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BUREAU OF MINES
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War Minerals Report 467

SULLIVAN CREEK TAILING
MANLEY HOT SPRINGS, TOFTY, ALASKA

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WAR MINERALS REPORT
UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

W.M.R. 467 - Tin November 1945

SULLIVAN CREEK TAILING
Manley Hot Springs, Tofty, Alaska

SUMMARY

The gold-placer tailing from the Sullivan Creek operation of the Cleary Hill Mines Co. in the Hot Springs District, Yukon Region, Alaska, has been sampled for tin and gold.

The tin content of the 309,000 cubic yards of tailing was found to be 0.241 pound per cubic yard; the gold content was 0.0015 ounce per cubic yard. The upper part of one block, which could be mined by dragline, contains 11,300 cubic yards averaging 0.777 pound tin and 0.0028 ounce gold per cubic yard. A few isolated samples indicate that small areas of the material might be minable grade; however, the areas are too small for commercial operation. Mining costs have averaged 45 cents a cubic yard, and it is not feasible to rework the tailing deposit at the present price of tin.

It is reported that prior to 1942 the Cleary Hill Mines Co. shipped cassiterite concentrates containing 11,850 pounds of tin, a portion of which probably was recovered from their operation on Tofty Creek, a short distance west of the Sullivan Creek pit. Taking into account the tin recovered to date and the estimated tin content of the Sullivan Creek tailing, the apparent maximum of contained tin in virgin ground is about 0.28 pound per cubic yard.

No further work by the Bureau of Mines is proposed at the present time.

INTRODUCTION

Gold miners in the Hot Springs area have been recovering a small tonnage of cassiterite each season as a byproduct of gold-placer operations. Though no special attention has been paid to cassiterite recovery, approximately 300 tons of these concentrates have been shipped.[1]

During the summer of 1941, the placer-tin potentialities of the district were investigated by the Federal Geological Survey; information from

1 U. S. Geological Survey, Potential Reserves of Tin Ore in the Hot Springs District, Alaska: Unpublished preliminary report to Office of Production Management.

several nongovernmental sources appeared encouraging. To determine more fully the productive possibilities of the district, the Bureau of Mines undertook to sample the Sullivan Creek area. Preparations began December 10, 1942, under the direction of an engineer[2] of the Bureau of Mines; actual sampling began January 9, 1943, and was completed March 18, 1943.

Camp facilities, thawing equipment, and a caterpillar tractor were supplied by the Cleary Hill Mines Co. Sampling tools were lent by miners and prospectors in the area.

LOCATION AND ACCESSIBILITY

The property is at longitude 150° 55 ' W., latitude 65° 05 ' N., about 40 miles east of the junction of the Tanana and Yukon Rivers. (Fig. 1.) The nearest settlement is Hot Springs, with a population varying from 50 to 100 people. The village has a general store, a roadhouse, and a small commercial airfield. Freight is brought in from the coast by railroad to Nenana, thence by river boat to Hot Springs. The property is accessible from Hot Springs over 15 miles of good truck road. Winter travel is by airplane or dog team. A small landing field is on the property.

PHYSICAL FEATURES AND CLIMATE

The area is part of the Yukon-Tanana upland and is characterized by smooth, rounded ridges, which rise from the wide flood plains of Sullivan and Baker Creeks. Relief is about 600 feet. North of the property, Roughtop Mountain rises to an altitude of 2,800 feet.

The climate is subarctic, with long, cold winters and short but rather warm summers. Except for seasonal surface thawing, the ground is permanently frozen.

