM reported by Bamburak and Fedikow (2001).

A total of 19 samples were taken at the downstream end of sandbars within streams flowing from the Porcupine Hills (Fig. GS-34-1). One sample was collected from the Red Deer River in Saskatchewan, just over the Manitoba boundary. Two samples were prepared from Cretaceous Swan River Formation outcrops; and one sample from a garnet-rich beach sand on Clearwater Lake, north of The Pas.

PREVIOUS WORK

Previous work on kimberlite mineral investigations by government and industry were reported by Bamburak and Fedikow (2001). In the 2001 study, a total of 44 sand and gravel samples, collected in west-central Manitoba from 1997 to 2000, were analyzed for KIM. Most of the samples (39 of them) were taken at the downstream end of sandbars within streams flowing from the Porcupine Hills (Fig. GS-34-1, 2001 stream sediment sample sites).

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Table GS-34-1: West-central Manitoba sediment samples - 2002 study.

Sample No.	Location	NTS	Zone	Easting	Northing	L.S.-Sec.-Twp.- Rge.-Mer.
99-01-PM-001A	Steeprock River Washout Fine	63C11NW	NAD 27 14U	340960	5842410	13-17-43-27-W1
99-01-PM-001B	Steeprock River Washout Coarse	63C11NW	NAD 27 14U	340960	5842410	13-17-43-27-W1
99-01-PM-002A	Steeprock River Rogers Creek Coarse	63C11NW	NAD 27 14U	343890	5844710	08-28-43-27-W1
99-01-PM-002B	Steeprock River Rogers Creek Fine	63C11NW	NAD 27 14U	343890	5844710	08-28-43-27-W1
99-01-PM-003A	Steeprock River	63C11NW	NAD 27 14U	347940	5842820	06-24-43-27-W1
99-01-PM-003B	Steeprock River	63C11NW	NAD 27 14U	347940	5842820	06-24-43-27-W1
99-01-PM-004A	Steeprock River	63C11NE	NAD 27 14U	349475	5842150	14-18-43-26-W1
99-01-PM-004B	Steeprock River	63C11NE	NAD 27 14U	349475	5842150	14-18-43-26-W1
99-01-PM-005A	Railway Pier Creek Bridge Upstream	63C13SE	NAD 27 14U	330030	5856050	04-31-44-28-W1
99-01-PM-005B	Railway Pier Creek Bridge Upstream	63C13SE	NAD 27 14U	330030	5856050	04-31-44-28-W1
99-01-PM-007A	Homestead Creek Coarse	63C14SW	NAD 27 14U	339875	5853660	13-19-44-27-W1
99-01-PM-007B	Homestead Creek Fine	63C14SW	NAD 27 14U	339875	5853660	13-19-44-27-W1
99-01-PM-008A	Rice River Inset Stream	63C14SW	NAD 27 14U	343925	5853570	15-21-44-27-W1
99-01-PM-008B	Rice River Dry Sand Bar	63C14SW	NAD 27 14U	343925	5853570	15-21-44-27-W1
99-01-PM-009D	Rice River	63C14SW	NAD 27 14U	343850	5853180	10-21-44-27-W1
99-01-PM-010A	Bell River Upstream	63C11SE	NAD 27 14U	355860	5827340	14-34-41-26-W1
99-01-PM-010B	Bell River Downstream	63C11SE	NAD 27 14U	355860	5827340	14-34-41-26-W1
99-01-PM-014	Bell River Above Bridge	63C11SE	NAD 27 14U	357850	5828100	06-02-42-26-W1
99-01-PM-015	Turnoff Creek Bridge	63C14SW	NAD 27 14U	331840	5855960	04-32-44-28-W1
99-93-SR-7-1	Swan River Composite Sample	63C03NE	NAD 27 14U	356150	5780510	04-11-37-26-W1
99-99-CL-002B	Clearwater Lake South Beach	63K03SE	NAD 83 14U	355759	5992666	16-35-58-26-W1
99-99-SR-001	Swan River Ford Bridge	63C03NE	NAD 27 14U	352705	5780075	12-05-37-26-W1
99-01-RD-004	Red Deer River (Sask.)	63C13NE	NAD 27 14U	315552	5873501	08-21-46-30-W1

