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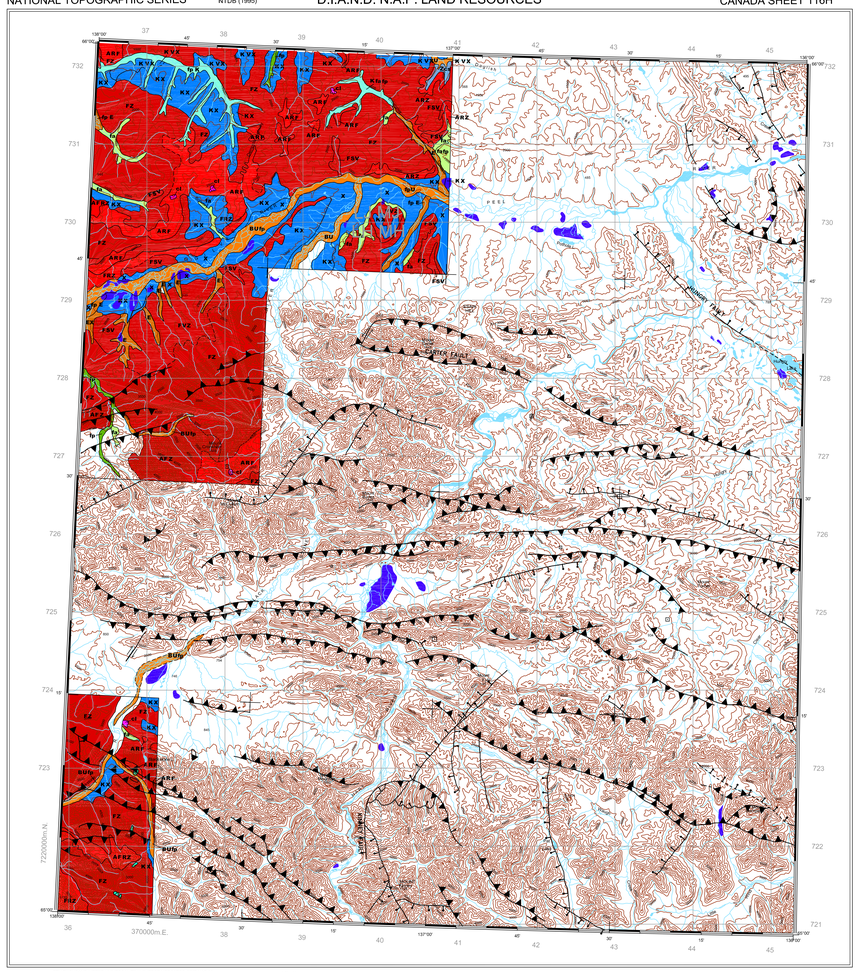

TEN THOUSAND METRE UNIVERSAL TRANSVERSE MERCATOR GRID NAD 83 ZONE 8

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

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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GEOPROCESS FILE - SUMMARY REPORT

HART RIVER MAP AREA - NTS 116H

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 Hart River map area is in the Foreland Belt. The topography of the region is mainly mountainous except the northern one-third, the Ogilvie-Peel basin, which is dominated by upland plateaus.

Bedrock geology of the map area is dominated by carbonate rocks of the Mackenzie Platform that are deformed into an east-trending fold and thrust belt typical of the Rocky Mountains. There is a general younging trend within the bedrock units with pre-600 million year old rocks in the south and 80 million year old, non-marine clastic rocks in the north. The oldest rocks belong to the Wernecke Supergroup (black slaty argillite and fine-grained quartzite), and the Gillespie Lake Group (silty dolomite). These rocks are unconformably overlain by 530-390 million year old limestone and dolomite; Road River Formation black shale and limestone; Michelle Formation black calcareous shale, limestone and dolomite; Ogilvie Formation limestone; 380-260 million year old Canol Formation black shale; Imperial Formation sandstone, siltstone and shale; Ford Lake shale, chert and limestone; Hart River Formation limestone, dolomite and chert; Ettrain Formation limestone, sandstone, shale and conglomerate; and Jungle Creek Formation sandstone, mudstone, sandstone and limestone.

In the northern portion of the map area, these rocks are unconformably overlain by 140-75 million year old Bieckerman argillite, siltstone and sandstone; and Eagle Plain Formation sandstone, siltstone and shale. All units in the map area are involved in the fold and thrust deformation except the 140 million year old and younger sedimentary rocks which are folded and not faulted.

Mineral Deposits and Occurrences

There are very few mineral occurrences in the Hart River map area. The occurrences include a few copper veins, a barite vein and a couple of lead-zinc occurrences. The young sedimentary rocks in the northern part of the map area have been explored for oil and gas, and at least four anticlines have been drilled.

