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GEOLOGIC MAP OF THE ST. MICHAEL QUADRANGLE, ALASKA

By
J. M. Hoare and W. H. Condon

MISCELLANEOUS GEOLOGIC INVESTIGATIONS
MAP I-682

HOARE AND CONDON—ST. MICHAEL, ALAS. 1:250,000 MAP I-682

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INTRODUCTION

The geologic map of the St. Michael quadrangle is one of a series presenting the results of regional geologic mapping in the lower Yukon-Norton Sound region, western Alaska. It is based upon fieldwork done by helicopter in 1961, 1963, and 1966 and the study of air photographs.

Rocks exposed in the quadrangle consist of deformed and altered volcanic rocks of probable Jurassic and Early Cretaceous age, a younger group of deformed sedimentary rocks of Cretaceous age, intrusive igneous rocks of Late Cretaceous or early Tertiary age, and a younger group of of basalt flows and cones of Quaternary age. The rocks are overlain by a variety of unconsolidated surficial deposits.

The writers wish to acknowledge the efficient work of N. W. Rutter, who assisted them in the field, and to express appreciation to members of Saint Mary's Mission, whose generous assistance greatly facilitated the field work.

BEDROCK

VOLCANIC ROCKS

Dark green and purple andesitic volcanic rocks form most, or all, of Hogback Hill west of the mountains near the south edge of the quadrangle. Only float fragments occur on Hogback Hill, but similar rocks crop out a few miles farther south in the Kwiguk quadrangle (Hoare and Condon, 1966).

No fossils have been found in the St. Michael quadrangle, but similar volcanic rocks elsewhere in western Alaska contain interbedded sedimentary rocks which have yielded pelecypods of Early Cretaceous age and belemnites and ammonites of possible Middle Jurassic age.

CRETACEOUS SEDIMENTARY ROCKS

The Cretaceous sedimentary rocks consist of marine and nonmarine sandstones and siltstones, some of which are tuffaceous. The rocks are lithologically similar to and almost certainly correlative with the Kaltag and Nulato Formations in the Yukon River drainage (Dall and Harris, 1892, p. 247-248; Martin, 1926, p. 395-414). However, the Kaltag and Nulato Formations cannot be differentiated in the St. Michael quadrangle because of structural complexity and lack of exposure.

Intraformational shale-chip conglomerate is fairly common, but the section, as a whole, is remarkably fine grained. True conglomerate was noted only on Point Romanof where beds of pebble-cobble conglomerate crop out. The sandstones are chiefly fine- to medium-grained, well-indurated graywackes consisting of subangular and subrounded grains in a matrix of silt and clay-sized particles which commonly make up 10 to 30 percent of the rock. The sand grains consist of varying amounts of quartz, quartzite, chert, siltstone or shale, and extrusive rocks. Most of the feldspar is plagioclase, but orthoclase is locally abundant. Detrital muscovite is very common in the finer grained rocks. Most of the matrix is too fine grained and altered to be resolved under the microscope, but recognizable minerals include chlorite, sericite, quartz, and feldspar. Calcite and/or laumontite is the chief cementing material in some of the sandstones.

Siltstone comprises about half of the sequence, but it rarely crops out except in cutbanks along the streams. Some of it is quite shaly, but most of it weathers into small, blocky, subconchoidal fragments. The composition of the siltstone appears to be about the same as the matrix of the sandstone. Calcareous concretions are very common in the siltstones, but the siltstones themselves are rarely calcareous.

For mapping purposes the Cretaceous sedimentary rocks have been divided into three lithologic units on the basis of whether the sandstones are predominantly calcareous, noncalcareous, or laumontitized. Each of these units contain about as much siltstone as sandstone. Most of the sandstones in the calcareous unit effervesce freely when treated with cold, dilute hydrochloric acid, but the unit also includes sandstones that are noncalcareous or slightly calcareous. The noncalcareous unit includes numerous beds that are at least weakly calcareous, but these beds are generally much more thickly bedded than the rocks of the calcareous unit. The laumontitized unit includes an equal or slightly greater amount of calcareous and noncalcareous strata which contain little or no laumontite.

These three lithologic units form four, possibly five, fairly well defined, northeast-trending belts which can be traced southwestward into the Kwiguk quadrangle for 60 miles or more. The stratigraphic and structural relationships of the three lithologic units and their belts of outcrop are uncertain because the rocks are highly deformed and poorly exposed. The belts of outcrop may indicate large-scale structural repetition by folding or faulting, or they may represent stratigraphic repetition. Because some of the rocks are marine and others are nonmarine, the three lithologic units may represent different facies deposited during the same time interval.

