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Structural geology of the northeastern Committee Bay belt, Ellice Hills area, central Nunavut[1]

M. Sanborn-Barrie, H. Sandeman, T. Skulski, J. Brown, M. Young, T. MacHattie, C. Deyell, C. Carson, D. Panagapko, and D. Byrne

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Abstract: The Ellice Hills map area, northeastern Committee Bay area, comprises several belts of supracrustal rocks separated by large tracts of plutonic rocks of variable composition and texture. The main, >80 km long supracrustal belt is the most complex structural domain, containing structures attributed to three deformation events: bedding-parallel S_1 foliation; northeast-striking S_2 fabrics axial-planar to northeast-trending F_2 folds; and conjugate, kink-style F_3 folds and north-northwest–striking faults. North of the main belt, mafic and ultramafic volcanic rocks with subordinate metasedimentary rocks form several narrow, northeast-trending, short strike-length belts that are penetratively affected by northeast-trending D_2 fabrics and folds. Regions of intervening plutonic rocks typically carry a northeast-striking D_2 fabric and are structurally less complex, due to their initial isotropic character and lower degree of accumulated finite strain. The southernmost batholithic complex is characterized by south-striking, west-dipping fabrics attributed to D_1, with only minimal effects of superposed D_2 strain.

Résumé : La région cartographique d'Ellice Hills, dans le secteur nord-est de la région de la baie Committee, renferme plusieurs ceintures de roches supracrustales séparées par de grandes bandes de roches plutoniques de compositions et de textures variables. La principale ceinture de roches supracrustales (longue de plus de 80 km) constitue le domaine structural le plus complexe et contient des structures attribuées à trois épisodes de déformation : une foliation S_1 parallèle à la stratification; des fabriques S_2 de direction nord-est parallèles aux surfaces axiales des plis P_2 de direction nord-est; et des plis P_3 conjugués en kink ainsi que des failles de direction nord–nord-ouest. Au nord de la ceinture principale, des roches volcaniques mafiques et ultramafiques et, en moindres quantités, des roches métasédimentaires forment plusieurs ceintures étroites de direction nord-est de faible extension longitudinale, qui ont été déformées de manière pénétrante par des fabriques et des plis D_2 de direction nord-est. Les zones de roches plutoniques intermédiaires présentent généralement une fabrique D_2 de direction nord-est, et leur style structural est moins complexe, car elles étaient initialement isotropes et ont été soumises à une accumulation moins importante de déformations finies. Le complexe batholitique le plus méridional est caractérisé par des fabriques de direction sud à pendage ouest attribuées à D_1. La déformation superposée D_2 n'a eu que des effets limités sur ce complexe.

[1] A contribution to the Committee Bay Targeted Geoscience Initiative

INTRODUCTION

The Committee Bay area, central Nunavut, is centred on a 600 km long supracrustal belt in the north-central western Churchill Province that was mapped at 1:100 000 scale as part of a three-year, multidisciplinary Geological Survey of Canada – Canada-Nunavut Geoscience Office Targeted Geoscience Initiative project (Fig. 1). The Ellice Hills map area (NTS 56 P) was the focus of geoscientific activity during the 2002 field season (*see also* Skulski et al., 2003; Deyell and Sherlock, 2003; Giangioppi et al., 2003). It contains on-strike extensions of supracrustal and plutonic domains exposed to the southwest (Skulski et al., 2002; Sandeman et al., 2001b) and displays several generations of structures that correlate with those described to the southwest (Sanborn-Barrie et al., 2002; Sandeman et al., 2001c).

Supracrustal rocks of the Committee Bay area consist mainly of the Prince Albert group, a Neoarchean volcano-sedimentary succession that includes conformable komatiite and quartzite, suggestive of a rift-related setting. These rocks appear to be part of a regionally extensive supracrustal succession of comparable age and lithology, which is exposed discontinuously for more than 2000 km from Saskatchewan to Committee Bay (Fig. 1) and northeast to Baffin Island. In the Committee Bay area, the Prince Albert group includes a lower, volcanic-dominated sequence of intercalated basalt and ca. 2.732 Ga felsic volcanic rocks, overlain by a substantial (~300 m thick) komatiite sequence. An upper, sedimentary-dominated sequence of psammite, semipelite, and quartzite appears to have been deposited conformably on komatiite between ca. 2.722 Ga (youngest detrital zircon analyzed; T. Skulski and N. Rayner, unpub. SHRIMP U-Pb data, 2002) and ca. 2.711 Ga (new U-Pb TIMS age for a conformably overlying intermediate tuff; M. Sanborn-Barrie and W. Davis, unpub. data, 2002). The uppermost part of the Prince Albert group contains minor komatiite and iron-formation, and a younger (<ca. 2.69 Ga) clastic sequence that locally attains lower granulite facies (Sanborn-Barrie et al., 2002; Carson et al., 2002). Two main stratigraphic horizons of oxide- and silicate-facies iron-formation are interpreted to reflect subaqueous hydrothermal activity between, and following, ca. 2.73 Ga and ca. 2.71 Ga volcanism. Gold mineralization in the region is spatially associated with iron- formation, particularly in polydeformed rocks where gold is localized in fold-related structures (Deyell and Sherlock, 2003).

The Committee Bay region has been affected by two penetrative deformation events, polymetamorphism, and late-stage shortening (folding±shearing). Current age constraints indicate that regional north-northwest–trending folds and fabrics that have affected both Prince Albert group strata and widespread Neoarchean plutonic rocks (D_1) may have formed

