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GEOLOGICAL SURVEY

RECONNAISSANCE GEOLOGY, MINERAL OCCURRENCES, AND GEOCHEMICAL ANOMALIES OF THE YENTNA DISTRICT, ALASKA

By

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Reconnaissance geology, mineral occurrences and geochemical anomalies of the Yentna district, Alaska

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Abstract

The Yentna district, in south-central Alaska, is underlain by slightly metamorphosed Mesozoic sedimentary rocks, and by sandstones, conglomerates and coaly materials of the Tertiary Kenai Formation. The bedrock is locally covered by extensive surficial deposits of Quaternary and Recent (Holocene) age. The Mesozoic strata are cut by a quartz monzonite batholith in the Tokositna Mountains and by alaskitic dikes and plugs in the Peters and Dutch Hills. A silica-carbonate dike, which formed by alteration of a mafic or ultramafic dike, was noted in the Peters Hills.

The major ore deposits are gold placer deposits of several types, including stream and bench deposits of Recent (Holocene age), glacial-fluviatile deposits of Quaternary age, and conglomerates of Tertiary age. Quartz-rich conglomerates and breccias have also been productive and are interesting and controversial genetically. The present study indicates that they are closely related to shear zones containing quartz veins and highly altered rocks; previously the origin of the associated altered rocks had been ascribed to deep weathering.

The report also contains descriptions of a few gold lode prospects and of geochemically anomalous areas such as those at Bunco Creek and near Mount Goldie.

Introduction

The Yentna district, on the eastern flank of the southern Alaska Range, has been a productive placer gold district since 1905. Although its production is only a fraction of that of Fairbanks, Nome, or major districts in the Upper Kuskokwim, it has the largest Alaskan placer gold production of any area south of the Alaska Range. Furthermore, it is of interest because of the multiple ages of productive placers, the thick sequence of auriferous gravels, and the complex mineralogy of the placers. Besides gold, other potentially economic placer minerals include platinum metals, cassiterite, scheelite, and uranothorianite. The main geologic contributions of this investigation are the identification of some lode deposits, alternative hypotheses on the relation of placers to quartz-rich conglomerate and breccias, additional data on the possible sources of the exotic minerals of the placer deposits, and the discovery of some geochemical anomalies indicative of placer and lode metal deposits.

The investigation on which this report is based was conducted in 1967 as part of the U.S. Geological Survey's Heavy Metals Program in Alaska. Mapping was primarily of a reconnaissance nature and only selected small areas were mapped in detail; published U.S. Geological Survey 1:63,360 maps were used as base copy, but in general the detail corresponds approximately to 1:125,000 scale mapping. Stream-sediment sampling was done in areas adjacent to the known placer deposits. No attempt was made to determine the geochemical regime of the known placers, but stream-sediment samples were collected from most permanent streams that drained bedrock, including those above productive placers.

In the Yentna placer district, placer operation on the main Yentna River, and Cache Creek and Peters Creek and their tributaries, and the Fairview Mountain area have produced approximately 7 million dollars worth of gold (valued at $35 per ounce) since the initial discovery of gold in 1905.

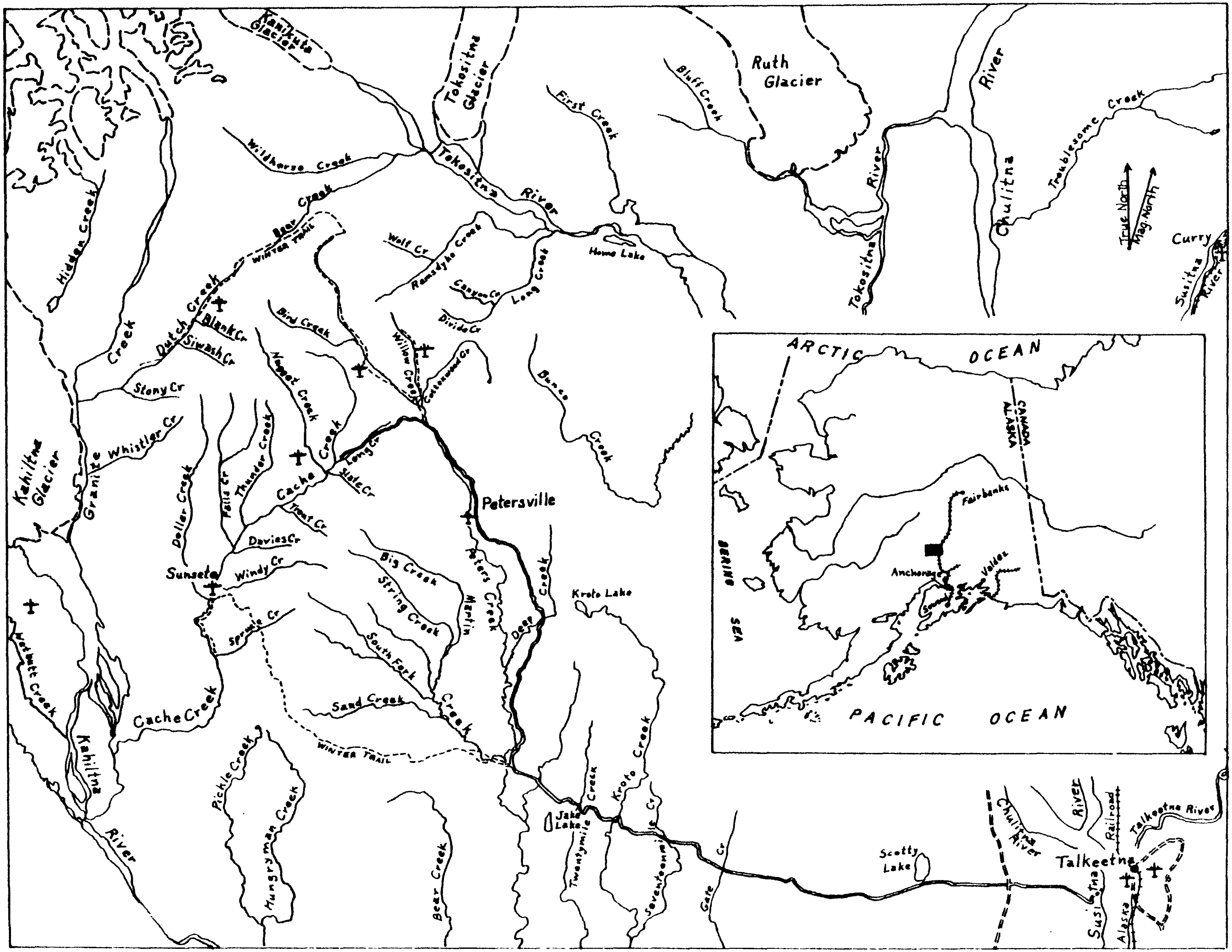
This report gives the results of investigations in 1967 that were concentrated in the northeastern part of the district. It also summarizes, briefly, geologic data in older Survey reports, as most of these are out of print.

Location and access

The Yentna placer district is located (fig. 1) on the eastern flank of the Southern Alaska Range, south of Mt. McKinley National Park. The Yentna district lies between the Tokositna and Yentna Rivers. The part of the district investigated in 1967 is between the Tokositna and Kahiltna Rivers; additional mapping was done northeast and northwest of the district, and extended northeasterly to Ruth Glacier and northwesterly almost to Mt. Goldie. Access to the area is by the Peters Creek road from a point a few miles south of Talkeetna, Alaska, 32 miles to the southeast.

History and production

Gold was discovered in the Yentna district in 1905, and production started the same year; through 1960 production totaled slightly over 204,000 ounces, reaching a maximum of 10,788 ounces in 1922. The production from the Yentna district is combined in most official production records with placer production from the Willow Creek district. Placer production from the Willow Creek district has been negligible in most years, and since records for the Yentna district itself are



✝ Airstrip suitable for bushplane

Index map of part of the Yentna placer district.

Base map from U.S. G.S. Topographic series 1:250,000, Talkeetna Quadrangle incomplete, the production figure probably is minimal for the Yentna district alone. The production, in ounces, is given in Table 1, with records on a yearly basis from 1931-1960. This table was mainly compiled by E. H. Cobb.

Production within the district can only be assigned in a general way. The early production was mainly from creeks tributary to Cache Creek; dominant production in the early 1920's was probably from the Cache Creek dredge. In the middle 30's the Peters Creek dredge was probably the main single source; thereafter, the dominant source has been tributaries to Cache and Peters Creeks. Many creeks have yielded some production.

Field work and acknowledgments

Field work on this project was done during mid-September, 1967, with helicopter support. Geologic data and sample locations were plotted on the following U.S. Geological Survey topographic maps: Talkeetna B-2, B-3, C-2 and C-3. Data on the Tertiary rocks of the Kenai Formation given by Barnes (1966, Pl. C) were combined with the authors' mapping of the older bedrock to produce the final geologic map (fig. 2).

Neil Matson of the U.S. Geological Survey, temporarily assigned to the project, aided in mapping and sampling.

We gratefully acknowledge the information supplied to the authors by the placer miners of the district and, in particular, to Messrs. Phil Brandl, Rocky Cummins, Forrest and Orville Engelhorn, Ray Gatz, and Leonard Zaiser.

Table 1.--Production of placer gold from the Yentna and Willow Creek districts, 1905-1960

Year	Fine ounces	Reference
1905-1930	118,215 [1/]	U. S. Geol. Survey Bull. 857-B
1931	2,709	Alaskan Geology Branch files
1932	2,902	Alaskan Geology Branch files
1933	2,467	Alaskan Geology Branch files
1934	2,800	Alaskan Geology Branch files
1935	2,800	Alaskan Geology Branch files
1936	4,514	Alaskan Geology Branch files
1937	9,629	Alaskan Geology Branch files
1938	6,286	Alaskan Geology Branch files
1939	3,000	Alaskan Geology Branch files, Incomplete
1940	3,343	Alaskan Geology Branch files, Incomplete
1941	4,329	Alaskan Geology Branch files, Incomplete
1942	1,029	Alaskan Geology Branch files, Incomplete
1943	620	U.S. Bureau of Mines, 10/17/62, written commun.
1944	401	U.S. Bureau of Mines, 10/17/62, written commun.
1945	289	U.S. Bureau of Mines, 10/17/62, written commun.
1946	1,069	U.S. Bureau of Mines, 10/17/62, written commun.
1947	3,899	Minerals Yearbook
1948	5,061	Minerals Yearbook
1949	2,233	Minerals Yearbook
1950	2,838	Minerals Yearbook
1951	389	Minerals Yearbook

[1/] Yentna-Cache Creek only

Table 1.--Production of placer gold from the Yentna and Willow Creek districts, 1905-1960--Continued

Year	Fine ounces	Reference
1952	3,704	Minerals Yearbook
1953	5,282	Minerals Yearbook
1954	5,531	Minerals Yearbook
1955	5,708	Minerals Yearbook
1956	1,571	Minerals Yearbook
1957	703	Minerals Yearbook
1958	651	Minerals Yearbook
1959	263	Minerals Yearbook
1960	111	Minerals Yearbook
Total	204,346	

Previous work

Parts of the Yentna district were traversed by U.S. Geological Survey reconnaissance parties of 1898 and 1902 (Brooks, 1911), but the first and only systematic investigation of the district was made by S. R. Capps in 1911, and reported on, briefly, in 1912 and in a final report in 1913. Capps (1913) outlined the basic geologic units of the district--an old series of slate and graywacke cut by somewhat younger dikes, and successively overlain by Tertiary coal-bearing strata, later Tertiary conglomerate, and Recent (Holocene) fluviatile-glacial deposits. Capps proposed that the placer deposits were near their lode source. He also recognized a strong northeasterly structural grain of the rocks and several steep northeasterly striking faults. Following the discovery of platinum in concentrates from the Kahiltna River and streams draining the Dutch Hills, Mertie (1919) reassessed the district and reported other minerals such as cassiterite and scheelite in several placers. He also reported the unusual auriferous angular quartz conglomerates or breccias at Thunder Creek (p. 250) and Dollar Creek (p. 252-253). These sites and one at Willow Creek were subsequently reinvestigated by Capps (1925, p. 54-58), who described them as "early Tertiary placer deposits." Capps also worked in the adjoining Skwentna region (1929).

The next Survey reports on the Yentna district followed much later. Data on the fineness of gold in Alaska, including the Yentna district, were summarized by Smith (1941), and in 1945 a Survey party investigated the radioactivity of the placers and reported the presence of uranothorianite (Robinson, Wedow, and Lyons, 1955). Investigations by F. F. Barnes over a number of years culminated in a paper emphasizing the coal-bearing Tertiary rocks of Beluga-Yentna district (Barnes, 1966); the

Kenai Formation of Barnes included both the coal-bearing strata and younger Tertiary gravels of Capps in the Kenai Formation. The upper conglomeratic part of the formation is locally auriferous. Capps (1913) and most later workers assigned the coal-bearing strata to the Eocene, but recent work by Wolfe, Hopkins, and Leopold (1966) shows that some of these rocks are definitely Miocene.

Analytical techniques

All samples collected were analyzed for gold by atomic absorption, and about 30 other elements were determined by semiquantitative spectrographic analysis (tables 3, 5, 7, 8, and 9). In the case of anomalously high gold values, a split of the sample analyzed by atomic absorption was analyzed by fire assay as a check.

Mineralogical content of whole rock samples was determined by X-ray diffraction and study of thin sections.

Geology

Cretaceous and Cretaceous(?) rocks

The Yentna placer district is underlain predominantly by a thick sequence of slightly metamorphosed graywackes, siltites, and argillites, called in older reports the graywacke and slate series (Capps, 1913, p. 25-28; Mertie, 1919, p. 236-237). These rocks form the bulk of the Peters Hill, Dutch Hills, the area around Mount Goldie, and the western and southern flanks of the Tokosha Mountains. Mertie (1919, p. 237) assigned a Cretaceous age to these rocks on the basis of *Inoceramus* found at Long Creek. Further work by Capps (1929, p. 84-86), in the Skwentna district, led to the conclusion that the sequence possibly ranges in age from Early Jurassic to Late Cretaceous.

The arkosic sandstones or graywackes, siltites, and argillites are almost black to dark greenish-black rocks that are weakly metamorphosed and locally show a well-developed cleavage. Near faults the rocks are strongly deformed and sheared. Throughout the sequence thinly laminated, platy, arkosic argillite alternates with siltite or graywacke that has local graded bedding. Local zones in the interlayered graywacke in the Dollar Creek drainage, contain up to 40 percent euhedral pyrite. In general, the pyrite-rich beds are thin, ranging in thickness from 1 to 2 inches.

Quartz is common in the form of gash fillings and as small pods. A very weak hematite stain generally coats fractures in the quartz masses.

Thin-section study of the graywacke, siltite, and argillite of the Yentna district shows that alteration from fine- to coarse-grained material is common. Transition from fine-grained laminae to coarser grained laminae is generally abrupt; in general, the particles of individual laminae are well sorted with respect to size, and poorly sorted with respect to composition. Most grains are subrounded to angular and are generally discrete minerals; lithic fragments constitute less than 5 percent of most rocks. Major minerals, in decreasing abundance, are quartz, plagioclase--generally sodic andesine--K-feldspar, chert, and muscovite. Minor minerals are sericite, pyrite, hematite, apatite, and zircon. Locally carbonaceous material(?) is common. The matrix of the graywacke contains abundant quartz and sericite, minerals which also occur with clay in the argillite and the matrix of the siltite. The sparse amounts of carbonaceous(?) materials form discontinuous laminae. Quartz adjacent to pyrite crystals has well-developed strain shadows, suggesting growth of pyrite in place during or after diagenesis.

