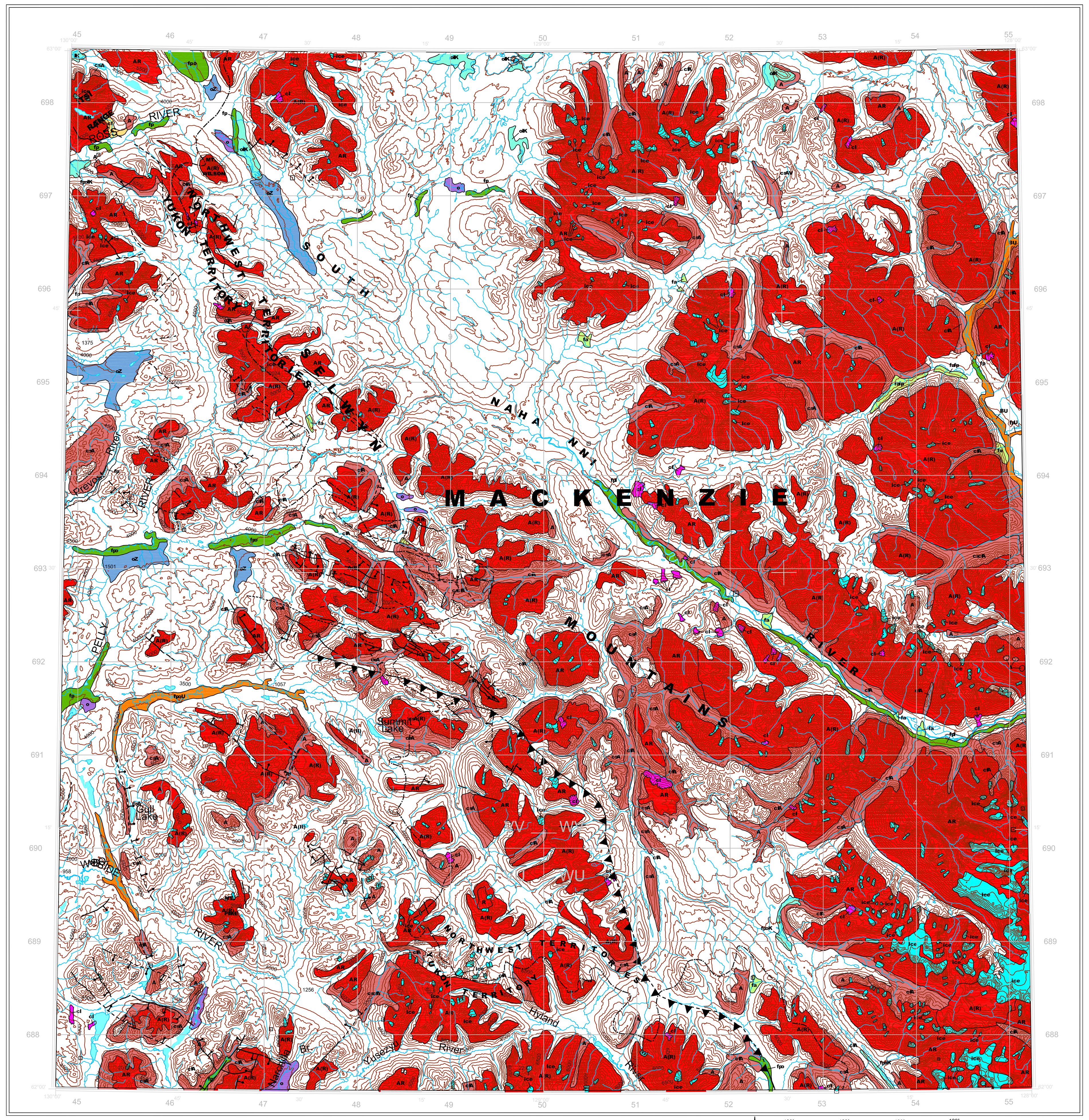
NATIONAL TOPOGRAPHIC SERIES NTDB (1995) **D.I.A.N.D. N.A.P. LAND RESOURCES** **CANADA SHEET 105 I**



TEN THOUSAND METRE UNIVERSAL TRANSVERSE MERCATOR GRID NAD 83 ZONE 9

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

THIS MAP IS ISSUED AS A PRELIMINARY GUIDE FOR WHICH THE DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT WILL ACCEPT NO RESPONSIBILITY FOR ANY ERRORS, INACCURACIES OR OMISSIONS WHATSOEVER.

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N A H A N N I

YUKON TERRITORY

SCALE 1:250 000

Kilometres 5 0 5 10 15 20 25 30 Kilometres

132° – 130°	130° – 128°	128° – 126°
105O NIDDERY LAKE	105P SEKWI MOUNTAIN	95M FORAN RIVER
105J SHELDON LAKE	105I NAHANNI	95L SOUTH REDSTONE
105G FINLAYSON LAKE	105H FRANCES LAKE	95E FLAT RIVER

Index to Adjoining Sheets.

