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STRUCTURAL CONTROL ON THE EMPLACEMENT OF THE FLORENCE LAKE GROUP AND ADJACENT SUPRACRUSTAL OUTLIERS IN THE SOUTHEASTERN HOPEDALE BLOCK, LABRADOR

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ABSTRACT

This report summarizes the results of the second year of investigation of the ca. *3105–2976 Ma supracrustal rocks in the Hopedale Block, with emphasis on the Florence Lake Group, and outliers of supracrustal belts that are proximal to the group. The Florence Lake Group preserves two fabrics, S_1 and S_2, produced by major crustal shortening in a northwest–southeast direction, and northeast–southwest transpression, major deformational events, generating the dominant fabric in the belt. No conformable contacts between the host gneisses and supracrustal rocks of either the Florence Lake Group or adjacent outliers have been observed. Field evidence indicates structural emplacement of the supracrustal rocks along shear zones. The foliated Kanairiktok Intrusive Suite appears to be synchronous with D_2 and intruded along D_2 shear zones by exploiting the permeability. Similar to the Florence Lake Group, preserved contacts of the supracrustal outliers in the southeastern Hopedale Block are structural, with implications for the tectonic configuration of the Hopedale Block during and after the deposition of the Florence Lake Group. Sedimentary and mafic volcanic rocks are the dominant lithologies in most greenstone belt outliers investigated. The margins of larger outliers are invariably strongly sheared, to the point where they resemble smaller amphibolite rafts hosted in Maggo Gneiss. The similarities of contact relationships on the margins of both Florence Lake Group rocks and smaller outliers indicate a similar emplacement mechanism that is most likely a purely structural contact. This has significant implications for mineral exploration since major shear zones and splays off of such zones in the brittle regime are commonly host to mineral deposits.*

INTRODUCTION

In Labrador, the Hopedale and Saglek blocks form the Nain Province, part of the North Atlantic Craton (NAC; Bridgewater *et al.*, 1973). The Hopedale Block contains two supracrustal (greenstone) belts, the *ca.* 3105 Ma, amphibolite facies, Hunt River Group (HRG), and the *ca.* 3003 to 2979 Ma, greenschist to amphibolite facies, Florence Lake Group (FLG: Wasteneys *et al.*, 1996; James *et al.*, 2002). In addition, there are numerous narrow lenses and rafts of dismembered volcanic, sedimentary and ultramafic rocks that were variably grouped as the Weekes Amphibolite or, if proximal to the Hunt River or Florence Lake groups, were incorporated with the adjacent group (Ermanovics, 1993). Recently, the definition of Weekes Amphibolite has been questioned (*see* Sandeman *et al.*, 2023; Hinchey *et al., this volume*) based on geochronology, lithogeochemistry and isotopic data that illustrates that the Weekes Amphibolite comprises belts of variable ages and origins. Thus, it has been suggested that the term Weekes Amphibolite be redefined or abandoned (Hinchey *et al.*, *this volume*). Because of the uncertainty in the definition of the Weekes Amphibolite, the rafts studied are referred to collectively as supracrustal belt outliers.

In 2023, bedrock mapping focused on understanding the lithology, stratigraphy and mineral potential of the FLG and on the contact relationships of the FLG with the host rock units including the 3262–3245 Ma Maggo Gneiss (Hinchey *et al.*, *this volume*). Deciphering the type of contacts is critical to understanding the magmatic, tectonic and metallogenic evolution of the Hopedale Block. Two end-member models of emplacement of the FLG were evaluated: 1) conformable deposition of supracrustal rocks on exposed (and rifted) gneissic basement, and 2) tectonic emplacement (*i.e.*, structural interleaving) of supracrustal rocks with gneissic basement rocks. Detailed mapping across exposed contact zones of the FLG was undertaken to test the above-referenced models of emplacement.

In addition to mapping and interpreting the FLG, a second focus was on understanding the type and relationship of the supracrustal outliers that occur in proximity to the FLG within the Maggo Gneiss they are hosted in (Figure 1). Many of the outliers are of uncertain age and origin and therefore may span the age range of the Hunt River and Florence Lake groups (3105–2979 Ma), and/or, in part originate from older, poorly constrained depositional events at >3262 and/or >3124 Ma (Hinchey *et al.*, *this volume*). Detailed mapping focused on the contacts of the outliers with the enveloping basement gneisses.

This research is a joint project between the Geological Survey of Canada (Geoscience for Minerals and Energy – GeoNorth), the Geological Survey of Newfoundland and Labrador, and the Nunatsiavut Government that aims to better understand the overall tectonic framework and mineral potential of the Hopedale Block. The report summarizes the findings of the second of three, planned field seasons determining the evolution of the FLG, and other outliers of supracrustal rocks in the Hopedale Block. This year's objectives were to complete a revised map of the FLG, and to improve its geoscientific understanding in support of exploration in northeastern Labrador.

