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Authors' addresses

Elizabeth Turner *(eturner@nrcan.gc.ca)*
626 Tumiit Building, P.O. Box 2319
Iqaluit, Nunavut X0A 0H0

Keith Dewing *(kdewing@nrcan.gc.ca)*
3303 - 33rd Street Northwest
Calgary, Alberta T2L 2A7

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Elizabeth Turner and Keith Dewing
Canada-Nunavut Geoscience Office, Iqaluit

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Abstract: Four zinc-lead showings are known from the Middle Ordovician Bay Fiord and Thumb Mountain formations at Rookery Creek on western Cornwallis Island. Mapping of the Rookery Creek area was updated at 1:50 000 scale. The geology is complex, with four fault sets superimposed on a broad anticlinorium. Three of four showings are at the intersection of a northwest-trending 'fulcrum fault', that forms the western edge of a half graben, with east-trending faults that offset stratigraphic units within the half graben. Despite the existence of three as yet untested areas in which mineralization might be expected, the attractiveness of Rookery Creek as an exploration target is reduced by the lack of a shale aquitard to mineralizing fluids, and by a low Pb/Zn ratio, suggesting a smaller fluid system than was present at Polaris mine. Other areas structurally similar to Rookery Creek and favourable for Zn mineralization, however, may be present elsewhere on the island.

Résumé : Au ruisseau Rookery, dans la partie ouest de l'île Cornwallis, on a identifié quatre indices de minéralisation de zinc-plomb dans les formations de Bay Fiord et de Thumb Mountain de l'Ordovicien moyen. Le levé de la région cartographique de Rookery Creek a été mis à jour à l'échelle de 1/50 000. La géologie est complexe; on y compte quatre jeux de failles dont les traces se superposent à celle d'un vaste anticlinorium. Trois des quatre indices minéralisés se trouvent à l'intersection de la « faille pivot » de direction nord-ouest qui forme la bordure ouest d'un demi-graben et de failles d'orientation est-ouest qui décalent les unités stratigraphiques dans le demi-graben. Même si l'on soupçonne la présence d'une minéralisation dans trois zones non encore vérifiées, la région cartographique de Rookery Creek offre un intérêt limité comme cible d'exploration, car il lui manque une couche de shale semi-perméable capable de piéger les fluides minéralisateurs, et le rapport Pb/Zn y est faible, indiquant un réseau d'écoulement de fluides plus limité qu'à la mine Polaris. Toutefois, il est possible que d'autres zones structuralement semblables à celle du ruisseau Rookery existent dans l'île et qu'elles soient favorables à la présence d'une minéralisation de Zn.

INTRODUCTION

Rookery Creek is on the western side of central Cornwallis Island (NTS 58 G/5, 75°23′N, 95°55′ to 75°18′N, 95°30′W; Fig. 1), about 40 km east of the Polaris mine and 60 km north of Resolute Bay. Zinc-lead mineralization was discovered in 1964 by prospectors from Bankeno Mines Ltd., and Cominco Ltd. acquired three mining leases totalling 2200 hectares (5437 acres) in the early 1970s. Cominco Ltd. drilled two diamond-drill holes in 1974 and 15 additional holes in 1992 without intersecting significant new mineralization. Subsurface mineral rights to land to the north, and surface rights to areas to the north and south are owned by Nunavut Tunngavik Incorporated.

With Polaris mine slated to close in 2002, the Canada-Nunavut Geoscience Office and GSC Calgary started a project to document the chemistry, structure, and stratigraphy of the Zn-Pb-Cu belt between Grinnell Peninsula and Somerset Island (Turner, 2001). This report summarizes the results of one part of that program in the form of an updated geological map of the Rookery Creek area. This area is of interest because it has a complex history of deposition, deformation, and erosion, and contains a half graben whose controlling structures are the locus of Zn mineralization.

GEOLOGICAL SETTING

The stratigraphic and structural summary that follows is modified from Okulitch et al. (1991) and Trettin (1991), unless otherwise noted.

The Ordovician succession in the Arctic represents a prolonged interval of slow subsidence on a passive margin, recorded by deposition of Lower to Upper Ordovocian platformal carbonate and evaporite rocks. Continued subsidence during the latest Ordovician resulted in southward migration of the shelf break. After the Late Ordovician the transition from shallow-shelf carbonate in the southeast, to basinal carbonate rocks and shale in the northwest, trended northeast across central Cornwallis Island.

Shelf carbonate rocks of latest Ordovician to earliest Devonian age consist of shallow-water fossiliferous limestone and dolostone. The basinal equivalents of these shelf carbonate units are the uppermost Ordovician to Upper Silurian, black, argillaceous carbonate rocks and shale of the Cape Phillips Formation. The upper part of the Cape Phillips Formation changes gradationally upward from shale with graptolites to fossiliferous limestone. This is overlain by the uppermost Silurian, shallow subtidal, crinoidal and reefal Barlow Inlet Formation.

