GEOPROCESS FILE
SUMMARY REPORT

TESLIN MAP AREA
N.T.S. 105C

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 Teslin map area is in the Intermontane and Omineca Belts which respectively occupy the southwestern and northeastern portions of the map area. The regions are separated by two large, through-going, northwest trending, strike-slip faults that parallel the Teslin Lake and River valleys. The two faults are known as the "Teslin Suture Zone" or "Teslin Fault".

The southwestern part of the map area hosts a complex array of volcanic and sedimentary rocks of the Cache Creek Terrane that range from 350-250 million years in age. The volcanic rocks are composed of altered basalt and andesitic greenstone with associated peridotite, serpentinized peridotite, diorite and gabbro. Cache Creek Terrane sedimentary rocks are composed of well-bedded grey to green ribbon chert, shale, siltstone and greywacke. All Cache Creek Terrane rock successions are folded and complexly faulted.

The northwestern-most part of the map area, as well as the region immediately east of the Teslin Lake and River valley is underlain by the 220-160 million year old rocks of Stikine Terrane. Stikine Terrane is dominated by folded Laberge Group greywacke, shale and siltstone with minor conglomerate that overlies Lewes River Group limestone and greywacke. These two sedimentary packages collectively comprise the fill of the Whitehorse Trough. Quesnel Terrane occupies a narrow belt of rocks immediately east of Teslin Lake. They are similar to Stikine Terrane in that they are the same age and dominated by greywacke, siltstone and shale, but also contain augite porphyry, augite tuff, diorite, gabbro, dunite and pyroxenite.

Northeast of Stikine and Quesnel Terrane are rocks of the Kootenay Terrane (Nisutlin subterrane) that are in thrust fault contact with Cassiar Terrane (North American margin) along the Nisutlin River valley. Kootenay Terrane is composed of very old (300 million years to greater than one billion years old) metamorphosed sedimentary and igneous rock packages that include schist, greenstone, marble, metagabbro, metadiorite, amphibolite, hornblendite, tonalite, graphitic phyllite and quartzite (in other areas of the Yukon these rocks are known as the Nasina and Nisling assemblages of the Yukon-Tanana Terrane). Cassiar Terrane is composed of variably metamorphosed, 345-325 million year old volcaniclastics and flows, limestone, phyllite, quartzite and siltstone that overlie a sedimentary package of shale, chert, sandstone, chert pebble conglomerate and siliceous argillite. The sedimentary package overlies the pre-650 million year old Ingenika Group sandstone, grit, siltstone, limestone, dolostone, schist, quartzite and gneiss. Cassiar Terrane rocks are structurally overlain by a northwest-trending strip of sedimentary and volcanic rocks of the Slide Mountain terrane which include peridotite, pyroxenite, serpentinite, conglomerate, greywacke, limestone and diorite.

Four felsic intrusive suites ranging in age from 188 to 80 million years form numerous plutons that cut the varied terranes. The most voluminous is the approximately 110 million year old suite of quartz monzonite, quartz monzodiorite and biotite granite plutons of the Cassiar Suite.

Mineral Occurrences and Deposits

There are 60 known mineral prospects listed in Yukon MINFILE for the Teslin map area, of which 22 host mineralization. Despite the small number of occurrences, there is a large diversity of the types of mineralization. Most occurrences are veins of which there are three main types: lead-silver; copper plus or minus gold-silver; and gold silver. Tin and tungsten skarns are associated with the 110 million year old granitic plutons that intrude carbonates in the northeastern part of the map area. A few asbestos and chromium occurrences associated with ultramafic rocks of Cache Creek Terrane are documented. A single stratabound barite-lead-zinc-silver occurrence has been discovered in Cassiar Terrane rocks. The largest mineral deposit is the Red Mountain porphyry molybdenum deposit (187 million tonnes of 0.167% molybdenum) which is centred around a small, 100 million year old pluton that intrudes Kootenay Terrane metamorphic rocks. Production has been reported from only one property - a rhodonite occurrence in

Kootenay Terrane. Placer gold has been reported from Iron, Sydney and Seaforth creeks.

SURFICIAL GEOLOGY

The main sources of information for the Teslin map sheet are a series of four surface geology and soil maps at the 1:100,000 scale (Morison and McKenna, 1990) and a surface geology map at the 1:250,000 scale (Morison and Klassen, in press).

The surface deposits of the Teslin map sheet are associated with the most recent Cordilleran ice sheet, the McConnell glaciers, believed to have covered south and central Yukon between 26,500 and 10,000 years ago. Most of the map sheet was covered by the Cassiar lobe which flowed westward and northwestward from the Cassiar Mountains (Jackson, 1994).

The distribution of Quaternary deposits in this area follows a general pattern. High elevation slopes are covered with colluvial or morainal veneer over bedrock. In most cases, at elevations of 1200 metres and above, the bedrock is weathered, frost shattered or covered by colluvium.

