Newfoundland Labrador

Natural Resources

Mines

GEOCHEMICAL DATA FROM THE ARCHEAN ASHUANIPI COMPLEX, WESTERN LABRADOR
(NTS MAP SHEETS 23J/02, 03, 04, 05, 06, 07, 10, 11 AND 14)

T.S. van Nostrand

Open File 023J/0396

St. John's
Newfoundland and Labrador
December, 2017

NOTE

DISCLAIMER

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GEOLOGICAL SURVEY
NEWFOUNDLAND AND LABRADOR
1864

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SUMMARY

This Open File release consists of whole-rock geochemistry of 112 samples collected from new mineral indications and previously known (MODS) occurrences in the Archean Ashuanipi Complex of western Labrador. The occurrences are located on NTS map sheets 23J/02, 03, 04, 05, 06, 07, 10, 11 and 14 and were sampled during a regional bedrock-mapping project of the region carried out in 2013, 2015 and 2016 (Figure 1; van Nostrand and Bradford, 2014; van Nostrand *et al.*, 2016; van Nostrand and Broughm, 2017). Geochemical analyses are reported for 90 samples of paragneiss, oxide-facies iron formation, gabbro, diorite, pyroxenite, tonalite gneiss, diatexite, granite, pegmatite and quartz veins that host indications of sulphide mineralization. Analyses are also reported for 22 samples of quartz syenite to alkali feldspar granite pegmatite, diatexite and late granite that recorded anomalous radioactive signatures with scintillometers. Several assays from sulphide-bearing samples indicate elevated gold (Au), silver (Ag), arsenic (As), copper (Cu), lead (Pb), zinc (Zn) and molybdenum (Mo). Assays from anomalous radioactive samples indicate elevated thorium (Th), uranium (U), zirconium (Zr) and rare-earth element (REE) contents. Previous studies have shown that the region is known to have potential to host gold and base-metal mineralization (Thomas and Butler, 1987; McConnell *et al.*, 1989; van Nostrand and Bradford, 2014).

NOTES ON DATABASE

This database includes the results of major-, trace-, and rare-earth element analyses of selected samples of mineralized and anomalous radioactive rocks. The location for each sample is referenced in Universal Transverse Mercator (UTM) eastings and northings (Zone 19, NAD 27). Complete whole-rock geochemical data (major-element oxides, trace elements and rare-earth elements) are presented in Appendix A as a digital data file available in comma-separated values (csv) format. A link to this file is provided in the Appendices listing below.

