IC 9123

Bureau of Mines Information Circular/1986

Placer Gold Deposits of the Eagle Trough, Upper Yukon River Region, Alaska

By James C. Barker

UNITED STATES DEPARTMENT OF THE INTERIOR

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Library of Congress Cataloging-in-Publication Data

Barker, James C.
Placer gold deposits of the Eagle Trough, upper Yukon River region, Alaska.

(Information circular/United States Department of the Interior, Bureau of Mines ; 9123)

Bibliography: p.

Supt. of Docs. no.: I 28.27:

1. Gold mines and mining—Yukon River Watershed (Yukon and Alaska) 2. Placer deposits—Yukon River Watershed (Yukon and Alaska) I. Title. II. Series: Information circular (United States. Bureau of Mines) ; 9123.

TN295.U4 [TN423.A7] 622 s [553.4'1'097984] 86-600295

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UNITS OF MEASURE ABBREVIATIONS USED IN THIS REPORT

ft	foot	ppm	part per million
ft^2	square foot	tr oz	troy ounce
g	gram	tr oz/st	troy ounce per short ton
in	inch	tr oz/yr	troy ounce per year
lb	pound	yd	yard
mg	milligram	yd^3	cubic yard
mi^2	square mile	yr	year

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PLACER GOLD DEPOSITS OF THE EAGLE TROUGH, UPPER YUKON RIVER REGION, ALASKA

By James C. Barker[1]

ABSTRACT

Gold placer deposits along the upper Yukon River, in the region between the river villages of Circle and Eagle, were investigated by the Bureau of Mines. The investigation was conducted intermittently between 1976 and 1985 as part of an evaluation of mineral resources on lands proposed for inclusion in the National Park System. At least 230,000 troy ounces (tr oz) of gold has been produced in the region, principally from Woodchopper, Coal, and Fourth of July Creeks.

The placers are underlain by, or occur downstream of, early Tertiary sediments that have been deposited in the Eagle Trough. Strike-slip displacement along the Tintina Fault is responsible for creation of the trough and may have been a factor in the formation of the present placers. Placers were found to have a close spatial correlation to certain altered fault lineaments of the Tintina Fault trench. Placer concentrates contain several different textural forms of gold, suggesting multiple origins.

Geological studies and a survey of 162 panned concentrates throughout the region indicated previously unreported sites of placer gold, and potential exists for the discovery of additional placer and lode gold. Because of nearly continuous soil and vegetation cover, further evaluation of the region will require subsurface sampling.

[1]Supervisory physical scientist, Alaska Field Operations Center, Fairbanks, AK.

INTRODUCTION

The Bureau conducted field studies on portions of the upper Yukon River drainage (fig. 1) intermittently between 1976 and 1981. Because of inclusion of the Eagle Trough area into the National Park System under the authority of the Alaska Native Claims Settlement Act (Public Law 92-203), and the need for minerals information on adjoining land managed by the Bureau of Land Management in the Steese and White Mountains areas, data gathering, analysis, and mineral resource evaluation continued through 1985.

Most of the approximately 230,000 tr oz of placer gold production from the upper Yukon River region (fig. 2) was produced prior to 1950. The most comprehensive published accounts of placer mining in the region are those by Mertie in 1937, 1938, and 1942 (*11-13*).[2] Other investigators who have contributed observations and data on these placer deposits include Brooks (*5*), Prindle (*17*), and Smith (*19*).

Reconnaissance-level geologic mapping was first compiled by Mertie (*12-13*). More recent work by Payne (*15*), Tempelman-Kluit (*21*), and Brabb (*4*) has contributed to the knowledge of geology in the area.

Previous work in the region by Sainsbury (*18*), suggesting possible associations of the placer gold to bedrock sources, partially led to this study. The work by Sainsbury raised fundamental questions regarding the previous assumption that placer gold in the region is derived from low-grade auriferous Tertiary gravels. Sainsbury compiled an unpublished manuscript in 1972 (*18*) that dealt in part with the area of interest. His conclusions, coupled with the evidence compiled by the Bureau, indicate that new exploration targets for gold exist which to date have not been tested.

The upper Yukon River region is an area of complex geology and nearly continuous vegetative and soil cover. This report presents observations and data pertaining to the distribution of gold in the region and a discussion of the potential host and geologic controls for yet undiscovered deposits of both lode and placer gold. In an area such as the upper Yukon River region, this type of subjective evaluation is one way a reconnaissance-level study with limited funding can provide an estimate of mineral development potential for the purpose of land-use planning.

ACKNOWLEDGMENTS

The author would like to acknowledge the helpful information and hospitality provided by Mr. Del Booth, manager of the Coal Creek placer operation, a tributary of the upper Yukon River, who made possible the investigation there. Similarly, Mr. Joe Volger, a local mine owner, provided access to the nearby Woodchopper Creek drainage. Suggestions and advice were also provided by C. Sainsbury, geologist, Air Samplex, Inc., Denver, CO. X-ray diffraction and petrographic studies were contributed by T. Mowatt and W. Roberts, geologists, and W. Gnagy, petrologist, all formerly with the Bureau's analytical laboratory in Juneau, AK.

ACCESS

The upper Yukon River region is most accessible near the Yukon River, which is navigable by moderate-size barges. Light river craft can also ascend the Charley River to the vicinity of Drayham Creek. Elsewhere, the region is typified by dense brush and forest cover, which makes overland travel exceedingly difficult. Helicopter service, available at Circle, AK, was utilized where river access was impractical.

LAND STATUS AND OWNERSHIP

The upper Yukon River region (fig. 1) is included within the Yukon-Charley Rivers National Park and is administered by the National Park Service from its headquarters in Eagle, AK. The park was established by passage of the Alaska National Interest Land Conservation Act of 1980 and is withdrawn from mineral exploration and entry under the Mining Law of 1872. Previously existing mineral rights are still valid on the principal gold placer creeks, and a mineral patent has been issued within the valley of Woodchopper Creek.

PHYSIOGRAPHIC FEATURES

Much of the topography along the upper Yukon River consists of low, rounded, forested hills. Elevations range from 900 ft along the river to hilltops at about 3,000 ft. However, in the area to the south (referred to later in this report as the Tanana Uplands crystalline terrane), the topography is much more rugged, with elevations ranging up to 5,784 ft (the elevation of Twin Mountain).

[2]Italic numbers in parentheses refer to items in the list of references preceding the appendixes at the end of this report.

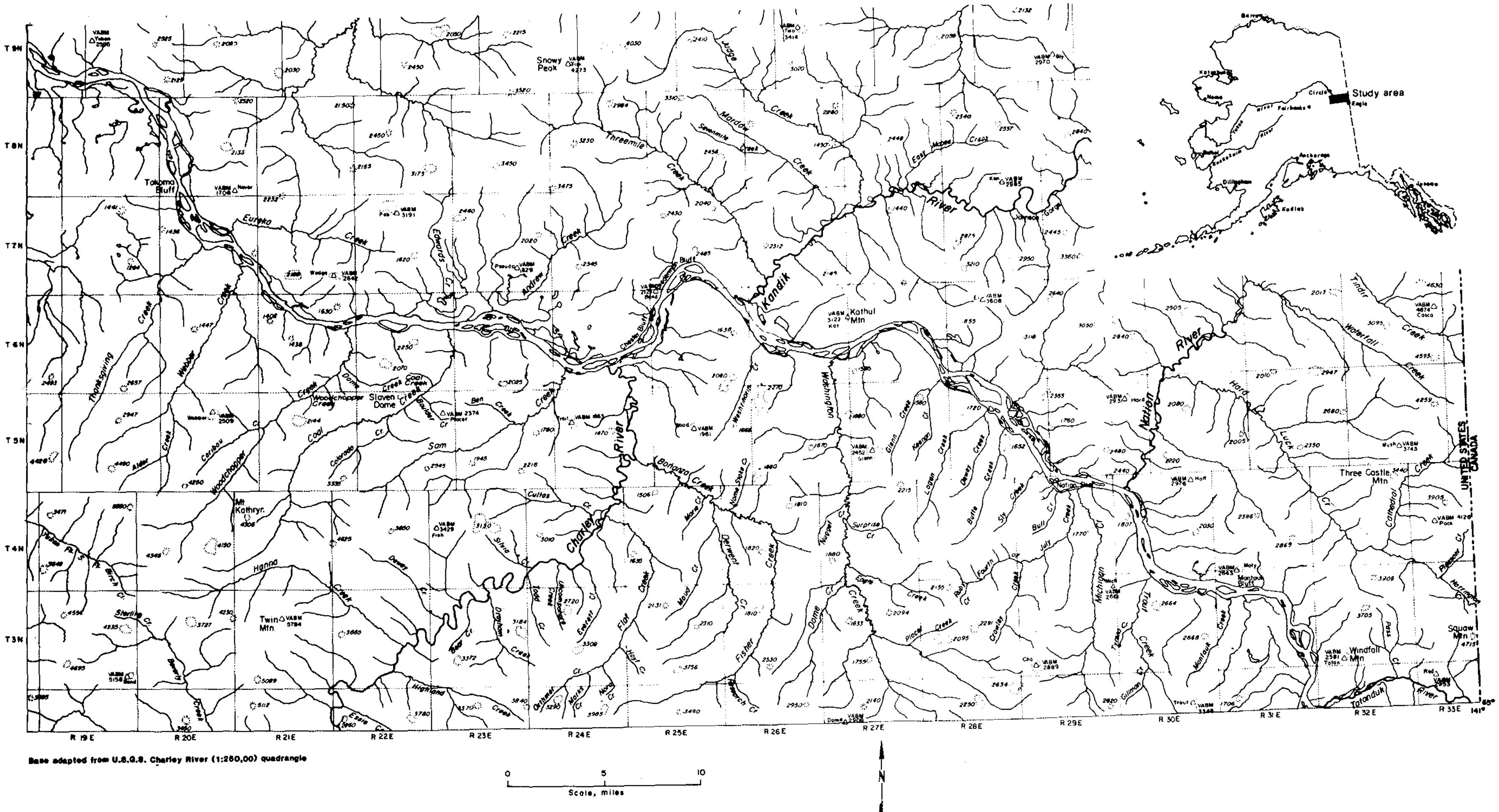


FIGURE 1.—Map of study area.

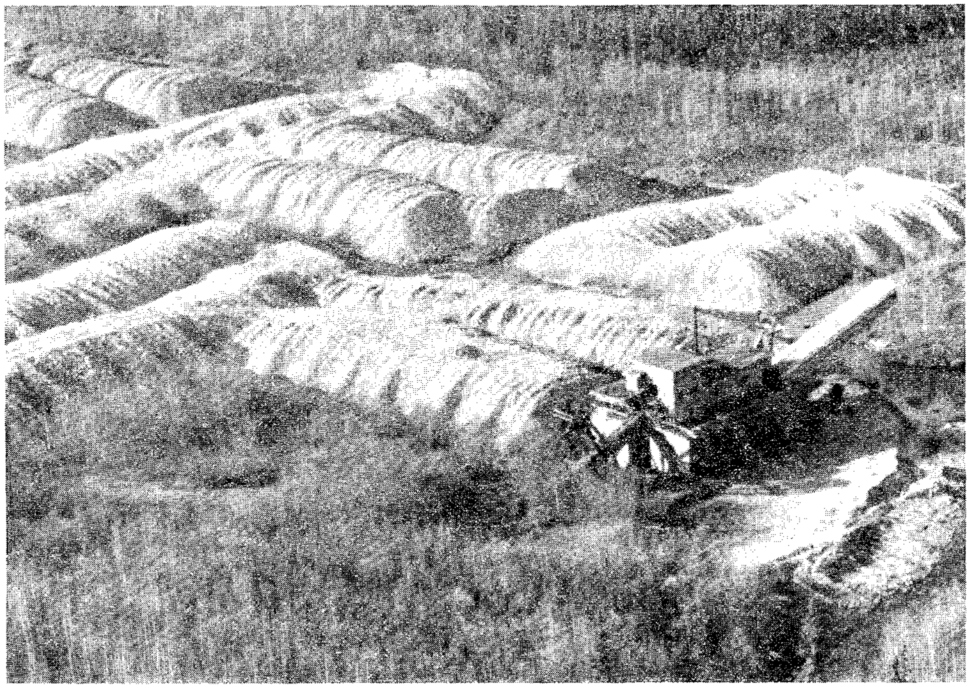


FIGURE 2.—Dredge on Woodchopper Creek.

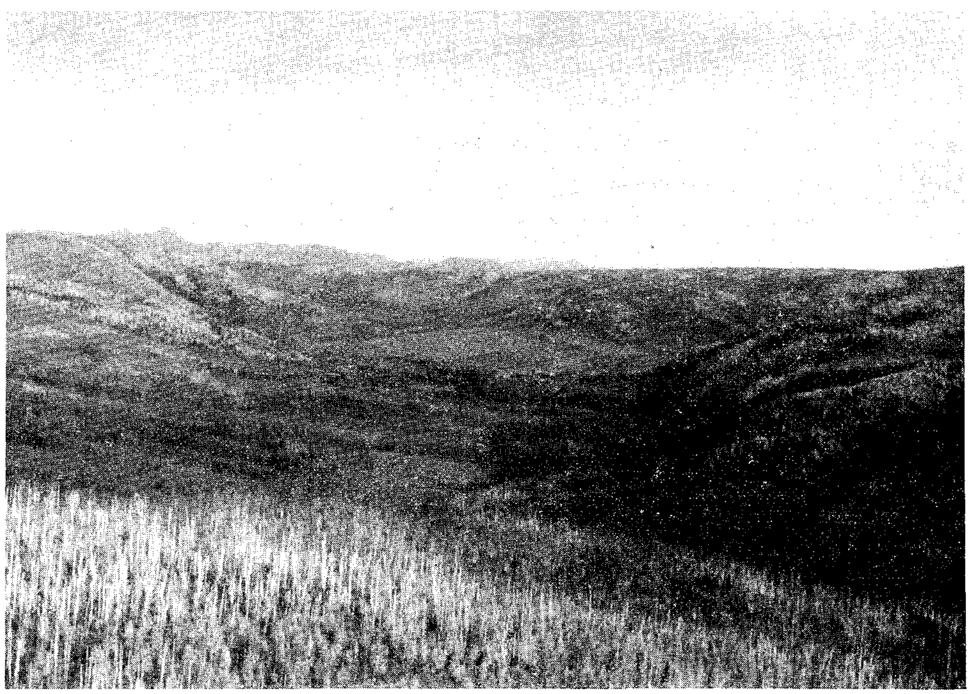


FIGURE 3.—Rolling forested terrain of upper Woodchopper Creek. Bedrock is Tertiary-age sediments. Mountains of Tanana Upland crystalline terrane are in background.

