DISTRIBUTION, ANALYSIS, AND RECOVERY OF PLACER GOLD FROM PORCUPINE MINING AREA, SOUTHEAST ALASKA

by Robert B. Hoekzema, Steven A. Fechner, and Tom Bundtzen,
Alaska Field Operations Center

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UNITED STATES DEPARTMENT OF THE INTERIOR

Donald P. Hodel, Secretary

BUREAU OF MINES

Robert C. Horton, Director

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UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

BP	before present
ft	foot
ft^3	cubic foot
gpm	gallons per minute
hp	horsepower
hr	hour
in	inch
lb	pound
mg	milligram
mi	mile
mi^2	square mile
m.y.	million year
oz	ounce
pct, %	percent
ppm	part per million
ppt	part per thousand
yd^3	cubic yard

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ABSTRACT

The Bureau of Mines (Bureau) and Alaska Division of Mining and Geology (ADMG) completed an evaluation of the placer resources of the Porcupine Mining Area near Haines, Alaska during 1985. The Bureau sampled and evaluated the placer deposits and the ADMG mapped the geology and summarized the glacial geologic history of the area. This report summarizes the results of the study.

Gold was discovered along the Klehini River in 1898. A gold rush ensued which resulted in the discovery of gold on Porcupine Creek and nearby drainages. The Porcupine Mining Area has produced 79,650 oz of raw placer gold, mostly before 1936. Three types of placer deposits occur in the area: (1) stream channel gravels, (2) bench placers, and (3) alluvial fans. Organic material from bench deposits were age dated at 2,100-2,700 years BP. Each of these deposit types was sampled to estimate resources, identify gold fineness, determine mineral development potential ratings for streams and calculate optimum screening sizes for use in recovery plants. Identified resources include 932,000 yd^3 of gravel rated as having moderate or high mineral development potential. Bulk character studies of gravel from Lower Porcupine Creek indicate washing plants should be designed to screen to -1 mesh and recover gold to +80 mesh. Gold fineness of 13 samples ranged from 669 to 902 and averaged 837.

INTRODUCTION

The mineral development potential of the Porcupine Mining Area in southeast Alaska has been evaluated as part of a four year cooperative effort conducted in the Juneau Mining District by the Bureau and the ADMG which was begun in 1985. The Bureau was responsible for site specific investigations including prospect sampling and mapping, calculating identified resources, and placer gold studies. The ADMG was responsible for geologic mapping, geochemical sampling and solving specific geologic problems such as age dating. This report summarizes the results of Bureau and ADMG placer studies in the Porcupine Mining Area during 1985 which included the collection of 78 reconnaissance, 53 channel, and 4 site specific bulk placer samples, surficial geologic mapping of auriferous gravels, and size fractionation studies.

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ACKNOWLEDGMENTS

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STUDY AREA

The Porcupine Mining Area is located in southeast Alaska approximately 30 mi west-northwest of Haines (fig. 1) in the Juneau Mining District. The mining area encompasses approximately 200 mi^2 of land and is bordered on the south and east by the Tsirku and Chilkat Rivers, on the west by the Canadian border, and on the north by Township line 27S (fig. 2). Land access is provided by the Dalton Highway, which runs from Haines, Alaska to Whitehorse, Canada and by numerous logging and mining roads. Access to the upper reaches of Tsirku River is either by helicopter or airboat.

Land status of the area is complex (fig. 2). Much of the mining area is currently managed by the Bureau of Land Management (BLM) and is open to mineral entry. According to BLM records, the area contained 5 patented and 444 unpatented placer claims as of 7/22/85 (49)[4/]. The approximate location of current 1985 mining claims is also shown on figure 2. BLM land status plats should be checked for detailed site specific information.

4/Underlined numbers in parentheses refer to references listed at the end of this report.

PREVIOUS STUDIES

Coastal Indian trade routes had long been in use in the Klehini River valley by the time of the first recorded exploration. G. M. Dawson (18) in 1888, and J. B. Tyrrell (47) in 1892, both members of the Geological Survey of Canada, explored the district as part of a reconnaissance program. A. H. Brooks of the U.S. Geological Survey (USGS) reported on the geology of the area in 1899 (3). The first detailed study of the Porcupine Mining Area was made in 1903 by C. W. Wright of the USGS (52). H. M. Eakin (19), also of the USGS, visited the area in 1916 and provided an excellent discussion of glaciation and placer mining operations in the area. Numerous references to the Porcupine Mining Area are made in USGS "Mineral Resources of Alaska" and related series (4-13, 38-43). B. D. Stewart reported on placer operations in the area in 1926 (45). W. B. Beatty (1) worked on Porcupine Creek in 1936 and wrote a comprehensive thesis concerning the placer deposits of the Porcupine Mining Area while at the University of Washington. More recent studies in the area have

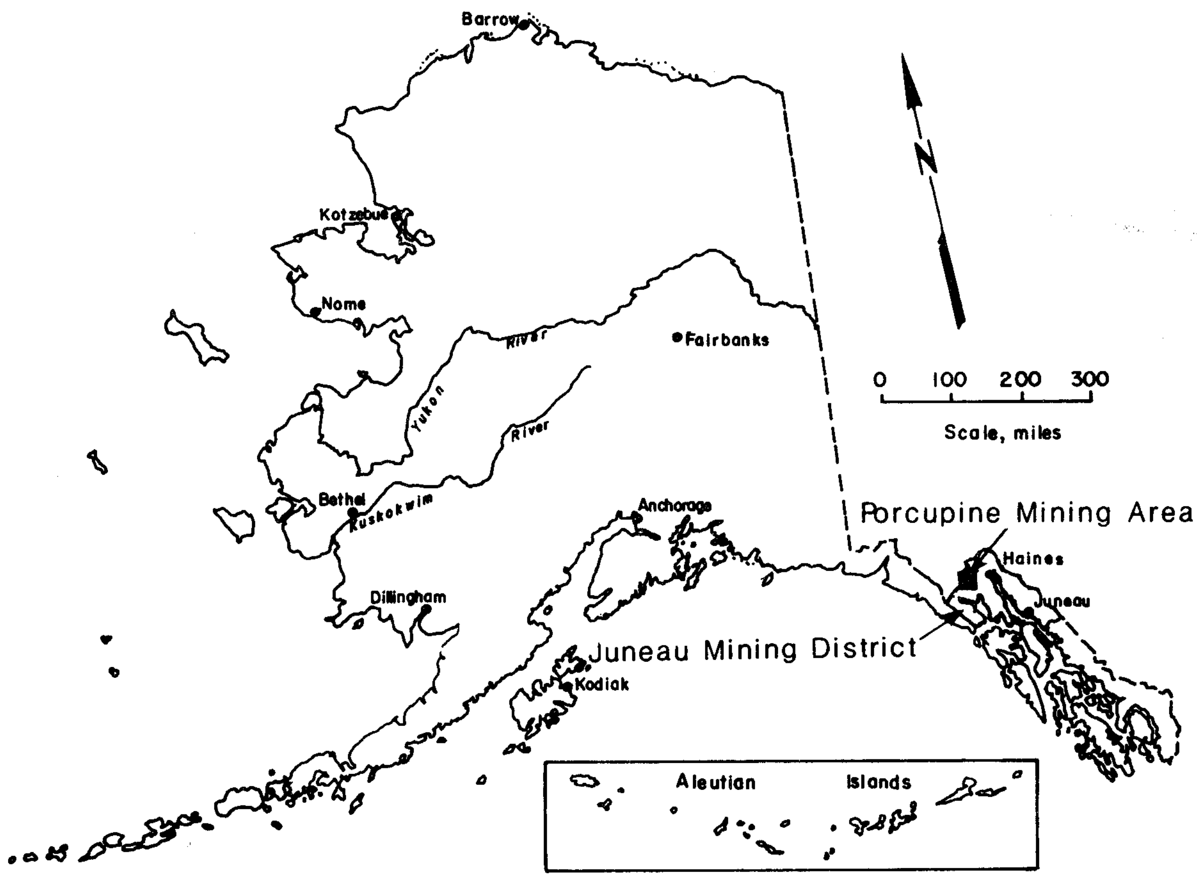
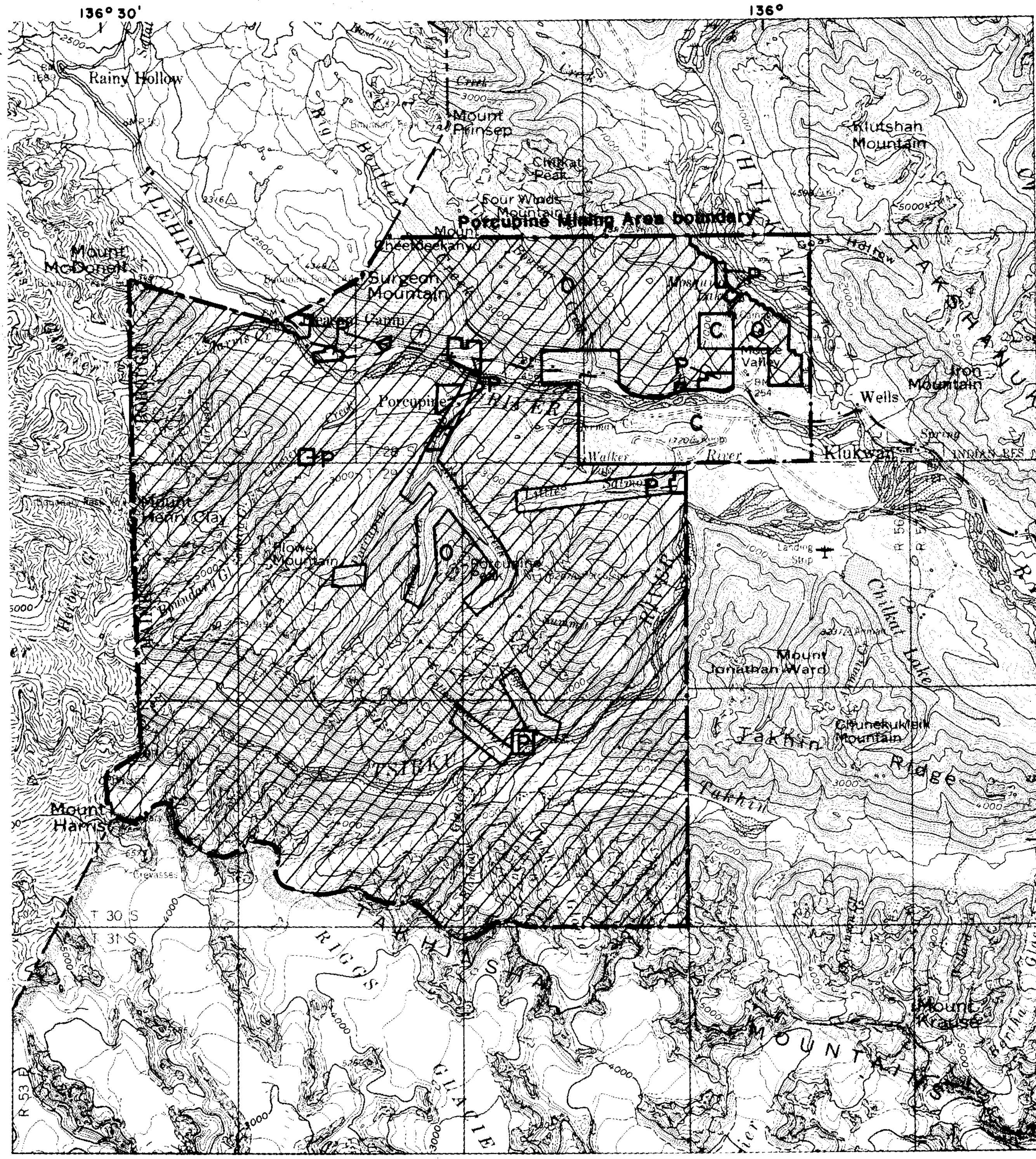


Figure 1. -- Index map of Alaska showing Porcupine Mining Area



Base adapted from U.S.G.S. 1:250,000 Skagway quadrangle

N

0 2.5 5

Scale, miles

Contour interval 200 feet

LEGEND

O (hatched)	Federal or State land - open to mineral exploration and development
P	Patented land - open to mineral exploration and development by owners
C	Land closed to mineral exploration and development
(line)	Land status boundary
(open rectangle)	Approximate location of current (1985) placer mining claims

Figure 2. -- Land status and placer claim map of Porcupine Mining Area

been completed by personnel of the USGS [Winkler and MacKevett (51), MacKevett and others (26), Cobb (16-17)], ADMG [Redman and others (33), Bundtzen (14), Bundtzen and Clautice (15)], and the Bureau [Roberts (36), Still (46)]. The history of the Porcupine Mining Area has been the subject of several recent articles (20-23, 28, 34, 35, 37). The most detailed history of the Porcupine Mining Area has been compiled by Roppel (37).

