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ANALYTICAL RESULTS FOR 46 WATER SAMPLES FROM A HYDROGEOCHEMICAL SURVEY OF THE BLACKBIRD MINE AREA, IDAHO

By

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INTRODUCTION

A hydrogeochemical study was conducted in the Blackbird mining area in east-central Idaho. Forty-six water samples were collected from the study area over a two-week period in July 1982. The purpose of the study was to examine the concentration of metals and anions in water to determine the hydrogeochemical characteristics associated with a cobalt mineralized area. The samples were analyzed for 14 metal ions, silica, and 4 anions along with pH and specific conductance. The study was funded by the USGS project for the development of hydrogeochemical techniques.

STUDY AREA

The study area is located in the Salmon River Mountains, 20 mi (32.2 km) west of Salmon, Idaho (fig. 1). The area is approximately 30 mi (48.3 km) south to north and 20 mi (32.2 km) east to west. The study area includes the Blackbird mining district and portions of the Mackinaw, Clear Creek and Mineral Hill mining districts. The area is mountainous with many streams. The Salmon River has the lowest elevation of the study area with 3,120 ft (951 m), and Blackbird Mountain has the highest elevation at 9,095 ft (2,772 m). Panther Creek drains most of the study area and flows north to the Salmon River. Most of the samples were collected in the Panther Creek drainage; a few were collected from the North Fork of Iron Creek, in the southeast part of the study area.

The study area is underlain by Proterozoic, dominantly clastic metasedimentary rocks which are intruded by felsic plutons of Proterozoic, Cretaceous, and Tertiary ages. The metasedimentary and granitic rocks are cut by thrust faults and numerous steeply dipping normal faults. Cobalt-copper mineralization occurs in the Proterozoic Yellowjacket formation.

The Blackbird mine is located in the central part of the study area and was mined primarily for cobalt. It was the largest cobalt mine in the United States (Lund and others, 1983).

SAMPLE COLLECTION

Forty-six water samples were collected from 36 streams and 10 springs, two of which were hot springs. At each site, a 60 ml sample was filtered through a 0.45 μm membrane filter into an acid-rinsed polyethylene bottle, and then acidified with reagent grade concentrated nitric acid to a pH of less than 2. A 500 ml untreated sample was also collected in a clean polyethylene bottle.

ANALYTICAL METHODS

Water temperature and pH were measured at the sample site. All other analyses were completed at the U.S. Geological Survey laboratory in Denver, Colorado.

Calcium, magnesium, sodium, potassium, lithium, silica, zinc, copper, molybdenum, arsenic, iron, manganese, aluminum, and cobalt were determined using the filtered-acidified sample. Alkalinity, sulfate, chloride, fluoride, uranium, and specific conductance were determined using the untreated sample. Alkalinity is a term used to indicate the total acid-neutralizable constituents in water and is generally due to carbonate and bicarbonate ions. A complete list of analytical methods used and a reference for each are listed in table 1.

