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**CANADIAN GEOSCIENCE MAP 292**  
**GEOLOGY**  
**MOUNT NANSEN–NISLING**  
**RIVER AREA**

Yukon



**Map Information  
Document**

**Preliminary**

**Geological Survey of Canada**  
**Canadian Geoscience Maps**

**2016**

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## **ABSTRACT**

The Mount Nansen–Nisling River area is underlain dominantly by Paleozoic rocks of Yukon Tanana terrane, and Triassic to Paleogene successor rocks. Rocks to the east are dominated by the Mississippian Simpson Range suite that is intruded by the voluminous Early Jurassic Long Lakes suite. The western geology is dominated by metasedimentary rocks of the Snowcap assemblage and Stevenson Ridge schist, and lesser Finlayson assemblage metavolcanic and metasedimentary rocks. Permian Sulphur Creek suite forms sparse intrusions of K-feldspar augen granite. The northern geology is dominated by the mid-Cretaceous Whitehorse plutonic suite and Mount Nansen Group volcanic rocks, that locally host Cu-Au porphyry and Au mineralization. Late Cretaceous Casino suite hypabyssal rocks are present sparsely across much of the area with and have known porphyry and epithermal mineral potential (e.g. Klaza). Paleogene volcanic and hypabyssal rocks are sporadically across the map, and are more prevalent to the southwest.

## **RÉSUMÉ**

La région cartographique de Mount Nansen–Nisling River repose principalement sur des roches du Paléozoïque du terrane de Yukon-Tanana ainsi que sur des roches successives du Trias au Paléogène. À l'est, les roches appartiennent en prédominance à la suite de Simpson Range du Mississippien, dans lesquelles s'est mise en place la volumineuse suite de Long Lakes du Jurassique précoc. À l'ouest, la géologie est caractérisée par la prédominance de roches métasédimentaires de l'assemblage de Snowcap et du schiste de Stevenson Ridge ainsi que par la présence, en moindres quantités, de roches métavolcaniques et métasédimentaires de l'assemblage de Finlayson. La suite de Sulphur Creek du Permien se présente sous forme d'intrusions éparses de granite œillé à feldspath potassique. La géologie de la partie nord est caractérisée par la prédominance de roches de la suite plutonique de Whitehorse et de roches volcaniques du Groupe de Mount Nansen du Crétacé moyen, lesquelles renferment par endroits des minéralisations de Cu-Au porphyriques et de Au. Des roches hypabyssales de la suite de Casino du Crétacé tardif sont dispersées un peu partout dans la région et présentent un potentiel connu de minéralisations épithermales (p. ex. Klaza). Des roches volcaniques et hypabyssales du Paléogène sont disséminées dans l'ensemble de la carte, mais sont plus répandues dans le sud-ouest de la région.

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## **SHEET 1 OF 1, BEDROCK GEOLOGY**

### **GENERAL INFORMATION**

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Geology by J.J. Ryan, E.E. Westberg, J.B. Chapman, M. Moher, and Y. Morneau, 2015

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Geology conforms to Bedrock Data Model v. 4.0.0

Geomatics and cartography by S.P. Williams and J.J. Ryan

Initiative of the Geological Survey of Canada, conducted under the auspices of the Cordilleran Project as part of Natural Resources Canada's Geo-mapping for Energy and Minerals (GEM) program, with support from the Yukon Geological Survey

Map projection Universal Transverse Mercator, zone 8. North American Datum 1983

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

Mean magnetic declination 2016, 20°18'E, decreasing 22.1' annually. Readings vary from 20°29'E in the NE corner to 20°06'E in the SW corner of the map.

This map is not to be used for navigational purposes.

Title photograph: Sparsely vegetated ridgelines looking westward to the Nisling Range, Nisling River area, Yukon. Photograph by J.J. Ryan. 2016-056

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Preliminary publications in this series have not been scientifically edited.

### **MAP VIEWING FILES**

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### **DESCRIPTIVE NOTES**

#### **INTRODUCTION**

Bedrock exposure in this partially glaciated terrain (Duk-Rodkin, 1999) forms broad upland ridges that are dominated by extensive frost-shattered felsenmeer. Outcrops are rare in the heavily forested valleys, but are locally found along stream cuts. Bedrock geology of Mount Nansen–Nisling River area consists primarily of metamorphosed and poly-deformed Paleozoic basement intruded and overlapped by relatively little-deformed Mesozoic and Cenozoic successions. The present work has benefitted from observations outlined in Tempelman-Kluit (1974), Carlson (1987), Ryan et al. (2013a; 2013b), Israel et al. (2011), Israel and Westberg (2011), and Klocking et al. (in press). Extension of geological elements beneath cover is greatly aided by aeromagnetic data (e.g. Hayward et al., 2012).