Although the strata have yielded no fossils in the St. Michael quadrangle, they are assigned a Cretaceous age because they strike southwestward into the Kwiguk quadrangle where similar rocks have yielded fossil plants and mollusks of Albian and possibly slightly younger ages (Hoare and Condon, 1966).

The order in which the three lithologic units are described below should not be construed as an indication of their relative ages.

Noncalcareous sandstone.—Predominantly noncalcareous sandstones and siltstones (Ks) form the west half of the Nulato Hills (Wahrhaftig, 1965, p. 28-29) in the southeast corner of the quadrangle. The rocks consist of fine- to medium-grained, dark-gray and greenish-gray sandstone interbedded with dark-gray siltstone. The sandstone is tough and well-indurated, and much of it tends to break into flaggy fragments 1 to 4 inches thick and 8 to 12 inches across.

Most of the rocks in this unit are probably marine. They contain a small amount of carbonized plant trash but have yielded no diagnostic fossils or good evidence of freshwater deposition.

Calcareous sandstone.—Highly calcareous sandstones and interbedded noncalcareous siltstones (Kcs) form two belts of outcrop in the Nulato Hills and apparently underlie much of the coastal plain west of the hills. Thin-bedded, highly calcareous sandstone crops out on the coastal plain near the mouth of the first small stream north of Hogback Hill, on the hill at Point Romanof, and at intervals in the bed of Charlie Green Creek as much as 10 miles inland from the sea coast. Similar calcareous rocks were noted on the coastal plain as much as 20 miles south of the quadrangle. The two belts of calcareous rocks in the hills extend southwestward about 70 miles to the vicinity of the Yukon River and northeastward for about 20 miles into the Unalakleet quadrangle where they are largely overlain by young lava flows.

The sandstone is mostly fine to medium grained and medium to dark gray. Weathered fragments are encased in a soft, brown, noncalcareous rind. Some of the rock is more than 50 percent calcium carbonate and could be termed impure limestone. The calcareous sandstones are well indurated but are not as tough as the noncalcareous sandstones, and they generally form lower, well-rounded hills and ridges that are surmounted by isolated ribs and conical points a few feet high.

The calcareous sandstone beds are mostly thin and separated by thin shaly partings. They commonly weather into plates less than 2 inches thick and several inches across. Predominantly sandy sequences of beds 10 to 20 feet thick are separated by equal or greater amounts of siltstone, which is commonly micaceous and shaly.

On Point Romanof the calcareous unit includes two or three 10- to 20-foot beds of pebble-cobble conglomerate. The conglomerate is made up largely of well-rounded clasts of volcanic rock, chert, and quartzite up to 4 inches in greatest diameter.

Few criteria were noted in the calcareous sandstones to indicate whether they are marine or nonmarine. However, crossbedding 6 to 12 inches thick which was noticed at one place and the close association of the calcareous sandstones with the laumontitized sandstones, which are probably nonmarine, suggest that at least part of the unit is nonmarine or littoral.

Laumontitized sandstone.—This unit consists of laumontitized sandstone (Kls) interbedded with equal or greater amounts of calcareous and noncalcareous strata containing little or no laumontite. The laumontitized strata are slightly to highly calcareous and are bounded on either side by northeast-trending belts of calcareous sandstones. They crop out southwestward in the Kwiguk quadrangle to the Yukon River, a distance of 70 miles, and apparently continue an additional 150 miles farther beneath the consolidated deposits south of the Yukon to Nelson and Nunivak Islands where laumontitized tuffs and tuffaceous sandstones containing plant fossils of Albian age are exposed. The laumontitized sandstones appear to intertongue and be infolded with the calcareous sandstones, especially along the eastern edge of the laumontitized belt. Laumontitized tuffs of fine-grained volcanic ash form part of the belt along its western margin where they grade laterally into laumontitized tuffaceous sandstones.

The laumontitized strata are recognizable because the dark-gray rocks are spotted or mottled with light gray areas. Rocks containing a large amount of laumontite (40 to 50 percent), such as the tuff, have an earthy appearance, are light gray or greenish gray, and are mottled with dark gray.