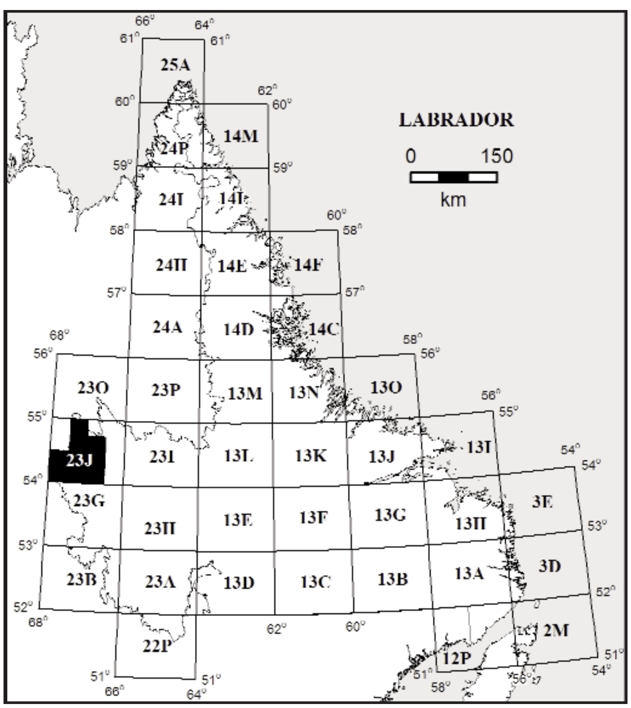

Figure 1. *Location of study area in western Labrador.*

Most analyses were performed at the Geological Survey of Newfoundland and Labrador (GSNL) laboratory in St. John's; these were supplemented by a Neutron Activation Analyses package (BQ-NAA-1) for selected trace elements, carried out externally at the commercial Maxxam Laboratories (former Becquerel Laboratories, *see* details of the analytical procedures at http://maxxam.ca/services/radioactivity-testing-trace-element-analysis/neutron-activation-analysis-trace-element). The major elements plus Cr, Zr and Ba are listed first in the database. Neutron activation analyses are listed second and all other analyses (ICP-OES_4ACID, ICP-MS_FUS, and Ag and F analyses) are listed third and organized alphabetically by element code. The major elements and Cr, Zr and Ba were determined by Inductively Coupled Plasma-Optical Emission Spectrometry following a lithium tetraborate and metaborate fusion (ICP-OES_FUS). Titanium (Ti) was analyzed by ICP-OES_4ACID method for some 13VNXXX samples. Where the oxidation state was determined by titration, iron is presented as FeO and Fe_2O_3, otherwise as Fe_2O_3T (total). Select trace elements were determined by Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES_4ACID) following a four-acid (HF-HCL-HNO_3-$HClO_4$) total digestion. Other trace elements were determined by Inductively Coupled Plasma-Mass Spectrometry following a lithium tetraborate and metaborate fusion (ICP-MS_FUS). At the GSNL laboratory, beryllium (Be), scandium (Sc), cadmium (Cd), vanadium (V) and cobalt (Co) were analyzed by ICP-MS_FUS or ICP-OES_4ACID methods depending on the year the analyses were performed. The 'Analytical Methods' line, in the digital databases, indicates which method was used for each column of data in the Appendices. Silver was analyzed by ICP-OES following a nitric acid digestion (ICP-OES_HNO_3). Fluorine was analyzed by ion selective electrode (ISE) method following a sodium carbonate and potassium nitrate fusion. Volatiles are reported as loss on ignition (LOI) determined through gravimetric methods. Gain-on-ignition (GOI) indicates a net increase in weight and is represented by the code value '-1'. The analytical methods are listed in Table 1 and further details are outlined in Finch (1998).

Major elements are reported in weight percent (wt. %), and minor and trace elements are reported in parts per million (ppm), except gold (Au), reported in parts per billion (ppb). Detection limits are listed for each element in Appendices A, B, C, D, E, F and G. Note that '-99' reported for a given element indicates that it was not analyzed for the sample, whereas all other negative numbers indicate the concentration of the specific element in the sample was below the detection limit (*e.g.*, -2 indicates the measured value was below the detection limit of 2). Note that for BQ-NAA-1 analyses, some samples have elevated detection limits due to high concentrations of Sb, Br or As and some Se detection limits are elevated due to interference from Ta.

The release also includes data for several standards completed at the GSNL and Maxxam laboratories (Appendices B, C, D, E, F and G). These may be used to assess accuracy and were analyzed at a frequency of one to 20. For ICP-OES (major element, Ag) and ICP-MS (trace element) standards were supplied by the Canadian Certified References Materials Project (CH-2, SU-1A) and the United States Geological Survey (AGV-1, BHVO-1, MAG-1, RGM-1, and W-2). Two standards were used for ICP-OES (trace element) analyses, supplied by the Canadian Certified References Materials Project (SY-4, WGB-1). The latter standard WGB-1 was also used for BQ-NAA-1 analyses at Maxxam. Duplicate analyses (labelled as sample xxx-DUP, *e.g.*, 16VN315A04-DUP) of selected samples are also included in Appendices B, C, D, E, F and G and these can be used to assess precision. Analytical duplicates were inserted at a frequency of one in 20, with the duplicate selected at random. A link to these files, provided as digital csv-formated files, are provided in the Appendices list below.

Table 1. Analytical methods for geochemical analyses

Analysis	Method	Preparation/Digestion
SiO_2, Al_2O_3, Fe_2O_3, MgO, CaO, Na_2O, K_2O, TiO_2, MnO, P_2O_5, Cr, Zr, Ba, Be*, Sc*	Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES_FUS)	50-50 Lithium Tetraborate Lithium Metaborate Fusion
As, Be*, Cd*, Co*, Cu, Li, Mn, Ni, Pb, Rb, Sc*, Ti, V*, Zn	Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES_4ACID)	Hf-HCl-HNO_3-$HC1O_4$ (total digestion)
Bi, Cd*, Ce, Co*, Cs, Dy, Er, Eu, Ga, Gd, Ge, Hf, Ho, La, Lu, Mo, Nb, Nd, Pr, Sm, Sn, Sr, Ta, Tb, Th, Tl, Tm, U, V*, W, Y, Yb	Inductively Coupled Plasma-Mass Spectrometry (ICP-MS_FUS)	50-50 Lithium Tetraborate Lithium Metaborate Fusion
As, Au, Ba, Br, Ce, Cs, Cr, Co, Eu, Hf, Fe, La, Lu, Mo, Rb, Sb, Sc, Se, Sm, Na, Ta, Tb, Th, U, W, Yb, Zr	Neutron Activation (Maxxam Laboratory (BQ-NAA-1)	Irradiation
Ag	Inductively Coupled Optical-Emission Spectrometry (ICP-OES_HNO_3)	HNO_3 digestion
F	Ion Selective Electrode (ISE)	Na_2CO_3 and KNO_3 fusion
LOI (Loss on ignition)	Gravimetric (Grav) at 1000°C	None

* Elements are analyzed with this method depending on year of analyses at the GSNL laboratory. *See* Appendix A for type of analyses method used for these elements.

