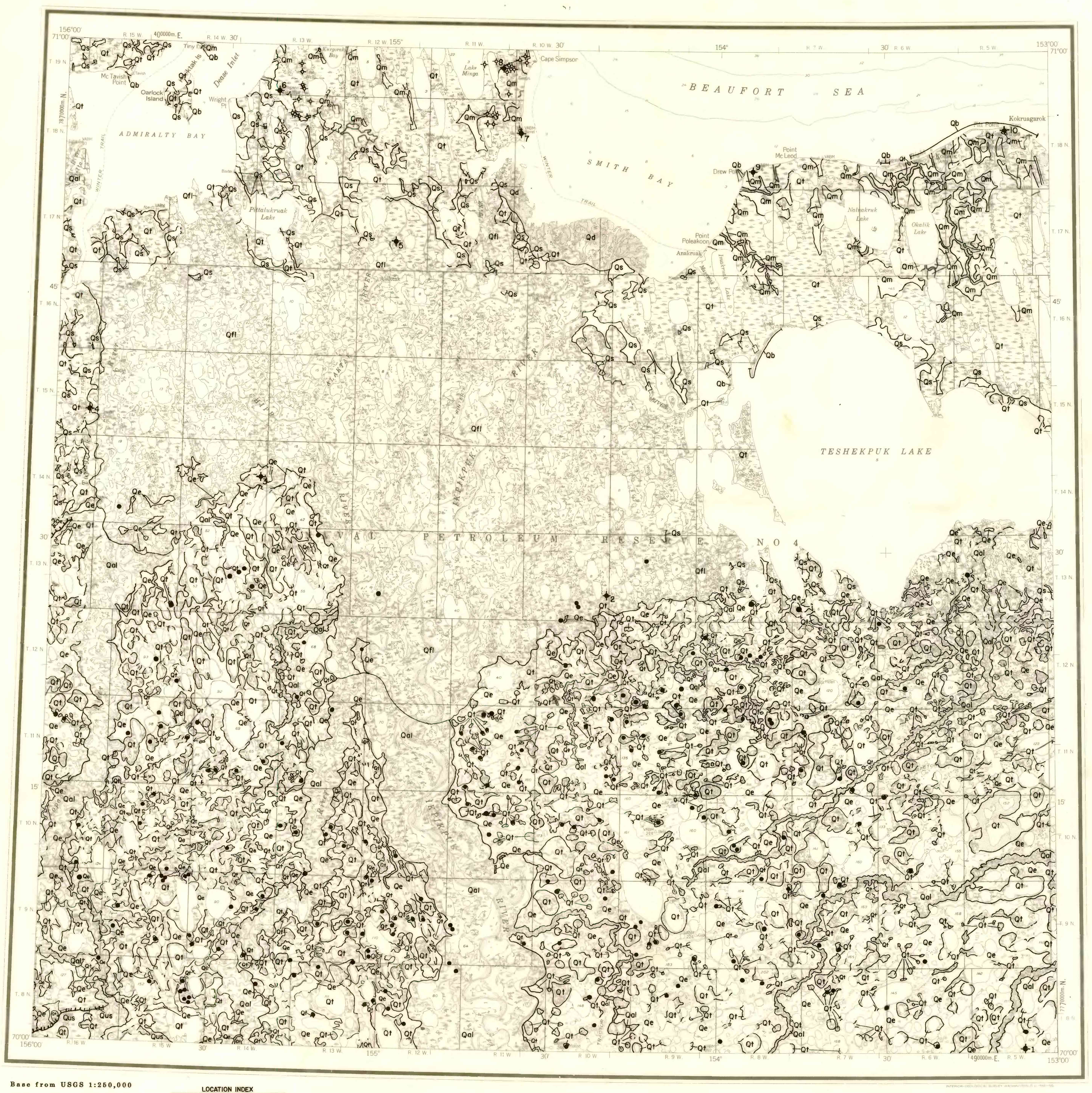
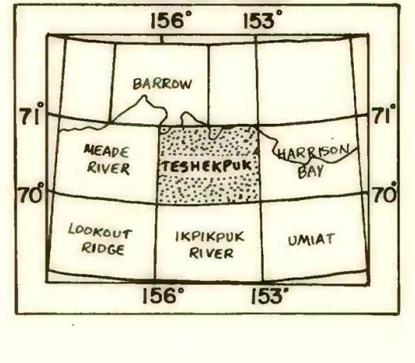
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

