SURFICIAL GEOLOGY OF ALASKA

Compiled by
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SCALE 1:1,584,000
1 inch = approximately 25 miles

CONTOUR INTERVAL 1000 FEET
DATUM IS MEAN SEA LEVEL

1964

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EXPLANATION

QUATERNARY

Glacial moraines and associated drift*

Recent

- Qi — Existing glaciers
- Qm_4 — Moraines and associated drift near existing glacier fronts

Pleistocene

- Qm_3 — Prominent little modified moraines and associated drift lying above or beyond boundaries of Qm_4
- Qm_2 — Modified moraines and associated drift lying above or beyond boundaries of Qm_3
- Qm_1 — Remnants of highly modified moraines and associated drift lying above or beyond boundaries of Qm_2

Glacio-lacustrine deposits

- Qg, Qgm, Qm_1 — Qg, proglacial lake deposits. Qgm, proglacial lake deposits, discontinuously mantling glacial and glacio-fluvial deposits but not completely obscuring glacial topography; age indicated by symbols

Glacio-fluvial deposits

- Qw_2 — Outwash and valley-train deposits graded to glacier fronts and recent moraines
- Qw_1 — Outwash deposits bordering older moraines: fluvial deposits further downvalley may be dissected distal parts of outwash aprons or valley trains and are included in Qat and Qaf

Fluvial deposits

- Qfp — Modern flood-plain and associated low-terrace and alluvial fan deposits
- Qat, Qaf — Qat, higher terrace deposits on valley margins and discontinuous terrace deposits in valleys where flood plains are too small to map. Qaf, alluvial-fan deposits

Eolian deposits

- Qed — Sand dunes: dotted pattern indicates areas of active dunes
- Qe, Qes — Qe, silt more than 5 feet thick, covering upland interfluve areas, predominantly eolian. Qes, thick valley bottom silt and sand, predominantly eolian but including much colluvium and stratified water-laid deposits

Coastal deposits

- Qcb, Qcd — Qcb, modern coastal beaches, spits, and bars. Qcd, coastal delta deposits
- Qcc — Older coastal deposits of inter-stratified alluvial and marine sediments, including, locally, glacial drift

Undifferentiated upland valley and lowland alluvium

- Qu — Alluvium in larger upland valleys and in lowlands of central Alaska including undifferentiated eolian, colluvial, fluvial, marine, and glacial deposits

Undifferentiated alluvium and slope deposits in mountainous and hilly regions

- Qra, Qrb, Qrc, Qrd, Qre
  - Qra, dominantly coarse rubbly deposits associated with steep-sloped mountains with high percentage of bedrock exposures
  - Qrb, coarse- and fine-grained deposits associated with moderate to steep-sloped mountains and hills with bedrock exposures largely restricted to upper slopes and crestlines
  - Qrc, dominantly fine-grained deposits associated with gently sloping hills with rare bedrock exposures
  - Qrd, deposits with high percentages of volcanic rock particles, ash, and pumice flanking volcanic cones and peaks of Quaternary and Tertiary age
  - Qre, discontinuous alluvial deposits overlying dissected unconsolidated, semiconsolidated, and locally consolidated silt, sand, and gravel of Tertiary and younger age

*The boundaries of moraine units, particularly those in mountains, are based on discontinuous as well as continuous moraines and associated drift. Most moraines are mantled by a variable thickness of loess, eolian sand, colluvium and other deposits which are not mapped. The named glacial deposits included in the moraine units are listed in the table

Contact

Major fault zone along which surficial deposits are locally offset: dashed where fault extensions are mapped from bedrock geology

▲B6 Locality of significant stratigraphic section or high level glacial drift or erratics. See list of detailed descriptions

Significant moraine boundary. Inferred position of submarine moraine boundary in part based on submarine topography; age indicated by symbol