Magnetic Declination 1987 varies from 31° 26' easterly at the centre of the west edge to 31° 40' easterly at the centre of the east edge. Mean annual change 19.9' westerly.

GEOPROCESS FILE - SUMMARY REPORT

NAHANNI RIVER MAP AREA - NTS 105I

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

The Nahanni map area is located in the Selwyn Basin part of the Omineca Belt. The area is mountainous; it includes parts of the Mackenzie and Selwyn mountain ranges. In some places, the mountains are extremely rugged and are characterized by sheer granite walls and spires. A major drainage divide along the Northwest Territories-Yukon Territory border separates the Nahanni River on the northeast from the Pelly, Ross and Hyland rivers to the southwest.

The southern Nahanni map area on the Yukon side of the border is dominated by 800-530 million year old Hyland Group rocks consisting of shale, sandstone, conglomerate and limestone. The west-central part of the map area contains Devonian-Mississippian (320 to 410 million year old) Earn Group shale, sandstone and conglomerate and Road River Group mudstone of the Selwyn Basin suite. The sedimentary packages are intruded by mid-Cretaceous (100 million year old) Selwyn plutonic suite granites.

Mineral Deposits and Occurrences

Yukon MINFILE lists 25 mineral prospects in the Yukon Territory portion, 12 hosting known mineralization. The most common known deposit types are zinc-lead sedimentary exhalative deposits or copper-skarn deposits. The most important deposit to date is the Howard's Pass zinc-lead sedimentary exhalative deposit hosted by Road River Formation rocks. Drill indicated reserves from 1982 for both the Howard's Pass and Anniv deposits are approximately 113.4 million tonnes averaging 5.4% zinc and 2.1% lead. Inferred reserves for both deposits are in excess of 362.9 million tonnes.

SURFICIAL GEOLOGY

The main source of information for this section is derived from a set of surficial geology maps at the 1:125 000 scale (1982) and report by Jackson (1987). The report provides an excellent description of the glacial events that shaped the area as well as several stereoscopic pair of air photographs to illustrate special features.

The surface exposed today is a result of the most recent glaciation, the McConnell. Traces of previous glaciations have not been identified. From geomorphic features and modeling, Jackson recreates the fairly complex history of the ice bodies which covered the map area. In general, ice flow direction was controlled by the underlying topography and, as is the case with the present drainage, an ice flow divide must have existed, with ice roughly diverging west and northeast. Radiocarbon dates from southeast Yukon locations bracket the onset of the McConnell Glaciation in the area from roughly after 23,900 BP and deglaciation to roughly 10,000 BP.

Steep rock faces are common at elevations above 1520 m; cirques, horns and arrêtes may be linked to rock and/or snow avalanches. In some cases, particularly in the Ragged Ranges, summits and cirques are covered by small Holocene glaciers, roughly at elevations above 1830 m. Rock glaciers are numerous in this general area and are usually restricted to north- and northeast-facing slopes. They range in thickness from 15 to 77 m at the snout and can be up to 3 km long. Active rock glaciers can be recognized by their unvegetated appearance, and steep snouts. Surface flow velocities of up to 51 m in 17 years were recorded with snout advances of 2.5 m.

Till covers most valley walls. The till is composed of coarse gravelly material with a matrix of roughly equal proportions of clay, silt and sand. Clast lithology is influenced by local rock, as is the till matrix. For example, tills found southwest of the South Nahanni River have lower carbonate content than the matrix from tills sampled northeast of the river, where bedrock includes lower Paleozoic carbonates. Recent morainal ridges are common within 2 km of small modern glacier margins and are often ice-cored. Buried ice in these recent morainal landforms could collapse, subside and slump either due to natural causes (warm summers) or man-related surface disturbances.

Glaciofluvial sand and gravel deposits are common, either as terraces, outwash plains, or as kame and eskers and can be as thick as 10 m. They are abundant in the south Nahanni River valley and in the Upper Hyland River valley. These deposits present fairly stable areas and could support roads and development when the topography is gentle enough.

Well-sorted fine-grained sediments were deposited in large lakes in areas where drainage was blocked by glaciers. There were several of these in the South Nahanni River valley, with the largest one being located near Mt. Wilson. Such deposits often contain large ice lenses and may also have shallow permafrost tables in areas covered by thick organic matter or dense spruce forest.

Colluvium consists of mixed debris ranging from clay to boulder size derived from bedrock and from other unconsolidated deposits. It mantles the upper slopes of mountains and is often modified by frost shattering, solifluction and snow and rock avalanches.

Organic deposits as identified on the map are usually more than 1 m thick. They generally indicate poor drainage and a high water table, and are commonly underlain by permafrost. Peat palsas and bog blankets particularly were found to contain ice-rich permafrost. Prospectors have found the colouring of the moss useful since the high contents of dissolved zinc in spring waters cause the mosses at the surface of organic deposits to change from their normal dull green to a bright lime green. This bright color of moss can easily be spotted, such as in the Howard's Pass area.

