



**Mines**

**GEOCHEMICAL, PETROGRAPHIC AND ISOTOPIC  
DATA FROM ZINC OCCURRENCES IN THE HARE  
BAY AREA, WESTERN NEWFOUNDLAND  
(NTS MAP SHEETS 02M/12, 12P/01, 08 AND 09)**

**J. Conliffe, R. King and D. Wilton**

**Open File NFLD/3329**

**St. John's  
Newfoundland and Labrador  
April, 2018**

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## SUMMARY

This Open File release consists of geochemical, petrographic and isotopic data from samples in the Hare Bay area of western Newfoundland (NTS map sheets 02M/12, 12P/01, 08 and 09). These samples were collected in the summer of 2016 as part of a study on the geology and geochemistry of zinc occurrences in the Hare Bay area. The data collected formed part of a recently completed B. Sc. (Hons.) thesis by Robert King at Memorial University (King, 2017), and this report presents the geochemical (whole-rock and Electron Probe Micro Analyser (EPMA) geochemistry) and isotopic (S, Pb) data from this thesis, as well as modal mineralogy and images collected from Scanning Electron Microscope–Mineral Liberation Analysis (SEM-MLA) of selected thin sections.

The geological setting of zinc occurrences has been described, in detail, by King and Conliffe (2017) and King (2017), and the data presented in this report have been used by Conliffe *et al.* (2018) to develop a genetic model for the formation of these deposit types. For more information on the regional geological setting, geological characteristics of individual occurrences and the exploration implication of this research, the reader is referred to these publications.

## METHODS

### WHOLE-ROCK GEOCHEMISTRY

All samples selected for geochemical analysis were prepared at the GSNL laboratory in St. John's, and full analytical methods are described in Finch *et al.* (2018). Samples were milled using ceramic mills. To determine precision and accuracy, reference standards and analytical duplicates were inserted at a frequency of one for every twenty samples. Major-element compositions were analyzed by ICP-OES methods, following lithium tetraborate and metaborate fusion. Rare-earth elements and selected trace elements were determined by ICP-MS analysis following an identical sample digestion procedure, whereas the remaining trace elements (As, Be, Cd, Co, Cu, Li, Mn, Ni, Pb, Rb, Sc, V, Zn) were analyzed by ICP-OES after total 4-acid digestion. Assay data for Zn was determined by ICP-OES after fusion by lithium tetraborate and dilution. The loss-on-ignition (LOI) was calculated after heating the sample to 1000°C.

Fluoride content was determined as described by Ficklin (1970). A 250 mg sample with 1 g of flux consisting of two parts by weight  $\text{Na}_2\text{CO}_3$  and one part by weight  $\text{KNO}_3$  was fused and the residue leached with deionized water. The “alkaline fused extract” was neutralized with 10 ml 10% (w/v) citric acid and the resulting solution diluted to 100 ml with water. The fluoride content of the test solution was then measured using a fluoride ion selective electrode on a Mettler Toledo T50 Ion Meter.

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 (C. Finch, personal communication, 2018).

Analytical duplicates were inserted at a frequency of one in 20, with the duplicate selected at random. In addition, a selection of reference standards was analyzed, also at a frequency of one in 20. Standards were supplied by United States Geological Survey (STM-1 and BIR-1). The raw, unprocessed data from duplicates and standards are included in the appendices, and can be used by the reader to assess accuracy and precision. 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). The code -99 indicates the sample was not analyzed for that element.

## **ELECTRON PROBE MICRO ANALYSER**

Eight polished thin sections were carbon-coated prior to analysis of zoned sphalerite crystals with a JEOL JXA-8230 microprobe equipped with a W source and 5 WDS spectrometers at the Department of Earth Sciences, Memorial University. Individual crystals were analyzed using a 20 nA beam at a 20 kV accelerating voltage. The beam was defocused by 5 to 10  $\mu\text{m}$  to prevent break down of sphalerite crystals. A series of synthetic, mineral and metal standards were used (*see* King, 2017 for standards). A correction factor of  $7.71 \times 10^{-4}$  had to be applied to Ga as its peak is beneath S, causing measurement interferences. Cu had a peak beneath Ag, however after calculation there was no need to apply a correction factor. A negative number indicates that the concentration of the specific element in the sample was below the detection limit.

## **BULK SULPHUR ISOTOPE ANALYSIS OF SPHALERITE**

Individual crystals of sphalerite were selected based on petrographic results. Crystals were powdered using a New Wave Research microdrill at Memorial University to gather a bulk sample weighing approximately 0.15 mg. Samples were sent to the University of Ottawa for analysis.

