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Preliminary Map P.3801, *Quaternary Geology, Drury and Denison Townships*, scale 1:20 000.

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Miscellaneous Release—Data 359

Till Geochemical and Mineralogical Data for Drury and Denison Townships, City of Greater Sudbury

by S. Hashmi[1,2]

This publication can be downloaded from
http://www.geologyontario.mndm.gov.on.ca/mndmaccess/mndm_dir.asp?type=pub&id=MRD359

This digital data release comprises the results of a regional till sampling and surficial mapping project conducted in 2015 and 2016 in Drury and Denison townships. It is part of a multi-disciplinary research program on low-sulphide, PGE-rich footwall mineralization, being conducted by the Mineral Exploration Research Centre of the Harquail School of Earth Sciences at Laurentian University in collaboration with the Ontario Geological Survey, and the results form part of the requirements of the author's PhD thesis, supervised by Dr. Matthew Leybourne at the Department of Geological Sciences and Geological Engineering at Queen's University. The data are released in conjunction with Open File Report 6342, *Quaternary Geology and Surficial Media Sampling in Drury and Denison Townships, City of Greater Sudbury*, and augments Preliminary Map P.3801, *Quaternary Geology, Drury and Denison Townships*, which was released August 9, 2016. The results of geochemical and mineralogical analyses are provided for 12 whole rock, 113 humus, 112 B-horizon and 126 C-horizon till samples and 115 C-horizon till heavy mineral concentrates; and includes loss on ignition. The data consists of heavy mineral grain counts that include kimberlite indicator minerals, chromite, metamorphic/magmatic massive sulphide indicator minerals, and gold grains; and pebble lithology data. All sample location information is presented as Universal Transverse Mercator co-ordinates using North American Datum 1983 (NAD83) in Zone 17 and is accompanied by site descriptions. The data files are provided as 53 Microsoft® Excel® 2013 (*.xlsx*) files along with 5 supporting documents in portable document format (*.pdf*).

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This data release provides geochemical and mineralogical data from surficial media sampling collected in 2015 and 2016. The file structure is set up to reflect the data collection season, 2015 and 2016. The description of each file follows.

2015 Data Set

Data presented include geochemistry and heavy mineral concentrate (HMC) results. Geochemical analyses were completed on humus, B- and C-horizon till. Humus samples underwent 1) a sodium pyrophosphate leach and were analyzed by ICP–MS (inductively coupled plasma mass spectrometry) (completed at ALS Global, Sudbury, Ontario); 2) an aqua regia leach analyzed by ICP–MS and ICP–AES (inductively coupled plasma-atomic emission spectroscopy (completed at Geoscience Laboratories, Sudbury, Ontario); and 3) instrumental neutron activation analysis (INAA) (completed at Maxxam Analytics, Mississauga, Ontario). The B- and C-horizon till samples underwent 1) nickel sulphide fire assay (NiS FA) and 2) an aqua regia leach followed by an ICP–MS and ICP–AES finish (completed at Geoscience Laboratories, Sudbury, Ontario). The HMC data presents a detailed overview of indicator minerals recovered from till samples and includes gold grain, platinum group mineral (PGM), kimberlite indicator mineral (KIM) and magmatic/metamorphic massive sulphide indicator mineral (MMSIM®)[3] data. Indicator mineral separation was completed by Overburden Drilling Management (ODM) in Nepean, Ontario. All sample location information is presented as Universal Transverse Mercator co-ordinates using North American Datum 1983 (NAD83) in Zone 17.

/2015 File Descriptions

MRD359_2015_1_Sample description.xlsx
Sample location and site information including media type sampled, underlying bedrock and moraine type, in UTM co-ordinates Easting and Northing (NAD 83, Zone 17N).

MRD359_2015_2_Humus_Sodium Pyrophosphate_ICP-MS.xlsx
Humus geochemistry results for sodium pyrophosphate (partial leach) digestion, ICP-MS finish. Values below reporting limit have been plotted as one-half the lower detection limit (LDL) (e.g., 0.5 ppm for <1 ppm LDL) in spatial plots. Values greater than upper reporting limit (URL) e.g., >260 ppm have been plotted as 260.1 ppm in spatial plots.

MRD359_2015_3_Humus_Aqua Regia_ICP-MS.xlsx
Humus geochemistry results for aqua regia leach ICP-MS finish. Values below reporting limit have been plotted as one-half the lower detection limit (0.5 ppm for <1 ppm) in spatial plots. Values greater than upper reporting limit, e.g., >260 ppm have been plotted a 260.1 ppm in spatial plots.

MRD359_2015_4_Humus_Aqua Regia_ICP-AES.xlsx
Humus geochemistry results for aqua regia leach ICP-AES. Values below reporting limit have been plotted as one-half the lower detection limit (0.5 ppm for <1 ppm) in spatial plots. Values greater than upper reporting limit, e.g., >260 ppm have been plotted a 260.1 ppm in spatial plots.

