Information Circular 9037

Critical and Strategic Minerals in Alaska

Tin, Tantalum, and Columbium

By J. Dean Warner

UNITED STATES DEPARTMENT OF THE INTERIOR
Donald Paul Hodel, Secretary

BUREAU OF MINES
Robert C. Horton, Director

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UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

ft	foot
ft^2	square foot
in	inch
lb	pound
lb/yd^3	pound per cubic yard
lb/yr	pound per year
m	meter
mg	milligram
mi	mile
MM lb	million pounds
MMyr	million years
oz/ton	ounce per ton
pct	percent
ppm	part per million
yd^3	cubic yard

CRITICAL AND STRATEGIC MINERALS IN ALASKA

Tin, Tantalum, and Columbium

By J. Dean Warner[1]

ABSTRACT

Alaska contains many critical and strategic minerals that are scarce in the conterminous United States. Among these are tin, tantalum, and columbium. This Bureau of Mines report summarizes available data on the production, reserves, and occurrences of these minerals in Alaska.

Alaska produces about 200,000 lb of tin per year, with historical production since 1901 estimated to have totaled 5,830,600 lb. Measured, indicated, and inferred tin reserves total over 140,000,000 lb. Much of the tin production has been from the placer mines of the western Seward Peninsula; however, most of the reserves are in that area's lode deposits.

Alaskan tin occurrences are part of a belt of tin mineralization that extends along the western coast of North and South America. The Alaskan portion of this "tin belt" comprises placer occurrences and lode occurrences of five major types: greisen, vein, skarn, pegmatite, and volcanogenic massive sulfide. Greisen and vein occurrences are the most abundant, but skarn deposits have historically been the most economically important.

Columbium and tantalum have not been produced in Alaska; however, they may be recoverable as byproducts of tin, tungsten, gold, or uranium mining. Approximately 135,000 lb of columbium oxide (Cb_2O_5) are inferred within the Tofty placer deposits in the Manley Hot Springs district.

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INTRODUCTION

Alaska has frequently been a source of tin, tungsten, platinum-group metals, antimony, mercury, chromite, and small amounts of asbestos during periods of national shortage, including the First and Second World Wars and the Korean and Vietnam conflicts. In a program that is part of the mineral studies mandated under the Alaska National Interest Lands Conservation Act (ANILCA),[2] the Bureau of Mines is evaluating occurrences of critical and strategic minerals in Alaska. The objective of this program is to locate deposits that could be mined if a prolonged national shortage should develop. Field work undertaken in 1981 concentrated on cobalt, platinum-group metals, and chromite (*1*).[3] This report presents findings from the second phase of the Bureau's critical and strategic minerals program in Alaska; it summarizes information on tin, tantalum, and columbium production, reserves, and occurrences. This information is meant to serve as a basis for future field and laboratory research.

ACKNOWLEDGMENTS

The mineral occurrence map (fig. 1, in pocket) and the mineral occurrence data presented in this report were compiled principally from the published sources listed in the reference section and from the computerized files of the Bureau of Mines Minerals Availability System (MAS). In addition, the following companies provided prospect information and/or assisted the author in obtaining prospect information: Anaconda Minerals Co., Bear Creek Mining Co., Duval Corp., Patino, Inc., and Tenneco Minerals Co., Anchorage, AK; Resource Associates of Alaska, Inc. and Doyon Ltd., Fairbanks, AK; Billiton Exploration, Inc., Denver, CO; and Union Carbide Corp., Grand Junction, CO.

DEFINITIONS

This report uses the following definitions:

Occurrence - The verifiable presence of a mineral or minerals.

Prospect - A mineral property, the value of which has not been proved by exploration.

Deposit - A natural occurrence of a useful mineral of sufficient extent and degree of concentration to invite exploration.

Mine - An opening or excavation in the earth for the purpose of extracting minerals.

Cassiterite (SnO_2) is the most abundant tin mineral and the only tin-ore mineral produced in Alaska. Some reports of tin production list pounds of concentrate, some pounds of cassiterite, and some pounds of tin metal. In this report, unless otherwise noted, concentrate is assumed to contain 75 pct Sn metal, which is essentially the same as the tin content, by weight, of cassiterite. This assumption probably results in a slight overestimation of total tin production, but is used as an upper limit for the tin content of concentrates where no specific information is available.[4]

HISTORY, PRODUCTION, AND RESERVES

TIN

Tin was first reported in Alaska in 1900 by A. H. Brooks of the U.S. Geological Survey (USGS), who identified cassiterite in placer concentrates from Buckner Creek and the Anikovik River on the Seward Peninsula (*2-3*). Followup exploration led to the location of tin placer deposits near Potato, Cape, Ear, and Brooks Mountains and later to the discovery of lode-tin occurrences in the same areas.

The largest of the lode discoveries was the Lost River Mine (map location *13*[5]) near Brooks Mountain, which yielded 695,400 lb Sn metal during intermittent operation from 1901 to 1964 (*4*), as shown in table 1. The Lost River Mine and minor production from lodes at Cape Mountain (map location *12*) and possibly at Potato Mountain (map location *11*) account for all Alaskan lode tin production.

Most Alaskan tin production has come from placer mines, and most of this production has been derived from Buck and Grouse Creeks in the Potato Mountain area, and Cape Creek in the Cape Mountain area, on the western Seward Peninsula (*4*). (See table 1.) Since the commencement of mining, the combined production of placer tin from these two areas has totaled an estimated 4,292,000 lb.

Following the discovery of tin on the Seward Peninsula, cassiterite was identified in concentrates from several gold mining districts in interior Alaska. The most productive was near Tofty (map location *36*), in the Manley Hot Springs district, where shipments of placer cassiterite concentrate from bench gravels commenced in 1911 (*11*). Intermittent production from this area through 1982 accounted for approximately 400,000 lb Sn,[6] or approximately 7 pct of total Alaskan tin production (table 1). Minor production of tin also has been reported from the Ruby (map location *32*), Circle (map location *33*), and Melozitna mining districts (map locations *29-31*) of interior Alaska.

Alaskan tin production is estimated to have totaled approximately 5,830,600 lb to 1983. Tin production from Cape Creek and Tofty was estimated to have totaled approximately 198,000 lb in 1982 and 215,000 lb in 1983 (*7-8, 12*). The 1983 output from these two areas was equal to

[2] Public Law 96-487, Dec. 2, 1980, title 10, section 1010.

[3] Italic numbers in parentheses refer to items in the list of references preceding the appendix.

[4] Of the total 5,830,600 lb Sn production reported later in the text, approximately 12,500 lb was derived using the 75-pct assumption.

[5] All references to map locations refer to locations shown in figure 1 (map in pocket). In addition, both lode and placer occurrences are described in appendix tables A-1 and A-2.

[6] Production estimates by Wayland (*19*) for the Tofty area are higher than those by Thomas (*11*), which were used to calculate this figure. Wayland estimates 352,600 lb Sn production through 1941, with little additional production from 1941 through 1961, while Thomas estimates 282,000 lb Sn production through 1956.

Table 1.—Estimated production[1] of tin from lode and placer sources in Alaska

Source (placer sources unless otherwise specified)	Map location (fig. 1)	Period	Reported production, lb (concentrate unless otherwise specified)	References
		SEWARD PENINSULA		
Lode sources:				
Lost River Mine area	*13*	1901-64	695,400 (Sn metal)	
Cape Mountain	*12*	1901-64	12,000 (Sn metal)	
Potato Mountain	*11*	1902-53	2,000 (Sn metal)	*4*
Lost River Mine area	*13*	1901-64	187,296 (Sn metal)	
Do	*13*	1964-65	([2])	
Cape Mountain area	*12*	1924-75	1,537,000 (Sn metal)	*4–5*
Do	*12*	1979-82	≅765,250 (Sn metal)	*5–8*
Potato Mountain area	*11*	1901-64	2,204,600 (Sn metal)	*4*
Otter Creek	*18*	To 1964	([3])	*9*
Others	NAp	U	<1,000 (Sn metal)	*10*
Total, Seward Peninsula	NAp	1901-82	≅5,400,000 (Sn metal)	NAp
		TOFTY TIN BELT, MANLEY HOT SPRINGS DISTRICT		
Cache Creek			5,155	
Dalton Creek			3,000	
Deep Creek			56,200	
Deep Creek tributaries			8,000	
Idaho Gulch			300	
Miller Gulch	*36*	1906-56	101,875	*10*
Patterson Creek			20,282	
Sullivan Creek			215,445	
Tofty Gulch			19,600	
Woodchopper Creek			40,300	
Unspecified sources		1966-82	>120,000 (Sn metal)	*12*
Total, Tofty tin belt[4]	NAp	1906-82	≅402,100 (Sn metal)	NAp
		RUBY DISTRICT		
Big Creek and Cox Pup		To 1962	2,100	
Birch Creek		1917-36	5,000	*13–14*
Glacier Creek		To 1962	150	*14*
Greenstone Creek		1940-42	300	*13–14*
Midnight Creek	*32*	1917-18	537 (Sn metal)	
Do		1940-42	7,320	*14*
Short Creek		1918	([5])	*13–14*
Straight		1916-20	([3])	*13*
Fifth of July Creek		1922	≅300 (Sn metal)	*14*
District total	NAp	1916-?2	≅402,100 (Sn metal)	NAp
		CIRCLE DISTRICT		
Deadwood and Boulder Creeks	*33*	To 1982	([3])	*15–17*
		MELOZITNA DISTRICT		
Mason Creek	*30*	1918	2,000	*14*
Tozimoran Creek	*29*	1938-43	≅500 (Sn metal)	*18*
Do	*29*	1983	≅12,500 (Sn metal)	*12*
District total	NAp	1918-83	≅14,500 (Sn metal)	NAp
		STATEWIDE		
Total for Alaska	NAp	1901-83	≅5,830,600 (Sn metal)	NAp

NAp Not Applicable. U Unknown.
[1] Totals calculated assuming concentrates contained 75 pct Sn, except for Tofty tin belt concentrates. (See footnote 4.)
[2] Several thousand pounds concentrate.
[3] Cassiterite recovered; quantity unknown.
[4] Total calculation based on 60-pct reported average tin content of concentrate (*10*).
[5] Few thousand pounds tin metal.

about 0.2 pct of the 1983 U.S. consumption of primary tin (88,000,000 lb) (*20*).

