

UNITED STATES DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

**Chemical analyses of major, minor, and trace elements
including gold and the arsenic species, As(III) and As(V),
in water samples from Kelly Creek Valley, Humboldt County,
Nevada**

by

D.J. Grimes*, J.B. McHugh*, and A.L. Meier*

Open-File Report 94-135

This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature. Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

*U.S. Geological Survey, DFC, Box 25046, MS 973, Denver, CO 80225

CONTENTS

	Page
Introduction.....	1
Sample collection.....	1
Analytical methods.....	3
Description of Table 2.....	3
Acknowledgments.....	4
References cited.....	5

ILLUSTRATIONS

Figure 1. Index map showing the location of Kelly Creek Valley, and the Preble, Pinson, Getchell, Rabbit Creek, and Chimney Creek disseminated gold deposits, Humboldt County, Nevada.....	2
Plate 1. Map showing water sample sites, Kelly Creek Valley, Humboldt County, Nevada.....in pocket	

TABLES

Table 1. Analytical methods used for the analyses of water samples.....	6
Table 2. Analytical data for water samples from Kelly Creek Valley, Humboldt County, Nevada.....	7

INTRODUCTION

Kelly Creek Valley is located about 45 miles northeast of Winnemucca in Humboldt County, Nevada (Fig. 1), and contains two known buried disseminated gold deposits, the Rabbit Creek and Chimney Creek¹ deposits. The gold deposits are hosted primarily in sedimentary rocks of lower Ordovician age (Parratt et al, 1989), and the gold generally occurs as sub-micron size particles of native gold. Other minerals occurring with these Carlin-type gold deposits include orpiment, realgar, and stibnite.

A hydrogeochemical study in Kelly Creek Valley was undertaken by the U.S. Geological Survey in 1989 to determine if the chemistry of ground water would reveal the presence of the concealed gold deposits. Ground-water samples were collected from drill holes in the vicinity of the known gold deposits and from nearby wells. This report includes a map showing the location of water sample sites (plate 1), a table of the analytical methods used (table 1), and a tabulation of the hydrogeochemical data (table 2).

SAMPLE COLLECTION

During the period 1989-1991, 101 ground-water samples were collected from 40 sample sites. The samples were collected primarily from drill holes during active drilling and from exploration drill holes that were several years old. The water samples collected during drilling were obtained from reverse-circulation rotary drill rigs. The samples were taken at 60- to 100-ft intervals during drill-pipe changes, immediately after water in the drill hole had been purged. No drilling mud was used in any of the drill holes sampled, and little, if any, injection water was added. The water samples from the old drill holes were collected at and below the water table using a custom-built double-check valve bailer with a maximum volume of 1.25 L. The bailer was manually lowered into the drill holes with nylon cord to sampling depths as great as 720 ft below the ground surface. The check-valve system of the bailer enabled water samples to be trapped and retrieved from any desired depth below the water table.

A 50-mL water sample from each sample location was filtered in the field through a 0.45-micron membrane filter and acidified to a pH of less than 2 with five drops of concentrated nitric acid. Also, 2 untreated water samples with volumes of about 200 mL and

¹The Chimney Creek Mine and the Rabbit Creek Mine were combined in June 1993. The new mine is named the Santa Fe Pacific Gold Corp. Twin Creeks Mine.

