



# Alaska Resource Data File, Bettles quadrangle, Alaska

By Joe Britton <sup>1</sup>

Open-File Report 03-52

2003

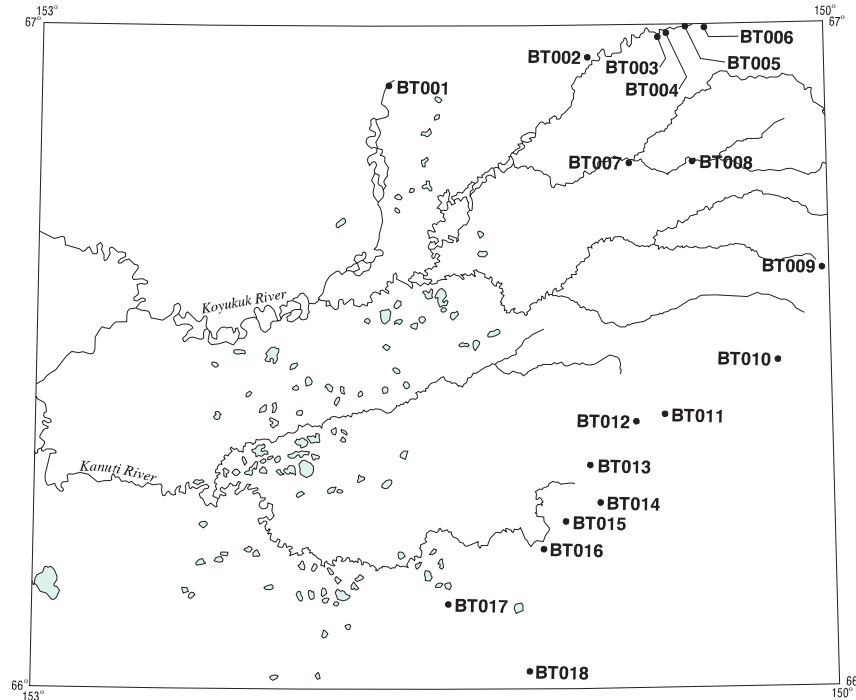
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**U.S. DEPARTMENT OF THE INTERIOR**  
**U.S. GEOLOGICAL SURVEY**

<sup>1</sup> Anchorage, Alaska

## Bettles quadrangle

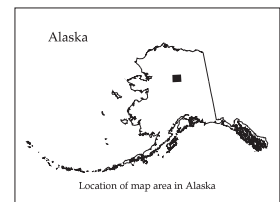
Descriptions of the mineral occurrences shown on the accompanying figure follow. See U.S. Geological Survey (1996) for a description of the information content of each field in the records. The data presented here are maintained as part of a statewide database on mines, prospects and mineral occurrences throughout Alaska.



*Distribution of mineral occurrences in the Bettles  
1:250,000-scale quadrangle, Alaska*

This and related reports are accessible through the USGS World Wide Web site <http://ardf.wr.usgs.gov>. Comments or information regarding corrections or missing data, or requests for digital retrievals should be directed to: Frederic Wilson, USGS, 4200 University Dr., Anchorage, AK 99508-4667, e-mail [fwilson@usgs.gov](mailto:fwilson@usgs.gov), telephone (907) 786-7448. This compilation is authored by:

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**OPEN-FILE REPORT 03-52**

**Site name(s): Bettles Bar; Bettles Riffle****Site type:** Mine**ARDF no.:** BT001**Latitude:** 66.9101**Quadrangle:** BT D-4**Longitude:** 151.6704**Location description and accuracy:**

Bettles Bar is on the east bank of the Koyukuk River, opposite the old site of Bettles, and about 0.5 mile downstream from the junction of John and Koyukuk Rivers. The mine is in NE1/4 of section 16, T. 24 N., R. 19 W. of the Fairbanks Meridian. The location is accurate within one-half mile.

**Commodities:****Main:** Au**Other:****Ore minerals:** Gold**Gangue minerals:****Geologic description:**

The gold in the Bettles Bar deposit is in a gravel layer composed of rounded cobbles embedded in fine sand, which in turn is mostly covered by a layer of fine river sand and silt (Reed, 1938). The gold is immediately below the sand and silt in the upper three feet of the cobble-and-sand layer, and is distributed throughout the sand fraction. The gold is very fine; so fine that when dry it is said to float. Although the locations of the bar deposits are relatively fixed, the individual spots where the river concentrates the gold are said to change from year to year (Reed, 1938). The deposits can be as much as 15 feet above the low-water level of the river (Reed, 1938). Similar deposits also occur along the Koyukuk River in the Bettles area, particularly at the so-called the Bettles Riffle near the Bettles Airport, at Evansville (Kurtak and others, 2002).

According to Reed (1938), with some effort, a person could generally recover as much as \$10 per day (gold at \$35 per ounce) working these bar deposits. In 1937, as much as \$600 in gold was said to have been recovered in two weeks by a man working a short distance above Bettles. Grybeck (1977) indicated mining activity through 1975.

Bettles Bar is one of a number of gold placers in the gravel bars along the Koyukuk River from Bettles upstream to the vicinity of Tramway Bar (Reed, 1938). See also Tramway Bar (WI006), Hanshaw Bar (WI005), and Grubstake Bar (WI004) in the Wiseman quadrangle.

**Alteration:****Age of mineralization:**

Quaternary.

**Deposit model:**

Placer Au (Cox and Singer, 1986; model 39a)

**Deposit model number (After Cox and Singer, 1986 or Bliss, 1992):**

39a

**Production Status:** Yes; small

**Site Status:** Inactive

**Workings/exploration:**

Surface mining. Grybeck (1977) indicated mining activity through 1975.

**Production notes:**

According to Reed (1938), with some effort, a person could generally recover as much as \$10 per day (gold at \$35 per ounce) working these bar deposits. In 1937, as much as \$600 in gold was said to have been recovered in two weeks by a man working a short distance above Bettles.

**Reserves:****Additional comments:****References:**

Reed, 1938; Heiner and Wolff, 1968; Cobb, 1978 (OF78-94); Cobb, 1972 (MF387); Grybeck, 1977; Bottge, 1986.

**Primary reference:** Reed, 1938

**Reporter(s):** J.M. Britton (Anchorage)

**Last report date:** 8/1/2002

**Site name(s):** Pope; Eldorado Creek

**Site type:** Occurrence

**ARDF no.:** BT002

**Latitude:** 66.9515

**Quadrangle:** BT D-2

**Longitude:** 150.9073

**Location description and accuracy:**

This occurrence is on Eldorado Creek, a south-flowing tributary to the South Fork, Koyukuk River. The junction of Eldorado Creek and South Fork Koyukuk River is opposite Squaw Creek, about 8 miles west-southwest of Gold Bench. The occurrence is about 1 mile upstream from the mouth of Eldorado Creek. The location is accurate within one-half mile.

