MINERALIZATION IN THE COAL CREEK TIN PROSPECT, SOUTH-CENTRAL ALASKA

by

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Field report

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UNITED STATES DEPARTMENT OF THE INTERIOR
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TS Ary, Director

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UNITS OF MEASURE AND ABBREVIATIONS USED IN THIS REPORT

An	Anorthite
o	Degrees
DDH	Diamond drill hole
C	Centigrade
cm	Centimeter
kb	Kilobar
m	Meter
Ma	Million years before present
Mi	Mile
Wt.%	Weight percent

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By Tracy V.L. Parker[1]

ABSTRACT

The Coal Creek tin prospect is located in the central Alaska Range, south-central Alaska. In 1982 Billiton Exploration USA identified 5 million metric tons of 0.2 percent tin with significant silver credits. Mineralization is hosted by two texturally and chemically distinct granite units: (1) a seriate granite porphyry which is intruded at depth by (2) a fine-grained granite porphyry. The contact between the two units is marked by a 1-3 meter zone of crenulate and dendritic crystals. Greisen alteration is centered in the upper seriate granite and only extends 10-20 meters into the fine-grained granite.

The granite units are very evolved with differentiation indices ranging from 91-97. They are also peraluminous but are still considered "I-type" igneous source granites.

The most important tin mineral is cassiterite. Stannite, sphalerite, arsenopyrite, pyrrhotite, pyrite, marcasite, loellingite, bismuthinite, chalcopyrite, and galena are also present. This mineral assemblage suggest a low oxidation and sulfidation state during mineralization. The majority of the ore minerals are located in, or near vertical 0.5 to 2.0 cm veins and their associated greisen alteration envelopes.

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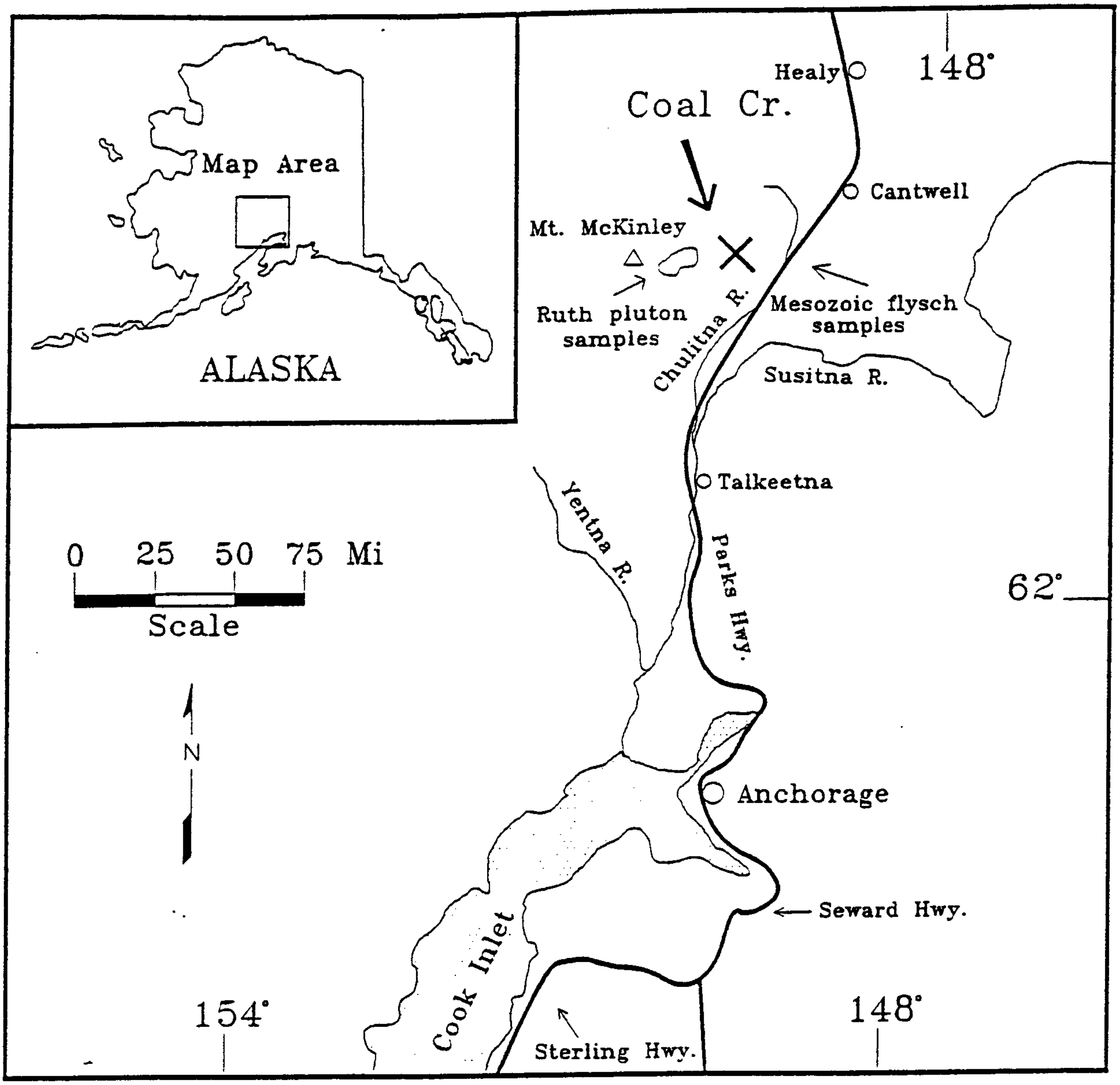

Figure 1. --Location map of the Coal Creek tin prospect.

INTRODUCTION

The Coal Creek tin prospect is located on the northwest side of the Chulitna River valley in the Talkeetna Mountains D-6 quadrangle (Sec. 21, T. 22 S., R. 12 W.) of southcentral Alaska (fig. 1). Coal Creek is within the Chulitna subdistrict of the Valdez Creek Mining District.

Study of the Coal Creek tin prospect has been supported by the U.S. Bureau of Mines as part of their ongoing project to evaluate Alaska's strategic and critical mineral resources. Tin is classified as a strategic mineral because the United States relies heavily on foreign sources of this commodity, and because it is used in defense-related technologies.

There is no direct road access to the Coal Creek prospect. The Parks Highway and Alaskan Railroad lie on the east side of the Chulitna River five miles to the southeast of the prospect. The prospect is located on a small brush covered knob on the side of a steep, talus-covered mountainside. Rock exposure is poor and consists of approximately 4,000 square meters of mineralized greisen-altered granite. The granite intrudes Devonian metasediments of the Chulitna sequence, locally producing hornfels and skarn.

In the summer of 1982 Billiton Exploration USA drilled 42 holes totalling over 20,000 feet into the granite and sediments of the prospect (fig. 2). Although 42 holes were drilled many intersected barren hornfels and are not included in figure 2. Billiton Exploration USA later gave the core to the U.S. Bureau of Mines for study. Because Alaska is endowed with the bulk of the United States tin resources, investigating the characteristics and manifestations of the igneous-hydrothermal tin mineralizing processes provides parameters to guide future exploration initiatives. The drill core and data available from the Coal Creek deposit offered a unique opportunity to investigate the intimate relationship between multiple igneous units and mineralizing processes of an Alaskan tin deposit. Appendix A and B lists pertinent location and analytical data for drill core collected by Billiton Exploration USA.

ACKNOWLEDGMENTS

Thanks are extended to Billiton Exploration USA for allowing access to their drill core and data from Coal Creek. Technical reviews and discussions with Dr. Rainer Newberry, Associate Professor of Geology, University of Alaska Fairbanks, and Roger Burleigh, Geologist, U.S. Bureau of Mines Alaska Field Operations Center, Anchorage Branch helped considerably with the organization and interpretations presented in this report.

PREVIOUS WORK

The Coal Creek tourmaline granite was first reported to the U.S. Bureau of Mines by C.C. Hawley. In 1977 Bruce Reed (USGS geologist) visited the site and identified it as a greisen-altered desseminated tin occurrence. Two granitic rock types were identified and presumed to be genetically linked to the McKinley sequence, a series of plutons thought to have been emplaced at about 55 Ma.(1)[2].

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[2] Underlined numbers in parentheses refer to the list of references at the end of this report.

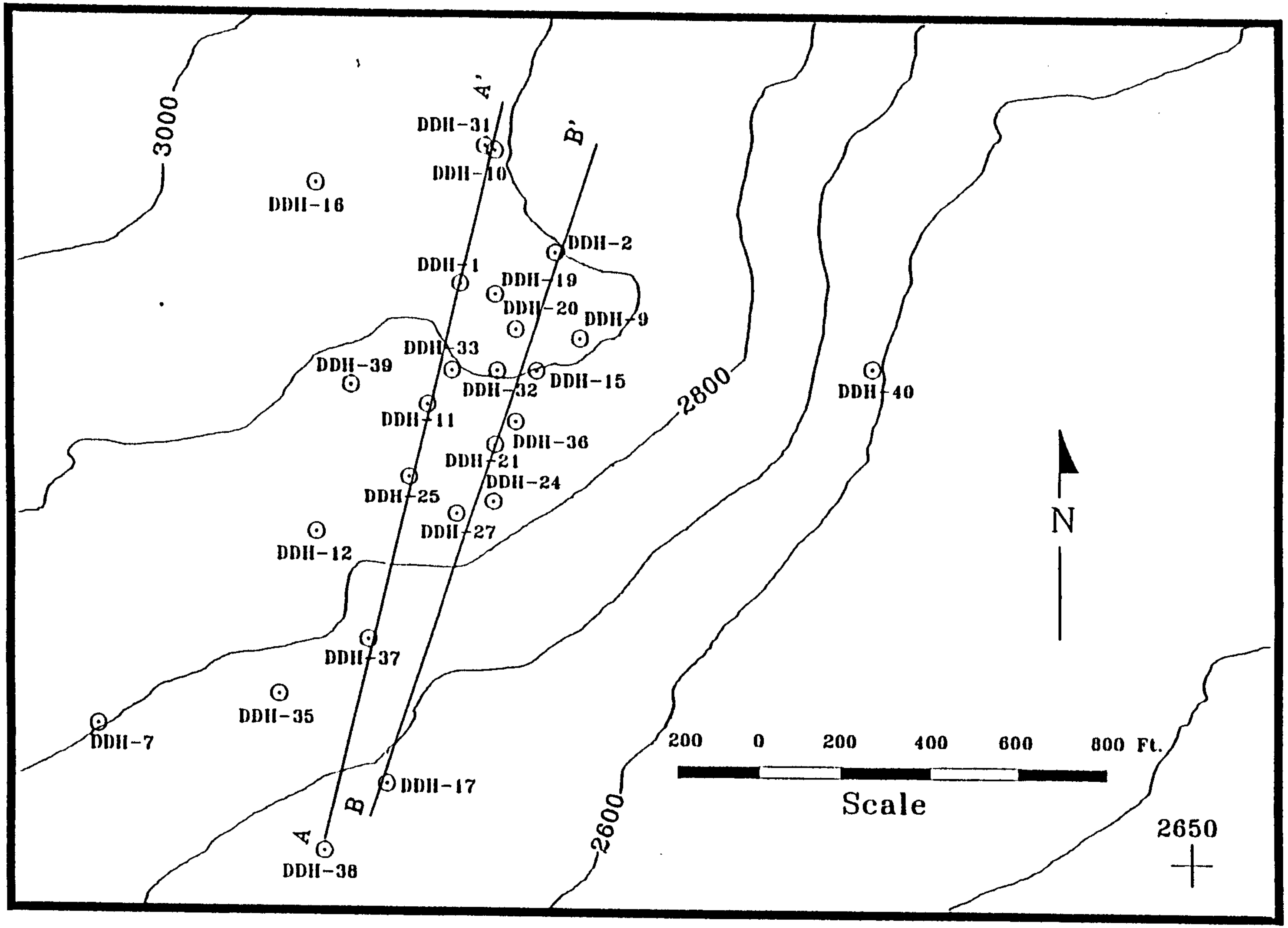

Figure 2. -- Drill hole and cross section location map.

