TEXT FOR
TECHNICAL MAP OF THE GEOTHERMAL RESOURCES OF CALIFORNIA GEOLOGIC DATA MAP NO. 5

1984

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Text for Technical Map of the Geothermal Resources of California Geologic Data Map No. 5

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PREFACE

The "Technical Map of the Geothermal Resources of California" has been designed to provide the scientific community as well as the engineer and project designer with information on the technical aspects of geothermal occurrences throughout the state. This information is intended to help those interested in development of a geothermal resource to make an intelligent choice in the selection of the resource or resource area that best fits their specific needs.

In addition to the basic information on location, temperature, flow, and total dissolved solids that was presented on the first "Geothermal Resources of California Map," this second map with accompanying text provides both a visual display and a tabular breakdown of the chemistry for each well or spring throughout the state for which data are available. In addition, information is provided on geologic relationships and associations regarding faults and young volcanic occurrences. As with the first map, an outline is provided of the Known Geothermal Resources Areas (KGRAs), the areas with known thermal waters, and general areas of the state that are suitable for geothermal prospecting.

It has been shown that higher temperature geothermal waters are most frequently associated with higher sodium chloride and boron contents. However, as further aid to those interested in prospecting for a new or known geothermal occurrence to meet a specific need, statistical information has been developed and provided on the types of thermal waters that are most prevalent in each of the geomorphic/geothermal provinces of the state and also on the relationships of deleterious boron, pH, temperature, and TDS, to predominant constituents or water types.

When used in conjunction with a knowledge of the desired location, elevation, range of fluid temperature, and acceptable limits of various chemical constituents for an intended use, data presented in this Technical Map are expected to provide the potential developer of a geothermal resource with the information needed to choose a resource or resource area that will fulfill project needs and at the same time present a minimum of problems to be overcome. Only with information such as this map presents, can a rapid and economical decision as to the best site or sites for a geothermal project be made.

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TECHNICAL MAP OF THE GEOTHERMAL RESOURCES OF CALIFORNIA

By
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INTRODUCTION

This is the second geothermal map produced as part of the statewide inventory and evaluation of California's geothermal resources conducted by the Department of Conservation, Division of Mines and Geology under the sponsorship of the U.S. Department of Energy. The first geothermal map (California Geologic Data Map Series Map Number 4) gathered together in a single source information on the distribution of geothermal resources in California, and was intended for use by interested members of the public at large as well as by members of the scientific community. The new geothermal map is intended primarily for use by the scientific community, and by engineers and developers who have a need for more technical and complex information than was presented on the first map. It is expected that this second map will provide the technical user with the information that is needed to select a satisfactory resource and design the necessary production facilities that will provide for the successful utilization of that resource.

The second map shows the relationships between the geothermal resources, faults, and Quaternary volcanic rocks. It also provides technical information on the character of the geothermal waters. This additional technical information includes details on the chemistry of the geothermal waters, interpretations of subsurface temperatures, and other resource parameters based on water chemistry, and an analysis of the significance of provincial distribution of thermal water types within the state, as well as explanations of the methodologies used.

Only a few of the springs and wells shown on this map are taken from data more recent than that used to compile the first map, which was published in 1980. A few spring or well names have been changed to better reflect the common usage by the local community. Data available as of June 15, 1981, have been included in the preparation of this map. Most of the wells shown on the map are agricultural or domestic wells, many of which are suitable for direct heat (non-electric) applications. Many commercial high temperature wells, especially in closely-spaced production fields, have not been plotted because of space limitations.

Springs and wells with temperatures 20°C and higher are shown. Not every spring and well in the state that is 20°C or above can be shown because of both graphical limitations and intended use of the map. The emphasis is on areas of geothermal activity as evidenced by the distribution of thermal springs and wells and attendant geochemical information.

Other pertinent data both presented on or excluded from the map include the following:

Data included:
- Volcanic rocks of the Quaternary period were taken from the Geologic Map of California (Jennings, 1977).
- Historic and Quaternary faults were taken from the Fault Map of California (Jennings, 1975).

Data excluded:
- Radiometric and seismic data are not included on this map but this information will be available on other maps which are to be published by the California Division of Mines and Geology in the future.
- Earthquake epicenter data are not included but the data are available on the earthquake epicenter map of California (Real, Toppozada, and Parke, 1978).
- Geopressure data and data on geothermal exploratory wells and mineral deposits related to geothermal activity could not be shown on this map because of insufficient data.
- Areas of elevated bottom-hole temperatures in wells also could not be shown on this map because of time restrictions in obtaining the data.

Page-size maps of heat flow data, groundwater temperature, and mean annual air temperature for the State of California are shown as Figures 1-3. Heat flow data were taken from Muffler (1979), Lachenbruch and Sass (1980), and Mase, Sass, and Lachenbruch (1980). The data points were plotted on the map and contours were drawn. Maps for groundwater temperature and mean annual air temperature were taken from maps of the United States published in the year book of agriculture by the U.S. Department of Agriculture (1941). Portions showing the State of California were enlarged for the present use.

Most of the data for springs and wells were collected from the published and unpublished works of U.S. Geological Survey (GEOTHERM files), California Department of Water Resources, California Division of Mines and Geology, and California Division of Oil and Gas. Financial support from the U.S. Geological Survey for computer retrieval and computer calculations is gratefully acknowledged.

PHYSICAL PARAMETERS AND CHEMICAL CONSTITUENTS

In the table of springs and wells (Table 1), the temperatures in degrees Celsius (°C) are the highest reported and also the most recent listed. When the temperatures were not available, "W" (for warm waters) and "H" (for hot waters) symbols were used. The temperature recorded is the temperature for a spring or non-boiling well discharge, the temperature of steam separation for well discharges above boiling, or the downhole temperature if a downhole sampler was used or if the analysis was recalculated to downhole conditions.

Flow rates were measured for thermal springs and given in liters per minute (L/min.). The temperature along with the total dissolved solids and flow rate data can change with time and therefore they should be considered approximate. Springs commonly flow from more than one orifice. The temperature reported in such cases is the highest and most recent of the group. The flow rate reported in such cases is for the whole group. In some cases where a group of wells in a very small area have dried up subsequent to the latest temperature measurement, the group is represented by only one symbol on the map and the temperature reported is the highest and most recent for the group.

Where more than one set of chemical data are available for the same spring or well, only the most recent or the most complete analyses have been selected for inclusion in this table. The effec-

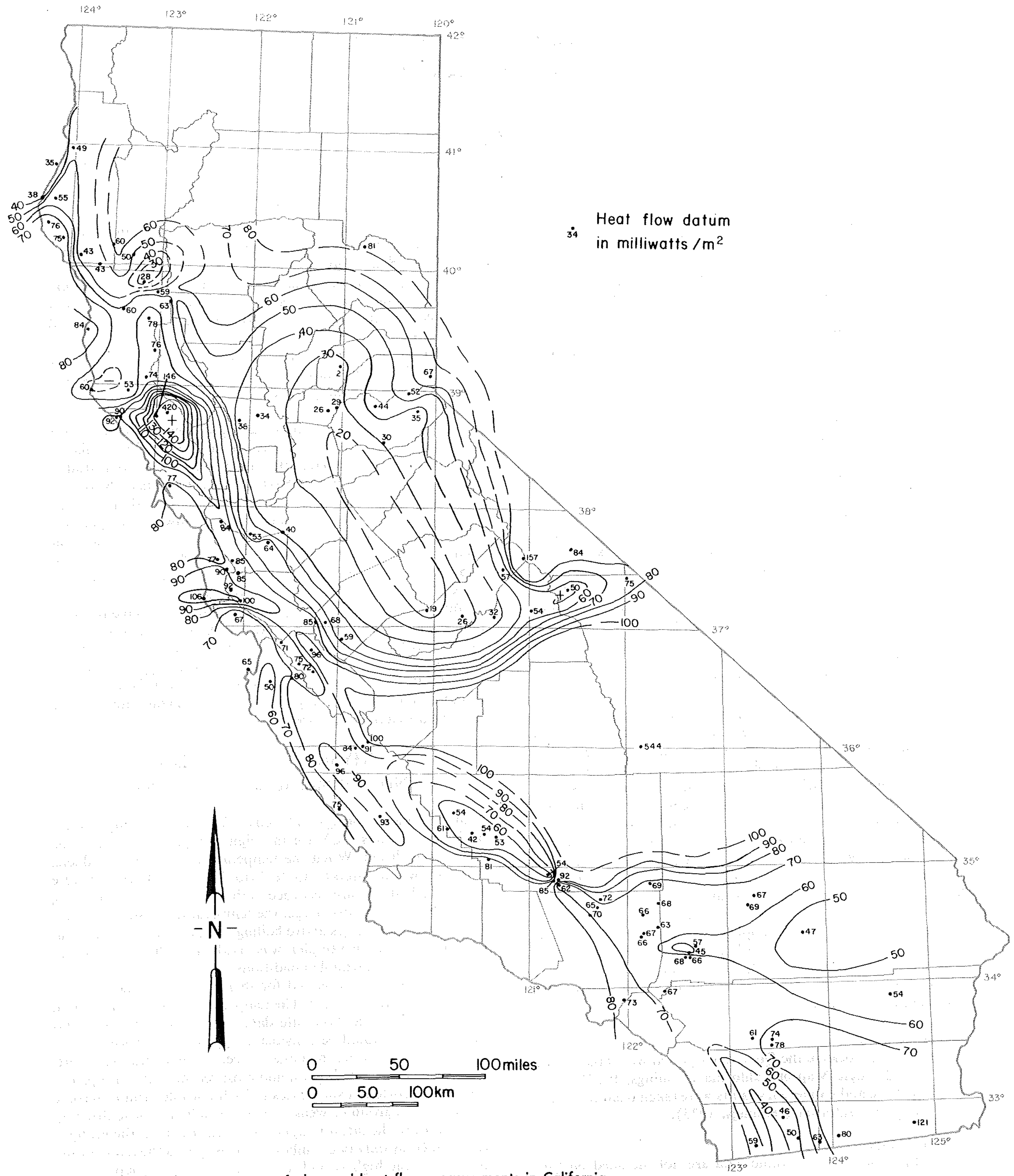

Figure 1. A contour map of observed heat flow measurements in California

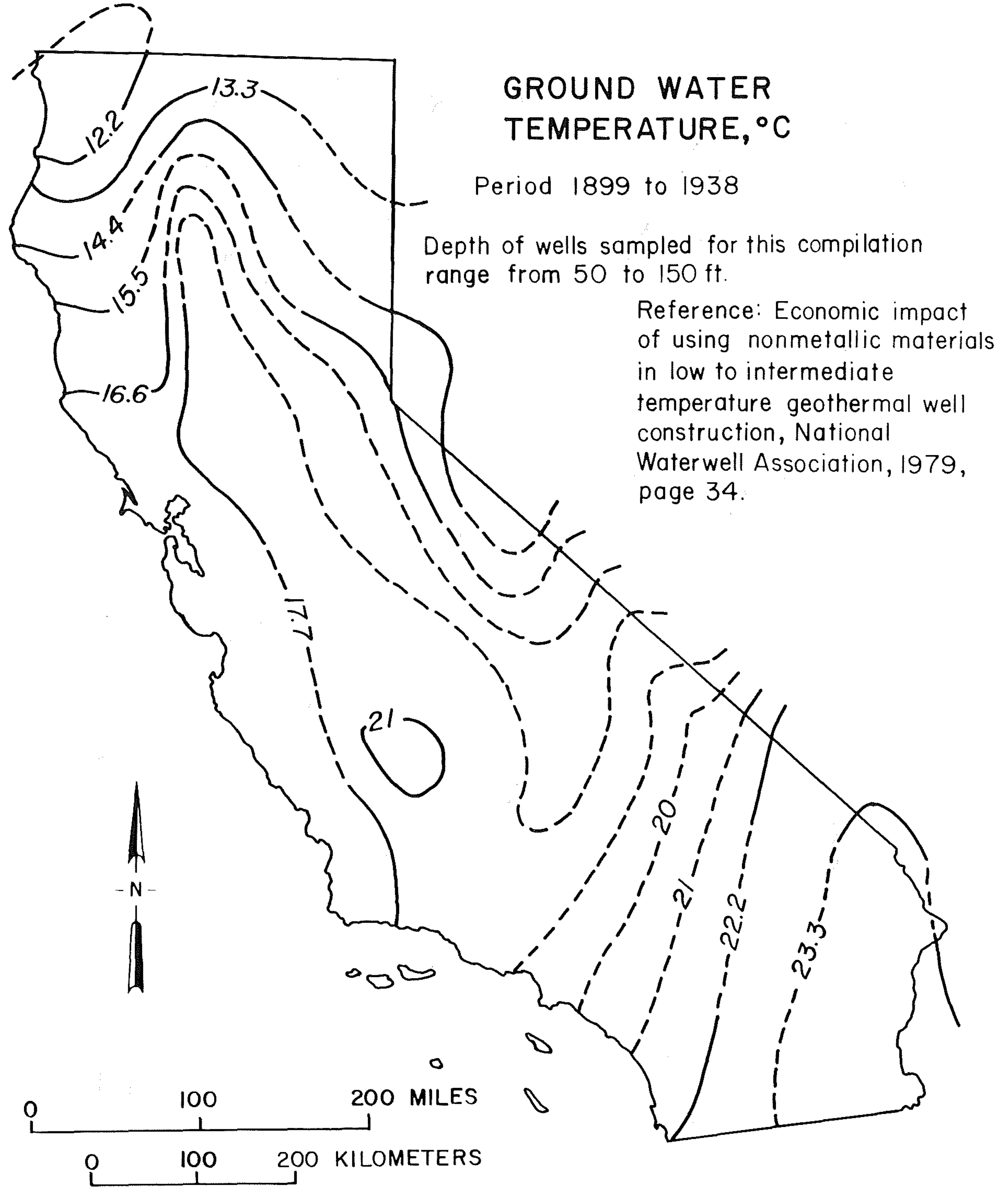

Figure 2. A contour map of groundwater temperatures in California.

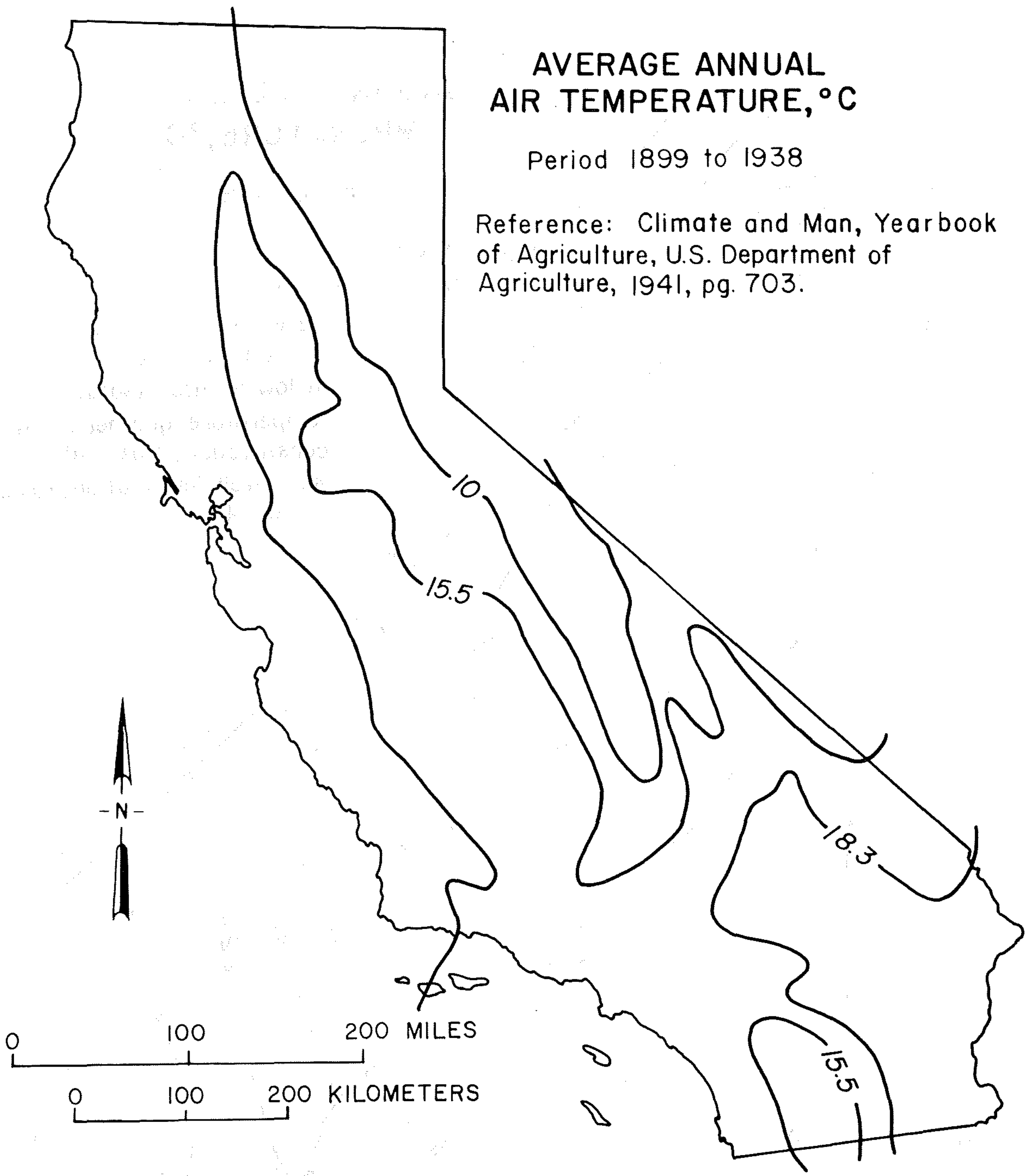

Figure 3. Average annual air temperatures of California.

Table 1. Physical Parameters and Chemical Constituents of Thermal Waters in California

Name		Latitude	Longitude	Temp °C	Flow		TDS	Concentrations		(mg/L)					HCO3					Ref
		north	west	Hi/Rec	L/min	pH	mg/L	Li	Na	K	Ca	Mg	Cl	F	Alk	SO4	SiO2	B	As	No.
	ALAMEDA																			
AL-1	CROHARE SPRING	37-37.92	121-45.72	21/21	8	7.9	659	-	164	8.4	27.0	29.0	150	0.2	309	74	37	1.6	-	3
AL-2	WARM SPRINGS	37-30.18	121-54.37	27/27	-	8.6	339	-	116	0.3	11.0	0.4	16	0.7	304	9	34	0.6	-	3
	ALPINE																			
AP-1	GROVERS HOT SPRINGS	38-41.90	119-50.70	66/64	400	6.79	1330	0.82	440	13.0	31.0	-	190	4.2	776	160	100	3.1	-	85
AP-2	UNNAMED SPRING	38-46.37	119-42.78	65/65	473	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
	CALAVERAS																			
CA-1	VALLEY SPRINGS	38-11.71	120-49.35	24/24	4	-	2530	-	1687	-	843.0	-	-	-	-	-	-			112
	COLUSA																			
CO-1	RED EYE SPRING	39-21.03	122-40.23	26/24	8	7.2	14200	5.80	5050	69.0	119.0	209.0	6040	2.2	4790	8	100	162.0	-	2
CO-2	ELGIN MINE (SPRING)	39-03.42	122-28.25	69/69	38	7.4	24699	-	9110	506.0	5.9	29.0	11000	3.0	7240	7	244	240.0	-	113
CO-3	WILBUR HOT SPRINGS	39-02.32	122-25.25	67/54	80	7.0	22750	-	8500	440.0	2.8	38.0	9700	-	7100	390	200	-	-	6
CO-4	EMPIRE SILVER MINE	39-02.27	122-25.53	38/38	1	-	14340	-	-	-	-	-	8460	-	11936	-	-	-	-	113
CO-5	JONES HOT SPRING (W)	39-02.05	122-25.59	61/61	8	8.6	28372	4.00	10790	556.0	-	19.0	12430	-	8346	150	-	317.0	-	6
CO-6	UNNAMED SPRINGS	39-02.09	122-25.59	61/61	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
CO-7	BLANCKS HOT SPRINGS	39-01.87	122-25.88	49/49	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
	CONTRA COSTA																			
CC-1	SULPHUR SPRING	37-54.88	122-02.52	27/24	8	8.2	1050	0.09	308	16.0	33.0	17.0	221	1.1	662	2	100	7.3	-	3
CC-2	UNNAMED SPRING	37-55.75	121-57.90	23/23	-	9.1	4830	-	1500	7.6	286.0	-	2750	0.2	130	16	23	10.03	-	3
CC-3	UNNAMED WELL	37-56.25	121-57.25	23/23	10	9.5	8210	-	2410	12.0	679.0	-	4870	-	85	7	17	7.4	-	113
CC-4	UNNAMED SPRING	37-53.67	121-52.42	21/21	-	7.7	10300	4.60	3100	53.0	431.0	12.0	5770	2.5	203	2	16	191.0	-	94
CC-5	BYRON HOT SPRINGS	37-50.83	121-37.83	51/51	2	7.0	11860	-	3640	47.0	736.0	81.0	7260	0.3	124	5	30	-	-	40
	EL DORADO																			
ED-1	WENTWORTH SPRINGS	39-00.78	120-20.28	24/24	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
ED-2	MEYERS WARM SPRING	38-51.00	120-01.50	24/24	15	9.4	114	0.02	33	0.9	2.4	0.9	14	0.5	55	13	22	0.3	-	113
	FRESNO																			
FR-1	FISH CREEK HOT SP	37-31.92	119-01.47	43/43	19	-	-	-	-	-	-	-	-	-	-	-	-			110
FR-2	UNNAMED SPRING	37-24.75	119-08.35	35/35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
FR-3	MONO HOT SPRINGS	37-19.60	119-01.00	44/43	200	6.92	1347	0.89	300	8.8	70.0	3.2	370	3.0	307	74	60	2.9	-	85
FR-4	BLANEY MEADOWS HOT SP	37-14.02	118-52.88	48/43	150	8.0	824	0.65	200	5.0	75.0	0.2	400	2.1	28	48	51	2.0	-	85
FR-5	MERCY HOT SPRINGS	36-42.20	120-51.57	48/48	28	8.7	2310	0.12	820	7.3	40.0	-	1310	0.5	67	6	72	14.0	-	3
FR-6	ESCARPADO SPRING	36-38.50	120-41.00	24/24	-	4.5	26800	-	4290	35.0	442.0	2470.0	399	9.8	10	18500	91	3.0	-	113
FR-7	COALINGA MINERAL SP	36-08.70	120-33.37	44/31	4	8.9	414	-	129	0.3	1.6	0.6	62	4.0	201	40	63	-	-	3
	GLENN																			
GL-1	SALT SPRING	39-25.82	122-32.18	25/24	20	6.5	22573	-	8400	90.0	115.0	262.0	11800	1.4	3068	63	140	-	-	6
	IMPERIAL																			
IM-1	FISH SPRINGS WELL	33-25.08	116-02.40	46/46	-	7.1	11080	-	3320	21.0	607.0	48.0	5950	2.6	29	463	-	10.0	-	67
IM-2	FISH SPRINGS	33-24.42	116-02.08	32/28	57	8.6	1900	-	585	8.4	88.0	14.0	910	3.6	96	211	33	1.4	-	4
IM-3	WELL 9S/9E-23M1 S	33-22.45	116-00.80	27/27	-	7.8	6200	-	1817	12.0	260.0	66.0	2360	3.6	76	1387	-	3.3	-	23
IM-4	BALLARD'S TRUCKHAVEN	33-17.83	115-58.57	40/38	45	7.8	3750	-	1460	14.0	11.0	6.1	1600	1.6	1180	1	34	-	-	23
IM-5	WELL 10S/9E-35N1 S	33-15.12	116-00.65	59/59	-	7.5	2210	-	846	-	8.0	1.0	960	-	454	132	-	-	-	67
IM-6	WELL 10S/9E-36P1 S	33-15.08	115-59.23	33/33	-	-	5798	-	2070	9.7	119.0	47.0	3039	-	566	236	-	-	-	8
IM-7	HOLLY CORP WELL	33-14.85	116-00.05	58/58	-	8.1	2256	0.36	860	6.0	-	-	960	3.4	459	119	-	6.6	0.3	23
IM-8	JACOBS NO. 3 WELL	33-07.00	116-01.07	39/39	-	8.4	1169	-	550	2.1	37.0	-	580	-	-	-	-	-	-	99
IM-9	JACOBS NO. 2 WELL	33-07.02	116-00.58	31/31	-	7.3	1650	-	381	-	162.0	31.0	628	-	84	388	19	-	-	99
IM-10	LANDMARK CORP. WELL	33-03.83	116-01.85	35/35	-	8.5	281	-	140	0.8	16.0	-	124	-	-	-	-	-	-	99
IM-11	WELL 14S/11E-32R1 S	32-54.18	115-50.88	28/28	-	7.5	1870	-	445	-	133.0	36.0	365	1.4	82	827	16	1.6	-	67
IM-12	C.L. SMITH WELL	32-43.00	115-57.78	29/29	-	8.6	878	-	832	8.4	38.0	-	-	-	-	-	-	-	-	99
IM-13	J. GREENE WELL	32-47.00	115-56.87	29/29	-	7.7	15243	-	4300	15.0	410.0	150.0	2200	0.6	109	8100	11	3.7	-	67
IM-14	DOLLINGER WELL	32-46.58	115-56.43	30/30	-	8.3	9345	-	3780	15.0	630.0	-	4920	-	-	-	-	-	-	99
IM-15	MILLER'S WELL	32-43.75	116-01.00	34/34	-	9.5	334	-	110	1.0	1.7	0.8	79	4.0	130	14	59	0.7	-	67
IM-16	H. D. CURREY WELL	32-44.33	116-00.28	29/29	-	7.6	923	-	240	6.1	69.0	13.0	340	1.3	130	130	40	0.8	-	67
IM-17	DAVIS SPRING (WELL)	32-41.67	116-01.50	28/28	-	9.5	394	-	120	1.0	1.0	-	99	3.2	111	25	50	0.7	-	4
IM-18	TEXACO STATION WELL	32-43.83	115-59.62	33/33	-	8.9	300	-	110	0.6	2.0	0.5	69	5.2	149	13	25	0.7	-	67
IM-19	W. SIMPSON WELL	32-41.38	115-55.48	29/29	-	7.9	455	-	89	5.0	49.0	8.0	85	0.6	115	113	-	-	-	67
IM-20	UNNAMED WELL	33-25.50	115-41.50	77/77	-	7.7	4060	-	978	53.0	138.0	33.0	1530	2.0	397	208	25	0.9	-	90
IM-21	HOT MINERAL SPA WELL	33-25.55	115-41.13	88/88	900	8.2	2810	4.00	880	50.0	74.0	35.0	1400	4.0	140	201	78	4.7	-	4
IM-22	BASHFORD'S HOT MIN (W)	33-25.42	115-40.85	62/62	-	7.8	3270	-	980	46.0	132.0	33.0	1540	3.2	305	207	-	-	-	23
IM-23	FOUNTAIN OF YOUTH (W)	33-24.20	115-39.70	60/60	-	6.5	4670	-	1380	77.0	245.0	57.0	2240	3.5	773	171	66	6.6	-	23
IM-24	WELL 9S/13E-20E1 S	33-22.73	115-38.62	31/31	-	7.1	4077	-	1224	56.0	191.0	39.0	1918	3.9	525	198	-	5.0	-	23
IM-25	UNNAMED MUD VOLC	33-20.70	115-35.25	W/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
IM-26	UNNAMED MUD VOLC	33-20.70	115-34.20	W/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
IM-27	UNNAMED MUD VOLC	33-19.40	115-34.20	W/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
IM-28	UNNAMED MUD VOLC	33-19.40	115-35.25	W/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
IM-29	UNNAMED MUD VOLC	33-18.70	115-36.40	W/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
IM-30	UNNAMED MUD VOLC	33-18.70	115-35.25	W/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
IM-31	UNNAMED MUD VOLC	33-17.10	115-34.20	W/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
IM-32	UNNAMED MUD VOLC	33-17.10	115-35.30	W/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
IM-33	WELL 11S/14E-2A1 S	33-14.65	115-28.63	45/44	-	6.8	1810	-	600	17.0	44.0	21.0	540	-	608	250	29	4.2	-	67
IM-34	UNNAMED MUD POT	33-13.18	115-34.82	100/38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
IM-35	J. MASSION WELL	33-13.18	115-34.72	41/40	-	6.4	23271	-	7200	504.0	854.0	232.0	12423	1.8	1684	377	-	50.0	-	23
IM-36	EARTH ENERGY HUDSON 1	33-12.73	115-34.17	89/40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23
IM-37	UNNAMED MUD POTS	33-12.75	115-35.75	100/38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
IM-38	WELL 11S/13E-22H1 S	33-11.90	115-35.82	28/28	-	7.4	1600	-	384	-	134.0	49.0	710	-	100	275	3	-	-	8
IM-39	IID 3 - IMP. THER. PR.	33-12.32	115-35.30	105/105	-	7.50	34700	40	10600	1250.0	1130.0	74.0	19700	1.0	574	621	120	100.0	0.2	50
IM-40	EARTH ENERGY RVR RANCH	133-12.15	115-34.68	345/345	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23
IM-41	UNNAMED MUD POT	33-12.05	115-34.63	38/38	-	7.4	16300	12.00	5540	307.0	360.0	22.0	9010	2.8	1260	218	71	69.0	-	4
IM-42	O'NEILL GEOTHERMAL INC	33-12.03	115-35.23	310/310	-	-	334987	-	70000	24000.0	34470.0	18.0	201757	-	-	34	5	149.0	-	23
IM-43	IID 1 - IMP.THERM. PR.	33-12.12	115-35.50	316/316	-	5.20	257800	215.00	50400	17500.0	28000.0	54.0	155000	15.0	150	5	400	390.0	-	50
IM-44	IID 2 - IMP. THER. PR.	33-11.80	115-39.90	360/348	3300	4.64	259000	-	53000	16500.0	27800.0	10.0	155000	-	1015	-	400	390.0	-	23
IM-45	ELMORE 1 WELL	33-10.98	115-36.73	360/360	2400	4.90	318000	-	62800	20800.0	31500.0	16.0	185000	-	40	49	-	350.0	-	50
IM-46	MAGMAMAX 3 MAGMA POWER	33-10.12	115-37.37	321/321	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50
IM-47	MAGMAMAX 2 MAGMA POWER	33-10.12	115-37.75	278/278	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50
IM-48	MAGMAMAX 1 MAGMA POWER	33-09.75	115-37.12	265/265	-	6.1	203406	76.00	47300	7960.0	23600.0	110.0	123389	12.0	62	10	435	-	0.2	50
IM-49	MAGMA POWER, WOOLSEY 1	33-09.75	115-36.87	171/171	-	6.4	98600	67.00	30000	3200.0	7800.0	120.0	52000	-	-	-	150	-	-	67
IM-50	SINCLAIR 4	33-08.92	115-37.28	255/164	-	5.6	285000	243.00	60100	15000.0	29800.0	35.0	167000	-	114	1	-	280.0	-	50
IM-51	SINCLAIR 3	33-08.82	115-36.45	280/168	4500	5.3	153836	49.00	36340	7820.0	14550.0	780.0	93650	2.4	60	58	350	210.0	10.0	50
IM-52	WELL 13S/14E-9R1 S	33-01.72	115-31.40	138/138	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	67
IM-53	C. BOWLES WELL	33-07.56	115-28.67	41/41	-	7.93	1185	-	682	5.2	93.0	-	405	-	-	-	-	-	-	99
IM-54	WELL 12S/15E-3A1 S	33-09.70	115-23.32	31/31	-	-	2148	-	708	-	54.0	48.0	763	-	628	267	-	0.5	-	67
IM-55	WELL 12S/15E-26J1 S	33-05.77	115-22.33	33/33	-	7.6	1450	-	502	-	20.0	11.0	477	1.4	278	275	24	-	-	8
IM-56	WELL 12S/15E-27R1 S	33-05.38	115-23.33	34/34	-	8.0	1710	0.24	530	3.7	19.0	9.7	510	1.5	293	300	36	2.7	-	98
IM-57	WELL 13S/15E-5D1 S	33-04.00	115-26.87	39/36	40	7.8	2330	0.32	620	5.4	11.0	11.0	230	1.4	1308	100	36	2.6	-	98
IM-58	WELL 13S/15E-3N1 S	33-02.65	115-24.97	40/41	-	8.1	1620	0.17	500	3.0	9.7	4.2	450	2.0	486	120	38	2.4	-	98
IM-59	WELL 13S/15E-3Q1 S	33-02.70	115-24.28	40/40	-	7.9	1320	-	489	-	17.0	2.6	490	1.5	368	115	23	-	-	8
IM-60	WELL 13S/15E-1B1 S	33-03.67	115-22.22	55/55	-	8.0	3220	0.63	1100	9.4	43.0	14.0	1200	1.3	380	620	33	9.7	-	67
IM-61	WELL 13S/16E-6A1 S	33-03.62	115-21.13	32/32	-	7.8	1250	-	448	-	14.0	9.0	467	1.5	268	160	14	-	-	67
IM-62	WELL 12S/16E-31N1 S	33-04.50	115-20.92	39/39	20	7.8	3350	0.68	1200	7.7	37.0	11.0	1700	1.3	292	60	27	8.9	-	98
IM-63	WELL 13S/16E-6J1 S	33-02.97	115-20.95	33/33	-	8.2	1730	0.32	560	3.8	21.0	10.0	610	1.2	253	250	22	2.5	-	98
IM-64	WELL 13S/16E-18F1 S	33-01.33	115-21.50	28/28	-	8.2	1127	-	530	2.6	32.0	-	562	-	-	-	-	-	-	99

(W) = WELL (SP) = SPRING

Table 1. Physical Parameters and Chemical Constituents of Thermal Waters in California - Continued.

