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PRELIMINARY INVESTIGATIONS INTO THE DISTRIBUTION OF MAGMATIC Ni–Cu–PGE MINERALIZATION IN ULTRAMAFIC–MAFIC ROCKS OF THE FLORENCE LAKE GROUP, HOPEDALE BLOCK, LABRADOR

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ABSTRACT

*The 3.0 Ga Florence Lake Group hosts magmatic sulphide Ni–Cu–PGE as well as orogenic gold, and Cu–Zn volcanogenic massive sulphide mineralization. The orogenic gold (*e.g*., Thurber Dog) and Ni–Cu–PGE (*e.g*., Baikie) showings and prospects are hosted within or along the margins of ultramafic host rocks. The ultramafic rocks occur as multiple flows and/or intrusions throughout the entirety of the belt for a total strike length of ~65 km. However, only ~8 km of strike length has been drill-tested, and only to a maximum depth of 300 m. The host rocks are polydeformed, metasomatized, and intruded by granitoid rocks of the* ca. *2892–2832 Ma Kanairiktok Intrusive Suite. Thus, the genesis of the ultramafic units and controls on the distribution of Ni–Cu–PGE mineral occurrences are unclear.*

This report summarizes the field observations and preliminary interpretations of the deformation history, characteristics of the ultramafic host rocks and factors controlling the distribution of Ni–Cu–PGE mineralization. Preliminary observations indicate that the ultramafic unit hosting the Baikie prospect appears slightly discordant to bedding suggesting an intrusive origin. The spatial association of disseminated and stringer-style sphalerite and chalcopyrite mineralization with the Ni–Cu–PGE occurrences indicate the presence of an older VMS hydrothermal system, which potentially could have provided a sulphur source for the ultramafic magmas to scavenge, leading to sulphur saturation and Ni–Cu–PGE mineralization. The proximity to volcanic vents and associated VMS mineralization might be a controlling factor on the distribution of Ni–Cu–PGE mineralization. Subsequent deformation has affected the geometry and distribution of the mineral occurrences. D_1 *is associated with a northeast striking, steeply dipping, penetrative foliation (*S_1*), which is subparallel to bedding and a steeply northeast plunging mineral lineation (*L_1*).* D_2 *is associated with an east-northeast striking steeply dipping spaced, crenulation cleavage. The Ni–Cu–PGE mineral occurrences are podiform and shoot-like in their geometry and are elongated parallel to the* S_1 *and* L_1 *fabrics.*

INTRODUCTION

This report highlights preliminary field observations from the first field season of a four-year project, by the Geological Survey of Newfoundland and Labrador (GSNL), forming part of a collaborative public geoscience initiative targeting Labrador as a highly prospective region for critical minerals. The aim is to advance the understanding of the genesis of Ni–Cu–PGE mineralization within the greenstone belts of the Hopedale block.

The Florence Lake greenstone belt is a 3.0 Ga supracrustal belt within the Hopedale block, eastern Labrador, which is known to host Ni–Cu (± PGE), Cu–Zn and Au mineral occurrences (*e.g.*, *see* Brace and Wilton, 1990; Miller, 1996; Figure 1). It comprises volcanic rocks of the Florence Lake Group (FLG) and is subdivided into five sub-belts; namely the Adlatok, Ugjoktok, Baikie, Schist Lakes and Knee Lake (James *et al.*, 1996), which are separated from each other by intrusive and/or structural contacts (Sutton, 1971; James *et al.*, 2002); James *et al.* (2002) suggested that the volcanic strata previously formed a continuous belt. However, a stratigraphic framework that correlates the volcano-sedimentary units across all five sub-belts and puts these mineral occurrences into context is lacking. This is due, in part, to limited geochronological and geochemical data and the complex deformation, metasomatic and intrusive histories, which obscures primary textures and contact relationships. The stratigraphic nomenclature of the FLG is currently being updated using new geochronological and geochemical data to create a framework for correlation of strata between the sub-belts (Diekrup *et al.*, 2023, 2024).

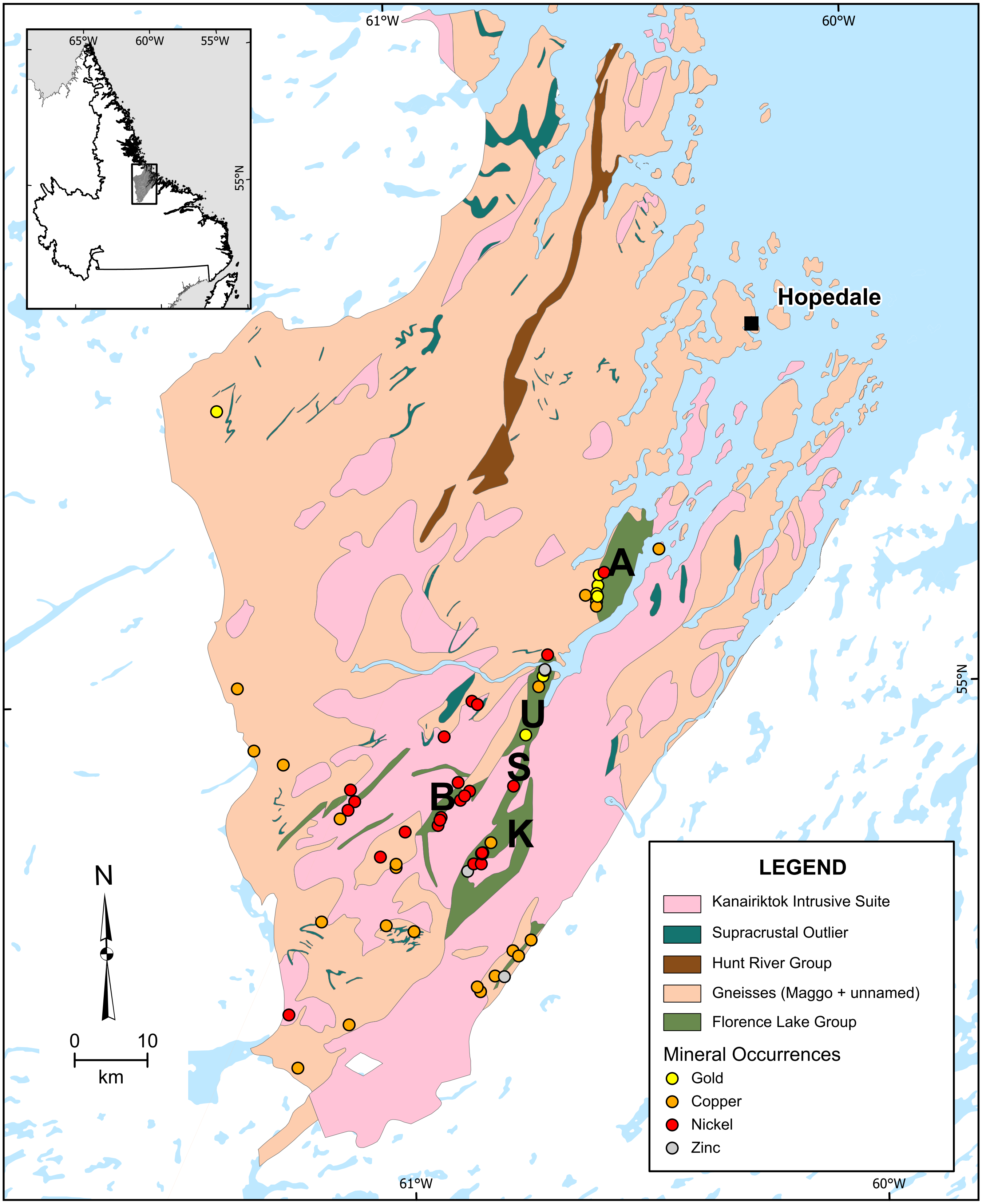

Figure 1. *Simplified geological map of the Hopedale Block showing the distribution of the Florence Lake and Hunt River greenstone belts (modified from Diekrup* et al.*, 2024). Geology after Ermanovics (1993) and Wardle* et al. *(1997). Sub-belts of the Florence Lake greenstone belt are labelled; A=Adlatok, U=Ugjoktok, S=Schist Lakes, K=Knee Lake, B=Baikie.*

The Ni–Cu (± PGE) occurrences are hosted by ultramafic rocks, which have been interpreted as peridotite intrusions (Brace, 1990), or alternatively as distal komatiitic sheet flows (Miller, 1996; James *et al.*, 1996). The mineral occurrences have been compared to the komatiite-related magmatic sulphide deposits of the Kambalda district, western Australia (Miller, 1996). Ultramafic rocks occur within all five sub-belts over a strike length of 65 km, but only ~8 km of strike length has been drill-tested, and only to a maximum depth of 300 m. The best historic intercepts came from the Baikie prospect with 2.19% Ni, 0.22% Cu and 0.16% Co over 11.3 m (McLean *et al.*, 1992). Elevated PGE values (497 ppb Pt and 1020 ppb Pd) have also been reported from grab samples at the Baikie prospect (Reusch, 1987; Brace and Wilton, 1990). Historically, most exploration activity has focused on the southern end of the Florence Lake greenstone belt (Baikie and Knee Lake sub-belts) where gossanous zones outcrop at surface (*e.g.*, McLean *et al.*, 1992; McLean and Butler, 1993; Mitchell and Churchill, 1996); therefore, potential remains for the discovery of blind deposits.

