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Open File Report 6320

Results of Regional Till Sampling in the Chapleau Area, Northern Ontario

2016

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ONTARIO GEOLOGICAL SURVEY

Open File Report 6320

Results of Regional Till Sampling in the Chapleau Area, Northern Ontario

by

C. Gao

2016

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Contents

Abstract	xv
Introduction	1
Bedrock Geology	1
Quaternary Geology	3
Previous Surficial Sampling	8
Methods	8
Heavy Minerals	10
Bulk Sample Geochemistry	11
Gold Grain Data	11
Results	11
Kimberlite Indicator Minerals	15
Garnet	15
Mg-Ilmenite	18
Chromite	18
Cr-Diopside	22
Olivine (Forsterite)	23
Total KIMs and Areas of Interest	23
Kimberlite and Nonkimberlitic Boulders of Mantle Origin	24
Kimberlite Boulder	24
Nonkimberlitic Boulders of Mantle Origin	27
Metamorphic/Magmatic Massive Sulphide Indicator Minerals	30
Carbonatite Indicator Minerals	32
Bulk Sample Geochemistry	33
Gold and Arsenic	33
Base Metals	36
Molybdenum	36
Phosphorus	36
Rare Earth Elements (REEs)	37
Niobium	38
Uranium and Thorium	38
Conclusions	39
Acknowledgments	40
References	40

APPENDIXES

Appendix 1. Sample site locations 87
Appendix 2. Tabling and clast lithology data .... MRD 331
Appendix 3. Summary of gold grain counts 95
Appendix 4. Details on gold grains .... MRD 331
Appendix 5. Heavy mineral concentrates for KIM and MMSIM picking .... MRD 331
Appendix 6. Summary of 0.25 mm heavy mineral concentrate .... MRD 331
Appendix 7. Summary of KIM counts 103
Appendix 8. KIM grain picking remarks .... MRD 331
Appendix 9. Summary of picked grains .... MRD 331
Appendix 10. Microprobe data for KIMs .... MRD 331
Appendix 11. Summary of adjusted KIM counts 113
Appendix 12. Heavy mineral data of kimberlite boulder .... MRD 331
Appendix 13. Microprobe data for kimberlite boulder KIMs .... MRD 331
Appendix 14. Microscope descriptions of nonkimberlitic boulders of mantle origin 119
Appendix 15. Heavy mineral data of nonkimberlitic boulders of mantle origin .... MRD 331
Appendix 16. Summary of MMSIM counts .... MRD 331
Appendix 17. Numerically converted MMSIM counts 123
Appendix 18. Summary of PGM grain counts .... MRD 331
Appendix 19. ICP-MS, ICP-OES and INAA data for 0.063 mm fraction .... MRD 331
Appendix 20. ICP-MS, ICP-OES and INAA duplicates QC data .... MRD 331
Appendix 21. ICP-MS, ICP-OES and INAA reference material QC data .... MRD 331
Metric Conversion Table 148

FIGURES

1. Surface elevation map of the Chapleau survey area, northern Ontario 2
2. Location of sample sites in the Chapleau survey area, northern Ontario...... back pocket
3. Bedrock geology of the Chapleau survey area and mineral occurrences 4
4. Quaternary geology of the Chapleau survey area 7
5. Regional distribution of gold grains in till and glaciofluvial sand and gravel in the Chapleau survey area 46
6. Gold grain distribution on the Borden Lake property 13
7. Gold grain distribution at site 14-CG-226 on Lafrenière Road...... 14
8. Compositional plot of CaO versus Cr_2O_3 for pyrope garnet grains 17
9. Compositional plot of MgNum versus TiO_2 for megacrystic, eclogitic and pyroxenitic garnet grains...... 17
10. Regional distribution of peridotitic garnet grains...... 47
11. Regional distribution of eclogitic and megacrystic garnet grains 48
12. Compositional plot of MgO versus Cr_2O_3 for ilmenite grains 19
13. Regional distribution of Mg-ilmenite grains...... 49
14. Compositional plot of MgO versus Cr_2O_3 for chromite grains 20
15. Compositional plot of TiO_2 versus Cr_2O_3 for chromite grains 20
16. Regional distribution of chromite grains...... 50
17. Compositional plot of Ca/(Ca+Mg) versus Na_2O for low-Cr diopside (clinopyroxene) grains 22
18. Regional distribution of Cr-diopside grains 51
19. Regional distribution of low-Cr diopside grains 52
20. Regional distribution of forsterite (olivine) grains...... 53
21. Regional distribution of total KIM grains (pyrope garnets, Mg-ilmenite and Cr-diopside)...... 54
22. Regional distribution of total KIM grains in pie charts...... 55
23. Locations of kimberlite and other mantle-derived boulders in the Chapleau survey area...... 56
24. Compositional plot of CaO versus Cr_2O_3 for pyrope garnet grains of the kimberlite boulder, 11-CG-068-K 28
25. Compositional plot of MgO versus Cr_2O_3 for chromite grains of the kimberlite boulder 11-CG-068-K ... 28
26. Compositional plot of TiO_2 versus Cr_2O_3 for chromite grains of the kimberlite boulder 11-CG-068-K 29
27. Compositional plot of MgO versus Cr_2O_3 for ilmenite grains of the kimberlite boulder 11-CG-068-K..... 29
28. Regional distribution of chalcopyrite grains 57
29. Regional distribution of gahnite grains 58
30. Regional distribution of red rutile grains 59
31. Regional distribution of PGE sulphide grains...... 60
32. Regional distribution of barite grains...... 61
33. Regional distribution of apatite grains 62

34. Enlarged view showing the regional distribution of apatite grains in the area adjacent to the Lackner Lake alkalic complex 63
35. Regional distribution of carbonatite indicator minerals 64
36. Regional distribution of niobium-bearing minerals 65
37. Regional distribution of REE-bearing minerals 66
38. Regional distribution of gold (ppb) by INAA 67
39. Enlarged view showing the regional distribution of gold (ppb) by INAA on the Borden Lake.......... 35
40. Regional distribution of arsenic (ppm) by INAA.......... 68
41. Regional distribution of copper (ppm) by ICP–MS 69
42. Regional distribution of nickel (ppm) by ICP–MS 70
43. Regional distribution of cobalt (ppm) by ICP–MS 71
44. Regional distribution of zinc (ppm) by ICP–MS 72
45. Regional distribution of lead (ppm) by ICP–MS 73
46. Regional distribution of molybdenum (ppm) by ICP–MS 74
47. Regional distribution of phosphorus (ppm) by ICP–OES 75
48. Regional distribution of REEs (ppm) by ICP–MS 76
49. Enlarged view showing the regional distribution of REEs (ppm) by ICP–MS around the Lackner Lake alkalic complex 77
50. Enlarged view showing the regional distribution of REEs (ppm) by ICP–MS around the Nemegosenda Lake alkalic complex 78
51. Regional distribution of niobium (ppm) by ICP–MS.......... 79
52. Enlarged view showing the regional distribution of niobium (ppm) by ICP–MS around the Lackner Lake alkalic complex 80
53. Regional distribution of uranium (ppm) by ICP–MS.......... 81
54. Regional distribution of thorium (ppm) by ICP–MS 82
55. Enlarged view showing the regional distribution of uranium (ppm) by ICP–MS in the northern part of the survey.......... 83

PHOTOS

1. Till deposits exposed in a wayside pit in a ridge of hummocky ground moraine.......... 5
2. Sampling sandy and stony till in a road ditch 9
3. Sampling till immediately down ice of the discovery bedrock outcrop on the Borden Lake gold property... 9
4. Kimberlite boulder 11-CG-068-K collected at a sand and gravel pit on Island Lake Road 25
5. Close-up view of kimberlite boulder 11-CG-068-K 25

TABLES

1. Summary of samples containing more than 10 gold grains 12
2. Classification scheme for garnets.......... 16
3. Results of microprobed garnets including GP, GO, almandine and spinel grains.......... 16
4. Results of microprobed chromite and ilmenite grains.......... 19
5. Geochemistry of chromite grains classified in the diamond and intergrowth field.......... 21
6. Results of microprobed diopside and forsterite grains.......... 23
7. Summary of KIMs of kimberlite and other mantle-derived boulders 26
8. Indicator minerals commonly associated with base metal mineralization 31
9. Summary of samples containing PGE sulphide grains.......... 32
10. Summary of samples containing carbonatite minerals.......... 34
11. Areas of interest indicated by base metal anomalies in the <0.063 mm fraction bulk sample geochemistry 37

Miscellaneous Release—Data 331

Indicator Mineral and Till Bulk Sample Geochemistry Data, Chapleau Area, Northern Ontario

By C. Gao

This digital data release presents the results of a regional till sampling survey undertaken in the Chapleau area, northern Ontario. The data include heavy mineral grain counts for kimberlite indicator minerals (KIMs), metamorphic/magmatic massive sulphide indicator minerals (MMSIM®*) and gold, as well as geochemistry of the <0.063 mm fraction of the bulk sample. The data are being released in conjunction with Open File Report 6320, available separately. The files are provided in 20 Microsoft® Excel® 2010 (*.xlsx*) spreadsheets that contain information on sample site locations, sample processing data, gold grain counts, KIM and MMSIM®* grain data, electron probe microanalyzer results for KIM and MMSIM®* grains, clastic lithology data, and geochemical data for the <0.063 mm fraction of the bulk sample; and as well, 1 file in portable document format (*.pdf*), containing binocular microscope descriptions of nonkimberlitic boulders of mantle origin.

These digital data are available separately from this report.

*MMSIM is a registered trademark of Overburden Drilling Management Limited, Nepean, Ontario.

Abstract

Surficial geology mapping and till sampling was completed in the Chapleau area of northern Ontario to assist mineral exploration efforts in the region overlying the Kapuskasing Structural Zone. Sampling was conducted using trucks and ATVs, over an irregular sample grid, and sampling sites were confined to proximity of roads. Both the heavy mineral and bulk sample geochemistry data suggest potential for gold, kimberlite (diamond) and rare earth element mineralization. The survey area exhibits low background value for gold grains (<5 grains) as indicated by both the current till sampling and previous modern alluvium sampling surveys. However, both the gold grain counts per 10 kg sample (14 to 33 grains) and <0.063 mm bulk sample geochemistry show prominent anomalies on the Borden Lake property and correlate well with the location of the known gold deposit. Furthermore, the gold grain data indicate potential for additional gold mineralization to the north of the Borden Lake property (i.e., north of Highway 101). Anomalous gold grains were recovered from 2 additional sites. One is located on Sheppard and Morse Road (Pineal Lake Road) in the southern part of the survey area and is defined by 2 till samples where up to 23 gold grains were recovered. The other site is located on Lafrenière Road in the northern part of the survey area and contains a single till sample that yielded 29 gold grains. Based on the data available, these 2 sites are recommended for further prospecting for potential gold mineralization.

The total kimberlite indicator mineral (KIM) grain counts, which include the sum of pyrope garnet, picroilmenite and chromium diopside grains, are low in general, not exceeding 4 grains. An exception is till sample 11-CG-127, located near the eastern boundary of the survey area, which yielded 59 KIM grains. An additional site, identified as part of a previously completed modern alluvium sampling survey, is located to the northwest of the current survey area, where 25 KIM grains were recovered from sample KAP-0513. A kimberlite boulder was collected from a sand and gravel pit in the Chapleau II end moraine on Island Lake Road near the western boundary of the survey area. The boulder, characterized by hypabyssal facies related to a kimberlite dike, has a heavy mineral suite that contains abundant picroilmenite, chromite and pyrope garnet. Although the source areas remain unknown, the presence of anomalous KIM grains and a kimberlite boulder indicate good potential for possible kimberlite discoveries in the survey area.

High grain counts of the phosphate mineral, apatite, making up as much as 60% in the 0.25 to 0.5 mm nonmagnetic heavy mineral fraction of the samples, were recovered in the survey area. The most prominent anomaly of this mineral occurs along a dispersal feature emanating from the Lackner Lake alkalic complex, and agrees closely with phosphorus concentrations in the <0.063 mm fraction bulk sample geochemistry. As well, the <0.063 mm fraction bulk sample geochemistry data show multiple, anomalous concentrations in rare earth elements, niobium, uranium and thorium along the same dispersal feature, consistent with the reported occurrence of these minerals in the alkalic complex. This dispersal feature also exhibits anomalous levels of base metal elements including zinc and lead. In addition, anomalous numbers of apatite grains were recovered in an area on Nemegos Road about 4 km north-northwest of the Lackner Lake alkalic complex, likely derived from an unknown alkalic rock or carbonatite source in the up-ice direction to the north-northeast. Anomalous concentrations of rare earth elements were also found at several other sites. Because they have no direct connections to any of the known alkalic and carbonatite intrusions, the anomalies indicate the potential for additional rare earth element mineralization in the survey area.

Results of Regional Till Sampling in the Chapleau Area, Northern Ontario

C. Gao[1]

Ontario Geological Survey
Open File Report 6320
2016

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Introduction

Surficial geology mapping and till sampling were conducted in the Chapleau area in northern Ontario during the summers of 2011, 2013 and 2014 (Figure 1). The survey area overlies the northeast-trending Kapuskasing Structural Zone and consists of three 1:50 000 scale National Topographic System sheets 42B/03 (Swanson River area), 41O/14 (Chapleau area) and 41O/11 (Nemegos area). The recently released 1:50 000 scale surficial geology maps from this project provide information on the till deposits, stratigraphy and ice-flow directions (Gao 2016a, 2016b, 2016c). The till sampling was undertaken to evaluate the regional potential for gold, kimberlite, rare earth elements (REEs), base metals and other metal mineralization. The survey area includes the Borden Lake deposit where significant gold mineralization has been found (Murahwi, Gowans and Martin 2012; Dzick 2014). A total of 240 samples were collected, mostly along roads, in an area greater than 3100 km^2. The samples consist of 194 till and 46 glaciofluvial sand and gravel samples (Figure 2, back pocket; Appendix 1).

The survey area has many lakes, with Schewabik, Racine, Nemegosenda and Borden lakes being the major ones. Major rivers are the northward-flowing Chapleau and Nemegosenda rivers (Figure 1). The watershed boundary that separates the rivers flowing north into Hudson Bay and those flowing south into the Great Lakes basins, is aligned from southeast to northwest roughly along Highway 667 in the southern part of the survey area. The southward-flowing rivers to the Great Lakes basin include the Little Wenebegon and Aubinadong rivers. The survey area is covered by boreal forest with a natural vegetation dominated by black spruce (*Picea mariana*) and tamarack (*Larix laricina*) in poorly drained lowlands; mixed stands of poplar (*Populus tremuloides* and *P. balsamifera*), balsam fir (*Abies balsamea*), white spruce (*Picea glauca*) and black spruce on the uplands; and jack pine (*Pinus banksiana*) and, to a lesser extent, white birch (*Betula papyrifera*) in well-drained sandy areas (Evans and Cameron 1984). The vegetation, however, has been significantly altered locally, by the dominance of highly valued jack pine in some raised areas as a result of logging and reforestation.

The survey area has fairly good access because of the availability of several major highways and many logging roads. Apart from Highways 101, 129 and 667, there are several important gravel roads in the survey area, which include Lafrenière (Missinaibi Park Road), Martel, Nemegos, Adams Lake and Sheppard and Morse roads. Local industry includes the manufacture of forest products and tourism associated with recreational fishing and hunting. Tembec Incorporation operates a sawmill in Chapleau and produces softwood lumber and wood chips. The Chapleau Game Reserve, the world's largest, is located north of the town. Hunting is banned within the reserve but fishing, hiking and camping are permitted. Gold exploration in the vicinity of Borden Lake has been active, providing contributions to the local economy in recent years (Dzick 2014).

This report summarizes the results of this surficial mapping and sampling project. It is released in conjunction with Miscellaneous Release—Data (MRD) 331 (available separately from this report), which contains the data in digital format (Gao 2016d). The Appendix numbering in this report is consistent with the data files contained in MRD 331; however, only a select number of data tables are included in the Appendixes of this report. The table of contents (*see* "Contents") indicates which tables and/or data are available in this report. The Quaternary geology maps for the project areas were released previously (Gao 2016a, 2016b, 2016c).

Bedrock Geology

The study area is located within the northeast-trending Kapuskasing Structural Zone (KSZ) and contains Precambrian gneissic and granitic rocks, locally with metasedimentary, metavolcanic and migmatized supracrustal rocks, as well as mafic to ultramafic intrusive rocks (Figure 3) (Thurston, Siragusa and Sage

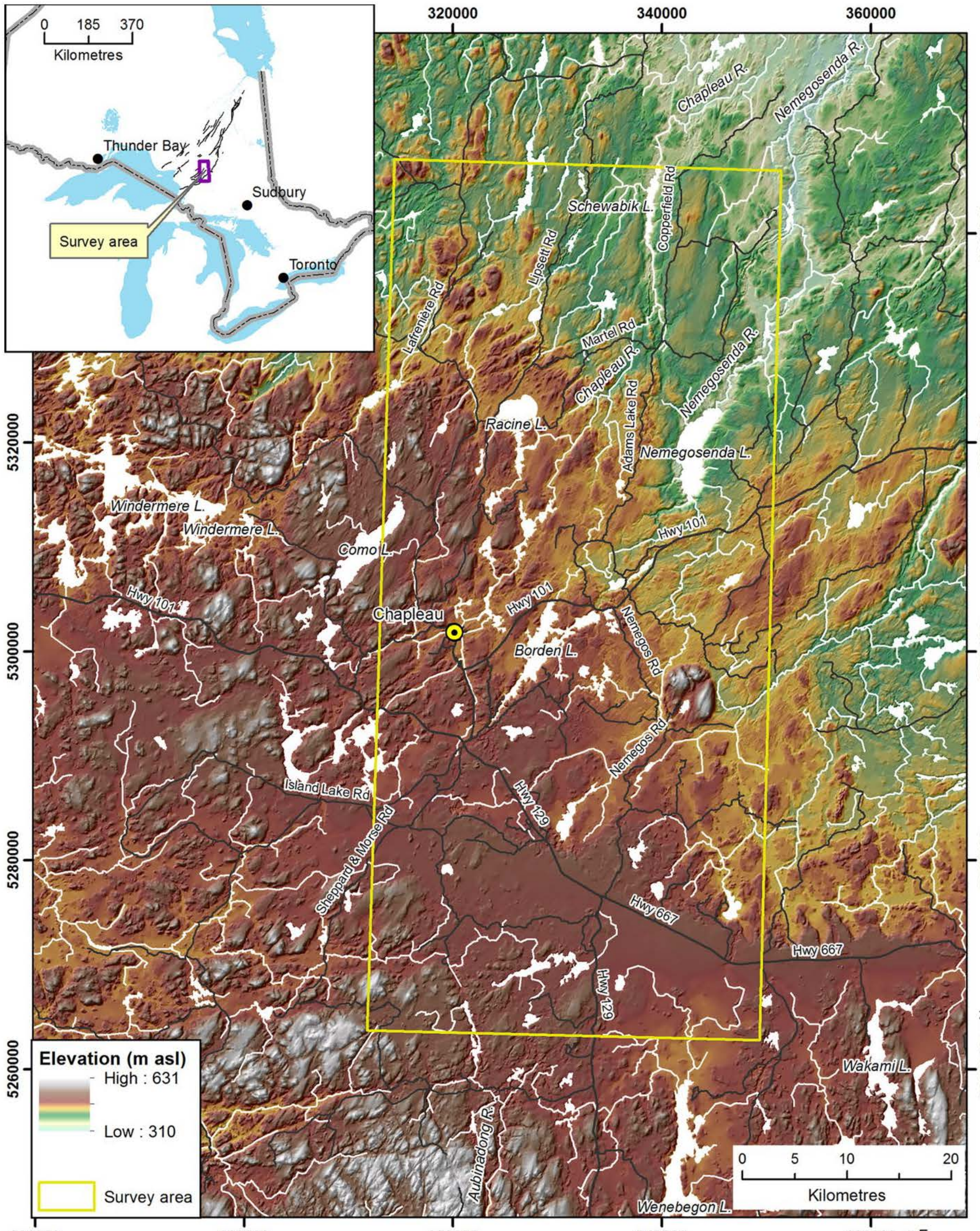

Figure 1. Surface elevation map of the Chapleau survey area, northern Ontario, *modified from* Ministry of Natural Resources and Forestry 2015. Black lines on the inset map illustrate the major faults of the Kapuskasing Structure Zone.

1971; Ontario Geological Survey 2011). The western part of the Swayze greenstone belt, characterized by mafic to intermediate metavolcanic rocks, extends just into the southeastern part of the survey area. Several alkalic-carbonatite intrusions of Proterozoic age, which contain rare earth element (REE), niobium and phosphorus occurrences, are present within the region (Sage 1992; Ontario Geological Survey 2016). They include, from north to south, the Nemegosenda Lake alkalic complex, Borden Township carbonatite complex and the Lackner Lake alkalic complex (*see* Figure 3). Carbonatite bands and lenses occur within the alkalic intrusions (Sage 1992).

Gold mineralization was previously reported from felsic gneiss of supracrustal origin in this region (Murahwi, Gowans and Martin 2012; Duguet and Szumylo 2016). Probe Mines Limited has since explored the gold deposit discovered on the northern peninsula of Borden Lake south of Highway 101, an area referred to as the Borden Lake property (acquired by Goldcorp in January 2015). The high-grade gold resources with potential for underground extraction in the Borden Gold Project total 1.60 million ounces of gold at a 2.5 g/t Au cutoff in the Indicated Resource category (9.3 million tonnes grading 5.39 grams of gold per tonne). The low-grade resources with potential for open pit extraction total 2.32 million ounces of gold at a 0.5 g/t Au cutoff in the Indicated Resource category (70.3 million tonnes grading 1.03 grams of gold per tonne) (Dzick 2014). The gold mineralization occurs both at the surface and at depth as indicated by the assay results of the samples obtained from bedrock outcrops and diamond drilling on the property (Murahwi, Gowans and Martin 2012; Dzick 2014).

Quaternary Geology

The survey area consists predominantly of a till-veneered Precambrian bedrock terrain in the north, with thick deposits of Late Pleistocene glaciolacustrine sand and glaciofluvial sand and gravel in the south (Figure 4) (Gao 2011; Gao 2013c; Gao, Wywrot and Zhu 2014; Gao 2016a, 2016b, 2016c). The Quaternary stratigraphy in the map area, from oldest to youngest, consists of a Late Wisconsinan sandy till, late glacial glaciofluvial sand and gravel, glaciolacustrine sand deposits and the Holocene peat. The till in the north ranges from less than 1 m to more than 4 m thick. The regional ice-flow direction, as indicated by striae, averages 190°, with a range of 155° to 230°, consistent with the orientation of flutings and drumlins (*see* Figure 4). An older westward ice-flow direction, as indicated by an array of faint striae at 278°, was observed at a single site (Gao, Wywrot and Zhu 2014; Gao 2016a). In line with the regional till stratigraphy and ice-flow directions proposed (Veillette et al. 2015), the westward striae might have resulted from an ice advance preceding the Late Wisconsinan (probably during the Early Wisconsinan). The rarity of such striae is a result of subsequent erosion by the Late Wisconsinan ice advance. It is likely that the till samples collected in the survey area are associated with the south-flowing Late Wisconsinan ice sheet.

The Late Wisconsinan till is sandy and bouldery, consisting of slightly silty, fine- to medium-textured sand mixed with moderate to large amounts of pebbly to bouldery clasts. Slight to strong compaction and fissility is usually present in the till matrix. Locally derived gneissic and granitic clasts are abundant with limestone clasts being observed occasionally. Rounded, pebble-size clasts from the Proterozoic Omarolluk Formation (omars) in southern Hudson Bay (Prest, Donaldson and Mooers 2000), although rare, are persistently present in the till and glaciofluvial deposits. The limestone and omar gravel clasts in the till indicate the presence of minor amounts of long-range transported clasts from the Hudson Bay and James Bay basins.

The till typically occurs in till plains and hummocky ground moraine. The till plains have a relatively flat topography and are usually fluted. The hummocky ground moraine comprises till mounds and ridges a few metres to tens of metres high. The till in the hummocky ground moraines is stony, containing characteristically oversized boulders up to 5 m in diameter, and a matrix that commonly shows

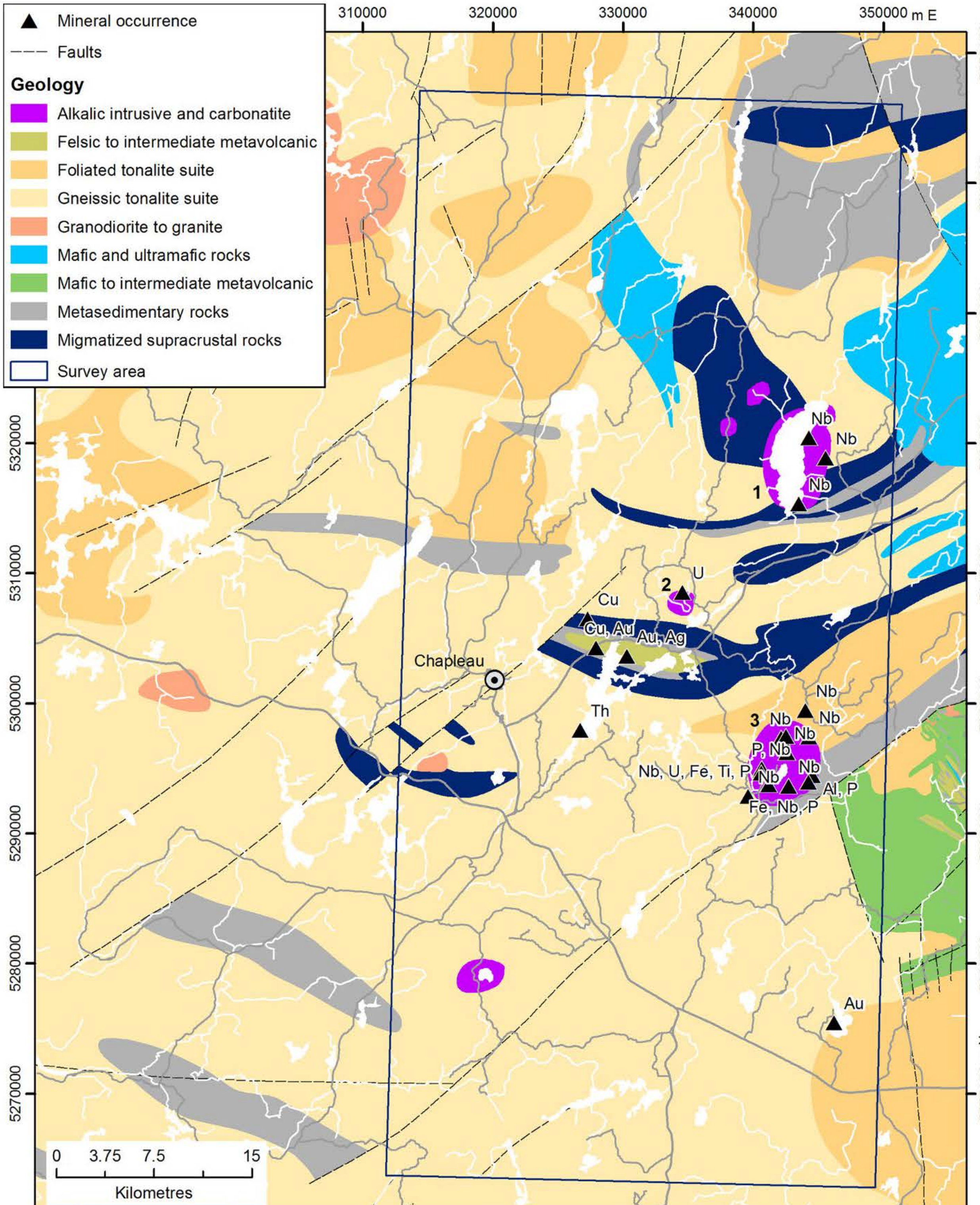

Figure 3. Bedrock geology of the Chapleau survey area and mineral occurrences (Ontario Geological Survey 2011, 2016). Location of alkalic-carbonatite complexes are numbered on the map: **1.** Nemegosenda Lake alkalic complex; **2.** Borden Township carbonatite complex; and **3.** Lackner Lake alkalic complex (Sage 1992).

compactness and fissility, attesting to a subglacial origin for the deposit. It contains sand lenses and stringers, suggesting its deposition as a subglacial meltout till. On the whole, the till is texturally similar and probably correlative to the Matheson Till of the Timmins and Cochrane regions that was deposited during the height of the Late Wisconsinan (Hughes 1965; Veillette 2007; Veillette and Thibaudeau 2007; Gao 2013a, 2013b).

The till matrix, in general, is noncalcareous and does not react to 10% hydrochloric acid (HCl). However, locally, calcareous till exists in the hummocky ground moraine with a matrix that reacts strongly to 10% HCl (Photo 1). These 2 types of tills are texturally indistinguishable based on visual observations. Because of the lack of well-exposed sections, it is unclear whether or not a significant hiatus or disconformity exists between them for stratigraphic studies. While its stratigraphic significance remains unknown, the calcareous till may be explained as rafts of undiluted calcareous till incorporated into the ice sheet from a source area probably located in the Hudson Bay Lowlands and englacially transported to the survey area as the ice sheet advanced southward.

Numerous eskers traverse the survey area in a direction parallel more or less to the south-southwestward regional ice-flow direction (*see* Figure 4). The eskers contain, in general, gravelly deposits and are covered by glaciolacustrine sand ranging from 1 m to over 10 m in thickness. In the southwestern part of the survey area, a bedrock upland occurs, which controlled the routing of subglacial meltwater. There, the meltwater was deflected eastward along the eastern edge of this bedrock upland, and resulted in the formation of eskers that trend to the south-southeast.

A prominent southeast-trending recessional end moraine, referred to by Boissonneau (1968) as the Chapleau II moraine, transects the survey area and extends both eastward and westward into adjacent

Photo 1. Till deposits exposed in a wayside pit in a ridge of hummocky ground moraine. The till to the left of the dashed line is noncalcareous, which is typical for the study area. The greyish till to the right of the dashed line, which forms the core of the ridge, appears similar in lithology and texture, but it is calcareous and reacts strongly with 10% HCl (the material in the ridge top above the greyish till has been removed). Whether or not it is part of an earlier till formation or merely represents localized material within the glacial system remains undetermined. Note the person on top of the ridge for scale.

regions (Roed and Hallett 1979; Bernier 1998b). The numerous eskers that terminate at this moraine, may have acted as meltwater conduits through which subglacial debris was transported to the ice margin and deposited as sand and gravel with occasional till. Some large eskers appear to extend south of the moraine, suggesting the presence of well-developed subglacial drainage systems, predating the formation of the moraine. The timing for the development of the moraine is estimated to be around 10 000 ^{14}C years before present (BP), based on the regional moraine stratigraphy (Barnett 1992; Dyke 2004). The majority of the moraine likely accumulated in a large proglacial lake, referred to as Lake Sultan by Boissonneau (1968). The moraine has a steep north-facing, ice-contact slope, the upper limit of which delineates the ridge of the moraine. To the south, the moraine grades into a flat glaciofluvial ramp or plain formed in Lake Sultan. The moraine crest has a consistent elevation of 460 to 470 m asl in the survey area. Today, this crest serves as the drainage divide between rivers flowing south to the Great Lakes and north to Hudson Bay.

The aforementioned glaciofluvial ramp or plain extends 3 to 4 km south of the moraine crest and is extensive laterally from northwest to southeast (70 km). It is veneered with glaciolacustrine sand and contains glaciofluvial sand and gravel deposits exceeding 20 m in thickness as indicated by water well records. The ramp is interpreted as a series of laterally-coalesced subaqueous fans formed by meltwater flowing from the ice sheet into Lake Sultan and its flat topography likely resulted from wave action on the lake floor. Presently, this ramp is informally referred to by the local residents as the "Sultan Sand Belt". Highway 667 and part of Highway 129 traverse it. Further to the south, the ramp grades into an extensive, flat and swampy glaciolacustrine plain.

The glaciolacustrine sand of Lake Sultan is extensive, in particular, in the southern part of the survey area (*see* Figure 4). In contrast, fine-grained glaciolacustrine material (i.e., silt and clay) is sparse. It was only observed at a single site in the survey area (Gao 2016a). The rarity of fine-grained glaciolacustrine material indicates a shallow lake probably no deeper than a few tens of metres under the influence of wave action. In addition, the sandy and bouldery till may have exerted some degree of control on the sandy facies of the glaciolacustrine deposits by providing ample material of this grain size to the lake. Glacial Lake Sultan had an outlet through a spillway along the Wenebegon River south of the map area (Boissonneau 1968). This outlet, which currently stands at about 460 m asl, likely controlled the level of the lake. At a locality near the southwestern boundary of the survey area (47.57033°N, 83.506738°W at 465 m asl), samples collected from the lower and upper parts of a 1.5 m thick section of nearshore sand on Precambrian bedrock for optically stimulated luminescence (OSL) dating, returned ages of 10.8±0.7 and 9.7±0.6 ka BP, respectively (Gao 2016b), which are consistent with the regional stratigraphy for the Chapleau II moraine and glacial Lake Sultan (Barnett 1992; Dyke 2004).

With further retreat to the north, the ice sheet became inactive again as indicated by a couple of short moraine crests near the northern tip of Borden Lake and a glaciofluvial subaqueous fan to the south (*see* Figure 4) (Gao 2016a). The subaqueous fan, which is pitted with kettle holes and lakes of kettle-hole origin, is mantled with glaciolacustrine sand and has a flat to gently rolling topography. It contains glaciofluvial sand and gravel with a thickness ranging from a few metres to more than 10 m as observed in gravel pits and as indicated by the depth of the ice-contact slopes of the kettle holes. To the south, the fan grades into a flat glaciolacustrine plain. The extensive glaciolacustrine sand was probably deposited in a later stage of Lake Sultan that migrated to the north with the retreat of the ice. Optically stimulated luminescence (OSL) dates for a 0.5 m thick section of nearshore sand overlying till in this region (47.751851°N, 83.134971°W at 442 m asl) returned ages of 9.9±0.6 and 10.2±0.6 ka BP (Gao 2016a), is comparable with the aforementioned OSL dates and confirms the presence of this lake following the withdrawal of the ice sheet from the Chapleau II moraine. Further to the north, the glaciolacustrine deposits become discontinuous (Lee and Scott 1980; Gao 2016c), indicating the probable development of isolated, small lakes or, alternatively, rapid withdrawal of the ice sheet from the map area without accumulation of thick glaciolacustrine sediments.

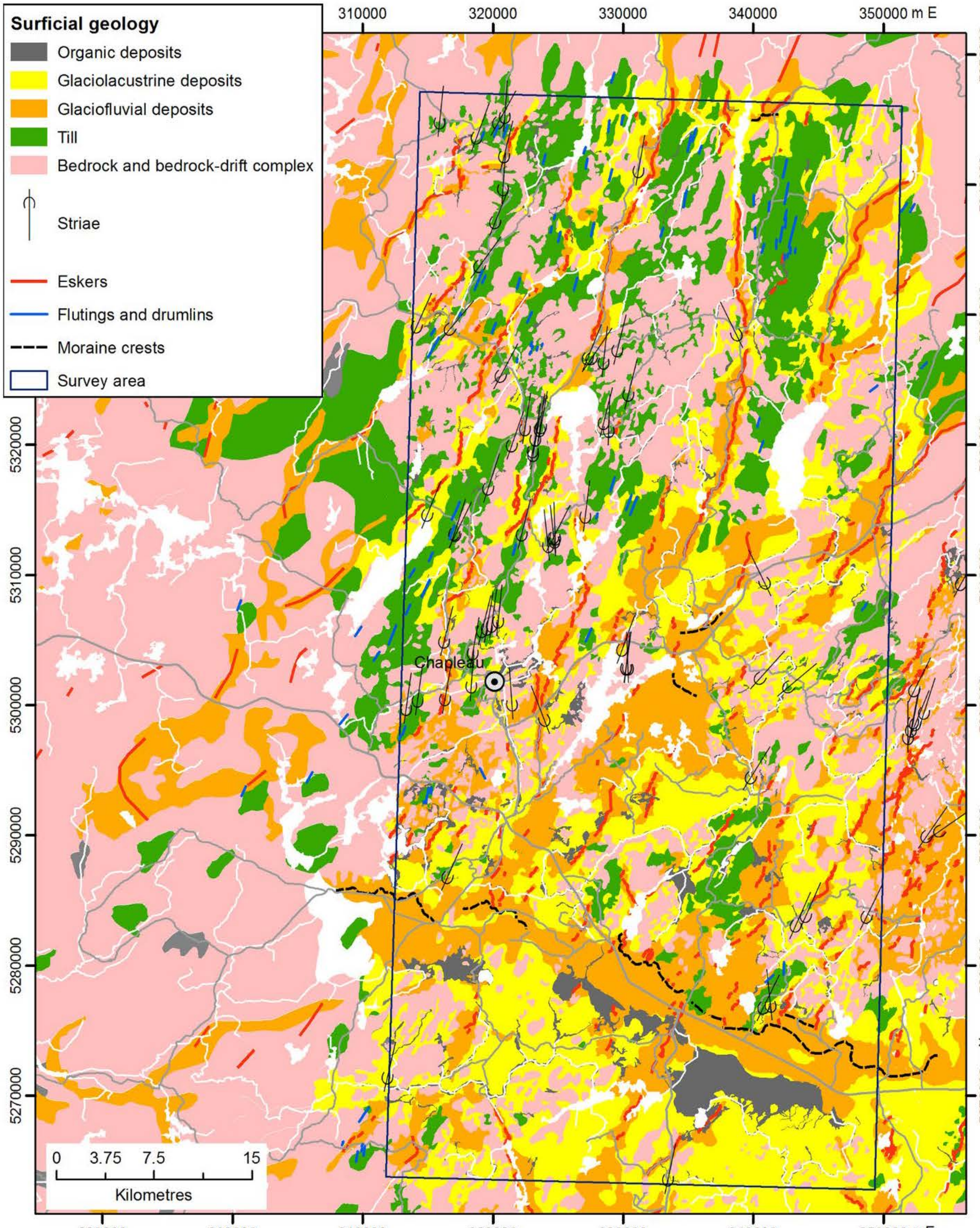

Figure 4. Quaternary geology of the Chapleau survey area, *from* Gao (2016a, 2016b, 2016c), Bernier (1998a, 1998b) and Ontario Geological Survey (1997).

Boissonneau (1968) referred to the latter moraine and much of the subaqueous fan together as the Chapleau I moraine and, on the basis of a change in ice-flow direction, he considered it to be older than the Chapleau II moraine that resulted from a subsequent ice readvance. The direction of striae measured in the field did not differ much from that in adjacent areas (Bernier 1998a; Gao 2016a, 2016b, 2016c), and therefore does not support his proposed moraine stratigraphy based on a change in ice-flow direction.

Postglacial deposits consist of eolian sand and peat. Parabolic eolian dunes of fine sand, with a relief up to a few metres, occur on the former glaciolacustrine sand plains, forming dune fields up to a few kilometres across. They probably developed by winds coming out of the west and northwest under arid conditions that existed during the early Holocene when the ground lacked dense vegetation following the retreat of the ice sheet and drainage of the glacial lakes. The dunes are now stabilized by forest. Peat accumulated in fens and bogs and along river floodplains with thicknesses ranging from 1 m to more than 3 m; usually water saturated; with fibrous texture; and containing fresh to partially decomposed wood fragments.

Previous Surficial Sampling

The Ontario Geological Survey (OGS) carried out a lake sediment geochemistry survey in the Foleyet–Missinaibi Lake area as part of the Operation Treasure Hunt (OTH) program in 1999 and the results on the <0.177 mm bulk sample geochemistry by ICP–MS and ICP–OES were released as Open File Report (OFR) 6014 and Miscellaneous Release—Data (MRD) 54 (Ontario Geological Survey 2000a, 2000b). The survey, although extensive in areal extent, only covered the northern part of the current survey area. Nonetheless, the results (391 samples) are useful to assist in the interpretation of the data generated from the current survey, in particular, the gold and uranium results.

Also under OTH, the OGS conducted stream sediment or modern alluvium sampling in 2000 using boats and helicopters for the recovery of indicator minerals, with a focus on kimberlites (diamonds) in a very broad region along the Kapuskasing Structural Zone. The results were released as OFR 6063 and MRD 82 and OFR6065 and MRD 83 for the Chapleau and Foleyet regions, respectively (Ontario Geological Survey 2001a-d). The surveys covered the area encompassed by the current sampling program. Of the 1052 samples from these previous surveys, 73 were in the current survey area. Using helicopter, the previous surveys were able to sample some inaccessible areas such as the Nemegosenda Lake alkalic complex, providing important additional information to the current survey. Results of the previous surveys showed low gold grain counts with background levels of ≤6 grains. Although the total kimberlite indictor mineral (KIM) grain counts are generally low, with combined pyrope garnet, Cr-diopside (chromium diopside) and Mg-ilmenite (magnesium ilmenite) counts not exceeding 2 grains, elevated KIMs (25 grains) were recovered from a single sample (KAP-0513) in the northwestern part of the current survey area. In addition, samples collected from the Nemegosenda Lake alkalic complex showed notably elevated numbers of REE-bearing minerals including bastnaesite, parasite and synchysite (Ontario Geological Survey 2001d).

Methods

The survey area was traversed using trucks and ATVs. Samples were mainly collected in sections exposed along the roads and in sand and gravel pits (Photo 2), resulting in an irregular sample grid (*see* Figure 2). With the exception of the Lackner Lake alkalic complex, no samples were collected on alkalic-carbonatite intrusions because of the lack of access. Apart from till, samples were obtained occasionally from glaciofluvial sand and gravel deposits in eskers and moraines. At each site, the material was screened to remove the fraction larger than 7 mm and 12 to 15 kg material was collected. Where possible,

Photo 2. Sampling sandy and stony till in a road ditch.

Photo 3. Sampling till immediately down ice of the discovery bedrock outcrop on the Borden Lake gold property. The samples collected at this site all contain elevated gold grain counts.

till samples were collected near the till–bedrock contact. At each of the sand and gravel pits visited, freshly exposed pit faces, if available, and piled cobbles and boulders discarded by pit operators were explored for kimberlite boulders. As a result, a kimberlite boulder and quite a few nonkimberlite boulders of mantle origin were collected. On the Borden Lake gold property, several till samples were collected, with 4 obtained immediately down ice of the discovery bedrock outcrop (Photo 3). Sample locations were determined using a global positioning system unit (Garmin GPSmap60Cx) and tabulated in Appendix 1 in Universal Transverse Mercator (UTM) projection and grid system, zone 17, North American Datum 1983 (NAD83).

HEAVY MINERALS

The samples collected in the field were processed by Overburden Drilling Management Limited (ODM) in Nepean, Ontario to extract heavy mineral concentrates and count kimberlite indicator mineral (KIM), gold, platinum group mineral (PGE) and metamorphic/magmatic massive sulphide indicator mineral (MMSIM®[1]) grains. In the laboratory, each sample was wet-sieved to remove the >2 mm fraction, and the <2 mm fraction was subjected to gravity tabling for initial separation of a table concentrate. Appendix 2 summarizes the weight distribution and other features of the clasts (>2 mm) and matrix (<2 mm) obtained from the tabling phase.

During the tabling phase, gold grains were counted under a large magnifying glass. If gold grains were observed during this stage, the <0.25 mm table concentrate was micropanned to refine the gold grain counts. The size and shape of gold grains, e.g., pristine, modified and reshaped, were determined and recorded at this stage. Most of the gold grains recovered were in the size range of 0.015 to 0.05 mm (silt). Appendixes 3 and 4 provide a summary of the gold grain counts and details on gold grain shapes and sizes, respectively. At this stage, PGE sulphide grains, if present, were also counted.

The table concentrate underwent further separation using density-dependent settling in methylene iodide, a heavy liquid with a specific gravity of 3.2. Ferromagnetic mineral grains were removed from the resultant heavy mineral concentrate using an automagnet. The nonferromagnetic heavy mineral concentrate was sieved into 0.25 to 0.5 mm, 0.5 to 1.0 mm and 1.0 to 2.0 mm fractions, with the <0.25 mm fraction archived for future use (Appendixes 5 and 6). Under a binocular microscope, indicator minerals in each size fraction were counted on the basis of their physical properties including colour, grain morphology and the presence of adhering kimberlite matrix material. Minerals counted or picked include reddish pyrope garnet, apple green chromium diopside (Cr-diopside, a pyroxene), black magnesium ilmenite (Mg-ilmenite), chromite, yellowish to light-coloured forsterite (olivine) grains, and as well MMSIM® grains (0.25 to 0.5 mm fraction only). During this process, some of the picked indicator minerals such as pyrope garnet, gahnite and brockite were examined using a scanning electron microscope (SEM) to verify their identity. Appendixes 7 and 8 summarize the KIM grain counts and picking remarks and Appendix 9 provides summary remarks on the picked grains for electron probe microanalyzer ("microprobe") analysis.

Microprobe analysis of the picked KIM and MMSIM® grains was conducted at the Geoscience Laboratories (Geo Labs) of Ontario Geological Survey in Sudbury, Ontario to determine their geochemical compositions (Appendix 10). The geochemical compositions are used to classify the KIM grains, e.g., garnets and chromite, and to evaluate the potential for diamonds of the source rocks. Based on the results of the microprobe analysis, some of the KIM grains were reclassified and, consequently, the original data set of KIMs was adjusted to incorporate such changes in classification (Appendix 11). As well, kimberlite indicator minerals were picked from disintegrated material of a kimberlite boulder (Appendix 12) and were subsequently microprobed for geochemical composition (Appendix 13). The

[1] MMSIM is a registered trademark of Overburden Drilling Management Limited, Nepean Ontario

nonkimberlite boulders of mantle origin are described in Appendix 14 and their heavy mineral data provided in Appendix 15. Appendixes 16 and 17 provide information on MMSIM® grains and are numerically converted grain counts and Appendix 18 summarizes PGM sulphide grain counts.

BULK SAMPLE GEOCHEMISTRY

The samples collected in the field were subsampled in the laboratory to obtain 1 kg material for bulk sample geochemical analysis. The <0.063 mm fraction of the subsamples was analyzed using ICP–MS, ICP–OES and instrumental neutron activation analysis (INAA) methods. Some of the glaciofluvial sand and gravel samples do not contain such fine fraction material. As a result, not all the glaciofluvial samples were analyzed for bulk sample geochemistry. Geochemical signatures are influenced by redox conditions and particle size of the sediments. During weathering, some elements from the breakdown of minerals such as chalcophiles may be mobilized in solution and readsorbed by clay minerals or reconstituted into secondary oxides and hydroxides or reprecipitated as small aggregates (Shilts and Kettles 1990; McMartin and McClenaghan 2001). Analysis of the fine fraction can therefore increase the geochemical contrast between background and anomaly.

The ICP–MS and ICP–OES determinations, which require 0.5 g of material in total, were undertaken following a standard aqua regia partial digestion of the samples at the Geo Labs. The INAA, which requires 30 g of material, was carried out by Becquerel Laboratories in Mississauga, Ontario. During sample preparation, blind duplicates and both certified (Till-1) and noncertified reference material (MCM-1) were inserted into the sample batches for submission. Each of the analytical methods provided simultaneous determinations of multiple elements (Appendix 19). Appendixes 20 and 21 summarize the duplicate and reference material quality-control (QC) data sets.

Gold Grain Data

RESULTS

Gold grain counts are low in most of the samples (<6 grains) (Appendixes 3 and 4), consistent with the results of the previous stream sediment sampling in this region (Figure 5) (Ontario Geological Survey 2001b, 2001d). However, anomalous gold grain counts of 14 to 33 were recovered in 2 areas and from a single sample in the survey area (*see* Figure 5; Table 1). Area 1 is located on the Borden Lake property where gold mineralization is known and Area 2 on Island Lake Road in the southern part of the survey area. A single sample (14-CG-226) collected on Lafrenière Road about 2.5 km northwest of Racine Lake returned anomalous gold grain counts (*see* Figure 5).

In Area 1, 8 samples were collected on the Borden Lake property and all but one returned anomalous gold grain counts ranging from 14 to 33 (Figure 6). Among them, 4 samples were collected immediately down ice of the discovery bedrock outcrop where gold occurrence was first noted (*see* Photo 3) and they contained 19 to 28 gold grains (*see* Table 1). Sample 13-CG-514, located about 600 m southeast of the discovery outcrop had the highest grain count (33 grains) of the survey (*see* Figure 6; Table 1). The anomalous gold grain counts on the Borden Lake property demonstrate the effective use of drift prospecting principles for gold exploration in the region. It is noteworthy that samples 14-CG-222 and 13-CG-520 at Highway 101 where 19 and 14 gold grains were recovered, respectively, are outside the current mineral exploration which is confined to the area south of this highway on the property (*see* Figure 6). The anomalous gold grain counts in these 2 samples thus suggest good potential for

Table 1. Summary of samples containing more than 10 gold grains.

Sample Number	Total	Reshaped	Modified	Pristine	Material sampled	Underlying bedrock	Location	Ice-flow direction**
13-CG-514	33	16	9	8	Till	Felsic gneiss rocks	Borden Lake	184° to 200°
14-CG-226	29	13	13	3	Till	Tonalite to granodiorite	Lafrenière Road	190° to 208°
14-CG-224*	28	15	8	5	Till	Felsic gneiss rocks	Borden Lake	184° to 200°
16-CG-004	23	22	0	1	Till	Gneissic tonalite	Sheppard & Morse Road	204° to 192°
14-CG-223*	21	12	5	4	Till	Felsic gneiss rocks	Borden Lake	184° to 200°
13-CG-493*	20	12	5	3	Till	Felsic gneiss rocks	Borden Lake	184° to 200°
13-CG-495*	19	8	7	4	Till	Felsic gneiss rocks	Borden Lake	184° to 200°
14-CG-222	19	12	4	3	Till	Felsic gneiss rocks	Borden Lake	184° to 200°
13-CG-520	14	12	2	0	Till	Felsic gneiss rocks	Borden Lake	184° to 200°
11-CG-029	11	9	2	0	Till	Gneissic tonalite	Camp 16 Road	206° to 174°
14-CG-861	11	11	0	0	Glaciofluvial sand and gravel	Paragneiss and migmatite metasedimentary rocks	Raptor Road	204° to 212°
11-CG-058	10	10	0	0	Till	Gneissic tonalite	Sheppard & Morse Road	204° to 192°
11-CG-072	10	10	0	0	Till	Gneissic tonalite	Nemegos Road	212° to 174°
11-CG-127	10	10	0	0	Till	Mafic to intermediate metavolcanic rocks	Raptor Road	212° to 206°

** Samples collected immediately down ice of the discovery bedrock outcrop on the Borden Lake property of gold deposit*
*** Inferred from nearby striae*

additional gold mineralization in the up-ice direction north of Highway 101 where exploration has been limited.

Area 2 is located on Sheppard and Morse Road where 10 and 23 gold grains were recovered from 2 closely spaced till samples (11-CG-058 and 16-CG-004) (*see* Figure 5). The gold grain counts in these 2 samples are comparable to those recovered from the Borden Lake property (*see* Table 1), which suggests potential for gold mineralization somewhere to the north-northeast of the sample sites in the up-ice direction.

On Lafrenière Road, 29 gold grains were recovered from sample 14-CG-226 (Figure 7; *see* Table 1). In early June of 2016, attempts were made to resample this site. However, the original location on the floor of the road ditch could not be reached because of the high water table. Instead, 3 till samples were collected about 20 m east of the original site at a shallower depth (about 1 to 1.5 m shallower than the original location). None of these samples returned anomalous gold grain counts (Figure 7; Appendix 3). The immediate adjacent area is covered with a thin layer of glaciolacustrine sand. Present at the base of the sand is a poorly sorted, loose, sandy material mixed with pebbles and mud, interpreted as reworked till resulting from lake-wave washing. Samples obtained from this material at 2 sites in the up-ice direction (northeast) yielded insignificant numbers of gold grains (*see* Figure 7; Appendix 3). The poor

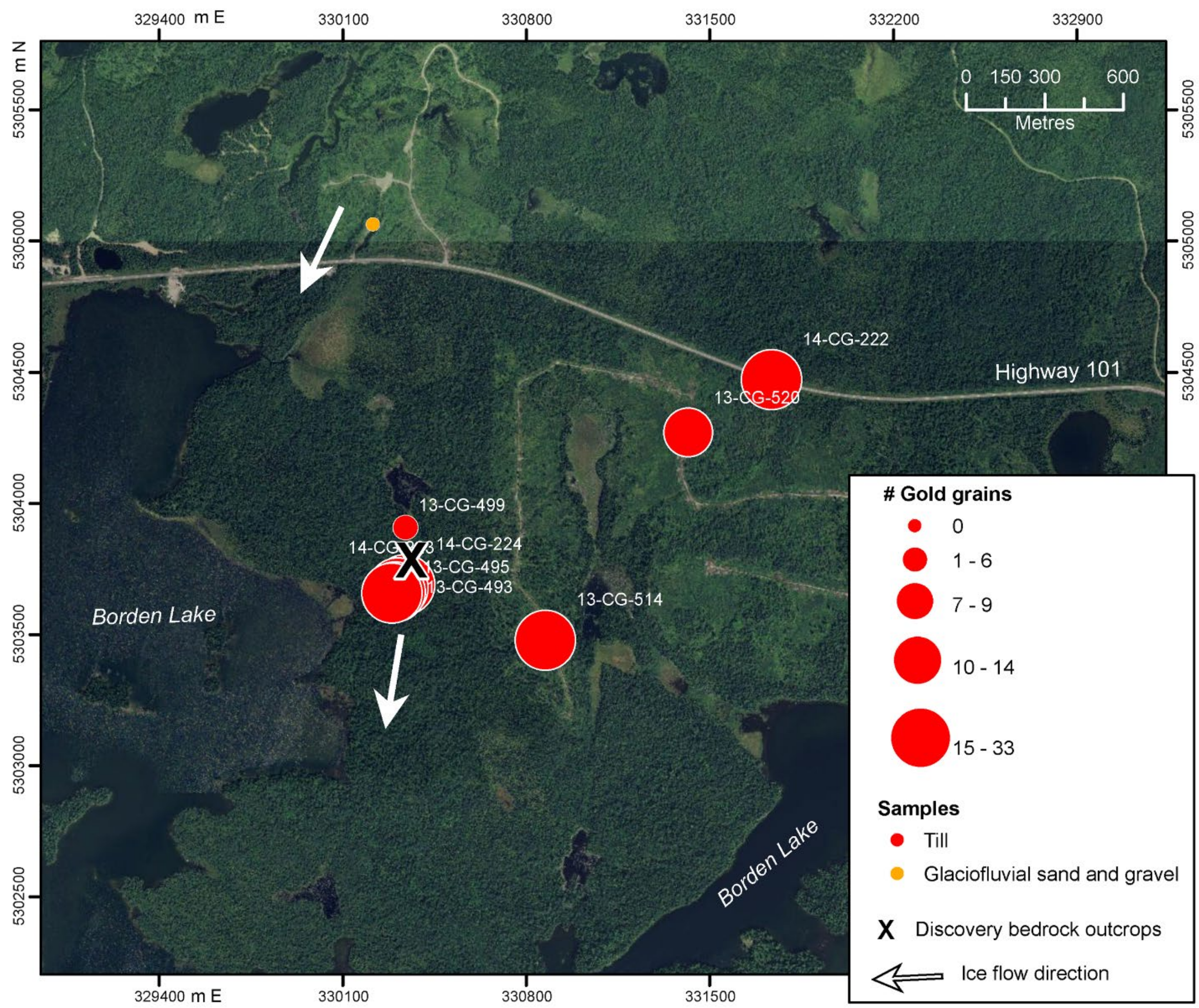

Figure 6. Gold grain distribution on the Borden Lake property. Aerial photograph *from* the Ontario Ministry of Natural Resources and Forestry (2007–2009).

reproducibility of the results may be attributed to purely technical constraints encountered during the resampling or, alternatively, to a single, long-range transported and weathered clast that contains gold. As such, additional sampling is recommended to better understand the significance of the original anomaly.

