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CANADIAN GEOSCIENCE MAP 132
PRECAMBRIAN BEDROCK GEOLOGY
SOUTHAMPTON ISLAND
Nunavut



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Cover Illustration

Shallowly foliated to gneissic granitoid rocks (unit Agd) containing a rust-weathering ultramafic inclusion (unit Aum) exposed on the northeast coast, Southampton Island, Nunavut. Caribou (1.2 m high) in foreground. Photograph by M. Sanborn-Barrie. 2013-260

ABSTRACT

Southampton Island, Nunavut, is situated between the Archean-dominated western Churchill Province and the Paleoproterozoic Baffin-Ungava segment of the Trans-Hudson Orogen. The island exposes a highland of Precambrian basement across much of its eastern half and flat-lying Paleozoic carbonate strata across its western half. The Precambrian basement complex consists predominantly of 3000–2700 Ma tonalite-granodiorite-granite gneiss, containing enclaves and inclusions of ca. 3 Ga mafic-ultramafic-anorthositic plutonic rocks and lesser metasedimentary rocks. A smaller proportion of Paleoproterozoic gabbroic and granitic plutons also occurs. These rocks experienced profound amphibolite- to granulite-facies tectono-metamorphic reworking at 1880–1820 Ma, during the Trans-Hudson Orogen collision between the Rae and Superior cratons, resulting in their strongly foliated to gneissic character, followed by exhumation and cooling at 1790–1780 Ma.

RÉSUMÉ

L'île Southampton (Nunavut) est située entre le domaine à prédominance de roches de l'Archéen de la Province de Churchill occidentale et le segment Baffin-Ungava de l'orogène trans-hudsonien du Paléoprotérozoïque. La majeure partie de la moitié orientale de l'île est occupée par des hautes terres qui mettent au jour un socle précambrien alors que la moitié occidentale laisse voir des strates carbonatées du Paléozoïque disposées à plat. Le socle précambrien est constitué principalement de gneiss tonalitiques-granodioritiques-granitiques datant de 3000-2700 Ma qui renferment des enclaves et des inclusions d'environ 3 Ga de roches plutoniques mafiques-ultramafiques-anorthositiques et de moindres quantités de roches métasédimentaires. Une plus faible proportion de plutons gabbroïques et granitiques du Paléoprotérozoïque sont également présents. Ces roches ont été soumises à un profond remaniement tectonométamorphique au faciès des amphibolites-granulites à 1880-1820 Ma lors de la collision trans-hudsonienne entre les cratons de Rae et du lac Supérieur, ce qui est à la source de leur nature fortement foliée à gneissique, événement qui a été suivi d'une exhumation et d'un refroidissement à 1790-1780 Ma.

ABOUT THE MAP

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Mean magnetic declination 2014, 21°44'W, decreasing 17.6' annually. Readings vary from 17°39'W in the SW corner to 25°30'W in the NE corner of the map.

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ABOUT THE GEOLOGY

Descriptive Notes

Southampton Island, Nunavut, is situated within a 400 km gap between the Archean-dominated western Churchill (Rae, Hearne) Province and the Paleoproterozoic Baffin-Ungava segment of the Trans-Hudson collisional orogen (Fig. 1). It exposes a Precambrian high-grade gneiss complex dominated by plutonic rocks with remnants of ultramafic-mafic-anorthositic intrusions and metasedimentary rocks. The plutonic gneiss complex consists of a component of ca. 3.68–3.39 Ga tonalite-granodiorite (unit *Atn*), cut by widespread 2.77–2.76 Ga orthopyroxene-bearing tonalite-quartz diorite (unit *Atg*) and 2.75 Ga biotite granodiorite (unit *Agd*). Anorthositic (unit *Aan*), ultramafic (unit *Aum*) and gabbroic (unit *Agb*) plutonic rocks commonly occur as inclusions in unit *Atg* and unit *Agd*, and form one of the oldest components of the island, with isotopic and zircon trace-element data (Rayner et al., 2012) pointing toward a ca. 3.0 Ga ancestry (map symbols #20, #31; Table 1). Lesser 2692 ± 6 Ma hornblende monzogranite (unit *Agd_{Hb}*) is prevalent in the northern Duke of York Bay region. Magnetite-bearing biotite monzogranite dated at 2618 ± 4 Ga (unit *Agg*) forms coherent phases locally expressed by high-intensity aeromagnetic signatures (Fig. 2).

