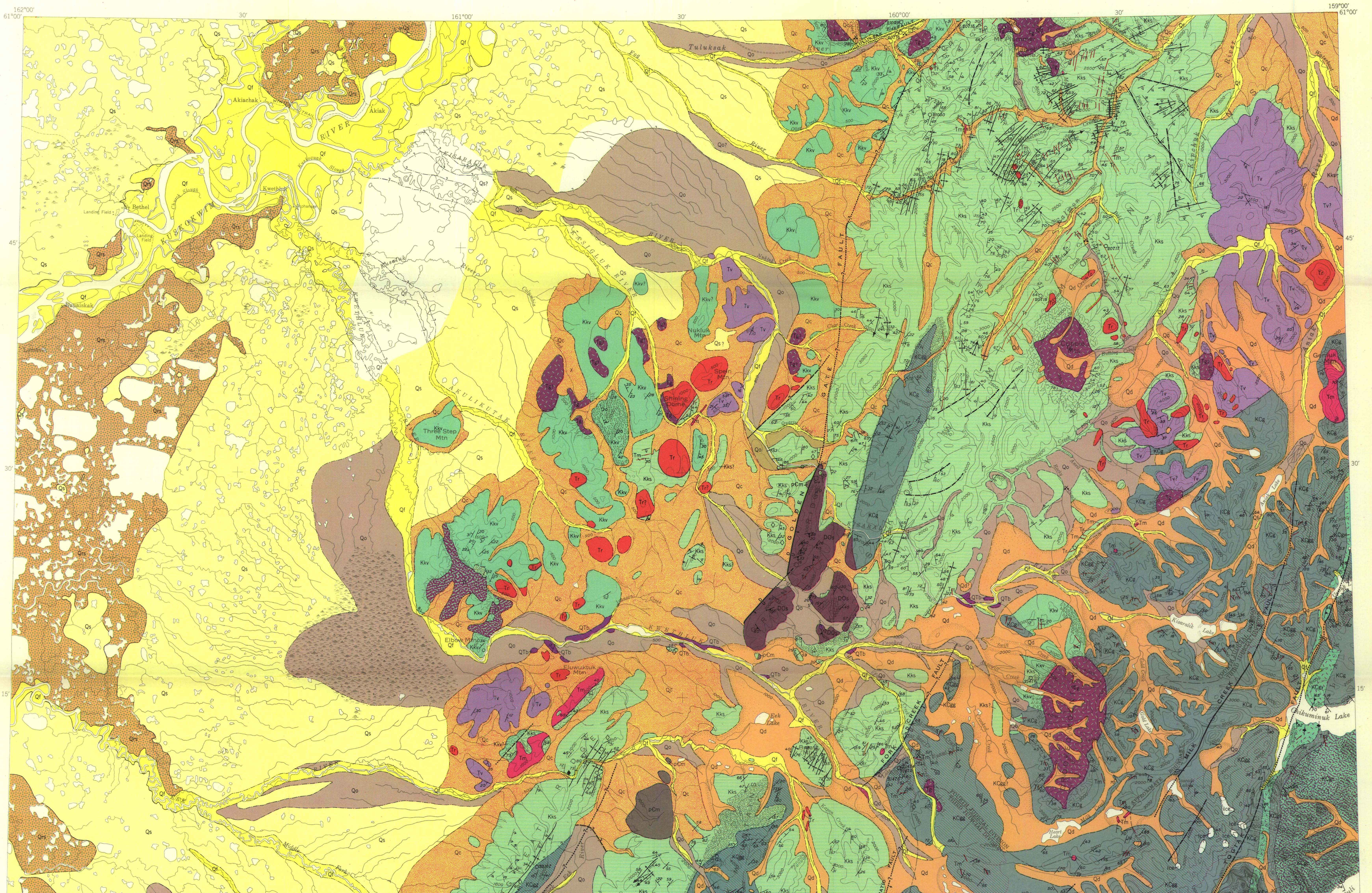