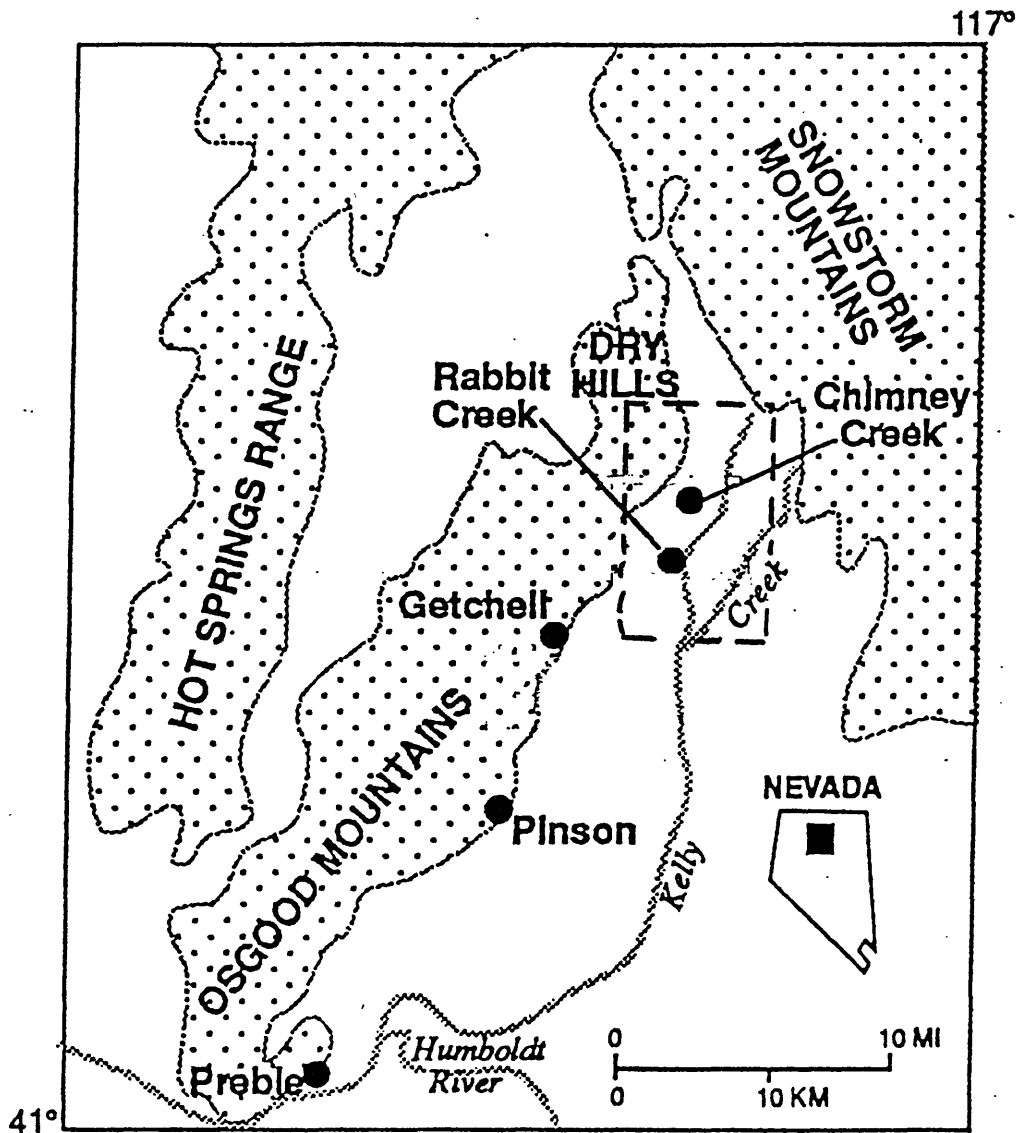


Figure 1. Index map showing the location of Kelly Creek Valley, and the Preble, Pinson, Getchell, Rabbit Creek, and Chimney Creek disseminated gold deposits, Humboldt County, Nevada; the water sampling area is outlined

1000 mL were collected at each location. For samples selected for the determination of the arsenic species, arsenite [As(III)] and arsenate [As(V)], a 10-mL aliquot of water was filtered through a 0.45-micron filter and preserved with one drop of concentrated hydrochloric acid. All the samples were stored in acid-rinsed polyethylene bottles. Temperature, alkalinity, specific conductance, and pH were measured at each site. The Eh of water samples collected with a bailer from the old drill holes was measured in the field using a platinum electrode. All other chemical analyses were determined at the Branch of Geochemistry, U.S. Geological laboratories in Denver, Colorado.

ANALYTICAL METHODS

Gold was determined in the 1000-mL water samples after filtration and acidification in the laboratory using anion-exchange graphite-furnace atomic-absorption spectrometry. Arsenic, antimony, tungsten, and other trace elements were determined in the filtered, nitric acid acidified samples, by inductively coupled plasma-mass spectrometry (ICP-MS). Calcium, iron, magnesium, manganese, potassium, silica, and sodium were determined by flame atomic absorption spectroscopy using the same sample aliquot used for the ICP-MS analysis. Chloride, fluoride, nitrate, and sulfate were determined by an ion chromatography technique using the untreated sample. Concentrations of the arsenic species, As(III) and As(V), were determined by ion-exchange graphite-furnace atomic-absorption spectrometry. The concentrations of these two species of arsenic commonly provide an approximation of the relative oxidation-reduction conditions (redox potential) present at the depth of sample collection. The analytical methods used to measure each constituent in the water samples are listed in table 1.

DESCRIPTION OF TABLE 2

Table 2 lists the field measurements and the chemical analyses for the water samples. The data are arranged so that column 1 contains the USGS-assigned sample numbers. These sample numbers correspond to the numbers shown on the site location map (plate 1). The sample numbers shown on table 2 are suffixed with the month and year of sample collection. Columns 2 and 3 list the latitude (north) and longitude (west) for each sample site in degrees, minutes, and seconds. Column 4 lists the depth of sample collection, measured in feet below the ground surface. Column 5 lists the depth to the water table at the time of sample collection. The remaining columns list analytical data. The

concentrations of the arsenic species, arsenite [As(III)] and arsenate [As(V)] are listed in columns 8 and 9, respectively, and the total arsenic (As-T) concentrations are listed in column 10.

Gold concentrations are given in nanograms per liter (note: 1 ng/L equals 1-part-per-trillion). Fe, Mn, Ca, K, Mg, Na, Cl, NO₃, SO₄, F, and SiO₂ are given in milligrams per liter (note: 1 mg/L equals 1-part-per-million). All other element concentrations are given in micrograms per liter (note: 1 µg/L equals 1-part-per-billion). The Eh values are given in millivolts (mV) and are not corrected for junction potential. The alkalinity (Alk) values are reported in milligrams per liter total alkalinity as calcium carbonate (CaCO₃). Specific conductance (Cond) is given in microSiemens/cm (µS). If an element was looked for but not detected in a sample, then a "less than" symbol was entered in the table followed by the lower limit of determination. The symbol "-" indicates the measurement was not made.

ACKNOWLEDGMENTS

The authors extend appreciation to Santa Fe Pacific Gold Corp. for permission to sample water and rock from drill holes and for sharing their time, expertise, and drill hole logs with us. Special thanks are also extended to Richard M. Wells of the Branch of Geochemistry, U.S. Geological Survey, for assisting in the design and testing of the drill-hole water sampling apparatus.

REFERENCES CITED

- Ficklin, W.H., 1983, Separation of arsenic(III) and arsenic(V) in ground waters by ion-exchange: *Talanta*, v. 30, p. 371-373.
- Fishman, M.J., and Pyen, Grace, 1979, Determination of selected anions in water by ion chromatography: U.S. Geological Survey Water Resources Investigations 79-101, 30 p.
- McHugh, J.B., 1986, Determining gold in water by ion-exchange batch extraction, *Talanta*, v. 33, p. 349-351.
- Orion Research Inc., 1978, Orion Research analytical guide (9th ed.): Cambridge, Mass., 48 p.
- Parratt, R.L., Tapper, C.J., and Bloomstein, E.I., 1989, Geology and mineralization of the Rabbit Creek gold deposit, Humboldt County, Nevada: Geological Society of Nevada Monthly Meeting Announcement, April, 1989, v. 1, no. 7.
- Perkin-Elmer Corporation, 1976, Analytical methods for atomic absorption spectrophotometry: Norwalk, Conn., Perkin Elmer Corp., 586 p.

