SURFICIAL GEOLOGY AND GEOMORPHOLOGY DESCRIPTIVE NOTES

The study area lies northeast of Tintina Trench in Stewart Plateau, a subdivision of Yukon Plateau. As noted by Bostock (1948, p. 64) "glaciation seems to have been a major factor in developing the present topography. Here the larger valleys have been accentuated and form a network surrounding tablelands on which the tributary valleys are shallow where the ice-cover was thin or lacking. Isolated mountains or small ranges crown the higher parts of most of the tablelands".

The glacial history of the area can be presumed to be similar to that of adjoining parts of central Yukon, where Bostock (1966) inferred four advances of the Cordilleran Ice Sheet, which he named (from oldest to youngest) Nansen, Klaza, Reid, and McConnell. During the late Wisconsinan McConnell Glaciation, the Cordilleran Ice Sheet moved generally westward, but with local direction of movement strongly controlled by topography. The western limit of the ice sheet was highly irregular, with ice tongues extending westward along major valleys. In addition to nunatak areas, which were completely surrounded by ice but not overridden, extensive parts of the study area between and beyond the ice tongues remained ice free at the maximum of the McConnell advance.

Four such areas, McArthur Group (Map 3-1982), Gustavus Range (Maps 4, 5-1982), Patterson Range (Map 5-1982), and Fork Plateau (Map 5-1982), had mountains high enough to support cirque glaciers. Moraine patterns in McArthur Group indicate that none of the cirque glaciers merged with the main Cordilleran Ice Sheet. In Gustavus Range, two cirque glaciers in the headwaters of McKim Creek and two in the headwaters of Granite Creek merged with the main ice sheet, as did those in Patterson Range. Three cirques at the head of Edmonton Creek in Fork Plateau appear to be relatively fresh, suggesting that they were occupied by glaciers during McConnell Glaciation. If so, the glaciers probably did not extend beyond the cirque basins.

Locally, prominent moraine ridges lie within the outer McConnell limit. They appear to mark stillstands or local readvances during post-McConnell retreat but are not consistent from valley to valley, suggesting that individual ice tongues behaved independently to some degree.

The limits of the more extensive, penultimate Reid Glaciation are subdued but nevertheless discernible along much of the former ice margin in McQuesten map area to the west (Bostock, 1966). In the study area where only a few nunataks stood above the ice sheet, the upper limit of the ice is discernible only locally, notably on the southwest flank of the McArthur Group and in the headwaters area of Crooked and North Crooked creeks. In the former area, the Reid limit is 670 to 700 m (2200 to 2300 feet) above the McConnell limit. That difference is probably typical for the western part of the study area (Maps 3 and 4-1982), but the two limits probably converge towards the source area of the ice in the Selwyn Mountains.

Cryoplanation (altiplanation) terraces are common in unglaciated parts of Yukon Territory and Alaska (Hughes et al., 1972). They occur on many of the ridges of the McArthur Group (Map 3-1982) and on other scattered peaks, mostly in the western half of the map area. No glacial erratics were found on these terraces, hence they appear to be good presumptive evidence that the surfaces lie above the all-time limit of glaciation. On the basis of lowest local occurrences of cryoplanation terraces, the Cordilleran Ice Sheet never covered surfaces above about 1280 m (4200 feet) in the vicinity of Mount Haldane (Map 4-1982), 1525 m (5000 feet) in the western part of the McArthur Group (Map 3-1982), and 1675 m (5500 feet) in the Patterson Range (Map 5-1982). Observations of upper limits of erratics suggest that the actual all-time limit of glaciation (referrable to Klaza and/or Nansen Glaciation) may be 60 m (200 feet) or more lower in each case.

During retreat of the Cordilleran Ice Sheet following the McConnell maximum, parts of several major valleys were occupied by glacial lakes in which thick glaciolacustrine sediments were deposited. Lakes developed in valleys such as those of Nogold Creek (Map 3-1982), upper Kalzas River (Maps 2, 3-1982), and Keno Ladue River (Map 5-1982) because the retreating ice blocked natural eastward drainage. A glacial lake in Stewart Valley at Mayo (Map 4-1982) was impounded behind massive morainic and glaciofluvial deposits that extend 15 km downstream beyond the map area to the type locality for the McConnell advance (Bostock, 1966, p. 1, Plate III). The lake may have extended upstream to Fraser Falls and thence up Watson Creek. If so, the alluvial plain (Ap) and thermokarst alluvial terraces (Atk) on the valley floor from Big Island above Mayo to Fraser Falls may overlie glaciolacustrine deposits. Remnant glaciolacustrine deposits extend up Stewart Valley from Five Mile Rapid (Map 3-1982) to the eastern limit of mapping. A glacial lake, inferred from the deposits, may have been impounded by drift that filled the reach between Five Mile Rapid and Fraser Falls, but additionally the valley must have been differentially downwarped to the east to some undetermined amount.