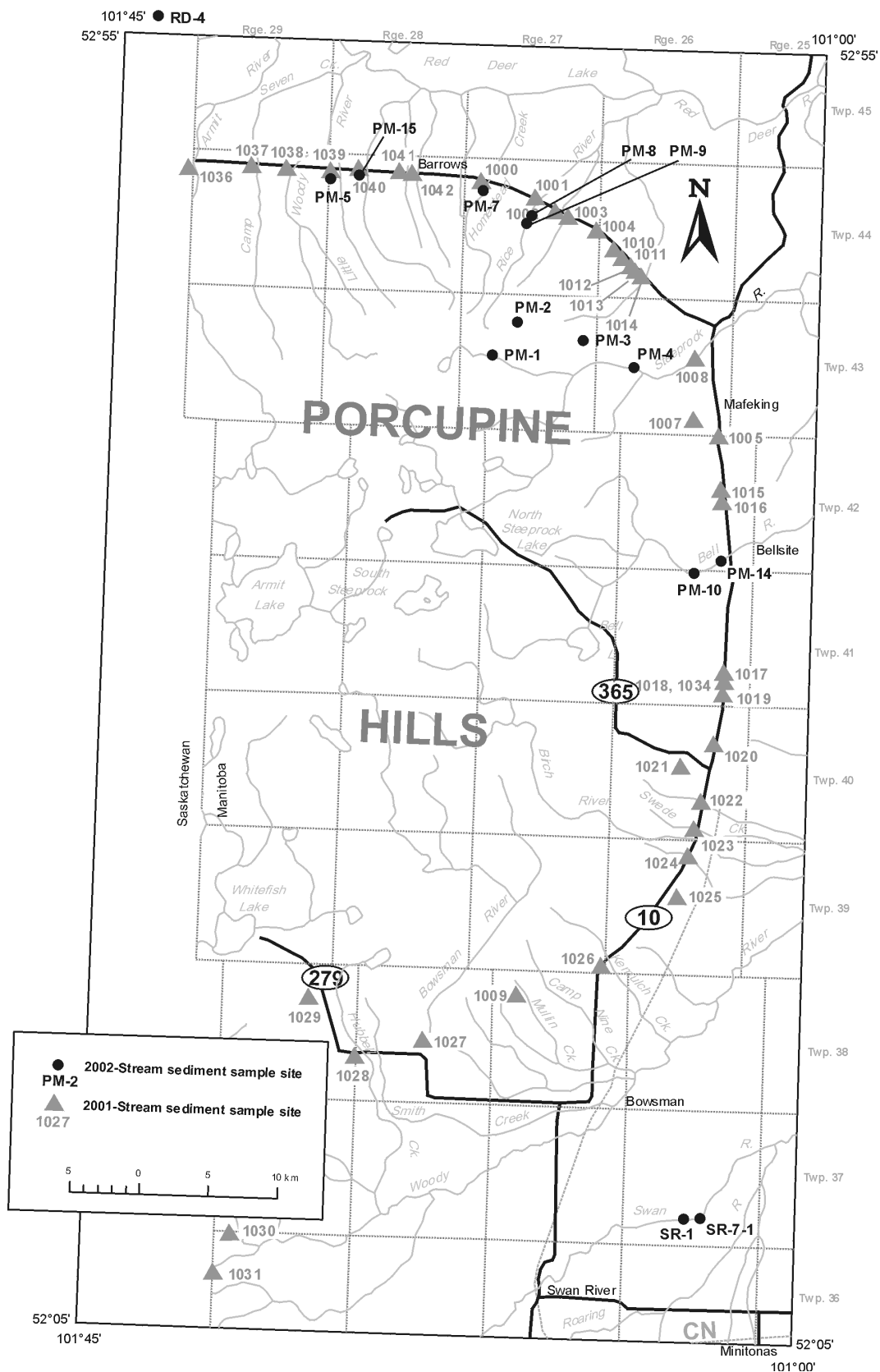


Figure GS-34-1: Sampling locations in the Porcupine Hills and vicinity - 2001 and 2002 studies.

SAMPLE COLLECTION, PREPARATION AND ANALYSIS

During the summer of 2001, a total of nineteen 5 kg samples of sand and fine gravel were collected at the downstream end of sandbars within 6 streams flowing from the Porcupine Hills [Fig. GS-34-1 (2002 stream sediment sample sites) and Table GS-34-1]. The purpose of the sampling was to test

- 1.) the stream beds in which relatively high quantities of KIM had been reported by Bamburak and Fedikow (2001);
- 2.) the Steeprock River for KIM at several locations to determine whether the Cretaceous Swan River Formation may have contributed anomalous quantities of KIM; and
- 3.) the Bell River, which had been omitted in the previous survey.

Three additional 5 kg samples in the immediate vicinity of the Porcupine Hills were also analyzed. One sample (99-01-RD-004) was collected in the Red Deer River, just west of the Manitoba–Saskatchewan boundary (Fig. GS-34-1). Two Cretaceous Swan River Formation samples (99-93-SR-7-1 and 99-99-SR-001) were taken 15 km downstream from the town of Swan River (Fig. GS-34-1).