REGIONAL GEOLOGY

The Hopedale Block is a *ca.* 3262–2545 Ma granite-greenstone terrane in the southern Archean Nain Province (Taylor, 1971; Ermanovics, 1993; Schiøtte *et al.*, 1993; Rayner, 2022; Hinchey *et al.*, *this volume*). It is separated to the southeast from the Makkovik Province by a Paleoproterozoic shear zone, to the east by the Paleoproterozoic Southeastern Churchill Province and to the North by the Archean Saglek Block (Connelly and Ryan, 1996; Wardle *et al.*, 2002; Ketchum *et al.*, 2002; Hinchey *et al.*, 2020; Godet *et al.*, 2021). The oldest dated rocks in the Hopedale Block are the *ca.* 3262–3245 Ma Maggo Gneiss. The block comprises two supracrustal successions, the *ca.* 3105 Ma HRG, and the *ca.* 3002–2979 Ma FLG (James *et al.*, 2002; Rayner, 2022). Many smaller, amphibolite-grade outliers of supracrustal rocks occur along the margins of the volcanic belts and are dispersed throughout the Hopedale Block (*see* Figure 1). Proximal to the FLG, small supracrustal outliers, including amphibolite-grade rafts of volcanic and volcaniclastic rocks, and potential dykes (*cf.* James *et al.*, 1996; Sandemann *et al.*, 2023) are hosted in Maggo Gneiss or in

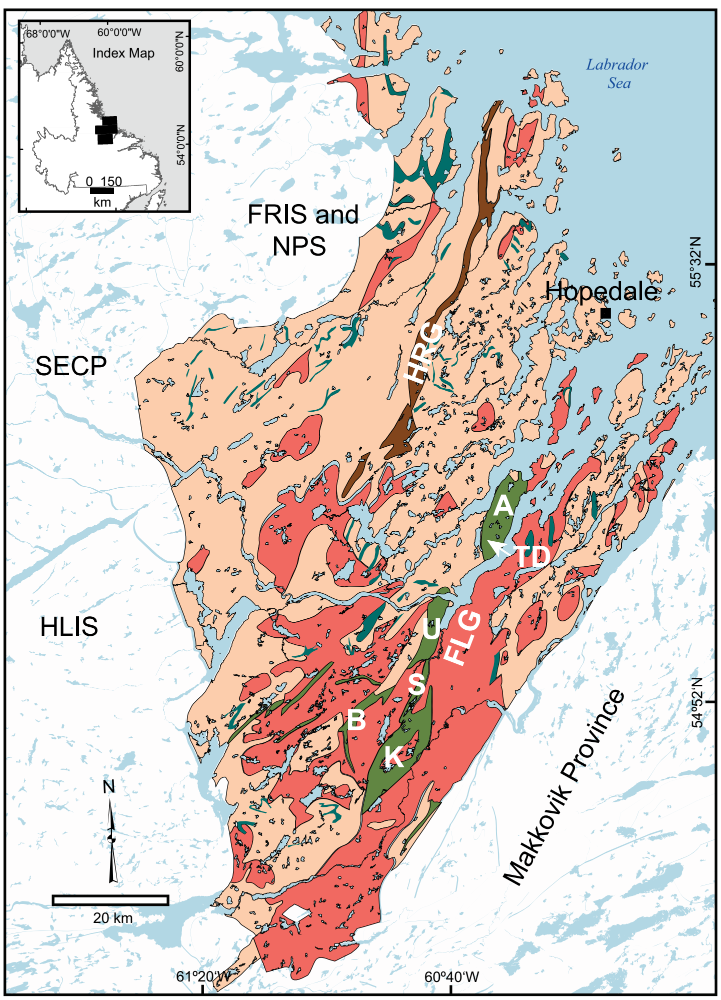

Figure 1. *Geological overview of the Hopedale Block. Supracrustal outliers are distributed throughout the Hopedale Block and comprise segments of FLG and HRG rocks, but some are of another provenance. FLG=Florence Lake Group, S=Schist Lake, A=Adlatok, U=Ugjoktok, B=Baikie, K=Knee Lake, TD=Thurber Dog Au-showing, HRG=Hunt River Group, FRIS=Flowers River Igneous Suite, NPS=Nain Plutonic Suite, HLIS=Harp Lake Intrusive Suite, SECP=Southeast Churchill Province. Geology after Wardle* et al. *(1997) and Ermanovics (1993).*

rocks of the Kanairiktok Intrusive Suite (KIS; Figure 1; Loveridge *et al.*, 1987; Ermanovics, 1993). Where the supracrustal rocks are hosted by Maggo Gneiss, their contact relationships are uncertain, and represent either primary depositional contacts with the gneisses acting as basement to the volcanic successions, or are structural in origin (Ermanovics *et al.*, 1982; Korstgård and Ermanovics, 1985; Brace and Wilton, 1989; James *et al.*, 2002). Ermanovics (1993) described all observed contacts as sheared. Alternatively, the erosion of Maggo Gneiss (or its precursor) could be the source of the clastic material in the FLG. Younger Archean magmatic events in the Hopedale Block include the 2982–2796 Ma KIS producing tonalite, granodiorite and monzogranite, an unnamed 2732–2700 Ma event consisting of granitic veins, and the 2567–2545 Ma Aucoin Plutonic suite (Wasteneys *et al.*, 1996; James *et al.*, 1996; Sandeman and McNicoll, 2015; Rayner, 2022; Hinchey *et al.*, *this volume*).

Two major structural trends produced by tectonometamorphic events have been reported for the Hopedale Block, an older "Hopedalian" event producing northwest-striking fabric, and a younger "Fiordian" event prevalent in the southeastern Hopedale Block producing a northeast-striking fabric in the FLG (Ermanovics, 1993). More recent investigations based on zircon and titanite geochronology identified a more complex metamorphic history and did not corroborate a >3100 Ma Hopedalian event. The oldest documented metamorphic event recorded by overgrowths on zircon is a cryptic event between *ca.* 2961–2953 Ma, shortly after the deposition of the FLG (Hinchey *et al.*, *this volume*). Two major metamorphic episodes occurred from *ca.* 2846–2796 Ma and *ca.* 2732–2700 Ma, the latter possibly representing the collision of the Hopedale–Saglek blocks. A final metamorphic event from *ca.* 2578–2542 Ma has only yet been documented in the western part of the Hopedale Block and its tectonic significance is unknown (Hinchey *et al.*, *this volume*).