Name	Latitude north	Longitude west	Temp °C Hi/Rec	Flow L/min	pH	TDS mg/L	Concentrations (mg/L) Li	Na	K	Ca	Mg	Cl	F	HCO_3 Alk	SO4	SiO2	B	As	Ref No.
IM-65 WELL 13S/16E-6P1 S	33-02.63	115-21.50	32/32	20	8.1	1830	0.41	580	4.1	23.0	9.3	660	1.0	273	240	31	4.7	-	98
IM-66 WELL 13S/16E-6N1 S	33-02.63	115-21.73	38/38	-	8.1	1610	-	572	-	19.0	9.8	672	-	210	205	3	-	-	8
IM-67 WELL 13S/15E-1Q1 S	33-02.80	115-22.22	29/29	-	-	1343	-	493	5.0	14.0	7.0	553	1.2	240	152	-	1.9	-	8
IM-68 MEYER-DICKERMAN WELL	33-01.83	115-22.22	37/37	-	8.2	1400	-	504	-	14.0	8.3	488	-	314	210	23	-	-	67
IM-69 DICKERMAN-BUTTERS (W)	33-01.40	115-21.98	52/52	-	7.8	1888	-	950	6.4	22.0	-	910	-	-	-	-	-	-	99
IM-70 WELL 13S/15E-16Q1 S	33-00.95	115-25.43	41/39	40	8.3	1610	0.18	490	3.1	9.9	3.3	400	1.9	550	120	30	2.4	-	98
IM-71 WELL 13S/15E-24E1 S	33-00.50	115-22.83	39/39	-	8.2	1200	-	447	-	11.0	4.0	442	1.7	316	125	15	-	-	8
IM-72 WELL 13S/15E-24N1 S	33-00.08	115-22.88	43/43	60	8.4	1610	0.17	500	2.9	8.7	3.3	450	1.4	480	130	29	1.8	-	98
IM-73 WELL 13S/15E-23Q1 S	33-00.08	115-23.32	56/56	160	7.7	3020	0.56	980	8.7	29.0	10.0	960	1.3	453	540	33	3.7	-	98
IM-74 T. SHANK WELL	32-58.95	115-26.93	44/44	-	7.8	2640	0.13	900	4.5	19.0	12.0	820	1.2	685	160	30	5.7	-	98
IM-75 N. FIFIELD WELL	32-58.07	115-26.93	54/51	-	7.8	3810	0.23	1200	6.9	40.0	15.0	1300	1.0	897	310	35	2.0	-	98
IM-76 MAGNOLIA SCHOOL WELL	32-58.95	115-25.32	53/51	140	7.7	3410	0.50	1100	8.9	29.0	14.0	1400	1.0	554	270	32	2.2	-	98
IM-77 WELL 13S/15E-33K1 S	32-58.47	115-25.45	33/33	-	7.7	5710	-	1760	-	135.0	77.0	1360	-	334	2200	13	-	-	8
IM-78 M. PHEGLEY WELL	32-58.50	115-25.50	44/44	40	8.2	1960	0.14	570	3.4	8.8	4.0	380	1.9	843	100	44	4.9	-	98
IM-79 FIFIELD-HOEPNER (W)	32-58.48	115-24.40	44/22	-	8.6	1055	-	562	-	13.0	-	328	1.7	816	121	29	-	-	67
IM-80 ORITA FEED LOT WELL	32-58.50	115-24.07	43/43	-	8.2	1460	-	555	-	11.0	4.0	342	1.8	748	145	27	-	-	99
IM-81 B. EMANUELLI WELL	32-58.95	115-20.17	41/41	-	8.2	531	-	518	2.6	10.0	-	-	-	-	-	-	-	-	67
IM-82 WELL 13S/16E-28R1 S	32-59.20	115-18.95	36/36	-	8.0	1680	-	593	-	-	-	608	-	211	336	-	-	-	99
IM-83 MAMER WELL	32-57.20	115-25.92	31/31	-	7.6	3170	-	1050	-	60.0	53.0	1160	-	510	575	21	-	-	67
IM-84 J. BIRGER WELL	32-56.70	115-25.90	31/31	20	7.8	3400	0.17	1000	5.9	52.0	45.0	1200	1.2	563	-	36	3.7	-	98
IM-85 MOIOLA WELL	32-57.20	115-23.83	42/42	28	8.2	1820	0.12	520	3.1	10.0	4.2	340	2.0	822	81	31	5.5	-	98
IM-86 BOWMAN WELL	32-56.28	115-24.35	48/48	239	8.1	2120	0.15	610	3.7	22.0	4.2	490	1.6	811	130	36	13.0	-	98
IM-87 MENDIBURI WELL	32-56.70	115-22.73	52/52	-	7.7	2970	0.42	940	8.0	33.0	10.0	1000	1.2	382	550	33	6.8	-	98
IM-88 F. BORCHARD WELL	32-57.48	115-19.17	39/38	48	8.4	1390	0.11	390	2.1	4.8	2.0	170	3.3	654	130	23	7.6	-	98
IM-89 F. BORCHARD WELL	32-57.57	115-19.25	38/37	-	8.4	1370	0.12	390	2.0	6.2	2.1	200	2.9	622	120	23	1.1	-	98
IM-90 WELL 14S/16E-11H1 S	32-57.05	115-17.02	35/35	-	8.2	1310	0.25	420	3.0	12.0	5.2	500	1.3	203	130	30	9.0	-	98
IM-91 WELL 14S/16E-16B1 S	32-56.32	115-19.18	35/32	-	8.1	1030	3.00	385	-	8.0	-	284	1.8	432	105	29	-	-	67
IM-92 WELL 14S/16E-15K1 S	32-55.88	115-19.18	29/25	4	8.2	1020	0.08	310	2.2	13.0	5.3	300	1.6	313	57	18	0.8	-	67
IM-93 WELL 14S/16E-21D1 S	32-55.47	115-19.70	36/36	-	7.9	1080	-	411	-	7.4	4.3	275	2.0	528	98	23	-	-	8
IM-94 WELL 14S/16E-21B1 S	32-55.47	115-19.18	35/33	20	8.3	1270	0.08	380	2.0	7.6	3.0	300	2.6	448	100	28	2.8	-	98
IM-95 WELL 14S/16E-22D1 S	32-55.47	115-28.68	42/42	20	7.9	2580	0.36	900	5.7	31.0	8.2	1200	1.7	272	130	28	2.7	-	98
IM-96 COONS WELL	32-54.15	115-18.33	31/31	-	8.3	637	-	375	1.7	6.3	-	254	-	-	-	-	-	-	99
IM-97 WELL 14S/16E-19N1 S	32-54.92	115-21.90	50/50	-	8.1	1310	-	765	-	27.0	6.9	955	-	332	135	23	-	-	8
IM-98 J. BIRGER NO. 1 WELL	32-55.02	115-23.85	39/39	20	8.2	1740	0.11	500	3.0	8.7	3.9	350	2.3	750	87	37	2.6	-	98
IM-99 J. BIRGER NO. 2 WELL	32-54.58	115-24.27	32/32	16	7.9	1920	0.09	530	4.2	26.0	15.0	330	1.7	704	280	24	3.7	-	98
IM-100 H. FOSTER WELL	32-54.15	115-25.40	31/31	-	8.2	1399	-	780	-	31.0	21.0	735	-	684	250	27	-	-	8,99
IM-101 JENSON WELL	32-53.72	115-24.38	30/30	120	8.0	2140	0.11	590	4.2	29.0	13.0	530	1.3	746	190	33	2.8	-	98
IM-102 GADDIS WELL	32-53.03	115-24.25	36/36	60	8.0	2150	0.11	620	4.6	30.0	17.0	420	1.3	655	370	24	2.7	-	98
IM-103 WELL 15S/15E-1H1 S	32-52.62	115-22.23	38/38	-	8.2	1240	-	480	-	9.1	3.5	315	2.6	676	65	30	3.2	-	8
IM-104 WELL 15S/16E-7F1 S	32-51.78	115-21.50	27/27	-	8.4	1120	-	421	-	8.0	3.0	213	-	644	114	39	-	-	67
IM-105 HOOKE WELL	32-51.47	115-21.18	36/36	12	8.3	1610	0.11	460	2.5	9.1	3.5	260	2.8	721	110	38	4.4	-	98
IM-106 WELL 15S/15E-12H1 S	32-51.73	115-22.23	39/38	-	8.2	1024	-	407	-	-	-	218	-	618	96	-	-	-	8
IM-107 UNNAMED WELL	32-51.70	115-22.50	38/38	-	7.6	1020	-	405	3.0	7.6	3.0	206	3.1	609	96	-	3.3	-	8
IM-108 C. ALLEN WELL	32-50.87	115-24.57	40/40	40	8.1	1750	0.11	490	2.9	11.0	4.0	320	2.0	800	84	33	2.5	-	98
IM-109 WELL 15S/15E-13N1 S	32-50.38	115-22.75	36/36	-	8.3	978	-	367	-	9.0	3.0	127	2.8	618	134	26	-	-	8
IM-110 WELL 15S/15E-9N1 S	32-51.45	115-26.00	34/34	-	7.6	4990	-	1790	-	54.0	67.0	2400	-	824	233	29	-	-	8
IM-111 WELL 15S/15E-10G1 S	32-51.73	115-24.37	32/32	108	7.8	2220	0.12	670	4.9	22.0	17.0	600	1.8	673	190	37	1.9	-	98
IM-112 WELL 15S/15E-9E1 S	32-51.93	115-25.90	34/33	-	8.0	2600	-	865	-	45.0	35.0	960	1.1	508	356	41	2.2	-	67
IM-113 UNNAMED WELL	32-51.00	115-27.50	38/38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	90
IM-114 WELL 15S/14E-13E1 S	32-50.88	115-28.92	35/35	-	7.2	9110	-	2300	-	560.0	361.0	4550	-	268	1200	8	-	-	67
IM-115 MAGMA EN. CO BONANZA 1	32-49.90	115-30.53	H/H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
IM-116 UNNAMED WELL	32-51.50	115-34.00	30/30	-	7.7	10520	-	3312	59.0	417.0	119.0	6000	3.0	281	452	22	2.2	-	8
IM-117 MAGMA EN. FED-RITE 1	32-41.20	115-39.37	H/H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	67
IM-118 MAGMA EN. HOLTZ 2	32-42.92	115-33.47	159/159	-	6.4	12800	3.20	3200	220.0	860.0	4.7	6500	-	-	-	75.0	-	-	67
IM-119 MAGMA EN. HOLTZ 1	32-42.92	115-32.55	168/168	-	6.3	11800	3.80	3600	240.0	860.0	37.0	6300	-	-	-	85	-	-	67
IM-120 CHEVRON, NOWLIN PARTNER	32-42.92	115-31.58	H/H	-	7.1	14080	6.60	3600	360.0	880.0	2.4	9000	1.6	20	100	120	4.8	-	50
IM-121 WELL 15S/15E-26B1 S	32-49.12	115-23.35	40/40	-	8.0	1760	0.12	500	3.2	11.0	4.7	300	2.0	797	110	26	3.6	-	98
IM-122 WELL 15S-15E-25D1 S	32-49.35	115-22.95	37/37	-	8.0	1313	-	500	4.0	13.0	3.0	304	1.9	666	99	-	2.0	-	8
IM-123 WELL 15S-15E-25F1 S	32-49.20	115-22.75	40/40	-	8.0	1280	-	484	-	13.0	1.8	282	1.2	692	120	29	-	-	8
IM-124 WELL 15S/15E-25B1 S	32-49.30	115-22.02	44/44	-	7.9	2140	-	794	-	18.0	6.6	870	-	470	180	32	-	-	8
IM-125 WELL 15S/16E-18Q1 S	32-50.43	115-21.15	36/36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	67
IM-126 WELL 15S/15E-36D1 S	32-48.57	115-22.82	29/29	12	7.8	1270	0.04	350	2.5	15.0	7.9	290	1.7	492	79	23	3.2	-	98
IM-127 WELL 15S/15E-35A1 S	32-48.60	115-23.08	45/45	115	8.0	2330	0.21	790	4.6	20.0	6.1	950	1.4	374	150	29	3.6	-	98
IM-128 SPANISH TRAILS PARK	32-48.93	115-21.83	43/43	-	8.0	1725	-	828	3.9	32.0	-	861	-	-	-	-	-	-	99
IM-129 A. FUSI JR. WELL	32-48.68	115-21.23	41/40	-	8.2	1600	0.09	450	2.5	9.0	3.3	260	2.3	700	130	41	6.7	-	98
IM-130 WELL 15S/16E-29Q2 S	32-48.65	115-20.23	37/37	-	8.3	1020	-	385	-	1.1	1.0	115	2.8	634	170	21	-	-	8
IM-131 R. GAREWAL WELL	32-50.58	115-18.52	33/32	-	8.4	1460	0.12	420	2.2	7.6	2.7	220	3.9	612	160	25	2.7	-	98
IM-132 WELL 15S/16E-22L1 S	32-49.95	115-18.37	35/35	12	8.2	1830	0.16	570	3.7	17.0	5.5	600	2.2	435	170	22	2.9	-	98
IM-133 WELL 15S/16E-23F1 S	32-50.02	115-17.45	34/34	100	8.4	1300	0.13	370	2.1	6.7	2.0	160	3.4	592	140	23	3.5	-	98
IM-134 WELL 15S/16E-36E1 S	32-48.22	115-16.52	38/38	-	8.3	787	-	300	-	8.2	1.6	159	3.0	450	76	14	-	-	8
IM-135 MAGMA EN. SHARP 1	32-47.77	115-17.18	126/126	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	67
IM-136 C. ANSIEL WELL	32-47.33	115-19.38	38/36	-	8.2	2080	0.12	610	3.5	11.0	5.2	490	1.6	863	74	22	3.2	-	98
IM-137 MESA 6-2 U.S.B.R.	32-47.15	115-15.33	187/186	900	7.70	2377	4.00	760	69.0	13.0	-	710	3.2	715	202	250	-	-	50
IM-138 MESA 6-1 U.S.B.R.	32-47.17	115-14.93	204/204	1500	5.45	26889	-	8100	1050.0	1360.0	17.0	15850	1.0	202	43	320	9.8	0.3	50
IM-139 UC 6-1S1 WELL	32-47.17	115-14.93	33/33	-	8.4	435	-	405	3.9	24.0	-	-	-	-	-	-	-	-	99
IM-140 MESA 5-1 U.S.B.R.	32-47.65	115-13.83	170/170	-	6.7	2394	-	798	49.0	47.0	4.0	825	-	705	196	130	-	-	50
IM-141 U.C. RIVERSIDE 127 (W)	35-45.97	115-14.17	83/83	-	7.5	3260	-	1195	27.0	44.0	3.2	1710	1.1	329	60	58	4.0	-	67
IM-142 LINDEN GRAVEL WELL	32-45.92	115-16.20	49/49	-	7.8	1864	-	840	5.2	24.0	-	995	-	-	-	-	-	-	99
IM-143 S. SCHNEIDER WELL	32-46.30	115-16.57	42/42	-	8.3	478	-	315	1.6	7.0	-	154	-	-	-	-	-	-	99
IM-144 WATTON WELL	32-45.95	115-17.03	44/43	-	8.1	1680	0.25	560	3.6	17.0	3.5	630	2.1	314	120	26	3.4	-	98
IM-145 WELL 16S/16E-15B1 S	32-45.95	115-18.17	37/37	16	8.3	1420	0.10	420	2.4	10.0	2.7	310	2.3	519	130	25	2.2	-	98
IM-146 LECHUGA STORE WELL	32-45.36	115-20.20	41/40	-	8.0	1210	-	615	3.1	9.5	-	582	-	-	-	-	-	-	99
IM-147 WELL 16S/16E-33D1 S	32-43.35	115-19.68	43/31	-	8.0	1550	-	576	-	17.0	4.3	662	-	316	115	21	-	-	99
IM-148 L. BORNT WELL	32-41.55	115-20.10	37/35	-	8.1	1460	0.11	450	2.9	17.0	4.2	400	1.7	374	180	29	1.5	-	98
IM-149 MAGMA EN. SHARP 2	32-42.93	115-17.87	H/H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	67
IM-150 SMITH BROTHERS WELL	32-59.87	115-04.32	71/71	-	6.8	1300	-	1135	86.0	79.0	-	-	-	-	-	-	-	-	99
IM-151 ERMA MINE WELL	32-59.90	114-58.90	30/30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	99
IM-152 GOLD ROCK RANCH (W)	33-52.10	114-54.70	37/37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	99
IM-153 USBR No. 115 WELL	32-48.12	115-00.92	100/100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9
INYO																			
IN-1 KEOUGH HOT SPRINGS	37-15.23	118-22.58	59/58	2000	8.8	450	0.34	145	2.5	13.0	0.1	180	8.1	28	60	30	0.7	-	85
IN-2 UNNAMED SPRINGS	37-16.05	118-16.33	29/29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
IN-3 GRAPEVINE SPRING	37-01.61	117-22.99	38/37	115	6.0	630	0.18	145	15.0	53.0	20.0	59	3.0	450	80	34	1.1	-	40
IN-4 UPPER WARM SPRING	36-49.8	117-44.2	50/50	-	6.78	897	-	210	20.0	63.0	19.0	66	5.4	433	260	45	1.6	-	83
IN-5 PALM SPRING	36-48.8	117-45.8	50/50	-	7.17	876	-	210	20.0	61.0	18.0	65	5.2	421	250	44	1.4	-	83
IN-6 LOWER BURRO WARM SP	36-48.35	117-46.30	43/43	-	7.9	850	-	231	22.0	51.0	22.0	67	6.4	368	210	54	1.1	-	90
IN-7 LITTLE HUNTER CAN SP	36-41.87	117-50.88	27/27	568	8.3	539	-	23	5.1	88.0	34.0	10	0.3	155	263	29	0.4	-	113
IN-8 UNNAMED SPRING	36-29.73	117-53.57	30/30	57	7.7	1502	1.20	440	46.0	22.0	65.0	238	0.4	1213	20	74	1.0	-	113
IN-9 DIRTY SOCKS H. S. (W)	36-19.77	117-56.92	34/34	-	7.6	7813	-	2000	95.0	48.0	70.0	1600	-	3000	52	94	19.0	-	91
IN-10 DEVILS KITCHEN FUMAROLE	36-02.08	117-47.92	97/97	-	2.2	2260	-	14	28.0	18.0	81.0	-	0.9	1	1450	326	0.6	-	90

(W) = WELL (SP) = SPRING

Table 1. Physical Parameters and Chemical Constituents of Thermal Waters in California - Continued.

Name	Latitude north	Longitude west	Temp °C Hi/Rec	Flow L/min	pH	TDS mg/L	Concentrations (mg/L) Li	Na	K	Ca	Mg	Cl	F	HCO_3 Alk	SO4	SiO2	B	As	Ref No.
IN-11 COSO HOT SPRINGS (W)	36-03.0	117-46.20	115/97	-	8.5	5345	-	1630	244.0	74.0	1.0	3040	2.2	156	53	154	72.0	7.5	90
IN-12 UNNAMED FUMAROLE	36-02.02	117-49.96	97/97	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
IN-13 UNNAMED SPRING	35-56.40	117-54.15	27/27	1	-	960	-	328	-	48.0	-	163	-	745	54	-	-	-	110
IN-14 BAINTER SPRING	35-50.57	117-22.86	33/24	1	6.0	250	-	30	0.6	43.0	7.0	45	0.6	114	29	38	0.4	-	21
IN-15 WELL 24S/43E-9P1 M	35-49.78	117-19.77	32/32	-	8.3	10980	-	4230	47.0	22.0	14.0	5000	1.3	531	1350	15	39.0	-	21
IN-16 WELL 24S/43E-9P1 M	35-51.35	117-20.43	58/58	-	-	53450	-	20300	-	16.0	0.42	23500	-	-	8520	-	40.0	-	21
IN-17 WARM SULFUR SPRINGS	36-07.35	117-12.90	27/27	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
IN-18 WARM SPRING	35-58.00	116-55.87	W/W	-	-	381	-	28	-	66.0	23.0	30	-	134	168	-	0.3	-	113
IN-19 TECOPA HOT SPRINGS	35-53.4	116-14.2	48/28	-	8.45	2488	-	885	17.0	2.0	0.2	545	3.0	712	580	100	9.2	-	83
IN-20 RESTING SPRING	35-52.65	116-09.38	27/27	980	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
IN-21 TECOPA WELL	35-53.15	116-14.00	48/48	-	8.1	2150	0.16	705	16.0	5.0	-	543	3.2	644	464	67	9.4	-	40
IN-22 UNNAMED SPRING	35-53.30	116-15.47	W/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
IN-23 CHAPPO SPRING	35-56.87	116-11.30	27/27	380	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
IN-24 SHOSHONE SPRING	35-58.80	116-16.38	32/32	-	7.3	965	-	244	21.0	42.0	28.0	144	1.6	374	247	-	4.0	-	113
IN-25 TRAVERTINE SPRINGS	36-26.45	116-49.75	32/32	-	8.0	601	0.13	145	11.0	26.0	22.0	39	3.0	321	158	43	-	-	113
IN-26 NEVARES SPRINGS	36-30.73	116-49.25	40/40	1325	6.7	650	0.13	120	11.0	42.0	21.0	38	3.5	340	224	22	0.9	-	113
IN-27 KEANE WONDER HOT SP	36-40.57	116-55.55	34/34	113	7.4	3001	0.78	932	42.0	89.0	43.0	514	7.0	1210	719	60	8.6	-	113
KERN																			
KR-1 UNNAMED SPRING	35-43.70	118-24.50	45/41	60	6.6	240	-	63	4.0	2.0	-	11	4.2	82	69	-	-	-	40
KR-2 SCOVERN HOT SPRINGS	35-37.25	118-28.40	56/43	151	8.2	420	0.22	136	2.7	2.8	0.2	37	8.5	277	17	65	2.5	-	113
KR-3 MIRACLE HOT SPRINGS	35-34.50	118-31.84	50/50	76	8.3	210	0.08	56	4.0	4.0	1.0	44	5.0	106	10	50	1.7	-	40
KR-4 DELONEGHA HOT SPRINGS	35-34.40	118-36.77	44/43	95	8.9	300	-	74	4.0	14.0	-	90	3.2	86	21	45	3.5	-	40
KR-5 UNNAMED SPRING	35-32.12	118-38.97	W/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
KR-6 DEMOCRAT HOT SPRINGS	35-31.73	118-40.02	46/39	95	8.05	280	-	71	4.0	2.0	-	64	2.2	148	10	56	3.8	-	40
KR-7 YATES HOT SPRINGS	35-25.90	118-28.90	38/38	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
KR-8 WELL 26S/39E-19Q1 M	35-39.16	117-49.18	31/31	-	7.2	455	-	84	4.2	65.0	9.2	152	0.6	84	99	-	-	-	14
KR-9 WELL 26S/39E-24P1 M	35-39.17	117-43.88	34/34	-	9.1	210	-	82	0.8	2.8	1.0	14	0.8	179	21	-	-	-	14
KR-10 WELL 26S/40E-22P1 M	35-39.20	117-39.80	32/32	-	8.6	1000	-	407	7.1	3.4	0.6	152	4.0	815	23	-	3.0	-	14
KR-11 WELL 27S/40E-7G1 M	35-36.10	117-42.70	30/30	-	7.4	1740	-	414	11.0	176.0	33.0	895	0.2	152	73	63	2.4	-	14
KR-12 WARM SPRING	35-08.85	118-46.98	W/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
KR-13 WELL 28S/27E-7C2 M	35-30.80	119-06.60	29/29	-	9.1	132	-	53	-	1.5	2.3	28	0.0	96	-	-	-	-	32
KR-14 MIZE SPRING	35-29.00	119-55.00	23/23	-	7.7	3060	-	484	4.8	301.0	140.0	264	0.6	207	1740	14	5.5	-	117
KR-15 CARNEROS SPRING	35-26.32	119-50.77	32/32	189	7.8	476	-	66	3.3	58.0	17.0	21	0.2	156	197	21	-	-	117
KR-16 UNNAMED SPRING	35-22.00	119-43.28	35/34	-	7.7	2830	-	430	10.0	230.0	181.0	250	-	337	1560	-	3.8	-	117
KR-17 CHINA LAKE WELL	35-38.60	117-42.75	30/30	5000	6.7	280	0.06	56	1.0	14.0	4.0	37	1.1	133	69	29	0.6	-	40
KR-18 PLACER CLAIM SPRING	35-34.65	118-32.94	40/40	8	8.1	-	0.09	54	4.0	13.0	1.0	47	4.0	638	-	38	1.2	-	40
LAKE																			
LK-1 CRABTREE HOT SPRINGS	39-17.43	122-49.27	42/41	76	7.8	5350	4.40	1650	34.0	50.0	188.0	1120	0.4	3680	29	154	277.0	-	2
LK-2 UNNAMED SPRING	39-12.00	122-43.50	32/32	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
LK-3 NEWMAN SPRINGS	39-11.88	122-42.86	33/33	94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
LK-4 COMPLEXION SPRING	39-10.22	122-30.75	23/23	1	11.2	34350	0.01	13200	391.0	8.0	1.3	20200	2.0	-	20	120	23.0	tr.	2
LK-5 UNNAMED SP (CHALK MT)	39-04.33	122-35.00	24/24	11	6.8	11325	11.00	3070	313.0	-	-	4660	-	5670	25	68	400.0	-	113
LK-6 UNNAMED SPRING	39-03.40	122-35.70	21/21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
LK-7 UNNAMED SPRING	39-01.33	122-35.51	27/27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
LK-8 SULPHUR BANK WELLS	39-00.23	122-39.68	166/99	-	8.1	5700	6.40	1340	44.0	26.0	23.0	900	1.4	2600	680	203	828.0	-	2
LK-9 SULFUR BANK HOT SP	39-00.20	122-39.90	80/70	1	7.5	4990	4.80	1100	33.0	7.0	22.0	690	1.0	2960	454	72	60.0	-	113
LK-10 UNNAMED SPRINGS	38-59.15	122-44.15	38/38	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
LK-11 KETTENHOFEN 1 WELL	38-56.95	122-45.10	187/187	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43
LK-12 BIG SODA SPRINGS	39-00.48	122-47.23	32/32	500	5.86	1116	-	100	12.0	92.0	130.0	63	-	1180	1	140	-	-	64
LK-13 UNNAMED WELL	38-58.60	122-50.00	24/24	38	-	2337	-	484	36.0	93.0	111.0	164	-	1171	639	110	5.8	-	110
LK-14 HIGHLAND SPRINGS	38-56.25	122-54.47	29/28	15	-	2030	-	134	12.0	295.0	231.0	19	-	2424	-	123	1.0	-	110
LK-15 ENGLAND SPRINGS	38-53.80	122-52.75	24/24	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110
LK-16 CARLSBAD SPRING	35-55.08	122-47.87	26/26	12	5.62	854	-	140	15.0	12.0	95.0	220	-	547	1	104	-	-	64
LK-17 SULLIVAN 1 WELL	38-53.10	122-47.40	82/82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43
LK-18 GORDON WARM SPRING	38-50.10	122-43.85	35/35	57	7.2	385	0.12	50	4.2	11.0	27.0	40	-	250	1	-	1.3	-	113
LK-19 SEIGLER HOT SPRING	38-52.57	122-41.28	57/52	28	6.88	1565	-	162	20.0	30.0	238.0	272	0.1	1322	6	170	19.0	-	6
LK-20 HOWARD SPRINGS	38-51.50	122-40.40	45/42	250	6.58	2050	-	240	23.0	32.0	320.0	460	-	1660	2	160	-	-	64
LK-21 SPIERS SPRINGS	38-50.25	122-39.10	29/29	57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110
LK-22 ANDERSON SPRINGS	38-46.37	122-42.43	53/52	2	7.9	753	0.22	38	6.7	106.0	46.0	1	0.4	286	335	59	0.2	-	114
LK-23 HARBIN SPRINGS	38-47.32	122-39.38	50/48	30	8.94	390	0.02	130	0.7	3.0	1.8	31	3.7	260	10	53	1.3	-	64
LK-24 CASTLE ROCK SPRINGS	38-46.20	122-42.90	73/73	38	-	346	-	-	-	62.0	-	6	-	122	24	113	-	-	110
LK-25 BAKER SODA SPRING	38-53.55	122-31.90	24/24	8	7.6	8930	7.00	2630	189.0	69.0	336.0	3010	0.8	4560	10	81	179.0	-	2
LASSEN																			
LS-1 BARE RANCH SPRING	41-10.00	120-02.10	32/32	19	8.4	254	-	50	1.8	7.1	-	15	2.1	72	43	34	0.3	-	13
LS-2 WARM SPRING	41-09.76	120-24.23	21/21	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
LS-3 KELLOG HOT SPRING	41-07.55	121-01.50	90/90	15	8.6	880	0.12	240	5.9	30.0	0.1	110	2.6	34	370	85	3.2	-	98
LS-4 BASSETT HOT SPRINGS	41-08.70	121-06.65	80/80	200	8.5	820	0.10	220	3.2	30.0	0.1	93	2.0	32	370	68	2.5	-	98
LS-5 UNNAMED SPRINGS	41-00.80	121-16.35	W/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
LS-6 ROOSEVELT POOL WELL	40-24.55	120-39.75	38/38	-	8.0	233	0.01	20	3.8	19.0	3.4	2	0.1	122	11	53	-	-	98
LS-7 CHURCH OF L.D.S. WELL	40-24.38	120-39.60	49/49	800	7.9	558	0.05	140	4.6	24.0	1.6	64	1.2	70	190	62	1.4	-	98
LS-8 WIRTH WELL NO. 1	40-24.40	120-39.30	49/49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	109
LS-9 N. STATE GROWERS (W)	40-24.28	120-39.38	61/61	-	7.6	660	-	177	8.0	32.0	1.0	98	-	36	260	66	1.9	-	109
LS-10 N. NO. 1 WELL	40-24.50	120-39.60	63/63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	109
LS-11 LASSEN LUMBER & BOX 2(W)	40-24.10	120-38.80	37/37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	109
LS-12 EAGLE LAKE LUMBER WELL	40-24.20	120-37.90	27/27	-	8.1	446	-	136	3.0	11.0	2.0	52	-	95	148	38	1.3	-	109
LS-13 UNNAMED WELL	40-24.80	120-39.50	53/53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
LS-14 WELL 30N/13E-31R1 M	40-24.50	120-33.00	26/26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	109
LS-15 SELLICKS SPRINGS	40-34.10	120-19.50	22/22	3939	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110
LS-16 TIPTON SPRINGS	40-34.80	120-15.90	21/21	3496	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110
LS-17 WELL 29N/15E-16G1 M	40-22.40	120-17.60	27/27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	109
LS-18 WENDEL HOT SPRINGS	40-21.35	120-15.31	96/96	1200	8.4	1040	0.12	280	7.5	18.0	0.1	190	4.1	52	360	120	5.5	-	98
LS-19 MAGMA POWER WENDELL 1	40-21.40	120-15.30	79/79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	81
LS-20 SOUTHERN PAC. RR (W)	40-20.52	120-13.25	28/28	300	8.3	279	0.01	58	8.0	6.0	2.2	17	0.2	114	32	42	0.2	-	98
LS-21 MAGMA POWER AMEDEE 1,2	40-18.00	120-11.68	107/107	227	8.9	830	0.30	227	6.8	16.0	-	160	-	-	274	-	4.1	-	113
LS-22 AMEDEE HOT SPRINGS	40-18.25	120-11.75	96/95	6840	8.43	860	0.08	250	5.5	14.0	tr	160	4.4	44	300	-	4.0	-	98
LS-23 WELL 28N/17E-20J1 M	40-15.90	120-04.50	27/27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	109
LS-24 HIGH ROCK SPRING	40-14.80	120-00.41	30/30	1984	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110
LS-25 UNNAMED SPRING*	39-58.80	120-03.83	42/42	577	-	-	-	-	-	-	-	-	-	-	-	-	-	-	66
LS-26 ZAMBONI HOT SPRING	39-55.30	120-01.40	41/41	473	9.37	212	-	66	0.6	2.2	-	14	2.0	74	57	36	1.0	-	83
LOS ANGELES																			
LA-1 WARM SPRINGS	34-36.43	118-33.73	33/33	76	9.0	1210	0.12	336	4.9	76.0	0.5	355	9.2	37	368	36	6.2	-	3
LA-2 WELL 6N/12W-13N1 S	34-36.15	118-06.50	27/27	-	7.8	193	-	50	1.2	16.0	3.2	8	0.4	156	23	-	-	-	35
LA-3 WELL 4N/16W-1Q1 S	34-27.25	118-30.75	28/28	-	6.7	875	-	130	3.0	115.0	34.0	62	-	261	403	-	-	-	29
LA-4 SEMINOLE HOT SP (W)	34-06.45	118-47.45	46/46	15	8.0	565	0.06	220	1.3	1.6	0.1	12	1.9	466	76	21	1.0	-	3
LA-5 WELL 1N/16W-14K1 S	34-10.00	118-31.50	56/56	-	7.1	1690	-	400	8.0	76.0	62.0	160	0.1	382	766	22	0.5	-	16
LA-6 EL ENCINO SPRINGS	34-07.55	118-29.93	26/26	17	8.4	1160	0.02	410	1.4	2.2	0.5	32	2.6	452	458	19	1.6	-	3
LA-7 BIMINI HOT SPRING (W)	34-04.15	118-17.44	40/40	380	-	1780	-	722	21	6.0	2.0	200	-	161	-	26	-	-	90

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*R.H. Mariner, U.S. Geological Survey, reports this spring no longer exists.

(W) = WELL (SP) = SPRING

Table 1. Physical Parameters and Chemical Constituents of Thermal Waters in California - Continued.

Name		Latitude	Longitude	Temp °C	Flow		TDS	Concentrations		(mg/L)					HCO_3					Ref
		north	west	Hi/Rec	L/min	pH	mg/L	Li	Na	K	Ca	Mg	Cl	F	Alk	SO4	SiO2	B	As	No.
LA-8	WELL 2S/14W-14C2 S	34-00.10	118-19.00	27/27	-	7.3	430	-	48	4.0	72.0	21.0	39	0.2	252	97	17	0.1	-	16
LA-9	WELL 1S/9W-1F1 S	34-06.90	117-46.80	36/36	-	7.6	380	-	62	2.0	68.0	22.0	38	0.9	211	85	-	-	-	34
LA-10	WELL 2S/11W-8N1 S	34-00.30	118-03.70	29/29	-	8.4	435	-	42	2.0	87.0	21.0	32	-	267	120	-	-	-	16
LA-11	ALVARADO HOT SP (W)	33-58.55	117-53.18	44/44	142	8.8	7740	0.28	2140	16.0	724.0	3.8	4740	0.9	55	37	31	5.9	0.2	3
LA-12	WELL 3S/11W-14H4 S	33-54.75	117-59.75	34/34	-	7.8	413	-	39	4.0	76.0	13.0	45	-	181	109	-	-	-	36
LA-13	WELL 4S/13W-27N1 S	33-47.50	118-14.10	28/28	-	8.3	285	-	86	3	20.0	2.0	48	0.4	203	2	19	0.25	-	16
LA-14	WELL 5S/13W-6D1 S	33-46.50	118-17.00	31/31	-	8.6	1275	-	450	12.0	30.0	16.0	481	-	554	12	-	-	-	20
LA-15	UNNAMED SPRING	33-48.10	118-24.00	25/25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	107
LA-16	WHITES POINT HOT SP	33-43.90	118-20.90	46/46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	90
	MADERA																			
MA-1	REDS MEADOW HOT SP	37-37.10	119-04.40	49/46	50	7.3	923	0.83	140	6.2	61.0	2.5	7	4.8	516	33	150	1.8	-	85
	MARIN																			
MR-1	ROCKY POINT SPRINGS	37-53.15	122-37.72	32/32	8	6.7	14000	-	4160	149.0	327.0	456.0	8030	2.5	112	704	41	1.8	-	2
	MENDOCINO																			
MN-1	JACKSON V. MUD SP	39-39.47	123-35.22	27/27	1	8.3	31900	7.60	12700	198.0	7.7	382.0	968	1.5	34347	53	40	617.0	0.5	2
MN-2	PINCHES SPRING	39-41.75	123-28.77	21/21	190	7.9	994	0.12	275	2.6	70.0	11.0	470	0.5	129	2	42	20.0	-	2
MN-3	MUIR SPRING	39-25.30	123-18.45	20/20	-	7.9	1820	0.07	525	3.0	83.0	29.0	745	3.1	479	2	71	125.0	tr	2
MN-4	ORRS HOT SPRINGS	39-13.75	123-21.85	40/40	114	8.6	436	0.10	140	1.3	4.8	0.1	50	14.0	253	1	61	38.0	-	2
MN-5	VICHY SPRINGS	39-09.93	123-09.37	29/29	64	7.7	2670	0.92	924	30.0	49.0	35.0	178	1.2	2510	1	91	112.0	-	2
MN-6	CAL-DRI ICE CO. WELL	39-00.30	123-06.50	W/W	-	8.1	6220	2.40	2200	57.0	-	-	1230	-	4140	tr	60	630.0	-	44
MN-7	POINT ARENA HOT SP	38-52.63	123-30.55	44/44	19	9.3	310	0.05	105	0.4	0.9	0.1	22	6.3	217	11	53	5.2	-	2
	MERCED																			
MC-1	SAN LUIS FOREBAY SP	37-05.00	121-02.50	21/21	-	7.0	1769	-	367	1.4	110.0	105.0	640	0.8	182	411	44	1.0	-	113
MC-2	IRIDAT SPRING	36-46.42	120-53.93	23/23	76	8.2	381	0.12	74	2.5	36.0	15.0	20	0.6	278	58	33	1.2	-	3
MC-3	UNNAMED SPRING	36-46.02	120-53.97	27/27	38	8.7	489	0.18	178	2.9	3.6	0.7	45	1.9	411	10	36	5.6	-	3
	MODOC																			
MD-1	WARM SPRING	41-57.52	120-56.57	W/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
MD-2	POTHOLE SPRING	41-49.51	120-54.92	26/26	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
MD-3	WELL 47/14E-2G5M	41-56.75	120-19.07	47/47	-	8.5	470	-	150	2.6	-	-	79	4.0	149	81	77	1.6	-	13
MD-4	FORT BIDWELL HS (W)	41-51.70	120-09.55	45/45	400	7.9	458	0.03	110	9.5	4.2	0.1	31	2.2	133	86	82	0.6	-	98
MD-5	WELL 46N/16E-31R1 M	41-48.48	120-10.23	28/28	-	8.3	256	-	62	7.5	4.0	0.3	18	0.9	121	32	72	0.6	-	13
MD-6	WELL 45N/16E-17M1 M	41-46.00	120-10.87	53/53	-	7.9	1060	-	320	12.0	23.0	3.8	222	2.0	407	132	134	5.9	-	13
MD-7	WELL 44N/16E-6E2 M	41-42.85	120-11.85	25/25	-	8.0	431	-	138	4.0	3.2	0.5	70	0.7	278	2	68	5.2	-	13
MD-8	MAGMA ENERGY WELLS	41-40.31	120-13.00	160/160	1370	-	1200	-	339	16.4	19.0	0.24	222	6.7	155	330	179	6.3	-	52
MD-9	LAKE CITY MUD VOLC. SP	41-40.08	120-12.55	97/97	-	7.4	1210	0.24	320	15.0	7.7	0.1	220	7.6	112	320	200	6.3	-	98
MD-10	HUTCHENS WELL	41-35.00	120-10.20	48/48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	66
MD-11	UNNAMED WELL	41-34.90	120-10.80	69/69	570	-	-	-	-	-	-	-	-	-	-	-	-	-	-	66
MD-12	ROBISON WELL	41-33.90	120-11.50	50/50	605	-	-	-	-	-	-	-	-	-	-	-	-	-	-	66
MD-13	LEONARDS HS (WEST)	41-35.92	120-05.48	41/41	200	7.8	1200	0.10	403	5.7	15.0	3.5	218	4.4	182	400	58	7.6	-	52
MD-14	SEYFERTH HOT SPRINGS	41-36.95	120-06.20	86/85	500	7.7	1110	0.15	300	9.0	28.0	0.1	220	5.4	63	370	110	7.6	-	98
MD-15	LEONARD HOT SP (E)	41-36.08	120-05.10	65/62	150	7.82	1180	0.13	330	8.5	26.0	0.6	220	5.2	84	390	110	7.6	-	98
MD-16	SURPRISE V. MIN. WELL	41-32.00	120-04.60	98/98	300	8.4	991	0.10	280	5.5	16.0	0.1	200	5.1	59	320	100	5.7	-	98
MD-17	UNNAMED SPRING	41-31.78	120-05.19	98/98	600	-	936	0.07	285	6.0	15.0	-	186	5.0	60	310	99	5.7	-	52
MD-18	BENMAC HOT SPRINGS	41-31.80	120-04.90	98/98	700	-	949	0.09	285	6.0	18.0	-	188	5.0	73	310	100	5.6	-	52
MD-19	MENLO BATHS HOT SP	41-15.95	120-04.73	59/57	500	8.9	370	0.02	100	1.4	5.1	0.1	25	3.8	62	120	53	0.9	-	98
MD-20	UNNAMED SPRING	41-12.50	120-03.25	43/43	-	9.0	220	-	62	1.6	2.4	0.2	21	0.2	73	57	38	0.6	-	13
MD-21	UNNAMED SPRING	41-13.30	120-04.00	41/41	175	-	202	0.01	62	1.1	2.4	-	14	-	86	41	40	-	-	52
MD-22	UNNAMED SPRING	41-11.50	120-23.00	77/77	12	7.8	1220	0.40	330	11.0	19.0	0.1	150	4.0	63	510	130	4.5	-	98
MD-23	UNNAMED SPRING	41-11.80	120-28.25	W/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
MD-24	UNNAMED SPRING	41-15.19	120-31.25	24/24	-	-	-		-	-	-	-	-	-	-	-	-	-	-	37
MD-25	NEW WILLIAMS R. WELL	41-16.10	120-31.50	29/29	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	66
MD-26	OLD WILLIAMS R. WELL	41-15.70	120-31.75	44/44	-	8.4	231	0.01	49	3.4	4.2	0.1	11	0.4	83	28	52	0.2	-	98
MD-27	UNNAMED SPRING	41-21.60	120-43.40	27/27	380	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110
MD-28	UNNAMED SPRING	41-28.00	120-31.50	22/22	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110
MD-29	UNNAMED SPRING	41-32.50	120-34.00	27/27	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110
MD-30	ESSEX SPRINGS	41-29.57	120-41.97	33/33	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	66
MD-31	UNNAMED SPRING	41-29.11	120-45.79	27/27	1041	-	85	-	-	-	3.1	-	22	-	108	7	-	-	-	110
MD-32	KELLY HOT SPRING	41-27.23	120-50.08	92/92	1250	8.1	899	0.15	250	6.5	20.0	0.1	160	2.1	47	300	110	3.8	-	98
MD-33	KELLY HS RANCH WELL	41-27.10	120-50.10	116/116	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
MD-34	LITTLE HOT SPRING	41-13.83	121-24.20	76/74	300	7.6	941	0.17	230	5.2	44.0	0.2	120	1.9	49	400	87	3.9	-	98
MD-35	WEIDNER WELL	41-56.87	120-19.05	47/47	-	8.6	402	-	130	1.0	14.0	-	74	4.0	126	58	55	4.0	-	40
	MONO																			
MO-1	UNNAMED SPRING	38-37.60	119-30.25	W/W	-	8.7	365	-	114	2.8	7.0	0.4	77	7.0	83	53	52	2.7	0.2	15
MO-2	SIERRA E. MOB. PK. (W)	38-31.50	119-28.50	41/35	-	-	198	0.06	33	3.0	18.0	4.0	57	0.8	60	15	28	1.9	-	40
MO-3	UNNAMED WELL	38-32.00	119-28.00	W/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
MO-4	FALES HOT SPRINGS	38-21.03	119-24.02	82/61	1000	6.6	2875	1.30	560	37.0	41.0	10.0	160	4.7	1130	260	114	8.2	-	85
MO-5	MAGMA POWER CO. WELL	38-21.00	119-24.00	38/38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	39
MO-6	BUCKEYE HOT SPRINGS	38-14.35	119-19.50	60/60	400	7.3	1430	0.84	310	10.0	22.0	4.2	28	9.2	429	340	75	1.1	-	85
MO-7	TRAVERTINE HOT SP	38-14.78	119-12.25	82/82	50	6.7	4324	2.50	1100	55.0	64.0	18.0	200	4.5	1880	920	100	9.9	-	85
MO-8	THE HOT SPRINGS	38-13.45	119-12.87	45/40	100	7.0	4394	2.80	1100	62.0	76.0	18.0	210	4.3	1880	910	65	11.0	-	85
MO-9	MAGMA POWER CO. WELL	38-13.50	119-12.80	51/51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	81
MO-10	WARM SPRING	38-12.13	119-07.19	25/25	2	-	13	-	10	2.2	1.1	0.2	-	-	-	-	-	-	-	37
MO-11	DECHAMBEAU WELL	38-02.87	119-04.83	66/66	150	7.7	1487	0.28	430	8.8	13.0	2.9	350	4.8	454	100	76	7.7	-	85
MO-12	UNNAMED SPRING	38-03.20	119-03.80	54/54	-	7.8	1594	-	520	44.0	8.0	6.2	584	-	639	12	106	-	-	78
MO-13	STATE PRC 4572.1 (W)	38-01.41	119-04.99	58/58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50
MO-14	WARM SPRINGS	38-01.98	118-54.26	31/31	76	6.95	1934	-	472	38.0	248.0	9.6	180	1.3	1757	2	110	3.6	-	78
MO-15	UNNAMED SPRINGS	37-59.75	119-01.40	86/86	250	9.3	26342	2.50	8000	225.0	0.2	0.1	6000	26.0	7700	2700	220	130.0	-	85
MO-16	STATE PRC 4397.1 (W)	37-56.36	119-01.81	54/54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50
MO-17	UNNAMED SPRING	37-56.40	119-01.10	42/42	4	6.57	1914	-	510	43.0	180.0	38.0	85	1.1	1830	48	97	4.2	-	78
MO-18	UNNAMED SPRING	37-50.15	119-00.95	36/36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	65
MO-19	UNNAMED FUMAROLES	37-37.15	119-01.67	W/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
MO-20	CASA DIABLO HOT SP	37-38.75	118-54.90	82/82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	103
MO-21	MAGMA POWER CO. WELLS	37-38.79	118-54.86	178/177	-	9.3	1555	-	475	30.0	1.0	2.0	310	21.0	622	96	98	13.0	1.6	18
MO-22	LITTLE HOT CR. SP	37-41.41	118-50.40	82/82	717	7.1	1115	-	410	30.0	25.0	-	200	8.6	727	90	110	-	1.1	18
MO-23	HOT CREEK SPRINGS	37-39.87	118-49.65	93/88	15,000	8.3	1110	1.70	350	20.0	4.4	0.2	200	10.0	513	90	131	10.0	1.0	18
MO-24	CASA DIABLO HOT POOL	37-38.81	118-51.57	89/89	390	6.1	1100	2.60	363	22.0	8.0	0.2	245	11.0	454	107	110	11.0	2.0	18
MO-25	UNNAMED SRPING	37-42.48	118-48.80	38/38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100
MO-26	UNNAMED SPRING	37-40.20	118-46.90	53/53	-	7.3	1270	-	380	37.0	28.0	-	160	4.9	791	60	-	31.0	0.5	18
MO-27	WHITMORE HOT SPRINGS	37-37.79	118-48.59	37/37	1560	8.2	510	-	140	9.0	21.0	3.0	74	3.2	276	41	32	3.7	0.2	30
MO-28	UNNAMED SPRING	37-38.80	118-45.45	41/41	150	6.6	1137	1.60	320	28.0	23.0	1.2	150	4.6	696	59	205	8.1	0.4	84
MO-29	UNNAMED SPRING	37-38.38	118-43.29	28/28	-	8.4	270	-	83	6.0	5.0	-	22	1.9	183	16	-	0.6	0.1	18
MO-30	UNNAMED SRPINGS	37-43.15	118-44.25	24/24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
MO-31	BENTON HOT SPRINGS	37-48.05	118-31.80	63/57	800	9.3	269	0.18	80	1.0	1.4	0.1	22	4.3	96	50	63	0.3	-	85
MO-32	BERTRAND RANCH SPRINGS	35-53.20	118-29.20	21/21	378	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110
	MONTEREY																			
MT-1	UNNAMED SPRING	36-37.10	121-50.67	38/38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
MT-2	UNNAMED SPRING	36-19.90	121-50.40	46/46	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
MT-3	UNNAMED SPRING	36-15.00	121-41.00	W/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
MT-4	SLATES HOT SPRINGS	36-07.40	121-38.12	50/47	95	9.1	245	0.06	66	0.4	3.0	0.1	10	2.8	83	59	65	0.4	-	3
MT-5	DOLANS HOT SPRING	36-05.02	121-35.18	37/37	114	9.4	168	-	46	0.6	2.0	-	6	0.9	97	16	44	0.2	-	3

