GEOPROCESS FILE
SUMMARY REPORT

WIND RIVER MAP AREA
N.T.S. 106E

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 Wind River map area is entirely within the Foreland Belt. The Richardson and Wernecke Mountains dominate in the northwest and southern regions of the map area, respectively, but the central region is characterized by the low-lying Bonnet Plume Basin.

The entire map area is underlain by sedimentary rocks. The mountainous regions are largely composed of marine sedimentary rocks older than 300 million years of age whereas the low-lying regions are composed of non-marine sedimentary rocks younger than 140 million years of age.

The southern part of the map area (Wernecke Mountain area) is dominated by Precambrian (older than 570 million years old) Quartet Group argillite and quartzite; Gillespie Lake Group dolomite; minor Pinguicula Group siltstone, sandstone, dolomite and limestone; Rapitan Group diamictite, conglomerate and sandstone. These rocks are overlain by 560 million year old Illtyd Formation limestone, and 570-530 million year old Slats Creek Formation siltstone, conglomerate, sandstone and limestone. This succession is unconformably overlain by 530-390 million year old Gull Lake limestone and dolomite, and Road River Formation limestone, breccia and shale.

The Knorr Range in the eastern part of the map area is underlain by the pre-570 million year old Tsezotene Formation shale, sandstone and dolomite; Katherine Group quartzite, dolomite and shale; Little Dal Formation dolomite, limestone and shale; and Knorr Range Succession limestone, dolomite and siltstone. These packages are overlain by Illtyd Formation limestone, and Road River Formation limestone and shale.

The Richardson Mountains is mainly underlain by Road River Formation shale and limestone, but the area south of the Richardson Mountains and northeast of the Knorr Range is underlain by a thick succession of 400 to 300 million year old Michelle Formation shale, limestone and dolomite; Ogilvie Formation limestone; Canol Formation shale; Imperial Formation siltstone, sandstone and shale; Ford Lake shale and sandstone; Hart River Formation limestone, dolomite and chert; Ettrain Formation limestone, shale and sandstone; and Jungle Creek Formation sandstone, mudstone and limestone.

Unconformably overlying the aforementioned units and making up the Bonnett Plume Basin are the 140-100 million year old Arctic Red Formation shale and siltstone in the northeastern part of the map area; and 140-70 million year old Bonnett Plume Formation sandstone, conglomerate, shale and coal in the central part of the map area.

The pre-570 million year old rocks have undergone numerous phases of deformation including extensive block faulting previous to the deposition of the younger rock packages. This has resulted in a large number of vertical north-northwest-trending faults cutting these rocks. A series of enigmatic breccia bodies (areas of shattered rock), some of which are enormous, outline a significant arcuate, west to west-northwest-trending zone of structural weakness in these ancient rocks and are known as the Wernecke Breccias. The western part of this arc occurs in the southern part of the map area. Rocks older than 300 million years old have been folded along east and northeast-

trending synclines and anticlines. Both short vertical and large, through-going, probably strike-slip faults affect all the rock packages.

Mineral Deposits and Occurrences

Yukon Minfile lists 40 prospects for the Wind River map area. Approximately 20 are uranium-copper-iron deposits associated with Wernecke Breccias. Although these occurrences are currently (1995) receiving extensive exploration attention, defined tonnages have not been documented. Most of the remainder of the mineral occurrences in the area are coal deposits in 80 million year old strata in the Bonnet Plume Basin. Combined inferred reserves from seven of these deposits, including the largest - the Illtyd, indicate more than 660 million tonnes of bituminous coal. In addition, there are a few, small lead-zinc-silver Mississippi Valley Type occurrences and lead-silver-zinc veins.

SURFICIAL GEOLOGY

There is no published information on this area, except for a general surface geology map at the 1:500,000 scale (Hughes, 1971). This information was not transferred onto the 1:250,000 Geoprocess File map accompanying this file because of the scale and general nature of the map.

