GEOLOGICAL SURVEY OF CANADA COMMISSION GÉOLOGIQUE DU CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
MINISTÈRE DE L'ÉNERGIE, DES MINES ET DES RESSOURCES

## EXPLANATION OF LANDFORM UNIT NOTATIONS

Compositional-Genetic Category — Age Modifier; Process or Form Modifier; Textural Modifier — Morphologic Modifier(s)

Example: gAp-A

Stratigraphic relationship given where thickness of upper unit is irregular and where underlying unit is a known compositional-genetic unit other than bedrock.

### Compositional-Genetic Categories[1]

- A- Alluvial Deposits: sand and gravel with veneer of fine sediment; Postglacial, rarely older; floodplain (Ap), modern.
- C- Colluvium: various materials, mainly rubble, includes landslides (Cs); undifferentiated Pleistocene in age; talus aprons (Ca), Neoglacial, mainly modern.
- D- Drift: undifferentiated till, sand, gravel, and lacustrine sediment; Late Wisconsinan (Macauley).
- E- Eolian Deposits: sand, silt; Postglacial.
- G- Glaciofluvial Deposits: sand and gravel with veneer of fine sediment; Late Wisconsinan (Macauley).
- I- Ice; snow and firn veneer; Neoglacial.
- L- Lacustrine Deposits: mainly silt and clay with little fine sand; Late Wisconsinan (Macauley).
- M- Morainal Deposits: till, silty/sandy, Late Wisconsinan (Macauley); ice-cored moraines and debris-covered glaciers (M/I) and rock glaciers, rubble, Neoglacial.
- O- Organic Deposits: peat, muck, organic silt; Postglacial
- R- Bedrock: various types; pre-Pleistocene.

### Textural Modifiers

- a- sand or gravel; aM- till containing a high proportion of sand, gravel, rubble, or boulders
- b- boulders, blocks, bouldery
- c- clay, clayey
- f- silt, clay, and fine sand; commonly with high organic content
- g- gravel, gravelly
- r- rubble; predominantly sand to boulder-sized fragments
- s- sand, sandy
- t- till, compact; low stone content (clasts greater than 2.5 cm diameter)
- x- interbedded coarse textured and fine textured material

### Process or Form Modifiers

- A- active alluviation
- G- channelled by meltwater
- P- pitted (kettle holes)
- K- thermokarst
- V- gullied

[1] General descriptions of texture and age are given for each category; only where texture and age differ from the general description are texture and age modifiers used.

### Age Modifier

- A- Modern
- N- Neoglacial
- P- Postglacial
- L- Late Wisconsinan (Macauley)
- 2- Early Wisconsinan or Illinoian (Mirror Creek)

### CHRONOLOGY

| | | |
|---|---|---|
| | MODERN | |
| | NEOGLACIAL | |
| 2800 years B.P. | | POSTGLACIAL |
| | HYPSITHERMAL | |
| 8700 years B.P. | | |
| | EARLY POSTGLACIAL | |
| 12 500 years B.P. | | |
| | MACAULEY GLACIATION | LATE WISCONSINAN |
| 29 500 years B.P. | | |
| | NONGLACIAL INTERVAL(S) | EARLY WISCONSINAN or ILLINOIAN |
| | MIRROR CREEK GLACIATION | |

### Morphologic Modifiers

- a- apron
- b- blanket[2]
- c- castled outcrop
- d- delta
- f- fan
- h- hummocky
- m- undulating, rolling
- n- nondescript slope, bedrock controlled
- p- plain, floodplain
- r- ridge, ridged
- s- steep slope (greater than 35°), cliff
- t- terrace, terraced
- v- veneer[3]
- 1- gentle to moderate slope (5-15°)
- 2- moderate to steep slope (15-35°)

[2] Blanket indicates category forms nearly continuous cover greater than 1 m thick, generally 0.5 to 3 m thick, over underlying unit.

[3] Veneer indicates category forms broken thin cover, usually less than 1 m thick, but averaging 0.5 m thick, over underlying unit.


