EXAMINATION OF THE WIN TIN PROSPECT, WEST-CENTRAL ALASKA

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TABLE OF CONTENTS

PLATE

FIGURES

TABLES

ABBREVIATIONS USED IN THIS REPORT

°	degree
ft	foot
>	greater than
in	inch
<	less than
mi	mile
ppb	parts per billion
ppm	parts per million
%	percent
st	short ton
oz/st	troy ounces per short ton

ABSTRACT

Mineralization at the Win prospect was investigated by the Bureau of Mines in June, 1990 and 1991, as part of an ongoing investigation of the tin, niobium, and tantalum resource potential in Alaska. The Win prospect is located twenty miles northwest of McGrath, AK. Mineral deposits consist of polymetallic sulfide and quartz-cassiterite mineralized vein and breccia vein systems within a quartz-tourmaline (dravite)-altered hornfels aureole that appears to be related to a small dacite stock and dikes. Host rocks for most of the veins are altered, Late Cretaceous Kuskokwim Group flyschoid rocks. The dacite is a calc-alkalic, high Ca, low K, biotite, magnetite, garnet-bearing coarse-grained intrusive. Mafic and accessory mineral distribution in the stock and dikes is highly erratic.

Veins and breccia veins often contain high tin and silver values (as much as 18.82 oz/st Ag and 6.97% Sn over 7.75 ft), variable, but significant, amounts of copper, lead, zinc, arsenic, niobium, antimony, bismuth and tellurium, and trace amounts of gold, indium, and selenium. Mineralization is both distal and proximal to the dacite intrusive rocks, covering a roughly circular area 1.25 mi in diameter. Bedrock exposure of vein systems is limited and no resource is calculated.

INTRODUCTION

The U. S. Bureau of Mines has investigated the tin resource potential of Alaska for several decades. This work has been done because tin is vital to industries in the United States, the United States relies on foreign countries to supply over 70% of its annual consumption (1)[1], and Alaska is the only portion of the United States that contains world-class tin deposits.

In 1990 and 1991, the Bureau investigated the Win tin prospect in west-central Alaska (fig. 1). The Win prospect is one of several recently discovered tin deposits that are distributed within the upper Kuskokwim River drainage. Another notable tin occurrence is the Won deposit (2). The Cloud prospect and the Mystery and Telida Mountains areas may also contain significant tin deposits (fig. 1).

The Bureau of Mines investigation of the Win prospect occurred during 1990 and 1991. This report describes the extent, mineralogy, morphology, distribution, and resource potential of its mineralized structures. Polymetallic sulfide and quartz-cassiterite mineral assemblages occur as fissure fillings, both distal and proximal to a small, partially greisen-altered dacite stock at the Win prospect. The vein systems cross-cut altered hornfels comprised of Cretaceous Kuskokwim Group siltstone and sandstones. The intrusive rock composition and vein character are similar to Bolivian-type tin-silver deposits described by Sillitoe and others (1975) (3).

Tantalum and niobium are two strategic and critical metals present in significant amounts in certain tin deposits. In addition to investigating the tin resource potential at the Win prospect, the tantalum and niobium mineral potential was also assessed.

LOCATION AND PHYSIOGRAPHY

The Win prospect is located in Sections 19, 20, 29, 30, 31, 32, of T. 26 S., R. 16 E., and Sections 25 and 36 of T. 26 S., R. 15 E., of the Kateel River Meridian (pl. 1). Geographically, the prospect is centered around a small hill, VABM Side, that flanks the northeastern portion of Cloudy Mountain. The prospect is located approximately 23 mi WNW of McGrath, Alaska. Access to the prospect in the summer is possible only by helicopter. Overland winter access from McGrath is possible.

Spruce, birch and alder vegetation are present on hill VABM Side to an elevation of about 1,800 feet. Sparse tundra covers talus above 1800 feet elevation. Water is present in small streams peripheral to hill VABM Side.

BUREAU INVESTIGATION

The Win prospect is located on the margin of, and is possibly related to, a volcano-plutonic complex centered on Cloudy Mountain. Cloudy Mountain is underlain by a volcano-plutonic complex composed of Late Cretaceous-early Tertiary high-K andesite flows, tuffs, and shallow hypabyssal rocks intruded by small granitic stocks (Moll and others, 1981 (4)). Mineralization consists of several polymetallic vein and breccia structures. The veins and breccia are in an altered hornfels aureole surrounding a small intrusive stock and associated dikes. The Bureau mapped and sampled outcrop, rubble crop, and float occurrences of vein and breccia material, and the various types of altered rock that were found. The bedrock geology and sample locations are shown on plate 1.

ANALYTICAL METHODS

The analytical methods for geochemical analyses presented in the tables and appendix of this report are

[1]Underlined numbers in parentheses refer to references found in the reference section preceding the appendix.

listed at the bottom of each table and the appendix.

INTRUSIVE ROCKS

Intrusive rocks at the Win prospect consist of a small dacite stock and related dikes. The stock is calc-alkalic, K-poor, high-Ca, magnetite-biotite-garnet-bearing dacite. Sample 36, table 1, best represents the composition of the dacite body. It is poorly exposed as an elongate rubble-crop that measures approximately 2,000 by 1,000 ft.

A bimodal grain size characterizes the texture of the biotite-bearing phases of the dacite. Quartz is present as subhedral to euhedral phenocrysts, 0.16 to 0.26 in in diameter, and as fine ($\leq$ 0.004 in), uniformly sized grains in the matrix. The larger quartz grains exhibit squarish outlines indicative of β-quartz. The quartz phenocrysts contain abundant fluid inclusions: many of which appear primary. These inclusions contain abundant gas and one to two daughter minerals, including halite. Plagioclase is found as large phenocrysts up to 0.4 in diameter but grain sizes vary. Inclusions of garnet, magnetite, biotite, and apatite are present in these phenocrysts. Potassium feldspar and the fine-grained mode of quartz comprise an anhedral groundmass to the phenocrysts. Biotite (0.004 to 0.08 in) is generally present as corroded, anhedral grains and rare euhedral grains. The stock and dikes exhibit considerable variation in biotite concentration (5 to 20%). It occurs in network to clot-like segregations in the otherwise coarse-grained leucocratic dacite stock. Some dikes also exhibit inhomogeneous distributions of biotite while others were nearly devoid of mafic minerals (sample 67, table 1). Inclusions of zircon, monazite, and xenotime are present in minor amounts in the biotite. Biotite is usually altered or replaced to some degree to quartz, and Fe-Ti oxide minerals. Fe-Ti oxide minerals form ghost outlines of severely altered biotite grains. Anhedral to euhedral garnet occurs as inclusions (0.002 to 0.02 in in diameter) in plagioclase and as separate grains that are locally altered to biotite. Trace magnetite (grain size as much as 0.2 in) is usually enclosed in biotite.

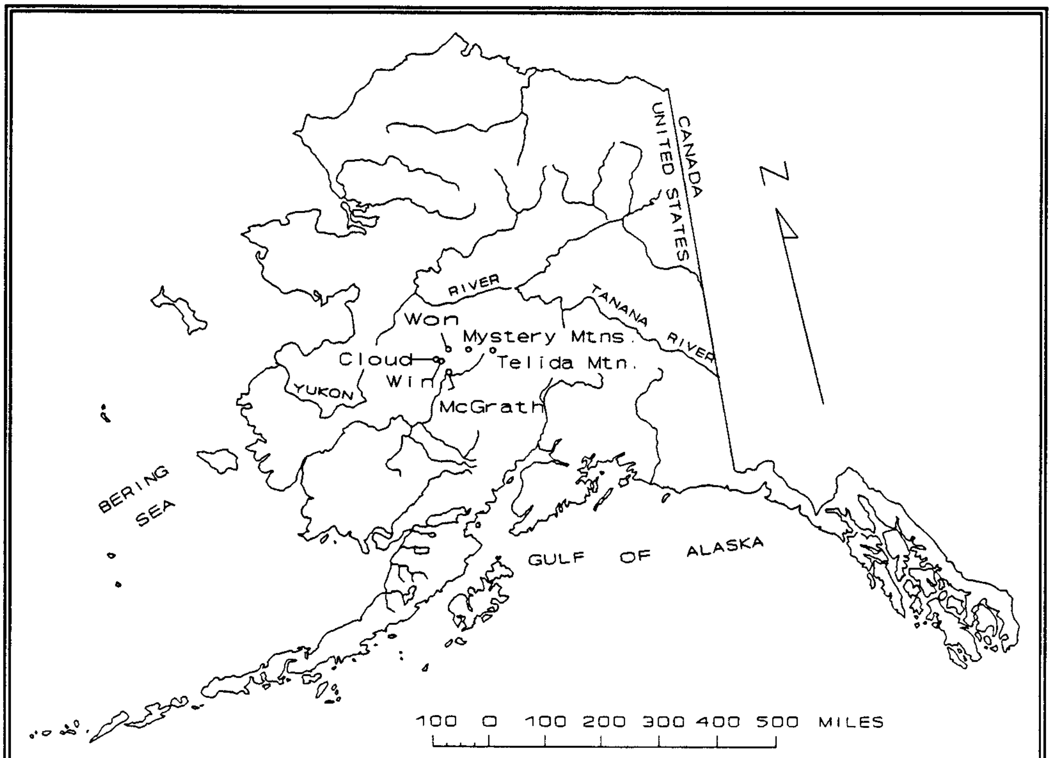

Figure 1. --Location map of the Won, Win and Cloud prospects and the Mystery and Telida Mtns.