MINING HISTORY

In the spring of 1898, packers on the Dalton trail panned gold from the gravels of the Klehini River. Shortly after the discovery most of the streams in the Porcupine Mining Area were staked; however, many claims were subsequently dropped because of the low quantities of gold found on many of the drainages. Several drainages in the Porcupine Mining Area have historically produced gold. These include Porcupine, McKinley, Cahoon, Nugget, Cottonwood, and Christmas Creeks. Production records for the Porcupine Mining Area are sparse. Minimum estimated production through 1985 based upon Bureau records (48) and reports by Wright (52), Roppel (37), and Beatty (1), is 79,650 oz (table 1).

Placer gold has reportedly been found on several other drainages in the area including Big Boulder and Little Boulder Creeks, the Tsirku and Klehini Rivers, and western drainages to the Chilkat River north of Mosquito Lake. However, no significant production has been reported.

Porcupine Creek

Mining started on Porcupine Creek in 1898. Production averaged as high as 9,000 oz of gold/yr until 1906, when high water destroyed much of the workings (1). During the early years relatively primitive methods of mining were used to recover the gold (37) such as with picks and shovels, small sluices, and rockers. Ground sluicing (booming) also became a popular method for recovering gold. This technique requires the diversion of the creek into a flume or pre-dug channel which allows the miners to remove large boulders from the original channel and loosen the gravel deposits. The water is allowed to flow back into the original channel to remove the loosened gravel and concentrate the gold in depressions for recovery after the stream has been diverted back into the flume or diversion ditch.

In 1907, the Porcupine Mining Company was organized to consolidate the workings in the area (37). The company erected a flume one mile below the junction of McKinley and Porcupine Creeks at a reported cost of $200,000 (37). This opened up the lower end of Porcupine Creek to gold mining. A trolley lift with 2.5 ft^3 automatic dump buckets was used to feed the hopper with gravel from the dried up creek channel (8). The company operated until 1915, with an average yearly production of 3,000 oz (1). The flume was destroyed by a disastrous flood in 1915.

In 1916, the operations of the Porcupine Mining Company were taken over by the Alaska Corporation. The old flume was repaired and a new flume constructed to feed water to hydraulic mining operations.

TABLE 1. -- Reported placer gold production from the Porcupine Mining Area

Drainage	Active years	Source	Quantity (oz)
Christmas Creek.....	1900-1985	estimated	200
Nugget Creek........	1902-1909	Beatty (1) 1/	350
	1909-1985		100
Porcupine, Cahoon, and McKinley Creeks	1898-1903	Wright (52) 1/	27,000
	1904-1915	Eakin (19) 1/	43,000
	1916-1925	Beatty (1) 1/	6,000
	1926-1936	Greatlander (20) 2/	3/ 500
	1936-1975	Roppel (37)	
	1975-1985	estimated	2,500
TOTAL			79,650

1/Based upon placer gold evaluated at $17.00/oz.

2/Based upon placer gold evaluated at $17.00 prior to 1934 and $30.00/oz from 1934 to 1936. One-half of the production during this period is assumed to have occurred from 1934 to 1936.

3/The Greatlander reported that 78,000 oz of gold were produced during this period. However, this quantity is unsubstantiated by any other source of information available to the authors. Some additional production is likely.

Mining continued until a flood destroyed the flume in September of 1918. Over 6,000 oz of gold were produced between 1916 and 1918 (1).

The next large mining operation began in 1926 when Porcupine Gold Mines (45), which subsequently became the Alaska Sunshine Gold Mining Company, managed by August Fritsch, took over the Porcupine Creek property (1). This company constructed several of the existing buildings at the townsite of Porcupine and a 12,000 ft-long "high line flume" to supply hydraulic water at any needed location on Porcupine Creek below its junction with McKinley Creek. The headgate of the flume was located 0.5 mi above the mouth of McKinley Creek. McKinley Creek was spanned by a bridge 160 ft above the creek bed a few hundred yards above its junction with Porcupine Creek. The flume and related structures were completed near the end of 1928. Mining commenced in 1929 but was shut down at the end of the season due to poor returns on investment. Following extensive exploration work (1) mining operations on Porcupine Creek restarted in 1935 by processing gravels from the MacElvery (dry) channel (fig. 5). Work continued into 1936 until the bridge over McKinley Creek was destroyed by a rock slide. The bridge was rebuilt later in the season. Fritsch died in 1936 and large scale mining on Porcupine Creek ceased. According to the Greatlander (20), Fritsch's records show that the Alaska Sunshine Gold Mining Company recovered $1,700,000 worth of gold from the Porcupine claims but this report has been unsubstantiated by any other source.

Activities since the second World War have been sporadic, but a brief mining resurgence occurred in 1959-1960, when five small operations employing 15 people worked various claims on Porcupine Creek and its tributaries (50). When gold prices soared in the late 1970's and early 1980's, mechanized placer mining was employed and produced up to several hundred ounces annually until 1984 (fig. 3). Jo Jurgeleit, James McLaughlin, Merrill Palmer, and others continue to take out small amounts of placer gold from their claims. Activity in 1985 was limited to minor hand placering with only a few ounces of gold being produced.

McKinley Creek

Mining on lower McKinley Creek (below Cahoon Creek) began at about the same time as activity on Porcupine Creek. Most of this section was mined out by 1904. From 1903-1916, old channels of McKinley Creek up to 200 ft above the current creek level were mined successfully by the Cahoon Creek Mining Company. The last operation of the Cahoon Creek Mining Company consisted of driving a tunnel through a narrow bedrock spur above McKinley Falls to divert the creek into Porcupine Creek and dry up the plunge pool and lowermost section of McKinley Creek (1). Over 4,400 oz of gold were recovered in a few weeks time during 1916 from the plunge pool and stream bed below the falls.

The lower section of McKinley creek has been mined sporadically by hand by individuals and small groups through the years. Recent attempts have been made to mine the plunge pool below McKinley Falls and suction dredges have been used to mine the channel.

Stewart (45) reported that in 1926 six men were mining on Upper McKinley Creek (above Cahoon Creek) about 1 mi above its mouth using "booming" techniques. Reportedly (45) $60,000 were expended on the property but no production figures are known. Upper McKinley Creek has been prospected in recent years using suction dredges and hand

Figure 3. -- Washing plant on Lower Porcupine Creek in 1984.

placering techniques. Significant production has not been reported from Upper McKinley Creek though placer gold concentrations have been identified as suggested by Stewart (45) and demonstrated by Bureau sampling in 1985.

Cahoon Creek

The lower 0.5 mi section of Cahoon Creek was extensively mined by the Cahoon Creek Mining Company from 1908 to about 1913. Wright (52) reports that a small hydraulic plant was set up and operated at the face of Cahoon Glacier in 1902 and 1903. This operation was apparently unsuccessful. A hydraulic plant also reportedly worked on Cahoon Creek from 1910-1913 (9, 13). Hand placer methods have been used to prospect the creek gravels in more recent years but results are unknown.

Glacier Creek

Glacier Creek and its tributaries were orginally prospected and staked in 1899 and 1900 but were undeveloped because of the great gravel depths and low ore grades. A keystone drill was used to prospect lower Glacier Creek in 1911, apparently with encouraging results. A mill was erected and a 2,000-ft-long flume constructed. Mining operations began in 1916 and continued into 1918. Recovery was poor and the operation closed down after working a quarter mile of stream channel. Beatty (1) reports that a quarter of a million dollars was spent to develop the property based upon the drilling returns which later proved to have been salted.

A small eastern tributary to Glacier Creek, known locally as Christmas Creek, was worked by a small hydraulic plant in 1910. This property was patented in 1916. A small heavy equipment operation worked near the mouth of Christmas Creek during the late 1970's with meager results. A total production of 200 oz of gold is estimated on the basis of tailings present and grades determined during 1985 Bureau field work.

Nugget Creek

Placer gold was discovered in Nugget Creek in 1899. Sporadic mining is reported to have occurred from 1902 to 1913, 1929, and since 1980 (1, 19, Wes Childers, personal communication). Eakin (19) reports that approximately 350 ounces of gold were produced by a small hydraulic operation between 1902 and 1909. The operation processed gravels near the mouth of Nugget Creek canyon by diverting the creek into a flume. This both freed the creek channel from water and supplied power to run a derrick used to remove large boulders from the creek. The remains of a small hydraulic plant exist on the east side of Nugget Creek about 1.5 mi above its junction with the Tsirku River. No known reports are available concerning this operation. Suction dredges were used to test the gravels in the lower section of Nugget Creek canyon between 1980 and 1985 with encouraging results. The alluvial fan at the mouth of Nugget Creek was patented in 1934 (49).

Cottonwood Creek

Gold was discovered on Cottonwood Creek in 1899 but workings on the creek never produced gold in significant amounts. The alluvial fan extending along the Tsirku River from Cottonwood Creek to below Nugget Creek was prospected with encouraging results prior to 1912 and a company was formed to dredge the alluvial fan gravels about that time (12). Fifty claims were staked to cover the fan but the ground was abandoned in 1916 (19). Portions of the Nugget-Cottonwood Creek fan were patented in 1934 (49).

Other Streams

Gold has been discovered on several other drainages in the Porcupine Mining Area. These include Big Boulder and Little Boulder Creeks, and the Little Salmon River. None of these drainages have been significant producers according to all historical data available. However, evidence of recent suction dredging and hand placer work exists on the Little Salmon River.

GEOLOGIC SETTING AND MINERALIZATION

Bedrock in the Porcupine Mining Area consists of metamorphosed sedimentary rocks (slates, phyllites, and marbles), which have been intruded by igneous rocks of the the Coast Range complex. The area has been extensively glaciated and glaciers still occur at the headwaters of many drainages.

BEDROCK GEOLOGY

Bedrock geology was examined only in mined areas during the investigation. The various sedimentary, metamorphic, and granitic rocks were originally described by Eakin (19), later by MacKevett and Winkler (26), and most recently by Redman and others (33).

Possibly the oldest rock unit in the area is the Middle to Late Paleozoic Porcupine Limestone or Marble, which forms prominent outcrops of carbonate along the access road on the south side of the Kleheni River and along canyon walls of Porcupine Creek. *Amphipora* - bearing zones on Porcupine Creek suggests Devonian or Mississippian ages.

Overlying the Porcupine Limestone is the Porcupine Slate, which may range in age from Mississippian to Pennsylvanian (33). The slate, sandstone, and siltstone of the Porcupine Slate forms a complex antiform throughout the central portion of the study area. Auriferous lodes cutting this 'slate belt' are believed by many previous workers to be the source of most placer gold in the Porcupine Mining Area.

The western and northeastern portions of the study area are underlain by pillow basalt, carbonate, and volcaniclastic sediments that may be Triassic in age, based on fossils collected in 1985 (Ken Dawson, oral communication, 1985)[5/].

5/Project geologist, Geological Survey of Canada, Vancouver, B.C.

Many of the contact relationships between major layered units are thought to be faults based on the most recent mapping (33). The highest portion of the massif-like upland is composed of a 15 mi^2 granodiorite pluton.

GLACIAL GEOLOGY

This section is a summary of the discussion of glacial geology by Bundtzen (14) to which the reader should refer for a more complete description of the glacial processes in the study area.

The study area bears impressive evidence of extensive glaciation but specific limits of the various Pleistocene and Holocene glacial advances are not well understood. The recent nature of glaciation throughout southeastern Alaska has masked all evidence of ice activity prior to about 70,000 yr BP (27, 31-32) and virtually all glacial deposits and landforms observed today in the Porcupine area are probably Late Wisconsinian (30,000 to 10,000 yd BP) and younger.

The Holocene glacial chronology worked out by Mann (27) in the adjacent Glacier Bay region shows a four-phase history of glacial maxima at 9,000 to 13,000 yr BP, 5,000 to 6,000 yr BP, 2,500 to 3,600 yr BP, and approximately 1,500 yr BP, each separated by periods of deglaciation, downcutting or incision of former glacial valleys, and stream aggradation of major trunk meltwater streams.

These Pleistocene ice advances and readvances resulted in at least three, and possibly four, bedrock-incised channels or terrace levels in the valleys of Porcupine, Cahoon, and McKinley Creeks (shown as Qat_1, Qat_2, and Qat_3 on figs. 4 and 5). Apparently in most cases the remnants of these channels avoided ice scour and were unaffected by later events except for deposition of glacial drift and erratics. The oldest recognized terrace level occurs at 250 to 300 ft above modern canyon levels of McKinley and Porcupine Creeks, followed downstream by channels at 140 to 200 ft, 50 to 75 ft, and a final and most youthful terrace that is 25 to 40 ft above the modern drainages. The oldest terrace level (Qat_1) may be a composite of fluvial material and drift not incised into bedrock.

Radiocarbon samples were collected from an exposed mine cut directly on the channel base of the "dry channel", as described by Beatty (1), which corresponds to Qat_3 shown on figures 4 and 5. The two dates, 2,150 yr BP and 2,640 yr BP (table 2), suggest that the third terrace level on Porcupine Creek was deposited subsequent to the third Holocene glacial advance shown by Mann (27) to have occurred 2,500 to 3,600 yr BP.