In 1982, a drilling project conducted by Billiton Exploration USA resulted in the discovery of a tin-bearing sheeted vein system, with a reported geologically indicated resource of 5 million metric tons with an average grade of 0.2 percent tin (2).

The Coal Creek tin prospect was investigated during brief reconnaissance in the summers of 1984, and 1988 by the U.S. Bureau of Mines(3). The investigations included geologic mapping, sample collection and analyses. Core from four diamond drill holes was shipped to the Bureau's Salt Lake City Research Center for mineral beneficiation testing. The results were reported by Johnson and Parker (4).

REGIONAL GEOLOGICAL SETTING

The Alaska Range batholith is part of the Talkeetna superterrane which is believed to have been accreted to the continental margin of stable Alaska in the Paleocene (5). The northern plutons of the Alaska Range batholith are known as the McKinley sequence (6). The Coal Creek granite is part of the McKinley sequence plutons which intrude Paleozoic and Mesozoic sedimentary and volcanic rocks.

Strontium and oxygen isotopic evidence suggest the source for the Coal Creek granite was influenced by sedimentary crustal material (5). Lead isotopes can also be used as an indicator of granite source material (7). Lead isotope ratios measured on a potassium feldspar collected from the Coal Creek granite implies that it was emplaced in a continental margin setting, incorporating lead from both an igneous and sedimentary source (table 1). The sulfur isotope values for the Coal Creek granite are negative (table 1), and can be best explained by the incorporation of some light biogenic sulfur from continental crust (8) and/or oxidation of a reduced fluid (9). Values of lead and sulfur isotopic ratios measured on the Mesozoic flysch in the Coal Creek area, identified by Lanphere and Reed (5) as the most likely contaminant, are sufficiently different from those seen at Coal Creek to suggest that these sediments constitute a small fraction of the source (table 1).

Table 1. —Available isotope data from Coal Creek and vicinity

Rock Type	$^{206}Pb/^{204}Pb$	$^{207}Pb/^{204}Pb$	$^{208}Pb/^{204}Pb$	$\delta^{34}S$
Granite	19.030	15.551	38.386	-7.9
Skarn	—	—	—	-5.4
Flysch	22.683	15.879	38.893	-34.6

Biotites from McKinley sequence plutons have been dated at 55 to 57 Ma.(5). Biotite from the younger Coal Creek granite has yielded a K/Ar date of 49 +/- 2.5 Ma. This is evidence that the tin related magma crystallized slightly later than the main plutonic event.

LOCAL GEOLOGY

The following sections describe the petrology, mineralogy and geochemistry at Coal Creek. Because there is limited surface exposure at Coal Creek the bulk of the data is derived from rock samples taken from the drill core.

Igneous Petrology

The Coal Creek prospect granite consists of two texturally and chemically different units: (1.) a seriate granite porphyry, which is intruded at depth by (2.) a fine-grained equigranular to slightly porphyritic granite.

The seriate granite outcrops at the surface and forms a small resistant knob on the flank of a hillside. This unit contacts Devonian metasediments locally, producing hornfels and skarn. The fine-grained granite lies below the seriate granite. Its only surface expression is 0.5 to 1 m thick aplitic granite dikes. At the contact between the two major units is a 1-3 meter zone of crenulate and dendritic layers. This texture has been recognized at the Henderson porphyry molybdenum deposit in Colorado, and described as unidirectional solidification textures which are useful for interpreting contacts and timing relationships between intrusive units (10). World-wide, they commonly occur as multilayer sequences in the apical and marginal parts of igneous intrusions. At Coal Creek these layers consist of pegmatitic quartz, potassium feldspar, and biotite dendrites mixed with aplitic granites. Throughout the rest of this paper this unit will be referred to as the pegmatite unit.

Greisen alteration is the main alteration type at Coal Creek. It is characterized by complete quartz flooding and destruction of the original igneous fabric. Other associated minerals include white mica, tourmaline, topaz, fluorite, pyrrhotite, cassiterite, sphalerite, arsenopyrite, pyrite, and chalcopyrite. The most intense alteration is located in the central portion of the seriate granite (fig. 3).

Major-Minor Element Geochemistry

The whole rock major oxide analytical results for all Coal Creek granitic units indicate that they are high in silica, alkalis and aluminum and low in titanium. Major oxide chemistry is not an effective means of differentiating between the three textural units because of their similar compositions. The major oxide content and normative calculations indicate that all the granitic units are very evolved with differentiation indices (D.I. = sum of normative quartz + orthoclase + albite) ranging from 91 to 97 (table 2). The data for the Ruth Pluton taken from Lanphere and Reed (5), which is a related granite in the vicinity of the deposit is included for comparison. All of the Coal Creek samples are peraluminous ($Al_2O_3 > K_2O + Na_2O + CaO$) and all but one contain normative corundum (table 3). The high D.I. and slightly peraluminous nature is similar to other granite related tin deposits in Alaska (11, 12, 13). The three Coal Creek textural units and the Ruth pluton can be discriminated on plots of trace element content versus D.I. (fig. 4). The pegmatite unit plots intermediate to within the fine-grained granite field and may represent a composition similar to that of the fine-grained unit. The plots display progressive fractionation from the Ruth pluton granites, to the seriate, to the most evolved, fine-grained, Coal Creek granite.

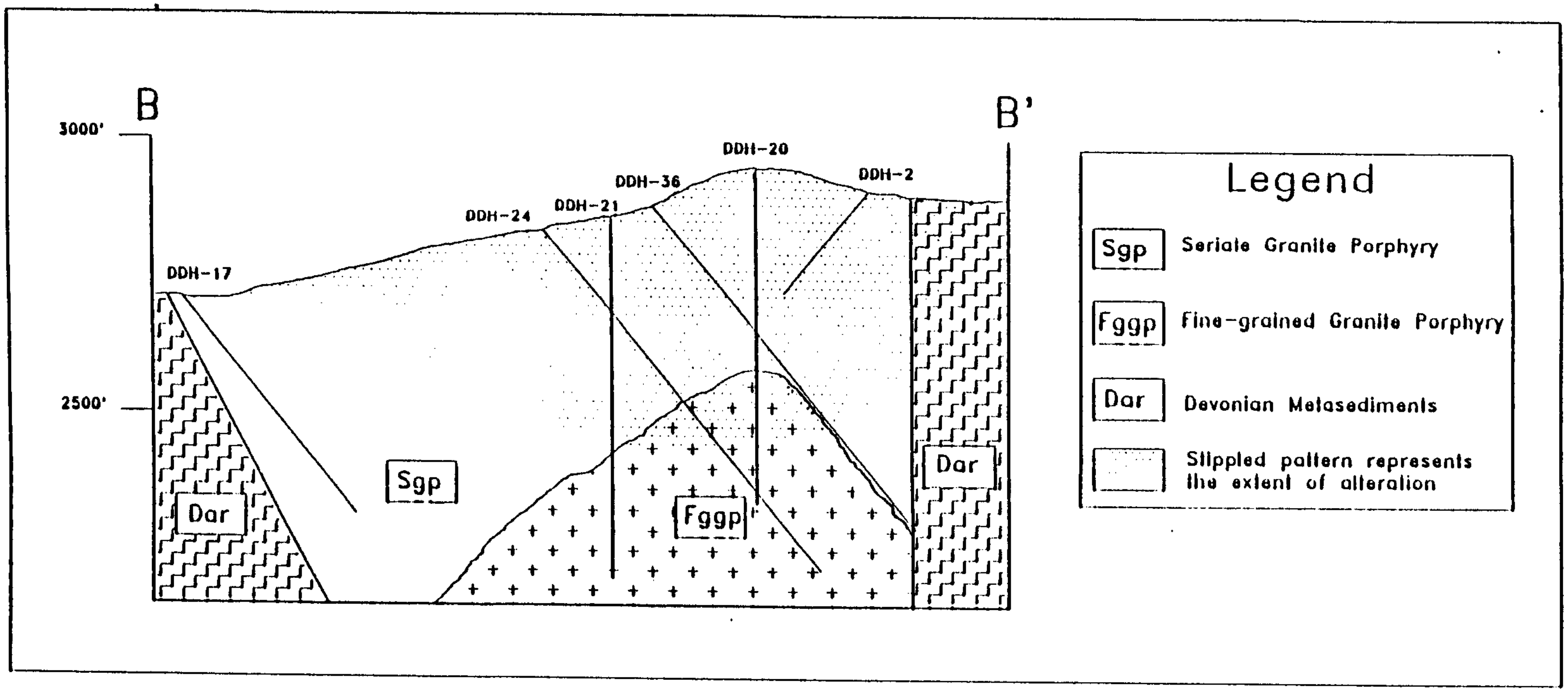

Figure 3. -- N15E cross section showing the extent of alteration with a stippled pattern.

Table 2. --Major element oxides and minor element analyses for Coal Creek and the Ruth Pluton

Rock Type	Seriate Granite Porphyry			Pegmatite Zone						Fine-Grained Granite Porphyry						Ruth Pluton*					
Sample Number\3	20-250	21-380	24-380	20-390A	20-390B	21-450A	21-450B	24-400A	24-400B	20-480	21-550	24-510	20-590	21-640	24-760	70AR-116	76AR-20	76AR-19	70AR-11	76AR-19	76AR-17
SiO_2 \1	73.20	72.50	74.30	73.60	73.00	75.40	73.20	74.70	75.80	73.00	74.80	73.30	74.10	73.50	74.40	74.70	73.50	75.10	68.60	72.40	76.00
Al_2O_3	13.80	13.40	13.10	13.00	12.60	13.30	13.10	12.20	11.80	13.20	12.90	13.40	12.80	13.20	12.50	13.30	13.80	13.10	15.30	14.40	13.20
Fe_2O_3	0.75	0.42	0.38	0.43	1.66	0.15	0.26	0.41	0.46	0.41	0.13	0.34	0.51	0.16	0.29	0.10	0.20	0.70	0.56	0.52	0.30
FeO	1.02	0.74	1.02	0.80	0.74	0.89	0.89	1.15	1.15	1.15	1.15	0.96	0.77	0.96	1.08	1.60	1.90	0.84	2.40	1.80	0.84
MgO	0.10	0.07	0.05	0.05	0.08	0.03	0.05	0.04	0.04	0.05	0.02	0.03	0.04	0.05	0.06	0.15	0.27	0.32	1.10	0.28	0.07
CaO	1.25	0.79	0.67	0.57	0.66	0.42	0.58	0.44	0.47	0.41	0.29	0.32	0.43	0.40	0.54	1.20	1.40	1.30	2.40	2.10	0.77
Na_2O	3.89	4.33	3.48	3.62	3.69	4.42	4.39	3.29	3.20	3.43	4.10	4.15	4.18	4.10	3.95	3.10	2.80	3.10	3.40	3.20	3.40
K_2O	4.32	4.43	5.00	5.21	5.30	4.86	4.88	5.22	5.11	5.00	4.29	4.59	4.22	4.48	4.33	4.70	4.70	4.80	4.40	4.10	4.90
TiO_2	0.08	0.06	0.01	0.14	0.31	0.02	0.07	0.01	0.04	0.03	0.02	0.01	0.10	0.03	0.12	0.18	0.37	0.17	0.50	0.40	0.07
P_2O_5	0.34	0.05	0.27	0.17	0.28	0.11	0.17	0.19	0.25	0.09	0.16	0.15	0.17	0.23	0.29	0.04	0.10	0.11	0.17	0.14	0.08
MnO	0.03	0.03	0.15	0.03	0.03	0.04	0.04	0.09	0.07	0.07	0.05	0.04	0.06	0.06	0.08	0.06	0.02	0.02	0.08	0.03	0.02
LOI	0.61	0.46	0.55	0.55	0.37	0.37	0.23	0.42	0.33	0.76	0.19	0.28	0.56	0.24	0.34	-	-	-	-	-	-
Totals	99.39	97.28	98.98	98.17	98.72	100.01	97.86	98.16	98.72	97.60	98.10	97.57	97.94	97.41	97.98	99.13	99.06	99.56	98.91	99.37	99.65
Ba \2	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	800	1300	780	1100	1900	385
Nb	17	18	15	24	31	23	27	19	26	27	34	38	37	37	34	29	22	20	22	20	24
Rb	320	310	550	495	520	555	500	525	500	870	840	755	790	880	845	229	179	158	126	99	245
Sr	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	69	119	87	346	217	47
Zr	27	39	32	21	16	18	18	23	19	15	12	16	26	16	13	160	220	120	190	250	92
Y	<5	<5	<5	42	39	35	43	23	38	48	54	81	54	60	40	50	36	39	16	40	86
S	0.05	0.02	0.14	0.02	0.02	0.02	0.02	0.12	0.14	0.02	0.02	0.02	0.02	0.02	0.03	-	-	-	-	-	-
Zn	311	84	185	141	129	63	63	301	282	178	63	78	42	63	65	60	71	42	50	55	44
Cl	200	200	200	200	200	200	200	200	200	200	50	50	200	200	740	50	90	40	80	80	30
F	3080	1142	4330	1331	1181	2060	2454	2480	2628	5780	4820	4850	4030	4375	3672	1200	700	600	500	500	900
Li	148	142	549	203	209	302	321	258	252	712	618	385	686	734	742	150	140	91	81	84	170
Sn	21	9	39	20	15	5	11	175	160	22	5	22	25	9	23	9	4	4	4	4	4

*Ruth Pluton data from Lanphere and Reed (1985)

\1 Major element oxides reported as weight percents

\2 Minor elements reported as ppm

\3 Sample numbers are defined as, drill hole number-intercept depth; reference cross sections in figures 3 and 5.