The aforementioned anomalous samples all contain high proportions of reshaped gold grains (*see* Table 1). This would suggest a prolonged and complex transport history. However, gold grains recovered from the samples collected immediately down ice of the discovery bedrock outcrop on the Borden Lake property are dominated by reshaped and modified grains, with only a few pristine gold grains present (*see* Table 1). For instance, sample 14-CG-224, collected just a couple of meters down ice of the discovery bedrock outcrop, returned a total of 28 gold grains but only 5 of them were pristine, with the rest being reshaped (15) and modified (8). This suggests that gold grains in glaciers can be modified and reshaped rapidly down ice from their source areas without long-range transport.

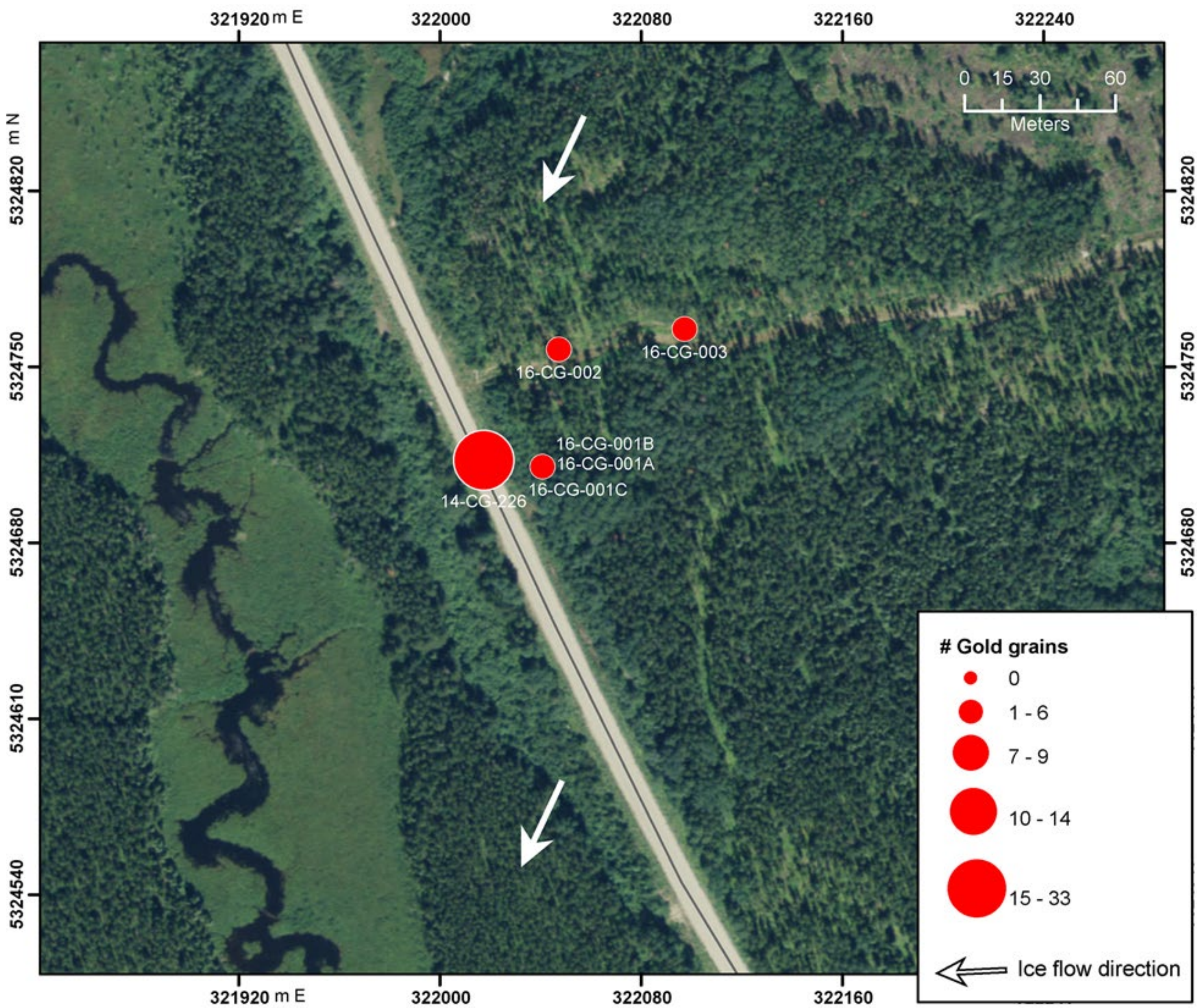

Figure 7. Gold grain distribution at site 14-CG-226 on Lafrenière Road. Aerial photograph *from* the Ontario Ministry of Natural Resources and Forestry (2007–2009).

Kimberlite Indicator Minerals

Kimberlite is the primary host rock for natural diamonds. During volcanic eruptions, kimberlitic magmas, often originating greater than 150 km below the Earth's surface, entrain various xenoliths including diamonds from the upper mantle and transport them to the surface. The most important source rocks for diamonds are peridotite and certain eclogitic rocks in the upper mantle. Harzburgite, lherzolite and wehrlite are the most common types of peridotite. Garnet harzburgite is the dominant source for diamonds, followed by chromite harzburgite and lherzolite.

Kimberlite indicator minerals (KIMs) are a unique group of heavy minerals with distinct physical and geochemical properties that can be isolated with relative ease from minerals of other origins. They often coexist with diamonds in the upper mantle and are far more abundant than diamonds. Therefore, in exploration, focus is placed on the recovery of the indicator minerals rather than diamonds. The kimberlite indicator minerals include, apart from diamond, pyrope garnet, chromite, Mg-ilmenite (picroilmenite), Cr-diopside (pyroxene) and forsterite (olivine), derived from both xenoliths of mantle and kimberlite magmas.

Indicator minerals from the xenoliths of upper mantle rocks include diamond, peridotitic and eclogitic pyrope garnets, chromite and Cr-diopside. Because they frequently coexist with diamonds, their presence can be used to evaluate the source rocks for diamond potential. Those minerals derived from kimberlite magmas include Mg-ilmenite and titanian pyrope garnet. Commonly, they are large in size and often referred to as megacrysts. It is believed that these crystals are precipitated from protokimberlitic melts at mantle depths (Mitchell 1986). Although the megacrysts cannot be directly used to evaluate the source rocks for diamond potential, they are important indicator minerals for kimberlite pipes.

GARNET

Garnets of purple to red wine colour are generally of a peridotitic origin, whereas the orange colour variety are eclogitic and megacrystic (Averill 1999). These 2 groups of garnets are coded in the laboratory as GP and GO, respectively (Appendixes 7 and 8). In a recent classification of garnets, GP and GO garnets also include those of pyroxenitic origin (Grütter et al. 2004).

A total of 24 GP and GO grains were isolated (Appendix 7), of which 23 were microprobed for major oxide compositions (Appendix 10). From the analysis of their compositions, as proposed by Grütter et al. (2004), the garnets were classified into harzburgitic G10, lherzolitic G9, wehrlitic G12, metasomatized peridotitic G11, eclogitic G3, megacrystic G1, and pyroxenitic G4 and G5 (Table 2; Figures 8 and 9). In the classification scheme, there is some overlap in the compositions between G9 and G5; and as well between G3 and G4 garnets. Apart from eclogitic and megacrystic G3 and G1, GO also includes G4 and G5. In addition, 13 almandine garnets and 2 spinel grains were analysed and 10 were reclassified as G9 garnets (Table 3).

The resultant garnet counts have a maximum number of 1 and 3 for GP and GO, respectively, per 10 kg sample (proportional dot plots in Figures 10 and 11; Appendix 11). The yields of GP and GO (>100 grains) in samples from the known Attawapiskat River and Cobalt–New Liskeard kimberlite fields in northern Ontario (Reid 2002; Crabtree 2003; Gao 2012a) are high in comparison to the GP and GO grain counts in this survey, which are low, and consistent with the previous alluvium sampling that showed a maximum number of 3 grains for either GP or GO in the samples (Ontario Geological Survey 2001b, 2001d).

Table 2. Classification scheme for garnets; oxide concentrations in weight % (Grütter et al. 2004).

Garnets	Cr_2O_3	CaO	TiO_2	MgO	CA_INT*	MgNum**
G1 Megacrystic	0 to <4		≥2.13-2.1MgNum; <4		≥3.375 to <6	≥0.65 to <0.85
G3 Eclogitic	0 to <1	≥6 to <32	<2.13-2.1MgNum; <2			≥0.17 to <0.86
G4 Pyroxenitic	<1		<2.13-2.1MgNum			≥0.3 to <0.9
G5 Pyroxenitic	≥1 to <4	≥2 to <6	<2.13-2.1MgNum		≥3.375 to <5.4	≥0.3 to <0.7
G9 Lherzolitic	≥1 to <20				≥3.375 to <5.4	≥0.7 to <0.9
G10 Harzburgitic	≥1 to <22				<3.375	<0.95
G11 Peridotitic, metasomatised	≥1 to <20	<28	≥2.13-2.1MgNum; <4		≥3	≥0.65 to <0.9
G12 Wehrlitic	≥1 to <20	<28		>5	>5.4	

**Ca_INT (garnet Ca_intercept value): If CaO ≤ 3.375+0.25Cr_2O_3, then Ca_INT=13.5CaO/(Cr_2O_3+13.5); else Ca_INT=CaO-0.25Cr_2O_3*
***MgNum=(MgO/40.3)/(MgO/40.3+FeO_t/71.85)*

Table 3. Results (statistical summary) of microprobed garnets including GP, GO, almandine and spinel grains.

GP grains analyzed						
Total	**G11**	**G9**	**G4**	**G3**	**G1**	**Other (Crustal)**
15	2	11	0	0	1	1
	GP	GO	Other			
	13	1	1			
GO grains analyzed						
Total	**G11**	**G9**	**G4**	**G3**	**G1**	**Other (Crustal)**
8	0	0	2	3	2	1
	GP	**GO**	**Other**			
	0	7	1			
Almandine grains analyzed						
Total	**G11**	**G9**	**G4**	**G3**	**G1**	**Other (Crustal)**
13	0	0	4	5	0	4
	GP	**GO**	**Other**			
	0	9	4			
Spinel grains analyzed						
Total	**G11**	**G9**	**G4**	**G3**	**G1**	**Other (Crustal)**
2	0	0	1	0	0	1
	GP	**GO**	**Other**			
	0	1	1			

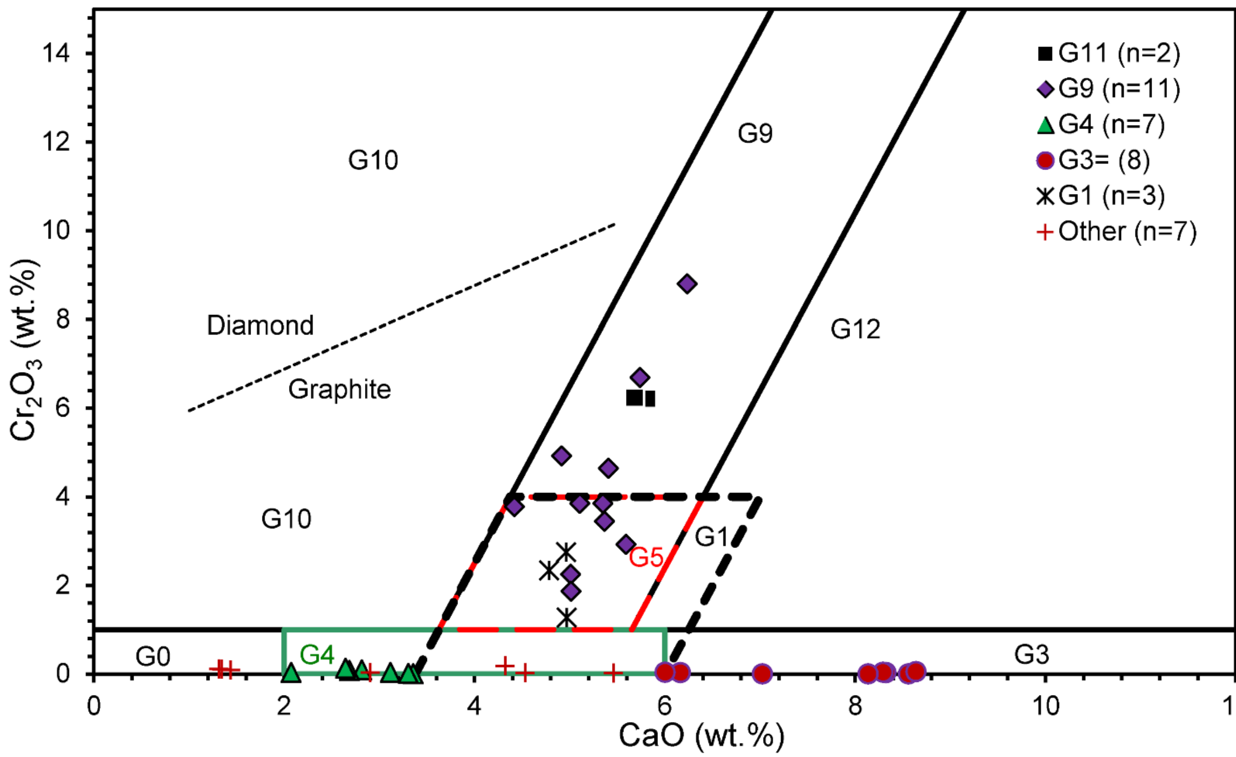

Figure 8. Compositional plot of CaO versus Cr_2O_3 for pyrope garnet grains, classification *after* Grütter et al. 2004.

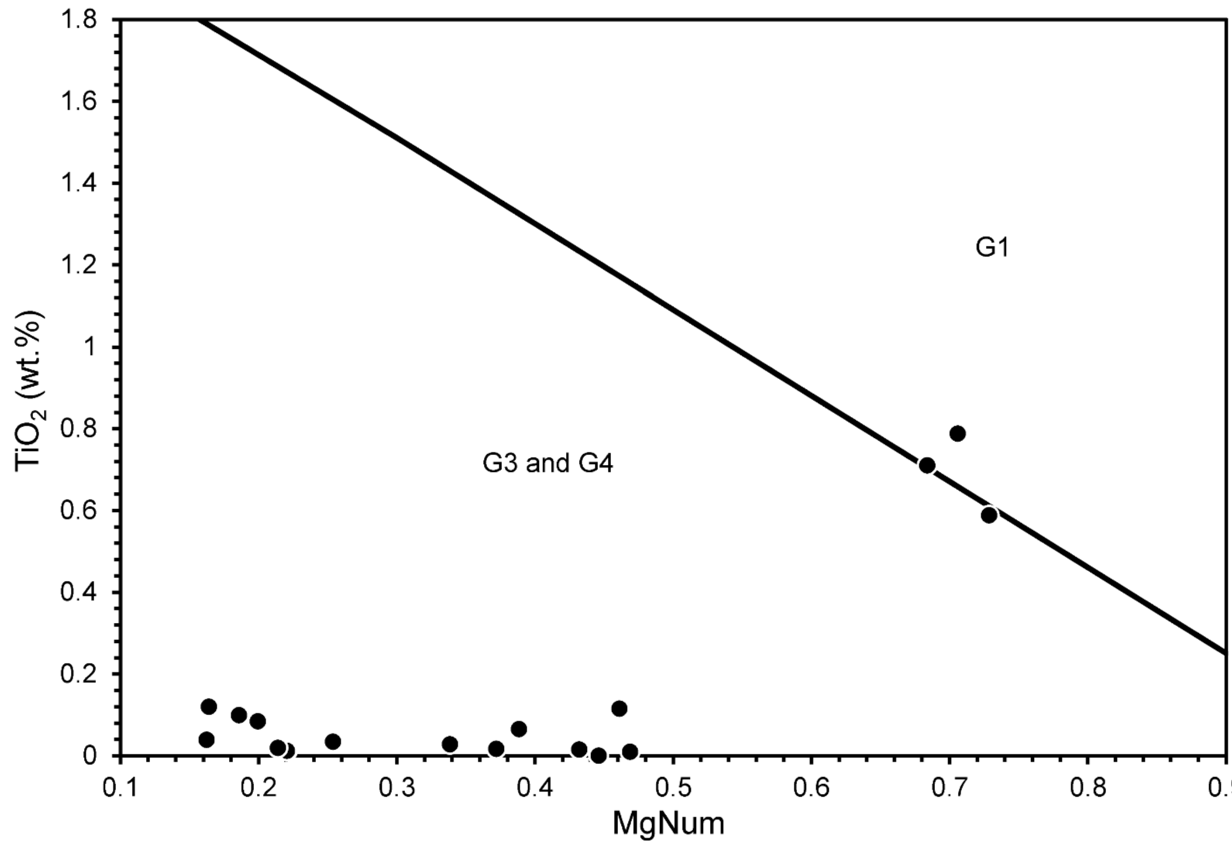

Figure 9. Compositional plot of MgNum versus TiO_2 for megacrystic, eclogitic and pyroxenitic garnet grains, classification *after* Grütter et al. 2004. MgNum=(MgO/40.3)/(MgO/40.3+FeO_t/71.85).

MG-ILMENITE

Ilmenite grains derived from kimberlite are typically enriched in MgO and Cr_2O_3 with concentrations greater than 4 and 0.11 weight %, respectively (as picroilmenite) (Mitchell 1986; Schulze 2003). Those from crustal sources are, in general, depleted in chromium and have concentrations of MgO less than 4 weight % (Figure 12). Approximately 80 Mg-ilmenite grains were recovered from the samples (Appendix 7). Of 51 grains analyzed, 41 were confirmed to be kimberlitic, with the rest being reclassified as either crustal ilmenite or other types of minerals (Table 4). Crustal ilmenite grains were also picked from the heavy mineral concentrates. Of 47 such grains analyzed, 2 were reclassified as kimberlitic (*see* Table 4).

Using the microprobe data, the Mg-ilmenite grain counts were adjusted to incorporate the changes in mineral reclassification (Appendix 11). Although they are low in number, with most samples containing just a few grains, approximately 60 Mg-ilmenite grains were recovered from sample 11-CG-127 near the eastern boundary of the survey area (Figure 13). It is notable that no other KIMs, e.g., pyrope garnets, were recovered from this sample. In the northwest of the survey area, the previous alluvium sampling documented a site where 25 grains of Mg-ilmenite were recovered from sample KAP-0513 (*see* Figure 13) (Ontario Geological Survey 2001d).

CHROMITE

Chromite harzburgite is an important host rock for diamonds. Chromite grains occur in mafic to ultramafic rocks; however, those with a kimberlitic origin often have elevated concentrations of Cr_2O_3 and MgO (Griffin et al. 1994; Fipke, Gurney and Moore 1995). Chromite grains in diamond inclusion and intergrowth fields typically have Cr_2O_3 and MgO greater than 60 and 9 weight %, respectively (Fipke, Gurney and Moore 1995). Using these variables, such grains can be isolated from chromites of other origins (Figure 14). In addition, Fipke, Gurney and Moore (1995) used concentrations of Cr_2O_3 and TiO_2 to further classify chromites into a diamond inclusion and intergrowth field, a field unique to kimberlites and lamproites, a nonkimberlitic/lamproitic field and an overlap field (Figure 15). However, recent studies show that some of the mineral grains derived from chromite deposits in the McFaulds Lake ("Ring of Fire") area of northern Ontario were located in the diamond inclusion and intergrowth field of the TiO_2 versus Cr_2O_3 compositional plot (Gao and Crabtree 2016). This calls for caution when using this scheme to differentiate kimberlitic chromite grains from those of nonkimberlite origins.

The total number of chromite grains were plotted on a dot map and those in the fields of diamond intergrowths and inclusions were highlighted with underlined sample numbers (Figure 16; Table 5). Till samples 13-CG-045 and 16-CG-002 have the highest chromite grain counts (11) per 10 kg sample in the survey area. However, most of the sites with high chromite grain counts (>5) were found in glaciofluvial sand and gravel samples, likely caused by glaciofluvial sorting and enrichment (Appendix 11). Abundant chromite grains were previously reported from alluvium sample KAP-0513 in the northwestern part of the survey area (Ontario Geological Survey 2001d). Notably, a couple of till samples collected nearby also showed elevated chromite grain counts (*see* Figure 16). As discussed above, this alluvium sample also yielded an elevated Mg-ilmenite grain count (*see* Figure 13). This concurrence of the 2 anomalies would suggest that the chromite grains recovered from this sample are probably of kimberlitic origin.

Table 4. Results (statistical summary) of microprobed chromite and ilmenite grains.

Mg-ilmenite grains analyzed					
Total	**Mg-ilmenite**	**Crustal ilmenite**	**Chromite**	**Other**	
51	41	8	1	1	
	%Mg-ilmenite	**%Crustal ilmenite**	**%Chromite**	**%Other**	**%Total**
	80.4	15.7	2.0	2.0	100
Crustal ilmenite grains analyzed					
Total	**Crustal ilmenite**	**Mg-ilmenite**	**Chromite**	**Other**	
47	43	2	0	2	
	%Crustal ilmenite	**%Mg-ilmenite**	**%Chromite**	**%Other**	**%Total**
	91.5	4.3	0	4.3	100
CR grains analyzed					
Total	**Chromite**	**Mg-ilmenite**	**Crustal ilmenite**	**Other**	
258	233	3	21	1	
	%Chromite	**%Mg-ilmenite**	**%Crustal ilmenite**	**%Other**	**%Total**
	90.3	1.2	8.1	0.4	100
Cr-spinel grains analyzed					
Total	**Chromite**	**Mg-ilmenite**	**Crustal ilmenite**	**Other**	
1	1	0	0	0	

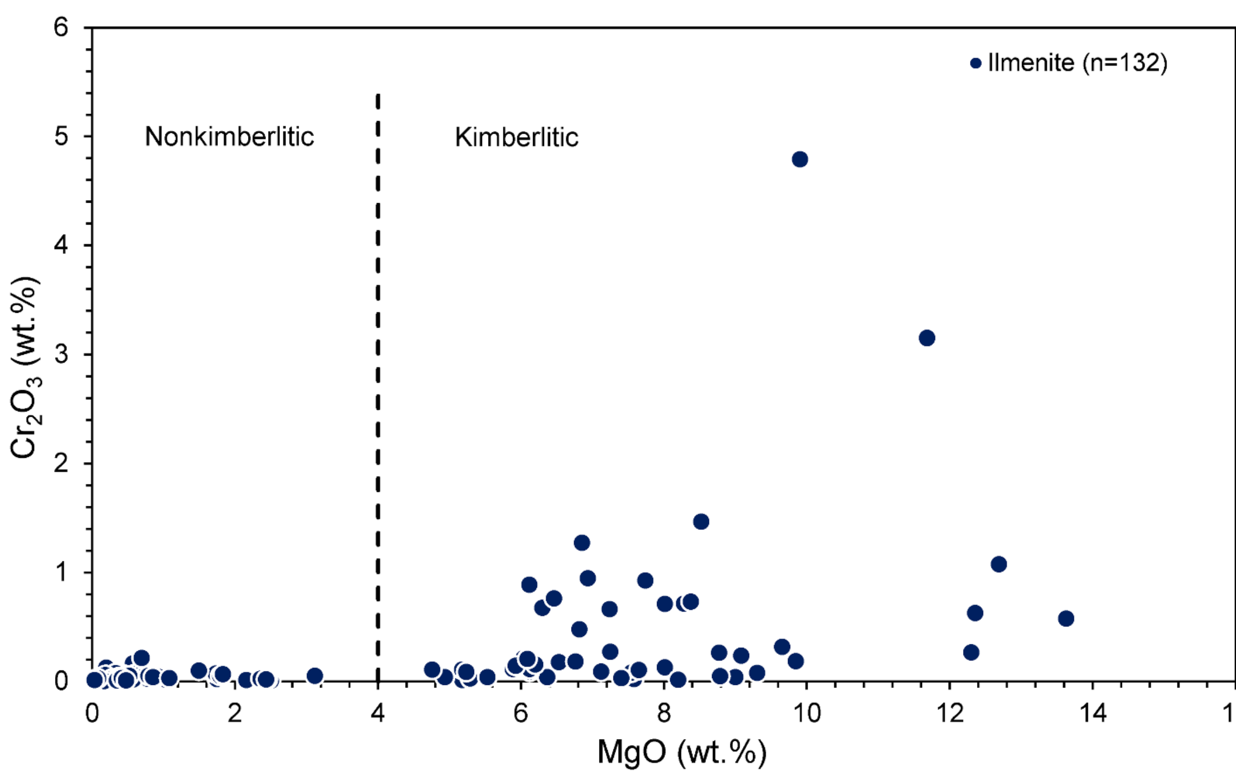

Figure 12. Compositional plot of MgO versus Cr_2O_3 for ilmenite grains.

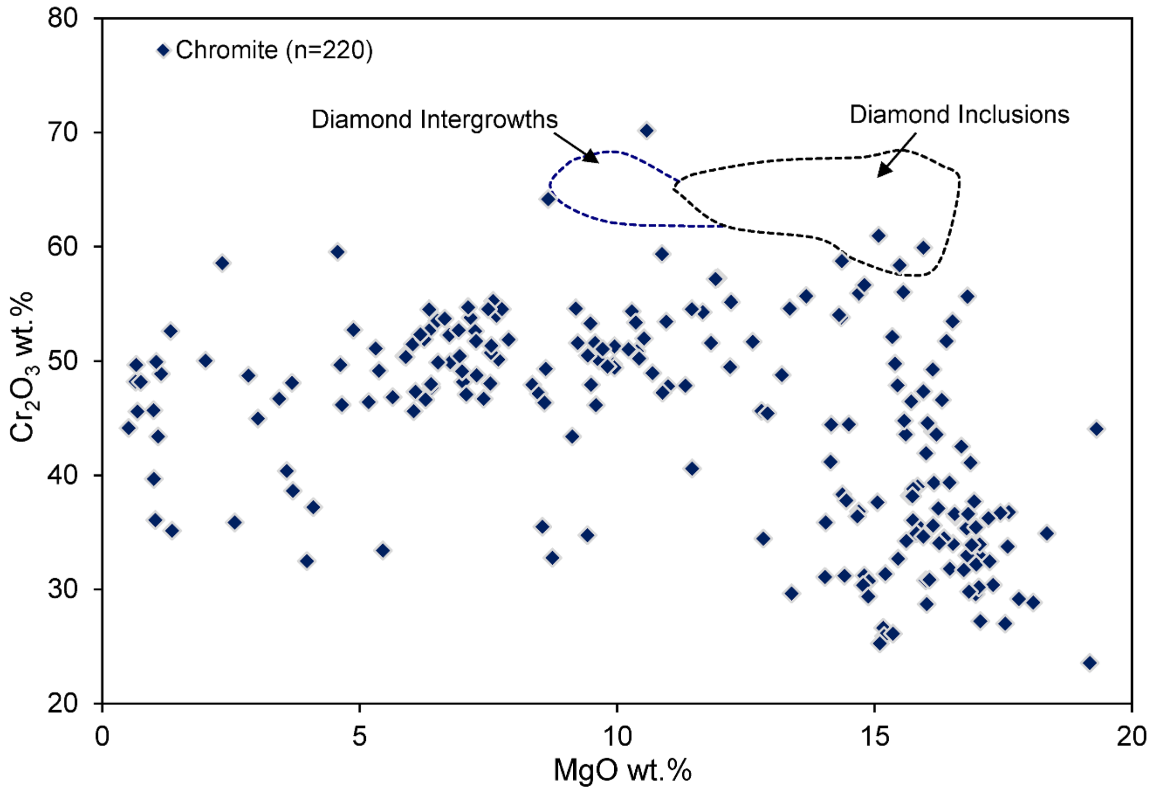

Figure 14. Compositional plot of MgO versus Cr_2O_3 for chromite grains, classification *after* Fipke, Gurney and Moore (1995).

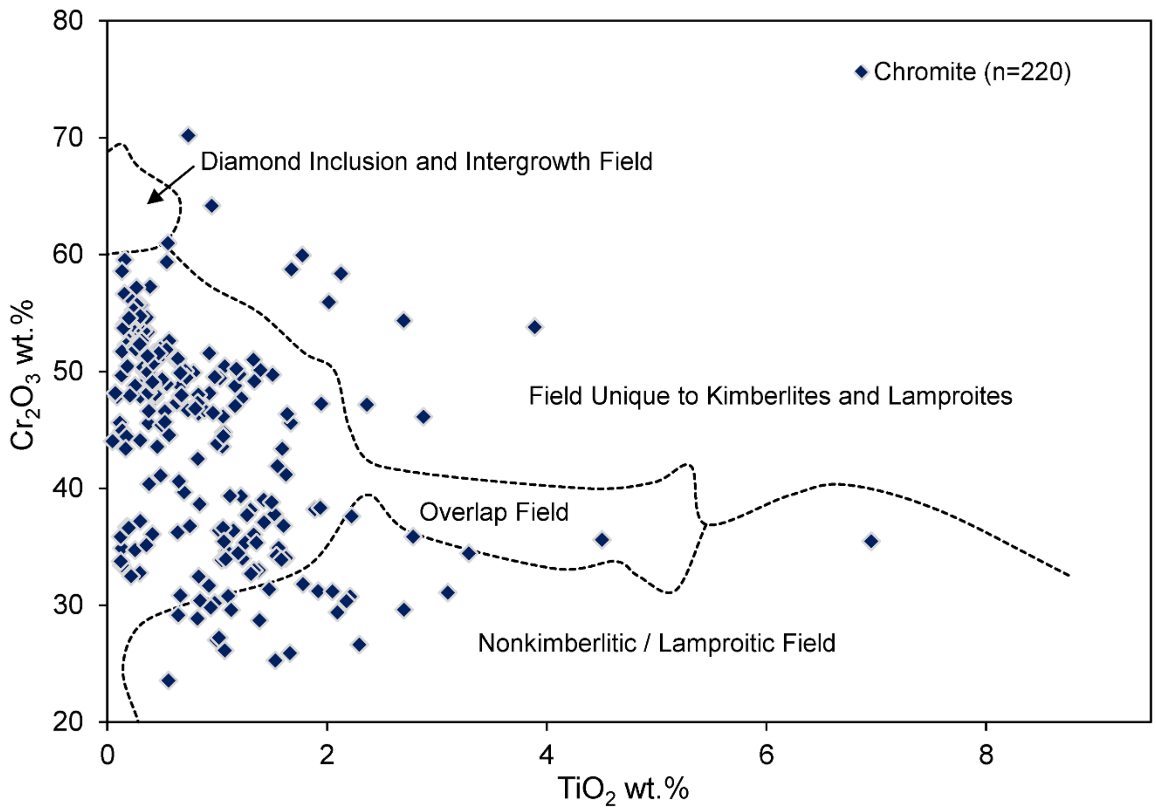

Figure 15. Compositional plot of TiO_2 versus Cr_2O_3 for chromite grains, classification *after* Fipke, Gurney and Moore (1995).

Table 5. Geochemistry (in weight %) of chromite grains classified into the diamond and intergrowth field (*see* Figure 14).

Sample Number	Sample Label	Sampling media	SiO_2	TiO_2	Al_2O_3	V_2O_3	Cr_2O_3	MgO	MnO	FeO_t	CoO	NiO	ZnO	Total
11-CG-334	11-CG-334-004	Glaciofluvial	0.16	1.78	8.08	0.12	59.90	15.95	0.14	12.98	0.02	0.16	0.03	99
11-CG-407A	11-CG-407A-003	Till	0.07	0.55	10.29	0.15	60.93	15.08	0.17	12.57	0.02	0.12	0.06	100
14-CG-938	14-CG-938-002	Glaciofluvial	0.20	2.13	9.29	0.19	58.35	15.49	0.16	13.98	0.03	0.16	0.04	100

**FeO_t: total iron expressed as FeO*

CR-DIOPSIDE

Chromium diopside, Cr-diopside, grains have a bright apple green colour and are easily isolated from heavy mineral concentrates. This clinopyroxene is a key component of lherzolitic peridotite and also occurs in wehrlitic peridotite and pyroxenite. Because harzburgitic peridotite is the primary host rock for diamonds and contains no clinopyroxene, this mineral provides limited information regarding to source rock diamond potential. Although Cr-diopside may be derived from rocks formed at crustal depths, it has nevertheless been used as an important indicator mineral in exploration for kimberlites (Morris et al. 2002; Crabtree 2003).

Cr-diopside grain counts are very low (≤2) per 10 kg sample. On the other hand, low-Cr diopside grains are abundant in the samples, with the highest grain count being 64 (Appendix 11). Of 2136 low-Cr diopside grains analyzed, 98.9% were confirmed to be this mineral, with the rest reclassified as amphibole, orthopyroxene and forsterite (Table 6). Using a compositional plot of Na_2O versus Ca/Ca+Mg (atomic) proposed by Crabtree (2003), 48 low-Cr diopside grains were reclassified as Cr-diopside (Figure 17). The regional distributions of Cr-diopside and low-Cr diopside grains were plotted in Figures 18 and 19, respectively. The general low Cr-diopside and high low-Cr diopside grain counts are consistent with the results of the previous alluvium sampling that showed 0 to 2 and 0 to 37 grain counts, respectively, for these 2 minerals (*see* Figures 18 and 19) (Ontario Geological Survey 2001b, 2001d).

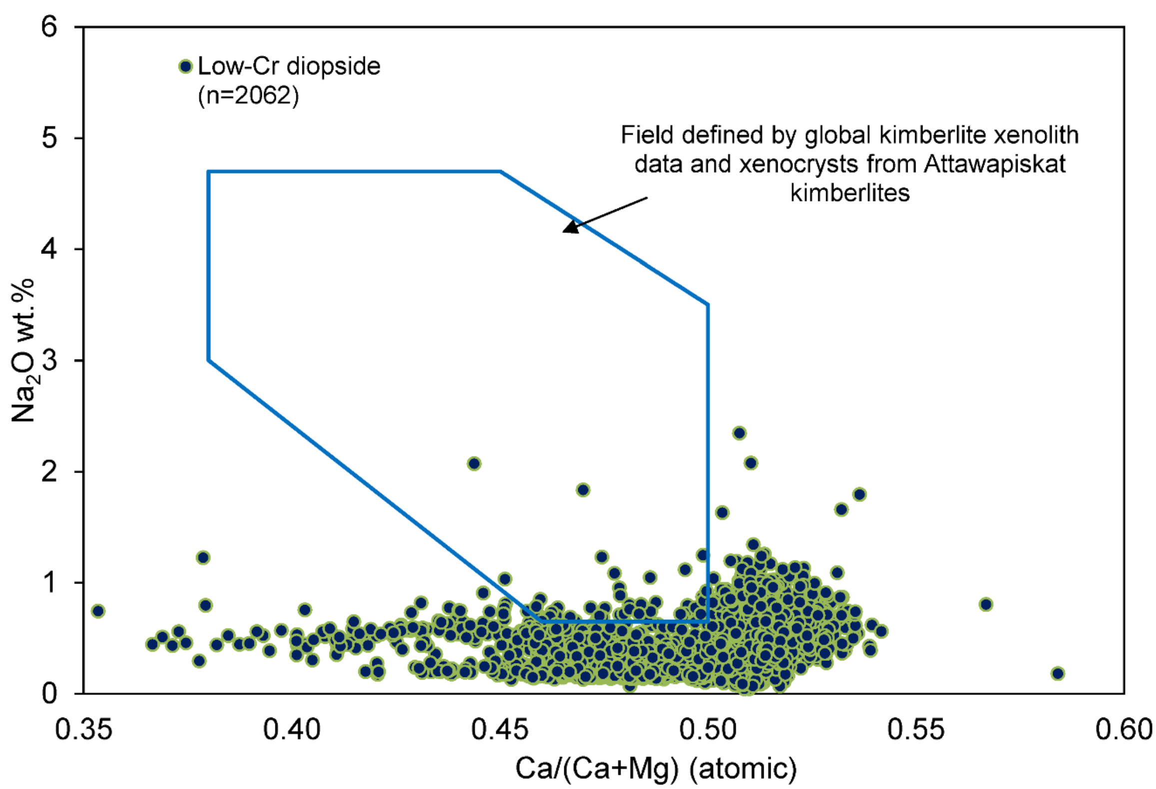

Figure 17. Compositional plot of Ca/(Ca+Mg) versus Na_2O for low-Cr diopside (clinopyroxene) grains, classification *after* Crabtree 2003.

Table 6. Results (statistical summary) of microprobed diopside and forsterite grains.

DC grains analyzed					
Total	**DC**	**Pyroxene (low-Cr diopside)**	**FO**	**Amphibole**	
20	17	0	3	0	
Low-Cr diopside grains analyzed					
Total	**Pyroxene (low-Cr diopside)**	**Other (Orthopyroxene)**	**FO**	**Amphibole**	
2136	2112	7	3	14	
	%Pyroxene (low-Cr diopside)	**%Other (Orthopyroxene)**	**%FO**	**%Amphibole**	**%Total**
	98.9	0.3	0.1	0.7	100
FO grains analyzed					
Total	**FO**	**Pyroxene (low-Cr diopside)**	**Other (Orthopyroxene)**		
1713	1657	55	1		
	%FO	**%Pyroxene (low-Cr diopside)**	**%Other (Orthopyroxene)**	**%Amphibole**	**%Total**
	96.7	3.2	0.1	0	100
Augite grains analyzed					
Total	**Pyroxene (low-Cr diopside)**	**Amphibole**	**Other (Orthopyroxene)**		
6	2	3	1		
Fayalite grains analyzed					
Total	**Pyroxene (low-Cr diopside)**	**Amphibole**	**Other (Orthopyroxene)**		
7	7	0	0		

OLIVINE (FORSTERITE)

Forsteritic olivine occurs in a variety of mafic and ultramafic rocks and it does not have compositions that can be definitively linked to kimberlite based on major oxide geochemistry (Crabtree 2003). Abundant forsteritic grains were recovered from both the till and glaciofluvial samples in the survey area (Appendix 11), which is in contrast to the previous alluvium sampling that showed low grain counts of this mineral (Figure 20) (Ontario Geological Survey 2001b, 2001d). More than 1700 forsterite grains were microprobed for their major oxide compositions and 96.7% of them were confirmed to be this mineral, with the rest reclassified mainly as low-Cr diopside (*see* Table 6). On Nemegos Road, north of the intersection between Highways 129 and 667, there is a notable cluster of till and glaciofluvial sand and gravel samples where up to 3041 and 12 060 grains were recovered per 10 kg sample, respectively (*see* Figure 20). In view of the low numbers of other KIM grains such as pyrope garnets and Cr-diopside, the majority of the forsteritic olivine grains recovered in the current survey area are probably nonkimberlitic and rather are derived from local mafic and ultramafic rocks.

TOTAL KIMS AND AREAS OF INTEREST

Pyrope garnet, Mg-ilmenite and Cr-diopside grain counts are summed to give total KIMs and the results are shown in proportional dot and pie-chart maps (Figures 21 and 22). The exclusion of forsteritic olivine from the total KIMs has already been discussed. Chromite grains may contain nonkimberlitic grains that are not easily separated from those of kimberlitic origin using the discrimination fields in the Cr_2O_3 versus TiO_2 compositional plots proposed by Fipke, Gurney and Moore (1995). As such, they are excluded from the total KIM counts shown in Figures 21 and 22.

The total KIM grain counts are low, not exceeding 4 grains per 10 kg sample in general. But sample 11-CG-127 near the eastern boundary of the survey area contains 59 ilmenite grains (*see* Figure 21; Appendix 11). In addition, the previous alluvium sampling showed 25 KIM grains in sample KAP-0513 in the northwestern part of the current survey, all of which are ilmenite as well (*see* Figure 21). Since these 2 samples lack the other primary indicator minerals such as pyrope garnet and chromium-rich diopside, their economic significance is questionable. Abundant chromite grains were, however, recovered from sample KAP-0513 (*see* Figure 22; also *see* Figure 16). Because the ilmenite anomaly was recovered from single samples, higher density sampling is required to determine the significance of these anomalies.

Ilmenite-dominated KIM grain assemblages occur frequently in surficial deposits as well as in the known kimberlites in northern Ontario (Kong, Boucher and Smith 1999; Sage 1996, 2000a, 2000b; Crabtree 2003; McClenaghan, Gauvreau and Kjarsgaard 2009; Gao 2012a). But surficial samples with anomalous ilmenite grain counts usually have other KIMs such as pyrope garnet and chromium-rich diopside in varying amounts. Erosion and reworking by surficial processes may cause preferential preservation and enrichment of certain KIM grains such as Mg-ilmenite in surficial sediments. However, Mg-ilmenite anomalies without other KIMs are uncommon in surficial samples of northern Ontario (e.g., Crabtree 2003; Gao 2012a; Gao and Crabtree 2016), rendering this proposition less plausible. The likely explanation is that such KIM assemblages are related to the source rocks which contain Mg-ilmenite–rich assemblages with few other KIMs. In northern Ontario, for instance, some known kimberlites, e.g., AM47 and Glinkers pipes contain abundant picroilmenite with few pyrope garnet grains (Sage 1996, 2000b). Another possible explanation is that the source rocks are not kimberlitic but related to picroilmenite-enriched mafic and ultramafic rocks of mantle origin such as lamprophyre. However, this suggestion requires follow-up work as lamprophyre and other mantle-derived boulders in the survey area do not contain Mg-ilmenite or other KIMs (*see* "Nonkimberlitic Boulders of Mantle Origin").

Kimberlite and Nonkimberlitic Boulders of Mantle Origin

KIMBERLITE BOULDER

A 28 kg kimberlite boulder 11-CG-068-K (Photo 4) was collected in an intermittently active sand and gravel pit in the Chapleau II end moraine on Island Lake Road near the western boundary of the survey area (Figure 23). The boulder was found among dumped cobbles and boulders. The slumped pit face and growth of small trees at the locality suggest it was exposed for a long time (more than 5 years). The boulder is hard and highly indurated and contains dark phlogopite and abundant, whitish, oval calcite clasts up to 1 cm diameter (Photo 5). It has a magmatic texture and is probably hypabyssal, related to a kimberlite dike that contributes to the high-degree of induration.

The boulder was processed by Overburden Drilling Management Limited (ODM). A 2.2 kg subsample of this boulder was milled using an electric pulse disaggregator (EPD) to obtain the constituent mineral grains. A heavy mineral concentrate (HMC) was prepared from the <1 mm EPD fraction and the 0.25 mm to 1 mm fraction examined for KIM grains. During the screening of the EPD products for preparation of HMC, some grains of the 1.0 to 2.0 mm size were able to pass the 1.0 mm mesh due to screen tolerance and were also examined for KIMs. Appendix 12 tabulates the resultant data which include KIM grain counts, tabling data, footnotes and EPD log. The heavy mineral data show abundant magnesium-rich picroilmenite (2812 grains), chromite (503 grains) and pyrope garnet grains (122 grains) (Table 7). The lack of chromium diopside is notable but not surprising because, in northern Ontario, some kimberlites such as AM47, Buzz No. 1, Morrisette Creek and N.D.N. No. 1 pipes are known to contain few grains of this mineral (Sage 1996).

Photo 4. Kimberlite boulder 11-CG-068-K collected at a sand and gravel pit (sample site 11-CG-068) on Island Lake Road (*see* Figure 23 for location). The boulder is hard and highly indurated.

Photo 5. Close-up view of kimberlite boulder 11-CG-068-K, showing dark phlogopite flakes and whitish, oval calcite clasts. Coin 2.3 cm diameter.

Table 7. Summary of KIMs of kimberlite and other mantle-derived boulders.

Sample Number	Rock type	2 mm to 0.25 mm							Total Weight	EPT** split	Nonmag. HMC		
		GP	GO	DC	IM	CR	FO	Low-Cr diopside	(kg)	(kg)	1.0 to 2.0 mm (g)	0.5 to 1.0 mm (g)	0.25 to 0.5 mm (g)
11-CG-068-K	Kimberlite boulder	122	0	0	2812	503	0	0	27.5	2.2	0.1	0.4	1
13-CG-123	Peridotite boulder* (lamprophyre)	0	0	0	0	17	0	0	16	1.4	0.2	0.2	0.2
13-CG-438-1	Carbonatite boulder*	0	0	0	0	31	0	0	8.7	1.4	0.4	8.8	5.6
13-CG-438-2	Peridotite boulder*	0	0	0	0	1	0	0	6	1.3	0.01	0.003	0.1
13-CG-438-3	Peridotite boulder*	0	0	0	0	0	0	0	5.3	1.2	0.3	0.8	0.6
13-CG-438-4	Peridotite boulder*	0	0	0	0	12	0	0	2	1.2	0	0.01	0.01
13-CG-438-5	Syenite boulder*	1	0	1823	0	3804	210200	0	1.9	1	2	21.1	24.3
13-CG-544	Pyroxenite boulder*	0	0	0	0	53	0	0	0.6	0.6	0.2	1.4	1.4
07-CG-294***	Lamprophyre boulder	0	0	0	0	0	3	0			0.03	1.3	3.6
07-CG-079***	Nippissing Hill Lookout lamprophyre dike	0	0	0	0	56	0	0			0	0.02	0.1
Ashton lamprophyre****	Dike	0	0	0	0	0	0	56000	19.4	17.2	0	130.2	117.6
Sandpit Lamprophyre****	Dike	0	0	0	0	2	16	5800	9.6	8.8	0	5.5	12.7

**Classified by Stu Averill of Overburden Drilling Management Ltd. (see Appendix 14)*
***EPD = Electric pulse disaggregator*
****Samples from New Liskeard–Cobalt area, northeastern Ontario*
*****From the Killala Lake area, northwestern Ontario (Morris 2000)*

The KIM grains were picked and microprobed to determine their geochemical compositions (Appendix 13). The pyrope garnet grains are mostly G9 garnets, including one G10 garnet (Figure 24). Several chromite grains placed in the diamond inclusion and intergrowth fields (Figures 25 and 26). The xenocryst mineral assemblages indicate a compositional trend that suggests derivation from a chromite- and garnet-bearing mantle where diamond is likely stable. Using the caustic dissolution method, 22.5 kg of the boulder were disintegrated for extraction of microdiamonds by SGS Environmental–Lakefield at Lakefield, Ontario, but no diamonds were recovered. The picroilmenite grains from the boulder have Cr_2O_3 contents of 1.2 to 4.9%, much higher than those recovered from the ilmenite-anomaly sample 11-CG-127 (< 0.9%) (Figure 27), suggesting the latter has a different source in composition.

The kimberlite boulder was transported by the ice from the north and deposited by meltwater in the Chapleau II end moraine (*see* "Quaternary Geology"). It may have a source rock related to the Kapuskasing Structural Zone. The current data available, however, are not sufficient enough to outline the specific location of the source rock and a distant source outside the survey area to the north cannot be excluded.

Nonkimberlitic Boulders of Mantle Origin

Lamprophyre boulders are common in the survey area and some show layered flow structures. They were encountered at virtually all of the sand and gravel pits visited in the survey area. The lamprophyre boulders were identified in the field using the known lamprophyre dikes in northern Ontario as reference, in particular, those in the Kirkland Lake and Cobalt–New Liskeard areas, which contain typically tabular phlogopite phenocrysts in seriate distribution set in a fine-grained, dark micaceous groundmass or matrix (Sage 1996; Grabowski and Wilson 2005). One such boulder was collected at a sand and gravel pit (13-CG-123) in an esker and processed to isolate its heavy minerals.

In addition to lamprophyre, boulders at some sites show centimetre-size oval-shaped clasts (phenocrysts or xenocrysts) in a fine-grained, dark greenish groundmass, which resemble, to a certain degree, kimberlite in texture (Sage 1996). Five such boulders (13-CG-438-1 to 5) were collected at a sand and gravel pit (13-CG-438) in the Chapleau II end moraine and one at a pit (13-CG-544) in an esker (*see* Figure 23).

All the boulders were submitted to ODM for heavy mineral analysis using the same process as described above for the kimberlite boulder. Prior to disaggregation, the boulders were described under a binocular microscope and, as a result, 3 of the kimberlite-like boulders were classified as peridotite and the rest as pyroxenite, syenite and carbonatite (*see* Table 7; Appendix 14) (Stu Averill of ODM, personal communication, 2013). Boulder 13-CG-123 picked as lamprophyre in the field was reclassified as peridotite by him. The heavy mineral data show that, except for boulder 13-CG-438-5 (classified as syenite by Averill which returned a single pyrope garnet (GP) and abundant Cr-diopside grains), none of the boulders contained KIM grains consistent with the heavy mineral suites of lamprophyre boulders and dikes in other regions of northern Ontario (*see* Table 7). It is notable that these mantle-derived boulders including the syenite are barren of Mg-ilmenite (*see* Table 7). This observation, based on a limited number of analyses, would suggest that the aforementioned anomalous picroilmenite grains recovered from both till and alluvium samples likely came from kimberlites rather than lamprophyre and other mantle-derived rocks of the survey area.

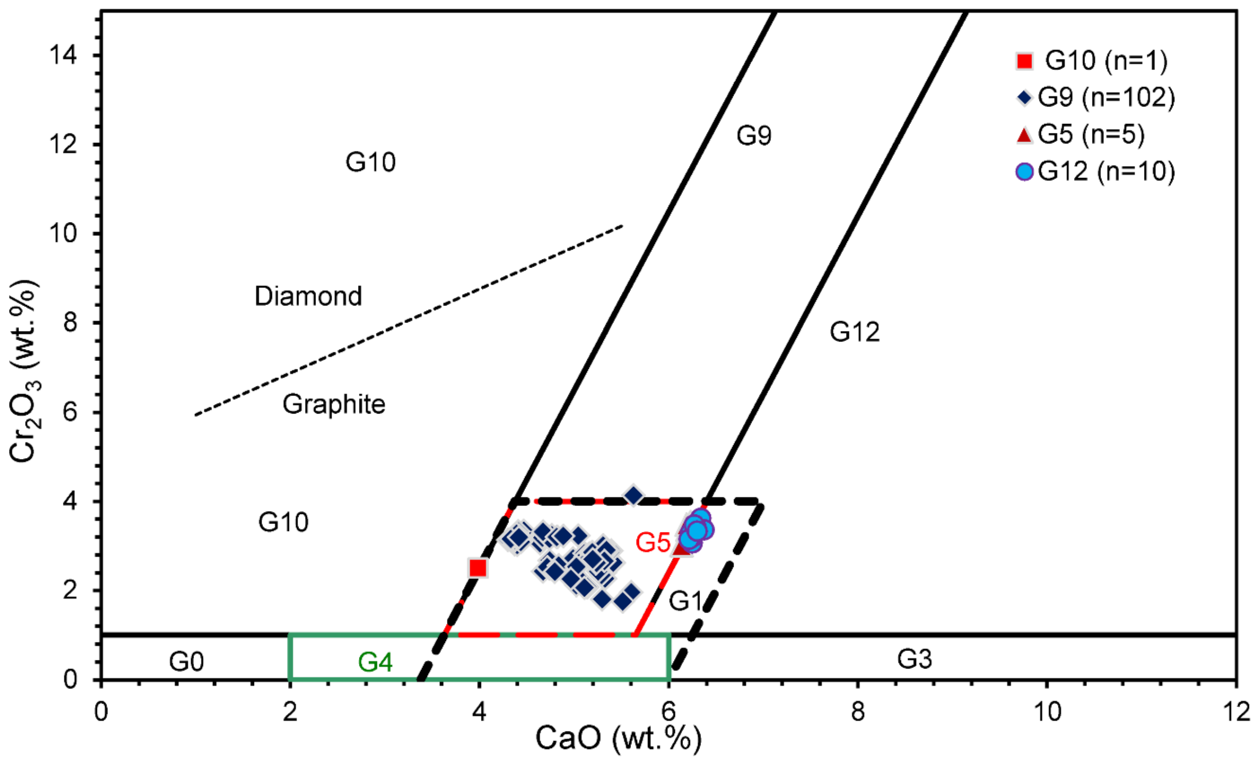

Figure 24. Compositional plot of CaO versus Cr_2O_3 for pyrope garnet grains of the kimberlite boulder 11-CG-068-K.

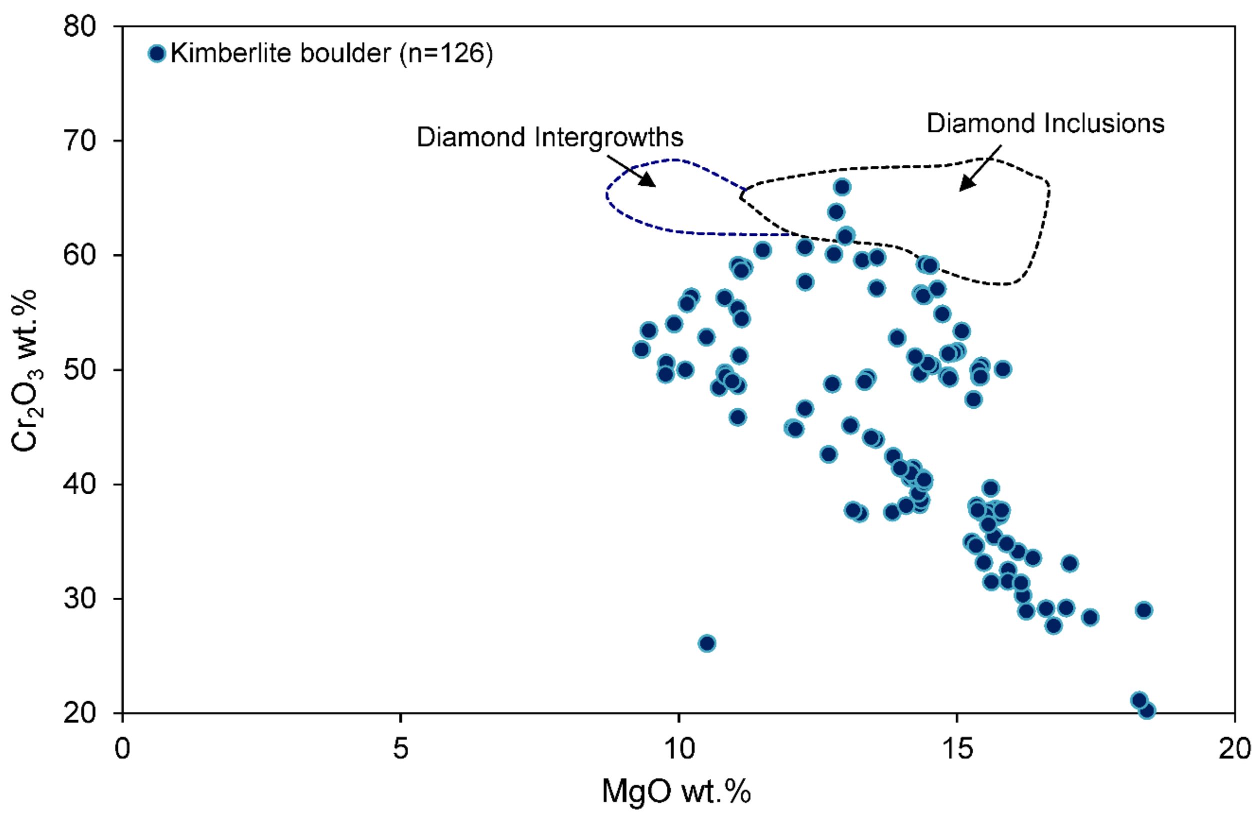

Figure 25. Compositional plot of MgO versus Cr_2O_3 for chromite grains of the kimberlite boulder 11-CG-068-K.

