GEOPROCESS FILE
SUMMARY REPORT

DEZADEASH MAP AREA
N.T.S. 115A

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 Dezadeash map area spans the contact between the Insular and Coast Belts. Topographic relief is pronounced throughout the area, and the western and southern portions are rugged. The large broad Shakwak Valley, the east-trending Dezadeash River valley and the fjord-like Kusawa Lake are prominent features.

The bedrock geology northeast of the Denali Fault is dominated by crystalline rocks of the Coast Plutonic Complex and high-grade metamorphic rocks of Yukon-Tanana Terrane. The Coast Plutonic Complex is composed of 100-55 million year old granodiorite and granite intrusions. Yukon-Tanana Terrane includes pre-570 million year old quartz mica schist, gneiss, slate, quartzite, limestone and greenstone. Metamorphic rocks in the western part of the Coast Belt are mainly younger, 50 million year old biotite-schist known as the Kluane Schist. A small region in the northeast part of the map area is covered by an assemblage of andesite, basalt, rhyolite, volcanic breccia, tuff, argillite, slate, limestone and porphyritic granite of uncertain age or affiliation.

Immediately east of the Denali Fault is a fold belt of conglomerate, slate, sandstone, tuff, argillite, chert, greywacke and coal that forms the 145-120 million year old Dezadeash Group.

West of the Denali Fault are the structurally complex rocks of Wrangellia and Alexander Terranes. These include the 362 to 245 million year old Kaskawalsh Group limestone, marble, slate, quartzite, argillite, chert, andesite and schist; 245-200 million year old Mush Lake Group andesite, basalt, rhyolite, volcanic breccia, tuff, argillite, slate, limestone and quartzite with some Dezadeash Group rocks and minor serpentinite, dunite, peridotite and gabbro. This folded and highly faulted package of mostly sedimentary rocks is intruded by 140-100 million year old granodiorite, granite, porphyritic granite and diorite of the Coast Plutonic Complex. This entire package is overlain by 65-56 million year old Amphitheatre Formation conglomerate, sandstone and shale in the Bates Lake area, and by the 35-20 million year old Wrangell Volcanics volcanic breccia, tuff, rhyolite, dacite, andesite and basalt. These rocks are intruded by coeval syenite.

Mineral Deposits and Occurrences

Yukon Minfile lists approximately 50 mineral prospects for the Dezadeash map area, of which 29 contain mineralization. Most occurrences are southwest of the Denali Fault and are copper veins with varying amounts of silver, gold, lead, or zinc. Copper also occurs in a few skarns and volcanogenic massive sulphide occurrences. Platinum group elements, chromium and asbestos are associated with ultramafic rocks. Copper and molybdenum porphyry deposits are associated with granitic rocks on both sides of the Denali Fault and small gold veins are known east of Kusawa Lake. No deposits in this map area have defined reserves although some of them have been mined for high-grade ores. Coal deposits exist in the Amphitheatre conglomerate. Placer gold has been mined from many creeks adjacent to the Denali Fault.

SURFICIAL GEOLOGY

The Dezadeash map area has been subjected to a number of late Pleistocene glaciations resulting in high land standing as nunataks above the ice. Most glacial landforms in this area are attributed to late Wisconsinan glaciation (McConnell or Macauley). During this glaciation ice originating in the Icefield Ranges flowed east along Mush Lake valley towards Dezadeash Lake to coalesce with ice flowing north from the Alsek and Boundary Ranges along the Tatshenshini, Blanchard, Klukshu and Takhanne valley systems. The ice then coalesced with ice flowing northeast along the Shakwak Trench from the Kusawa Lake area and continued on in a northwest direction (Rampton, and Paradis, 1979). Part of this glacier then moved into the Takhini valley. In addition to ice streams occupying the valleys, smaller cirque glaciers capped summits of the Dezadeash, Ruby and Kluane Ranges and locally coalesced with the main ice streams. Ice limits are traced using erratic boulders, streamlined landforms, moraines and other ice margin indicators. Late Wisconsinan ice reached elevations of 1700 m at the southern edge of the map area, with the ice surface sloping gently towards the north. Ice elevations reached 1550 m to 1580 m at Dezadeash lake, and 1520 m east of Kloo Lake.

As the ice retreated from the Takhini valley, glacial Lake Champagne occupied the valley, up to approximately 2800 years ago (Liddle, 1979) with lake levels as high as 850 m. The Dezadeash and Takhini Valleys as well as parts of tributary valleys were flooded by this ice dam lake, as shown by beach lines at various elevations along valley walls, and thick silt and clay deposits on valley floors. Kusawa Lake valley was still glaciated until the lake level lowered to approximately 760 m as indicated by kame and kettle complexes at the north end of the lake. The lake level slowly lowered to approximately 715 m, with the spillway located through Taye Lake. Glacial Lake Kloo also formed during deglaciation, with water levels as high as 915 m, and remained flooded until the Jarvis River (present) was drained.

In the last 3000 years, and more specifically during the last 500 years, a series of major glacier readvances occurred in the St. Elias Mountains. Evidence for such activity includes recent ice-cored moraines southwest of Haines Junction; moraines from small ice caps showing various stages of stability and vegetation development; ice margins of some glaciers showing significant retreat since the earliest air photos were taken in this area in 1947; and the development of nivation terraces in the Dezadeash and Ruby Ranges (due to persistent snow banks). In addition, blockage of the Alsek River by fluctuating ice fronts of the Lowell Glacier resulted in formation of lakes with beaches and benches located at elevations of approximately 670 m. More recently, "between 350 and 500 years ago, a couple of lakes were formed whose maximum levels were near 640 m; around 250 years ago a lake was formed with a maximum level of 620 m; and between 75 and 150 years ago another lake formed with a maximum elevation of 595 m" (Rampton and Paradis, 1979).