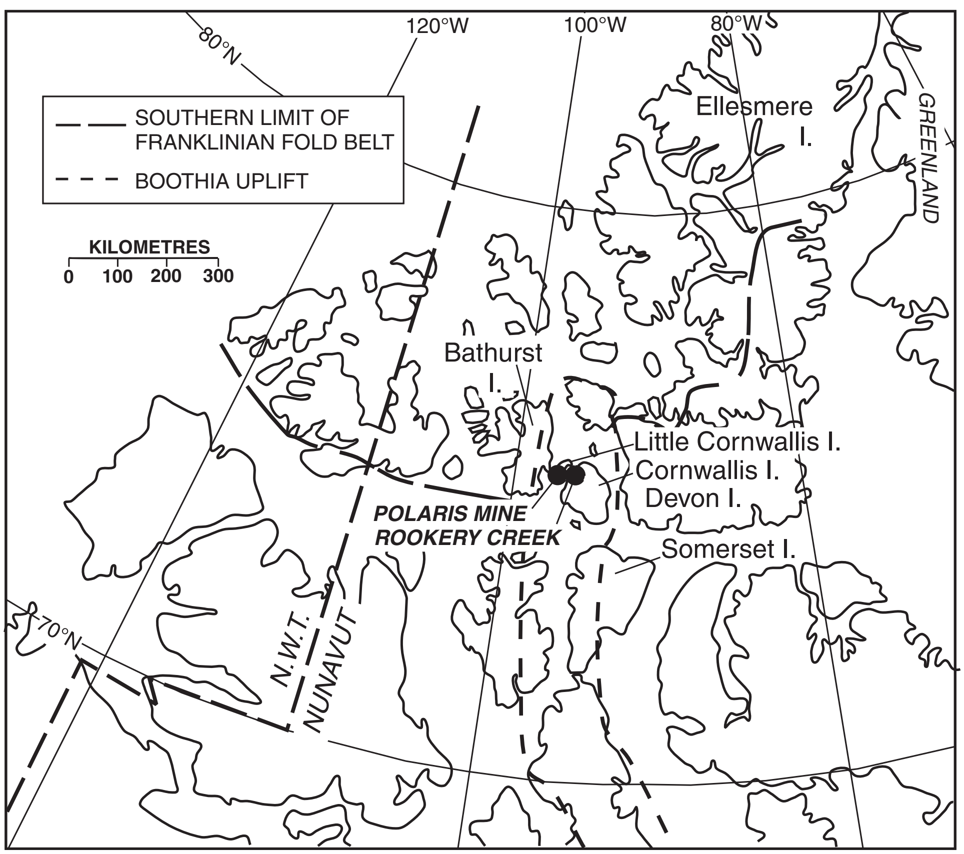


Figure 1. *Location of Rookery Creek map area on Cornwallis Island, with Boothia Uplift and southern limit of Ellesmerian Orogen after Trettin (1991).*

Progradation of the Barlow Inlet Formation during latest Silurian time as far west as Bathurst Island was propelled by the incipient development of the Boothia Uplift in this region, and is the earliest evidence of uplift. Deformation continued into the Early Devonian. Structures of the Cornwallis fold belt are presumably the result of basement-rooted, east-west compressional stress, and consist of northwest-trending folds, with décollement probably localized in Lower Ordovician evaporite units, and blind thrusts at the cores of the anticlinoria mapped at surface. The lack of seismic data, together with overprinting by later deformation currently limits structural interpretation on Cornwallis Island, but west-verging basement-cored thrusts are exposed elsewhere in the Boothia Uplift (Okulitch et al., 1991).

The sedimentary deposits resulting from uplift and erosion associated with the Boothia Uplift are conglomerate and sandstone locally preserved on Cornwallis, Devon, and Bathurst islands. These unconformity-bounded units are middle Early Devonian and represent alluvial fans and braided rivers that had source areas in the Boothia Uplift. The unconformity produced by subaerial exposure during the Cornwallis (Boothia) fold event was covered regionally by carbonate rocks of the late Early Devonian Bird Fiord Formation.

Overlying the Bird Fiord Formation are increasingly quartzose strata derived from the north and east. These were the result of progradation of a large clastic wedge that records the onset of north-south compression during the Middle Devonian–Early Carboniferous Ellesmerian Orogeny. Although most of the clastic wedge has been removed by subsequent erosion, at least 1–1.5 km of strata covered the Cornwallis area. The Boothia Uplift formed a structural buttress and hence did not experience the same degree of north-south shortening evident elsewhere (e.g. 25 km or 10% on Bathurst Island), although there is evidence for gentle folding perpendicular to the earlier folds of the Boothia Uplift. Shortening on the margins of the Boothia Uplift (e.g. northeastern Bathurst Island) was accommodated by large north-south strike-slip faults, some of which might have originally formed during development of the Boothia Uplift structures.

Development of the Sverdrup sedimentary basin on the northern and westernmost parts of the present Arctic Archipelago dominated the late Paleozoic and Mesozoic eras. The only strata of this interval on Cornwallis Island are terrestrial Cretaceous units preserved in grabens. Widespread erosion prevailed, removing much of the Devonian clastic wedge.

Eocene to Recent crustal compression (on northern Ellesmere Island) and extension (farther south) of the Eurekan Orogeny produced faulting as far south as Cornwallis Island, where high-angle normal faults produced horst-and-graben structures that define the present-day islands and straits.

MAP UNITS

The stratigraphic nomenclature follows that of Thorsteinsson (1980, 1986). Detailed descriptions of strata equivalent to most of the following units on Devon Island, 50–125 km north of Cornwallis Island, are presented in Mayr et al. (1998). A schematic stratigraphic section for Rookery Creek is presented in Figure 2, with the caveat that thicknesses and stratigraphic detail are estimates owing to the dearth of continuous outcrop.

Bay Fiord Formation (unit Ocb)

Lower Bay Fiord Formation (unit Ocb-l)

Interbedded light to dark brown, finely crystalline dolostone and anhydrite at the base of the formation have a thickness of more than 50 m on Cornwallis Island (Mayr, 1978). In surface exposures, the evaporite units are gypsum. The evaporite units are overlain by dolostone or limestone interbedded with green to grey mudstone. The carbonate units are grey to brown, commonly burrowed, argillaceous, nodular or with shaly partings, and typically mud grade. Terrigenous mudstone is finely laminated to massive, commonly with thin carbonate interbeds and rarely with soft-sediment deformation. Thickness is visually estimated at less than 100 m at Rookery Creek although there is no continuous exposure.

Upper Bay Fiord Formation (unit Ocb-u)

The remainder of the formation consists of interbedded green mudstone to siltstone and nodular grey dolostone or limestone. Carbonate units consist of grey, nodular wackestone with trilobite and brachiopod fragments (Fig. 3A). Mudstone and siltstone are green, massive to finely laminated, and locally display desiccation cracks. Proportions of carbonate and mudstone are subequal for the lower 5 m, but green mudstone predominates over rare carbonate interbeds or nodules in the upper 10–15 m. Total thickness is approximately 25 m. The contact with the overlying lower Thumb Mountain Formation is sharp.

