

YELLOW FOX ANTIMONY / GOLD PROPERTY

METALS CREEK RESOURCES LTD



NTS 02D/14

Licenses: 027536m & 037936M

INTRODUCTION

Prospecting in 2011 by Metals Creek Resources resulted in the new discovery of antimony within an area primarily explored for gold. This prospecting program returned samples anomalous in gold (Au), antimony (Sb), lead (Pb), zinc (Zn) and silver (Ag) referred to as the Yellow Fox Showing. Trenching took place for better exposure, resulting in grab samples to 59.43g/t Au, 11.10% Sb, 7.00% Zn, 72.90g/t Ag and 5.50% Pb in arsenopyrite-stibnite veins within altered monzogranite. Channel results of 0.35g/t Au, 3.04g/t Ag, 0.77% Zn, 0.27% Sb and 0.21% Pb over 16.49m have been attained. Included in this channel result is a higher grade channel sample of 4.57% Sb, 0.84% Pb, 0.35% Zn and 16.5 g/t Ag. Soil sampling resulted in the identification of several discrete indicator mineral anomalies consisting of As, Pb, Zn and Sb (See images below). The Yellow Fox Project is located 25km north-northeast of Beaver Brook Antimony Mine. This deposit is the only producing antimony mine in north America and is currently under care and maintenance. A large portion of this project has not seen any exploration for antimony and remains a high priority exploration target. The Yellow Fox Project has never been drill tested.

LAND TENURE

The Yellow Fox Property consists of 28 claim units in two licences for a total of 7 sq. km. All Licenses are 100% owned by Metals Creek Resources highlighted in Table 1 below. The project is now in an option agreement with Lomiko Metals.

Table 1: Yellow Fox Property Exploration Licences

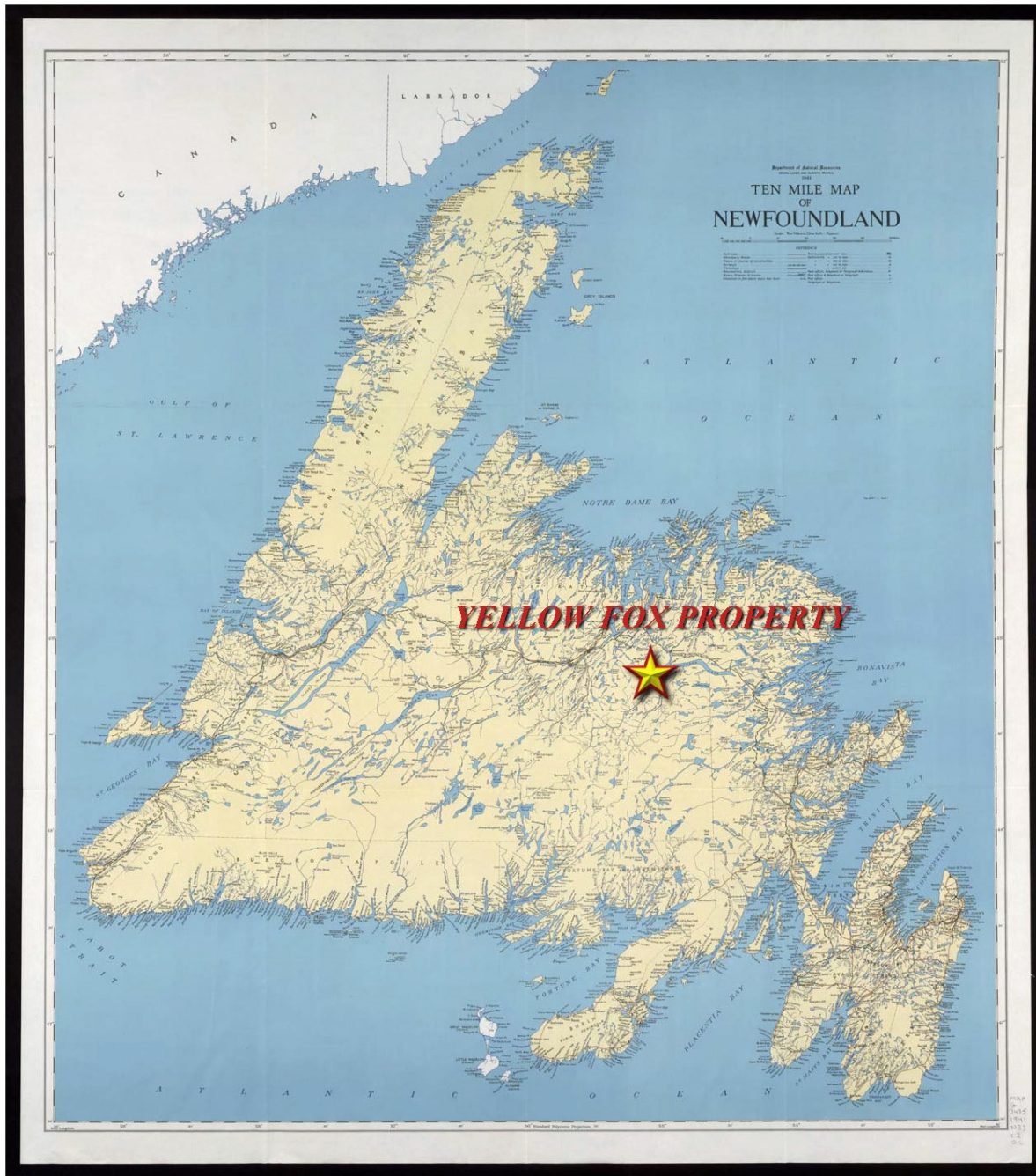
Property	License Number	Client Name	Issuance Date	No. Of Claims	NTS Map Sheets
Yellow Fox	027536M	Metals Creek Resources	Dec 26/2019	4	12D/14
Yellow Fox	037936M	Metals Creek Resources	May 2/2020	24	12D/14-15

TOTAL 2 Licenses 28 units

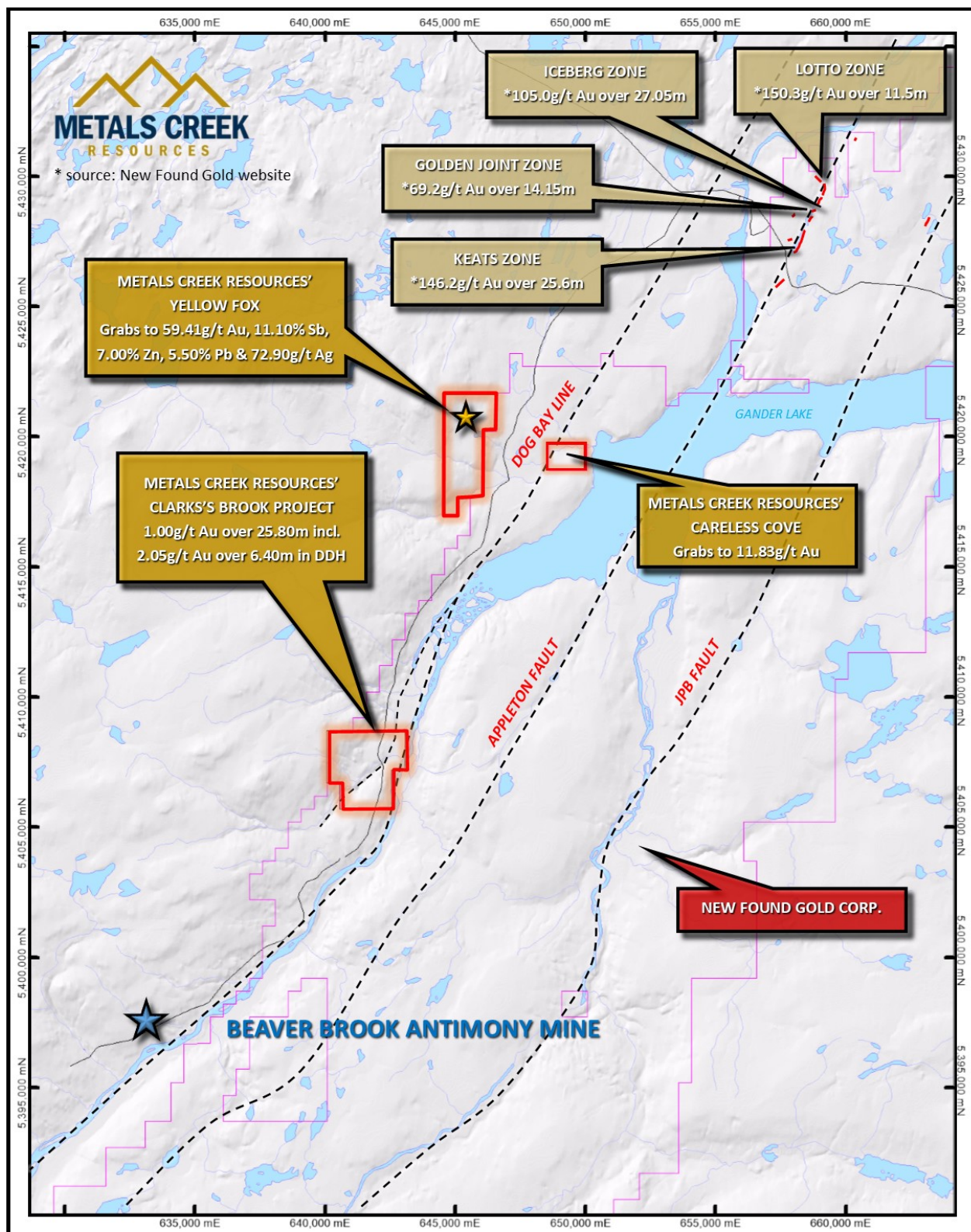
LOCATION AND ACCESS

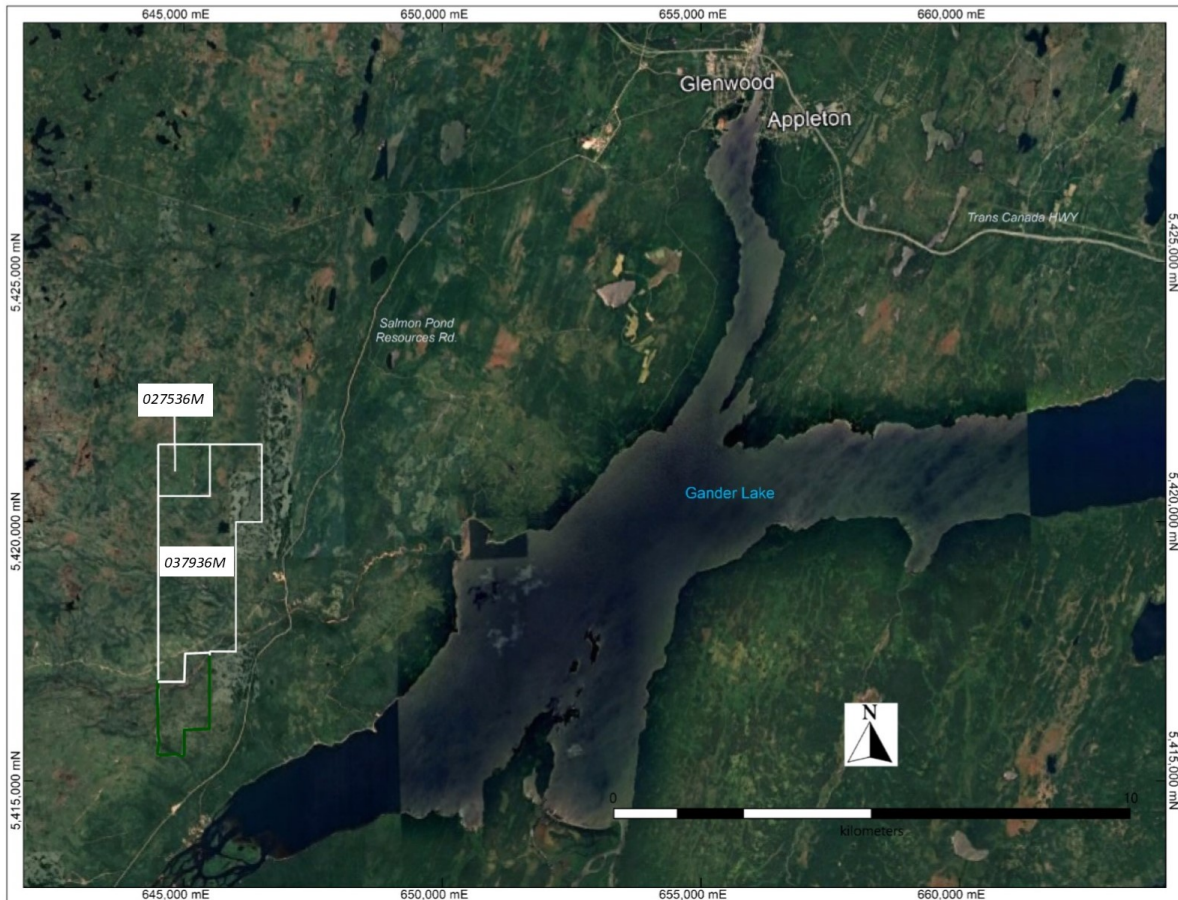
The Yellow Fox Property is located approximately 10 km southwest of the Town of Glenwood NL, and south of the Trans-Canada Highway. The Property occurs within NTS map sheets 02D/14 and 15 with access excellent along several logging and skidder roads originating from Glenwood. The main Yellow Fox showing is located in the central part of License 027536M, 5km from the western end of Gander Lake. The property is centered at approximately UTM (NAD 27) grid coordinates are 5,419,400m

North and 645,300m East. The property lies 25 kilometers north-northeast of the Beaver Brook Antimony Mine which is currently on care and maintenance.



Property Location Map





Yellow Fox Claim Map

REGIONAL GEOLOGY

The Yellow Fox Property occurs within the eastern Dunnage Zone, approximately 20km west of the Dunnage Zone – Gander Zone boundary (Williams, 1979). Within the Dunnage Zone, geology ranges from Cambro-Ordovician ophiolitic, volcanic, volcanoclastic and sedimentary rocks of island-arc and back-arc affinity. The zone consists of the Exploits subzone to the east and the Notre Dame subzone to the west. The Gander Zone contains pre to middle Ordovician rocks of predominantly continental derivation and is subdivided into three subzones: Gander Lake, Mount Cormack and Meelpaeg (Williams, 1993). The boundary between the Gander and Dunnage Zones is marked by the Gander River Complex – a discontinuous belt of ophiolitic rocks (O’Neil and Blackwood, 1989). The majority of Metals Creek Resources’ Yellow Fox Property is contained within the Mount Payton Intrusive Suite which is a large Siluro-Devonian batholith that has intruded the Botwood, Indian Islands and Davidsville groups. There are numerous fine to medium-grained intrusive gabbroic bodies related to the Mount Peyton Intrusive Suite (Evans, 2001a).

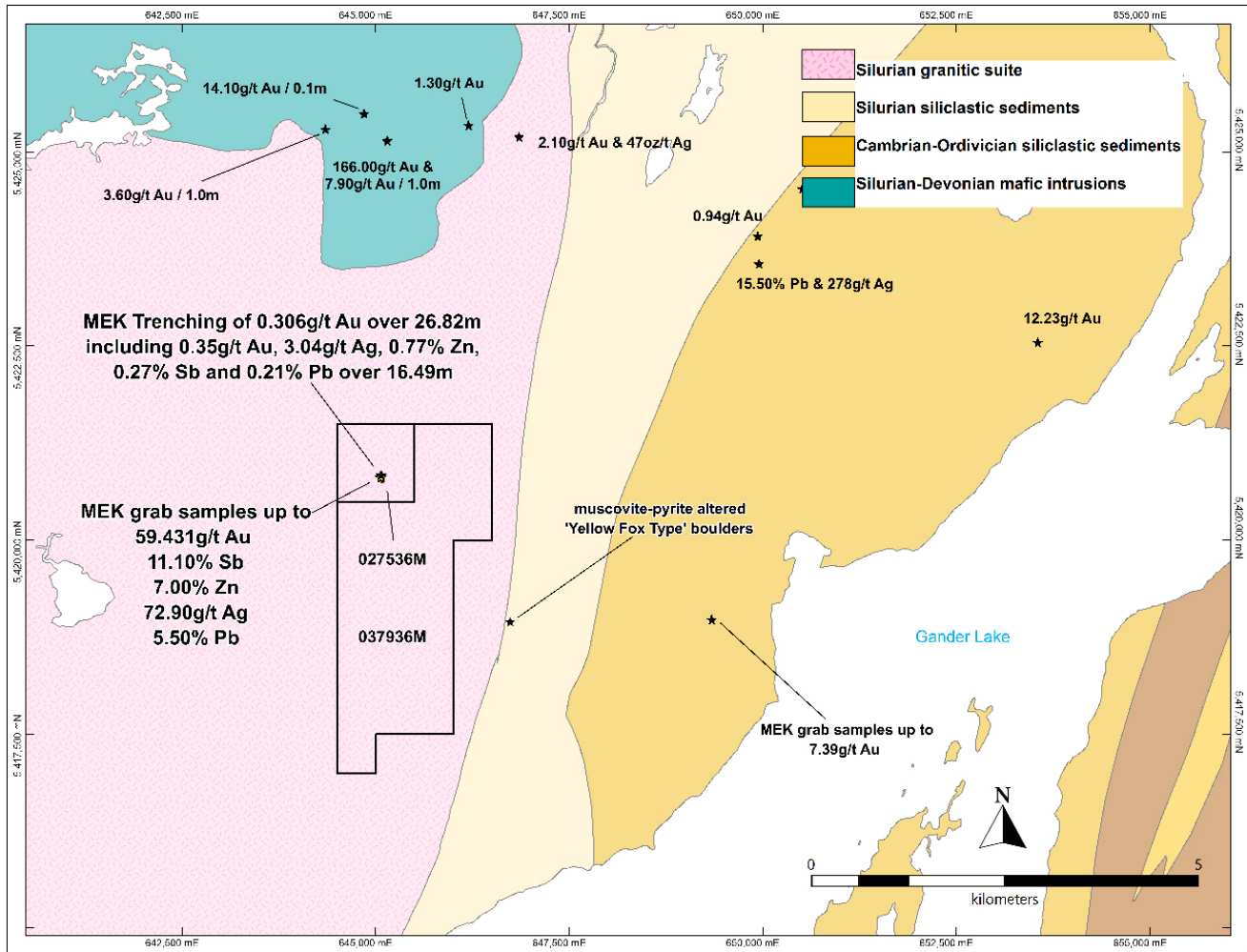
PROPERTY GEOLOGY

The Yellow Fox claims are underlain by fine to medium grained monzogranite rocks of the Mount Peyton Intrusive Suite (Figure 3). The Yellow Fox Project lies along the same northeast trending structural zone (Dog Bay line) to that of the Beaver Brook Mine. Geologically, Yellow Fox exhibits similar traits to that of Beaver Brook with cross cutting structural zones which show strong carbonate alteration with sulphide bearing stringers to veins of stibnite and arsenopyrite with similar high-grade tenors of antimony, gold, lead, zinc and silver. The presence of arsenopyrite is also present in both locations.

The following excerpt is taken directly from A Geological Survey Report 20-1 written by H. Sandeman and C. Spurrell 2020...

"The showing is hosted by fractured, muscovite-pyrite-rutile-altered, medium-grained, plagioclase porphyritic, granophyric-textured biotite +/- hornblende monzogranite. Muscovite-pyrite-rutile alteration occurs in an approximately 100m long by 30m wide, broadly north-trending bleached and rusty zone, characterized by three distinct fracture sets. The most prominent fracture set is north-trending (356o/80oE), occurs on a spacing of 5-20cm and is accompanied by abundant muscovite and disseminated pyrite. A weakly developed, north-northeast-trending (025o/86oE) fracture set, locally hosts a few narrow (<4cm) stibnite-quartz-arsenopyrite veins. Arsenopyrite, mainly confined to vein margins, is extensively altered to supergene scorodite and goethite. The muscovite-pyrite-rutile alteration and north-trending fractures are cut by the north-northeast-trending stibnite-quartz-arsenopyrite-veined fractures. Relative to unaltered monzogranite, the early muscovite-pyrite-rutile-associated fracture set, and altered-host monzogranite samples, are typically moderately anomalous in As, Au, Sb, Pb and Cd. In contrast, the later stibnite-quartz-arsenopyrite-veined fractures and host rocks are strongly anomalous in all metals (Sb, As, Au, Ag, Pb, Zn and Cd) and weakly anomalous in Cu."