In general, the coarser grained rocks are more highly laumontitized than are the finer grained sandstones and siltstones. The sandstones are poorly sorted mixtures of subangular and subrounded mineral and rock fragments in a poorly defined matrix containing laumontite, chloritized biotite, sericite, and calcite. The clasts are chiefly quartz, albite, chert, finely porphyritic volcanic rock, shale chips, and carbonized plant trash. Most of the laumontite appears to be in the matrix, but it also replaces some of the albite.

The probable origin of the laumontite through diagenesis has been discussed previously (Hoare and others, 1964, p. C77-78). The laumontitized beds themselves are probably nonmarine as they contain abundant plant trash and large deciduous fossil leaves and are locally crossbedded. At one place, laumontitized tuff with mud cracks and fragile vertical plant stems was noted. However, at least some of the nonlaumontitized strata in the unit are marine because, about 200 miles farther northeastward, they contain fossil ammonites (Bickel and Patton, 1957).

The laumontite probably formed diagenetically either at the time of deposition or shortly thereafter. The fact that the laumontite favors the coarser grained rocks, which were presumably more porous, suggests that it may have formed through the action of ground water after the rocks were compacted but before they were indurated. The close association of the laumontitized sandstones with tuff and highly calcareous sandstone suggests that the laumontite formed by interaction of volcanic ash that fell or was washed into a shallow basin containing calcium carbonate. The natural formation of sodic zeolites through the reaction of volcanic glass and solutions of sodium carbonate has been described by Bradley (1929) and Hay (1963), and similar zeolites have been synthesized in the laboratory (DiPiazza and others, 1959). However, laumontite, a calcic zeolite, has not yet been made artificially, and the exact chemical conditions of its formation are not known.

INTRUSIVE ROCKS

The only intrusive rocks found in the quadrangle consist of two small rhyolitic dikes. The dikes trend northeastward and intrude the Cretaceous strata near the southeast corner of the quadrangle. They are less than 20 feet thick and are not shown on the geologic map because of their small size.

QUATERNARY BASALT

Basalt flows, tuffs, and associated cones and craters form Stuart and St. Michael Islands and underlie most of the coastal plain from the Kogok River northeastward along the coast to a point about 36 miles east of the quadrangle. For mapping purposes they are divided into two sub-units on the basis of relative age using physiographic expression and paleomagnetic data (see map).

Older basalts.—Older basalts of Quaternary age (Qbo) form the east half of Stuart Island and crop out at three places on the west half of the Island. They constitute all of St. Michael Island and underlie the coastal plain from the Kogok River to the east edge of the quadrangle. They also extend down the valley of the Andreafsky River into the southeast corner of the quadrangle.

The unit consists of many columnar-jointed flows, a variety of pyroclastic material, several cones, and six maar-type craters. In most areas the rocks are concealed by silt which varies in thickness from a thin veneer to several feet. The silt contains a large amount of permafrost and is probably wind deposited. Large isolated basalt boulders lie on the silt north of the Kogok River and indicate the presence of underlying lava flows.

The flows and cones are moderately altered by frost action and erosion. The Andreafsky River has cut through 60 to 80 feet of basalt flows in the southeast corner of the quadrangle. On Stuart and St. Michael Islands, sea cliffs more than 200 feet high are cut in the flows, tuffs, and breccias.

The five largest lakes on St. Michael Island, the Clear Lakes, are in maar-type craters. A sixth maar, which has a broken wall and is full of silt, is visible west of the largest lake-filled maar. Four soundings made in the largest maar reveal that the lake is about 125 feet deep and has a flat bottom and that the walls slope inward at angles of 20° to 30°. The walls rise 20 to 50 feet above lake level so the maar is about 175 feet deep. Scant exposures indicate that the rims of the maars consist of massive vesicular basalt with some tuff and breccia.

The log of a water well drilled by the Bureau of Indian Affairs at St. Michael Village in 1963 indicates that the well penetrated about 135 feet of black lava rock with thin clay layers overlying at least 77 feet of clay and sand. Possibly, the material called clay and sand by the driller is misidentified, because some of the volcanic dust and lapilli-tuff on Stuart Island has a clay-like and sand-like texture. A 36-foot well drilled at Stebbins penetrated only unconsolidated material and ended in fine sand.

