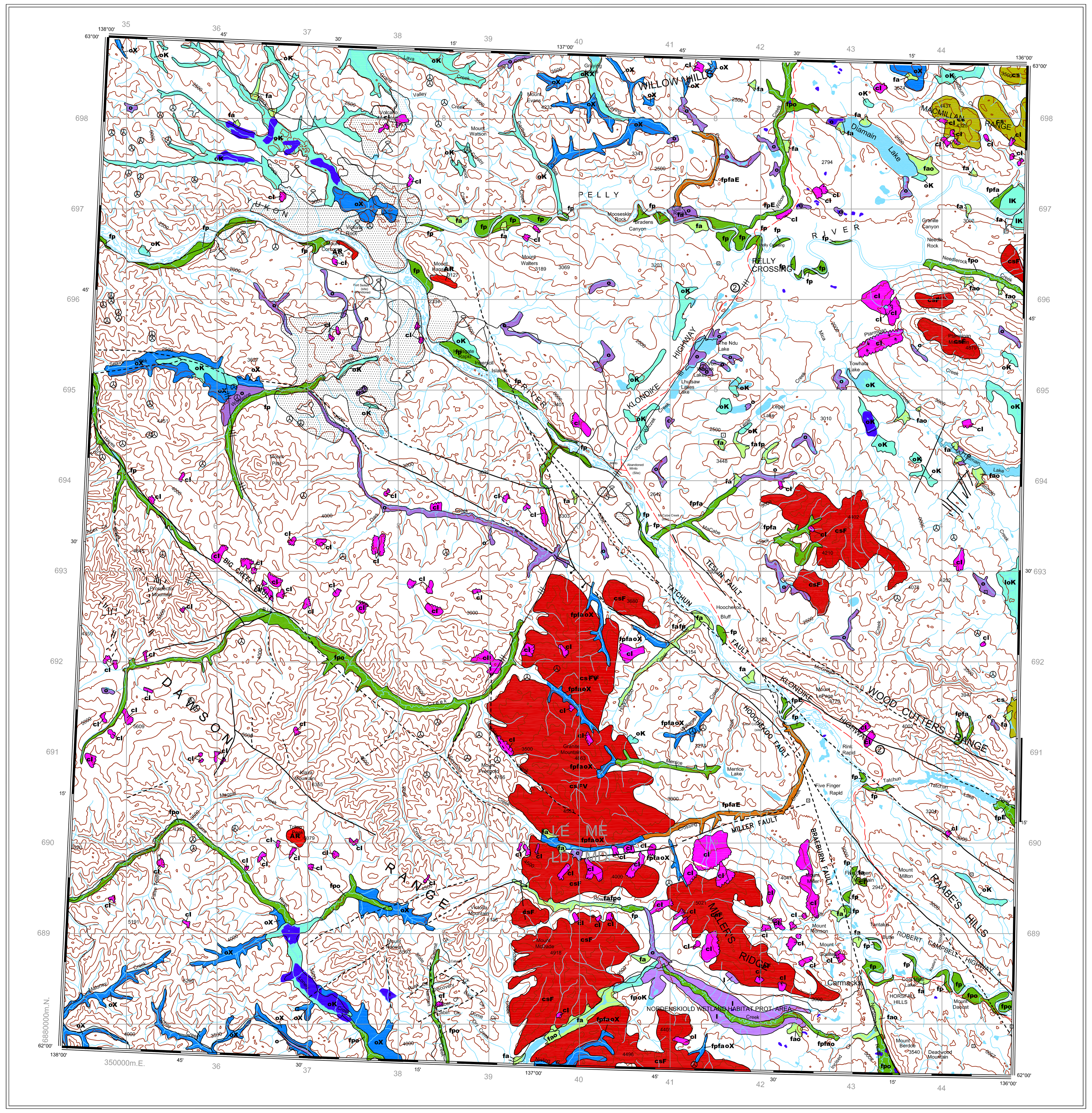
Yukon Government

YUKON GEOLOGY PROGRAM

Canada



TEN THOUSAND METRE UNIVERSAL TRANSVERSE MERCATOR GRID NAD 83

Zone 8

NOTE: THIS MAP HAS BEEN PRODUCED BY THE COMPILATION OF DATA FROM VARIOUS SOURCES. IT IS NOT TO BE USED TO DEFINE LEGAL BOUNDARIES.

EDITION: 2 PRINT DATE: 99/08/27

CARMACKS

YUKON TERRITORY

115 I

Scale

10 0 10 20 30 km

5 0 5 10 15 miles

CONTOUR INTERVAL 500 FEET Elevations in Feet above Mean Sea Level
North American Datum 1983 Transverse Mercator Projection
Universal Transvers Mercator Grid ZONE 8

	141°	138°	136°	134°
64°	115O & 115N (E1/2) STEWART RIVER	115P McQUESTEN	105M MAYO	64°
63°	115J & 115K (E1/2) SNAG	115I CARMACKS	105L GLENYON	63°
62°	115G & 115F (E1/2) KLUANE LAKE	115H AISHIHIK LAKE	105E LABERGE	62°
61°				61°

Index to Adjoining Sheets.

Magnetic Declination 1990 varies from 29° 30' easterly at the centre of the west edge to 29° 59' easterly at the centre of the east edge. Mean annual change 12.2' westerly.

