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Preliminary Geologic Map of the Congahbuna Area, Cook Inlet Region, Alaska

By

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INTRODUCTION

The preliminary geologic map of the Congahbuna area, Cook Inlet region, Alaska (map A) is an advance release of parts of the Tyonek (A-4) and (A-5) quadrangles in which surficial geologic mapping is currently in progress. Proposed mining areas in the Chuitna and Capps coal fields of the Beluga coal resource area lie respectively about 15 and 30 km to the northwest; sites within the map area are presently under consideration for a methanol conversion plant and other facilities related to coal extraction.

The Congahbuna area is situated on the northwest side of Cook Inlet about 80 km west of Anchorage (see index). Features within the area include Congahbuna and Tyonabuna Lakes in the northeast part, and, near the coast, the small community of Shirleyville, an oil pipeline pumping station, and the private Nikolai airstrip, a 1500-m-long gravel runway (map B). The area is traversed by a principal private road used mainly for hauling logs from cutting areas north and west of the map area to a chip mill and dock about 15 km to the east. Spur roads lead to the pumping station, the airstrip, and to Shirleyville. Other roads, mostly not maintained, lead off the principal road to former logging areas.

The physiography and environmental geology of the Beluga coal resource area, including the area of this map, have been discussed briefly (Schmoll and others, 1981). The map area straddles the Nikolai escarpment, which extends from the northwest corner southeastward to the coast, dividing the area into two physiographically and geologically distinct parts. The escarpment rises from near sea level to 50-150 m in elevation. Northeast of the escarpment is a gently hummocky plateau surface underlain by numerous bog and pond deposits and by deposits of the Nikolai moraine of late Pleistocene age. Along the coast, the morainal deposits are underlain by bedded diamicton of glacial or glaciomarine origin of Tertiary or Quaternary age. Underlying the morainal deposits or the bedded diamicton are Tertiary sedimentary rocks, principally siltstone and sandstone, known only from bluff exposures along the Chuitna River to the north (Barnes, 1966) and from oil and gas wells within the area (Magoon and others, 1976). These rocks extend to a depth of several thousand meters.

Southwest of the escarpment is a very flat lowland, here informally called the Chakachatna-McArthur embayment. The surface is underlain by fine-grained deposits of marine, tidal, and (or) estuarine origin. West and northwest of the map area these deposits are overlain extensively by, and probably interbedded with, coarse-grained alluvial deposits. The map area includes the distal parts of this alluvium which is predominantly fine grained, but probably includes some sand and gravel. The nature and stratigraphic complexities of the embayment fill are not well known in the subsurface. Tertiary sedimentary rocks similar to those underlying the plateau also underlie the lowland, but at depths of a few hundred meters.

Major concealed fault zones may transect the area. The Bruin Bay fault (map A) has been postulated to extend across the area from the coast near the

mouth of Nikolai Creek to the northeast corner of the area (Magoon and others, 1976, and Detterman and others, 1976, showing a slightly different alinement). We have found no surface evidence of faulting within the map area, which suggests there may have been no surface rupturing along this line since at least pre-late Pleistocene time. The presumed trace of the fault zone may be marked however by the long narrow depression occupied by Congahbuna Lake, by other parallel linear features such as Tyonabuna Lake, and by lineaments seen on aerial photographs. The straight alinement of the Nikolai escarpment suggests that it might be fault controlled, but we have found no direct evidence for this. The bluff along the base of the escarpment, continuous with the present coastal bluffs, was probably formed by erosion along a former shoreline bordering the Chakachatna-McArthur embayment, but this erosion and resultant bluff are secondary features rather than a primary cause of the escarpment.

Nearly all of the geologic contacts have been derived from aerial photograph interpretation. Field checking to confirm validity of the interpretations and to provide descriptions of the geologic materials within the map units has been limited largely to good exposures along the coastal bluffs, to very widely scattered natural exposures elsewhere, to roadcuts and other shallow manmade exposures, and to hand augering at selected sites in the lowland; consequently material descriptions and thicknesses are mainly estimates.