Some limited Pleistocene glaciation was reported by Péwé (*16*) to have occurred at the higher elevations; however, no glaciers are present. Elevations exceeding 4,000 ft are believed to have supported early Pleistocene valley glaciers and small icecaps (*24*). Auriferous gravels occur at elevations between 900 and 1,800 ft. No evidence was seen during this study to indicate glacial influence on the formation or preservation of placer deposits in the area.

Below 3,000 ft, very little bedrock outcrops, except along the major rivers. Smaller streams often lack float rock and have poorly defined channels choked with muskeg and vegetation, especially in areas underlain by Tertiary mudstone. Bedrock in the upper Yukon River region is further masked by discontinuous permafrost soils. Most placer mining has encountered permafrost. Early mining ventures consisted of drift mining in frozen ground. Dense vegetation, tundra and muskeg ground mat, and wind-blown loess cover bedrock at all lower elevation levels (fig. 3).

High bench deposits of alluvial and glaciofluvial gravels typically mantle the slopes above some stream valleys, indicating relatively recent but undated regional uplift. The Yukon River once flowed through a wide, gently inclined valley, into which it has now incised a canyon 700 to 800 ft below its former channels (*13*).

GEOLOGY

GEOLOGICAL TERRANES

There are four major geological terranes underlying or adjoining the upper Yukon River region (fig. 4). Lying north of the Tintina Fault trench are stratigraphic sequences of mostly marine Paleozoic and Precambrian age sedimentary rocks (including the Tindir Group), with minor mafic volcanics and associated red beds. These rocks have been recently included with the Yukon tectonostratigraphic terrane by Jones (*10*). East of the Kandik River, these rocks have been exposed by uplift that began in the early Tertiary and resulted in the formation of the Nation Arch, as described by Miller (*14*).

Overlying the older rocks of the Yukon terrane is a remnant succession of Triassic to Cretaceous clastic sediments. These rocks have been mapped as a terrane of deformed upper Mesozoic flysch (*10*) and lie in a wide trough that roughly parallels the Kandik River valley. This unit is also referred to as the Kandik Group by Brabb (*4*) and generally consists of a monotonous sequence of sandstone, graywacke, quartzite, and argillite that is underlain by a carbonaceous shale.

South of the Tintina Fault trench are metasedimentary and igneous rocks of the Tanana Uplands crystalline terrane. Phyllites, quartz-mica schist, quartzites, and gneisses are intruded by undated granitic rocks and pegmatites. The intrusions are probably Mesozoic in age, based on similarities to the Circle Hot Springs quartz monzonite pluton to the west, which was dated at 71 million yr by potassium-argon mica and whole-rock, and rubidium-strontium whole-rock methods (*22*). Some units of metamorphosed greenstones and serpentinized mafic and ultramafic complexes of the 70-mile mafic terrane, as defined by Jones (*10*), are also included in the Tanana Uplands crystalline terrane, but are not differentiated on figure 4.

The fourth and youngest terrane shown on figure 4 is composed of Late Cretaceous (?) to early Tertiary age nonmarine, coal-bearing sediments that lie in the Eagle Trough and align with the Tintina Fault trench.

GEOLOGY OF TERTIARY SEDIMENTS

A sequence of conglomerate, sandstone, mudstone, lignite, and carbonaceous sediments extends in a west-northwest trend up to 15 miles wide (fig. 4). The Tertiary sediments lie in the Eagle Trough as described by Miller (*14*) and are reported by Brabb (*4*) to be 3,000 to 10,000 ft thick. They are generally characterized by a subdued topography and complexly faulted and folded structure due to the proximity of the Tintina Fault.

The conglomerates are generally composed of well-rounded white, green, and rarer black chert, quartz, and quartzite clasts in a sandy matrix with minor carbonate (identified as ankerite on Sam Creek). Clasts rarely exceed 3 in across. Induration varies widely from resistant, cliff-forming units on Washington and Sam Creeks, to more common weakly cemented gravel found elsewhere.

Within the Tertiary section are local units of poorly sorted and consolidated conglomerate that contain subrounded clasts up to 16 in. in diameter. Unlike the more common well-rounded chert congolmerates, these local units contain clasts of high-grade metamorphic rocks, intrusive rocks, vein quartz, and arkosic sandstone. The age of this limited, higher energy sedimentation is unknown, althought it is likely older than the lower energy environment that produced stratified, well-rounded and sorted sediments. Southeast of the study area, in the vicinity of Eagle, Mertie (*13*) reports conglomerate with similar high-grade metamorphic and igneous clasts at the base of the Tertiary section. This is also apparently the case on Iron Creek, a tributary to Woodchopper Creek, but not on Coal and Boulder Creeks. On Washington Creek, the local higher energy conglomerate appears to lie above mudstone and lignite. The contrasting compositions of the two conglomerate units indicates that multiple sources of detritus filled the Eagle Trough. These sources included the Paleozoic and Precambrian terrane to the north, during the development of the early Tertiary Nation Arch, and the Tanana Uplands crystalline terrane to the south (fig. 4).

During Quaternary time, there was up to 900 ft of downcutting by the Yukon River, and its tributaries and the Tertiary sediments are deeply incised. North of the Tintina Fault trench at localities on upper Washington, Ben, and Surprise Creeks, erosion and dip-slip or thrust faulting have exposed older rock that correlates to the Paleozoic and Precambrian marine sediments. A Cambrian age is tentatively assigned to the pre-Tertiary rocks due to *Oldhamia* fossils found in olive-green argillite and quartzite near Washington Creek (fig. 4). Tentative identification of the fossils as *Oldhamia* was made by Allison (*1*). The occurrence is comparable to *Oldhamia* reported elsewhere along the

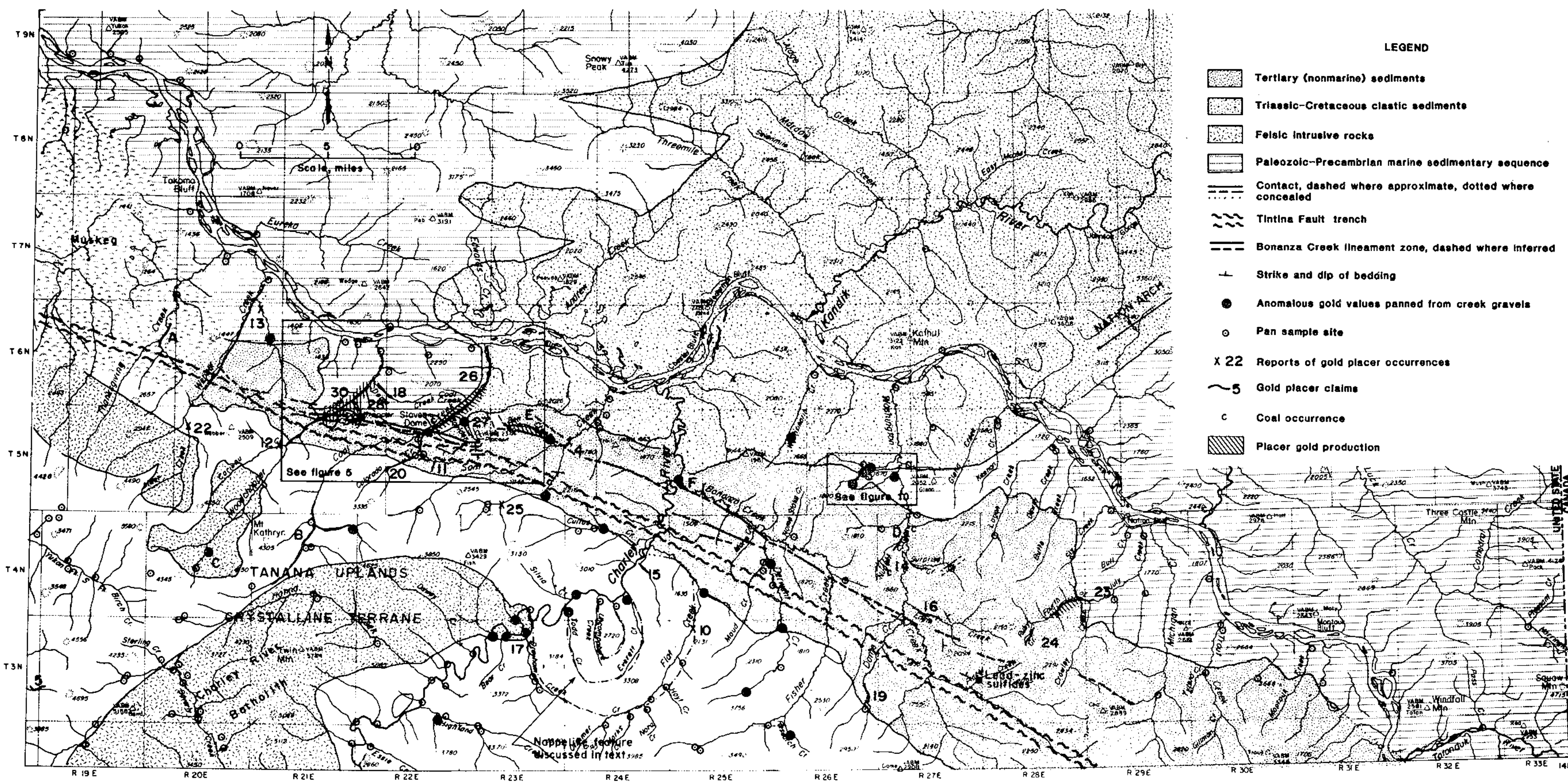


FIGURE 4.—Study area geology and gold occurrences.

Tintina Fault zone, as reported by Churkin (*6*). Rock resembling Precambrian Tindir volcanics was found protruding through the Tertiary section on Surprise Creek, and Paleozoic conglomerate occurs south of Boulder Creek. South of the Tintina Fault trench, the Tertiary rocks appear to disconformably overlie crystalline terrane. Exposures, however, are poor.

TINTINA FAULT TRENCH

The Tertiary strata overlie and are transected by the Tintina Fault trench. This trench, at least 600 miles long, is a major regional, structural, and topographic feature in northwestern Canada and eastern Alaska. Elongated basins, one of which is the Eagle Trough, occur discontinuously along the length of the trench. Davies (*7*) estimated the fault trench to have 200 to 260 miles of right-lateral displacement. More recent estimates by Templeman-Kluit (*20-21*) have been slightly greater. Studies within the Canadian portion of the trench suggest displacement along subparallel interconnected faults rather than along a single fault plane (*9*, p. 2). The trench, where it transects the Eagle Trough, appears similarly complex with multiple faults, as exhibited on Coal Creek (fig. 5). Faults and other lineaments comprising the Tintina Fault trench within the Eagle Trough occur across a width of at least 5 to 10 miles. One of these lineaments is discussed in this report and is informally referred to as the Bonanza Creek lineament.

Although the Tintina Fault displays dominantly strike-slip offset, a minor component of dip-slip movement is locally present. The fault escarpment and prominent butte near the upper terminus of placer mine workings of Coal Creek is evidence of dip-slip displacement.

The ages of displacements on the Tintina Fault trench are poorly defined at present. Studies by U.S. and Canadian geologists (*10, 20-21*) conclude that most of the movement probably occurred in Late Cretaceous time. Dip-slip offset accompanying the strike-slip displacement resulted in elongated basins such as the Eagle Trough (*9*). These basins have been filled by coal-bearing sediments containing Late Cretaceous (?) and early Tertiary age fossils (*11-13*). Fault escarpments and highly deformed Tertiary sediments and coal seams near Coal Creek indicate an episode of post-early Tertiary displacement. Similarly, to the southeast, in the Yukon Territory, 32 miles of post-Eocene movement that deformed Tertiary coal-bearing sediments within the Tintina Fault trench has been mapped (*9, 15*). This movement was presumed to be middle or late Tertiary in age. Geomorphic evidence of late Tertiary or early Quaternary right-lateral strike-slip movement elsewhere in the study area includes the prominent arc pattern of stream valleys. This feature occurs repetitiously on Woodchopper, Coal, and Sam Creeks, and possibly on the lower Charley River. Large nappelike features, 10 miles in diameter, such as in the vicinity of Drayham Creek to Flat Creek (fig. 4), and visible in aerial photographs and on topographic maps, represent the apparent result of strike-slip movement accompanied by local thrusting and foreshortening south of the Tintina Fault.

MINERAL PRODUCTION AND HISTORY

Between 1898 and 1981, placer mines in the upper Yukon River region produced at least 229,632 tr oz Au and 20,569 tr oz Ag (the latter as a refinery byproduct). Evidence of past unreported mining on some creeks suggests that the actual production total is somewhat higher. Following World War II the district had been inactive, but gold production resumed in the mid-1970's because of the increase in the price of gold. In 1981, about 20 to 30 people were working gold placer deposits in the upper Yukon River region.