NAMED GLACIAL DRIFTS INCLUDED IN MORAINE UNITS

MAP UNIT	COOK INLET	BRISTOL BAY	UPPER KUSKOKWIM	Mc KINLEY PARK QUAD	NENANA GORGE	BIG DELTA	SEWARD PENINSULA	NORTH SLOPE	LAKE PETERS
Qm_4	Tunnel / Tustumena	Unnamed	Unnamed	Unnamed	Clear Creek I and II	Black Rapids I and II	Unnamed	Fan Mountain	Cirque I and II
Qm_3	Naptowne / Knik	Brooks Lake / Mak Hill	Farewell I and II	Wonder Lake I and II	Riley Creek	Donnelly	Mt. Osborn	Alapah Mountain / Echooka	Peters / Schrader
Qm_2	Eklutna	Johnston Hill	Selatna	Slow Fork	Healy	Delta	Salmon Lake	Itkillik	Chamberlin
Qm_1	Caribou Hills / Mt. Susitna	Pre-Johnston Hill		Pre-Slow Fork	Dry Creek / Browne / Pre-Browne?	Darling Creek	Nome River / Iron Creek	Sagavanirktok / Anaktuvuk	Weller
REFERENCES	Karlstrom 1953; 1957 Krinsley, 1953	Muller, 1953, — in Karlstrom 1957	Fernald 1953; 1960	Reed 1955	Wahrhaftig 1953; 1958	Péwé 1953	Hopkins 1953; 1960	Detterman, 1953; Detterman and others, 1959	Holmes and Lewis 1959; 1960

LOCALITY DESCRIPTIONS OF SIGNIFICANT STRATIGRAPHIC SECTIONS OR ERRATICS

Arctic Slope

A1 Sea bluff section near village of Barrow.—Vegetation mat, 3 feet, on stratified tan sand with numerous gravel lenses and containing an extensive marine fauna, 25 feet (wood from base of unit dates greater than 38,000 yrs B.P.: W–380); on tan silt, laminated with dark staining along partings and with high percentage of included ice masses, 15 feet; on pebbly clay, 5 feet (Coulter, H. W., unpublished data, 1955)

A2 Footprint Lake, just inland from coast near village of Barrow.—Lacustrine silt, about 4 feet; on peat lens (peat dates 9100 ±260 yrs B.P.); on lacustrine silt overlying uppermost member of Gubik formation (Coulter, H. W., Hussey, K. M., and O'Sullivan, J. B., 1960, U.S. Geol. Survey Prof. Paper 400–B, Art. 160, p. B. 350)

A3 Upland till.—Weathered brownish black clayey till with sandstone schist, gneiss, black chert and limestone pebbles and cobbles, 3½ feet; underlying highly modified drift-covered upland surface with rare boulder erratics at surface (Lewis, C. R., written communication, 1959)

A4 Sea bluff section, Camden Bay.—Vegetation mat, ½ foot; on blue-gray massive silt with lenses and streaks of organic material, 12–15 feet; on buff, fine-grained, stratified sand, 3–4 inches; on clay with large particles of pink granite, coarse diabase, and gray limestone, 1–6 inches; on blue-gray silt with scattered rounded black chert and quartz pebbles, 6–10 feet; on buff sand, 6–12 inches exposed locally at base of bluff (Lewis, C. R., written communication, 1959)

A5 Sea bluff section near Manning Point.—Vegetation mat, 3–4 inches; on peat and peaty silt, max. 3 feet; on buff sand and silty sand with few scattered, rounded quartz pebbles, 12 feet (Lewis, C. R., written communication, 1959)

A6 Sea bluff section, Beaufort Lagoon.—Vegetation mat, 6 inches; on peaty silt, ca. 1 foot; on gray to buff sand with scattered lenses of gravel, 6–8 feet (Lewis, C. R., written communication, 1959)

Brooks Range

B1 North slope of Delong Mountains.—Geomorphic evidence suggests at least 2 periods of valley glaciation. Little glacial drift remains in the area which may be attributed to nearly debris-free glaciers, rapid retreat, or to their antiquity (Sable, E. G., written communications, 1960)

B2 River bluff, Killik River.—Lacustrine silt containing layers of woody organic material, 80 feet exposed above river level. The deposits record deposition in a large lake dammed by recessional moraines of Itkillik age and located downvalley from moraines of Echooka age. The thickness and character of the deposits with alternating organic and inorganic deposits suggest a long history of lake fluctuations prior to final drainage. When final drainage took place remains uncertain, but it is possible that the moraine dam may have been breached during the advance of the Echooka glaciation. C–14 analyses of wood samples taken near base of section should date an early event in the lake's history, provided a minimum date for the Itkillik glaciation, and perhaps a maximum date for the Echooka glaciation (Detterman, R. L., unpublished data, 1953; and written communications, 1960)

