# Geofile 2016-2

## Geochemical results from GEM2 reconnaissance surveys between the Stikine River and Atlin

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### *Introduction*

The renewed Geoscience for Energy and Minerals program (GEM2) builds upon the success of the first GEM program with a focus on sustainable economic development in the North. Here we report on work conducted as part of the GEM2 Porphyry Transitions activity (Zagorevski et al., 2015) which is aimed at characterizing volcanic and intrusive rocks across the BC-Yukon border, especially in terms of their potential to contain copper porphyry mineralization. GEM2 work in the northern Cordillera includes an ambitious geochronological sampling program designed to test and refine the currently-defined early Mesozoic magmatic belts and their relationship to mineralization. The footprint of the sampling program extends from northwest BC into southwest Yukon. Part of this work involves reconnaissance sampling for geochronology and geochemistry. Where altered and mineralized magmatic rocks were encountered, they were sampled and analyzed for metal contents. Here we report on analyses of sample sets collected during various excursions along the lower Stikine River, near the lower Tahltan River, near Trapper Lake, near Atlin, and in the Sinwa Creek map area (Fig. 1). Geological observations from near Atlin and Sinwa Creek are largely reported in Geological Fieldwork 2016, Paper 2017-1 (Mihalynuk et al., 2017a, b) and are not repeated here. Included in this report are observations from the first three regions that are not part of the public record elsewhere, and which provide some geological context for the geochemical analyses reported in the accompanying tables.

### *Contents*

This document outlines the contents of Geofile 2016-2, which includes 2 files:

1. This pdf document, *Geofile2016-2 GEM2014&15 GeochemMihalynuk& Zagorevski.pdf*
2. An Excel format workbook containing four data tables (worksheets)

| | |
|---|---|
| Sheet 1 | ICP-MS analyses of 2014 samples, Acme Analytical Laboratories (now Bureau Veritas), includes field Station number and Lab number cross reference, and sample locations given in UTM coordinates (NAD 83 CONUS mean, UTM zone 9) |
| Sheet 2 | ICP-MS analyses of 2015 samples, sample locations given in UTM coordinates (NAD 83 CONUS mean, UTM zone 8) |
| Sheet 3 | ICP-MS raw data table for 2014 samples with QC |
| Sheet 4 | ICP-MS raw data table for 2015 samples with QC |

## *File names and download Size:*

*Geofile2016-2 GEM2014&15 GeochemMihalynuk&Zagorevski.pdf* 1.3 Mb
*Geofile2016-2 GEM2014&15 GeochemMihalynuk&Zagorevski.xls* 0.09 Mb

## *Methods*

Samples collected in 2014/2015 were prepared by two methods. Samples collected in 2014 were prepared at the BC Geological Survey Branch laboratory facilities in Victoria. Samples were reduced to pea-sized fragments in a jaw crusher using steel plates, and then pulped in a chrome steel disk mill. Both pieces of machinery used in the sample preparation are sources of potential Fe and Cr contamination. Samples collected in 2015 were prepared at Acme Analytical Laboratories (Vancouver) Ltd. (now Bureau Veritas and henceforth BV) using their published methodology which includes drying and pulverizing to ≥85% passing a 75 μm mesh. Commercial standards that are included for the purposes of quality control and assurance rely on special preparation strategies that minimize contamination and those techniques can be found on the web sites of the vendors of the standards that we used.

A broad suite of elements is reported with samples analyzed by Inductively Coupled Mass Spectroscopy (ICP-MS) following Aqua Regia digestion of a 0.5 g sample (procedure 1F04) at BV and those analyses were augmented with Instrumental Neutron Activation Analyses (INAA, procedure 1D, enhanced) at Activation Laboratories of Ancaster Ontario (henceforth Actlabs). INAA theoretically provides a complete analysis of all components of a sample, including parts that may not be susceptible to acid attack and missed by the ICP-MS technique. Further details of analytical procedures including limitations, such as interferences, can be obtained from the company websites.