## PHYSIOGRAPHY

WESTERN MOUNTAINS




- VALLEY or BASIN (DEPRESSION) - Low-lying land bordered by higher ground; flat, smooth, or gently undulating terrain with few surface irregularities.
- PLATEAU - Land standing well above valleys but below elevation of nearby mountains; flat, smooth, gently sloping to moderately hilly terrain; in places dissected by valleys, but major part of surface is near summit level.
- HILLS - Prominences that rise above surrounding terrain; relief less than 350 m; rounded summits.
- MOUNTAINS - Prominences that rise above surrounding terrain; relief more than 350 m; have restrictive summit area and steep slopes.

BOUNDARIES
- Between physiographic systems.
- Between major physiographic subdivisions.
- Delineating minor physiographic subdivisions.
- Between physiographic elements.

Geological boundary (defined, approximate, assumed)
Bedrock outcrop
Castled bedrock outcrop
Fault scarp, postglacial
Rock drumlin, crag and tail, fluted bedrock
Glacially scoured bedrock hillock
Drumlin, fluted till
Esker
Kame
Kame terrace
Pits (kettle holes)
Morainic ridges
Late Wisconsinan
Neoglacial
Lake strandline
Late Wisconsinan
Neoglacial

Meltwater channel
Late Wisconsinan
Neoglacial
Altiplanation terrace
Nivation terrace
Thermokarst depression
Landslide scar
Rock glacier
Dunes (inactive; active, blowout)
Stream-trimmed scarp, postglacial (unconsolidated material, bedrock in part)
Stream-trimmed scarp, modern (unconsolidated material, bedrock in part)
Stream-cut ravines and canyons, postglacial (unconsolidated material, bedrock in part)
Stream-cut ravines and canyons, modern (unconsolidated material, bedrock in part)
Areas where snow patches common

INDEX MAP

Copies of this map may be obtained from the Geological Survey of Canada:
601 Booth Street, Ottawa, Ontario K1A 0E8
3303 - 33rd Street, N.W., Calgary, Alberta T2L 2A7
100 West Pender Street, Vancouver, B.C. V6B 1R8

MAP 13-1981

SURFICIAL GEOLOGY AND GEOMORPHOLOGY

# KUSAWAK RANGES

BRITISH COLUMBIA

Scale 1:100 000

Kilometres 2 0 2 4 6 8 Kilometres

Miles 2 0 2 4 Miles

Universal Transverse Mercator Projection



Printed by the Surveys and Mapping Branch, 1982

## SURFICIAL GEOLOGY AND GEOMORPHOLOGY

## KUSAWAK RANGES
(114P-part of NE1/4)

### DESCRIPTIVE NOTES

The Boundary Ranges consist of highlands dotted with irregularly scattered groups of peaks and carved into blocks by deeply entrenched steep-walled valleys[1]. Small tributary hanging valleys have local relief in excess of 1373 m. Many peaks and ridges are sharp crested, although an intensely glacially scoured plateau-like area occurs northeast of Mount Kelsall. Small glaciers and icefields are scattered throughout the Boundary Ranges. The ranges are well drained except for some broad, gently sloping alpine valleys. Most streams are tributary to Tatshenshini, Kusawa, and Kelsall rivers; the Kusawa drains towards Yukon Territory whereas the others drain more directly to the Pacific. The Boundary Ranges consist mainly of Jurassic and Cretaceous schists, hornfels, and gneiss intruded by Cretaceous and Tertiary granodiorites and isolated Tertiary volcanics[1,2].

The Alsek Ranges are precipitous with sharp serrated peaks, steep valley walls, and relief in excess of 1000 m[1]. The Kusawak Range and the group of peaks including Seltat Peak are separated from the main part of the Alsek Ranges by a plateau-like area flanking Haines Road. The undulating plateau surface stands 300 to 600 m above adjacent valleys. Most of the area is well drained with the northern part draining to Tatshenshini River and the southern part draining more directly to the Pacific Ocean via Kelsall and Klehini rivers. The Alsek Ranges are mostly Paleozoic carbonates and greywackes intruded by granitic rocks varying in age from late Paleozoic to Tertiary[2,3]. The northeastern edge of the Alsek Ranges are marked by two major fault systems that superimpose late Paleozoic and Mesozoic sediments and volcanic rocks against the above sequence[2,3].

The area lies outside the southern limit of continuous permafrost, but within an area noted for high altitude permafrost[4,5]. Permafrost is absent under valley bottoms and south-facing slopes but is present under north-facing slopes and at high altitudes.