This field season focused primarily on the Baikie sub-belt, where the highest-grade Ni occurrences are found, to provide a baseline for comparison to the other sub-belts and evaluate their potential for Ni–Cu–PGE mineralization. Field observations and structural data were combined with non-confidential mineral-industry data from assessment files. Preliminary reconnaissance mapping and sampling within the rest of the FLG, as well as the Hunt River Group was also undertaken in preparation for subsequent field seasons. At the time of writing, no geochemical results or thin sections were available from the 2024 field season. A portable XRF was used to aid the preliminary lithological classifications and sampling.

PREVIOUS WORK

A detailed summary of early exploration work is provided by Brace (1990) and is only briefly summarized herein. The Baikie prospect was discovered as a gossanous zone on surface by prospector F. Baikie in 1960. Brinex Ltd. in joint venture with Asbestos Corporation subsequently stripped, trenched and sampled the occurrence, both at surface and to shallow depths using packsack diamond drills (1960–1963). Piloski (1962) completed the first map of the Baikie prospect at a scale of 1′:100″ and subsequently Sutton (1971) completed a 1:24 000 scale map.

The last extensive exploration programs occurred in the 1990s. Falconbridge Ltd. completed a 12-hole, 1634-m drilling campaign along the northeastern edge of the Baikie sub-belt in 1992, principally focused around the main Baikie prospect. In addition, a geological mapping and sampling program was completed across the Baikie sub-belt, and two new Ni occurrences were discovered; namely the DCP and Boomerang prospects (McLean *et al.*, 1992). Subsequent drilling in 1993 focused on the DCP and Boomerang prospects, as well as step-out exploratory holes along strike from the main Baikie prospect; the program consisted of 23 holes totaling 3145 m (McLean and Butler, 1993). Tapestry Ventures Ltd. entered into joint venture agreement with Falconbridge Ltd. in 1996 and drilled 11 additional holes (1471.85 m) within the main Baikie prospect area (Cullen and Churchill, 1997).

The claims of the Baikie sub-belt are currently held by Churchill Resources Inc. They conducted a due-diligence sampling program in 2021 and 2022 of historic core from Tapestry Ventures Ltd. and Falconbridge Ltd., as well as grab sampling and compilation of historical geochemical data. A magnetic and time-domain electromagnetic survey was completed in 2022 with follow up soil sampling programs in 2022 and 2023, results of which outlined several exploration targets for follow-up work (Wilton *et al.*, 2023).

REGIONAL GEOLOGY

The Hopedale block is a wedge-shaped, *ca.* 3.3–2.8 Ga granite–greenstone terrane that comprises the southern part of the North Atlantic Craton and is bound by the Paleoproterozoic Makkovik and Torngat orogens to the southeast and west, respectively (Bridgewater *et al.*, 1973; James *et al.*, 2002). A comprehensive summary of the geological history of the Hopedale block and new U–Pb Shrimp ages is provided by Hinchey *et al.* (2024) and is briefly summarized herein. The Hopedale block contains two main supracrustal belts, the *ca.* 3.1 Ga Hunt River Group (HRG) and the *ca.* 3.0 Ga FLG, as well as numerous smaller, coeval and possibly older (>3.2 Ga) supracrustal belt outliers, surrounded by orthogneiss and granitoid intrusions (Sandeman *et al.*, 2023; Hinchey *et al.*, 2024).

The FLG is composed of supracrustal rocks that were deposited between 3003 and 2979 Ma (Ermanovics, 1993; James *et al.*, 2002). It consists predominantly of mafic volcanic rocks, lesser ultramafic and felsic volcanic and volcaniclastic rocks and minor sedimentary rocks (James *et al.*, 2002), which are structurally dismembered into five lenticular, northeast-striking sub-belts termed the Adlatok, Ugjoktok, Baikie, Schist Lakes and Knee Lake (James *et al.*, 1996). The *ca.* 2892–2832 Ma Kanairiktok Intrusive Suite (KIS) surrounds and intrudes the volcanic strata of the FLG (Hinchey *et al.*, 2024). Lower amphibolite facies conditions were reached in the contact metamorphic aureole of these younger intrusions, which were overprinted and retrogressed by regional greenschist-facies metamorphism and deformation (McLean *et al.*, 1992; Ermanovics, 1993; James *et al.*, 2002). Although all rock types have been metamorphosed, the prefix meta- is omitted in this report for brevity.

The volcanic rocks of the FLG were deformed and metamorphosed during a minimum of two deformational events (Diekrup *et al.*, 2023). The first deformation event is characterized by a penetrative sub-vertical, north-northeast striking foliation marked by regional greenschist-facies minerals. Isoclinal folding (F_1) of primary bedding occurs locally with north-northeast striking axial planes (James *et al.*, 1996). The second deformation event is characterized by a spaced north-northwest to south-southeast striking cleavage and open to tight F_2 folds, which overprint S_1 and F_1 (Diekrup *et al.*, 2023, 2024). Pre-syn D_1, layer parallel contractional faults may occur in the belt, perhaps resulting in thrust-repetition of volcanic strata (James *et al.*, 1996). Up to two additional deformational events were described locally, comprising a pre-D_1 event wherein the earlier fabric was transposed into the S_1 fabric and is only preserved within folded sedimentary units in the Baikie sub-belt, and a later D_3 event marked by weak cleavages, and kink bands that strike east–west (McLean *et al.*, 1992). The timing and nature of these deformation events remains uncertain. The S_1 and S_2 fabrics might represent discrete stages of the regional “Fiordian” deformation event (*e.g.*, Ermanovics, 1993), or, they could be unrelated, fabric forming events. Further work is required to link the deformation fabrics observed in the FLG to the regional tectonothermal events. Hinchey *et al.* (2024) described three metamorphic events for the Hopedale block. The oldest at *ca.* 2961–2953 Ma, followed by a 2846–2796 Ma event that is, in part, coeval with the KIS, and finally a *ca.* 2732–2700 Ma event that was interpreted to mark the collision of the Hopedale and Saglek blocks.

LOCAL GEOLOGY AND Ni–Cu–PGE MINERALIZATION

BAIKIE SUB-BELT

The Baikie sub-belt is an ~11 km long and ~2 km wide, northeast striking, arcuate belt of supracrustal rocks (Figure 2) that occurs ~6 km north of the main Florence Lake greenstone belt trend (Figure 1). It is separated from the main Florence Lake greenstone belt trend by intrusive rocks of the KIS (Sutton, 1971). Miller and James (1997) subdivided the Baikie sub-belt into two domains (western and eastern) based on dominant rock types, their magnetic signatures and limited geochemistry. The eastern domain is characterized by abundant ultramafic rocks, whereas mafic volcanic rocks dominate the western domain. The mafic volcanic rocks in the western domain are high-Fe tholeiites having relatively low Ti contents, whereas the mafic volcanic rocks in the eastern domain are basaltic komatiites having a relatively high Ti content and marked by a prominent magnetic high (Miller and James, 1997). The mafic volcanic rocks tend to be more resistive to weathering and outcrop along ridges, whereas the ultramafic rocks are highly susceptible to weathering and typically occur as small exposures within valleys. The mafic volcanic rocks are light to dark grey, aphanitic, strongly foliated and cut by epidote and quartz–carbonate veins. Massive flow facies predominate, however, pillowed facies and volcaniclastic units are also locally present. Pillowed flows in the southeastern portion of the Baikie sub-belt suggest younging towards the southeast (Diekrup *et al.*, 2023). Thin units (≤1 to 8 m thick) of white to purple, siliceous, garnet bearing, chert and/or felsic tuff and black, sulphide bearing, argillite are also observed intercalated with the volcanic rocks.