According to Hughes (1969), most of the Wind River map area was affected by the Laurentide Glaciation. Limits of this glaciation are located along the south and east portion of the map, at around elevations of approximately 2000 ft. The Wernecke Mountains south of the Bonnet Plume Basin were therefore affected by local, small alpine glaciers. In the northwest portion of the map, west of the Little Wind River, the upper ice limit along the valley wall ranges from slightly less than 3000 ft. to 2000 ft.

Morainal deposits are limited to blankets of till over rock. Glaciofluvial deposits are concentrated along Bonnet Plume River valley at elevations lower than 2000 feet in the south and 1000 feet close to Chappie Lake. No large glaciolacustrine deposits were identified .

Valley floors are occupied by recent fluvial deposits.

TERRAIN HAZARDS.

There is no published information on hazards in this area. The following comments are based on conditions present in adjoining map sheets and on Hughes (1969).

Seismicity

There are 132 recorded seismic events within the Wind River map area. Most of the events are located in the east side of the map area in the Knorr Range and Bonnett Plume Basin. The seismic events are 5.0 to 5.999 or less in magnitute.

Mass Movement Processes

The steeper topography of the Richardson and Wernecke Mountains may present avalanches or rock fall hazards. A few landslides were identified on the map at 1;500,000 scale, concentrated along the east side of the Bonnet Plume River valley, directly north and south of Noisy Creek. Slow mass movement related to permafrost processes can be expected on valley walls covered with colluvial, residual or morainal deposits. Soil creep, solifluction lobes and detachment slides are most probably present on most slopes covered by matrix-rich deposits.

Permafrost

This area lies within the extensive discontinuous permafrost zone (Heginbottom and Radburn, 1992). There is low to moderate ice content in morainal and colluvial deposits with organic cover, and in fine grained fluvial and alluvial deposits located on terraces above stream level. Permafrost is assumed to have a higher ice content in north- to northeast-facing slopes covered by fine-grained poorly drained deposits overalin by thick organic material. Permafrost is assumed to be absent, or to have a very low ice content in coarse well drained sediments. Only one glacier was identified in Hughes (1969), along the south side of Prongs Creek.

Flooding

There is no information available on flooding. The braided nature of the Bonnet Plume and Little Wind Rivers suggests seasonal flooding in the lower reaches and interchannel areas of the valley floor.

References

Wind River Map Area
N.T.S. 106E

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., Gordey, S.P., Roots, C. and Turner, R.J., 1990, Selwyn-Wernecke cross-sections, Yukon: a joint Indian and Northern Affairs Canada - Geological Survey of Canada project. ***In:*** Current Research, Part E, Paper 90-1E, Geological Survey of Canada, p. 1-3.

Abbott, J.G., 1990, Geology of the Mt. Westman map area (106D/1). Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada, Open File 1990-1.

Bell, R.T., 1978, Breccias and uranium mineralization in the Wernecke Mountains, Yukon-a progress report. ***In:*** Current Research, Paper 78-1A, Geological Survey of Canada, p. 317-322.

Bell, R.T., 1982, Comments on the geology and uraniferous occurrences of the Wernecke Mountains, Yukon and District of Mackenzie. ***In:*** Current Research, Part B, Paper 82-1B, Geological Survey of Canada, p. 279-284.

Bell, R.T., 1986, Megabreccias in northeastern Wernecke Mountains, Yukon Territory. ***In:*** Current Research, Geological Survey of Canada, Part A, Paper 86-1A, p. 375-384.
NTS 106C, 106D, 116A, 116H, 106E, 106F

Bell, R.T., 1986, Geological map of northeastern Wernecke Mountains, Yukon Territory. Geological Survey of Canada, Open File 1207.
NTS 106C, 106D, 106E, 106F

Bell, R.T. and Delaney, G.D., 1977. Geology of some uranium occurrences in Yukon Territory. ***In:*** Current Research, Geological Survey of Canada, Paper 77-1A, p. 33-37.

Brown, R.J.E., 1976, Permafrost in Canada. Geological Survey of Canada, Map 1246A (scale 1:7,603,200).