Samples were weighed into tin capsules with at least twice the sample weight of tungstic oxide for inorganic and organic sulphur. Samples were then loaded into a Vario Micro Cube (Elementar, Germany) elemental analyser to be flash combusted at 1800°C. Released gases are carried by helium through the elemental analyser to be cleaned, and then separated. The  $\text{SO}_2$  gas is carried into the Delta XP isotope ratio mass spectrometer (ThermoFinnigan, Germany) *via* a conflo IV interface for  $\delta^{34}\text{S}$  determination. The analytical precision is  $\pm 0.2$  per mil.

## **SECONDARY ION MASS SPECTROMETRY (SIMS) ANALYSIS**

Sulphur isotope ratios of pyrite and galena, and lead isotope ratios of galena were analyzed by Secondary Ion Mass Spectrometry (SIMS) at the MAF-IIC Microanalysis Facility, Memorial University. Epoxy mounted Pb- and Zn-sulphide-bearing rocks were polished and sputter coated with 300 Å of Au before analysis by the Cameca IMS 4f Secondary Ion Mass Spectrometer (*see* King, 2017 for analytical methods).

## **SCANNING ELECTRON MICROSCOPE–MINERAL LIBERATION ANALYSIS (SEM-MLA)**

Four polished thin sections from various deposits and occurrences in the region were carbon coated and analyzed at the SEM-MLA facility in the Micro Analysis Facility-Bruneau Innovation Center (MAF-IIC) at Memorial University.

Samples were scanned using a 10 mA beam current and 25 kV voltage in a high vacuum. The facility consists of a fast Scanning Electron Microscope (SEM) equipped with GX map software (Mineral Liberation Analysis), which generates maps of the polished thin sections as well as Back Scatter Electron (BSE) images. *See* Wilton (2010) for analytical methods.

### **ACKNOWLEDGMENTS**

Gerry Hickey provided critical equipment and support for this project without which it would not have been possible. Former mine geologist Roland Crossley is thanked for providing a tour and information on pits of the Daniels Harbour mine. Prospectors Wayde Guinchard and Peter Rogers are thanked for providing drill samples and extra backs for carrying samples. Thank you to Newfoundland Helicopters for bringing us to several of our field locations and flying reconnaissance flights over other areas of interest as we would not have been able to keep to our schedule otherwise. Chris Moran and his summer students were a great help in finding and carrying core boxes. Whole-rock geochemical analyses were carried out under the supervision of Chris Finch of the GSNL Geochemistry Laboratory. Thanks are also given to the lab staff at Memorial University and the University of Ottawa who helped in data collection, including Wanda Aylward, David Grant, Dylan Goudie, Glenn Piercey and Paul Middlestead.

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APPENDIX A:

SEM-MLA False Colour Maps and BSE Backscatter Images

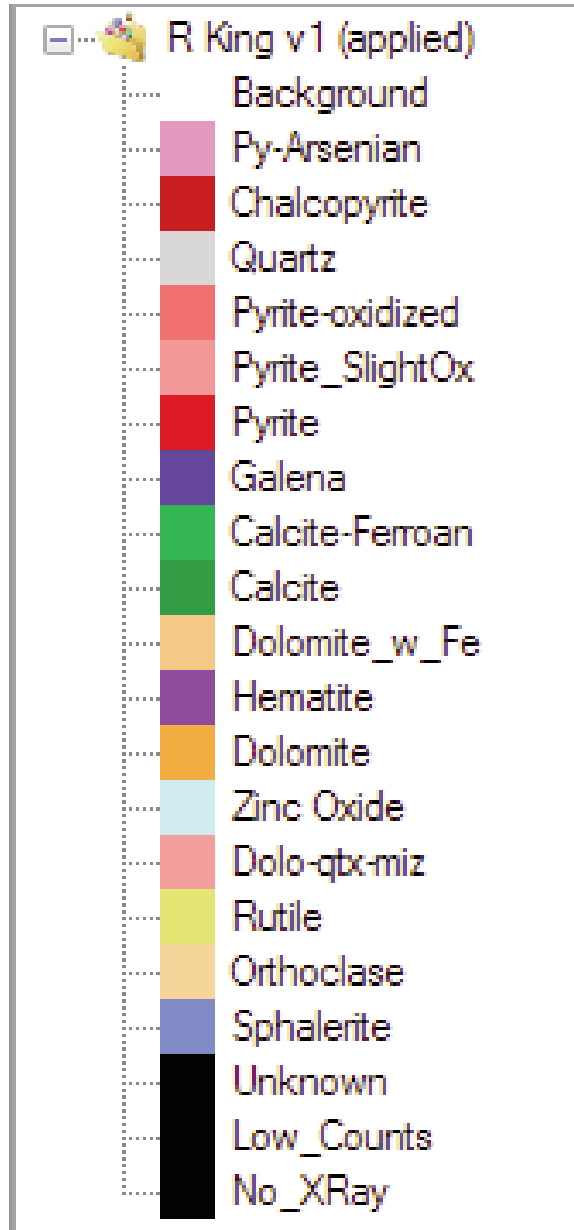
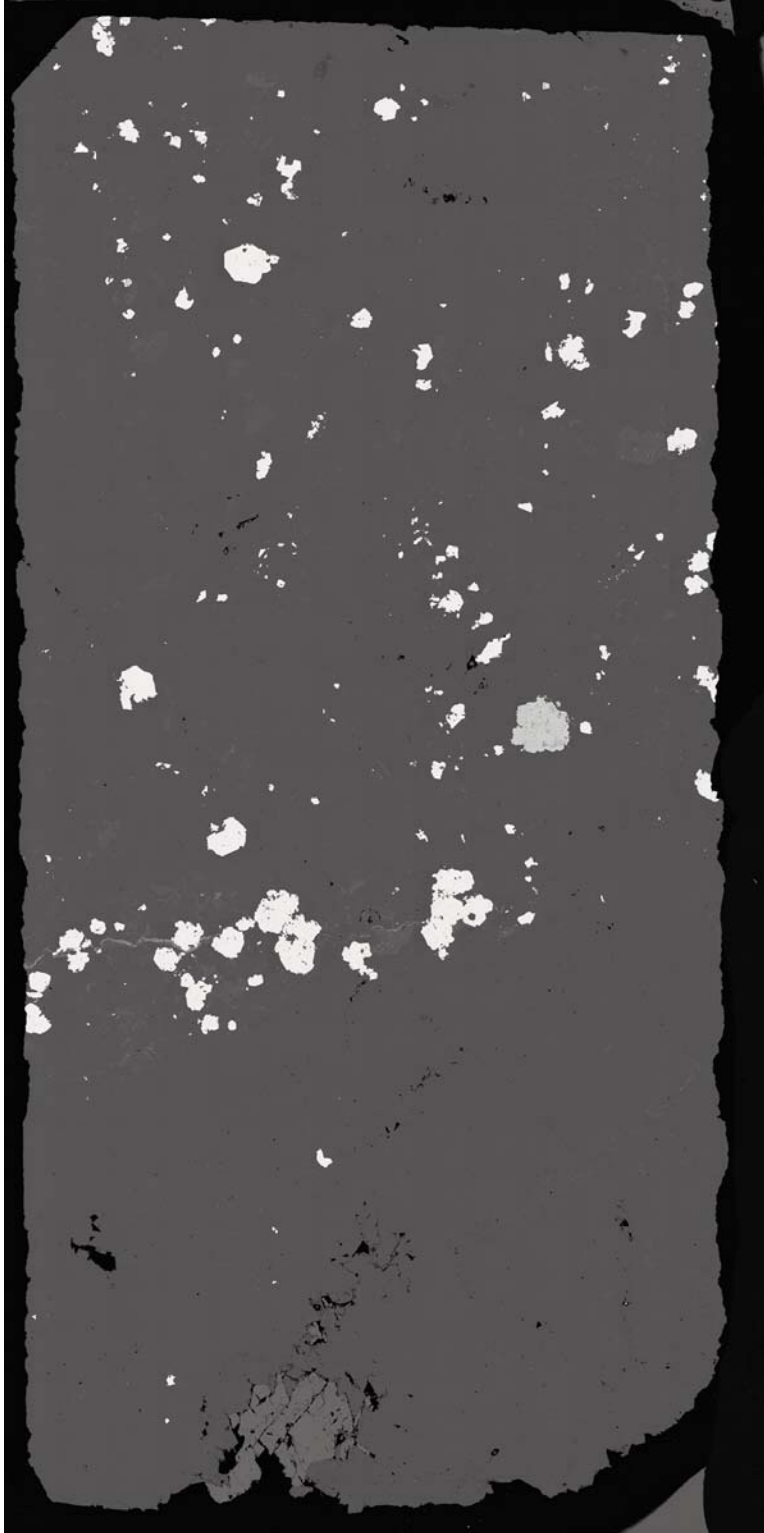