GEOPROCESS FILE SUMMARY REPORT

CARMACKS MAP AREA - NTS 115I

INTRODUCTION

The GEOPROCESS File is a compilation of information and knowledge on geological processes and terrain hazards, including mass movement processes, permafrost, flooding risks, faults, seismic activity and recent volcanism, etc. Please refer to the GEOPROCESS File User Guide for more in-depth information on how the maps were developed, which other GEOPROCESS File maps are available, how to utilize this inventory and how to interpret the legend. Special interest should be taken in the detailed description of the terrain hazard map units. Appendices in the User Guide include summary papers on the geological framework, permafrost distribution, and Quaternary geology in Yukon and a list of comprehensive GEOPROCESS File references.

This report includes a brief discussion of the scope and limitations of the GEOPROCESS File compilation maps followed by summaries of the bedrock geology, surficial geology and terrain hazards for this NTS map area, and a list of references.

Geological Processes and Terrain Hazard Compilation Maps

The GEOPROCESS File map units were drafted on the 1:250 000 topographic base maps through interpretation from bedrock geology maps, surficial geology maps and in some cases terrain hazard maps at various scales. The compilation maps have a confidence level reflecting the original source material. All materials used to produce the maps are listed in the references on each map. A file containing the documentation used to construct these maps is available at the Indian and Northern Affairs library in Whitehorse, Yukon. Areas for which no surficial geology or terrain hazard information is published were left blank. Summary reports on surficial geology and terrain hazards for these map sheets were written by extrapolating the data from adjacent map sheets or smaller scale maps. Information from small scale (e.g., 1:1 000 000) maps was used for the summary reports, but not redrafted onto the 1:250 000 GEOPROCESS File maps.

The GEOPROCESS File compilation maps are intended as a first cut planning tool; the legend on the maps describes the general aspects of terrain hazards (also see below) and associated geological processes. **These maps should never replace individual site investigations for planning of site specific features, such as buildings, roads, pits, etc.**

Bedrock Geology Summaries

Each 1:250 000 NTS map area is described according to morphogeological belts and terranes defined by Gabrielse et al. (1991) and Wheeler et al. (1991). Bedrock geology (including structure) and mineral occurrences are briefly described and taken largely from the referenced, most recent 1:250 000 geological map with additional contributions from Wheeler and McFeely (1991), and Yukon MINFILE (1993). A summary paper ("A Geological Framework for Yukon") in Appendix A of the User Guide provides a framework and context for each of the bedrock summaries.

The level of knowledge and understanding of Yukon geology is constantly evolving with more detailed mapping and development of geological models. Names, ages and terrane affinities of rock units on the most recent 1:250 000 geological maps may, in some cases, now be considered incorrect. Thus information contained within some of the bedrock geology summaries may be out of date. Although much of the information reflects the knowledge at the time that the source map was published, additional information has been inserted whenever possible to assist the user in merging the information with current geological maps, concepts and understanding. The age ranges for similar packages of rocks may also vary between map areas since the actual rocks, or at least the constraints on their age, may vary between map areas.

BEDROCK GEOLOGY (Tempelman-Kluit, 1984)

The Carmacks map area is almost entirely within the Omineca Belt except for its southeasternmost corner and a zone along the Yukon River valley which is in the Intermontane Belt. The Intermontane Belt rocks are composed of the 230-200 million year old andesitic and basaltic volcanic breccia, augite porphyry, chlorite-amphibolite schist, limestone, greywacke and shale of the Lewes River Group, and 200-160 million year old Laberge Group silty shale, conglomerate and arkose, as well as Nordenskiold Formation dacite tuff, siltstone and argillite. Collectively, Laberge and Lewes River Group sedimentary rocks comprise the Whitehorse Trough of Stikinia. These rocks are overlain by chert-pebble conglomerate, sandstone and shale of the 100-60 million year old Tantalus Formation. The remainder of the area is underlain by metamorphic rocks attributed to Yukon Cataclastic (Nisutlin) and Yukon Crystalline terranes (collectively the Yukon-Tanana Terrane). Yukon Crystalline Terrane rocks are in the southwestern part of the map area and include 360 million year old granodiorite gneiss, known as the Pelly Gneiss, and pre-550 to 400 million year old Nisling Assemblage quartz-mica schist, amphibolite and marble. Yukon Cataclastic Terrane rocks in the northern part of the map area include 290-250 million year old hornblende-biotite-chlorite gneiss and biotite granite gneiss of the Selwyn Gneiss; 360-250 million year old Anvil Allochthon Assemblage amphibolite, serpentinized dunite and augen amphibolite gneiss; and Nisutlin Allochthonous Assemblage of 410-320 million year old muscovite-quartz schist and marble. Much of the map area is covered by volcanic and plutonic rocks. Large batholiths of 185 million year old biotite granite to biotite-hornblende granodiorite intrude rocks in the northern area and are likely part of the Klotassin Suite. Plutons of biotite-hornblende granodiorite, biotite leucogranite, hornblende syenite, as well as Mount Nansen Group andesitic plagioclase porphyry, andesite breccia and quartz feldspar porphyry, all of approximately 100 million years of age, are prevalent in the southern portion of the map area. Extensive flows of nearly flat-lying, 75 million year old Carmacks Group columnar jointed and vesicular basalt flows, andesite basalt flows, volcanic sandstone and conglomerate, flow banded rhyolite, welded felsic tuff and gabbro occur throughout the map area. Very young, columnar jointed, olivine basalt flows overlie river gravels in the Yukon River valley near Fort Selkirk. These are believed to have last vented in the 19th century.

