GEOPROCESS FILE
SUMMARY REPORT

QUIET LAKE MAP AREA
N.T.S. 105F

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 Quiet Lake map area is in the western Omineca Belt. The northwest trending structural grain that is seen in most of Yukon is particularly evident in this region, illustrated by the long, linear ridges of the Pelly Mountains.

The bedrock geology in this area is very complex (Tempelman-Kluit 1977). Much of the western and southwestern portion of the area is comprised of pre-570 million year old metamorphosed sedimentary and igneous rocks that make up part of Cassiar Terrane (ancient North American continental margin rocks). These rocks include muscovite-biotite granodiorite gneiss, migmatite, muscovite-biotite schist, garnet-mica-quartz schist, micaceous schist, marble and amphibolite. Younger (600-300 million year old) sedimentary and volcanic rocks of the Nisutlin, Cassiar and Slide Mountain Terranes occur in the southwestern corner, where they are strongly metamorphosed within the region attributed to the Teslin Suture Zone. Locally, ultramafic rocks associated with the Slide Mountain Terrane are altered to serpentinite and talc.

The northeastern part of the map area is dominated by sedimentary rocks of the Cassiar Terrane, including siliciclastic rocks of the 390-325 million year old Earn Group and 530 million year old platform carbonate rocks. Northeast of the Tintina Fault, in the northeast corner of the map area are 290-250 million year old muscovite-quartz schist and phyllite (Klondike Schist) structurally overlain by 360-290 million year old basalt, pyroxene gabbro, serpentinized peridotite and pyroxenite of the Slide Mountain Terrane.

Large northwest-trending 100 million year old granitic plutons underlie a large portion of the southwestern half of the area and include the Quiet Lake, Nisutlin and Big Salmon Batholiths. These intrusions have resulted in large hornfels zones in the surrounding sedimentary rock.

Much of the valley that formed in response to erosion along the Tintina Fault is filled with 50 million year old sandstone, conglomerate and shale, and rhyolite, basalt, basalt breccia, and olivine basalt.

Mineral Deposits and Occurrences

The Quiet Lake map area has an abundance of mineral occurrences clustered in the Ketza River and Groundhog Creek areas. The Ketza River gold deposit hosted in 530 million year old carbonate was mined from 1988 to 1990, producing over 3 million grams gold from high grade oxide manto ore. The deposit also contains a sulphide reserve of 190 000 tonnes of 11 grams per tonne gold. The Groundhog deposit contains 273 000 tonnes of 5.0% zinc, 2.5% lead, 500 grams per tonne cadmium, 137 grams per tonne silver and 1.3 grams per tonne gold. The Risby tungsten skarn contains 2.7 million tonnes of 0.8% tungsten oxide. The Grew Creek gold deposit has drill indicated reserves of 270 000 tonnes grading 11.11 grams per tonne gold.

SURFICIAL GEOLOGY

The main sources of information for the Quiet Lake area are a terrain inventory (Jackson, 1987), surficial geology maps (Jackson ,1993a, b, c and d) and a report by Jackson (1994) which discusses the terrain hazards and surficial geology of NTS map sheets 105K, J, F and G.

The surface deposits of the Quiet Lake map sheet are associated with the most recent Cordilleran ice sheet (McConnell) believed to have covered south and central Yukon between 26,500 and 10,000 years ago.

The Pelly Mountains occupy most of the central part of the map area. During the last Cordilleran ice advance, they were covered by ice caps which shed ice both south to the Selwyn, and north to the Cassiar Lobes (Hughes et al. 1969). Because of the great elevations and rugged topography of the Pelly Mountains, the ice bodies separated in a complex series of tongues or lobe extensions through the narrow valleys. Jackson (1994) warns that this complex ice geometry in conjunction with the variable bedrock geology of the Pelly Mountains renders drift prospecting extremely difficult in this area. The highest peaks of the Pelly Mountains were exposed above the ice caps (nunataks).

Bedrock is very well exposed in the Pelly Mountains area (60-80% exposure). Sorted polygons, solifluction lobes, block fields and rock glaciers are common on colluvium or moraine covered slopes. Lateral moraine deposits from the Cassiar Lobe form benches along major valleys such as the Gray, Caribou, Pony and Scurvy Creeks and Salmon River. At lower elevations, these same valleys floors are covered with glaciofluvial sand and gravel. Rock glaciers are common at elevations greater than 5000 m, mostly on north and northeast facing slopes. A few small cirque glaciers are still active in the Pelly Mountains.