OPEN-FILE REPORT
83- 634

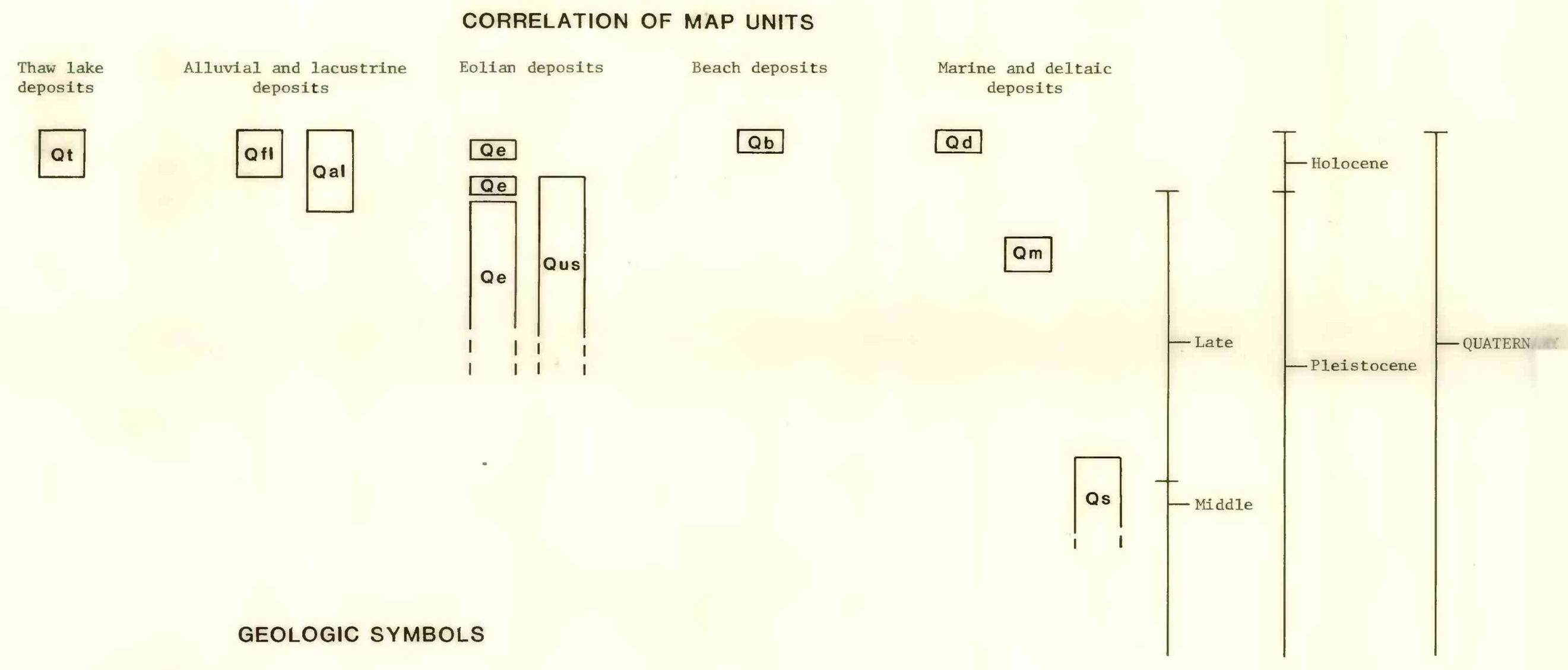


Base from USGS 1:250,000
TESHEKPUK, 1955, 100 ft



Geology mapped in 1977-82.
Pingos from Galloway and Carter (1979).

CORRELATION OF MAP UNITS



GEOLOGIC SYMBOLS

───	Contact
┷┷┷	Scarp, hachures on downslope side
●	Pingo
⌖	Core test (see Robinson, 1964)
✦	Test well (see Bird, 1982)

1. Inigok 1	6. Simpson 1
2. Ikpikpuk 1	7. E. Simpson 1
3. E. Topagoruk 1	8. E. Simpson 2
4. Topagoruk 1	9. Drew Point
5. S. Simpson 1	10. J. W. Dalton

Introduction

This preliminary report presents information obtained by fieldwork during the summers of 1977-1982. Fieldwork during 1977 and 1978 was done in support of Chapters 105b (Environmental Impact Assessment) and 105c (Land-Use Study) of the National Petroleum Production Act of 1976 (PL 94-258). From 1979 through 1981 fieldwork was carried out as a part of the U.S. Geological Survey's Arctic Environmental Studies Program. Fieldwork in 1982 and the production of this report was done as part of the Northern Alaska Engineering Geology Project, for the purpose of providing engineering/surficial geologic information to the Minerals Management Service and the Bureau of Land Management.

Assistance in the field was provided by Marc P. Springer (1977) and John P. Galloway (1978-1982).