#### **GEOLOGICAL FRAMEWORK**

##### *Yukon-Tanana Terrane*

The west side of the map area is dominantly underlain by polydeformed and metamorphosed Yukon-Tanana terrane (YTT), made up mainly of the pre-Devonian Snowcap assemblage. The Snowcap assemblage is characterized by amphibolite facies quartzite, micaceous quartzite and psammitic quartz-muscovite-biotite ( $\pm$  garnet) schist (unit  $\frac{3}{4}$ " S1) and rare, decametre-thick lenses of marble (unit  $\frac{3}{4}$ " S2). Common massive amphibolite and lesser garnet amphibolite (unit  $\frac{3}{4}$ " S3) are interpreted as metamorphosed mafic sills and dykes.

More prominent and extensive occurrences of amphibolite across the map are correlated to the Devonian-Mississippian Finlayson assemblage (unit "  $\geq$  F1). This unit is characterized by strongly foliated and compositionally layered amphibolite and garnet amphibolite. It locally interdigitates with the Snowcap assemblage and can be difficult to distinguish from unit  $\frac{3}{4}$ " S3. These rock types are typically spatially associated with the Simpson Range suite (see following). We interpret a metafelsite (unit "  $\geq$  F3) spatially associated with amphibolite as derived from a Finlayson assemblage felsic metavolcanic rock.

A large domain in the central part of the area is dominated by a monotonous sequence of grey to black, carbonaceous quartzite, psammite and phyllite that we correlate with the Stevenson Ridge schist (unit  $\geq$  SRS; see Ryan et al., 2014). The unit is interpreted as Late Devonian to Early Mississippian because it is intruded by the Mississippian Simpson Range suite. The unit is distinguished from the Snowcap assemblage by its carbonaceous composition, though carbonaceous horizons do occur in unit  $\frac{3}{4}$ " S1. Elsewhere in YTT, similar carbonaceous metasedimentary rocks are

grouped in the Finlayson assemblage. The interstratification of light grey to beige marble (unit  $\sim^2$  F2) and general proximity to the  $\sim^2$  F1 possibly supports a similar interpretation here.

Much of the eastern half of the map area is dominated by the Early Mississippian Simpson Range suite (unit  $\sim^2$  SR) constrained by a single preliminary age of ca. 356 Ma (W. McClelland, unpublished data). The Simpson Range suite is characterized by highly foliated to gneissic hornblende-biotite and biotite granodiorite to intermediate orthogneiss, and is commonly K-feldspar augen textured.

The Snowcap and Finlayson assemblages are intruded by sporadic K-feldspar porphyritic to porphyroclastic augen granite that we correlate with the Permian Sulphur Creek suite (unit  $\gg$  S), one of which yielded a preliminary age of ca. 264 Ma (D. Kellett, unpublished data).

#### *Mafic-ultramafic complexes*

The Schist Creek complex occurs in the northwest part of the map area and is dominated by serpentinite, peridotite with minor metagabbro. The complex appears juxtaposed with the Snowcap assemblage by faults. The serpentinite has a predominantly harzburgitic protolith, indicated by high-temperature deformed orthopyroxene porphyroclasts and aligned olivine suggesting that it originated as lithospheric mantle (Dubman, 2016). The serpentinite is intruded by plagioclase porphyritic metagabbro dykes that yield late Permian ages (W. McClelland, unpublished data). Other minor lenses (10 to 100 m wide) of serpentinite, talc-tremolite schist and listwaenite may be related to the Schist Creek complex.

#### *Stikinia/Quesnellia*

The Stikine plutonic suite (unit  $\sim$  LÆS) is only exposed in the area in the vicinity of Mount Nansen, and is characterized by weakly to moderately foliated white to beige hornblende-biotite granodiorite, diorite, and quartz monzodiorite; it is commonly alkali-feldspar porphyritic. A sample dated by Mortensen et al. (2003) yielded an age of 211 Ma. Younger Mesozoic rocks in the area lack evidence of regional polyphase deformation and metamorphism.