TERRAIN HAZARDS

Terrain hazards are derived from the surface geology maps. The Geological Survey of Canada's Pacific Geoscience Centre in Victoria provided the seismic information.

Mass Movement Processes

Rockfalls on steep rock faces are the most common slope failures in the area. Talus aprons and cones are the result of rockfalls and short, low volume rock falls of less than 100 000 cubic metres are common. Very few larger landslides have occurred within this area. Bedrock failures followed by large volumes of rocky debris are usually related to bedding planes or cleavages such as the one in Precambrian slate, south of Howard's Pass.

Permafrost

The map area lies within the discontinuous permafrost zone (Brown, 1967). According to the recent compilation by Heginbottom (1995) it lies within the Extensive Discontinuous Permafrost Zone, and ice contents vary from low to moderate (<10% to 20% ground ice), increasing in the western part of the map area. Mean annual ground temperatures range from 0 to -2 degrees Celsius. Ice content is expected to be nil to low in glaciofluvial and fluvial coarse-grained deposits in most landforms such as terraces, fans, eskers, kames.

Ice content in morainal and colluvial deposits is expected to be low to moderate and is often indicated by the presence of thick organic mats in poorly drained sites such as bog blankets, solifluction lobes and stripes and sorted stone polygons. Rock glaciers are very common and are associated with conditions favorable to permafrost. Active rock glaciers may also present a low rockfall risk.

High ice content is possible in fine-grained fluvial terraces located above stream level and in silty to clayey glaciolacustrine sediments. Slumping can develop along river banks where the sediments are undercut by the stream. Ice lenses or veins are also common at the toe of colluviated (inactive) slopes covered by thick mosses. Organic landforms located on floodplains, paludifying lakes and bogs are particularly sensitive as they contain large ice lenses. Peat palsas have been identified in many areas. Thermokarst processes may be triggered by surface disturbances such as forest fire, road construction or logging.

Flooding and Other Risks

Floods related to ice-jams, snow melt and summer rainstorms are possible hazards in lower reaches of most streams. The steep portions of alluvial fans are exposed to the additional possibility of mud and debris flows associated with a rapid increase in discharge, in addition to the inherent risk of flooding.

Seismicity

There are 20 recorded seismic events in the Nahanni map area ranging from less than 2.0 to 4.999 in magnitude.

References

Nahanni Map Area - NTS 105I

To be thorough, check the references for adjacent NTS map sheets and the General Reference List (See User Guide).

Most of the following references should be available for viewing in the DIAND library on the third floor of the Elijah Smith building in Whitehorse. The library and call number of some internal government reports are listed.

Anderson, R.G., 1982. Geology of the Mactung pluton in Niddery Lake map area and some of the plutons in Nahanni map area, Yukon Territory and District of Mackenzie. In: Current Research, Part A, Geological Survey of Canada, Paper 82-1A, p. 299-304.
(NTS 105I, 105O)

Blusson, S.L., Green, L.H. and Roddick, J.A., 1968. Geology, Nahanni, District of Mackenzie and Yukon Territory. Geological Survey of Canada, Map 8-1967.

Brown, R.J.E., 1967. Permafrost in Canada. Geological Survey of Canada, Map 1246A (scale 1:7 603 200).

*Canadian Earthquake Epicentre File; Maintained by the Geological Survey of Canada, Geophysics Division.

Gabrielse, H., Tempelman-Kluit, D.J., Blusson, S.L. and Campbell, R.B. (comps.), 1980. MacMillan River, Yukon - District of MacKenzie-Alaska (Sheet 105, 115). Geological Survey of Canada, Map 1398A (one 1:1 000 000 map).

Gabrielse, H. and Yorath, C.J. (eds.), 1991. Geology of the Cordilleran Orogen in Canada. Geological Survey of Canada, Geology of Canada, No. 4, 844 p.

Geological Survey of Canada, 1982. Regional stream sediment and water geochemistry of the Nahanni map area (NTS 105I), Yukon and N.W.T. Geological Survey of Canada, Open File 868.

Goodfellow, W.D., 1989. Interpretation of stream geochemistry leading to the discovery of a secondary zinc deposit, Pelly River, Nahanni map area, Yukon. In: Current Research, Geological Survey of Canada, Paper 89-1E, p. 31-50.

Gordey, S.P., 1981. Geology of Nahanni map area, Yukon Territory and District of Mackenzie. Geological Survey of Canada. Open File 780.

Gordey, S.P. and Anderson, R.G., 1993. Evolution of the northern Cordilleran miogeocline, Nahanni map area (105I), Yukon and Northwest Territories. Geological Survey of Canada, Memoir 428.

Memoir 428 includes:

* Gordey, S.P., 1992. Geology, Little Nahanni River, Northwest Territories - Yukon Territory. Geological Survey of Canada, Map 1762A (scale 1:250 000).

Gordey, S.P., 1992. Geology, South Nahanni River area (105I/6), Northwest Territories - Yukon Territory. Geological Survey of Canada, Map 1-1992, Sheet 1 of 6 (scale 1:50 000).