One 5 kg sample, collected 140 km north of the Porcupine Hills area, was also submitted for analysis of KIM. The garnet sand (99-99-CL-002B) was sampled on a beach at the northwest end of Clearwater Lake, 30 km north of The Pas. In the 2001 study, a similar garnet sand sample, taken from a nearby beach on Clearwater Lake, produced a single G10 garnet

When required, the samples were washed to remove organics and coarse sieved to remove pebbles. They were shipped to De Beers Canada Exploration Inc. (De Beers) for processing at the end of the 2001 sampling program. According to Fedikow et al. (2001), processing by De Beers included screening the 5 kg samples at 2.0 mm, with the oversize discarded except for a representative aliquot of the -5.6 to +2.0 mm fraction, which was used for pebble counts. The -2.0 mm size fraction was passed over a 0.3 mm aperture sieve and the -0.3 mm size fraction discarded. The -2.0 to +0.3 mm fraction was concentrated by gravity separation, dried in ovens and further sieved into -2.0 to +1.0 mm, -1.0 to +0.5 mm and -0.5 to +0.3 mm size fractions, which were packaged, labelled and shipped to De Beers' laboratories for further treatment.

These three size fractions were individually separated using the heavy liquid bromoform (specific gravity of 2.86). The heavy fractions that sank through the bromoform were washed and sorted for KIM. Indicator minerals were analyzed by electron microprobe (Fedikow et al., 2001).

Table GS-34-2: Visual mineralogy of the KIM, -2.0 to +1.0 mm size fraction.

Sample No.	TFND	TGA	ROK	OTH	TIL	PM	OTH	TCD	ROS	OTH	TSP
99-01-PM-001A	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-001B	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-002A	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-002B	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-003A	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-003B	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-004A	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-004B	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-005A	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-005B	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-007A	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-007B	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-008A	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-008B	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-009D	1	0	0	0	1	0	1	0	0	0	0
99-01-PM-010A	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-010B	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-014	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-015	0	0	0	0	0	0	0	0	0	0	0
99-93-SR-7-1	0	0	0	0	0	0	0	0	0	0	0
99-99-CL-002B	0	0	0	0	0	0	0	0	0	0	0
99-99-SR-001A	0	0	0	0	0	0	0	0	0	0	0
99-01-RD-004	0	0	0	0	0	0	0	0	0	0	0

Abbreviations: **TFND**, total number of KIMs; **TGA**, total number of kimberlitic garnet grains; **ROK**, number of garnet grains with Remnants Of Kelyphite (surface texture feature) preserved as a crust around the grain; **OTH**, number of other kimberlitic garnet grains; **TIL**, total number of ilmenite grains; **PM**, number of ilmenite grains with Perovskite Mantle (surface texture feature); **OTH**, number of other ilmenite grains; **TCD**, total number of chrome diopside grains; **ROS**, number of chrome diopside grains with Remnants of Original Surface (texture feature); **OTH**, number of other chrome diopside grains; **TSP**, total number of chrome spinel (chromite) grains.

Table GS-34-3: Visual mineralogy of the KIM, -1.0 to +0.5 mm size fraction.

Sample No.	TFND	TGA	ROK	OTH	TIL	PM	OTH	TCD	ROS	OTH	TSP
99-01-PM-001A	1	0	0	0	0	0	0	1	0	1	0
99-01-PM-001B	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-002A	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-002B	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-003A	2	0	0	0	1	0	1	0	0	0	1
99-01-PM-003B	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-004A	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-004B	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-005A	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-005B	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-007A	2	0	0	0	2	0	2	0	0	0	0
99-01-PM-007B	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-008A	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-008B	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-009D	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-010A	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-010B	1	0	0	0	1	0	1	0	0	0	0
99-01-PM-014	1	0	0	0	1	0	1	0	0	0	0
99-01-PM-015	0	0	0	0	0	0	0	0	0	0	0
99-93-SR-7-1	0	0	0	0	0	0	0	0	0	0	0
99-99-CL-002B	0	0	0	0	0	0	0	0	0	0	0
99-99-SR-001A	0	0	0	0	0	0	0	0	0	0	0
99-01-RD-004	0	0	0	0	0	0	0	0	0	0	0

Abbreviations: TFND, total number of KIMs; TGA, total number of kimberlitic garnet grains; ROK, number of garnet grains with Remnants Of Kelyphite (surface texture feature) preserved as a crust around the grain; OTH, number of other kimberlitic garnet grains; TIL, total number of ilmenite grains; PM, number of ilmenite grains with Perovskite Mantle (surface texture feature); OTH, number of other ilmenite grains; TCD, total number of chrome diopside grains; ROS, number of chrome diopside grains with Remnants of Original Surface (texture feature); OTH, number of other chrome diopside grains; TSP, total number of chrome spinel (chromite) grains.

Table GS-34-4: Visual mineralogy of the KIM, -0.5 to +0.3 mm size fraction.

