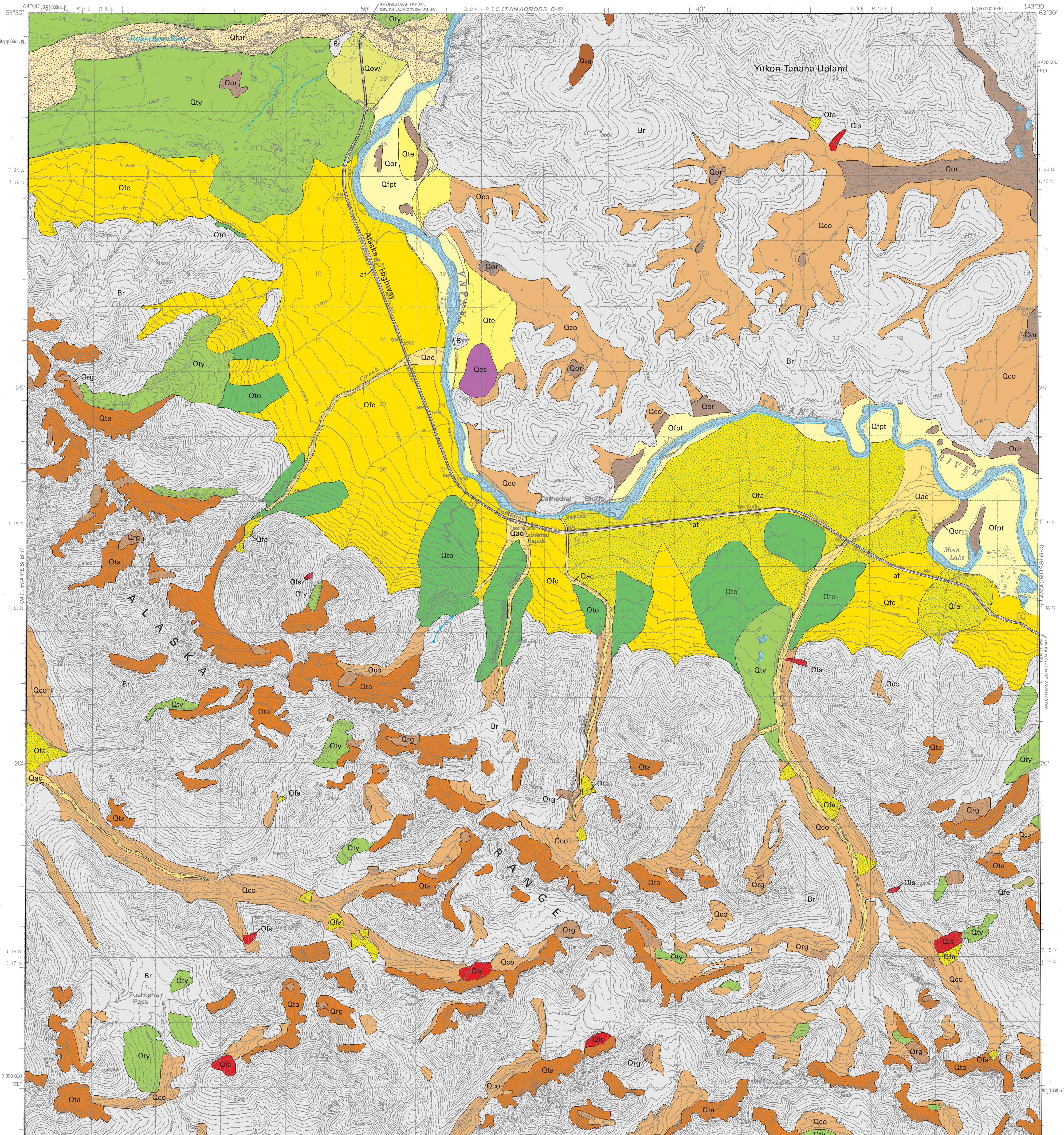
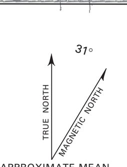
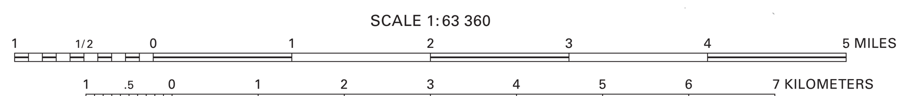
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