FLORENCE LAKE GROUP

Supracrustal rocks of the FLG comprise mostly volcanic and volcaniclastic rocks deposited between 3002 ± 2 to 2979 ± 1 Ma, and now preserved as a ~60-km long and 0.5–5-km wide northeast–southwest trending greenstone belt in the south Hopedale Block. Rocks were metamorphosed at upper greenschist to amphibolite-facies, with local contact metamorphic aureoles in proximity to KIS (meta-prefix for all rock types omitted for brevity). Some of the peak, contact metamorphic mineral assemblages have undergone retrograde regional metamorphism.

Ermanovics' (1993) subdivision of the FLG into stratigraphic formations was later rejected by James *et al.* (1996) based on a lack of type sections and correlative rock types, in favour of a metamorphic-lithologic subdivision distinguishing 13 intrusive, volcanic and sedimentary rock types as part of the FLG. Part of this ongoing project is an effort to establish a protolith-based lithostratigraphic classification, informed by new lithogeochemistry and geochronology, as well as field observations such as younging indicators. In this report, the stratigraphy by James *et al.* (1996) is adopted to maintain coherence while the origin of their units like "metamorphic schist" and several generic sedimentary units are under investigation.

Structures in the FLG identified by James *et al.* (1996), include a prominent foliation (S_1), likely produced during two stages of deformation (D_1 and D_2). The first, D_1, isoclinal folding of the original layering (S_0) and a later deformation producing open to tight northeast- to north–northeast-trending folds. The D_2 folding event is not associated with a pervasive foliation but with a bending of S_1 foliation. Both deformation events likely occurred during peak metamorphism (James *et al.*, 1996), the latter dominated by sinistral shearing and producing the "Fiordian" north–northeast-striking structural trend observed in the FLG (Ermanovics, 1993). Shearing of some KIS rocks along the margins of the FLG suggested a syn-kinematic timing of emplacement (James *et al.*, 1996). Up to four stages of deformation with associated foliation (S_3–S_4) have been recorded locally in the Baikie sub-belt, likely caused by later dextral and sinistral shearing and differential strain uptake (McLean and Butler, 1993).

RESULTS

The 2023 field-mapping season focused on the central and southwestern parts of the FLG, namely the Ugjoktok, Schist Lake and Knee Lake sub-belts (*see* Figure 1). Work by boat examined the continuous exposure along the eastern shore of the Adlatok sub-belt. Several supracrustal outliers were also investigated, including several localities previously documented by Ermanovics (1993), James *et al.* (1996) and Miller (1996). These outliers and their margins were studied to evaluate their origin as part of a larger supracrustal assemblage, or as individual lenses of volcanic- and volcaniclastic rocks.

Structural observations in and around the FLG indicate that bedding orientations (S_0) trend on average 32º with a dip of 83°. The earliest foliation (S_1) is subparallel to bedding, striking 045° and dipping 78° on average (Figure 2; Plate 1). A later foliation (S_2) dips subvertically, and trends mostly north-northeast–south-southwest. Mineral lineations plunge steeply (52–85°) with variable azimuth. Fold axes of cm- to m-scale folds are similarly oriented with steep dips (55–72°) and no preferential azimuth (Plate 2). However,