Table 1 Analytical methods used for the analyses of water samples

Variable	Method	Reference
Alkalinity	Gran's plot potentiometric titration	Orion Research Inc. (1978)
Cl, F, NO ₃ , SO ₄	Ion chromatography	Fishman and Pyen (1979)
Ca, Fe, K, Mg, Mn, Na, SiO ₂	Flame atomic absorption spectrophotometry	Perkin-Elmer Corp. (1976)
Ag, As, Cd, Co, Cr, Cu, Ge, Mo, Pb, Sb, W, Zn	Inductively coupled plasma-mass spectrometry	unpublished
Au	Anion exchange - flameless atomic absorption	McHugh (1986)
As species - As(III), As(V)	Anion exchange - flameless atomic absorption	Ficklin (1983)

Table 2. Analytical data for water samples from Kelly Creek Valley, Humboldt County, Nevada

Sample #	Latitude	Longitude	Sample Depth (Ft.)	Water Table Depth (Ft.)	pH	Eh mV	Au ng/L	As(III) µg/L	As(V) µg/L	As-T µg/L	Sb µg/L	W µg/L	Fe mg/L	Mn mg/L	Ge µg/L	Mo µg/L
CHIM-1-JN89	41 12 44	117 9 37	-	-	7.3	77	1	<2	28	16	0.2	<1	<0.01	<0.01	0.2	2
CHIM-2-OC89	41 15 53	117 8 32	205	-	8.8	220	<1	-	-	1	0.2	1	<0.01	0.02	-	4
DE1-FB90	41 14 48	117 11 48	380	380	7.6	212	-	-	-	3	0.2	<1	<0.01	<0.01	<0.1	2
DE6-FB90	41 14 48	117 11 27	380	380	7.5	190	<1	-	-	<2	0.1	<1	<0.01	0.12	<0.1	4
DE34-OC89	41 14 36	117 10 58	329	-	7.9	190	2	<2	86	84	0.8	6	0.01	<0.01	-	5
DE36-A-JN90	41 14 13	117 10 59	260	207	7.4	16	4	<1	44	63	<0.1	5	0.01	<0.01	0.2	5
DE36-B-JN90	41 14 13	117 10 59	400	400	7.4	66	20	<1	46	70	<0.1	5	<0.01	0.01	0.2	4
DE-77-JL91	41 19 43	117 5 58	540	540	7.1	-31	1	32	15	88	1.1	<1	1.45	0.63	0.1	6
DE-115-JL91	41 17 34	117 7 4	410	391	7.6	230	2	-	-	23	0.2	8	0.02	0.21	0.9	22
KEL-1-JL91	41 19 7	117 5 54	0	-	7.7	240	<1	4	8	17	0.1	1	0.04	0.41	0.4	3

Sample #	Ca mg/L	K mg/L	Mg mg/L	Na mg/L	Cl mg/L	NO3 mg/L	SO4 mg/L	F mg/L	Alk. mg/L	SiO2 mg/L	Ag µg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Pb µg/L	Zn µg/L	Cond. µS	Temp. °F
CHIM-1-JN89	26	5.3	6	36	15	<0.1	21	0.5	150	62	<0.1	<0.2	0.1	1.4	1	0.3	9	340	62.0
CHIM-2-OC89	16	6.9	6	20	15	<0.1	7	0.6	104	5	-	-	<0.1	<0.1	1	0.3	2	290	58.0
DE1-FB90	48	8.8	34	18	41	17.0	48	<0.1	210	19	-	-	<0.1	1.7	2	<0.4	5	570	63.0
DE6-FB90	44	3.2	27	24	38	8.7	69	<0.1	190	16	-	-	0.3	<0.2	1	<0.4	6	480	58.0
DE34-OC89	37	7.4	20	56	16	120.0	37	16.5	207	14	-	-	0.2	3.3	2	<0.2	1	600	61.0
DE36-A-JN90	41	3.5	20	28	25	0.8	47	0.3	160	19	-	-	0.4	0.4	3	<0.3	3	490	61.6
DE36-B-JN90	42	3.7	23	45	44	0.3	58	-	170	20	-	-	0.5	0.4	4	<0.3	5	500	63.1
DE-77-JL91	118	4.6	36	49	25	<0.1	12	-	300	17	<0.1	<0.2	2.7	0.8	9	<1.0	10	1140	73.0
DE-115-JL91	45	9.7	6	60	19	<0.1	18	1.2	210	67	<0.1	<0.2	0.6	0.3	2	<1.0	4	580	72.0
KEL-1-JL91	40	6.1	9	46	26	4.0	17	1.8	190	67	<0.1	<0.2	0.8	0.3	2	<1.0	9	530	67.3

Table 2. Continued

Sample #	Latitude	Longitude	Sample Depth (Ft.)	Water Table Depth (Ft.)	pH	Eh mV	Au ng/L	As(III) µg/L	As(V) µg/L	As-T µg/L	Sb µg/L	W µg/L	Fe mg/L	Mn mg/L	Ge µg/L	Mo µg/L
SEC031-A-JN90	41 14 21	117 10 43	203	203	7.2	116	13	<1	44	49	0.8	5	0.01	0.01	0.5	3
SEC031-B-JN90	41 14 21	117 10 43	270		7.1	-66	4	22	17	51	0.6	5	0.31	0.42	0.6	3
SEC096-A-AUG90	41 15 22	117 8 44	158	158	7.4	189	6	<2	20	14	0.8	<3	<0.01	<0.01	0.5	9
SEC096-B-AUG90	41 15 22	117 8 44	500		7.3	170	4	<2	20	21	0.9	<3	0.01	<0.01	0.5	8
SEC171-A-JN90	41 14 21	117 9 59	170	150	7.4	53	8	<1	18	19	0.8	3	<0.01	<0.01	0.3	8
SEC171-B-JN90	41 14 21	117 9 59	400		7.3	83	4	8	19	17	0.6	2	<0.01	<0.01	0.3	7
SEC172-A-JN90	41 14 19	117 10 1	170	154	7.5	94	6	<1	24	23	0.8	3	<0.01	<0.01	0.3	9
SEC172-B-JN90	41 14 19	117 10 1	400		7.6	-16	9	<1	23	20	1.1	3	0.04	<0.01	0.4	8
SEC172-C-JN90	41 14 19	117 10 1	530		7.6	77	8	<1	23	20	1.0	3	0.01	<0.01	0.4	8
SEC182-A-JN90	41 14 24	117 9 19	120	111	7.3	187	<1	<1	18	13	<0.1	1	0.01	<0.01	0.2	6
SEC182-B-JN90	41 14 24	117 9 19	500		7.5	247	2	<1	16	14	<0.1	1	0.01	<0.01	0.3	6