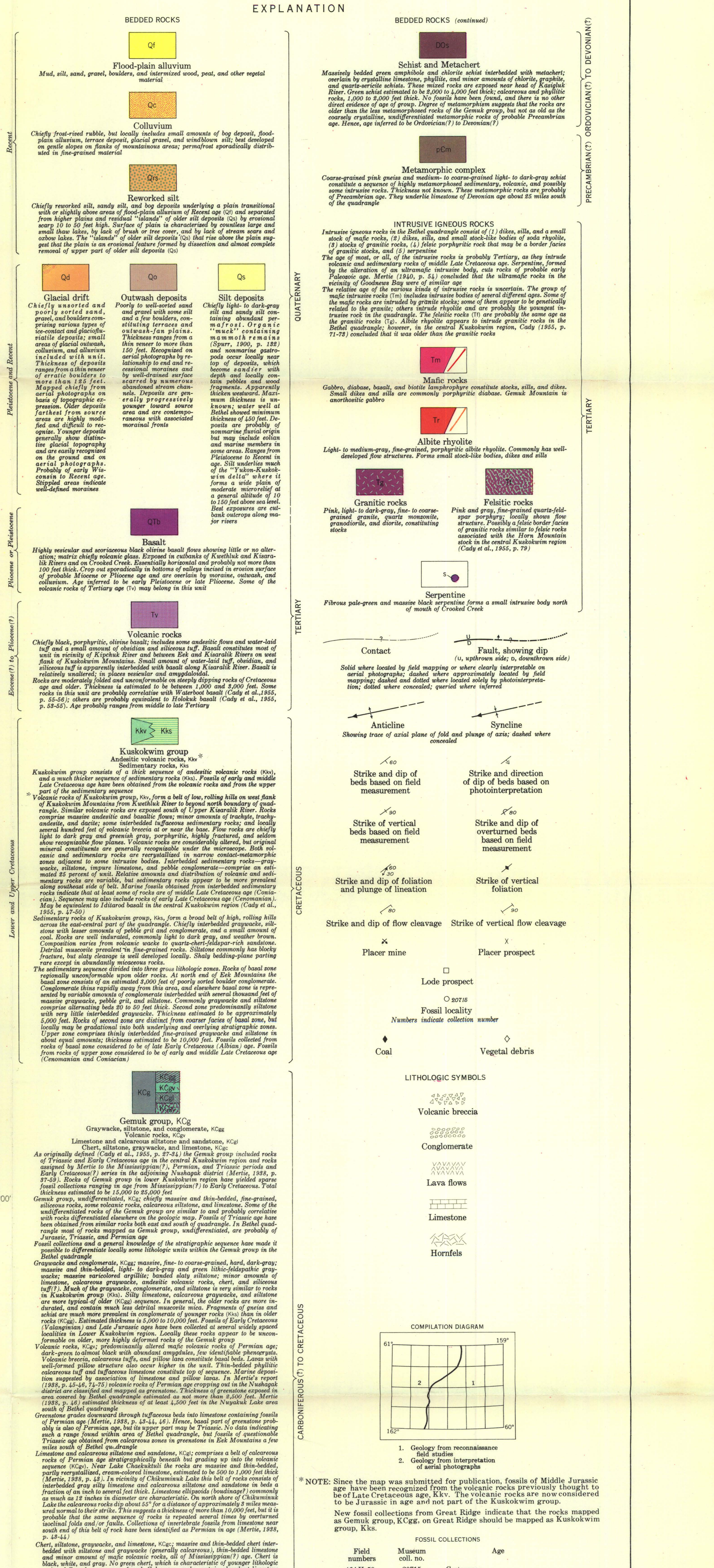