The eastern side of the map area is dominated by the Aishihik batholith, which is composed of massive to weakly foliated white to beige hornblende-biotite granodiorite, monzogranite, quartz monzonite, and quartz monzodiorite of the Long Lake suite (unit E $\sim$  L1). The Long Lake suite rocks are commonly very pink on the weathered surface. They are locally equigranular but commonly alkali-feldspar porphyritic. There is localized compositional layering at or near the northwest margin of the batholith. Hypabyssal phases of the suite (unit E $\sim$  L2) are characterized by small, deeply weathered occurrences of pink to beige quartz porphyritic hornblende-biotite granodiorite to rhyodacite. This phase is similar to the younger Casino suite or Rhyolite Creek complex (see below). Late-phase granitic pegmatite and aplitic dikes are prominent in the plutons and in the country rocks. The Long Lake suite has a well-constrained age range of between 190 and 180 Ma (Joyce et al., 2016).

#### *Mesozoic-Cenozoic successor rocks*

Middle Cretaceous to Eocene successor magmatic rocks are common in the area. Mount Nansen is underlain by a well-preserved mid-Cretaceous aphyric and feldspar-phyric andesite to dacite breccias, flows and tuffaceous rocks of the Mount Nansen Group (unit m $\sim$  N). Heterolithic quartz and feldspar-phyric felsic lapilli tuff, and rare flow-

banded quartz-phyric rhyolite are less abundant. The group has yielded U/Pb ages ranging between 110 and 105 Ma (Klocking et al., 2016) making it comagmatic the Whitehorse plutonic suite.

The Middle Cretaceous Whitehorse plutonic suite is represented by two distinct phases in the map area. The voluminous Dawson Range phase (unit m<sub>1</sub> W2) is exposed around Mount Nansen, and is composed of white to beige, hornblende-biotite granodiorite and lesser granite, tonalite, quartz diorite, and diorite (108–105 Ma: Mortensen et al., 2003, 2016). It is characteristically blocky hornblende-phyric and medium- to coarse-grained, and weakly foliated to unfoliated. The western side of the map hosts the easternmost occurrences of the Maloney Creek phase (unit m<sub>1</sub> W1) of the Whitehorse suite, and comprises grey to beige biotite-hornblende monzogranite to granodiorite. It is medium- to coarse-grained, unfoliated, and is smoky quartz bearing. The Maloney Creek phases has yielded U/Pb and Ar-Ar ages of ca. 105 Ma (W. McClelland, unpublished data).

The late Cretaceous Casino suite (unit L<sub>1</sub> C) is represented in the area by small scattered occurrences of porphyritic dacite to rhyolite. It is generally fine to medium grained; alkali feldspar-, plagioclase-, biotite and quartz-porphyritic. More rhyolitic occurrences near Mount Nansen exhibit blebby white to smoky quartz phenocrysts, is more hypabyssal than volcanic in appearance, and is limonite and carbonate altered. The Casino suite typically ranges in age from ca. 73 to 78 Ma (e.g. Selby and Creaser, 2001; Bennett et al., 2010; Mortensen et al., 2016).

The Late Cretaceous Carmacks Group (unit u<sub>1</sub> C; ca. 70–69 Ma), is present in the very northeast corner of the map area. It comprises an intermediate to mafic volcanic and volcanoclastic lower sequence, and a more mafic, flow-dominated upper sequence.

The Paleogene Rhyolite Creek complex (unit u<sub>2</sub> RC; ca. 59–56 Ma: N. Joyce, unpublished data; J. Crowley, unpublished data) constitute small erosional remnants of felsic and intermediate volcanic and hypabyssal rocks dominantly in the southwest part of the area, sparsely dotted occurrences across the remainder of the area. The felsic rocks are predominant and comprise smoky quartz±feldspar porphyritic, and locally flow-banded tan to cream rhyolite to rhyodacite dykes, flows, sills, crystal and ash tuff. Intermediate to mafic rocks are less abundant and comprise grey green to mauve plagioclase-hornblende porphyritic andesitic to dacite tuff breccia, massive flows, dykes and sills. Two samples from this suite in the map area yielded ages between 57–58 Ma (W. McClelland, unpublished data).

The Ruby Range suite (unit u<sub>2</sub> R) is characterized by fine to medium grained, unfoliated light grey to pinkish biotite±hornblende granodiorite with typical smoky grey quartz and is coeval with the Rhyolite Creek complex.

## STRUCTURAL GEOLOGY

The structural geology of the map area is typical of the Yukon-Tanana terrane in western Yukon and is characterized by at least two phases of isoclinal folding and development of transposition foliation. The main foliation observed in these rocks developed at upper greenschist-amphibolite facies conditions and may represent a second generation fabric. This regionally pervasive foliation is present in Permian and older rocks, and may have developed in the Late Permian (e.g. Berman et al., 2007).