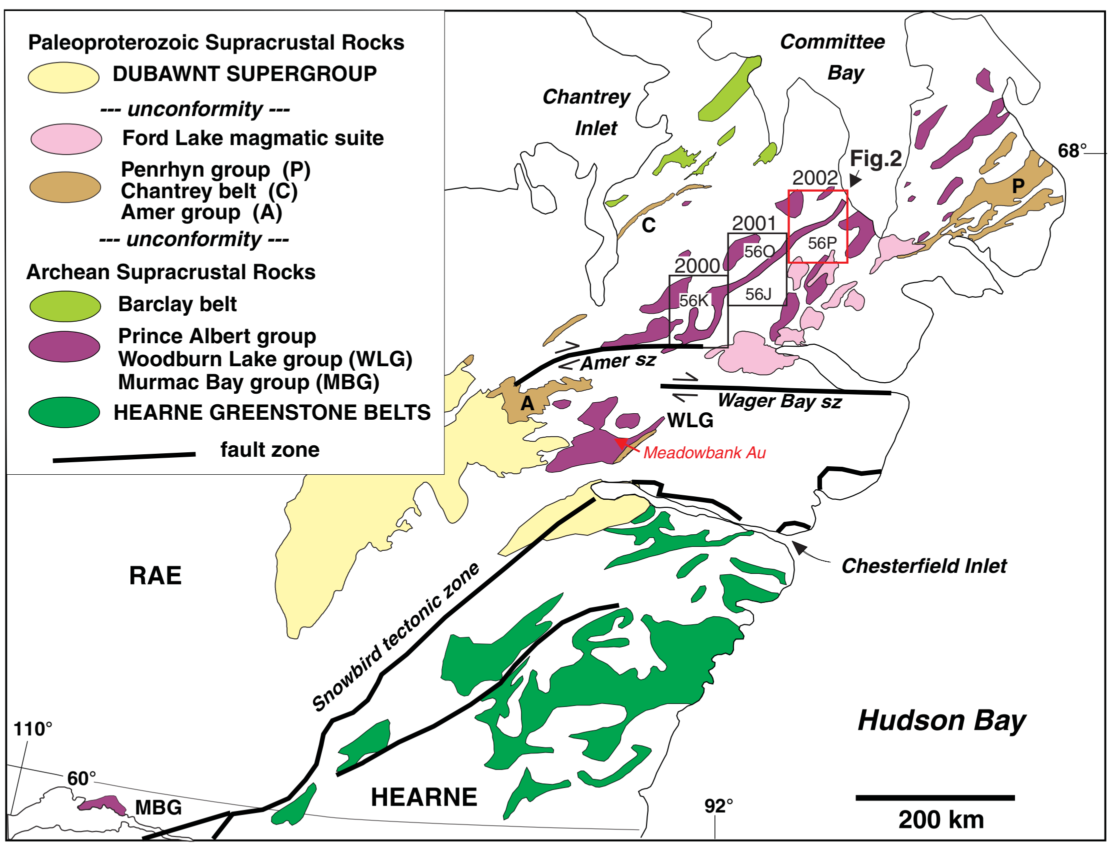

Figure 1. Regional geology of the north-central western Churchill Province. Meadowbank Au = Meadowbank gold deposit; sz = shear zone.

at ca. 2.58 Ga, or possibly at ca. 2.35 Ga (T. Skulski and N. Rayner, unpub. SHRIMP U-Pb data, 2002). Regional northwest-vergent folds and northeast-striking fabrics (D_2) formed between ca. 1.85 and 1.82 Ga (Carson et al., 2002; T. Skulski and M. Sanborn-Barrie, unpub. data, 2002). Localized dextral ductile shearing (Johnstone et al., 2002) and variably developed nonpenetrative folding and faulting (D_3) likely occurred between ca. 1.82 Ga and 1.765 Ga (Carson et al., 2002; M. Sanborn-Barrie, unpub. data, 2002).

STRUCTURAL DOMAINS OF THE ELLICE HILLS AREA

The Ellice Hills map area (Fig. 2) comprises several belt-like exposures of supracrustal rocks separated by large tracts of plutonic rocks of variable composition and texture. The main supracrustal belt, an ~80 km long segment of the Committee Bay supracrustal belt, is a metasedimentary-dominated domain that extends across the central part of the map sheet (*see* Skulski et al., 2003). It represents the northeastern extension of supracrustal rocks described by Skulski et al. (2002) and Sandeman et al. (2001b,c). North of the main belt, exposures of mafic and ultramafic volcanic rocks with subordinate metasedimentary rocks form several northeast-trending belts of short strike-length, the most continuous of which is designated as the Ellice Hills supracrustal strand (Fig. 2). These northern mafic to ultramafic strands may correlate with an along-strike, amphibolite-dominated supracrustal belt to the southwest (Skulski et al., 2002).

The structural geology of the Ellice Hills map area can be considered in terms of three principal domains, delimited on the basis of the orientation of planar and linear structural elements and of the phases of deformation recorded by rocks in each domain (Fig. 3). The central domain includes rocks proximal to and including the Committee Bay supracrustal belt, and contains the most complex structure, attributed to three main deformation events (D_1, D_2, D_3). The northern structural domain is dominated by plutonic rocks that typically carry northeast-trending D_2 fabrics and are structurally less complex, largely owing to their initial isotropic character and to a lower degree of accumulated finite strain. The southern structural domain, which includes the Walker Lake intrusive complex, is characterized by south-trending, west-dipping fabrics attributed to D_1, with only minimal effects from superposed D_2 strain.

Central supracrustal domain

The Committee Bay supracrustal belt is dominated by mid-amphibolite–facies metasedimentary rocks, including semipelite, psammite, and impure and pure quartzite, which are interbedded on a centimetre to metre scale and intruded by ultramafic sills (Skulski et al., 2003). Determination of primary younging direction was possible in some beds, based on consistency in grading, crossbed geometry, and scour structures. Across-bed variations in fuchsite or aluminosilicate porphyroblast abundances were also locally helpful in supporting estimations of younging, since these minerals may preferentially be concentrated at the base (detrital chromite content in quartzite) or top (clay content in pelitic rocks) of beds, respectively. Interpreted facing directions indicate that the Committee Bay belt consists of map-scale, northeast-trending, northwest-vergent to upright folds, which will be shown below to correspond to F_2.

The Committee Bay supracrustal belt records three generations of structures (Fig. 4). D_1 involved development of a bedding-parallel foliation, in part defined by aluminosilicate porphyroblasts. Penetrative D_2 strain involved folding of S_0-S_1, development of an axial-planar L-S fabric, transposition into throughgoing zones of northeast-structural trend, and S_0+S_1+S_2 layer-parallel extension. Nonpenetrative D_3 strain involved layer (S_0+S_1+S_2)–parallel shortening, resulting in conjugate kink-style F_3 folds and/or chevron folds with locally developed zones of typically weakly developed north-south schistosity.

D_1 structures

Within the central domain, D_1 fabrics are generally only locally developed and/or preserved. In two areas, however, a bedding-parallel S_1 foliation is the dominant tectonic element observed. These two regions, the Kinngalugjuaq Mountain area and the Curtis River area (Fig. 5), correspond to the hinge zones of major F_2 folds (*described in the next section*). In general, S_1 is defined by aligned biotite and muscovite in pelite and quartzite, with local biotite alignment and quartz elongation in plutonic rocks. In addition, numerous localities along the belt display bedding-parallel S_1, defined by aligned, elongate, white-weathering aluminous nodules (Fig. 6). Based on petrographic observations from the adjacent map area to the southwest (56 J), we interpret these to represent sillimanite porphyroblasts, subsequently retrogressed to muscovite and locally reoriented by D_2 strain. These relationships indicate that early mid-amphibolite–facies metamorphism (M_1) of < ca. 2710 Ma supracrustal rocks in the Ellice Hills area was pre- to syn-D_1.

