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CANADIAN GEOSCIENCE MAP 193

GEOLOGY

WINTER COVE BAY

Victoria Island, Northwest Territories

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Cover Illustration

NW-trending fault offsets sill/limestone contact. Victoria Island, Northwest Territories. Photograph by A. Winpenny. 2014-146

ABSTRACT

NTS 87-G/10 (Winter Cove Bay) and the southern part of NTS 87-G/15 are mostly underlain by Neoproterozoic Shaler Supergroup sedimentary rocks, with limestone and dolostone of the Boot Inlet and Jago Bay formations, quartz arenite of the Fort Collinson Formation, and gypsum evaporite of the Minto Inlet Formation. Sedimentary rocks are injected by basaltic sills and dykes of Franklin age (ca. 720 Ma) that can be divided into older, more olivine rich Type 1 intrusions and younger diabasic to feldspar-porphyritic

Type 2 intrusions. Strata are either flat-lying, or dip gently to the north or south to either side of the Walker Bay Anticline. Steeper bedding orientations occur near faults as a result of structural entrainment. A regional-scale unconformity separates Paleozoic clastic and carbonate rocks in the north from underlying Proterozoic rocks to the south, but the contact is often faulted, and isolated domains of Paleozoic rocks are preserved within graben. North-northwest-trending syn-magmatic (Proterozoic) and east-northeast-trending (Phanerozoic) normal faults are ubiquitous, breaking up the outcrop pattern into a series of polygonal blocks.

RÉSUMÉ

Le sous-sol du feuillet 87-G/10 (Winter Cove Bay) ainsi que de la partie sud du feuillet 87-G/15 du SNRC est principalement constitué de roches sédimentaires du Supergroupe de Shaler du Néoprotérozoïque, qui comprennent des calcaires et des dolomies des formations de Boot Inlet et de Jago Bay, des arénites quartzeuses de la Formation de Fort Collinson et des évaporites gypseuses de la Formation de Minto Inlet. Les roches sédimentaires sont injectées de filons-couches et de dykes basaltiques d'un âge correspondant à celui de l'événement de Franklin (env. 720 Ma), qui se divisent en intrusions de type 1, plus anciennes et plus riches en olivine, et en intrusions de type 2, plus récentes et à texture diabasique ou porphyrique à feldspath. Les strates reposent à plat ou s'inclinent faiblement vers le nord ou le sud, de part et d'autre de l'anticlinal de Walker Bay. Des pendages plus abrupts sont observés près de failles en raison d'un entraînement structural. Une discordance régionale sépare les roches détritiques et les roches carbonatées du Paléozoïque présentes au nord des roches du Protérozoïque sous-jacentes que l'on trouve au sud, mais le contact est souvent faillé et des domaines isolés de roches du Paléozoïque ont été conservés dans des grabens. Des failles normales de direction nord–nord-ouest (failles synmagmatiques du Protérozoïque) et de direction est–nord-est (failles du Phanérozoïque) sont omniprésentes et produisent une mosaïque d'affleurements constituée de blocs polygonaux.

ABOUT THE MAP

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Map projection Universal Transverse Mercator, zone 11.
North American Datum 1983

Base map at the scale of 1:50 000 from Natural Resources Canada, with modifications.
Elevations in metres above mean sea level

Shaded relief image derived from the digital elevation model supplied by GeoBase.
Illumination: azimuth 225º, altitude 45º, vertical factor 1x

Proximity to the North Magnetic Pole causes the magnetic compass to be erratic in this area.
Magnetic declination 2015, 20º17'E, decreasing 46.8' annually.

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ABOUT THE GEOLOGY

Descriptive Notes

The Winter Cove Bay map area consists of NTS 87-G/10 and the southernmost part of 87-G/15. It lies within the Minto Inlier, a ~300 km long by 100–150 m wide belt of gently folded sedimentary and igneous rocks of early Neoproterozoic age (late Tonian-early Cryogenian). The Neoproterozoic sedimentary rocks belong to the Shaler Supergroup, a ~4 km thick succession of shallow marine carbonate and evaporite rocks with interbedded terrigenous metasedimentary strata deposited in a shallow intracontinental epeiric sea known as the Amundsen Basin (Thorsteinsson and Tozer, 1962; Young, 1981; Rainbird et al., 1994; 1996a). The basin is considered to have formed within the supercontinent Rodinia and similar rocks outcrop in the Mackenzie Mountains of the northern Cordillera, suggesting that the basin extended for more than 1000 km to the southwest (Long et al., 2008; Rainbird et al., 1996a). Basal strata of the Shaler Supergroup (Rae Group) are exposed only at the northeastern end of the Minto Inlier, near Hadley Bay, where they unconformably overlie Paleoproterozoic sedimentary rocks, which in turn, unconformably overlie Archean granitic rocks (Campbell, 1981; Rainbird et al., 1994).