Thin- to thick-bedded, fine-grained volcanic ash, lapilli-tuff, and breccia constitute many of the sea cliffs on the east half of Stuart Island and three small erosional remnants on the west half of the Island. They also crop out in the sea cliff west of Stebbins on St. Michael Island and on the north coast. Locally, the pyroclastic rocks overlie massive basalt flows or contain one or more interbedded flows. Most of them are moderately well consolidated. They are broken by many small faults and appear to dip gently northward.

These clastic volcanic rocks and associated flows are the oldest rocks exposed on Stuart and St. Michael Islands. They are generally overlain by a thick layer of wind-deposited silt and are separated by an erosional disconformity from flows which issued from Stuart and St. Michael mountains and other smaller cones.

Most of the flows and cones in this subunit are fluid, tholeiitic basalt or basalt with tholeiitic affinities. The flows are fine-grained, black or dark-gray, porphyritic, vesicular basalt. Scattered olivine and clinopyroxene phenocrysts occur in a groundmass of labradorite, clinopyroxene, brown to black glass, and opaque ores, probably magnetite. They commonly contain glomeroporphyritic labradorite. Olivine phenocrysts are embayed and partly resorbed by the fine groundmass but lack clinopyroxene. Chemical analyses of similar rocks on Nunivak Island (Hoare and others, 1968, p. 395-401) suggest that they are tholeiitic. However, Crater Mountain and the cones and flows which surround it consist of highly alkalic basalt. The steep-sided cones are composites of cinders, breccia, and short flows. The flows are mostly fine grained, porphyritic, black or dark gray, dense or finely vesicular. They consist of numerous olivine and a few clinopyroxene phenocrysts in a microcrystalline ground mass. Olivine phenocrysts as large as 2 or 3 mm are generally embayed and rounded but lack reaction rims. Clinopyroxene phenocrysts are commonly replaced by a fine-grained, highly birefringent mineral which has not been indentified. The groundmass is generally microporphyritic and essentially holocrystalline but too fine grained to be resolved by the microscope. It appears to consist of opaque iron ores, microphenocrysts of olivine and pyroxene(?); and plagioclase laths that are embedded in a gray anisotropic mesotasis. X-ray analyses of similar basalts on Nunivak Island (Hoare and others, 1968, p. 402) reveal that analcime and nepheline form part, or all, of the mesotasis. The basalts are classified as basanite because they contain modal olivine and nepheline (Yoder and Tilley, 1962, p. 355). Lherzolite xenoliths which were found at several places also indicate that the basalts are highly alkalic; elsewhere in the world similar xenoliths occur only in alkalic basalts (Forbes and Kuno, 1965, p. 161-179; Jackson, 1968, p. A98-A99).

The relative age of the basalts in this subunit is based upon physiographic expression. Polarity measurements reveal that most of the basalts are normally magnetized but that Crater Mountain and the flows in the Andreafsky valley in the southeast corner of the quadrangle are reversely magnetized. The normally polarized rocks that constitute Stuart and St. Michael Islands show widely differing degrees of dissection and silt cover. Stuart and St. Michael Mountains and several smaller cones, which are fairly well preserved and have little silt on them, probably formed early in the present (Brunhes) normal polarity epoch which began about 0.7 million years ago (Cox and Dalrymple, 1967, p. 173-177). The tuffs and breccias and associated flows on Stuart and St. Michael Islands are also normally magnetized but probably cooled during an older period of normal polarity. They are faulted and heavily mantled by silt and appear to be old erosion remnants.

Crater Mountain probably formed near the close of the Matuyama reversed polarity epoch because it is reversely polarized and closely associated with three or four nearby cones which show about the same degree of dissection and erosion but are normally polarized. The Matuyama reversed polarity epoch began about 2.4 million years ago and ended 0.7 million years ago (Cox and Dalrymple, 1967, p. 173-177). The normally polarized cones probably formed near the beginning of the Brunhes epoch. The reversely polarized flows in the southeast corner of the quadrangle came from a much older reversely magnetized cone in the adjoining Unalakleet quadrangle. They probably cooled early in the Matuyama reversed polarity epoch.

Younger basalts.—The younger subunit (Qby) consists of the youngest volcanic rocks in the quadrangle. They form the low west half of Stuart Island and are separated from the higher eastern part of the island by a swampy lowland and a narrow waterway, the Stuart Island "canal". Most, or all, of the young lava came from the well-preserved crater in West Hill and two smaller cratered cones about 2 miles farther west. The young flows surround three isolated, steep-sided remnants of older volcanic rocks which form peaks 50 to 150 feet high. The shape and location of these remnants and the Stuart Island canal suggest that they were old seastacks. However, the young flows which surround them appear to be terrestrial and not marine.