Thumb Mountain Formation (unit Oct)

Lower Thumb Mountain Formation (unit Oct-l)

The lower part of the Thumb Mountain Formation is approximately 250 m thick and consists of dolomitic limestone or dolostone. Near its base is a marker unit of thick-bedded to massive, slightly mottled limestone or dolostone up to 45 m thick, which contains disseminated, dark brown, lightly silicified fossil material (predominantly nautiloid and brachiopod fragments) and chert-replaced cylindrical burrows about 1 cm in diameter (Fig. 3B). Strata above this unit consist of medium- to thick-bedded, pale grey dolostone or lime mudstone, commonly containing ostracodes, and, locally, burrowed skeletal wackestone to packstone. Metre-scale cycles of mottled dolostone overlain by plane-laminated dolostone are common (Fig. 3C). This approximately 180 m interval is distinguished from the Bay Fiord Formation by its much thicker bedding and lack of shaly interlayers. The uppermost 10–20 m of the lower Thumb Mountain Formation, known as the *Tetradium* zone on Little Cornwallis Island (Sharp et al., 1995), contains rare to abundant *Tetradium* (a possible coral characterized by millimetre-scale calcite-filled tubes, usually with square cross-sections). Two rock types are

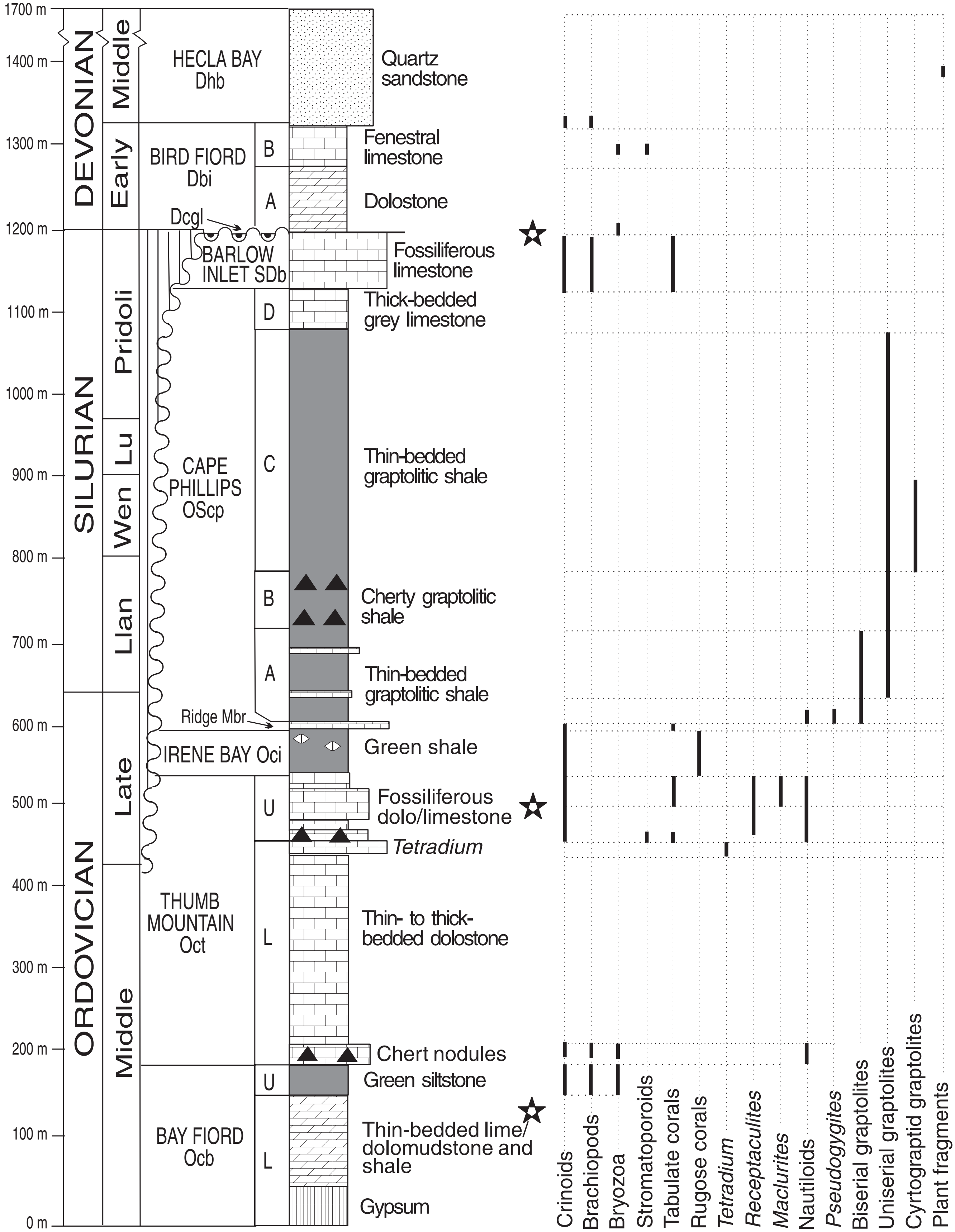


***Figure 2**. Stratigraphic column for the Rookery Creek area. Llan = Llandovery, Wen = Wenlock, Lu = Ludlow. Fossil assemblages help to identify stratigraphic units in the field. Filled triangles = chert, stars = sulphides.*

present in the *Tetradium* zone, interbedded at 40 cm to 1 m scale: beige wackestone, commonly dolomitized, with 10–20% ostracodes, gastropods, and *Tetradium* fragments and faint, light grey mottling; and light brown, massive lime mudstone or dolomudstone with sparse fenestrae and planar bed contacts. Weathered surfaces of dolomitized *Tetradium* zone rock display distinctive, resistant, millimetre-scale, white tubes (Fig. 3D), whereas rocks that remain limestone must be broken and examined with a hand lens to identify the minute *Tetradium* tubes. The transition to upper Thumb Mountain Formation is gradational.