The rugged topography of the Dezadeash map area and the great range of elevation between valley floors and summits was partially responsible for the complex distribution of Quaternary deposits associated with glacial, glaciofluvial, colluvial and fluvial activity. Slopes at high elevations are commonly steep rock outcrops, or are covered with thin moraine or colluvial deposits. The colluvial blankets and veneer are composed of cobbly and bouldery diamicton; a finer grained matrix and permafrost is common at shallower depths. Slopes covered by such material are susceptible to creep, solifluction, gullying and active layer detachment flows. Steep rocky slopes are potential sites for avalanches and rock slides. Colluvial fans or aprons are considered to be loose and unstable surfaces, and are susceptible to rock avalanches, mudflows and slides.

Slopes at mid-elevations are commonly covered by moraine deposits which are streamlined or ridged. Till is composed of diamicton with high sand, silt and stone content. Permafrost is present locally and is therefore vulnerable to creep and thermokarst.

Glaciofluvial sand and gravel are abundant at lower elevations and on valley floors. The gentle topography and coarseness of the deposits make these sediments a stable, well drained surface. Valley floors are commonly occupied by glaciolacustrine fine sand, silt and clay deposits, as is the case in the Takhini and Dezadeash valleys. Ice rich permafrost, in the form of large lenses or bodies of ice, veins or crystals, is very common in such deposits. Disturbance of the surface vegetation or forest cover by natural causes, such as forest fire or riverbank erosion, or by human activities such as road building, stripping or excavation may trigger permafrost degradation and generate slumping, failing and thermokarst subsidence for many years.

The lowest river terraces, controlled by glacial melt water, flood catastrophically during the summer months and are particularly susceptible to erosion and flooding. Eolian landforms such as dune fields are sensitive to surface vegetation disturbance.

TERRAIN HAZARDS

Terrain hazards information is derived from the Kluane Land Use Plan (Thurber Consultants Ltd, 1989) and from surficial geology maps (Rampton and Paradis, 1979; Rampton, 1981). Rock falls and avalanches are the most serious risks in the area. Mudslides and debris flows, although a lower threat to life, are nevertheless a hazard affecting roads and campsites in many areas. Heavy rainfalls are often responsible for increased mass movement activity at the base of colluvial and alluvial fans.

The area also shows very high seismic activity with some evidence of postglacial faulting.

The discharge of several streams is closely related to ice and snow melt and floodplains can be subject to catastrophic flooding in summer months.

Seismicity

There are 20 recorded seismic events within the Dezadeash map area. All of the recorded events are 3.0 to 3.999 in magnitude or less.

Mass Movement Processes

Avalanches and rapid mass movements such as rock falls on steep bedrock slopes are the most severe hazards. Permafrost related mass movements are always a possibility particularly on north facing slopes and at high elevations. Active layer detachment slides can be triggered by surface disturbances on colluvium or moraine covered slopes underlain by permafrost. Mudslides, mudflows and debris flows can occur at the base of colluvial and fluvial fans after heavy rainfall or snowmelt. Roads, campsites or other development could incur costly restoration or repairs after such events. An example is the large debris flow that took place on the northwest shore of Kusawa Lake in 1981 (Bremner, 1985), where large volumes (1 to 3 m thick) of bouldery saturated silt and sand were rapidly dumped over the campsite and access road.

Permafrost

This area lies within the continuous permafrost zone (Brown, 1967). Permafrost is most common in the fine-grained alluvial deposits, fine-grained fan toe deposits and glaciolacustrine deposits. Large bodies of segregated ice (up to 40% volume) are common in the well sorted silt and clays along the Takhini and Dezadeash River valleys. Thick organic deposits are also common on the floodplain deposits and are very likely underlain by permafrost. Thermokarst ponds, frost heaving and cracking are found in many of the poorly drained alluvial terraces, creeks and rivers. Surface disturbances can accelerate or trigger mudslides, permafrost thawing and thermokarst depressions. Poor drainage may follow.

Permafrost is also common on north facing slopes and at high elevations in the morainal and colluvial deposits. Solifluction lobes, stripes and sorted polygons are common throughout the map area on mid and high elevation slopes. Large surfaces along the Dezadeash River valley and its tributaries have been mapped by Rampton (1981) and by Thurber (1979) as soliflucted slopes. Nivation, terraces and frost shattered rocks are common. Ice content in such permafrost affected landforms is expected to be moderate to high. Glaciofluvial and fluvial gravels are expected to contain very little ice even if the soils have low temperatures. These areas would provide fairly stable surfaces.

Rock glaciers as well as debris covered glaciers are numerous in the Kluane Ranges. Glaciers often cap summits in the western and southern part of the map.

Flooding and Other Risks

Most of the central and southwest portions of the map area are part of the Dezadeash River basin. The eastern portion of the St. Elias Mountains and the northwestern part of the Coast Mountains are drained to the south by the Alsek River. The streams draining through the Alsek River are characterized by peak flow in spring due to snow melt and glacial melting, and again in late summer due to snow melt at high elevations. Drainage of the Dezedeash River has been blocked several times during the last 3000 years by the Lowell glacier, creating lakes and therefore flooding the areas up glacier.

The Takhini river is part of the Yukon River watershed and drains to the northwest. Ice jams and peak flows usually take place here during late spring to early summer.

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Dezadeash Map Area
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