DESCRIPTION OF MAP UNITS

[Age symbol "Q" omitted from map symbols as all units (with the exception of "QTd") are of Quaternary age]

ALLUVIAL DEPOSITS

Present-day stream alluvium (Holocene)

a — Sand and gravel--Observed in only very few places; probably only a few meters thick, underlain in lowland by fine-grained marine/tidal deposits and on plateau by glacial deposits. Not a good source for gravel and sand except very locally. Drainage and foundation conditions fair to good

af — Very fine grained sand and silt--In lowland the material largely may be reworked from underlying deposits. Thickness not known, possibly a few meters, deposits may not be distinguishable readily from underlying similar materials. Drainage and foundation conditions poor

Older alluvium in channels (Holocene)

oc — Sand and gravel--In poorly defined broad channels cut into southeastern end of the Nikolai escarpment; some channels may be erosional features and alluvial deposits may be lacking. Alternatively, they may be the headward part of old landslides, with landslide debris formerly extending outward beyond the present Nikolai escarpment and subsequently removed; although little evidence supports this debris-removal hypothesis, it should not be dismissed. (See also discussion of curvilinear features, this report). Where present, deposits probably no more than a few meters thick, may not be good sources of gravel and sand. Drainage and foundation conditions fair to good

of Silt and fine-grained sand, or silt-clay--In crudely defined channels developed on surface of marine/tidal deposits of lowland; identified primarily by drainage patterns seen on aerial photographs, this presumed alluvium may not be distinguishable readily from the marine/tidal deposits, may represent only minor reworking of them by streams. Drainage and foundation conditions poor, as ground is soft and wet except when seasonally frozen

ag Small valley alluvium within glacial deposits (Holocene or uppermost Pleistocene)--Chiefly sand and gravel as much as a few meters thick; includes some irregular topography underlain by glacial deposits (diamicton or poorly sorted gravel) in areas too small to map separately. Channels may have developed shortly after deglaciation, or may reflect preexisting valleys; significant alluviation may have occurred for only a short period of time. Probably not good sources of sand and gravel except locally. Drainage and foundation conditions fairly good

Alluvial fan deposits (Holocene)

f Gravel and sand--In well-developed, fairly small, alluvial fans where small streams, having descended the Nikolai escarpment in narrow canyons, debouch onto the lowland, depositing much of their load; thickness not known, probably several meters near apex and thinner near toe of each fan. Good but somewhat limited sources of sand and gravel; thicker proximal parts of fans may contain bouldery material. Drainage and foundation conditions good

fc Coalesced smaller fans--Along base of the Nikolai escarpment; probably contains finer grained or less well-sorted material probably thinner than in larger fans; toward the southeast, may include beach ridge deposits of well-sorted sand in areas too small or too poorly defined to map separately. Sources of sand and gravel available locally. Drainage and foundation conditions fairly good

ff Distal edges of fans--Probably fine grained sand and silt a few meters thick. Drainage and foundation conditions poor, as ground is soft and wet except when seasonally frozen

DEPOSITS OF THE CHAKACHATNA-McARTHUR EMBAYMENT (HOLOCENE)--Deposits underlying this lowland thought to be chiefly marine, initially deposited in open water in embayment, then gradually filled so most recent and near-surface deposits may be tidal or estuarine shallow-water deposits, generally fine grained. Concomitant with filling, alluvial deposits of the major rivers and their distributaries encroached upon marine deposits, adding coarser grained material to area; only distal edges of this alluvial encroachment enter map area (units af and of). Coarser deposits also occur near lateral margins of embayment, exemplified by beach ridges (unit b) in southeastern corner of lowland. Beach ridge series may be indicative of minor, possibly tectonic, emergence of this area in very recent time. (Unpublished radiocarbon dates about 500 yr B.P. obtained from similar features near Beluga in the Susitna River embayment about 25 km to northeast)

m Modern beach deposits--Chiefly sand, gravelly in part, probably a few to several meters thick, deposited along coastal bluffs and extend westward where unit includes most recently abandoned raised beach ridge. (Much of ridge has served as base for Nikolai airstrip; also the site of Shirleyville). Ridge is dry and reasonably firm, providing good drainage and fair foundation conditions; may be subject to flooding during high spring and storm tides; modern beach, however, is flooded twice daily by tides (mean height about 5 m), not suited for permanent facilities

b Older beach deposits--Long narrow ridges rise only a meter or so above surrounding terrain and probably underlain by sand less than a few meters thick; these ridges support trees and brush, probably better drained and may provide somewhat better foundation conditions than adjacent areas; toward the west ridges gradually lose their identity and superior characteristics, merge with surrounding terrain