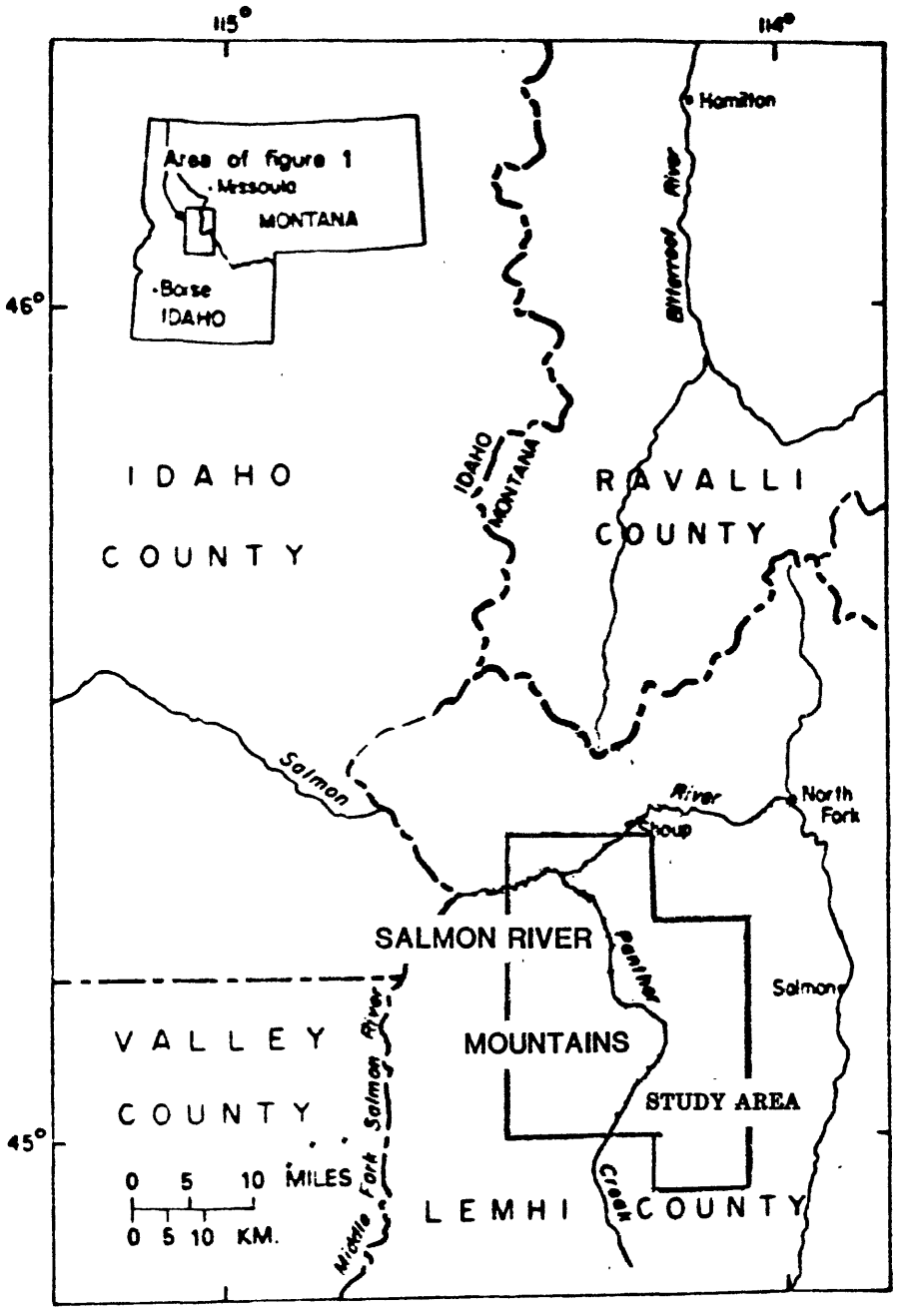

Figure 1. Index map of the Blackbird Creek study area, northeastern Idaho

RESULTS

Figure 2 is a map showing the location of each sample. Sample numbers 13 and 16 are hot springs with respective temperatures of 45°C and 90°C. The Blackbird mine is located on Blackbird Creek just above sample site 24.

The analytical results of the 22 constituents that were determined for these samples are shown in table 2 along with the latitude and longitude for each sample location. Duplicate samples were collected at sites 10-11, 30-31, 40-41, and 45-46. The results of the charge balance shown in table 2 for the 46 samples show good accuracy of analyses. Ionic solutions are electrically neutral. By comparing the sum of the charges for cations against anions, accuracy of analyses can be checked. Twenty-eight of the samples are within 5 percent, fourteen samples are between 5-10 percent, and four samples are between 10-21 percent of electrical neutrality.

The samples collected on Blackbird Creek (nos. 24, 10, 8, 11, 14, 15) and Bucktail Creek (nos. 25, 32) have very high values for cobalt, copper, zinc, and sulfate. These waters were also very acidic with pH of 3.27-6.78. These two creeks drain the Blackbird mine and surrounding area. Cobalt values from 230-150,000 ppb, copper values from 70-78,000 ppb, zinc values up to 770 ppb, and sulfate to 2,400 ppm were found in these waters.