The following sections give brief descriptions of all creeks known to have produced gold or for which gold values have been reported. In these sections, comments pertaining to mining activity during the early years of this century are summarized from Mertie (*11-13*). Production data are derived from the Bureau's Minerals Availability System files. Mining claim location data are available from files of the Alaska Division of Geological and Geophysical Survey (ADGGS)[3] and map overlays prepared by the Bureau for each of Alaska's 153 quadrangles (*23*). The map location number or letter (as shown in figure 4) and ADGGS Kardex[4] system file number for each creek is given at the end of each section.

SAM CREEK

No past production has been reported, but caved shafts are evidence of past prospecting. Above the mouth of Ben Creek, a total of 14 shafts encountered only scant gold. Below Ben Creek, gold appears to be derived from a lode source in the Ben Creek drainage. Alluvial gold was also found on the east fork (sample 68, appendix A). There are seven active claims on Sam Creek. Location 4 (fig. 4); ADGGS file 11.

WILLOW CREEK

Willow Creek is a headwater tributary to the Salcha River. No production has been reported. The most recent exploration and test mining was done in 1977. Abundant garnet in the gravels has made mining difficult. The source of gold is apparently quartz veins in the metamorphic rocks. There are seven inactive claims on the creek. Location 5 (fig. 4); ADGGS file 28.

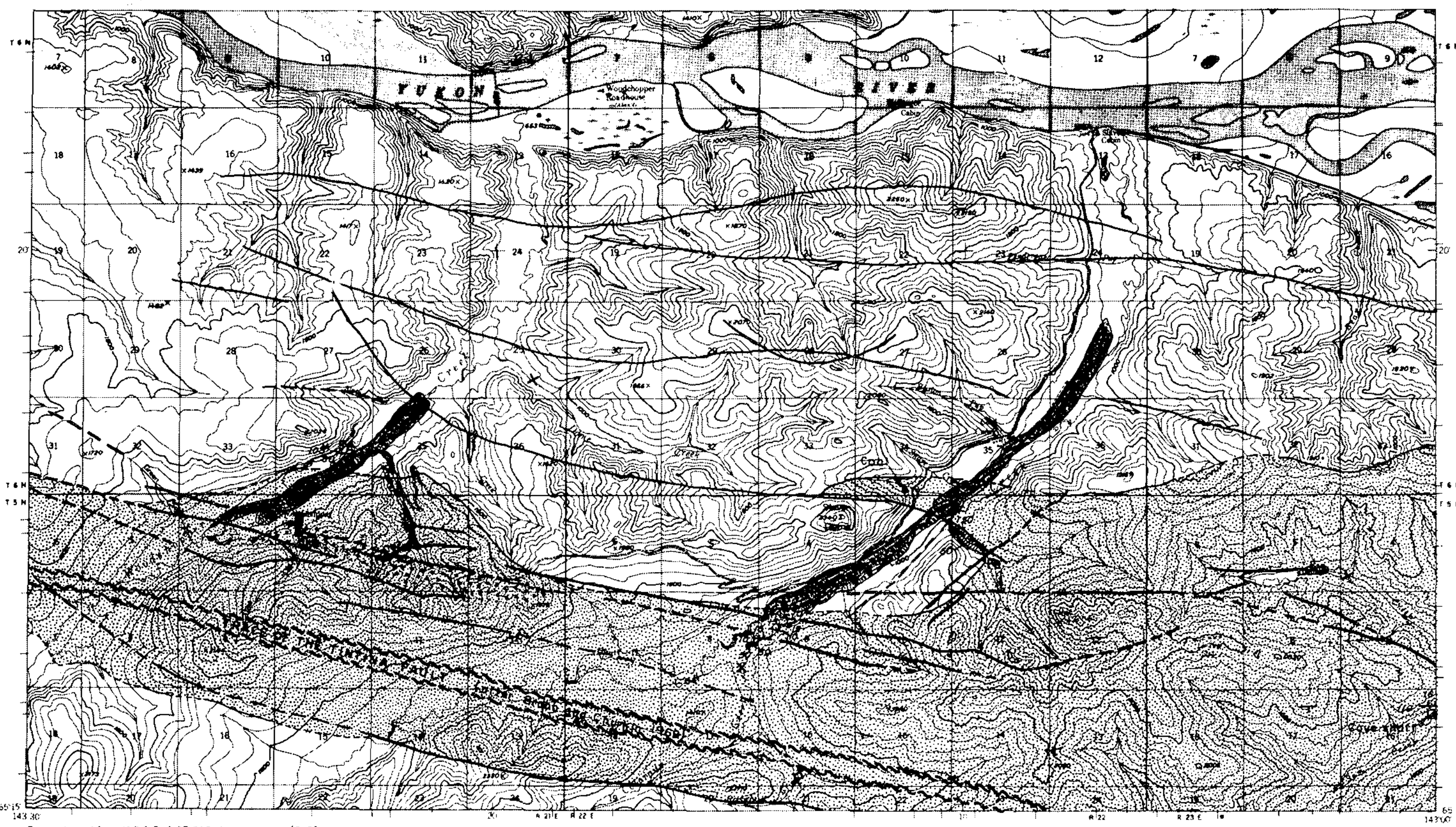
FLAT CREEK

No known production has been reported, but there are unverified past references to the occurrence of placer gold. No evidence of mining was found during this investigation, although gold was panned from the creek by Bureau investigators (fig. 4). Claim locations are inactive. Location 10 (fig. 4); ADGGS file 12.

ROSEBUD CREEK

Production has not been reported, but limited mining

[3]Public Information Office, Box 80586, Fairbanks, AK 99708.
[4]Reference to specific products does not imply endorsement by the Bureau of Mines.



Base adapted from U.S.G.S. 1:63,360 Charley River (B-5) quadrangle

0 1 2
Scale, miles
Contour interval 100 ft

LEGEND

- Tertiary: Chert-quartz pebble conglomerate: coal-bearing mudstone and sandstone
- Tertiary: Conglomerate containing subrounded schist, quartzite, quartz, and intrusive rock clasts
- Fe — Iron-stained zone
- Contact, dashed where inferred
- Bonanza Creek fault-lineament zone, dashed where inferred
- Aerial-photograph-interpreted linears or faults, dashed where inferred
- Strike and dip of bedding
- Strike and dip of joints
- Strike of vertical joints
- × Placer gold prospect
- Placer gold production

N

FIGURE 5.—Coal Creek area.

has taken place, and exploration is continuing. The gold source is unknown. Gold is generally coarse and occurs on a clay bedrock. A sample of rust-coated placer gold consisted of highly rounded shot to 1/8 in across. Analysis indicated a fineness of 807. One claim was located in 1974. Location 11 (fig. 4); ADGGS file 41.

GROUSE CREEK

The creek was reported by Brooks (*5*) to have been prospected as early as 1906 but with no known production. Bedrock is mapped as phyllite. Location 12 (fig. 4) is tentative; no ADGGS file.

WEBBER CREEK

No production has been reported, although field observations suggest some mining occurred. Limited prospecting found minor gold values (*25*). The creek drains granitic bedrock at its headwaters. Phyllites and Tertiary conglomerate outcrop further downstream. During this investigation, previously unmapped conglomerate and mudstone were found on the east fork near a location where sparse gold was panned from the streambed. There are six inactive claims on the creek. Location 13 (fig. 4); ADGGS files 5, 35, and 42-43.

SURPRISE CREEK

Gold was discovered in 1907, and intermittent mining was reported for several years. Production is unknown, and no apparent traces of the past activity remain. Bedrock is Tertiary conglomerate and Tindir volcanics. An unknown number of inactive claims have been located. Location 14 (fig. 4); ADGGS files 17b and 18a.

IRISH GULCH

Mertie (*12*) reported that gold was found in the early 1900's, but no production has been reported. Examination and panning in the lower half of the creek valley revealed no trace of gold. An unknown number of inactive claims have been located. Location 15 (fig. 4); ADGGS file 13a.

EAGLE CREEK

There are no reports of production. Gold was reported by Mertie (*12-13*) to be derived from the Tertiary conglomerate. Location 16 (fig. 4); ADGGS file 18.

DRAYHAM CREEK

Placer gold occurrences were reported by Mertie (*13*), but no production is recorded. Gold was panned from Drayham Creek and three nearby streams during this investigation (fig. 4). An unknown number of inactive claims are present. Location 17 (fig. 4); ADGGS file 13b.

DOME CREEK

Several creeks in the region are named Dome Creek. The creek discussed here is a tributary to Woodchopper Creek. Production has not been reported, but Mertie (*12-13*) reported a placer gold occurrence. The source of the gold is unknown, although Mertie suggested that the Tertiary bedrock outcrops near the head of the valley may be the proximate host. Location 18 (fig. 4); ADGGS files 1, 6-8, and 25.

DOME CREEK

Location 19 is a tributary to Washington Creek. There is no reported production, but intermittent mining occurred in the years after the turn of the century (*12-13*). An unknown number of inactive claims are present on the creek. Location 19 (fig. 4); ADGGS files 14 and 17d.

COLORADO CREEK

Reported production in 1946 was 49 tr oz Au and 1 tr oz Ag. There was also limited, small-scale mining in previous years near the mouth of the creek. Further drill testing near the mouth of the creek was in progress in 1981. A galena-bearing quartz vein has been reported (*5*) in the creekbed near the junction with Coal Creek. An unknown number of inactive claims and four active claims are present on the creek. Location 20 (fig. 4); ADGGS files 9 and 41.

ALDER CREEK

No production has been reported, but some limited mining appears to have taken place. The source of the gold is unknown; however, sulfide-bearing tactite occurs further upstream. An unknown number of inactive mining claims have been located on the creek. Location 22 (fig. 4); ADGGS file 5.

FOURTH OF JULY CREEK

Gold was discovered in 1898, and recorded production prior to 1939 was 6,624 tr oz Au and 736 tr oz Ag. No production has been reported since then. Exploration activity continued in 1978. According to Mertie (*12-13*), the paystreak is 400 to 500 ft wide and lies partially on a "clay bedrock" averaging $0.25 per bedrock foot at $35/tr oz Au. The gravel section is 6 to 15 ft thick and is overlain by 2 to 7 ft of muck. Gold has an average fineness of 892; however, fineness varies up to 912 on the east side of the creek. Nuggets up to 0.5 tr oz have been recovered, although generally the gold is of a fine-grain size.

Mertie speculated that the source of the gold is the conglomerate that underlies the creek's upper headwaters. It appears that much of the gold production has been derived from the Union Gulch area. Exposures consisting of either weathered conglomerates or weakly cemented Quaternary terrace gravel near Union Gulch contain metamorphic clasts, chert, and vein quartz, from which a few specks of gold were panned. Higher bench gravels reportedly contain some gold, but little exploration has been done. Mertie (*12-13*) cited a shaft sunk on a bench along the west side of the valley which encountered gold values similar to those in ground being worked beneath the active channel.

There are 25 claims on the creek. Location 23 (fig. 4); ADGGS files 19, 26, and 39.

RUBY CREEK

Production reported for 1926 was 5 tr oz Au and 1 tr oz Ag, although it appears that more extensive mining has taken place. The proximate source of gold is the Tertiary conglomerate (*12-13*); however, a sample of silicified Paleozoic argillite creek rubble collected during this investigation contained traces of gold. No outcrop could be viewed. There are at least two inactive claims on the creek. Location 24 (fig. 4); ADGGS files 20 and 29.

SAWYER GULCH

Production reported for 1918 was 6 tr oz Au and 2 tr oz Ag. The source of the gold is unknown. There are no known past mining claims. Location 25 (fig. 4) is tentative; no ADGGS file

COAL CREEK

Placer gold production reported through 1957 was 94,493 tr oz Au and 9,668 tr oz Ag. The creek was first mined in the early 1900's with sluices and by drift mining. In 1936, a 4-ft^3 bucket-line dredge was installed on a 400- to 900-ft-wide paystreak; it operated into the 1940's. After a number of idle years, the dredge and sluice operation was reactivated in 1976. Between 1976 and 1978, an additional 4,000 tr oz Au was produced, and 280,000 yd^3 of material was handled by a 12- to 25- person crew (*25*). In 1981, sluice box mining was in progress at a production rate of 2,000 to 4,000 tr oz/yr.

The gravel section occurs at varying depths from 5 to 18 ft and requires thawing prior to mining. Locally, the gravel contains a high percentage of clay, which complicates recovery. The source of the gold is uncertain. There is a mix of bright angular and rounded, variably manganese-coated gold. Nuggets up to 2.5 tr oz have been found. The average fineness of past production is 897 (*13*). Estimates of drilled reserves provided by the operator in 1980 indicate that the section between the lower workings and the Yukon River contains a minimum of 21,000 tr oz Au. This paystreak lies at depths to 20 ft, but generally averages between 14 to 18 ft.

Ground formerly worked may also contain considerable unrecovered gold. An additional 16,000 tr oz Au is estimated by the operator to remain adjacent to the uppermost workings, but no economic reserves have been found upstream. Some gold is also reported by the operator in the higher alluvial benches, but there has been no detailed exploration. Apparently, unrelated placer gold occurrences also occur in the upper headwaters of the creek (location B on figure 4). Nearby is evidence of limited mining and water ditch development.

Coal Creek is currently staked with 45 active claims. Locations 26 and B (fig. 4); ADGGS files 3, 10, and 40.