Mineral deposits and occurrences

The Carmacks map area contains a large number of mineral prospects, 121, 76 with known occurrences, and a large number with defined tonnages. Most of the mineral occurrences and deposits are copper and/or gold porphyry or vein deposits which occur in the Dawson Range. The Nucleus deposit hosts 4.1 million tonnes of 1 gram per tonne gold. The Laforma vein deposit, a past producer, in the Mount Freegold region has present reserves of 500 000 tonnes of 11 grams per tonne gold, the Augusta/Margarete deposits hosts 123 800 tonnes of 4.1 grams per tonne gold and 48 grams per tonne silver, and the Antoniuk porphyry-style deposit hosts almost 4 million tonnes of 1.36 grams per tonne gold. The past producing Mt. Nansen mine contains current reserves of 950 000 tonnes of 9.4 grams per tonne gold and 190 grams per tonne silver. The Carmacks Copper (Williams Creek) deposit contains 20 million tonnes of 1 % copper, 0.45 grams per tonne gold and the geologically similar Minto deposit has reserves of approximately 8 million tonnes of 1.85 % copper and 10 grams per tonne silver The nearby Tinta Hill deposit contains 700 000 tonnes of 10 grams per tonne gold and 240 grams per tonne silver. Placer gold is also produced from several creeks in the Mount Freegold and Mount Nansen areas. Numerous coal deposits near Carmacks are hosted in the Tantalus Formation, and have been mined intermittently over this past century. Current reserves at the Tantalus Butte deposit are approximately one million tonnes.

SURFICIAL GEOLOGY

The main sources of information on the Carmacks map sheet are surficial geology maps by (Klassen, Morison and Duk-Rodkin (1987) and Jackson (1997a and 1997b).

Most of the Carmacks map area is located beyond the McConnell glacial ice limit. It is believed that Reid and pre-Reid glacial ice advanced into the Carmacks map sheet and covered most of the area with the exception of the high peaks such as Mt. Nansen and Mt. Victoria.

Reid moraines are exposed roughly 5 to 10 kilometres west of the Nordenskiold and Yukon rivers and north of Tatchun River and at mid- to high elevations on the Dawson Range. McConnell till, in the south and east of the map area are common at lower elevations. For example, a 5- to 8-km-wide belt north and south of Talmain Lake is covered with deposits of McConnell age. Morainal deposits in the area have a general sandy loam to loamy sand matrix and a variable content of coarse fragments (Mougeot, field observations). Organic mat as thick as 30 cm is common over the colluvial or morainal deposits. Thick wind blown silt and sand also cap moraines in many areas.

The margin of the Reid glaciers are located a few kilometres east from Victoria Creek and deposits related to the retreating glaciers are found at lower elevations in the major valley floors of the area. Some gravel deposits at higher elevations could also be linked to the Reid glaciations (Jackson, 1997) as well as some of the terraces along the main streams. The floors of the Yukon and Pelly river valleys are covered by glaciofluvial sand and gravel, commonly overlain by a veneer of wind deposited silt and fine sand (loess). In general, the area was also subjected to variations of stream base level. For example, during glaciation, rising base levels caused considerable aggradation in the valleys of Victoria and Nansen Creeks (LeBarge, 1993). During de-glaciation, lowering base levels resulted in the degradation and dissection of pre-existing alluvial fans. These base level cycles may have occurred several times during either or both the Reid and McConnell glaciations, affecting both fluvial stream and fan activity, and explaining the numerous colluvial deposits in the area.

The dominant surface deposits in this map area consist of till. Till blankets are difficult to differentiate from colluvial deposits or colluviated tills. In this study, colluvial blankets or veneers can be interpreted as including till of pre-Reid age.

Colluvial processes and permafrost-related processes are still active in the area. Permafrost is probably quite extensive at higher elevations, and probably continuous on north-facing slopes where the friable colluvial blanket is covered by thick moss or organic mat. At lower elevations, permafrost with high ice content (large ice lenses or pods) can be expected in fine-grained sediments with a thick organic cover. Disruption of the organic cover will breach the insulation, which preserves the frozen soil, and therefore initiate or enhance soil creep, solifluction and slope failure. In fine-grained sediments such as silt and clay or fine sandy, silty alluvial or fan toe deposits, surface disturbance disruption may trigger thermokarst collapse as well as very poor drainage conditions for several years.

Recent volcanic activity at Volcano Mountain, 17 km north of the confluence of Yukon and Pelly rivers is dated to the early Pleistocene or late Pliocene. Selkirk volcanic rocks consist of alkaline olivine basalt, olivine nephelinite and basanite (Jackson and Stevens, 1992).

TERRAIN HAZARDS

Limited information on terrain hazards is derived from the surficial geology map. Flooding of the major creeks and rivers is the most common hazard. Numerous landslides (Jackson, 1997) have been mapped on the eastern part of the map area.