Published lode- and placer-tin reserve estimates are summarized in table 2. The largest reserves are at the Lost River Mine (map location *13*) on the western Seward Peninsula, where indicated tin reserves are estimated at 85,000,000 lb in a zone of 0.15 pct Sn, 5,200,000 lb in a deposit grading 0.26 pct Sn, and 1,600,000 lb in a deposit grading 1.3 pct Sn. Inferred reserves at Lost River total 21,000,000 lb of tin in four deposits ranging in grade from 0.4 to 1.5 pct Sn. Approximately 20,000,000 lb Sn is also inferred at the Coal Creek prospect in the Chulitna area (map location *49*) and approximately 300,000 and 1,000,000 lb Sn are reported to be indicated and inferred, respectively, at the Boulder Creek prospect (map location *51*) in the southern Alaska Range[7] (*24-25*). Tofty (map location *36*) is the only placer area for which tin reserve figures have been published. Approximately 3,900,000 lb Sn are indicated to

[7] Reed (*27-28*) suggests substantially lower reserves at Boulder Creek.

Table 2.—Tin reserves in Alaskan lode and placer deposits (Published estimates)

Deposit name	Map location (fig. 1)	Grade, pct	Reserves, million lb: Measured and indicated	Reserves, million lb: Inferred	References
Lode deposits:					
Lost River Mine:					
Cupola		0.151	85	NR	*21*
Cassiterite Dike		1.5	NR	2.4	
Do		1.3	1.6	NR	
Do	*13*	[1]>1.0	NR	9	
Do		.4	NR	5.2	*22*
Do		.26	5.2	NR	
Ida Bell Dike		.76	NR	4.4	
Coal Creek	*49*	.2	NR	20	*24*
Boulder Creek	*51*	[1]2.41	NR	1.0	*25*
Do		2.41	.3	NR	
Placer deposits:					
Tofty	*36*	[2]2.63	3.9	NR	*11, 19, 26*
Do		[2]0.58	NR	.7	*26*
Cape Creek	*12*	[2]2.6	NR	2.2	*23*
Total			96.0	44.9	NAp

NAp Not applicable. NR None reported.
[1] Grade uncertain.
[2] Pounds per cubic yard.

remain in 1,490,000 yd^3 of placer deposits, and approximately 733,000 lb Sn are inferred to remain in 1,259,000 yd^3 of tailings gravels in the Tofty area[8] (*11, 19, 26*).

Additional reserves can be calculated from figures given by Mulligan (*23*). Calculations suggest that 2,200,000 lb Sn remain in 850,000 yd^3 gravel at Cape Creek in the Cape Mountain area (map location *12*). Also, based on minimal drill data, in excess of 400,000 lb Sn is suggested to occur in the combined placer deposits of Ear Mountain and Tozimoran and Morelock Creeks (map locations *10, 29,* and *31*) (*14, 29*).

TANTALUM AND COLUMBIUM

Tantalum and columbium have no reported production in Alaska, and no domestic production has been reported since 1959 (*30-31*). The only established reserves of columbium in Alaska are at Tofty (map location *36*), where approximately 135,000 lb of columbium oxide are inferred to be contained within 2,660,000 yd^3 of placer and tailings gravels (*32*).

BUREAU OF MINES INVESTIGATIONS

The Bureau has published several reports concerning tin, tantalum, or columbium in Alaska. Recent work includes published and ongoing studies in the Sithylemenkat (*33-34*), Porcupine Plateau (*35-36*), Tofty (32), and Circle Quadrangle areas of interior Alaska (*16, 37-38*), the Mt. McKinley and Lake Clark areas of the central and southern Alaska Range (*39-40*), and the Selawik Hills area of northwestern Alaska (41). Previous Bureau studies include extensive evaluation of placer and lode deposits on the western Seward Peninsula (*23, 29, 42-47*) as well as investigations in the Manley Hot Springs district (*11*) and Melozitna district (*18*) in interior Alaska.

TRENDS OF ALASKAN TIN OCCURRENCES

Alaskan lode and placer occurrences containing tin, tantalum, and/or columbium are listed in the appendix, in tables A-1 and A-2. Where available, abbreviated geologic, geochemical, and production data are provided. Generally, the criteria for inclusion of a tin occurrence or deposit in these tables were (1) the presence of greater than trace amounts of tin and (2) a possibility for large, although undefined, volumes of material. However, a few tin occurrences that are in unique geologic settings but do not necessarily meet these criteria are also included for illustrative purposes. All reported occurrences of tantalum and/or columbium are included in these tables. The only commodities listed are metals with potential economic importance.

On a broad scale, the tin-bearing lode and placer occurrences of Alaska are part of a belt of tin mineralization that extends along the western flank of North and South America. As shown in figure 1 (map), the Alaskan portion of the belt parallels major geologic provinces from the Alaska-Yukon border across central Alaska to the Seward Peninsula (*48*). Most of the tin occurrences within this belt are spatially associated with nearby outcropping or subcropping biotite-bearing composite intrusions or felsic hypabyssal stocks and dikes of Cretaceous or early Tertiary age. The intrusions cut rocks of Precambrian (?) to Tertiary age and probably resulted from anatectic melting of sialic crust during a postorogenic period of magmatism (*48-50*). Thus, the distribution of tin occurrences in Alaska may be an indirect indication of areas underlain by continental crust.

On a smaller scale, the Alaskan tin belt is composed of several stanniferous trends, each of which has particular geologic characteristics and a variety of mineral deposit types. In figure 1, these trends are referred to as "Alaska Range," "Kuskokwim," "Yukon-Tanana," "Kokrine-Hodzana," "Seward Peninsula," "Brooks Range," and "Northeast Alaska." These mineral trends generally coincide with trends of granitic intrusions and gravity lows (*51-52*) and generally correlate with areas underlain by miogeosynclinal shelf or slope deposits. Parallelism with the trend of some ophiolite terranes and regional fault zones also suggests that the tin trends are in part controlled by crustal suture or major deep-seated fracture zones. Each of the regional trends is discussed below.

ALASKA RANGE

The Alaska Range trend of tin occurrences (fig. 1) extends south from near Healy to near Lake Clark, generally subparallel to the McKinley strand of the Denali fault. The trend includes the Chulitna-Yentna and parts of the Dall and Kantishna mineral belts delineated by Hawley (*39*). Sulfide-rich veins and skarns are locally enriched in tin, and cassiterite is present in greisenized granite stocks along this trend. A volcanogenic massive sulfide deposit in the northeastern part of the trend contains local tin enrichments. All the tin occurrences, except the massive sulfide, show close affinities to approximately 56-m.y.-old McKinley Series biotite-muscovite granites (*49, 53*) that generally intruded Jurassic to Cretaceous age argillite south of the Denali fault, but which also cut mixed volcano-sedimentary assemblages west of Cantwell and north of the Denali fault.

YUKON-TANANA

The Yukon-Tanana trend of tin occurrences follows the Yukon-Tanana Upland province in interior Alaska and generally parallels the Tintina fault to the north, which is interpreted as an extension of the Rocky Mountain trench in Canada (*54*). Virtually every placer gold district in the province contains at least traces of cassiterite, but most of the tin occurrences are confined to the area between Circle Hot Springs and the White Mountains, north and northeast of Fairbanks (fig. 1). Tin occurrences in this area are associated with late Cretaceous-early Tertiary age biotite granite composite intrusions that have intruded the sedimentary facies boundary between late Precambrian-early Paleozoic miogeosynclinal shelf and slope deposits, a boundary represented by the transition between rocks of the Wickersham and White Mountain terranes to the northwest and the Yukon-Tanana terrane to the southeast (*54-55*). This boundary may be the fault-offset analog of the MacKenzie Mountain-Selwyn Basin transition in Canada (*54, 56-57*), which coincides with a belt of Canadian tin occurrences (*58*). The Yukon-Tanana tin trend, therefore, may be an extension of the Canadian tin belt.

The placer tin deposits of the Tofty area in the Manley Hot Springs district have similarities to and may be transitional between tin occurrences of the Yukon-Tanana and Kuskokwim tin trends. At Tofty, although the tin source is unknown, both a biotite granite, similar to those of the Yukon-Tanana trend, and a monzonite stock, similar to those of the Kuskoskwim trend, are exposed (*19*). Like the placer deposits of the Yukon-Tanana trend, the tin at Tofty occurs as an accesory to gold; however, like many of the Kuskokwim

[8] Thomas (*11*) estimates 733,000 lb Sn in gravels in the Tofty area with a total volume of 1,259,000 yd^3, but does not give specific reserve locations. Wayland (*19*), however, estimates 433,600 lb Sn in three specific tailings areas, but does not give specific locations of in-place placer tin reserves.

trend deposits, the Tofty deposits are enriched with columbium. Lastly, both the Tofty and the Kuskokwim trend deposits are underlain by clastic sedimentary rocks of Jurassic-Cretaceous or Cretaceous age (*19*).

KUSKOKWIM

The Kuskokwim trend of tin occurrences extends subparallel to the Iditarod-Nixon Fork fault in west-central Alaska, from near Aniak northeastward to near Manley Hot Springs (fig. 1). Tin occurrences are associated with a varied assemblage of hypabyssal and plutonic intrusive rocks of monzonitic to granitic or rhyolitic composition. These rocks are of late Cretaceous to early Tertiary age and generally intrude sedimentary rocks of the Cretaceous Kuskokwim group. The presence of hypabyssal stocks and dikes, locally widespread thermal alternation and tourmalinization, and tin-silver-copper-rich veins (*59*) (table A-1) suggests that many of the occurrences in this area occur within shallow, possibly subvolcanic settings.

KOKRINE-HODZANA

The Kokrine-Hodzana tin trend lies northwest of the Kuskokwim and Yukon-Tanana trends, stretching from near Tanana northeastward across interior Alaska subparallel with the Kaltag fault system (fig. 1). Tin occurrences along the trend are associated with a 90- to 110-m.y.-old suite of plutons that has intruded lower to middle Paleozoic (?) age pelitic metasedimentary rocks of the Ruby "geanticline" (*50, 60-62*). These intrusions are in part separated from younger ones in the Yukon-Tanana and Kuskokwim trends by the southwest-trending Kaltag fault. The Ruby district (map location *32*) may be an extension of the Kokrine-Hodzana trend that has been offset to the southwest by the Kaltag fault.