Moraine deposits cover most mid-elevation slopes, the base of which can consist of mixed moraine blankets and colluvial fans or aprons. Large portions of the map surface are covered by morainal deposits or till. Till, or more correctly diamicton of glacial origin, is an unsorted mixture of coarse material ranging in size from pebble to boulder, with a matrix of clay, silt and sand. The general composition of the till matrix in adjoining map sheets (Jackson, 1994) indicates a wide range of content of sand (20 to 70%), silt (20 to 80%) and commonly lower clay (5 to 30%). The low clay content is reflected by the low plasticity and high permeability of the matrix. Morainal deposits can provide a stable base, if there is no permafrost present. Isolated lenses of ice-rich permafrost may occur locally on north facing slopes and at high elevations, where thick organic deposits are present over the Quaternary sediments. Many of the till covered slopes are channeled or gullied.

In some valleys, benches of glaciofluvial sand and gravel flank the low elevation slopes. Glaciofluvial sand and gravel of variable thickness and composition are found in Lubbock River and Michie Creek valleys, Teslin River and Squanga Creek valleys, and in the northeast corner of the map area in the Red River valley. These deposits are mostly free of permafrost, commonly have stable surfaces and may contain undesirable lithologies (weak) for their potential use as aggregate.

During deglaciation, large volumes of meltwater were dammed in some valleys and formed large glacial lakes. Beachlines, lake bottom sediments, and modern lakes are now found in many of these valleys. Teslin Lake, Little Atlin and Atlin Lakes, as well as the Nisutlin River valley and the Red River valley north of Fish Lake are bordered by glaciolacustrine silt and clay deposits which can be as thick as 15 m. They commonly contain massive ice bodies and are prone to retrogressive thaw slide and thermokarst degradation when disturbed either by river erosion, forest fires, or other changes in surface conditions.

The White River tephra, deposited approximately 1,200 years ago, is visible in the upper horizons of soil profiles on most surfaces, and can sometimes be used as an indicator of active mass movement or erosion.

TERRAIN HAZARDS

There are no terrain hazard maps available for this area. Information on terrain hazards is derived from surface geology and soil maps.

Slope failures in steep bedrock represent the highest risk hazard in the area. Although not documented in any of the publications available and not present on the terrain hazard map, the potential for rock slides and avalanches should be kept in mind when an area is investigated.

Seismicity

There are five recorded seismic events within the map area. All of the recorded events are 2.0 to 2.999 or less in magnitude.

Mass Movement Processes

Snow and rock avalanches involving potentially large volumes of boulders and debris could occur on steep bedrock slopes. Development of any kind in close proximity to steep escarpments, ridges, cirques and arrêtes prone to these hazards should be discouraged. Colluvium covered slopes are usually unstable.

Permafrost

The Teslin map sheet lies within the discontinuous permafrost zone (Brown, 1967). 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, as well as in recent slides. Ice content in morainal and colluvial deposits is expected to be low to moderate. Morainal and colluvial deposits located at high elevations covered by thick organic deposits are the most likely to contain significant ice content. Permafrost is often detected by the presence of thick organic mats in poorly drained sites, solifluction lobes and stripes and sorted stone polygons.

High ice content is possible in fine-grained fluvial terraces located above stream level, in silty to clayey glaciolacustrine sediments. Thermokarst collapse and thaw slides are possible hazards in fine-grained glaciolacustrine deposits around Atlin, Little Atlin, Teslin Lakes area, east of Quiet Lake and in the Red River valley north of Fish Lake.

Flooding and Other Risks

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

References

Teslin Map Area
N.T.S. 105C

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.

Bostock, H.S., 1936, Prospecting possibilities of Teslin-Quiet Lake - Big Salmon area, Yukon. Geological Survey of Canada, Paper 36-2, 6 p.

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

Bustin, R.M. and McKenzie, K.J., 1989, Stratigraphy and depositional environments of the Sustut Group, southern Sustut Basin, north central British Columbia. Bulletin of Canadian Petroleum Geology, Vol. 37, No. 2, p. 210-223.

Carlyle, L., 1995, Placer mining and exploration compilation (NTS 105A/B/C/D). Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada, Canada/Yukon Economic Development Agreement, Open File 1995-10(G).

Department of the Environment, 1973, Teslin, Yukon Territory. Land Use Information Series, Department of the Environment, Ottawa, Ontario, Vol. 105C, 1 colored environmental geology map.

Dighem I Power, 1994, Airborne EM and Mag surveys, Jakes Corner project. Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada, Canada/Yukon Economic Development Agreement, Open File 1994-10(G).

Erdmer, P., 1981, Comparative studies of cataclastic allochthonous rocks in McQuesten, Laberge and Finlayson Lake map-areas. ***In:*** Yukon Geology and Exploration, 1979-1980, Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada, p. 60-64.

