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GEOCHEMICAL DATA FROM THE GLOVER ISLAND AND GRAND LAKE AREAS, WESTERN NEWFOUNDLAND (NTS MAP AREAS 12A/12, 13 AND 12H/03)

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CONTENTS

FIGURE

TABLES

SUMMARY

This open file includes lithogeochemical data collected on drillcore and outcrop samples from the Glover Island and Grand Lake areas in western Newfoundland (NTS map areas 12A/12, 13 and 12H/03). These samples were collected in 2019 and 2021 as part of a multi-year project investigating the geology and mineral potential of the Glover Island and Grand Lake areas; additional geochemical data from this project were previously published in Conliffe (2021a, 2023). The geological context of samples and a description of the regional geology are contained in Conliffe (2021b, 2022); additional publications are expected in the coming years.

Whole-rock geochemistry results are included for 183 samples, including 118 outcrop samples, 8 samples of massive to semi-massive sulphide boulders, and 57 drillcore samples. Drillcore samples were collected from historical drillcore located at the Government of Newfoundland and Labrador Core Storage facilities in Pasadena, Springdale and Baie Verte.

NOTES ON THE DATABASE

This database includes the results of whole-rock major-element, trace-element and rare-earth-element (REE) analyses of 183 samples. Also included are the sample-location data and brief sample descriptions. The location data for samples are presented in Appendix A, with locations reported as Universal Transverse Mercator (UTM) eastings and northings (zone 21, NAD27). The data are available in digital format (*i.e.*, *.csv comma-separated values files) in Appendices A to C.

All samples selected for geochemical analysis were prepared at the Geological Survey of Newfoundland and Labrador's (GSNL) Geochemical Laboratory in St. John's. Samples were milled using ceramic mills. Most analyses were carried out at the GSNL geochemical laboratory and analytical methods are described in Finch *et al.* (2018) and summarized in Table 1. Additional analyses (for trace elements including Au, Hg, Pd and Pt) of selected samples were conducted by Bureau Veritas and Actlabs.

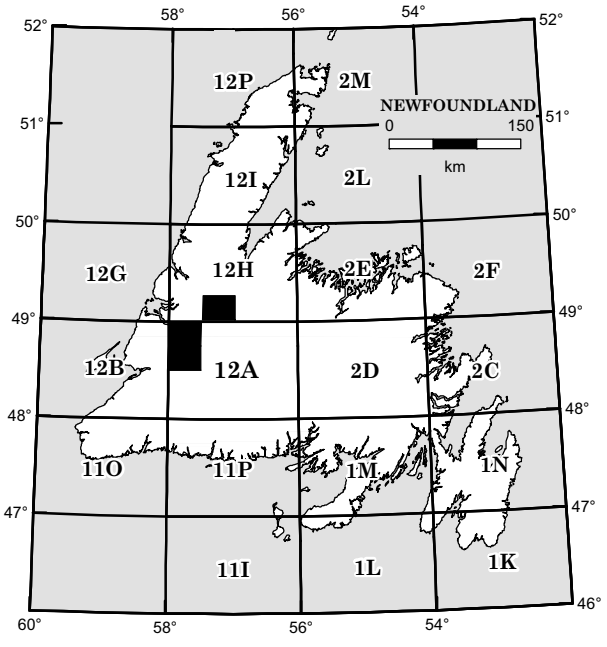

Figure 1. *Location map of study area in western Newfoundland.*

Major-element compositions (plus Ba, Be, Cr, Sc and Zr) were analyzed by ICP-OES methods, following lithium tetraborate and metaborate fusion. REE and selected trace elements were determined by ICP-MS analysis following an identical sample digestion procedure, whereas other trace elements (As, Cd, Co, Cu, Li, Mo, Ni, Pb, Rb, S, V and Zn) were analysed by ICP-OES after 4-acid total digestion. Volatiles are represented as loss-on-ignition (LOI) at 1000°C, which represents