## *Results*

A subset of samples and elements from the accompanying analytical results files are presented in Table 1 and are described below, with their geological context, on an area by area basis.

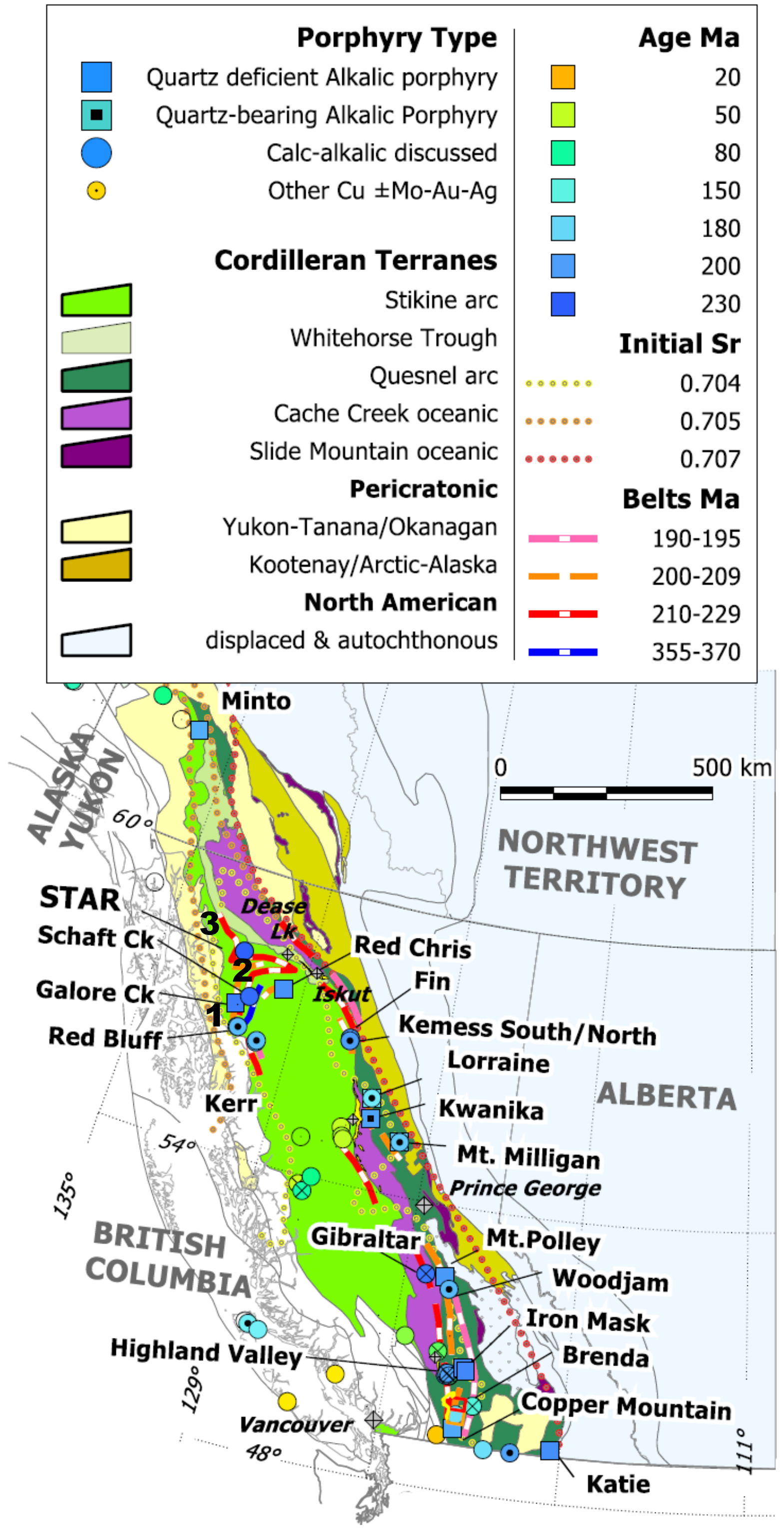



*Figure 1. Porphyry deposits and belts superimposed on Intermontane arc complex terranes of the Canadian Cordillera (modified after Logan and Mihalynuk, 2014). Also shown are initial strontium isotopic ratio isopleths. Areas discussed here are labelled 1, 2, 3 for Lower Stikine River, Lower Tahltan River and Trapper Lake region (Metla prospect).*

