Preliminary Geologic Investigations in the Kanuti River Region, Alaska

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CONTRIBUTIONS TO ECONOMIC GEOLOGY

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By William W. Patton, Jr., and Thomas P. Miller

ABSTRACT

Reconnaissance geologic mapping and geochemical studies in the Kanuti River region of central Alaska indicate three areas worthy of further mineral investigation. Six large previously unreported ultramafic bodies have been mapped in a 65-mile-long belt extending from Caribou Mountain to the upper Melozitna River. Although no mineral occurrences of economic significance were noted during the brief examination of these bodies, additional investigation is warranted, particularly for such related commodities as asbestos, platinum, chromium, and nickel. Anomalous amounts of tin were found in stream sediment and pan concentrate samples from a tributary of Kanuti Kilolitna Creek draining the Sithylemenkat pluton. The presence of placer tin deposits on strike 60 miles to the southwest in the Gold Hill district suggests that the granitic terrane in the intervening areas as well as in the Kanuti Kilolitna area is favorable for the occurrence of tin. Disseminated galena and sphalerite were found in a small Tertiary(?) rhyolite body on the upper Kanuti River. The striking similarity to a lead-zinc-silver occurrence previously reported in a rhyolite body on the Indian River suggests that such rhyolite bodies may be particularly favorable targets for exploration in this part of Alaska.

INTRODUCTION

Reconnaissance geologic mapping and geochemical studies in the Kanuti River region of central Alaska suggest three areas of possible interest for mineral prospecting (fig. 1). No mining is being carried out in the region at the present time and there is no record of significant mining activity in the past. Because of its inaccessibility, the region proabably has not been thoroughly prospected.

The Kanuti River region extends over an area of nearly 4,000 square miles in the eastern part of the Koyukuk River basin and includes parts of the Kanuti Flats and Kokrines-Hodzana Highlands. It is covered by parts of the Bettles and Tanana 1:250,000 scale topographic maps.

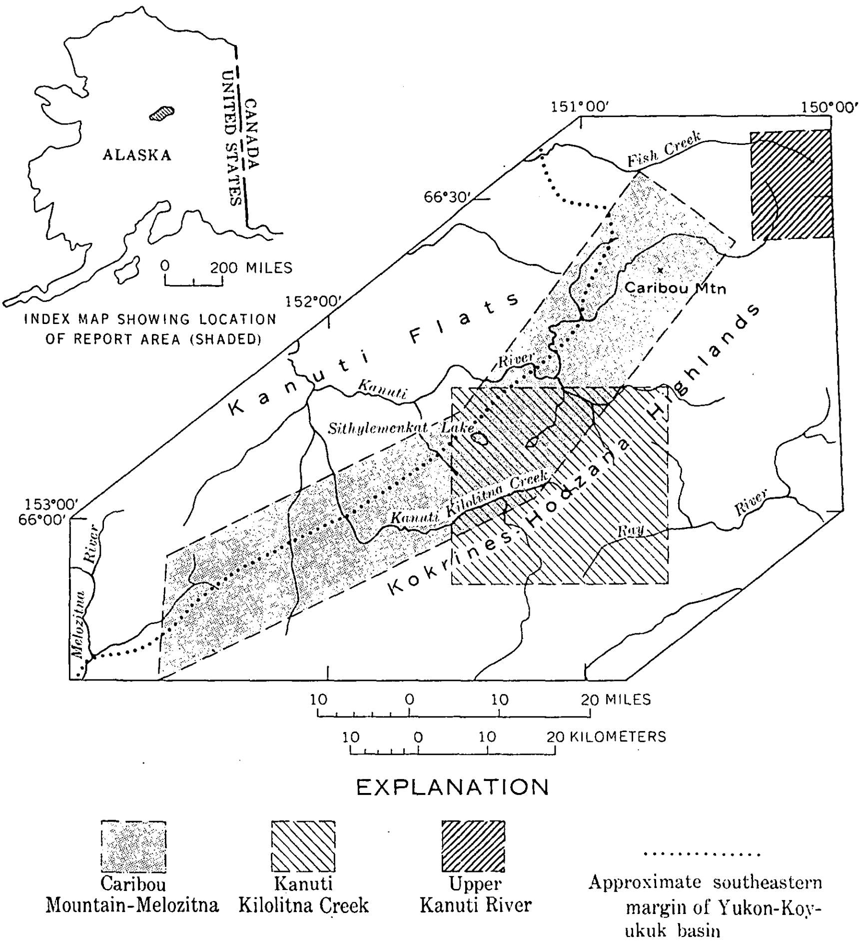

FIGURE 1.—Map of Kanuti River region showing location of areas described in text.