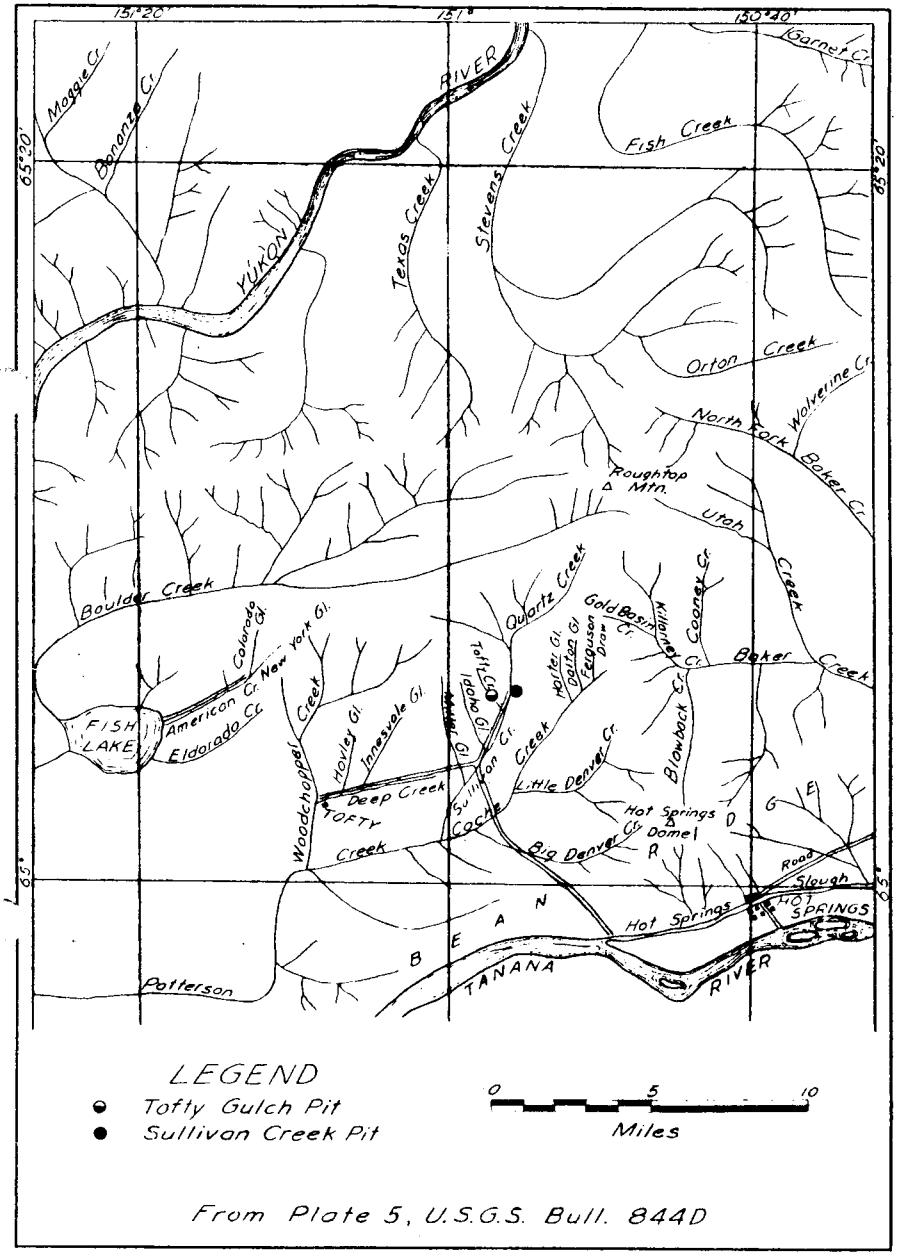
Average annual precipitation is about 12 inches, approximately 3 inches of which falls as snow between November and March and lies 3 to 4 feet deep on the level. Water can not be stored in the frozen ground; hence, run-off is very rapid. Summer precipitation is more important than spring run-off for placer mining in this area.

The area is covered by a sparse growth of spruce, birch, and cottonwood, the greater part of the original timber having been cut or burned off during the last 20 years. Fifteen miles northeast, at the head of Baker Creek, enough timber for camp and mining use is available. Wood for fuel may be obtained 3 miles east of the property. Except in timbered areas and natural meadows, the surface is covered with the usual Alaskan carpet of mosses, brush, and creeping plants, which somewhat regulate the run-off of summer rains.

LABOR

A limited amount of labor is available at Fairbanks at the following approximate rates:

2 R. L. Thorne.



From Plate 5, U.S.G.S. Bull. 844D

FIG. 1-SKETCH OF TOFTY AREA, HOT SPRINGS DIST., ALASKA

	Per hour
Dragline operators	$2.00
Bulldozer operators	1.70
Laborers.	1.25

Average charge for board is $2.50 per man per day.