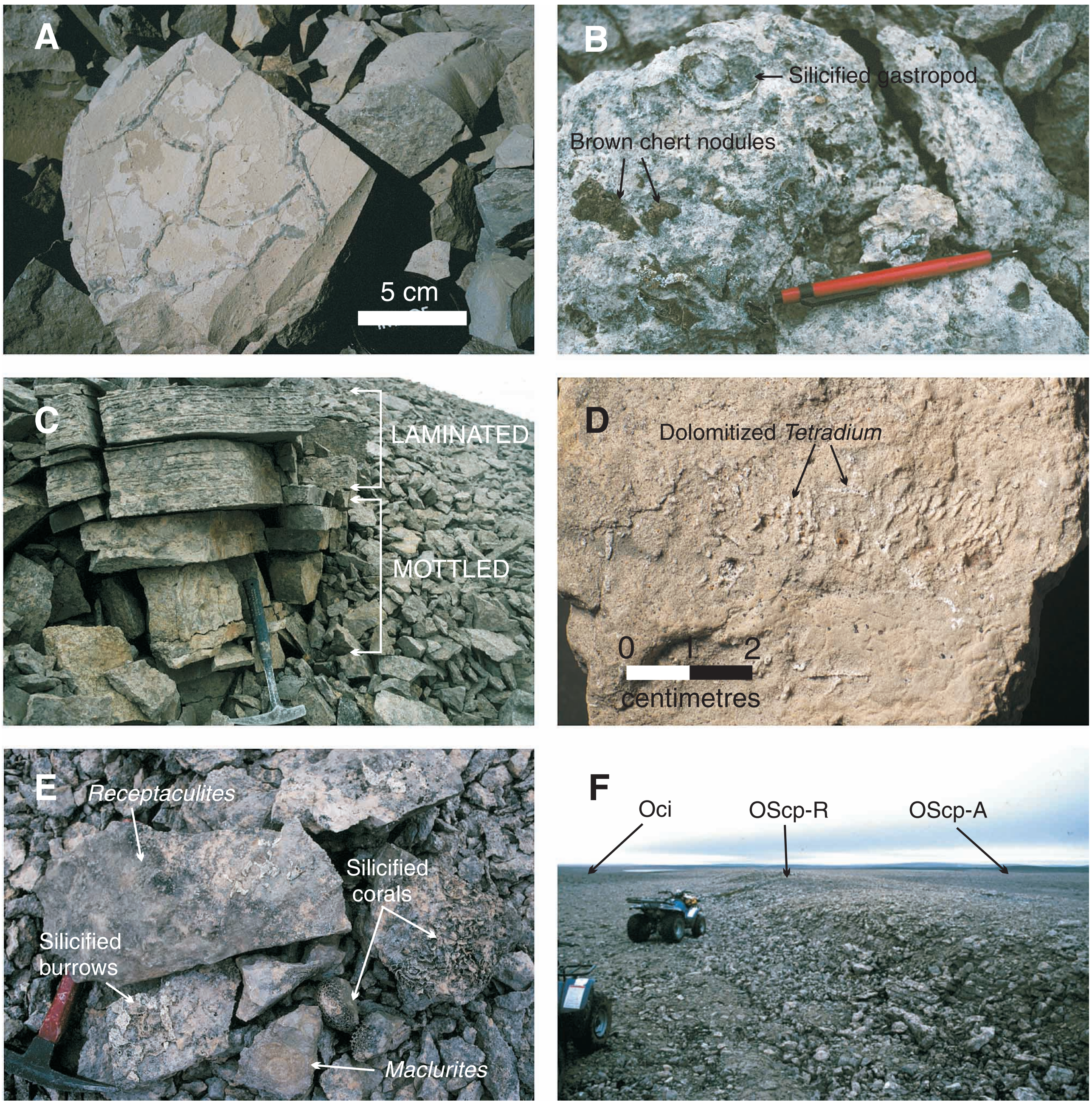


Figure 3. *Ordovician map units.* ***A****) Upper Bay Fiord Formation (unit Ocb) mudcracked siltstone.* ***B****) Chert marker in lowest Thumb Mountain Formation (unit Oct-l).* ***C****) Metre-scale cyclic units in the lower Thumb Mountain Formation (unit Oct-l). Hammer for scale.* ***D****) Dolomitized* Tetradium *zone rock, lower Thumb Mountain Formation (unit Oct-l).* ***E****) Chert marker from lower upper Thumb Mountain Formation (unit Oct-u).* ***F****) Typical exposure of the ridge-forming member of the Cape Phillips Formation (unit OScp-R). All-terrain vehicle about 1 m high.*

Upper Thumb Mountain Formation (unit Oct-u)

The upper Thumb Mountain Formation is approximately 80 m thick, and consists of a well defined succession of rock units at Rookery Creek. A basal chert marker (about 10 m thick; Fig. 3E) consists of dolomitized, burrow-mottled skeletal wackestone with white-weathering silicified burrows several centimetres in diameter, and scattered silicified chain corals and stromatoporoids. Above this is a approximately 50 m thick unit of partly dolomitized, burrow-mottled, medium-bedded skeletal wackestone containing sparse macrofossils (predominantly *Receptaculites*). This is followed by about 20–30 m of massive, buff-weathering fossiliferous dolostone containing abundant poorly preserved macrofossils (particularly *Receptaculites* and *Maclurites*). The uppermost part of the Thumb Mountain Formation at Rookery Creek consists of 20–25 m of argillaceous, locally dolomitized nodular skeletal wackestone with interbedded green terrigenous mud. This unit outcrops rarely, and grades up into the Irene Bay Formation as the proportion of terrigenous mud increases.

Irene Bay Formation (unit Oci)

The recessive Late Ordovician Irene Bay Formation is approximately 50 m thick at Rookery Creek, and consists of grey-green shale with 0–50% skeletal wackestone nodules 4–10 cm in diameter. Its lower contact is difficult to pinpoint owing to lack of outcrop and the gradational contact with the argillaceous upper Thumb Mountain Formation. Areas underlain by Irene Bay Formation rocks are generally topographically low and wet, although intervals containing comparatively high volumes of carbonate nodules, particularly towards the upper part of the formation, may be expressed as nodule-littered knolls. Transition to the Cape Phillips Formation is gradational over several metres.

Cape Phillips Formation (unit OScp)

This formation spans the Upper Ordovician to Upper Silurian, and is approximately 550 m thick on Little Cornwallis Island (Héroux et al., 2000). Five stratigraphic units are recognized (Fig. 2), which can be further subdivided into 18 biostratigraphic zones based on graptolite content (Melchin, 1989; Lenz and Melchin, 1990).

Ridge-forming member (unit Oscp-R)

Orange- to brown-weathering, massive dolomitic to calcareous wackestone contains 20% by volume of millimetre-scale crinoid, brachiopod, and trilobite fragments. At Rookery Creek, the ridge-forming member is 7–15 m thick and consists of a 4 m thick unit of resistant, massive, irregularly parted dolomitic limestone, overlying 4–11 m of similar dolomitic limestone interbedded with green-grey shale. It forms extensive, linear ridges about 20–40 m wide that rise some 10 m above the surrounding low ground which is underlain by Irene Bay and Cape Phillips Formation rocks; these ridges are littered with distinctive orange-weathering felsenmeer and locally graced with a low 1–1.5 m outcrop (Fig. 3F). The contact with overlying argillaceous carbonate rocks is abrupt.