Locally, as in parts of Dollar and Thunder Creeks, the graywacke-argillite-siltite sequence has been strongly altered and converted from a hard almost black rock to a white clayey rock easily pulverized by hand. This alteration is strongly developed near northeasterly striking faults, in part quartz-bearing, and in Thunder Creek near a body of argillized igneous rock. Such altered rocks were noted and described by Mertie (1919, p. 250-251; p. 252) and by Capps (1925, p. 56-60) who attributed their origin to weathering. Although more observations and fresh openings would be very desirable, a strong case can also be made for the hydrothermal origin of the altered rocks by hot solutions that moved along major fault zones of the district.

The dominance of a graywacke-argillite lithology, the mineralogy of the rocks, and sedimentary characteristics, such as graded bedding, combine to show that the slightly metamorphosed sedimentary rocks of the Yentna district were deposited in a geosyncline, and that they were derived from a terrane rich in igneous rocks which could provide the abundant fresh feldspar. Later weak metamorphism is indicated by incipient recrystallization. The structure in which they accumulated has been called the Alaska Range geosyncline by Miller, Payne, and Gryc (1959, p. 18), and was a basin which persisted throughout nearly all Mesozoic time, but was strongly uplifted starting in the Laramide.

Kenai Formation

The Kenai Formation of Tertiary age forms the youngest bedrock unit in the Yentna district. It underlies a large part of the basin between the Peters and Dutch Hills, most of lower Cache Creek, the southeastern flank of the Peters Hills and the eastern foothills of the Tokosha Mountains (fig. 2). In most of these areas, however, it is concealed by glacial-fluviatile deposits of Quaternary age. The Kenai Formation is well exposed in the area of Willow and Poorman Creeks in the Peters Creek drainage, on the steep slopes of creeks like Nugget and Dollar, and at places on the flank of the Tokosha Mountains.

The rocks mapped by Barnes as Kenai Formation include both the so-called Eocene coal-bearing beds and the later Tertiary gravels of Capps (1913) and others; these subdivisions coincide approximately with Barnes' middle and upper members of the Kenai Formation. Plant fossils from the middle member in the Peters Hills-Dutch Hills (Wolfe, Hopkins, and Leopold, 1966) are of Miocene age, but neither the upper nor lower members are fossiliferous and the Kenai is classed as Oligocene(?), Miocene and Pliocene(?) in age (Barnes, 1966) in the Yentna district areas.

The middle member of the Kenai Formation, not separated on figure 2, underlies Cache Creek downstream from a point about 1 mile above the junction of Nugget Creek, part of the area southeast of the Peters Hills, and a small area on the northwest side of the Peters Hills north of Peters Creek. The upper member is well exposed in Nugget Creek and in the Willow Creek-Poorman Creek area. The middle member is mainly poorly indurated sandstone, claystone, and lignitic coal; the upper member dominantly conglomerate. Thicknesses are unknown, but the upper unit must exceed 200 feet thick at both Nugget Creek and in the Willow Creek area. The upper or conglomeratic member is at least locally auriferous; it has been placer mined at both Nugget Creek in the NE 1/4 sec. 16, T. 28° N., R. 9° W., near Willow Creek in the approximate center of sec. 30, T. 29° N., R. 8° W. and probably at other places.

A section of the rock exposed at the center of sec. 30, T. 28° N., R. 9° W., showed:

	Feet
Quaternary	
Soil and vegetation covered zone, top of steep slope	10
Upper Member, Kenai Formation	
Sandstone, very poorly consolidated, silty, claystone seams and sparse lenses of conglomerate	25
Conglomerate, sandy, with sparse poorly consolidated sandstone layers. Most cobbles are 2-6 inches across and are well-rounded; in composition are a pale greenish-white feldspar porphyry, well indurated conglomerate with pebbles and cobbles of black siltstone, quartz, granite or quartz monzonite, and graywacke. No visible gold and only sparse black sand was found in a panned concentrate. Base not exposed	140
Largely covered interval. Quaternary and Holocene sediments and placer tailings	100

The cobbles in the conglomerate appear to be an Alaska Range assemblage. The granite or quartz monzonite is similar to that of the Tokosha Mountains. Similar porphyry was observed to the northeast on Eldridge Glacier, and the conglomerate cobbles could have been derived from the Cantwell Formation. Northeast of the measured section, on the left limit of Willow Creek just downstream from the conglomerate-graywacke contact, a different type of conglomerate lies on and possibly fills a channel cut in the typical upper Kenai rock. The rock is a limonitic-cemented angular quartz grit consisting of coarse sand and fine pebble-sized material; it has been sluiced and so presumably was gold bearing.

Auriferous white quartz conglomerates and breccias also are associated with the coaly strata of the middle member of the Kenai Formation to the southwest in Thunder and Dollar Creek, and these rocks have been interpreted (Capps, 1925) as conglomerate zones in the Tertiary rocks, and locally as basal conglomerates of the coal-bearing strata. They are discussed further in the sections on placer gold deposits.

Igneous rocks

Quartz monzonite

The Tokosha Mountains in the northeast part of the area are partly underlain by quartz monzonite which forms part of a batholithic body also exposed on the north side of the Ruth Glacier (Capps, 1940, p. 2; Tuck, 1934). As shown by Capps, the pluton is irregular in shape, but the southeastern part has a strong northeasterly trend, a direction subparallel to major faults in the Yentna district. The northwestern contact of the part of the batholith in the Yentna district is steep and trends northeasterly; the southwest contact of the body is low dipping, as shown by exposures in First Creek, and so the batholith is apparently further elongated in a NE-SW direction in the subsurface (fig. 2). Its subsurface projection is, of course, not known, but the batholith could continue under the main part of the Yentna district.

The quartz monzonite is a light-colored, almost white rock of medium- to coarse-grain size. It is massive and, generally, little altered. Its minerals are dominantly feldspar which is almost white in color, and pale gray quartz, and subordinately scattered greenish-black

biotite. The quartz grains are mostly less than 5 mm across; feldspar or intricate feldspar aggregates are more than 5 mm and commonly more than 10 mm across.

A point count of a typical slab of quartz monzonite indicates about 5 percent biotite, and of the remaining 95 percent, one-third quartz and two-thirds white feldspar. Examination of a thin section of the same rock shows that perthitic K-feldspar exceeds plagioclase (calcic oligoclase) in amount; both feldspars are almost white. Zircon, epidote, allanite, apatite, and an opaque oxide are trace constituents. Alteration is very weak; some sericite is in cores of plagioclase crystals and the biotite is partly chloritized. Epidote is on hairline fractures in plagioclase.

Porphyritic alaskite and related rocks

Distribution and occurrence

The graywacke, siltite and argillite of Mesozoic age are cut by dikes, plugs, or stocks of light-colored igneous rocks, which have only been partly distinguished in the reconnaissance mapping. Larger or more continuous bodies include a dike as much as 200 feet wide that was traced for more than two miles on a strike of about N. 57° E. in the Peters Hills (fig. 2). Other dikes were seen and mapped in the vicinity of Nugget and Bird Creeks.

Plugs or small stocks of igneous rock were mapped in Thunder Creek, at the headwaters of Williams Creek, near the head of Ramsdyke Creek, and on the southwest flank of the Tohositna Mountains. The pluton near Williams Creek, northwest of the headwaters of Wolf Creek, is about 2500 feet long and 500 feet wide. A small plug, about 400 feet across, occurs on the ridge crest one and one-half miles to the southwest. The incompletely exposed body along Thunder Creek, which has been strongly altered to clay minerals, is at least 1500 feet wide.

Petrography

The igneous rocks in the dikes and plugs are generally light colored, ranging from white to buff, and are porphyritic with a fine-grained to aphanitic groundmass. The phenocrysts are quartz and feldspar. In hand specimen the feldspar phenocrysts are generally subdivided by weathering and as a result appear to be smaller and less numerous than they actually are. Phenocrysts range in size from approximately 2 mm to 10 mm across or in length and constitute less than 20 percent of the rock. Quartz veinlets, locally with sulfides, are a common megascopic feature of the dikes, occurring as ladder veins and as veins parallel to the margin of the dikes and on intersecting joints in the plugs.

Thin-section study shows that the dikes are mainly composed of, in approximate order of abundance, albite-oligoclase, quartz, and orthoclase and subordinately of muscovite, biotite, epidote, carbonate minerals, chlorite, apatite, rutile, and opaques (table 2). The opaque minerals include magnetite and ilmenite and less abundant pyrite. Groundmass of the dikes is approximately equigranular quartz and dominant orthoclase; contacts between the mainly anhedral grains are sutured. Small blebs of quartz, generally less than one-fourth the size of typical groundmass grains, are poikiloblastically oriented throughout the groundmass. Plagioclase and quartz phenocrysts are generally somewhat resorbed by the groundmass, and a corona of fine-grained quartz, less than .01 mm thick, surrounds quartz phenocrysts.

Table 2.--Mineralogical composition of dike rocks of the Yentna district

Field No.	Estimated mineral percentages: Plagioclase	An Content	Quartz	K-feldspar	Muscovite or sericite	Biotite	Epidote	Carbonate Minerals	Chlorite	Apatite	Rutile	Opaques	Texture	Comments	Rock Name
67ACx276	55-60	3	10-15	15-20	3-5	--	Tr	1-2	--	Tr	Tr	<1	Porphyritic, hypidio-morphic granular	Weakly altered, Tr sphalerite noted associ-ated with quartz grains	Porphyritic alaskite
343	--	--	85-90	--	5-7	--	--	--	--	--	<1	3-5	Open space filling - breccia	Border zone of alaskite dike; composed of 15-20 percent alaskite fragments included in open space filling quartz	Quartz-alaskite breccia
351	25-30	12	40-45	15-20	10-15	--	--	--	--	--	--	1-3	Weakly glommero-porphyritic; hypidi-omorphic granular	Rock cut by veinlets of sericite, muscovite and opaques form local concentrations	Porphyritic alaskite
67AHx380	45-50	12	15-20	20-25	3-5	2-4	<1	--	1	Tr	--	<1	Porphyritic, hypidio-morphic granular	Epidote replaces plagioclase, biotite altered to chlorite	Porphyritic alaskite
408	45-50	7	30-35	5-10	3-5	Tr				<1	Tr		Porphyritic, hypidio-morphic granular	Plagioclase phenocrysts replaced by muscovite	Porphyritic alaskite
412	30-35	8	20-25	25-30	5-10	Tr	1-2	5-7	--	--	--	<1	Porphyritic, hypidio-morphic granular	Micrographic intergrowths common. K-feldspar altered by clay. Plagioclase altered by seri-cite and carbonate	Porphyritic alaskite

(An determinations by Michel-Levy Method)

Muscovite or biotite rather than hornblende or pyroxene are the characteristic minerals in the dikes. Muscovite is dominantly in large, fresh grains uniformly dispersed throughout the rock, and subordinately in veinlets which cut across both the groundmass and the phenocrysts. The less abundant biotite is generally altered.

Sample 67ACx343 (table 2) is representative of the complex quartz veins, approximately 5 inches wide, that occur in porphyritic alaskite dikes. The veins are composed almost entirely of euhedral quartz, muscovite, and minor fragments of porphyritic alaskite. Most of the quartz appears to have been formed during open-space filling. Arsenopyrite is disseminated throughout the quartz groundmass and concentrated at the borders of the porphyritic alaskite fragments.

Muscovite occurs as large, fresh grains uniformly dispersed through the veins.

Silica-carbonate dike

In addition to the porphyritic alaskite, an originally mafic or ultramafic dike, completely converted to a silica-carbonate rock was found in a new exposure at the Bird Creek placer mine. The dike is approximately 3 feet across and strikes northeast.

The dike rock is fine grained and pale greenish white, and at first glance appeared to be similar to the other light-colored igneous rocks. Thin-section study, X-ray diffraction, and spectrographic analysis show, however, that it is composed of quartz, magnesite, and dolomite, and that it contains elements such as chromium and nickel not characteristic of the porphyritic alaskite.

The carbonate minerals are of two generations. Magnesite occurs as dark mottled grains crowded with inclusions arranged in a sagenitic pattern

which may be relict from the original mafic minerals. Dolomite is in anhedral to subhedral clear grains and locally crosscuts the magnesite. Quartz is fine grained and is found both in the groundmass and in open-space fillings. Mica (muscovite?) that is pale green in hand specimen occurs in discrete grains and imparts a regular foliation to the rock; it appears to crosscut both magnesite and dolomite.

The dike, like the porphyritic alaskite dikes, is cut by quartz-filled ladder veins which contain sphalerite. The rock also contains some arsenopyrite and magnetite or ilmenite.

A semiquantitative spectrographic analysis of the dike shows 5 percent of magnesium, 5 percent of calcium, and 700 ppm of chromium, and 300 ppm of nickel, compared with only fractional amounts of these elements in the porphyritic alaskite dike rocks (table 3).

Singificance of silica-carbonate dikes

The presence of magnesite and dolomite is unique to the silica-carbonate dike rock, although where altered, the porphyritic alaskitic dikes also contain a carbonate mineral, generally calcite. The silica-carbonate dike also differs from the porphyritic alaskite dikes by containing high concentrations of Ca, Mg, Ni, and Cr.

The silicate-carbonate dike rock was probably derived from mafic or ultramafic igneous rock and because of the two generations of carbonate rather than one in the alaskite, had a more complex geologic history and possibly is older than the alaskite.

Platinum has been reported from the Yentna district by Mertie (1919, p. 233), but the source has not been defined.

Table 3 .--Analysis of porphyritic alaskite dikes, Yentna district, Alaska

Analysts: Gold, by atomic absorption, A. L. Meier, R. L. Miller, T. A. Roemer; spectrographic, Arnold Farley, Jr., R. H. Heidel, E. E. Martinez;

Analyses, unless noted, are semiquantitative spectrographic and are reported in the series 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, 1.5, and so on, or by the following symbols: N = not detected; L = detected but below limit of determination;

No.	Lab. No.	Field No.	Ag	As	Au[1/]	B	Ba	Be	Bi	Cd	Co	Cr	Cu	La	Mo	Mn	Nb	Ni	Pb	Sb	Sc	Sn	Sr	V	W	Y	Zn	Zr	Fe	Mg	Ca	Ti
			Parts per million																										Percent			
216	ACL-101	67AG 3[illegible]	N	N	.02	20	15	3	N	N	N	L	5	N	N	150	15	7	L	N	L	15	N	10	N	10	N	70	.3	L	L	L
217	ACL-109	67AG 392	N	N	.02	20	15	3	N	N	N	L	20	N	N	150	15	3	10	N	N	20	N	N	N	L	N	70	.5	.05	L	L
218	ACL-110	67AG 393	.5	N	.04	20	70	1.5	N	N	N	L	30	N	N	150	20	3	15	N	N	15	N	N	N	L	N	70	.7	.02	L	.001
222	ACL-106	67AG-351	N	N	<.02	30	1,500	1	N	N	N	7	30	20	N	15	10	10	L	N	L	N	300	30	N	15	N	150	.7	.3	.2	.3
229	ACL-120	67AHx380	N	N	.04	L	1,500	1	N	N	5	15	20	20	N	200	L	15	10	N	L	N	1,500	15	N	L	N	150	2	.5	.7	.2
231	ACL-124	67AHx412	N	N	.8	L	300	1	N	N	N	L	30	N	N	150	10	5	20	N	N	L	100	L	N	N	N	70	1	L	.1	.002
Limits of determination			.5	200	.02	10	5	1	10	20	5	5	5	20	5	10	10	2	10	100	5	10	50	10	50	10	200	20	.05	.02	.05	.001

1/ Atomic absorption

(Sample locations shown on Figure 2)

The silica-carbonate dike recognized in this study is the only known mafic or ultramafic body in the district and is near the area of highest known platinum recovery.