HISTORY AND PRODUCTION

Placer-gold deposits were discovered in this area in the winter of 1906-7, and during the following decade much drift mining was done. Howell and Cleveland drift-mined the greater portion of the Sullivan Creek pit. Their procedure involved thawing and sinking a shaft through 50 to 100 feet of overlying material, then thawing the 4 feet of gravel adjacent to bedrock. This gravel was hoisted to the surface and washed in elevated washing plants. Mining and washing costs ran from $3 to $5 a cubic yard.

Later, the property was acquired by an English company, which drilled extensively. Their results are not available. Soon thereafter, Tillison and L'Hereux stripped and mined by means of a hydraulic lift at the lower end of the present pit.

The property was purchased by Cleary Hill Mines Co., 250 Pere Marquette Building, Minneapolis, Minn., in 1935. Mining and stripping have been carried on in alternate years. Water from the head of Sullivan Creek is used in monitors to strip the 50 to 60 feet of top gravel. Three to eight feet of gravel on bedrock is mined by dragline and washed in elevated sluices. Considerable money and effort have been expended for years in blocking out the gold reserves on Sullivan and neighboring creeks, but unfortunately no record of tin content was kept, and only recently have gold contents been permanently recorded.

Gold production from this section was about $500,000 in 1940, of which $100,000 was from Sullivan Creek. The tin concentrate shipped by Cleary Hill Mines Co. in 1940 had accumulated during three mining seasons and amounted to 15,476 pounds of concentrate containing 8,350 pounds of tin. In 1941, 6,600 pounds of concentrate was shipped that contained 3,500 pounds of tin. During the same period, drift-mine operations along the outlying creeks resulted in the production of several hundred pounds of cassiterite.

WATER SUPPLY

Water is supplied to the workings through 7,000 feet of ditch, which draws water from Sullivan and Quartz Creeks. The ditch supplies enough water at a 50-foot head to remove the overburden in the Sullivan Creek pit. Three to five giants are used in stripping. Water for the washing plant is circulated from a settling pond by means of a 12- by 12-inch Diesel-powered pump.

OCCURRENCE OF DEPOSITS

The zone is about 10 miles long and is referred to as the "tin belt."[3]

> The country rock along this belt is probably more or less continually mineralized, but no continuous pay streak has been formed. Instead, a number of small discontinuous pay streaks are present whose major directions are normal to the zone of mineralization. The sites of these pay streaks are the the gulches that drain from the hills to the north, or more commonly the ground lying along the sides of such gulches. In general, cassiterite and gold occur together in placers, and where the cassiterite becomes scarce or absent the gold content also drops. The sharpness of the cut-off of these small pay streaks as they are followed north to the hills is amazing. The limit of the placer is suddenly reached, and north of this limiting line no tin and but little gold can be found. The south line is less exactly defined, because the ancient gulches draining southward had a tendency to distribute the gold and tin downstream from the mineralized zone, as in the deposit on Sullivan Creek.

Mertie gives the origin of the placers as follows:

> A relatively narrow zone in the country rock was originally mineralized with gold and tin. Where this belt was cut by streams the gold and tin were eroded and concentrated by the fluviatile action to form commercial placers, and subsequently these old gravel deposits were deeply buried by silt.

According to Waters:[4]

> The lodes were not localized along the present tin belt but originated nearer to Hot Springs Dome, and the present placers are the result of a reworking of older tin-bearing gravel laid down by an ancient stream that once flowed parallel to the present site of the tin placers but at a higher level.

This older stream, referred to by Waters, could well have been above the level of the divide now separating the headwaters of Baker and Sullivan Creeks. Present topography suggests the possibility that the Baker-Sullivan Creek depression is in line with what was once an ancient stream. The concentrates are reported to be of a lower specific gravity at the west end than at the east end of the tin belt. This could have been the result of alluvial transportation from east to west. In addition, the tin belt is at a lower level westward from Sullivan Creek. Individual particles are rounded to a degree exceeding that to be expected had their source been along or just above the "tin belt." Cassiterite particles in Sullivan Creek are coarser than rice grains, and finer particles are entirely absent. This

3 Mertie, J. B., Jr., Mineral Deposits of the Rampart and Hot Springs Districts, Alaska: Geol. Survey Bull. 844 (d), 1934, pp. i-iv, 163-246.

