# GEOPROCESS FILE
# SUMMARY REPORT

# FINLAYSON LAKE
# N.T.S. 105G

## 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 Users 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 Users 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 Exploration and Geological Services Division, Indian and Northern Affairs Canada 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, geological structures 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 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 (Tempelman-Kluit, 1977)

The Finlayson Lake map area is entirely within the Omineca Belt. The Tintina Trench cuts across the southwestern part of the map area.

Southwest of the Tintina Trench, the Pelly Mountains region is underlain by Omineca Crystalline Terrane and Pelly-Cassiar Platform rocks. Collectively these rocks comprise the Cassiar Terrane which is composed of assemblages of pre-550 million year old silty slate, shaly quartzite, feldspathic sandstone, orthoquartzite, calcareous argillite, limestone and dolomite overlain by 550-440 million year old chlorite-muscovite-quartz phyllite, slaty phyllite, calcareous shale, silty limestone, calcareous siltstone, tuff, tuffaceous slate, amygdaloidal basalt, diabase and diorite; 500-370 million year old black slate, dolomitic siltstone and sandstone, calcareous shale and siltstone, argillaceous limestone, orthoquartzite and bioclastic limestone; 380-320 million year old black siliceous slate, sandy tuff, volcanic breccia, andesitic flows, thin-bedded chert, cherty tuff, bioclastic and silty limestone; and 220 million year old bioclastic and silty limestone. These various rock units are faulted together along thrust and strike-slip faults near the Tintina Fault,

North of the Tintina Fault, Yukon-Tanana Terrane rocks are dominant and include pre-570 million year old biotite-muscovite-quartz-feldspar augen gneiss and biotite-muscovite-quartz schist; and 290-250 million year old Klondike Schist metaquartzite, graphitic slate, muscovite-quartz blastomylonite, muscovite-chlorite-quartz phyllite, siliceous phyllite, amphibole-chlorite phyllite and biotite-muscovite quartzofeldpathic gneiss. This package of rocks is structurally overlain by 360-250 million year old Anvil Allochthon (Slide Mountain) dark green basalt, augite porphyry, dunite, peridotite, and pyroxenite and their serpentinized equivalents; and 350 million year old Simpson Range Allochthon (Pelly Gneiss) biotite quartz monzonite protomylonite and mylonite. The extreme northern portion of the map area is underlain by Selwyn Basin sedimentary rocks mainly black shale and chert of the 530 to 325 million year old Road River and Earn groups.

Numerous 100 and 50 million year old granite plutons mostly of the Selwyn Plutonic Suite intrude the map area. Three small successions (<10 $km^2$) of 1-10 million year old columnar-jointed, fresh brown olivine basalt and basalt breccia occur in the northwest portion of the map area.

### *Mineral deposits and occurrences*

The Finlayson Lake map area contains 117 mineral prospects, approximately half of which host mineralization of a wide range of mineral deposit styles. Base-metal sulphide deposits are dominant and include four major types: zinc-lead-silver deposits in limestone; zinc-lead-silver-barite deposits in black shale (sedex); copper-lead-zinc-barite deposits associated with volcanic rocks (volcanogenic massive sulphide); and a variety of tungsten, copper, and lead-zinc deposits hosted in marble (skarns). The most notable deposit is the newly discovered Kudz Ze Kayah, 13 million tonne massive sulphide deposit with grades of 5.5% zinc, 1% copper, 125 grams per tonne silver and 1.2 grams per tonne gold. Other deposits include the Tintina vein deposit which hosts 91,000 tonnes grading 686 grams per tonne silver, 10% zinc and 6% lead; and the Fyre volcanogenic massive sulphide deposit which contains 1.36 million tonnes of 1% copper, 1% zinc, 5.14 grams per tonne silver and 0.69 grams per tonne gold. There are also numerous silver-lead-zinc and copper-silver veins throughout the map area. Also of note are a few occurrences of coal, asbestos and jade.

## SURFICIAL GEOLOGY

The main source of information for the Finlayson Lake area is Jackson (1994). This report discusses the terrain hazards and surficial geology of NTS map sheets 105K, J, F and G.