Also contained within the plutonic gneiss complex are semipelitic (unit *Asp*) and psammitic (unit *Aps*) rocks that typically occur as panels less than 100 m wide, but

locally attain a thickness of 1–2 km. These metasedimentary rocks, which everywhere lack primary textures, are demonstrably Archean in the central part of the basement complex where they are cut by 2.68 Ga peraluminous granite (map symbol #26; Table 1). Associated quartz-rich clastic rocks (unit Aqz) and magnetite-bearing oxide-facies iron-formation (unit A_{Fe}), the latter typically associated with semipelite, occur at numerous localities along the length of the northeastern coast of the island and are inferred to be Archean.

A north-trending corridor proximal to the western margin of the exposed basement is characterized by a low-intensity aeromagnetic signature (Fig. 2) and by sparse exposures of psammite-quartzite±semipelite (unit P_{As}) and calc-silicate (unit P_{Ac}). Detrital zircon in quartzite establishes this sequence was deposited after ca. 2615 Ma (map symbol #9; Table 1), distinctly younger than semipelitic rocks (unit A_{sp}) elsewhere on the island. The lithological association of quartzite–calc-silicate opens the possibility that this sequence may be a remnant of Paleoproterozoic cover rocks recognized elsewhere on the Rae Craton (Rainbird et al., 2010). Notable other potential supracrustal rocks of uncertain age include dark green-weathering amphibolite gneiss (unit P_{Aam}) the fine (less than 2 mm) grain size of which at amphibolite facies is suggestive of a volcanic origin.

Paleoproterozoic rocks are mainly plutonic, with most voluminous components represented by 1852 ± 8 Ma granodiorite (unit P_{mz}) and massive to weakly foliated 1822 ± 3 Ma syenogranite (unit P_{gr}). Lesser mafic plutonic components include 2.06 Ga gabbroic anorthosite (unit P_{gb}) and 1.84 Ga quartz diorite (unit P_{dr}).

Gossanous outcrops sampled for multi-element assay (Table 2) are mainly developed in iron-formation±chert interstratified with semipelite or ultramafic-mafic plutonic rocks, particularly those in contact with metasedimentary rocks. Although gossanous semipelite only rarely contains elevated metal contents (i.e. samples 23, 26, 27, 45, 57; Table 2), iron-formation at several localities has elevated Au, Pt-Pd±sulphide minerals (samples 5–7, 82; Table 2). Gossanous peridotite more commonly contains sulphide minerals (samples 33–35), elevated Au (samples 36–40), and/or elevated Pd±Pt (samples 64–70; Table 2).

The map area is characterized by moderately to strongly developed, shallow-dipping, gneissic foliation (Fig. 3, 6) commonly displaying inclined to overturned folds, the axial plane of which is parallel to the dominant foliation (Fig. 3a, b). Two penetrative deformational events (D₁ and D₂) are established by overprinting fabric relationships and by recognition of folded foliation (S₁) in the hinge zones of the dominant fold set (Fig. 3a, b, 5), establishing the latter as F₂. Where recognized, S₁ is a moderately to steeply inclined planar-tectonic fabric (Fig. 4), typically defined by high-grade mineral alignment, leucosome, and/or compositional layering. In metasedimentary rocks, S₁ is defined by aligned sillimanite, whereas orthopyroxene and biotite define S₁ in granodiorite. The attitude of S₁ is highly variable due to strong reworking during subsequent deformation. Where least reworked in the north, S₁ strikes north to northwest. In the southwest, where exposure is less continuous, S₁ is inferred to have been at a high angle to the south- and southeast-striking S₂ foliation. Elongate monazite inclusions that contribute to S₁ within garnet porphyroblasts yield a mean U-Pb SHRIMP age of 1881 ± 6 Ma for metamorphism (M_{P2}) at an early stage of penetrative D₁ deformation (Berman et al., 2013).