B3 Anaktuvuk Pass.—Wood fragments collected from permanently frozen lacustrine silt, 9 feet below present ground surface in an Eskimo cellar beside Summit (Eleanor) Lake. The wood dated 6260 ±160 yrs B.P.: Y–770, and provides a minimum for the Echooka glaciation (Porter, Stephen, written communications, 1960)

B4 Anaktuvuk Pass.—Wood fragments collected from base of 17.5-foot section of stratified gravel exposed along Inukpasugruk Creek 6.5 miles above its mouth date 2830 ±170 yrs B.P.: Y–771. The gravel constitutes an outwash fan graded upstream to an end moraine of post-Echooka age (Porter, Stephen, written communications, 1960)

B5 River bluff, Chandalar valley.—Yellowish to buff till of ground moraine along the Chandalar River in bluffs about 100 feet high (Schrader, F. C., 1900, U.S. Geol. Survey 21st Annual Rept., pt. 2, p. 441–486)

B6 Chandalar valley.—Isolated patches of drift and apparently ice-scoured slopes and summits above and beyond limits of oldest recognizable end and lateral moraines (Williams, J. R., U.S. Geol. Survey Bull. 1111, in preparation)

Interior and Bering Coastal Uplands and Lowlands

C1 River bluff, stream tributary to north channel of Kivalina River, 1.5 miles above mouth.—Windblown silt, 5–10 feet; on brown pebble gravel, 10–15 feet (possibly either marine gravel or glacial outwash with surface about 50 feet above sea level); on pebbly marine clay containing fauna indicative of late Pliocene or early Pleistocene age, 10–15 feet; on limestone bedrock of Mississippian age (Hopkins, D. M. and MacNeil, F. S., 1960, U.S. Geol. Survey Prof. Paper 400–B, Art. 157, p. B-339–B-342.)

C2 Sea bluff section, Hotham Inlet.—Organic silt, 5 feet; on stratified sand and silt, 35 feet; on organic peat and silt, 10 feet (peat dates greater than 38,000 yrs B.P.: W–344); on gray till, 50 feet (Fernald, A. T., unpublished data, 1952)

C3 Sea bluff section, Kotzebue Sound near Deering.—Cover, 20 feet; on organic silt, 20 feet; on weathered gravel, 1 foot; on green silt, 2 feet; cover, 5 feet; woody layer, 1½ feet (wood dates greater than 35,000 yrs B.P.: W–192); on green silt, 2 feet exposed at base of bluff (Hopkins, D. M., unpublished data, 1948)

C4 Submarine Beach dredging area near Nome, on south side of Snake River about 2 miles above the mouth.—Peat and silty colluvium filling casts of ice wedges, 5 feet (peat and colluvium range in age from 13,000 yrs B.P.: W–463 to younger than 2770 yrs B.P.: W–484, ice wedges thawed about 10,050 yrs : W–461 to 9690 yrs ago : W–485); ice wedges penetrate estuarine silt of "Second Beach", 10 feet (nearby "Second Beach" strand line approximately at 45 feet above sea level); on till of Nome River (Qm1) age, 21 feet; on marine sand of Intermediate Beach-Third Beach, 2 feet (Third Beach strand line at about 75 feet elevation); on till of Iron Creek age, 19 feet; on marine sand containing molluscan fauna indicative of late Pliocene or early Pleistocene age, 2 feet; on schist bedrock at an elevation of 29 feet below present sea level (Hopkins, D. M., MacNeil, F. S., and Leopold, E. B., 1960, 21st Internat. Geol. Cong. Copenhagen Proc., sec. 4, pt. 4, p. 46–57).

