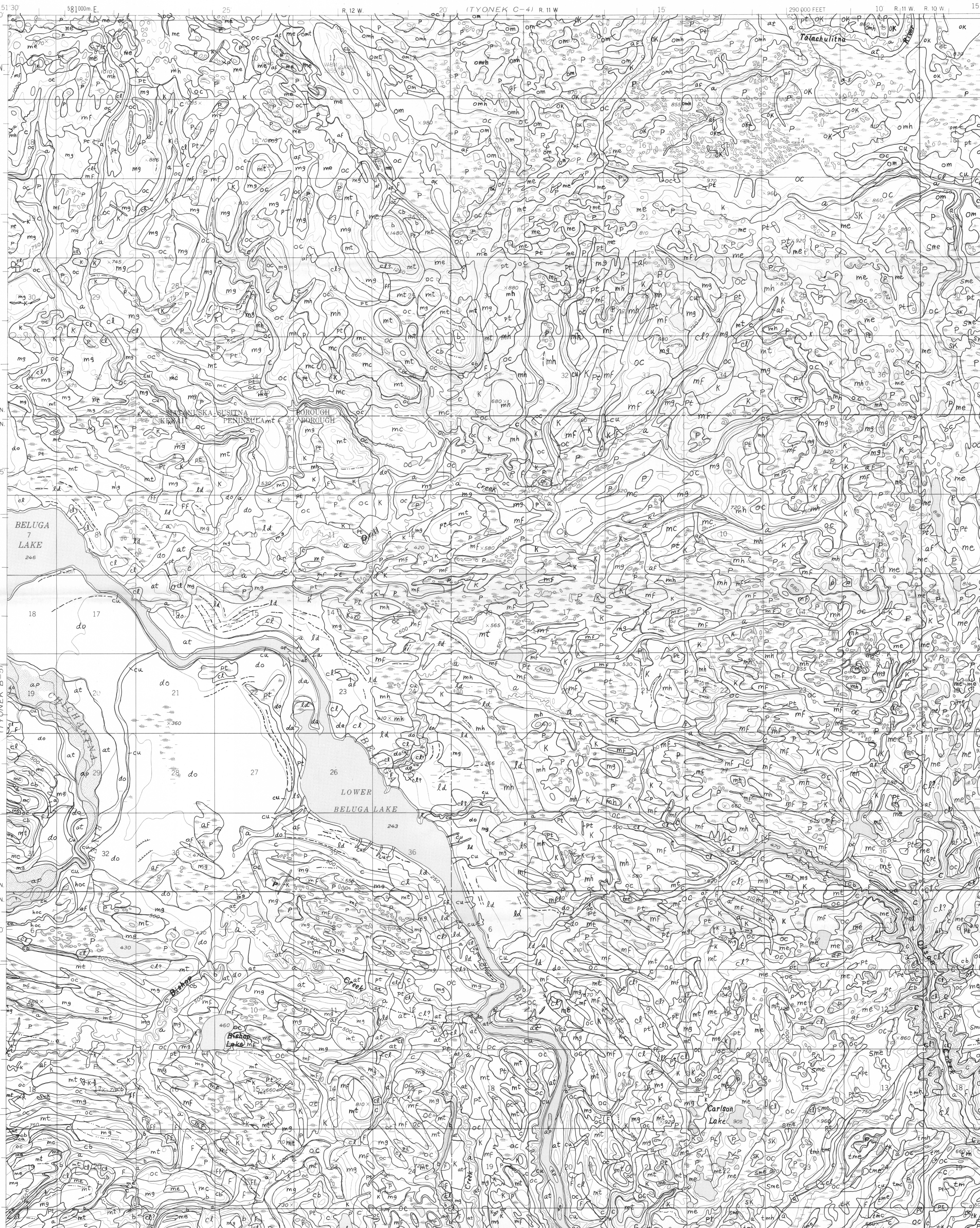
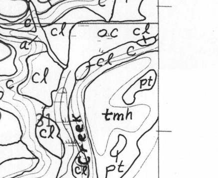


Base from U.S. Geological Survey, Tyonek B-4, 1:63,360, 1954.

SCALE 1:31 680



Surficial geology mapped by Yehle chiefly from 1952 airphotos. Field investigations by Yehle and Schmoll 1978, 1981, 1982, and 1984, assisted in 1978 by J.M. Core and in 1981 and 1982 by C.A. Gardner and J.K. Odum. Bedrock data from Warfield (1963), Barnes (1966), Magoon and others (1976), Manning and Hinderman (1979), Merritt and others (1982), and current studies.