Samples collected by Sandeman and Spurrell (2020) have returned maximum values of 129,000ppm As, 40,700ppm Sb, 29,970ppm Pb, and 10,600ppm Zn.



Generalized Geology Map of the Yellow Fox Claim Group Area



Plate 1: pod of stibnite mineralization



Plate 2: vein of stibnite-arsenopyrite mineralization

PREVIOUS REGIONAL WORK

A large portion of the exploration history was taken from Paragon Minerals Corp's 'Assessment Report on the Soil Geochemistry Survey and Prospecting for the Mt. Peyton Linear Property central Newfoundland' (Milton, 2008) and covers a broad area around Metals Creek's Yellow Fox Property:

The Geological Survey of Newfoundland and Labrador completed 1:50,000 scale bedrock mapping of the Mount Peyton map sheet (Dickson, 1993). A regional lake sediment geochemical survey was also completed by the survey and it identified some potential target areas for gold (Davenport, et al., 1988).

Noranda Exploration completed some detailed exploration work, including trenches, geophysical surveys and diamond drilling to trace the source of mineralized quartz-vein float samples. This program led to the discovery of the Hurricane and Corsair prospects and the initial recognition of the Peyton trend as well as the Apache, Comanche and Sabre showings (Tallman, 1990; Tallman, 1991).

In 1999, Black Bart Prospecting Inc began prospecting in the Shirley Lake area with efforts focused on the possible extension of the Peyton Trend. The work was primarily focused along areas with coincidental anomalous values for arsenic in lake sediments. Several concentrations of gold-bearing float, along with base metals, were discovered and a centralized land position around Shirley Lake was acquired (Evans, 2001a).

In December 2001, Rubicon Minerals Corp. entered into an option agreement with Black Bart Prospecting Inc. to explore the Peyton Trend. During the spring and fall of 2002, a limited prospecting and reconnaissance soil sampling program was carried out to assess the potential of the property. As a result, sampling returned values of 17.0 g/t and 18.9 g/t gold from an angular boulder. Another area named the 'SS' showing located approximately 2.5 km north of Shirley Lake, returned values of 1.0 g/t and 1.26 g/t gold.

From March to November, 2002, Rubicon conducted a limited prospecting, geological mapping and soil sampling program as part of a regional exploration program on the Mount Peyton Linear Property (Sparkes, 2002). The prospecting effort resulted in a new discovery of auriferous quartz-arsenopyrite float south of Middle Lake that assayed 17.030 g/t and 18.895 g/t and a new mineralized zone in bedrock located approximately 2.4 km north of Shirley Lake ('SS' Zone).

From July 2002 through September 2003, another regional program was initiated to further explore the Peyton Trend. It included more detailed prospecting in areas of known gold mineralization in angular float and soil sampling to cover other areas with little previous mineral exploration by Rubicon Minerals Corp. Assays up to 14.1 g/t gold in float were achieved.

From July 2007 through November 2007, Paragon Minerals conducted a regional program to further explore the Peyton and Hurricane Trends (House, 2007). It included more detailed prospecting in areas of known gold mineralization in float, a soil/rock geochemistry survey to evaluate other areas with little historic mineral exploration, plus a diamond drill program to test mineralized zones intersected by Noranda in 1990 at the Hurricane Trend.

In mid-October, 2008, Paragon Minerals Corp. conducted a soil geochemistry survey and prospecting program to better assess the potential of the area to host gold mineralization.

METALS CREEK WORK ON PROPERTY

From May to December 2011, Metals Creek Resources (MEK) of Gander NL, completed a program of B-horizon soil sampling and prospecting on the Yellow Fox Property. This prospecting led to the discovery of the main Yellow Fox showing which resulted in MEK carrying out trenching and surface stripping over a small area. This first year work was an attempt to assess the potential of the property to host gold mineralization. In total, 36 soil samples and 11 prospecting grab samples were taken along with 13 grab samples from the newly trenched areas. Subsequently, 153 cut channel samples were put down in the new trenches on present licence 027536M. Soil sampling also resulting in the identification of additional discrete anomalies (See images below) of indicator minerals (As,Sb,Pb,Zn) outside of the main discovery area further enhancing the exploration potential of the project.

Initial prospecting took place as access to the property is very good due to the forest roads bisecting the claim group. ATV's were used and small traverses off the shoulders of the roads were performed. This initial prospecting resulted in a concentration of highly anomalous gold values with one sample returning an assay of 59.413 g/t Au (main Yellow Fox showing). The sampling showed anomalous lead, zinc, antimony and silver. This led to a larger work program in the area including B-horizon soils.

The soil program was conducted over two, 100m spaced, east-west trending recce lines over the higher-grade gold sample in an attempt to trace the direction of mineralization. Sampling of the soil was done at approximately 25m along the line with locations recorded with a handheld GPS.

Trenching was carried out over the vicinity of the anomalous grab samples. Six 25-45m stripped and trenched areas were put down running east-west over the Yellow Fox Showing. Upon completion of trenching, 13 grab samples were collected throughout the trenches with high-grade assay values to 7.00% Zn, 11.10% Sb, 72.90g/t Ag, 5.50% Pb and 1.88 g/t Au. The first five trenches were then channel sampled along their length using a diamond bladed rock saw. The results from this trenching were encouraging as Trench #1 showed an assay value of 0.35g/t Au, 0.77% Zn, 0.27% Sb, 3.04g/t Ag and 0.21% Pb over 16.49m within 18 continuous samples with a higher-grade channel cut grading 4.57% Sb, 0.84% Pb, 0.35% Zn and 16.5 g/t Ag over 43cm.

The trenches have since been reclaimed. These results from the trenching give the possibility that a large scale, bulk tonnage deposit could be present on the Yellow Fox claim group.

Trench Grab Samples

SAMPLE #	Northing	Easting	TYPE	CERT_NO	Au (ppb)	As (ppm)	Zn (ppm)	Cu (ppm)	Sb (ppm)	Ag (ppm)	Pb (ppm)
96551	5420834	645086	o/c	645-1101435	1386	>2200	1654	77	90000	18.4	4100
96552	5420834	645086	o/c	645-1101435	1495	>2200	36	300	111000	56.0	8800
96553	5420834	645086	o/c	645-1101435	318	>2200	502	21	14000	1.4	758
96554	5420799	645070	o/c	645-1101435	1136	>2200	2300	109	1700	19.2	11100
96555	5420799	645070	o/c	645-1101435	1615	>2200	70000	920	9700	41.4	38000
96556	5420799	645070	o/c	645-1101435	979	>2200	1959	360	1700	26.5	19500
96557	5420799	645070	o/c	645-1101435	932	>2200	12600	520	5400	38.7	31000
96558	5420799	645070	o/c	645-1101435	960	>2200	2900	102	1100	7.7	4400
96559	5420799	645083	o/c	645-1101435	245	>2200	821	85	900	8.8	4000
96560	5420799	645083	o/c	645-1101435	660	>2200	61	30	147	2.4	489
96561	5420780	645083	o/c	645-1101435	1114	>2200	10600	480	26400	72.9	55000
96562	5420799	645083	o/c	645-1101435	1877	>2200	5500	490	18000	21.1	34000
96563	5420780	645085	o/c	645-1101435	214	1908	2600	80	117	3.8	1998

2023 LiDAR and INTERPRETATION

An airborne LiDAR and Imagery survey was flown by Eagle Mapping of Langley British Columbia between August 3rd and September 4th of 2023 to attain detailed digital elevation data for New Found Gold Corp. The Yellow Fox property fell within the survey area, hence, the airborne data and expenditures were windowed out and given to MEK. A total of 7.0 km² was flown over the Yellow Fox property. The survey achieved a LiDAR point density of 8 pulses/m² resulting in a horizontal accuracy of +/- 0.30m, a vertical accuracy of 0.15m and a photo resolution of 20cm.

2025 WORK BY LOMIKO METALS

Work in 2025 has consisted of soil sampling and minor prospecting for the collection of 850 soil samples and 22 rock samples. Several highly prospective, multi-element (Au, Sb, Ag, Zn, Pb, As, Fe, Mn, Ce) soil anomalies were generated with many new anomalies trending roughly north-northeast, similar to that of the highly prospective regional structures which also trend north-northeast. A new gold showing has been identified through prospecting returning assays to 1.55g/t. This new gold showing is hosted within a zone of carbonatized granite with finely disseminated pyrite. This new showing is located in an area where little to no exploration work has been conducted.

POINTS OF INTEREST

- Numerous multi-element soil anomalies that remain unexplained
- New gold discovery of 1.55g/t Au
- Structurally controlled sulphide vein sets like that hosting the past producing Beaver Brook Antimony Mine
- High-grade polymetallic veins
- Never diamond drill tested
- Large vastly underexplored property with lots of potential
- A structural interpretation of the LiDAR data, particularly the DEM data, appears to show faults/shear structures with favourable orientations trending northeast, east-west and northwest to north-northwest. There is possibly a tighter density of structures in the north-central portion of licence 037936M.

In a 2022 paper written by H.Campbell, H. Sandemann, J. Organ and S. Norris of the Department of Earth and Environmental Sciences, Dalhousie University, *“two locations of muscovite-pyrite altered boulders were located and studied south and southeast of the Yellow Fox showing.”* They write *“there are two distinct paleo-channels, south and west of the quarries that may have transported the boulders from the west, where they could have been re-entrained and dispersed northward, or transported from the west by eastward ice flow. Given the angularity and abundance of the Yellow Fox-type altered boulders, and their tendency to disintegrate, the source may be closer to the locations where the boulders were found. Thus the most likely source for the boulders and cobbles would be within 2-3 km radius, either south, southwest or west of the quarries.”* That could mean that the source of the boulders may be on the south-central portion of licence 037936M.

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NEW GOLD SHOWING
Grab sample of 1.30g/t Au

YELLOW FOX SHOWING
Grabs to 59.43g/t Au, 11.10% Sb, 7.00% Zn,
5.50 Pb + 72.90g/t Ag
Channeling of 0.35g/t Au + 0.27% Sb +
0.77% Zn + 0.21% Pb + 3.04g/t Ag over
16.49m

027536M

037936M

039252M



LOMIKO
METALS

0 1
kilometers

All_YF_soils by Au_ppb

- 51 to 100
- 26 to 50
- 21 to 25
- 16 to 20
- 11 to 15
- 6 to 10
- 0 to 5

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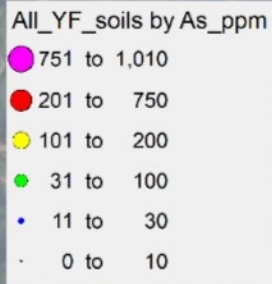
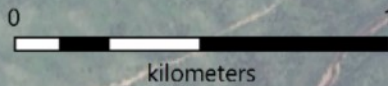
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5,417,500 mN

NEW GOLD SHOWING
Grab sample of 1.30g/t Au

YELLOW FOX SHOWING
Grabs to 59.43g/t Au, 11.10% Sb, 7.00% Zn,
5.50 Pb + 72.90g/t Ag
Channeling of 0.35g/t Au + 0.27% Sb +
0.77% Zn + 0.21% Pb + 3.04g/t Ag over
16.49m

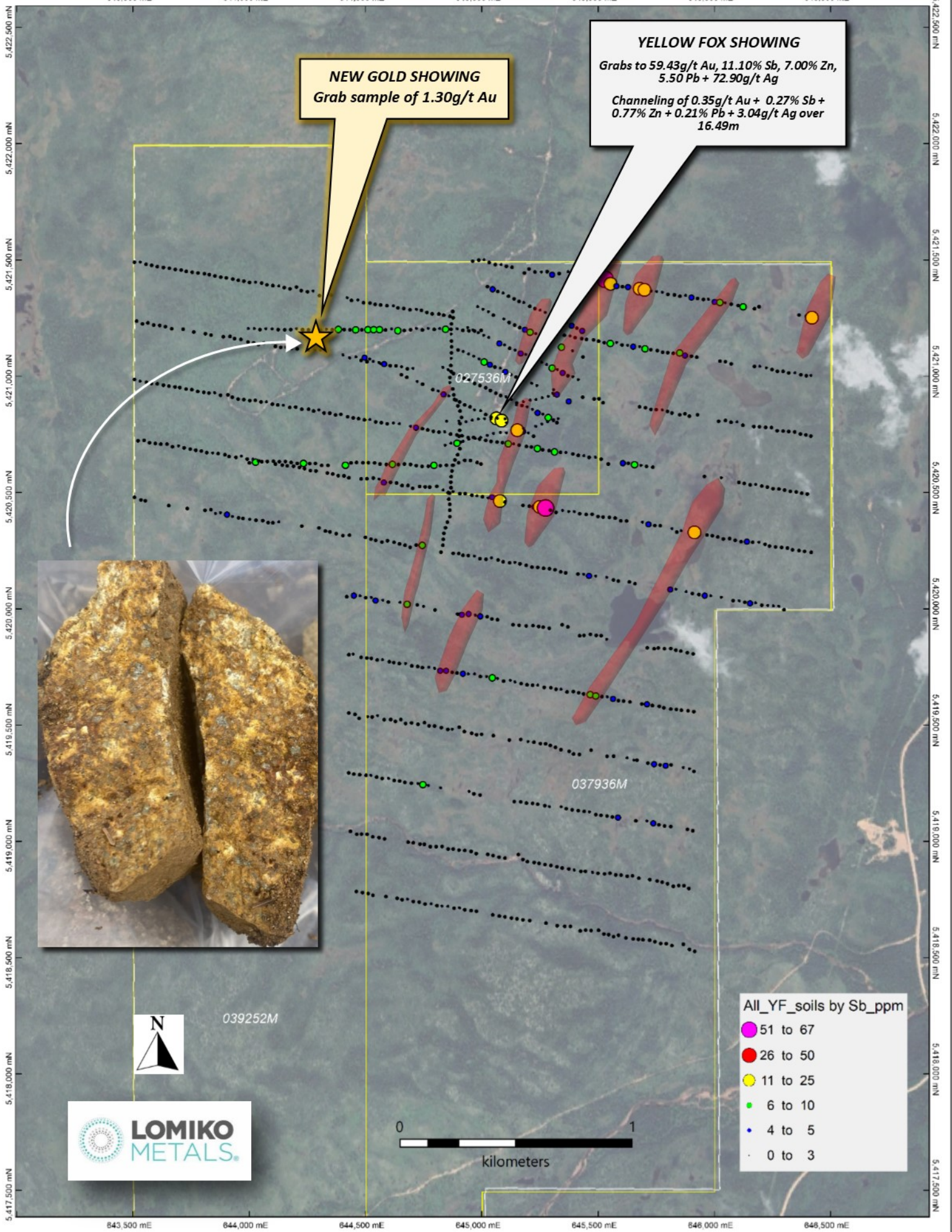


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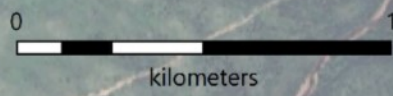
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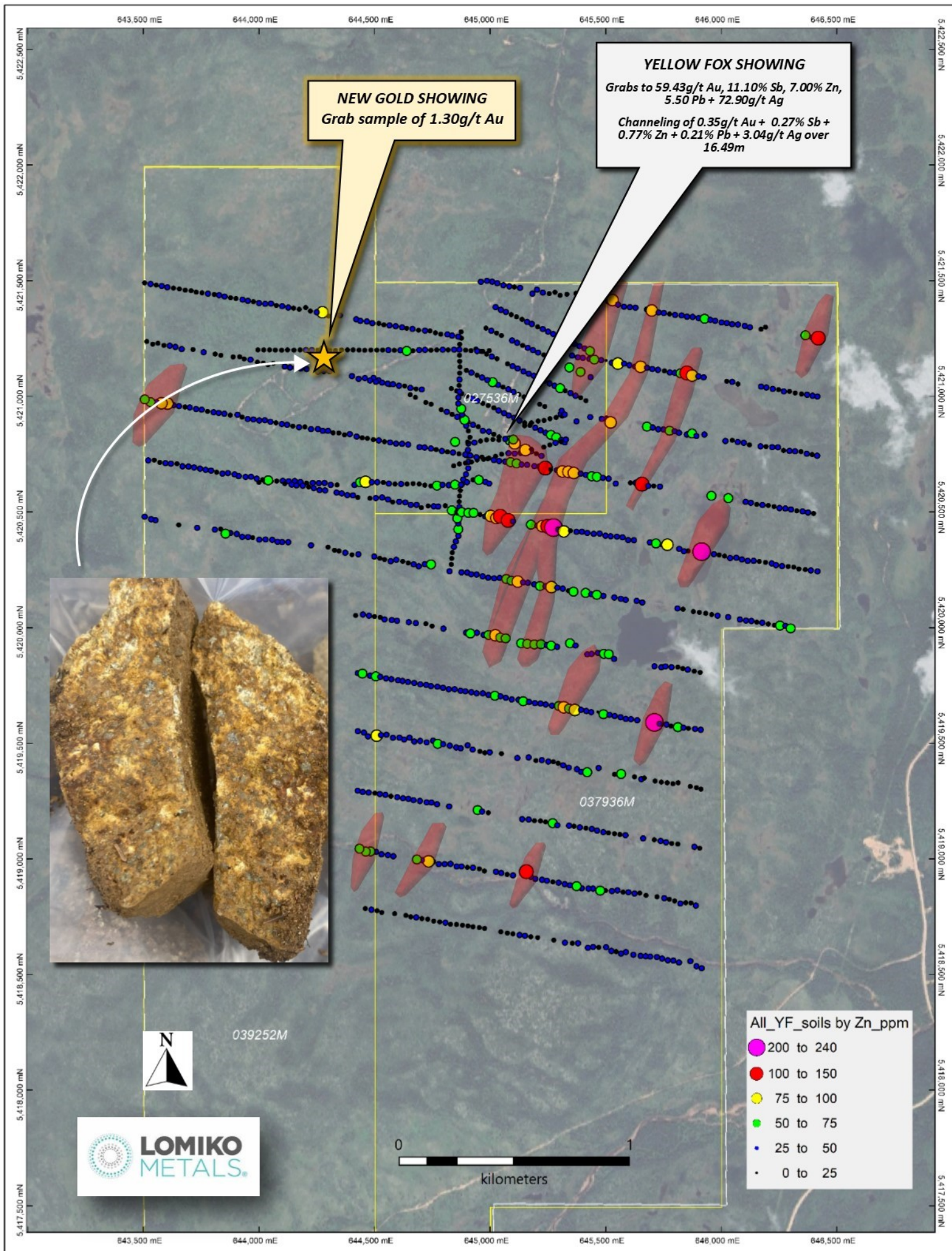
NEW GOLD SHOWING
Grab sample of 1.30g/t Au

YELLOW FOX SHOWING
Grabs to 59.43g/t Au, 11.10% Sb, 7.00% Zn,
5.50 Pb + 72.90g/t Ag
Channeling of 0.35g/t Au + 0.27% Sb +
0.77% Zn + 0.21% Pb + 3.04g/t Ag over
16.49m



All_YF_soils by Sb_ppm

51 to 67
26 to 50
11 to 25
6 to 10
4 to 5
0 to 3



THE YELLOW FOX SHOWING: MONZOGRAHITE-HOSTED, FRACTURE RELATED ANTIMONY–SILVER–GOLD MINERALIZATION NEAR THE EASTERN MARGIN OF THE MOUNT PEYTON INTRUSIVE SUITE, CENTRAL NEWFOUNDLAND (NTS MAP AREA 2D/14)

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Mineral Deposits Section

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ABSTRACT

The Yellow Fox showing is located 13 km southwest of Glenwood and was discovered in 2011 through grass-roots prospecting. It is hosted by monzogranite of the Late Silurian to Early Devonian Mount Peyton intrusive suite, central Newfoundland, and lies 1.8 km west of the inferred position of the southern extension of the Dog Bay Line. Sparse regional bedrock outcrops and five mineral-exploration-industry trenches demonstrate that the showing is hosted by fractured, muscovite–pyrite–rutile-altered, medium-grained, plagioclase porphyritic, granophyric-textured biotite ± hornblende monzogranite. Muscovite–pyrite–rutile alteration occurs in an approximately 100-m-long by 30-m-wide, broadly north-trending bleached and rusty zone, characterized by three distinct fracture sets. The most prominent fracture set is north-trending (356°/80°E), occurs on a spacing of 5–20 cm, and is accompanied by abundant muscovite and disseminated pyrite. A less common, metre-spaced, east-striking (098°/84°S) fracture set is barren with respect to alteration minerals or mineralization, whereas a third, weakly developed, north-northeast-trending (025°/86°E) fracture set, locally hosts a few narrow (<4 cm) stibnite–quartz–arsenopyrite veins. Arsenopyrite, mainly confined to vein margins, is extensively altered to supergene scorodite and goethite. The muscovite–pyrite–rutile alteration and north-trending fractures are cut by the north-northeast-trending stibnite–quartz–arsenopyrite-veined fractures. Relative to unaltered monzogranite, the early muscovite–pyrite–rutile-associated fracture set, and altered-host monzogranite samples, are typically moderately anomalous in As, Au, Ag, Sb, Pb and Cd. In contrast, the later stibnite–quartz–arsenopyrite-veined fractures and host rocks are strongly anomalous in all metals (Sb–As–Au–Ag–Pb–Zn–Cd) and weakly anomalous in Cu. No appreciable enrichment in Mo or W is evident. The host monzogranite is identical to other granites from the northeastern Mount Peyton intrusive suite, and all are weakly alkaline I- to A-type, biotite ± hornblende monzogranites. Mineralization must be younger than the ca. 419 Ma age of the monzogranite, may be contemporaneous with other intrusion-hosted mineralization in the area, and is probably Early Devonian. Fracturing and mineralization likely occurred in response to north-northwest-directed oblique sinistral Acadian deformation.

