Recent Kimberlite Indicator Mineral Results and Sampling in Northern Manitoba
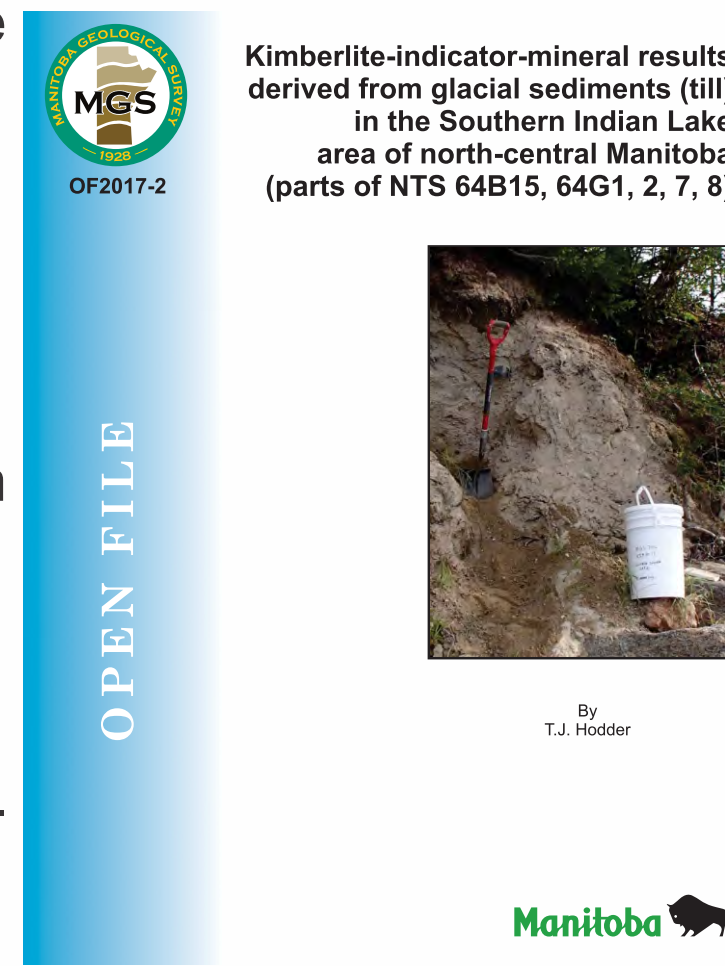
Hodder, T.J.[1], Gauthier, M.S.[1], Böhm, C.O.[1], Kelley, S.E.[2]

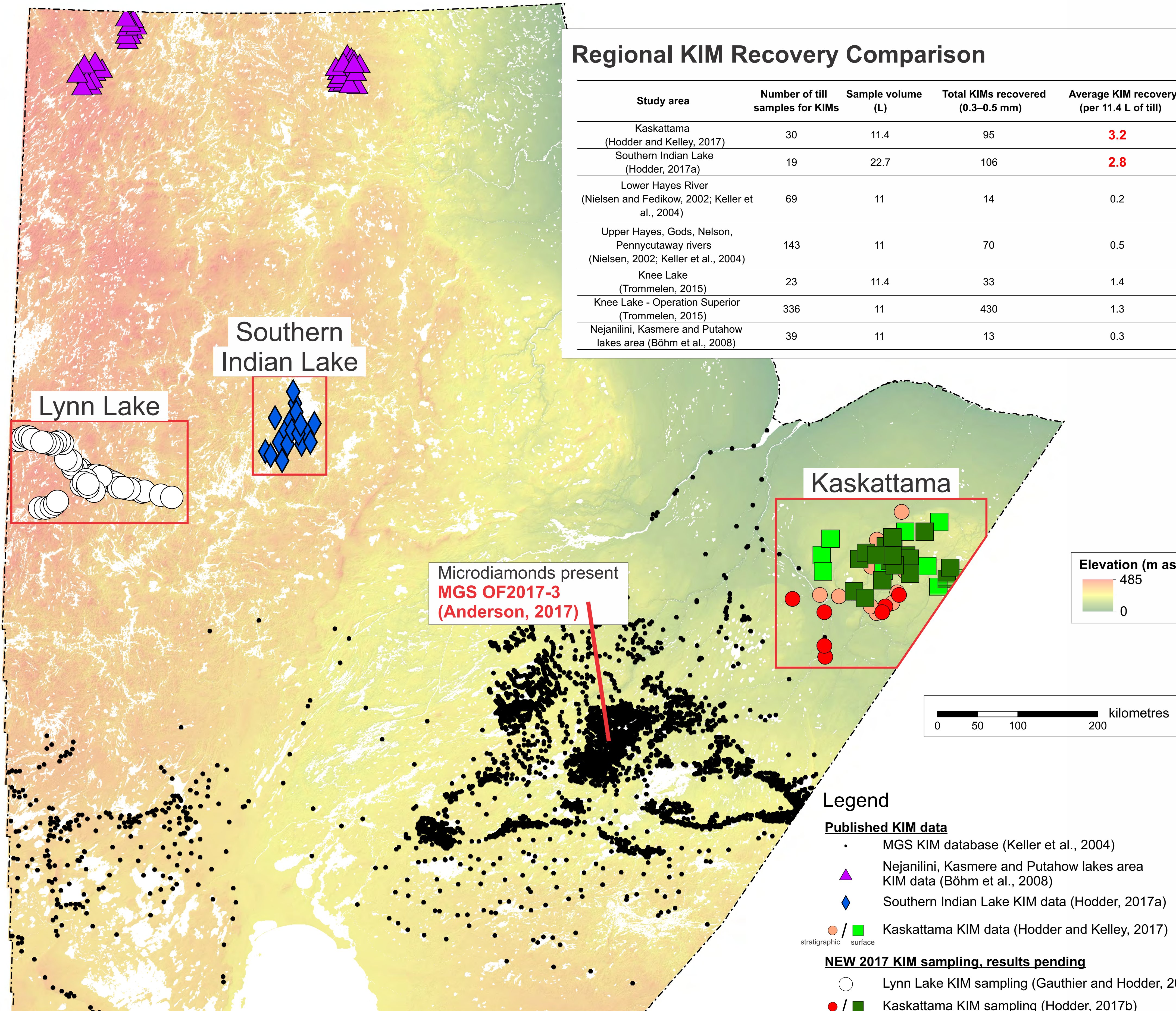1. Manitoba Geological Survey 2. University of Waterloo