Manuscript approved for publication December 10, 1993

SURFICIAL GEOLOGIC MAP OF THE TYONEK B-4 QUADRANGLE, SOUTH-CENTRAL ALASKA

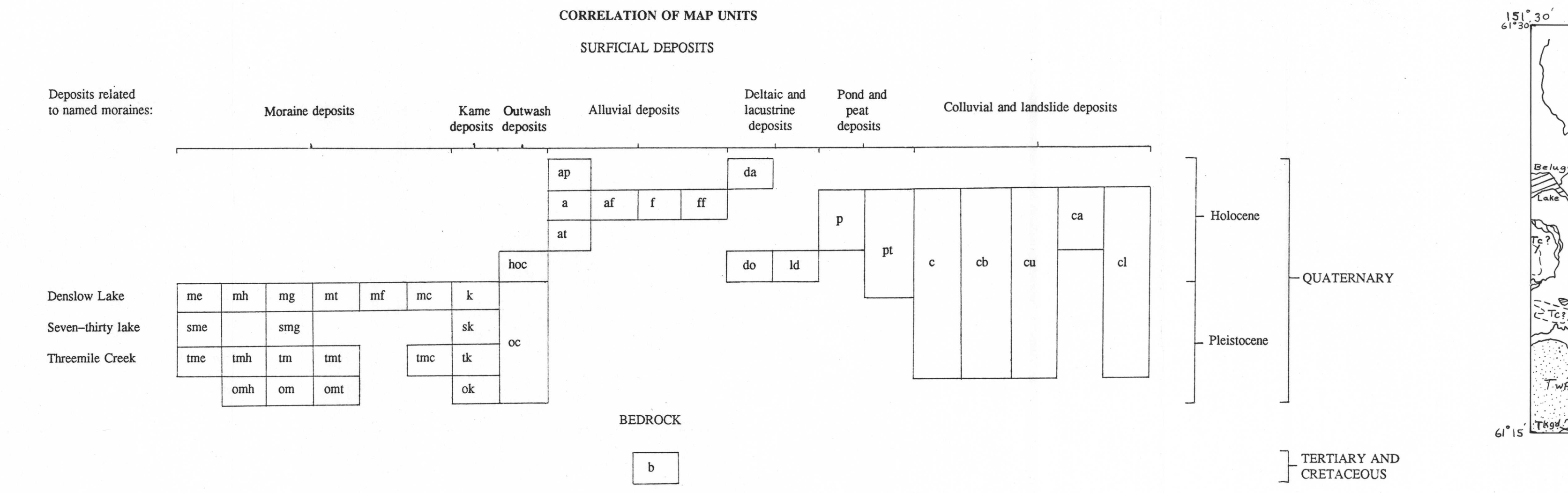
By

Lynn A. Yehle and Henry R. Schmoll

1994

CORRELATION OF MAP UNITS

SURFICIAL DEPOSITS



DESCRIPTION OF MAP UNITS

[The map delineates deposits considered to be about 1 m or more in thickness. Many of them are covered by a variably thick mantle, generally less than 1 m thick, of discontinuous layers of organic material and volcanic ash–sized tephra. Thickness estimates generally are based on field observations. Grain–size distribution of unconsolidated deposits follow the modified Wentworth grade classification scale (American Geological Institute, 1989). Standard age symbols are omitted from map–unit symbols, as all units except bedrock are of Quaternary age. Units were originally designed for and mapped at a scale of 1:63,360; they were subsequently enlarged to a scale of 1:31,680 for greater legibility]

SURFICIAL DEPOSITS

Moraine Deposits

[Till, primarily diamicton, consisting of mixed gravel, sand, and silt with variable, commonly lesser, amounts of clay; clasts as large as boulders. Generally unsorted, but locally well sorted in discontinuous lenses of sand to sandy pebble gravel. Moderately compact. Formed into ridges, hummocky ground, and some relatively smooth plains. In places includes scattered bedrock exposures too small to show]

End–, lateral–, and recessional–moraine deposits (late Pleistocene)––Chiefly diamicton formed into heterogeneous assemblage of landforms some of which are linearly continuous steep–sided ridges tens of meters high. The diamicton may contain a relatively high percentage of coarse clasts. Includes some kame, outwash, pond, alluvial, and peat deposits too small to map. Thickness less than 30 m

me **End– and recessional–moraine deposits of the Denslow Lake moraine**––Form bold moraines having moderately steep sides. The end moraines are distributed as a fringing belt with locally as many as three subparallel, discontinuous ridges around most of the periphery of the map area. Moraines are traceable from the northwestern part of the map area near Kitty hill eastward, bending southward and southwestward to the vicinity of Felt Lake and 4 km farther south to Denslow Lake. West of Denslow Lake, the end moraines curve northwestward to Lone Ridge in the southwestern part of the map area. Several recessional moraines are present in the southwestern part of the quadrangle as semicontinuous to scattered remnants

sme **End–moraine deposits of the Seven–thirty lake moraine**––Formed into discontinuous, slightly subdued moraines generally within a few kilometers northeast and southeast of the outermost Denslow Lake end moraine. Not recognized in the northern part of the quadrangle because moraines probably were overridden and obscured by the subsequent Denslow Lake glacial advance

tme **Lateral–moraine deposits of the Threemile Creek moraine**––Form some distinct ridges in southeastern corner of map area that are parallel to the margins of the last trunk glacier that occupied the upper Cook Inlet–Susitna River region. Deposits probably older than Denslow Lake or Seven–thirty lake moraines