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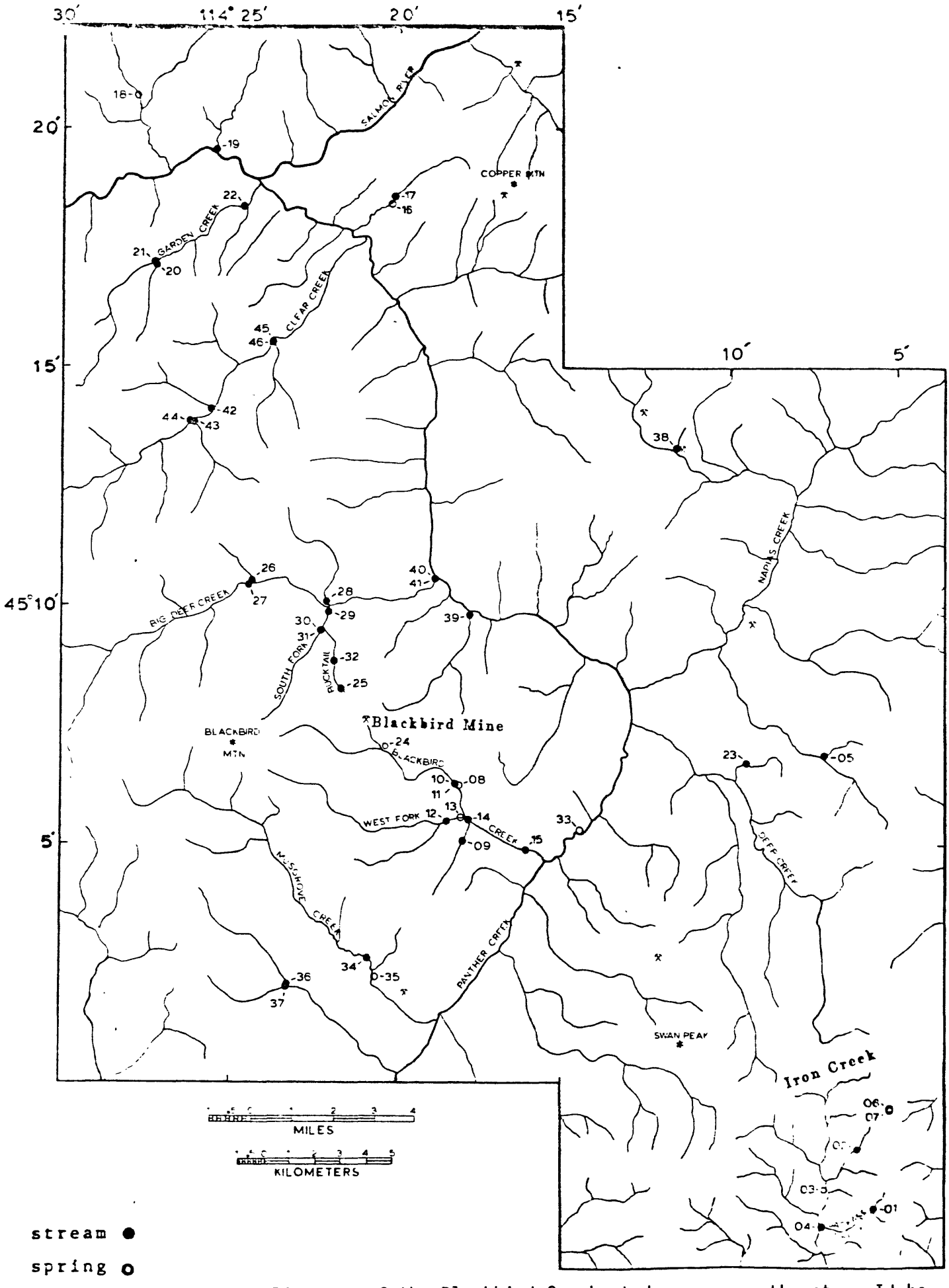

Figure 2. Sample locality map of the Blackbird Creek study area, northeastern Idaho

Table 1. Analytical methods used for water analyses, Blackbird mine area, Idaho

Constituents	Method	Reference
Alkalinity	Gran's plot potentiometric titration	Orion Research, Inc. (1978).
Sulfate, chloride, and fluoride	Ion chromatography	Fishman and Pyen (1979).
Uranium	Laser-excited fluorescence	Scintrex Corp. (1979).
Specific conductance	Conductivity bridge	Skougstad et al. (1979), p. 545.
Calcium, magnesium, sodium, potassium, silica, lithium, aluminum, iron, manganese, and zinc	Flame atomic-absorption spectrophotometry	Perkin-Elmer Corp. (1976).
Arsenic, cobalt, copper, and molybdenum	Flameless atomic-absorption spectrophotometry	Perkin-Elmer Corp. (1977).

