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GEOLOGICAL SURVEY

Preliminary Geologic Map of the Middle Part of the Eagle River Valley, Municipality of Anchorage, Alaska

By

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Description of Map Units on Plate 1

ALLUVIAL DEPOSITS--Chiefly gravel and sand along major streams; generally well bedded and well sorted, clasts commonly fairly well rounded. Contacts generally well defined. Slopes[1] generally less than 1 percent, but as much as about 5 percent in some small valleys; terrace edges commonly steep to very steep, locally precipitous where actively eroding

Qala — Alluvium in active flood plain of Eagle River--Gravel and sand in bars along braided channels; the streams commonly change their courses and erode, transport, and redeposit the material; also includes alluvium at meanders where the river is in a single channel. Vegetative cover generally absent or just beginning to form in areas that have been stable for a few years. Area subject to flooding and erosion

Qal — Alluvium in lowest terraces--Usually within a meter above present stream level; includes active flood plain where too narrow to map separately. Along Eagle River, sand may be more common than gravel except in the upstream and downstream extremities of the mapped area, and probably overlies glaciolacustrine deposits, mainly silt and clay with some fine-grained sand, at depths of a few to several meters. Generally vegetation covered and stable except subject to erosion where bordered by the active flood plain; flooding infrequent, only likely during exceptionally high stages of the rivers

Qalf — Areas of alluvium in lowest terraces--Thought to be underlain by finer grained deposits, chiefly fine grained sand and silt. May include areas where alluvium is thin or absent and lacustrine deposits are near or at the surface

Qalo — Older alluvium in terraces--From several to as much as 10 m above present streams. Chiefly gravel from a few to several meters thick. Generally covered by vegetation and stable except along the terrace edge where slopes may be unstable

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[1] See figure 1 for explanation of slope terminology.

Qag/Qan Alluvium deposited in channels and fans during the waning phases of glaciation--Dominantly gravel, probably relatively thin in channels but several meters thick in broader areas. Qan, the apex of the large alluvial fan that extends to downtown Anchorage (map unit an, Schmoll and Dobrovolny, 1972a) and was probably formed by breakout of water impounded behind glacier ice related to the Elmendorf Moraine in Eagle River valley

Qaf Alluvial-fan deposits--Chiefly gravel and sand, fairly well bedded and sorted, deposited in fan-shaped configurations where streams enter the major valley, decrease their gradient, and deposit and rework much of their load. Deposits thickest at the apex, probably from several to 10 m or more, thinning towards the toe of the fan where there is usually a gradational contact with the major valley alluvium. Other contacts fairly well defined. Slopes very gentle to gentle, rarely more than 10 percent or less than 3 percent. Generally vegetation covered and stable, but may be subject to some flooding and to relatively permanent changes in stream course

Qac Alluvial-cone deposits--Chiefly gravel and sand, well bedded but more poorly sorted and with more angular phenoclasts than the alluvial-fan deposits (Qaf); deposited in cone-shaped bodies that occur mainly along the margins of the Eagle River valley where relatively small tributaries enter the valley, abruptly decrease in gradient, and deposit most of their load within a short distance. These deposits are probably thickest, from several to 10 m, near the middle, thinning both toward the apex and toward the toe where there usually is a gradational contact with the main valley alluvium. Slopes generally steep, locally less than 25 percent at the toe and more than 45 percent at the apex. Vegetation covered and stable in part, but a larger part of the cone is subject to more frequent stream course changes, flooding, erosion, and general instability than is true of the alluvial fans; snow avalanching with resultant thick accumulations of snow and some rock and organic debris are also common here

Qaco Older alluvial-cone deposits--Similar to alluvial-cone deposits (Qac), except that these deposits were graded to a base level higher than the present level, and are only rarely subject to the activity of and resultant instability caused by present-day streams; they are subject to erosion only where bordered by alluvial-cone deposits (Qac). Snow avalanches common