This dominant foliation is itself deformed locally by less pervasive open F3 and F4 folds. The contrast in deformation character between the Stikine suite, the Long Lakes Suite and the Mississippian to Permian rocks indicates that the main foliation in the Paleozoic rocks is pre-Late Triassic, and a weak to moderate foliation in the Stikine suite which is lacking in the Long Lake suite indicates a regional deformation also occurred in the Late Triassic to early Jurassic time. A significant difference in the character of the main foliation in the map area is that it is dominantly northeast-trending, in significant obliquity to the main foliation across much of western Yukon which is typically northwest-trending. We interpret this as a consequence of Mesozoic folding of the late Paleozoic fabric.

Northwest trending faults that are prominent in the aeromagnetic data (see Figure 1). These structures offset the margin of the 190–180 Ma Aishihik batholith, and also appear to help control the distribution of the Mount Nansen group, indicating that these faults are mid-Cretaceous or younger. These structures appear to be overlain by the Paleogene Rhyolite Creek complex. At Mount Nansen, the complex interplay between the northwest-trending faults and east-northwest trending faults appears to expose different levels of the mid-Cretaceous rocks such that Mount Nansen Group may be exposed in grabens, and the Dawson Range phase granodiorite in horsts. The only occurrences of the Stikine plutonic suite in this area may be confined to one or more of the horsts.

In other parts of western Yukon, the presence of lenses or slivers of peridotite has helped to delineate crustal scale structural breaks (e.g. Ryan et al., 2013a). The preservation of high temperature tectonite fabric in the Schist Creek complex suggests that mantle and/or lower crust were juxtaposed with siliciclastic rocks of the Snowcap assemblage along a major detachment fault (cf. Canil et al., 2003). This detachment was likely reactivated as a thrust fault emplacing Schist Creek complex within or on top of the Snowcap assemblage during Permian to Jurassic deformation. The Schist Creek complex lies along a distinct lineament (greater than 100 km long) on the regional geology map, that offsets units as young as Carmacks Group. We interpret that this may reflect reactivation of a fundamental basement structure.

In the region between Mackintosh Creek and the Nisling river (south part of map area) a couple lenses of serpentinite, and an unexposed magnetically high anomaly that we interpret as an ultramafic sliver, occur at the contact between Stevenson Ridge schist and the Snowcap assemblage. It is probable that this marks a structural break between these two units there.

## MINERALIZATION

The main mineral occurrences in the map area are porphyry to epithermal style that are concentrated around Mount Nansen, and appear to be most strongly linked to the late Cretaceous Casino suite (e.g. Klaza, Cyprus; see Hart and Langdon, 1998; Mortensen et al., 2016). A number of Casino suite plugs and hypabyssal intrusions are newly recognized on the current map suggesting further potential for mineralization. Correlatives of the Long Lakes suite are host to Cu-Au-Mo porphyry mineralization along strike in British Columbia, however, the porphyry potential of this suite in Yukon is not well understood. The presence of hypabyssal phases of this suite in the map area indicates that the crustal depth appropriate for porphyry mineralization is exposed, however porphyry potential remains unknown. The Long Lake suite is demonstrably younger than the early Jurassic Minto suite, as such Minto style mineralization (Topham et al., 2016) within the Long Lake suite is unlikely.

No definitive syngenetic occurrences are recognized in this map area, although felsic and amphibolite rock types within the Finlayson assemblage rocks of YTT have VMS potential regionally (Colpron et al., 2006).

#### ACKNOWLEDGMENTS

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### **ADDITIONAL INFORMATION**

The Additional Information folder of this product's digital download contains figures and tables that appear in the map surround as well as additional geological information not depicted on the map, nor this document, nor the geodatabase.

-PDF of each figure/table that appears in the CGM surround.

-Excel file of the Master Legend Table (legend symbols, descriptions, headings, etc.).

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### **COORDINATE SYSTEM**

Projection: Universal Transverse Mercator

Units: metres

Zone: 8

Horizontal Datum: NAD83

Vertical Datum: mean sea level

### **BOUNDING COORDINATES**

Western longitude: 138°16'00"W

Eastern longitude: 136°45'00"W

Northern latitude: 62°10'00"N

Southern latitude: 61°38'00"N

### **SOFTWARE VERSION**

Data has been originally compiled and formatted for use with ArcGIS™ desktop version 10.2.2 developed by ESRI®.

### **DATA MODEL INFORMATION**

#### **Bedrock**

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 1:50 000 scale. Therefore, some of the feature classes and feature attributes described in these documents may not be present.