Gordey, S.P., 1992. Geology, South Nahanni River area (105I/7), District of Mackenzie, Northwest Territories. Geological Survey of Canada, Map 1-1992, Sheet 2 of 6 (scale 1:50 000).

Gordey, S.P., 1992. Geology, South Nahanni River area (105I/8), District of Mackenzie, Northwest Territories. Geological Survey of Canada, Map 1-1992, Sheet 3 of 6 (scale 1:50 000).

Gordey, S.P., 1992. Geology, South Nahanni River area (105I/9), District of Mackenzie, Northwest Territories. Geological Survey of Canada, Map 1-1992, Sheet 4 of 6 (scale 1:50 000)

Gordey, S.P., 1992. Geology, South Nahanni River area (105I/10), District of Mackenzie, Northwest Territories. Geological Survey of Canada, Map 1-1992, Sheet 5 of 6 (scale 1:50 000).

Gordey, S.P., 1992. Geology, South Nahanni River area (105I/16), District of Mackenzie, Northwest Territories. Geological Survey of Canada, Map 1-1992, Sheet 6 of 6 (scale 1:50 000).

Green, L.H. and Roddick, J.A., 1967. Geology, Nahanni, Yukon Territory and District of MacKenzie. Geological Survey of Canada, Map 8-1967.

Groat, L.A., Ercit, T.C., Mortensen, J.K. and Mauthner, M.H.F., 1995. Granitic pegmatites in the Canadian Cordillera: Yukon and Northwest Territories. Exploration and Geological Services Division, Yukon Region, Indian and Northern Affairs Canada, Canada/Yukon Economic Development Agreement, Geoscience Open File, 1995-14 (G), 40 p.

Hamilton, S.M., Michel, F.A. and Jefferson, C.W., 1988. Groundwater geochemistry, South Nahanni Resource Management Area, District of Mackenzie. Geological Survey of Canada, Paper 88-01E, p. 127-136. (NTS 95E, 105H, 105I)

Heginbottom, J.A. and Tadburn, L.K. (comps.), 1992. Permafrost and ground ice conditions of northwestern Canada. Geological Survey of Canada, Map 1691A, scale 1:1 000 000.

Heginbottom, J.A., 1995. Canada Permafrost, The National Atlas of Canada 5th Edition, Natural Resources Canada, Geological Survey of Canada, Map MCR 4177F, 1:7 500 000 scale.

* Jackson, L.E., 1982. Terrain conditions of the Nahanni map area, Yukon and N.W.T. (105I). Geological Survey of Canada, Open File 886 (1:125 000-scale map).

* Jackson, L.E., 1987. Terrain inventory and Quaternary history of Nahanni map area, Yukon Territory and Northwest Territories. Geological Survey of Canada, Paper 86-18, 23 p.

Lamontagne, M. and Milkereit, B., 1988. Reprocessing of industry data of the North Nahanni region: Implications for the interpretation of the Nahanni earthquake sequence. Geological Survey of Canada, Open File 1728, 33 p.

Weichert, D.H., Wetmiller, R.J., Horner, R.B., Munro, P.S. and Mork, P.N., 1986. Strong motion records from the 23 Dec., 1985, MS6.9 Nahanni, NWT and some associated earthquakes. Geological Survey of Canada, Open File 1330, 120 p.

Wetmiller, R.B., Horner, R.B., Hasegawa, H.S., North, R.G., Lamontagne, M., Weichert, D.H. and Evans, S.G., 1989. An analysis of the 1985 Nahanni earthquakes. Bulletin of the Seismological Society of America, v. 78, p. 590-616.

* Wheeler, J.O., Brookfield, A.J., Gabrielse, H., Monger, J.W.H., Tipper, H.W. and Woodsworth, G.J., 1991. Terrane map of the Canadian Cordillera. Geological Survey of Canada, Map 1713.

* Wheeler, J.O. and McFeely, 1991. Tectonic assemblage map of the Canadian Cordillera and adjacent parts of the United States of America. Geological Survey of Canada, Map 1712A.

Yukon MINFILE, 1994. 105I - Nahanni. Exploration and Geological Services Division, Yukon Region, Indian and Northern Affairs Canada.

* References used in compiling this map

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	Solifluction.	low to intermediate
Z	Grouped, cryoturbated, solifluction, 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