Sample #	Ca mg/L	K mg/L	Mg mg/L	Na mg/L	Cl mg/L	NO3 mg/L	SO4 mg/L	F mg/L	Alk. mg/L	SiO2 mg/L	Ag µg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Pb µg/L	Zn µg/L	Cond. µS	Temp. °F
SEC031-A-JN90	46	7.6	20	38	31	<0.1	58	-	250	21	-	-	0.5	<0.2	4	2.2	6	540	62.0
SEC031-B-JN90	46	4.4	20	37	31	8.3	60	-	200	21	-	-	1.1	<0.2	3	<0.3	4	550	64.4
SEC096-A-AUG90	34	3.6	13	19	14	4.8	13	0.7	160	26	-	-	0.6	1.6	3	<0.3	9	330	58.9
SEC096-B-AUG90	34	3.5	13	22	16	4.1	25	-	160	26	-	-	0.6	1.1	2	<0.3	4	330	60.4
SEC171-A-JN90	32	6.7	13	21	20	5.1	13	-	150	21	-	-	0.3	2.2	2	<0.3	4	350	61.0
SEC171-B-JN90	34	4.4	13	24	25	11.0	14	-	150	21	-	-	0.3	2.2	2	<0.3	4	390	61.0
SEC172-A-JN90	29	3.7	10	23	13	<0.1	13	0.9	140	20	-	-	0.3	2.8	1	<0.3	3	320	62.2
SEC172-B-JN90	30	3.7	10	23	12	<0.1	11	-	160	20	-	-	0.3	2.0	1	<0.3	3	330	61.3
SEC172-C-JN90	30	6.9	18	25	20	1.8	22	-	160	20	-	-	0.2	2.3	2	<0.3	3	330	61.0
SEC182-A-JN90	33	6.3	10	20	14	<0.1	9	1.1	210	38	-	-	0.2	0.8	2	<0.3	4	320	59.0
SEC182-B-JN90	32	4.0	10	19	11	<0.1	9	-	160	35	-	-	0.3	0.8	2	<0.3	4	320	63.8

Table 2. Continued

Sample #	Latitude	Longitude	Sample Depth (Ft.)	Water Table Depth (Ft.)	pH	Eh mV	Au ng/L	As(III) µg/L	As(V) µg/L	As-T µg/L	Sb µg/L	W µg/L	Fe mg/L	Mn mg/L	Ge µg/L	Mo µg/L
SEE161-A-AUG90	41 15 16	117 10 13	359	359	6.9	119	8	<2	30	43	16.0	27	0.04	0.37	0.7	4
SEE161-B-AUG90	41 15 16	117 10 13	400		7.1	158	9	<2	36	42	23.0	28	0.02	0.31	0.8	4
SEE161-C-AUG90	41 15 16	117 10 13	450		7.1	124	82	15	30	43	56.0	33	0.05	0.32	0.8	4
SEE161-D-AUG90	41 15 16	117 10 13	500		7.2	-49	25	24	40	70	82.0	39	0.27	0.29	0.7	4
SEE367-A-FB90	41 15 15	117 10 18	390	390	7.3	160	1	<2	660	600	110.0	130	0.01	0.11	1.2	13
SEE367-B-FB90	41 15 15	117 10 18	480		7.0	150	1	480	175	650	130.0	140	0.12	0.11	1.3	14
SEE367-C-FB90	41 15 15	117 10 18	560		7.3	-10	2	750	50	710	140.0	140	0.21	0.07	1.3	13
SEE367-D-FB90	41 15 15	117 10 18	660		7.1	6	6	758	96	660	120.0	140	0.16	0.10	1.0	12
SEE367-E-FB90	41 15 15	117 10 18	720		7.3	-6	11	800	40	680	140.0	140	0.21	0.08	1.5	13
SEE596-A-JN90	41 14 19	117 10 5	157	157	7.6	96	6	<1	25	26	7.4	4	<0.01	<0.01	0.4	9
SEE596-B-JN90	41 14 19	117 10 5	170		7.5	103	5	<1	26	24	2.4	4	<0.01	<0.01	0.4	9
SEE596-C-JN90	41 14 19	117 10 5	400		7.5	107	2	3	24	25	1.6	3	0.01	<0.01	0.5	8
SEE630-A-AUG90	41 14 4	117 10 4	124	124	7.5	194	2	<2	16	22	6.3	<3	<0.01	0.03	0.4	10
SEE630-B-AUG90	41 14 4	117 10 4	300		7.5	257	2	<2	19	23	2.7	<3	<0.01	0.02	0.3	10
SEE630-C-AUG90	41 14 4	117 10 4	580		7.2	200	4	<2	21	25	1.6	<3	<0.01	0.02	0.4	10

Sample #	Ca mg/L	K mg/L	Mg mg/L	Na mg/L	Cl mg/L	NO3 mg/L	SO4 mg/L	F mg/L	Alk. mg/L	SiO2 mg/L	Ag µg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Pb µg/L	Zn µg/L	Cond. µS	Temp. °F
SEE161-A-AUG90	48	4.5	18	27	11	<0.1	66	-	220	23	<0.1	<0.2	2.2	<0.1	9	<0.3	9	400	62.4
SEE161-B-AUG90	47	4.3	18	27	10	0.4	61	-	180	23	<0.1	<0.2	1.9	<0.1	4	<0.3	5	410	63.4
SEE161-C-AUG90	49	3.9	18	26	10	<0.1	61	-	210	22	<0.1	<0.2	1.8	<0.1	4	<0.3	5	410	64.1
SEE161-D-AUG90	48	4.2	18	26	10	<0.1	63	-	220	22	<0.1	<0.2	1.6	<0.1	4	<0.3	5	410	64.9
SEE367-A-FB90	46	5.3	19	22	9	<0.1	59	0.3	201	13	-	-	0.7	<0.2	2	0.4	19	450	64.0
SEE367-B-FB90	46	4.8	19	21	8	<0.1	60	0.5	190	13	-	-	0.7	0.2	3	0.4	11	450	59.0
SEE367-C-FB90	47	4.0	19	22	7	<0.1	60	0.3	178	13	-	-	0.3	<0.2	2	<0.4	8	450	63.0
SEE367-D-FB90	47	3.5	19	21	7	<0.1	68	0.3	171	13	-	-	0.5	<0.2	1	<0.4	7	450	61.0
SEE367-E-FB90	46	3.8	19	22	7	<0.1	61	0.3	244	13	-	-	0.4	<0.2	2	<0.4	10	450	62.0
SEE596-A-JN90	29	2.5	15	19	16	<0.1	23	-	150	20	-	-	0.2	2.6	1	1.7	3	330	60.6
SEE596-B-JN90	29	4.8	13	20	18	<0.1	23	-	150	20	-	-	0.2	2.4	2	<0.3	3	330	61.1
SEE596-C-JN90	29	4.7	13	19	18	<0.1	22	-	140	20	-	-	0.3	2.4	2	<0.3	2	300	60.9
SEE630-A-AUG90	32	3.3	13	26	10	7.3	60	-	150	21	-	-	0.7	2.6	2	<0.3	5	350	59.0
SEE630-B-AUG90	31	2.7	13	25	17	6.5	20	-	180	22	-	-	0.6	2.3	2	<0.3	3	300	61.1
SEE630-C-AUG90	31	2.8	13	25	19	7.4	20	-	160	23	-	-	0.6	1.9	2	<0.3	4	340	62.5