\- Not analyzed

Table 3. --CIPW normative minerals from Coal Creek and the Ruth Pluton

Rock Type	Seriate Granite Porphyry			Pegmatite Zone						Fine-Grained Granite Porphyry						Ruth Pluton*					
Sample Number\1	20-250	21-380	24-380	20-390A	20-390B	21-450A	21-450B	24-400A	24-400B	20-480	21-550	24-510	20-590	21-640	24-760	70AR-116	76AR-20	76AR-19	70AR-11	76AR-19	76AR-17
Q	32.01	29.17	33.84	32.09	31.02	29.82	28.20	35.00	37.06	33.45	34.08	31.39	33.60	32.38	34.47	35.09	35.26	35.62	24.46	32.79	35.58
Or	25.83	27.07	30.02	31.56	31.85	28.84	29.55	31.56	30.67	30.49	25.88	27.89	25.59	27.24	26.18	28.04	28.03	28.48	26.28	24.37	29.05
Ab	33.34	37.82	29.95	31.39	31.73	37.57	38.08	28.52	27.50	29.95	35.45	36.13	36.30	35.71	34.27	26.49	23.91	26.34	29.08	27.24	28.86
An	4.08	3.74	1.61	1.77	1.49	1.37	1.65	0.99	0.75	1.50	0.44	0.66	1.07	0.47	0.77	5.75	6.16	5.63	10.91	9.43	3.12
C	1.26	0.16	1.40	0.79	0.26	0.26	-	0.79	0.75	1.67	1.38	1.40	1.00	1.48	1.06	1.04	1.89	0.75	1.00	1.27	1.17
Hy	1.44	1.17	1.98	1.09	0.20	1.63	1.46	2.07	1.92	2.04	2.14	1.66	1.06	1.86	1.89	-	-	-	-	-	-
Mt	1.10	0.62	0.55	0.64	1.59	0.22	0.39	0.61	0.68	0.62	0.20	0.51	0.77	0.25	0.43	-	0.29	1.02	0.82	0.76	0.44
Il	0.15	0.11	0.02	0.27	0.61	0.04	0.13	0.02	0.08	0.06	0.04	0.02	0.19	0.06	0.23	0.35	0.71	0.32	0.96	0.76	0.13
Ap	0.79	0.12	0.63	0.39	0.65	0.25	0.39	0.44	0.58	0.21	0.37	0.35	0.39	0.56	0.70	0.10	0.24	0.26	0.41	0.33	0.19
Hm	-	-	-	-	0.60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Di	-	-	-	-	-	-	0.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-
En	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.38	0.68	0.80	2.77	0.70	0.17
Fs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.78	2.78	0.72	3.30	2.28	1.22
Cc	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.07	0.05	-	0.05	0.07
Plag Is An	11	9	5	5	4	4	4	3	3	5	1	2	3	1	2	17	20	17	26	25	9
D.I.	91.18	94.06	93.81	95.04	94.60	96.23	95.83	95.08	95.23	93.89	95.41	95.41	95.49	95.33	94.92	89.62	87.19	90.44	79.83	84.41	93.49

*Ruth Pluton data from Lanphere and Reed (1985)

\1 Sample numbers are defined as, drill hole number-intercept depth; reference cross sections in figures 3 and 5.

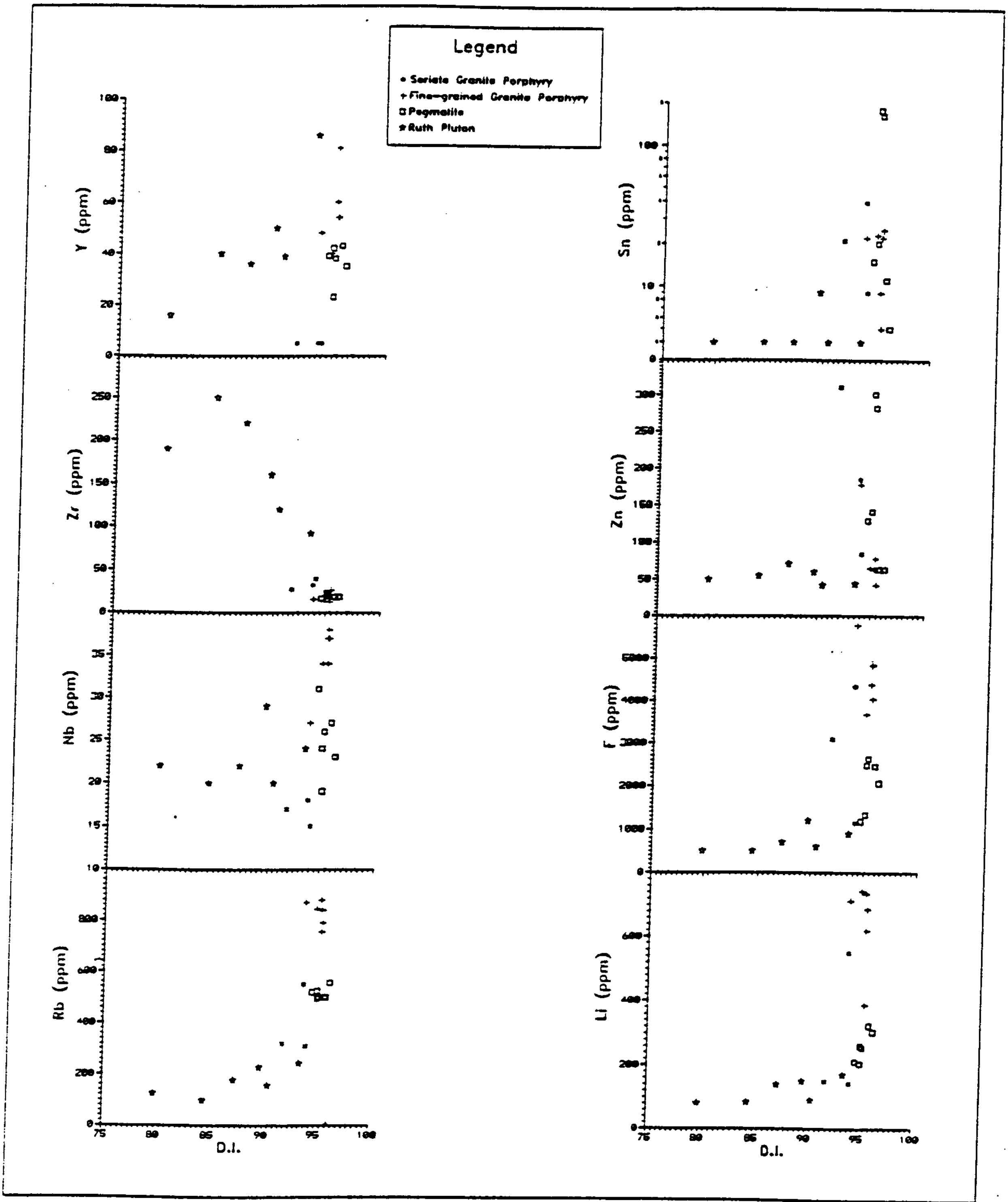

Figure 4. --Trace element versus differentiation index plots.

Granite Mineralogy

Feldspars

Potassium feldspar is the most abundant feldspar. In the seriate granite unit it is subhedral to euhedral and ranges in length from 0.5-3.0 cm. It is generally perthitic with individual albite perthites reaching 0.2 cm in size. In the fine-grained granite unit the potassium feldspar is subhedral to anhedral and 0.2 cm in length. In the pegmatite unit it occurs as dendrites and euhedral crystals that can reach 20 cm. The potassium feldspar is usually altered to fine-grained clays or sericite, and in some samples it takes on a brown color.

Plagioclase is strongly altered and only a few primary grains remain. They are albite rich with "An" contents of 1-5 %. The plagioclase is altered to clays or replaced by silica in the silicified zones .

Micas

Three mica minerals were identified. The sericite is a fine-grained alteration product of the feldspars and topaz. The sericites have low iron, fluorine, and chlorine contents which help distinguish them from the other coarse-grained white mica.

The biotites are end member siderophyllites, with high fluorine and chlorine contents. Biotites are scarce in both the seriate and fine-grained unit. In the pegmatite, biotite forms 20-40 cm layers of biotite dendrites in a quartz, potassium feldspar matrix. Individual biotite dendrites may reach 10 cm.

The coarse-grained white micas are most abundant. They are located near veins and in the areas most affected by the silicic and greisen alteration. The white micas have the highest fluorine contents with an average of 5 wt.% . Based on their very high iron content they are zinnwaldite, which is a common lithium-bearing white mica associated with tin deposits. Lithium can not be detected with an electron microprobe, but the whole rock data indicates high lithium contents, and micas are the likely host.

Quartz

Quartz is abundant in all units. It forms 1 cm euhedral phenocrysts in both the fine-grained and seriate units. It also occurs as fine anhedral grains in the silicified areas. In the pegmatite unit it is subhedral to anhedral and forms as open space fillings.

Alteration Minerals

Tourmaline is a common alteration mineral. It occurs in veins and pods in the areas most affected by greisen and silicic alteration. Colors range from brown to blue. The variation in color is probably due to small differences titanium content.

Topaz is associated with the open spaced veins related to mineralization. It is subhedral to euhedral and difficult to distinguish from quartz. Topaz contains fluorine and is commonly associated with fluorite, both of which suggest high fluorine concentrations in the hydrothermal fluid during mineralization.

Ore Mineralogy

The ore minerals are concentrated in near vertical 0.5-2.0 cm open-spaced quartz, topaz, and tourmaline veins with up to 15 cm silicic envelopes. Within these envelopes the primary igneous texture is destroyed. The vein envelopes are commonly vuggy and contain tourmaline, cassiterite and sulfides. The open-spaced veins are late and crosscut all other vein types. These veins are concentrated in the upper seriate granite and appear to be rooted in the equigranular granite, as they can only be traced 10-20 m below the seriate-equigranular granite contact.

There are a variety of sulfide, and oxide minerals associated with the mineralization at Coal Creek. The most important are cassiterite, stannite, sphalerite, arsenopyrite, pyrrhotite, pyrite, marcasite, loellingite, bismuthinite, chalcopyrite, and galena. This mineral assemblage indicates a low sulfidation and oxidation state during mineralization.