SEWARD PENINSULA

The Seward Peninsula tin trend largely consists of a group of deposits that extends across the Seward Peninsula from Cape Mountain eastward to Kougarok Mountain and beyond (fig. 1). The deposits are characterized by tin-fluorine-beryllium zoned replacement lodes and veins formed by metasomatism of upper Precambrian (?) to middle Paleozoic age pelitic and carbonate rocks adjacent to 70- to 80-m.y.-old biotite-bearing granites (table A-1).

Additional tin occurrences, associated with the 80-m.y.-old Darby pluton, have been identified in the Darby Mountain area of the southeastern Seward Peninsula (*63*). Tin occurrences in this area are probably unrelated geologically to the other Seward Peninsula occurrences.

NORTHEAST ALASKA AND BROOKS RANGE

Unlike other tin occurrences in Alaska, tin occurrences of the northeast Alaska trend (fig. 1) are associated with probable middle Paleozoic age (350 m.y.) intrusions. These intrusions have invaded Precambrian (?) to lower Paleozoic age miogeosynclinal metasedimentary rocks of the Porcupine Plateau (*36*). The northeast Alaska trend may extend into the Brooks Range trend (fig. 1), where recent interpretations (*64*) suggest intrusions of similar mid-Paleozoic age; however, detailed data are lacking.

OTHER AREAS WITH TIN OCCURRENCES

Several tin occurrences in southern and southeast Alaska are not associated with known tin trends. (See figure 1 and "Other Occurrences" portion of table A-1.) In southern Alaska, near Cordova, tin is associated with two breccia or altered zones in greenstone and metasedimentary rocks. In southeast Alaska, tin occurs as a minor element in several base-metal vein or replacement deposits.

TIN LODE OCCURRENCES

Lode occurrences of tin in Alaska generally are of five main types: greisen, vein, skarn, pegmatite, and volcanogenic massive sulfide. Tin also occurs in a fumarole deposit at the Valley of Ten Thousand Smokes (*65*) (map location *54*). Greisen and vein occurrences far outnumber the other types of occurrences; however, in terms of production, the skarn type (at the Lost River Mine, map location *13*) historically has been most important. The following sections summarize the tin lode occurrence data presented in table A-1.

GREISEN

Greisen occurrences are centered about or confined to biotite granite or felsic hypabyssal stocks. These occurrences are typified by lithophile element-rich alteration minerals that accompany disseminated and stockwork or sheeted vein mineralization within or near the cupola of an intrusion. Important examples include the Lost River Mine (map location *13*) and the recent discovery at Coal Creek in the Chulitna area (map location *49*). Other unevaluated occurrences include greisen mineralization at Lime Peak (map location *34*), Ketchem Dome in the Circle mining district (map location *33*), Sithylemenkat (map location *25*), Kougarok Mountain (map location *16*), Rapid River (map location *3*), Esotuk and McCall Glaciers (map location *1*), and Ohio Creek in the Chulitna area (map location *49*).

VEIN

Vein mineralization most commonly occurs distal from the intrusion. The veins cut regionally or contact metamorphosed rocks and typically can be traced for hundreds of feet. Mineralization is usually polymetallic and silver- and sulfur-rich; and it is usually enclosed within a shear or breccia zone by a relatively restricted quartz-rich alteration selvage. Unlike the stockwork and sheeted veins associated with greisen mineralization, these veins are generally more continuous, more enriched in silver and sulfur, and usually are relatively isolated.

Examples of Alaskan vein occurrences include the Boulder Creek prospect (map location *51*), which is described as a cluster of narrow, open-space-filling fractures localized along a 1- to 6-m-wide fracture zone within metasedimentary rocks overlying a granite cusp (*28*). Lesser known occurrences that may prove to be important include those at Cosna (map location *37*), Quartz Creek (map location *28*), the Omilak and Foster prospects (map location *21*), and new discoveries in the western Medfra Quadrangle (Win and Won prospects, map locations *38-39*).

SKARN

Tin-bearing skarn deposits occur as tabular or vein like zones within carbonate rocks adjacent to biotite granites or felsic dikes. Commonly, like the adjacent greisenized granite, these deposits contain lithophile element-rich alteration minerals and potentially economic concentrations of fluorine, beryllium, and tungsten. Well-known metasomatic-replacement deposits are the Lost River Mine (map location *13*) and Cape Mountain lode (map location *12*). Minor tin-bearing skarn occurrences also occur at Mountain Creek (Rapid and Porcupine Rivers area, map location *3*) in northeastern Alaska and several prospects in the Brooks Range (Kaluich and two unnamed occurrences, map locations *4-6*).

PEGMATITE

Tin-bearing pegmatites are poorly documented in Alaska. Pegmatites carrying tin values have been found at the Ketchem Dome prospect in the Circle district (map location *33*), at the Janiksela occurrence in the Fairbanks district (map location *35*), and at the Kiana occurrence (map location *7*) in the Brooks Range.

VOLCANOGENIC MASSIVE SULFIDE

Tin-bearing volcanogenic massive sulfide has been discovered at the Sheep Creek prospect (map location *47*) in the central Alaska Range (*66*). One 350-ft drill intersection there averages 0.035 pct Sn. A narrower, 8-ft zone contains 1.2 pct Sn. The deposit is hosted within a siliceous exhalite (?) horizon and overlain by graphitic schists.

TIN PLACER OCCURRENCES

Like most world tin production, the bulk of Alaskan tin production comes from placer deposits. Cassiterite is a common accessory mineral in placer concentrates throughout much of Alaska. Approximately 90 pct of Alaskan placer production has been from the western Seward Peninsula. The remainder was recovered with gold from placer mines in interior Alaska (tables 1 and A-2). Placer tin occurrences of unknown grade occur in the Sithylemenkat River area (map location *25*) of interior Alaska and in the Rapid and Porcupine Rivers area (map location *3*) of northeastern Alaska (*33-35*). Anomalously large amounts of tin also have been found in numerous creeks in other areas of the Seward Peninsula, in interior Alaska, and in the Yentna district (map location *52*), southeast of the Alaska Range (*67*).

Tin occurs as cassiterite, along with various other high-specific-gravity minerals such as gold, scheelite, wolframite, magnetite, ilmenite, rutile, garnet, monazite, allanite, zircon, columbite, and cinnabar, in the heavy-mineral fraction of sands and gravels. Many of the tin placer deposits listed in table A-2 contain associated gold, tungsten, rare-earth elements, tantalum, and/or columbium, which must be considered in evaluating the placer's economic viability.

Cassiterite occurs in placers both as individual grains, which range from extremely fine to sand and pebble size, and as a constituent of larger cobbles. Grains of all sizes may vary from extremely angular to well-rounded. Cassiterite-bearing cobbles, sometimes termed "tinstone," often were not recovered in the past because their size necessitated hand sorting.

Cassiterite is present in bench, stream, river, and beach placers. Small, but anomalous amounts of cassiterite have also been detected in bottom sediment samples collected offshore in the Bering Strait-Cape Prince of Wales area (*68*), suggesting a potential for marine placers.

Insufficient data preclude determining average grade and yardage figures for tin-bearing placer deposits in Alaska as a whole. Generally, however, creeks that have yielded tin contain approximately 1 lb/yd^3 cassiterite or more, 60 pct or more tin in concentrates, and 10,000 yd^3 or more of placer material (table A-2). However, the major tin-producing creeks, including Buck, Grouse, and Cape Creeks in the Potato and Cape Mountain areas (map locations *11-12*) on the Seward Peninsula and many of the creeks in the Tofty area (map location *36*), probably contain material grading greater than 2.0 lb/yd^3 Sn. On Buck and Grouse Creeks, 2,204,600 lb Sn was produced from 560,000 yd^3 of gravels between 1901 and 1964 (*42-43*). In the Tofty area, approximately 1,490,000 yd^3 of reserve placer gravels is indicated to contain 2.6 lb/yd^3 Sn (*19*). A published drill report on Cape Creek indicates approximately 850,000 yd^3 of gravels with an average grade of 2.6 lb/yd^3 Sn (*23*).

REGIONAL FEATURES OF ALASKAN TANTALUM AND COLUMBIUM OCCURRENCES

Worldwide, deposits of columbium and tantalum occur in carbonatite-alkaline syenite complexes, pegmatites, or alkali-rich granites (*69*). Until 1961, the major source of columbium consumed in the United States was columbite in placers derived from the erosion of peralkaline granites and pegmatites in Nigeria; however, the major source today is pyrochlore obtained from carbonatites in Canada and Bolivia. Pegmatites are the dominant source of tantalum in the world.

In Alaska, most of the columbium and tantalum occurrences are found within the same trends as the tin occurrences. Columbium and tantalum are reported in the Northeast Alaska, Kokrine-Hodzana, Yukon-Tanana, and Kuskokwim tin trends. Where they are associated with tin, tantalum and columbium occur within minor accessory minerals either within the tin-bearing granite or within a related, more alkaline phase of the granite. Columbium and tantalum may also occur in trace amounts in cassiterite or may be associated with cassiterite in pegmatites.

In other areas of Alaska, for example southeastern Alaska and the western Yukon-Koyukuk basin, tantalum and columbium occurrences are not associated with tin and do not occur within tin trends. In these areas, columbium and tantalum are associated with peralkaline intrusions or pegmatites. Other alkaline intrusive complexes in southeastern, western, and other areas of Alaska may also contain columbium and tantalum.

TANTALUM AND COLUMBIUM LODE OCCURRENCES

Tantalum and columbium reported in Alaskan lode prospects occur in trace amounts associated with uraniferous alkaline complexes, in pegmatites, in tungsten-bearing molybdenum porphyries or in tin-bearing greisens (table

A-1). Tantalum and columbium in these occurrences may be recoverable as byproduct commodities.

At Bokan Mountain (map location *61*), columbium occurs in grades of 0.01 to 1.0 pct and is associated with uranium and thorium minerals within a peralkaline granite (*70*). Mineralization in the Bokan Mountain area consists of disseminated uranium-thorium minerals in granite, aplite, and pegmatite; hydrothermally deposited uranium-thorium minerals in or near fractures; and uranium-thorium minerals in interstices of quartzite (*70-71*). Both columbite and pyrochlore have been identified.