Table 2.-- ANALYSES FOR 46 WATER SAMPLES FROM BLACKBIRD MINE AREA, IDAHO

Sample	LATITUDE	LONGITUD	CA(mg/L)	MG(mg/L)	NA(mg/L)	K(mg/L)	LI(ug/L)	SIO2(mg/L
BB01	44 57 19	114 5 38	14.0	2.50	3.3	1.60	<4	17.0
BB02	44 58 38	114 6 0	7.9	1.50	2.0	1.40	<4	12.0
BB03	44 57 45	114 6 57	10.0	11.00	6.8	2.00	<4	20.0
BB04	44 56 58	114 7 9	14.0	3.70	4.1	1.70	<4	20.0
BB05	45 6 52	114 7 9	5.0	1.10	2.6	1.80	<4	25.0
BB06	44 59 36	114 5 5	3.6	.75	2.5	.72	<4	17.0
BB07	44 59 36	114 5 5	3.5	.78	2.5	.70	<4	18.0
BB08	45 6 13	114 18 11	5.0	1.60	2.6	1.70	5	15.0
BB09	45 5 4	114 18 1	11.0	3.50	2.9	1.30	6	14.0
BB10	45 6 15	114 18 13	31.0	5.50	2.2	4.10	17	12.0
BB11	45 6 15	114 18 13	28.0	5.40	2.2	4.10	18	13.0
BB12	45 5 31	114 18 29	7.0	1.80	2.4	1.30	4	13.0
BB13	45 5 34	114 18 4	9.1	2.10	2.0	1.50	<4	11.0
BB14	45 5 31	114 17 52	15.0	3.60	2.2	2.80	12	13.0
BB15	45 4 54	114 16 10	22.0	4.20	2.6	2.90	11	13.0
BB16	45 18 26	114 20 17	7.0	.40	220.0	16.00	640	126.0
BB17	45 18 33	114 20 9	25.0	4.40	11.0	2.50	<4	26.0
BB18	45 20 41	114 27 47	6.0	.25	116.0	4.70	230	76.0
BB19	45 19 32	114 25 28	29.0	4.50	10.0	1.70	<4	23.0
BB20	45 17 8	114 27 13	25.0	3.80	5.1	2.90	<4	11.0
BB21	45 17 14	114 27 13	8.0	1.70	2.0	.91	<4	8.0
BB22	45 18 22	114 24 38	12.0	2.40	2.9	1.30	<4	9.2
BB23	45 6 44	114 9 30	6.7	3.00	4.6	2.00	4	26.0
BB24	45 7 3	114 20 23	24.0	23.00	3.9	9.00	26	24.0
BB25	45 8 16	114 21 42	140.0	115.00	2.6	80.00	140	30.0
BB26	45 10 32	114 24 23	18.0	3.30	4.3	2.00	<4	13.0
BB27	45 10 26	114 24 26	6.8	.82	2.4	.54	<4	11.0
BB28	45 10 6	114 22 9	23.0	4.10	6.3	2.60	<4	16.0
BB29	45 9 51	114 22 4	30.0	4.00	2.4	2.50	<4	7.5
BB30	45 9 31	114 22 17	25.0	1.50	2.1	1.10	<4	7.5
BB31	45 9 31	114 22 17	24.0	1.50	2.1	1.10	<4	7.5
BB32	45 8 49	114 21 55	80.0	61.00	2.9	42.00	50	27.0
BB33	45 5 18	114 14 26	24.0	7.20	7.8	2.90	<4	9.0
BB34	45 2 39	114 20 54	18.0	2.20	2.9	.83	<4	8.8
BB35	45 2 14	114 20 41	6.0	1.70	2.6	2.70	6	32.0
BB36	45 2 4	114 23 17	11.0	2.80	2.1	.60	<4	8.7
BB37	45 2 1	114 23 20	27.0	4.80	4.6	1.20	<4	14.0
BB38	45 13 19	114 11 33	5.8	.85	3.0	.78	<4	17.0
BB39	45 9 49	114 17 51	6.8	1.80	3.7	2.70	<4	15.0
BB40	45 10 36	114 18 52	12.0	1.50	3.0	1.00	<4	11.0
BB41	45 10 36	114 18 52	12.0	1.50	3.0	1.00	<4	10.0
BB42	45 14 7	114 25 35	10.0	2.00	4.0	1.10	<4	11.0
BB43	45 13 51	114 26 6	30.0	3.20	5.7	1.90	<4	12.0
BB44	45 13 51	114 26 11	7.7	.57	3.4	.42	<4	12.0
BB45	45 15 34	114 23 50	24.0	1.60	5.1	1.30	<4	18.0