Base from U.S. Geological Survey, 1949; minor revisions 1970
Universal Transverse Mercator projection
10,000-foot grid based on Alaska coordinate system, zone 2
1000-meter Universal Transverse Mercator grid ticks, zone 7
1927 North American Datum



SCALE 1:63 360



CONTOUR INTERVAL 100 FEET
DOTTED LINES REPRESENT 50-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

QUADRANGLE LOCATION

Geology mapped by P.E. Carrara 2001 and 2002; assisted in field by F.R. Weber in 2001 and F.R. Weber and J.S. Honke in 2002
Digital database prepared by Scott Snyders and Kenzie Turner
Editing and digital cartography by Alessandro J. Donatich, Central Publications Group
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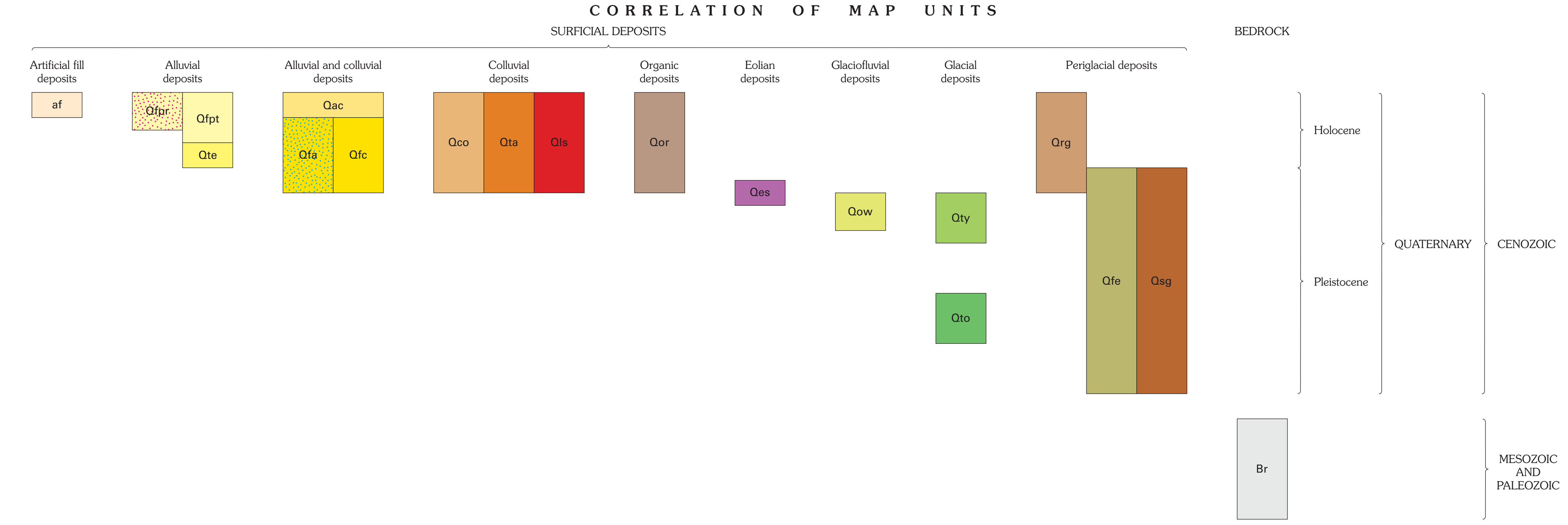
SURFICIAL GEOLOGIC MAP OF THE TANACROSS B-6 QUADRANGLE, EAST-CENTRAL ALASKA

By
Paul E. Carrara
2004

125 years of science for America 1879–2004

CORRELATION OF MAP UNITS



INTRODUCTION

The Tanacross B-6 quadrangle contains parts of three physiographic provinces—the Alaska Range, the Yukon-Tanana Upland, and the Northway-Tanana Lowland (Wahrhaftig, 1965). The high, rugged, glaciated landscape of the eastern Alaska Range dominates the southern and western areas of the map. Within the map area, about 20 peaks rise to more than 2,000 m asl (above sea level). The highest peak, an unnamed summit at the head of Cathedral Rapids Creek No. 2, rises to 2,166 m asl. In contrast, the gently rolling hills of the Yukon-Tanana Upland, in the northeastern map area, rise to only about 1,000 m asl. Between the Alaska Range and the Yukon-Tanana Upland lies the Northway-Tanana Lowland (hereafter referred to as the upper Tanana valley), which contains the northwesterly flowing Tanana River. Altitudes along the floor of the lowland generally range between 450 and 490 m asl.