Member A (unit OScp-A)

This 115–130 m thick unit consists of thin-bedded, grey to black bitumenous limestone or dolostone, with about 20% argillaceous matter, and locally abundant calcareous or dolomitic nodules where argillaceous content is high. Graptolites demonstrate that it spans the Upper Ordovician *fastigatus* to middle Llandovery *minor* zones. The basal 30 m of member A (*fastigatus* zone) are black, highly bitumenous, and rich in trilobites and cephalopods. Strata higher in member A are less bitumenous and contain only graptolites.

Member B (unit OScp-B)

Black, cherty or dolomitic siltstone and mudstone (Fig. 4A) are medium to thick bedded, with abundant pyrite and fractures. Carbonate concretions 5–50 cm in diameter are abundant. Upper and lower contacts are gradational. On Little Cornwallis Island, member B spans the middle Llandovery *turriculatus* to basal portion of the late Llandovery *sakmaricus* zones and is 50–60 m thick (Melchin, 1989).

Member C (unit Oscp-C)

Thin-bedded, medium to dark grey dolomitic siltstone and mudstone contain abundant graptolites. This member is lithologically monotonous and spans 10 graptolite zones with a total thickness of 320 m on Little Cornwallis Island (Heroux et al., 2000). Three crude biostratigraphic assemblages are recognized: 1) Cyrtograptid assemblage (*sakmaricus* to *testis* zones) which corresponds to the Wenlock; 2) Bohemograptid assemblage (*dubius* to *tenuis* zones) which corresponds to the Ludlow; and 3) Pseudomonoclimacis assemblage (*parultimus* and *ultimus* zones) which are Pridoli.

Member D (unit OScp-D) (new subdivision)

Thickly bedded, light to medium grey lime mudstone (Fig. 4B) and siltstone contain rare gastropods, inarticulate brachiopods, and nautiloids. The lower contact is defined by a distinct change from thin to thick bedding. Member D is at least 50 m thick and spans the upper part of the *ultimus* and most of the *birchensis* graptolite zones. At Rookery Creek, it is overlain by the Barlow Inlet Formation with a sharp, possibly erosive contact.

Barlow Inlet Formation (unit SDb)

This highly fossiliferous limestone consists of thin-bedded, nodular, light to medium grey wackestone, packstone, floatstone, and rudstone containing abundant brachiopods, crinoids, and trilobites, and medium-bedded crinoid grainstone with abundant corals, stromatoporoids, and brachiopods. The thickness and age extent of this formation at Rookery Creek are as yet uncertain.

Conglomerate (unit Dcgl)

Polymictic conglomerate locally unconformably overlies Ordovician and Silurian rocks (Fig. 4C). Clasts are subangular to rounded, equant to oblate, moderately sorted, and typically 0.5–5 cm in diameter (largest 30 cm). The conglomerate is apparently absent at the base of the Bird Fiord Formation along the unconformity in the half graben. Clasts are red, yellow, brown, grey, and white carbonate, with rare chert and quartz sandstone fragments. Clasts are framework supported and commonly imbricated, with a matrix of pink to white, fine to coarse carbonate sand. Beds are from 10 cm to 40 m thick. Conglomerate units consisting of pebble-sized clasts locally contain ramose bryozoan fragments. Original thickness is unknown and would presumably have been extremely variable.

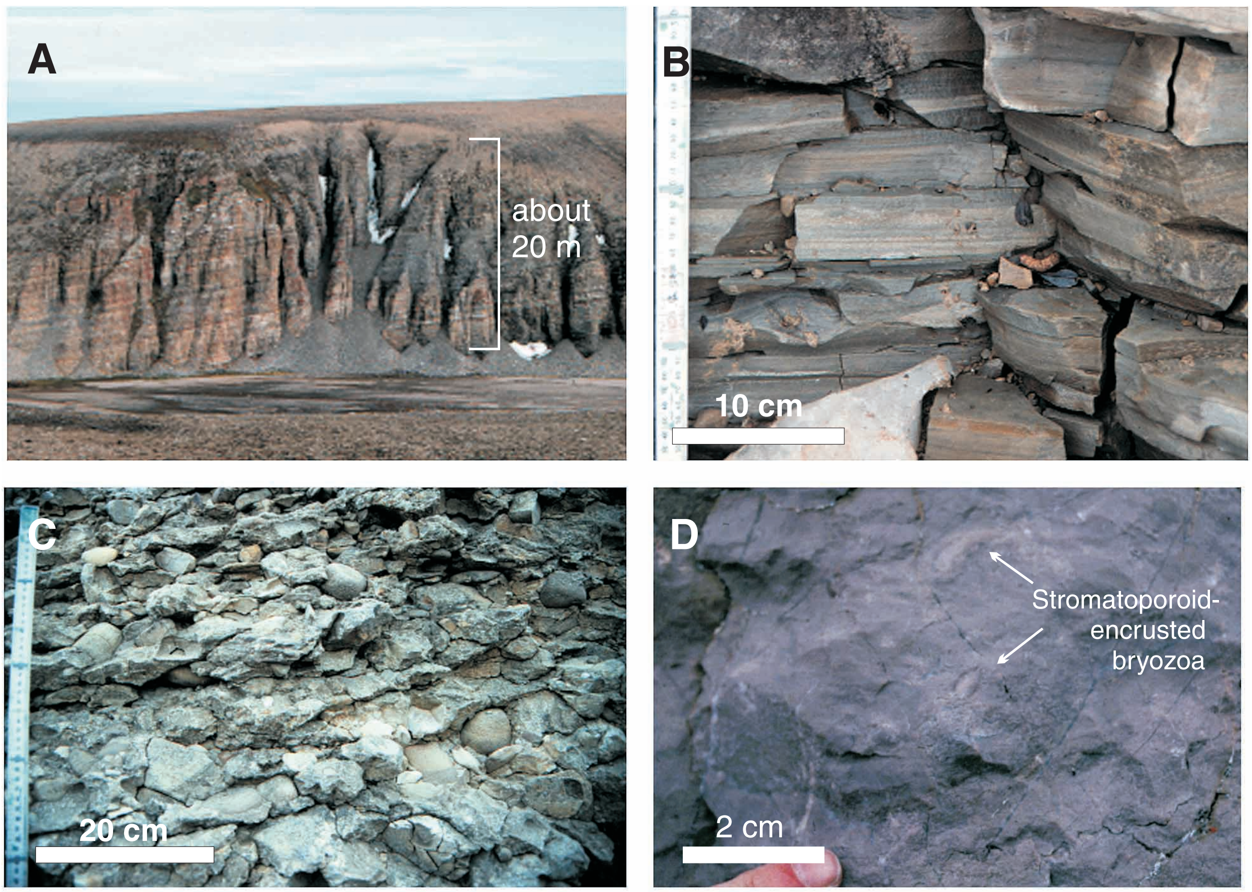


Figure 4.

