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ADVANCED ARGILLIC ALTERATION ZONES OF THE BURIN PENINSULA, NEWFOUNDLAND: NEW INSIGHTS UTILIZING FIELD-BASED SHORTWAVE INFRARED SPECTROMETRY

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ABSTRACT

The Burin Peninsula has long been known to host advanced argillic alteration, the distribution of which was largely confined to three main areas, namely the Hickey's Pond trend, the Stewart trend and the Stroud's Pond prospect. Recent investigations utilizing field-based shortwave infrared (SWIR) spectrometry demonstrates that this style of alteration is more widespread than previously recognized, spanning some 135 km along the length of the Burin Peninsula. Minerals associated with the development of advanced argillic alteration, such as pyrophyllite, dickite, kaolinite and alunite, were identified at five locations that were previously only inferred, or were entirely unknown, to host such mineral associations. Exploration in the region has largely focused on the Hickey's Pond and Stewart trends, which are known to host localized Cu–Au mineralization, along with the enrichment of the typical epithermal suite of elements (Ag, As, Bi, Cu, Hg, Mo, Pb, Sb, Se, Sn, Te, Zn); the remaining occurrences of advanced argillic alteration have received much less attention. These occurrences have no documented mineralization in outcrop, but many are associated with anomalous values of the epithermal suite of elements in the overlying till cover that have yet to be sourced.

New insights provided by the ability to collect and identify spectral data in the field allows for more accurate mapping and vectoring within these zones of hydrothermal alteration. This method, combined with the use of a handheld portable XRF facilitates the identification of both mineralogical and geochemical anomalies in the field, thus allowing for more guided sampling of the alteration than was previously possible.

INTRODUCTION

Advanced argillic alteration is defined by the development of aluminosilicate or sulphate-bearing minerals which include: pyrophyllite, alunite, dickite and kaolinite (Meyer and Hemley, 1967; Hedenquist *et al.*, 2000; Hedenquist and Arribas, 2022). This report provides a summary of the known occurrences of advanced argillic alteration on the Burin Peninsula, including recent results from field-based shortwave infrared (SWIR) studies. The development of advanced argillic alteration is indicative of several potential geological environments as illustrated by Hedenquist and Arribas (2022). The presence of both alunite and pyrophyllite on the Burin Peninsula is related to hypogene acidic alteration within a lithocap environment (O'Brien *et al.*, 1999; Hedenquist, 2007). Such environments have exploration significance due to their association with epithermal-style mineralization (Hedenquist *et al.*, 2000; Hedenquist and Arribas, 2022). In addition, lithocap environments share a genetic link and are spatially associated with deeper porphyry-related mineralization (Sillitoe, 1983; Arribas *et al.*, 1995; Hedenquist *et al.*, 1998; Sillitoe and Perelló, 2023), and may represent potential exploration targets for some areas on the Burin Peninsula.

High-sulphidation related advanced argillic alteration has been recognized on the Burin Peninsula of Newfoundland since the late 1970s (Hussey, 1978; O'Driscoll, 1984). The most extensive development of this style of alteration occurs in two main areas, namely the Hickey's Pond trend in the northern Burin Peninsula, and the Stewart trend in the central Burin Peninsula (Figure 1). Mineralization in these areas is locally accompanied by gold, silver, copper, arsenic, antimony, and less commonly zinc and molybdenum (O'Brien *et al.*, 1999; Sparkes and Dunning, 2014; Sparkes *et al.*, 2016). Other smaller occurrences of advanced argillic alteration reported throughout the Burin Peninsula are largely based on visual identification of potential advanced argillic alteration, without supporting analytical confirmation. Due to the cryptic nature of many of the minerals associated with this style of alteration such zones are often overlooked, or simply broadly classified as "sericite". Early investigations of known occurrences lacked the use of a field-portable SWIR spectrometer, which

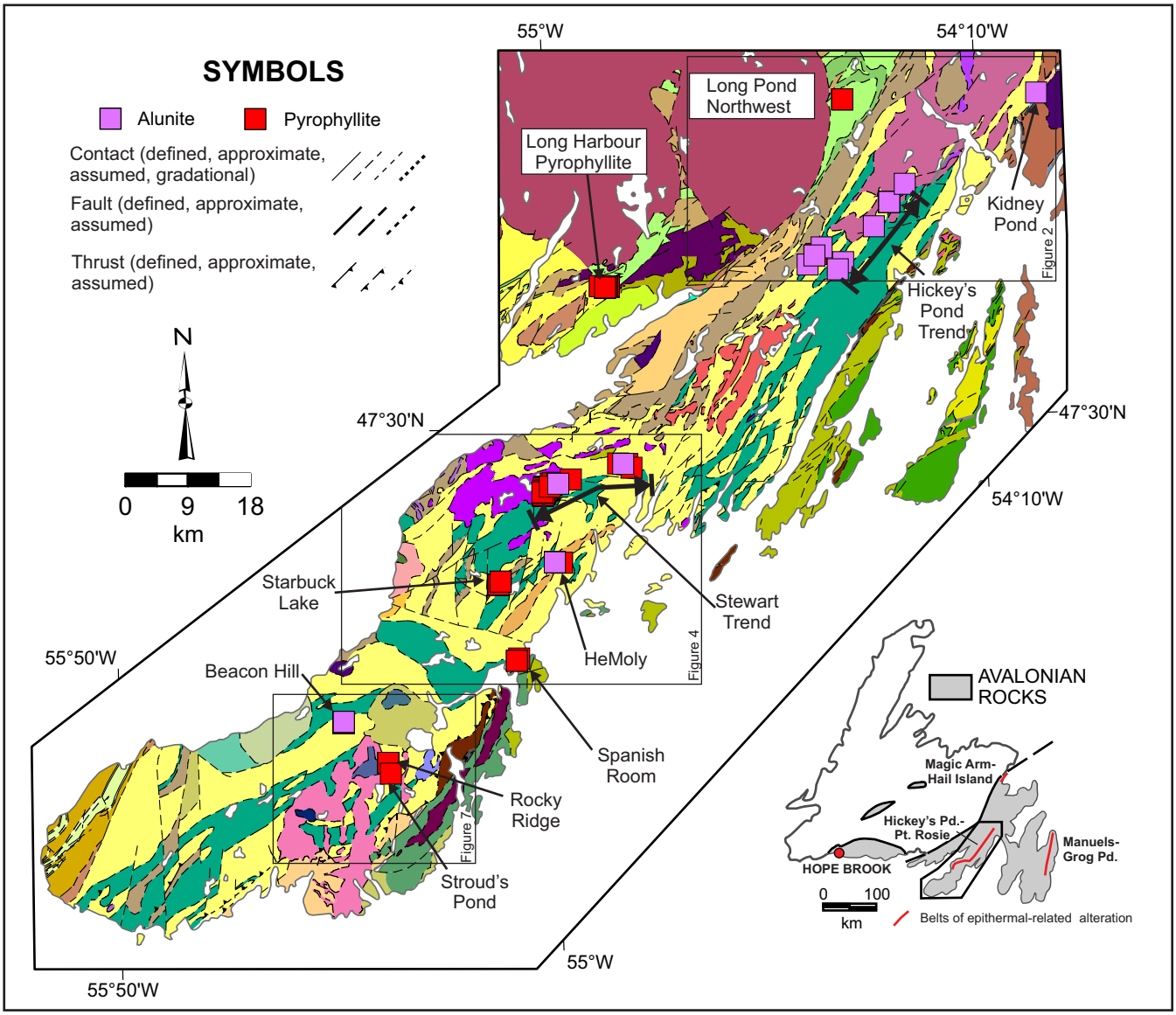

Figure 1. *Regional geology map of the Burin Peninsula region (modified from O'Driscoll* et al.*, 1995), outlining the distribution of the known occurrences of advanced argillic alteration. Note only the main advanced argillic mineral for each prospect is shown.*

hampered the mapping of the often-complex alteration patterns and overprinting relationships.

Recent field investigations, utilizing a field-based SWIR spectrometer, focused on documenting the reported but unconfirmed areas of advanced argillic alteration in the region, and the identification of several new unreported occurrences. Some of these occurrences are demonstrably fault-bounded, structurally attenuated remnants, of former aerially extensive hydrothermal systems. Many of the identified advanced argillic alteration zones are spatially associated with geochemical anomalies within the overlying till cover (*e.g.*, Au, Ag, Cu, Mo, Pb, Sb, Se; Batterson and Taylor, 2006, 2009; Campbell *et al.*, 2023, pers. comm. 2025). However, some of these anomalies have yet to be systematically explored and remain unsourced. In addition, the presence of advanced argillic alteration locally noted in boulders or eroded cobbles represent unsourced material from alteration zones that have yet to be located.

SWIR spectrometry provides the ability to obtain mineralogical information on the crystallinity and/or compositional variations associated with certain mineral groups, such as white micas (*e.g.*, paragonite, muscovite and phengite). Spectral measurements were collected using either a TerraSpec® Pro or TerraSpec® Halo spectrometer, and

LEGEND (FIGURES 1, 2 4 and 7)

CARBONIFEROUS
- Sandstone and conglomerate
- Pebble and cobble conglomerate

DEVONIAN
- Ackley Granite
- Bar Haven Granite
- Sall The Maid Granite
- St. Lawrence Granite
- Undivided mafic intrusive rocks
- Crystal and crystal-lithic tuff
- Flow-banded rhyolite and ash-flow tuff
- Undivided red sandstone and conglomerate

SILURO-DEVONIAN
- Felsic tuff, agglomerate and epiclastic breccia; rhyolite porphyry
- Basaltic flow, tuffs and agglomerate

CAMBRO-ORDOVICIAN
- Undivided Lower and Middle Cambrian rocks
- Undivided shale and slate
- Undivided black and grey shale and siltstone
- Micaceous quartzite and slate
- Quartzitic sandstone and quartzite
- Micaceous siltstone, sandstone and conglomerate

LATE NEOPROTEROZOIC

Long Harbour Group
- Conglomerate, sandstone and siltstone
- Argillite, siltstone, shale and sandstone
- Rhyolite flows and ash-flow tuffs
- Basalt and andesite
- Pyroclastic and epiclastic volcanic rocks, mudstone, sandstone and conglomerate
- Massive porphyritic rhyolite and ash-flow tuff
- Welded ash-flow tuff, rhyolite flows, tuffs, breccias and agglomerate.
- Welded ash-flow tuff, tuffs, breccias and agglomerate

Musgravetown Group
- Pebble sandstone, siltstone and conglomerate
- Rhyolitic ash-flow tuffs, breccias and flows, massive and flow-banded rhyolite
- Vesicular to massive basaltic flows, tuffs, breccias and agglomerate

Marystown Group
- Siliciclastic sedimentary rocks
- Rhyolite porphyry
- Xenolithic quartz-feldspar porphyry and breccia
- Heterolithic volcanic breccia
- Mafic volcanic breccia and conglomerate
- Rhyolitic ash-flow tuffs, flows and breccias
- Basaltic flows, tuffs and breccias

NEOPROTEROZIC

Connecting Point Group
- Conglomerate and coarse-grained sandstone
- Sandstone and interbedded shale

Burin Group
- Wandsworth gabbro
- Volcanogenic sandstone, siltstone and conglomerate
- Pillow basalt, basaltic tuff and agglomerate and breccia

NEOPROTEROZOIC INTRUSIVE ROCKS
- Anchor Drogue Granodiorite
- Cape Roger Mountain Granite
- Cross Hills Intrusive Suite – granite to gabbro
- Deepwater Point Granodiorite
- Grole Intrusive Suite – diorite to gabbro
- Loughlins Hill Gabbro
- Seal Cove Intrusive Suite – granite to gabbro
- Swift Current Intrusive Suite – diorite to gabbro
- Swift Current Intrusive Suite – granite to granodiorite
- Powderhorn Intrusive Suite – granite to gabbro

these spectra were subsequently processed using The Spectral Geologist (TSG™) software (version 8.1.0.5) to obtain mineral identifications. The spectral data can also be utilized to illustrate the systematic variation in the Al-OH absorption feature (~2200 nm), allowing insight into the compositional differences within various white mica minerals (*e.g.*, paragonite (2180–2195 nm), muscovite (2195–2215 nm) and phengite (2215–2225 nm; Pontual *et al.*, 1997; AusSpec, 2008). The position of the Al-OH feature can also be used as a hydrothermal pH indicator, with shorter wavelengths representative of more acidic hydrothermal conditions (Halley *et al.*, 2015). Current investigations provide a detailed spectral analysis of select occurrences, highlighting both similarities and differences between geographical areas, which may aid in the future exploration of the region.