The climate of the map area is typical of that of the Alaskan interior. Winters are long and cold, summers are short and generally mild, and precipitation is light. Climate records from the town of Tok, in the upper Tanana valley along the Alaska Highway about 40 km to the east of the central map area, indicate a mean January temperature of –26.4°C and a mean July temperature of 14.5°C. Mean annual precipitation at Tok is 23.5 cm with almost 60 percent occurring during the summer months (June, July, August) (Western Regional Climate Center, unpublished data accessed Dec. 1, 2003, on the World Wide Web at URL http://www.wrcc.dri.edu/index.html).

The lower regions of the map area are colonized by boreal forest and muskeg that in many areas reflect the underlying geology. The boreal forest consists primarily of black spruce (*Picea mariana*), white spruce (*Picea glauca*), balsam poplar (*Populus balsamifera*), and quaking aspen (*Populus tremuloides*). Black spruce is characteristic of cold, poorly drained, nutrient-poor sites where it commonly grows as small, stunted trees 3–5 m high (Johnson and others, 1995). Well-drained, moist sites are commonly inhabited by white spruce, 10–20 m in height, balsam poplar, and quaking aspen along with some black spruce, which can obtain heights of about 10 m in these locations. Timberline, the upper altitudinal limit of large, upright trees, is generally about 850 m asl, above which alpine tundra and rocky slopes dominate. Muskegs, commonly containing *Sphagnum* mosses and heath shrubs, are characterized by areas of poor drainage and high water table and may contain permafrost at shallow depths. Black spruce may be present in the muskegs and will commonly form open-canopied stands of low, stunted trees (Johnson and others, 1995).

The Alaska Highway (originally called the Alcan Highway) generally lies to the south and west of the Tanana River, following it through the Tanacross B-6 quadrangle for about 29 km. Stretching for 2,290 km from Dawson Creek in British Columbia to Delta Junction in Alaska, the highway traverses rugged mountains, raging rivers, and seemingly endless forest and muskegs. Remarkably, the U.S. Army Corps of Engineers built the highway in just 8 months and 12 days in 1942 (Cohen, 2001) as an overland route to relieve Alaska from the wartime hazards of shipping; the highway was then turned over to civilian contractors for improvements (widening, graveling, and rerouting in many areas). Paving was completed in about 1984. Today, the Alaska Highway is one of the primary transportation corridors in Alaska carrying both freight and passengers. Although there are no permanent settlements in the Tanacross B-6 quadrangle, scattered homes occur throughout the map area, usually within a short distance of the Alaska Highway.

Permafrost (permanently frozen ground) is common throughout the map area, especially in highly organic deposits (Qor) within the upper Tanana valley and fine-grained sediments (Qco) in the Yukon-Tanana Upland, where permafrost is common at depths below 50 cm. At many localities the presence of permafrost is indicated by stunted black spruce. Above tree line in the Alaska Range the presence of permafrost is indicated by collapse pits in till and rock glaciers caused by the melting of underlying ice. Man-made structures can be disrupted and damaged by the melting of underlying permafrost. Hence, care should be taken when building in permafrost areas.

The Alaska Range was heavily glaciated during the Pleistocene (Péwé, 1975). In the Tanacross B-6 quadrangle, Holmes (1965) recognized deposits of two glaciations in the valleys of the Alaska Range. The older glaciation (Delta) was named by Péwé (1953) for a pair of prominent end moraines in the Fort Greeley and Delta Junction area about 160 km to the west-northwest of the map area. In the map area, deposits of this glaciation extend beyond the mouths of valleys in the Alaska Range (Robertson River, Cathedral Rapids Creeks Nos. 1 and 2, and Sheep and Yerrick Creeks) out onto the floor of the upper Tanana valley, where they commonly form hummocky end moraines. The younger glaciation (Donnelly) was also named by Péwé (1953) for a large moraine near Donnelly Dome south of Delta Junction. Glaciers of the Donnelly glaciation were less extensive than those of the Delta glaciation. In the map area, only glaciers in the larger valleys of the Alaska Range (Robertson River and Yerrick Creek) extended out onto the floor of the upper Tanana valley during the Donnelly glaciation. Glaciers in the smaller valleys in the map area were confined to their respective mountain valleys. Further information is given in the unit descriptions of these glacial deposits.