Seismicity

There are 10 recorded seismic events, mostly in the eastern portion of the map. Two of the events are of magnitude 3.0 to 4.0, the rest are of lower magnitude.

Mass Movement Processes

Rapid mass movement hazards include slope failures, avalanches and rock falls. These active processes are severe hazards and thus should be considered in development activities in the Carmacks area where bedrock outcrops have steep slopes. Periglacial processes present, such as solifluction, nivation and thermokarst, may impact the stability of slopes covered by colluvial and morainal deposits, as well as the stability of river banks cut into silty sediments.

Numerous landslides, some of considerable size as the ones on the north side of Miller's ridge, have been mapped by Jackson (1997, see map accompanying this report).

Permafrost

This map area is part of the scattered permafrost zone (Brown, 1978). Generalized comments about permafrost distribution can be inferred from information available in adjoining map sheets (Heginbottom and Radburn, 1992). Permafrost is probably more common at high elevations, in morainal and colluvial deposits with visible ice, nivation and cryoplanation features. At lower elevations, alluvial and glaciolacustrine sediments may have less extensive permafrost, but higher ice content. Thermokarsting can develop in fine-grained glaciolacustrine sediments and fine-grained alluvial sediments in areas such as the Rowlinson Creek area. Organic deposits shown on the accompanying map may contain a large amount of ground ice.

Flooding Risks

Flooding in the map area is caused by unusually high precipitation, snowmelt runoff or ice jams during break-up time. The community of Carmacks has been flooded at least three times in the last 100 years (1910, 1920s and 1958; Underwood McLellan, 1983). Ice jams occur frequently along the Yukon River (Underwood McLelland, 1983) particularly at Five Finger Rapid and Tantalus (Underwood McLelland, 1983).

References: Carmacks Map Area, NTS 115I

Note: To be thorough, check the references for adjacent NTS map sheets and the General Reference List.

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NOTE: A new digital compilation of Yukon Geology is now available by Steve Gordey and Andrew Makepeace (GSC Open File D3826 and/or DIAND Open File 1999-1(D)), and more recent MINFILE updates should also be verified (Yukon MINFILE, 2001).

LEGEND

LEGEND TERRAIN HAZARDS

MAP SYMBOL	TERRAIN HAZARDS	ASSOCIATED RISK LEVELS, COMMENTS
	Mass Movement Processes	
A	Snow Avalanched.	high
F	Extremely slow to moderate rates of failure in soil and bedrock, including soil creep, rock creep, earthflow, soil or rock slump, debris or rock slide.	low to intermediate
R	Moderate to extremely rapid rates of failure in soil and bedrock (1.5 m/d to >3 m/s), including rock slump, debris slide, rock slide, debris flow, debris torrent, debris avalanche, rockfall, rock avalanche.	high
	Arctic, Alpine and Periglacial Processes	
X	Permafrost present.	low
K	Thermokarst present.	low
S	Soliflucted.	low to intermediate
Z	Grouped, cryoturbated, soliflucted, nivated.	low to intermediate
	Fluvial Processes	
B	Braided, unstable channels, risk of flooding.	intermediate to high
E	Fluvial erosion, deposition and low risk of flooding.	low to intermediate
J	Anastomosing.	intermediate to high
U	Flooded regularly.	intermediate to high
	Miscellaneous Erosion Processes	
T	Karst.	intermediate
P	Piping.	intermediate to high
V	Gullied.	low to intermediate

On Site Symbols	Risk Level
Unit boundary (defined, approximate).	
Erosional escarpment.	high
Landslide escarpment.	high
Landslide (includes source and runout areas).	high
Pingo.	high
Rock glacier.	high
Spring or saline seep.	low
Observation of frozen soil or ground ice.	low
Rapid mass movements (debris torrent) with known point source. Limits of runout not implied by symbol.	high
Slow mass movement (earth flow) with landslide, escarpment source. Limits of landslide runout not implied by symbol.	intermediate to high

LEGEND SEISMIC EVENTS

SYMBOL	MAGNITUDE REPRESENTED	SYMBOL	MAGNITUDE REPRESENTED
⊡	<2.0	⊡	4.0 to 4.999
⊡	2.0 to 2.999	⊡	5.0 to 5.999
⊡	3.0 to 3.999	⊡	>6.0

LEGEND GEOLOGICAL PROCESSES

MAP SYMBOL	DESCRIPTION	INFERRED HAZARDS
cf	Talus fan or apron, moderate to steep slope, coarse angular bedrock fragments, sources are often areas of rapidly disintegrating bedrock.	Rock fall and debris flows common on active fans, steep slopes generally unstable to traffic.
cl	Landslide, moderate slope, varies from large blocks of bedrock to finer material.	Landslides generally are recurrent in susceptible areas and may be become active if disturbed.
cs	Colluvium covered slope, gentle to moderate slope, underlain by unsorted rubble, solifluction and other periglacial features common.	Areas of fine textured materials and gentle slopes at high elevations, where there is ground ice will be susceptible to high solifluction rates and thermokarst if disturbed.
fa	Alluvial fan, active.	Subject to shifts in channel and bar positions, occasionally subject to flooding.
fp	Floodplain.	Subject to shift in channel and bar positions, occasionally subject to flooding.
ice	Glacier ice.	Crevasses.
im	Mountain ice caps.	Avalanches, ice and rock falls, and crevasses.
is	Cliff glacier.	Avalanches, ice and rock falls.
l	Lacustrine or glaciolacustrine sediments.	Silt and clay, usually susceptible to frost heaving and, if permafrost present, to thermokarsting when disturbed.
m/i	Rock glacier, debris covered glacier.	Ice at depth make surface susceptible to thermokarst, unstable slopes.
o	Organic.	Thick organic matter is often underlain by permafrost. Disturbance of permafrost may cause poor drainage and thermokarsting.