Hummocky moraine deposits––Form landforms having an uneven surface and very little or no linear continuity. The diamicton comprising the deposits may contain a large percentage of coarse clasts and include some bedded material. Thickness as much as 20 m

mh **Deposits of the Denslow Lake moraine (late Pleistocene)**––Many deposits located in east–central part of the map area within the belt of end moraines; scattered elsewhere

tmh **Deposits of the Threemile Creek moraine (late Pleistocene)**––Several deposits in southeastern part of map area between lower Beluga River and Olson Creek

omh **Older deposits (Pleistocene)**––Extensive deposits in northeastern part of map area east of Kitty hill and near the Talachulitna River. Deposits are drift of the glacier that advanced from the north and was a subsidiary part of a trunk glacier that occupied the upper Cook Inlet–Susitna River region

Ground–moraine deposits––Form mostly low, gently rolling mounds and hills on gentle to moderate slopes or in small plains. Thickness probably less than 7 m

mg **Deposits of Denslow Lake moraine (late Pleistocene)**––Widely distributed in center of area and within belt of end moraines

mt **Thinner deposits**––Thickness less than 2 m; bedrock exposures locally common. Scattered deposits situated south of Kitty hill, along lower Beluga River, and north of Lone Ridge

smg **Deposits of the Seven–thirty lake moraine (late Pleistocene)**––A few deposits along the southern edge of the area at Lone Ridge

tm **Deposits of Threemile Creek moraine (late Pleistocene)**––Scattered deposits in southeastern part of area between lower Beluga River and Olson Creek

tmt **Thinner deposits**––Thickness about 2 m. Bedrock exposures locally common. A few deposits east of lower Beluga River

om **Older deposits (Pleistocene)**––Scattered deposits in northeastern part of map area near the Talachulitna River and near Kitty hill

omt **Thinner deposits**––Thickness about 2 m. Bedrock exposures locally common. A few deposits on the flanks of Kitty hill

mf **Moraine deposits in drumlin and fluted landforms of the Denslow Lake moraine (late Pleistocene)**––Mostly ground moraine formed parallel to direction of glacier flow. Bedrock exposed locally. Many deposits located near upper Drill Creek and upper part of a creek discharging into Lower Beluga Lake in the SW¼ sec. 25, T. 15 N., R. 12 W.; several deposits southwest of Kitty hill. Thickness probably less than 10 m

Channeled moraine deposits (late Pleistocene)––Chiefly ground–moraine deposits in areas containing so many abandoned glacial–meltwater channels that they are too numerous or small to show. Most channels are subparallel to slope contour and range in depth from 2 to 10 m; bedrock exposed along margins of some channels. Selected channels shown on map. Includes some peat and pond deposits. Thickness less than 5 m

mc **Deposits of the Denslow Lake moraine**––Widely scattered throughout area of Denslow Lake ground moraine; prominent near the middle reach of Drill Creek

tmc **Deposits of the Threemile Creek moraine**––Several deposits southwest of lower Olson Creek

Kame deposits

[Mostly gravelly sand and some gravelly, silty sand and diamicton in landforms ranging from irregularly shaped hills to almost smooth terraces. Most deposits loose, some compact]

k **Deposits related to the Denslow Lake moraine (late Pleistocene)**––Widely distributed throughout map area except near Chichantna River and its delta and near Beluga and Lower Beluga Lakes. Thickness less than 15 m

sk **Deposits related to the Seven–thirty lake moraine (late Pleistocene)**––Some occurrences in eastern and southeastern part of map area

tk **Deposits related to the Threemile Creek moraine (late Pleistocene)**––A few localities in the southeastern part of the map area

ok **Older deposits (Pleistocene)**––A few occurrences in the northeastern part of the map area

Outwash deposits

[Mostly bedded sandy gravel and sand deposited by glacial meltwaters in diamicton– or bedrock–bounded channels or on low–gradient plains. Most deposits loose and moderately well sorted; commonly more gravelly at depth and commonly overlain by pond and (or) peat and other organic deposits]

hoc **Deposits related to the Chichantna moraine (early? Holocene)**––Flank the south side of Chichantna River along its farthest upstream reach in map area, which is about 3.5 km downstream from the typical locality of the Chichantna moraine (Yehle and others, 1983a). About 20 m higher than the river level. Thickness possibly as much as 25 m

oc **Deposits related to the Denslow Lake, Seven–thirty lake, and Threemile Creek moraines (late Pleistocene)**––Channels especially well developed (1) on the southwest flank of Kitty hill and other nearby bedrock hills to the southeast, (2) on the northeast flank of Lone Ridge, and (3) between Olson Creek and the Beluga River. Thickness as much as 7 m

Alluvial deposits

Alluvial valley–floor and terrace deposits––Mostly pebbly sand to some cobble gravel. Well bedded; moderately well sorted in beds

ap **Flood–plain deposits (latest Holocene)**––Include some boulder gravel and sand forming the presently active flood plain and lowermost, mostly unvegetated terraces of the Chichantna and Beluga Rivers. Thickness as much as 20 m. Mapped only on islands in the Beluga River; also present on sides of the river but too small to map separately. Along the Beluga River include course–grained flood deposits containing conspicuous concentrations of boulders that accumulate following passage of high water from episodic breakout of Strandline Lake dammed by Triumvirate Glacier

a **Alluvium along small and medium–sized streams of low to moderate gradient (Holocene)**––Include deposits in low terraces a few meters above stream level. Distributed throughout map area. Thickness as much as 15 m, but much less along small streams