Southern Indian Lake region

Reconnaissance-scale kimberlite-indicator-mineral (KIM) sampling was undertaken in the Southern Indian Lake region of north-central Manitoba. This is the first study to investigate the diamond potential of the region using till-derived indicator-minerals. Results have been released in **MGS OF2017-2** (Hodder, 2017a).

A total of 106 KIM grains were recovered from the 0.3–0.5 mm size-fraction of nineteen 22.7 L till samples. The majority of the KIMs recovered are Cr-spinel (77%) and Mg-ilmenite (15%). Additionally, three G9 garnets (4%), one G11 garnet (1%) and four diamond-inclusion Cr-spinels (4%) were identified with the results of the survey displayed below.

2016 KIM results displayed as proportional-sized symbols (Hodder, 2017a). Background hillshade image was generated using Canadian digital surface model (Natural Resources Canada, 2015).

2016 KIM results displayed as proportional-sized compositional pie charts (Hodder, 2017a). Background hillshade image was generated using Canadian digital surface model (Natural Resources Canada, 2015)

Overview of kimberlite indicator mineral data in northern Manitoba

Regional KIM Recovery Comparison

Study area	Number of till samples for KIMs	Sample volume (L)	Total KIMs recovered (0.3–0.5 mm)	Average KIM recovery (per 11.4 L of till)
Kaskattama (Hodder and Kelley, 2017)	30	11.4	95	3.2
Southern Indian Lake (Hodder, 2017a)	19	22.7	106	2.8
Lower Hayes River (Nielsen and Fedikow, 2002; Keller et al., 2004)	69	11	14	0.2
Upper Hayes, Gods, Nelson, Pennycutaway rivers (Nielsen, 2002; Keller et al., 2004)	143	11	70	0.5
Knee Lake (Trommelen, 2015)	23	11.4	33	1.4
Knee Lake - Operation Superior (Trommelen, 2015)	336	11	430	1.3
Nejanilini, Kasmere and Putahow lakes area (Böhm et al., 2008)	39	11	13	0.3

Legend

Published KIM data
- MGS KIM database (Keller et al., 2004)
- Nejanilini, Kasmere and Putahow lakes area KIM data (Böhm et al., 2008)
- Southern Indian Lake KIM data (Hodder, 2017a)
- Kaskattama KIM data (Hodder and Kelley, 2017)

NEW 2017 KIM sampling, results pending
- Lynn Lake KIM sampling (Gauthier and Hodder, 2017)
- Kaskattama KIM sampling (Hodder, 2017b)

Kimberlite indicator mineral (KIM) data was compiled by the Manitoba Geological Survey (MGS) as part of a 2003 initiative and version 3.0 of the database was released as part of stand alone KIM database (Keller et al., 2004). Since 2004, in northern Manitoba, KIM results have been published for the far north (Böhm et al., 2008), Southern Indian Lake (Hodder, 2017a) and Kaskattama highland (Hodder and Kelley, 2017) areas. 2017 KIM sampling was undertaken along the road network in the Lynn Lake area (Gauthier and Hodder, 2017) and additional sampling was conducted in the Kaskattama highland area (Hodder, 2017b).

Lynn Lake region

The diamond potential of the Lynn Lake area of Manitoba is unknown. There is currently no public KIM data available for the Lynn Lake region (Keller et al., 2004), hence this study will provide the first regional-scale insight into diamond potential from an indicator-mineral perspective.

To the west, the Sask craton is known to host the Cretaceous aged Fort-a-la-Corne diamondiferous kimberlites (Leckie et al., 1997). In addition, recent diamondiferous kimberlites have been discovered within the Sask craton at the Pikoo project (Armstrong and Kupsch, 2016), which is located approximately 100 km west of Flin Flon, Manitoba. Ages consistent with that of the Sask craton were also observed in the Lynn Lake area in rocks from the Sickle Group (Beaumont-Smith et al., 2006). The presence of Archean to earliest Proterozoic rocks in the west-central area of Southern Indian Lake, as well as the ubiquitous presence of zircons of Archean age in volcaniclastic rocks of the Southern Indian domain, suggests the potential existence for Archean crust in the area (Kremer et al., 2009). This may be analogous to the Archean crust of the Sask craton.