INTRODUCTION

The Yellow Fox showing is located 13 km southwest of Glenwood in central Newfoundland (Figures 1 and 2; NTS map area 2D/14), and was discovered in 2011 by Metals Creek Resources Corporation during regional reconnaissance gold exploration (Reid and Myllyaho, 2012). The showing is poorly exposed because of the thick glacial till cover and the local landscape that consists mostly of gently undulating, till-mantled boggy ground covered by black spruce-dominated forest. Bedrock exposures are almost entirely restricted to sparse low bedrock ridges, stream beds and borrow pits constructed for forest-access road construction. The showing may be accessed using an all-terrain vehicle via a network of old logging roads.

The Yellow Fox showing occurs in the northeastern sector of the Mount Peyton map area, near the juncture of four 1:50 000-scale NTS map areas (2D/14, 15, 2E/03, 04), and 4.5 km south of the Corsair and Hurricane prospects and associated showings exposed along the Salmon River (Tallman, 1990; Evans, 1996; O'Driscoll and Wilton, 2005; Sandeman *et al.*, 2017; Figure 2). The showing is hosted by monzogranite of the Late Silurian to Early Devonian Mount Peyton intrusive suite (MPIS) of central Newfoundland (Blackwood, 1982; Dickson, 1993, 1996; Sandeman *et al.*, 2017), which is predominantly composed of gabbro, varying to diorite, and intruded by less voluminous monzogranite.

The Yellow Fox showing is located approximately 1.8 km west of the projected position of the southern extension

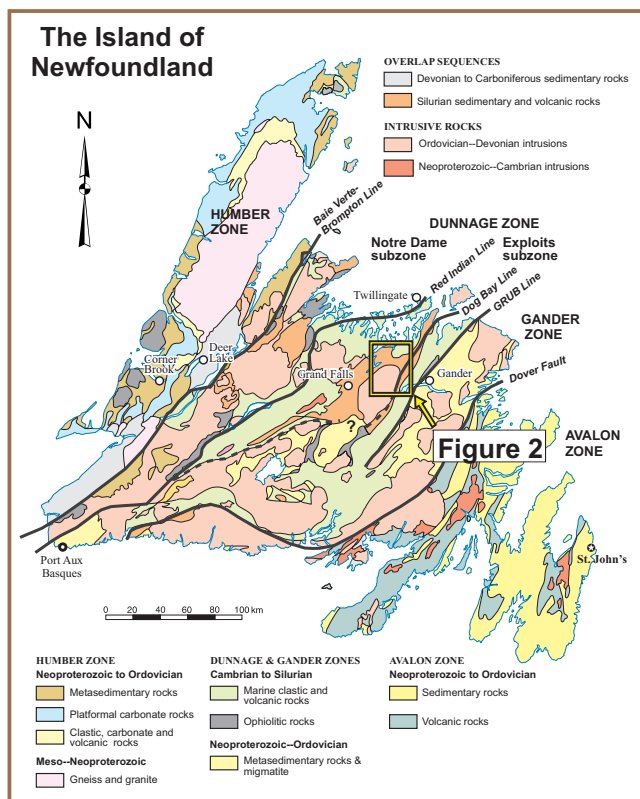


Figure 1. Simplified geological map of the Island of Newfoundland showing the location of the Yellow Fox showing and Figure 2 with respect to major geological terranes and tectonic boundaries (after Colman-Sadd *et al.*, 1990).

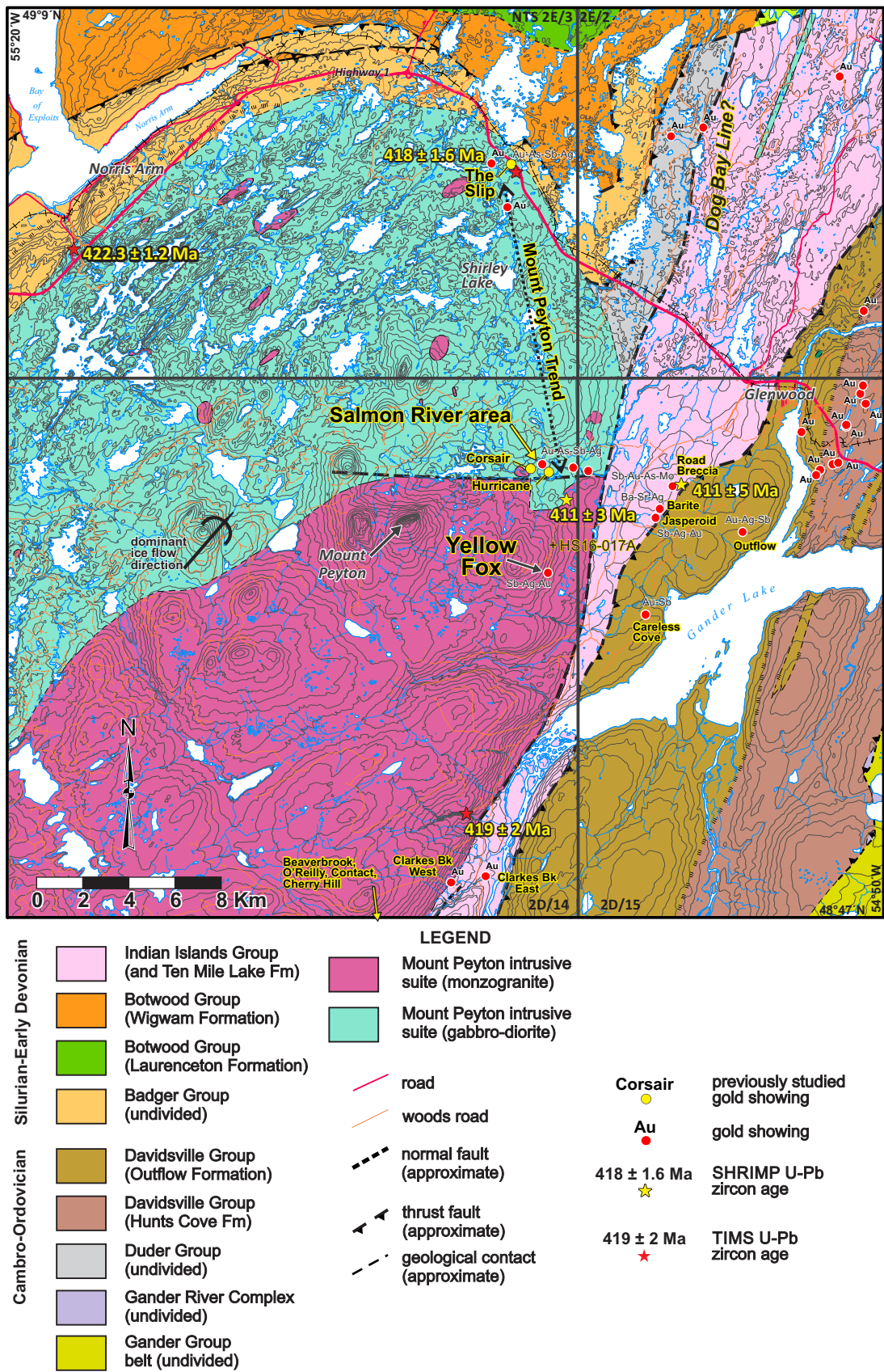
of the proposed terminal Iapetan suture, termed the Dog Bay Line (Currie, 1993; Piasecki, 1993; Williams, 1993; Williams *et al.*, 1993; Pollock *et al.*, 2007). East of the MPIS, and presumably constituting the most westerly unit lying southeast of the Dog Bay Line, lies the Silurian, shallow-marine, locally calcareous and macro-fossil-bearing siltstones and sandstones of the Indian Islands Group (Williams *et al.*, 1993; Currie, 1993, 1995; Dickson, 1993, 1996, 2006). These Silurian rocks are demonstrably imbricated with both Middle Ordovician siltstones and sandstone, and Late Ordovician graphitic, pyritic, and graptolitic shale (Sandeman *et al.*, 2018). Extensive mineral exploration work in the area has identified a number of precious-metal- and antimony-mineralized zones (Evans, 1996; Barbour and Churchill, 1999, 2004; O'Reilly *et al.*, 2010; Sandeman *et al.*, 2017, 2018) that may share common genetic attributes.

This report is a component of an ongoing, broader study of precious-metal mineralization in, and around, the MPIS and the Botwood and Indian Islands basins. These investigations build upon the extensive mapping, geochronology, biostratigraphy and lithogeochemical work of previous investigators (Dunning, 1992, 1994; Dunning and Manser, 1993; Dickson, 1993, 1994, 2006; Boyce and Ash, 1994; Dickson *et al.*, 2000, 2007; O'Brien, 2003; Boyce and Dickson, 2006; McNicoll *et al.*, 2006), as well as the more detailed mineral-deposit studies in the area (Evans and Wilson, 1994; Evans, 1996; O'Driscoll and Wilton, 2005; Squires, 2005; Lake and Wilton, 2006; Sandeman *et al.*, 2017, 2018), which collectively provide a framework upon which a better understanding of the mineralized systems of the region may be constructed. Herein, new field, petrographic and lithogeochemical data, along with Mineral Liberation Analysis (MLA) electron beam mapping and imagery, are presented for rocks of the Yellow Fox mineralized zone. Some of the data and observations presented herein formed the B.Sc. thesis of C. Spurrell at Memorial University of Newfoundland and Labrador (Spurrell, 2017). These data are supplemented by lithogeochemical data for granitic rocks of the region (Dickson and Kerr, 2007; Sandeman *et al.*, 2017) and are compared to available industry-assessment report data for the showing (Reid and Myllyaho, 2012) and to mineralized samples from the proximal, MPIS diorite-hosted Salmon River prospects (Tallman, 1990, 1991a; Hoffe and Sparkes, 2003; House, 2007a; Quinlan, 2009). The lithogeochemical data, along with field and petrographic observations on the style and character of alteration and additional observations from industry-assessment reports, enhance our collective knowledge-base for these intrusion-hosted precious-metal mineralized zones in the MPIS. These mineralized zones may share common genetic attributes with numerous proximal metasedimentary rock-hosted mineralized zones exposed east of the MPIS (*e.g.*, O'Driscoll and Wilton, 2005; Squires, 2005). Mineral abbreviations used herein are from Whitney and Evans (2010).

REGIONAL SETTING

The Yellow Fox showing lies in the northeastern Exploits Subzone of the Newfoundland Appalachians, and occurs 1.8 km west of the projected position of terminal Iapetan suture termed the Dog Bay Line (Figures 1 and 2; Currie, 1993; Piasecki, 1993; Williams, 1993; Williams *et al.*, 1993;

Figure 2. (Figure on page 3) Geology of the northern part of the MPIS and adjacent country rocks illustrating the location of the Yellow Fox showing and its proximity to the projected southern extension of the Dog Bay Line as based on the detailed airborne geophysical data of Moore and Smith (2003) and House and McConnell (2003). The red dots are precious-metal showings taken from the Mineral Occurrence Database (MODS: gis.geosurv.gov.nl.ca/mods/mods.asp). Previous studied mineralization refers to those discussed in Sandeman *et al.* (2017).



Pollock *et al.*, 2007). The rocks of the Exploits Subzone are largely composed of a collage of Ordovician intra-oceanic arcs, back-arcs and associated marine sedimentary rocks, which in its eastern portion, have demonstrably been structurally emplaced over metasedimentary basement rocks of Ganderia (Colman-Sadd *et al.*, 1990; Vaquero-Valverde *et al.*, 2006). Ordovician volcanic and marine sedimentary rocks of the Exploits Subzone are both conformably and unconformably overlain by the Siluro-Devonian overlap sequences of the Badger, Botwood and Indian Islands groups (Evans *et al.*, 1993; Williams, 1993; Currie, 1993; Williams *et al.*, 1995; O'Brien, 2003). Collectively, these diverse units have been intruded by Late Silurian to Early Devonian intrusive and hypabyssal rocks of the Mount Peyton and Fogo Island intrusive suites (Dickson, 1996; van Staal *et al.*, 2014).

The greater Mount Peyton area (Figures 1 and 2) has been the subject of extensive governmental work, much of which has been summarized by Dickson (1993, 1994, 1996, 2006), O'Driscoll and Wilton (2005), McNicoll *et al.* (2006) and Dickson *et al.* (2007), and the character and styles of mineralization in the region have been documented by Tallman (1991b), Tallman and Evans (1994), Evans (1996), O'Driscoll and Wilton (2005), Squires (2005) and Lake and Wilton (2006). Sandeman *et al.* (2017) provided an updated summary of previous work on the MPIS, examined the age and composition of components of the intrusive suite, and presented new observations on the setting, petrography and structure of the Hurricane and Corsair zones of the Salmon River area and the Slip showing in the Neyles Brook quarry; all of which occur in the granitoid rocks of the MPIS. The relative age, lithostratigraphic and structural geology of the rocks proximal to, and hosting, the Beaver Brook Antimony Mine were discussed in Sandeman *et al.* (2018) who provide the most recent geological summary of the area. Previous investigations in the region pertaining to the age, petrochemistry and contact relationships of the granitoid rocks are briefly reviewed below.

Baird *et al.* (1951) recognized that a large part of north central Newfoundland is underlain by gabbroic and granitic rocks that intrude adjacent sedimentary units. The first 1:250 000-scale map of the region (Williams, 1962) outlined a large gabbro to diorite intrusion cut by monzogranite, outcropping to the south of the community of Norris Arm (Figures 1 and 2). Williams (*op. cit.*) proposed a Devonian age for these intrusive rocks, but stated that 'the relationships of these various rock types are not well known'. The intrusive rocks were included in the regional 1:250 000-scale map of Anderson and Williams (1970).

The earliest geochronological work on the MPIS yielded imprecise K–Ar ages from widely separated localities

ranging from 418 ± 21 to 270 ± 52 Ma (Wanless *et al.*, 1967). Subsequently, four granitic (*s.l.*) rocks of the MPIS yielded a Devonian Rb–Sr whole-rock isochron age of 380 ± 30 Ma (Bell *et al.*, 1977). Biotite from the gabbroic part of the MPIS gave a conventional K–Ar date of 410 ± 21 Ma (Williams, 1962; Anderson and Williams, 1970). These early radiometric data were supplemented by more precise ^{40}Ar – ^{39}Ar step-heating plateau ages for hornblende and biotite, from a MPIS gabbro sample obtained near Norris Arm that yielded overlapping plateau ages suggesting a 420 ± 8 Ma, latest Silurian age (Reynolds *et al.*, 1981). A reconnaissance petrological study, focused mainly on the northern part of the intrusive complex, outlined that the granitoid rocks comprise a bimodal geochemical assemblage of granite and gabbro (Strong, 1977). Further petrological investigations (Strong and Dupuy, 1982) demonstrated that the intrusive suite comprises gabbro, formed from mantle-derived melts, and granite (*s.l.*) that formed *via* anatexis resulting from introduction of the mafic magma into the crust. The few intermediate compositions noted (Strong and Dupuy, *op. cit.*) were considered to have formed either by magma mixing between the magmatic end-members and/or contamination of the gabbroic magma by the surrounding metasedimentary country rocks. Regional 1:50 000-scale mapping of the Gander Lake map area at that time (Blackwood, 1982) resulted in the introduction of the term Mount Peyton intrusive suite for these diverse plutonic rocks. Using combined magnetic, gravity and lake-sediment geochemical data (Miller and Thakwalakwa, 1992), the MPIS has been shown to comprise an inward-dipping ellipsoidal gabbro to diorite laccolith intruded, and overlain, by a relatively thin mantle of granite.

Much of the subsequent governmental and academic work on the MPIS has been summarized by Dickson (1993, 1994, 1996, 2006) and Dickson *et al.* (2000) and comprised regional geological mapping, lithogeochemical sample collection and interpretation. An updated lithogeochemical database for the MPIS was included in Dickson and Kerr (2007).

The northern margin of the MPIS gabbro–diorite has been demonstrated to have been emplaced into Late Ordovician to Early Silurian Badger Group sedimentary rocks and yielded a marginal hornfels that was metamorphosed at $\sim 810^\circ\text{C}$ and 2.5 kbar (Hynes and Rivers, 2002). The western contact of the MPIS comprises a km-scale-wide zone of migmatitic agmatite consisting of angular, biotite psammite paleosome blocks engulfed by a granodiorite, to locally gabbro neosome that passes westward into sandstone hornfels; the agmatite blocks and hornfels are also interpreted as Badger Group strata (Dickson, 1993; Dickson *et al.*, 2000; O'Brien, 2003).

East of the MPIS, and presumably constituting the most westerly unit lying southeast of the Dog Bay Line, are the Silurian, shallow-marine, locally calcareous and macro-fossil-bearing siltstones and sandstones of the Indian Islands Group (Williams *et al.*, 1993; Currie, 1993, 1995; Dickson, 1996). Along its eastern margin, monzogranite of the MPIS intrudes and generates hornfels in 5- to 20-cm-scale bedded muscovitic sandstone and siltstone of probable Silurian age (Dickson, 1993, 1996; Sandeman *et al.*, 2018). These Silurian rocks are demonstrably imbricated with both Middle Ordovician siltstone and sandstone and Late Ordovician graphitic and pyritic, graptolitic shale (Sandeman *et al.*, *op. cit.*). The most recent field, litho-geochemical and geochronological investigations (Sandeman *et al.*, 2017, 2018) have demonstrated that the MPIS exhibits both intrusive, as well as faulted, contacts with southeastward-lying rocks of the Indian Islands Group, and that most of the gabbroic components of the MPIS were emplaced in the interval *ca.* 425.4 to 421.1 Ma, whereas the granitic parts intruded the gabbro–diorite from *ca.* 419.6 to 416.4 Ma.