Cassiterite is the dominant tin-bearing mineral, however, petrographic and electron microprobe study of the sulfide mineral assemblage shows that stannite represents approximately 3 percent of the total tin-bearing minerals. The bulk of the silver is contained in the stannite and in the 2-5 micron galena grains. This is important to the deposit's ultimate economic potential because a small amount of the tin, but a large portion of the silver may be difficult to extract.

Sulfidation state and temperatures of formations were obtained using the composition of coexisting mineral pairs. Sulfide mineral compositions were determined using an electron microprobe (table 4). Three different mineral pairs and methods were used to test for variation within the system and between the methods.

The compositions of coexisting pairs of arsenopyrite and sphalerite indicate temperatures of formation of 412-496° C (table 5). Similar values were calculated using arsenopyrite-loellingite-pyrrhotite mineral stability. Coexisting sphalerite and stannite pairs indicate temperatures of formation of 287-388° C (table 6). Therefore the stannites probably crystallized at lower temperatures than the arsenopyrite, loellingite and sphalerite. The observation that stannite normally rims sphalerite also supports this hypothesis.

The arsenopyrite-sphalerite temperature contours were plotted on the cross section A-A' (fig 5). They indicate a trend of increasing ore mineral crystallization temperature with distance from the fine-grained unit. This interesting inwardly decreasing trend for ore mineral crystallization temperature was supported by all three geothermometers, although much more data is needed to confirm this pattern.

CONCLUSIONS

The Coal Creek prospect consist of a seriate granite porphyry that is intruded at depth by a fine-grained granite porphyry. The two greisen-altered granites intrude Devonian metasediments locally producing hornfels and skarn. At the contact between the two units is a 1-3 meter zone of UST's. The whole rock geochemistry indicates that the granite units are slightly peraluminous, extremely fractionated granites.

The mineralization and greisen alteration is centered in the upper seriate unit. The majority of the ore minerals are located in near vertical 0.5 to 2.0 cm open-spaced quartz veins and their associated greisen alteration envelopes. Cassiterite and stannite are the two tin-bearing minerals present at Coal Creek. The stannite is important because

Table 4. –Chemical compositions of coexisting mineral pairs determined with the electron microprobe

Sample #	\1	As*	S	Zn	Cu	Fe	Mn	Ag	Cd	Sn	Tot.
17-400	St-1	0.00	32.03	1.88	26.66	15.18	0.01	0.14	0.00	25.56	101.46
17-400	Sp-1	0.00	34.59	45.97	0.10	15.64	2.51	0.00	0.47	0.03	99.32
17-400	St-2	0.00	29.92	7.12	24.42	13.54	0.07	0.16	0.07	22.75	98.05
17-400	Sp-2	1.49	34.59	47.34	0.15	14.91	2.55	0.05	0.31	0.00	101.39
17-400	St-3	0.20	29.00	7.67	23.73	13.19	0.10	0.08	0.01	21.74	95.73
17-400	Sp-3	0.13	34.43	47.11	0.13	15.11	2.44	0.01	0.38	0.00	99.75
17-400	St-4	0.00	29.27	3.24	26.68	12.45	0.03	0.20	0.07	25.20	97.13
17-400	Sp-4	0.00	34.41	48.83	0.10	13.67	1.94	0.04	0.37	0.00	99.37
25-522	St-1	0.35	30.15	1.56	28.43	13.36	0.01	0.34	0.01	25.82	100.03
25-522	Sp-1	0.00	33.97	49.3	0.32	13.27	1.18	0.00	0.46	0.01	98.51
25-522	St-2	0.18	29.86	1.67	28.42	12.33	0.02	0.24	0.04	24.79	97.56
25-522	Sp-2	0.07	34.2	49.47	0.24	13.59	1.06	0.00	0.50	0.00	99.13
25-346	St-1	0.00	29.95	5.51	26.02	12.65	0.08	0.25	0.05	24.26	98.77
25-346	Sp-1	0.00	33.3	47.8	0.13	14.09	1.72	0.01	0.41	0.02	97.49
25-566	St-1	0.46	30.1	1.45	28.34	12.71	0.04	0.37	0.00	27.32	100.8
25-566	Sp-1	0.07	33.95	47.22	0.25	14.84	1.90	0.24	0.43	0.00	98.91
25-566	St-2	0.00	29.03	1.82	28.19	12.78	0.02	0.19	0.00	25.85	97.89
25-566	Sp-2	0.00	33.66	45.00	0.07	15.10	2.63	0.00	0.53	0.01	97.00
25-566	St-3	0.00	29.58	3.71	27.20	13.66	0.13	0.35	0.05	25.34	100.03
25-566	Sp-3	0.00	33.90	47.06	0.10	14.60	2.41	0.00	0.41	0.00	98.48
25-346A	St-1	0.59	29.63	1.80	28.01	12.96	0.03	0.21	0.00	26.70	99.94
25-346A	Sp-1	0.00	34.01	47.62	0.23	14.02	1.69	0.00	0.43	0.02	98.01

Sample #		As	S	Zn	Cu	Fe	Mn	Ag	Cd	Sn	Tot.
25-380	asp-1	47.95	19.41	0.00	0.00	34.82	0.00	0.00	0.00	0.01	102.19
25-380	sp-1	0.26	33.78	46.27	0.15	15.10	1.73	0.08	0.34	0.00	97.71
25-380	asp-2	47.43	20.31	0.16	0.00	35.23	0.01	0.00	0.00	0.01	103.15
25-380	sp-2	0.21	34.03	48.12	0.16	14.35	1.64	0.00	0.52	0.00	99.03
25-380	asp-3	45.46	20.18	0.04	0.00	35.03	0.03	0.00	0.02	0.02	100.78
25-380	sp-3	0.21	34.03	48.12	0.16	14.35	1.64	0.00	0.52	0.00	99.03
25-380	asp-4	47.35	19.56	0.03	0.01	34.92	0.00	0.02	0.00	0.00	101.89
25-380	sp-4	1.38	34.05	48.01	0.11	14.24	1.31	0.00	0.45	0.04	99.59
25-500	asp-1	44.33	18.67	2.74	0.00	33.88	0.07	0.00	0.00	0.00	99.69
25-500	sp-1	0.00	33.75	47.77	0.06	14.68	1.85	0.06	0.41	0.09	98.67
25-500	asp-2	48.89	17.81	0.03	0.00	34.43	0.01	0.00	0.07	0.02	101.26
25-500	sp-2	0.00	34.26	44.34	0.13	16.11	2.20	0.00	0.52	0.02	97.58
25-346A	asp-1	52.76	16.54	0.00	0.00	33.27	0.03	0.00	0.01	0.01	102.62
25-346A	sp-1	0.28	33.86	46.58	0.11	14.81	1.96	0.00	0.42	0.00	98.02

Sample #		As	S	Zn	Cu	Fe	Mn	Ag	Cd	Sn	Tot.
25-346A	lo-2	70.60	2.15	0.02	0.01	28.97	0.00	0.03	0.00	0.00	101.78
25-346A	asp-2	48.39	17.67	0.01	0.00	34.13	0.00	0.08	0.08	0.00	100.36
25-522	lo-1	71.09	1.75	0.02	0.00	28.71	0.02	0.00	0.00	0.00	101.59
25-522	asp-1	47.33	18.99	0.00	0.00	34.52	0.01	0.04	0.05	0.05	100.99

*All elements reported as weight percent

\1 Sample numbers are defined as, drill hole number-intercept depth; reference cross sections in figures 3 and 5.

st. Represents stannite

sp. Represents sphalerite

asp. Represents arsenopyrite

lo. Represents loellingite

Table 5. –Temperatures derived from coexisting sphalerite and arsenopyrite in degrees C . The geothermometer from Scott and Barnes (14)

Sample #	As	Zn	Temp
25-380-1	34.2	72	496
25-380-2	33.3	74	460
25-380-3	32.5	75	426
25-380-4	33.8	74	479
25-500-1	32.4	74	412
36-625-1	33.0	72	428
36-625-2	32.8	72	417

As: Atomic percent arsenic in arsenopyrite
Zn: [(X_{Zn} in sphalerite)/(X_{Zn} + X_{Fe} in sphalerite) x 100]

Table 6. –Temperatures derived using the stannite-sphalerite geothermometer of Shimizu and Shikazono (15)

Sample #	I	II	Temp.
17-400-1	9.43	0.39	301
17-400-2	2.22	0.37	381
17-400-3	2.01	0.37	388
17-400-4	4.49	0.33	331
25-522-1	10.01	0.32	287
25-522-2	8.65	0.32	295
25-346-1	2.68	0.35	365
25-566-1	10.25	0.37	293
25-566-2	8.23	0.39	308
25-566-3	4.31	0.36	339
25-346A-1	8.44	0.34	300

I: ($X_{Stannite}/X_{Kesterite}$) in Stannite
II: ($X_{Pyrrhotite}/X_{Sphalerite}$) in Sphalerite

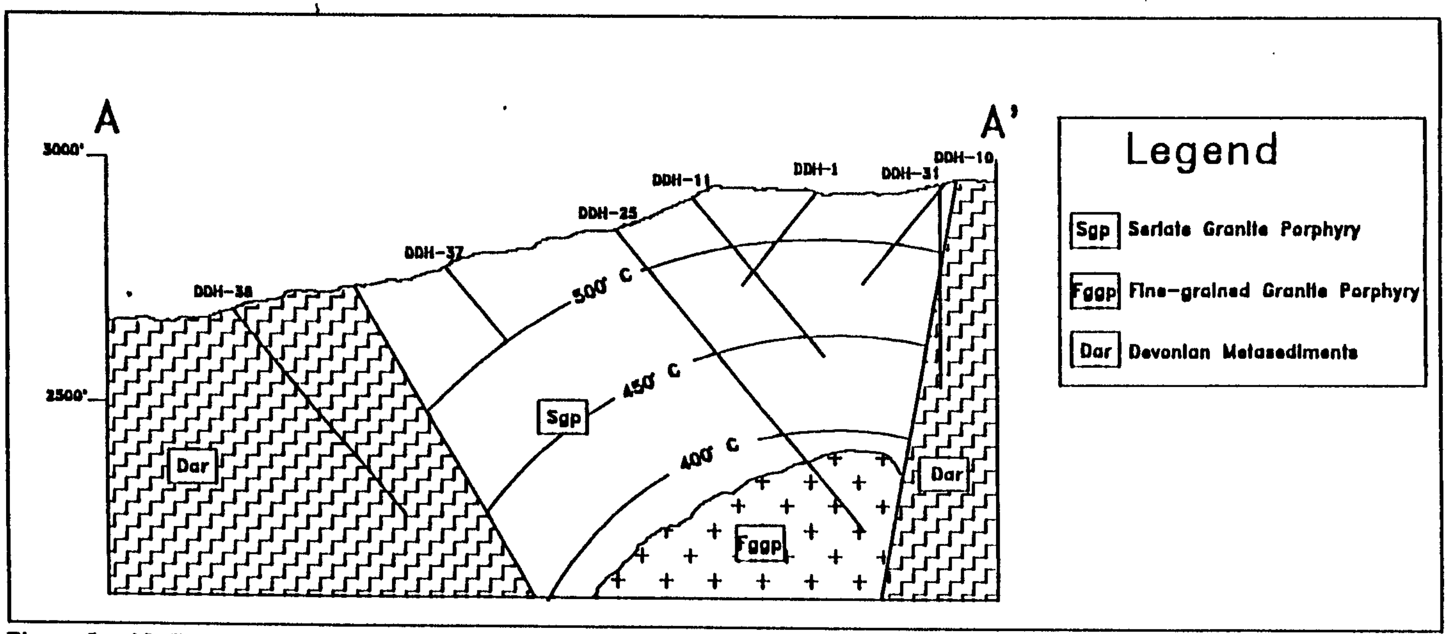

Figure 5. --N15E cross section showing temperature contours derived from coexisting arsenopyrite, sphalerite, mineral pairs

although it contains a small portion of the total tin, it contains a significant portion of the silver. Silver is also hosted by 2 to 5 micron argentiferous galena grains. The alteration and ore mineralogy suggest that the mineralizing fluids were enriched in F, B, Li, and Cl. The ore mineralogy also indicates a low oxidation and sulfidation state,and crystallization temperature range of 300 to 500^{o} C.