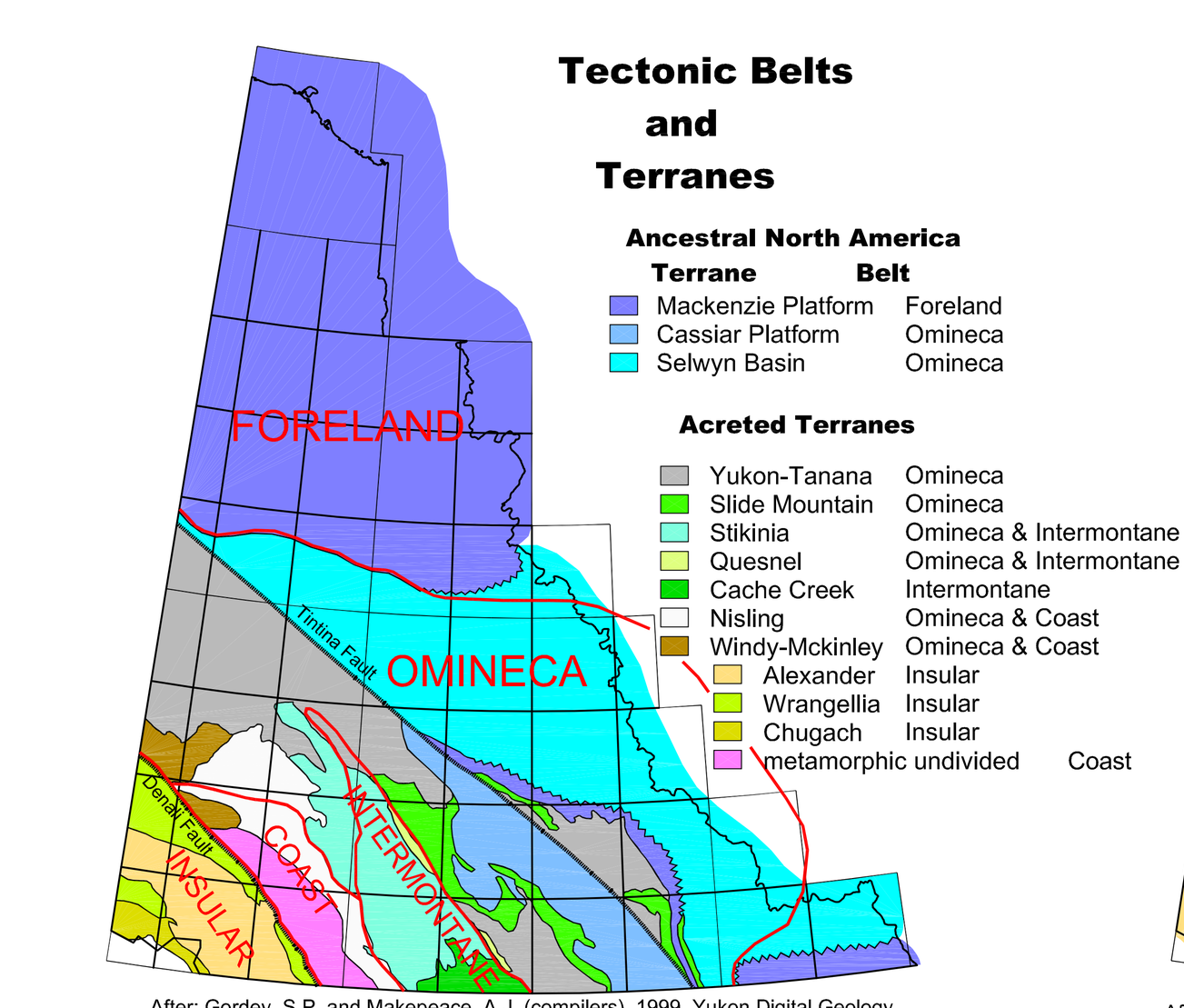
LEGEND QUATERNARY VOLCANISM

Unit shown is late Tertiary/Pleistocene olivine basalt.