Sample No.	TFND	TGA	ROK	OTH	TIL	PM	OTH	TCD	ROS	OTH	TSP
99-01-PM-001A	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-001B	1	0	0	0	1	0	1	0	0	0	0
99-01-PM-002A	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-002B	6	0	0	0	0	0	0	0	0	0	6
99-01-PM-003A	5	0	0	0	5	0	5	0	0	0	0
99-01-PM-003B	1	0	0	0	0	0	0	0	0	0	1
99-01-PM-004A	2	0	0	0	0	0	0	0	0	0	2
99-01-PM-004B	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-005A	3	0	0	0	0	0	0	0	0	0	3
99-01-PM-005B	2	0	0	0	0	0	0	2	0	2	0
99-01-PM-007A	4	0	0	0	4	0	4	0	0	0	0
99-01-PM-007B	0	0	0	0	0	0	0	0	0	0	0
99-01-PM-008A	3	0	0	0	0	0	0	0	0	0	3
99-01-PM-008B	2	1	0	1	0	0	0	0	0	0	1
99-01-PM-009D	4	0	0	0	1	0	1	0	0	0	3
99-01-PM-010A	3	0	0	0	2	0	2	0	0	0	1
99-01-PM-010B	4	1	0	1	1	0	1	1	0	1	1
99-01-PM-014	1	0	0	0	0	0	0	0	0	0	1
99-01-PM-015	0	0	0	0	0	0	0	0	0	0	0
99-93-SR-7-1	0	0	0	0	0	0	0	0	0	0	0
99-99-CL-002B	0	0	0	0	0	0	0	0	0	0	0
99-99-SR-001A	0	0	0	0	0	0	0	0	0	0	0
99-01-RD-004	4	0	0	0	0	0	0	0	0	0	4

Abbreviations: TFND, total number of KIMs; TGA, total number of kimberlitic garnet grains; ROK, number of garnet grains with Remnants Of Kelyphite (surface texture feature) preserved as a crust around the grain; OTH, number of other kimberlitic garnet grains; TIL, total number of ilmenite grains; PM, number of ilmenite grains with Perovskite Mantle (surface texture feature); OTH, number of other ilmenite grains; TCD, total number of chrome diopside grains; ROS, number of chrome diopside grains with Remnants of Original Surface (texture feature); OTH, number of other chrome diopside grains; TSP, total number of chrome spinel (chromite) grains.

VISUAL MINERALOGY AND MINERAL CHEMISTRY

In the 2002 study samples, one kimberlitic grain was recovered in the -2.0 to +1.0 mm size fraction (Table GS-34-2), 7 grains were recovered in the -1.0 to +0.5 mm size fraction (Table GS-34-3), and 45 grains were recovered in the -0.5 to +0.3 mm size fraction (Table GS-34-4). Original surface remnants were not observed on any of the kimberlitic grains recovered in the 2002 study.

The picked KIM were analyzed with an electron microprobe and classified. The resultant mineral chemistry is listed in Table GS-34-5 for the -2.0 to +1.0 mm size fraction, in Table GS-34-6 for the -1.0 to +0.5 mm size fraction and in Table GS-34-7 for the -0.5 to +0.3 mm size fraction.

The KIM from the 2002 study comprise 22 chrome spinel grains, 7 Mg-ilmenite grains, 3 chrome diopside grains, 1 titanian chrome pyrope and 1 non-titanian chrome pyrope. These kimberlitic grains are more or less evenly distributed. The samples collected from the streams draining the northern slope of the Porcupine Hills are marked by an assemblage of primarily chrome spinel, chrome diopside, Mg-ilmenite and 1 G9 garnet (from site PM-8). Sites PM-1 through PM-4 represent a series of samples collected from an east-west transect on the Steeprock River and its tributaries (south of the north slope of the Porcupine Hills). These sites are also characterized by chrome spinel (n=14) and Mg-ilmenite (n=1). The samples from sites PM-10 and PM-14 along the Bell River, south and east of the Steeprock River also contain KIM. Site PM-10 contains a G11 non-titanian chrome pyrope, 2 chrome spinel and a chrome diopside; PM-14 contains 1 chrome spinel grain.

DISCUSSION

The results of the analyses for KIM are summarized in Table GS-34-8.