During the Pleistocene, periglacial processes have affected the terrain at high elevations. Solifluction lobes and sorted stripes, steps, and polygons are present at high elevations and indicate frost creep and sporadic active solifluction[6,7]. The origin of nivation terraces and hollows, which are common in the area, is related to the presence of snowbanks that persist during the summer; nivation terraces commonly form on moderately sloping valley walls, along benches formed by meltwater channels, along morainic ridges, and along the toes of solifluction lobes.

The area has been subjected to a number of late Pleistocene glaciations, but most glacial landforms in the area are attributed to late Wisconsin glaciation. During this glaciation, a large ice cap in the Boundary Ranges appears to have been present in the area east and northeast of Kelsall Lake; from this ice cap, glacier ice flowed north along Kusawa River valley, west through Kelsall Lake valley, and south to the east of the map area. Some high peaks and ridges above 2000 m probably stood as nunataks above the ice.

In the Alsek Ranges, glaciers built up in valleys and on the plateau-like area southwest of Kusawak Range. Accumulating ice generally flowed north towards the northern edge of the map area, coalescing with ice from the Boundary Ranges at Kelsall Lake. In the valley just south of Scottie Mountain, ice appears to have flowed in a westerly direction for most of the late Wisconsinan, although in waning stages ice flow map have reversed direction. At the ice divide near Three Guardsmen Mountain, some ice flowed southeast down Kelsall valley, some down Klehini valley, and some north towards Kelsall Lake. Divergent directions of flutings southwest of Kusawak Range suggest that frequent changes in direction of glacial flow occurred in this area. West of Kusawak Lake, it appears that ice flow was from west to east during the waning stages of late Wisconsinan glaciation, whereas earlier it had been from south to north.

Deglaciation proceeded from north to south in Tatshenshini valley; a large channel was eroded by meltwater from the receding glacier front parallel to the present course of Tatshenshini River. At the west end of Kelsall Lake deglaciation was complex: it appears that an outwash plain was deposited here when ice still occupied Kelsall, Nadahini, and Tatshenshini valleys; after deglaciation of upper Tatshenshini valley, the lake drained northward; stream piracy and damming of the valley by alluvial fans then established the present drainage pattern.

During the Neoglacial, from about 3000 years ago to the present, a series of major glacier readvances has occurred in the St. Elias Mountains to the northwest[8]. Locally, evidence suggests that Neoglacial readvances have been restricted to the last 500 years. Multiple Neoglacial moraines front many glaciers, but most lack lichens, preventing estimates to be made of their age. The glacier at the head of West Nadahini River is fronted by Neoglacial moraines of at least four ages: the oldest has **Rhizocarpon geographicum** diameters of up to 46 mm, the next of up to 23 mm, the next of up to 3 mm, and a zone with no lichens. The glacier front has retreated about 550 m since 1948 when the aerial photographs were taken. The present trend of glacial retreat has been confirmed by volumetric surveys of Nadahini Glacier between 1964 and 1976[9]. During the Neoglacial, the persistence of snow patches in summer has also become common and has probably accelerated the formation of nivation terraces.

Some small fresh-looking scarps just west of Bear Camp within the Duke River/Dalton Fault zones[2] may be the result of recent faulting. The area lies within a zone of high seismic activity, and evidence of postglacial faulting is present to the northwest[10].

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Linework by Terrain Analysis and Mapping Services Limited, Carp, Ontario

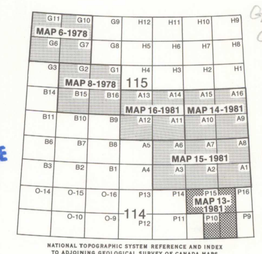


Base maps at the 1:50 000 scale published by the Surveys and Mapping Branch

Copies of the various topographical editions of this map may be obtained from the Canada Map Office, Department of Energy, Mines and Resources, Ottawa, K1A 0E9

Approximate magnetic declination 1981, 29°09.4' East, decreasing 5.9' annually

Elevations in feet above mean sea level




NATIONAL TOPOGRAPHIC SYSTEM REFERENCE AND INDEX TO ADJOINING GEOLOGICAL SURVEY OF CANADA MAPS

MAP 13-1981
KUSAWAK RANGES
BRITISH COLUMBIA