| StatNum | LabNum | Mo | Cu | Ag | Co | As | U | Au |
|---|---|---|---|---|---|---|---|---|
| MMI14-28-03 | 62601 | 2.43 | 27.35 | 232 | 31 | 4.2 | 0.3 | 0.6 |
| MMI14-28-12 | 62602 | 1.23 | 44.18 | 57 | 19.2 | 2.1 | 0.1 | 0.4 |
| MMI14-29-10 | 62603 | 1.30 | 9731.7 | 28810 | 10.0 | 121.4 | <0.1 | 54.3 |
| MMI14-29-10b | 62604 | 0.49 | 190.28 | 100 | 13.8 | 2.9 | 0.2 | 0.4 |
| MMI14-29-19 | 62605 | 5.24 | 51.69 | 5640 | 11.5 | 413.3 | <0.1 | 25.1 |
| MMI14-31-6 | 62607 | 3.13 | 1463.88 | 1924 | 431.9 | 595 | <0.1 | 79.9 |
| MMI14-31-7 | 62606 | 0.38 | 203.74 | 714 | 27.5 | 12.2 | 0.4 | 24.6 |
| MMI14-32-4 | 62608 | 10.65 | 258.72 | 743 | 15.7 | 49.1 | 1.4 | 24 |
| MMI14-32-5 | 62609 | 0.43 | 45.96 | 66 | 9.5 | 1.4 | 0.7 | 2.3 |
| MMI14-32-6 | 62610 | 0.75 | 1524.95 | 384 | 16.5 | 8.3 | 0.7 | 3.3 |

*Table 1. Selected elements from ICPMS analytical results for a subset of samples collected during Porphyry Transitions Project activities. See the accompanying Excel file for complete analytical results and UTM coordinates.*

## Lower Stikine River region

During the sampling program along the lower Stikine River we discovered semi-spherical, massive sulphide inclusions up to 0.4 m in diameter within a granodioritic pluton ~20 m from its skarnified contact zone, a ~2-5m thick envelope of intense mineral replacement. Skarn mineralization is massive epidote, magnetite, and grossular garnet (in order of abundance), pyrite, minor pyrrhotite, and traces of chalcopyrite. A sample of the largest sulphide inclusion was analyzed, returning elevated Cu, Ag and Au (Sample MMI14-31-6; Table 1 and accompanying Excel file). Petrographic analysis shows that the pyrite is extensively included with chalcopyrite, and traces of pyrrhotite and covellite (Figs. 2A, 2B).