REGIONAL GEOLOGY

The Burin Peninsula in the western Avalon Zone in Newfoundland contains several occurrences of advanced argillic alteration hosted within late Neoproterozoic volcanic rocks (O'Brien *et al.*, 1999; Sparkes, 2012; Sparkes and Dunning, 2014; Sparkes *et al.*, 2016). These alteration zones are developed within rocks ranging in age from 590 to 560 Ma and are interpreted to have formed within arc, or arc-adjacent, and continental extensional settings (O'Brien *et al.*, 1999; Sparkes and Dunning, 2014). Within the Burin Peninsula, advanced argillic alteration zones are most abundant in volcanic rocks of the *ca.* 590–570 Ma Marystown Group (Strong *et al.*, 1978a, b; O'Brien *et al.*, 1999; Sparkes and Dunning, 2014). This volcanic sequence comprises the central core of the Burin Peninsula, forming a broad-scale anticlinorium, flanked to the east by a shoaling-upward sequence of marine to terrestrial volcano-sedimentary rocks of the Neoproterozoic Musgravetown Group (O'Brien, *et al.*, 1999). The volcano-sedimentary sequence is overlain by a Cambrian platformal sedimentary 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). The Neoproterozoic rocks, along with the associated Paleozoic cover sequence, are unconformably overlain by sparsely preserved remnants of Late Silurian to Carboniferous terrestrial volcanic and asso-

ciated siliciclastic rocks (Laracy and Hiscott, 1982; O'Brien *et al.*, 1995). To the west and north of the peninsula, the Marystown Group is overlain by the *ca.* 570 to 550 Ma Long Harbour Group, which passes conformably upward into fossiliferous Cambrian sedimentary rocks of the platformal cover sequence (Williams, 1971; O'Brien *et al.*, 1984, 1995). Rocks of the Burin Peninsula display localized zones of moderate to strong deformation, largely inferred to be Late Silurian–Devonian and attributed to the Acadian orogeny (Dallmeyer *et al.*, 1983; Dunning *et al.*, 1990; O'Brien *et al.*, 1991, 1999; van Staal, 2007; Mills and Jones, 2024).

High-level intrusions on the Burin Peninsula generated regional-scale magmatic–hydrothermal systems locally accompanied by precious-metal deposition (O'Brien *et al.*, 1999). Intrusions spatially related to, and inferred as coeval with, advanced argillic alteration have been dated at 580–575 Ma (O'Brien *et al.*, 1998; Sparkes and Dunning, 2014; Ferguson, 2017). Although minimum age constraints for the alteration zones are lacking. Local evidence of potential porphyry-style (Cu–Au) mineralization occurs in the central Burin Peninsula (*e.g.*, Stewart prospect) and, when coupled with the identified lithocap environments, represents another exploration target for the region.

NORTHERN BURIN PENINSULA

The northern Burin Peninsula region is host to some of the most extensively explored advanced argillic alteration in the Avalon Zone of Newfoundland. The Hickey's Pond trend is divisible into two subparallel belts, namely the Hickey's Pond–Tower belt and the Monkstown Road belt (O'Brien *et al.*, 1999; Sparkes and Dunning, 2014). This area is host to high-grade gold mineralization associated with advanced argillic alteration (Sparkes *et al.*, 2016), and has been explored by numerous companies since the early 1980s. Exploration activities conducted in the area from the 1980s to mid-2010s are summarized in Sparkes and Dunning (2014), Sparkes *et al.* (2016) and O'Brien and Burke (2021). Activities conducted since the mid-2010s are summarized below.

Outside of the main Hickey's Pond trend, advanced argillic alteration has been identified at three other localities, namely the Long Harbour Pyrophyllite, Kidney Pond and Long Pond Northwest prospects (Figure 1). Advanced argillic alteration at the Long Harbour Pyrophyllite prospect is barren, but occurs proximal to auriferous network-style chalcedonic quartz veining (Sparkes and Dunning, 2014). Recently completed, field-based SWIR studies in the northern Burin Peninsula area focused on the lesser known occurrences of advanced argillic alteration found in boulders at the Kidney Pond prospect, as well as recently discovered boulders in an area herein referred to as the Long Pond Northwest prospect.

RECENT EXPLORATION

The focus of exploration here has been the Hickey's Pond trend, which was most recently investigated by Burin Gold (formerly Bonavista Resources) from 2018 to 2022. During this time, the company conducted geochemical surveys over the Hickey's Pond–Tower and Monkstown Road belts, along with geophysical surveys, trenching and diamond drilling along the Hickey's Pond–Tower belt (O'Brien and Burke, 2021). Most of this work concentrated on the Hickey's Pond prospect, with 35 of the 44 drillholes targeting 700 m of strike around the main prospect. The other 9 drillholes tested the southern limit of the trend at the Tower prospect (Figure 2). Results from the work at Hickey's Pond identified a tennantite-bearing hydrothermal breccia at surface, which produced channel samples of up to 9.3 g/t Au over 20 m, with local higher grade intervals of up to 58 g/t Au and 6.4% Cu over 1 m; follow-up diamond drilling of this area intersected up to 4.4 g/t Au over 10.8 m (O'Brien and Burke, 2021). Limited prospecting at Kidney Pond has locally returned up to 1.7 g/t Au in float (Smith, 1999), while no publicly available exploration work exists for the Long Pond Northwest prospect.

HICKEY'S POND TREND

The Hickey's Pond trend represents an aerially extensive, structurally bound, zone of advanced argillic alteration that can be traced intermittently along strike, for upwards of 15 km along the Hickey's Pond–Tower belt, and up to 3.5 km along the subparallel Monkstown Road belt (Figure 2). The most significant gold mineralization identified to date occurs at the Hickey's Pond prospect, but anomalous gold values have locally been reported along the entire length of the trend (Sparkes and Dunning, 2014; Sparkes and Sandeman, 2015; Clark, 2019a, b). Recent drilling at Hickey's Pond demonstrates that the area is structurally complex, and the overall hydrothermal system has been structurally attenuated and folded. However, as such lithocap environments are barren upon their initial formation (Hedenquist and Arribas, 2022), the Hickey's Pond prospect demonstrates the development of a mineralizing fluid phase within the overall hydrothermal system, and thus highlights the potential fertility of this trend.

Local Geology

The advanced argillic alteration within the Hickey's Pond trend is largely hosted within volcanic rocks of the Marystown Group. The exact nature of the protolith is

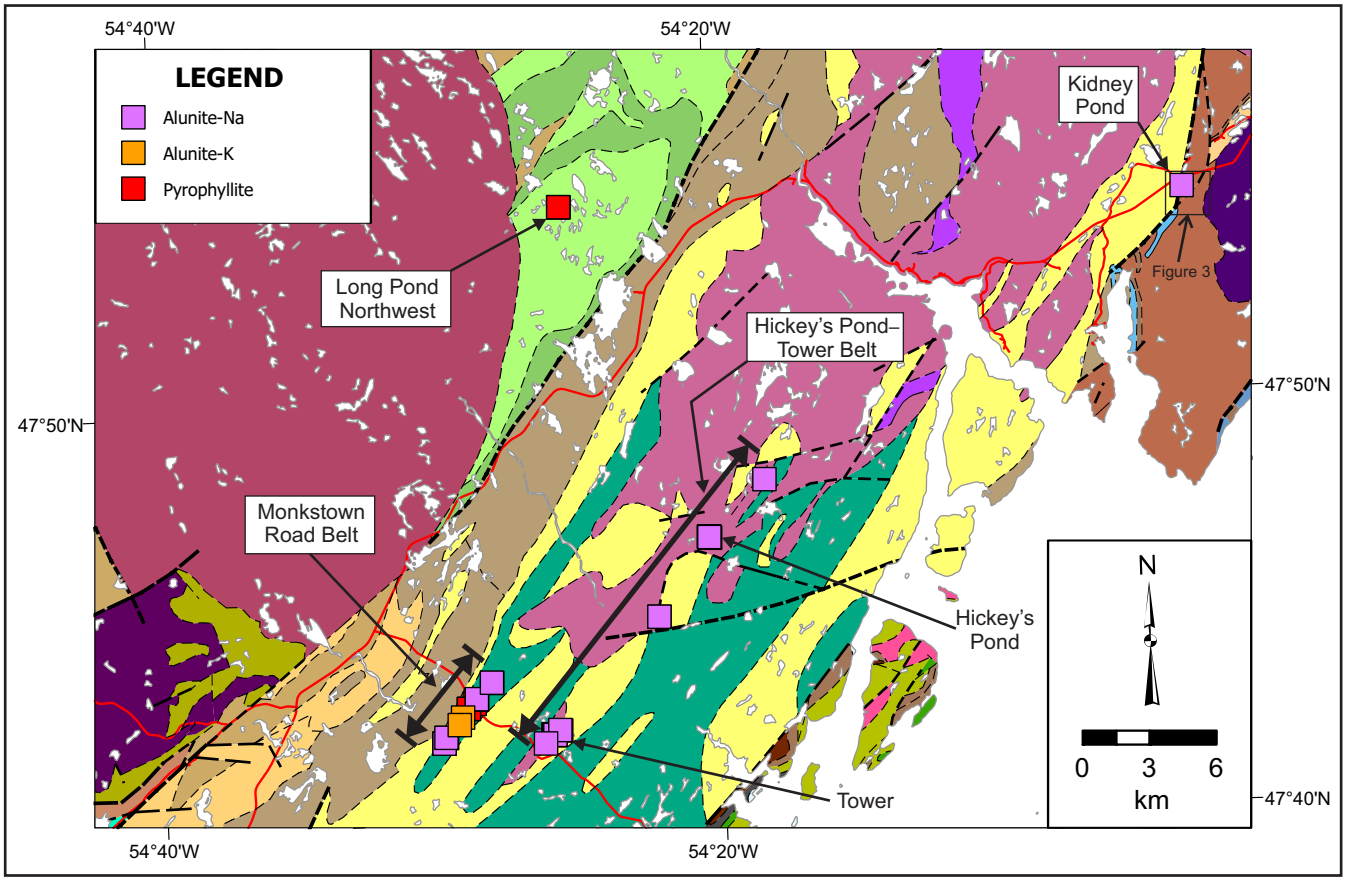

Figure 2. *Regional geology (modified from O'Driscoll* et al.*, 1995) of the northern portion of the Burin Peninsula, outlining the distribution of the known occurrences of advanced argillic alteration. Note only the main advanced argillic mineral for each prospect is shown; for the geology legend refer to Figure 1.*

uncertain due to the intensity of the alteration, but mafic and felsic volcanic rocks occur marginal to the zone and are inferred to host the alteration. This alteration is spatially associated with the eastern margin of the Swift Current granite but is structurally bound within the footwall of the Hickey's Brook fault (Huard, 1989; O'Brien *et al.*, 1999; Sparkes *et al.*, 2016). The northeast–southwest orientation of both the Hickey's Pond–Tower belt and the Monkstown Road belt parallels the regional fabric, and the advanced argillic alteration, outside of the quartz-dominated zones, is strongly foliated and locally crenulated.

