DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

OPEN-FILE REPORT 84-401

HOWARD PASS

Base from USGS 1:250,000 Howard Pass 1957

SCALE 1:250,000

CONTOUR INTERVAL 200 FEET
DATUM IS MEAN SEA LEVEL

INTRODUCTION

The Howard Pass quadrangle covers a physiographically diverse area of about 14,000 km^2 in northern Alaska. To the south, the map area extends into the central Brooks Range and the De Long Mountains, and also includes part of the Noatak Lowlands (Wahrhaftig, 1965). To the north, it extends across the southern Arctic Foothills to the broad valley of the Colville River. Relief generally is low (150 to 200 m) in the Colville and Noatak Valleys, somewhat higher (200 to 400 m) in the Arctic Foothills, and highest (500 to 1,000 m) within the mountains.

The Brooks Range consists of sparsely vegetated mountain masses that are separated from each other by deep valleys with low divides that were carved by glaciers that originated south of the map area. Lithologies are dominantly limestone, quartzite, sandstone, shale, and siltstone of Devonian through Permian age. The De Long Mountains are more varied in lithology, including volcanic and ultramafic rocks of Jurassic through Permian age in addition to the rock types that dominate farther east. Valley heads are deeply indented by cirques, and the De Long Mountains were a source for glaciers that flowed north and south into the adjacent foothills and lowlands. The Arctic Foothills, an east-west-trending fold belt, consist of generally unglaciated ridges whose relief, shape, and surficial cover are controlled by rock resistance. Sandstones and conglomerates underlie the steepest and highest ridges, which commonly bear only a thin mantle of talus. Shales and siltstones underlie more subdued ridges, which commonly are covered by thick deposits of ice-rich silty loess and colluvium. The Noatak Lowlands, which form a broad intermontane trough, were dammed by glacier ice during several episodes of late and middle(?) Pleistocene glaciation (Hamilton and Ashley, 1983). This depression is filled with a complex of glacial, glaciolacustrine, glaciofluvial, and fluvial sediments with a probable maximum thickness of several hundred meters.

Permafrost is continuous throughout the map area. Depth of the active layer ranges from 20 to 40 cm in poorly drained deposits beneath thick sod and peat to half a meter or more in permeable coarse-grained sediments. Unfrozen zones several tens of meters thick may exist beneath the larger lakes and rivers. Although total thicknesses are unknown, records elsewhere in northern Alaska (e.g. Ferrians, 1965; Williams, 1970) suggest that the base of permafrost may lie at depths of 150 to 250 m in much of the map area.

This map has been prepared with partial support of the Bureau of Land Management, Department of the Interior. It is a generalized version of U.S. Geological Survey Miscellaneous Field Studies Map MF-1677, Surficial geologic map of the Howard Pass quadrangle, Alaska (Hamilton, in press), which was based on helicopter-supported field mapping during 1977, 1979, and 1982. Seventy-one surficial geologic map units were defined in MF-1677, and these have been generalized into 12 units on this map to facilitate presentation of engineering properties in the form of a tabular text. The complex bedrock geology of the Howard Pass quadrangle has been mapped loeally (Chapman and others, 19764; Tailleur, Kent, and Reiser, 1966; Mayfield, Tailleur, and Sable, 1978; Nelson and Nelson, 1982), but is imperfectly known elsewhere in the map area. For this reason we have shown bedrock as a single undifferentiated unit on our map.

REFERENCES CITED

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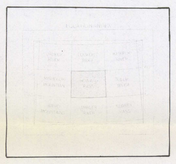
Equivalence of engineering-soils units used in this map to surficial geologic units shown on U.S. Geological Survey Map MF-1677.