Results from the Lynn Lake area will be compared to recent KIM results in the Southern Indian Lake area (Hodder, 2017a) to provide additional insight into the diamond potential of northwestern Manitoba.

A total of 48 till samples (22.7 L each) were collected during the 2017 field season (Gauthier and Hodder, 2017). 2017 KIM results are anticipated to be released in Spring 2018.

2017 till sample sites and historical sampling in the Lynn Lake area (Gauthier and Hodder, 2017).
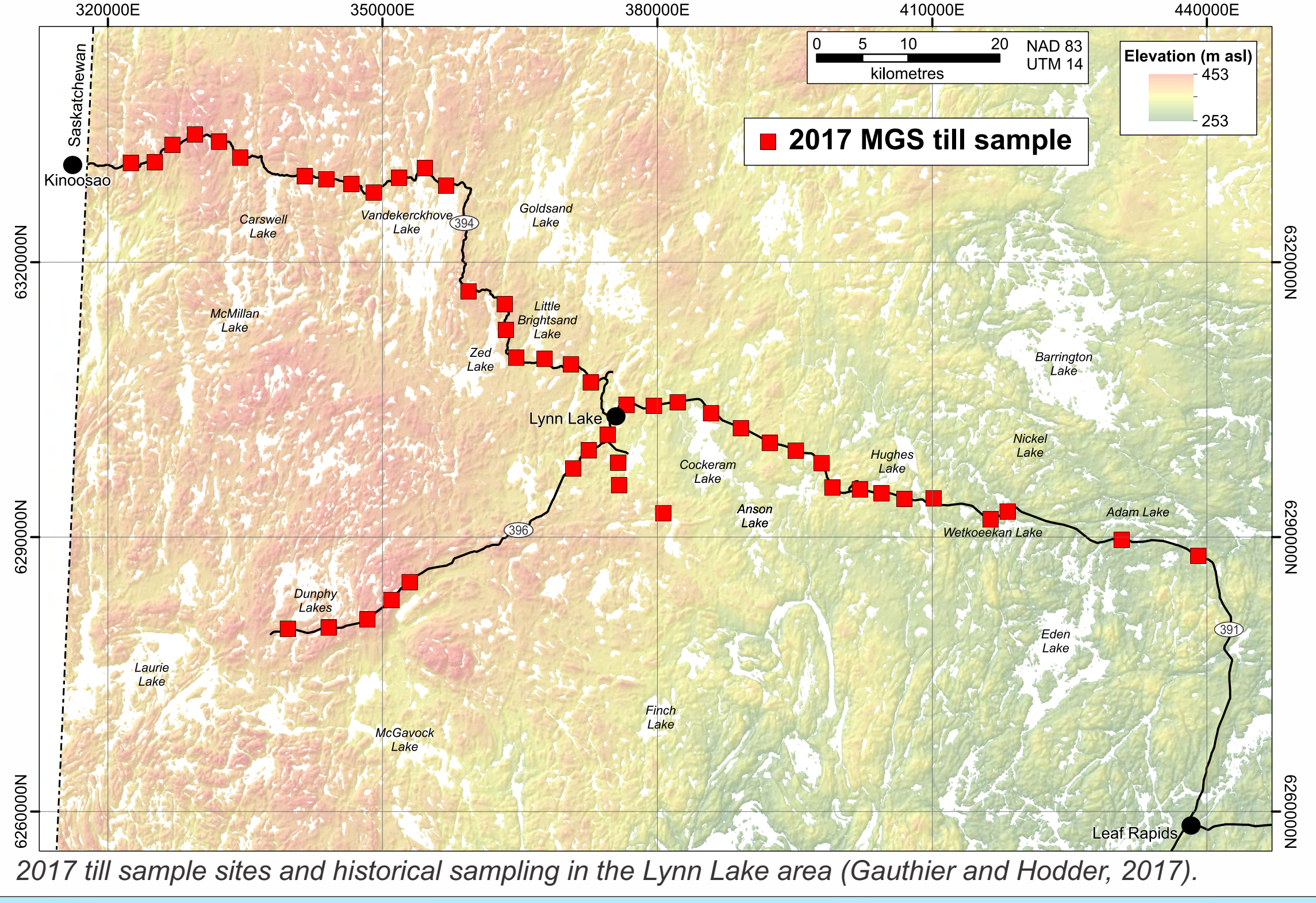
Kaskattama region

Reconnaissance-scale KIM sampling was undertaken during the 2016 and 2017 field season in the Kaskattama highland region of northeastern Manitoba. This is the first public study to assess the diamond potential of the area from an indicator-mineral perspective. An additional thirty-four KIM samples were collected during the 2017 field season to follow-up on 2016 results and tighten the sampling density in the study area. 2016 KIM results have been released in **MGS OF2017-1** (Hodder and Kelley, 2017). 2017 KIM results are anticipated to be released in the spring of 2018.