(W) = WELL (SP) = SPRING

Table 1. Physical Parameters and Chemical Constituents of Thermal Waters in California - Continued.

Name		Latitude	Longitude	Temp °C	Flow		TDS	Concentrations		(mg/L)					HCO_3					Ref
		north	west	Hi/Rec	L/min	pH	mg/L	Li	Na	K	Ca	Mg	Cl	F	Alk	SO4	SiO2	B	As	No.
MT-6	TASSAJARA HOT SP	36-14.00	121-33.01	62/62	189	9.6	355	0.05	89	2.3	3.0	0.1	18	5.0	128	65	109	0.3	-	3
MT-7	PARAISO HOT SPRINGS	36-19.86	121-22.12	37/37	38	8.1	908	0.16	260	3.4	23.0	0.4	52	8.4	30	496	43	1.7	-	3
MT-8	SULFUR SPRING	36-02.47	121-13.24	48/31	15	7.3	1010	0.13	202	4.0	103.0	39.0	48	0.7	810	165	40	1.0	-	3
MT-9	TABLE MOUNTAIN (SP)	35-54.40	120-20.00	31/30	-	8.97	946	-	10	0.3	7.9	260.0	34	0.1	1201	13	31	0.4	-	113
	NAPA																			
NA-1	UNNAMED SPRING	38-50.00	122-21.40	22/22	189	6.9	3190	1.80	604	34.0	218.0	224.0	940	0.7	1500	261	95	59.0	0.1	2
NA-2	AETNA SPRINGS	38-39.22	122-29.03	33/33	40	6.5	1970	0.25	608	11.0	18.0	84.0	266	1.6	1620	8	88	80.0	-	2
NA-3	CALISTOGA PWR CO. W	38-35.73	122-36.02	138/138	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
NA-4	PACHETEAU WELL	38-34.93	122-34.43	100/95	1968	8.4	610	2.26	222	10.0	4.0	-	219	12.3	121	12	139	11.0	0.1	82
NA-5	CALISTOGA HOT SPRINGS	38-34.95	122-34.45	78/78	-	-	713	-	212	8.2	12.0	5.7	255	-	55	110	62	-	-	110
NA-6	WELL 8N/6W-4F1 M	38-34.43	122-31.93	82/81	-	-	690	-	176	-	0.8	36.0	270	-	183	2	111	-	-	37
NA-7	PHILLIPS SODA SPRING	38-31.30	122-15.65	24/24	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
NA-8	NAPA ROCK SODA SP	38-31.12	122-15.58	26/26	84	6.4	1750	0.55	136	5.6	22.0	349.0	146	0.1	1920	-	111	23.0	-	2
NA-9	WELL 8N/6W-25H2 M	38-31.05	122-28.20	21/21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
NA-10	WHITE SULFUR SPRINGS	38-29.43	122-29.80	36/36	34	8.8	698	0.36	232	3.0	4.6	0.6	224	5.7	-	250	12	46	32.0	2
NA-11	WELL 7N/5W-3M1 M	38-29.10	122-24.40	25/25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
NA-12	WELL 7N/5W-15A1 M	38-27.80	122-23.65	21/21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
NA-13	WELL 7N/5W-14G1 M	38-27.55	122-22.85	21/21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
NA-14	WELL 7N/5W-26D1 M	38-26.05	122-23.45	27/27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
NA-15	WELL 7N/5W-26E1 M	38-25.85	122-23.35	30/30	-	7.3	355	-	37	8.2	27.0	15.0	19	0.3	212	13	131	0.78	-	37
NA-16	NAPA VICHY SRPINGS	38-20.33	122-15.55	24/24	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
NA-17	WELL 6N/4W-23J1 M	38-21.00	122-15.90	29/29	184	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
NA-18	UNNAMED SPRING	38-19.30	122-16.30	28/28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
NA-19	WELL 6N/4W-24M1 M	38-21.05	122-15.06	24/24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
	ORANGE																			
OR-1	LA VIDA MIN SP WELL	33-56.03	117-47.80	43/43	76	8.3	4360	0.30	1780	8.4	8.8	1.9	935	2.3	3230	3	25	5.0	-	3
OR-2	WELL 3S/9W-22C2 S	33-54.15	117-48.75	73/73	-	8.3	592	-	65	5.0	40.0	67.0	46	0.2	537	19	-	0.1	-	16
OR-3	SEGURO NO. 1 (W)	33-41.37	118-00.37	218/218	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42
OR-4	OBRIEN PORTER NO. 2 (W)	33-41.05	117-59.90	H/H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41
OR-5	MCCASDEN WELL	33-40.13	118-00.82	H/H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41
OR-6	BELOIL DAVENPORT	33-40.50	117-59.75	H/H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41
OR-7	FAIRVIEW HOT SP (W)	33-40.40	117-55.00	36/36	57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
OR-8	WELL 5S/9W-34Q1 S	33-41.30	117-48.21	30/30	-	7.7	259	-	-	-	-	-	157	-	209	-	-	-	-	17
OR-9	WELL 7S/8W-16Q1 S	33-33.50	117-42.90	28/28	-	8.1	1156	-	442	10.0	6.0	4.0	284	0.9	602	81	23	3.9	-	19
OR-10	UNNAMED SPRING	33-30.82	117-36.26	35/35	-	8.0	440	-	63	2.0	55.0	26.0	72	0.6	254	64	-	0.1	-	19
OR-11	SAN JUAN HOT SP	33-35.33	117-31.02	49/49	57	9.4	319	0.05	92	1.6	2.8	0.1	69	8.0	78	26	79	0.9	-	3
	PLACER																			
PC-1	BROCKWAY HOT SPRINGS	39-13.60	120-00.75	56/56	190	8.7	451	0.50	110	3.0	4.4	0.2	100	2.9	84	34	71	2.8	-	85
	PLUMAS																			
PL-1	UNNAMED SPRING	40-26.55	121-24.75	28/28	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
PL-2	DEVIL'S KITCHEN	40-26.48	121-26.00	96/95	-	-	1402	-	41	9.7	20.0	11.0	-	-	-	963	286	-	-	112
PL-3	TERMINAL GEYSER	40-25.28	121-22.60	96/96	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
PL-4	DRAKE HOT SPRINGS	40-26.70	121-24.63	66/66	76	-	510	-	43	8.2	49.0	12.0	5	0.2	114	174	162.1	1.0	-	113
PL-5	BOILING SPRINGS LAKE	40-26.13	121-23.80	88/88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
PL-6	TERMINAL GEYSER WELL	40-25.25	121-22.60	129/129	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
PL-7	INDIAN VALLEY HOT SP	40-08.48	120-56.02	41/41	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
PL-8	UNNAMED SPRING	40-01.16	121-02.13	39/39	133	6.48	4725	-	820	52.0	120.0	21.0	270	-	2250	44	30	16.0	-	7
PL-9	MCCLEAR'S WARM SP	39-43.75	120-32.87	30/30	530	9.3	210	-	51	1.0	3.6	0.2	6	-	82	44	63.0	0.4	-	12
PL-10	MARBLE HOT WELLS	39-45.38	120-21.50	73/73	180	8.0	1360	0.40	400	7.4	38.0	0.1	460	2.2	53	330	62.0	7.3	-	98
PL-11	WELL 22N/14E-25H1 M	39-43.86	120-21.20	39/38	40	6.80	1170	-	386	5.5	14.0	4.6	435	0.4	72	222	65	6.1	-	12
PL-12	WELL 22N/15E-17C3 M	39-45.90	120-19.32	29/29	-	7.8	195	-	71	2.0	4.0	1.0	22	-	189	1	-	1.2	-	16
PL-13	WELL 23N/15E-36J2 M	39-48.05	120-14.45	26/26	4	6.8	200	-	25	5.1	8.0	2.4	6	0.7	73	22	95	0.2	-	12
PL-14	WELL 22N/15E-23C1 M	39-45.00	120-16.20	28/28	-	8.2	190	-	35	6.3	1.0	1.8	6	-	113	1	82	0.2	-	12
PL-15	WELL 22N/15E-28L1 M	39-43.75	120-18.33	55/32	-	7.7	170	-	35	1.5	1.0	0.4	3	0.5	88	2	87	0.4	-	12
PL-16	W. HAGGE WELL NO. 1	39-43.30	120-19.30	44/40	3	7.6	1270	0.5	400	6.3	26.0	1.3	440	1.5	76	270	80	7.8	-	98
PL-17	WELL 22N/15E-32F1 M	39-42.95	120-19.45	94/94	50	8.0	1570	0.65	450	13.0	39.0	0.1	545	2.6	52	370	98	8.8	-	98
PL-18	WELL 22N/15E-32R1 M	39-42.55	120-19.00	52/52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
PL-19	WELL 22N/015E-33M1 M	39-42.92	120-18.60	32/32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
	RIVERSIDE																			
RV-1	GLEN IVY HOT SP	33-45.37	117-29.67	55/55	-	9.3	300	-	83	0.7	4.0	-	12	3.3	20	110	54	0.4	-	3
RV-2	WELL 3S/7W-11F1 S	33-55.50	117-35.25	48/48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	90
RV-3	WELL 3S/3W-2L1 S	33-56.33	117-09.90	27/27	-	8.0	280	-	56	3.0	26.0	44.0	46	0.4	131	20	20	0.1	-	16
RV-4	WELL 3S/2W-7P1 S	33-55.20	117-08.00	40/40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	90
RV-5	HIGHLAND SPRINGS	33-58.17	116-56.50	49/44	-	8.1	161	-	15	1.2	21.0	5.5	5	0.4	108	6	29	0.1	-	113
RV-6	EDEN HOT SPRINGS	33-53.80	117-03.75	43/43	114	9.6	260	-	106	-	-	0.1	15	-	98	32	56	1.4	tr	90
RV-7	UNNAMED SPRING	33-51.95	117-05.96	W/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
RV-8	LAKEVIEW HOT SP	33-50.27	117-08.67	38/38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
RV-9	GILMAN HOT SP	33-50.10	116-59.20	47/47	76	-	588	-	193	-	54.0	14.0	229	-	58	233	29	-	-	111
RV-10	SOBOBA HOT SPRINGS	33-48.05	116-55.60	40/40	40	9.5	210	-	62	0.6	1.0	0.5	19	1.6	47	10	40	0.1	-	40
RV-11	WELL 5S/1E-5M2 S	33-45.80	116-54.40	49/49	-	8.8	100	-	34	3.0	6.0	-	14	0.2	42	6	-	0.16	-	24
RV-12	WELL 5S/1W-16C1 S	33-44.50	116-59.50	39/39	-	-	1320	-	381	10.0	246.0	2.0	507	-	88	133	-	7.1	-	90
RV-13	WRENDEN HOT SP	33-40.15	117-19.65	48/48	-	-	300	-	79	-	6.0	4.1	52	-	112	36	68	-	-	111
RV-14	ELSINORE HOT SP	33-40.17	117-19.83	52/52	-	-	296	-	-	-	6.0	4.1	52	-	112	36	68	-	-	3
RV-15	WELL 6S/2W-10D1 S	33-40.23	117-04.93	37/37	-	7.3	750	-	117	5.0	98.0	29.0	129	0.4	304	184	40	0.4	-	26
RV-16	UNNAMED WELL	33-40.25	117-03.82	37/37	-	7.1	600	-	74	4.5	85.0	24.0	98	-	228	141	48	0.05	-	26
RV-17	WELL 5S/1W-32Q1 S	33-41.15	117-00.13	28/28	-	-	2110	-	330	3.0	317.0	41.0	303	0.2	390	884	47	0.2	-	26
RV-18	WELL 6S/1W-4J1 S	33-40.70	116-58.77	59/43	-	7.8	330	-	62	3.0	44.0	13.0	51	0.4	183	65	-	0.07	-	26
RV-19	WELL 6S/2W-10E1 S	33-40.00	117-04.97	49/49	-	7.0	2160	-	365	10.0	250.0	95.0	433	0.8	219	844	58	0.31	-	26
RV-20	WELL 6S/2W-15D1 S	33-39.33	117-04.95	25/25	-	7.8	410	-	76	2.0	49.0	19.0	64	0.1	268	33	37	0.14	-	26
RV-21	WELL 6S/4W-34J2 S	33-36.27	117-16.52	40/40	-	7.8	270	-	49	0.7	30.0	12.0	43	0.5	192	-	38	0.11	-	26
RV-22	WELL 6S/4W-35D1 S	33-36.73	117-16.44	43/43	-	7.4	330	-	45	0.9	49.0	15.0	89	0.1	138	31	33	0.03	-	26
RV-23	TEMECULA HOT SPRINGS	33-33.23	117-10.05	47/47	-	9.2	715	-	244	1.0	7.0	-	347	-	6	14	71	4.4	tr	90
RV-24	WELL 8S/3W-7D3 S	33-30.20	117-14.35	29/29	-	7.5	675	-	82	4.0	74.0	52.0	142	0.4	189	226	-	0.05	-	8
RV-25	MURIETTA HOT SP	33-33.50	117-09.33	58/56	284	9.5	720	-	237	4.0	7.0	5.0	350	4.0	51	18	64	4.5	tr	90
RV-26	WELL 7S/2W-3N1 S	33-35.03	117-04.97	40/40	-	7.6	965	-	196	2.2	89.0	43.0	234	0.7	363	184	38	0.11	-	26
RV-27	WELL 7S/2W-2P2 S	33-35.17	117-03.44	37/37	-	8.2	790	-	143	1.4	98.0	38.0	209	0.4	339	131	-	0.07	-	26
RV-28	UNNAMED SPRING	33-32.50	116-44.50	W/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
RV-29	AGUA CALIENTE SPRING	33-49.40	116-32.67	42/42	121	9.5	220	-	68	1.3	0.4	2.5	20	2.4	51	36	41	0.1	-	90
RV-30	UNNAMED WELL	33-54.50	116-22.30	49/49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	90
RV-31	UNNAMED WELL	33-53.92	116-21.88	44/44	-	7.8	800	-	223	4.0	42.0	3.0	136	0.6	69	350	18	1.4	-	90
RV-32	WELL 5S/6E-24N2 S	33-42.93	116-19.12	83/27	-	7.8	295	-	57	4.8	37.0	5.0	66	0.04	82	71	-	12.0	-	40
RV-33	WELL 7S/9E-18M1 S	33-33.70	116-05.55	32/32	-	9.0	170	-	55	1.0	5.0	1.0	17	0.8	83	31	13	0.01	-	23
RV-34	WELL 8S/8E-10B1 S	33-29.75	116-08.25	33/33	-	9.0	200	-	77	1.0	2.0	-	21	2.8	90	44	-	0.2	-	22
RV-35	WELL 8S/8E-13Q1 S	33-28.20	116-06.20	32/32	-	9.2	170	-	66	1.0	-	-	11	2.4	103	37	-	0.9	-	23
RV-36	WELL 8S/9E-29Q1 S	33-26.47	116-04.15	43/43	-	8.3	435	-	139	1.0	14.0	3.0	145	4.8	58	99	-	0.2	-	23
RV-37	WELL 8S/9E-29R1 S	33-26.45	116-03.85	39/39	-	8.4	470	-	162	1.5	8.0	-	133	3.5	73	111	14	0.5	-	8
RV-38	DOS PALMAS SPRING	33-30.65	115-49.58	31/29	1136	8.6	1350	0.55	380	14.0	53.0	28.0	440	2.3	182	307	24	2.1	-	23
RV-39	HUNTER'S SP WELLS	33-29.30	115-47.45	32/32	-	7.8	2000	-	700	4.0	38.0	27.0	968	3.0	234	144	-	2.8	-	23
RV-40	CANYON SPRING	33-32.71	115-39.20	36/36	-	8.3	21340	-	5000	-	1110.0	800.0	3260	-	603	10100	-	410.0	-	113
RV-41	KAISER NORTH WELL	33-56.48	115-25.00	29/29	-	8.48	90	-	-	-	-	-	90	-	-	-	-	-	-	99

(W) = WELL (SP) = SPRING

Table 1. Physical Parameters and Chemical Constituents of Thermal Waters in California - Continued.

Name		Latitude	Longitude	Temp °C	Flow		TDS	Concentrations		(mg/L)					HCO$_3$					Ref
		north	west	Hi/Rec	L/min	pH	mg/L	Li	Na	K	Ca	Mg	Cl	F	Alk	SO4	SiO2	B	As	No.
RV-42	THURMAN RAGSDALE WELL	33-49.57	115-25.58	40/40	-	8.82	88	-	-	-	-	-	88	-	-	-	-	-	-	99
RV-43	STANLEY RAGSDALE (W)	33-42.80	115-24.00	33/33	-	-	846	-	-	-	-	-	846	-	-	-	-	-	-	99
RV-44	SUNLAND OIL WELL	33-42.37	115-26.40	30/30	-	8.04	66	-	-	-	-	-	66	-	-	-	-	-	-	99
RV-45	LAZY C TRAILER PARK (W)	33-44.38	115-22.23	30/30	-	9.01	79	-	-	-	-	-	79	-	-	-	-	-	-	99
RV-46	DIV OF HWYS, WELL	33-42.80	115-24.38	32/32	-	8.08	82	-	-	-	-	-	82	-	-	-	-	-	-	99
RV-47	SD TRAILER PK (W)	33-43.00	115-23.75	34/34	-	7.69	763	-	-	-	-	-	763	-	-	-	-	-	-	99
RV-48	HOWARD BROWN WELL	33-44.95	115-21.38	35/35	-	-	85	-	-	-	-	-	85	-	-	-	-	-	-	99
RV-49	DESERT CTR AP (W)	33-45.20	115-19.90	47/30	-	8.8	1000	-	272	6.8	32.0	0.7	100	10.0	17	490	69	1.3	-	113
RV-50	CORN SPRING	33-37.50	115-19.48	22/22	-	7.4	810	-	111	-	158.0	30.0	183	-	494	80	-	5.1	-	113
RV-51	MCCOY SPRING	33-43.98	114-54.40	28/28	-	7.5	1440	-	405	-	102.0	23.0	533	-	296	233	-	0.9	-	113
RV-52	WILEY WELL	33-36.65	114-54.02	48/48	-	7.94	1036	-	-	-	-	-	1036	-	-	-	-	-	-	99
RV-53	L.C. WINTERS WELL	33-41.75	114-40.60	31/31	-	7.2	1290	-	316	-	128.0	2.1	395	2.2	58	380	29	-	-	89
RV-54	WELL 6S/22E-9P1 S	33-39.75	114-41.15	32/32	-	7.5	1670	-	422	-	154.0	9.4	578	-	34	475	16	-	-	8
RV-55	WELL 6S/22E-20A1 S	33-38.75	114-41.65	31/31	-	8.0	840	-	223	-	55.0	10.0	268	1.8	76	212	30	-	-	8
RV-56	RIVERSIDE CO AP (W)	33-36.70	114-42.40	31/31	-	8.12	212	-	-	-	-	-	212	-	-	-	-	-	-	99
RV-57	MESA VERDE WELL	33-36.92	114-43.50	31/31	-	8.00	466	-	-	-	-	-	466	-	-	-	-	-	-	99
RV-58	NICHOLLS WM SP (W)	33-36.20	114-43.67	33/33	-	7.6	3010	-	927	-	108.0	24.0	845	4.0	104	1060	-	-	-	89
RV-59	BASHA # 3 WELL	33-34.12	115-44.75	45/45	-	7.5	4540	-	1510	-	150.0	14.0	1990	5.2	65	800	45	-	-	89
RV-60	BILL PASSEY WELL	33-36.25	115-41.53	31/31	-	7.6	1520	-	427	-	67.0	24.0	301	1.7	204	575	22	-	-	89
RV-61	BASHA # 1 WELL	33-37.60	114-40.85	31/31	8422	7.7	910	-	268	217.0	38.0	8.5	245	2.9	217	220	18	0.63	-	89
RV-62	E. WEEKS WELL	33-38.80	114-39.75	33/33	-	7.90	750	-	257	-	23.0	0.1	183	2.3	240	150	17	-	-	89
RV-63	E. FORTNER WELL	33-41.05	114-39.42	31/31	-	7.6	1330	-	376	-	110.0	1.8	415	1.7	80	365	20	1.3	-	89
RV-64	C. CHEELY WELL	33-41.58	114-38.63	31/31	-	7.4	1265	-	376	-	68.0	5.0	405	1.8	122	330	18	1.2	-	89
RV-65	LUCKY 7 WELL	33-55.53	116-26.45	93/93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	95
RV-66	KING SPA WELL	33-26.15	115-41.30	79/79	-	6.13	1280	-	-	-	-	-	1280	-	-	-	-	-	-	99
RV-67	NEW PILGER HOT MIN (W)	33-25.65	115-41.20	82/82	-	7.7	2850	-	888	33	107.0	16.0	1360	5.0	268	225	79	4.4	tr	90
	SAN BENITO																			
SE-1	SAN BENITO MIN (W)	36-48.92	121-21.17	24/24	76	8.3	2610	0.09	875	3.6	26	54.0	790	0.6	730	426	37	6.0	-	3
SE-2	SULFUR SPRINGS	36-17.58	120-59.03	23/23	189	7.3	16081	1.50	5250	61.0	221.0	289.0	7380	1.3	1470	2060	74	24.0	-	113
	SAN BERNARDINO																			
SB-1	MH MORRIS WELL	35-46.50	117-21.60	30/30	-	9.2	91800	-	36600	1050.0	-	-	23400	90.0	37000	4210	-	360.0	-	21
SB-2	SARATOGA SPRING	35-40.91	116-25.30	28/28	475	8.1	3040	-	970	30.0	33.0	34.0	680	2.2	420	1040	44	-	-	113
SB-3	SHEEP CREEK SPRING	35-35.33	116-22.53	23/23	-	7.7	720	-	87	6.0	73.0	52.0	25	-	190	383	-	0.6	-	113
SB-4	MAGMA POWER CO (W)	35-23.07	117-32.17	96/96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	102
SB-5	PARADISE SPRING	35-08.60	116-48.80	40/40	104	7.8	512	-	151	3.6	8.4	1.0	47	20.0	99	164	54	0.5	-	113
SB-6	SODA STATION SP	35-08.50	116-06.25	24/24	189	-	1990	-	708	16.0	16.0	5.0	736	-	264	321	53	2.2	-	106
SB-7	NEWBERRY SPRING	34-49.57	116-40.57	25/25	1192	-	290	-	-	-	25.0	4.9	30	-	163	40	54	-	-	106
SB-8	FLAMINGO WELL	34-57.33	114-50.33	40/39	-	8.8	345	-	115	3.2	3.0	0.5	66	3.4	73	80	27	0.4	-	90
SB-9	UNNAMED WELL	34-50.60	114-58.50	33/33	-	7.6	320	-	112	3.2	5.0	3.0	66	8.0	102	72	-	0.3	-	113
SB-10	WELL 1S/24E-10F1 S	34-06.17	114-26.90	29/29	-	7.2	1270	-	264	-	129.0	38.0	432	1.3	148	308	25	-	-	89
SB-11	WELL 1S/24E-10N1 S	34-05.70	114-27.20	30/30	-	7.45	1420	-	335	-	123.0	27.0	398	1.1	173	425	29	-	-	89
SB-12	WELL 1S/24E-9K1 S	34-05.97	114-27.67	32/32	-	7.6	380	-	119	-	14.0	2.2	67	2.2	154	72	27	-	-	89
SB-13	WELL 1S/24E-16B1 S	34-05.50	114-27.60	42/42	-	7.5	1070	-	297	-	73.0	7.3	356	-	90	248	26	0.74	-	89
SB-14	WELL 2N/7E-3B1 S	34-17.62	116-14.20	27/27	-	7.9	180	-	46	3.0	12.0	-	24	0.7	75	36	18	0.05	-	8
SB-15	WELL 1N/8E-2N1 S	34-11.70	116-07.30	53/53	-	8.4	730	-	215	3.0	14.0	0.6	60	17.0	37	341	54	0.5	-	90
SB-16	WELL 1N/9E-29F1 S	34-08.70	116-03.80	48/48	-	9.2	450	-	145	-	10.0	0.6	60	18.0	57	176	-	-	-	90
SB-17	WELL 1N/9E-14C1 S	34-10.67	116-00.80	63/63	-	7.7	1240	-	347	11.0	24.0	18.0	178	4.2	44	596	43	1.3	-	90
SB-18	WELL 1N/5E-12D1 S	34-11.50	116-25.15	42/42	-	8.2	190	-	74	0.8	2.0	-	17	5.0	134	19	-	0.44	-	90
SB-19	PAN HOT SPRINGS	34-16.30	116-50.25	32/32	19	9.6	430	0.10	134	1.2	4.0	0.1	8	10.0	49	209	37	0.1	tr	3
SB-20	UNNAMED SPRING	34-20.46	117-10.17	38/38	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
SB-21	UNNAMED SPRING	34-20.35	117-10.56	42/42	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
SB-22	TYLERS BATH (S)	34-13.87	117-29.03	33/33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
SB-23	WATERMAN HOT SP	34-11.30	117-16.22	51/51	19	8.2	1150	0.30	308	14.0	30.0	2.9	61	9.0	86	578	104	3.5	0.1	3
SB-24	ARROWHEAD HOT SP	34-11.22	117-15.78	94/90	190	8.2	950	0.40	255	12.0	29.0	2.1	52	8.0	83	454	94	3.2	-	3
SB-25	UNNAMED SPRINGS	34-07.33	117-04.72	32/32	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
SB-26	HARLEM HOT SPRINGS	34-07.35	117-13.90	49/49	-	-	350	-	90	-	40.0	-	10	-	33	144	50	-	-	110
SB-27	WELL 1N/3W-32N3 S	34-07.40	117-13.50	54/54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	90
SB-28	WELL 1N/3W-33M1 S	34-07.60	117-12.30	51/51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	90
SB-29	WELL 1S/3W-6C3 S	34-07.25	117-14.25	43/43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	90
SB-30	URBITA HOT SP (W)	34-05.00	117-18.50	41/41	760	-	320	-	114	-	-	-	21	-	85	133	10	-	-	110
SB-31	WELL 1S/4W-16J2 S	34-05.00	117-17.75	41/41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	90
SB-32	WELL 1S/4W-16L3 S	34-05.00	117-18.25	42/42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	90
SB-33	WELL 1S/4W-22A1 S	34-04.50	117-16.75	44/44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	90
SB-34	WELL 1S/4W-22H3 S	34-04.40	117-16.75	51/51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	90
SB-35	WELL 1S/4W-22H4 S	34-04.30	117-16.75	43/43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	90
SB-36	WELL 1S/4W-15L3 S	34-05.00	117-17.25	41/41	-	8.6	240	-	84	1.0	11.0	-	50	3.0	110	23	-	1.3	-	25
	SAN DIEGO																			
SD-1	DELUZ WARM SPRINGS	33-26.15	117-19.50	29/29	19	9.5	290	-	7.5	0.7	1.6	0.5	43	1.6	42	57	57	0.3	-	3
SD-2	AGUA TIBIA SPRING	33-21.75	117-00.75	33/38	38	-	380	-	120	-	30.0	-	70	-	73	100	21.0	-	-	110
SD-3	WELL 10S/1W-23N1 S	33-17.27	116-57.52	27/27	-	7.4	300	-	29	5.0	42.0	12.0	18	0.4	151	72	45	0.02	-	19
SD-4	WARNER HOT SPRINGS	33-17.05	116-37.82	59/59	-	9.2	367	-	96	1.8	2.4	0.5	49	4.4	97	66	81	0.6	-	3
SD-5	WELL 12S/2W-17H1 S	33-07.92	117-06.17	27/27	-	7.4	940	-	165	6.0	87.0	75.0	2	0.2	224	317	-	0.1	-	19
SD-6	CIRC T TRAILER PK (W)	33-08.97	116-10.12	37/37	-	8.59	99	-	-	-	-	-	99	-	-	-	-	-	-	99
SD-7	M.A. SMITH WELL	33-09.37	116-10.08	31/31	-	7.88	326	-	-	-	-	-	326	-	-	-	-	-	-	99
SD-8	E. ROBINSON WELL	33-08.67	116-08.05	37/37	-	7.9	286	-	-	-	-	-	286	-	-	-	-	-	-	99
SD-9	A. TONER WEL.	33-08.70	116-06.55	32/32	-	8.63	443	-	-	-	-	-	443	-	-	-	-	-	-	99
SD-10	A. WILLIAMS WELL	33-07.60	116-07.80	36/36	-	8.19	184	-	-	-	-	-	184	-	-	-	-	-	-	99
SD-11	CORNISH WELL	33-06.35	116-07.80	32/32	-	8.50	143	-	-	-	-	-	143	-	-	-	-	-	-	99
SD-12	DE ANZA TRL INN (W)	33-07.40	116-07.78	38/38	-	7.23	296	-	-	-	-	-	296	-	-	-	-	-	-	99
SD-13	C. PETERSON WELL	33-08.32	116-09.33	32/32	-	8.12	167	-	-	-	-	-	167	-	-	-	-	-	-	99
SD-14	IRONWOOD MOTEL WELL	33-08.97	116-10.92	37/37	-	8.1	101	-	-	-	-	-	101	-	-	-	-	-	-	99
SD-15	VALLECITOS SPRING	32-58.22	116-25.38	26/26	19	7.9	920	-	126	5.4	84.0	57.0	92	0.4	267	380	40	0.2	0.8	3
SD-16	AGUA CALIENTE SPRINGS	32-56.88	116-18.22	38/38	76	9.0	315	-	104	1.2	0.8	0.5	68	4.0	57	55	40	0.9	-	3
SD-17	RAYMOND RASCO WELL	32-37.30	116-09.45	31/31	-	7.48	58	-	-	-	-	-	58	-	-	-	-	-	-	99
SD-18	JACUMBA HOT SPRINGS	32-36.95	116-11.53	38/38	57	9.8	310	-	101	1.0	1.0	1.0	91	18.0	90	-	53	0.6	-	90
SD-19	HENRY LAZARE WELL	32-36.97	116-17.52	38/38	-	9.65	81	-	-	-	-	-	81	-	-	-	-	-	-	99
SD-20	WELL 17S/5E-3R1 S	32-43.22	116-27.30	30/30	-	7.6	330	-	48	3.0	52.0	19.0	40	0.8	256	40	-	0.04	-	19
SD-21	WELL 15S/1W-14Q1 S	32-51.73	116-57.03	31/31	-	7.2	1090	-	215	2.0	114.0	70.0	515	0.6	173	58	30	0.14	-	19
SD-22	WELL 16S/2W-16C1 S	32-47.23	117-05.67	27/27	-	7.5	2210	-	280	5.0	359.0	122.0	1200	0.4	188	112	40	0.03	-	19
SD-23	WELL 18S/2E-14E1 S	32-36.53	116-45.12	27/27	-	7.4	1050	-	199	2.0	95.0	60.0	297	0.6	426	142	44	0.45	-	19
SD-24	WELL 18S/2W-28L1 S	32-34.48	117-05.67	27/27	-	7.5	2550	-	547	6.0	226.0	121.0	1230	0.6	341	213	33	0.42	-	19
SD-25	WELL 18S/2W-21H1 S	32-35.57	117-05.17	28/28	-	8.0	1275	-	230	4.0	148.0	64.0	644	0.2	146	99	13	0.07	-	19
SD-26	WELL 18S/2W-28P1 S	32-34.30	117-05.55	36/36	-	7.9	1000	-	316	-	32.0	31.0	298	0.8	323	169	-	0.38	-	19
SD-27	WELL 18S/2W-33L10 S	32-33.50	117-05.55	36/36	-	7.8	1390	-	342	10.0	42.0	50.0	349	0.6	616	232	62	0.38	-	16
SD-28	WELL 18S/1W-31H1 S	32-33.73	117-01.05	33/33	-	7.1	1475	-	437	16.0	42.0	1.0	700	2.1	43	104	18	0.7	-	19
SD-29	WELL 18S/1W-34N1 S	32-33.38	116-58.73	28/28	-	7.1	1400	-	391	2.0	54.0	1.0	651	2.6	49	43	200	1.07	-	19
SD-30	WELL 19S/1W-3E1 S	32-32.92	116-58.50	28/28	-	7.9	870	-	63	4.0	69.0	-	613	4.9	27	79	18	0.97	-	19
	SAN JOAQUIN																			
SJ-1	LONE TREE MIN SPRING	37-34.38	121-26.72	22/22	-	8.3	400	-	18	0.3	36.0	51.0	10	0.1	251	113	43	0.4	tr	3
SJ-2	UNNAMED SPRING	37-34.12	121-26.78	23/23	38	8.0	1080	0.13	196	6.0	94.0	67.0	124	0.6	534	312	17	2.4	tr	3

(W) = WELL (SP) = SPRING

Table 1. Physical Parameters and Chemical Constituents of Thermal Waters in California - Continued.