l Lagoon and overwash deposits--Silt and fine-grained sand with some clay and organic material, probably a few to several meters thick, deposited in areas landward from beach ridges as accumulations in lagoons, includes some material washed in over beach ridges during spring and storm tides. At present these areas contain many small ponds and, nearest the coast, still may be subject to overwash. Drainage and foundation conditions very poor, ground soft and wet except when seasonally frozen

lh Older areas landward from higher beach ridges--Similar in character to other lagoonal areas, but no longer subject to any overwash, and generally without many small ponds

t Tidal, estuarine, or marine deposits--Chiefly silt and clay, in places may contain fine-grained sand; commonly overlain by about a meter of peat and other organic accumulation. Drainage and foundation conditions very poor, ground soft and wet except when seasonally frozen

tl Areas of numerous lakes and ponds--Slightly lower lying than adjacent areas with fewer bodies of water; ground conditions are the wettest in the lowland, and water-free land has little extent and continuity

ty Young tidal/marine deposits--In a belt that parallels present shore but no longer subject to tidal and overwash processes

ti Present-day intertidal zone--Subject to flooding twice daily by tides (mean height about 5 m)

DEPOSITS OF THE NIKOLAI MORAINE (UPPER PLEISTOCENE)--Complex system of lateral and ground moraines deposited by a glacier emanating from the Chakachatna and McArthur valleys (see index). Northwest of map area a fairly narrow but prominent lateral moraine parallels the Nikolai escarpment on southwest edge of plateau. Within, north, and east of map area the Nikolai moraine broadens to include kames and similar landforms as well as ground moraine. Lateral moraine intercepts coast near North Foreland about 15 km east of map area. Glacier that deposited this system of moraines extended southeastward across Cook Inlet to vicinity of Boulder Point on Kenai Peninsula (Karlstrom,

1964). Moraine comprises two belts, the lateral moraine and associated kames, and a broader area of ground moraine. Each of these belts is further subdivided into three map units on the basis of geomorphic considerations from which inferences about materials and thicknesses can be made; another map unit comprises isolated eskers that extend from lateral moraine into ground moraine. Almost all of moraine within map area is ground moraine, with only kames of inner edge of lateral moraine belt in north edge and northeast corner of map area; well-developed lateral moraine ridge not in map area. Little evidence that more than one ice advance and retreat represented by the Nikolai moraine complex. Radiocarbon dates obtained thus far (none within map area) suggest moraine complex of late Pleistocene age, possibly equivalent to 12,000-yr-old Elmendorf Moraine at Anchorage, dated in part by its overlying relationship to Bootlegger Cove Clay (Schmoll and others, 1972). However, the moraine within map area may have been modified by marine water as evidenced by a possible shoreline at about 70-m elevation; should this shoreline prove to represent water in which Bootlegger Cove Clay was deposited, it is likely that the Nikolai moraine is somewhat older than the Elmendorf Moraine, but still late Pleistocene in age

Kame and related deposits--Probably gravel and sand, some diamicton, in series of irregular hills best developed to north and east of map area. May provide good sources of sand and gravel locally. Drainage and foundation conditions very good

k Better developed features--Relief about 25 m, and at least comparable thickness of deposits

kl Lesser features--Relief of 15 m or less and correspondingly thinner deposits

e Esker deposits--Gravel and sand in single ridge, appears to be an esker on the basis of similarities to better developed features north of map area. Probably several meters thick, only minor source of gravel and sand. Drainage and foundation conditions good

Ground moraine deposits--Till, primarily diamicton; includes some better sorted material, mainly gravel and sand, in thin lenses within deposit. In much of map area, especially western and central parts, material within at least a few meters of surface is coarse, bouldery, and more than 99 percent volcanic in lithology, little matrix. Volcanic material may have originated as a flow emplaced on the glacier farther upstream, subsequently deposited as ablation moraine. At depth, and especially near the Nikolai escarpment, is lower percentage of volcanic lithologies and more matrix. Well-bedded and well-stratified sand and gravel, some notably rich in volcanics, also found near escarpment. A few good sources of sand and gravel may be found within the ground moraine locally. Drainage and foundation conditions generally good; coarse material at surface may pose slight hindrance to developmental activity

gh — Hills of greatest height--Relief of about 10 m, moderately hummocky surfaces, most likely the thickest deposits, perhaps in excess of 10 m thick

g — Moraine with lower hills--More modest relief and hummocks, thickness perhaps less than 10 m

gl — Moraine with low relief--Relatively smooth surface, likely contains thinnest deposits; about 5 m is known along coast. Here however, and perhaps elsewhere as well, ground moraine may not be readily distinguishable at depth from underlying older diamicton (map unit QTd)

