



Assay data for volcanogenic massive sulfide (VMS) deposit samples from British Columbia

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Front cover:

Historical Hidden Creek deposit workings of volcanogenic massive sulphides in the Anyox camp. **Photo by Steve Piercey.**

Back cover:

Photomicrograph showing framboidal pyrites that are overgrown by euhedral pyrite with grey minerals around their edges including sphalerite (dark grey) and galena (white)-bournonite (light grey), 21B zone, Eskay Creek **Photo by Steve Piercey.**



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Abstract

This release provides multi-element assay and quality control and quality assurance data to support the initial study of critical minerals in provincial volcanogenic massive sulphide deposits by Piercey et al. (2025).

Keywords: Volcanogenic massive sulphide, VMS, critical minerals, bulk-rock geochemistry, assay

1. Introduction

British Columbia hosts VMS systems that are endowed in metals that are on the 2024 version of the national critical minerals list (NRCan, 2024) including Cu and Zn as primary commodities, and other metals in lesser amounts (Bi, Co, In, Sb, Sn, Te). Nonetheless, the abundance, mineralogy, and siting of these metals and the controls on their origins remain unclear. To address this knowledge gap, Piercey et al. (2025) initiated a study to better understand the concentrations of metals, the sulfide mineralogy, and metal residence in British Columbia VMS deposits using archived samples previously collected from across the province (Fig. 1). Presented herein ([BCGS_GF2025-12.zip](#)) are multi-element assay data that were used in element probability plots and principal component analysis in Piercey et al. (2025).

2. Sampling and analytical methods

VMS deposit samples were retrieved from the archives of the British Columbia Geological Survey (BCGS) and the Mineral Deposit Research Unit (MDRU) at the University of British Columbia (UBC). These samples were originally collected during previous studies by BCGS geologists (e.g., Höy, 1991; Höy et al., 1984), and as part of the VMS project of MDRU undertaken in the 1990s (e.g., Barrett and Sherlock, 1996; MacDonald et al., 1996; McKinley et al., 1996; Sherlock et al., 1996).

The VMS deposits in British Columbia have different host rocks, commodity metals, and styles and represent different VMS sub-types; we have used classified the sub-types of deposits based on lithostratigraphy and host rocks (e.g., Barrie and Hannington, 1999; Franklin et al., 2005; Galley et al., 2007;

Piercey et al., 2015) although we include reference to BCGS deposit profile terminology as partly updated by Lefebure and Jones (2022). Samples presented herein reflect three VMS sub-types: 1) bimodal felsic (i.e., Kuroko-type) deposits, which are hosted in predominantly felsic volcanic host rocks and sequences; 2) hybrid bimodal felsic (i.e., Eskay Creek-type) deposits, which are hosted in felsic volcanic sequences but have evidence for both VMS and epithermal/magmatic-hydrothermal mineralization; and 3) mafic siliciclastic deposits, which are hosted in sequences that contain both basaltic flows and intrusions and siliciclastic rocks.

Samples acquired from the archives at the BCGS have unique identification codes that link them to previous projects and the geologists who collected them. Samples from the MDRU archives have codes that reflect the original samplers, mostly linked to previous thesis projects at UBC. Each sample was described, photographed, and cut to provide sufficient material for a bulk rock geochemical analysis with most of the sample material remaining in the BCGS and MDRU archives.

All samples were analyzed for multi-element analysis at ALS Minerals in North Vancouver, BC. The samples were crushed in a steel jaw crusher, riffle split, and an aliquot was pulverized in mild steel to generate a powder that was used for all analyses. Sample powders were digested via two methods then analyzed by inductively coupled plasma mass spectrometry (ICP-MS). The aqua regia digestion is less aggressive and was assumed to provide better results for relatively volatile trace elements in sulphides (e.g., As, Bi, Hg, Sb, Se, Te). The four-acid digestion is more aggressive and is the standard used in the mineral industry for elements like Cu, Zn, Pb, Ag, Co, Ni, and Fe. Samples above the detection limit by ICP-MS (overlimit