TABLE 2. - Summary of radiocarbon analyses of channel gravels from Porcupine Mining Area

Lab number	Field number	C-14 age	Remarks
Beta 11090.	85BTE2........	2,190 $\pm$ 90 BP	Woody material in dry channel near waterfall.
Beta 11091.	85BTE3........	2,640 $\pm$ 100 BP	Wood from base of dry channel, western side of Porcupine Creek

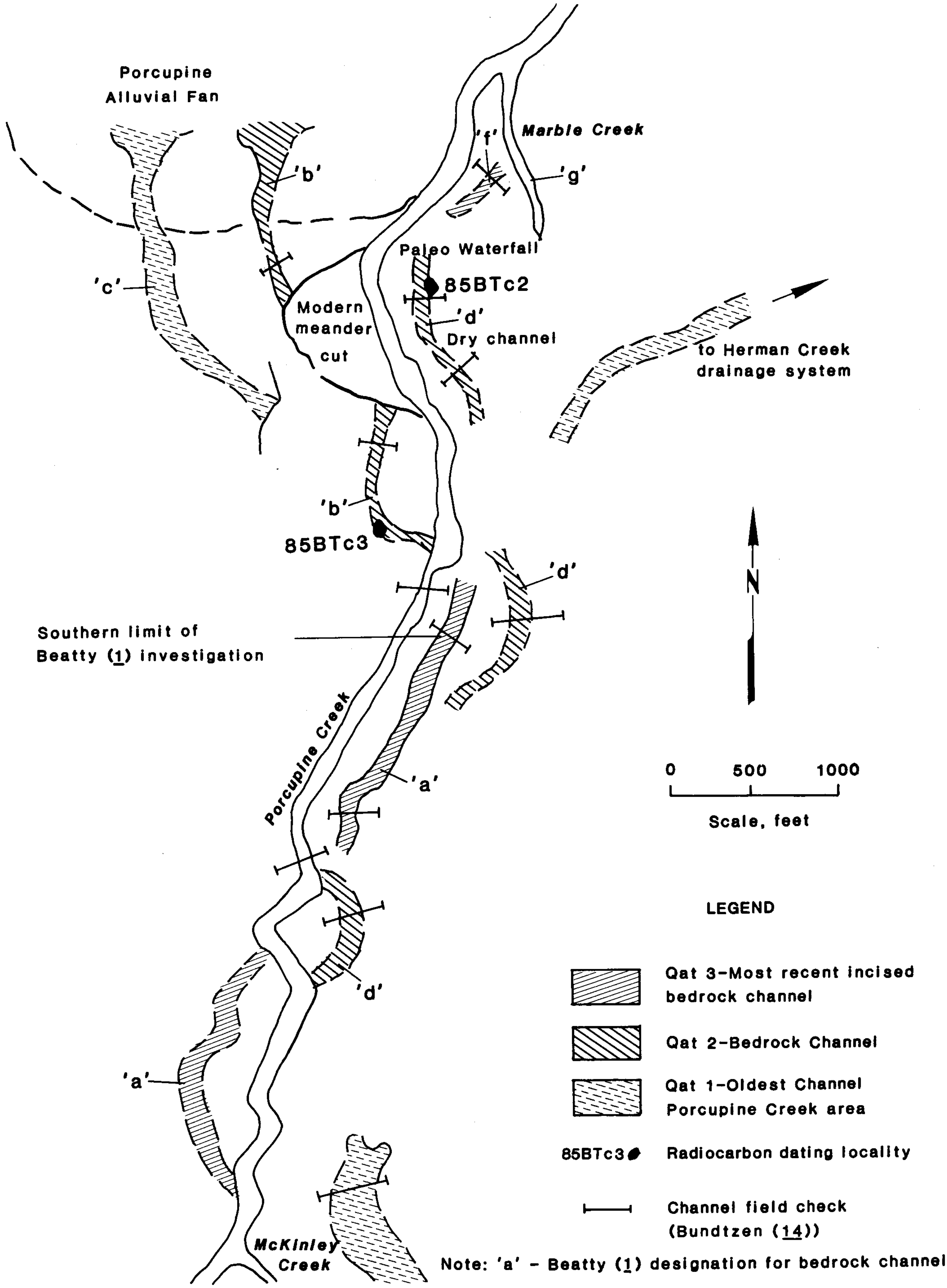


Figure 5. -- Abandoned channels on Lower Porcupine Creek, after Bundtzen (14)

The last Holocene advance [Beatty's (1) second and final retreat] occupied 1- to 2-mi stretches of Porcupine, McKinley, and Glacier Creek valleys below present glacial termini as clearly indicated by recent morainal limits on air photos. It could correlate with the 1,000 to 1,500 yr BP Late Holocene advance described by Mann (27). Beatty (1) reports that the active glacier on Cahoon Creek retreated nearly a mile during the years 1898 to 1937, indicating that the region is still undergoing deglaciation following the latest Holocene advance.

Besides leaving behind multiple drift limits, bedrock-incised bench channels, trimlines, and hanging valleys, multiple glacial episodes also produced perched alluvial and colluvial fans and ice-marginal meltwater channels (fig. 4). The alluvial fan complex of Porcupine and Glacier Creeks (Qaf unit on fig. 4) has obviously had more than one period of aggradational development and the former fan apex was probably at least 1 mi south of its present position. A distributary channel of this fan probably spilled over into the drainage now occupied by Walker Lake. As Porcupine and other alluvial fans built up, the streams developed multiple distributary channels across their surfaces. The barbed tributary effect of the Glacier and Porcupine fans for the last 1.5 mi of their courses to the Klehini River reflects these changes during fan evolution.

Development of alluvial fans on Cottonwood and Nugget Creeks have been significantly influenced by earlier east to west glacial-meltwater features that drained Late Wisconsinian or Holocene valley ice in the Tsirku River. Former ice marginal meltwater channels have left prominently notched, beheaded drainages in the Herman Creek and Walker Lake area, along the Klehini River near the United States-Canada border, and in isolated sections of the Tsirku River (fig. 4). The meltwater channels are incised in glacial drift in contrast to the bedrock incision of fluvial channels previously described.

Elevated, modern terrace alluvium and alluvial fans of Late Holocene age parallel the modern floodplains of the Tsirku and Klehini Rivers and are a result of recent periods of stream aggradation during distributary channel development.

PLACER GEOLOGY

Heavy-mineral placer deposits in the Porcupine Mining Area formed during multiple glaciofluvial cycles previously described. The excellent work of Beatty (1) provides many detailed summaries of placer deposits and their exploitation in the district. Heavy-mineral placer concentrations occur in bench deposits in incised bedrock channels and glacial till, alluvial fans, and modern-stream incisions.

Very high bedrock-stream gradients (fig. 6) indicate that the Porcupine Mining Area, as a whole, is characterized as very immature and nested in a very high energy fluvial environment. The average stream gradient of the study area is about 500 ft/mi compared with averages of 80 to 150 ft/mi in many interior Alaska placer districts.

Bedrock sources of most heavy-mineral concentrations, including the placer gold, have been identified by Eakins (19), Beatty (1), Still and others (46), and Bundtzen and Clautice (15). The most likely

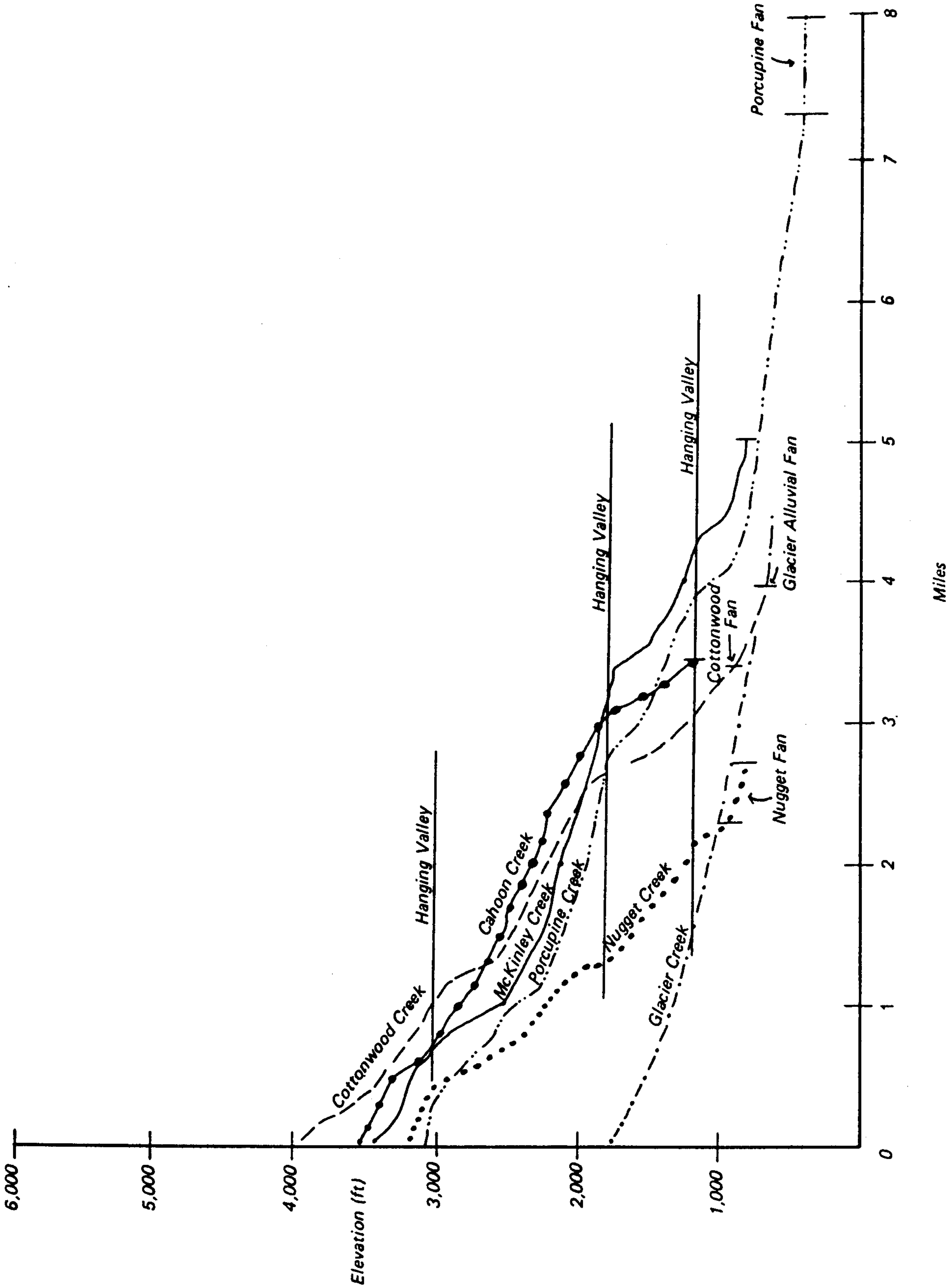


Figure 6. Stream gradients in the Porcupine district, Alaska.

bedrock sources are crosscutting quartz-sulfide-gold fissure veins associated with altered mafic dikes cutting Porcupine Slate in the McKinley and Cahoon Creek drainages. Pyritiferous zones in the Porcupine Slate also contain anomalous gold values ranging up to 1-2 ppm gold (Jan Still, oral communication, 1986)[6/]. Localized

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silver-lead-(gold) deposits, such as those identified in the Summit Creek drainage may also contribute to heavy-mineral placer concentrations (Jan Still, oral communication, 1985). Placer gold in Christmas and Herman Creeks may be derived from deposits in the Porcupine Slate, or alternatively from stratiform metallic mineral deposits in metavolcanic rocks such as the Glacier Creek deposits (26, 46).

Table 3 summarizes trace element and gold fineness of placer gold collected during the course of investigations. ADGGS samples are mainly reconnaissance concentrates (three to five pans of gravel) while most collected by Bureau personnel are derived from processing 0.1 yd^3 channel samples. Sample locations are shown on figure 4. The gold-fineness results are consistent with features observed in the field but the small sample sizes limit geologic interpretations. Because there are significant impurities in the bullion, gold fineness is expressed as a ratio of gold to silver + gold as suggested by Boyle (2) and Metz and Hawkins (29).

Gold fineness on Porcupine Creek and its incised bench deposits ranges from 841 to 909 and averages 866 (7 samples). There does not appear to be a noticeable difference in fineness between the lower elevated fluvial channels and the modern stream though Beatty (1) mentions that the highest bench levels on Porcupine Creek have a distinctly lower fineness than bullion mined in the modern stream.

Placer-gold fineness from McKinley and Cahoon Creeks ranges from 786 to 859 and averages 821 (4 samples); gold extracted from two lode deposits in the area averages 750. Fineness predictably increases downstream with increasing distance from the probable lode sources in these two drainages (25). Results from this study also show an increase in fineness downstream from an average of 821 on McKinley and Cahoon Creeks to an average of 866 on Porcupine Creek.

Fineness of placer gold collected from Nugget and Cottonwood Creeks averages 779 (3 samples), while that of Glacier Creek drainage averages 865 (2 samples), which is very similar to values found in lower Porcupine Creek.