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DESCRIPTION OF MAP UNITS

	Description of materials	Distribution and thickness	Topography and drainage	Permafrost	Susceptibility to frost action	Suitability for construction	Special Problems
Qt Thaw lake deposits	Lithology dependent upon the materials in which the thaw lake develops. In the area underlain by marine silt and clay (Qm) north of Teshekpuk Lake and between Smith Bay and Dease Inlet the lake deposits consist of silt and clay. Lake deposits developed in unit Qs are fine to medium sand and silty sand; those in eolian sand consist of fine sand, and lake deposits formed in the upland silt unit are composed of silt to very fine sand. All of the deposits contain disseminated detrital organic matter and chunks of peat of various sizes. Detrital wood is common in lake deposits developed in the upland silt unit. Scattered, discrete, cobble to boulder-sized erratics and lenses of granules to small pebbles occur where the lake deposits are developed in Qm or Qs. Unit includes the deposits of minor streams that cross or connect lake basins.	Occurs throughout the quadrangle but not differentiated in alluvium or the area of fluvio-lacustrine deposits. Generally less than 3 m thick except where developed in Qus where a thick ness of 11 m has been reported (Williams and Yeend, 1979).	Forms flat to moderately dissected areas within isolated, interlocking, or overlapping basins. Maximum surface relief within basins is determined by the degree of dissection and presence of pingos, and ranges from about 3 m for deposits developed within units Qs and Qm to about 10 m for deposits developed within units Qe and Qus. Maximum relief between basin floors and surrounding areas ranges from about 5 m for basins developed in units Qs and Qm to about 15 m for thaw lake basins formed in units Qe and Qus. Pingos occur primarily in lake deposits developed in Qe (Galloway and Carter, 1978; Carter and Galloway, 1979) and attain a maximum height of about 10 m. Drainage is poor except in those basins in the upland silt and eolian sand units that have been breached and deeply dissected.	Perennially frozen beneath an active layer about 0.5 m thick. Amount of excess ice largely dependent upon the age of the deposit; early Holocene deposits are ice-rich, whereas the deposits and subjacent strata of recently drained bsins may have relatively low ice contents. However, wedge ice in the subjacent strata may have survived the lake episode if the lake was shallower than about 2 m.	Highly frost susceptible where developed in Qus or Qm. Susceptibility in remainder of area varies within individual lake deposits depending upon silt content and amount of detrital organic matter; deposits in the central part of lake basins generally very susceptible due to concentration there of silt and organic matter.	Generally unsuitable as a source of materials due to silt and organic content and due to seasonal flooding of the lake basins by snow melt. Deposits become less suitable with age as construction sites due to increasing amount of excess ice with age.	Differential settlement may occur upon thaw. Very poor drainage except where deeply incised. Commonly contains massive ice in the form of pingos where developed in Qe.
Qal Alluvium	Stratified deposits of fine to medium sand and silty sand. Contains detrital wood and chunks of detrital peat. Includes deposits of flood plain lakes and thaw lakes on terraces. Organic-rich silt occurs as thin overbank deposits and as thicker lacustrine deposits that fill abandoned channels. Includes eolian dunes common modern point bars.	Occurs as deposits of the Ikpikpuk, Oumalik, and Topagoruk Rivers that head in foothills south of the Teshekpuk quadrangle, and of minor streams that head in the eolian sand unit. Includes flood plain and alluvial terrace deposits as much as 15 m above modern streams. Probably not more than 5 m thick along modern channels; terrace deposits as thick as 15m.	Forms channels and bars of the modern rivers and terraces of older river courses. Meander scrolls are well preserved on the lowest terraces, but have been nearly to completely obliterated by thaw lake activity on the highest terraces. Terrace drainage generally poor. Subject to flooding to 6 or 8 m above low water on some streams.	Permafrost underlies the entire unit. Active layer on modern channels and bars perhaps as much as 2 m thick; on terraces and away from lakes about 0.5 m thick. Ice wedges are well developed in the terrace materials, and the silty deposits that form the filling material of abandoned channels contain abundant intergranular ice.	Organic-rich silty materials that fill abandoned channels and form overbank deposits are highly frost susceptible. Point bar and channel deposits with less than 6 percent silt generally not frost susceptible.	Provides good foundations in channel and bar areas and moderately good to poor foundations on terraces and the older parts of floodplains. Organic-rich lacustrine silt that fills abandoned channels not suitable for foundations. Gravel is not present in the alluvium of this quadrangle.	Subject to bank erosion, scour, channel shifting, and seasonal flooding. Wind erosion and dune building common on point bars and would occur on other parts of the flood plain and on terraces if surface vegetation is disturbed. Excavation of streambed materials may pose environmental problems.
