

# LOW-SULPHIDATION STYLE PRECIOUS-METAL MINERALIZATION OF THE WESTERN AVALON ZONE, NEWFOUNDLAND

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## ABSTRACT

*The recognition of precious-metal-bearing, low-sulphidation related epithermal mineralization within the Avalon Zone of Newfoundland represents an important style of mineralization for mineral exploration. The western Avalon Zone is host to several occurrences of low-sulphidation veining distributed over some 200 km of strike length, including the Long Harbour Gold, Big Easy, Heritage, and Root and Cellar prospects. Each of these areas contain precious-metal-bearing veins locally displaying classic low-sulphidation features, such as colloform–crustiform-banded chalcedonic quartz, lattice-bladed textures and adularia. These Neoproterozoic epithermal systems demonstrate remarkable preservation of relatively shallow levels within the overall system, with locally preserved “sinter-like” deposits and vein features indicative of fluid boiling. Low-sulphidation veining is locally host to bonanza-grade gold–silver mineralization, in addition to enrichment of antimony, molybdenum, zinc, lead and tellurium.*

*Most of these prospects were discovered through the follow-up analysis of till- and lake-sediment gold anomalies in provincial government datasets. Over the last twenty years, several of these occurrences have progressed from initial discoveries to drill-defined prospects, with mineralized veining locally identified over 500 m of strike length and up to 250 m in vertical depth. However, exploration of these systems is hampered by poor outcrop exposure and extensive surficial cover. Future exploration in the region would benefit from denser sampling programs of surficial media, combined with the application of less commonly used geochemical vectors from the epithermal suite of elements (e.g., Hg, Pb, Sb, Se, Te).*

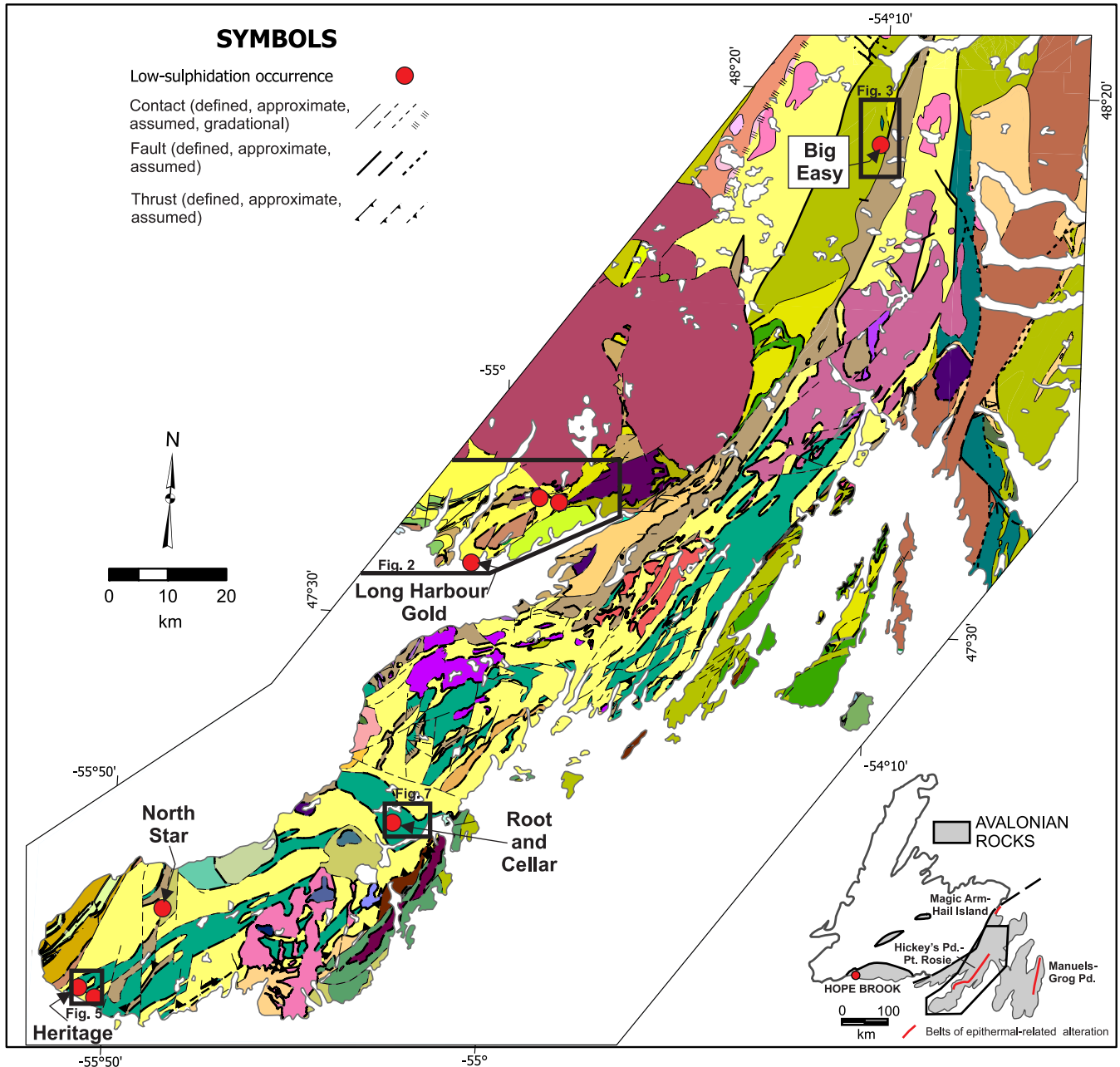
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## INTRODUCTION

Epithermal-style low-sulphidation related mineralization was first identified in the Avalon Zone of Newfoundland in the late 1990s (O’Brien *et al.*, 1998). Since that time, mineral exploration in the region has identified several occurrences of low-sulphidation veining hosted within Neoproterozoic rocks, locally containing appreciable gold–silver mineralization. The Long Harbour Gold prospect, discovered in the mid-2000s (Seymour, 2006), represents the first discovery of low-sulphidation style, adularia-bearing, crustiform–colloform-banded chalcedonic quartz veining in the western Avalon Zone in Newfoundland. Subsequent exploration for this style of mineralization over the last twenty years has largely focused on three main areas, namely the Big Easy (Rojas, 2022 and references therein), Heritage (Corbin, 2022 and references therein) and Root and Cellar (Kaine, 2025 and references therein) prospects, which are distributed over some 200 km of strike length along the western margin of the Avalon Zone (Figure 1). Diamond drilling at these prospects has locally intersected veins containing bonanza-grade gold–silver min-

eralization, with several of these prospects remaining open along strike and at depth.

Prospecting around surficial gold anomalies in the provincial government till (Heritage, Noel, 2012; Root and Cellar, Brushett, 2015) and lake-sediment (Big Easy, Dyke, 2009) datasets led to the initial discovery of mineralization in these areas. Elsewhere within the Avalon Zone of Newfoundland, selenium in lake sediments has been used as a vector for low-sulphidation related mineralization (e.g., Hussey, 2006). More recent exploration around the Heritage prospect highlights antimony in soils as a potential vector for this style of mineralization (Corbin, 2022). The recognition of these often subtle, and commonly single-point, geochemical anomalies in the regional-scale government till- and lake-sediment surveys highlight the potential of the western Avalon Zone. Given the restricted footprint of this style of mineralization, coupled with the broad (approximately 2 km) spacing of the regional surveys, implies that denser sampling surveys of surficial material along prospective trends within the region would prove beneficial in outlining additional areas for follow-up investigations.



**Figure 1.** Regional geology map of the western Avalon Zone (modified from Meyer et al., 1984; Hill and Kirby, 1984; King et al., 1988; O'Brien, 1992; O'Driscoll et al., 1995), outlining the distribution of the known occurrences of low-sulphidation mineralization.

The following discussion highlights the key characteristics and current understanding of this important style of mineralization within the western Avalon Zone of Newfoundland. This includes a summary of the geological setting and associated alteration, as identified using short-wave infrared (SWIR) spectroscopy, at the four main prospects. In addition, the various styles of mineralization and related low-sulphidation vein textures are summarized

along with the local enrichment of antimony, molybdenum, zinc, lead and tellurium. Exploration at several of the main prospects is ongoing, with new information continually adding to the knowledge-base related to the development of this style of mineralization, which will undoubtedly lead to further refinement of the key characteristics related to low-sulphidation systems within the Avalon Zone of Newfoundland.

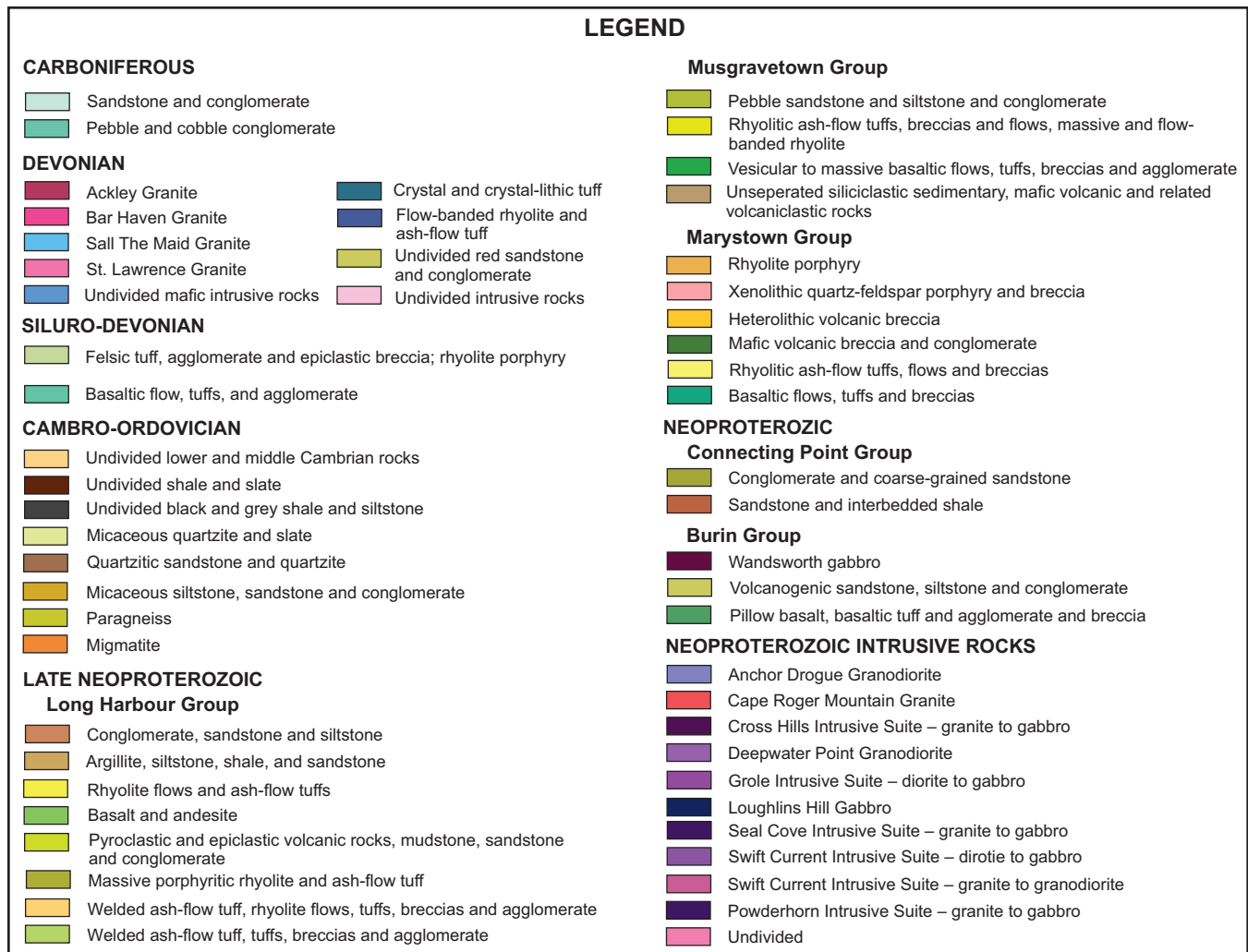


Figure 1. Legend.

## REGIONAL GEOLOGY

The Avalon Zone of Newfoundland is characterized by magmatic activity ranging in age from *ca.* 760–550 Ma (O'Brien *et al.*, 1996) within arc, or arc-adjacent and continental-extensional settings (O'Brien *et al.*, 1999). These volcanic sequences are host to high-level intrusions, which generated regional-scale magmatic–hydrothermal systems, that were locally accompanied by precious-metal deposition (O'Brien *et al.*, 1999). These volcanic rocks are intercalated with, and overlain by, sequences of marine, deltaic and fluvial siliciclastic sedimentary rocks. The deposition of these sedimentary sequences can locally be demonstrated to have played an important role in the preservation of the underlying epithermal systems through rapid burial (*e.g.*, Sparkes *et al.*, 2005).

Within the western Avalon Zone, rocks related to the 590–570 Ma Marystown Group form a broad-scale anticline,

flanked by a shoaling-upward sequence of marine to terrestrial sedimentary rocks of the Neoproterozoic Musgravetown Group (O'Brien *et al.*, 1999; Figure 1). To the west and north, the Marystown Group is overlain by the *ca.* 570 to 550 Ma Long Harbour Group, dominated by sub-aerial felsic volcanic rocks of alkaline to peralkaline affinity along with lesser mafic volcanic rocks and siliciclastic sedimentary rocks. This sequence is conformably overlain by Cambrian fossiliferous sedimentary rocks related to the development of a platform cover sequence that follows the cessation of Ediacaran volcanic activity and related epithermal systems within the Avalon Zone (O'Brien *et al.*, 1996; Murphy *et al.*, 2023). Low-sulphidation veins within the western Avalon Zone have been identified in a variety of host rocks, which include: 1) volcanic rocks of the Marystown Group (Heritage prospect, Ferguson, 2017; Root and Cellar prospect, Kaine, 2025), 2) siliciclastic sedimentary rocks of the Musgravetown Group (Big Easy prospect, Clarke, 2013; Rojas, 2022), and 3) felsic volcanic rocks of

the Long Harbour Group (Long Harbour Gold prospect; Ferguson, 2017).

## KEY EXAMPLES OF LOW-SULPHIDATION SYSTEMS

Classic low-sulphidation style vein textures have been identified at several prospects within the western Avalon Zone (French and Woodland, 2013; Ferguson, 2017; Rojas, 2022). These textures include: crustiform–colloform banded chalcidonic quartz, lattice-bladed quartz and cockade breccia (Dong *et al.*, 1995; Terry *et al.*, 2021). Mineralized veins at these prospects display variable gold/silver ratios, suggesting the presence of multiple mineralizing events. Vein and breccia development is associated with variable wallrock alteration, ranging from no visible alteration to pervasive quartz–white mica alteration extending for tens of metres into the surrounding country rock. The restricted nature of the hydrothermal alteration associated with low-sulphidation systems, coupled with the vertical zonation of base- and precious-metal enrichment, and the fluctuation of the boiling zone within mineralized veins contribute to the exploration challenges associated with this style of mineralization.

Low-sulphidation systems are commonly developed in extensional settings (Corbett, 2002), and most vein systems within the region display a spatial association with post-mineralization mafic dykes that are assumed to exploit the same extensional regime. Local dating of the post-mineral dykes (*e.g.*, Big Easy prospect; *see below*) provide minimum age constraints on the development of mineralization in the region. Despite being Neoproterozoic, occurrences in the region contain remarkably well-preserved examples of epithermal-style low-sulphidation mineralization. The individual prospects display several similarities with other examples of low-sulphidation related mineralization identified elsewhere in the Avalon Zone of Newfoundland (*e.g.*, Mills *et al.*, 1999; Pryor, 2025). However, several key differences, in relation to the development of vein textures, related alteration, and enrichment of the epithermal suite of elements (*e.g.*, Au, Ag, As, Bi, Cu, Hg, Pb, Sb, Se, Sn, Te and Zn) are evident when comparing individual prospects.