Table 2. Continued

Sample #	Latitude	Longitude	Sample Depth (Ft.)	Water Table Depth (Ft.)	pH	Eh mV	Au ng/L	As(III) µg/L	As(V) µg/L	As-T µg/L	Sb µg/L	W µg/L	Fe mg/L	Mn mg/L	Ge µg/L	Mo µg/L
SEE647-A-AUG90	41 13 58	117 9 58	360	114	7.9	229	<1	<2	11	14	4.3	23	0.02	<0.01	0.1	23
SEE647-B-AUG90	41 13 58	117 9 58	500		7.8	222	2	<2	30	35	2.6	15	0.03	0.08	0.9	10
SEE647-C-AUG90	41 13 58	117 9 58	720		7.9	208	200	<2	38	44	5.7	28	0.02	0.05	0.8	9
SEE647-D-AUG90	41 13 58	117 9 58	960		8.4	169	310	<2	53	64	29.0	99	0.01	0.02	1.0	6
SEE683-A-FB91	41 13 48	117 10 4	285	120	8.1	112	350	25	70	62	0.9	5	0.04	0.03	0.4	6
SEE683-B-FB91	41 13 48	117 10 4	500		8.0	-86	690	<1	35	32	8.3	29	0.04	0.03	0.3	10
SEE683-C-FB91	41 13 48	117 10 4	680		7.6	63	12	<1	27	16	5.6	12	0.04	0.04	0.3	9
SEE683-D-FB91	41 13 48	117 10 4	900		7.7	-	27	12	90	93	21.0	49	0.02	0.04	0.7	5
SEE743-A-APR91	41 14 17	117 11 10	400	-	8.0	-	13	-	-	6	<0.5	1	<0.01	0.06	<0.5	3
SEE743-B-APR91	41 14 17	117 11 10	600		8.0	-	1	-	-	<2	<0.5	1	<0.01	0.12	<0.5	5
SEE743-C-APR91	41 14 17	117 11 10	800		8.0	-	1	-	-	39	6.1	9	<0.01	0.12	<0.5	11
SEE743-D-APR91	41 14 17	117 11 10	1000		7.9	-	<1	-	-	55	77.0	24	<0.01	0.06	<0.5	11

Sample #	Ca mg/L	K mg/L	Mg mg/L	Na mg/L	Cl mg/L	NO3 mg/L	SO4 mg/L	F mg/L	Alk. mg/L	SiO2 mg/L	Ag µg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Pb µg/L	Zn µg/L	Cond. µS	Temp. °F
SEE647-A-AUG90	32	5.3	10	25	15	<0.1	23	-	180	21	<0.1	<0.2	0.8	<0.1	7	<0.3	2	350	63.8
SEE647-B-AUG90	36	6.0	18	28	15	<0.1	36	-	210	25	<0.1	<0.2	3.2	6.3	3	<0.3	3	350	68.9
SEE647-C-AUG90	36	5.7	18	26	14	<0.1	37	-	240	19	<0.1	<0.2	1.3	<0.1	3	<0.3	2	380	71.4
SEE647-D-AUG90	40	6.0	23	25	17	<0.1	44	-	270	15	<0.1	<0.2	1.0	<0.1	3	<0.3	3	410	75.4
SEE683-A-FB91	33	4.3	15	37	13	0.7	38	-	210	20	-	-	0.5	0.7	<1	<0.4	<1	360	59.5
SEE683-B-FB91	34	5.2	15	43	21	<0.1	42	-	180	17	-	-	2.4	1.1	3	<0.4	1	360	-
SEE683-C-FB91	28	3.6	13	38	52	1.1	29	-	180	18	-	-	0.2	0.2	<1	<0.4	1	310	62.4
SEE683-D-FB91	39	4.9	23	41	19	<0.1	66	-	210	13	-	-	0.5	0.3	1	<0.4	4	450	-
SEE743-A-APR91	31	3.8	20	35	11	<0.1	41	-	300	19	-	-	0.9	<0.5	1	<0.5	2	430	-
SEE743-B-APR91	35	3.6	25	40	23	0.6	63	-	270	16	-	-	0.3	0.6	1	<0.5	<1	480	-
SEE743-C-APR91	39	4.2	27	43	27	<0.1	89	-	240	13	-	-	0.3	<0.5	2	<0.5	2	510	-
SEE743-D-APR91	42	4.6	25	44	28	<0.1	95	-	240	12	-	-	0.7	<0.5	2	<0.5	1	560	-