The region is not accessible by any type of all-weather road or trail, although a winter road constructed in 1968–69 connecting Fairbanks with the Arctic Slope passes through the northern part of the region. The Kanuti River is navigable by small river boat in high water as far as the western edge of the Kokrines-Hodzana Highlands, and several small lakes in the Kanuti Flats and along the western edge of the Kokrines-Hodzana Highlands are suitable for float plane landings. The villages of Bettles, 50 miles to the north, and Tanana, 70 miles to the south, are the closest points served by scheduled airlines.

Geologic mapping and geochemical studies were carried out over a 3-week period during the summer of 1967 and a 2-week period during the summer of 1968. A helicopter was used for transportation into the region from an operating base at Bettles. Approximately 225 stream sediment and rock samples were collected and analyzed by semiquantitative spectrographic and atomic-absorption methods. The authors were assisted in the field by R. L. Elliott, geologist, M. B. Estlund and V. D. DeRuyter, field assistants, and R. E. Leonard, camphand.

Very little was known of the geology of this region prior to the present investigations. Early exploratory surveys by Mendenhall (1902), Maddren (1913), and Eakin (1916) traversed the region, but their reports contain only abbreviated accounts of the geology.

GEOLOGIC SETTING

The Kanuti River region straddles the southeastern boundary of the Yukon-Koyukuk basin (fig. 1) and includes sedimentary and volcanic rocks of the basin sequence as well as metamorphic and plutonic rocks of the adjoining Kokrines-Hodzana Highlands complex. The structural grain of the bedrock parallels the margin of the basin, and the regional dip is northwestward into the basin.

The oldest bedrock unit in the region is a thick sequence of pelitic schist, quartzite, and phyllite which underlies a large part of the Kokrines-Hodzana Highlands. These metasedimentary rocks are extensively intruded and altered by granitic rocks of Cretaceous age. Although the age of the metasedimentary rocks cannot be fixed more closely than pre-Late Triassic in the Kanuti River region, they are believed to be largely Paleozoic because they appear to interfinger to the northeast and southwest with limestone containing mid-Paleozoic fossils (Brosgé and Reiser, 1964; Mertie and Harrington, 1924).

Overlying and intruding the metasedimentary rocks along the northwest flank of the Kokrines-Hodzana Highlands is an ophiolitelike assemblage including altered pillow basalt, diabase, and gabbro, serpentinized peridotite and dunite, and bedded chert. These rocks appear to be alined along a major structural hinge line which marks the edge of the Yukon-Koyukuk basin. There is no proof that all the rocks comprising this ophiolitelike assemblage are the same age, but their close spatial relationship in the Kanuti River region and elsewhere around the rim of the Yukon-Koyukuk basin suggests emplacement at roughly the same time, probably in Late Triassic or Jurassic. Similar mafic intrusive rocks on strike to the northeast have been dated by potassium-argon methods as Jurassic (Reiser and others, 1965) and a possibly equivalent mafic intrusive near Rampart on the Yukon River has been dated by the same methods as Late Triassic (Brosgé and others, 1969).

Both the ophiolite assemblage and the metasedimentary rock unit of the Kokrines-Hodzana Highlands are intruded by granitic rocks which have been dated as mid-Cretaceous (Albian and Cenomanian) by potassium-argon methods. Two large discordant intrusive bodies were mapped in the Kanuti River region, the Sithylemenkat pluton on the south and the Kanuti pluton on the north. Both bodies are composed predominantly of coarsely porphyritic biotite quartz monzonite. Dikes of coarse pegmatite occur in local abundance on the perimeters of these intrusive bodies.

Bordering the Kokrines-Hodzana Highlands on the northwest are sedimentary and volcanic rocks of the Yukon-Koyukuk basin sequence. The sedimentary rocks include a highly deformed section of marine volcanic graywacke and mudstone of mid-Cretaceous age and a gently deformed succession of nonmarine quartz conglomerate, sandstone, shale, thin coal seams, and ash-fall tuffs of probable Late Cretaceous age. These sedimentary rocks are overlain by a thick pile of flows and volcaniclastic rocks, chiefly of rhyolitic and latitic composition, which are mainly early Tertiary in age but may range into Late Cretaceous.