The surface of the young flows consists of rough blocks of scoriaceous black and gray lava upon which a little tundra vegetation has started to grow. The low coastline formed by the flows is highly irregular and fringed by low lava reefs; sea cliffs are mostly less than 10 feet high.

Paleomagnetic measurements reveal that the cones and flows are normally polarized, and their fresh appearance suggests that they are only a few thousand years old. they clearly cooled during the present (Brunhes) magnetic polarity epoch which began about 0.7 million years ago (Cox and Dalrymple, 1967, p. 173-177).

The tholeiitic basalts in this unit are petrologically similar to those in the older unit. No highly alkalic basalts were identified.

STRUCTURE

The bedded rocks in the St. Michael quadrangle comprise three distinct tectonic units which correspond to the three main stratigraphic units. The old volcanic rocks of Early Cretaceous and possible Jurassic age are part of the basement complex which was warped into northeast-trending geanticlinal and geosynclinal belts in Mesozoic time. The Cretaceous sedimentary rocks are deposits laid down in one of the geosynclinal belts, the Koyukuk geosyncline (Payne, 1955; Hoare, 1961, fig. 3). They are regionally unconformable upon the older volcanic rocks and are unconformably overlain by the third tectonic unit which consists of the Quaternary lava flows and tuffs.

The structure of the old volcanic rocks in St. Michael quadrangle is not known because the rocks occur only as float fragments on Hogback Hill. However, elsewhere in western Alaska where the rocks are well exposed, they are generally considerably deformed.

The Cretaceous sedimentary rocks are compressed into northeast-trending folds which appear to plunge southwestward and probably are asymmetric or overturned southeastward. Most structural observations show westward dips of 10° to 80°. Cutbanks along the East Fork of Andreafsky River a few miles southeast of the quadrangle expose numerous northeast-trending folds which are asymmetric to the southeast. The southeast limbs of the synclines are long and dip gently westward. The northwest limbs are commonly short, steep, and locally overturned southeastward.

The strata are broken by two sets of faults, one of which trends about N. 40° E., the other N. 20° W. Only the more obvious faults are shown on the geologic map. The northeast set is generally longer and better defined. Some of these faults show a small amount of right-lateral separation. Faults of the northwest set are shorter but probably more numerous. In the Kwiguk quadrangle farther south this set commonly shows left-lateral separation of a few feet or few tens of feet.

Neither of the two sets of faults is parallel to the regional strike or to the fold axes. Small axial-plane faults were noted in cutbank exposures on the East Fork of Andreafsky River, and it is reasonable to expect that the rocks may be offset by one or more large-scale, west-dipping reverse faults which parallel the regional strike.

A major structural feature of the quadrangle is the inferred seaward extension of the Kaltag fault (Patton and Hoare, 1968, p. D151, fig. 5), which is sharply expressed in bedrock in the adjoining Unalakleet quadrangle. Southwest of the St. Michael quadrangle the trace of the fault is inferred from seismic reflection profiles which show a broad sediment-filled trough under the Bering Sea shelf trending N. 60-65° E. for a distance of about 250 miles (Scholl and others, 1970, p. 141-142). There is no direct evidence of the fault in the St. Michael quadrangle, but the proximity of the inferred trace to the young volcanic rocks is probably significant. Geologic investigations elsewhere in western Alaska (Hoare and Coonrad, 1961a, 1961b) indicate a close association between late Cenozoic volcanism and large faults.

The thickness of the sedimentary sequence cannot be determined directly because the rocks are deformed and poorly exposed. A reconnaissance airborne magnetometer survey in the Koyukuk geosyncline about 150 miles farther northeast yielded data suggesting a maximum depth of 15,000 to 20,000 feet for the geosyncline (Zietz and others, 1959). An oil well drilled about 175 miles south of the quadrangle in a parallel depositional trough penetrated Cretaceous strata to a depth of 15,000 feet. It is probable that the sedimentary sequence in the St. Michael quadrangle is of comparable thickness. However, the true stratigraphic thickness may be much less because the rocks are probably isoclinally folded and may be broken by large reverse faults.