Table 2. Continued

Sample #	Latitude	Longitude	Sample Depth (Ft.)	Water Table Depth (Ft.)	pH	Eh mV	Au ng/L	As(III) µg/L	As(V) µg/L	As-T µg/L	Sb µg/L	W µg/L	Fe mg/L	Mn mg/L	Ge µg/L	Mo µg/L
DW-1-MY89	41 14 53	117 10 14	-	-	7.1	-	<1	34	110	230	2.1	8	0.08	0.03	0.9	4
DW-1-JN89	41 14 53	117 10 14	-	-	7.4	57	1	39	110	160	1.1	8	0.07	0.03	-	4
DW-1-JL89	41 14 53	117 10 14	-	-	7.7	-	2	47	120	120	1.2	6	0.01	0.03	-	5
DW-1-OC89	41 14 53	117 10 14	-	-	7.7	68	1	26	95	100	1.4	9	0.13	0.02	-	4
DW-2-JN89	41 15 9	117 10 9	-	-	7.2	33	2	24	100	100	8.1	10	0.12	0.08	-	4
DW-2-JL89	41 15 9	117 10 9	-	-	7.5	-	1	13	88	75	7.2	8	0.04	0.08	-	5
DW-2-OC89	41 15 9	117 10 9	-	-	7.8	128	<1	75	73	70	8.0	10	0.04	0.07	-	4
DW-2-FB90	41 15 9	117 10 9	-	-	7.9	213	<1	11	55	58	3.4	10	0.01	0.07	0.7	4
DW-3-JL89	41 14 52	117 10 21	-	-	7.5	-	1	580	660	1100	9.5	72	0.09	0.04	-	3
DW-3-OC89	41 14 52	117 10 21	-	-	7.7	100	<1	9	340	300	8.6	34	0.02	0.04	-	3
DW-3-FB90	41 14 52	117 10 21	-	-	7.9	209	6	20	380	340	4.3	54	0.03	0.06	1.9	3
OW1-1A-JN90	41 14 49	117 10 10	240	237	7.9	227	2	<1	23	19	0.6	2	<0.01	<0.01	0.3	4
OW1-1B-JN90	41 14 49	117 10 10	300	-	7.9	210	<1	<1	18	19	0.6	2	<0.01	<0.01	0.2	4
OW1-1C-JN90	41 14 49	117 10 10	400	-	7.9	223	2	<1	22	18	0.7	2	<0.01	<0.01	0.3	4
OW1-1D-JN90	41 14 49	117 10 10	560	-	7.9	191	1	<1	140	170	1.0	5	0.01	<0.01	0.5	5

Sample #	Ca mg/L	K mg/L	Mg mg/L	Na mg/L	Cl mg/L	NO3 mg/L	SO4 mg/L	F mg/L	Alk. mg/L	SiO2 mg/L	Ag µg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Pb µg/L	Zn µg/L	Cond. µS	Temp. °F
DW-1-MY89	45	3.3	17	29	20	<0.1	51	-	195	21	-	-	0.3	2.3	1	<0.2	4	480	64.0
DW-1-JN89	44	3.7	19	30	24	<0.1	57	0.4	200	21	-	-	0.2	2.6	3	0.2	11	510	64.0
DW-1-JL89	44	3.4	19	31	23	<0.1	84	-	200	21	-	-	0.1	-	1	<0.2	11	510	64.0
DW-1-OC89	44	3.6	19	21	21	<0.1	49	0.4	198	20	-	-	0.3	0.9	1	<0.2	1	500	65.0
DW-2-JN89	43	3.2	17	27	10	<0.1	50	0.5	200	20	-	-	2.4	1.8	1	<0.2	6	470	65.0
DW-2-JL89	43	2.9	17	28	10	<0.1	52	-	210	20	-	-	0.9	-	1	<0.2	3	470	64.0
DW-2-OC89	44	3.4	17	19	22	<0.1	51	0.3	198	20	-	-	0.6	0.5	1	<0.2	2	480	65.0
DW-2-FB90	45	4.7	17	21	11	<0.1	54	0.4	140	21	-	-	0.5	<0.1	2	<0.4	13	430	-
DW-3-JL89	46	3.4	18	33	17	<0.1	66	-	220	11	-	-	0.2	-	2	0.2	7	500	65.0
DW-3-OC89	43	3.9	18	22	20	<0.1	44	0.3	201	-	-	-	0.3	0.7	3	<0.2	1	510	63.0
DW-3-FB90	44	3.6	19	24	23	<0.1	51	0.4	190	17	-	-	0.2	<0.1	2	<0.4	46	460	-
OW1-1A-JN90	46	4.9	20	26	25	<0.1	64	-	150	23	-	-	0.5	1.7	3	0.4	7	480	64.3
OW1-1B-JN90	46	3.6	20	26	23	1.2	81	-	150	22	-	-	0.4	1.7	3	<0.3	6	480	63.4
OW1-1C-JN90	47	3.6	20	24	22	1.7	80	-	140	22	-	-	0.4	1.7	3	<0.3	7	470	62.8
OW1-1D-JN90	45	3.7	25	26	24	0.9	86	-	170	32	-	-	0.4	1.4	3	0.3	11	450	64.8

Table 2. Continued

Sample #	Latitude	Longitude	Sample Depth (Ft.)	Water Table Depth (Ft.)	pH	Eh mV	Au ng/L	As(III) µg/L	As(V) µg/L	As-T µg/L	Sb µg/L	W µg/L	Fe mg/L	Mn mg/L	Ge µg/L	Mo µg/L
OW1-2A-JN90	41 14 51	117 10 12	245	242	7.8	160	<1	<1	15	19	0.6	2	0.01	<0.01	0.3	4
OW1-2B-JN90	41 14 51	117 10 12	400		7.7	146	<1	<1	33	40	0.5	2	<0.01	<0.01	0.4	4
OW1-2C-JN90	41 14 51	117 10 12	560		7.7	139	3	<1	140	160	0.4	5	0.01	<0.01	0.9	4
OW1-3A-JN90	41 14 55	117 10 15	260	258	7.9	151	<1	3	22	20	0.8	2	0.01	<0.01	0.3	4
OW1-3B-JN90	41 14 55	117 10 15	400		7.9	144	2	<1	65	88	0.8	2	<0.01	<0.01	0.6	5
OW1-3C-JN90	41 14 55	117 10 15	560		7.9	179	2	<1	110	120	1.1	2	0.01	<0.01	0.7	5
OW2-1A-JN90	41 15 14	117 10 8	350	350	7.2	22	1	35	68	180	130.0	80	0.07	0.06	1.2	8
OW2-1B-JN90	41 15 14	117 10 8	400		7.2	-30	8	170	64	280	130.0	83	0.42	0.06	1.3	8
OW2-1C-JN90	41 15 14	117 10 8	450		7.1	8	5	72	77	210	140.0	82	0.17	0.06	1.2	8
OW2-1D-JN90	41 15 14	117 10 8	540		7.2	-42	4	200	25	280	130.0	85	0.43	0.06	1.2	8
OW2-2A-JN90	41 15 12	117 10 8	360	347	6.7	-122	8	470	7	540	0.7	120	0.80	2.30	0.7	4
OW2-2B-JN90	41 15 12	117 10 8	400		6.9	-107	14	350	1	490	0.8	70	0.92	1.40	0.7	3
OW2-2C-JN90	41 15 12	117 10 8	500		6.9	-77	17	220	17	430	2.6	88	0.83	1.30	0.8	5
OW2-2D-JN90	41 15 12	117 10 8	546		6.9	-71	23	490	5	450	1.2	74	1.00	1.60	0.7	4