LEGEND FAULTS

Fault defined, approximate, assumed, extrapolated beneath overburden

Fault
Solid circle indicates downthrown side
Arrows indicate relative movement

Thrust Fault (teeth indicate upthrust side)

Airphoto Lineament

LEGEND QUATERNARY VOLCANISM

All units shown are Selkirk Volcanics (Pliestocene to Recent)

OTHER FEATURES

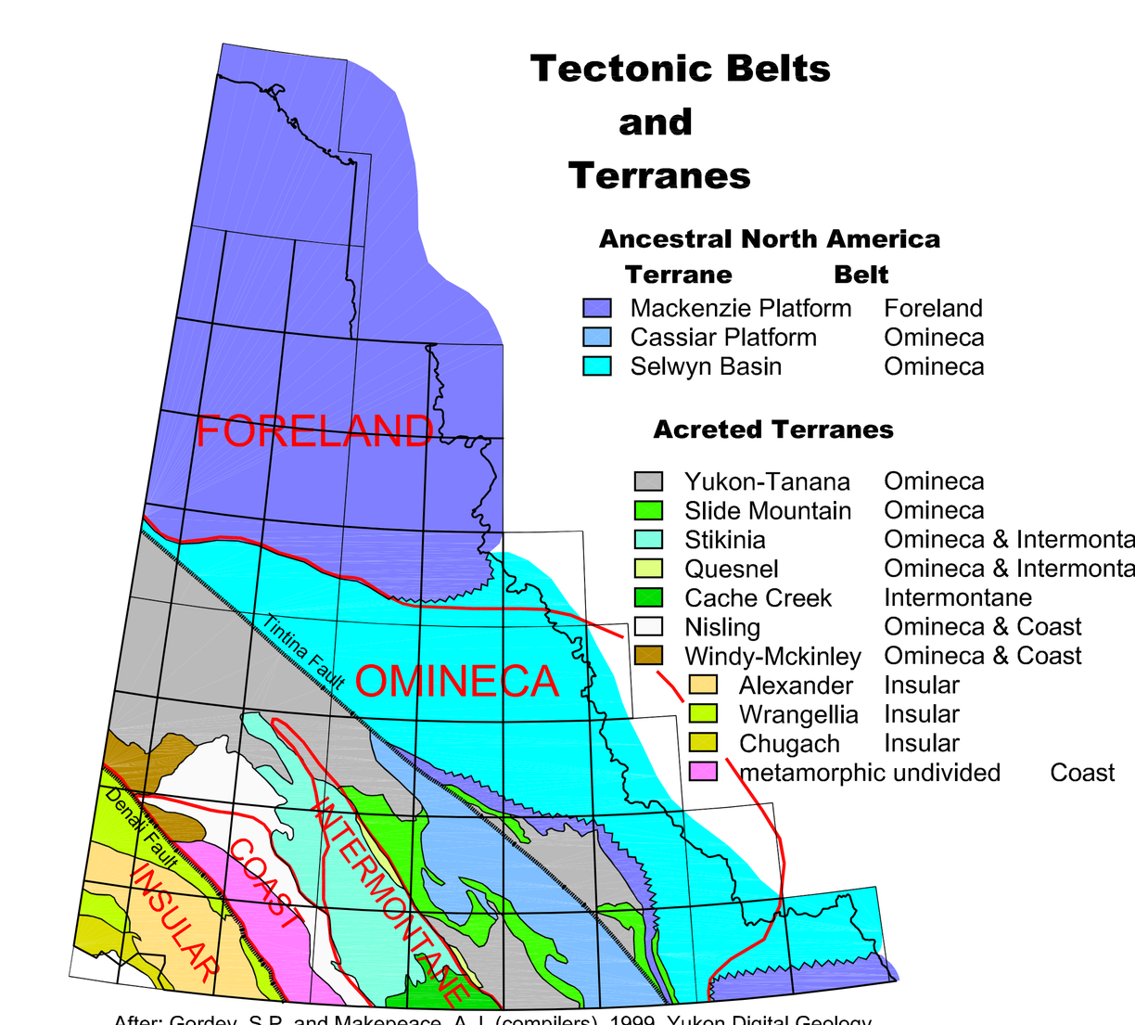
Roads

Streams

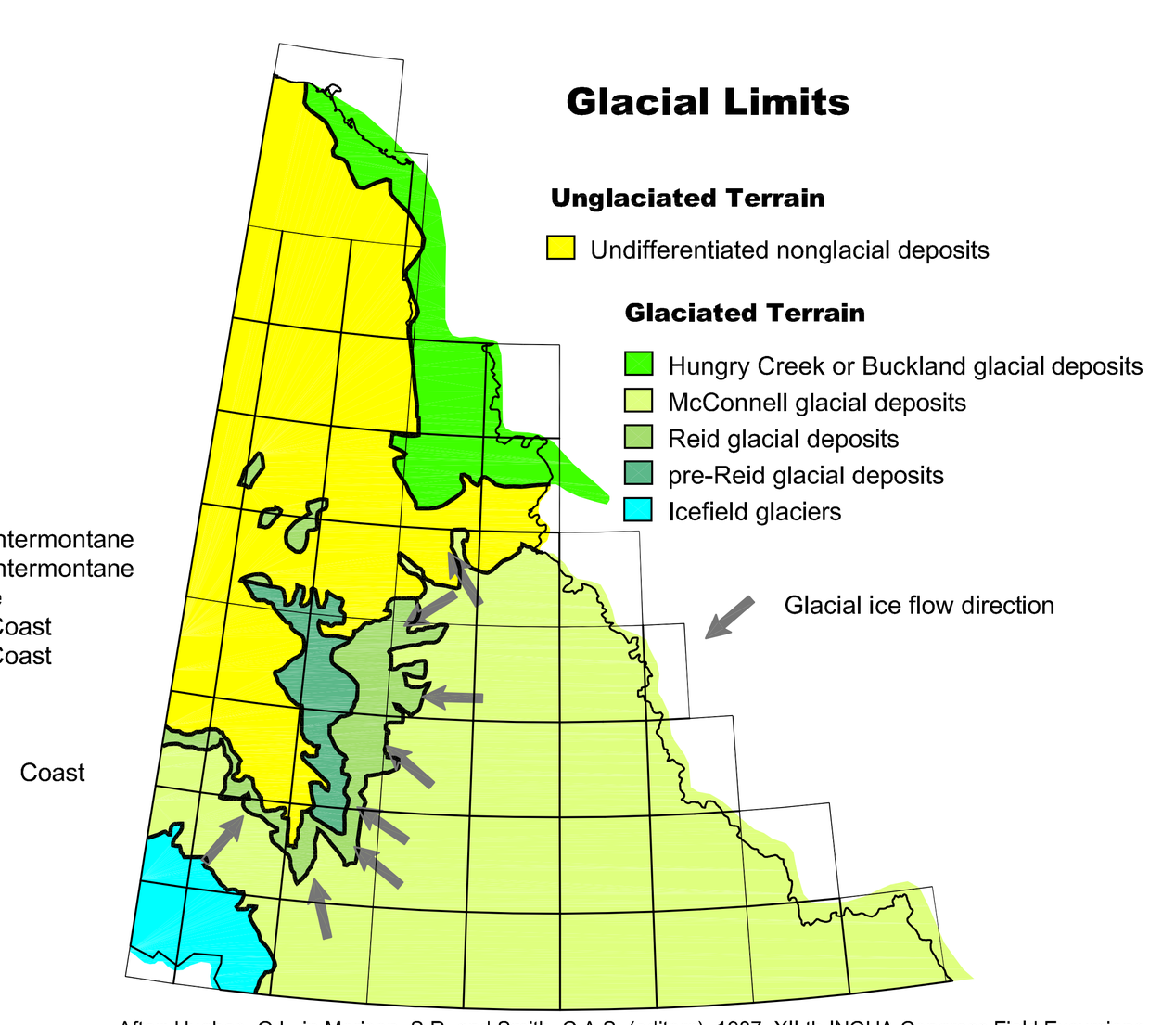
Lakes

Marsh