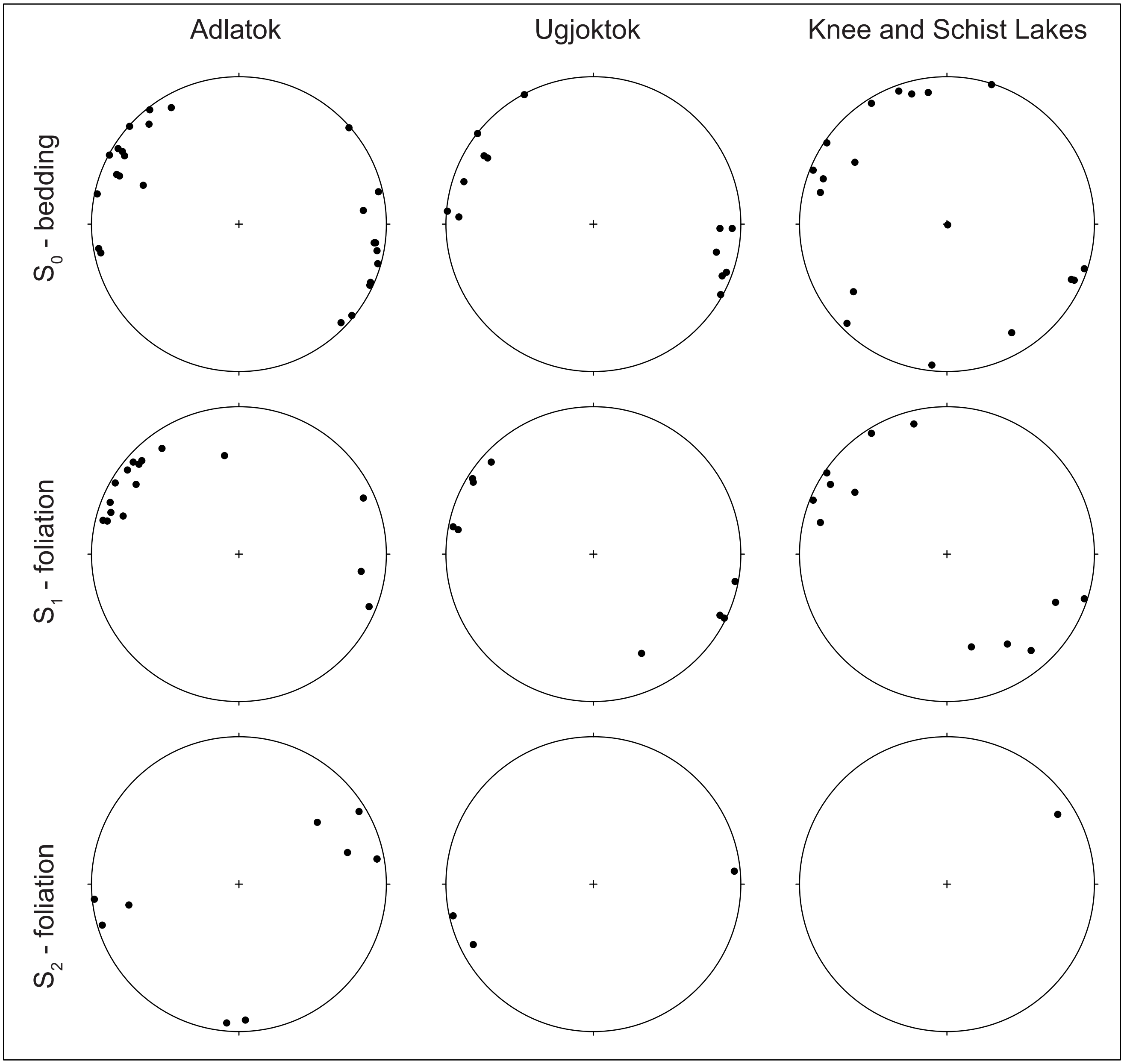

Figure 2. *Summary of structural field measurements plotted as poles. Orientations of bedding (S_0), and two generations of foliation (S_1 and S_2), are variable but consistent from north (Adlatok sub-belt) to south (Knee and Schist lakes sub-belts). Higher variation in the bedding and foliation orientations in the Knee and Schist lakes sub-belts reflects the more structurally segmented character, and more abundant KIS. S_0 and S_1 are subparallel and trend northeast–southwest, whereas younger S_2 is north-northwest–south-southeast-trending and steeply dipping.*

rare, shallow plunges (18°) of north-trending folds have been observed in the Adlatok sub-belt.

Some of the supracrustal outliers exhibit higher metamorphic grade but similar fabrics and geometries as the rocks of the FLG. These include: an exposure on a small unnamed island in Ugjoktok Bay northeast of the FLG, another occurrence approximately 12 km east of the Schist Lake sub-belt, and supracrustal rocks including banded iron formation on the southern shore of Fred's Bay. A small exposure of volcanic and volcaniclastic rocks just north of the town of Hopedale has a different fabric with main orientations trending northwest, but all share similar contact characteristics with gneissic host rocks: structural contacts with strong shearing in variable directions, and shearing of both host gneisses and supracrustal rocks (Plate 3). Larger shear