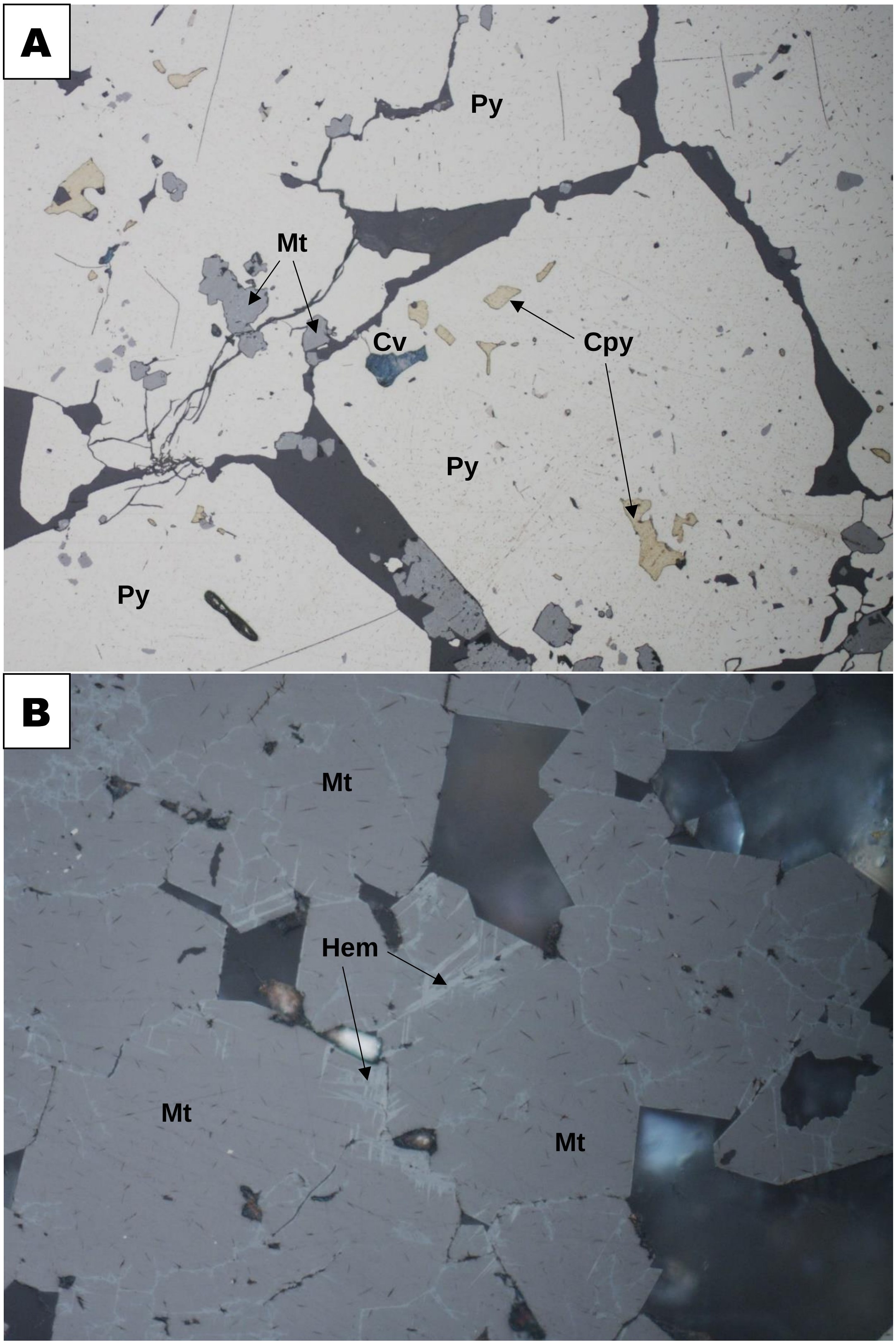



*Figure 2. (A) Plane polarized, reflected light view of sample MMI14-31-6 showing corroded pyrite grains (Py) that are extensively included by irregular yellow chalcopyrite (Cpy) patches and sparse pyrrhotite (tan) and covellite (Cv,*

*blue pleochroic). Subidiomorphic magnetite (Mt, medium grey) is enveloped by and rims pyrite and is altered along cleavage to hematite. Width of photomicrograph represents 2mm. (B) close-up of magnetite (Mt) altered (oxidized) to hematite (Hem, light blue-grey).*

## *Lower Tahltan River region*

Tahltan River flows southeast across the southwest corner of the Dease Lake map area (Fig. 3). The old Golden Bear mine access road cuts across this same rolling and forested area with new outcrops intermittently exposed along its route. About 22 km from the Telegraph Creek road junction, the Golden Bear road is slumped and washed out (near where road ends at Tahltan River on Fig. 3). Existing published geological maps (Cui et al., 2015, Fig. 3) show that the currently operational part of the road crosses undivided marine sedimentary and volcanic rocks of the Late Triassic Stuhini Group (Fig. 3). Reconnaissance mapping along the road shows that, in fact, parts of the passable road cross intrusive rocks (at localities MMI14-32-5 and 6) and that some of the outcrops show evidence of pink alteration and copper mineralization (Fig. 4). See sample number MMI14-32-6 (Table 1 and accompanying Excel file).