GLACIAL DEPOSITS

Qrg Rock glaciers--Accumulations of angular to subrounded fragments derived from upslope talus deposits (Qct) and bedrock; cemented by interstitial ice, rock glaciers move slowly downslope similar to ice glaciers. The surface contains predominantly coarse fragments, commonly cobbles and boulders, with substantial amounts of finer grained material thought to be present at depth; thus the deposit is essentially a coarse rubbly diamicton. Thickness from several to a few tens of meters. Contacts mostly well defined except at upslope margin where deposits commonly merge with talus. Surface is moderately hummocky and (or) ridged, and rough because of bouldery nature; slopes generally moderate on upper surface, steep on margins, and very steep at the leading (downstream) edge. Because these materials are in the transport mode, rock glaciers are very unstable, especially at the leading edge, where clasts fall from the top of the slope to the base

Qrd Rock-glacier deposits--Similar in nature to rock glaciers, except that forward movement of the mass has ceased, probably because the interstitial ice is either no longer present or is not sufficient in quantity to enable movement. The deposit is thus inherently more stable, but because of the loose nature of the material and the likelihood, at least in younger deposits, that some remaining interstitial ice may be melting, some instability persists, especially if the deposit is excavated

Qmle
Qmlf
Qmlr Lateral and terminal moraines--Chiefly diamicton (till); probably includes minor amounts of poorly sorted to well-sorted gravel; and some sand and silt in discrete lenses or beds. Where these deposits occur on steep valley walls they are discontinuous and only the major occurrences are mapped separately from the colluvium (Qcg, Qca) that partly conceals the moraines and with which boundaries are largely inferred. Thicknesses are variable and not well known, but several meters to a few tens of meters are probable. Slopes are gentle to moderate on the upper surface of the moraines but steep on the side facing the valley. Parts of these areas, as well as the larger kame terraces and valley fills, comprise the principal benches on otherwise steep valley walls, and consequently are more usable for building sites than the surrounding areas. Differentiated by age: Qmle, includes upper end of Elmendorf Moraine; Qmlf, inferred equivalents to the lateral moraines that occur along the mountain front just south of this area, near Fort Richardson (mapped as pre-Wisconsin by Miller and Dobrovolny, 1959); Qmlr, inferred equivalents of the higher level moraines near Rabbit Creek south of Anchorage

Qmg Ground moraine--Chiefly till composed of diamicton or poorly sorted gravel containing relatively small amounts of clay and silt. Locally, beds of moderately well sorted gravel, sand, and silt may be present. Thickness of 10 m and more is common; the upper part is equivalent in age to the deposits of the Elmendorf Moraine at Anchorage, but much of the deposit is probably older, equivalent to moraines near Fort Richardson. Contacts with younger units are fairly sharp, but those with lateral moraines and ice-contact deposits are gradational in places. Slopes are commonly moderately gentle, and the terrain is gently rolling rather than hummocky. Foundation conditions and general stability are good, except in some small areas of poor drainage

Qmm Ground and lateral moraines--Appear to have been modified by shore processes of either a lake that formerly occupied Eagle River valley, or a formerly more extensive Cook Inlet in which the Bootlegger Cove Clay was deposited. No exposures of deposits mapped as unit Qmm have been observed, but they may include thin sand and (or) gravel beds overlying the diamicton of the moraines. The areas commonly consist of a small bench with gentle slope notched into the steeper side slope of the moraines. Stability may be somewhat greater than on the other parts of the slope

GLACIO-ALLUVIAL, LACUSTRINE, AND DELTAIC DEPOSITS

Qkt Kame terrace deposits and related valley fills--Deposited in tributary valleys blocked by glacier ice in the main valley. Poorly exposed but thought to consist chiefly of gravel, sand, and diamicton of both alluvial and lacustrine origin. The deposits may range from several to a few tens of meters in thickness. Contacts are fairly sharp at the side toward the main valley, but gradational on the upslope side where colluvial deposits commonly lap onto the terrace deposit. Slopes are generally gentle to moderate, but steep on the side facing the main valley. These deposits form relatively stable benches along valley walls similar to lateral moraines