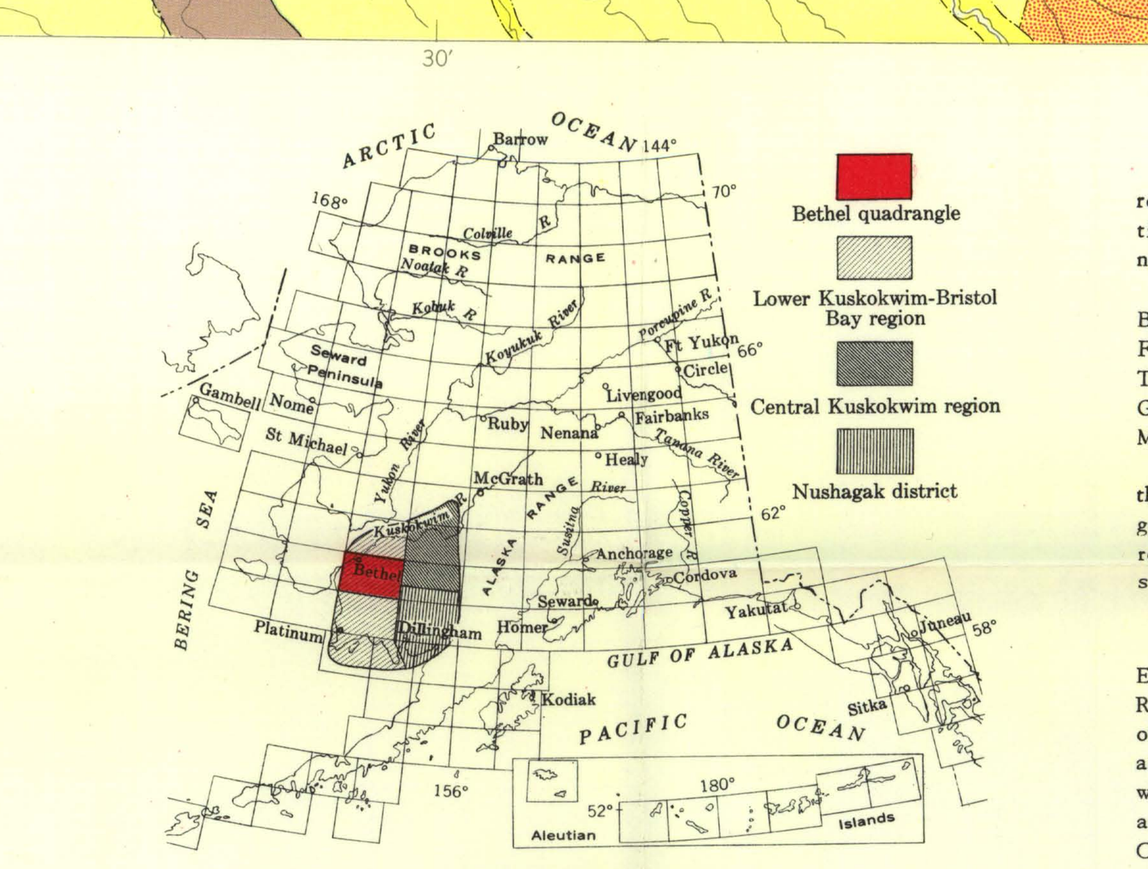


* NOTE: Since the map was submitted for publication, fossils of Middle Jurassic age have been recognized from the volcanic rocks previously thought to be of Late Cretaceous age, Kkv. The volcanic rocks are now considered to be Jurassic in age and not part of the Kuskokwim group.

New fossil collections from Great Ridge indicate that the rocks mapped as Gemuk group, KCgg, on Great Ridge should be mapped as Kuskokwim group, Kks.

FOSSIL COLLECTIONS

Field numbers	Museum coll. no.	Age
46AHr59	20715	Cretaceous
46AHr64	20716	Late Cretaceous (Coniacian)
46AHr91	20717	Late Cretaceous (Coniacian)
46AHr101	20718	Late Cretaceous (Cenomanian?)
47AHr1	21029	Late Cretaceous (Cenomanian?)
47AHr36	21030	Early Cretaceous (Albian?)
48AHr50A	21473	Early Cretaceous (Valanginian)
48AHr50B	21474	Early Cretaceous (Valanginian)
48AHr56	21475	Early Cretaceous (Valanginian)
48AHr91	21476	Early Cretaceous (Albian)
48AHr263	21481	Late Cretaceous (Coniacian)
50AHr302	23167	Early Cretaceous (Valanginian)
35AMt23	8007	Permian



INDEX MAP OF ALASKA
Showing location of the Bethel quadrangle relative to the Lower Kuskokwim-Bristol Bay region, the Central Kuskokwim region, and the Nushagak district.

INTRODUCTION

The geologic map of the Bethel quadrangle is one of several presenting the results of a reconnaissance study of the geology and mineral resources of the Lower Kuskokwim-Bristol Bay region, southwestern Alaska. Field studies, which began in 1946 and ended in 1953, were concerned primarily with the bedrock geology. Data were obtained by extensive boat and foot traverses from several base camps and numerous overnight camps. The routes of most of the traverses are shown by the distribution of strike symbols with numerical dip values.