Miller (1996) mapped out five, 1–25-m thick ultramafic units, in the eastern volcanic domain. Only one ultramafic unit was mapped out in the western domain, a 60-m thick ultramafic unit along the western edge of the sub-belt (Miller, 1996). Primary textures and contact relationships are rare due to intense metasomatism and deformation; the ultramafic rocks were historically described by their secondary mineral assemblages. Five distinct secondary mineral assemblages are observed in the ultramafic rocks: 1) serpentine ± tremolite ± carbonate; 2) talc–carbonate (magnesite and calcite); 3) actinolite–chlorite; 4) biotite–amphibole; and 5) magnesite–quartz (Plate 1; McLean *et al.*, 1992; McLean and Butler, 1993; James *et al.*, 2002). The serpentine ± tremolite ± carbonate association (Plate 1A) occurs in the least altered ultramafic rocks and was only observed in drillcore from the DCP prospect (Figure 2), as crosscutting green and white, serpentine, chlorite and carbonate veins, and trace fine-grained disseminated carbonate. The talc–magnesite altered ultramafic rocks are blue-grey on fresh surfaces and weather grey to brown, depending on the amount of magnesite present, and are commonly associated with quartz–carbonate veining (Plate 1B, C). The magnesite–quartz altered ultramafic rocks are white on fresh surfaces and weather brown. They are composed predominantly of fine- to medium-grained magnesite with only minor blue grey-green ribbons of talc ± serpentine preserved, and are associated with abundant crosscutting quartz–carbonate veins. The actinolite–chlorite association is composed of medium- to coarse-grained, bright green, randomly oriented crystals of actinolite in a fine-grained matrix with variable amounts of chlorite, talc and serpentine (Plate 1D). The talc–magnesite and actinolite–chlorite altered ultramafic rocks are the dominant alteration types observed in the Baikie sub-belt and their mutual contacts range from sharp to diffuse (Plate 1B, C). The biotite–amphibole association is only locally observed, typically in close spatial association with younger intrusive rocks of the KIS. The biotite–amphibole assemblage is black-brown, fine-grained and

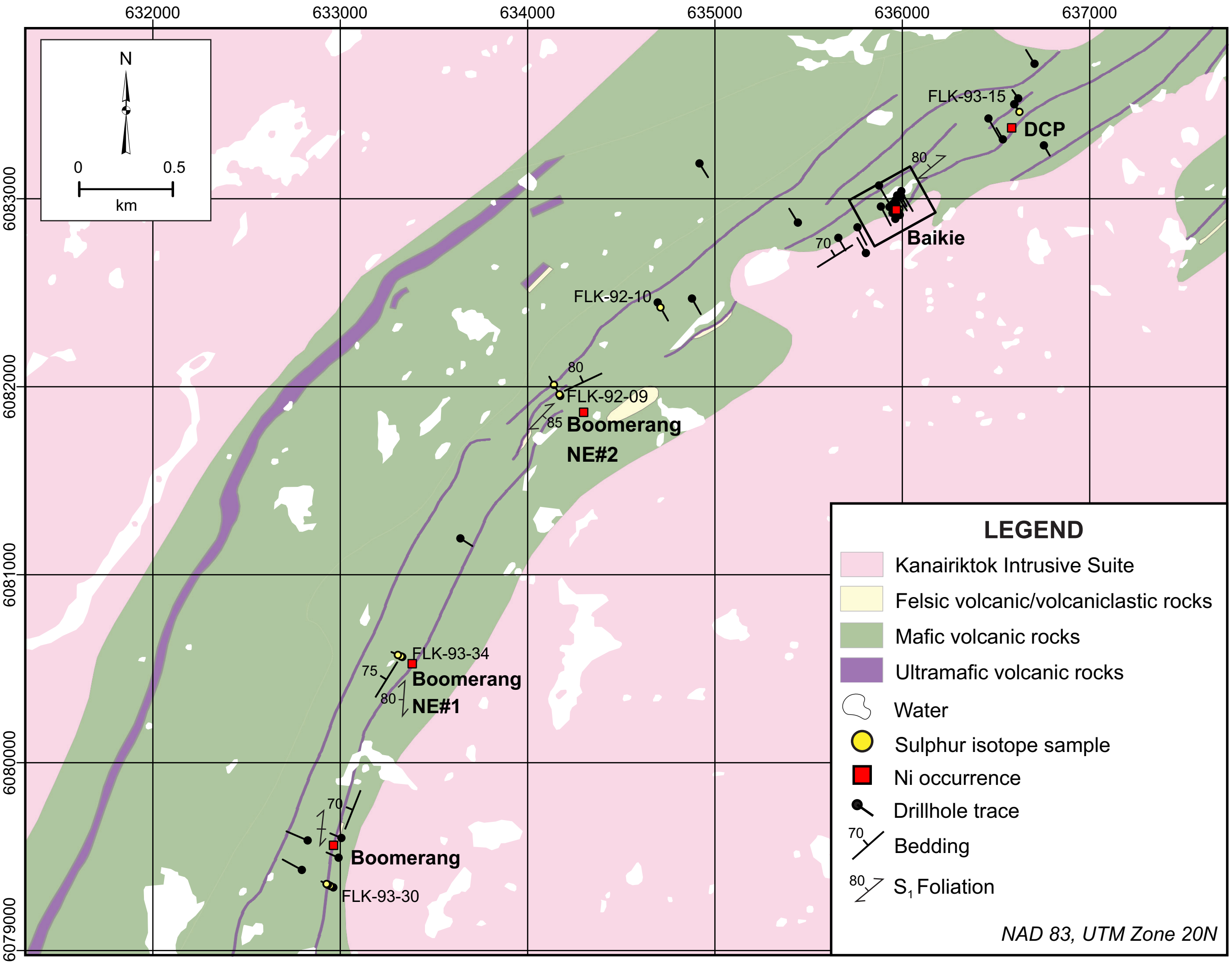

Figure 2. *Local geological map of the Baikie sub-belt (Miller and James, 1997) showing the distribution of known mineral occurrences and drillhole traces for holes that were drilled by Falconbridge (1992, 1993) and Tapestry Ventures Limited (1996). Note: DCP NE is located just off the edge of the map, northeast of the DCP prospect. Drillcore from diamond-drill holes that were relogged during the present study are labelled and samples collected for sulphur isotopic analysis are highlighted in yellow. Rectangle delineates location of detailed map for the Baikie prospect (Figure 4).*

exhibits gradational contacts with the actinolite–chlorite altered rocks; it is locally observed as irregular patches within actinolite–chlorite altered rocks.

The volcanic rocks of the FLG and granitoid rocks of the KIS are intruded by at least two suites of younger mafic dykes; a north to north-northeasterly striking gabbroic dyke set and an east–west striking diabase dyke set (Brace, 1990; McLean *et al.*, 1992).

Ni–Cu–PGE MINERALIZATION

There are six known Ni–Cu–PGE mineral occurrences in the Baikie sub-belt. Listed from northeast to southwest they include DCP northeast, DCP, Baikie, Boomerang NE#2, Boomerang NE#1 and Boomerang (Figure 2). They are all located within the eastern domain of the Baikie sub-belt (Figure 2) and are hosted by thin talc–magnesite altered ultramafic units (Miller, 1996). Mineralization is stratabound and consists of massive to disseminated pentlandite, pyrrhotite, pyrite and minor chalcopyrite, chromite and magnetite (Brace, 1990). It is unclear if all the occurrences are hosted by the same volcanic or intrusive unit, which is structurally dismembered and/or folded (*e.g.*, McLean and Butler, 1993), or if they occur within separate parallel flows (*e.g.*, Miller, 1996). There are no known Ni–Cu–PGE occurrences within the western domain of the Baikie sub-belt.

METHODOLOGY

Lithological, structural, mineralization and alteration data were collected from 138 individual outcrops and 6 diamond-drill hole cores that were stored at the Provincial Goose Bay Core Storage Facility. All six mineral occurrences within the Baikie sub-belt (DCP northeast, DCP, Baikie, Boomerang, Boomerang NE#1 and Boomerang NE#2), as well as the western domain ultramafic unit, were visited and sampled. Two hundred and two rock samples were collected from outcrop and drillcore for lithogeochemical analysis and thin section preparation. Field data were collected using the Geological Survey of Canada's (GSC) field application on a Panasonic ToughPad. Structural data

Plate 1. *Drillcore photographs of ultramafic rocks from the Baikie sub-belt. A) Black, very fine-grained ultramafic rock with serpentine and carbonate veins, DCP prospect (DDH FLK-93-15, 83–93 m); B) Actinolite–chlorite (Act–Chl) and talc–magnesite (Tlc–Mgs) altered ultramafic rock, showing sharp (solid yellow line) and gradational (dashed yellow line) contact zones (DDH FLK-92-10, 50–66 m); C) Close up of sharp contact between Act–Chl and Tlc–Mgs altered ultramafic units from B; D) Close up of Act–Chl altered ultramafic rock from the Baikie prospect (DDH FLK-92-12, 126 m).*

were collected using a Freiberger compass set to a declination of -20.5° and plotted using the Stereonet application (Allmendinger *et al.*, 2012).