The average overall fineness from the Porcupine Mining Area, using the Boyle (2) method is 837, compared to 820 reported by Smith (44), who used records from four locations on the Porcupine Creek drainage for his analysis. The range of fineness in the Porcupine Mining Area is consistent with those reported by Moiser (30) for epithermal and lower mesothermal temperatures of formation. Bullion was analyzed for the trace metals copper, lead, zinc, and antimony besides the precious metals. Significantly, samples containing detectable copper were found in McKinley and Cahoon Creeks, perhaps suggesting recent

TABLE 3. -- Trace element and gold fineness analyses of placer gold from Porcupine Mining Area[1/]

Field no.	Drainage basin locality (creek)	Sample weight (mg)	Gold (ppt)	Silver (ppt)	Copper (ppt)	Antimony (ppt)	Other (ppt)	True fineness [2/]	Remarks
9047.......	Porcupine.........	21.64	794	140	15	50	1	850	Channel sample 0.1 yd^3, Porcupine Creek.
9096.......	Porcupine.........	64.01	902	90	ND	ND	8	909	Channel sample 0.1 yd^3, but below channel.
9081.......	Porcupine.........	35.36	817	145	ND	ND	38	849	Channel sample 0.1 yd^3, modern Porcupine channel.
9043.......	Porcupine.........	34.75	812	144	ND	ND	44	849	Channel sample 0.1 yd^3, bench upstream from cabin.
9002.......	Porcupine.........	64.94	822	155	ND	ND	29	841	3 pans on bedrock from bench west side of creek.
9037.......	Porcupine.........	67.18	838	107	ND	ND	55	886	Channel sample 0.1 yd^3.
9119.......	Porcupine.........	50.70	838	115	ND	ND	47	879	0.5 pan, dry channel, east side Porcupine Creek.
9112.......	McKinley..........	65.82	811	187	ND	ND	2	813	Channel sample 0.1 yd^3, on bedrock.
9109.......	McKinley..........	4.97	779	170	ND	ND	51	820	Channel sample 0.1 yd^3, boulder layer under colluvium.
9106[3/].......	McKinley..........	33.74	669	259	22	ND	50	721	From sulfide vug, 'ladder vein'.
84BT313....	McKinley..........	16.15	855	136	9	ND	0	859	3 pans, modern flood-plain, boulder-rich.
84BT317a[3/]...	McKinley..........	8.15	780	219	ND	ND	1	780	From Golden Eagle vug vein.
9054.......	Cahoon............	70.10	738	201	37	11	13	786	Channel sample 0.1 yd^3, on and in bedrock cracks.
9005.......	Glacier...........	36.60	855	136	ND	ND	9	863	Channel sample 0.1 yd^3, 6 in gravel on bedrock.
85BT25.....	Christmas.........	9.01	835	129	ND	ND	36	866	3 pans from auriferous till on bedrock.

See footnotes at end of table.

TABLE 3. -- Trace element and gold fineness analyses of placer gold from Porcupine Mining Area1/ -- Continued

Field no.	Drainage basin locality (creek)	Sample weight (mg)	Gold (ppt)	Silver (ppt)	Copper (ppt)	Antimony (ppt)	Other (ppt)	True 2/ fineness	Remarks
9061.......	Nugget............	60.09	722	236	ND	ND	42	754	Channel sample 0.1 yd^3, fluvial gravel and till.
85BT29.....	Nugget............	28.40	756	207	ND	ND	37	785	3 pans, modern floodplain, not on bedrock.
85BT28.....	Cottonwood........	18.30	769	193	ND	ND	38	799	3 pans, modern floodplain, not on bedrock.

1/Raw placer gold derived from channel and grab samples collected by Bureau and ADMG. All elements presented in parts per thousand; gold and silver determinations by commercial laboratories in Vancouver, B.C., Lakewood, Colorado, and ADMG Mineral Laboratory in Fairbanks, Alaska. Zinc and lead were looked for but, not detected.

2/'True Fineness' as defined by Boyle (2, p. 197) is the ratio of gold to gold plus silver times 1,000 or

$$\frac{Au}{Au + Ag} \times 1000$$

3/Gold panned from 'hardrock' quartz-sulfide vein near Golden Eagle prospect (15).

ND = not detected.

association with lode sources. The gold to copper ratio is much too high for typical gold placers of any temperature range, but the presence of antimony in single samples on Cahoon and Porcupine Creeks also suggests formation in epithermal or lower mesothermal temperature ranges (30).

Heavy mineral concentrates from nine streams are summarized in table 4. Sample locations are shown on figure 4. A preponderance of magnetite in virtually all drainages suggests that magnetometer exploration techniques may be useful in delineating buried channels and other heavy mineral concentrations. Pyrite is predictably abundant in Porcupine, Cahoon, McKinley, Nugget, and Cottonwood Creeks, where it could be derived from pyritiferous zones in the slate as well as epigenetic-vein deposits. Scheelite and uncommonly cassiterite are present in McKinley, Cahoon, and Cottonwood Creeks but the minor concentrations are probably not economically noteworthy. Barite is abundant in Glacier Creek and in the immature placers of the Herman Creek area. Its presence in the Herman Creek drainage suggests that barite mineralization may exist in metavolcanics underlying the thick glacial drift that blankets the area. Massive barite-sulfide deposits in metavolcanics at the head of Glacier Creek are probably the source of barite in this drainage.

Placer gold from McKinley, Porcupine, Nugget, and Christmas Creeks was examined under the microscope in hopes of delineating characteristics of transport and origin of the bullion that has been mined. Consistently, two distinctive types of gold are present in the analyzed concentrates: well-worn, rounded, bright 'nugget' gold that shows evidence of fluvial transport, and small wire-like grains with quartz and undetermined gangue mineralogy that shows little evidence of stream transport. There may be either more than one lode source present, or alternatively, proximal lode gold and 'nugget' gold that has been transported by fluvial mechanisms.

Beatty (1) and the authors have noted a general lack of fine gold (100 mesh or smaller) in the Porcupine Mining Area. The extremely high-energy nature of placer formation in the area suggests that virtually all fine gold has been flushed down the streams and possibly out of the study area. However, the Glacier, Porcupine, and Nugget alluvial fans represent significantly lower energy fluvial environments than those of the main feeder streams entering into the lower valleys, suggesting that alluvial fans may have accumulated part of the fine-gold fraction absent in the main-production streams.

Gold was panned from a thick section of glacial till exposed in Christmas Creek, a tributary of Glacier Creek during this study. The gold was apparently interspersed throughout at least the lower 6 ft of till with no apparent concentration on bedrock. The bullion is very fine-grained, well-worn 'glacial' gold possibly due to milling effects of glaciation. Although Christmas Creek was the only locality where gold was recognized in till, its existence, as well as that mentioned in till by Beatty (1) in other drainages, suggests that 'glacial gold' may be an intermediate host between hard-rock sources and downstream accumulations in fluvial deposits.

TABLE 4. -- Mineralogical identifications of selected pan concentrate and placer samples from Porcupine Mining Area

Field no.	Drainage	Major >15%	Minor (3-15%)	Trace <3%	Remarks/field notes
9043[1/]...	Porcupine..........	Magnetite (60%)	Sulfide	Zircon, magnetite	32 gold colors iron stained and smoothed on edges.
9012[1/]...	Porcupine..........	ND	Pyrite, magnetite	Zircon, garnet, scheelite	24 gold colors; some shiny and rodlike.
9037[1/]...	Porcupine..........	Magnetite (25%)	Pyrite	Zircon, garnet	22 gold colors, iron stained
85BT32[2/].	Porcupine 'Palmer' bench level (Qat_2).	Magnetite (30%), ilmenite (10%)	Pyrite, sphalerite, zircon	Idocrase, cassiterite (?), pyrrhotite	37 flat-shaped colors; 1-2 pennyweight nugget; gold in Fe rug-like features on bedrock; gold heavily Fe stained; derived from pyrite ?
85BT35[2/].	McKinley...........	Pyrite (65%), magnetite (15%)	Sphalerite (6-8%)	Scheelite (30 grains), cassiterite, pyrrhotite	7 colors - bright rounded 'glacial gold'?
84BT313[2/] 85BT42.	McKinley...........	Magnetite (65%), amphibole	Garnet, pyrite, ilmenite	Cassiterite, bornite	150 colors; both chunky Fe stained type; bright rounded fine 100 mesh; Bureau sample contains idocrase.
9054[1/]...	Cahoon.............	Magnetite (70%)	Garnet, zircon	Sulfide (pyrite)	128 colors of gold; biggest smooth; some are bright and shiny and haven't traveled far.
85BT25[2/].	Christmas Creek.....	Magnetite (15%), ilmenite (10%)	Pyrite, barite	Scheelite, undetermined sulfides	6 colors of gold, smooth and bright, sample very clay rich.
85BT44[2/].	Glacier Creek.......	Magnetite (25%), barite (15%)	Amphibole/pyroxene	Undetermined sulfide	No gold observed; barite grains up to 0.2 in diam.
85BT28[2/].	Cottonwood Creek....	Pyrite (30%), magnetite (25%)	Pyroxene	Zircon	35 rounded to angular colors; Bureau sample contains scheelite, olivine.

See footnotes at end of table.

TABLE 4. -- Mineralogical identifications of selected pan concentrate and placer samples from Porcupine Mining Area -- Continued

Field no.	Drainage	Major >15%	Minor (3-15%)	Trace <3%	Remarks/field notes
85BT29[2/].	Nugget Creek........	Pyrite (45%), magnetite (35%)	ND	Scheelite, amphibole	Rounded colors indicate transportation.
85BT55[2/].	Herman Creek........	Barite (20%), magnetite (15%)	Amphibole	ND	Abundant barite grains; no gold.
85BT57[2/].	Marble Creek........	Magnetite (15%), sulfide (pyrite)	ND	Zircon, garnet	No gold observed, some pyrite as cubes up to 0.4 in diam.

1/Visual inspection including ultraviolet radiation by Steve Fechner, Bureau.

2/X-ray diffraction analyses of 3.3 specific gravity fractions augmented by visual inspection and ultraviolet radiation; 1984 analyses by N. C. Veach; 1985 analyses by T. K. Bundtzen (ADMG).

ND - Not determined.

BUREAU OF MINES INVESTIGATION

In 1985, the Bureau collected 78 reconnaissance, 53 channel, and 4 site specific bulk placer samples. All of the major streams in the mining area were sampled, with at least one sample taken from each drainage. All site specific bulk samples were taken from lower Porcupine Creek.

The procedure for collecting reconnaissance placer samples consisted of processing, on the average, 0.1 yd^3 of gravel through a portable aluminum mini-sluice box. Where use of the sluice box was not feasible, pans were used. Sixteen slightly heaping 16-in gold pans equal 0.1 yd^3 of gravel.

The procedure for channel placer sampling consisted of digging an approximate 1 ft x 1 ft channel from the top of a gravel section to bedrock (whenever feasible). The gravel taken from the channel was processed in 0.1 yd^3 increments through a hydraulic concentrator.

The concentrates from all of the samples were saved and were examined with a binocular microscope to identify heavy minerals present and examine the character of the gold (table 4). Gold particles which weighed greater than approximately 0.0001 oz were recovered from the concentrates by use of a pan. The concentrates have been retained for future chemical analysis. The gold was weighed and thirteen samples of gold were sent to the ADGGS laboratory in Fairbanks for fineness determination. Results of the fineness determinations and sampling are summarized in table 3 and in the appendix, respectively.

The procedures for taking site specific bulk samples were to dry screen, using 1, 2, and 4-in mesh screens, 560 to 690 lbs of gravel in the field. The plus 1, 2, and 4-in size fractions were weighed, washed through a hydraulic concentrator, and discarded in the field. The minus 4 mesh fraction was bagged and shipped to the Bureau's processing lab in Anchorage, Alaska. The samples were then dried and screened to +6, +10, +14, +20, +30, +40, +50, +60, +70, +80, +100, +200, and -200 mesh sizes. The +100 mesh and greater size fractions were separated by using a sluice and pan. The free gold was separated from the heavy mineral concentrates by panning.

RESULTS OF RECONNAISSANCE AND CHANNEL SAMPLING

Sample locations are plotted on figures 7, 8, and 9 and sample results are listed in the appendix. Of the 78 reconnaissance and 53 channel samples collected 35 were found to contain values greater than 0.005 oz/yd^3 Au.

Results from reconnaissance and channel sampling were used to give each stream a mineral development potential rating for placer gold using one of four levels: "high", "moderate", "low", and "unknown" (table 5). These ratings are estimates based on an evaluation of grades and extent of mineralization as well as other factors such as depth of overburden, presense of large boulders, and stream configuration.

A deposit of high mineral development potential would, by definition, have high grades (>0.01 oz/yd^3 Au) and probable continuity of mineralization. A deposit of moderate mineral

TABLE 5. -- Mineral development potential ratings and identified resource estimates for drainages in the Porcupine Mining Area

Drainage	Mineral development potential				Identified resources (yd^3)
	High	Moderate	Low	Unknown	
Big Boulder..........			X		ND
Cahoon..............		X			10,000
Christmas...........		X			42,000
Cottonwood..........				X	ND
Glacier.............			X		ND
Klehini.............				X	ND
Little Boulder.......			X		ND
Little Salmon........			X		ND
McKinley	X				20,000
Nugget Channel.......		X			3,000
Alluvial fan..				X	2,000,000
Porcupine - (lower) Channel..........		X			500,000
Bench............	X				152,000
Alluvial fan......				X	6,000,000
Porcupine - (upper)..			X		ND
Summit..............			X		ND
Tsirku...............				X	ND

1/Identified resources include auriferous gravels identified by the Bureau in 1985. Additional hypothetical resources are likely to exist but were not evaluated.