MRD359_2015_5_Humus_INAA.xlsx
Humus geochemistry results for INAA. Samples with values below detection limit are reported as negative values, e.g., -1 ppm. Abundant elements are reported in %. Values below reporting limit have been plotted as one-half the lower detection limit (0.5 ppm for -1 ppm) in spatial plots.

MRD359_2015_6_Humus_LOI.xlsx
This spreadsheet contains results for weight % lost during 3 step LOI procedure completed on humus samples.

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

MRD359_2015_7_B-Horizon_Aqua Regia_ICP-MS.xlsx
B-horizon geochemical results for aqua regia ICP-MS. Values below reporting limit have been plotted as one-half the lower detection limit (0.5 ppm for <1 ppm) in spatial plots. Values greater than upper reporting limit, e.g., >260 ppm have been plotted a 260.1 ppm in spatial plots.

MRD359_2015_8_B-Horizon_Aqua Regia_ICP-AES.xlsx
B-horizon geochemical results for aqua regia ICP-AES. Values below reporting limit have been plotted as one-half the lower detection limit (0.5 ppm for <1 ppm) in spatial plots. Values greater than upper reporting limit, e.g., >260 ppm have been plotted a 260.1 ppm in spatial plots.

MRD359_2015_9_B-Horizon_INAA.xlsx
B-horizon geochemistry results for INAA. Samples with values below detection limit are reported as negative values, e.g., -1 ppm. Abundant elements are reported in %. Values below reporting limit have been plotted as one-half the lower detection limit (0.5 ppm for -1 ppm) in spatial plots.

MRD359_2015_10_B-Horizon_NiSFA.xlsx
B-horizon geochemical results for aqua regia nickel sulphide fire assay ICP-MS. Values below reporting limit have been plotted as one-half the lower detection limit (0.5 ppm for <1 ppm) in spatial plots. Values greater than upper reporting limit, e.g., >260 ppm have been plotted a 260.1 ppm in spatial plots.

MRD359_2015_11_B-Horizon_PSA.xlsx
Particle size analysis results completed for B-horizon samples.

MRD359_2015_12_B-Horizon_LOI.xlsx
Results for weight % lost during 3 step LOI procedure completed on B-Horizon samples.

MRD359_2015_13_C-Horizon_Aqua Regia_ICP-MS.xlsx
C-horizon geochemical results for aqua regia ICP-MS, where values below reporting limit have been plotted as one-half the lower detection limit (0.5 ppm for <1 ppm) in spatial plots. Values greater than upper reporting limit, e.g., >260 ppm have been plotted a 260.1 ppm in spatial plots.

MRD359_2015_14_C-Horizon_Aqua Regia_ICP-AES.xlsx
C-horizon geochemical results for aqua regia ICP-AES, where values below reporting limit have been plotted as one-half the lower detection limit (0.5 ppm for <1 ppm) in spatial plots. Values greater than upper reporting limit, e.g., >260 ppm have been plotted as 260.1 ppm in spatial plots.

MRD359_2015_15_C-Horizon_INAA.xlsx
C-horizon geochemistry results for INAA. Samples with values below detection limit are reported as negative values, e.g., -1 ppm. Abundant elements are reported as %.

MRD359_2015_16_C-Horizon_NiSFA.xlsx
C-horizon geochemical results for nickel sulphide fire assay ICP-MS, where values below reporting limit have been plotted as one-half the lower detection limit (0.5 ppm for <1 ppm) in spatial plots. Values greater than upper reporting limit, e.g., >260 ppm have been plotted as 260.1 ppm in spatial plots.

MRD359_2015_17_C-Horizon_PSA.xlsx
Particle size analysis results for C-horizon samples.

MRD359_2015_18_C-Horizon_LOI.xlsx
Results for weight % lost during 3 step LOI procedure completed on C-horizon samples.

MRD359_2015_19_HMC tabling data.xlsx
This spreadsheet presents tabling information including weight of sample received, tabling weight, clast and matrix characteristics. Till samples were pre-sieved to <5 mm in the field before shipping. Detailed information on pebble characteristics, percentage and lithology are presented in *MRD359_2015_29_Pebble count data.xlsx*.

MRD359_2015_20_HMC processing weights.xlsx
Table of weights of grain fractions processed at each stage of the indicator mineral separation, starting with received bulk weight.

MRD359_2015_21_HMC_Paramagnetic separation.xlsx
Table of grains in 0.25 to 0.50 mm fraction that were separated for indicator mineral picking using paramagnetic separation.