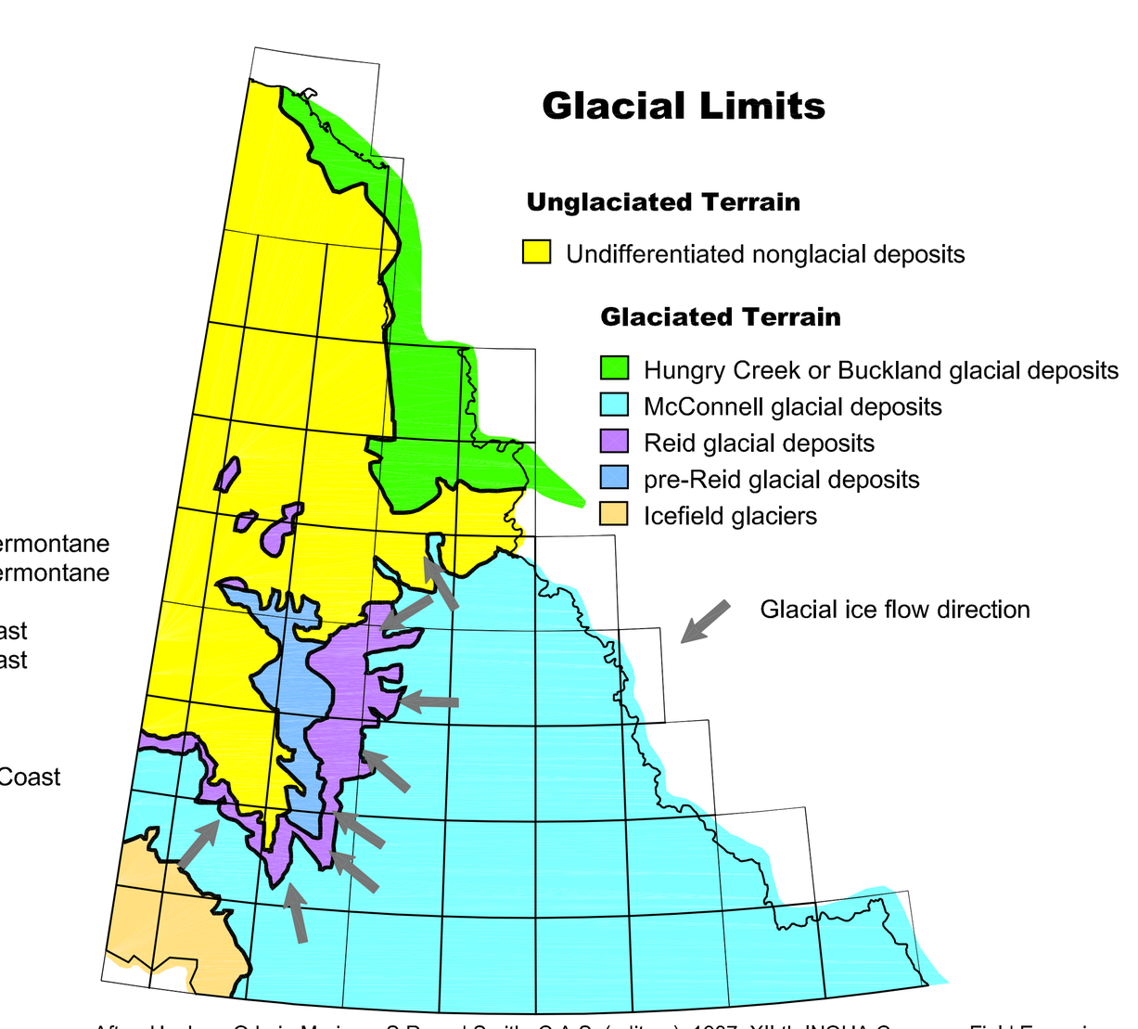
OTHER FEATURES

Roads
Streams
Lakes
Marsh

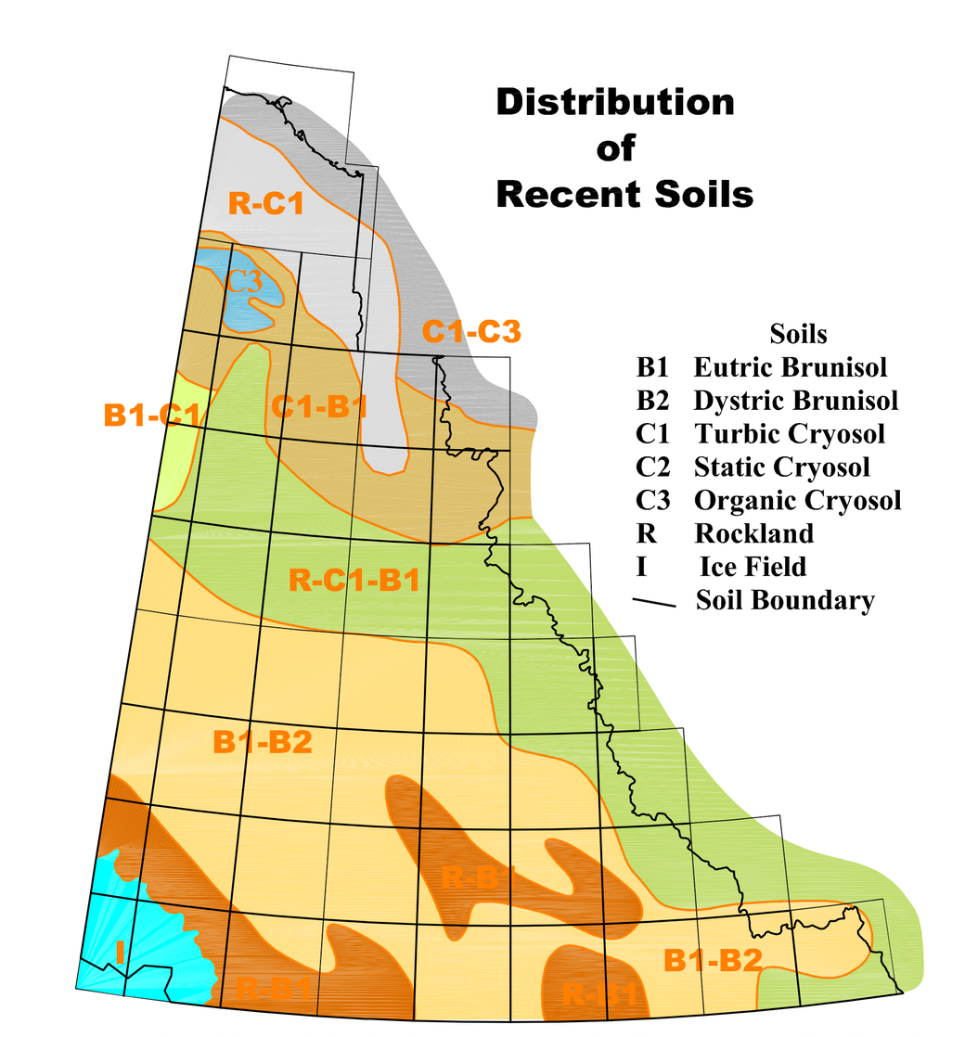
NOTE: Where areas have more than one identified process or hazard, the colour of the encompassing polygon is assigned based on a hierarchical scheme relating to the severity of the hazard. The relative order of severity is: Terrain Hazards (Mass Movement Processes then Fluvial Processes then Arctic,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



