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**GEOLOGICAL SURVEY OF CANADA
OPEN FILE 8983**

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hosted gold mineralization in the Geraldton area,
northwestern Ontario**

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2023

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Table of Contents

| | |
|--------------------------|---|
| Foreword/Context | 1 |
| Summary | 1 |
| Analytical Methods | 1 |
| References | 3 |

Whole-rock lithogeochemistry of the banded iron formation-hosted gold mineralization in the Geraldton area, northwestern Ontario

Foreword/Context

The Targeted Geoscience Initiative 4 (TGI-4) was a five-year (2010-2015) research program by Natural Resources Canada to conduct collaborative, multidisciplinary, thematic, and knowledge-driven ore systems studies aimed at assisting in the discovery of future resources through more effective targeting of buried mineral deposits in Canada's established and emerging mining camps.

Seven of Canada's major ore systems were studied through TGI-4, including a major project on lode gold deposits. The TGI-4 Lode Gold project, which comprised numerous site-specific and thematic research activities, covered the entire spectrum of crustal settings for lode gold deposits, from orogenic banded iron formation-hosted and greenstone-hosted quartz carbonate vein-type gold deposits formed deep in the crust (>5 km), to intrusion-related deposits that are formed at shallower crustal levels (~2–5 km), and to deposits formed at or near the seafloor. The main findings of the Lode Gold project are summarized in Dubé et al. (2015, and references therein). The banded iron formation-hosted gold mineralization in the Geraldton area research activity contributed to the banded iron formation-hosted gold deposits sub-project and led to several publications to date and a graduate thesis of the first author (Tóth, 2018).

Summary

This report releases 235 analysis runs of whole-rock geochemical and assay results of 235 samples/subsamples from the Archean banded iron formation-hosted gold mineralization in the Geraldton area, eastern Wabigoon subprovince, northwestern Ontario. The samples were collected during the 2012, 2013, 2014 and 2016 field seasons as part of a PhD study by the senior author (Tóth, 2018) at Laurentian University in Sudbury. Geochemical analyses were funded in part by the GSC for the 2012, 2013 samples, while analyses of the 2014 and 2016 samples were graciously paid by the second author, Bruno Lafrance and Greenstone Gold Mines, respectively. The geochemical data is presented in a format easily importable in a geographic information system (GIS). Samples were collected from drill core and outcrops to document host units, the alteration halo, and the mineralized zones. Preliminary interpretations about the auriferous mineralization and its geological setting are presented in Lafrance et al. (2012) and in Tóth et al. (2013a, 2013b, 2014, 2015a, 2015b). The final interpretation of the geological setting of the gold mineralization was published in Tóth and others (2022, 2023). Sample information and geochemical results are presented in Appendices 1 and 2 (worksheet "Results"), respectively. The results worksheet combines 5 reports produced between 2012 and 2016.

Analytical Methods

Part of the whole-rock analyses were performed at Activation Laboratories Ltd. in Ancaster, Ontario, using a combination of their standard preparation and analytical packages, the details of which can be found at <https://actlabs.com/geochemistry/lithochem-and-whole-rock-analysis>. Methods and detection limits are reported for oxides and elements in Appendix 2-worksheet "DetectionLimit" while method abbreviations appear in *italic* below.

Samples were initially dried (60°C) and crushed to at least 90% (<2mm) in a steel jaw crusher. A mechanically split fraction was pulverized in a chromium-free steel mill until 95% of the sample material passed through a 74 µm mesh. Major elements were determined by lithium metaborate-tetraborate fusion followed by inductively coupled plasma mass spectrometry (ICP-MS; *FUS-MS*). Trace and rare earth elements were determined by a combination of lithium metaborate-tetraborate, and total digestion (four acids) followed by inductively coupled plasma mass spectrometry (ICP-MS; *FUS-MS*) and inductively coupled plasma atomic emission spectrometry (ICP-OES; *FUS-ICP*). FeO was determined by titration using a cold acid digestion (ammonium metavanadate and hydrofluoric acid) in an open system (*TITR*).