In the Selawik Hills (map location *9*), columbium is found in uraniferous altered zones within an alkaline complex (*41*). A columbium-uranium-titanium-bearing mineral has been identified in this area. This same or a similar mineral has been reported in the placers of Vulcan and Clear Creeks (map location *22*), where it is apparently derived from the Darby Mountain igneous complex in the eastern Seward Peninsula.

Columbium occurs in a pegmatite at the Edelweiss prospect (map location *59*) in southeastern Alaska, and tantalum and columbium are reported in a pegmatite at the Kiana occurrence (map location *7*) in the western Brooks Range (*72-73*). At the Kiana occurrence, columbite and tantalite are reported to occur with cassiterite. Both localities remain unevaluated.

An open-ended 4,000-ft-long by 200- to 2,000-ft-wide columbium soil geochemical anomaly with values of 0.006 to 0.018 pct Cb corresponds to molybdenum-tungsten mineralization associated with an altered porphyry at Bear Mountain (map location *2*) in northeastern Alaska (*74*). Pyrochlore was identified in a pan concentrate sample collected nearby.

At the Kougarok prospect (map location *16*) on the Seward Peninsula, tantalum and columbium values in the 0.01- to 0.03-pct range are associated with parts of the tin-mineralized greisen. The tantalum- and columbium-bearing minerals have not been identified.

COLUMBIUM AND TANTALUM PLACER OCCURRENCES

Columbium and, less commonly, tantalum occur in anomalously large amounts in many placer and heavy-mineral concentrate samples in Alaska. They are not known to occur in concentrations that would justify mining them as a primary commodity, but some of the higher concentrations may be recoverable as byproducts of tin or gold mining. The only occurrences that have been studied in any detail are at Tofty (map location *36*) in the Manley Hot Springs district of interior Alaska. (See table A-2 for detailed data on placer occurrences.)

At Tofty, columbium occurs within columbite and possibly aeschynite [Ce, Ca, Fe, Th)(Ti, Cb)$_2$(O, OH)$_6$] (*32*). The columbium occurs in grades averaging 0.05 lb/yd^3 columbium oxide and is associated with tin and gold in the placer deposits; however, the columbium and tin may have different sources. The sources of the columbium and tin are unknown.

Also in interior Alaska, anomalously large amounts of tantalum and columbium occur in the Sithylemenkat area (map location *25*), where placer concentrate samples containing detectable columbium and tantalum average 0.26 and 0.062 pct, respectively (*34*). Several other placer deposits in interior Alaska, including those of the Ruby, Circle, and Fairbanks districts (map locations *32-33* and *35*), also contain anomalously large amounts of columbium (*75*).

In northeastern Alaska, values of 0.05 to 0.1 pct Cb have been found in association with tin, tungsten, and rare-earth metals in sluice-box concentrate samples from the Rapid River drainage (map location *3*) (*35*). At the Bear Mountain prospect (map location *2*), concentrate from a bulk sample of alluvial gravel collected 2 mi downstream from the mineralized zone contained 0.15 pct Cb and 3 pct W (*74*).

On the Seward Peninsula, columbium is reported in tin-bearing gravels of Tuttle Creek (Ear Mountain area, map location *10*), Boulder and Cape Creeks (Cape Mountain area, map location *12*), and Cassiterite Creek (Lost River Mine area, map location *13*) (*28, 42, 75*). Reported values range from 0.001 to 0.10 pct Cb in spectrographic analyses of churn-drill concentrate samples. Columbium values associated with uranium occur in the Clear and Vulcan Creeks area (map location *22*) of the Darby Mountains on the southeastern Seward Peninsula, where a range of 0.03 to 0.18 lb/yd^3 Cb and an average of 1 pct Cb in concentrates (19 samples) was reported (*44*). Creeks draining the Kougarok Mountain (map location *16*) and Granite Mountain (map location *23*) areas on the central and eastern Seward Peninsula, respectively, are also reported to contain anomalously large concentrations of columbium (*75*).

In the Kuskokwim Mountains, anomalously large amounts of columbium are reported in stream gravels from the Vinasale Mountain (map location *42*) and Marvel Creek (map location *46*) areas (*75*). These occurrences have not been evaluated.

SUMMARY

Data compiled from published and unpublished sources indicate that Alaska contains a significant portion of the United States' reserves of tin. The State also contains minor reserves of columbium and occurrences of tantalum. All three of these critical and strategic metals could be obtained from Alaska during a period of national shortage.

An estimated 5,830,600 lb of tin has been produced, and an estimated additional 140,900,000 lb has been measured, indicated, or inferred to occur within Alaskan lode and placer deposits. Alaskan tin reserves represented about 150 pct of U.S. consumption of primary tin in 1983, whereas the State's current production of about 200,000 lb/yr represents about 0.2 pct of domestic consumption. Western Seward Peninsula placer mines have yielded most of the tin produced; however, it is that area's lode deposits that contain most of the State's reserves.

On a broad scale, Alaskan tin lode and placer occurrences are part of a belt of tin mineralization that extends along the western flank of North and South America. On a smaller scale, however, the Alaskan portion of the "tin belt" comprises several stanniferous trends, each with particular geologic attributes and a variety of lode and placer occurrence types. Five main tin lode types are represented: greisen, vein, skarn, pegmatite, and volcanogenic massive sulfide. Although greisen and vein occurrences are the most abundant in the State, skarn deposits have historically been the most valuable. Bench, stream, river, and beach placers are also represented within the Alaskan tin trends. Most of these placers are located on the Seward Peninsula or in interior Alaska; however, occurrences are also reported in northern and south-central Alaska.

Alaska has not produced columbium or tantalum and has no tantalum reserves. Approximately 135,000 lb of niobium oxide is inferred within the tin- and gold-bearing placers of Tofty, in interior Alaska. Anomalously high columbium concentrations are also reported in association with uraniferous alkaline complexes in southeastern and western Alaska, with a molybdenum-tungsten-mineralized porphyry in northeastern Alaska, and in tin- and/or gold-bearing placers on the Seward Peninsula and in interior Alaska. Anomalously high tantalum and columbium values are reported in association with tin-bearing greisen on the Seward Peninsula, with pegmatites in southeastern and northern Alaska, and in a placer in interior Alaska. Where the columbium and tantalum concentrations are relatively high, these minerals may be recoverable as byproducts of tin or gold mining.

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APPENDIX.—LISTINGS OF LODE AND PLACER OCCURRENCES OF TIN, TANTALUM, AND COLUMBIUM IN ALASKA

Tables A-1 and A-2 list Alaskan lode and placer occurrences containing tin, tantalum, and/or columbium. Where available, abbreviated geologic, geochemical, and production data are provided. Generally, the criteria for inclusion of a tin occurrence or deposit in these tables were (1) the presence of greater than trace amounts of tin and (2) a possibility for large, although undefined, volumes of material. However, a few tin occurrences that are in unique geologic settings but do not necessarily meet these criteria are also included for illustrative purposes. All reported occurrences of tantalum and/or columbium are included in these tables. The only commodities listed are metals with potential economic importance.

Table A-1.—Lode occurrences

(For placer occurrences in the vicinity of a listed location, see listings in table A-2 with the same map location number. If the location number does not appear in table A-2, placer occurrences have not been reported in the area.)

Name and lat-long location	Map location (fig. 1)	Commodities (in order of importance)	Ore grade and/or assay data	Production and/or description	References
NORTHEAST ALASKA TREND					
Esotuk Glacier, 69°19′N, 144°22′W.	*1*	Pb, Zn, Sn, Cu, W	Up to 300 ppm Sn and 1,500 ppm W.	Skarn contains galena, sphalerite, axinite, and quartz-tourmaline veins.	*76-77*
McCall Glacier, 69°18′N, 143°37′W.	*1*	Cu, Zn, Pb, Sn	NA	Sulfides in deformed quartz veins and schist along sheared granite-quartz monzonite dike contacts. Nearby occurrence of fluorite in greisen in granite.	*76-77*
Bear Mountain, 68°23′N, 142°05′W.	*2*	Mo, W, Cb	60-180 ppm Cb in open-ended 200-ft-wide by 4,000-ft-long geochemical soil anomaly.	Soil anomaly corresponds to Mo-W-mineralized gossan associated with an altered porphyry. Pyrochlore identified in a pan concentrate.	*74*
Mountain Creek, 67°30′N, 141°12′W.	*3*	Cu, Pb, Zn, Sn, Be, Ag	140-800 ppm Sn and up to 10 pct Cu.	Skarn mineralization adjacent to rhyolite porphyry sills occurs as thin lenses up to 50 ft long.	*35-36*
Rapid River lodes, approx 67°35′N, 141°15′W.	*3*	U, Sn, Pb, Zn, Cu	Several hundred parts per million Sn, Pb, and Zn and 100 ppm U.	Greisen and veins in granite.	*35-36*
BROOKS RANGE TREND					
Unnamed, 67°30′N, 155°00′W.	*4*	Cu, Pb, Zn, Mo, Ag, Sn	NA	Contact metamorphic mineralization near contact zone of granite.	*76*
Unnamed, 67°28′N, 155°06′W.	*4*	Au, Ag, Pb, Zn, Sn, Mo	Up to 55 ppm Au, 55 ppm Ag, 6,320 ppm Pb, 8,5000 ppm Zn, and 450 ppm Sn in rock samples.	Granite-metamorphic rock contact. Molybdenite and fluorite present.	*76, 78*
Unnamed, 67°24′N, 152°45′W.	*5*	Ag, Cu, Zn, W, Sn, B, Be, Bi, Cd, Sb	700-1,000 ppm Sn and up to 20 ppm Ag. 1 100- by 300-ft zone contains approx 1 pct combined WO_3 and Sn.	Tin disseminated and in skarn near contact of granite.	*7, 79*
Kaluich, 67°34′N, 158°12′W.	*6*	Pb, Zn, F, U, Sn, W, Ag	NA	Mineralization in or near granite contact.	*80*
Kiana, approx 67°30′N, 160°33′W.	*7*	Sn, Cb, Ta	NA	Unevaluated report of cassiterite, columbite, and tantalite in hills north of Kiana, apparently in a pegmatite.	*72-81*
SEWARD PENINSULA TREND					
Selawik Hills area, approx 66°07′N, 160°15′W.	*9*	U, Cb, F	Several samples contained 20-90 ppm U and 150-500 ppm Cb.	Altered zones in Selawik Hills alkaline complex. Cb-U-Ti mineral identified.	*41*
Ear Mountain, 65°56′N, 166°12′W.	*10*	Sn, Cu, Au, Ag, Pb, Zn, U, Cb	0.2 pct Sn and 0.3 pct Cu inferred over 1,000-ft-long by 65-ft-wide zone. 0.01-0.1 pct Cb identified spectrographically in mineralized rock at Winfield Shaft.	Cassiterite in skarn adjacent to small granite stock.	*10, 29*
Potato Mountain, 65°39′N, 167°34′W.	*11*	Sn, Cu, Pb, Zn	Average grade of mineralized zones may be approx 0.25 pct Sn. Largest zone is 3 to 10 ft wide and 300 ft long and may average 1 pct Sn.	Cluster of cassiterite-bearing quartz veinlets in tourmalinized metasedimentary rocks. Small irregular mineralized zones. 2,000 lb Sn reported to have been produced (*4*).	*4, 10, 43*
Cape Mountain, 65°35′N, 167°56′W.	*12*	Sn	Average of 5- to 5.5-ft channel samples was 6.5 pct Sn.	Small, irregular, podlike replacement cassiterite-sericite-quartz-tremolite bodies in limestone adjacent to granite. 12,000 lb Sn produced.	*4, 42*

NA Not available.