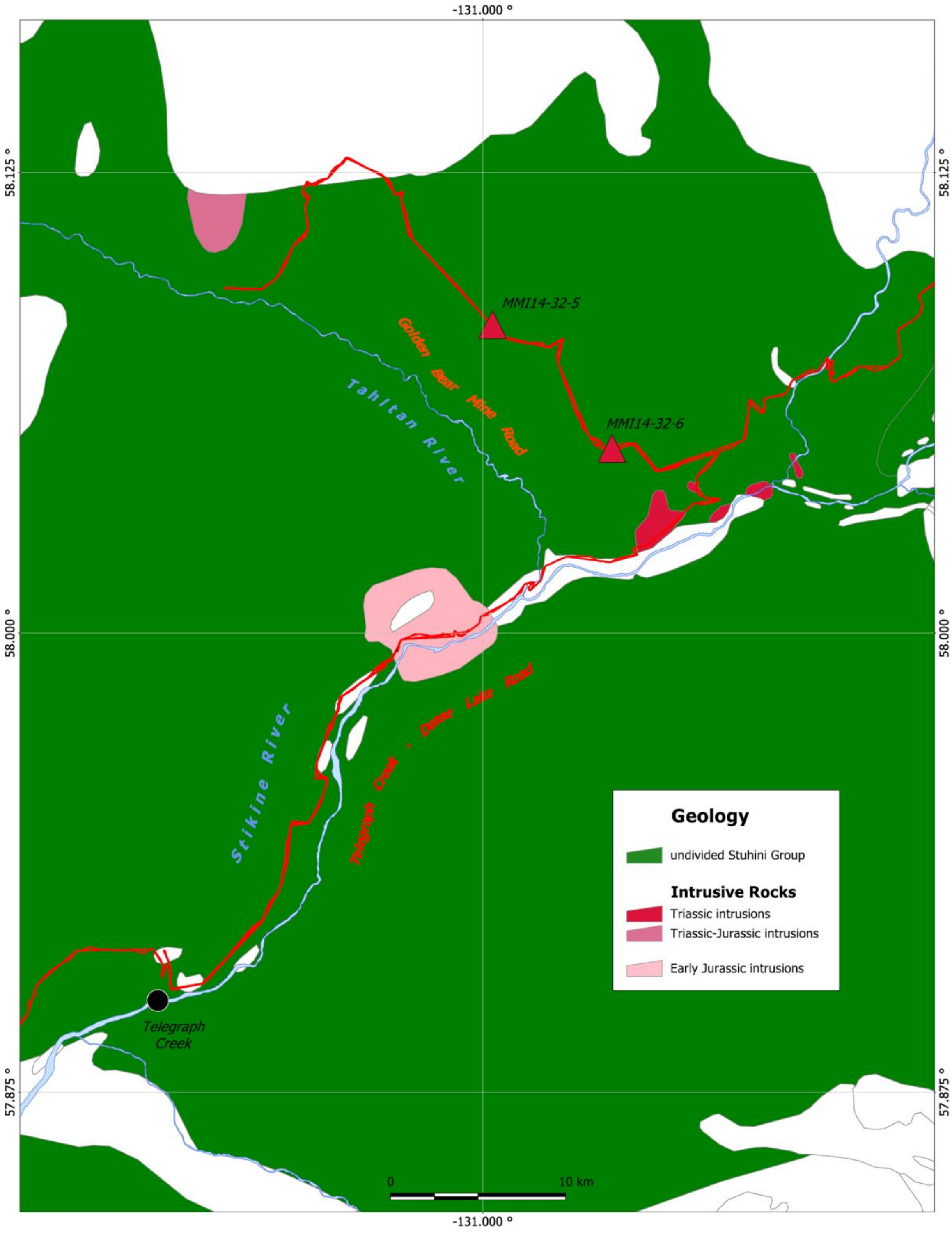