Sample #	Ca mg/L	K mg/L	Mg mg/L	Na mg/L	Cl mg/L	NO3 mg/L	SO4 mg/L	F mg/L	Alk. mg/L	SiO2 mg/L	Ag µg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Pb µg/L	Zn µg/L	Cond. µS	Temp. °F
OW1-2A-JN90	47	4.0	20	26	24	<0.1	45	-	160	22	-	-	0.4	1.4	3	1.2	4	450	62.5
OW1-2B-JN90	46	4.0	20	26	25	<0.1	48	-	190	23	-	-	0.5	1.6	3	<0.3	5	460	63.9
OW1-2C-JN90	43	5.2	20	28	24	<0.1	67	-	190	23	-	-	0.4	1.7	3	<0.3	4	420	64.9
OW1-3A-JN90	43	5.0	20	36	20	<0.1	71	0.3	150	23	-	-	0.4	0.9	3	<0.3	7	480	66.5
OW1-3B-JN90	43	6.3	18	35	19	<0.1	38	0.3	170	26	-	-	0.4	1.4	2	<0.3	5	460	66.4
OW1-3C-JN90	43	4.9	18	35	18	<0.1	37	0.3	250	26	-	-	0.3	0.9	3	<0.3	6	470	67.0
OW2-1A-JN90	40	3.4	15	26	6	<0.1	32	0.9	190	20	-	-	0.8	<0.2	2	<0.3	8	400	65.7
OW2-1B-JN90	40	3.5	15	25	7	<0.1	32	0.9	160	19	-	-	0.8	<0.2	2	<0.3	10	400	68.7
OW2-1C-JN90	40	3.6	15	26	6	<0.1	32	0.9	160	22	-	-	0.7	<0.2	3	<0.3	19	400	67.6
OW2-1D-JN90	40	3.4	15	26	6	<0.1	32	0.9	230	21	-	-	0.6	<0.2	2	<0.3	16	390	69.5
OW2-2A-JN90	42	8.0	15	29	7	<0.1	39	-	200	23	-	-	1.7	<0.2	1	<0.3	27	440	65.1
OW2-2B-JN90	42	5.6	18	28	7	<0.1	32	-	200	24	-	-	1.2	<0.2	2	<0.3	7	430	65.2
OW2-2C-JN90	42	6.3	15	29	8	<0.1	38	-	180	23	-	-	1.7	<0.2	2	<0.3	18	430	65.8
OW2-2D-JN90	43	6.9	15	28	7	<0.1	40	-	170	25	-	-	1.5	<0.2	2	<0.3	11	430	65.5

Table 2. Continued

Sample #	Latitude	Longitude	Sample Depth (Ft.)	Water Table Depth (Ft.)	pH	Eh mV	Au ng/L	As(III) µg/L	As(V) µg/L	As-T µg/L	Sb µg/L	W µg/L	Fe mg/L	Mn mg/L	Ge µg/L	Mo µg/L
OW2-3A-JN90	41 15 11	117 10 8	350	346	7.1	-20	6	44	12	76	3.5	8	0.24	0.07	0.4	5
OW2-3B-JN90	41 15 11	117 10 8	400		7.1	-15	2	40	13	71	3.6	8	0.23	0.08	0.4	5
OW2-3C-JN90	41 15 11	117 10 8	540		7.1	-4	15	41	18	75	3.5	8	0.17	0.09	0.3	5
OW3-1A-JN90	41 14 54	117 10 28	300	263	7.7	213	2	<1	55	70	0.9	3	0.03	0.01	0.5	4
OW3-1B-JN90	41 14 54	117 10 28	400		7.7	209	2	<1	88	110	0.7	6	0.02	<0.01	0.5	4
OW3-1C-JN90	41 14 54	117 10 28	600		7.7	217	10	<1	84	91	0.8	5	0.02	0.01	0.5	4
OW3-2A-JN90	41 14 54	117 10 25	270	267	7.8	218	<1	<1	18	25	0.7	2	0.02	<0.01	0.4	3
OW3-2B-JN90	41 14 54	117 10 25	400		7.7	203	<1	<1	37	32	0.6	3	0.02	<0.01	0.5	4
OW3-2C-JN90	41 14 54	117 10 25	590		7.9	194	9	<1	69	120	0.9	11	0.01	<0.01	1.0	4
OW3-3A-JN90	41 14 54	117 10 22	270	268	7.8	183	1	<1	25	20	0.5	2	0.01	<0.01	0.4	4
OW3-3B-JN90	41 14 54	117 10 22	400		7.8	184	3	<1	22	20	0.6	2	0.02	<0.01	0.4	4
OW3-3C-JN90	41 14 54	117 10 22	560		7.9	188	23	<1	24	31	0.6	2	0.02	0.01	0.4	4
OW4-1A-JN90	41 14 19	117 9 7	75	75	7.4	134	2	<1	38	40	<0.1	1	0.02	<0.01	0.2	6
OW4-1B-JN90	41 14 19	117 9 7	550		7.4	147	2	<1	40	48	<0.1	1	0.02	0.01	0.4	7

