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PRELIMINARY GEOLOGIC MAP OF THE MCGRATH C-1 QUADRANGLE, ALASKA

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EXPLANATION OF MAP UNITS,SYMBOLS AND GEOLOGY
MCGRATH C-1 QUADRANGLE

DESCRIPTION OF MAP UNITS

QUATERNARY UNITS

Qu UNDIFFERENTIATED QUATERNARY DEPOSITS. Surficial deposits of complex or incompletely understood origin, which mask underlying bedrock, but do not have adequate exposures or morphologic characteristics to infer internal composition. This unit may contain any of the Quaternary units identified more specifically below.

ALLUVIAL DEPOSITS

Qa STREAM ALLUVIUM UNDIFFERENTIATED. Fluvially derived silt, sand and gravel of floodplains, terraces and fans. Grain size, degree of sorting and stratification vary according to stream size, flow regimen and the source of bedload material. Alluvium thickness varies from a few feet in some rapidly downcutting stream floodplains to several tens of feet in alluvial fans and plains on piedmont slopes.

Qaf ALLUVIAL FAN DEPOSITS. Poorly- to moderately-sorted alluvial silt, sand and gravel occurring as deltoid fans where tributaries join higher order streams, or as extensive piedmont aprons flanking foot hills north of the Farewell-Denali fault system. These deposits include numerous gravel and sand intervals that should provide plentiful materials sources for future construction activities in the area. Fan accumulations in mountain trunk valleys are generally poorly sorted, with material tending to be coarse, bouldery and more angular than piedmont materials that have been transported considerably farther from their source and contain a larger percentage of fine grained components

Qat ALLUVIAL TERRACE DEPOSITS Fluvially derived silt, sand and gravel deposited on former flood plains which now lie above and/or beyond the normal depositional regime of the modern stream. Fluvial sediments in terraces generally resemble those of Qa and Qaf, with the possible exceptions that in older terrace deposits weathering and downward percolation may have added to the silt and clay size fraction. Cementation may have occurred or may be occurring, and permafrost may have developed.

Qca MIXED COLLUVIAL AND ALLUVIAL DEPOSITS. Mixed or alternating,poorly- to moderately-sorted silt sand gravel and diamicton of colluvial and fluvial origin. Deposits commonly contain alternating stratified and unstratified zones or lenses. Colluvial-alluvial fans generally are most active in early to late spring during breakup when intense freeze-thaw cycles and large quantities of melt water are present. Colluvial-alluvial apron deposits flanking the mountains and foothills on the north near the Farewell Fault and extending somewhat onto the piedmont have a relatively higher percentage of fine-grained (silt sized) material than small steep fans issuing from short tributaries and chutes flanking mountain valleys.

COLLUVIAL DEPOSITS

Qc COLLUVIUM UNDIFFERENTIATED. Usually unconsolidated and unsorted deposits (although sorting may in some cases be inherited from parent material) derived primarily from mass wasting processes. Includes primary products of bedrock weathering and erosion as well as retransported surficial deposits. Colluvium is very widespread in this Quadrangle but is mapped only where an appreciable thickness obscures or masks bedrock lithologies and structures .

Qct TALUS. Angular bedrock debris derived from frost riving followed by rapid gravity transport on steep slopes, cirque headwalls, and in steep gullies and avalanche chutes. Forms cones or aprons lying at or near the angle of repose along valley walls. Distal ends of cones and aprons are sometimes transitional into rock glaciers.

Qcl LANDSLIDE DEPOSITS. Chaotically deformed deposits derived from relatively sudden mass movement of bedrock or surficial deposits along a plane(s) of failure. Surfaces of Qcl deposits are characteristically hummocky and commonly lie below a well defined failure scarp. Recent landslide failiars display surface features such as randomly tilted trees, ripped vegetation mats and closed depressions which sometimes contain standing water

EOLIAN DEPOSITS

Qe EOLIAN DEPOSITS Well sorted sand and silt transported by and deposited by wind. Mapped in this Quadrangle only in the vicinity of cliff heads and bluffs where exceptional thicknesses occur. A widespread holocene tephra layer whose age is roughly bracketed to be about 1,800 yr. occurs in loess exposed in cutbanks at several localities in this and adjacent quadrangles.

