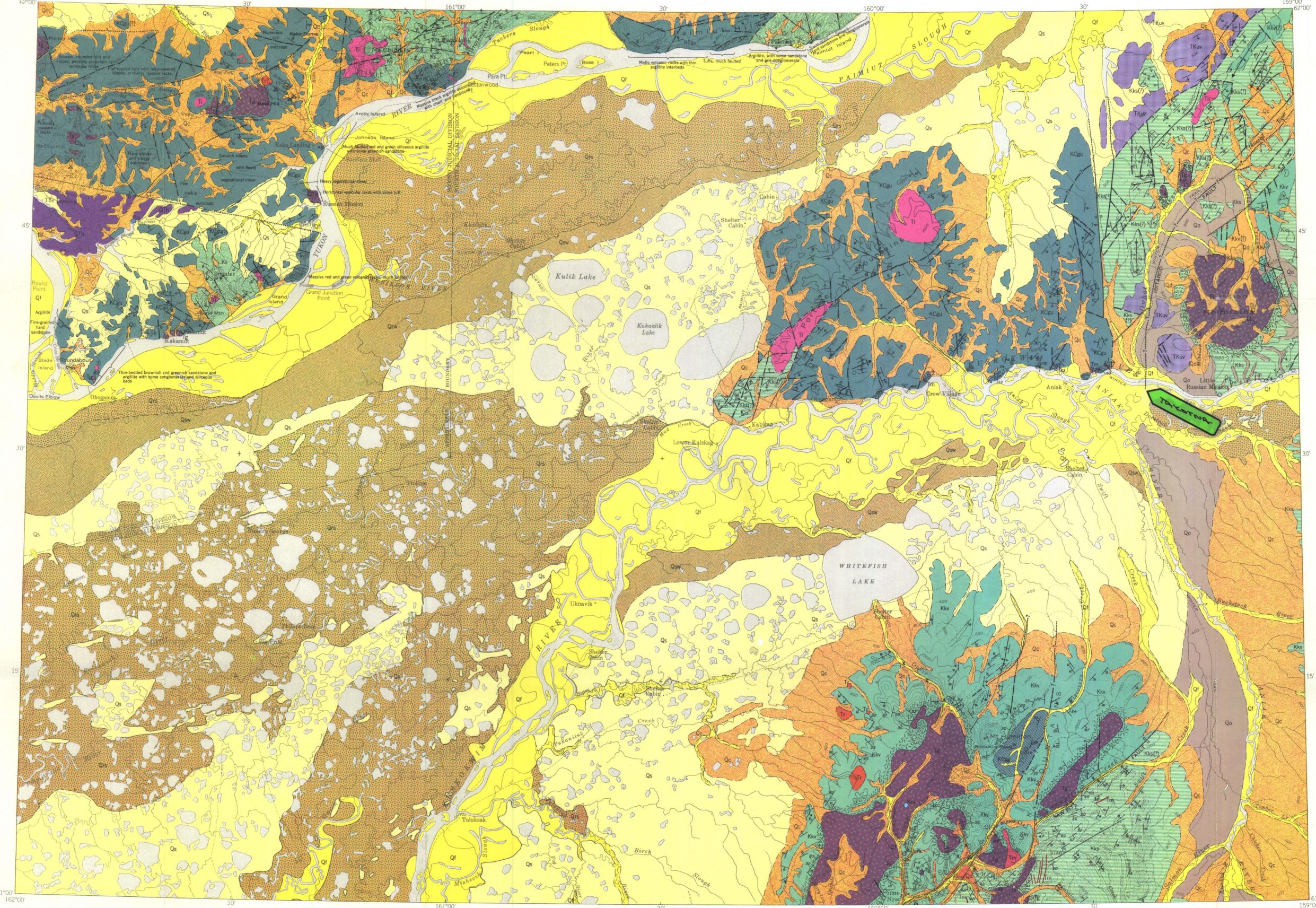
MAP 1-292



Base map by Topographic Division U.S. Geological Survey, 1950

INTRODUCTION

The geologic map of the Russian Mission quadrangle is one of several maps resulting from reconnaissance study of the geology and mineral resources of the Lower Kuskokwim-Bristol Bay region, southwest Alaska. The map is based upon reconnaissance field studies by Harrington (1918), Fox (written communication 1940), Cady and others (1955), and J. M. Hoare in 1946, and 1947, in the vicinity of Mount Hamilton and upon photogeologic interpretation