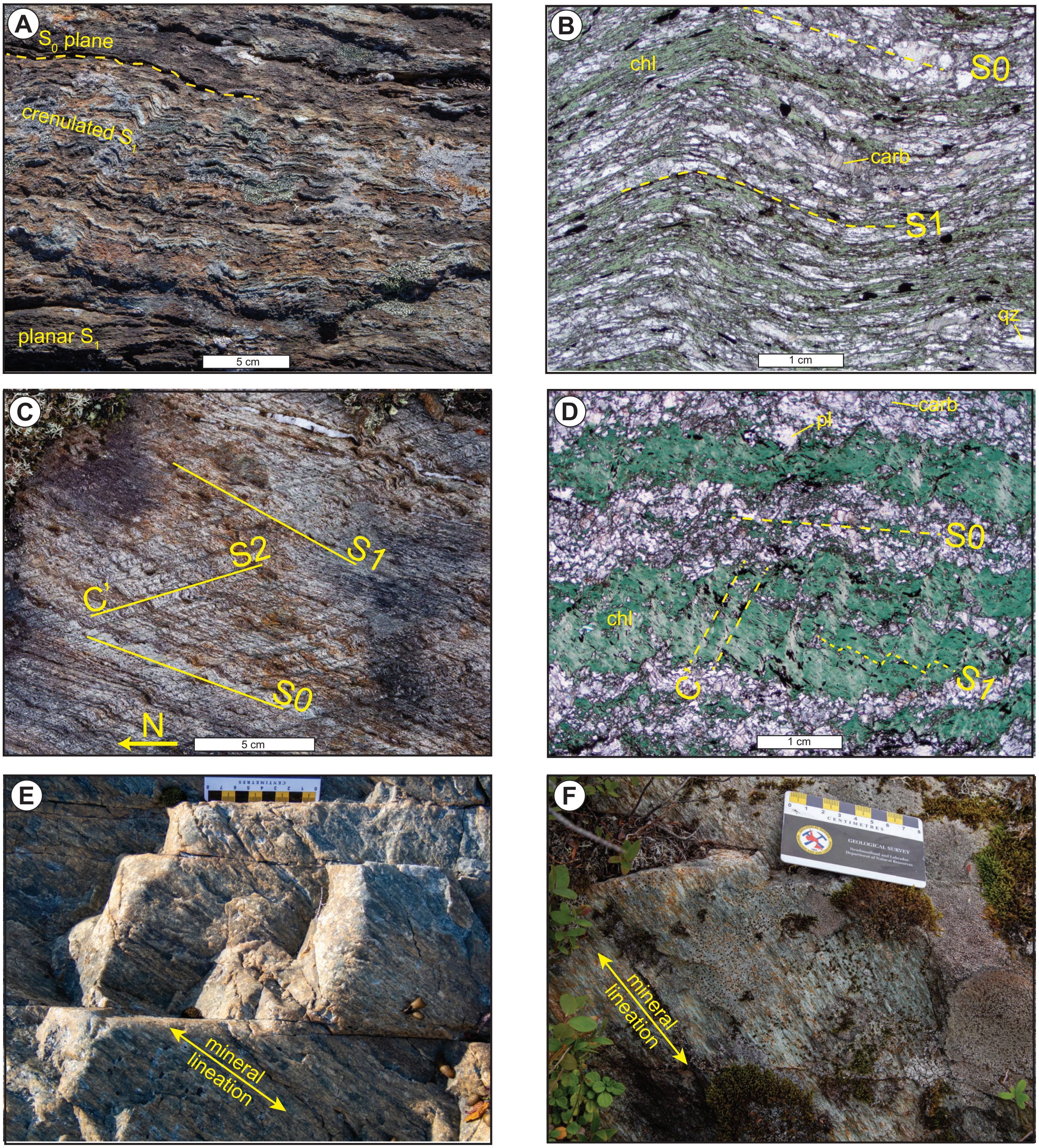

Plate 1. *Representative field photographs and microphotographs of structural fabrics in FLG rocks. A) Bedding (S_0) and earliest foliation (S_1) in volcaniclastic rocks. Crenulation of S_1 marks the onset of D_2; B) Thin section photomicrograph (plain-polarized light: PPL) of (A). Chl=chlorite, carb=carbonate (Fe-dolomite?), qz=quartz; C) S-C fabric developed in volcaniclastic rocks. Shear planes (C') are a local manifestation of S_2 foliation; D) Thin section photomicrograph of (C). Chl=chlorite, carb=carbonate (Fe-dolomite?), pl=plagioclase; E, F) Variably steeply plunging mineral lineation indicates the strong deformation associated with the D_1 event.*