Basalt of Late Cretaceous- early Tertiary age (4) is present on the flanks of VABM Side. Basalt contains feldspar and/or amphibole phenocrysts. Basalt contains clusters of plagioclase phenocrysts and lath-shaped amphibole phenocrysts oriented with a foliate texture. Whole-rock analyses for the basalt are presented in table 1: samples 50 and 56. On the east flank of hill VABM Side, the basalt is less well exposed and more deeply weathered. The basalt is altered and locally mineralized with tin and silver (samples 97 and 100, appendix, pl. 1) near the poorly-defined contact with the hornfels.

ALTERATION

Alteration of dacite is characterized by an assemblage of light-green, finely acicular tourmaline and quartz (samples 39, 40, 41, appendix, pl. 1). Sericite and quartz comprise another, but less abundant alteration assemblage in the dacite (samples 37, 38; appendix, pl. 1). The altered dacite is not highly mineralized. Structural controls or localized areas of alteration could not be determined because the stock is only exposed as rubble crop.

Table 1. --Major oxide and trace element analytical data for igneous rocks and tourmaline vein material

Map Number	Sample Number	Al_2O_3 %	CaO %	Fe_2O_3 %	FeO %	K_2O %	LOI %	MgO %	MnO %	Na_2O %	P_2O_5 %	SiO_2 %	TiO_2 %	Totals %
14	KS27769	26.2	0.87	2.32	-	0.08	2.84	8.41	0.04	1.71	0.13	55.2	0.81	98.68
35	KS27774	14.9	3.58	2.47	1.57	1.75	1.02	1.53	0.06	4.63	0.25	67.5	0.71	98.40
36	KS28585	14.2	5.16	0.62	0.65	0.37	2.30	1.32	0.04	5.52	0.02	67.8	0.70	98.00
50	KS27770	13.2	5.75	7.89	-	1.80	3.26	7.52	0.09	1.86	0.31	55.8	0.69	98.32
55	KS27762	14.6	2.66	4.81	3.05	4.05	0.65	1.34	0.09	3.52	0.26	66.3	0.71	98.99
56	KS27773	14.0	3.38	6.59	-	2.89	1.92	6.81	0.09	2.26	0.26	59.9	0.60	98.90
67	KS27776	15.1	4.29	1.00	0.42	0.40	2.69	1.49	0.04	5.44	0.30	67.8	0.75	99.30
101	KS27795	13.9	5.75	7.16	-	1.72	6.49	6.71	0.18	0.89	0.25	55.2	0.61	98.86
Typical tin-granite (5)		12.87	0.37	0.48	0.46	4.75	-	0.03	0.02	3.54	0.11	75.74	0.06	-

Map Number	Sample Number	Ba ppm	Nb ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Li ppm	F ppm	Sn ppm	Rock Type
14	KS27769	-	-	-	-	-	-	-	-	-	Tourmaline-veined hornfels
35	KS27774	710	30	76	328	35	220	132	733	<5	Biotite-garnet dacite stock
36	KS28585	350	26	14	384	36	264	-	-	19	Leucocratic dacite stock
50	KS27770	-	-	-	-	-	-	-	-	-	Feldspar porphyry basalt
55	KS27762	1200	-	-	-	-	-	-	-	-	Biotite dacite dike
56	KS27773	-	-	-	-	-	-	-	-	-	Feldspar porphyry basalt
67	KS27776	130	32	16	407	56	245	112	1333	69	Lecocratic dacite dike
101	KS27795	-	-	-	-	-	-	-	-	-	Magnetite-bearing basalt

Note: Ba, Nb, Rb, Sr, Zr, Y, and Sn analyzed by X-ray fluorescence. Whole-rock major oxides analyzed by direct coupled plasma emission after borate fusion extraction except for FeO. FeO analyzed by titrametric methods. LOI (loss on ignition) determined by gravimetric methods. Li by HF-$HNO_3$$HClO_4$HCl extraction - atomic absorption and F by potassium hydroxide fusion - specific ion methods.

Note: Map numbers refer to locations on plate 1.

Thermal metamorphism of the sedimentary rocks surrounding the intrusive is not easily distinguished from the extensive silicification and tourmalinization events which overprint these rocks. Only on the eastern side of hill VABM Side can the transition from sedimentary to hornfels rocks be observed. Across the higher elevations of hill VABM Side, alteration of the sedimentary rocks is depicted by anastomosing quartz veins, fine-grained silicification, and fine-grained tourmalinization. The alteration produced hard, flinty rock. Figure 2 is a photograph demonstrating multiple events of quartz and tourmaline alteration which overprints purplish-brown hornfels.

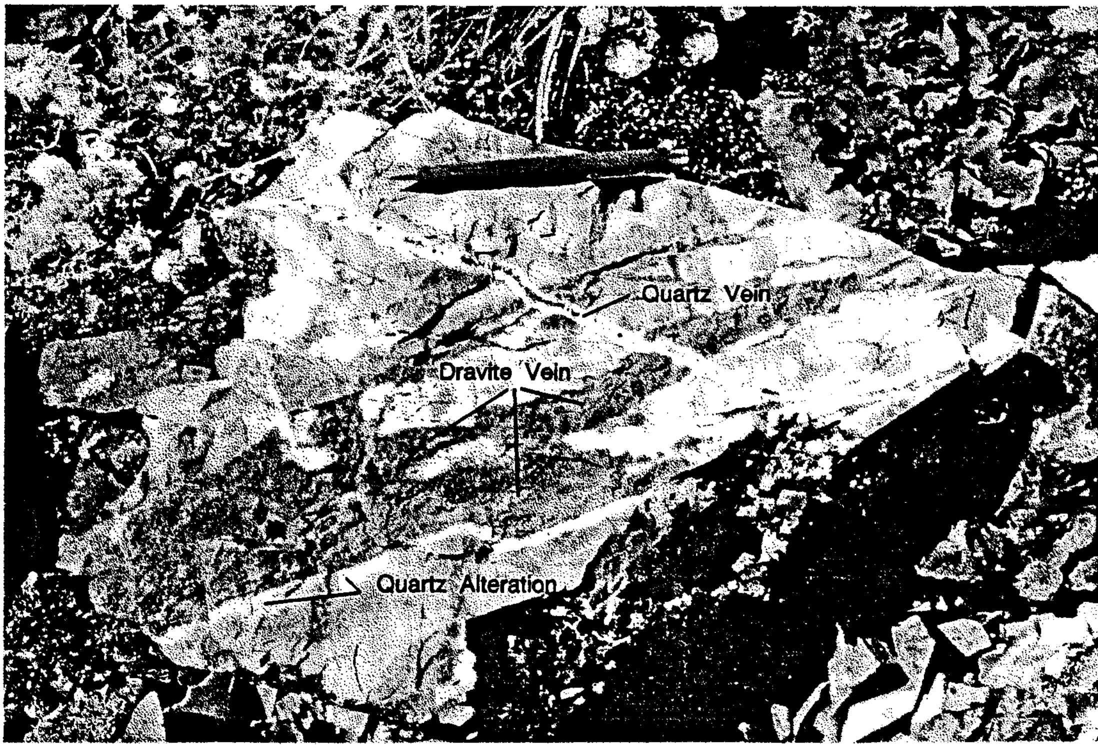

Figure 2. --Irregular dravite-tourmaline veining cross-cut by later quartz veins in quartz-tourmaline-altered hornfels

Alteration minerals in the hornfels generally consist of a distinctly, light-root beer-colored tourmaline, granular, milky-white quartz, and titanium oxides. Tourmaline occurs as stubby crystals in vein-like masses and is probably the dravite end-member of the dravite-schorl series as indicated by the Mg-rich (8.41% MgO) and Fe-poor (2.32% Fe_2O_3) geochemistry of sample 14, table 1. Titanium oxide minerals form small knots of radiating crystals and disseminated grains. In contrast to dravite-tourmaline veins, the tourmaline in quartz-cassiterite veins is light gray to bluish gray in color and forms compact intergrowths of acicular radiating crystals and disseminated grains in veins and adjacent wall rock. Broadly surrounding areas of significant tin mineralization (figs. 3 to 5) hornfels contains disseminated casts and grains of cubic pyrite.

Quartz associated with cassiterite veins is generally clear and fluid inclusion-free. Quartz associated with massive arsenopyrite contains abundant and large, two-phase fluid inclusions. Fluid inclusions in quartz of the more wide-spread quartz-dravite-tourmaline alteration are moderately abundant and are generally liquid-vapor inclusions with one or two daughter minerals: including halite.

A large, intensely quartz-tourmaline-greisen-altered breccia vein, strikes N60°W and is exposed for 4,000 ft along strike. The trend is parallel to the intrusive dikes and cuts across the top of hill VABM Side.