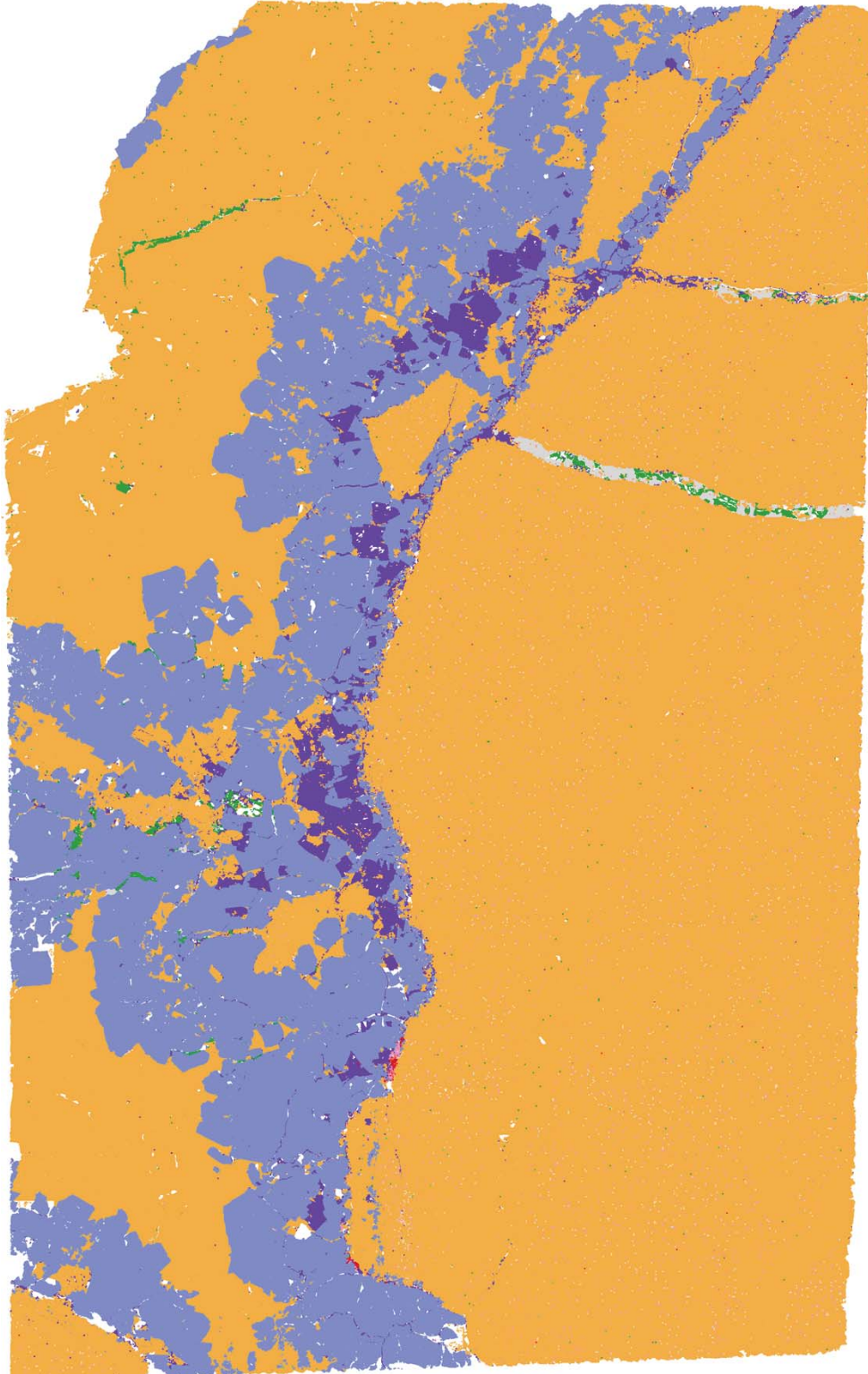
Figure 1. Legend for MLA false colour maps.



**Figure 2.** *MLA false colour map of sample 16JC026A04 (mineralized pseudobreccia from Main Zone Trench at the Round Pond Deposit). Field of view 44 x 20 mm.*