The affinity for platinum and mafic to ultramafic bodies is well known. Therefore, the area should be examined in detail for similar rocks, especially since they may constitute a possible lode source for platinum in the Yentna district.

Alteration of dike rocks

The porphyritic alaskite dikes of the Yentna district are commonly strongly altered and display the characteristic saccharoidal texture of quartz-sericite alteration on fresh fracture surfaces. A weak limonitic stain on most dike rocks and fractures is primarily goethite. The dike rocks which have been argillized, propylitized, and sericitized characteristically have a pale green color.

In the porphyritic alaskites the central portion of plagioclase phenocrysts is generally altered to sericite or muscovite and locally to epidote and carbonate. Plagioclase grains of the groundmass are rarely altered. K-feldspar grains of the groundmass characteristically show a weak pervasive clay-sericite alteration throughout.

Besides the dominant oligoclase, albite forms rims on the more calcic plagioclase and sparse veinlets.

Biotite is commonly altered to chlorite along the margin. Green biotite noted in 67AHx342 (table 2) is thought to be an intermediate product of chloritization. Muscovite of the rock cuts phenocrysts and groundmass, indicating that it is late stage and probably hydrothermal. The abnormal amount of muscovite in 67ACx343 (table 2), which is a hydrothermal, mineralized quartz dike, further supports a hydrothermal origin for the muscovite.

Alteration in the quartz-carbonate dike has been so extreme as to destroy all of the primary minerals.

Elemental composition of dike rocks

Dike rocks were analyzed for elemental composition by semiquantitative spectrographic techniques. The results are tabulated in table 3 and locations are shown on figure 2. Only those bodies which were not visibly mineralized are included in table 3.

In general the analyses show that the porphyritic alaskites are typical of low-calcium granitic rocks (Turekian and Wedepohl, 1961, p. 175-192; Vinogadov, 1963, p. 555-571). The porphyritic alaskites are, however, markedly high in Au, Sn and Cu when compared with average abundance (Turekian and Wedepohl, 1961, p. 175-192; Vinogadov, 1963, p. 555-571).

The high concentration of gold in the altered porphyritic alaskites is noteworthy and will be discussed later with the origin of the auriferous white quartz conglomerates.

Thunder Creek altered zone

Strongly altered rocks occur in Thunder Creek (fig. 2) near the head of the main productive placer deposits. Two types of altered rocks are exposed; one is white to pale greenish gray, has relict bedding and fold structures and in places grades into graywacke. The second type is a clayey, massive rock; its massive nature and mineral and chemical composition suggest an igneous parentage.

The rocks at Thunder Creek are like those described previously as highly weathered slate and graywacke, but association with fault zones and mineralogy, particularly the abundance of mica (muscovite) suggests a hydrothermal-igneous parentage. Kaolinite also is in the altered rocks (table 4) and although kaolinite is compatible with either hydrothermal or

Table 4.--Mineralogical composition of the Thunder Creek altered zone

Sample No.	Particle size	Minerals present	Estimated amounts (parts in ten)
67AHx397	Clay	Montmorillonite	Tr
		Mica (Muscovite)	3
		Kaolinite	6+
		Quartz	Tr
	Silt	Montmorillonite	Tr
		Mica (Muscovite)	1+
		Kaolinite	2+
		Quartz	6
	Sand	Quartz	9+
		Mica (Muscovite)	Tr
	Total	Montmorillonite	Tr
		Mica (Muscovite)	1+
		Kaolinite	3
		Quartz	5

Analyses by P. D. Blackmon

weathering origins, muscovite is easily degraded in a strong weathering environment, hence the muscovite is interpreted as being diagnostic for the hydrothermal origin of the altered rocks. Muscovite is in considerable abundance in some less altered igneous rocks of the area (table 2). Except for the low content of Ca and Na, compatible with hydrothermal leaching, the composition of the rock is like the less altered porphyry (table 5).

Structure

Major faults in the Yentna district have a rather consistent N. 50°-70° E. strike and are steeply dipping. This strike is essentially parallel to the larger regional structures such as the Castle Mountain fault zone south of the Yentna district which trends N. 60° E. (Grantz and others, 1963b, p. 126, 127, pl. 18), and the Denali fault (Reed, 1961, p. A-19, A-20, pl. 1) which trends N. 60° E. north of the Yentna district. Near Pass Creek, southwest of the area described in this report, a large N. 50°-70° E. fault has been mapped by Capps (1912, pl. IX) and by Barnes (1966, p. C-19, pl. 1). Along the fault older rocks have been upthrown against Tertiary rocks. The surface trace of all these faults indicates they have steep dips, the same as smaller, parallel faults in the Yentna district.

Detailed mapping in the Yentna district, particularly along Dollar and Willow Creeks, shows a definite pattern of faulting (fig. 2). The major faults strike approximately N. 65° E. and dip steeply. The major faults are intersected by minor high-angle faults which strike approximately N. 40°-50° E. The resultant pattern is an acute grid. In Dollar Creek it appears that the contact between the graywacke, siltite and argillite and the Kenai Formation is a fault contact.

Table 5.--Semiquantitative spectrographic analysis of the Thunder Creek altered zone

Sample No.	Element	%	Element	PPM	Element	PPM
67AHx397	Si	>10	Mn	50	Ce	A
	Al	10	Ag	A	Co	5
	Fe	1.5	As	A	Cr	150
	Mg	.3	Au	A	Cu	150
	Ca	.07	B	70	Ga	30
	Na	.2	Ba	1500	Ge	A
	K	3.0	Be	A	Hf	A
	Ti	1.0	Bi	A	Hg	A
	P	A	Cd	A	In	A
	F	.11				

	Element	PPM	Element	PPM	Element	PPM
	La	30	Sb	A	V	300
	Li	A	Sc	20	W	A
	Mo	A	Sn	A	Y	50
	Nb	10	Sr	300	Yb	15
	Ni	100	Ta	A	Zn	A
	Pb	10	Te	A	Zr	300
	Pd	A	Th	A	F	
	Pl	A	Tl	A		
	Re	A	U	A		

A - Looked for but absent

Analyst: R. H. Heidel

The faults of the district have been active in Tertiary time, as evidenced by steeply dipping to vertical beds of the Kenai Formation along faults. Movement in Tertiary time appears to have been widespread throughout the region as Barnes (1966, p. C-19) states:

"A third zone of complex structure extends along the foot of the mountains that form the western border of the Susitna lowland from the vicinity of Chelatna Lake to the head of Canyon Creek. At several places within these limits, rocks are exposed that have been strongly folded and faulted parallel to the mountain front. This deformation, together with the general dip of the Tertiary beds toward the center of the Cook Inlet basin, is believed to have resulted from general uplift of the bordering mountains during Tertiary time."

Faults in the Yentna district have played a large role in controlling the emplacement of igneous bodies and apparently the subsequent formation of productive placers.

Mineral deposits

The productive mineral deposits of the Yentna district are placer deposits, which have yielded about $7,000,000 in gold (valued at $35.00 per ounce), and small amounts of platinum. The placer deposits are of several types. The most productive placers have been in alluvial channels of Holocene age in Cache Creek and Peters Creek, but gold has been produced also from glacial-fluviatile deposits of Quaternary age and from fluviatile conglomerates of Tertiary age. Some productive placers are in or head into conglomerates and breccias composed largely of white quartz. Although some of these bodies are of fluviatile origin, others are essentially fault breccias in hydrothermally altered zones, and their occurrence strongly suggests that gold was derived from the fault zones.

Lode deposits of the region are mainly vein deposits, many of which are intimately associated with light-colored igneous dikes, which contain anomalous amounts of metals. Other deposits, as the vein deposit on Mount Goldie, are sulfide-gold-bearing quartz veins with no apparent igneous affiliation. The vein deposits contain scheelite, sphalerite, arsenopyrite, and probably cassiterite; most have not been described previously. They are discussed first here not because of importance, but because they are the source rock of at least some of the gold and detrital heavy minerals contained in the black sands of the placer deposits.

Lode deposits

Classification and occurrence.--The lode deposits consist of ladder and strike veins in dikes, quartz-rich veins not closely associated with igneous rocks, and, probably, disseminated fracture controlled deposits in plugs and small stocks of igneous rocks. The richest lode deposits seen during the course of this investigation are in strike and ladder veins in and near dike rocks. Gold in very minute amount was detected chemically in hydrothermally altered shear zones and in massive quartz veins. Gold was also detected chemically in some igneous dikes not obviously mineralized.

Only a very few possible lode sources of gold are in the main part of the district, but probable lodes form a possible cluster of gold-bearing deposits in the headwaters of Bird and Nugget Creeks, and slightly auriferous hydrothermally altered shear zones (faults) in upper Dollar, Nugget, Thunder, and Willow Creeks, all in the Dutch Hills. One slightly auriferous dike was sampled in the Peters Hills. Very slight concentrations of gold were detected chemically in igneous rocks at two places on the northwest flank of the Dutch Hills, and gold, panned and

determined chemically, occurs in the Cummins' Mount Goldie prospect north of the Tokositna River. The small igneous body exposed at the head of Wonder Gulch, a tributary of Ramsdyke Creek, is almost certainly auriferous as it is cut by numerous quartz veinlets and has been ground sluiced.

Detailed maps and descriptions of some of the occurrences are given in the section on the description of prospects, mineral occurrences, and anomalous areas.

Mineralogy and metal content.--No detailed mineralogy has been done on the lode deposits, but some minerals can be identified in hand specimen and inferences on mineral compositions also can be based on the chemical analyses of the ores.

Minerals identified thus far are pyrite, arsenopyrite and its oxidation products scorodite and pitticite, sphalerite, scheelite, chalcopyrite, pyrite, and native gold. Cassiterite is very probably present in small amounts at the Mount Goldie prospect and probably elsewhere.

The main gangue mineral is quartz, but muscovite or sericite occurs in distinct books in some of the veins, suggesting a similarity to greisen-type deposits characterized by quartz and muscovite gangue.

Placer deposits

The placer gold deposits of the Yentna district range from mid-Tertiary to Holocene in age. Although gold was the main product from the placers, trace amounts of platinum metals were recovered. Deposits here called stream and bench placers occur near two types of bedrock, as distinguished by the local miners, a "soft bedrock" where the productive gravels overlie the claystone, sandstone and conglomerate of the Kenai

Formation of Tertiary age and "hard bedrock" where the gravels overlie weakly metamorphosed argillite-graywacke units of Mesozoic age.

Distribution

Placer gold is widespread throughout the Yentna district. To date the major production has been from the Cache Creek-Peters Creek drainage basin and the Twin Creek basin, which was not studied during this investigation. In addition to the two major areas Capps (1912, p. 180) reported that fine gold could be found almost anywhere along the Yentna River, and that fine gold had been recovered along the lower Kahiltna River and along Lake Creek. Mertie (1919, p. 262) states that two areas along the Kahiltna River were actively prospected:

"...one about 3 miles by stream below the mouth of Peters Creek... the other 30 miles downstream."

Within the Cache Creek-Peters Creek basin, the main placer deposits have been found on Cache, Dollar, Falls, Thunder, Rambler, Lucky, Nugget, Gold, Bird, Peters, Willow, Cottonwood, Poorman, and Long Creeks.

Minor amounts of gold have been recovered from streams north of the Dutch Hills, in particular along First Creek.

Mineralogy

Although gold is the major economic element of the Yentna placers, the black sands also contain unusual and possible valuable amounts of cassiterite, platinum group metals, and uranothorianite. In particular, the placers of Williams, Poorman, Cottonwood, and Long Creeks have anomalous concentrations of platinum.

Robinson and others (1955, p. 20) studied placer concentrates throughout the Cache Creek basin and found:

"The following minerals are the abundant and common constituents of the concentrates: zircon, hornblende, hypersthene, augite, epidote, garnet, pyrite, ilmenite, chromite (or a chrome spinel), cassiterite, magnetite, quartz, and altered feldspar. The minor and erratic constituents are gold, tourmaline, andalusite, biotite, chlorite, iron oxides, allanite(?), arsenopyrite, copper, stibnite(?), apatite, sphene, monazite, graywacke fragments, iddingsite, prehnite, rutile(?), marcasite, galena, and two unidentified minerals--one of them brown and wedge-shaped, the other whitish and anhedral. Platinum has been reported by Mertie (1919) in some of the placers of the Yentna district, but was not found in the samples collected in 1945."

Robinson and others (1955) also reported the local presence of uranothorianite.

Mertie (1919) studied platinum occurrences in the Yentna district and gave the following chemical analysis of platinum and associated metals in a sample from Poorman Creek:

Element	Percent
Silicate	1.0
Iridosmium	32.0
Iridium	11.3
Rhodium	1.4
Platinum	47.3
Iron	5.2
Gold	1.5
Palladium	Tr
Copper	.1
Nickel	.03
Zinc and silver	Tr
Specific gravity of sample 18.1	99.83

Types of deposits

Placer gold has been produced in the Yentna district from three main types of deposits: (1) stream and bench gravel deposits of Holocene age in and near the valleys of modern-day streams, (2) fluviatile glacial deposits of Quaternary age, and (3) conglomerates of the middle unit of the Kenai Formation of Tertiary age. The Recent bench and alluvial gravels have been the most productive, but gold has been recovered economically from all three types.

Gold has also been recovered from quartz-breccia zones in bedrock that at places appear to grade upwards into fluviatile conglomerates of both Recent and Tertiary. The quartz-breccia zones are associated with the strongly altered rocks described earlier and apparently are auriferous fault zones. The productive placer deposits of Recent age, the placers of fluviatile-glacial type, and those of the Kenai Formation have been well described by Capps (1912) or Mertie (1919) and so are only briefly described here. Although the quartz-breccia deposits were also noted and described by both Capps (1923) and Mertie (1919), their origin has been reinterpreted and they are described in considerable detail.

(Holocene) placer deposits

Stream and bench placers have been the most productive in the Yentna district. In particular those along Cache and Peters Creeks, which were amenable to dredging operations, have produced the greatest amounts of gold. More restricted production, from sluice type operations, has come from Long, Dollar, Nugget, Rambler, Gold, Falls, Bird, and Poorman Creeks.

General features

Stream placers of the Yentna district commonly occur at the contact between the sandstones, siltstones, and claystones of the Kenai Formation

and the Holocene stream deposits. The gravels worked range in thicknesses from several inches to tens of feet. Their basal portions are richest. The highest concentrations of gold are found where streams cross the coarser grained material of the Kenai Formation; gravels adjacent to clayey beds are almost always barren.