Silurian and Devonian map units. ***A****) Cape Phillips (unit OScp) member B on Rookery Creek.* ***B****) Argillaceous lime mudstone of Cape Phillips Formation, member D.* ***C****) Devonian conglomerate unit (unit Dcgl).* ***D****) Fenestral lime mudstone of Bird Fiord Formation (unit Dbi), member B locally contains bryozoa and stromatoporoids.* ***E****) Typical exposure of poorly indurated quartz arenite of the Hecla Bay Formation (unit Dhb). All-terrain vehicle for scale.*

Bird Fiord Formation (unit Dbi)

Two members of this formation are present at Rookery Creek. Member A consists of flaggy- to platy-weathering, finely crystalline, buff to dark brown dolostone with few distinguishing characteristics. Very rare beds containing intraclasts or poorly preserved skeletal material are locally present. The unit is estimated to be approximately 50–75 m thick, and has been documented only in felsenmeer.

Member B is a resistant-weathering, pale grey, massive fenestral lime mudstone. Rarely, it contains sparse ramose bryozoans and stromatoporoid oncoids (Fig. 4D); a skeletal rudstone of silicified bryozoa and stromatoporoids is also locally present. The member is estimated to be 30–50 m thick. Members C and D of the Bird Fiord Formation as described from Devon Island (Mayr et al., 1998) have not been documented at this locality. Contact relationships have not been observed.

Hecla Bay Formation (unit Dhb)

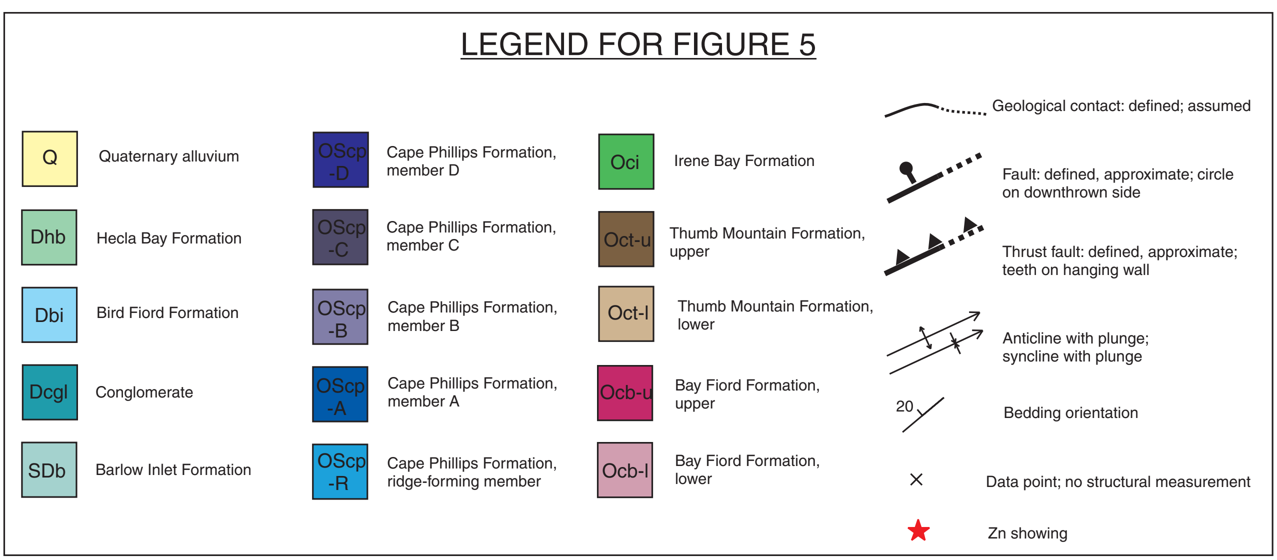
This formation consists of unlithified to moderately lithified, variably micaceous quartz sand (Fig. 4E). Lithified sandstone is locally exposed in the central to eastern part of the area mapped as Hecla Bay Formation; these exposures consist of easily eroded, sphaeroidally weathering outcrops. Weathering colours include white, yellow, pale grey, and maroon. Particles are fine to medium grade and moderately rounded. Sedimentary structures present in better lithified exposures include plane lamination and trough cross-stratification up to 20 cm thick. Fossil material is present at two levels. One fossiliferous interval consists of centimetre-scale parted, dark green-grey quartz sandy skeletal grainstone containing abundant trilobite and crinoid fragments and whole atrypid brachiopods. The other interval consists of quartz arenite with abundant plant remains. If structural measurements from the west-central part of the half graben apply across the width of the structure, the Hecla Bay Formation may be approximately 400 m thick. Given the sparse and structurally convoluted nature of Hecla Bay outcrops, it is unclear whether this extrapolation is valid.

STRUCTURAL GEOLOGY

The Rookery Creek area sits on the western flank of a 10 km wide, north-northwest-trending anticlinorium (Thorsteinsson, 1986), interpreted to have resulted from development of the Boothia Uplift in the late Silurian–early Devonian. The anticline axis is just east of the area mapped in this study. Within the approximately 100 km^2 of the map area, excluding rocks within the half graben, Ordovician and Silurian units are in general gently west dipping (10–15°; Fig. 5). The sub-Devonian unconformity cuts across these west-dipping strata, from west to east: in the western part of the map area, Devonian rocks overlie the uppermost member of the Cape Phillips Formation, whereas in the central area, Devonian rocks overlie upper Thumb Mountain Formation strata. In the eastern part of the map area, Devonian rocks would presumably have overlain the now eroded lower Thumb Mountain Formation strata. This means that almost 600 m of apparent downcutting took place over the 4 km perpendicular to strike between the western and central parts of the map area as erosional levelling of the folded Boothia landscape took place.