**Commodities:**

**Main:** Au

**Other:**

**Ore minerals:** Gold

**Gangue minerals:**

**Geologic description:**

A panned-concentrate sample collected during a Bureau of Land Management examination of the area contained a single particle of coarse gold (Kurtak and others, 2002); the concentrate contains 8.79 ppm gold. Several other panned-concentrate samples, as well as a stream-sediment sample, were barren. The rocks in the area are Cretaceous graywacke interbedded with mudstone (Patton and Miller, 1973). No other information is available.

**Alteration:**

**Age of mineralization:**

Quaternary?

**Deposit model:**

Placer Au(?) (Cox and Singer, 1986; model 39a)

**Deposit model number (After Cox and Singer, 1986 or Bliss, 1992):**

39a(?)

**Production Status:** None

**Site Status:** Inactive

**Workings/exploration:**

Surface sampling. Five, lode claims were located in the 1960's in the vicinity.

**Production notes:**

**Reserves:**

**Additional comments:**

**References:**

Patton and Miller, 1973; Bottge, 1986; Bundtzen and others, 1988; Dillon and others, 1989; Kurtak and others, 2002.

**Primary reference:** Kurtak and other, 2002

**Reporter(s):** J.M. Britton (Anchorage)

**Last report date:** 8/1/2002

**Site name(s): Gold Bench****Site type:** Mine**ARDF no.:** BT003**Latitude:** 66.9810**Quadrangle:** BT D-2**Longitude:** 150.6367**Location description and accuracy:**

Gold Bench is located on a prominent bend in the South Fork Koyukuk River about 1.2 miles upstream from the mouth of John R Creek. The mine is shown on the current (1970, photorevised 1975) Bettles D-2 topographic map. The placer is about 1000 feet wide and 0.8 mile long and covers an area of about 60 to 100 acres. The location is accurate.

**Commodities:****Main:** Au**Other:** Bi(?), Cu, Hg, Pb, REE, Sn, Th, Ti, U, W**Ore minerals:** Bismuthinite(?), cassiterite, chalcopyrite, cinnabar, galena, gold, magnetite, monazite, pyrite, rutile, scheelite, uranothorianite**Gangue minerals:** Garnet, hematite, magnetite, sphene**Geologic description:**

Gold-bearing gravels occur in a high channel along the north side of the South Fork, Koyukuk River at Gold Bench. This high channel is about 30 feet higher than the present river channel. Maddren (1913) described the deposit as surficial, fine-washed stream gravels overlying other unconsolidated deposits. The gold-bearing gravels consist predominately of schist and quartz pebbles with lesser amounts of flint and igneous rocks. The most productive deposit was an 18- to 24-inch thick layer of gravel that covers an area of about 60 acres. The gold typically rested on a 2 - to 12-inch-thick layer of reddish sand, which acted as false bedrock. Small amounts of gold occurred throughout the gravel section (Maddren, 1913). Bedrock is decomposed to blue clay that probably was derived from shale (Reed, 1938). The depth to bedrock was estimated by Reed (1938) to be about 6 feet, although Maddren reported shafts to 20 feet deep that had not reached solid rock. The gold was generally fine, well worn and very flattened.

Studies of panned samples in the 1950's described a variety of accessory minerals including magnetite, hematite, garnet, pyrite, chalcopyrite, cinnabar, rutile, cassiterite, scheelite, monazite, uranothorianite, galena, sphene, and possibly bismuthinite (Wedow and others, 1952; Nelson and others, 1954). Placer concentrates contain as much as 0.18 percent equivalent uranium. The source of the gold is not known. Maddren (1913) specu-

lated that it might have come from the Tramway Bar (WI006) area on the Middle Fork, Koyukuk or, more likely, from the hills to the south. Cobb (1973 [B1374]) thought that at least some of the gold was probably from reworked glacial deposits.

The deposit was mined mostly at the surface by hand methods. A few shafts were apparently sunk, but these produced little gold. Heiner and Wolff (1968) noted mining in the 1940's using heavy equipment. Grybeck (1977) indicated mining activity through 1975.

**Alteration:****Age of mineralization:**

Quaternary.

**Deposit model:**

Placer Au (Cox and Singer, 1986; model 39a)

**Deposit model number (After Cox and Singer, 1986 or Bliss, 1992):**

39a

**Production Status:** Yes

**Site Status:** Inactive

**Workings/exploration:**

The deposit was mined mostly at the surface by hand. A few shafts were apparently sunk, but these produced little gold. Heiner and Wolff (1968) noted mining in the 1940's using heavy equipment. Grybeck (1977) indicated mining activity through 1975.

**Production notes:**

Maddren (1913) reported that \$150,000 (approximately 7,500 oz.) in gold was produced through 1909. Figures for later production are not known.

**Reserves:****Additional comments:**

Pleistocene bones are said to have been common in the gravels of Gold Bench (Reed, 1938). See also: Ironside Bench (BT004).

**References:**

Schrader, 1904; Maddren, 1910; Maddren, 1913; Reed, 1938; Wedow and others, 1952; White, 1952; Wedow and others, 1953; Nelson and others, 1954; Overstreet, 1967; Heiner and Wolff, 1968; Cobb, 1972 (MF387); Cobb, 1973 (B1374); Mulligan, 1974; Grybeck, 1977; Bottge, 1986.

**Primary reference:** Maddren, 1913

**Reporter(s):** J.M. Britton (Anchorage)



**Last report date:** 8/1/2002

**Site name(s): Ironside Bench; Ironside Bar****Site type:** Mine**ARDF no.:** BT004**Latitude:** 66.9870**Quadrangle:** BT D-2**Longitude:** 150.6039**Location description and accuracy:**

The Ironside Bench located along the south side of the South Fork Koyukuk River about a mile upstream from Gold Bench. Both Ironside Bench and Gold Bench are marked on the current (1970, photorevised 1975) Bettles D-2 topographic map. The location is accurate.

**Commodities:****Main:** Au**Other:****Ore minerals:** Gold**Gangue minerals:****Geologic description:**

The high channel which constitutes the Ironside Bench placer is about 30 feet higher than the current level of the South Fork Koyukuk River. It is about at the same level as the nearby Gold Bench channel (BT003). Reed (1938) suggests that the channels at both locations are the same. River-washed gravel at Ironside Bench is heavy, coarse and waterworn, with few large boulders. The gravel lies on a layer of blue clay, which Reed (1938) suspected is decomposed shale. The depth to bedrock varies from 6 to 30 feet ; the upper 5 to 6 feet is muck and ice. The gold is waterworn, fine and flaky; it occurs throughout the gravel but is found mostly at the top of the clay.