The genetic origin of the tin mineralization is interpreted from petrographic observations and a collection of trace and major element concentration data from the different igneous rock types at Coal Creek and vicinity. These interpretations combine to form a rational basis for relating the distribution of hydrothermal mineralization to the igneous host lithologies. Exploration criteria and limiting constraints on the potential size of this type of tin deposit can be gleaned from this data.

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APPENDIXES

Appendix A. Drill hole data from the summer 1982 drilling project at Coal Creek.

Hole Number	Depth of Hole	Bearing	Dip	Coordinates
1	248.4	S15W	50	N10167,E9698
2	250.3	S15W	50	N10118,E9892
3	201.6	S70E	50	N10859,E9436
4	196.6	S70E	50	N8238,E9485
5	201.7	S60E	50	N4840,E8745
6	160.2	N70W	50	N7934,E6710
7	248.2	S70E	50	N8980,E6770
8				
9	158.9	N15E	50	N9883,E9917
10	270.0	S15E	50	N10368,E9746
11	405.0	N15E	50	N9784,E9603
12	874.0	N15E	50	N9444,E9317
13	196.0	S45E	50	N12230,E12207
14	376.0	S83W	70	N6196,E5894
15	570.0	0	90	N9828,E9840
16	866.0	S15E	70	N10265,E9312
17				
18				
19	693.3	0	90	N10001,E9740
20	609.8	0	90	N9915,E9790
21	653.8	0	90	N9656,E9740
22	555.4	0	90	N9484,E9640
23	692.8	0	90	N9915,E10090
24	803.2	N15E	50	N9539,E9735
25	800.3	N15E	50	N9588,E9552
26	206.3	0	90	N8768,E6881
27	172.8	0	90	N8322,E7017
28	91.6	0	90	N8579,E7589
29	295.7	0	90	N11418,E11055
30	133.7	0	90	N10883,E10492
31	418.5	0	90	N10373,E9741
32	727.5	0	90	N9828,E9740
33	746.9	0	90	N9828,E9640
34	593.0	0	90	N10001,E9940
35	500.7	N15E	50	N9054,E9214
36	762.8	N15E	50	N9732,E9794
37	194.3	N15E	50	N9200,E9454
38	547.2	N15E	50	N8725,9309
39	645.4	N15E	50	N9831,E9403
40	237.4	N15E	50	N9828,E10626
41	215.1	N35E	50	N12254,E11729
42	172.0	N35E	50	N12493,11691

Appendix B. Available interval and assay data from the summer 1982 drilling project at Coal Creek.

DDH	FROM (ft.)	TO (ft.)	RECOVERY (ft.)	Sn (ppm)	Ag (ppm)
19	5	10	3.5	2100	19.0
19	10	20	9.3	105	3.8
19	20	28	8.4	47	3.3
19	28	37	9.0	390	5.1
19	37	47	10.0	500	2.6
19	47	57	10.0	280	2.5
19	57	63	6.0	620	8.3
19	63	71	7.7	1480	14.0
19	71	78	6.4	140	4.0
19	78	88	8.0	1000	8.0
19	88	98	8.2	180	4.1
19	98	108	8.4	2053	0.7
19	108	115	6.1	110	6.1
19	115	125	8.8	32	2.4
19	125	135	7.5	160	4.4
19	135	145	9.8	820	6.3
19	145	154	8.9	90	4.2
19	154	164	9.8	1500	4.4
19	164	174	9.9	25	1.3
19	174	179	5.0	1000	11.0
19	179	189	9.9	1000	2.1
19	189	199	9.5	1804	0.7
19	199	207	7.9	135	2.4
19	207	213	5.9	535	18.0
19	213	220	7.0	830	2.8
19	220	225	4.9	80	4.8
19	225	235	9.8	475	3.1
19	235	245	10.0	36	5.8
19	245	253	7.9	5	0.4
19	253	261	8.0	595	8.1
19	261	271	10.0	1070	2.2
19	271	281	9.9	19	9.2
19	281	290	9.0	3150	6.5
19	290	300	9.4	1750	9.2
19	300	309	8.0	1000	9.9
19	309	319	10.0	390	2.0
19	319	329	10.0	3175	9.2
19	329	339	10.0	4000	6.3
19	339	350	10.9	3250	25.0
19	350	360	9.6	315	1.1
19	360	370	9.6	2300	3.5
19	370	380	9.1	28	1.0
19	380	391	9.9	330	1.4
19	391	401	9.7	57	1.2
19	401	411	9.3	5	0.5
19	411	421	9.3	12	0.4
19	421	428	6.8	13	0.4
19	428	438	9.2	770	3.6
19	438	448	10.0	100	0.4

DDH	FROM (ft.)	TO (ft.)	RECOVERY (ft.)	Sn (ppm)	Ag (ppm)
19	448	458	9.8	65	0.4
19	458	468	9.8	295	1.8
19	468	478	9.7	225	7.5
19	478	488	9.5	6000	7.5
19	488	498	9.7	2200	2.6
19	498	508	9.8	225	0.8
19	508	518	9.8	2400	8.0
19	518	528	9.9	4360	16.0
19	528	538	10.0	415	1.2
19	538	548	10.0	175	2.4
19	548	553	5.0	28	0.4
19	553	563	9.9	2700	2.0
19	563	573	10.0	210	0.3
19	573	583	10.0	713	0.3
19	583	593	9.9	195	0.2
19	593	603	10.0	87	0.2
19	603	613	10.0	660	2.6
19	613	623	10.0	1000	1.9
19	623	633	10.0	41	0.2
19	633	643	10.0	365	0.3
19	643	653	10.0	215	0.2
19	653	663	10.0	29	0.2
19	663	673	10.0	26	0.2
19	673	683	10.0	62	0.2
19	683	693	10.3	77	0.2
20	0	8	7.8	9	5.8
20	8	17	8.8	160	6.6
20	17	27	9.7	195	1.4
20	27	37	9.4	205	2.4
20	37	47	9.6	545	1.5
20	47	52	5.0	3450	3.6
20	52	59	7.0	2320	3.5
20	59	69	9.8	210	2.0
20	69	79	9.8	2590	7.4
20	79	87	7.9	3000	2.6
20	87	97	9.8	385	1.0
20	97	107	9.8	1800	1.8
20	107	117	9.6	6300	14.0
20	117	127	7.8	7350	20.0
20	127	137	7.5	500	2.7
20	137	147	9.7	210	1.4
20	147	157	9.8	185	2.9
20	157	167	8.5	3050	2.2
20	167	177	9.4	3900	1.4
20	177	187	8.9	1800	2.9
20	187	197	8.9	5700	4.5
20	197	207	8.6	2200	3.2
20	207	217	8.2	1900	5.3
20	217	222	4.6	3860	3.1
20	222	232	9.5	110	1.4
20	232	242	9.8	380	0.9
20	242	252	9.8	820	0.6
20	252	262	9.4	4360	8.5
20	262	272	9.5	615	3.2
20	272	282	9.8	600	6.0
20	282	293	10.8	690	2.6
20	293	303	9.8	4200	9.2
20	303	313	9.8	325	4.0
20	313	323	10.0	110	1.6

DDH	FROM (ft.)	TO (ft.)	RECOVERY (ft.)	Sn (ppm)	Ag (ppm)
20	323	333	10.0	3800	6.6
20	333	343	10.0	530	3.3
20	343	353	9.9	29	0.8
20	353	363	9.9	1400	3.7
20	363	373	10.0	32	0.6
20	373	383	10.0	1200	4.0
20	383	393	9.8	8500	35.0
20	393	403	9.4	125	0.5
20	403	413	9.2	2700	18.0
20	413	423	8.9	140	0.7
20	423	433	9.5	38	0.2
20	433	443	9.8	210	0.6
20	443	453	9.8	220	2.9
20	453	463	9.5	1900	12.0
20	463	473	10.0	725	11.0
20	473	483	10.0	2750	0.5
20	483	487	4.3	550	3.3
21	10	20	9.3	29	1.7
21	20	30	9.3	26	0.9
21	30	40	9.7	77	0.7
21	40	50	9.7	165	0.4
21	50	60	9.9	21	1.4
21	60	70	9.8	26	1.0
21	70	80	9.9	54	0.8
21	80	90	10.0	46	2.8
21	90	100	10.0	43	3.7
21	100	110	10.0	11	0.7
21	110	120	9.8	13	1.8
21	120	130	9.8	32	3.6
21	130	140	9.7	26	9.0
21	140	150	9.6	15	2.4
21	150	160	9.6	22	1.5
21	160	170	9.1	11	0.8
21	170	180	9.4	9	1.7
21	180	190	8.3	360	1.3
21	190	200	6.3	134	4.5
21	200	210	7.0	35	1.4
21	210	220	8.6	20	1.2
21	220	230	9.2	82	1.5
21	230	240	9.3	42	0.9
21	240	250	9.6	27	0.8
21	250	260	9.8	54	1.9
21	260	270	10.1	25	0.5
21	270	280	10.0	57	1.3
21	280	290	9.8	11	0.5
21	290	300	9.6	175	1.1
21	300	310	9.8	430	2.5
21	310	320	8.1	155	3.1
21	320	330	9.4	100	6.5
21	330	340	9.6	200	4.9
21	340	350	9.4	800	9.0
21	350	360	9.7	740	2.6
21	360	370	8.1	2000	17.0
21	370	380	7.2	28	1.6
21	380	390	9.6	440	2.9
21	390	400	9.5	1100	0.4
21	400	410	8.8	30	0.6
21	410	420	10.3	5	0.4
21	420	430	9.8	11	0.5

DDH	FROM (ft.)	TO (ft.)	RECOVERY (ft.)	Sn (ppm)	Ag (ppm)
21	430	440	9.9	6	0.4
21	440	450	9.9	6	0.6
21	450	460	9.9	5	0.4
21	460	470	9.7	19	0.4
21	470	480	9.7	66	0.5
21	480	490	9.9	31	0.2
21	490	500	8.8	69	0.2
21	500	510	9.0	270	0.4
21	510	520	9.0	11	0.2
21	520	530	9.7	18	0.2
21	530	540	9.8	12	0.2
21	540	550	9.8	7	0.2
21	550	560	10.0	22	0.4
21	560	570	10.0	12	0.2
21	570	580	10.0	17	0.3
21	580	590	9.9	9	0.2
21	590	600	9.9	3600	0.5
21	600	610	9.7	1800	0.3
21	610	620	9.8	855	0.2
21	620	630	9.9	38	0.2
21	630	635	4.9	105	0.4
21	635	645	9.2	700	0.6
21	645	653	6.3	13	0.2
22	10	20	10.0	85	0.6
22	20	30	9.5	125	1.3
22	30	40	9.6	500	2.0
22	40	50	9.9	26	0.6
22	50	60	9.9	68	1.5
22	60	70	9.8	780	1.4
22	70	80	9.8	61	0.4
22	80	90	9.7	41	0.6
22	90	100	9.9	27	0.4
22	100	105	4.8	70	0.4
22	105	115	9.7	205	0.7
22	115	125	10.0	16	0.6
22	125	135	9.9	32	1.1
22	135	140	4.5	13	0.4
22	140	151	7.3	30	0.9
22	151	161	4.7	110	0.3
22	161	169	7.5	95	0.4
22	169	179	9.6	19	1.0
22	179	189	7.4	45	2.2
22	189	199	7.4	45	1.7
22	199	209	8.4	70	4.2
22	209	219	9.5	45	6.7
22	219	229	9.7	31	0.9
22	229	239	8.5	34	1.2
22	239	249	9.3	25	1.2
22	249	259	9.9	325	1.7
22	259	269	9.5	1000	2.2
22	269	279	9.7	18	0.7
22	279	289	9.8	14	0.3
22	289	299	9.9	23	0.7
22	299	309	9.9	7	0.4
22	309	319	9.9	57	1.0
22	319	329	9.9	175	0.9
22	329	339	9.9	210	1.1
22	339	349	9.8	14	0.5
22	349	355	6.0	17	1.3