Locally, glaciolacustrine deposits are mantled by glaciofluvial sand and gravel. Along Mayo River above Wareham Lake (Map 4-1982) downcutting of the river through gravel into glaciolacustrine sediments has resulted in failed slopes (Cz) with characteristic hummocky to distinctly stepped topography. The same stratigraphic relationship has resulted in similar topography along Kalzas River near Sideslip Creek, and along Talbot Creek (Map 3-1982).

The chronology of glacial events in the study area and adjacent areas is incompletely known. Wood in a volcanic ash layer, within organic silt overlying Reid drift (on Stewart River, 60°30.2'N, 137°16'W in McQuesten map area to the west), has been dated as more than 42 000 years old (GSC-524, Lowdon and Blake, 1968); the maximum of the Reid advance may be considerably older. A bog bottom sample from Two Buttes, Talbot Plateau (Map 3-1982), dated at 10 840 ± 150 years B.P. (GSC-365, Dyck et al., 1966), also overlies Reid drift but clearly is much younger than the underlying drift. Neither a date of greater than 35 000 years (I [GSC]-180, Trautman and Walton, 1962) at the base of McConnell till near Mayo, nor a date of greater than 46 580 years (GSC-331, Dyck et al., 1966) from subjacent silt are of value for fixing the time when McConnell ice advanced over the area. The timing was probably comparable to that for other localities in the Yukon: after 30 100 years B.P. in southwestern Yukon (Denton and Stuiver, 1967) and after about 24 000 years B.P. in Liard Plain in southeastern Yukon (GSC-2811, Lowdon and Blake, 1982; Klassen, 1978).

Assistance of members of Operation Keno (Gleeson, 1965) in determining the limits of distribution of glacial erratics is gratefully acknowledged.