PRELIMINARY RESULTS

STRUCTURE

The volcanic and intercalated sedimentary units strike northeasterly and are steeply (75 to 85°) dipping (S_0; Figure 2). At least two structural fabrics have been identified in the field, consistent with the observations of Diekrup *et al.* (2023). The main pervasive foliation (S_1) strikes northeasterly subparallel to bedding (Figure 3) and is defined by chlorite and sericite in mafic and felsic rocks, respectively, and talc and chlorite in ultramafic rocks. The ultramafic rocks exhibit variable degrees of strain depending on their secondary mineral assemblages; talc dominant assemblages are typically strongly foliated (Plate 2A, B), whereas magnesite-, actinolite- and serpentine-dominant assemblages appear more massive to weakly foliated. The mafic and felsic volcanic and volcaniclastic rocks are moderately to strongly foliated and banded, and, in the field, it can be difficult to differentiate primary-depositional banding from superimposed metamorphic/deformation-induced banding. Garnet porphyroblasts are observed within the sedimentary units and are flattened parallel to the S_1 foliation (Plate 2C). The KIS granitoid rocks range from undeformed to moderately deformed (Plate 2D), with the foliation concentrated on the outer margins of thicker units. In addition, the granitoid intrusions host foliated xenoliths of ultramafic and mafic volcanic rocks, indicating late syn- to post-deformational (D_1) emplacement. A moderate to steeply north-northeasterly plunging mineral lineation (L_1) is also observed locally (Figure 4), however, the orientation of the L_1 varies on a regional scale, because of rotation by younger F_2 folds (Diekrup *et al.*, 2024).

The S_1 foliation is locally folded and overprinted by a spaced cleavage (S_2) that strikes east-northeast and also dips steeply (Figure 3, Plate 2A, B). In addition, the strike of the host volcanic rocks and the main pervasive S_1 foliation, changes gradually from a more north-northeasterly striking orientation within the Boomerang trend along the southern end of the Baikie sub-belt, to a northeasterly strike within the Baikie–DCP trend along the northeastern part of the Baikie sub-belt (Figure 2). The youngest structures appear to be east-southeast–west-northwest striking faults (*e.g.*, Figure 4) that are defined by topographic lineaments at surface and fault gouge in drillcore. The sense of displacement on these structures is uncertain, but clockwise rotation of the S_1 fabric in the main Baikie prospect outcrop suggests a possible dextral sense of shear (Plate 3).

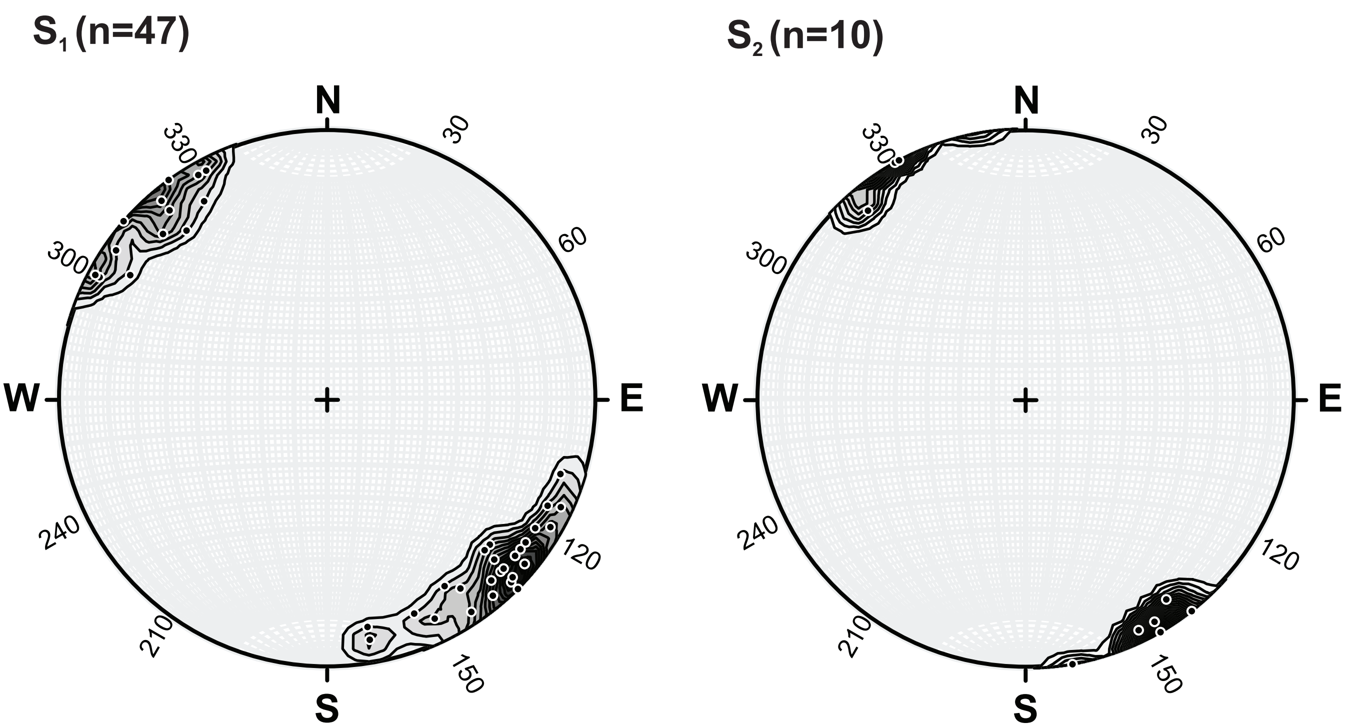

Figure 3. *Equal area projection stereonet plot of foliation measurements from the Baikie prospect area. Measurements are plotted as poles and contoured using a 1% area contour.*