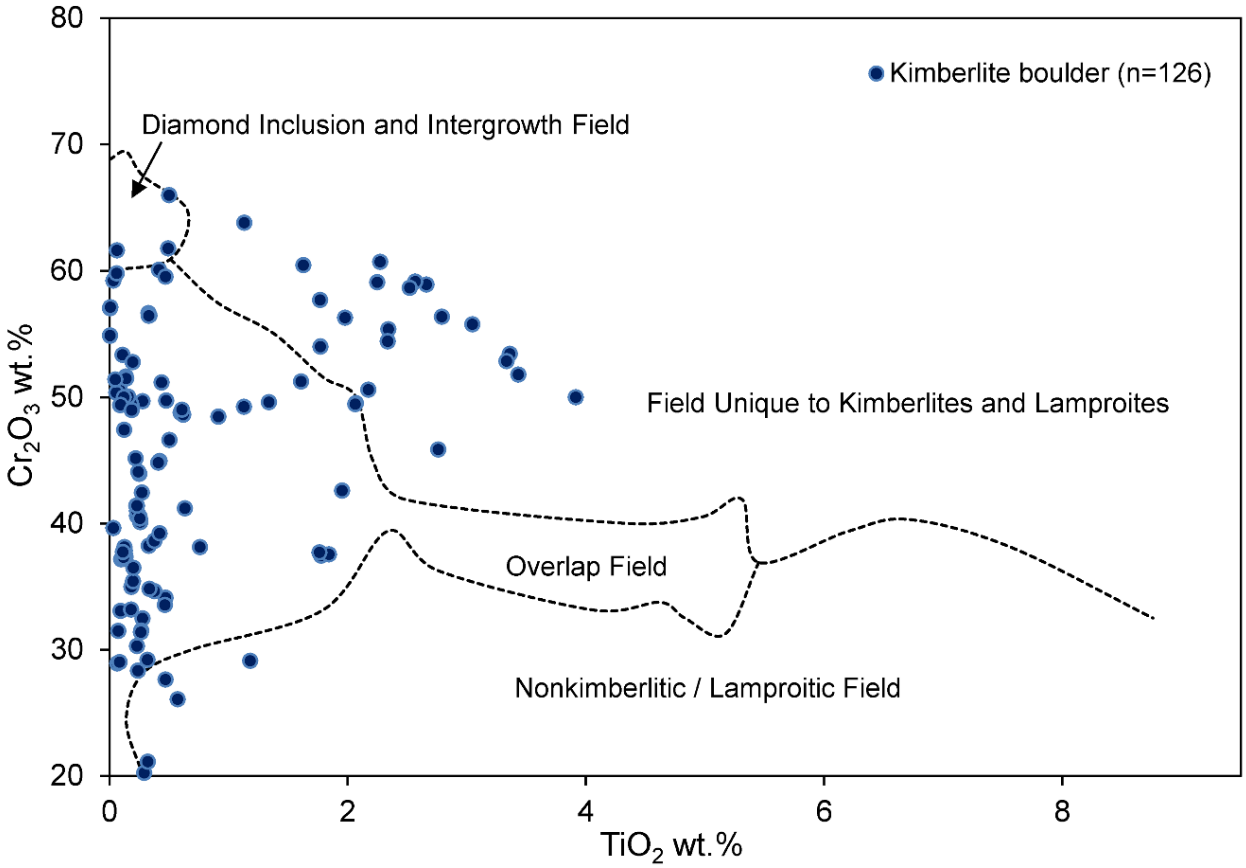

Figure 26. Compositional plot of TiO_2 versus Cr_2O_3 for chromite grains of the kimberlite boulder 11-CG-068-K.

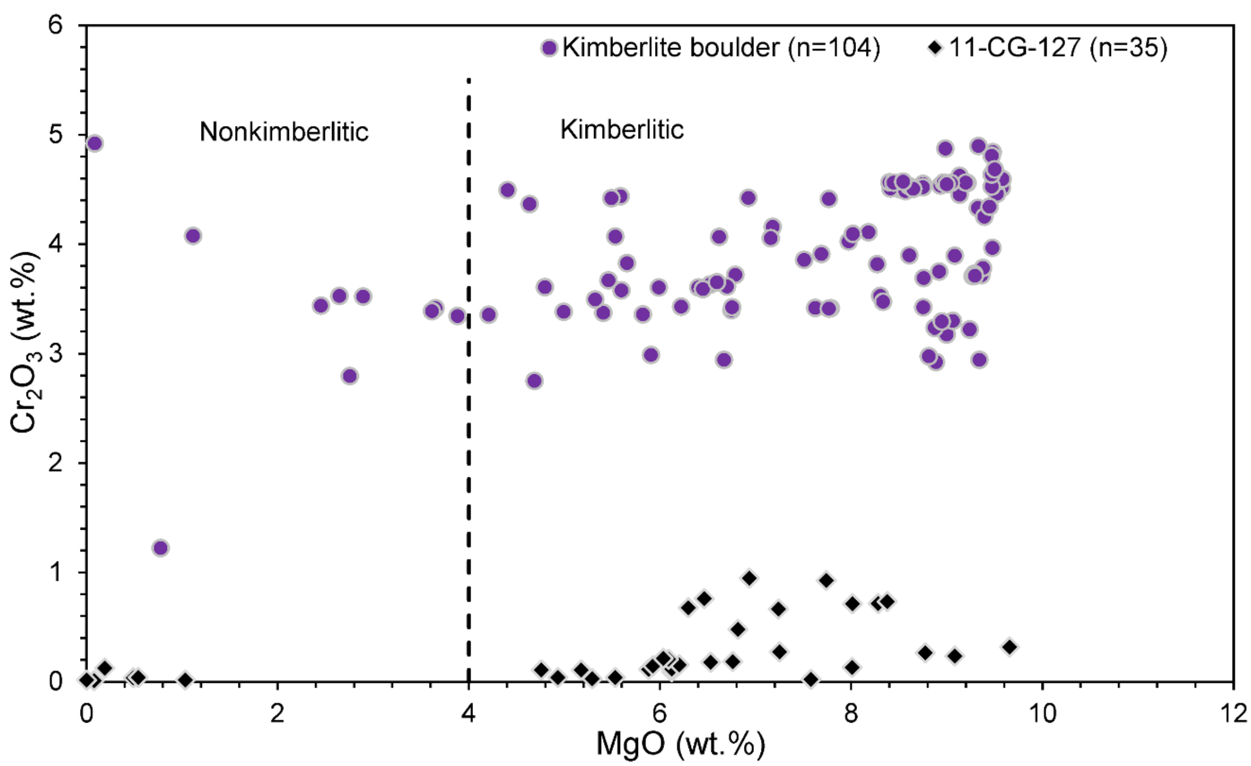

Figure 27. Compositional plot of MgO versus Cr_2O_3 for ilmenite grains of the kimberlite boulder 11-CG-068-K.

Metamorphic/Magmatic Massive Sulphide Indicator Minerals

Metamorphic/magmatic massive sulphide indicator minerals (MMSIM®) are a group of stable heavy minerals that may have derived, as Averill (1999) suggested, from volcanogenic massive sulphide (VMS) and magmatic nickel–copper sulphide deposits, as well as from skarn and greisen rocks. Common MMSIM® grains are listed in Table 8, which include chalcopyrite and gahnite (zincian spinel) often associated with VMS deposits and chromium-rich phases derived from magmatic nickel–copper deposits such as chrome diopside, chromite and chrome rutile (Averill 1999). Gahnite can also be derived from pegmatite and peraluminous granite and grains of this origin usually have MgO values less than 2 weight % (Morris et al. 1998; Ontario Geological Survey 2001b). In general, MMSIM® grains derived from nonmineralized mafic to ultramafic rocks are common in surficial deposits in northern Ontario (Averill 1999; Crabtree 2003; Gao 2012a, 2015; Gao and Crabtree 2016). These minerals become significant only if other diagnostic minerals such as sulphides of the ore phases co-exist with them. However, sulphide heavy minerals are easily weathered and, with exception of chalcopyrite and, to a lesser degree, sphalerite, they are uncommonly preserved in till and stream sediments (Barnett and Averill 2010). This often renders the use of MMSIM® grains for assessment of potential mineralization difficult.

MMSIM® grains were counted in the 0.25 to 0.5 mm nonmagnetic heavy mineral fraction and listed in Appendixes 16 and 17. The low-Cr diopside grains counted as MMSIM® differed slightly in number from those in the KIM data set where grain counts were made on the coarser fraction, 0.25 to 2 mm (*see* Appendixes 7 and 11). For this reason, the KIM grain counts for this mineral were used instead.

The results show only background levels of base metal indicator minerals which include chalcopyrite and gahnite, suggesting low potential for base metals in the survey area although the majority of gahnite grains recovered have MgO concentrations exceeding 2 weight % and are probably linked to VMS deposits (Figures 28 and 29). The previous alluvium sampling, on the other hand, returned elevated counts of chalcopyrite grains (16 and 11 grains) in samples KAP-1014 and KAP-0451 near the community of Chapleau and Nemegosenda Lake, respectively, and gahnite grains (6 grains) in sample KAP-0513 (*see* Figures 28 and 29) (Ontario Geological Survey 2001b, 2001d). In view of the scarcity of the 2 minerals in the adjacent till samples, the sources of these elevated grain counts remain undetermined. It is noteworthy that alluvium sample KAP-0513 also has elevated picroilmenite and chromite grain counts (*see* Figures 13 and 16). The significance of the coexistence of these minerals is unclear.

Red rutile grains were recovered in high numbers from both till and glaciofluvial sand and gravel samples, in particular, in the southwest of the survey area, with 500 grains in glaciofluvial sand and gravel sample 11-CG-212 and 200 grains in till sample 11-CG-058 (Figure 30; also *see* Appendixes 16 and 17). No microprobe analyses were conducted on the recovered grains. However, those analyzed in northern Ontario show compositions of >82% Ti_2O_3 with minor Cr_2O_3 (<1.3%), for instance, in the Cobalt–New Liskeard and the McFaulds Lake areas (Gao 2012b; Gao, Crabtree and Dyer 2016). This mineral may be associated with VMS and magmatic nickel–copper mineralization (Averill 1999). However, the presence of few ore-forming minerals such as chalcopyrite suggests that its source remains to be determined. Red rutile is also a common accessary mineral in low- to high-grade metamorphic rocks ranging from greenschist to eclogite and granulite facies (Meinhold 2010). As well, red rutile has been used as an indicator mineral for carbonatites because of its common association with the latter (Morris et al. 2000; Ripp et al. 2006). But the till and alluvium samples at the known alkalic-carbonatite intrusions do not show elevated grain counts of this mineral, making this link unlikely for the survey area (*see* Figure 30).

Table 8. Indicator minerals commonly associated with base metal mineralization (*after* Averill 1999). Areas marked with an X indicate the association between mineral and type of deposit.

Indicator Mineral	VMS	Magmatic Ni-Cu	Skarn	Greisen	Other occurrence
Sillimanite	X				High-grade metamorphic rocks
Kyanite	X				High-grade metamorphic rocks
Corundum	X				High-grade metamorphic rocks
Anthopyllite	X				High-grade metamorphic rocks
Mg-spinel	X				High-grade metamorphic rocks
Sappharine	X				High-grade metamorphic rocks
Staurolite	X				High-grade metamorphic rocks
Dumortierite	X				
Mn-epidote	X				
Spessartine	X				Metavolcanic rocks
Gahnite	X				
Franklinite	X				
Willemite	X				
Barite	X				
Cinnabar	X				
Native Au	X		X		
Loellingite	X	X			
Orthopyroxene	X	X			High-grade metamorphic rocks
Cr-rutile	X	X			
Chalcopyrite	X	X	X	X	
Tourmaline	X			X	
Olivine (Forsterite)		X	X		Mafic igneous rocks
Hercynite		X			
Low-Cr diopside		X			Mafic igneous rocks
Chromite		X			Mafic igneous rocks
Uvarovite		X			
Rammelsbergite		X			
Sperrylite		X			
PGE alloys		X			
Olivine (knebelite)			X		
Vesuvianite			X		
Johannsenite			X		
Grossular			X		
Scheelite			X		
Topaz				X	
Fluorite				X	
Cassiterite				X	
Wolframite				X	

Lastly, PGE sulphide grains were sought, together with gold grains, from the <0.25 mm table concentrate (Appendixes 4 and 18). Only single PGE sulphide grains of sperrylite ($PtAs_2$), braggite ((Pt, Pd, Ni)S) and osmium sulphide were recovered from 4 samples (Table 9; Figure 31). The low grain counts per 10 kg sample are thus considered to be background value.

Table 9. Summary of samples containing PGE sulphide grains.

Sample Number	Sampling medium	Osmium sulphide	Braggite	Sperrylite	PGE Total	Low-Cr diopside	Red Rutile
11-CG-084	Till	0	0	1	1	50	0
11-CG-382	Till	1	0	0	1	19	100
11-CG-384	Glaciofluvial	1	0	0	1	33	30
11-CG-856	Glaciofluvial	0	1	0	1	9	1

Carbonatite Indicator Minerals

A suite of indicator minerals often associated with carbonatite include rutile, barite, apatite, monazite, perovskite, pyroclore, columbite and rare earth element (REE)-bearing fluorocarbonates such as bastnaesite and synchysite (Morris et al. 2000; Ontario Geological Survey 2001b, 2001d; Mackay et al. 2016). In the data set presented by ODM, the first 4 minerals are not labelled as carbonatite minerals largely because of their occurrence in a variety of rock types. However, a brief discussion of their spatial distribution and relationship with the known alkalic-carbonatite intrusions is useful for assessment of the potential for additional alkalic-carbonatite rocks in the survey area (*see* discussion on rutile in “Metamorphic/Magmatic Massive Sulphide Indicator Minerals”).

Barite in surficial sediments on Precambrian terrain is usually associated with VMS and carbonatite deposits in northern Ontario (Averill 1999; Morris et al. 2000; Bajc and Crabtree 2001; Mackay et al. 2016). In the survey area, the mineral concentration is low, in general, not exceeding 2 grains per 10 kg sample. However, 80 and 10 grains were recovered from till samples 14-CG-224 and 13-CG-344, respectively (Figure 32). The samples are a few kilometres south-southwest of the Borden Township carbonatite and Nemegosenda Lake alkalic complexes in the down-ice direction, suggesting that the barite anomalies are likely derived from these intrusions (*see* Figure 32). In contrast, the samples collected at the Lackner Lake alkalic complex are virtually barren of this mineral.

Among phosphate minerals, monazite is rare (<0.25%), whereas apatite is extremely abundant, making up to 60% of the 0.25 to 0.5 mm nonmagnetic heavy mineral concentrate (Appendixes 16 and 17). The samples containing 20% to 60% apatite in the heavy mineral concentrate are mostly in Area A along a dispersal feature emanating from the Lackner Lake alkalic complex (Figures 33 and 34). There is another area, Area B, on Nemegos Road where anomalous apatite grain counts were obtained from both the glaciofluvial and till samples (*see* Figures 33 and 34). Area B is located north-northwest of the Lackner Lake alkalic complex and is probably not related but derived from an unknown source located somewhere to the north-northeast in the up-ice direction. The samples adjacent to other alkalic-carbonatite complexes have low apatite grain counts (*see* Figure 33) and this observation, together with the aforementioned heterogeneous distribution of barite, indicates the presence of different mineral assemblages in the various alkalic-carbonatite intrusions.

The prime carbonatite indicator minerals picked by ODM include perovskite, pyrochlore, columbite, bastnaesite, synchysite, euxenite, brockite and stillwellite (Appendixes 16 and 17). In addition, parisite, aegirine and ilmenorutile were isolated in the previous alluvium sampling surveys (Ontario Geological Survey 2001b, 2001d). These minerals usually occur in low concentrations in surficial samples including those collected immediately down ice from known carbonatite mineralization (Morris et al. 2000; Mackay et al. 2016). Indeed, in this survey, only a few grains of such minerals were recovered, with most of the samples barren of them (Table 10; *see* Appendixes 16 and 17). However, elevated grain counts up to 35 were recovered from the previous alluvium samples at the Lackner Lake and Nemegosenda Lake alkalic complexes (Ontario Geological Survey 2001b, 2001d), confirming their close association with these alkalic intrusions (Figure 35).

Among the prime carbonatite indicator minerals, niobium-bearing pyrochlore, columbite and ilmenorutile are the major ore-forming minerals of niobium. The rest, except perovskite and aegirine, are important REE-bearing minerals (Mackay et al. 2016). The niobium-bearing minerals are in low concentrations in both the till and glaciofluvial deposits and only a couple of the samples contain a single grain (Figure 36). However, 4 such grains were recovered from a previous alluvium sample (KAP-0570) at the Lackner Lake alkalic complex (Ontario Geological Survey 2001b), suggesting potential mineralization of niobium in the source area, consistent with the reported niobium occurrence in this alkalic complex (*see* Figure 3).

REE-bearing minerals occur at low concentrations (≤2 grains) per 10 kg sample, with most of the samples barren of them (Figure 37; Table 10). In the previous alluvium sampling survey (Ontario Geological Survey 2001b), samples collected at the Nemegosenda Lake alkalic complex had elevated grain counts of REE-bearing minerals (bastnaesite, parasite and synchysite) (*see* Figure 37), indicating the potential for REE mineralization in the source rock, agreeing with the reported REE occurrence in this alkalic intrusion (Ontario Geological Survey 2016). Monazite is also a major REE-bearing mineral. However, only a trace amount of this mineral is found in the samples, which likely represents the background value (*see* Appendixes 16 and 17).

In summary, anomalous apatite grain concentrations were obtained from till samples collected along a south-southwest dispersal feature emanating from the Lackner Lake alkalic complex, which are likely linked to the carbonatite components within this alkalic complex. Abundant grains were also recovered in Area B on Nemegos Road and they are likely derived from an unrecognized alkalic-carbonatite source to the north-northeast. Among the prime carbonatite indicator minerals, elevated niobium- and REE-bearing minerals were recovered from previous alluvium samples at the Lackner Lake alkalic and Nemegosenda Lake complexes, confirming their presence in the source rocks.

Bulk Sample Geochemistry

The geochemistry of the <0.063 mm fraction bulk samples is presented in Appendix 19. The quality-control (QC) data are summarized in Appendixes 20 and 21. Interpretation of the proportional dot plots is based on percentiles to highlight anomalous areas. Samples are considered elevated, anomalous and highly anomalous with respect to a particular element if concentrations are above the 90th, 95th and 98th percentiles, respectively. Where multiple sample sites are anomalous or highly anomalous in a particular element, the area is defined as an area of interest.

GOLD AND ARSENIC

Elevated to anomalous gold concentrations up to 130 ppb by INAA occur on the Borden Lake property where gold mineralization is well documented, agreeing well with the heavy mineral grain counts (Figure 38; also *see* Figure 5). The 2 samples collected along Highway 101, which have anomalous gold grain counts, returned relatively low concentrations of gold (<22 ppb) (Figure 39; also *see* Figure 6). Till samples 11-CG-058 and 16-CG-004 on Sheppard and Morse Road, as well as sample 14-CG-226 on Lafrenière Road where anomalous gold grain counts were obtained, also exhibit low concentrations of

Table 10. Summary (grain counts) of samples containing carbonatite minerals.

Sample Number	**Sampling media**	Perovskite	Pyrochlore	Columbite	Bastnaesite	Brockite	Euxenite	Stillwellite	Synchysite	Total	Nb-bearing minerals*	REE-bearing minerals**
11-CG-211	Till	3	0	0	0	0	0	0	0	3	0	0
11-CG-090	Till	2	0	0	0	0	0	0	0	2	0	0
11-CG-666	Till	0	0	0	0	2	0	0	0	2	0	2
14-CG-815	Glaciofluvial	0	0	0	0	0	2	0	0	2	0	2
14-CG-938	Glaciofluvial	0	0	0	2	0	0	0	0	2	0	2
11-CG-046	Glaciofluvial	0	1	0	0	0	0	0	0	1	1	0
11-CG-058	Till	0	0	0	0	0	0	1	0	1	0	1
11-CG-084	Till	0	0	0	0	1	0	0	0	1	0	1
11-CG-199	Till	0	0	0	1	0	0	0	0	1	0	1
11-CG-327	Till	0	0	1	0	0	0	0	0	1	1	0
11-CG-726	Glaciofluvial	0	0	0	0	0	0	0	1	1	0	1
11-CG-730	Glaciofluvial	0	0	0	0	0	0	0	1	1	0	1

**Niobium-bearing minerals: Sum of pyrochlore and columbite*
***REE-bearing minerals: Sum of bastnaesite, brockite, euxenite, synchysite and stillwellite*

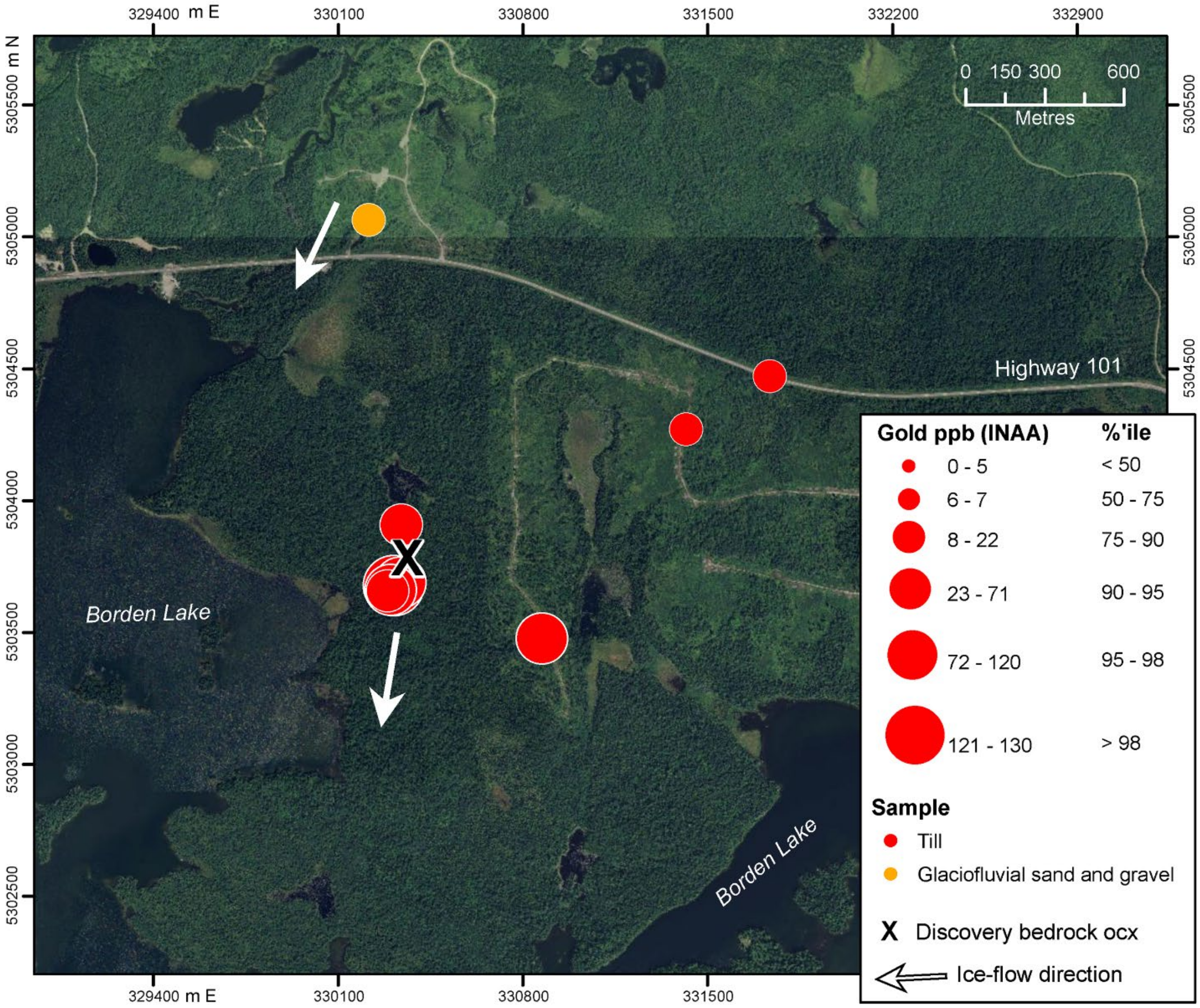

Figure 39. Enlarged view showing the regional distribution of gold (ppb) by INAA on the Borden Lake. Aerial photograph *from* the Ontario Ministry of Natural Resources and Forestry (2007–2009).

gold (*see* Figure 38 and also Figure 5). Because the gold grains recovered are mostly silt-sized (*see* Appendix 4), the inconsistency between the bulk sample geochemistry and gold grain counts may be attributed to the nugget effect in the INAA Au results due to a much smaller sample used (30 g) in this method than in the heavy mineral counts (10 kg).

Till sample 14-CG-252 collected on Nemegos Road just north of Highway 667 is notable for slightly elevated concentration of gold at 36 ppb by INAA (*see* Figure 38). Only 1 gold grain was recovered from this sample, but the adjacent till sample 11-CG-072, about 4 km to the north, has elevated gold grain counts (10 grains) (*see* Figure 5). The elevated gold in these samples requires attention in future prospecting efforts in this area.

To compare with the current data, results from previous lake sediment sampling were also plotted in Figure 38 (Ontario Geological Survey 2000a, 2000b). It is interesting to note that the lake sediment samples adjacent to sample 14-CG-226 where elevated gold grains were recovered, also have elevated to anomalous concentrations of gold (*see* Figure 38). The lake sediment sampling survey also showed additional gold anomalies in a cluster of samples near Nemegosenda Lake to the west, as well as in several individual samples across the northwestern part of the current survey (*see* Figure 38). However, no till samples were collected from the current survey at the corresponding sites to make the comparison with these previous findings.

Arsenic is a common pathfinder element of gold and its occurrence at high concentrations may signify the potential for additional gold mineralization. This seems to be true as most of the samples on the Borden Lake property have elevated to anomalous concentrations of this element (Figure 40). This is further evidenced by anomalous gold and arsenic concentrations in sample 14-CG-252 (Figure 40; *see also* Figure 38). However, there are quite a few sites where distinct arsenic anomalies occur but no corresponding elevated concentrations of gold are seen (*see* Figure 40). This calls cautions in using this element for prospecting of gold.

BASE METALS

The geochemistry of the <0.063 mm fraction bulk sample exhibits anomalous concentrations of base metal elements including copper, nickel, cobalt, zinc and lead in Areas 1 to 5 in the southern half of the survey area (Figures 41 to 45; Table 11). Several individual samples also exhibit anomalous levels of these elements, in particular, along the eastern boundary of the survey area (*see* Figures 41 to 45). It is noteworthy that Area 2 is centered at the Borden Lake property where gold mineralization is known (*see* Figures 5 and 6).

Areas 2 and 3 seem to be related to the migmatized supracrustal rocks and Area 4 likely has a link to the Lackner Lake alkalic complex because of their proximity and intimate relation to these deposits (*see* Figure 41). The source rocks of the remaining anomalies in Areas 1 and 5 are unclear in view of the extensive granitic bedrock and lack of significant mafic and ultramafic bedrock in the vicinity. Nonetheless, the presence of multiple anomalous base metal elements in these areas indicates that the geochemical anomalies are genuine features and further sampling and prospecting may provide insight into their provenance.

MOLYBDENUM

Almost all the samples collected on the Borden Lake property exhibit anomalous concentrations of molybdenum, with sample 13-CG-514 having the highest value (3.7 ppm) (Figure 46; Appendix 18). The molybdenum anomaly coincides with anomalous gold in both heavy minerals and bulk sample geochemistry, indicating a good correlation between the 2 elements for this particular mineral deposit type (*see* Figure 46; also *see* Figures 5, 6, 38 and 39). Several individual samples near the eastern boundary of the survey area also show anomalies of this element, which may require attention in future prospecting efforts (Figure 46).

PHOSPHORUS

The samples exhibit significantly anomalous concentrations of phosphorus along a distinct dispersal feature emanating from the Lackner Lake alkalic complex, similar in trend with that of apatite grain counts (*see* Figure 47; also *see* Figure 33). Such a similarity confirms the close association of this element with the alkalic intrusion, consistent with the reported occurrence of this mineral in this source rock (*see* Figure 3) (Ontario Geological Survey 2016). In the survey area, 3 samples contain more than 1700 ppm phosphorus: 2 of which are located in the aforementioned dispersal feature at the Lackner Lake alkalic complex (14-CG-808 and 14-CG-821) (Figure 47). The sample on Nemegos Road about 2 km

Table 11. Areas of interest as indicated by base metal anomalies in the <0.063 mm fraction bulk sample geochemistry.

Areas	Anomalous elements	Other	Location
Area 1	Copper, cobalt, lead* and zinc	REEs*	West of Chapleau
Area 2	Copper, lead, zinc, cobalt and nickel*	Gold, molybdenum, REEs (elevated)	Borden Lake on Highway 101
Area 3	Nickel, copper, cobalt, zinc and lead	REEs	Nemegos Road, NW of Lackner Lake carbonatite complex
Area 4	Zinc, lead, nickel and cobalt	Phosphorus, REEs, niobium, thorium, uranium	Nemegos Road at Lackner Lake carbonatite complex
Area 5	Nickel, zinc, copper and cobalt	Elevated lead and REEs	Highway 129

**Prominence in glaciofluvial sand and gravel samples*

northwest of this alkalic complex (11-CG-146) appears related to the other apatite anomaly (Area B; *see* Figure 33), that was derived, as discussed before, from an unknown source to the north-northeast in up-ice direction.

RARE EARTH ELEMENTS (REES)

Rare earth elements (REEs) comprise the 15 lanthanide elements, namely, lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), promethium (Pm), samarium (Sm), europium (Eu), gadolinium (Gd), terbium(Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb) and lutetium (Lu), as well as yttrium (Y) and scandium (Sc) which exhibit similar properties and often occur in many of the same mineral deposits with the lanthanides. The sum of their concentrations, except promethium (Pm) which is not available in the ICP–MS data set, gives the total REEs used in the discussions below (Appendix 19).

In this survey, there are 2 areas, Area i and Area ii, where anomalous REE concentrations occur in multiple samples (Figure 48). Area i is centered at Lackner Lake alkalic complex, whereas Area ii is located adjacent to this intrusion to the north-northeast (Figure 48). The REE concentrations in Area i, with values up to 243 ppm, the highest in the survey area, occur in a distinct dispersal feature emanating from the Lackner Lake alkalic complex, resembling phosphorus in spatial distribution (Figures 48 and 49; also *see* Figure 47). This prominent dispersal feature testifies to the intimate association between surficial geochemistry and the location of REEs mineralized alkalic intrusions (*see* Figure 3).

Area ii is defined by a couple of till samples containing anomalous REE concentrations (Figure 49). In view of the ice-flow directions toward the south-southwest, the REE anomaly in Area ii appears to be related to an unknown source to the north-northeast in the up-ice direction. Similarly, the REE anomaly in sample 11-CG-146 adjacent to the Lackner Lake alkalic complex to the west on Nemegos Road might have come from an unknown source to the north-northeast (*see* Figure 49). This sample, as discussed above, also contains anomalous concentrations of phosphorus, indicating a source probably related to alkalic-carbonatite intrusions rather than granite pegmatites (see Figure 47). Sample 11-CG-146 is not far from the apatite heavy mineral anomaly (Area B in Figure 33) and would have come from a similar alkalic-carbonatite source. However, those samples that contain anomalous apatite grain counts show negligible levels of REEs and this would negate the supposition for a single source.

No samples were collected on other known alkalic-carbonatite intrusions in the survey area because of poor access and the lack of till exposures. As a result, their potential for REE mineralization cannot be assessed in this survey. Sample 14-CG-030 immediately adjacent to the Nemegosenda Lake alkalic complex to the east exhibits anomalous concentration of REEs (Figures 48 and 50). In view of its location and the regional ice-flow direction, this REE anomaly appears unrelated to this alkalic intrusion but derived from an unknown source to the north-northeast. REE anomalies also occur in individual samples 11-CG-832 (till) and 11-CG-738 (glaciofluvial sand and gravel) (Figure 48). Because there are no known alkalic-carbonatite intrusions in the immediate vicinity, the source of these REE anomalies remains unknown.

NIOBIUM

Like REEs, niobium has anomalous concentrations in all the samples collected at the Lackner Lake alkalic complex and its immediately adjacent area along a south-southwestward dispersal feature the southern extent of which reaches Highway 667 (Figures 51 and 52). The prominent anomaly suggests good potential for significant mineralization of this mineral in the source rocks, and agrees with the reported occurrence of this element in this alkalic complex (*see* Figure 3) (Ontario Geological Survey 2000a, 2000b).

In addition, elevated concentrations of niobium were found in 2 individual samples: one immediately adjacent to the Nemegosenda Lake alkalic complex (11-CG-899) and the other 3.5 km south of this alkalic complex on Highway 101 (11-CG-292) (Figure 51). The former is very close to sample 14-CG-030 that contains anomalous concentrations of REEs (*see* Figures 48 and 51). As discussed above, the anomaly in this area was not derived from the Nemegosenda Lake alkalic complex but an unknown source to the north-northeast. The anomaly in sample 11-CG-292 on Highway 101 may be derived from this same source or, alternatively, the known Nemegosenda Lake alkalic complex or both because of its down-ice location.

URANIUM AND THORIUM

Uranium and thorium display similar geochemical patterns regionally and both show strong anomalies in the samples along a south-southwestward dispersal feature emanating from the Lackner Lake alkalic complex (Figures 53 and 54). The dispersal feature resembles those of phosphorus, REEs and niobium (*see* Figures 47, 48 and 51). The anomaly in the surficial deposits agrees well with the reported elevated uranium and thorium in this alkalic complex (*see* Figure 3) (Ontario Geological Survey 2016).

Elsewhere in the survey area, uranium and thorium occur at low concentrations. But there are individual samples where anomalous levels of these elements occur, namely, sample sites 11-CG-658, 11-CG-738, 14-CG-070, 14-CG-223 and 14-CG-244 (Figures 53, 54). Of particular interest are samples 14-CG-224 and 14-CG-223 located at the Borden Lake gold deposit (Figures 53 and 54). The likely source of the anomalies in these 2 samples is the Borden Township carbonatite complex which is located about 5 km to the north-northeast in the up-ice direction where uranium and thorium occurrences have been reported (Ontario Geological Survey 2016).

Sample 11-CG-738 comprises glaciofluvial sand and gravel and has anomalous concentrations of both uranium and thorium (Figures 53 and 54). The sample was collected in an esker and the anomalies could have a distant source. Samples 14-CG-070 and 11-CG-658 show anomalous levels of thorium and uranium, respectively (Figures 53 and 54). The former is located about 20 km southwest of the Lackner Lake alkalic complex and is within the distal part of the uranium and thorium dispersal feature emanating from this intrusion (Figures 53 and 54). The anomaly may thus have a source in this alkalic intrusion.

Sample 11-CG-658, located on the northwestern corner of the survey area, exhibits a strong uranium anomaly. In addition, a sample immediately adjacent to it to the southeast also shows elevated level of this element (Figure 53). To compare, the previous lake sediment sampling also showed anomalous levels of uranium in the nearby lakes, confirming the uranium anomaly in this area (Figure 55) (Ontario Geological Survey 2000a, 2000b). There are no alkalic-carbonatite intrusions known in the vicinity that could serve as a possible source for the anomaly. Alternatively, this anomaly may be related to the extensive tonalitic and granitic rocks within this area. This hypothesis requires further work for confirmation.

To summarize, anomalous concentrations of uranium and thorium occur along a distinct south-southwest dispersal feature emanating from the Lackner Lake alkalic complex. The prominent anomalies indicate potential mineralization in the source rocks, consistent with the reported uranium and thorium occurrences in this alkalic complex. Anomalous uranium and thorium at the Borden Lake property may be linked to the Borden Township carbonatite complex less than 5 km to the northeast. Anomalies also occur in a few isolated samples but their source areas remain largely unknown.

Conclusions

The heavy mineral and bulk sample geochemistry data suggest potential for gold, kimberlite (diamond) and REE mineralization. The survey area has a low background value for gold grains (<5 grains) as indicated by both the current till sampling and previous modern alluvium sampling surveys. However, both the gold grain counts (14 to 33 grains) and <0.063 mm bulk sample geochemistry show prominent anomalies on the Borden Lake property and agree well with the known gold deposit there. Furthermore, the gold grain data indicate potential for additional gold mineralization to the north of the Borden Lake property (i.e., north of Highway 101). Elsewhere, anomalous gold grains were recovered from 2 additional sites. The one located on Sheppard and Morse Road (Pineal Lake Road) in the southern part of the survey has 2 till samples where up to 23 gold grains were recovered. The other site is located on Lafrenière Road in the northern part of the survey and it contains a single till sample that has yielded 29 gold grains. Based on the data available, these 2 sites are suggested for further higher density till sampling and prospecting.

The total KIM grain counts, the sum of pyrope garnet, picroilmenite and chrome diopside, are low in general, not exceeding 4 grains. However, till sample 11-CG-127 near the eastern boundary of the survey area has yielded 59 KIM grains of picroilmenite. An additional site was identified in the previous OGS modern alluvium sampling where 25 picroilmenite grains were recovered from sample KAP-0513 in the northwest of the current survey area. A kimberlite boulder was collected in a sand and gravel pit in the Chapleau II end moraine on Island Lake Road near the western boundary of the survey area. The boulder appears to derive from a hypabyssal kimberlite dike and has a heavy mineral suite that contains abundant picroilmenite, chromite and pyrope garnet grains. Although the source areas remain undiscovered, the presence of the anomalous KIM grains and the kimberlite boulder indicate good potential for finding kimberlites in the survey area.

The phosphate mineral apatite was recovered in high concentrations throughout the study area, making up to 60% of the 0.25 to 0.5 mm nonmagnetic heavy mineral concentrate locally. The most prominent anomaly of this mineral occurs along a dispersal feature emanating from the Lackner Lake alkalic complex, agreeing closely with phosphorus concentrations in the <0.063 mm fraction bulk sample. The phosphorus anomaly has a direct link with this alkalic intrusion. As well, the geochemistry of the <0.063 mm fraction bulk sample shows multiple, anomalous concentrations in REEs, niobium, uranium and thorium along the same dispersal feature, consistent with the reported occurrence of these elements in this alkalic intrusion. This dispersal feature also exhibits anomalous levels of base metal elements including zinc and lead. In addition, anomalous apatite grain counts were recovered in an area on Nemegos Road about 4 km north-northwest of the Lackner Lake alkalic complex and they are likely derived from an unknown alkalic-carbonatite source to the north-northeast in the up-ice direction. Anomalous concentrations of REEs were also found in the <0.063 mm fraction bulk sample geochemistry at several other sites. Because they have no direct connections to any of the known alkalic and carbonatite intrusions, the anomalies indicate the potential for additional REE mineralization in the survey area.

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References

Averill, S.A. 1999. The application of heavy indicator mineralogy in mineral exploration; *in* Drift exploration in glaciated terrain, short course notes; Society of Exploration Geochemists, 19th International Geochemical Exploration Symposium, Vancouver, B.C., p.117-132.

Bajc, A.F. and Crabtree, D.C. 2001. Results of regional till sampling for kimberlite and base metal indicator minerals, Peterlong Lake–Radisson Lake area, northeastern Ontario; Ontario Geological Survey, Open File Report 6060, 65p.

Barnett, P.J. 1992. Quaternary geology of Ontario; *in* Geology of Ontario, Ontario Geological Survey, Special Volume 4, Part 2, p.1011-1088.

Barnett, P.J. and Averill, S. 2010. Heavy mineral dispersal trains in till in the area of the Lac des Iles PGE deposit, northwestern Ontario, Canada; Geochemistry: Exploration, Environment, Analysis, v.10, no.4, p. 391-399.

Bernier, M.A. 1998a. Quaternary geology, Rollo Lake area; Ontario Geological Survey, Map 2488, scale 1:50 000.

Bernier, M.A. 1998b. Quaternary geology, Sultan area; Ontario Geological Survey, Map 2489, scale 1:50 000.

Boissonneau, A.N. 1968. Glacial history of northeastern Ontario II. The Timiskaming–Algoma area; Canadian Journal of Earth Sciences, v.5, p.97-109.

Crabtree, D.C. 2003. Preliminary results from the James Bay Lowland indicator mineral sampling program; Ontario Geological Survey, Open File Report 6108, 115p.

Duguet, M. and Szumylo, N. 2016. Archean and Proterozoic geology of the Borden Lake area, Kapuskasing structural zone, Abitibi–Wawa terrane; *in* Summary of Field Work and Other Activities 2016, Ontario Geological Survey, Open File Report 6323, p.4-1 to 4-20.

Dyke, A.S. 2004. An outline of North American deglaciation with emphasis on central and northern Canada; *in* Quaternary glaciations: Extent and chronology, Part II: North America, Elsevier, Amsterdam, The Netherlands, Developments in Quaternary Science, v.2b, p.373-424.

Dzick, W. 2014. Probe Mines Limited mineral resource estimate update, Borden Gold Project, prepared for Probe Mines Limited; Technical Report NI 43-101, filed June 10, 2014 with SEDAR®, *see* SEDAR Home Page, 179p.

Evans, L.J. and Cameron, B.H. 1984. Reconnaissance soil survey of the Chapleau–Foleyet area, northern Ontario; Ontario Ministry of Natural Resources, 40p.

Fipke, C.E., Gurney, J.J. and Moore, R.O. 1995. Diamond exploration techniques emphasizing indicator mineral geochemistry and Canadian examples; Geological Survey of Canada, Bulletin 423, 86p.

Gao, C. 2011. Surficial geology mapping and till sampling in the Chapleau area, northern Ontario; *in* Summary of Field Work and Other Activities 2011, Ontario Geological Survey, Open File Report 6270, p.20-1 to 20-5.

——— 2012a. Results of regional till sampling in the Cobalt–New Liskeard–Englehart areas, northern Ontario; Ontario Geological Survey, Open File Report 6259, 87p.

——— 2012b. Till sample and indicator mineral data for the Cobalt, New Liskeard and Englehart areas, northern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 284.

——— 2013a. Quaternary geology, Burntbush area, northeastern Ontario; Ontario Geological Survey, Preliminary Map P.3770, scale 1:100 000.

——— 2013b. Quaternary geology, Detour Lake area, northeastern Ontario; Ontario Geological Survey, Preliminary Map P.3669, scale 1:50 000.

——— 2013c. Surficial geology mapping and till sampling in the Chapleau area, northern Ontario: Second phase; *in* Summary of Field Work and Other Activities 2013, Ontario Geological Survey, Open File Report 6290, p.27-1 to 27-5.

——— 2015. Results of regional till sampling in the Detour Lake and Burntbush area, northern Ontario; Ontario Geological Survey, Open File Report 6297, 120p.

——— 2016a. Quaternary geology, Chapleau area, northern Ontario; Ontario Geological Survey, Preliminary Map P.3789, scale 1:50 000.

——— 2016b. Quaternary geology, Nemegos area, northern Ontario; Ontario Geological Survey, Preliminary Map P.3790, scale 1:50 000.

——— 2016c. Quaternary geology, Swanson River area, northern Ontario; Ontario Geological Survey, Preliminary Map P.3788, scale 1:50 000.

——— 2016d. Indicator mineral and till bulk sample geochemistry data, Chapleau area, northern Ontario; Ontario Geological Survey; Miscellaneous Release—Data 331.

Gao, C. and Crabtree, D.C. 2016. Results of regional till and modern alluvium sampling in the McFaulds Lake ("Ring of Fire") area, northern Ontario; Ontario Geological Survey, Open File Report 6309, 164p.

Gao, C., Crabtree, D.C. and Dyer, R.D. 2016. Till and alluvium sample, indicator mineral and geochemistry data for the McFaulds Lake ("Ring of Fire") area, Far North of Ontario; Ontario Geological Survey, Miscellaneous Release—Data 322.

Gao, C., Wywrot, A. and Zhu, D. 2014. Surficial geology mapping and till sampling in the Chapleau area, northern Ontario: A progress report; *in* Summary of Field Work and Other Activities 2014, Ontario Geological Survey, Open File Report 6300, p.24-1 to 24-7.

Grabowski, G.P.B. and Wilson, A.C. 2005. Sampling lamprophyre dikes for diamonds: Discover Abitibi Initiative; Ontario Geological Survey, Open File Report 6170, 262p.

Griffin, W.L., Ryan, C.G., Gurney, J.J., Sobolev, N.V. and Win, T.T. 1994. Chromite macrocrysts in kimberlites and lamproites: Geochemistry and origin; *in* Kimberlites, related rocks and mantle xenoliths; Companhia de Pesquisa de Recursos Minerais, Rio de Janeiro, Brazil, Special Publication 1A, p.366-377.

Grütter, H.S., Gurney, J.J., Menzies, A.H. and Winter, F. 2004. An updated classification scheme for mantle-derived garnet, for use by diamond explorers; Lithos, v.77, p.841-857.

Hughes, O.L. 1965. Surficial geology of part of the Cochrane District, Ontario, Canada; *in* International Studies on the Quaternary, 7th International Quaternary Association (INQUA) Congress, Geological Society of America, Special Paper 84, p.535-565.

Kong, J.M., Boucher, D.R. and Scott–Smith, B.H. 1999. Exploration and geology of the Attawapiskat kimberlites, James Bay Lowlands, northern Ontario, Canada; *in* The J.B. Dawson Volume, Proceedings of the Seventh International Kimberlite Conference, Cape Town, South Africa, v.1, p.452-467.

Lee, H.A. and Scott, S.A. 1980. Missinaibi Lake, NTS 42B/SW, data base map, northern Ontario engineering geology terrain study; Ontario Geological Survey, M5101, scale 1:100 000.

Mackay, D.A.R., Simandl, G.J., Ma, W., Redfearn, M. and Gravel, J. 2016. Indicator mineral-based exploration for carbonatites and related specialty metal deposits—A QEMSCAN® orientation survey, British Columbia, Canada; Journal of Geochemical Exploration, v.165, p.159-173.

McClenaghan, M.B., Gauvreau, D. and Kjarsgaard, B.A. 2009. Mineral chemistry data for kimberlite, surficial sediments and kimberlite boulders from the Lake Timiskaming and Kirkland Lake kimberlite fields, Ontario and Quebec; Geological Survey of Canada, Open File 5833.

McMartin, I. and McClenaghan, M.B. 2001. Till geochemistry and sampling techniques in glaciated terrain: A review; *in* Drift exploration in glaciated terrain, Geological Society, Special Publication No.185, p.19-43.

Meinhold, G. 2010. Rutile and its applications in earth sciences; Earth-Science Reviews, v.102, p.1-28.

Mitchell, R.H. 1986. Kimberlites, mineralogy, geochemistry, and petrology; Plenum Press, New York, 442p.

Morris, T.F. 2000. Kimberlite, base metal, gold and carbonatite exploration targets, derived from overburden heavy mineral data, Killala lake area, northwestern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 52.

Morris, T.F., Sage, R.P., Ayer, J.A. and Crabtree, D.C. 2002. A study of clinopyroxene composition: Implications for kimberlite exploration; Geochemistry: exploration, environment, analysis, v.2, no.4, p.321-331.

Morris, T.F., Sage, R.P., Crabtree, D.C. and Pitre, S.A. 2000. Kimberlite, base metal, gold and carbonatite exploration targets, derived from overburden heavy mineral data, Killala Lake Area, northwestern Ontario; Ontario Geological Survey, Open File Report 6013, 107p.

Morris, T.F., Crabtree, D.C., Sage, R.P. and Averill, S.A. 1998. Types, abundances and distribution of kimberlite indicator minerals in alluvial sediments, Wawa–Kinniwabi Lake area, northeastern Ontario; implications for the presence of diamond-bearing kimberlite; Journal of Geochemical Exploration, v.63, p.217-235.

Murahwi, C., Gowans, R. and Martin, A.J.S. 2012. Technical report on the updated mineral resource estimate for the Borden Lake gold deposit, Borden Lake property, northern Ontario, Canada; NI 43-101 Technical Report for Probe Mines Limited, March 13, 2012, 188p.

Ontario Geological Survey 1997. Quaternary geology, seamless coverage of the province of Ontario; Ontario Geological Survey, Data Set 14.

——— 2000a. Foleyet–Missinaibi area lake sediment survey: Operation Treasure Hunt—Area A; Ontario Geological Survey, Open File Report 6014, 122p.

——— 2000b. Foleyet–Missinaibi area lake sediment survey: Operation Treasure Hunt—Area A; Ontario Geological Survey, Miscellaneous Release—Data 54.

——— 2001a. Modern alluvium data release, Foleyet Area, Northeastern Ontario: Operation Treasure Hunt, Ontario Geological Survey, Miscellaneous Release—Data 83.

——— 2001b. Results of modern alluvium sampling, Chapleau area, northeastern Ontario: Operation Treasure Hunt—Kapuskasing Structural Zone; Ontario Geological Survey, Open File Report 6063, 164p.

——— 2001c. Results of modern alluvium sampling, Chapleau area, northeastern Ontario: Operation Treasure Hunt–Kapuskasing Structural Zone; Ontario Geological Survey, Miscellaneous Release—Data 82.

——— 2001d. Results of modern alluvium sampling, Foleyet area, northeastern Ontario: Operation Treasure Hunt–Kapuskasing Structural Zone; Ontario Geological Survey, Open File Report 6065, 144p.

——— 2011. 1:250 000 scale bedrock geology of Ontario; Ontario Geological Survey, Miscellaneous Release—Data 126–Revision 1.

——— 2016. Mineral Deposit Inventory—2016; Ontario Geological Survey.

Prest, V.K., Donaldson, J.A. and Mooers, H.D. 2000. The omar story: the role of omars in assessing glacial history of west-central North America; Géographie physique et Quaternaire, v.54, p.257-270.

Reid, J.L. 2002. Regional modern alluvium sampling survey of the Mattawa–Cobalt corridor, northeastern Ontario; Ontario Geological Survey, Open File Report 6088, 235p.

Ripp, G. S., Karmanov, N. S., Doroshkevich, A. G., Badmatsyrenov, M. V. and Izbrodin, I. A. 2006. Chrome-bearing mineral phases in the carbonatites of northern Transbaikalia; Geochemistry International, v.44, p.395-402.

Roed, M.A. and Hallett, D.R. 1979. Northern Ontario engineering geology terrain study, engineering capability map, Chapleau, NTS 41O/NW, M5018, scale 1:100 000.

Sage, R.P. 1992. Alkalic rock, carbonatite and kimberlite complexes of Ontario, Superior Province; *in* Geology of Ontario, Ontario Geological Survey, Special Volume 4, Part 1, p.683-709.

——— 1996. Kimberlites of the Lake Timiskaming Structural Zone; Ontario Geological Survey, Open File Report 5937, 435p.

——— 2000a. Kimberlites of the Attawapiskat area, James Bay Lowlands; Ontario Geological Survey, Open File Report 6019, 341p.

——— 2000b. Kimberlites of the Lake Timiskaming Structural Zone: Supplement; Ontario Geological Survey, Open File Report 6018, 123p.

Schulze, D.J. 2003. A classification scheme for mantle-derived garnets in kimberlite: A tool for investigating the mantle and exploring for diamonds; Lithos, v.7, p.195-213.

Shilts, W.W. and Kettles, I.M. 1990. Geochemical–mineralogical profiles through fresh and weathered till; Glacial indicator tracing, Balkema, Rotterdam, p.187-216.

Thurston, P.C., Siragusa, G.M. and Sage, R.P. 1971. Geological series, Operation Chapleau, Chapleau sheet, districts of Algoma and Sudbury, P.674, scale 1:126 720.

Veillette, J.J. 2007. Géologie des formations en surface et histoire glaciaire, Rivière Harricana, Québec; Geological Survey of Canada, Map 1993A, scale 1:100 000.

Veillette, J.J. and Thibaudeau, P. 2007. Géologie des formations en surface et histoire glaciaire, Rivière Wawagosic, Québec; Geological Survey of Canada, Map 1995A, scale 1:100 000.

Veillette, J.J., Ménard, M., St-Jacques, G., Roy, M., Paulen, R.C. and Paradis, S.J. 2015. The buried component of the James Bay Winisk ice stream; abstract *in* Canadian Quaternary Association, 2015 CANQUA, Biennial Meeting, St. John's, Newfoundland and Labrador, August 16-19, 2015, p.82-83.

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Data

Proportional Dot Plots

Figures 5, 10, 11, 13, 16, 18 to 23, 28 to 38 and 40 to 55

The following figures contain the data discussed in the report as proportional dot plots.

These figures are provided in this location for ease of discovery and retrieval and include Figures 5, 10, 11, 13, 16, 18 to 23, 28 to 38 and 40 to 55. The remaining figures are interspersed within the main body of the report.

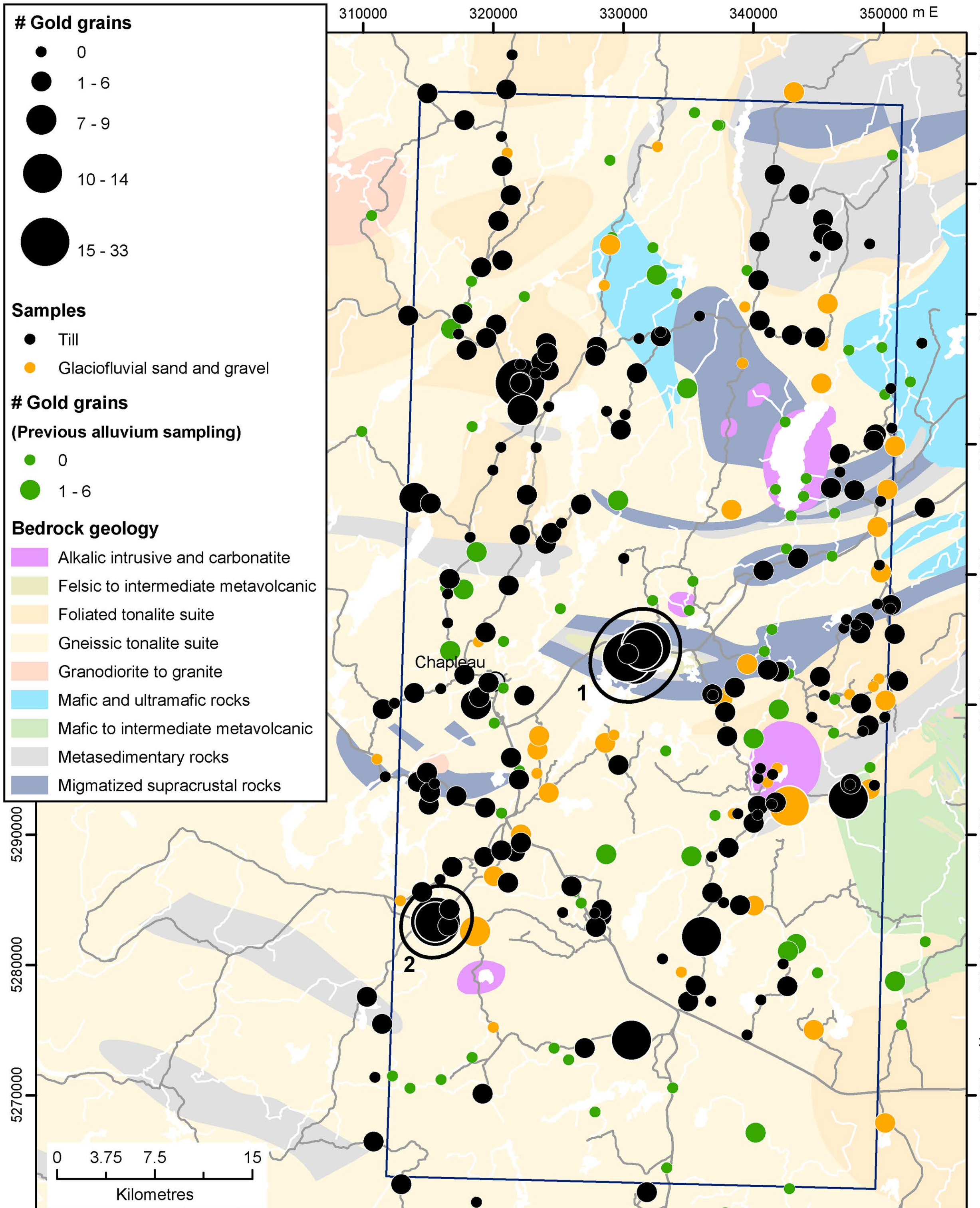

Figure 5. Regional distribution of gold grains in till and glaciofluvial sand and gravel in the Chapleau survey area. Data include results from previous (modern) alluvium sampling by Ontario Geological Survey (2001a-d).