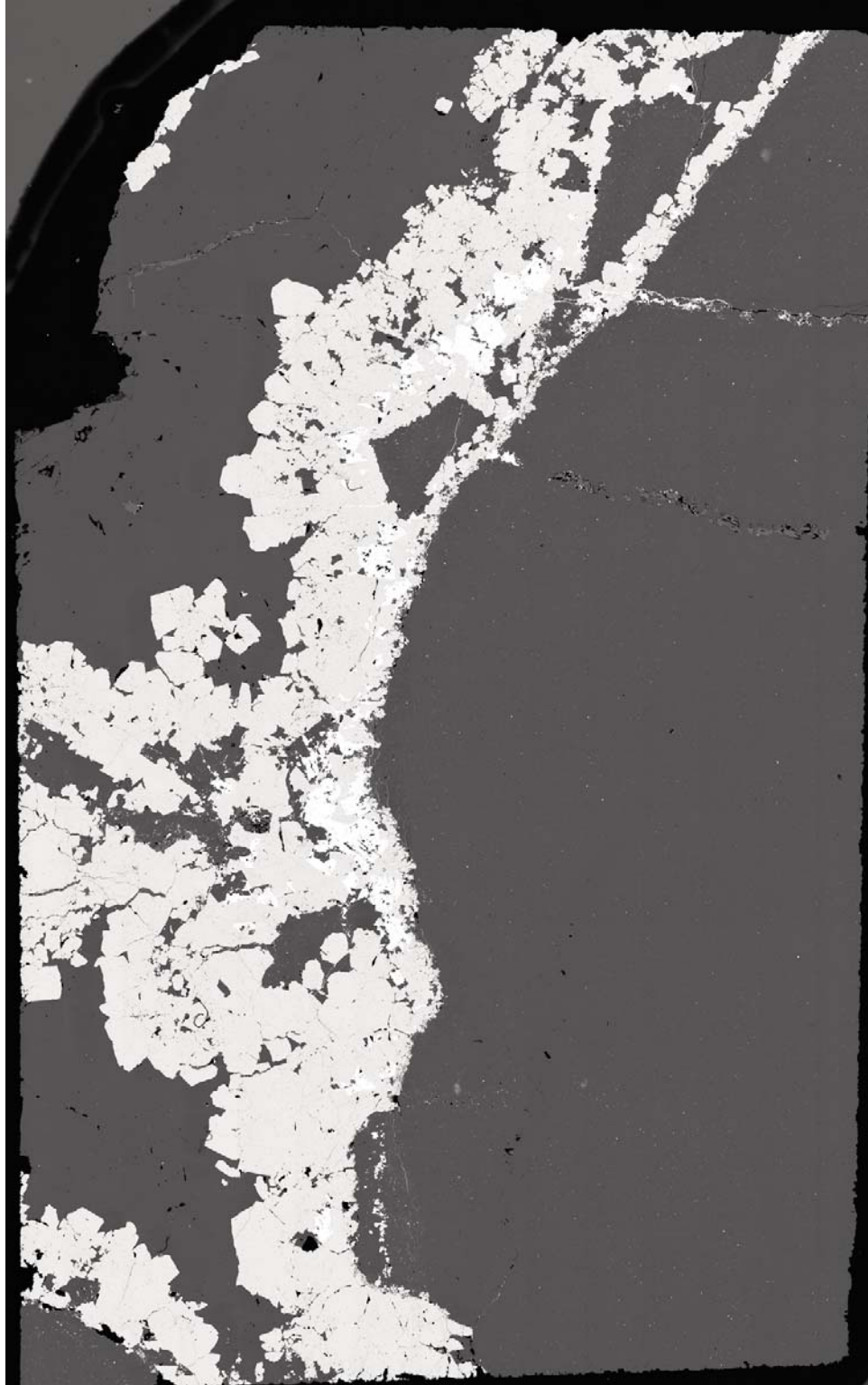


**Figure 3.** Backscatter SEM image of sample 16JC026A04 (mineralized pseudobreccia from Main Zone Trench at the Round Pond Deposit). Field of view 44 x 20 mm.