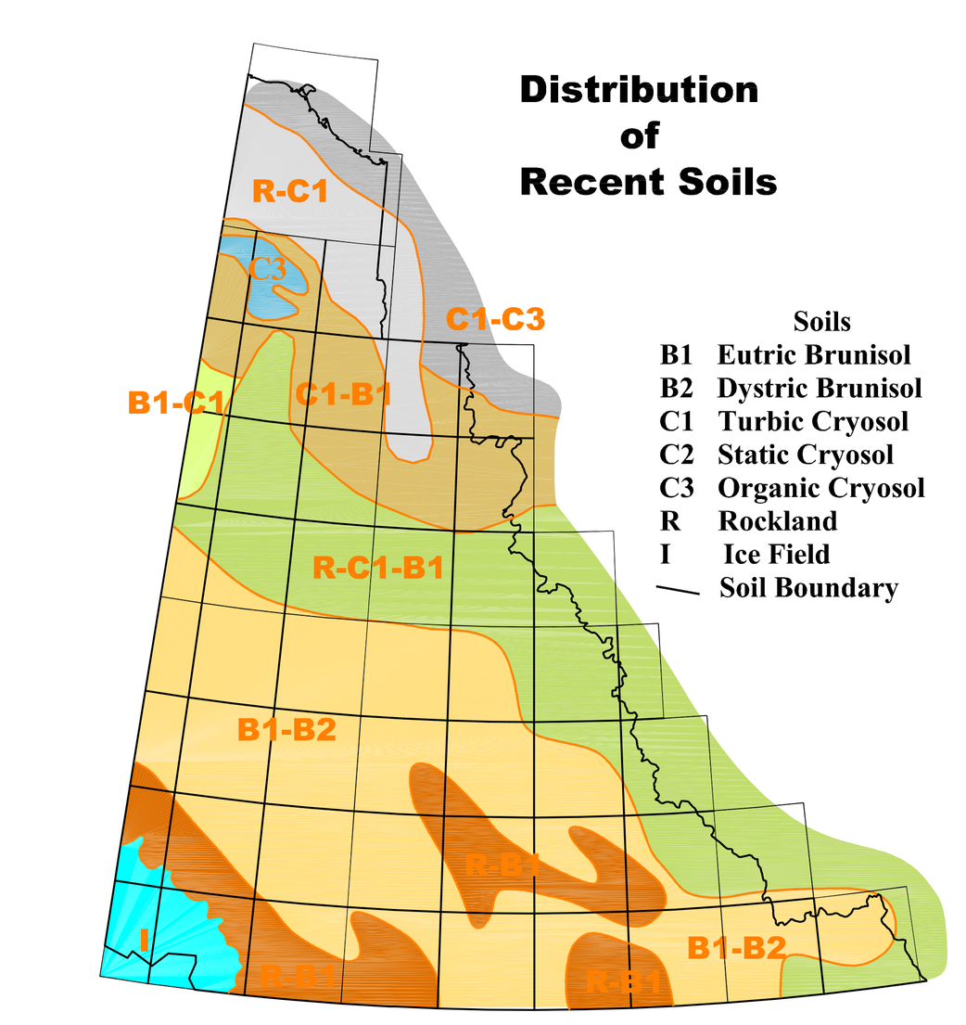
NOTE: Where areas have more than one identified process or hazard, the colour of the encompassing polygon is assigned based on a hierarchical scheme relating to the severity of the hazard. The relative order of severity is: Terrain Hazards (Mass Movement Processes then Fluvial Processes then Arctic, Alpine and Periglacial Processess) followed by Geological Processes.