BOULDER CREEK

Drift mining was reported in 1935 and 1936. Production reported prior to 1951 was 334 tr oz Au and 42 tr oz Ag, although evidence of past mining suggests that these are only partial totals. Mining was undertaken in 1976 and 1977 by an open-cut dozer operation. The source of the gold appears to be within the contact area of the Tertiary bedrock and adjacent quartz stockworks in the Permian bedrock. A sample of placer gold examined by the Bureau consisted of semirounded bright flakes up to 1/8 in across with a fineness of 903. There are four active claims on the creek. Location 27 (fig. 4); ADGGS file 2.

MINERAL CREEK

Production prior to 1947 was reported (*13*) to be 660 tr oz Au and 32 tr oz Ag with a gold fineness of 925. The creek has a paystreak about 100 ft wide and reportedly was first staked in 1898. Some gold and evidence of prospecting and mining activity have also been found on a small headwater tributary known as Alice Gulch. Nuggets weighing up to 2.5 tr oz have been found. Limited mining between 1979 and 1981 was undertaken on lower Mineral Creek. Mining claims on Mineral Creek are part of the group of mining claims located in the Woodchopper Creek valley. Location 28 (fig. 4); ADGGS files 15 and 17a, same as Woodchopper Creek.

WOODCHOPPER CREEK

Woodchopper Creek was reportedly first mined in 1898. Production prior to 1963 was 117,654 tr oz Au and 9,783 tr oz Ag, with an unusually high gold fineness of 933. Bucket-line dredging began in 1937. In 1981, operations were limited to exploration and mining near the confluence of Iron Creek. The paystreak is 600 to 700 ft wide, with gravel depths of 11 to 30 ft. These gravels contain a high percentage of granitic material and clay. The gold is generally coarse. Table 1, a mineralogic analysis of a sample of dredge concentrate collected by the Bureau in 1970, notes the presence of cassiterite and wolframite. The source of the gold is primarily from the east side of the valley in the Mineral and Iron Creeks area and to some extent from the area just above the terminus of the workings. Claims are patented. Location 30 (fig. 4); ADGGS files 15 and 17a. Claims are also staked at the head of the valley (location C in figure 4), but there appears to have been no past mining.

Table 1.—Mineralogic analysis[1] of Woodchopper Creek placer concentrate, percent

Minerals:	
Arsenopyrite	Tr
Cassiterite	2.0
Feldspar	.3
Garnet	45.0
Goethite and limonite[2]	13.0
Gold and mercury	.3
Hematite	.1
Ilmenite	2.0
Platinum metals	ND
Pyrite	.4
Quartz	4.0
Rutile	3.0
Scheelite	.7
Sphene	.2
Staurolite	5.0
Wolframite	4.0
Rock fragments	19.0
Unknown manganese minerals	1.0
Total	100.0

ND Not detected. Tr Trace.
[1]Optical microscope and optical emission spectroscopic methods.
[2]Includes some garnet and rock fragments cemented by limonite.

Source: W. Gnagy, petrologist, Bureau of Mines, Juneau, AK (retired).

IRON CREEK

Production reported in 1926 was 9 tr oz Au and 1 tr oz Ag. Evidence of past activity indicates mining also occurred in more recent years. Prospecting and limited mining were undertaken from 1979 to 1981. The creek has unusually abundant ferricrete sediment, and gravels are composed of a high percentage of schist and quartz aggregate. Mining Claims on Iron Creek are part of the group of mining claims located in the Woodchopper Creek valley. Location 31 (fig. 4); ADGGS files 15 and 17a, same as Woodchopper Creek.

THANKSGIVING CREEK

There have been unverified reports of placer gold values. Six placer claims were located in 1977. Location A (fig. 4); ADGGS file 44.

NUGGET CREEK

Production prior to 1939 was 1,772 tr oz Au and 302 tr oz Ag. Brooks (*5*) suggested the proximate source of gold is quartz stockwork in black slates. An unknown number of inactive claims are present on the creek. Location D (fig. 4); ADGGS files 15, 17a.

BEN CREEK

Production reported in 1965 was 26 tr oz Au and 2 tr oz Ag, with a gold fineness of 896. Evidence of past mining activity suggests more gold was produced. Reportedly a right-limit bench deposit yielded 300 tr oz Au from a 70- by 250-ft cut, but this could not be verified. A sluice box-dozer operation was working in the 1977-79 period, but no production records are available. The proximate source of gold is reportedly the Tertiary conglomerate (*12-13*), but Cambrian(?) argillite and chlorite-altered quartzite with quartz stockwork and breccia were also found as rubble in the headwaters immediately upstream of the placer deposit. A sample of placer gold examined by the Bureau consisted of bright subangular flakes with a fineness of 908. Location E (fig. 4); no ADGGS file.

BONANZA CREEK

No production has been reported; however, there is evidence of prospect pits and possibly drift mining near the mouth of the creek. Gold could be panned in the creek gravels at this location and from a clay zone in the opposite bank of the Charley River (fig. 4). An exploratory drilling project on lower Bonanza Creek was conducted in 1936 (fig. 6). The drilling indicated gold values were present but too low in grade and too inconsistently disbursed for dredge mining at the time. Location F (fig. 4); no ADGGS file.

GOLD CONTENT IN PANNED CONCENTRATES

The feasibility of using widespread panned concentrate sampling to determine favorable areas for gold deposition has been demonstrated by Boyle (*3*) near Keno Hill, Yukon Territory, Canada, and in an orientation study by Fischer (*8*) in the Telluride District, CO. In the latter study, non-mineralized, marginally mineralized, and known producing areas were compared by analyses of concentrates. This technique was adopted in the upper Yukon River region with some refinements in sample preparation. In this investigation, samples were further concentrated by heavy-liquid separations, which thereby enhanced the detention of gold. Analytical values were then corrected to reflect the actual recovery of gold in the original quantity of gravel. Bureau investigators collected and examined 162 samples from the locations shown in figure 7.

Samples were obtained using a steel shovel to collect silty gravels from the channel center of smaller creeks or, in a few cases, from the leading edge of gravel bars on larger streams. A 14-in gold pan was filled and carefully panned until approximately 40 g of material remained. In the laboratory, the concentrated sample was air-dried and further concentrated in bromoform (sp gr 2.85). The plus 2.85-sp gr material was then sized on a 14-mesh screen, the oversize inspected for nuggets and discarded, and the undersize magnetically separated. The minus 14-mesh nonmagnetic fraction was dried and weighed. This material was not pulverized for analysis, because pulverizing could have resulted in the loss of flake gold. Instead, the entire split was taken into solution with aqua regia. Following the aqua regia digestion, gold was analyzed by an atomic absorption method, using a detection limit of 0.2 ppm.[5]

[5]Analyses performed by the Mineral Industry Research Laboratory, University of Alaska, Fairbanks, AK.

Sample splits were also analyzed for 24 elements by optical emission spectrography. These analyses are reported in a more comprehensive heavy-mineral survey of the Tanana Uplands by Barker (*2*).

To reflect the regional pattern of background levels of gold, the actual gold recovery was calculated. This calculation is possible where a standard size gravel sample and a similar procedure of concentration are used for each site. The recovery was determined by dividing the atomic absorption analysis (A), in parts per million, by 1 million and then multiplyng the quotient by the weight (W) of the nonmagnetic concentrate, in grams, times 1,000:

$$R = \frac{A}{1{,}000{,}000} \times 1{,}000W,$$

where R = recovered gold, mg/(14-in) pan,
A = analysis, ppm Au,
and W = weight of minus 14-mesh, plus 2.85-sp gr nonmagnetic concentrate, g.

The final calculated value represents the weight (in milligrams) of minus 14-mesh gold that occurred in the original pan of creek gravel. This procedure eliminates the variability in gold concentration incurred when gold is determined as a percentage of contained heavy minerals. Gold values (in parts per million) will vary disproportionally relative to the amount of biotite, zircon, garnet, pyrite, and other heavy minerals. The percentage of these minerals in the heavy-mineral nonmagnetic concentrate will differ considerably from one site to another, particularly in a metamorphic-igneous terrane, and consequently often mask true background levels of gold. Normally, higher concentrations of gold are encountered at depth in alluvial gravels

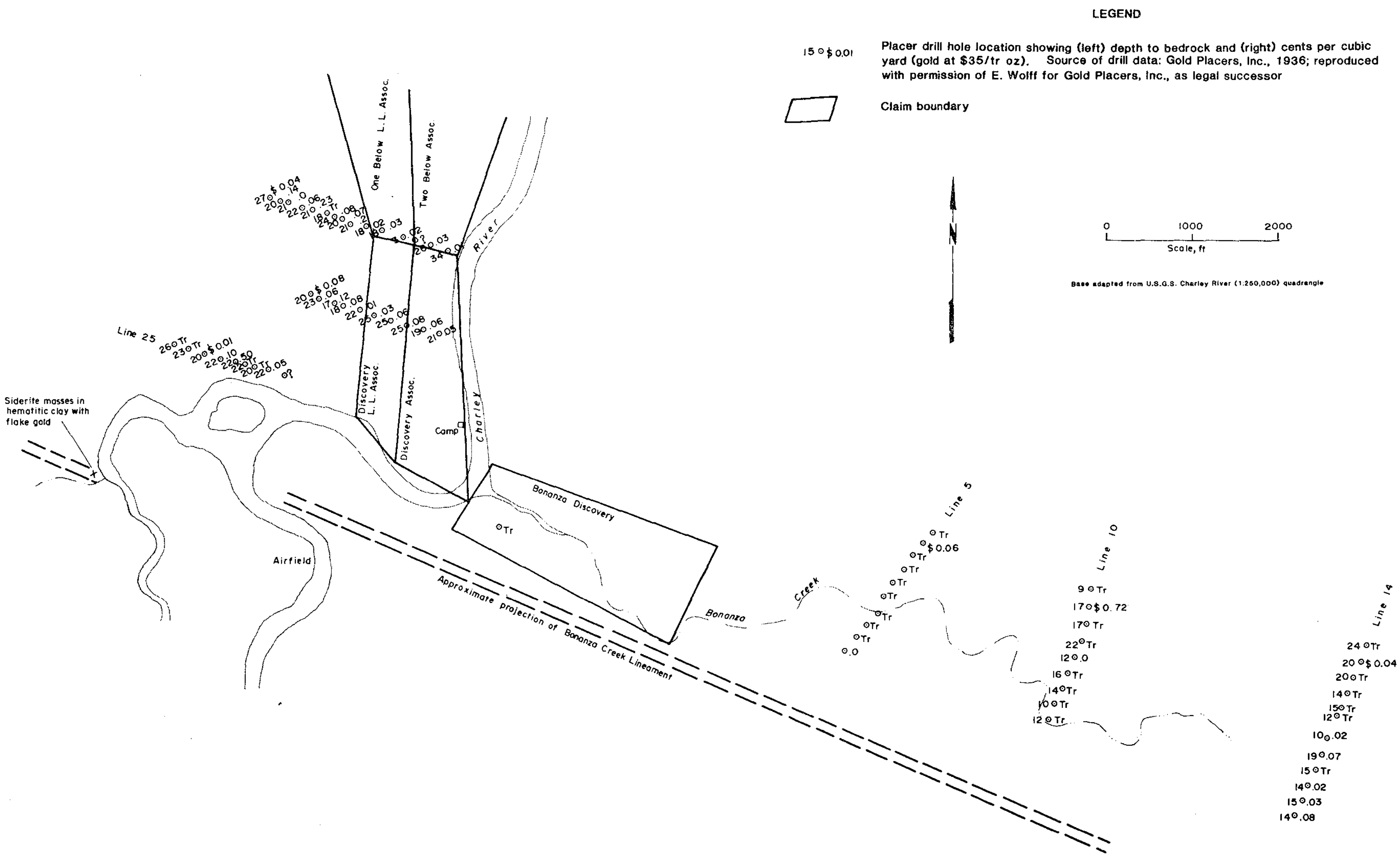
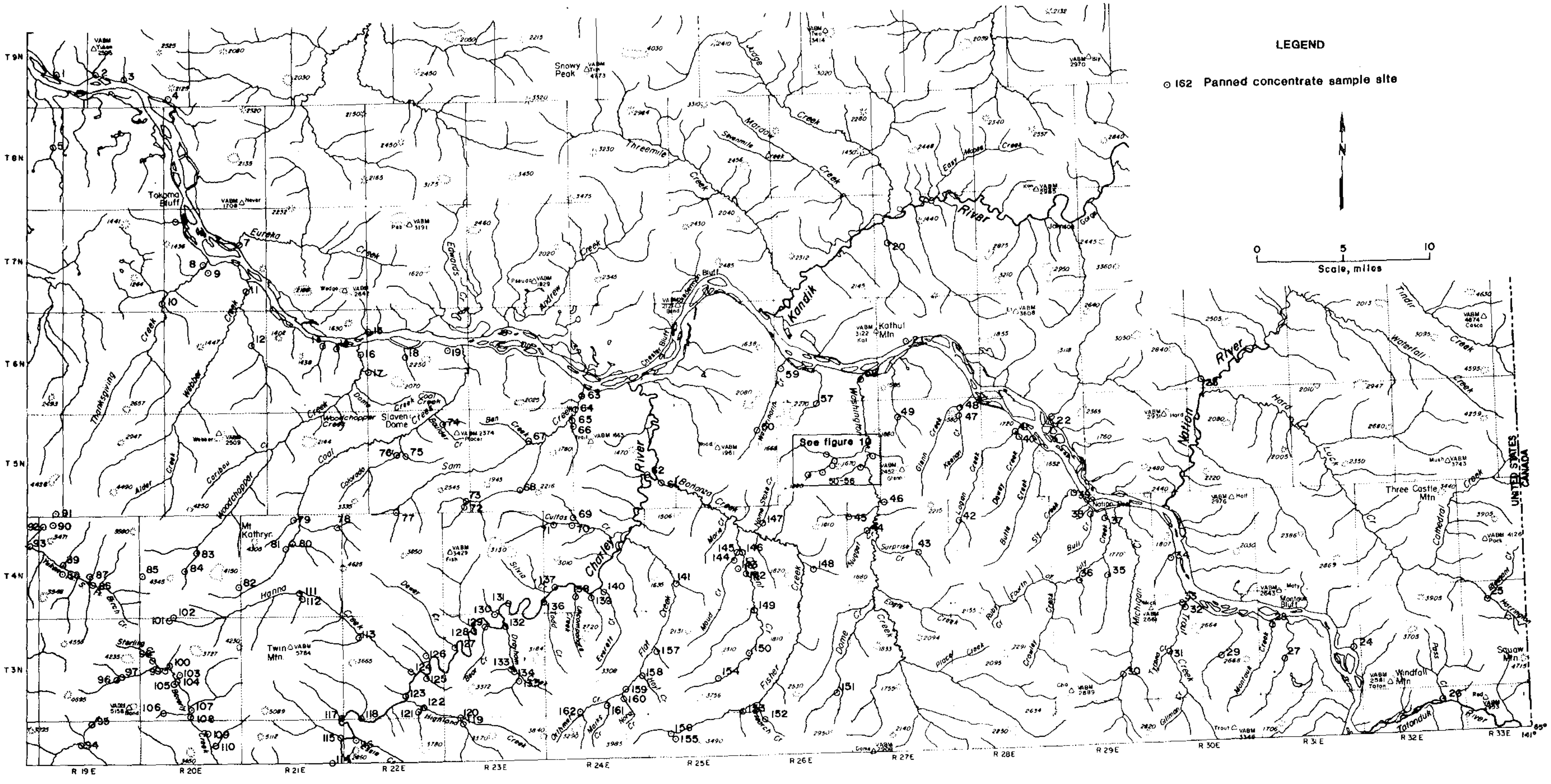


FIGURE 6.—Bonanza Creek placer drill hole location map.