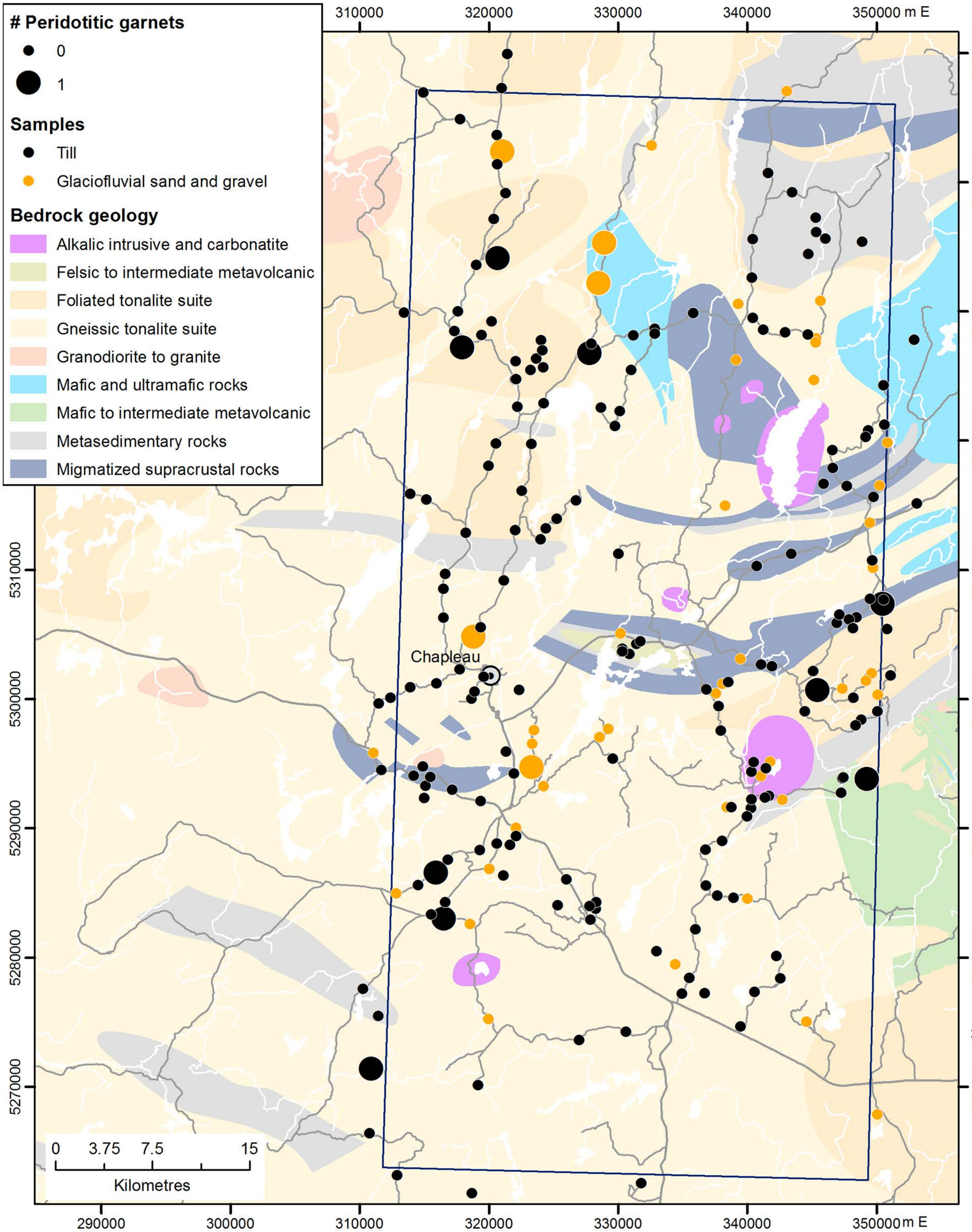

Figure 10. Regional distribution of peridotitic garnet grains for the Chapleau survey area.

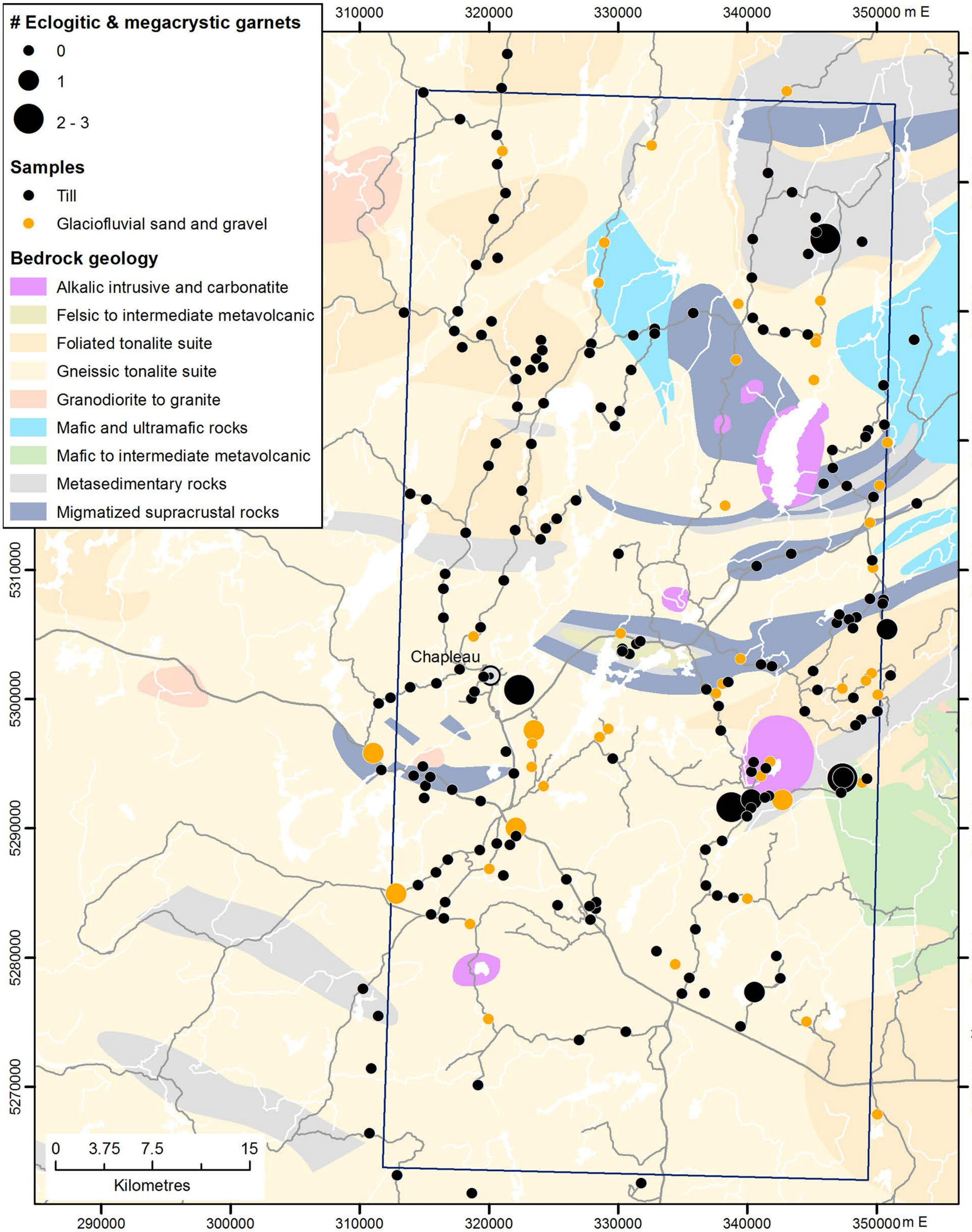

Figure 11. Regional distribution of eclogitic and megacrystic garnet grains for the Chapleau survey area.

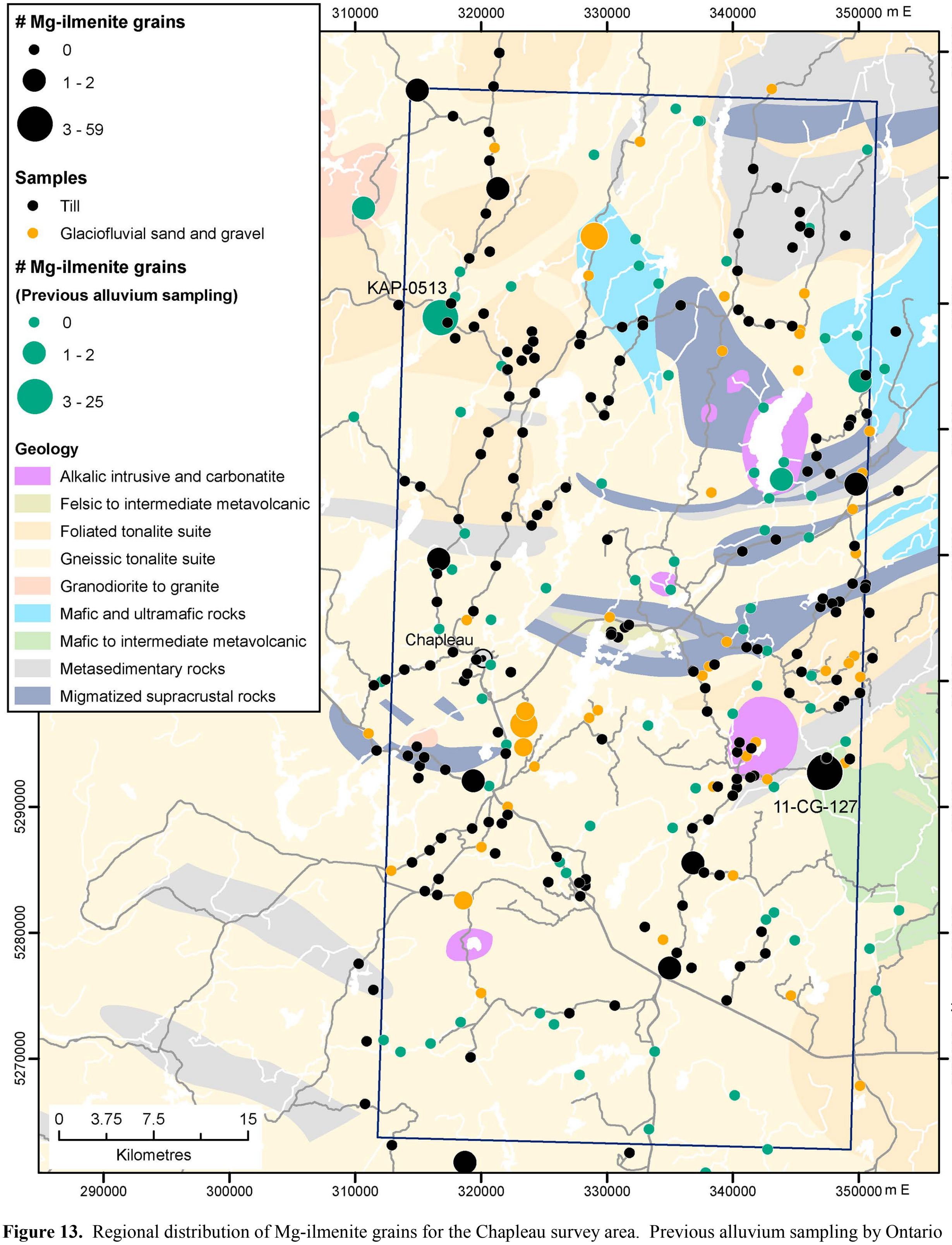

Figure 13. Regional distribution of Mg-ilmenite grains for the Chapleau survey area. Previous alluvium sampling by Ontario Geological Survey (2001a-d).

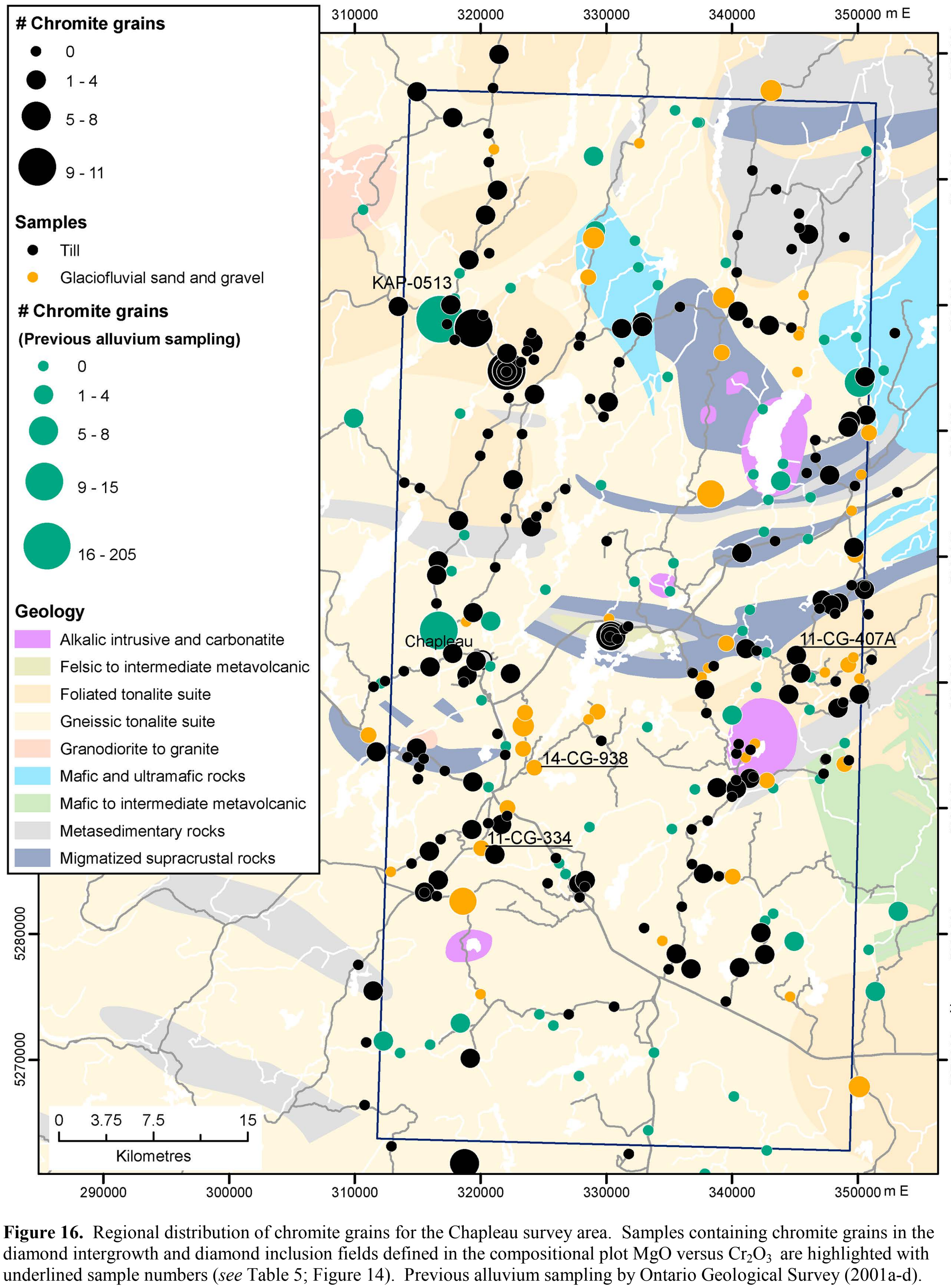

Figure 16. Regional distribution of chromite grains for the Chapleau survey area. Samples containing chromite grains in the diamond intergrowth and diamond inclusion fields defined in the compositional plot MgO versus Cr_2O_3 are highlighted with underlined sample numbers (*see* Table 5; Figure 14). Previous alluvium sampling by Ontario Geological Survey (2001a-d).

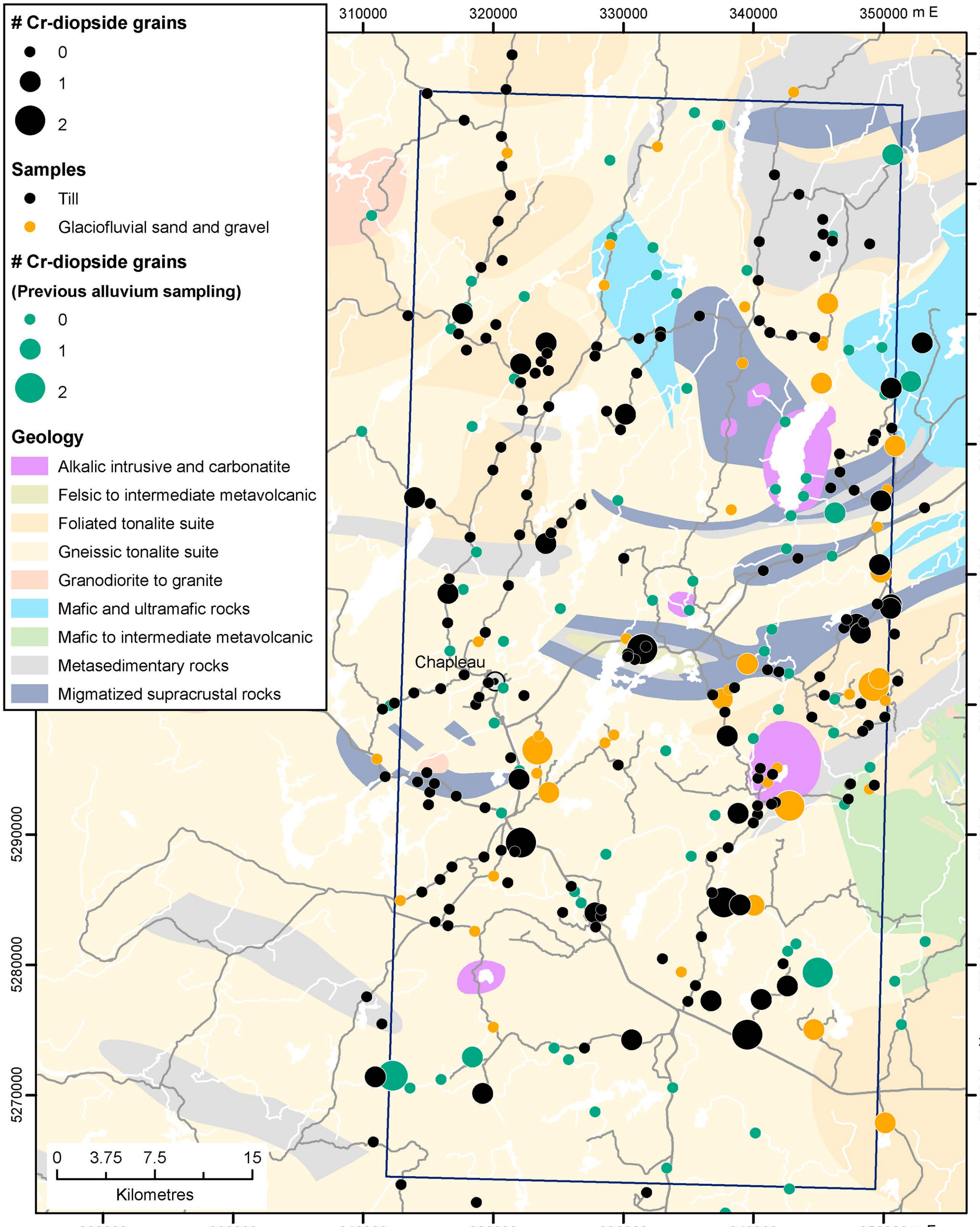

Figure 18. Regional distribution of Cr-diopside grains for the Chapleau survey area. Previous alluvium sampling by Ontario Geological Survey (2001a-d).

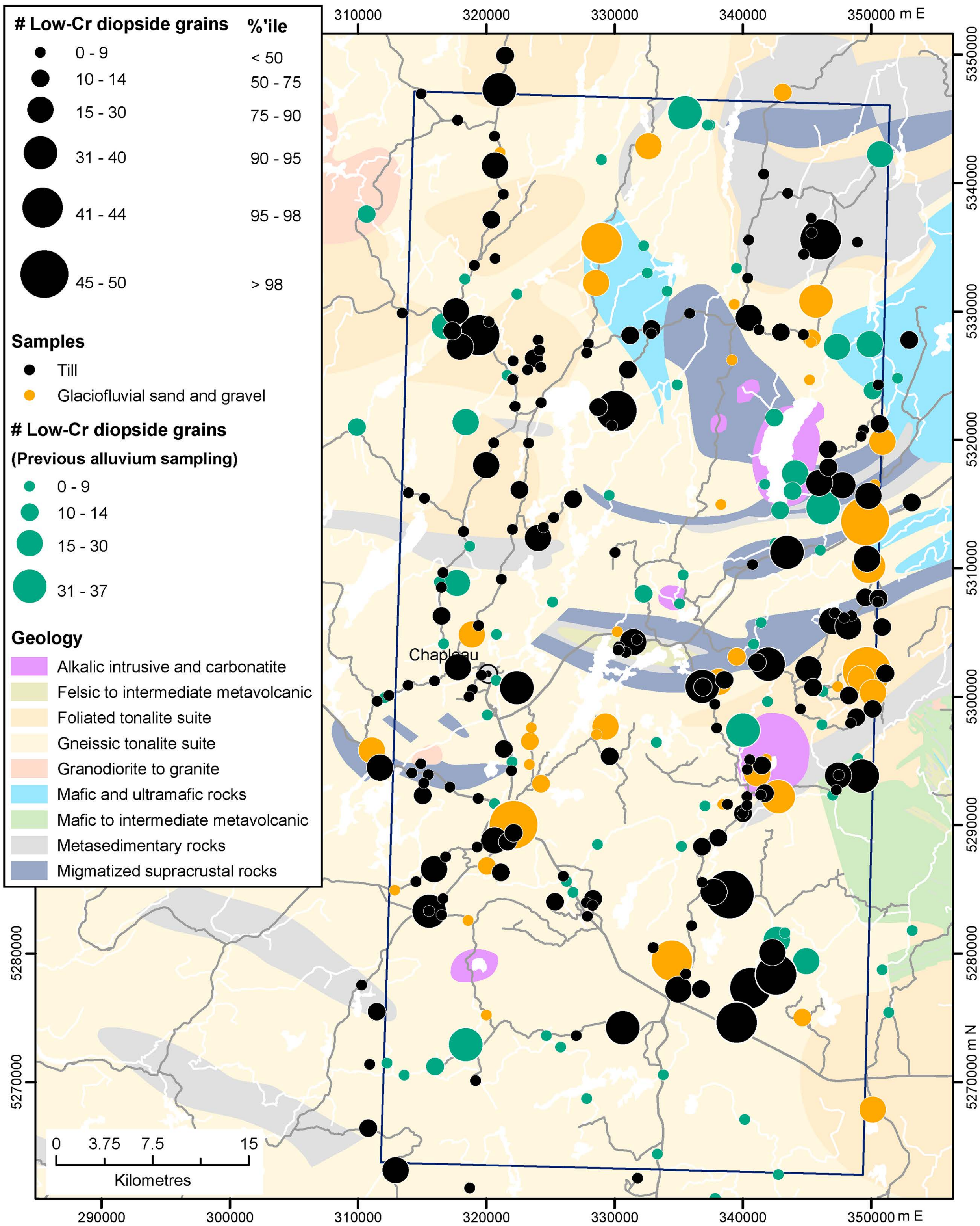

Figure 19. Regional distribution of low-Cr diopside grains for the Chapleau survey area. Previous alluvium sampling by Ontario Geological Survey (2001a-d).

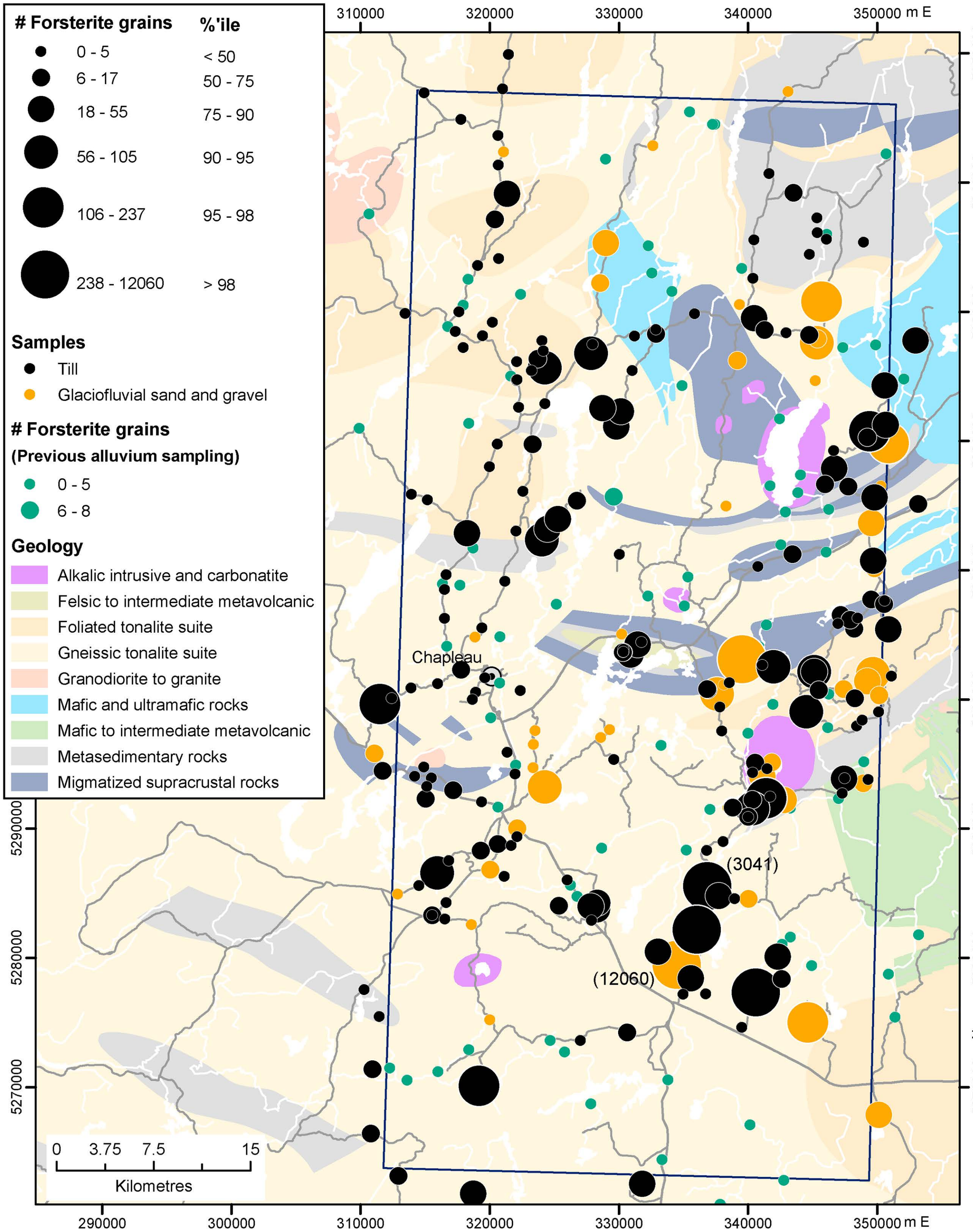

Figure 20. Regional distribution of forsterite (olivine) grains for the Chapleau survey area. Numbers in brackets are the highest grain counts per 10 kg sample in the survey area. Previous alluvium sampling by Ontario Geological Survey (2001a-d).

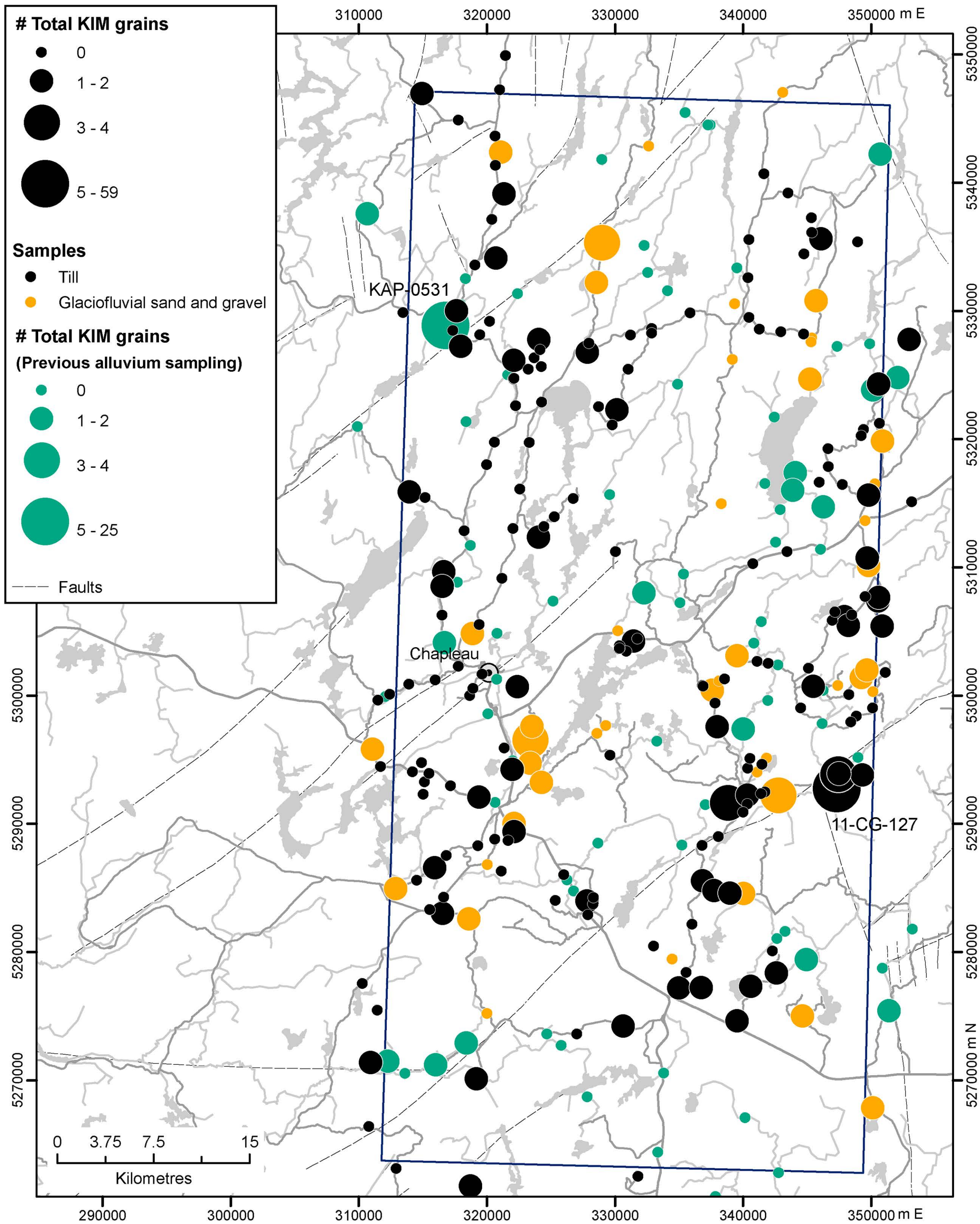

Figure 21. Regional distribution of total KIM grains (pyrope garnets, Mg-ilmenite and Cr-diopside) for the Chapleau survey area. Previous alluvium sampling by Ontario Geological Survey (2001a-d).

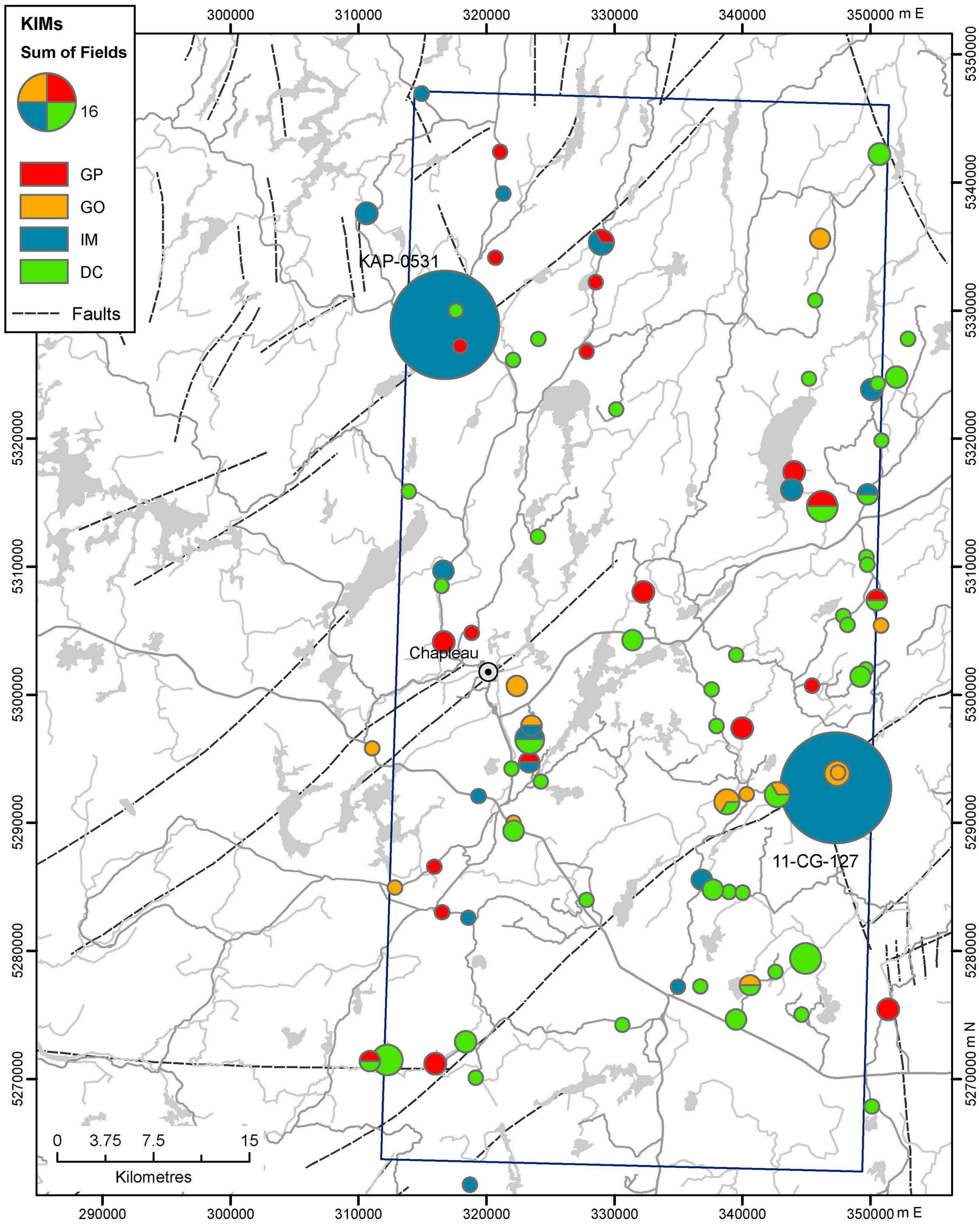

Figure 22. Regional distribution of total KIM grains in pie charts, for the Chapleau survey area. Refer to Figure 21 for the quantity of total KIM grains with respect to the size of the symbols at sample sites.

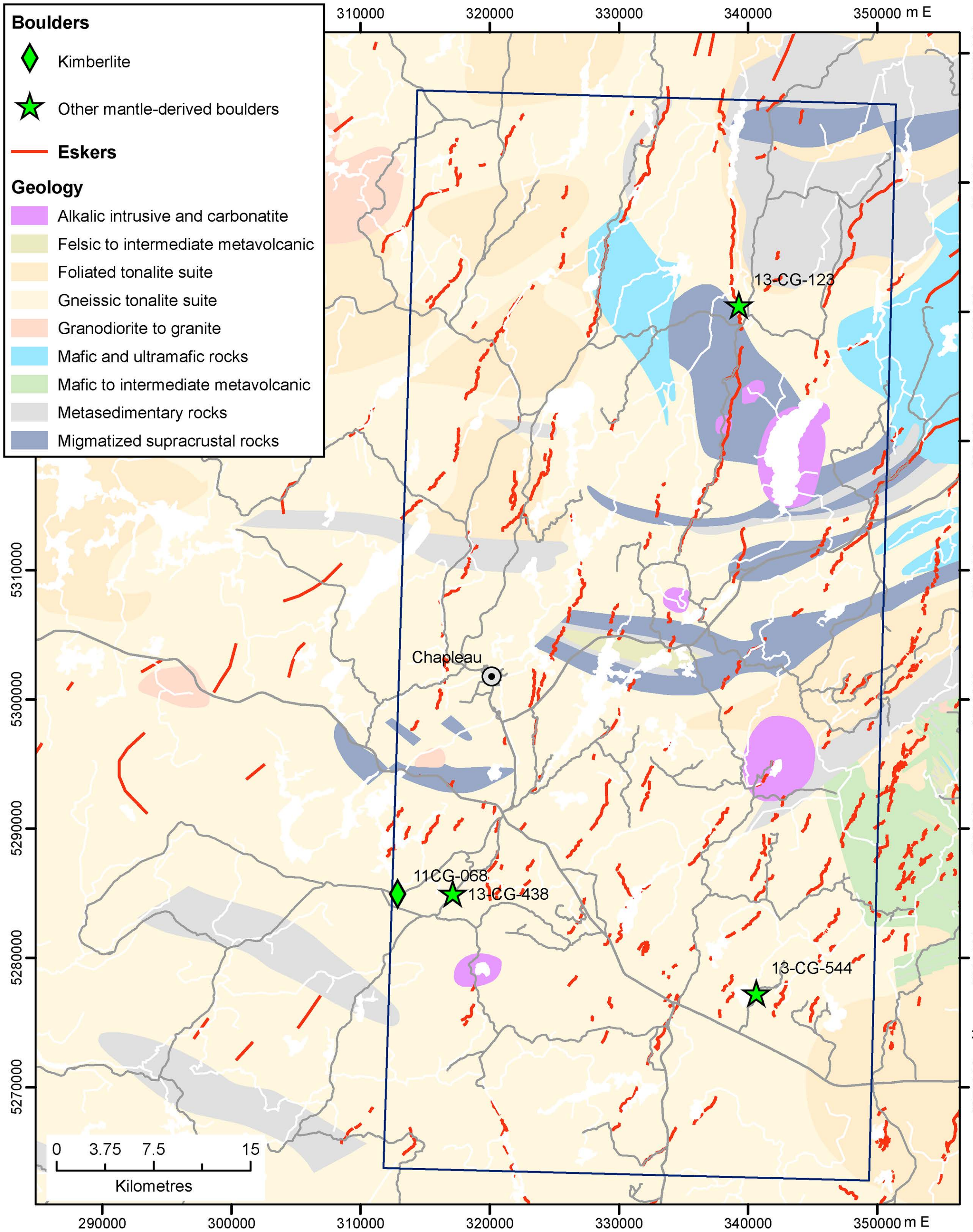

Figure 23. Locations of kimberlite (11-CG-068-K) and other mantle-derived boulders in the Chapleau survey area.

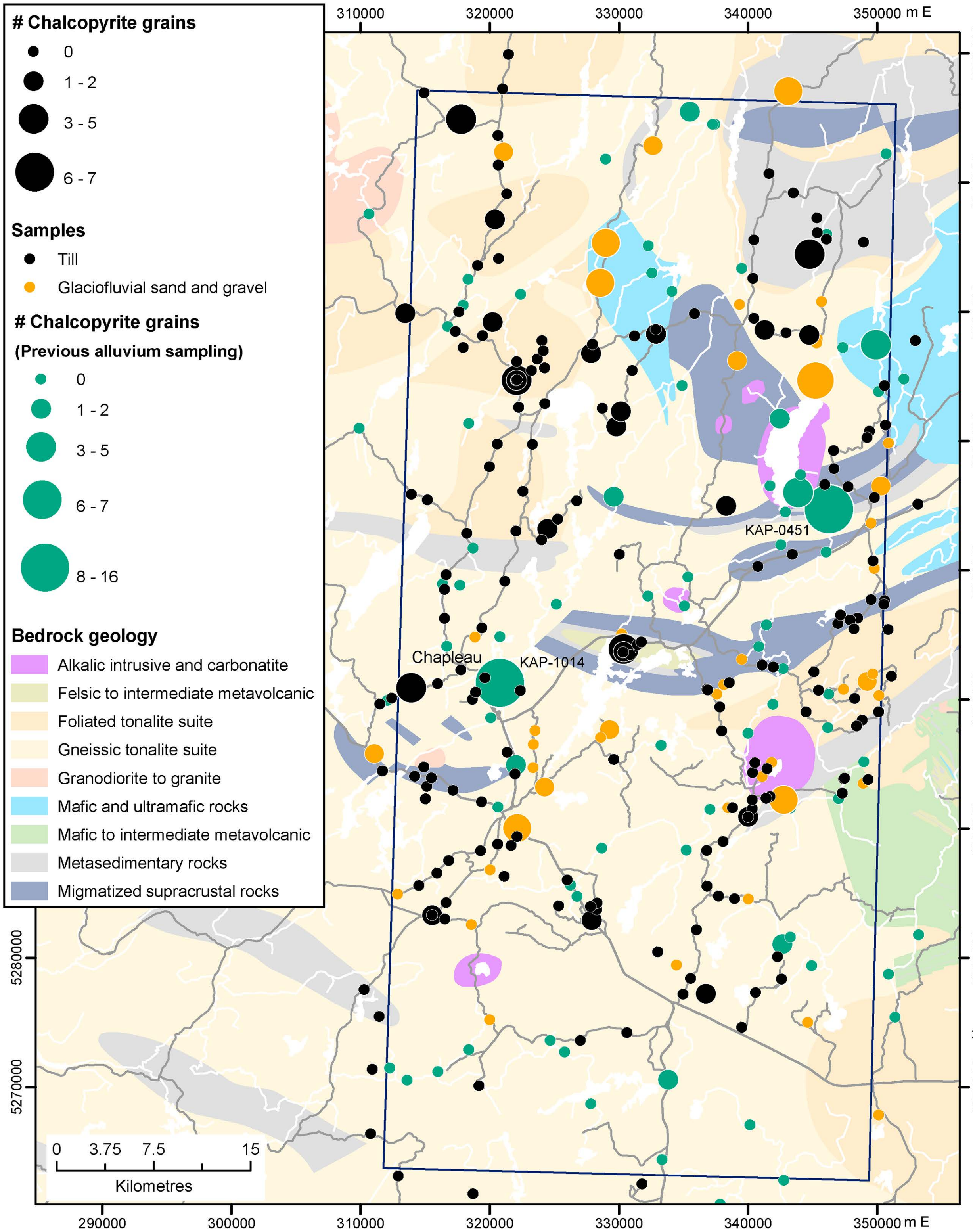

Figure 28. Regional distribution of chalcopyrite grains for the Chapleau survey area. Previous alluvium sampling by Ontario Geological Survey (2001a-d).

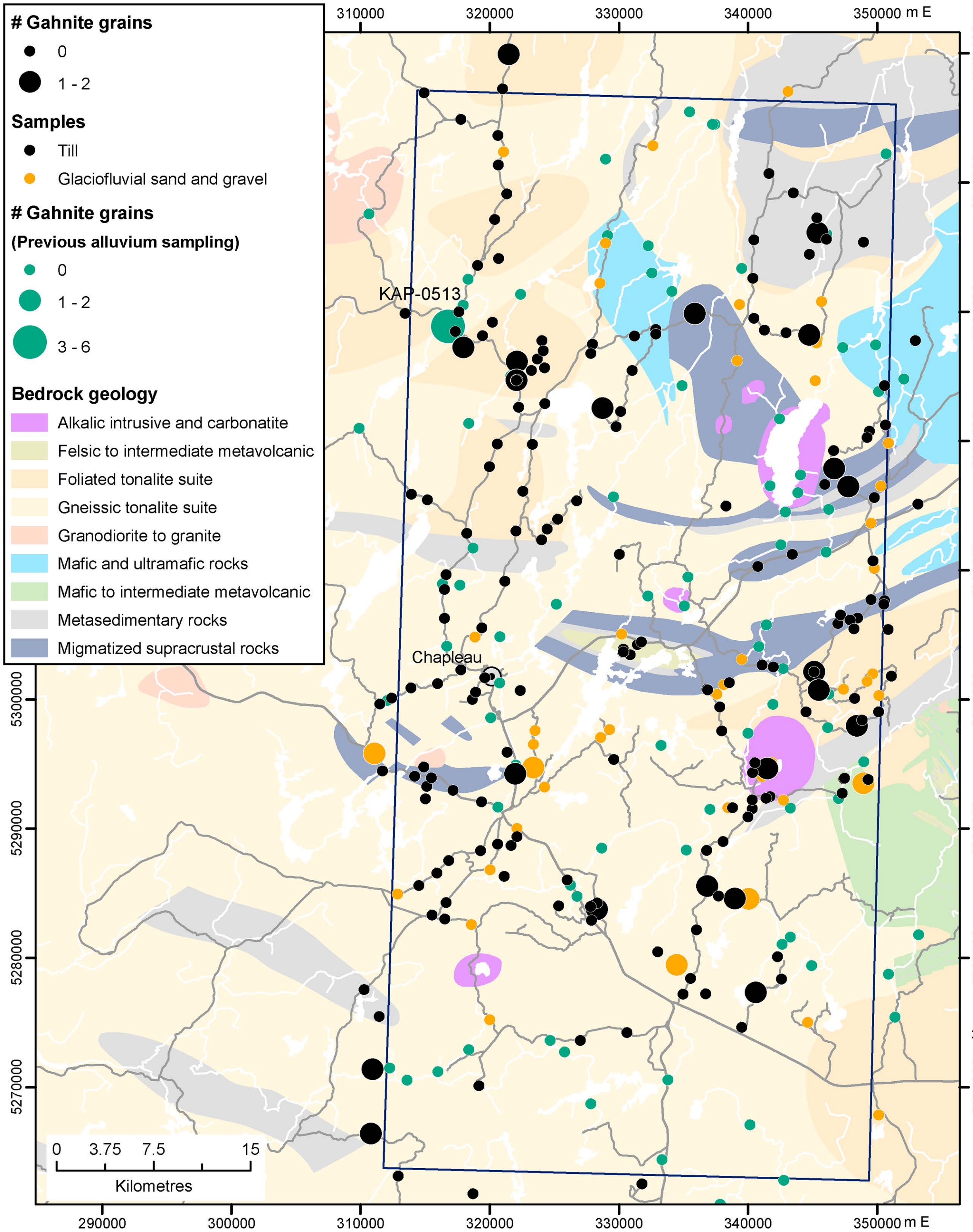

Figure 29. Regional distribution of gahnite grains for the Chapleau survey area. Previous alluvium sampling by Ontario Geological Survey (2001a-d).

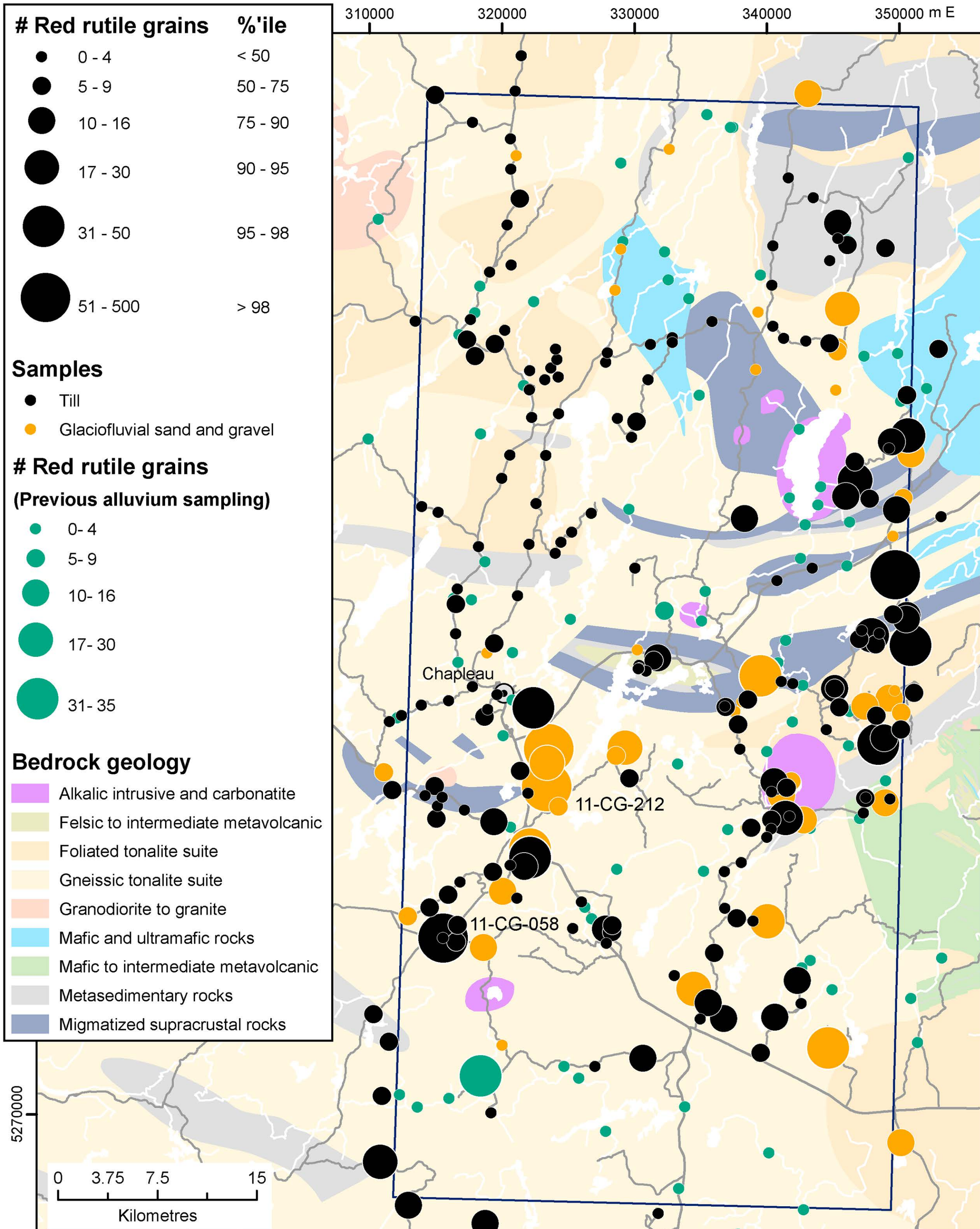

Figure 30. Regional distribution of red rutile grains for the Chapleau survey area.

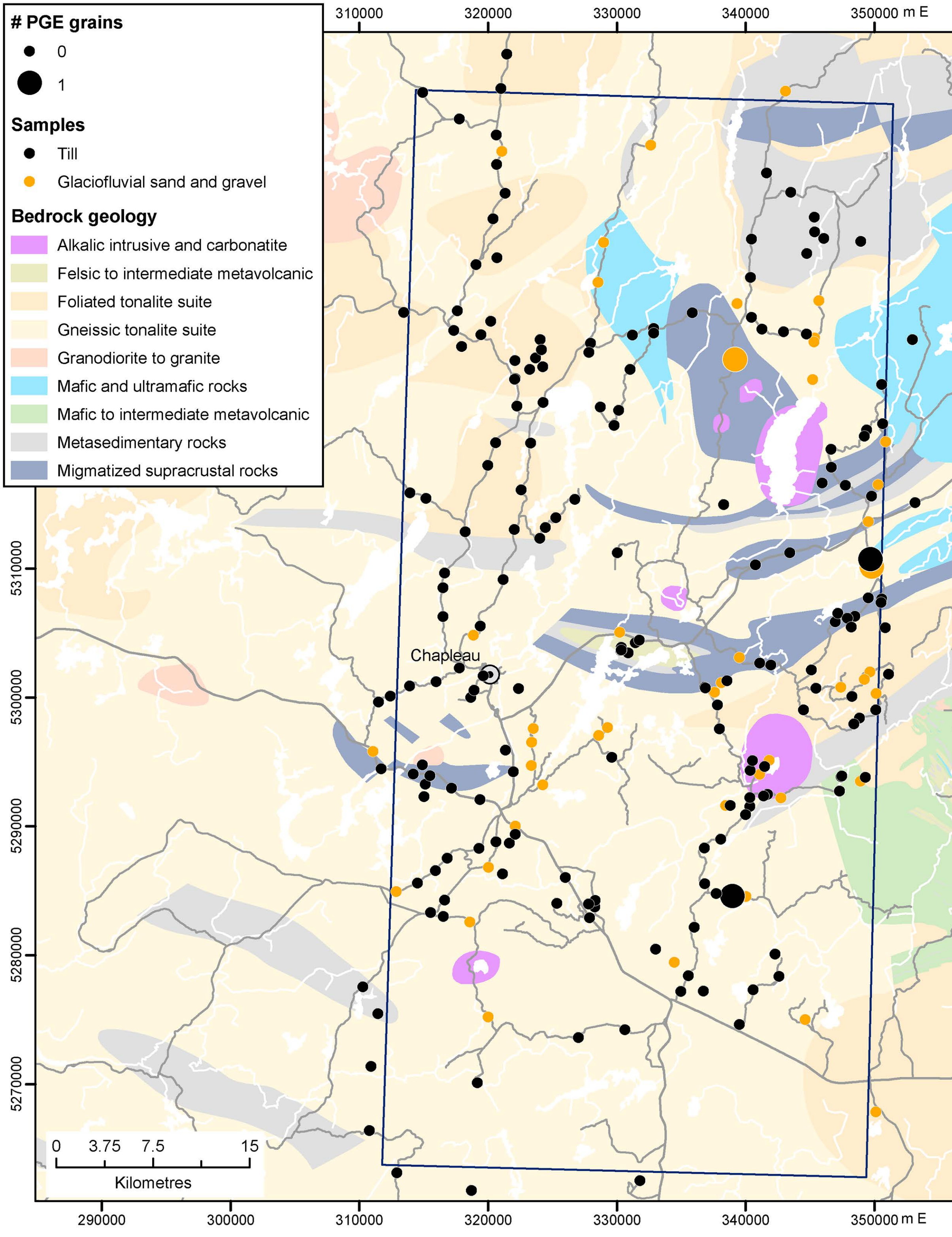

Figure 31. Regional distribution of PGE sulphide grains for the Chapleau survey area.

