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Miscellaneous Release—Data 379

Geological and Geochemical Data from the Terrace Bay Pluton, Western Schreiber–Hemlo Greenstone Belt, Wawa–Abitibi Terrane, Superior Province, Northwestern Ontario

by K.A. Arnold[1], P. Hollings[1], S.J. Magnus[2]

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This publication can be downloaded from
http://www.geologyontario.mndm.gov.on.ca/mndmaccess/mndm_dir.asp?type=pub&id=MRD379

This digital data release includes field notes and geochemical data collected as part of the Terrace Bay pluton mapping project (Project NW-16-003). The Terrace Bay pluton is located in Syine, Strey and Priske townships, within the western portion of the Schreiber–Hemlo greenstone belt, in the Wawa–Abitibi Terrane of the Superior Province. The Terrace Bay pluton mapping project was supported by an Ontario Geological Survey–Lakehead University Mapping School agreement; these data are part of an unpublished Master of Science (MSc) thesis (Arnold 2019). This release comprises 2 Microsoft® Excel® for Office 365 (*.xlsx*) workbook files and 3 documents in portable document format (*.pdf*).

The data and interpretation presented in this publication represent part of an unpublished MSc thesis by the lead author at Lakehead University. Analytical support was provided by the Ontario Geological Survey (Project NW-16-003). Analytical methods are described in detail in the 2 Geoscience Laboratories (GeoLabs) brochures, which are included on this release as *.pdf* files.

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Contents

There are 5 files provided in this release:

MRD379_Readme — this document

MRD379_FieldData.xlsx contains 7 worksheets labelled "Station", "Intrusive", "Sample", "Structure", "Alteration", "Mineralization" and "Photo". The workbook file in this folder contains raw data collected while working in the field during the summers of 2016 and 2017 using a customized ESRI® ArcPad® application on a portable computer (Trimble® Juno™ SB Handheld). The original files have been edited (to remove abbreviations and spelling errors) and abridged; in particular, blank columns have been removed from the original files. Some columns, such as Mineralization Identifier and Rock Type Identifier, have been retained in the workbooks to facilitate the import of these files into either ESRI® ArcGIS® or database software.

"Station" worksheet provides a brief description of each station visited, including descriptions of the observed outcrops, as well as the date of each visit and the geographic co-ordinates for each station (in UTM co-ordinates using North American Datum 1983 (NAD83) in Zone 16).

"Intrusive" worksheet contains a description of each outcrop that was classified as an intrusive rock, regardless of whether it was metamorphosed or not.

"Sample" worksheet contains a brief description of the analysis performed on each rock sample collected in the field, along with the purpose (based on rock type) for collecting each sample.

"Structure" worksheet contains any planar, linear and curvilinear (folded) structural features, including the classification, orientation and a brief description for each feature. Abbreviations in this worksheet correspond to those listed in Jackson, Muir and Romkey (1995, 2010).

"Alteration" worksheet provides descriptions of and structural and/or alteration features observed at a station.

"Mineralization" worksheet provides descriptions of and structural and/or mineralization features observed at 4 stations.

"Photo" worksheet contains a brief description of each site in the field where photographs were taken. Note: photos have not been included in this MRD. Please see Arnold (2019) or contact the lead author (Arnold) to obtain copies of the photos.

MRD379_Geochemistry.xlsx consists of 2 worksheets that contain the results of whole-rock geochemical analyses performed at the Geoscience Laboratories (GeoLabs), Ontario Geological Survey, Sudbury. The samples are split into 2 worksheets, "2016 samples" and "2017 samples" according to which year the samples were analyzed, because the analytes reported by GeoLabs changed in 2017, particularly the reporting of Loss on Ignition for the XRF-M01 method. The methods used, lower detection limit for each method, and reported units for each method are included for each element (and oxide) listed. These worksheets also contain location data "Easting" and "Northing", as well as "Rock Type" and stratigraphic information, if known, for each sample collected; UTM co-ordinates are provided in North American Datum 1983 (NAD83), Zone 16.