Since the early 2000s, the Long Harbour Gold, Big Easy, Heritage, and Root and Cellar prospects have been the focus of intermittent mineral exploration (*see below*). These areas have progressed from initial prospecting discoveries to, in most cases, drill defined, kilometre-scale vein systems. However, in all areas except the Long Harbour prospect, extensive surficial cover hinders exploration, adding further challenges in the exploration of a complex ore system.

## LONG HARBOUR GOLD PROSPECT

The Long Harbour Group is known to host examples of both high- and low-sulphidation styles of epithermal mineralization (Sparkes, 2012; Sparkes and Dunning, 2014, and references therein; Sparkes *et al.*, 2023; Sparkes, 2025). Exposure of much of the Long Harbour Group is unique given the overall lack of surficial cover (Sparkes *et al.*, 2023), and exploration targeting prospective rocks in the area resulted in the initial discovery of low-sulphidation style veining at the Long Harbour Gold prospect. However, even in such terrain, identifying the cryptic vein textures associated with mineralization through the extensive lichen cover developed on outcrops in this area remains challenging.

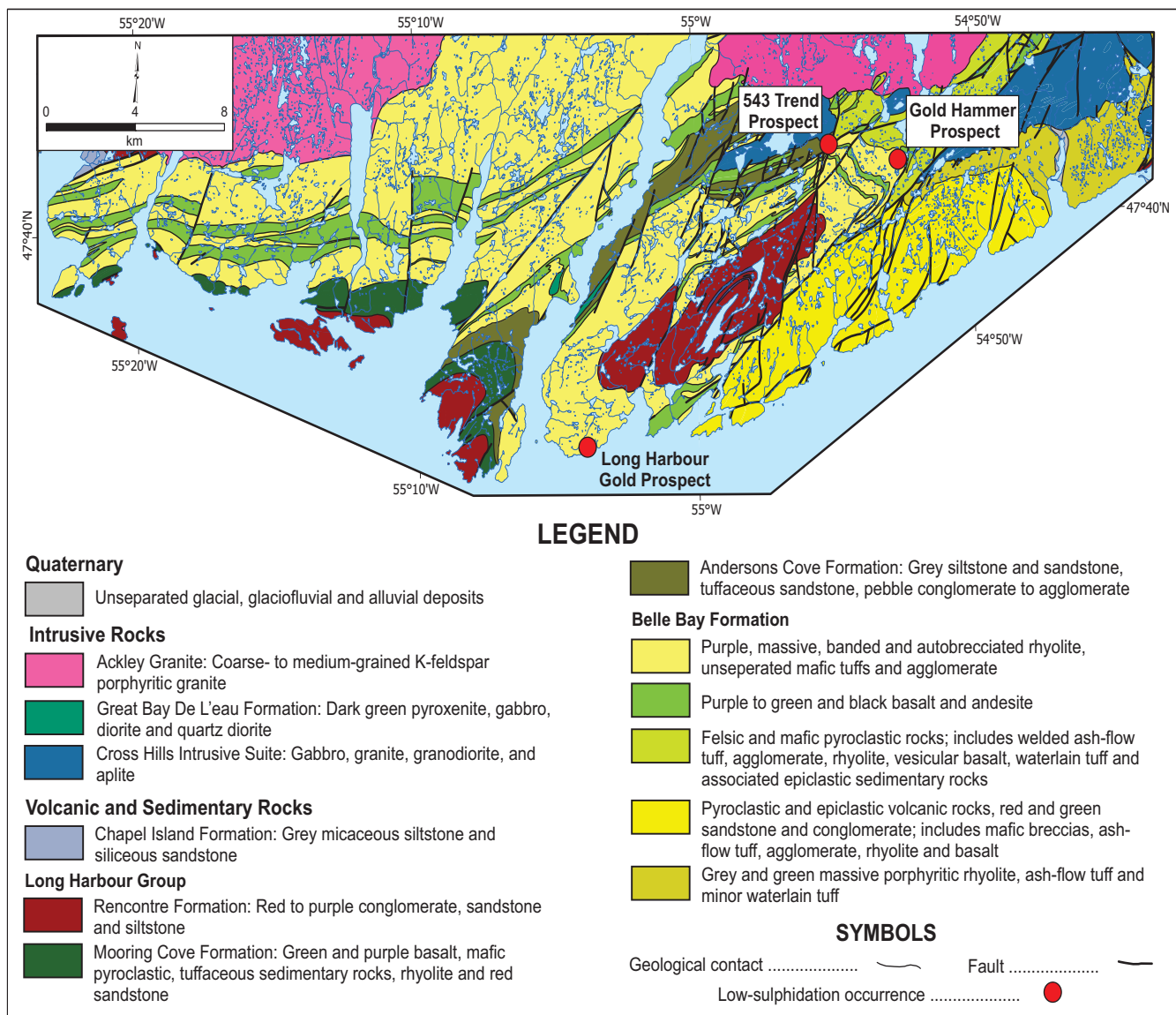
### Exploration History

For a detailed review of the previous work conducted in the Long Harbour area the reader is referred to Jacobs (2019). Exploration activities in the area first discovered low sulphidation-style veining in the early 2000s (Seymour, 2004a, b). Follow-up investigations discovered well-developed crustiform–colloform banded, adularia-bearing, chalcidonic quartz veins and associated cockade breccias, locally assaying up to 5.2 g/t Au and 3.8 g/t Ag at the Long Harbour Gold prospect (Figure 2; Seymour, 2006; Crewe and Seymour, 2007). Anomalous gold (up to 487 ppb) has also been identified up to 500 m to the southwest of this prospect in association with localized chalcidonic quartz veining and associated quartz-rich breccias (Jacobs, 2019).

Reconnaissance prospecting, targeting anomalous selenium values in the provincial lake-sediment database, has also resulted in the discovery of gold mineralization farther to the northeast at the Gold Hammer prospect (Hussey, 2006; Figure 2). Here, stockwork-style chalcidonic quartz veins, associated with phengitic white mica alteration, locally assay up to 61 g/t Au (Hussey, 2006). This mineralization is inferred to be of a low-sulphidation affinity based on vein textures and associated alteration (Hussey, 2006; Sparkes, 2012). Similar low-sulphidation veining and phengitic white mica alteration has also been identified approximately 3 km to the west of the Gold Hammer prospect, along a subparallel northeast trending structural lineament known as the 543 Trend (Hussey, 2009; Figure 2). Here, chalcidonic quartz veining and related cockade breccias are locally developed along with rare examples of chalcidonic quartz banding formed perpendicular to vein margins (Sparkes *et al.*, 2023).

### Local Geology

The Long Harbour Group is divided into a lower volcanic sequence (Belle Bay Formation) and an upper vol-



**Figure 2.** Regional geology map outlining the distribution of the Long Harbour Group and related low-sulphidation prospects. Bedrock geology modified from O'Brien *et al.* (1984) and O'Brien (1998).

canic sequence (Mooring Cove Formation), which are separated by a clastic sedimentary unit known as the Anderson's Cove Formation (Williams, 1971; O'Brien *et al.*, 1984; O'Brien *et al.*, 1995; Mills and Alvaro, 2025 and references therein). Rhyolites from both the Belle Bay and Mooring Cove formations have been dated at  $568 \pm 5$  and  $552 \pm 3$  Ma, respectively (O'Brien *et al.*, 1995). Flow-banded rhyolite hosting the low-sulphidation veining at the Long Harbour Gold prospect has been dated at  $566.5 \pm 1.9$  Ma (Ferguson, 2017). The Mooring Cove Formation of the Long Harbour Group is, in turn, unconformably overlain by siliciclastic sedimentary rocks of the Rencontre Formation of the Fortune Group (Mills and Alvaro, 2025).

The Long Harbour Group is predominantly composed of subaerial felsic volcanic rocks of alkaline to peralkaline affinity, and lesser mafic volcanic and siliciclastic sedimentary rocks. These bimodal volcanic rocks were deposited in an extensional setting within the western Avalon Zone during the late Ediacaran (Mills and Alvaro, 2025). Low-sulphidation veining is inferred to be coeval with the host felsic volcanic rocks of the Belle Bay Formation during this period of arc extension.

### Mineralization and Associated Alteration

The main mineralized veining and related hydrothermal brecciation at the Long Harbour Gold prospect forms a

steeply dipping, north-northwest–south-southeast-trending zone up to 5 m wide and is traceable along strike for up to 70 m, pinching out to the northwest (Plate 1A). Sampling of the vein system has returned up to 3.4 g/t Au and 4.5 g/t Ag over 0.9 m from a channel sample, and up to 5.2 g/t Au and 3.8 g/t Ag from a grab sample (Crewe and Seymour, 2007). Both samples were collected from breccias hosting rhyolite fragments and colloform–crustiform banded chalcedonic quartz with locally developed lattice-bladed textures (Plate 1B).

The host flow-banded rhyolite displays no visual signs of alteration related to the vein and breccia development (Plate 1C). Shortwave infrared (SWIR) spectral analysis of samples from the area generally produce a poor spectral response, which is supported by the overall lack of visual alteration. However, some clay alteration is detected with SWIR, which included muscovite, phengite, and rare kaolinite. In addition, the spectral data also indicated the presence of carbonate minerals, which included siderite, ankerite and magnesite.

Detailed petrography and SEM analysis on samples from the prospect identified precious-metal bearing minerals such as native gold, electrum, acanthite, hessite and naumannite (Ferguson, 2017). These phases were exclusive to quartz–adularia lattice-bladed bands within crustiform veins. Samples of this style of veining have produced the highest grades from the prospect, locally returning up to 5.3 g/t Au and 10 g/t Ag, along with anomalous Sb (56.6 ppm; Plate 1D–F). No significant enrichment of mercury, selenium, or tellurium has been identified in geochemical samples collected by the author (*e.g.*, Sparkes and Sandeman, 2015). Likewise, no significant base-metal enrichment is observed in the assay data, but sulphide phases such as arsenopyrite, galena, sphalerite, pyrrhotite, boulangerite, and chalcopyrite along with native bismuth and antimony have been identified in thin section (Ferguson, 2017). However, industry sampling approximately 2 km to the northwest of the prospect has identified elevated Zn (0.34%), Cu (0.17%), Pb (0.01%), Sb (174 ppm), Ag (30.5 g/t) and Bi (46 ppm) along with weakly anomalous Au (36 ppb; Seymour, 2004a).

## BIG EASY PROSPECT

The Big Easy prospect is unique in that it is the only low-sulphidation prospect within the western Avalon Zone that is hosted within siliciclastic sedimentary rocks of the Musgravetown Group. This prospect contains evidence for the preservation of the paleosurface environment as demonstrated by the development of finely laminated chalcedonic quartz layers interbedded with coarse-grained volcanoclastic sandstone (Sparkes, 2012); such horizons are associated with weakly anomalous gold, silver, arsenic, antimony, mer-

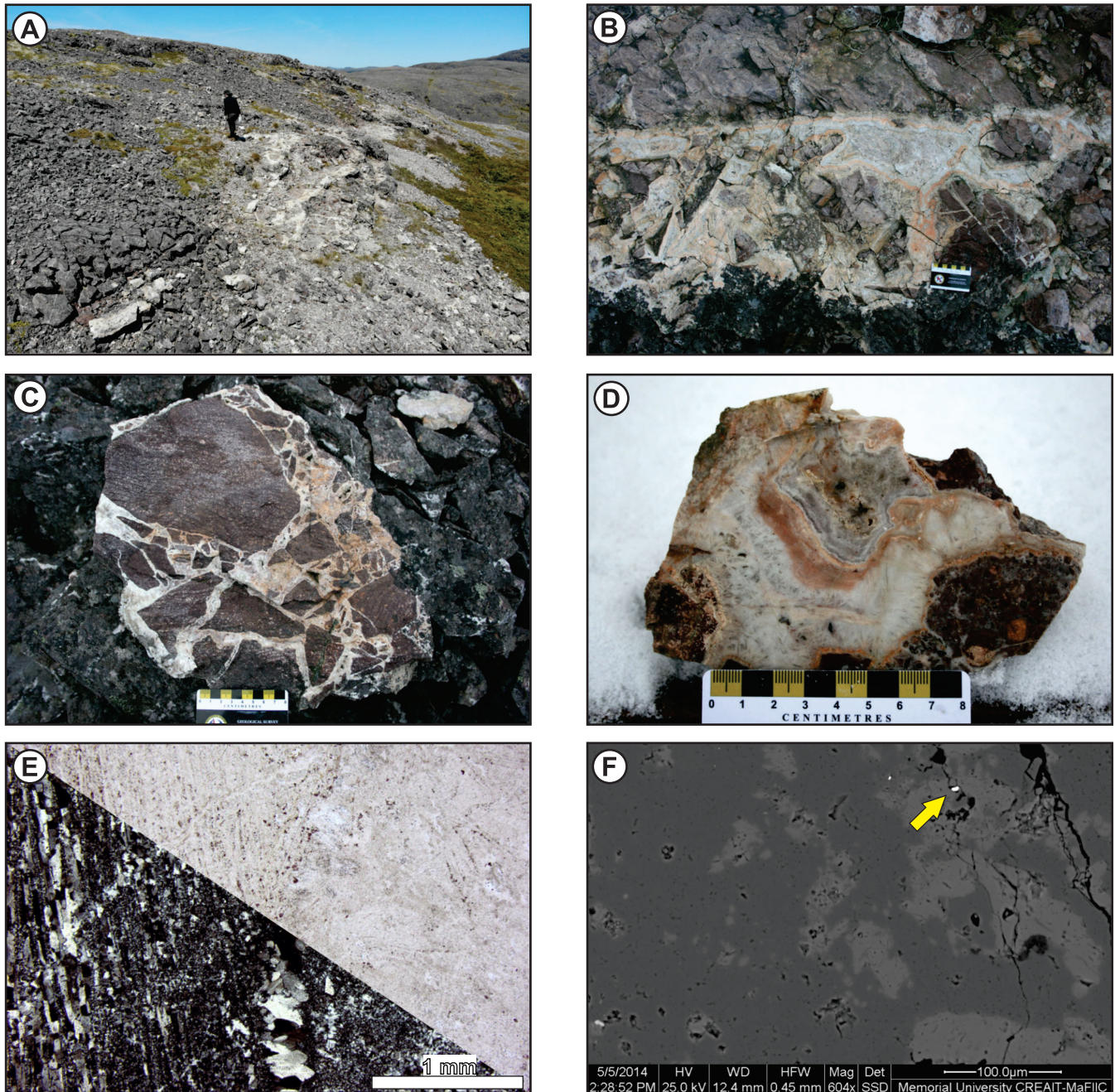
cury and molybdenum. The presence of this finely laminated chalcedonic quartz material, both as discrete layers and as eroded fragments within the host volcanoclastic rock, provides evidence of the syn-depositional nature of this “sinter-like” material at the paleosurface with the host sedimentary sequence (Sparkes, 2012).