GLACIAL AND RELATED DEPOSITS

Qrg ROCK GLACIERS AND ROCK GLACIER DEPOSITS. Very coarse-grained deposits of unsorted, angular, frost shattered material derived from former ablation moraine or talus. Active rock glaciers contain interstitial ice allowing them to move or flow by internal deformation. Sand and smaller grain sizes, are scarce or absent near the surface, but become more prevalent a few feet below the surface. Two basic forms occur in the map area and readily fall into the classification defined by Warhaftig and Cox (1959). Lobate forms tend to form at distal ends of extensive talus accumulations along valley walls and move toward the valley axis. Tongue shaped forms which occur in cirques and valleys formerly occupied by ice glaciers tend to flow in a down valley direction. All rock glaciers mapped in this Quadrangle are probably of Holocene age because they cross-cut or overlie drift of inferred late Wisconsin age.

Qd UNDIFFERENTIATED QUATERNARY GLACIAL DEPOSITS. Stratified and unstratified drift. May include till, outwash, ice-contact, and glaciolacustrine sediments. Deposits of glacial origin may be mantled by subsequent accumulations of eolian and organic material from 1-30 ft. thick, especially on piedmont slopes.

Qd' THIN DRIFT OVER BEDROCK. Patchy or very thin drift as defined above, lying on bedrock. The presence of this unit where mapped indicates former glacial limits and may be important in evaluating geochemical soil samples.

Qdt TILL. Diamicton deposited directly by glacial ice. Characteristically unsorted to poorly sorted composed of varying amounts of clay, silt, sand, gravel and boulders. Cobble and boulder size clasts commonly polyhedrally faceted and striated, sub-angular to sub-rounded. Till mapped in this Quadrangle ranges in age from pre-Wisconsin to Holocene based upon relationships to radiocarbon dated units in adjacent quadrangles as well as surface morphology, relative extents, degree of surface weathering and stratigraphic relationships in stream cuts.

Qdo OUTWASH. Glaciofluvial sand and gravel derived from streams originating at or near former or present-day glacier margins. Anastomosing channel scars appear on many outwash surfaces which otherwise have little or no surface relief. Deposits tend to be graded to former terminal and lateral ice marginal positions. Materials deposited close to ice margins tend to be coarser and have generally poorer sorting than materials which have undergone longer transport by meltwater. Distal portions of some outwash deposits lose their identity as they interfinger with alluvium from other sources.

Qdic ICE CONTACT STRATIFIED DRIFT Gravel, sand and flow till deposited on, against or under stagnant masses of glacial ice by meltwater streams Individual layers within the deposit have extremely variable lateral extent, degree of sorting and thickness. Extreme surface relief is a common morphologic characteristic of this type of deposit, with kame and kettle topography and kame terraces being the most conspicuous features noted in this quadrangle.

Qdac ABANDONED GLACIAL MELTWATER CHANNEL DEPOSITS Generally isolated deposits of poorly- to moderately- sorted coarse grained gravel of limited thickness. Channels represent the course of former temporary streams of glacial meltwater where due to blockage of previously established drainage courses by ice or morainal dams they have escaped by breaching bedrock divides or barriers composed of surficial materials .

uTg TILL AND OUTWASH OF LATE TERTIARY OR EARLY QUATERNARY AGE
Unconsolidated to weakly cemented diamicton possibly interbedded with crudely stratified outwash containing lithologies exotic to bedrock in the McGrath C-1 Quadrangle as well as local lithologies. Facets and striations indicative of glacial transport are present on some cobble and boulder clasts. Although the outcrop is weathered some crude stratification appears both at the outcrop and in aerial photographs to dip parallel to underlying Tertiary coal bearing rocks. It is unclear whether or not their contact is conformable.