Qk Kame and related ice-contact deposits--Chiefly gravel and sand deposited by running water in and around glacier ice during the waning phases of glaciation. Includes numerous interbeds and complex admixtures of poorly sorted gravel and sand, as well as silt and diamicton. Commonly occurs in more sharply defined hills, hummocks, and channeled topography than the surrounding morainal terrain. Slopes are variable, from steep on hillsides to very gentle on some hilltops and in channels. Contacts well defined where adjacent to younger alluvial deposits, and may be poorly defined near morainal deposits

Qgl_3, Qgl_2, Qgl_1, Qglf Glaciolacustrine and lacustrine deposits--Chiefly clay and silt where well exposed in the center of the Eagle River valley, but elsewhere may include some sand, gravel, and diamicton (Qglf). Thickness may be from several meters (exposed) to several tens of meters (including the subsurface). Contacts well defined on the basis of morphology, but the materials probably grade laterally to glacial or colluvial deposits. Surfaces flat to very gentle except where steep bluffs have developed because of stream erosion. Because of the dominantly fine grained and unconsolidated nature of these materials, foundation conditions are generally poor and bluffs are unstable. In Eagle River valley, three levels of lake deposits are recognized: two earlier, higher level stages, Qgl_1 and Qgl_2, and a later lower level stage Qgl_3

Qgd_3 Qgd_2 Qgd_1 Deltaic deposits marginal to former lakes in Eagle River valley--Poorly exposed but probably chiefly gravel and sand; some of these deposits may be alluvial fans, at least in part. Thickness from several to 10 m. Contacts generally well defined. Slopes commonly gentle to very gentle, rarely more than 10 percent. These areas are quite stable and probably a source of sand and gravel. Subdivided into three stages correlative with those used for map unit Qgl

POND DEPOSITS

Qp Postglacial pond deposits--Poorly exposed, but they probably consist of intermixed clay, silt, peat, and other organic debris; thin beds of marl may be present. These deposits occupy depressions in channel and lake deposits; they are thin near the edges but thicken to several meters in the center. Surfaces are nearly flat. The ground is generally soft and poorly drained and provides poor foundation conditions

Qi Interglacial pond deposits--Chiefly silt and clay with interbedded organic debris that is older than 40,000 years as determined by ^{14}C analysis; these deposits may represent the last interglacial interval (Sangamon) but could represent one or more early Wisconsin interstadial intervals. Exposed in a few places along Eagle River, these deposits are only a few meters thick; the exposures as mapped include underlying older glacial deposits

COLLUVIAL DEPOSITS

Qca Colluvio-alluvial apron on valley walls--Deposits consist of a mixture of colluvium, derived directly from weathering of the bedrock upslope and moved downward primarily by gravity, and alluvium similar to that in alluvial-cone deposits (Qac) but in deposits too small to map separately; much of the material has probably moved downslope by both alluvial and colluvial processes. Includes both poorly sorted sand and gravel, and loose sandy to rubbly diamicton, together with small amounts of organic debris. Probably thickest in the middle to lower reaches of the slope, thinning gradually upward and more abruptly downward; thickness ranges from several meters to less than 1 m. Bedrock underlies the deposit at most places and may be encountered in shallow excavations. Bedrock crops out at scattered places within the area of the map unit, especially in the higher parts of the deposit and along some gullies. Contacts commonly are poorly defined. Slopes steep to very steep, ranging from 35 to 70 percent. Some slope instability may be expected because of steepness of slope and looseness of material; snow avalanches common

Qcg Mixed colluvial and glacial deposits--Similar to deposits mapped as colluvio-alluvial apron (Qca), but include minor to substantial amounts of morainal deposits, chiefly lateral moraine remnants, both as discrete surface deposits too small to map separately and as deposits buried by a variable thickness of colluvial and alluvial material. The surface is generally more irregular than that of map unit Qca and in places is moderately hummocky; consequently, the total thickness of the deposit is likely to be more variable than that of the colluvio-alluvial apron (Qca), commonly from a few to several meters. Contacts are usually gradational. Slopes are steep to very steep, commonly ranging from 35 to 70 percent; locally there are gentle to moderate slopes on small ridgetops. Some downslope movement and snow avalanche activity can be expected