A total of 95 KIM grains were recovered from the 0.3–0.5 mm size-fraction of thirty 11.4 L till samples. The majority of the KIMs are Cr-spinels (81%) and Mg-ilmenites (8%), though G9 garnets (5%) and Cr-diopsides (3%) are also present. One diamond-inclusion Cr-spinel, G11 garnet and G3 garnet were also recovered. The highest concentration from one sample is 17 KIMs, collected from a surface mudboil. A gold grain was recovered from a sample in the central region of the study area.
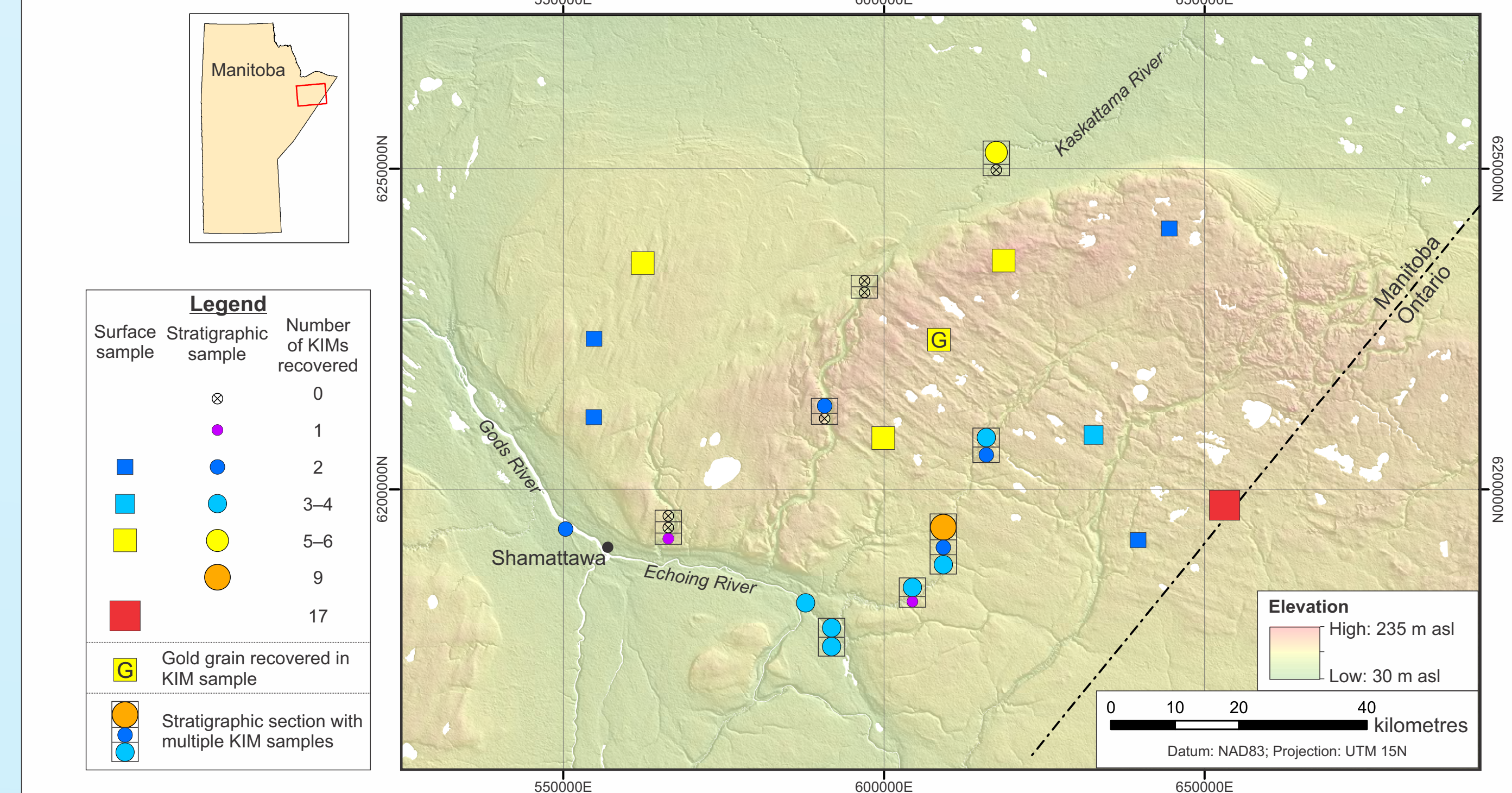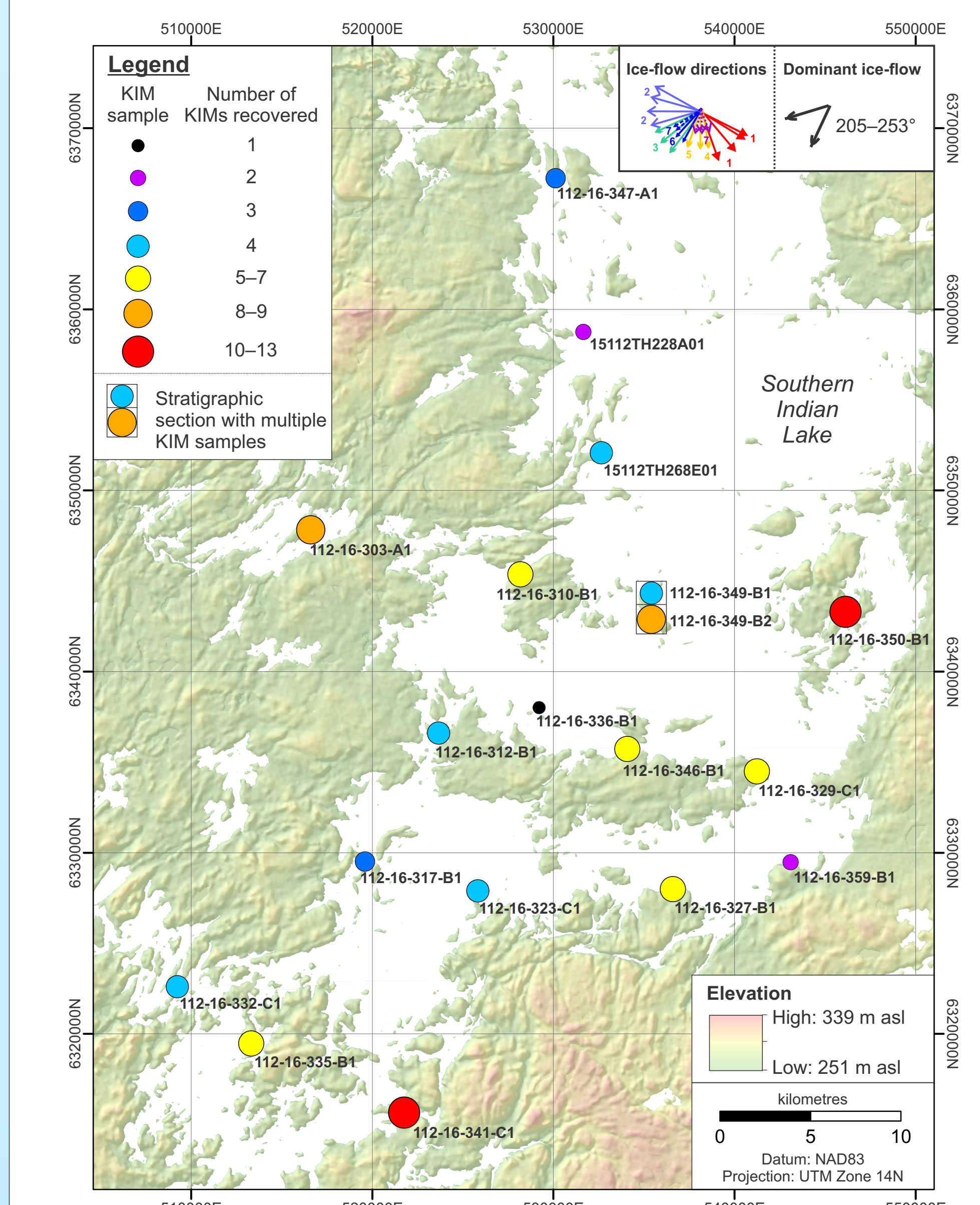

