154. SURFICIAL DEPOSITS OF ALASKA

By Thor N. V. Karlstrom, Washington, D.C.

Work done in cooperation with the Office, Chief of Engineers

The surficial deposits of Alaska map (compilation scale 1 : 1,584,000) provides for the first time a regional synthesis of geologic information on the surficial deposits of the State. A preliminary copy of the map, on open-file inspection at Washington, D.C., was exhibited by the U.S. Geological Survey at the First International Symposium on Arctic Geology, Calgary, Canada, January 1960. Final compilation is in progress.

The map, a product of over 50 years of geologic mapping in Alaska, incorporates field observations of numerous geologists, and was compiled in coordination with a Survey Committee appointed to compile a glacial map of Alaska. Principal collaborators in compilation are Henry W. Coulter, John R. Williams, Arthur T. Fernald, David M. Hopkins, Troy L. Péwé, and Harald Dremes.

MAP EXPLANATION

Density and quality of information on surficial deposits varies appreciably from region to region in Alaska; the map legend is designed to show available information at various levels of completeness. The deposits are classified, where possible, into genetic categories including glacial, glaciofluvial, glaciolacustrine, fluvial, eolian, volcanic, and coastal-type sediments. Where such distinctions are not possible, broader categories are used to show the deposits as sedimentary complexes associated with different types of mountainous and hilly terrain, and as undifferentiated units in unmapped parts of lowlands and broad upland valleys.

The glacial deposits are subdivided, largely on the basis of morainal sequence and morphology, into four map units ranging in age from early Pleistocene to Recent. The age ranges of the nonglacial surficial deposits are placed in reference to the glacial sequence. The moraine units represent the major subdivisions recognized in most regions. More refined subdivisions made in local areas are shown by lines representing significant moraine boundaries within the mapped units. The named glacial deposits of published chronologies included within each map unit are listed in a chart. The chart has been brought up to date by each geologist involved, and represents the latest judgments on correlations between the moraine sequences of Alaska.

In addition to an areal breakdown of deposits into 23 genetic and age categories, the map shows (a) distribution of present glaciers and ice fields; (b) location of significant stratigraphic sections, high-level glacial drifts, and erratics, with accompanying brief descriptions in an inset; (c) major faults along which surficial deposits hare been displaced locally; (d) inferred boundaries of submarine glacial drift in coastal areas; and (e) regions compiled by each principal contributor (presented in an index map and accompanied by a list of principal sources of information).

SCIENTIFIC RESULTS

The pattern of surficial deposits in Alaska provides basic geologic information bearing primarily on the Stab's Quaternary history. As field mapping continues, refinements in the map and in geologic interpretations will follow.

In figure 154.1 the surficial deposits are generalized to show regional units which reflect the major geomorphic environments and dominant geologic processes that affected Quaternary deposition.

The major areas of coastal sediments are restricted to the Arctic coastal plain, the north coast of Seward Peninsula, and the large Bering Sea delta formed at the mouths of the Yukon and Kuskokwim Rivers. Elsewhere emerged coastal sediments are restricted to narrow discontinuous zones commonly interrupted by abrupt rocky shorelines. Where studied, the coastal deposits record complex sea level changes of both tectonic and eustatic origin. The present coastal deposits are much more restricted than in the past, when marine regressions accompanying Pleistocene glaciations exposed vast areas of shallow sea bottom, particularly in the Bering Sea.

Important areas of fluvial deposits occur in the unglaciated interior region where thick alluvium underlies the Yukon and other large valleys. Likewise the main areas of thick eolian deposits lie in unglaciated regions bordering heavily glaciated terrain or along major valleys of the interior. Deposits with high percentages of volcanic material are associated with vol-