- The two Swan River Formation samples (99-93-SR-7-1 and 99-99-SR-001) collected in the Swan River valley did not contain KIM. One of the samples was a bulk channel sample collected over a 5 m vertical section. The absence of KIM in the Swan River Formation samples can be contrasted with the numbers of KIM found within present day stream sediments from the Steeprock and Bell river basins and those on the north slope of the Porcupine Hills, described above. This indicates that the Swan River Formation did not contribute KIM to the stream sediments.
- Samples taken from the coarse and fine portions of the same streambed do not show any marked difference in the abundance of KIM. Sample pairs 99-01-PM-007A and -007B, 99-01-PM-001A and -001B, and 99-01-PM-002A and -002B do not show any trends.
- In the 2001 study for the Porcupine Hills (Fig. GS-34-1, Table GS-34-9), one half of the ten KIM in the -1.0 to +0.5 mm grain-size range (including a G9 garnet and a diamond inclusion spinel) were found in streams draining the northern slope of the Hills (99T-1038 to 99T-1004). Secondly, almost 80% of the indicators in the -0.5 to +0.3 size fraction were from streams that share the same headwaters area (Little Woody, Rice and Steeprock rivers and Homestead and Little Rice creeks).
- The relative abundance of KIM in the same streams in the 2001 study, as was described above, was higher than in this study. This may have been due to the time of year when the sampling was done. Water flow may have been greater during the spring of 1997 than in mid-summer of 2001.
- No KIM were found in the garnet sand sample (99-99-CL-002B) from a beach on Clearwater Lake, north of The Pas. In the 2001 survey, a garnet sand sample (99T-1035), taken from a nearby beach on Clearwater Lake, contained a single G10 garnet in the -0.5 to +0.3 mm size fraction.

Table GS-34-5: Mineral chemistry of the KIM, -2.0 to +1.0 mm size fraction.

Sample No.	MnO	Na ₂ O	Al ₂ O ₃	FeO	SiO ₂	TiO ₂	CaO	Cr ₂ O ₃	MgO	TOTAL	Classification
99-01-PM-009D	0.18	0	0.19	40.28	0.06	50.55	0	0.17	7.94	99.37	Mg-ilmenite

Table GS-34-6: Mineral chemistry of the KIM, -1.0 to +0.5 mm size fraction.

Sample No.	MnO	Na ₂ O	Al ₂ O ₃	FeO	SiO ₂	TiO ₂	CaO	Cr ₂ O ₃	MgO	TOTAL	Classification
99-01-PM-003A	0.21	0	0.42	34.48	0.09	50.9	0	1.24	10.94	98.28	Mg-ilmenite
99-01-PM-007A	0.23	0	0.34	37.77	0.06	51.01	0	0.32	9.8	99.53	Mg-ilmenite
99-01-PM-007A	0.15	0.11	0.48	39.08	0.09	50.36	0.05	0.46	9.31	100.1	Mg-ilmenite
99-01-PM-010B	0.26	0.02	0.36	32.68	0.04	52.96	0	1.07	11.74	99.13	Mg-ilmenite
99-01-PM-014	0.18	0	7.15	27.67	0.21	3.73	0.01	47.23	14.19	100.38	ilmenite
99-01-PM-003A	0.39	0.07	12.58	29.76	0	0.22	0	47.63	9.09	99.73	chrome spinel
99-01-PM-001A	0.09	1.17	1.88	2.82	54.03	0.08	22.69	1.39	15.22	99.38	chrome andradite

Table GS-34-7: Mineral chemistry of the KIM, -0.5 to +0.3 mm size fraction.