2016 KIM results displayed as proportional-sized symbols (Hodder and Kelley, 2017). Background hillshade image was generated using Canadian digital surface model (Natural Resources Canada, 2015).
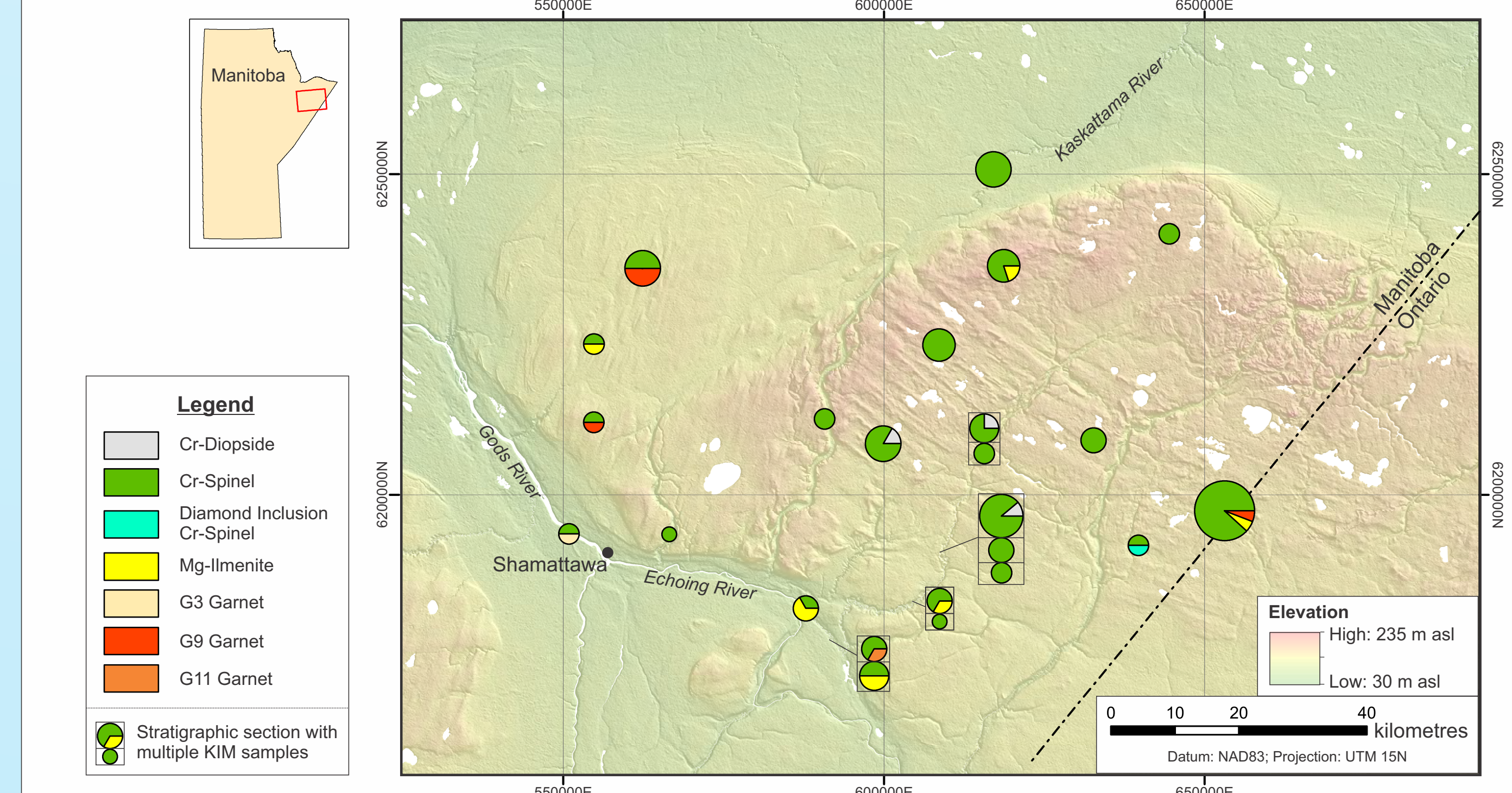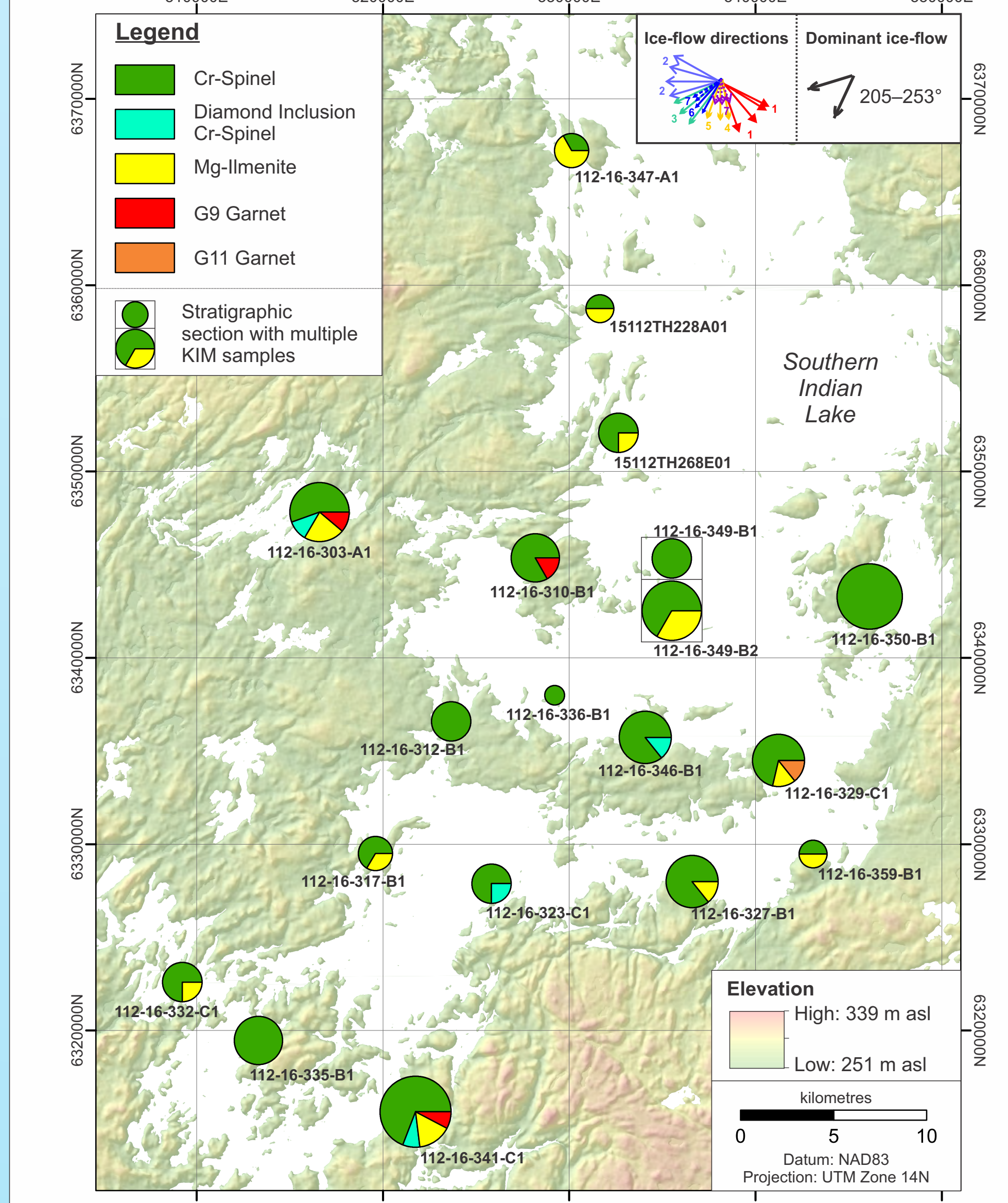