TERTIARY COAL-BEARING SEDIMENTS

Ts TERTIARY COAL-BEARING SANDSTONE, SHALE AND CONGLOMERATE
Thin- to thick-bedded, indurated, grey to tan sandstone, shale and conglomerate. Locally brick red due to baking from coal seam ignition. Contains abundant terrestrial plant fossils. This unit is continuous with coal bearing sediments outcropping along the little Tonzona River just outside the quadrangle boundary, and is considered to be part of a discontinuous string of fault bounded Tertiary basins that occur along the north and northwest flanks of the Alaska Range.

BEDDED ROCK UNITS OF THE MCKINLEY AND PINGSTON TERRANES OF JONES AND OTHERS (1983).

KJs SLATE. Very thin-bedded, fissile, rusty brown-weathering, black slate, shale, siltstone, and very fine-grained micaceous brown sandstone; with very rare silty limestone turbidites Minor quartz veinlets usually parallel cleavage. Age based on radiolaria and megafossils in probable correlative rocks in the Talkeetna C-6 Quadrangle, (Reed and Nelson, 1980; Jones and others, 1983).

TRls LIMESTONE AND SHALE. Thin-bedded medium grey quartzitic limestone, grey silty limestone, and grey shale. Basal beds are predominantly fine-grained grey sandstone and siltstone with subordinate cherty limestone containing clasts of black chert. Commonly cut by quartz veins and veinlets. Late Triassic age indicated by conodonts collected just east of the quadrangle boundary (Jones and others, 1983).

TRs PHYLLITIC SHALE SANDSTONE AND CHERT. Buff to orange weathering phyllitic shale, sandstone, white green and black chert and minor limestone. Interbedded with and overlying Trb. Late Triassic age inferred from Monotis sp. found in this unit near the eastern quadrangle boundary (Jones and others, 1983).

TRb PILLOW BASALT AND GABBRO. Dark green pillow basalt; locally includes gabbro sills and dikes and beds of Trs too small to map separately. Late Triassic age inferred from Monotis sp. reported by Jones and others (1983) from Trs interbed, fossil locality 6 on map.

Pc PHYLLITIC CHERT. White-weathering gray green banded phyllitic chert and siliceous phyllite. Probably in part correlative with uPzsc. Pennsylvanian? though Permian age indicated by radiolaria identified from a locality in the central portion of the quadrangle.[b] Unit occurs as a persistant narrow belt in the central portion of the quadrangle and tracks with TRs and TRb along a fault bounded contact to the south and with KJs along an apparent depositional contact to the north.

Pzsc CHERT AND SILICEOUS PHYLLITE. White-weathering, tan, grey, grey-green and black chert, with subordinate maroon and dark grey phyllite. Commonly pyritic and cut by quartz veins and veinlets. Just east of the quadrangle boundary Mississippian thru Permian radiolaria and conodonts have been collected from this unit at several localities, (Jones and others 1983). Probably in part correlative with Pc. In some localities near the eastern quadrangle boundary it appears that TRls depositionally overlies uPzsc.

Pzs PHYLLITE. Similar to uPzsc however dark grey phyllite predominates. Pyritic in places. Cut by quartz veins and veinlets. Stratigraphic relationships imply that this unit underlies and is transitional upward into uPzsc.

BEDDED ROCKS OF THE DILLINGER-MYSTIC SEQUENCE

DSls LIMESTONE AND SANDSTONE Very thin- to thick-bedded laminated grey silty limestone and orange to brown weathering grey sandstone. Tentatively correlated with DSls of Bundtzen and others, (1983), but possibly part of Ssa. Silurian conodonts reported by Armstrong and others (1977) from one locality in limestone on the north side of Dillinger River.(fossil locality 6.)