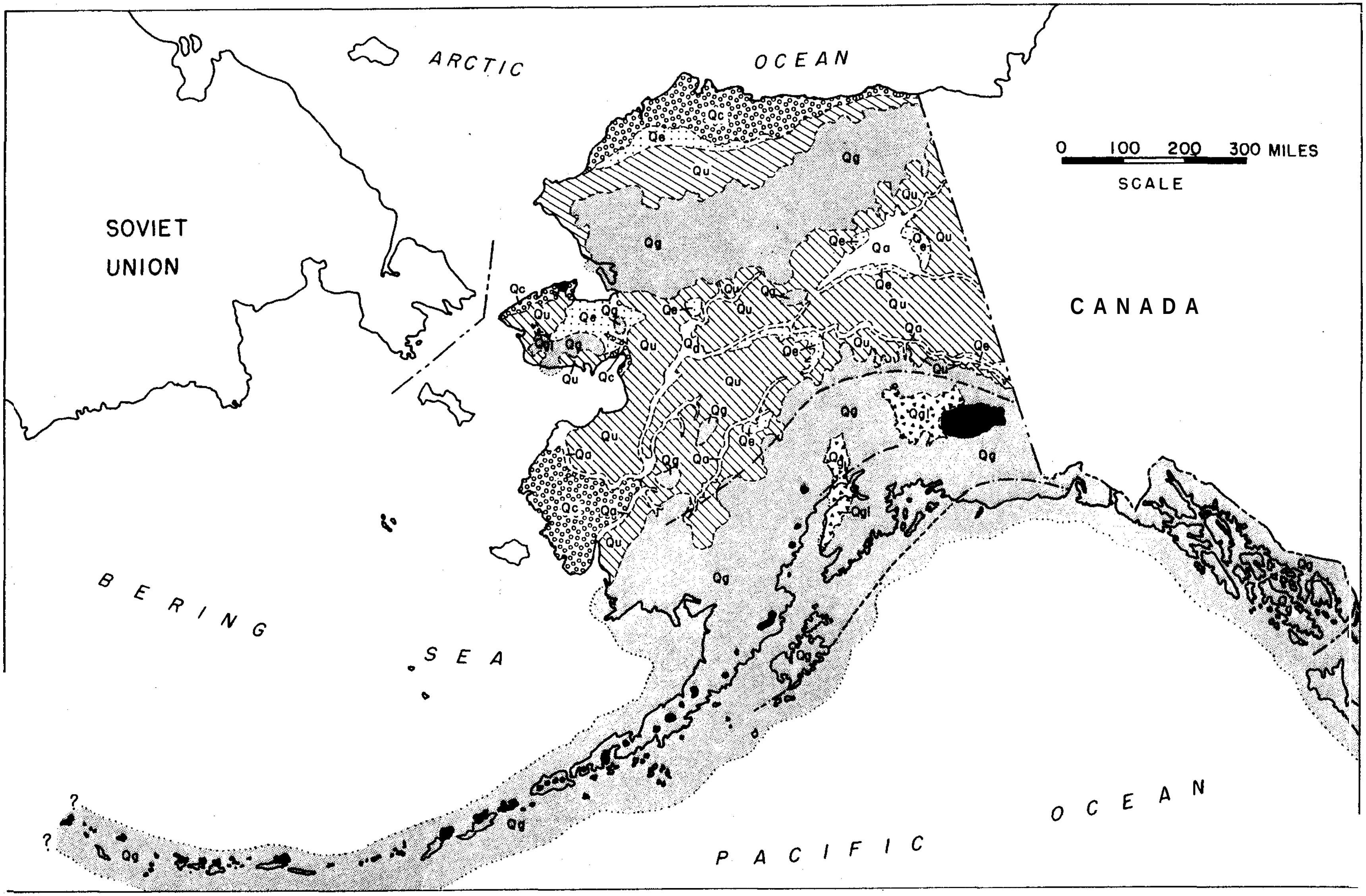

FIGURE 154.1.—Sketch map of major regional groups of **surficial** deposits in Alaska. Qg—glacial and other deposits associated with heavily glaciated alpine mountains; **Ggl—glaciolacustrine** deposits of larger Pleistocene proglacial lakes; **Qu—undifferentiated deposits associated** with generally **unglaciated** up lands and lowlands of the interior and North Slope; Qa—fluvial deposits; Qe—eolian deposits; and **Qc—coastal** deposits of interbedded marine and **terrestrial** sediments. Solid black **areas—deposits associated** with volcanic peaks and flows of Quaternary and Tertiary age. Heavy **dot-dash** lines—traces of major **pre-Quaternary** faults recording local Quaternary displacements (washed line&—inferred trace). Dotted lines—inferred, **partly schematic,** boundaries of submarine glacial deposits.