Qct Talus--Cone-shaped to apronlike deposits on valley walls, usually confined to the more rugged mountains, composed of loose angular fragments derived directly from weathering of the bedrock upslope and moving downslope chiefly by gravity without much aid of running water; particles range widely in size, from silt-clay to boulders. Thickness variable, probably thickest in the middle to lower parts of the slope, where it may be several meters thick, thinning gradually upward and more abruptly downward. Contacts commonly gradational, with feather edges at apex and toe, and grading laterally and upslope to bedrock overlain locally by patches of talus too small to map separately; individual talus cones may have well-defined boundaries. Slopes steep to very steep, nearly 100 percent near apex, rarely less than 35 percent near toe. These areas are commonly free of vegetation and subject to continuing deposition from above, partly in the form of rockfalls and debris-laden snow avalanches; they are not particularly subject to erosion, but are generally unstable, especially when excavated, because of steepness of slope and looseness of material

Qcb
Qcbp Colluvium developed in surficial deposits on river bluffs and canyon walls--Chiefly diamicton, with minor interbeds of gravel, sand, and silt; adjacent to glaciolacustrine and lacustrine deposits (Qgl)

sand, silt, and (or) clay, may dominate; generally poorly sorted. Accumulations of loose material derived from adjacent upslope deposits form a thin veneer on bluffs and bedrock following erosion by the adjacent stream; generally a few meters thick, thinner at the upslope part, thickening downslope. In canyons along streams tributary to Eagle River, bedrock may crop out in places or be encountered in excavations. Contacts well defined. Slopes commonly steep to very steep. Although commonly stabilized by heavy vegetative cover, these slopes are subject to local gully erosion or renewed erosion by the main stream, thus they are generally unstable when excavated. Qcbp, areas of poorly defined bluffs, where material, probably fine grained, has slumped sufficiently to obscure the morphology of the bluffs. Landslides and earthflows have been common in the past in these areas and may be reactivated, especially if the slope is disturbed

Qcl
Qcle
Qclb
Qcll
Qcld

Landslide deposits--Chiefly loosely packed rubbly diamicton which may include boulders and large blocks. Occurs as hummocky to smoothly rounded massive deposits that mainly have been emplaced rapidly by debris avalanching (Qcl), or in some places more slowly by earthflow (Qcle). Qclb, large masses of bedrock that appear to have moved downslope intact. From several meters to a few tens of meters in thickness. Contacts fairly well defined. Slopes variable, most areas hummocky with steep to moderate slopes. Most deposits are covered by vegetation and appear relatively old and fairly well stabilized, although they may be subject to further instability if excavated or eroded. Some landslide deposits are interpreted to have been modified and are mapped separately, as follows: Qcll, landslide debris with somewhat subdued hummocky terrain, possibly modified by lacustrine erosion and deposition. Qcld, area of apparent landslide debris with substantially subdued terrain, possibly modified both by lacustrine erosion and deposition and by subsequent deltaic and (or) alluvial deposition

Qcs

Solifluction deposits, and other deposits of related types of downslope creep--Generally silty to rubbly loose diamicton derived largely from fairly soft argillitic bedrock. Thickness not well known but probably on the order of from 1 to a few meters. The areas mapped occur on steep to very steep slopes that are slightly irregular, hummocky, or contain arcuate to lobate ridges that appear to be caused by downslope movement. These slopes are thus somewhat unstable and are likely to become more so if excavated. Contacts are approximately located and the unit grades into adjacent areas of bedrock with a less-well-developed veneer of solifluction deposits