Base adapted from U.S.G.S. Charley River (1:250,00) quadrangle

FIGURE 7.—Panned sample location map.

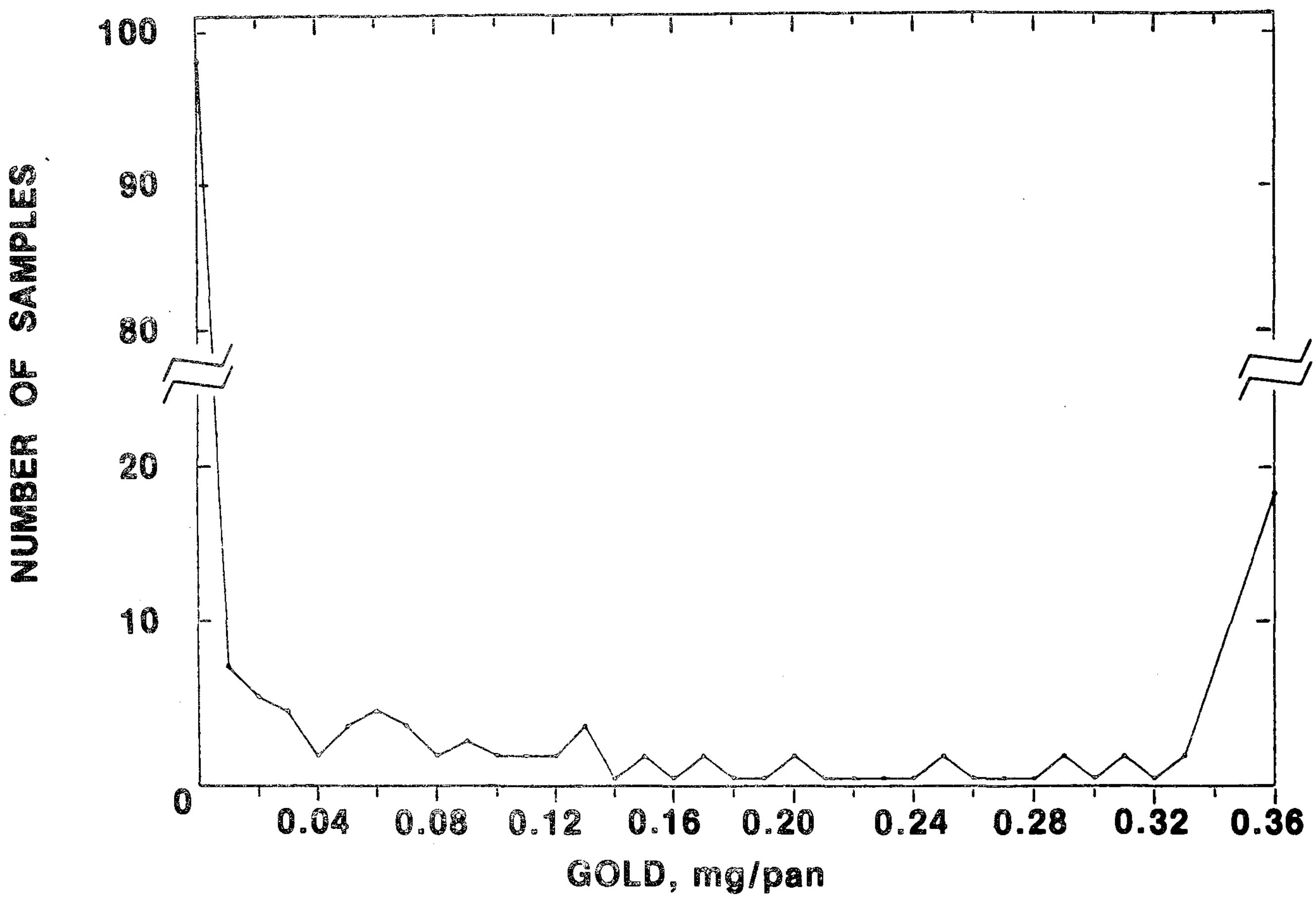


FIGURE 8.—Histogram of gold content in 159 panned concentrates. (Values of 0.19 mg Au/pan and greater are anomalous.)

or on bedrock. Samples collected in this study were collected from surface gravels only and therefore represented lower grade materials.

For the purpose of this study, a value of 0.19 mg/pan was arbitrarily chosen as anomalous (fig. 8). Samples with equal or higher values are indicated on figure 4. This value (0.19 mg/pan) is equivalent to approximately \$0.40/yd³ at \$500/tr oz. Analyzed and recovered gold values for the 162 samples examined in the panned concentrate survey are listed in appendix A.

MODE OF OCCURRENCE AND CHARACTER OF PLACER GOLD

It has been suggested that the principal alluvial gold placer deposits of the upper Yukon River region formed from sparsely auriferous Tertiary conglomerate containing fossil placer gold (*5*, *12-13*). The gold is believed to have been originally derived from the Tanana Uplands crystalline rocks, some miles to the south, south of the Tintina Fault. Most of the present economic alluvial placers occur within or downstream of the conglomerate. Within the areas of Tertiary bedrock, however, only certain creeks have been found to be substantially gold-bearing; others are notably barren or contain only traces. As for the creeks that are auriferous, it appears that gold is contributed only from certain zones of the valleys. In the case of Coal Creek, for example, placer gold comes primarily from the northern edge of the Tertiary bedrock in the vicinity of Boulder and Colorado Creeks (fig. 5). There are other tributaries of Coal Creek, including those that drain Tertiary conglomerate, that have not been found to contain placer gold. On Fourth of July Creek, gold appears to come principally from the Union and Ruby Creek areas. Throughout the upper Yukon region, erosion, soils, and vegetation cover allow very little outcrop, which makes stratigraphic examination difficult. Therefore, no positive correlation of the gold to the Tertiary sediments or any other lode source has yet been made.

Other similarities exist among the placers of the upper Yukon River region. Green and red clay is often abundant within the paystreaks. Concentrates contain wolframite, cassiterite, and abundant garnet. Galena grains or galena-bearing vein material has been observed on several creeks including Coal, Colorado, Placer, and Rosebud Creeks.

Several types of gold are found in the placers. The gold particles usually occur as either well-rounded, tarnished,

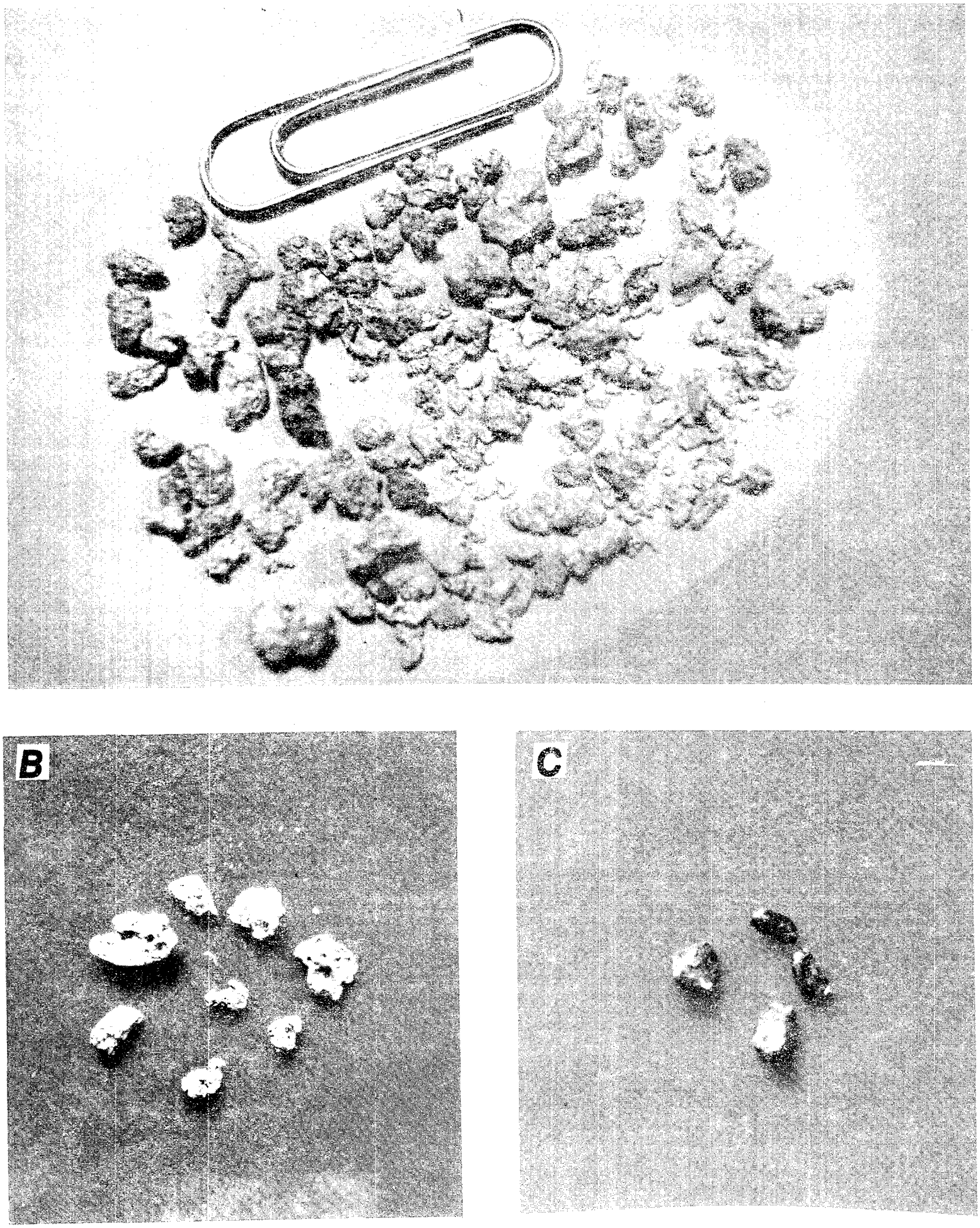


FIGURE 9.—Textures of placer gold. *A*, Angular gold from a 1977 placer cleanup of the uppermost workings on Coal Creek. The largest piece is 0.25 in diam. *B*, Angular gold from Coal Creek, magnification is × 25. *C*, Enlargement (× 25) of rounded gold with iron and manganese coatings from Rosebud Creek.

variably iron- and manganese-stained blebs; or as bright, subangular to subrounded scales, flakes, and nuggets with quartz occasionally attached. On some creeks, both types of gold are present. On Coal Creek, a portion of the gold occurs as angular to subangular nuggets with a sugary-frothy surface texture (fig. 9, *A* and *B*). Several angular gold nuggets recovered from Coal Creek in 1980, from the clay zones near the uppermost workings, were found attached and enveloped around garnet, black sand, and quartz particles. These contrasting forms of placer gold indicate multiple origins. They are quite evident in the field and have been noted by all who have worked in the region.

Sainsbury (*18*), who examined the Coal and Woodchopper Creeks area in 1966, noted a distinct change in the gold character. Rounded, stained gold from the Tertiary conglomerate area contrasted with bright, flaky gold from the clay zones further downstream. He also noted dredge concentrate containing nuggets intergrown with angular vein quartz but coated with manganese stain.

Fineness values of gold samples from the upper Yukon River region (table 2) are relatively high compared to those of other areas in interior Alaska. (See gold fineness data given by Smith (*19*)). Although most of the fineness values are in the 895 to 915 range, there are several notable exceptions, with values that closely approximate those of one or the other of the two types of gold discussed above. Gold from Rosebud Creek is mostly of the highly rounded, tarnished type and has a much lower fineness of 807. Gold of the subangular, bright scaly type, at sample location 54 (fig. 7), had an unusually high value of 970. Based on visual examination of the other samples, it is likely that the fineness range of 895 to 915 resulted from assays of concentrates containing both of these texture types, and thus reflected a combination of the higher grade angular, scaly gold and the rounded gold with its lower fineness value.