Cecile, M.P., 1982, The lower Paleozoic Misty Creek embayment, Selwyn Basin, Yukon and Northwest Territories. Geological Survey of Canada, Bulletin 335, 78 p. (includes map).
NTS 105M, 105N, 105O, 106B, 106C, 106D, 106E, 106F

Cullingham, O. and Hope, D., 1979, Report - reserves and grade of coal in the Bonnet Plume basin, Yukon Territory. Pan Ocean Oil Ltd., Bonnet Plume Project, Pan Ocean Report No. 25-79, 2 volumes.
NTS 106E
(Economic Development library)
Call Number: DC 553.24 PAN

Cullingham, O.R., 1980, Report on geology and exploration of the Bonnet Plume Basin, Yukon Territory. Pan Ocean Oil Ltd - Bonnet Plume Project, Pan Ocean Report 1-80.
NTS 106E
(Economic Development library)
Call Number: DC 553.24 PAN

Delaney, G.D., 1978, Stratigraphic investigations of the lowermost succession of Proterozoic rocks, northern Wernecke Mountains, Yukon Territory. Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada, Open File 1978-10.
NTS 106C, 106D, 106F

Delaney, G.D., 1981, The mid-Proterozoic Wernecke Supergroup, Wernecke Mountains, Yukon Territory. ***In:*** Campbell, F.H.A. (ed.), Proterozoic Basins of Canada, Geological Survey of Canada, Paper 81-10, p. 1-23.

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

Eisbacher, G.H., 1978, Two major Proterozoic unconformities, Northern Cordillera. ***In:*** Current Research, Part A, Paper 78-1A, Geological Survey of Canada, p. 53-58.

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

Geological Survey of Canada, Regional Stream Sediment and Water Geochemical Reconnaissance Data - NTS 106D, parts of 106C, 106E, 106F. Geological Survey of Canada, Open File 2175.

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., 1971, Northern Yukon Territory and northwestern District of Mackenzie. Geological Survey of Canada, Map 1319A (scale 1:506,880).
NTS 106E, 106F, 106/NW, 116F, 116G, 116H, 117

Indian and Northern Affairs, 1995, Yukon MinFile 106 E - Wind River. Exploration and Geological Services Division, Yukon, Indian and Northern Affairs, Canada.

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.

Laznicka, P. and Gaboury, D., 1988, Wernecke breccias and Fe, Cu, U mineralization: Quartet Mountain-Igor area (NTS 106E). ***In:*** Yukon Geology, Vol. 2, Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada, p. 42-50.

Mustard, P.S., Roots, C.F. and Donaldson, J.A., 1990, Stratigraphy of the middle Proterozoic Gillespie Lake Group in the southern Wernecke Mountains, Yukon. In: Current Research, Part E, Paper 90-1E, Geological Survey of Canada, p. 43-53.

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

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. and Hopkins, W.S., Jr., 1977, The geology of the Bonnet Plume Basin, Yukon Territory. Geological Survey of Canada, Paper 76-8, 20 p.

Norris, D.K., 1982, Geology of Wind River, Yukon Territory. Geological Survey of Canada, Map 1528A, scale 1:250,000.

Norris, D.K., 1984, Geology of the northern Yukon and northwestern District of MacKenzie. Geological Survey of Canada, Map 1581A, scale 1:500,000.
NTS 116SE, 116NE, 106SW, 106NW, 117SW, 107SW

Norris, D.K., 1984, 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

Pan Ocean Oil Ltd., 1981, Report on geology and exploration of the Bonnet Plume Basin, Yukon Territory. Pan Ocean Oil Ltd., Bonnet Plume Project, Pan-Ocean Report No. 4-81.
NTS 106E
(Economic Development library)
Call Number: DC 553.24 PAN

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

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.

Williams, G.K., 1988, A review of the Bonnet Plume area, east-central Yukon Territory (including Snake River, Solo Creek, Noisy Creek and Royal Creek areas). Geological Survey of Canada, Open File Report 1742.
NTS 106C, 106D, 106E, 106F