MRD359_2015_22_Gold grain summary data.xlsx
Summary of gold grains recovered during HMC panning phase and includes information on gold grain morphology and parts per billion (ppb) equivalents.

MRD359_2015_23_Detailed gold grain and panned concentrate data.xlsx
Detailed panned gold grains, sperrylite and sulphide mineral data, including gold grain measurements.

MRD359_2015_24_PGM data.xlsx
This spreadsheet contains total and picked number of panned (<0.25 mm) and picked (0.25 to 2.0 mm) sperrylite grains.

MRD359_2015_25_HMC KIM counts.xlsx
Summary of kimberlite indicator mineral data for minerals picked in 0.25 to 0.50 mm, 0.50 to 1.0 mm and 1.0 to 2.0 mm fractions.

MRD359_2015_26_HMC KIM remarks.xlsx
Remarks noted while processing KIM counts.

MRD359_2015_27_MMSIM(R)_counts.xlsx
Summary of MMSIM® counts for minerals in 0.25 to 0.50 mm, 0.50 to 1.0 mm and 1.0 to 2.0 mm fractions.

MRD359_2015_28_MMSIM(R)_remarks.xlsx
Remarks for picked MMSIM® minerals in the 0.25 to 0.50 mm, 0.50 to 1.0 mm and 1.0 to 2.0 mm fraction.

MRD359_2015_29_Pebble count data.xlsx
Summary of identified pebbles from till samples that were sent for HMC separation and contain information of clasts type, abundance in sample and location.

2016 Data Set

The 2016 data comprise geochemical analyses on 12 whole rock, 16 B-horizon and 17 C-horizon tills. Heavy mineral concentrates were separated from 15 till (B- and C-horizon) samples. All whole-rock and sediment analysis (except INAA) were completed at Geoscience Laboratories (Geo Labs), Ontario Geological Survey, Sudbury, Ontario. Instrumental neutron activation analysis (INAA) on till samples was completed at Maxxam Laboratories in Mississauga, Ontario. Heavy mineral separation was completed at Overburden Drilling Management (ODM) in Nepean, Ontario. The rock samples were prepared using the agate mill preparation technique (*see* method code SAM-AGM in GeoLabs brochure). The following analyses were completed on whole-rock samples.

1) Minor and trace elements were determined using aqua regia digest and analyzed with inductively coupled plasma mass spectrometry (ICP–MS) and an open-vessel multi-acid digest and analyzed with inductively coupled plasma atomic emission spectrometry (ICP–AES) finish.
2) Platinum group elements (PGEs), i.e., Pt, Pd, Ru, Rh and Ir, and Au were determined using nickel sulphide fire assay (NiS FA) followed by an ICP–MS finish.
3) Total carbon and sulphur concentrations were also measured in whole-rock samples. Results are expressed as CO_2 and SO_2 (in percent).

4) Major element oxides were determined by X-Ray fluorescence (XRF). Because of elevated base metal and sulphide content in the rock samples, a custom fusion method was used, and samples diluted by a factor of 24.
5) A 3 step loss on ignition (LOI) was completed on samples to determine volatile content.

The B- and C-horizon till samples were sieved to the 63 micron fraction. External standard reference materials (Canadian certified reference material (CCRM) Till-1) and internal standard (MCM) were inserted for QA/QC purposes. The samples underwent the following procedures.

1) Particle size analysis was completed on B- and C-horizon till samples to determine the sand, silt and clay percentages.
2) Major, minor and trace element content in samples (both mineralized and non-mineralized) was determined using aqua regia digestion followed by ICP–MS and inductively coupled plasma atomic emission spectrometry (ICP–AES) finishes.
3) Platinum group element and gold content was determined via NiS FA followed by an ICP–MS finish.
4) Total carbon and sulphur concentrations were measured in B- and C-horizon till samples. Results are expressed as CO_2 and SO_2 (in percent).
5) A 3 step loss on ignition LOI procedure was completed to determine the volatile content and to remove any organics present within the sample.
6) Instrumental neutron activation analysis to determine levels of Au plus 32 elements.

Heavy mineral concentrate separation data for B- and C-horizon till samples includes the following.

1) Gold grain counts and detailed morphology
2) Platinum group mineral (PGM) counts
3) Magmatic massive sulphide indicator mineral (MMSIM®) counts
4) Kimberlite indicator mineral (KIM) counts

/2016 File descriptions

2017 Geo Labs Brochure

MRD359_16_0326_IAT_100-QC.pdf

MRD359_CCRMP Till certificate of analysis.pdf

MRD359_2016_1_Sample description.xlsx
Sample number, location and site information including media sampled, bedrock and moraine type. Sample locations are in UTM Easting and Northing (NAD 83, Zone 17N).