Decametre- to kilometre-scale north-trending folds formed during development of the Boothia Uplift are present within the larger anticlinorium, but evidence for later Ellesmerian cross folding is poorly defined owing to the dearth of outcrop. One fault, interpreted as a thrust, runs parallel to the strike of stratigraphic units on the flank of the anticlinorium and cuts subtly upsection through basal units of the Cape Phillips Formation (not visible at the scale of Fig. 5). The map area is riddled with brittle faults, interpreted as subvertical, which trend north-northeast, northwest, and north, although no pervasive pattern is evident. Many of these faults have vertical displacement, but some have negligible cumulative movement. The general picture is one of complex and repeated block-faulting.

Rocks exposed within the half graben, located in the south-central part of the map area, consist of flat-lying Thumb Mountain Formation strata unconformably overlain by east-northeast-dipping Devonian units. The graben-boundary fault is arcuate, steep to vertical, and juxtaposes Ordovician Bay Fiord Formation



rocks with strata of the Devonian Hecla Bay Formation. Half-graben formation postdates subaerial exposure and Devonian sedimentation. In this part of the map area, the sub-Devonian unconformity would have been approximately at the level of the upper lower Thumb Mountain Formation, so the fault probably represents at least 500–750 m of vertical offset (units Oct-l+Dbi+Dhb). At several locations along its length, 10–80 m wide and up to 1 km long splinters of chaotically disposed, competent Bird Fiord Formation limestone are caught up along the fault surface, between Bay Fiord and Hecla Bay formation blocks (Fig. 6).

In the central and southern part of the half graben, the western limit of rocks affected by rotation along the graben-margin fault is delimited by a north-northwest-trending 'fulcrum fault' having minimal west-side-down movement (drops argillaceous upper

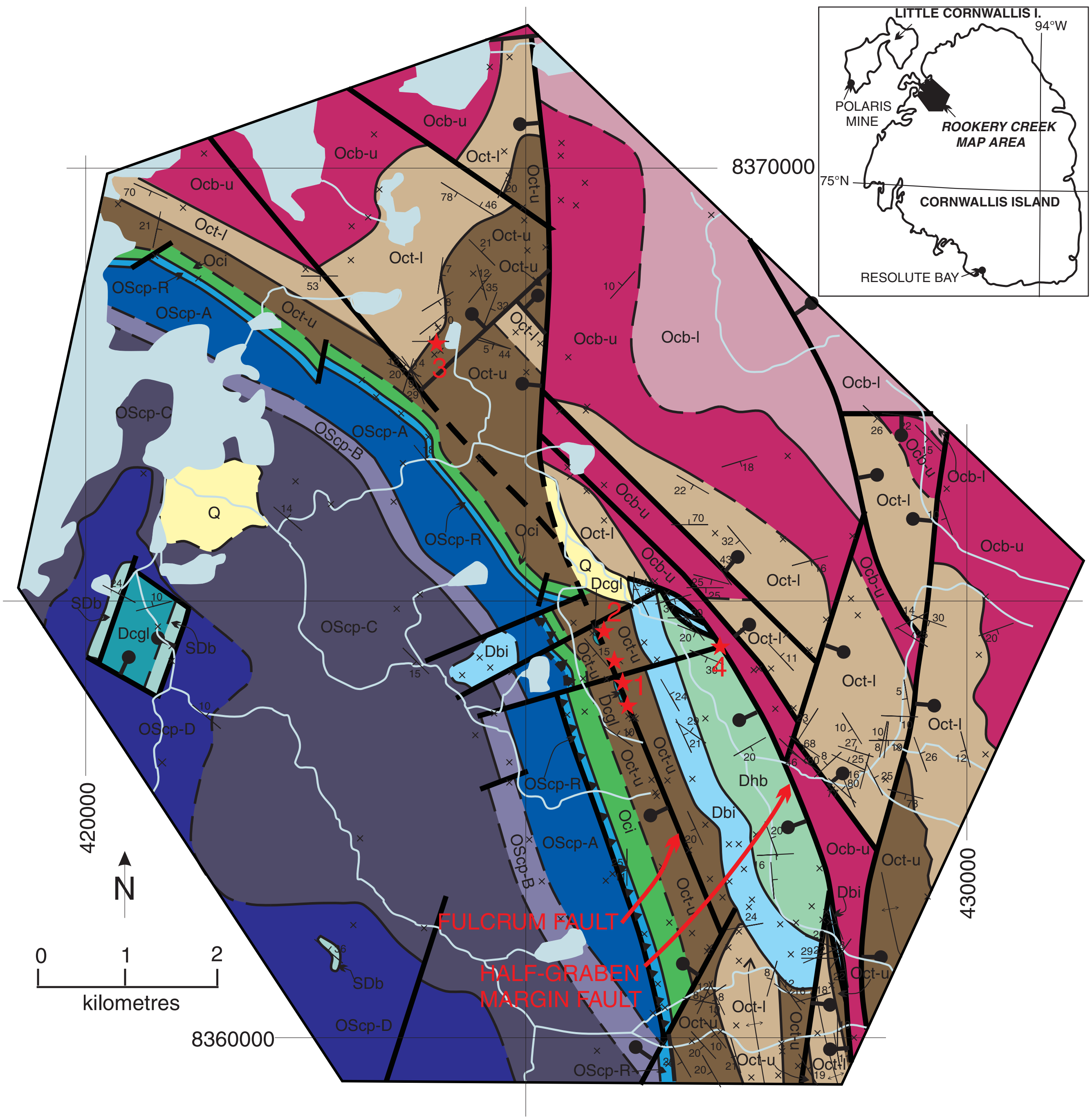


Figure 5. Geological map of the Rookery Creek half graben and associated showings, Cornwallis Island. Grid co-ordinates are NAD 83. 1= South showing; 2= Central showing; 3= North showing; 4= East showing.

Figure 6. Chaotic blocks of Bird Fiord Formation limestone in graben-margin fault zone. Geologist for scale.

Thumb Mountain Formation to same level as upper Thumb Mountain dolostone). This fault served as a hinge around which strata in the southern part of the graben rotated. West of this fault, strata are oriented in the regional, gently west-dipping orientation, and are not affected by eastward downdropping of the graben. East of this fault, graben formation rotated Thumb Mountain Formation strata back to a roughly horizontal orientation, and Devonian strata to a moderately east-dipping orientation (about 20–25°). In the northernmost part of the half graben, a broader area has been affected by rotation during half-graben formation. Movement along the graben-margin fault is moderated by east-northeast-trending cross faults that extend west beyond the north-northwest-trending fulcrum fault into the area underlain by Cape Phillips Formation strata; vertical displacement at the eastern limit of the blocks defined by these cross faults is large, whereas displacement dies out to nothing at their western extreme. These cross faults, together with the north-northwest-trending fulcrum fault and the graben-margin fault, control the distribution of the main showings at Rookery Creek.

