Cassiterite in Gold Placers at Humboldt Creek Serpentine-Kougarok area Seward Peninsula, Alaska

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Abstract

Large amounts of cassiterite accompany placer gold in Humboldt Creek in the Serpentine-Kougarok area, Seward Peninsula, Alaska. Cassiterite has also been reported from other placer-gold workings nearby. To date, no cassiterite has been recovered commercially; chemical analyses of concentrates from Humboldt Creek show a tin content of 60 percent—a commercially saleable product. Recovery of a saleable tin product would increase the possibility for profitable operation of the gold placers.

The cassiterite is intergrown with vein quartz without any noticeable sulfide minerals; the cassiterite grains occur in size and quantity that suggest a nearby lode source worth the effort of a search to find it.

INTRODUCTION

The occurrence of cassiterite in placer-gold concentrates from Humboldt Creek, in the Serpentine-Kougarok area (fig. 1), was reported by Knopf in 1908; traces of cassiterite in placer-gold deposits elsewhere in the region were reported by Knopf (1908, p. 63) and Moxham and West (1953). In 1967, during a helicopter reconnaissance of the streams in the granite area west of Humboldt Creek, Kachadoorian sampled concentrates present in substantial tonnages at old placer-gold workings on Humboldt Creek; the concentrates proved to be composed principally of cassiterite in the form of nuggets as much as 3 inches in diameter. The amount, size, and composition of the nuggets all suggest that an economic placer operation could be established on Humboldt Creek provided the cassiterite is recovered during placer-gold operations. Moreover, a nearby lode source of cassiterite must exist.

This brief report includes a new geologic map of the Serpentine-Kougarok area prepared by the authors. Earlier work includes geologic reconnaissance and mineral-deposit investigations by Collier, Hess, Smith, and Brooks (1908), Smith (1908), and Moxham and West (1953). Moxham and West also investigated radioactive deposits in the Serpentine Hot Springs area. The present work was done as part of the Heavy Metals program of the U.S. Geological Survey.