The dominant structures across the area are attributed to D_2 , given that S_1 is generally either reoriented about F_2 folds or transposed into parallelism with F_2 axial planes. D_2 resulted in tight, inclined to recumbent, west- to southwest-trending, south- to southeast-vergent F_2 folds (Fig. 3a, b) and/or relatively straight panels of shallow-dipping S_1+S_2 transposition foliation (Fig. 3c, 6). D_2 folds and fabrics define a broad bend at the scale of the exposed basement such that, in the north, $S_2\pm S_1$ strikes southwest, with progressively more southerly orientations along the western margin of the exposed basement. This bend, or orocline, is thought to reflect syn- D_2 boundary conditions, rather than a separate, subsequent buckling event, given the absence of suitably oriented overprinting structures that would accommodate this amplitude of post- D_2 buckling. S_2 mineral assemblages regardless of orientation indicate upper amphibolite- to granulite-facies conditions, consistent with the ubiquitous occurrence of S_2 -concordant leucosome. Textural features of monazite-bearing mineral assemblages (M_{P3}) establish initiation of D_2 deformation at 1860 Ma, and its waning by about 1841 Ma in the north and by 1825 Ma in the south (Berman et al., 2013).

Open, upright, northeast-trending F_3 folds of the transposition foliation (Fig. 3b, 6) highlight a nonpenetrative, near-horizontal component of shortening (D_3). A distinct episode of post-tectonic monazite growth took place from 1826–1815 Ma during a high-grade event (M_{P4}) at calculated P-T conditions between 5.5–7.3 kbar and 690–775°C (Berman et al., 2013); however, a relationship to D_3 could not be independently established. Exhumation and cooling took place at ca. 1790–1780 Ma.

Southampton Island's lithological units, isotopic character and geophysical expression collectively support correlation of this region to the Rae Craton (Fig. 1). Voluminous 2.77–2.7 Ga plutonic rocks with ca. 2.9–3.0 Sm-Nd model ages (Whalen et al., 2011) are typical of much of the Rae Craton, whereas remnants of 3.4–2.9 Ga crust and/or 3.6–3.0 Ga Nd model ages identified on Southampton Island, are also recognized at several localities within the margins of the Rae Craton (Hartlaub et al., 2005; Young et al., 2007; Peterson et al., 2010; Corrigan and Tremblay, 2011). In addition, the occurrence of ca. 2.62 Ga monzogranite (map symbol #18; Table 1) and an epiclastic rock with a unimodal, ca. 2.61 Ga zircon detrital population (map symbol #10; Table 1) highlight a potential link to voluminous 2.62–2.58 Ga plutonic rocks that extend across much of the mainland Rae Craton (e.g. Hinchey et al., 2011). Penetrative deformation and metamorphism at ca. 1.88 Ga (D_1) and ca. 1.86–1.82 Ga (D_2) is attributed to crustal shortening and thickening during the early stages of the ca. 1.89–1.8 Ga Trans-Hudson collisional orogeny. The island's numerous occurrences of ultramafic plutonic rocks should be of economic interest for Pd-Pt, Au, base metals, and carving stone.

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Coordinate System

Projection: Universal Transverse Mercator
Units: metres
Zone: 17 N
Horizontal Datum: NAD83
Vertical Datum: mean sea level

Bounding Coordinates

Western longitude: 85°15'00" W
Eastern longitude: 80°00'00" W
Northern latitude: 65°30'00" N
Southern latitude: 63°40'00" N

Data Model Information

Surface bedrock data are organized into feature classes and themes consistent with logical groupings of geological features. All field observation point data are related through the Station_ID property of the Station theme. These feature attribute names and definitions are identical in the shapefiles and the XML files.