This Map	MF-1677
Alluvium (al)	al, al_1, al_2, al-sa, als, sa
Terrace gravels (tg)	tg, tg_1, tg_2, Ttg, wo, wo_1 wo_2, wi, io, io_A, io_A, io_B, ii, so, so_1, so_2, sk, ao, Tgmo, gr
Younger glacial drift (dy)	wd, wd_1, wd_2, wk, id, id_A, id_B, ik, b
Older Glacial drift (do)	sd, sd_1, sd_2, ad, ad-E, ak, Tgmd, Tgmd-E, d
Glacial lake deposits (gl)	wgl, igl, igl_A, igl_B, igl/sd, igl/so, igl/sdt, sgl, sgl_1, sgl_2, l, dt
Fan deposits (f)	af, af_i, f, f_i, fd
Solifluction deposits (sf)	sf
Upland silt deposits (us)	us
Talus deposits (tr)	tr_i, tr_a
Holocene glacier and rock glacier deposits (mr)	nd, rgi, rga
Silty and peaty depression fillings (sp)	sp, tl
Colluvium (c)	c, pes
Bedrock (B)	None.



SYMBOLS

contact

Landslide

B — Discontinuous bedrock exposures seperated by thin sheetsof silt and colluvium

Description of Map Units

	Description of Materials	Distribution of and Thickness	Topography and Drainage	Permafrost	Susceptibility to Frost Action	Suitability for Construction	Special Problems
al — Alluvium	Range from poorly sorted, moderately well stratified, subangular coarse gravel near heads of mountain valleys to moderately well sorted, gravelly sand and sandy fine gravel along slow-flowing stretches of major streams. May contain local beds and lenses of sand and sandy silt. Boulders commonly are present as lag concentrations where streams cut glacial deposits. Older vegetated deposits contain overbank silt, organic silt, and fine sand above sand and gravel.	Include fan, flood-plain, and low terrace deposits that are less than 3-5 m above river level. Thickness ranges from less than 1 meter where streams cut bedrock to several meters along smaller streams and 10 meters or more along major river valleys.	Forms strips of low relief along valley centers. Active stream channels and bars are bordered by vegetated flood plains and terraces. Crescentic lakes (meander scrools) on younger surfaces are modified by thaw-lake processes into more equidimensional lakes on older surfaces. Younger surfaces generally well drained; older surfaces become progressively more marshy with increasing age.	Perennially frozen except perhaps for thaw bulbs beneath deep pools of larger rivers. Active layer 0.3 m thick beneath older vegetated surfaces; increasing in thickness to 2 m or more beneath active channels and bars. Ice wedges are present in many of the older floodplains and low terraces. Silty channel fillings commonly contain abundant ice lenses and disseminated ice.	Granular alluvium having silt content below 6 percent is generally not frost susceptible. Fine-grained, organic-rich overbank deposits and channel fillings are highly frost susceptible.	Gravel and sand provide good foundations, except where thin and underlain by clay or ice-rich silt. Granular borrow material limited, except for the largest streams. Organic-rich silt of thaw lakes and channel fillings is not suitable for foundations.	Subject to bank erosion, channel scour, and seasonal flooding, except on the highest terraces. Aufeis forms along some channel segments during winter months. Access may be difficult owing to breakup and freeze-up processes and to winter ice cover.
tg — Terrace gravels	Gravel or sandy gravel, subrounded to well rounded, of variable composition. Bears mantle 0.3 to 10 m thick of ice-rich silt, organic silt, sand, or peat (loess or solifluction deposits). Older terraces generally have greater silt content and thicker loess and solifluction cover than younger terraces.	Extend along river valleys as paired strips that border modern and recent alluvium. Sediments generally range in thickness from 5 to 20 m, and occur in terraces that stand up to 60 m above modern river levels. Bedrock commonly is exposed beneath gravel in the highest terraces.	Forms gently sloping, benchlike terraces that border modern streams and their floodplains. Drainage poor to very poor, with marshes and thaw lakes common.	Entirely underlain by near-surface permafrost, with active layer generally 0.3 to 0.5 m thick. Ice content moderate to high; ice wedges commonly present.	Organic-rich silty loess and solifluction deposits that cap the gravels are highly frost susceptible. Underlying gravels are not frost susceptible except where silt has infiltrated from above and filled intergranular voids.	Overlying deposits of ice-rich silt require special techniques such as insulated pads or thermopiles for foundations.	Drainage generally is poor because of frozen state and overlying fine-grained deposits. Overlying deposits are subject to thermal erosion where insulating vegetation is damaged. Subject to gullying along terrace edges.