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EXTENDED LEGEND

Map Unit*		Name	Material	Typical thickness (m)	Landform	General Comments
pO	Organic deposits	Peat bog	Fibric to mesic bryophytic peat; may be underlain by mesic to humic sedge peat and/or gyttja, in turn underlain by organic silt.	1-3	Generally flat but with up to 35% of area consisting of thermokarst ponds and depressions 1 to 4 m below the general bog surface.	Permafrost is found throughout bog areas except in taliks beneath thermokarst ponds and depressions; uppermost 1 to 3 m of mineral soil beneath peat typically has 30 to 50% segregated ice by volume.
fO		Fen; locally includes marsh, swamp, and shallow water classes of Tarnocai (1980)	Mesic to humic woody sedge peat; commonly underlain by woody organic silt.	0.4-1.5	Flat except for low hummocks and/or ridges.	Occurrence of permafrost sporadic, in general more prevalent with increasing elevation; in some areas mapped as fO organic accumulation is less than 0.4 m and hence does not meet the thickness criterion for organic deposits.
Ap, Apk	Alluvial deposits	Alluvial plain	Alluvial plains of rivers typically have 1 to 3 m of silt overlying gravel; small streams have various thicknesses of silt, sand, and gravel.	5-30	Flat to gently irregular, commonly with distinct meander scrolls and oxbow lakes; old floodplain surfaces of large streams commonly have irregular thermokarst ponds (Apk).	Flooding common to infrequent; permafrost common; silt layer is generally ice rich and unstable when thawed.
At, Atk		Alluvial terrace	As for Ap.	2-30	Flat to gently irregular; irregular thermokarst lakes common in low terraces bordering large streams (Atk).	Flooding rare, permafrost common; silt layer is generally ice rich and unstable when thawed.
Af		Alluvial fan or fan apron (bahada)	Mainly coarse gravel in steeply sloping fans; sand, silt, and organic layers in gently sloping fans.	2-30	Gently to steeply sloping fans occur where high gradient tributary streams meet lower gradient trunk streams; closely spaced fans merge to form fan aprons.	Streams on fans are subject to sudden and damaging changes of course; fans comprising mainly gravel may be permafrost free or if perennially frozen are thaw stable; fans comprising mainly silt are typically perennially frozen and the silt ice rich and unstable when thawed.
Ax		Alluvial complex; combinations of Ap, At, and Af	Silt, sand, gravel.	2-30	Various	See Ap, At, Af as applicable.
Lp, Lpk	Glaciolacustrine deposits	Glaciolacustrine plain	Silt, clay; locally may have sand cover up to 3 m thick; up to 2 m of organic silt, marl, or peat common at surface.	2-50	Generally flat but commonly with 25% or more of area occupied by thermokarst ponds or depressions 1 to 4 m below the general surface (Lpk).	Permafrost present throughout except in taliks beneath thermokarst ponds; 15 to 50% segregated ice by volume common; highly unstable when thawed; retrogressive-thaw flow slides and/or rotational slope failures (Cz) common where large streams are incised into glaciolacustrine sediments.
Lb		Glaciolacustrine blanket	As for Lp.	2-50	Gently to moderately sloping, conforming to slope of valley sides.	Same as Lb.
Lv		Glaciolacustrine veneer	As for Lp.	0-2	Thin layer conforming to surface of subjacent unit (commonly Mb).	Permafrost common; ice content variable.
Gp	Glaciofluvial deposits	Glaciofluvial plain	Sand, gravel; typically with 20 to 100 cm-thick veneer of eolian silt or fine grained sand.	2-50	Generally flat, commonly with shallow anastomosing channels (Gp-C).	Permafrost not common but where present the deposits are mostly thaw stable; constitute main source of aggregate for construction purposes; good drainage and soil stability make the units suitable for location of most types of facilities; areas of Gp, Gt are preferred for airstrips or other installations requiring large areas of well drained level terrain; generally high permeability permits use of septic disposal systems.
Gt		Glaciofluvial terrace	Gravel, sand.	2-20	As Gp, but in terrace position adjacent to a major stream.	
Gh, Gr		Hummocky or ridged glaciofluvial deposits	Gravel, sand.	2-50	Hummocky (including kames) or ridged (including eskers and esker complexes).	
Gx		Glaciofluvial complex; combinations of Gp, Gh, Gr, and Gt.	Gravel, sand.	2-50	Various; includes areas that would be classsed as Gp or Gt except for presence of kettles.	
Mp	Morainic deposits	Moraine plain	Glacial till consisting of pebbles, cobbles, and boulders in a clayey silt to silty sand matrix.	2-30	Flat to gently sloping or undulant.	Occurrence of permafrost sporadic; prevalent on most northerly facing slopes, less common on southerly facing slopes. Suitable for conventional cut-and-fill road construction where permafrost is absent or ground ice content low; high ground ice content may necessitate pad mode of construction on undisturbed surface.
Mb, Mb-C, Mb-v		Moraine blanket	As for Mp.	2-30	Gently to moderately sloping, conforming to topography of subjacent bedrock; commonly with subparallel ice-marginal channels (Mb-C) or with postglacial gullying (Mb-V).	
Mh, Mr		Hummocky or ridged moraine	Glacial till consisting of pebbles, cobbles, and boulders in silty sand matrix.	2-50	Hummocks and ridges with slopes to 30° and relief to 20 m (exceptionally 40 m) superposed on level to moderately steep surfaces. Mr locally includes levees of large mudflows formed during early retreat stage of McConnell Glaciation, where lateral moraines formed embankments on steep slopes.	Few data on distribution of permafrost; vegetation cover suggests general absence of permafrost or presence of unusually thick active layer; locally affords suitable road location sites and constitutes source of well drained common fill; potential for large mudflows of type described under "Landform" is judged to be very low.
Mm		Rolling moraine	Glacial till consisting of pebbles, cobbles, and boulders in a clayey silt to silty sand matrix; up to 2 m silt and/or organic deposits common in depressions.	5-50	Broad hummocks 10 to 30 m high and 100 to 300 m across; slopes to 12°.	Permafrost widespread; few data on ground ice conditions in unit within study area but similar terrain elsewhere in Yukon Territory has irregularly shaped and irregularly distributed bodies of segregated ice.
Md		Drumlinoid till plain	As for Mp.	5-50	Till plain with individual drumlins and/or distinct glacial fluting; organic silt and/or peat common between drumlins or in troughs of flutings.	Occurrence of permafrost sporadic; commonly drumlins and elevated part of flutings are permafrost free or have a thick active layer, whereas depressions between are perennially frozen; construction of roads, airstrips, etc. in general is much easier parallel to rather than across the grain of the topography.
Mv, Mv-C		Moraine veneer	As for Mp.	0-2	Gently to highly irregular, conforming to irregularities of subjacent bedrock; locally has subparallel ice-marginal channels which typically are incised to or into bedrock (Mv-C).	Occurrence of permafrost sporadic; engineering capabilities and limitations determined in part by lithology and topography of subjacent bedrock.
Cb	Colluvial deposits	Colluvial blanket	Any of the deposits described above, plus bedrock detritus, modified and/or intermixed as a result of downslope movement of material; texture ranges from coarse blocky bedrock detritus of mountain tops to clayey or silty diamicton of lower slopes; locally includes talus and/or mudflow deposits.	2-30	Gently to moderately sloping, conforming to topography of subjacent bedrock; periglacial features, including small solifluction lobes, sorted polygons, and felsenmeer are conspicuous and widespread above treeline (1280 to 1370 m; 4200 to 4500 ft.).	Occurrence of permafrost sporadic; prevalent on most northerly facing slopes and on high plateau and mountain surfaces, less common on southerly facing slopes; other properties variable, depending on constituent materials.
Cv		Colluvial veneer	As for Cb.	0-2	As for Cb.	As for Cb.
Cz		Landslides, rockslides	Landslides mainly along scarps developed in glaciolacustrine sediments; rockslides in various rock types.		Landslides typically exhibit multiple arcuate steps resulting from multiple rotational failures; rockslides exhibit usual variety of forms.	Landslides developed in glaciolacustrine deposits (with or without overlying glaciofluvial deposits) are subject to reactivation if disturbed and should be avoided; rockslide potential is dependent on bedrock lithology and structure; detailed evaluation is warranted prior to construction on or near steep mountain slopes.

* The most commonly occurring units are shown above; for others, refer to Explanation of Map Unit Designations.