by Coonrad and Hoare. Harrington's original field observations, which were largely limited to areas readily accessible by boat (Harrington, 1918, p. 5, pls. 3, 4), are the basis for the photogeologic map of the area north of Yukon River. A geologic sketch map drawn by E. F. Fox (written communication, 1940) supplied additional information in the vicinity of Kako Creek. A small area east of Owhat River in the northeast corner of the quadrangle is modified after Cady (1955, pl. 1). Most of the rocks exposed between the Yukon and Kuskokwim Rivers west and north of Owhat River have been mapped by photogeologic interpretation. Some of the rocks exposed on the north bank of the Kuskokwim River were examined by Maddren (Smith, 1939, p. 33) and by Hoare in 1950. Hoare mapped the bedrock south of Kuskokwim River in 1946 and 1947 as part of a reconnaissance study of the lower Kuskokwim-Bristol Bay region. Additional structural information on the area was obtained by photogeologic means when vertical air photographs became available in 1955. The surficial deposits in the Russian Mission quadrangle have been subdivided on the basis of photogeologic study and scattered field observations. The topographic base is highly generalized but adequate in most areas for presenting the results of this reconnaissance study. The writers made a more detailed planimetric map of part of the area enclosed by the great south bend of Yukon River. Locally the small scale of the quadrangle map has necessitated the generalization or exaggeration of some geologic details. Lithologic symbols have been used to indicate known occurrences of distinctive types of rocks. The geologic age of the rocks shown by lithologic symbols is the same as the formation with which they occur.

Efficient assistance in the field was given at different times by P. C. Tremel, S. P. Brown, and L. A. Brubaker. W. L. Coonrad did most of the photogeologic interpretation. Fossil collections were studied by R. W. Imlay, J. B. Reeside, Jr., and J. S. Williams. Appreciation is herewith expressed to the personnel of the New York-Alaska Gold Dredging Corp. and the Awe Mining Co. for the assistance, information, and hospitality they rendered.

BEDDED ROCKS Bedded rocks ranging in age from late Paleozoic to late Cenozoic and associated intrusive rocks of Tertiary age crop out in about

half of the quadrangle. Unconsolidated surficial deposits of Quaternary age conceal the bedrock elsewhere in the quadrangle. Bedrock formations consist primarily of fine- and coarse-grained clastic rocks with lesser amounts of interbedded mafic volcanic rocks. Bedded rocks older than lava flows of late Cenozoic or early Quaternary age are complexly folded and faulted. They strike generally northeast.

As originally defined (Cady et al., 1955, p. 27-34) the Gemuk group includes rocks of Triassic and Early Cretaceous age in the Central Kuskokwim region and rocks of Mississippian(?), Permian, Triassic, and Early Cretaceous(?) age (Mertie, 1937, p. 37-59) in the adjoining Nushagak district. Rocks of the Gemuk group in the lower Kuskokwim region have yielded sparse fossil collections ranging in age from Carboniferous(?) to Early Cretaceous. In the Russian Mission quadrangle the Gemuk group is exposed southeast of Mount Hamilton, north of Kuskokwim River from the

mouth of Aniak River westward, and north of the Yukon. Cut-bank exposures of the Gemuk group undivided (KCgu) have been examined in the field on the north bank of the Kuskokwim. The rest of the rocks north of the river are mapped on the basis of photogeologic interpretation. Exposures along the river consist of andesitic or basaltic flows and volcanic breccia interbedded with siliceous siltstone, graywacke, and a small amount of calcareous conglomerate, and limestone. Volcanic rocks comprise an estimated 20 to 30 percent of the sequence. Study of air photos suggests that the rocks comprising most of the Portage Mountains are more massive than those exposed along the Kuskokwim. The nature of the rocks exposed in the Portage Mountains is unknown; however, their appearance on air photos is similar to that of "schistose" and "gneissoic" rocks described by Harrington (1918, p. 24) in the vicinity of Mount Okumiak in the northwest corner of the quadrangle. The rocks "probably represent a metamorphosed series of andesite or basalt tuffs and flows which have included some gabbroic intrusives" (Harrington, 1918, p. 24). Fossils of Permian age have been obtained from rocks exposed along the north bank of Kuskokwim River (Smith, 1939, p. 33). Hoare collected fragmentary crinoid columnals of probable Paleo-

zoic age at two other places in the same sequence of rocks.