Drilling at the prospect has intersected less than one metre-scale veins containing colloform–crustiform banded chalcedonic quartz at relatively shallow depths (<170 m), locally hosting significant gold–silver enrichment, in addition to broad intervals of hydrothermal breccia displaying anomalous gold (*e.g.*, 870 ppb Au and 33 g/t Ag over 30.5 m; Delazzer and Dimmell, 2012). This vein system has been tested by 53 drillholes, totalling some 18 000 m of drilling and has been traced intermittently for up to 2.5 km along strike. Low-sulphidation style veining and related alteration has been traced to a vertical depth of 230 m (DDH BE-14-15; Dimmell *et al.*, 2015), with the most significant intersection to date assaying 10.0 g/t Au and 1094 g/t Ag over 0.2 m (Dimmell *et al.*, 2015).

## Exploration History

The area around the Big Easy prospect was first investigated in the mid-1990s, initially targeting a 10 ppb gold in lake-sediment anomaly, which resulted in the identification of an extensive (0.5 x 1.8 km) zone of pyritic alteration, hosting anomalous gold, silver, arsenic, zinc and molybdenum (Harris, 1996; Saunders, 1996); but no follow-up work was carried out. In the late 2000s, Cornerstone Resources optioned the property from a local prospector and conducted an initial evaluation of the area, identifying the potential for low-sulphidation style mineralization (Dyke, 2009). The property was subsequently optioned by Silver Spruce Resources in 2010, who conducted the first trenching and channel sampling on the prospect, which resulted in assays of up to 2.1 g/t Au and 4.1 g/t Ag over 0.7 m (MacGillivray *et al.*, 2011). The first diamond drilling was conducted on the prospect in 2011, with seven holes testing over 1 km of strike length along the alteration zone, which produced assays of up to 7.6 g/t Au and 10 g/t Ag over 1 m (Delazzer and Dimmell, 2012). Follow-up drilling along with geophysical and geochemical surveys was conducted by Silver Spruce between 2012 and 2014, which resulted in drill intersections of up to 10.0 g/t Au and 1094 g/t Ag over 0.2 m, in association with colloform–crustiform banded chalcedonic quartz veining (Dimmell *et al.*, 2012, 2013, 2015).

The claims were returned to the original property owners in 2015, at which point the property was purchased by a private Newfoundland and Labrador company (65241 NL Inc.), who carried out additional diamond drilling in the fall of 2016. This drilling intersected up to 3.5 g/t Au and 510.5



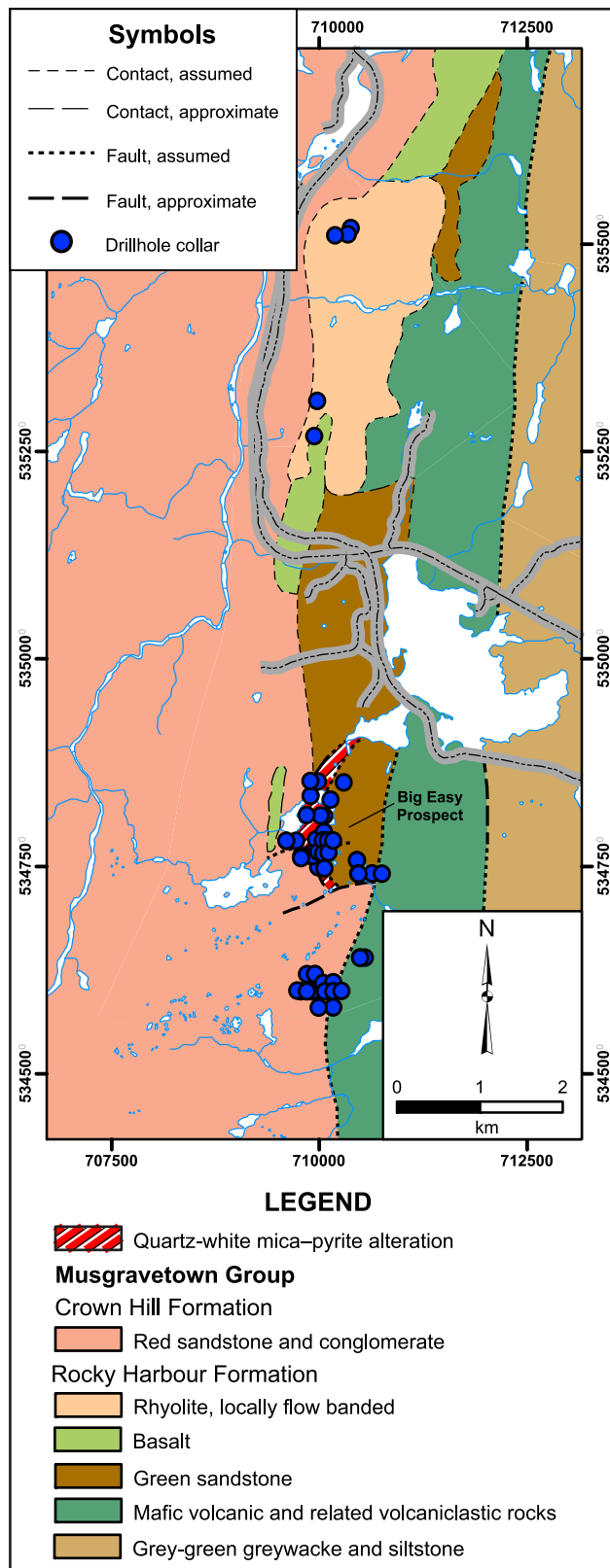
**Plate 1.** Representative photographs of the Long Harbour Gold prospect. A) Vein and breccia zone, locally up to five metres wide; viewed looking along strike to the northwest; B) Well-developed colloform–crustiform banded chalcidonic quartz–adularia (pink mineral forming discrete bands) vein. Note the purple, relatively unaltered rhyolite wall rock; C) Jig-saw breccia hosting angular, relatively unaltered, fragments of flow-banded rhyolite within a white comb textured quartz matrix; D) Crustiform-banded quartz–adularia and overprinting lattice textured quartz within a grab sample that returned to 5.3 g/t Au and 10 g/t Ag (GS-11-325); E) Photomicrograph illustrating plane-polarized and cross-polarized light images highlighting the contact between the crustiform-banded quartz–adularia (right) and overprinting lattice textured quartz (left); note most of the gold mineralization occurs along this contact zone; F) SEM image of very fine-grained electrum (yellow arrow) developed along the contact zone illustrated in E.

g/t Ag over 2 m (Dimmell and Harris, 2017). The property was optioned by Cartier Iron Corporation (now Cartier Silver) in 2017, who still retain the mineral rights to the prospect. The company conducted additional geochemical and geophysical surveys along with diamond drilling from 2017 to 2023. This work extended the strike length of the alteration zone for an additional 1.5 km to the south, outlining a broad zone of anomalous gold within altered siliciclastic sediments, with assays of up to 0.11 g/t Au and 2.65 g/t Ag over 180.4 m, including 0.3 g/t Au and 6.3 g/t Ag over 40 m (Burke *et al.*, 2019).

### Local Geology

The area around the Big Easy prospect is predominated by red fluviatile siliciclastic sedimentary rocks, green sandstone and siltstone, and lesser mafic and felsic volcanic rocks of the Musgravetown Group. This sequence forms a moderately westward dipping succession along the eastern margin of a regional-scale, north-northeast–south-southwest trending sedimentary basin that is bound by older volcanic rocks (Figure 1). These bounding volcanic rocks have been correlated with both the Love Cove and the Musgravetown groups (Reusch and O’Driscoll, 1987; O’Brien, 1993) and most recently have been included within the Love Cove schist of the Musgravetown Group (Mills *et al.*, 2021). The two volcanic-dominated belts are locally host to epithermal-style mineralization and associated alteration and are likely correlative with rocks of the Marystown Group farther to the south based on existing geochronology (Sparkes, 2012; Mills *et al.*, 2021; Figure 1).

The immediate area surrounding the low-sulphidation veining at the Big Easy prospect is dominated by an extensive zone of quartz–pyrite–white mica alteration measuring up to 500 m in width and extending along strike for upwards of 2.5 km (Figure 3). Clastic rocks consisting of medium- to coarse-grained sandstone and interbedded pebble conglomerate outside of the alteration zone are similar to those hosting the alteration and related veining but are red to purple in colour. A rhyolite dome is locally developed north of the Big Easy prospect along the eastern margin of the sedimentary basin (Figure 3), which has been dated at  $573.3 \pm 2.7$  Ma (Ferguson, 2017) and is potentially correlative with the Rocky Harbour Formation of Mills *et al.* (2021). A similar rhyolite unit has been intersected in drillcore at the Big Easy prospect and is locally host to crustiform banded chalcidonic quartz veining (Plate 2). The sequence hosting the rhyolite unit is in structural contact to the west with red siliciclastic sedimentary rocks along the Grassy Pond Fault, which marks the western limit of the quartz–pyrite–white mica alteration (Wall, 2017). A series of northeast–southwest trending mafic dykes crosscut the sedimentary sequence and postdate the development of the hydrothermal alteration and associated veining. Dating of one of these



**Figure 3.** Local geology map of the area around the Big Easy prospect (modified from Wilton and Way, 2001), outlining the main alteration zone and distribution of diamond drillholes. Location data in NAD 27, Zone 21.



**Plate 2.** Basal contact of flow-banded rhyolite with underlying thinly-bedded green siltstone at the Big Easy prospect. Note the weakly developed, locally crustiform-banded, centimetre-scale quartz veins crosscutting the rhyolite unit. This veining, developed along the margin of the rhyolite, is associated with anomalous gold (69 ppb) and molybdenum (18.5 ppm) over 1 m (Delazzer and Dimmell, 2012; DDH BE-11-05; 217 m depth).

mafic dykes crosscutting the quartz–pyrite–white mica alteration zone in drillcore produced an age of  $566 \pm 2$  Ma (Clarke, 2013).

Outcrops in the area surrounding the Big Easy prospect is minimal, and most geological information is obtained through trenching and diamond drilling. Alteration related to vein development is locally observed to grade outwards into red coarse-grained siliciclastic sandstone and interbedded pebble conglomerate, which is inferred to be correlative with the Crown Hill Formation of the upper Musgravetown Group (*e.g.*, O’Brien and King, 2002). These altered rocks are separated from unaltered equivalents to the west by the Grassy Pond Fault (Wall, 2017), and at depth by a faulted contact with underlying rocks inferred to be correlative with the Rocky Harbour Formation of the Musgravetown Group. Limited drilling along the eastern boundary of the alteration zone also suggests the presence of a fault structure (Webster, 2022).

### Mineralization and Associated Alteration

Several detailed studies on mineralization and associated alteration at the Big Easy prospect have been carried out (*e.g.*, Clarke, 2013, Ferguson, 2017, Rojas, 2022), and only a brief summary of this prospect is provided herein. The alteration developed around the Big Easy prospect represents a structurally bound zone of quartz–pyrite–white mica alteration, which is largely covered by quaternary material. Shortwave infrared (SWIR) spectral data from drillcore highlights the phengitic composition of the white mica alter-

ation associated with the quartz–pyrite–white mica alteration (Plate 3). The potassic nature of this phengitic alteration accounts for the prominent radiometric signature associated with the Big Easy prospect in airborne geophysical surveys (Dimmell *et al.*, 2013). In addition, the area is associated with a magnetic low in airborne surveys, as well as a resistivity high with a moderate chargeability and a gravity low from ground-based investigations (Wall, 2017; Burke *et al.*, 2019).

The presence of chalcedonic quartz interbedded with altered siliciclastic sediments is unique to the Big Easy prospect. This material occurs in both surface outcrops and drillcore, and is associated with anomalous gold, silver, arsenic, antimony, mercury and molybdenum (Plate 4A, 4B). Early drilling at the prospect was oriented toward the east, resulting in intersections of the “sinter-like” horizons with layering roughly perpendicular to core axis (Plate 4B), indicating a gently westward dip, like the regional dip of the Crown Hill Formation in the area. Subsequent drilling was oriented to the west to produce better intersection angles with the mineralized veins, which are interpreted to be steeply eastward dipping (Dimmell *et al.*, 2012). Drilling at the prospect has intersected adularia-bearing chalcedonic quartz veining locally displaying lattice-bladed textures (Plate 4C) as well as locally developed ginguro-style banding (Plate 4D). Rare molybdenum-rich veins are also locally developed (Plate 4E) and generally form late crosscutting veins in drillcore. Broad zones of gold–silver mineralization intersected during drilling are associated with the development of hydrothermal breccias hosting abundant chalcedonic quartz fragments (*e.g.*, 870 ppb Au and 33 g/t Ag over 30.5 m; Delazzer and Dimmell, 2012; Plate 4F).

Detailed investigations of the low-sulphidation veining at the Big Easy prospect has defined four discrete mineralized events, these include: 1) electrum dominant, 2) high Au:Ag, 3) ginguro and 4) molybdenite-rich (Rojas, 2022). Within these mineralized veining events, detailed petrography conducted by Rojas (2022) identified the presence of electrum, native silver, naumannite, acanthite, molybdenite, pyrite, sphalerite and chalcopyrite. From this work, it is inferred that the molybdenite-rich phase represents one of the latest events. This relationship is further supported by detailed core logging and portable XRF analysis that highlight the molybdenite-bearing veins as being one of the last phases developed within the hydrothermal system.

As indicated above, phengitic white mica alteration is developed in association with the low-sulphidation mineralization at the prospect, which is associated with higher potassium values in geochemical analyses. The molar ratio plot in Figure 4A displays two distinct clusters having elevated gold values. Those samples displaying low potassi-

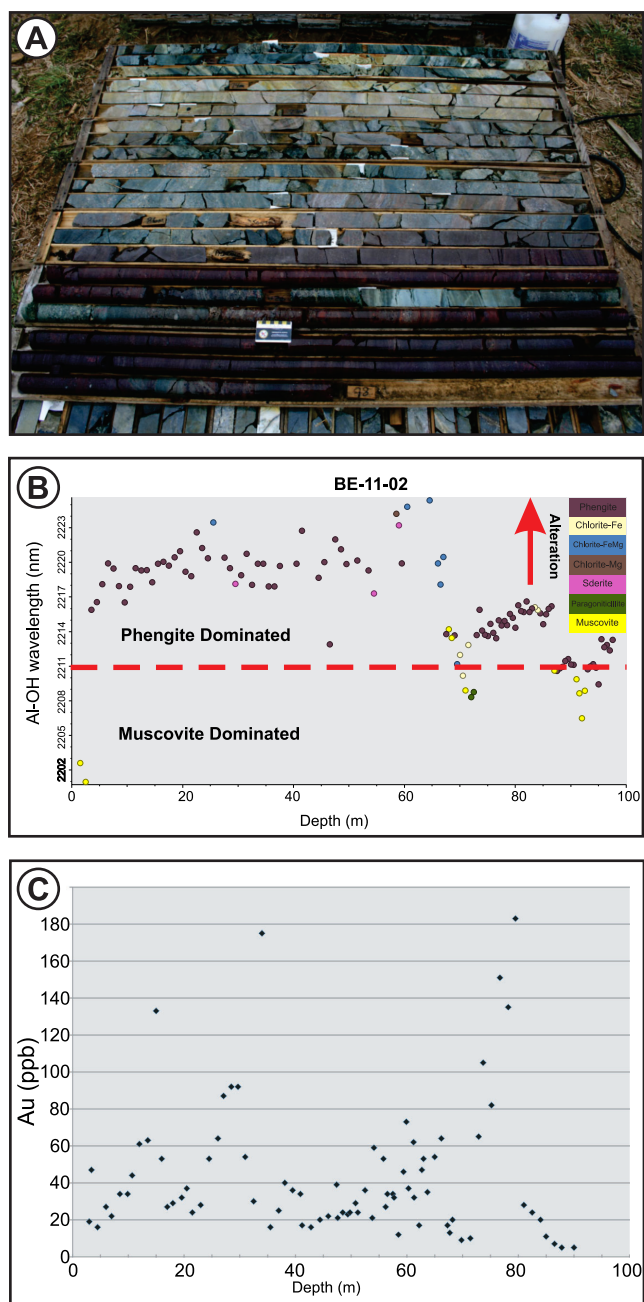
um/aluminum ratios ( $<0.2$ ) in association with elevated gold values represent analysis from 2014, which were analyzed by fire assay, utilizing an *aqua-regia* digest, at Eastern Analytical. The second cluster of samples displaying high potassium/aluminum ratios ( $>0.5$ ) and elevated gold values represent analysis from 2016 and 2021, which were analyzed by ICP four acid digest at Eastern Analytical and is more representative of the actual alteration signature. Gold–silver ratios for the compiled dataset display significant variability, but for gold values above the 60<sup>th</sup> percentile ( $>11$ ppb), ratios indicate the presence of a gold–silver enriched phase (Au:Ag ratios between 1:10 and 1:100), in addition to a gold enriched, silver poor phase (Au:Ag ratios

between 1:1 and 1:10) and a silver enriched, gold poor phase (Au:Ag ratios between 1:100 and 1:1000; Figure 4B).