Mining was generally by hand methods. Mining by ground sluicing and shoveling into sluice boxes was being done in 1937 ; about 40 acres were said to have been mined by that time (Reed, 1938). Grybeck (1977) indicated mining activity through 1975. The only production figures available are Maddren's (1913), who indicates that a total of \$2,000 (about 100 oz.) in gold had been recovered by 1909. No figures are available for later production. Reed (1938) reported that the value of the ground ranged from 25 to 50 cents per square foot of bedrock and that the average fineness of the gold is 907.5.

**Alteration:**

**Age of mineralization:**

Quaternary.

**Deposit model:**

Placer Au (Cox and Singer, 1986; model 39a)

**Deposit model number (After Cox and Singer, 1986 or Bliss, 1992):**

39a

**Production Status:** Yes; small

**Site Status:** Inactive

**Workings/exploration:**

Mining was generally by hand methods. Mining by ground sluicing and shoveling in was being done in 1937 and about 40 acres were said to have been mined by that time (Reed, 1938). Grybeck (1977) indicated mining activity through 1975.

**Production notes:**

The only production figures available are Maddren's (1913), who indicated that a total of \$2,000 (about 100 oz.) in gold had been recovered by 1909. No figures are available for later production. Reed (1938) reported that the value of the ground ranged from 25 to 50 cents per square foot of bedrock foot and that the average fineness of the gold is 907.5.

**Reserves:****Additional comments:**

See also: Gold Bench (BT003).

**References:**

Schrader, 1904; Cobb, 1972 (MF387); Maddren, 1910; Maddren, 1913; Reed, 1938; Heiner and Wolff, 1968; Mulligan, 1974; Cobb, 1978 (OF78-94); Grybeck, 1977; Bottge, 1986; Bundtzen and others, 1992; Swainbank and others, 1993.

**Primary reference:** Reed, 1938

**Reporter(s):** J.M. Britton (Anchorage)

**Last report date:** 8/1/2002

**Site name(s):** Rock Creek

**Site type:** Mine

**ARDF no.:** BT005

**Latitude:** 66.9963

**Quadrangle:** BT D-2

**Longitude:** 150.5298

**Location description and accuracy:**

Rock Creek is not named on the current Bettles D-2 topographic map (1970, revised 1975). It is a short, south-flowing tributary to South Fork Koyukuk River. Its mouth is about 2 miles east (upstream) from Ironsides Bar. The coordinates are for a site on the lower portion of Rock Creek but the exact location of placer mining on the creek is uncertain. The location is accurate within one-half mile.

**Commodities:**

**Main:** Au

**Other:**

**Ore minerals:** Gold

**Gangue minerals:**

**Geologic description:**

Reed (1938) reported that \$800 in gold (about 40 ounces) was produced in from 1900 to 1910. The rocks in the area are predominantly Cretaceous conglomerate (Patton and Miller, 1973). No other information is available.

**Alteration:**

**Age of mineralization:**

Quaternary.

**Deposit model:**

Placer Au (Cox and Singer, 1986; model 39a)

**Deposit model number (After Cox and Singer, 1986 or Bliss, 1992):**

39a

**Production Status:** Yes

**Site Status:** Inactive

**Workings/exploration:**

Some mining in the period 1900 to 1910.

**Production notes:**

Reed (1938) reported that \$800 in gold (about 40 ounces) was produced in from 1900 to 1910.

**Reserves:**

**Additional comments:**

**References:**

Reed, 1938; Cobb, 1972 (MF387); Patton and Miller, 1973; Cobb, 1978 (OF78-94);  
Bottge, 1986.

**Primary reference:** Reed ,1938

**Reporter(s):** J.M. Britton (Anchorage)

**Last report date:** 8/1/2002

**Site name(s):** Davis Creek

**Site type:** Mine

**ARDF no.:** BT006

**Latitude:** 66.9947

**Quadrangle:** BT D-1

**Longitude:** 150.4570

**Location description and accuracy:**

Davis Creek is a north-flowing tributary to the South Fork, Koyukuk River. The mouth of Davis Creek is about 4.5 miles east-northeast of Gold Bench and 3.5 miles northwest of Grayling Lake. Placer mining has occurred along the lower 0.8 mile of the creek; most of the mining was within a few hundred feet of its mouth. (Little mining was done at the mouth itself as the gravel bars there are typically dry.) The center of mining is a short distance upstream from the mouth of Davis Creek in the NW1/4 of section 17, T. 25 N., R. 13 W. of the Fairbanks Meridian. The location is accurate.

**Commodities:**

**Main:** Au

**Other:** Bi

**Ore minerals:** Gold

**Gangue minerals:**

**Geologic description:**

Thick, washed gravel above the mouth of Davis Creek is cut by the creek channel and contains small amounts of gold (Maddren, 1913). Maddren (1913) reports that a little mining occurred on Davis Creek in the early 1900's. Reed (1938), however, indicates that considerable mining was done then. Davis Creek may have been mined as late as the 1990's (Kurtak and others, 2002). Little mining was done near the mouth as the bars near the mouth are typically dry. The rocks near the mouth of the creek are Paleozoic pelitic schist with subordinate quartzite (Patton and Miller, 1973). A panned-concentrate sample of gravel collected about 0.8 mile above the mouth of Davis Creek contains 6 coarse and 6 fine gold particles; the sample was analyzed and contains 220 ppm gold and 351 ppm bismuth (Kurtak and others, 2002). A sample of a 3-inch-wide quartz vein that cuts micaceous schist on Davis Creek contains 150 ppb gold (Kurtak and others, 2002).

**Alteration:**

**Age of mineralization:**

Quaternary.

**Deposit model:**

Placer Au (Cox and Singer, 1986; model 39a)

**Deposit model number (After Cox and Singer, 1986 or Bliss, 1992):**

39a

**Production Status:** Yes

**Site Status:** Inactive

**Workings/exploration:**

Maddren (1913) reports that a little mining occurred on Davis Creek in the early 1900's. Reed (1938), however, indicates that considerable mining was done then. Davis Creek may have been mined as late as the 1990's (Kurtak and others, 2002).

**Production notes:**

Maddren (1913) reports that about \$5,000 in gold (about 250 ounces) was produced from 1900 to 1909.

**Reserves:**

**Additional comments:**

**References:**

Maddren, 1910; Maddren, 1913; Reed, 1938; Heiner and Wolff, 1968; Cobb, 1972 (MF387); Patton and Miller, 1973; Mulligan, 1974; Cobb, 1978 (OF78-94); Eakins and others, 1985; Bottge, 1986; Bundtzen and others, 1986; Dillon and others, 1989; Swainbank and others, 1991; Swainbank and others, 1997; Kurtak and others, 2002.