at **Terrace deposits (Holocene)**––Form terraces at least several meters higher than adjacent active flood plain. Many deposits along the Beluga and Chichantna Rivers and Bishop and Scarp Creeks. Thickness less than 10 m

af **Fine–grained deposits (Holocene)**––Chiefly fine sand and some silt and organic material deposited by small, low–gradient streams. Uniformly bedded. A few widely scattered deposits especially in the northeast part of the map area. Thickness less than 5 m

f **Alluvial–fan deposits (Holocene)**––Mostly gravel and gravelly sand deposited where active, steep gradient streams reach moderate or gentle slopes. Irregularly bedded; poorly to moderately well sorted within beds. Several deposits scattered along Olson Creek and along the upper part of Bishop Creek. Thickness as much as 15 m

ff **Fine–grained deposits**––Chiefly sand and gravelly sand deposited by medium–gradient streams. Some deposits are the distal phase of coarser alluvial–fan deposits. A few deposits along the upper part of Bishop Creek and locally elsewhere. Thickness as much as 10 m

Deltaic and lacustrine deposits

da **Active delta deposits (latest Holocene)**––Mostly pebble gravel and sand deposited in Lower Beluga Lake by Beluga River. Thickness possibly as much as 50 m

do **Old delta deposits (early? Holocene)**––Mostly pebble gravel and some cobble gravel and sand deposited into a higher, ancestral Beluga Lake by streams ancestral to Chichantna River, Bishop Creek, Drill Creek, and several unnamed companion streams to the southeast that flow into Lower Beluga Lake. The maximum altitude of deposits is about 55 m above the modern levels of Beluga and Lower Beluga Lakes; largest area of deposits occurs at that altitude and extends northeastward to the lakes. These deposits are coeval with outwash–channel deposits (hoc) that resulted from melting of the glacier that formed Chichantna moraine of early(?) Holocene age (Yehle and others, 1983a). Thickness probably less than 50 m

ld **Emerged shore– and lake–floor deposits (early? Holocene)**––Mostly massive to laminated silt and clay and some pebbly sand deposited at the margin or on the floor of ancestral Beluga Lake. Extend outward several kilometers from the present Beluga and Lower Beluga Lakes to the middle reach of Bishop Creek to the southwest and to lower Drill Creek and unnamed companion streams to the southeast. Occur as much as 60 m above present lake level. In places, well–developed possible beach berms, many of which are parallel to the present Beluga River, shown on the map by line symbol as lineaments. Thickness as much as 10 m

Pond and peat deposits

p **Pond deposits (Holocene)**––Chiefly organic silt and organic very fine sand adjacent to modern ponds and lakes; in many places includes organic deposits too small or numerous to show at map scale. Underlying deposits generally similar to those mapped adjacent to map unit. Many deposits scattered throughout map area especially east of Kitty hill, southeast of Drill Creek, and near Bishop Lake. Thickness as much as 4 m

pt **Peat and other organic deposits (Holocene and late Pleistocene)**––Organic materials, chiefly mosses, sedges, and some wood fragments all in varying states of decomposition. Includes some silt, very fine sand, and discontinuous thin layers of volcanic ash–sized tephra ranging in color from very light gray to dark brown. Soft and moist. In many places merge with and include deposits formed in ponds and adjacent to lakes. In addition, many of the emerged lake–shore and lake–bottom deposits between Beluga and Lower Beluga Lakes are overlain by widespread peat deposits too thin to map. Underlying deposits generally similar to adjacent map unit. Many small deposits scattered throughout map area. Thickness less than 4 m

Colluvial and landslide deposits

[Heterogeneous deposits of irregularly mixed rock fragments of various sizes all derived from weathering and chiefly gravity processes acting on older geologic materials. Mostly diamicton consisting of gravelly or rubbly silt with sand, and locally, some organic material. Generally unsorted and loose to compact]

c **Colluvial deposits, undivided (Holocene and Pleistocene)**––Sources of deposits are both bedrock and unconsolidated materials. Mostly on steep to moderate slopes along present or abandoned stream courses. Many deposits in northwestern part of map area, along Olson Creek, Coffee Creek, lower Beluga River, northeast of Lone Ridge, and scattered elsewhere. Thickness less than 5 m

cb **Deposits derived chiefly from bedrock**––In many places include numerous bedrock outcrops. Several deposits near Kitty hill, along the Beluga River, and north and northeast of Lone Ridge. Thickness less than 3 m

cu **Deposits derived from unconsolidated geologic materials**––Several deposits along Beluga and Lower Beluga Lakes, Chichantna River, and upper and middle reaches of Beluga River. Thickness probably less than 3 m

ca **Mixed deposits of colluvium and fine–grained alluvium (Holocene)**––Present in areas where colluvial deposits are crossed by so many small watercourses and their alluvium that the alluvial deposits are too numerous and small to map separately. Slopes generally moderate to gentle. A few deposits widely scattered throughout map area. Thickness probably less than 5 m

cl **Landslide deposits (Holocene and Pleistocene)**––All types of unconsolidated geologic materials and bedrock in simple to complex landslides, including block slides, slumps, and debris flows, many of which grade into one another. Surface varies from very irregular and hummocky to almost smooth. Distributed throughout the map area especially northeast of Lone Ridge and along and near Olson Creek, Beluga River, and Beluga and Lower Beluga Lakes where fine–grained lacustrine deposits or Tertiary sedimentary rocks are present. Thickness possibly as much as 30