Advanced Argillic Alteration Minerals

The alteration at the Hickey's Pond prospect, detailed in O'Brien *et al.* (1999) and Sparkes *et al.* (2016), is summarized herein. The main showing at Hickey's Pond consists of locally vuggy, quartz alteration enveloped by more extensive alunite–specularite-dominated advanced argillic alteration (O'Brien *et al.*, 1999). Surface sampling along both the Hickey's Pond–Tower and the Monkstown Road belts demonstrate that the advanced argillic minerals, identified by SWIR analysis, are predominated by sodic alunite and lesser potassic alunite, pyrophyllite, dickite and kaolinite (Sparkes and Dunning, 2014). Detailed investigations of drillcore from the Hickey's Pond and Tower prospects show that the advanced argillic alteration occurs as deformed lenses within more extensive paragonite-dominated white mica alteration (Plate 1A). Drilling along strike to the northeast and southwest of the main Hickey's Pond prospect demonstrates that the alunite alteration transitions into pyrophyllite dominated alteration along strike and at depth. The surrounding white mica alteration is typically characterized by Al-OH features with relatively short spectral wavelengths (<2200 nm), and are classified as paragonite. Distal from the main core of the hydrothermal alteration, the Al-OH feature transitions to longer spectral wavelengths (>2200 nm) and is classified as muscovite or phengite, which predominates in less altered rocks.

Limited evaluation of core from the Tower prospect is consistent with the relationships observed in the Hickey's

Plate 1. *A) Strongly foliated sodic alunite–specularite (Alun–Spec) enveloped by paragonite–pyrite (Pg–Py) alteration. Note the alunite–specularite interval contains up to 1.9 g/t Au over 2 m, while the paragonite–pyrite contains up to 0.5 g/t over 2 m; DDH HP-22-017, 110 m depth, Hickey's Pond prospect; B) Sulphide-rich, tennantite-bearing, hydrothermal breccia, Hickey's Pond prospect; C) Pyrophyllite altered flow-banded rhyolite, Long Harbour Pyrophyllite prospect; D) Moderate to strongly foliated sodic alunite containing <5% disseminated pyrite, Kidney Pond prospect; E) Metre-scale boulder of brecciated pyrophyllite–kaolinite–paragonite alteration, located at the Long Pond Northwest prospect; F) Aerial view looking north toward the inferred source of the altered boulders, which are located on the ridge to the right of the pond, Long Pond Northwest prospect..*

Pond area, with a structurally bound zone of advanced argillic alteration flanked by less altered felsic volcanic rocks characterized by muscovite or phengite alteration. In this area, the subsurface alteration is also dominated by pyrophyllite along with lesser sodic alunite. The remainder of the Hickey's Pond trend is dominated by sodic alunite and lesser potassic alunite (Sparkes and Dunning, 2014). However, the spectral data from the remainder of the trend is limited to surface sampling of sporadic outcrop exposures, which hampers the recognition of subtle mineral zonation patterns. Despite this, the predominance of sodic alunite along the entirety of the Hickey's Pond trend suggests a common level of erosion throughout the hydrothermal system.

Mineralization

Gold mineralization is best developed at the main Hickey's Pond prospect, locally assaying up to 60.4 g/t Au (O'Brien *et al.*, 1999; Sparkes *et al.*, 2016), and occurs in association with enrichment of the typical epithermal suite of elements (Ag, As, Bi, Cu, Hg, Pb, Sb, Se, Sn, Te; Table 1; Sparkes and Dunning, 2014). This mineralization occurs as disseminated sulphides in vugs and localized hydrothermal breccias (O'Brien *et al.*, 1999; Sparkes *et al.*, 2016). The discovery of a tennantite-rich hydrothermal breccia (Plate 1B) by Burin Gold, which returned channel samples of up to 9.3 g/t Au over 20 m, and 7 m of 3.68% Cu (O'Brien and Burke, 2021), was a focal point of the most recent exploration in the area; however, similar styles of mineralization were not identified in drillholes that undercut the mineralized zone.

LONG HARBOUR PYROPHYLLITE

This occurrence, located to the immediate west of the northern Burin Peninsula, is the first documented example of advanced argillic alteration within the Long Harbour Group (Figure 1). The alteration zone is developed within the southeastern limb of a southwest-plunging syncline, and can be traced along strike for 1.5 km (Sparkes and Dunning, 2014). The Long Harbour Pyrophyllite prospect is barren of precious metals, but it occurs proximal (<1 km) to a zone of network-style chalcedonic quartz veining, assaying up to 61 g/t Au (Gold Hammer prospect; Sparkes and Dunning, 2014).

Local Geology

The alteration zone at the Long Harbour Pyrophyllite prospect is hosted within felsic volcanic and related volcani-

Table 1. Summary table of all known prospects containing advanced argillic mineral associations on the Burin Peninsula, highlighting their main alteration minerals, and associated anomalous elements from the epithermal suite (Ag, As, Bi, Cu, Hg, Mo, Pb, Sb, Se, Sn, Te, Zn) based on data from Sparkes and Sandeman (2015) and portable XRF analysis. Location data is provided in NAD 83, Zone 21 format

Easting	Northing	Prospect	Trend/Belt	Alteration Minerals	Anomalous Elements
620781	5220313	Beacon Hill		Pyrophyllite, alunite-K, dickite, kaolinite	Bi, Mo, Pb, Te, Zn
664605	5254512	Brookside	Stewart	Pyrophyllite, alunite-K, dickite	Se
687475	5286011	Bullwinkle	Monkstown Road	Alunite-Na, dickite, kaolinite	Bi, Pb
697125	5291662	Chimney Falls	Hickey's Pond-Tower	Alunite-Na	Au, Sb, Se
701853	5297845	Eric's	Hickey's Pond-Tower	Alunite-Na, kaolinite	Au, Bi, Pb, Sb
651229	5243339	HeMoly		Pyrophyllite, alunite (Na, K), kaolinite	Mo
699390	5295244	Hickey's Pond	Hickey's Pond-Tower	Alunite-Na, pyrophyllite, dickite, kaolinite	Au, Ag, As, Bi, Cu, Hg, Pb, Sb, Se, Sn, Te
720559	5311012	Kidney Pond		Alunite-Na	Au
688361	5287147	Little Pond	Monkstown Road	Alunite-K	Se
658954	5283018	Long Harbour Pyrophyllite		Pyrophyllite, dickite, kaolinite, diaspore	As, Bi, Hg, Mo, Sb, Se
692624	5310016	Long Pond Northwest		Pyrophyllite, kaolinite	Bi, Pb, Sb, Sn
688879	5287760	Monkstown Road	Monkstown Road	Alunite-Na, pyrophyllite, lazulite	Pb
688623	5287535	Monkstown Road South	Monkstown Road	Pyrophyllite	
688212	5286811	Paradise River	Monkstown Road	Alunite-K	
660790	5257848	Rattle Brook	Stewart	Pyrophyllite, alunite-K, dickite	Hg, Sb
652257	5243288	Red Harbour River East		Pyrophyllite, kaolinite	
689663	5288698	Ridge	Monkstown Road	Alunite-Na, pyrophyllite	
627229	5214437	Rocky Ridge		Pyrophyllite, kaolinite	
645761	5229144	Spanish Room		Pyrophyllite, dickite, kaolinite, topaz	Au, Ag, Hg, Pb
643044	5240082	Starbuck Lake		Pyrophyllite	Bi, Cu, Mo, Pb, Sb, Zn
649767	5253208	Stewart	Stewart	Pyrophyllite, dickite, kaolinite, alunite-K, diaspore	Au, Cu, Mo, Pb, Se, Sn
625644	5208744	Stroud's Pond		Pyrophyllite, dumortierite	Mo, Sb
692497	5286362	Tower	Hickey's Pond-Tower	Alunite-Na, pyrophyllite, kaolinite, topaz	Mo, Pb, Se, Sn

clastic rocks of the *ca.* 570 Ma Belle Bay Formation (Sparkes *et al.*, 2023) and represents the youngest known example of advanced argillic alteration in the region based on the age of the host rock. Aside from minor folding, the advanced argillic alteration in this area is much less deformed than that observed farther to the east.

Advanced Argillic Alteration Minerals

The alteration in this area is dominated by pyrophyllite, along with lesser dickite, kaolinite and diaspore (Plate 1C). These minerals are associated with quartz alteration of the felsic volcanic host rocks that occur both within and marginal to the main zone of advanced argillic alteration. Unlike the occurrences farther to the east, no alunite has been identified at the Long Harbour Pyrophyllite prospect.

Mineralization

As noted above, the advanced argillic alteration in this area is barren with respect to precious-metal enrichment but occurs proximal to an area of gold mineralization associated with network-style chalcedonic quartz veining. Weakly anomalous values of As, Bi, Hg, Mo, Sb and Se are locally noted in association with the pyrophyllite–diaspore alteration (Table 1; Sparkes and Sandeman, 2015). Fine-grained disseminated pyrite (<10%) is locally developed, but the alteration is largely devoid of any significant sulphides.

NEW OCCURRENCES

Kidney Pond

The Kidney Pond prospect was first reported in the late 1990s (Smith, 1999), but there was no documented analytical confirmation of the inferred advanced argillic alteration occurring in the area. Spectral analysis of altered boulders has confirmed the presence of sodic alunite, which occurs in moderately to strongly foliated, <0.5 m in diameter, boulders that form a discrete cluster along the western side of Kidney Pond (Figure 3, Plate 1D). However, due to limited outcrop in the immediate area, no *in situ* advanced argillic alteration has been identified. The initial auriferous sample from the prospect assayed 1.7 g/t Au; however, reanalysis of the coarse rejects only returned 5 ppb Au (Smith, 1999), and no additional follow-up is reported for the area. The sodic alunite identified at the prospect is similar in composition to that observed elsewhere along the Hickey's Pond trend, some 23 km to the southwest, and represents the most northeastern occurrence of advanced argillic alteration in the region.