**Primary reference:** Kurtak and others, 2002

**Reporter(s):** J.M. Britton (Anchorage)

**Last report date:** 8/1/2002

**Site name(s): Jim Prospect Confluence; Jim River; Jim River Confluence**

**Site type:** Occurrence

**ARDF no.:** BT007

**Latitude:** 66.7916

**Quadrangle:** BT D-2

**Longitude:** 150.7535

**Location description and accuracy:**

These two placer-gold occurrences are along the Jim River. One is at the mouth of Prospect Creek (locally called the Jim Prospect Confluence). The second is in the canyon of Jim Creek about 6 miles downstream. The coordinates at the Jim Prospect Confluence, just northwest of the center of section 26, T. 23 N., R. 15 W. of the Fairbanks Meridian, and about 0.5 mile southwest of Prospect Creek Camp.

**Commodities:**

**Main:** Au

**Other:**

**Ore minerals:** Gold, magnetite

**Gangue minerals:**

**Geologic description:**

Fine placer gold, identified in panned concentrates occurs at two sites along Jim River (Kurtak and others, 2002). At the 'Jim Prospect Confluence', a panned -concentrate contained a single, very fine grained, gold particle, with abundant magnetite. An analysis of this concentrate indicated that it contained 1,590 ppb gold. Another placer sample from the same site contained 13 very fine gold particles and an analysis showed that it has a value of 0.0003 ounce of gold per cubic yard. At a site on Jim River about 6 miles downstream from the mouth of Prospect Creek, very fine gold flakes were observed in a panned-concentrate; an analysis showed a value of 1,230 ppb gold (Kurtak and others, 1999). Kurtak and others (1999) suspect that the gold is derived from the Jim River pluton, which crops out north of the Jim River canyon.

The rocks in the region are Triassic to Jurassic mafic volcanic and intrusive rocks, and mid-Cretaceous granitic, plutonic rocks (Patton and Miller, 1973). The rocks in the vicinity of the occurrences on the Jim River are altered volcanics, including pillow basalts (Kurtak and others, 2002). No bedrock was observed at the 'Jim Prospect Confluence' occurrence.

**Alteration:**



**Age of mineralization:**

Quaternary.

**Deposit model:**

Placer Au (Cox and Singer, 1986; model 39a)

**Deposit model number (After Cox and Singer, 1986 or Bliss, 1992):**

39a

**Production Status:** None

**Site Status:** Inactive

**Workings/exploration:**

In the 1970's, claims were located at the Jim Prospect Confluence occurrence, and the occurrence about 6 miles below Prospect Creek (BT008) the other site on the Jim River (Kurtak and others, 2002).

**Production notes:**

**Reserves:**

**Additional comments:**

**References:**

Reed, 1938; Patton and Miller, 1973; Bottge, 1986; Kurtak and others, 1999; Kurtak and others, 2002.

**Primary reference:** Kurtak and others, 2002

**Reporter(s):** J.M. Britton (Anchorage)

**Last report date:** 8/1/2002

**Site name(s): Prospect Creek****Site type:** Mine**ARDF no.:** BT008**Latitude:** 66.7930**Quadrangle:** BT D-2**Longitude:** 150.5119**Location description and accuracy:**

Prospect Creek is a southeast tributary to Jim River. Its mouth is about 0.5 mile downstream from the Prospect Creek camp. Mining occurred in the upper part of the drainage about 6 miles east of Prospect Creek Camp. The coordinates are at the boundary between sections 25 and 26, T. 23 N., R. 14 W. of the Fairbanks Meridian, where at least two references (Bundtzen and others, 1993; Kurtak and others, 1999) indicate some mining activity.

**Commodities:****Main:** Au**Other:****Ore minerals:** Gold**Gangue minerals:****Geologic description:**

Maddren (1913) reported that in 1909 a Geological Survey party in 1909 found gold colors while panning gravels from the upper part of Prospect Creek. Reed (1938), however, noted that considerable later prospecting was unable to locate the deposit reported by Maddren. Bundtzen and others (1984; 1994) noted claim staking and prospecting on Prospect Creek in 1983, and that a mining operation was said to be active in 1993. No other information is available on this occurrence.

**Alteration:****Age of mineralization:**

Quaternary.

**Deposit model:**

Placer Au (Cox and Singer, 1986; model 39a)

**Deposit model number (After Cox and Singer, 1986 or Bliss, 1992):**

39a

**Production Status:** Undetermined.

**Site Status:** Probably inactive

**Workings/exploration:**

Maddren (1913) reported that in 1909 a Geological Survey party in 1909 found gold colors while panning gravels from the upper part of Prospect Creek. Reed (1938), however, noted that considerable later prospecting was unable to locate the deposit reported by Maddren. Bundtzen and others (1984; 1994) noted claim staking and prospecting on Prospect Creek in 1983, and that a mining operation was said to be active in 1993.

**Production notes:**

**Reserves:**

**Additional comments:**

**References:**

Maddren, 1910; Maddren, 1913; Reed, 1938; Mulligan, 1974; Cobb, 1978 (OF78-94); Bundtzen and others, 1982; Bundtzen and others, 1983; Bundtzen and others, 1984; Bottge, 1986; Bundtzen and others, 1990; Swainbank and others, 1991; Bundtzen and others, 1994; Kurtak and others, 1999; Kurtak and others, 2002.

**Primary reference:** Maddren, 1913

**Reporter(s):** J.M. Britton (Anchorage)

**Last report date:** 8/1/2002

**Site name(s): Bonanza****Site type:** Prospects**ARDF no.:** BT009**Latitude:** 66.6301**Quadrangle:** BT C-1**Longitude:** 150.0261**Location description and accuracy:**

These prospects are approximately centered at an elevation of about 2,750 feet on a small hill informally called Windy Knob which is in about the center of the SW 1/4 of section 19, T. 21 N., R. 11 W. of the Fairbanks Meridian. The prospects are scattered over an area about 1.5 miles wide and 5.5 miles long (which extends into the adjacent Beaver quadrangle). The coordinates are the center of the Bonanza claim block, which is the locus of the principal mineral showings in the area. The location is accurate.