Cache Creek stream and bench placers

The bench placers along Cache Creek were described by Capps (1919, p. 247) and are typical of most stream and bench placers in the district.

"On upper Cache Creek, just above the mouth of Gold Creek, the bench gravels on the left bank of the creek, at an elevation of 2,300 feet, were being worked in 1917 by hydraulicking. The bedrock at this locality is composed of Eocene coal-bearing sediments and consists mainly of sandstone, with some clay shale, and conglomerate and coal seams. The bedrock surface is decidedly irregular, and good sized "pot-holes" are exposed as the surface is uncovered. A lens of conglomerate covered by a seam of brown to black iron hydroxide forms the bedrock surface at one place, and on this irregular surface coarse gold is found. Much of the gold, particularly the coarse gold, occurs on such iron-stained bedrock surfaces, as well as in similar unstained gravel beds higher in the placer body. Some gold, however, is distributed throughout the gravels.

....A body of heavier gravel wash, about 7 feet thick, lies next to bedrock. It is apparent that such bench gravels have undergone a high degree of stream sorting...."

Stream and bench placers appear to be transitional with deposits of glacio-fluviatile origin as observed by Capps (1919, p. 248) on Gold Creek:

"This deposit, though showing plainly the effect of water action, is not nearly so well assorted as the one just described. It may be considered to be intermediate in character between the glacio-fluviatile material and the well-washed bench gravels.

The deposit is about 35 feet thick, and the lower 12 feet is subangular wash. Overlying this wash is 12 feet of blue glacial mud containing angular unsorted boulders, above which lies 8 feet of the same material stained brown by surface oxidation. The bedrock is slate, which continues downstream for several hundred feet before the Eocene coal-bearing formation begins. The gold is said to be distributed in the lower 12 feet of washed gravel, but little gold is present on the slate bedrock."

Glacio-fluvial placer deposits

Only a restricted amount of placer mining has been done on glacio-fluvial placers; and consequently, their gold production is small. The potentially largest placer of this type is at Bird Creek (fig. 2). The best described placers of this type are at Windy Creek and Nugget Creek.

General features

Glacio-fluvial placers commonly rest on both "soft bedrock" and "hard bedrock" surfaces.

The major common characteristic of glacio-fluvial placers is that there is a basal unit of coarse gravel and boulders overlain by a thick sequence of blue mud. Gold values occur throughout the mass; however, the main concentration occurs at the basal contact.

Windy Creek

Windy Creek (fig. 2) is a small stream which enters Cache Creek between Falls and Dollar Creek. The Windy Creek deposit is of glacio-fluviatile origin, and according to Capps (1919, p. 254) consists of:

"...160 to 180 feet of glacio-fluviatile material. The lower 40 to 60 feet consist of gravel, of which the lower 6 feet are iron stained and

firmly cemented. This body of gravel is overlain by 100 feet of blue mud containing large angular boulders, and this in turn is covered by 20 feet of gravel which extends to the surface. The gravel in general averages 5 inches in diameter, though boulders from 1 to 3 feet in diameter are uncovered. The bedrock is clay and sandrock of the coal-bearing (Kenai) Formation. Most of the gold occurs in the lower 6 feet of the deposit and is fine and flaky...."

Bird Creek

The placer gold of Bird Creek is similar in occurrence to that of Windy Creek. According to Capps (1919, p. 260):

"This deposit seems to be purely of glacio-fluviatile origin and consists of 50 to 75 feet of glacial mud and angular to subangular boulders of all sizes, resting upon a much broken, decayed, and uneven-surfaced slate. The upper 10 feet is stained yellowish brown from the effects of surface oxidation."

White quartz conglomerate and breccia deposits

Although not as important economically as the stream and bench placers, the auriferous white quartz-rich deposits occur at several places near the heads of the productive stream and bench placers, were worked in several places, and, most significant, offer a clue to the origin of placer gold in the district. It is proposed later in the report that these deposits are more or less reworked auriferous quartz-bearing zones in and near faults, altered rocks, and dikes. Other origins have, however, been proposed and because neither Mertie's (1919) or Capps (1923) reports are widely available, excerpts are given from their reports on the deposits.

Distribution

White quartz in placer tailings, outcrops, and residual surficial deposits is abundant in several parts of the area, but particularly in Thunder, Dollar, and Willow Creeks where in each instance white quartz conglomerate deposits occurred near the head of the main placer pay.

White quartz conglomerate placers

Thunder Creek

The quartz conglomerate of the Thunder Creek area was well exposed during Mertie's visit in 1919 and was described thus (Mertie, 1919, p. 249-250):

"This placer body is most remarkable, however, on account of the peculiar character of the underlying bedrock. The coal-bearing formation (Kenai) is considered to be the bedrock, though hydraulic operations have cut through it in places exposing a much weathered phase of the slate and graywacke series, which projects upwards as reefs. In general the rock at this locality is a brown clay, locally carrying thin streaks of coal, which strikes N. 40° E. and dips 35° NW., or toward Thunder Creek. Two well-defined beds of quartzose material, however, are interbedded with the clay rock, and these beds carry coarse angular gold.....These quartzose seams are composed largely of angular fragments of a much weathered and disintegrated gold quartz and a minor amount of well-rounded quartz pebbles, cemented in a white clayey material, which on close examination proves also to consist largely of fine fragments of quartz--that is, it is a siliceous clay.

Thin seams of coal are also found in these siliceous seams, together with fine fragments of coal in all orientations, resembling washed material. A considerable proportion of the gold recovered at this placer

comes from this siliceous clay, and even the adjoining brown clay contains a little gold. Two such siliceous deposits, each averaging about 12 feet in thickness, are exposed in the cut, about 50 feet apart stratigraphically.

Both these deposits can be traced downstream, and in that direction they appear to lie farther apart. Seams of clay gouge that strike N. 80° W. and dip 85° N. cut these seams, as well as other coal-bearing sediments, showing the presence of later faulting."

Capps (1919, p. 250) continues and describes the quartz fragments of the quartzose seams:

"Some of the quartz pebbles in the quartzose seams were also found to be badly disintegrated and ready to fall apart into angular fragments when separated from the clay matrix. Moreover, the matrix, when viewed under the microscope, is seen to be composed of subangular to rounded grains of decayed cloudy quartz."

Dollar Creek

Detailed mapping in Dollar Creek (fig. 2) showed a similar occurrence of white quartz conglomerate in the old placer working. In general, the Dollar Creek white quartz conglomerate is composed of angular to subangular fragments of quartz ranging in size from 4 inches to microscopic. Most of the quartz fragments are white to dark gray and strongly fractured. The larger quartz fragments are contained in a matrix of white clay, muscovite, and very fine quartz.

Underlying the white quartz conglomerate is a strongly altered sequence of country rock described by Capps (1919, p. 252):

"At the site of the present mining operations, on the east end of the creek, the bedrock is a deeply weathered green graywacke, which strikes N. 25° E. and dips from 70° E. to 90°. In the creek bed the bedrock consists of slate in a similar state of alteration, but more crushed and folded, and therefore with a less uniform trend."

Of particular importance to the later discussion of origin of white quartz conglomerates is the following observation by Mertie (1919, p. 253):

"At one place in the cut a body of green graywacke, about 75 feet long and 30 feet thick, lies in and takes the place of the quartzose bed, about 10 feet of which lies both above and below the graywacke. This body may be an exceptionally large detrital boulder lying in the quartzose formation, or a reef projecting upward from the underlying bedrock, undercut on the west side and filled with placer material, or possibly a block of graywacke faulted upward from the underlying bedrock."

Willow Creek

Gold is also associated with a white quartz conglomerate at Willow Creek (fig. 2). Capps (1925, p. 58) described the Willow Creek placer:

"At the extreme head of Willow Creek basin, where numerous small streams drain the steep eastward slope of the Dutch Hills, there is a deposit of white, well-rounded gravel in a white siliceous clay matrix that contains sufficient placer gold to justify mining. The stratigraphic relations at this place are much less plain than on Thunder and Dollar Creeks, for the deposit has been greatly confused and disturbed, probably by landslides."

From a study of the various types of placers and modes of occurrences of placers in the Yentna district, it is concluded that the white quartz conglomerate placers represent the oldest placers of the area. The gold in the bench and stream, and glacio-fluvial placers has apparently been rehandled since its initial deposition by the action of streams and

glaciers. It was concluded that the white quartz conglomerate placers may be the primary source of gold in all other placers of the district; therefore, the character and distribution of the white quartz conglomerate placers were studied in detail. The results of that study are presented in the following chapter.

Origin and significance of the auriferous white quartz conglomerates

White quartz conglomerates form important paystreaks in the district, and during our investigation were noted in Dollar, Thunder, Willow and Bunco Creeks. They have been described variously; however, according to Capps (1925, p. 54), the white quartz conglomerate is the basal unit of the Kenai Formation. Capps interpreted the conglomerate as follows:

"The lower portion of the Eocene beds, in places having a thickness of 60 feet, consists primarily of subangular or partly rounded fragments of quartz, with some imperfectly rounded greywacke fragments, and a smaller number of well-rounded pebbles of quartz and greywacke. The pebble-sand fragments are embedded in a bluish-white clayey matrix that is itself composed largely of broken vein quartz and siliceous clay. This quartzose stratum is gold bearing throughout, though there is a main concentration."

Mertie (1917, p. 250) described the auriferous white quartz conglomerate in Thunder Creek as composed of well-rounded quartz pebbles cemented by a white siliceous clay matrix.

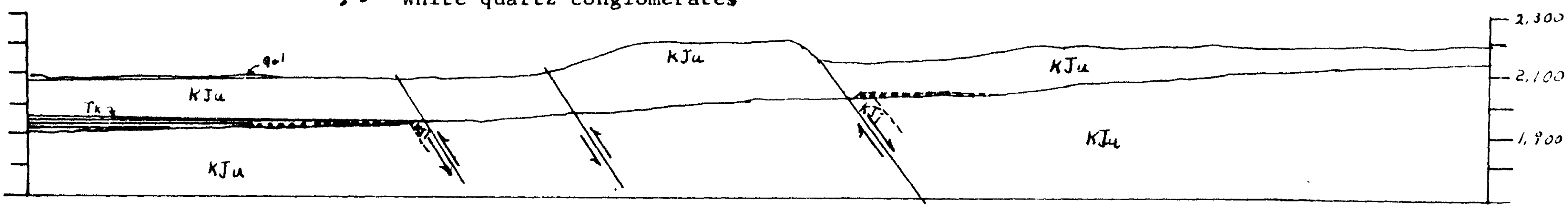
The white quartz conglomerate in Dollar Creek (fig. 3) is composed of angular to subangular fragments of quartz ranging in size from 4 inches to microscopic. In general, most of the quartz is white to dark gray and strongly fractured. The larger quartz fragments are contained in a matrix of white clay and very fine quartz.

Explanation

	Rock type	
Quaternary	Qal	Undifferentiated colluvial and alluvial deposits
Tertiary	Tk	Kenai Formation-primarily conglomerate sandstone and siltstone with local lignite seams
Late Mesozoic	KJi	Intrusive rocks-primarily quartz porphyry
Mesozoic	KJu	Undifferentiated metasediments, primarily argillite and metagraywacke

Fault

Auriferous White quartz conglomerates



(Geology by A.L. Clark, 1967)

Figure 3. Dollar Creek. Vertical cross-section A-A' projected to stream profile

Three features of the white quartz conglomerate generally agreed on by all observers are noteworthy:

1. Fragments are generally angular to subangular,

2. Matrix is primarily clay and very fine grained quartz, and

3. The white quartz conglomerate is overlain, probably disconformably, by sediments more typical of the Kenai Formation.

The angular to subangular fragments and the fine-grained clay-quartz matrix described by Capps and Mertie indicate that the white quartz conglomerates are not typical fluviatile sediments. Any extensive reworking of the white quartz conglomerate would have rounded the pebbles and destroyed the clay matrix. Therefore, the white quartz conglomerate is considered to be very near its source.

The disconformable contact between the white quartz conglomerate and the Kenai Formation is suggested by the following:

1. Rock fragments of the Kenai Formation are of fluvial origin and generally rounded, whereas those in the white quartz conglomerates are not.

2. The matrix of the white quartz conglomerate is highly altered, whereas that of the Kenai Formation is not.

The present study indicates that the white quartz conglomerate is near its original source and is an older unit upon which sediments of the Kenai Formation were deposited.

Controls of occurrence of white quartz conglomerates

Detailed mapping in the Dollar Creek drainage (fig. 3) suggests that the sources of the white quartz conglomerates are altered auriferous alaskite-bearing fault zones and possibly porphyry intrusives which were emplaced along major fault zones (fig. 2); relations are the same in Thunder Creek.

Detailed mapping in Dollar Creek (fig. 2), Thunder Creek, and Willow Creek showed that in each area the white quartz conglomerates are near major faults. The strong general structural control of the white quartz conglomerates in the district is indicated by:

1. The linear alinement of white quartz conglomerate placers over 8 miles strongly suggests a fault control.

2. Except for the occurrence south of the Peters Hills at Bunco Creek, the known white quartz conglomerates occur only north of Cache Creek, indicating that they are structurally controlled and are not fluvial deposits, or which should be more widespread.

3. Detailed mapping in other parts of the region indicate that major faults of the area have the same trend as Cache Creek, substantiating the present mapping that indicates that streams of the Yentna district are fault controlled.

Source rocks of white quartz conglomerates

The white quartz conglomerates apparently were derived from strongly altered quartz-bearing rocks in and near fault zones. The pebbles, cobbles, and angular fragments in the conglomerates are mainly vein quartz; the matrix is siliceous and micaceous clay. Both vein quartz and clays are abundant in and near the fault zones so a local source is feasible.

The occurrence of strongly argillized rocks in the district was noted by Mertie (1919, p. 250-251), but he attributed them to deep residual weathering of the slate-graywacke country rock. We believe, however, that the mode of occurrence and mineralogy of the altered rock is more in keeping with a hydrothermally altered porphyry and associated quartz veins as described on page 58. The linear occurrence of the argillized rocks, as seen in Thunder, Dollar and Willow Creeks, suggests that deep residual weathering is unlikely because residual weathering should be widespread. Other evidence against an origin by deep residual weathering is the lack of recognizable soil profiles.

The high quartz, muscovite, and clay content of the matrix of the white quartz conglomerate and altered intrusive, plus their proximity to the placers, leave little doubt that the altered igneous rock is the source rock for the auriferous white quartz conglomerate placers. An additional indication that the placer gold was derived from the altered intrusive rocks is the high gold content of these rocks and their associated quartz veins (table 6).

During reconnaissance stream sediment sampling of the Yentna district many anomalies were found associated with quartz veins which are generally in major fault zones or associated with igneous intrusives, or white quartz conglomerate. Very minute amounts of gold were found in argillized fault zones and in quartz veins not associated with igneous rocks. No anomalies could be attributed to areas of quartzite, argillite and arkosic siltites. A close genetic relation between gold and intrusives is indicated by the gold content of igneous rocks sampled in the Yentna district.

