DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

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DESCRIPTION OF THE MAP

This map is simplified from a standard detailed geologic map of Anchorage and vicinity currently being prepared. Deposits are grouped into fewer map units so that this map is easier to read than the standard geologic map. Age relations are not distinguished, and deposits with similar characteristics are combined into single map units; features of the standard geologic map that are essential to a general understanding of the geology remain unaltered. Additional maps to follow will relate the geology to specific uses and to activities of man.

An earlier geologic map and report described the surficial geology of Anchorage and vicinity (Miller and Dobrovolny, 1959). The 1964 Alaska earthquake brought about increased awareness of the usefulness of such geologic information, and consequently the Greater Anchorage Area Borough requested that a program be started to prepare new geologic and interpretive maps of the entire borough; a map of a small area including the town of Eagle River was open filed (Schmoll and others, 1971). The map presented here encompasses much of the same area as the 1959 map, but at a larger scale and in greater detail made possible in part by many new exposures of geologic materials created by rapid urban development.

The Anchorage and vicinity map area is between Turnagain Arm and Knik Arm at the edge of the Cook Inlet basin. The southeastern part of the map area is within the Chugach Mountains, which rise abruptly to elevations of more than 3,500 feet above sea level. The remainder of the area is a lowland which declines in elevation from about 1,000 feet at the mountain front through a series of ridges and isolated hills to a broad trough about 80 feet above sea level that extends from the city of Anchorage southward to Turnagain Arm. The Anchorage plain is a large alluvial fan that rises gently northeastward from the trough to an elevation of 500 feet just east of the map area. West of the trough and north of the Anchorage plain hummocky topography rises to heights of more than 300 feet. The entire lowland is separated from the sea by steep bluffs that range from less than 60 to more than 300 feet high. Only in relatively narrow valleys along the principal streams does the land approach sea level with a gentle gradient. The lower parts of these valleys are incised beneath the general lowland surface and separated from it by steep valley walls comparable to the sea bluffs.

Relatively hard but intensely fractured metamorphic rocks constitute the bedrock in the mountains and in isolated patches west of the mountain front. The lowland is underlain by a wedge of surficial deposits that thickens from zero at the mountain front to at least 800 feet near Point Woronzof (W. W. Barnwell, oral commun., 1972). Relatively soft sedimentary rocks underlie the surficial deposits but were not observed at the surface within the map area.

Most of the surficial materials were deposited during the last of several glaciations that occurred in the Anchorage area. Three main agents of deposition were involved: glacier ice, flowing water in streams and on deltas, and still water in small lakes and ponds or in the ancestral Cook Inlet. Other deposits resulted from downward movement of loose material on slopes, and from wind. In general the deposits from the glacier ice are in two belts, one along the Chugach Mountain front and another in the northern part of the map area (including the Elmendorf Moraine). Stream and delta deposits dominate the area between these two belts as well as the hummocky region between Point Woronzof and Point Campbell. The deposits of ancestral Cook Inlet chiefly underlie the broad low trough. Pond and lake deposits are scattered throughout the map area.

Interplay of the three main depositional agents produce a complexly interrelated series of deposits that vary widely in character. Although many deposits are single large bodies of easily described materials with distinct boundaries, other deposits consist of various interlayered materials, and still others change imperceptibly in character over relatively short distances. The materials in these latter two situations are difficult to classify and describe in a simple straightforward way. Users of the map are thus cautioned that although in many localities the descriptions indeed match closely what exists on (and in) the ground, at other places departures from the generalized descriptions are to be expected. Likewise, although many of the sharply drawn boundaries between map units correspond to an abrupt change in materials, others of these boundaries indicate a gradual change between materials.

Descriptions of deposits are based largely on examinations of natural and manmade exposures that are unevenly distributed. Thus the reliability of the information presented varies from place to place on the map. Most of the contacts between units are the boundaries of landforms that are visible on aerial photographs. Although these boundaries are not as reliable as indicators of change in geologic materials in some places as they are in many other places, the generalized geologic map can provide much useful information. The descriptions of the deposits emphasize gradational relationships and other uncertainties in differentiating between deposits, and these characteristics should be carefully noted by the user.

The 80 or so map units of the standard detailed geologic map are here combined into 16 units according to origin and composition of the deposits. Two overprint patterns indicate modifications to the map units. The map units representing surficial deposits are grouped in the explanation according to their grain size and sorting (sorting is an expression that indicates the range of grain sizes in a material; most of the grains in a well-sorted material are similar in size, whereas the grains in a poorly sorted material extend over a wide range of sizes): (1) coarse-grained materials, chiefly gravel and sand, generally rather well sorted; (2) fine-grained materials, chiefly silt and clay without much coarse material, relatively well sorted; (3) mixtures of coarse- and fine-grained material, consisting of either alternating beds of relatively well sorted materials of different sizes, or single beds of poorly sorted material that may include boulders, gravel, sand, silt, and clay. Such poorly sorted material is called diamicton, a relatively new word coined because of the lack of a suitable textural term for this material (Flint, 1971, p. 154). Diamicton is fairly common in Anchorage and vicinity; some diamicton accumulated from glaciers and is called till; other diamicton formed in marine waters or lakes, or on slopes as colluvium.