Attitudes of S_1 are variable within the central domain, owing to reorientation by subsequent deformation events D_2 and D_3. This is reflected by the dispersed great-circle distribution of poles to S_1 (Fig. 4a).

D_2 structures

A penetrative northeast-striking foliation is developed throughout much of the Committee Bay supracrustal belt. This is axial-planar to folds interpreted as F_2 on account that they reorient S_0-S_1 (*described in the previous section*). S_2 is a northeast-striking, typically moderately southeast-dipping (30–70°), variably developed foliation marked by mineral and stretching lineations that primarily plunge moderately to the southwest (Fig. 4b). S_2 is axial-planar to macroscopic folds that typically plunge southwest, coaxial to L_2 (Fig. 7). Boudinage structure is preferentially developed in quartzite, both at an outcrop scale (e.g. Crater Lake area) and at the map scale (e.g. along-strike discontinuity of quartzite units south of the Inuk occurrence), indicating that a degree of layer-parallel extension affected the central domain during D_2.

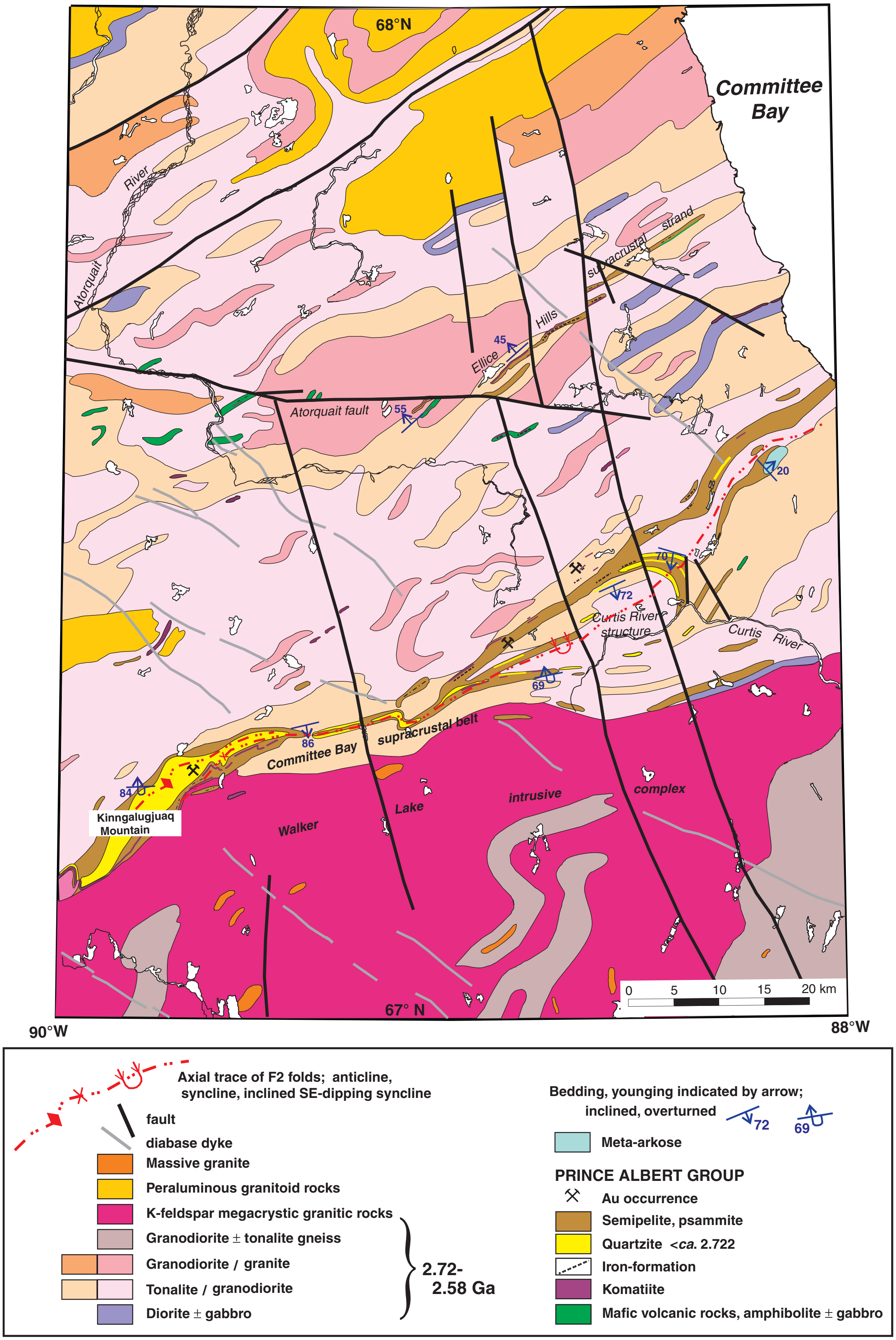

Figure 2. *Geology of the Ellice Hills map area (NTS 56 P), Committee Bay region, Nunavut. Red lines mark the trace of map-scale F_2 folds, as defined by younging reversals and folded S_1 (see Fig. 5).*