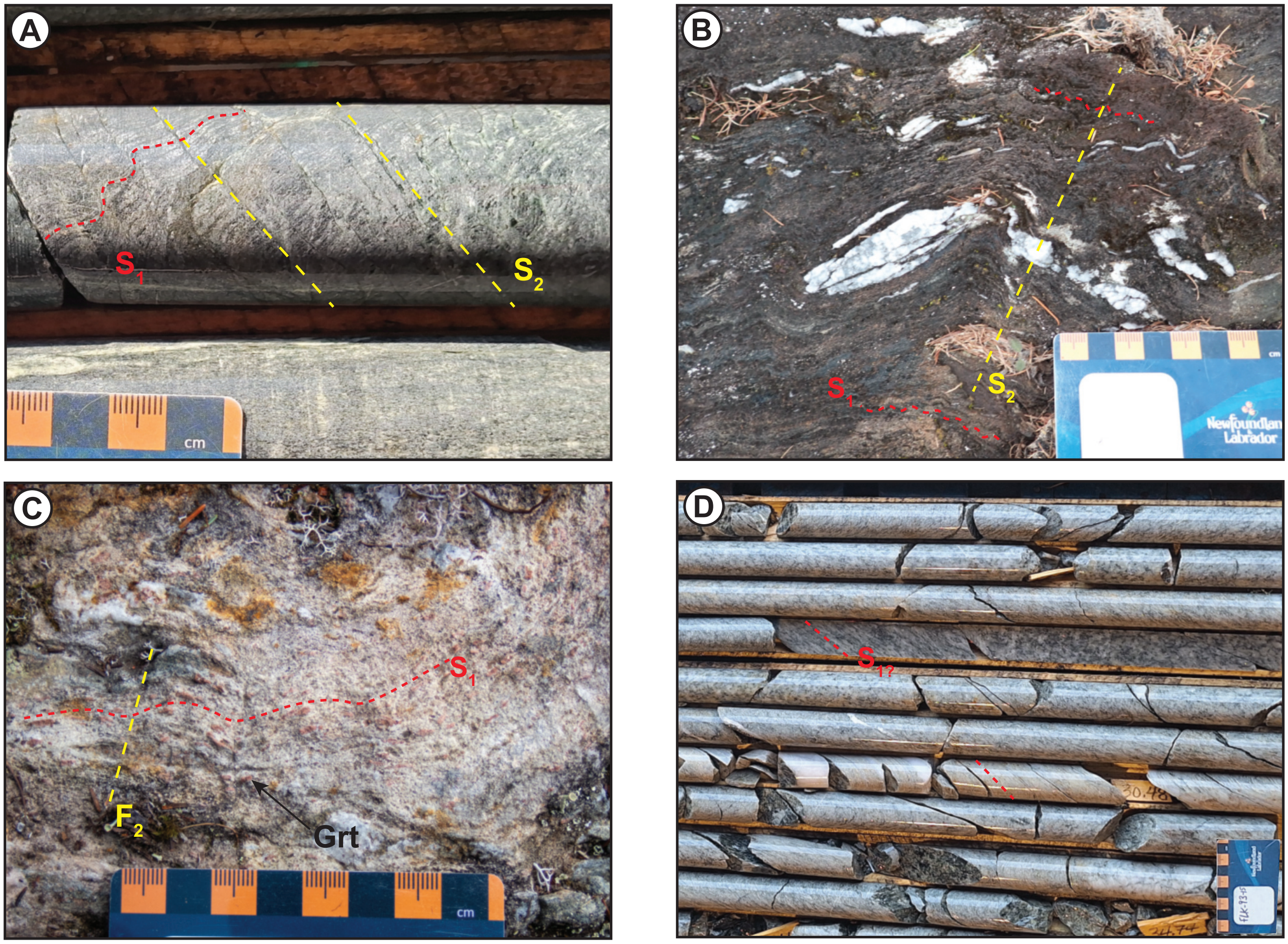

Plate 2. *Field and drillcore photographs of the structural fabrics observed. A) Drillcore photograph from DCP, showing the penetrative S_1 fabric defined by talc in an ultramafic unit. Note: the S_1 fabric is crenulated by a spaced S_2 crenulation cleavage (DDH FLK-93-25); B) Outcrop of strongly foliated ultramafic rock at Boomerang NE#2. Note: the early S_1 foliation, is parallel to bedding and the later S_2 cleavage crenulates S_1 and folds quartz–carbonate veins; C) Outcrop of siliceous sedimentary unit south of the main Baikie prospect outcrop showing S_1 defined by flattened garnet porphyroblasts (Grt), which is openly folded into F_2 folds with an axial plane of 65° towards 340°; D) Drillcore from the DCP prospect showing a coarse-grained granitoid inhomogeneously foliated (DDH FLK-93-15, ~30 m). Note: only one fabric has been observed within the granitoid rocks and the presence of foliated xenoliths within the granitoid rocks might suggest that this fabric is related to the regional S_2 fabric instead of the S_1 fabric.*

MINERALIZATION

Baikie

The Baikie prospect, located near the eastern margin of the Baikie sub-belt (Figure 2), is characterized by abundant crosscutting granitoid intrusions of the KIS. It consists of an ~11-m thick interval of disseminated (2–5%) pyrite, pyrrhotite, pentlandite and chalcopyrite as well as two intervals (0.5- and 0.9-m thick) of massive (>95%) sulphide minerals (McLean *et al.*, 1992). The dominant host rocks for mineralization are intensely talc–carbonate, as well as actinolite "altered", ultramafic rocks. These range from ~10–30-m thick on average and have a maximum thickness of 50 m.

The mineralized zone was initially interpreted to be limited in strike length, occurring only within a small xenolith of ultramafic rock that was enveloped by a trondjhemitic phase of the KIS (Brace, 1990). Subsequent drilling by Falconbridge (McLean *et al.*, 1992; McLean and Butler, 1993) and Tapestry Ventures Ltd. (Cullen and Churchill, 1997) demonstrated that while crosscut by abundant granitoid dykes/sills, the mineralized ultramafic rock continues along strike and down-dip. Mineralized ultramafic rock can

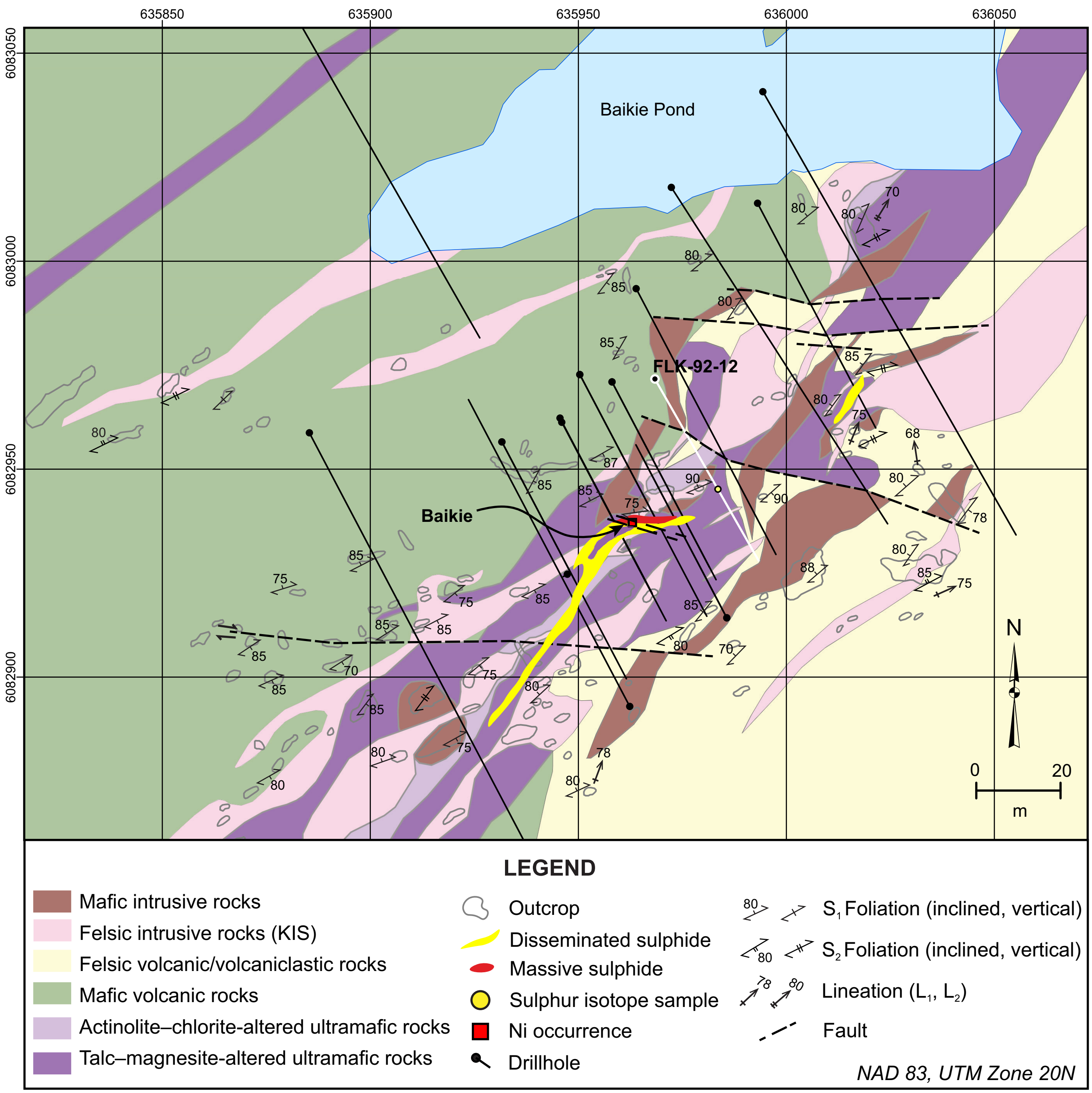

Figure 4. *Preliminary detailed geological map from the Baikie prospect at 1:1000 scale. Geology projected to surface from drillhole data augmented with historic surface mapping (Mclean* et al.*, 1992) and new observations from the 2024 field season. Surface plan of massive and disseminated sulphide mineral distribution from Cullen and Churchill (1997). Drillcore from diamond-drill hole FLK-92-12 (highlighted in white) was relogged (Figure 5) and sampled.*

be traced along strike intermittently for ~110 m and to a vertical depth of at least 150 m and remains open down-dip (Cullen and Churchill, 1997). On surface, the mineralized trend comprises northeasterly striking lensoidal zones that are aligned parallel to S_0 and S_1 (Figure 4) and plunge steeply to the northeast (Cullen and Churchill, 1997). McLean *et al.* (1992) interpreted the mineralized zone to plunge 75° towards 035°, subparallel to the mineral lineation (L_1). The nature of the ultramafic host rock remains uncertain; preliminary mapping and compilation of historic drillhole data suggests that the ultramafic unit might be intrusive and slightly discordant to bedding defined by the contact between the mafic volcanic and felsic volcanic to volcaniclastic rocks (Figure 4).