**Commodities:****Main:** Mo, W**Other:** Cu**Ore minerals:** Chalcopyrite, molybdenite, pyrrhotite, scheelite**Gangue minerals:** Calc-silicate minerals, quartz**Geologic description:**

Clautice (1983) reports modest amounts of scheelite and molybdenite along the contact of the Cretaceous, Kanuti batholith with Paleozoic metasedimentary rocks. This 30-square-mile area extends into the Beaver quadrangle. The principal scheelite occurrences are near a feature informally named Windy Knob. Here, the highest grade tungsten mineralization occurs in pyrrhotite-rich, chalcopyrite-bearing, dark green tactite along the margin of biotite, quartz monzonite. A grab sample contains as much as 0.89% tungsten, 300 grams of silver per ton, and 0.65% copper. However, the scheelite most commonly occurs as disseminated grains in relatively sulfide-free pyroxene-garnet skarn. The skarn appears to form irregular pods. Scheelite also occurs on fracture surfaces in calc-silicate schist and less commonly in quartz veins. Molybdenite typically occurs as rosettes and small flakes in quartz veins in biotite, quartz monzonite and less commonly in aplite, pegmatite, and calc-silicate rock. Several select samples of skarn contain up to 1.44% tungsten, 24.3 ppm silver, 1,438 ppm zinc, and 936 ppm lead. (Kurtak and others, 2002). The Kanuti batholith is Cretaceous based on a K-Ar date of 90.6 Ma (Nokleberg and others, 1987).

**Alteration:**

Calc-silicate skarn.

**Age of mineralization:**

The Kanuti batholith is Cretaceous based on a K-Ar date of 90.6 Ma. (Nokleberg and others, 1987).

**Deposit model:**

W skarn deposit (Cox and Singer, 1986; model 14a)

**Deposit model number (After Cox and Singer, 1986 or Bliss, 1992):**

14a

**Production Status:** None

**Site Status:** Inactive

**Workings/exploration:**

Surface sampling, geologic mapping, and trenching.

**Production notes:**

**Reserves:**

**Additional comments:**

See also Bonanza (Beef Claims), (BV003) in the Beaver quadrangle.

**References:**

Clautice, 1978; Clautice, 1983; Clautice, 1987; Bottge, 1986; Clautice, 1987; Nokleberg and others, 1987; Nokleberg and others, 1996; Newberry and others, 1997; Swainbank and others, 1997; Kurtak and others, 1999; Kurtak and others, 2002.

**Primary reference:** Clautice, 1983

**Reporter(s):** J.M. Britton (Anchorage)

**Last report date:** 8/1/2002

**Site name(s):** HET

**Site type:** Occurrence

**ARDF no.:** BT010

**Latitude:** 66.4923

**Quadrangle:** BT B-1

**Longitude:** 150.2012

**Location description and accuracy:**

This occurrence is located on a bluff on the west side of the upper Kanuti River, about 9.5 miles northeast of Olsons Lake. It is at an elevation of about 2,200 feet, near the center of the NW1/4 section 7, T. 19 N., R. 12 W. of the Fairbanks Meridian. The location is accurate within one-half mile.

**Commodities:**

**Main:** Ag, Pb, Zn

**Other:** Cu

**Ore minerals:** Galena, pyrite, sphalerite

**Gangue minerals:** Limonite

**Geologic description:**

This occurrence consists of small grains of galena and sphalerite disseminated in a pyritiferous gossan zone (Patton and Miller, 1970). The gossan zone is about 100 yards long and occurs in silicified and sericitized lower Tertiary(?) rhyolite tuff and tuff breccia. The rhyolite lies on, and possibly intrudes, Cretaceous, biotite quartz monzonite of the Kanuti pluton. Scattered pendants of hornfelsed schist occur in the quartz monzonite. Grab samples from the gossan zone contain as much as 20,000 ppm lead, 3,000 ppm zinc, 30 ppm silver, and 500 ppm copper. Lead values are higher at the north end of the zone; zinc and copper values predominate at the south end.

**Alteration:**

Pyritiferous zone extensively oxidized to limonite. Rhyolite host is silicified and sericitized.

**Age of mineralization:**

**Deposit model:**

**Deposit model number (After Cox and Singer, 1986 or Bliss, 1992):**

**Production Status:** None

**Site Status:** Inactive

**Workings/exploration:**  
Only surface sampling.

**Production notes:**

**Reserves:**

**Additional comments:**  
Examination of deposit was brief and exposures are poor (Patton and Miller, 1970).

**References:**  
Patton and Miller, 1970; Cobb, 1972 (MF387); Cobb, 1978 (OF78-94); Bottge, 1986;  
Nokleberg and others, 1987; Nokleberg and others, 1996.

**Primary reference:** Patton and Miller, 1970

**Reporter(s):** J.M. Britton (Anchorage)

**Last report date:** 8/1/2002

**Site name(s): Unnamed (near Caribou Mountain)****Site type:** Occurrences**ARDF no.:** BT011**Latitude:** 66.4126**Quadrangle:** BT B-2**Longitude:** 150.6308**Location description and accuracy:**

This site includes several similar occurrences along the ridge which extends northeast from the summit of Caribou Mountain. The coordinates are of one occurrence approximately at the center of these occurrences; it is near hill 2355 at an elevation of about 2,300 feet, about 0.25 mile south-southwest of the center of section 6, T. 15 N., R. 14 W., of the Fairbanks Meridian. The other occurrences extend to about 0.8 mile northeast and 1.5 miles southwest. The location is accurate.

**Commodities:****Main:** Cr**Other:** Co, Ni, PGE**Ore minerals:** Chromite**Gangue minerals:****Geologic description:**

This site consists of ten chromite occurrences in Jurassic or older, dunite and pyroxene-peridotite of the Caribou Mountain ultramafic complex (Foley and McDermott, 1983). The chromite occurs as massive chromitite in alternating layers of dunite and pyroxene-peridotite; as wispy concentrations of disseminated chromite in dunite; and as disseminated and massive chromite in dunite. The chromite deposits are small and discontinuous (Foley and McDermott, 1983). Samples of the occurrences contain up to 20% chromium but the mean is less than 2%. Chromium analyses vary erratically as is typical of podiform chromite deposits (Foley and McDermott, 1983). Samples also contain cobalt, copper and nickel values typical of ultramafic rocks, consistent with the apparent absence of sulfide minerals (Foley and McDermott, 1983). The platinum group elements are generally low, although one high-grade chromite sample contains 377 ppb Pd and 1,337 ppb Pt (Foley, 1992).

The ultramafic, mafic volcanic and intrusive rocks, and associated chert in this area are thought to represent a dismembered ophiolite assemblage (Foley and McDermott, 1983). The mafic-ultramafic components are mainly interlayered dunite and pyroxene-peridotite, with subordinate gabbro, pyroxenite, serpentinite, and chromitite. Individual layers may



range from tens to thousands of feet thick. The richest chromite deposits are in the dunite. Although chromite is ubiquitous in the dunite and pyroxene-peridotite, it seldom exceeds 1 or 2% of the rock.

**Alteration:**

Some serpentization of the ultramafics.