This 10-foot-plus-wide vein does not contain significant metallic mineralization where sampled (samples 57, 59, 83, appendix, pl. 1). Because of the breccia veins similar strike orientation, it is probable that the responsible hydrothermal fluids were related to the intrusive system which formed the dacite dikes and stock. Greisen alteration of the brecciated hornfels produced resistant rock which forms large blocky rubble crop. The breccia vein is distinct from mineralized veins which generally strike north-south.

Centers of hydrothermal alteration associated with the Cloudy Mountain volcano-plutonic complex are not confined to the Win prospect. At the Cloud prospect, located 10 miles to the west (fig. 1), intense tourmaline-quartz alteration and mineralization is superimposed upon aphanitic flow banded volcanic rocks, bedded volcanic breccia, and lapilli tuff of the Cloudy Mountain volcano-plutonic complex and sandstone and siltstone which underlie the volcanic rocks (6).

VEIN AND BRECCIA VEIN DEPOSITS

The Bureau defined three areas (pl. 1, figures 3 to 5) that exhibit moderately well exposed and distinctive mineralized vein systems.

The first vein system (fig. 3) consists of: (1) scoria-like gossan veins bounded by highly fractured, gossany cassiterite-veined hornfels, (2) quartz-tourmaline-cassiterite veins, (3) vuggy, coarse-grained quartz-cassiterite veins and (4) fine-grained massive cassiterite-veins in a quartz-altered hornfels. Primary sulfide ore minerals are completely oxidized except for trace grains of Pb-Bi-Sb-Ag-sulfosalt minerals in thin fracture fillings.

Analyses (table 2) of chip samples across portions of the three gossan vein outcrops (fig. 3), show anomalous concentrations of silver, arsenic, bismuth, copper, iron, niobium, lead, antimony, tin, and zinc. Weighted averages of silver and tin concentrations in the three outcrops of this vein range from 11.5 to 27.1 oz/st Ag and 1.56 to 6.97% Sn over 5.7 to 8.0 ft (table 3). Other trace elements range up to 926 ppb Bi, 3,680 ppm Cu, >10% Fe, 834 ppm Nb, 1.39% Pb, >5,000 ppm Sb, 1,250 ppm Se, and 6,900 ppm Zn (table 3).

The vein system trends N10°E and can be traced for 200 ft along strike (fig. 3). The talus covered slope downhill of this vein is covered with heavily iron-stained, highly fractured, and altered hornfels. Tin mineralized rocks in the talus are moderately abundant at the foot of the hill and suggest a separate vein structure is buried beneath the talus near the vicinity of samples 18, 22, 24, 25, 26 (pl. 1, appendix). Float samples that consist of anastomosing, light gray, and very-fine-grained, massive cassiterite veins in bleached hornfels contain up to 50.47% Sn (samples 18, 22, appendix) over widths of 2 in. A float sample of altered hornfels (sample 23, appendix) cut by veinlets of silver-rich Pb-Bi-Sb-Ag sulfosalt minerals contained about 80 oz/st Ag. Veins that contained sulfosalt minerals are less than a ¼ in wide.

A zone of north-south striking cassiterite-quartz veins occur within the area of figure 4. Although vein orientations were determined from the distribution of mineralized rubble-trains, mineralized rubble could not be traced significant distances. Veins vary from thin, massive cassiterite adjacent to gossany, brecciated hornfels wall rock (samples 75, 76, 77, 79, fig. 4), to massive coarse-grained quartz veins with up to 15% disseminated cassiterite (sample 70, 78, fig. 4). These veins contain from 3.52 to 57.13% Sn and 0.43 to 1.9 oz/st Ag (table 4). Gossan-coated, brecciated or highly fractured quartz-veined hornfels are characteristic of breccia veins at the Win prospect. Tin values are lower in the breccia veins and range from 0.21 to 0.81% Sn over widths of 1.5-4 ft (samples 69, 71, 72, and 74, table 4); silver values range from 0.12 to 0.96 oz/st. Arsenopyrite-rich samples contain the highest silver values (up to 10.22 oz/st, sample 73, table 4), but overall, veins within the area of figure 4 are not base or precious metal-rich compared to those within the area of figure 3.

The third mineralized zone (fig. 5) consists of cassiterite-quartz veining that fills brittle fractures of pyrite-altered and bleached hornfels. Individual cassiterite veinlets are an ⅛ to 6 in wide and contain up to 60% medium- to coarse-grained cassiterite. No outcrops were noted. Compass and tape mapping of the talus surrounding the zone delineated two areas of concentrated cassiterite-bearing rubble and float. The trend of the rubble is N-S (fig. 5). The mineralized zone could not be traced to the north and much of the area along the southeastern portion of figure 5 is heavily vegetated. The mineralized rubble/float located in the southern area rakes slightly across a west-facing slope. If this rubble-train represents a southern extension of the veins found in rubble within the northern portion of the area, then the vein structure has an eastern dip.

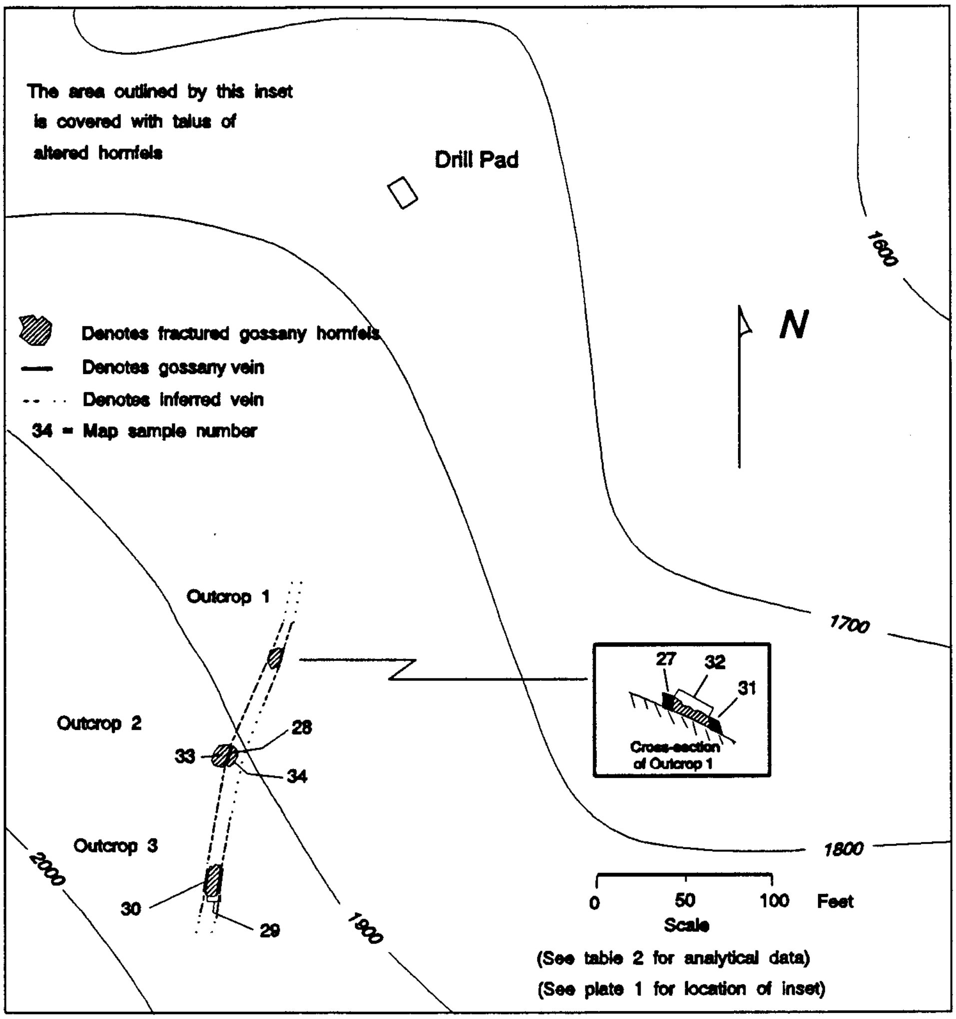

Figure 3. --Outcrop and sample location map

Boulders of hornfels in the area of figure 5 contain several quartz-cassiterite veinlets spread over widths of up to 3 ft. Gossany, brecciated hornfels, with silver-enriched quartz-sulfide-sulfosalt-bearing veinlets also occur in this mineralized zone. Values of up to 45.38% Sn and 5.13 oz/st Ag were found in rocks collected from this area (table 5, pl. 1).