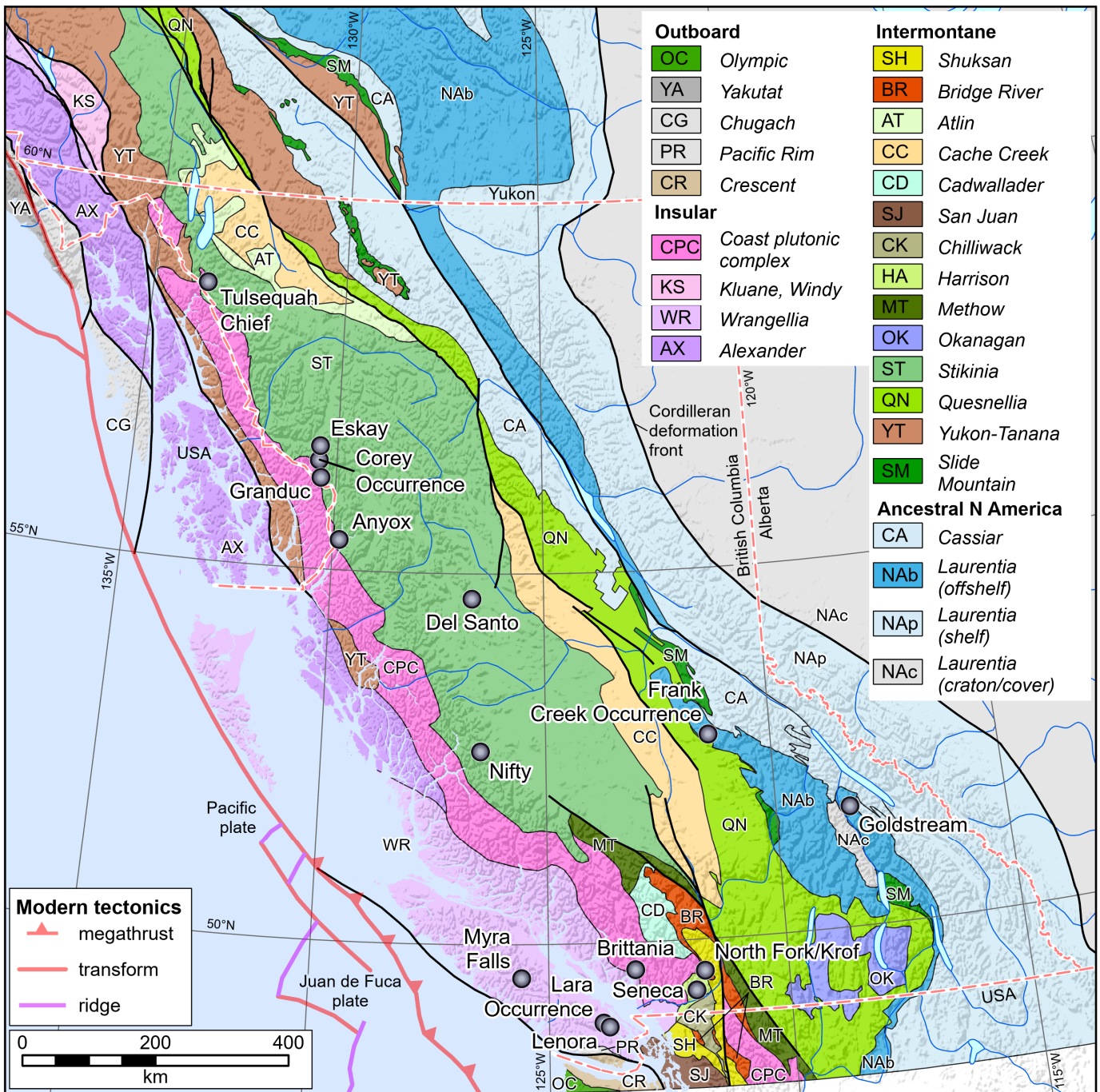


Fig. 1. Location of volcanogenic massive sulphide (VMS) occurrence samples. Terranes after Colpron (2020).

values), were further analyzed using ‘ore grade methods’ that included analysis by inductively coupled plasma emission spectroscopy (ICP-ES) or atomic absorption spectroscopy (AAS) for all elements except Au, for which overlimit values were determined by either ICPEs or gravimetric methods depending on grade.

3. Assay data

All analytical data and metadata of importance are provided in Appendix 1. Elements in Appendix 1 have subscripts based on their predominant digestion and analytical method, including: 1) AR = aqua regia with ICP-MS finish; 3) ARAA = aqua regia with AAS finish; 3) ARGRA = aqua regia with gravimetric finish; 4) 4A = four acid with ICP-MS finish; 5) 4AAA = four acid with gravimetric finish; 6) FAICP = four acid with ICP-ES finish; and 7) GRA = four acid with gravimetric finish.