canic peaks of Quaternary and Tertiary age along the Aleutian chain and in the Wrangell Mountains, and with cones and flows of Quaternary age on Seward Peninsula. Thick proglacial lake deposits, including "till-like" stony silt, locally underlie basins and trunk valleys in or adjoining the glaciated regions, and record ice damming of regional drainage lines during one or more glaciations.

Quaternary faulting, recorded by minor offsets of surficial deposits, is concentrated along major arcuate pre-Quaternary fault zones cutting underlying bedrock, and assists in delineating these regional fault trends as important linear elements in the tectonic structure and history of the State. Greatest Quaternary movement seemingly was concentrated along the Chugach-St. Elias fault of southern coastal Alaska. Elevated strandlines and marine deposits along the coast south of the fault record notable tectonic displacements during late Quaternary time. In contrast, the evidence along the coast north of the fault indicates essential crustal stability over the same time interval.

The regional pattern of glacial deposits provides significant information on the nature of Quaternary climatic changes in Alaska. The deposits, recording separate, successively less extensive glaciations, form subparallel belts flanking the alpine mountain ranges. The regional distribution indicates that the Pleistocene glaciers: (a) fed from the same high areas which essentially comprise the modern alpine divides, (b) were largest near the Pacific coast and progressively smaller northward towards the Arctic coast, and (c) were more extensive on the south slopes than on the north slopes of all the alpine ranges. This regional glacial intensity pattern, repeated during each glaciation, conforms with the distribution of existing glaciers, with regional southward inclination of the modern climatic snowline, and with present climatic zonation orographically produced by predominant precipation supplies from the Pacific Ocean. The pattern reveals neither significant differential uplifts between the coastal mountains north of the Chugach-St. Elias fault and the Alaska and Brooks Ranges nor profound regional atmospheric circulation changes throughout the period of morainal record. The recorded shifts towards more glacial climate thus appear to have been produced primarily from increased precipitation rates resulting from intensification of atmospheric circulation patterns centered, as today, in the North Pacific.

155. RECENT EUSTATIC SEA-LEVEL FLUCTUATIONS RECORDED BY ARCTIC BEACH RIDGES

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Work done in cooperation with the U.S. Atomic Energy Commission

In the areas near Point Hope and Cape Krusenstern, on the northwestern coast of Alaska, extensive barrier bars composed of numerous beach ridges have been formed since the last major rise of sea level. These areas are about 300 km northwest of Bering Strait and about 190 km apart. The building of gravel beach ridges has prograded the shoreline (moved it seaward) approximately 2 km at Point Hope and 7 km at Cape Krusenstern. Sea level rose nearly to its present position in this area (and throughout the world) about 3000 B.C. (Hopkins, 1959), and the ridges were formed more recently. The age of many of the ridges can be closely estimated from archeological findings. The former inhabitants subsisted principally on marine mammals, and it is safe to assume that they lived close to the sea (Giddings, 1960); the present-day Eskimos build their houses about 100 m from the shoreline. The dated beach ridges thus provide evidence regarding former positions of sea level.

John Y. Cole, Jr., assisted in the geological work. The estimates of age were made possible by archeological studies, especially those of J. L. Giddings of Brown University, who made some of his results available to us before he had published them.

The barrier bars extend parallel to the shore for about 15 km at both Point Hope and Cape Krusenstern. The individual beach ridges in the barrier bars are remarkably persistent. The highest ridges stand about 3 m above sea level. The amplitudes between crests and swales may be as much as 2 m, and the