Trimetrogon vertical and oblique 1:40,000-scale aerial photographs facilitated both the planning of field work and the mapping. Recently obtained vertical photographs provided essentially complete coverage of the western third of the quadrangle. Surficial deposits have been mapped almost entirely on the basis of photointerpretation supplemented by a few field observations. The topographic base is highly generalized but adequate for presenting the results of this reconnaissance study. Locally the small scale of the 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 these distinctive types of rocks is the same as the formation in which they occur. The rocks are more extensive than shown on the map but have not been traced out parallel to their strike.

Efficient assistance in the field was given at different times by R. P. Nickolsen, L. A. Brubaker, S. P. Brown, V. E. Swanson, B. Mears, Jr., E. G. Wermund, and P. C. Tremel. Fossil collections were studied by R. W. Imlay, J. B. Reeside, Jr., Roland W. Brown, and Teng-chien Yen. Appreciation is herewith expressed to the personnel of the New York-Alaska Gold Dredging Corp., the Awe Mining Co., the Peandori Mining Co., and the Canyon Creek Mining Co. for their assistance, information, and hospitality.

Previous investigations in the Bethel quadrangle were made by Spurr (1900), who described the unconsolidated deposits along the Kuskokwim River, by Maddren (1915), who investigated gold placers in the Tuluksak River-Cripple Creek area, and by Mertie (1938), who mapped on reconnaissance scale in the Tikchik Lakes area. Coonrad (1957) made a reconnaissance study of the area west of Bethel.

STRUCTURE

Major structural elements in the Bethel quadrangle trend north-northeastward. Rocks of Early Cretaceous age and older are commonly exposed in geanticlinal tracts and anticlinoria. Rocks of Late Cretaceous age occupy intervening geosynclinal and synclinorial tracts. Strata of Cretaceous age and older are commonly compressed into numerous minor folds of small amplitude. Superimposed upon the small folds are successively larger folds, the largest of which are anticlinorial and synclinorial folds several miles across. Examples of anticlinoria are the Eek Mountains and the large doubly plunging fold northeast of the mouth of Crooked Creek. Both of these structures are strongly asymmetric and, in places, overturned northwestward toward the northeastward-plunging geanticlinal tract between Eek Mountains and Great Ridge. They are flanked southeastward by a synclinal belt that parallels the course of Salmon River and plunges northeastward. Southeast of the synclinorial tract, rocks of the Gemuk group are compressed into two or more broad folds. Near the south edge of the quadrangle, these older rocks are thrust northwestward onto the synclinorium along the Mount Oratio and Fork Creek faults. Near the eastern margin of the map they are thrust southwestward onto a geanticlinal uplift along the Togiak fault.

The Mount Oratio and Fork Creek faults are two of the several large reverse faults that have been recognized in the Bethel quadrangle. These two faults and Golden Gate and Tuluksak faults all dip steeply southeastward and are upthrown on the southeast side. Togiak fault dips steeply northwestward and is upthrown on the northwest side. The opposed dip of the reverse faults and the relative movement on them, as well as numerous asymmetric and overturned folds indicate that the geosynclinal tract between Golden Gate and Togiak faults has been compressed between two relatively resistant geanticlinal tracts.

MINERAL RESOURCES AND OCCURRENCES

Gold.—Placer gold that contains a minor amount of silver is currently mined on the Tuluksak River and on Canyon Creek. The two mines produce an estimated total of $500,000 in gold and silver annually, of which more than 90 percent is dredged from the Tuluksak River and its tributaries. Placer mines on Cripple Creek, Marvel Creek, Granite Creek, and Bear Creek ceased operation within the period 1946 to 1949. The history and description of some of the mines were given by Maddren (1915, p. 298-360).

Prospecting activities show that gold occurs on many streams other than those that 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. Secondary reconcentration of glacial gravels may account for some of the placer deposits.

Quicksilver.—Cinnabar, ore mineral of mercury, has been identified in placer concentrates from several streams, but no lode deposits have been found in the Bethel quadrangle. The nearest known lode deposit is about a mile south of the quadrangle on Arsenic Creek, a tributary to Rainy Creek, which is a headwater tributary of Eek River. About 2,000 pounds of cinnabar concentrates were recovered from a placer gold mine on Rainy Creek (Rudledge, 1948, p. 3).