PREVIOUS EXPLORATION

Exploration for gold in the Mount Peyton area began in the late 1980s, accompanying an increase in the price of gold bullion. Subsequent to the release of a government regional lake-sediment survey that covered the Mount Peyton area (Davenport and Nolan, 1989), Noranda Exploration Ltd. staked claims and conducted reconnaissance prospecting and regional-till and lake/stream-sediment sampling programs in the northeastern parts of the MPIS (Tallman, 1990). These investigations resulted in the discovery of a number of bedrock gold showings along the Salmon River that yielded up to 25.8 g/t Au and accompanying elevated Ag, Sb and As (Tallman, 1990). In 1990, geophysics, trenching and diamond drilling were completed and led to the discovery of a number of north- and north-northeast-striking, moderately east-dipping mineralized zones including the Hurricane and Corsair prospects (Figure 2; Tallman, 1991a).

Modest exploration for gold in central Newfoundland in the mid-1990s led to Forex Resources' discovery of the Slip showing (Figure 2) in 1993 (Clarke, 1996), hosted by the MPIS and located off the TCH in the Neyles Brook Quarry. Renewed gold exploration in 1999, particularly in the Shirley Lake area (Figure 2; Evans and Dimmell, 2001; Evans *et al.*, 2001), revealed anomalous lake-sediment, soil and bedrock samples defining a north-northwest-trending, 13.5-km-long corridor hosting gold, arsenic and antimony occurrences known as 'the Peyton' or 'the Mount Peyton' trend (Tallman, 1991a; Evans, 1996; Evans and Dimmell, 2001; Evans *et al.*, 2001; Hoffe and Sparkes, 2003; House, 2003, 2005, 2007a, b).

From 2002 to 2007, Rubicon Minerals explored the northeastern parts of the MPIS and completed a regional program including detailed (75-m- and 50-m-line spacing), helicopter-borne aeromagnetic programs, soil-sampling surveys and two diamond drill-holes on the Hurricane prospect (Figure 2; House and McConnell, 2003; Moore and Smith, 2003; House 2007a). Rubicon Minerals also supported a B.Sc. (Hons.) thesis (Hoffe, 2003) encompassing a detailed, multi-element litho-geochemical and geochronological examination of the phases of the MPIS at the Slip showing, results of which are summarized in a mineral-exploration industry assessment report (Hoffe and Sparkes, 2003) and a recent current research report (Sandeman *et al.*, 2017). Further work in the area around the Slip showing (Quinlan, 2009) resulted in the discovery of two additional bedrock and float occurrences, for which fourteen samples returned anomalous gold values ranging from 12 to 12 880 ppb. Those samples consisted of mineralized quartz veins, or quartz vein breccia hosted by gabbro of the MPIS (Quinlan, *op. cit.*).

To the east and southeast, along the margin of the MPIS, many new mineralized zones consisting of epithermal quartz veins, vein breccias and disseminated mineralization in altered wall rock were concurrently discovered and explored (Figure 2; Barbour and Churchill, 1999, 2004; O'Reilly and Churchill, 2004; O'Driscoll and Wilton, 2005; Squires, 2005; House, 2005, 2007a, b; O'Reilly *et al.*, 2008, 2010; Quinlan, 2013). Results outlined northeast-trending zones of veining, silicification and brecciation with disseminated and vein-hosted Au–Ag–As–Sb mineralization at the Mustang and Piper zones (Barbour and Churchill, 2004) as well as epithermal, vuggy and chalcedonic vein- and vein-breccia-related Au ± As ± Ag ± Sb ± Mo mineralization at the O'Reilly showing (O'Reilly *et al.*, 2008, 2010). A number of other discoveries including the Cherry Hill, Clarkes Brook East and Contact showings (Squires, 2005; O'Reilly *et al.*, 2008) all appear to have metal associations similar to those described above. The Yellow Fox showing (Figure 2) was discovered about this time through grass-roots prospecting by Metals Creek Resources in May 2011 (Reid and Myllyaho, 2012). Prospecting yielded a number of grab samples having anomalous metals and yielding a maximum gold assay value of 59.41 ppm Au with coincident elevated silver (15.34 ppm Ag) and weakly anomalous antimony (19 ppm Sb) and copper (531 ppm Cu) (Reid and Myllyaho, 2012). The positive results from prospecting resulted in 2 reconnaissance B-horizon soil-sampling lines; however, soil-sampling results were poor, yielding <5 ppb Au. The company then excavated six east–west-oriented trenches and completed channel sampling in 5 of these trenches. Results were positive, yielding up to 306 ppb Au over 26.82 m, however, there has been no further work on the property and the trenches reclaimed in mid-summer 2017.

GEOLOGY OF THE YELLOW FOX SHOWING

Bedrock exposures near the showing are rare and are confined mainly to ground disturbances associated with forest-access road construction. The showing was exposed during the excavation of 6 east–west-oriented trenches, labelled from north to south Trench 1 through 6 (only 5 are shown in Figure 3). The northern 4 trenches exposed fractured, medium-grained, generally equigranular and locally plagioclase porphyritic monzogranite that is either reddened, or bleached and rusty (Figure 3). The few proximal outcrops of Mount Peyton monzogranite typically lack the pervasive fracturing and the reddening or bleaching (Plate 1A) noted at the Yellow Fox showing (Plate 1B–D). The monzogranite underlying the western margins of the 4 northern trenches is the least altered and exhibits minor reddening and fracturing

(Plate 1B); however, the remainder of the exposed monzogranite is variably bleached, fractured and rusty and contains sparse disseminated pyrite. The most intensely altered monzogranite occurs along the central, north–south axis of the trenches and consists of strongly bleached, fractured and rusty, muscovite–pyrite–rutile-altered monzogranite (Plate 1C). At the northernmost Trench 1, the intensely muscovite–pyrite–rutile-altered monzogranite is cut by a 4-cm-wide, north-northeast-trending stibnite–quartz–arsenopyrite vein (Plate 1D).

Examination of the bedrock in the trenches revealed three distinct fracture sets (Plate 2). These include: 1) widely spaced, roughly east–west barren fractures; 2) north–south trending, 5 to 20 cm-spaced fractures in muscovite–pyrite–rutile-altered monzogranite and; 3) sparse, north-northeast-trending, locally stibnite–quartz–arsenopyrite-

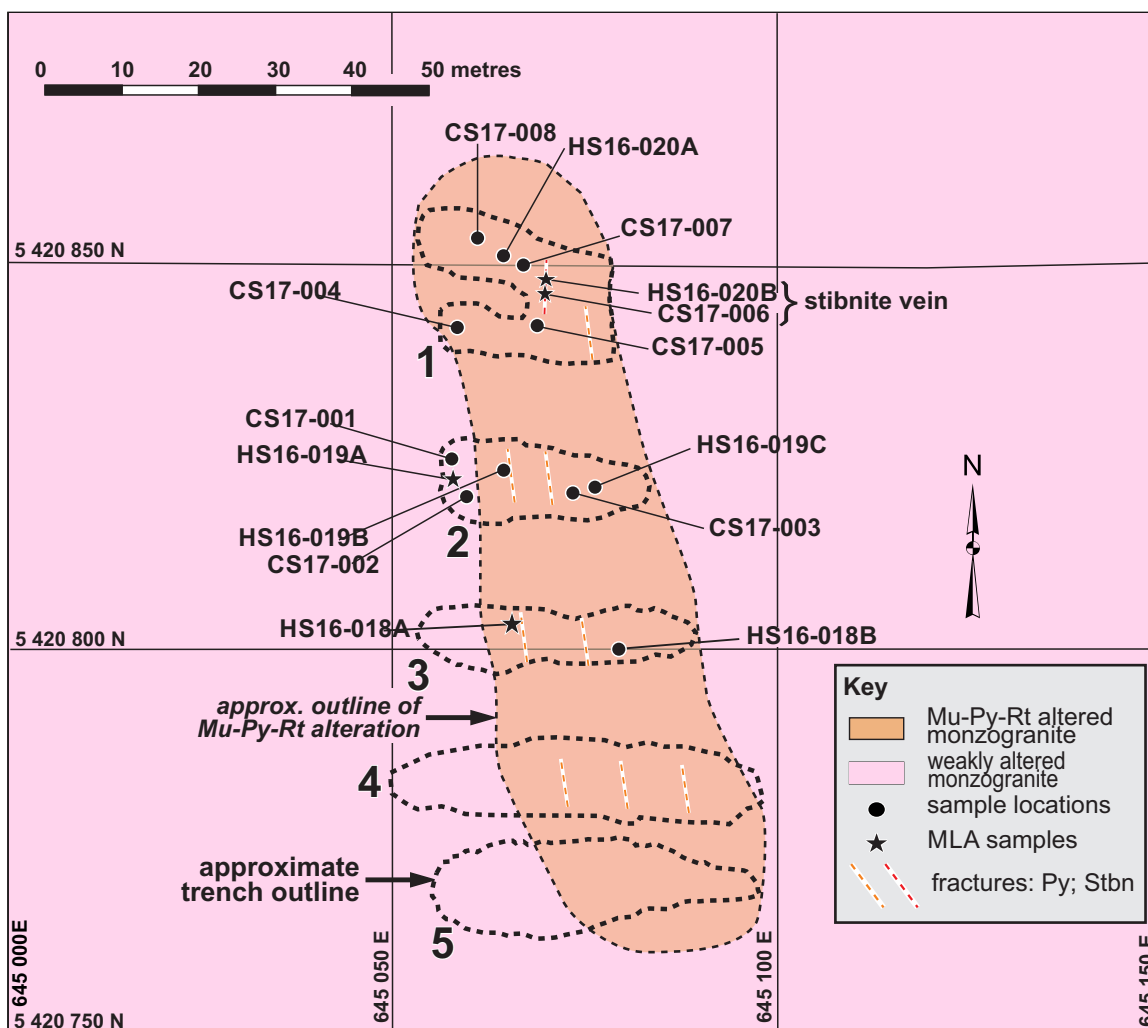


Figure 3. Geological sketch map of the Yellow Fox showing as determined through examination of the industry trenches (Reid and Myllyaho, 2012). Also shown are sample locations (except HS16-017A; see Figure 2), the approximate distribution of alteration and, a few representative, salient fractures.

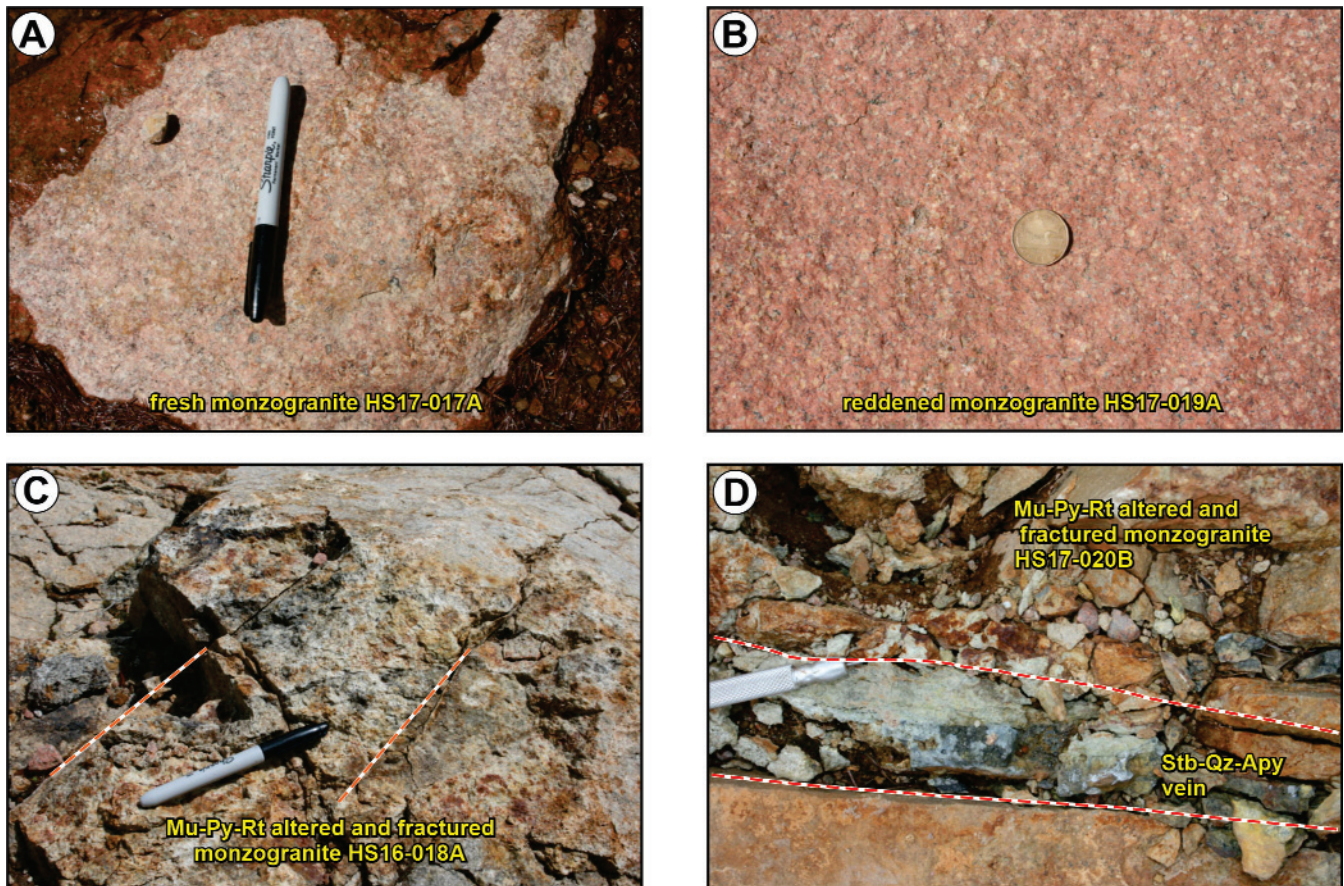


Plate 1. Representative photographs. A) Relatively fresh, unaltered plagioclase porphyritic monzogranite (sample HS16-017A: UTM's 645117E, 5421989N); B) Reddened, weakly plagioclase porphyritic monzogranite at the western margin of Yellow Fox Trench 2 (Figure 3: sample station HS16-019A: UTM's 654048E, 5420802N); C) Bleached and fractured, muscovite-pyrite-rutile altered monzogranite from Yellow Fox Trench 3 (Figure 3: sample station HS16-018A: UTM's 645081E, 5420793N); D) The ≤ 4 -cm-wide stibnite-quartz-arsenopyrite vein cutting bleached monzogranite at the discovery outcrop in Trench 1 (Figure 3: sample station HS16-020B: UTM's 645069E, 5420827N). Marker and pen magnet in photos point north.

veined fractures. An equal area stereographic projection of the poles to fractures (Figure 4) indicates that the barren (green) fractures have a mean orientation of $98^{\circ}/84^{\circ}\text{S}$, the muscovite-pyrite-rutile-mineralized fractures (orange) have a mean orientation of $356^{\circ}/80^{\circ}\text{E}$ and, the stibnite-quartz-arsenopyrite-veined (red) fractures have a mean orientation of $25^{\circ}/86^{\circ}\text{E}$.

SAMPLING AND ANALYTICAL METHODS

Nineteen bedrock samples were collected from the Yellow Fox trenches and showing area for petrographic and lithogeochemical analysis and include: 4 samples of relatively fresh monzogranite from the peripheries of the industry trenches and one from 1 km north of the showing (including 2 duplicate analyses); 11 samples of altered and fractured, muscovite-pyrite-rutile-altered monzogranite from the trenches and; 3 samples of strongly altered monzo-

granite cut by a stibnite-quartz-arsenopyrite-bearing vein (Table 1). Of the nineteen samples, three were selected for further detailed petrographic analysis using mineral liberation analysis-scanning electron microscopy (MLA-SEM). These three samples were selected to illustrate the mineralogical changes in the granite in and around the mineralized zone as they span the complete spectrum of fresh or deuterically altered through strongly hydrothermally altered monzogranite marginal to the stibnite vein.

All samples were crushed and processed for standard lithogeochemistry and were analyzed at the Government of Newfoundland and Labrador, Department of Natural Resources Howley Building Laboratory using: Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES) for the major elements and selected trace elements including Ag and Inductively Coupled Plasma Mass Spectrometry (ICP-MS) for selected trace elements and the

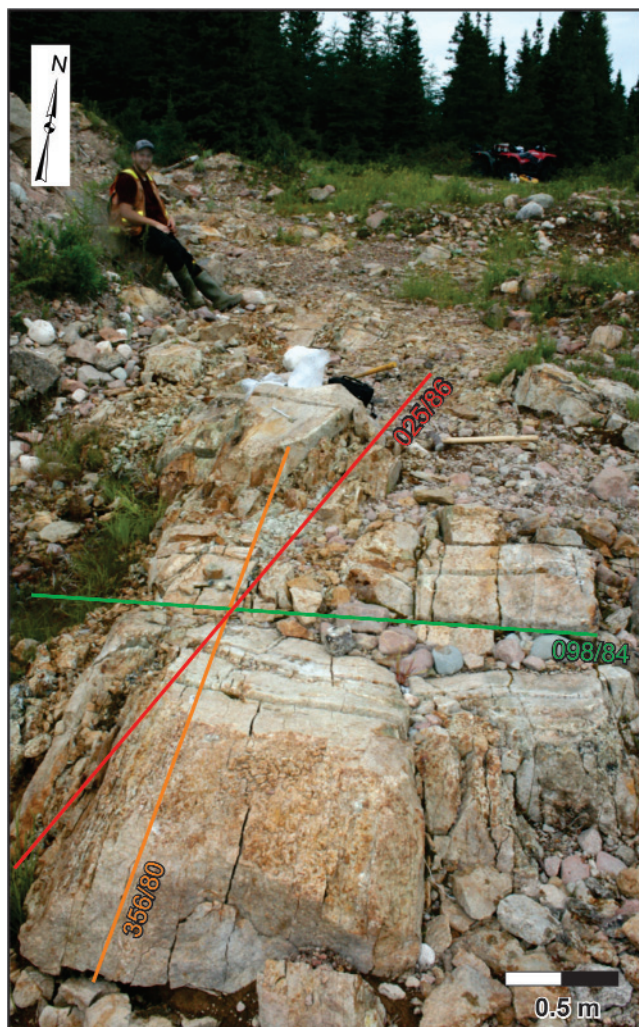


Plate 2. Photograph looking north, showing the distribution and disposition of barren and mineralized fracture sets at the Yellow Fox showing. Illustrated are the planes of barren fractures (green; $98^{\circ}/84^{\circ}\text{E}$), muscovite-pyrite-rutile-mineralized fractures (Orange; $356^{\circ}/89^{\circ}\text{E}$) and stibnite-quartz-arsenopyrite-veined fractures (Red; $25^{\circ}/86^{\circ}\text{E}$). Note the cut channel samples that parallel to the barren, east-west fracture system.

rare-earth elements (REE). Gold, Cd, Bi, As and Sb were determined *via* Instrumental Neutron Activation Analysis (INAA) at Bureau Veritas Laboratories (www.bvlabs.com; formerly Maxxam Analytics) using their standard techniques. Fluorine was analyzed using an ion specific electrode. Complete analytical methods are given in Finch *et al.* (2018) and Sandeman *et al.* (2017) and the data are presented in Table 1. These lithogeochemical data are compared to regional samples of fresh monzogranite from the northern part of the MPIS in order to examine their petrogenesis, and to altered and mineralized rocks of the suite for a comparison of the metal enrichment signatures of the

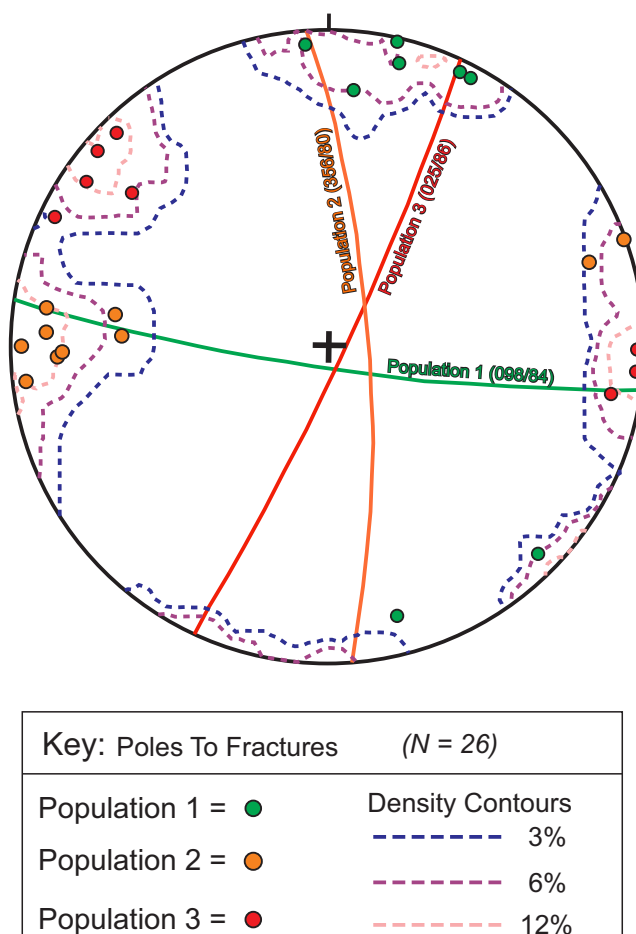


Figure 4. Lower hemisphere, equal-area plot of poles to barren, muscovite-pyrite-rutile-altered, and stibnite-quartz-arsenopyrite-veined fractures.

mineralized zone (Tallman, 1991a; Evans, 1996; Evans and Dimmell, 2001; Evans *et al.*, 2001; Hoffe and Sparkes, 2003; House, 2003, 2005, 2007a, b; Dickson and Kerr, 2007; Sandeman *et al.*, 2017). Strongly elevated Sb in the stibnite-quartz-arsenopyrite-veined monzogranite resulted in gamma-ray spectral interference in the INAA data that yielded unresolvable Au in those analyses. Hence, the mineral-exploration fire assay data for gold (Reid and Myllyaho, 2012) are more useful for interpretation.