Pleistocene drift, deposited by glaciers fed from the Brooks Range, mantles most of the Kanuti Flats and obscures broad areas of the underlying bedrock.

CARIBOU MOUNTAIN-MELOZITNA ULTRAMAFIC BELT

Reconnaissance mapping has served to outline six large ultramafic bodies extending in a belt along the northwest flank of the Kokrines-Hodzana Highlands from Caribou Mountain to the upper Melozitna River, a distance of 65 miles (fig. 2). These bodies range in size from less than a square mile to 22 square miles and have a combined total area of about 60 square miles. In addition, numerous smaller bodies (too small to be shown in fig. 2) were identified along this belt. Other than brief mention of serpentinite along the Kanuti River by Mendenhall (1902), none of these ultramafic bodies has previously been reported and it seems unlikely, in view of their inaccessibility, that any of the bodies has been given more than a cursory examination by prospectors. Although no significant mineral occurrences were found during the course of our reconnaissance mapping, further investigation of these bodies is believed to be warranted particularly for such related commodities as asbestos, platinum, chromium, and nickel.

Field and aerial photo studies suggest that these ultramafic rocks occur as grossly layered tabular bodies dipping generally northwestward 10° to 60°. Judging from the dip of the layering and the width of outcrop, the Holonada body appears to be about 2,500 feet thick. In

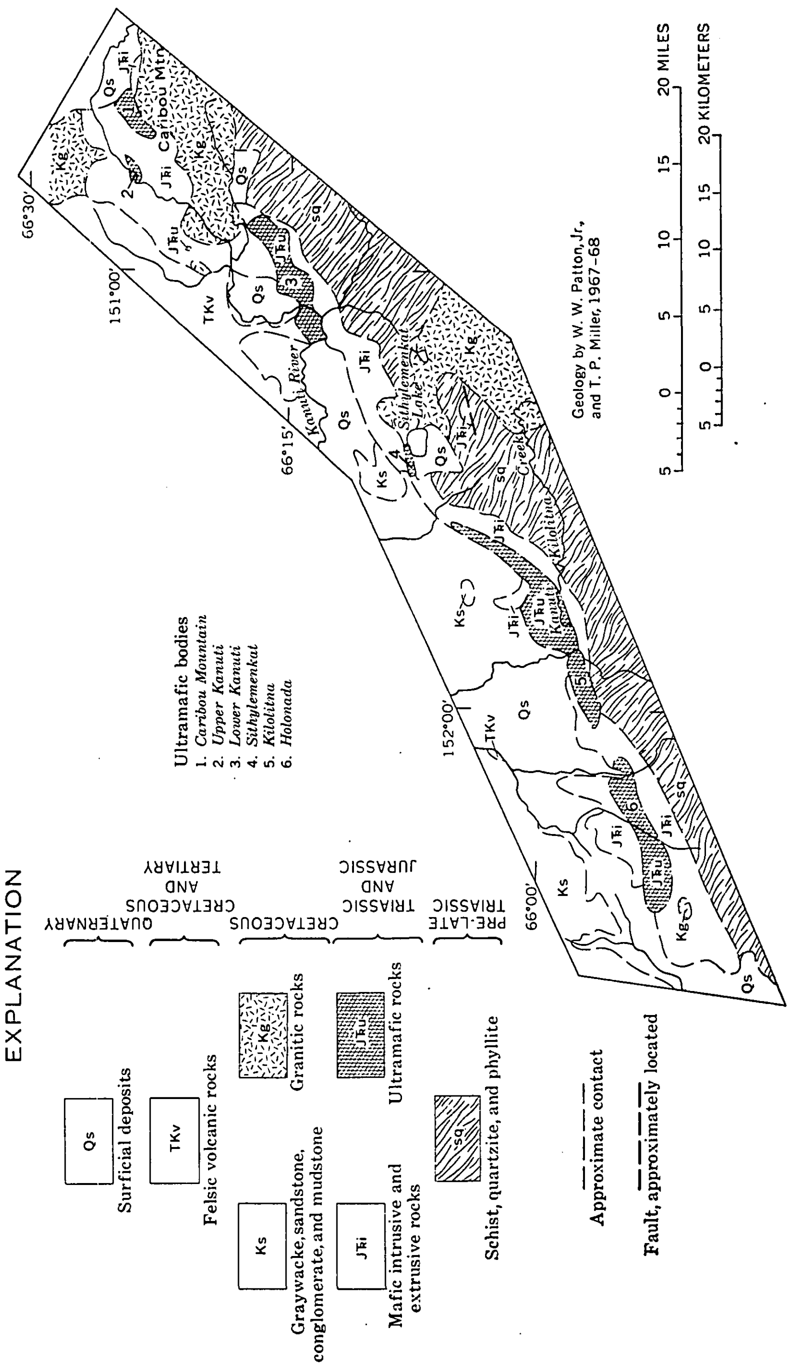

FIGURE 2.—Reconnaissance geologic map of Caribou Mountain-Melozitna ultramafic belt.