Antimony.—Stibnite, an ore mineral of antimony, occurs in a small quartz vein cutting rhyolite on top of Fisher Dome near the head of Fisher Creek. The deposit is probably of no economic importance.

Copper.—Traces of copper minerals were found in andesitic bedrock brought up by a gold dredge on Tuluksak River, and in green amphibole schist in the fault zone at Golden Gate Falls and about a mile south of the Falls. Float specimens of copper minerals and galena (an ore mineral of lead) are reported from the valley of the Kwethluk River (Maddren, 1915, p. 304).

Tungsten.—Scheelite and wolframite, ore minerals of tungsten, have been identified in placer concentrates from several streams, but no lode deposits have been found.

Platinum.—A very small amount of platinum is recovered with the gold on Tuluksak River.

Coal.—A bed of soft coal about 8 inches thick crops out in the gorge cut by Eek River through the Great Ridge. The coal is associated with about 10 feet of black carbonaceous shale interbedded with steeply dipping graywacke, conglomerate, and siltstone of Cretaceous age.

SUGGESTIONS FOR PROSPECTING

Gold, cinnabar, and scheelite are the three minerals most likely to be of interest to the prospector in the Bethel quadrangle. Systematic search for these minerals should be guided by the fact that gold and tungsten minerals are associated with rhyolitic and granitic intrusive bodies and that quicksilver is almost always associated with bodies of silica-carbonate rock.

The currently productive gold deposits are all placers. Placer concentrates of heavy minerals commonly occur on creeks that flow through or head in mineralized source areas associated with intrusive rocks. They are generally better developed in areas of low relief where prolonged and undisturbed stream erosion and concentration have taken place. In the Bethel quadrangle, these desirable conditions are found especially in the rolling, mountainous, unglaciated terranes that lie northwest of a line drawn between the Eek Mountains and the northeast corner of the quadrangle. Economic placer deposits are generally more difficult to find in glaciated areas, as in the southeastern part of the Bethel quadrangle, because the heavy minerals are likely to be disseminated through a large volume of glacial or glaciofluvial deposits. Placer deposits occur in glaciated areas, however, as for example, the one on Canyon Creek. This small, rich gold placer was probably preserved by the high mountains at the head of the creek, which split the ice and kept it out of Canyon Creek valley. Preglacial gravels and placer deposits may also be preserved in narrow preglacial stream valleys that are transverse to the broad major valleys down which large tongues of ice moved. Deposits of this type are likely to be covered by younger surficial deposits, hence difficult to find. Drilling operations in connection with mining activities show that narrow, deep, preglacial stream channels lie beneath surficial deposits in many of the broad valleys. Some of the buried channels may contain valuable placer deposits.

The gold prospector is advised to watch for scheelite, ore mineral of tungsten, because it is commonly associated with gold and may be recovered as a valuable byproduct. Scheelite can easily be identified with an ultraviolet lamp.

Cinnabar, ore mineral of quicksilver, has been identified in placer concentrates from several streams in the Bethel quadrangle, but no lode deposits are known. Experience in adjoining areas indicates that quicksilver lodes in the Kuskokwim region are almost always closely associated with bodies of silica-carbonate rock formed by the alteration of mafic dikes and sills. The altered rock is pearl gray on fresh surfaces and weathers a yellow brown, forming the "yellow rock" of the prospector. Few bodies of silica-carbonate rock were found in the Bethel quadrangle, and the chances of finding quicksilver in economic quantities are not very great. Cinnabar lode deposits and bodies of altered mafic intrusive rocks are more common in the adjoining Central Kuskokwim region (Cady et al., 1955, p. 104-116).

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

GEOLOGY OF THE BETHEL QUADRANGLE, ALASKA

By
J. M. Hoare and W. L. Coonrad

Scale 1:250 000

5 0 5 10 15 Miles

Contour intervals 200 and 1000 feet
Datum is mean sea level
1957 magnetic declination at south edge of sheet

1959

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.,MR 6072

Geology by J. M. Hoare and W. L. Coonrad, assisted by P. C. Tremel, S. P. Brown, V. E. Swanson, G. E. Wermund, R. P. Nickelsen, L. A. Brubaker, Jr., and B. Mears, Jr.
Surveyed 1946 to 1950 and 1953

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