Table 2.—Fineness of upper Yukon River region gold samples

Location	Fineness	Sample description
SAMPLES COLLECTED BY BUREAU OF MINES[1,2]		
Boulder Creek	903	Bright gold, some pieces moderately to well-rounded, from placer cut on lower portion of creek.
Rosebud Creek	807	Highly rounded shot with variable Fe and Mn staining; from lower creek.
Ben Creek	908	Moderately rounded bright flakes and bright subrounded shot; from sluice box concentrate.
Do	864	Bright rounded to subrounded flakes.
Coal Creek	914	Subangular bright flakes and rounded small nuggets; from upper area of placer workings, 1979 cleanup.
Mineral Creek	897	Bright flake gold, some with Mn coatings; from 1980 cleanup near mouth of creek.
Washington Creek[3]	970	Very bright, subangular scales to flakes; 2 assays, sample 55 (fig. 10).
Bonanza Creek	855	Bright subrounded specks and scales; sample 61 (fig. 7).
Charley River[4]	845	Subrounded flat nuggets and scales; as sample 62 (fig. 7).
DATA FROM REFERENCE 13		
Fourth of July Creek	892	No description, av of 24 assays.
Ben Creek	896	No description, 1 assay.
Coal Creek	897	No description, av of 16 assays.
Mineral Creek	925	No description, av of 13 assays.
Woodchopper Creek	932	No description, av of 6 assays.

[1]Of these samples, only those from Washington and Bonanza Creeks and the Charley River were among the 162 samples discussed in this report (and listed in appendix A).
[2]Fineness determinations provided by N. Veach, mineralogist, Alaska Division of Geological and Geophysical Surveys, Fairbanks, AK.
[3]Unnamed tributary.
[4]Clay zone.

SIGNIFICANCE OF BONANZA CREEK LINEAMENT ZONE FOR PLACER GOLD

The Tintina Fault trench comprises numerous faults and fracture zones across its width of 5 to 10 miles. Most of these are poorly exposed, if they are exposed at all, and are only discernable as alignments of topographic and vegetation features. The Bonanza Creek lineament, as interpreted from aerial photographs[6] (figs. 4-5), was examined in detail because very nearly all of the gold production in the upper Yukon River region has been derived from creeks immediately downstream of it.

The Bonanza Creek lineament, informally named in this report because of its alignment with Bonanza Creek, is a zone intermittently traceable from near Woodchopper Creek eastward to Washington Creek that may extend to Fourth of July Creek. On both Coal and Woodchopper Creeks, the lineament zone (fig. 5) is characterized by probable low-level hydrothermal alteration, as indicated by varicolored massive green, red, and white clay, bleached and decomposed sedimentary rock, quartz stockworks, and boxworks. Gypsum and slickensides are also common features. On Woodchopper and Coal Creeks, silicification and brecciation occur in the resistant Permian or older bedrock to the immediate north, whereas angular quartz masses are found in the clay zones that border the bleached and sheared Tertiary strata to the south. The saline-evaporite mineral dawsonite [$NaAlCO_3(OH)_2$], which can be associated with low-level hydrothermal alteration, was identified in sheared Tertiary mudstone.[7] A sample of this material also contained traces of gold (0.01 tr oz/st). Fragments of sheared coal contain stockwork veinlets of quartz, siderite, and pyrite. Coal from near the lineament was visibly vitreous. A sample collected on Coal Creek was found to have a vitrinite reflectance of 0.48; another nearby coal sample gave a reflectance of 0.65. These values are somewhat higher than would be expected for interior Alaska lignitic Tertiary coals, which typically have reflectance values of 0.2 to 0.3, suggesting minor thermal upgrading.

X-ray diffraction analyses of clay samples from the lineament zone on Coal Creek indicated a mineral assemblage of quartz, gypsum, potassium feldspar, muscovite, kaolinite, and variable amounts of chlorite, which, when present, imparts a bright green color. Because of weathering of the clay, only tentative confirmation of these clays as being hydrothermal is possible. Similar clay is found aligned with and along the Bonanza Creek lineament where it crosses Boulder and Sam Creeks, at the very lower end of Cheese Creek, on the Charley River, and in creek float on Bonanza Creek. Placer gold can be found at all these locations. Elsewhere, the lineament zone is totally covered by vegetation.

The Coal Creek placer deposit, according to the operator there, has a drill-indicated paystreak approximately 700

[6]False-color high-altitude imagery, flight lines 67-69, available for inspection at the Geophysical Institute, Room 501, University of Alaska, Fairbanks, AK.

[7]Analysis by X-ray diffraction; performed by T. C. Mowatt, geologist, Bureau of Mines, Juneau, AK

to 900 ft wide downstream of the projected trace of the lineament. Upstream of the projected trace, no mining has been attempted, and the paystreak sharply reduces to 300 ft in width and a lower tenor. Little drilling has been done further upstream, and there has been no lode gold exploration. A sample of partially cleaned Coal Creek placer concentrates taken from downstream of the lineament was found to commonly contain angular or frothy-textured gold particles (fig 9, *A* and *B*) and abundant grains of conchoidal-shaped, gray, friable metallics identified as the halides of cotunnite ($PbCl_2$) and laurionite [Pb(OH)Cl][8] In several observed instances, the lead minerals formed around grains of gold.

OTHER LOCATIONS CONTAINING GOLD

Several other locations (not listed in the "Mineral Production and History" section) in the upper Yukon River region have been reported, or were found during this project, to contain gold. (See sites of anomalous gold values on figure 4.) None of these sites, however, have produced any significant quantity of gold, and none are currently being prospected.

In the Placer Creek valley, a tributary to upper Washington Creek, sphalerite and galena were found, occurring as disseminated sulfides in the conglomerate matrix. (See figure 4, location labeled "Lead-zinc sulfides," near location 24.) An analyzed sample contained 1.0% Pb, 2.7% Zn, a trace of gold (less than 0.01 tr oz), and 0.37% As. The occurrence was found in rubble and could not be assessed further.

Bedrock in the vicinity of sample 54 (fig. 10) was mapped in an attempt to delineate the lode source of the placer gold found there, which has an unusually high fineness. Bedrock on the north side of the valley comprises Tertiary mudstone and lignite, whereas bedrock on the south side consists of olive-green argillite and quartzite which is silicified along fractures. A thrust fault contact is interpreted to parallel the valley. Hydrothermal(?) quartz stockwork has permeated the silicified sediments. The quartz veinlets contain accessory magnetite and particularly well-developed chlorite along the selvage zones. Chlorite is pervasive in the silicified groundmass and typically coats the quartz grains. Some samples contain over 50% chlorite. No visible gold could be observed in hand specimens, and two analyzed samples were barren.

Similar olive-green rock was also seen in the creek float on the gold placer creeks of Ruby, Webber, Woodchopper, Ben, Boulder, and Surprise. Six random samples of this material, one composited from each creek, were fire-assayed for gold, but gold was detected only in the sample from Ruby Creek. That analysis indicated 0.01 tr oz/st Au. A neutron-activation analysis of another split of the Ruby Creek sample indicated 0.32 tr oz/st Au.

A group of gold anomalies was found during the panned concentrate survey in the vicinity of the eastern Charley River batholith. Free gold was observed in the concentrates. The source of the gold is unknown; however, abundant vein quartz in the creeks suggests a local hydrothermal origin.

Anomalous gold values in panned concentrates occur in several other areas within or downstream of Tertiary bedrock. These include the east forks of Webber and Sam Creeks (figure 7, samples 12 and 68), nearby Cultas Creek (sample 69), and several sites on Derwent Creek (samples 146 and 149). Sample 51, which was taken 1 mile south of the creek where sample 54 was collected (fig. 10), was particularly anomalous for gold (appendix A). The origin of the gold is unknown.

PLATINUM ASSOCIATION

Mertie, in 1942 (*13*, pp. 257-259), reported unusually high platinum concentrations, thought to be alloyed in placer gold. His analyses of gold from Woodchopper Creek indicated 0.42% Pt; Broken Neck and Fourth of July Creeks yielded 0.20% Pt and 0.28% Pt, respectively. All of the Bureau's gold samples listed in table 2 were analyzed for platinum by a fire assay-spectrographic method, but no platinum was detected, even at trace levels. Mertie's 1942 analyses reporting significant platinum in placer gold may be suspect, given the analytical procedures for platinum available at that time. Rare grains of platinum-metal alloys do occur in placer concentrates and were found during this investigation on Boulder Creek (sample 74) and near Washington Creek (sample 55). On Boulder Creek, the panned concentrate contained grains of chromite and a single grain of osmiridium[9] with an osmium-to-iridium ratio of 5:1.[9] Pan sample 55 contained a grain of ferroplatinum.[9]

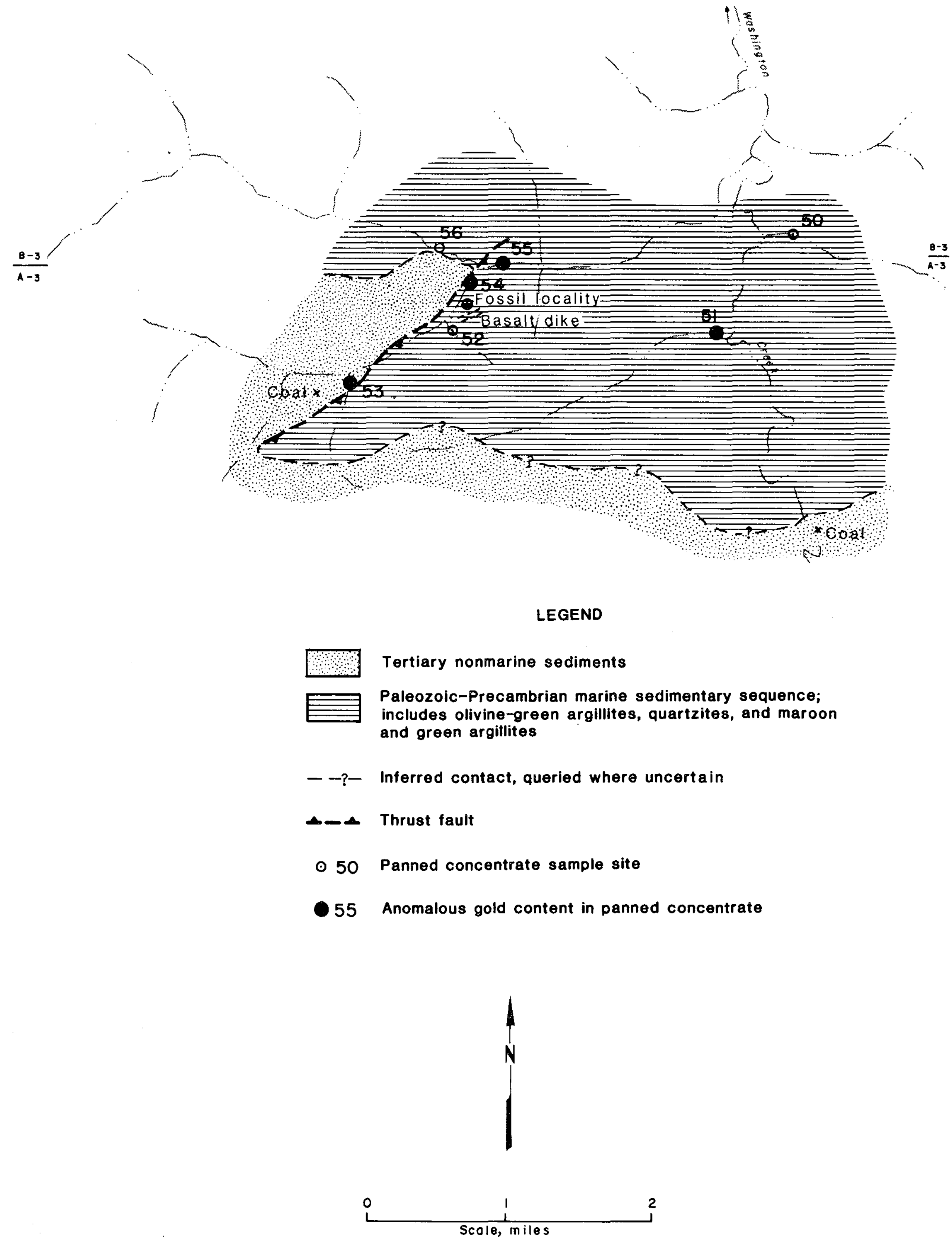
DISCUSSION AND RECOMMENDATIONS

The upper Yukon River region has produced a significant amount of placer gold from operations dating back to 1898. Most of this production has come from dredges on Coal and Woodchopper Creeks, where additional dredging ground still remains. Many other creeks are known to contain gold.

The gold placers of the upper Yukon River region may have formed, at least in part, from local hydrothermal sources. A notable feature of the placers is the spatial association of most known deposits with the Bonanza Creek lineament. Previous suggestions that the gold in the Woodchopper and Coal Creeks area is reworked from Tertiary conglomerates and originally derived from the present Tanana Uplands crystalline terrane to the south are incon-

[8]Analysis by X-ray diffraction; performed by W.S. Roberts, geologist, Bureau of Mines, Juneau, AK.

[9]Scanning electron microscope analysis by J. Sjoberg, mineralogist, Bureau of Mines, Reno, NV.