Table A-1.—Lode occurrences—Continued

Name and lat-long location	Map location (fig. 1)	Commodities (in order of importance)	Ore grade and/or assay data	Production and/or description	References
			SEWARD PENINSULA TREND—Continued		
Lost River Mine, 65°28′N, 167°10′W.	*13*	Sn, F, W, Be	Proven and indicated reserves: 6.8 MM lb Sn grading 0.26 to 1.3 pct in cassiterite dike and 85 MM lb Sn grading 0.151 pct in cupola. Inferred reserves: 16.6 MM lb Sn in cassiterite dike and 4.4 MM lb Sn in Ida Bell Dike. 4.94 MM tons fluorite reserves. Grades of 1.0 to 2.0 pct Sn mined from 1952 to 1955.	695,400 lb Sn produced. Skarn and greisen bodies near or within granite or related rhyolite dikes. Be deposits located zonally away from Sn and F deposits. Total proven and indicated reserves are 91.8 MM lb Sn; total inferred reserves are 21 MM lb Sn.	*4, 10, 21–22, 82*
Bessie Maple, 65°27′N, 167°12′W.	*13*	Sn, Ag, Pb, Cu, Sb, Zn, W, Be, F	NA	Sulfide-Sn replacement deposit is flanked by fluoriteberyllium deposits. No production noted.	*4, 10*
Rapid River lode, 65°24′N, 167°14′W.	*13*	Be, F, Sn	NA	Cassiterite encountered at depth of several hundred feet in drill core. Cupola may underlie area.	*10*
Brooks Mountain, 65°31′N, 167°09′W.	*13*	Sn, F, W, Pb, Zn, Cu, Be	NA	Granite stock intrudes metasedimentary rocks. Small replacement pod of sulfide mineralization noted.	*4, 10*
Black Mountain, 65°31′N, 166°43′W.	*14*	Sn, W, Zn, Pb	NA	Sulfide-bearing skarn mineralization adjacent to altered fault zone near biotite granite. Minor greisen developed.	*10, 83*
Unnamed, 65°28′N, 165°37′W.	*15*	Sn	>1,000 ppm Sn in skarn samples.	Sn-bearing skarn found in boulders of frostriven bedrock and scattered outcrops.	*10*
Kougarok, 65°40′N, 165°13′W.	*16*	Sn, Ta, Cb	Several ore zones defined with 0.36-2.32 pct Sn and potential for 0.01-0.03 pct Ta and Cb.	Mineralization consists of steep cylindrical bodies and dikes of greisenized granite, greisens developed along tops of granite sills, and veins and stockwork in schist.	*84-85*
Omilak Mine, 65°04′N, 162°35′W.	*21*	Ag, Pb, Sn, Sb	0.2 pct Sn found in rock sample.	Several hundred tons Pb-Ag ore produced from lenticular sulfide body within limestone.	*86*
Foster prospect, 65°04′N, 162°35′W.	*21*	Ag, Pb, Sn, Au, Sb	High-grade ore contains 0.1-1.0 pct Sn. Trace to 0.3 pct Sn irregularly distributed throughout 1.7- to 10.4-ft drill intersections and channel gossan samples.	Gossan along fracture zone. Sn apparently associated with Pb.	*86*
Granite Mountain, 65°30′N, 161°08′W.	*23*	Ag, Pb, Zn, Sn, Cb	Sn detected in 50 pct of analyzed soil and rock samples. Highest value was 500 ppm Sn in sulfide veins in altered andesite. Numerous pan concentrate samples on north flank contain detectable Cb.	Numerous small argentiferous galena-sphalerite-pyrite-arsenopyrite-tourmaline occurrences in 18-mi-long by 2- to 5-mi-wide altered zone in andesite and quartz monzonite.	*87, 75*
			KOKRINE-HODZANA TREND		
Sithylemenkat, 66°03′N, 151°03′W.	*25*	Sn, Cu, Pb, Zn, W, Cb	0.23 pct Sn in greisen samples. Up to 87 ppm Cb, 0.18 pct Cu, 3.4 pct Pb, 0.4 pct Zn, and 135 ppm W also found in greisen samples.	Chlorite-magnetite greisen occurs in rubble at head of east fork of Kanuti Kilolitna River.	*34*
Quartz Creek, 65°16′N, 151°22′W.	*28*	Ag, Pb, Sn	0.01-0.10 pct Sn in mineralized samples.	Work by the Bureau has shown a stockwork of quartz-galena veins 0.5-6 in wide along a zone approx 11 ft wide in metasedimentary rocks. Minor Ag production. Sn not recovered.	*NAp*
			YUKON-TANANA TREND		
Porcupine Dome, 65°31′N, 145°32′W.	*33*	Au, Ag, Sn	NA	Au-Ag-bearing quartz veins in metasedimentary rock contain cassiterite.	*15-16*
Ketchem Dome, 65°27′N, 144°42′W.	*33*	Sn, W	2.3 pct Sn in high-grade samples and 0.05-0.4 pct Sn in channel samples of vein zones. 0.5 pct Sn in pegmatites.	Greisen and pegmatites associated with multiple-phase biotite granite.	*15, 88*

NA Not available. NAp Not applicable.

Table A-1.—Lode occurrences—Continued

Name and lat-long location	Map location (fig. 1)	Commodities (in order of importance)	Ore grade and/or assay data	Production and/or description	References
			YUKON-TANANA TREND—Continued		
Lime Peak, 65°38′N, 146°37′W.	*34*	Sn, Cb	Stream sediments contain anomalously large amounts of Cu, Zn, Ba, Be, La, Mo, Pb, Ag, Sn, Th, and U. Pan concentrate samples from streams draining Lime Peak summit contained the following values, in milligrams per pan: 43.6-561.8 Sn, 24.7-101.4 W, and 1.2-5.5 Cb. 60-1, 560 ppm Sn in greisen samples.	Multiple-phase biotite granite contains chlorite-sericite (topaz-tourmaline) greisen zones. Work by the Bureau has shown that greisen vein zones up to 300 ft wide can be traced for up to 6,000 ft along strike.	*15, 37, 89*
Janiksela, 64°58′N, 147°36′W.	*35*	Sn	NA	Cassiterite in pegmatite stringer on contact of mica and graphitic schists.	*13*
Cosna, 64°32′N, 151°49′W.	*37*	Pb, Sn, Ag	Samples of dumps and mineralized rocks contained traces to 3.18 pct Sn and up to 80 pct Pb and 97 oz/ton Ag. Sample from head of Tin Creek reportedly contained 35 pct Sn. 14 of 16 rock samples collected from Fe-stained zones in area contained anomalously large concentrations of Ag, Sn, Bi, Be, Zn, Cu, Mo, and/or Pb.	Apparently veinlike mineralization. Numerous quartz veins and rhyolite dikes within andulusite- and tourmaline-bearing hornfels suggest a granitic body at depth. Cassiterite identified.	*90-91*
			KUSKOKWIM TREND		
Win claims, 63°29′N, 155°41′W.	*38*	Sn, Ag	Sn and sporadic Ag values in rock samples. Anomalously large concentration of Sn, W, Bi, Ag, Zn, Pb, and As in pan concentrates.	Linear breccia zones within hornfelsed argillites. Hypabyssal intrusions crop out nearby.	*59, 92*
Won claims, 63°12′N, 155°54′W.	*39*	Sn, Ag, Au	Sporadic Sn and Ag values in rock samples. >1,000 ppm Sn in pan concentrate samples.	Breccia and quartz vein stockwork in horn-felsed argillite near partially unroofed intrusion.	*59, 92*
Mystery Mountain, 63°30′N, 154°30′W.	*40*	Sn, Pb	Anomalously large concentrations of Sn and Bi in rock samples. Local gossans contain Pb values of several percent. Several samples of nonmagnetic heavy-mineral concentrates contained >1,000 ppm Sn.	Large area of hornfels cut by altered rhyolite dikes. Local tourmaline flooding and tourmalinized breccias.	*59*
Telida Mountains, 63°32′N, 153°09′W.	*41*	Sn	Anomalously large concentrations of Sn, Ag, Bi, Cu, Mo, Pb, As, and Be in rock samples of tourmaline zones. Several samples of nonmagnetic heavy-mineral concentrations contained >1,000 ppm Sn.	Biotite granite intruding clastic sedimentary rocks and gabbro. Widespread tourmaline in flat-dipping sheeted zones.	*59*
Beaver Mountains, 62°50′N, 156°51′W.	*43*	Cb, Sn, Cu, Ag,	200 and 1,000 ppm Cb in 2 samples of sulfide veinlet in greisensenized basalt. 100 ppm Sn in channel samples of Cu-Ag-rich tourmaline-axinite-greisen fracture fillings.	Veins and greisen zones in monzonite and overlying basalt.	*93*
Russian Mountains, 61°40′N, 159°07′W.	*45*	Cu, Au, Ag, Sn	Typical mineralized rock contains 1 pct Cu, 0.1 oz/ton Au, and 1.0 oz/ton Ag, with local Sn values up to 1.4 pct.	800-ft fissure vein within quartz monzonite.	*94-96*
			ALASKA RANGE TREND		
Sheep Creek, 63°56′N, 148°17′W.	*47*	Zn, Pb, Sn, Ag	Average over 350 ft was 1.4 pct Zn, 0.6 pct Pb, 0.035 pct Sn, and 0.3 oz/ton Ag. Higher grade 8-ft zone within horizon contained 1.2 pct Sn.	Volcanogenic massive sulfide hosted by siliceous exhalite (identification uncertain) and overlain by graphitic schists.	*66*
Kantishna district, 63°35′N, 150°46′W.	*48*	Ag, Au, Sb, Cu, Pb, Zn, W, Sn	NA	Cassiterite- and scheelite-bearing cobbles reported to be coarse and abundant in Caribou and Glen Creeks; may suggest a lode source nearby.	*97*
Long Creek, 63°11′N, 149°39′W.	*49*	Ag, Au, Cu, Bi, Sn	Up to 700 ppm Sn in rock samples.	Sn occurs in arsenopyrite-bearing veins and is disseminated in country rock within 300- by 600-ft area.	*98-99*

NA Not available.