Other areas of the Win prospect exhibit potential for significant tin or silver mineralization, but lack exposures sufficient for detail mapping. Types of mineralized rock sampled in these areas include (1) polymetallic Sb-Pb-Bi-Ag-Te-Sn sulfosalt veining, (2) gossany quartz-tourmaline matrix-supported brecciated hornfels, and (3) greisen-like quartz-tourmaline-cassiterite-arsenopyrite veining. Two areas in particular contain significant amounts of tin-niobium and silver mineralized rubble or float. These areas lie immediately to the north and south of the dacite stock (pl. 1). North of the stock lies a knoll on which abundant mineralized float and rubble occur (samples 3, 5-8, 10-12, 16, 19, appendix, pl. 1). Tin and silver values range up to 0.15% Sn and 337.6 oz/st Ag. Tin values were highest in greisen-like, arsenopyrite-bearing, quartz-tourmaline veins. Silver is most enriched in yellow-green gossany veins containing loellingite in association with complex intergrowths of Bi-Pb-Sb-Ag-S and Ag-Te-Sn-S minerals and brecciated hornfels with yellow-green staining. The yellow-green staining represents some combination of antimony, bismuth and arsenic oxidation products. Silver mineralized rocks were not abundant, although brecciated, altered, and gossany rock occur widely.

Table 2. --Analytical data for mineralized samples collected in the area of figure 3.

Map Number	Sample Number	Au ppb	Ag oz/st	As ppm	Bi ppm	Cu ppm	Fe %	Nb ppm	Pb ppm	Sb ppm	Se ppm	Sn %	Zn ppm
27	KS27751	< 1000	41.41	> 10000	775	3010	> 10.0	237	10270	> 5000	< 510	5.38	< 4100
28	KS27752	< 2200	94.63	> 10000	73	3680	> 10.0	11	12430	> 5000	< 1100	1.32	< 7700
29	KS27753	< 990	28.54	> 10000	407	3300	> 10.0	85	3870	> 5000	1250	1.31	6900
30	KS27754	< 830	17.80	> 10000	234	799	> 10.0	294	8610	> 5000	< 410	4.45	2900
31	KS27758	< 710	17.68	> 10000	926	1449	> 10.0	71	13970	> 5000	< 350	1.24	< 3000
32	KS27759	< 120	5.50	5020	154	362	4.6	188	1046	3480	< 56	1.09	< 570
33	KS28552	62	14.62	-	43	421	-	834	1812	-	0.1	10.59	1030
34	KS28553	62	12.32	-	161	259	-	579	757	-	<0.1	3.39	325

Note: Samples were analyzed accordingly: Au and Ag by fire assay, Sn by peroxide fusion extraction - atomic absorption, Nb by X-ray fluorescence, As, Fe, Zn, Sb by instrument neutron activation, Bi, Cu, Pb by HNO_3-HCL hot extraction - atomic absorption.

Map Number	Sample Number	Sample Description
27	KS27751	7 in continuous chip; scoria-like gossan vein
28	KS27752	6 in continuous chip; scoria-like gossan vein
29	KS27753	7 ft continuous chip; 7 in gossan-vein with gossany, tourmaline-altered siltstone
30	KS27754	12 in continuous chip; scoria-like gossan vein
31	KS27758	13 in continuous chip; scoria-like gossan vein
32	KS27759	4 ft continuous chip; highly fractured, gossany hornfels with gossan-coated fractures
33	KS28552	4 ft chip; highly fractured, gossany hornfels; < 5% gossan veinlets
34	KS28553	3.3 ft chip; quartz stockwork-veined, gossany, fractured hornfels; minor sulfosalts

Note: Map numbers refer to locations on pl. 1 and figure 3.

Table 3. --Calculated weighted average silver and tin concentrations for the vein described in figure 3.

Outcrop	Ag (oz/st)	Sn (%)	Width (ft)
1	11.50	1.56	5.70
2	18.82	6.97	7.75
3	27.10	1.70	8.00

Along the southern margin of the dacite stock, intense quartz-tourmaline-altered and matrix-supported brecciated hornfels is commonly found in float and isolated rubble-crops. Based upon the size of rubble material these breccia zones have a 2-3 ft minimum width. Strike orientations could not be discerned from the distribution of rubble. The Bureau noted variations in clast alteration. Tan-colored quartz-rich and greenish gray extensively tourmalinized rock are the dominant clast types in the breccia (fig. 6). The breccia in figure 6 is matrix supported. Variations in clast alteration probably indicate that different original rock compositions were entrained in the breccia system. Several grab samples collected from this area (samples 41-46, appendix, pl. 1) represent intense tourmaline- and tourmaline-quartz-altered breccia and contain up to 3.5% Sn and 129.88 oz/st Ag. Knots of compact, fine-grained, grayish-green tourmaline up to 8 in by 6 in formed in this breccia. No metallic minerals were observed; however, light yellow-green coatings stain the silver-rich samples.

High bismuth and silver values were found at two other locations (samples 99, 103, appendix, pl. 1). Both locations have rubble with distinctive yellow-green oxide coatings or boxworks, strong tourmalinization, and brecciation.

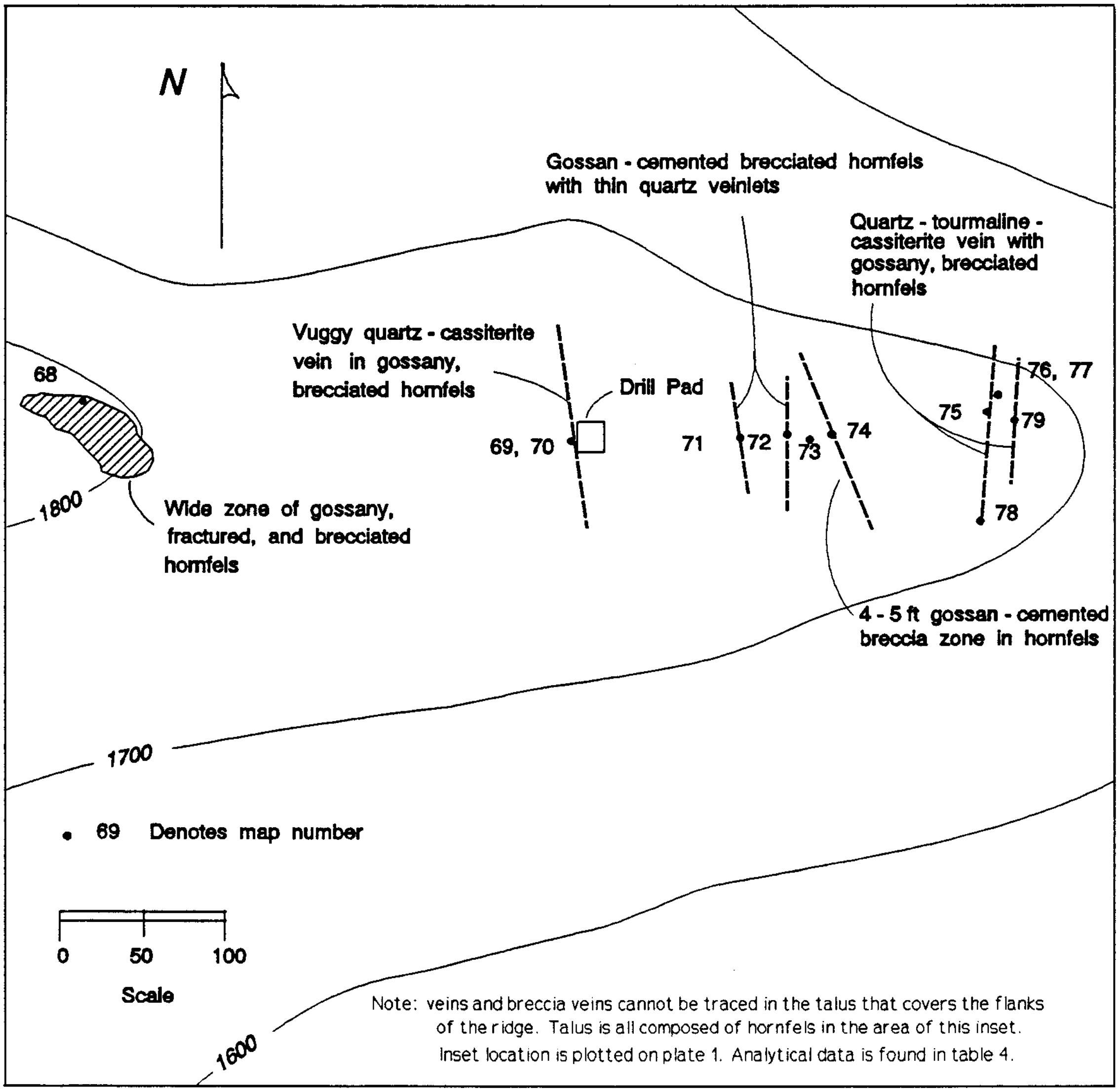

Figure 4. --Outcrop and sample location map

Table 4. --Select analytical results for samples represented in figure 4

Map Number	Sample Number	Au ppb	Ag oz/ton	As ppm	Bi ppm	Cu ppm	Fe %	Nb ppm	Pb ppm	Sb ppm	Se ppm	Sn %	Zn ppm
68	KS27756	<21	1.87	2660	64	276	>10.0	32	298	633	<10	0.08	1300
69	KS27788	<28	0.96	2680	-	-	>10.0	191	-	538	98	0.81	<200
70	KS27768	<10	1.90	1180	85	99	5.9	663	56	107	<10	8.45	<200
71	KS27790	-	0.12	*200	4	-	-	66	-	-	-	0.21	-
72	KS27671	<5	0.35	362	6	87	4.0	271	7	36.7	<10	1.13	<200
73	KS27789	-	10.22	*135700	252	-	-	230	-	-	-	1.56	-
74	KS27791	-	0.12	*7500	9	-	-	143	-	-	-	0.65	-
75	KS27784	-	0.76	-	-	-	-	775	-	-	-	12.89	-
76	KS27787	<1100	1.33	7530	-	-	7.5	181	-	5000	<390	3.52	<3100
77	KS27786	-	0.43	-	-	-	-	1699	-	-	-	31.35	-
78	KS27785	<20	0.32	3360	-	-	1.1	915	-	72.8	<10	13.90	<200
79	KS28594	<62	0.44	-	-	-	-	-	-	-	-	57.13	-

Note: Samples were analyzed accordingly: Ag by fire assay, Sn by peroxide fusion extraction - atomic absorption, Nb by X-ray fluorescence, Au, As, Fe, Zn, Sb by instrument neutron activation, Bi, Cu, Pb by HNO_3-HCL hot extraction - atomic absorption, * indicates As assay by HCl-HNO_3-HF extraction-atomic absorption.