Certain symbols on the map indicate localities where the materials represented by a particular map unit are well exposed and may be examined in detail. The quality of such exposures changes rapidly with time, so that good exposures may become poor within a few years; also, man removes exposed material in many places such as gravel pits. New exposures are likely to develop in other places, however, and if some indicated localities vanish, new ones nearby may take their place.

DESCRIPTION OF MAP UNITS

COARSE-GRAINED SURFICIAL DEPOSITS

an — Alluvium of the Anchorage plain. Gravel and sand, generally well bedded and well sorted. Chiefly gravel in the eastern part of the map area, grading into sand westward; chiefly sand at Spenard and Turnagain Heights. At western end of the deposit the sand grades imperceptibly into material mapped as unit sl. Commonly overlain by 1-5 feet of silt similar to silty material mapped as unit s, but in built-up areas much of this silt has been removed.

al — Alluvium in abandoned stream channels and in terraces along modern streams. Gravel and sand, generally well bedded and well sorted. Deposits in large channels and in other broad areas are chiefly gravel and are thicker than deposits in small narrow channels and terraces, which contain chiefly sand and gravel; some channels and broad areas on the map overprinted by the dot pattern (peat) contain significant amounts of silt and clay.

af — Deposits in alluvial fans, alluvial cones, and emerged deltas. Dominantly gravel in most areas, but mostly sand with conspicuous coal fragments between Point Woronzof and Point Campbell. Generally well bedded and well sorted except for small alluvial cones in the mountains where the material is less well sorted and contains some silt and clay. These latter deposits are contiguous with and grade into materials mapped as unit c.

qa — Glacial alluvium in irregular-shaped hills (including kames, eskers, and kame terraces) deposited in and near glacier ice; includes similar deposits that may be marine rather than glacial in origin. Chiefly gravel and sand, moderately well bedded and moderately well sorted; includes some beds of diamicton, and generally consists of more heterogeneous materials than other alluvial deposits. In places materials mapped as unit qa are difficult to distinguish from materials mapped as units m and mg.

sh — Sand deposits in broad low hills, and windblown sand deposits in cliffhead dunes near Point Campbell. Almost exclusively sand, very well sorted and well bedded. The broad low hills are generally underlain by the Bootlegger Cove Clay (bc) at depths of 40 feet or more. Deposits of unit sh commonly are well drained.

sl — Sand deposits in a wide low-lying belt centered around Connors Lake. Chiefly sand, well bedded and well sorted, and small amounts of gravel; commonly contains coal fragments. Deposits grade laterally into material mapped as unit an from which it is not readily distinguishable. Contacts with materials mapped as units bc and s are not well defined; the deposits are probably complexly interrelated. Generally underlain by Bootlegger Cove Clay (bc) at depths of 20 feet or less and overlain by varying thicknesses of peat. Deposits of unit sl are commonly poorly drained. Includes small patches of modern beach sand.

FINE-GRAINED SURFICIAL DEPOSITS

Peat. Many relatively low lying areas are covered by a few feet of peat. This overprint pattern is used in conjunction with other map units where the peat is probably more than 2 feet thick. Peat commonly ranges from 5 to 10 feet thick and in places it is as much as 30 feet thick. Pond deposits (l) may occur at the base of the peat. Peat commonly is removed or buried by fill during construction and urban development, but such areas are not shown on the map.

l — Lake and pond sediments. Lowland deposits, exposed in few places, are chiefly silt and clay, with some marl; may be considerably thinner than overlying peat deposits. Near the mountains chiefly silt and clay with some fine sand, and sand and gravel; accumulated in former ice-dammed lakes; may be several tens of feet thick.

s — Silt. Near International Airport fine sand and some clay interbedded locally where the deposits, which may be more than 40 feet thick, occur in irregular hills. The boundary with materials mapped as unit sl is approximate; the two types of material may grade into one another. Between Point Woronzof and Point Campbell the deposit includes clay and is somewhat similar to material mapped as Bootlegger Cove Clay (bc), but is only about 10 feet thick; materials similar to adjacent deposits mapped as unit af underlie unit s. Also includes sediments in the tidal zone and in adjacent areas no longer or only rarely covered by tidal water.

bc — Bootlegger Cove Clay. Chiefly clay and silt, locally containing pebbles, cobbles, and boulders. Near Anchorage exposed mostly in sea bluffs and valley walls; extends continuously at depth from near Cairn Point to an area of surface exposure at Turnagain Arm. Thicknesses of about 60 feet of the Bootlegger Cove Clay are exposed in the sea bluffs, but in the central part of the lowland area wells penetrate as much as 200 feet. Interbeds of fine sand are generally thin in the north, but thicker beds of sand in the south are similar to materials mapped as unit sl; there the boundary between the two deposits is obscure. The western margin of this deposit interfingers at depth with material mapped as unit af, and on the east side it may merge at depth with material mapped as unit mg.