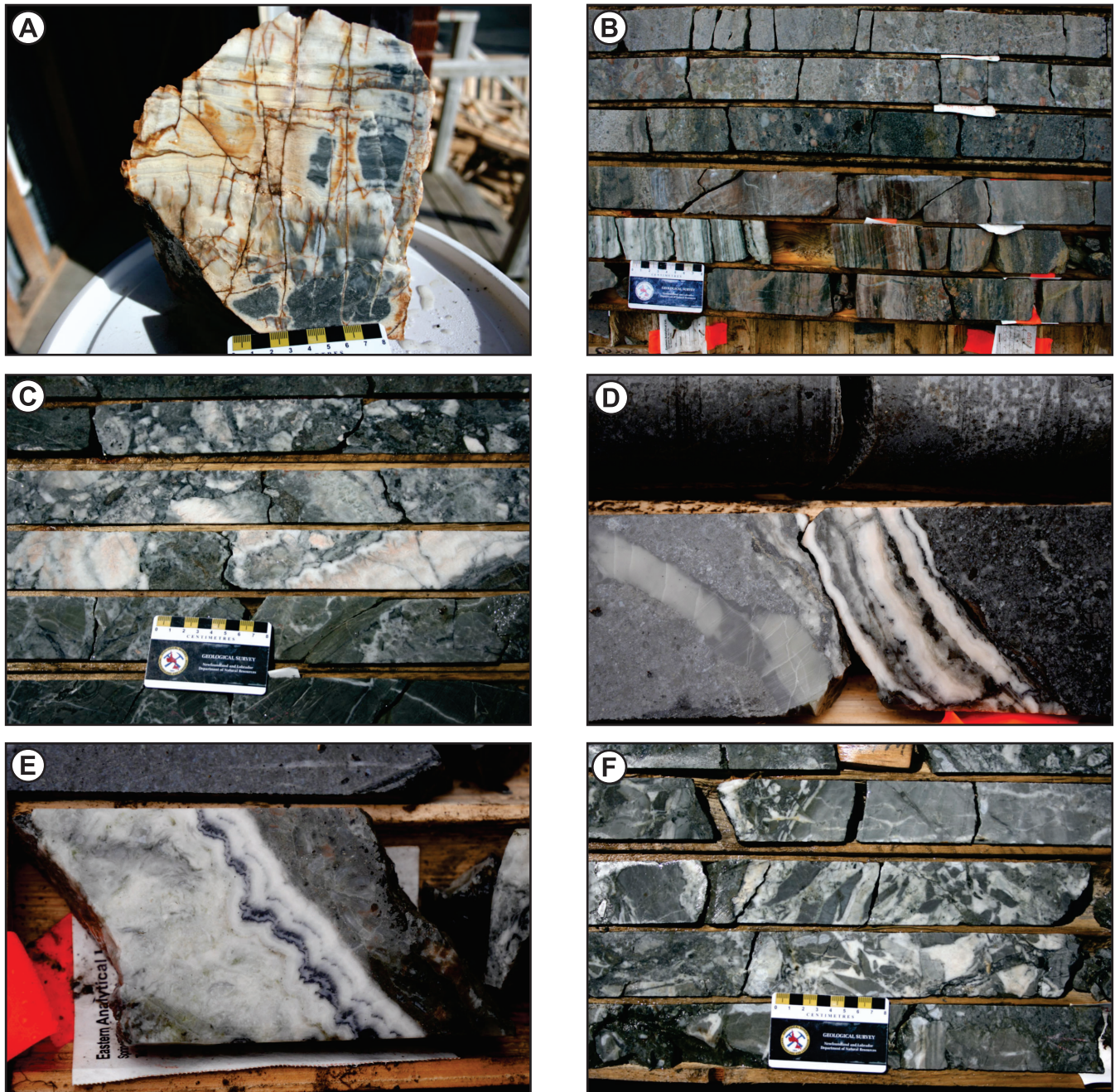
A strong spatial correlation between gold, silver, molybdenum and arsenic is noted in the assay data from drillcore (Rojas, 2022). However, molybdenum enrichment is not associated with significant gold mineralization in the dataset (Figure 4C), with only three samples containing  $>1$  g/t gold displaying molybdenum enrichment ( $>220$  ppm). Note that in the compiled dataset for this prospect, most molybdenum values greater than the upper level of detection (220 ppm) were not quantified, with sixty eight of the seventeen hundred and fifty-nine assays being greater than the upper detection limit ( $\sim 4\%$ ; Table 1). Elevated base-metal values are limited at the prospect and are not correlated with precious-metal enrichment (Figure 4D).

### HERITAGE PROSPECT

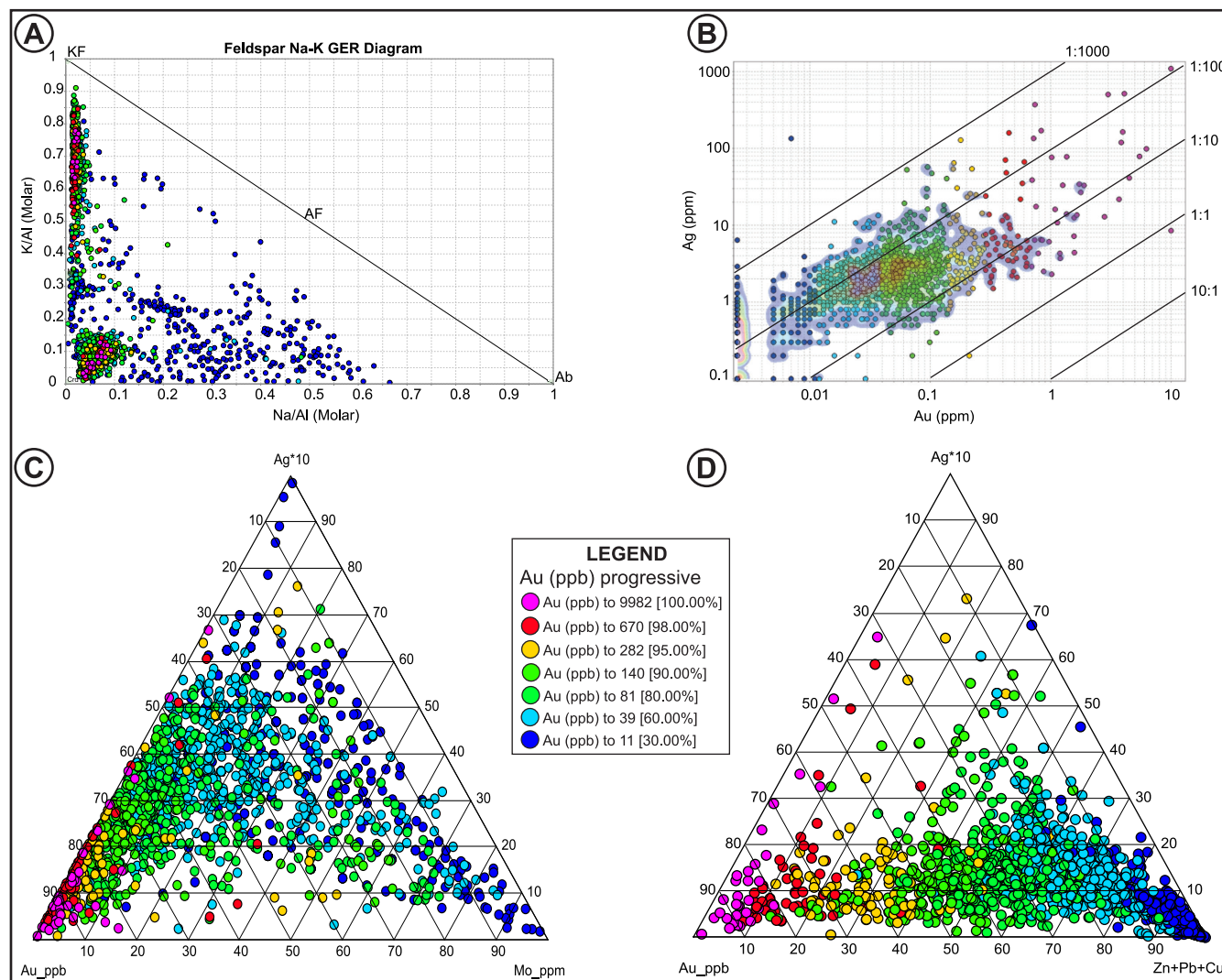
The Heritage prospect is noted for having the highest-grade drill intersection from low-sulphidation systems in the region, locally returning 46.5 g/t Au and 10 516 g/t Ag over 0.12 m (DDH HE-26-16; French and Mugford, 2016a); this sample also contained 0.8% Pb, 0.5% Zn, 0.3% Cu and 500 ppm Sb. The significant silver enrichment that accompanies gold mineralization, along with lead, zinc, copper and antimony, highlights the Heritage prospect as being geochemical distinct relative to other low-sulphidation prospects in the region. Such base-metal enrichment in low-sulphidation systems is generally associated with deeper levels within the overall epithermal system (*e.g.*, Buchanan, 1981; Morrison *et al.*, 1990). Typical low-sulphidation vein textures are less common at this prospect relative to the Long Harbour Gold and Big Easy prospects, but textural features observed in outcrop and drillcore (*e.g.*, colloform–crustiform banding, lattice-bladed textures) provides evidence for localized fluid



**Plate 3.** Spectral data from the Big Easy prospect (DDH BE-11-02). A) Photograph illustrating the gradational transition from phengite-dominated (Al-OH 2220 nm) quartz–pyrite–white mica alteration associated with localized low-sulphidation veining, through a zone of dark green phengite–chlorite and then into relatively unaltered red, hematite-rich, muscovitic (Al-OH 2210 nm) siliciclastic sediments ( $\sim 70$ – $98$  m depth); B) Graph illustrating the Al-OH spectral wavelength feature vs. down-hole depth, showing the distinct shift from the longer wavelength ( $\sim 2220$  nm) phengitic signatures associated with the hydrothermal alteration to shorter wavelength ( $\sim 2210$  nm) background signatures of relatively unaltered equivalents; C) Graph showing gold assay values vs. down-hole depth; note the distinct drop in anomalous gold values below 80 m depth associated with the transition out of the hydrothermal alteration (data compiled from Delazzer and Dimmell, 2012).



**Plate 4.** Representative photographs of the Big Easy prospect. A) Surface sample of centimetre-scale beds of chalcedonic quartz, locally interlayered with coarse-grained volcaniclastic sandstone displaying quartz-pyrite-white mica alteration. This zone, exposed within the central portion of the alteration zone is anomalous in gold (74 ppb), silver (8.7 g/t), arsenic (89 ppm), antimony (74 ppm), mercury (62 ppb) and molybdenum (9 ppm); B) Drill-hole intersection of similar chalcedonic quartz interbedded with altered coarse-grained sandstone and pebble conglomerate. The interval consists of a lower 0.7 m chalcedonic quartz horizon and an upper 0.35 m horizon separated by 0.6 m of sandstone; the chalcedonic quartz layers are associated with anomalous gold (117 ppb), silver (3.0 g/t), arsenic (110 ppm), antimony (15 ppm) and molybdenum (4 ppm; DDH BE-14-15, 68.2–69.9 m; Dimmell et al., 2015); C) Quartz adularia vein displaying lattice-bladed texture; assays from this zone returned 163 ppb Au and 32.3g/t Ag over 6.5 m (DDH BE-11-05, 97–103.5m; Delazzer and Dimmell, 2012); D) Crustiform-banded chalcedonic quartz vein displaying sulphide-rich, “ginguro-style”, banding, which assayed 6.2 g/t Au, 98.7 g/t Ag, 219 ppm As, 35 ppm Sb and 34 ppm Mo over 0.2 m. Note drillcore is ~4 cm wide (DDH BE-14-19, 148.6 m depth; Dimmell et al., 2015); E) Crustiform-banded chalcedonic quartz vein displaying sulphide-rich, “ginguro-style” banding, which assayed >220 ppm Mo, 89 ppb Au, 7.9 g/t Ag, 96 ppm As and 15 ppm Sb over 0.1 m. Note drillcore is ~4 cm wide (DDH BE-14-19, 117.4 m depth; Dimmell et al., 2015); F) Hydrothermal breccia zone hosting grey chalcedonic quartz fragments in a white quartz-rich matrix. This breccia zone is associated with broad, lower-grade mineralization locally returning 870 ppb Au and 33 g/t Ag over 30.5 m (DDH BE-11-03; Delazzer and Dimmell, 2012).



**Figure 4.** Geochemical plots of compiled industry drillhole data from 2014 to 2021 (Dimmell et al., 2015; Dimmell and Harris, 2017; Burke et al., 2019; Webster, 2022) for the Big Easy prospect. A) Molar ratio plot of Na/Al vs. K/Al; B) Gold vs. silver plot illustrating the distribution of Au:Ag ratios; C) Gold–silver–molybdenum ternary diagram; D) Gold–silver–zinc + lead + copper ternary diagram.

boiling and demonstrates that relatively shallow levels of the epithermal system are locally preserved.

Mineralized veining and related hydrothermal breccias developed at the prospect have been identified in four sub-parallel trends that comprise a zone that is traced intermittently for up to 4.5 km along strike and 2.5 km in width (Corbin, 2022). However, this area is poorly exposed and most of the geological information comes from trenching and diamond drilling. The Heritage prospect has been tested with a total of 109 drillholes, totalling some 16 000 m of diamond drilling. Much of this drilling has targeted the western portion of the prospect, which is known as the Eagle Zone (Figure 5). Here drilling has intersected wide intervals of

quartz veining, locally displaying colloform–crustiform banding, lattice-bladed textures, and ginguro-style banding, returning assays of up to 1.2 g/t Au and 20.0 g/t Ag over 35.8 m, which includes a higher grade interval of 4.9 g/t Au and 48.4 g/t Ag over 7.4 m (DDH HE-EZ-20-07; Corbin, 2022).