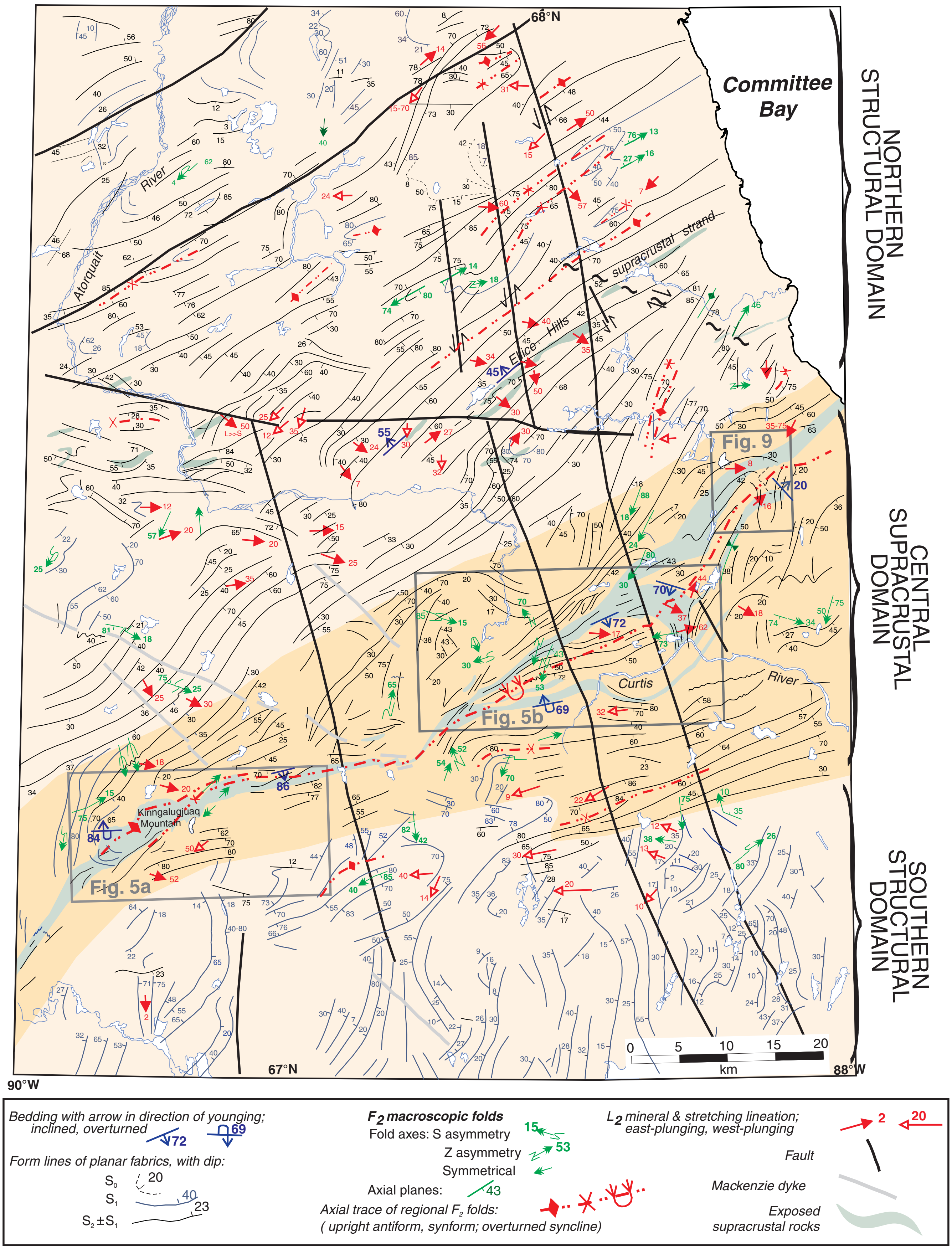

Figure 3. *Structural geology of the Ellice Hills area. Extent of exposed supracrustal rocks shown in pale green, plutonic rocks in pale yellow (northern and southern structural domains) and straw yellow (central structural domain).*

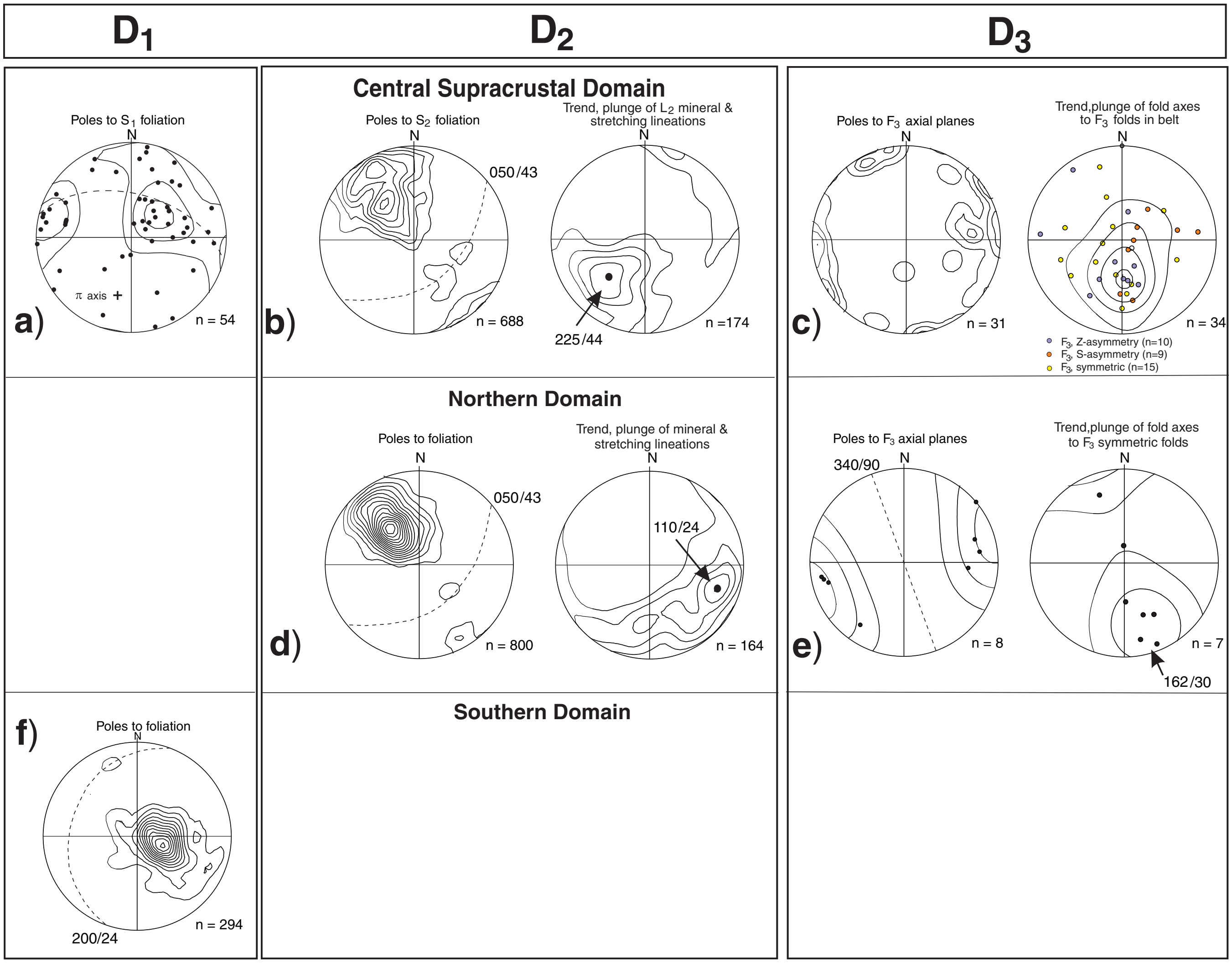

Figure 4. *Summary of structural elements for the Ellice Hills area, portrayed for three structural domains described in the text, and subdivided according to relative age (i.e. D_1, D_2, D_3). All data are represented on lower-hemisphere equal-area stereonets. The distribution of poles to S_1 is consistent with superposed D_2 strain, as reflected by the correspondence between the girdle pole (π axis) and maxima of L_2 lineations (Fig. 4b) and F_2 fold axes (Fig. 7). Dispersion of D_1 and D_2 elements in the central domain is attributed to the D_3 overprint (described in text).*

