GEOPROCESS FILE
SUMMARY REPORT

HART RIVER MAP AREA
N.T.S. 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 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 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 Biederman 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 and 1982b) 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 proximity of 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 slopes have active, long term, slow mass 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 where 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
N.T.S. 116H

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

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

Dixon, J., 1992, A review of Cretaceous and Tertiary stratigraphy in the northern Yukon and adjacent Northwest Territories. Geological Survey of Canada, Paper 92-9, 79 p.
NTS 106E, 106F, 106K, 106L, 116F/G, 116H, 116I, 116J/K, 116N/O, 116P, 117

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

Gabrielse, H. and Yorath, C.J. (eds.), 1991, Geology of the Cordilleran Orogen in Canada. Geological Survey of Canada, Geology of Canada, Map 1581A, scale 1:500,000.

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

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

Hughes, O.L., 1969, Surficial geology of northern Yukon Territory and northwestern District of MacKenzie, Northwest Territories. Geological Survey of Canada, Paper 69-36, 11 p.

Indian and Northern Affairs, 1995, Yukon MinFile Hart River - 116H. Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada.

Jingfors, K. and McKenna, K., 1991, Initial environmental evaluation: Terrain, vegetation, wildlife and resource use for Dempster Highway Multi-Department mobile radio system and microwave project (prepared for Northwestel, Whitehorse).
NTS 116B/C, 116F/G, 116H

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, (scale 1:250,000).
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, 116/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 8-1982, scale 1:100,000.

Thomas, R.D. and Rampton, V.N., 1982, Surfical 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.