### Exploration History

Low-sulphidation style veining was first discovered on the southern Burin Peninsula in the late 2000s at the Peter Brook prospect (Figure 5), during regional prospecting related to uranium exploration in the region. The Peter Brook prospect locally contains well-developed colloform–crustiform banded chalcedonic quartz veining that assayed 1.2 g/t

**Table 1.** Summary of select elements of interest compiled from industry drillcore assay data for the Big Easy, Heritage and Root and Cellar prospects

	Au_ppb	Ag_ppm	As_ppm	Mo_ppm	Sb_ppm	Se_ppm	Zn_ppm	Pb_ppm	Cu_ppm	Au:Ag ratio (>60 percentile)
<b>Big Easy</b>										
Count Numeric	1964	1803	1759	1759	1759	1759	1759	1759	1759	1260
Minimum	2.5	0.1	2.5	0.5	1.5	0.5	4	1	2.5	0.85
Maximum	9982	1094	741	366	79	29	1717	1209	539	825.00
Mean	98.65	4.95	67.62	19.63	11.53	2.22	83.63	12.97	26.79	67.11
Standard Deviation	454.82	33.80	87.14	46.66	10.85	3.90	62.66	51.99	38.28	70.87
<b>Heritage</b>										
Count Numeric	1768	1768	1768	1768	1768	1768	1768	1768	1768	1238
Minimum	2.5	0.1	2.5	0.5	1.5	5	8	1	2.5	1.27
Maximum	15664	1402.2	307	488	139	22	21600	44700	3758	1894.12
Mean	291.06	16.12	15.76	16.80	7.84	5.06	399.29	205.97	48.13	78.32
Standard Deviation	885.42	50.82	14.92	32.24	6.14	0.76	1342.04	1252.84	137.33	81.62
<b>Root and Cellar</b>										
Count Numeric	1174	1174	1174	1174	1174	1174	1174	1174	1174	779
Minimum	0.5	0.005	0.4	0.13	0.05	0.5	11	1	0.5	0.44
Maximum	23500	16.7	965	508	24	40	567	582	11850	700.00
Mean	169.99	0.81	65.02	3.30	3.03	4.44	120.15	25.46	159.94	34.17
Standard Deviation	879.28	1.51	104.39	20.15	2.06	2.48	82.34	41.28	495.23	53.21

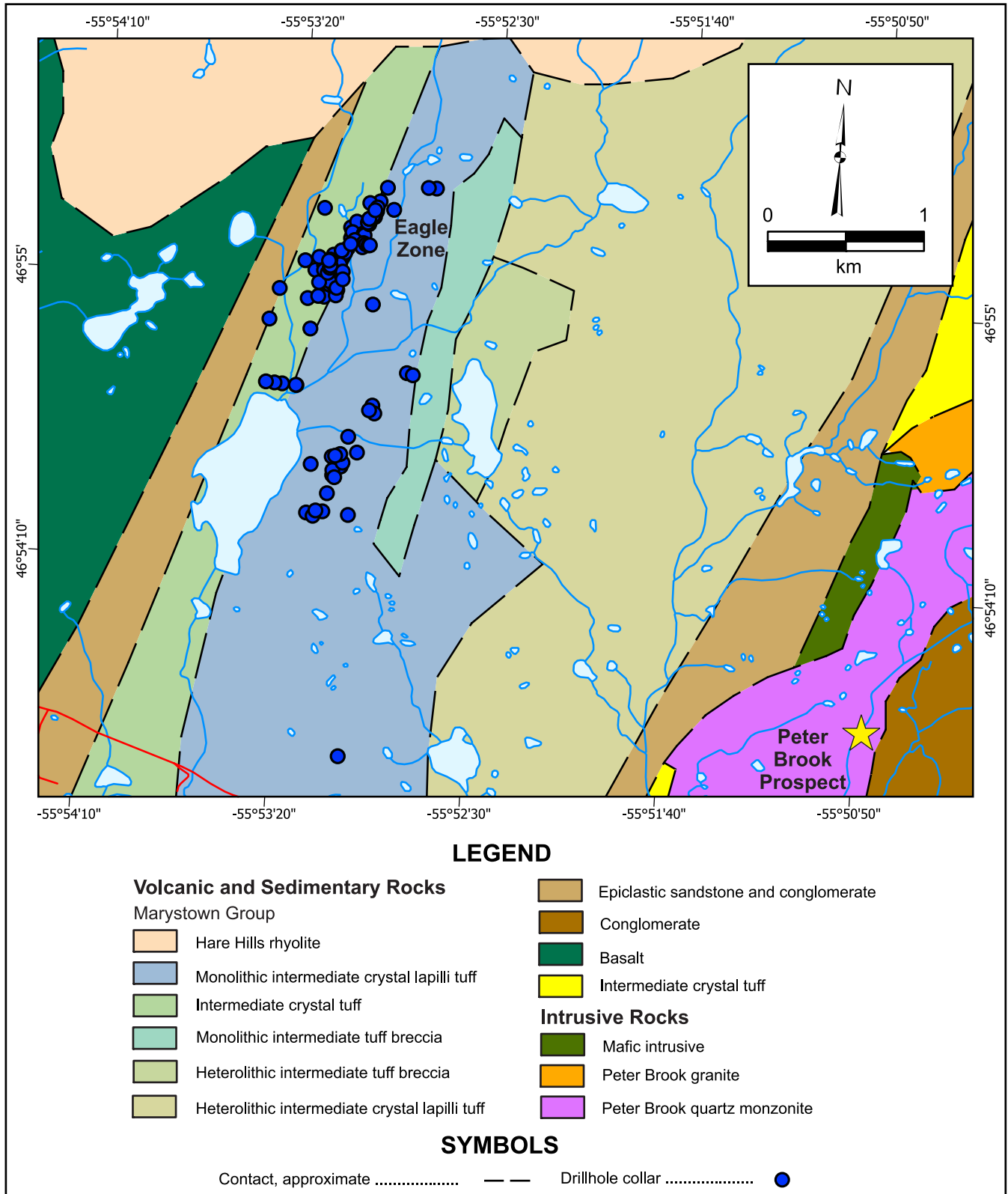
**Note:** This compilation includes assay data from the following sources: Drillcore data from 2014 to 2021 for the Big Easy prospect (Dimmell *et al.*, 2015; Dimmell and Harris, 2017; Burke *et al.*, 2019; Webster, 2022); drillcore data from 2018 to 2020 for the Heritage prospect (French and Mugford, 2019, 2020a; Corbin, 2022); unpublished drillcore data from 2021 to 2025 for the Root and Cellar prospect.

Au and 130.4 g/t Ag (Evans and Vatcher, 2010; Sparkes and Dunning, 2014). Subsequent work by local prospectors following up on anomalous regional gold in till values lead to the discovery of the Heritage prospect in 2011, 3 km northwest of the Peter Brook prospect. Here, assays of up to 7.7 g/t Au and 352 g/t Ag were obtained from a kilometre-scale zone of quartz alteration hosting hydrothermal breccias and related low-sulphidation veining (Figure 5; Noel, 2012). The property was optioned by Puddle Pond Resources in 2012, who conducted a series of exploration programs from 2012–2019, which included geological mapping, trenching, geophysical surveying and diamond drilling (Woodland and French, 2012; French and Woodland, 2013; French and Diorio, 2015; French *et al.*, 2016).

The first drilling on the property was carried out by Puddle Pond in 2013, with subsequent drill programs in 2015, 2016, 2018 and 2019 (Woodland and French, 2013; French *et al.*, 2014; French and Mugford, 2016a, b, 2019, 2020a). Early drilling in 2013 intersected board intervals of gold–silver mineralization, locally returning up to 1.3 g/t Au and 58.0 g/t Ag over 32.3 m (DDH HD-06-13) along with local high-grade intercepts of up to 34.9 g/t Au and 94.6 g/t

Ag over 0.4 m (DDH HD-13-13; French *et al.*, 2014). Regional reconnaissance work also identified a zone of quartz alteration and related hydrothermal breccia, locally assaying up to 2.6 g/t Au, 18 km northeast of the Heritage prospect, in an area referred to as the North Star prospect (Figure 1; Woodland, 2012; French and Mugford, 2016c).

The Heritage prospect was optioned from Puddle Pond by Golden Ridge Resources in 2020, who conducted airborne geophysical and ground surveys, along with additional diamond drilling (French and Mugford, 2020b; Corbin, 2022). This work generated some of the deepest intersections of the vein system obtained to date, extending the mineralized veining to a vertical depth of 250 m. In addition, surface investigations during this period of exploration included a soil-sampling program over the western portion of the prospect, which identified a spatial association between antimony in soils and the surface projection of the mineralized zone, highlighting a potential vectoring tool for regional exploration (Corbin, 2022). However, the company terminated the option agreement on the property in 2023. The Heritage prospect has most recently been optioned from Puddle Pond by Carmanah Minerals Corporation in 2025.



**Figure 5.** Local geology map of the Heritage prospect (modified from French and Mugford, 2020b), outlining the distribution of diamond drillholes.

## Local Geology

Rock units within the area of the Heritage prospect generally form a series of northeast–southwest trending belts, displaying variable magnetic intensities. Inland from the coast, and aside from areas of higher topographic relief, outcrops are poorly developed, which includes the area immediately surrounding the Heritage prospect. Here, the primary host to the low-sulphidation veining are intermediate volcanic rocks of the Marystown Group (Figure 5; French and Mugford, 2016a; Ferguson, 2017). These rocks include well-developed hyaloclastite, massive polymict breccia and related volcanoclastic rocks, along with lesser rhyolitic crystal tuff, interbedded sandstone and conglomerate and amygdaloidal basalt (Ferguson, 2017). The intermediate volcanic rocks are crosscut by several felsic and mafic dykes, the latter of which have variable orientations, primarily striking north–south (Ferguson, 2017) but also include a subset associated with east–west trending magnetic highs visible on airborne surveys (*e.g.*, French and Mugford, 2020b).

To the northwest of the prospect, areas of higher topographic relief are predominated by felsic volcanic rocks of the Hare Hills Tuff (O'Brien *et al.*, 1977), which is locally dated at  $575 \pm 2$  Ma (McNamara *et al.*, 2001). To the east, granite exposed at the Peter Brook prospect is dated at  $635 \pm 2$  Ma (Sparkes and Dunning, 2014), highlighting the local exposure of older basement rocks to the younger volcanic rocks of the Marystown Group, and suggests the presence of significant fault structures in the area. Dating of felsic volcanic rocks and felsic dykes observed in drillcore from the Heritage prospect have produced ages of *ca.* 575 Ma (Woodland, pers. comm., 2025), supporting their inclusion within the Marystown Group.

## Mineralization and Associated Alteration

Alteration surrounding the Heritage prospect is similar to that of the Big Easy prospect, with a large area of quartz–white mica alteration developed marginal to the mineralized veins and related hydrothermal breccia. Corresponding spectral data from this marginal alteration highlights a shift to longer wavelength white mica (phengite) in association with this alteration. Such alteration signatures locally extend for up to 30 m marginal to vein development (Plate 5). Pyrite is identified as the most abundant sulphide within the quartz–white mica alteration (Ferguson, 2017), but the pyrite abundance is much less than that developed at the Big Easy prospect. Ferguson (2017) noted that pyrite locally contained inclusions of chalcopyrite, galena, acanthite, sphalerite and arsenopyrite, however more commonly pyrite grains were found to be rimmed by sphalerite and lesser acanthite.

The development of widespread hydrothermal brecciation is more extensive at the Heritage prospect, relative to other low-sulphidation related systems in the region. This brecciation ranges from localized crackle breccia to well-developed cockade-style breccia (Plate 6A, 6B). Drilling at the prospect commonly intersects metre-scale quartz veining, with much of the vein consisting of massive featureless quartz and does not display the typical low-sulphidation style vein textures observed elsewhere. However, crustiform banded veins are locally observed, and veining commonly contains adularia (Plate 6B; French and Woodland, 2013; Ferguson, 2017). In addition, lattice-bladed textures have been observed in outcrop and drillcore (Plate 6C; French and Woodland, 2013; Ferguson, 2017).

Ginguro-style bands are commonly observed within the massive quartz, with such veins producing narrow high-grade intersections, displaying enrichment in gold, silver, zinc, lead, copper, antimony and locally molybdenum (Plate 6D). Detailed petrography of these veins has identified minerals such as hessite, acanthite, naumannite, native bismuth and stibnite (Ferguson, 2017). Vein development commonly forms a complex network of crosscutting relationships demonstrating multiple mineralizing events. In Plate 6E, a 4–5-cm quartz vein consisting of cm-scale marginal grey quartz–pyrite, hosting anomalous silver, base metals and molybdenum, with a more massive white quartz–chlorite  $\pm$  pyrite core, is crosscut by a second cm-scale, sulphide-poor vein of white quartz–chlorite containing anomalous silver based on portable XRF analyses. Local pale-pink colouration of the immediate wallrock adjacent to veining is associated with manganese-enriched epidote alteration. Like the Big Easy prospect, local enrichment in molybdenum is also observed in rare veins (Plate 6F), with local drill intersections containing up to 488 ppm Mo over 1.6 m; DDH HE-EZ-20-03; Corbin, 2022). Molybdenum-rich bands are generally formed late in the overall paragenesis of the mineralized veins.

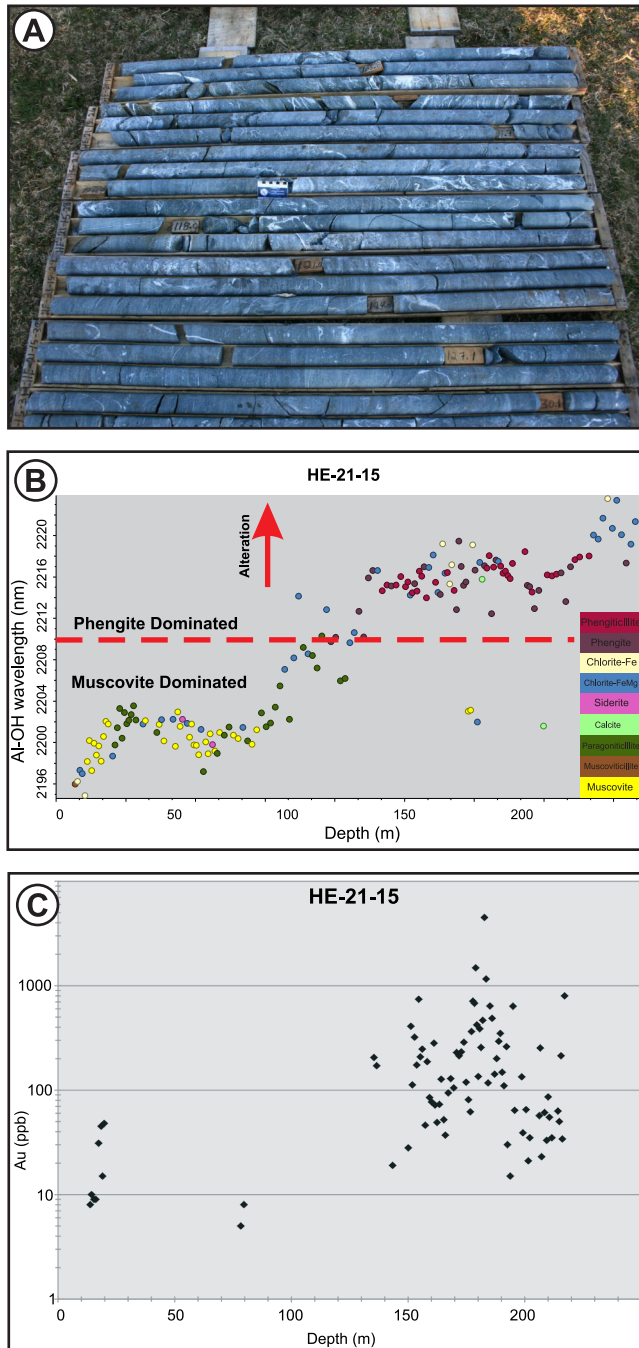
Industry assay data highlights a range in potassium/aluminum ratios associated with elevated gold values despite the phengitic alteration associated with mineralization (Figure 6A). However, those samples containing lower potassium/aluminum ratios ( $<0.3$ ) with elevated gold values are generally associated with metre-scale vein intersections and are likely dominated by quartz with lesser phengitic altered wallrock, thus accounting for the lower potassium values. Assay data for the prospect illustrates a similar relationships to that of the Big Easy prospect for gold values above the 60<sup>th</sup> percentile ( $>28$  ppb), with gold–silver ratios indicating a gold–silver-enriched phase (Au:Ag ratios between 1:10 and 1:100), in addition to a gold-enriched, silver-poor phase (Au:Ag ratios between 1:1 and 1:10) and a

silver-enriched, gold-poor phase (Au:Ag ratios between 1:100 and 1:1000; Figure 6B). As noted above, the Heritage prospect is more silver enriched relative to other low-sulphidation prospects in the region, which account for the large spread in the highest gold assays between the gold and silver nodes in Figure 6C. The same figure also shows that molybdenum enrichment is generally not associated with significant gold mineralization. However, this prospect does contain a higher proportion of samples (10) displaying molybdenum enrichment (100–300 ppm) within samples contain-