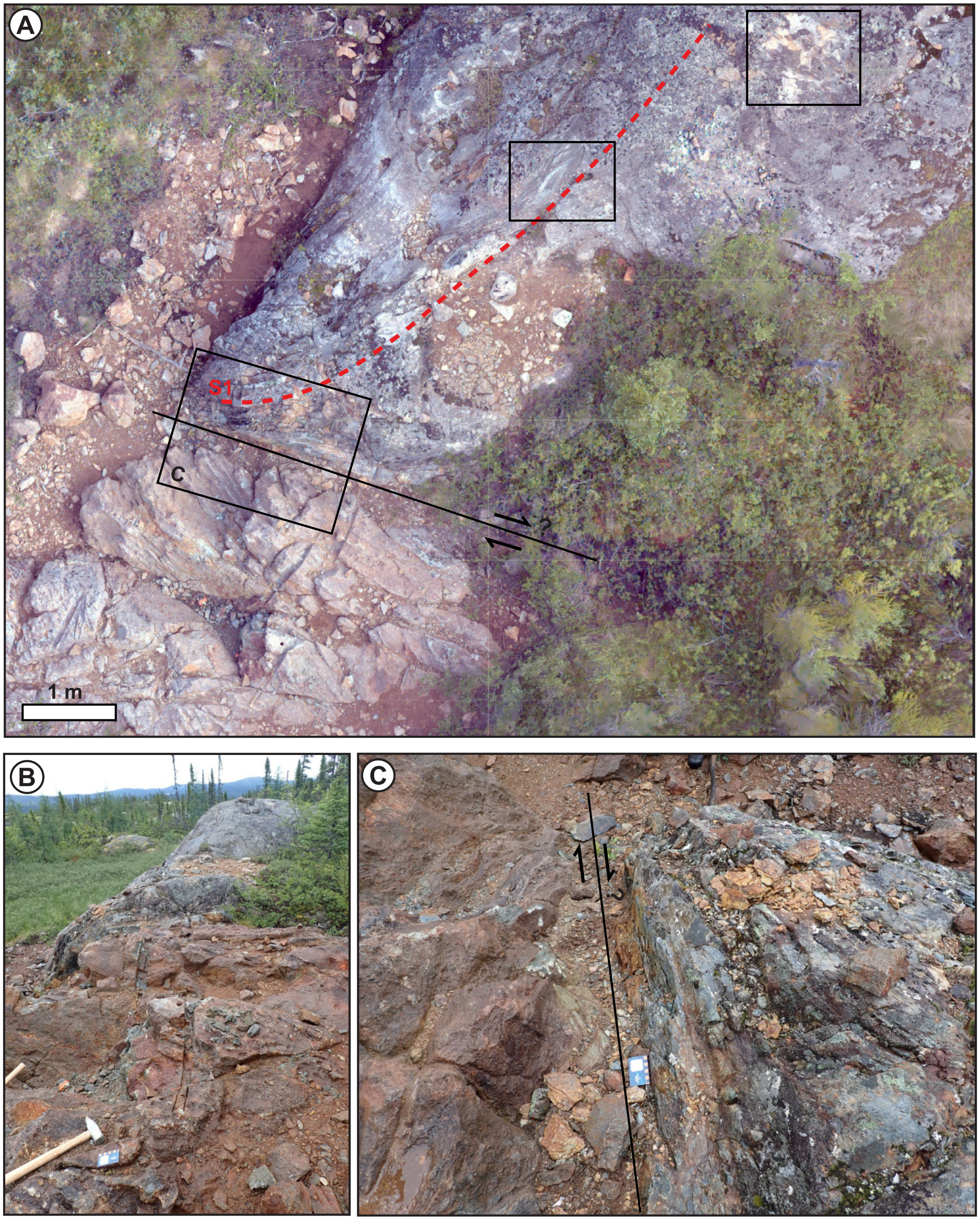

Plate 3. *Field photographs of the Baikie prospect. A) Drone image taken above the main Baikie prospect. Brown-weathered highly broken outcrop on lower (southern) part of photograph is the mineralized talc–magnesite altered ultramafic unit. The black rectangle in the upper right part of the photograph shows an intrusive breccia zone with the Kanairiktok tonalite (white) intruding into more massive basalt/gabbro (black/grey). Foliation is defined by chlorite and flattened mafic fragments within intrusive breccia (black rectangle in the middle of the photograph). Note: clockwise rotation of foliation into late fault indicating apparent dextral movement; B) Field photograph of a gossanous zone within mineralized talc–magnesite altered ultramafic; view is looking to the northeast; C) Field photograph of the late shear zone; view is looking to the west-northwest.*

In addition to the Ni–Cu–PGE mineralization, minor sphalerite was observed as fracture-controlled mineralization within pillow selvages approximately 500 m west of the Baikie prospect (McLean *et al.*, 1992). An arsenopyrite showing is also reported approximately 165 m northeast of the main Baikie prospect, consisting of a 50-cm-thick carbonate-rich quartz sericite schist unit with 5–25% euhedral, prismatic arsenopyrite crystals 4–5 mm in length (Sutton, 1971; Brace, 1990).

DCP

The DCP prospect is located 700 m northeast along strike of the Baikie prospect (Figure 2). The ultramafic unit ranges from ~10–30-m thick and the surface exposure is discontinuous over a ~40 m strike-length. The host rocks consist of talc–carbonate altered and serpentinized ultramafic rocks within a northeast-trending steep-sided valley (McLean *et al.*, 1992). The serpentinized ultramafic rocks are more resistive to weathering and form the valley walls, whereas the mineralized talc–carbonate altered rocks are recessively weathered and form the valley floor (McLean *et al.*, 1992). The best assay reported was 0.9% Ni over a 0.5-m-long channel sample, and the mineralized zone averaged 0.7% Ni over a cumulative 2.23 m thickness of channel samples (McLean *et al.*, 1992). Follow up drilling intercepted 3 m of 1% disseminated pyrite and pyrrhotite with anomalous Ni values (0.3%) at shallow depths (~50-m vertical depth) in talc–magnesite altered ultramafic rock but attempts to extend the zone at depth were unsuccessful (McLean and Butler, 1993).

Boomerang Trend

The Boomerang trend in the southeastern part of the Baikie sub-belt consists of mineralized ultramafic and mafic volcanic rocks that occur over a strike length of ~1100 m. Three historic occurrences are reported that make up the Boomerang trend: namely, the Boomerang, Boomerang NE#1 and Boomerang NE#2 prospects (Figure 2).

The Boomerang prospect is located 4.5 km southwest of Baikie and consists of a gossanous zone surrounding a <1-m thick ultramafic unit in contact with a massive, weakly foliated, mafic unit to the northwest and a thin-bedded, siliceous, sedimentary unit to the southeast. The ultramafic unit is strongly sheared, and z-folding of its internal foliation suggests a dextral sense of shear (Plate 4). This is equivocal because of the irregular folding patterns caused by overprinting deformation events and lack of additional shear-sense indicators. A massive, medium-grained, equigranular, granitoid sill, with irregular margins, occurs along the contact zone between the mafic and ultramafic unit. The gossanous zone contains 2–3% fine-grained disseminated sulphide minerals (Py, Po) and historic assays from this zone returned 2.11% Ni over a 0.3 m long channel sample (Mclean and Butler, 1993). In drillcore, the Boomerang prospect consists of stringer and disseminated pyrrhotite and pentlandite hosted within mafic volcanic rocks in contact with ultramafic rocks (Figure 5). The ultramafic host rocks contain 0.1–0.2% Ni and no visible sulphide mineralization.

The Boomerang NE#1 prospect is located 1 km northeast of the Boomerang prospect (Figure 2). It was intercepted in a drillhole targeting a conductive anomaly (HLEM) along strike from the Boomerang prospect; however, there was no surface exposure of mineralized ultramafic rock reported (McLean and Butler, 1993). The drillhole intercept was 1.23% Ni over 0.42 m, in a zone with 10–15% sulphide veins in mafic volcanic rocks in contact with ultramafic rocks (Figure 5). Like the Boomerang prospect, the ultramafic rocks at Boomerang NE#1 contain 0.1–0.2% Ni (McLean and Butler, 1993). The projected mineralized unit occurs below a northeast-trending boggy wetland. A small north-northeast trending ridge south of the mineralized zone contains a thin (≤1 m) sliver of strongly foliated and carbonatized ultramafic rock in contact with a mafic unit and crosscut by a massive equigranular granitoid sill, and a much younger diabase dyke. However, no sulphide mineralization was observed in the exposed ultramafic unit.