Map Number	Sample Number	Sample Description
68	KS27756	Rubble; random chip; gossany brecciated hornfels
69	KS27788	Bedrock; 18 in continuous chip; Fe-stained hornfels w/ ¼- 3-in-thick cass-qtz veinlets
70	KS27768	Rubble; grab; gossany quartz-cassiterite veining; pieces to 12 in
71	KS27790	Bedrock; random chip; 3- 4-ft-wide altered hnfls with ¼ in qtz-arsenopyrite-cass veins
72	KS27671	Rubble; random chip; 1-2 ft blocks; silicified-brecciated hornfels w/ qtz-cass veinlets
73	KS27789	Rubble; grab; 2 in-thick vuggy qtz vein with approximately 2% cass, and 10-50% arsenopyrite + pyrite
74	KS27791	Bedrock; 3.5 ft continuous chip of heavily Fe-stained brecciated hornfels
75	KS27784	Float; grab; ⅛-in-thick quartz-cassiterite veinlet in Fe-stained hornfels
76	KS27787	Rubble; random chip; gossany brecciated hornfels rubble, blocks to 10 inch thick
77	KS27786	Rubble; grab; 1- 2-in-thick massive cass-tour-qtz vein in tour-qtz-altered hornfels
78	KS27785	Rubble; grab; 6- 8-in-thick, qtz veins; 10-15% disseminated cass, 1-5% fine-grained tour
79	KS28594	Bedrock; grab; massive, 3- 4-in-thick medium-grained gossany cass vein; approximately 40% cass

Abbreviations: tour=tourmaline, qtz=quartz, aspy=arsenopyrite, cass=cassiterite, hnfls=hornfels

Note: Map numbers refer to locations on pl. 1 and figure 4.

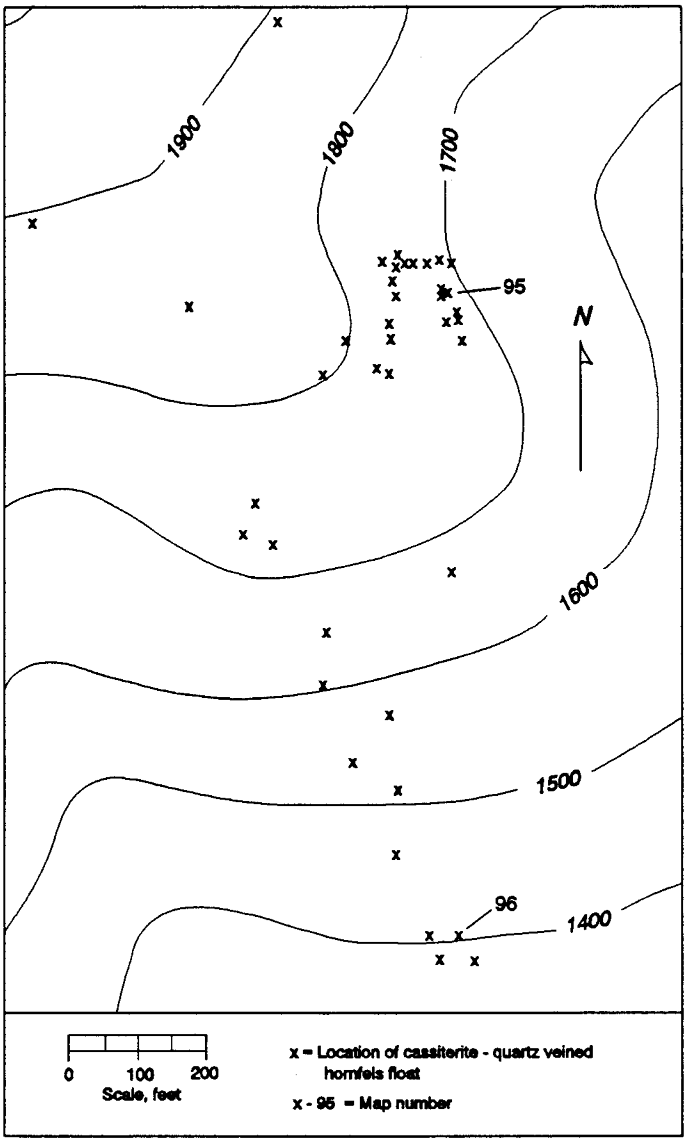

Figure 5. --Geology and sample location map

A prominent linear depression cuts across the slope immediately south and up hill of samples 61-64 (pl. 1, appendix). These samples are believed to represent alteration associated with a fault (or breccia vein) system) that occupies the linear depression. The samples are generally silicified, tourmalinized, brecciated and have quartz-arsenopyrite veining. Electron microprobe examination showed that considerable bismuthinite is associated with the arsenopyrite. Samples 61, 63 and 64 contain anomalous gold whereas sample 62 is silver-enriched with no gold.

An area of intensely silicified hornfels is located north of the prominent linear depression and crops out on the left limit of a northwest trending gully. Within the gully most of the rubble consists of tourmaline-altered dacite dike rock (samples 52-54, appendix, pl. 1). The silicified hornfels outcrop is not mineralized and nowhere else at the Win prospect is this high degree of silicification found.

Table 5. --Analytical results for samples collected in the area of figure 5

Map Number	Sample Number	Au ppb	Ag oz/ton	As ppm	Bi ppm	Cu ppm	Fe %	Nb ppm	Pb ppm	Sb ppm	Se ppm	Sn %
95	KS27777	-	-	-	-	-	-	1843	-	-	-	45.38
96	KS27796	-	5.13	900	2	-	-	138	1819	-	-	0.64

Map Number	Sample Number	Description
95	KS27777	Rubble; high-grade grab; massive, cassiterite-quartz-tourmaline vein
96	KS27796	Rubble; random chip; gossany qtz-tour altered, brecciated hnfls; ¼-½ in qtz-aspy-sulfosalt-cass veinlets

Abbreviations: tour=tourmaline, qtz=quartz, aspy=arsenopyrite, cass=cassiterite, sulf=sulfosalt

Note: Samples were analyzed accordingly: Ag by fire assay, Sn by peroxide fusion extraction - atomic absorption, Nb by X-ray fluorescence, As by instrument neutron activation, Bi, Pb by HNO_3-HCL hot extraction - atomic absorption, * indicates As assay by HCl-HNO_3-HF extraction-atomic absorption.

Note: Map numbers refer to locations on pl. 1 and figure 5.

Figure 6. --Hydrothermally altered hornfels breccia with tourmaline matrix

Sulfosalt Mineralogy

Many samples collected at the Win prospect contain high silver and base metal values, but other than cassiterite and arsenopyrite, no other metallic minerals were identified. There is not sufficient lead in the high silver value samples to account for argentiferous galena. Fine-grained, dull grey sulfide minerals were observed in silver-rich samples, and it was believed that these unknown minerals were silver-sulfosalts of unknown composition.

Sample number 6 (pl. 1, appendix) contains a complex assemblage of Bi-Pb-Sb-Ag and Ag-Te-Sn-S sulfosalt minerals. Electron microprobe analysis[2] shows that the Ag-Te-Sn-S mineral is intimately intergrown with at least three subspecies of Pb-Bi-Sb-Ag sulfosalt minerals. Approximate stoichiometries (table 6) are calculated from average elemental values of electron microprobe results (fig. 7) for each species. A variable representation of these mineral species probably accounts for the high silver and bismuth concentrations found throughout the Win prospect. These sulfosalt minerals occur in rock samples with yellow-green gossan veinlets and yellow-green staining. Samples are shown to contain up to 337.2 oz/ton Ag, 1.6% Bi, 0.1% Te, 7.04% Sb, 5.39% Pb, and 40 ppm In (samples 7, 43, appendix).