the Kilolitna and lower Kanuti bodies the layering is less well defined but the width of outcrop suggests that these two bodies probably are at least as thick. The lower contact of the ultramafic bodies is sharply defined, possibly by a fault, and there is little evidence of thermal alteration of the underlying rocks. The upper contact is poorly exposed but, in the few places where seen in the field, it appears gradational from the ultramafics through a zone of interlayered mafic and ultramafic intrusives into the overlying assemblage of mafic volcanics and intrusives.

The ultramafic rocks are typical alpine serpentinites, composed almost entirely of serpentinized peridotites, chiefly harzburgite, and serpentinized dunite. In the field these rocks are recognizable, even at a distance, by their characteristic red-brown weathering and sparse cover of vegetation. The peridotites are typified by rough "hobnail" surfaces due to the relative resistance to weathering of large pyroxene pseudomorphs. Exposed surfaces of the dunite, by contrast, are generally smooth except for streaks of resistant chrome spinels. Both peridotites and dunites are pervasively cut by veinlets and irregular masses of chalcedony and drusy quartz. One small mass of colloform magnesite was found in the northern part of the Kilolitna body.

In order to determine the trace content of chromium, nickel, and platinum metals in the ultramafic rocks, composite chip samples were collected on foot traverses across the Kilolitna and lower Kanuti bodies. Nine samples, each weighing approximately 3 pounds, were collected and analyzed. Chromium and nickel values were determined by atomic absorption methods and platinum group metal values by fire assay:

	Parts per million (ppm)
Cr	2400–3000
Ni	1900–2400
Pt	<.010
Rd	<.005
Pd	<.004–.008

Chromium values range as high as 9 percent in selected grab samples of dunite streaked with grains of chrome spinel. However, the average value of 2,600 ppm for the nine composite chip samples agrees closely with the average value of 2,400 ppm given by Goles (1967) for ultramafic rocks.

The average value for nickel in the nine composite chip samples is 2,300 ppm; this is higher than the average of 1,500 ppm given by Goles (1967) for ultramafic rocks but is within the range of various published estimates. Although no nickel sulfides were recognized in the ultramafics, a careful search should be made for residual deposits enriched in nickel, particularly beneath the overlapping nonmarine Cretaceous and Tertiary rocks along the northwest flank of the Kokrines-Hodzana Highlands.

KANUTI KILOLITNA CREEK AREA

Anomalous tin values in stream sediment samples collected along the upper part of Kanuti Kilolitna Creek suggest that further investigation for placer and lode tin deposits in this area (fig. 3) may be

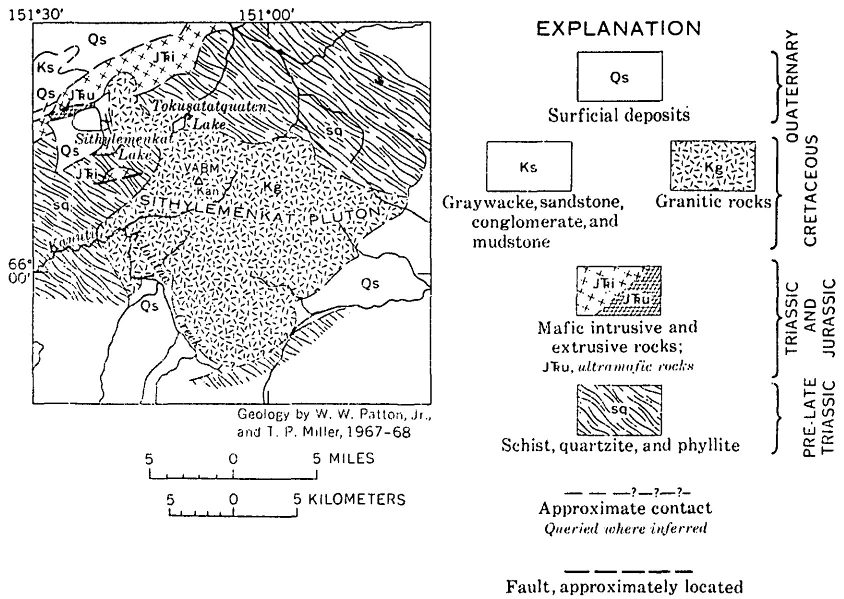

FIGURE 3.—Reconnaissance geologic map of the Kanuti Kilolitna Creek area.