Fig 1

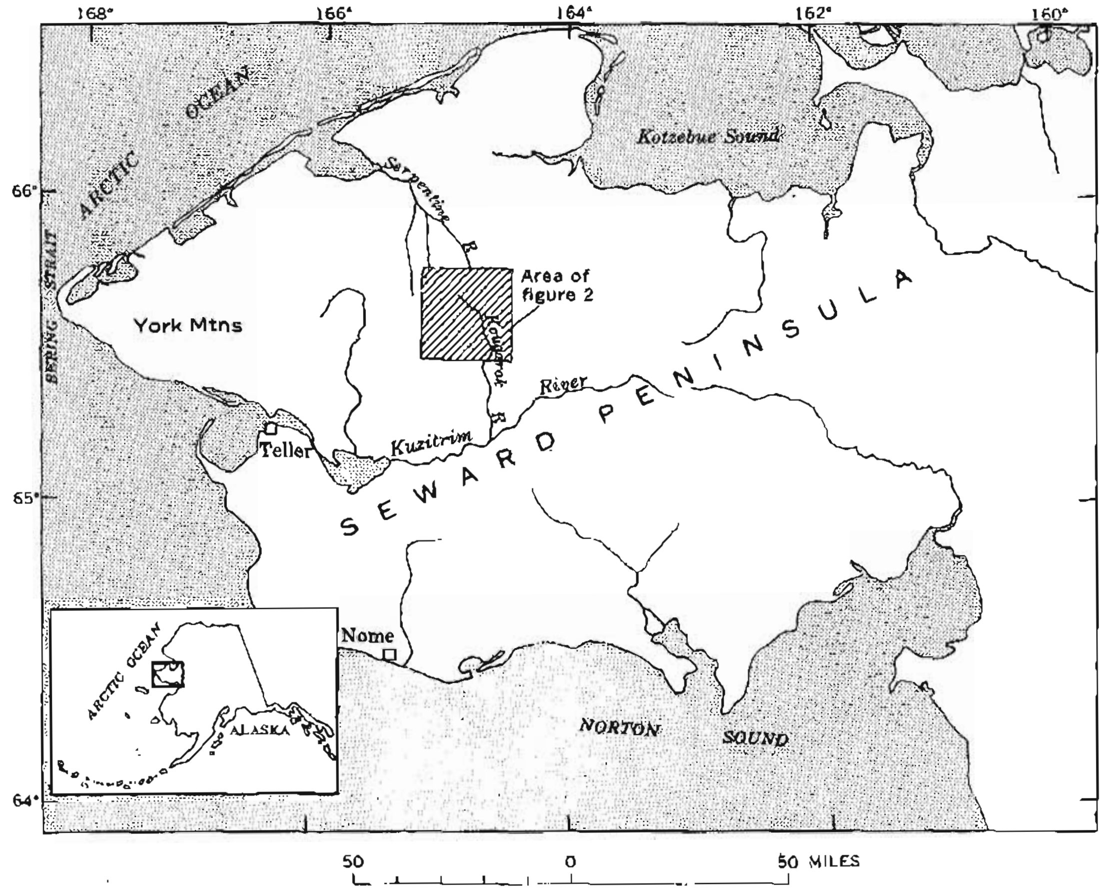
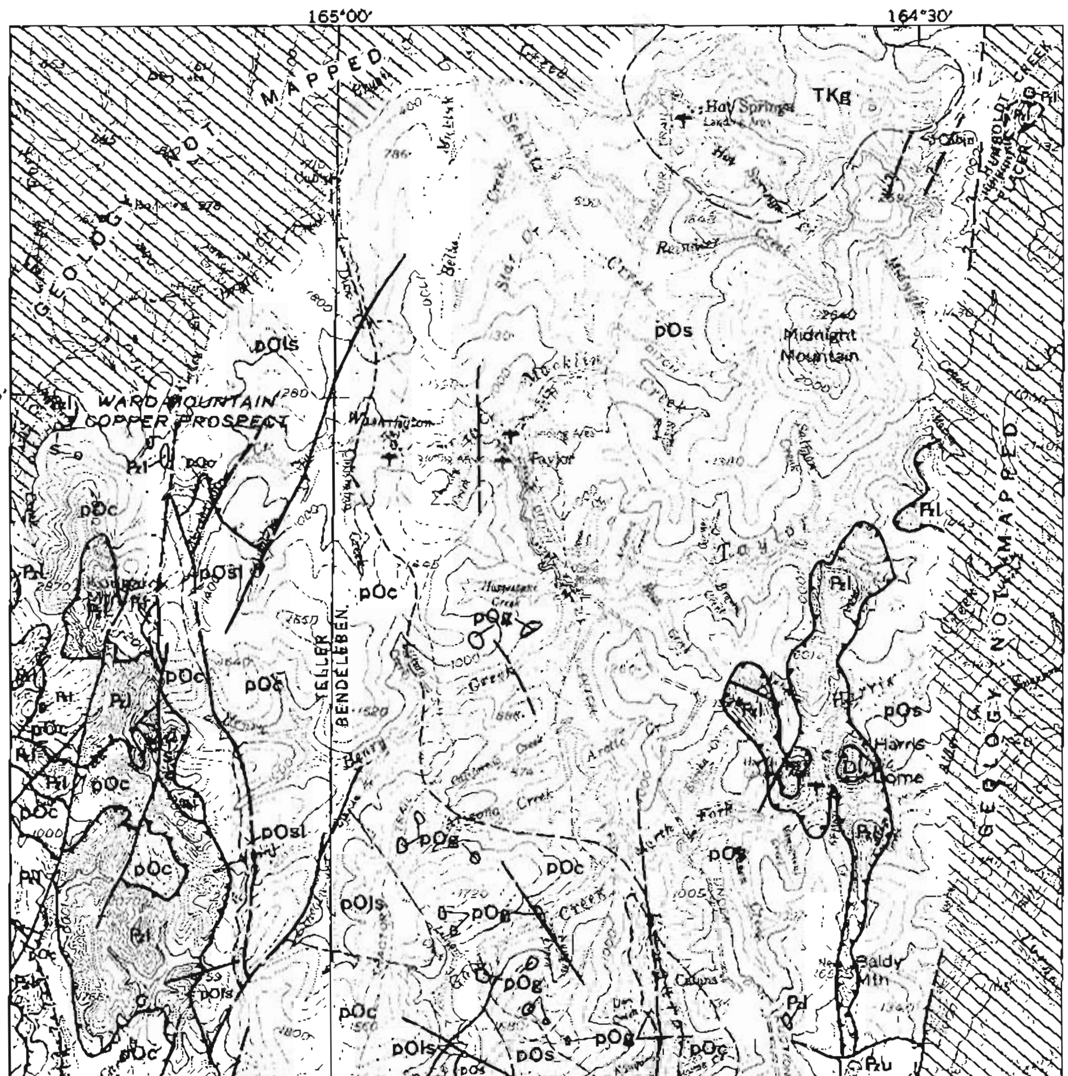


FIGURE 1. Index map of Seward Peninsula, showing location of Serpentine-Kougarok area.