4 Waters, A. B., Jr., Placer Concentrates of the Rampart and Hot Springs Districts: Geol. Survey Bull. 844 (d), 1934, pp. i-iv, 163-246.

suggests selective reconcentration. Cassiterite has not been found outside the tin belt.

Placer deposits of the streams which drain from the north are not buried deeply and have been prospected. South of the tin belt, however, the placers are deeply buried and have not received much attention. Unless cassiterite was present in considerable quantity, it was usually overlooked by the average prospector.

It is possible that the lower aggraded portion of Sullivan Creek may contain a large area of low-grade tin and gold-bearing gravel. This ground is deep, difficult to prospect by shaft sinking, and prospectors have found the gold and cassiterite distributed throughout the gravel rather than lying directly on bedrock. If minable gravel should be discovered in these lower alluvial deposits, considerable time and money would be required to explore them adequately and bring them into production.

CHARACTER OF DEPOSITS

The gravel is composed principally of quartzite particles but includes also much quartz and some phyllite. Enriched gravel averages 3 to 10 feet in thickness and is overlain by 50 to 60 feet of lean or barren gravel. All of the gravel is permanently frozen, is not cemented, and contains few rocks larger than 10 inches in diameter. The amount of cassiterite in the gravel varies directly with gold content.

The bedrock of phyllite and pyritized slate is easily removed to a depth of 2 feet; cassiterite and gold have not penetrated the bedrock below this level.

It was noted in the high-grade gravel that the cassiterite grains were small and the gold was coarse. Larger, though fewer, pebbles of cassiterite are found in the low-grade gravel, where the gold is flaky. It appears that as grade increases there is a proportional decrease in cassiterite particle size. The cassiterite pebbles usually have quartz inclusions. These are freed as the pebbles are worn down in size, with concurrent increase in specific gravity of individual particles. Cassiterite ranges in size from 1 inch down to rice-grain size, with almost total absence of finer particles.

In general, there is no gold or cassiterite in the lower portions of the present tailing piles, which are the top sediments sluiced and piled on bedrock. In some places the tailing has been re-piled in such manner that tin- and gold-bearing gravel is enclosed by barren material. This is the result of placing material from several pits on one pile.

After the tailing was piled, new drains were dug with a dragline, and the material was heaped along the sides in irregular cones. Later, these drains were cleared or deepened, and the original cones bordering the drains were covered with fine, barren sediments.

The gravel is free from pyrite, but about 0.1 pound per cubic yard occurs in the bedrock. As a considerable portion of bedrock is mined in each section, this pyrite is now found in that general portion of the tailing containing the higher percentages of gold and tin. If the tailing is sluiced, it may be expected that some difficulty will result from pyrite clogging the riffles.

SAMPLING

Sampling was carried on at temperatures of 35° to 45° below zero. Samples froze quickly and had to be panned in heated cabins. Difficulty was experienced in preventing the steam lines and exterior fittings from freezing. Shafts and "gopher holes" excavated to obtain samples rapidly returned to their original frozen state, and frequent re-thawing was necessary.

Some bulldozed piles in the form of flat-topped mounds, where the various gravels lay in a horizontal position, were sampled by shafts. The gravel was thawed by means of a boiler and steam points, and each successive foot was sampled. The average size of shafts was 3 by 5 feet in cross section and 10 feet in depth. Each shaft was continued for at least 1 foot into bedrock. No tin or gold was found in the lower portions of the shafts or on bedrock.

Horizontal sample cuts were made in piles or cones of tailing. "Gopher holes" 18 inches in diameter and 6 feet long were thawed to cut the internal structure at right angles. These holes were started midway up the pile, and each linear foot was sampled separately.

Channel samples 4 by 6 inches in section were cut in vertical faces along roads and drains. Surface samples were taken when no other type of sampling was practicable. These were cut as shallow holes in the surface of piles. Shaft and gopher-hole samples were removed in a thawed state. Surface and channel samples were cut from frozen gravels. Tests showed that the average weight of material is 135 pounds a cubic foot in place.