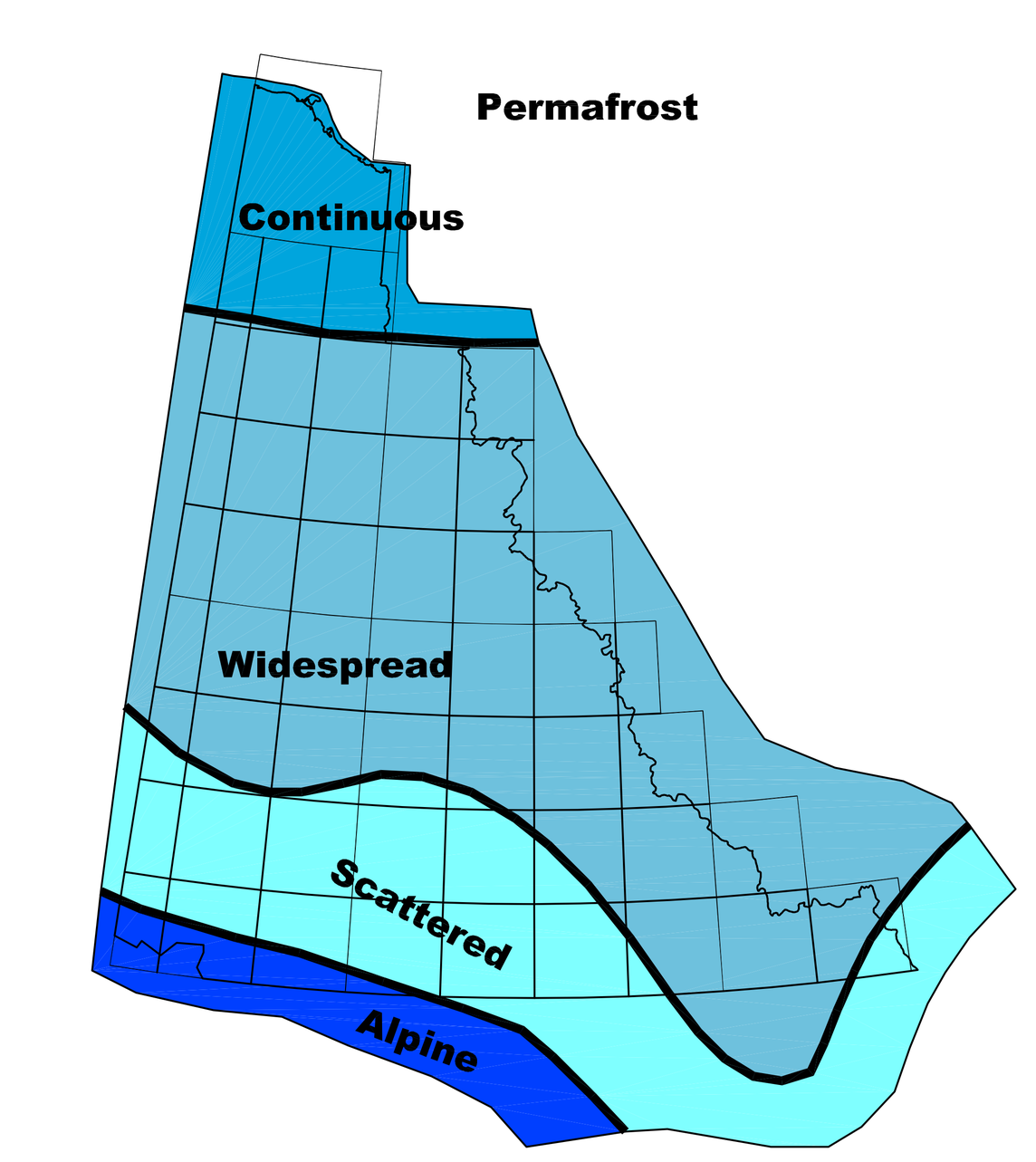
After: Gordey, S.P. and Makepeace, A.J. (compilers), 1999. Yukon Digital Geology Geological Survey of Canada Open File D3826, Exploration and Geological Services Division Yukon, Indian and Northern Affairs, Open File 1999-1 (D)