BEDROCK

b **Bedrock (Tertiary and Cretaceous)**––Exposed in steep to moderately steep bluffs and escarpments especially in the northwest and southwest parts of the map area and along Beluga River and Olson Creek. Many scattered exposures of bedrock present within areas of map units c and cb. Distribution of rock types and their ages shown on figure 3 as derived from Warfield (1963), Barnes (1966), Magoon and others (1976), Manning and Hinderman (1979), Beikman (1980), Wolfe and Tanai (1980), Merritt and others (1982), and current studies, and includes the following: (1) Late Cretaceous to early Tertiary age plutonic rocks, chiefly granodiorite, at Kitty hill and other prominent hills to the southeast and at Lone Ridge; (2) latest Paleocene to early Eocene age sedimentary rocks of the West Foreland Formation, chiefly sandstone, conglomeratic sandstone, and siltstone, located mainly south of Bishop Creek, west of Scarp Creek, and along the nearby part of Beluga River; (3) early Oligocene through middle Miocene age sedimentary rocks of the Tyonek Formation of the Kenai Group, chiefly sandstone, siltstone, and a few beds of coal, located mainly along the lower Beluga River and scattered along Drill Creek. Near Drill Creek a coal bed averaging 17.5 m in thickness was drilled (coal prospect, fig. 3; Warfield, 1963). A thinner coal bed, the Beluga bed, with a maximum thickness of about 9.1 m, is traceable along the east side of lower Beluga River for about 1.6 km (Barnes, 1966). Several small areas of continental sedimentary rocks of undetermined Tertiary age including sandstone, conglomeratic sandstone, and siltstone, were identified on airphotos and by ground reconnaissance in areas south of Beluga Lake, near Scarp Creek, along lower Beluga River, and along Olson Creek; because of the extensive cover of colluvium and the small size of most outcrops, these rocks largely are included in colluvial map units c or cb

Contact––Approximate, inferred, or indefinite

Glacial outwash channel––Channels either too small to show separately or obscured by younger deposits. Shown in general location only

Lineament––Straight or curvilinear; narrow ridge or narrow depression having possible deposition, ground stability, or tectonic significance

Escarpment––Steep slope prominent within map unit; hachures on downslope side

INTRODUCTION

The Tyonek B–4 quadrangle area lies about midway between Anchorage and the Tordrillo Mountains whose southerly peak is Mount Spurr, a 3,375–m–high volcano (fig. 1). About three quarters of the quadrangle, in the northern and eastern parts, lies in Matanuska–Susitna Borough and the remainder in Kenai Peninsula Borough (fig. 2). No roads or permanent residents are present in the quadrangle, but about 10 km southeast of the southeastern corner of the map area, and adjacent to Cook Inlet (fig. 1), is the community of Beluga with an airfield, a powerplant, a producing gasfield, and a network of minor roads.

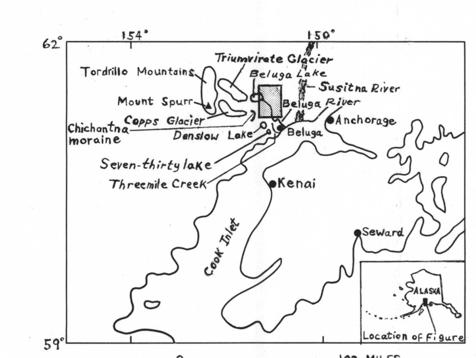


Figure 1. Index of part of south–central Alaska showing location of quadrangle (dotted pattern) and selected geographic features.

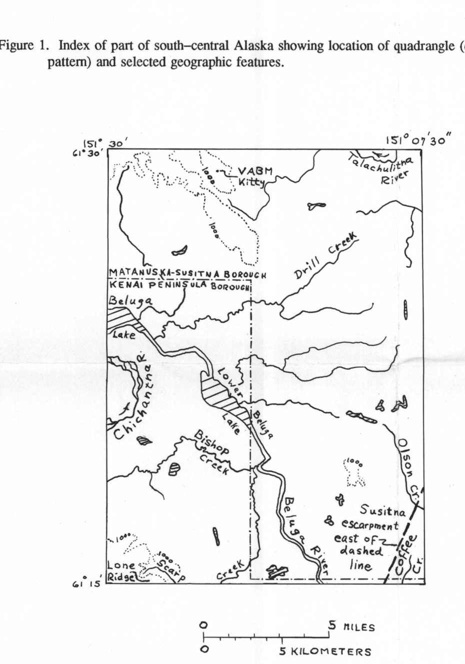


Figure 2. Generalized geographic features of the Tyonek B–4 quadrangle, Alaska. Base modified from U.S. Geological Survey, Tyonek B–4, 1:63,360, 1963. Lined pattern, lakes; contour interval, 1,000 ft.