**Age of mineralization:**

The chromite is a normal primary constituent of the ultramafic rocks which are Jurassic or older.

**Deposit model:**

Podiform chromite (Cox and Singer, 1986; model 8a)

**Deposit model number (After Cox and Singer, 1986 or Bliss, 1992):**

8a

**Production Status:** None

**Site Status:** Inactive

**Workings/exploration:**

Only surface sampling and mapping.

**Production notes:****Reserves:**

Foley (1992) estimates that there are 1,800 to 2,200 million tons of chromic oxide in three deposits. Seven other unmeasured or minor chromite occurrences were noted.

**Additional comments:**

See also Upper Kanuti (BT012) and Lower Kanuti (BT014).

**References:**

Herreid, 1969; Patton and Miller, 1970; Clautice, 1978; Arctic Environmental Information and Data Center, 1982; Foley and McDermott, 1983; Foley and others, 1985; Bottge, 1986; Nokleberg and others, 1987; Foley, 1992; Nokleberg and others, 1996; Kurtak and others, 2002.

**Primary reference:** Foley and McDermott, 1983

**Reporter(s):** J.M. Britton (Anchorage)

**Last report date:** 8/1/2002

**Site name(s):** Unnamed (on upper Kanuti River)

**Site type:** Occurrences

**ARDF no.:** BT012

**Latitude:** 66.4019

**Quadrangle:** BT B-2

**Longitude:** 150.7390

**Location description and accuracy:**

This site includes several similar several occurrences in a northeast-southwest-trending area centered about 2 miles northwest of Caribou Mountain. The center of the occurrences is about 0.2 mile southwest of the center of section 10, T. 18 N., R. 15 W. of the Fairbanks Meridian. The other occurrences extend for about 1 mile northeast and and 1 mile southwest in a band that is about one mile wide.

**Commodities:**

**Main:** Cr

**Other:** Co, Ni, PGE

**Ore minerals:** Chromite

**Gangue minerals:**

**Geologic description:**

Several small occurrences of disseminated and massive chromite in dunite and peridotite were found in the upper Kanuti River ultramafic complex (Foley, 1992). The area is geologically similar to the Caribou Mountain occurrence (BT011), but there is little information specific to this site. Samples contain as much as 1.5% chromium (Foley and McDermott, 1983).

**Alteration:**

**Age of mineralization:**

The chromite is a normal primary constituent of Jurassic or older ultramafic rocks.

**Deposit model:**

Podiform chromite (Cox and Singer, 1986; model 8a)

**Deposit model number (After Cox and Singer, 1986 or Bliss, 1992):**

8a

**Production Status:** None

**Site Status:** Inactive

**Workings/exploration:**

Only surface sampling.

**Production notes:**

**Reserves:**

**Additional comments:**

See also: Caribou Mountain (BT011); Lower Kanuti (BT014).

**References:**

Herreid, 1969; Patton and Miller, 1970; Clautice, 1978; Foley and McDermott, 1983; Foley and others, 1985; Bottge, 1986; Nokleberg and others, 1987; Foley, 1992; Kurtak and others, 2002.

**Primary reference:** Foley and McDermott, 1983

**Reporter(s):** J.M. Britton (Anchorage)

**Last report date:** 8/1/2002

**Site name(s):** Unnamed (near Kanuti Hot Springs)

**Site type:** Occurrence

**ARDF no.:** BT013

**Latitude:** 66.3369

**Quadrangle:** BT B-2

**Longitude:** 150.9140

**Location description and accuracy:**

This occurrence is at an elevation of 1250 feet, about 0.5 mile northwest of the Kanuti River, and just north of the center of the south boundary of section 35, T. 18 N., R. 16 W., of the Fairbanks Meridian. The location is accurate within one-quarter mile.

**Commodities:**

**Main:** Sn, U

**Other:** Cu, Li, Pb

**Ore minerals:** Metazeunerite

**Gangue minerals:**

**Geologic description:**

This occurrence consists of anomalous U, Sn, Pb, As, Sb, Cu, and Li in altered rhyolite porphyry, biotite granite, and leucocratic granite within the Cretaceous(?), Hot Springs granitic complex (Barker and Foley, 1986). The highest values were in samples of the altered rhyolite porphyry; metazeunerite was identified by X-ray diffraction in one sample (Barker and Foley, 1986). A gray-green weathering rock contains 1,000 ppm uranium, 216 ppm tin, 2,616 ppm lead, and 341 ppm copper. The extent of this mineralization is uncertain due to poor exposures, but similar pieces of mineralized float occur elsewhere in the area. The Hot Springs pluton is composed principally of coarse-grained porphyritic and seriate biotite granite and biotite, quartz monzonite. The granitic rocks are intruded by younger rhyolite porphyry dikes and stocks (Barker and Foley, 1986).

**Alteration:**

Published reports indicate that the rocks are altered, but the alteration is not described.

**Age of mineralization:**

The Hot Springs pluton is assumed to be Cretaceous because it is similar to isotopically-dated Cretaceous plutons in the region.

**Deposit model:**

**Deposit model number (After Cox and Singer, 1986 or Bliss, 1992):**

**Production Status:** None

**Site Status:** Inactive

**Workings/exploration:**

Only surface sampling. Claims were located in 1980 but there is no indication of further activity.

**Production notes:**

**Reserves:**

**Additional comments:**

**References:**

Barker and Foley, 1986.

**Primary reference:** Barker and Foley, 1986

**Reporter(s):** J.M. Britton (Anchorage)

**Last report date:** 8/1/2002

**Site name(s): Unnamed (near lower Kanuti River)****Site type:** Occurrences**ARDF no.:** BT014**Latitude:** 66.2802**Quadrangle:** BT B-2**Longitude:** 150.8769**Location description and accuracy:**

This site includes fourteen similar mineral occurrences that form a northwest-trending belt about 7 miles long. The coordinates are at the northeast end of the belt at the best exposed of these deposits which is about 0.6 mile north-northwest of hill 2190 and about 9 miles southwest of Caribou Mountain. This locality is at an elevation of about 1,900 feet, in the SE1/4 section 24, T. 17 N., R. 16 W. of the Fairbanks Meridian. Similar mineralization also occurs in three other areas to the southwest .

**Commodities:****Main:** Cr**Other:** Co, Ni, PGE**Ore minerals:** Chromite**Gangue minerals:****Geologic description:**

Fourteen occurrences of podiform chromite occur within the lower Kanuti ultramafic body (Foley and McDermott, 1983). The best exposure of this mineralization is an 80-ft. long, 5-ft.-thick interval up to 4 inches thick composed of layers of disseminated to coalescent chromite, alternating with barren dunite. A number of other occurrences in the area are poorly exposed or exposed only as rubble. They consist of local concentrations of wispy, disseminated chromite in serpentinized dunite; pods of massive chromite in rubble; discontinuous lenses of chromite; and massive and coalescent chromite. Samples contain from 0.2 to 23.5% chromium over 1-foot intervals, and 8.5% chromium over a 5-foot interval (Foley and McDermott, 1983). The average chromium content of the samples is less than 2%. The cobalt, copper, and nickel content of these samples show little enrichment above what is typical for ultramafic rocks (Foley and McDermott, 1983). One concentrated sample of chromite from the area contains 340 ppb platinum.