After: Gordey, S.P. and Makepeace, A.J. (compilers), 1999. Yukon Digital Geology Geological Survey of Canada Open File D3826, Exploration and Geological Services Division Yukon, Indian and Northern Affairs, Open File 1999-1 (D)



After: Hughes, O.L. in Morison, S.R. and Smith, C.A.S. (editors), 1987, XII th INQUA Congress Field Excursions A20, p12 to 16 - Research in Yukon, National Research Council of Canada, Ottawa, Canada, 110p



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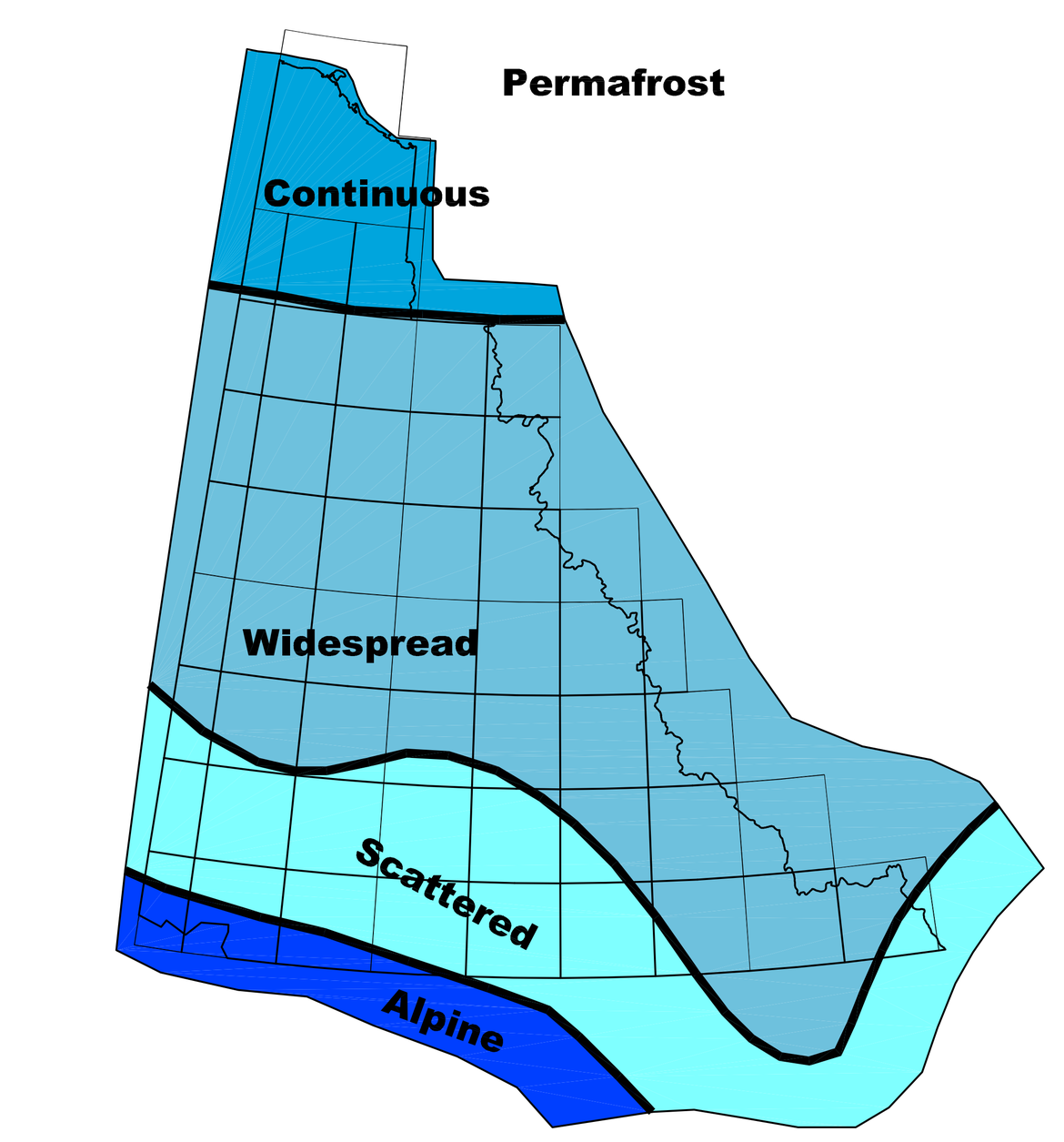