Table 1. Analytical methods for geochemical analyses

Element	Analytical Method	Preparation/Digestion
SiO_2, Al_2O_3, Fe_2O_3T, MgO, CaO, Na_2O, K_2O, TiO_2, MnO, P_2O_5, Ba, Be, Cr, Sc, Zr	ICP-OES	50-50 Lithium Tetraborate Lithium Metaborate Fusion
FeO	Titration	None
Fe_2O_3	Calculation	None
LOI	Gravimetric at 1000°C	None
As, Cd, Co, Cu, Li, Mo, Ni, Pb, Rb, S, V, Zn	ICP-OES	HF-HCl-HNO_3-$HClO_4$ (4-acid total digestion)
Bi, Ce, Cs, Dy, Er, Eu, Ga, Gd, Ge, Hf, Ho, La, Lu, Nb, Nd, Pr, Sm, Sn, Sr, Ta, Tb, Th, Tl, Tm, U, W, Y, Yb	ICP-MS	50-50 Lithium Tetraborate Lithium Metaborate Fusion
As, Au, Ba, Br, Ce, Co, Cr, Cs, Eu, Fe, Hf, La, Lu, Mo, Na, Rb, Sb, Sc, Se, Sm, Ta, Tb, Th, U, W, Yb, Zr	INAA	Irradiation
Au, Pd, Pt	FA-MS	Ag doré bead
Ag	ICP-OES	HNO_3 digestion
Hg	CV-AAS	*Aqua regia*

the breakdown of all minerals and release of all volatiles. The ferrous-iron content (FeO) of silicate rocks is determined by the Wilson Method (Wilson, 1960), as outlined by Finch *et al.* (2018). For silver analysis, 0.5 g of sample powder was weighed into a 15 ml digestion tube with 2 ml of concentrated nitric acid, and digested for two hours. The digested sample was analyzed by ICP-OES (Finch *et al.*, 2018). Seventeen samples were sent for Hg analysis, which was conducted by Actlabs using the *aqua regia* leach and Cold Vapour Atomic Absorption Spectrophotometry (CV-AAS).

Pd, Pt and Au contents were analyzed for two samples at Actlabs using the following protocol (*see* also Hoffman *et al.*, 1998; Hoffman and Dunn, 2002). A sample size of 5 to 50 g can be used but the routine size is 30 g for rock pulps, soils or sediments (exploration samples). The sample is mixed with fire assay fluxes (borax, soda ash, silica, litharge) and with Ag added as a collector and the mixture is placed in a fire clay crucible. The mixture is then preheated to 850°C, intermediate 950°C and finish 1060°C with the entire fusion process lasting 60 minutes. The crucibles are

Table 2. List of abbreviations

Abbreviation	Explanation
-99	Samples not analyzed for that element
%_difference	Percent difference between original and duplicate
Avg	Average value
CV-AAS	Cold Vapour-Atomic Absorption Spectrophotometry
FA-MS	Fire Assay Mass Spectrometry
ICP-OES-4-ACID	Inductively Coupled Plasma-Optical Emission Spectrometry following HF-HCl-HNO_3-$HClO_4$ acid digestion
ICP-OES-FUS	Inductively Coupled Plasma-Optical Emission Spectrometry following lithium metaborate/tetraborate fusion
ICP-OES-HNO_3	Inductively Coupled Plasma-Optical Emission Spectrometry following nitric acid digestion
ICP-MS-FUS	Inductively Coupled Plasma-Mass Spectrometry following lithium metaborate/tetraborate fusion
INAA	Instrumental Neutron Activation Analysis
LCL	Lower control limit
LOI	Loss-on-ignition
negative detection limit	Below detection limit
ppb	Parts per billion
ppm	Parts per million
Rec_Val	Recommended value
UCL	Upper control limit
wt_pct	Weight percent

then removed from the assay furnace and the molten slag (lighter material) is carefully poured from the crucible into a mould, leaving a lead button at the base of the mould. The lead button is then placed in a preheated cupel which absorbs the lead when cupelled at 950°C to recover the Ag (doré bead) + Au, Pt and Pd. The Ag doré bead is digested in hot (95°C) HNO_3 + HCl. After cooling for 2 hours the sample solution is analyzed for Au, Pt, Pd by ICP-MS. On each tray of 42 samples there are two method blanks, three sample duplicates and 2 certified reference materials.

Thirty-two samples were also selected for analyses for trace elements including Au, Cd, Sb and As. These were conducted by Maxxam Analytics (now Bureau Veritas) using Instrumental Neutron Activation Analysis (INAA), and results are presented in Appendix A (*see* details of the analytical procedures in Finch *et al.*, 2018). Twenty-one of the 27 elements analyzed by INAA are duplicates of elements analyzed by different methods at the GSNL laboratory. Although the detection limit varies between analytical methods, these data can be used to evaluate inter-laboratory precision. To prevent confusion, duplicate elements that have been analyzed by INAA have been assigned the suffix _INA (*e.g.*, As_INA, Ba_INA, etc.).