Field mapping along a river approximately 800 m to the south-southwest of the prospect located a zone of strongly foliated muscovite–pyrite altered felsic volcanic rocks. This alteration is anomalous in Sb and Mo based on portable XRF analysis. Both the muscovite alteration and the advanced argillic boulders plot along a north-northeast trending fault that separates siliciclastic sedimentary rocks of the Connecting Point Group to the east, from felsic volcanic rocks of the Marystown Group to the west (Figure 3; Hinchey, 2001). The spatial association of the advanced argillic boulders with a significant fault structure highlight similarities with the structurally bound alteration of the Hickey's Pond trend, and indicates that the altered material may not be far removed from its source.

Long Pond Northwest

Altered boulders reported to contain advanced argillic minerals were recently discovered by a local prospector in the Long Pond area (P. Dimmell and G. Layne, pers. comm., 2023; Figure 2). SWIR analysis of boulders occurring within the till cover confirmed the presence of pyrophyllite and kaolinite, along with paragonite-dominated white mica alteration (Plate 1E). These boulders are up to 1.5 m in diameter and are distributed over an area of approximately 100 m. SWIR investigations of rare outcrops in the immediate area indicate the presence of altered felsic volcanic rocks characterized by muscovite–pyrite alteration, locally containing up to 10% pyrite, but no *in situ* advanced argillic minerals were identified. The altered boulders overlie rocks mapped as the Long Harbour Group (O'Brien *et al.*, 1999), and based on the glacial interpretation of the area by Batterson and Taylor (2006), the transported material originated to the northwest (Plate 1F). No known mineralization is associated with the altered boulders, but portable XRF analysis indicates anomalous Bi, P, Pb, Sb, Sr and Sn.

CENTRAL BURIN PENINSULA

The central Burin Peninsula is host to some of the most aerially extensive advanced argillic alteration, with semi-continuous alteration locally extending for up to 3 km along strike and up to 0.8 km in width at the Stewart prospect. This prospect marks the western extent of an advanced argillic alteration trend that can be traced intermittently along strike to the east for up to 15 km, forming the Stewart trend (Figure 4). The western portion of this trend has been the focus of mineral exploration in the area and is inferred to host porphyry-related copper–gold mineralization (Dyke and Pratt, 2008). Results of a recent airborne geophysical survey (Kilfoil, 2022) illustrates that the Stewart trend is associated with a prominent magnetic low that continues westward from the Stewart prospect to the Point Rosie area. The latter area contains muscovite–paragonite dominated alteration that is locally associated with up to 0.4 g/t Au along with anomalous Ag, As, Bi, Cu, Sb, Se and Te (Clark, 2019c).

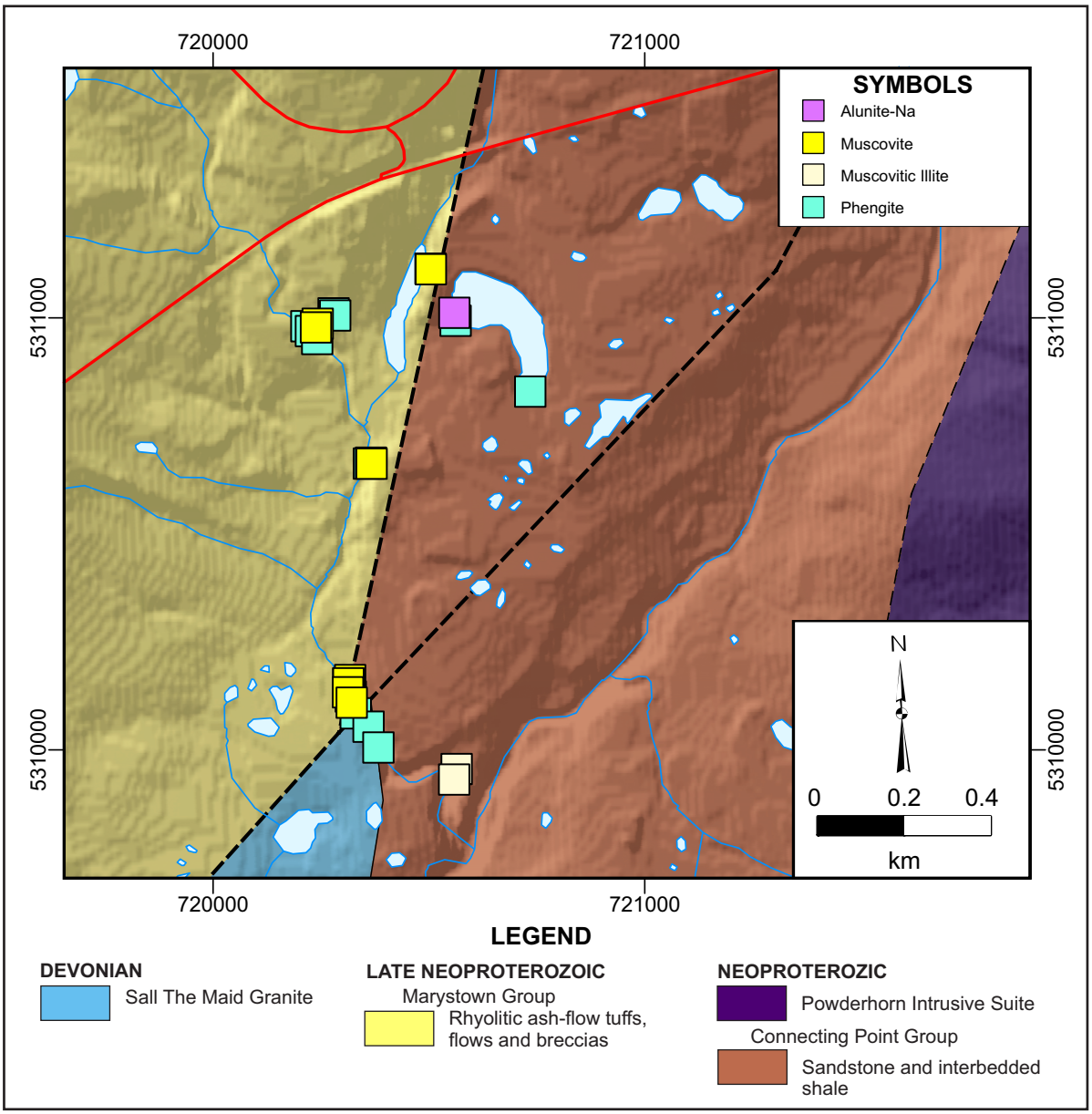

Figure 3. *Detailed map outlining the distribution of spectral data points collected around the Kidney Pond prospect. Geology modified from O'Driscoll* et al. *(1995) and Hinchey (2001). Location data is in NAD83, Zone 21 format.*

Other occurrences of advanced argillic alteration in the central Burin Peninsula include the Starbuck Lake, Red Harbour River East, and Spanish Room prospects (Figure 4). In addition, recent prospecting has also discovered similar styles of alteration at the Brookside and HeMoly prospects (*see* below). Advanced argillic alteration in the central Burin Peninsula is distributed over 30 km, demonstrating the significant aerial extent of this style of alteration within at least two separate trends. Limited, to no, systematic mineral exploration has been conducted on these areas, but local enrichment of various elements within the typical epithermal suite (Au, Ag, As, Bi, Cu, Hg, Mo, Pb, Sb, Se, Sn, Te) have been identified in association with the alteration (*see* below).

RECENT EXPLORATION

Exploration activities within the Stewart area, prior to the early 2010s, is summarized in Sparkes (2012) and references therein. The Stewart prospect is the only area in the central Burin Peninsula that has been investigated by diamond drilling and was most recently explored by TerraX Minerals (2011–2019). As part of the exploration by TerraX, a Titan IP survey was conducted over the Stewart prospect,

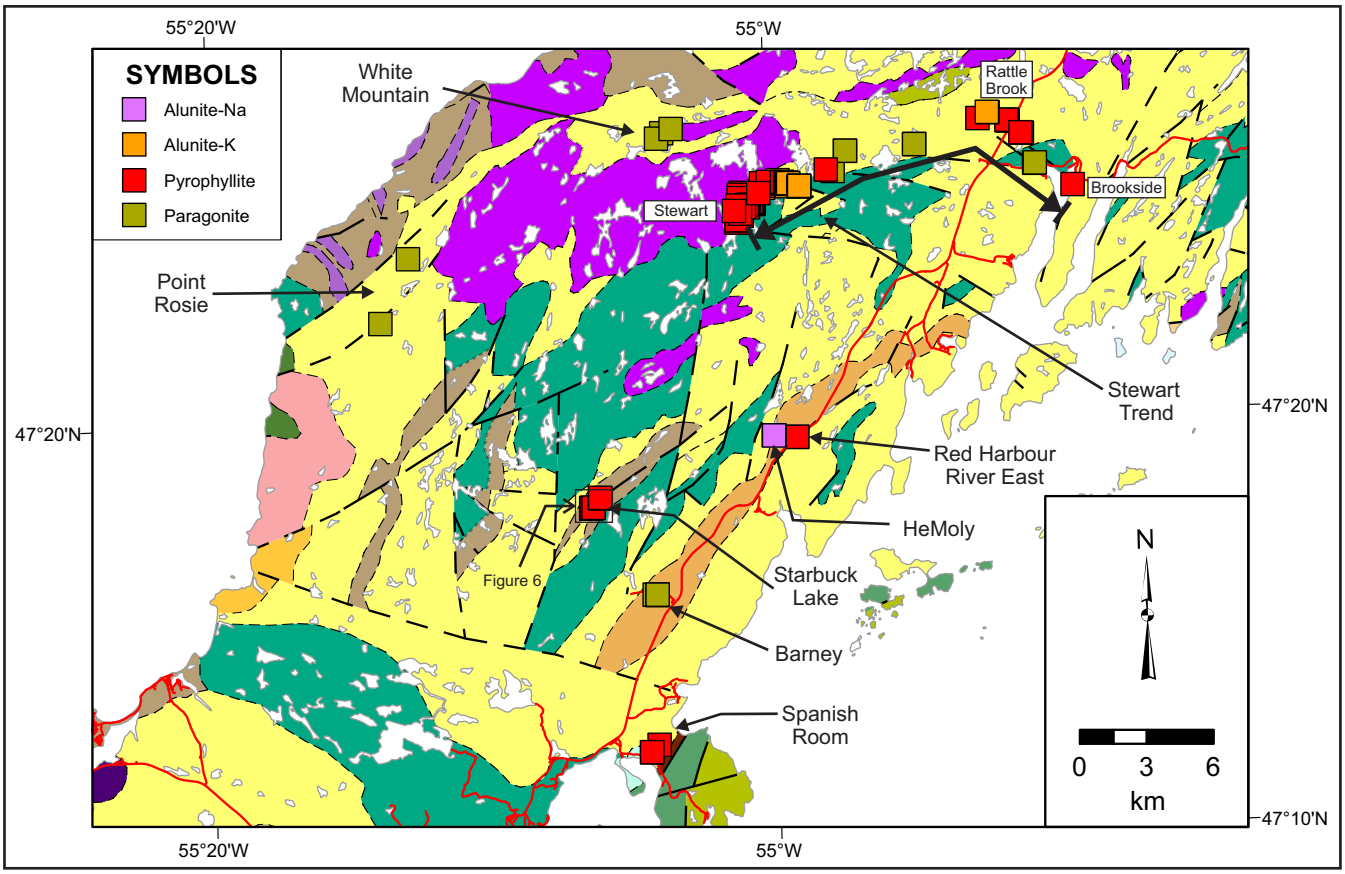

Figure 4. *Regional geology (modified from O'Driscoll* et al.*, 1995) of the central portion of the Burin Peninsula, outlining the distribution of the known occurrences of advanced argillic alteration. Note only the main advanced argillic mineral for each prospect is shown; for the geology legend refer to Figure 1.*