because rocks of Permian and Triassic ages are closely associated elsewhere in Alaska. However, no fossils of Triassic age have been

p. 23-25) described as "Carboniferous greenstones and associated minor part of the series." The volcanic rocks are altered to greengroup are complexly folded and faulted. No accurate estimate of 10,000 feet thick.

group north of the Yukon. The greenstones and intercalated sedimentary rocks are thought to be of Permian age as they are lithologically similar to rocks exposed north of the Kuskokwim (Harrington, 1918, p. 26). Presumably younger rocks, which the writers believe comprise part of the Gemuk group, consist of sandstone and argillite interbedded with chert, fine-grained siliceous rocks, and tuffs. These rocks are exposed east of Pilcher Mountain and Mount. Okumiak, near Devils Elbow, and near the mouth of Tuckers Slough (Harrington, 1918, p. 24, 29, 30). Field studies by the writers elsewhere in the Kuskokwim region show that chert, fine-grained siliceous rocks, and tuffs are not typical of rock sequences of late Early Cretaceous (Albian) age or younger and that these rock types are typical of early Early Cretaceous (Neocomian) age or older. Although the schistose and gneissoid rocks described by Harrington (1918, p. 24) in the vicinity of Pilcher Mountain and Mount Okumiak have been mapped as part of the Gemuk group, the writers think that these more highly metamorphosed rocks may be of pre-Carboniferous age, as they have identified gneissoid greenstone of probable pre-Carboniferous age farther south in the Bethel

stone, impure limestone, graywacke, chert, volcanic tuff and breccia. The rocks crop out southeast of Mount Hamilton. Fossils of Late Jurassic age occur in siltstones that are interbedded with at least 300 feet of thin-bedded, greenish-gray tuff. These rocks of Jurassic age appear to be unconformably overlain by volcanic rocks of Late Cretaceous age (Kky).

rocks (Kkv) and a much thicker sequence of sedimentary rocks (Kks). Fossils of middle and probable early Late Cretaceous age have been obtained from the volcanic rocks and from the upper part of the sedimentary sequence. Thus the two sequences of rocks are correla-

Volcanic rocks of the Kuskokwim group (Kkv) are exposed over a broad area south of Kuskokwim River in the vicinity of Mount Hamilton. They form part of a broad northeastward-trending belt of volcanic rocks that extends about 60 miles south of the Russian Mission quadrangle. Similar volcanic rocks in the vicinity of the Russian Mountains, which have previously been mapped as the Iditarod basalt (Cady et al., 1955, p. 47-50), are thought to be correlative and are mapped as part of this unit.

andesitic flows. Basalt, trachyte, and trachyandesite form a minor part of the sequence. Graywacke, siltstone, pebble conglomerate, volcanic rocks. Locally several hundred feet of volcanic breccia occurs at or near the base of the sequence. The volcanic rocks are chiefly light to dark gray and greenish gray, porphyritic, and highly fractured; they seldom show recognizable flow planes. Their minerals are considerably altered to uralite, chlorite, epidote, and calcite, but the original constituents which are chiefly andesine, pyroxene, and hornblende are generally recognizable with the aid of a microscope.

This unit is estimated to be 1,000 to 4,000 feet thick. Marine fossils from interbedded sedimentary rocks indicate that at least some of the volcanic rocks in the vicinity of Mount Hamilton are of middle Late Cretaceous age (Coniacian). Fossils of possible early Late Cretaceous age (Cenomanian) were obtained from the sequence on the north bank of Tuluksak River about a mile south of the Russian Mission quadrangle. No fossils have been reported from the volcanic rocks of the Kuskokwim group in the vicinity of the Russian Mountains.

Sedimentary rocks of the Kuskokwim group (Kks) are exposed southeast of Sawpit Creek in the southeast corner of the quadrangle and in the vicinity of the Russian Mountains. North and west of Owhat River and in the vicinity of Oknagamut the unit is mapped on the basis of photogeologic interpretation.

The writers think that some of the rocks may be of Triassic age,

Rocks comprising the Gemuk group north of the Yukon in the Russian Mission quadrangle include the rocks Harrington (1918, sediments," and part of the rocks he described as "Cretaceous sediments" (p. 26-30). The older, "Carboniferous" rocks are described (Harrington, 1918, p. 23) as "Metamorphosed tuffs, flows, and intercalated sedimentary rocks, together with some rocks that may represent altered basic intrusives. * * * A large proportion of these rocks are igneous, but rocks of sedimentary origin make up a stones that are locally schistose or gneissoid. The rocks of the Gemuk their thickness can be made but the unit is probably not less than

No fossils have been reported from the rocks mapped as Gemuk

quadrangle. Upper Jurassic rocks of the Gemuk group (KCgg) consist of silt-

KUSKOKWIM GROUP The Kuskokwim group consists of a thick sequence of volcanic

tive in part.