warranted. Kanuti Kilolitna Creek drains the southwestern part of the Sithylemenkat pluton, a 170-square-mile body of biotite quartz monzonite that intrudes the metasedimentary rocks of the Kokrines-Hodzana Highlands. Eleven samples were collected along the tributary stream that heads near VABM Kan (fig. 3) and were analyzed by semiquantitative spectrographic methods. Of these, nine showed tin values ranging from 10 to 300 ppm. In addition, six of these samples gave anomalous lead values ranging from 70 to 300 ppm, and two samples had anomalous beryllium values of 10 and 20 ppm. (The following values, based on hundreds of analyses of stream sediment samples from central and western Alaska, are considered by the authors to be anomalous for granitic rock terranes: for tin, 10 ppm or greater; for lead, 70 ppm or greater; and for beryllium, 7 ppm or greater.) A pan concentrate from near the head of the tributary yielded values much greater than 1,000 ppm (upper limit of determinability) for tin and 2,000 ppm for tungsten. Some stream sediment samples collected along streams draining the north side of the Sithylemenkat pluton also had detectable amounts of tin, although none of the values exceeded 15 ppm. Two pan concentrates from the stream draining Tokusatatquaten Lake contained 300 ppm tin.

Two bulk samples of tourmalinized quartz monzonite from near Sithylemenkat Lake gave tin values of 20 and 70 ppm. However, five bulk samples of the intrusive rock from the central and eastern part of the pluton showed no detectable tin.

The Kanuti Kilolitna tin occurrence appears to be roughly on strike with the tin placer deposits of the Gold Hill district, 60 miles to the southwest (Cobb, 1960). A brief reconnaissance of the intervening area shows it to be underlain in large part by porphyritic biotite quartz monzonite intrusives of the Sithylemenkat type. This suggests that not only the Kanuti Kilolitna Creek area but also the entire belt extending southwestward to the Gold Hill district may be worthy of investigation for additional tin deposits. Sainsbury and Hamilton (1967) have pointed out the nearly universal association of tin deposits with such biotite-bearing granitic rocks and have noted that tin deposits commonly are distributed along narrow structurally controlled zones.

UPPER KANUTI RIVER AREA

Galena, sphalerite, and pyrite were found as disseminated fine grains in oxidized and silicified rhyolite on the upper Kanuti River (fig. 4). The sulfides occur in a gossan about 100 yards long exposed in a bluff on the west side of the river. The rhyolite is composed of tuff and tuff breccia and is exposed over an oval-shaped area 3 miles long by 1 mile wide. It has been silicified and sericitized and is composed of angular fragments of quartz and felsic volcanic rock in a fine-grained to cryptocrystalline groundmass of quartz and sericite. The rhyolite, which is probably early Tertiary in age, rests on and probably intrudes Cretaceous biotite quartz monzonite of the Kanuti pluton. Located nearby are scattered roof pendants of hornfelsic schist.

Galena and sphalerite in grains as much as 5 mm (millimeters) long are disseminated through a pyritiferous zone about 100 yards long in the rhyolite. This pyritiferous zone is extensively oxidized and the rocks are stained and permeated by limonite. Composite grab samples collected along the oxidized part of the bluff contain 700 to 20,000