Most of the Quaternary volcanic rocks are essentially horizontal except for the oldest tuffs and flows on St. Michael and Stuart Islands, which commonly dip 5° to 15°. They are also broken by small faults showing vertical movement of a foot or less. These rocks are probably the remnants of older cones and were probably initially deposited on a sloping surface. The small faults may have formed by differential compaction in the volcanic ash or by swelling and contraction of the cones during periods of eruption.

SURFICIAL DEPOSITS

Most of the unconsolidated surficial deposits in the St. Michael quadrangle lie west and north of the mountains where they comprise the northern part of the present delta of the Yukon River and veneer the coastal plain.

The coastal plain, which is 8 to 15 miles wide, is bounded on the south and east by a steep escarpment that may be a wave-cut, fault-controlled feature. Toward the southwest the coastal plain is underlain by sedimentary and volcanic rocks of Cretaceous age, farther east, by Pleistocene lava flows. Most of the unconsolidated material on the coastal plain consists of sand and gravel deposited as coalescing alluvial fans by streams draining the adjacent mountains. The coarse-grained deposits are mantled by several feet of silt in which a great many small thaw lakes have developed. The silt may be wind deposited.

Fine sand, silt, and woody material comprise most of the deltaic deposits. Most of this fine-grained material was derived from the interior highlands of Alaska and deposited by the Yukon and its distributaries beyond the western edge of the coastal plain. The deposits have been extensively reworked by the shifting mouth of the Yukon and its distributaries and by ocean currents and waves. Some of it has probably been reworked by wind, although no wind-deposited material has been recognized.

The surficial deposits have been subdivided and mapped largely on the basis of physiographic expression through the study of topographic maps and vertical air photos. The map units more nearly mark stages in the physiographic evolution of the region than lithologic differences.

Old alluvial deposits.—Deposits mapped as old alluvium (Qoa) include sand, gravel, and silt laid down on the coastal plain and terrace gravels and colluvium in and near the mountains. Most of the coastal plain deposits probably consist of broad, thin alluvial fans laid down by streams draining the mountains in the southeast corner of the quadrangle. Stream exposures show that the deposits are mostly well-rounded gravel near the mountains and chiefly sand and silt farther out on the coastal plain.

The surface of the coastal plain is mantled by several feet of silt some of which is probably wind deposited. Hundreds of small thaw lakes have developed in the silt cover. Most of the old alluvial deposits are drained by a fairly well-integrated stream system.

The thickness of the deposits is probably not over a few tens of feet because bedrock crops out at two or three places along the coast and at intervals along most of the length of Charley Green Creek.

The age of the deposits probably ranges from late Pleistocene to Holocene. Local inhabitants report finding fossil bones near Coffee Point.

Old floodplain deposits.—The area mapped as old floodplain deposits (Qof) in the St. Michael quadrangle is a northern continuation of a map unit that is widespread farther south in the Kwiguk quadrangle. The old flood plain deposits for which the unit is named merge seaward with estuarine, deltaic, and other types of near-shore deposits which are mapped as part of the unit because they cannot be easily differentiated.

In the St. Michael quadrangle west of Hogback Hill, these deposits include a northeast-trending belt of near-sea-level deposits which is bordered on the west by a parallel belt of ridges 20 to 35 feet in elevation. The belt of ridges is interpreted as a former offshore bar which is presently joined to the mainland by filling of the lagoon.

The western portion of the old flood plain deposits has been reworked and modified by small distributaries of the Yukon.

Beach and lagoonal deposits.—Beach and lagoonal deposits (Qbl) consist of silt and sand laid down between the two parts of Stuart Island and along the coast between St. Michael Island and Point Romanof. Between Canal Point and St. Michael Island the deposits form a belt of subdued, northeast-trending ridges 8 to 12 feet high which apparently mark the location of an old offshore bar. Between the ridges and the mainland is a much wider, low, swampy area which is probably a filled lagoon.

Formerly, the deposits probably extended from St. Michael Island to a point some miles southwest of Hogback Hill where deposits of similar appearance, including ridges as high as 35 feet, are mapped with the old floodplain deposits. The deposits are presently being removed by shoreline erosion which has truncated both the bar and lagoonal deposits southwest of Canal Point.

Young floodplain deposits.—Young floodplain deposits (Qyf) form the present delta of the Yukon River. Most of the deposits are silt and fine sand except in and near the Nulato Hills where the floodplains are chiefly sand, gravel, and boulders.

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