South of the Kuskokwim the rocks of this unit are chiefly massive impure limestone, and some cherty rocks are interbedded with the

have been mapped by photogeologic interpretation.

The sedimentary rocks of the Kuskokwim group (Kks) are chiefly interbedded graywacke and siltstone. Pebble grit and conglomerate in beds a few inches to a few feet thick are locally interbedded with the finer grained rocks. The rocks are usually light to dark gray on fresh surfaces and brown on weathered surfaces. Most of them are well indurated. The graywacke consists of varying amounts of quartz, chert, feldspar, and fragments of volcanic and sedimentary rocks. Detrital muscovite is very common. Siltstone has a blocky fracture and rarely shows shaly parting. Slaty cleavage is well developed locally in siltstone. The rocks are highly folded and faulted and no accurate estimate of their thickness can be made at present, but the unit is probably between 5,000 and 15,000 feet thick.

Fragmentary fossils of possible late Early Cretaceous (Albian) age were obtained from the rocks exposed southeast of Sawpit Creek. The rocks consist of alternating massive beds of siltstone and gravwacke 10 to 50 feet thick. Fossils of early Late Cretaceous (Cenomanian) age have been obtained from sedimentary rocks in the vicinity of the Russian Mountains (Cady et al., 1955, p. 44-47). These rocks are generally less massively bedded and finer grained than older rocks of the Kuskokwim group. Air photos of the rocks west and north of Owhat River show that they are massively bedded similar to the rocks southeast of Sawpit Creek.

SHAKTOLIK GROUP The Shaktolik group (Ks) comprises part of the rocks mapped and escribed by Harrington (1918, p. 26-35, pl. 3) north of the Yukon as Upper Cretaceous. The rocks described by Harrington that are included in the Shaktolik group are interbedded sandstone, shale, 'argillite," grit, and conglomerate. They have been mapped on the basis of Harrington's field notes and on the basis of photogeologic interpretation. The tuffaceous, "argillaceous," and siliceous rocks as well as "associated grit and conglomerate" mapped by Harrington as Upper Cretaceous are probably of Early Cretaceous (Neocomian) age or older and do not belong to the Shaktolik group. Recent reexamination of Cretaceous fossil collections from Alaska (Imlay and Reeside, 1954, p. 236-238) indicates that the Shaktolik

the lower part of the Kuskokwim group (Cady et al. 1955, p. 46-47). **VOLCANIC ROCKS** Volcanic rocks of Tertiary or Cretaceous age (TKuv) are exposed in the northeast corner of the quadrangle in the vicinity of Owhat River. They are thought to be chiefly of volcanic origin, as specimens of andesitic lava were obtained from the unit on the west bank of the Owhat River. The rocks have been mapped as a separate unit, because aerial photographs indicate that they show few well-defined bedding traces and have a smoother appearance than adjacent rocks. Bedding traces, which are detectable within the unit, may indicate interbedded sedimentary rocks. The rocks are thought to be of Tertiary or Cretaceous age as they are closely associated with rocks of Cretaceous age, and volcanic rocks of both Tertiary and Cretaceous age have been identified southeast of the Iditarod River (Cady et al., 1955, p. 47-55, pl. 1). These rocks have been inter-

group is of late Early Cretaceous (Albian) age. It is correlative with

preted and mapped by photogeologic means. Horizontal basalt flows (QTb) are exposed north of Yukon River, south of Spruce Creek, and in the vicinity of Russian Mission. Harrington (1918, p. 47-48) describes this unit as a series of basaltic flows with interbedded gravel of basaltic composition. Most of the lava is vesicular and some of it is amygdaloidal. The feldspar is mostly labradorite. Olivine is conspicuous locally, but augite is the commonest mafic mineral. The published description of these flows (Harrington, 1918, p. 47-50) contains no information on their attitude or thickness. The writers believe that the flows are probably essentially horizontal and not over 500 feet thick. They are probably of late Pliocene or early Pleistocene age (Harrington, 1918, p. 49-50).

