

UNITED STATES DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY

**ANALYTICAL RESULTS FOR 38 HOT SPRING SAMPLES  
COLLECTED IN THE WESTERN UNITED STATES**

by

Walter H. Ficklin, Cole L. Smith, and Jerry R. Motooka

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## ABSTRACT

Water samples were collected from hot springs in Colorado, New Mexico, Utah, Nevada, and California. The concentrations of the major constituents were determined by ion chromatography and flame atomic-absorption spectrophotometry. Temperature and pH were determined by conventional techniques. Arsenic and antimony were determined by graphite furnace atomic-absorption spectrophotometry. Iron, zinc, copper, tungsten, and molybdenum were determined by inductively coupled plasma emission spectrometry following preconcentration by coprecipitation.

## INTRODUCTION

The chemical constituents in hot-spring water are important in the study of high-temperature geochemistry. The analytical results for 38 samples collected from hot springs are reported here. The data may be useful for general water quality assessment, as well as background information on the dissolved constituents in hot-spring water.

## SAMPLING TECHNIQUE

The water collected for arsenic and antimony and the group of elements determined by the coprecipitation technique was filtered through a 0.45-micron filter. A 50-ml portion of the filtered water was acidified with concentrated nitric acid (1/2 ml per 50 ml of sample) and used for the determination of arsenic and antimony. A liter of unacidified, filtered water was collected for coprecipitation of the other trace elements (Smith, Motooka, and Willson, 1984). An untreated water sample was also collected at each location and used for the determination of the major constituents.

## ANALYTICAL TECHNIQUES

The water was analyzed for all of the major constituents. Lithium, sodium, potassium, calcium, and magnesium were determined by conventional flame atomic absorption (Skougstad and others, 1979). Fluoride, chloride, and sulfate were determined by ion chromatography (Fishman and Pyen, 1979).

The concentration of arsenic and antimony was determined by graphite furnace atomic-absorption spectrophotometry with addition of nickel to stabilize the analyte during charring (Tam, 1974). The trace metals, iron, copper, zinc, tungsten, and molybdenum, were determined by inductively coupled plasma emission spectrophotometry following preconcentration (Smith, Motooka, and Willson, 1984). Boron was determined by the carminic acid method (Skougstad and others, 1979). Alkalinity was determined by Gran's Plot Titration (Orion Research, Inc., 1978). Silica was determined by flame atomic absorption using a nitrous oxide flame (Skougstad and others, 1979).

Analytical results for the major constituents, and for iron, copper, zinc, tungsten, molybdenum, arsenic, and antimony, are listed in table 1, as well as temperature, pH, and location.

## REFERENCES

- Fishman, J. J., and Pyen, G., 1979, Determination of selected anions in water by ion chromatography: U.S. Geological Survey Water Resources Investigations 79-101, 30 p.
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- Skougstad, M. W., Fishman, M. J., Friedmann, L. C., Erdmann, D. E., and Duncan, S. S., 1979, Methods for determination of inorganic substances in water and fluvial sediments: Techniques of Water Resources Investigations of the U.S. Geological Survey, chapter A1, 26 p.
- Smith, Cole L., Motooka, Jerry M., and Willson, Wyley R., 1984, Analysis of trace metals in water by inductively coupled plasma emission spectrometry using sodium dibenzylidithiocarbamate for preconcentration: Analytical Letters, v. 17, no. 15, p. 1715-1730.
- Tam, K. C., 1974, Arsenic in water by flameless atomic-absorption spectrophotometry: Environmental Science and Technology, v. 8, p. 734.

Table 1. Analytical Results for 38 Hot Springs in the Western U.S.