Erdmer, P., 1985, An examination of the cataclastic fabrics and structures of parts of Nisutlin, Anvil and Simpson allochthons, central Yukon; test of the arc-continent collision model. Journal of Structural Geology, Vol. 7, No. 1, p. 57-72.

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

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

Gareau, S.A., 1992, Report on fieldwork in the southern Big Salmon metamorphic complex, Teslin map area, Yukon Territory. ***In:*** Current Research, Part A, Paper 92-1A, Geological Survey of Canada, p. 267-277.

Geological Survey of Canada, 1986, Regional stream and water geochemical reconnaissance data,

Yukon Territory - 105C. Geological Survey of Canada, Open File 1217.

Gordey, S.P., 1991, Teslin map area, a new geological mapping project in southern Yukon. ***In:*** Current Research, Part A, Paper 91-1A, Geological Survey of Canada, p. 171-178.

Gordey, S.P., 1992, Geological fieldwork in Teslin map area, southern Yukon Territory. ***In:*** Current Research, Part A, Paper 1992-1A, Geological Survey of Canada, p. 279-286.

Gordey, S.P. and Stevens, R.A., 1994, Preliminary interpretation of bedrock geology of the Teslin area (105C); southern Yukon. Geological Survey of Canada, Open File 2886 (1:250,000 scale map).

Hall, A. and Liverton, T., 1992, Trace ammonium in granites of the southern Yukon and its petrogenetic significance. ***In:*** Yukon Geology, Vol. 3, Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada, p. 45-51.

Hansen, V.L., 1986, Petrotectonic study of the Teslin suture zone, Yukon; a progress report. ***In:*** Yukon Geology, Vol. 1, Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada, p. 125-130.

Hansen, V.L., 1986, Preliminary structural and kinematic analysis of mylonitic rocks of the Teslin suture zone, 105E, Yukon. ***In:*** Yukon Geology, Vol. 1, Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada, p. 119-124.

Hansen, V.L., 1987, Structural, metamorphic and geochronologic evolution of the Teslin suture zone, Yukon; Evidence for Mesozoic oblique convergence outboard of the northern Canadian Cordillera. Unpublished Ph.D. thesis, University of California, Los Angeles, California, 261 p. (available at University microfilms, Ann Arbor, Michigan, U.S.).

Hansen, V.L., 1989, Structural and kinematic evolution of the Teslin suture zone, Yukon; record of an ancient transpressional margin. Journal of Structural Geology, Vol 11, No. 6, p. 717-733.

Hansen, V.L., Mortensen, J.K. and Armstrong, R.L., 1989, U-Pb, Rb-Sr and K-Ar isotopic constraints for ductile deformation and related metamorphism in the Teslin suture zone, Yukon-Tanana terrane, south-central Yukon. Canadian Journal of Earth Sciences, Vol. 26, No. 11, p. 2224-2235.

Hansen, V.L., 1991, Mesozoic thermal evolution of the Yukon-Tanana composite terrane; new evidence from 40 Ar/39 Ar data. Tectonics, Vol. 10, No. 1, p. 51-76.

Hansen, V.L., 1992, Backflow and margin-parallel shear within an ancient subduction complex. Geology, Vol. 20, No. 1, p. 71-74.

Hansen, V.L., 1992, P-T evolution of the Teslin suture zone and Cassiar tectonites, Yukon, Canada; evidence for A- and B- type subduction. Journal of Metamorphic Geology, Vol. 10, No. 2, p. 239-263.

Harms, T.A., 1992, Stratigraphy of the southern Thirtymile Range, Teslin map area, southern Yukon Territory. ***In:*** Current Research, Part A, Paper 92-1A, Geological Survey of Canada, p. 297-302.

Hunt, J.A., Hart, C.J.R. and Gordey, S.P., 1995, Interpretive geology of the Jakes Corner geophysical survey (105C/5, 105D/8 and 105D/9). Exploration and Geological Services Division, Yukon, Indian and Northern Affairs, Canada, Canada/Yukon Economic Development Agreement, Open File 1995-5(G).

Hydrogeological consultants Ltd., February, 1974, A review of groundwater data, Teslin, Yukon Territory. Hydrogeological Consultants Ltd., Edmonton, Alberta.

Indian and Northern Affairs, 1993, Abandoned Mines Assessment, 105C-13-1, Slate Mountain. DIAND Technical Services, Yukon, Indian and Northern Affairs Canada.

Indian and Northern Affairs, 1995, Yukon MinFile 105C - Teslin. Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada.