INTRUSIVE ROCKS Intrusive igneous rocks in the Russian Mission quadrangle consist of (1) dikes, sills, and a small stock of mafic rocks, (2) small stocklike bodies of rhyolite, (3) stocks of granitic rocks, and (4) questionable bodies of intrusive rocks of unknown composition that

The age of most, or all, of the intrusive rocks is thought to be Tertiary; however, because they intrude volcanic and sedimentary rocks only as young as middle Late Cretaceous age, the possibility exists that some of them may be late Late Cretaceous in age. The relative age of the various intrusive rocks is uncertain. Most of the mafic intrusive rocks (Tm) mapped in the Russian Mission quadrangle are either younger than the granitic rocks (Smith and Maddren, 1915, p. 313) or are genetically related to the granitic rocks. South of the Russian Mission quadrangle the writers have found mafic dikes and sills that are both older and younger than the granitic and rhyolitic rocks. The relative age of albite rhyolite and the granitic rocks was not determined in the Russian Mission

quadrangle as the two rocks were not found in contact with each other. A single contact examined in the adjoining Bethel quadrangle suggests that the rhyolite is younger than the granitic rocks. However, Cady and others (1955, p. 71-73) concluded that the rhyolite is older than the granitic rocks in the Central Kuskokwim region east of the Russian Mission quadrangle.

Granitic rocks (Tg) form several stocks and stocklike intrusive bodies that are less than a square mile to more than 100 square miles in areal extent. The stocks are much more extensive at depth as unroofing by erosional processes is apparently in the early stages. Contacts of the stocks commonly dip outward. Some of the stocks, such as that forming the Russian Mountains, are nearly round in ground plan. Other stocks, such as those near Mount Hamilton are elongate northeasterly parallel to the regional strike. Most of the stocks consist primarily of quartz monzonite, but they range in composition from granodiorite to granite and contain minor amounts of gabbroic, diabasic, and aplitic rocks. The stocks are surrounded by metamorphic aureoles of hornfels formed by the recrystallization of sedimentary and volcanic rocks intruded by the stocks. Albite rhyolite (Tr) forms small stock or pluglike intrusive bodies that commonly show well-developed flow structures. The rock is

Mafic rocks (Tm) chiefly gabbro and diabase constitute small stocklike bodies, dikes, and sills. The proximity of many of the mafic intrusive rocks to the granitic rocks suggests that the two kinds of rocks may be genetically related. Intrusive rocks(?) (Ti) have been mapped north of Owhat River, in the Portage Mountains, and north of the Yukon. On air photos these rocks appear to be massive and are generally not as dark as adjacent rocks known to be of sedimentary and volcanic origin.

They are interpreted as intrusive granitic rocks, of probable Ter-

fine grained, light to medium gray, and porphyritic.

tiary age. UNCONSOLIDATED QUATERNARY DEPOSITS Silt deposits (Qs) consist of light- and dark-gray silt and sandy silt that underlie a wide depositional plain in the western half of the quadrangle. The plain is incised by several large streams and is characterized by a general lack of vegetation other than moss and lichen, a fretwork of small consequent streams, and countless large and small thaw lakes. The plain is separated from areas of reworked silt (Qrs) and flood-plain deposits (Qf) by steep outward-facing scarps 10 to 50 feet high. The unit has been mapped mostly by

photogeologic methods. Organic "muck" associated with mammoth remains (Spurr, 1900, p. 132) and nonmarine gastropods occur locally near the top of the deposits. The silt becomes sandier with depth and locally contains pebbles and wood fragments. The silt is at least 450 feet thick at Bethel about 15 miles south of the quadrangle. The permafrost extends to a depth of about 400 feet. The deposits probably thicken westward away from the mountains. They are chiefly of nonmarine fluvial origin and correlative with coarse-grained outwash deposits laid down within and near the mountains. They may include material of eolian and marine origin. Most of the silt was probably deposited during periods of maximum glaciation in Pleistocene time. Outwash deposits (Qo) consist of poorly to well-sorted sand and gravel, with some silt and boulders. The deposits occur as terraces and outwash fan-plains. They are recognizable on air photos by their relationship to transverse moraines and by well-drained surfaces scarred by numerous abandoned stream channels. They are generally progressively younger toward their source area and are emporaneous with associated moraines. The deposits may be only a thin veneer, or they may be more than 150 feet thick. They

have been mapped mostly by photogeologic methods. Glacial drift (Qd) consists of unsorted and poorly sorted sandl, gravel, and boulders forming various types of moraines deposited by alpine-type glaciers that formed in the Russian Mountains and in the vicinity of Mount Plummer, 2 miles south of the quadrangle. The thickness of the unit varies; in places it is a thin veneer of erratic boulders, in other places it is 100 feet thick or more. The unit has been mapped chiefly from aerial photographs on the basis of topographic expression. Older deposits, farthest from the source areas, are highly modified. Younger deposits generally show distinctive hummocky glacial topography. The deposits are probably of early Wisconsin to Recent age.