The continuation of the fulcrum fault to the northwest of the half graben is buried by Quaternary sediment in the valley of Rookery Creek. The fulcrum fault is interpreted to continue under the area of poor exposure and connect to a northwest-trending fault that runs roughly parallel to the ridge-forming member of the Cape Phillips Formation in the northwest part of the map area. This fault is similar to the fulcrum fault in that it separates more steeply dipping strata to the west from gently dipping strata to the east.

Relative ages of the faults are difficult to determine. The thrust at the base of the Cape Phillips Formation is probably synchronous with the Boothia Uplift based on its vergence, and because it is crosscut by other faults. The second generation of faulting appears to be the two north-trending faults, roughly at grid lines 425000 and 430000. The third generation of faulting appears to be the northwest-trending fault swarm including the fulcrum fault and bounding fault of the half graben; these faults generally terminate against the north-trending faults rather than being offset by them. The youngest set of faults, the three east-trending faults at the centre of the map area (just south of 8365000), moderate half-graben width and displacement at the graben-margin fault. These faults appear to control the location of mineralization. If the age of mineralization at Rookery Creek is the same as at Polaris mine (365 Ma; Christensen et al. (1995)), then the three episodes of brittle faulting must be earlier than 365 Ma.

MINERALIZATION

Zinc showings in the Rookery map area (Fig. 5) are generally signalled by rusty weathering. Four main showings are present.

The central showing (#2, Fig. 5; 130 x 8 m plan extent) and southern showing (#1, Fig. 5; 200 x 6 m) are located in felsenmeer along the north-northwest-trending, low-displacement normal fulcrum fault. Sulphides are concentrated where east-trending faults cross the fulcrum fault, and are in the dolostone unit of the upper Thumb Mountain Formation. Mineralization consists of dark brown sphalerite with minor carbonate, mainly along fractures, but also locally associated with solution breccia. Galena, iron-sulphide, and pyrobitumen are rare. Rusty weathering is limited to the northern end of the elongate southern showing, near the east-west cross fault. Both the central and south showings also contain partially mineralized rubble of the Devonian conglomerate unit, suggesting not only that different stratigraphic units are hosting sulphides, but also that the upper Thumb Mountain Formation horizon that became mineralized was close to the sub-Devonian unconformity and might have been affected by ground-preparing diagenesis as a result of lengthy subaerial exposure.

The eastern showing (#4, Fig. 5; 5 x 5 m plan extent) is located where the graben-margin fault intersects one of the east-trending cross faults; mineralization is in dolostone felsenmeer of the upper Bay Fiord Formation. The area of rusty weathering and mineralized rubble is small, but abundant dark brown sphalerite and sparry dolomite are present in the gravel-sized material suggesting local high-grade material.

The northern showing (#3, Fig. 5; 40 x 8 m) is not obviously associated with any structural feature. Dark brown sphalerite and galena fill moulds of macrofossils in lower upper Thumb Mountain Formation dolostone, and are not associated with significant sparry carbonate.

Drilling on the Rookery Creek property consists of fourteen holes spaced at 1 km intervals along the OScp-R–OScp-A unit contact (1992), one hole about 30 m east of the central showing, collared in unit Octu (1992), one hole 150 m southwest of the central showing (1970s), collared in unit Oci shale, and one hole 20 m west of the north end of the south showing, collared in upper unit Octu (1970s).

Mineralization in the Rookery Creek area seems to have several controls.

Three of the four showings are located on faults or near fault intersections associated with a half graben. It is unknown whether these normal faults formed a result of local extension during Ellesmerian compression of already complexly deformed rocks, or during early Carboniferous relaxation of the Ellesmerian Orogen.

The rock units that host mineralization were are all dolomitized prior to mineralization, with the possible exception of the Devonian conglomerate. The dolostone unit of the upper Thumb Mountain Formation is a significant host, and upper Bay Fiord Formation dolostone may be important as well.

The central and southern showings are in strata that are known to have been close to the sub-Devonian unconformity, leading to the possibility that diagenetic alteration of rocks immediately below the unconformity played a role in increasing permeability.

Given the disposition of prospective rock units with respect to important faults at the time of mineralization (presumably latest Devonian or early Carboniferous), and the composition (units Oct-u and Ocb dolostone, Dcgl conglomerate) of the zinc-hosting units, metalliferous fluids might be expected to have migrated up through the fulcrum fault and its crosscutting faults into favourably disposed strata of the prospective hosts. In the case of the central and south showings, west of the fulcrum fault, Ordovician strata dip west and belong to the argillaceous part of the upper Thumb Mountain Formation, an inauspicious combination. East of the fault, Ordovician strata are roughly horizontal and belong to the dolostone unit of the upper Thumb Mountain Formation. If more extensive mineralization had taken place, it might be expected in the area east of the fulcrum fault where flat-lying upper Thumb Mountain dolostone units are in close proximity to the fulcrum fault, the east-northeast-trending cross fault, and the sub-Devonian unconformity; however, the absence of an aquitard cap rock here is problematic.

In the case of the eastern showing, mineralization could conceivably continue within lower parts of the upper Bay Fiord Formation dolostone adjacent to the graben-margin fault where the east-northeast-trending cross fault terminates. Mineralization is also plausible within any of the prospective host units adjacent to the cross fault beneath the Devonian cover rocks in the half graben. Features controlling the northern showing are not well understood.

The large untested areas beneath the Devonian in the half graben, beneath covered areas in Rookery Creek valley, and beneath the dolomitized Cape Phillips Formation due west of the three main showings, along with the thermal anomaly documented by Heroux et al. (2000), indicate potential for further discoveries at Rookery Creek. Two factors dampen the hope for a Polaris-scale discovery: the Irene Bay Formation in the vicinity of the half graben was eroded prior to the Devonian, so there was no impermeable cap to prevent fluid escape (Randell, 1994), and the low Pb/Zn ratio compared to Polaris mine may suggest a smaller, less intense mineralizing system. Areas possessing similar extensional Ellesmerian structures and more propitious host-cap rock geometries may exist elsewhere on Cornwallis Island, however, and could be favourable exploration targets.

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