Sample No.	MnO	Na ₂ O	Al ₂ O ₃	FeO	SiO ₂	TiO ₂	CaO	Cr ₂ O ₃	MgO	TOTAL	Classification
99-01-PM-005B	0.12	0.98	1.69	3.62	55.31	0.11	22.15	1.13	16.34	101.45	chrome diopside
99-01-PM-005B	0.09	0.94	1.81	2.94	55.06	0.11	22.6	1.4	16.47	101.41	chrome diopside
99-01-PM-010B	0.07	0.42	1.19	2.12	54.37	0.13	23.66	1.29	16.63	99.88	chrome diopside
99-01-PM-008B	0.51	0.14	19.36	7.89	43.22	0.09	5.15	4.72	20.63	101.71	non-titanian Cr-pyrope (G9)
99-01-PM-010B	0.22	0.02	18.16	7.19	41.97	0.39	7.11	6.7	19.76	101.51	titanian Cr-pyrope (G11)
99-01-PM-003A	2.19	0.12	0	48.46	0.07	49.87	0.01	0	0.11	100.85	ilmenite
99-01-PM-007A	0.47	0.07	0	48.91	0.03	50.72	0.01	0.03	0.7	100.95	ilmenite
99-01-PM-007A	2.11	0.07	0	46.9	0.04	51.01	0.01	0	0.16	100.31	ilmenite
99-01-PM-010A	0.29	0	0.65	34.68	0.06	52.01	0	0.48	12.21	100.38	Mg-ilmenite
99-01-PM-010A	0.3	0	0.06	48.32	0	48.47	0	0.14	2.28	99.59	ilmenite
99-01-PM-010B	0.37	0.02	0.59	42.13	0.01	48.69	0	0	8.57	100.39	Mg-ilmenite
99-01-PM-001B	0.34	0	0	92.93	0.19	0	0.04	0.02	0	93.51	magnetite
99-01-PM-003A	0.07	0	0.07	93.46	0.08	0.02	0.04	0	0	93.74	magnetite
99-01-PM-003A	0.11	0	0	93.16	0.06	0.07	0.03	0.14	0.06	93.64	magnetite
99-01-PM-003A	0.07	0	0.12	94.65	0.12	0.09	0.01	0.06	0.15	95.25	magnetite
99-01-PM-003A	0.1	0.15	0.38	94.59	0.12	0	0.09	0.09	0.3	95.82	magnetite
99-01-PM-007A	0.02	0	0.34	94.01	0.03	0.06	0	0.08	0.04	94.58	magnetite
99-01-PM-009D	0.08	0	0.07	93.11	0.01	0	0.01	0.06	0	93.35	magnetite
99-01-PM-007A	0	0.18	0.07	0.15	0.04	99.24	0	0.19	0.01	99.88	rutile
99-01-PM-008A	1.88	0	0	45.9	0.04	52.13	0	0.02	0.33	100.3	ilmenite
99-01-PM-009D	0.32	0	0.04	47.49	0.1	50.46	0	0.1	1.46	99.97	ilmenite
99-01-PM-005A	0.14	0	0	93.63	0.15	0	0.02	0	0	93.95	magnetite
99-01-PM-009D	0.03	0	0	93.26	0.1	0.12	0	0	0	93.52	magnetite
99-01-PM-009D	0.18	0	0	93.63	0.01	0.1	0	0.04	0.02	93.98	magnetite
99-01-PM-002B	0.59	0.17	8.37	31.38	0.01	0.18	0	53.29	5.63	99.62	chrome spinel
99-01-PM-002B	0.5	0.21	13.06	35.66	0.25	0.2	0.02	43.66	6.48	100.04	chrome spinel
99-01-PM-002B	0.18	0	17.53	17.14	0.18	0.53	0	49.55	14.25	99.36	chrome spinel
99-01-PM-002B	0.38	0	10.8	37.72	0.06	0.18	0	45.05	5.33	99.51	chrome spinel
99-01-PM-002B	1.06	0.07	15.66	38.62	0.11	0.37	0	42.69	1.4	99.99	chrome spinel
99-01-PM-002B	0.37	0.06	17.95	27.2	0.04	0.38	0	44.06	9.18	99.24	chrome spinel
99-01-PM-003B	0.21	0	19.34	26.85	0.03	0.44	0	42.95	10.26	100.09	chrome spinel
99-01-PM-004A	0.31	0.11	17.63	30.49	0.13	0.66	0	42.16	8.94	100.42	chrome spinel
99-01-PM-004A	0.52	0.25	13.65	24.99	0.09	0.18	0.01	53.73	7.32	100.74	chrome spinel
99-01-PM-005A	0.43	0	22.01	36.75	0.06	0.2	0.01	33.6	7.02	100.08	chrome spinel
99-01-PM-005A	0.4	0.02	11.77	31.02	0.08	0.19	0	48.23	8.46	100.17	chrome spinel
99-01-PM-008A	0.32	0.06	18.11	32.81	0.1	0.16	0	39.91	8.32	99.79	chrome spinel
99-01-PM-008A	0.44	0	7.83	37.47	0.04	0	0	51.82	1.5	99.11	chrome spinel
99-01-PM-008B	0.13	0	17.25	21.85	0.1	1.77	0	43.18	15.55	99.83	chrome spinel
99-01-PM-010A	0.13	0	31.07	17.37	0	0.38	0	38.86	13.5	101.31	chrome spinel
99-01-PM-010B	0.14	0.23	17.76	16.6	0.04	0.19	0	51.85	13.72	100.54	chrome spinel
99-01-PM-014	0.3	0	17.01	26.49	0.06	0.53	0	43.94	9.64	97.98	chrome spinel
99-01-RD-004	0.31	0	6.63	21.3	0.07	0	0	63.13	7.5	98.94	chrome spinel
99-01-RD-004	0.38	0.02	5.87	41.95	0.01	0.31	0	45.37	4.68	98.59	chrome spinel
99-01-RD-004	0.29	0.02	18.94	29.85	0.13	1.17	0	39.51	9.44	99.36	chrome spinel
99-01-RD-004	0.44	0	2.87	44.33	0.04	0.45	0	46.35	3.09	97.58	chrome spinel

CONCLUSIONS

This brief KIM follow-up study indicates that the source for the kimberlitic grains is north and/or northwest of the streams sampled in the Porcupine Hills. This could indicate that the Fort a la Corne kimberlites, in Saskatchewan, are the source for these KIM, or that another source exists north of the Porcupine Hills.