	Lat	Long	Na	K	Ca	Mg	Cl	SO <sub>4</sub>	HCO <sub>3</sub>	F	Li	SiO <sub>2</sub>	B	pH	Temp	As	Sb	Fe	Cu	Mo	Zn	W
	deg m s	deg m s	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
h002	35 50 58	106 37 39	47	2.1	2	2	13	17	125	0.7	0.6	65	2.1	7.9	42	50	L2	16	0.9	30	3	12
h003	35 47 29	106 41 10	1800	320	64	32	2000	29	1380	3.6	12	48	17	6.2	47	2000	10	61	1	0.6	10	4
h005	33 15 30	116 01 30	940	9	11	6	1410	120	419	2	0.2	53	14	7.5	59	210	2	56	0.8	24	4	L3
h006	33 12 02	115 34 39	5400	330	64	71	8390	200	1460	16	10	48	110	6.0	31	6	L2	37	2.4	1.5	8	L3
h009	38 30 26	112 51 08	2100	320	30	22	3450	140	297	9	16	93	80	6.2	30	3600	18	2500	0.6	3	5	30
h010	38 38 21	112 05 52	690	55	55	41	703	700	410	5.2	0.7	150	5.5	6.3	73	330	3	100	0.9	1.3	5	7
h011	35 47 29	106 41 10	1100	210	360	26	1600	31	821	3.3	13	45	45	6.1	47	1970	10	83	0.4	<0.5	3	5
h013	35 38 44	106 53 19	3200	92	350	56	3160	2764	1190	5.5	5.1	55	32	6.3	53	270	27	1000	1.3	4.7	9	L3
h015	34 02 16	106 56 19	31	3.1	22	7	11	24	148	0.6	0.1	25	24	8.2	32	49	L2	13	1.4	2.5	3	L3
h016	33 08 06	107 15 14	1100	66	190	19	1650	73	201	3.2	1.1	42	26	6.9	38	3.5	L2	12	1.1	6.3	4	L3
h017	32 33 17	107 59 39	70	8.2	40	11	21	40	263	4.8	0.1	40	16	7.4	52	8.2	L2	17	0.9	19	2	4
h018	32 44 53	107 50 10	76	1.1	8	5	29	59	101	14	0.1	54	12	9.1	59	3.5	L2	16	1.3	17	5	L3
h019	33 14 00	108 14 05	130	3.7	20	2	102	64	135	7.8	0.3	80	15	7.9	64	4.8	L2	29	1.5	12	3	9
h020	33 14 38	108 52 48	210	12	41	9	347	30	125	1.6	0.3	73	27	7.5	40	11	L2	10	0.8	5.6	2	L3
h021	35 39 11	105 17 24	160	6.6	7	5	130	37	117	16	0.3	69	17	9.0	48	2.4	L2	13	2.3	12	3	87
h022	36 19 26	105 36 22	130	4.4	15	4	71	98	87	11	0.3	52	26	8.6	35	4.1	L2	14	3.1	31	6	75
h023	36 30 29	105 43 19	52	7.4	33	9	20	49	180	1.5	0.1	58	23	7.1	33	15	L2	13	1.6	10	6	13
h024	36 18 17	106 03 09	640	39	25	10	203	133	1550	13	2.8	62	15	6.9	42	160	3	130	1.2	10	5	L3
h025	36 18 17	106 03 07	1000	38	23	13	325	129	1770	11	2.9	58	27	6.7	41	150	3	41	68	10	34	L3
h026	37 15 47	107 00 40	480	85	290	27	160	1560	530	4.1	2.5	51	20	6.3	54	120	2	17	1.0	0.5	3	5
h027	37 44 28	107 02 02	30	0.2	6	4	3.2	6.2	95	1.4	0.01	43	25	9.2	32	L2	L2	12	1.0	8.6	2	L3
h028	38 16 19	107 06 00	340	69	130	45	123	120	990	3.8	0.7	75	28	6.6	41	51	L2	28	2.6	6.2	11	L3
h029	38 30 50	107 30 29	140	10	8	4	16	160	141	16	0.2	120	24	8.3	77	3	L2	16	1.1	37	14	36
h031	38 07 59	107 44 10	350	32	290	18	102	1130	420	3.3	1.4	56	0.5	6.2	51	260	4	1200	1.1	2.9	22	7
h032	38 01 08	107 40 37	100	9.3	290	13	41	790	130	2.9	0.7	48	10.1	7.0	53	60	L2	8	1.9	9	8	12
h035	39 23 17	119 44 05	630	79	15	3	980	120	350	2.4	7.7	320	26	8.0	97	1450	43	24	0.1	--	3	56
h036	39 09 40	119 10 59	260	17	42	2	54	470	73	7.4	0.3	100	0.5	8.6	96	20	L2	17	0.2	49	4	87
h037	40 36 14	117 38 53	170	15	16	4	40	76	390	8.7	0.8	110	0.9	7.4	81	L2	2	29	0.4	--	7	53
h038	40 05 17	117 43 30	160	30	150	20	77	350	304	5.4	0.6	58	0.8	6.6	73	14	12	25	0.6	--	21	34
h039	40 24 29	117 52 59	500	86	120	19	840	71	450	5.5	2.9	160	3.5	7.1	59	8	L2	140	0.1	--	6	36
h040	40 34 01	116 35 17	200	28	8	2	68	120	325	13	1.3	340	2.0	9.3	93	39	L2	42	0.3	9	5	110
h041	40 18 58	116 25 59	270	40	16	3	51	100	545	8.8	2.2	210	3.9	8.3	61	19	L2	18	0.1	--	7	59
h043	40 57 40	117 29 38	140	26	39	8	26	53	455	3.6	0.5	57	1.2	7.2	61	14	3	22	0.2	--	8	6
h044	40 49 44	117 18 22	160	17	60	15	32	73	496	1.5	0.3	38	1.3	7.1	36	19	L2	22	0.2	19	4	L3
h046	39 12 29	118 43 23	370	31	41	2	259	350	110	7.2	0.6	160	1.9	8.2	97	23	L2	6	0.2	--	4	80
h048	40 22 55	121 30 47	1400	180	130	4	2370	85	52	2.8	8.4	190	46	7.8	93	11600	230	10	L10	--	4	16
h049	40 23 35	121 30 25	1400	190	150	7	2420	68	53	3.7	8.2	230	52	7.8	94	12800	210	19	L10	--	21	38
h050	40 27 18	121 30 04	16	6.6	18	11	1.3	380	11	0.2	0.01	210	1.5	2.0	51	4	L2	5000	6.7	--	39	L3
h051	41 02 10	121 55 34	360	5.5	57	2	160	460	46	3.7	0.10	47	4.5	8.9	58	12	L2	24	L0.1	4	18	6