# GEOPROCESS FILE
# SUMMARY REPORT

# MAYO MAP AREA
# N.T.S. 105M

## 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 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 (Roots and Murphy, 1992)**

The Mayo map area encompasses a landscape of high rounded hills and wide swampy valleys. Higher mountains occur to the southwest in the McArthur Range, and north of Mayo Lake lie the Gustavus Mountains. Holocene glaciers filled the valleys but uplands above 1370 metres remained exposed. Bedrock is located in north-facing cirques, as erosional remnants on hill tops, and in stream canyons. Uplands are typically mantled with frost-fractured rock (felsenmeer).

The map area is within the Omineca Belt and dominated by sedimentary rocks of the Selwyn Basin geological province. The rocks are divisible into three main packages which are progressively more deformed from south to north. The sedimentary sequence in the southernmost quarter of the map area includes 800-530 million year old Hyland Group quartz metasandstone, conglomerate, maroon shale, siltstone and phyllite; overlain by 530-450 million year old siltstone and sandstone of the Kechika Formation; 450-390 million year old Road River Group siltstone and chert; and the 380-325 million year old Earn Group sandstone, chert-pebble conglomerate, siltstone, mudstone, dark limestone and chert. The broad folds and widely spaced thrust faults that repeat these rocks are offset by northwest-trending faults that are spaced 3-8 km apart. The Tintina Fault is located in the southwestern corner of the map area.

Across the centre of the map area is a 45 km wide belt of quartz-mica schist and chlorite schist of the Hyland Group. These rocks are tightly folded and strongly foliated and form the hanging wall of the south-dipping Robert Service Thrust. These and the overlying stratigraphy described in the paragraph above have been called the Robert Service Thrust Sheet.

The northern quarter of the map area contains flattened, moderately south-dipping metasedimentary and meta-igneous rocks that occur as thrust panels beneath the Robert Service Thrust Fault and the Tombstone Thrust. This is known as the Tombstone Thrust Sheet. Earn Group sericite schist and chloritic phyllite and Keno Hill quartzite (360-320 million years old) are intruded by dykes and sills of 220 million year old metadiorite. Phyllite is generally incompetent while adjacent quartzite and metadiorite are more resistant and brittle. Farther north in the McQuesten River valley is less strained chert and meta-siltstone of the Earn Group.

Several small 100-90 million year old biotite-hornblende granite and quartz monzonite plutons of the Selwyn Suite occur along a northwesterly trend across the map area. Two larger plutons are both 94 million years old. The low-lying Roop Lakes pluton (130 $km^2$) northeast of Mayo Lake is thought to be responsible for mineralization in the Keno Hill area, and the craggy, irregular shaped McArthur Pluton (160 $km^2$) has one active, and several fossil, hotsprings along its margin.

### *Mineral Deposits and Occurrences*

Yukon MINFILE lists 80 mineral occurrences for the Mayo area. Most are associated with the Keno Hill silver camp or are in the McArthur Game Sanctuary. Approximately 50 occurrences are silver-lead-zinc veins, with or without copper, tungsten, tin or gold. A number of tungsten-gold and copper skarns are found at the margins of the granitic intrusions. Two barite occurrences are located in the northeast corner of the map area in Earn Group sedimentary rocks near Tiny Island Lake. The Keno Hill-Galena Hill mining area has produced 6.7 billion grams of silver, 274 million kilograms of lead and 153 million kilograms of zinc from 4.8 billion tonnes of ore between 1921 and 1988. Current reserves are approximately 400,000 tonnes of 1000 grams per tonne silver and 5% lead.

Placer deposits in the Mayo map area are located on creeks draining into Mayo Lake and on Duncan Creek and its tributaries. Total recorded production from approximately eight creeks is 317,180 gms of gold between 1978 to 1990.

## SURFICIAL GEOLOGY

The Mayo map area lies within the limits of the McConnell glaciation. A complex assemblage of moraines, glaciofluvial and glaciolacustrine deposits is found in valley bottoms. Fine-grained deposits from glacial lakes are present in No-gold Creek, Upper Kalzas River and the Keno-Ladue River valleys as well as in the Stewart River valley. These deposits have a tendency to fail when undercut by streams and to develop thermokarst collapse features when the permafrost is disturbed.

The main source of information for this map sheet is the set of surficial geology maps surveyed by O. Hughes (1982) and the soil survey maps produced by Rostad, *et al.* (1977).

## TERRAIN HAZARDS

Most terrain hazards in the Mayo map area are related to permafrost. Areas underlain by greenstones that are more resistant than the enclosing metasedimentary rocks could be susceptible to rock slides, however, distribution of this lithology is confined to areas around Mayo Lake, and there are no documented landslides.

### *Seismicity*

One magnitude 3.8 seismic event has been recorded with a focal point apparently unrelated to any surface fault trace.

### *Mass Movement Processes*

The surficial geology maps in this area do not contain information relevant to rockslides, avalanches or other rapidly occurring landslides; however, as permafrost is widespread in this area, movement of soil and debris on slopes can easily be triggered if the permafrost is disturbed. Solifluction and soil creep are common especially on steeper slopes covered with a blanket of colluvium or moraine. The glaciolacustrine silt and clay deposits are susceptible to failure when undercut, and recessive slides are common where the vegetation cover has been disturbed.

***Permafrost***

Permafrost in the Mayo area is extensive and discontinuous, with a low to moderate ice content. Frozen surficial sediments contain ice veins, ice lenses and ice wedges (Heginbottom and Radburn, 1992). Larger ice bodies are present at depth, especially in thick fine grained glaciolacustrine and alluvial sediments. River valley floors usually contain discontinuous permafrost with visible ice which may be present as massive ice wedges or in thermokarst collapse features.

***Flooding Hazards***

Although very few hydrological studies were available when this map was compiled, it is locally known that alluvial flat areas within the lower reaches of the Liard, Stewart, Mayo and other small rivers are flooded seasonally. Some years, low level terraces up to 3 metres above the stream channel are flooded as a result of the snow melt or ice jam during break-up. The Town of Mayo has been flooded in the past due to ice jams in the Mayo River (Underwood and McLelland, 1983). This situation has been prevented in the recent past by controlling stage levels at the hydroelectric plant on the Mayo River.

***Other***

Geothermal gradients around the McArthur River Game Sanctuary are high and a number of hot springs are active in the area.

# References

## Mayo Map Area
## N.T.S. 105M

**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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