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Miscellaneous Release—Data 386

Geochemical and Geochronological Data from the Elliot Lake Group and Hough Lake Group of the Huronian Supergroup, Southern Province, Northeastern Ontario

by J.A. Ménard[1]

This publication can be downloaded from
http://www.geologyontario.mndm.gov.on.ca/mndmaccess/mndm_dir.asp?type=pub&id=MRD386

This digital data release consists of geochronology data, field photographs, scanning-electron microscope (SEM) images and whole-rock geochemical data collected as part of a Huronian Supergroup provenance study of the Sudbury area (Project NE-17-005). Sampling occurred in July and August 2016 and in July 2017, with analytical data acquired between October 2016 and May 2018. This thesis study complements 1:20 000 scale bedrock geological mapping conducted in Denison and Drury townships by the Ontario Geological Survey. Location data are provided in the Universal Transverse Mercator (UTM) projection and grid system, Zone 17, North American Datum 1983 (NAD83). This release comprises 51 photographs (as *.jpg* files), 215 backscattered scanning electron microscope images (as *.jpg* files), 2 Microsoft® Excel® for Office 365 (*.xlsx*) files and 7 documents, including 2 presentations, in portable document format (*.pdf*).

Data are organized into 4 folders, 1 of which has 2 subfolders:

1. Geochemistry
2. Geochronology
3. Photographs
   - MRD386_Field Photographs
   - MRD386_SEM Images (with 7 subfolders)
4. Presentations and Publication

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1. Geochemistry. This folder contains 1 Microsoft® Excel® for Office 365 (*.xlsx*) file and 2 portable document format (*.pdf*) files.

MRD386_Huronian Supergroup_Geochemistry.xlsx consists of 1 worksheet that contains the results of whole-rock major and trace element geochemical analyses acquired from samples collected as part of this study. The geochemical analyses were performed at the Ontario Geological Survey Geoscience Laboratories (Geo Labs) in Sudbury. The methods used, lower detection limit for each method, and reported units for each method are included for each analyte listed. The methods are described in more detail in the accompanying files "*2016 Geo Labs Brochure.pdf*" and "*2017 Geo Labs Brochure.pdf*". This worksheet also contains location data ("Easting", "Northing" and "Township"), "Rock Type", "Stratigraphic Unit" and "Rock Description" for each sample collected; UTM co-ordinates are provided in NAD83, Zone 17.

2016 Geo Labs Brochure.pdf describes the analytical methods used by the Ontario Geological Survey Geoscience Laboratories for rock analyzed during 2016.

2017 Geo Labs Brochure.pdf describes the analytical methods used by the Ontario Geological Survey Geoscience Laboratories for rock analyzed during 2017.

2. Geochronology. This folder contains 1 Microsoft® Excel® for Office 365 (*.xlsx*) file.

MRD386_Huronian Supergroup_Geochronology.xlsx consists of 3 worksheets.

"Provenance Data" worksheet provides U/Pb laser ablation inductively coupled plasma mass spectrometry (LA-ICP–MS) data of single-spot analyses of individual zircon grains. These data were collected at the Jack Satterly Geochronology Laboratory at the University of Toronto as part of the Ontario Geological Survey geochronology contract. Also included for each sample are concordia and/or probably distribution plots for each of the 6 rock samples analyzed. Analytical methods used in the studied are summarized in Ménard (2019, p.7-10).

"Reproducibility Data" worksheet provides U/Pb laser ablation inductively coupled plasma mass spectrometry (LA-ICP–MS) data for repeat analyses of single grains that were conducted on a subset of the samples reported in the worksheet "Provenance Data".

"GPS Sample Locations" worksheet provides the GPS co-ordinates of all the samples collected as part of the project including those not selected for U/Pb detrital zircon analysis. It also includes a regional sample location figure from Ménard (2017c).

3. Photographs. This folder contains 8 subfolders with 266 photographs (as *.jpg* files) and 1 portable document format *(.pdf*) file with photo captions.

"**MRD386_Field Photographs**" subfolder contains 51 selected photos (as *.jpg* images) taken during 2016 and 2017 in the study area. The photo file names are based on the following custom: beginning with the year (16 or 17), followed by the initials of the geologist (JAM or CG), followed by the location-based station number (002) and ending with the image number, for example 17JAM-0005-23. Descriptions of each photograph are provided in the *MRD351_Perth_Field Photo Captions* document.

MRD386_Huronian Supergroup_Field Photo Captions.pdf provides descriptions and location information for the photographs taken in 2016 and 2017. Station location information is provided in UTM co-ordinates, NAD83, Zone 17.

"**MRD386_SEM Images**" subfolder contains 215 photos (as *.jpg* images) and is subdivided into 7 subfolders: "Annotated_M160927B", "Annotated_M160927C", "Annotated_M180123", "Annotated_M180129A", "Annotated_M180129B", "Mounts" and "Zircon Redate".