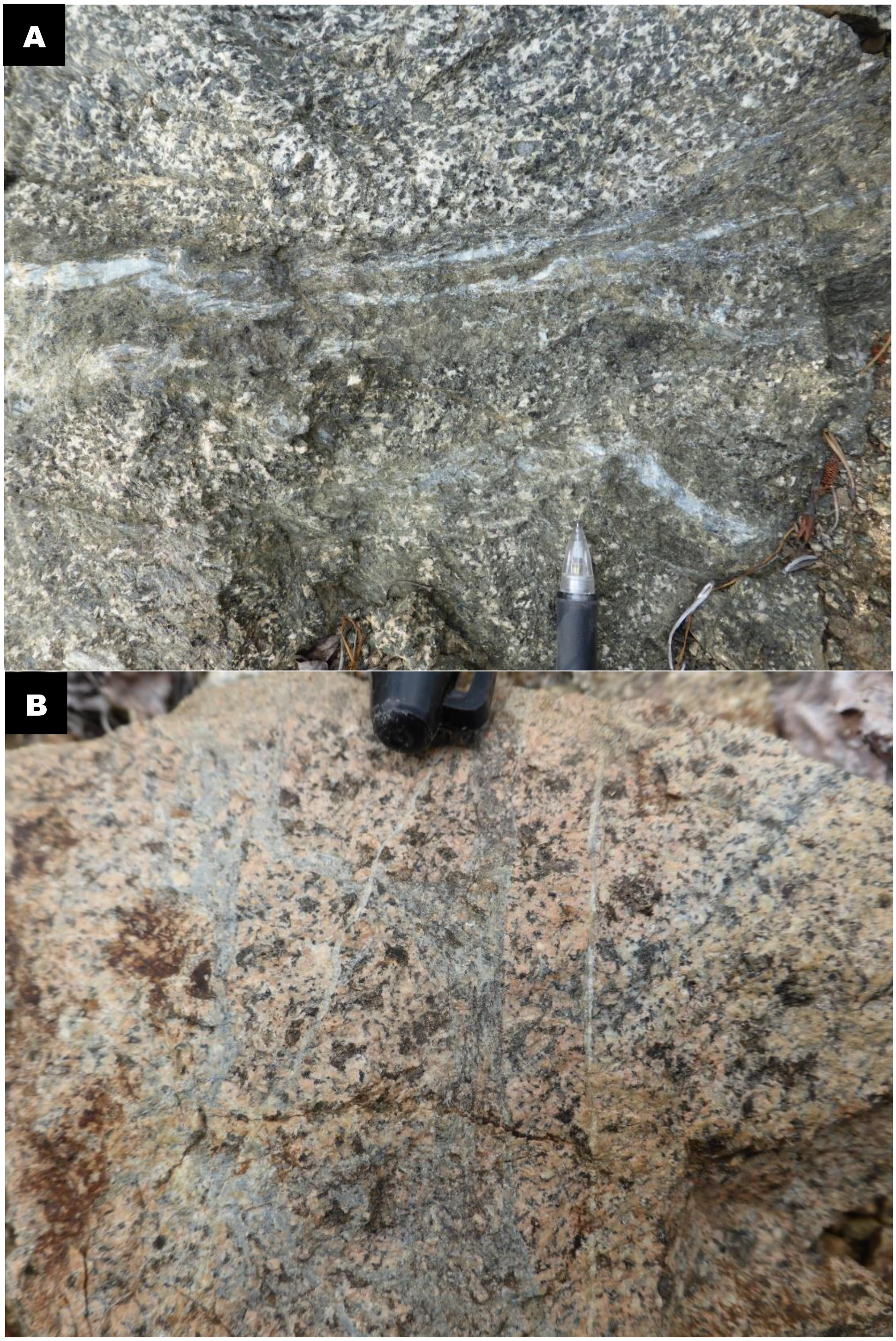