Two major northeast-trending, southwest-plunging F_2 folds within the Committee Bay supracrustal belt are defined by facing reversals and folded S_0-S_1 fabrics. In the Kinngalugjuaq Mountain area (Figure 5a), southeast-striking, moderately southwest-dipping S_1 foliation surfaces collectively define the hinge zone of a major southwest-plunging F_2 anticline. Supporting evidence for this anticline is found in indicators of northward and southward younging in quartzite along its north and south flanks, respectively. At a number of localities along its hinge zone, variably oriented S_1 foliation is transected by a second-generation foliation (S_2) that trends 070–080°, axial-planar to the anticlinal trace. In the Curtis River area (Figure 5b), variably oriented (steeply west-dipping to near-vertical) bedding-parallel foliation planes define the closure of an open fold that is complementary to the closure defined by S_1-S_0 trends in the Kinngalugjuaq Mountain area. Opposing stratigraphic facing across the supracrustal belt in the Curtis River area suggests a major synclinal structure that folds S_0-S_1. The inclined, northwest-vergent Curtis River F_2 syncline exposes quartzite and semipelite in its limbs, and mainly plutonic rocks with inclusions of metasedimentary rocks in its hinge.

D_2 structures are a dominant influence on the map pattern of the Committee Bay area, in that they have preserved (and/or exposed) northeast-trending corridors of supracrustal rocks from different stratigraphic levels. D_2 structures also play a fundamental role in the localization of gold mineralization. This is particularly well displayed in the Ellice Hills map area where, at the three known gold occurrences, mineralization in iron-formation is localized within the hinge zones of F_2 folds, and in zones that are axial-planar to these folds (Deyell and Sherlock, 2003).

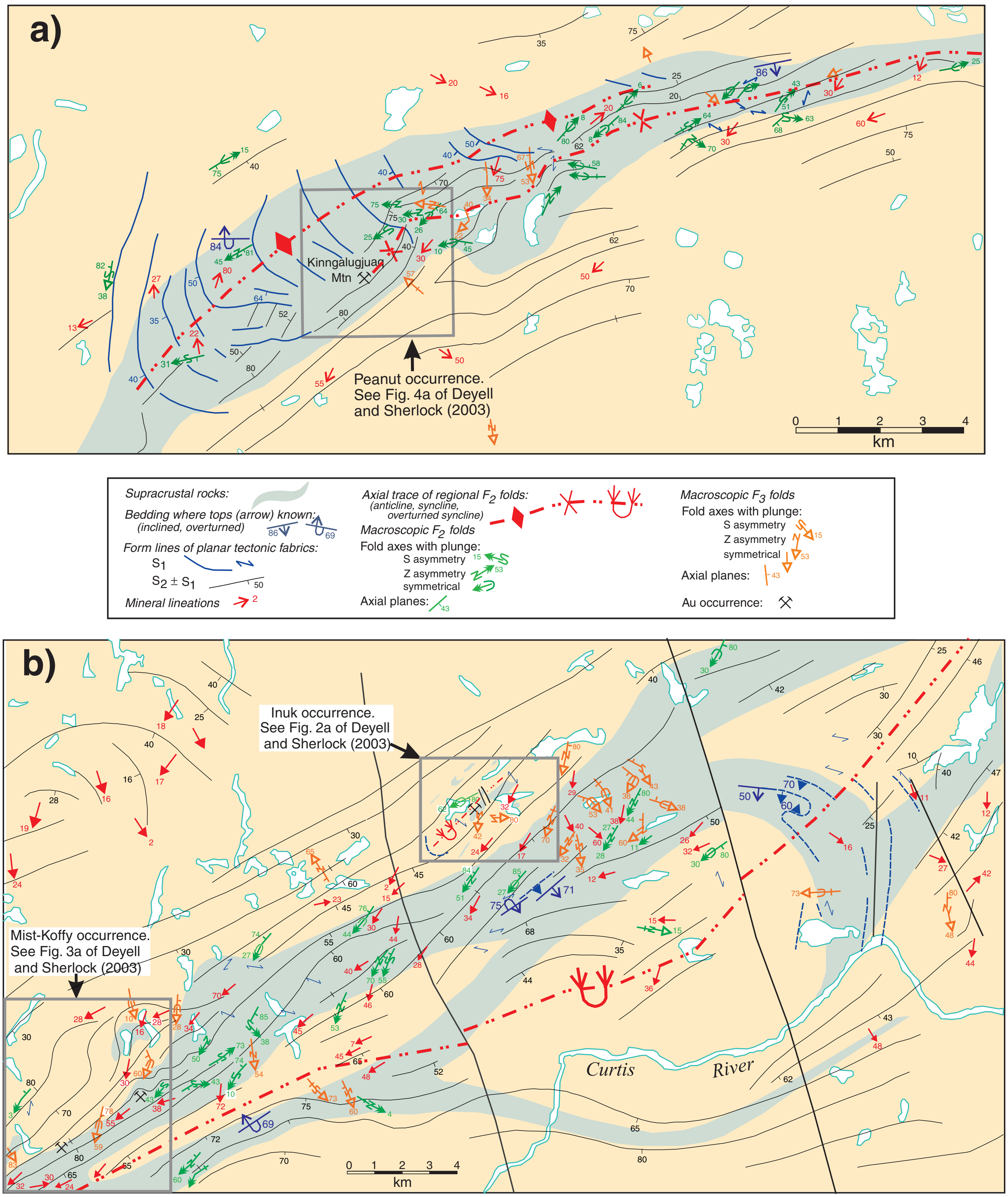

Figure 5. *Detailed structural geology of parts of the Committee Bay supracrustal belt, central structural domain. Location of inset figures is shown in Fig. 3.* ***a)*** *Kinngalugjuaq Mountain area, host to the Peanut gold occurrence (*see *Deyell and Sherlock, 2003);* ***b)*** *Curtis River area, host to the Mist-Koffy and Inuk gold occurrences (*see *Deyell and Sherlock, 2003).*

Figure 6. Impure quartzite south of the Inuk gold occurrence, Committee Bay supracrustal belt. Bedding (S_0) is defined by variation in aluminosilicate porphyroblast abundance, which is interpreted to reflect primary clay content. Bedding-parallel S_1 is defined by aligned, elongate porphyroblasts, except where the porphyroblasts are reoriented to define an axial-planar S_2 cleavage in the hinge of the macroscopic F_2 fold.