Glaciation does not seem to have occurred during the Holocene in the Tanacross B-6 quadrangle. In many areas of the world, the most extensive advance of glaciers during the Holocene occurred during the "Little Ice Age" (about the 15th to the mid-19th century) (Bradley, 1985). Glacial deposits of the Little Ice Age are commonly found fronting present-day glaciers and snowfields in mountainous regions. Sharp-crested, rubbly moraines as much as 50 m or more in height that rest at the angle of repose, lack soils, and are generally devoid of vegetation typify Little Ice Age moraines. Hence, these deposits are readily recognized on aerial photographs and in the field. Although a small glacier or perennial snowfield is depicted on the topographic base along the crest of the Alaska Range in the south-central map area, no obvious Little Ice Age glacial deposits are present in this area. In fact this ice body is not present on either 1:46,000-scale black and white aerial photographs of August 1954 or 1:63,000-scale color infrared aerial photographs of July 1978. The depiction of this ice body on the topographic base appears to be a mistake and the area is actually occupied by a rock glacier.

Mapping of the surficial deposits in the Tanacross B-6 quadrangle was accomplished by a variety of methods including (1) compilation from existing geologic maps, (2) stereoscopic analysis of 1:46,000-scale 1954 black and white and 1:63,000-scale 1978 color-infrared aerial photographs, and (3) fieldwork, including field traverses and a helicopter visit. Where accessed in the field, detailed information was obtained on the surficial deposits. Some areas were then extrapolated to the less accessible areas. Some areas within the map were not observed directly; however, many of these areas were observed from a helicopter and, of course, on aerial photographs. Such areas include much of the map area south of the crest of the Alaska Range and much of the map area north of the Tanana River. Unit boundaries were plotted on a stable mylar topographic base with the use of a photogrammetric stereo plotting instrument (Kern PG-2). Lines were digitized on screen from the scanned mylar.

Surficial deposits in the Tanacross B-6 quadrangle consist of artificial fill, alluvial, colluvial, organic, eolian, glaciofluvial, glacial, and periglacial deposits. Deposits shown on this map are generally greater than 1 m thick. Thinner, discontinuous colluvial and eolian deposits, residual material on bedrock, and some artificial fill were not mapped and are simply incorporated with the underlying mapped unit. For instance, in many areas a mantle of light-yellowish-brown (10YR 6/2) loess, usually less than 25 cm thick, blankets the surface. Because of the thin, discontinuous nature of this material it could not be accurately mapped. Many contacts between map units are approximately located because of the poor exposures or gradational nature of the surficial deposits in the map area (for example, the contacts between bedrock (Br) and coalescing fan deposits (Qfc) along the north flank of the Alaska Range; and between undivided colluvium (Qco) and bedrock (Br) on steep slopes in both the Alaska Range and the Yukon-Tanana Upland).

Divisions of the Quaternary are modified from Hansen (1991) and Richmond and Fullerton (1986): Holocene, 0–10,000 yrs ago; late Pleistocene, 10,000–127,000 yrs ago; middle Pleistocene, 127,000–778,000 yrs ago; and early Pleistocene, 778,000–1,806,000 yrs ago (D.S. Fullerton, written commun., 1997). Age assignments for the surficial deposits are based chiefly on stratigraphic and depositional relations and the degree of erosional modification of the original surface morphology.

Grain-size terminology of the surficial deposits is based on visual estimate and follows the modified Wentworth grain scale (American Geological Institute, 1982). In descriptions of surficial deposits, the term "clast" refers to a particle greater than 2 mm in diameter, whereas the term "matrix" refers to particles less than 2 mm in size.

The dry matrix colors of the surficial deposits in the map area were determined by comparison with a Munsell Soil Color Chart (Munsell Color, 1973).

DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

Artificial fill deposits

af — **Artificial fill (latest Holocene)**—Compacted and uncompacted fill mapped only beneath the Alaska Highway. Mainly subrounded and rounded, pebble- and cobble-size clasts derived from local alluvial deposits and angular basaltic rock fragments, all in a pale-brown to light-yellowish-brown (10YR 6/3 to 6/4) silty sand to sand matrix. In places unit may be susceptible to failure by liquefaction and slumping of underlying material during seismic events. Such liquefaction and slumping occurred along the Glenn Highway between Slana and Mentasta Pass (south of map area), resulting in severe damage, during the magnitude 7.9 earthquake of November 3, 2002 along the nearby Denali fault (Harp and others, 2003). Thickness of unit ranges from about 1 m to as much as 10 m in areas of permafrost and muskeg along eastern border of map area

Alluvial deposits

Qfpr — **Floodplain alluvium of Robertson River (late Holocene)**—Mainly poorly stratified to well-stratified, well-sorted, clast-supported, pebble and cobbly pebble gravel deposited along floodplain of Robertson River. Clasts are mainly subrounded to rounded quartzite, biotite gneiss and schist, and granitic rocks, the largest about 50 cm in diameter. Matrix is gray (5Y 6/1), medium sand. Unit contains lenses of pebbly sand 5–20 cm thick. Locally overlain by as much as 50 cm of light-olive-gray (5Y 6/2), well-sorted, fine and medium sand. Forms a relatively flat (commonly less than 1 m of relief), unvegetated area of gravel as much as 1 km wide. Area underlain by unit is subject to periodic flooding. Exposed thickness about 6 m; base not exposed, estimated maximum thickness 20 m

Qfpt — **Floodplain alluvium of Tanana River (late Holocene)**—Floodplain deposits of Tanana River, including those in recently abandoned channels and winding sloughs. Upper 1–2 m of unit, commonly an overbank deposit, consists of dark-olive-gray (5Y 3/2), well-sorted, massive, fine sand that locally contains minor amounts of pebbles. Poorly exposed lower part of unit consists of unstratified to stratified, well-sorted sand, pebbly sand, and sandy cobbly pebble gravel. Clasts are chiefly subrounded to rounded. Unit locally includes colluvium (Qco) and organic (Qor) deposits and alluvium underlying low terraces along river. Areas underlain by this unit have a high water table and are subject to periodic flooding and possible liquefaction during seismic events. Harp and others (2003) observed that nearly every bar in the area along the Tanana River showed extensive liquefaction effects from the November 3, 2002 earthquake. Exposed thickness about 2 m; base not exposed, estimated maximum thickness 20 m

Qte — **Terrace alluvium of Tanana River (Holocene)**—Poorly exposed, well-sorted, rounded to well-rounded, cobbly pebble gravel deposited by Tanana River. Gravel commonly overlain by 1 m of overbank material consisting of massive, light-yellowish-brown (10YR 6/4) silty fine sand and fine sand. Unit underlies several terrace remnants about 5–10 m above river in north-central map area. Unit is a potential gravel resource. Thickness commonly 5–10 m

Alluvial and colluvial deposits

Qac — **Active channels and alluvium and debris flow deposits of streams from Alaska Range (late Holocene)**—Active channels and alluvium and debris flow deposits of streams emerging from Alaska Range (Sheep, Yerrick, and Cathedral Rapids Creeks Nos. 1 and 2). Contains point bar deposits 50–100 cm in height consisting of subrounded cobbles and boulders and containing lenses of sandy pebble gravel 10–50 cm thick. Clasts are mainly biotite gneiss and schist derived from the various drainages and deposited in part by flash floods and debris flows. The largest are about 1 m in diameter. Matrix is light-yellowish-brown (10YR 6/4) sand. Unit commonly forms a zone of unvegetated, cobbly boulder gravel as much as 100 m wide. Relief about 2 m. Areas underlain by unit are subject to floods and (or) debris flows. In August 1997, heavy rains in Alaska Range caused flooding along these stream channels, damaged the bridge abutment over Yerrick Creek, and closed the Alaska Highway. Exposed thickness about 2 m; base not exposed, estimated maximum thickness 10 m

Qfa — **Fan deposits of Alaska Range (Holocene and late Pleistocene)**—Fans deposited mainly by flowing water and debris flows along front and within valleys of Alaska Range. Unit consists mainly of an unstratified to poorly stratified, poorly sorted to well-sorted, clast-supported, cobbly pebble and pebbly cobble gravel with a pale-brown (10YR 6/3), silty sand matrix. Clasts are mainly biotite gneiss and schist. Also includes lenses of medium sand to coarse sand about 5 cm thick. Along front of Alaska Range, clasts are mainly subrounded to rounded pebbles and cobbles with a minor amount of boulders. Largest clasts are about 1 m in diameter. Within Alaska Range, clasts consist of angular to subangular cobbles and boulders. In places unit contains bouldery debris flow levees about 1 m high. Locally includes colluvium (Qco) and sheetwash alluvium. Unit is subject to both floods and debris flows. Exposed thickness about 10 m; estimated maximum thickness along front of Alaska Range 30 m