GENERAL GEOLOGY

The bedrock in the Humboldt Creek area (fig. 2) consists of two dissimilar groups of rocks. The older, of pre-Ordovician age, consists of slate, schist, and schistose limestone intruded by bosses of gabbro and related mafic rocks, in part altered to glaucophane-garnet rock. The younger group consists entirely of carbonate rocks of Paleozoic age; its contact with the older rocks is everywhere thrust faulted. These faults form part of an extensive belt of thrust faults that extend from near the western tip of the Seward Peninsula to beyond the Humboldt Creek area. The belt is not yet completely delineated, but has been mapped in detail in the York Mountains some 70 miles west of the area of this report (Sainsbury, 1965).

The bedrock near Humboldt Creek consists dominantly of slate, quartzitic slate, graphitic siltstone, and hornfels encircling a stock of biotite granite; to the east, calcareous schist and marble prevail. The granite crops out over a roughly oval area about 8 by 6 miles; it extends over a low divide into a creek which joins Humboldt Creek from the west below the placer cuts from which the coarse cassiterite was obtained. The granite is coarse grained and is composed of quartz, orthoclase, and biotite; zircon, sphene, and allanite are common accessories (Moxham and West, 1953, p. 8). Local variants include aplite, quartz-muscovite pegmatite, and biotite-rich facies. Neither these variants nor the granite itself has been studied in detail. Megascopically, the granite is similar to some of the other granites



Base from U.S. Geological Survey 1:250,000 topographic quadrangles: Teller, 1950; Bendeleben, 1950

Geology by C. L. Sainsbury, 1964–67, Reuben Kachadoorian, T. E. Smith, and W. C. Todd, 1967

1 0 1 2 3 4 5 MILES

EXPLANATION

PRE-ORDOVICIAN

pOg — Gabbro and altered mafic rocks

pOs — Slate, graywacke, hornfels

pOls — Limestone, mica-calcite schist

pOc / pOsl / pOc — Schist and limestone
pOc, chloritic schist
pOsl, schistose limestone

CRETACEOUS OR TERTIARY

TKg — Granite

PALEOZOIC

DEVONIAN

Dl — Limestone and dolomite

Pzl — Limestone, marble, and dolomite

Pzu — Limestone and mica-calcite schist, undifferentiated

Silicified limestone with copper minerals

Contact
Dashed where gradational or inferred

Fault
Dashed where approximately located; queried where inferred

Thrust fault
Sawteeth on upper plate; queried where inferred

FIGURE 11 Reconnaissance geologic map of the Serpentine-Kougarok area. Humboldt Creek placer deposit is in northeast corner of area.

of the western Seward Peninsula with which lode or placer tin is associated (Knopf, 1908); the tin unquestionably is genetically related to the granite (Hosking, 1967; Sainsbury and Hamilton, 1967).

RELATION OF GEOLOGIC STRUCTURE AND MINERALIZATION

The structure of the area covered by figure 2, although not shown in detail on the map, is similar to that found elsewhere on the Seward Peninsula (Sainsbury, 1965). After thrusting, granite stocks pierced the thrust plates, probably during Late Cretaceous or Tertiary time. Still later, several sets of faults, including a strong set of normal faults striking about north to N. 15°–20° E., cut the thrust plates and, locally, the granites. Hydrothermal alteration took place along many of these north-trending faults, and most of the main placer-gold deposits are spatially related to them.

In contrast to the alteration along the normal faults, during which gold (and tin?) was introduced, material brought in along the thrust faults consists of large masses of dolomite, sideritic carbonate, or silica with but minor amounts of ore minerals, the type of material depending on the composition of the underlying rocks. Where carbonate rocks of the thrust plates overlie dolomitic limestone, barren dolomite has extensively replaced the upper carbonate rocks; where chloritic schist is overridden, masses of sideritic carbonate and minor amounts of quartz, with traces of gold, have migrated upward; where thrust plates have overridden slates, large amounts of quartz have replaced the carbonate rocks of the upper plate, bringing anywhere from a trace to considerable amounts of copper (as at the Ward Mountain copper prospects) without detectable gold or tin. Hence, although some ore minerals accompanied the materials migrating upward from the underlying rocks during thrust faulting, most of the economically interesting deposits of gold and tin seem to be related to a distinctly later period of mineralization which followed intrusion of granite and normal faulting.