DDH	FROM (ft.)	TO (ft.)	RECOVERY (ft.)	Sn (ppm)	Ag (ppm)
22	355	365	9.9	395	1.2
22	365	375	9.7	12	0.3
22	375	385	9.9	14	0.4
22	385	390	5.0	19	0.2
22	390	400	9.2	130	1.1
22	400	410	9.8	2010	1.8
22	410	420	9.8	27	0.4
22	420	430	9.9	540	0.7
22	430	440	9.9	18	0.4
22	440	450	9.8	16	0.3
22	450	460	9.8	38	0.4
22	460	470	9.6	17	0.3
22	470	480	10.1	6	0.2
22	480	490	9.9	15	0.3
22	490	500	9.9	19	0.2
22	500	510	10.0	15	0.3
22	510	520	9.9	22	0.3
22	520	530	9.8	12	0.2
22	530	542	11.1	57	0.4
22	542	555	12.2	14	0.2
23	4	10	5.5	70	1.2
23	10	20	9.8	325	1.0
23	20	30	9.9	3450	1.7
23	30	40	10.0	110	0.7
23	40	50	10.0	63	0.5
23	50	60	10.0	25	0.4
23	60	70	10.1	20	0.3
23	70	80	10.0	28	0.3
23	80	90	9.9	36	2.5
23	90	100	9.8	32	0.2
23	100	110	9.9	145	0.7
23	110	120	9.9	45	0.5
23	120	130	9.9	100	0.2
23	130	140	9.3	45	0.4
23	140	150	9.0	24	0.4
23	150	160	9.8	40	1.1
23	160	165	3.1	65	0.5
23	165	175	9.2	475	50.0
23	175	182	5.6	2270	0.9
23	182	186	3.5	83	2.6
23	186	196	6.5	150	1.0
23	196	206	6.9	25	0.9
23	206	216	8.5	325	2.2
23	216	226	8.9	39	0.9
23	226	236	9.8	740	1.3
23	236	246	10.1	95	0.6
23	246	256	9.9	85	0.6
23	256	266	9.5	275	4.8
23	266	276	9.9	230	1.2
23	276	286	9.0	140	0.8
23	286	296	10.0	58	0.9
23	296	306	10.1	350	12.0
23	306	316	9.9	37	0.5
23	316	326	9.8	24	0.7
23	326	336	9.6	500	6.4
23	336	346	10.2	16	0.4
23	346	356	9.9	24	0.4
23	356	366	10.0	1000	1.6
23	366	376	9.7	65	0.8

DDH	FROM (ft.)	TO (ft.)	RECOVERY (ft.)	Sn (ppm)	Ag (ppm)
23	376	386	9.7	670	1.4
23	386	396	9.2	17	0.4
23	396	406	9.4	30	0.4
23	406	418	11.8	21	0.4
23	418	428	9.7	6350	6.8
23	428	438	9.2	1960	4.1
23	438	448	8.4	145	2.0
23	448	453	4.9	1050	2.0
23	453	463	9.8	54	0.9
23	463	468	4.9	17	0.7
23	468	478	10.2	12	0.3
23	478	488	10.1	27	3.1
23	488	498	10.1	22	0.5
23	498	508	9.7	5	0.5
23	508	513	4.6	14	0.5
23	513	523	9.8	340	2.0
23	523	533	9.4	5	0.2
23	533	543	9.0	165	0.4
23	543	553	8.0	445	0.4
23	553	558	5.0	27	0.5
23	558	568	9.2	30	0.3
23	568	578	9.9	9	0.2
23	578	588	9.9	7	0.2
23	588	598	10.0	9	0.2
23	598	608	9.8	10	0.2
23	608	618	9.8	9	0.2
23	618	628	9.8	5	0.2
23	628	638	9.9	12	0.2
23	638	648	9.6	8	0.2
23	648	658	9.3	22	0.3
23	658	668	8.5	160	2.0
23	668	678	10.0	26	0.8
23	678	688	9.7	205	4.2
23	688	693	3.7	9	0.6
24	10	15	4.6	1025	2.2
24	15	25	9.3	230	4.5
24	25	35	10.0	97	5.0
24	35	40	5.0	24	0.7
24	40	47	7.0	22	0.5
24	47	52	5.0	1050	1.2
24	52	62	9.7	1600	2.4
24	62	72	9.8	155	0.8
24	72	82	10.0	210	2.0
24	82	87	4.9	205	2.7
24	87	92	4.8	240	1.4
24	92	102	9.7	940	2.8
24	102	107	4.9	550	2.2
24	107	112	5.0	190	5.9
24	112	122	9.9	83	1.7
24	122	132	9.8	32	5.4
24	132	142	9.9	68	0.9
24	142	152	10.0	53	2.6
24	152	162	9.9	185	4.0
24	162	172	9.9	330	1.3
24	172	182	9.9	125	1.5
24	182	192	9.0	425	0.8
24	192	202	8.0	59	0.7
24	202	212	6.4	355	0.8
24	212	222	9.0	16	0.8

DDH	FROM (ft.)	TO (ft.)	RECOVERY (ft.)	Sn (ppm)	Ag (ppm)
24	222	227	2.8	18	0.6
24	227	235	7.5	62	0.9
24	235	240	4.8	21	0.6
24	240	245	4.6	345	1.4
24	245	255	5.1	11	0.6
24	255	265	7.7	17	0.4
24	265	270	4.9	94	0.7
24	270	275	4.6	9	0.5
24	275	283	7.8	60	0.6
24	283	293	7.8	1900	1.3
24	293	303	9.2	435	0.9
24	303	313	9.6	210	1.2
24	313	318	5.2	985	2.2
24	318	323	5.0	5400	5.4
24	323	328	4.9	2300	0.7
24	328	338	9.8	635	5.6
24	338	343	4.9	210	2.2
24	343	353	9.7	3500	22.0
24	353	358	4.2	975	12.0
24	358	363	4.9	49	4.2
24	363	373	9.9	150	3.0
24	373	383	9.8	890	3.6
24	383	393	9.8	200	1.2
24	393	403	9.8	42	1.2
24	403	413	9.8	2860	15.0
24	413	423	6.5	1630	3.4
24	423	433	6.0	835	6.4
24	433	438	4.9	1620	11.0
24	443	448	4.5	1570	5.6
24	448	458	7.2	650	6.2
24	458	468	7.7	395	1.1
24	468	478	9.7	1600	7.5
24	478	485	6.8	77	1.0
24	485	495	9.8	1550	2.1
24	495	505	10.0	33	0.5
24	505	513	7.6	1200	1.4
24	513	523	9.7	3200	7.3
24	523	528	4.6	995	2.6
24	528	538	8.2	941	3.6
24	538	548	8.6	1100	4.2
24	548	553	4.4	180	0.9
24	553	558	4.8	2120	4.1
24	558	568	10.0	110	0.4
24..	568	578	10.0	30	1.8
24	578	588	9.9	185	0.6
24	588	598	10.0	49	0.3
24	598	603	4.9	115	0.3
24	603	609	5.9	670	0.9
24	609	619	9.9	4800	15.0
24	619	630	11.0	6100	19.0
24	630	635	5.0	2260	2.0
24	635	645	9.8	1170	0.5
24	645	650	4.9	1790	6.3
24	650	655	5.0	33	0.3
24	655	665	9.9	270	1.0
24	665	670	5.0	390	1.6
24	670	680	10.0	1580	7.0
24	680	685	4.9	2110	3.3
24	685	691	5.9	3740	3.2

DDH	FROM (ft.)	TO (ft.)	RECOVERY (ft.)	Sn (ppm)	Ag (ppm)
24	691	701	9.9	105	0.6
24	701	711	9.8	19	0.4
24	711	721	9.9	150	0.4
24	721	731	10.0	45	0.4
24	731	741	10.0	115	0.4
24	741	751	10.0	17	0.4
24	751	761	10.0	25	0.5
24	761	771	10.0	125	0.3
24	771	779	8.0	165	1.6
24	779	789	9.7	695	3.7
24	789	795	5.8	7790	3.7
24	795	803	6.7	9999	3.4
25	11	20	3.9	38	0.6
25	20	30	8.5	27	0.7
25	30	40	4.0	21	0.8
25	40	50	9.0	80	1.3
25	50	60	8.2	44	3.0
25	60	70	7.4	41	2.9
25	70	80	1.5	76	6.5
25	80	90	4.2	98	4.8
25	90	100	8.6	315	3.9
25	100	110	7.8	2010	8.9
25	110	120	9.9	70	3.9
25	120	130	6.2	75	1.7
25	130	140	4.4	31	2.4
25	140	150	5.8	1700	5.9
25	150	160	8.7	51	2.6
25	160	170	9.4	160	3.0
25	170	180	8.1	35	1.5
25	180	190	8.7	75	1.3
25	190	200	10.1	760	5.7
25	200	210	9.1	195	3.4
25	210	220	8.8	580	3.7
25	220	230	9.1	235	1.7
25	230	240	9.7	100	1.0
25	240	250	9.7	27	1.0
25	250	260	9.3	30	1.4
25	260	270	9.9	34	0.8
25	270	275	5.0	30	0.8
25	275	287	9.8	2160	5.9
25	287	297	9.7	1000	4.0
25	297	307	9.8	1000	1.8
25	307	318	10.8	3250	14.0
25	318	329	10.6	590	3.0
25	329	339	9.5	235	4.1
25	339	344	4.8	2550	7.6
25	344	345	9.8	1750	12.0
25	354	364	9.9	1020	3.7
25	364	374	9.6	130	1.2
25	374	384	9.8	685	2.0
25	384	396	11.9	490	1.3
25	396	408	11.8	2500	9.1
25	408	418	9.9	250	18.0
25	418	428	9.8	855	1.0
25	428	437	8.6	360	1.5
25	437	447	10.0	1050	7.7
25	447	457	10.0	2650	35.0
25	457	465	7.8	310	0.9
25	465	470	4.9	69	0.8

DDH	FROM (ft.)	TO (ft.)	RECOVERY (ft.)	Sn (ppm)	Ag (ppm)
25	470	480	9.9	780	15.0
25	480	485	5.0	14	0.4
25	485	490	4.8	750	19.0
25	490	500	9.7	750	1.1
25	500	510	10.1	1550	1.7
25	510	515	5.0	105	0.6
25	515	520	4.9	335	14.0
25	520	525	4.8	5600	10.0
25	525	530	4.7	2000	1.7
25	530	540	9.6	2500	13.0
25	540	551	10.9	2100	4.6
25	551	561	9.9	540	2.4
25	561	570	9.0	1100	3.7
25	570	575	5.0	1560	6.6
25	575	580	5.0	975	1.9
25	580	590	10.0	315	0.4
25	590	601	11.0	4150	11.0
25	601	610	8.6	3700	7.6
25	610	615	4.6	880	7.6
25	615	620	4.9	2250	4.6
25	620	630	10.0	3600	0.5
25	630	635	4.9	1560	0.4
25	635	640	5.0	3350	0.9
25	640	650	9.9	180	0.3
25	650	660	9.4	195	0.2
25	660	670	9.0	395	10.0
25	670	675	4.6	2250	2.0
25	675	680	4.9	6700	25.0
25	680	685	4.9	2150	13.0
25	685	690	5.3	2900	18.0
25	690	695	5.0	920	0.7
25	695	705	9.1	105	0.2
25	705	715	10.2	39	0.2
25	715	725	9.8	60	0.2
25	725	735	9.9	17	0.2
25	735	745	10.0	32	0.2
25	745	755	10.0	59	0.2
25	755	765	9.9	455	0.3
25	765	775	9.7	9	0.3
25	775	785	9.9	27	0.3
25	785	795	10.0	390	0.6
25	795	800	5.3	13	0.5
26	16	30		130	0.5
26	30	40		5	0.7
26	40	50		5	0.8
26	50	60		6	0.9
26	60	70		7	0.8
26	70	80			
30	96	106	9.7	57	0.5
30	106	117	8.5	40	0.9
30	117	125	8.1	80	0.3
30	125	134	8.2	93	0.6
31	7	18	9.4	31	1.0
31	18	28	9.7	43	1.7
31	28	38	9.8	41	0.4
31	38	48	9.8	18	0.4
31	48	58	8.9	24	0.4
31	58	68	9.9	145	0.8
31	68	78	9.5	92	2.0