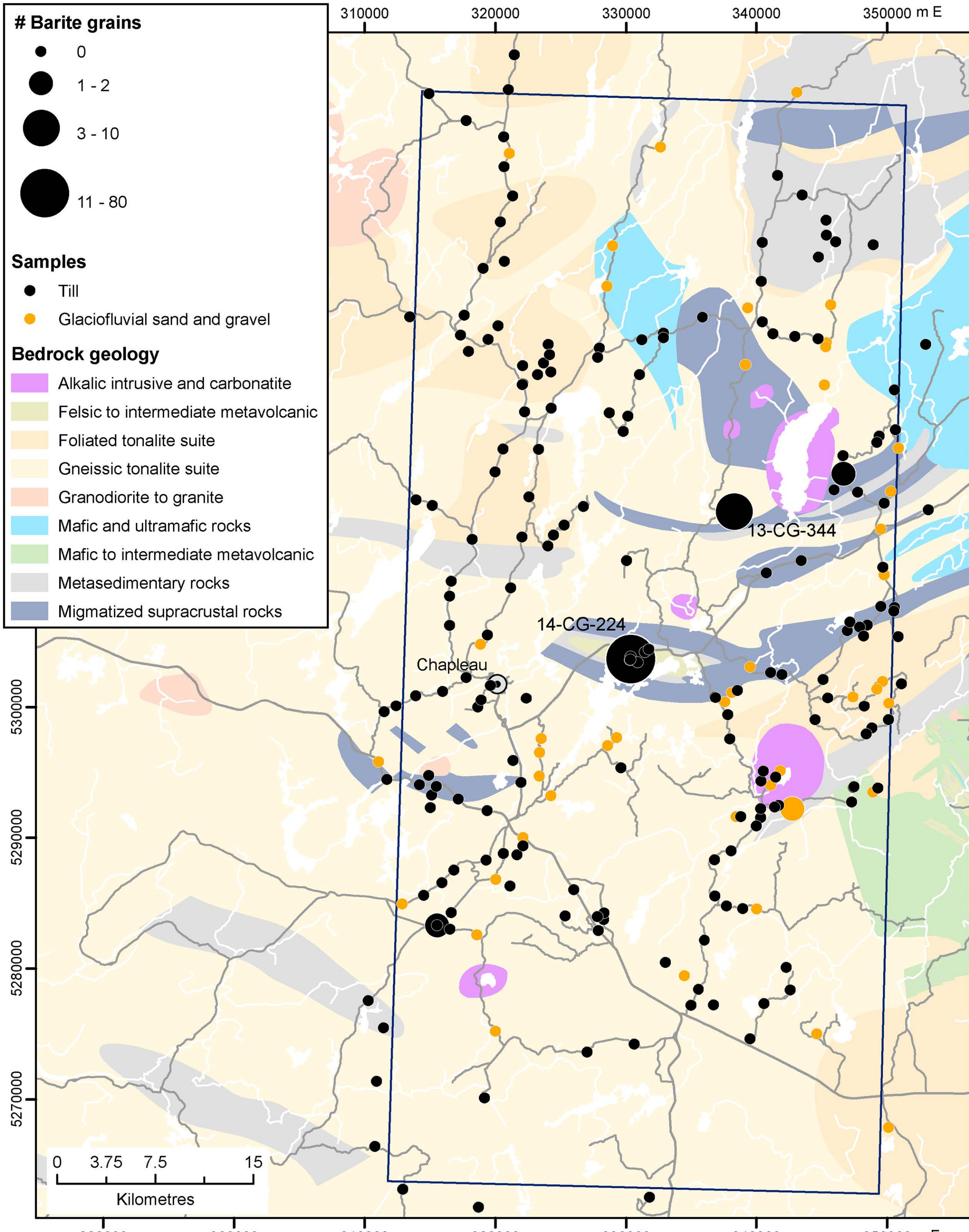

Figure 32. Regional distribution of barite grains for the Chapleau survey area.

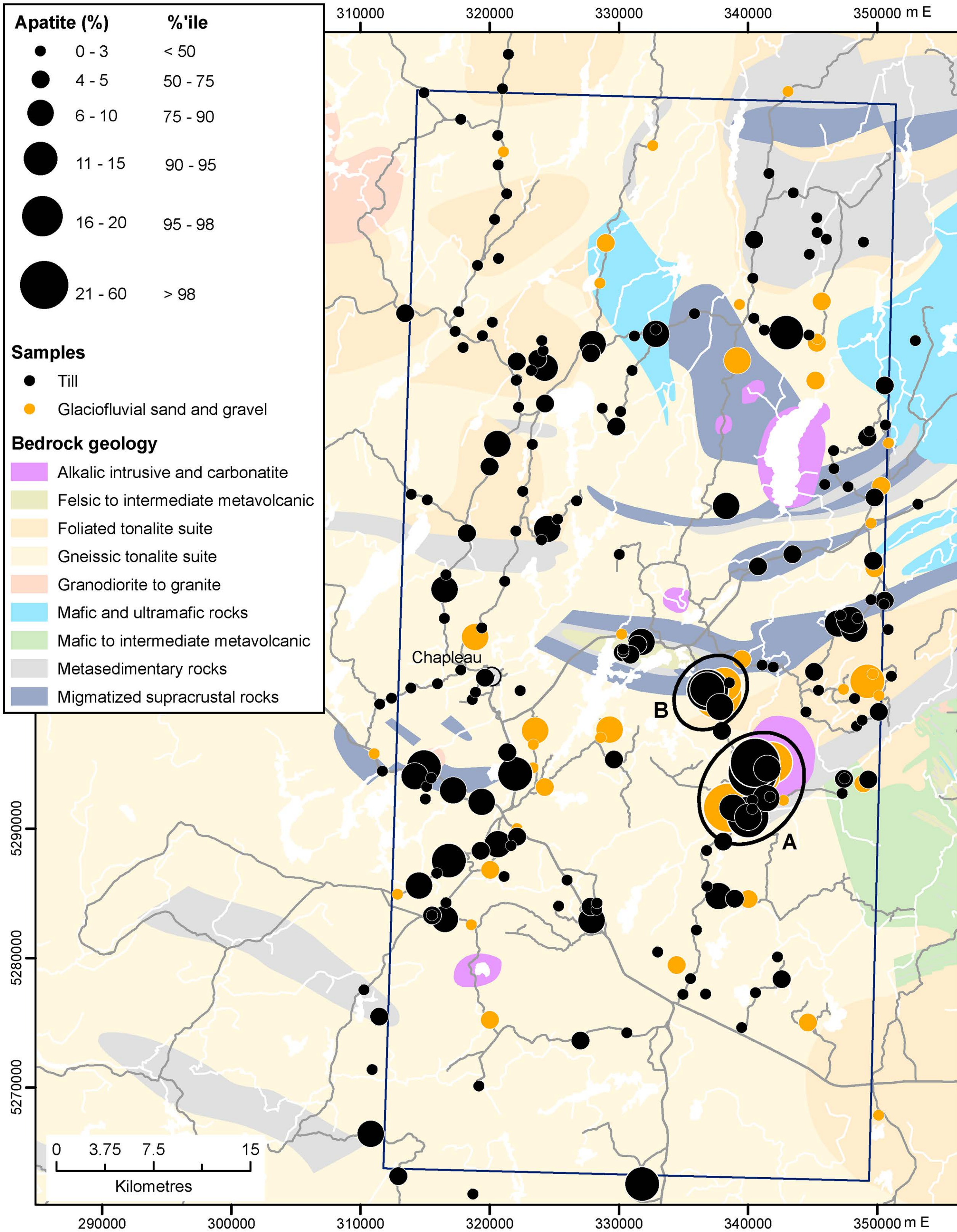

Figure 33. Regional distribution of apatite grains for the Chapleau survey area.

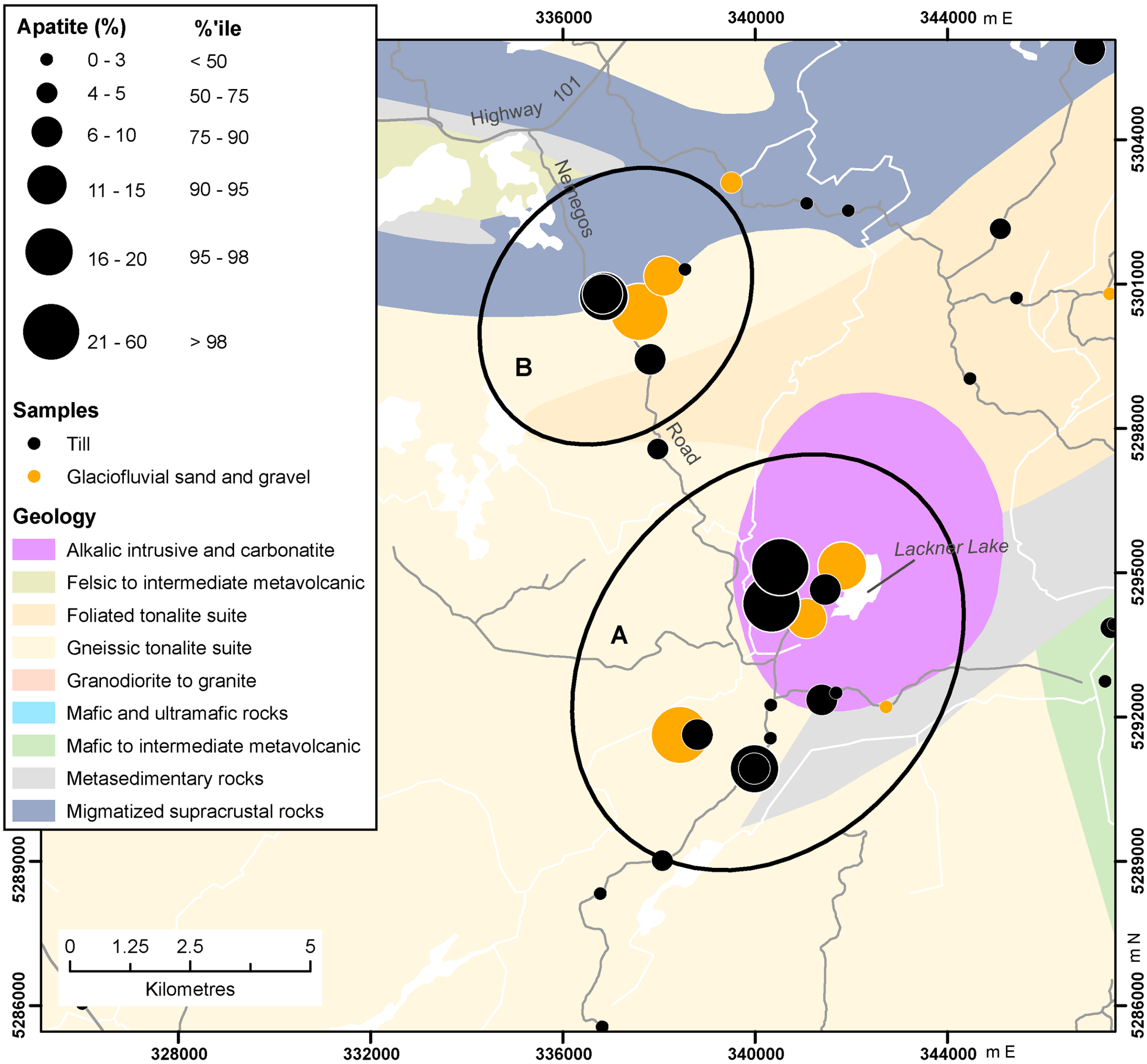

Figure 34. Enlarged view showing the regional distribution of apatite grains in the area adjacent to the Lackner Lake alkalic complex.

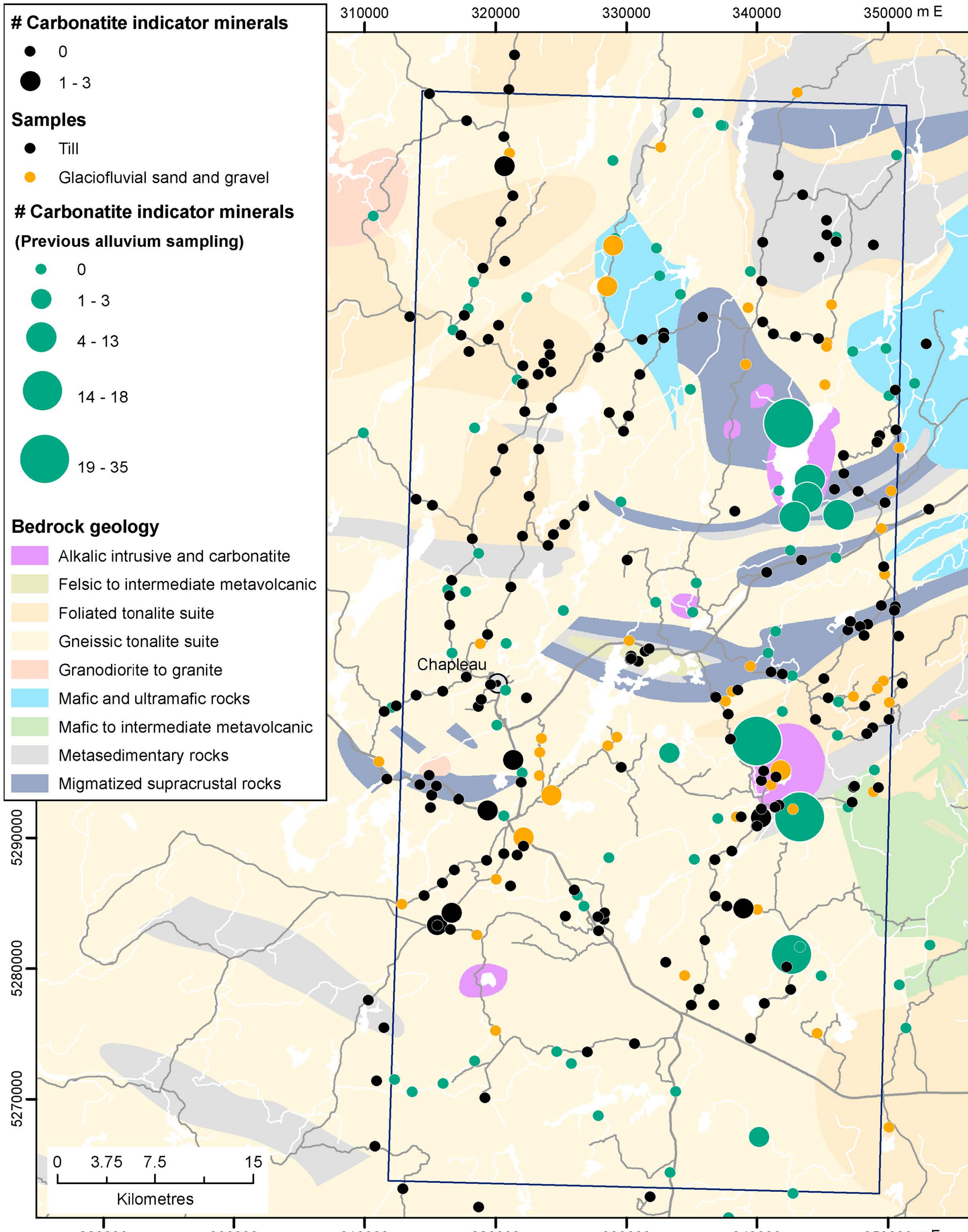

Figure 35. Regional distribution of carbonatite indicator minerals comprising perovskite, pyrochlore, columbite, bastnaesite, brockite, euxenite synchysite, stillwellite. This suite of minerals also includes parisite, aegirine and ilmenorutile from the previous alluvium sampling survey (Ontario Geological Survey 2001b, 2001d).

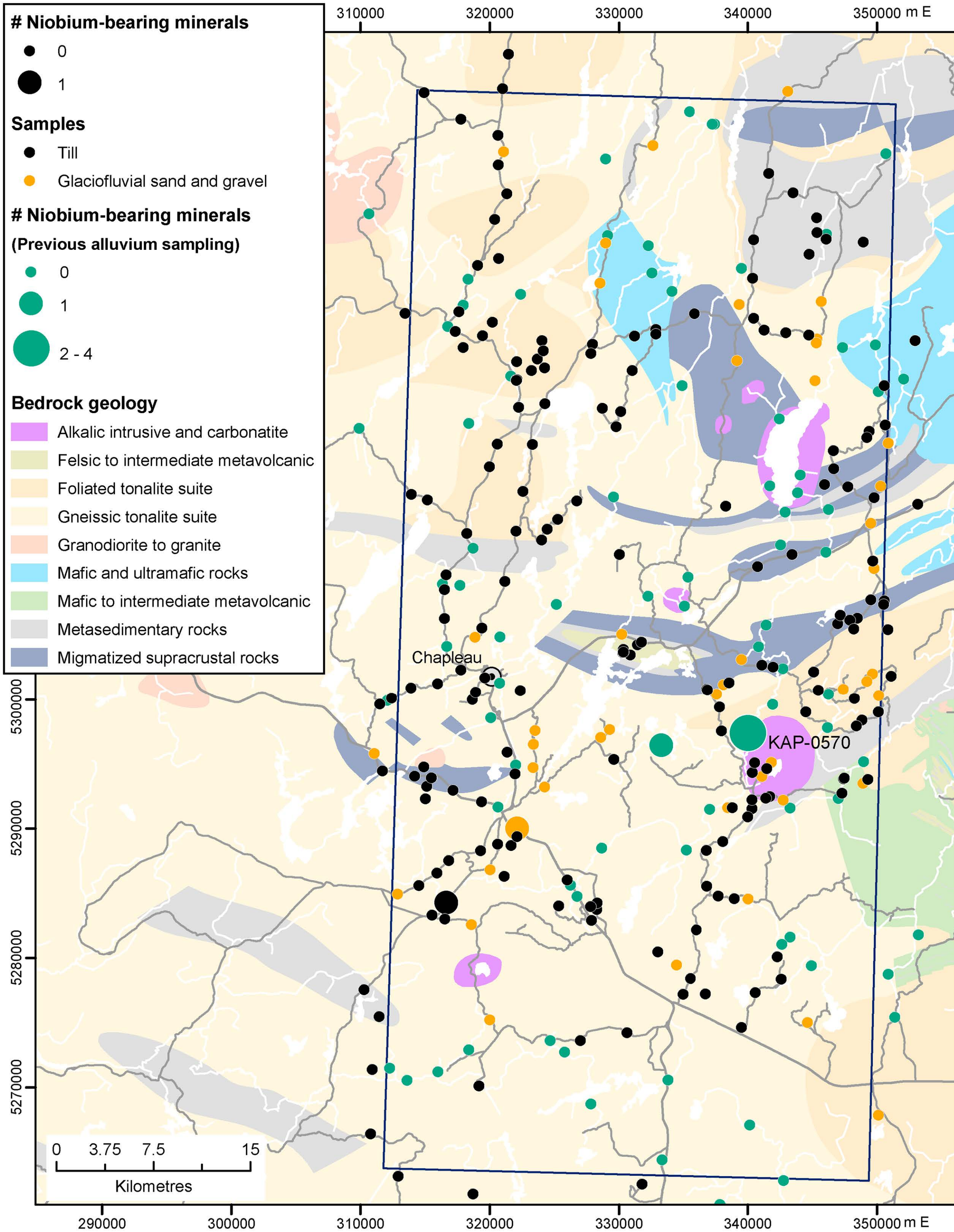

Figure 36. Regional distribution of niobium-bearing minerals (pyrochlore and columbite grains) for the Chapleau survey area. This suite of minerals also includes ilmenorutile from the previous alluvium sampling survey (Ontario Geological Survey 2001b, 2001d).

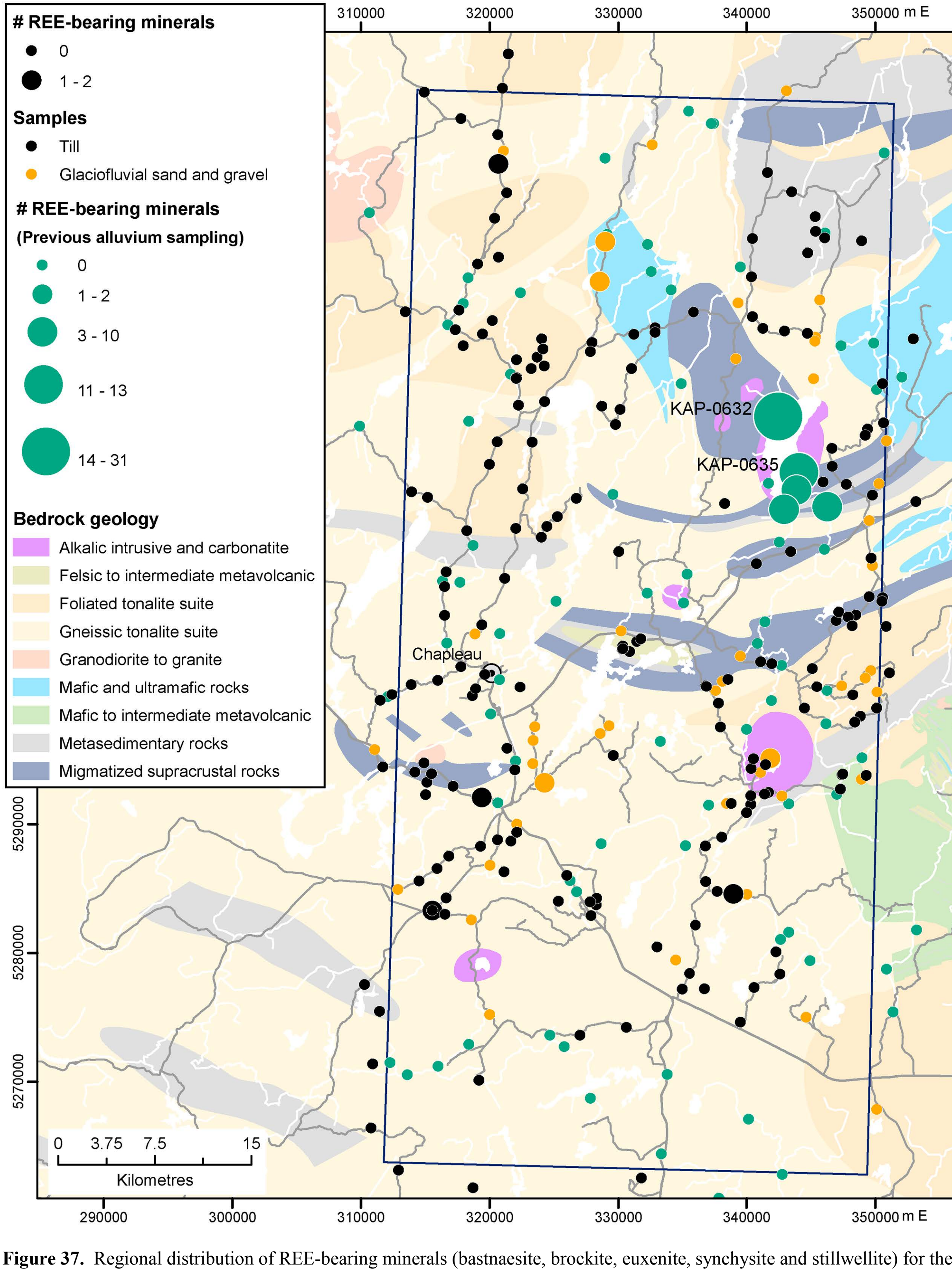

Figure 37. Regional distribution of REE-bearing minerals (bastnaesite, brockite, euxenite, synchysite and stillwellite) for the Chapleau survey area. This suite of minerals also includes parisite from the previous alluvium sampling survey (Ontario Geological Survey 2001b, 2001d).

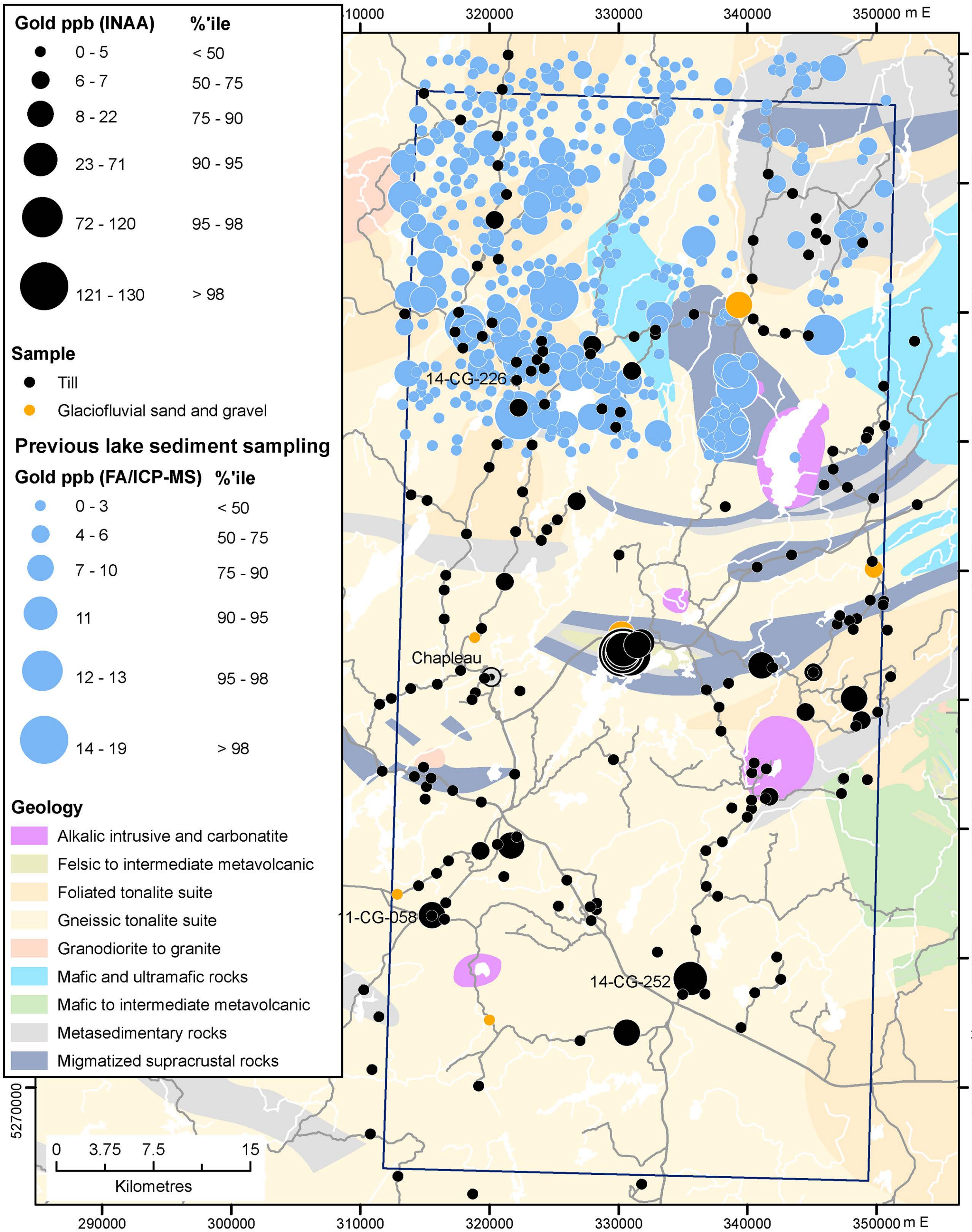

Figure 38. Regional distribution of gold (ppb) by INAA for the Chapleau survey area. Note that gold results in a previous lake sediment survey was determined on 30 grams of the <0.177 mm fraction using fire assay (FA) with ICP–OES finish (Ontario Geological Survey 2000a, 2000b).

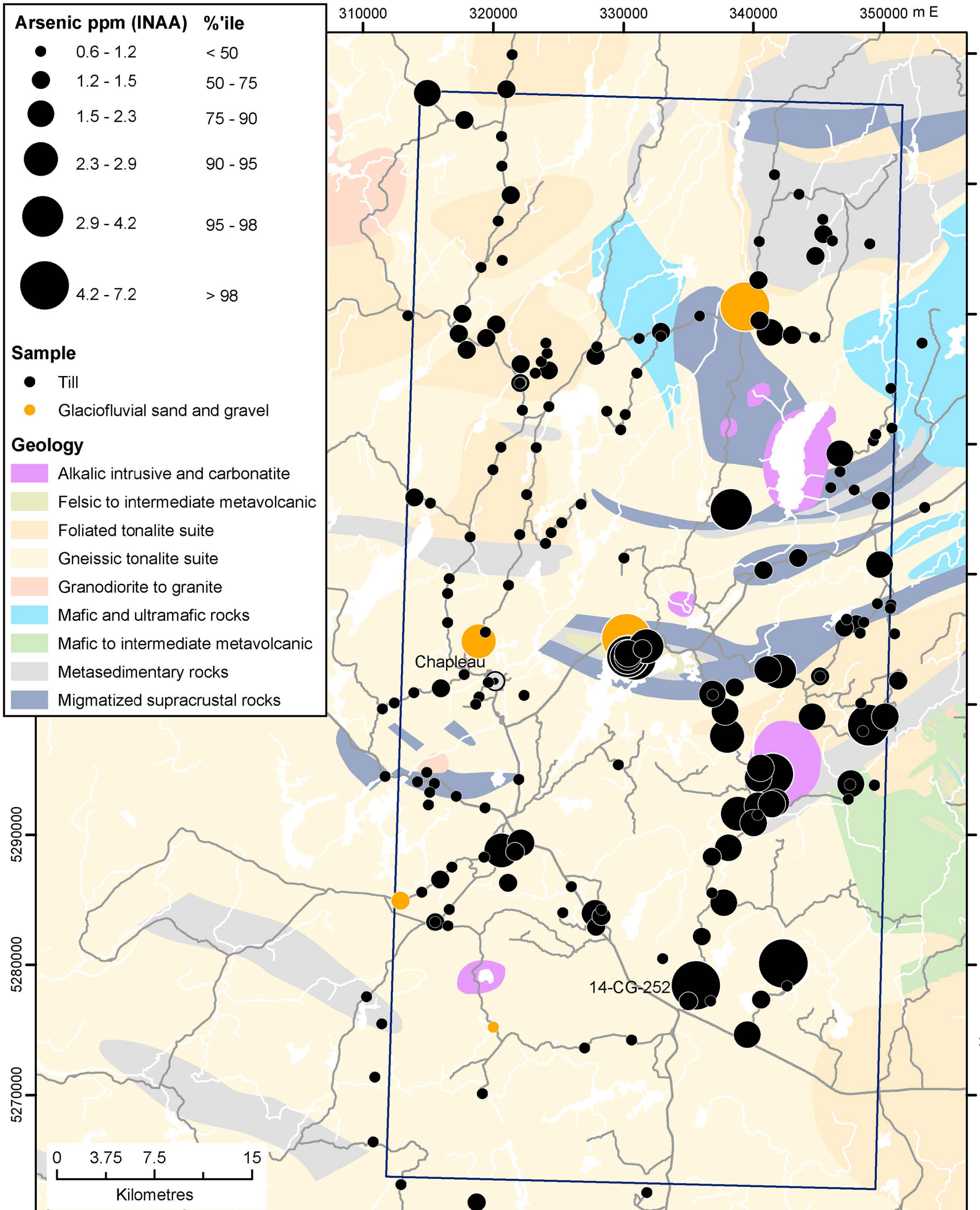

Figure 40. Regional distribution of arsenic (ppm) by INAA in the Chapleau survey area.

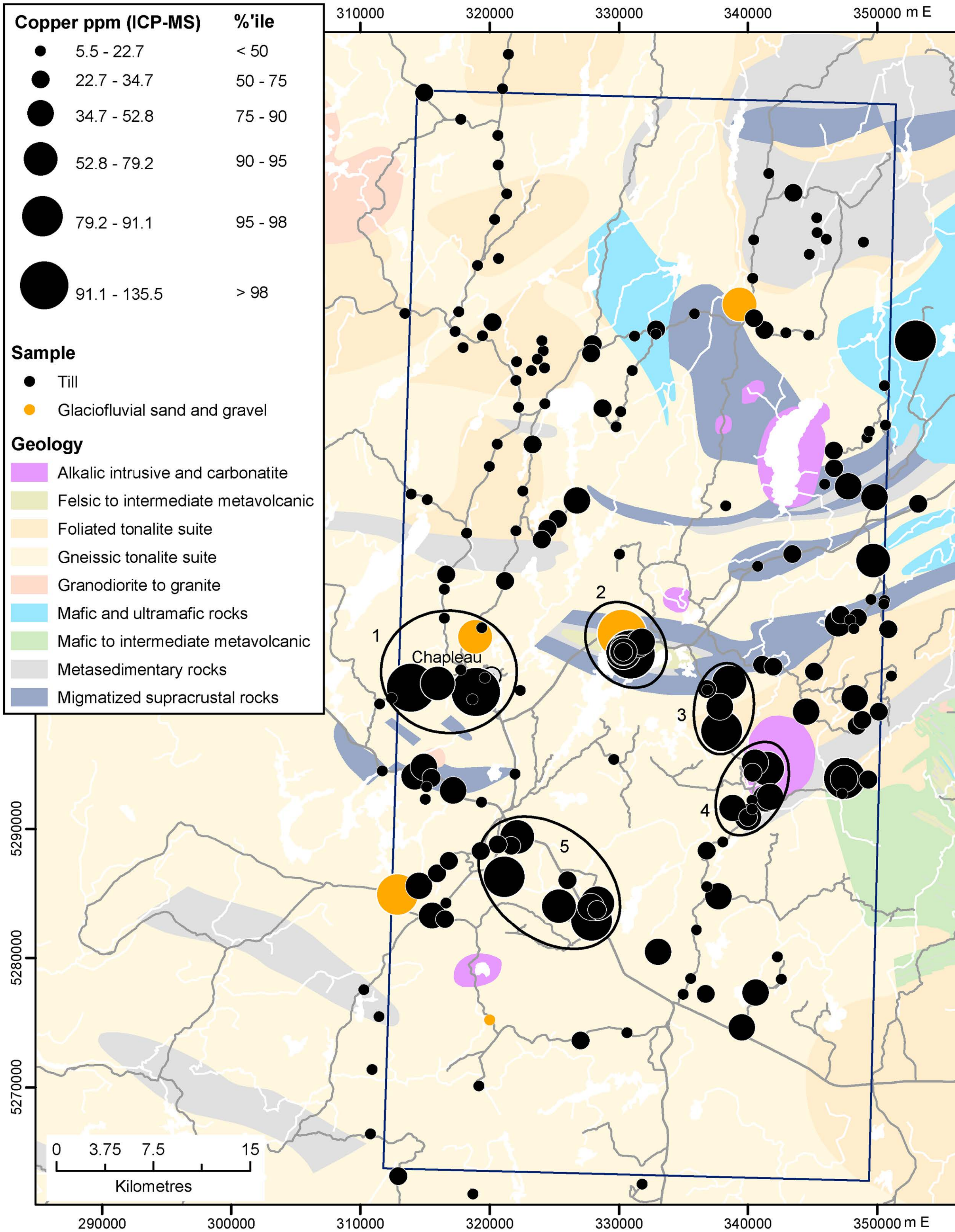

Figure 41. Regional distribution of copper (ppm) by ICP–MS for the Chapleau survey area.

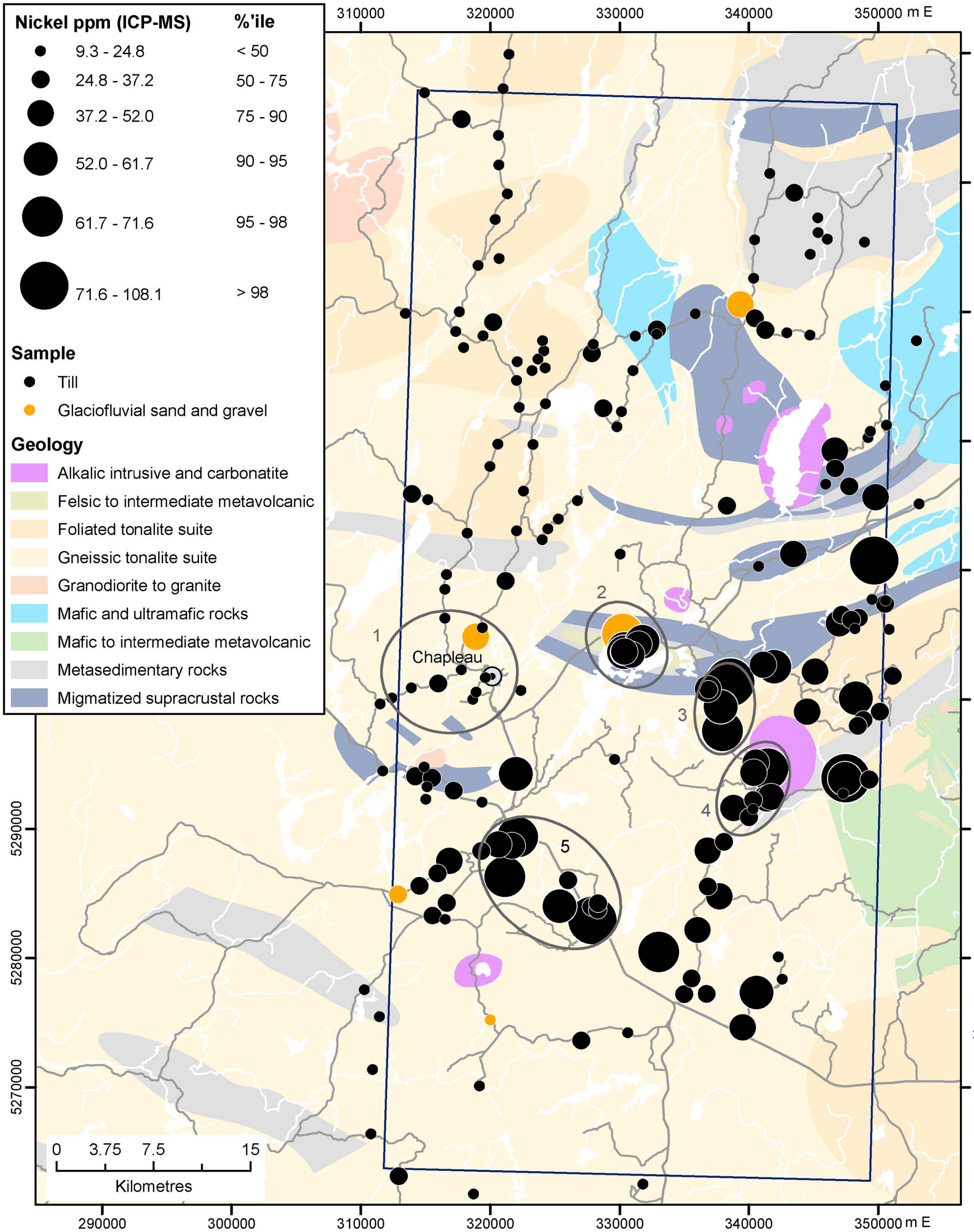

Figure 42. Regional distribution of nickel (ppm) by ICP–MS for the Chapleau survey area.

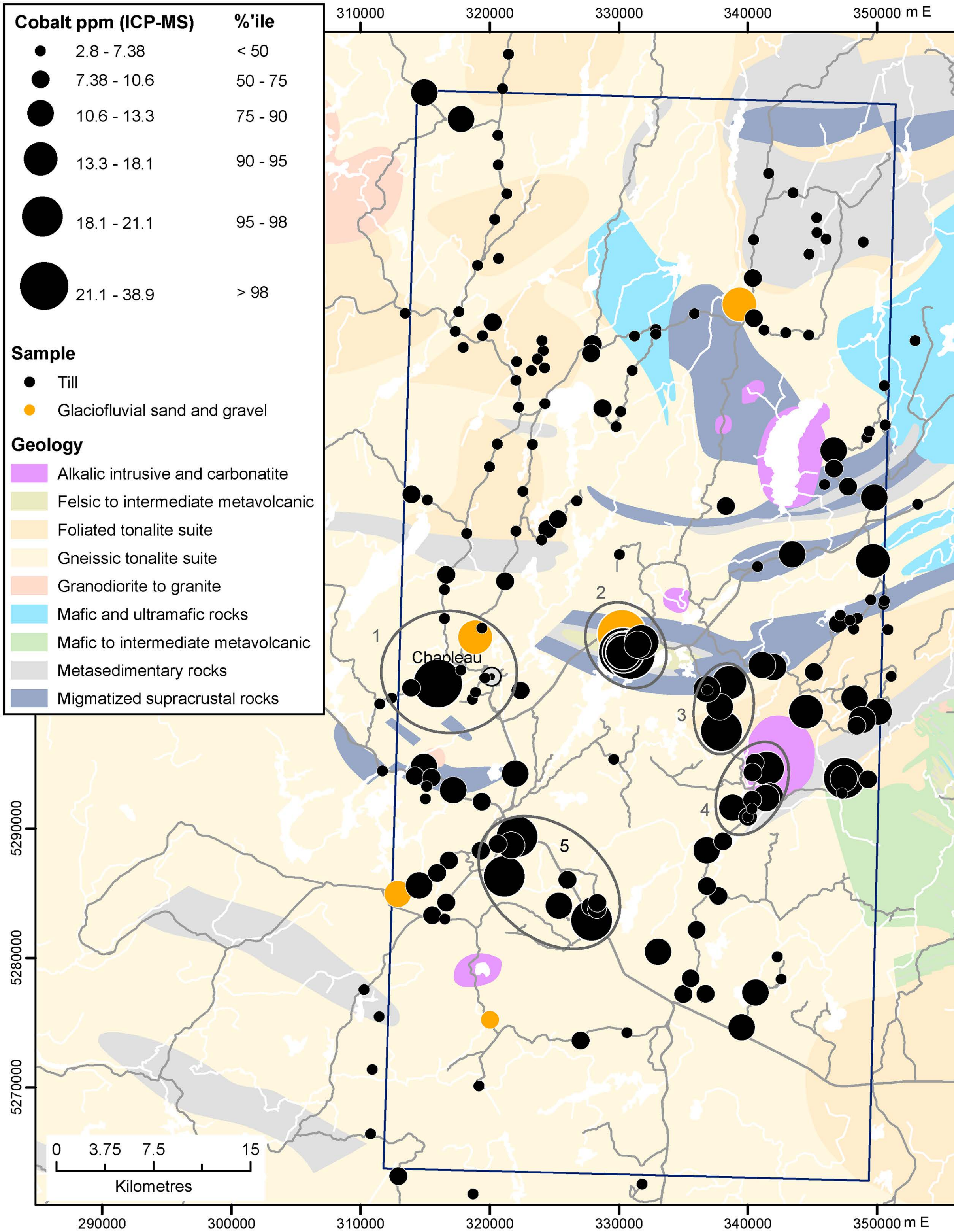

Figure 43. Regional distribution of cobalt (ppm) by ICP–MS for the Chapleau survey area.

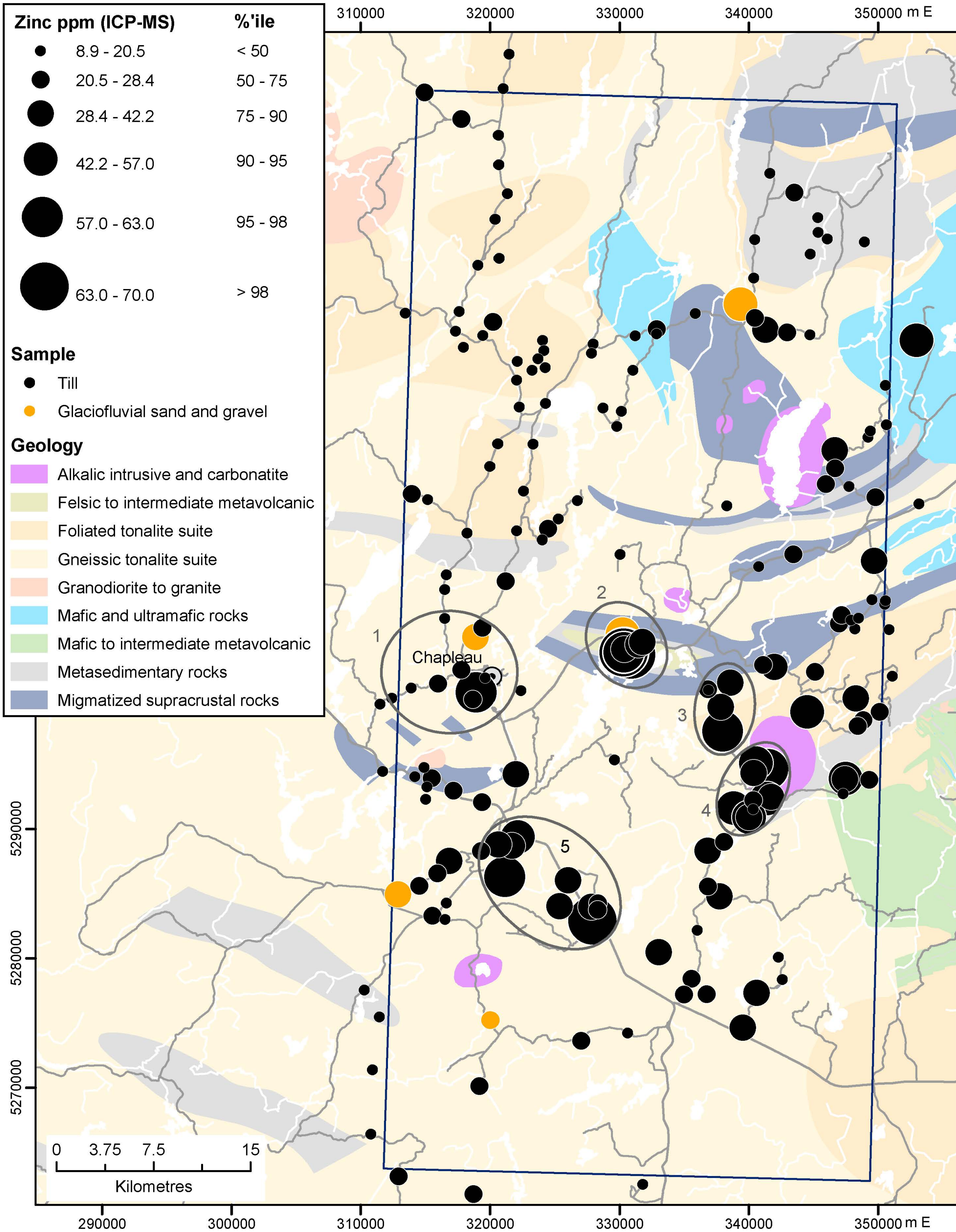

Figure 44. Regional distribution of zinc (ppm) by ICP–MS for the Chapleau survey area.

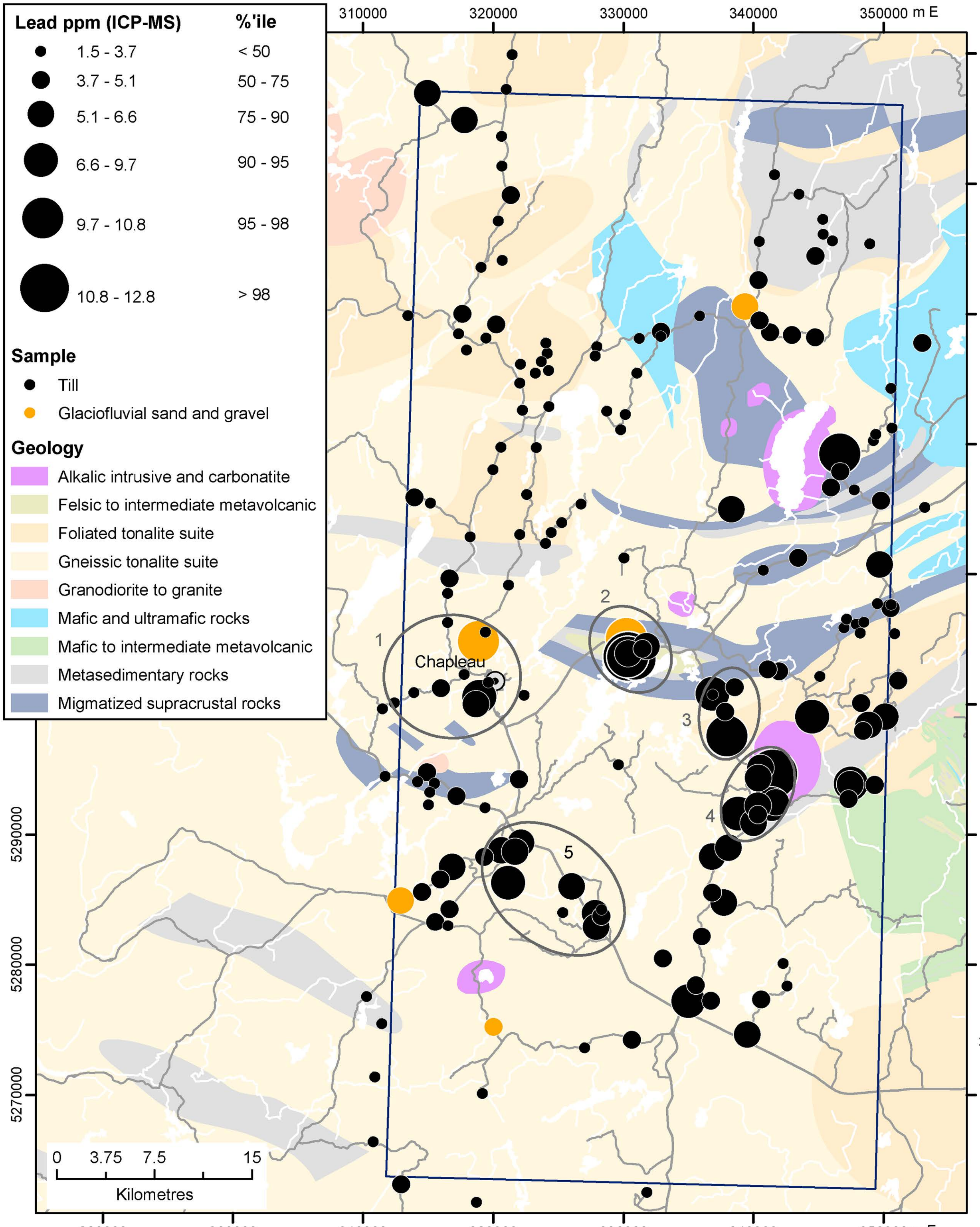

Figure 45. Regional distribution of lead (ppm) by ICP–MS for the Chapleau survey area.

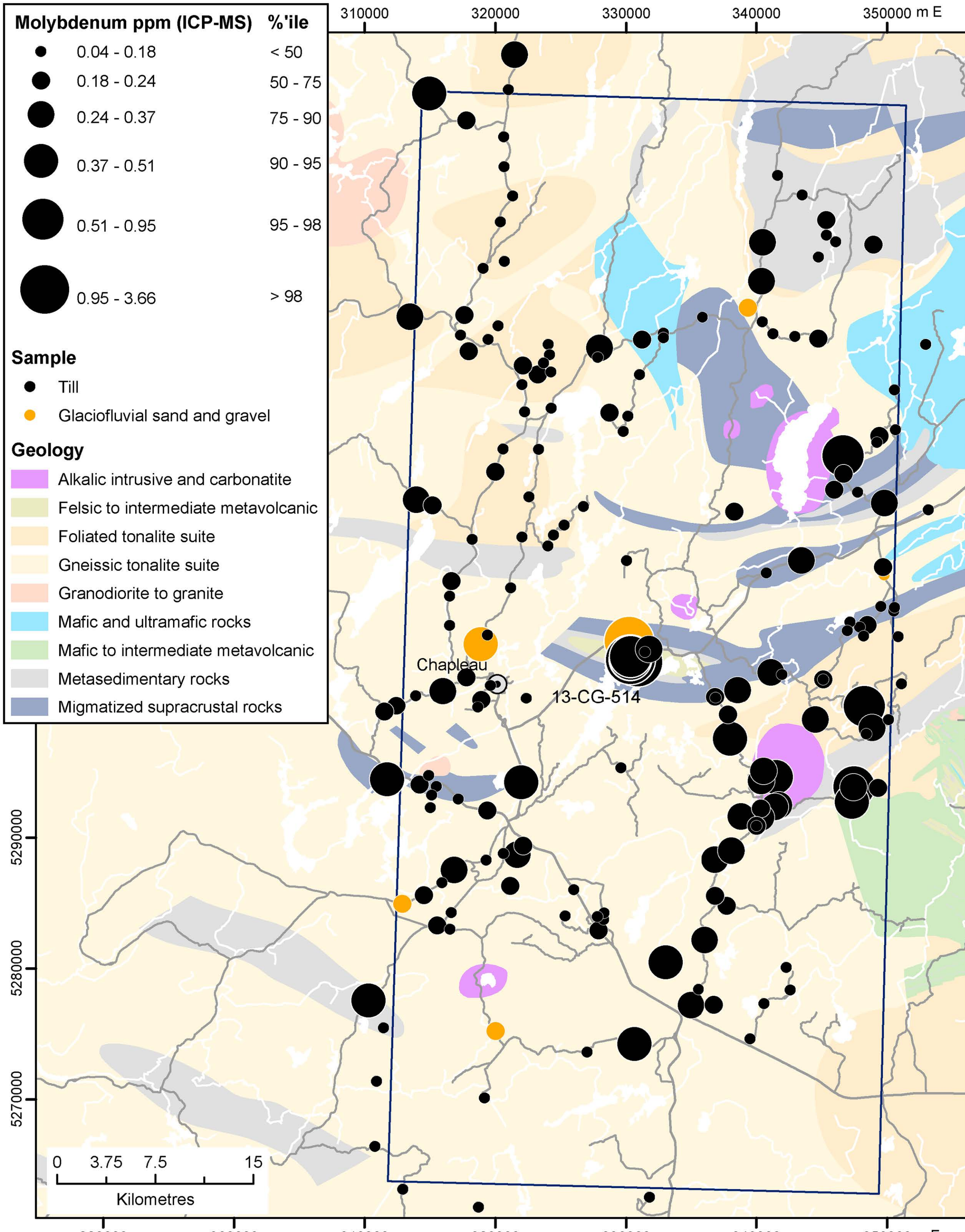

Figure 46. Regional distribution of molybdenum (ppm) by ICP–MS for the Chapleau survey area.

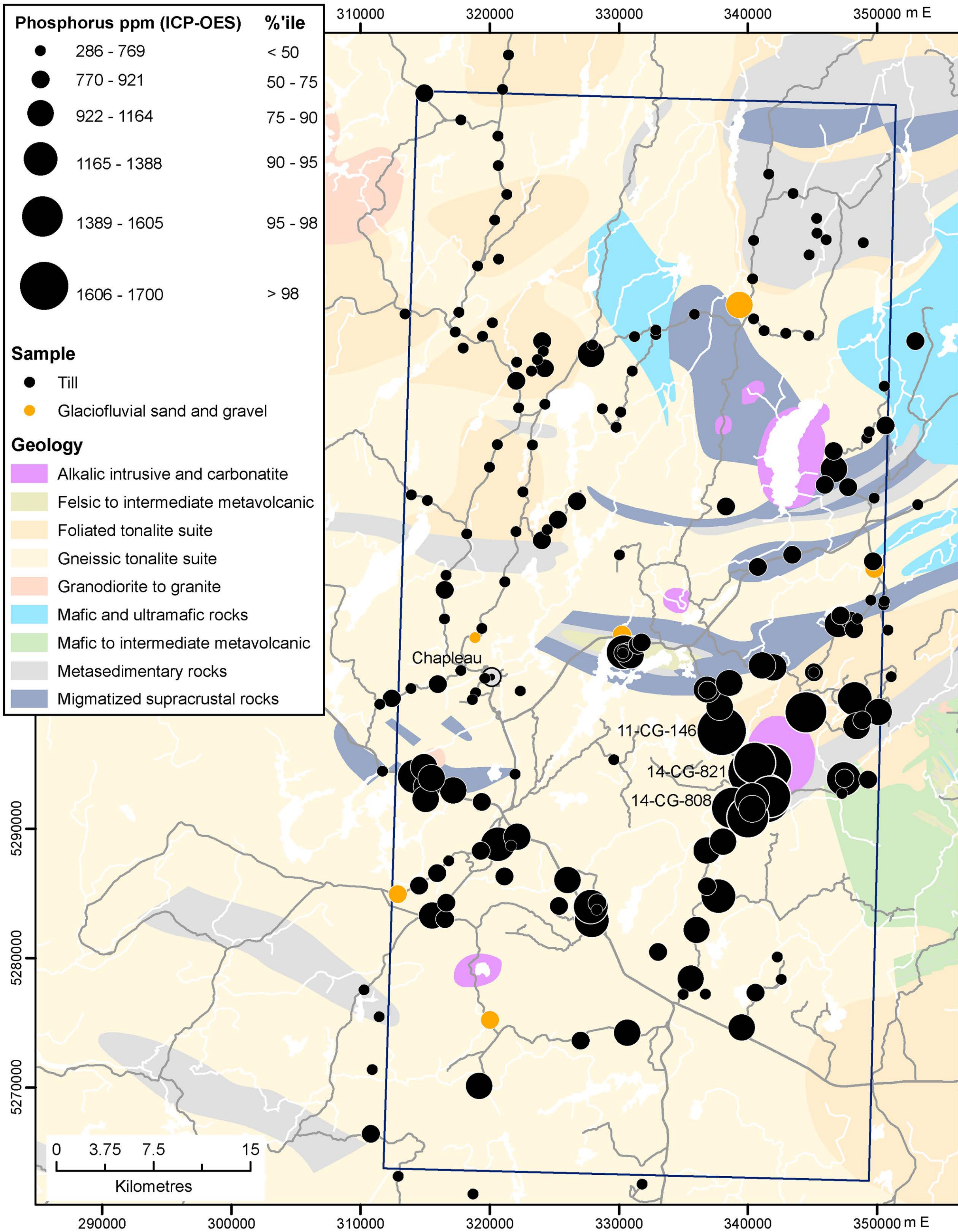

Figure 47. Regional distribution of phosphorus (ppm) by ICP–OES for the Chapleau survey area. Note that till samples 11-CG-146, 14-CG-808 and 14-CG-821 have phosphorus concentrations exceeding the limit of the method (1700 ppm). On the map, the limit (1700 ppm) was used as the minimum value for these samples.