Reworked silt (Qrs) consists of silt, sandy silt, and bog deposits,

which form a broad discontinuous plain between Yukon and

Kuskokwim Rivers. The plain merges with, or is slightly above,

areas of Recent flood-plain alluvium (Qf) and is separated from higher plains and residual "islands" of old silt deposits (Qs) by a scarp 10 to 50 feet high. It is characterized by countless large and small thaw lakes, lack of brush or tree cover, and lack of stream scars and oxbow lakes. The origin of the plain and of the deposits that form it is not known. The writers think that the plain may be an erosion surface cut in the upper part of the older silt deposits (Qs). If this explana-

tion is correct, the deposits are a veneer of material derived from the

erosion and reworking of the upper part of the older silt deposits.

The deposits have been mapped mostly by photogeologic methods. Silt and sand that are interpreted as wind deposits (Qsw) form two narrow belts that range from half a mile to 5 miles in width. One belt is south of and roughly parallel to Kuskokwim River; the other is south of the Yukon. The deposits overlie older silt deposits (Qs) at and near the edge of a steep scarp that separates older silt deposits from reworked silt deposits (Qrs) and flood-plain alluvium (Qf). The wind-deposited silt forms small, rounded hillocks and swales that are covered by short, close-growing vegetation, and are essentially undissected except by through-flowing streams. The wind-deposited silt was probably derived from older silt deposits as they (Qs) were being reworked to form areas mapped as Qrs. The unit has been mapped by photogeologic methods.

Colluvium (Qc) is chiefly frost-rived rubble but locally includes bog deposits, flood-plain alluvium, terrace deposits, glacial gravels, and wind-blown silt. Colluvial deposits are best developed on gentle to moderate slopes of unglaciated mountains. They merge and interfinger with other kinds of unconsolidated deposits near the base of the slopes. Permafrost is sporadically distributed in fine-grained material. The unit has been mapped partly by photogeology. Flood-plain alluvium (Qf) consists of mud, silt, sand, gravel, boulders, and intermixed woody material. The deposits occur along present-day streams and are incised from a few feet to a few tens of feet below the surface of older unconsolidated deposits and bedrock

STRUCTURE Major structural elements in the Russian Mission quadrangle trend northeastward. Rocks of early Early Cretaceous age and older are exposed chiefly in large positive elements, notably north of the Kuskokwim between the towns of Aniak and Kalskag, where they form part of the Aniak-Ruby geanticline (Cady et al., 1955, p. 18-21, pl. 2). Rocks of comparable age north of the Yukon in the northwest corner of the quadrangle probably form part of a separate northeast-trending geanticlinal tract. Rocks of Late Cretaceous and late Early Cretaceous age—exposed at the northern edge of the quadrangle, in the vicinity of the Russian Mountains, and south of the Kuskokwim—occupy geosynclinal tracts. The rocks of pre-Cretaceous age that are exposed south of the Kuskokwim near Mount Hamilton and in the Paimute Hills north of the Yukon probably indicate the axial zones of anticlinorial folds in the geosynclinal tracts. Strata of Cretaceous age and older are commonly compressed into numerous small tight folds; the older rocks are generally more tightly folded that the younger rocks. Most of the faults in the Russian Mission quadrangle have been mapped from the study of aerial photographs. The straight linear traces of the faults probably indicate that most of the faults are either normal faults or high-angle reverse faults. The experience of the writers indicates that most of the longer faults are high-angle reverse faults, and some of them are probably scissors faults (Cady

et al., 1955, p. 90). Most of the faults in the western half of the quadrangle strike between east-northeast and east-southeast. In the eastern half of the quadrangle most of the faults strike northward or northeastward. The trace of some of the faults is marked by small fault scarps in the surficial deposits caused by recent movement on the faults. Eastward-facing scarps in the surficial deposits a few miles west of Owhat River mark the trace of a long fault that strikes a few degrees west of north. Strata of probable late Early Cretaceous age are uplifted on the southeast side of Sawpit fault and juxtaposed against rocks of Late Cretaceous age northwest of the fault.