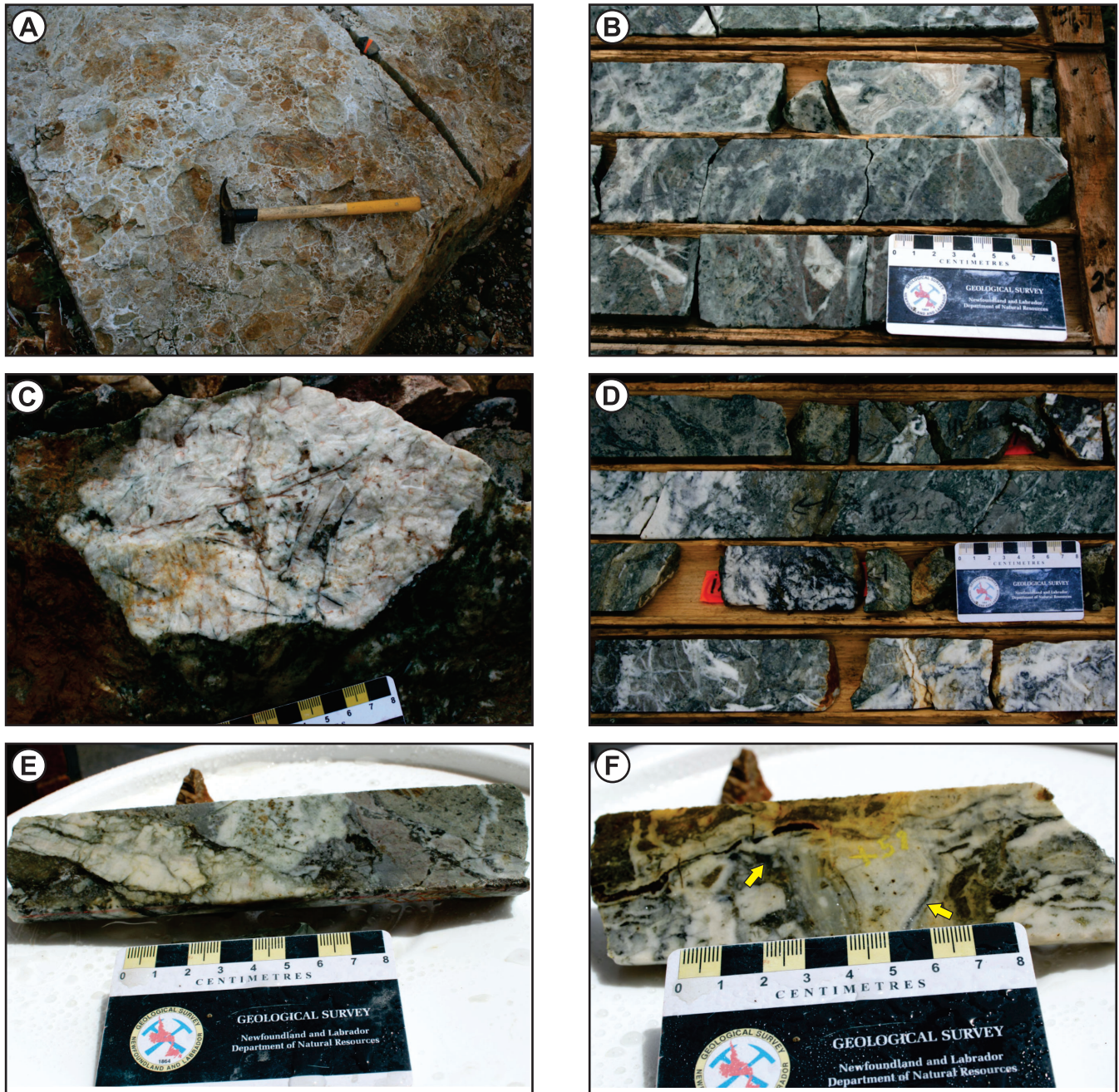
ing >1g/t gold, relative to the Big Easy prospect. Base-metal enrichment also locally accompanies precious metal mineralization at the prospect, as demonstrated by locally significant gold values accompanied by appreciable zinc, lead and copper (Figure 6D). Much more significant base-metal enrichment is observed at the Heritage prospect in comparison to the Big Easy prospect, in addition to a higher mean Au:Ag ratio due to the greater abundance of silver (Table 1).

## ROOT AND CELLAR PROSPECT

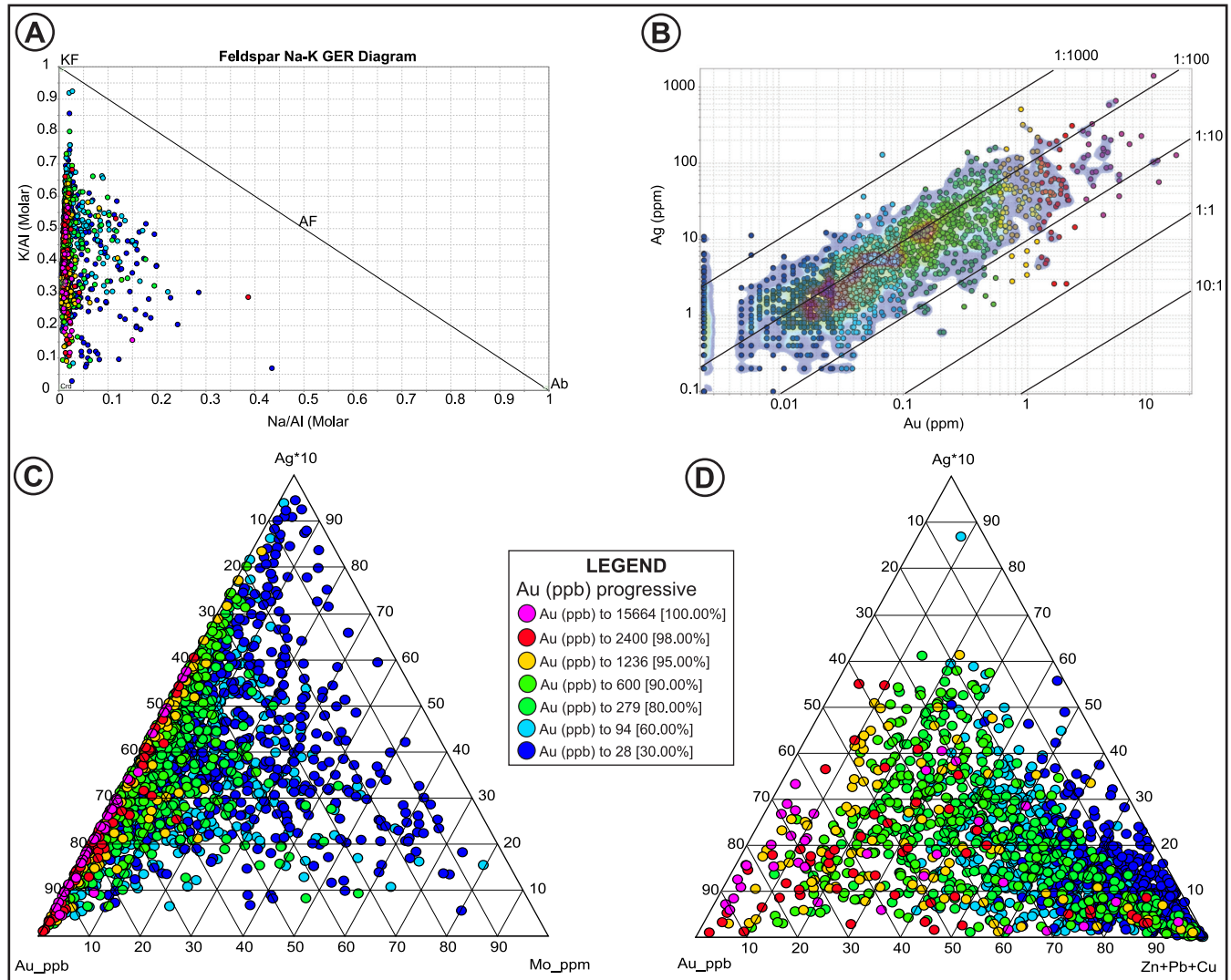
The Root and Cellar prospect represents the newest discovery of low-sulphidation related mineralization in the western Avalon Zone. This prospect was discovered in 2014 (Brushett, 2015), through the follow-up of anomalous gold values in the provincial government till database. Subsequent prospecting in the area identified two zones of gold mineralization, referred to as the Drop and the Conquest zones, from which grab samples of up to 45.5 g/t Au and 1365 g/t Ag have been obtained, accompanied by anomalous lead (822 ppm), tellurium (700 ppm) and molybdenum (144 ppm) (Brushett *et al.*, 2016). These two zones occur approximately 2.5 km apart, and contain mineralization associated with quartz alteration and accompanying hydrothermal brecciation and veining, with the latter locally displaying textures indicative of a low-sulphidation system. The Root and Cellar prospect also contains a cluster of anomalous copper values in the provincial-till database, highlighting this area as one of the few coincident gold and copper anomalies overlying rocks of the Marystown Group on the southern Burin Peninsula. Prospecting in the area has also identified copper-dominated mineralization associated with a magmatic-hydrothermal breccia, with individual grab



**Plate 5.** Spectral data from the Heritage prospect (DDH HE-21-15). A) Photograph illustrating the gradational transition from a muscovite–paragonite–chlorite-bearing assemblage (Al-OH ~2200 nm) into quartz–phengite-bearing hydrothermal alteration associated with localized low-sulphidation veining and related brecciation (~100–130 m depth). Note that there is no obvious visual change in the core over this interval, but there is a distinct shift in the related spectral data; B) Graph illustrating the Al-OH spectral wavelength feature vs. down-hole depth, showing the distinct shift from the shorter wavelength (~2200 nm) muscovite–paragonite signature of the country rock, to the longer wavelength (~2216 nm) signature of quartz–phengite alteration associated with mineralization; C) Graph showing gold assay values vs. down-hole depth; note the lack of anomalous gold values above 135 m depth, and the associated elevated gold values with the transition into the longer wavelength white mica alteration (data compiled from French and Mugford, 2016b).



**Plate 6.** Representative photographs of the Heritage prospect. A) Cockade-style hydrothermal breccia; from near original discovery site of 7.7 g/t Au; B) Well-developed hydrothermal breccia and crustiform banded quartz veining; note veining occurs both as fragments within the breccia and as crosscutting veins, demonstrating multiple veining events within the hydrothermal system; C) Well-developed lattice-bladed textures exposed in surface outcrop; D) High-grade sample (immediately to the left of the scale card) that assayed 46.5 g/t Au, 10 516 g/t Ag, 0.8% Pb, 0.5% Zn, 0.3% Cu and 500 ppm Sb over 0.12 m (DDH HE-26-16; French and Mugford, 2016a); E) Base-metal bearing vein containing Zn–Pb–Ag mineralization; industry assay data covering this interval returned 445 ppb Au, 15.7 g/t Ag, 0.3% Zn, 0.1% Pb, 0.02% Cu, 31 ppm Mo and 4 ppm Sb over 1.5 m (DDH HE-EZ-20-14, 183.1–183.3m depth; Corbin, 2022); F) Ag–Mo–Sb-enriched vein phase; industry assay data covering this interval returned 444 ppb Au, 33.3 g/t Ag, 0.05% Zn, 0.02% Pb, 0.003% Cu, 79 ppm Mo and 15 ppm Sb over 0.5 m (DDH HE-EZ-20-04, 64.3–64.4 m depth). Yellow arrows denote areas of ginguro-style banding anomalous in molybdenum and silver based on portable XRF analysis.



**Figure 6.** Geochemical plots of compiled industry drillhole data from 2018 to 2020 (French and Mugford, 2019, 2020a; Corbin, 2022) for the Heritage prospect. A) Molar ratio plot of Na/Al vs. K/Al; B) Gold vs. silver plot illustrating the distribution of Au:Ag ratios; C) Gold–silver–molybdenum ternary diagram; D) Gold–silver–zinc + lead + copper ternary diagram.

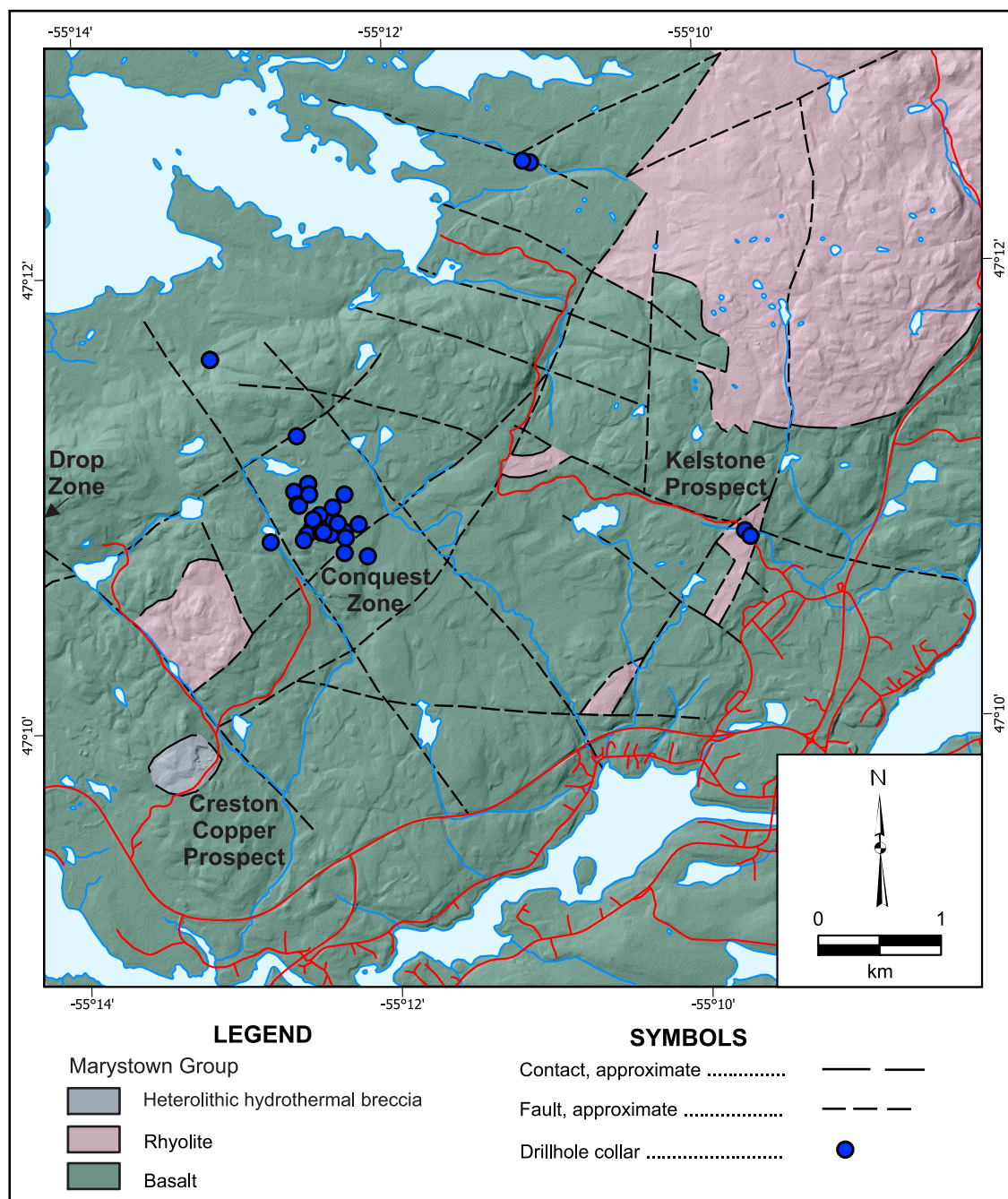
samples containing up to 10.4% Cu, 1.1% Mo and 330 g/t Te (Creston Copper prospect; Figure 7; Northern Shield Resources website, 2025).