Physiographically the quadrangle is dominated by the gentle to moderate relief of the Beluga plateau which lies in altitude between about 240 and 275 m and is covered mostly by light forest and brush. Two areas of rounded hills have higher relief and altitudes: Lone Ridge in the southwestern part of the quadrangle rises to about 600 m, and there are a few hills in the northwestern part of the quadrangle, on the highest of which topographic control point VABM Kitty has an altitude of 413 m (fig. 2). This prominent hill is referred to here informally as Kitty hill. The Beluga plateau terminates in the southeastern part of the quadrangle along the gently sloping Susitna escarpment (Schmoll and others, 1981, 1984). The scarp is dissected by a succession of well–formed southwestward–graded channels cut by glacial meltwater streams that drained the last trunk glacier occupying the upper Cook Inlet–Susitna River region. Some of the streams cut as much as 75 m into the surface; part of Coffee Creek follows a good example of one of these channels.

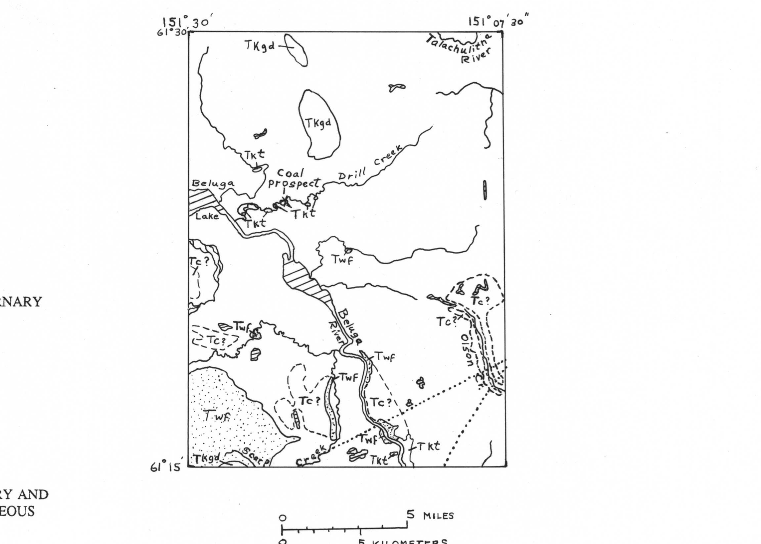


Figure 3. Generalized bedrock geology of the Tyonek B–4 quadrangle, Alaska; modified from Warfield (1963), Barnes (1966), Magoon and others (1976), Manning and Hinderman (1979), Beikman (1980), Wolfe and Tanai (1980), Merritt and others (1982), and current studies. Tkt, Tyonek Formation (middle Miocene through early Oligocene)––sandstone, siltstone, and coal; fine–dotted pattern, Twf, West Foreland Formation (early Eocene to latest Paleocene)––sandstone, conglomeratic sandstone, and siltstone; coarse–dotted pattern, Tc?, continental rocks (Tertiary)––sandstone, conglomeratic sandstone, and siltstone; TKgd, granodiorite (Tertiary and Cretaceous). Solid contact, bedrock previously mapped; dashed contact, bedrock at shallow depth, newly mapped; dotted line, concealed fault. Ruled pattern, lakes. Base modified from U.S. Geological Survey, Tyonek, 1:250,000, 1958.

The Beluga River and its numerous small– and medium–sized tributaries dominate the drainage pattern of the map area. The principal tributary is the Chichantna River which drains Capps Glacier (fig. 1). Other named tributaries include Scarp, Bishop, and Drill Creeks, as well as Coffee and Olson Creeks that join the river south and southeast of the map area, respectively. In the northern part of the map area, the Talachulitna River drains northward as part of the Susitna River drainage. The Beluga River is subject to episodic flooding caused by the breakout of ice–dammed Strandline Lake adjacent to Triumvirate Glacier (fig. 1) (Sturm and Benson, 1985; Sturm and others, 1987; Sturm, 1989). Such events are known to have occurred at least eight times between 1940 and 1986.

The Beluga River includes two relatively stilled reaches, Beluga Lake (mostly west of the map area) and Lower Beluga Lake; the outlets of both lakes are controlled primarily by the downcutting of Tertiary rocks in the canyon along the reach of the river downstream from Lower Beluga Lake. The level of Beluga Lake is influenced also by the damming effects of the enlarging delta of the Chichantna River. Other named lakes in the area include Carlson and Felt Lakes. Numerous small– and medium–sized lakes dot the landscape.

Bedrock within the quadrangle includes both continental sedimentary rocks of Tertiary age and granodiorite of early Tertiary to Late Cretaceous age and is shown in a generalized manner on figure 3. The sedimentary rocks probably underlie much of the area but crop out mainly in valley walls along the Beluga River and its principal tributaries. The igneous rocks are restricted to Lone Ridge and Kitty hill and nearby hills to the southeast.

The sedimentary rocks include sandstone, conglomeratic sandstone, and siltstone of the West Foreland Formation of late Paleocene to early Eocene age and sandstone, siltstone, and coal of the Tyonek Formation of early Oligocene through middle Miocene age of the Kenai Group (Barnes, 1966; Magoon and others, 1976; Wolf and Tanai, 1980). The West Foreland Formation is present in the center of the quadrangle and is found in scattered outcrops to the south and southwest; the Tyonek Formation is identified in even more scattered localities near Drill Creek and along the lower part of the Beluga River. Similar rocks of probable continental sedimentary origin and Tertiary age are here first noted as present, mainly under a thin cover of surficial deposits, in scattered localities west of Scarp Creek, east of the lower Beluga River, and along Olson Creek.

