



Natural Resources

Mines

**LITHOGEOCHEMICAL DATABASE FOR  
IGNEOUS ROCKS FROM THE BONAVISTA  
PENINSULA, NORTHEASTERN NEWFOUNDLAND  
(NTS MAP AREAS 2C/05, 06, 11 AND 12SE)**

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**Open File 002C/0245**

**St. John's, Newfoundland  
February, 2020**

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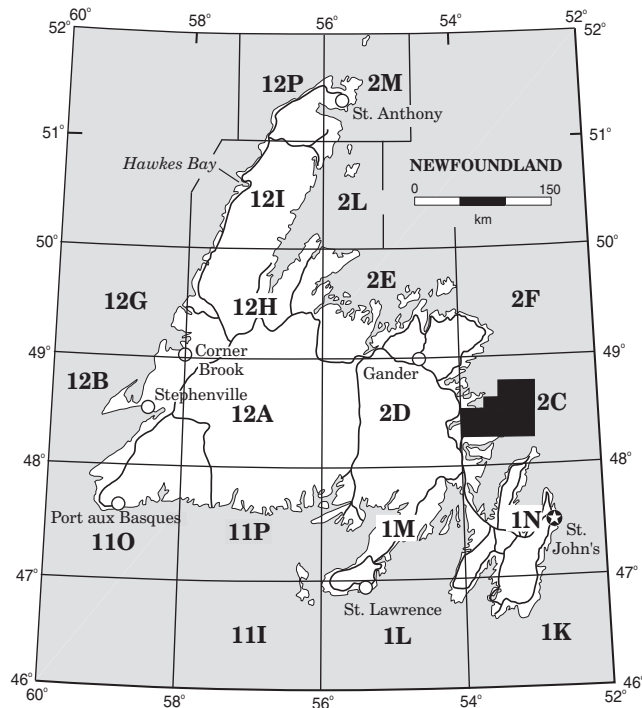
## SUMMARY

This database consists of whole-rock lithochemical data of samples from volcanic (n=90) and intrusive (n=63) rocks collected on the Bonavista Peninsula of northeastern Newfoundland (Figure 1, NTS map areas 2C/05, 06, 11 and the southeast corner of 2C/12) and, owing to the inclusion of additional samples and data, supersedes Open File reports OF\_002C\_0226 and OF\_002C\_0227 (Mills, 2017a, b). The regional geology is discussed in reports by O'Brien (1994), O'Brien and King (2002, 2004, 2005), Normore (2010, 2011), and Mills (2014). The samples were collected from the Bonavista Peninsula by L. Normore (2009, 2010) and A.J. Mills (2013, 2014, 2015, 2017, 2019). Details of the analytical methods used are provided by Finch *et al.* (2018).

This open file data release provides no interpretation of the data. Mills and Sandeman (2015, 2017) discuss preliminary lithochemical results for subsets of mafic volcanic and mafic intrusive rocks, respectively. The database includes brief sample descriptions, location data, thickness, trend and dip of dykes (where known; Right-Hand-Rule convention), petrographic descriptions and photomicrographs as well as major-element and trace-element data. The data are available in digital format (*i.e.*, comma separated value files; \*.csv).

## NOTES ON DATABASE

All location data are presented in Universal Transverse Mercator (UTM), eastings and northings (Zone 22, NAD27) format. These coordinates were collected using a Trimble™ Juno 3B



**Figure 1.** Location map of the study areas.

handheld unit. Samples are prefixed by the year and initials of the geologist who collected them. Appendices A and B contain whole-rock geochemical analytical data of the samples collected, along with four field-duplicate analyses (indicated in the 'Field Notes' column) and laboratory duplicate analyses (Appendix C). In addition, a number of reference materials (Standards) were analyzed for quality assurance (Appendix D). Most data were acquired at the Geological Survey's Geochemical Laboratory (GSNL) in St. John's. A small subset of seven samples was analyzed by Neutron Activation Analysis (INAA) at Becquerel Laboratories (Bec; now Bureau Veritas) in Mississauga, Ontario (Appendix E; analytical standards are in Appendix F). Photomicrographs are included in Appendix G.

Major elements are presented as weight percent of their oxides. The minor-, trace-, and rare-earth elemental abundances are given in ppm, except for Au (ppb), and Fe and Na (analyzed by Neutron Activation Analysis, INAA), which are given in percent (pct). Volatiles are represented as loss-on-ignition (LOI) determined by gravimetric analysis.

Major elements and some trace elements (*e.g.*, Ba, Zr, Cr) were analyzed by inductively coupled plasma-optical emission spectrometry following lithium borate fusion and multi-acid attack (ICP-OES-FUS). Other trace elements, including rare-earth elements (REE), were analyzed by inductively coupled plasma-mass spectrometry following lithium borate fusion and multi-acid attack (ICP-MS-FUS). A small subset of trace elements (As, Be, Co, Cu, Li, Mn, Ni, Pb, Rb, Sc, Ti, V and Zn) were analyzed by inductively coupled plasma-optical emission spectrometry and a four acid digestion (ICP-OES 4 Acid). Silver was determined by inductively coupled plasma-optical emission spectrometry following a nitric acid digestion (ICP-OES-HNO<sub>3</sub>). Fluorine was subjected to sodium carbonate and potassium nitrate fusion prior to Ion Selective Electrode determination (ISE). Further details of analytical procedures are outlined in Finch *et al.* (2018).