Consult PDFs in Data folder for complete description of the feature classes, feature attributes, and attribute domains.

The Bedrock Data Model and the Bedrock Domains documents are intended to describe all bedrock features which may be compiled at the 1:250 000 scale. Therefore, some of the feature classes and feature attributes described in these documents may not be present.

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ACCORD DE LICENCE D'UTILISATION SANS RESTRICTION DE DONNÉES NUMÉRIQUES DE GÉOGRATIS

CE DOCUMENT constitue une entente légale entre vous (ci-après le "Détenteur de licence") et SA MAJESTÉ LA REINE DU CHEF DU CANADA (ci-après le "Canada"), représentée par le Ministre des Ressources naturelles du Canada. **EN ATTEIGNANT, TÉLÉCHARGEANT, IMPRIMANT OU UTILISANT LES DONNÉES, L'INFORMATION OU LE MATÉRIEL FOURNIS OU ACCESSIBLES SELON CETTE ENTENTE, VOUS VOUS ENGAGEZ À RESPECTER LES MODALITÉS DE CET ACCORD. SI VOUS ÊTES EN DÉSACCORD AVEC CES MODALITÉS, VOUS DEVEZ IMMÉDIATEMENT ÉLIMINER TOUTE COPIE DE CES DONNÉES, INFORMATION, MATÉRIEL ET PRODUITS DÉRIVÉS.**

- I. **ATTENDU QUE** le Canada détient les droits de propriété sur les données (les "Données") accessibles aux termes des modalités de cet Accord;
- II. **ATTENDU QUE** le Détenteur de licence désire obtenir certains droits sur les Données, sous réserve des modalités énoncées ci-après;
- III. **ATTENDU QUE** le Canada déclare avoir la pleine autorité pour accorder les droits demandés par le Détenteur de licence, sous réserve des modalités énoncées ci-après;
- IV. **ET ATTENDU QUE** les parties veulent en venir à une entente d'utilisation à partir de ce qui suit.
- V. **À CES CAUSES**, en considérant les conventions contenues dans cet Accord, les parties conviennent de ce qui suit :

1.0 DÉFINITIONS

1. Données du Canada signifie toute Donnée dont le Canada détient le droit de propriété.
2. Données signifie toute donnée numérique, métadonnée ou documentation visée par les modalités de cet Accord.
3. Produits dérivés signifie tout produit, système, sous-système, appareil, composant, matériel ou logiciel qui comprend ou utilise toute partie des Données.
4. Droits de propriété intellectuelle signifie tout droit de propriété intellectuelle reconnu par la loi, y compris tout droit de propriété intellectuelle protégé par une législation telle que celle qui régit, sans être limitée à, les droits d'auteur et les brevets.

2.0 CESSION D'UNE LICENCE

1. 2.1 Sous réserve des modalités du présent Accord, le Canada octroie au Détenteur de licence une licence non exclusive, sans frais ni redevances exigibles, et le droit d'exercer tous les Droits de propriété intellectuelle sur les Données. Ceci comprend le droit d'utiliser, incorporer, accorder des licences d'utilisation (avec droit subséquent d'accorder des licences d'utilisation), modifier, améliorer, développer et distribuer les Données; et de fabriquer ou distribuer des Produits dérivés.
2. Les Droits de propriété intellectuelle découlant de toute modification, amélioration, développement ou traduction des Données, ou de la fabrication de Produits dérivés, effectués par ou pour le Détenteur de licence seront détenus par le Détenteur de licence ou tout substitut identifié par le Détenteur de licence.

3.0 PROTECTION ET IDENTIFICATION DE LA SOURCE

1. L'utilisation des Données ne constitue en aucune façon une reconnaissance par le Canada d'un Produit dérivé. Le Détenteur doit identifier la source de données, de la façon suivante, lorsque toute partie des Données est redistribuée ou comprise dans un Produit dérivé :
© Le ministère des Ressources naturelles Canada. Tous droits réservés.