Table 6. --Approximate stoichiometry for sulfosalt minerals

Pb-Bi-Sb-Ag-S Minerals		Ag-Te-Sn-S Mineral
Sub-type 1	$Pb_{1.68}Bi_{1.02}Sb_{2.94}Ag_{1.27}S_8$	$Ag_{8.18}Te_{2.07}Sn_{0.96}S_4$
Sub-type 2	$Pb_{2.01}Bi_{1.46}Sb_{2.32}Ag_{1.13}S_8$	
Sub-type 3	$Pb_{1.70}Bi_{2.13}Sb_{0.19}Ag_{2.23}S_6$	

Niobium Distribution

Niobium concentration correlates positively to the concentration of tin at the Win prospect and is quantified by a power regression curve represented on figure 8. Figure 8 is a log-log plot comparing the niobium content of samples with a wide range of tin concentrations. Thirty three Nb-Sn data pairs represented in tables 2, 4, 5, and the appendix were used for computing the regression curve. Considering a cassiterite concentrate of essentially 100% cassiterite, this concentrate would contain approximately 75% Sn and 2200 ppm Nb. Tantalum is not enriched at the Win prospect. Two samples containing 31.35% Sn (sample 77, table 4) and 45.38% Sn (sample 96, table 5) only contained 11 and 18 ppm Ta respectively.

[2]Cameca SX-50 electron microprobe, Department of Geology and Geophysics, University of Alaska - Fairbanks

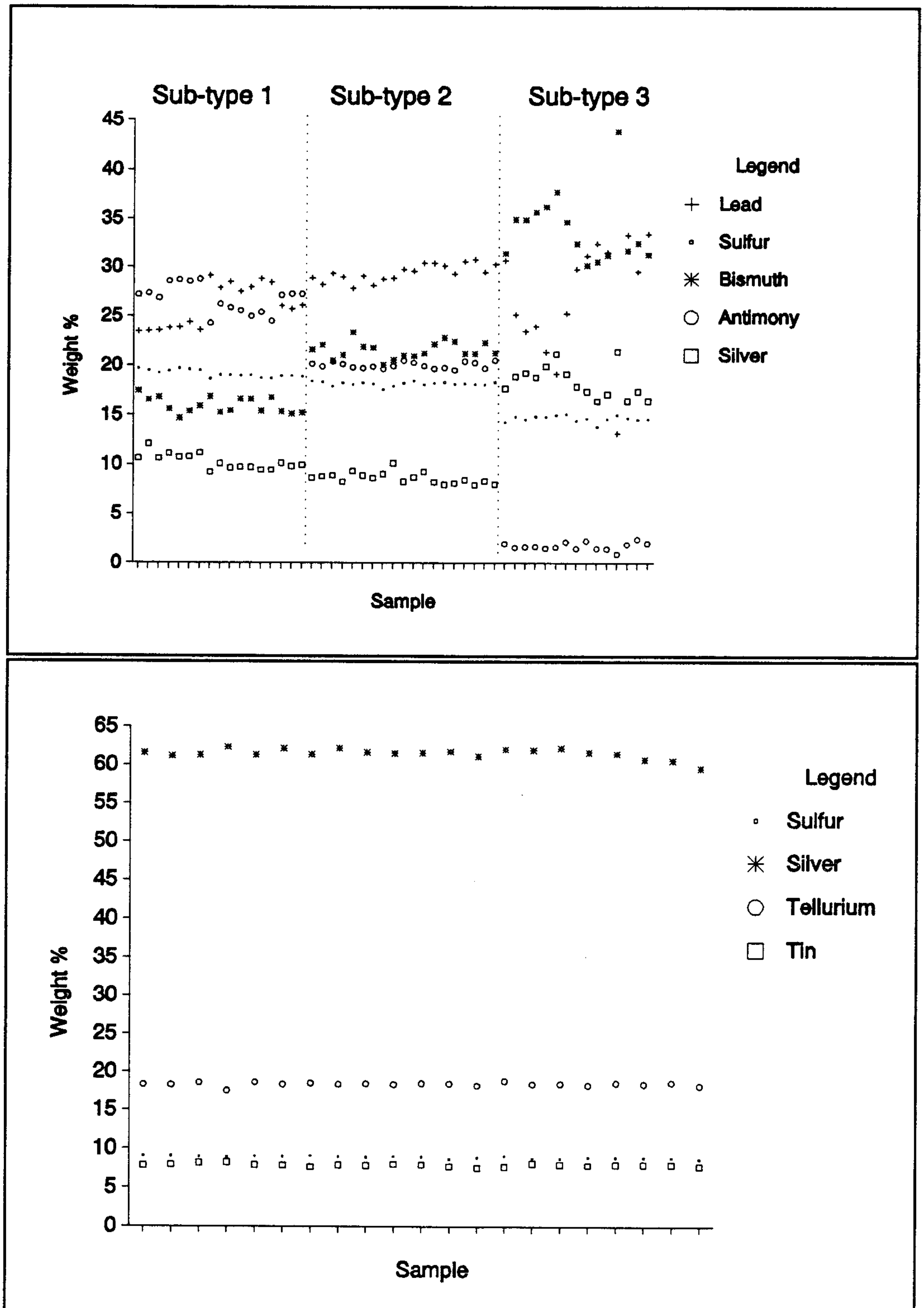

Figure 7. --Graphical representation of electron microprobe analysis of Pb-Bi-Sb-Ag-S and Ag-Te-Sn-S minerals in sample 6, appendix.

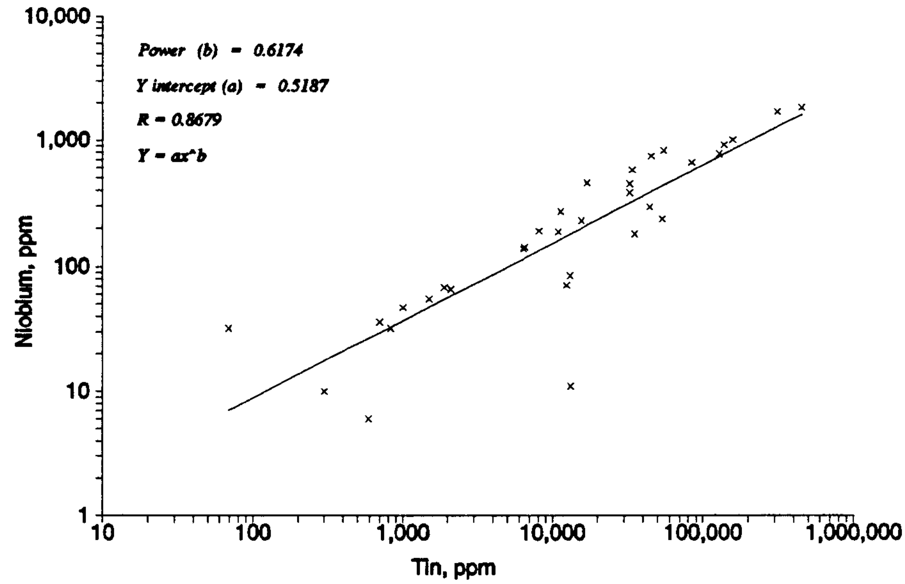

Figure 8. -- Log-Log plot of niobium and tin concentrations of mineralized rocks from the Win prospect

CONCLUSION

Tin and polymetallic vein mineralization at the Win prospect occurs in tourmaline and quartz-altered Kuskokwim Group flyschoid rocks and to a lesser extent mafic volcanic rocks adjacent to the Cloudy Mountain volcano-plutonic complex. Cassiterite-bearing veins generally have a north-south orientation, and form narrow brittle fracture fillings; often with very high concentrations of cassiterite. The veins occur sheeted in localized areas. Tin and polymetallic minerals (particularly the silver minerals) occur as void and irregular fracture fillings of brecciated and altered sedimentary rocks. Veins often contain high tin (and niobium), high silver, and variable but significant copper, lead, zinc, arsenic, antimony, bismuth, and tellurium values. Cassiterite is not always associated with significant silver and base-metal mineralization. While niobium is abundant in the presence of tin, tantalum is not enriched in this tin deposit.

Although intrusive rocks outcropping in the prospect area are altered they are not significantly mineralized with tin or silver. The dacite intrusive rocks which form a small stock and several sub-parallel dikes are chemically unlike the typical tin-granite in terms of trace element and major oxide compositions. The high barium and strontium, and low rubidium trace element compositions of the dacite intrusive (samples 35, 36, 67, table 1) are contrary to low barium, and strontium, and high rubidium levels commonly found in composition fields of tin related granites (Biste, 1982, (7)). The Win prospect dacite has high CaO, TiO_2, Al_2O_3, Fe_2O_3, MgO, Na_2O, and low SiO_2, and K_2O compositions in comparison to the typical tin-granite. A whole rock composition for a typical tin-granite is included in table 1. The intrusive rocks are only variably altered. The dacite rocks may have been intruded prior to the emplacement of a subsequent mineralizing tin-granite phase buried at depth. Alternatively, the geologic data collected on the tin-silver veins at the Win prospect have many characteristics that are similar to the famous tin-silver deposits of Bolivia (3). The Bolivian deposits formed in sedimentary rocks, overlying volcanic rocks, and subvolcanic quartz-latite or dacite intrusive of stratovolcanos. The geologic setting of the Win prospect includes no stratovolcano. Applying the Bolivian model would then indicate that mineralization at the Win prospect is characteristic of a deeply eroded Bolivian-style tin system. Both tin-granite and Bolivian-style tin systems may exhibit tin and polymetallic veining distal to intrusive and hydrothermal centers (8) and so it remains for future exploration to test the Win prospect against these tin-ore deposit models.