which generated two main chargeability anomalies (Setterfield, 2011). One drillhole of a five-hole program investigated the southernmost chargeability anomaly, intersecting 111 m of 0.13 g/t Au and 0.05% Cu, with the other four holes testing the northern anomaly; the latter drillholes failed to intersect any significant mineralization (Setterfield, 2012). Exploration along the Stewart trend by TerraX also resulted in the discovery of bonanza-grade gold values at the Forty Creek prospect, where boulders of an inferred intermediate-sulphidation style quartz vein assayed up to 59 g/t Au and 2290 g/t Ag (Setterfield and Heberlein, 2011). The eastern portion of the Stewart trend has received much less exploration, with only limited documented work (*e.g.*, Weick, 2010; Kelloway, 2016; Noel, 2017).

The first reported work in the Starbuck Lake area consisted of general prospecting by Selco Inc. in early 1980s (Webster, 1984), and limited follow-up exploration occurred in the late 1980s (Hepp and Dearin, 1987) and early 1990s (Dimmell *et al.*, 1991). The later work noted anomalous Pb, Mo, Cu, Zn, Bi and Sb in association with the exposed alteration. Limited reports on both the Red Harbour River East and Spanish Room prospects are also available (*e.g.*, Walsh, 2010, 2011; Woodland and French, 2012; Sparkes and Dunning, 2014). While no mineralization has been identified in association with the Red Harbour River East prospect, rare auriferous clasts are noted within a boulder conglomerate at the Spanish Room prospect (*see* below).

STEWART TREND

The Stewart trend locally contains some of the widest (up to 800 m) advanced argillic alteration on the Burin Peninsula within a trend that extends along strike for upwards of 15 km, from the Stewart prospect in the west, to the Brookside prospect in the east (Figure 4). Along this trend several occurrences of advanced argillic alteration have been identified which include the development of pyrophyllite, diaspore, dickite and alunite. To date, associated mineralization has only been identified within the western portion of this trend, and diamond drilling is restricted to this area. This drilling has targeted potential porphyry-relat-

ed mineralization, occurring within a telescoped hydrothermal system, whereby porphyry mineralization has been overprinted by the overlying advanced argillic alteration (Dyke and Pratt, 2008).

Local Geology

The advanced argillic alteration occurring along the Stewart trend is primarily hosted within felsic volcanic rocks of the Marystown Group, but is also locally developed within a quartz diorite/tonalite intrusion (Ferguson, 2017). Advanced argillic alteration occurring along the remainder of the trend is primarily hosted within tuffaceous felsic volcanic rocks. This trend is unique in that most alteration zones on the Burin Peninsula have a predominant northeast orientation, but the Stewart trend displays a distinct east-west alignment, which parallels a flexure in the regional structural fabric. In the western portions of the trend, the alteration forms a curvilinear zone, which displays a stratiform distribution extending northeast away from the quartz diorite/tonalite intrusion (Dyke and Pratt, 2008). The alteration zone narrows to the east and is locally disrupted by north-northeast oriented faults in the eastern portion of the trend (Weick, 2010; Sparkes and Dunning, 2014).

Advanced Argillic Alteration Minerals

As indicated above, the Stewart prospect is inferred to represent a telescoped hydrothermal system, whereby the advanced argillic alteration has been superimposed on underlying porphyry-related mineralization. Based on SWIR analysis, the highest temperature mineral associations, consisting of pyrophyllite–diaspore, are developed in the extreme western extent of the defined alteration zone. From here, the alteration continues to the northeast, through a zone of pyrophyllite–dickite–kaolinite–paragonite dominated alteration, spanning some 2.5 km along strike. The alteration then transitions into a predominant east–west trending zone of potassic alunite and locally developed vuggy textured quartz, which extends for upwards of 1 km along strike. This style of alteration and related textures is indicative of a lithocap environment, similar to the Hickey's Pond prospect, but in the Stewart area this part of the hydrothermal system is unmineralized. From here, there is a break in the defined alteration trend, east of which the advanced argillic alteration, consisting of pyrophyllite, dickite and potassic alunite, occurs intermittently, but without a defined alteration pattern or zonation. In the extreme eastern portion of the trend, the advanced argillic alteration becomes disrupted by north-northeast oriented shear zones, characterized by muscovite-dominated white-mica alteration.

Detailed SWIR analysis of drillcore from the Stewart prospect highlight the spatial association of elevated copper–gold values with iron chlorite–muscovite–paragonite dominated spectral signatures, which is associated with the least altered quartz diorite/tonalite intrusion (Figure 5, Plate 2A). In Figure 5, areas predominated by pyrophyllite alteration (*e.g.*, ~160 and 320 m), display much lower copper and gold values, and represent the most intensely altered portions of the drillhole. Higher copper and gold values are associated with intervals predominated by white mica (muscovite–paragonite). The broadest zone of copper–gold enrichment within the drillhole is associated with an area of iron chlorite–muscovite dominated alteration, between 180–280 m depth, which is hosted within the quartz diorite/tonalite intrusion. The two highest gold assays reported for the drillhole (0.8 and 1.0 g/t Au over 1.5 and 1.4 m, respectively), occur at the upper and lower transitions of the iron chlorite–muscovite dominated alteration, occurring between 234 and 270 m depth, where this alteration is bound above and below by the overprinting pyrophyllite alteration (Figure 5, Plate 2B). This zone is also associated with some of the longer wavelength Al-OH values within the drillhole, that potentially represent the remnants of earlier porphyry-related alteration that was subsequently overprinted by the advanced argillic alteration.

Mineralization

The Stewart trend represents one of the few areas of the central Burin Peninsula where copper–gold mineralization has been identified in association with advanced argillic alteration. However, this mineralization is thus far restricted to the western portion of this trend. Locally, channel sampling of the exposed alteration has returned assays of up to 1.2 g/t Au, 0.08% Cu and 48 ppm Mo over 12 m (Dyke and Pratt, 2008), while broader, lower grade intervals of up to 0.25 g/t Au over 63 m have also been reported (Dimmell and MacGillivray, 1993). The main sulphide mineral associations within this alteration zone include pyrite, pyrite–chalcopyrite, pyrite–chalcopyrite–specularite, chalcopyrite–galena and molybdenite–pyrite (Ferguson, 2017). Although, as noted above, the highest grades of mineralization occur in association with the iron chlorite altered quartz diorite/tonalite intrusion, the advanced argillic alteration also hosts disseminated pyrite–specularite ± chalcopyrite along with anomalous gold and molybdenum. However, the advanced argillic alteration in this area contrasts with that of the northern Burin Peninsula, in that it lacks the associated enrichment of the Ag, As, Bi, Hg, Pb, Sb, Se, Sn and Te. No significant enrichment in gold has yet been identified in association with the locally developed alunite alteration along the trend.

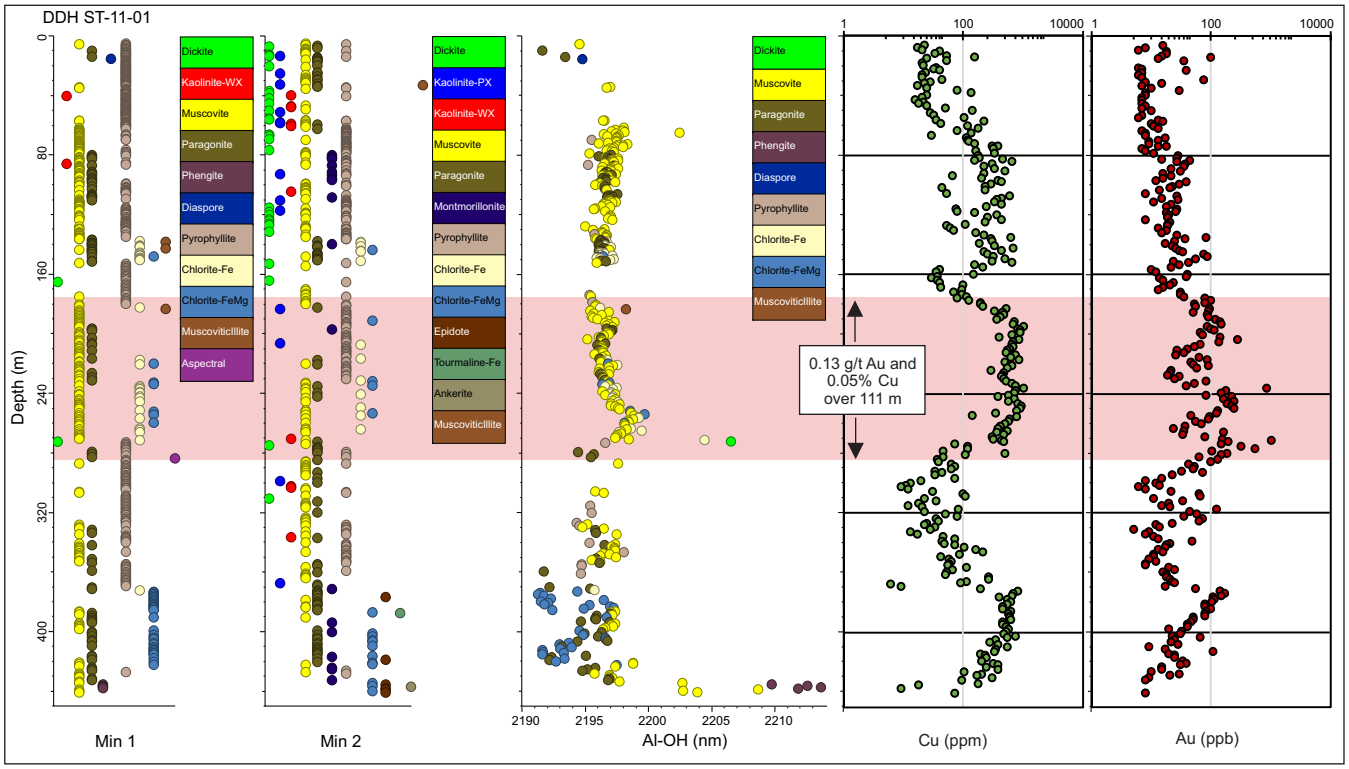

Figure 5. *Downhole plot of SWIR measurements (1 m spacing) for drillhole ST-11-01 outlining the two most abundant minerals present (Min 1 and Min 2) along with associated Al-OH values. Also shown is the corresponding copper and gold assay data from Setterfield (2012).*

STARBUCK LAKE

The Starbuck Lake prospect was first reported in the early 1980s as a zone of aluminous alteration. Detailed company mapping of the exposed alteration highlights a structurally bound alteration zone extending for up to 1.5 km along strike and up to 350 m in width (Dimmell, *et al.*, 1991). Limited SWIR investigations have outlined a zone of advanced argillic alteration at least 600 m in strike length, hosting localized lenses of chalcedonic quartz, associated with anomalous Pb and Mo (*see* below).