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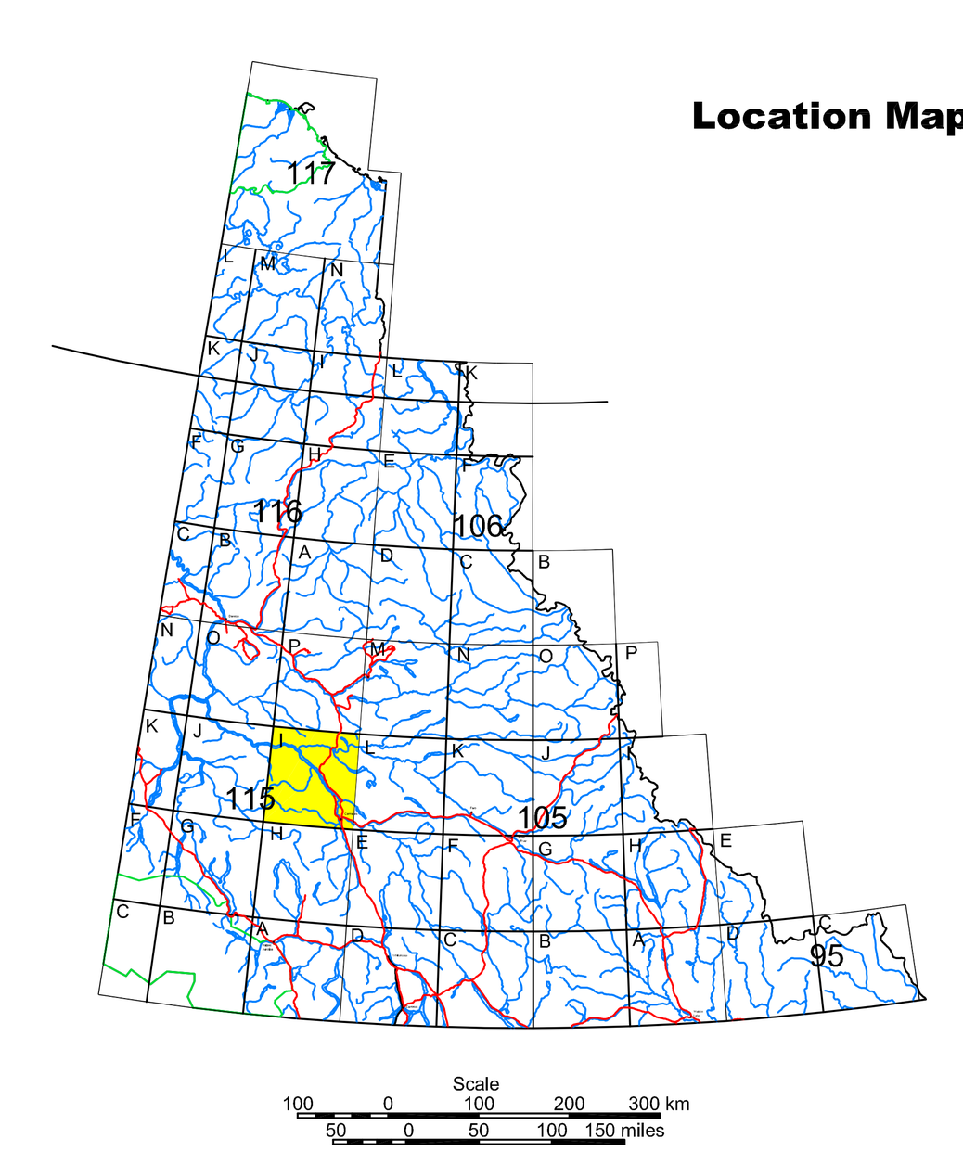

North American Datum 1927, Universal Transverse Mercator Projection ZONE 7

Exploration and Geological Services Division
Yukon Region
Indian and Northern Affairs Canada

Yukon GEOPROCESS File

Geological Processes and Terrain Hazards of Carmacks 115I

by

Mougeot, C.M. and Walton, L.A.

Copies of this map may be obtained from
Geoscience and Information Sales
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