MIXED COARSE- AND FINE-GRAINED SURFICIAL DEPOSITS

m — Morainal deposits, generally in long ridges marking the margins of former glaciers. The topography on the Elmendorf Moraine in the northern part of the map area is notably hummocky, whereas the topography north of the moraine and along the mountain front is more subdued. Chiefly till, including diamicton and poorly sorted gravel; better sorted gravel and sand may be present locally; the deposit is not everywhere clearly distinguishable from materials mapped as unit qa.

gm — Glacial and (or) marine deposits, typically in elongate hills. These features consist chiefly of diamicton, but they include some beds of fine sand and silt; thin beds of gravel and sand occur locally. May grade into deposits mapped as unit mg.

mg — Marine, glacial, and(or) lacustrine deposits, typically in broad low areas adjacent to the hills mapped as unit gm, and in isolated hills farther west; deposits consist of a variety of interbedded materials that generally have much fine-grained material and include diamicton, stony silt, silt, fine-grained sand, and some clay. Silty materials are more common in the eastern part of the map unit and sandy materials in the western part. The isolated hills are the intermediate member of a series, the end members of which are the sharply defined hills mapped as unit gm (diamicton) to the east, and the broad low hills mapped as unit sh (sand) to the west. It is not always possible to determine precisely into which of these three map units the materials in some of the intermediate hills should be placed. In addition, some of the hills may contain silt and clay resembling Bootlegger Cove Clay (bc).

c — Colluvium (slope deposits). Extensive deposits on mountain sides and in narrow bands along sea bluffs and valley walls in the lowland. Chiefly diamicton and poorly sorted to well-sorted gravel with some sand, silt, and clay; crude bedding is common parallel to the slope. The material reflects the composition of upslope deposits. Bedrock (b) may be encountered locally at shallow depth in the mountains; the boundary with bedrock (b) is actually a broad zone approximated by the contact on the map.

ls — Deposits of landslides of the 1964 earthquake and older landslides, chiefly block-glide. Most of the slides involved large blocks consisting of beds of gravel and sand (an) lying on beds of clay and silt (bc). These blocks moved laterally from their original positions behind former bluffs to new locations at lower elevations. In places the blocks moved intact and so remain, but particularly at the outer parts of the slides most of the blocks broke into heterogeneous mixtures of gravel, sand, silt, and clay.

f — Manmade fill. Chiefly gravel and sand, but includes some silt- and clay-size material. Mapped only where unusually high embankments or very broad fills were emplaced.

Areas containing numerous manmade cuts and fills. Overprint pattern is used in conjunction with other map units, where topography is extensively altered and underlying deposits are obscured as a result of major construction activity.

BEDROCK

b — Metamorphic rocks, principally the McHugh Complex comprising weakly metamorphosed siltstone, graywacke, arkose, conglomeratic sandstone, and greenstones commonly associated with chert and argillite. Near the mouth of Little Rabbit Creek, rocks of another complex include marble, greenstone, and cherty argillite. These descriptions are based on recent mapping by S. H. B. Clark (written commun., 1972). Bedrock locally is mantled by colluvium (c) and by morainal deposits (m); the boundary between bedrock and adjacent deposits is commonly a broad zone only approximated by the contact on the map.

——— Contact - Ranges from sharp to approximately located or gradational; dotted where concealed beneath water

b——b Locality where good exposures of a particular deposit (indicated by letters) may be examined

REFERENCES

Flint, R. F., 1971, Glacial and Quaternary geology: New York, John Wiley and Sons, 892 p.

Miller, R. D., and Dobrovolny, Ernest, 1959, Surficial geology of Anchorage and vicinity, Alaska: U.S. Geol. Survey Bull. 1093, 128 p.

Schmoll, H. R., Dobrovolny, Ernest, and Zenone, Chester, 1971, Generalized geologic map of the Eagle River—Birchwood area, Greater Anchorage Area Borough, Alaska: U.S. Geol. Survey open-file map.

NOTE: Map shows pre-1964 topography and shoreline. Dotted line indicates approximate position of shoreline immediately following 1964 landslide. Subsequently shoreline has returned to near position shown on map.

Base from U.S. Geological Survey, 1962
Roads modified 1971

GENERALIZED GEOLOGIC MAP OF ANCHORAGE AND VICINITY, GREATER ANCHORAGE AREA BOROUGH, ALASKA

By
Henry R. Schmoll and Ernest Dobrovolny

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10 FOOT CONTOURS
DATUM IS MEAN SEA LEVEL
DEPTH CURVES AND SOUNDINGS IN FEET, DATUM IS MEAN LOWER LOW WATER
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE MEAN RANGE OF TIDE IS APPROXIMATELY 37 FEET

Modified from geology mapped by H. R. Schmoll and Ernest Dobrovolny, 1965-71; bedrock contacts in part from geology mapped by S. H. B. Clark, 1969-71