The Tertiary sedimentary rocks form part of the Beluga structural basin of Hackett (1977). A few minor anticlines, synclines, and subbasins have been identified (Warfield, 1963; Barnes, 1966) but bedrock exposures are too few to clearly discern regional structural trends or fault histories. Where they have been measured in detail, strikes are quite variable and dips range from 3 to 50° (Warfield, 1963; Barnes, 1966). Major regional northeast–southwest oriented fault zones are considered to cross the quadrangle according to several geologic and geophysical studies of the Cook Inlet region (Barnes, 1966; Grantz and others, 1963; Detterman and others, 1976; and Hackett, 1977). However, surface evidence of faulting has been found only at exposures along the Beluga River; there is no readily apparent expression of these faults across the vegetation–covered ground surface away from the Beluga River. A few lineaments approximately parallel the faults, but all of these can be just as readily explained as glacial meltwater channels or fortuitously oriented stream segments that are not related to bedrock structure. Further structural details probably could be gained from the extensive proprietary seismic data the existence of which can be inferred from the numerous seismic lines that crossed the area; many of these trend normal to the possible faults.

A coal bed of economic potential has been identified by drilling near Drill Creek where Tertiary rocks occur in a structural subbasin. The bed averages 17.5 m in thickness (Warfield, 1963).

Surficial deposits cover most of the map area. The most extensive of these comprise deposits of the well–formed and prominent Denslow Lake end and recessional moraines of late Pleistocene age (Yehle and others, 1983a, b; Yehle, Schmoll, and Gardner, 1983; Schmoll and Yehle, 1986, 1987). On the basis of their relative position proximal to other moraines, the Denslow Lake moraines are the youngest moraines in the map area. The source areas for glaciers that built these moraines and associated deposits were along the eastern flank of the Tordrillo Mountains. The end moraine in the northwestern part of the area impinges on the southwest side of Kitty hill and the next hill southeast, and can be traced eastward and then southward as a bold set of as many as three discontinuous ridges locally as high as 50 m. The outermost segment of this end moraine decreases in prominence toward the southeastern part of the quadrangle near the Beluga River but regains prominence south of the river where it recurves back northwestward to impinge on the north side of Lone Ridge.

Other drift deposits lie beyond the distal Denslow Lake end moraine in the northeastern, southeastern, and southwestern parts of the map area; most of these are remnants of the Seven–thirty lake and Threemile Creek moraines, both of which are better preserved south of the quadrangle where their typical localities occur (Schmoll and Yehle, 1987, 1992). Because of a subparallel orientation, seemingly the same source area, and a position only a short distance out beyond the Denslow Lake moraine, the Seven–thirty lake moraine is thought to be only slightly older than the Denslow Lake moraine. The Threemile Creek moraines occupy the Susitna escarpment and approximately parallel the shore of Cook Inlet. They were deposited by the last trunk glacier to occupy the upper Cook Inlet–Susitna River region. The Threemile Creek moraines may be equivalent to the well–formed Rabbit Creek lateral moraines on the opposite side of Cook Inlet basin near Anchorage (Schmoll and others, 1984; Schmoll and Yehle, 1986; Yehle and Schmoll, 1989), and, if so, they are older than the Denslow Lake and Seven–thirty lake moraines, but the age relationships are somewhat problematic because of the different source areas for the glaciers that deposited these moraines. In the northeastern part of the map area, especially near the Talachulitna River, scattered moraine and other drift deposits mark a still older glacial advance from the north which was part of a tributary of an upper Cook Inlet–Susitna River region trunk glacier.

Other deposits in the quadrangle include alluvial, colluvial, landslide, lacustrine, and pond and peat deposits. Of these, the first three types are associated with both major and lesser streams throughout the area. Lacustrine deposits are associated with higher levels of ancestral Beluga and Lower Beluga Lakes in the west–central part of the map area. Extensive pond and peat deposits are associated with marshy ground and the myriad of ponds and numerous lakes that cover much of the area between streams. Within these organic deposits are ubiquitous, thin to discontinuous beds of tephra; some beds have been described and dated (Riehle, 1985; Riehle and others, 1990).

REFERENCES

American Geological Institute, 1989, Data sheets, third edition, data sheet 29.1, Dutro, J.T., Dietrich, R.V., and Foose, R.M., compilers, Grain–size scale used by American geologists, modified Wentworth scale: Falls Church, Virginia, American Geological Institute.

Barnes, F.F., 1966, Geology and coal resources of the Beluga–Yentna region, Alaska: U.S. Geological Survey Bulletin 1202–C, 54 p.

Beikman, H.M., compiler, 1980, Geologic map of Alaska: U.S. Geological Survey, scale 1:2,500,000.

Detterman, R.L., Hudson, Travis, Plafker, George, Tysdal, R.G., and Hoare, J.M., 1976, Reconnaissance geologic map along Bruin Bay and Lake Clark faults in Kenai and Tyonek quadrangles, Alaska: U.S. Geological Survey Open–File Report 76–477, 4 p., scale 1:250,000.