Qfc — **Coalescing fan deposits along front of Alaska Range (Holocene and late Pleistocene)**—Large coalescing fans deposited mainly by flowing water and debris flows along front of Alaska Range. Unit consists of mainly unstratified to poorly stratified, poorly sorted to well-sorted, clast-supported, cobbly pebble and pebbly cobble gravel with a light-olive-brown (2.5Y 5/4) to pale-brown (10YR 6/3), silty sand and sand matrix. Clasts are mainly biotite gneiss and schist. Clasts are mainly subrounded to subangular and consist of subangular to subrounded cobbles and boulders; the largest are about 1 m in diameter. In places unit contains bouldery debris flow levees about 1 m high. Locally overlain by as much as 50 cm of massive, light-yellowish-brown (10YR 6/4) silt (loess?). Unit may locally include colluvium (Qco) and sheetwash alluvium. Unit is subject to both floods and debris flows. Exposed thickness about 6 m; estimated maximum thickness 30 m

Colluvial deposits

Qco — **Colluvium, undivided (Holocene and late Pleistocene)**—On valley walls and slopes within Alaska Range unit mainly consists of poorly stratified, poorly sorted, clast-supported, cobbly boulder gravel deposited mainly by mass-wasting processes. Clasts are angular to subrounded and generally consist of biotite gneiss and schist; the largest are about 1 m in intermediate diameter. Matrix is mainly a pale-brown (10YR 6/3) sand. In places unit contains bouldery debris flow levees about 1 m high. Unit includes undifferentiated rock avalanche, debris flow, and solifluction deposits as well as fan (Qfa), talus (Qta), younger glacial (Qty), and rock-glacier (Qrg) deposits too small to show at map scale. Hence, this unit is subject to a wide range of geologic hazards. May contain permafrost at shallow depths. Exposed thickness about 5 m; estimated maximum thickness 20 m. In the Yukon-Tanana Upland, unit is poorly exposed but appears to primarily consist of poorly sorted and poorly stratified, locally organic-rich silt, silty sand, and pebbly sand. Permafrost is common at depths below 50 cm. Maximum thickness of unit in northern map area estimated to be 10 m

Qta — **Talus deposits (Holocene and late Pleistocene)**—Poorly stratified, poorly sorted, angular rock fragments ranging in size from pebbles to large boulders deposited at base of steep slopes and cliffs in Alaska Range mainly by rockfall. Largest clasts are about 2 m in intermediate diameter. Limited exposures suggest unit may grade into finer material at depth. Locally contains bouldery debris flow levees. In some instances, toe of deposit is lobate indicating rock glacier-like flowage. Many boulders on surface of unit support an extensive lichen cover indicating they have been stable for at least the last several centuries. Upper reaches of unit rest at angle of repose and therefore are potentially unstable. Unit may locally include some alluvium and colluvium (Qco). Unit is prone to rockfall hazards from above slopes. Locally, unit may exceed 20 m in thickness

Qls — **Landslide deposits (Holocene and late Pleistocene)**—Mainly translational and flow types of movement have resulted in an array of landslide deposits including rock slides, rock avalanches, debris slides, and debris avalanches (Varnes, 1978). Unit consists of unconsolidated, heterogeneous mixture of surficial material and bedrock fragments in a wide range of sizes. In some deposits in Alaska Range boulders exceed 2 m in intermediate diameter. Size and lithology of clasts and matrix depend on the various bedrock and surficial deposits involved in landslide. Locally includes small alluvial and talus (Qta) deposits. Many of these landslide deposits may have been induced by seismic events. The magnitude 7.9 earthquake of November 3, 2002, is known to have triggered thousands of landslides in Alaska Range and surrounding areas (Harp and others, 2003) and may have triggered a small recent landslide near confluence of Tanana River and Porcupine Creek, about 52 km east of central map area, on Tanacross B-4 quadrangle. Maximum thickness estimated to be about 30 m

Organic deposits

Qor — **Organic-rich deposits (Holocene and late Pleistocene)**—Mainly black (10YR 2/1) to brown (10YR 4/3) peat, woody peat, muck, and organic-rich sand, silt, and clay. Unit occurs in low-lying areas adjacent to Tanana River, along drainages in Yukon-Tanana Upland, and in a bog underlain by Donnelly-age till (Qty) south of Robertson River in northern map area. Areas underlain by this unit have poor drainage and high water tables, are subject to periodic flooding, and may contain permafrost at shallow depths. Thickness 1–10 m

