

GEOPROCESS FILE - SUMMARY REPORT

NADALEEN MAP AREA - N.T.S. 106C

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 Nadaleen River map area is in the Foreland Belt and has typical Rocky Mountain topography. The bedrock geology is mainly within the Mackenzie Platform of Ancient North America.

Three pre-550 million year old rock packages dominate the Nadaleen River map area: 1) the Backbone Ranges, in the northeastern map area, are underlain by sandstone, conglomerate, shale, slate, quartzite, limestone and dolomite of the Sekwi Formation, Backbone Ranges and Atan Group; 2) the Wernecke Mountains and Rackla Range, in the central map area, are underlain by Wernecke Supergroup (Gillespie, Quartet and Fairchild Lakes Groups) quartzite, conglomerate, sandstone, siltstone, limestone and dolomite, and Pinguicula Group sedimentary rocks; 3) the Nadaleen Range, in the southern map area, is largely underlain by Hyland Group siltstone, conglomerate, sandstone, quartzite and limestone.

Younger rocks in the map area are dominated by the 530-390 million year old Road River Group shale, conglomerate and limestone, and the 390-325 million year old Earn Group shale and conglomerate in the Wernecke Mountains and Nadaleen Range. The 360-320 million year old Keno Hill quartzite is also present in the Nadaleen Range, adjacent to Road River Group rocks and juxtaposed against Hyland Group rocks along the easternmost extent of the northerly-verging Dawson Thrust.

Rocks in the Backbone Ranges and southwest of the Snake River are deformed into northwest-trending fault panels typical of Rocky Mountain-style geology. The Wernecke Supergroup rocks in the Wernecke Mountains are cut by numerous vertical faults. A series of enigmatic breccia bodies (areas of shattered rock), some of which are enormous, outline a significant arcuate, west to west-northwest-trending zone of structural weakness and are known as the Wernecke Breccias. The eastern part of this arc occurs in the northern part of the map area. In the Nadaleen Range, the structures are dominated by, and sub-parallel with, the Dawson Thrust.

Mineral Deposits and Occurrences

The Nadaleen River map area contains 91 mineral prospects of which 70 host mineralization.

Most of the mineralization consists of Mississippi Valley type and associated vein lead-zinc-silver deposits. Many of the mineral occurrences have been drilled and a few have defined tonnages: the Craig deposit contains 480,800 tonnes averaging 8.2% lead, 13.3% zinc and 106 grams per tonne silver; the Vera deposit contains 1.36 million tonnes of approximately 3.7% combined lead and zinc with 306 grams per tonne silver; the Val deposit contains 272,000 tonnes of 137 grams per tonne silver with minor lead; and the Goz Creek deposit contains approximately 2.5 million tonnes of 11% zinc. Other deposit types in the map area include several uranium-copper Wernecke Breccias and copper-cobalt veins.

SURFICIAL GEOLOGY

A surficial geology map derived entirely from air photo interpretation was drafted in 1974 by Ricker (1974). This 1:125,000 scale map presents geomorphic information only, with some interpretation as to active and inactive processes, glaciation and deglaciation sequence, and type and distribution of landforms.

Glaciers covering this area were part of a large transection glacier system which flowed generally northwestwards. Most valleys were interconnected through this major ice network. In the Wernecke Mountains, several cirque glaciers contributed to the main ice bodies. Three major ice advances are inferred based on geomorphic evidence only.

The extent of the oldest glaciation (Pre-Reid, Bostock, 1966) is not well defined in this area and is assumed based on evidence in adjoining map sheets. Evidence of the intermediate Reid glaciers (Bostock, 1966) consists of erosional surfaces and the presence of erratic boulders. From these, an ice elevation of 1430 m a.s.l. is assumed in the western boundary of the map, and was possibly 200 m higher at Nadaleen Mountain and around Rackla Lake. The terminus of these glaciers is located beyond the boundary of map 106C.

