Report of Investigation 2024-6

SURFICIAL-GEOLOGIC MAP OF THE BIG HURRAH–COUNCIL–BLUFF AREA, SOUTHERN SEWARD PENINSULA, ALASKA

De Anne S.P. Stevens

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Cover. Location map of Council geologic map study area.

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SURFICIAL-GEOLOGIC MAP OF THE BIG HURRAH–COUNCIL–BLUFF AREA, SOUTHERN SEWARD PENINSULA, ALASKA

De Anne S.P. Stevens[1]

INTRODUCTION

This surficial-geologic map shows the distribution of unconsolidated deposits and undifferentiated bedrock in the Big Hurrah-Council-Bluff area in parts of the Solomon C-4, C-5, D-4, D-5, and Bendeleben A-4 quadrangles. The boundaries of the study area were developed to best address questions of bedrock geology and mineral potential, which were the key drivers of the project of which this work is a part. The map was prepared principally by interpreting 1:63,360-scale, false-color, infrared aerial photographs, and multi-scale, multi-band satellite imagery. It is locally verified by ground observations during field studies in 2002, 2003, 2004, and 2006. Surficial geology in this area was previously mapped at a reconnaissance scale (1:250,000) by D.S. Kaufman (1986), and his mapping was used as a baseline and guide with which to target areas for closer inspection. While the current map shows differences in many of its details as well as in the larger-scale interpretation of glacial units and their distribution, much of the general breakdown of surficial units follows Kaufman (1986). Surficial-geologic maps of the Big Hurrah and Council sub-areas were previously published (Stevens, 2005a, 2005b).

The surficial-geologic mapping was derived in part from a project funded by the National Aeronautics and Space Administration (NASA) to apply remote sensing imagery, Digital Elevation Models (DEMs), and high-altitude color-infrared photography integrated with knowledge of geomorphology, surficial deposits, and bedrock geology to evaluate the placer gold potential of part of the Council mining district. As part of this project, we evaluated the utility of Landsat-7 ETM+ multispectral imagery (30 m resolution) in distinguishing key geomorphic features on a regional scale by applying remote sensing analysis techniques that included three-dimensional image drapes using the U.S. Geological Survey (USGS) National Elevation Database (NED) DEM (60 m resolution). Edge detection using a combination of visible and infrared bands (bands 3, 4, 5) gave the maximum interpretability of classes of edges, allowing distinctions to be made between bedrock and clouds, major streams and wetlands, minor streams, and sea and lake ice. Principal Components (PC) analysis using combinations of one of the first three PC bands with two of the higher PC bands (4, 5, and 6) results in images where wetlands formed in areas of permafrost-rich silt and peat can be discerned by their color and texture. Unsupervised classification was effective in distinguishing wetlands and other saturated substrates, water (streams, lakes, and ocean), sea and lake ice, snow, silty colluvium, and better-drained uplands and transitional areas. While we were able to distinguish many key geomorphic features in this phase, critical distinctions could not be made at this scale regarding important groups of glacial deposits. To address this need, the second phase of the project evaluated Quickbird multispectral imagery (2.4 m resolution) used in conjunction with DEMs derived from ERS tandem mission SAR data (30 m resolution) to generate high-resolution three-dimensional image drapes. These data were field checked and combined with analysis of 1:63,360-scale, false-color, infrared aerial photograph stereopairs and orthophotos to generate the final surficial geology map.

Glacial deposits mapped in the study area were assigned to glacial episodes according to the chronology developed by Kaufman and Hopkins (1986) and Kaufman (1986), and include Nome River drift, Sinuk drift, and an undifferentiated Sinuk or pre-Sinuk drift. Nome River drift—the

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youngest glacial deposit in the map area—is believed to be of middle Pleistocene age based on radiometric dating of basaltic lava by Kaufman and others (1991). Nome River moraines have been extensively modified by slope processes and are typically overlain by up to a meter of windblown silt. Surfaces are completely vegetated, somewhat smooth to slightly hummocky, and rarely develop local bogs and ponds. Gross primary morphology is retained, and the deposits form pronounced, arcuate ridges that are readily identified as moraines up to 3.5 km wide, with crests up to 75 m above modern river level. Nome River moraines extend at least 5 km south of the Bendeleben Mountains front, which is roughly coincident with the northern boundary of the map area.

