GEOPROCESS FILE
SUMMARY REPORT

NAHANNI RIVER MAP AREA
N.T.S. 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 Introduction and User's 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's 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 and summaries followed by summaries of the bedrock geology, surficial geology and terrain hazards for this N.T.S. 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 attached to 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 N.T.S. 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 Introduction and User's 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 Howards Pass zinc-lead sedimentary exhalative deposit hosted by Road River Formation rocks. Drill indicated reserves from 1982 for both the Howards 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 which shaped the area as well as several stereoscopic pair of air photographs to illustrate special features.

The surface exposed today results from 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 at roughly sometime after 23,900 BP and deglaciation to roughly 10,000 BP.

Steep rock faces are common at elevations above 1520 m, cirques, horns and arretes 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 with roughly equal proportions of clay, silt and sand. Clast lithology is influenced by local rock and so 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, 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 coloring 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 Center 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 10^5 m^3 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, with ice contents varying 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 rock fall 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

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To be thorough, check the references for adjacent N.T.S. map sheets and the General Reference List (See Introduction and User's Guide).

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