Sample #	Ca mg/L	K mg/L	Mg mg/L	Na mg/L	Cl mg/L	NO3 mg/L	SO4 mg/L	F mg/L	Alk. mg/L	SiO2 mg/L	Ag µg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Pb µg/L	Zn µg/L	Cond. µS	Temp. °F
OW2-3A-JN90	45	3.7	18	32	7	<0.1	38	-	150	23	-	-	1.0	<0.2	2	<0.3	6	450	63.8
OW2-3B-JN90	45	6.3	18	31	7	<0.1	39	-	200	24	-	-	0.9	<0.2	2	<0.3	6	420	65.5
OW2-3C-JN90	45	3.7	20	31	7	<0.1	40	-	210	24	-	-	1.1	<0.2	2	<0.3	15	440	64.3
OW3-1A-JN90	44	5.1	18	36	22	<0.1	38	-	210	23	-	-	0.2	0.6	2	<0.3	3	490	65.7
OW3-1B-JN90	43	4.7	18	37	21	<0.1	38	-	200	23	-	-	0.3	0.7	2	<0.3	4	490	65.1
OW3-1C-JN90	43	4.5	23	38	19	<0.1	33	-	250	23	-	-	0.3	0.6	3	<0.3	7	490	65.1
OW3-2A-JN90	41	3.2	18	37	14	0.3	34	0.3	210	23	-	-	0.3	0.6	2	<0.3	4	460	65.7
OW3-2B-JN90	42	4.3	18	54	14	<0.1	31	0.1	210	22	-	-	0.5	6.3	4	<0.3	10	470	66.5
OW3-2C-JN90	43	3.9	15	39	16	<0.1	34	<0.1	220	22	-	-	0.5	0.7	3	0.4	11	480	64.3
OW3-3A-JN90	41	5.1	18	39	17	<0.1	37	-	210	22	-	-	0.5	0.8	3	0.3	7	440	65.7
OW3-3B-JN90	41	4.5	15	40	18	<0.1	38	-	170	23	-	-	0.4	0.9	3	<0.3	10	470	65.0
OW3-3C-JN90	46	4.1	18	41	15	<0.1	34	-	310	23	-	-	0.4	0.7	2	<0.3	3	490	65.7
OW4-1A-JN90	28	4.9	10	33	11	<0.1	10	-	150	45	-	-	0.3	0.7	<1	<0.3	7	310	61.2
OW4-1B-JN90	28	4.5	8	35	11	0.6	8	-	180	39	-	-	0.2	1.0	2	<0.3	4	330	64.7

Table 2. Continued

Sample #	Latitude	Longitude	Sample Depth (Ft.)	Water Table Depth (Ft.)	pH	Eh mV	Au ng/L	As(III) µg/L	As(V) µg/L	As-T µg/L	Sb µg/L	W µg/L	Fe mg/L	Mn mg/L	Ge µg/L	Mo µg/L
R072-A-JN90	41 14 56	117 10 42	290	277	7.4	274	11	<1	38	50	32.0	1	0.02	<0.01	<0.1	2
R090-A-JN90	41 14 50	117 10 44	270		7.7	139	2	<1	56	61	3.9	1	0.02	<0.01	0.1	4
R090-B-JN90	41 14 50	117 10 44	300		7.8	125	6	<1	55	60	3.7	<1	0.02	<0.01	0.1	4
R200-A-JN90	41 14 31	117 10 18	190		7.4	126	15	<1	23	21	0.5	2	0.01	<0.01	0.3	5
R200-B-JN90	41 14 31	117 10 18	250		7.4	119	9	<1	16	20	0.6	2	<0.01	<0.01	0.3	5
R200-C-JN90	41 14 31	117 10 18	450		7.4	170	11	4	24	31	0.8	2	0.57	0.05	0.4	6
R298-A-JN90	41 14 26	117 10 0	170	160	7.7	245	11	<1	25	24	0.7	3	0.02	<0.01	0.3	10
R298-B-JN90	41 14 26	117 10 0	500		7.6	248	26	<1	25	27	0.9	3	0.01	<0.01	0.5	8
DW-5-JL91	41 14 59	117 10 18	560	-	7.7	135	<1	-	-	570	48.0	150	0.02	0.04	3.0	4
BAC-4-JN90	41 14 30	117 6 38	8	8	6.8	212	-	<1	<1	5	<0.1	<1	0.04	<0.01	<0.1	1

Sample #	Ca mg/L	K mg/L	Mg mg/L	Na mg/L	Cl mg/L	NO3 mg/L	SO4 mg/L	F mg/L	Alk. mg/L	SiO2 mg/L	Ag µg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Pb µg/L	Zn µg/L	Cond. µS	Temp. °F
R072-A-JN90	46	4.5	18	35	9	<0.1	30	-	240	13	-	-	0.4	<0.2	3	<0.3	6	480	64.0
R090-A-JN90	41	5.5	18	34	10	<0.1	30	0.3	190	13	-	-	0.4	<0.2	2	<0.3	4	460	65.2
R090-B-JN90	41	3.8	18	38	9	0.6	33	-	160	13	-	-	0.4	0.5	2	<0.3	6	460	64.5
R200-A-JN90	40	5.9	18	29	22	2.1	37	0.3	170	21	-	-	0.4	1.0	2	<0.3	3	450	62.5
R200-B-JN90	39	6.6	15	27	21	2.4	34	-	170	21	-	-	0.4	2.0	2	<0.3	4	450	61.9
R200-C-JN90	39	6.9	15	27	20	2.4	27	-	120	22	-	-	0.6	2.0	2	<0.3	11	410	63.1
R298-A-JN90	29	2.5	10	23	13	3.0	15	-	120	19	-	-	0.3	2.5	2	<0.3	4	330	61.1
R298-B-JN90	34	3.3	13	23	17	6.2	20	-	140	20	-	-	0.3	2.0	2	<0.3	2	360	61.6
DW-5-JL91	46	3.2	18	25	19	<0.1	25	-	210	14	<0.2	<0.1	0.5	<0.2	3	<1.0	15	520	77.6
BAC-4-JN90	25	3.8	3	20	9	<0.1	8	-	110	41	-	-	0.2	<0.2	2	<0.3	10	220	59.8