Sinuk drift is significantly more modified than Nome River drift, and the surface is characterized by numerous thaw ponds and bogs as well as incised drainages. Gross primary morphology is largely lost, although broad, sweeping moraine crests can still be discerned in the northeastern map area. Sinuk moraines extend at least 10 km beyond the Bendeleben Mountains front in the north part of the study area, and from the uplands to the coast in the Solomon area. The highly subdued moraines are up to 4 km wide with remnant crests up to 75 m above modern river level.

Undifferentiated Sinuk or pre-Sinuk drift is represented by a scattering of boulders and cobbles derived from the Casadepaga schist unit and interpreted as glacial erratics. Clast lithology is predominantly dark greenish gray, equigranular metabasite with small garnets; a few are schist. Many of these boulders and cobbles are perched individually or in clusters directly on scoured bedrock and are easily recognized on the smooth, largely unvegetated, light-colored marble (OpꞒx of Mixed Unit in Werdon and others, 2005a) comprising many of the ridges and slopes in the western part of the study area. The higher elevation and distribution beyond the limits of Sinuk drift suggest the erratics were deposited by an older, more extensive glaciation than the Sinuk, although a Sinuk age for these deposits cannot be ruled out.

The area around Council consists primarily of colluvium-draped hills of moderate relief drained by moderate- to low-gradient (9 m per kilometer and less) streams. Niukluk River bisects the southern part of the area, draining formerly glaciated uplands in the northwest and flowing through a possible fault-bounded basin that heads near the mouths of Richter and Ophir creeks. The upper contacts of lowland silt deposits generally conform to the locations of photolinears that delineate the western margins of the basin through which the river flows and generally mark the western extent of the down-dropped block or blocks. The distribution and orientation of the photolinears, coupled with the topographic relief in this area, suggest en echelon style faulting. Werdon and others (2005b), whose mapping was aided by airborne geophysical data, show an inferred fault coincident with the location and trend of the photolinears. Rather than indicating the faulting is Quaternary in age, it is more likely lowland silt was simply deposited on the downdropped block/blocks from pre-Quaternary faulting. The river follows this basin through the marshy lowlands south and southeast of Council and ultimately drains into Golovin Lagoon via a large delta system. Seward Peninsula coastal areas at 100 feet elevation or less are candidates to preserve features and deposits developed during the late Pleistocene (130,000 yr B.P.; marine isotope stage [MIS] 5; Liseicki and Raymo, 2005) high sea level stand. Sainsbury and others (1972) identify the lowlands from near Council south as sandy and possibly related to a higher sea level stand. Mendenhall (1901) thought these lowlands were caused by sea level flooding of a subsiding valley. Niukluk River is flanked by terrace deposits along most of its length in the study area. Smith and Eakin (1911) describe a hole that was sunk in 1906 on a surface 50 ft (15 m) above the Niukluk River and midway between Fox and Bear creeks west of Council. The hole reached a depth of 250 ft (75 m), all through gravel.

The northeastern portion of the Council map area is dominated by glacial deposits derived from ice flowing from the Bendeleben Mountains to the north. Prior to glaciation, the headwaters of Ophir Creek drained eastward into McCarthys Marsh, a large late Cenozoic basin fault-bound to the north adjacent to the Bendeleben Mountains (Kaufman, 1986). By middle Pleistocene time glaciers of Sinuk age had advanced beyond the mountain front, crossed the McCarthys Marsh lowlands, and locally overtopped drainage divides into Ophir and Melsing creek basins. Fine-grained sediments and bedded sands in upper Ophir Creek indicate a small lake probably formed in the headwaters as the river was dammed by advancing glaciers. The lake waters ultimately overtopped the drainage divide to the south and carved the deep, narrow, steep-walled canyon that forms the modern course of upper Ophir Creek. Glacial meltwater flowing into the headwaters of Ophir, Snowball, and Melsing creeks deposited gravels and boulders with characteristic Bendeleben Mountain lithologies (granitic and amphibolite facies metamorphic rocks) and locally formed benches that may be correlative with "pocket bench" placers described by Collier and others (1908) perched 120 ft (36 m) above creek level on the east side of Ophir Creek.