Name		Latitude	Longitude	Temp °C	Flow		TDS	Concentrations		(mg/L)					HCO$_3$					Ref
		north	west	Hi/Rec	L/min	pH	mg/L	Li	Na	K	Ca	Mg	Cl	F	Alk	SO4	SiO2	B	As	No.
	SAN LUIS OBISPO																			
SL-1	PASO ROBLES ART. SPRING	35-39.75	120-41.50	47/39	380	8.0	1400	0.10	505	4.0	6.0	0.1	250	2.5	596	273	68	2.8	-	113
SL-2	PASO ROB. MUD BTH (S)	35-39.42	120-41.67	43/42	360	7.1	2370	0.52	720	11.0	116.0	0.5	840	4.9	56	558	85	9.2	-	3
SL-3	UNNAMED SPRING	35-38.95	120-41.21	42/42	760	8.3	1310	0.12	465	5.1	5.0	0.6	184	2.7	578	252	79	2.0	-	8
SL-4	WELL 26S/13E-11L1 M	35-40.75	120-32.60	31/31	-	8.2	600	-	195	5.0	15.0	8.0	33	0.8	340	164	-	1.2	-	28
SL-5	UNNAMED WELL	35-38.50	120-38.75	W/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
SL-6	SANTA YSABEL SPRINGS	35-34.93	120-39.87	33/33	190	8.4	900	0.06	325	2.3	4.0	1.3	133	1.7	467	141	52	1.3	tr	3
SL-7	PASO ROB. CITY BTHS	35-37.52	120-41.28	38/38	568	8.2	1480	0.10	520	11.0	11.0	5.5	315	1.9	642	239	63	2.3	-	3
SL-8	CALAQUA NO. 1	35-35.03	120-32.75	47/47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
SL-9	CAMETA WARM SPRING	35-24.00	120-15.00	23/23	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
SL-10	PECHO WARM SPRINGS	35-16.15	120-51.42	35/35	65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
SL-11	SYCAMORE HOT SP	31-11.20	120-42.79	38/38	-	7.6	530	0.02	84	15.0	46.0	29.0	38	0.7	444	35	61	0.1	tr	3
SL-12	ONTARIO HOT SPRINGS	35-10.85	120-42.10	57/57	200	8.1	785	0.10	212	25.0	24.0	32.0	69	0.9	618	38	77	1.2	-	3
SL-13	NEWSOM SPRINGS	35-07.37	120-32.60	37/37	57	7.8	540	0.06	70	11.0	54.0	46.0	43	0.4	426	69	38	0.1	tr	3
	SANTA BARBARA																			
SA-1	WELL 10N/27W-5L1 S	34-58.62	119-47.58	34/34	-	7.9	1330	-	308	4.0	101.0	24.0	172	1.4	132	656	-	0.68	-	16
SA-2	WELL 7N/35W-17Q1 S	34-41.07	120-35.08	42/42	-	7.8	5560	-	2100	46.0	34.0	31.0	2550	1.9	1547	33	-	5.4	-	8
SA-3	WELL 5N/33W-31A1 S	34-28.67	120-22.08	47/47	-	7.8	520	-	131	2.0	50.0	2.0	53	0.3	186	189	-	0.21	-	8
SA-4	LAS CRUCES HOT SPRING	34-30.13	120-13.07	37/37	38	8.2	550	0.22	196	1.4	15.0	2.3	58	6.6	423	27	38	1.4	tr	3
SA-5	WELL 5N/32W-35F1 S	34-28.58	120-12.08	31/31	-	8.2	730	-	215	2.0	37.0	8.0	138	0.6	261	182	18	1.3	-	16
SA-6	WELL 5N/30W-32P1 S	34-27.88	120-02.78	39/39	-	8.9	2550	-	1010	5.0	16.0	4.0	915	5.0	972	1	24	3.9	-	8
SA-7	UNNAMED SPRING(TEC TUN)	34-30.98	119-54.25	43/43	-	8.8	300	-	105	1.0	-	-	11	2.6	122	35	40	0.32	-	8
SA-8	SAN MARCOS HOT SPRING	34-32.23	119-52.87	43/43	303	8.2	420	-	163	1.2	4.4	-	101	2.8	226	36	-	3.0	-	3
SA-9	UNNAMED SP (TEC TUNNEL)	34-30.62	119-54.05	34/34	-	8.2	296	-	110	-	-	-	8	2.8	200	55	25	0.4	-	8
SA-10	MONTECITO HOT SPR	34-27.00	119-38.00	48/48	360	-	350	-	128	2.0	5.0	1.0	50	3.6	235	14	29	1.3	-	40
SA-11	LITTLE CALIENTE SP	34-32.42	119-37.17	32/32	57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
SA-12	AQUA CALIENTE SPRING	34-32.38	119-33.72	56/56	760	8.2	685	0.20	258	2.3	2.0	-	46	12.0	570	17	60	6.0	tr	3
SA-13	BORON SPRING	34-25.37	119-32.28	22/22	95	7.8	2220	0.68	720	5.5	89.0	6.3	1160	5.0	248	17	24	14.0	-	3
	SANTA CLARA																			
SC-1	WHITE SULFUR SPRING	37-23.84	121-47.82	29/29	19	7.2	2130	0.77	700	23.0	85.0	35.0	193	1.8	2010	74	23	8.3	tr	3
SC-2	GILROY HOT SPRING	37-06.55	121-28.67	41/41	15	7.0	1290	0.16	274	6.0	13.0	134.0	130	0.4	1240	2	101	17.0	tr	3
SC-3	SARGENT ESTATE WARM SP	36-56.42	121-33.82	25/25	3	7.7	840	0.05	272	7.5	38.0	16.0	222	1.6	544	8	21	2.0	tr	3
	SANTA CRUZ																			
SZ-1	MAPLETHORPE WELL	36-59.20	121-56.30	23/23	-	7.2	573	-	66	8.4	83.0	19.0	67	-	310	113	65	0.1	-	113
	SHASTA																			
SH-1	HUNT HOT SPRINGS	41-02.05	121-55.82	58/58	32	8.88	1110	0.12	300	4.3	52.0	0.1	140	3.6	49	520	47	12.8	-	98
SH-2	UNNAMED WELL	41-00.95	121-54.42	29/29	-	7.6	318	-	96	1.4	12.0	3.6	57	1.3	201	2	41	4.0	-	113
SH-3	BIG BEND HOT SPRINGS	41-01.35	121-55.17	82/82	340	8.1	1930	0.66	565	20.0	88.0	0.6	850	1.2	40	276	73	32.0	0.9	2
SH-4	WELL 31N/4W-7A1 M	40-33.75	122-21.25	31/31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
SH-5	UNNAMED SPRINGS	40-27.40	121-32.50	66/66	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	113
SH-6	TOPHET HOT SPRINGS	40-27.02	121-32.03	93/93	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-112
SH-7	BUMPASS HELL	40-27.45	121-30.00	100/93	400	-	1420	-	43	15.0	38.0	31.0	1	-	-	1034	259	0.2	-	113
	SIERRA																			
SI-1	WELL 21N/15E-5D1 M	39-42.35	120-19.85	44/44	-	7.1	920	-	294	8.5	13.0	2.1	270	1.6	147	153	101	5.5	-	12
SI-2	WELL 21N/15E-5E1 M	39-42.15	120-19.90	34/34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
SI-3	WELL 21N/15E-5E2 M	39-42.10	120-19.90	51/51	8	7.42	1160	0.35	380	5.6	20.0	0.6	390	1.8	103	220	85	7.4	-	98
SI-4	WELL 21N/15E-5P1 M	39-41.65	120-19.65	29/29	-	8.2	120	-	56	-	-	-	-	0.5	129	-	-	1.1	-	33
SI-5	WELL 21N/15E-6Q1 M	39-41.70	120-20.30	27/27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
SI-6	WELL 21N/15E-6Q3 M	39-41.70	120-20.40	27/27	-	7.7	265	-	78	2.4	1.0	1.6	11	0.5	169	6	77	2.1	-	12
SI-7	WELL 21N/15E-4L1 M	39-41.93	120-18.37	30/30	-	7.5	330	-	96	4.4	2.0	1.0	76	-	114	25	67	1.5	-	12
SI-8	CAMPBELL HOT SPRINGS	39-34.50	120-20.95	44/44	300	10.13	325	0.06	92	1.1	2.0	tr	52	tr	86	27	82	1.6	-	98
	SISKIYOU																			
SK-1	SULPHUR SPRINGS	41-39.57	123-19.09	29/29	8	10.0	270	0.07	82	0.7	4.0	-	90	0.4	41	16	49	1.0	-	2
SK-2	BOGUS SODA SPRINGS	41-55.10	122-22.10	24/24	-	6.37	10568	5.50	4000	96.0	180.0	54.0	4250	0.5	3620	42	70	97.0	-	83
SK-3	KLAMATH HOT SPRINGS	41-57.27	122-12.10	69/69	95	-	1940	tr	543	4.8	143.0	2.9	788	-	-	365	82	15.0	-	113
SK-4	WELL 48N/1W-28F1 M	41-58.60	121-59.27	28/28	-	8.2	120	-	46	1.2	3.3	0.2	16	-	111	1		-	-	24
SK-5	UNNAMED WELL	41-56.22	121-51.03	30/30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	116
SK-6	UNNAMED FUMAROLE	41-36.35	121-31.30	88/88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
SK-7	UNNAMED SPRING	41-24.50	112-11.68	84/84	4	2.3	1550	0.01	14	3.4	-	16.0	2	0.3	-	967	213	0.1	-	113
	SOLANO																			
SO-1	TOLENAS SPRINGS	38-18.61	122-03.19	20/20	1	6.75	18165	-	6110	173.0	453.0	228.0	7740	2.0	6110	47	71	331.0	-	2
SO-2	VALLEJO WT. SUL SP	38-07.49	122-11.29	21/20	263	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38
SO-3	UNNAMED SPRING	38-06.07	122-10.13	23/23	64	7.9	788	0.12	170	2.7	0.03	54.0	243	0.4	432	2	56	8.2	-	2
	SONOMA																			
SN-1	HOODS HOT SPRINGS	38-47.90	123-09.65	38/38	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-112
SN-2	THE GEYSERS (DEV KIT)	38-48.10	122-48.40	100/100	-	1.8	6280	-	12	5.0	47.0	281.0	1	-	-	5710	225	3.1	-	2
SN-3	UNNAMED SPRING	38-46.60	122-45.72	49/49	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
SN-4	LITTLE GEYSERS	38-46.45	122-44.87	71/71	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-112
SN-5	SKAGGS SPRINGS	38-41.63	123-01.54	57/55	15	6.87	2500	-	955	31.0	13.0	4.6	56	10.0	2450	6	133	85.0	-	6
SN-6	MARK WEST SPRINGS	38-32.95	122-43.25	31/31	1	8.5	327	0.04	29	3.9	31.0	19.0	16	0.2	246	1	105	1.0	-	2
SN-7	UNNAMED SPRING	38-23.31	122-34.02	27/23	76	8.2	260	0.04	26	3.8	21.0	14.0	6	0.4	187	8	88	0.1	tr	2
SN-8	LOS GUILICOS WRM (S)	38-23.69	122-33.01	31/29	76	7.3	440	-	104	13.0	19.0	6.4	61	-	290	1	86	4.3	-	2
SN-9	UNNAMED SPRING	38-21.40	122-30.52	22/21	38	8.6	370	0.09	73	12.0	19.0	9.8	51	0.5	172	33	77	0.8	tr	2
SN-10	AGUA CALIENTE SP	38-19.30	122-29.25	46/46	38	6.8	650	3.20	168	40.0	10	6.0	249	-	-	41	69	2.4	-	110
SN-11	FETTERS HOT SP (W)	38-19.12	122-29.00	38/29	-	7.1	280	0.20	53	5.0	4	0.1	46	2.5	121	44	67	2.1	-	40
SN-12	BOYES HOT SP (W)	38-18.75	122-29.00	50/44	-	8.1	875	1.50	286	13.0	10	1.2	368	7.0	145	7	94	13.0	-	113
SN-13	WELL 5N/6W-25P2 M	38-14.67	122-28.50	28/28	-	7.9	320	-	124	3.0	2.6	3.5	22	-	316	-	7	1.2	-	27
	STANISLAUS																			
ST-1	SALT GRASS SPRINGS	37-25.86	121-18.50	23/23	4	6.6	2925	0.22	375	2.8	540.0	-	196	2.0	11	1760	29	11.0	tr	113
	TEHAMA																			
TH-1	GROWLER HOT SP	40-23.65	121-30.47	96/95	38	7.8	4540	9.20	1400	196.0	79.0	0.8	2430	1.5	52	79	233	88.0	2.2	113
TH-2	MORGAN HOT SPRINGS	40-23.02	121-30.80	96/96	323	6.6	4064	7.10	1220	148.0	111.0	9.3	2160	-	138	111	159	71.0	-	113
TH-3	TUSCAN SPRINGS	40-14.45	122-06.60	30/29	3	8.3	21574	2.00	8076	51.0	22.0	17.0	11800	4.2	1259	67	-	01.0	-	113
TH-4	STINKING SPRINGS	40-13.38	122-44.97	38/38	57	8.8	1950	0.08	555	4.8	170.0	-	1160	1.4	2	4	44	2.8	0.1	2
	TULARE																			
TU-1	KERN HOT SPRING	36-28.68	118-24.28	43/43	15	7.6	910	0.80	257	7.4	50.0	0.7	345	-	62	150	67	4.3	-	113
TU-2	JORDAN HOT SPRING	36-13.75	118-18.10	51/43	285	6.07	3280	-	970	92.0	110.0	38.0	880	1.0	1480	250	190	22.0	-	83
TU-3	SODA SPRINGS	36-12.63	118-10.55	38/38	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
TU-4	SODA SPRING	36-07.83	118-48.90	22/22	6	6.6	2030	1.70	519	16.0	165.0	43.0	568	1.2	1220	1	84	6.7	0.1	113
TU-5	WARD SPRING	36-07.05	118-46.53	21/21	4	7.0	154	-	16	2.2	15.0	4.7	7	0.2	100	5	54	-	-	113
TU-6	CALIFORNIA HOT SP	35-52.90	118-40.20	51/45	19	9.08	201	-	59	0.6	1.5	-	28	1.8	106	6	54	0.5	-	83
	VENTURA																			
VN-1	WELL 8N/23W-20H1 S	34-46.25	119-20.00	32/32	-	7.80	440	-	128	3.9	28.0	5.6	123	0.6	128	85	-	0.29	-	32
VN-2	WILLET HOT SP	34-34.91	119-02.83	42/42	568	8.80	820	0.22	292	3.4	15.0	2.1	91	12.0	512	67	45	6.6	-	3
VN-3	SESPE HOT SPRINGS	34-35.80	118-59.90	90/90	380	7.74	1091	-	330	14.0	22.0	0.1	290	12.0	70	290	98	13.0	-	83
VN-4	VICKERS HOT SP	34-30.10	119-20.75	51/51	27	7.90	1110	0.84	340	13.0	42.0	4.4	502	6.8	111	71	56	16.0	tr	3
VN-5	WHEELERS HOT SP	34-30.55	119-17.45	39/39	95	8.70	905	0.28	336	3.6	8.0	0.6	245	7.4	478	29	31	7.4	-	3
VN-6	STINGLEYS HOT SP	34-29.97	119-20.43	51/51	190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
VN-7	MATILIJA HOT SP	34-29.05	119-18.43	44/44	250	8.30	270	-	90	0.8	7.0	-	19	1.8	151	39	39	0.3	-	40

(W) = WELL (SP) = SPRING

tive activity (concentration) of hydrogen ions (pH) may be expressed in the same kind of units as other dissolved constituents, provided H^+ concentrations in milligrams per liter (mg/L) are high enough to show, as in strongly acidic waters. In general cases, the concentrations of hydrogen ions are very low and therefore its activity can be most conveniently expressed in logarithmic units. The pH represents the negative logarithm to the base 10 of the hydrogen-ion activity in moles per liter. The pH of a water represents the interrelated result of a number of chemical equilibria. To satisfactorily get the original equilibrium conditions of an aquifer, a pH measurement must be taken immediately at the time of sampling. The pH measured after a sample has been stored for sometime in the laboratory, has no relation to the original equilibrium conditions. This is also true with the samples containing dissolved gases (Hem, 1979).

Total dissolved solids (TDS) are the measure of salts in solution. Water-quality criteria for this study are based on the type and amount of dissolved mineral matter in water, and on intended use of the thermal water. Dissolved matter in water is mainly in the form of electrically charged particles (ions) whose concentration is measured in mg/L. Positively charged ions are called cations and negatively charged ions are called anions. Total dissolved solids can be determined by evaporating an aliquot of water to dryness and weighing the residue. It can also be approximated by measuring the specific conductance of the water. A third and easy procedure for determining TDS is to sum up the concentrations reported for various dissolved constituents and subtract part of the bicarbonate after converting it to carbonate. For certain types of water, this computation method is more reliable than the residue or evaporation method. In the present study, TDS were obtained by summing up the constituents present in the water analysis for each spring or well and subtracting part of the bicarbonate. This is done by dividing the bicarbonate value by a factor of 2.03 (Skougstad and others, 1979) or by multiplying the bicarbonate value by a factor of 0.4917 (Hem, 1970) and subtracting this figure from the total sum of all the cations and anions. Table 1 lists the physical parameters and chemical constituents of thermal waters in California. Table 1a lists the chemical characteristics of these thermal waters.

In hydrogeochemistry, alkalinity is defined as the capacity of the solution to neutralize acid. In most natural water, the alkalinity is practically all produced by dissolved carbonate and bicarbonate ions. A more meaningful and useful statement of the alkalinity in these geothermal waters is obtained by expressing the results of the determination as concentrations of bicarbonate and carbonate. Carbonate values are converted to bicarbonate values by multiplying them by 2.03, and these converted values are added to the bicarbonate values and tabulated in Table 1 as a column designated as "HCO_3 Alk" (bicarbonate alkalinity).

GEOTHERMOMETRY

Table 2 lists the estimated temperatures by various geothermometers for each of the analyzed thermal springs and wells plotted on the geothermal resources map, along with the most recent surface temperature and calculated water type. Estimation of subsurface temperatures were made for 448 of the analyzed springs and wells in California (97.2% of the total analyzed springs and wells). These estimates were made from the constituents of thermal waters (Table 1) by the U.S. Geological Survey using its computer program GEOTHERM. Estimates of subsurface temperatures by isotope-geothermometers were not included because of insufficient data.

Information on the subsurface temperature, flow patterns, the recharge source, type of reservoir rock, and other important parameters of the geothermal system can be obtained from the chemical and isotopic composition of the geothermal waters when they reach the surface in springs or wells. Thus, geothermometry is the estimation of subsurface temperatures of geothermal waters by relating certain of the chemical component concentrations or ratios. The theory of quantitative chemical geothermometers has been discussed by Fournier, White, and Trusdell (1974), and Fournier and Trusdell (1974). These geothermometers depend on the existence of temperature-dependent equilibria and water-rock reactions at depth. The most common soluble chemical constituents of thermal waters are SiO_2, Na, K, Ca, Mg, Cl, HCO_3, and CO_3. The silica and Na-K-Ca geothermometers are those most commonly used to estimate subsurface temperature of the reservoir.

The validity of these geothermometers is based on the following assumptions:

1. Temperature-dependent reactions at depth;
2. An adequate supply of reactants from the reservoir;
3. Water-mineral equilibrium in the reservoir;
4. The constituents do not re-equilibrate with the confining rock as the water flows to the surface; and
5. Dilution or mixing of thermal and non-thermal groundwater does not occur.

Mixing, which is possible for many of the thermal springs, leads to low aquifer-temperature estimates from the silica geothermometer. Isotope-chloride relationships indicate the mixtures of thermal and surface waters. Re-equilibrium of water with its environment probably affects the Na-K-Ca geothermometer more often than the silica geothermometer. Loss of calcium due to precipitation of $CaCO_3$ is probably the major cause of excessively high temperature estimates from the Na-K-Ca geothermometer. A correction is made to the Na-K-Ca geothermometer when magnesium makes up a significant part of the cation composition. At high magnesium concentrations the correction factor reduces the calculated temperature to agree with observed temperatures.

The geothermometers which are currently available include a set using silica. The SiO_2 concentrations used in all computations are mg/L. The following computations were used for various types of silica geothermometers:

Type	*Computation used*
Quartz (conductive)	$T°C = \dfrac{1309}{5.19 - \log SiO_2} - 273.15$
Quartz (adiabatic)	$T°C = \dfrac{1522}{5.72 - \log SiO_2} - 273.15$
Chalcedony	$T°C = \dfrac{1032}{4.69 - \log SiO_2} - 273.15$
α-cristobalite	$T°C = \dfrac{1000}{4.78 - \log SiO_2} - 273.15$
Amorphous silica	$T°C = \dfrac{731}{4.52 - \log SiO_2} - 273.15$

Table 1A. Chemical Characteristics of the Springs and Wells of California

COUNTY CODE #	CHEMICAL CHARACTERISTICS
	ALAMEDA COUNTY
AL-1	Sodium Mixed Anions
AL-2	Sodium Bicarbonate
	ALPINE COUNTY
AP-1	Sodium Bicarbonate
AP-2	No Chemistry
	CALAVERAS COUNTY
CA-1	Partial·Chemistry
	COLUSA COUNTY
CO-1	Sodium Chloride
CO-2	Sodium Chloride
CO-3	Sodium Chloride
CO-4	Partial Chemistry
CO-5	Sodium Chloride
CO-6	No Chemistry
CO-7	No Chemistry
	CONTRA COSTA COUNTY
CC-1	Sodium Bicarbonate
CC-2	Sodium Chloride
CC-3	Sodium Chloride
CC-4	Sodium Chloride
CC-5	Sodium Chloride
	EL DORADO COUNTY
ED-1	No Chemistry
ED-2	Sodium Bicarbonate
	FRESNO COUNTY
FR-1	No Chemistry
FR-2	No Chemistry
FR-3	Sodium Chloride
FR-4	Sodium Chloride
FR-5	Sodium Chloride
FR-6	Mixed Cations Sulfate
FR-7	Sodium Bicarbonate
	GLENN COUNTY
GL-1	Sodium Chloride
	IMPERIAL COUNTY
IM-1	Sodium Chloride
IM-2	Sodium Chloride
IM-3	Sodium Chloride
IM-4	Sodium Chloride
IM-5	Sodium Chloride
IM-6	Sodium Chloride
IM-7	Sodium Chloride
IM-8	Sodium Chloride
IM-9	Sodium Chloride
IM-10	Sodium Chloride
IM-11	Sodium Sulfate
IM-12	Partial Chemistry
IM-13	Sodium Sulfate
IM-14	Sodium Chloride
IM-15	Sodium Mixed Anions
IM-16	Sodium Chloride
IM-17	Sodium Chloride
IM-18	Sodium Mixed Anions
IM-19	Sodium Mixed Anions
IM-20	Sodium Chloride
IM-21	Sodium Chloride
IM-22	Sodium Chloride
IM-23	Sodium Chloride
IM-24	Sodium Chloride
IM-25	No Chemistry
IM-26	No Chemistry
IM-27	No Chemistry
IM-28	No Chemistry
IM-29	No Chemistry
IM-30	No Chemistry
IM-31	No Chemistry
IM-32	No Chemistry
IM-33	Sodium Chloride
IM-34	No Chemistry
IM-35	Sodium Chloride
IM-36	No Chemistry
IM-37	No Chemistry
IM-38	Sodium Chloride
IM-39	Sodium Chloride
IM-40	No Chemistry
IM-41	Sodium Chloride
IM-42	Sodium Chloride
IM-43	Sodium Chloride
IM-44	Sodium Chloride
IM-45	Sodium Chloride
IM-46	No Chemistry
IM-47	No Chemistry
IM-48	Sodium Chloride
IM-49	Sodium Chloride
IM-50	Sodium Chloride
IM-51	Sodium Chloride
IM-52	No Chemistry
IM-53	Sodium Chloride
IM-54	Sodium Chloride
IM-55	Sodium Chloride
IM-56	Sodium Chloride
IM-57	Sodium Bicarbonate
IM-58	Sodium Chloride
IM-59	Sodium Chloride
IM-60	Sodium Chloride
IM-61	Sodium Chloride
IM-62	Sodium Chloride
IM-63	Sodium Chloride
IM-64	Sodium Chloride
IM-65	Sodium Chloride
IM-66	Sodium Chloride
IM-67	Sodium Chloride
IM-68	Sodium Chloride
IM-69	Sodium Chloride
IM-70	Sodium Mixed Anions
IM-71	Sodium Chloride
IM-72	Sodium Chloride
IM-73	Sodium Chloride
IM-74	Sodium Chloride
IM-75	Sodium Chloride
IM-76	Sodium Chloride
IM-77	Sodium Sulfate
IM-78	Sodium Bicarbonate
IM-79	Sodium Bicarbonate
IM-80	Sodium Mixed Anions
IM-81	Partial Chemistry
IM-82	Sodium Chloride
IM-83	Sodium Chloride
IM-84	Sodium Chloride
IM-85	Sodium Chloride
IM-86	Sodium Mixed Anions
IM-87	Sodium Chloride
IM-88	Sodium Bicarbonate
IM-89	Sodium Bicarbonate
IM-90	Sodium Chloride
IM-91	Sodium Mixed Anions
IM-92	Sodium Chloride
IM-93	Sodium Mixed Anions
IM-94	Sodium Mixed Anions
IM-95	Sodium Chloride
IM-96	Sodium Chloride
IM-97	Sodium Chloride
IM-98	Sodium Bicarbonate
IM-99	Sodium Mixed Anions
IM-100	Sodium Chloride
IM-101	Sodium Mixed Anions
IM-102	Sodium Mixed Anions
IM-103	Sodium Bicarbonate
IM-104	Sodium Bicarbonate
IM-105	Sodium Bicarbonate
IM-106	Sodium Bicarbonate
IM-107	Sodium Bicarbonate
IM-108	Sodium Bicarbonate
IM-109	Sodium Bicarbonate
IM-110	Sodium Chloride
IM-111	Sodium Chloride
IM-112	Sodium Chloride
IM-113	No Chemistry
IM-114	Sodium Chloride
IM-115	No Chemistry
IM-116	Sodium Chloride
IM-117	No Chemistry
IM-118	Sodium Chloride
IM-119	Sodium Chloride
IM-120	Sodium Chloride
IM-121	Sodium Bicarbonate
IM-122	Sodium Bicarbonate
IM-123	Sodium Bicarbonate
IM-124	Sodium Chloride
IM-125	No Chemistry
IM-126	Sodium Mixed Anions
IM-127	Sodium Chloride
IM-128	Sodium Chloride
IM-129	Sodium Bicarbonate
IM-130	Sodium Bicarbonate
IM-131	Sodium Bicarbonate
IM-132	Sodium Chloride
IM-133	Sodium Bicarbonate
IM-134	Sodium Bicarbonate
IM-135	No Chemistry
IM-136	Sodium Mixed Anions
IM-137	Sodium Mixed Anions
IM-138	Sodium Chloride
IM-139	Partial Chemistry
IM-140	Sodium Chloride
IM-141	Sodium Chloride
IM-142	Sodium Chloride
IM-143	Sodium Chloride
IM-144	Sodium Chloride
IM-145	Sodium Mixed Anions
IM-146	Sodium Chloride
IM-147	Sodium Chloride
IM-148	Sodium Chloride
IM-149	No Chemistry
IM-150	Partial Chemistry
IM-151	No Chemistry
IM-152	No Chemistry
IM-153	No Chemistry
	INYO COUNTY
IN-1	Sodium Chloride
IN-2	No Chemistry
IN-3	Sodium Bicarbonate
IN-4	Sodium Mixed Anions
IN-5	Sodium Mixed Anions
IN-6	Sodium Mixed Anions
IN-7	Calcium Sulfate
IN-8	Sodium Bicarbonate
IN-9	Sodium Bicarbonate
IN-10	Magnesium Sulfate
IN-11	Sodium Chloride
IN-12	No Chemistry
IN-13	Sodium Bicarbonate
IN-14	Calcium Bicarbonate
IN-15	Sodium Chloride
IN-16	Sodium Chloride
IN-17	No Chemistry
IN-18	Calcium Sulfate
IN-19	Sodium Mixed Anions
IN-20	No Chemistry
IN-21	Sodium Mixed Anions
IN-22	No Chemistry
IN-23	No Chemistry
IN-24	Sodium Mixed Anions
IN-25	Sodium Bicarbonate
IN-26	Sodium Bicarbonate
IN-27	Sodium Mixed Anions
	KERN COUNTY
KR-1	Sodium Mixed Anions
KR-2	Sodium Bicarbonate
KR-3	Sodium Bicarbonate
KR-4	Sodium Chloride
KR-5	No Chemistry
KR-6	Sodium Bicarbonate
KR-7	No Chemistry
KR-8	Mixed Cations Chloride
KR-9	Sodium Bicarbonate
KR-10	Sodium Bicarbonate
KR-11	Sodium Chloride
KR-12	No Chemistry
KR-13	Sodium Bicarbonate
KR-14	Mixed Cations Sulfate
KR-15	Mixed Cations Sulfate
KR-16	Mixed Cations Sulfate
KR-17	Sodium Mixed Anions
KR-18	Sodium Bicarbonate
	LAKE COUNTY
LK-1	Sodium Bicarbonate
LK-2	No Chemistry
LK-3	No Chemistry
LK-4	Sodium Chloride
LK-5	Sodium Chloride
LK-6	No Chemistry
LK-7	No Chemistry
LK-8	Sodium Bicarbonate
LK-9	Sodium Bicarbonate
LK-10	No Chemistry
LK-11	No Chemistry
LK-12	Magnesium Bicarbonate
LK-13	Sodium Bicarbonate
LK-14	Mixed Cations Bicarbonate
LK-15	No Chemistry
LK-16	Magnesium Bicarbonate
LK-17	No Chemistry
LK-18	Mixed Cations Bicarbonate
LK-19	Magnesium Bicarbonate
LK-20	Magnesium Bicarbonate
LK-21	No Chemistry
LK-22	Mixed Cations Sulfate
LK-23	Sodium Bicarbonate
LK-24	Partial Chemistry
LK-25	Sodium Chloride
	LASSEN COUNTY
LS-1	Sodium Mixed Anions
LS-2	No Chemistry
LS-3	Sodium Sulfate
LS-4	Sodium Sulfate
LS-5	No Chemistry
LS-6	Mixed Cations Bicarbonate
LS-7	Sodium Sulfate
LS-8	No Chemistry
LS-9	Sodium Sulfate
LS-10	No Chemistry
LS-11	No Chemistry
LS-12	Sodium Sulfate
LS-13	No Chemistry
LS-14	No Chemistry
LS-15	No Chemistry
LS-16	No Chemistry
LS-17	No Chemistry
LS-18	Sodium Sulfate
LS-19	No Chemistry
LS-20	Sodium Bicarbonate
LS-21	Sodium Sulfate
LS-22	Sodium Sulfate
LS-23	No Chemistry
LS-24	No Chemistry
LS-25	No Chemistry
LS-26	Sodium Mixed Anions
	LOS ANGELES COUNTY
LA-1	Sodium Chloride
LA-2	Sodium Bicarbonate
LA-3	Mixed Cations Sulfate
LA-4	Sodium Bicarbonate
LA-5	Sodium Sulfate
LA-6	Sodium Sulfate
LA-7	Sodium Bicarbonate
LA-8	Mixed Cations Bicarbonate
LA-9	Mixed Cations Bicarbonate
LA-10	Calcium Bicarbonate
LA-11	Sodium Chloride
LA-12	Calcium Mixed Anions
LA-13	Sodium Bicarbonate
LA-14	Sodium Chloride
LA-15	No Chemistry
LA-16	No Chemistry
	MADERA COUNTY
MA-1	Sodium Bicarbonate
	MARIN COUNTY
MR-1	Sodium Chloride
	MENDOCINO COUNTY
MN-1	Sodium Bicarbonate
MN-2	Sodium Chloride
MN-3	Sodium Chloride
MN-4	Sodium Bicarbonate
MN-5	Sodium Bicarbonate
MN-6	Sodium Bicarbonate
MN-7	Sodium Bicarbonate
	MERCED COUNTY
MC-1	Sodium Chloride
MC-2	Sodium Bicarbonate
MC-3	Sodium Bicarbonate
	MODOC COUNTY
MD-1	No Chemistry
MD-2	No Chemistry
MD-3	Sodium Mixed Anions
MD-4	Sodium Mixed Anions
MD-5	Sodium Bicarbonate
MD-6	Sodium Mixed Anions
MD-7	Sodium Bicarbonate
MD-8	Sodium Mixed Anions
MD-9	Sodium Mixed Anions
MD-10	No Chemistry
MD-11	No Chemistry
MD-12	No Chemistry
MD-13	Sodium Mixed Anions
MD-14	Sodium Sulfate
MD-15	Sodium Sulfate
MD-16	Sodium Sulfate
MD-17	Sodium Sulfate
MD-18	Sodium Sulfate
MD-19	Sodium Sulfate
MD-20	Sodium Mixed Anions
MD-21	Sodium Bicarbonate
MD-22	Sodium Sulfate
MD-23	No Chemistry
MD-24	No Chemistry
MD-25	No Chemistry
MD-26	Sodium Bicarbonate
MD-27	No Chemistry
MD-28	No Chemistry
MD-29	No Chemistry
MD-30	No Chemistry
MD-31	No Chemistry
MD-32	Sodium Sulfate

Table 1A. Chemical Characteristics of the Springs and Wells of California - Continued.