ND-Not determined

727,000

7770
24000
31770

development potential would have either a high metal content or continuous mineralization identified but not both. A deposit with low mineral development potential would contain uneconomic grades and/or show little evidence of continuity of mineralization. For example, a placer deposit with grades below 0.001 oz/yd^3 Au would rank as low. Similarly, deposits containing less than 5,000 yd^3 would rank low unless the grade was very high. Unknown mineral development potential has been assigned to placer occurrences having little or no available geologic information.

Resource estimates were made for streams having moderate or high potential for placer gold mineral development and for the Nugget and Porcupine Creek fans. Resource estimates were derived by multiplying the length of the deposit being evaluated by the average width (as identified from available maps or from tape and compass traverses) by the average depth of the gravel. Average depths used were based upon trenching results except in the case of the Porcupine and Nugget Creek fans where assumed depths are used due to lack of information. The results of these estimates are listed on table 5.

The following drainages will be discussed in greater detail below because of their moderate to high mineral development potential: Porcupine, McKinley, Cahoon, Nugget, and Christmas Creeks. Glacier and Cottonwood Creeks will also be discussed because of their historical interest.

PORCUPINE CREEK

Porcupine Creek is a steep rapidly downcutting drainage, with an average gradient of 350 ft/mi (fig. 6). Gold was discovered on Porcupine Creek in 1898. Since then over 77,000 oz of gold have been produced from the creek and its tributaries. Reportedly (1) little gold was produced from Porcupine Creek above its junction with McKinley Creek, and during this study six reconnaissance samples taken above the junction contained nondetectable to 0.0004 oz/yd^3 Au (81, 107-111)[7]. The following discussion pertains to lower Porcupine Creek (below McKinley Creek).

7/Numbers refer to samples listed in the appendix and found on figures 6-8.

Three categories of placer deposits occur on Lower Porcupine Creek: abandoned channel and bench deposits; recent stream gravels; and an alluvial fan. Bureau sampling identified the highest grades in the abandoned channels and bench deposits where the identified resources are limited in quantity. A much larger potential resource occurs in the alluvial fan but grades are unknown.

Abandoned Channels and Bench Deposits

Figures 4 and 5 depict a series of bedrock-incised, ancestral-fluvial channels of at least three ages in Porcupine Creek valley, each formed during glaciofluvial activity previously described. The original channel designations by Beatty (1) have been correlated with the assigned geologic units on figures 4 and 5 by Bundtzen (14).

According to Beatty (1):

> "Channels 'a', 'b', 'c', and 'd', because of good bedrock conditions, are considered likely to contain placer concentrations in natural riffles formed by the bedrock. Channel 'a' is the narrowest and the steepest of all; the stream coming down that channel must have been very rapid. These conditions make this less likely to be of value than others. However, the fact that a later wing of the stream cut off the lower portion of this channel, leaving a bluff twenty ft high across the end makes a section where bedrock may quickly be reached for hand prospecting...The greater widths, more gradual slopes (gradients) and considerably greater lengths of channels 'b' and 'c' make these more favorable for consideration...Depth to bedrock in these channels is unknown, but if the upper open channels of 'b' and 'c' prove to be profitable, a geophysical survey of their extensions in bedrock under the patented ground -- the channels to be mined...Porcupine Creek was carrying gold at the time it was occupying these three channels."

Figures 8 and 9 identify five gravel resource areas on Lower Porcupine Creek blocked out on the basis of channel samples collected by the Bureau in 1985. These areas consist of abandoned channel and bench gravels, some of which correlate with old channels identified by Beatty (1) in 1936 and Bundtzen (14) in 1985 (fig. 5). Area 4 corresponds to channel f (Qat_3), area 3 to channel d (Qat_2), and area 2 incorporates a portion of channel b (Qat_2). These gravels are apparently quite young as wood obtained from Beatty's "dry channel" was dated at about 2,200 years BP (table 2, sample 85BTc2) (fig. 5). The abandoned channels are known to contain gold as proven by past production and Bureau sampling. Portions of channels d, f, and g have been mined historically. Channel d was reportedly a significant producer (1).

The Bureau collected twelve samples from channels labeled as b (31), d (60-63), e (64), f (39-41, 50-51), and g (22) on figures 5 and 8. These samples contained from a trace to 0.021 oz/yd^3 Au (appendix). Thirty-eight additional channel samples were collected from abandoned channels and bench deposits located further upstream in the area referred to locally as the "mushroom" (67-68, 73), area 5 (65-66, 69-72) and old channel (74-76) on fig. 9, and from bench deposits in areas 1 (32-43) and 2 (44-49, 53-59) on fig. 8. These samples contained from a trace to 0.058 oz/yd^3 Au (35). Gold sizes were 4% larger than 0.08 in, 20% from 0.04 to 0.08 in, 25% from 0.02 to 0.04 in, and 51% smaller than 0.02 in. Concentrates contained 5 to 70% magnetite, up to 10% pyrite, and less than 1% zircon, garnet, and scheelite. The balance of the concentrates consist of rock fragments and quartz (table 4).

Samples collected indicate a collective identified resource in the 5 resource areas of approximately 152,000 yd^3 grading 0.0106 oz/yd^3 Au. These values are likely to be lower than actual values as bedrock was not reached at all channel sample sites. Table 6 summarizes the quantities of gravel and weighted average grades for each of the 5 areas.

TABLE 6. -- Identified resources in bench and abandoned channel deposits, Porcupine Mining Area

Area	Figure	Volume (yd^3) 1/	Grade (oz/yd^3 Au) 2/	Samples
1	5	21,000	0.0215	B 3, 32-43
2	5	75,000	0.0087	B 4, 44-59
3	5	23,000	0.0106	60-63
4	5	20,000	0.0038	39-41, 50, 51
5	6	13,000	0.0145	B 2, 65-72
TOTAL		152,000	0.0106	

1/Volumes were calculated by multiplying the surface area of the block times a thickness chosen on the basis of field information if available. Thickness figures used tended to be minimum values.

2/Grades were calculated by averaging the grades determined for each channel. No weighting factors were used. These values are likely to be lower than the actual values as bedrock was not reached at every sample site. However, gold values are distributed throughout the gravel. Best values are correlated with coarse gravel layers.

Additional resources are known to exist along upstream portions of Porcupine Creek but were not evaluated as part of this study. Some of these deposits, such as at Bear Gulch (fig. 4), have been previously mined but unmined deposits which warrant further evaluation also remain.

Recent Stream Gravels

The present day stream gravels consist of poorly to moderately well sorted gravels containing appreciable silt and boulders weighing up to several tons. These gravels have been worked historically with apparently good results.

The Bureau collected five samples (26-27, 52, 77, 80) from recent gravel deposits. These samples, which contained from a trace to 0.004 oz/yd^3 Au (80), are representative of surface values only. Since gold values in the Porcupine mining area are concentrated on bedrock, higher values should be anticipated at depth. The gold sizes were 3% between 0.04 and 0.08 in, 11% from 0.02 to 0.04 in, and 86% less than 0.02 in. The concentrates consisted of from 15 to 35% magnetite, 5 to 45% pyrite, and minor percentages of zircon, garnet, and scheelite (table 4). Results indicate gold is continuing to be transported by Porcupine Creek during flood stages. The best values are concentrating just below McKinley Creek which is the acknowledged source of most of the Porcupine Creek placer gold. The McKinley Creek junction area of Porcupine Creek has been mined several times in the past. Apparently, placer gold in this area reconcentrates periodically depending upon flood intervals. However, little gold appears to have been transported downstream to the fan area in recent years. Several thousand feet of stream bed beginning about 1,000 ft below McKinley Creek and extending to the southern limit of the Beatty (1)(fig. 5) investigation have not been mined completely. This section is virtually inaccessible to large heavy equipment but suction dredging might be possible. The channel gravels of Lower Porcupine Creek comprise an identified resource of at least 500,000 yd^3 of unknown grade based upon an average thickness of 18 ft and an average width of 90 ft (table 6). Actual thickness of mined sections is reported to have exceeded 40 ft in some locations (37).

Alluvial Fan

The alluvial fan gravels consist of 12-15 ft of recent stream gravels overlying an unknown thickness of older gravels. Old channels correlative with older abandoned channels along Porcupine Creek are anticipated to occur beneath the fan. To date these potentially gold-bearing channels have not been identified. Some drilling is reported to have occurred in the early 1900's but results are unknown. Rumors suggest that bedrock was encountered at a depth of 70 ft in at least one hole.

The Bureau collected eight samples (9-10, 23-25, 28-30) on the alluvial fan. However, these are mostly representative of recent surface gravels and with the possible exception of samples (24) and (30) did not test the older channel deposits which may exist at depth. Results were encouraging however as these samples recovered from a trace to 0.011 oz/yd^3 Au (30). The gold sizes consisted of 1% greater than 0.08 in, 23% between 0.04 and 0.08 in, 24% between 0.02 and 0.04 in, and 52% less than 0.02 in. The concentrates contained magnetite (up to 40%), garnet, zircon, and minor pyrite and scheelite.

The Porcupine Fan contains in excess of 6 million yd^3 of potential resources based upon a length of 2,400 ft, width of 1,800 ft, and depth of 40 ft (table 5). Most of this volume will likely prove to be uneconomic to mine. However, potential exists for the presence of several potentially high grade channels at depths of less than 100 ft. Additional evaluation of this resource is warranted.

MCKINLEY CREEK

McKinley Creek is the largest northwest flowing tributary of Porcupine Creek. The average gradient of the creek is nearly 500 ft/mi (fig. 6). A lode gold deposit is located adjacent to the creek at 1,800 ft elevation approximately 2 mi above its junction with Porcupine Creek (fig. 7). Free gold can be panned from the sulfides in the lode deposit.

By 1904, the last mile of McKinley Creek below Cahoon Creek had been mined. It was remined in 1908. Abandoned channels have also been mined on the west and east sides of McKinley Creek below Cahoon Creek. Approximately 4,500 oz of gold were taken out from below McKinley Falls, which is located at the junction of McKinley and Porcupine Creeks.

Bureau reconnaissance samples (92-98) collected above the lode deposit contained from less than 0.0004 to 0.0056 oz/yd^3 Au. Samples taken below the lode deposit (83-91) contained from less than 0.0004 to 0.0539 oz/yd^3 Au. The concentrates contained up to 30% magnetite, 10% pyrite, minor zircon, garnet, and scheelite. The gold consisted of rough angular fragments with 0.54% greater than 0.08 in, 8.45% between 0.04 and 0.08 in, 13.31% between 0.02 and 0.04 in, and 77.7% less than 0.02 in in size.

Identified resources consist of narrow point bar deposits and channel deposits comprising from a few hundred to 2,000 yd^3 each. Approximately 20,000 yd^3 grading from 0.001 to 0.054 oz/yd^3 Au are estimated to occur on McKinley Creek between sample location 91 and Cahoon Creek (fig. 7). Additional resources exist below Cahoon Creek but this section has been mined several times in the past and grades of the remaining gravels are unknown.

CAHOON CREEK

Cahoon Creek is a steep northeast flowing tributary to McKinley Creek. The average gradient is 650 ft/mi (fig. 6). Very little gravel is present in the channel of the creek, with much of the stream flowing on bedrock. Cahoon Creek has been recognized by miners as a source for the gold on McKinley and Porcupine Creeks. The lower 0.5 mi of the creek has been extensively worked.

Steep terrain and the presence of large amounts of brush precluded sampling of the lower one mi of the creek. Sampling was also impeded by the lack of gravel present. The nine samples taken indicate that the gold concentration increases as the junction with McKinley Creek is approached (99-106). The samples contained from less than 0.0004 to 0.045 oz/yd^3 Au. The concentrates contained greater than 70% magnetite, with minor pyrite, zircon, and garnet. The gold is nuggetty with 1% greater than 0.08 in, 8% between 0.04 and 0.08 in, 8% between 0.02 and 0.04 in, and 83% less than 0.02 in in size.

Limited quantities of channel gravels occur in Cahoon Creek (table 5). Some potential for abandoned channels or bench deposits may exist but these have generally been covered or diluted with colluvium and avalanche debris. The channel gravels might be successfully mined on a small scale using suction dredges, especially along the lower 1.5 mi of the creek. An abandoned channel of Cahoon Creek which joins McKinley Creek about 0.25 mi upstream from the current junction should be investigated.

NUGGET CREEK

Nugget Creek flows south into the Tsirku River. Its average gradient is over 900 ft/mi (fig. 6). Placer deposits are present as alluvium/colluvium in the stream bottom, abandoned channels at high elevations on the east side of the creek, and an alluvial fan at the mouth of the creek. Alluvium in the lower canyon of the creek is from 12 to 20 ft deep. Gold is found on or near bedrock, with little gold found in the overlying gravels.