The Big Hurrah portion of the study area includes uplands along the divides between the Solomon and Skookum river drainages where possible north–northwest-facing cirques are preserved. Solifluction deposits are extensive on many slopes and display spectacular lobate forms. The relief in this area derives largely from the distribution of Casadepaga Schist, a resistant unit forming the upland summits. Headwall and valley morphology indicate many of the peaks may have supported cirque glaciers at elevations of 400–450 m during very old glaciations, but no deposits are readily observable except in the western portion of the study area. Similar features have been interpreted as ancient cirques in Interior Alaska, although those were mapped in higher elevations (~1200 m in Péwé and others, 1967; ~900 m in Pinney, 1997). The oldest and most extensive glacial deposit is a Sinuk or pre-Sinuk undifferentiated drift. The limit of this deposit was generally mapped according to the maximum elevation and lateral extent of numerous glacial erratics. During this glaciation, ice overtopped the divide into Johnson Creek in the northwest part of the map area and joined with a major ice stream in the Casadepaga River basin to the north. It is unclear whether these erratics are of Sinuk age or if they are older, hence they have been mapped as Sinuk or pre-Sinuk drift. Glacial deposits that Kaufman (1986) confidently assigned to the Sinuk glaciation are confined to the western part of the map area. West of the map area, large glaciers in Bonanza and Eldorado creeks flowed onto the coastal plain and extended east across lower Shovel Creek and Solomon River (Kaufman, 1986). The south fork of Quartz Creek heads in a prominent broad, steep-walled channel that cuts south to Uncle Sam Creek through the ridge separating Big Hurrah Creek from the coastal plain. This channel may have been an outlet of a lake in the Solomon River basin that was dammed by the large ice lobe from the west. MIS 5 high sea level coastal processes likely influenced the lower Solomon river area. Beach deposits were noted by Smith (1910) on Rabbit Creek at elevations apparently above 100 feet and probably about 200+/- feet (Smith, 1910).

UNCONSOLIDATED DEPOSITS

Terms used to describe the estimated percentages of cobbles and boulders are "numerous," "scattered," and "rare." "Numerous" implies that drilling through the layer would encounter two cobbles or boulders in an interval of 0.6 m; "scattered" implies that drilling would encounter two cobbles or boulders in an interval of 3 to 4.5 m; and "rare" implies that drilling would encounter two cobbles or boulders in an interval of more than 4.5 m. Estimated content of gravel, sand, and silt, based on field observations, is indicated by the terms "some" and "trace." "Some" implies a general composition of 12 to 30 percent. "Trace" implies a general composition of 4 to 12 percent. Estimated compositions of less than 4 percent were not recorded in the field.

ALLUVIAL DEPOSITS

Qas

SILTY ALLUVIUM (HOLOCENE)—Broad, elongate deposits of moderately well stratified silt and minor fine sand beneath modern channels and floodplains of streams draining silt-mantled slopes. Generally composed of reworked eolian silt. May include fine-grained debris-flow deposits, especially in the upper reaches. Moderately to well sorted and medium to thin bedded; locally crossbedded. Surface smooth except for local shallow, interconnected channels and low scarps. Mapped in Klokerblok and Skookum river valleys and near the headwaters of Big Hurrah Creek in the Big Hurrah area.

Qfp

FLOODPLAIN ALLUVIUM (HOLOCENE)—Elongate deposits of moderately to well sorted, well stratified, fluvial gravel, sand, and silt with scattered to numerous boulders forming modern floodplains and associated low terraces. Deposits may reflect former channels and flow regimes. Medium to thick bedded, locally crossbedded, shows fining-upward cycles, and may be locally auriferous. Clasts generally rounded. Typically mantled by thin layer of silty overbank deposits. Generally finer grained than similar deposits in Qal unit because of deposition during floods. May locally include latest Pleistocene to Holocene terrace alluvium. Lower surfaces may be flooded during periods of high stream discharge. Ground ice content highly variable, but generally expected to be low. Surface typically well vegetated, smooth to hummocky with local low scarps and bogs. Mapped along Niukluk River in the Council area.

Qal

ALLUVIUM, UNDIFFERENTIATED (PLEISTOCENE–HOLOCENE)—Elongate deposits of moderately to well sorted, well stratified, fluvial pebble–cobble gravel, sand, and silt, with scattered to numerous boulders, deposited in active stream channels, floodplains, and associated low terraces. Deposit is medium to thick bedded, locally crossbedded, shows fining-upward cycles, and is locally auriferous. Clasts generally rounded. Extensive willow–alder thickets grow on many Qal deposits in mature valley fills. Surface smooth to hummocky except for local low scarps.