Shaler Supergroup strata were injected by tholeiitic basaltic sills of the ca. 723–720 Ma (Heaman et al., 1992; Macdonald et al., 2010) Franklin igneous event. Sills are generally 20–60 m thick, constitute 10–50% of the stratigraphic section, and commonly extend for 20 km or more along-strike with little change in thickness. Rare north-northwest striking dykes are interpreted to have intruded along syn-magmatic normal faults, to feed sills and possibly the flood basalts (Bédard et al., 2012). Sills of similar type and age also occur in the Coppermine Homocline, Brock Inlier and Duke of York Inlier to the south (Jefferson et al., 1994; Rainbird et al., 1996b; Shellnutt et al., 2004) and coeval, geochemically similar intrusions and volcanic rocks associated with the Franklin event extend from Greenland to the western Yukon (Heaman et al., 1992; Denyszyn et al., 2009; Macdonald et al., 2010). The Shaler Supergroup in Minto Inlier is capped by Natkusiak Formation flood basalt lava flows and interflow sedimentary rocks (Williamson et al., 2013). The lavas are up to 1 km thick and are the extrusive equivalent of the Franklin sills (Baragar, 1976; Jefferson et al., 1985; Dostal et al., 1986; Dupuy et al., 1995). Two main Franklin magma populations are identified and discriminated on the map where possible (*see* legend). Basal lavas and older sills (Type 1) are slightly enriched in very incompatible trace elements (high Ce/Yb), tend to be more primitive (higher MgO), and the sills may have peridotitic bases, with up to 55% olivine (annotated as 'o' where observed: Hayes et al., 2015). These primitive Type 1 sills have potential for Ni-Cu-PGE mineralization (Jefferson et al., 1994). Younger diabasic sills (low Ce/Yb, Type 2) correspond to the major sheet flow units of the lava succession. A prominent feldspar porphyritic facies characterizes some Type 2 intrusions (annotated as 'p' where observed). Note that feldspar porphyries are not observed in Type 1 intrusions, peridotite is never observed in Type 2 intrusions, whereas diabasic or gabbroic textures are undiagnostic of magmatic affinity.

The irregular edge of the exposed Minto Inlier is defined by an erosional unconformity that separates the Neoproterozoic rocks from Lower Cambrian sandstone and siltstone (Quyuk Formation) that passes upward into a thick succession of mainly dolomitic carbonate rocks, ranging in age from Cambrian to Devonian (Thorsteinsson and Tozer, 1962; Dewing et al., 2015). Minto Inlier rocks are affected by open folds with northeast trending axial traces. Beds typically dip no more than 10° and there is generally no penetrative deformation fabric. The origin of the folding is unknown but it occurred after 720 Ma, before uplift and erosion of the Proterozoic rocks and prior to deposition of overlying lower Cambrian siliciclastic rocks (Durbano et al., 2015), which are not folded, but dip gently towards the northwest. Two main generations of faults are present (Bédard et al., 2012; Harris, 2014): north- to northwest trending syn-magmatic Proterozoic normal faults; and a younger set of east-northeast to east trending normal faults that cut all rocks in the area. The normal faults form horst and graben systems with up to 200 of metres of stratigraphic separation on individual faults, although throws are generally much less than this. A wide zone of intense east-northeast to east trending normal faulting stretches from Boot Inlet in the west to Wynniatt Bay in the east. This regional-scale, en-echelon, stepping normal fault system records sinistral transtensional motion (Harris, 2014). Observed contacts and lithologies were extrapolated and/or inferred using aeromagnetic data and satellite imagery (e.g. orthorectified air photos, Landsat7, SPOT5, and Google Earth™). Many linear structures visible on air photos and linear discontinuities on the 1st-derivative aeromagnetic maps (Kiss and Oneschuk, 2010) are interpreted to be faults, although significant throws cannot always be demonstrated. Late Wisconsinan proglacial and glacial deposits cover about 50% of the map's area (Hodgson, 2012). The extent of Quaternary cover shown on this map is not meant to be comprehensive, but to highlight areas where bedrock attributions are uncertain.

NTS 87-G/10 (Winter Cove Bay and the southern part of NTS 87-G/15) is mostly underlain by Neoproterozoic rocks of the Reynolds Point Group (Boot Inlet, Fort Collinson, Jago Bay formations) and the Minto Inlet Formation. In places, insufficient data were available to allow subdivision of Reynolds Point Group rocks. Detailed descriptions of these rocks are provided in Young and Long (1977), Young (1981), and Morin and Rainbird (1993). Together with intercalated mafic sills, strata are typically either flat lying, or dip gently to the north or south to either side of the Walker Bay Anticline, the axial trace of which crosses the map area. The common bulls-eye contact patterns (e.g. UTM, 494000E, 7936000N) reflect the relative thinness of some units, the shallowly dipping contacts, and significant topographic relief. The poorly exposed regional-scale erosional unconformity that separates Paleozoic rocks in the north from the Proterozoic rocks is commonly faulted out. Exposed Paleozoic rocks include pebbly sandstones of the Cambrian Quyuk Formation (Durbano et al., 2015) and massive tan dolostone of the overlying Uvayualuk Formation (Dewing et al., 2015). Isolated domains of Paleozoic rocks are also preserved within east-northeast trending graben in the south-center, north of Amgmaluqtuhuk (lake, e.g. UTM, 479500E, 7943000N).