QTd — GLACIAL OR GLACIOMARINE DEPOSITS (LOWER QUATERNARY OR UPPER TERTIARY)--Chiefly diamicton, well to obscurely bedded; well exposed in bluffs along coast extending eastward from map area about 4 km to Beshta Bay. Includes minor interbedded gravel, sand, and silt, and, east of map area, at least one bed of coal as much as 4 m thick and other beds of volcaniclastic debris, sandstone, and siltstone. Bedding, marked most conspicuously by discontinuous zones of cobbles and boulders, shows consistent gentle dips to west, increases eastward. Near Beshta Bay deposit presumably underlain by the Miocene Beluga Formation (Barnes, 1966; Magoon and others, 1976). Total stratigraphic thickness exposed about 100 m. Deposits exposed only in bluffs where overlain by ground moraine (map unit gl); the bedded diamicton not known to occur elsewhere at ground surface, nor is its extent in subsurface known

p — POND AND BOG DEPOSITS (HOLOCENE AND UPPERMOST PLEISTOCENE)--Post-glacial deposits in depressions on moraine surface; chiefly peat and other accumulations of organic debris; may contain silt, clay, and fine-grained sand especially at base or interbedded within deposit; also includes several thin (commonly a few centimeters or less) beds of volcanic ash; in one bog east of map area at least 12 ash beds have been deposited within last 12,000 yr. Poorly exposed deposits, but probably thin near edges where merge with ubiquitous vegetation mat, commonly less than a meter thick, that covers all of morainal deposits; bog deposits probably thicken toward center of bogs where several meters of deposit may be expected. Surfaces of bogs generally flat and covered only by low-growing plants. Drainage and foundation conditions very poor; ground is soft and wet except when seasonally frozen

Dot pattern indicates areas of wettest ground conditions with numerous small ponds and little continuity of water-free ground; these areas may be slightly lower than surrounding parts of bog although not necessarily areas of thickest deposits

Ruled areas have slightly more vegetation and appear less wet; may contain more interbedded mineral matter than other bogs, or consist of thinner deposits

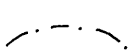
c — COLLUVIAL DEPOSITS (HOLOCENE)--Developed on steep slopes of coastal bluffs, in relatively low bluff along base of the Nikolai escarpment, and along small canyon walls cut into escarpment. Chiefly diamicton that is more loosely

compacted than glacial diamicton; derived from erosion of bluffs and accumulated as a veneer on their surfaces. Generally a few meters thick, thinnest at upper part of bluff and thickening toward base. Although commonly stabilized by heavy vegetation cover, these slope deposits subject to concentrated gully wash at times of heavy rain and of snow melt; may be unstable when excavated. Well-drained but steep slopes and loose nature of material make for poor foundation conditions

CONTACT--Interpreted mainly from aerial photographs, most represent readily discernable lines and are accurately located; may not represent abrupt changes in materials

FAULT--Inferred approximate position of concealed Bruin Bay fault, modified from Magoon and others (1976)

LINEAMENT--Straight lines observed on aerial photographs, generally marking a subtle change or break in vegetation or drainage pattern; not observed on ground in map area; most lineaments mapped here appear to be related to the Bruin Bay fault zone



CURVILINEAR FEATURE--Arcuate lines similar to lineaments described above; may represent incipient landslide scarps or zones of gravitational spreading. (Possible major gravitational spreading features inferred along the Nikolai escarpment just northwest of map area where these features are lacking). If at least some of areas mapped as unit oc represent old landslide scars, the curvilinear features could be indicative of possible incipient failure

INFERRED FORMER SHORELINE--On the lowland, these linear features seem to be extensions of beach ridges, and as such may mark a former position of the shore across the lowland. On the plateau, represents a small scarp that appears on aerial photographs to be relatively continuous across the area, and is thought to represent erosion along a former shoreline. Although no other evidence to suggest the existence of sea level at this elevation has been found within the map area, inferred beach deposits do occur about 10 km to the east at a similar elevation, and the inferred shoreline can be traced discontinuously to that area. The shoreline might be related to deposition of the Bootlegger Cove Clay

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