*Figure 3. Map showing locations of intrusive rocks not on previously published regional geological maps (BC Geological Survey base digital geology map after Cui et al., 2015).*


A
B

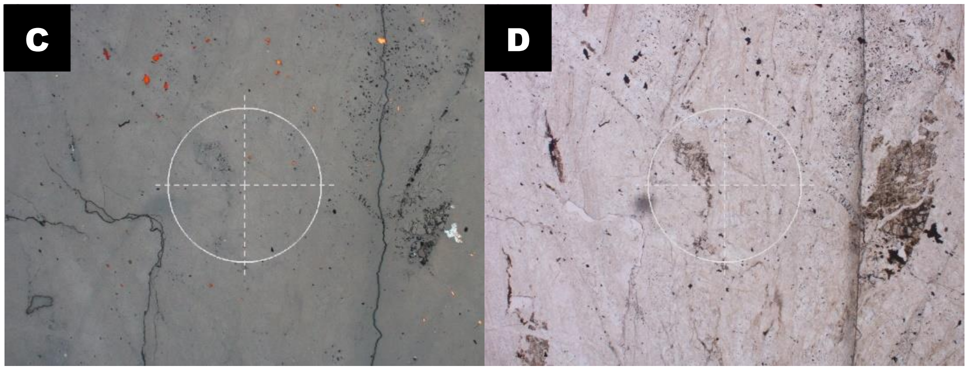



*Figure 5. Intrusive rocks along the Golden Bear mine access road. (A) shear band and veining containing copper mineralization in chlorite-epidote-altered diorite; (B) pink alteration and two stages of veining of granodioritic intrusion. Photomicrograph of vein in (A) in reflected (C) and plane polarized (D) light. Copper-coloured flecks above the cross hairs in C (opaque in D) are native copper. Bornite and chalcopyrite are present outside of the field of view. Diameter of circle at cross hairs is ~1mm.*

## *Trapper Lake region*

Sampling in the Trapper Lake area included a stop at the Metla prospect (MINFILE 104K 161), ~5 km southwest of Trapper Lake. At Metla, massive sulphide cements brecciated calcareous argillite and basalt, and is disseminated within the breccia fragments and surrounding country rocks. Pyrite and sphalerite are the predominant sulphides, although chalcopyrite and lesser galena are locally abundant. Silver values of several hundred g/t and gold values of 174 g/t have been reported from mineralized boulders. These boulders have not been traced to a bedrock source with similar metal tenor; although, an area of elevated gold more than 1.2 km long has been identified (further description of the mineralization and a history of mineral exploration is presented in MINFILE: http://minfile.gov.bc.ca/Summary.aspx?minfilno=104K%20%20161 ).

Despite the significance of this mineral occurrence, little is known of its genesis. Perhaps because of the proximity of the Coast Batholith, and because argentiferous and auriferous pyrite-sphalerite-galena cements a brecciated feldspar porphyry dike presumed related to the batholith, an intrusive affiliation and Late Cretaceous age has been inferred.

In our cursory examination of the main breccia showing and surrounding area, sulphide clasts were observed in sparse volcaniclastic layers within a predominantly argillaceous succession about 100 metres away from the breccia mineralization. These clasts appear to be primary, with sharp margins, suggesting that they may have been eroded from submarine sulphide source. Alternatively, the clasts may have been selectively replaced by sulphide during a mineralization event significantly post-dating deposition of the strata. Primary / syngenetic versus seconday/epigenetic origin for the sulphide mineralization could be better evaluated if the ages for the sulphides and host strata could be demonstrated. We sampled the polymetallic breccia for direct Re-Os dating of the sulphides and the calcareous mudstones for conodonts. Two samples of breccia (MMI15-

21-5A and 5C), were submitted for geochemical analyses. They returned 3 and 10.4 ppb Au and 16.7 and 11 ppm Ag. Similar sulphide-rich samples were submitted for Re-Os extraction. Unfortunately, analysis of the sulphides show that they contain insufficient Re to permit a reliable Re-Os age determination. Conodont results are pending. Definitive evidence constraining the genesis of Metla mineralization remains elusive.

## *References*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