The Bureau collected eleven reconnaissance samples from Nugget Creek and its alluvial fan (116-126). The best value (0.0138 oz/yd^3 Au) was in a sample (116) collected at the mouth of an abandoned channel of Nugget Creek adjacent to the Tsirku River. Only minor amounts of gold (trace to 0.0007 oz/yd^3 Au) were found in the creek itself. A sample collected from a hydraulic cut at 2,550 ft elevation on the east side of the creek contained 0.0006 oz/yd^3 Au (122). Gold sizes were 0.3% greater than 0.08 in, 2.4% from 0.04 to 0.08 in, 4.3% from 0.02 to 0.04 in, and 93% less than 0.02 in. Concentrates contained from 25 to 70% magnetite, less than 1 to 70% pyrite, and minor percentages of zircon, garnet, scheelite, and galena.

Gravel resources in the existing stream channel are minimal in volume but have been shown to contain coarse gold by recent suction dredging operations. The alluvial fan contains an estimated 2,000,000 yd^3 of identified resource but the grade remains unknown. Only portions of this volume would be minable as high grades would likely be restricted to channels.

COTTONWOOD CREEK

Cottonwood Creek is a southeast flowing tributary of the Tsirku River located approximately 1 mi west of Nugget Creek. The average gradient of the creek is 750 ft/mi (fig. 6). Encouraging amounts of gold have been found in the creek, but no extensive mining has been done.

The Bureau took three reconnaissance samples (113-115) from the creek and found from less than 0.0004 to 0.0005 oz/yd^3 Au. Concentrates contained from 10 to 20% magnetite, up to 10% pyrite, and minor percentages of garnet, zircon, and minor scheelite (table 5).

Gravel resources in the creek channel are very limited due to the steep gradient and narrow bedrock canyon. A significant though untested identified resource does exist in the alluvial fan at the mouth of the creek. This fan coalesces with the Nugget Creek fan. Abandoned channels have been identified in the fan between Cottonwood and Nugget Creeks which should be investigated.

GLACIER CREEK

Glacier Creek is a northeast flowing tributary of the Klehini River and is located approximately 2 mi west of Porcupine Creek. The creek is less steep than most of the creeks of the area, with an average gradient of 250 ft/mi (fig. 6).

The Bureau's reconnaissance sampling of the drainage found no significant recoverable gold values in 7 samples collected (8, 12-14, 19-21). The concentrates contained up to 70% sulfides (mostly pyrite), 10% magnetite, minor garnet, and zircon.

Glacier Creek contains a significant gravel resource. However, no evidence of recoverable gold values in these gravels exists. Christmas Creek is the only auriferous tributary to Glacier Creek identified to date.

CHRISTMAS CREEK

Christmas Creek is a small north flowing eastern tributary of Glacier Creek. The gradient is 1,000 ft/mi.

The Bureau collected four reconnaissance samples from gravels exposed in the mining cut near the junction of Christmas and Glacier Creeks (15-18). Results indicate that there is a relatively equal distribution of gold through 8 ft of gravel. The value of the gravel averages 0.0065 oz/yd^3 Au. The gold is rough and nuggetty with 3.8% greater than 0.08 in, 24% from 0.04 to 0.08 in, 12.7% from 0.02 to 0.04 in, and 59.5% less than 0.02 in in size. The concentrates contained magnetite, zircon, garnet, minor pyrite, and scheelite (table 4).

Identified resources are largely restricted to the lower 0.5 mi of the creek. The lowermost section of the creek in the vicinity of the workings is estimated to contain 12,000 yd^3 of identified resource grading 0.0065 oz/yd^3 Au. An additional resource of up to 30,000 yd^3 is estimated to occur further upstream (table 5).

RESULTS OF SITE SPECIFIC BULK PLACER SAMPLING

Four site specific bulk placer samples (B1-4) were collected from previously unworked gravels on Porcupine Creek for purposes of analyzing gravel and gold particle sizes. Because of the disseminated nature of most placer gold within a gravel deposit, the gold from the channel samples taken at the site specific sample locations was also screened and weighed. The weights of the gold recovered from the channel samples were added to the weights recovered from the site specific samples to reflect a larger sampling volume and are listed in table 7. Because of this the totals on table 7 cannot be used to calculate grades. Histograms of the precentages of gravel and gold in the mesh sizes are shown on figures 10-14.

TABLE 7. -- Results of site specific bulk placer samples collected from Lower Porcupine Creek

Sieve size (mesh)	Sample B-1		Sample B-2		Sample B-3		Sample B-4	
	Gravel weight (lb)	Gold weight (grams)	Gravel weight (lb)	Gold weight (grams)	Gravel weight (lb)	Gold weight (grams)	Gravel weight (lb)	Gold weight (grams)
+1.............	308	0	300	0	360	0	395	0
+2.............	33	0	40	0	22	0	42	0
+4.............	70	0	78	0	54	0	79	0
+6.............	17.25	0	10.75	0	10.5	0	14	0
+10............	41	0	35.75	0	28	0	42.8	0
+14............	20	0	17.6	0.0989	12.75	0.0824	19.4	0.0405
+20............	20	0.0025	17.5	0.0208	11.8	0.0206	18	0.0314
+30............	18.75	0.0060	15.75	0.0475	10.75	0.0654	16	0.0322
+40............	16.5	0.0049	13	0.0078	9.75	0.0294	13.4	0.0117
+50............	16	0.0028	8.5	0.0094	8.5	0.0202	11.25	0.0163
+60............	6.75	0.0007	4.8	0	4	0.0051	4	0.0038
+70............	5.25	0.0004	3.6	0.0002	3.2	0.0018	3.25	0.0010
+80............	4.8	0.0006	3.5	0	3	0.0025	2.75	0.0026
+100...........	5	0.0005	4.25	0.0004	3.5	0.0005	3.25	0.0016
+200...........	11.75	0	17.25	0	11.4	0	13.4	0
-200...........	10	0	14	0	9.25	0	12.4	0
Total	604.05	0.0184	584.25	0.1850	562.40	0.2279	689.90	0.1411