The more recent glaciation (McConnell Glaciation, Bostock 1966) shows a more restricted distribution with large ice-free surfaces at high elevations and smaller tributary glaciers. Based on geomorphic evidence, ice elevation ranged from 1525 m in the east and north to 1300 m in the west. In the northern portions of the Snake and Bonnet Plume River valleys, ice was as low as 900 m a.s.l. and in some of the tributaries of the Arctic Red River valley, glaciers were only a few tens of metres above their valley floor. Approximately 80% of the cirques had active glaciers at that time. Numerous rock drumlins, faceted rock exposures and grooves provide erosional evidence of this glaciation. Most morainal deposits in the map area, except for the very recent deposits of Neoglacial ice, are related to the McConnell glaciation. Moraine thickness ranges from 45 m in the major valley to a complete absence in some valleys northwest of the Snake River area. Glaciofluvial deposits are present along the walls of most large river valleys, such as the North Rackla, Bonnet Plume and Snake River valleys.

Approximately 3000 years B.P., cooling of the climate triggered a small ice age, and again, approximately 600 years B.P., as witnessed by the accumulation of ice and the development of cirque, valley and small glaciers. No accurate dates exist for these recent glaciers and their moraines.

Modern processes include the development of fans which can modify drainage and affect roads. The ongoing impact of frost shattering and weathering and slope processes contributes to the formation of colluvial fans and talus.

Terrain Hazards

Seismicity

There are 26 recorded seismic events within the Nadaleen River map area. Twenty-two of these events are located in the northwest corner of the map area. All of the recorded events are 4.0 to 4.999 in magnitude or less.

Mass Movements

Several large rock slides in the 30-50 x 106 m³ class are indicative of possible rapid and severe mass movements. One of these slides blocked the drainage of the Bonnet Plume River (Wheeler, 1954) on the eastern map boundary. Sedimentary rocks are prone to such catastrophic slumps when the bedding plane is subparallel to steep slope surfaces. This was the case here, as the source of the slump is in limestone with the slide plane parallel to the bedding plane on a limb of an faulted fold. Ricker (1974) mentions "house-sized debris overshot the river and rebounded off the opposite valley slope". There is another large slide in the centre of the map sheet. Two fairly recent large slumps up Corn Creek, one on the north side of Mt. McDonald and several more throughout the map area confirm the tendency of the shale, carbonate and quartzitic bedrock to slump under the appropriate combination of fault or bedding plane and surface plane.

Quaternary and recent deposits can also be prone to slumping. Mudslides and debris slides are mapped throughout the map area. Disturbance of surface vegetation and slope can also trigger permafrost degradation and associated mass movements such as detachment and retrogressive thaw slides. Solifluction lobes, soil creep and polygonal ground are present on many of the hillsides and valley walls, and are a indication of permafrost. Colluvial fans and talus cones are considered to be unstable and in many cases are ice rich.

Permafrost

This area lies within the extensive discontinuous permafrost zone (Heginbottom and Radburn, 1992), with low to moderate ice content in morainal and colluvial deposits above valley floors, low to moderate ice content in alluvial and fluvial deposits, and moderate to high ice content in fine grained glaciolacustrine deposits, such as the deposits around McQuesten Lake, and in fine-grained alluvial fans and terraces above stream level. Permafrost is assumed to be absent or thinner under south facing, well drained slopes.

In the adjacent map area, 106D, Vernon and Hughes (1966) quote observations from McTaggart (1960) of permafrost thickness in excess of 122 m (400 ft). Permafrost as thick as 137 m has been reported near Elsa, 80 km to the southwest of the map area. Although not mapped by Ricker (1974), felsenmeer, nivation hollows, patterned ground, thermokarst pits and solifluction lobes are assumed to be present throughout the map area. Valley bottom with thick peat

deposits, evidence of patterned ground, or cryoturbation should be avoided, as disturbance of permafrost may trigger long term surface subsidence, slope movement and poor drainage.

Rock glaciers and debris covered glaciers, as well as ice cored or ice rich talus cones are prolific in the area.

Flooding

Braided rivers have unstable channels and are subject to seasonal flooding after ice thaw and rain storms. Expansive river icing takes place on most streams. 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 flooding risk, the steep portions of alluvial fans are also exposed to the additional possibility of mud flows and debris flows associated with rapid discharge increases.

References

Nadaleen Map Area - N.T.S. 106C

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.

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