Tourmaline in the sedimentary rocks appears to be dravite, or magnesium-rich tourmaline, which is typically found associated with sedimentary rocks (Pirajno and Smithies, 1992, (9)). Pirajno and Smithies (9) found that higher MgO contents of tourmaline formed from hydrothermal fluids of granite-related tin-tungsten-mineral deposits are distal to cupola-style greisen mineralization that is usually more proximal to the related granite. No attempt to apply this relation was made at the Win prospect; however, the chemical variations of tourmaline documented in other tin-granite deposits may prove useful in targeting drill holes to probe for cupola-style mineralization at the Win prospect.

Adequate data is unavailable to make a tin-resource estimate at the Win prospect due to the poor bedrock exposure of the veins along strike. Also, many of the highly mineralized samples collected constitute rubble and float samples. Veins do occur in sufficient density (especially within areas of figures 4 and 5) to constitute potential minable widths. Lateral and down dip dimensions of these vein systems will have to be determined by surface trenching and drilling.

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APPENDIX

SELECT ANALYSES FOR MINERALIZED SAMPLES AT THE WIN PROSPECT

Map Number	Sample Number	Au ppb	Ag oz/ton	As ppm	Bi ppm	Nb ppm	Pb ppm	Sb ppm	Se ppm	Te ppm	In ppm	Sn ppm	Zn ppm
1	KS28579	-	0.60	-	-	-	-	-	-	-	-	19	-
3	KS28581	<62	1.24	-	6	<1	-	-	-	-	-	<5	-
3	KS28582	62	4.57	-	21	<1	-	-	-	-	-	500	-
4	KS28557	<62	0.18	-	-	58	-	-	-	-	-	500	-
5	KS27781	230	35.45	1310	-	-	53900	862	<10	-	-	200	<200
6	KS27782	<26	0.35	2780	-	-	-	557	21	-	-	630	630
7	KS28558	62	337.20	-	*16000	-	>10000	70400	2.6	*600	*20	<5	-
8	KS27780	230	3.15	2180	59	-	-	549	39	-	-	250	<200
9	KS28556	<62	0.05	-	-	32	-	-	-			2900	-
10	KS27757	<72	12.30	1150	-	6	-	1340	<32	-	-	590	<200
11	KS27778	<21	2.68	511	42	55	-	541	<20	-	-	1500	<200
12	KS27779	<14	6.10	422	78	36	-	322	40	-	-	700	260
13	KS28555	-	-	-	-	-	-	-	-	-	-	-	-
15	KS28540	156	0.07	-	151	36	-	-	-	-	-	<5	-
15	KS28541	62	20.60	-	*10900	9	-	-	-	*500	-	<5	-
16	KS28583	-	0.38	-	6	22	-	-	-	-	-	325	-
17	KS28548	<62	1.30	-	79	-	216	519	<0.1	27.3	-	51700	-
18	KS28542	<62	1.16	-	94	-	-	-	-	-	*30	504700	-
19	KS28584	62	9.18	-	146	14	-	-	-	-	-	325	-
20	KS28550	-	0.72	-	10	45	546	304	0.1	1.0	-	2100	-
21	KS28551	-	0.94	-	18	5	793	840	0.6	0.9	<1	600	-
22	KS28544	<5	1.16	-	36	746	-	-	-	-	-	45500	-
23	KS28547	62	79.89		*10700	42	2331	>5000	0.4	*300	<50	-	-
24	KS28545	<62	0.20	-	27	1004	-	-	-	-	-	158700	-
24	KS28546	<62	0.48	-	8	824	-	-	-	-	-	54900	-
25	KS28543	<62	2.80	-	*3500	14	-	-	-	*<50	-	2200	-
26	KS28554	<5	1.44	-	*<50	-	-	-	-	*<50	*30	371100	-
37	KS28586	28	0.35	-	-	46	-	-	-	-	-	235	-
38	KS28587	<62	1.27	-	-	29	-	-	-	-	-	800	-
39	KS28588	<62	0.25	-	-	21	-	-	-	-	-	800	-
40	KS28589	<62	0.22	-	-	15	-	-	-	-	-	800	-
41	KS28590	<62	1.73	-	-	3	-	-	-	-	-	1800	-
42	KS28559	62	6.20	-	-	32	-	-	-	-	-	2900	-

APPENDIX, continued													
Map Number	Sample Number	Au ppb	Ag oz/ton	As ppm	Bi ppm	Nb ppm	Pb ppm	Sb ppm	Se ppm	Te ppm	In ppm	Sn ppm	Zn ppm
43	KS28560	2022	129.88	-	*11800	<1	36800	*23200	1.3	*1000	*40	1300	-
44	KS28561	62	5.24	-	137	19	-	-	-	-	-	1100	-
45	KS28562	62	12.64	-	1380	16	3165	2370	0.1	67.7	*20	1800	-
46	KS27775	<150	19.63	2980	1119	382	-	3710	<150	-	-	32700	<1100
47	KS27783	-	-	-	-	47	-	-	-	-	-	1000	-
48	KS27763	-	-	-	-	-	-	-	-	-	-	<5	-
49	KS27792	<23	0.45	>10000	59	-	97	230	27	-	-	360	<200
49	KS27793	<5	0.93	207	2	-	21	136	<10	-	-	560	<200
51	KS27755	460	0.55	5980	14	10	74	541	67	-	-	300	510
52	KS28591	<62	0.37	-	-	7	-	-	-	-	-	600	-
53	KS28592	<62	0.98	-	-	14	-	-	-	-	-	600	-
54	KS28593	<62	0.04	-	-	24	-	-	-	-	-	400	-
57	KS27771	67	<0.20	1420	<1	-	-	234	22	-	-	45	<200
58	KS28576	-	0.20	-	24	26	-	-	-	-	-	29	-
59	KS27760	60	0.32	332	7	-	-	222	<10	-	-	200	<200
60	KS28575	79	0.19	-	-	26	-	-	-	-	-	29	-
61	KS28563	1450	0.28	-	-	-	-	-	-	-	-	55	-
62	KS28564	34	3.43	-	425	-	-	-	-	25	-	<5	-
63	KS28566	820	0.44	-	-	-	-	-	-	-	-	55	-
64	KS28565	1410	0.11	-	-	-	-	-	-	-	-	36	-
65	KS27761	<38	0.68	9740	312	-	581	1120	440	-	-	270	<200
66	KS28567	<62	1.84	-	116	10	-	-	-	-	-	37	-
80	KS28568	124	0.97	-	883	9	-	-	-	-	-	54	-
81	KS27767	<67	4.24	2700	-	-	-	812	45	-	-	300	-
82	KS28573	124	0.16	-	29	18	-	-	-	-	-	74	-
83	KS28572	560	0.55	-	47	24	-	-	-	-	-	165	-
84	KS28578	-	0.18	-	23	55	-	-	-	-	-	900	-
85	KS28534	<62	0.07	-	5	-	-	-	-	-	-	1500	-
86	KS28574	<62	0.14	-	79	13	-	-	-	-	-	13	23
87	KS28569	1182	1.35	-	41	27	-	-	-	-	-	280	-
88	KS27765	1510	2.74	>10000	-	-	-	2530	190	-	-	680	610
88	KS27766	200	9.41	304	-	-	-	664	<32	-	-	<200	-
89	KS28535	<62	2.72	-	18	455	-	-	-	-	-	17000	-
90	KS28570	156	0.36	-	266	22	-	-	-	-	-	43	-
91	KS27764	-	-	-	-	-	-	-	-	-	-	78	-
92	KS28577	<62	0.06	-	29	28	-	-	-	-	-	83	-

APPENDIX, continued

Map Number	Sample Number	Au ppb	Ag oz/ton	As ppm	Bi ppm	Nb ppm	Pb ppm	Sb ppm	Se ppm	Te ppm	In ppm	Sn ppm	Zn ppm
93	KS28571	<62	0.12	-	27	8	-	-	-	-	-	44	-
94	KS28538	<5	0.38	-	-	19	-	-	-	-	-	17	
97	KS27672	<5	<0.20	97	<1	68	16	23.1	<10	-	-	1900	300
98	KS28537	<62	0.20	-	8	20	-	-	-	-	-	88	-
99	KS28536	62	28.21	-	1028	<1	-	-	-	-	-	<5	-
100	KS27794	<5	0.42	129	-	-	-	91.6	<10	-	-	28	500
102	KS27772	<19	<0.20	259	4	-	351	460	<27	-	-	57	<200
103	KS28539	622	7.67	-	*7300	-	-	-	-	>100	-	<5	-

Note: Samples were analyzed accordingly: Ag by fire assay, Sn by peroxide fusion extraction - atomic absorption, Nb by X-ray fluorescence, Au, As, Fe, Zn, Sb by instrument neutron activation, Bi, Cu, Pb by HNO_3HCL hot extraction - atomic absorption. *Bi denotes assay by atomic absorption, *Sb denotes assay by atomic absorption, *Te assay by atomic absorption and *In by assay - atomic absorption.