Major elements are reported in weight percent (wt. pct), and minor and trace elements are reported in parts per million (ppm), except gold (Au), platinum (Pt) and palladium (Pd), which are

Table 3. Standards used during analysis at GSNL Geohemical Laboratory

Abbreviation	Explanation
AGV-1	Andesite, Lake County, OR (USGS)
BHVO-1	Basalt, Hawaii (USGS)
BIR-1	Basalt, Iceland (USGS)
CH-2	Gold Bearing Sulphide Ore (NRCAN)
G-2	Granite, Bradford RI (USGS)
MAG-1	Gray-brown clayey mud, Gulf of Maine (USGS)
MP-1a	Zinc-Tin-Copper-Lead Ore (NRCAN)
QLO-1	Quartz Latite, Oregon (USGS)
RGM-1	Rhyolite, California (USGS)
SDC-1	Mica Schist, Washington DC (USGS)
STM-1	Peralkaline nepheline syenite, Oregon (USGS)
SY-4	Diorite gneiss, Brudendell Township, ON (NRCAN)
W-2	Diabase, Virginia (USGS)
WGB-1	Gabbro, Wellgreen Complex, YT (NRCAN)

reported in parts per billion (ppb). A negative number indicates the concentration of the specific element in the sample was below the detection limit (*e.g.*, -0.01 indicates the measured value was below the detection limit of 0.01). Some samples analyzed by INAA have elevated detection limits due to high Sb, Br or Au contents. Detection limits are listed for each element in the .csv files.

A selection of reference standards was analyzed at a frequency of one in 20. The raw, unprocessed data from standards that were run during analysis in 2019 and 2021 is included in Appendix B, and these data can be used by the reader to assess accuracy and precision. Analytical duplicates were also inserted at a frequency of one in 20, with the duplicate selected at random. For duplicates the variation between original and duplicate values was calculated in Appendix C using the following equation: %_difference = [(OriginalValue -¬ Lab Split Value)/Original Value] * 100.

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REFERENCES

Conliffe, J.

2021a: Geochemistry and hyperspectral data from gold occurrences in the Glover Island and Grand Lake areas, western Newfoundland. Government of Newfoundland and Labrador,

Department of Industry, Energy and Technology, Geological Survey, Open File 12A/12/1845, 9 pages.

2021b: Structurally controlled orogenic gold mineralization in the Glover Island and Grand Lake area, western Newfoundland. *In* Current Research. Government of Newfoundland and Labrador, Department of Natural Resources, Geological Survey, Report 21-1, pages 1-26.

2022: VMS-style mineralization in the Kettle Pond Formation, Glover Island (NTS map areas NTS 12A/12 and 12A/13). *In* Current Research. Government of Newfoundland and Labrador, Department of Industry, Energy and Technology, Geological Survey, Report 22-1, pages 1-28.

2023: Geochemical data from volcano-sedimentary rocks associated with VMS-style massive sulphide occurrences in the Kettle Pond Formation, Glover Island, western Newfoundland (NTS map areas 12A/12 and 13). Government of Newfoundland and Labrador, Department of Industry, Energy and Technology, Geological Survey Division, Open File 12A/1900, 8 pages.

Finch, C., Roldan, R., Walsh, L., Kelly, J. and Amor S.
2018: Analytical methods for chemical analysis of geological materials. Government of Newfoundland and Labrador, Department of Natural Resources, Geological Survey, Open File NFLD/3316, 67 pages.

Hoffman, E.L., Clark, J.R. and Yeager, J.R.
1998: Gold analysis – fire assaying and alternative methods. Exploration Mining Geology, Volume 7(1/2), pages 155-160.

Hoffman, E.L. and Dunn, B.
2002: Sample Preparation and Bulk Analytical Methods for PGE. *In* The Geology, Geochemistry and Mineral Beneficiation of Platinum Group Elements. *Edited by* L.J. Cabri. CIM Special Volume 54, pages 1-11.

Wilson, A.D.
1960: The micro-determination of ferrous iron in silicate minerals by a volumetric and a colorimetric method. Analyst, Volume 85, Issue 1016, pages 823-827.

APPENDICES

Appendices A–C are included in the OF_NFLD_3444 zip folder as Microsoft Excel (.xlsx) and/or Comma Delimited Value (.csv) files.

APPENDIX A: Major-element and Trace-element Data

APPENDIX B: Major-element and Trace-element Data for Standards

APPENDIX C: Major-element and Trace-element Data for Duplicates