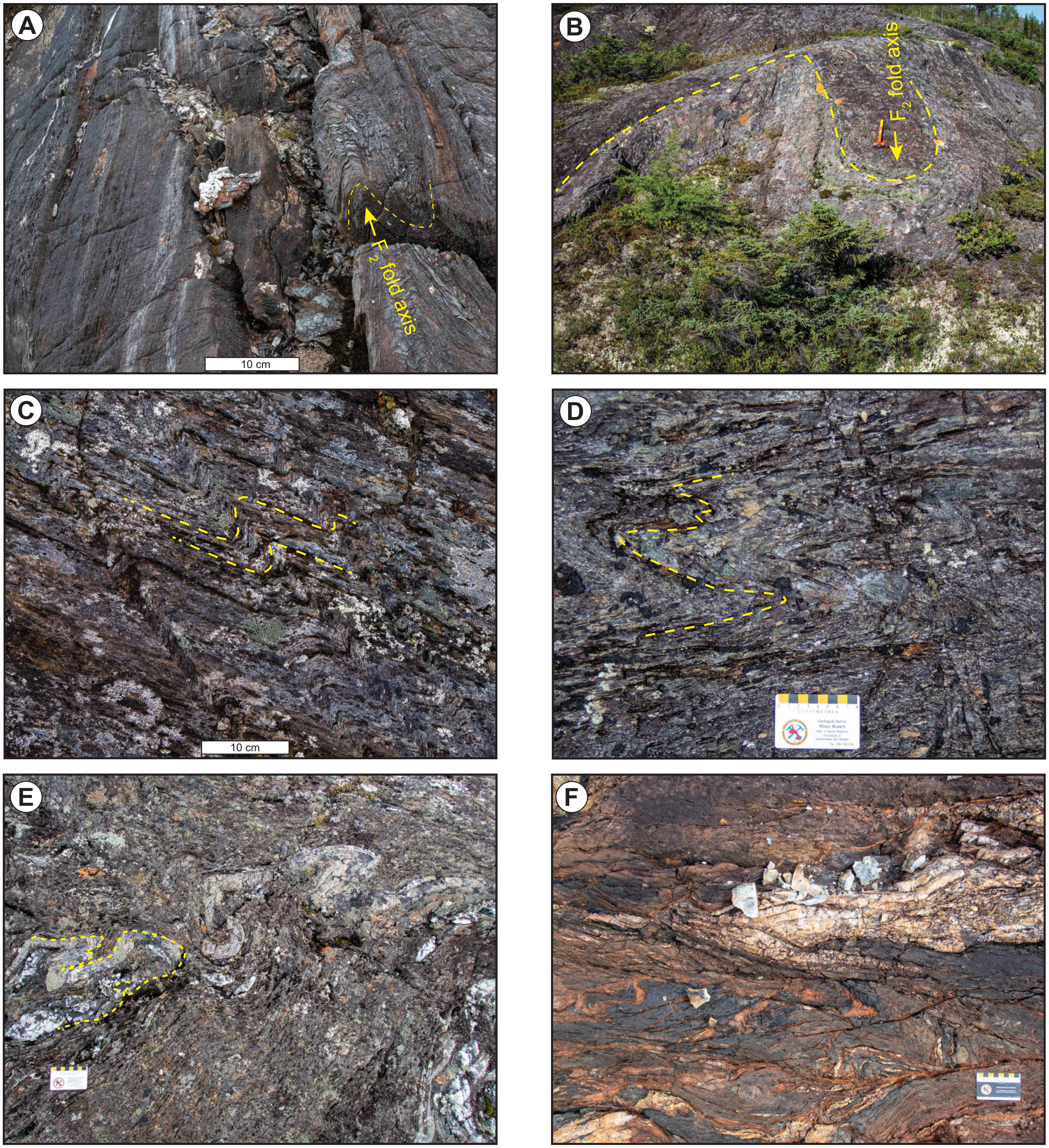

Plate 2. *Representative photographs of folding patterns documented in the field. A) Rare, shallowly dipping F_2 fold axes indicate the variable orientation of movement during D_2; B) Outcrop-scale isoclinal F_2 fold with steeply southwards dipping fold axis, representative of many F_2 fold geometries recorded. Hammer is 60 cm long; C) Sets of S-folds indicating local sinistral shear sense in F_2 folds. Dextral shear sense indicators are equally common across the FLG; D) Complex M-fold geometry in the core of a larger S-fold; E, F) Polydeformed and complexly folded lithologies are common along the margins of the FLG.*

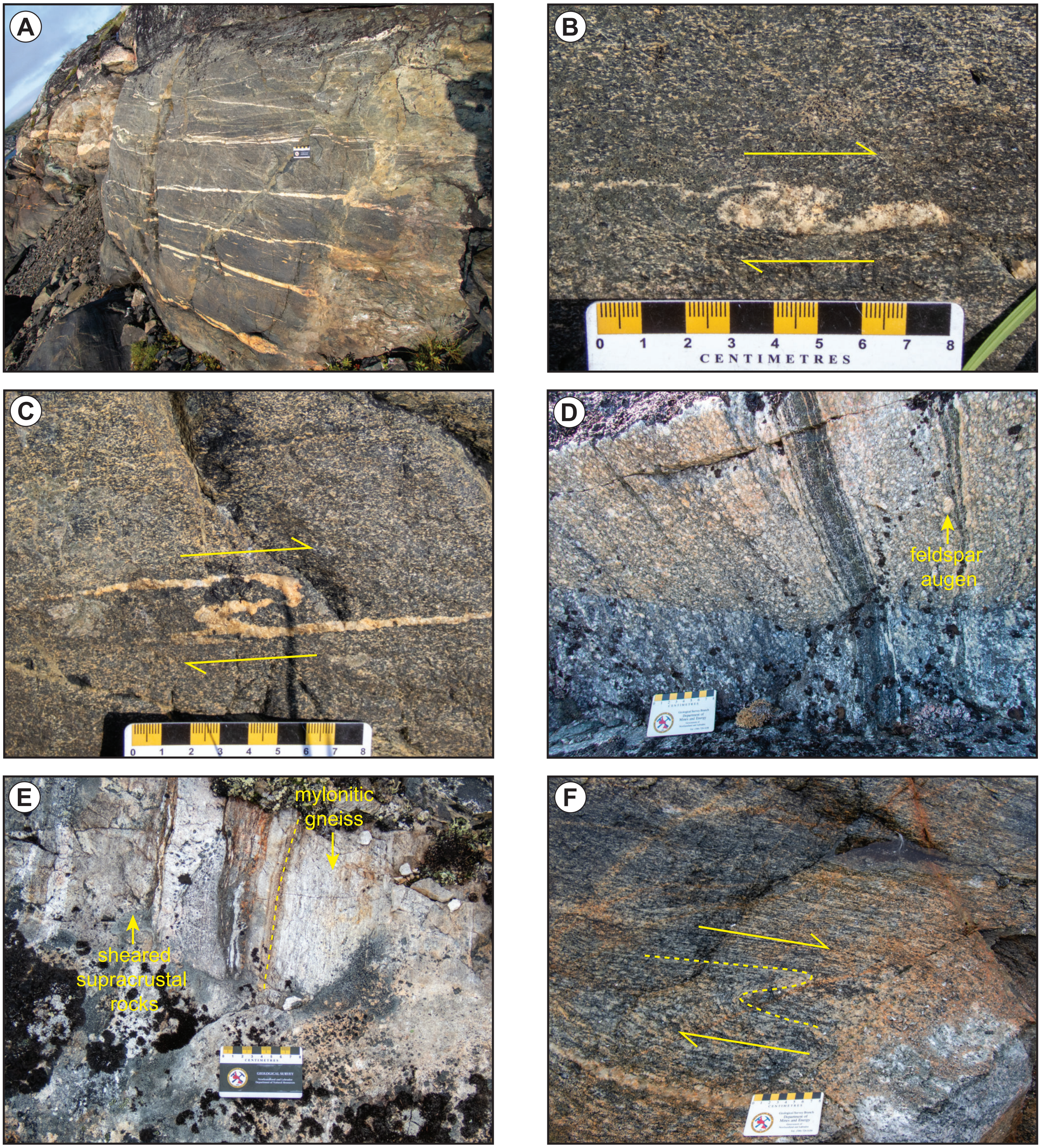

Plate 3. *Field photographs of strongly deformed lithologies along the sheared margins of the FLG and other supracrustal outliers in the Hopedale Block. A) Sheared amphibolite on Comma Island, along strike north of the FLG. Amphibolite is potentially derived from mafic flows, as indicated by the variable abundance of feldspar porphyroclasts and residual epidotized pillow fragments at the bottom of the section; B, C) Dextral shear sense indicated by asymmetric folds; D) Mylonitic gneiss with darker amphibolite bands. Abundant feldspar augens are rounded by shearing. The shear zone is several metres wide, steeply dipping and trending ~160° from the northwestern part of Fred's Bay. Several different rock types are caught up as a mélange in the shear zone, including m-scale rounded soapstone and dm-scale massive sulphide blocks; E) Mylonitic gneisses in contact with sheared supracrustal rocks on the eastern margin of the Ugjoktok sub-belt. F) Dextral shear sense with vertical component in the same shear zone as (E), indicating uplift of FLG rocks against gneisses during or after D_2.*

zones (*e.g.*, along Ugjoktok Bay) are commonly intruded by variably deformed granitoids of the KIS.