- The Swan River Formation is not the source of the KIM that have been found in the Porcupine Hills. The Lower Cretaceous Swan River Formation is exposed along cut banks in both the Steeprock and Bell rivers, this makes these river basins unlikely candidates for KIM exploration.
- The present stream sediments are derived from the multiple tills and glaciofluvial deposits that drape the Porcupine Hills. The source of these tills and glaciofluvial deposits is open to speculation. More till sampling north of the Hills would be required to determine whether there is a local kimberlite source in Manitoba.
- A more likely source for the KIM within the tills and glaciofluvial deposits on the Porcupine Hills may have been from the beds of preglacial and glacial streams that flowed in a southeasterly direction from the Fort a la Corne area in Saskatchewan (280 km west-northwest). Sample 99-01-RD-004, collected from the Red Deer River (SK), also suggests a western source for the KIM in Saskatchewan, possibly Fort a la Corne.

Table GS-34-8: Summary of kimberlite indicator-mineral occurrences - 2002 study.

Sample No.	Location	Kimberlite Indicator Grain Size		
		-2.0 to +1.0 mm	-1.0 to +0.5 mm	-0.5 to +0.3 mm
Porcupine Hills (clockwise)				
99-01-RD-004	Red Deer River (Sask.)	0	0	4
99-01-PM-005A	Railway Pier Creek Bridge Upstream	0	0	3
99-01-PM-005B	Railway Pier Creek Bridge Upstream	0	0	2
99-01-PM-015	Turnoff Creek Bridge	0	0	0
99-01-PM-007A	Homestead Creek Coarse	0	2	4
99-01-PM-007B	Homestead Creek Fine	0	0	0
99-01-PM-008A	Rice River Inset Stream	0	0	3
99-01-PM-008B	Rice River Dry Sand Bar	0	0	2
99-01-PM-009D	Rice River	1	0	4
99-01-PM-002A	Steepprock River Rogers Creek Coarse	0	0	0
99-01-PM-002B	Steepprock River Rogers Creek Fine	0	0	6
99-01-PM-001A	Steepprock River Washout Fine	0	1	0
99-01-PM-001B	Steepprock River Washout Coarse	0	0	1
99-01-PM-003A	Steepprock River	0	2	5
99-01-PM-003B	Steepprock River	0	0	1
99-01-PM-004A	Steepprock River	0	0	2
99-01-PM-004B	Steepprock River	0	0	0
99-01-PM-014	Bell River Above Bridge	0	1	1
99-01-PM-010A	Bell River Upstream	0	0	3
99-01-PM-010B	Bell River Downstream	0	1	4
99-93-SR-7-1	Swan River Composite Sample	0	0	0
99-99-SR-001	Swan River Ford Bridge	0	0	0
External Sites				
99-99-CL-002B	Clearwater Lake South Beach	0	0	0

- Both the 2001 and 2002 studies indicate that the abundance of KIM appears to be gradually declining in a southeast direction, across the Porcupine Hills.
- Clearwater Lake garnet sands do not appear to have been derived from a nearby kimberlite source.

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De Beers Canada Exploration Inc. is thanked for concentrating, picking and analyzing (by electron microprobe) the KIM, free of charge. In keeping with the usual confidentiality practice of the MGS, the sampling site locations were not revealed to De Beers.

B. Lenton is acknowledged for the preparation of Figure GS-34-1.

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- Fedikow, M.A.F., Nielsen, E., Conley, G.G. and Lenton, P.G. 2001: Operation Superior: kimberlite indicator mineral survey results (2000) for the northern half of the Knee Lake greenstone belt, northern Superior Province, Manitoba (NTS 53M/1,2,3,7 and 53L/15); Manitoba Industry, Trade and Mines, Geological Survey, Open File Report OF2001-5, 59 p.

Table GS-34-9: Kimberlite indicator-mineral summary from Bamburak and Fedikow (2001).