Placer gold characteristics

Characteristics of gold from the Yentna placers indicate that the gold is associated with faulting, veining, and igneous intrusives, and that the gold is very near its source. The following characteristics were noted:

1. Most gold is coarse and subangular, and crystalline particles and wire gold are common. Some coarse gold grains are subrounded. Shapes of grains suggest that the gold has not been extensively reworked.

2. Much of the gold is slickensided. Many samples show oxidized slickensided surfaces that cannot be attributed to the placer operations.

Table 6.--Gold content of bedrock types from the Yentna district

	Sample No.	Au (ppm)	Rock description and sample type (Grab sample unless otherwise noted)
Igneous intrusive rock	67ACx333(216)	.02	Quartz porphyry dike-weakly altered.
	67ACx351(222)	<.02	Quartz-sericite altered quartz porphyry-weakly limonite stained. 2-foot chip sample @ 6" centers.
	67ACx392(217)	.02	Quartz-sericite altered quartz diorite. Abundant quartz veins, <1/8 inch.
	67ACx393(218)	.04	Quartz sericitized altered quartz diorite. Abundant quartz veins, <1/8 inch.
	67AHx343(226)	<.02	White medium- to coarse-grained quartz monzonite.
	67AHx374C(214)	.04	Quartz porphyry.
	67AHx380(229)	.04	Felsite dike rock.
	67AHx412(231)	.80	White aplite dike.
Quartz veins in country rock	67ACx348(221)	<.02	Quartz pod in black argillite, weakly limonite stained.
	67AHx374(215)	.02	1-2 inch quartz vein.
	67AHx378(227)	.02	Quartz vein material in graywacke-argillite.
	67AHx403V(224)	.04	Quartz vein material from 50-foot wide stringer lode deposit. Composite grab sample.
	67AHx409V(230)	<.02	Quartz vein material in graywacke-argillite. Composite grab sample.

(216) Sample number on Figure 2

Table 6.--Gold content of bedrock types from the Yentna district--Continued

	Sample No.	Au (ppm)	Rock description and sample type (Grab sample unless otherwise noted)
Sulphide-rich bodies associated with intrusives	67AHx413A(200)	1.00	Quartz vein material. 2 1/2-foot chip sample across vein @ 6" centers.
	67AHx413B(201)	.20	Quartz vein. 1-foot chip sample.
	67AHx413D(203)	.02	Quartz vein material above 413A.
	67AHx413F(205)	1.4	Quartz vein material.
	67AHx413FI(206)	1.0	Quartz vein material with minor sulphides.
	67AHx370A(207)	.06	Quartz with sparse sulfides from 3-4 inch ladder vein in dike.
	67AHx370B(208)	28.0	Quartz with abundant arsenopyrite from 1-inch ladder vein in dike.
	67AHx370C(209)	1.4	Dike rock cut by ladder veins.
	67AHx370D(210)	103	Arsenopyrite vein ≈3-inch thick occurring on hanging wall of dike.
	67AHx370E(211)	1.1	Limonite-stained dike rock and admixed ladder vein quartz.
	67AHx372(212)	.10	Dike rock and admixed quartz ladder vein material.
	67AHx374B(213)	.20	Admixed quartz-arsenopyrite vein material, dike rock and greisen contact rock between dike and vein.
	67AHx379(228)	.80	Felsite dike material and admixed disseminated arsenopyrite and arsenopyrite veinlets.
	67ACx343(232)	2.5	Altered quartz porphyry-open space filling and disseminated pyrite and arsenopyrite.

(216) Sample number on Figure 2

Table 6.--Gold content of bedrock types from the Yentna district--Continued

	Sample No.	Au (ppm)	Rock description and sample type (Grab sample unless otherwise noted)
Altered rocks along shear zones	67AHx396(223)	.06	Argillic fault zone.
	67AHx404(225)	.02	Limonite-stained argillic fault zone.
	67AHx413C(202)	.20	1-inch dark gouge seam in 413A and 413B area.
Graywacke country rock	67AHx355(233)	<.02	Graywacke country rock

(216) Sample number on Figure 2

The close association of the gold placers with known faults, the small amount of reworking and the large number of slickensided particles strongly suggest that the slickensided gold is genetically connected with faulting in the Yentna area.

3. Detailed studies of fineness (purity) of gold in the Yentna district by Smith (1941, p. 175-176) showed that the gold was very uniform in fineness (table 7), averaging 865 fine. Since Fisher (1945) has demonstrated that fineness of gold increases with increasing distance from the source, the uniform fineness of gold in the Yentna district strongly suggests that the placer gold is near the source. The uniform fineness also indicates a common source or type of source (Fisher, 1956).

4. Some fragments of placer gold have cassiterite included, indicating that the gold has not moved far and has not been reworked. Cassiterite is also common in the heavy sand concentrates from the placers. The association suggests that the source rock must be high in tin. Only the intrusives of the area are high in tin (table 3).

Trace element content of gold

Gold from a common source is expected to show common trace element content for individual samples. To test the hypothesis that gold in the Yentna district is not a mixture of sources but rather is derived from a common source, i.e., a hydrothermally altered zone in some areas, a detailed trace element analysis of gold from Dollar Creek was undertaken.

Ten samples of gold, differentiated on the basis of size, shape and megascopically variable alternation were studied; the results are presented in table 8.

Elements present in detectable quantities, such as copper and lead, are remarkably consistent from sample to sample. The general lack of

Table 7.--Fineness of placer gold from Cache Creek and Peters Creek areas, Yentna district

Cache Creek area, Yentna district

Creek	Number of records	Range of fineness	Average fineness
Cache	34	850 3/4-871	866
Dollar	8	857 -871	865
Falls	3	860 -863	861
Thunder	7	858 1/4-876 1/2	865
Short	2	868 3/4-870	869
Nugget	5	860 -864	861
Gold	1	857 1/2	857
Chechako Gulch	1	869 1/4	869
First and Dutch	2	875 3/4-877 3/4	876
Total	63	-------------	865

Peters Creek area, Yentna district

Creek	Number of records	Range of fineness	Average fineness
Peters	6	865 1/4-870 3/4	868
Canyon	1	870	870
Willow	2	870 -870 1/4	870
Ruby	1	857	857
Puzzle	2	861 -880	870
Gopher	1	871 1/4	871
Bird	5	[1]835 1/2-879 1/4	859
Total	18	-------------	866

(after Smith, P.S., 1941)

[1]Only one record below 854.

Table 8.--Trace element content of gold from Dollar Creek placer, Yentna district

Analysts: A. L. Sutton

Analyses, unless noted, are semiquantitative spectrographic and are reported in the series 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, 1.5, and so on, or by the following symbols: N = not detected; L = detected but below limit of determination, - = not looked for; G = greater than 10 Percent

No.	Lab. No.	Field No.	Ag	As	Au[1/]	B	Ba	Be	Bi	Cd	Co	Cr	Cu	La	Mo	Mn	Nb	Ni	Pb	Sb	Sc	Sn	Sr	V	W	Y	Zn	Zr	Fe	Mg	Ca	Ti
			Parts per million																										Percent			
	D130920	DC-1	G	-	G	-	N	N	L	N	N	L	150	N	N	L	N	N	100	N	N	-	-	N	N	N	N	N	.001	-	-	-
	D130931	DC-2	G	-	G	-	N	N	N	N	N	L	200	N	N	L	N	N	L	N	N	-	-	N	N	N	N	N	.03	-	-	-
	D130932	DC-3	G	-	G	-	N	N	N	N	N	L	200	N	N	L	N	N	L	N	N	-	-	N	N	N	N	N	L	-	-	-
	D130933	DC-4	G	-	G	-	N	N	N	N	N	L	200	N	N	L	N	N	L	N	N	-	-	N	N	N	N	N	.003	-	-	-
	D130934	DC-5	G	-	G	-	N	N	N	N	N	L	200	N	N	L	N	N	L	N	N	-	-	N	N	N	N	N	.007	-	-	-
	D130935	DC-6	G	-	G	-	N	N	N	N	N	L	200	N	N	L	N	N	L	N	N	-	-	N	N	N	N	N	.001	-	-	-
	D130936	DC-7	G	-	G	-	N	N	N	N	N	L	150	N	N	L	N	N	L	N	N	-	-	N	N	N	N	N	L	-	-	-
	D130937	DC-8	G	-	G	-	N	N	N	N	N	L	150	N	N	L	N	N	L	N	N	-	-	N	N	N	N	N	L	-	-	-
	D130938	DC-9	G	-	G	-	N	N	N	N	N	L	150	N	N	L	N	N	200	N	N	-	-	N	N	N	N	N	.03	-	-	-
	D130939	DC-10	G	-	G	-	N	N	N	N	N	L	500	N	N	L	N	N	L	N	N	-	-	N	N	N	N	N	.005	-	-	-

Limits of determination

	Ag	As	Au	B	Ba	Be	Bi	Cd	Co	Cr	Cu	La	Mo	Mn	Nb	Ni	Pb	Sb	Sc	Sn	Sr	V	W	Y	Zn	Zr	Fe	Mg	Ca	Ti
	.5	200	.02	10	5	1	10	20	5	5	5	20	5	10	10	2	10	100	5	10	50	10	50	10	200	20	.05	.02	.05	.001

[1/] Atomic absorption

local highs in other elements also indicate a close similarity between all types of gold.

The results of this study, therefore, further support the concept that the gold has one source and is not a mixture of gold types.

Alteration

Many of the placers in the Yentna district are associated with large zones of argillic alteration such as the Thunder Creek altered zone (page 21). In other areas the arkosic sandstone, siltite, and argillite have been strongly argillically altered along fault zones so that all that remains is a varicolored greenish-black clay.

Near small intrusives a thin zone of hornfels is common. Generally there is also minor silicification and sericitization. All igneous dikes and plugs of the area are strongly quartz-sericite altered and locally silicified. The basal part of the Kenai Formation is locally strongly altered by weathering and has a limonite matrix.

Origin of the Yentna placers

Previous hypotheses

Previous workers in the Yentna district agree, in general, that the auriferous white quartz conglomerate placers have an origin similar to that proposed by Capps (1923, p. 59-60) which is summarized in the following:

1. Prior to deposition of the earliest Tertiary beds a long period of erosion produced a residual accumulate of gold from the weathering of quartz veins in the Mesozoic slates and graywackes.

2. Rejuvenation occurred in early Tertiary time and the downcutting streams carried the residual gold to the nearby lowlands where it was deposited.

3. Later in the Tertiary further downcutting by streams resulted in the quartzose gold-bearing placers being buried by clastic material of the Kenai Formation.

4. This was followed by structural deformation of the Kenai Formation by faulting and folding.

5. Pleistocene glaciation locally eroded the buried placers and later deposited a thick cover of till over the area. The till contained the gold from the eroded placers.

6. After the retreat of the ice, the present streams entrenched themselves through the gold-bearing glacial till and locally into the Mesozoic slate and graywacke. In so doing they concentrated gold from the till, the Eocene deposits, and from quartz veins in the Mesozoic slate and graywacke.

Present hypothesis

Available data indicate that the auriferous white quartz conglomerates of the Yentna district are not produced by a process of repeated reworking of gold-bearing gravels; rather they are the product of shearing and weathering in situ of argillic altered auriferous quartz porphyry intrusives and associated auriferous quartz veins.

The characteristics of the placer gold show that it has a common source, has not moved far from the source and has not been reworked.

All of the observed features indicate that the following sequence of events produced the auriferous white quartz conglomerate placers of the Yentna district.

In late Mesozoic or early Tertiary time, the Yentna district was cut by a series of northeast-trending high angle, normal faults. Closely following, or contemporaneous with the faulting, small auriferous quartz porphyry bodies and associated auriferous quartz veins were emplaced along the pre-existing faults. The igneous bodies were strongly hydrothermally altered.

Following the emplacement of the auriferous bodies recurrent faulting crushed the quartz veins and the igneous bodies. The faulting was followed by a period of weathering, erosion, and nearby deposition of the auriferous fault material as white quartz conglomerates.

Subsequently the Kenai Formation was deposited unconformably on the white quartz conglomerate. Continuing faulting caused local mixing of white quartz conglomerate and Kenai Formation.

Following deposition of the Kenai Formation the white quartz conglomerates were reworked locally during the ensuing glacial epochs.

Description of prospects, mineral occurrences, and anomalous areas

Rocky Cummins prospect

The Rocky Cummins prospect is approximately 4.5 miles S. 62° E. of Mount Goldie at an altitude of about 2900 feet (fig. 2). The prospect is on a steeply dipping quartz lode which strikes about N. 75° W. and contains free gold. The lode is best exposed on the west side of a southeasterly flowing tributary stream to the Tokositna. At this place the main vein fissure is about 2 1/2 feet across; the lode is about 30 feet across but consists mainly of wallrock with subordinate narrow quartz veins. Shallow prospects in vein material 200 and 700 feet west of the tributary indicate that the lode probably continues for more than 700 feet to the west, but it can only be traced for about 100 feet to the east. The quartz is milky white, locally vuggy, and contains minor amounts of pyrite, arsenopyrite, an unidentified grayish-brown metallic mineral, and a small amount of white

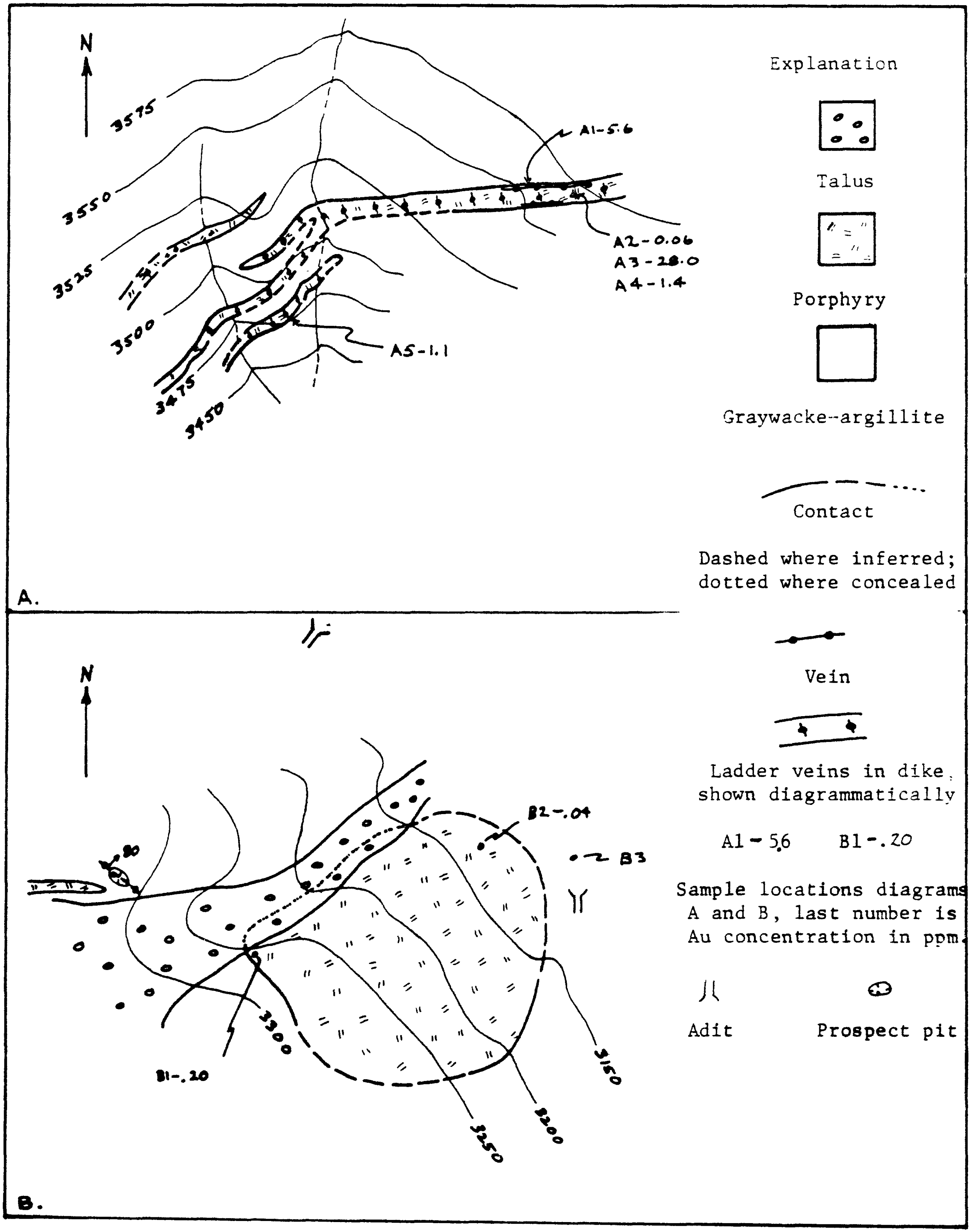
mica. Free gold was panned from crushed quartz vein material and from quartz tailings.