Table A-1.—Lode occurrences—Continued

Name and lat-long location	Map location (fig. 1)	Commodities (in order of importance)	Ore grade and/or assay data	Production and/or description	References
			ALASKA RANGE TREND—Continued		
Ohio Creek, 63°11′N, 149°55′W.	*49*	Sn, Ag, Au, Cu, Pb, Zn, W, Cb	>0.10 pct Sn in gresien samples. Anomalous Sn, W, Ag, Pb, Bi, Be, and Zn in stream sediment samples.	Cassiterite-bearing muscovite-tourmaline greisen, probably limited in extent.	*39, 99-100*
Canyon Creek and Ready Cash area, 63°09′N, 149°51′W.	*49*	Ag, Sn	Rock samples of veins average 20 oz/ton Ag and 0.1-1.0 pct Sn.	Vein potential reported in hundreds of thousands of tons. 1 vein, 400 ft of which averaged 0.5 pct Sn, has about 25,000 ton potential.	*39, 98-100*
Coal Creek, 63°00′N, 149°51′W.	*49*	Sn, Ag, W, Zn	Rock samples contain 0.002-1.5 pct Sn and are reported to average >0.2 pct Sn. 2 samples assayed 2.9 and 4.3 oz/ton Ag.	Inferred ore reserves of >5 MM tons of >0.2 pct Sn associated with multiple-phase biotite granite. Ore body consists of stockwork greisen veins.	*24, 39, 101*
Tsusena Creek, 63°01′N, 148°40′W.	*50*	Ag, Cu, Pb, Zn, Sn	Channel samples of vein yielded 0.5 pct Sn over 4 ft and 0.10 pct Sn over 10 ft.	Sheeted veins within felsic to intermediate volcanic flows, tuffs, breccia, and agglomerate.	*88*
Boulder Creek (Purkeypile), 62°53′N, 152°08′W.	*51*	Sn, Ag	Up to 18 pct Sn and 230 oz/ton Ag. 12 of 24 drill hole intersections contained >0.53 pct Sn; average of 2.41 pct Sn over a 9-ft vein width. 1.11-9.47 oz/ton Ag found over lengths of 2-34 ft in 9 of 24 drill holes.	300,000 lb Sn proven and 1.05 MM lb Sn inferred (*24*) within stockwork of cassiterite-sulfide veinlets along a probable fracture zone near granite. Work by Reed (*26*) suggests substantially lower Sn reserves.	*25, 28, 39, 102-103*
Tired Pup, approx 61°20′N, 154°05′W.	*53*	Sn, U	Up to 1,000 ppm Sn in stream sediment samples.	Reported Sn-U mineralization.	*40*
			OTHER OCCURRENCES		
Valley of Ten Thousand Smokes, 58°18′N, 155°18′W.	*54*	Sn, Pb, Zn	0.019 pct Sn, 0.054 pct Pb, and 0.034 pct Zn found in precipitate in throat of fumarole.	Precipitate consists largely of opal, gypsum, and traces of arsenic sulfide and barium sulfate.	*65*
Copper Mountain, 60°47′N, 146°34′W.	*55*	Sn	0.5 pct Sn in sample of quartz-cemented breccia found in float.	Host rock may be greenstone.	*104*
Rude River, 60°45′N, 145°19′W.	*56*	Sn	0.17 pct Sn in pyritiferous slate.	Red-stained zone in metasedimentary rocks.	*104*
Tarr Inlet Knob, 58°57′N, 136°54′W.	*57*	Au, Ag, Cu, Pb, Zn, Sn	Channel samples up to 10-ft-long contained 50-200 ppm Sn and up to 0.68 pct Cu, 4.3 pct Zn, 0.15 pct Pb, 100 ppm Ag, and 0.70 ppm Au.	Mineralized fault zones in porphyritic granite and quartz monzonite.	*105*
Johns Hopkins Inlet, 58°53′N, 137°01′W.	*58*	Cu, Au, Ag, Sn, W	Rock sample contained 4,100 ppm Cu, 0.15 ppm Au, 7 ppm Ag, 700 ppm Sn, and 793 ppm W.	Hornfels in float.	*105*
Edelweiss prospect, 58°04′N, 134°27′W.	*59*	U, Th, Zr, Cs, Cb, REE	Heavy-mineral concentrate samples contained trace to major amounts Cb.	Rare-earth-bearing pegmatite.	*73*
Salmon Bay, 56°19′N, 133°10′W.	*60*	Th, REE, Cb	Average of 290 ppm Cb (high of 700 ppm) in 5 samples of felsic dikes associated with mineralized veins. 100 ppm Cb in some vein material.	Radioactive carbonate-hematite veins and nonradioactive rare-earth carbonate veins found along 8 mi of coast.	*106-107*
Bokan Mountain, 55°55′N, 132°09′W.	*61*	U, Th, REE, Pb, Cb, Be	12 ore samples from Ross Adams Mine averaged 1.1 pct U and 0.01 pct Cb. Other prospects contain 0.003-1.0 pct Cb associated with U mineralization over widths probably <1-6 ft.	94,000 tons ore grading approx 1 pct U mined from Ross Adams Mine to 1971. Cb not recovered. Mineralization consists of disseminated U-Th accessory minerals in pegmatite, aplite, and peralkaline granite; hydrothermally deposited U-Th minerals in or near fractures; and U-Th minerals in interstices of quartzite. Columbite and pyrochlore identified.	*70-71*

REE Rare-earth elements.

Table A-2.—Placer occurrences

(For lode occurrences in the vicinity of a listed location, see listings in table A-1 with the same map location number. If the location number does not appear in table A-1, lode occurrences have not been reported in the area.)

Name and lat-long location	Map location (fig. 1)	Commodities (in order of importance)	Ore grade and/or assay data	Production and/or description	References
			NORTHEAST ALASKA TREND		
Bear Mountain, 68°23′N, 142°05′W.	*2*	W, Cb	Concentrate from bulk sample of gravel contained 3-12 pct WO_3 and up to 0.15 pct Cb.	Downstream from Bear Mountain lode. Pyrochlore-like mineral identified.	*74*
Rapid River, 67°38′N, 141°20′W.	*3*	Sn, W, REE, U, Cb,	1.6-21.0 pct Sn in monazite-rich concentrates from sluicebox samples. 0.04-5.7 lb/yd³ Sn. 0.14-0.75 pct associated W and 0.05-0.1 pct Cb.	Potentially very large reserves in basin.	*35*
Porcupine River, 67°21′N, 141°17′W.	*3*	Sn, REE	Up to 0.7 pct Sn in pan concentrate sample of ancient channel gravels. Cassiterite identified.	Potential for large, low-grade reserves in terrace deposits.	*35*
			BROOKS RANGE TREND		
Gold Bench, 66°59′N, 150°19′W.	*8*	Au, Sn	Cassiterite in concentrates.	Only Au recovered..............	*108*
			SEWARD PENINSULA TREND		
Kreuger and Eldorado Creeks 65°56′N, 166°07′W.	*10*	Sn	Unweighted average for 26 churn drill holes in Kreuger and Eldorado Creeks was 0.3 lb/yd³ over 10-ft mining section.	Creeks drain Ear Mountain stock and contact zone. No mining reported.	*10, 29*
Tuttle Creek, 65°56′N, 166°21′W.	*10*	Sn, Cb	Trace to 1.2 lb/yd³ Sn in placer samples. Traces of Cb also present.	No mining reported	*29*
Potato Creek, 65°40′N, 167°39′W.	*11*	Sn	Composite sample of concentrate contained 45.22 pct Sn. Average for 15 churn drill holes was 0.2 lb/yd³ Sn in pay streak.	....do	*43*
Buck Creek 65°39′N, 167°31′W.	*11*	Sn	Average of 3.9 lb/yd³ Sn in pay streak. Averages of 1.0 and 1.1 lb/yd³ Sn in upper (17 samples) and west (18 samples) forks of Buck Creek, respectively.	From 1902 to 1953, 2,204,600 lb Sn produced from 560,000 yd³ of gravel (including Grouse Creek). Largely mined out.	*43*
Peluk Creek, 65°39′N, 167°31′W.	*11*	Sn	Composite sample of concentrate contained 53.46 pct Sn. 0.01-0.77 lb/yd³ Sn. Average for 2 churn drill holes near creek mouth was 0.5 lb/yd³ Sn in pay streak.	Some mining possibly occurred near mouth of creek.	*10, 43*
Sutter Creek, 65°38′N, 167°31′W.	*11*	Sn	Abundant Sn occurs near mouth of Iron Creek. Up to 0.90 lb/yd³ cassiterite recovered. Average for 30 churn drill holes was 0.2 lb/yd³ Sn in pay streak.	Mining extends 1,000 ft from mouth of Iron Creek.	*10, 43*
Iron Creek, 65°39′N, 167°33′W.	*11*	Sn	Gravels containing 3.38 lb/yd³ Sn mined in 1917. Average for 11 churn drill holes was 0.6 lb/yd³ Sn in pay streak.	1,500-ft section along stream bed was hand-mined; unknown amount of Sn recovered.	*10, 43*
Oakland Creek, 65°41′N, 167°36′W.	*11*	Sn	15 churn drill samples in pay streak averaged 0.10 lb/yd³ Sn.	Pay streak extends about 1 mi along creek near western base of Potato Mountain.	*43*
Grouse Creek 65°39′N, 167°34′W.	*11*	Sn	Average of 2.9 lb/yd³ Sn in pay streak.	See Buck Creek for production. Mining extends 5,000 ft downstream from mouth of Buck Creek. Largely mined out.	*10, 43*
Village Creek 65°37′N, 168°03′W.	*12*	Sn	Average for 8 churn drill holes was 0.18 lb/yd³ Sn.	No mining reported	*42, 109-110*
Boulder Creek, 65°37′N, 167°59′W.	*12*	Sn, Cb	Average values in churn drill-hole lines in pay streak: 0.12-1.7 lb/yd³ Sn. 22 churn drill samples from pay streak yielded average of 1.0 lb/yd³ Sn. 0.01-0.1 pct Cb detected in a composite concentrate sample.	Pay gravels extend at least 4,000 ft along creek, but no mining recorded.	*10, 23, 109-110*
Goodwin Creek, 65°35′N, 167°54′W.	*12*	Sn	Composite concentrate sample contained 58.5 pct Sn. Average grade of 2 churn drill samples from pay streak at mouth of Goodwin Gulch was 4.0 lb/yd³ Sn. Average for 3 churn drill holes in pay streak at mouth of Wales Creek was 1.0 lb/yd³ Sn.	Several hundred pounds cassiterite concentrate recovered from narrow 1,000-ft-long pay streak.	*10, 42, 109-110*