2016 KIM results displayed as proportional-sized compositional pie charts (Hodder and Kelley, 2017). Background hillshade image was generated using Canadian digital surface model (Natural Resources Canada, 2015).

Kaskattama ice-flow indicators
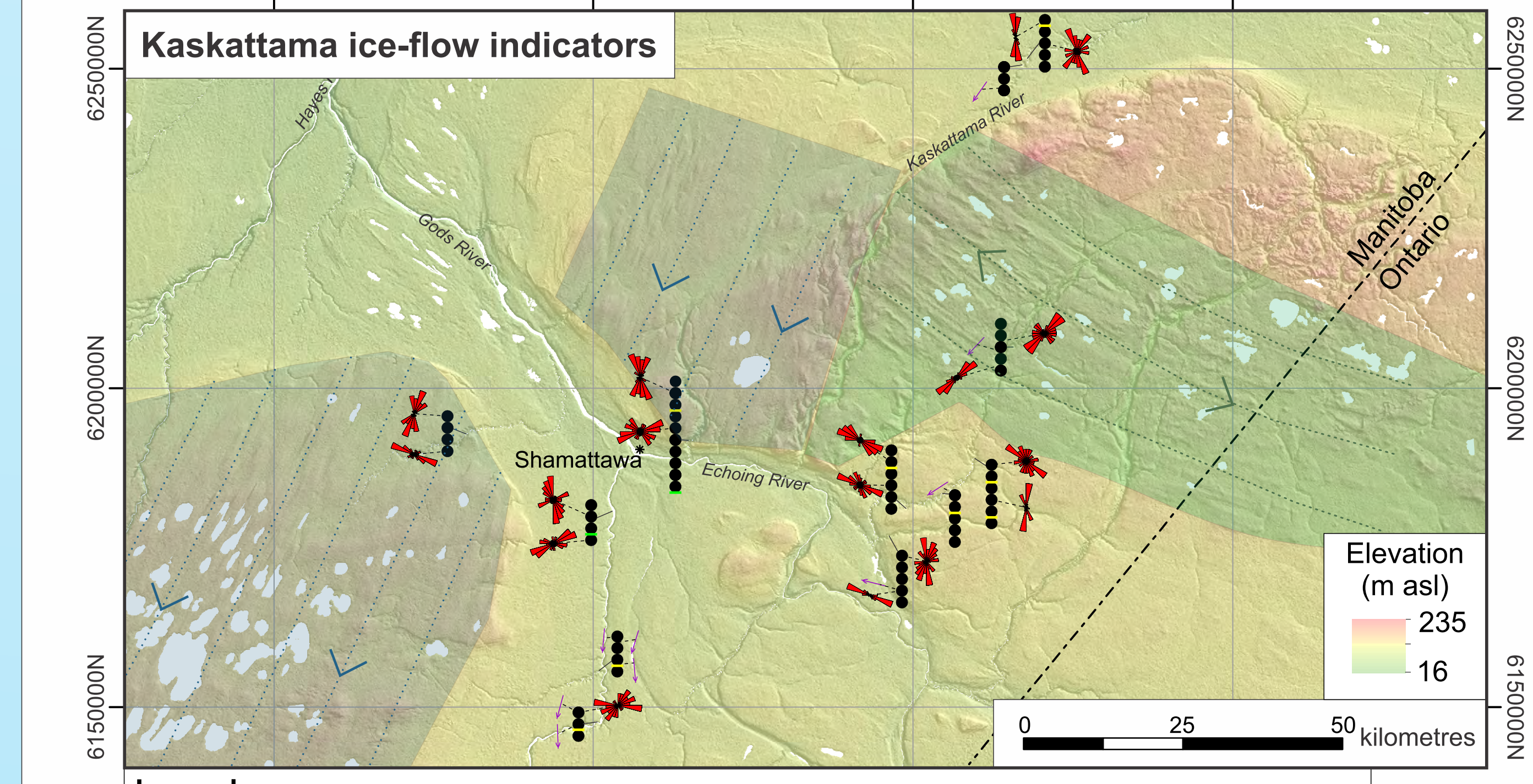
Ice-flow data in the Kaskattama study area (modified from Hodder, 2017b). Clast fabric data collected during the 2017 field season is portrayed as bidirectional rose diagrams. Two streamlined landform flowsets are present in the study area referred to as the Kaskattama and Hayes flowsets. The Hayes flowset is SW trending. The Kaskattama flowset is either NW or SE trending. Background hillshade image was generated using Canadian digital surface model (Natural Resources Canada, 2015).