COUNTY CODE #	CHEMICAL CHARACTERISTICS
MD-33	No Chemistry
MD-34	Sodium Sulfate
MD-35	Sodium Mixed Anions
	MONO COUNTY
MO-1	Sodium Mixed Anions
MO-2	Sodium Chloride
MO-3	No Chemistry
MO-4	Sodium Bicarbonate
MO-5	No Chemistry
MO-6	Sodium Mixed Anions
MO-7	Sodium Bicarbonate
MO-8	Sodium Bicarbonate
MO-9	No Chemistry
MO-10	Partial Chemistry
MO-11	Sodium Chloride
MO-12	Sodium Chloride
MO-13	No Chemistry
MO-14	Sodium Bicarbonate
MO-15	Sodium Mixed Anions
MO-16	No Chemistry
MO-17	Sodium Bicarbonate
MO-18	No Chemistry
MO-19	No Chemistry
MO-20	No Chemistry
MO-21	Sodium Mixed Anions
MO-22	Sodium Bicarbonate
MO-23	Sodium Bicarbonate
MO-24	Sodium Mixed Anions
MO-25	No Chemistry
MO-26	Sodium Bicarbonate
MO-27	Sodium Bicarbonate
MO-28	Sodium Bicarbonate
MO-29	Sodium Bicarbonate
MO-30	No Chemistry
MO-31	Sodium Mixed Anions
MO-32	No Chemistry
	MONTEREY COUNTY
MT-1	No Chemistry
MT-2	No Chemistry
MT-3	No Chemistry
MT-4	Sodium Mixed Anions
MT-5	Sodium Bicarbonate
MT-6	Sodium Bicarbonate
MT-7	Sodium Sulfate
MT-8	Sodium Sulfate
MT-9	Magnesium Bicarbonate
	NAPA COUNTY
NA-1	Mixed Cations Mixed Anions
NA-2	Sodium Bicarbonate
NA-3	No Chemistry
NA-4	Sodium Chloride
NA-5	Sodium Chloride
NA-6	Sodium Chloride
NA-7	No Chemistry
NA-8	Magnesium Bicarbonate
NA-9	No Chemistry
NA-10	Sodium Chloride
NA-11	No Chemistry
NA-12	No Chemistry
NA-13	No Chemistry
NA-14	No Chemistry
NA-15	Mixed Cations Bicarbonate
NA-16	No Chemistry
NA-17	No Chemistry
NA-18	No Chemistry
NA-19	No Chemistry
	ORANGE COUNTY
OR-1	Sodium Bicarbonate
OR-2	Magnesium Bicarbonate
OR-3	No Chemistry
OR-4	No Chemistry
OR-5	No Chemistry
OR-6	No Chemistry
OR-7	No Chemistry
OR-8	Partial Chemistry
OR-9	Sodium Bicarbonate
OR-10	Mixed Cations Bicarbonate
OR-11	Sodium Mixed Anions
	PLACER COUNTY
PC-1	Sodium Chloride
	PLUMAS COUNTY
PL-1	No Chemistry
PL-2	Mixed Cations Sulfate
PL-3	No Chemistry
PL-4	Mixed Cations Sulfate
PL-5	No Chemistry
PL-6	No Chemistry
PL-7	No Chemistry
PL-8	Sodium Bicarbonate
PL-9	Sodium Mixed Anions
PL-10	Sodium Chloride
PL-11	Sodium Chloride
PL-12	Sodium Bicarbonate
PL-13	Sodium Bicarbonate
PL-14	Sodium Bicarbonate
PL-15	Sodium Bicarbonate
PL-16	Sodium Chloride
PL-17	Sodium Chloride
PL-18	No Chemistry
PL-19	No Chemistry
	RIVERSIDE COUNTY
RV-1	Sodium Sulfate
RV-2	No Chemistry
RV-3	Mixed Cations Bicarbonate
RV-4	No Chemistry
RV-5	Calcium Bicarbonate
RV-6	Sodium Bicarbonate
RV-7	No Chemistry
RV-8	No Chemistry
RV-9	Sodium Chloride
RV-10	Sodium Bicarbonate
RV-11	Sodium Bicarbonate
RV-12	Sodium Chloride
RV-13	Sodium Mixed Anions
RV-14	Sodium Mixed Anions
RV-15	Mixed Cations Mixed Anions
RV-16	Mixed Cations Mixed Anions
RV-17	Mixed Cations Sulfate
RV-18	Mixed Cations Bicarbonate
RV-19	Mixed Cations Sulfate
RV-20	Mixed Cations Bicarbonate
RV-21	Mixed Cations Bicarbonate
RV-22	Mixed Cations Mixed Anions
RV-23	Sodium Chloride
RV-24	Mixed Cations Mixed Anions
RV-25	Sodium Chloride
RV-26	Sodium Mixed Anions
RV-27	Mixed Cations Mixed Anions
RV-28	No Chemistry
RV-29	Sodium Bicarbonate
RV-30	No Chemistry
RV-31	Sodium Sulfate
RV-32	Sodium Mixed Anions
RV-33	Sodium Bicarbonate
RV-34	Sodium Bicarbonate
RV-35	Sodium Bicarbonate
RV-36	Sodium Chloride
RV-37	Sodium Chloride
RV-38	Sodium Chloride
RV-39	Sodium Chloride
RV-40	Sodium Sulfate
RV-41	Partial Chemistry
RV-42	Partial Chemistry
RV-43	Partial Chemistry
RV-44	Partial Chemistry
RV-45	Partial Chemistry
RV-46	Partial Chemistry
RV-47	Partial Chemistry
RV-48	Partial Chemistry
RV-49	Sodium Sulfate
RV-50	Calcium Bicarbonate
RV-51	Sodium Chloride
RV-52	Partial Chemistry
RV-53	Sodium Chloride
RV-54	Sodium Chloride
RV-55	Sodium Chloride
RV-56	Partial Chemistry
RV-57	Partial Chemistry
RV-58	Sodium Mixed Anions
RV-59	Sodium Chloride
RV-60	Sodium Sulfate
RV-61	Sodium Mixed Anions
RV-62	Sodium Mixed Anions
RV-63	Sodium Chloride
RV-64	Sodium Chloride
RV-65	No Chemistry
RV-66	Partial Chemistry
RV-67	Sodium Chloride
	SAN BENITO COUNTY
SE-1	Sodium Chloride
SE-2	Sodium Chloride
	SAN BERNARDINO COUNTY
SB-1	Sodium Bicarbonate
SB-2	Sodium Mixed Anions
SB-3	Mixed Cations Sulfate
SB-4	No Chemistry
SB-5	Sodium Mixed Anions
SB-6	Sodium Chloride
SB-7	No Chemistry
SB-8	Sodium Mixed Anions
SB-9	Sodium Mixed Anions
SB-10	Sodium Chloride
SB-11	Sodium Chloride
SB-12	Sodium Mixed Anions
SB-13	Sodium Chloride
SB-14	Sodium Mixed Anions
SB-15	Sodium Sulfate
SB-16	Sodium Mixed Anions
SB-17	Sodium Sulfate
SB-18	Sodium Bicarbonate
SB-19	Sodium Sulfate
SB-20	No Chemistry
SB-21	No Chemistry
SB-22	No Chemistry
SB-23	Sodium Sulfate
SB-24	Sodium Sulfate
SB-25	No Chemistry
SB-26	Sodium Sulfate
SB-27	No Chemistry
SB-28	No Chemistry
SB-29	No Chemistry
SB-30	Sodium Sulfate
SB-31	No Chemistry
SB-32	No Chemistry
SB-33	No Chemistry
SB-34	No Chemistry
SB-35	No Chemistry
SB-36	Sodium Bicarbonate
	SAN DIEGO COUNTY
SD-1	Sodium Mixed Anions
SD-2	Sodium Mixed Anions
SD-3	Mixed Cations Bicarbonate
SD-4	Sodium Mixed Anions
SD-5	Mixed Cations Mixed Anions
SD-6	Partial Chemistry
SD-7	Partial Chemistry
SD-8	Partial Chemistry
SD-9	Partial Chemistry
SD-10	Partial Chemistry
SD-11	Partial Chemistry
SD-12	Partial Chemistry
SD-13	Partial Chemistry
SD-14	Partial Chemistry
SD-15	Mixed Cations Sulfate
SD-16	Sodium Mixed Anions
SD-17	Partial Chemistry
SD-18	Sodium Chloride
SD-19	Partial Chemistry
SD-20	Mixed Cations Bicarbonate
SD-21	Mixed Cations Chloride
SD-22	Mixed Cations Chloride
SD-23	Mixed Cations Mixed Anions
SD-24	Sodium Chloride
SD-25	Mixed Cations Chloride
SD-26	Sodium Mixed Anions
SD-27	Sodium Mixed Anions
SD-28	Sodium Chloride
SD-29	Sodium Chloride
SD-30	Calcium Chloride
	SAN JOAQUIN COUNTY
SJ-1	Magnesium Bicarbonate
SJ-2	Mixed Cations Mixed Anions
	SAN LUIS OBISPO COUNTY
SL-1	Sodium Mixed Anions
SL-2	Sodium Chloride
SL-3	Sodium Bicarbonate
SL-4	Sodium Bicarbonate
SL-5	No Chemistry
SL-6	Sodium Bicarbonate
SL-7	Sodium Mixed Anions
SL-8	No Chemistry
SL-9	No Chemistry
SL-10	No Chemistry
SL-11	Mixed Cations Bicarbonate
SL-12	Sodium Bicarbonate
SL-13	Mixed Cations Bicarbonate
	SANTA BARBARA COUNTY
SA-1	Sodium Sulfate
SA-2	Sodium Chloride
SA-3	Sodium Mixed Anions
SA-4	Sodium Bicarbonate
SA-5	Sodium Mixed Anions
SA-6	Sodium Chloride
SA-7	Sodium Mixed Anions
SA-8	Sodium Bicarbonate
SA-9	Sodium Bicarbonate
SA-10	Sodium Bioarbonate
SA-11	No Chemistry
SA-12	Sodium Bicarbonate
SA-13	Sodium Chloride
	SANTA CLARA COUNTY
SC-1	Sodium Bicarbonate
SC-2	Sodium Bicarbonate
SC-3	Sodium Bicarbonate
	SANTA CRUZ COUNTY
SZ-1	Mixed Cations Bicarbonate
	SHASTA COUNTY
SH-1	Sodium Sulfate
SH-2	Sodium Bicarbonate
SH-3	Sodium Chloride
SH-4	No Chemistry
SH-5	No Chemistry
SH-6	No Chemistry
SH-7	Mixed Cations Sulfate
	SIERRA COUNTY
SI-1	Sodium Chloride
SI-2	No Chemistry
SI-3	Sodium Chloride
SI-4	Partial Chemistry
SI-5	No Chemistry
SI-6	Sodium Bicarbonate
SI-7	Sodium Mixed Anions
SI-8	Sodium Mixed Anions
	SISKIYOU COUNTY
SK-1	Sodium Chloride
SK-2	Sodium Chloride
SK-3	Sodium Chloride
SK-4	Sodium Chloride
SK-5	No Chemistry
SK-6	No Chemistry
SK-7	Magnesium Sulfate
	SOLANO COUNTY
SO-1	Sodium Chloride
SO-2	No Chemistry
SO-3	Sodium Bicarbonate
	SONOMA COUNTY
SN-1	No Chemistry
SN-2	Magnesium Sulfate
SN-3	No Chemistry
SN-4	No Chemistry
SN-5	Sodium Bicarbonate
SN-6	Mixed Cations Bicarbonate
SN-7	Mixed Cations Bicarbonate
SN-8	Sodium Bicarbonate
SN-9	Sodium Bicarbonate
SN-10	Sodium Chloride
SN-11	Sodium Mixed Anions
SN-12	Sodium Chloride
SN-13	Sodium Bicarbonate
	STANISLAUS COUNTY
ST-1	Calcium Sulfate
	TEHAMA COUNTY
TH-1	Sodium Chloride
TH-2	Sodium Chloride
TH-3	Sodium Chloride
TH-4	Sodium Chloride
	TULARE COUNTY
TU-1	Sodium Chloride
TU-2	Sodium Mixed Anions
TU-3	No Chemistry
TU-4	Sodium Bicarbonate
TU-5	Mixed Cations Bicarbonate
TU-6	Sodium Bicarbonate
	VENTURA COUNTY
VN-1	Sodium Mixed Anions
VN-2	Sodium Bicarbonate
VN-3	Sodium Chloride
VN-4	Sodium Chloride
VN-5	Sodium Bicarbonate
VN-6	No Chemistry
VN-7	Sodium Bicarbonate

Table 2. Summary of Estimated Geothermometer Temperatures and Type of Thermal Waters of California

COUNTY CODE NUMBER	RECENT SURFACE TEMP. (°C)	SILICA					Na-K-Ca					WATER TYPE
										Mg CORRECTED		
		Conductive	Adiabatic	Chalcedony	α-Cristobalite	Amorphous	Na-K	Na-K-Ca (1/3)	Na-K-Ca (4/3)	Na-K-Ca (1/3)	Na-K-Ca (4/3)	
ALAMEDA COUNTY												
AL-1	21	88	91	57	38	−26	132	144	92	COOL	COOL	Na >> Mg ≥ Ca >> K HCO_3 > Cl > SO_4 >>> F
AL-2*	27	85	88	54	35	−29	10	42	13	NONE	NONE	Na >>> Ca >> > Mg > K HCO_3 >>> Cl > CO_3 = SO_4 >>> F
ALPINE COUNTY												
AP-1	64	137	133	110	87	17	102	133	117	NONE	NONE	Na >>> Ca > K > > Mg HCO_3 >> SO_4 ≥ SO_4 > >> F
COLUSA COUNTY												
CO-1	24	137	133	110	87	17	67	125	194	COOL	COOL	Na >>> Mg > Ca > K Cl > HCO_3 >>> SO_4 > > F
CO-2	69	157	149	133	107	35	142	241	675	155	476	Na >>> K >> > Mg >> Ca Cl >>> HCO_3 >> > SO_4 >>> CO_3 > F
CO-3	55	180	168	159	130	56	133	240	781	98	464	Na >>> K >> > Mg >>> Ca Cl > HCO_3 >>> SO_4 > >> CO_3 > F
CO-5*	61	–	–	–	–	–	132	–	–	NONE	NONE	Na >>> K >> > Mg Cl > HCO_3 >> CO_3 >> SO_4
CONTRA COSTA COUNTY												
CC-1	24	137	133	110	87	17	133	153	119	30	34	Na >> Ca > Mg ≥ K HCO_3 > Cl >>> SO_4 > F
CC-2*	23	69	74	37	19	−42	30	70	62	NONE	NONE	Na >> Ca >>> K Cl >>> CO_3 >> SO_4 >>> F
CC-3*	23	57	64	25	9	−51	30	70	63	NONE	NONE	Na >> Ca >>> K Cl >>> CO_3 >> SO_4 >>> F
CC-4	21	55	62	23	7	−53	77	119	130	NONE	NONE	Na >> Ca >> K > > Mg Cl >>> HCO_3 >> > F > SO_4
CC-5	51	48	55	15	0	−59	65	111	128	49	46	Na >> Ca >> Mg > K Cl >>> HCO_3 >> > SO_4 >>> F
El DORADO COUNTY												
ED-2*	24	69	74	37	19	−42	97	109	50	61	–	Na >>> Ca >> K = Mg HCO_3 > Cl ≥ CO_3 ≥ SO_4 > >> F
FRESNO COUNTY												
FR-3	43	111	110	81	60	−7	102	122	79	NONE	NONE	Na >> Ca >> K > Mg Cl ≥ HCO_3 >> SO_4 >> > F
FR-4	43	103	103	73	52	−13	94	109	56	NONE	NONE	Na >> Ca >>> K >>> Mg Cl >> SO_4 > HCO_3 >> > F
FR-5*	48	120	118	91	69	1	50	93	97	NONE	NONE	Na >>> Ca >> K Cl >>> CO_3 >> HCO_3 = SO_4 >>> F
FR-6	24	132	128	105	81	12	47	95	117	COOL	COOL	Na > Mg >> Ca >> > K SO_4 >>> Cl >> > F
FR-7*	31	109	109	79	58	−8	60	99	97	NONE	NONE	Na >>> K = Ca > >> Mg HCO_3 >> Cl > SO_4 >> F
GLENN COUNTY												
GL-1	24	153	146	128	103	32	68	144	314	COOL	COOL	Na >>> Mg > K > > Ca Cl >> HCO_3 >>> SO_4 >> F
IMPERIAL COUNTY												
IM-1	46	–	–	–	–	–	38	81	87	NONE	NONE	Na >> Ca >>> Mg > K Cl >>> SO_4 >> > HCO_3 >>> F
IM-2*	28	83	87	52	33	−30	69	101	80	85	90	Na >> Ca >> Mg > K Cl >> SO_4 > HCO_3 >> > CO_3 >>> F
IM-3	27	–	–	–	–	–	39	81	80	69	69	Na >>> Ca >> Mg >> K Cl > SO_4 >>> HCO_3 > >> F
IM-4	38	85	88	54	35	−29	53	110	171	45	40	Na >>> K > Ca > Mg Cl >> HCO_3 >>> F > SO_4
IM-5												Na >>> Ca >> Mg Cl > HCO_3 >> SO_4
IM-6	33	–	–	–	–	–	28	75	92	52	45	Na >>> Ca > Mg > > K Cl >> HCO_3 > SO_4
IM-7	58	–	–	–	–	–	41	–	–	NONE	NONE	Na >>> K Cl > HCO_3 >> SO_4 >> > F
IM-8	39	–	–	–	–	–	21	61	54	NONE	NONE	Na >>> Ca >> > K Cl
IM-9	31	62	67	29	12	−48	–	–	–	NONE	NONE	Na > Ca >> Mg Cl > SO_4 >> HCO_3

* Samples with 8.50 or more pH. In these samples, the dissociation of silicic acid may account for higher temperatures estimated from the quartz or chalcedony geothermometer relative to the Na-K-Ca geothermometer.

Table 2. Summary of Estimated Geothermometer Temperatures and Type of Thermal Waters of California — Continued

COUNTY CODE NUMBER		RECENT SURFACE TEMP. (°C)	SILICA					Na-K-Ca					WATER TYPE
											Mg CORRECTED		
			Conductive	Adiabatic	Chalcedony	α-Cristobalite	Amorphous	Na-K	Na-K-Ca (1/3)	Na-K-Ca (4/3)	Na-K-Ca (1/3)	Na-K-Ca (4/3)	
IMPERIAL COUNTY (Continued)	IM-10*	35	–	–	–	–	–	34	64	32	NONE	NONE	Na>>Ca>>>K Cl
	IM-11	28	55	62	23	7	−53	–	–	–	NONE	NONE	Na>>Ca>>Mg SO_4>Cl>>HCO_3>> >F
	IM-12*	29	–	–	–	–	–	55	98	103	NONE	NONE	Na>>>Ca>>K
	IM-13	29	42	50	10	−6	−63	19	67	87	58	50	Na>>>Ca>Mg> >K SO_4>>Cl>>> HCO_3>>>F
	IM-14	30	–	–	–	–	–	23	68	76	NONE	NONE	Na>>Ca>>>K Cl
	IM-15*	34	110	109	80	59	−7	51	88	78	49	53	Na>>>Ca>K>Mg HCO_3=Cl>>CO_3>SO_4> >F
	IM-16	29	92	94	61	42	−23	95	113	65	75	89	Na>>Ca>>Mg>K Cl>HCO_3=SO_4>>F
	IM-17*	28	102	103	72	51	−14	48	89	91	NONE	NONE	Na>>>Ca=K Cl>CO_3≥HCO_3>SO_4> >F
	IM-18*	33	72	77	40	23	−39	33	71	59	NONE	NONE	Na>>>Ca>Mg≥K HCO_3>Cl>>CO_3≥SO_4>F
	IM-19	29	–	–	–	–	–	137	135	57	82	99	Na>Ca>>Mg>K HCO_3=SO_4>Cl>>>F
	IM-20	77	72	77	40	23	−39	135	162	147	68	68	Na>>Ca>K>Mg Cl>>HCO_3>SO_4>> >F
	IM-21	88	124	121	96	73	5	138	168	162	37	37	Na>>>Ca>K>Mg Cl>>SO_4>HCO_3>> >F
	IM-22	62	–	–	–	–	–	127	156	142	64	64	Na>>Ca>>K>Mg Cl>>HCO_3>SO_4>> >F
	IM-23	60	115	114	86	65	−2	137	165	152	68	68	Na>>Ca>>K> >Mg Cl>HCO_3>>SO_4>> >F
	IM-24	31	–	–	–	–	–	125	155	143	75	74	Na>>Ca>>K>Mg Cl>>HCO_3>SO_4> >>F
	IM-33	44	78	82	47	28	−34	100	133	123	34	35	Na>>>Ca>Mg≥K HCO_3≥Cl>SO_4
	IM-35	40	–	–	–	–	–	151	195	244	70	82	Na>>Ca>K>Mg Cl>>HCO_3>>SO_4> >>F
	IM-38	28	5	15	−28	−41	−92	–	–	–	NONE	NONE	Na>Ca>Mg Cl>SO_4>HCO_3
	IM-39	105	148	141	122	97	26	188	233	312	190	247	Na>>K≥Ca>> >Mg Cl>>>HCO_3>> SO_4>>>F
	IM-41	38	119	117	90	68	1	137	185	244	159	196	Na>>>Ca≥K> >>Mg Cl>>HCO_3>>SO_4> >>F
	IM-42	310	18	28	−15	−28	−82	286	323	460	NONE	NONE	Na>Ca>K>>> Mg Cl>>>SO_4
	IM-43	316	125	122	97	74	6	308	345	509	320	473	Na>Ca≥K>>> Mg Cl
	IM-44	348	233	210	221	186	108	275	309	417	NONE	NONE	Na>Ca>K>>> Mg Cl>>>HCO_3
	IM-48	265	240	216	230	194	115	216	258	343	256	344	Na>Ca>K>>> Mg Cl>>>HCO_3>>F ≥SO_4
	IM-49	171	161	153	137	111	39	180	228	312	224	302	Na>>Ca>K>> >Mg Cl
	IM-50	164	131	128	104	81	12	254	295	410	269	373	Na>Ca>K>>> Mg Cl>>>SO_4>F
	IM-51	168	222	202	208	174	97	238	276	365	220	288	Na>Ca>K>>> Mg Cl>>>HCO_3=SO_4> >>F
	IM-53	41	–	–	–	–	–	45	80	65	NONE	NONE	Na>>Ca>>> K Cl
	IM-55	33	70	75	39	21	−40	–	–	–	NONE	NONE	Na>>>Ca>Mg Cl>HCO_3=SO_4
	IM-56	34	87	90	56	37	−26	41	83	85	40	40	Na>>>Ca>Mg> K Cl>SO_4=HCO_3>>> CO_3>F
	IM-57	36	87	90	56	37	−26	49	96	115	COOL	COOL	Na>>>Ca=Mg>K HCO_3>>Cl>SO_4>> >CO_3>>F
	IM-58	41	89	92	59	39	−25	36	82	93	50	46	Na>>>Ca>Mg> K HCO_3=Cl>>SO_4>> >CO_3>F
	IM-59	41	69	74	37	19	−42	–	–	–	NONE	NONE	Na>>>Ca>> Mg Cl>HCO_3>>SO_4>> >F
	IM-60	55	83	87	52	33	−30	49	94	108	56	52	Na>>>Ca>Mg> K Cl>SO_4>HCO_3>>>F
	IM-61	32	51	57	18	2	−56	–	–	–	NONE	NONE	Na>>>Ca>Mg Cl>HCO_3>SO_4>>>F
	IM-62	39	75	79	44	25	−36	38	86	105	63	57	Na>>>Ca>> Mg>K Cl>>HCO_3>>SO_4> >>CO_3>F

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* Samples with 8.50 or more pH. In these samples, the dissociation of silicic acid may account for higher temperatures estimated from the quartz or chalcedony geothermometer relative to the Na-K-Ca geothermometer.

Table 2. Summary of Estimated Geothermometer Temperatures and Type of Thermal Waters of California — Continued

COUNTY CODE NUMBER		RECENT SURFACE TEMP. (°C)	SILICA					Na-K-Ca					WATER TYPE
											Mg CORRECTED		
			Conductive	Adiabatic	Chalcedony	α-Cristobalite	Amorphous	Na-K	Na-K-Ca (1/3)	Na-K-Ca (4/3)	Na-K-Ca (1/3)	Na-K-Ca (4/3)	
IMPERIAL COUNTY (Continued)	IM-63	33	67	72	35	18	−43	40	83	85	43	42	Na>>>Ca>Mg> K Cl>HCO_3=SO_4>>> CO_3>F
	IM-64	28	–	–	–	–	–	29	69	63	NONE	NONE	Na>>>Ca>> >K Cl
	IM-65	32	81	84	49	31	−32	42	84	86	49	49	Na>>>Ca>Mg> K Cl>HCO_3≥SO_4>>> CO_3>>F
	IM-66	38	5	15	−28	−41	−92	–	–	–	NONE	NONE	Na>>>Ca>Mg Cl> >HCO_3=SO_4
	IM-67	29	–	–	–	–	–	55	97	102	39	38	Na>>>Ca>Mg> K Cl>>HCO_3>SO_4>> >F
	IM-68	37	69	74	37	19	−42	–	–	–	NONE	NONE	Na>>>Ca>Mg Cl>HCO_3>SO_4
	IM-69	52	–	–	–	–	–	40	88	109	NONE	NONE	Na>>>Ca>> >K Cl
	IM-70	39	79	83	48	30	−33	38	83	93	61	57	Na>>>Ca>Mg=K HCO_3>Cl>>SO_4>> >CO_3>>F
	IM-71	39	53	60	21	4	−55	–	–	–	NONE	NONE	Na>>>Ca>Mg Cl>HCO_3>SO_4>>>F
	IM-72	43	78	82	47	28	−34	35	81	94	56	52	Na>>>Ca>Mg≥ K HCO_3=Cl>>SO_4>> >CO_3>>F
	IM-73	56	83	87	52	33	−30	50	96	114	55	50	Na>>>Ca>Mg> K Cl>SO_4≥HCO_3>>> CO_3>F
	IM-74	44	79	83	48	30	−33	30	78	98	35	28	Na>>>Ca>Mg> K Cl≥HCO_3>>SO_4>> >CO_3>>F
	IM-75	51	86	89	55	36	−28	35	82	99	53	47	Na>>>Ca>Mg> K Cl>HCO_3>SO_4>>> CO_3>>F
	IM-76	51	82	85	51	32	−31	47	95	116	41	35	Na>>>Ca>Mg> K Cl>HCO_3>SO_4>>> CO_3>>F
	IM-77	33	48	55	15	0	−59	–	–	–	NONE	NONE	Na>>>Ca>Mg SO_4>Cl>>HCO_3
	IM-78	44	96	97	66	46	−19	36	83	101	49	42	Na>>>Ca>Mg≥ K HCO_3>Cl>>SO_4>> CO_3>>F
	IM-79*	22	78	82	47	28	−34	–	–	–	NONE	NONE	Na>>>Ca HCO_3>Cl>SO_4>>>F
	IM-80	43	75	79	44	25	−36	–	–	–	NONE	NONE	Na>>>Ca>Mg HCO_3>Cl>SO_4>>F
	IM-81	41	–	–	–	–	–	30	76	88	NONE	NONE	Na>>>Ca>> K
	IM-83	31	65	71	33	16	−45	–	–	–	NONE	NONE	Na>>>Ca≥Mg Cl>SO_4≥HCO_3
	IM-84	31	87	90	56	37	−26	36	79	86	COOL	COOL	Na>>>Ca≥Mg> >K Cl>HCO_3>>>CO_3>F
	IM-85	42	81	84	49	31	−32	36	82	94	51	47	Na>>>Ca>Mg> K HCO_3>Cl>>SO_4>> CO_3>>F
	IM-86	48	87	90	56	37	−26	36	80	84	NONE	NONE	Na>>>Ca>> Mg≥K HCO_3>Cl>>SO_4>> >CO_3>>F
	IM-87	52	83	87	52	33	−30	49	94	107	60	57	Na>>>Ca>> Mg>K Cl>SO_4>HCO_3>>> CO_3>F
	IM-88	38	69	74	37	19	−42	32	79	94	55	49	Na>>>Ca>K≥ Mg HCO_3>>Cl>SO_4>> CO_3>>F
	IM-89	37	69	74	37	19	−42	31	76	86	63	59	Na>>>Ca>Mg≥ K HCO_3>>Cl>SO_4>> >CO_3>>F
	IM-90	35	79	83	48	30	−33	42	84	86	48	47	Na>>>Ca>Mg> K Cl>HCO_3>SO_4>>> CO_3>F
	IM-91	32	78	82	47	28	−34	–	–	–	NONE	NONE	Na>>>Ca HCO_3>Cl>SO_4>>>F
	IM-92	25	60	65	27	11	−49	42	80	71	50	54	Na>>>Ca>Mg> K HCO_3=Cl>>SO_4>> >CO_3>F
	IM-93	36	69	74	37	19	−42	–	–	–	NONE	NONE	Na>>>Ca>Mg HCO_3>Cl>SO_4>>>F
	IM-94	33	77	81	45	27	−35	32	76	82	56	53	Na>>>Ca>Mg> K HCO_3>Cl>SO_4>>> CO_3>F
	IM-95	42	77	81	45	27	−35	38	83	95	69	65	Na>>>Ca>> Mg>K Cl>>HCO_3>SO_4>> >CO_3>F
	IM-96	31	–	–	–	–	–	27	72	80	NONE	NONE	Na>>>Ca>> K Cl
	IM-97	50	69	74	37	19	−42	–	–	–	NONE	NONE	Na>>>Ca>> Mg Cl>HCO_3>SO_4
	IM-98	39	88	91	57	38	−26	36	82	96	49	44	Na>>>Ca>Mg> K HCO_3>Cl>>SO_4>> CO_3>>F
	IM-99	32	70	75	39	21	−40	46	86	83	34	36	Na>>>Ca>Mg> >K HCO_3>Cl≥SO_4>>> CO_3>F

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* Samples with 8.50 or more pH. In these samples, the dissociation of silicic acid may account for higher temperatures estimated from the quartz or chalcedony geothermometer relative to the Na-K-Ca geothermometer.

Table 2. Summary of Estimated Geothermometer Temperatures and Type of Thermal Waters of California — Continued

								Na-K-Ca					
COUNTY CODE NUMBER		RECENT SURFACE TEMP. (°C)	SILICA								Mg CORRECTED		WATER TYPE
			Conductive	Adiabatic	Chalcedony	α-Cristobalite	Amorphous	Na-K	Na-K-Ca (1/3)	Na-K-Ca (4/3)	Na-K-Ca (1/3)	Na-K-Ca (4/3)	
IMPERIAL COUNTY (Continued)	IM-100	31	75	79	44	25	−36	–	–	–	NONE	NONE	Na>>>Ca>Mg Cl≥HCO_3>SO_4
	IM-101	30	83	87	52	33	−30	42	83	81	45	45	Na>>>Ca>Mg> K HCO_3>Cl>SO_4>>> CO_3>>F
	IM-102	36	70	75	39	21	−40	44	85	84	35	35	Na>>>Ca>Mg> >K HCO_3>Cl≥SO_4>>> CO_3>>F
	IM-103	38	79	83	48	30	−33	–	–	–	NONE	NONE	Na>>>Ca>Mg HCO_3>Cl>>SO_4>> >F
	IM-104	27	91	93	60	40	−24	–	–	–	NONE	NONE	Na>>>Ca>Mg HCO_3>Cl>SO_4
	IM-105	36	89	92	59	39	−25	33	78	87	56	52	Na>>>Ca>Mg> K HCO_3>Cl>SO_4>>> CO_3>>F
	IM-107	38	–	–	–	–	–	43	88	96	53	50	Na>>>Ca>K=Mg HCO_3>Cl>SO_4>>>F
	IM-108	40	83	87	52	33	−30	36	80	89	57	54	Na>>>Ca>Mg> K HCO_3>Cl>>SO_4>> CO_3>>F
	IM-109	36	74	78	42	24	−38	–	–	–	NONE	NONE	Na>>>Ca>Mg HCO_3>>SO_4=Cl>> >F
	IM-110	34	78	82	47	28	−34	–	–	–	NONE	NONE	Na>>>Mg≥Ca Cl>HCO_3>>SO_4
	IM-111	32	88	91	57	38	−26	43	87	94	COOL	COOL	Na>>>Ca>Mg> >K HCO_3≥Cl>>SO_4>> >CO_3>F
	IM-112	33	93	95	62	43	−22	–	–	–	NONE	NONE	Na>>>Ca>Mg Cl>HCO_3>SO_4>>>F
	IM-114	35	32	41	−1	−15	−71	–	–	–	NONE	NONE	Na>>>Ca>Mg Cl>>SO_4>>HCO_3
	IM-116	30	67	72	35	18	−43	78	122	137	54	52	Na>>Ca>>Mg> K Cl>>>SO_4>HCO_3> >>F
	IM-118	159	175	164	154	126	52	129	166	178	166	175	Na>>Ca>>K> >>Mg Cl>>>SO_4>> >F
	IM-119	168	201	185	183	152	76	118	159	179	156	177	Na>>Ca>>K> >>Mg Cl>>>SO_4>> >F
	IM-120	H	148	141	122	97	26	175	203	206	NONE	NONE	Na>>Ca>K>> >Mg Cl>>>SO_4>> HCO_3>>CO_3>>F
	IM-121	40	74	78	42	24	−38	38	83	92	50	46	Na>>>Ca>Mg> K HCO_3>Cl>SO_4>>> CO_3>>F
	IM-122	37	–	–	–	–	–	46	90	96	76	74	Na>>>Ca>> K>Mg HCO_3>Cl>>SO_4>> >F
	IM-123	40	78	82	47	28	−34	–	–	–	NONE	NONE	Na>>>Ca HCO_3>Cl>SO_4>>F
	IM-124	44	82	85	51	32	−31	–	–	–	NONE	NONE	Na>>>Ca>Mg Cl>HCO_3>SO_4
	IM-126	29	69	74	37	19	−42	42	81	73	40	43	Na≥Ca>>>Mg> >K HCO_3>Cl>>SO_4>> >CO_3≥F
	IM-127	45	78	82	47	28	−34	35	82	96	64	59	Na>>>Ca>> Mg>K Cl>HCO_3>SO_4>>> CO_3>F
	IM-128	43	–	–	–	–	–	28	73	80	NONE	NONE	Na>>>Ca>> K Cl
	IM-129	40	93	95	62	43	−22	33	78	87	58	54	Na>>>Ca>Mg> K HCO_3>Cl>SO_4>>> CO_3>>F
	IM-130	37	65	71	33	16	−45	–	–	–	NONE	NONE	Na>>>Ca=Mg HCO_3>>SO_4>Cl>> >F
	IM-131	32	72	77	40	23	−39	32	76	86	60	57	Na>>>Ca>Mg> K HCO_3>Cl>SO_4>>> CO_3>F
	IM-132	35	67	72	35	18	−43	39	82	89	61	58	Na>>>Ca>> Mg>K Cl>HCO_3>SO_4>>> CO_3>F
	IM-133	34	69	74	37	19	−42	34	78	86	68	65	Na>>>Ca>> K≥Mg HCO_3>>Cl≥SO_4>> >CO_3>>F
	IM-134	38	51	57	18	2	−56	–	–	–	NONE	NONE	Na>>>Ca>> Mg HCO_3>Cl>SO_4>>>F
	IM-136	36	67	72	35	18	−43	35	82	98	46	41	Na>>>Ca>Mg> K HCO_3>Cl>>SO_4>> CO_3>>F
	IM-137	186	178	167	157	128	55	152	186	199	NONE	NONE	Na>>>K>Ca HCO_3>Cl>>SO_4
	IM-138	204	214	196	199	166	90	195	231	279	NONE	NONE	Na>>Ca>K>> >Mg Cl>>>HCO_3>> SO_4>>>F
	IM-139	33	–	–	–	–	–	53	90	79	NONE	NONE	Na>>>Ca>> K
	IM-140	170	152	145	127	102	31	143	174	175	143	143	Na>>>K≥Ca> >>Mg Cl≥HCO_3>>SO_4
	IM-141	83	109	109	79	58	−8	89	133	154	126	134	Na>>>Ca>K> >Mg Cl>>HCO_3>SO_4>> >F

Table 2. Summary of Estimated Geothermometer Temperatures and Type of Thermal Waters of California — Continued

								Na-K-Ca					
COUNTY CODE NUMBER		RECENT SURFACE TEMP. (°C)	SILICA								Mg CORRECTED		WATER TYPE
			Conductive	Adiabatic	Chalcedony	α-Cristobalite	Amorphous	Na-K	Na-K-Ca (1/3)	Na-K-Ca (4/3)	Na-K-Ca (1/3)	Na-K-Ca (4/3)	
IMPERIAL COUNTY (Continued)	IM-142	49	–	–	–	–	–	37	83	97	NONE	NONE	Na>>>Ca>> K Cl
	IM-143	42	–	–	–	–	–	31	73	74	NONE	NONE	Na>>>Ca>> K Cl
	IM-144	43	74	78	42	24	−38	38	82	88	81	79	Na>>>Ca>> K=Mg Cl>HCO_3>SO_4>>> CO_3>F
	IM-145	37	72	77	40	23	−39	34	78	83	71	69	Na>>>Ca>> Mg=K HCO_3>Cl>SO_4>>> CO_3>>F
	IM-146	40	–	–	–	–	–	30	78	97	NONE	NONE	Na>>>Ca>> K Cl
	IM-147	31	65	71	33	16	−45	–	–	–	NONE	NONE	Na>>>Ca>> Mg Cl>HCO_3>SO_4
	IM-148	35	78	82	47	28	−34	39	80	78	73	74	Na>>>Ca>> Mg>K Cl=HCO_3>SO_4>>> CO_3>F
	IM-150	71	–	–	–	–	–	156	187	193	NONE	NONE	Na>>>K≥Ca
INYO COUNTY	IN-1*	58	79	83	48	30	−33	77	102	67	NONE	NONE	Na>>>Ca>> K Cl>SO_4>HCO_3>>F
	IN-3	37	85	88	54	35	−29	178	171	95	41	50	Na>Ca>Mg>K HCO_3>>SO_4>Cl>> >F
	IN-5	49	105	105	75	54	−12	193	182	104	150	119	Na>Ca>>K>> Mg HCO_3>SO_4>Cl>>CO_3 >>F
	IN-6	43	105	106	76	55	−11	172	175	117	37	42	Na>>Ca>K=Mg HCO_3>SO_4>>Cl>> CO_3>F
	IN-7	27	78	82	47	28	−34	241	174	35	34	76	Ca>Mg>Na>>K SO_4>HCO_3>>>Cl> >CO_3>>F
	IN-8	30	121	119	93	70	3	179	200	188	COOL	COOL	Na>>Mg>K>Ca HCO_3>>Cl>>> SO_4>>>F
	IN-9	34	134	130	107	83	14	128	177	232	COOL	COOL	Na>>>K>Mg> Ca HCO_3>Cl>>>SO_4
	IN-10	97	216	197	201	168	91	588	341	117	COOL	COOL	Mg>K>Ca>Na SO_4>>>F
	IN-11*	97	161	153	137	111	39	206	238	275	NONE	NONE	Na>>K>>Ca> >>Mg Cl>>>CO_3>SO_4> >>F
	IN-14	24	89	92	59	39	−25	83	82	0	NONE	NONE	Ca>Na>>Mg>> >K HCO_3>Cl>SO_4>>>F
	IN-15	32	53	60	21	4	−55	59	126	236	47	55	Na>>>K>Ca> Mg Cl>>SO_4>HCO_3>> >CO_3>>>F
	IN-19	28	115	114	86	65	−2	99	148	190	84	90	Na>>>K>> Ca>>Mg HCO_3>Cl>SO_4>>>F
	IN-21	48	116	115	87	65	−2	89	142	193	NONE	NONE	Na>>>K>> Ca HCO_3≥Cl≥SO_4>>> CO_3>>F
	IN-24	32	101	102	71	50	−15	165	172	121	20	25	Na>>Ca>Mg>K HCO_3>SO_4>Cl>>>F
	IN-25	32	95	97	64	45	−20	156	161	101	COOL	COOL	Na>>Ca≥Mg>K HCO_3>SO_4>>Cl>> >F
	IN-26	40	67	72	35	18	−43	169	163	88	27	41	Na>Ca>Mg>K HCO_3>SO_4>>Cl>> >F
	IN-27	34	111	110	81	60	−7	125	156	149	33	33	Na>>>Ca>Mg=K HCO_3>SO_4>Cl>>>F
KERN COUNTY	KR-1	41	94	96	63	44	−21	145	160	117	NONE	NONE	Na>>>K>Ca HCO_3≥SO_4>>Cl>CO_3 >F
	KR-2	43	100	101	70	50	−16	125	142	101	103	101	Na>>>Ca>K> >Mg HCO_3>>Cl>SO_4>F
	KR-3	50	87	90	56	37	−26	152	158	98	79	82	Na>>>K=Ca> >Mg HCO_3>Cl>CO_3>SO_4>F
	KR-4*	43	97	98	67	47	−18	135	139	73	NONE	NONE	Na>>Ca>>K Cl>HCO_3>CO_3≥SO_4> >F
	KR-6	39	107	107	78	57	−9	138	156	119	56	58	Na>>>K>Ca> Mg Cl=HCO_3>CO_3>>SO_4> >F
	KR-8	31	–	–	–	–	–	131	127	46	88	108	Na>Ca>>Mg>K Cl>SO_4≥HCO_3>>>F
	KR-9*	34	–	–	–	–	–	54	85	58	57	69	Na>>>Ca>Mg> K HCO_3>>CO_3>SO_4>Cl >>>F

* Samples with 8.50 or more pH. In these samples, the dissociation of silicic acid may account for higher temperatures estimated from the quartz or chalcedony geothermometer relative to the Na-K-Ca geothermometer.