SURFICIAL GEOLOGY

Sources of information for surficial geology are two surficial geology maps (Thomas and Rampton, 1982a,b) at 100 000 scale which partially cover the western half of map 116H.

The mapped area was not glaciated by Cordilleran or Laurentide ice sheets during the Pleistocene; however, Laurentide ice stopped 50 km east of the mapped area and the permafrost limit at the ice margin is reflected along valley corridors. Meltwater from either the Reid or McConnell age ice is responsible for some of the terraces along the Peel, Ogilvie and Blackstone rivers.

Unglaciated portions of the map show that long term subaerial erosion has contributed to pediment formation along major valley sides. This gently sloping surface consists of approximately 3 m of colluvium over bedrock. In many places, it has been affected by thermokarst subsidence. This surface is believed to date from the late Tertiary.

In addition, the very long exposure of surfaces to weathering, frost shattering and creep has resulted in well developed colluvial blankets on most surfaces at mid to high elevations and thick alluvial fans and aprons in valley bottoms. These deposits can be subject to slope and permafrost-related processes. Their surface is usually sensitive to disturbance and is prone to slow to moderate, long term mass movement. Colluvium derived from shale formations such as the Carboniferous Hart River formation and the Upper Cretaceous Eagle Plains formation tend to possess low shear strength and be particularly prone to slumping and rapid mass movements along gullies and creeks. Alluvial and colluvial fans are usually susceptible to channel migrations and erosion.

Bedrock exposures are limited to resistant lithologies which form arretes and castellated outcrops on crests. Thomas and Rampton (1982a) mention that karst features such as caves and collapse features are probably associated with some of the limestone and dolomite formations but no such features were identified on their maps.

TERRAIN HAZARDS

Seismicity

There are a total of eight recorded seismic events within the Hart River map area. They are in the central portion of the map area and are 4.0 to 4.999 or less in magnitude.

Mass Movement Processes

Most mass movement processes on this map sheet are related to the presence of permafrost. Most features are relict or inactive, but some movement related to solifluction, soil creep, and in some cases, detachment slides. Colluvium derived from shale formations such as the Carboniferous Hart River formation and the Upper Cretaceous Eagle Plains formation tend to possess low shear strength and to be particularly prone to slumping and rapid mass movements.

A few areas in the mapped portions of the Hart River map area are considered prone to avalanche and rock slides. They are restricted to steep rocky mountain sides, and it is likely that unmapped areas are also prone to similar high risk processes.

Thomas and Rampton (1982a) mention that karst features such as caves and collapse features are probably associated with some of the limestone and dolomite formations, but no such features were identified on their maps.

Permafrost

Although only portions of 116H were mapped, the following comments apply to most of the map. This area lies within the extensive discontinuous permafrost zone (Heginbottom and Radburn, 1992) with low to moderate ice content in morainal and colluvial deposits above valley floors, low to moderate ice contents in alluvial and fluvial deposits, and moderate to high ice content in fine-grained alluvial fans and terraces above stream level. Permafrost is assumed to be absent or thinner under south-facing, well-drained slopes. Most slopes in this area are believed to be affected by permafrost related processes, either by solifluction, creep or possible thermokarst (see section above).

In general, permafrost can be as thick as 100 m, possibly 200 m (Judge, 1973). The highest content of ice lenses, seams or wedges is in fine-grained alluvial, lacustrine and glaciolacustrine sediments. Ice wedges are common in peat and fine-grained sediments. Low to moderate ice content is expected in morainal and colluvial material and alluvial deposits such as floodplains, terraces and fans. Coarser textured frozen deposits such as glaciofluvial and alluvial sand and gravel, or recent deposits such as landslide debris are likely free of segregated ice bodies or have a very low ice content. In such cases, the material can be well bonded with no visible ice.

Soil creep and solifluction are active on most steep colluvial covered slopes. Active detachment slides are most common on shale bedrock such as the Eagle Plains Formation, where thawed colluvium becomes very unstable. Thermokarst subsidence is common in areas of thick peat and fine-grained deposits.

Flooding and Other Risks

Most streams in this area are subjected to seasonal flooding after spring thaw and following rainstorms. Braided rivers, in particular the Ogilvie River, meander actively within their floodplains.

References: Hart River Map Area - NTS 116H

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.

Abbott, J.G., 1993. Revised stratigraphy and exploration targets in the Hart River area, (NTS 116A/10, 116A/11), southeastern Yukon. In: Yukon Exploration and Geology, 1992; Exploration and Geological Services Division, Yukon Region, Indian and Northern Affairs Canada.

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.

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EBA Engineering Consultants Ltd., 1991. Geotechnical/Environmental report, Northwestel's Multi-Departmental mobile radio and Digital microwave project, Phases I and III, Dempster Highway, Yukon/N.W.T. (NTS 116B/C, 116F/G, 116H)

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Geological Survey of Canada, 1990, Regional Stream Sediment and Water Geochemical Reconnaissance Data - NTS 116A, 116H (southern half). Geological Survey of Canada, Open File 2176.