Qat

TERRACE ALLUVIUM (PLEISTOCENE–HOLOCENE)—Elongate deposits of well sorted, well rounded to subrounded pebble–cobble gravel and sand with trace to some silt and rare to numerous boulders composing stream terraces bordering modern floodplains and clearly related to modern drainage. Surface smooth except for local low scarps.

COLLUVIAL DEPOSITS

Qrg

ROCK GLACIER DEPOSITS (HOLOCENE)—Tongue-shaped heterogeneous mixtures of angular to subangular blocks of local bedrock and ice with trace to some gravel, sand, and silt at depth that accumulate on floors and lower walls of cirques by flow of rock glaciers derived from shrinking of former glaciers (ice cored) or from deposition and cementation of precipitation-derived ground ice (ice cemented). Perennially frozen where active. Probably generally clast-supported. Surface furrowed, pitted, or hummocky and covered with angular to subangular blocks. Single possible example mapped in northern part of map area.

Qc

COLLUVIUM, UNDIFFERENTIATED (PLEISTOCENE–HOLOCENE)—Irregular, heterogeneous blankets, aprons, and fans of angular to subrounded rock fragments, gravel, sand, and silt that are left on slopes, slope bases, or high-level surfaces by residual weathering and complex mass-movement processes, including rolling, sliding, flowing, gelifluction, and frost creep. May include greatly modified drift of older glaciations. Locally washed by meltwater and slope runoff. Medium to thick bedded. Generally unsorted to very poorly sorted. Thickness is highly variable, with thickest deposits at the bases of slopes. Surface disturbances, such as from excavation, may result in thawing of permafrost and subsequent slumping and flowage. Surface smooth, lobed, or terraced and, if deposit is thin, generally reflects configuration of underlying bedrock surface.

Qcd COLLUVIUM WITH GLACIAL DRIFT (?) (PLEISTOCENE–HOLOCENE)—Irregular, heterogeneous blankets, aprons, and fans of angular to subrounded rock fragments, gravel, sand, and silt deposited on slopes in the Casadepaga River area by residual weathering, complex mass-movement processes (including rolling, sliding, flowing, gelifluction, and frost creep) and possibly by glaciers. Distribution of glacial erratics believed to be of Sinuk age or older suggests that these deposits likely include greatly modified drift of ancient glaciations. Locally washed by meltwater and slope runoff. Medium to thick bedded. Generally unsorted to very poorly sorted. Thickness is highly variable, with thickest deposits at the bases of slopes. Surface smooth.

Qcs SOLIFLUCTION DEPOSITS (PLEISTOCENE–HOLOCENE)—Irregular drapes of poorly sorted mixtures of angular rock fragments of local origin with trace to abundant sand and silt deposited on slopes primarily by soil creep (gelifluction/solifluction). Deposits on upper slopes and hills consist of irregular drapes and sheets of coarse (≥ 1 meter blocks are common), angular rock fragments and rubble with minor silt, sand, and gravel deposited more or less in place by block weathering and frost riving. Deposits on lower slopes consist primarily of silt with varying proportions of angular rock fragments and sand. Deposits are widely subjected to secondary reworking by cryoturbation, including frost heave and frost jacking of rock fragments. Surface smooth to hummocky and gently to moderately sloping with prominent steps and lobes oriented approximately perpendicular to slope.

GLACIAL DEPOSITS

Nome River Glaciation

Qdn DRIFT OF NOME RIVER AGE (MIDDLE PLEISTOCENE)—Heterogeneous blanket of pebble–cobble gravel, sand, silt, and clay in varying proportions deposited by glaciers. Contains rare to numerous large (≥1 m) boulders deposited directly from glacial ice. Sorting, bedding, and clast roundness highly variable, depending on degree of water reworking. Deposit locally includes or is gradational with outwash. Typically overlain by up to 1+ meter of windblown silt. Surface smooth to highly irregular with uncommon local bogs and ponds. Forms broad, arcuate ridge at head of Ophir Creek.