Table 2. Summary of Estimated Geothermometer Temperatures and Type of Thermal Waters of California — Continued

COUNTY	CODE NUMBER	RECENT SURFACE TEMP. (°C)	SILICA					Na-K-Ca					WATER TYPE
			Conductive	Adiabatic	Chalcedony	α-Cristobalite	Amorphous	Na-K	Na-K-Ca (1/3)	Na-K-Ca (4/3)	Mg CORRECTED		
											Na-K-Ca (1/3)	Na-K-Ca (4/3)	
KERN COUNTY (Continued)	KR-10*	32	–	–	–	–	–	77	125	155	110	116	Na>>>K>Ca>>Mg HCO_3>>Cl>>CO_3=SO_4>>F
	KR-11	30	113	112	84	62	−4	97	116	70	75	87	Na>Ca>>Mg>K Cl>>HCO_3>SO_4>>>F
	KR-14	23	51	57	18	2	−56	54	79	38	42	65	Na>Ca>Mg>>>K SO_4>>Cl>HCO_3>>>F
	KR-15	32	65	71	33	16	−45	131	124	40	50	85	Na≥Ca>>Mg>>K SO_4>HCO_3>>Cl>>>F
	KR-16	34	–	–	–	–	–	90	109	62	COOL	COOL	Na>Ca>Mg>>>K SO_4>>HCO_3>Cl
	KR-17	30	78	82	47	28	−34	78	92	32	60	–	Na>>Ca>>Mg>>K HCO_3>SO_4>Cl>>>F
	KR-18	40	89	92	59	39	−25	155	150	71	125	–	Na>>Ca>>K>>Mg HCO_3>>>Cl>CO_3>>F
LAKE COUNTY	LK-1	41	163	154	139	113	40	85	133	166	COOL	COOL	Na>>Mg>>Ca>K HCO_3>>Cl>>>SO_4>>>F
	LK-4*	23	148	141	122	97	26	102	202	610	NONE	NONE	Na>>>K>>>Ca>>Mg Cl>>>CO_3>>>SO_4>>>F
	LK-5	24	117	115	88	66	−1	177	–	–	NONE	NONE	Na>>>K HCO_3>Cl>>>SO_4
	LK-8	99	181	169	160	131	57	108	156	201	24	26	Na>>>K>Ca≥Mg HCO_3>Cl>SO_4>>>F
	LK-9	70	94	96	63	44	−21	82	132	172	COOL	COOL	Na>>>Mg>K≥Ca HCO_3>>Cl≥SO_4>>>F
	LK-12	32	157	149	133	107	35	189	167	71	COOL	COOL	Mg>Na≥Ca>>K HCO_3>>>Cl>>>SO_4
	LK-13	24	143	137	116	92	22	155	170	131	COOL	COOL	Na>>Mg≥Ca>K SO_4≥CO_3>>Cl
	LK-14	28	149	143	124	99	28	168	148	51	COOL	COOL	Ca>Mg>Na>>>K CO_3>>>Cl
	LK-16	26	139	135	113	89	19	180	185	134	COOL	COOL	Na>Mg>>K>Ca HCO_3>Cl
	LK-18	35	–	–	–	–	–	163	156	76	COOL	COOL	Na>Mg>Ca>K HCO_3>>Cl>>>SO_4
	LK-19	52	169	159	146	119	46	191	188	122	COOL	COOL	Mg>Na>>Ca>K HCO_3>>Cl>>>SO_4>>CO_3
	LK-20	42	165	156	142	115	42	172	180	132	COOL	COOL	Mg>Na>>Ca>K HCO_3>>Cl>>>SO_4
	LK-22	52	111	110	81	60	−7	233	177	47	28	–	Ca>Mg≥Na>>K SO_4≥HCO_3>>>Cl>>F
	LK-23*	48	105	105	75	54	−12	32	70	59	37	42	Na>>>Ca>Mg>K HCO_3>>Cl≥CO_3>SO_4>F
	LK-25	24	126	123	98	75	7	153	202	271	COOL	COOL	Na>>Mg>K>Ca HCO_3>Cl>>>SO_4>>>F
LASSEN COUNTY	LS-1	32	85	88	54	35	−29	112	121	59	NONE	NONE	Na>>Ca>>K HCO_3>SO_4>Cl>>F=CO_3
	LS-3*	90	116	115	87	65	−2	88	113	77	NONE	NONE	Na>>Ca>>K SO_4>>>HCO_3=Cl>>CO_3>F
	LS-4*	80	108	108	79	58	−9	71	95	57	NONE	NONE	Na>>Ca>>>K Cl≥SO_4>>>CO_3>HCO_3>F
	LS-6	38	105	105	75	54	−12	227	177	53	83	99	Na≥Ca>>K=Mg HCO_3>>>SO_4>>Cl>CO_3
	LS-7	49	112	111	83	62	−5	108	123	73	120	113	Na>>Ca>>K>Mg SO_4>HCO_3>>>Cl>>F≥CO_3
	LS-9	61	115	114	86	65	−2	125	138	87	NONE	NONE	Na>>Ca>>K>>Mg SO_4>Cl>HCO_3
	LS-12	27	89	92	59	39	−25	88	112	76	81	90	Na>>>Ca>>K>Mg SO_4>HCO_3>Cl
	LS-18	96	150	143	125	100	29	100	128	104	NONE	NONE	Na>>>Ca>K SO_4>Cl>>>F
	LS-20	28	94	96	63	44	−21	200	190	115	66	65	Na>>K≥Ca>Mg HCO_3>>SO_4>Cl>>>CO_3>>F
	LS-21*	107	–	–	–	–	–	103	129	101	NONE	NONE	Na>>>Ca>K SO_4>Cl>>HCO_3
	LS-22	95	134	130	107	84	14	88	118	98	NONE	NONE	Na>>>Ca>K SO_4>Cl>>HCO_3>>>F>CO_3

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* Samples with 8.50 or more pH. In these samples, the dissociation of silicic acid may account for higher temperatures estimated from the quartz or chalcedony geothermometer relative to the Na-K-Ca geothermometer.

Table 2. Summary of Estimated Geothermometer Temperatures and Type of Thermal Waters of California — Continued

COUNTY	CODE NUMBER	RECENT SURFACE TEMP. (°C)	SILICA					Na-K-Ca					WATER TYPE
			Conductive	Adiabatic	Chalcedony	α-Cristobalite	Amorphous	Na-K	Na-K-Ca (1/3)	Na-K-Ca (4/3)	Mg CORRECTED		
											Na-K-Ca (1/3)	Na-K-Ca (4/3)	
LOS ANGELES COUNTY	LA-1*	33	87	90	56	37	−26	70	96	60	NONE	NONE	Na>>Ca>>>K>>Mg SO_4≥Cl>>>CO_3>F
	LA-2	27	–	–	–	–	–	92	100	33	74	–	Na>>Ca>>Mg>K HCO_3>>SO_4>Cl>>>F
	LA-3	28	–	–	–	–	–	90	98	31	55	–	Na≥Ca>>Mg>>>K SO_4>HCO_3>>Cl
	LA-4	46	65	71	33	16	−45	36	82	96	NONE	NONE	Na>>>Ca>K>>>Mg HCO_3>>SO_4>>Cl>>F
	LA-5	56	67	72	35	18	−43	83	110	77	COOL	COOL	Na>>Ca>Mg>>K SO_4>HCO_3>Cl>>>F
	LA-6	26	62	67	29	12	−48	18	69	99	NONE	NONE	Na>>>Ca>K>Mg HCO_3≥SO_4>>>Cl>>CO_3>>F
	LA-7	40	74	78	42	24	−38	101	152	203	97	110	Na>>>K>>Ca>Mg CO_3>>Cl
	LA-8	27	57	64	25	9	−51	163	140	38	49	–	Ca>Na>Mg>>K HCO_3>SO_4>Cl>>>F
	LA-9	36	–	–	–	–	–	107	105	24	49	–	Ca=Na>Mg>>>K HCO_3>SO_4>Cl>>>F
	LA-10	29	–	–	–	–	–	128	113	17	61	–	Ca>Na>Mg>>>K HCO_3>SO_4>>Cl
	LA-11*	44	81	84	49	31	−32	44	81	69	77	64	Na>Ca>>>K>>Mg Cl>>>SO_4>CO_3>>>F
	LA-12	34	–	–	–	–	–	177	146	35	78	–	Ca>Na>Mg>>K HCO_3>SO_4>Cl
	LA-13	28	62	67	29	12	−48	111	120	59	106	–	Na>>Ca>>K>Mg HCO_3>>Cl>>CO_3>SO_4>>F
	LA-14*	31	–	–	–	–	–	97	129	115	30	32	Na>>>Ca>Mg>K HCO_3=Cl>>>CO_3>SO_4
MADERA COUNTY	MA-1	46	161	153	137	111	39	126	131	64	NONE	NONE	Na>Ca>>K>Mg HCO_3>>>SO_4>>Cl>F
MARIN COUNTY	MR-1	32	93	95	62	43	−22	112	158	195	COOL	COOL	Na>>Mg>>Ca>K Cl>>>SO_4>>HCO_3>>>F
MENDOCINO COUNTY	MN-1	27	92	94	61	42	−23	73	167	495	COOL	COOL	Na>>>Mg>K>>>Ca HCO_3>>>CO_3>Cl>>>SO_4>>>F
	MN-2	21	94	96	63	44	−21	52	79	42	NONE	NONE	Na>>Ca>>Mg>>K Cl>>HCO_3>>>SO_4>>F
	MN-3	20	119	117	90	68	1	34	69	49	59	70	Na>>Ca>Mg>>K Cl>HCO_3>>>F>SO_4
	MN-4*	40	111	111	82	61	−6	52	86	67	NONE	NONE	Na>>>Ca>>K>>>Mg HCO_3>>Cl>CO_3>F>>>SO_4
	MN-5	29	132	128	105	81	12	107	145	151	20	20	Na>>>Ca>Mg≥K HCO_3>>>Cl>>>F≥SO_4
	MN-6	W	111	110	81	60	−7	96	–	–	–	–	Na>>>K HCO_3>>Cl
	MN-7*	44	105	105	75	54	−12	21	63	62	NONE	NONE	Na>>>Ca>K>Mg HCO_3>CO_3>Cl>SO_4>F
MERCED COUNTY	MC-1	21	96	97	66	46	−19	21	52	22	COOL	COOL	Na>>Ca≥Mg>>>K Cl>SO_4>HCO_3>>>F>>>CO_3
	MC-2	23	83	87	52	33	−30	109	113	42	37	68	Na>Ca>Mg>>K HCO_3>>SO_4>Cl>>>F
	MC-3*	27	87	90	56	37	−26	74	111	103	89	89	Na>>>Ca>K>>Mg HCO_3>>Cl>CO_3>SO_4>>F
MODOC COUNTY	MD-3*	47	123	121	95	72	4	77	–	–	NONE	NONE	Na>>>K HCO_3>SO_4=Cl>>CO_3>>F
	MD-4	45	143	137	116	92	22	95	124	102	NONE	NONE	Na>>>K>Ca>>>Mg HCO_3>SO_4>Cl>>>F>CO_3

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* Samples with 8.50 or more pH. In these samples, the dissociation of silicic acid may account for higher temperatures estimated from the quartz or chalcedony geothermometer relative to the Na-K-Ca geothermometer.

Table 2. Summary of Estimated Geothermometer Temperatures and Type of Thermal Waters of California — Continued

COUNTY CODE NUMBER		RECENT SURFACE TEMP. (°C)	SILICA					Na-K-Ca					WATER TYPE
											Mg CORRECTED		
			Conductive	Adiabatic	Chalcedony	α-Cristobalite	Amorphous	Na-K	Na-K-Ca (1/3)	Na-K-Ca (4/3)	Na-K-Ca (1/3)	Na-K-Ca (4/3)	
MODOC COUNTY (Continued)	MD-5	28	120	118	91	69	1	189	187	124	164	130	Na>>K>Ca>>>Mg HCO_3>>SO_4>Cl>>CO_3>>F
	MD-6	53	154	147	130	104	32	115	141	118	91	91	Na>>>Ca>K>>Mg HCO_3>Cl>SO_4>>>F
	MD-7	25	117	115	88	66	−1	101	132	115	106	104	Na>>>K>Ca>>Mg HCO_3>>Cl>>>SO_4>F
	MD-8	160	173	162	150	123	49	127	154	136	NONE	NONE	Na>>>Ca≥K>>>Mg SO_4>Cl>HCO_3>>>F
	MD-9	97	180	168	159	130	56	127	160	161	NONE	NONE	Na>>>K>Ca SO_4>Cl>HCO_3>>>F
	MD-13	41	109	109	79	58	−8	68	107	103	72	73	Na>>>Ca>K>Mg SO_4>Cl>HCO_3>>>F
	MD-14	85	143	137	116	92	22	103	129	101	NONE	NONE	Na>>>Ca>>K SO_4>Cl>>HCO_3>>>F
	MD-15	62	143	137	116	92	22	95	124	102	NONE	NONE	Na>>>Ca>>K>>>Mg SO_4>Cl>HCO_3>>>F>>CO_3
	MD-16	98	137	133	110	87	17	83	114	96	NONE	NONE	Na>>>Ca>K SO_4>Cl>>HCO_3>>>F>CO_3
	MD-17	98	137	132	110	86	16	86	118	101	NONE	NONE	Na>>>Ca>K>>>Mg SO_4>Cl>>HCO_3>>>F
	MD-18	98	137	133	110	87	17	86	117	96	NONE	NONE	Na>>>Ca>K>>>Mg SO_4>Cl>HCO_3>>>F
	MD-19*	57	105	105	75	54	−12	68	96	65	NONE	NONE	Na>>>Ca>>K SO_4>>CO_3>HCO_3≥Cl>>F
	MD-20*	43	89	92	59	39	−25	95	118	80	NONE	NONE	Na>>>Ca>K>>Mg SO_4>HCO_3>Cl≥CO_3>>>F
	MD-21	41	92	94	61	42	−23	78	103	68	NONE	NONE	Na>>>Ca>K HCO_3>SO_4>>Cl
	MD-22	77	152	145	127	102	31	108	138	120	NONE	NONE	Na>>>Ca>K SO_4>>Cl>HCO_3>>>F
	MD-26*	44	95	97	64	45	−20	154	154	85	NONE	NONE	Na>>>Ca>K HCO_3>SO_4>>Cl>>CO_3>>F
	MD-32	92	143	137	116	92	22	96	123	95	NONE	NONE	Na>>>Ca>>K>>>Mg SO_4>Cl>>HCO_3>>>F>CO_3
	MD-34	74	117	115	88	66	−1	89	106	56	NONE	NONE	Na>Ca>>>K>>Mg SO_4>Cl>>HCO_3>>>F
	MD-35	47	106	106	77	56	−10	45	73	39	NONE	NONE	Na>>Ca>>>K HCO_3>Cl>SO_4>>>F
MONO COUNTY	MO-1*	W	104	104	74	53	−12	93	117	82	NONE	NONE	Na>>>Ca>K>>Mg HCO_3≥Cl>>SO_4>>CO_3>F
	MO-2	35	77	81	45	27	−35	169	149	52	66	–	Na>Ca>>Mg>K HCO_3≥Cl>>SO_4>>>F
	MO-4	61	123	121	95	72	4	146	172	158	84	82	Na>>>Ca=K>>Mg HCO_3>>SO_4>Cl>>>F
	MO-6	60	122	120	93	71	3	107	134	111	82	83	Na>>>Ca>K>Mg HCO_3>SO_4>>>Cl>F
	MO-7	82	137	133	110	87	17	131	167	176	70	71	Na>>>Ca≥K>>Mg HCO_3>SO_4>>Cl>>>F
	MO-8	40	114	113	86	64	−3	138	171	176	80	81	Na>>>Ca>K>>Mg HCO_3>SO_4>>Cl>>>F
	MO-10	25	–	–	–	–	–	240	199	87	127	106	Na>>K>Ca>>Mg
	MO-11	66	122	120	94	72	4	85	123	125	79	78	Na>>>Ca>K>Mg HCO_3>Cl>>SO_4>>>F
	MO-12	54	140	135	114	90	20	164	201	230	73	80	Na>>>K>>Ca>Mg Cl=HCO_3>>>CO_3>SO_4
	MO-14	31	143	137	116	92	22	160	165	106	153	122	Na>Ca>>K>>Mg HCO_3>>>Cl>>>SO_4>F
	MO-15*	86	187	174	166	137	63	100	227	1225	NONE	NONE	Na>>>K>>>Ca HCO_3>Cl>SO_4>>>F
	MO-17	42	136	131	109	85	15	163	171	120	73	72	Na>Ca>>K≥Mg HCO_3>>>Cl>SO_4>>>F
	MO-21*	171	136	132	109	85	16	145	202	305	108	153	Na>>>K>>>Mg>Ca HCO_3≥Cl>CO_3>SO_4>>F
	MO-22	82	–	–	–	–	–	156	178	160	NONE	NONE	Na>>>K≥Ca HCO_3>>Cl>SO_4>>>F
	MO-23	88	153	146	128	102	31	138	177	198	NONE	NONE	Na>>>K>>Ca>>>Mg HCO_3>Cl>>SO_4>>>F>CO_3
	MO-24	89	143	137	116	92	22	142	176	183	NONE	NONE	Na>>>K>Ca>>>Mg HCO_3>Cl>SO_4>>F
	MO-26	53	–	–	–	–	–	173	191	166	NONE	NONE	Na>>>K>Ca HCO_3>>Cl>SO_4>>>F

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* Samples with 8.50 or more pH. In these samples, the dissociation of silicic acid may account for higher temperatures estimated from the quartz or chalcedony geothermometer relative to the Na-K-Ca geothermometer.

Table 2. Summary of Estimated Geothermometer Temperatures and Type of Thermal Waters of California — Continued

COUNTY CODE NUMBER		RECENT SURFACE TEMP. (°C)	SILICA					Na-K-Ca					WATER TYPE
											Mg CORRECTED		
			Conductive	Adiabatic	Chalcedony	α-Cristobalite	Amorphous	Na-K	Na-K-Ca (1/3)	Na-K-Ca (4/3)	Na-K-Ca (1/3)	Na-K-Ca (4/3)	
MONO COUNTY (Continued)	MO-27	37	82	85	51	32	−31	146	154	99	99	97	Na>>Ca>K>Mg HCO_3>>Cl>SO_4>>>F
	MO-28	41	182	170	161	132	58	166	183	155	167	149	Na>K>Ca>>>Mg HCO_3>>Cl>SO_4>>>F>>>CO_3
	MO-29	28	–	–	–	–	–	153	163	113	NONE	NONE	Na>>>K≥Ca HCO_3>>Cl>SO_4>CO_3>F
	MO-31	57	113	112	84	62	−4	63	97	79	NONE	NONE	Na>>>Ca>K>>>Mg HCO_3>SO_4>Cl>>F
MONTEREY COUNTY	MT-4*	47	119	117	90	68	1	50	78	44	NONE	NONE	Na>>>Ca>>K SO_4≥HCO_3=CO_3>>Cl>F
	MT-5*	37	96	97	66	46	−19	65	90	51	NONE	NONE	Na>>>Ca>>K HCO_3≥CO_3>SO_4>Cl>>F
	MT-6*	62	144	139	118	94	23	100	123	88	NONE	NONE	Na>>>Ca>K SO_4≥CO_3>>Cl>HCO_3>F
	MT-7	37	95	97	64	45	−20	65	96	71	NONE	NONE	Na>>>Ca>>K>>Mg SO_4>>Cl>HCO_3>>F
	MT-8	31	87	90	56	37	−26	63	94	69	NONE	NONE	Na>>>Ca>>K>>Mg SO_4>>Cl>HCO_3>>F
	MT-9*	30	81	84	49	31	−32	103	93	1	COOL	COOL	Mg>>>Na>Ca>>>K HCO_3>>>CO_3>Cl>SO_4>>>F
NAPA COUNTY	NA-1	22	134	130	107	84	14	138	153	108	COOL	COOL	Na>Mg=Ca>>K HCO_3>Cl>>SO_4>>>F
	NA-2	33	130	127	103	80	11	79	121	130	COOL	COOL	Na>>Mg>>Ca>K HCO_3>>Cl>>>SO_4>>F
	NA-4	95	107	107	78	57	−9	125	158	156	NONE	NONE	Na>>>K>Ca Cl>HCO_3>>F=SO_4
	NA-5	78	112	111	83	62	−5	116	141	115	38	42	Na>>>Ca>K>Mg Cl>SO_4>>CO_3
	NA-6	81	143	138	117	93	22	–	–	–	NONE	NONE	Na>Mg>>>Ca Cl>CO_3>>>SO_4
	NA-8	26	143	138	117	93	22	120	133	81	COOL	COOL	Mg>Na>>Ca>>K HCO_3>>>Cl>>>F
	NA-10*	36	98	99	68	48	−17	65	104	102	103	103	Na>>>Ca>K>>Mg Cl>HCO_3>CO_3>>SO_4>F
	NA-15	30	153	146	128	102	31	241	194	75	24	43	Na>Ca>Mg>K HCO_3>>>Cl>SO_4>>>F
ORANGE COUNTY	OR-1	43	72	77	40	23	−39	–	–	–	NONE	NONE	Na>>>Ca>>Mg HCO_3>>Cl>>>CO_3>>>SO_4>F
	OR-2	73	–	–	–	–	–	157	146	57	COOL	COOL	Mg=Na>Ca>>K HCO_3>>>Cl>SO_4>CO_3>>>F
	OR-9	28	69	74	37	19	−42	39	133	154	38	36	Na>>>K>Ca>Mg HCO_3>Cl>>SO_4>>>F
	OR-10	35	–	–	–	–	–	106	106	28	33	72	Na≥Ca>Mg>>>K HCO_3>>Cl≥SO_4>>>F
	OR-11*	49	124	122	96	74	6	77	107	81	NONE	NONE	Na>>>Ca>K>>>Mg Cl>CO_3>SO_4>>HCO_3=F
PLACER COUNTY	PC-1*	55	119	117	90	68	1	98	124	94	NONE	NONE	Na>>>Ca>K=Mg Cl≥HCO_3>SO_4>>>F
PLUMAS COUNTY	PL-2	95	206	189	189	157	81	247	203	88	29	41	Na>Ca>Mg≥K SO_4>>>F
	PL-4	66	166	157	143	116	43	227	183	64	63	80	Ca≥Na>>Mg>K SO_4>HCO_3>>>Cl>>>F
	PL-9*	30	113	112	84	62	−4	83	102	55	NONE	NONE	Na>>>Ca>>K>>Mg SO_4≥CO_3>>HCO_3>F
	PL-10	73	112	111	83	62	−5	80	111	90	NONE	NONE	Na>>>Ca>>K>>>Mg Cl>SO_4>>HCO_3>>>F
	PL-11	38	114	113	86	64	−3	69	107	103	56	57	Na>>>Ca>K≥Mg Cl>SO_4>>HCO_3>>>F

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* Samples with 8.50 or more pH. In these samples, the dissociation of silicic acid may account for higher temperatures estimated from the quartz or chalcedony geothermometer relative to the Na-K-Ca geothermometer.

Table 2. Summary of Estimated Geothermometer Temperatures and Type of Thermal Waters of California — Continued

COUNTY CODE NUMBER		RECENT SURFACE TEMP. (°C)	SILICA					Na-K-Ca					WATER TYPE
											Mg CORRECTED		
			Conductive	Adiabatic	Chalcedony	α-Cristobalite	Amorphous	Na-K	Na-K-Ca ($\frac{1}{3}$)	Na-K-Ca ($\frac{4}{3}$)	Na-K-Ca ($\frac{1}{3}$)	Na-K-Ca ($\frac{4}{3}$)	
PLUMAS COUNTY (Continued)	PL-12	29	–	–	–	–	–	100	120	77	69	80	Na>>>Ca>K> Mg HCO_3>>Cl>>>SO_4
	PL-13	26	134	130	107	84	14	233	193	81	64	73	Na>>Ca>K>Mg HCO_3>>SO_4>>Cl> >F
	PL-14	28	126	124	99	76	7	222	215	156	30	27	Na>>K>>Mg> Ca HCO_3>>>Cl>>SO_4
	PL-15	32	130	126	102	79	10	122	139	96	54	62	Na>>>K>Ca> Mg HCO_3>>>Cl>SO_4> >F
	PL-16	40	125	122	97	74	6	73	107	93	NONE	NONE	Na>>>Ca>> K>>Mg Cl>SO_4>>HCO_3>> >F
	PL-17	94	136	132	109	85	16	101	131	112	NONE	NONE	Na>>>Ca>K> >>Mg Cl>SO_4>>HCO_3>> >F>CO_3
RIVERSIDE COUNTY	RV-1*	55	105	106	76	55	−11	48	77	46	NONE	NONE	Na>>>Ca>> K>Mg SO_4>>CO_3≥HCO_3>Cl >>F
	RV-3	27	63	69	31	14	−46	135	130	50	COOL	COOL	Na>Mg>Ca>>K HCO_3>Cl>SO_4>>>F
	RV-5	44	78	82	47	28	−34	160	130	20	55	–	Ca>Na>Mg>>K HCO_3>>>SO_4≥Cl> >>F
	RV-6*	43	107	107	78	57	−9	–	–	–	NONE	NONE	Na>>>Mg HCO_3>SO_4>CO_3≥Cl
	RV-9	47	78	82	47	28	−34	–	–	–	NONE	NONE	Na>>Ca>>Mg SO_4=Cl>>HCO_3
	RV-10*	40	92	94	61	42	−23	53	87	67	47	56	Na>>>Ca>K≥ Mg HCO_3≥CO_3>Cl>SO_4> >F
	RV-11*	49	–	–	–	–	–	167	157	74	NONE	NONE	Na>>Ca>K HCO_3>CO_3>Cl>SO_4> >>F
	RV-12	39	–	–	–	–	–	96	112	60	NONE	NONE	Na>Ca>>>K> >Mg Cl>>SO_4>HCO_3
	RV-13	48	117	115	88	66	−1	–	–	–	NONE	NONE	Na>>>Ca>Mg HCO_3>Cl>SO_4
	RV-14*	52	124	121	96	73	5	–	–	–	NONE	NONE	Na>>Ca>>Mg Cl=SO_4>CO_3>HCO_3
	RV-15	37	92	94	61	42	−23	122	122	46	50	–	Na≥Ca>>Mg>> K HCO_3>SO_4>Cl>>>F
	RV-16	37	100	101	70	50	−16	142	131	42	51	–	Ca≥Na>Mg>>K HCO_3>SO_4>Cl
	RV-17	28	99	100	69	49	−16	51	72	23	NONE	NONE	Na=Ca>>Mg>> >K SO_4>HCO_3>Cl>>>F
	RV-18	43	–	–	–	–	–	129	124	41	50	–	Na>Ca>>Mg>> K HCO_3>SO_4>Cl>>>F
	RV-19	49	109	109	79	58	−8	98	113	59	40	–	Na>Ca>Mg>>K SO_4>Cl>HCO_3>>>F
	RV-20	25	88	91	57	38	−26	96	102	31	42	–	Na>Ca>Mg>>K HCO_3>>Cl>SO_4>> >F
	RV-21	40	89	92	59	39	−25	69	78	11	49	–	Na>Ca>Mg>>> K HCO_3>>Cl>>>F
	RV-22	43	83	87	52	33	−30	83	86	9	57	–	Ca=Na>Mg>>>K HCO_3>Cl>SO_4>>>F
	RV-23*	47	119	117	90	68	1	24	64	57	NONE	NONE	Na>>>Ca>> K Cl>>>CO_3>SO_4> HCO_3
	RV-24	29	–	–	–	–	–	129	124	42	COOL	COOL	Na≥Ca>Mg>>> K SO_4≥HCO_3>Cl>>>F
	RV-25*	56	114	113	85	63	−4	76	112	102	25	28	Na>>>Ca>Mg> K Cl>>>SO_4≥CO_3
	RV-26	40	89	92	59	39	−25	59	80	31	41	–	Na>Ca>Mg>>> K HCO_3>Cl>SO_4>>>F
	RV-27	37	–	–	–	–	–	54	71	17	53	–	Na>Ca>Mg>>> K HCO_3>Cl>SO_4>>>F
	RV-29*	42	93	95	62	43	−22	81	104	62	30	46	Na>>>Ca>Mg> K HCO_3>SO_4>CO_3=Cl>> F
	RV-31	44	60	65	27	11	−49	79	102	62	NONE	NONE	Na>>Ca>>> K>Mg SO_4>Cl>HCO_3>>>F
	RV-32	83	45	53	13	−3	−61	163	148	57	93	–	Na>Ca>>Mg=K HCO_3≥SO_4≥Cl>>>F
	RV-33*	32	48	55	15	−0	−59	79	98	50	78	–	Na>>>Ca>> Mg=K HCO_3>SO_4>Cl>CO_3> >F
	RV-34*	33	–	–	–	–	–	65	96	71	NONE	NONE	Na>>>Ca>K HCO_3>SO_4>Cl>>CO_3 >F

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* Samples with 8.50 or more pH. In these samples, the dissociation of silicic acid may account for higher temperatures estimated from the quartz or chalcedony geothermometer relative to the Na-K-Ca geothermometer.

Table 2. Summary of Estimated Geothermometer Temperatures and Type of Thermal Waters of California — Continued

COUNTY CODE NUMBER		RECENT SURFACE TEMP. (°C)	SILICA					Na-K-Ca					WATER TYPE
											Mg CORRECTED		
			Conductive	Adiabatic	Chalcedony	α-Cristobalite	Amorphous	Na-K	Na-K-Ca ($\frac{1}{3}$)	Na-K-Ca ($\frac{4}{3}$)	Na-K-Ca ($\frac{1}{3}$)	Na-K-Ca ($\frac{4}{3}$)	
RIVERSIDE COUNTY (Continued)	RV-35*	32	–	–	–	–	–	71	–	–	NONE	NONE	Na>>>K HCO_3>SO_4>>Cl>CO_3 >F
	RV-36	43	–	–	–	–	–	42	72	40	NONE	NONE	Na>>Cl>>Mg> K Cl>SO_4>HCO_3>>>F
	RV-37	39	51	57	18	2	−56	52	85	63	NONE	NONE	Na>>>Ca>> K>Mg Cl≥SO_4>HCO_3>>>F
	RV-38*	29	70	75	39	21	−40	114	137	105	27	33	Na>>Ca>Mg>K Cl>SO_4>HCO_3>>> CO_3>>F
	RV-39	32	–	–	–	–	–	74	76	76	COOL	COOL	Na>>>Ca>Mg> >K Cl>>HCO_3>SO_4>> >F
	RV-49*	30	117	116	89	67	−1	94	119	87	NONE	NONE	Na>>Ca>>K> >Mg SO_4>>Cl>>HCO_3> F>CO_3
	RV-53	31	78	82	47	28	−34	–	–	–	NONE	NONE	Na>Ca>>>Mg Cl=SO_4>>HCO_3>> >F
	RV-54	32	55	62	23	7	−53	–	–	–	NONE	NONE	Na>Ca>>>Mg Cl>SO_4>>>HCO_3
	RV-55	31	79	83	48	30	−33	–	–	–	NONE	NONE	Na>>Ca>>Mg Cl>SO_4>HCO_3>>>F
	RV-59	45	97	98	67	47	−18	–	–	–	NONE	NONE	Na>>>Ca>> >Mg Cl>SO_4>>>HCO_3> >>F
	RV-60	31	67	72	35	18	−43	–	–	–	NONE	NONE	Na>>Ca>Mg SO_4>Cl>HCO_3>>>F
	RV-61	31	60	65	27	11	−49	–	–	–	NONE	NONE	Na>>Ca>>Mg Cl≥SO_4=HCO_3>>>F
	RV-62	33	57	64	25	9	−51	–	–	–	NONE	NONE	Na>>>Ca>> >Mg HCO_3>Cl≥SO_4>>>F
	RV-63	31	63	69	31	14	−46	–	–	–	NONE	NONE	Na>>Ca>>> Mg Cl≥SO_4>>HCO_3>> >F
	RV-64	31	60	65	27	11	−49	–	–	–	NONE	NONE	Na>>Ca>>> Mg Cl>SO_4>HCO_3>>>F
	RV-67	82	124	122	96	74	6	114	145	132	92	91	Na>>Ca>>K> Mg Cl>>HCO_3≥SO_4>> >F
SAN BENITO COUNTY	SE-1	22	75	79	44	25	−36	24	70	83	COOL	COOL	Na>>>Mg>Ca> >K Cl≥HCO_3>SO_4>>> CO_3>>>F
	SE-2	23	121	119	93	70	3	60	115	165	COOL	COOL	Na>>>Mg>Ca> >K Cl>>SO_4>HCO_3>> >F
SAN BERNARDINO COUNTY	SB-1*	30	–	–	–	–	–	101	–	–	NONE	NONE	Na>>>K HCO_3>Cl>CO_3>SO_4> >>F
	SB-2	28	96	97	66	46	−19	104	147	165	COOL	COOL	Na>>>Mg=Ca≥K SO_4>Cl>HCO_3>>>F
	SB-3	23	–	–	–	–	–	150	140	54	COOL	COOL	Na≥Ca>Mg>>K SO_4>HCO_3>>Cl
	SB-5	38	63	69	31	14	−46	–	–	–	NONE	NONE	Na>>>Ca>> Mg SO_4>HCO_3>Cl>F>CO_3
	SB-6	24	105	105	75	54	−12	89	133	153	66	66	Na>>>K=Ca> >Mg Cl>SO_4≥HCO_3
	SB-8*	39	75	79	44	25	−36	99	129	110	96	96	Na>>>K≥Ca> >Mg SO_4≥HCO_3≥Cl>>CO_3 >>F
	SB-9	33	–	–	–	–	–	100	125	93	30	38	Na>>>Ca>K=Mg HCO_3>SO_4≥Cl>F
	SB-10	29	72	77	40	23	−39	–	–	–	NONE	NONE	Na>Ca>>Mg Cl>SO_4>HCO_3>>>F
	SB-11	30	78	82	47	28	−34	–	–	–	NONE	NONE	Na>Ca>>Mg SO_4≥Cl>HCO_3>>>F
	SB-12	32	75	79	44	25	−36	–	–	–	NONE	NONE	Na>>Ca>>Mg HCO_3>SO_4≥Cl>>>F
	SB-13	42	74	78	42	24	−38	–	–	–	NONE	NONE	Na>>Ca>>Mg Cl>SO_4>HCO_3
	SB-14	27	60	65	27	11	−49	147	142	63	NONE	NONE	Na>>Ca>>K HCO_3>SO_4>Cl>>>F
	SB-15	53	105	106	76	55	−11	68	99	75	NONE	NONE	Na>>>Ca>> K>>Mg SO_4>>Cl>HCO_3>F> CO_3
	SB-17	63	95	97	64	45	−20	106	135	114	COOL	COOL	Na>>>Ca>Mg> K SO_4>>Cl>>HCO_3> >>F

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* Samples with 8.50 or more pH. In these samples, the dissociation of silicic acid may account for higher temperatures estimated from the quartz or chalcedony geothermometer relative to the Na-K-Ca geothermometer.