Exploration of this area is in the relatively early stages, with 36 drillholes targeting the Conquest and Drop zones, totalling some 6000 m of diamond drilling. From this work drill intercepts of up to 23.5 g/t Au and 13.7 g/t Ag over 0.5 m (Northern Shield Resources press release, November 30, 2025) have been obtained in association with quartz–white mica alteration related to low-sulphidation veining and hydrothermal brecciation. The alteration associated with the low-sulphidation system overprints a zone of extensive epidote alteration developed within the host mafic volcanic rocks. These same mafic volcanic rocks host the magmatic-

hydrothermal breccia locally containing copper, molybdenum, gold, silver and tellurium mineralization, indicative of a potential porphyry copper environment.

### Exploration History

Mineralization was first discovered in the area of the Root and Cellar prospect in 2010 by a local prospector, with the discovery of grab samples of up to 8.9% Cu and 54.7 g/t Ag in a local quarry (Brushett, 2012). Continued prospecting in the area subsequently lead to the discovery of locally significant gold mineralization at the Drop and Conquest zones, located some 2.2 km northwest and 2.4 km northeast of the main copper mineralization, respectively (Brushett, 2015; Brushett *et al.*, 2016; Figure 7). The property was



**Figure 7.** Local geology map of the Root and Cellar prospect (modified from Jacobs and Noel, 1999), outlining the distribution of diamond drillholes and the location of select prospects.

optioned by Northern Shield Resources in 2019, and the first diamond drilling was carried out in 2021, which intersected 1.3 g/t Au and 2.6 g/t Ag over 8.6 m (DDH 21-RC-05: 28.1–37.0 m; Northern Shield Resources press release, February 24, 2022). Follow-up drilling in 2023 intersected near surface mineralization, returning 10.4 g/t Au and 7.1 g/t Ag over 1.5 m (DDH 23-RC-21: 1.3–2.8 m; Northern Shield Resources press release, November 11, 2023). The most

recent drilling, conducted in 2025, has intersected some of the deepest mineralization to date, returning 3.4 g/t Au and 6.1 g/t Ag over 4.3 m, associated with crustiform banded quartz and locally developed ginguro-style banding; this interval also contains up to 0.3% Cu and 8.6 ppm Te (DDH 25-RC-34: 130.6–135 m; Northern Shield Resources press release, October 10, 2025).

### Local Geology

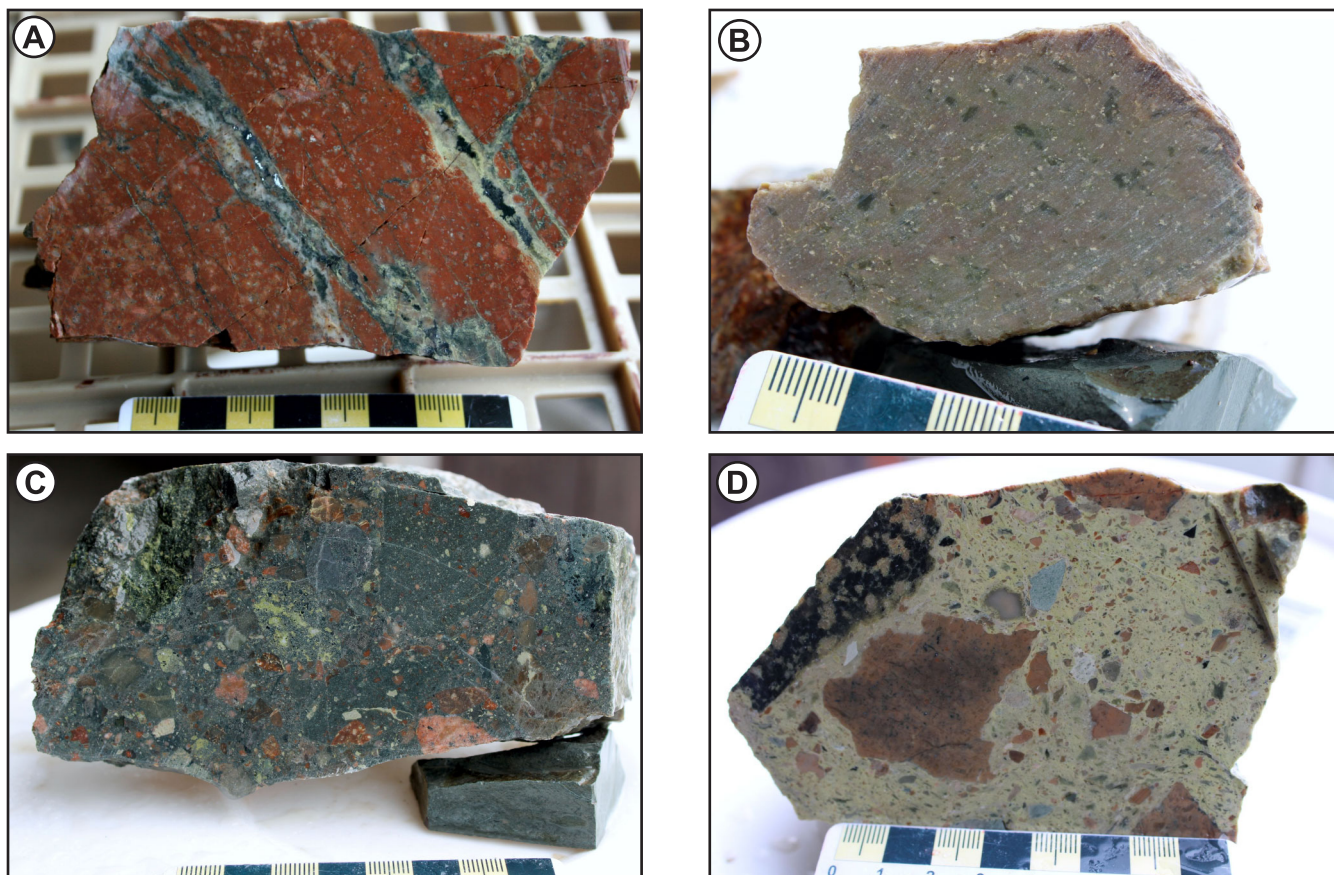
The Root and Cellar prospect is primarily hosted within mafic volcanic rocks forming a distinct east–west trending belt associated with an area of lower topographic relief, which is bound to the north and south by felsic volcanic rocks all of which are included within the Marystown Group (O’Driscoll *et al.*, 1995; Figure 7). This east–west belt contrasts the regional northeast–southwest trend of the Marystown Group in the southern Burin Peninsula (Figure 1). These mafic volcanic rocks are intruded by rhyolitic intrusions, ranging from fresh to strongly altered, and locally developed magmatic–hydrothermal breccias hosting rare granitic and juvenile rhyolitic fragments (Plate 7; Brushett, 2018, 2019). Dating of select rhyolite units from the area of the Root and Cellar prospect has produced ages of *ca.* 575 Ma (Kaine, 2025), and support these rocks being coeval with the Marystown Group, which has produced similar

ages on the southern Burin Peninsula (*e.g.*, Sparkes and Dunning, 2014).

East of the prospect, similar rhyolitic intrusive rocks are locally host to gold mineralization at the Kelstone prospect (O’Brien *et al.*, 1999; Figure 7). Here, the mafic volcanic rocks are overlain to the northeast by intermediate to felsic volcanic rocks (Jacobs and Noel, 1999); these rocks locally display well-developed flow-banding, implying a vent proximal environment. Felsic volcanic rocks to the northeast of the Root and Cellar prospect have been dated at  $587 \pm 3$  Ma (McNamara *et al.*, 2001).

### Mineralization and Associated Alteration

The main alteration developed in association with adularia-bearing low-sulphidation veining and hydrothermal brecciation is characterized by quartz–white-mica–pyrite.

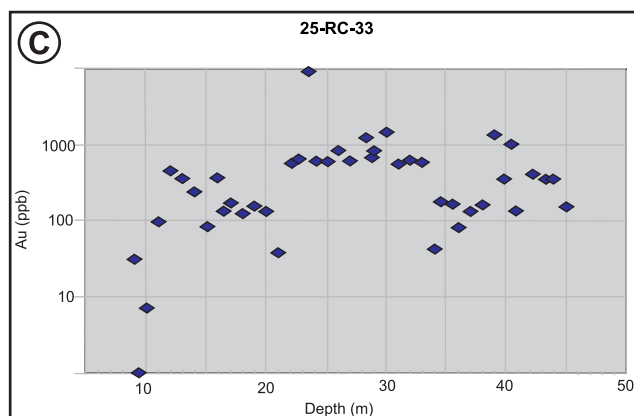
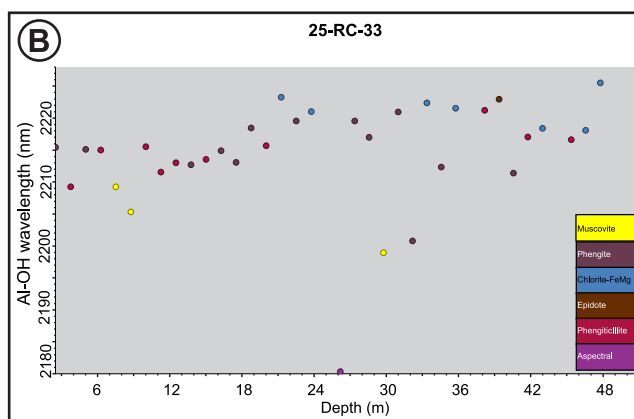


**Plate 7.** Representative photos of lithologies at the Root and Cellar prospect. A) Phengite altered porphyritic rhyolite, crosscut by quartz–specularite–epidote bearing veining; unit is associated with anomalous (<392 ppb) gold mineralization (Brushett *et al.*, 2017); B) Intensely altered light green porphyritic rhyolite, characterized by muscovitic illite white mica alteration; C) Heterolithic breccia containing subrounded to rounded fragments of an early breccia phase, epidote altered mafic volcanic rock, pink granite and porphyritic rhyolite; D) Heterolithic breccia with epidote altered groundmass, hosting fragments of white mica alteration, pink rhyolite and porphyritic intrusive rocks.

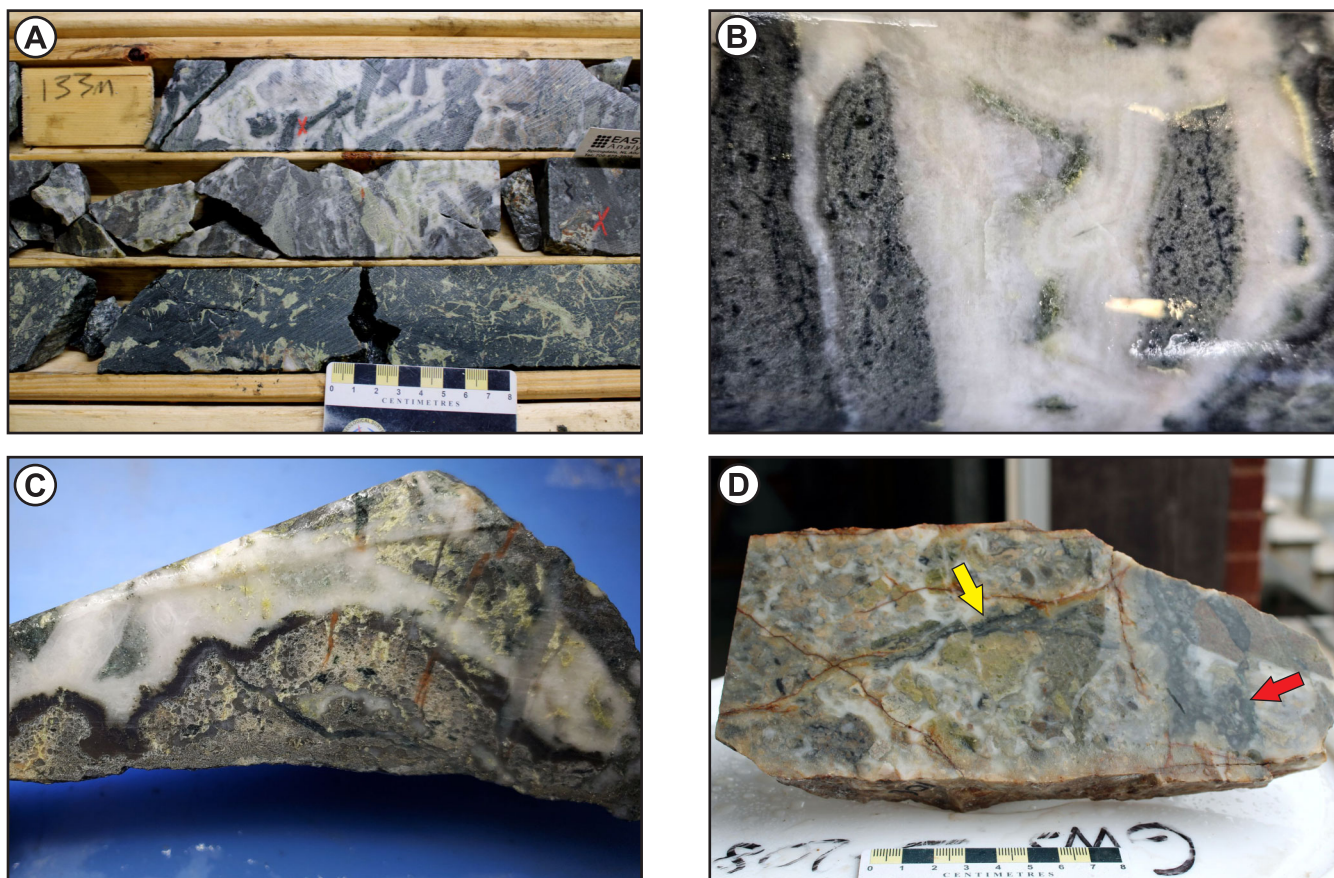
Spectral data from this alteration highlights the development of longer wavelength white-mica (phengite) alteration associated with gold mineralization (Plate 8). This alteration extends outwards for tens of metres from the mineralization and is primarily developed within mafic volcanic rocks and lesser rhyolite intrusions. The alteration overprints an earlier chlorite–epidote assemblage, which is widely distributed throughout the prospect (Plate 9A). Locally developed colloform–crustiform and ginguro-banding are present in some veins (Plate 9B, C) and appear to be associated with deeper intersections of the vein system. Visible gold is locally noted in outcrop and drillcore and preliminary petrography and SEM imaging highlight a genetic association with pyrite (Brushett, 2018). Elevated arsenic, antimony, molybdenum and lead is also locally developed in association with gold–silver mineralization (Plate 9D). Rare chalcopyrite accompanies gold mineralization, but no significant zinc enrichment is observed within the veining.