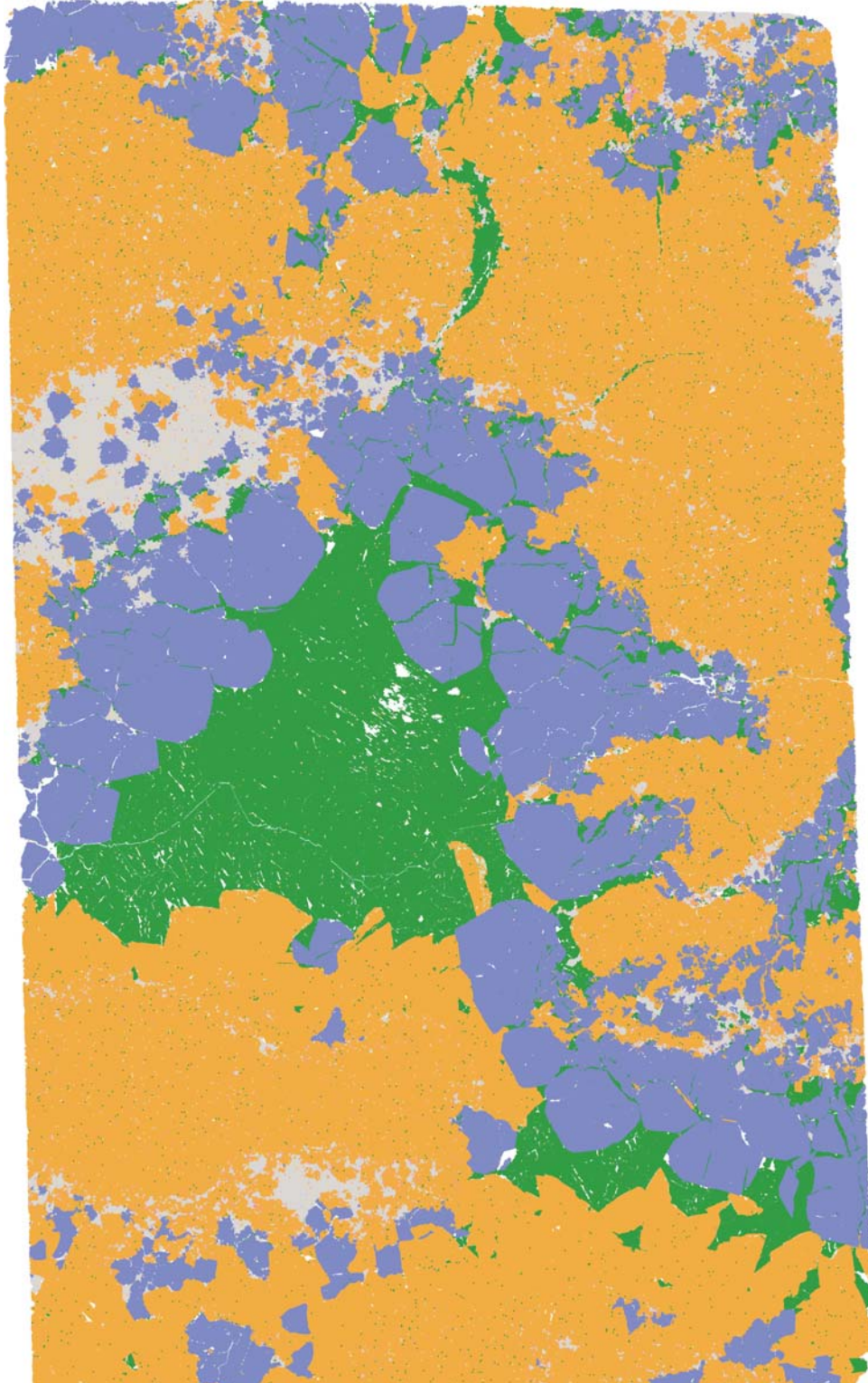


**Figure 4.** *MLA false colour map of sample 16JC027A01 (crackle breccia sample from Main Zone Trench at the Round Pond Deposit). Field of view 34 x 22 mm.*