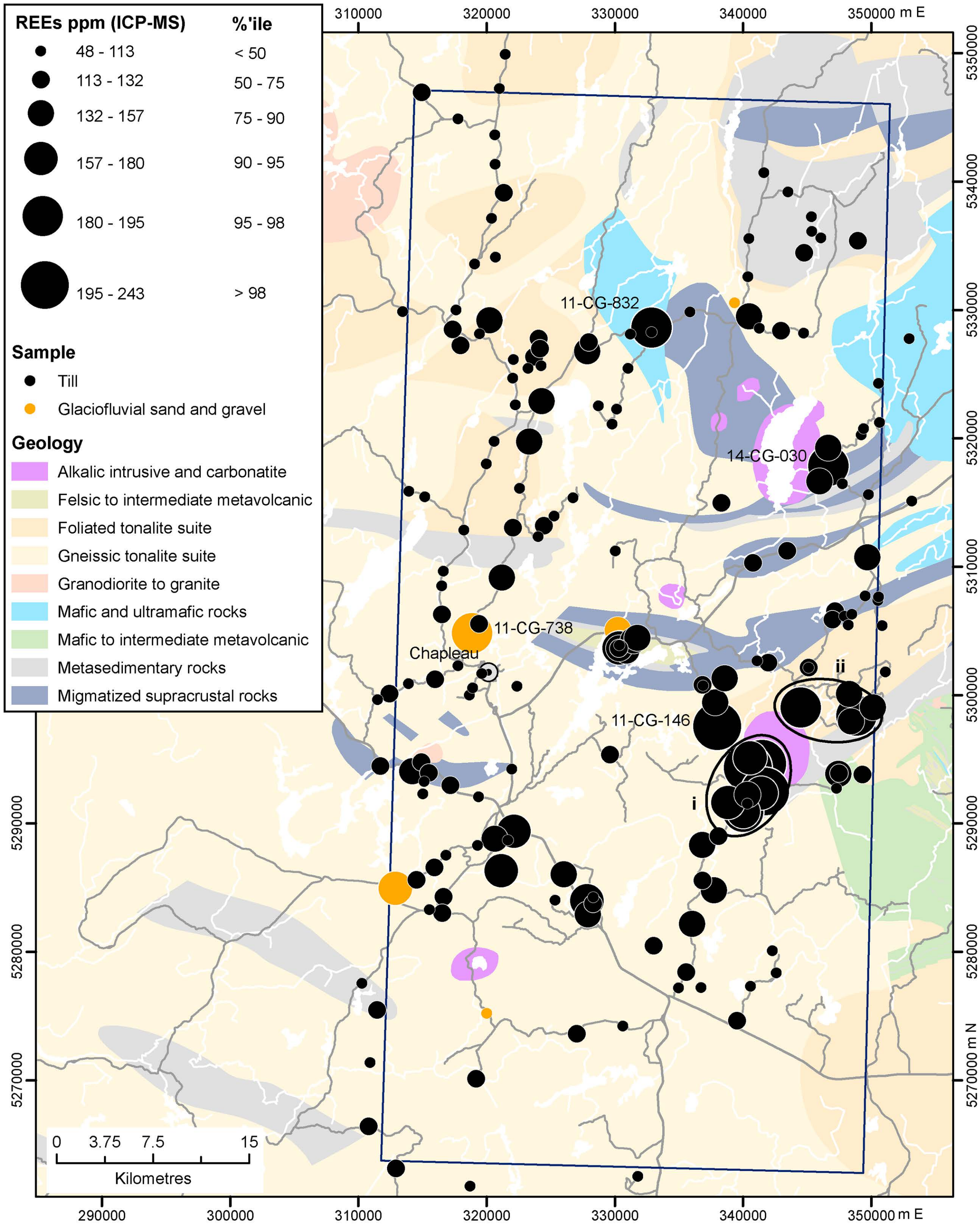

Figure 48. Regional distribution of REEs (ppm) by ICP–MS for the Chapleau survey area.

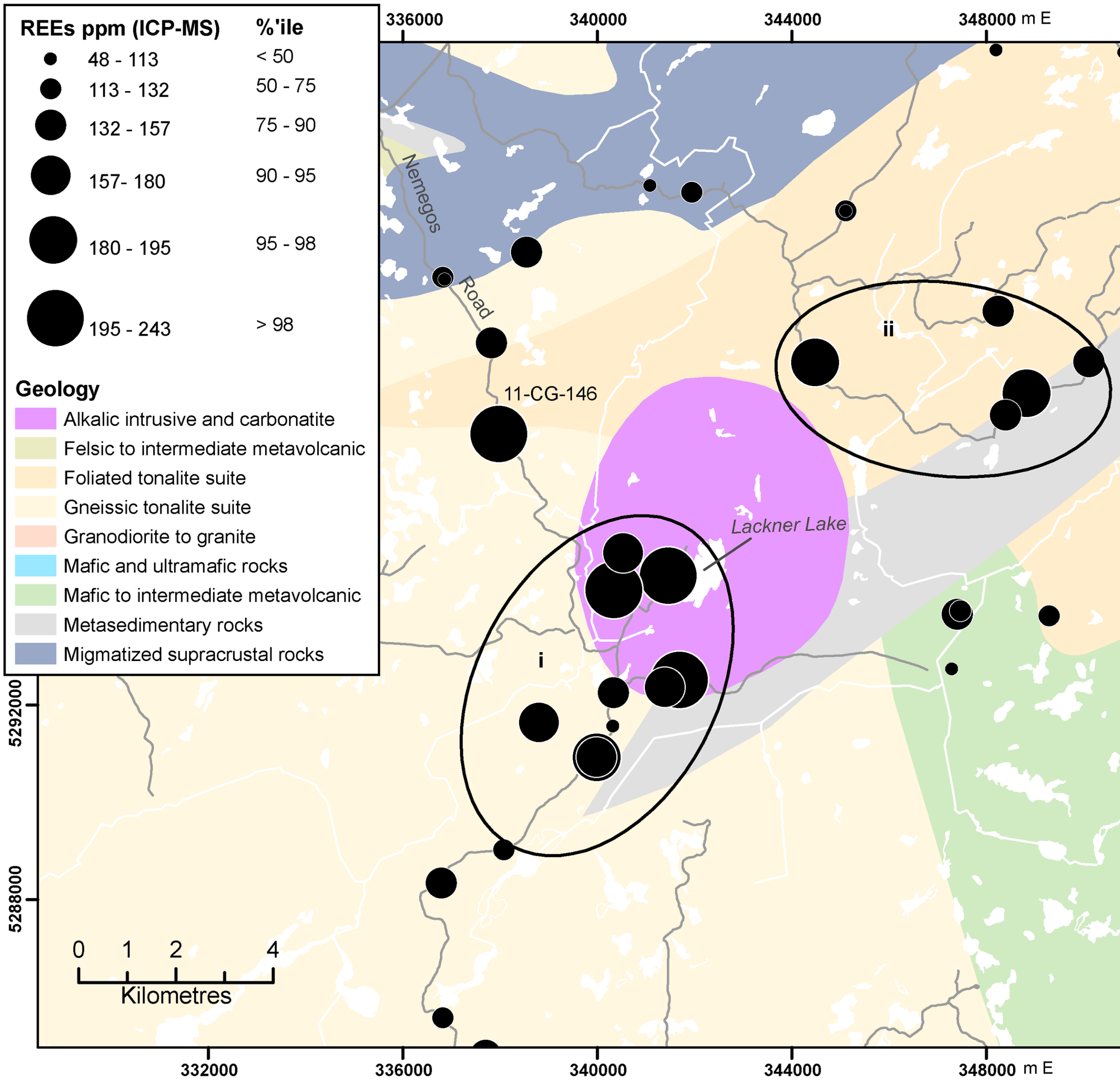

Figure 49. Enlarged view showing the regional distribution of REEs (ppm) by ICP–MS around the Lackner Lake alkalic complex.

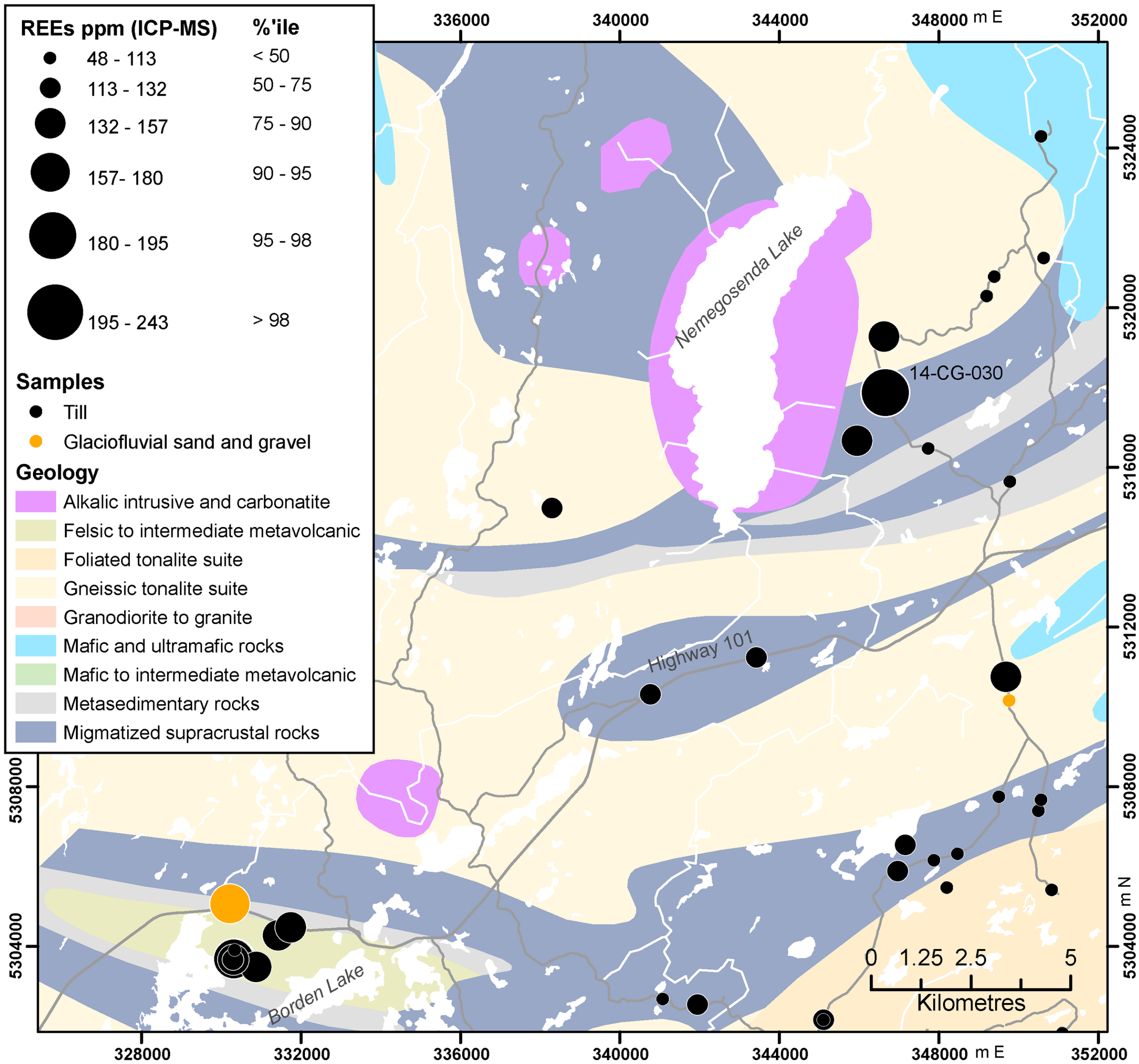

Figure 50. Enlarged view showing the regional distribution of REEs (ppm) by ICP–MS around the Nemegosenda Lake alkalic complex.

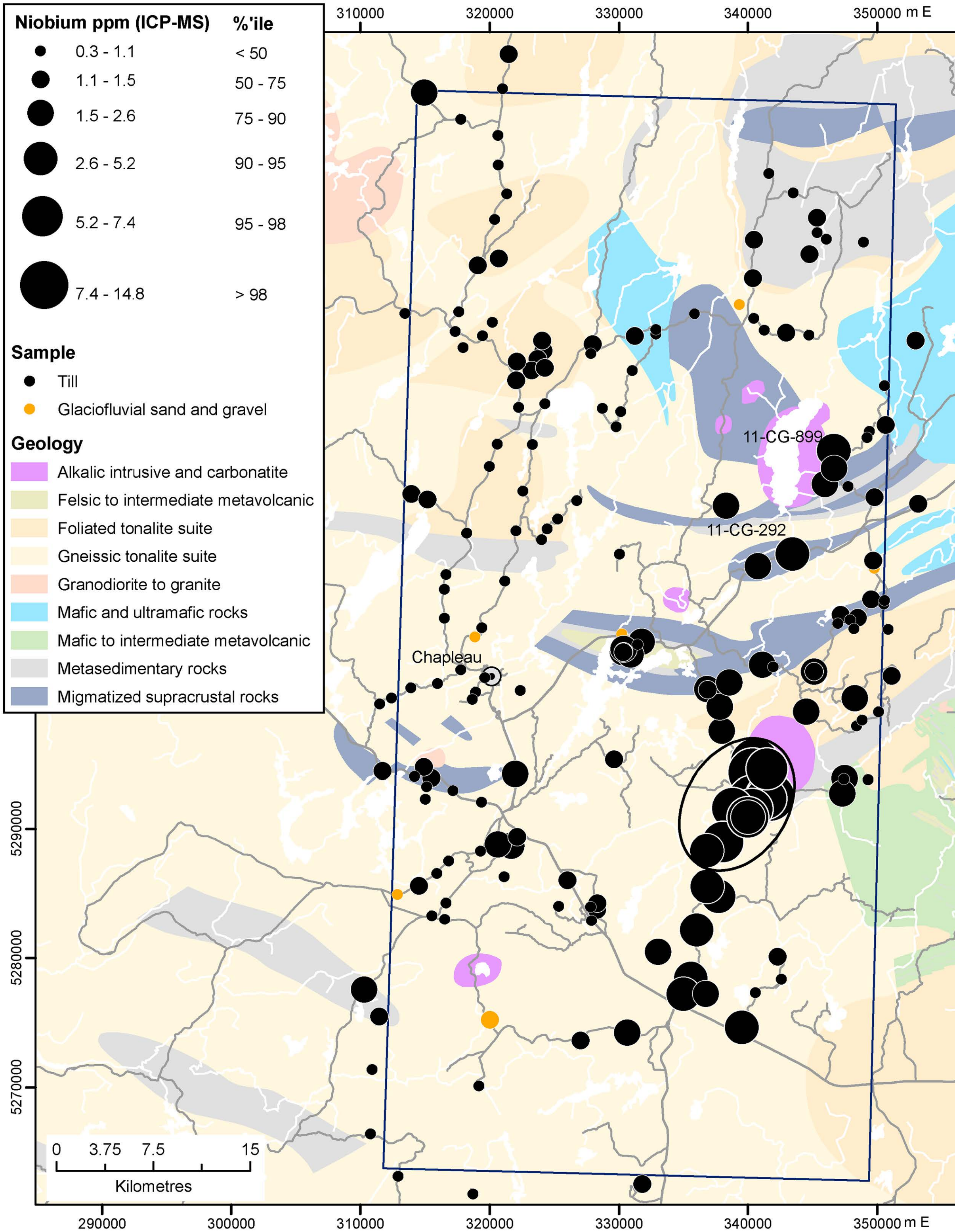

Figure 51. Regional distribution of niobium (ppm) by ICP–MS for the Chapleau survey area. Open oval highlights the area that has anomalous niobium concentrations.

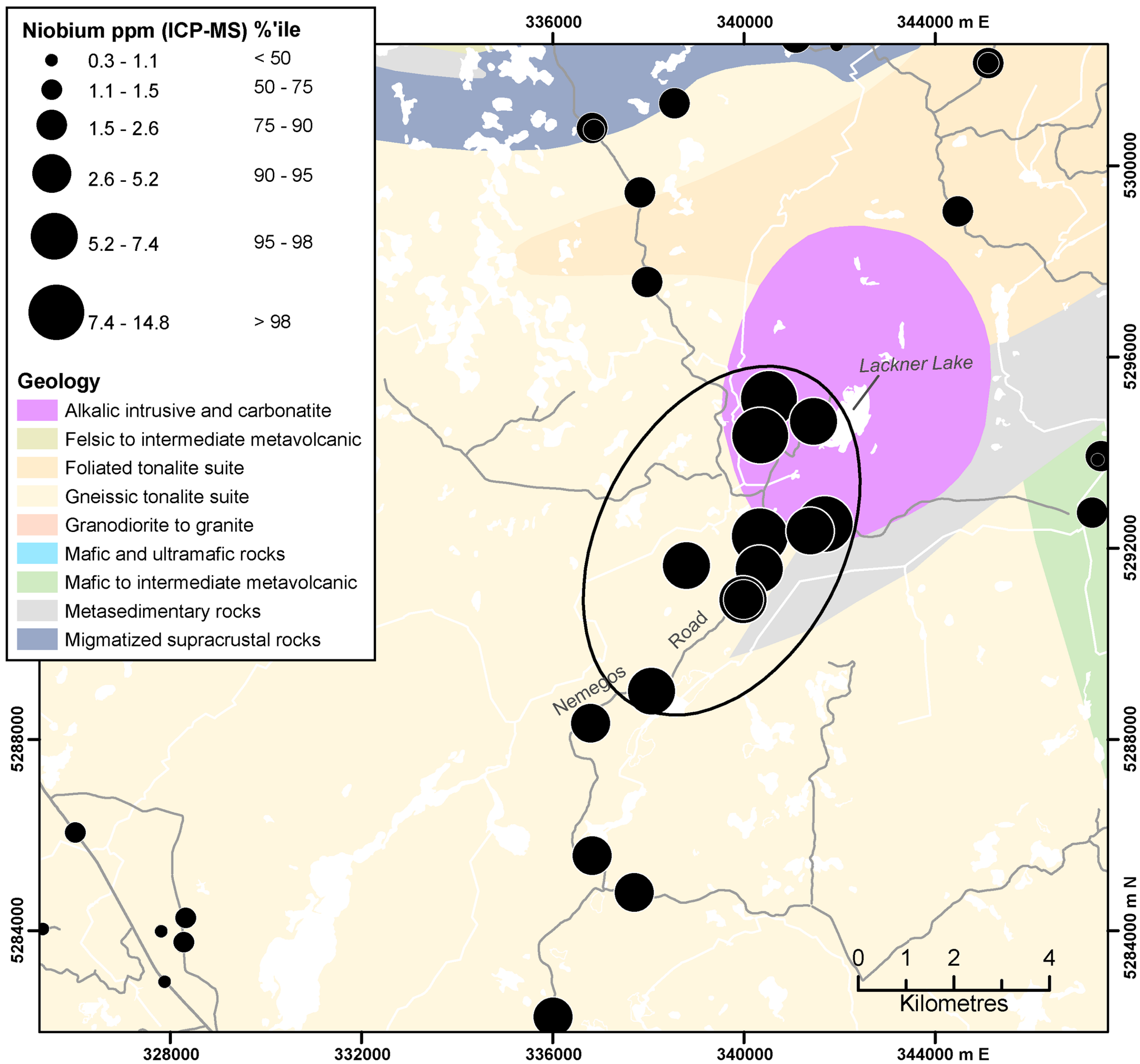

Figure 52. Enlarged view showing the regional distribution of niobium (ppm) by ICP–MS around the Lackner Lake alkalic complex. Open oval highlights the area that has anomalous niobium concentrations.

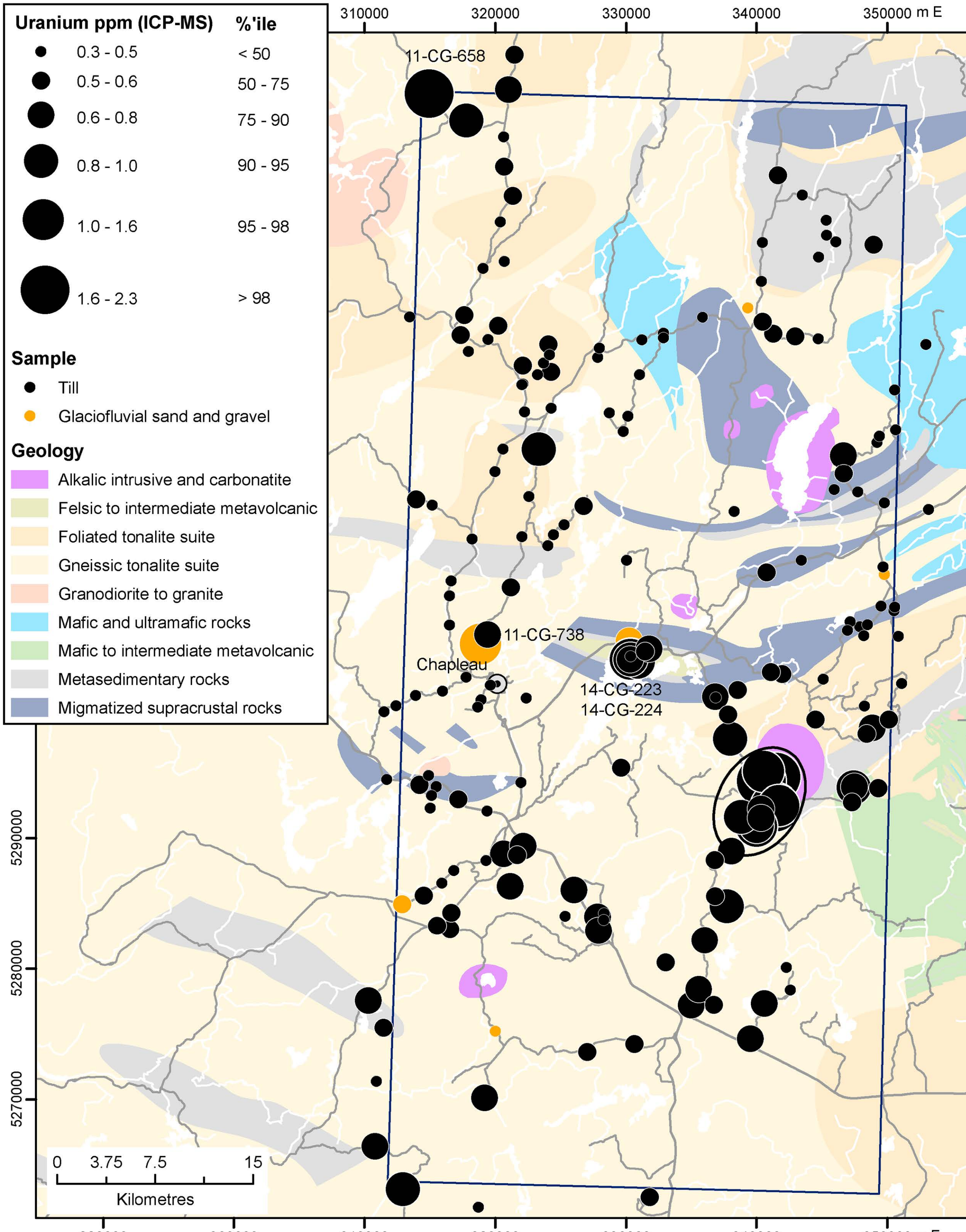

Figure 53. Regional distribution of uranium (ppm) by ICP–MS for the Chapleau survey area. Open oval highlights the area that has anomalous uranium concentrations. Where anomalous levels exist in individual samples, the samples are highlighted with sample numbers.

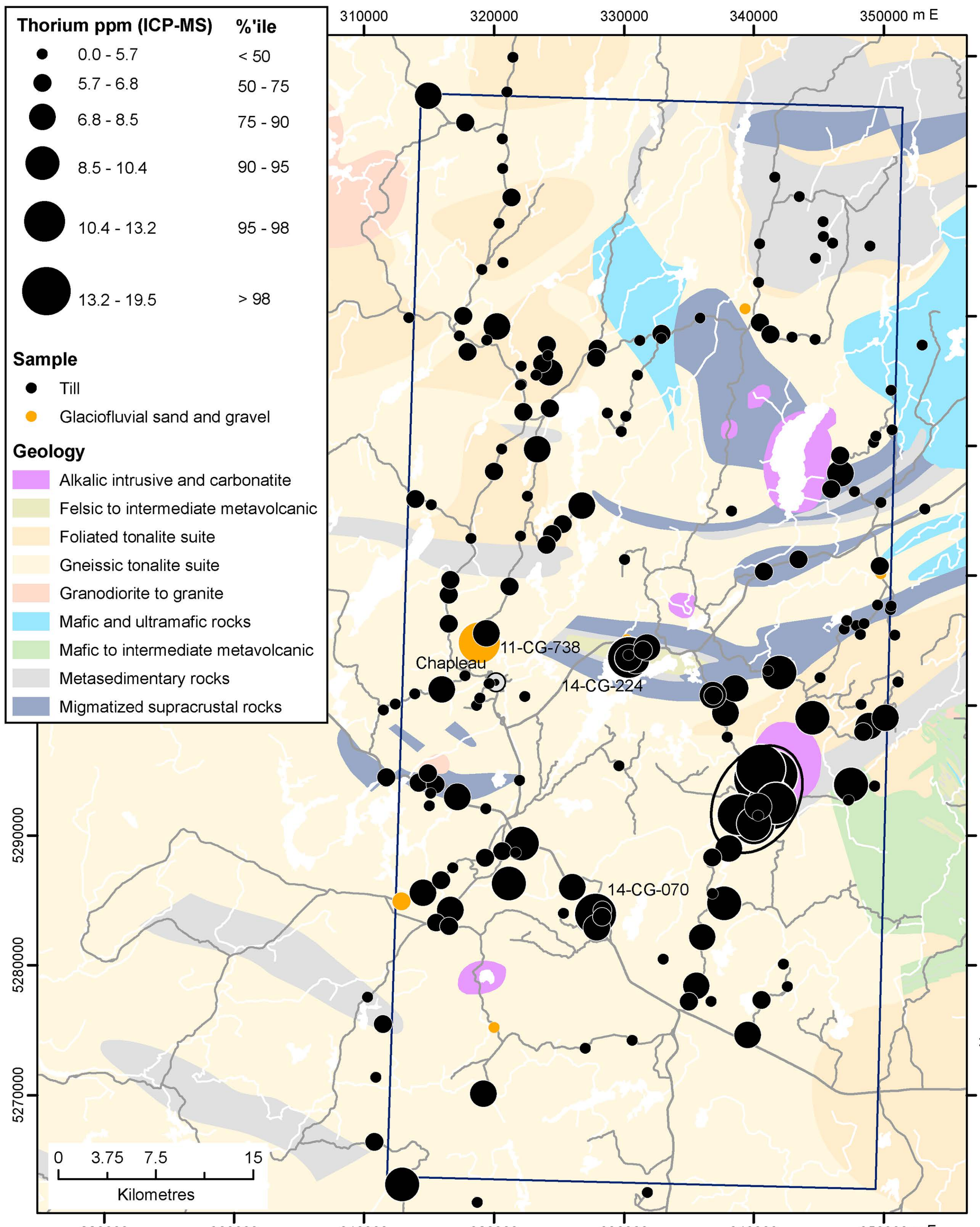

Figure 54. Regional distribution of thorium (ppm) by ICP–MS for the Chapleau survey area. Open oval highlights the area that has anomalous thorium concentrations.

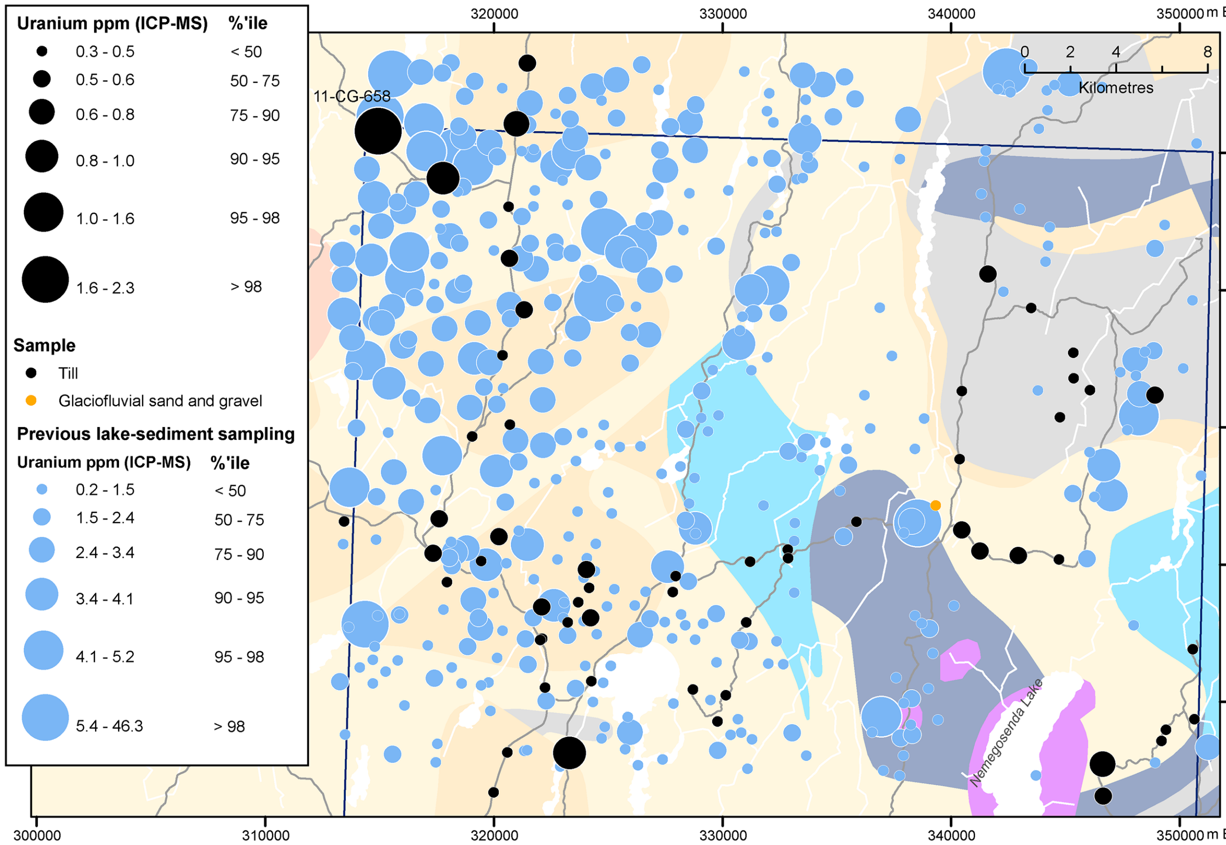

Figure 55. Enlarged view showing the regional distribution of uranium (ppm) by ICP–MS for the northern part of the survey area, plotted against the results of previous lake-sediment sampling (Ontario Geological Survey 2000a, 2000b).

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Appendixes

The following Appendixes are provided in this report. All others (Appendixes 2, 4, 5, 6, 8 to 10, 12, 13, 15, 16, and 18 to 21), as well as those listed below, are found in MRD 331, available separately from this report.

Appendix 1. Sample site locations

Appendix 3. Summary of gold grain counts

Appendix 7. Summary of KIM counts

Appendix 11. Summary of adjusted KIM counts

Appendix 14. Microscope descriptions of nonkimberlitic boulders of mantle origin

Appendix 17. Numerically converted counts of MMSIM®

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Appendix 1.

Sample Site Locations

UTM co-ordinates in North American Datum 1983 (NAD 83), Zone 17

Abbreviations:

UTM: Universal Transverse Mercator
NAD: North American Datum

Sample Number	UTM zone	X_Easting (NAD83)	Y_Northing (NAD83)	Sampling material
11-CG-013	17	338065	5289016	Till
11-CG-017	17	325999	5286050	Till
11-CG-018	17	327875	5282933	Till
11-CG-029	17	330618	5274240	Till
11-CG-033	17	326999	5273617	Till
11-CG-046	17	322103	5290028	Glaciofluvial sand and gravel
11-CG-048	17	319992	5275221	Glaciofluvial sand and gravel
11-CG-054	17	318569	5282592	Glaciofluvial sand and gravel
11-CG-055	17	316527	5283026	Till
11-CG-058	17	315515	5283315	Till
11-CG-065	17	310270	5277567	Till
11-CG-068	17	312847	5284961	Glaciofluvial sand and gravel
11-CG-070	17	334962	5277209	Till
11-CG-072	17	335998	5282192	Till
11-CG-078	17	336815	5285566	Till
11-CG-084	17	338945	5284612	Till
11-CG-087	17	336782	5288336	Till
11-CG-090	17	340317	5291567	Till
11-CG-101	17	341682	5292510	Till
11-CG-107	17	319284	5288318	Till
11-CG-109	17	316830	5287556	Till
11-CG-110	17	314519	5285610	Till
11-CG-122	17	348911	5293525	Glaciofluvial sand and gravel
11-CG-123	17	349290	5293828	Till
11-CG-127	17	347282	5292747	Till
11-CG-129	17	347398	5293860	Till
11-CG-131	17	347461	5293931	Till
11-CG-136	17	336816	5300797	Till
11-CG-139	17	338538	5301312	Till
11-CG-146	17	337966	5297573	Till
11-CG-178	17	311065	5295822	Glaciofluvial sand and gravel
11-CG-181	17	311684	5294493	Till
11-CG-185	17	314177	5294083	Till
11-CG-190	17	317152	5292982	Till
11-CG-199	17	319372	5292088	Till
11-CG-206	17	321952	5294243	Till
11-CG-211	17	321331	5295917	Till
11-CG-212	17	323342	5294736	Glaciofluvial sand and gravel
11-CG-214	17	323374	5296529	Glaciofluvial sand and gravel
11-CG-239	17	328589	5297067	Glaciofluvial sand and gravel

Sample Number	UTM zone	X_Easting (NAD83)	Y_Northing (NAD83)	Sampling material
11-CG-251	17	329597	5295381	Till
11-CG-267	17	353133	5315139	Till
11-CG-273	17	349501	5313654	Glaciofluvial sand and gravel
11-CG-276	17	349777	5315650	Till
11-CG-292	17	343412	5311239	Till
11-CG-295	17	340756	5310311	Till
11-CG-305	17	321654	5288708	Till
11-CG-315	17	321114	5286340	Till
11-CG-327	17	316623	5284290	Till
11-CG-334	17	320033	5286842	Glaciofluvial sand and gravel
11-CG-340	17	322115	5289394	Till
11-CG-382	17	349671	5310750	Till
11-CG-384	17	349758	5310164	Glaciofluvial sand and gravel
11-CG-389	17	350559	5307673	Till
11-CG-391	17	350825	5305419	Till
11-CG-396	17	348463	5306320	Till
11-CG-407A	17	345100	5302155	Till
11-CG-407B	17	345100	5302155	Till
11-CG-417	17	341937	5302537	Till
11-CG-425	17	341075	5302683	Till
11-CG-437	17	345438	5300721	Till
11-CG-446	17	348242	5300091	Till
11-CG-451	17	349636	5301998	Glaciofluvial sand and gravel
11-CG-453	17	351095	5301827	Till
11-CG-455	17	350114	5300320	Glaciofluvial sand and gravel
11-CG-459	17	348827	5298409	Till
11-CG-472	17	344471	5299045	Till
11-CG-517	17	347733	5316477	Till
11-CG-522	17	345938	5316662	Till
11-CG-655	17	320986	5347273	Till
11-CG-656	17	320634	5343659	Till
11-CG-658	17	314926	5346953	Till
11-CG-661	17	317770	5344893	Till
11-CG-665	17	321068	5342400	Glaciofluvial sand and gravel
11-CG-666	17	320668	5341385	Till
11-CG-667	17	320368	5337158	Till
11-CG-668	17	319045	5333605	Till
11-CG-675	17	317606	5330006	Till
11-CG-697	17	322227	5322630	Till
11-CG-703	17	319970	5318041	Till
11-CG-713	17	318215	5312877	Till

Sample Number	UTM zone	X_Easting (NAD83)	Y_Northing (NAD83)	Sampling material
11-CG-720	17	332627	5342865	Glaciofluvial sand and gravel
11-CG-726	17	328966	5335334	Glaciofluvial sand and gravel
11-CG-730	17	328523	5332216	Glaciofluvial sand and gravel
11-CG-738	17	318841	5304842	Glaciofluvial sand and gravel
11-CG-739	17	319383	5305561	Till
11-CG-740	17	321160	5309168	Till
11-CG-742	17	322038	5313056	Till
11-CG-748	17	322554	5316126	Till
11-CG-751	17	323308	5319757	Till
11-CG-756	17	324254	5322901	Till
11-CG-762	17	315178	5315460	Till
11-CG-776	17	316499	5306292	Till
11-CG-790	17	316629	5309680	Till
11-CG-800	17	313919	5315888	Till
11-CG-808	17	343084	5347054	Glaciofluvial sand and gravel
11-CG-812	17	341610	5340712	Till
11-CG-814	17	340453	5335591	Till
11-CG-816	17	340356	5332621	Till
11-CG-824	17	327946	5327498	Till
11-CG-829	17	331201	5328133	Till
11-CG-832	17	332838	5328656	Till
11-CG-836	17	335841	5329875	Till
11-CG-840	17	345350	5327897	Glaciofluvial sand and gravel
11-CG-843	17	345680	5330809	Glaciofluvial sand and gravel
11-CG-856	17	339144	5326245	Glaciofluvial sand and gravel
11-CG-861	17	341254	5328593	Till
11-CG-862	17	340454	5329511	Till
11-CG-869	17	344703	5328226	Till
11-CG-877	17	348916	5335409	Till
11-CG-886	17	343492	5339223	Till
11-CG-889	17	345328	5337270	Till
11-CG-895	17	350856	5319854	Glaciofluvial sand and gravel
11-CG-896	17	349388	5320785	Till
11-CG-899	17	346614	5319279	Till
11-CG-901	17	349195	5320299	Till
11-CG-906	17	350560	5324301	Till
11-CG-913	17	318657	5300017	Till
11-CG-914	17	317748	5302313	Till
11-CG-915	17	311486	5299675	Till
13-CG-006	17	320690	5334128	Till
13-CG-009	17	321452	5349928	Till

Sample Number	UTM zone	X_Easting (NAD83)	Y_Northing (NAD83)	Sampling material
13-CG-034	17	313436	5329897	Till
13-CG-042	17	317942	5327240	Till
13-CG-045	17	319430	5328166	Till
13-CG-047	17	320210	5329218	Till
13-CG-107	17	345349	5336147	Till
13-CG-110	17	344744	5334453	Till
13-CG-115	17	346057	5335629	Till
13-CG-124	17	339316	5330589	Glaciofluvial sand and gravel
13-CG-175	17	324017	5312353	Till
13-CG-177	17	324430	5313207	Till
13-CG-185	17	328695	5322547	Till
13-CG-198	17	329771	5321139	Till
13-CG-200	17	330129	5322291	Till
13-CG-204	17	331022	5325482	Till
13-CG-205	17	332860	5328283	Till
13-CG-212	17	325260	5313968	Till
13-CG-216	17	326736	5315376	Till
13-CG-228	17	318910	5300584	Till
13-CG-244	17	322365	5300700	Till
13-CG-268	17	330215	5305065	Glaciofluvial sand and gravel
13-CG-344	17	338292	5314977	Glaciofluvial sand and gravel
13-CG-347	17	330037	5311256	Till
13-CG-382	17	319612	5301708	Till
13-CG-391	17	315950	5301231	Till
13-CG-395	17	313905	5300913	Till
13-CG-400	17	312405	5300111	Till
13-CG-433	17	328274	5283757	Till
13-CG-450	17	325324	5284033	Till
13-CG-490	17	336709	5277236	Till
13-CG-493	17	330299	5303664	Till
13-CG-495	17	330287	5303658	Till
13-CG-499	17	330338	5303908	Till
13-CG-514	17	330872	5303479	Till
13-CG-520	17	331417	5304271	Till
13-CG-530	17	332993	5280483	Till
13-CG-537	17	339498	5274655	Till
13-CG-543	17	340576	5277334	Till
13-CG-549	17	342571	5278381	Till
13-CG-556	17	342281	5280100	Till
13-CG-759	17	315914	5286585	Till
13-CG-765	17	327818	5326801	Till

Sample Number	UTM zone	X_Easting (NAD83)	Y_Northing (NAD83)	Sampling material
14-CG-003	17	350490	5307397	Till
14-CG-009	17	349504	5307750	Till
14-CG-021	17	347376	5300804	Glaciofluvial sand and gravel
14-CG-030	17	346652	5317872	Till
14-CG-038	17	350271	5316519	Glaciofluvial sand and gravel
14-CG-047	17	350624	5321250	Till
14-CG-050	17	352929	5327793	Till
14-CG-053	17	320571	5319784	Till
14-CG-054	17	342937	5328398	Till
14-CG-056	17	345303	5327609	Glaciofluvial sand and gravel
14-CG-060	17	345196	5324679	Glaciofluvial sand and gravel
14-CG-065	17	316493	5308519	Till
14-CG-069	17	328313	5284262	Till
14-CG-070	17	327801	5283988	Till
14-CG-081	17	350108	5267863	Glaciofluvial sand and gravel
14-CG-090	17	344603	5275034	Glaciofluvial sand and gravel
14-CG-109	17	310898	5271395	Till
14-CG-132	17	312906	5263136	Till
14-CG-140	17	310780	5266404	Till
14-CG-149	17	331791	5262527	Till
14-CG-167	17	318698	5261756	Till
14-CG-175	17	311438	5275487	Till
14-CG-180	17	319162	5270113	Till
14-CG-215	17	315005	5292332	Till
14-CG-216	17	315108	5293284	Till
14-CG-217	17	315474	5293954	Till
14-CG-219	17	314890	5294783	Till
14-CG-222	17	331734	5304472	Till
14-CG-223	17	330310	5303678	Till
14-CG-224	17	330335	5303691	Till
14-CG-226	17	322017	5324713	Till
14-CG-227	17	323672	5326358	Till
14-CG-229	17	324229	5325673	Till
14-CG-230	17	323223	5325476	Till
14-CG-232	17	317332	5328498	Till
14-CG-234	17	321314	5339140	Till
14-CG-250	17	334440	5279460	Glaciofluvial sand and gravel
14-CG-252	17	335538	5278419	Till
14-CG-256	17	324043	5327788	Till
14-CG-257	17	324146	5326985	Till
14-CG-259	17	322083	5326148	Till

Sample Number	UTM zone	X_Easting (NAD83)	Y_Northing (NAD83)	Sampling material
14-CG-799	17	336853	5300753	Till
14-CG-800	17	337813	5299444	Till
14-CG-808	17	340335	5294359	Till
14-CG-809	17	340326	5292252	Till
14-CG-815	17	341807	5295145	Glaciofluvial sand and gravel
14-CG-821	17	341453	5294655	Till
14-CG-823	17	341066	5294047	Glaciofluvial sand and gravel
14-CG-829	17	340518	5295125	Till
14-CG-831	17	338791	5291638	Till
14-CG-832	17	338433	5291630	Glaciofluvial sand and gravel
14-CG-852	17	337582	5300427	Glaciofluvial sand and gravel
14-CG-858	17	338099	5301170	Glaciofluvial sand and gravel
14-CG-859	17	341381	5292362	Till
14-CG-861	17	342728	5292218	Glaciofluvial sand and gravel
14-CG-872	17	339977	5290927	Till
14-CG-881	17	320610	5288819	Till
14-CG-882	17	337697	5284797	Till
14-CG-884	17	340017	5284566	Glaciofluvial sand and gravel
14-CG-934	17	339982	5290928	Till
14-CG-935	17	323512	5297597	Glaciofluvial sand and gravel
14-CG-938	17	324241	5293240	Glaciofluvial sand and gravel
14-CG-940	17	329267	5297679	Glaciofluvial sand and gravel
14-CG-947	17	339501	5303113	Glaciofluvial sand and gravel
14-CG-966	17	349205	5301419	Glaciofluvial sand and gravel
14-CG-973	17	350108	5299057	Till
14-CG-977	17	348393	5297960	Till
14-CG-991	17	346957	5305883	Till
14-CG-996	17	347153	5306541	Till
14-CG-997	17	347877	5306162	Till
14-CG-999	17	348200	5305469	Till
16-CG-001A	17	322041	5324710	Till
16-CG-001B	17	322041	5324710	Till
16-CG-001C	17	322041	5324710	Till
16-CG-002	17	322047	5324757	Till
16-CG-003	17	322097	5324765	Till
16-CG-004	17	315526	5283334	Till

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Appendix 3.

Summary of Gold Grain Counts

Abbreviations:

g:	grams
HMC:	Heavy Mineral Concentrate
PPB:	parts per billion

Sample Number	Number of Visible Gold Grains				Nonmag HMC Weight (g)	Calculated PPB Visible Gold in HMC			
	Total	Reshaped	Modified	Pristine		Total	Reshaped	Modified	Pristine
11-CG-013	1	1	0	0	32.4	1	1	0	0
11-CG-017	2	1	1	0	30.0	1	<1	1	0
11-CG-018	1	1	0	0	31.6	1	1	0	0
11-CG-029	11	9	2	0	40.4	83	76	7	0
11-CG-033	4	4	0	0	32.4	154	154	0	0
11-CG-046	1	0	0	1	18.8	1	0	0	1
11-CG-048	0	0	0	0	28.4	0	0	0	0
11-CG-054	7	6	1	0	25.6	652	652	<1	0
11-CG-055	3	3	0	0	43.6	10	10	0	0
11-CG-058	10	10	0	0	34.8	210	210	0	0
11-CG-065	3	3	0	0	36.8	5	5	0	0
11-CG-068	0	0	0	0	33.6	0	0	0	0
11-CG-070	4	3	1	0	41.6	5	4	1	0
11-CG-072	10	10	0	0	42.0	100	100	0	0
11-CG-078	4	4	0	0	37.6	61	61	0	0
11-CG-084	3	2	1	0	36.0	10	<1	10	0
11-CG-087	0	0	0	0	34.8	0	0	0	0
11-CG-090	0	0	0	0	35.2	0	0	0	0
11-CG-101	2	2	0	0	24.4	16	16	0	0
11-CG-107	3	3	0	0	42.8	11	11	0	0
11-CG-109	1	1	0	0	45.6	14	14	0	0
11-CG-110	3	3	0	0	32.4	121	121	0	0
11-CG-122	4	4	0	0	22.4	77	77	0	0
11-CG-123	0	0	0	0	36.8	0	0	0	0
11-CG-127	10	10	0	0	38.0	26	26	0	0
11-CG-129	0	0	0	0	68.8	0	0	0	0
11-CG-131	2	2	0	0	28.4	3	3	0	0
11-CG-136	3	3	0	0	29.6	107	107	0	0
11-CG-139	2	2	0	0	30.0	43	43	0	0
11-CG-146	5	4	1	0	32.0	90	90	1	0
11-CG-178	0	0	0	0	29.2	0	0	0	0
11-CG-181	0	0	0	0	25.2	0	0	0	0
11-CG-185	3	2	1	0	44.4	16	16	<1	0
11-CG-190	3	3	0	0	44.8	25	25	0	0
11-CG-199	1	1	0	0	42.8	9	9	0	0
11-CG-206	2	2	0	0	36.8	15	15	0	0
11-CG-211	3	2	0	1	31.6	15	9	0	6
11-CG-212	0	0	0	0	28.0	0	0	0	0
11-CG-214	2	2	0	0	27.2	606	606	0	0
11-CG-239	3	3	0	0	23.2	3302	3302	0	0
11-CG-251	6	5	1	0	43.6	37	36	1	0
11-CG-267	2	2	0	0	24.4	27	27	0	0
11-CG-273	2	2	0	0	16.4	6	6	0	0
11-CG-276	0	0	0	0	44.0	0	0	0	0
11-CG-292	2	2	0	0	26.8	8	8	0	0
11-CG-295	6	6	0	0	36.4	84	84	0	0

Sample Number	Number of Visible Gold Grains				Nonmag HMC Weight (g)	Calculated PPB Visible Gold in HMC			
	Total	Reshaped	Modified	Pristine		Total	Reshaped	Modified	Pristine
11-CG-305	4	4	0	0	30.8	20	20	0	0
11-CG-315	3	2	1	0	38.0	1	1	1	0
11-CG-327	3	3	0	0	42.4	26	26	0	0
11-CG-334	4	4	0	0	32.4	4116	4116	0	0
11-CG-340	3	2	1	0	34.8	286	144	142	0
11-CG-382	0	0	0	0	40.0	0	0	0	0
11-CG-384	3	3	0	0	35.6	55	55	0	0
11-CG-389	2	2	0	0	42.8	1	1	0	0
11-CG-391	5	4	1	0	43.2	74	74	1	0
11-CG-396	1	1	0	0	30.4	1	1	0	0
11-CG-407A	2	2	0	0	28.4	2	2	0	0
11-CG-407B	3	3	0	0	38.0	165	165	0	0
11-CG-417	2	2	0	0	32.0	3	3	0	0
11-CG-425	2	1	1	0	18.4	4	4	<1	0
11-CG-437	0	0	0	0	11.6	0	0	0	0
11-CG-446	1	1	0	0	34.4	1	1	0	0
11-CG-451	0	0	0	0	35.6	0	0	0	0
11-CG-453	1	1	0	0	32.8	<1	<1	0	0
11-CG-455	4	4	0	0	24.0	8906	8906	0	0
11-CG-459	3	3	0	0	40.8	3	3	0	0
11-CG-472	0	0	0	0	34.0	0	0	0	0
11-CG-517	2	2	0	0	32.8	8	8	0	0
11-CG-522	2	2	0	0	28.0	39	39	0	0
11-CG-655	2	2	0	0	30.0	83	83	0	0
11-CG-656	0	0	0	0	40.4	0	0	0	0
11-CG-658	2	2	0	0	25.2	130	130	0	0
11-CG-661	1	1	0	0	28.4	3	3	0	0
11-CG-665	0	0	0	0	21.6	0	0	0	0
11-CG-666	1	1	0	0	33.2	64	64	0	0
11-CG-667	1	1	0	0	34.4	29	29	0	0
11-CG-668	1	1	0	0	34.0	1	1	0	0
11-CG-675	2	2	0	0	37.2	2	2	0	0
11-CG-697	9	9	0	0	29.6	735	735	0	0
11-CG-703	0	0	0	0	35.2	0	0	0	0
11-CG-713	0	0	0	0	34.0	0	0	0	0
11-CG-720	0	0	0	0	27.2	0	0	0	0
11-CG-726	1	1	0	0	33.2	45	45	0	0
11-CG-730	0	0	0	0	26.0	0	0	0	0
11-CG-738	0	0	0	0	19.6	0	0	0	0
11-CG-739	2	2	0	0	28.0	179	179	0	0
11-CG-740	4	4	0	0	30.8	130	130	0	0
11-CG-742	4	4	0	0	34.0	164	164	0	0
11-CG-748	3	3	0	0	30.8	7	7	0	0
11-CG-751	0	0	0	0	31.6	0	0	0	0
11-CG-756	0	0	0	0	44.0	0	0	0	0
11-CG-762	3	3	0	0	34.4	35	35	0	0
11-CG-776	0	0	0	0	33.2	0	0	0	0

Sample Number	Number of Visible Gold Grains				Nonmag HMC Weight (g)	Calculated PPB Visible Gold in HMC			
	Total	Reshaped	Modified	Pristine		Total	Reshaped	Modified	Pristine
11-CG-790	2	2	0	0	31.2	9	9	0	0
11-CG-800	9	9	0	0	27.2	84	84	0	0
11-CG-808	3	3	0	0	32.8	40	40	0	0
11-CG-812	3	3	0	0	33.6	11	11	0	0
11-CG-814	2	2	0	0	48.8	2	2	0	0
11-CG-816	4	4	0	0	32.8	4	4	0	0
11-CG-824	3	3	0	0	34.0	23	23	0	0
11-CG-829	0	0	0	0	27.6	0	0	0	0
11-CG-832	0	0	0	0	32.8	0	0	0	0
11-CG-836	0	0	0	0	35.2	0	0	0	0
11-CG-840	0	0	0	0	33.2	0	0	0	0
11-CG-843	1	1	0	0	24.8	8	8	0	0
11-CG-856	0	0	0	0	22.8	0	0	0	0
11-CG-861	0	0	0	0	28.8	0	0	0	0
11-CG-862	2	2	0	0	31.2	249	249	0	0
11-CG-869	4	4	0	0	35.6	34	34	0	0
11-CG-877	0	0	0	0	32.4	0	0	0	0
11-CG-886	1	1	0	0	46.4	2	2	0	0
11-CG-889	6	6	0	0	32.0	908	908	0	0
11-CG-895	1	1	0	0	24.4	26	26	0	0
11-CG-896	1	1	0	0	28.0	3	3	0	0
11-CG-899	1	1	0	0	26.8	738	738	0	0
11-CG-901	1	1	0	0	34.0	11	11	0	0
11-CG-906	0	0	0	0	33.6	0	0	0	0
11-CG-913	9	9	0	0	26.4	46	46	0	0
11-CG-914	3	3	0	0	38.4	9	9	0	0
11-CG-915	2	2	0	0	37.2	4	4	0	0
13-CG-006	1	1	0	0	38.4	17	17	0	0
13-CG-009	0	0	0	0	36.8	0	0	0	0
13-CG-034	2	2	0	0	38.0	7	7	0	0
13-CG-042	1	1	0	0	41.6	5	5	0	0
13-CG-045	1	1	0	0	37.6	102	102	0	0
13-CG-047	3	3	0	0	38.4	87	87	0	0
13-CG-107	1	1	0	0	38.4	5	5	0	0
13-CG-110	0	0	0	0	42.4	0	0	0	0
13-CG-115	1	1	0	0	36.8	2	2	0	0
13-CG-124	0	0	0	0	29.6	0	0	0	0
13-CG-175	3	3	0	0	38.4	6	6	0	0
13-CG-177	1	1	0	0	39.6	2	2	0	0
13-CG-185	0	0	0	0	42.4	0	0	0	0
13-CG-198	1	1	0	0	43.6	1	1	0	0
13-CG-200	0	0	0	0	46.4	0	0	0	0
13-CG-204	1	0	1	0	38.0	1	0	1	0
13-CG-205	6	6	0	0	42.4	4	4	0	0
13-CG-212	0	0	0	0	40.4	0	0	0	0
13-CG-216	1	1	0	0	35.2	11	11	0	0
13-CG-228	3	3	0	0	35.2	12	12	0	0

Sample Number	Number of Visible Gold Grains				Nonmag HMC Weight (g)	Calculated PPB Visible Gold in HMC			
	Total	Reshaped	Modified	Pristine		Total	Reshaped	Modified	Pristine
13-CG-244	2	2	0	0	32.0	26	26	0	0
13-CG-268	0	0	0	0	19.6	0	0	0	0
13-CG-344	1	1	0	0	36.4	2	2	0	0
13-CG-347	0	0	0	0	35.2	0	0	0	0
13-CG-382	2	2	0	0	36.0	13	13	0	0
13-CG-391	0	0	0	0	28.8	0	0	0	0
13-CG-395	1	1	0	0	34.0	11	11	0	0
13-CG-400	0	0	0	0	30.0	0	0	0	0
13-CG-433	2	2	0	0	38.4	49	49	0	0
13-CG-450	0	0	0	0	40.0	0	0	0	0
13-CG-490	0	0	0	0	33.6	0	0	0	0
13-CG-493	20	12	5	3	32.8	300	131	67	102
13-CG-495	19	8	7	4	34.4	1156	1134	17	4
13-CG-499	1	0	0	1	34.8	43	0	0	43
13-CG-514	33	16	9	8	36.4	182	111	35	36
13-CG-520	14	12	2	0	39.6	95	94	1	0
13-CG-530	0	0	0	0	35.6	0	0	0	0
13-CG-537	0	0	0	0	35.6	0	0	0	0
13-CG-543	0	0	0	0	34.8	0	0	0	0
13-CG-549	1	1	0	0	36.8	7961	7961	0	0
13-CG-556	0	0	0	0	36.8	0	0	0	0
13-CG-759	0	0	0	0	40.0	0	0	0	0
13-CG-765	1	1	0	0	38.8	2	2	0	0
14-CG-003	0	0	0	0	30.0	0	0	0	0
14-CG-009	0	0	0	0	30.8	0	0	0	0
14-CG-021	0	0	0	0	20.8	0	0	0	0
14-CG-030	0	0	0	0	36.0	0	0	0	0
14-CG-038	1	1	0	0	38.8	<1	<1	0	0
14-CG-047	0	0	0	0	30.4	0	0	0	0
14-CG-050	0	0	0	0	34.8	0	0	0	0
14-CG-053	0	0	0	0	36.4	0	0	0	0
14-CG-054	4	4	0	0	36.8	74	74	0	0
14-CG-056	0	0	0	0	23.6	0	0	0	0
14-CG-060	1	1	0	0	36.8	10	10	0	0
14-CG-065	0	0	0	0	37.6	0	0	0	0
14-CG-069	2	2	0	0	31.2	1	1	0	0
14-CG-070	0	0	0	0	30.4	0	0	0	0
14-CG-081	4	3	1	0	26.8	24	24	<1	0
14-CG-090	1	1	0	0	29.2	22	22	0	0
14-CG-109	0	0	0	0	42.0	0	0	0	0
14-CG-132	2	2	0	0	34.4	1	1	0	0
14-CG-140	2	2	0	0	34.4	3	3	0	0
14-CG-149	3	3	0	0	28.4	27	27	0	0
14-CG-167	0	0	0	0	35.6	0	0	0	0
14-CG-175	1	1	0	0	31.6	20	20	0	0
14-CG-180	3	3	0	0	30.8	16	16	0	0
14-CG-215	2	2	0	0	34.0	44	44	0	0

Sample Number	Number of Visible Gold Grains				Nonmag HMC Weight (g)	Calculated PPB Visible Gold in HMC			
	Total	Reshaped	Modified	Pristine		Total	Reshaped	Modified	Pristine
14-CG-216	1	1	0	0	33.6	422	422	0	0
14-CG-217	0	0	0	0	29.6	0	0	0	0
14-CG-219	1	1	0	0	36.0	117	117	0	0
14-CG-222	19	12	4	3	38.0	253	242	6	5
14-CG-223	21	12	5	4	28.4	180	159	15	6
14-CG-224	28	15	8	5	27.2	266	175	83	9
14-CG-226	29	13	13	3	38.8	364	354	9	<1
14-CG-227	1	1	0	0	34.8	6	6	0	0
14-CG-229	4	3	1	0	34.4	2	2	<1	0
14-CG-230	0	0	0	0	34.0	0	0	0	0
14-CG-232	0	0	0	0	34.8	0	0	0	0
14-CG-234	1	1	0	0	35.6	1	1	0	0
14-CG-250	0	0	0	0	32.8	0	0	0	0
14-CG-252	1	1	0	0	32.8	1	1	0	0
14-CG-256	1	1	0	0	32.8	6	6	0	0
14-CG-257	1	1	0	0	18.4	10	10	0	0
14-CG-259	0	0	0	0	29.2	0	0	0	0
14-CG-799	0	0	0	0	32.0	0	0	0	0
14-CG-800	1	1	0	0	33.6	6	6	0	0
14-CG-808	0	0	0	0	36.4	0	0	0	0
14-CG-809	3	3	0	0	28.4	45	45	0	0
14-CG-815	0	0	0	0	24.8	0	0	0	0
14-CG-821	0	0	0	0	26.8	0	0	0	0
14-CG-823	0	0	0	0	29.2	0	0	0	0
14-CG-829	0	0	0	0	30.4	0	0	0	0
14-CG-831	0	0	0	0	26.8	0	0	0	0
14-CG-832	0	0	0	0	28.8	0	0	0	0
14-CG-852	2	2	0	0	27.2	47	47	0	0
14-CG-858	0	0	0	0	28.8	0	0	0	0
14-CG-859	0	0	0	0	30.0	0	0	0	0
14-CG-861	11	11	0	0	37.6	1648	1648	0	0
14-CG-872	1	1	0	0	33.2	1	1	0	0
14-CG-881	3	3	0	0	29.6	86	86	0	0
14-CG-882	0	0	0	0	31.2	0	0	0	0
14-CG-884	1	1	0	0	35.6	1	1	0	0
14-CG-934	1	0	1	0	33.6	6	0	6	0
14-CG-935	2	2	0	0	37.6	129	129	0	0
14-CG-938	2	2	0	0	34.8	112	112	0	0
14-CG-940	0	0	0	0	30.8	0	0	0	0
14-CG-947	1	1	0	0	37.2	17	17	0	0
14-CG-966	0	0	0	0	34.8	0	0	0	0
14-CG-973	0	0	0	0	33.6	0	0	0	0
14-CG-977	0	0	0	0	32.0	0	0	0	0
14-CG-991	0	0	0	0	40.0	0	0	0	0
14-CG-996	0	0	0	0	35.6	0	0	0	0
14-CG-997	0	0	0	0	29.2	0	0	0	0
14-CG-999	1	1	0	0	37.2	2	2	0	0

Sample Number	Number of Visible Gold Grains				Nonmag HMC Weight (g)	Calculated PPB Visible Gold in HMC			
	Total	Reshaped	Modified	Pristine		Total	Reshaped	Modified	Pristine
16-CG-001A	2	2	0	0	51.2	1	1	0	0
16-CG-001B	5	5	0	0	41.6	36	36	0	0
16-CG-001C	1	1	0	0	38.4	5	5	0	0
16-CG-002	4	4	0	0	36.8	3	3	0	0
16-CG-003	2	2	0	0	42.0	27	27	0	0
16-CG-004	23	22	0	1	43.2	154	154	0	<1

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Appendix 7.