Eolian deposit

Qes — **Eolian sand (late Pleistocene)**—A single sheet-like deposit of olive-gray (5Y 4/2), fine- to medium-grained, eolian sand along east side of Tanana River derived from adjacent floodplain. A similarly derived eolian sand deposit along Tanana River near Tetlin Junction, about 60 km to the east, consists of 50 percent quartz, feldspar, and small fragments of granitic and metamorphic rocks, 35 percent dark-gray to black fine-grained volcanic rock fragments, which give the sand its dark color, and about 2 percent magnetite (Foster and Keith, 1969). Many of the sand grains were found to be rounded and frosted by wind action (Foster and Keith, 1969). Unit is well drained and presently stabilized by a forest of mainly quaking aspen and white spruce. Maximum thickness about 10 m

Glaciofluvial deposits

Qow — **Outwash of former Robertson Glacier (late Pleistocene; Donnelly glaciation)**—Mainly well-sorted, stratified, clast-supported, cobbly pebble gravel deposited by meltwaters of Robertson Glacier of Alaska Range during Donnelly glaciation. Clasts are subrounded to rounded basalt, gneiss, quartzite, amphibolite, and granitic rocks. Boulders are common; the largest is about 75 cm in diameter. Unit locally overlain by as much as 1 m of yellowish-brown (10YR 5/4) silt (loess?). Unit may include some alluvium and colluvium (Qco). Unit underlies an extensive, well-drained, flat area along south side of Robertson River in northern map area about 25–30 m above river. Unit is an excellent source of sand and gravel. Exposed thickness 20 m; estimated maximum thickness 30 m

Glacial deposits

Qty — **Younger till of Alaska Range glaciers (late Pleistocene; Donnelly glaciation)**—Mainly an unstratified, unsorted, clast-supported, pebbly cobble gravel, with a pale-yellow (5Y 7/3) sandy silt and sand matrix deposited by glaciers heading in valleys in Alaska Range during Donnelly glaciation. Clasts consist of mainly subangular to subrounded granitic biotite gneiss and schist, and quartzite pebbles and cobbles and occasional boulders. Largest clast is about 1 m in diameter. Unit locally overlain by 10–20 cm of loess consisting of light-yellowish-brown (10YR 6/4) silt and sandy silt. In Robertson River area, unit forms broad, hummocky end moraines, as high as 25 m, containing pond and bogs. In Yerrick Creek area, south of Alaska Highway, unit also forms hummocky end moraines, also containing ponds and bogs, with about 20 m of local relief. Other glaciers in Alaska Range in map area during Donnelly glaciation were not extensive enough to extend beyond the range into upper Tanana valley. Deposits from this glaciation are found throughout Alaska Range and generally consist of scattered deposits of ground moraine. Unit locally includes some colluvium (Qco), talus (Qta), and rock glacier (Qrg) deposits and small areas of bedrock (Br). Age of Donnelly glaciation is probably equivalent in part to oxygen isotope stage 2, which occurred about 12–24 k.y. ago (Martinson and others, 1987). Thickness probably greater than 30 m in places

Qto — **Older till of Alaska Range glaciers (middle Pleistocene; Delta glaciation)**—Mainly an unstratified, unsorted, clast-supported, pebbly cobble gravel with a pale-yellow (5Y 7/3) to light-yellowish-brown (10YR 6/4) sandy silt and sand matrix deposited along southern margin of upper Tanana valley by glaciers that emerged from valleys in Alaska Range during Delta glaciation. Clasts consist of subangular and subrounded granite, biotite gneiss and schist, and quartzite pebbles and cobbles and occasional boulders; the largest is about 1 m in diameter. Locally overlain by as much as 1 m of loess consisting of light-yellowish-brown (10YR 6/4) silt and sandy silt. North of Robertson River (immediately north of map area), unit forms broad, subdued, hummocky moraines. In northwestern map area, Robertson Glacier deposited a small lateral moraine trending southeast to northwest about 30 m above general land surface. In areas adjacent to Sheep Creek, Cathedral Rapid Creeks Nos. 1 and 2, and Yerrick Creek, unit forms hummocky end moraines extending out from base of Alaska Range. Locally includes alluvium and colluvium (Qco), and small areas of bedrock (Br). This unit is probably equivalent in age to marine oxygen isotope stage 6, based on correlation with similar deposits in Delta River valley (Begét and Keskinen, 2003) thought to have occurred between about 130 and 188 k.y. ago (Martinson and others, 1987). Thickness probably greater than 30 m in places