DISCUSSION

Previous structural observations in the FLG and surrounding rocks (Ermanovics, 1993; McLean and Butler, 1993; James *et al.*, 1996) have been verified; however, some aspects of the interpreted structural history of the FLG require explanation and are outlined below:

1) Several younging indicators were documented in the southwestern part of the Adlatok sub-belt that indicated stratigraphic younging to the southeast. These include pillow-facing directions, mafic feeder dykes, and thermal erosion features at the base of ultramafic flows (Diekrup *et al.*, 2023). However, if the structural reconstruction discussed below is valid, the stratigraphic tops may be only locally applicable and younging indicators across the belt are needed to validate the folding model.

2) The S_1 foliation is pervasive in sedimentary rocks and moderately well-developed in volcanic and intrusive rocks of the FLG (*see* Plate 1A–D). It is developed subparallel to bedding (S_0), strikes north-northeast–south-southwest and dips subvertically, on average. Both S_0 and S_1 are modified by a later D_2 event (*see* F_2 folds produced during D_2 modifying S_0 and S_1; Plate 2A–D). The S_1 foliation was produced during late stages of D_1, developing in isoclinal folds parallel to north-northeast-striking, steeply dipping axial planes. The lack of observations of S_1 cutting S_0 at steep angles could be an indication of large amplitude F_1 folds, with rare exposures of fold hinges, while most outcrops comprise the long, thinned, planar limbs of the folds, where S_1 is developed parallel to S_0. D_1 was likely a major south-south-east–north-northwest crustal shortening event that produced isoclinal folds (F_1) and subvertical dips of S_0 along fold limbs. Steeply plunging mineral lineations likely originate from the same D_1 shortening event and relate to strong crustal thinning of up to a factor of approximately 1:10 in south-southeast–north-northwest direction (Diekrup *et al.*, 2023). The variable plunge and azimuth of mineral lineations are likely a product of later F_2 overprint and potential buckling of F_1 folds.

3) Variably well-developed S_2 structures are steeply dipping and east–west to southeast–northwest striking sets of foliations, crenulation cleavages and S-C fabrics (Plate 1). They are rarely observed macroscopically in outcrop but are commonly notable at the thin section scale in up to a quarter of all samples of FLG sedimentary rocks (*see* Plate 1A–D). S_2 overprints S_1 and is therefore attributed to a later event having a variable sinistral and dextral shear component: D_2. There is a clear distinction of the D_1 and D_2 events as indicated by S_1, which is systematically deformed by later, outcrop-scale F_2 folds. However, variable plunges of F_2 fold axes suggests an irregular vertical component as part of D_2 shearing. This observation is supported by a shear indicator found in the contact zone east of the Schist Lake sub-belt, reflecting a vertical uplift of the FLG block wirth respect to the gneissic basement.

4) The presence of several dextral shear indicators at various scales reflects either the complexity of the D_2 event, or separate D_3 and later events characterized by dextral shear. Dextral shear sense was also reconstructed for some of the high-strain zones bounding the FLG. Several observations of more complex folding and up to D_3 or D_4 events were reported from the Baikie sub-belt (McLean and Butler, 1993) and could be related to locally polydeformed felsic and ultramafic horizons in the southwest Adlatok sub-belt (*e.g.*, hosting the Thurber Dog Au-showing; *see* Figure 1)). The marginal zones of the FLG tend to be more strongly and more complexly deformed than their interiors, except for the contact aureoles around larger felsic intrusive bodies including KIS.

FOLDING MODEL AND IMPLICATIONS

Major fabrics are mutually parallel in the FLG (S_0–S_1), in the adjacent high-grade gneisses, as well as some proximal KIS. This indicates that a common major deformation and fabric-forming event occurred in the area after *ca.* 2979 Ma and affected rocks of the FLG, the surrounding early KIS and the Maggo Gneiss. The boundary-parallel foliation in some *ca.* 2892–2796 Ma KIS on the margins of the FLG supports their syn-tectonic origin, and limits the timing of the major fabric-forming events to between *ca.* 3003–2796 Ma. The events could have occurred earlier in this time frame if the KIS, along the margins of the FLG, were affected by re-activation of shear zones rather than the main deformation events. The origin of the S_1, north-northeast–south-southwest "Fiordian" fabric, is a major crustal shortening event between the last deposition of FLG rocks (~2979 Ma), and the emplacement of some foliated, syntectonic KIS rocks (~2832 Ma, Hinchey *et al.*, *this volume*). D_2 is a later transpressional event dominated by sinistral and dextral shearing with a vertical component, and possibly a north–south to northeast–southwest shortening direction.

The FLG is a segmented greenstone belt, with km-scale separation or offset between individual sub-belts. The origin of the segmentation remains cryptic but follows the same geometry as the orientation of larger shear zones marginal to the FLG that could represent early D_1 structures that were later modified and reactivated during D_2. The major deformation components of D_1, southeast–northwest shortening, and D_2, shear and northeast–southwest shortening agree with the general map pattern of the belt, specifically the northeast–southwest elongated and curvilinear exposures of the Baikie- and Adlatok sub-belts.