The ultramafic, mafic volcanic and intrusive rocks, and associated chert in this area are thought to represent a dismembered ophiolite assemblage (Foley and McDermott, 1983). The mafic-ultramafic rocks at these occurrences are similar to those at Caribou Mountain (BT011). They consist principally of interlayered dunite and pyroxene-peridotite, with

subordinate gabbro, pyroxenite, serpentinite, and chromitite. Individual layers range from tens to thousands of feet thick. The richest chromite deposits are in the dunite. Although chromite is ubiquitous in the dunite and pyroxene-peridotite, it seldom exceeds 1 to 2 percent of the rock.

**Alteration:**

Some serpentinization of the ultramafics.

**Age of mineralization:****Deposit model:**

Podiform chromite (Cox and Singer, 1986; model 8a)

**Deposit model number (After Cox and Singer, 1986 or Bliss, 1992):**

8a

**Production Status:** None**Site Status:** Inactive**Workings/exploration:**

The U.S. Bureau of Mines carried out surface sampling and some beneficiation studies (Foley and McDermott, 1983) One of their sample locations was from a pit on claims located in 1975 by the Oil Development Co. of Texas.

**Production notes:****Reserves:**

Foley and McDermott (1983) estimated that 6 to 7 million tons of chromic oxide are present in one 80-ft.-long x 5-ft.-thick exposure of banded and disseminated chromite. Thirteen additional occurrences are minor or unmeasured.

**Additional comments:**

See also: Caribou Mountain (BT011); upper Kanuti River (BT012).

**References:**

Herreid, 1969; Patton and Miller, 1970; Clautice, 1978; Foley and McDermott, 1983; Foley and others, 1985; Bottge, 1986; Foley, 1992; Nokleberg and others, 1996; Kurtak and others, 2002.

**Primary reference:** Foley and McDermott, 1983**Reporter(s):** J.M. Britton (Anchorage)**Last report date:** 8/1/2002

**Site name(s): Dome Creek****Site type:** Occurrence**ARDF no.:** BT015**Latitude:** 66.2522**Quadrangle:** BT B-3**Longitude:** 151.0074**Location description and accuracy:**

Dome Creek, which is unnamed on the Bettles B-3 topographic map (1970), is a tributary of the Kanuti River. Its mouth is about 14 miles southwest of Caribou Mountain. Cobb's (1978 [OF78-94]) description of this occurrence indicates considerable uncertainty as to its location. The coordinates above are based on U.S. Bureau of Mines and Bureau of Land Management records that locate the occurrence, but do not indicate the basis on which the location was determined (Bottge, 1986; Kurtak and others, 2002) This occurrence is probably about 0.5 mile east-southeast of the center of section 32, T. 17 N., R. 16 W., of the Fairbanks Meridian. The location is accurate within 2 miles.

**Commodities:****Main:** Au**Other:** Cr(?)**Ore minerals:** Gold, chromite(?)**Gangue minerals:****Geologic description:**

Brooks (1912) reported that placer gold prospects were found on Dome Creek in 1911. There are no other published reports of mining or prospecting on this creek. The U.S. Bureau of Mines investigated the area in the 1980's, apparently for its chrome potential (Foley and McDermott, 1983; Kurtak and others, 2002). Two panned-concentrate samples from Dome Creek, about three miles east of the Kanuti River, contain 2 very fine gold flakes, and 425 and 508 ppm chromium (Kurtak and others, 2002).

**Alteration:****Age of mineralization:**

Quaternary.

**Deposit model:**

Placer Au (Cox and Singer, 1986; model 39a) and podiform chromite(?) (Cox and Singer,



1986; model 8a)

**Deposit model number (After Cox and Singer, 1986 or Bliss, 1992):**

39a and 8a(?)

**Production Status:** None

**Site Status:** Inactive

**Workings/exploration:**

Placer prospecting and some surface sampling.

**Production notes:**

**Reserves:**

**Additional comments:**

**References:**

Brooks, 1912; Heiner and Wolff, 1968; Cobb, 1978 (OF78-94); Foley and McDermott, 1983; Bottge, 1986; Kurtak and others, 2002.

**Primary reference:** Brooks, 1912; Kurtak and others, 2002

**Reporter(s):** J.M. Britton (Anchorage)

**Last report date:** 8/1/2002

**Site name(s):** Unnamed (tributary to the Kanuti River)

**Site type:** Occurrence

**ARDF no.:** BT016

**Latitude:** 66.2108

**Quadrangle:** BT A-3

**Longitude:** 151.0910

**Location description and accuracy:**

This placer occurrence is on an unnamed, north-flowing tributary to the Kanuti River about 0.5 mile upstream from its mouth. The creek is about 6.2 miles north-northeast of the north end of Tokusatatquaten Lake in the SW1/4 section 14, T. 16 N., R. 17 W. of the Fairbanks Meridian. The location is accurate within 1 mile.

**Commodities:**

**Main:** Au

**Other:**

**Ore minerals:** Gold

**Gangue minerals:**

**Geologic description:**

Two very fine gold flakes were noted in eight panned samples collected from this unnamed creek. The panned samples contain 2,119 ppb gold and 252 ppm chromium (Kurtak and others, 2002). The rocks in the area are chlorite schist and interbedded meta-graywacke cut by quartz veinlets (Patton and Miller, 1973). Upstream, the creek passes over the contact of the Sithylenkat Pluton. No other information is available.

**Alteration:**

**Age of mineralization:**

Quaternary.

**Deposit model:**

Placer Au (Cox and Singer, 1986; model 39a)

**Deposit model number (After Cox and Singer, 1986 or Bliss, 1992):**

39a

**Production Status:** None

**Site Status:** Inactive

**Workings/exploration:**

Placer claims were located in the 1960's and 1970's.

**Production notes:**

**Reserves:**

**Additional comments:**

**References:**

Patton and Miller, 1973; Bottge, 1986; Kurtak and others, 2002.