Sinuk Glaciation

Qds DRIFT OF SINUK AGE (EARLY? PLEISTOCENE)—Heterogeneous blanket of pebble–cobble gravel, sand, silt, and clay in varying proportions deposited by glaciers. Contains rare to numerous boulders (≥1.6 meter) deposited directly from glacial ice. Sorting, bedding, and clast roundness highly variable, depending on degree of water reworking. Deposit may locally include or be gradational with outwash. Observed thickness ranges from a thin and patchy veneer or lag of pebbles, cobbles, and boulders over ice-scoured bedrock in higher elevations to an unknown maximum thickness in lower elevations, where it is mantled by thick (>1 meter), heavily vegetated, reworked silt cover. Surface smooth to highly irregular with local bogs and small ponds. Forms broad, arcuate ridges at head of Ophir Creek, and blankets southwestern corner of Big Hurrah map area.

Qds-v DRIFT OF SINUK AGE, VENEER (EARLY? PLEISTOCENE)—Very thin and patchy veneer of pebbles, cobbles, and boulders deposited directly from glacial ice. Preserved as a scattered lag of exotic cobbles and boulders on and in silty colluvium east of Sardine Creek in upper Ophir Creek area.

Qds-w DRIFT OF SINUK AGE, WASHED (EARLY? PLEISTOCENE)—Meltwater-washed equivalent of Sinuk-age drift (unit Qds). Surface gently to steeply sloping, hummocky, and channeled with lag of coarse cobbles and boulders on surface.

Sinuk Glaciation or Older

Qdu

OLDER DRIFT, UNDIFFERENTIATED (EARLY? PLEISTOCENE)—Deposits of probable glacial origin and uncertain composition and age along Shovel Creek and associated tributaries in the Big Hurrah area, as well as in the Casadepaga River drainage. Upper limits mapped primarily on the basis of distribution of glacial erratics composed of lithologies (principally Casadepaga metabasite and some schist) exotic to the local bedrock. Erratics preserved singly or as boulder–cobble lags on glacially scoured bedrock; some are glacially striated; up to 1 m diameter. Deposits probably thicken downslope where they are thickly mantled by silt and colluvium and are very poorly exposed.

GLACIOFLUVIAL DEPOSITS

Sinuk Glaciation

Qds-os

SANDY OUTWASH OF SINUK AGE (EARLY? PLEISTOCENE)—Blanket of bedded sand with some washed, rounded to subrounded pebble–cobble gravel and scattered to numerous subangular to rounded boulders deposited by meltwater draining margins of former glaciers terminating in headwaters of Ophir Creek. Includes local fine-grained glaciolacustrine and delta deposits from glacier damming of upper Ophir Creek basin. Thin to thick bedded, locally crossbedded. Surface generally smooth and gently sloping, except for local low scarps.

Qds-ow

OUTWASH OF SINUK AGE (EARLY? PLEISTOCENE)—Elongate to irregular heterogeneous mixture of washed, rounded to subrounded pebble–cobble gravel with some sand and silt and scattered to numerous subangular to rounded boulders deposited by meltwater draining margins of former glaciers in headwaters of Ophir and Snowball creeks. Forms terrace deposits along margins of these creeks and may be correlative with documented "pocket bench" placers of Ophir Creek (Collier and others, 1908). Thin to thick bedded, locally crossbedded. Surface generally smooth and gently sloping, except for local low scarps.

MARINE DEPOSITS

Qb

BEACH DEPOSITS (HOLOCENE)—Elongate deposits of washed, rounded pebble gravel and sand deposited by wave action. Local scattered cobbles and boulders. Forms modern beaches adjacent to bedrock bluffs along coast. Thin to thick bedded, locally crossbedded. Surface smooth and gently sloping with local scarps.

PALUDAL DEPOSITS

Qs

SWAMP DEPOSITS (HOLOCENE)—Elongate to blanket deposits of complexly bedded peat, organic silt, and organic sand accumulated as surface deposits in local basins and in former stream channels. Saturated and locally frozen, locally ice rich. Thickness highly variable. Surface smooth, ridged, mounded, hummocky, or pitted. May have standing water.

Qtl

THAW LAKE DEPOSITS (HOLOCENE)—Semicircular to irregularly shaped deposits of moderately stratified, heterogeneous, brown to dark gray silt, sand, and organic silt filling small, locally interconnected basins resulting from the thawing of ice-rich permafrost in silt. Saturated and locally refrozen, locally ice rich.