Periglacial deposits

Qrg — **Rock glacier deposits (Holocene and late Pleistocene)**—Poorly stratified, poorly sorted, large, angular rock fragments formed by periglacial processes and deposited on slopes mainly at head of cirques in Alaska Range. Surface is mostly covered with angular cobbles and boulders. Although larger surface clasts may be 2–3 m in intermediate diameter, clasts grade into finer material at depth. Presently active rock glaciers have steep frontal slopes, as much as 30 m high, which are commonly at angle of repose. These frontal slopes are lobate, indicating flowage induced by either interstitial ice or an ice core at depth. Upper reaches of unit commonly grade into steep talus (Qta) deposits. Unit may locally include talus (Qta) deposits. Some of these deposits are presently downwasting in that they contain collapse pits as much as several tens of meters in diameter and 5 m deep probably caused by melting of underlying ice. In August 2002, a collapse pit in a rock glacier near head of Yerrick Creek was 4–7 m in diameter and contained a small pond several meters below surface of rock glacier. The pit was surrounded by circular cracks at least 10 m beyond the pit itself that indicated a much larger area of subsidence. An exposure along one side of the pit consisted of 2–3 m of poorly stratified, poorly sorted, angular, pebbly cobble gravel overlying an ice core that disappeared at depth into the pond. Some deposits exceed 30 m in thickness

Qfe — **Felsenmeer (Pleistocene)**—Large, tabular-shaped, subangular to angular boulders derived from underlying bedrock by intense frost action. Most boulders are horizontal, some are turned on edge. Largest boulder is about 3x3x0.5 m. Area between boulders contains angular, coarse sand (gruss). Found at only one locality in map area, along eastern border on a high, flat, unnamed summit at an altitude of 1,900 m asl. Poorly exposed, but thickness probably less than 5 m

Qsg — **Sorted ground deposits (Pleistocene)**—A border of unsorted subangular granitic slabs, 1–1.5 m in intermediate diameter and with little matrix material, surrounding a central area of finer material consisting of coarse sand and pebbles. Unit was derived from underlying bedrock by intense frost action during the Pleistocene and possibly earlier. Mapped at only two localities in map area where visited in field, in Yukon-Tanana Upland along north-central border. These deposits probably occur elsewhere in higher regions of map area but are too subtle to distinguish on aerial photographs. Thickness 1–3 m

BEDROCK

Br — **Granitic and metamorphic rocks (Mesozoic and Paleozoic)**—Within map area, Alaska Range is underlain by an extensive group of metamorphic rocks that were subjected to one or more periods of high-grade regional metamorphism (Holmes, 1965); Holmes referred to these rocks as the "Birch Creek Schist" (name abandoned by Foster and others, 1973). Foster (1970) showed that much of Alaska Range within map area is underlain by a "biotite gneiss and schist" unit of Paleozoic age consisting primarily of quartz-biotite gneiss and schist, quartz-hornblende gneiss, quartz-feldspar-biotite gneiss, augen gneiss, quartz-muscovite-garnet gneiss, and quartzite. Also in Alaska Range, in southwestern part of map area, Foster (1970) mapped a "phyllite and schist" unit, also of Paleozoic age, consisting of phyllite with some included greenstone, discontinuous marble beds, and quartzite. North of Tanana River, in Yukon-Tanana Upland, bedrock is primarily granitic rocks of Mesozoic age consisting of mainly fine-grained biotite and biotite-hornblende granodiorite but ranging in composition from diorite to granite (Holmes, 1965; Foster, 1970; Carter and Galloway, 1978). Within map area, bedrock slopes are in places veneered with a thin (less than 1 m) mantle of locally derived rocky rubble

Contact

Meltwater channel

Moraine crest

Terrace scarp

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CONVERSION FACTORS

Multiply	By	To obtain
centimeters (cm)	0.394	inches (in.)
meters (m)	3.281	feet (ft)
kilometers (km)	0.621	miles (mi)

To convert Celsius (°C) to Fahrenheit (°F), use formula (°C x 1.8) + 32