dy — Younger glacial drift	Unsorted to poorly sorted, generally nonstratified, compact till ranging in composition from muddy sandy gravel to gravelly muddy sand, with local stratified ice-contact deposits consisting of moderately sorted sand and sandy gravel. Boulders are abundant in most deposits.	Restricted to mountain valleys in southern part of map area. Thickness variable, ranging up to several tens of meters.	Forms sharply defined lobate bodies with narrow-crested (1-10 m) arcuate moraines, hummocky kame and kettle topography, and flat-topped, discontinuous kame terraces and kame deltas. Crests and upper slopes typically gravelly and well drained; lower slopes and swales of older deposits are filled with 2 to 5 m of poorly drained silt and organic silt.	Entirely underlain by permafrost, with active layer thickness ranging from 0.5 m in moist swales up to 2 m on unvegetated moraine crests. Ice content generally low to moderate, but silty depression fillings may be ice rich.	Gravelly glacial deposits having silt content below 6 percent are generally not frost susceptible. Compact unsorted tills are moderately frost susceptible; silty depression fillings are highly frost susceptible.	Sand and gravel deposits provide good foundations, but irregular relief and steep slopes cause problems for heavy equipment. Clay- and silt-rich tills provide unstable foundations, especially on slopes.	Subject to solifluction and earthflows on slopes. Deposits within steep-sided mountain valleys are subject to landslides, rockfalls, and snow avalanches. Boulders in till deposits may cause problems in excavation and drilling.
do — Older glacial drift	Unsorted to poorly sorted, generally nonstratified, compact till ranging in composition from muddy sandy bouldery gravel to gravelly muddy sand. Local stratified ice-contact deposits consist of moderately sorted sand and sandy gravel. Generally weathered, with increased silt and clay content through weathering profile. Generally covered by thick (more than 2-3 m) blanket of nonstratified to weakly stratified silt, stony silt, and organic silt (loess, solifluction, thaw-lake, and muskeg deposits).	Most extensive along valleys of Kuna and Etivluk rivers and their tributaries in foothills north of the Brooks range. Thickness ranges up to several meters.	Forms undulating till plains and low broad morainal ridges with gentle flanking slopes (except where steepened by postglacial erosion). Poorly drained except where slopes have been steepened postglacially.	Entirely underlain by permafrost, with active layer ranging in thickness from 0.3 m beneath heavy sod cover to about 1 m across lightly vegetated moraine crests. Ice content of glacial deposits generally moderate, but silt cover generally is ice rich.	Compact unsorted tills are moderatley frost susceptible. Overlying silty deposits generally are highly frost susceptible, as are weathered tills with secondary silt enrichement.	Clay- and silt-rich tills provide unstable foundations, especially on slopes. Overlying deposits of ice-rich silt are generally unsuited for construction, and require special techniques such as insulated pads or thermopiles.	Subject to solifluction and earthflows on slopes. Overlying deposits are subject to thermal erosion where insulating vegetation is damaged. Boulders in till deposits may cause excavation and drilling problems.