For chalcophile elements a four-acid digestion ICP-MS (*TD-MS*) method was preferred. Aqua regia (*AR-MS*) digestion coupled with ICP-MS was chosen to analyze As, Sb, Bi, Se and Te.

Boron was determined by gamma neutron activation analysis (*PGNAA*).

Gold and silver were measured by a combination of atomic absorption (*FA-AA*), fire assay, and gravimetry (*FA-GRAV*). High-grade ore zone samples were re-analyzed with a combination of fire assay and gravimetric methods for gold and silver (*FA-GRAV*) and aqua regia dissolution (*ICP-OES*) or sodium peroxide fusion (*FUS-Na2O2*) with ICP-OES depending on the analyte.

CO₂ and Total (S) were determined by combustion infrared analysis (*IR*).

Fluorine was determined by lithium metaborate and tetraborate fusion and fluoride ion electrode analysis (*FUS-ISE*). Chlorine was determined by instrumental neutron activation analysis (*INAA*). Mercury was determined by cold vapour flow injection (*FIMS*) following aqua regia digestion.

Actlabs reports LOI, LOI2, Total and Total 2. LOI is determined by weighing a small amount of the sample before and after ignition. However, because FeO was measured, it was possible to adjust LOI to take into account the weight gain resulting from oxidation of FeO to Fe₂O₃. This adjusted value of LOI is LOI2. Total1 is the total of all major oxides using Fe₂O₃(T) and LOI, whereas Total2 includes LOI2.

Seventeen samples were analyzed at the Geoscience Laboratories of the Ministry of Northern Developments and Mines in Sudbury, Ontario, using their routine sample preparation and standard analytical packages. The specific details of the analytical packages can be accessed at https://www.geologyontario.mndm.gov.on.ca/mines/ogs/geo_labs/ndmnr-2022-geo-labs-brochure-en-2022-03-29.pdf. Methods and detection limits are reported for oxides and elements in Appendix 2-worksheet “DetectionLimit” while method abbreviations appear in *italic* below.

Dry samples were crushed in a small steel-plated jaw crusher and pulverized in an agate mill to pass through a 88 µm mesh (*SAM-AGM*). Major elements and some trace elements (Co, Cu, Ni, V, Zn) were determined by fusion X-ray fluorescent spectrometry (XRF; *XRF-M01 and XRF-M02*). Forty-five trace elements were determined using inductively coupled plasma mass spectrometry (ICP-MS) following closed vessel four-acid digestion (IMC-100). This method is the preferred analytical method to determine the concentration of rare-earth elements, high field strength elements and large ion lithophile elements.

Fifty-two elements were determined using inductively coupled plasma mass spectrometry (ICP-MS) following aqua regia dissolution (*IML-100*). This method is preferred to analyze Bi, Te, Se, Au, Ag and As concentrations.

The total carbon and sulphur concentrations were determined by combustion-infrared LECO method (*IRC-100*; Amirault and Burnham, 2013).

Loss on ignition (LOI) reported among the major oxide analyses are determined by heating the sample at 105°C under nitrogen atmosphere and heating at 1000 °C under oxygen atmosphere. The Total is calculated as the sum of all the major oxides and the LOI.

Quality assurance and quality control (QA/QC)

The Geo Labs maintains a management system registered to ISO 9001:2015 and select test methods are accredited to ISO/IEC 17025:2017. Activation Laboratories internal QA/QC system under ISO 17025 or ISO 9001:2008 accreditation, quality control materials (certified standards and duplicates and Blanks).

All laboratory quality control materials are reported in Appendix 2 in worksheets “Lab_Standards”, “Lab_Duplicates” and “Lab_Blanks”. In addition to these laboratory quality control measures, blind internal standards were also included to monitor analytical reliability.

Precision estimated from internal standards and duplicates are within 2 standard deviation (2σ) of the mean standard value. Limitations include insufficient material for analysis of some standards. Blank sample analyses show minimal contamination between samples except in blank analysis for V_TD_ICPMS_ppm, Cr_TD_ICPMS_ppm, Mn_TD_ICPMS_ppm and Hg_TD_ICPMS_ppm in certificate A16-09057, and CO₂_IR_% in certificate A13-14689

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