4. 4. Quality control and quality assurance

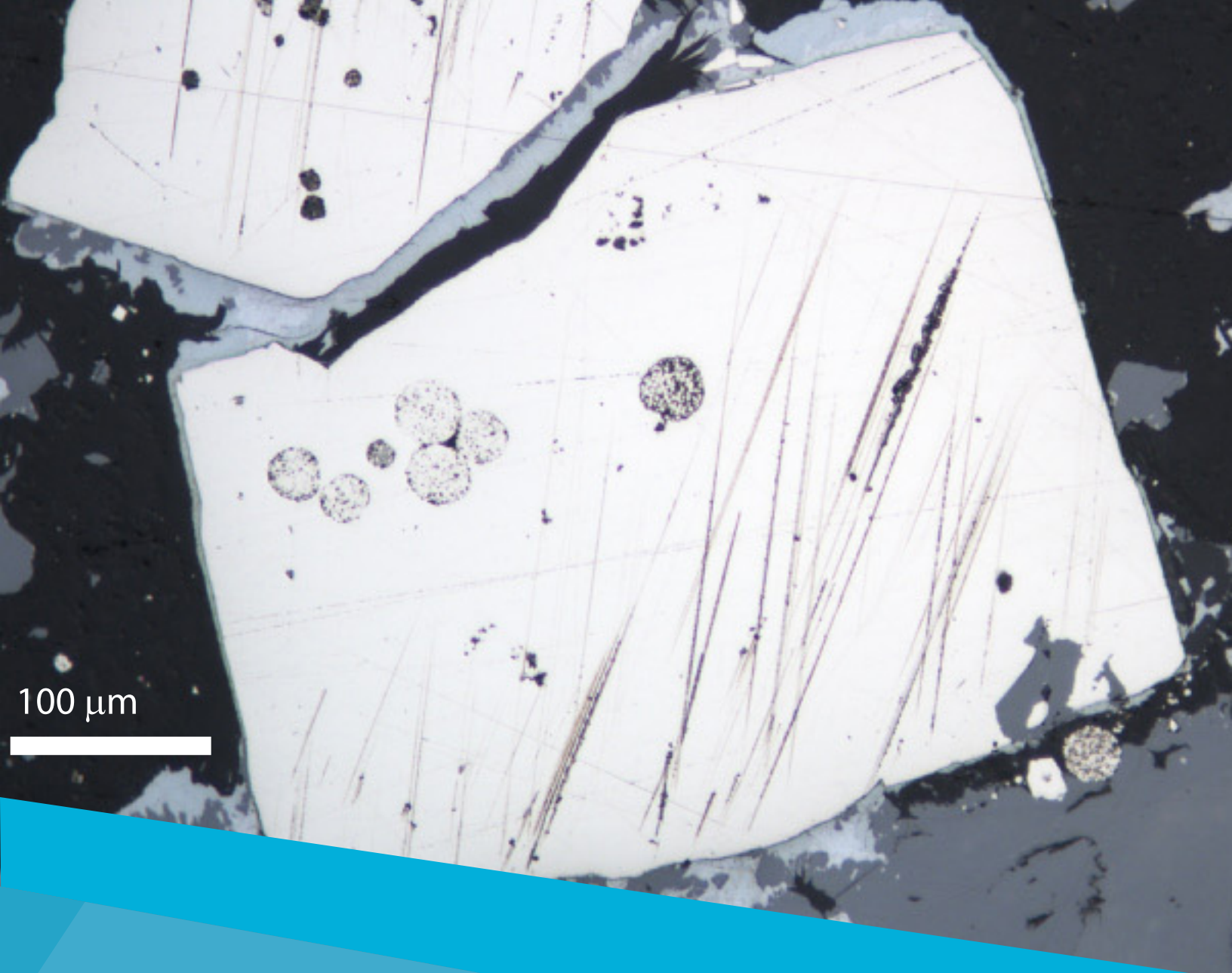
Analytical results from blank and reference materials, certified reference material values, and measures of precision and accuracy are provided in Appendix 2. Four matrix-matched reference materials were chosen that reflect the potential ranges of concentrations, including critical metals, found in the VMS samples (Appendix 2). These reference materials include: 1) OREAS 151c, which is a blend of porphyry Cu-Au ore, barren granodiorite, and molybdenite concentrate; 2) OREAS 507, which is a blend of porphyry Cu-Au ore, barren granodiorite, and Cu-Mo concentrate; 3) OREAS 550, which is blend of Cu-Co oxide ores; and 4) OREAS 607b, which is a blend Au-Cu-Ag-bearing ores and barren rhyodacite rock. Further details can be found from OREAS (2025). In addition, a blank (CDN-BL-10) from Canadian Resource Laboratories Ltd. (2025) was also used. These four reference materials and blank were run after every 25 samples or, if a batch of samples was less than 25, it was run at the end of a batch of samples.

Precision and accuracy were determined based on samples using the percent relative standard deviation (%RSD) and percent relative difference (%RD). In general, precision and accuracy are proportional to concentration in that as one approaches the limit of detection (LOD) and limit of quantification (LOQ = 3.3xLOD) then these values increase and precision and accuracy decrease – this is the case for the data herein – all these quality control data are presented in Appendix 2. Nevertheless, for most elements of interest for critical minerals and other commodities, for most values above the LOQ precision is good to excellent (see review by Piercey, 2014)

The blank was used to monitor contamination and in general, for elements of interest, the values are low and at or below typical values for upper crust (Hu and Gao, 2008; Rudnick and Gao, 2003), suggesting minimal contamination during sample processing and analysis (Appendix 2).

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