Significantly, several high-angle faults similar in orientation to those which controlled the gold deposits of the Kougarok River drainage cross Humboldt Creek or its tributaries above the placer cuts from which the cassiterite was recovered. These faults were plotted from aerial photographs; they were not examined on the ground, but might be a source of the cassiterite.

CASSITERITE ON HUMBOLDT CREEK

Humboldt Creek (fig. 2) flows northeastward from the north peak of Midnight Mountain, and joins the Goodhope River some 18 miles from the cassiterite-bearing placer cuts. The placer cuts that yielded the cassiterite begin some 3 miles from the headwaters of Humboldt Creek and extend about 2 miles downstream. According to one of the former miners (Harold Tweet, oral commun., 1967), the cassiterite, not then identified, was so plentiful that during placer mining it clogged the sluice riffles in a few hours and very seriously hampered the recovery of gold. This problem, in conjunction with a royalty, rendered the operation unprofitable. A dredge operation is now being considered and would very likely be profitable if both cassiterite and gold were recovered.

Figure 3 is a photograph of some cassiterite nuggets selected from a can of concentrate taken randomly from one of the many barrels of stripped concentrate found at the gold-placer cuts. ("Stripped concentrate" is one from which all gold has been removed except that which could be recovered by grinding in an amalgamation barrel.) The nuggets are angular to subrounded; many are intergrown with vein quartz. Nuggets as much as 4 inches across were seen in the barrels; however, the sand fraction also contains abundant cassiterite, with a few visible grains of bright yellow gold. At least three distinctly different types of cassiterite occur in the nuggets. Most nuggets larger than half an inch in diameter consist of brown brecciated cassiterite intergrown with broken quartz, some consist of very dark brown cassiterite with a limonitic-brown streak , and a few consist of black crystalline cassiterite, still exhibiting crystal faces, intergrown with quartz. The brecciated cassiterite apparently is very unusual, as it has not been observed elsewhere by Sainsbury in the tin deposits of the Seward Peninsula.