ANALYSES FOR 46 WATER SAMPLES FROM BLACKBIRD MINE AREA, IDAHO

Sample	ALK(mg/L	SO4(mg/L	CL(mg/L)	F(mg/L)	ZN(ug/L)	CU(ug/L)	MO(ug/L)	AS(ug/L)
BB01	54	2.3	.60	.09	5.2	2.6	<1.0	6.3
BB02	32	1.9	.50	.08	2.7	1.7	<1.0	2.6
BB03	76	23.0	1.70	.33	5.7	40.0	1.1	2.9
BB04	67	5.2	.90	.10	2.0	1.8	<1.0	2.7
BB05	23	1.1	1.40	.12	3.2	4.2	<1.0	1.3
BB06	15	1.1	1.60	.06	4.0	4.5	<1.0	1.4
BB07	14	1.0	.80	.05	4.5	3.3	<1.0	1.0
BB08	15	8.9	.80	.09	4.3	70.0	<1.0	2.9
BB09	49	5.8	.90	.49	2.0	<1.0	<1.0	1.9
BB10	<1	92.0	2.70	.18	50.0	1,400.0	<1.0	1.7
BB11	<1	99.0	6.90	.27	40.0	1,400.0	<1.0	1.5
BB12	29	4.7	.90	.11	2.8	30.0	<1.0	4.2
BB13	35	6.8	1.50	.12	1.5	1.4	<1.0	4.6
BB14	7	44.0	1.90	.15	14.0	460.0	<1.0	1.4
BB15	10	60.0	2.20	.18	10.0	110.0	<1.0	2.5
BB16	540	46.0	29.00	16.00	<1.0	2.8	2.0	5.9
BB17	120	12.0	3.90	.76	1.8	2.5	3.7	2.2
BB18	230	50.0	5.80	20.00	<1.0	2.5	3.1	3.6
BB19	110	8.4	1.90	.62	1.2	1.5	1.9	3.6
BB20	96	6.5	1.60	.17	1.1	<1.0	5.5	2.0
BB21	34	7.8	.40	.13	3.0	<1.0	<1.0	3.2
BB22	51	3.1	.70	.18	1.4	<1.0	1.4	3.2
BB23	42	1.6	1.60	.09	2.4	1.6	<1.0	2.9
BB24	<1	510.0	9.50	1.00	360.0	12,000.0	2.2	50.0
BB25	<1	2,400.0	21.00	2.40	700.0	78,000.0	45.0	39.0
BB26	74	9.3	1.10	.12	10.0	2.9	<1.0	1.9
BB27	23	1.8	.40	.79	1.6	2.0	2.6	3.1
BB28	101	9.9	1.80	.21	1.1	3.5	1.2	8.6
BB29	67	43.0	.83	.18	13.0	980.0	3.0	2.2
BB30	85	5.5	.47	.14	1.1	5.9	3.1	1.2
BB31	62	4.8	.71	.13	1.1	6.6	3.2	1.0
BB32	<1	1,160.0	11.00	1.20	770.0	27,000.0	9.6	8.0
BB33	118	23.0	3.50	.16	2.0	10.0	5.5	14.0
BB34	50	5.1	.56	.32	2.2	2.4	1.8	2.6
BB35	<1	28.0	1.10	.26	9.2	5.6	<1.0	12.0
BB36	53	3.2	.44	.42	1.0	5.4	<1.0	1.1
BB37	106	3.4	.73	.09	1.1	1.5	<1.0	<1.0
BB38	20	1.0	.43	.06	1.1	2.3	<1.0	<1.0
BB39	29	4.9	1.30	.16	3.4	<1.0	<1.0	8.4
BB40	37	10.0	.62	.80	3.1	310.0	3.3	17.0
BB41	34	11.0	.59	.82	4.4	6.5	3.2	1.0
BB42	42	2.9	.82	.19	20.0	13.0	<1.0	1.5
BB43	110	8.6	1.60	.16	7.4	3.7	1.4	1.3
BB44	21	7.6	.73	.95	11.0	8.9	2.9	<1.0
BB45	81	4.0	1.20	.15	6.8	2.3	1.2	<1.0
BB46	80	4.0	1.30	.12	4.8	1.1	1.8	<1.0