Analyses of samples of vein material showed small amounts of gold in all samples, and anomalous amounts of silver, arsenic, bismuth, tin, and tungsten in most of them (table 9). The gold values seem unusually small, and Mr. Cummins has had assays which show much higher contents of gold and silver. It can be concluded that gold values are scattered in the vein material, but that the average grade is likely to be low. The trace element suite and the presence of white mica suggest that the veins are similar to Lindgren's hypothermal type.

A stream-sediment sample (fig. 4, table 10) taken at the prospect did not contain anomalous amounts of gold. However, stream-sediment samples about 1 mile north-northwest and another mile southwest do contain anomalous amounts of gold. Analysis for other elements showed that samples from all the streams of the area are anomalous in two or more elements (fig. 5, table 10). In particular, the anomalous metal content of station 56 indicates a promising area for prospecting. The anomalous samples from four streams and the known metallization at the Cummins vein suggest that the area between the Tokositna and Kahiltna glaciers is auriferous and should be prospected further.

Bird Creek prospect

The Bird Creek prospect, also known as the Bradley scheelite prospect, is on a left limit tributary to Bird Creek in the SW 1/4 sec. 22, T. 29° N., R. 9° W. as shown on the U.S. Geological Survey Talkeetna (C-2) quadrangle. There are no workings, but according to residents (fig. 7A) of Talkeetna the late Shorty Bradley packed out about 600-800 pounds of scheelite-bearing float cobbed from the hillside.



Geology and topography by pace and compass, C.C. Hawley, 1967.

Figure 6.--GEOLOGIC SKETCH MAPS OF: A. BIRD CREEK AND B. UPPER NUGGET CREEK PROSPECTS

(Datum is approximate mean sea level as estimated from topographic map)

Table 9.--Analysis of bedrock samples, veins, and altered rocks, Yentna district, Alaska

Analysts: Gold, by atomic absorption, A. L. Meier, R. L. Miller, T. A. Roemer; spectrographic, Arnold Farley, Jr., R. H. Heidel, E. E. Martinez;

Analyses, unless noted, are semiquantitative spectrographic and are reported in the series 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, 1.5, and so on, or by the following symbols: N = not detected; L = detected but below limit of determination.

No.	Lab. No.	Field No.	Ag	As	Au[1]	B	Ba	Be	Bi	Cd	Co	Cr	Cu	La	Mo	Mn	Nb	Ni	Pb	Sb	Sc	Sn	Sr	V	W	Y	Zn	Zr	Fe	Mg	Ca	Ti
			Parts per million																										Percent			
																											Rocky Cummins Prospect					
200	ACL-126	67AHx413A	.7	1500	1.00	70	500	3	10	N	N	70	100	L(20)	L	50	L	5	L	N	7	15	N	50	L	15	N	100	2	.3	L	.2
201	127	413B	L(.5)	2,000	.20	20	300	1.5	N	N	N	30	30	N	N	15	L	3	L	N	5	L	L	30	L	10	N	20	1.5	.1	L	.1
202	128	413C	1.5	3,000	.20	150	700	3	L(10)	N	N	70	50	N	N	20	L	10	L	100	7	15	L	20	L	15	N	100	5	.3	L	.2
203	129	413D	N	200	.02	70	700	2	N	N	N	150	70	N	N	100	L	15	L	N	10	20	L	70	N	10	N	[illegible]	2	.5	.05	.3
204	130	413E	5	700	.34	N	30	L	200	N	10	N	100	N	N	L(10)	L	7	10	N	N	N	N	L	N	N	N	N	.2	L	L	.01
205	131	413F	20	500	1.4	N	200	5	100	N	N	L	100	N	7	15	L	5	L	N	N	100	N	10	N	N	N	N	.3	.02	L	.21
206	132	413FD	10	3,000	1.0	N	150	20	70	N	50	N	500	N	N	10	L	10	L	N	N	70	N	10	N	N	N	N	.5	L	L	.01
																											Bird Creek Prospect					
207	ACL-113	67AHx-370A	N	200	.06	N	150	L	N	N	N	L	70	N	N	100	L	3	L	N	N	N	N	N	N	N	N	20	.2	.02	L	.05
208	114	370B	1	>10,000	28.0	N	150	L	N	N	5	L	70	N	N	150	L	3	20	N	N	N	N	L	100	L	N	30	7	L	L	.03
209	115	370C	.5	2,000	1.4	20	1,500	2	N	N	N	10	20	20	N	300	15	15	L	N	5	N	500	20	50	10	N	150	3	.5	.1	.3
210	116	370D	15	>10,000	103	N	150	1	15	N	5	L	7	N	N	30	L	5	100	150	N	N	N	L	N	L	N	30	15	L	L	.05
211	117	370E	N	1,000	1.1	10	1,000	1	N	N	N	7	20	N	N	70	L	15	N	N	L	N	300	15	70	N	N	150	2	.2	.1	.3
212	118	372	5	2,000	.10	15	1,500	2	10	N	5	7	30	50	N	300	10	15	70	N	L	N	300	15	L	10	N	150	1.5	.2	.07	.2
																											Colby #5 Prospect					
213	ACL-119	67AHx-374A	N	7000	.20	15	1,000	1.5	N	N	N	5	30	N	L	200	10	10	15	N	L	N	L	10	N	L	N	100	1.5	.15	.07	.1
214	133	-374B	N	N	.04	10	1,500	2	N	N	5	L	20	30	N	200	15	10	15	N	L	N	1,000	15	N	10	N	150	2	.5	1	.3
215	078	374	1.5	1,000	.02	30	500	2	N	N	10	70	70	20	N	1,000	L	30	70	N	15	N	150	150	N	20	L	100	3	.7	.2	.3
																											Upper Bear Creek					
216	ACL-101	67AHx333	N	N	.02	20	15	3	N	N	N	L	5	N	N	150	15	7	L	N	L	15	N	10	N	10	N	70	.3	L	L	L
217	ACL-109	333	N	N	.02	20	15	3	N	N	N	L	20	N	N	150	15	3	10	N	N	20	N	N	N	L	N	70	.5	.05	L	L
218	ACL-110	333	.5	N	.04	20	70	1.5	N	N	N	L	30	N	N	150	20	3	15	N	N	15	N	10	N	L	N	70	.2	.02	L	.001
		Limits of determination	.5	200	.02	10	5	1	10	20	5	5	5	20	5	10	10	2	10	100	5	10	50	10	50	10	200	20	.05	.02	.05	.001

[1] Atomic absorption

(Sample locations shown on Figure 2)

Table 9.--Analysis of bedrock samples, veins, and altered rocks, Yentna district, Alaska--Continued

Analysts: Gold, by atomic absorption, A. L. Meier, R. L. Miller, T. A. Roemer; spectrographic, Arnold Farley, Jr., R. H. Heidel, E. E. Martinez;

Analyses, unless noted, are semiquantitative spectrographic and are reported in the series 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, 1.5, and so on, or by the following symbols: N = not detected; L = detected but below limit of determination.

No.	Lab. No.	Field No.	Ag	As	Au 1/	B	Ba	Be	Bi	Cd	Co	Cr	Cu	La	Mo	Mn	Nb	Ni	Pb	Sb	Sc	Sn	Sr	V	W	Y	Zn	Zr	Fe	Mg	Ca	Ti
			Parts per million																										Percent			
																													Dollar Creek Area			
219	ACL-103	67AG-344	N	N	.06	10	200	L	N	N	5	50	15	N	N	70	L	30	N	N	5	N	N	70	N	10	N	70	.2	.1	.07	.07
220	-104	345	N	N	.02	15	700	L	N	N	2	70	50	N	N	200	L	30	L	N	7	N	N	70	N	10	N	150	1.5	.5	.05	.3
221	-105	348	N	N	<.02	N	150	L	N	N	5	10	30	N	N	1,000	L	20	L	N	11	N	200	50	N	15	N	N	1.5	1.0	3	.05
																													Falls Creek Area			
222	ACL-106	67AGx351	N	N	<.02	30	1,500	1	N	N	N	7	30	20	N	15	10	10	L	N	L	N	300	30	N	15	N	150	.7	.3	.2	.3
																													Thunder Creek			
223	ACL-121	67AMx376	.5	N	.06	50	700	1	N	N	15	150	70	70	N	5,000	10	150	15	N	15	N	700	100	N	30	200	150	7	.7	.15	.3
																													Willow Creek Area			
224	ACL-122	67AMx403V	N	L	.04	10	300	L	N	N	7	10	20	N	N	200	L	30	L	N	5	N	N	50	N	N	N	20	7	.7	L	.03
225	ACL-123	404	N	N	.02	50	500	L	N	N	7	150	70	N	N	500	L	30	L	N	15	N	50	70	N	15	L	150	7	.1	N	.3
																													UPPER Nugget Creek			
226	ACL-108	67AG-343	N	10,000	2.5	L	500	L	N	N	N	L	15	N	N	50	L	5	L	N	L	N	N	10	N	10	N	70	1.5	.02	.07	.1
227	ACL-134	67AMx378	N	N	.02	N	70	N	N	N	N	7	30	N	N	150	L	15	L	N	L	N	N	10	N	N	N	N	.3	.1	.05	.2
228	135	379	.5	5,000	.80	15	1,500	2	N	N	N	7	30	50	N	15	10	7	10	N	5	N	N	30	L	10	N	150	1.5	.5	N	.3
229	130	380	N	N	.04	L	1,500	1	N	N	5	15	20	20	N	200	L	15	10	N	L	N	1,500	15	N	L	N	150	2	.5	.7	.2
																													Peters Creek Area			
230	ACL 123	67AMx409V	N	N	<.02	10	300	N	N	N	N	30	20	N	N	700	L	20	N	N	7	N	50	30	N	10	N	70	1.5	.2	.07	.15
231	ACL 124	67AMx-412	N	N	.80	L	300	1	N	N	N	L	30	N	N	150	10	5	20	N	N	L	100	L	N	N	N	20	1	L	.1	.002
																													Tokosha Mountains			
232	ACL-111	67AMx347	N	N		N	1,000	L	N	N	N	L	20	20	N	150	N	3	10	N	7	N	100	N	N	15	N	150	1	.02	.3	.1
233	ACL-112	67AMx355	N	N		50	1,000	L	N	N	15	150	70	30	N	500	N	70	15	N	15	N	150	100	N	15	L	150	5	1.5	.7	.5
			Limits of determination																													
			.5	200	.02	10	5	1	10	20	5	5	5	20	5	10	10	2	10	100	5	10	50	10	50	10	200	20	.05	.02	.05	.001

1/ Atomic absorption

(Sample locations shown on Figure 2)

Table 10.--Analysis of stream-sediment samples, Yentna district, Alaska

Analysts: Gold, by atomic absorption, A. L. Meier, R. L. Miller, T. A. Roemer; spectrographic, Arnold Farley, Jr., R. H. Heidel, E. E. Martinez;

Analyses, unless noted, are semiquantitative spectrographic and are reported in the series 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, 1.5, and so on, or by the following symbols: N = not detected; L = detected but below limit of determination,