Base adapted from U.S.G.S. 1:63,360 Charley River quadrangles (A-3 and B-3)

FIGURE 10.—Sample locations 50 through 56, Washington Creek. (Location of this figure is shown in figure 7.)

sistent with the presence of flake and subangular gold and nuggets as large as 2.5 tr oz, such as have been found on Mineral Creek. Furthermore, no significant gold placers have been found over the straight-line distance of 7 or more miles between these two areas. Similarly, there are no known nearby sources of the garnets and friable heavy minerals such as native bismuth found on Rosebud Creek, galena found on Coal and Colorado Creeks, and wolframite and cassiterite found on Woodchopper Creek. Placers derived from distant bedrock sources would not likely contain these minerals in the abundance found in the study area.

Alluvial gold from the upper Yukon River region appears to have several origins, and the present placers are an apparent mix of both reworked ancient placers and low-temperature(?) hydrothermal gold. The first of these types of gold is rounded, oxide-coated, shotty-type gold that is likely being reworked from ancient Tertiary fossil placers. Probably the fossil placers originally derived gold from nearby upland sources now displaced to the west by the Tintina Fault, prior to much of the sedimentation that is now filling the Eagle Trough. The similar westerly arc-shaped feature of Woodchopper, Coal, and Sam Creeks, and possibly the Charley River, indicates right-lateral displacement (fig. 4). Continuing post-early Tertiary right-lateral movement along the Tintina Fault, which appears to have occurred in stages, has displaced the upland gold sources to the west and has resulted in the abandonment of alluvial gold placers.

If allowance is made for some 50 miles of displacement along the Tintina fault zone, a plausible source of placer Tertiary gold in the upper Yukon River region could be the 71-million-yr-old Circle meta-igneous complex (in the Circle Quadrangle, west of the study area shown in figure 4). Middle- to late-Tertiary displacements on the order of 30 miles have been indicated along the Tintina Fault in Canada (*9*). It is noteworthy that a spatial correlation of the Woodchopper-Coal-Ben Creeks area and the Portage-Deadwood-Crooked Creeks area in the Circle district can be made by a reconstruction of fault movement. Wolframite- and cassiterite-bearing placers on Deadwood Creek align with Woodchopper Creek, where these minerals are also found. Placer occurrences associated with the Tertiary bedrock region are limited to the north side of the main trace of the Tintina Fault, whereas the Circle Hot Springs district has produced gold only to the south of the fault.

Low-temperature(?) hydrothermal veins and shear zones, such as the Bonanza Creek lineament zone, possibly account for the second type of gold. This type is typified by generally bright, subangular to subrounded flat flakes, scales, and nuggets with high fineness values and, particularly, the angular, sugary-textured gold. This latter texture type and its apparent higher fineness suggest that an authigenic process may be involved.

The evidence of gold in primary sources, particularly in altered shear zones such as the Bonanza Creek zone, should be thoroughly examined with respect to both placer and lode deposits. Bonanza Creek, where past drift mining is in evidence, is particularly favorable since it aligns parallel to the lineament instead of merely crossing it (figs. 4 and 6). The Webber and Thanksgiving Creeks areas warrant evaluation for both abandoned paleo-alluvial channels and fault-zone-related placers. Other linear geologic features, such as the inferred thrust fault near sample 54, may also be mineralized. Trenching or shallow drilling to intersect the fault zone will be necessary. Further characterization of the geochemical and geothermal history (e.g., hot springs activity) of altered fault zones should also be made. Exploration targets should address the fault zones with potential for gold deposits in both Tertiary and basement Cambrian(?) bedrock. Similarly, the presence of lead, zinc, arsenic, and iron sulfides in the conglomerate, such as on Colorado and Placer Creeks, suggests gold may also be deposited in this association.

The anomalous gold values found in creeks draining into the Charley River, particularly east of Twin Mountain and extending downstream of Bonanza Creek, suggest the possibility of placer enrichment in the Charley River flood plain. The gold anomalies at sample locations 68 and 69 possibly indicate gold enrichment along the southern extent of the Tertiary sediments.

High-level terrace gravels may locally contain placer gold. There have been unverified local reports of placer gold from such gravels on both Coal and Fourth of July Creeks. Mineral and Iron Creeks may also contain some high-level terrace gold.

CONCLUSIONS

The predominant Tertiary-age sediments of the Eagle Trough are well-rounded chert-, quartzite-, and quartz-conglomerate; coal-bearing mudstone; and sandstone that were deposited by the ancestral Yukon River or other major southwesterly flowing drainages. The detritus probably derived from the marine Paleozoic and Precambrian rocks to the east and north, which were eroded during the Eocene development of the Nation Arch. They can be expected to be barren of alluvial gold.

Conversely, less common conglomerate composed of meta-igneous sediments from the Tanana Uplands crystalline terrane to the south may contain ancient placer gold and thereby account for part of the gold in the present alluvial placers. To date, however, there is no positive evidence that any Tertiary conglomerates contain ancient placer gold.

Examination and fineness analyses of gold concentrates indicate that other origins of gold are responsible for placers. There is a close spatial correlation of the significant placer deposits and the Bonanza Creek lineament. Alteration and mineralizing processes associated with the lineament zone may be at least partially responsible for the placers.

With the exception of Coal and Woodchopper Creeks, the region is poorly explored due to the extensive soil and vegetation cover and permafrost. A heavy-mineral survey of 162 panned concentrate samples found 26 to contain anomalous levels of gold. The region is favorable for the discovery of additional reserves of both lode and placer gold, and exploration along the Bonanza Creek lineament is particularly suggested.

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APPENDIX A.—GOLD IN HEAVY-MINERAL CONCENTRATES

Sample	Minus 14-mesh nonmagnetic conc, g	Gold		Rock types present in creek rubble, estimated % × 0.1 (See end of tabulation for explanation of abbreviations.)																
		Content, ppm	Recovered, mg	A	C	D	E	G	H	I	L	O	P	Q	R	S	T	W	X	Z
1	13.710	ND	ND	3	1	—	—	—	3	—	—	—	—	1	—	—	—	—	2	—
2	22.851	ND	ND	3	1	—	—	—	3	—	—	—	—	1	—	—	—	—	2	—
3	24.120	ND	ND	1	—	—	—	—	—	—	—	—	—	1	—	2	—	—	6	—
4	7.060	.32	0.002	1	4	—	—	—	—	—	—	—	—	1	4	—	—	—	—	—
5	2.744	22.00	.060	—	1	—	—	—	4	—	—	—	—	1	—	2	2	—	—	—
6	14.825	1.2	.018	—	2	—	—	—	—	—	4	—	—	3	—	—	1	—	—	—
7	6.885	7.34	.050	—	.5	—	—	—	3	—	—	.5	—	2	—	Tr	1	—	1	2
8	1.690	ND	ND	—	3	—	—	—	—	1	3	1	—	—	—	—	—	—	—	2
9	16.662	ND	ND	—	1	—	—	—	—	—	3	1	—	3	—	—	—	2	—	—
10	15.004	ND	ND	—	—	—	—	—	1	1	—	Tr	2	2	—	—	1	3	—	—
11	15.702	4.2	.066	1	1	—	—	—	1	1	—	—	—	1	—	—	2	3	—	—
12	30.285	12	.363	—	Tr	—	—	—	1	2	—	—	1	—	—	—	2	4	—	—
13	6.316	ND	ND	5	—	—	—	—	—	—	5	—	—	—	—	—	—	—	—	—
14	11.901	.2	.002	.5	—	—	.5	—	—	—	—	—	—	—	—	—	—	—	—	9
15	3.301	ND	ND	—	—	—	—	—	2	—	7	—	—	—	—	—	—	—	—	1
16	31.257	ND	ND	—	2	—	—	—	—	.5	1	1	—	2	—	—	—	2	.5	1
17	1.026	ND	ND	—	—	—	—	—	9	—	—	—	—	Tr	—	1	—	—	—	—
18	4.452	ND	ND	—	—	—	—	—	2	—	—	—	—	1	—	—	1	—	—	6
19	11.471	ND	ND	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10
20	1.741	ND	ND	—	Tr	—	—	—	4	—	—	1	—	Tr	—	5	—	—	—	—
21	1.637	ND	ND	—	—	—	—	—	5	—	—	—	—	—	—	5	—	—	—	—
22	10.101	ND	ND	—	2	—	—	—	2	—	1	1	—	1	—	—	3	—	—	—
23	.546	1.75	.001	—	—	—	—	—	4	—	2	2	—	—	—	2	—	—	—	—
24[1]	9.261	ND	ND	—	1	—	—	—	3	—	3	1	—	1	—	—	1	—	—	—
25	2.822	ND	ND	—	2	—	—	—	—	—	4	—	—	—	—	2	—	—	—	2
26	7.735	1.12	.009	—	—	2	—	—	3	—	3	—	—	—	—	2	—	—	—	Tr
27	3.563	ND	ND	—	—	—	—	—	3	—	—	—	—	—	—	7	—	—	—	—
28	4.745	ND	ND	—	1	—	—	—	1	—	—	2	—	2	—	2	2	—	—	—
29	.676	ND	ND	—	—	—	—	—	2	—	—	2	—	1	—	5	—	—	—	—
30	.166	ND	ND	—	—	—	—	—	2	—	—	—	—	—	—	3	4.5	—	—	—
31[2]	4.976	ND	ND	—	—	1	—	—	2	—	1	2	—	—	—	3	—	—	—	—
32	4.351	ND	ND	.5	—	—	—	—	3	—	.5	1	—	1	—	1	3	—	—	—
33	1.479	ND	ND	—	—	—	—	—	1	—	—	3	—	—	—	2	4	—	—	—
34	.450	ND	ND	—	—	—	—	—	3	—	—	—	—	—	—	4	—	—	3	—
35	.974	ND	ND	—	—	—	—	—	2	—	—	4	—	—	—	2	—	—	—	—
36	.646	ND	ND	—	—	—	—	—	2	—	2	—	—	Tr	—	6	—	—	—	—
37	4.164	ND	ND	1	1	—	—	—	1	—	2	2	—	1	—	2	—	—	—	—
38	5.868	.69	.004	2	—	—	—	—	2	—	5	—	—	1	—	—	—	—	—	—
39	6.791	4.4	.030	2	1	—	—	—	3	—	—	1	—	2	—	—	1	—	—	—
40	7.241	9.8	.071	5	.5	—	—	—	2	—	—	.5	—	1	—	—	1	—	—	—
41	4.569	1.5	.007	.5	—	—	—	—	3	—	—	1	—	2	—	.5	3	—	—	—
42	.978	ND	ND	—	—	—	—	—	3	—	—	—	—	1	—	6	—	—	—	Tr
43	NA	ND	ND	—	2	—	—	—	—	—	—	—	—	1	—	—	2	—	—	5
44	NA	ND	ND	—	1	—	—	—	3	Tr	—	—	—	2	—	—	2	1	—	1
45[3]	5.805	2.6	.015	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
46	2.473	ND	ND	—	—	—	—	—	2	—	—	3	—	1	2	1	—	—	—	1
47	3.345	ND	ND	1	1	—	—	—	3	—	—	—	—	2	—	—	3	—	—	—
48	2.295	ND	ND	.5	1	—	—	—	4.5	—	1	—	—	1.5	—	.5	1	—	—	—
49	.322	ND	ND	—	—	—	—	—	7	—	—	—	—	1	—	1	1	—	—	—
50	3.058	ND	ND	—	1	—	—	—	3	—	—	—	.5	.5	3	1	—	—	Tr	1
51	15.568	270	4.203	—	—	—	—	—	—	—	—	—	Tr	Tr	3	—	—	Tr	1	6
52	NA	ND	ND	—	—	—	—	—	—	—	—	—	—	—	6	—	4	—	—	—
53[4]	NA	NA	[5]6	—	3	—	—	—	—	—	—	1	—	2	1	—	2	—	—	1
54[4]	NA	ND	[6]297.1	—	—	—	—	—	2	—	—	1	—	1	2	5	2	—	—	—
55	3.650	300 0	10.95	—	—	—	—	—	2	—	—	1	—	1	2	2	2	—	—	—
56[4]	NA	NA	[7]2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
57	.095	ND	ND	—	Tr	—	—	—	6	—	—	—	—	1	—	3	—	—	—	—
58	6.985	8.2	.057	—	2	—	—	—	2	—	—	3	—	1	1	—	1	—	—	—
59	1.871	6.2	.012	—	—	—	—	—	8	—	—	—	—	1	—	—	1	—	—	—
60[3]	3.189	139.00	.443	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
61[4]	NA	NA	[7]6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
62[4]	NA	NA	15.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
63[8]	14.484	2.0	.029	.5	.5	—	—	—	4	Tr	—	—	—	3	—	Tr	1	.5	.5	—
64	11.403	1.4	.016	—	—	—	—	—	1	—	—	2	2	2	—	3	—	Tr	—	—
65	2.480	ND	ND	—	1	—	—	1	1	1	2	—	—	—	—	1	2	1	—	—
66	3.654	ND	ND	—	1	—	—	—	3	1	—	—	—	2	—	3	—	.5	—	.5
67[4]	1.500	ND	ND	—	2	—	—	—	2	—	—	—	2	1	—	2	—	—	—	1
68	23.701	22	.521	—	—	—	—	1	2	2	—	—	1	1	—	—	1	2	—	—
69	10.807	83	.897	—	—	—	—	—	—	1	—	—	4	1	—	—	4	Tr	—	—
70	26.191	3.4	.089	—	—	—	—	—	—	3	—	—	3	3	—	—	Tr	1	—	—
71	23.450	1.1	.026	—	—	—	—	—	—	4	—	—	4	2	—	—	—	—	—	—
72	18.854	ND	ND	—	—	—	—	—	—	3	—	—	2	2	—	—	—	3	—	—
73	10.025	ND	ND	—	—	—	—	—	—	4	—	—	4	2	—	—	—	—	—	—
74[9]	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp
75	7.145	5.4	.039	—	—	—	—	—	1	—	—	—	1	—	—	1	—	1	—	6
76	3.161	29	.092	—	1	—	—	—	2	1	—	—	2	1	—	—	1	—	—	2
77	8.030	1.0	.008	—	—	—	—	—	—	3	—	—	—	—	—	—	3	4	—	—
78	3.655	140	.512	—	—	—	—	4	—	Tr	—	—	—	1	—	—	2	3	—	—
79	75.473	ND	ND	—	—	—	—	—	—	5	—	—	2	2	—	—	—	1	—	—
80	4.511	13	.059	—	—	—	—	8	2	—	—	—	—	—	—	—	—	—	—	—
81	11.495	ND	ND	—	—	—	—	—	1	2	—	—	2	2	—	—	2	1	—	—
82[3]	8.710	.43	.004	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
83	18.694	198.00	3.701	—	—	—	—	—	—	—	—	—	3	Tr	—	—	3	4	—	—
84	8.193	ND	ND	—	—	—	—	—	—	4	—	—	—	2	—	—	1	3	—	—
85	31.674	.40	.013	—	—	—	—	—	—	3	—	—	—	4	—	—	3	—	—	—

See explanatory notes at end of tabulation.