Carbonate rocks of the Boot Inlet Formation are widespread. Only the upper third of the formation is exposed in the map area. Massive to brecciated, orange-tinged dolomitized zones are common near faults. Most outcrops are composed of rhythmically layered grey calcareous and buff dolomitic arenite and siltite, but stromatolites, oolitic grainstones and intraformational conglomerates are locally prominent. The locally well exposed Fort Collinson Formation is typified by variably dolomitic, medium-bedded, orange to grey-weathering quartz arenite, commonly with herringbone cross-stratification. This unit is gradational with parallel-stratified to crossbedded, quartz sand-bearing, oolitic grainstone of the underlying Boot Inlet Formation. Its overall thickness varies from 50–100 m (Young and Long, 1977, Rainbird et al., 1994). In the northern part of the map area, diagenesis, contact metamorphism and facies variations make this unit difficult to recognize. Extensive occurrences of Fort Collinson Formation rocks are probably present among the unsubdivided Reynolds Point Group outcrops in the north (e.g. UTM, 471000E, 7953000N). Jago Bay rocks comprise massive, thick-bedded, yellowish-grey-weathering limestone or dolostone that alternate with thinner-bedded carbonate grainstones, silty limestones, and stromatolitic units. Rare gypsum interlayers have been observed near the gradational upper contact with the Minto Inlet Formation. A small domain of Minto Inlet Formation rocks is exposed on a graben floor near the south-eastern margin of the map area (UTM, 498000E, 7934500N). The rocks are crumbly weathering, thin- to thick laminated white gypsum with interbedded grey-green calcisiltite, red gypsiferous siltstone and nodular gypsum.

At least two Type 1 sills are exposed in the area, but block faulting makes correlation difficult. One example with a prominent peridotitic base was emplaced just above the Fort Collinson quartz arenite (UTM, 499240E, 7941760N) and similar, presumably correlative sills occupy the same stratigraphic level in adjoining mapsheets (NTS 87-G/9: Bédard et al., 2012; NTS 87-G/7: Hayes et al., 2015). Type 1 sills are also hosted by the Boot Inlet Formation at UTM, 495600E, 7933220N. Several Type 2 sills occur in this map area. Feldspar-rich porphyritic rocks characterize a prominent sill (UP sill) emplaced within the Jago Bay Formation (e.g. UTM, 499500E, 7934000N), about 20 m above the peridotite-based LP sill. The UP sill also can be traced for considerable distances toward the southwest (NTS 87-G/7) and east (NTS 87-G/9).

This entire area is heavily affected by both normal fault sets. North to northwest-trending faults are interpreted to be syn-magmatic (Franklin-age) because associated cataclastic breccias contain fragments from older basaltic pulses that are injected by chilled basalt (Bédard et al., 2012). Both east-side down and west-side-down normal motions are recorded. An especially prominent fault runs through Jago Bay and extends all the way to the southern edge of the map and into the next sheet to the south (NTS 87-G/7). The main east- to northeast-trending normal faults are associated with contemporaneous east-west and north-south-trending oblique-slip faults. This fault system was initiated during deposition of the basal Cambrian clastic rocks (Quyuk Formation: Durbano et al., 2015) but continued to move afterwards. Locally, these faults anastomose and form multiple splays (e.g. UTM, 499000E, 7955500N), that locally reactivated the older fault set. Bedding and sill contacts are markedly steepened adjacent to some faults (UTM, 491000E, 7935500N) demonstrating local north-side down motions. Conversely, south-side-down motion is required by the offsets of formation boundaries at UTM, 499500E, 7948650N. These two intersecting fault sets break up the outcrop pattern into polygonal blocks. Prominent aeromagnetic discontinuities (Kiss and Oneschuck, 2010) allow the major faults to be traced beneath the Quaternary cover (e.g. UTM, 489000E, 7962000N).

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Coordinate System

Projection: Universal Transverse Mercator
Units: metres
Zone: 11
Horizontal Datum: NAD83
Vertical Datum: mean sea level

Bounding Coordinates

Western longitude: 118°00’00”W
Eastern longitude: 117°00’00”W
Northern latitude: 71°48’00”N
Southern latitude: 71°30’00”N

Data Model Information

No Model

This Canadian Geoscience Map does not conform to either the Bedrock or Surficial Mapping Geodatabase Data Models. The author may have included a complete description of the feature classes and attributes in the Data\Data Model Info folder.