gl — Glacial lake deposits	Stony silt, stony clayey silt, and silty sand, faintly bedded to structureless, with disseminated stones up to boulder size. Contain some interstratified layers and lenses of poorly sorted gravel. Grades laterally into sandy and gravelly beach deposits in some places. Older deposits commonly have surface blankets of silt, stony silt, and organic silt (loess, solifluction, and thaw-lake deposits).	Widespread through southern third of map area. Particularly extensive across floor of Noatak valley and lower courses of its principal tributaries. Thickest in valley centers; thinning toward valley sides. Maximum known thickness in river bluffs is 63 m, but total thickness in center of Noatak valley probably exceeds 100 m.	Flat to gently undulating surfaces, rising toward valley sides at gentle (less than 3°) gradients. Thaw lakes common. Drainage generally very poor, with widespread pools and marshes.	Entirely underlain by permafrost, with active layer generally less than 0.5 m thick. Ice content of younger and more sandy lake deposits is low to moderate; ice content of older deposits generally is high. Overlying silty deposits are extremely ice rich, and commonly contain ice wedges.	Most deposits are highly frost susceptible.	Unsuitable for most construction activities. Limited construction may be possible if special techniques such as insulated pads or thermopiles are employed. Discontinuous bench deposits along margins of Noatak basin provide locally favorable routes for transportation lines.	Generally unstable on slopes. Subject to slides and flows on river bluffs. Clay-rich subsurface deposits form mud volcanoes and other extrusions where overburden removed, as by river incision. Scattered boulders may impede drilling or excavations. Subject to thermal erosion following disturbance of vegetation cover.
f — Fan deposits	Very poorly sorted, weakly stratified, subangular, silty sandy coarse gravel to moderately sorted and stratified, subrounded to rounded, sandy gravel. Also includes (1) coarse, very poorly sorted, subangular to subrounded, silty sandy gravel of steep alpine fans and (2) well sorted silt, sand, and fine gravel of fan-deltas.	Occur through southern half of map area at mouths of avalanche chutes, steep mountain canyons, and larger tributary valleys with gentler gradients. Generally a few tens of meters thick, but some fans may be more than 100 m thick.	Fan-shaped to conical sloping surfaces with gradients ranging from 12°-25° (steep alpine fans) to 3°-7° (alluvial fans at mouths of larger valleys). Generally well drained, but older portions of some fans may be marshy where silt cap overlies fan gravels.	Entirely underlain by permafrost, with active layer generally ranging in thickness from 0.5 m on vegetated older fans to 2-3 m beneath active stream channels. Ice content low to moderate, but overlying loess and solifluction deposits generally are ice rich where thick and extensive. Ice wedges locally present.	Moderately frost susceptible where poorly sorted and silty. Overlying deposits of organic-rich silt are highly frost susceptible.	Generally suitable for construction except where overlying deposits are thick and ice rich or where silt has been concentrated by weathering in older fan deposits. Larger fans generally are excellent sources of borrow materials.	Aufeis accumulation commonly occurs along stream channels during winter months. Steep alpine fans are subject to snow avalanches and slushflows during spring and debris flows during summer.
sf — Solifluction deposits	Very poorly sorted, nonstratified to weakly stratified, stony silt and organic silt. Beds, lenses, and platy stones, where present, generally are oriented parallel to surface slope.	Forms widespread deposits on gentle to moderate slopes beyond limits of glacial deposits north of Brooks Range. Locally present farther south on older glacial deposits and on shale bedrock. Thickness generally 0.5 m to 3 m; locally up to 5 m thick in depressions at slope bases.	Forms smoothly sloping aprons and sheets that commonly occupy middle and lower flanks of hills, ridges, and mountain flanks. Moderately to poorly drained, with marshy surfaces and some standing water.	Entirely underlain by permafrost, with active layer generally 0.3 to 0.5 m thick. Ice content low to moderate in alluvial gravels, but overlying loess and solifluction deposits generally are ice rich. Ice wedges common.	Highly susceptible to frost action.	Unsuitable for construction. Limited construction may be feasible using special techniques to preserve permafrost and to limit damage due to downslope movements.	Subject to downslope movement at rates up to several cm per year. Disturbance of insulating vegetation may cause development of bimodal failures ("tundra earthflows").