4.0 GARANTIE, EXCLUSION ET INDEMNISATION

1. Le Canada ne fait aucune représentation ou garantie, expresse ou tacite, découlant de la loi ou d'autres sources, en ce qui concerne entre autres l'exactitude, l'utilité, la nouveauté, la validité, l'étendue, l'intégralité ou l'actualité des Données et rejette expressément toute garantie implicite de qualité loyale et marchande ou l'à propos à une fin particulière des Données. Le Canada n'assure ni ne garantit la compatibilité du site qui contient les Données avec les versions antérieures, actuelles et futures de n'importe quel fureteur.
2. Le Canada ne peut être tenu responsable par le Détenteur de licence en ce qui a trait à toute réclamation, revendication ou action en justice, quelle qu'en soit la cause, concernant toute perte ou tout préjudice ou dommage ou frais, direct ou indirect, qui pourrait résulter de la possession ou de l'utilisation des Données par le Détenteur de licence.
3. Le Détenteur de licence tiendra le Canada et ses représentants, employés, agents et exécutants, indemnes et à couvert à l'égard de toute réclamation, revendication ou action en justice, quelle qu'en soit la cause, alléguant toute perte, tout frais, toute dépense, tout dommage ou toute blessure (y compris toute blessure mortelle) qui pourrait résulter de la possession ou de l'utilisation des Données par le Détenteur de licence.
4. Le Détenteur de licence devra accorder des licences d'utilisation à toute personne ou partie qui obtient les Données ou des Produits dérivés au moyen d'un accord de licence, et cet accord devra imposer à ces personnes ou parties les mêmes modalités que celles qui sont énoncées dans la section 4.0 de cet Accord.
5. L'obligation du Détenteur de licence d'indemniser le Canada selon cet Accord ne peut affecter ni empêcher le Canada d'exercer tout autre droit selon la loi.

5.0 DURÉE

1. Cet Accord entre en vigueur à partir de la date et de l'heure d'acceptation des modalités de l'Accord (Heure de l'Est) et restera en vigueur pour une période d'un (1) an, en vertu de la sous-section 5.2 et de la section 6.0 qui suivent.
2. À la fin du premier terme, cet Accord sera automatiquement renouvelé pour des termes successifs d'un (1) an, en vertu de la section 6.0 qui suit.

6.0 RÉSILIATION

1. 6.1 Nonobstant la section 5.0, cet Accord peut être résilié :
 - i. automatiquement et sans préavis, si le Détenteur de licence manque à ses engagements ou obligations selon cet Accord;
 - ii. par un préavis écrit de résiliation émis par le Détenteur de licence, en tout temps, et cette résiliation prendra effet trente (30) jours suivant la réception d'un tel préavis par le Canada; ou
 - iii. par consentement mutuel des parties.

2. Lors de la résiliation de cet Accord, pour quelque raison que ce soit, les obligations qui incombent au Détenteur de licence en vertu de la section 4.0 continueront de s'appliquer et les droits du Détenteur de licence en vertu de la section 2.0 cesseront immédiatement.
3. Lors de la résiliation de cet Accord, pour quelque raison que ce soit, le Détenteur de licence devra immédiatement effacer ou détruire toutes les Données obtenues en vertu de cet Accord, ou à l'intérieur d'un délai raisonnable lorsque les Données sont nécessaires pour terminer la livraison de Produits dérivés commandés avant la résiliation de cet Accord.

7.0 GÉNÉRAL

1. **Lois d'application**

Le présent Accord est régi et interprété en vertu des lois en vigueur dans la province de l'Ontario. Les parties acceptent de tomber sous la juridiction de la Cour supérieure de la Province de l'Ontario.

2. **Totalité de l'Accord**

Le présent Accord constitue l'intégralité de l'entente conclue entre les parties relativement à l'objet du présent Accord. Toute modification à cet Accord ne peut être que par écrit, doit porter la signature de chaque partie et exprimer clairement l'intention de modifier cet Accord.

3. **Solution des litiges**

Si un litige survient à propos de cet Accord, les parties tenteront de le résoudre par des négociations de bonne foi.