DDH	FROM (ft.)	TO (ft.)	RECOVERY (ft.)	Sn (ppm)	Ag (ppm)
31	78	88	9.2	240	4.0
31	88	98	9.6	27	0.8
31	98	108	9.7	155	1.7
31	108	118	9.8	335	3.0
31	118	128	9.8	360	4.6
31	128	138	9.7	235	11.0
31	138	148	8.8	1930	20.0
31	148	158	8.2	660	28.0
31	158	168	6.7	120	2.2
31	168	178	4.3	350	11.0
31	178	188	2.7	160	15.0
31	188	198	3.8	165	1.6
31	198	205	4.1	66	1.6
31	205	218	10.1	70	1.4
31	218	228	9.0	54	1.1
31	228	238	9.5	74	0.6
31	238	248	9.5	72	0.7
31	248	255	6.4	58	0.7
31	255	265	7.1	105	3.9
31	265	273	4.0	50	1.0
31	273	283	6.7	65	1.2
31	283	293	4.5	115	2.6
31	293	303	8.4	54	0.7
31	303	313	9.8	45	0.8
31	313	323	7.0	40	0.4
31	323	333	9.6	86	0.4
31	333	343	10.1	340	0.8
31	343	353	9.9	26	0.6
31	353	363	9.5	55	0.5
31	363	373	10.0	45	0.5
31	373	383	10.0	110	0.4
31	383	393	9.8	130	0.3
31	393	403	9.7	63	1.8
31	403	413	9.8	750	1.2
31	413	418	5.0	97	0.5
32	3	13	9.3	2400	1.3
32	13	23	9.9	795	2.6
32	23	33	9.7	2110	2.4
32	33	43	9.7	3300	13.0
32	43	53	9.9	365	7.3
32	53	63	9.8	2200	31.0
32	63	68	4.9	850	9.3
32	68	78	10.0	9300	38.0
32	78	88	9.9	2640	18.0
32	88	98	10.0	4190	25.0
32	98	108	9.9	2870	40.0
32	108	118	10.0	1110	23.0
32	118	128	9.4	1250	13.0
32	128	140	5.6	1165	5.4
32	140	150	9.2	340	1.8
32	150	160	9.3	410	2.9
32	160	170	9.5	210	5.4
32	170	180	9.8	5100	27.0
32	180	190	10.0	120	1.0
32	190	200	8.8	245	2.5
32	200	207	4.2	375	2.4
32	207	217	5.6	1800	8.0
32	217	225	7.2	12	0.4
32	225	232	6.3	2300	1.7

DDH	FROM (ft.)	TO (ft.)	RECOVERY (ft.)	Sn (ppm)	Ag (ppm)
32	232	240	7.6	14	0.8
32	240	250	9.9	38	0.8
32	250	260	9.9	305	0.9
32	260	270	9.8	1880	1.0
32	270	280	9.9	125	1.0
32	280	290	10.0	91	0.4
32	290	300	10.0	920	0.5
32	300	305	5.0	360	0.6
32	305	315	9.8	1660	5.8
32	315	325	9.8	3200	5.5
32	325	335	9.8	165	1.1
32	335	345	9.3	215	1.0
32	345	355	9.5	12	0.8
32	355	360	4.5	16	1.1
32	360	370	9.6	4500	2.6
32	370	380	9.9	91	1.4
32	380	390	9.1	215	4.4
32	390	400	8.7	360	2.4
32	400	410	9.3	140	5.0
32	410	420	9.5	6000	7.8
32	420	425	4.6	3500	22.0
32	425	435	9.7	2200	3.0
32	435	445	9.9	900	5.0
32	445	455	9.7	130	1.4
32	455	465	9.5	3500	50.0
32	465	475	9.4	460	2.7
32	475	480	4.7	3800	8.6
32	480	490	10.0	1920	5.0
32	490	500	10.0	3600	9.0
32	500	510	9.8	2680	4.6
32	510	520	9.4	3010	3.6
32	520	530	9.9	2750	6.6
32	530	540	10.1	3500	2.3
32	540	550	10.0	425	0.7
32	550	560	10.0	42	0.4
32	560	570	10.1	560	0.6
32	570	580	10.0	12	0.5
32	580	590	10.0	5	0.3
32	590	600	10.0	28	0.4
32	600	610	10.0	9999	0.7
32	610	620	10.0	21	0.5
32	620	630	10.0	28	0.7
32	630	640	10.0	17	1.0
32	640	650	10.0	39	0.5
32	650	660	10.0	6	0.3
32	660	670	10.0	6	0.3
32	670	680	10.0	5	0.2
32	680	690	10.0	750	2.0
32	690	700	9.1	15	0.2
32	700	710	9.9	880	1.2
32	710	720	9.3	5	0.2
32	720	728	6.0	1650	1.3
33	3	10	5.5	20	0.5
33	10	20	9.7	2200	1.7
33	20	30	9.1	45	1.3
33	30	40	9.5	145	1.2
33	40	50	9.5	93	1.5
33	50	60	9.2	175	2.9
33	60	70	9.8	220	3.6

DDH	FROM (ft.)	TO (ft.)	RECOVERY (ft.)	Sn (ppm)	Ag (ppm)
33	70	80	10.0	100	2.4
33	80	90	10.0	77	1.6
33	90	100	10.0	32	0.7
33	100	110	9.9	73	0.8
33	110	120	7.9	80	3.1
33	120	130	5.6	235	13.0
33	130	140	3.3	580	19.0
33	140	150	4.8	920	13.0
33	150	160	7.2	1060	5.7
33	160	170	7.6	2800	10.0
33	170	180	8.5	1000	3.6
33	180	190	8.6	1800	5.2
33	190	200	9.8	1950	4.7
33	200	210	8.9	840	5.8
33	210	220	9.4	705	5.2
33	220	230	9.7	855	3.9
33	230	240	9.8	675	13.0
33	240	250	8.9	2900	3.0
33	250	260	9.9	20	0.5
33	260	270	9.7	635	1.4
33	270	280	9.5	2800	4.9
33	280	290	9.5	3700	4.6
33	290	300	9.5	105	1.2
33	300	310	9.2	105	1.8
33	310	320	9.7	205	3.8
33	320	330	9.9	37	1.1
33	330	340	9.7	3000	11.0
33	340	350	9.9	28	0.8
33	350	355	4.6	150	7.3
33	355	365	8.7	450	12.0
33	365	375	9.9	275	2.0
33	375	385	9.7	20	0.7
33	385	395	9.6	20	0.9
33	395	405	9.6	180	2.8
33	405	415	9.6	770	2.2
33	415	425	9.9	12	0.5
33	425	435	10.0	7	0.6
33	435	445	9.9	13	0.4
33	445	455	9.9	26	0.4
33	455	465	9.8	1580	4.4
33	465	475	9.7	46	1.2
33	475	485	9.9	900	2.8
33	485	495	9.9	5	0.2
33	495	505	9.9	10	0.2
33	505	515	9.9	75	0.4
33	515	525	9.5	27	0.4
33	525	535	9.3	550	0.3
33	535	545	9.5	450	0.4
33	545	555	9.8	635	4.3
33	555	565	9.8	745	3.1
33	565	576	11.0	58	0.9
33	576	587	11.5	32	0.3
33	587	597	10.4	2200	5.9
33	597	607	10.0	305	3.4
33	607	617	10.0	25	0.4
33	617	627	10.0	12	0.3
33	627	637	10.0	13	0.9
33	637	647	10.0	18	0.4
33	647	657	10.0	16	0.2

DDH	FROM (ft.)	TO (ft.)	RECOVERY (ft.)	Sn (ppm)	Ag (ppm)
34	470	480	9.8	74	0.5
34	480	490	9.9	24	0.3
34	490	500	9.9	12	0.7
34	500	510	10.0	10	0.6
34	510	520	9.8	5	0.5
34	520	530	5.6	10	1.4
34	530	540	2.8	10	0.9
34	540	550	6.4	6	1.8
34	550	560	10.1	35	3.0
34	560	570	9.8	28	2.8
34	570	580	10.0	10	0.3
34	580	593	12.9	6	0.2
35	1	10	6.8	110	1.5
35	10	20	9.5	1000	3.3
35	20	30	10.0	725	1.1
35	30	40	9.8	400	3.2
35	40	50	9.3	1200	2.9
35	50	60	9.8	1500	2.7
35	60	70	10.0	95	0.6
35	70	80	9.7	565	2.2
35	80	90	9.8	665	5.0
35	90	95	4.9	1850	10.0
35	95	100	5.0	1550	3.8
35	100	110	9.8	785	2.3
35	110	120	9.9	2400	12.0
35	120	125	5.0	910	17.0
35	125	135	9.7	505	3.7
35	135	140	4.6	315	4.2
35	140	145	4.8	452	7.4
35	145	155	10.0	860	3.9
35	155	165	10.0	875	5.0
35	165	175	9.9	455	2.8
35	175	185	9.8	500	2.7
35	185	195	9.7	815	5.3
35	195	205	9.9	1760	5.3
35	205	215	9.9	955	5.1
35	215	225	9.8	340	3.3
35	225	235	9.7	270	2.2
35	235	245	9.8	400	3.7
35	245	255	10.3	685	5.1
35	255	265	10.0	240	2.5
35	265	270	4.8	48	1.4
35	270	280	9.5	260	2.8
35	280	285	4.6	140	2.6
35	285	295	9.2	440	2.1
35	295	305	9.8	570	4.6
35	305	315	9.7	185	1.9
35	315	325	9.6	135	1.1
35	325	335	10.0	700	2.2
35	335	345	9.7	330	1.5
35	345	355	9.7	175	0.9
35	355	365	7.5	275	1.1
35	365	375	6.4	23	0.5
35	375	385	9.0	20	0.8
36	20	30	10.0	215	3.4
36	30	35	5.0	32	2.0
36	35	45	10.0	1530	7.8
36	45	55	10.0	750	3.0
36	55	65	9.8	340	3.1