C5 River bluff, Koyukuk River south of Alatna.—Gravel deposit, nearly 200 feet above river level, composed of angular and subangular ice-worn pebbles with polished surfaces, commonly profusely striated (Schrader, F. C., 1904, U.S. Geol. Survey Prof. Paper 20, p. 90)

C6 River bluff, Koyukuk River near Alatna.—Predominantly stratified silt and gravel, 30–50 feet; on till-like deposit, 50 feet (Schrader, F. C., 1904, U.S. Geol. Survey Prof. Paper 20, p. 90)

C7 Alatna River valley just north of Alatna.—What appear to be till terraces (lateral moraines) occur up to a height of 1600 feet (Schrader, F. C., 1904, U.S. Geol. Survey Prof. Paper 20, p. 90)

C8 River bluff, Koyukuk River near Bettles.—About 100 feet of till exposed in bluffs (Schrader, F. C., 1904, U.S. Geol. Survey Prof. Paper 20, p. 89)

Yukon Flats

D1 River bluff near Venetie.—Thin-bedded local pond silt, 6–8 feet; on iron-stained, stratified alluvial-fan sand and sandy pebble-cobble gravel, reportedly containing mammalian fossils, more than 25 feet. The alluvial-fan gravel is interpreted as equivalent to oldest preserved moraine in Chandalar valley and of possible early to middle Pleistocene age (Williams, J. R., U.S. Geol. Survey Bull. 1111– , in preparation)

D2 Fort Yukon water well No. 2 (Alaska District, Corps of Engineers, U.S. Army, Aug. 7–Oct. 1, 1954).—Eolian sand, 48 feet; on alluvial gravel of Pleistocene age, 100 feet; on silt and silty sand interpreted as quiet water (lake?) sediments of late Tertiary or early Pleistocene age, 292 feet. Permafrost logged between 8 and 320-foot depths (Williams, J. R., U.S. Geol. Survey Bull. 1111– , in preparation)

D3 Steese Highway roadcut, mile 148 (from Fairbanks) near Circle.—Loess or slumped silt, less than 6 feet; on slightly iron-stained sandy pebble-cobble gravel containing sand lenses and locally woody material replaced by iron oxide, about 100 feet. Gravel interpreted as high-level alluvium of late Tertiary or early Pleistocene age (Williams, J. R., U.S. Geol. Survey Bull. 1111– , in preparation)

Kilbuk-Kuskokwim Mountains and Uplands

E1 Sea bluff section, Hagemeister Island.—Interbedded sand and silt (probably outwash of Qm_2 age), 60 feet; on yellow brown till of (Qm_1 age), 40 feet; on stratified sand and gravel, 30 feet (Coulter, H. W., unpublished data, 1953)

E2 Placer mining cut, Ophir.—Organic silt with extinct vertebrate fossils, 25–35 feet; on gravel, 5–6 feet; on bedrock. Above placer workings in upper part of Gaines Creek, the valley is floored with morainal deposits (Mertie, J. B., Jr., 1936, U.S. Geol. Survey Bull. 864–C, p. 184)

E3 Placer mining cut, Poorman Creek.—Organic silt, 18–68 feet; on fine gravel, 1–14 feet; on coarse gravel, 2–12 feet; on bedrock (Mertie, J. B., Jr., 1936, U.S. Geol. Survey Bull. 864–C, p. 161)

E4 Placer mining cut, Big Creek.—Silt and clay, 14–53 feet; on gravel, 1–7 feet; on bedrock (Mertie, J. B., Jr., 1936, U.S. Geol. Survey Bull. 864–C, p. 44–45)

Yukon-Tanana Upland

F1 Idaho Bar.—High level gravel deposit (maximum thickness, 100 feet) of Pliocene or Pleistocene age occurring at elevation of 1600 feet (Waters, A. E., 1934, U.S. Geol. Survey Bull. 844–D, p. 183)

F2 Happy.—Silt, 187 feet; on gravel, 46 feet; on bedrock (Péwé, T. L., 1958, U.S. Geol. Survey Geol. Quad. Map GQ–110)

F3 Goldstream.—Silt, 46 feet; on gravel, 113 feet; on bedrock (Péwé, T. L., 1958, U.S. Geol. Survey Geol. Quad. Map GQ–110)

F4 Mount Harper and Charley River areas.—Deposits in these areas record the longest glacial advances presently recognized in the Yukon-Tanana Uplands. In both areas glaciers advanced at least 15 miles downvalley from cirque heads. In some of the deposits mapped as Qm_3 there are as many as 2 or 3 distinct moraines (Péwé, T. L., written communications, 1960)