Jackson, L.E., Jr., 1994. Terrain inventory and quaternary history of the Pelly River area, Yukon Territory. Geological Survey of Canada, Memoir 437.
(105K, 105J, 105G, 105F)

Jackson, L.E., Jr. and MacKay, T.D., 1990, Glacial limits and ice-flow directions of the last Cordilleran ice sheet in Yukon Territory between 60 and 63 degrees north. Geological Survey of Canada, Open File 2329.
NTS 95D, 105A, 105B, 105C, 105D, 115A, 115E, 115F, 115G, 115H, 115I, 115J, 106K, 106L, 115G, 115H

Jackson, L.E., 1994, Terrain inventory and Quaternary history of the Pelly River area, Yukon Territory. Geological Survey of Canada, Memoir 437, 41 p.
NTS 105J, 105K, 105F, 105G

Kindle, E.D., 1945, Geological reconnaissance along the Canol Road, from Teslin River to MacMillan Pass, Yukon. Geological Survey of Canada, Paper 45-21, 26 p.

Klassen, R.W., 1978, Surficial geology, southern Yukon Territory (105D 11-14, 105D 7-10; 105C 2-7; 104O 13-14; 105B 3-4; 105N 16; 105C 1; 105B 1-2; 105A 3-6). Geological Survey of Canada, Open File 539 (1:100,000 scale maps).

Klassen, R.W., Thorsteinsson, E. and Hughes, O.L., 1978, Surficial geology and terrain evaluation, southern Yukon. ***In:*** Current Research, Part A, No. 78-1A, Geological Survey of Canada, p. 465.

Lees, E.J., 1936, Geology of the Teslin-Quiet Lake Area, Yukon. Geological Survey of Canada, Memoir 203, Publication 2429, 30 p.

Lees, E.J., 1936, Teslin-Quiet Lake area, Yukon Territory. Geological Survey of Canada, Geological Map No. 350A, scale 1:253,440.

Liverton, T., 1990, Tin-bearing skarns of the Thirtymile Range, N.T.S. sheet 105 C 9: A progress report. ***In*****:** Yukon Geology, Vol. 3; Exploration and Geological Services Division, Indian and Northern Affairs Canada, p. 52-70.

Lord, C.S., 1944, Geological reconnaissance along the Alaska Highway between Watson Lake and Teslin River, Yukon and British Columbia. Geological Survey of Canada, Paper 44-25, 20 p.

Monger, J., 1975, Upper Paleozoic rocks of the Atlin terrane, northwestern British Columbia and south-central Yukon. Geological Survey of Canada, Paper 74-47, 63 p.

Morison, S.R. and McKenna, K., 1990, Surficial geology and soils, Southern Lakes Study. Department of Renewable Resources, YTG, 100,000 scale.

Morison, S.R. and Klassen, R.W. (in prep), Surficial geology, Teslin (105C), Yukon Territory. Geological Survey of Canada, 1:250,000 scale.
(105C, 105D - 4 maps at 1:100,000 scale)

Mulligan, R., 1963, Geology of Teslin map-area, Yukon Territory (105C). Geological Survey of Canada,

Memoir 326, 96 p., Map 1125A, scale 1:253,440.

Mulligan, R., 1969, Metallogeny of the region adjacent to the northern part of the Cassiar Batholith, Yukon Territory and British Columbia (parts of 104O, P and 105B). Geological Survey of Canada, Paper 68-70, 13 p.

Power, M.A., 1995, Notes to prospectors - Jakes Corner Digem survey interpretation. Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada, Canada/Yukon Economic Development Agreement, Open File 1995-12(G).

Senyk, J.P., 1979, Surficial deposits and landforms, Nisutlin River Valley (105C 2,7,10, 15), Yukon Territory. Canadian Forestry Service (1:50,000 scale).

Stevens, R.A., 1991, The Teslin suture zone in northwest Teslin map area, Yukon. ***In:*** Current Research, Part A, Paper 91-1A, Geological Survey of Canada, p. 271-277.

Stevens, R.A., 1992, Regional geology, fabric and structure of the Teslin suture zone in northwest Teslin map area, Yukon Territory. ***In:*** Current Research, Part A, Paper 92-1A, Geological Survey of Canada, p. 287-295.

Stevens, R.A., 1995, Geology of the Teslin suture zone in parts of Laberge (105E/1), Quiet Lake (105F/4) and Teslin (105C/11, 13, 14) map areas, Yukon Territory. Geological Survey of Canada, Open File 2768.

Stroink, L. and Friedrich, G., 1992, Gold sulphide quartz-veins in metamorphic rocks as a possible source for placer gold in the Livingstone Creek area, Yukon Territory, Canada. ***In:*** Yukon Geology, Vol. 3, Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada, p. 87-98.

Tempelman-Kluit, D., 1980, Highlights of field work in Laberge and Carmacks map areas, Yukon Territory. ***In:*** Current Research, Part A, No. 80-1A, Geological Survey of Canada, p. 357-362.

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.