The Boomerang NE#2 prospect is located 1.5 km northeast of Boomerang NE#1 and 2 km southwest from Baikie (Figure 4). It was discovered in 1992 from a grab sample of a rusty siliceous sedimentary unit, which contained 3900 ppm Ni, 754 ppm Cu and 106 ppm Co (McLean *et al.*, 1992). It marks the flexure zone where the northeast-striking Baikie–DCP trend changes to the north-northeast-striking Boomerang trend. This prospect consists of a ~0.4-m thick, thinly laminated, pyrite-bearing argillite unit in contact with a strongly foliated mafic volcanic unit to the northwest and southeast. The mafic unit locally contains 5% disseminated medium-grained (1–3 mm) euhedral magnetite (Plate 4), which correlates spatially with the magnetic anomaly seen in the regional aeromagnetic survey data. A strongly foliated, carbonate altered ultramafic unit is also exposed as a thin <1 m wide ridge immediately northwest of the gossanous outcrop; the ultramafic unit does not contain visible sulphide mineralization and assayed 0.2% Ni (McLean *et al.*, 1992; McLean and Butler, 1993). Additionally, trace disseminated sphalerite and chalcopyrite, and folded sphalerite veins occur in the mafic volcanic rocks (Plate 5, Figure 5), as well as within the thin interbedded argillite units. Chaotic folding is observed in the argillite unit (Plate 5B), which might reflect primary soft-sediment deformation features. Two brittle faults crosscut the gossanous zone, one that strikes northeast and dips steeply to the southeast, and one

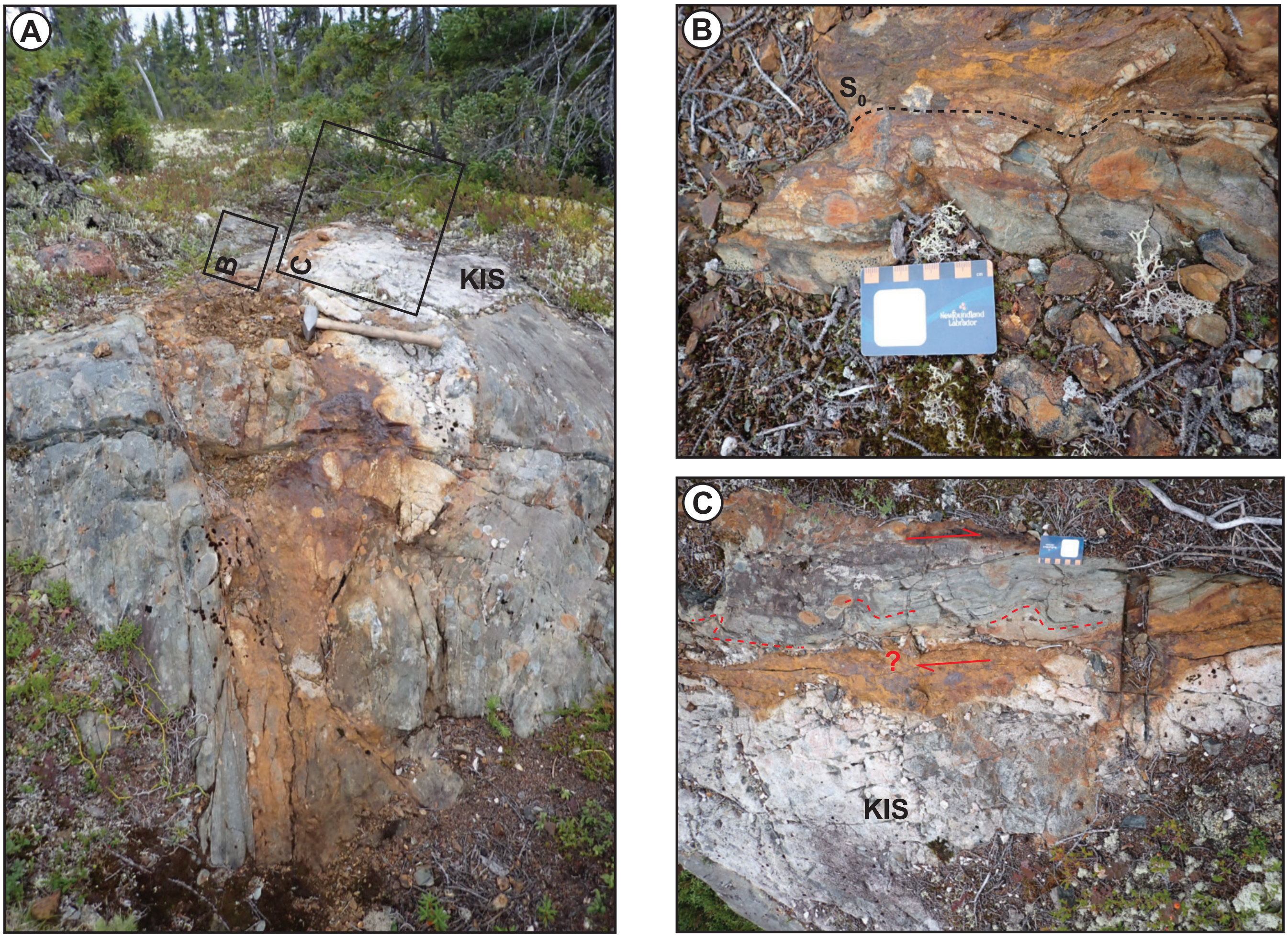

Plate 4. *Field photographs of the Boomerang prospect. A) Gossanous zone with an historic channel sample at the Boomerang prospect, view is looking south; inset box shows the location for Plate 4B, C; B) Thinly bedded, cherty unit, view is looking northwest; C) Sheared ultramafic unit, showing z-folding of S_1 foliation (red), suggesting dextral shear. Note sharp contact between mafic and ultramafic volcanic units, with the gossanous zone occurring at the contact zone but principally within the mafic unit. A younger tonalite sill of the Kanairiktok Intrusive Suite (KIS) occurs along the contact zone. View is looking southeast.*

that strikes west-southwest and dips steeply to the north-northwest. These faults appear late as they truncate the S_1 foliation and F_1 folds (Plate 5B) and might be of similar timing to the late faults observed at the Baikie prospect.

SUMMARY DISCUSSION AND ONGOING WORK

Significant metamorphism and deformation have evidently obscured primary contact relationships and at least three deformation events have been reported within the Baikie sub-belt. Younging indicators are sparse, and geochemical and geochronological data are limited (James *et al.*, 1996). A major focus of Diekrup *et al.* (2023, 2024) is to provide an updated stratigraphic–structural framework for the FLG and this project complements and works in tandem with that goal to better understand the stratigraphic and structural controls on mineralization.

Preliminary observations from the Boomerang and Baikie prospects suggest structural modification to their primary geometry. Cullen and Churchill (1997) interpreted the geometry of the Baikie prospect to define a transposed isoclinal fold, with the highest sulphide concentrations occurring within the fold hinge (Figure 4). The isoclinal fold interpretation of Cullen and Churchill (1997) would be consistent with the description of McLean and Butler (1993), wherein the Baikie prospect is interpreted to occur on the northwestern limb of a steeply plunging to subvertical fold, which on a regional scale forms a doubly plunging antiform with a northeast striking axial trace. However, there does not appear to be any documented field evidence to support the isoclinal