**Primary reference:** Kurtak and others, 2002

**Reporter(s):** J.M. Britton (Anchorage)

**Last report date:** 8/1/2002

**Site name(s):** Unnamed (west of Sithylenkat Lake)

**Site type:** Occurrence

**ARDF no.:** BT017

**Latitude:** 66.1281

**Quadrangle:** BT A-3

**Longitude:** 151.4485

**Location description and accuracy:**

This occurrence is at an elevation of about 1,100 feet on the ridge about 0.75 mile west-northwest of the outlet of Sithylenkat Lake. The location is accurate to within one-half mile.

**Commodities:**

**Main:** Co, Cr

**Other:** Ni

**Ore minerals:** Chromite, magnetite

**Gangue minerals:** Serpentine

**Geologic description:**

This occurrence consists of chromite as an accessory mineral in mafic and ultramafic rocks (Foley, 1992). The rocks are part of the Caribou Mountain-Melozitna ultramafic belt which hosts chromite occurrences elsewhere. The rocks that define the belt consist of serpentinitized dunite, peridotite, and gabbro. A serpentinite sample from a frost boil contains 700 ppm cobalt, 3,000 ppm chromium, and 500 ppm copper (Foley, 1992). Kurtak and others (1999 and 2002) report that 3 samples of serpentinitized dunite and/or gabbro contain as much as 0.74% chromium, 120 ppm cobalt, and 2,400 ppm nickel. Disseminated chromite was observed in the sample with the highest chromium value.

**Alteration:**

Serpentinization.

**Age of mineralization:**

**Deposit model:**

Podiform chromite (Cox and Singer, 1986; model 8a)

**Deposit model number (After Cox and Singer, 1986 or Bliss, 1992):**

8a

**Production Status:** None

**Site Status:** Inactive

**Workings/exploration:**  
Only surface sampling.

**Production notes:**

**Reserves:**

**Additional comments:**  
See also: Caribou Mountain (BT011).

**References:**  
Patton and Miller, 1970; Foley and McDermott, 1983; Foley and others, 1985; Barker and Foley, 1986; Foley, 1992; Kurtak and others, 1999; Kurtak and others, 2002.

**Primary reference:** Foley, 1992

**Reporter(s):** J.M. Britton (Anchorage)

**Last report date:** 8/1/2002

**Site name(s):** Unnamed (southeast of Sithylemenkat Lake)

**Site type:** Occurrences

**ARDF no.:** BT018

**Latitude:** 66.0265

**Quadrangle:** BT A-3

**Longitude:** 151.1472

**Location description and accuracy:**

This record describes several lode and placer occurrences in an area approximately 9 to 10 miles southeast of the center of Sithylemenkat Lake. The occurrences are centered at an elevation of about 2,350 feet, about 0.3 mile east-northeast of the center of section 21, T. 14 N., R.17 W. of the Fairbanks Meridian. The occurrences include a small group of lode deposits at these coordinates; other lode occurrences are about 1 mile south and about 1.5 mile northeast. There are also several placer occurrences in streams draining the area. The location is accurate.

**Commodities:**

**Main:** Sn

**Other:** As, Bi, Cs, Cu, Nb, Pb, Rb, REE, Ta, W

**Ore minerals:** Arsenopyrite, cassiterite, galena, hematite, ilmenite, magnetite, molybdenite, monazite(?), pyrite, wolframite

**Gangue minerals:** Chlorite, garnet, quartz, sericite, tourmaline

**Geologic description:**

Tin-bearing rocks occur in the batholith of the Sithylemenkat granite and mineralized float is common in streams in the area (Barker and Foley, 1986). Tin minerals are also concentrated in the alluvial gravels of the upper Kanuti Kilolitna River. Cassiterite has been identified in chlorite-rich and locally magnetite-bearing greisen zones in the granitic rocks (Barker and Foley, 1986). Mineralized rock samples exhibit variable effects of greisenization, with tourmaline and magnetite sometimes present. Sericite-quartz veins and altered dikes contain abundant secondary chlorite and may contain up to several percent sulfides. The sulfide minerals include pyrite, arsenopyrite, galena, and molybdenite. The greisen range in color from light to dark green; the highest Sn values are in the darker varieties. The extent of the greisen is difficult to determine due to poor exposures. Some zones have been traced for as much as 1,200 feet, and one greisen zone is up to 10 feet thick (Barker and Foley, 1986).

Thin sections of the greisen show relict porphyritic texture; feldspar phenocrysts are replaced by intergrown quartz and sericite, which, in the more altered samples are replaced

by chlorite and clay minerals.

Greisen samples contain 25 to 2,300 ppm tin (Barker and Foley, 1986). The analyses also show up to 5,126 ppm arsenic, 326 ppm bismuth, 253 ppm cesium, 1,808 ppm copper, 34,027 ppm lead, 1,156 rubidium, 135 ppm tungsten, and 4,044 ppm zinc. More recent rock samples also contain anomalous tin, zinc, copper, and lead, as well as up to 25.9 ppm silver, up to 75.6 ppm uranium, and up to 101 ppm thorium (Kurtak and others, 2002).

Reconnaissance placer sampling shows alluvial concentrations of tin minerals in the upper part of the Kanuti Kilolitna River (Barker and Foley, 1986). Placer samples taken from near the surface contain up to 0.4 pounds of tin per cubic yard, with lesser tantalum, columbium, tungsten, and rare earth minerals. In addition to cassiterite, the placer concentrates also contained wolframite, pyrite, ilmenite, hematite, garnet, and monazite(?).

The Sithylemenkat pluton is a composite batholith. Geologic mapping of its northern half has identified four textural phases, including porphyritic granite, granite porphyry, coarse-grained granite, and graphic granite (Barker and Foley, 1986). It is Early Cretaceous, based on K/Ar dating (Patton and Miller, 1973).

**Alteration:**

Greisenization.

**Age of mineralization:**

The Sithylemenkat pluton which is probably the source of the deposits is Early Cretaceous based on a K/Ar date of 106 +/- 3 my for biotite (Patton and Miller, 1973).

**Deposit model:**

Sn greisen deposits (Cox and Singer, 1986; model 15c) and alluvial placer Sn (Cox and Singer, 1986; model 39e)

**Deposit model number (After Cox and Singer, 1986 or Bliss, 1992):**

15c and 39e

**Production Status:** None

**Site Status:** Inactive

**Workings/exploration:**

Only surface sampling.

**Production notes:**

**Reserves:**

**Additional comments:**

**References:**

Herreid, 1969; Patton and Miller, 1970; Patton and Miller, 1973; Bundtzen and others,

1982; Barker, 1983; Foley and McDermott, 1983; Foley and others, 1985; Barker and Foley, 1986; Foley, 1992; Hudson and Reed, 1997; Kurtak and others, 1999; Kurtak and others, 2002.

**Primary reference:** Barker and Foley, 1986

**Reporter(s):** J.M. Britton (Anchorage)

**Last report date:** 8/1/2002



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