A few samples were washed by rocker, but the coarse particles of cassiterite remained in the hopper and were difficult to distinguish from associated gravels. Two panners were employed; each cut wood, melted snow, and panned 6 cubic feet of samples a day.

ORE RESERVES

Sample results were found to vary between wide limits. The only portion of the tailing deposit approaching minable grade at the present price of tin is the upper part of the block represented by shafts 48, 49, 57, and 58 and "gopher" holes 52 and 65. Here the average tin content is 0.777 pound per cubic yard, and the average gold content is 0.0028 ounce per cubic yard. The block is estimated to contain 11,300 cubic yards and

could be moved by dragline without disturbing the underlying subeconomic material. Mining costs in 1941 averaged more than $0.41 a cubic yard.

There are isolated areas of indicated economic grade. These are represented by shafts 9, 86, 88, and 119 and gopher holes 29, 70, 75, and 93. Sampling was not sufficiently close to define the exact limits, but adjacent samples indicate that the areas are too small to be minable.

The volume of the entire tailing deposit has been calculated as follows:

TABLE 1. - Volume of Sullivan Creek tailing deposit

Block	Section	Length of block, feet	Width of block, feet	Average depth, feet	Cu. ft.	Cu. yd.
I . . .	A	150	240	15	540,000	20,000
II . . .	B	195	280	12	655,200	24,267
III . . .	C	180	260	10	468,000	17,333
IV . . .	D	220	230	13	657,800	24,363
V . . .	E	145	290	10	420,500	15,574
VI . . .	F	320	280	8	716,800	26,548
VII . . .	G	170	410	9	627,300	23,233
VIII . . .	H	195	310	11	664,950	24,628
IX . . .	I	180	550	14	1,386,000	51,333
X . . .	J	240	470	12	1,353,600	50,133
XI . . .		215	400	10	860,000	31,852
		2,210			8,350,150	309,264

It is estimated that the entire tailing deposit has an average content of 0.241 pound tin and 0.0015 ounce gold per cubic yard. An estimated 309,300 cubic yards of tailing (table 1) is believed to contain 37.27 tons of tin.

TABLE 2. - Grade of Sullivan Creek tailing deposit

Block	Cubic yards	Tin, pounds per cubic yard	Gold, ounce per cubic yard	Total	
				Tin, pounds	Gold, ounces
I...	20,000	0.218	0.0002	4,360.00	4.000
II...	24,267	.589	.0003	14,293.26	7.280
III...	17,333	.285	.0014	4,939.90	24.266
IV...	24,363	.382	.0017	9,306.66	41.417
V...	15,574	.613	.0020	9,546.86	31.418
VI...	26,548	.260	.0021	6,902.48	55.750
VII...	23,233	.270	.0022	6,272.91	51.112
VIII...	24,628	.151	.0017	3,718.83	41.867
IX...	51,333	.203	.0003	10,420.60	15.400
X...	50,133	.043	.0014	2,155.72	70.186
XI...	31,852	.082	.0038	2,611.86	121.038
	309,264	[1] 0.241	[1] 0.0015	74,529.08	463.734
Parts of IV, V, and VI....	11,300	0.777	0.0028	8,780.10	31.640

1 Average.

Cleary Hill Mines Co. has 200,000 square feet of gravel stripped in preparation for mining. If mining is begun on this area now, a narrow strip will be left along the pit. Two shafts in this area 50 feet apart have shown an average content of 0.205 pound of tin per cubic yard. The tin content of virgin ground may be estimated on the basis of recovered tin plus that remaining in the tailing. It appears that the recovery of tin has been less than 0.04 pound a cubic yard. This, added to that in the tailing, gives an indicated original content of 0.281 pound of tin per cubic yard.

Complete details of the samples taken and yardage computations are on file at the Juneau, Alaska, and Rolla, Mo., offices of the Bureau of Mines.

CONCLUSIONS

The Sullivan Creek tailing, upon the basis of the combined tin and gold content, is of subeconomic grade. The virgin placer is minable but does not contain enough tin to justify the installation of extensive equipment for its recovery alone.

No further investigation of the cassiterite content of the placers in this area is planned by the Bureau of Mines at this time.

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