ANTHROPOGENIC DEPOSITS

Qmf — Engineered fill along Glenn Highway--Shown only where a prominent embankment several meters high is present. Chiefly gravel, with a more poorly sorted base course of sandy to silty gravel. Contacts well defined. Surface nearly flat, sides steep

Qma — Area altered by man--Includes both cut and fill, especially for a sanitary landfill operation; deposit includes anthropogenic trash mixed with geologic materials

SEDIMENTARY ROCKS

Tkt — Tyonek Formation (Miocene and Oligocene)--Chiefly nonmarine sandstone, siltstone, and coal; not known to occur east of the outcrops mapped, but may occur in the subsurface as far as about 0.5 km to the east

METAMORPHIC AND IGNEOUS ROCKS[2]

KJv — Valdez Group (Cretaceous)--Chiefly argillite, siltite, and metagraywacke. The rocks of this group are generally somewhat weaker, form mountain slopes somewhat more rounded and less steep (although steep to very steep slopes are common) and are more likely to be concealed on slopes by colluvial and solifluction deposits than those of the McHugh Complex, KJm

KJm — McHugh Complex (Cretaceous and (or) Upper Jurassic)--Chiefly massive, weakly metamorphosed sandstone and conglomeratic sandstone. Crops out in characteristically massive jagged outcrops and the mountains developed in the area of these rocks tend to be higher and more rugged than those of the Valdez Group, with steep to precipitous slopes common; such characteristics are better developed just east of the mapped area, however

JPu — Igneous and metaigneous rocks (Jurassic to Permian)--Chiefly gabbro in the one small outcrop mapped

IGNEOUS ROCKS[2] (Tertiary)

Tf — Felsic to intermediate hypabyssal rock (Tertiary)--Occurs as dikes, sills, and small intrusive bodies; mapped only where known to occur; other small occurrences likely

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[2] These rocks are described more fully by Clark and Bartsch (1971) and Clark (1972).

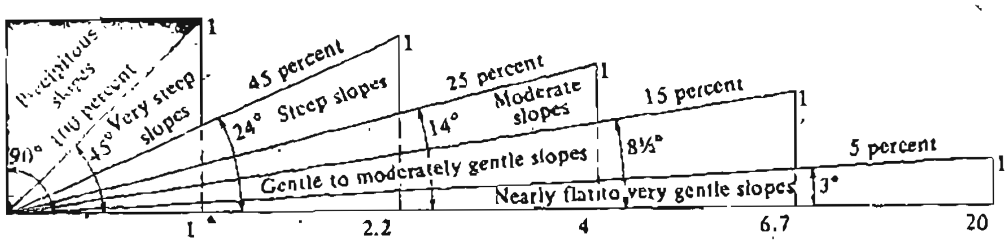

Figure 1.--Diagram showing numerical values for slope terms used in the description of map units. Values are given in percent, in degrees, and as slope ratio, horizontal (numbers along bottom line) to vertical (taken as 1). From Schmoll and Dobrovolny (1972b).

Contact mainly from airphoto interpretation; general nature of contacts discussed for each map unit

Contact that coincides with river

Contact between bedrock units

Inferred Eagle River thrust fault between bedrock units, teeth on upper plate

Approximate position of concealed Knik fault zone

Inferred margin of former glacier; shown in selected places only

Inferred shoreline of former lake; shown in selected places only

Terrace escarpment; separates alluvial surfaces of different ages included within the same map unit; teeth on younger surface

Sackung trench, a few to several meters deep, the steeper scarps facing uphill; line drawn on bottom of trench. These features are believed to be indicative of gravitational spreading of the ridge that takes place by gradual displacement along a series of disconnected planes or by plastic deformation of the rock mass without formation of a through-going slide plane (Zischinsky, 1966, 1969; Radbruch-Hall and others, 1976). The process probably was initiated after glaciers retreated from the adjacent valley, leaving oversteepened valley walls unsupported; earthquakes and tectonic or glacio-isostatic uplift may have enhanced or accelerated development of the process. It is not known whether this is an ongoing process, but these features suggest the possibility of potential instability of the valley walls beneath them

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