ABBREVIATIONS USED IN THE DATABASE

The mineralization observed in each analyzed sample is listed in order of relative abundance in Appendix A with the following abbreviations: ga – galena; pyr – pyrite; cpy – chalcopyrite; bo – bornite; po – pyrrhotite; apy – arsenopyrite; mo – molybdenite; all – allanite; mz – monazite; mt – magnetite; sm – semi-massive; tr – trace.

Geochemical analyses abbreviations: -99 – element not analyzed; LOI – loss on ignition; GOI – gain on ignition; DUP – duplicate sample analysis.

DISCUSSION

The assessment of the mineral potential of the northern part of the Ashuanipi Complex in western Labrador and adjacent areas of Québec has focused primarily on gold and base-metal potential associated with paragneiss and associated iron formation rocks and to a lesser extent with gabbro, pyroxenite, tonalite gneiss and diatexite (Thomas and Butler, 1987; McConnell *et al.*, 1989). During regional bedrock mapping several new sulphide-bearing indications having elevated Au, Ag, Cu, Ni, Pb and Zn hosted in these and other rocks were discovered. This suggests that further targeted exploration for gold, base metal, and in the case of mafic and ultramafic rocks, platinum-group-element mineralization, is warranted throughout the region. In addition, the examination of granite to alkali feldspar granite pegmatite, garnet-rich diatexite and granite plutons in the region indicates that anomalous Th, U, Zr and rare-earth element values are associated with these rocks and may suggest a new mineral exploration target in the Ashuanipi Complex.

Most of the Ashuanipi Complex in Labrador is underexplored and vast areas remain untested for their mineral potential, particularly in parts near the Québec–Labrador border but also in the vicinity of known occurrences in the more accessible eastern areas. Surveys to date indicate the presence of known occurrences having elevated gold and base-metal contents, numerous new sulphide-bearing indications and anomalous Th, U, Zr and rare-earth element contents. These results indicate that additional, systematic gold, base-metal, platinum group element, U, Th and rare-earth element exploration is required to realize the mineral potential of the Ashuanipi Complex in Labrador.

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APPENDICES

APPENDIX A: Field Data and Major- and Trace-element Geochemistry
The data are available as a digital comma-separated file (.csv) through this link.

NOTE: The following files (Appendices B to G) will be released in the near future.

APPENDIX B: Major-element Standards and Duplicates by ICP-OES (Fusion)
The data are available as a digital comma-separated file (.csv) through this link:

http://www.nr.gov.nl.ca/nr/mines/geoscience/publications/openfiles/OF_023J_0396/OF_023J_0396_AppendixB.csv

APPENDIX C: Trace-element Standards and Duplicates by INAA
The data are available as a digital comma-separated file (.csv) through this link:

http://www.nr.gov.nl.ca/nr/mines/geoscience/publications/openfiles/OF_023J_0396/OF_023J_0396_AppendixC.csv

APPENDIX D: Trace-element Standards and Duplicates by ICP-OES (4 Acid)
The data are available as a digital comma-separated file (.csv) through this link:

http://www.nr.gov.nl.ca/nr/mines/geoscience/publications/openfiles/OF_023J_0396/OF_023J_0396_AppendixD.csv

APPENDIX E: Trace-element Standards and Duplicates by ICP-MS (Fusion)
The data are available as a digital comma-separated file (.csv) through this link:

http://www.nr.gov.nl.ca/nr/mines/geoscience/publications/openfiles/OF_023J_0396/OF_023J_0396_AppendixE.csv

APPENDIX F: Silver Standards and Duplicates by ICP-OES (HNO_3)
The data are available as a digital comma-separated file (.csv) through this link:

http://www.nr.gov.nl.ca/nr/mines/geoscience/publications/openfiles/OF_023J_0396/OF_023J_0396_AppendixF.csv

APPENDIX G: Fluorine Standards and Duplicates by ISE
The data are available as a digital comma-separated file (.csv) through this link:

http://www.nr.gov.nl.ca/nr/mines/geoscience/publications/openfiles/OF_023J_0396/OF_023J_0396_AppendixG.csv