Figure 10. Histogram of Sample B-1

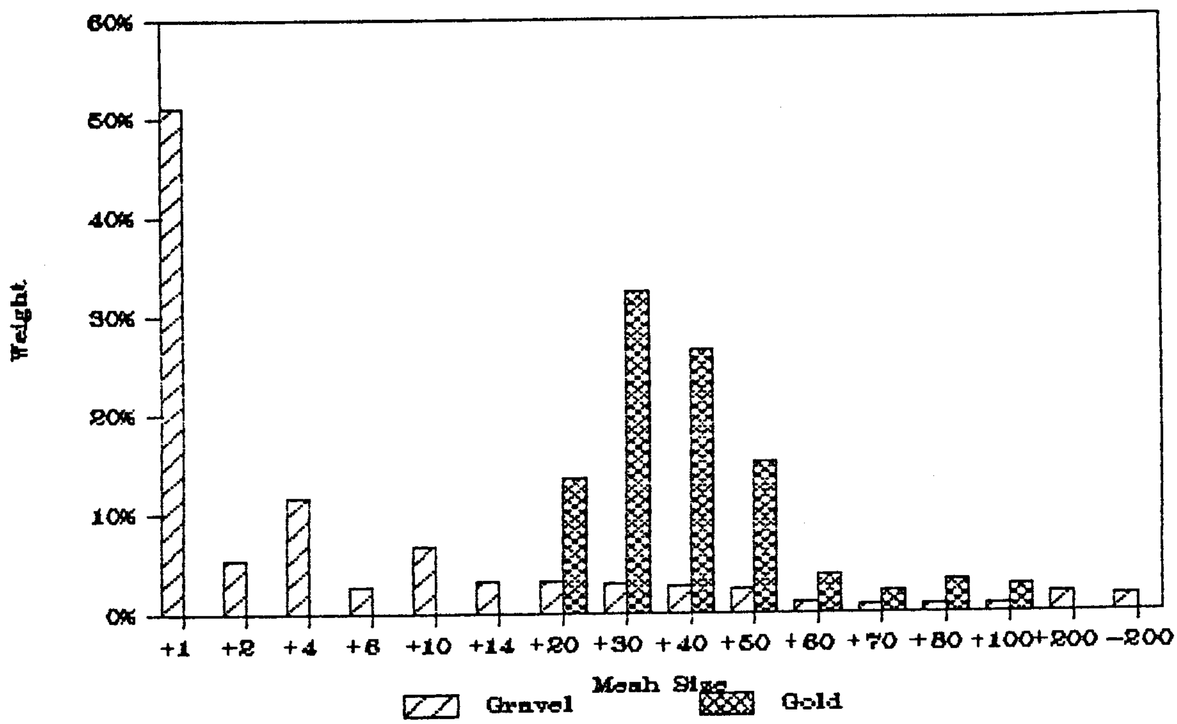


Figure 11. Histogram of Sample B-2

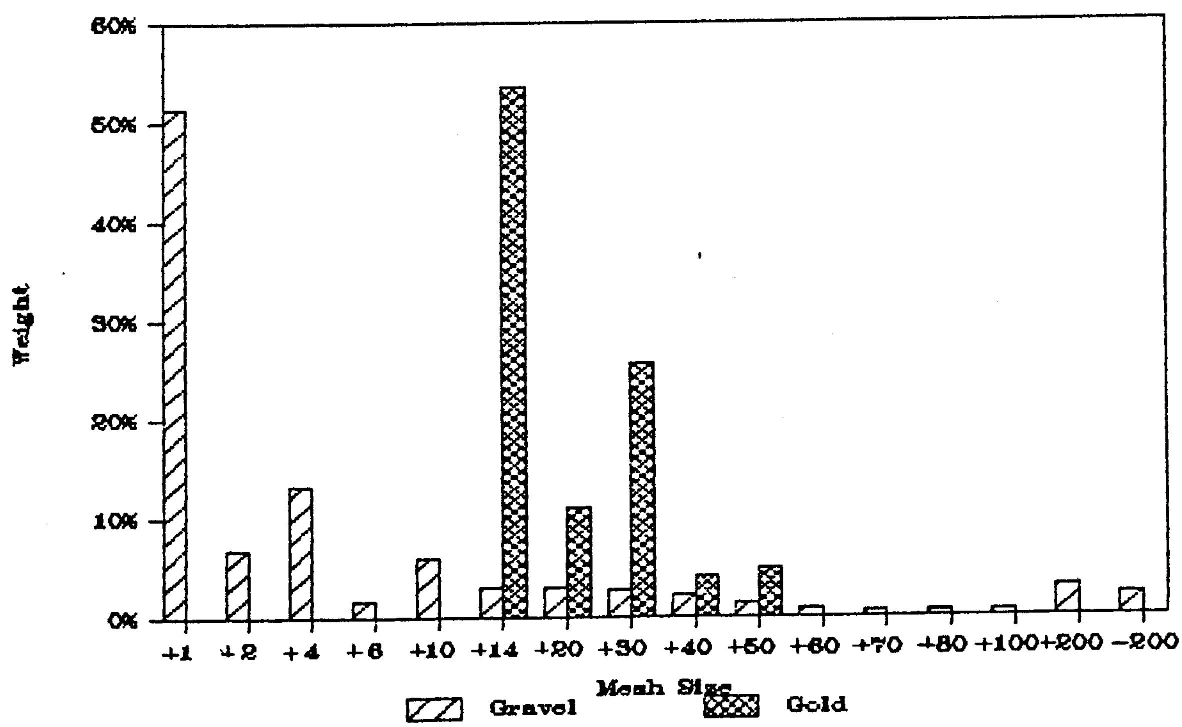


Figure 12. Histogram of Sample B-3

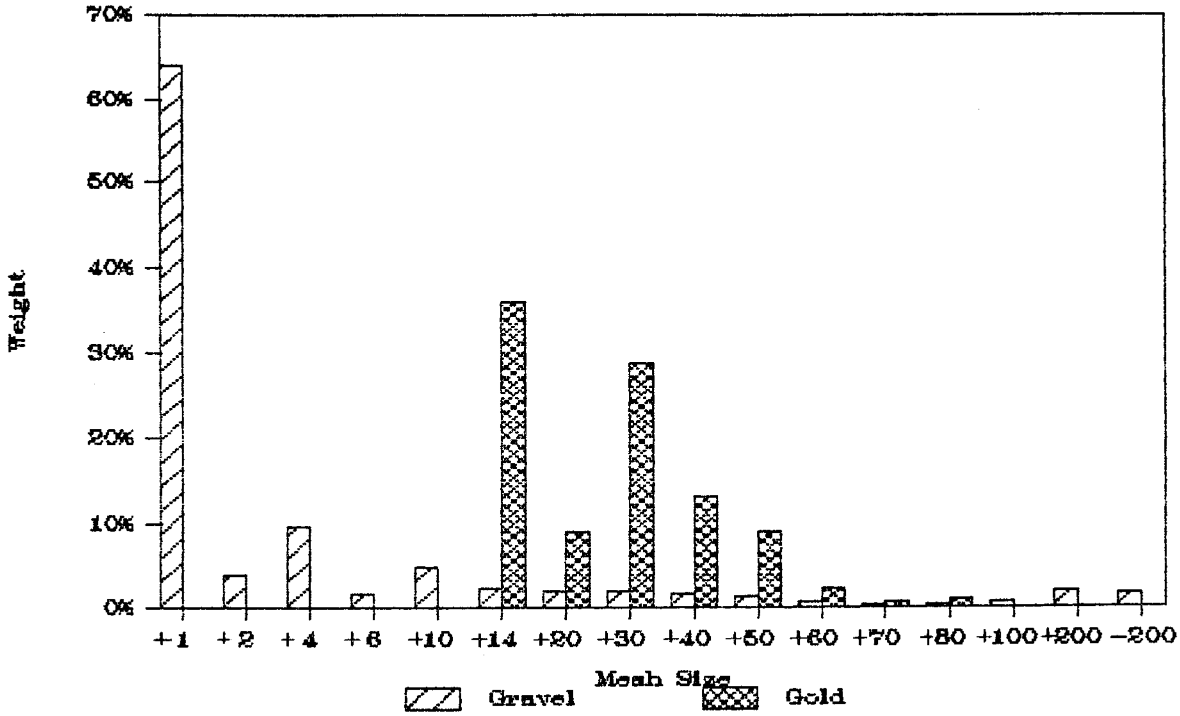


Figure 13. Histogram of Sample B-4

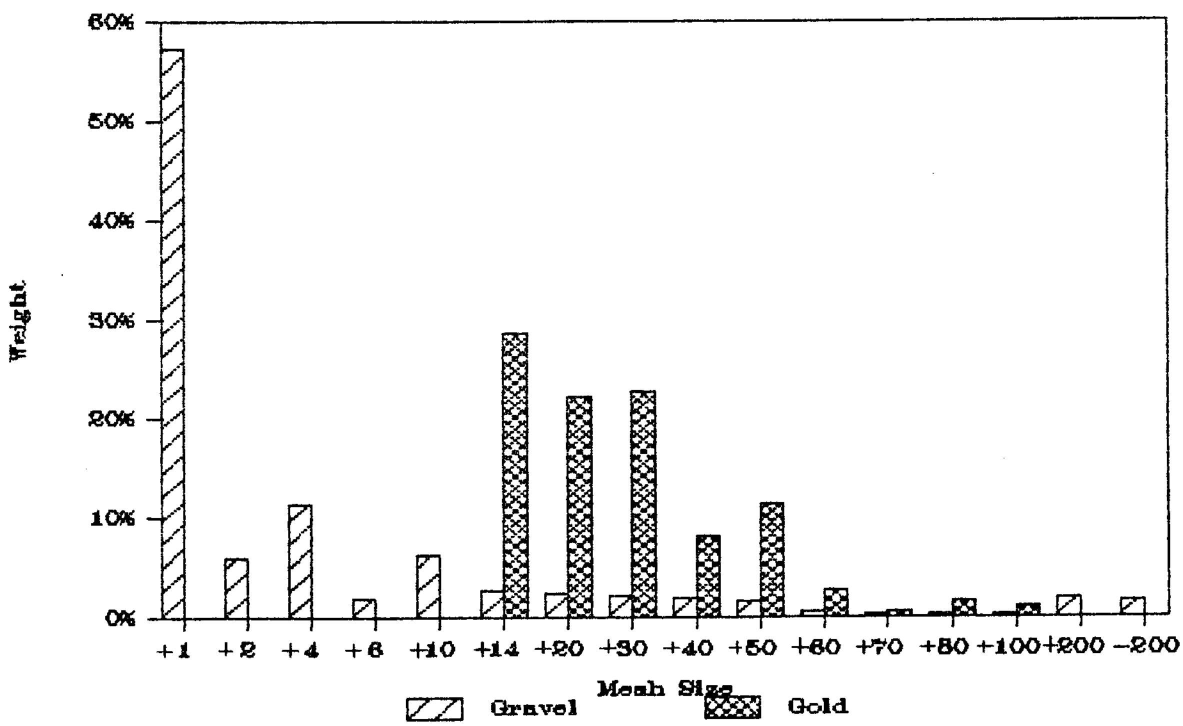
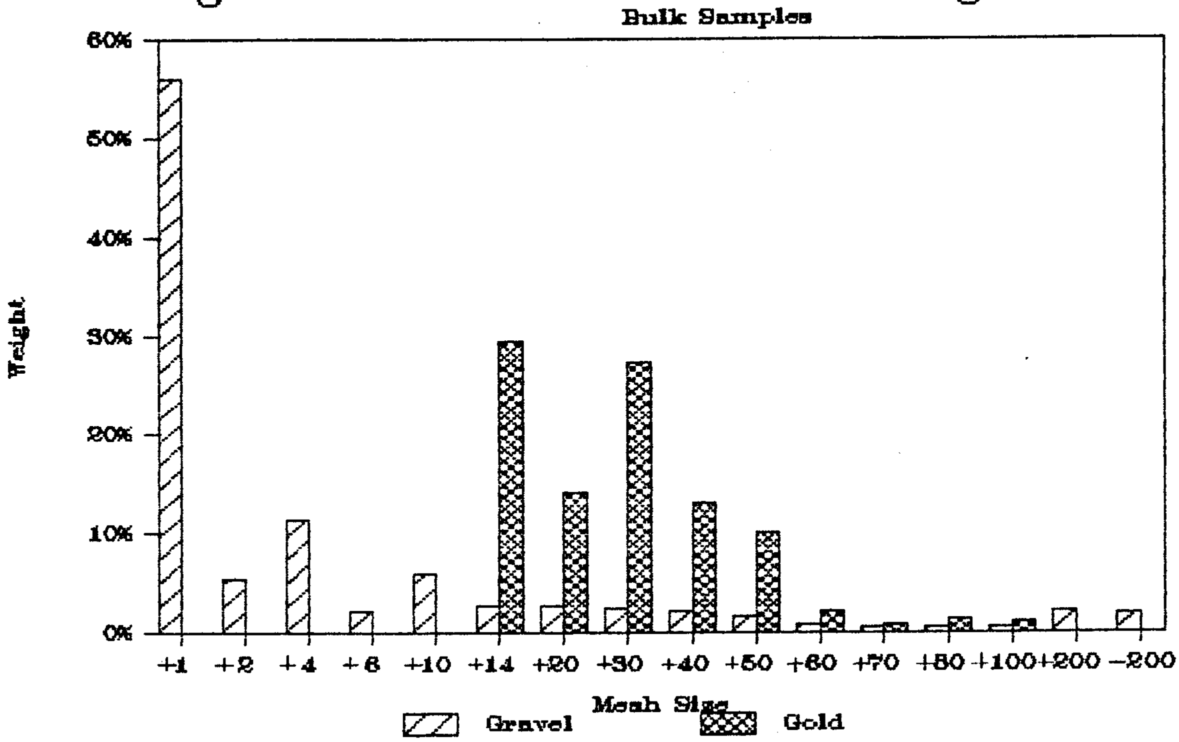


Figure 14. Cumulative Histogram of



A 604.05 lb sample (B-1) was taken from the Porcupine Creek alluvial fan (fig. 8). The sample was taken from approximately a 10-ft thick internal of alluvium. Over 65% of the gravel is greater than +4 mesh in size. Gold was found in mesh sizes betweeen -14 and +100, with over 88% in the -14 to +50 mesh sizes (fig. 10).

A 584.25 lb sample (B-2) was taken from a gravel bench along Porcupine Creek (fig. 9). The sample was taken from 12 ft of alluvium resting on slate bedrock. Over 90% of the gold was from -10 to +30 mesh in size (fig. 11).

A 562.4 lb sample (B-3) was taken from an abandoned channel of Porcupine Creek (fig. 8). The sample was taken from 16 ft of alluvium. Over 95% of the gold was from -10 to +50 mesh in size (fig. 12).

A 689.9 lb sample (B-4) was taken from alluvium along Porcupine Creek (fig. 8). The sample was taken from 13 ft of gravel. Over 90% of the gold was from -10 to +60 mesh in size (fig. 13).

Figure 14 is a graph of the cumulative results for all four site specific samples. The graph indicates that over 90% of the gold is from -10 to +50 mesh in size; and that over half of the gravel is greater than 1 mesh in size.

SUMMARY

The Bureau conducted reconnaissance and site specific bulk placer sampling in the Porcupine Mining Area in 1985. Reconnaissance sampling identified gravel deposits having moderate to high mineral development potential on Lower Porcupine, Cahoon, Christmas, McKinley, and Nugget Creeks.

Abandoned channel and bench deposits on Lower Porcupine Creek have the best potential for supporting a small to medium sized (500-1,000 yd^3/day) heavy equipment type placer operation. However, the prospective developer should identify a resource having average grades nearly double those identified by this study (ie 0.02 oz/yd^3 Au) prior to making a substantial investment in the area. Bureau records indicate that successful operators in Alaska, during the past 5 years (1980-1985) using heavy equipment to mine at these rates, mine ground averaging >0.015 oz/yd^3 Au. A 1-mi-long section of McKinley Creek above Cahoon Creek has high mineral development potential for small placer operations using suction dredge and hand placer techniques. Moderate development potential for small heavy equipment (50-500 yd^3/day) and/or hand placer operations exist on Christmas and Nugget Creeks. However, the greatest potential for future mining on a large scale in the area is dependent upon the results of exploring the Porcupine and Nugget Creeks alluvial fans which together conservatively contain in excess of 8,000,000 yd^3 of gravel resource. Site specific samples collected from Lower Porcupine Creek indicate that washing plants should screen to minus 1 mesh and be designed to recover gold down to +80 mesh.

The ADMG investigated and mapped the Quaternary geology and placer deposits of the Porcupine Mining Area and identified the fineness values of gold samples collected from the study area. The average overall fineness of placer gold from the Porcupine Mining Area is

837. Dating of organic material collected from bench deposits indicate that the Porcupine placers are less than 3,000 years old. Glacial features suggest 4 stages of glacial advance within the past 13,000 years.

9320
8000
18320

933,000 mod to high

.001

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APPENDIX. - Results of reconnaissance and channel sampling in the Porcupine Mining Area

APPENDIX. - Results of reconnaissance and channel placer sampling in the Porcupine Mining Area

Sample no.	Drainage	Sample type	Sample size (yd^3)	Grade (oz/yd^3 Au)	Comments [1]
1........	Big Boulder..	Sluice......	0.1	trace [2]	Alluvial gravel. Fair sample location.
2........	....do........	....do.......	0.1	trace	Do.
3........	Little Boulder.	....do.......	0.1	trace	Do.
4........	Tributary of Chilkat River	....do.......	0.1	trace	Do.
5........	....do........	....do.......	0.1	trace	Alluvial fan. Fair sample location.
6........	Jarvis Glacier.	....do.......	0.1	none	Alluvial gravel. Fair sample location.
7........	Little Jarvis Glacier.	....do.......	0.1	trace	Do.
8........	Glacier......	....do.......	0.1	trace	Do.
9........	Porcupine....	....do.......	0.1	trace	Alluvial bar. Fair sample location.
10.......	Klehini......	....do.......	0.1	trace	Alluvial fan. Fair sample location.
11.......	....do........	....do.......	0.1	trace	Alluvium. Fair sample location.
12.......	Glacier......	....do.......	0.1	trace	Do.
13.......	....do........	....do.......	0.1	trace	Do.
14.......	....do........	....do.......	0.1	trace	Do.
15.......	Christmas....	Pans........	0.05	0.0510	Bedrock. Excellent sample location.
16.......	....do........	Sluice......	0.1	0.0260	Alluvial gravel on bedrock. Excellent sample location.
17.......	Christmas....	Sluice......	0.1	0.0102	Alluvial gravel. Good sample location.

See footnotes at end of table.

APPENDIX. - Results of reconnaissance and channel placer sampling in the Porcupine Mining Area - continued

Sample no.	Drainage	Sample type	Sample size (yd^3)	Grade ($oz/yd^3 Au$)	Comments
18........	....do........	....do.......	0.1	0.0030	Alluvial gravel on bedrock. Good sample location.
19........	Glacier......	....do.......	0.1	none	Alluvium. Fair sample location.
20........	....do........	....do.......	0.1	none	Alluvium and till. Fair sample location.
21........	....do........	....do.......	0.1	none	Alluvium. Fair sample location.
22........	Marble.......	Hydraulic concentrator	0.1	none	Do.
23........	Porcupine....	....do.......	0.1	0.0011	Alluvial fan material. Fair sample location.
24........	....do........	....do.......	0.1	0.0032	Do.
25........	....do........	....do.......	0.1	0.0017	Alluvial fan material. Poor sample location.
26........	....do........	Sluice......	0.1	trace	Alluvium. Fair sample location.
27........	....do........	....do.......	0.1	trace	Do.
28........	....do........	Hydraulic concentrator	0.1	trace	Alluvium. Good sample location.
29........	....do........	....do.......	0.1	0.0020	Do.
30........	....do........	... do.......	0.1	0.0109	Do.
31........	....do........	....do.......	0.1	trace	Do.
32........	....do........	....do.......	0.1	0.0273	Alluvium on a bench. Excellent sample location.
33........	Porcupine....	Hydraulic concentrator	0.1	0.0181	Alluvium on a bench. Excellent sample location.
34........	....do........	....do.......	0.1	0.0062	Do.

See footnotes at end of table.