Sample	Minus 14-mesh nonmagnetic conc, g	Gold Content, ppm	Gold Recovered, mg	A	C	D	E	G	H	I	L	O	P	Q	R	S	T	W	X	Z
				Rock types present in creek rubble, estimated % × 0.1 (See end of tabulation for explanation of abbreviations.)																
86	50.119	120.00	6.014	—	—	—	—	—	—	3	—	—	2	2	—	—	Tr	3	—	—
87	[10]320	.2	[10].12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
88[3]	18.574	ND	ND	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
89	17.132	ND	ND	—	3	—	—	—	—	3	2	—	—	2	—	—	—	—	—	—
90	44.710	ND	ND	—	—	—	—	—	—	7	—	—	—	1	—	—	12	—	—	—
91	18.694	ND	ND	—	—	—	—	—	—	9	—	—	—	Tr	—	—	1	—	—	—
92	43.443	ND	ND	—	—	—	—	—	—	4	—	—	—	2	—	—	4	—	—	—
93	33.440	4.40	.147	—	—	—	—	—	—	2	—	—	—	3	—	—	5	—	—	—
94	21.855	ND	ND	—	—	—	—	—	—	4	—	—	—	2	—	—	—	4	—	—
95	4.923	ND	ND	—	—	—	—	—	—	3	—	—	—	3	—	—	—	4	—	—
96	12.662	ND	ND	—	—	—	—	—	—	7	—	—	—	3	—	—	—	—	—	—
97	37.290	ND	ND	—	—	—	—	—	—	—	—	—	—	2	—	—	8	—	—	—
98	31.025	.59	.018	—	—	—	—	—	—	4	—	—	—	5	—	—	1	—	—	—
99	22.186	ND	ND	—	—	—	—	—	—	3	—	—	3	2	—	—	—	2	—	—
100	5.684	ND	ND	—	—	—	—	—	—	—	—	—	—	2	—	—	—	8	—	—
101	12.203	ND	ND	—	—	—	—	—	—	6	—	—	—	4	—	—	—	—	—	—
102	6.179	.60	.004	—	—	—	—	—	—	7	—	—	—	3	—	—	—	—	—	—
103	2.963	.22	.001	—	—	—	—	—	—	—	—	—	—	1	—	—	—	9	—	—
104	40.268	ND	ND	—	—	—	—	—	—	4	—	—	—	2	—	—	—	4	—	—
105	3.351	.20	.001	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—	—
106	3.155	ND	ND	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—	—
107	20.943	ND	ND	—	—	—	—	—	—	5	—	—	—	1	—	—	—	4	—	—
108	2.389	.32	.001	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—	—
109	12.385	ND	ND	—	—	—	—	—	—	—	—	—	—	1	—	—	—	9	—	—
110	14.907	ND	ND	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—	—
111	5.564	ND	ND	—	—	—	—	—	Tr	4	—	—	—	1	—	—	—	5	—	—
112	11.443	11	.126	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8	2	—
113	9.670	2.2	.021	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—	—
114	15.919	.46	.007	—	—	—	—	7	—	2	—	—	—	—	—	—	1	—	—	—
115	11.229	.84	.009	—	—	—	—	—	—	4	—	—	—	1	—	—	—	5	—	—
116	10.155	ND	ND	—	—	—	—	—	—	—	—	—	—	1	—	—	—	3	6	—
117	11.556	ND	ND	—	—	—	—	4	—	—	—	—	—	—	—	—	—	6	—	—
118	19.659	ND	ND	—	—	—	—	5	—	—	—	—	—	—	—	—	—	5	—	—
119[11]	21.465	ND	ND	—	—	—	—	—	2	—	—	—	1	1	—	—	1	—	1	4
120[11]	28.660	ND	ND	—	—	—	—	—	1	1	—	—	2	1	—	—	—	—	2	3
121	12.651	53	0.671	—	—	—	—	—	—	—	—	—	1	—	—	—	—	2	—	7
122	15.111	ND	ND	—	2	—	—	—	—	—	—	—	2	Tr	—	—	1	—	Tr	5
123	11.187	ND	ND	—	Tr	—	—	—	—	.5	—	—	.5	.5	—	.5	—	3	5	—
124	22.116	5.7	.126	—	—	—	—	—	1	1	—	—	—	Tr	—	—	—	8	—	—
125	28.286	ND	ND	—	—	—	—	—	1	—	—	—	6	1	—	—	—	Tr	2	—
126	1.622	59	.096	—	—	—	—	—	—	4	—	—	Tr	1	—	—	—	4	1	—
127	2.834	ND	ND	—	—	—	—	—	—	2	—	—	3	1	—	—	Tr	4	—	—
128	4.870	76	.370	—	—	—	—	6	—	—	—	—	—	—	—	—	—	4	—	—
129	9.772	65	.635	—	—	—	—	2	—	5	—	—	—	Tr	—	—	2	1	—	—
130	2.430	800	1.944	—	—	—	—	—	—	—	—	—	—	1	—	—	2	7	—	—
131	2.442	22	.054	—	—	—	—	—	—	2	—	—	—	1	—	—	—	7	—	—
132	44.371	52	2.307	—	—	—	—	1	—	2	—	—	2	2	—	—	3	—	—	—
133	7.117	ND	ND	—	—	—	—	—	—	3	—	—	2	1	—	—	2	2	—	—
134	33.704	ND	ND	—	—	—	—	—	—	3	—	—	—	1	—	—	3	1	—	2
135	29.747	ND	ND	—	—	—	—	—	—	5	—	—	3	1	—	1	—	—	—	—
136	18.654	32	.597	—	—	—	—	1	—	3	—	—	3	1	—	—	2	—	—	—
137	27.567	7.4	.204	—	—	—	—	—	—	4	—	—	4	2	—	—	—	—	—	—
138	11.075	ND	ND	—	—	—	—	—	—	5	—	—	3	2	—	—	—	—	—	—
139	19.759	ND	ND	—	—	—	—	—	—	2	—	—	6	2	—	—	—	—	—	—
140	11.230	29	.326	—	—	—	—	—	—	4	—	—	3	3	—	—	—	—	—	—
141	3.828	65	.249	—	—	—	—	—	3	—	—	—	—	Tr	—	6	—	1	—	—
142	4.577	26	.119	—	—	—	—	—	2	—	—	—	—	3	—	3	—	2	—	—
143	NA	ND	ND	—	2	—	—	—	1	2	—	—	—	1	—	—	—	3	—	1
144	11.610	11	.128	—	1	—	—	—	1	1	—	—	—	4	—	—	—	2	—	1
145	2.708	8.6	.025	—	2	—	—	1	1	—	—	—	2	2	—	—	—	1	—	1
146[12]	8.690	110	.956	—	2	—	—	1	—	—	—	—	—	2	—	3	—	1	—	Tr
147	1.145	ND	ND	—	3	—	—	—	1	1	—	—	—	2	—	2	—	—	—	1
148[13]	3.349	33	.110	—	—	—	—	—	—	—	—	—	?	—	—	—	—	—	—	—
149	5.413	54	.292	—	—	—	—	—	3	—	—	—	2	—	—	2	—	—	—	—
150	6.504	12	.078	—	—	—	—	—	1	—	—	—	5	3	—	—	—	—	Tr	Tr
151	2.154	26	.056	—	—	—	—	—	2	3	—	—	3	2	—	—	—	—	—	—
152	12.373	42	.520	2	2	—	—	—	1	2	—	—	—	1	—	—	—	1	—	—
153	12.280	5.7	.070	2	—	—	—	—	—	2	—	—	—	2	—	—	—	—	2	2
154	6.107	50	.305	—	—	—	—	—	1	—	—	—	1	2	—	1	—	—	1	4
155	35.515	4.7	.167	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	5	4
156	32.462	ND	ND	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	5	4
157	5.947	ND	ND	—	—	—	—	—	—	5	—	—	1	2	—	—	2	—	—	—
158	18.746	ND	ND	—	—	—	—	Tr	—	6	—	—	—	—	—	—	2	—	—	2
159	10.959	ND	ND	—	—	—	—	—	—	4	—	—	—	—	—	—	4	—	—	2
160	4.695	ND	ND	—	—	—	—	—	—	4	—	—	—	1	—	—	2	—	3	—
161	20.680	2	ND	—	—	—	—	—	3	—	—	—	—	Tr	—	—	1	—	3	3
162	10.927	ND	ND	—	—	—	—	—	2	—	2	—	—	2	—	1	1	—	—	2

— Rock type not present. NA Not analyzed. NAp Not applicable. ND Not detected. Tr Trace.

[1]Burned shale also present.
[2]Hematite also present, 0.1%.
[3]No rock types, only sands.
[4]Manually separated gold, samples not analyzed by atomic absorption methods.
[5]Flakes.
[6]In 30-pan bulk sample.
[7]Specks.
[8]Clay, sideritic sandstone.
[9]Boulder.
[10]5.5-pan sample.
[11]Traces of grit also present.
[12]Clay also present, 0.1%.
[13]Mostly sand, possible phyllite rock type present.

Rock type abbreviations

A... Slate
C... Chert
D... Dolomite
E... Calcite
G... Gneiss
H... Shale, siltstones, fine-grain clastics
I... Schist
L... Limestone
O... Conglomerate
P... Phyllite
Q... Quartz
R... Argillite
S... Sandstone
T... Quartzite
W... Intrusive—felsic
X... Intrusive—mafic
Z... Volcanic—mafic

NOTE.—Recovered gold values of 0.19 mg/pan were arbitrarily chosen as anomalous.

APPENDIX B.—SAMPLE IDENTIFICATION KEY

(Sample numbers used in this report related to field numbers referenced in previous Bureau open file report (*2*))

Sample	Field number	Sample	Field number	Sample	Field number	Sample	Field number
1	KD1807	42	KD8378	83	UP341	124	UP8025
2	KD1805	43	KD10658	84	UP278	125	UP8027
3	KD1801	44	KD10662	85	UP271	126	UP8029
4	KD1643	45	KD8373	86	UP8011	127	UP8032
5	KD8147	46	KD8375	87	UP10610	128	UP8217
6	KD1653	47	KD1703	88	UP345	129	UP8221
7	KD1794	48	KD1701	89	UP343	130	UP8036
8	KD1661	49	KD8383	90	UP298	131	UP8040
9	KD1659	50	KD8367	91	UP289	132	UP8223
10	KD8232	51	KD8370	92	UP301	133	UP95
11	KD1791	52	KD10630	93	UP304	134	UP97
12	KD8152	53	KD10634	94	UP66	135	UP99
13	KD1673	54	KD8368	95	UP59	136	UP8227
14	KD1671	55	KD8101	96	UP449	137	UP8043
15	KD1675	56	KD2971	97	UP4	138	UP8046
16	KD1669	57	KD8388	98	UP51	139	UP8049
17	KD8234	58	KD1772	99	UP146	140	UP8126
18	KD1786	59	KD1689	100	UP149	141	UP353
19	KD1784	60	KD2968	101	UP220	142	UP360
20	KD8262	61	KD12379	102	UP222	143	KD10650
21	KD1695	62	KD12439	103	UP934	144	UP357
22	KD1763	63	KD1778	104	UP936	145	UP8300
23	KD8249	64	KD8156	105	UP938	146	UP8342
24	KD1744	65	KD2965	106	UP880	147	UP8344
25	KD8109	66	KD2964	107	UP883	148	UP8347
26	KD8161	67	KD8240	108	UP885	149	UP8311
27	KD8270	68	KD8415	109	UP70	150	UP8309
28	KD1752	69	KD8390	110	UP6	151	UP8351
29	KD8272	70	KD8392	111	UP370	152	UP8355
30	KD8277	71	KD8413	112	UP367	153	UP8358
31	KD8252	72	KD8417	113	UP362	154	UP8305
32	KD1722	73	KD8419	114	UP8054	155	UP8361
33	KD1720	74	KD1809	115	UP8206	156	UP8303
34	KD1717	75	KD8236	116	UP8016	157	UP296
35	KD8256	76	KD8238	117	UP8018	158	UP294
36	KD8259	77	KD8422	118	UP8020	159	UP291
37	KD1757	78	UP8425	119	UP237	160	UP248
38	KD1759	79	UP338	120	UP235	161	UP243
39	KD1712	80	UP8002	121	UP8215	162	UP241
40	KD1708	81	UP8004	122	UP8213		
41	KD1706	82	UP279	123	UP8023		