Note: Map numbers refer to locations on figure 2.

APPENDIX, continued		
Map Number	Sample Number	Sample Description
1	KS28579	Bedrock; grab; black silty sandstone with framboidal pyrite
3	KS28581	Float; grab; gray tourmaline-altered brecciated hornfels; minor Fe-gossan
3	KS28582	Float; grab; 4 by 4 in gossan with 30% massive botryoidal veins of metal oxides
4	KS28557	Creek float; grab; massive brown tourmaline-altered hornfels; 1 ft by 3 in
5	KS27781	Float; grab; 2.5 by 2 by 1 ft; Fe-oxide cemented, brecciated hornfels; minor qtz veins
6	KS27782	Rubble; grab; 1 ft wide quartz-tourmaline plus or minus arsenopyrite vein in hornfels
7	KS28558	Rubble; grab; gossany tour-qtz-altered hornfels; minor sulfosalts in laminar veinlets
8	KS27780	Float; grab; 3.5 in wide, greisen-like quartz-tourmaline vein in hornfels
9	KS28556	Rubble; grab; 1.3 by 0.5 ft; tan, tourmaline-altered, quartz-veined hornfels
10	KS27757	Float; grab; intense quartz-tourmaline-altered hornfels; locally abundant
11	KS27778	Rubble; grab; greisen-like qtz-tour-altered hornfels; yellow staining; locally abundant
12	KS27779	Rubble; grab; vuggy qtz-tour-altered, brecciated hornfels; pieces to 1 ft diameter
13	KS28555	Rubble; grab; 5 by 4 in massive fine-grained brown-black tourmaline; locally abundant
15	KS28540	Float; grab; dark brown hornfels with ½ in quartz-arsenopyrite veinlet
15	KS28541	Float; grab; yellow-oxide stained, quartz-clay-altered hornfels
16	KS28583	Rubble; grab; bleached hornfels with green-red-brown tourmaline stockwork veining
17	KS28548	Rubble; grab; 2 in banded brown-black tour, milky white and gray qtz vein in hornfels
18	KS28542	Float; grab; 2 in vein with 30% fine-grained cass veinlets in tan hornfels plus gossan
19	KS28584	Rubble; grab; 2 by 1.5 ft cindery qtz-tour-altered, gossany, brecciated hornfels
20	KS28550	Bedrock; 3.5 ft chip across vertical quartz-veined hornfels; 15-20% quartz veining
21	KS28551	Bedrock; 1.5 ft chip across intensely crushed/fractured, gossany hornfels
22	KS28544	Float; grab; 1/16 to 1/8 in cass-qtz veinlets in gray quartz-altered hornfels
23	KS28547	Float; grab; gossany hornfels with ¼-in-thick, partially oxidized sulfosalt veinlet
24	KS28545	Float; grab; 1 by ¾ by ½ ft vuggy coarse-grained quartz and cassiterite vein
24	KS28546	Float; grab; 6 by 5 by 5 in gray silicified hornfels with ⅛ qtz-cass veins; yellow stain
25	KS28543	Float; grab; yellow-stained vuggy qtz-veined hornfels; <0.5% sulfosalts and arsenopyrite
26	KS28554	Float; grab; 0.5 by 0.25 ft grey qtz-tour-veined hornfels; veinlets 1/16 to 1/2 in
37	KS28586	Rubble; grab; intense argillic alteration of dacite; biotite→sericite, feldspars→clay
38	KS28587	Rubble; grab; massive green-gray tourmaline greisen altered dacite
39	KS28588	Rubble; grab; massive green-gray tour, fine-grained sericite and quartz-altered dacite

APPENDIX, continued		
Map Number	Sample Number	Sample Description
40	KS28589	Rubble; grab; massive green-gray tourmaline greisen after dacite; yellow staining
41	KS28590	Rubble; grab; near contact, gray-green tourmaline greisen-altered dacite
42	KS28559	Float; grab; greenish yellow-stained, tour-altered, brecciated hornfels; up to 2 ft
43	KS28560	Float; grab; green-gray tourmaline-clay-altered, brecciated hornfels; dacite margin
44	KS28561	Rubble; grab; gray tour-altered, brecciated hornfels; minor sulfosalt; yellow staining
45	KS28562	Bedrock; grab; green-gray tourmaline-altered, brecciated hornfels with milky quartz vein
46	KS27775	Rubble; grab; 2-3 ft wide zone of qtz-tour-altered, brecciated hornfels; vuggy texture
47	KS27783	Float; grab; ¼-in-thick quartz-cassiterite vein in hornfels
48	KS27763	Float; grab; quartz-tourmaline-pyrite-altered and veined hornfels
49	KS27792	Float; grab; ¼- ½-in-thick arsenopyrite veining in Fe-stained hornfels
49	KS27793	Float; grab; 1 by ½ by 1 ft; quartz-tourmaline-altered, veined, brecciated hornfels
51	KS27755	Float; grab; gossany, quartz-tourmaline-altered, brecciated hornfels
52	KS28591	Rubble; grab; matrix supported, silicified, brecciated hornfels; green-gray tour matrix
53	KS28592	Bedrock; 8 by 4 ft silicified, brecciated hornfels; green-gray tourmaline matrix
54	KS28593	Float; grab; green-gray tourmaline-altered dacite
57	KS27771	Rubble; grab; qtz-tour-altered breccia zone in hornfels; clasts are clay-altered
58	KS28576	Float; grab; silicified, tan, hornfels with yellow-green and pink blooms
59	KS27760	Rubble; grab; quartz-tourmaline-altered breccia-zone in hnfls; clasts are clay altered
60	KS28575	Rubble; grab; tan hornfels with milky quartz veining
61	KS28563	Rubble; grab; tan, silicified hornfels with dark brown, remnant hornfels
62	KS28564	Float; grab; ¾-ft-thick, tourmaline and clay-altered, brecciated hornfels
63	KS28566	Float; grab; qtz-veined hornfels; < 1% aspy in veins and hornfels; locally abundant
64	KS28565	Rubble; grab; tan, silicified hornfels; quartz-tourmaline-veined with minor arsenopyrite
65	KS27761	Rubble; grab, 6-8 in pieces of gossan
66	KS28567	Rubble; grab; silicified, quartz-veined hornfels; minor fine-grained sulfides
80	KS28568	Rubble; select; 1.5 by 1 ft argillic-altered hornfels; minor gray sulfosalts
81	KS27767	Float; grab; ¼-in-thick quartz-cassiterite-gossan veinlet in hornfels
82	KS28573	Float; grab; silicified hornfels with clots of light-brown tourmaline
83	KS28572	Rubble; grab; large blocks of tour-qtz-altered breccia dike; moderate limonite stains
84	KS28578	Rubble; select; vuggy quartz-tourmaline-veined hornfels; possibly minor cassiterite
85	KS28534	Bedrock; grab of 5 ft wide gossany, brecciated hornfels

Map Number	Sample Number	Sample Description
86	KS28574	Float; grab; milky quartz, stockwork-veined, tan hornfels; < < 0.5% gray-black sulfides
87	KS28569	Rubble; grab; gossany, argillic-altered hornfels breccia
88	KS27765	Rubble; select; pieces to 8 in of Fe-gossan; yellow-staining
88	KS27766	Rubble; grab; compact, massive, gray-colored, coarse-grained quartz
89	KS28535	Rubble; grab; 3 by 1 ft vuggy qtz, grey tour matrix supported, brecciated hornfels
90	KS28570	Float; grab; 4 by 3 ft; silicified, tan hornfels; green-yellow fracture coatings
91	KS27764	Float; grab; tour-altered, brecciated hornfels; tourmaline is compact, massive, felty
92	KS28577	Float; grab; 4-in-thick gossany, vuggy, tour-qtz-veined hornfels; locally abundant
93	KS28571	Float; grab; quartz-veined, tan, silicified hornfels with clots of brown tourmaline
94	KS28538	Rubble; grab; striped, quartz-altered hornfels
97	KS27672	Float; grab; sugary-textured, sericite-altered intermediate volcanic rock (?)
98	KS28537	Float; grab; brown tourmaline veined, silicified hornfels; locally abundant
99	KS28536	Rubble; grab; vuggy qtz-veined, qtz-tour-altered, brecciated hornfels; 1- 1.5-ft-thick
100	KS27794	Rubble; grab; deeply weathered mafic volcanic rock
102	KS27772	Bedrock; random chips; qtz-tour-altered, gossany, brecciated hornfels; 4 by 4 by 4 ft
103	KS28539	Bedrock; grab; yellow-stained, quartz-tourmaline matrix, brecciated, silicified hornfels

Abbreviations: tour=tourmaline, qtz=quartz, aspy=arsenopyrite, cass=cassiterite, hnfls=hornfels