Northeast of the Pelly Mountains, moraine and glaciofluvial deposits from the Selwyn Lobe cover most of the Pelly River valley. The surface of the ice of the Selwyn lobe was estimated at 1645 m (Duk-Rodkin et al., 1986). Numerous drumlins or streamlined landforms are indicative of northwestward flowing ice. The creek and valley floors are commonly occupied by glaciofluvial sand and gravel. 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 this area indicates a wide range of content of sand (20 to 70%), silt (20 to 80%) and lower clay (5 to 30%). This low clay content is reflected by the low plasticity of the matrix. Morainal deposits can usually provide a stable base, if there is no ice-rich permafrost present.

In the southern part of the map area, around Quiet Lake, lower elevations are covered by moraines, and glaciofluvial sand and gravel deposited during the retreat of the Cassiar Lobe of the Cordilleran Ice sheet. Till in the Pelly Mountains generally has high carbonate content due to the abundance of carbonate bedrock. Glaciolacustrine deposits in this area are restricted to a few small basins; the largest is located in the Ross River valley.

Deglaciation in this area was generally marked by widespread ice stagnation alternating with periods of ice thickening (Jackson, 1987). The higher elevations, such as mountain peaks, were the first to emerge from the ice. As deglaciation proceeded, the ice bodies were controlled by valley configurations. Sequences of glaciofluvial benches of sand and gravel, and glaciolacustrine deposits are witness to this gradual and fluctuating ice retreat. The last area to be free of ice was the Tintina Trench. According to Jackson (1987), the lowest major lake was ponded along the Tintina trench in the Pelly River by isostatic downwarping.

The Pelly River valley is also benched and covered by glaciofluvial sand and gravel. The glaciofluvial sand and gravel have variable thickness and composition, are usually stable surfaces, however may contain undesirable lithologies (weak) for their potential use as aggregate. The lowermost terraces of the Pelly River are composed of mixed alluvial deposits and can be prone to flooding.

The White River tephra, deposited approximately 1,200 years ago, is visible on most surfaces, even in the soil profiles on some of the alluvial (modern) terraces of the Pelly River.

TERRAIN HAZARDS

Snow avalanches and slope failures resulting in rock avalanches on steep bedrock slopes represent the highest risk hazard in the area.

Seismicity

There are three recorded seismic events within the map area. All of the recorded events are 4.0 to 4.999

or less in magnitude.

Mass Movement Processes

Landslides have occurred in a variety of rock lithologies in the area (Jackson, 1994). Large rock avalanches and rock falls are still taking place, as indicated by the large number and volume of talus cones and aprons throughout the mountainous areas. Snow avalanches are common and can entrain large volumes of boulders and debris. Numerous landslides have been mapped in the Pelly Mountains (Jackson, 1994, Jackson and Isobe, 1990). Five large rock avalanches in non-carbonate rocks involved volumes of material greater than the range of 1 to 5 x 10^6 m^3 and are reported to have travelled great distances (Jackson and Isobe, 1990). All these failures took place in very steep arrête or cirque walls. The addition of moisture via snow and rains plays a key role in triggering such large and rapid rock slides. Development of any kind in close proximity to steep escarpments, ridges, cirques and arrêtes prone to these hazards should be discouraged.

Failure in unconsolidated deposits is also a concern, due to the presence of permafrost and associated processes such as thermokarst and solifluction. These failures can be rapid and involve large volumes of material or they can occur slowly, on small surfaces. Erosion of friable sediments such as glaciolacustrine sediments by streams may cause bank erosion.

Rock glaciers are common throughout the Pelly Mountains. They can be as thick as 10 m. Rates of surface movements of up to 51 m and snout advances of 2.5 m over 17 years have been recorded in Nahanni National Park, east of this map area (Jackson and McDonald, 1980).

Permafrost

Permafrost is widespread in the area and is often present in colluvial and morainal blankets at high elevations. Its presence is commonly indicated by solifluction lobes, stripes and sorted stone polygons. Thermokarst collapse and thaw slides are possible hazards in fine-grained glaciolacustrine and fluvial sediments.

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, in addition to the flooding risk, are also exposed to the additional possibility of mud flows and debris flows associated with rapid discharge increase.

References

Quiet Lake Map Area
N.T.S. 105F

Note: 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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