Sample No.	Location	Kimberlite Indicator Grain Size		NTS	Zone	Easting	Northing	L.S.-Sec.-Twp.-Rge.-Mer.
		-1.0 to +0.5 mm	-0.5 to +0.3 mm					
Porcupine Hills								
99T-1036	Armit River (Sask.)	0	0	63C13SE	NAD 27 14U	319590	5856300	02-36-44-30-W1
99T-1037	Camp Seven Creek	0	0	63C13SE	NAD 27 14U	324190	5856370	07-33-44-29-W1
99T-1038	Woody Creek (Little Woody River)	0	3	63C13SE	NAD 27 14U	326710	5856230	04-35-44-29-W1
99T-1039	Railway Pier Creek Bridge	1	11	63C13SE	NAD 27 14U	330030	5856050	04-31-44-28-W1
99T-1040	Turnoff Creek Bridge	0	7	63C14SW	NAD 27 14U	331840	5855960	04-32-44-28-W1
99T-1041	Barrows West Creek Bridge	1	0	63C14SW	NAD 27 14U	334920	5856050	05-34-44-28-W1
99T-1042	Whisky Creek Bridge	0	0	63C14SW	NAD 27 14U	335710	5855980	02-34-44-28-W1
99T-1000	Homestead Creek Bridge	1	27	63C14SW	NAD 27 14U	340750	5855110	15-30-44-27-W1
99T-1001	Rice River Bridge	0	12	63C14SW	NAD 27 14U	344530	5854090	04-27-44-27-W1
99T-1002	Centre Rice Creek Culvert	1	1	63C14SW	NAD 27 14U	346140	5853140	12-23-44-27-W1
99T-1003	Cement Culvert Creek (Little Rice)	0	4	63C14SW	NAD 27 14U	346980	5852670	07-23-44-27-W1
99T-1004	(Little) Rice Creek Bridge	1	5	63C14SW	NAD 27 14U	348850	5851760	15-13-44-27-W1
99T-1010	Baden West Creek Bridge	0	0	63C14SE	NAD 27 14U	350190	5850360	02-18-44-26-W1
99T-1011	Baden East Creek (South of hamlet)	0	0	63C14SE	NAD 27 14U	350200	5849850	10-07-44-26-W1
99T-1012	Sling Creek	0	0	63C14SE	NAD 27 14U	351620	5848880	03-08-44-26-W1
99T-1013	Beaver Dam Creek	0	0	63C14SE	NAD 27 14U	352110	5848310	16-05-44-26-W1
99T-1014	77 Creek	0	0	63C14SE	NAD 27 14U	353270	5847450	07-04-44-26-W1
99T-1008	Steeprock River Old Crossing	0	0	63C11NE	NAD 27 14U	356110	5842530	06-23-43-26-W1
99T-1007	Mafeking Creek Ford	0	1	63C11NE	NAD 27 14U	356010	5838400	11-02-43-26-W1
99T-1005	Smith (Morgan) Creek Bridge	0	0	63C11NE	NAD 27 14U	358070	5837000	14-35-42-26-W1
99T-1015	Raven Creek	0	2	63C11NE	NAD 27 14U	358020	5833170	10-23-42-26-W1
99T-1016	Nowhere Creek	0	1	63C11SE	NAD 27 14U	358100	5832020	15-14-42-26-W1
99T-1017	Dry Creek	0	0	63C11SE	NAD 27 14U	358120	5821610	08-14-41-26-W1
99T-1018	Glade Creek	0	0	63C11SE	NAD 27 14U	358120	5821230	01-14-41-26-W1
99T-1034	New Creek	0	2	63C11SE	NAD 83 14U	358127	5821407	07-14-41-26-W1
99T-1019	Post Creek	2	1	63C11SE	NAD 27 14U	358050	5819370	01-11-41-26-W1
99T-1020	Unnamed Creek	0	4	63C06NE	NAD 27 14U	357320	5815050	06-26-40-26-W1
99T-1021	Steeprock Road Creek	0	0	63C06NE	NAD 27 14U	355150	5813340	05-22-40-26-W1
99T-1022	Turnoff Creek	0	2	63C06NE	NAD 27 14U	356400	5811010	16-10-40-26-W1
99T-1023	Rusty Creek	0	0	63C06NE	NAD 27 14U	355960	5809010	10-03-40-26-W1
99T-1024	Birch River (Primrose Wayside Park)	1	0	63C06SE	NAD 27 14U	355670	5807090	07-34-39-26-W1
99T-1025	Iron Creek	0	0	63C06SE	NAD 27 14U	353860	5804420	11-21-39-26-W1
99T-1026	Kematch River	0	0	63C06SE	NAD 27 14U	349370	5799250	08-01-39-27-W1
99T-1009	Mudlen Creek Discovery	0	0	63C06SW	NAD 27 14U	343410	5796870	13-29-38-27-W1
99T-1027	Bowman River	1	0	63C06SW	NAD 27 14U	336640	5793750	16-16-38-28-W1
99T-1028	Hubbell Creek	0	4	63C06SW	NAD 27 14U	331860	5792560	04-18-38-28-W1
99T-1029	Trout Creek	1	0	63C04NE	NAD 27 14U	328200	5786210	16-22-37-29-W1
99T-1030	Woody Creek	0	0	63C04NE	NAD 27 14U	322750	5779910	16-31-36-29-W1
99T-1031	Hart Creek	0	0	63C04SE	NAD 27 14U	321450	5777200	05-30-36-29-W1
External Sites								
99T-1006	German Lake Salt Spring	0	0	63C15SW	NAD 27 14U	372630	5846460	03-04-44-24-W1
99T-1043	East Favel River	0	1	63C03SE	NAD 27 14U	360750	5765700	14-19-35-25-W1
99T-1032	Fishing River Gravel Pit	0	0	62N08NE	NAD 83 14U	425200	5699233	06-33-28-19-W1
99T-1033	Sulphur Spring Creek Bridge	0	0	62N07SE	NAD 27 14U	381750	5689700	01-36-27-24-W1
99T-1035	Clearwater Lake	0	1	63K03SE	NAD 83 14U	355759	5992666	16-35-58-26-W1