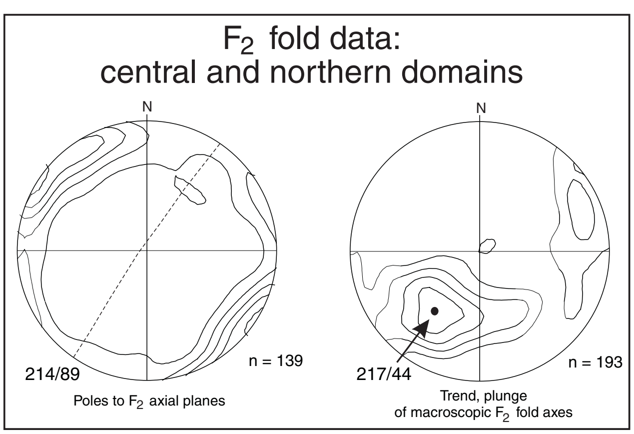

Figure 7. Stereographic representation of macroscopic F_2 fold orientations from the Ellice Hills map area.

D_3 structures

Within the central structural domain, northeast-trending D_2 structures are locally reoriented by F_3 folds that commonly lack an associated cleavage. F_3 folds are best developed in metasedimentary rocks, particularly in pelitic to semipelitic units, but are also observed in quartzite. The style of F_3 folds

*Figure 8. F_3 folds in metasedimentary rocks, Committee Bay supracrustal belt. **a**) open F_3 folds in rusty weathering pyriferous quartzite; **b**) symmetrical, tight F_3 folds in pelite.*

varies with respect to rock type: open, kink-style folds are generally displayed in quartzite (Fig. 8a), whereas tight, chevron-style folds are more typically developed in pelitic rocks (Fig. 8b). They are commonly observed in two main orientations. Dominant are moderately east- to southeast-plunging folds of S-asymmetry with steeply dipping axial planes that trend 150°–180°. Less common are south- to southwest-plunging folds of Z-asymmetry with moderately to steeply dipping axial planes striking between 040° and 060°. These fold sets are variably developed: typically, only one set is developed, but less commonly both may occur together as conjugate sets. The variability in the style and orientation exhibited by F_3 folds is interpreted as a function of competency and degree of pre-existing anisotropy of these different rock types, as well as of the proportion of shortening they accommodated during D_3 (cf. Patterson and Weiss, 1967). Superposition of F_3 folds on F_2 folded surfaces has resulted in local development of dome-and-basin interference patterns, and may also be responsible for variations in the plunge of the regional F_2 fold structures.

Structure of (?)Paleoproterozoic metasedimentary rocks

In the northeastern part of the Committee Bay belt, a small, 8 km^2 exposure of layered, hematized, calc-silicate–bearing rocks with vuggy weathering represents an apparent clastic sequence that is distinct from that of the structurally underlying Neoarchean Prince Albert group. This distinctive sequence of unknown age (*see also* Skulski et al., 2003) may represent an outlier of a Paleoproterozoic succession, the Folster Lake group, which unconformably overlies Archean basement on the northeastern shore of Committee Bay (Frisch, 1982). In the map area, these rocks appear to be medium- to thick-bedded, poorly graded units that are generally shallowly to moderately dipping (Fig. 9). They contain local metre-scale obliquities in layering, consistent with cross-stratification. Bedding attitudes define an openly folded, shallowly northeast-plunging sequence that coincides with the on-strike extension of the Curtis River F_2 syncline. These rocks invariably carry a foliation. Most typically, this is a moderately developed, north-northeast–striking, shallowly to moderately southeast-dipping cleavage which is oblique to bedding (*see* Fig. 10 of Skulski et al., 2003), and whose orientation is consistent with regional S_2 trends in the underlying rocks (Fig. 9). At several localities, a bedding-parallel foliation is observed, but how this correlates with fabrics elsewhere in the map area is unclear.

Northern structural domain

The northern half of the Ellice Hills map area comprises variably foliated plutonic rocks with amphibolite-facies, mafic to ultramafic, volcanic-dominated rafts, the most continuous of which is designated as the Ellice Hills supracrustal strand (Fig. 2; *see also* Skulski et al., 2003). The plutonic rocks generally range in composition from diorite-tonalite to granodiorite, with compositional variations corresponding to intrusions of tabular, or sheet-like, geometry. In general, the northern structural domain is characterized by a moderately developed, northeast-trending foliation (Fig. 3, Fig. 4d). Throughout the southern part of this domain, the northeast-striking foliation consistently dips 30° to 50° to the southeast. In the north, the northeast-striking foliation is more steeply dipping and shows closely spaced reversals in dip direction. Mineral (amphibole) lineations and quartz stretching lineations throughout the entire northern structural domain plunge moderately or shallowly to the southeast.

A coherent muscovite-granite pluton in the north-central part of the map area (Fig. 2, 3) contains a relatively weak concentric foliation in its centre, and a moderately dipping northeast-striking foliation along its northwest and southeast margins. The concentric nature of its internal foliation, and the low strain state of much of this pluton relative to higher strain intermediate plutonic rocks that mantle it, suggest that this peraluminous pluton may have intruded relatively late in the deformational history of the region, presumably post-D_1 and pre- to syn-D_2. Muscovite-bearing monzogranite pegmatite south of the Inuk occurrence in the central structural domain shows similar textural relationships (cuts S_1, carries S_2) and is targeted for U-Pb dating to place a minimum age constraint on D_1 and a maximum on D_2.

The northern structural domain is transected by a number of semi-brittle to brittle faults (Fig. 2, 3). Dominant are north-northwest–striking, near-vertical faults that are best revealed by their magnetically low, linear character, across which small offsets of magnetic anomaly trends occur. On the ground, these structures typically correspond to linear topographic lows generally coinciding with modern drainage features. Where these faults are exposed, they are marked by discontinuous exposures of hematitized, fractured rocks that locally attain a cataclastic texture. A sinistral component of horizontal offset is generally on the order of 1 km, and rarely up to 2 km, as estimated by apparent offset of komatiite along the Ellice Hills supracrustal strand (Fig. 2). Two major east-striking fault zones also transect the northern structural domain. The most throughgoing of these, the Atorquait fault (Fig. 2, 3), coincides with a 1 km wide, topographically low lineament that corresponds to a linear magnetic low. Along the Atorquait fault trace, rare rock exposures are pervasively hematitized and fractured, with brittle deformation locally reflected by well-developed fault grooves and striae. Dextral offset of spinifex-textured komatiite and komatiitic basalt of the Ellice Hills strand across the Atorquait fault suggests ca. 8 km of apparent dextral displacement.