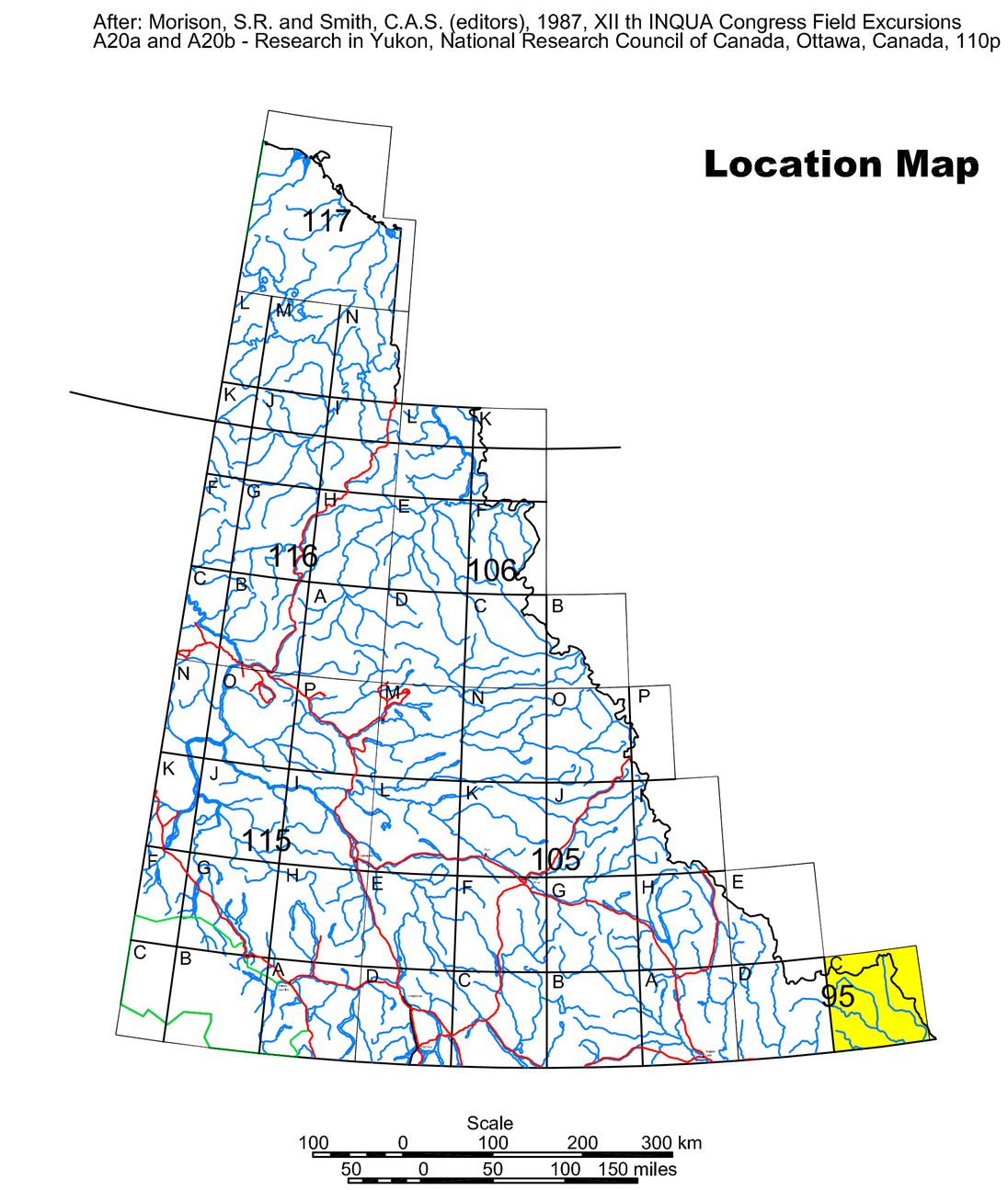
After: Hughes, O.L. in Morison, S.R. and Smith, C.A.S. (editors), 1987, XII th INQUA Congress Field Excursions A20, p12 to 16 - Research in Yukon, National Research Council of Canada, Ottawa, Canada, 110p



After: Morison, S.R. and Smith, C.A.S. (editors), 1987, XII th INQUA Congress Field Excursions A20a and A20b - Research in Yukon, National Research Council of Canada, Ottawa, Canada, 110p



After: Brown, R.J.E., 1978, Permafrost: Plate 32, Hydrological Atlas of Canada, Fisheries and Environment, Canada. 34 plates



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

Yukon GEOPROCESS File

Geological Processes and Terrain Hazards of Nahanni 105I

by

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

Copies of this map
may be obtained from Geoscience and Information Sales
c/o Whitehorse Mining Recorder, Indian and Northern Affairs Canada,
Room 102, 300 Main Street, Whitehorse, Yukon Y1A 2B5
(867) 667-3266; FAX; (867) 667-3267

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Yukon GEOPROCESS File (2002), Geological Processes and Terrain Hazards of Nahanni, 105I
Exploration and Geological Services Division, Yukon Region, Indian and Northern Affairs Canada, 1:250 000 scale.