REE Rare-earth elements.

Table A-2.—Placer occurrences—Continued

Name and lat-long location	Map location (fig. 1)	Commodities (in order of importance)	Ore grade and/or assay data	Production and/or description	References
			SEWARD PENINSULA TREND—Continued		
First Chance Creek, 65°35′N, 167°56′W.	12	Sn, Cb, Ta	20 churn drill holes yielded average of 1.0 lb/yd^3 Sn in pay streak that extends 1,500 ft up creek from mouth. Traces of Cb and Ta present.	Some past mining is evident. Production may be credited to Cape Creek.	10, 42, 109-110
Cape Creek, 65°37′N, 167°59′W.	12	Sn, Cb, Ta	32 churn drill holes near mouth of creek averaged 0.2 lb/yd^3 Sn. 48 churn drill holes above mouth of First Chance Creek averaged 4.5 lb/yd^3 Sn. Total inferred reserves, including gravels below First Chance Creek, average 2.6 lb/yd^3 Sn. Trace of Cb and Ta detected.	Delta-like deposit in beach gravels at mouth of Cape Creek and alluvial deposits in upper creek. Production, including Goodwin Gulch, from 1924 to 1975 was 1.537 MM lb Sn. Production from Cape Creek is presently 150,000-200,000 lb cassiterite concentrate per year. 550,250 lb Sn produced from 1979 to 1982. Calculated inferred Sn reserves: 2.2 MM lb within 850,000 yd^3 gravel.	6-7, 10 23, 42 109-110
Anikovik River, 65°31′N, 167°36′W.	13	Sn, Au	31 pct Sn in concentrate. 156,000 yd^3 of mined gravels averaged 0.003 lb/yd^3 Sn.	496 lb Sn produced from within 0.5 mi of river mouth in 1914 and 1915.	10, 46
Cassiterite Creek, 65°28′N, 167°10′W.	13	Sn, W, Cb	Mine records indicate 3.6 lb/yd^3 Sn was mined. Trace Cb detected.	93.4 tons Sn recovered from 52,000 yd^3 of gravel from 1949 to 1951.	4, 46
Lost River, 65°27′N, 167°10′W.	13	Sn	0.04-0.35 lb/yd^3 Sn found in 6 churn drill holes.	Cassiterite not mined.	46
Rapid River, 65°27′N, 167°12′W.	13	Sn	Trace of Sn found in 2 churn drill holes.	No mining reported	10, 46
Kougarok River area (Washington and Mascot Creeks), 65°44′N, 164°58′W.	16	Au, Sn, Cb	Cassiterite in concentrate.	Intermittent mining to 1968. Cassiterite not recovered.	75, 111 112
Humboldt Creek, 65°49′N, 164°25′W.	16	Au, Sn, Cb	Concentrates show 60 pct Sn and trace Cb.	Coarse cassiterite hampered Au recovery. In 1919, a few hundred pounds cassiterite was saved but not shipped.	84, 111
Hannum Creek, 65°54′N, 163°11′W.	17	Au, Sn, Pb	Cassiterite and Pb minerals in concentrate.	Mined for Au; no cassiterite recovered.	109, 111
Otter Creek, 65°06′N, 162°23′W.	18	Au, Sn	>5,000 ppm Sn in pan concentrate sample.	Evidence of past mining; some recovery of Sn reported.	9, 63
Monument Creek, 64°36′N, 165°30′W.	19	Au, Sn	Cassiterite reported.	Mined for Au	109
Rocky Mountain Creek, 64°46′N, 165°12′W.	20	Au, Sn, W	Cassiterite reported in placer concentrates.	. . do	109
Clear and Vulcan Creeks, 64°57′N, 162°12′W.	22	Cb, Sn, U, W	500-800 ppm Cb in pan concentrate samples. 1 pct Cb found in composite samples of concentrates from 19 test pits (0.03-0.18 lb/yd^3 Cb).	Pits irregularly distributed over 19-mi length of several creeks.	44
			KOKRINE-HODZANA TREND		
Hogatza, 66°11′N, 155°43′W.	24	Au, Sn, PGM	Cassiterite and PGM identified in concentrates.	Dredge operation in glaciofluvial deposits recovers Au.	13, 109
Sithylemenkat pluton area 66°03′N, 151°00′W.	25	Sn, W, Ta, Cb	Trace to 0.404 lb/yd^3 Sn in bulk gravel samples from upper east fork and 0.08 lb/yd^3 Sn from main branch of Kanuti Kilolitna River. 21 of 35 placer concentrate samples contained average of 0.26 pct Cb; 35 concentrate samples contained average of 0.06 pct Ta.	Sn-bearing gravels in streams draining Ray Mountain and Sithylemenkat plutons.	33-34
Hot Springs pluton area, 66°20′N, 150°46′W.	26	Sn	Several pan concentrate samples contained 1,000-7,000 ppm Sn.	No mining reported	33-34
Fort Hamlin Hills pluton area, 66°07′N, 150°08′N	27	Sn, Cb	Pan concentrate samples contained 7,000->10,000 ppm Sn and trace Cb.	Creeks draining northwestern portion of Fort Hamlin Hills.	33-34
Tozimoran and Ash Creeks, 65°30′N, 153°00′W.	29	Au, Sn	Churn drilling showed 0.73 lb/yd^3 Sn over 650- by 80-ft block of ground on Tozimoran Creek. 2-3 pct Sn in concentrates from Ash Creek.	Approx 13,000 lb Sn produced from Tozimoran Creek in 1938-43 and 1983. Cassiterite-bearing cobbles reported. No production from Ash Creek.	12, 14, 18
Melozimoran Creek, 65°23′N, 152°49′W.	29	Au, Sn	Trace Sn in lower creek.	No mining reported	14, 18
Mason Creek, 65°11′N, 153°19′W.	30	Au, Sn	Concentrate recovered in 1918 averaged 0.5 lb/yd^3 Sn.	Unconfirmed report of 1 ton cassiterite concentrate recovered from 4,000 yd^3 of gravel in 1918. No cassiterite found in 1944.	14

PGM Platinum-group metals.