Local Geology

Detailed exploration mapping of the area outlined a zone of quartz–sericite schist–pyrite–specularite and silicification that is structurally bound by siliciclastic sedimentary rocks (Dimmell, *et al.*, 1991). These sedimentary rocks, which are assigned to the Musgravetown Group, occupy a northeast–southwest trending synclinal structure and overlie strongly welded ash flow tuff and associated pyroclastic breccias of the Marystown Group (Figure 6; O'Brien and Taylor, 1983). Both the alteration zone and the bounding red, unaltered, siltstone and sandstone are strongly foliated, and the alteration is inferred to occur along a northeast striking, northwest dipping thrust fault like that described farther to the south by Mills and Jones (2024).

Advanced Argillic Alteration Minerals

The main zone of advanced argillic alteration contains only pyrophyllite based on eight SWIR analyses collected from three outcrops over a 600-m-strike length (Figure 6). The pyrophyllite alteration hosts minor fine-grained disseminated pyrite, but pyrite is largely absent in the metre-scale, quartz-rich, discontinuous lenses that occur within the more massive pyrophyllite (Plate 2C). Northeast of the pyrophyllite alteration the zone transitions into white mica dominated muscovite–pyrite alteration that is terminated by a fault. Limited data from the surrounding siliciclastic sedimentary rocks indicate these rocks are characterized by iron chlorite–muscovite, while the relatively unaltered felsic volcanic rocks to the south display phengite-dominated spectral signatures (Figure 6).

Mineralization

Preliminary analysis of the advanced argillic alteration in the field utilizing a hand-held portable XRF did not record any anomalous values of the epithermal suite of ele-

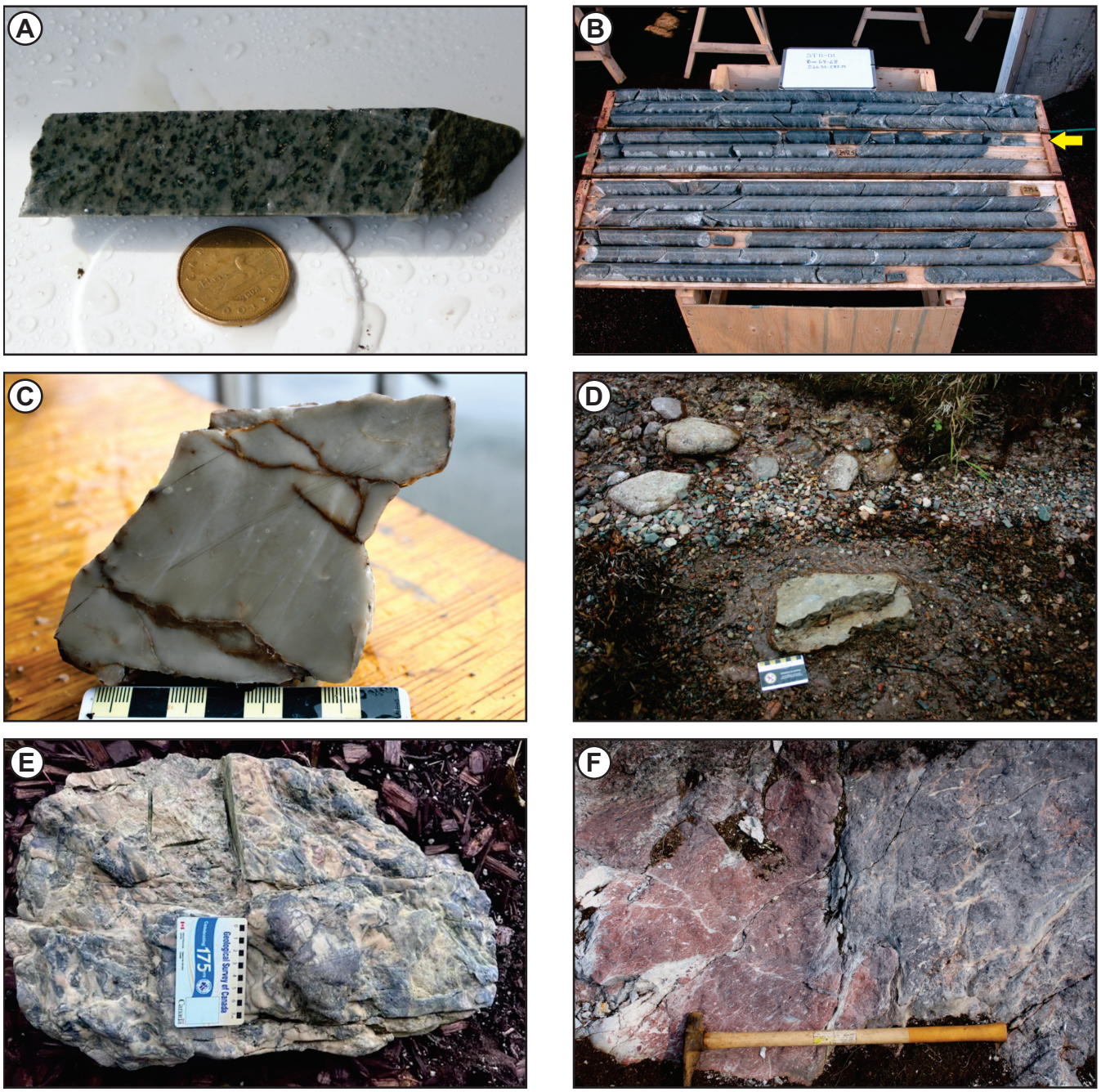

Plate 2. *A) Iron chlorite–paragonite altered quartz diorite/tonalite intrusion; DDH ST-11-01, ~141 m. Sample collected from an interval that returned 0.07% Cu, 0.04% Zn, 40 ppm Mo and 26 ppb Au over 1.5 m (Setterfield, 2012); B) Sharp transition (yellow arrow) from iron chlorite–muscovite (above arrow) dominated alteration into overprinting, pyrophyllite-dominated, advanced argillic alteration (below arrow). The interval above the arrow assays 1.0 g/t Au, 0.05% Cu and 108 ppm Mo over 1.4 m, while below the arrow contains 151 ppb Au, 0.01% Cu and 24 ppm Mo Cu over 1.7 m (Setterfield, 2012); DDH ST-11-01, 266-282 m; C) Representative sample of a quartz(chalcedony)–pyrophyllite lens containing anomalous Pb and Mo hosted within more massive pyrophyllite-dominated alteration; Starbuck Lake prospect; D) Example of a rounded, quartz-altered clast, hosted within unaltered cobble conglomerate; similarly altered clasts locally contain advanced argillic alteration and associated gold mineralization, Spanish Room prospect; E) Representative photograph of the advanced argillic alteration exposed along the coastline of the Brookside prospect; photograph courtesy of K. Kelloway; F). Structurally juxtaposed pyrophyllite (left) and alunite (right) advanced argillic alteration; HeMoly prospect.*

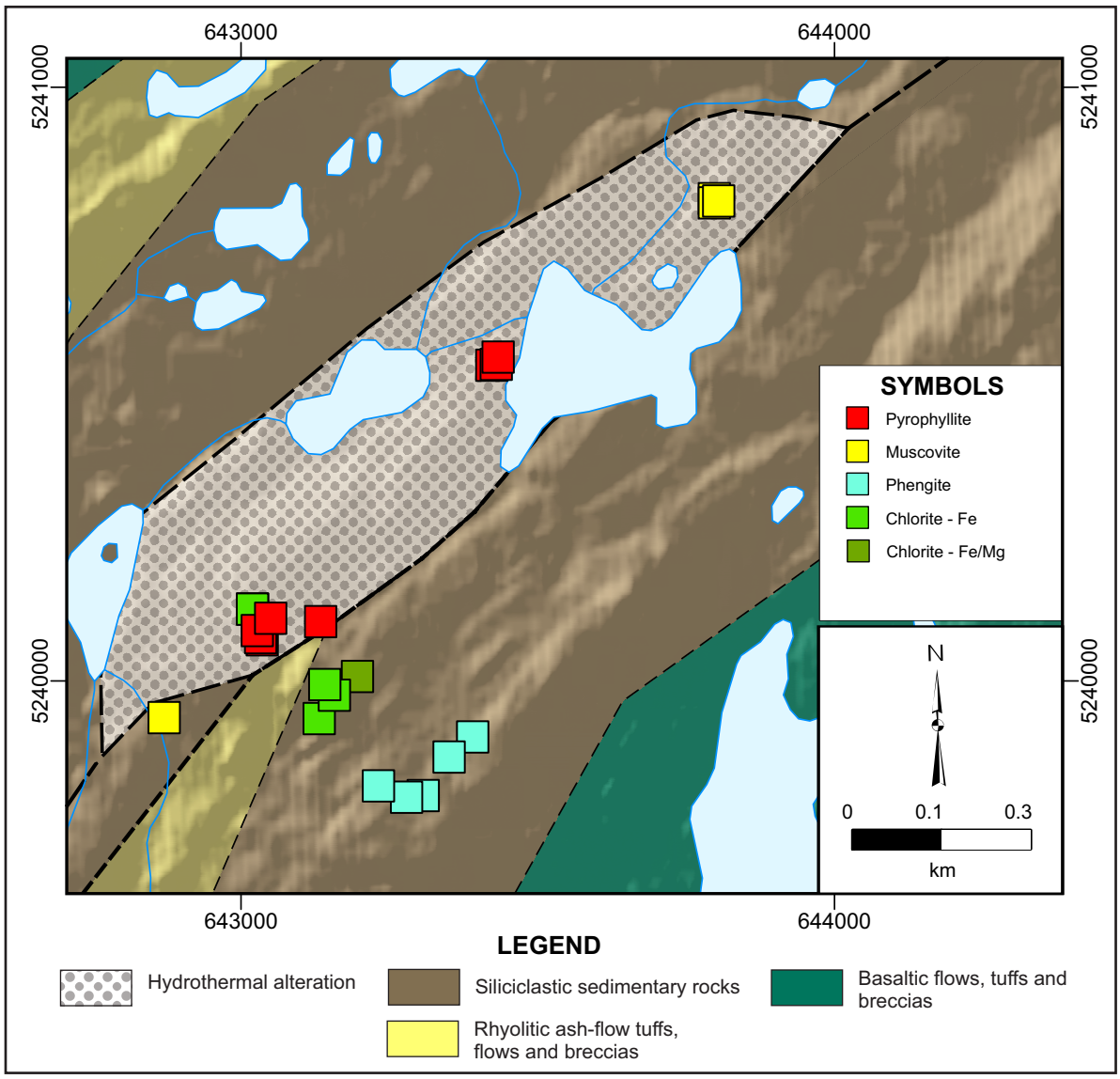

Figure 6. *Detailed map outlining the distribution of spectral data points collected at the Starbuck Lake prospect. Geology modified from Dimmell* et al.*, 1991 and O'Driscoll* et al. *(1995). Location data is in NAD83, Zone 21 format.*

ments within the massive pyrophyllite alteration. However, the localized quartz-rich lenses described above (Plate 2C) were noted to contain anomalous As, Mo, Pb and Sn (Table 1). This anomaly is proximal to a Pb–Mo soil anomaly outlined by Dimmell *et al.* (1991). Marginal to the main zone of pyrophyllite alteration, vuggy textured quartz–pyrite–iron chlorite veins crosscut the alteration and contain anomalous Pb, based on portable XRF analysis.