CONTACT RELATIONSHIPS

Contacts between the FLG and its host rocks are ambiguous, and interpretations range from supracrustal rocks deposited stratigraphically on rifted Maggo Gneiss to their structural emplacement on the Maggo Gneiss (Korstgard *et al.*, 1985; Ermanovics, 1993; James *et al.*, 1996; James *et al.*, 2002). The best-exposed contact between Maggo Gneiss and FLG rocks is located on the western side of the Ugjoktok sub-belt (60°44’45”W, 54°58’02”N), and comprises an ~300-m wide, subvertically dipping shear zone (Plate 3E, F). Shearing affects both gneisses on the western side of the zone, and volcaniclastic sedimentary rocks on the eastern side, obliterating original gneissosity and any primary depositional features. The zone is evident at surface as a northeast-trending topographic low, hosting a series of elongated lakes and bogs. Unsheared gneisses farther west, and less deformed volcanic rocks in the east form topographic highs. Other margins of the FLG display similar characteristics, pointing at least locally to the presence of shear zones along the contact. This is illustrated by strongly deformed volcanic and volcaniclastic rocks occurring close to the contact zone, topographic lows and poor exposure after erosion of less competent mylonitic rocks in the core of the shear zone, and small bodies of variably sheared KIS. These field observations all point towards systematically developed shear zones along the margins of the FLG.

Due to the sparse exposures of contact zones around the main belt of FLG rocks, the contact relationships of several outliers of supracrustal rocks were investigated to evaluate any similarities with the FLG. Such outliers exposed outside of the main belts in the Hopedale Block are hosted in Maggo Gneiss and KIS intrusions and were somewhat arbitrarily assigned to the FLG or HRG, or derived from supracrustal rocks or intrusions of similar age and preserved as amphibolite rafts (*i.e.*, Weekes Amphibolite; Ermanovics and Raudsepp, 1979). However, several of these outliers yielded depositional ages between *ca.* 3262–3124 Ma, older than the *ca.* 3105 Ma HRG (Schiotte *et al.*, 1993; Hinchey *et al.*, *this volume*). The geochronological results are consistent with the lithogeochemistry of several of the mafic and ultramafic outliers, interpreted to originate from different pulses of magmatic activity (Sandeman *et al.*, 2023). The contact relationships between both FLG rocks and supracrustal outliers with the gneissic basement almost invariably share these key characteristics:

- The major fabrics in the supracrustal rocks, gneisses, and granitoids are parallel.
- The contacts are sheared, and deformation affects both supracrustal rocks, gneisses and granitoids, and is more intense along these contact zones.
- Contact zones along larger supracrustal remnants are commonly aligned with major shear zones in the Hopedale Block, which are, in turn, exploited by syn- to post-kinematic intrusions of the KIS.

The small, 10s–100s m scale of several supracrustal outliers is at odds with some of their contained lithologies, such as mature subarkosic sandstones. Such small occurrences of sedimentary rocks can be reconciled best with their (volcani-)clastic origin by structural dissection of units with an originally much larger depositional extent. The depositional basement of these rocks remains enigmatic, but they likely represent allochthonous wedges that underwent significant structural transport.

The similarities of contact relationships on the margins of the FLG and smaller supracrustal outliers imply a comparable emplacement mechanism. In the absence of any known conformable contact relationships, these most likely represent purely structural contacts, indicated by displacement along the margins of any supracrustal rock remnants in the southeastern Hopedale Block. This observation has significant implications for mineral exploration, as in the brittle deformation regime, major shear zones and splays off of such zones commonly host mineral deposits.

ONGOING AND FUTURE WORK

The origin of the supracrustal outliers remains a key area of research and will be supported by *in-situ* geochronology and reconstruction of P-T conditions during metamorphism. Early results that indicate that the outliers are of variably older ages than the FLG require testing of the timing of structural superposition against the gneiss and granitoids, and was such an event repeated during different tectonic phases, or did all supracrustal rocks undergo structural transport contemporaneously. Newly identified shear zones need to be placed into the context of the tectonothermal history of the Hopedale Block and linked to major tectonic events such as the proposed Saglek–Hopedale collision. Results will have implications for the economic potential of the FLG, including the origin of the Baikie sub-belt and the continuity of its lithologies and contained Ni–Cu mineralization, and the link between deformation events and Au-mineralization in the southwestern Adlatok sub-belt (*e.g.*, Thurber Dog prospect).

CONCLUSIONS

The major fabrics in the FLG are S_1 and S_2 foliations, produced by major, northwest–southeast crustal shortening, and northeast–southwest transpression, respectively. Future work will test the possible relationships between these fabrics and the metamorphic events recently identified by Hinchey *et al.* (*this volume*).

No conformable contacts between supracrustal rocks and gneisses have been observed. All field evidence indicates structural emplacement of the FLG and its adjacent supracrustal outliers with earlier D_1 faults overprinted by belt and outlier margin-parallel D_2 shear zones. The KIS intruded along the D_2 shear zones likely exploiting their permeability. The origin of the supracrustal rocks will be tested using the detrital zircon age distributions and their Lu–Hf compositions to identify possible sources of the clastic units.

Sedimentary and mafic volcanic rocks are the dominant lithologies in most supracrustal belt outliers investigated. The margins of larger outliers are invariably strongly sheared, comparable to the margins of smaller amphibolite rafts hosted in Maggo Gneiss. The maturity of some of the sedimentary rocks in the outliers (*e.g.*, subarkosic sandstones) is at odds with the small areal extent of the units, often only 10s to few 100s of m in strike length, highlighting their likely structural mode of emplacement.

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