ECONOMIC GEOLOGY MINERAL RESOURCES AND OCCURRENCES Gold.—Placer gold that contains a minor amount of silver is currently mined on California Creek, tributary to Tuluksak River near the southern edge of the quadrangle and on Willow Creek in the northwest corner of the quadrangle. The two mines produce an estimated total of about \$500,000 in gold and silver annually. The early history of mining and prospecting activities in the northwest corner of the quadrangle is described by Harrington (1918, p. 56-67). Maddren (1915, p. 298-360) has described early mining and prospecting activities in the vicinity of Bear Creek near

the southern edge of the quadrangle.

Prospecting activities show that gold occurs in many streams other than those which have been mined. The location of most of the mines and prospects indicates that mineralization associated with intrusive bodies of granitic and rhyolitic rocks is the primary source of the gold. Several quartz veins containing free gold have been found and staked, but no mines have been developed on them. Quicksilver.—Cinnabar, ore mineral of mercury, constituted a large part of the placer concentrates obtained by a gold dredge working on Bear Creek below the mouth of Bonanza Creek (personal communication from the dredge operator). No lode deposits of cinnabar are known in the Russian Mission quadrangle. The nearest known lode deposit is on the north bank of Kuskokwim River about 2 miles east of the quadrangle (Cady et al., 1955, p. 116, pl. 1).

Copper.—Copper mineralization associated with minor amounts of gold, silver, tin, lead, zinc, tungsten, and the radioactive mineral, metazuenerite, in quartz veins is reported from the Russian Mountains (Cady et al., 1955, p. 121-122). Considerable development work has been done on two prospects, but there has been no production to date. Quartz veins containing traces of copper mineralization were found on the isolated mountain southeast of Bear Creek where Bear Creek recurves to the northwest and in the bedrock bench southeast of the mouth of Bear Creek. Traces of copper mineralization associated with pyrite, galena, molybdenite, free gold, and wulfenite are reported from the northwest corner of the quadrangle in the vicinity of Spruce and Wilson Creeks (Harrington, 1918, p. 63-64).

Antimony and molybdenum. — Stibnite, ore mineral of antimony, and molybdenite, ore mineral of molybdenum, are reported from the upper Owhat River (Ebbley and Wright, 1948, p. 5, 40; figs. Platinum.—A small amount of platinum is associated with the gold on Wilson and Willow Creeks (Harrington, 1918, p. 59, 62).

SUGGESTIONS FOR PROSPECTING Gold and cinnabar are probably the minerals most likely to be of interest to the prospector in the Russian Mission quadrangle, Systematic search for lode deposits of these minerals should be guided by the fact that gold mineralization is associated with rhyolitic and ciated with silica-carbonate rock, which formed by the alteration of

small intrusive bodies of mafic rock. Placer deposits of heavy minerals, such as gold, commonly occur on streams that flow through, or head in, mineralized areas associated with intrusive bodies of granitic or rhyolitic rocks. Placer deposits are generally better developed where prolonged and undisturbed stream erosion has produced a broadly rolling land surface. In the Russian Mission quadrangle these desirable conditions are widespread. Glacial disruption of placer deposits is of concern only in the vicinity of the Russian Mountains and south of Bear Creek near the southern edge of the quadrangle. Most of the large placer deposits were in wide valleys that formed part of a broadly rolling preglacial land surface. Where these deposits have been dissected by present-day streams, they may form bench placers on the sides of the valleys well above present stream level. These placers are relatively easy to find and evaluate if they are dissected enough to expose the bedrock beneath the bench gravels, where most of the gold is commonly concentrated. Gravel-capped bedrock benches are common over most of the Russian Mission quadrangle. In the vicinity of Tuluksak River and Bear Creek some of the bench gravels contain mineable quantities of gold. The existence of bench placers suggests that buried placers may occur in areas that are little dissected, where surface or shallow prospecting has failed to find any gold. Buried placers are likely to occur in valleys whose transverse profiles form smooth, open S curves from the stream bank to the rounded slopes of the valley sides. Sharp, V-shaped valleys have probably had most or all of their once-buried placer deposits

Cinnabar, ore mineral of quicksilver, has been identified in placer concentrates from Bear Creek but no lode deposits are known. Experience in the Sleetmute quadrangle to the east indicates that quicksilver lodes are almost always associated with small bodies of silica-carbonate rock formed by the alteration of mafic dikes and sills. The altered rock is pearl gray on fresh surfaces and yellow brown on weathered surfaces. Fragments of this distinctive rock are easily recognized on gravel bars and can be traced upstream to their source. No bodies of silica-carbonate rock were found in the Russian Mission quadrangle, but the area has not been closely examined.