Grantz, Arthur, Zietz, Isidore, and Andreasen, G.E., 1963, An aeromagnetic reconnaissance of the Cook Inlet area, Alaska: U.S. Geological Survey Professional paper 316–G, 134 p.

Hackett, S.W., 1977, Gravity survey of Beluga basin and adjacent area, Cook Inlet region, Report 49, 26 p.

Magoon, L.B., Adkison, W.L., and Egbert, R.M., 1976, Map showing geology, wildcat wells, Tertiary plant fossil localities, K–Ar age dates, and petroleum operations, Cook Inlet area, Alaska: U.S. Geological Survey Miscellaneous Investigations Series Map I–1019, scale 1:250,000.

Manning, K.H., and Hinderman, T.K., 1979, Uranium resource evaluation––Tyonek quadrangle, Alaska: U.S. Department of Energy Open–File Report PGJ–059(81), 18 p.

Merritt, R.D., Eakins, G.R., and Clough, J.G., 1982, Coal investigations of the Susitna Lowland, Alaska: Alaska Division of Geological and Geophysical Surveys, Alaska Open–File Report AOF 142, 42 p.

Riehle, J.R., 1985, A reconnaissance of the major Holocene tephra deposits in the upper Cook Inlet region, Alaska: Journal of Volcanology and Geothermal Research, v. 25, no. 5/6, p. 37–74.

Riehle, J.R., Bowers, P.M., and Ager, T.A., 1990, The Hayes tephra deposits, an upper Holocene marker horizon in south–central Alaska: Quaternary Research, v. 33, no. 3, p. 270–290.

Schmoll, H.R., and Yehle, L.A., 1986, Pleistocene glaciation of the upper Cook Inlet basin, *in* Hamilton, T.D., Reed, K.M. and Thorson, R.M., eds., Glaciation in Alaska––The geologic record: Anchorage, Alaska Geological Society, p. 193–218.

___1987, Surficial geologic map of the northwestern quarter of the Tyonek A–4 quadrangle, Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF–1934, scale 1:31,680.

___1992, Geologic map of the lower Beluga–Chuitna area, Tyonek A–3 and A–4 quadrangles, south–central Alaska: U.S. Geological Survey Open–File Report 92–346, 27 p., scale 1:63,360.

Schmoll, H.R., Chleborad, A.F., Yehle, L.A., Gardner, C.A., and Pasch, A.D., 1981, Reconnaissance engineering geology of the Beluga coal resource area, southcentral Alaska, *in* Rao, P.D., and Wolff, R.N., eds., Focus on Alaska's Coal '80, Conference, Fairbanks, Alaska, October 21–23, 1980, Proceedings: University of Alaska Mineral Industry Research Laboratory MIRL Report 50, p. 92–110.

Schmoll, H.R., Szabo, B.J., Rubin, Meyer, and Dobrovolny, Ernest, 1972, Radiometric dating of marine shells from the Bootlegger Cove Clay, Anchorage area, Alaska: Geological Society of America Bulletin, v. 83, no. 4, p. 1107–1114.

Schmoll, H.R., Yehle, L.A., Gardner, C.A., and Odum, J.K., 1984, Guide to surficial geology and stratigraphy in the upper Cook Inlet basin [prepared for the 80th annual meeting of the Cordilleran Section, Geological Society of America]: Anchorage, Alaska Geological Society, 89 p.

Sturm, Matthew, 1989, Jokulhlaups from Strandline Lake, Alaska, with special attention to the 1982 event: Alaska Department of Geological and Geophysical Surveys, Report of Investigations 88–10, 19 p.

Sturm, Matthew, Beget, James, and Benson, Carl, 1987, Observations of jokulhlaups from ice–dammed Strandline lake, Alaska: implications for paleohydrology, *in* Catastrophic flooding, Mayer, L., and Nash, D., eds.: The Binghamton Symposium in Geomorphology, International Series, no. 18, p. 79–94.

Sturm, Matthew, and Benson, C.S., 1985, A history of jokulhlaups from Strandline Lake, Alaska: Journal of Glaciology, v. 31, no. 109, p. 272–280.

Warfield, R.S., 1963, Investigation of a subbituminous coal deposit suitable for opencut mining, Beluga River coal field, Alaska: U.S. Bureau of Mines Report of Investigations 6238, 100 p.

Wolfe, J.A., and Tanai, Toshimasa, 1980, The Miocene Seldovia Point Flora from the Kenai Group, Alaska: U.S. Geological Survey Professional Paper 1105, 52 p.

Yehle, L.A., and Schmoll, H.R., 1989, Surficial geologic map of the Anchorage B–7 SW quadrangle, Alaska: U.S. Geological Survey Open–File Report 89–318, 22 p., scale 1:25,000.

Yehle, L.A., Schmoll, H.R., and Chleborad, A.F., 1983a, Preliminary surficial geologic map of the southeastern part of the Tyonek B–5 quadrangle, south–central Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF–1161–C, scale 1:31,680.

_____1983b, Preliminary surficial geologic map of the southwestern part of the Tyonek B–5 quadrangle, south–central Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF–1161–B, scale 1:31,680.

Yehle, L.A., Schmoll, H.R., and Gardner, C.A., 1983, Preliminary surficial geologic map of the northern part of the Tyonek B–5 quadrangle, south–central Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF–1161–A, scale 1:31,680.