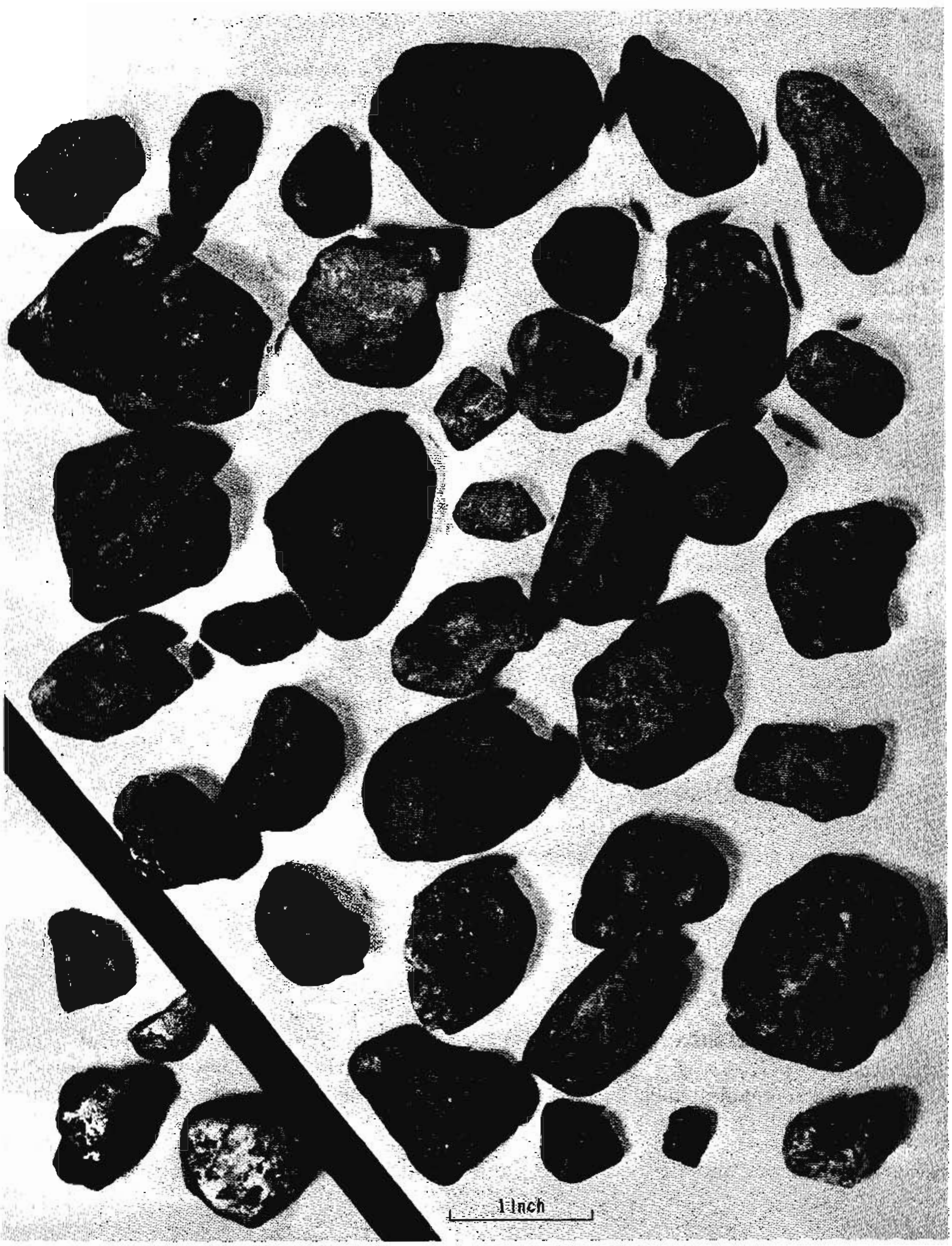


FIGURE 3. Cassiterite nuggets from Humboldt Creek. Shiny nuggets at lower left are coated with tin by the action of nascent hydrogen in the laboratory. Nuggets as much as 4 inches in diameter were found in the placer concentrates. Photograph by E. P. Krier.

In addition to cassiterite, the finer grained concentrates contain numerous tabular striated crystals of black hematite, noticeable sulfide minerals (principally pyrite), bits of bleached slate and schist, and unidentified mineral grains, together with rounded gold nuggets heavily coated with iron oxides. Some cassiterite occurs as euhedral doubly terminated pyramids as much as a quarter of an inch in diameter. To check for other elements often associated with tin deposits—notably tantalum and niobium—semiquantitative spectrographic analyses were made of a cassiterite nugget and of a sample of tin-bearing stripped concentrate. The results are given in table 1. As elsewhere in the Seward Peninsula, tantalum is absent, and niobium is but a minor constituent, in contrast to some other placer tin deposits of the world (Nigeria, for example) that contain economic amounts of columbite and tantalite.

A random grab sample of bulk concentrate was analyzed by Claude Huffman, Jr., using a wet chemical method. The sample was found to contain slightly more than 60 percent tin, and thus meets the requirements for a high-grade saleable tin concentrate.

TABLE 1.—*Semiquantitative spectrographic analyses of a cassiterite nugget and of a placer concentrate from Humboldt Creek*

[A indicates absent or below detection limit for that element; M, major (>10 percent). Detection limits are given only for elements listed as A. Quantities of Si through Ti are in percent, all others are in parts per million. Analysts: J. L. Finlay (nugget), R. H. Heidel (concentrate)]

Element	Cassiterite nugget	Tin-bearing stripped concentrate	Detection limit
Field No.	67-ASn652	67-ASn492	
Lab. No.	ACB 293	D129728	
Si	0.3	7.0	---
Al	.15	.5	---
Fe	5.0	10.0	---
Mg	.005	.1	---
Ca	.08	.15	---
Na	A	.3	0.05
Ti	.07	.5	---
Mn	100	500	---
Ag	A	1	1
B	A	50	20
Ba	10	70	---
Co	7	50	---
Cr	5	30	---
Cu	15	7	---
Ga	5	A	5
Nb	50	A	10
Ni	20	50	---
Pb	50	300	---
Sc	20	A	5
Sn	M	M	5
Sr	A	10	5
V	100	150	---
Y	20	20	---
Yb	5	3	---
Zr	200	30	---

CONCLUSIONS

Cassiterite accompanies gold in placers in the Serpentine Hot Springs area. In at least one creek (Humboldt Creek), cassiterite is present in large amounts. In the past, the cassiterite hindered the recovery of gold, but if, in future placer operations, the cassiterite could be recovered and sold, the economic potential would be considerably enhanced, and marginal gold ground might become profitable to mine.

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