ANALYSES FOR 46 WATER SAMPLES FROM BLACKBIRD MINE AREA, IDAHO

Sample	FE(mg/L)	MN(mg/L)	AL(mg/L)	CO(ug/L)	U(ug/L)	SP.COND.	pH	TEMP. C	CHAR BAL
BB01	.02	<.01	<.1	.4	.52	94	7.82	10.0	6.3
BB02	<.01	<.01	<.1	.2	.10	57	7.78	10.0	4.8
BB03	.05	.22	<.1	80.0	.48	170	7.77	7.0	-.8
BB04	.01	<.01	<.1	2.5	.46	112	7.73	10.0	-.3
BB05	.03	<.01	.5	.7	<.10	41	7.70	9.0	5.6
BB06	.03	<.01	<.1	.5	<.10	28	7.04	3.0	7.6
BB07	.04	<.01	.1	.6	<.10	28	7.04	3.0	14.0
BB08	.08	.03	.4	230.0	.10	58	6.94	5.0	8.0
BB09	.02	<.01	.1	.8	<.10	90	7.33	9.0	1.3
BB10	.26	.36	.4	1,500.0	.20	220	5.30	15.0	4.8
BB11	.27	.36	.4	1,600.0	.20	270	5.30	15.0	-5.1
BB12	.03	<.01	<.1	8.3	<.10	57	6.78	9.0	2.6
BB13	.59	.03	<.1	15.0	<.10	72	6.93	45.0	-.6
BB14	.58	.23	<.1	1,000.0	<.10	140	6.57	10.5	5.3
BB15	<.01	.20	<.1	1,000.0	<.10	185	6.78	14.0	4.8
BB16	.02	.01	<.1	3.6	<.10	935	7.21	90.0	-5.1
BB17	.01	<.01	<.1	.1	3.20	210	7.89	10.0	-4.6
BB18	<.01	<.01	<.1	2.5	<.10	490	8.04	11.0	-4.7
BB19	<.01	<.01	<.1	.2	2.20	200	8.06	13.0	5.4
BB20	<.01	<.01	<.1	.2	1.30	165	7.94	10.5	2.7
BB21	.01	<.01	<.1	<.1	.36	57	7.62	11.0	3.0
BB22	<.01	<.01	<.1	.1	.56	85	7.39	12.0	1.5
BB23	.13	<.01	.5	.3	<.10	72	7.07	8.5	3.9
BB24	140.00	4.80	6.9	16,000.0	<.10	1,850	3.27	9.0	4.4
BB25	.15	14.00	54.0	150,000.0	.10	2,850	4.38	5.5	-21.0
BB26	<.01	<.01	<.1	1.7	1.50	128	7.31	9.5	-1.1
BB27	.01	<.01	<.1	.5	1.20	45	7.15	10.5	5.9
BB28	<.01	<.01	<.1	7.9	5.20	165	7.64	10.0	-2.4
BB29	<.01	.14	<.1	1,300.0	<.10	195	7.58	9.0	-.7
BB30	<.01	<.01	<.1	.2	2.40	130	7.87	8.5	-1.1
BB31	<.01	<.01	<.1	.4	2.20	130	7.87	8.5	-.9
BB32	.67	6.40	20.0	65,000.0	1.60	1,650	4.37	11.0	-21.0
BB33	.02	.01	<.1	6.0	1.20	210	7.40	21.0	-6.5
BB34	.03	<.01	<.1	.9	1.40	112	7.44	12.5	6.4
BB35	.01	.18	.5	2.7	.16	90	4.57	8.0	-.5
BB36	.01	<.01	<.1	.2	.30	82	6.78	8.5	-4.3
BB37	.03	<.01	<.1	.3	1.70	175	7.35	8.5	3.8
BB38	.07	<.01	.1	.2	<.10	35	7.08	11.5	7.1
BB39	.05	<.01	.1	5.3	.72	66	7.18	11.5	7.1
BB40	.02	.02	<.1	220.0	.82	84	7.21	14.0	.5
BB41	.01	.02	<.1	32.0	.84	84	7.21	14.0	2.0
BB42	.01	<.01	<.1	.4	.60	75	7.24	9.5	5.2
BB43	<.01	<.01	<.1	.4	8.80	185	7.93	9.5	.6
BB44	.01	<.01	<.1	.3	.90	42	7.83	10.5	14.0
BB45	<.01	<.01	<.1	.2	15.00	130	7.78	11.5	4.4
BB46	<.01	<.01	<.1	.3	16.00	130	7.78	11.5	2.6