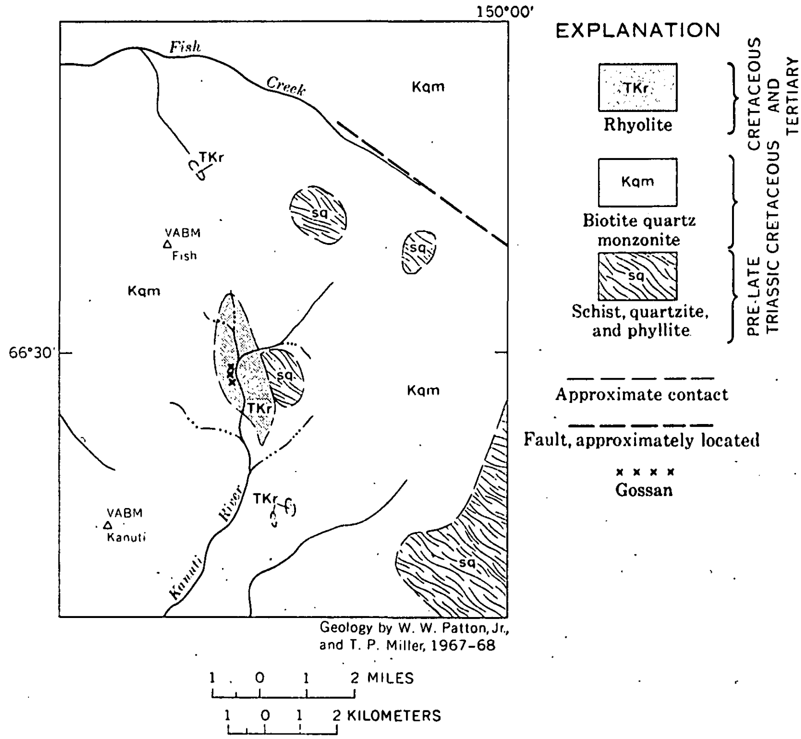

FIGURE 4.—Reconnaissance geologic map of upper Kanuti River area.

ppm lead, <200 (trace) to 3,000 ppm zinc, 3 to 30 ppm silver, and 70 to 500 ppm copper. The north end of the gossan is richer in lead and the south end is richer in zinc and copper.

Sediment samples from streams draining the mineralized zone contain anomalous (that is, 70 ppm or greater) concentrations of lead. The highest values are from the upstream end of the gossan where samples contain as much as 700 ppm lead, 700 ppm zinc, and 3 ppm silver. Values drop to 70 ppm or less a short distance downstream from the gossan.

The examination of this deposit was brief and, because of poor exposure, evaluation of its economic potential is difficult. The sparsely disseminated sulfides in the gossan may represent leakage from an underlying more extensive mineral deposit. This deposit is also of interest because of the similarity to lead-zinc-silver mineralized rhyolite bodies on the Indian River, 75 miles to the southwest (Miller and Ferrians, 1968). The association of this type of mineralization with Tertiary(?) rhyolites suggests that such bodies may be favorable targets for exploration in this part of Alaska.

REFERENCES CITED

Brosgé, W. P., Lanphere, M. A., Reiser, H. N., and Chapman, R. M., 1969, Probable Permian age of the Rampart Group, central Alaska: U.S. Geol. Survey Bull. 1294–B. (In press.)

Brosgé, W. P., and Reiser, H. N., 1964, Geologic map and section of the Chandalar quadrangle, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I–375.

Cobb, E. H., 1960, Molybdenum, tin, and tungsten occurrences in Alaska: U.S. Geol. Survey Mineral Inv. Resource Map MR–10.

Eakin, H. M., 1916, The Yukon-Koyukuk region, Alaska: U.S. Geol. Survey Bull. 631, 88 p.

Goles, G. G., 1967, Trace elements in ultramafic rocks, *in* Wyllie, P. J., ed., Ultramafic and related rocks: New York, John Wiley & Sons, Inc., p. 352–362.

Maddren, A. G., 1913, The Koyukuk-Chandalar region, Alaska: U.S. Geol. Survey Bull. 532, 119 p.

Mendenhall, W. C., 1902, Reconnaissance from Fort Hamlin to Kotzebue Sound, Alaska: U.S. Geol. Survey Prof. Paper 10, 68 p.

Mertie, J. B., Jr., and Harrington, G. L., 1924, The Ruby-Kuskokwim region, Alaska: U.S. Geol. Survey Bull. 754, 129 p.

Miller, T. P., and Ferrians, O. J., Jr., 1968, Suggested areas for prospecting in the central Koyukuk River region, Alaska: U.S. Geol. Survey Circ. 570, 12 p.

Reiser, H. N., Lanphere, M. A., and Brosgé, W. P., 1965, Jurassic age of a mafic igneous complex, Christian quadrangle, Alaska: U.S. Geol. Survey Prof. Paper 525–C, p. C68–C71.

Sainsbury, C. L., and Hamilton, J. C., 1967, Geology of lode tin deposits: Tech. Conf. on Tin, Internat. Tin Council, London, March 1967, 35 p.

U.S. GOVERNMENT PRINTING OFFICE: 1969