Nushagak-Upper Kuskokwim-Tanana Lowlands

G1 Sea bluff at mouth of abandoned slough, Nushagak Bay.—Organic silt and peat, 6 feet (peat collected above base of unit dates 3600 ±400 yrs B.P.: L–137J); on stratified fine estuarine sand. Date places a ceiling on a level of sea level several feet higher than present (Muller, E. H., in Breecker, W. S., Kipp, J. L., and Tucek, C. S., 1956, Sci., v. 124, p. 154–155) or consistent with the dating of the 5–10-foot strand line along the Aleutian chain and in Cook Inlet (see Aleutian Island notes nos. 2, 3)

G2 Stony River.—Buried morainelike ridge of gravel, with marked kettle-like depressions. Nearby river bluffs exposed deposits of stratified gravel and sand with scattered boulders overlain by section of well-stratified sand and mud (silt) (Smith, P. S., 1917, U.S. Geol. Survey Bull. 655, p. 93–95)

G3 River bluffs, Big River.—Peat with admixture of loess, 2 feet; on yellowish-gray loess, 10 feet; on compact peat with admixture of loess, 15 feet; on interbedded till and outwash, 70 feet (Fernald, A. T., 1960, U.S. Geol. Survey Bull. 1071–G)

Alaska Range, Talkeetna and Wrangell Mountains

H1 Riley Creek section, Nenana Gorge.—Congeliturbate and till-like deposits, 8 feet; on lacustrine clay and sand with layers of peat, 8 feet (peat from middle of unit dates 10,560 ±200 yrs B.P.: W–49); on till and drift of Riley Creek age exposed locally at base of railroad cut (Wahrhaftig, Clyde, 1958, U.S. Geol. Survey Prof. Paper 293–A, p. 45)

H2 Nenana Gorge.—Numerous granite and gabbro erratics of Brown or pre-Browne age on top of 3674-foot mountain west of Slate Creek (Wahrhaftig, Clyde, 1958, U.S. Geol. Survey Prof. Paper 293–A, p. 25)

H3 Nenana Gorge.—Erratic boulders of pre-Browne age on top of 2540-foot mountain 4 miles northeast of Browne (Wahrhaftig, Clyde, 1958, U.S. Geol. Survey Prof. Paper 293–A, p. 25)

H4 Gold King Creek.—Erratic boulders of granite and gabbro of Browne age mantle the plateau surface to the east and west of Gold King and Bonnefield Creeks at elevations of between 3000 and 4000 feet (Wahrhaftig, Clyde, 1958, U.S. Geol. Survey Prof. Paper 293–A, p. 25)

H5 River bluff section, White River, about 8 miles downvalley from Russel Glacier.—Fibrous peat full of stumps and roots, 39 feet; on gray till. Capps estimated that it took at least 7,800 yrs for the development of the 39 feet of peat and provided a minimum date for retreat upvalley from the site of the last major Pleistocene advance of Russel Glacier (Capps, S. R., 1916, U.S. Geol. Survey Bull. 630, p. 70 and 74)

Aleutian Range and Bristol Bay Lowlands

J1 Pavlof Bay, Alaska Peninsula.—Extensive, only slightly modified moraines fringe the lower slopes of Pavlof Volcano, and contain fragments of crystalline igneous rock foreign to area (Kennedy, G. C., and Waldron, H. H., 1955, U.S. Geol. Survey Bull. 1028–A, p. 14), probably derived by ice transport from ice centers that covered the Pacific islands to the south during the Brooks Lake (Naptowne) and earlier glaciations (Karlstrom, T. N. V.)

Aleutian Islands

K1 Near Islands.—Glacial deposits cover parts, or all, of the insular shelf (Drewes, Harald, written communications, 1960)

K2 Amchitka Island.—Evidence from the southeastern end of the island and adjoining insular shelf indicates that both the island and insular shelf have been extensively glaciated. Locally, the presence of stratified fossiliferous silt sand and gravel overlying glacially scoured bedrock and overlain by till record at least 2 glaciations separated by an interglacial interval of higher sea level. The glacial deposits of the island contain exotic rock types, which have not been found in place in any of the Aleutian Islands. A postglacial higher sea level stand is recorded by an elevated strand line 6–8 feet above the present datum and pre-4000 yrs old (Powers, H. A., Coates, R. R., and Nelson, W. H., 1960, U.S. Geol. Survey Bull. 1028–P). Postglacial strand lines ca. 5–10 feet above present datum are found elsewhere throughout the Aleutians, and in Cook Inlet where the culmination of this higher sea level stand has been dated ca. 3500 B.C. (Karlstrom, T. N. V., 1956, U.S. Geol. Survey Bull. 1021–J)