One representative sample each of reddened monzogranite, bleached muscovite-pyrite-rutile-altered monzogranite and the stibnite-quartz-arsenopyrite-veined monzogranite were selected for qualitative mineral chemical analysis and MLA imaging of thin sections using a FEI MLA 650FEG(2) Scanning Electron Microscope (SEM) at Memorial University of Newfoundland and Labrador Micro Analysis Facility (MUN MAF-IIC). Qualitative analyses were completed with high throughput Energy-dispersive X-ray spectroscopy (EDX) detectors from Bruker (Bruker

Mineral Assay Gun. <https://www.mun.ca/creait/>). The purpose of this SEM work was to map the electron energy spectra of the thin section in order to identify all minerals; in particular, fine-grained alteration phases, and to visually illustrate diagnostic mineral textures.

A cut representative piece of each of the 19 rock samples were analyzed using visible/infrared reflectance spectrometric (VIRS) analysis collected on and exported from a TerraSpec® Pro spectrometer. Spectral and mineral identification of the VIRS data were determined using the TSG™ Pro software. A summary of this method and its applications at the Geological Survey of Newfoundland and Labrador are presented in Kerr *et al.* (2011). Each sample was scanned at least twice in order to test analytical reproducibility. Within the dataset (Table 2), an estimate of the relative proportions of the two dominant mineral phases within each sample are provided (wt. % mineral 1 and wt. % mineral 2), along with a corresponding error related to the overall ‘fit’ of the sample spectra relative to reference spectra in the TSG™ Pro spectral database (Error_sTSAS). The lower the error value, the better the match with the reference spectra. Because of the nature of the alteration, absorption features in the short-wavelength-infrared region (~1300–2500 nm) characteristic of the white mica minerals are the main topic of interest. Table 2 also provides the calculated depth of wavelength troughs for three characteristic (1400, 1900 and 2200 nm) absorption features of white micas along with the position of the 2200 nm absorption feature and estimates of the illite spectral maturity (ISM (H₂O)) for the samples.

ANALYTICAL RESULTS

VIRS ANALYSIS

Whereas all samples have muscovite as a significant hydrous mineral, six analyses from three specific samples contain additional hydrous minerals. The representative, regional monzogranite sample HS17-017A contains muscovite with chlorite and siderite. The marginal, weakly altered and reddened monzogranite HS16-019A is characterized by a phengitic white mica. The stibnite–quartz–arsenopyrite-veined monzogranite sample HS17-020B yielded two analyses with only muscovite and two with both muscovite and chlorite (Table 2). A plot of illite spectral maturity (Doublier *et al.*, 2010) or ISM(H₂O) vs. the white mica ~2200 nm spectral trough position (Duke, 1994) outlines the distinction between the muscovite only, vs. muscovite–chlorite- or phengite-bearing samples (Figure 5A). On this diagram, the six differing analyses with spectral trough positions at >2205 nm have lower spectral maturity, corresponding lower crystallinity, and hence plot to the right of the remainder of the samples. Similarly, the six distinct analyses have relatively small ~2200 vs. ~1900 nm troughs,

corresponding with low ISM (H₂O), and fall on a distinct array from the remainder of the analyses (Figure 5B). These observations indicate that the VIRS analyses of the least altered monzogranite sampled less crystalline white mica that was formed at lower temperatures than those in the muscovite only samples. The two analyses of the stibnite–quartz–arsenopyrite-veined sample (HS16-020B), located off the main trend, contain spectral signatures that are dominated by broad water features coupled with weak 2200 nm absorption troughs. Such analyses may result from spectral interference from the vein quartz and chlorite present within the sample.

PETROGRAPHY AND MLA DATA

On the basis of field, VIRS and petrographic observations, the samples are grouped into: 1) regional, background, locally deuterically altered fresh monzogranite; 2) weakly hydrothermally altered monzogranite distal (>25 m) from the central axis of the Yellow Fox fracture and vein systems (HS16-019A); 3) muscovite–pyrite–rutile-altered monzogranite lying within the fractured and veined area (HS16-018A) and; 4) stibnite–quartz–arsenopyrite-veined monzogranite at the core of the fracture systems (HS16-020B). All sample locations (Table 1; Figures 2 and 3) are recorded in NAD27 datum and UTM zone 21. Below we discuss the petrographic characteristics of the monzogranite with respect to the collective petrography of all samples, but in particular, with reference to the three samples chosen for MLA analysis.

Regional, Fresh Monzogranite (*e.g.*, HS16-017A)

Sample HS16-017A is a representative plagioclase porphyritic, fine- to medium-grained, granophyric-textured, hornblende–biotite monzogranite obtained from a small borrow pit on the north side of the Yellow Fox access road, ~1 km north of the showing (Figure 2). Plagioclase phenocrysts are variably saussuritized, although lamellar twinning is locally preserved (Plate 3A, B). Mafic mineral phases are sparse, forming small clots in what are interpreted as miarolitic cavities between the quartz and feldspars that include: variably chloritized, subhedral, bladed biotite, subhedral dark green hornblende with sparse anhedral grains of intergrown magnetite and ilmenite, and minor euhedral zircon and subhedral commonly accicular apatite (Plate 3B).

Weakly Altered Reddened Monzogranite (*e.g.*, HS16-019A)

Sample HS16-019A is a representative, incipiently altered, medium-grained, plagioclase porphyritic, granophyric-textured biotite–hornblende monzogranite of the MPIS that was collected from the west end of Trench 2

Table 1. Lithogeochemical data for samples from the Yellow Fox showing. Negative numbers indicate detection limits. Large negative numbers for INAA data further indicate significant spectral interference

Sample	CS17-001	CS17-002	CS17-003	CS17-004	CS17-005	CS17-006	CS17-007	CS17-008	HS16-017A
Lab Number	8941276	8941277	8941278	8941279	8941339	8941281	8941338	8941282	8941124
rock-type	Mu-Py-Rt	Mu-Py-Rt	Mu-Py-Rt	Stbn-Qtz-Apy- veined mzn	Stbn-Qtz-Apy- veined mzn	Mu-Py-Rt	Mu-Py-Rt	Mu-Py-Rt	Fresh mzn
UTM_East	645147	645143	645151	645151	645155	645151	645155	645151	645117
UTM_North	5421026	5421015	5421014	5421014	5421050	5421014	5421050	5421014	5421989
zone	21	21	21	21	21	21	21	21	21
datum	NAD 27	NAD 27	NAD 27	NAD 27	NAD 27	NAD 27	NAD 27	NAD 27	NAD 27
Mg#	12.55	16.05	18.56	3.05	4.00	14.54	19.06	13.98	20.58
SiO ₂ (wt.%)	78.20	78.41	78.35	61.59	67.94	77.48	76.14	78.11	73.60
Al ₂ O ₃	11.60	11.85	12.27	8.40	9.87	12.08	12.78	12.35	12.71
Fe ₂ O ₃ ^T	2.61	2.16	1.85	7.31	6.34	2.17	2.34	2.13	2.35
Fe ₂ O ₃	1.21	0.71	NA	0.65	1.93	0.70	0.60	0.85	0.68
FeO	1.26	1.31	NA	5.99	3.97	1.32	1.57	1.15	1.50
MgO	0.19	0.21	0.21	0.12	0.13	0.19	0.28	0.17	0.31
CaO	0.04	0.06	0.05	0.03	0.03	0.03	0.05	0.04	0.13
Na ₂ O	0.07	0.07	0.05	0.04	0.05	0.06	0.04	0.06	3.02
K ₂ O	3.63	3.67	3.59	2.56	3.07	3.82	3.58	3.82	4.70
TiO ₂	0.214	0.209	0.231	0.160	0.177	0.216	0.240	0.174	0.228
MnO	0.055	0.026	0.013	0.030	0.027	0.025	0.085	0.038	0.020
P ₂ O ₅	0.016	0.018	0.020	0.014	0.014	0.016	0.023	0.019	0.024
LOI	1.93	2.39	2.67	10.86	7.93	2.28	2.69	2.18	1.67
Total	98.55	99.08	99.31	91.11	95.59	98.36	98.23	99.10	98.76
F (ppm)	491	500	547	379	435	570	547	552	381
Cr	6	7	5	4	14	6	5	5	6
Zr	177	200	223	168	173	230	283	152	231
Ba	498	387	140	304	389	396	124	384	402
Be	1.8	1.8	2.7	1.9	2.0	2.0	2.8	2.1	2.5
Sc	7.2	7.3	7.5	4.9	6.1	7.3	8.4	6.7	8.4
Ag	0.1	0.2	0.2	5.1	1.2	1.3	-0.1	0.2	-0.1
As	75	2463	29	39700	33000	3815	189	1655	6
Cd	0.2	2.2	0.1	206.2	123.2	4.1	0.3	0.9	-0.1
Co	-5	-5	-5	-5	-5	-5	-5	-5	2
Cu	22	20	18	480	140	63	10	16	3
Li	11.9	13.7	34.1	12.8	11.7	11.1	35.1	10.8	11.9
Mn	428	200	98	236	206	194	656	291	158
Ni	4	3	3	8	7	3	4	3	5
Pb	346	262	47	19800	8642	484	63	619	5
Rb	108	111	137	89	115	126	154	125	176
V	8	8	8	6	6	8	9	5	7
Zn	85	286	87	10600	4005	424	29	62	22
Ga	17	18	17	13	15	18	19	20	21
Ge	1.5	1.6	1.4	1.3	-1.0	1.7	1.5	1.1	6.3
Sr	3	4	101	9	6	3	5	2	27
Y	48	58	53	33	38	51	54	60	87
Nb	9	9	11	8	9	9	10	9	11
Mo	4.6	3.4	-2.0	2.2	-2.0	2.3	3.4	-2.0	-2.0
Sn	14	20	8	14	14	16	4	21	4
Cs	1.5	1.5	2.1	1.5	1.6	1.7	1.9	1.7	1.8
La	36.82	34.97	39.07	33.39	34.87	38.44	55.49	47.27	86.29
Ce	82.06	81.10	90.41	63.88	68.99	86.42	107.30	99.21	115.67
Pr	9.44	9.35	10.67	8.54	8.70	10.34	12.73	11.95	22.18
Nd	35.70	36.85	41.43	31.99	34.31	38.69	46.83	45.53	84.98
Sm	7.95	8.62	9.12	7.33	7.67	8.25	10.34	9.75	17.68
Eu	0.77	1.06	0.86	0.54	0.65	0.67	1.02	1.01	1.57
Gd	8.48	9.73	9.66	6.42	7.17	9.10	10.17	10.11	16.71
Tb	1.45	1.66	1.65	1.04	1.19	1.53	1.72	1.79	2.52
Dy	8.52	10.53	10.00	6.14	6.98	9.54	10.37	11.02	14.87
Ho	1.67	2.12	2.06	1.29	1.45	1.92	2.03	2.14	2.90
Er	5.13	6.57	6.14	3.76	4.25	5.90	6.28	6.67	8.77
Tm	0.77	0.97	0.91	0.57	0.63	0.83	0.92	1.02	1.13
Yb	5.11	6.28	5.84	3.70	4.50	5.58	6.13	6.55	8.03
Lu	0.75	0.96	0.96	0.56	0.68	0.97	0.99	1.02	1.21
Hf	5.58	6.23	7.02	4.53	5.39	6.91	8.46	5.06	7.42
Ta	-1.0	-1.0	-1.0	3.0	-1.0	-1.0	1.5	-1.0	0.7
W	1.7	2.8	-1.0	3.0	5.5	3.6	1.5	3.1	-1.0
Tl	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.5
Bi	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Th	16.68	17.74	18.72	12.67	13.66	18.32	19.00	20.64	18.84
U	4.21	4.43	4.16	5.92	3.52	3.60	4.73	5.08	3.84
Sb	208	98.6	35.2	40700	13300	290	40.2	524	1.6
Br	-1	-1	-1	-320	-87	-1	-1	-1	-1
Au (ppb)	38	692	5	-800	-277	294	153	317	-1
Se	-2	-2	-1	-130	-37	-4	-1	-9	-1

Table 1. Continued

HS16-018A 8941174 Mu-Py-Rt altered mzgn 645081 5420793 21 NAD 27	HS16-018B 8941175 Mu-Py-Rt altered mzng 645092 5420789 21 NAD 27	HS16-019A 8941125 Reddened mzgn 654048 5420802 21 NAD 27	HS16-019A DUP 8941130 Reddened mzgn 654048 5420802 21 NAD 27	HS16-019B 8941176 Mu-Py-Rt altered mzgn 645062 5420807 21 NAD 27	HS16-019C 8941177 Mu-Py-Rt altered mzgn 645086 5420804 21 NAD 27	HS16-020A 8941178 Mu-Py-Rt altered mzgn 645066 5420836 21 NAD 27	HS16-020B 8941179 Stbn-Qtz-Apy- veined mzgn 645069 5420827 21 NAD 27	HS17-019 8941302 Fresh mzgn 639502 5408229 21 NAD 27	HS17-020B 8941304 Fresh mzgn 645980 5424008 21 NAD 27
22.50	13.94	15.24	16.25	14.20	14.75	15.71	1.21	14.21	15.78
78.39	75.80	73.45	73.97	77.04	74.53	76.41	48.66	73.00	73.15
11.92	12.18	12.70	12.56	12.28	12.94	13.70	5.87	12.76	12.18
1.84	3.48	1.91	1.89	2.46	2.98	2.42	15.37	2.73	2.31
0.15	NA	0.72	0.68	0.31	1.03	0.18	4.86	1.73	0.81
1.52	NA	1.07	1.09	1.93	1.76	2.01	9.46	0.90	1.35
0.27	0.28	0.17	0.19	0.21	0.26	0.23	0.10	0.23	0.22
0.05	0.07	0.18	0.20	0.20	0.04	0.06	0.04	0.36	0.50
0.05	0.31	3.01	2.97	0.06	0.16	0.17	0.05	3.38	3.21
3.44	3.70	4.99	4.91	3.67	4.82	3.70	1.80	4.90	4.81
0.218	0.227	0.222	0.218	0.229	0.231	0.252	0.115	0.304	0.232
0.013	0.022	0.042	0.041	0.101	0.017	0.022	0.037	0.029	0.029
0.018	0.026	0.026	0.026	0.017	0.029	0.027	0.012	0.043	0.025
2.17	2.87	1.34	1.27	2.01	2.36	2.65	21.34	1.96	1.47
98.38	98.97	98.04	98.25	98.26	98.36	99.63	93.39	99.70	98.12
738	963	380	401	832	866	596	280	81	137
6	-1	4	5	4	4	9	3	8	6
217	219	224	216	245	250	223	104	300	216
121	349	446	439	391	360	105	192	512	541
2.1	3.1	2.8	2.7	2.0	2.9	3.2	1.7	1.9	2.1
7.7	9.4	8.6	8.7	8.7	9.1	9.2	3.9	7.5	7.9
0.3	-0.1	-0.1	-0.1	-0.1	0.3	0.1	2.5	-0.1	-0.1
98	17	4	4	31	15	124	129000	4	3
0.6	0.1	-0.1	-0.1	0.5	0.1	0.5	717.5	-0.1	-0.1
-1	2	2	2	3	1	1	7	-5	-5
12	16	2	3	18	12	7	135	8	3
27.1	23.8	12.8	12.9	10.8	20.6	27.9	11.6	32.2	14.7
112	169	336	336	817	136	181	181	226	226
4	5	4	4	5	4	4	14	4	4
33	50	4	4	529	57	132	29970	16	11
130	159	209	210	110	176	142	60	203	170
8	8	8	7	8	8	8	4	10	9
86	61	22	22	110	52	66	97	58	31
16	19	18	18	17	18	20	9	17	16
3.3	3.2	3.7	4.5	4.5	3.8	5.0	4.4	-1.0	1.3
5	19	31	29	4	32	6	5	31	49
44	65	59	60	66	62	69	36	52	35
13	11	10	9	13	13	15	8	13	13
2.7	4.2	2.0	-2.0	2.9	3.6	3.3	2.1	-2.0	-2.0
5	8	5	5	14	9	5	14	7	4
2.1	0.7	2.5	2.7	1.5	2.6	3.1	1.2	6.2	4.4
40.64	57.20	48.97	46.67	57.65	51.86	66.98	28.93	34.70	24.87
89.68	118.26	101.17	97.56	109.76	113.16	140.46	55.78	77.70	56.61
10.11	13.77	12.69	12.97	14.90	12.12	16.02	7.07	9.38	6.63
37.42	51.02	48.38	50.86	57.08	44.86	59.57	25.96	35.49	25.10
7.94	10.11	10.56	11.23	13.49	8.97	12.52	5.59	8.25	6.26
0.76	0.87	1.12	1.14	1.71	0.72	1.16	0.44	0.96	0.87
8.41	10.68	10.07	10.62	13.84	9.15	12.27	6.07	8.32	6.16
1.40	1.93	1.71	1.80	2.18	1.60	2.03	0.98	1.44	1.08
8.30	11.88	10.69	11.27	12.52	10.60	12.52	6.42	9.19	6.78
1.66	2.44	2.08	2.19	2.54	2.18	2.50	1.31	1.91	1.42
4.92	7.46	6.32	6.89	7.40	6.71	7.59	4.06	5.93	4.23
0.73	1.11	0.87	0.95	1.07	0.96	1.08	0.57	0.86	0.64
4.60	7.12	6.07	6.56	6.97	6.54	6.89	3.69	5.73	4.44
0.75	1.17	0.88	1.00	1.07	0.96	1.08	0.58	0.95	0.67
6.92	7.09	6.80	7.24	7.83	7.86	7.11	3.14	7.89	6.40
1.9	1.4	-0.5	-0.5	1.9	2.0	1.9	2.9	2.5	2.5
2.2	1.5	-1.0	-1.0	3.0	2.4	3.9	3.9	3.3	-1.0
-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.1	-0.1
-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
17.51	17.18	18.28	18.19	18.41	19.47	19.83	8.84	17.07	17.15
3.63	4.55	4.29	4.75	4.61	4.61	4.91	6.27	4.79	4.41
46.7	40.8	6.1	6.6	30.6	38.1	48.7	22800	0.9	1.3
-1	-1	-1	-1	-1	-1	-1	-80	-1	-1
24	6	-1	-1	8	5	87	-510	-1	-1
-1	-1	-1	-1	-1	-1	-1	-160	-1	-1