Table 2. Summary of Estimated Geothermometer Temperatures and Type of Thermal Waters of California — Continued

COUNTY CODE NUMBER		RECENT SURFACE TEMP. (°C)	SILICA					Na-K-Ca					WATER TYPE
			Conductive	Adiabatic	Chalcedony	α-Cristobalite	Amorphous	Na-K	Na-K-Ca (1/3)	Na-K-Ca (4/3)	Mg CORRECTED		
											Na-K-Ca (1/3)	Na-K-Ca (4/3)	
SAN BERNARDINO COUNTY (Continued)	SB-18	42	–	–	–	–	–	58	89	64	NONE	NONE	Na>>>Ca>K $HCO_3 >> SO_4 \geq Cl >> CO_3 = F$
	SB-19*	31	88	91	57	38	−26	50	85	66	NONE	NONE	Na>>>Ca>K>>>Mg $SO_4 >> HCO_3 >> F > Cl > CO_3$
	SB-23	51	139	135	113	89	19	125	147	117	118	112	Na>>>Ca>K>>Mg $SO_4 >> HCO_3 > Cl >> F$
	SB-24	90	134	130	107	83	14	127	146	109	128	–	Na>>Ca>K>>Mg $SO_4 >> HCO_3 > Cl >> F$
	SB-26	49	102	103	72	51	−14	–	–	–	NONE	NONE	Na>Ca $SO_4 >> CO_3 > Cl$
	SB-30	41	39	47	7	−9	−65	–	–	–	NONE	NONE	Na>Ca $SO_4 >> CO_3 > Cl$
	SB-36*	41	–	–	–	–	–	61	84	39	NONE	NONE	Na>>Ca>>>K $HCO_3 > Cl > SO_4 > CO_3 >> F$
SAN DIEGO COUNTY	SD-1*	29	108	108	79	58	−9	52	85	64	66	–	Na>>>Ca>K>Mg $SO_4 > Cl = HCO_3 \geq CO_3 >>> F$
	SD-2	33	65	71	33	16	−45	–	–	–	NONE	NONE	Na>>Ca $SO_4 > Cl > CO_3$
	SD-3	27	97	98	67	47	−18	218	172	49	51	–	Ca>Na>Mg>K $HCO_3 > SO_4 >> Cl >>> F$
	SD-4*	59	141	136	115	90	20	56	100	111	68	66	Na>>>K>Ca>Mg $HCO_3 > SO_4 = CO_3 > Cl >> F$
	SD-5	27	–	–	–	–	–	113	121	57	COOL	COOL	Na>Ca≥Mg>>>K $SO_4 > HCO_3 > Cl >>> F$
	SD-15	26	92	94	61	42	−23	122	124	52	COOL	COOL	Na>Ca>Mg>>>K $SO_4 > HCO_3 > Cl >>> F$
	SD-16*	38	92	94	61	42	−23	60	101	101	46	46	Na>>>K>Ca>Mg $Cl \geq HCO_3 \geq SO_4 >> CO_3 > F$
	SD-18*	38	105	105	75	54	−12	54	93	89	COOL	COOL	Na>>>K=Ca=Mg $Cl > CO_3 > F = HCO_3$
	SD-20	30	–	–	–	–	–	144	130	36	39	–	Ca≥Na>Mg>>K $HCO_3 >> Cl = SO_4 >>> F$
	SD-21	31	79	83	48	30	−33	52	73	26	COOL	COOL	Na>Ca>Mg>>>K $Cl > HCO_3 > SO_4 >>> F$
	SD-22	27	92	94	61	42	−23	78	92	32	51	–	Ca>Na>Mg>>>K $Cl >> HCO_3 > SO_4 >>> F$
	SD-23	27	96	97	66	46	−19	55	76	28	COOL	COOL	Na>Ca>Mg>>>K $HCO_3 > Cl > SO_4 >>> F$
	SD-24	27	83	87	52	33	−30	58	85	50	35	–	Na>Ca>Mg>>>K $Cl >> HCO_3 > SO_4 >>> F$
	SD-25	28	48	55	15	0	−59	77	94	39	40	–	Na>Ca>Mg>>>K $Cl >> HCO_3 > SO_4 >>> F$
	SD-27	36	112	111	83	62	−5	102	127	97	COOL	COOL	Na>>Mg≥Ca>>K $HCO_3 > Cl > SO_4 >>> F$
	SD-28	33	60	65	27	11	−49	113	140	118	NONE	NONE	Na>>>Ca>K>>>Mg $Cl >> SO_4 > HCO_3 >>> F$
	SD-29	28	180	168	159	130	56	31	65	43	NONE	NONE	Na>>Ca>>>K>Mg $Cl >>> HCO_3 \geq SO_4 >>> F$
	SD-30	28	60	65	27	11	−49	145	132	41	NONE	NONE	Ca≥Na>>>K $Cl >> SO_4 > HCO_3 >> F$
SAN JOAQUIN COUNTY	SJ-1	22	95	97	64	45	−20	75	72	−14	COOL	COOL	Mg>Ca>Na>>>K $HCO_3 > SO_4 >>> Cl >> CO_3 >>> F$
	SJ-2	23	57	64	25	9	−51	104	116	57	COOL	COOL	Na>Ca>Mg>>>K $HCO_3 > SO_4 > Cl >>> F$
SAN LUIS OBISPO COUNTY	SL-1	39	117	115	88	66	−1	46	94	114	NONE	NONE	Na>>>Ca>K>>>Mg $HCO_3 > SO_4 \geq Cl >>> F$
	SL-2	42	128	125	101	78	9	72	104	85	94	73	Na>>Ca>>>K>>>Mg $Cl > SO_4 >>> HCO_3 >>> F$
	SL-3	42	124	122	96	74	6	58	106	130	–	113	Na>>>K=Ca>>Mg $HCO_3 > SO_4 > Cl >> CO_3 >>> F$
	SL-4	31	–	–	–	–	–	95	121	90	30	39	Na>>>Ca>Mg>K $HCO_3 > SO_4 >> Cl >> CO_3 >>> F$

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* Samples with 8.50 or more pH. In these samples, the dissociation of silicic acid may account for higher temperatures estimated from the quartz or chalcedony geothermometer relative to the Na-K-Ca geothermometer.

Table 2. Summary of Estimated Geothermometer Temperatures and Type of Thermal Waters of California — Continued

COUNTY CODE NUMBER		RECENT SURFACE TEMP. (°C)	SILICA					Na-K-Ca					WATER TYPE
			Conductive	Adiabatic	Chalcedony	α-Cristobalite	Amorphous	Na-K	Na-K-Ca (1/3)	Na-K-Ca (4/3)	Mg CORRECTED		
											Na-K-Ca (1/3)	Na-K-Ca (4/3)	
SAN LUIS OBISPO COUNTY (Continued)	SL-6	33	104	104	74	53	−12	42	87	99	66	62	Na>>>Ca>K>Mg $HCO_3 >> SO_4 = Cl >> CO_3 >> F$
	SL-7	38	113	112	84	62	−4	86	129	142	43	41	Na>>>K=Ca>Mg $HCO_3 > Cl > SO_4 >>> F$
	SL-11	38	111	111	82	61	−6	221	192	92	20	32	Na>Ca>Mg>K $HCO_3 >>> Cl = SO_4 >>> F$
	SL-12	57	123	121	95	72	4	188	192	142	COOL	COOL	Na>>Mg>K=Ca $HCO_3 >> Cl > SO_4 >>> F$
	SL-13	37	89	92	59	39	−25	210	180	76	COOL	COOL	Na>Ca≥Mg>>K $HCO_3 >> SO_4 > Cl >>> F$
SANTA BARBARA COUNTY	SA-1	34	–	–	–	–	–	65	89	48	69	–	Na>>Ca>>Mg>>K $SO_4 >> Cl > HCO_3 >>> F$
	SA-2	42	–	–	–	–	–	88	142	202	21	21	Na>>>K>Ca≥Mg $Cl > HCO_3 >>> SO_4 >>> F$
	SA-3	47	–	–	–	–	–	72	89	35	NONE	NONE	Na>Ca>>>K=Mg $SO_4 = HCO_3 >> Cl >>> F$
	SA-4	37	89	92	59	39	−25	42	75	50	NONE	NONE	Na>>>Ca>>Mg>K $HCO_3 >> Cl > SO_4 >> F$
	SA-5	31	60	65	27	11	−49	52	79	45	77	–	Na>>Ca>>Mg>>K $HCO_3 > SO_4 > Cl >>> F$
	SA-6*	39	70	75	39	21	−40	30	80	108	75	67	Na>>>Ca>>K>Mg $HCO_3 \geq Cl >>> CO_3 >>> F >> SO_4$
	SA-7*	43	92	94	61	42	−23	53	–	–	NONE	NONE	Na>>>K $HCO_3 > CO_3 > SO_4 >> Cl >> F$
	SA-8	43	–	–	–	–	–	43	80	68	NONE	NONE	Na>>>Ca>Mg>K $HCO_3 > Cl > SO_4 >>> F$
	SA-9	34	81	84	49	31	−32	34	69	49	NONE	NONE	Na>>Ca>>Mg>>K $HCO_3 > SO_4 > Cl >>> F$
	SA-10	44	78	82	47	28	−34	73	103	79	81	–	Na>>>Ca>K>Mg $HCO_3 >> Cl >> SO_4 >> F$
	SA-12	56	111	110	81	60	−7	50	96	109	NONE	NONE	Na>>>Ca=K $HCO_3 >>> Cl > SO_4 > F$
	SA-13	22	70	75	39	21	−40	45	81	68	COOL	COOL	Na>>Ca>Mg>>>K $Cl >> HCO_3 >>> SO_4 >> F$
SANTA CLARA COUNTY	SC-1	29	69	74	37	19	−42	108	137	120	37	40	Na>>Ca>Mg>K $HCO_3 >>> Cl > SO_4 >>> F$
	SC-2	41	138	133	111	87	17	88	120	104	COOL	COOL	Na>Ca>Mg>K $HCO_3 >> Cl >>> SO_4 >> F$
	SC-3	25	65	71	33	16	−45	99	122	86	37	47	Na>>Ca>Mg>K $HCO_3 > Cl >>> SO_4 >> F$
SANTA CRUZ COUNTY	SZ-1	23	114	113	86	64	−3	193	164	59	63	–	Ca>Na>>Mg>K $HCO_3 > SO_4 > Cl >>> CO_3$
SHASTA COUNTY	SH-1*	58	99	100	69	49	−16	69	96	63	NONE	NONE	Na>>Ca>>>K $SO_4 >> Cl > HCO_3 >> CO_3 > F$
	SH-2	29	93	95	62	43	−22	70	92	48	59	–	Na>>Ca>>Mg>K $HCO_3 >> Cl >>> F$
	SH-3	82	120	118	92	70	2	111	137	110	NONE	NONE	Na>>Ca>>K>>>Mg $Cl >> SO_4 >> HCO_3 >>> F$
	SH-7	93	198	183	180	149	74	287	221	89	COOL	COOL	Na≥Ca≥Mg>K $SO_4 >>> Cl$
SIERRA COUNTY	SI-1	44	138	133	111	87	17	101	133	118	95	94	Na>>>Ca>K>>Mg $Cl > SO_4 = HCO_3 >>> F$
	SI-3	51	128	125	101	78	9	70	106	95	NONE	NONE	Na>>>Ca>>K>>Mg $Cl > SO_4 > HCO_3 >>> F$
	SI-6	27	123	121	95	72	4	104	135	118	COOL	COOL	Na>>>K>Mg>Ca $HCO_3 >>> Cl > SO_4$
	SI-7	30	116	115	87	65	−2	126	149	122	64	65	Na>>>K>Ca>Mg $HCO_3 > Cl > SO_4$
	SI-8*	44	126	124	99	76	7	62	95	76	NONE	NONE	Na>>>Ca>K $HCO_3 > Cl > SO_4 = CO_3$

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* Samples with 8.50 or more pH. In these samples, the dissociation of silicic acid may account for higher temperatures estimated from the quartz or chalcedony geothermometer relative to the Na-K-Ca geothermometer.

Table 2. Summary of Estimated Geothermometer Temperatures and Type of Thermal Waters of California — Continued

COUNTY CODE NUMBER		RECENT SURFACE TEMP. (°C)	SILICA					Na-K-Ca					WATER TYPE
											Mg CORRECTED		
			Conductive	Adiabatic	Chalcedony	α-Cristobalite	Amorphous	Na-K	Na-K-Ca (1/3)	Na-K-Ca (4/3)	Na-K-Ca (1/3)	Na-K-Ca (4/3)	
SISKIYOU COUNTY	SK-1*	29	101	102	71	50	−15	49	78	48	NONE	NONE	$Na>>>Ca>>K$ $Cl>>CO_3>SO_4>HCO_3>>>F$
	SK-2	24	122	120	93	71	3	99	148	192	61	65	$Na>>>Ca>K>Mg$ $Cl\geq HCO_3>>>SO_4$
	SK-3	69	126	124	99	76	7	50	80	52	NONE	NONE	$Na>>Ca>>>K>Mg$ $Cl>SO_4$
	SK-4	28	–	–	–	–	–	96	112	61	NONE	NONE	$Na>>>Ca>K>>Mg$ $HCO_3>>Cl>>>SO_4$
	SK-7	84	184	172	164	135	60	250	–	–	NONE	NONE	$Mg\geq Na>>K$ $SO_4>>>Cl>>F$
SOLANO COUNTY	SO-1	20	119	117	90	68	1	100	151	199	29	31	$Na>>>Ca>Mg>K$ $Cl>HCO_3>>>SO_4>>>F$
	SO-3	23	107	107	78	57	−9	73	–	–	NONE	NONE	$Na>>Mg>>>K>>>Ca$ $HCO_3>Cl>>>SO_4>>F$
SONOMA COUNTY	SN-2	100	188	175	168	139	64	308	203	39	COOL	COOL	$Mg>>Ca>>Na>>K$ $SO_4>>>Cl$
	SN-5	55	154	147	129	103	32	107	156	201	81	89	$Na>>>K>Ca>Mg$ $HCO_3>>>Cl>>F>SO_4$
	SN-6*	31	140	135	114	89	19	198	162	48	17	–	$Ca=Na>Mg>>K$ $HCO_3>>>Cl>CO_3>>>SO_4>>F$
	SN-7	23	130	127	103	80	11	204	167	53	COOL	COOL	$Na\geq Ca>Mg>>K$ $HCO_3>>>SO_4>Cl>>>F$
	SN-8	29	129	126	101	78	10	192	184	111	57	59	$Na>>Ca>K>Mg$ $HCO_3>>Cl>>>SO_4$
	SN-9*	21	123	121	95	72	4	214	193	104	34	41	$Na>>Ca>K>Mg$ $HCO_3>>Cl>SO_4>>CO_3>>>F$
	SN-10	46	117	116	89	67	−1	248	241	193	85	73	$Na>>K>>Ca>Mg$ $Cl>>CO_3>SO_4$
	SN-12	44	134	130	107	83	14	125	155	144	124	120	$Na>>>K>Ca>>Mg$ $Cl>HCO_3>>>SO_4=F$
	SN-13	28	–	–	–	–	–	86	118	103	COOL	COOL	$Na>>>Mg>K=Ca$ $HCO_3>>>Cl>SO_4$
STANISLAUS COUNTY	ST-1	23	78	82	47	28	−34	44	64	14	NONE	NONE	$Ca>Na>>>K$ $SO_4>>Cl>>>HCO_3>CO_3>F$
TEHAMA COUNTY	TH-1	95	191	177	171	141	66	201	229	251	228	251	$Na>>K>Ca>>>Mg$ $Cl>>>SO_4>HCO_3>>>F$
	TH-2	96	166	156	142	115	43	198	223	229	221	227	$Na>>K>Ca>>>Mg$ $Cl>>>SO_4>HCO_3$
	TH-3	29	53	60	21	4	−55	44	119	276	42	58	$Na>>>K>>Ca\geq Mg$ $Cl>>>HCO_3>>CO_3>>>F$
	TH-4*	38	96	97	66	46	−19	49	79	49	NONE	NONE	$Na>>Ca>>>K$ $Cl>>>CO_3>SO_4>HCO_3>F$
TULARE COUNTY	TU-1	43	116	115	87	65	−2	101	121	79	NONE	NONE	$Na>>Ca>>K>>>Mg$ $Cl>SO_4>HCO_3$
	TU-4	22	128	125	100	77	8	104	125	86	57	67	$Na>>Ca>>Mg>K$ $HCO_3>Cl>>>F>SO_4$
	TU-5	21	105	106	76	55	−11	199	159	40	47	–	$Na=Ca>Mg>K$ $HCO_3>>>Cl>SO_4>>>F$
	TU-6	45	91	93	60	40	−24	145	139	56	129	–	$Na>Ca>>K>Mg$ $HCO_3>Cl>CO_3>SO_4>>F$
VENTURA COUNTY	VN-1	32	–	–	–	–	–	104	118	64	73	–	$Na>>Ca>>Mg>K$ $HCO_3=Cl>SO_4>>>F$
	VN-2*	42	97	98	67	47	−18	61	96	81	94	–	$Na>>>Ca>>K>Mg$ $HCO_3>>Cl>SO_4>CO_3>F$

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* Samples with 8.50 or more pH. In these samples, the dissociation of silicic acid may account for higher temperatures estimated from the quartz or chalcedony geothermometer relative to the Na-K-Ca geothermometer.

Table 2. Summary of Estimated Geothermometer Temperatures and Type of Thermal Waters of California — Continued

COUNTY CODE NUMBER		RECENT SURFACE TEMP. (°C)	SILICA					Na-K-Ca					WATER TYPE
											Mg CORRECTED		
			Conductive	Adiabatic	Chalcedony	α-Cristobalite	Amorphous	Na-K	Na-K-Ca (1/3)	Na-K-Ca (4/3)	Na-K-Ca (1/3)	Na-K-Ca (4/3)	
VENTURA COUNTY (Continued)	VN-3	90	123	129	105	82	13	131	155	130	142	115	$Na>>>Ca>K\geq Mg$ $Cl=SO_4>>HCO_3>>F$
	VN-4	51	107	107	78	57	−9	116	138	106	109	106	$Na>>>Ca>>K>>Mg$ $Cl>>HCO_3>SO_4>>>F$
	VN-5*	39	81	84	49	31	−32	57	98	98	NONE	NONE	$Na>>>Ca>K>>Mg$ $HCO_3>Cl>>SO_4\geq CO_3>>F$
	VN-7	44	91	93	60	40	−24	50	77	42	NONE	NONE	$Na>>>Ca>>K$ $HCO_3>>SO_4>Cl>>>F$

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* Samples with 8.50 or more pH. In these samples, the dissociation of silicic acid may account for higher temperatures estimated from the quartz or chalcedony geothermometer relative to the Na-K-Ca geothermometer.

"Conductive" refers to the quartz saturation temperature assuming no steam loss during cooling (conductive cooling). "Adiabatic" refers to the quartz saturation temperature assuming maximum steam loss during cooling (adiabatic cooling). No correction has been made for dissociation of dissolved silica at high pH (7.0-8.5).

In the Na-K-Ca geothermometers, the concentrations of constituents are in molality. The data given in Table 1 are reported in mg/L and provisions for appropriate conversions are included in the GEOTHERM computer program from which the data were drawn (Rapport, 1982). The following computations for Na-K and Na-K-Ca geothermometers are used:

Type	*Computation used*
Na-K	$T°C = \dfrac{1217}{\log(Na/K) + 1.483} - 273.15$
Na-K-Ca	$T°C = \dfrac{1647}{\log(Na/K) + \beta^{*}\log(\sqrt{Ca}/Na) + 2.24} - 273.15$

Magnesium is also one of the constituents in the thermal waters and therefore a correction for magnesium should be applied to the Na-K-Ca geothermometer. Details of the magnesium correction methods are described by Fournier and Potter II (1978), and Fournier (1979).

When the estimated temperature from the Na-K-Ca geothermometer is less than 70°C, the magnesium correction is not needed.

Use of the following magnesium correction computation is made only when Na-K-Ca estimated temperatures are above 70°C and when "R" values are between 5 and 50:

$$\Delta t_{mg} = a_1 - b_1R + C_1(\log R)^2 - d_1\frac{(\log R)^2}{T} - e_1\frac{(\log R)^2}{T^2} + f_1\frac{(\log R)^3}{T^2}$$

Where: "Δt_{mg}" is the temperature converted in °C, which is to be subtracted from the respective estimated Na-K-Ca temperatures;

"R" is the percent Mg/ (Mg+Ca+K) in equivalents;
"T" is absolute temperature (°K), which is obtained by adding 273 to the respective Na-K-Ca estimated temperature;

"a_1" = 10.66;
"b_1" = 4.7415
"c_1" = 325.867;
"d_1" = 1.0321×10^5;
"e_1" = 1.9683×10^7; and
"f_1" = 1.6053×10^7.

In cases where the estimated temperatures for the Na-K-Ca geothermometer are above 70°C and "R" values are less than 5, then the following computation for magnesium correction is used:

$$\Delta t_{mg} = -a_2 + b_2(\log R) + c_2(\log R)^2 - d_2\frac{(\log R)^2}{T} - e_2\frac{(\log R)}{T^2}$$

Where:

"a_2" = 1.029-95;
"b_2" = 59.97116;
"c_2" = 145.049;
"d_2" = 36711.6; and
"e_2" = 1.67516×10^7

In either case, if the corrected computation comes to a negative value, the correction is not applied to the Na-K-Ca geothermometer estimated value.

When the "R" value is less than 0.5, no magnesium correction is calculated and "NONE" is written.

When the "R" value is greater than 50, the water is interpreted as "COOL" and the measured temperature is likely to be more valid than the calculated Na-K-Ca temperature.

When the "R" value is found to be between 0.5 and 50, the geothermometer temperature is considered to be too high and will require reduction by the appropriate correction.

The Mg-corrected estimated temperatures for Na-K-Ca (1/3) and Na-K-Ca (4/3) geothermometer should be used, wherever available, instead of non-corrected Na-K-Ca (1/3) and Na-K-Ca (4/3) temperatures.

WATER TYPE

Water type given in Table 2 for each of the analyzed springs and wells is calculated on the "weight" basis. The following is an explanation of the symbols and procedure of calculation used for determining the water type. In the explanation the symbols "A" and "B" are substituted for various cations and anions:

A = B	meaning "A" approximately equals "B" in concentrations;
A ≥ B	meaning "A" is 1 to 1.2 times the concentration of "B";
A > B	meaning "A" is 1.2 to 3 times the concentration of "B";
A > > B	meaning "A" is 3 to 10 times the concentration of "B"; and
A > > > B	meaning "A" is more than 10 times the concentration of "B".

The waters of thermal springs and wells shown on this map have been grouped into five main classes by comparing the relative concentrations of chemical constituents in waters (Table 3). The classes are named after the dominant cation and anion present in the water. To consider the dominance of a cation or anion, the mg/L values of the constituents were converted to milliequivalents per liter (meq/L) or equivalent parts per million (epm). When a cation or anion is present in 50 percent or more in quantity, that water is assigned to the class named after that cation and anion. The term "mixed" is used to describe the water where no one cation or anion dominates (Table 1a).

STATISTICAL SUMMARIES

The statewide statistical summary of the chemical characteristics of the thermal springs and wells of California is given in Table 3. This table lists the number of thermal springs and wells of each class that occurs in each geomorphic/geologic/geochemical province. The main classes of water present in California thermal springs and wells are sodium-chloride, sodium-bicarbonate, sodium-sulfate, magnesium-bicarbonate, and others. The "others" class is further divided into the subclasses magnesium-sulfate, calcium-chloride, calcium-bicarbonate, calcium-sulfate, sodium-mixed anions, calcium-mixed anions, mixed cations-chloride, mixed cations-bicarbonate, mixed cations-sulfate, and mixed cations-mixed anions.

Due to the complexity of the geochemical relations, it is very

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*If the number obtained from the log ($\sqrt{Ca}$/Na) calculation is negative, use β = 1/3; If the number is positive, use β = 4/3.

Table 3. Statewide Statistical Summary of the Chemical Characteristics of the Thermal Waters of California.

GEOMORPHIC/GEOLOGIC /GEOCHEMICAL PROVINCES OF CALIFORNIA	GREAT VALLEY OF CALIFORNIA	SIERRA NEVADA	CASCADE RANGE	MODOC PLATEAU	KLAMATH MOUNTAINS	COAST RANGES	TRANSVERSE RANGES	PENINSULAR RANGES (+LA Basin)	COLORADO DESERT	MOJAVE DESERT	BASIN RANGES	ALL THERMAL SPRINGS AND WELLS		
	Total Number	Total Number	Total Number	Total Number	Total Number	Total Number	Total Number	Total Number	Total Number	Total Number	Total Number	TOTAL Number	% of TOTAL	
Thermal Springs	1	34	17	19	2	98	17	22	11	8	61	290	44.4	100%
Thermal Wells	2	17	1	19	--	34	14	64	150	35	27	363	55.6	
Nonanalyzed Springs/Wells	1	16	7	25	--	34	10	17	25	2	22	159	24.4	100%
Partially Analyzed Springs and Wells	--	2	--	--	--	2	--	12	5	11	1	33	5.0	
Analyzed Springs/Wells	2	33	11	13	2	96	21	57	131	30	65	461	70.6	
CHEMICAL CHARACTERISTICS														
1. Sodium Chloride	1	12	6	1	1	30	2	10	87	14	7	171	37.1	100%
2. Sodium Bicarbonate	1	15	1	2	--	33	7	9	24	1	23	116	25.2	
3. Sodium Sulfate	--	--	--	9	1	3	7	2	3	5	8	38	8.2	
4. Magnesium Bicarbonate	--	--	--	--	--	7	--	1	--	--	--	8	1.7	
5. Others														
a. Magnesium Sulfate	--	--	1	--	--	1	--	--	--	--	1	3	0.7	
b. Calcium Chloride	--	--	--	--	--	--	--	1	--	--	--	1	0.2	
c. Calcium Bicarbonate	--	--	--	--	--	--	1	1	--	1	1	4	0.9	
d. Calcium Sulfate	--	--	--	--	--	1	--	--	--	--	2	3	0.7	
e. Sodium-Mixed Anions	--	5	--	--	--	6	3	10	17	9	21	71	15.4	
f. Calcium-Mixed Anions	--	--	--	--	--	--	--	1	--	--	--	1	0.2	
g. Mixed Cations-Chloride	--	--	--	--	--	--	--	3	--	--	1	4	0.9	
h. Mixed Cations-Bicarbonate	--	1	--	1	--	8	--	9	--	--	--	19	4.0	
i. Mixed Cations-Sulfate	--	--	3	--	--	5	1	3	--	--	1	13	2.8	
j. Mixed Cations-Mixed Anions	--	--	--	--	--	2	--	7	--	--	--	9	2.0	

Table 4. Ranges used for the Convenience of Discussion of Tables 5 through 8.

BORON (mg/L)		TEMPERATURE (°C)		pH		TOTAL DISSOLVED SOLIDS (mg/L)	
>20	High	>50	Very warm to hot	>10.00	Strongly Basic	>10,000	Very High
Between 5-20	Medium	Between 30-49	Moderately warm	Between 8.00-10.00	Moderately Basic	Between 3,000-9,999	High
<5	Low	Between 20-29	Slightly warm	Between 7.50-8.00	Slightly Basic	Between 1,000-2,999	Medium
				Between 6.50-7.50	Neutral	Between 0-999	Low
				Between 6.00-6.50	Slightly Acidic		
				Between 4.00-6.00	Moderately Acidic		
				<4.00	Strongly Acidic		

difficult to compare the various waters* in relation to geology. The detailed geology of each locality is reflected to some extent in the types of waters found there. The water source in special cases, like structurally complex fault zones or structurally simple clastic marine sediments, can make great differences in the chemical content of the waters. Without doubt, the structurally chaotic Franciscan terrane issues very unusual waters, especially from serpentinite and its related rocks.

A general relationship between the composition of waters and the minerals present in the rocks in contact with the waters is to be expected. This relationship may be simple or complex, depending on various factors such as whether or not the aquifer receives direct recharge by rainfall, whether water is being discharged without contacting any other aquifer, whether there is influence from one or more interconnected aquifers of different composition, and whether chemical reactions such as cation exchange, adsorption of dissolved ions, or biological influences take place. Thus, composition of the water can be related to the lithology in the area in which a spring or well occurs and its constituents are most likely derived from the solution of minerals in rocks and soils. These constituents are dissolved silica and the cations. The anions in rainfall are also balanced by the cations, for example H^+. For the most part, the constituent anions may have been derived from nonlithologic sources. The common example of such a nonlithologic derivation is the bicarbonate. The bicarbonate present in most waters is derived mainly from carbon dioxide of the air which has been extracted and liberated in the soil by biochemical activities. Chloride and sulfate are derived through the direct solution of some of the rocks. Atmospheric chloride influences the anion content in many waters. The circulation of sulfate is greatly influenced by biologically triggered oxidation and reduction.

The above discussion about the sources of the anions is generally for dilute waters. The geothermal waters with higher concentrations of CO_2 ($HCO_3 + H_2CO_3$) must be generated from unspecified sources at depth, either in the lower crust or possibly in the upper mantle. It is quite possible that due to weathering processes, CO_2 may be generated at relatively shallow depths.

Barnes and others (1981) have discussed the geochemical evidence, based on the chemistry of the thermal waters, for the nature of the basement rocks of the Sierra Nevada. They have given an account of the work done by others on the relationships between the chemistry of thermal waters and the lithology. The evidence for the nature of the unexposed rocks at depth in the Sierra Nevada and Klamath mountains is supplied by the chemical and isotopic composition of the waters collected from the thermal springs. Heat production by radioactive decay in the granitic rocks of the Sierra Nevada is high relative to heat flow (Lachenbruch, 1968; Lachenbruch and Sass, 1977; both cf. Barnes and others, 1981). This suggests that less heat production is taking place in the rocks underlying the granitic batholith, which, in turn, suggests that the chemical composition of the rocks of the Sierra Nevada changes with depth.

From this study, Barnes and others (1981) concluded that the carbon dioxide-rich waters of the Sierra Nevada required nongranitic rocks at some depth in the batholith to explain their chemical characteristics. That nongranitic rocks may be present at depth in the batholith is suggested by the fact that igneous rocks intrude metamorphic rocks originating from marine sediments. All the carbon isotope data indicate that the CO_2 is from a deep source, possibly the mantle. Chloride, bromide, iodide, boron, and ammonia concentrations also show that metamorphic rocks of a marine clastic origin exist at depth.

From the silica and magnesium contents, they concluded that the waters have reacted at shallow depths with unexposed serpentinite at lower temperatures.

Carbon dioxide-rich waters react with lizardite and chrysotile serpentine in the Coast Ranges to form silica-carbonate rocks (Barnes and others, 1973). The presence of serpentinite in the Coast Ranges and the Sierra Nevada is shown by the amorphous silica saturation and high magnesium content in some of the CO_2 springs. But the fact remains that magnesium contents in such carbon dioxide-rich springs of the Coast Ranges are higher than those in the Sierra Nevada at the same silica range, pH, and temperature. The serpentine mineral in the Sierra Nevada is less soluble than the lizardite and chrysotile of the Coast Ranges, thus it is antigorite.

The summary of the water quality of the geothermal area is the type of water-analysis interpretation one most commonly expects from the hydrogeochemist. Such an interpretation should convey water-quality information in the manner in which it can be understood by all readers.

GEOTHERMAL PROVINCES

Usually a map depicting the quality of thermal spring and well water is prepared by entering numbers or symbols at spring or well locations to represent temperature, flow rate, depth, pH, concentrations of predominant cation-anion constituents, and total dissolved solids. Many of the wells are open to more than one aquifer and in some instances the water of an aquifer may vary in composition with the depth. These variations change the water quality. To develop an idea of the relationships of water chemistry to provinces, locations of thermal springs and wells were plotted on a map of California and colored with symbols depicting different chemical characteristics. The geomorphic/geologic provinces of California were then overlaid and were modified to reflect the chemical characteristics of the thermal waters. The resulting geomorphic/geologic/geochemical provinces map is shown in Figure 4. The boundaries of the provinces are very crude so far as the nomenclature "geochemical" is concerned. The data throughout the state of California are only for thermal waters and are not sufficient to draw exact lines for "geochemical provinces."

There are eleven geomorphic/geologic/geochemical provinces in California (Figure 4). They are the Great Valley, the Sierra Nevada, the Cascade Range, the Modoc Plateau, the Klamath Mountains, the Coast Ranges (northern and southern), the Transverse Ranges, the Peninsular Ranges with the Los Angeles basin, the Colorado Desert, the Mojave Desert, and the Basin and Range provinces. For the sake of describing these provinces briefly from the point of view of their geologic growth, they were combined by Jenkins (1950) into five groups of somewhat similar physical features. Group I includes three mountainous areas—the Sierra Nevada, the Klamath Mountains, and the Peninsular Ranges. These mountains provided sediments which filled the basins during the Cretaceous and Tertiary periods. These basin areas were subsequently raised, folded, and faulted, and became the present-day Coast Ranges and Transverse Ranges, thus forming Group II. Group III includes the Great Valley and the Colorado Desert provinces. Many later workers have included the Colorado Desert province along with the Mojave Desert and the Basin and Range provinces to form Group V. In the present study, we have followed this procedure and included the Colorado Desert province in Group V. Group IV includes the Modoc Plateau and the Cascade Range provinces.

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*Some authors prefer to use the word "fluids" for geothermal waters. For the sake of simplicity, we have used the word "waters" throughout the text. The term "fluids" includes the gas and liquid phases and the supercritical state of water.

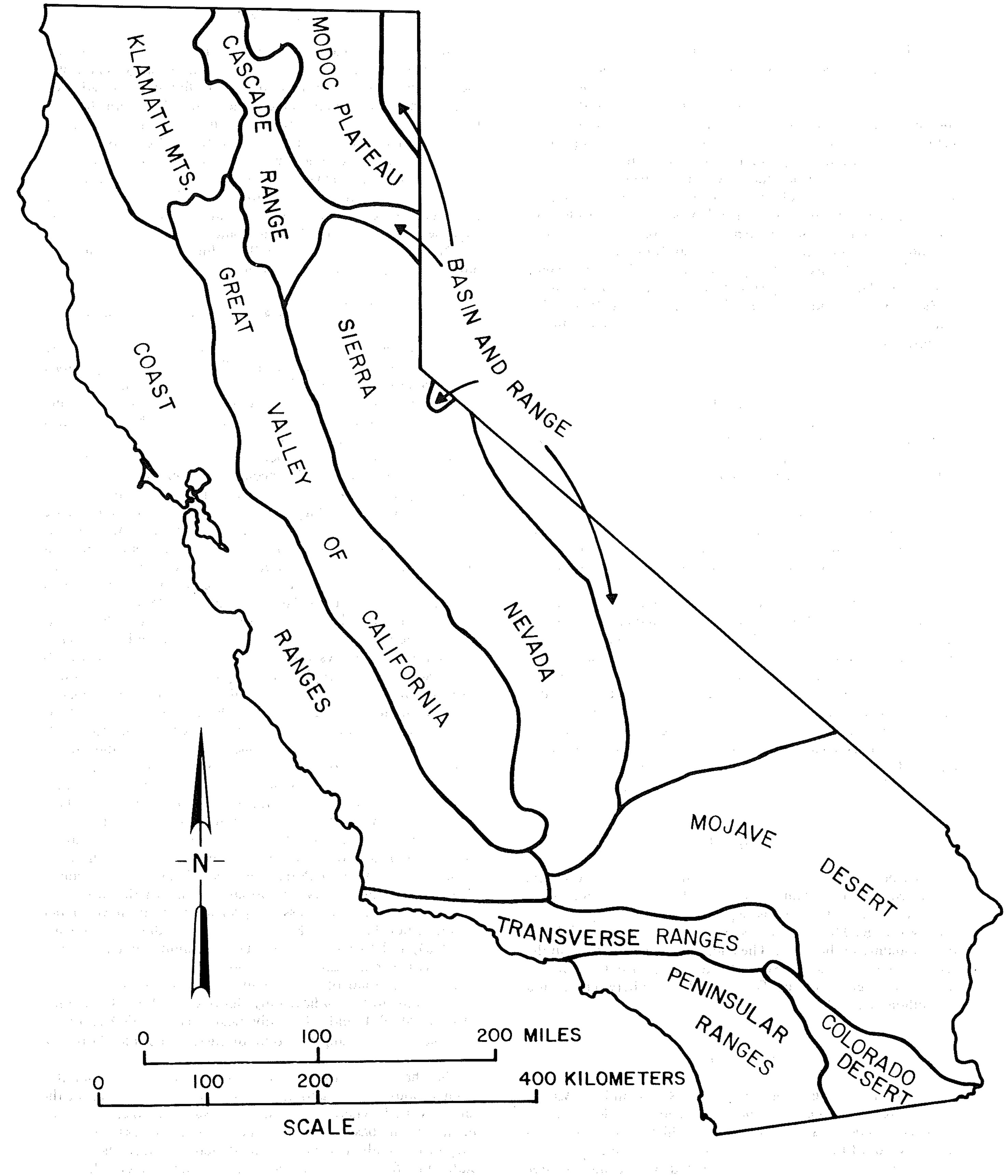

Figure 4. Geomorphic/geologic/geochemical provinces of California.

Group I

The Sierra Nevada province contains large numbers of plutons of various sizes, shapes, and mineralogic and petrologic compositions. Overlying these granitic rocks are various volcanic rocks, dominantly andesitic on the western slopes and rhyolitic to basaltic on the eastern slopes. Sedimentary and metamorphic rocks occur on the western slopes and metamorphic rocks appear as both large and small roof pendants throughout the plutons. The Klamath Mountains province contains metavolcanic and metasedimentary rocks of Paleozoic age, serpentinite of pre-Cretaceous age, granitic rocks of Paleozoic and Mesozoic age, and Triassic and Jurassic sedimentary and volcanic rocks. Serpentinite is not present in the Peninsular Ranges of southern California. The Peninsular Ranges province, on the other hand, does contain large areas of pegmatites, which are not present in the Sierra Nevada and the Klamath Mountains. The Peninsular Ranges are made up of granitic rocks intruded into older metamorphic rocks.