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removed by erosion.

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EXPLANATION SURFICIAL DEPOSITS Flood-plain alluvium Colluvium Chiefly frost-rived rubble, locally includes stream alluvium, terrace gravels, glacial deposits, and wind-blown silt Reworked silt. Wind-deposited silt Silt, sandy silt, and bog deposi Glacial drift Silt deposits Poorly to well-sorted silt, sand, gravel, and boulders in terraces Poorly sorted sand, gravel, and and outwash fan-plains BEDDED ROCKS Horizontal vesicular basalt flou Volcanic rocks robably andesitic lava for the most part, with some inter Kuskokwim group Shaktolik group Massive gray and greenish-gray porphyritic ande-site lava flows, flow breccia, and agglomerate with Interbedded sandstone, shale, "argillite," grit, and conglomerate some interbedded sedimentary rocks, Kky; n lium- to dark-gray siltstone and graywacke wi interbeds of grit and conglomerate, Kks Mafic lava flows, volcanic breccia, and agglomerate inter bedded with siliceous siltstone, chert, graywacke and a small amount of calcareous conglomerate and limestone, KCgu. Mafic volcanic rocks altered to gneissoid and schistose rocks in some areas. Light greenish gray tuff with interbedded stone, graywacke, and chert, KCgg INTRUSIVE IGNEOUS ROCKS Mafic rocks Medium- to coarse-grained, light-to dark-gray gabbro and dia-base. Occurs as small stocklike bodies, dikes and sills Albite rhyolite Light- to medium-gray, fine-grained, porphyritic; occurs as Granitic rocks Medium- to coarse-grained, pink and gray granitic-textured rocks. Forms stocks chiefly of quartz monzonite, but ranges from granodiorite to granite; minor facies include gabbro, Intrusive rocks(?) Probable stocks of granitic rocks; interpreted and mapped by Solid where located by field mapping or where clearly interlocated by field mapping; dashed and dotted where local solely by photointerpretation; dotted where concealed; queri Fault, showing direction of dip Solid where located by field mapping or where clearly inter pretable on aerial photographs; dashed where approximately located by field mapping; dashed and dotted where located where inferred. U, upthrown side; D, downthrown side Anticline, showing trace of axial plane of fold and plunge of axis Syncline, showing trace of axial plane of fold and plunge of axis Strike and dip of beds by field measurement Strike and dip of beds by photointerpretation Strike and dip of flow cleavage Trace of bedding Placer mine Placer prospect Au Lode prospect Letter symbol indicates chief metal Fossil locality Numbers indicate collection number Lithologic symbols Volcanic breccia Lava flows west of Owhat River by Permian and Permian(?) Geology by G. L. Harrington, 1918, extended and modified by photogeology, 1956 Geology by E. F. Fox, 1940, extended and modified by photogeology, 1956 Geology by W. M. Cady and others, 1942-1945 extended and modified by photogeology, 1950 4. Geology by J. M. Hoare, 1946-1950 Photogeologic mapping, 1956. Photogeologic interpretation chiefly by W. L. Coonrad **EXPLANATION** Lower Kuskokwim-Bristol Bay region 0 50 100 200 Miles

GEOLOGY OF THE RUSSIAN MISSION QUADRANGLE, ALASKA

1959

J. M. Hoare and W. L. Coonrad

-----Contour intervals 200 and 1000 feet Dotted lines represent half interval contours
Datum is mean sea level 1959 Magnetic declination varies from 19° to 21° east INTERIOR-GEOLOGICAL SURVEY, WASHINGTON, D. C. MR 6554

INDEX MAP OF ALASKA SHOWING LOCATION OF THE RUSSIAN MISSION QUADRANGLE RELATIVE TO THE LOWER

KUSKOKWIM-BRISTOL BAY REGION, THE CENTRAL KUSKOKWIM REGION, AND THE NUSHAGAK DISTRICT