Summary of Kimberlite Indicator Mineral (KIM) Counts

Abbreviations:

CR: Chromite
DC: Cr-diopside; distinctly emerald green (paler emerald green low-Cr diopside picked separately)
FO: Forsterite
GO: Orange mantle garnet, which includes both eclogitic pyrope-almandine (G3) and Cr-poor megacrystic pyrope (G1/G2) varieties, and may include unchecked (by SEM) grains of common crustal garnet
GP: Purple to red peridotitic garnet (G9/10 pyrope)
IM: Mg-ilmenite, which may include unchecked (by SEM) grains of common crustal ilmenite lacking diagnostic inclusions or crystal faces
SEM: Scanning Electronic Microscope

	Number of Grains																				
	Selected Pseudo KIMs			KIMs																	
	1.0 to 2.0 mm	0.5 to 1.0 mm	0.25 to 0.5 mm	1.0 to 2.0 mm						0.5 to 1.0 mm						0.25 to 0.5 mm					
Sample Number	Low-Cr diopside	Low-Cr diopside	Low-Cr diopside	GP	GO	DC	IM	CR	FO	GP	GO	DC	IM	CR	FO	GP	GO	DC	IM	CR	FO	Total KIMs
11-CG-013	0	1	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
11-CG-017	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-018	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-029	0	0	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	8
11-CG-033	0	0	8	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	2
11-CG-046	0	2	50	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	1	15	19
11-CG-048	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-054	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	11
11-CG-055	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
11-CG-058	0	2	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	8
11-CG-065	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-068	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
11-CG-070	0	0	16	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
11-CG-072	0	0	1	0	0	0	0	0	1	0	0	0	0	0	40	0	0	0	0	0	500	541
11-CG-078	0	0	0	0	0	0	0	0	1	0	0	0	0	0	40	0	0	0	2	0	3000	3043
11-CG-084	0	1	50	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	2
11-CG-087	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
11-CG-090	0	0	2	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	2	50	61
11-CG-101	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
11-CG-107	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	9	10
11-CG-109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
11-CG-110	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-122	0	2	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	10
11-CG-123	0	0	40	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	4	5
11-CG-127	0	2	2	0	0	0	0	0	0	0	0	0	12	0	1	0	0	0	50	0	1	64
11-CG-129	0	1	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	40
11-CG-131	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1

	Number of Grains																				
	Selected Pseudo KIMs			KIMs																	
	1.0 to 2.0 mm	0.5 to 1.0 mm	0.25 to 0.5 mm	1.0 to 2.0 mm						0.5 to 1.0 mm						0.25 to 0.5 mm					
Sample Number	**Low-Cr diopside**	**Low-Cr diopside**	**Low-Cr diopside**	**GP**	**GO**	**DC**	**IM**	**CR**	**FO**	**GP**	**GO**	**DC**	**IM**	**CR**	**FO**	**GP**	**GO**	**DC**	**IM**	**CR**	**FO**	**Total KIMs**
11-CG-136	0	1	30	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	5	6
11-CG-139	0	1	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
11-CG-146	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-178	0	2	15	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	16	19
11-CG-181	0	2	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6	7
11-CG-185	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5
11-CG-190	0	0	9	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	9	10
11-CG-199	0	0	9	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	1	1	5
11-CG-206	0	2	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4
11-CG-211	0	3	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	7
11-CG-212	0	1	8	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	3	0	5
11-CG-214	0	0	12	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0	1	7	3	15
11-CG-239	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-251	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-267	0	0	14	0	0	0	0	0	0	0	0	0	1	0	4	0	0	0	0	0	5	10
11-CG-273	0	4	60	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	40	41
11-CG-276	0	2	15	0	0	0	0	0	1	0	0	0	0	0	5	0	0	0	2	0	40	48
11-CG-292	0	1	30	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	7	8
11-CG-295	0	1	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	4
11-CG-305	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	5
11-CG-315	0	0	14	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	2
11-CG-327	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	6
11-CG-334	0	0	12	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	7	11
11-CG-340	0	1	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4
11-CG-382	0	6	14	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	50	53
11-CG-384	0	4	30	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	15	17
11-CG-389	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4
11-CG-391	1	3	10	0	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	0	30	34
11-CG-396	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1

	Number of Grains																					
	Selected Pseudo KIMs			KIMs																		
	1.0 to 2.0 mm	0.5 to 1.0 mm	0.25 to 0.5 mm	1.0 to 2.0 mm						0.5 to 1.0 mm						0.25 to 0.5 mm						
Sample Number	Low-Cr diopside	Low-Cr diopside	Low-Cr diopside	GP	GO	DC	IM	CR	FO	GP	GO	DC	IM	CR	FO	GP	GO	DC	IM	CR	FO	Total KIMs
11-CG-407A	0	1	14	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	4	60	65
11-CG-407B	0	5	14	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	50	53
11-CG-417	0	0	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	0
11-CG-425	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	4
11-CG-437	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	4	11	16
11-CG-446	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6
11-CG-451	0	3	50	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	100	103
11-CG-453	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-455	0	1	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	10
11-CG-459	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-472	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	60	61
11-CG-517	0	4	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	16	18
11-CG-522	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	10
11-CG-655	0	0	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-656	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-658	0	1	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	3
11-CG-661	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4	6
11-CG-665	0	1	9	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
11-CG-666	0	0	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5
11-CG-667	0	1	13	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	14	16
11-CG-668	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
11-CG-675	0	2	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2
11-CG-697	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
11-CG-703	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-713	0	1	6	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	40	44
11-CG-720	0	1	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
11-CG-726	0	4	40	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	6	30	38
11-CG-730	0	0	22	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	7	11
11-CG-738	0	1	15	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	3

	Number of Grains																					
	Selected Pseudo KIMs			KIMs																		
	1.0 to 2.0 mm	0.5 to 1.0 mm	0.25 to 0.5 mm	1.0 to 2.0 mm						0.5 to 1.0 mm						0.25 to 0.5 mm						
Sample Number	Low-Cr diopside	Low-Cr diopside	Low-Cr diopside	GP	GO	DC	IM	CR	FO	GP	GO	DC	IM	CR	FO	GP	GO	DC	IM	CR	FO	Total KIMs
11-CG-739	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
11-CG-740	0	1	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
11-CG-742	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-748	0	1	9	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	3	6
11-CG-751	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	8
11-CG-756	0	1	6	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	3
11-CG-762	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-776	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
11-CG-790	0	0	3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	5	3	10
11-CG-800	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
11-CG-808	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	4	10
11-CG-812	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-814	0	1	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-816	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-824	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-829	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	6
11-CG-832	0	1	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	4
11-CG-836	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-840	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	17
11-CG-843	0	0	40	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	150	153
11-CG-856	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	7	9
11-CG-861	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	11
11-CG-862	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	40	43
11-CG-869	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	7
11-CG-877	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-886	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	11
11-CG-889	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-895	0	0	18	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	3	200	207
11-CG-896	0	1	6	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	2	150	155

	Number of Grains																					
	Selected Pseudo KIMs			KIMs																		
	1.0 to 2.0 mm	0.5 to 1.0 mm	0.25 to 0.5 mm	1.0 to 2.0 mm						0.5 to 1.0 mm						0.25 to 0.5 mm						
Sample Number	Low-Cr diopside	Low-Cr diopside	Low-Cr diopside	GP	GO	DC	IM	CR	FO	GP	GO	DC	IM	CR	FO	GP	GO	DC	IM	CR	FO	Total KIMs
11-CG-899	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-901	0	2	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	15	18
11-CG-906	1	2	2	0	0	0	0	0	2	0	0	0	0	1	3	0	0	0	0	1	30	37
11-CG-913	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-CG-914	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	8	10
11-CG-915	0	0	1	0	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0	100	130
13-CG-006	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	2
13-CG-009	0	1	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
13-CG-034	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	7	9
13-CG-042	0	2	13	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
13-CG-045	1	1	40	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	11	1	13
13-CG-047	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-CG-107	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-CG-110	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-CG-115	0	4	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	5	14
13-CG-124	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	5
13-CG-175	0	3	12	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	2	60	65
13-CG-177	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	50
13-CG-185	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	30
13-CG-198	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	40
13-CG-200	0	2	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	40	44
13-CG-204	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	7
13-CG-205	0	0	4	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	11	14
13-CG-212	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	30
13-CG-216	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	18
13-CG-228	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	4
13-CG-244	0	0	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	6
13-CG-268	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-CG-344	0	2	4	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	9	2	13

	Number of Grains																					
	Selected Pseudo KIMs			KIMs																		
	1.0 to 2.0 mm	0.5 to 1.0 mm	0.25 to 0.5 mm	1.0 to 2.0 mm						0.5 to 1.0 mm						0.25 to 0.5 mm						
Sample Number	Low-Cr diopside	Low-Cr diopside	Low-Cr diopside	GP	GO	DC	IM	CR	FO	GP	GO	DC	IM	CR	FO	GP	GO	DC	IM	CR	FO	Total KIMs
13-CG-347	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-CG-382	0	2	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	2
13-CG-391	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
13-CG-395	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-CG-400	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-CG-433	0	0	3	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	30	33
13-CG-450	0	2	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	10
13-CG-490	0	0	13	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	0	4
13-CG-493	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	20	27
13-CG-495	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0
13-CG-499	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	1
13-CG-514	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	50	54
13-CG-520	0	3	12	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	30	31
13-CG-530	0	0	9	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	50	52
13-CG-537	0	3	40	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	3	2
13-CG-543	0	5	40	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	1	600	609
13-CG-549	0	2	40	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	4	2
13-CG-556	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	50	52
13-CG-759	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	100	103
13-CG-765	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	80	83
14-CG-003	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	6	8
14-CG-009	0	2	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	12
14-CG-021	0	1	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	13
14-CG-030	0	0	15	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	21	23
14-CG-038	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4
14-CG-047	0	2	10	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	50	58
14-CG-050	0	1	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	40
14-CG-053	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
14-CG-054	0	2	12	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	3	7

	Number of Grains																					
	Selected Pseudo KIMs			KIMs																		
	1.0 to 2.0 mm	0.5 to 1.0 mm	0.25 to 0.5 mm	1.0 to 2.0 mm						0.5 to 1.0 mm						0.25 to 0.5 mm						
Sample Number	Low-Cr diopside	Low-Cr diopside	Low-Cr diopside	GP	GO	DC	IM	CR	FO	GP	GO	DC	IM	CR	FO	GP	GO	DC	IM	CR	FO	Total KIMs
14-CG-056	0	0	3	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	100	105
14-CG-060	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
14-CG-065	0	1	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3
14-CG-069	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	19	20
14-CG-070	0	0	8	0	0	0	0	0	0	0	0	0	0	1	2	0	0	1	0	3	17	24
14-CG-081	0	4	18	0	0	0	0	0	0	0	0	0	0	1	4	0	0	1	1	8	22	37
14-CG-090	0	2	10	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	100	109
14-CG-109	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	10	11
14-CG-132	0	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	16
14-CG-140	0	2	9	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	14	15
14-CG-149	0	1	7	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	19	21
14-CG-167	0	0	5	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	5	21	28
14-CG-175	0	1	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	5	7
14-CG-180	0	0	1	0	0	0	0	0	0	0	0	0	0	0	9	0	0	1	0	1	120	131
14-CG-215	0	1	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	7
14-CG-216	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-CG-217	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
14-CG-219	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
14-CG-222	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4
14-CG-223	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	4	6
14-CG-224	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	3	8
14-CG-226	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
14-CG-227	0	0	10	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	6	8
14-CG-229	0	0	6	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	60	65
14-CG-230	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-CG-232	0	2	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-CG-234	0	0	5	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	40	43
14-CG-250	0	1	40	0	0	0	0	0	0	0	0	0	0	0	60	0	0	0	0	0	12000	12060
14-CG-252	0	0	6	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	18	22

	Number of Grains																					
	Selected Pseudo KIMs			KIMs																		
	1.0 to 2.0 mm	0.5 to 1.0 mm	0.25 to 0.5 mm	1.0 to 2.0 mm						0.5 to 1.0 mm						0.25 to 0.5 mm						
Sample Number	Low-Cr diopside	Low-Cr diopside	Low-Cr diopside	GP	GO	DC	IM	CR	FO	GP	GO	DC	IM	CR	FO	GP	GO	DC	IM	CR	FO	Total KIMs
14-CG-256	0	1	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-CG-257	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
14-CG-259	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
14-CG-799	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	16
14-CG-800	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3
14-CG-808	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-CG-809	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	12	13
14-CG-815	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	10
14-CG-821	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-CG-823	0	1	30	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	40	47
14-CG-829	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	8
14-CG-831	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	3	6	11
14-CG-832	0	1	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-CG-852	0	3	5	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	80	81
14-CG-858	0	2	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-CG-859	0	0	3	0	0	0	0	0	1	0	0	0	0	0	16	0	0	0	0	4	200	221
14-CG-861	0	1	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	50	51
14-CG-872	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-CG-881	0	1	17	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	12	13
14-CG-882	0	2	19	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	27	31
14-CG-884	0	0	14	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	7	11
14-CG-934	0	0	10	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	10	12
14-CG-935	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	4	0	6
14-CG-938	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	100	104
14-CG-940	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
14-CG-947	0	1	14	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	1	300	308
14-CG-966	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	40	41
14-CG-973	0	1	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3
14-CG-977	0	0	4	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	4	6

	Number of Grains																					
	Selected Pseudo KIMs			KIMs																		
	1.0 to 2.0 mm	0.5 to 1.0 mm	0.25 to 0.5 mm	1.0 to 2.0 mm						0.5 to 1.0 mm						0.25 to 0.5 mm						
Sample Number	**Low-Cr diopside**	**Low-Cr diopside**	**Low-Cr diopside**	**GP**	**GO**	**DC**	**IM**	**CR**	**FO**	**GP**	**GO**	**DC**	**IM**	**CR**	**FO**	**GP**	**GO**	**DC**	**IM**	**CR**	**FO**	**Total KIMs**
14-CG-991	0	0	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5
14-CG-996	0	0	5	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	15	17
14-CG-997	0	0	7	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	6	8
14-CG-999	0	2	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	10
16-CG-001A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	5
16-CG-001B	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16-CG-001C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
16-CG-002	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	11
16-CG-003	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	5
16-CG-004	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	3	7

Appendix 11.

Summary of Adjusted Kimberlite Indicator Mineral (KIM) Counts and Sample Calculations

Abbreviations:

CR: Chromite

DC: Cr-diopside; distinctly emerald green (paler emerald green low-Cr diopside picked separately)

FO: Forsterite

GO: Orange mantle garnet, which includes both eclogitic pyrope-almandine (G3) and Cr-poor megacrystic pyrope (G1/G2) varieties, and may include unchecked (by SEM) grains of common crustal garnet

GP: Purple to red peridotitic garnet (G9/10 pyrope)

IM: Mg-ilmenite, which may include unchecked (by SEM) grains of common crustal ilmenite lacking diagnostic inclusions or crystal faces

SEM: Scanning Electronic Microscope

Sample calculations to show how adjusted KIM counts were determined

Case A: less than 20 grains microprobed

Sample 1 has counts of 10 GP and 2 GO grains

Microprobed: 8 GP grains; 0 GO grains

Results of microprobing

Of the 8 GP grains microprobed, there are 5 GP, 2 GO and 1 other grains

- 0 GO grains microprobed

Adjusted GO and GP

GP: 10-2-1=7 or 5+2=7

GO: 2+2=4

Case B: 20 or more grains microprobed

Sample 2 has counts of 200 GP and 100 GO grains

Microprobed: 100 GP grains; 50 GO grains

Results of microprobing

Of the 100 GP grains microprobed, there are 80 GP, 19 GO, and 1 other grains

Of the 50 GO grains microprobed, there are 30 GO, 15 GP, and 5 other grains

Adjusted GP and GO

GP: (80/100)x200+(15/50)x100=160+30=190

GO: (30/50)x100+(19/100)x200=60+38=98

GP includes G9, G10, G11 and G12

GO includes G1, G3, G4 and G5

Sample Number	X_Easting	Y_Northing	GP	GO	DC	IM	CR	FO	Low-Cr diopside	Sampling media	GP-GO-DC-IM
11-CG-013	338065	5289016	0	0	0	0	0	1	12	Till	0
11-CG-017	325999	5286050	0	0	0	0	0	0	8	Till	0
11-CG-018	327875	5282933	0	0	0	0	0	0	5	Till	0
11-CG-029	330618	5274240	0	0	1	0	0	8	38	Till	1
11-CG-033	326999	5273617	0	0	0	0	0	2	8	Till	0
11-CG-046	322103	5290028	0	1	0	0	1	17	52	Glaciofluvial sand and gravel	1
11-CG-048	319992	5275221	0	0	0	0	0	0	8	Glaciofluvial sand and gravel	0
11-CG-054	318569	5282592	0	0	0	1	10	0	6	Glaciofluvial sand and gravel	1
11-CG-055	316527	5283026	1	0	0	0	0	0	4	Till	1
11-CG-058	315515	5283315	0	0	0	0	0	8	32	Till	0
11-CG-065	310270	5277567	0	0	0	0	0	0	1	Till	0
11-CG-068	312847	5284961	0	1	0	0	0	0	9	Glaciofluvial sand and gravel	1
11-CG-070	334962	5277209	0	0	0	1	0	0	16	Till	1
11-CG-072	335998	5282192	0	0	0	0	0	541	1	Till	0
11-CG-078	336815	5285566	0	0	0	2	0	3041	0	Till	2
11-CG-084	338945	5284612	0	0	1	0	0	2	50	Till	1
11-CG-087	336782	5288336	0	0	0	0	0	2	12	Till	0
11-CG-090	340317	5291567	0	0	0	0	2	59	2	Till	0
11-CG-101	341682	5292510	0	0	0	0	0	3	14	Till	0
11-CG-107	319284	5288318	0	0	0	0	1	9	3	Till	0
11-CG-109	316830	5287556	0	0	0	0	0	1	0	Till	0
11-CG-110	314519	5285610	0	0	0	0	0	0	9	Till	0
11-CG-122	348911	5293525	0	0	0	0	1	10	10	Glaciofluvial sand and gravel	0
11-CG-123	349290	5293828	1	0	0	0	0	4	40	Till	1
11-CG-127	347282	5292747	0	0	0	59	0	2	4	Till	59
11-CG-129	347398	5293860	0	3	0	0	0	40	21	Till	3
11-CG-131	347461	5293931	0	1	0	0	0	1	3	Till	1
11-CG-136	336816	5300797	0	0	0	0	0	6	31	Till	0
11-CG-139	338538	5301312	0	0	0	0	0	2	14	Till	0
11-CG-146	337966	5297573	0	0	1	0	0	0	5	Till	1
11-CG-178	311065	5295822	0	1	0	0	1	16	17	Glaciofluvial sand and gravel	1
11-CG-181	311684	5294493	0	0	0	0	1	6	18	Till	0
11-CG-185	314177	5294083	0	0	0	0	0	5	7	Till	0
11-CG-190	317152	5292982	0	0	0	0	0	10	9	Till	0
11-CG-199	319372	5292088	0	0	0	1	2	2	8	Till	1
11-CG-206	321952	5294243	0	0	1	0	0	4	8	Till	1
11-CG-211	321331	5295917	0	0	0	0	0	4	11	Till	0
11-CG-212	323342	5294736	1	0	0	1	3	0	9	Glaciofluvial sand and gravel	2
11-CG-214	323374	5296529	0	0	2	2	8	5	10	Glaciofluvial sand and gravel	4
11-CG-239	328589	5297067	0	0	0	0	0	0	5	Glaciofluvial sand and gravel	0
11-CG-251	329597	5295381	0	0	0	0	0	0	11	Till	0
11-CG-267	353133	5315139	0	0	0	0	0	9	13	Till	0
11-CG-273	349501	5313654	0	0	0	0	0	41	64	Glaciofluvial sand and gravel	0
11-CG-276	349777	5315650	0	0	1	1	0	46	16	Till	2
11-CG-292	343412	5311239	0	0	0	0	0	8	31	Till	0
11-CG-295	340756	5310311	0	0	0	0	1	3	7	Till	0
11-CG-305	321654	5288708	0	0	0	0	1	4	13	Till	0
11-CG-315	321114	5286340	0	0	0	0	1	1	14	Till	0
11-CG-327	316623	5284290	0	0	0	0	4	2	3	Till	0

Sample Number	X_Easting	Y_Northing	GP	GO	DC	IM	CR	FO	Low-Cr diopside	Sampling media	GP-GO-DC-IM
11-CG-334	320033	5286842	0	0	0	0	4	7	12	Glaciofluvial sand and gravel	0
11-CG-340	322115	5289394	0	0	2	0	0	4	12	Till	2
11-CG-382	349671	5310750	0	0	1	0	1	51	19	Till	1
11-CG-384	349758	5310164	0	0	1	0	1	16	33	Glaciofluvial sand and gravel	1
11-CG-389	350559	5307673	0	0	1	0	0	4	11	Till	1
11-CG-391	350825	5305419	0	1	0	0	0	33	14	Till	1
11-CG-396	348463	5306320	0	0	0	0	1	0	6	Till	0
11-CG-407A	345100	5302155	0	0	0	0	4	61	15	Till	0
11-CG-407B	345100	5302155	0	0	0	0	3	50	19	Till	0
11-CG-417	341937	5302537	0	0	0	0	0	60	40	Till	0
11-CG-425	341075	5302683	0	0	0	0	1	2	14	Till	0
11-CG-437	345438	5300721	1	0	0	0	2	11	11	Till	1
11-CG-446	348242	5300091	0	0	0	0	0	6	11	Till	0
11-CG-451	349636	5301998	0	0	1	0	0	103	52	Glaciofluvial sand and gravel	1
11-CG-453	351095	5301827	0	0	0	0	0	0	12	Till	0
11-CG-455	350114	5300320	0	0	0	0	0	10	16	Glaciofluvial sand and gravel	0
11-CG-459	348827	5298409	0	0	0	0	0	0	14	Till	0
11-CG-472	344471	5299045	0	0	0	0	1	60	6	Till	0
11-CG-517	347733	5316477	0	0	0	0	2	16	15	Till	0
11-CG-522	345938	5316662	0	0	0	0	0	10	15	Till	0
11-CG-655	320986	5347273	0	0	0	0	0	0	40	Till	0
11-CG-656	320634	5343659	0	0	0	0	0	0	4	Till	0
11-CG-658	314926	5346953	0	0	0	1	2	0	9	Till	1
11-CG-661	317770	5344893	0	0	0	0	2	4	4	Till	0
11-CG-665	321068	5342400	1	0	0	0	0	0	9	Glaciofluvial sand and gravel	1
11-CG-666	320668	5341385	0	0	0	0	0	5	24	Till	0
11-CG-667	320368	5337158	0	0	0	0	1	15	14	Till	0
11-CG-668	319045	5333605	0	0	0	0	1	0	7	Till	0
11-CG-675	317606	5330006	0	0	1	0	1	1	18	Till	1
11-CG-697	322227	5322630	0	0	0	0	0	1	5	Till	0
11-CG-703	319970	5318041	0	0	0	0	0	0	18	Till	0
11-CG-713	318215	5312877	0	0	0	0	3	41	7	Till	0
11-CG-720	332627	5342865	0	0	0	0	0	3	16	Glaciofluvial sand and gravel	0
11-CG-726	328966	5335334	1	0	0	2	5	30	44	Glaciofluvial sand and gravel	3
11-CG-730	328523	5332216	1	0	0	0	3	7	22	Glaciofluvial sand and gravel	1
11-CG-738	318841	5304842	1	0	0	0	0	2	16	Glaciofluvial sand and gravel	1
11-CG-739	319383	5305561	0	0	0	0	1	0	6	Till	0
11-CG-740	321160	5309168	0	0	0	0	0	2	9	Till	0
11-CG-742	322038	5313056	0	0	0	0	0	0	5	Till	0
11-CG-748	322554	5316126	0	0	0	0	2	4	10	Till	0
11-CG-751	323308	5319757	0	0	0	0	0	8	7	Till	0
11-CG-756	324254	5322901	0	0	0	0	1	2	7	Till	0
11-CG-762	315178	5315460	0	0	0	0	0	0	3	Till	0
11-CG-776	316499	5306292	0	0	0	0	0	3	13	Till	0
11-CG-790	316629	5309680	0	0	0	2	4	3	3	Till	2
11-CG-800	313919	5315888	0	0	1	0	0	1	4	Till	1
11-CG-808	343084	5347054	0	0	0	0	5	4	11	Glaciofluvial sand and gravel	0
11-CG-812	341610	5340712	0	0	0	0	0	0	3	Till	0
11-CG-814	340453	5335591	0	0	0	0	0	0	7	Till	0

Sample Number	X_Easting	Y_Northing	GP	GO	DC	IM	CR	FO	Low-Cr diopside	Sampling media	GP-GO-DC-IM
11-CG-816	340356	5332621	0	0	0	0	0	0	9	Till	0
11-CG-824	327946	5327498	0	0	0	0	0	0	4	Till	0
11-CG-829	331201	5328133	0	0	0	0	3	3	10	Till	0
11-CG-832	332838	5328656	0	0	0	0	1	2	11	Till	0
11-CG-836	335841	5329875	0	0	0	0	0	0	8	Till	0
11-CG-840	345350	5327897	0	0	0	0	0	17	12	Glaciofluvial sand and gravel	0
11-CG-843	345680	5330809	0	0	1	0	0	152	39	Glaciofluvial sand and gravel	1
11-CG-856	339144	5326245	0	0	0	0	2	7	9	Glaciofluvial sand and gravel	0
11-CG-861	341254	5328593	0	0	0	0	0	11	9	Till	0
11-CG-862	340454	5329511	0	0	0	0	2	40	15	Till	0
11-CG-869	344703	5328226	0	0	0	0	0	7	9	Till	0
11-CG-877	348916	5335409	0	0	0	0	0	0	2	Till	0
11-CG-886	343492	5339223	0	0	0	0	0	11	7	Till	0
11-CG-889	345328	5337270	0	0	0	0	0	0	1	Till	0
11-CG-895	350856	5319854	0	0	1	0	3	202	17	Glaciofluvial sand and gravel	1
11-CG-896	349388	5320785	0	0	0	0	3	152	6	Till	0
11-CG-899	346614	5319279	0	0	0	0	0	0	10	Till	0
11-CG-901	349195	5320299	0	0	0	0	2	16	3	Till	0
11-CG-906	350560	5324301	0	0	1	0	2	35	4	Till	1
11-CG-913	318657	5300017	0	0	0	0	0	0	0	Till	0
11-CG-914	317748	5302313	0	0	0	0	2	8	18	Till	0
11-CG-915	311486	5299675	0	0	0	0	0	130	1	Till	0
13-CG-006	320690	5334128	1	0	0	0	0	1	0	Till	1
13-CG-009	321452	5349928	0	0	0	0	1	0	10	Till	0
13-CG-034	313436	5329897	0	0	0	0	2	5	6	Till	0
13-CG-042	317942	5327240	1	0	0	0	0	0	15	Till	1
13-CG-045	319430	5328166	0	0	0	0	11	0	43	Till	0
13-CG-047	320210	5329218	0	0	0	0	0	0	7	Till	0
13-CG-107	345349	5336147	0	0	0	0	0	0	2	Till	0
13-CG-110	344744	5334453	0	0	0	0	0	0	1	Till	0
13-CG-115	346057	5335629	0	2	0	0	2	5	44	Till	2
13-CG-124	339316	5330589	0	0	0	0	5	0	1	Glaciofluvial sand and gravel	0
13-CG-175	324017	5312353	0	0	1	0	2	61	16	Till	1
13-CG-177	324430	5313207	0	0	0	0	0	48	3	Till	0
13-CG-185	328695	5322547	0	0	0	0	0	22	10	Till	0
13-CG-198	329771	5321139	0	0	0	0	0	39	2	Till	0
13-CG-200	330129	5322291	0	0	1	0	4	39	41	Till	1
13-CG-204	331022	5325482	0	0	0	0	0	0	12	Till	0
13-CG-205	332860	5328283	0	0	0	0	1	12	5	Till	0
13-CG-212	325260	5313968	0	0	0	0	0	29	2	Till	0
13-CG-216	326736	5315376	0	0	0	0	0	15	13	Till	0
13-CG-228	318910	5300584	0	0	0	0	2	1	5	Till	0
13-CG-244	322365	5300700	0	2	0	0	1	5	40	Till	2
13-CG-268	330215	5305065	0	0	0	0	0	0	0	Glaciofluvial sand and gravel	0
13-CG-344	338292	5314977	0	0	0	0	9	3	6	Glaciofluvial sand and gravel	0
13-CG-347	330037	5311256	0	0	0	0	0	0	2	Till	0
13-CG-382	319612	5301708	0	0	0	0	2	1	4	Till	0
13-CG-391	315950	5301231	0	0	0	0	1	2	9	Till	0
13-CG-395	313905	5300913	0	0	0	0	0	0	1	Till	0

Sample Number	X_Easting	Y_Northing	GP	GO	DC	IM	CR	FO	Low-Cr diopside	Sampling media	GP-GO-DC-IM
13-CG-400	312405	5300111	0	0	0	0	0	0	9	Till	0
13-CG-433	328274	5283757	0	0	0	0	0	37	4	Till	0
13-CG-450	325324	5284033	0	0	0	0	0	10	14	Till	0
13-CG-490	336709	5277236	0	0	1	0	4	0	12	Till	1
13-CG-493	330299	5303664	0	0	0	0	7	17	4	Till	0
13-CG-495	330287	5303658	0	0	0	0	0	7	0	Till	0
13-CG-499	330338	5303908	0	0	0	0	1	3	3	Till	0
13-CG-514	330872	5303479	0	0	0	0	0	53	2	Till	0
13-CG-520	331417	5304271	0	0	2	0	0	29	15	Till	2
13-CG-530	332993	5280483	0	0	0	0	0	52	9	Till	0
13-CG-537	339498	5274655	0	0	2	0	0	5	41	Till	2
13-CG-543	340576	5277334	0	1	1	0	1	608	44	Till	2
13-CG-549	342571	5278381	0	0	1	0	1	7	41	Till	1
13-CG-556	342281	5280100	0	0	0	0	2	50	20	Till	0
13-CG-759	315914	5286585	1	0	0	0	2	85	20	Till	1
13-CG-765	327818	5326801	1	0	0	0	0	81	3	Till	1
14-CG-003	350490	5307397	1	0	1	0	1	6	4	Till	2
14-CG-009	349504	5307750	0	0	0	0	0	12	13	Till	0
14-CG-021	347376	5300804	0	0	0	0	0	13	8	Glaciofluvial sand and gravel	0
14-CG-030	346652	5317872	0	0	0	0	0	23	13	Till	0
14-CG-038	350271	5316519	0	0	0	0	0	4	6	Glaciofluvial sand and gravel	0
14-CG-047	350624	5321250	0	0	0	0	4	54	12	Till	0
14-CG-050	352929	5327793	0	0	1	0	0	40	12	Till	1
14-CG-053	320571	5319784	0	0	0	0	0	3	0	Till	0
14-CG-054	342937	5328398	0	0	0	0	3	4	14	Till	0
14-CG-056	345303	5327609	0	0	0	0	0	105	2	Glaciofluvial sand and gravel	0
14-CG-060	345196	5324679	0	0	1	0	0	2	0	Glaciofluvial sand and gravel	1
14-CG-065	316493	5308519	0	0	1	0	1	2	9	Till	1
14-CG-069	328313	5284262	0	0	0	0	1	19	12	Till	0
14-CG-070	327801	5283988	0	0	1	0	4	19	7	Till	1
14-CG-081	350108	5267863	0	0	1	0	8	26	22	Glaciofluvial sand and gravel	1
14-CG-090	344603	5275034	0	0	1	0	0	109	10	Glaciofluvial sand and gravel	1
14-CG-109	310898	5271395	1	0	1	0	0	10	9	Till	2
14-CG-132	312906	5263136	0	0	0	0	0	16	19	Till	0
14-CG-140	310780	5266404	0	0	0	0	0	15	10	Till	0
14-CG-149	331791	5262527	0	0	0	0	0	21	8	Till	0
14-CG-167	318698	5261756	0	0	0	1	5	22	5	Till	1
14-CG-175	311438	5275487	0	0	0	0	2	5	14	Till	0
14-CG-180	319162	5270113	0	0	1	0	1	129	1	Till	1
14-CG-215	315005	5292332	0	0	0	0	0	7	13	Till	0
14-CG-216	315108	5293284	0	0	0	0	0	0	3	Till	0
14-CG-217	315474	5293954	0	0	0	0	0	2	5	Till	0
14-CG-219	314890	5294783	0	0	0	0	1	0	3	Till	0
14-CG-222	331734	5304472	0	0	0	0	0	4	8	Till	0
14-CG-223	330310	5303678	0	0	0	0	1	5	1	Till	0
14-CG-224	330335	5303691	0	0	0	0	5	3	3	Till	0
14-CG-226	322017	5324713	0	0	0	0	0	1	1	Till	0
14-CG-227	323672	5326358	0	0	0	0	0	8	10	Till	0
14-CG-229	324229	5325673	0	0	0	0	0	65	6	Till	0

Sample Number	X_Easting	Y_Northing	GP	GO	DC	IM	CR	FO	Low-Cr diopside	Sampling media	GP-GO-DC-IM
14-CG-230	323223	5325476	0	0	0	0	0	0	7	Till	0
14-CG-232	317332	5328498	0	0	0	0	0	0	12	Till	0
14-CG-234	321314	5339140	0	0	0	1	1	41	5	Till	1
14-CG-250	334440	5279460	0	0	0	0	0	12060	41	Glaciofluvial sand and gravel	0
14-CG-252	335538	5278419	0	0	0	0	2	20	6	Till	0
14-CG-256	324043	5327788	0	0	1	0	0	0	8	Till	1
14-CG-257	324146	5326985	0	0	0	0	1	0	6	Till	0
14-CG-259	322083	5326148	0	0	1	0	2	0	1	Till	1
14-CG-799	336853	5300753	0	0	0	0	0	16	12	Till	0
14-CG-800	337813	5299444	0	0	0	0	1	2	8	Till	0
14-CG-808	340335	5294359	0	0	0	0	0	0	1	Till	0
14-CG-809	340326	5292252	0	1	0	0	0	12	9	Till	1
14-CG-815	341807	5295145	0	0	0	0	0	10	1	Glaciofluvial sand and gravel	0
14-CG-821	341453	5294655	0	0	0	0	0	0	12	Till	0
14-CG-823	341066	5294047	0	0	0	0	0	42	30	Glaciofluvial sand and gravel	0
14-CG-829	340518	5295125	0	0	0	0	0	8	5	Till	0
14-CG-831	338791	5291638	0	2	1	0	3	6	1	Till	3
14-CG-832	338433	5291630	0	0	0	0	0	0	7	Glaciofluvial sand and gravel	0
14-CG-852	337582	5300427	0	0	1	0	0	81	7	Glaciofluvial sand and gravel	1
14-CG-858	338099	5301170	0	0	0	0	0	0	18	Glaciofluvial sand and gravel	0
14-CG-859	341381	5292362	0	0	0	0	4	217	3	Till	0
14-CG-861	342728	5292218	0	1	2	0	1	50	39	Glaciofluvial sand and gravel	3
14-CG-872	339977	5290927	0	0	0	0	0	0	8	Till	0
14-CG-881	320610	5288819	0	0	0	0	0	13	17	Till	0
14-CG-882	337697	5284797	0	0	2	0	3	28	19	Till	2
14-CG-884	340017	5284566	0	0	1	0	3	8	13	Glaciofluvial sand and gravel	1
14-CG-934	339982	5290928	0	0	0	0	0	12	10	Till	0
14-CG-935	323512	5297597	0	1	0	1	4	0	7	Glaciofluvial sand and gravel	2
14-CG-938	324241	5293240	0	0	1	0	4	100	14	Glaciofluvial sand and gravel	1
14-CG-940	329267	5297679	0	0	0	0	1	0	30	Glaciofluvial sand and gravel	0
14-CG-947	339501	5303113	0	0	1	0	1	307	13	Glaciofluvial sand and gravel	1
14-CG-966	349205	5301419	0	0	2	0	1	40	27	Glaciofluvial sand and gravel	2
14-CG-973	350108	5299057	0	0	0	0	1	0	11	Till	0
14-CG-977	348393	5297960	0	0	0	0	1	5	4	Till	0
14-CG-991	346957	5305883	0	0	0	0	0	5	28	Till	0
14-CG-996	347153	5306541	0	0	0	0	1	16	5	Till	0
14-CG-997	347877	5306162	0	0	1	0	1	7	4	Till	1
14-CG-999	348200	5305469	0	0	1	0	0	10	20	Till	1
16-CG-001A	322041	5324710	0	0	0	0	4	1	0	Till	0
16-CG-001B	322041	5324710	0	0	0	0	0	0	2	Till	0
16-CG-001C	322041	5324710	0	0	0	0	0	1	0	Till	0
16-CG-002	322047	5324757	0	0	0	0	11	0	5	Till	0
16-CG-003	322097	5324765	0	0	0	0	5	0	6	Till	0
16-CG-004	315526	5283334	0	0	0	0	4	3	3	Till	0

Appendix 14.

Microscope Descriptions of Nonkimberlitic Boulders of Mantle Origin

From Overburden Drilling Management Limited
for George Gao, Ontario Geological Survey,
by S.A. Averill, December 3-5, 2013

13-CG-438-1 CARBONATITE Subrounded 25 cm, 9 kg boulder. Medium grey, massive, nonmagnetic, mafic, hypabyssal intrusive rock consisting of 3% small (2-5 mm), angular to resorbed, monolithic fragments comprised of fine-grained (0.2-0.3 mm) leucocratic (probably bleached) and commonly brecciated and hematite-stained basalt or andesite plus 1% large (3-8 mm) biotite phenocrysts in a medium-grained (0.3-0.5 mm), equigranular, interlocking groundmass comprised of 70% ankerite (SEM confirmed), 20% titanian biotite (SEM confirmed; not phlogopite) and 10% finer-grained (0.05-0.1 mm) titanite (SEM confirmed; partly altered to leucoxene). No mantle xenoliths or xenocrysts.

13-CG-438-2 PERIDOTITE. Subangular 25 cm, 6 kg boulder. Dark grey-green, weakly foliated, strongly magnetic, cumulate-textured, probably extrusive (komatiitic flow) ultramafic rock consisting of 20% cumulus olivine as euhedral, completely calcite-altered, 1-5 mm crystals in a groundmass comprised of 30% finer 0.1-0.4 mm olivine crystals (also completely calcite-altered), 15% biotite flakes (SEM confirmed), 10% calcite, 40% talc and 3% magnetite. No xenoliths or mantle xenocrysts.

13-CG-438-3 PERIDOTITE. Subangular, highly fractured, 20 cm, 5.4 kg boulder. Dark green-black, moderately foliated, strongly magnetic, cumulate-textured, probably extrusive (komatiitic flow) ultramafic rock consisting of abundant (40%), wholly serpentinized, 1-5 mm, cumulus olivine crystals in a groundmass comprised of 50% smaller (0.1-0.4 mm), similarly serpentinized olivine crystals, 10% biotite flakes, 10% calcite, 30% talc and 3% magnetite. No xenoliths or mantle xenocrysts.

13_CG-438-4 PERIDOTITE. Subangular, highly fractured, calcite veined, 15 cm, 2 kg boulder. Dark grey-green, brown-weathering, weakly foliated, strongly magnetic, weakly cumulate-textured, extrusive (komatiitic flow) ultramafic rock consisting of sparse (10%), small (1-2 mm), wholly serpentinized, cumulus olivine crystals in groundmass comprised of 50% much finer-grained (0.1-0.2 mm), similarly serpentinized olivine crystals, 10% biotite flakes, 40% calcite and 3% magnetite. No xenoliths or mantle xenocrysts.

13-CG-438-5 SYENITE. Subrounded, 15 cm, 2 kg boulder. Dark grey, massive, weakly magnetic to locally strongly magnetic, mafic, aphyric but strongly xenolithic and xencrytic, hypabyssal (dyke) rock consisting of 5% small (mostly 1-5 mm, rarely to 25 mm), flow-foliated, monolithic (probably autolithic) leucosyenite (pink alkali feldspar with 10% biotite and 2% magnetite; feldspar and biotite both SEM confirmed) xenoliths and a similar proportion of rounded 1-10 mm mantle xenoliths comprised of unaltered forsteritic olivine, titanian augite with conchoidal thermal fractures resembling chromite; SEM confirmed), sanidine (SEM confirmed) and Cr-diopside (not low-Cr diopside) in a 10:1:1:1 ratio in a very fine-grained, 0.05-0.15 mm groundmass comprised of 50% brown titanian augite (SEM confirmed), 10% titanian biotite (SEM confirmed; alteration product of Ti-augite; more abundant in gradational reaction zones between groundmass and xenoliths), 40% K-spar (SEM confirmed), 3% calcite, 1% ilmenite (SEM confirmed) and trace magnetite.

13-CG-123 PERIDOTITE. Subangular, vuggy, 30 cm, 6 kg boulder. Dark grey-green, moderately foliated, very strongly magnetic, weakly cumulate-textured, extrusive (komatiitic flow) ultramafic rock consisting of sparse (15%), small (1-3 mm) wholly serpentinized cumulus olivine crystals in a groundmass comprised of subequal proportions of finer-grained (0.2-0.5 mm) olivine crystals (also wholly serpentinized), biotite flakes and calcite, all finely dusted with 3% magnetite. High calcite content accounts for vuggy weathered surface of bouler. No xenoliths or mantle xenocrysts.

13-CG-544 PYROXENITE. Hard, well rounded but fractured, 8 cm, 0.6 kg boulder. Dark grey-brown, massive, very weakly magnetic, weakly cumulate-textured, extrusive (komatiitic flow) ultramafic rock consisting of sparse (5%), small (1-3 mm), wholly calcite-altered, cumulus olivine crystals and very sparse (<1%), similar-sized, euhedral, dark brown, cumulus augite and bornite (both SEM confirmed) crystals in a finely (0.1-0.2 mm) equigranular interlocking groundmass comprised of 80% grey-brown augite (SEM confirmed) and 20% titanian biotite with trace magnetite. No xenoliths or mantle xenocrysts.

From: Stu Averill [mailto:odm@storm.ca]
Sent: December-05-13 5:46 PM
To: Gao, George (MNDM)
Subject: "Kimberlitic" Boulders

Hello George.

I have just logged the seven potentially kimberlitic boulders that you submitted earlier this year. My descriptions are attached. These descriptions were made mainly by binocular microscope with SEM confirmation of key or questionable minerals.

All of the boulders are of mantle-derived lithologies and thus are worthy candidates for kimberlite - i.e. you have a good eye for selecting such candidates!

Five of the boulders are of Archean komatiites of which four are peridotites and the fifth - No. 544 - is a pyroxenite. The peridotites are all significantly foliated and their olivine has been wholly altered to either serpentine or calcite, with finely disseminated magnetite as a byproduct. As a result the boulders are subangular and strongly magnetic. The pyroxene in the pyroxenite boulder, in contrast, is unaltered. Consequently this boulder is hard, rounded and only nominally magnetic.

One boulder, No. 438-1, is comprised of carbonatite in which the carbonate mineral is ankerite rather than the usual calcite. The carbonatite contains volcanic xenoliths derived from the upper crust but contains no mantle xenoliths or xenocrysts and thus is of no particular interest.

The remaining boulder - No. 438-5 - is rather unique. It consists of syenite yet contains rounded mantle-derived xenocrysts of both forsteritic olivine and bright green Cr (not low-Cr) diopside - minerals that are normally found only in kimberlite, lamproite and lamprophyre. The boulder is clearly derived from a hypabyssal dyke as the syenite is flow-foliated and its groundmass is very fine grained (0.05-0.15 mm). The groundmass consists subequally of K-spar and titanian augite with subordinate titanian biotite, which appears to be an alteration product of the augite, and minor ilmenite and magnetite.

In addition to containing xenocrysts of olivine and Cr-diopside, the syenite contains ~5% xenoliths, all of which are composed of leucosyenite which appears to represent an earlier-crystallized phase of the syenite (i.e. the xenoliths are autoliths), and ~0.5% rounded, resorbed xenocrysts of both sanidine and titanian augite which appear to be derived from the leucosyenite. The augite xenocrysts were evidently baked at high pressure (great depth) by the syenite melt as they have conchoidal fractures and physically resemble chromite xenocrysts.

The syenite may contain xenocrysts of mantle minerals other than the observed olivine and Cr-diopsite, possibly even diamond. We therefore recommend that approximately half of the ~2 kg syenite boulder be milled by EPD and processed and searched for indicator minerals. Please advise whether you would like us to proceed - the cost would be in the $500 range. There is no need to process any of the other six samples.

Best regards,

Stu

Stuart Averill, P.Geo., Chairman

Overburden Drilling Management Limited
107-15 Capella Court
Nepean, ON, Canada
K2E 7X1
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Appendix 17.

Numerically Converted MMSIM Counts

The data in this Appendix was split into 2 sections:

The first part presents results for MMSIM® minerals: chalcopyrite, barite, pyrite, goethite, spinel, gahnite, hercynite, sapphirine, corundum, low-Cr diopside, Mn-epidote, Cr-grossular, Green Cr-garnet and red rutile.

The second part presents results for carbonatite indicator minerals: pyrochlore, stillwellite, brockite, perovskite, bastnaesite, ferro-columbite, synchysite, euxenite, apatite and monazite.

Numerical conversion:

MMSIM® grains were reported as either actual grain counts (e.g., gahnite), as a percentage of a particular grain size (e.g., apatite), or as "trace" amounts (e.g., kyanite).

To show the data numerically, where an MMSIM® was reported as "trace", a value representing one-half the lowest recorded value in percentage was applied (0.25).