Group II

There is a belt of Jurassic to Cretaceous granitic rocks in some parts of the Coast Ranges province west of the San Andreas fault and east of the Sur-Nacimiento faults. The granitic rocks intrude schist, gneiss, and crystalline limestone of the Sur Series, the oldest rocks in the province. Other parts of the province contain Jurassic to Tertiary Franciscan rocks. The Coast Ranges province is divided into two parts, the northern and the southern Coast Ranges. The northern Coast Ranges province is dominated by Franciscan rocks and its eastern border is marked by Cretaceous strata of the Great Valley sequence. Volcanic cones and flow rocks of the Clear Lake area are some of the youngest rocks present. The southern Coast Ranges province is made up of a series of Cretaceous and Tertiary sedimentary strata, but includes areas with major exposures of Franciscan rocks and the Coast Ranges granitic belt. The southern Coast Ranges province has many characteristics similar to those of the Transverse Ranges province, which has one of the thickest Cenozoic sedimentary sections in the world. The large oil and gas fields of the state of California are grouped into these two provinces—the southern Coast Ranges and the Transverse Ranges.

Group III

This group is made up of only one province, the Great Valley, which also has important oil and gas deposits in sedimentary rocks of Tertiary age and gas deposits in sedimentary rocks of Cretaceous age. This province is an alluvial basin with oil fields located mainly in the south. The Sacramento Valley plain in the north is interrupted by the Sutter Buttes, which are the remnants of an isolated group of late Tertiary volcanoes between 1.5 and 2.5 million years old.

Group IV

This group is made up of the Cascade Range and the Modoc Plateau provinces, both of which are Cenozoic volcanic provinces. The Modoc Plateau is made up of thick accumulations of lava flows and tuff beds with many small volcanic cones. Conversely, the Cascade Range is dominated by a chain of large volcanic cones.

Group V

This group is made up of three provinces, the Colorado Desert, the Mojave Desert, and the Basin and Range. The Colorado Desert province is made up of an alluvium covered low-lying desert basin which includes the Salton Sea. Both the Mojave Desert and Basin and Range are made up of mountainous desert regions with distinct geologic features. Precambrian sedimentary and metemorphic rocks occur in these provinces as well as Paleozoic to Cenozoic sedimentary and volcanic rocks and Precambrian to Mesozoic granitic rocks. The Mojave Desert province is made up of isolated mountain ranges separated by expanses of desert plains. The Basin and Range province is largely a Nevada province, lying wholly within the Great Basin with only peripheral sections in California.

Chemical Characteristics of the Provinces

The distribution of analyzed thermal springs and wells by water type and province are given in Table 3. The upper portions of the table show the number of thermal springs and wells by province and the number analyzed. Of all the geothermal occurrences shown on the present map, 44.4% (or 290) are springs and 55.6% (or 363) are wells.

The principle classes of thermal waters found in California include sodium-chloride (171 occurrences equaling 37.1% of the total analyzed thermal springs and wells), sodium-bicarbonate (116 occurrences equaling 25.2% of the total). Sodium-sulfate (38 occurrences equaling 8.5% of the total), and magnesium-bicarbonate (8 occurrences equaling 1.7% of the total). The fifth class shown as "others" combines ten subclasses (128 occurrences equaling 27.8% of the total). The number of occurrences and percent for each subclass is given in Table 3.

There are six "mixed" subclasses in the "others" class. Considering the highest "epm" value of the cation and/or anion in question further analysis of each of these mixed subclasses follows. Note that this highest epm figure of the cation/anion is always lower than 50% of the total of all cations or anions.

In the sodium-mixed anions subclass, 38 springs and wells have higher bicarbonate (53.5%), 24 higher chloride (33.8%), and 9 higher sulfate (12.7%) anions present. The calcium-mixed anions subclass has only one well with higher bicarbonate anions. In the mixed cations-chloride subclass, all 4 wells have higher sodium anions. In the mixed cation-bicarbonate subclass, 7 springs and wells have higher sodium (36.8%), 6 higher calcium (31.6%), and 6 higher magnesium (31.6%) cations present. In the mixed cations-sulfate subclass, 8 springs and wells have higher sodium (61.5%), 3 higher calcium (23.1%) and 2 higher magnesium (15.4%) cations present. In the mixed cations-mixed anions subclass, 3 springs and wells have higher sodium-chloride (33.3%), 3 higher sodium-bicarbonate (33.3%), and 1 each (11.1%) higher sodium-sulfate, calcium-chloride, and magnesium-sulfate present.

Out of the total of 33 partially analyzed springs and wells (5.0% of the total), 24 have only chloride (73.0%), 8 have only cations (24.0%), and 1 has only bicarbonate (3.0%) reported.

Table 4 lists the ranges used for discussion of Tables 5 through 8.

The chemical analyses of the thermal waters are compiled from various sources and are of various dates. Selection of the analyses used, where more than one was available, was made mainly on the basis of recency and/or completeness. The accuracy of the analytical methods used were, in most cases, never stated in referenced publications. Each analysis was utilized for statistical computation although a few appeared to be non-

Table 5. Statistical comparison of Boron content (in mg/L) with chemical characteristic of thermal water by province.

PROVINCE	SIERRA NEVADA			CASCADE RANGE			MODOC PLATEAU			COAST RANGES			TRANSVERSE RANGES		
CHARACTERISTIC OF THERMAL WATER	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	KEY {ALL COAST RANGES NORTHERN RANGES SOUTHERN RANGES} RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN
Sodium Chloride	0.70-8.80	4.66	3.50	15.00-88.00	53.00	51.50	---	---	---	0.29-400.00 2.40-400.00 0.29-191.00	93.00 133.00 24.80	13.00 51.00 8.60	---	---	---
Sodium Bicarbonate	0.20-11.00	2.64	0.70	---	---	---	---	---	---	0.10-828.00 1.30-828.00 0.10-17.00	84.95 141.00 3.72	2.50 33.50 1.95	0.30-3.00	1.05	1.00
Sodium Sulfate	---	---	---	---	---	---	1.30-4.50	3.04	3.00	0.68-13.00 --- 0.68-13.00	4.90 --- 4.90	3.50 --- 3.50	0.10-3.50	1.51	0.25
Magnesium Bicarbonate	---	---	---	---	---	---	---	--	--	0.10-23.00 0.10-23.00 0.10-0.40	5.14 7.57 0.30	0.16 0.91 0.38	---	---	---
Calcium Bicarbonate	---	---	---	---	---	---	---	--	--	---	---	---			

Table 5. Statistical comparison of Boron content (in mg/L) with chemical characteristic of thermal water by province. (Continued)

PROVINCE	PENINSULAR RANGES (Including LA Basin)			COLORADO DESERT			MOJAVE DESERT			BASIN RANGE		
CHARACTERISTIC OF THERMAL WATER	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN
Sodium Chloride	0.03-5.90	1.79	0.45	0.20-514.00	31.16	2.36	0.30-6.20	1.81	0.50	1.90-130.00	27.34	8.50
Sodium Bicarbonate	0.10-5.00	0.96	0.25	0.01-7.60	3.06	2.00	0.05-0.63	0.34	0.34	0.30-360.00	20.22	3.50
Sodium Sulfate	0.08-0.40	0.25	0.20	1.60-3.70	2.65	2.65	0.50-410	103.28	1.30	0.26-7.60	4.19	5.00
Magnesium Bicarbonate	---	---	---	---	---	---	---	--	--	---	---	---
Calcium Bicarbonate	0.04-0.20	0.11	0.12	---	---	---	---	--	--	---	---	---

characteristic for the specific region. Thus, the mean may be larger or smaller than the median. "Mean" is the arithmetic average of a group of samples; "median" is a measure of central tendancy, being the value which is less than the value observed in 50% of the cases and greater than the value observed in 50% of the cases. From the statistical point of view, the median values should represent the correct generalization of a group of values because it is relatively insensitive to the presence of one or two very large or very small values.

Sodium-chloride type water is considered associated with geothermal activity. In California, this type of water contains relatively high concentrations of sodium, chloride, and boron ions.

The sodium-bicarbonate type water contains high concentrations of sodium and bicarbonate ions with moderate amounts of chloride ions. Boron is present in the same proportions as in sodium-chloride type waters. Sodium-sulfate type water contains high concentrations of sodium and sulfate with moderate amounts of chloride ions and smaller amounts of bicarbonate ions. Magnesium-bicarbonate type water contains high concentrations of magnesium and bicarbonate with only moderate amounts of sodium and chloride ions.

Tables 5 through 8 list the statistical data by province.

As two provinces, the Great Valley and the Klamath Mountains, have only two analyzed water samples, these provinces are not considered in the listings and discussions of Tables 5 through 8.

Table 5 lists the statistical comparison of chemical characteristics and the boron content by province. Figure 5 shows boron content in thermal waters by province. All the values given for boron are in mg/L.

In the Sierra Nevada province, two types of thermal waters are present, the sodium-chloride and the sodium-bicarbonate types. Both types of waters have low boron contents. In the Cascade Range province only the sodium-chloride type of thermal water is present, which has high boron contents. In the Modoc Plateau province also, only the sodium-sulfate type of thermal water is present, which has low boron content. The Coast Ranges province has four types of thermal waters: sodium-chloride type[1] has medium to high boron content (higher boron content in the northern and medium in the southern Coast Ranges); sodium-bicarbonate type[2] has low to medium boron content (higher boron content in the northern and low in the southern Coast Ranges); and sodium-sulfate and magnesium-bicarbonate types have low boron contents. In the Transverse Range province, there are two types of thermal waters, sodium-bicarbonate and sodium-sulfate; both have low boron content. The Peninsular Ranges province has four types of thermal waters: sodium-chloride type, sodium-bicarbonate type, sodium-sulfate type, and calcium-bicarbonate type: all have low boron content. The Colorado Desert, Mojave Desert, and Basin and Range provinces have three types of thermal waters: sodium-chloride type, sodium-bicarbonate type, and sodium-sulfate type. In the Colorado Desert province, the sodium-chloride type[3] has low to high boron content; the sodium-bicarbonate and sodium-sulfate types have low boron content. In the Mojave Desert province, the sodium-chloride and the sodium-bicarbonate types have low boron content; the sodium-sulfate type[4] has low to high boron content. In the Basin and Range province, the sodium-chloride type has medium boron content; the sodium-bicarbonate type has low to medium boron content; and the sodium-sulfate type has low boron content.

Table 6 lists the statistical comparison of chemical characteristics and temperatures by province. All the figures given are in degrees Celsius (°C). In the Sierra Nevada province, two types of thermal waters are present, sodium-chloride and sodium-bicarbonate types. Both types of water are moderately warm. Only the sodium-chloride type of thermal water is present in the Cascade Range province, which shows high temperatures. The Modoc Plateau province also has only sodium-sulfate type of thermal water present which also shows high temperatures. Of the four types of thermal waters in the Coast Ranges province, the sodium-chloride and magnesium-bicarbonate types are warm to moderately warm in temperature (including northern and southern Coast Ranges province) and sodium-bicarbonate and sodium-sulfate types are moderately warm in temperatures (including the northern and southern Coast Ranges). Both types of thermal waters in the Transverse Ranges, the sodium-bicarbonate and the sodium-sulfate, are moderately warm. Of the four types of thermal waters in the Peninsular Ranges province, the sodium-chloride and sodium-sulfate types are moderately warm, the sodium-bicarbonate type warm to moderately warm, and the calcium-bicarbonate type warm in temperature. Of the three types of thermal waters in the Colorado Desert, the Mojave Desert, and the Basin and Range provinces, the sodium-chloride type is moderately warm to hot, warm to moderately warm, and high in temperatures, respectively. The sodium-bicarbonate type of water is moderately warm in all the provinces. The sodium-sulfate type of water is warm in temperature in the Colorado Desert, moderately warm in the Mojave Desert, and high in the Basin and Range province.

Table 7 lists the statistical comparison of chemical characterisitcs and pH by province.

A 5% solution of pure sodium-chloride at 25°C gives 6.00 pH (slightly acidic). A 5% solution of pure sodium-bicarbonate at 25°C gives 9.00 pH (moderately basic). A 5% solution of sodium-sulfate at 25°C gives 7.80 pH (slightly basic). There is no pure compound like magnesium-bicarbonate available on the market, but a 5% solution at 25°C should be slightly acidic because magnesium hydroxide is a slightly weaker base than carbonic acid is an acid. In nature, the thermal waters behave differently. White and others (1963, Table 19) have reported a water having 20,000 mg/L Cl and pH of 0.40. Other pH values reported by White for chloride waters range from 1.70 to 3.20. At the other extreme, a small nonthermal spring in north-central California (Aqua de Ney) had 7,200 mg/L Cl and a pH of 11.60 (Feth, J.H., and others, 1961). Barnes and others (1972, p. 265) have reported 18,000 mg/L Cl and 12.07 pH for Complexion Spring, Lake County.

Similar abnormal situations also exist in sodium-bicarbonate, sodium-sulfate, magnesium-bicarbonate, and calcium-bicarbonate waters. This can easily explain some of the abnormal pH values in range/mean/median listings of Table 7.

Table 8 lists the statistical comparison of chemical characteristics and total dissolved solids (TDS) by province. All the figures given for total dissolved solids are in mg/L. In the Sierra Nevada province, two types of thermal waters are present, the sodium-chloride and the sodium-bicarbonate. Both the types of

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[1] 37% (11 samples) of the analyses have a range of 59-400 mg/L B, and 63% (19 samples) have 0.29-50 mg/L B. Considering these two ranges as separate populations, the mean and median in the first range are 224.82 and 144.75; the same in the second range are 11.87 and 5.38 mg/L B respectively.

[2] 22% (9 samples) of the analyses have a range of 80-828 mg/L B, and 78% (32 samples) have 0.1 - 17 mg/L B. Considering these two ranges as separate populations, the mean and median in the first range are 365.22 and 151; the same in the second range are 3.47 and 1.17 mg/L B respectively.

[3] 13% (8 samples) of the analyses have a range of 50-514 mg/L B and 87% (55 samples) have 0.2 - 13 mg/L B. Considering these two ranges as separate populations, the mean and median in the first range are 226.75 and 151.00; and the same in the second range are 3.84 and 1.83 mg/L B respectively.

[4] One sample has 410 mg/L B, while the rest of the three samples range between 0.5 and 1.3. Because of a very high value of 410, the mean is 103.28 as opposed to only 1.30 mg/L B median.

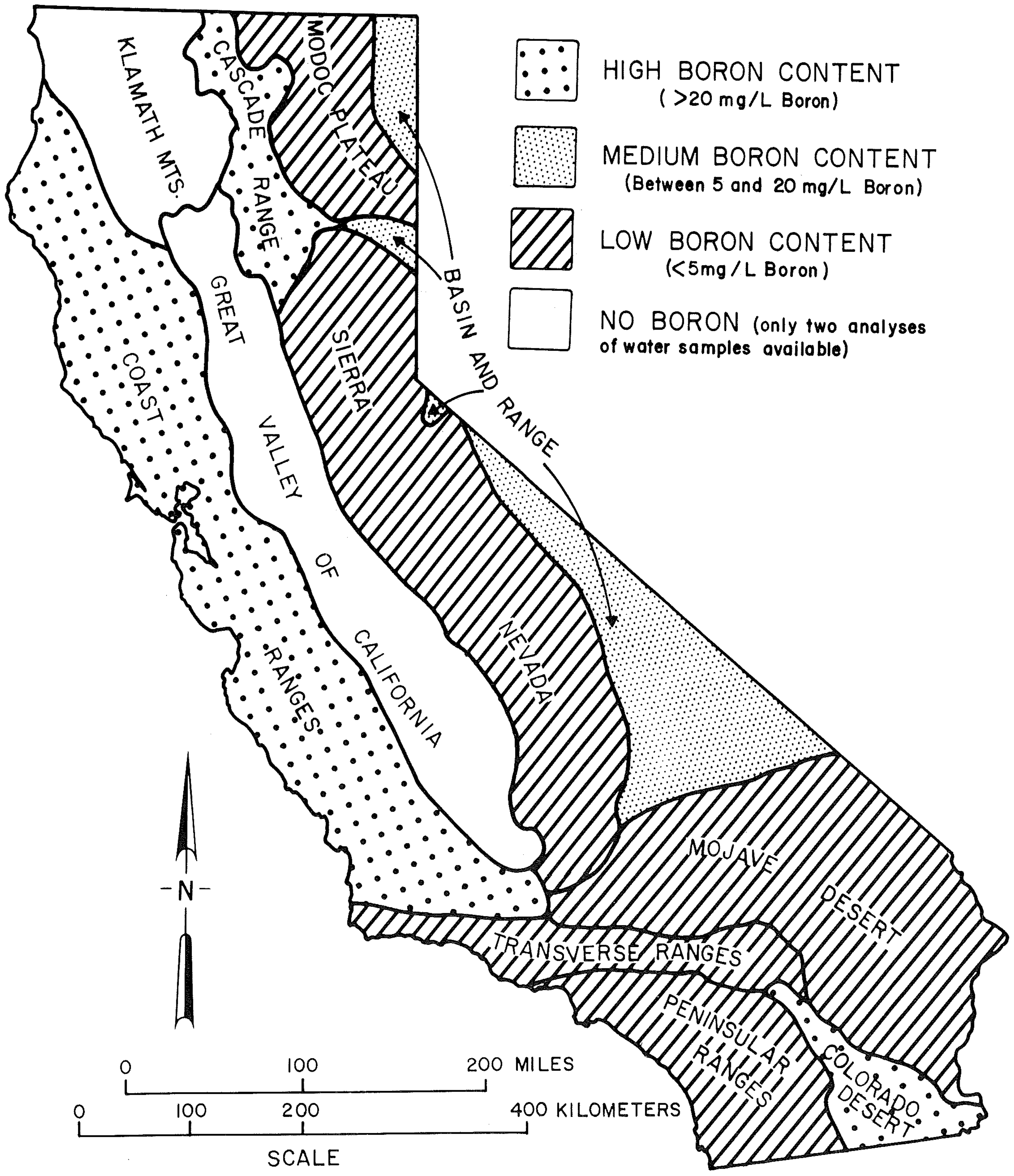

Figure 5. Boron content in thermal waters by province.

Table 6. Statistical comparison of temperature (in °C) with chemical characteristic of thermal water by province.

PROVINCE	SIERRA NEVADA			CASCADE RANGE			MODOC PLATEAU			COAST RANGES			TRANSVERSE RANGES		
CHARACTERISTIC OF THERMAL WATER	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	KEY {ALL COAST RANGES NORTHERN RANGES SOUTHERN RANGES RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN
Sodium Chloride	30-94	50	40	24-96	66	75	---	---	---	20-95 20-95 20-90	39 42 37	23 31 24	---	---	---
Sodium Bicarbonate	21-89	40	34	---	---	---	---	---	---	21-99 21-99 21-62	37 38 36	30 25 32	31-48	46	43
Sodium Sulfate	---	---	---	---	---	---	27-107	73	66	23-37 --- 23-37	31 --- 31	33 --- 33	28-90	47	45
Magnesium Bicarbonate	---	---	---	---	---	---	---	---	---	22-52 22-52 22-37	32 33 30	23 27 30			
Calcium Bicarbonate	---	---	---	---	---	---	---	--	--	---	---	---			

Table 6. Statistical comparison of temperature (in °C) with chemical characteristic of thermal water by province. (Continued)

PROVINCE	PENINSULAR RANGES (Including LA Basin)			COLORADO DESERT			MOJAVE DESERT			BASIN RANGE		
CHARACTERISTIC OF THERMAL WATER	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN
Sodium Chloride	27-56	36	32	25-348	63	35	24-45	33	28	32-177	73	49
Sodium Bicarbonate	37-59	40	25	22-44	36	38	27-33	31	33	25-82	45	38
Sodium Sulfate	26-55	41	41	28-33	29	29	30-63	43	36	32-160	81	76
Magnesium Bicarbonate	---	---	---	---	---	---	---	--	--	---	---	---
Calcium Bicarbonate	27-37	31	28	---	---	---	---	--	--	---	---	---

Table 7. Statistical Comparison of pH with chemical characteristic of thermal water by province.

PROVINCE	SIERRA NEVADA			CASCADE RANGE			MODOC PLATEAU			COAST RANGES			TRANSVERSE RANGES		
CHARACTERISTIC OF THERMAL WATER	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	KEY {ALL COAST RANGES NORTHERN RANGES SOUTHERN RANGES RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN
Sodium Chloride	6.80-8.90	7.80	8.50	6.55-8.40	7.51	7.45	---	---	---	6.70-11.20 6.70-11.20 7.00-9.50	7.89 7.80 8.00	6.69 6.50 7.71	---	---	---
Sodium Bicarbonate	6.10-10.13	7.68	6.71	---	---	---	---	---	---	6.50-9.60 6.50-9.30 7.00-9.60	6.26 7.83 8.34	7.25 7.32 8.12	7.70-8.80	8.20	8.49
Sodium Sulfate	---	---	---	---	---	---	7.60-9.11	8.22	8.00	4.50-7.90 --- 4.50-7.90	7.17 --- 7.17	7.50 --- 7.50	6.70-9.60	7.98	6.99
Magnesium Bicarbonate	---	---	---	---	---	---	---	--	--	5.62-8.97 5.62-8.50 7.80-8.97	7.30 6.90 8.36	6.25 6.00 8.30	---	---	---
Calcium Bicarbonate	---	---	---	---	---	---	---	--	--	---	---	---	---	---	---

Table 7. Statistical Comparison of pH with chemical characteristic of thermal water by province. (Continued)

PROVINCE	PENINSULAR RANGES (Including LA Basin)			COLORADO DESERT			MOJAVE DESERT			BASIN RANGE		
CHARACTERISTIC OF THERMAL WATER	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN
Sodium Chloride	7.10-9.80	8.15	7.00	4.64-9.50	7.71	7.84	7.20-9.00	7.78	7.49	7.20-9.31	8.20	7.99
Sodium Bicarbonate	7.30-10.10	8.67	7.67	7.60-9.20	8.27	8.49	7.60-7.90	7.75	7.45	2.20-9.32	7.59	6.77
Sodium Sulfate	7.00-9.30	7.90	7.45	7.50-7.70	7.63	7.70	7.60-9.20	8.33	8.50	7.40-9.00	8.16	8.50
Magnesium Bicarbonate	---	---	---	---	---	---	---	--	--	---	---	---
Calcium Bicarbonate	7.10-8.40	7.60	7.49	---	---	---	---	--	--	---	---	---

Table 8. Statistical comparison of total dissolved solids (in mg/L) with chemical characteristic of thermal water by province.

PROVINCE	SIERRA NEVADA			CASCADE RANGE			MODOC PLATEAU			COAST RANGES			TRANSVERSE RANGES		
CHARACTERISTIC OF THERMAL WATER	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	KEY {ALL COAST RANGES NORTHERN RANGES SOUTHERN RANGES} RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDANM
Sodium Chloride	300–1550	893	875	270–20,490	4,932	10,380	---	---	---	440–34,350 610–34,350 440–16,090	8,225 10,617 4,238	2,550 4,001 4,001	---	---	---
Sodium Bicarbonate	125–2000	522	171	---	---	---	---	---	---	165–31,900 280–31,900 165–2,130	2,054 3,694 822	750 901 651	190–730	415	350
Sodium Sulfate	---	---	---	---	---	---	440–1180	784	750	460–26,250 --- 460–26,250	5,804 --- 5,804	1,300 --- 1,300	350–1,680	857	699
Magnesium Bicarbonate	---	---	---	---	---	---	---	--	--	260–2,055 260–2,055 400–950	1,008 1,051 630	583 1,133 450	---	---	---
Calcium Bicarbonate	---	---	---	---	---	---	---	--	--	---	---	---	---	---	---

Table 8. Statistical comparison of total dissolved solids (in mg/L) with chemical characteristic of thermal water by province. (Continued)

PROVINCE	PENINSULAR RANGES (Including LA Basin)			COLORADO DESERT			MOJAVE DESERT			BASIN RANGE		
CHARACTERISTIC OF THERMAL WATER	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN
Sodium Chloride	310–7,725	1,487	967	280–399,900	20,118	1,790	320–4,540	1,459	1,200	198–53,450	8,602	1,500
Sodium Bicarbonate	100–4,350	683	225	170–2,330	1,119	1,075	180–3,010	902	399	200–91,800	3,836	850
Sodium Sulfate	300–940	1,160	950	1,865–15,240	7,605	8,553	450–21,340	3,821	1,000	220–3,040	999	863
Magnesium Bicarbonate	---	---	---	---	---	---	---	--	--	---	---	---
Calcium Bicarbonate	300–600	407	350	---	---	---	---	--	--	---	---	---

waters have low total dissolved solids. Only one type of thermal water, sodium-chloride type[1], is present in the Cascade Range province, which has high to very high content of total dissolved solids. In the Modoc Plateau province also, only one type of thermal water, sodium-sulfate type, is present, which has low content of total dissolved solids. The Coast Ranges province has four types of thermal waters: sodium-chloride type, sodium-bicarbonate type, sodium-sulfate type, and magnesium-bicarbonate type. The sodium-chloride[2] and sodium-sulfate[3] types have medium to high content of total dissolved solids; sodium-bicarbonate[4] has low to medium content of total dissolved solids and magnesium-bicarbonate has low content of total dissolved solids. In the Transverse Ranges province, there are two types of thermal waters: sodium-bicarbonate and sodium-sulfate, both have low content of total dissolved solids. The Peninsular Ranges province has four types of thermal waters: sodium-chloride, sodium-bicarbonate, sodium-sulfate, and calcium-bicarbonate types. The sodium-chloride and sodium-sulfate types of waters have low to medium content of total dissolved solids; sodium-and calcium-bicarbonate types of waters have low content of total dissolved solids. The Colorado Desert, Mojave Desert, and Basin and Range provinces have three types of thermal waters: sodium-chloride, sodium-bicarbonate, and sodium-sulfate types. In the Colorado Desert province, the sodium-chloride[5] type has medium to very high content of total dissolved solids; the sodium-bicarbonate type has medium content of total dissolved solids; and the sodium-sulfate type has high content of total dissolved solids. In the Mojave Desert province, the sodium-chloride type has medium content of total dissolved solids; the sodium-bicarbonate type has low content of total dissolved solids; and the sodium-sulfate[6] type has medium to high content of total dissolved solids. In the Basin and Range province, the sodium-chloride[7] type also has medium to high content of total dissolved solids; and the sodium-bicarbonate[8] type has low to high content of total dissolved solids; and the sodium-sulfate type has low content of total dissolved solids.

SUMMARY OF INFORMATION ON CHEMISTRY OF THERMAL WATERS

1. *Chemical Characteristics*

a. The Colorado Desert, the Cascade Range, and the Mojave Desert provinces have the highest proportions of the sodium-chloride type of thermal waters.
b. The Sierra Nevada and the Basin and Range provinces have the highest proportions of the sodium-bicarbonate type of thermal waters.
c. The Modoc Plateau province has the highest proportion of the sodium-sulfate type of thermal waters.
d. The Transverse Ranges province has sodium-bicarbonate and sodium-sulfate types of thermal waters in equal proportions.
e. The Transverse Ranges and the Coast Ranges provinces have sodium-bicarbonate type of thermal waters in comparable proportions.
f. The Coast Ranges and the Peninsular Ranges provinces have more or less comparable proportions of the sodium-chloride and the sodium-bicarbonate type of thermal waters.

2. *Boron*

a. Statewide, the sodium-chloride type of thermal waters has the highest boron content, followed by the sodium-bicarbonate and the sodium-sulfate types of thermal waters.
b. High boron content is found mainly in the thermal waters of the Cascade Range, the Coast Ranges, and the Colorado Desert provinces.
c. Medium boron content is found in the thermal waters of the Basin and Range province.
d. Low boron content is found in the thermal waters of the Sierra Nevada, Modoc Plateau, Transverse Ranges, Peninsular Ranges, and Mojave Desert provinces.
e. The sodium-chloride and the sodium-bicarbonate types of thermal waters in the Coast Ranges province have the highest boron content.

3. *Temperature*

(It is important to note that comments in this section refer to statistical comparisons and not to individual well or spring temperature such as those in the Colorado Desert province, which may be very high.)

a. Statewide, the sodium-chloride type of thermal waters is the hottest along with the sodium-sulfate types.
b. High temperatures are found in the thermal waters of the Cascade Range and the Modoc Plateau provinces.
c. Moderately warm to very high temperatures are found in the thermal waters of the Sierra Nevada, the Colorado Desert, and the Basin and Range provinces.
d. Moderately warm temperatures are found in the thermal waters of the Transverse Ranges province.
e. Warm to moderately warm temperatures are found in the Coast Ranges, the Peninsular Ranges, and the Mojave Desert provinces.
f. The sodium-chloride type of thermal waters in the Cascade Range and the Basin and Range provinces are higher in temperature; in the Sierra Nevada and the

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[1] 83% (5 samples) of the analyses have a range of 270-4540 mg/L TDS and only 1 sample (17%) has 20490 mg/L TDS. Because of this very high value, the mean is 4932 as opposed to 10380 median. The mean and median of the range 270-4540 are 2578 and 1875 mg/L TDS.

[2] 50% (16 samples) of the analyses have a range of 3170-34350 mg/L TDS, and 50% (16 samples) have 440-2610 mg/L TDS. Considering these two ranges as separate populations, the mean and median in the first range are 15161 and 13001, and the same in the second range are 1288 and 901 mg/L TDS respectively.

[3] 83% (5 samples) of the analyses have a range of 460-3055 mg/L TDS, and only 1 sample (17%) has 26250 mg/L TDS. Because of this very high value, the mean is 5804 as opposed to 1300 median. The mean and median of the range 460-3055 are 1715 and 751 mg/L TDS.

[4] 12% (5 samples) of the analyses have a range of 4820-31900 mg/L TDS, and 88% (38 samples) have 165-2660 mg/L TDS. Considering these two ranges as separate populations, the mean and median in the first range are 10006 and 4750, and the same in the second range are 860 and 501 mg/L TDS respectively.

[5] 6% (6 samples) of the analyses have a range of 153430-399900 mg/L TDS; 26% (26 samples) have 3090-93270 mg/L TDS; and 68% (69 samples) have 280-2850 mg/L TDS. Considering these three ranges as separate populations, the mean and median in the first range are 266027 and 225001; in the second, they are 12720 and 4501; and in the third, they are 1522 and 1411 mg/L TDS respectively.

[6] 86% (6 samples) of the analyses have a range of 450-1520 mg/L TDS and only 1 sample (14%) has 21340 mg/L TDS. Because of this very high value, the mean is 3821 as opposed to 1000 median. The mean and median of the range 450-1520 are 902 and 801 mg/L TDS.

[7] 27% (3 samples) of the analyses have a range of 10980-53450 mg/L TDS and 73% (8 samples) have 198-2150 mg/L TDS. Considering these two ranges as separate populations, the mean and median in the first range are 28510 and 15000; and in the second 1137 and 751 mg/L TDS respectively.

[8] 14% (5 samples) of the analyses have a range of 3010-5460 mg/L TDS; 33% (12 samples) have 1000-1930 mg/L TDS; 50% (18 samples) have 200-965 mg/L TDS; and 1 sample (3%) has 91800 mg/L TDS. Considering all these ranges as separate populations, the mean and median in the first range are 4115 and 3276; and for the second and third ranges are 1372 and 1051, and 513 and 351 mg/L TDS respectively.

Colorado Desert provinces temperatures are moderately warm to high; in the Coast Ranges, the Peninsular Ranges, and the Mojave Desert provinces temperatures are warm to moderately warm.

g. The sodium-bicarbonate type of thermal waters in all the provinces is moderately warm in temperature.

h. The sodium-sulfate type of thermal waters is higher in temperature in the Basin and Range and the Modoc Plateau provinces; and moderately warm in the Transverse Ranges, the Mojave Desert, the Peninsular Ranges, and the Coast Ranges provinces.

4. *pH*

a. Statewide, the sodium-chloride type of thermal waters is slightly basic; the sodium-bicarbonate type moderately basic; the sodium-sulfate type slightly to moderately basic; and the magnesium-bicarbonate type slightly acidic to neutral in nature.

b. Neutral to slightly basic sodium-chloride type of thermal waters is present in the Cascade Range, the Coast Ranges, and the Mojave Desert provinces; neutral to moderately basic in the Peninsular Ranges province; slightly basic in the Colorado Desert province; slightly to moderately basic in the Sierra Nevada and the Basin and Range provinces; and moderately basic in the Transverse Ranges province.

c. Slightly acidic to neutral sodium-bicarbonate type of thermal waters is present in the Coast Ranges province; neutral to slightly basic in the Sierra Nevada, the Mojave Desert, and the Basin Range provinces; slightly to moderately basic in the Peninsular Ranges province; and moderately basic in the Transverse Ranges and the Colorado Desert provinces.

d. Neutral sodium-sulfate type of thermal waters is present in the Coast Ranges province; neutral to slightly basic in the Transverse Ranges province; slightly basic in the Peninsular Ranges province; slightly basic to moderately basic in the Modoc Plateau province; and moderately basic in the Colorado Desert, the Mojave Desert, and the Basin and Range provinces.

5. *Total Dissolved Solids*

a. Statewide, the sodium-chloride type of thermal waters has the highest TDS, followed by the sodium-sulfate and the sodium-bicarbonate types of thermal waters.

b. High TDS content is present in the thermal waters of the Colorado Desert province; medium in the Cascade Range, the Coast Ranges, the Mojave Desert, and the Basin and Range provinces; and low in the Sierra Nevada, the Modoc Plateau, the Peninsular Ranges, and the Transverse Ranges provinces.

c. The sodium-sulfate type of thermal waters in the Colorado Desert province has the highest TDS content.

d. The sodium-chloride and the sodium-sulfate types of thermal waters in the Coast Ranges have medium to high TDS content.

e. The sodium-chloride type of thermal waters in the Cascade Range, the Colorado Desert, and the Mojave Desert provinces has medium TDS content.

f. The sodium-bicarbonate type of thermal waters in the Colorado Desert province has medium TDS content.

g. The sodium-chloride type of thermal waters in the Peninsular Ranges and the Basin and Range provinces, the sodium-bicarbonate type in the Coast Ranges and Basin and Range provinces, and the sodium-sulfate type in the Peninsular Ranges have low to moderate TDS content.

h. The sodium-chloride type of thermal waters in the Sierra Nevada province, the sodium-bicarbonate type in the Sierra Nevada, the Transverse Ranges, Peninsular Ranges, and the Mojave Desert provinces, and the sodium-sulfate type in the Modoc Plateau, the Transverse Ranges, the Mojave Desert, and Basin and Range provinces have low TDS content.

In conclusion, although these general findings concerning the provincial distribution of thermal water types seem to hold up, based in many instances on meager evidence, there are exceptions. Other factors, such as depth of percolating water and local rock type, are much more influential in the determination of the specific character of water than the province relationships that are shown. At this time, the evidence does not appear conclusive as to the regional significance of the water characteristics described. These records reflect their existance and may serve as a guide to geothermal resource areas with waters having specific characteristics. Subsequent observations may clarify the influence of local lithology and other factors on water chemistry.

CONCLUSIONS

The "Technical Map of the Geothermal Resources of California" has brought together for the first time, in a single source, statewide information on the geochemistry of geothermal resources and the relationship of the resource occurrences to young volcanic rocks and faulting, as well as to geomorphic/geothermal provincial distribution. The materials presented are a compilation of data from a number of sources and for this reason do not provide new discoveries or a breakthrough, but rather tend to emphasize what is known. For example, it has been shown that higher temperature geothermal waters are most frequently associated with higher sodium chloride and boron content. However, area of occurrence and geomorphologic conditions may play the most important role in this association; this is exemplified by the fact that the highest brine content in thermal waters of the state is found in the Imperial Valley, in the Salton Sea geothermal fields, where alternate filling and evaporation in the Salton Sink have left massive accumulations of salt.

The association of geothermal occurrences with young volcanic rocks has long been recognized. Good examples are seen in the proximity of The Geysers geothermal field to the outcrop area of the Clear Lake Volcanic rocks and also in the association of young volcanic rocks with geothermal occurrences at Coso and in the Mono-Long Valley areas. By providing graphic information on the distribution of young volcanic rocks, the technical map is expected to benefit the investigator who is interested in exploration for a new resource using volcanic rocks as a guide. Similarly, faults are often associated with geothermal occurrence, both as a barrier that may help contain a body of geothermal water, and as an avenue along which meteoric waters may circulate into the deeper subsurface to become heated due to the normal temperature gradient of the earth. A good example of a major association of faulting and geothermal occurrence is found along the Surprise Valley fault in northeastern California. By providing a display of fault distribution throughout the state, the map is expected to benefit the investigator with information on where to prospect for additional geothermal resources, as well as to provide information on the fault association that may be responsible for a known geothermal occurrence.

Much statewide information on the estimation of subsurface temperature using various geothermometers is brought together and presented here for the first time. Although data of this type can be highly useful in providing an idea of the maximum temperature that may be available at depth in a given resource area (as opposed to usually lower temperatures measured at the surface), caution must be used until the temperature data can be corroborated by actual drilling into the resource. However, the geothermometry data presented in Table 2 should provide the investigator with some new ideas as to the elevated temperatures that may be available at depth in many areas of the state—temperatures that may suggest that a resource, previously considered to be too cool for a proposed use, is in fact a viable resource for the purpose. Thus many of the state's "lower temperature geothermal resource areas" may now warrant a reexamination to determine whether or not they should be placed in a higher temperature category.

Useful information has been developed and is presented in the preceding sections devoted to thermal water chemistry relationships and the provincial distribution of the water types. Examples of uses to which this information may be put are many: boron is an element to which many plants are sensitive; if the end use of cascaded thermal waters for a prospective project is to be for agriculture, then the developer would be wise to consider utilization of resources in provinces where boron content is shown to be low, such as the Sierra Nevada, Modoc Plateau, Transverse Ranges, Peninsular Ranges, or Mojave Desert.

The information presented here on geomorphic/geothermal provinces represents a "first cut" effort. It is believed that extensive additional work using computer techniques, perhaps with added information from non-thermal wells, may provide a much more detailed and clear picture of geothermal provinces and their relationship to geomorphic provinces and other parameters. An effort of this type is highly recommended.

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