SPANISH ROOM

Mineralization at the Spanish Room prospect was first reported in the early 2010s, when up to 3 g/t Au was identified in chert (chalcedony) boulders contained within the Carboniferous conglomerate (Walsh, 2010). Subsequent SWIR analysis of these boulders identified advanced argillic alteration minerals in association with intense silicification and brecciation.

Local Geology

Detailed mapping of the Spanish Room prospect was most recently conducted by Woodland and French (2013), while Laracy and Hiscott (1982) describe the distribution and depositional setting of the Carboniferous rocks exposed in the area. The latter work proposed that the Carboniferous conglomerate was deposited in an alluvial fan-type environment, with streams flowing from the northwest to the south-

east (Laracy and Hiscott, 1982). A significant thrust to the immediate east of the prospect, as outlined by Strong *et al.* (1978a), emplaced felsic volcanic rocks of the Marystown Group over Cambrian siliciclastic rocks. The felsic volcanic rocks within the hangingwall of the thrust are locally unconformably overlain by the Carboniferous conglomerate, which is host to the altered and mineralized clasts (Plate 2D). These altered clasts are locally up to 0.5 m in diameter and are inferred to be sourced from an unidentified zone of auriferous advanced argillic alteration located to the northwest, based on paleo-flow directions. The closest known occurrence of this style of alteration is the Starbuck Lake prospect, situated some 11 km to the northwest.

Advanced Argillic Alteration Minerals

SWIR data for the area is limited, as the overall abundance of the altered fragments occurring within the poorly exposed conglomerate, comprise a small percentage of the detritus. Pyrophyllite–dickite–kaolinite ± topaz has locally been identified in these altered clasts. However, as the clasts typically display strong silicification, their overall spectral response is poor.

Mineralization

Mineralized boulders are described as "cherty" in initial reports, due to their intense silicification (now identified as chalcedony). These mineralized clasts have assayed up to 3.0 g/t Au (Walsh, 2010), although not all the altered detritus is mineralized. Limited sampling of altered clasts indicates anomalous Au, Ag, Hg and Pb.

NEW OCCURRENCES

Brookside

Prospecting along the eastern end of the Stewart trend identified pyrophyllite–dickite–alunite within felsic volcanic rocks of the Marystown Group and is the easternmost advanced argillic alteration along this trend, located 3 km southeast of the Rattle Brook prospect (Figure 4). The Brookside prospect occurs on the eastern side of Boat Harbour, proximal to an east–west trending, 700-m-wide shear zone (O'Brien and Taylor, 1983). The alteration, identified at two localities approximately 100 m apart (Kelloway, 2016), occurs along strike from an east–west trending shear zone west of Boat Harbour that hosts paragonite–pyrite alteration up to 150 m in width. No significant precious-metals values have been identified at the prospect, but anomalous Ba and Se is reported in siliceous boulders (Kelloway, 2016).

HeMoly

Pyrophyllite–kaolinite alteration in the Red Harbour River East prospect was first noted in a roadside outcrop by Sparkes and Dunning (2014). More recent prospecting has identified a zone of pyrophyllite–alunite alteration, along with local silicification, at the HeMoly prospect, located 1 km west of the Red Harbour River East prospect (Figure 4). Here, a structurally bound lens of pyrophyllite–alunite altered felsic volcanic rock of the Marystown Group occurs along an inferred northeast–southwest trending thrust, similar to that at the Starbuck Lake prospect 8 km to the southwest. The exposed alteration at the HeMoly prospect is limited to a single outcrop, approximately 5 m wide (Plate 2F), and is barren of precious or base metals. However, the alteration occurs within 100 m of a zone of quartz–specularite–muscovite alteration and associated hydrothermal brecciation, locally hosting disseminated pyrite and up to 1000 ppm Mo (K. Kelloway, pers. comm., 2024). Marginal to the main alteration zone, hematite mobilization within the felsic volcanic sequence results in localized bleaching of the host rock accompanied by the development of specularite-rich hydrothermal breccias, which are observed up to several hundred metres from the advanced argillic alteration.

SOUTHERN BURIN PENINSULA

The physiography of the southern Burin Peninsula contrasts that of the central and northern areas in that the outcrop exposure is poor, with the landscape covered by extensive bog and quaternary cover. This region is host to the first documented occurrence of advanced argillic alteration on the peninsula, identified in the late 1940s at the Stroud's Pond prospect (Van Alstine, 1948). Since then, there has been limited mineral exploration focused on epithermal-style mineralization in the region. The only other documented occurrence of advance argillic alteration is the Beacon Hill prospect, 12 km to the northwest of Stroud's Pond (Figure 7), and was first noted in the mid-2000s. Both occurrences are hosted within felsic volcanic rocks of the Marystown Group and occur proximal to the margin of the regionally extensive St. Lawerence Granite. The epithermal alteration on the peninsula is currently interpreted to be late Neoproterozoic and unrelated to the St. Lawerence Granite (O'Brien *et al.*, 1999; Sparkes and Dunning, 2014). Although of limited exposure, the advanced argillic alteration zones of the southern Burin Peninsula appear less deformed than those farther to the northeast. Exploration of these areas has failed to identify any significant mineralization, but enrichment in the epithermal suite of elements has been identified locally (*see* below).

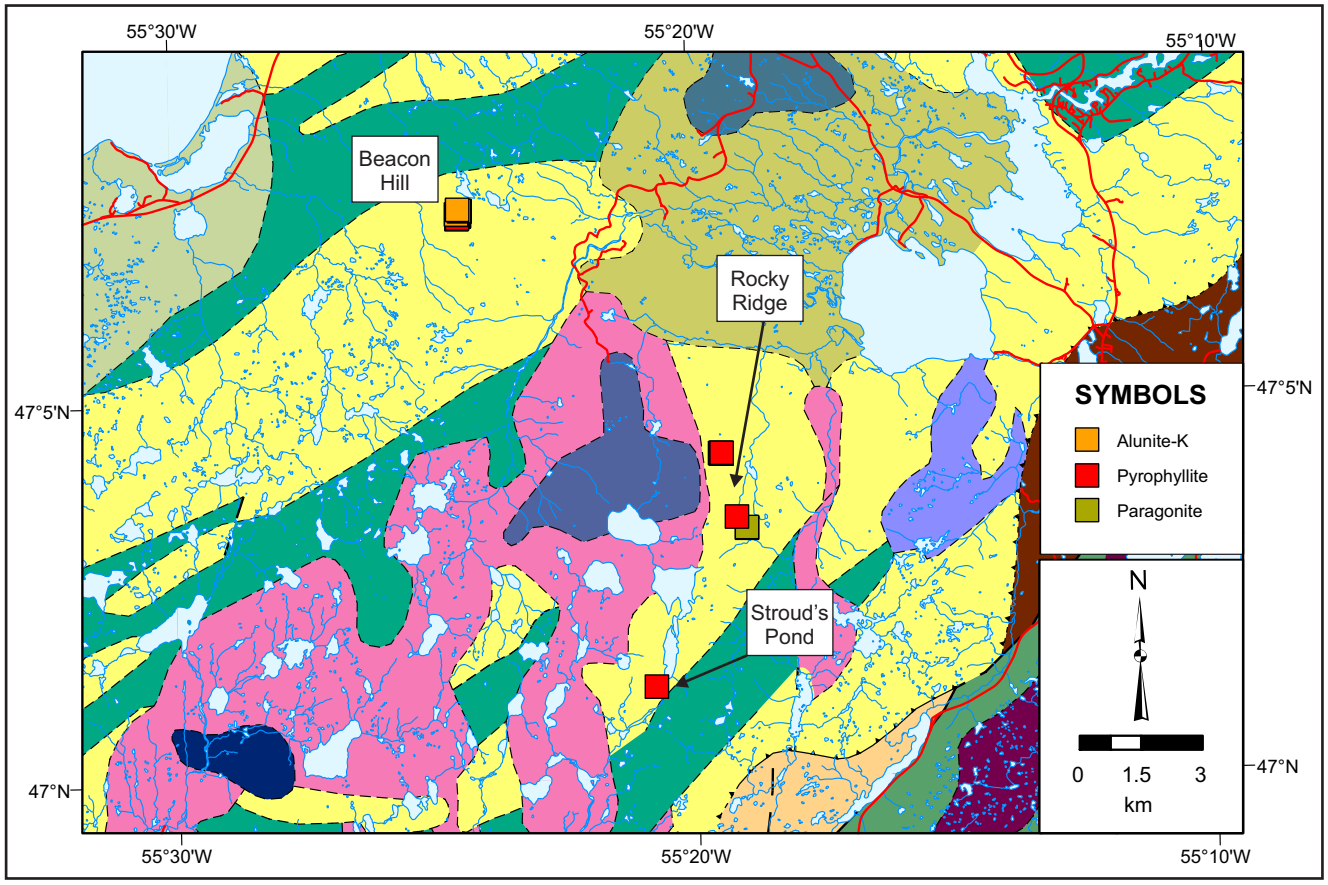

Figure 7. *Regional geology (modified from O'Driscoll* et al.*, 1995) of the southern Burin Peninsula, outlining the distribution of the known occurrences of advanced argillic alteration. Note only the main advanced argillic mineral for each prospect is shown; for the geology legend refer to Figure 1.*

Recent field investigations by the author have identified a new zone of advanced argillic alteration that has a preliminary strike length of up to 1.6 km (Rocky Ridge prospect; Figure 7; *see* below). This zone occurs immediately adjacent to the largest (23 ppb) regional gold in till anomaly overlying rocks of the Marystown Group on the southern Burin Peninsula. No mineral exploration of this anomaly has been documented.

RECENT EXPLORATION

The only targeted mineral exploration of the advanced argillic alteration at the Stroud's Pond prospect was initiated by BP Canada and Selco Inc. during the mid-1980s (McKenzie and Harris, 1985). The remaining documented investigations of the anomaly are by local prospectors (*e.g.*, Noel, 2004, 2006; Brushett, 2018). Exploration of the Beacon Hill prospect is limited to its initial discovery (Marsden and Bradford, 2005), and a few prospecting reports around the main occurrence (Turpin and French, 2012; Turpin, 2019).