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

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

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Summary of Project

Preliminary results of the project were reported by Magnus and Arnold (2016) and Arnold, Hollings and Magnus (2017). Full project results can be found in Arnold (2019). This summary is based on the abstract found in Arnold (2019).

The Terrace Bay pluton, also known as the Terrace Bay batholith, is a 25 km long, oval-shaped granitoid intrusion located in the western portion of the Schreiber–Hemlo greenstone belt, part of the larger Wawa–Abitibi Terrane. The pluton was emplaced at 2689±1.1 Ma and intrudes metavolcanic rocks, *circa* 2720 Ma in age, of the Schreiber assemblage. The purpose of this study was to classify the Terrace Bay pluton petrographically and geochemically in order to investigate the petrogenesis and tectonic setting in which the pluton formed, and to characterize the association with gold and base metal mineralization.

Detailed mapping of the pluton can separate the pluton into 3 mineralogically distinct lithologies: 1) granodiorite (typically consisting of medium- to coarse-grained quartz and feldspar phenocrysts with a groundmass of fine-grained amphibole, biotite, disseminated magnetite, and sulphide minerals); 2) a monzogranite (composed of medium-grained quartz and feldspar with increased amounts of potassium feldspar and amphibole relative to the granodiorite) and 3) a diorite (composed of medium-grained amphibole and plagioclase with little to no quartz or potassium feldspar present). Two types of hydrothermal alteration are present in the pluton: a chlorite-epidote and a pervasive hematite alteration. These are present across the pluton, and always in proximity to cross-cutting regional-scale faults or shears; however, no association was found between gold mineralization and regional structures.

Whole-rock geochemical analyses were undertaken on 148 samples from the Terrace Bay pluton. Geochemically, the pluton is a homogenous calc-alkalic pluton, with minimal geochemical change between lithologies. The pluton exhibits trace element signatures that are characteristically arc-related signatures: fractionated heavy rare earth elements, negative high field strength element anomalies, enrichment of Th over light rare earth elements and enrichment of light rare earth elements. The fractionated heavy rare earth elements and the Th-Nb-La systematics are consistent with formation in a subduction zone at depths where garnet is stable. The Sr/Y and La/Yb signatures support formation within the garnet stability field and suggest small amount of slab-derived melt incorporated into the mantle wedge. The isotopic signature suggests that the pluton underwent minimal crustal contamination as shown by the depleted primitive mantle ε_{Nd} values ranging from +2.16 to +2.49.

The emplacement of the pluton was determined to be through multiple injections in the intrusion from a single source. The pluton underwent prolonged fractional crystallization, creating subtle mineralogical lithologies with no geochemical differences. The homogeneous nature of the pluton suggests it is unlikely that there were numerous pulses because these would result in more variation across the pluton.

Rhenium-osmium isotope data were obtained on molybdenite to obtain an age of mineralization for the pluton, yielding a value of 2671±12 Ma. The molybdenum mineralization is spatially associated with gold mineralization in the pluton, suggesting that they were deposited from the same hydrothermal event. As is common in Archean cratons, this age of mineralization is syn- to post- both D_2 and regional metamorphism, as well as postdating the emplacement of the pluton. The gold and molybdenum mineralization in the pluton is generally disseminated throughout with local occurrences hosted in quartz veins. Although these exhibit elevated gold and molybdenum values, there is no distinct mineralization style characterized with gold deposits. These features can be explained by the magmatic vapor-dispersed system theory which suggests that when a pluton is emplaced at depth, the aqueous phase will remain dispersed throughout the pluton instead of concentrating in economic amounts.

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References

Arnold, K.A. 2019. Geology and geochemistry of the Terrace Bay batholith, N. Ontario; unpublished MSc thesis, Lakehead University, Thunder Bay, Ontario, 235p. [thesis can be downloaded from https://knowledgecommons.lakeheadu.ca/handle/2453/4542 (last accessed December 17, 2019)]

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