The 5 "***Annotated_***" subfolders provides annotated backscattered electron (BSE) images indicating the location of the U/Pb LA-ICP–MS analysis point (*see* data in worksheet "Provenance Data" in workbook "*MRD386_Huronian Supergroup_Geochronology*" in folder "Geochronology"). The number beginning with M following "Annotated_" represents the identification number of the zircon mount, for example Annotated_M160927B. Image number in the "Annotated_" subfolders is sample number, followed by grain number, for example 16CG106 grain 1-3 BSE or 16CG106 grain 110-113.

"***Mounts***" subfolder provides images (as *.jpg* files) of the labelled mounts, in addition to images of the picked populations of zircons for each sample.

"***Zircon Redate***" subfolder provides annotated BSE images of the zircons analyzed to ensure the reproducibility of the U/Pb data (*see* data in worksheet "Reproducibility Data" in workbook "*MRD386_Huronian Supergroup_Geochronology*" in folder "Geochronology").

4. Presentations and Publication. This folder contains 3 portable document format (*.pdf*) files for 2 presentations and 1 preliminary report.

MRD386_CTG-2018_presentation_Huronian_Ménard.pdf is an oral presentation, titled "Sedimentary Provenance of the Elliot Lake and Hough Lake Groups, Huronian Supergroup, Sudbury Area", presented by the author at the Canadian Tectonics Group Conference in Saints-Martyrs-Canadiens, Québec in September 2018. It focusses on the sedimentary provenance aspects of the data collected during the project. Ménard (2018) is the abstract related to this presentation.

MRD386_GAC-MAC-2017_presentation_Huronian_Ménard.pdf is an oral presentation, titled "Sedimentary Provenance of the Matinenda and Ramsay Lake Formations in Drury Township using Laser Ablation Detrital Zircon Analysis", presented at the Geological Association of Canada—Mineralogical Association of Canada Annual Meeting in Kingston, Ontario, on May 17, 2017. The presentation focusses on the sedimentary provenance of the samples and an unusually young population of 2590–2480 million-year-old zircons. Ménard (2017b) is the abstract related to this presentation.

MRD386_SoFW2017-17_Huronian_Ménard.pdf is an article (Ménard 2017c), published in the Ontario Geological Survey *Summary of Field Work and Other Activities, 2017* volume. It outlines the objectives of the project as initially designed and presents preliminary results from Ménard (2017a, 2017b).

Summary of Project

Preliminary results of the project were reported by Ménard (2017a, 2017b, 2017c, 2018) and Ménard et al. (2019). Full project results can be found in Ménard (2019).

This project (NE-17-005) examined detrital zircon populations from the Matinenda and McKim formations of the Elliot Lake Group and the Ramsay Lake and Mississagi formations of the Hough Lake Group of the Huronian Supergroup near Sudbury, Ontario. The detrital zircons were analyzed using U/Pb laser ablation inductively coupled plasma mass spectrometry (LA-ICP–MS) at the Jack Satterly Geochronology Laboratory at the University of Toronto. Full methods are provided in Ménard (2019, p.7-10).

Uranium-lead (U/Pb) geochronology of zircon by LA-ICP–MS was selected because it is a widely used tool that permits rapid analysis of many zircon and of multiple points on individual zircons. The Huronian Supergroup is a transitional rift to passive margin sedimentary sequence of siliciclastic rocks deposited between 2450 and 2220 Ma. The 6 samples studied were collected at varying distances from the Sudbury Igneous Complex. Interpretation of the data from a provenance perspective can be found in Ménard (2017c, 2018, 2019).

A sample of the Ramsay Lake Formation, collected 4.4 km away from the outer edge of the Sudbury Igneous Complex, and described by Ménard (2017a, 2017c), contains an anomalously young detrital zircon population at 2590 to 2480 Ma (n=13/49). This age range is very uncommon in the source material of the lower Huronian Supergroup. These zircons were reanalyzed to verify the reproducibility of their ages and to determine whether these ages are crystallization ages of a source material for the lower Huronian Supergroup. Individual grains from this population were reanalyzed with 2 to 12 data points analyzed per zircon. Backscatter electron (BSE) images of the grains did not show any evidence of planar deformation features that would be definitive evidence for shock metamorphism or differential growth events which could cause single grains to contain different age domains. The U/Pb ages for these grains could not be reproduced and had elevated discordance, errors and mean square weighted deviation (MSWD) values, consistent with Pb-loss. Some grains appear to have been partially reset by the Sudbury impact event, because discordant analyses trend along a discordia line with the impact

event at 1850 Ma. Therefore, the previously identified 2590 to 2480 Ma population of grains represent Pb-loss ages between their original crystallization ages (unknown) and the Sudbury impact event at 1850 Ma. These results imply that deformation related to the Sudbury impact event has had a stronger affect on the grains of this population, which have suffered more Pb mobility, leading to false young $^{207}Pb/^{206}Pb$ ages (cf. Andersen, Elburg and Magwaza 2019). However, only a fraction of the zircons collected from this sample have suffered an increase in Pb mobility. This observation indicates that distance from the impact is not the sole factor affecting the reaction of individual zircon to shock metamorphism.

Overall, shock metamorphism can affect the U/Pb data of zircon that do not show any obvious signs of shock metamorphism. Lead mobility within the zircon during and after the impact event can cause the U/Pb data to falsely record an anomalously young $^{207}Pb/^{206}Pb$ age.

References

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