Ss CALC-SANDSTONE. Very thin-to very thick-bedded, buff-to orange-weathering grey to olive-green calc sandstone and siltstone . Commonly displays turbidite sedimentary structures and paleocurrent indicators. No fossils known from this unit in the McGrath C-1 quadrangle, but lithologically correlative with mSa, mSs, mSl, uSl, Ss, and uSsl of Bundtzen and others (1982). ls. Thin to very thick bedded medium-gray-weathering, dark grey laminated limestone, mappable as conspicuous interbeds

SOsh BLACK SHALE AND ARGILLITE. Dark grey to black shale, argillite, siltstone and very fine-grained sandstone; with discontinuous intervals of siliceous argillite and chert, (designated SOsc where mappable). Pyritic in places. Graptolites from fossil localities 1,2,and3 (map and table 1) indicate a middle Ordovician age, but in McGrath B-3 Quadrangle Lower Ordovician through Lower Silurian graptolites have been identified from horizons of this unit (Bundtzen and others 1982).

INTRUSIVE IGNEOUS ROCKS LYING NORTH OF THE FAREWELL FAULT

Tif FELSIC INTRUSIONS. Aphanitic to sub-phanaritic felsic plugs occurring in the northeastern portion of the Quadrangle. Mafic minerals are rare or absent and when they occur consist of biotite and hornblende.

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[b] Radiolaria identified by Katherine Reed, U.S. Geological Survey, Anchorage, Alaska.

KJg GABBRO. Buff weathering dark green and grey gabbro. Age based on intrusive and stratigraphic relationships.

INTRUSIVE IGNEOUS ROCKS LYING SOUTH OF THE FAREWELL FAULT ZONE

Tid DIKES. Mafic, intermediate and felsic dikes or swarm of dikes tentatively correlated with early or mid Tertiary to the east mapped by Bundtzen and others.

Td DIORITE. Phanaritic diorite intrusion.

Tg GRANITIC ROCKS. Felsic igneous intrusion.

INTRODUCTION

Prior to 1977 reconnaissance level geologic investigations in the region were performed by various workers (Capps, 1935 ; Fernald, 1960; Armstrong, 1967; Herreid, 1967; Reed and Elliot, 1968;

This geologic map is one of a series of reports summarizing resource investigations performed by the Alaska Division of Geological and Geophysical Surveys during 1977-1984. In addition to geologic maps (Gilbert, 1981; Bundtzen and others, 1982; Gilbert and others, 1982; Gilbert and Solie 1983; Bundtzen and others, 1985; Bundtzen and others, in press; Gilbert and others, 1984a;), previous reports connected with the DGGS effort in the area have discussed geochemical, intrusive,stratigraphic and tectonic relationships in the Area (Potter and others, 1980; ; Gilbert and Bundtzen, 1983a; Gilbert and Bundtzen, 1983b; Kline, and Bundtzen, , 1986; Kline, 1983; Solie, 1983; Solie and others, 1982).

The McGrath C-1 Quadrangle contains lithologic units characteristic of the Cambrian to Jurassic Dillinger-Mystic sequence of Gilbert and Bundtzen,1983, the upper Paleozoic to upper Triassic sedimentary and volcanic rocks of the Pingston and Mckinley Terranes of Jones and others, 1983, Tertiary continental clastic and coal bearing sediments, and small felsic plutons of probable Tertiary age.

QUATERNARY GEOLOGY

Extensive glacial, fluvial, colluvial and eolian agents are responsible for a variety of surficial deposits which cover more than half of the map area.Several Quaternary and one or more possible late Tertiary episodes of glaciation are inferred from extensive drift deposits and erosional landforms.

Fluvially sorted deposits are most favorable sources of sand and gravel for construction and engineering purposes. These include, modern stream alluvium-(Qa), terrace alluvium-(Qat) glacial outwash-(Qdo), and to a somewhat lesser degree alluvial fan deposits. The latter tend to have a lesser degree of sorting, especially in steeper mountain valley fans.

Both active and inactive Holocene rock glaciers are common throughout the mountainous portions of the map area indicating that an environment for the

development and 'maintenance of permafrost exists down to elevations as low as the floodplane of the Dillinger River, and that conditions have existed for the production of large amounts of talus.

The northwest portion of the map area is covered by a complex of mid-to late Quaternary interlobate moraines and intervening outwash. Relative ages of some of these moraines are shown.

Vertical offsets of several meters occur in Quaternary deposits along segments of the Denali-Farewell fault in the area.