Table 2. VIRS data for samples from the Yellow Fox showing. Illite spectral maturity [ISM(H₂O)] is the value of the depth of the 2200 nm trough/depth of the 1900 nm trough (Doublier *et al.*, 2010)

Sample	Rock-type	Identified mineral 1	Wt. % mineral 1	Identified mineral 2	Wt. % mineral 2	Error sTAS	Depth_1400nm	Depth_1900nm	Depth_2200nm	WhitMica_Comp	ISM_H2O
CS17-001	fractured Mu-Py-Rt-altered monzogranite	Muscovite	1	NULL	NULL	102.61	0.325	0.167	0.449	2202.86	2.686
CS17-001-2	fractured Mu-Py-Rt-altered monzogranite	Muscovite	1	NULL	NULL	91.90	0.414	0.229	0.480	2203.27	2.093
CS17-002	fractured Mu-Py-Rt-altered monzogranite	Muscovite	1	NULL	NULL	91.35	0.568	0.550	0.529	2201.84	0.961
CS17-002-2	fractured Mu-Py-Rt-altered monzogranite	Muscovite	1	NULL	NULL	73.03	0.408	0.351	0.418	2202.71	1.192
CS17-003	fractured Mu-Py-Rt-altered monzogranite	Muscovite	1	NULL	NULL	197.32	0.466	0.339	0.471	2198.08	1.390
CS17-003-2	fractured Mu-Py-Rt-altered monzogranite	Muscovite	1	NULL	NULL	149.91	0.437	0.271	0.470	2199.92	1.732
CS17-004	Sibn-Qtz-Apy-veined monzogranite	Muscovite	1	NULL	NULL	85.84	0.466	0.316	0.505	2202.61	1.598
CS17-004-2	Sibn-Qtz-Apy-veined monzogranite	Muscovite	1	NULL	NULL	99.85	0.445	0.242	0.501	2202.87	2.071
CS17-006	fractured Mu-Py-Rt-altered monzogranite	Muscovite	1	NULL	NULL	71.19	0.468	0.435	0.441	2203.85	1.014
CS17-006-2	fractured Mu-Py-Rt-altered monzogranite	Muscovite	1	NULL	NULL	87.11	0.400	0.335	0.425	2204.34	1.268
CS17-007	fractured Mu-Py-Rt-altered monzogranite	Muscovite	1	NULL	NULL	217.59	0.482	0.197	0.520	2198.63	2.636
CS17-007-2	fractured Mu-Py-Rt-altered monzogranite	Muscovite	1	NULL	NULL	177.53	0.346	0.182	0.473	2199.69	2.593
CS17-008	fractured Mu-Py-Rt-altered monzogranite	Muscovite	1	NULL	NULL	95.36	0.459	0.245	0.506	2201.90	2.070
CS17-008-2	fractured Mu-Py-Rt-altered monzogranite	Muscovite	1	NULL	NULL	92.78	0.450	0.207	0.514	2202.75	2.487
HS16-017A	fresh monzogranite	Muscovite	0.585	Chlorite-Fe	0.415	104.30	0.133	0.183	0.132	2207.96	0.719
HS16-017A-2	fresh monzogranite	Muscovite	0.701	Siderite	0.299	106.88	0.072	0.181	0.115	2208.56	0.638
HS16-018A	fractured Mu-Py-Rt-altered monzogranite	Muscovite	1	NULL	NULL	139.41	0.467	0.152	0.525	2200.18	3.460
HS16-018A-2	fractured Mu-Py-Rt-altered monzogranite	Muscovite	1	NULL	NULL	129.78	0.437	0.137	0.471	2201.09	3.429
HS16-018B	fractured Mu-Py-Rt-altered monzogranite	Muscovite	1	NULL	NULL	149.62	0.369	0.236	0.426	2199.51	1.804
HS16-018B-2	fractured Mu-Py-Rt-altered monzogranite	Muscovite	1	NULL	NULL	114.00	0.368	0.177	0.431	2200.77	2.443
HS16-019A	reddened monzogranite	Phengite	1	NULL	NULL	175.99	0.108	0.124	0.158	2208.84	1.275
HS16-019A-2	reddened monzogranite	Phengite	1	NULL	NULL	174.95	0.120	0.122	0.178	2209.40	1.463
HS16-019B	fractured Mu-Py-Rt-altered monzogranite	Muscovite	1	NULL	NULL	100.89	0.414	0.143	0.486	2203.56	3.386
HS16-019B-2	fractured Mu-Py-Rt-altered monzogranite	Muscovite	1	NULL	NULL	97.18	0.409	0.123	0.486	2203.69	3.933
HS16-019C	fractured Mu-Py-Rt-altered monzogranite	Muscovite	1	NULL	NULL	129.01	0.499	0.155	0.533	2202.67	3.452
HS16-019C-2	fractured Mu-Py-Rt-altered monzogranite	Muscovite	1	NULL	NULL	114.60	0.493	0.168	0.536	2202.75	3.185
HS16-020A	fractured Mu-Py-Rt-altered monzogranite	Muscovite	1	NULL	NULL	174.48	0.402	0.176	0.451	2198.83	2.567
HS16-020A-2	fractured Mu-Py-Rt-altered monzogranite	Muscovite	1	NULL	NULL	175.49	0.455	0.194	0.495	2199.26	2.555
HS16-020B	Sibn-Qtz-Apy-veined monzogranite	Muscovite	1	NULL	NULL	79.51	0.355	0.199	0.394	2202.48	1.986
HS16-020B-2	Sibn-Qtz-Apy-veined monzogranite	Muscovite	1	NULL	NULL	90.66	0.386	0.223	0.422	2202.59	1.889
HS16-020B-3	Sibn-Qtz-Apy-veined monzogranite	Muscovite	0.539	Chlorite-Fe	0.461	112.10	0.137	0.152	0.110	2205.77	0.727
HS16-020B-4	Sibn-Qtz-Apy-veined monzogranite	Muscovite	0.548	Chlorite-Fe	0.452	123.82	0.123	0.157	0.123	2206.94	0.785

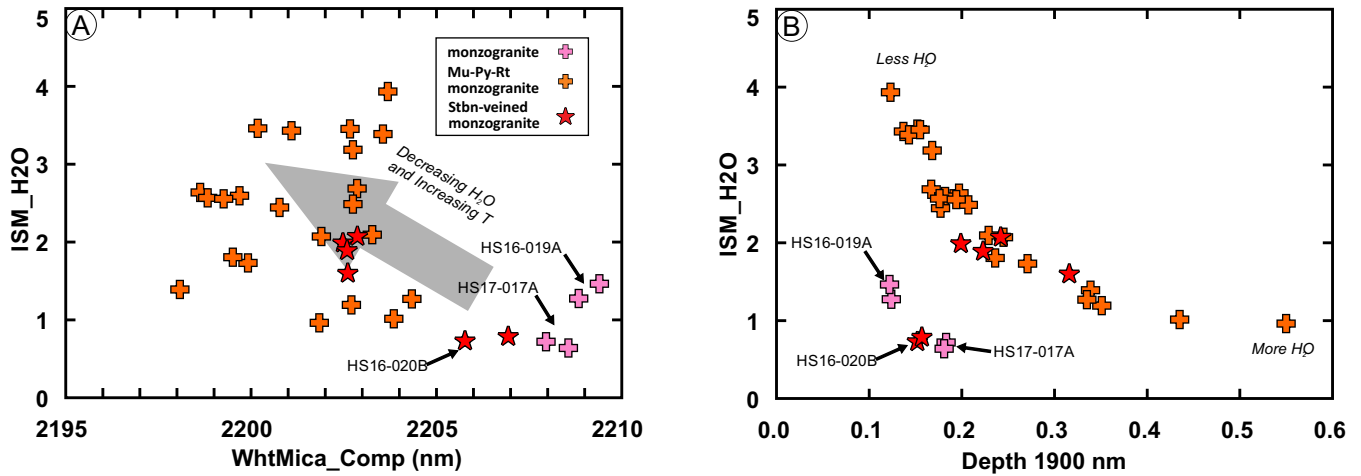


Figure 5. VIRS data for the Yellow Fox showing. A) Illite spectral maturity (ISM) H_2O vs. white mica composition (Al-OH); B) ISM H_2O vs. the depth of the 1900 nm absorption trough. ISM (H_2O) corresponds to the depth of the 2200 nm trough/1900 nm trough (Doublier et al., 2010).

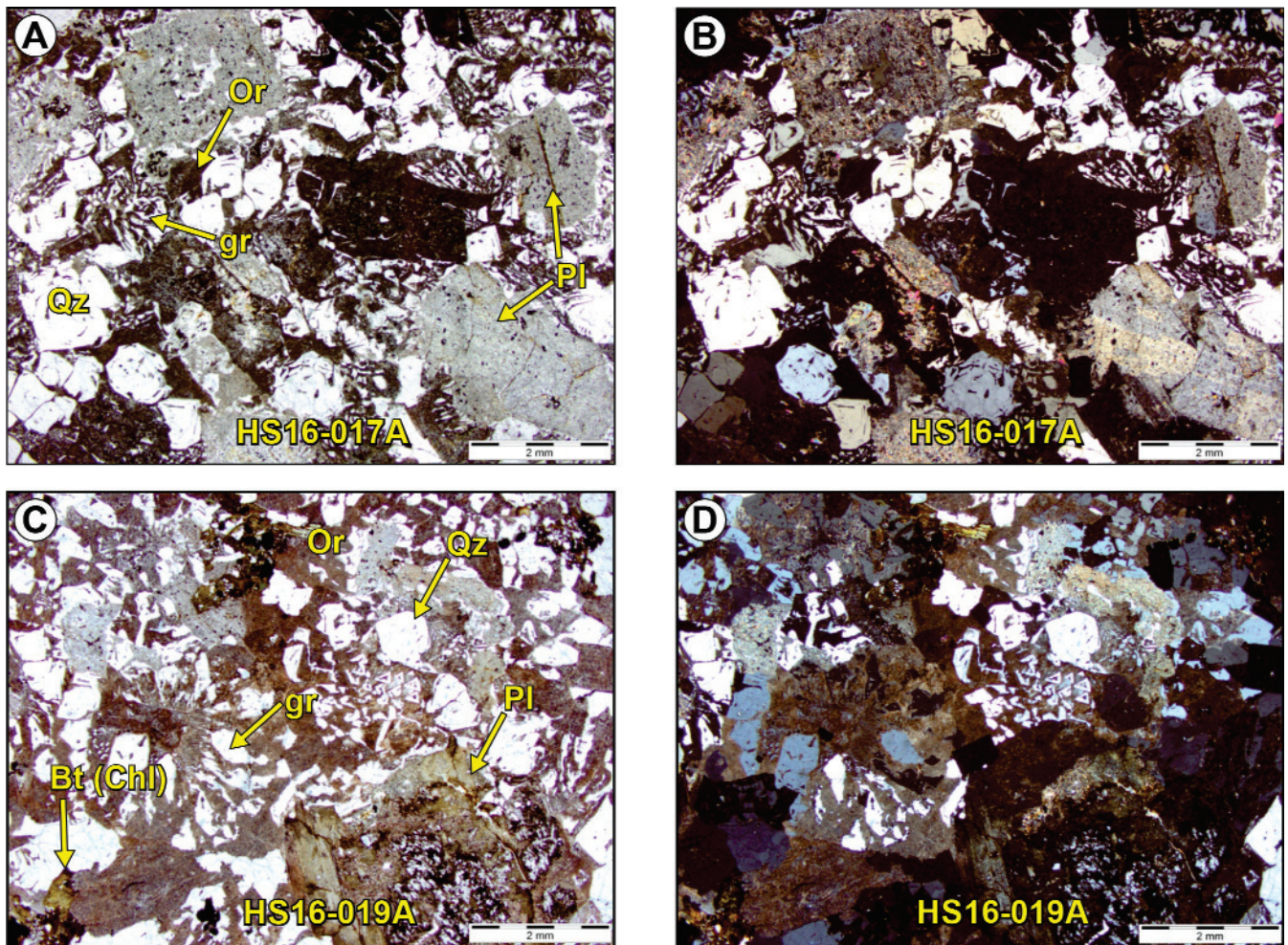


Plate 3. Representative photomicrographs. A) Fresh, regional monzogranite sample HS16-017A under plane-polarized light (ppl); B) Same field of view of monzogranite sample HS16-017A under crossed nicols; C) Weakly altered, reddened monzogranite sample HS16-019A under ppl; D) Same field of view of monzogranite sample HS16-019A under crossed nicols. Key: Qz-quartz; Pl-Plagioclase; Or-orthoclase; Bt (Chl)-chloritized biotite; gr-granophytic texture.

(Figure 3; Plate 3C). The rock is reddened, and plagioclase crystals are a pale yellow-green. Plagioclase grains locally appear to preserve oscillatory zoning, which is represented by inner zones preferentially enriched in a fine-grained intergrowth of albite-quartz-muscovite, and outer zones characterized by muscovite alone (Figure 6; Plate 3C, D). Ferromagnesian silicates (biotite and hornblende) occur as inter-grown clots, and are variably altered to chlorite + muscovite + rutile + goethite with common euhedral cubic zircon. The rock consists of 20.3 volume %, subhedral, variably sericitized and saussuritized plagioclase phenocrysts (≤ 4 mm) and 37.9 % anhedral quartz grains that commonly form granophyric and locally myrmekitic intergrowths with alkali feldspar (21.8%), which constitutes much of the remainder of the rock (Plate 3D; Figure 6). A proportion of the plagioclase, likely more calcic end-members, as well as orthoclase forming the granophyric texture, are variably replaced by muscovite (13.8%), albite and chlorite (2.0%). White mica alteration is minimal in comparison to samples

more proximal to the fracture system. Accessory phases include euhedral zircon, subhedral apatite and less common anhedral monazite and xenotime (Figure 6)

**Bleached, Fractured Pyritic Monzogranite
(e.g., HS16-018A)**

Sample HS16-018A represents an altered, fractured monzogranite of the MPIS obtained from Trench 3, approximately 12 m west of the axis of the central, fractured and pyritic zone (Figure 3). This sample is an intensely muscovite-altered, medium-grained, plagioclase-pyritic, granophyric-textured monzogranite with essentially all primary feldspar phases (plagioclase and orthoclase) entirely replaced by muscovite. Figure 7 illustrates that a number of the muscovite-dominant patches have partial rectangular outlines reflecting pseudomorphed plagioclase phenocrysts and, that what was primary granophyric texture is now intergrowths of muscovite lamellae in quartz (Plate 4A, B).

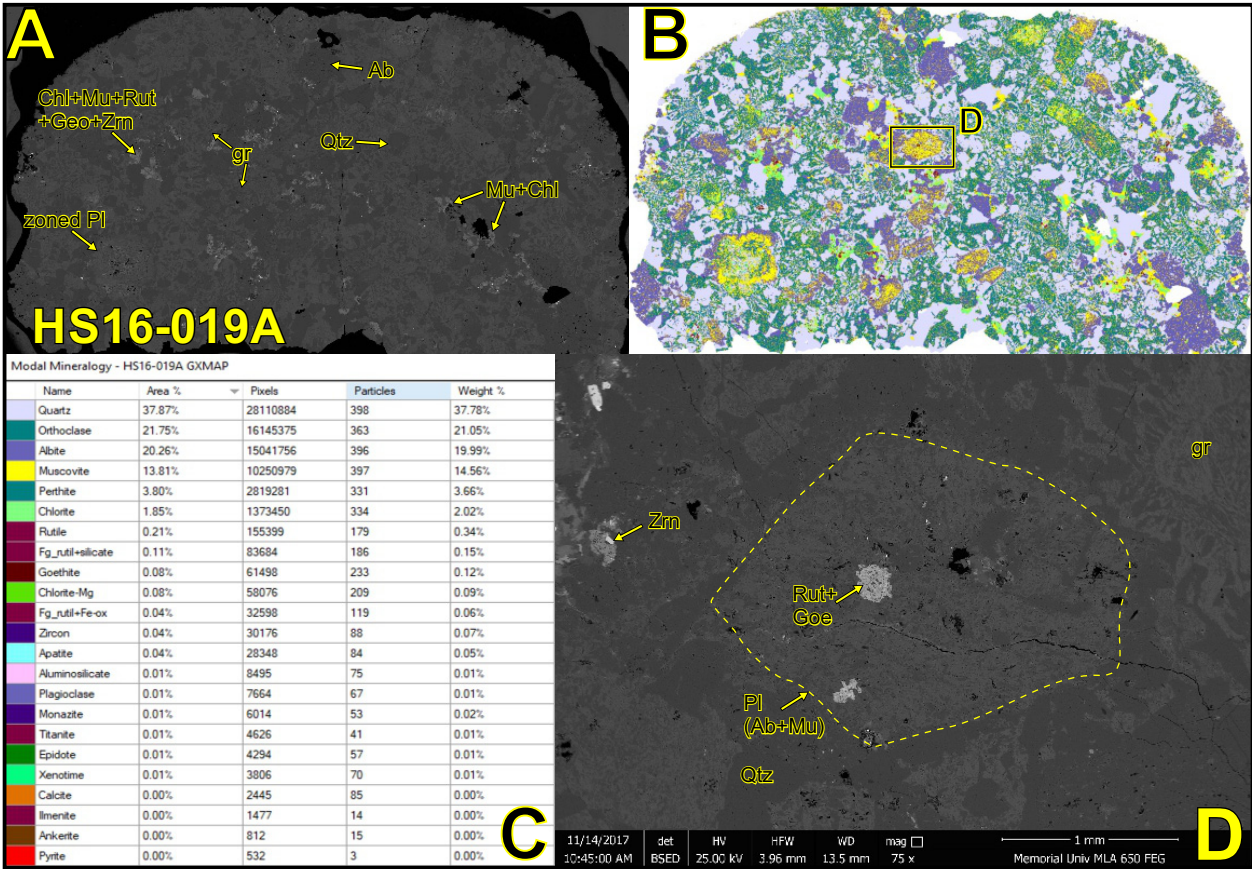


Figure 6. Electron microprobe MLA imagery for sample HS16-019A composed of reddened, weakly altered monzogranite from the western margin of Yellow Fox Trench 2. A) Backscattered electron (BSE) image of the thin section; B) MLA false colour image of the mineralogy of the thin section, showing the locations of image D; C) Coloured legend for B; D) BSE image of a sericite-altered plagioclase phenocryst with a rutile and goethite inclusion, surrounded by granophyric intergrowths of orthoclase and quartz. Key: Qtz-quartz; Chl-chlorite; Mu-muscovite; Apy-arsenopyrite; Pl-plagioclase; Ab-albite; Goe-goethite; Or-orthoclase; Rut-rutile; gr-granophyric texture; Zrn-zircon.