The surface deposits of the Finlayson Lake map area are associated with the most recent Cordilleran ice sheet, the McConnell glaciation, believed to have covered south and central Yukon between 26,500 and 10,000 years ago. Finlayson Lake map area was covered by three lobes. The Cassiar lobe, which flowed in a northwesterly direction, covered the area southwest of the Pelly Mountains. The Liard lobe, which flowed east to southeast, covered the area southeast of the Pelly Mountains. The area north of the Pelly Mountains was covered by the east-northeast flowing Selwyn lobe. A complex of ice-caps and cirque glaciers was active at high elevations in the Pelly Mountains and contributed to the ice bodies surrounding them.

The north half of the map sheet is dominantly covered by morainal deposits, with numerous drumlins or streamlined landforms indicative of north and westward flowing ice of the Selwyn lobe. The ice surface of the Selwyn lobe was estimated at 1645 m (Duk-Rodkin et al., 1986). 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 sand content (20 to 70%), of silt (20 to 80%) and a low clay content (5 to 30%). This low clay content is reflected by the low plasticity of the matrix. Carbonate content in the till varies, and is higher where outcrops of carbonate rock have locally enhanced the carbonate content of the till, for example in the allochtanous terrane north of the Tintina trench. Morainal deposits usually can provide a stable base, if there is no permafrost present. The more recent moraines, which are associated with Neoglacial ice bodies may still contain stagnant buried glacial ice and be prone to collapse.

The Pelly River valley is often benched and covered by glaciofluvial sand and gravel, and in its western half, by glaciolacustrine deposits. The glaciofluvial sand and gravel have variable thickness and composition, are usually stable surfaces, and may contain undesirable lithologies (weak) for their potential use as aggregate. The glaciolacustrine sediments, which were deposited in valleys blocked by ice, can be as thick as 18 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 south half of the map sheet is intersected diagonally by the Tintina Fault more or less parallel to the Hoole and Black Rivers. Within the Tintina Trench and northeast of it, recent (Tertiary) volcanic rocks (basalts and rhyolites) are interstratified with coal bearing clastic rocks. The bedrock southwest of the Tintina Trench is composed mainly of carbonate, arenite, argillite and chert. The rock falls and avalanches occurring in the area have not been identified with particular rock units but are probably due to the slope steepening during glaciations. On either side of the fault, the steep and rugged topography is composed dominantly of exposed bedrock, colluvial deposits and at lower elevation, of morainal veneer and blankets. The creek and valley floors are often occupied by glaciofluvial sand and gravel. Sorted polygons, solifluction lobes, blockfields and rock glaciers are common in that part of the map.

## TERRAIN HAZARDS

The main source of information for the terrain hazards map is derived from surficial geology and soil survey maps. The Geological Survey of Canada Pacific Geoscience Center in Victoria provided the seismic information.

Slope failures in steep bedrock represent the highest risk hazard in the area. Failure in unconsolidated deposits are also a concern, due to the presence of permafrost. These failures can be rapid and involve large volumes of material or they can occur slowly, on small surfaces.

### *Seismicity*

There are 17 recorded seismic events within the Finlayson Lake map area. Thirteen of these events are located on the southwest side of the Tintina Fault in the southwest corner of the map area. Two of the 17 recorded events are of magnitude >4.0 to <5.0, the rest are of lower magnitude.

### *Mass Movement Processes*

Landslides have occurred in a variety of 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 portions of the map area. 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 volume of material greater than the range of 1 to 5 x $10^6$ square metres are a reported to have travelled greater than 1 km (Jackson and Isobe, 1990). All of these failures took place in very steep arrete or cirque walls and 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 arretes prone to these hazards should be discouraged.

### *Permafrost*

Rock glaciers as thick as 10 m are restricted to the higher elevations of north facing slopes, mainly in the southern portion of the map area. Surface movement of up to 51 m and snout advances of 2.5 m over 17 years have been recorded in Nahanni National Park, east of the Finlayson Lake map area (Jackson and McDonald, 1980).

Permafrost is often present in colluvial and morainal blankets at high elevation and is 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 a possible hazard in lower reaches of most streams in the area. In addition to the flooding risk, the steep portion of alluvial fans are also exposed to the additional possibility of mud flows and debris flows associated with rapid discharge increase.

# References

## Finlayson Lake Map Area
## N.T.S. 105G

**Note: To be thorough, check the references for adjacent N.T.S. map sheets and the General Reference List.**

**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. The library and call number of some internal government reports are listed.**


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