MRD359_2016_2_Whole-rock_aqua regia_ICP-MS.xlsx
Mineralized whole-rock lithogeochemistry results for minor and trace elements using an aqua regia digestion and an ICP–MS finish. Information includes sample number, UTM coordinates, trace element levels, lower reporting limit and abbreviations.

MRD359_2016_3_Whole-rock_multi-acid_ICP-AES.xlsx
Whole-rock lithogeochemistry results for trace and minor elements undergoing an open vessel multi-acid digestion and ICP–MS finish. Data includes element levels and units, sample co-ordinates, lower reporting limit and abbreviations used.

MRD359_2016_4_Whole-rock_NiSFA.xlsx
Whole-rock lithogeochemistry results for PGEs and gold analyzed using nickel sulphide fire assay with an ICP–MS finish. Excel sheet contains element levels and units, sample co-ordinates, lower reporting limit and abbreviations used. Note that Rh and Ru values for 2016-HS-5008A and 2016-HS-5008C could not be determined because of elevated Cu values.

MRD359_2016_5_Whole-rock_C&S%.xlsx
Total C and S levels in whole-rock sample, expressed as carbon dioxide and sulphur dioxide percentages, their respective sample number and co-ordinates and abbreviations.

MRD359_2016_6_Whole-rock_LOI%.xlsx
Total loss on ignition (LOI) results for whole-rock samples determined using X-ray fluorescence. The spreadsheet contains LOI weight percent, sample number and co-ordinates and abbreviations.

MRD359_2016_7_B-C-horizon_aqua regia_ICP-MS.xlsx
B- and C-horizon geochemical results for aqua regia digestion, ICP–MS finish.

MRD359_2016_8_B-C-horizon_aqua regia_ICP-AES.xlsx.
B- and C-horizon geochemical results for aqua regia digestion, ICP–AES finish. Excel sheet lists the code for method used, lower reporting limit, units for each element and abbreviations used.

MRD359_2016_9_B-C-horizon_aqua regia_ICP-MS_mineralized till.xlsx
Additional trace element results for B- and C-horizon, with elevated levels of Ag, Co, Cu, Ni, Pb and Zn (see method code IML-101, GeoLabs brochure).

MRD359_2016_10_B-C-horizon_NiSFA.xlsx.
B- and C-horizon geochemical results for NiS FA, ICP–MS finish. Code for method used, lower reporting limit, units for each element, and abbreviations used.

MRD359_2016_11_B-C-horizon_INAA.xlsx
B- and C-horizon geochemical results for INAA. Code for method used, lower reporting limit, units for each element, and abbreviations used.

MRD359_2016_12_B-C-horizon_LOI.xlsx
Total loss on ignition (LOI) results for B- and C-horizon samples determined by X-ray fluorescence. The spreadsheet contains LOI weight percent, sample number and co-ordinates and abbreviations.

MRD359_2016_13_B-C-horizon_C&S%.xlsx
Total C and S levels in B- and C-horizon tills, expressed as carbon dioxide and sulphur dioxide percentages, their respective sample number and co-ordinates and abbreviations.

MRD359_2016_14_B-C-horizon_PSA.xlsx
Particle size analysis results for B- and C-horizon samples.

MRD359_2016_15_HMC sample locations.xlsx
Bulk till sample (collected for HMC separation) numbers and their respective location co-ordinates.

MRD359_2016_16_HMC tabling data.xlsx
Tabling information including weight of sample received, tabling weight and matrix characteristics.

MRD359_2016_17_gold grain summary.xlsx
Summary of gold grains recovered during HMC panning phase and includes information on gold grain morphology and parts per billion (ppb) equivalents.

MRD359_2016_18_detailed gold grain & panned concentrate data.xlsx
Detailed panned gold grains, sperrylite and sulphide mineral data, including gold grain measurements.

MRD359_2016_19_PGM data.xlsx
Total and picked number of panned (<0.25 mm) and picked (0.25-2.0 mm) sperrylite grains.

MRD359_2016_20_HMC processing weights.xlsx
This spreadsheet tabulates the weights of grain fractions processed at each stage of indicator mineral separation, starting with received bulk weight.

MRD359_2016_21_HMC KIM counts.xlsx
Summary of KIM data for minerals picked in 0.25-0.50 mm, 0.50-1.0 mm and 1.0-2.0 mm fractions.

MRD359_2016_22_HMC KIM remarks.xlsx
This spreadsheet contains remarks noted while processing KIM counts.

MRD359_2016_23_paramagnetic separation.xlsx
Grains in 0.25-0.50 mm fraction that were separated for indicator mineral picking using paramagnetic separation.

MRD359_2016_24_MMSIM(R)_counts and remarks.xlsx
Summary of MMSIM® counts (and remarks) for minerals in 0.25-0.50 mm, 0.50-1.0 mm and 1.0-2.0 mm fractions.