TERRANES

Recent studies in the central Alaska Range have identified as many as nine tectonostratigraphic terranes, three of which are present in the McGrath C-1 Quadrangle, (Jones and others, 1982, 1983). Here, Northwest of the Denali-Farewell fault, units Trs, Trb and possibly KJs are part of the McKinley terrane, and units uPzsc, uPzs and Trl are part of the Pingston terrane. Crystalline basement of the Yukon-Tanana terrane occurs just east of the Quadrangle boundary, (Jones and others 1983).

Gilbert and Bundtzen (1983) have suggested that rocks of the Yukon-Tanana, Pingston and McKinley terranes originated at different positions along a common continental margin defined by the Yukon-Tanana block. This interpretation is reinforced by observations mad during geologic mapping in the McGrath C-1 and adjacent Quadrangles, where KJs stratigraphically overlies Trb and Trs, and both Trl (Pingston) and KJs (McKinley) stratigraphically overlie upper Paleozoic volcanogenic phyllite and chert sequences (uPzs and uPzsc in this report), that are thought to represent a distal manifestation of late Paleozoic volcanism on the Yukon-Tanana block.

Southeast of the Farewell-Denali fault in the McGrath Quadrangle, Paleozoic strata (DSls, Ss, SOsh, this report) are part of the Dillinger terrane of Jones and others (1982) and the Dillinger-Mystic sequence of Gilbert and Bundtzen (1984). At present there is no evident stratigraphic connection between this succession and terranes thought to be associated with the Yukon-Tanana block.

STRUCTURE

The structure of the McGrath C-1 Quadrangle is dominated by subisoclinal to isoclinal folding of pre-Cenozoic rocks, and both strike-slip and dip-slip displacement of the Farewell-Denali fault system. Folds in Paleozoic units southeast of the Farewell-Denali fault generally verge northwest, whereas in units northwest of the fault, axial surfaces in bedrock are commonly near vertical.

In the McGrath C-1 Quadrangle the Farewell-Denali fault system is composed of several major high angle faults that trend approximately northeast across it's center The Farewell-Denali fault juxtaposes the terranes of the Yukon-Tanana block to the northwest with the Dillinger-Mystic succession to the southeast. Northwest of this boundary two major high angle faults juxtapose contrasting portions of the Pingston and McKinley terranes Additional high angle faults are present in the foot hills of the

Alaska Range and display holocene apparent vertical displacements from a few to several tens of meters.

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Table 1. FOSSIL IDENTIFICATION FROM McGRATH C-1 QUADRANGLE

MAP NO. (Field no.)	DESCRIPTION
1 (83 BT 137a)	Graptolites from shale interbedded with radiolarian chert (SOsh). *Dicellograptus* cf. *D. Divericatus salipiensis* Ellis and Wood, *Dicellograptus* sp., *Nemagraptus gracillus* (Hall), ?*Apoglossograptus lyra* (Ruedemann) Climagraptus riddellensis(Harris), *Climagraptus* sp. Age: Dicellograptus zone; Llanvernian (mid-Lower Ordovician)[a]
2 (83 WG 41)	Graptolites from black argillite (SOsh) on ridge crest. Amplexograptus? cf. *A. fallax* (Bulman), other biserial forms too poorly preserved to be identified. No diagnostic forms present but probably mid-Ordovician.[a]
3 (83 WG 42)	Graptolites from black argillite (SOsh) on ridge crest. Very poor preservation. *Dicellograptus* cf. *D. divericatus salopensis* Ellis and Wood, *Dicranograptus* sp., *Climacograptus*? sp., *Glyptograptus* sp., *Orthograptus*? sp. cf. *O. calcaratus* senso lato. Approximately *Climacograptus bicornus* zone; mid-Ordovician.[a]
4 (83 JK 64)	Radiolaria from tan green and dark grey semi-phyllitic banded chert (uPzsc) north of Farewell fault. Pennsylvanian? and probable Permian forms identified.[b]

[a] Identified by Claire Carter, U.S. Geological Survey, Menlo Park, California.
[b] Identified by Katherine Reed, U.S. Geological Survey, Anchorage, Alaska.