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Judge, A., 1973. Deep temperature observations in the Canadian north; in Permafrost, North American Contribution, Second International Conference (Yakutsk, USSR), 1973, National Academy of Sciences, p 35-40.

* Norris, D.K., 1974. Geology of Hart River. Geological Survey of Canada, Map 1527A, scale 1:250 000.

Norris, D.K., (compiler), 1975. Geological maps of parts of Yukon and Northwest Territories; Hart River, Wind River and Snake River (116H, 106E, 106F - Scale: 1:250 000). Geological Survey of Canada, Open File Report 279. (NTS 106E, 106F, 116H)

Norris, D.K., 1984a. Geology of the northern Yukon and northwestern District of MacKenzie. Geological Survey of Canada, Map 1581A, scale 1:500 000.

Norris, D.K., 1984b. Composite legend to accompany maps 1514A to 1529A, and structure section diagram 1530A (Operation Porcupine project area), (NTS 117, 116I/NE, 116/NW, 116F, 116G, 116H, 106/NW, 106E, 106F)

Norris, A.W., 1985. Stratigraphy of Devonian outcrop belts in northern Yukon Territory and northwestern District of Mackenzie (Operation Porcupine area). Geological Survey of Canada, Memoir 410, 81 p. (Includes maps), (NTS 116F/G, 116H, 106E, 106F)

Pugh, D.C., 1983. Pre-Mesozoic geology in the subsurface of Peel River map area, Yukon Territory and District of MacKenzie. Geological Survey of Canada, Memoir 401, 61 p.(Includes maps). (NTS 116F/G, 116H, 106E, 106F)

Thomas, R. D. and Rampton, V. N., 1982a. Surficial geology and geomorphology, Engineer Creek. Geological Survey of Canada, "B-series maps", Map B-1982, scale 1:100 000.

* Thomas, R.D. and Rampton, V.N., 1982. Surficial geology and geomorphology, Lower Ogilvie River. Geological Survey of Canada, "B-series maps", Map 9-1982, scale 1:100 000.

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, P., 1991. Tectonic Assemblage map of the Canadian Cordillera and adjacent parts of the United States of America. Geological Survey of Canada, Map 1712A.

* 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 D3828 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
I	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, undertain 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.	Avallanches, ice and rock falls, and crevasses.
is	Cliff glacier.	Avallanches, 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.
mi	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)

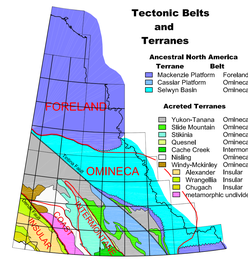
Airphoto Lineament

LEGEND QUATERNARY VOLCANISM

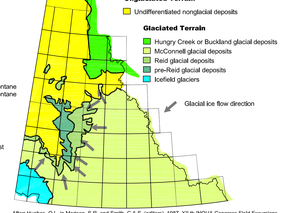
No known recent volcanism in map area 116H

OTHER FEATURES

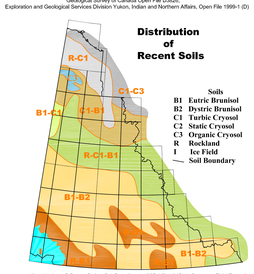
Roads
Streams
Lakes
Marsh



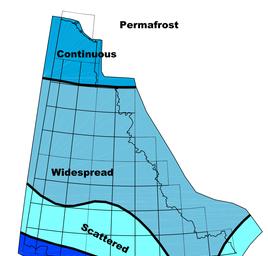
After: Gordey, S.P. and Makepeace, A.J. (compilers), 1999. Yukon Digital Geology Geological Survey of Canada Open File D3828; Exploration and Geological Services Division Yukon, Indian and Northern Affairs, Open File 1999-1 (D)



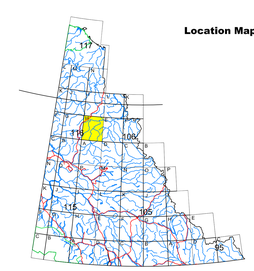
After: Hughes, O.L. in Morison, S.R. and Smith, C.A.S. (editors), 1987. XII th INQUA Congress Field Excursions A2D, p12 to 18 - Research in Yukon, National Research Council of Canada, Ottawa, Canada, 110p



After: Morison, S.R. and Smith, C.A.S. (editors), 1987. XII th INQUA Congress Field Excursions A2bis and A2bi - 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 Hart River 116H

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 Hart River, 116H
Exploration and Geological Services Division, Yukon Region, Indian and Northern Affairs Canada, 1:250 000 scale.