us — Upland silt deposits	Moderately sorted silt, organic silt, and slightly clayey, sandy or stony silt. Generally structureless, but may contain contorted lenses of peat or organic-rich silt. Generally bears tussock cover broken by frost boils.	On uplands of low to moderate relief, primarily within northern 25 percent of map area. Grades laterally into solifluction deposits on slopes steeper than about 1° - 2°. Thickness ranges from less than 1 meter to about 10 m.	Occupies higher parts of gently rolling ridge and valley terrain. Drainage generally poor, except on steep slopes and hillcrests. Bears abundant thaw-lake basins, both modern and relict.	Entirely underlain by permafrost with active layer 0.3 to 1 m thick. Contains ice wedges and very high volume of ice as interstitial grains, masses and lenses.	Highly frost susceptible in most localities.	Extremely sensitive to disturbance during construction due to high ice content. Limited construction may be feasible using special techniques to preserve permafrost.	Subject to thermokarst processes where vegetation cover disturbed. Readily gullied by running water on slopes where vegetation has been disturbed or where sheet flow is concentrated by construction activities or other surface disturbance.
tr — Talus deposits	Angular, unsorted, nonstratified rock debris. Maximum size is controlled by lithology, ranging from a few centimeters at edges to 100 m or more in centers of cones and aprons. Also forms thinner (0.5 to 1.5 m) and generally discontinuous sheets over many uplands mapped as "bedrock".	Occur along lower walls of mountain valleys and in cirques at valley heads. Thickness ranges from a few centimeters at edges to 100 m or more in centers of cones and aprons. Also forms thinner (0.5 to 1.5 m) and generally discontinuous sheets over many uplands mapped as "bedrock".	Forms cones and aprons with surface slopes generally 30° - 35°. Generally well drained, especially where deposition is active and debris is unvegetated.	Entirely underlain by permafrost with active layer generally 1-2 m thick. Rock rubble generally is ice-cemented below a few meters depth due to percolation and freezing of rainwater and snow meltwater.	Generally not frost susceptible where older and stabilized talus rubble has accumulated secondary silt through weathering or infiltration.	Generally not suitable due to steep slopes, unstable debris blocks, and continued influx of rock rubble. Older and more stable talus deposits are suitable for limited use, especially where surface slopes have been lowered below angle of repose. Good source of construction materials.	Subject to rock falls, slush avalanches, debris flows, and other alpine slope hazards. May undergo deep-seated creep due to deformation of interstitial ice.
mr — Holocene glacier and rock glacier deposits	Very poorly sorted, nonstratified, fine to coarse angular rock debris. Glacier deposits commonly have matrix of finer debris in silt-to-sand range. Rock-glacier deposits contain abundant interstitial ice.	Most common in higher cirques and valleys of Siniktanneyak Mountain and in adjoining parts of De Long Mountains. Thickness variable; generally about 30-100 m. Glacier deposits typically are restricted to cirques; rock-glacier deposits occur both in cirques and along bases of steep valley walls.	Glacier deposits form steep-fronted, lobate rubble masses that extend outward from cirque headwalls. Rock-glacier deposits, where active, have steep (25° - 28°) and highly unstable frontal slopes that meet upper surfaces at abrupt angles. Inactive rock glaciers have gentler, more rounded, more stable frontal slopes. All deposits are well drained.	Entirely underlain by permafrost with active layer generally 0.5-2 m thick. Rock-glacier deposits are ice-cemented below a few meters depth.	Generally not frost susceptible except where secondary silt has accumulated in older inactive deposits.	Generally not suitable due to steep slopes, unstable debris blocks, and remote locations. Good source of construction materials for transportation corridors traversing rugged alpine terrain.	Subject to rock falls, slush avalanches, debris flows, and other alpine slope hazards. Rock-glacier deposits move at rates up to several centimeters per year due to deformation of interstitial ice.