K3 Umnak Island.—Geologic and geomorphic evidence appears to indicate widespread glaciation of both the island and adjoining insular shelf to the south similar to that described from the Near Islands and Amchitka Island. At least 3 glaciations are recognized, the youngest is post-Altithermal (Qm_3) in age and the older is pre-Altithermal (Qm_2). Strand-line features on the island record a recent stand of sea level roughly 10 feet above present datum which probably predates 5000 yrs B.P. (Byers, F. M., 1959, U.S. Geol. Survey Bull. 1028–L, p. 342–349)

Cook Inlet Lowlands

L1 Sea bluff near Clam Gulch.—Surface peat, 5 feet; on stratified silt and gravel complex of Knik and Naptowne age, 160 feet; on poorly stratified sandy silt of Eklutna age, containing ice-rafted boulders, 35 feet; on siltstone and sandstone of Tertiary age exposed at base of sea bluffs (Krinsley, D. B., written communication, 1959)

L2 Sea bluffs, Boulder Point to Swanson River.—Soil and loess of post-Naptowne and Naptowne age, max. 4 feet; on proglacial lake deposits of late Naptowne age, max. 30 feet; on blue-gray till and stratified drift of early to middle Naptowne age, max. 200 feet; on weathered buff to gray till and stratified drift of Knik age, max. 150 feet; on deeply weathered buff to brown stratified drift and till of Eklutna age, max. 75 feet. Radiocarbon sample collected from Eklutna drift dates older than the dating range: L–117M; the only finitely dated sample collected nearby from early Naptowne deposits dates 39,000 ±2000 yrs B.P.: L–163A; and oldest basal peat from surface bogs dates 8430 ±200 yrs B.P.: L–117 and L–163B, providing a close minimum date for final drainage of proglacial water out of Cook Inlet and below the 50-foot strand line (Karlstrom, T. N. V.)

L3 Sea bluff near Point Possession.—Stratified sand, largely cliff head dune sand, 40–60 feet; on bog deposits, 8–13 feet; on glaciolacustrine blue-gray stony silt of Naptowne age, 20–30 feet; on weathered buff to gray till and stratified drift of Knik age, 30–40 feet. Basal organic silt unit of buried bog dates 10,270 ±350 yrs B.P.: W–474; a stratigraphically higher woody peat bed dates 8530 ±200 yrs B.P.: W–602, and log collected in sand 12 feet above top contact of bog dates 1530 ±200 yrs B.P.: W–838 (Karlstrom, T. N. V.)

L4 Mount Susitna.—Remnants of weathered drift and erratics of Mount Susitna age exposed at elevation of 4300 feet and above limits of lateral moraines of Caribou Hills age (Karlstrom, T. N. V.)

L5 Sea bluff west of Naptowne end moraine near Point McKenzie. Undifferentiated soil, loess and proglacial lake sand and gravel of post-Naptowne and Naptowne age, max. 10 feet; on blue-gray laminated silt with middle marine zone containing abundant marine pelecypods and gastropods, 50–60 feet; on blue-gray boulder till of Knik age, 5–15 feet exposed locally at base of bluff. Just west of location the Knik till rises higher in bluff section and terminates beneath proglacial lake sediments in a near vertical contact with highly contorted (ice-shoved) buff to brown stratified silt and sand of Eklutna age. The marine horizon records an interglacial high sea level stand between the Knik and Naptowne glaciations. Shells from this horizon collected across Knik Arm near Point Woronzof date sometime between 33,000 and 48,000 yrs B.P. by the Ionium-Uranium dating method (Sackett, W. M., 1958, Ph. D. Thesis, Washington Univ. St. Louis, Mo.)