No.	Lab. No.	Field No.	Ag	As	Au 1/	B	Ba	Be	Bi	Cd	Co	Cr	Cu	La	Mo	Mn	Nb	Ni	Pb	Sb	Sc	Sn	Sr	V	W	Y	Zn	Zr	Fe	Mg	Ca	Ti
			Parts per million																										Percent			
1	ACL-046	67ANx 341	L	N	N	L	500	3	N	N	L	10	20	20	N	500	L	5	20	N	7	N	100	30	N	30	N	200	1.5	.2	.7	.07
2	047	342	L	N	N	L	700	3	N	N	L	L	20	50	N	300	L	L	20	N	5	N	200	10	N	30	N	300	1	.1	1	.07
4	049	344	N	N	N	50	300	1	N	N	15	150	70	20	N	1,500	L	50	30	N	20	N	100	200	N	30	L	150	5	1	.15	.3
5	050	345	N	N	N	L	500	3	N	N	L	5	5	150	N	700	15	5	20	N	7	N	150	50	N	50	N	200	2	.3	1	.2
6	051	346	N	N	N	L	200	10	N	N	L	L	20	100	N	300	30	L	20	N	5	N	100	10	N	30	N	150	1.5	.15	.7	.1
7	052	347	N	N	N	L	500	3	N	N	L	L	7	500	N	1,000	20	L	15	N	7	N	100	20	N	50	N	1,000	1.5	.1	.7	.3
8	053	348	N	N	N	L	500	3	N	N	L	15	20	150	N	700	10	5	20	N	7	N	150	30	N	30	N	300	2	.2	.7	.15
9	054	349	N	N	N	L	300	3	N	N	L	5	15	200	N	700	15	L	20	N	10	N	150	30	N	70	N	200	2	.2	.7	.2
10	055	350	N	N	N	L	200	3	N	N	5	10	10	50	N	500	20	10	50	N	15	N	100	30	N	70	N	150	3	.2	.3	.1
11	056	67ANx 351	N	N	N	30	500	1.5	N	N	15	200	50	30	N	1,000	N	50	30	N	15	N	N	200	N	20	L	150	3	1	.1	.3
12	057	352	N	N	N	30	500	2	N	N	7	50	30	70	N	1,000	L	30	20	N	10	N	150	100	N	20	N	150	2	.5	.7	.3
13	058	353	N	N	N	L	500	3	N	N	5	5	30	150	N	500	10	5	15	N	10	N	150	20	N	30	N	200	2	.15	1	.1
14	059	354	N	N	N	30	300	1.5	N	N	15	150	50	30	N	1,000	L	70	20	N	15	N	150	200	N	20	L	150	3	1	.2	.3
16	061	356	L	N	N	L	300	3	N	N	L	15	30	70	N	500	15	5	30	N	15	N	L	50	N	50	N	200	2	.2	.7	.15
17	062	357	N	N	N	L	700	3	N	N	L	7	20	70	N	300	10	5	20	N	7	N	100	20	N	30	N	200	1.5	.15	.7	.1
18	063	358	N	N	N	20	300	2	N	N	10	70	50	20	N	700	N	30	20	N	10	N	150	150	N	20	N	150	2	.7	.3	.2
19	064	359	N	N	N	30	300	1.5	N	N	20	100	70	30	N	1,000	L	70	30	N	15	N	150	200	N	20	L	150	3	1	.2	.3
20	065	360	N	N	N	50	500	1.5	N	N	15	100	30	30	N	700	L	70	20	N	15	N	100	200	N	20	L	200	3	1	.15	.3
21	ACL 066	67ANx 361	N	N	.02	50	500	1.5	N	N	15	100	50	20	N	1,500	10	70	20	N	15	N	100	200	N	20	L	200	3	.7	.2	.3
22	067	362	N	N	N	20	300	1.5	N	N	15	100	50	50	N	1,500	10	70	30	N	15	N	100	200	N	20	L	200	3	1	.15	.3
23	068	363	.5	N	N	50	1,000	2	N	N	50	200	150	70	N	1,500	L	100	100	N	20	N	100	300	N	50	L	300	5	1	.5	.5
24	069	364	N	N	N	30	300	1.5	N	N	7	70	30	L	N	700	N	30	20	N	10	N	150	150	N	15	N	150	2	.5	.5	.2
25	070	365	N	N	N	50	500	1.5	N	N	15	150	20	20	N	1,000	L	70	20	N	15	N	150	200	N	30	L	200	7	1	.5	.5
26	071	366	N	N	N	50	500	1.5	N	N	15	100	20	20	N	2,000	N	50	20	N	15	N	150	200	N	20	L	150	3	.7	.5	.3
27	072	367	N	N	N	50	500	1.5	N	N	30	150	70	20	N	5,000	10	70	20	N	20	N	150	200	N	20	L	150	5	.7	.2	.3
28	073	368	N	N	N	50	500	1.5	N	N	20	150	70	20	N	2,000	L	70	20	N	20	N	150	200	N	20	200	150	5	1	.5	.3
29	074	369	N	N	N	50	500	1.5	N	N	15	100	50	L	N	5,000	L	70	20	N	20	N	100	200	N	20	L	150	5	1	.2	.3
30	075	370	L	N	N	50	300	1.5	N	N	10	100	50	L	N	1,000	L	30	30	N	15	N	200	150	N	20	N	150	3	.7	.7	.2
Limits of determination			.5	200	.02	10	5	1	10	20	5	5	5	20	5	10	10	2	10	100	5	10	50	10	50	10	200	20	.05	.02	.05	.001

1/ Atomic absorption

(Sample locations shown on Figures 4 and 5)

Table 10.--Analysis of stream-sediment samples, Yentna district, Alaska --Continued

Analysts: Gold, by atomic absorption, A. L. Meier, R. L. Miller, T. A. Roemer; spectrographic, Arnold Farley, Jr., R. H. Heidel, E. E. Martinez;

Analyses, unless noted, are semiquantitative spectrographic and are reported in the series 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, 1.5, and so on, or by the following symbols: N = not detected; L = detected but below limit of determination.

No.	Lab. No.	Field No.	Ag	As	Au[1/]	B	Ba	Be	Bi	Cd	Co	Cr	Cu	La	Mo	Mn	Nb	Ni	Pb	Sb	Sc	Sn	Sr	V	W	Y	Zn	Zr	Fe	Mg	Ca	Ti
			Parts per million																										Percent			
32	ACL-077	67AHk 372	N	N	N	50	700	1	N	N	20	150	20	20	N	1,500	L	70	30	N	20	N	150	300	N	30	L	150	5	1	.2	.3
34	ACL-079	375	N	N	N	30	500	1.5	N	N	15	100	50	20	N	1,500	L	50	20	N	15	N	150	200	N	20	N	150	3	.7	.2	.3
35	080	377	N	N	.04	50	700	1.5	N	N	20	100	50	20	N	2,000	L	70	20	N	15	N	150	200	N	20	L	150	3	1	.3	.3
36	081	381	N	N	N	30	700	1.5	N	N	15	100	30	20	N	700	L	10	20	N	15	N	150	200	N	20	L	150	3	1	.5	.3
37	082	382	N	N	N	30	700	1.5	N	N	7	150	50	L	N	1,500	L	50	30	N	15	N	150	200	N	20	N	200	3	1	.7	.3
38	083	383	N	N	N	30	700	1.5	N	N	10	200	50	20	N	1,500	L	10	10	N	30	N	200	200	N	30	N	200	5	2	2	.5
39	084	384	N	N	N	20	700	1	N	N	15	300	20	20	N	1,500	L	100	10	N	30	N	200	300	N	20	L	150	5	3	2	.5
40	085	385	N	N	N	50	700	1.5	N	N	15	100	70	30	N	1,500	L	70	20	N	20	N	150	200	N	20	L	200	5	1.5	.2	.5
41	ACL-086	386	N	N	N	30	700	1.5	N	N	15	100	50	20	N	1,000	L	50	30	N	15	N	150	200	N	20	N	150	3	1	.3	.3
42	087	387	N	N	N	50	700	1.5	N	N	15	100	50	30	N	1,500	L	70	15	N	15	N	150	200	N	20	L	200	3	1	.2	.5
43	088	388	.5	N	N	30	700	1.5	N	N	15	150	100	20	N	1,500	L	70	30	N	15	N	150	200	N	20	L	150	3	1	.5	.5
44	089	389	L	N	N	30	700	1.5	N	N	15	100	50	20	N	1,500	L	70	20	N	15	N	150	200	N	20	L	150	3	1	.5	.5
45	090	390	N	N	.04	50	700	2	N	N	15	150	50	20	N	1,000	10	70	20	N	15	N	200	200	N	20	L	200	5	1.5	.3	.5
46	091	391	N	N	N	30	700	2	N	N	15	200	50	30	N	1,500	10	70	N	N	30	N	300	300	N	30	L	150	5	2	1.5	.5
47	092	392	N	N	.04	30	700	2	N	N	20	100	70	30	N	1,500	L	70	20	N	15	N	200	200	N	30	L	200	5	1	.2	.5
48	093	393	N	N	N	50	700	2	N	N	20	100	70	30	N	2,000	L	70	30	N	20	N	300	200	N	30	L	150	5	1.5	.5	.5
49	094	394	N	N	N	30	500	2	N	N	20	70	50	20	N	5,000	15	70	20	N	15	N	300	200	N	30	L	150	5	1	.7	.5
50	095	395	N	N	N	50	500	2	N	N	20	150	70	20	N	5,000	L	70	30	N	15	N	200	300	N	30	L	150	5	1.5	.7	.5
52	ACL 097	67AHk 406S	N	N	N	50	500	1.5	N	N	15	70	20	L	N	1,500	L	50	10	N	10	N	150	200	N	15	N	150	3	.7	.15	.5
55	100	406S	N	N	N	50	500	1.5	N	N	15	70	30	30	N	1,000	L	50	10	N	15	N	200	200	N	20	N	200	3	.7	.3	.3
56	151	67ACk 315	.7	1,000	.2	50	500	3	N	N	30	150	150	20	N	3,000	10	70	50	N	15	20	N	200	N	20	200	150	3	1	.15	.3
57	152	316	N	N	N	50	700	2	N	N	20	100	50	50	N	1,000	L	70	30	N	15	N	150	200	N	30	L	150	3	1	.2	.5
58	153	317	N	200	N	70	500	2	N	N	20	100	100	20	N	2,000	L	70	30	N	15	N	100	200	N	30	L	200	3	1	.15	.5
59	154	318	.5	N	N	70	500	1.5	N	N	10	100	30	20	N	700	L	50	30	N	15	N	200	200	N	15	N	150	3	1	.5	.5
60	155	319	N	N	.3	30	700	2	N	N	20	150	50	70	N	1,000	L	70	10	N	15	N	200	200	N	20	L	200	3	1	.2	.5
Limits of determination			.5	200	.02	10	5	1	10	20	5	5	5	20	5	10	10	2	10	100	5	10	50	10	50	10	200	20	.05	.02	.05	.001

1/ Atomic absorption

(Sample locations shown on Figures 4 and 5)

Table 10.--Analysis of stream-sediment samples, Yentna district, Alaska --Continued

Analysts: Gold, by **atomic absorption**, A. L. Meier, R. L. Miller, T. A. Roemer; spectrographic, **Arnold** Farley, Jr., R. H. Heidel, E. E. Martinez;

Analyses, unless noted, are semiquantitative spectrographic and are reported in the series 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, 1.5, and so on, or by the following symbols: N = not detected; L = detected but below limit of determination.

No.	Lab. No.	Field No.	Ag	As	Au[1]	B	Ba	Be	Bi	Cd	Co	Cr	Cu	La	Mo	Mn	Nb	Ni	Pb	Sb	Sc	Sn	Sr	V	W	Y	Zn	Zr	Fe	Mg	Ca	Ti
			Parts per million																										Percent			
61	ACL 156	67ACL 320	N	N	.02	70	700	2	N	N	20	100	50	70	N	1500	10	70	20	N	15	N	100	300	N	30	L	200	5	1.5	.15	.5
62	157	321	L	N	N	30	700	1.5	N	N	10	100	50	N	N	700	L	30	20	N	10	N	200	200	N	20	N	150	2	.7	.7	.3
63	158	322	.7	200	N	50	700	3	N	N	30	150	70	L	N	1,500	L	70	50	N	15	N	300	300	N	20	L	150	5	1	.7	.3
64	159	323	N	N	N	70	700	2	N	N	15	150	70	L	N	1,000	L	70	15	N	15	N	100	300	N	30	L	200	5	1	.2	.5
65	160	324	L	N	N	70	1,000	2	N	N	20	100	50	100	N	1,000	10	70	30	N	15	N	200	300	N	30	L	150	5	1	.5	.5
66	161	325	N	N	N	50	1,000	3	N	N	20	150	100	30	N	2,000	10	70	30	N	20	N	150	200	N	30	L	150	5	1	.3	.5
67	162	326	N	N	N	50	700	2	N	N	20	150	70	30	N	1,000	10	70	20	N	20	N	150	200	N	30	L	150	5	1	.2	.5
68	163	327	L	N	N	50	700	2	N	N	20	150	70	50	N	1,500	L	70	30	N	20	N	200	[illegible]	N	20	L	150	3	1.5	.3	.5
69	164	328	N	N	N	50	700	2	N	N	30	150	70	20	N	2,000	10	70	20	N	20	N	200	300	N	30	L	200	5	1.5	.7	1
70	165	329	N	N	N	30	700	2	N	N	15	100	70	20	N	1,000	L	50	20	N	20	N	300	200	N	20	L	150	3	1	1	.5
71	166	67ACL 330	L	N	N	30	700	2	N	N	15	70	70	20	N	1,500	L	50	30	N	20	N	300	200	N	20	L	150	3	1	1.5	.5
72	167	331	N	N	N	50	700	2	N	N	20	150	100	150	N	1,500	10	20	20	N	20	N	150	300	N	30	L	150	5	1	.3	.7
73	168	332	N	N	N	30	700	1.5	N	N	15	150	30	20	N	1,500	10	50	10	N	15	N	150	200	N	20	N	150	3	.7	.5	.5
75	170	334	N	N	N	50	500	2	N	N	20	150	70	20	N	1,500	L	70	30	N	20	N	200	300	N	20	L	150	3	1	.5	.5
76	171	335	N	N	N	70	500	3	N	N	50	150	100	20	N	1,500	L	70	10	N	20	N	150	300	N	20	200	150	5	1.5	.2	.5
77	172	336	N	N	N	70	500	3	N	N	30	200	70	30	N	3,000	10	70	20	N	20	N	200	300	N	20	200	150	3	1.5	.5	.5
78	173	337	N	N	N	70	500	3	N	N	30	150	100	30	N	3,000	10	70	30	N	20	N	200	300	N	20	L	150	3	1	.2	.7
79	174	338	N	N	N	50	500	1.5	N	N	20	70	50	30	N	3,000	L	50	10	N	15	N	150	200	N	20	N	300	3	1	.5	.5
80	175	339	N	N	N	70	500	2	N	N	20	150	70	30	N	3,000	10	70	20	N	15	N	200	300	N	100	L	150	5	1	.2	.5
81	176	67ACL 340	N	N	N	50	500	2	N	N	20	100	50	50	N	2,000	10	50	10	N	15	N	300	200	N	15	L	150	5	.7	.5	.5
82	177	341	N	N	.04	50	500	2	N	N	15	150	70	50	N	1,000	L	70	30	N	20	N	300	300	N	30	L	200	5	1	.7	.5
83	178	342	N	N	N	70	500	2	N	N	30	150	70	50	N	1,500	10	70	30	N	20	N	200	300	N	20	L	150	5	1	.3	.5
85	180	352	L	N	N	50	500	2	N	N	20	150	70	100	N	1500	L	50	30	N	15	N	200	200	N	20	L	150	5	1	.3	.5
86	ACL-216	[illegible]	N	N	.02	50	500	1.5	N	N	15	100	70	20	N	1,500	N	70	20	N	20	N	300	300	N	20	L	200	5	1.5	1.5	.5
87	217	392	N	N	N	30	700	1.5	N	N	20	100	30	50	N	1,500	10	50	15	N	15	N	200	200	N	30	N	200	3	.7	.2	1
88	218	396	N	N	N	30	500	1.5	N	N	10	70	30	30	N	200	10	30	10	N	15	N	100	200	N	20	N	300	3	.7	.15	1
89	219	[illegible]	L	N	N	20	300	1	N	N	10	70	30	L	N	200	N	30	30	N	10	N	300	200	N	15	N	150	2	.7	1	.3
90	220	[illegible]	N	N	N	70	700	1.5	N	N	20	100	70	30	N	2,000	L	70	20	N	20	N	150	300	N	30	L	200	5	1	.2	.5
Limits of determination			.5	200	.02	10	5	1	10	20	5	5	5	20	5	10	10	2	10	100	5	10	50	10	50	10	200	20	.05	.02	.05	.001

[1] Atomic absorption

(Sample locations shown on Figures 4 and 5)

Table 10.--Analysis of stream-sediment samples, Yentna district, Alaska --Continued

Analysts: Gold, by atomic absorption, A. L. Meier, R. L. Miller, T. A. Roemer; spectrographic, Arnold Farley, Jr., R. H. Heidel, E. E. Martinez;