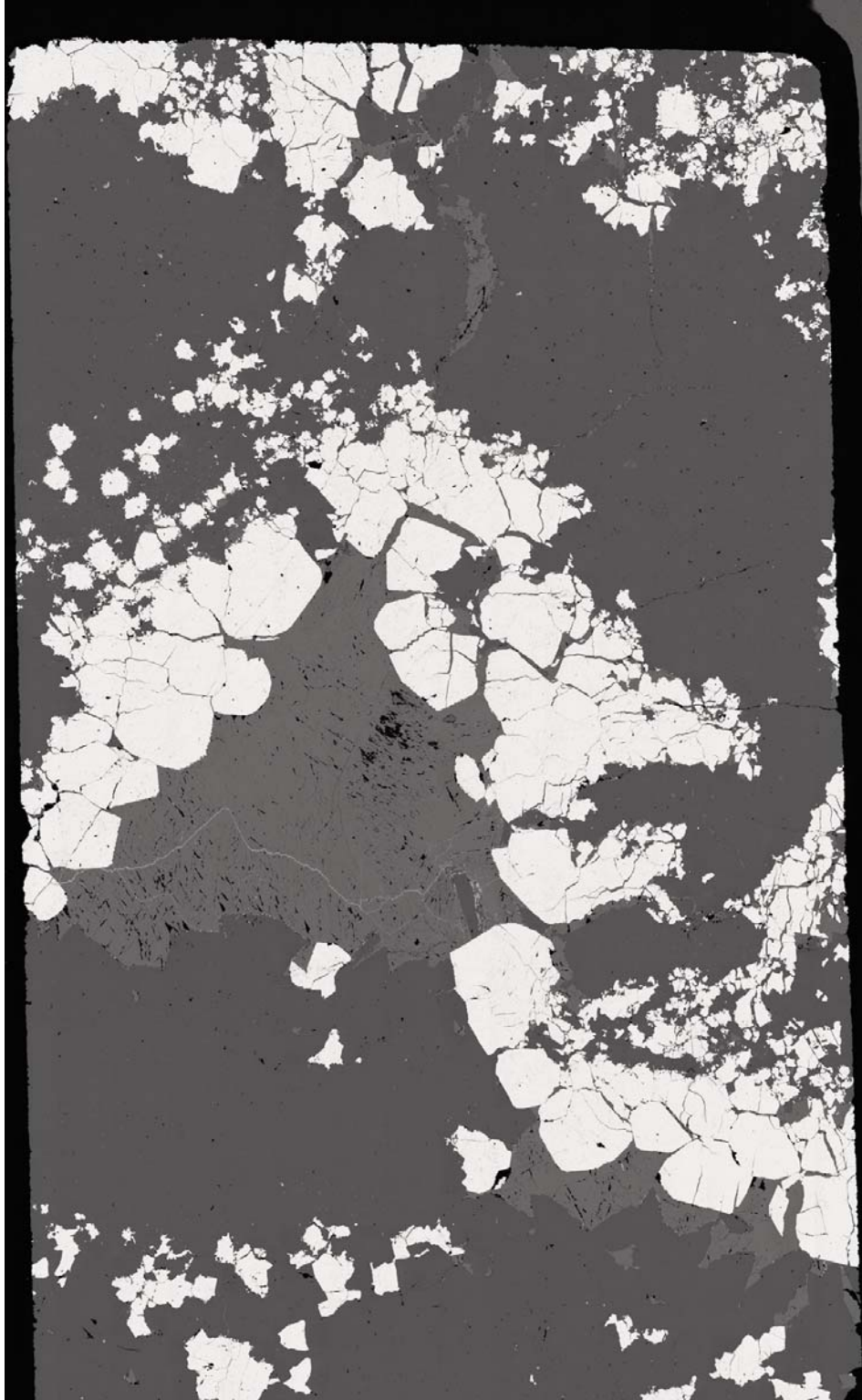


**Figure 5.** Backscatter SEM image of sample 16JC027A01 (crackle breccia sample from Main Zone Trench at the Round Pond Deposit). Field of view 34 x 22 mm.



**Figure 6.** *MLA false colour map of sample 16JC043A01 (mineralized pseudobreccia from Salmon River #6 prospect). Field of view 39 x 22 mm.*