STROUD'S POND

The Stroud's Pond prospect is unique as it is the only known occurrence of dumortierite on the Burin Peninsula. The alteration zone is poorly exposed in rare outcrops and trenches along a northwest–southeast trend, indicating a width of up to 200 m and extending for up to 400 m in strike length based on the mapped outcrops of Strong *et al.* (1978a). No other occurrences are known in the immediate area, however the evaluation of the alteration using SWIR was limited to a few outcrops and trenches at the main prospect.

Local Geology

The advanced argillic alteration is hosted within felsic volcanic rocks of the Marystown Group (Mount Lucy Anne Formation of Strong *et al.* (1978a)). Locally, relic tuffaceous and flow-banding textures are preserved within the altered material indicating both volcaniclastic and volcanic protoliths. An abrupt transition to unaltered felsic volcanic

rocks occurs immediately to the east (McKenzie and Harris, 1985), indicating a potential structural contact.

Advanced Argillic Alteration Minerals

Pyrophyllite–dumortierite is reported from the main zone of advanced argillic alteration at the prospect (O'Brien *et al.*, 1999). SWIR analysis of select grab samples from the area indicate the presence of kaolinite–pyrophyllite–paragonite. The local development of dumortierite, which is a distinctive blue (Plate 3A), indicates the presence of boron within the related hydrothermal fluid.

Mineralization

No significant mineralization has been identified in outcrop in the Stroud's Pond area, but limited sampling indicates anomalous Mo and Sb within kaolinite–paragonite altered rocks (Sparkes and Sandeman, 2015). Anomalous As, F, Mo and Sb are also reported from a basal-till survey conducted over the alteration zone (McKenzie and Harris, 1985).

BEACON HILL

The Beacon Hill prospect coincides with a prominent topographic feature, and advanced argillic alteration is exposed at its peak in several outcrops and trenches over an area measuring 200 x 100 m (Plate 3B). Outside of the exposed alteration, outcrop in the area is minimal with the nearest identified outcrop occurring 1 km to the west.

Local Geology

Like the Stroud's Pond prospect, the advanced argillic alteration in the Beacon Hill area is inferred to be hosted within felsic volcanic rocks of the Marystown Group (Beacon Hill Formation of Strong *et al.* (1978a)); however, given the intensity of the alteration, the exact nature of the protolith remains uncertain. Outcrops occurring 1 km to the west of the prospect consist of moderately to strongly chlorite–muscovite–pyrite altered intermediate volcanic rocks.

Advanced Argillic Alteration Minerals

The alteration exposed at Beacon Hill displays a weak zonation pattern, with outcrops in the southeast dominated by pyrophyllite and lesser dickite, while the outcrops to the northwest are dominated by potassic alunite and kaolinite. The pyrophyllite-dominated alteration is more sulphide-rich and contains up to 20% disseminated and vein-hosted pyrite (Plate 3C). In contrast, the alunite-dominated alteration locally occurs with specularite, and displays a vuggy texture, but lacks any significant sulphide development (Plate 3D).

Mineralization

Prospecting around the main occurrence highlights the local enrichment of Mo, Pb and Zn (Turpin, 2019; Marsden and Bradford, 2005). Detailed sampling of the alteration indicates anomalous Bi, Mo and Te associated with the advanced argillic alteration, with highest concentrations associated with alunite-bearing samples (Table 1; Sparkes and Sandeman, 2015).

NEW OCCURRENCE

Rocky Ridge

The southern limit of the recently identified Rocky Ridge prospect occurs 4.5 km northeast of the Stroud's Pond prospect (Figure 7). In this area, two outcrops of pyrophyllite–kaolinite alteration occur, approximately 1.5 km apart along a north–south trend, with no intervening outcrop. Both outcrops consist of a similar quartz-phyric felsic volcanic rock of the Marystown Group (Mount Lucy Anne Formation of Strong *et al.*, 1978a; Plate 3E), displaying variably developed pyrophyllite, kaolinite and rare dickite alteration. Preliminary portable XRF analysis of samples from the prospect did not record any anomalous elements of the typical epithermal suite, but the northern limit of the alteration is located proximal to a 23 ppb gold in till anomaly (Batterson and Taylor, 2009; Plate 3F).

DISCUSSION

The highest grade mineralization on the Burin Peninsula (Hickey's Pond prospect) is associated with sodic alunite and vuggy-textured quartz alteration indicating the local preservation of a mineralized lithocap environment. Subsurface investigations demonstrate a transition to pyrophyllite-dominated alteration at depth and along strike, and given the strongly deformed nature of the alteration, the main Hickey's Pond prospect may represent a structurally preserved lens of the lithocap within a larger scale fault structure. This is supported by the restricted distribution of the vuggy-textured residual quartz to surface outcrops. The auriferous, tennantite-rich, hydrothermal breccia implies the preservation of the lower portion of this lithocap environment, as illustrated by Robert *et al.* (2007). The predominance of a single mineral phase (Na-alunite) along the entire length of the Hickey's Pond trend, points to a similar level of erosion along its entire length, which has only been tested at depth at two localities along its combined 18 km of strike length. The recognition of this same mineral phase at the Kidney Pond prospect supports its designation as the northern continuation of the Hickey's Pond trend.

Plate 3. *A) Advanced argillic alteration hosting dumortierite (blue) in altered felsic volcanic rocks; Stroud's Pond prospect. Photograph from Brushett (2019); B) Aerial view of the Beacon Hill prospect (centre of photograph) highlighting the limited exposure of the area; photograph taken looking to the northwest; C) Pyrophyllite-dominated alteration hosting disseminated and vein-hosted pyrite; Beacon Hill prospect; D) Alunite alteration associated with well-developed vuggy textured quartz; Beacon Hill prospect; E) Pyrophyllite–kaolinite alteration hosted within quartz-phyric felsic volcanic rocks; Rocky Ridge prospect; F) Outcrop of pyrophyllite dominated alteration at the recently discovered Rocky Ridge prospect. Note the photograph is taken looking to the northwest, towards the area containing a 23 ppb gold in till anomaly approximately 200 m away.*

Pyrophyllite is the most widely distributed mineral associated with advanced argillic alteration on the Burin Peninsula, with alunite primarily concentrated in more northern regions. This style of alteration is indicative of deeply eroded lithocap environments which represent prospective environments for potential porphyry-related mineralization (Sillitoe, 2010). However, most advanced argillic alteration zones on the Burin Peninsula have been structurally modified and the preservation of primary zonation patterns is limited. In rare instances however, such as at the Stewart prospect, the distribution of mineral associations implies a deeper, higher temperature environment in the southwestern portion of the alteration zone, which transitions to shallower, steam-heated alteration to the northeast over several kilometres. The copper–gold mineralization in this area, which is restricted to the deeper, higher temperature environment, may represent an example of porphyry-related mineralization underlying a barren lithocap environment. The presence of additional pyrophyllite alteration to the southwest at the Starbuck Lake prospect, combined with recently discovered alunite–pyrophyllite alteration along strike to the northeast at the HeMoly prospect, highlights the potential for further advanced argillic alteration in the central Burin Peninsula.

The Beacon Hill prospect represents another potential lithocap environment, with the presence of well-developed vuggy textured quartz and alunite. This area, although barren at surface, remains an untested target for deeper porphyry-related mineralization, like that developed at the Stewart prospect. The similar alteration associations of pyrophyllite–kaolinite at both the Stroud's Pond and Rocky Ridge prospects points to a similar hydrothermal environment, and may imply a genetic link between these two prospects. However, limited field investigations of the area between these two prospects failed to identify any additional advanced argillic alteration. Although no mineralization has yet been identified in association with the alteration in this area, the northern Rocky Ridge prospect is spatially associated with a 23 ppb gold in till anomaly. Similarly, 12 km to the northeast of the Rocky Ridge prospect, a previously undocumented zone of kaolinite–pyrite alteration is coincident with a 12 ppb gold in till anomaly (Batterson and Taylor, 2009). Although kaolinite alteration on its own is not diagnostic of advanced argillic alteration, the spatial association of these hydrothermal alteration zones and overlying surficial geochemical anomalies highlights multiple areas within the southern Burin Peninsula for additional follow-up.

Newly recognized unsourced boulders of advanced argillic alteration in the Long Pond area points to an unidentified hydrothermal system within the northern portion of the Long Harbour Group. Although these boulders are not mineralized, similar styles of alteration elsewhere in the Long Harbour Group (*e.g.*, Long Harbour Pyrophyllite prospect) are spatially associated with precious-metal mineralization, and thus the northern region represents a notable target for mineral exploration. Likewise, the presence of auriferous detritus of advanced argillic alteration within Carboniferous conglomerate at the Spanish Room prospect points to the existence of a mineralized hydrothermal system somewhere to the northwest within the central Burin Peninsula.

In addition to the typical mineral's that are diagnostic of advanced argillic alteration, white mica alteration, abundant on the Burin Peninsula, can also provide valuable mineralogical information that can be used to highlight areas potentially associated with more acidic hydrothermal conditions. Shorter wavelength white-mica minerals (<2200 nm) are representative of higher temperature, acidic hydrothermal conditions (Halley *et al.*, 2015). Preliminary SWIR investigations show that paragonite (and paragonitic illite) primarily occurs around known zones of advanced argillic alteration. However, several areas within the central Burin Peninsula contain paragonite alteration without associated advanced argillic minerals. These areas include the Barney, White Mountain, and Point Rosie prospects (Sparkes *et al.*, 2015; Figure 4). Samples from these zones display enrichment of some of the elements within the typical epithermal suite, and could potentially be linked to the development of advanced argillic alteration, representing additional targets for potential follow-up.

CONCLUSION

The confirmation and documentation of several new occurrences of advanced argillic alteration distributed throughout the Burin Peninsula highlights the widespread distribution of this style of alteration and the underexplored potential of the region. The Kidney Pond prospect now represents the most northeastern occurrence of advanced argillic alteration in the Burin Peninsula area, while the Stroud's Pond prospect represents the southwestern extent. The aerial distribution of the advanced argillic alteration over such a vast area implies the development of several distinct hydrothermal systems. The presence of mineralization at the Hickey's Pond prospect illustrates the development of a mineralizing fluid phase within that hydrothermal system and highlights the potential fertility of this trend. Development of potential porphyry-style mineralization at the Stewart prospect, along strike from barren lithocap-style alteration and at an inferred deeper level within the overall hydrothermal system, highlights the potential of such environments whereby barren, near-surface (*e.g.*, alunite-dominated) alteration could overlie copper–gold mineralization at depth; analogous to similar relationships noted globally (*e.g.*, Valeriano lithocap, Sillitoe *et al.*, 2016). In addition,

the potential exists for intermediate sulphidation gold–silver mineralization marginal to zones of advanced argillic alteration like that at the Forty Creek prospect.

Unraveling the complicated alteration associations in these types of hydrothermal systems is hampered by their structural modification during post-mineral deformation. In both the northern and south–central portions of the Burin Peninsula, the spatial association of structurally bound advanced argillic alteration zones by northeast trending structural features provide another targeting tool for mineral exploration. This, combined with new detailed geophysics (Kilfoil, 2022, 2024), and geochemical anomalies of various elements within the epithermal suite (Campbell pers. comm., 2025), provide valuable tools to aid future exploration in the region.

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