Qfl Fluvio-lacustrine deposits	Undifferentiated alluvial and lacustrine very fine sand and silty sand. Lake deposits contain detrital peat.	Extends westward from Teshekpuk Lake to just beyond the Topagoruk River. Thickness undetermined but probably no more than 10 to 15 m.	Forms coalescent fan-shaped plains containing numerous lakes, marshes, and distributary channels and abandoned channels of the Ikpikpuk and Topagoruk Rivers. Drainage poor due to low gradients.	Permafrost underlies the entire unit, with an active layer that ranges in thickness from 0.5 m to perhaps as much as 2 m beneath active channels. Materials contain abundant intergranular ice and well developed ice wedges except along active channels.	Dependent upon silt and organic content. Lake deposits probably frost susceptible, and frost susceptibility may generally increase northward across the map unit.	Poor for foundations due to excessive differential settlement on thaw of ice-rich permafrost. Channel deposits with proper silt content may be suitable for fill.	Very poor drainage. Subject to bank erosion, scour, channel shifting, and seasonal flooding. Wind erosion and dune building common on point bars. Excavation of channel materials may pose environmental problems.
Qe Eolian sand	Fine sand containing abundant quartz with minor dark minerals. Well sorted, stratified, with large-scale cross bedding in places. Contains peat beds and wood in upper few m.	Occupies most of the southern half of the quadrangle. Thickness ranges from a few m to more than 30 m, and is generally thickest east of the Ikpikpuk River.	Forms generally well drained dune ridges as much as 30 m high. Contains poorly drained depressions that are not part of an integrated drainage system.	Permafrost underlies entire unit; active layer less than 1.5 m thick on well drained slopes and summits and less than 0.5 m thick in poorly drained depressions. Ice wedges occur in the upper few m but the remainder of the deposit is generally free of excess ice. However, the presence of deep lakes east of the Ikpikpuk River (Sloan and Snyder, 1978) suggests that these deposits may overlie sediments that contain large amounts of massive ice.	Generally non frost susceptible, except where silt content exceeds 6 percent.	Adequate for natural foundations but requires stabilization for use as a surfacing material, fill, etc. Relatively easy to excavate with a ripper on well drained dune ridges.	Extremely susceptible to wind erosion when protective vegetation is removed, or if used. as surfacing material or fill without binder. Very sensitive to surface disturbance.
Qus Upland silt	Predominantly wind blown silt in the upper few m, with silty sand and fine sand common at greater depths. Includes some clay and layers and lenses of chert granules and pebbles in basal few m. Stratification indistinct, but locally indicated by detrital wood and peat. Deposits are calcareous and generally well sorted.	Occurs only in the southwest corner of the quadrangle. Ranges from a few m to as much as 30 to 40 m thick.	Forms flat to gently rolling terrain broken by deep thaw lake basins, major stream valleys, and ravines. Drainage good on slopes, fair to poor on flatter surfaces.	Contains large ice wedges and a very high volume of interstitial ice. In some areas ground ice may occupy 45 to 90 percent of the volume of subsurface materials to a depth of 15 m (Lawson, 1982). Active layer about 0.5 m to as much as 1.5 m thick at well drained sites.	Silt and silty sand are frost susceptible.	Not suitable for borrow except as binder material. Not suitable for foundations because of excessive differential settlement on thaw of ice-rich permafrost.	Easily gullied by running water when water is channeled by construction activities or when surface vegetation is removed. Disruption of surface vegetation may cause melting of large ice masses and lead to as much as 10 m of subsidence.
Qb Beach deposits	Marine and lacustrine deposits of gravelly sand and sand, locally with considerable amounts of detrital organic material including peat and wood. Gravel composed of chert, red granite, pink quartzite, dolomite, diabase, and other lithologies, and is derived from erosion of units Qm and Qs. Occasional erratic boulders to 1 m or more in diameter.	Present along the Beaufort Sea coast, Dease Inlet, and the north shore of Teshekpuk Lake. Deposits are thin and narrow, generally from 1 to 3 m thick and from 10 to 50 m wide.	Forms low ridges along and slightly inland from the modern shorelines. Drainage good on ridges but where more than one ridge is present the inter-ridge areas are poorly drained.	The active layer on presently forming beaches and spits may be as much as 2 m thick. Inactive beach ridges may have actively growing ice wedges. Probably contains less total ice than in sandy and silty deposits of other map units.	Granular materials not susceptible to frost action.	Poor for concrete due to chert content and unsuitable size grading. Otherwise, generally good except may require addition of binder for surfacing or base course. Materials of limited volume.	Subject to ice shove along shore and along the Beaufort Sea and Dease Inlet coasts subject to storm surge flooding below 3 m in altitude. Excavation of actively forming beaches need impact evaluation to determine effect of borrow on coastal erosion and deposition.