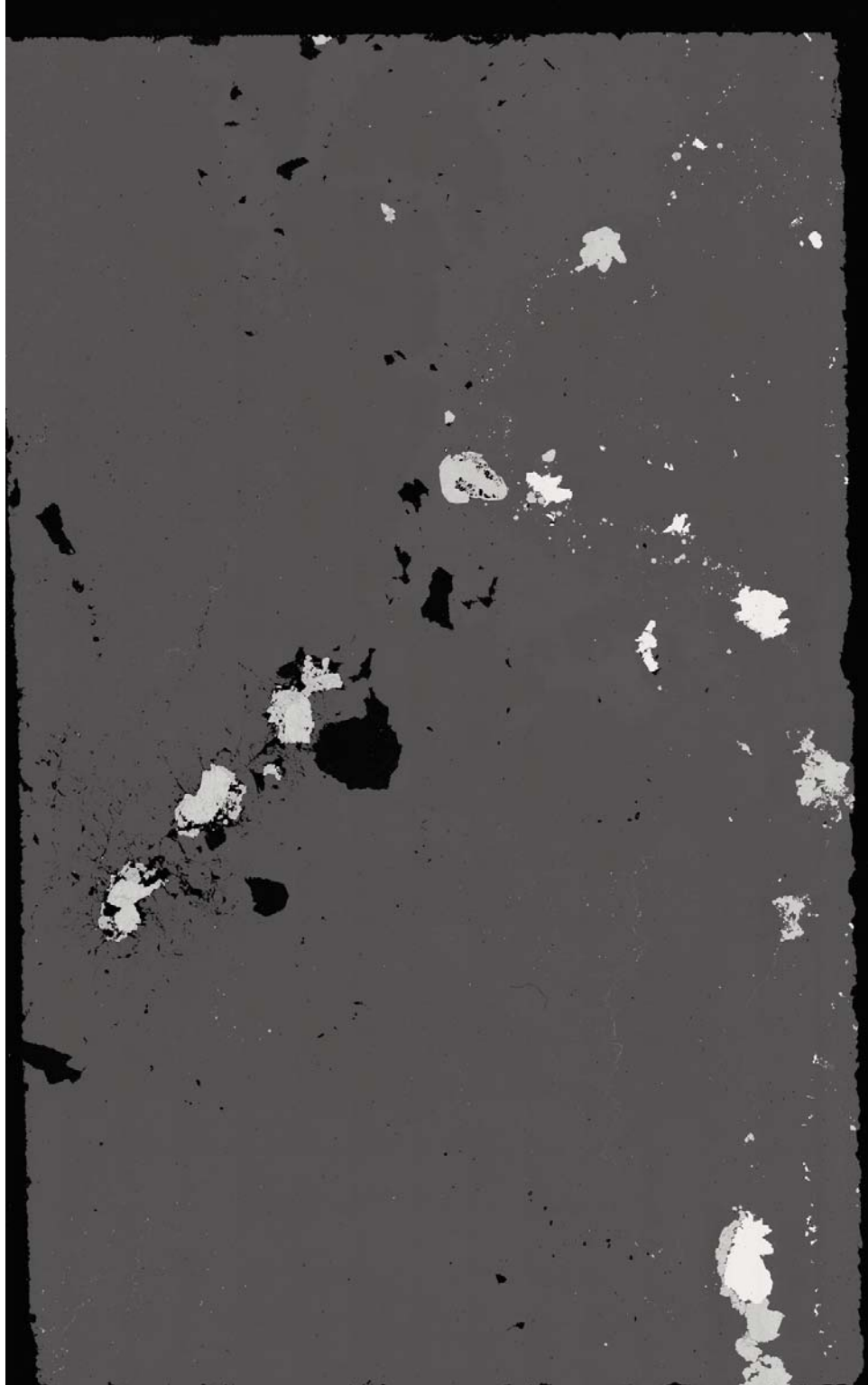


**Figure 7.** Backscatter SEM image of sample 16JC043A01 (mineralized pseudobreccia from Salmon River #6 prospect). Field of view 39 x 22 mm.



**Figure 8.** *MLA false colour map of sample 16JC051A01 (pseudobreccia sample from Salmon River #3 showing). Field of view 35 x 22 mm.*





**Figure 9.** Backscatter SEM image of sample 16JC051A01 (pseudobreccia sample from Salmon River #3 showing). Field of view 35 x 22 mm.

## APPENDICES B to I

### **APPENDIX B: Sample Locations and Descriptions**

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\\_NFLD\\_3329/OF\\_NFLD\\_3329\\_AppendixB.csv](http://www.nr.gov.nl.ca/nr/mines/geoscience/publications/openfiles/OF_NFLD_3329/OF_NFLD_3329_AppendixB.csv)

### **APPENDIX C: Major-element ICP-OES FUS Data (including Standards and Duplicate Samples)**

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\\_NFLD\\_3329/OF\\_NFLD\\_3329\\_AppendixC.csv](http://www.nr.gov.nl.ca/nr/mines/geoscience/publications/openfiles/OF_NFLD_3329/OF_NFLD_3329_AppendixC.csv)

### **APPENDIX D: Trace-element ICP-OES Data (including Standards and Duplicate Samples)**

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\\_NFLD\\_3329/OF\\_NFLD\\_3329\\_AppendixD.csv](http://www.nr.gov.nl.ca/nr/mines/geoscience/publications/openfiles/OF_NFLD_3329/OF_NFLD_3329_AppendixD.csv)

### **APPENDIX E: Trace-element ICP-MS FUS Data (including Standards and Duplicate Samples)**

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\\_NFLD\\_3329/OF\\_NFLD\\_3329\\_AppendixE.csv](http://www.nr.gov.nl.ca/nr/mines/geoscience/publications/openfiles/OF_NFLD_3329/OF_NFLD_3329_AppendixE.csv)

### **APPENDIX F: Electron Probe Micro Analyser Data**

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\\_NFLD\\_3329/OF\\_NFLD\\_3329\\_AppendixF.csv](http://www.nr.gov.nl.ca/nr/mines/geoscience/publications/openfiles/OF_NFLD_3329/OF_NFLD_3329_AppendixF.csv)

### **APPENDIX G: Sulphur Isotope Data (Bulk and SIMS)**

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\\_NFLD\\_3329/OF\\_NFLD\\_3329\\_AppendixG.csv](http://www.nr.gov.nl.ca/nr/mines/geoscience/publications/openfiles/OF_NFLD_3329/OF_NFLD_3329_AppendixG.csv)

### **APPENDIX H: Lead Isotope Data**

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\\_NFLD\\_3329/OF\\_NFLD\\_3329\\_AppendixH.csv](http://www.nr.gov.nl.ca/nr/mines/geoscience/publications/openfiles/OF_NFLD_3329/OF_NFLD_3329_AppendixH.csv)

### **APPENDIX I: Modal Mineralogy Obtained from SEM-MLA Analysis**

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\\_NFLD\\_3329/OF\\_NFLD\\_3329\\_AppendixI.csv](http://www.nr.gov.nl.ca/nr/mines/geoscience/publications/openfiles/OF_NFLD_3329/OF_NFLD_3329_AppendixI.csv)