Southern structural domain

South of the Committee Bay supracrustal belt, foliated plutonic rocks are widespread. These rocks are dominated by K-feldspar–megacrystic granodiorite and monzogranite, forming a coherent batholithic complex that represents the northeastern extension of the ca. 2.6 Ga Walker Lake intrusive complex (Skulski et al., 2002; Sandeman et al., 2001a,b,). In contrast to the regional northeasterly structural trends of much of the central and northern structural domains, plutonic rocks of the southern domain are characterized by southerly structural

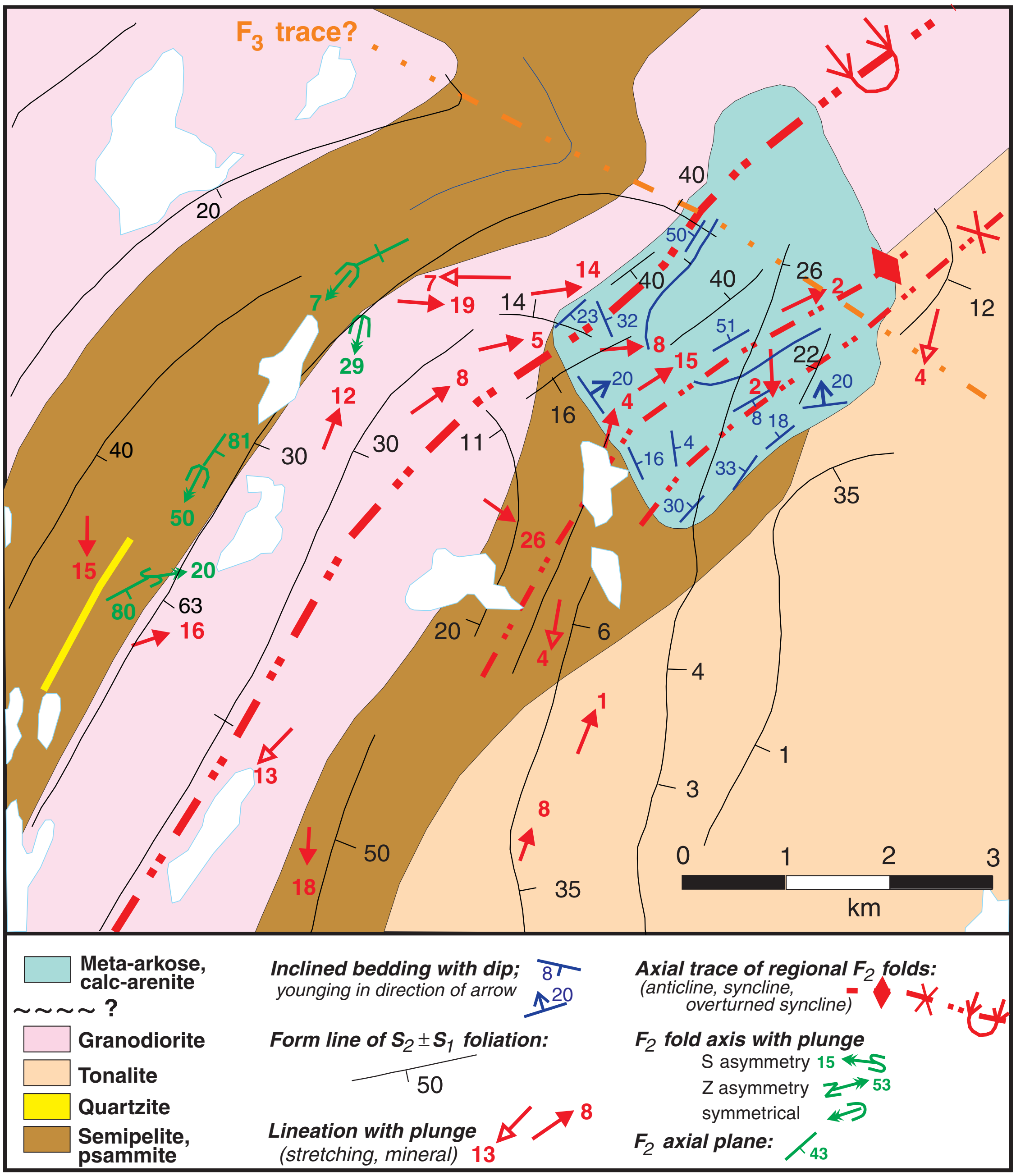

Figure 9. *Detailed structural geology of an outlier of (?)Paleoproterozoic metasedimentary rocks exposed near the hinge zone of the Curtis River F_2 syncline.*

trends (Fig. 3) only locally affected by superimposed east- and northeast-striking fabrics. Across the southern structural domain, south-striking foliation surfaces consistently dip shallowly to moderately to the west, commonly varying between 10° and 55° (Fig. 4f). Only in the extreme southwestern corner of the map sheet does foliation dip locally to the east. Mineral lineations in the southern structural domain are less well developed relative to other parts of the map area, and plunge moderately westward. Rare macroscopic folds are generally symmetrical, and are defined by compositional layering and by folded inclusion trails in the granitoid rocks.

In the southeastern corner of the map area, a plutonic gneiss complex consists of well foliated and lineated tonalite to granodiorite that contains abundant xenoliths of amphibolite, diorite, and tonalite. These rocks are collectively cut by moderately foliated monzogranitic and granodioritic veins and sheets. These magmatically complex rocks contain a single penetrative L-S fabric parallel to that in the augen granodiorite that dominates the southern domain.

Locally within the southern domain, superimposed D_2 strain is manifested by open undulations of the south-striking S_1 foliation, and by a component of extensional strain where limbs of F_2 folds display L>>S fabrics, in contrast to open-hinge areas where L=S fabrics are marked by moderately strong (rodding) lineations.

DISCUSSION

Supracrustal and plutonic rocks of the Ellice Hills area record evidence of a polyphase deformational history, elements of which are recorded to the southwest, in other parts of the Committee Bay area (Sanborn-Barrie et al., 2002; Sandeman et al., 2001c). In the Ellice Hills map area, the earliest tectonic elements appear to be best represented in the southern part of the map area, where south-striking, shallowly west-dipping $L_1<S_1$ fabrics are penetratively developed. D_1 fabrics are also prevalent at two localities in the central supracrustal domain, where composite S_0-S_1 fabrics define the hinge zones of regional F_2 folds.

The dominant northeasterly structural fabric of the central and northern Ellice Hills map area is related to penetrative D_2 deformation that has been bracketed between ca. 1.86 and 1.82 Ga (Carson et al., 2002; T. Skulski and M. Sanborn-Barrie, unpub. data, 2002). This northeasterly structural grain is defined by the orientation of the supracrustal belts and intervening plutonic domains, and also by the macroscopic structural elements that characterize these rocks. Penetrative D_2 deformation involved northwest-directed shortening that resulted in upright to inclined, northwest-vergent F_2 folds and northeast-striking, moderately southeast-dipping foliations. L_2 lineations plunge to the southeast in the lower-strain rocks of the northern structural domain, and plunge mainly to the southwest throughout the central supracrustal structural domain. A notable exception to this occurs in the northeastern part of the Committee Bay supracrustal belt, where shallow northeast-plunging lineations may reflect modification by an F_3 fold. Variation in the intensity of D_2 strain between these domains suggests that during D_2, strain was preferentially partitioned into the supracrustal rocks of the Committee Bay belt. This central domain is dominated by metasedimentary rocks that have low competency and high anisotropy relative to the intervening plutonic domains. Strain partitioning may also account for the variation in the direction of maximum finite extension, as reflected by L_2 lineations. In the northern domain, down-dip extension as reflected by southeast-plunging lineations may indicate a more significant thrusting component; whereas throughout the Committee Bay supracrustal structural domain, subhorizontal, strike-parallel extension, as recorded by shallow southwest-plunging lineations and by boudinage structure in near-horizontal exposures, may reflect a progressively greater shearing component.