The development of increased potassium concentrations in association with elevated gold mineralization is noted within the area of the Conquest zone (Kaine, 2025; Figure 8A). This elevated potassium is associated with the development of phengitic white-mica alteration based on SWIR data from mineralized drillcore. Soil sampling within the area also notes a spatial association of arsenic, antimony, mercury and tellurium enrichment with gold mineralization (Northern Shield corporate presentation, January 2025). This system contains much less silver enrichment relative to the other low-sulphidation prospects in the region, which is reflected by the lower mean Au:Ag ratio for the prospect (Table 1). Mineralized veins are associated with lower concentrations of silver, but like the other prospects, the compiled assay data show a range of gold–silver ratios for mineralized samples. For gold values above the 60<sup>th</sup> percentile (>1 ppb) gold–silver ratios indicate a gold–silver enriched phase (Au:Ag ratios between 1:1 and 1:10), a gold enriched, silver poor phase (Au:Ag ratios between 1:1 and 10:1; Figure 8B), and a silver enriched, gold poor phase (Au:Ag ratios between 1:10 and 1:100; Figure 8B).

This prospect contains much less molybdenum enrichment associated with gold mineralization relative to the other prospects (Figure 8C), which is reflected by a low mean molybdenum value in Table 1. However, nine samples containing >1 g/t gold display elevated (10–31 ppm) molybdenum values. No significant base-metal enrichment is developed in association with the highest gold mineralization (>1 g/t), but minor copper mineralization is locally accompanied by weakly anomalous gold (Figure 8D).



**Plate 8.** Spectral data from the Root and Cellar prospect (DDH 25-RC-33). A) Photograph of typical quartz–phengite alteration and related hydrothermal breccia associated with anomalous gold mineralization (~34 m depth); B) Graph displaying the Al–OH spectral wavelength feature versus down-hole depth, displaying the longer wavelength (~2215–2220 nm) signature of quartz–phengite alteration associated with mineralization. Note that the phengitic alteration extends outside of the anomalous gold mineralization; C) Graph showing gold assay values vs. down-hole depth highlighting the anomalous gold throughout the phengitic alteration (unpublished data from Northern Shield Resources).



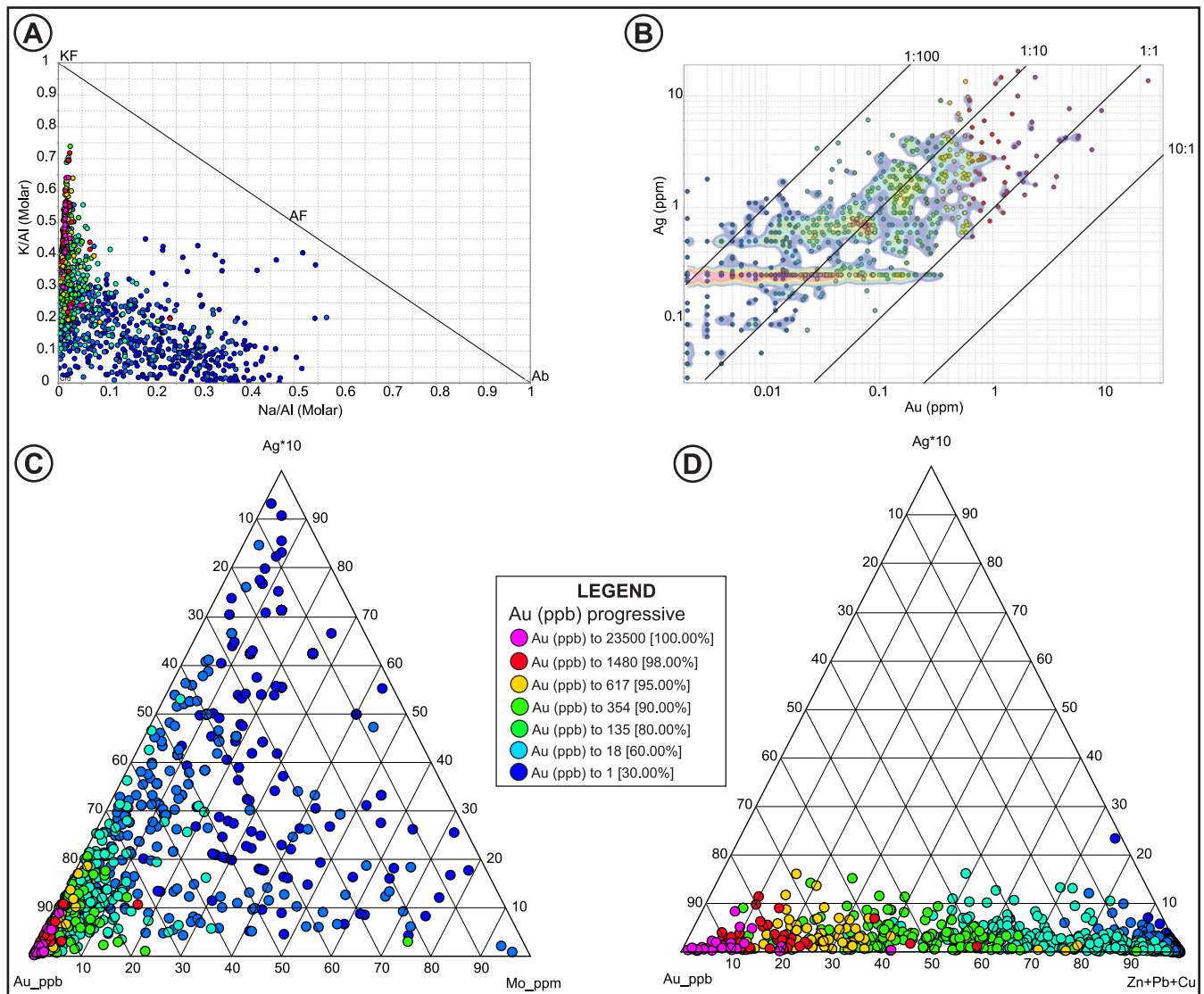
**Plate 9.** Representative photographs of the Root and Cellar prospect. A) Cockade-style quartz breccia associated with phengite alteration overprinting earlier chlorite–epidote alteration within the host mafic volcanic rocks (DDH 25-RC-34; 133 m depth); B) Crustiform banded quartz veining. Note field of view ~7 cm wide. (Northern Shield Resources press release, October 10, 2025); C) Ginguro-style veining associated with precious metal mineralization. Note field of view ~7 cm wide. (Northern Shield Resources press release, October 10, 2025); D) Mineralized silver–molybdenum-bearing vein (yellow arrow) crosscut by later molybdenum–lead-bearing vein (red arrow) based on portable XRF analyses; Drop Zone.

## NEW OCCURRENCE

A new occurrence of possible low-sulphidation veining was identified approximately 1 km south of the North Star prospect (Figure 1) by the Geological Survey during regional reconnaissance of the area (Sparkes, 2026). Here, chalcidonic quartz veining displaying local crustiform banding is host to anomalous gold (358 ppb) and silver (6.8 ppm; Plate 10) and is associated with phengitic alteration of the adjacent country rock. Veining exposed in the area forms a north–south trending zone up to one metre wide, but outcrop is limited. This zone is located approximately 800 m north of an antimony anomaly (2.3 ppm) in the provincial till database, which represents the highest antimony anomaly overlying rocks of the Marystown Group on the southern Burin Peninsula. This anomaly may be indicative of low-sulphidation mineralization in the area like that noted around the Heritage prospect to the south (e.g., Corbin, 2022).

## DISCUSSION

Local vein textures such as the development of chalcidonic quartz banding formed perpendicular to vein margins at the Long Harbour Gold prospect are like those described from the Rodalquilar gold deposit (Arribas *et al.*, 1995). Such features are interpreted to represent the precipitation of amorphous silica in the near-surface environment, suggesting shallow levels of preservation within the overall epithermal system. Based on current geochronological constraints, low-sulphidation veining developed within the Long Harbour Group represents a younger mineralizing event (maximum age of  $566.5 \pm 1.9$  Ma; Ferguson, 2017) than other low-sulphidation epithermal systems of the western Avalon Zone (*ca.* 575 Ma; Ferguson, 2017; Kaine, 2025; Woodland, pers. comm., 2025). Although vein development is limited in aerial extent at the prospect, the development of this style of mineralization within the Long Harbour Group highlights its regional potential for epithermal-related mineralization.

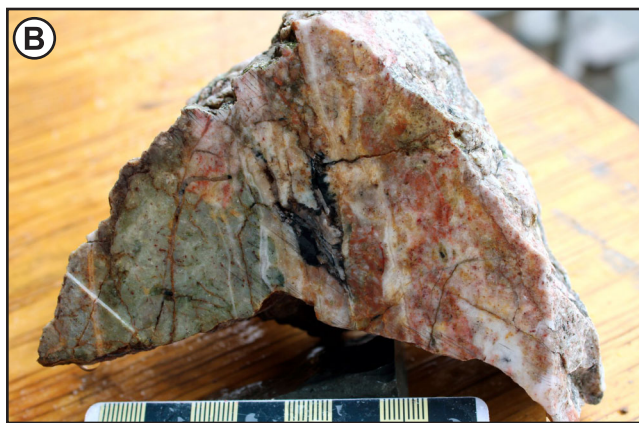


**Figure 8.** Geochemical plots of unpublished compiled industry drillhole data from 2021 to 2025 for the Root and Cellar prospect. A) Molar ratio plot of Na/Al vs. K/Al; B) Gold vs. silver plot illustrating the distribution of Au:Ag ratios; C) Gold–silver–molybdenum ternary diagram; D) Gold–silver–zinc + lead + copper ternary diagram.

The presence of “sinter-like” surficial features at the Big Easy prospect indicates shallow levels of preservation within the overall epithermal system, with the main exploration challenge being the identification of deeper feeder structures to the identified shallow mineralization. Diamond drilling at the prospect highlights the structural complexities controlling the distribution of the alteration zone and related mineralization, which is locally structurally truncated. However, the most recent drilling along trend to the south targeting an IP anomaly has intersected broad low-grade gold mineralization with no obvious surface expression. Similarly, the development of this style of mineralization within rocks of the Musgravetown Group highlights the

prospectivity of the associated sedimentary basin, which is locally host to unsourced gold and selenium anomalies within provincial till- and lake-sediment datasets.

The Heritage prospect represents one of the most extensive low-sulphidation systems identified to date, with veining in the area of the Eagle Zone defined over 500 m of strike length and up to 250 m vertical depth. The overall lack of well-developed vein textures, combined with the base-metal enrichment within mineralized veins, is suggestive of deeper levels within the overall epithermal system. Although vein textures such as colloform–crustiform banding and lattice-bladed quartz are locally developed, the pre-



**Plate 10.** Representative photographs from a new occurrence of low-sulphidation veining in the Marystown Group. A) Weakly developed crustiform banded chalcidonic quartz veining hosted within felsic volcanic rocks (UTM coordinates: 597369/5208168; NAD 83, Zone 21); B) Mineralized vein hosting anomalous gold (358 ppb) and silver (6.8 ppm) and associated marginal phengite alteration of the adjacent wall rock.

dominance of more crystalline quartz is supportive of deeper levels within the overall system, but mineralization remains open at depth.

Mafic volcanic rocks are the primary host to low-sulphidation veining at the Root and Cellar prospect but altered rhyolite intrusions display a spatial association with mineralization. This mineralization is primarily gold-dominated, but is also accompanied by silver, molybdenum and tellurium enrichment based on industry data. The extensive epidote alteration developed around the prospect, coupled with the local development of magmatic–hydrothermal breccias locally containing significant copper–molybdenum mineralization, provides supporting evidence of a potential porphyry environment. The development of late gold–silver–tellurium mineralization in low-sulphidation-style veins overprinting propylitic alteration related to porphyry sys-

tems is noted by Cook *et al.* (2014) and provides a possible analogue for the mineralization developed at the Root and Cellar prospect.

In comparing the various prospects, several commonalities and differences are noted in the associated epithermal suite of elements (*e.g.*, Au, Ag, As, Bi, Cu, Hg, Pb, Sb, Se, Sn, Te and Zn) contained in each. All prospects have elevated arsenic, selenium and mercury in association with gold–silver mineralization. In addition, molybdenum enrichment is noted in the three most extensively studied prospects but is not a common element in such systems. However, elsewhere in the Avalon Zone, such as the Haile deposit in South Carolina, gold mineralization is also noted to occur in association with silver, arsenic, antimony, molybdenum and tellurium (Mobley *et al.*, 2014). The Heritage prospect is unique due to the enrichment in silver, zinc and lead, which may be explained by deeper levels of exposure within the vein system. Mineralization at the Root and Cellar prospect is distinct given the predominance of gold (and accompanying enrichment of tellurium) without significant silver. Such features are present in marginal environments to porphyry-copper systems, highlighting another exploration model for the region.

Prospecting of anomalous gold in provincial till- and lake-sediment datasets has proved useful in identifying alteration zones associated with these mineralized systems, and recent exploration work indicates that antimony may also prove useful as a vector to mineralization. Given the extensive surficial cover in the region, more detailed systematic till- and lake-sediment surveys may prove beneficial in identifying new mineralizing environments. On a regional scale, low-sulphidation systems within the western Avalon Zone display a spatial association with the development of rhyolite domes and associated rhyolitic intrusive rocks. Regional reconnaissance investigations of anomalous mercury values in tills (Cambell *et al.*, 2025), indicate that elevated values overlying rocks of the Marystown Group occur proximal to the development of flow-banded rhyolite, and may prove useful in identifying dome complexes.

## CONCLUSION

The preservation of relatively shallow-levels within low-sulphidation epithermal systems of the western Avalon Zone is demonstrated by the presence of local “sinter-like” features, and the occurrence of lattice-bladed textures indicative of fluid boiling. Such features are not commonly preserved in Neoproterozoic rocks, and therefore such environments are not common exploration targets for this style of mineralization. Given the low topographic relief and extensive surficial cover over many of these prospects, extensive diamond drilling is required to properly evaluate

such systems. Initial drilling at prospects within the western Avalon Zone highlights the fact that mineralization and the associated alteration zones are structurally modified by post-mineral deformation, further complicating the exploration of an already challenging ore system. However, the local development of bonanza-grade precious-metal mineralization over narrow widths demonstrates the potential of these epithermal environments, coupled with the enrichment of several critical elements (antimony, molybdenum, tellurium, zinc) make these systems attractive exploration targets for the mineral industry. Ongoing efforts in the region continue to apply new geochemical and geophysical techniques, and have been successful in identifying new discoveries, highlighting the relatively under-explored nature of the western Avalon Zone for low-sulphidation systems.

## ACKNOWLEDGMENTS

This study benefitted from informative discussions with several industry personnel, Peter Dimmell (formerly with Silver Spruce Resources), Bill Pearson (Cartier Silver), Victor French (Puddle Pond Resources) and Ian Bliss (Northern Shield Resources), who are thanked for their cooperation. Jordan Harvey is thanked for aiding in sample collection and spectral acquisition in the field.

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