Three volcanic and four intrusive rock samples were also analyzed by instrumental neutron activation analysis (INAA) at Becquerel Laboratories (Bec; now Bureau Veritas) in Mississauga, Ontario. The INAA data are captured in separate tables (Appendix E) and pertinent data from Standards are in Appendix F. Basic methods involve bombardment of the samples with neutrons in a nuclear reactor; the elements present are identified and quantified by gamma rays that are emitted during radioactive decay (<https://www.bvlabs.com/markets-services/radiochemistry/radioactivity-testing>).

Data acquisition by ICP-MS commenced in 2012 at the GSNL. Therefore, selected samples collected by L. Normore (09LN, 10LN prefixes) were re-analyzed in 2014 to acquire abundances of select trace elements (Cs, Er, Eu, Ga, Gd, Ge, Hf, Ho, Lu, Nd, Pr, Sm, Sn, Ta, Tb, Th, Tl, Tm, U, W, Yb) for petrogenetic analysis and interpretation. The new analyses are associated with different reference materials than those used for the initial trace-element analyses and this applies only to the list of elements above. The reference materials analyzed when the original data were acquired are cited for elements not included in this list.

Calculations and abbreviations used in the database are described herein for clarity (Table 1). The column 'Cuts' refers to the map unit through which intrusive rocks crosscut; map unit abbreviations are indicated in Table 2.

$$\text{Mg\#} = (\text{MgO}/40.312)/((\text{MgO}/40.312)+(\text{FeO}^{\text{T}}/71.847))*100.$$

Within the Duplicates Table (Appendix C):

$$\%_{\text{difference}} = [(\text{Original Value} - \text{Lab Split Value})/\text{Original Value}] * 100.$$

In the %\_difference rows, BD = Below Detection, and is used where both the original sample value and duplicate value are less than the limit of detection; LOD = Limit of Detection, where

**Table 1.** Code to Map\_Unit in Volcanics database (Appendix A)

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BAF	Bull Arm Formation
BrHr	British Harbour basalts (alkaline; locally <580 Ma)
CPG_Fels	Felsic volcanic rocks of upper Connecting Point Group
DP	Dam Pond basalt (alkaline; <i>see</i> Mills and Sandeman, 2015)
HB	Headland basalt (calc-alkaline; <i>see</i> Mills and Sandeman, 2015)
HB_I	Headland basalt / basaltic andesite
PCvbF	Plate Cove volcanic belt – Felsic volcanic rock
PCvbI	Plate Cove volcanic belt – Intermediate volcanic or pyroclastic rock
PCvbM	Plate Cove volcanic belt – Mafic volcanic rock (transitional – weakly calc-alkaline to tholeiitic; <i>see</i> Mills and Sandeman, 2015)
Peperite	Peperite of the Rocky Harbour Formation (Herring Cove Facies, as described by Normore, 2011)

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**Table 2.** Code to Map\_Units (map unit crosscut by dyke, denoted ‘Cuts’ in Appendix B)

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BHF	Big Head Formation, Musgravetown Group
CPG	Connecting Head Point
MRF	Manuels River Formation, Harcourt Group
RHF	Rocky Harbour Formation, Musgravetown Group
CHF	Crown Hill Formation, Musgravetown Group

---

either the original sample value or the duplicate value (but not both) is less than the limit of detection; -99 = Not Analyzed.

In Appendix 2 (major-element and trace-element geological survey data (intrusive rocks)), in the Field for the trend of a sampled dyke (Column N; Trend), -99 denotes “trend not measured/not measurable”.

A total of 193 photomicrographs are available in digital, zip compressed files in Appendix G. (ppl = plane polar light; xpl = cross polar light).

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## APPENDICES A–G

Appendices A–F are available as digital comma-separated files (.csv) and Appendix G is available as digital images (.jpg) in zip files through [this link](#).

**Appendix A:** Major-element and Trace-element GSNL Data (Volcanic Rocks)

**Appendix B:** Major-element and Trace-element GSNL Data (Intrusive Rocks)

**Appendix C:** Major-element and Trace-element Data for GSNL Duplicates

**Appendix D:** Major-element and Trace-element Data for GSNL Standards

**Appendix E:** Major-element INAA Data – Intrusive

Major-element INAA Data – Volcanic

**Appendix F:** Major-element INAA Standards – Intrusive

Major-element INAA Standards – Volcanic

**Appendix G:** Photomicrographs. The .jpg file names correspond to the names in the TSPPhoto columns in the GSNL data spreadsheets in Appendices A and B.

Intrusive Photomicrographs: plain-polarized light

Intrusive Photomicrographs: cross-polarized light

Volcanic Photomicrographs: plain-polarized light

Volcanic Photomicrographs: cross-polarized light