APPENDIX. - Results of reconnaissance and channel placer sampling in the Porcupine Mining Area

Sample no.	Drainage	Sample type	Sample size (yd^3)	Grade (oz/yd^3 Au)	Comments [1]
1........	Big Boulder..	Sluice......	0.1	trace [2]	Alluvial gravel. Fair sample location.
2........	....do........	....do.......	0.1	trace	Do.
3........	Little Boulder.	....do.......	0.1	trace	Do.
4........	Tributary of Chilkat River	....do.......	0.1	trace	Do.
5........	....do........	....do.......	0.1	trace	Alluvial fan. Fair sample location.
6........	Jarvis Glacier.	....do.......	0.1	none	Alluvial gravel. Fair sample location.
7........	Little Jarvis Glacier.	....do.......	0.1	trace	Do.
8........	Glacier......	....do.......	0.1	trace	Do.
9........	Porcupine....	....do.......	0.1	trace	Alluvial bar. Fair sample location.
10.......	Klehini......	....do.......	0.1	trace	Alluvial fan. Fair sample location.
11.......	....do........	....do.......	0.1	trace	Alluvium. Fair sample location.
12.......	Glacier......	....do.......	0.1	trace	Do.
13.......	....do........	....do.......	0.1	trace	Do.
14.......	....do........	....do.......	0.1	trace	Do.
15.......	Christmas....	Pans........	0.05	0.0510	Bedrock. Excellent sample location.
16.......	....do........	Sluice......	0.1	0.0260	Alluvial gravel on bedrock. Excellent sample location.
17.......	Christmas....	Sluice......	0.1	0.0102	Alluvial gravel. Good sample location.

See footnotes at end of table.

APPENDIX. - Results of reconnaissance and channel placer sampling in the Porcupine Mining Area - continued

Sample no.	Drainage	Sample type	Sample size (yd^3)	Grade (oz/yd^3 Au)	Comments
18........	....do........	....do.......	0.1	0.0030	Alluvial gravel on bedrock. Good sample location.
19........	Glacier......	....do.......	0.1	none	Alluvium. Fair sample location.
20........	....do........	....do.......	0.1	none	Alluvium and till. Fair sample location.
21........	....do........	....do.......	0.1	none	Alluvium. Fair sample location.
22........	Marble.......	Hydraulic concentrator	0.1	none	Do.
23........	Porcupine....	....do.......	0.1	0.0011	Alluvial fan material. Fair sample location.
24........	....do........	....do.......	0.1	0.0032	Do.
25........	....do........	....do.......	0.1	0.0017	Alluvial fan material. Poor sample location.
26........	....do........	Sluice......	0.1	trace	Alluvium. Fair sample location.
27........	....do........	....do.......	0.1	trace	Do.
28........	....do........	Hydraulic concentrator	0.1	trace	Alluvium. Good sample location.
29........	....do........	....do.......	0.1	0.0020	Do.
30........	....do........	... do.......	0.1	0.0109	Do.
31........	....do........	....do.......	0.1	trace	Do.
32........	....do........	....do.......	0.1	0.0273	Alluvium on a bench. Excellent sample location.
33........	Porcupine....	Hydraulic concentrator	0.1	0.0181	Alluvium on a bench. Excellent sample location.
34........	....do........	....do.......	0.1	0.0062	Do.

See footnotes at end of table.

APPENDIX. - Results of reconnaissance and channel placer sampling in the Porcupine Mining Area - continued

Sample no.	Drainage	Sample type	Sample size (yd^3)	Grade ($oz/yd^3 Au$)	Comments
35.......	....do.......	....do.......	0.1	0.0580	Do.
36.......	....do.......	....do.......	0.1	0.0421	Do.
37.......	....do.......	....do.......	0.1	trace	Bench alluvium. Excellent sample location.
38.......	....do.......	....do.......	0.1	0.0081	Do.
39.......	....do.......	....do.......	0.1	0.0040	Alluvium. Good sample location.
40.......	....do.......	....do.......	0.1	0.0052	Do.
41.......	....do.......	....do.......	0.1	0.0014	Do.
42.......	....do.......	....do.......	0.1	0.0004	Alluvium on bench. Good sample location.
43.......	....do.......	....do.......	0.1	trace	Do.
44.......	....do.......	....do.......	0.1	trace	Do.
45.......	....do.......	....do.......	0.1	0.0013	Do.
46.......	....do.......	....do.......	0.1	trace	Do.
47.......	....do.......	....do.......	0.1	0.0092	Do.
48.......	....do.......	....do.......	0.1	0.0017	Do.
49.......	....do.......	....do.......	0.1	0.0012	Do.
50.......	Porcupine....	Hydraulic concentrator	0.1	0.0065	Alluvium on a bench. Good sample location.
51.......	....do.......	....do.......	0.1	0.0015	Do.

See footnotes at end of table.

APPENDIX. - Results of reconnaissance and channel placer sampling in the Porcupine Mining Area - continued

Sample no.	Drainage	Sample type	Sample size (yd^3)	Grade ($oz/yd^3 Au$)	Comments
52.......	....do........	Sluice......	0.1	0.0008	Stream alluvium. Fair sample location.
53.......	....do........	Hydraulic concentrator	0.1	0.0035	Alluvium on a bench. Good sample location.
54.......	....do........	....do.......	0.1	0.0162	Do.
55.......	....do........	....do.......	0.1	0.0373	Alluvium. Good sample location.
56.......	....do........	....do.......	0.1	0.0222	Do.
57.......	....do........	....do.......	0.1	0.0123	Do.
58.......	....do........	....do.......	0.1	0.0013	Do.
59.......	....do........	....do.......	0.1	0.0095	Duplicate of sample No. 56.
60.......	....do........	....do.......	0.1	0.0007	Alluvium. Good sample location.
61.......	....do........	....do.......	0.1	0.0144	Alluvium on bench. Good sample location.
62.......	....do........	....do.......	0.1	0.0210	Do.
63.......	....do........	....do.......	0.1	0.0069	Do.
64.......	....do........	Pan.........	NA	NA	Bench. Gold on bedrock.
65.......	....do........	Hydraulic concentrator	0.1	0.0161	Bench alluvium. Excellent sample location.
66.......	...do........	...do.......	0.1	0.0420	Do.
67.......	Porcupine....	Hydraulic concentrator	0 1	none	Alluvium and colluvium on bench. Good sample location.
68.......	....do........	....do.......	0.1	trace	Do.

See footnotes at end of table.

APPENDIX . Results of reconnaissance and channel placer sampling in the Porcupine Mining Area - continued

Sample no.	Drainage	Sample type	Sample size (yd^3)	Grade (oz/yd^3 Au)	Comments
69........	....do........	....do.......	0.1	0.0005	Alluvium on bench. Good sample location.
70........	....do........	....do.......	0.1	0.0014	Do.
71........	....do........	....do.......	0.1	0.0139	Alluvium on bench. Excellent sample location.
72........	....do........	....do.......	0.1	0.0132	Do.
73........	....do........	(3) Pans....	NA	NA	Do.
74........	....do........	Hydraulic concentrator	0.1	trace	Bench alluvium. Good sample location.
75........	....do........	....do.......	0.1	trace	Do.
76........	....do........	....do.......	0.1	trace	Do.
77........	....do........	Sluice......	0.1	0.0027	Alluvial bar. Good sample location.
78........	....do........	Hydraulic concentrator	0.2	trace	Alluvium on bench. Poor sample location.
79........	....do........	Sluice......	0.1	trace	Alluvium on bench. Fair sample location.
80........	....do........	....do.......	0.1	0.0041	Alluvial bar. Fair sample location.
81........	....do........	....do.......	0.1	trace	Alluvial bar. Poor sample location.
82........	Tributary of McKinley.	Pans........	0.04	0.0081	Alluvium on bedrock. Excellent sample location.
83........	McKinley.....	Sluice......	0.1	0.0035	Alluvial bar. Fair sample location.
84........	McKinley.....	Sluice......	0 1	0.0099	Alluvium on bedrock. Good sample location.
85........	....do........	....do.......	0.1	trace	Colluvium on bedrock. Poor sample location.

See footnotes at end of table.

APPENDIX. - Results of reconnaissance and channel placer sampling in the Porcupine Mining Area - continued

Sample no.	Drainage	Sample type	Sample size (yd^3)	Grade (oz/yd^3 Au)	Comments
86........	....do........	....do.......	0.1	0.0539	Alluvium on bedrock. Excellent sample location.
87........	....do........	....do.......	0.1	0.0094	Alluvial bar. Good sample location.
88........	....do........	....do.......	0.1	0.0009	Alluvium on bench. Good sample location.
89........	....do........	....do.......	0.1	0.0162	Do.
90........	McKinley.....	....do.......	0.1	0.0014	Alluvial bar. Fair sample location.
91........	....do........	Pan.........	NA	NA	Gold from quartz vein.
92........	....do........	Sluice......	0.1	0.0057	Alluvial bar. Good sample location.
93........	....do........	....do.......	0.1	0.0006	Alluvium and bedrock. Good sample location.
94........	....do........	....do.......	0.1	trace	Alluvial bar. Fair sample location.
95........	....do........	....do.......	0.1	trace	Alluvium and colluvium. Poor sample location.
96........	....do........	....do.......	0.1	trace	Do.
97........	....do........	....do.......	0.1	0.0007	Do.
98........	....do........	....do.......	0.1	trace	Do.
99........	Cahoon......	....do.......	0.1	0.0450	Alluvium on bedrock. Good sample location.
100.......	....do........	....do.......	0.1	0.0020	Alluvium and colluvium. Fair sample location.
101.......	Cahoon......	Pans........	0 03	trace	Alluvium and colluvium. Fair sample location.
102.......	....do........	Sluice......	0.1	trace	Alluvium and colluvium. Good sample location.

See footnotes at end of table.

APPENDIX. - Results of reconnaissance and channel placer sampling in the Porcupine Mining Area - continued

Sample no.	Drainage	Sample type	Sample size (yd^3)	Grade (oz/yd^3 Au)	Comments
103......	....do........	....do.......	0.1	trace	Alluvium on bedrock. Good sample location.
104......	....do........	....do.......	0.1	0.0006	Do.
105......	....do........	....do.......	0.1	none	Alluvium and colluvium. Fair sample location.
106......	....do........	....do.......	0.1	none	Do.
107......	....do........	....do.......	0.1	trace	Do.
108......	Tributary of Porcupine.	....do.......	0.1	none	Do.
109......	Porcupine....	....do.......	0.1	trace	Alluvial bar. Good sample location.
110......	....do........	....do.......	0.1	none	Alluvium and colluvium. Fair sample location.
111......	....do........	....do.......	0.1	none	Do.
112......	....do........	....do.......	0.1	none	Alluvium and till. Fair sample location.
113......	Cottonwood...	....do.......	0.1	trace	Alluvium. Good sample location.
114......	....do........	....do.......	0.1	0.0005	Alluvium in fan. Good sample location.
115......	....do........	....do.......	0.1	trace	Do.
116......	Nugget.......	....do.......	0.1	0.0138	Alluvial bar (till?). Poor sample location.
117......	....do........	Pan.........	0.05	trace	Colluvium. Poor sample location.
118......	Nugget.......	Sluice......	0.2	trace	Alluvial fan. Poor sample location.

See footnotes at end of table.

APPENDIX. - Results of reconnaissance and channel placer sampling in the Porcupine Mining Area - continued

Sample no.	Drainage	Sample type	Sample size (yd^3)	Grade (oz/yd^3 Au)	Comments
119.......	....do........	....do.......	0.1	trace	Alluvium. Fair sample location.
120.......	....do........	....do.......	0.1	trace	Alluvium on bedrock. Poor sample location.
121.......	....do........	....do.......	0.1	trace	Do.
122.......	....do........	Pans........	0.1	0.0006	Alluvium on bedrock. Fair sample location.
123.......	....do........	Sluice......	0.1	0.0007	Do.
124.......	....do........	Rock........	NA	NA	Calcite vein.
125.......	....do........	Sluice......	0.1	0.0006	Alluvium and colluvium. Fair sample location.
126.......	....do........	....do.......	0.1	trace	Do.
127.......	Little Salmon.	....do.......	0.1	trace	Alluvial bar. Fair sample location.
128.......	....do........	....do.......	0.1	trace	Bench gravel on gray clay. Good sample location.
129.......	....do........	....do.......	0.1	trace	Alluvial bar. Fair sample location.
130.......	Salmon.......	....do.......	0.1	trace	Do.
131.......	....do........	....do.......	0.1	none	Alluvial bar. Poor sample location.
132.......	Summit.......	Pans........	0.025	none	Alluvium on bedrock. Poor sample location.

NA - not applicable

1/Comments include a description of the geology of the sample site and an evaluation of the site based on the following criteria

Excellent: Bedrock reached, little water in hole. Good location for gold to accumulate. Likely high graded sample in excess of average value of gravels in immediate area.

Good: Bedrock reached, may have water in hole, fair to good area for gold to accumulate. Likely representative of value of gravels in immediate area.

Fair: Bedrock not reached and/or poor location for gold to accumulate. May under-estimate value of gravels in immediate area.

Poor: Bedrock not reached and water in hole. Bad location for gold to accumulate. Likely under-estimates value of gold.

2/Trace - less than 0.0001 oz/yd^3 Au recovered.