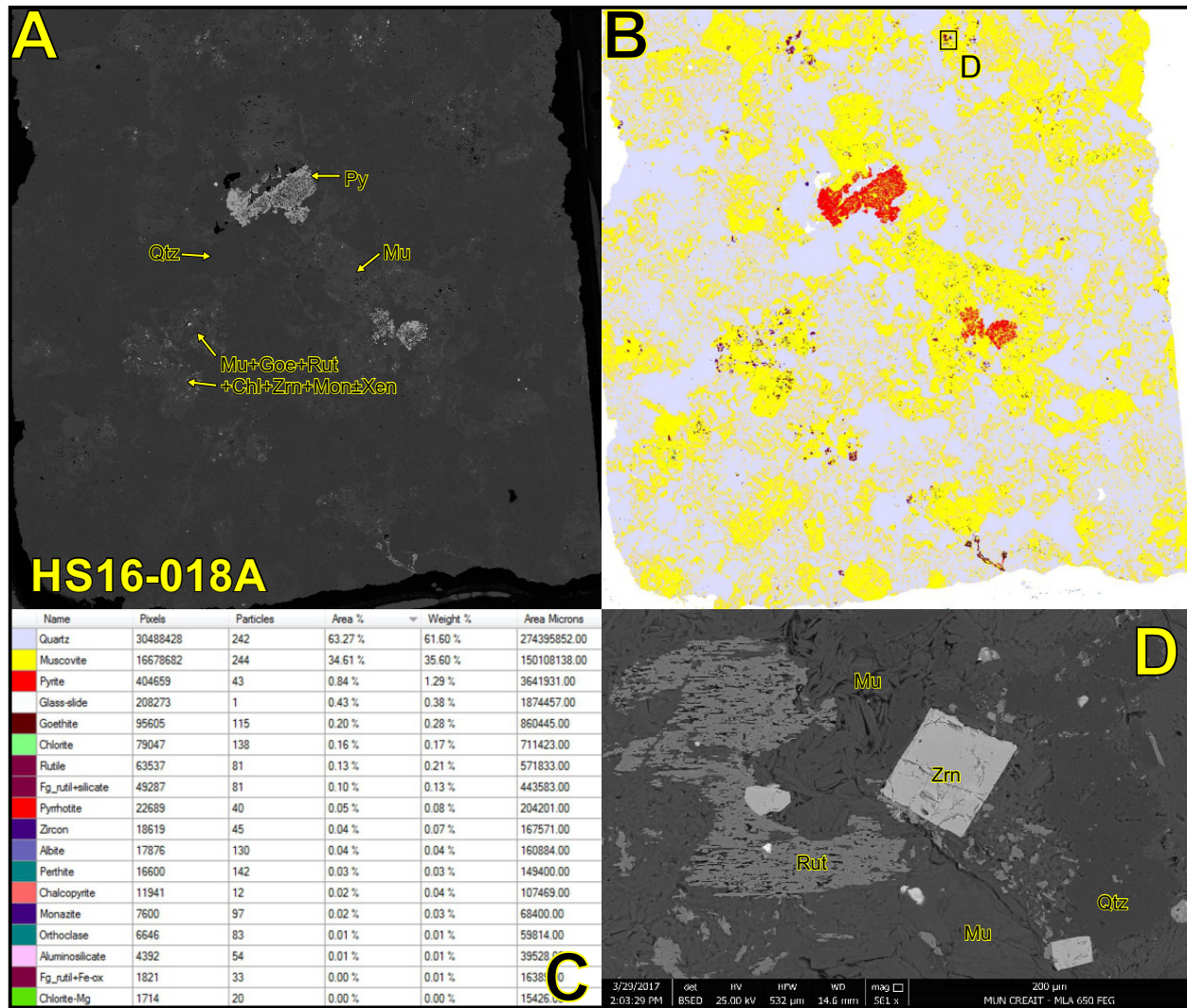


Figure 7. Electron microprobe MLA imagery for sample HS16-018A composed of bleached and fractured, muscovite–pyrite–rutile-altered monzogranite from near the centre of Yellow Fox Trench 3. A) BSE image of the thin section; B) MLA false-colour image of the mineralogy of the thin section showing subhedral spongy pyrite and the location of image D; C) Coloured legend for B; D) BSE image of an anhedral rutile accompanying muscovite and quartz and cubic zircon. Key: Qtz–quartz; Chl–chlorite; Mu–muscovite; Py–pyrite; Goe–goethite; Rut–rutile; Zrn–zircon; Mon–monazite; Xen–xenotime.

Patches dominated by chlorite intergrown with muscovite + rutile + zircon + goethite ± xenotime (Figure 7D) are interpreted to represent the remnants of hydrothermally altered, intergrown primary biotite–hornblende–ilmenite–magnetite–zircon, such as those noted in miarolitic cavities in less strongly altered samples (*e.g.*, see HS16-017A: Sandeman *et al.*, 2018). In fresh samples, the ferromagnesian phases typically occur in small intercrystal druses or miarolitic cavities (Sandeman *et al.*, 2017). The rock consists of 63.3 wt. % quartz, 34.6% muscovite and <1% embayed and inclusion-rich pyrite with trace goethite, rutile and chlorite. All other phases identified in MLA analysis are in abundances of <0.1% (Figure 7). This sample also contains trace chalcopryite, sphalerite, pyrrhotite, calcite and siderite.

Strongly Altered Stibnite-veined Monzogranite (*e.g.*, HS16-020B)

Sample HS16-020B is a sample of strongly altered, locally stibnite-veined monzogranite from Trench 1 (Figure 3) at the Yellow Fox showing. The wall rock to the vein is a chalky-orange-weathered, strongly sericite-altered, medium-grained monzogranite containing disseminated subhedral spongy pyrite (Figure 8). The altered rock is cut by anastomosing veinlets/fractures and patches filled with scorodite ($\text{FeAsO}_4 \cdot 2\text{H}_2\text{O}$; Plate 4C, D) and arsenopyrite partly altered to scorodite and goethite (Figure 8). The stibnite-dominated veins consist of stibnite intergrown with radial muscovite, and euhedral quartz and arsenopyrite

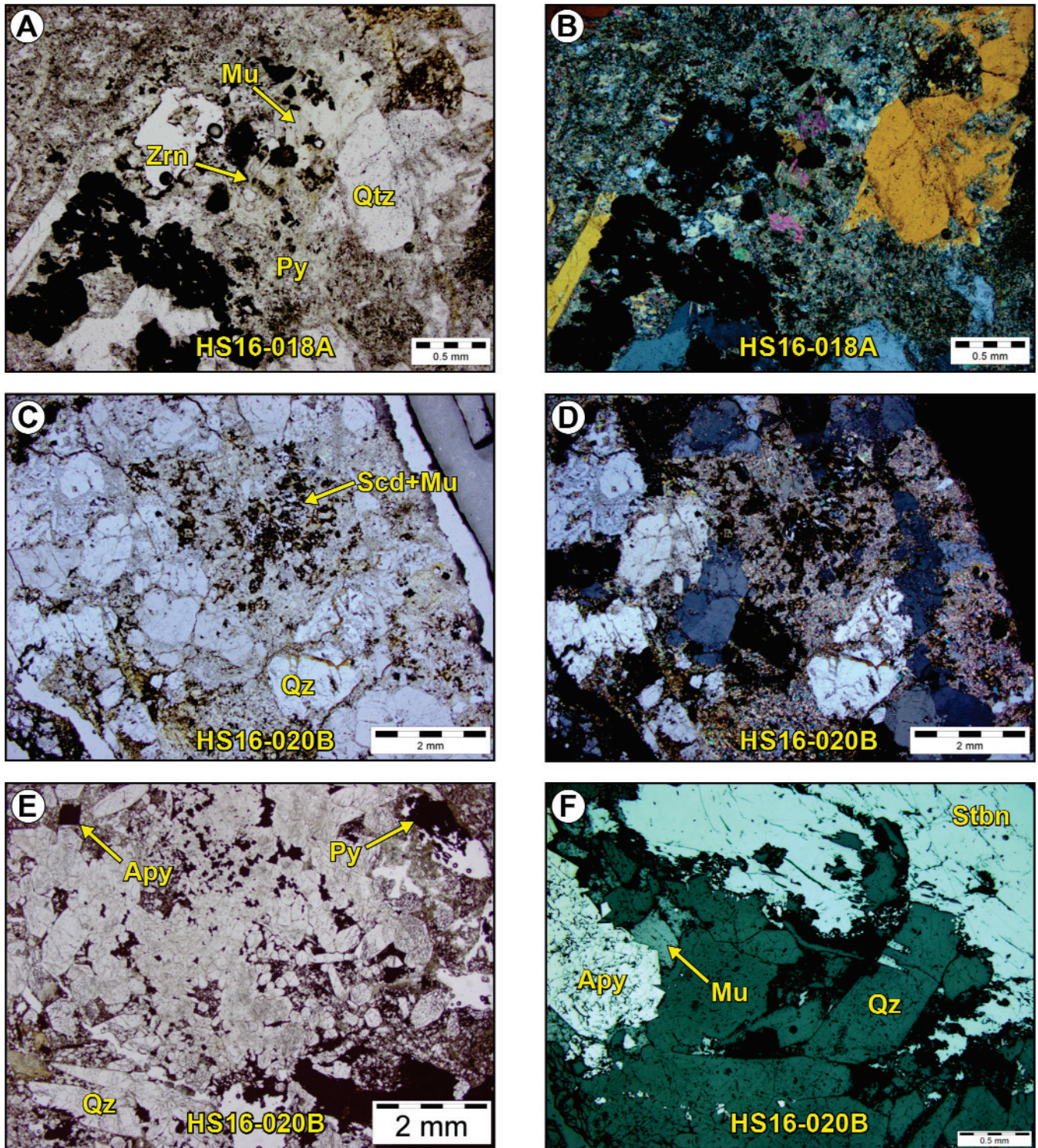


Plate 4. Representative photomicrographs. A) Fractured muscovite–pyrite–rutile-altered monzogranite sample HS16-018A under ppl; B) Same field of sample HS16-18A view under crossed nicols. Note that this is a thick thin section; C) Stibnite–quartz–arsenopyrite-veined monzogranite sample HS16-020B under ppl; D) Same field of view of monzogranite sample HS16-020B under crossed nicols; E) Margin of stibnite–quartz–arsenopyrite vein and altered monzogranite sample HS16-020B under ppl; F) BSE image of intergrown stibnite, quartz, arsenopyrite and muscovite in sample HS16-020B. Key: Qz–quartz; Py–Pyrite; Apy–arsenopyrite; Stbn–stibnite; Mu–muscovite; Scd–scorodite; Zrn–zircon.

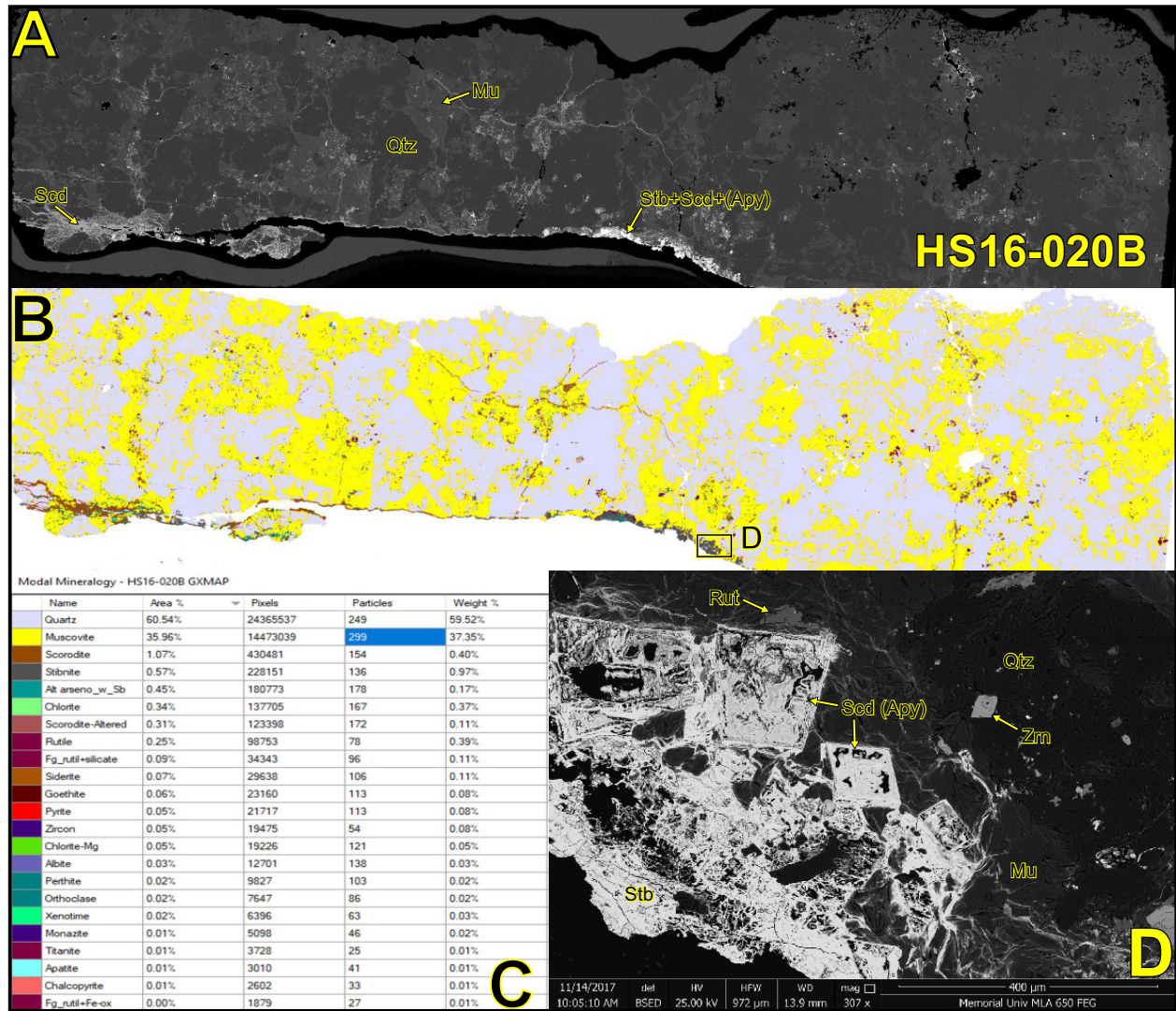


Figure 8. Electron microprobe MLA imagery for sample HS16-020B composed of stibnite-quartz-arsenopyrite-veined monzogranite from the north central area of Yellow Fox Trench 1. A) BSE image of the thin section; B) MLA false-colour image of the mineralogy of the thin section showing the location of image D; C) Coloured legend for B; D) BSE image of the mineralized margin of the scorodite-altered stibnite-quartz-arsenopyrite vein in sample HS16-020B. Key: Qtz-quartz; Mu-muscovite; Apy-arsenopyrite; Goe-goethite; Rut-rutile; Zrn-zircon; Scd-scorodite; Stb-stibnite.

(Figure 8; Plate 4E, F). The host rock consists of 60.5 wt. % quartz surrounded by 36.0%, radial and locally tabular muscovite that has essentially completely replaced all earlier feldspars in the rock (albite-orthoclase-perthite comprise 0.07%). Chalcopyrite, sphalerite, galena, siderite and calcite are present in trace amounts (Figure 8). The rock still locally retains a discernible granophyric texture.

LITHOGEOCHEMISTRY

Examination of the dataset reveals that weakly altered reddened monzogranite is chemically identical to the region-

al, background monzogranite samples, with no apparent depletion or enrichment in any element. Hence, these samples are all treated as fresh monzogranite unaffected by hydrothermal alteration and have major- and trace-element characteristics of calc-alkaline monzogranite (Figure 9A–C). Relative to these fresh rocks, bleached and fractured muscovite-pyrite-rutile-altered monzogranite exhibits elevated SiO₂ (74.5–78.4 vs. 70.3–74.0 wt. %), LOI (1.93–2.87 vs. 1.27–1.96 wt. %) and F (491–963 vs. 81–401 ppm), lower K₂O (3.44–4.82 vs. 4.70–4.99 wt. %), Ba (105–498 vs. 402–786 ppm), Rb (108–176 vs. 164–210 ppm), Sr (2–32 vs. 27–67 ppm), and Cs (0.7–3.1 vs. 1.8–6.2 ppm), and, signifi-

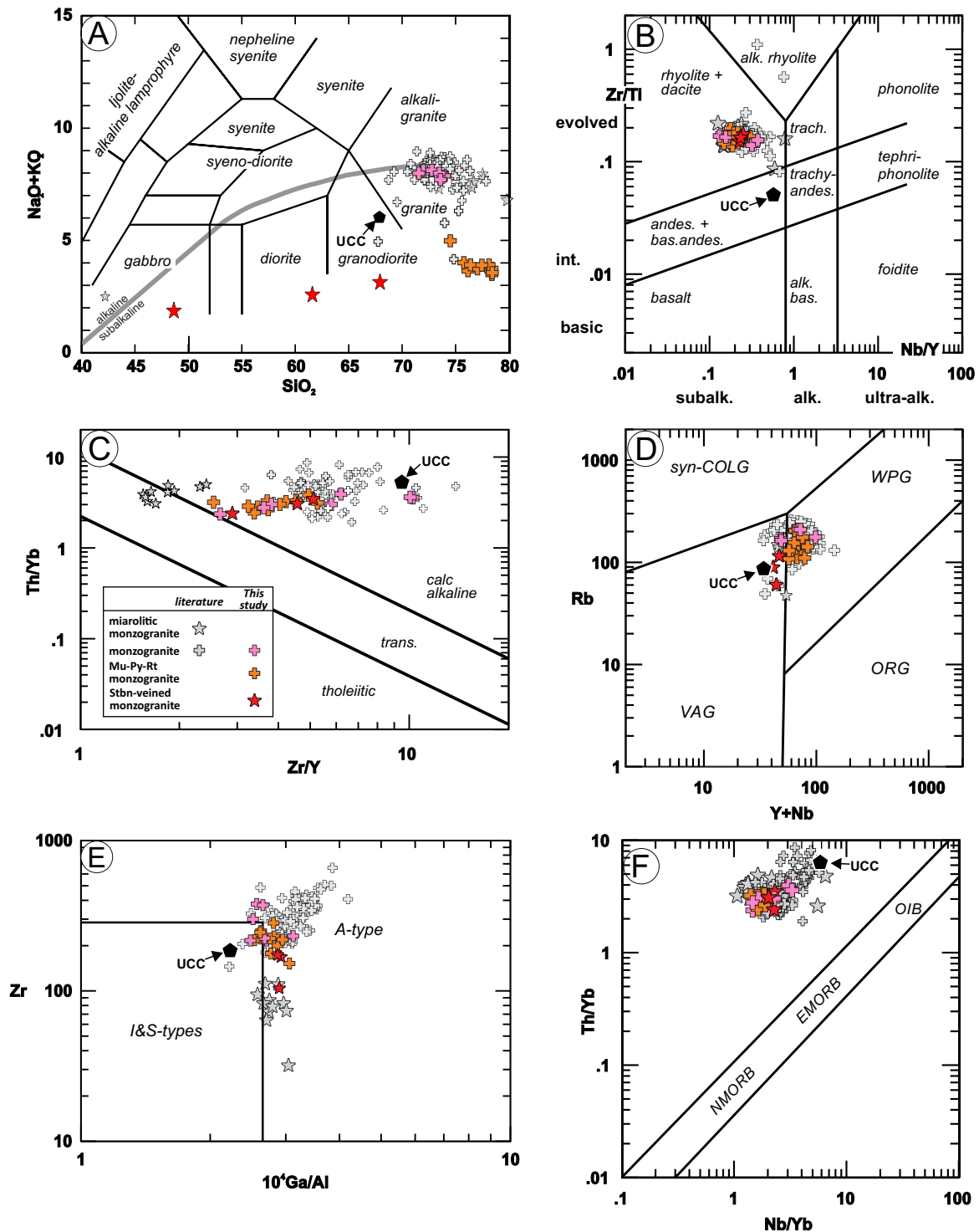


Figure 9. Lithogeochemistry of the Yellow Fox samples including fresh (pink crosses), muscovite–pyrite–rutile-altered (orange crosses) and stibnite–quartz–arsenopyrite-veined monzogranite (red stars) compared to samples of regional Mount Peyton monzogranite (grey crosses: Dickson and Kerr, 2007; Sandeman, unpublished data, 2019). A) total alkalis vs. SiO₂ (after Wilson, 1989); B) Zr/Ti vs. Nb/Y classification diagram (after Pearce, 1996); C) Th/Yb vs. Zr/Y discrimination diagram (Ross and Bédard, 2009); D) Rb vs. Y+Nb paleotectonic discrimination diagram (Pearce et al., 1984); E) Zr vs. 10⁴Ga/Al (Whalen et al., 1987); F) Th/Yb vs. Nb/Yb (Pearce, 2008). Also shown are corresponding values for upper continental crust (UCC; Rudnick and Gao, 2003).

cantly lower CaO (0.03–0.20 vs. 0.13–1.80 wt. %) and, in particular, Na₂O (0.04–0.31 vs. 2.97–3.50 wt. %). Many of the remaining major and incompatible trace elements in muscovite–pyrite–rutile-altered monzogranite have broadly similar concentrations as those in unaltered monzogranite, regardless of the intensity of alteration. Samples of the stibnite–quartz–arsenopyrite-veined monzogranite have the lowest concentrations of all of the major elements with the exception of FeO^T and LOI. The majority of incompatible trace elements, including the large ion lithophile elements (LILE) and the rare-earth elements (REE), also have substantially lower abundances in stibnite–quartz–arsenopyrite-veined monzogranite although their multi-element patterns are essentially identical. The precious metals Au and Ag, as well as many of the pathfinder elements (As, Sb, Cd) are all variably enriched in the stibnite-veined monzogranite relative to both the unaltered monzogranite and the bleached, fractured muscovite–pyrite–rutile-altered monzogranite.