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No.	Lab. No.	Field No.	Ag	As	Au[1]	B	Ba	Be	Bi	Cd	Co	Cr	Cu	La	Mo	Mn	Nb	Ni	Pb	Sb	Sc	Sn	Sr	V	W	Y	Zn	Zr	Fe	Mg	Ca	Ti
			Parts per million																										Percent			
91	ACL 021	67ACx 399	N	N	.04	50	700	1.5	N	N	30	150	100	30	N	1,500	L	70	30	N	15	N	100	300	N	20	200	150	5	1.5	.3	.5
92	022	400	N	N	N	50	500	1.5	N	N	20	150	70	20	N	1,000	L	70	30	N	15	N	100	500	N	20	L	200	5	1	.2	.5
93	023	401	N	N	.1	50	500	1.5	N	N	15	100	30	30	N	1,000	L	50	20	N	15	N	100	200	N	20	N	300	3	1	.15	.5
94	024	402	N	N	.5	50	500	1.5	N	N	30	100	30	20	N	5,000	L	50	30	N	10	N	100	200	N	20	N	200	5	1	.3	.5
95	025	403	N	N	N	70	700	2	N	N	30	150	70	20	N	1,500	L	70	30	N	15	N	100	300	N	20	N	200	5	1.5	.2	.7
96	026	404	N	N	.02	70	500	1.5	N	N	20	100	50	20	N	1,500	L	70	20	N	15	N	150	300	N	20	N	200	3	1	.2	.5
97	ACL 227	405	N	N	.02	50	1,000	2	N	N	30	200	70	20	N	2,000	L	70	20	N	15	N	200	200	N	20	L	150	5	1	.7	.3
98	228	406	N	N	N	30	300	1.5	N	N	15	100	30	30	N	1,500	L	50	N	N	15	N	150	200	N	20	N	200	3	1	.5	.3
99	229	407	N	N	N	50	500	2	N	N	20	150	50	20	N	2,000	L	70	10	N	15	N	150	200	N	20	L	150	5	1	.3	.5
100	230	408	N	N	N	30	700	1.5	N	N	10	70	20	50	N	500	L	30	10	N	10	N	200	150	N	15	N	150	2	.7	.3	.3
101	ACL-231	67ACx 409	N	N	N	50	500	1	N	N	20	150	50	L	N	1,500	L	70	10	N	20	N	100	300	N	20	L	150	3	1	.3	.5
102	232	410	N	N	N	30	700	1	N	N	10	150	10	30	N	500	L	30	10	N	10	N	200	150	N	20	N	300	3	.5	.3	.5
103	233	411	N	N	N	50	700	1.5	N	N	30	150	50	50	N	1,500	L	70	20	N	15	N	200	300	N	20	N	200	3	1	.5	.5
104	234	412	N	N	N	50	700	1.5	N	N	10	70	20	20	N	500	L	30	10	N	10	N	200	150	N	15	N	150	2	.7	.5	.3
105	235	413	N	N	N	50	700	1	N	N	20	150	70	20	N	700	10	70	L	N	20	N	150	300	N	30	L	200	5	1	.2	.5
106	236	414	N	N	N	30	500	1	N	N	20	150	50	20	N	1,000	L	70	10	N	20	N	200	300	N	20	L	300	5	1.5	.7	.7
107	237	415	N	N	N	70	500	2	N	N	30	150	70	20	N	2,000	L	50	30	N	15	N	150	200	N	20	L	200	3	1	.3	.5
108	238	416	N	N	N	50	700	1.5	N	N	20	150	70	70	N	1,500	L	70	30	N	20	N	300	300	N	30	L	200	5	1	.7	.5
109	239	417	N	N	N	30	700	1.5	N	N	20	150	50	L	N	1,500	L	70	20	N	20	N	200	200	N	20	L	150	5	1	.7	.5
110	240	418	N	N	N	50	700	1.5	N	N	15	150	50	20	N	1,000	L	70	10	N	20	N	200	200	N	20	L	200	5	1	.5	.5
111	ACL-242	420	L	N	N	50	500	1.5	N	N	20	150	70	30	N	1500	L	70	20	N	20	N	200	300	N	30	L	200	5	1.5	.5	.5
112	243	421	N	N	N	50	700	2	N	N	15	150	70	L	N	1,500	L	50	30	N	20	N	200	300	N	20	N	200	5	1.5	.7	.5
113	244	422	N	N	N	50	700	1.5	N	N	20	150	70	30	N	1,000	L	70	15	N	15	N	200	300	N	50	L	150	5	1.5	.5	.5
114	245	423	N	N	N	50	500	1	N	N	20	150	70	20	N	700	L	70	30	N	15	N	200	300	N	20	N	200	5	1	.7	.5
115	246	424	N	N	N	50	500	1	N	N	30	150	50	30	N	700	10	70	10	N	15	N	150	200	N	20	N	300	5	1	.5	.5
116	247	425	N	N	N	30	500	1	N	N	20	150	50	70	N	1,000	L	70	10	N	15	N	150	300	N	20	L	200	5	1.5	.3	.5
117	250	428	N	N	N	50	500	1.5	N	N	20	150	50	30	N	1,000	L	70	15	N	15	N	150	200	N	30	N	150	3	1	.5	.5
118	251	429	N	N	.09	70	700	2	N	N	20	150	100	30	N	1,500	L	70	10	N	20	N	150	300	N	30	L	200	5	1.5	.5	.5
119	252	430	N	N	N	70	700	2	N	N	30	150	70	50	N	2,000	L	100	10	N	20	N	150	500	N	30	L	200	5	1.5	.3	.5
Limits of determination			.5	200	.02	10	5	1	10	20	5	5	5	20	5	10	10	2	10	100	5	10	50	10	50	10	200	20	.05	.02	.05	.001

[1] Atomic absorption

(Sample locations shown on Figures 4 and 5)

Table 10.--Analysis of stream-sediment samples, Yentna district, Alaska--Continued

Analysts: Gold, by atomic **absorption, A. L. Meier**, R. L. Miller, T. A. Roemer; spectrographic, **Arnold Farley**, Jr., R. H. Heidel, **E. E. Martinez;**

Analyses, unless **noted**, **are semiquantitative spectrographic** and are reported in the series 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, 1.5, and so on, or by the following symbols: N = not detected, L = detected but below limit of determination.

No.	Lab. No.	Field No.	Ag	As	Au[1/]	B	Ba	Be	Bi	Cd	Co	Cr	Cu	La	Mo	Mn	Nb	Ni	Pb	Sb	Sc	Sn	Sr	V	W	Y	Zn	Zr	Fe	Mg	Ca	Ti
			Parts per million																										Percent			
120	ACL 253	67ACK431	N	N	N	20	500	1.5	N	N	15	70	50	20	N	1,000	N	30	20	N	10	N	300	150	N	20	N	150	2	.7	.7	.3
121	254	432	.7	N	N	30	500	2	N	N	15	100	70	20	N	1,500	N	30	30	N	15	N	300	200	N	20	N	150	3	1	1	.5
122	ACL 039	67AMx301	N	N		50	700	1	N	N	10	150	70	20	N	700	10	70	20	N	15	N	200	100	N	30	N	150	5	.7	.2	.5
123	ACL 040	67AMx306	N	N		50	1,000	1	N	N	10	150	70	20	N	1500	L	70	20	N	20	N	300	150	N	30	N	150	7	1	.2	.5
Limits of determination			.5	200	.02	10	5	1	10	20	5	5	5	20	5	10	10	2	10	100	5	10	50	10	50	10	200	20	.05	.02	.05	.001

1/ Atomic absorption

(Sample locations shown on Figures 4 and 5)

The country rock is argillite-graywacke cut by a series of felsite porphyry dikes which strike about N. 40° E. and dip at 35°-40° NW. The mineralization is associated with these dikes.

The potentially economic minerals are scheelite and free gold which are in quartz-arsenopyrite veins and veinlets of two types. The most abundant type are ladder veins which cut the felsite dikes at a high angle; a less abundant type are veins parallel to the dikes, commonly at either the hanging- or footwall- dike contacts. Fractures host to the ladder veins extend into the country rock for short distances but are only open and mineralized in the dikes. Most of the ladder veins range from 1/2 inch to 3 inches thick and are separated by 1 to 3 feet of dike material which is itself cut by even smaller quartzose or limonitic stringers.

Although no scheelite was seen under ultraviolet light in random vein materials collected at the prospect, spectrographic analyses, made by D. J. Grimes, showed distinctly anomalous amounts of tungsten in four of five samples (table 9). The same analyses also give strong evidence of the particulate nature of gold in the veins. Mr. Grimes detected about 220 ppm gold or 6 oz/ton in a first spectrographic analyses of sample ; but only about 30 ppm or slightly less than 1 oz/ton on a second split of the sample. The same sample showed only 5.6 ppm Au by atomic absorption, and the sample highest in Au by atomic absorption (28.0 ppm) showed slightly less than 10 ppm Au by spectrograph. All samples (table 9) were determined to be slightly auriferous by atomic absorption, and it seems clear that the ladder and "parallel" type veins are probably generally auriferous at the prospect. The samples collected were all of individual veins or veinlets in the dike system. It would be of scientific value, at least, to obtain large samples of dikes and wall rocks at the prospect.

Two old hand-dug water ditches end at the tributary below the prospect, indicating this small drainage was sluiced and probably was productive.

Upper Nugget Creek prospect

The Upper Nugget Creek prospect is in the SW 1/4, sec. 33, T. 29° N., R. 9° W., as shown on the U.S. Geological Survey Talkeetna (C-2) quadrangle. Work on the prospect consists of: (1) two short adits driven subparallel to white quartz veins and cleavage in argillite-graywacke country rock, and (2) a shallow prospect pit, also in argillite; both adits and the prospect pit are near a roughly circular plug of felsite porphyry 200 feet across. The porphyry is cut by very sparsely distributed quartz veins on joint surfaces.

Little evidence of mineralization was found. A 1/8-inch to 2-inch quartz-arsenopyrite vein at the contact of the plug (B1, fig. 6B, table 9) showed 0.20 ppm Au and a sample of the porphyry showed even less (.04 ppm Au, table 9, no. 229). According to Roy Gatz (oral commun., 1967) gold also occurred very sparsely on joint surfaces of the rocks.

Colby prospect

A 4-foot wide felsite porphyry dike, locally auriferous, is exposed on the ridge between Nugget and Bird Creeks, in the SE 1/4, sec. 28, T. 29° N., R. 9° W. A location notice nearby, which is probably at least 30 years old, calls this the Colby No. 5. From the crest of the ridge the dikes trend about S. 50° W. as exposed in four shallow pits, and N. 35° E. where exposed in one very small pit.

Arsenopyrite is disseminated in the dike. A quartz vein composed of layered dike rock fragments in massive and locally euhedral quartz is at the margin of the dike. The quartz vein has a weak goethite stain. Small euhedral arsenopyrite crystals are concentrated near the margins of the dike fragments and disseminated throughout the quartz matrix. Approximately 5 percent of the vein formed by open-space filling.

Thin-section study shows the vein to be composed of 90 percent quartz with muscovite, arsenopyrite, pitticite, and minor zircon and sericite making up the remainder of the rock.

Fragments of the dike are composed of equal amounts of quartz and muscovite. Sutured borders and undulatory extinction of quartz suggest cataclasis. Muscovite is most concentrated near the borders of the fragments. The larger fragments commonly have concentrations of arsenopyrite near their borders. The small fragments are almost completely replaced by arsenopyrite and probably acted as loci for arsenopyrite accumulation.

Quartz of the groundmass ranges from fine grained to coarse grained and is euhedral and unstrained. The lack of evidence of cataclasis in groundmass quartz indicates that the dike was sheared prior to or during the emplacement of the quartz and arsenopyrite. Much of the euhedral groundmass quartz is surrounded by pitticite which is clearly the latest mineral to form.

Semiquantitative spectrographic analysis (by E. E. Martinez) of a grab sample of the arsenopyrite-bearing porphyry showed about 0.80 ppm Au and the following anomalous amounts of other metals:

Ag	As	Ba	Pb	W	Zr
.5	5,000	1,500	10	50	150

A sample of quartz vein material, typical of those found in the argillite-graywacke country rock 200 feet to the northeast, showed a trace amount of gold (.02 ppm), but no significant amount of other metallic elements.

Stream sediment geochemical anomalies

Geochemical stream-sediment sampling in the Yentna district revealed two areas with anomalous values for gold and other metals, Bunco Creek and near Mount Goldie area (figs. 4 and 5).

Bunco Creek area

The Bunco Creek anomaly is in secs. 25, 26, 27, 34, 35, and 36, T. 29° N., R. 8° W., and secs. 1, 2, and 3, T. 28° N., R. 8° W. Bunco Creek and its tributaries drain this area of the southeastern part of the Peters Hills (fig. 4).

Anomalous gold values, ranging from .02 to .5 ppm, were found in five of the nine samples taken in the area (fig. 4). Anomalous concentrations of Cu and Zn were also found in samples 91, 92, and 118 (table 10). Spectrographic analyses, of 30 elements, are given for all samples collected in table 10.

Bunco Creek and its tributaries head in the Peters Hills, which are composed of interbedded quartzites, siltites, and argillites that are cut by numerous faults (fig. 2). The anomalous gold values are associated with a white quartz conglomerate. The white quartz conglomerate occurs at the contact between the metasedimentary country rock and the Kenai Formation. It is composed of angular to subrounded quartz fragments in a matrix of fine cataclastic quartz and clay. The composition and appearance of the white quartz conglomerate are identical to those of the white quartz conglomerate which forms the main paystreak in the Yentna district.

The white quartz conglomerate, with associated high gold values, indicates placer potential in the Bunco Creek drainage. Placer potential and the fact that there is a good flow of water in Bunco Creek drainage year round makes it extremely favorable for prospecting.

Mount Goldie anomaly

The Mount Goldie anomaly is located in secs. 31 and 32, T. 31° N., R. 8° W., and secs. 7 and 8, T. 30° N., R. 8° W. Six stream-sediment samples were taken in the area and two showed anomalous gold values of .2 ppm and .3 ppm, respectively (fig. 4). Anomalous concentrations of As, Ag, Be, Cu, Cr, Nb, Pb, Sn, Zn, and Co were also found locally (fig. 5). Complete spectrographic analyses for 30 elements are given in table 9.

The area of the Mount Goldie anomaly is underlain by quartzites, siltites, and argillites. Auriferous quartz veins cut the bedrock, as at the Rocky Cummins prospect (see page 40), and are known to have a lateral extent of over 700 feet.

The high gold values and other anomalous metal values suggest that the Mount Goldie area should be examined in detail for extensions of known veins and for new lode sources of gold.

Conclusions and recommendations

The present study suggests a potential for new additional placer deposits and small lode mine operations in the Yentna district. No indications of large areas of mineralization were found.

The auriferous white quartz conglomerate in the Bunco Creek area should be investigated by detailed sampling to determine its true potential as a placer deposit.

Detailed mapping and sampling of the Mount Goldie area should be undertaken to determine: (1) the size and extent of mineralization near the Rocky Cummins prospect, and (2) the location of other possible mineralized zones in the same area which are responsible for the geochemical anomalies north and south of the Rocky Cummins prospect.

The proposed fault control of auriferous white quartz conglomerates should be investigated by shallow drilling or trenching on trend with known placers and faults.

Of particular significance is the silica-carbonate dike rock found in the William Creek area (67AHx300d). This rock is significant as an altered mafic or ultramafic rock. Platinum has been recorded rather widely in the district, but previously no possible source rocks have been identified. The association of platinum and mafic to ultramafic rocks is very common and, therefore, similar rocks in the Yentna district may have furnished platinum to the placer deposits. Such rocks may be hard to distinguish in the field because they are likely to be strongly altered. Dike rocks with a strong greenish cast are, however, to be suspected of a mafic parentage. Such rocks should be searched for in areas of platinum producing placers as potential lode sources of platinum.

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