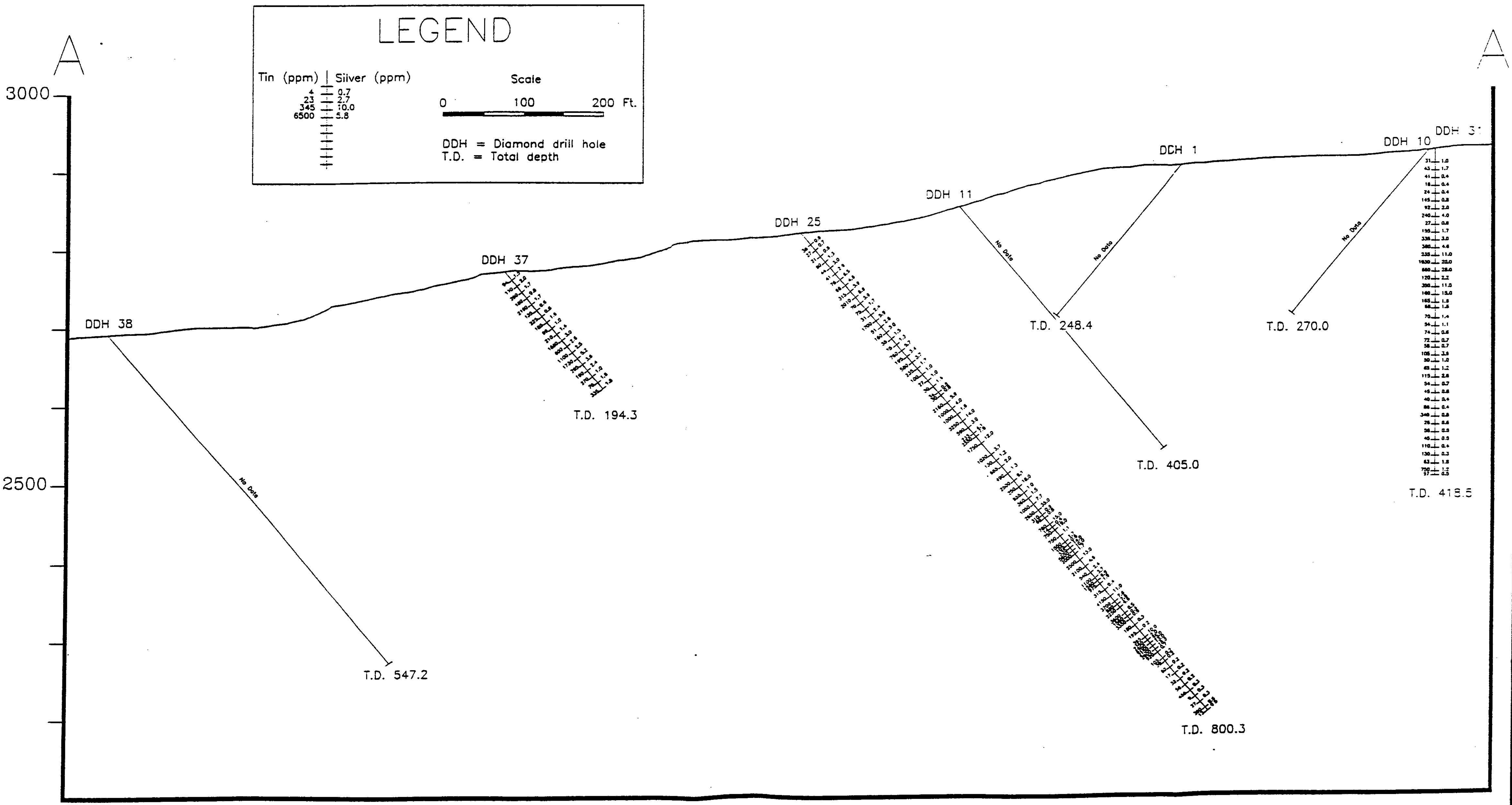
DDH	FROM (ft.)	TO (ft.)	RECOVERY (ft.)	Sn (ppm)	Ag (ppm)
33	657	667	9.9	500	0.5
33	667	677	10.0	10	0.3
33	677	687	10.0	8	0.2
33	687	692	5.0	9999	5.5
33	692	702	9.9	365	0.8
33	702	712	9.6	275	0.6
33	712	717	4.8	110	0.2
33	717	727	8.3	5200	3.0
33	727	737	4.5	340	0.4
33	737	747	5.8	61	0.5
34	5	15	10.1	610	2.7
34	15	25	9.6	545	1.4
34	25	35	9.2	335	1.0
34	35	45	9.7	125	0.2
34	45	55	9.8	2500	0.4
34	55	65	9.9	500	10.0
34	65	75	9.7	3500	19.0
34	75	85	9.7	2200	9.1
34	85	90	4.9	260	5.8
34	90	100	8.3	600	2.1
34	100	110	5.6	900	6.2
34	110	120	8.4	2900	3.4
34	120	130	8.5	265	6.3
34	130	140	3.8	100	2.0
34	140	150	8.9	1440	2.5
34	150	160	8.9	150	0.4
34	160	170	7.7	130	1.5
34	170	180	8.7	2800	1.2
34	180	190	9.2	190	0.8
34	190	200	9.3	3200	0.5
34	200	210	9.3	46	0.6
34	210	220	9.7	24	0.9
34	220	230	9.2	36	1.0
34	230	235	4.8	17	1.0
34	235	245	9.5	28	0.4
34	245	255	9.5	75	1.6
34	255	265	6.5	35	0.2
34	265	270	2.9	5	0.4
34	270	280	8.5	40	0.6
34	280	290	4.4	5	0.3
34	290	300	8.7	8	0.5
34	300	310	9.7	5	0.4
34	310	320	9.5	5	0.4
34	320	330	9.7	26	0.6
34	330	340	9.7	15	0.5
34	340	350	9.8	18	0.5
34	350	360	9.3	16	0.3
34	360	370	8.5	8	0.4
34	370	380	9.7	13	0.4
34	380	390	9.6	10	0.5
34	390	400	8.7	8	0.7
34	400	410	7.9	50	0.6
34	410	420	9.5	350	1.0
34	420	430	9.5	30	0.7
34	430	440	9.4	15	0.5
34	440	445	4.2	48	0.4
34	445	455	7.2	1120	0.8
34	455	465	7.7	25	0.5
34	465	470	4.8	18	0.7

DDH	FROM (ft.)	TO (ft.)	RECOVERY (ft.)	Sn (ppm)	Ag (ppm)
36	65	75	9.3	1610	1.8
36	75	85	9.8	85	1.2
36	85	90	4.8	310	3.6
36	90	100	9.7	1810	11.0
36	100	105	4.8	1600	3.7
36	105	115	9.6	910	4.4
36	115	125	9.9	1500	11.0
36	125	135	9.7	1940	13.0
36	135	145	9.2	395	4.5
36	145	155	7.6	460	3.6
36	155	165	8.0	140	2.0
36	165	170	4.8	125	2.6
36	170	180	10.0	1510	14.0
36	180	190	10.0	5590	2.5
36	190	200	9.8	1910	11.0
36	200	210	8.1	46	1.3
36	210	220	8.2	425	1.4
36	220	225	4.5	810	1.4
36	225	235	8.1	2370	11.0
36	235	245	10.0	2090	15.0
36	245	255	7.0	680	3.3
36	255	265	9.6	1160	5.5
36	265	275	9.7	3590	6.5
36	275	285	9.7	2970	13.0
36	285	295	10.0	2010	12.0
36	295	304	8.9	2410	14.0
36	304	314	9.7	4160	15.0
36	314	323	9.0	2620	18.0
36	323	331	8.0	110	1.4
36	331	337	6.0	210	0.6
36	337	344	7.0	285	3.0
36	344	354	10.0	840	1.2
36	354	364	10.0	3780	20.0
36	365	369	5.0	7150	26.0
36	369	374	4.9	3740	2.2
36	374	384	9.8	2440	19.0
36	384	394	9.9	710	1.5
36	394	404	9.8	215	2.5
36	404	414	9.8	100	1.0
36	414	424	9.9	325	2.4
36	424	434	9.7	220	0.8
36	434	439	4.9	595	3.2
36	439	449	9.9	31	2.2
36	449	459	8.9	56	0.6
36	459	469	10.0	175	0.5
36	469	479	10.0	475	1.8
36	479	489	10.0	270	1.2
36	489	499	10.0	67	0.8
36	499	509	9.9	200	0.8
36	509	519	9.4	20	0.5
36	519	525	6.0	2590	17.0
36	525	535	9.6	680	4.3
36	535	542	7.0	2110	9.4
36	542	552	9.7	2510	11.0
36	552	562	8.8	9999	9.5
36	562	572	9.3	960	1.0
36	572	582	8.3	105	0.6
36	582	592	9.2	2250	1.6
36	592	602	8.2	1700	3.6

DDH	FROM (ft.)	TO (ft.)	RECOVERY (ft.)	Sn (ppm)	Ag (ppm)
36	602	612	8.2	2510	8.3
36	612	620	5.6	3290	4.0
36	620	625	3.9	5650	35.0
36	625	635	9.2	2680	20.0
36	635	645	8.5	960	4.2
36	645	655	9.0	270	1.1
36	655	665	8.5	790	3.8
36	665	675	9.6	1300	1.4
36	675	685	9.2	31	0.5
36	685	695	9.7	320	1.8
36	695	705	9.5	970	1.9
36	705	715	9.2	335	1.4
36	715	725	9.6	89	0.4
36	725	735	9.3	260	6.2
36	735	745	9.8	1300	0.8
36	745	755	9.6	100	0.5
36	755	762	6.8	86	1.0
37	4	14	8.2	94	1.5
37	14	24	7.8	110	2.0
37	24	34	9.6	290	1.7
37	34	44	9.6	180	0.8
37	44	54	9.7	2190	1.7
37	54	64	9.6	135	0.6
37	64	74	10.0	225	0.6
37	74	84	9.3	185	1.6
37	84	94	10.0	89	1.0
37	94	104	9.8	210	1.4
37	104	114	9.8	1680	3.0
37	114	124	9.5	600	2.6
37	124	134	9.6	1100	2.5
37	134	144	9.4	1730	5.2
37	144	154	7.5	295	3.6
37	154	164	2.8	190	2.4
37	164	174	6.1	270	1.0
37	174	184	4.6	70	1.6
37	184	194	4.8	335	1.8
39	6	12	4.7	320	2.6
39	12	21	8.0	96	1.5
39	21	31	7.2	260	1.8
39	31	41	9.3	120	0.6
39	41	51	7.8	250	1.8
39	51	61	7.2	220	2.0
39	61	71	4.6	1630	16.0
39	71	81	9.8	690	8.0
39	81	91	9.7	1300	5.0
39	91	101	9.3	150	1.2
39	101	111	8.5	830	1.1
39	131	140	9.1	75	1.6
39	140	150	10.1	105	1.4
39	150	160	10.2	180	1.7
39	160	170	10.0	140	2.3
39	170	180	9.6	605	4.2
39	180	190	9.8	47	2.0
39	190	200	9.9	87	1.2
39	200	209	9.1	74	1.2
39	209	220	11.0	1000	12.0
39	220	230	10.0	7340	5.4
39	230	240	10.0	380	4.3
39	240	250	10.1	260	7.6

DDH	FROM (ft.)	TO (ft.)	RECOVERY (ft.)	Sn (ppm)	Ag (ppm)
39	250	260	10.1	1800	2.6
39	260	270	10.0	855	6.7
39	270	280	9.6	375	2.6
39	280	290	9.3	1530	4.8
39	290	300	9.9	415	6.5
39	300	310	8.9	1820	9.6
39	310	320	9.9	550	6.2
39	320	330	9.9	3650	19.0
39	330	340	10.0	500	7.4
39	340	350	9.9	1890	5.8
39	350	359	9.5	890	1.9
39	359	369	9.9	115	1.4
39	369	379	10.0	850	8.6
39	379	389	10.0	520	4.8
39	389	401	12.1	1600	16.0
39	401	408	6.9	3180	3.1
39	408	415	6.9	145	1.4
39	415	422	6.9	3030	31.0
39	422	432	10.0	1810	9.8
39	432	442	10.0	485	5.3
39	442	452	10.0	270	2.2
39	452	462	9.9	1530	5.0
39	462	467	4.8	72	0.6
39	467	477	9.8	40	1.8
39	477	487	10.0	53	0.2
39	487	497	9.9	69	0.7
39	497	507	10.1	87	0.2
39	507	517	9.8	63	0.2
39	517	527	9.7	40	0.2
39	527	537	9.9	49	0.6
39	537	547	8.5	120	0.6
39	547	554	7.2	82	0.2
39	554	565	8.4	330	1.7
39	580	590	4.8	33	0.3
39	590	600	8.2	1630	1.3
39	600	610	9.0	1130	5.6
39	610	620	8.0	42	0.4
39	620	630	7.0	57	0.4
39	630	635	1.7	295	18.0
39	635	645	7.1	8	0.2
41	75	85	6.4	260	1.4
41	85	95	7.4	29	2.0
41	95	105	7.0	44	2.0
41	105	125	9.7	350	1.9
41	125	135	9.6	280	1.1
41	135	145	9.9	355	0.7
41	145	155	10.2	385	0.6
41	155	165	10.1	200	0.6
41	165	175	10.0	165	0.9
41	175	185	10.2	125	0.8
41	185	195	10.1	320	0.7
41	195	205	9.8	245	1.2
41	205	215	10.2	105	1.2

Appendix C. N15E cross section with assay data



Appendix D. N15E cross section with assay data