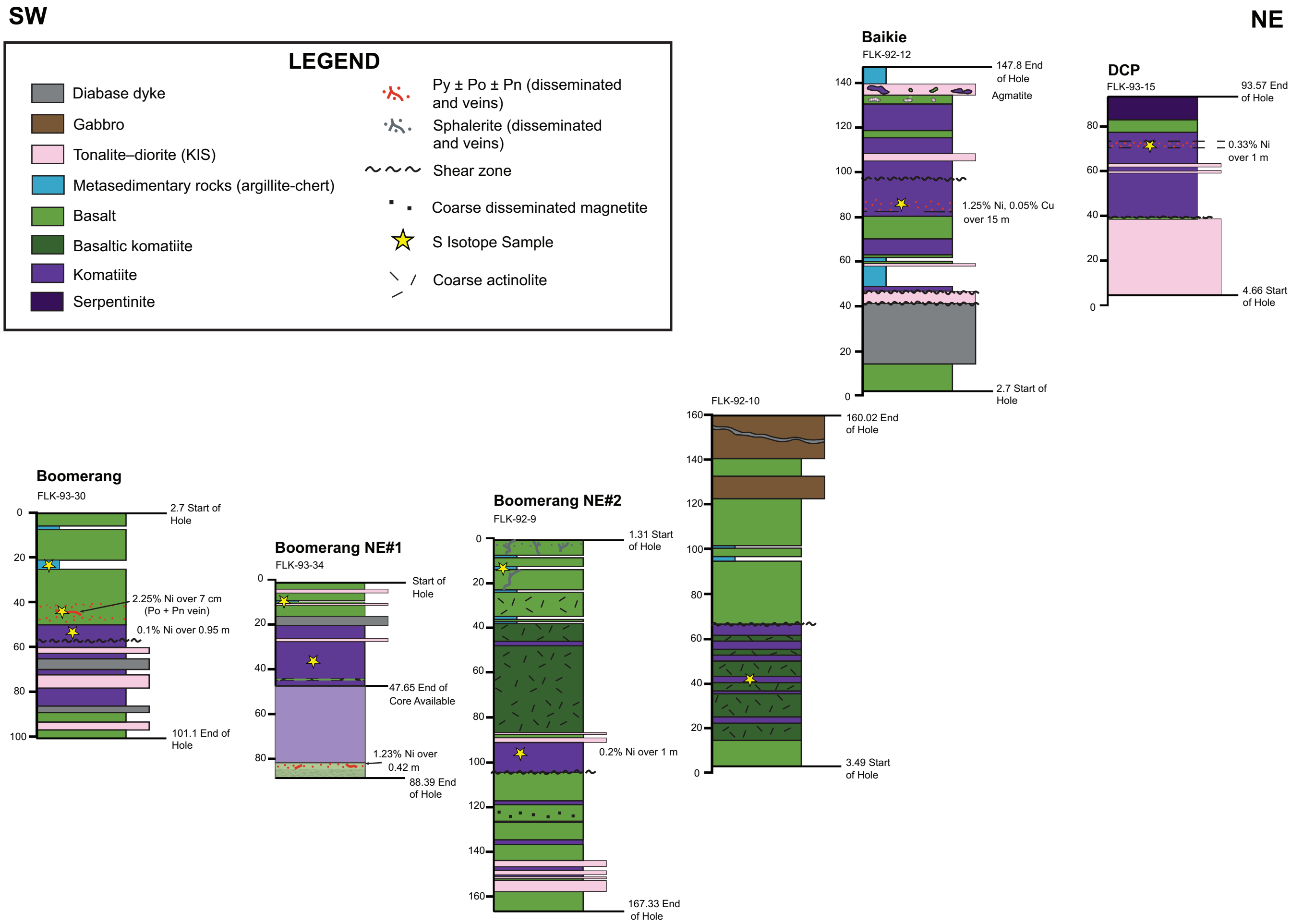

Figure 5. *Graphic logs for drillholes through the mineralized zones of the Baikie sub-belt, Florence Lake greenstone belt. Graphic logs are oriented right way-up, assuming a southeast younging direction. As a result, the depth axis is flipped on some of the logs, because of the different drillhole azimuths. Logs are staggered to reflect their approximate interpreted stratigraphic position; it is uncertain if the Baikie–DCP trend occurs in the same unit as the Boomerang trend or stratigraphically above it. Note, the core is missing for the lower part of DDH FLK-93-34 and the mineralized intercept and lithology for that section is taken from the historic log (McLean and Butler, 1993).*

fold interpretation, such as younging reversals, obvious stratigraphic repetitions and/or changes in the relative bedding-foliation orientations. The few stratigraphic indicators documented in the belt (*e.g.*, Diekrup *et al.*, 2023) suggest the dominant younging direction is towards the southeast, and the succession appears to change gradually from a mafic-volcanic-dominant succession northwest of the Baikie prospect, to a felsic-volcanic/volcaniclastic-dominant succession southeast of the Baikie prospect. As such, further information is required to determine if the stratigraphic succession is in fact isoclinally folded or represents a homoclinal sequence. As felsic volcanic/volcaniclastic rocks are limited in volume in the Baikie sub-belt, these units might serve as stratigraphic markers to aid in unravelling the deformation history and better constraining the stratigraphy. The deformation history is also of interest from the perspective of the controls on gold mineralization in the area. There are several gold occurrences throughout the belt, which are often spatially associated with the ultramafic units; however, little is known about their genesis. Follow-up work will include further mapping, sampling, and geochronology.

The sphalerite and chalcopyrite mineralization at Boomerang NE#2 and near the main Baikie prospect might reflect the presence of an older VMS-related hydrothermal system. Older deposits of VMS-related sulphide minerals could have provided a crustal sulphur source for the ultramafic magmas to scavenge leading to sulphur saturation and Ni–Cu–PGE mineralization. Such a model was proposed for the komatiite-associated deposits in the Agnew-Wiluna greenstone belt of Western Australia (Fiorentini *et al.*, 2012). Determining the relationship between the Ni–Cu–

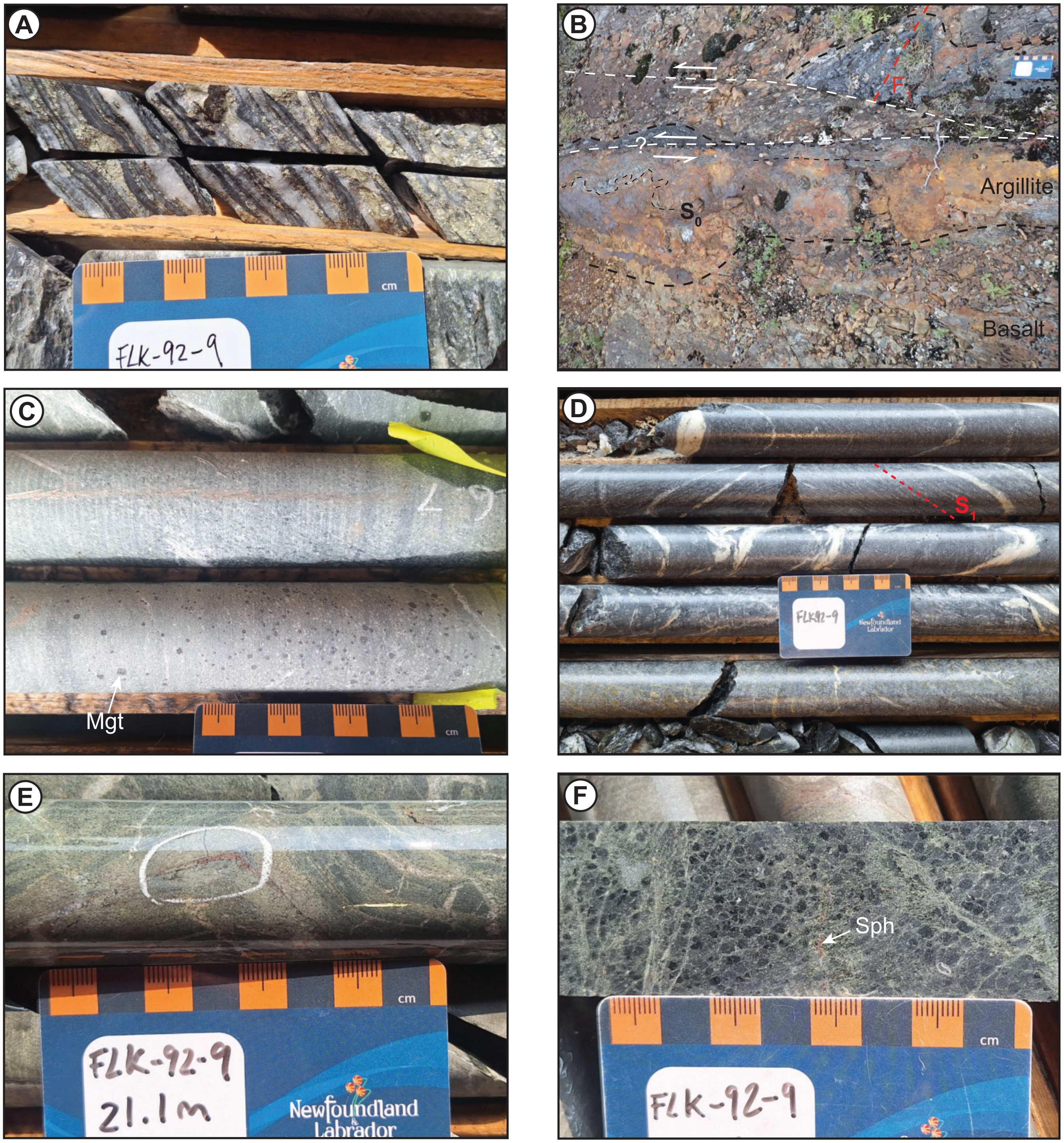

Plate 5. *Field and drillcore photographs from the Boomerang NE#2 prospect. A) Pyrite-rich layers within thinly laminated graphitic argillite; B) Outcrop of gossanous zone. Note irregular fold pattern within argillite and two late brittle faults that truncate these folds and offset the argillite unit; C) Medium-grained disseminated magnetite (Mgt) within basalt (DDH FLK-92-9, 125 m); D) Talc–magnesite altered ultramafic unit in drillcore (DDH FLK-92-9, ~100 m), note abundant quartz–carbonate veins; E) Folded sphalerite (sph) and veinlet in basalt, note bleached alteration selvedge surrounding sphalerite vein (DDH FLK-92-9, 21 m); F) Stringer sphalerite and carbonate veinlets with thin bleached alteration selvedges within basalt. Note: abundant amphibole porphyroblasts (DDH FLK-92-9, 3.8 m).*

PGE occurrences and Cu–Zn occurrences will be a focus of ongoing studies. Follow-up work will include detailed petrography and *in situ* sulphur isotope studies (Δ33S and δ34S) at the University of Alberta's Canadian Centre for Isotopic Microanalysis.

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