sp — Silty and peaty depression fillings	Weakly stratified to nonstratified silt, organic silt, clayey to sandy silt, and peat. Commonly ice rich.	Most common on floor of Noatak valley and on uplands and terraces in northern part of map area. More widely scattered elsewhere. Thickness ranges from about 2 m to 10 m or more.	Generally associated with thaw-lake basins and with other topographic depressions, generally in areas of locally gentle relief. Poorly drained, with ponds and marshes common.	Entirely underlain by permafrost. Active layer about 0.5 to 1 m thick; locally thicker beneath ponds and lakes. Thaw bulbs (taliks) occur beneath lakes deeper than about 2 m. Generally ice rich, with ice wedges and lenses common.	High moisture and high silt content make this unit extremely susceptible to frost action.	Unsuitable for structures and as source of construction material. Limited construction feasible only if special methods are employed to preserve permafrost.	Subject to severe thaw settlement if insulating vegetation cover is disturbed. Commonly flooded during spring snowmelt season.
c — Colluvium	Silty, angular, unsorted rock debris on upper slopes; grading downslope into rubbly solifluction deposits (poorly sorted, nonstratified to weakly stratified stony silt, and organic silt). Interfingers with alluvium (coarse to fine gravel and sandy gravel) beneath floors of narrow mountain valleys.	Most common along walls of mountain valleys above and beyond limits of Younger Glacial Deposits. Thickness ranges from 1-2 m up to several tens of meters. Includes widely scattered landslide deposits east of Nigu River, at south flank of Avingnak Hills, and within De Long Mountains near head of Wager Creek.	Forms sheets and aprons on middle and lower valley walls. Upper slopes tend to be relatively steep (up to about 30°), and relatively well drained. Lower slopes are gentler (about 5° - 10°), more silty, and poorly drained.	Entirely underlain by permafrost. Rubbly deposits of upper slopes have thicker (1-2 m) active layers and generally lower ice contents. Silty deposits of lower slopes have thinner active layers (about 0.5 m) and commonly are ice rich. Ice wedges commonly are present on lower slopes.	Upper slopes moderately frost susceptible. Lower slopes subject to frost heave, thaw subsidence, solifluction, and other processes related to freezing and thawing.	Upper slopes are steep, subject to frost creep, and commonly exposed to alpine mass-wastage hazards. Lower slopes are subject to slow flowage, and gullveying or bimodal failures are likely if deposits are ice rich. Silt content generally too high to permit use as construction material.	Subject to landslides, snow avalanches, debris flows, and rockfalls. Lower slopes subject to slow or rapid flowage, thermal erosion, or thaw settlement if insulating vegetation is disturbed.
B — Bedrock	Hard to friable limestone, quartzite, sandstone, shale, and siltstone of Devonian through Cretaceous age, with local masses of volcanic and ultramafic rock in the De Long Mountains. (Stippled pattern designates discontinuous bedrock exposures separated by sheets of silt and colluvium; patterniess areas are generally continuous bedrock exposures.)	Extensive exposures through Brooks Range and De Long Mountains; forms narrower east-west trending ridges farther north in Arctic Foothills. Exposed thicknesses up to 1000 m in the mountains and 400 m in the foothills.	Underlies slopes of rugged to moderate steepness and relief in Brooks Range and De Long Mountains. Forms elongate ridges with gentle to moderate flanking slopes in Arctic Foothills.	Permafrost extends into bedrock throughout map area. Active layer thickness highly variable owing to variations in rock type, overlying soils and vegetation, slope steepness, and slope aspect. Permafrost depth uncertain, but probably in order of 200 ±50 m.	Shale and siltstone subject to frost heaving, especially where weathered. All rock types subject to frost shattering along joints and bedding planes.	Highest and steepest slopes generally contain durable rock types that are suitable for construction materials.	Locally subject to landslides (shown by hachures on map).

ENGINEERING - GEOLOGIC MAPS OF NORTHERN ALASKA - HOWARD PASS QUADRANGLE

by

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1984