Qd Deltaic deposits	Silt and very fine sand. Contains some very fine-grained detrital organic matter.	Occurs at the mouth of the Ikpikpuk River. Thicknesss unknown, but probably no more than 3 m.	Forms channels and islands of the modern Ikpikpuk River delta. Very poorly drained.	Islands are underlain by permafrost and contain active ice wedges. Channels probably also underlain by permafrost at depth.	Highly frost susceptible.	Not suitable for borrow except possibly as binder, but excavation may pose environmental problems and would be subject to flooding. Not suitable for foundations due to frost susceptibility, poor drainage, and frequent channel shifts.	Subject to seasonal flooding, bank erosion, scour, and channel shifting.
Qm Marine silt and clay	Clayey silt, silty clay, and minor sandy silt. Includes thin, superposed marine deposits of two or more marine transgressions. The uppermost of these contains scattered ice-rafted pebbles, cobbles and boulders of red granite, pink quartzite, dolomite, and other rocks not found in streams draining the north flank of the Brooks Range. Also present are the remains of marine mammals, mollusks, foraminifers, and ostracodes. These deposits have been extensively reworked by thaw lake activity and are overlain by 1 to 2 m of peat.	Occupies the northern part of the quadrangle east of Dease Inlet. Thickness not determined, but extends at least to the base of coastal bluffs that are as much as 6 m in height.	Forms poorly to moderately well drained surfaces isolated by thaw lake basins.	Perennially frozen beneath an active layer that is generally less than 0.5 m thick. Active ice wedges well developed and fossil ice wedges locally occur at depths of a few m. Interstitial ice content in excess of natural voids down to 6 or 8 m below surface and may produce more settlement upon thawing than the 3.3 m noted in marine sand near Barrow (Hussey and Michelson, 1966).	Highly frost susceptible when unfrozen.	Not suitable for foundations because of excessive differential settlement on thaw of ice-rich permafrost. Construction materials not readily available.	Easily eroded. Silt has high liquefaction potential when thawed.
Qs Marine sand over silt and clay	Predominantly silty sand with scattered granules and pebbles, but along the north edge of the unit includes pods of pebbly sand that are probably barrier island deposits. These are best exposed along the north shore of Teshekpuk Lake and on both sides of Dease Inlet opposite Oarlock Island. The pebbles consist of chert of probable Brooks Range derivation and of the exotic lithologies described for Qm. The barrier island deposits contain abundant marine mollusks, foraminifers, and ostracodes, sparse sea mammal remains, and locally common driftwood. Elsewhere, the sand contains sparse remains of marine mollusks, ostracodes, and foraminifers. Disconformably underlying the marine sand at altitudes that range from sea level to about 2 m is marine silt and clay that contains pebble, cobble, and boulder-sized dropstones of the lithologies described for Qm. The silt and clay contains marine ostracodes and foraminifers, but no mollusks have been collected within this quadrangle. Overlying the marine sand west of the Topagoruk River is thin eolian sand and peat. Elsewhere, the sand is overlain by thin lacustrine or deltaic deposits and by peat.	Occurs over a broad area in the north half of the quadrangle. The sand ranges from 4 to 6 m thick, and the underlying marine silt and clay is of undetermined thickness. The overlying deposits are generally 1 to 4 m thick.	Forms residual surfaces between thaw lake basins. Drainage generally good and not subject to snowmelt flooding.	Permafrost present beneath an active layer that is generally less than 0.5 m thick. Ice wedges well developed and high interstitial ice content. Similar deposits near Barrow are supersaturated with ice down to about 6 or 8 m (Sellmann and others, 1975), with ice content of 75% by volume at a depth of 1 m, exclusive of wedge ice.	Sand marginally frost susceptible, depending on silt content. Silt and clay highly frost susceptible when thawed. Overlying lacustrine or deltaic deposits are highly frost susceptible.	Not suitable for foundations because of excessive differential settlement on thaw of ice-rich permafrost. Sand may be suitable for fill, base course, or surfacing if silt content is appropriate and if stabilized to prevent deflation.	Easily eroded by running water if surface vegetation is removed or if flow is concentrated by construction activities.

ENGINEERING - GEOLOGIC MAPS OF NORTHERN ALASKA, TESHEKPUK QUADRANGLE

By

L. David Carter

1983