Subsequent D_3 deformation of supracrustal rocks has resulted in the widespread development of open, conjugate, kink-style F_3 folds and tight chevron folds. These are attributed to layer-parallel shortening of anisotropic metasedimentary rocks. Attitudes of F_3 folds throughout the central domain are consistent with late-stage, northeast-southwest–directed shortening across the Committee Bay belt.

An outlier of (?)Paleoproterozoic metasedimentary rocks exposed near the Committee Bay coast has the potential to provide important insight into the timing of tectonometamorphism in the area, when its age and the structures it preserves are better understood. These rocks contain a tectonic foliation and metamorphic mineral assemblage consistent with deposition prior to D_2. They also locally contain a bedding-parallel cleavage (Fig. 9), which, if correlative with the regional S_1 foliation, has important implications for the maximum age (i.e. Paleoproterozoic) of D_1 strain. Alternatively, this bedding-parallel cleavage may represent a refracted S_2 foliation, consistent with deposition of these rocks after D_1 but prior to D_2. Another possibility is that this outlier may contain a fabric unrecognized in other parts of the belt. For example, the absence of an apparent unconformity at the base of the sequence, and the presence of rocks interpreted to be of relatively higher strain, highlight the possibility of a tectonic contact, with potential tectonic emplacement prior to, or at an early stage of, D_2 deformation.

Regional correlations

Other parts of the Committee Bay region display several generations of structures consistent with observations from the Ellice Hills area. However, the extent to which structures attributed to D_1, D_2, and D_3 have affected these rocks is variable. Moderately to strongly developed northwest-trending planar fabrics attributed to D_1 dominate the southwestern part of the area (56 K), west and east of a major ca. 2718 Ma synvolcanic pluton, the central tonalite (Sandeman et al., 2001a; T. Skulski, unpub. data, 2002). West of the central tonalite, these dip moderately to the northeast, whereas northeast and southwest of the pluton, S_1 dips consistently to the southwest. F_1 folds to which S_1 is axial-planar are best documented northeast of the central tonalite, where upright to inclined, closed, north-trending, south-plunging F_1 folds are defined by reversals in primary younging directions in komatiite, and by symmetrically disposed map units (MacHattie, 2002). North and south of the central tonalite, northeast-trending D_2 structures are more prevalent. The spatial distribution of D_1 and D_2 structures in 56 K highlights the role of a Neoarchean synvolcanic pluton in shielding parts of 56 K from the penetrative effects of D_2 strain.

The adjacent Walker Lake–Arrowsmith River map area (Fig. 1; Sanborn-Barrie et al., 2002) is dominated by northeast-trending folds and fabrics correlative with D_2 structures throughout the Committee Bay region. In this map area, only rare windows of supracrustal (typically komatiite) and plutonic rocks display northwest-trending, variably dipping S_1 fabrics. These in turn are cut or folded by northeast-trending D_2 fabrics. Macroscopic F_2 folds plunge mainly to the northeast, but also are southwest-plunging throughout several panels. In contrast to the Ellice Hills map area, D_2 structures show little evidence of reorientation by subsequent D_3

strain, except in the vicinity of the east-striking, dextral, strike-slip Walker Lake shear zone (Johnstone et al., 2002). In this map area, variations in D_2 structures are instead interpreted to reflect the geometry of the D_1 folded surfaces.

CONCLUSIONS

A polyphase tectonic history for the Committee Bay region is recorded by at least three generations of structures that are variably displayed by both its supracrustal and plutonic rocks. The oldest rocks presently identified in the area are ca. 2.73 Ga intermediate volcanic rocks and associated komatiites of the Prince Albert group. Penetrative deformation of these rocks may have taken place ca. 100 million years after their formation, approximately coincident with a period of voluminous plutonic activity manifested by regionally extensive ca. 2.6 Ga plutonic rocks that cut the Prince Albert group strata. Across the Committee Bay area, attitudes of observed D_1 structures and of D_2 structures (i.e. plunge of F_2 folds) suggest that D_1 involved east-west shortening (present-day co-ordinates) which resulted in open to closed, upright to inclined map-scale folds and generation of northerly trending, variably dipping $L_1 < S_1$ fabrics. Alternatively, observed D_1 structures may be Paleoproterozoic (e.g. ca. 2.35 Ga).

The dominant penetrative structural elements of the region are attributed to D_2 deformation and include northeast-trending folds and fabrics within which gold mineralization is known to be localized (Deyell and Sherlock, 2003). Metamorphism associated with D_2 strain had attained amphibolite facies at ca. 1.85 Ga (Carson et al., 2002), suggesting that shortening and thickening related to D_2 likely began prior to ca. 1.85 Ga. A minimum age for penetrative regional D_2 strain is ca. 1820 Ma, the age of monzogranite plutons that cut regional D_2 fabrics at several localities across the region (T. Skulski and N. Rayner, unpub. SHRIMP U-Pb data, 2002; M. Sanborn-Barrie and W. Davis, unpub. TIMS U-Pb data, 2002). Generation of penetrative, upright to northwest-vergent D_2 structures across the Committee Bay area and elsewhere throughout the western Churchill Province may reflect penetrative strain on the northern margin of the Trans-Hudson Orogen (St-Onge et al., 2002). Foliated ca. 1.82 Ga granites proximal to the dextral strike-slip Walker Lake shear zone and to the oblique-slip Amer fault zone indicate that localized ductile strain took place after ca. 1.82 Ga, possibly synchronously with dextral shearing along other segments of the Amer mylonite zone (Tella et al., 1997) and the Wager Bay shear zone (Henderson and Roddick, 1990).

Late-stage, northeast-southwest–directed shortening across the northeastern Committee Bay area is manifested by kink- to chevron-style F_3 folds. Late-stage, northeast-directed shortening is also attributed to upright, gentle, northwest-striking F_3 crossfolds in the western part of the area (Sandeman et al., 2001c). Northeast-directed D_3 shortening postdates D_2, and likely formed at or prior to ca. 1.76 Ga, the time of widespread cooling and possible exhumation of the region (H. Sandeman, unpub. Ar-Ar data, 2002).

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