L6 Sea bluff, Goose Bay.—Loess, dune sand, and proglacial lake deposits of post-Naptowne and Naptowne age, max. 20 feet; on blue-gray till of Naptowne age, 15–30 feet; on advance outwash, 15–20 feet (transported log near base of unit dates greater than 40,000 yrs B.P.: W–644; on lignitized and contorted peat and organic silt, 3–8 feet (wood near top dates greater than 38,000 yrs B.P.: W–174; wood near base dates greater than 32,000 yrs B.P.: W–77); on weathered buff to gray gravel, 20–30 feet; on blue-gray laminated silt with buried soil at top and middle, marine ? zone containing highly macerated calcium carbonate mollusks, 5–15 feet; on buff gravel with thin peat and soil at top, 10–20 feet; on unweathered blue-gray boulder till of Knik age exposed only at low tide (Karlstrom, T. N. V.)

L7 River bluff, Eklutna valley.—Undifferentiated soil, loess, and terrace gravel of post-Naptowne and Naptowne age, max. 20 feet; on blue-gray boulder till and stratified drift of Naptowne age, 30–60 feet; on buff to gray weathered till and stratified drift of Knik age 20–30 feet; on deeply weathered buff to brown drift of Eklutna age, max. 40 feet (Karlstrom, T. N. V.)

L8 Matanuska Glacier.—Surface peat and pond silt, 4 feet; on glacial drift of late Naptowne age. Basal peat dates 8000 ±300 yrs B.P.: W–431 (Williams, J. R., and Ferrians, O. J., Jr., 1958, Geol. Soc. America Bull., v. 69, p. 1757)

Copper River Basin

M1 West bank Tyone Creek.—Till, 3 feet; on fine gravel, about 4 feet; cover 15 feet; on interbedded silt and peat containing a few pods and lenses of oxidized sand and gravel, 8 feet exposed (peat sample near base of unit dates older than 35,000 yrs B.P.: W–357) (Williams, J. R., unpublished data, 1954)

M2 Low bank, south shore Blue Lake.—Surface peat, about 3 feet (basal peat dates 13,280 ±400 yrs B.P.: W–583); on sandy outwash gravel exposed at base of section (Williams, J. R., unpublished data, 1954, 1957)

M3 Nelchina River bluff.—Surficial eolian sand containing organic rich layers, max. 10 feet (base of unit in nearby section dates 975 ±160 yrs B.P.: W–306); on till, 47 feet; on coarse gravel 412 feet; on stratified sand containing peat beds and woody debris, 20–25 feet (organic sample dates greater than 38,000 yrs B.P.: W–295); on thick stratified to massive silt and stony silt (Williams, J. R., unpublished data, 1954, 1957)

M4 River bluff, Copper River near Gakona.—Eolian sand with peaty layers, 5–20 feet (basal peat dates 9400 ±300 yrs B.P.: W–714); on glaciolacustrine and glaciofluvial silt, gravelly sandy silt, sand, and gravel of youngest majorglaciation, 50–220 feet (wood fragments at base of unit date greater than 38,000 yrs B.P.: W–531); on glaciolacustrine and glaciofluvial silt, sand and gravel of intermediate glaciation, max. 35 feet; on till and glaciolacustrine silty clay of an older glaciation, 15–80 feet (Ferrians, O. J., Jr., Schmoll, H. R., 1957, Geol. Soc. America Bull., v. 68, p. 1726; written communication, 1959)

M5 River bluff, Gakona River.—Surface peat, 1–3 feet; on glaciolacustrine stony silt and glaciofluvial gravel and sand of youngest major glaciation, 10–20 feet (forest zone at base dates greater than 35,000 yrs B.P.: W–377); on glaciofluvial and glaciolacustrine gravel and sand of an older glaciation 10–60 feet (Ferrians, O. J., Jr., and Schmoll, H. R., 1957, Geol. Soc. America Bull., v. 68, p. 1726; written communication, 1959)

M6 River bluff, Sanford River.—Eolian sand, 5–75 feet; on glaciolacustrine and glaciofluvial pebbly silt, silt, and gravel of youngest major glaciation, 25–130 feet (peat bed 90 feet from top of unit dates 31,000 ±1000 yrs B.P.: W–843); on glaciolacustrine and glaciofluvial silt, sand, and gravel of intermediate-age glaciation, max. 40 feet; on volcanic mudflow, max. 15 feet; on gravel, max. 20 feet; on till and glaciolacustrine fine sand, and silt of an older generation, max. 75 feet (Ferrians, O. J., Jr., and Schmoll, H. R., written communications, 1959)