VOLCANIC DEPOSITS

Qv

BASALT LAVA FLOWS (QUATERNARY)—Elongate to irregular blanket of aphanitic, variably vesicular to scoriaceous, locally amygdaloidal basalt flows and associated vent deposits. Basalt flows form a 4-mile-long terrace along the eastern margin of Bear River. Lava flowed predominantly northeast along the valley floor away from the northwest-trending vent axis, with relatively minor flows to the southwest. Basalt is oxidized brown to reddish-brown near the vent site, with interlayered ropey flows, spatter, and other ejecta. Fresh surfaces are dark gray. Basalt flows distal to the vent site are dark gray to black, massive, blocky, and locally columnar-jointed. Amygdules variably contain calcite, quartz, and chlorite. Major- and minor-oxide and trace-element analyses indicate the basalt is alkalic and formed in a within-plate, extension-related tectonic setting (sample 04MBW254A in Werdon and others, 2005c). The basalt is normally magnetized and has a high magnetic susceptibility. An $^{40}Ar/^{39}Ar$ whole rock isochron age of 0.778 ± 0.013 Ma (Werdon and others, in preparation—map location A13; table 2) is slightly older than the interpreted age of Kaufman and others (1991) for the Imuruk Volcanics of north-central Seward Peninsula. Surface smooth to gently sloping.

COMPLEX DEPOSITS

Qls

LOWLAND SILT (QUATERNARY)—Irregular blankets of massive, generally homogeneous, silt and organic silt originally laid down by eolian processes and subsequently minorly to extensively reworked by fluvial and colluvial processes on lower slopes and valley bottoms. Deposits in lower Solomon River (outside map area) and Niukluk River likely influenced by MIS 5 high sea level coastal processes. May include areas of upland silt (Qus). Includes silt-rich debris-flow deposits. Locally extensively modified by development, thawing, and regrowth of ice-rich permafrost. Includes semicircular to irregularly shaped deposits of moderately stratified, heterogeneous silt, sand, and organic silt filling small, often interconnected basins resulting from the thawing of ice-rich permafrost in silt. Commonly contains angular clasts of local origin and scattered small charcoal fragments and root casts. Generally massive, but locally bedded. Commonly perennially frozen with variable ice content. Basin deposits are commonly saturated and locally refrozen, locally ice rich. Maximum observed thickness approximately 1 m, but total thickness is potentially much greater. Surface generally smooth to gently sloping with local low-center ice-wedge polygons; may be pitted, hummocky, and gullied by thawing of ice-rich permafrost (thermokarst), or characterized by numerous shallow, interconnected channels; small ponds and boggy areas are abundant where ice rich.

Qus

UPLAND SILT (QUATERNARY)—Irregular blankets, fans, and aprons of massive, generally homogeneous, silt initially laid down by eolian processes and subsequently minorly to extensively reworked by fluvial and colluvial processes. Silt is largely retransported by mudflows, slopewash, gelifluction, and frost action. Includes fine-grained colluvium. May contain abundant angular clasts of local origin. Massive to thinly bedded, with some wavy bedding and crossbedding. Thickness is highly variable, with thickest deposits at the bases of slopes. Commonly perennially frozen with variable ice content. Surface smooth and steep to gently sloping.

Qus-r

REWORKED UPLAND SILT (QUATERNARY)—Irregular fans and aprons of retransported silt. Includes fine-grained colluvium and may include abundant angular clasts of local origin. Surface is moderately to steeply sloping.

MAN-MADE DEPOSITS

Qmt

MINE TAILINGS (HOLOCENE)—Water-washed pebble–cobble gravel with trace to some sand and silt piled in active or former gravel pits, open-pit mines, and dredged areas. Typically well sorted. Surface smooth to irregular or forming symmetrical ridges and cones.

BEDROCK

b

BEDROCK, EXPOSED—Undifferentiated bedrock with essentially no cover.

b'

BEDROCK, THINLY COVERED—Undifferentiated bedrock covered by a thin (generally <1 m thick) discontinuous veneer of unconsolidated deposits. Cover is sufficiently thin that planar bedrock structures, like joints, foliation, and bedding or glacier-scoured bedrock subcrops are reflected at the ground surface by linear and curvilinear shallow troughs and bands of moist ground or hydrophilic vegetation.

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