Abbreviations:

Adr: Andradite
Ap: Apatite
Ase: Anatase
Crd: Corundum
Cpy: Chalcopyrite
Cr: Chromite
Fay: Fayalite
Gh: Gahnite
Gr: Grossular
gr: Grain
Gth: Goethite
Ky: Kyanite
Mz: Monazite
N/A: Not available
Ol: Olivine
Opx: Orthopyroxene
Py: Pyrite
Sil: Sillimanite
Sph: Sapphirine
Spi: Spinel
Sps: Spessartine
St: Staurolite
Tm: Tourmaline
Tr: Trace
Ttn: Titanite

Sample Number	# Cpy	# Barite	# Py	% Gth	# Spinel	# Gahnite	# Hercynite	# Sapphirine	# Corundum	# Low-Cr diopside	# Mn-epidote	# Cr-grossular	# Green Cr-garnet	# Red Rutile	% Ky	% Sil	% Tm	% St	% Sps	% Fay	% Opx	# CR
11-CG-013	0	0	0	0	0	0	0	0	0	12	0	0	0	1	0	0.5	0	0.25	0	0	1	0
11-CG-017	0	0	150	0.3	0	0	0	0	0	8	0	0	0	0	0	0.25	0	0.25	0	0	0.25	0
11-CG-018	1	0	0	0.3	3	0	0	1	0	5	0	0	0	2	0	0	0	1	0.25	0	0.25	0
11-CG-029	0	0	0	0.3	0	0	0	5	0	38	0	0	0	12	0	0.25	0	0.25	0	0	0.25	0
11-CG-033	0	0	0	0.3	0	0	0	0	0	8	0	0	0	2	0	0.25	0	0.25	0.25	0	0.25	0
11-CG-046	5	0	30	0.3	0	0	0	0	1	52	0	0	0	50	0.25	0	0.25	0.25	0	0	0.25	1
11-CG-048	0	0	20	0	1	0	0	0	0	8	0	0	0	4	0.25	0	0	0.25	0	0	0.25	0
11-CG-054	0	0	5	0.3	0	0	0	0	0	6	2	0	0	11	0.25	0	0.25	0.25	0	0	1	10
11-CG-055	0	0	0	0	0	0	0	0	0	4	0	0	0	8	0	0	0	0	0	0	0.25	0
11-CG-058	1	2	3	0	0	0	0	5	3	32	1	0	0	200	0.25	0.25	0.25	0.25	0	0	0.25	0
11-CG-065	0	0	0	0.3	0	0	0	0	0	1	0	0	0	5	0.25	0	0	0	0.25	0	0	0
11-CG-068	0	0	3	0.3	0	0	0	3	0	9	0	0	0	7	0.25	0.25	0	0.25	0.25	0	0.25	0
11-CG-070	0	0	0	0	0	0	0	3	0	16	0	0	0	1	0.25	0.25	0	0.25	0.25	0	0.25	0
11-CG-072	0	0	0	0.3	0	0	0	0	0	1	0	0	0	5	0	0.25	0	0.25	0.25	0	0	0
11-CG-078	0	0	1	0	0	1	0	3	0	0	0	0	0	4	0	0	0	0	0.25	0	0	0
11-CG-084	0	0	0	0.3	0	1	0	2	0	50	0	0	0	0	0	0.25	0	0.25	0	0	1	0
11-CG-087	0	0	0	0.3	1	0	0	0	0	12	0	0	0	2	0	0.25	0	0.25	0	0	0.25	0
11-CG-090	0	0	1	0	0	0	0	1	0	2	0	0	0	4	0.25	0	0	0.25	0.25	0	1	2
11-CG-101	0	0	0	0.3	0	0	0	7	0	14	0	0	0	0	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-107	0	0	3	0	1	0	0	0	1	3	0	0	0	7	0.25	0	0	0.25	0.25	0	0.25	1
11-CG-109	0	0	4	0.3	0	0	0	0	0	0	0	0	0	2	0.25	0.25	0	0.25	0.25	0	0.25	0

Sample Number	# Cpy	# Barite	# Py	% Gth	# Spinel	# Gahnite	# Hercynite	# Sapphirine	# Corundum	# Low-Cr diopside	# Mn-epidote	# Cr-grossular	# Green Cr-garnet	# Red Rutile	% Ky	% Sil	% Tm	% St	% Sps	% Fay	% Opx	# CR
11-CG-110	0	0	0	0.3	0	0	0	0	0	9	0	0	0	5	0.25	0.25	0	0.25	0.25	0	0.25	0
11-CG-122	0	0	1	0	1	1	0	2	0	10	0	0	0	12	0.25	0	0	0.25	0.25	0	0.25	1
11-CG-123	0	0	0	0.3	0	0	0	0	1	40	0	0	0	4	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-127	0	0	0	0.3	0	0	0	2	1	4	0	0	0	4	0.25	0.25	0	0.25	0.25	0	0.25	0
11-CG-129	0	0	0	0.3	0	0	0	5	1	21	0	0	0	5	0.25	0.25	0	0.25	0.25	0	6	0
11-CG-131	0	0	1	0.3	0	0	0	0	0	3	0	0	0	1	0.25	0	0	0.25	0.25	0	6	0
11-CG-136	0	0	0	0.3	0	0	0	1	2	31	0	0	0	4	0.25	0.25	0	0.25	0.25	0	0.25	0
11-CG-139	0	0	0	0	0	0	0	1	0	14	0	0	0	5	0	0.25	0	0.25	0	0	0.25	0
11-CG-146	0	0	0	0	0	0	0	2	0	5	0	0	0	1	0.25	0	0	0.25	0	0	0.25	0
11-CG-178	2	0	30	0.3	0	2	0	1	1	17	1	0	0	7	0.25	0	0.25	0.25	0	0	0.25	1
11-CG-181	0	0	10	0	1	0	0	0	0	18	1	0	0	7	0.25	0	0.25	0.25	0.25	0	0.25	1
11-CG-185	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0.25	0	0.25	0.25	0	0	0.25	0
11-CG-190	0	0	3	0	0	0	0	0	0	9	0	0	0	1	0.25	0.25	0.25	0.25	0.25	0	0.25	0
11-CG-199	0	0	1	0.3	0	0	0	0	1	8	0	0	0	16	0.25	0.25	0	0.25	0.25	0	1	2
11-CG-206	0	0	5	0.3	0	1	0	2	0	8	1	0	0	4	0.25	0.25	0.25	0.25	0.25	0	0.25	0
11-CG-211	0	0	5	0.3	0	0	0	0	0	11	1	0	0	6	0.25	0.25	0.25	0.25	0.25	0	0	0
11-CG-212	0	0	0	0	0	1	0	1	1	9	0	0	0	500	0.25	0	0	0.25	0	0	0	3
11-CG-214	0	0	20	0.3	1	0	0	1	0	10	0	0	0	23	0.25	0.25	0	0.25	0	0	0.25	8
11-CG-239	0	0	20	0.3	0	0	0	0	0	5	0	0	0	5	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-251	0	0	5	0.3	0	0	0	2	0	11	0	0	0	7	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-267	0	0	2	0.3	0	0	0	9	0	13	0	0	0	3	0.25	0.25	0	0.25	0	0	0.25	0

Sample Number	# Cpy	# Barite	# Py	% Gth	# Spinel	# Gahnite	# Hercynite	# Sapphirine	# Corundum	# Low-Cr diopside	# Mn-epidote	# Cr-grossular	# Green Cr-garnet	# Red Rutile	% Ky	% Sil	% Tm	% St	% Sps	% Fay	% Opx	# CR
11-CG-273	0	0	2	0.3	0	0	0	0	1	64	0	0	0	1	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-276	0	0	0	0	0	0	0	1	0	16	0	0	0	11	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-292	0	0	0	0.3	0	0	0	0	0	31	0	0	0	1	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-295	0	0	2	0.3	0	0	0	1	1	7	0	0	0	3	0.25	0.25	0	0.25	0	0	0.25	1
11-CG-305	0	0	10	0.3	0	0	0	1	0	13	0	0	0	15	0.25	0.25	0	0.25	0	0	0.25	1
11-CG-315	0	0	5	0.3	0	0	0	0	0	14	0	0	0	1	0.25	0.25	0	0.25	0	0	0.25	1
11-CG-327	0	0	2	0.3	0	0	0	0	0	3	0	0	0	8	0.25	0.25	0	0.25	0	0	0.25	4
11-CG-334	0	0	2	0.3	0	0	0	0	1	12	2	0	0	16	0.25	0.25	0.25	0.25	0	0	0.25	4
11-CG-340	0	0	3	0.3	0	0	0	0	0	12	0	0	0	50	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-382	0	0	4	0.3	0	0	0	11	1	19	3	0	0	100	0.25	0.25	0	0.25	0	0	0.25	1
11-CG-384	0	0	1	0.3	0	0	0	6	0	33	0	0	0	30	0.25	0.25	0	0.25	0	0	0.25	1
11-CG-389	0	0	0	0.3	1	0	0	1	0	11	0	0	0	13	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-391	0	0	0	0.3	3	0	0	30	1	14	2	0	0	40	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-396	0	0	0	0.3	0	0	0	0	0	6	0	0	0	2	0.25	0.25	0	0.25	0	0	0.25	1
11-CG-407A	0	0	0	0.3	1	1	0	1	0	15	2	0	0	15	0.25	0.25	0	0.25	0	0	0.25	4
11-CG-407B	0	0	0	0.3	0	0	0	5	0	19	0	0	0	6	0.25	0.25	0	0.25	0	0	0.25	3
11-CG-417	0	0	1	0.3	2	0	0	0	0	40	0	0	0	0	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-425	0	0	0	0.3	0	0	0	0	0	14	0	0	0	0	0.25	0.25	0	0.25	0	0	0.25	1
11-CG-437	0	0	0	0.3	0	1	0	3	0	11	0	0	0	6	0.25	0.25	0	0.25	0	0	0.25	2
11-CG-446	0	0	0	0.3	0	0	0	4	0	11	0	0	0	9	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-451	0	0	1	0.3	0	0	0	2	0	52	0	0	0	4	0.25	0.25	0	0.25	0	0	0.25	0

Sample Number	# Cpy	# Barite	# Py	% Gth	# Spinel	# Gahnite	# Hercynite	# Sapphirine	# Corundum	# Low-Cr diopside	# Mn-epidote	# Cr-grossular	# Green Cr-garnet	# Red Rutile	% Ky	% Sil	% Tm	% St	% Sps	% Fay	% Opx	# CR
11-CG-453	0	0	0	0	0	0	0	0	0	12	0	0	0	6	0	0.25	0.25	0.25	0	0	0.25	0
11-CG-455	0	0	0	0.3	0	0	0	11	0	16	0	0	0	9	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-459	0	0	0	0	1	0	0	0	6	14	0	0	0	13	0.25	0.25	0.25	0.25	0	0	0.25	0
11-CG-472	0	0	0	0	1	0	0	3	1	6	1	0	0	3	0.25	0.25	0.25	0.25	0	0	2	1
11-CG-517	0	0	0	0	2	1	0	2	0	15	0	0	0	8	0.25	0.25	0	0.25	0	0	0.25	2
11-CG-522	0	0	0	0.3	1	0	0	0	1	15	0	0	0	14	1	0.25	0.25	0	0	0	2	0
11-CG-655	0	0	0	0.3	0	0	0	0	0	40	0	0	0	1	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-656	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0.25	0.25	0.25	0.25	0	0	0.25	0
11-CG-658	0	0	0	0.3	0	0	0	0	0	9	0	0	0	8	0.25	0.25	0.25	0.25	0	0	0.25	2
11-CG-661	3	0	20	0.3	0	0	0	0	0	4	0	0	0	0	0.25	0.25	0.25	0.25	0	0	0.25	2
11-CG-665	1	0	0	0.3	0	0	0	0	0	9	0	0	0	0	0	0.25	0	0.25	0	0	0.25	0
11-CG-666	0	0	0	0.3	1	0	0	0	0	24	1	0	0	4	0.25	0.25	0.25	0	0	0	0.25	0
11-CG-667	1	0	3	0.3	0	0	0	0	0	14	3	0	0	2	0.25	0.25	0	0.25	0	0	0.25	1
11-CG-668	0	0	0	0.3	0	0	0	1	0	7	0	0	0	0	0.25	0.25	0	0.25	0.25	0	0.25	1
11-CG-675	0	0	2	0.3	0	0	0	0	0	18	1	0	0	4	0.25	0.25	0.25	0.25	0	0	0.25	1
11-CG-697	0	0	0	0	0	0	0	0	0	5	0	0	0	2	0.25	0.25	0	0.25	0	0	1	0
11-CG-703	0	0	0	0.3	0	0	0	0	0	18	0	0	0	4	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-713	0	0	1	0.3	0	0	0	0	1	7	1	0	0	1	0.25	0.25	0.25	0	0	0	1	3
11-CG-720	1	0	15	0.3	0	0	0	0	0	16	1	0	0	0	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-726	3	0	2	0.3	0	0	0	0	0	44	5	0	0	1	0.25	0.25	0.25	0.25	0	0	0.25	5
11-CG-730	3	0	3	0.3	0	0	0	0	0	22	0	1	0	3	0.25	0.25	0	0.25	0	0	0.25	3

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11-CG-738	0	0	1	0.3	0	0	0	0	0	16	2	0	0	1	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-739	0	0	0	0.3	1	0	0	0	0	6	1	0	0	7	0.25	0.25	0	0.25	0	0	0.25	1
11-CG-740	0	0	1	0.3	0	0	0	0	0	9	1	0	0	1	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-742	0	0	0	0.3	0	0	0	0	0	5	1	0	0	1	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-748	0	0	0	0.3	0	0	0	0	0	10	1	0	0	3	0.25	0.25	0	0.25	0	0	0.25	2
11-CG-751	0	0	0	0.3	0	0	0	0	0	7	1	0	0	1	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-756	0	0	0	0.3	0	0	0	0	0	7	0	0	0	0	0.25	0.25	0	0.25	0	0	0.25	1
11-CG-762	0	0	0	0.3	0	0	0	0	0	3	1	0	0	0	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-776	0	0	2	0.3	0	0	0	0	0	13	0	0	0	1	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-790	0	0	10	0.3	0	0	0	0	1	3	0	0	0	2	0.25	0.25	0	0.25	0.25	0	0.25	4
11-CG-800	0	0	10	0.3	0	0	0	0	1	4	0	0	0	0	0.25	0.25	0	0.25	0.25	0	0.25	0
11-CG-808	4	0	5	0.3	1	0	0	0	0	11	1	0	0	14	0.25	0.25	0	0.25	0.25	0	0.25	5
11-CG-812	0	0	3	0.3	0	0	0	0	0	3	0	0	0	4	0.25	0.25	0	0.25	0.25	0	0.25	0
11-CG-814	0	0	8	0.3	0	0	0	0	0	7	0	0	0	0	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-816	0	0	0	0.3	1	0	0	0	0	9	1	0	0	3	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-824	0	0	0	0.3	0	0	0	0	0	4	1	0	0	2	0.25	0.25	0.25	0.25	0	0	0.25	0
11-CG-829	0	0	0	0.3	1	0	0	0	1	10	0	0	0	3	0	0.25	0.25	0.25	0	0	0.25	3
11-CG-832	0	0	0	0.3	0	0	0	0	0	11	2	0	0	3	0.25	0.25	0	0.25	0	0	0.25	1
11-CG-836	0	0	0	0.3	0	2	0	0	0	8	2	0	0	0	0.25	0.25	0.25	0.25	0	0	0.25	0
11-CG-840	0	0	0	0.3	0	0	0	0	1	12	1	0	0	7	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-843	0	0	0	0.3	0	0	0	1	0	39	2	0	0	18	0.25	0.25	0.25	0.25	0.25	0	1	0

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11-CG-856	2	0	40	0.3	0	0	0	0	0	9	0	0	0	1	0.25	0.25	0.25	0.25	0	0	0.25	2
11-CG-861	1	0	1	0.3	0	0	0	0	0	9	2	0	0	2	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-862	0	0	0	0.3	0	0	0	0	1	15	0	0	0	4	0.25	0.25	0	0.25	0	0	0.25	2
11-CG-869	1	0	0	0.3	1	1	0	0	1	9	0	0	0	8	0.25	0.25	0.25	0.25	0	0	1	0
11-CG-877	0	0	0	0.3	0	0	0	0	0	2	0	0	0	6	0.25	0.25	0.25	0.25	0	0	0.25	0
11-CG-886	0	0	0	0.3	0	0	0	0	0	7	0	0	0	3	0.25	0.25	0	0.25	0	0	0.25	0
11-CG-889	0	0	0	0.3	0	0	0	0	0	1	1	0	0	11	0.25	0.25	0.25	0.25	0	0	0.25	0
11-CG-895	0	0	0	0.3	1	0	0	0	2	17	4	0	0	14	0.25	0.25	0.25	0.25	0	0	2	3
11-CG-896	0	0	0	0	0	0	0	1	1	6	0	0	0	12	0.25	0	0	0.25	0	0	0.25	3
11-CG-899	0	0	2	0	0	0	1	1	2	10	1	0	0	6	0	0	0	0.25	0	0	0.25	0
11-CG-901	0	0	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0.25	0	0.25	2
11-CG-906	0	0	0	0	0	0	0	1	1	4	0	0	0	8	0.25	0	0	0	0.25	0	0.25	2
11-CG-913	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0.25	0	0	0.25	0
11-CG-914	0	0	20	0.3	0	0	0	0	1	18	4	0	0	4	0.25	0.25	0	0.25	0	0	0.25	2
11-CG-915	0	0	3	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0.25	0.25	0	0.25	0
13-CG-006	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0.25	0
13-CG-009	0	0	0	0	0	1	0	0	0	10	0	0	0	0	0	0.25	0.25	0.25	0	0	0.25	1
13-CG-034	1	0	8	0.3	0	0	0	0	0	6	0	0	0	4	0.25	0.25	0	0.25	0	0	0.25	2
13-CG-042	0	0	0	0.3	0	1	0	0	0	15	0	0	0	6	0.25	0	0.25	0.25	0	0	0.25	0
13-CG-045	0	0	0	0	5	0	0	0	0	43	0	0	0	6	0.25	0.25	0.25	0.25	0.25	0	0.25	11
13-CG-047	2	0	10	0.3	0	0	0	0	0	7	2	0	0	1	0.25	0	0	0.25	0.25	0	0	0

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13-CG-107	0	0	5	0.3	0	1	0	0	0	2	0	0	0	3	0	0	0	0.25	0	0	0	0
13-CG-110	5	0	3	0	0	0	0	0	0	1	0	0	0	1	0.25	0.25	0	0.25	0	0	0.25	0
13-CG-115	0	0	0	0.3	0	0	0	0	0	44	1	0	0	8	0.25	0	0.25	0.25	0.25	0	0.25	2
13-CG-124	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0.25	0	0	0.25	0.25	0	0	5
13-CG-175	0	0	0	0	1	0	0	0	0	16	0	0	0	3	0	0.25	0	1	0.25	0	0.25	2
13-CG-177	1	0	0	0.3	0	0	0	0	0	3	0	0	0	2	0.25	0	0	0.25	0	0	0	0
13-CG-185	0	0	0	0.3	0	1	0	0	0	10	0	0	0	1	0	0	0	0.25	0.25	0	0.25	0
13-CG-198	1	0	0	0.3	0	0	0	0	1	2	0	0	0	3	0.25	0.25	0	0.25	0	0	0	0
13-CG-200	1	0	0	0	0	0	0	0	0	41	1	0	0	9	0.25	0	0.25	0.25	0.25	0	0.25	4
13-CG-204	0	0	0	0	0	0	0	0	0	12	0	0	0	1	0	0	0	0	0.25	0	0.25	0
13-CG-205	1	0	0	0.3	1	0	0	0	0	5	0	0	0	3	0.25	0.25	0.25	0.25	0.25	0	0.25	1
13-CG-212	0	0	0	0.3	2	0	0	0	0	2	0	0	0	0	0.25	0	0	0.25	0	0	0	0
13-CG-216	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0.25	0	0	0.25	0.25	0	0	0
13-CG-228	0	0	2	0.3	0	0	0	0	0	5	0	0	0	4	0.25	0	0	0.25	0.25	0	0.25	2
13-CG-244	0	0	0	0.3	2	0	0	0	0	40	0	0	0	40	0.25	0	0.25	0.25	0.25	0	0.25	1
13-CG-268	0	0	8	0.3	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0.25	0	0	0.25	0
13-CG-344	1	10	0	0	0	0	0	0	1	6	0	0	0	13	0.25	0.25	0.25	0.5	0	0	0.25	9
13-CG-347	0	0	0	0.3	0	0	0	0	2	2	0	0	0	0	0	0	0	0.25	0	0	0.25	0
13-CG-382	0	0	0	0	0	0	0	0	0	4	0	0	0	1	0.25	0.25	0	0.25	0	0	0.25	2
13-CG-391	0	0	0	0.3	1	0	0	0	0	9	2	0	0	3	0.25	0	0	0.25	0.25	0	0.25	1
13-CG-395	3	0	3	0.3	0	0	0	0	0	1	0	0	0	3	0.25	0	0.25	0.25	0	0	0.25	0

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13-CG-400	0	0	1	0.3	1	0	0	0	0	9	0	0	0	3	0.25	0	0.25	0.25	0	0	0.25	0
13-CG-433	0	0	0	0.3	2	1	0	4	1	4	0	0	0	8	0.25	0.25	0	0.25	0	0.25	0.25	0
13-CG-450	0	0	0	0	1	0	0	0	0	14	0	0	0	3	0.25	0	0.25	0.25	0	8	0.25	0
13-CG-490	1	0	0	0.3	0	0	0	7	0	12	2	0	0	12	0.25	0.25	0	0.25	0	0	0.25	4
13-CG-493	0	0	1	0.3	1	0	0	0	0	4	0	0	0	1	0.25	0.25	0	0.25	0.25	0	0.25	7
13-CG-495	0	0	400	0.3	0	0	0	0	0	0	0	0	0	0	0.25	1	0	0.25	0	0	0	0
13-CG-499	4	0	20	0.3	0	0	0	0	1	3	0	0	0	3	0.25	0	0	0.25	0.25	0	0.25	1
13-CG-514	0	0	80	0.3	0	0	0	0	1	2	0	0	0	2	0.25	0.25	0	0.25	0.25	0	0.25	0
13-CG-520	0	0	0	0	0	0	0	0	0	15	0	0	1	7	0.25	0	0.25	0.25	0	0	0.25	0
13-CG-530	0	0	0	0	0	0	0	0	0	9	0	0	0	1	0.25	0.25	0.25	0.25	0	0	0.25	0
13-CG-537	0	0	2	0.3	2	0	0	3	0	41	0	0	0	8	0.25	0.25	0	0.25	0	0	0.25	0
13-CG-543	0	0	0	0.3	4	1	0	0	0	44	0	0	0	14	1	0.25	0.25	0.25	0	0	0.25	1
13-CG-549	0	0	0	0.3	1	0	0	3	0	41	0	0	0	2	0.25	0.25	0	0.25	0	0.25	0.25	1
13-CG-556	0	0	0	0	1	0	0	3	1	20	0	0	0	13	0.25	0.25	0	0.25	0	0	0.25	2
13-CG-759	0	0	0	0	0	0	0	0	1	20	0	0	0	6	0.25	0	0	0.25	0.25	0	0.25	2
13-CG-765	1	0	2	0	0	0	0	0	0	3	0	0	0	4	0.25	0.25	0.25	0.25	0	0	0.25	0
14-CG-003	0	0	0	0	1	0	0	0	1	4	0	0	0	11	0.25	0	0.25	0.25	0.25	0	1	1
14-CG-009	0	0	0	0	0	0	0	1	0	13	1	0	0	9	0.25	0	0.25	0.25	0.25	0	0.25	0
14-CG-021	0	0	60	0	0	0	0	1	1	8	0	2	0	14	0.25	0	0.25	0.25	0.25	0	1	0
14-CG-030	0	2	0	0	0	1	0	1	0	13	2	0	0	17	0.25	0	0.25	0.25	0.25	0	0.25	0
14-CG-038	1	0	1	0	0	0	3	7	0	6	1	0	0	6	0.25	0.25	0.25	0.25	0.25	0	1	0

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14-CG-047	0	0	0	0	0	0	1	11	0	12	1	0	0	23	0.25	0.25	0	0.25	0.25	0	1	4
14-CG-050	0	0	0	0	1	0	0	3	0	12	0	0	0	6	0.25	0	0.25	0.25	0.25	0	0.25	0
14-CG-053	0	0	4	0.3	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0.25	0	0	0.25	0
14-CG-054	0	0	0	0	0	0	0	1	0	14	0	0	0	3	0.25	0	0	0.25	0.25	0	0.25	3
14-CG-056	0	0	20	0.3	0	0	0	0	0	2	0	0	0	6	0.25	0	0	0.25	0.25	0	0.25	0
14-CG-060	7	0	4	0	0	0	0	0	0	0	1	0	0	0	0.25	0	0	0.25	0.25	0	1	0
14-CG-065	0	0	15	0.3	2	0	0	0	0	9	1	0	0	9	0.25	0	0	0.25	0	0	0.25	1
14-CG-069	0	0	0	0	0	0	0	0	3	12	1	0	0	6	0.25	0	0	0.25	0.25	0	0.25	1
14-CG-070	0	0	0	0	0	0	0	4	0	7	0	0	0	16	0.25	0.25	0.25	0.25	0.25	0	2	4
14-CG-081	0	0	0	0	0	0	1	1	5	22	0	0	0	12	0.25	0	0	0.25	0.25	0	1	8
14-CG-090	0	0	12	0.3	0	0	0	9	1	10	0	0	0	50	0.25	0.25	0	0.25	0.25	0	2	0
14-CG-109	0	0	0	0	0	1	0	3	3	9	0	0	0	8	0.25	0	0	0.25	0.25	0	0.25	0
14-CG-132	0	0	0	0	0	0	0	1	0	19	2	0	0	10	0.25	0	0	0.25	0.25	0	0.25	0
14-CG-140	0	0	0	0	0	2	0	3	0	10	0	0	0	30	0.25	0.25	0	0.5	0.25	0	2	0
14-CG-149	0	0	0	0	0	0	0	4	0	8	0	0	0	1	0.25	0.25	0	0.25	0.25	0	1	0
14-CG-167	0	0	0	0	0	0	0	0	2	5	2	0	0	15	0	0.25	0	0.25	0.25	0	1	5
14-CG-175	0	0	0	0	0	0	1	0	0	14	0	0	0	5	0.25	0.25	0	0.25	0.25	0	0.25	2
14-CG-180	0	0	0	0	0	0	1	0	1	1	0	0	0	4	0.25	0	0	0.25	0	0	3	1
14-CG-215	0	0	0	0	0	0	0	0	0	13	0	0	0	6	0.25	0	0	0.25	0.25	0	0.25	0
14-CG-216	0	0	0	0	0	0	0	0	0	3	0	0	0	4	0.25	0.25	0	0.25	0.25	0	0.25	0
14-CG-217	0	0	0	0	0	0	0	0	0	5	1	0	0	3	0.25	0	0	0.25	0.25	0	0.25	0

Sample Number	# Cpy	# Barite	# Py	% Gth	# Spinel	# Gahnite	# Hercynite	# Sapphirine	# Corundum	# Low-Cr diopside	# Mn-epidote	# Cr-grossular	# Green Cr-garnet	# Red Rutile	% Ky	% Sil	% Tm	% St	% Sps	% Fay	% Opx	# CR
14-CG-219	0	0	0	0.3	0	0	0	0	0	3	0	0	0	7	0.25	0.25	0	0.25	0.25	0	0.25	1
14-CG-222	0	0	20	0.3	0	0	0	0	0	8	0	0	0	16	0.25	0	0	0.25	0.25	0	0.25	0
14-CG-223	0	0	400	0.5	0	0	0	0	1	1	0	0	0	1	0.25	0.5	0	0	0.25	0	0.25	1
14-CG-224	2	80	0	0.3	0	0	0	0	1	3	0	0	0	3	0	1	0.25	0	0.25	0	0.25	5
14-CG-226	0	0	20	0.3	0	0	0	0	0	1	0	0	0	3	0	0.25	0	0.25	0	0	0.25	0
14-CG-227	0	0	5	0.3	0	0	0	0	0	10	0	0	0	4	0.25	0.25	0	0	0.25	0	0.25	0
14-CG-229	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0.25	0	0	0.25	0.25	0	0.25	0
14-CG-230	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0.25	0	0	0.25	0.25	0	0.25	0
14-CG-232	0	0	2	0	0	0	0	0	0	12	0	0	0	8	0	0.25	0	0.25	0.25	0	0.25	0
14-CG-234	0	0	1	0	0	0	0	0	0	5	0	0	0	7	0.25	0.25	0	1	0	0	2	1
14-CG-250	0	0	0	0	1	1	1	10	1	41	4	0	0	18	0.25	0.25	0.25	0.25	0.25	0	0.25	0
14-CG-252	0	0	0	0	0	0	0	6	0	6	0	0	0	12	0.25	0.25	0.25	0.25	0.25	0	5	2
14-CG-256	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0.25	0	0.25	0.25	0	0.25	0
14-CG-257	0	0	0	0	0	0	0	0	0	6	0	0	0	4	0.25	0.25	0	0.25	0.25	0	0.25	1
14-CG-259	0	0	0	0	0	1	0	0	0	1	0	0	0	2	0.25	0.25	0	2	0.25	0	0.25	2
14-CG-799	0	0	0	0	2	0	0	0	0	12	0	0	0	9	0.25	0.25	0	0.25	0.25	0	0.25	0
14-CG-800	0	0	6	0.3	2	0	0	0	0	8	0	0	0	7	0.25	0.25	0	0.25	0.25	0	2	1
14-CG-808	0	0	0	0.3	0	0	0	4	1	1	0	0	0	1	0.25	0.25	0	0.25	0.25	0	0.25	0
14-CG-809	0	0	0	0	0	0	0	0	1	9	0	0	0	9	0.25	0.25	0	0.25	0.25	0	0.25	0
14-CG-815	0	0	1	0	2	0	0	0	0	1	0	0	0	7	0	0.25	0.25	0	0	0	0.25	0
14-CG-821	0	0	0	0.3	0	2	0	3	0	12	0	0	0	5	0	0.25	0.25	0	0.25	0	0.25	0

Sample Number	# Cpy	# Barite	# Py	% Gth	# Spinel	# Gahnite	# Hercynite	# Sapphirine	# Corundum	# Low-Cr diopside	# Mn-epidote	# Cr-grossular	# Green Cr-garnet	# Red Rutile	% Ky	% Sil	% Tm	% St	% Sps	% Fay	% Opx	# CR
14-CG-823	0	0	3	0	0	0	0	0	0	30	0	0	0	14	0.25	0.25	0.25	0.25	0.25	0	0.25	0
14-CG-829	0	0	2	0.3	0	0	0	1	0	5	0	0	0	10	0.25	0.25	0.25	0	0.25	0	0.25	0
14-CG-831	0	0	3	0	0	0	2	2	1	1	0	0	0	8	0.25	0.25	0	0.25	0.25	0	4	3
14-CG-832	0	0	0	0.3	0	0	0	0	0	7	0	0	0	3	0.25	0.25	0	0.25	0.25	0	0	0
14-CG-852	0	0	0	0	0	0	0	2	0	7	1	0	0	0	0.25	0.25	0	0.25	0.25	0	0.25	0
14-CG-858	0	0	0	0.3	0	0	0	1	0	18	0	0	0	4	0.25	1	0	0.25	0.25	0	0.25	0
14-CG-859	0	0	3	0.3	1	0	0	1	1	3	0	0	0	22	0.25	0	0	0.25	0.25	0	2	4
14-CG-861	5	1	30	0.3	0	0	0	6	0	39	2	0	0	10	0.25	0	0.25	0.25	0.25	0	0.25	1
14-CG-872	0	0	0	0.3	0	0	0	2	0	8	0	0	0	0	0	0.25	0	0	0.25	0	0.25	0
14-CG-881	0	0	0	0.3	0	0	0	3	0	17	0	0	0	4	0.25	0.25	0	0	0.25	0	0.25	0
14-CG-882	0	0	0	0	3	0	0	1	0	19	1	0	0	7	0.25	0.25	0.25	0	0.25	0	0.25	3
14-CG-884	0	0	3	0.3	0	2	0	3	0	13	5	0	0	24	0.25	1	0.25	0	0.25	0	3	3
14-CG-934	1	0	0	0	0	0	0	0	0	10	1	0	0	1	0.25	0	0	0.25	0.25	0	0.25	0
14-CG-935	0	0	40	0.3	2	0	0	0	1	7	0	0	0	150	0.25	0.25	0.25	0.25	0.25	0	1	4
14-CG-938	1	0	30	0.3	0	0	0	0	2	14	1	0	0	8	0.25	0.25	0	0.25	0.25	0	1	4
14-CG-940	1	0	0	0.3	0	0	0	0	0	30	0	0	0	30	0	0.25	0	0.25	0.25	0	0.25	1
14-CG-947	0	0	10	0.3	0	0	2	6	0	13	0	0	0	50	0.25	0.25	0.25	0.25	0.25	0	3	1
14-CG-966	2	0	10	0.3	2	0	0	20	4	27	8	0	0	16	0.25	0.25	0	0.25	0.25	0	1	1
14-CG-973	0	0	0	0.3	3	0	0	3	0	11	0	0	0	7	0.25	0.25	0	0.25	0.25	0	0.25	1
14-CG-977	0	0	1	0.3	0	2	0	1	0	4	0	0	0	40	0.25	0	0	0.25	0.25	0	0.25	1
14-CG-991	0	0	1	0.3	0	0	0	3	0	28	0	0	0	5	0.25	0.25	0	0.25	0.25	0	0.25	0

Sample Number	# Cpy	# Barite	# Py	% Gth	# Spinel	# Gahnite	# Hercynite	# Sapphirine	# Corundum	# Low-Cr diopside	# Mn-epidote	# Cr-grossular	# Green Cr-garnet	# Red Rutile	% Ky	% Sil	% Tm	% St	% Sps	% Fay	% Opx	# CR
14-CG-996	0	0	0	0	1	0	1	0	0	5	0	0	0	4	0.25	0.25	0	0.25	0.25	0	0.25	1
14-CG-997	0	0	1	0	1	0	0	4	4	4	0	0	0	19	0	0.25	0	0.25	0.25	0	1	1
14-CG-999	0	0	0	0	0	0	0	3	1	20	1	0	0	6	0.25	0.25	0	0.25	0.25	0	1	0
16-CG-001A	1	0	10	0.3	0	0	0	1	1	0	0	0	0	0	0.25	0	0	0.25	0	0	0.25	4
16-CG-001B	0	0	50	0.3	0	1	0	0	0	2	0	0	0	4	0	0.25	0	0	0	0	0.25	0
16-CG-001C	4	0	50	0.3	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0.25	0
16-CG-002	0	0	2	0.3	0	0	0	0	0	5	0	0	0	1	0	0.25	0	0.25	0	0	0.25	11
16-CG-003	0	0	4	0.3	0	0	0	0	0	6	0	0	0	2	0	0.25	0	0.25	0.25	0	0.25	5
16-CG-004	0	0	150	0.3	2	0	0	0	0	3	0	0	0	2	0.25	0.25	0	0.25	0.25	0	0.25	4

Sample Number	Sampling media	# Carbonatite Indicator Minerals	# Pyrochlore	# Stillwellite	# Brockite	# Perovskite	# Bastnaesite	# Ferro-columbite	# Synchysite	# Euxenite	% Ap	% Mz
11-CG-013	Till	0	0	0	0	0	0	0	0	0	4	0.25
11-CG-017	Till	0	0	0	0	0	0	0	0	0	2	0
11-CG-018	Till	0	0	0	0	0	0	0	0	0	8	0
11-CG-029	Till	0	0	0	0	0	0	0	0	0	0.25	0.25
11-CG-033	Till	0	0	0	0	0	0	0	0	0	4	0.25
11-CG-046	Glaciofluvial sand and gravel	1	1	0	0	0	0	0	0	0	2	0.25
11-CG-048	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	4	0.25
11-CG-054	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	2	0.25
11-CG-055	Till	0	0	0	0	0	0	0	0	0	7	0
11-CG-058	Till	1	0	1	0	0	0	0	0	0	5	0.25
11-CG-065	Till	0	0	0	0	0	0	0	0	0	0.25	0
11-CG-068	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	0.25	0.25
11-CG-070	Till	0	0	0	0	0	0	0	0	0	1	0.25
11-CG-072	Till	0	0	0	0	0	0	0	0	0	2	0.25
11-CG-078	Till	0	0	0	0	0	0	0	0	0	0.25	0
11-CG-084	Till	1	0	0	1	0	0	0	0	0	5	0.25
11-CG-087	Till	0	0	0	0	0	0	0	0	0	1	0.25
11-CG-090	Till	2	0	0	0	2	0	0	0	0	0.25	0.25
11-CG-101	Till	0	0	0	0	0	0	0	0	0	1	0.25
11-CG-107	Till	0	0	0	0	0	0	0	0	0	5	0.25

Sample Number	Sampling media	# Carbonatite Indicator Minerals	# Pyrochlore	# Stillwellite	# Brockite	# Perovskite	# Bastnaesite	# Ferro-columbite	# Synchysite	# Euxenite	% Ap	% Mz
11-CG-109	Till	0	0	0	0	0	0	0	0	0	15	0
11-CG-110	Till	0	0	0	0	0	0	0	0	0	10	0
11-CG-122	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	5	0.25
11-CG-123	Till	0	0	0	0	0	0	0	0	0	5	0.25
11-CG-127	Till	0	0	0	0	0	0	0	0	0	1	0.25
11-CG-129	Till	0	0	0	0	0	0	0	0	0	5	0.25
11-CG-131	Till	0	0	0	0	0	0	0	0	0	0.25	0.25
11-CG-136	Till	0	0	0	0	0	0	0	0	0	15	0.25
11-CG-139	Till	0	0	0	0	0	0	0	0	0	2	0.25
11-CG-146	Till	0	0	0	0	0	0	0	0	0	5	0.25
11-CG-178	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	0.25	0.25
11-CG-181	Till	0	0	0	0	0	0	0	0	0	0.25	0.25
11-CG-185	Till	0	0	0	0	0	0	0	0	0	10	0.25
11-CG-190	Till	0	0	0	0	0	0	0	0	0	10	0.25
11-CG-199	Till	1	0	0	0	0	1	0	0	0	8	0.25
11-CG-206	Till	0	0	0	0	0	0	0	0	0	15	0.25
11-CG-211	Till	3	0	0	0	3	0	0	0	0	5	0.25
11-CG-212	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	3	0.25
11-CG-214	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	1	0.25
11-CG-239	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	0.25	0.25
11-CG-251	Till	0	0	0	0	0	0	0	0	0	4	0.25

Sample Number	Sampling media	# Carbonatite Indicator Minerals	# Pyrochlore	# Stillwellite	# Brockite	# Perovskite	# Bastnaesite	# Ferro-columbite	# Synchysite	# Euxenite	% Ap	% Mz
11-CG-267	Till	0	0	0	0	0	0	0	0	0	1	0.25
11-CG-273	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	2	0.25
11-CG-276	Till	0	0	0	0	0	0	0	0	0	5	0.25
11-CG-292	Till	0	0	0	0	0	0	0	0	0	5	0.25
11-CG-295	Till	0	0	0	0	0	0	0	0	0	5	0.25
11-CG-305	Till	0	0	0	0	0	0	0	0	0	3	0.25
11-CG-315	Till	0	0	0	0	0	0	0	0	0	2	0.25
11-CG-327	Till	1	0	0	0	0	0	1	0	0	3	0.25
11-CG-334	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	5	0.25
11-CG-340	Till	0	0	0	0	0	0	0	0	0	5	0.25
11-CG-382	Till	0	0	0	0	0	0	0	0	0	5	0.25
11-CG-384	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	4	0.25
11-CG-389	Till	0	0	0	0	0	0	0	0	0	4	0.25
11-CG-391	Till	0	0	0	0	0	0	0	0	0	3	0.25
11-CG-396	Till	0	0	0	0	0	0	0	0	0	1	0.25
11-CG-407A	Till	0	0	0	0	0	0	0	0	0	5	0.25
11-CG-407B	Till	0	0	0	0	0	0	0	0	0	5	0.25
11-CG-417	Till	0	0	0	0	0	0	0	0	0	0.25	0.25
11-CG-425	Till	0	0	0	0	0	0	0	0	0	1	0.25
11-CG-437	Till	0	0	0	0	0	0	0	0	0	0.25	0.25
11-CG-446	Till	0	0	0	0	0	0	0	0	0	0.25	0.25

Sample Number	Sampling media	# Carbonatite Indicator Minerals	# Pyrochlore	# Stillwellite	# Brockite	# Perovskite	# Bastnaesite	# Ferro-columbite	# Synchysite	# Euxenite	% Ap	% Mz
11-CG-451	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	1	0.25
11-CG-453	Till	0	0	0	0	0	0	0	0	0	0.25	0.25
11-CG-455	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	0.25	0.25
11-CG-459	Till	0	0	0	0	0	0	0	0	0	0.25	0.25
11-CG-472	Till	0	0	0	0	0	0	0	0	0	0.25	0.25
11-CG-517	Till	0	0	0	0	0	0	0	0	0	0.25	0.25
11-CG-522	Till	0	0	0	0	0	0	0	0	0	0.25	0.25
11-CG-655	Till	0	0	0	0	0	0	0	0	0	0.25	0.25
11-CG-656	Till	0	0	0	0	0	0	0	0	0	1	0.25
11-CG-658	Till	0	0	0	0	0	0	0	0	0	0.25	0.25
11-CG-661	Till	0	0	0	0	0	0	0	0	0	0.25	0.25
11-CG-665	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	0	0.25
11-CG-666	Till	2	0	0	2	0	0	0	0	0	0.25	0.25
11-CG-667	Till	0	0	0	0	0	0	0	0	0	0.25	0.25
11-CG-668	Till	0	0	0	0	0	0	0	0	0	1	0.25
11-CG-675	Till	0	0	0	0	0	0	0	0	0	0.25	0.25
11-CG-697	Till	0	0	0	0	0	0	0	0	0	3	0.25
11-CG-703	Till	0	0	0	0	0	0	0	0	0	4	0.25
11-CG-713	Till	0	0	0	0	0	0	0	0	0	5	0.25
11-CG-720	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	3	0.25

Sample Number	Sampling media	# Carbonatite Indicator Minerals	# Pyrochlore	# Stillwellite	# Brockite	# Perovskite	# Bastnaesite	# Ferro-columbite	# Synchysite	# Euxenite	% Ap	% Mz
11-CG-726	Glaciofluvial sand and gravel	1	0	0	0	0	0	0	1	0	5	0.25
11-CG-730	Glaciofluvial sand and gravel	1	0	0	0	0	0	0	1	0	3	0.25
11-CG-738	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	8	0.25
11-CG-739	Till	0	0	0	0	0	0	0	0	0	1	0.25
11-CG-740	Till	0	0	0	0	0	0	0	0	0	3	0.25
11-CG-742	Till	0	0	0	0	0	0	0	0	0	3	0.25
11-CG-748	Till	0	0	0	0	0	0	0	0	0	3	0.25
11-CG-751	Till	0	0	0	0	0	0	0	0	0	1	0.25
11-CG-756	Till	0	0	0	0	0	0	0	0	0	5	0.25
11-CG-762	Till	0	0	0	0	0	0	0	0	0	3	0.25
11-CG-776	Till	0	0	0	0	0	0	0	0	0	3	0.25
11-CG-790	Till	0	0	0	0	0	0	0	0	0	2	0.25
11-CG-800	Till	0	0	0	0	0	0	0	0	0	2	0.25
11-CG-808	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	3	0.25
11-CG-812	Till	0	0	0	0	0	0	0	0	0	2	0.25
11-CG-814	Till	0	0	0	0	0	0	0	0	0	4	0.25
11-CG-816	Till	0	0	0	0	0	0	0	0	0	1	0.25
11-CG-824	Till	0	0	0	0	0	0	0	0	0	8	0.25
11-CG-829	Till	0	0	0	0	0	0	0	0	0	0.25	0.25
11-CG-832	Till	0	0	0	0	0	0	0	0	0	1	0.25

Sample Number	Sampling media	# Carbonatite Indicator Minerals	# Pyrochlore	# Stillwellite	# Brockite	# Perovskite	# Bastnaesite	# Ferro-columbite	# Synchysite	# Euxenite	% Ap	% Mz
11-CG-836	Till	0	0	0	0	0	0	0	0	0	0.5	0.25
11-CG-840	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	3	0.25
11-CG-843	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	5	0.25
11-CG-856	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	10	0.25
11-CG-861	Till	0	0	0	0	0	0	0	0	0	0.25	0.25
11-CG-862	Till	0	0	0	0	0	0	0	0	0	3	0.25
11-CG-869	Till	0	0	0	0	0	0	0	0	0	0.25	0.25
11-CG-877	Till	0	0	0	0	0	0	0	0	0	2	0.25
11-CG-886	Till	0	0	0	0	0	0	0	0	0	3	0.25
11-CG-889	Till	0	0	0	0	0	0	0	0	0	2	0.25
11-CG-895	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	3	0.25
11-CG-896	Till	0	0	0	0	0	0	0	0	0	2	0.25
11-CG-899	Till	0	0	0	0	0	0	0	0	0	3	0.25
11-CG-901	Till	0	0	0	0	0	0	0	0	0	4	0
11-CG-906	Till	0	0	0	0	0	0	0	0	0	5	0
11-CG-913	Till	0	0	0	0	0	0	0	0	0	2	0
11-CG-914	Till	0	0	0	0	0	0	0	0	0	3	0.25
11-CG-915	Till	0	0	0	0	0	0	0	0	0	2	0
13-CG-006	Till	0	0	0	0	0	0	0	0	0	1	0
13-CG-009	Till	0	0	0	0	0	0	0	0	0	0.25	0

Sample Number	Sampling media	# Carbonatite Indicator Minerals	# Pyrochlore	# Stillwellite	# Brockite	# Perovskite	# Bastnaesite	# Ferro-columbite	# Synchysite	# Euxenite	% Ap	% Mz
13-CG-034	Till	0	0	0	0	0	0	0	0	0	5	0.25
13-CG-042	Till	0	0	0	0	0	0	0	0	0	1	0
13-CG-045	Till	0	0	0	0	0	0	0	0	0	0.25	0
13-CG-047	Till	0	0	0	0	0	0	0	0	0	2	0
13-CG-107	Till	0	0	0	0	0	0	0	0	0	2	0
13-CG-110	Till	0	0	0	0	0	0	0	0	0	2	0
13-CG-115	Till	0	0	0	0	0	0	0	0	0	0.25	0
13-CG-124	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	2	0
13-CG-175	Till	0	0	0	0	0	0	0	0	0	2	0
13-CG-177	Till	0	0	0	0	0	0	0	0	0	10	0.25
13-CG-185	Till	0	0	0	0	0	0	0	0	0	0.25	0
13-CG-198	Till	0	0	0	0	0	0	0	0	0	4	0.25
13-CG-200	Till	0	0	0	0	0	0	0	0	0	2	0.25
13-CG-204	Till	0	0	0	0	0	0	0	0	0	0.25	0
13-CG-205	Till	0	0	0	0	0	0	0	0	0	6	0.25
13-CG-212	Till	0	0	0	0	0	0	0	0	0	3	0
13-CG-216	Till	0	0	0	0	0	0	0	0	0	1	0
13-CG-228	Till	0	0	0	0	0	0	0	0	0	2	0
13-CG-244	Till	0	0	0	0	0	0	0	0	0	2	0
13-CG-268	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	2	0
13-CG-344	Till	0	0	0	0	0	0	0	0	0	8	0.25

Sample Number	Sampling media	# Carbonatite Indicator Minerals	# Pyrochlore	# Stillwellite	# Brockite	# Perovskite	# Bastnaesite	# Ferro-columbite	# Synchysite	# Euxenite	% Ap	% Mz
13-CG-347	Till	0	0	0	0	0	0	0	0	0	0.5	0
13-CG-382	Till	0	0	0	0	0	0	0	0	0	5	0
13-CG-391	Till	0	0	0	0	0	0	0	0	0	1	0
13-CG-395	Till	0	0	0	0	0	0	0	0	0	0.25	0
13-CG-400	Till	0	0	0	0	0	0	0	0	0	2	0
13-CG-433	Till	0	0	0	0	0	0	0	0	0	3	0
13-CG-450	Till	0	0	0	0	0	0	0	0	0	2	0
13-CG-490	Till	0	0	0	0	0	0	0	0	0	0.25	0
13-CG-493	Till	0	0	0	0	0	0	0	0	0	2	0
13-CG-495	Till	0	0	0	0	0	0	0	0	0	4	0
13-CG-499	Till	0	0	0	0	0	0	0	0	0	1	0
13-CG-514	Till	0	0	0	0	0	0	0	0	0	4	0
13-CG-520	Till	0	0	0	0	0	0	0	0	0	5	0
13-CG-530	Till	0	0	0	0	0	0	0	0	0	0.25	0
13-CG-537	Till	0	0	0	0	0	0	0	0	0	3	0
13-CG-543	Till	0	0	0	0	0	0	0	0	0	2	0
13-CG-549	Till	0	0	0	0	0	0	0	0	0	5	0
13-CG-556	Till	0	0	0	0	0	0	0	0	0	0.25	0.25
13-CG-759	Till	0	0	0	0	0	0	0	0	0	0.25	0
13-CG-765	Till	0	0	0	0	0	0	0	0	0	5	0
14-CG-003	Till	0	0	0	0	0	0	0	0	0	0.25	0.25

Sample Number	Sampling media	# Carbonatite Indicator Minerals	# Pyrochlore	# Stillwellite	# Brockite	# Perovskite	# Bastnaesite	# Ferro-columbite	# Synchysite	# Euxenite	% Ap	% Mz
14-CG-009	Till	0	0	0	0	0	0	0	0	0	0.25	0.25
14-CG-021	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	2	0.25
14-CG-030	Till	0	0	0	0	0	0	0	0	0	1	0.25
14-CG-038	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	4	0.25
14-CG-047	Till	0	0	0	0	0	0	0	0	0	1	0
14-CG-050	Till	0	0	0	0	0	0	0	0	0	1	0.25
14-CG-053	Till	0	0	0	0	0	0	0	0	0	10	0
14-CG-054	Till	0	0	0	0	0	0	0	0	0	12	0.25
14-CG-056	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	5	0.25
14-CG-060	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	5	0
14-CG-065	Till	0	0	0	0	0	0	0	0	0	10	0.25
14-CG-069	Till	0	0	0	0	0	0	0	0	0	2	0.25
14-CG-070	Till	0	0	0	0	0	0	0	0	0	4	0
14-CG-081	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	1	0.25
14-CG-090	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	5	0.25
14-CG-109	Till	0	0	0	0	0	0	0	0	0	2	0
14-CG-132	Till	0	0	0	0	0	0	0	0	0	5	0
14-CG-140	Till	0	0	0	0	0	0	0	0	0	6	0.25
14-CG-149	Till	0	0	0	0	0	0	0	0	0	15	0.25
14-CG-167	Till	0	0	0	0	0	0	0	0	0	2	0.25

Sample Number	Sampling media	# Carbonatite Indicator Minerals	# Pyrochlore	# Stillwellite	# Brockite	# Perovskite	# Bastnaesite	# Ferro-columbite	# Synchysite	# Euxenite	% Ap	% Mz
14-CG-175	Till	0	0	0	0	0	0	0	0	0	5	0.25
14-CG-180	Till	0	0	0	0	0	0	0	0	0	1	0
14-CG-215	Till	0	0	0	0	0	0	0	0	0	2	0.25
14-CG-216	Till	0	0	0	0	0	0	0	0	0	2	0.25
14-CG-217	Till	0	0	0	0	0	0	0	0	0	2	0
14-CG-219	Till	0	0	0	0	0	0	0	0	0	12	0.25
14-CG-222	Till	0	0	0	0	0	0	0	0	0	8	0
14-CG-223	Till	0	0	0	0	0	0	0	0	0	2	0.25
14-CG-224	Till	0	0	0	0	0	0	0	0	0	2	0
14-CG-226	Till	0	0	0	0	0	0	0	0	0	2	0
14-CG-227	Till	0	0	0	0	0	0	0	0	0	5	0
14-CG-229	Till	0	0	0	0	0	0	0	0	0	10	0
14-CG-230	Till	0	0	0	0	0	0	0	0	0	1	0
14-CG-232	Till	0	0	0	0	0	0	0	0	0	1	0
14-CG-234	Till	0	0	0	0	0	0	0	0	0	2	0.25
14-CG-250	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	5	0.25
14-CG-252	Till	0	0	0	0	0	0	0	0	0	2	0
14-CG-256	Till	0	0	0	0	0	0	0	0	0	0.25	0
14-CG-257	Till	0	0	0	0	0	0	0	0	0	2	0
14-CG-259	Till	0	0	0	0	0	0	0	0	0	5	0.25

Sample Number	Sampling media	# Carbonatite Indicator Minerals	# Pyrochlore	# Stillwellite	# Brockite	# Perovskite	# Bastnaesite	# Ferro-columbite	# Synchysite	# Euxenite	% Ap	% Mz
14-CG-799	Till	0	0	0	0	0	0	0	0	0	20	0.25
14-CG-800	Till	0	0	0	0	0	0	0	0	0	10	0.25
14-CG-808	Till	0	0	0	0	0	0	0	0	0	60	0.25
14-CG-809	Till	0	0	0	0	0	0	0	0	0	1	0.25
14-CG-815	Glaciofluvial sand and gravel	2	0	0	0	0	0	0	0	2	20	0
14-CG-821	Till	0	0	0	0	0	0	0	0	0	10	0
14-CG-823	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	15	0
14-CG-829	Till	0	0	0	0	0	0	0	0	0	25	0
14-CG-831	Till	0	0	0	0	0	0	0	0	0	8	0.25
14-CG-832	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	30	0.25
14-CG-852	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	40	0.25
14-CG-858	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	15	0.25
14-CG-859	Till	0	0	0	0	0	0	0	0	0	10	0.25
14-CG-861	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	3	0
14-CG-872	Till	0	0	0	0	0	0	0	0	0	8	0
14-CG-881	Till	0	0	0	0	0	0	0	0	0	10	0.25
14-CG-882	Till	0	0	0	0	0	0	0	0	0	10	0.25
14-CG-884	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	5	0.25
14-CG-934	Till	0	0	0	0	0	0	0	0	0	20	0.25
14-CG-935	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	10	0.25
14-CG-938	Glaciofluvial sand and gravel	2	0	0	0	0	2	0	0	0	5	0.25

Sample Number	Sampling media	# Carbonatite Indicator Minerals	# Pyrochlore	# Stillwellite	# Brockite	# Perovskite	# Bastnaesite	# Ferro-columbite	# Synchysite	# Euxenite	% Ap	% Mz
14-CG-940	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	8	0
14-CG-947	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	5	0
14-CG-966	Glaciofluvial sand and gravel	0	0	0	0	0	0	0	0	0	12	0.25
14-CG-973	Till	0	0	0	0	0	0	0	0	0	5	0
14-CG-977	Till	0	0	0	0	0	0	0	0	0	3	0
14-CG-991	Till	0	0	0	0	0	0	0	0	0	10	0.25
14-CG-996	Till	0	0	0	0	0	0	0	0	0	2	0.25
14-CG-997	Till	0	0	0	0	0	0	0	0	0	6	0
14-CG-999	Till	0	0	0	0	0	0	0	0	0	10	0
16-CG-001A	Till	0	0	0	0	0	0	0	0	0	0.25	0
16-CG-001B	Till	0	0	0	0	0	0	0	0	0	0.25	0
16-CG-001C	Till	0	0	0	0	0	0	0	0	0	0.25	0
16-CG-002	Till	0	0	0	0	0	0	0	0	0	0.25	0
16-CG-003	Till	0	0	0	0	0	0	0	0	0	0.25	0
16-CG-004	Till	0	0	0	0	0	0	0	0	0	0.25	0.25

Metric Conversion Table

Conversion from SI to Imperial			Conversion from Imperial to SI		
SI Unit	*Multiplied by*	*Gives*	*Imperial Unit*	*Multiplied by*	*Gives*
			LENGTH		
1 mm	0.039 37	inches	1 inch	**25.4**	mm
1 cm	0.393 70	inches	1 inch	**2.54**	cm
1 m	3.280 84	feet	1 foot	**0.304 8**	m
1 m	0.049 709	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	**1.609 344**	km
			AREA		
1 cm^2	0.155 0	square inches	1 square inch	**6.451 6**	cm^2
1 m^2	10.763 9	square feet	1 square foot	**0.092 903 04**	m^2
1 km^2	0.386 10	square miles	1 square mile	2.589 988	km^2
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
			VOLUME		
1 cm^3	0.061 023	cubic inches	1 cubic inch	**16.387 064**	cm^3
1 m^3	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m^3
1 m^3	1.307 951	cubic yards	1 cubic yard	0.764 554 86	m^3
			CAPACITY		
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	**4.546 090**	L
			MASS		
1 g	0.035 273 962	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 747	ounces (troy)	1 ounce (troy)	**31.103 476 8**	g
1 kg	2.204 622 6	pounds (avdp)	1 pound (avdp)	**0.453 592 37**	kg
1 kg	0.001 102 3	tons (short)	1 ton(short)	**907.184 74**	kg
1 t	1.102 311 3	tons (short)	1 ton (short)	**0.907 184 74**	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	**1016.046 908 8**	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	**1.016 046 9**	t
			CONCENTRATION		
1 g/t	0.029 166 6	ounce (troy) / ton (short)	1 ounce (troy) / ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights / ton (short)	1 pennyweight / ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

	Multiplied by	
1 ounce (troy) per ton (short)	31.103 477	grams per ton (short)
1 gram per ton (short)	0.032 151	ounces (troy) per ton (short)
1 ounce (troy) per ton (short)	20.0	pennyweights per ton (short)
1 pennyweight per ton (short)	0.05	ounces (troy) per ton (short)

Note: Conversion factors in ***bold*** *type are exact. The conversion factors have been taken from or have been derived from factors given in the* Metric Practice Guide for the Canadian Mining and Metallurgical Industries*, published by the Mining Association of Canada in co-operation with the Coal Association of Canada.*

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Figure 2. Location of sample sites in the Chapleau survey area, northern Ontario. This map accompanies OFR 6320.