M7 Roadcut, Tok Highway just east of Ahtell Creek.—Thin vegetation mat; on unoxidized coarse gravel containing cobbles and a few boulders, 5 feet; on peat interbedded with fine sand and silt, 3 feet (basal peat dates 11,440 ±400 yrs B.P.: W–428, peat from top of unit dates 9240 ±300 yrs B.P.: W–487); on unoxidized coarse gravel containing cobbles and a few boulders, 4 feet; on lens of unoxidized till-like material, 1 foot; on well oxidized, well-sorted, coarse gravel, 6 feet Ferrians, O. J., Jr., and Schmoll, H. R., written communications, 1959)

Pacific Coastal Ranges

N1 Sea bluff, Ayakulik River, southwest Kodiak Island.—Unweathered till and stratified drift, 50–100 feet; on beach deposits with marine shells, 20–40 feet; on basal till and stratified drift (Maddren, A. G., 1919, U.S. Geol. Survey Bull. 692–E, p. 307). The drift contains rocks of foreign lithologies which may have come from the Alaska Peninsula (Capps, S. R., 1937, U.S. Geol. Survey Bull. 880–C, p. 168). The surface drift is correlated with the Naptowne, the basal drift with the Knik, and the intervening marine deposits with the interglacial marine zone exposed at Cook Inlet localities 5 and 6—see above (Karlstrom, T. N. V.)

N2 Tustumena Glacier, Kenai Mountains.—Bare to shrub-covered moraines of Tunnel I and Tunnel II age lie respectively 500 and 200 feet in front of Tustumena Glacier snout, and about 3 miles upvalley from forest-covered moraines of Tustumena age. Wood from buried mature forest incorporated in till of Tunnel II age and overlying till of Tunnel I age dates A.D. 1550 ±150 yrs B.P.: L–117K. The buried forest records a significant interval of retreat between Tunnel I and II glacial advances (Karlstrom, T. N. V.)

N3 Skilak Platform, Kenai Mountains.—Statistical studies of surface boulders on moraines indicate significant age differences and roughly equal intervals of time between the Naptowne, Knik, and Eklutna glaciations and a somewhat longer interval between the Eklutna, and Caribou Hills glaciations. A few granite erratics of Mount Susitna age occur on gray wacke-argillite bedrock slopes between elevations of 3500 and 4000 feet, and above lateral moraines of Caribou Hills age. Rock glaciers of both Tustumena and Tunnel age locally overlap moraines of late Naptowne age (Karlstrom, T. N. V.)

N4 Bartlett Glacier, Kenai Mountains.—Bare to shrub-covered moraines of Tunnel I and Tunnel II age lie respectively 1 mile and ½ mile downvalley from Bartlett Glacier snout. Railroad cut near Tunnel section house exposes till of Tunnel I age with incipient soil, 4–6 feet; on buried forest and soil (wood sample dates A.D. 550 ±220 yrs : W–318); on till of Tustumena III age, more than 15 feet (wood from ice-scoured log at base of till dates 420 B.C. ±100 yrs : W–78) (Karlstom, T. N. V.)

N5 Malaspina Glacier, Yakutat Bay.—Oldest belt of moraines 20 miles in front of Malaspina Glacier snout on Pacific coastal shelf is dated between A.D. 600 and 1290; the outermost moraine of a younger morainal belt between A.D. 1700 and 1791, and the intervening interval of retreat between A.D. 1290 and 1700 (Plafker, George, and Miller, D. J., 1957, Geol. Soc. America Bull., v. 68, no. 12, pt. 2, p. 1909), or contemporaneous with the Tunnel I and II moraines as dated in the Kenai Mountains (Pacific coastal ranges localities 2 and 4)

INDEX MAP SHOWING GEOGRAPHIC REGIONS

A Arctic Slope
B Brooks Range
C Interior and Bering Coastal Uplands and Lowlands
D Yukon Flats
E Kilbuk-Kuskokwim Mountains and Uplands
F Yukon-Tanana Upland
G Nushagak-Upper Kuskokwim-Tanana Lowlands
H Alaska Range, Talkeetna and Wrangell Mountains
J Aleutian Range and Bristol Bay Lowlands
K Aleutian Islands
L Cook Inlet Lowlands
M Copper River Basin
N Pacific Coastal Ranges

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