References:
Anderson, S.D. 2017: Preliminary geology of the diamond occurrence at southern Knee Lake, Oxford Lake–Knee Lake greenstone belt, northern Manitoba (NTS 53L15); Manitoba Growth, Enterprise and Trade, Manitoba Geological Survey, Open File OF2017-3, 27 p.
Armstrong, K. and Kupsch, B. 2016: Pikoo diamond project – 2016 exploration update; Saskatchewan Geological Survey, Saskatchewan Ministry of the Economy, Open House 2016, Saskatoon, Saskatchewan, November 28–30, 2016, PowerPoint® presentation, 20 p., URL <http://publications.gov.sk.ca/documents/310/96863-6_Kupsch_Pikoo%202016%20Sask%20Geological%20Open%20House.pdf> [October 2017].
Beaumont-Smith, C.J., Machado, N. and Peck, D.C. 2006: New uranium-lead geochronologic results from the Lynn Lake greenstone belt, Manitoba (NTS 64C11–16); Manitoba Science Technology, Energy and Mines, northern Manitoba (NTS 64N, 64O, 64P); Manitoba Science, Technology, Energy and Mines, Manitoba Geological Survey, Open File 2008-13, 46 p.
Böhm, C.O., Anderson, S.D., Matile, G.L.D. and Kupsch, B.G. 2008: Geochemical and kimberlite-indicator-mineral results for till samples from the Nejanilini, Kasmere and Putahow lakes area, northern Manitoba (NTS 64N, 64O, 64P); Manitoba Science, Technology, Energy and Mines, Manitoba Geological Survey, Data Repository Item DRI2008-13, 6 p.
Gauthier, M.S. and Hodder, T.J. 2017: Till sampling and ice-flow mapping between Leaf Rapids, Lynn Lake and Kinoosao, northern Manitoba (parts of NTS 64B12, 64C9, 11, 12 14, 15, 16, 64F3, 4) in Report of Activities 2017, Manitoba Growth, Enterprise and Trade, Manitoba Geological Survey, p. 191–204.
Hodder, T.J. 2017a: Kimberlite-indicator-mineral results derived from glacial sediments (till) in the Southern Indian Lake area of north-central Manitoba (parts of NTS 64B15, 64G1, 2, 7, 8); Manitoba Growth, Enterprise and Trade, Manitoba Geological Survey, p. 200–214.
Hodder, T.J. 2017b: Quaternary stratigraphy and till sampling in the Kaskattama highland region, northeastern Manitoba (parts of NTS 53N, O, 54B, C) – Year 2; in Report of Activities 2017, Manitoba Growth, Enterprise and Trade, Manitoba Geological Survey, p. 205–214.
Hodder, T.J. and Kelley, S.E. 2017: Kimberlite-indicator-mineral results derived from glacial sediments (till) in the Kaskattama highland area of northeast Manitoba (parts of NTS 53N, O, 54B, C); Manitoba Growth, Enterprise and Trade, Manitoba Geological Survey, Open File OF2017-1, 6 p.
Keller, G.R., Bogdan, D.J. and Matile, G.L.D. 2004: Manitoba Kimberlite Indicator Mineral Database (Version 3.0); Manitoba Industry, Economic Development and Mines, Manitoba Geological Survey, Open File Report OF2004-25, zipped Microsoft Access2000 database.
Kremer, P.D., Rayner, N. and Corkery, M.T. 2009: New results from geological mapping in the west-central and northeastern portions of Southern Indian Lake, Manitoba (parts of NTS 64G1, 2, 8, 64H4, 5); in Report of Activities 2009, Manitoba Innovation, Energy and Mines, Manitoba Geological Survey, p. 94–107.
Leckie, D.A., Kjarsgaard, B.A., Bloch, J., McIntyre, D., McNeil, D., Stasiuk, L. and Heaman, L. 1997: Emplacement and reworking of Cretaceous, diamond-bearing, crater facies kimberlite in central Saskatchewan, Canada; Geological Society of America, Bulletin 109, p. 1000–1020.
Natural Resources Canada 2015: Canadian digital surface model; Natural Resources Canada, URL <http://geogratis.gc.ca/api/en/nrcan-rncan/ess-sst/3411b8d6-4340-4a37-ae38-036d3433ffbb.html> [September 2015].
Nielsen, E. 2002: Quaternary stratigraphy and ice-flow history along the lower Nelson, Hayes, Gods and Pennycutaway rivers and implication for diamond exploration in northeastern Manitoba; in Report of Activities 2002, Manitoba Industry Trade and Mines, Manitoba Innovation, Energy and Mines, Manitoba Geological Survey, p. 209–215.
Nielsen, E. and Fedikow, M.A.F. 2002: Kimberlite indicator-mineral survey, lower Hayes River; Manitoba Industry, Trade and Mines, Manitoba Geological Survey, Geoscientific Paper GP2002-1, 11 p.
Trommelen, M.S. 2015: Glacial history and till composition, Knee Lake area, northeastern Manitoba (NTS 53L14, 15, 53M1, 2); Manitoba Natural Resources, Manitoba Geological Survey, Geoscientific Paper GP2013-3, 30 p.