Table A-2.—Placer occurrences—Continued

Name and lat-long location	Map location (fig. 1)	Commodities (in order of importance)	Ore grade and/or assay data	Production and/or description	References
			KOKRINE-HODZANA TREND—Continued		
Morelock and Bonanza Creeks, 65°19′N, 151°20′W.	*31*	Au, Sn	Trace to 0.18 lb Sn per square foot of bedrock in pay streak at Morelock Creek. 0.15 lb Sn per square foot of bedrock 900 ft above mouth of Bonzana Creek. 47.3-65.2 pct Sn in 6 concentrate samples from different parts of pay streak.	Sn-bearing area is approx 1.5 mi long and 400- to 500-ft wide on Morelock Creek and at least 900 ft up Bonanza Creek. Probably about 2 ft of irregularly distributed pay streak. Sn recovered from a few small cuts.	*13-14, 113*
Big Creek, 64°40′N, 155°29′W.	*32*	Au, Sn	Cassiterite in headwaters.	Pay streak estimated to be 5,000 ft long, 30 ft wide, and 1-15 ft thick. Approx 1,100 lb cassiterite concentrate recovered.	*14*
Birch Creek, 64°28′N, 155°22′W.	*32*	Au, Sn	Min 0.01-0.04 lb cassiterite per square foot of bedrock in pay streak. 0.5 lb cassiterite per square foot of bedrock recovered from 88,900 ft^2 of underground workings.	At least 5,000 lb cassiterite concentrate recovered 1914-36. Pay streak on bench estimated to cover 18 acres.	*14, 114*
Cox Gulch, 64°40′N, 155°29′W.	*32*	Au, Sn	0.2-0.33 lb Sn per square foot of bedrock.	Cassiterite very coarse. approx 1,000 lb cassiterite concentrate recovered.	*14*
Crooked Creek, 64°28′N, 155°23′W.	*32*	Au, Sn	Sn reported	Au mining just above Birch Creek.	*14*
Fifth of July Creek, 64°23′N, 155°33′W.	*32*	Au, Sn	Cassiterite common in concentrates.	Approx 300 lb Sn represents incomplete recovery from approx 6,000 ft^2 of bedrock.	*14*
Flint Creek, 64°24′N, 155°23′W.	*32*	Cb	Trace Cb detected in concentrates.	Cb not recovered	*75*
Glacier Creek, 64°40′N, 155°29′W.	*32*	Au, Sn, Bi	NA	150 lb cassiterite concentrate recovered. Pay streak estimated to cover 12 acres.	*14, 114*
Greenstone Creek, 64°18′N, 155°32′W.	*32*	Au, Sn	NA	Approx 300 lb cassiterite recovered 1940-42. Pay streak estimated to cover 18 acres.	*14, 114*
Long Creek, 64°23′N, 155°32′W.	*32*	Au, Sn	NA	Cassiterite reported in Au concentrates. Pay streak estimated to cover 61 acres and to be at least 6.4 mi long.	*14, 114*
Midnight Creek, 64°19′N, 155°32′W.	*32*	Au, Sn	Cassiterite recovered averaged 0.06 lb/yd^3.	7,320 lb cassiterite concentrate produced in 1940-42. 1,037 lb concentrate containing 537 lb Sn produced in 1917-18. Pay streak estimated to cover 9 acres.	*14, 114*
Monument Creek, 64°19′N, 155°23′W.	*32*	Sn, Cb	Trace Sn and Cb detected in concentrates.	Sn and Cb not recovered.	*75*
Poorman Creek, 64°06′N, 155°32′W.	*32*	Au, Sn	Some cassiterite reported.	Pay streak estimated to cover 61 acres.	*13, 114*
Short Creek, 64°19′N, 155°33′W.	*32*	Au, Sn	Cassiterite is common.	In 1918, a few thousand pounds of cassiterite was recovered from placer workings 1-1.5 mi long, 20-40 ft wide, and 10-15 ft deep.	*13-14*
Spruce Creek, 64°09′N, 155°28′W.	*32*	Au, Sn	Cassiterite reported.	Cassiterite not produced. Pay streak estimated to cover 6 acres.	*13, 114*
Straight Creek, 64°23′N, 155°23′W.	*32*	Au, Sn	NA	Unconfirmed report of cassiterite recovered with Au in lower portion of creek.	*14*
			YUKON-TANANA TREND		
Yankee Creek, 65°32′N, 145°23′W.	*33*	Au, Sn	Cassiterite associated with placer Au.	Cassiterite not recovered.	*15*
Mastadon Creek, 65°29′N, 145°18′W.	*33*	Au, Sn	Cassiterite reported in concentrates.	Pay streak in lower valley is 200 ft wide and 7-10 ft thick	*15*
Miller Creek, 65°31′N, 145°14′W.	*33*	Au, Sn	>1 pct Sn in sluice-box sample.	Cassiterite not recovered. Pay streak has max width of 50 ft.	*15-16*
Granite Gulch, 65°30′N, 145°12′W.	*33*	Au, Sn, W	Sluicebox sample contained >40 pct Sn and 0.4 pct W.	Cassisterite not recovered.	*16*
Harrison Creek, 65°25′N, 145°14′W.	*33*	Au, Sn	Sluicebox sample from upper portion of creek contained >1 pct Sn.	..do	*16*
Bedrock Creek, 65°30′N, 145°07′W.	*33*	Sn, W	Pan concentrate samples showed anomalously large concentrations of Sn and W.	..do	*16*
Boulder Creek, 65°29′N, 145°03′W.	*33*	Au, Sn, W	Estimate of >2 lb/yd^3 cassiterite at mine site. 63 pct cassiterite and 0.2 pct scheelite in sluice-box concentrates.	Pay streaks limited to 200- to 300-ft wide and 4- to 15-ft-deep alluvial gravels. Some concentrate recovered.	*16*

NA Not available.

Table A-2.—Placer occurrences—Continued

Name and lat-long location	Map location (fig. 1)	Commodities (in order of importance)	Ore grade and/or assay data	Production and/or description	References
YUKON-TANANA TREND—Continued					
Deadwood Creek (Switch Creek), 65°28′N, 144°57′W.	*33*	Au, Sn, W	Average of 1-2 lb/yd^3 concentrates (principally wolframite and cassiterite). 2 sluicebox concentrate samples from Switch Creek showed approx 10 pct Sn and 2 pct W.	Cassiterite recovered from concentrates during early mining. Pay streak reported to be about 9 mi long.	*15-16*
Ketchem Creek, 65°29′N, 144°45′W.	*33*	Au, Sn, W	Cassiterite in concentrates. >1 pct Sn and >1 pct W in sluicebox sample.	Cassiterite not recovered.	*15-16*
Half Dollar Creek, 65°25′N, 144°37′W.	*33*	Au, Sn, W	Cassiterite abundant and scheelite common.	..do	*15-16*
Portage Creek, 65°26′N, 144°37′W.	*33*	Au, Sn, W, Cb	Sluicebox sample contained >1 pct Sn and trace Cb.	Cassiterite not recovered. Bismuthinite and wolframite also present.	*15-16*
Twin Creek, 65°02′N, 147°27′W.	*35*	Au, W, Sn	Cassiterite common	May have most abundant cassiterite in Fairbanks district.	*13*
Gilmore Creek, 64°59′N, 147°25′W.	*35*	Au, Sn, Cb	Trace Cb in concentrates.	Only Au recovered	*75*
Cache Creek, 65°06′N, 150°48′W.	*36*	Au, Sn, Cb	Average of 0.019 lb/yd^3 Cb and 2.26 lb/yd^3 Sn found in channel samples of tailings.	5,155 lb cassiterite concentrate recovered 1909-56. Aeschymite [(Ce, Ca, Fe, Th)(Ti, Cb)$_2$(O, OH)$_6$] reported.	*11, 19, 32*
Dalton Gulch, 65°06′N, 150°50′W.	*36*	Au, Sn, Cb	Average of 3.9 lb/yd^3 Sn and 0.0002 lb/yd^3 Cb_2O_5 found in 5 channel samples of tailings.	3,000 lb cassiterite concentrate produced from discontinuous pay streaks, 1909-56.	*11, 19, 32*
Deep Creek area, 65°04′N, 150°58′W.	*36*	Au, Sn, Cb	Average of 1.98 lb/yd^3 Sn and 0.10 lb/yd^3 Cb_2O_5 in 26 channel samples of tailings.	Columbite [(Fe, Mn)(Nb, Ta)$_2$O$_6$] and aeschymite reported. 64,200 lb concentrate averaging 56 pct Sn produced from drift mining. Pay streak estimated to cover 18 acres. 169,400 lb indicated Sn reserves in tailings of Woodchopper and Deep Creeks.	*11, 19, 32, 114*
Ferguson Draw and Harter Gulch, 65°06′N, 150°51′W.	*36*	Au, Sn	0.1-0.4 lb cassiterite per square foot of bedrock in pay streak at Ferguson Draw. 4 channel samples of tailings from Harter Gulch showed an average of 0.27 lb/yd^3 Sn and trace Cb_2O_5.	Harter Gulch and Ferguson Draw pay streak estimated to cover 27 acres.	*11, 19, 32, 114*
Gold Basin Creek, 65°07′N, 150°45′W.	*36*	Au, Sn	NA	Unverified Sn production reported. Pay streak estimated to cover 12 acres.	*13, 32 114*
Idaho and Tofty Gulches, 65°05′N, 150°52′W.	*36*	Au, Sn, Cb	5 channel samples of tailings from Idaho Gulch averaged 1.0 lb/yd^3 Sn and 0.019 lb/yd^3 Cb_2O_5.	Production of cassiterite concentrate, 1909-56: 300 lb from Idaho Gulch and 19,600 lb from Tofty Gulch. Idaho Gulch to Tofty Gulch pay streak estimated to cover 36 acres. 157,000 lb indicated Sn reserves in tailings from Miller Gulch to Tofty Gulch.	*11, 19, 32, 114*
Killarney Creek, 65°07′N, 150°44′W.	*36*	Au, Sn	Cassiterite reported.	Fine cassiterite abundant for 1,000 ft along creek.	*19*
Miller Gulch, 65°05′N, 150°56′W.	*36*	Au, Sn, Cb	16 channel samples of tailings averaged 0.775 lb/yd^3 Sn and 0.03 lb/yd^3 Cb_2O_5. Up to 7 pct Cb_2O_5 in concentrates.	Columbite and aeschymite in concentrate. Production through 1956 was 101,875 lb cassiterite concentrate. Long, narrow continuous pay streak estimated to cover 10 acres. 2 pay streaks 200 ft apart in upper 2,000 ft of workings.	*11, 19, 32, 114*
Patterson Creek, 65°05′N, 150°54′W.	*36*	Au, Sn	NA	20,282 lb cassiterite concentrate recovered 1909-56.	*11, 19*
Sullivan Creek, 65°07′N, 150°55′W.	*36*	Au, Sn, Cb	Tailings average 0.241 lb/yd^3 Sn and trace Cb.	215,445 lb cassiterite concentrate produced 1909-56. Aeschymite also reported. 117,800 lb Sn indicated to remain in tailings from Sullivan Bench and Ferguson Draw.	*11, 19*
Woodchopper Creek, 65°03′N, 151°01′W.	*36*	Au, Sn, Cb	12 channel samples of tailings averaged 0.72 lb/yd^3 Sn and 0.010 lb/yd^3 Cb_2O_5. 1.2-1.3 lb cassiterite per square foot of bedrock recovered at south end of pay streak.	40,300 lb cassiterite concentrate recovered 1909-56 from drift mining. Lower Woodchopper Creek pay streak estimated to cover 73 acres. 169,400 lb indicated Sn reserves in tailings of Woodchopper and Deep Creeks.	*11, 19 114*

NA Not available.

Table A-2.—Placer occurrences—Continued

Name and lat-long location	Map location (fig. 1)	Commodities (in order of importance)	Ore grade and/or assay data	Production and/or description	References
KUSKOKWIM TREND					
Vinasale Mountain, 62°38′N, 157°59′W.	*42*	Au, Cb, Sn	Anomalously large concentrations of Cb and Sn reported in concentrates.	Only Au recovered	*75*
Malamute Creek, 62°28′N, 158°00′W.	*44*	Au, Sn, Hg, W, Cr	Cassiterite, cinnabar, scheelite, ferberite, chromite, realgar, and allanite in concentrates.	..do	*13, 116*
Marvel Creek, 60°54′N, 159°30′W.	*46*	Au, Cb	Anomalously large concentrations of Cb reported in concentrates.	..do	*75*
ALASKA RANGE TREND					
Poorman Creek, 62°35′N, 150°49′W.	*52*	Au, Sn, Pt	Cassiterite in concentrates.	11-ft-deep Tertiary gravels on lower portion of creek mined for Au. May have most cassiterite in Yentna district.	*39, 98, 67*