Collectively, including all textural and chemical variants, the Yellow Fox samples are very similar to the regional samples of the MPIS monzogranite, and are transitional I to A-type granite (Pearce *et al.*, 1984; Whalen *et al.*, 1987; Figure 9D, E) having Th/Yb and Nb/Yb ratios characteristic of calc alkaline granite formed through subduction processes (Figure 9F; Pearce, 2008).

All samples, including the fresh, muscovite–pyrite–rutile-altered, and the stibnite-mineralized monzogranite samples exhibit broadly comparable REE patterns (Figure 10A) and multi-element patterns (Figure 10B) with LILE and light-REE enrichment ($La_{CN}/Sm_{CN} = 2.56–3.18$; CN denotes chondrite normalized) and weakly inclined middle to heavy REE segments ($Gd_{CN}/Yb_{CN} = 1.15–1.72$). They also exhibit modest Ba, Nb and Eu troughs and prominent negative Sr, P and Ti troughs (Figure 10B). Apart from variable relative abundances, little difference exists between the REE and multi-element patterns of the samples from the three monzogranite types (Table 1; Figure 10B), except that the muscovite–pyrite–rutile-altered monzogranite and the stibnite–arsenopyrite–quartz-veined monzogranite typically have deeper Ba, Nb, Sr, P, Ti and Eu troughs. The stibnite–arsenopyrite–quartz-veined monzogranite exhibits the lowest incompatible trace-element abundances of the three types (Figure 10A, B), although all samples have REE and multi-element patterns comparable to a field for 27 archival samples of MPIS granite (*sensu lato*; Dickson and Kerr, 2007; Sandeman, unpublished data, 2019).

ELEMENTS ASSOCIATED WITH MINERALIZATION

Figures 11 and 12 present the salient inter-element variations for specific elements of interest for samples collected from the Yellow Fox showing. Data from this study are com-

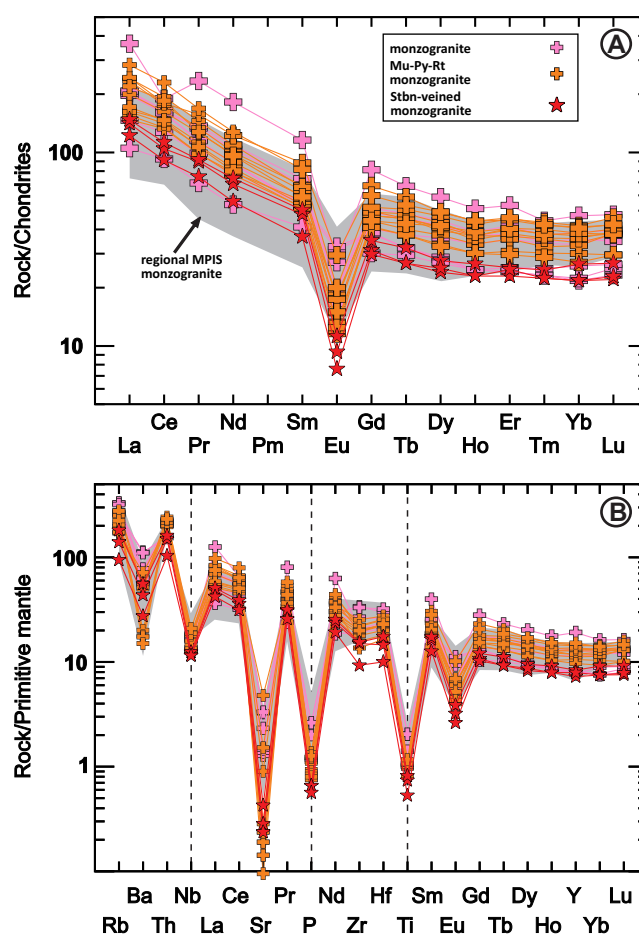


Figure 10. A) Chondrite normalized rare-earth element plot and; B) Multi-element diagram for samples from the Yellow Fox showing. Normalization values are from Sun and McDonough (1989). Symbols and fields as in Figure 9.

pared to the available mineral-exploration industry data from the showing (Reid and Myllyaho, 2012), the regional MPIS monzogranite database (Dickson and Kerr, 2007; Sandeman *et al.*, 2017; Sandeman, unpublished data, 2019) and, the altered and precious-metal mineralized MPIS rocks from the Salmon River prospects (Tallman, 1991a; Evans, 1996; Evans and Dimmell, 2001; Evans *et al.*, 2001; Hoffe and Sparkes, 2003; House, 2003, 2005, 2007a, b; Sandeman *et al.*, 2017). The industry data mainly incorporate ICP and fire assay data for mineralized rocks from these areas, whereas the data of Hoffe and Sparkes (2003), Sandeman *et al.* (2017) and this study include a more complete and accurate lithogeochemical database. Figure 11 illustrates that, relative to the unaltered monzogranite, muscovite–pyrite–rutile-altered granite is characterized by variably elevated F (mean 655 vs. 256 ppm) and LOI (mean 2.38 vs. 1.49 wt. %). In contrast, the stibnite–quartz–arsenopyrite-veined monzogranite has broadly comparable F (mean 365 ppm), but strongly elevated LOI (mean 13.38 wt. %), relative to

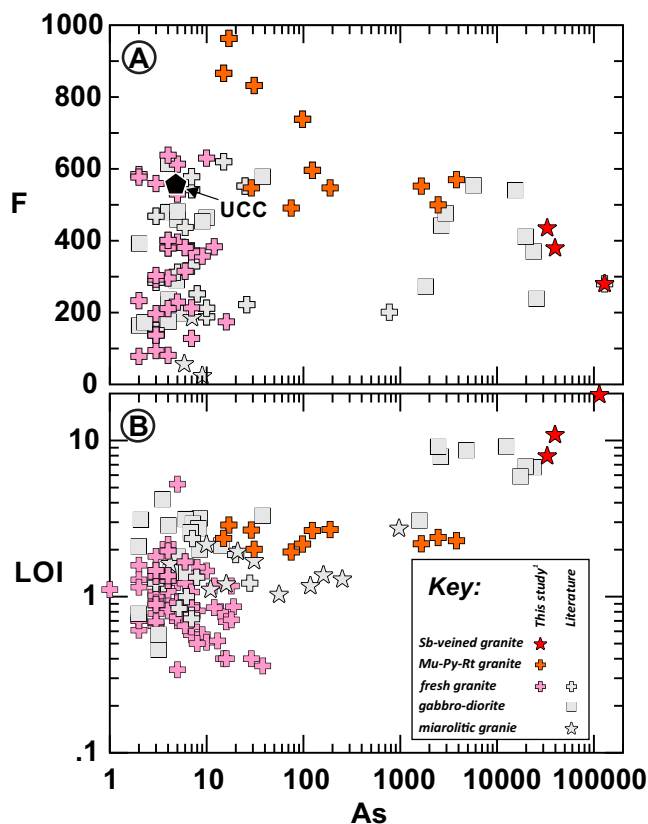


Figure 11. Binary diagrams of (A) *F* vs. *As* and (B) *LOI* vs. *As* for samples from the Yellow Fox showing. Grey symbols represent samples from the MPIS-hosted, Salmon River and Slip mineralized zones (Tallman, 1991a; Evans, 1996; Evans and Dimmell, 2001; Evans et al., 2001; Hoffe and Sparkes, 2003; House, 2003, 2005, 2007a, b; Sandeman et al., 2017). UCC= upper continental crust composition from Rudnick and Gao (2003). Regional, fresh MPIS monzogranite analyses from this study supplemented with those from Dickson and Kerr (2007).

unaltered monzogranite. Figure 12 shows that muscovite–pyrite–rutile-altered granite has variably elevated *As*, *Au*, *Ag*, *Sb* and *Pb*, but only weakly anomalous, *Zn*, *Cu*, *Cd* and *Sn* relative to unaltered monzogranite. Stibnite–arsenopyrite–quartz-veined monzogranite samples are the most enriched in *As*, *Ag*, *Sb* and *Pb*, and also contain anomalous *Zn*, *Cu* and *Cd* and weakly anomalous *Sn* (Figure 12). The granophile elements *Mo* and *W* are not enriched in hydrothermally altered samples relative to unaltered Yellow Fox monzogranite; however, these elements, as well as *Sn*, are all slightly elevated relative to average upper continental crust (UCC; Rudnick and Gao, 2003).

DISCUSSION

Field observations in 2016 and 2017, from mineral exploration trenches that are now backfilled and reclaimed,

indicate that the Yellow Fox showing is a fracture-controlled, roughly north–south-trending, 30-m-wide by 100-m-long, hydrothermally altered and mineralized zone hosted by *ca.* 419 Ma plagioclase porphyritic, granophyric-textured, hornblende–biotite monzogranite of the MPIS. The core of the alteration zone is characterized by common, 5–20-cm-spaced, north-trending fractures (356°/80°E) around which strong bleaching and muscovite–pyrite–rutile alteration of the monzogranite has occurred. This core is mantled by reddened and weakly altered monzogranite. In the northernmost exposed bedrock (Trench 1), the fractured, muscovite–pyrite–rutile-altered monzogranite is cut by a ≤4-cm-wide stibnite–quartz–arsenopyrite vein (025°/86°E) and veinlets that have euhedral arsenopyrite, stibnite, muscovite and quartz, with mineralization also developed in the vein margins. The euhedral arsenopyrite grains are now largely replaced by a mixture of altered arsenopyrite, stibnite and scorodite, and the vein-marginal monzogranite is cut by scorodite–goethite-coated anastomosing fractures. The latter represent the products of late-stage, supergene alteration of the sulphide minerals and arsenopyrite in particular.

The fractured, muscovite–pyrite–rutile-altered monzogranite exhibits variable, but modestly anomalous, *As*, *Au*, *Ag*, *Sb*, *Pb*, and *Cd* relative to unaltered or weakly altered granite. In contrast, the stibnite–quartz–arsenopyrite-veins and altered wall-rock samples exhibit highly anomalous concentrations of *As*, *Ag*, *Sb*, *Pb*, *Zn*, *Cd* and weakly anomalous in *Cu*. Gold is apparently absent in the stibnite–quartz–arsenopyrite-veined monzogranite according to INAA data from this study (likely the result of gamma spectrum interference from antimony); however, fire assay data presented in Reid and Myllyaho (2012) suggest gold enrichment in their stibnite-veined monzogranite samples. The style and mineralogical characteristics of the alteration suggest the early infiltration of an acidic (H_2O – HF – HCl ?), $\text{SiO}_2 + \text{K}_2\text{O} + \text{Fe} + (\text{S}) + \text{Au} + \text{Ag} + \text{Sb} + \text{As} + \text{Pb} \pm \text{Zn}$ – Cd – Cu – Sn (?)–bearing hydrothermal fluid along north-trending fractures in the monzogranite. This led to the destruction of feldspar, biotite and hornblende and the extensive replacement of the primary minerals in the monzogranite through the deposition of muscovite, pyrite and rutile. This event was followed by the development of a second suite of north-east-trending fractures, and the infiltration along those fractures of a second, $\text{H}_2\text{O} + \text{CO}_2 + \text{SiO}_2 + \text{K}_2\text{O} + \text{Fe} + (\text{S}?) + \text{Au} + \text{Sb} + \text{As} + \text{Ag} + \text{Pb} + \text{Zn} + \text{Cd} \pm \text{Cu}$ – Sn (?)–bearing hydrothermal fluid. Injection of this fluid led to the development of stibnite–quartz–arsenopyrite veins, accompanied by the deposition of euhedral stibnite, arsenopyrite and quartz in the vein wall rock. Subsequent supergene oxidation and hydration of the mineralization, possibly accompanying uplift and erosion, generated the young, anastomosing, scorodite–goethite-coated fractures.

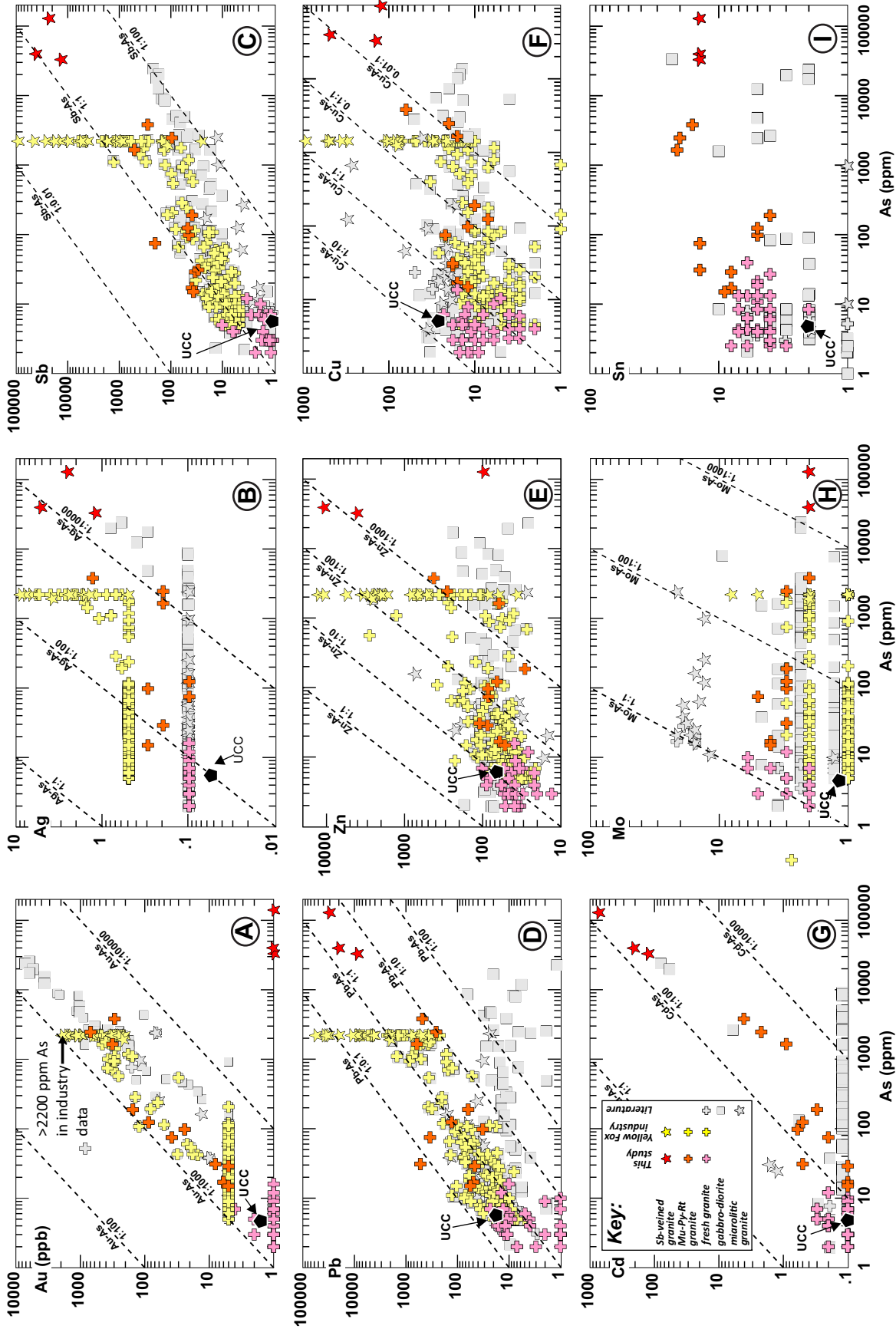


Figure 12. Log-log plots for samples from the Yellow Fox showing. A) Au vs. As; B) Ag vs. As; C) Sb vs. As; D) Pb vs. As; E) Zn vs. As; F) Cu vs. As; G) Cd vs. As; H) Mo vs. As and I) Sn vs. As. Yellow symbols represent samples from a mineral-exploration industry assessment report (Reid and Myllahao, 2012). Grey symbols are samples from the Salmon River and Slip mineralized zones. Dashed lines represent lines of constant element/element ratios.

The samples of muscovite–pyrite–rutile-altered monzogranite at Yellow Fox exhibit similar Au:As, Cd:As and perhaps Ag:As ratios to those of the intrusion-hosted, precious-metal-mineralized zones along the Salmon River; however their Sb:As and Pb:As distributions are distinct. Free gold has not been observed in thin section, or through MLA analysis, and may be hosted in the lattice of spongy pyrite. The elevated metal content of the stibnite–quartz–arsenopyrite-veined monzogranite is directly correlated with the volume % sulphide minerals. Preliminary electron microprobe analysis suggest the elevated As in the muscovite–pyrite–rutile-altered monzogranite may be hosted in arsenian pyrite.

The age of the mineralization is not known, but must be younger than the *ca.* 419 Ma age of the monzogranite. Fracturing, alteration and deposition of anomalous metals likely occurred in response to brittle failure of the rigid MPIS accompanying Early Devonian, north–northwest-directed thrusting (Dunning *et al.*, 1990; McNicoll *et al.*, 2006; Sandeman *et al.*, 2018), and imbrication of the adjacent, greenschist-facies grade metasedimentary rock-dominated sequences. The latter include the Badger Group in the west and northwest, and the Indian Islands Group strata to the east, which collectively form the country-rock carapace to the MPIS (*e.g.*, Dickson, 1993, 1996, 2006; Dickson *et al.*, 2000, 2007; O'Brien, 2003; Sandeman *et al.*, 2018). Termination of Early Devonian ductile deformation in the northern Exploits Subzone has been precisely constrained at 415–410 Ma on Birchy Island in the Bay of Exploits, 48 km to the north–northwest (McNicoll *et al.*, 2006). The brittle fracturing of the MPIS that generated the fracturing and alteration at Yellow Fox, and the Salmon River mineralized zones may have been synchronous with, or postdated, that final ductile deformation event. Direct geochronological data for the age of alteration and mineralization are necessary to resolve this temporal issue.

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