

Bieber Area

All hot springs in the Bieber area exhibit a basic pH(7.2-8.7), moderate concentrations of fluoride (1.7-2.9 ppm), chloride (42-52 ppm) and sulphate (700-860 ppm). These levels are generally characteristic of hot water systems. Sodium is present at expected concentrations (180-220 ppm) while potassium is present at almost background levels (7 ppm) indicating absorption in valley sediments during transit. Lithium concentrations range from 9 to 13 times that of background lithium but are still not significant enough to indicate a magmatic fluid contribution.

The very low concentrations of magnesium (0.1 to 0.6 ppm) qualitatively indicates high subsurface equilibrium temperatures. Equilibrium temperatures by the silica method range from 90° to 95°C and are probably quite conservative on account of dilution effects. The Na/K equilibrium temperatures are not considered reliable because of the very low potassium concentrations already mentioned. Na-K-Ca equilibrium temperatures range from 180°C to 260°C.

Discussion

The chemical composition of samples taken from the Livermore property do not reflect deep subsurface conditions but rather very shallow conditions. Livermore Warm Spring (X89558) contains the largest thermal-chemical component and is probably derived in part from a ground water conductive heating zone above the capping horizon. The remaining springs appear to be almost entirely meteoric in origin. Further sampling over a broader area utilizing the volatile substances generally found in geothermal steam (B, NH₃, H₂S, CO₂) and age dating of water will lend a better understanding of the Livermore prospect.

The Bieber area appears in the context of this preliminary study to be a potentially interesting source of hot water of reasonable quality. Further sampling including age dating should indicate the capacity and extent of the reservoir underlying Big Valley. Also, analysis of the volatile elements and gases from bubbling springs may indicate the existence of a steam reservoir at depth.

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Sample DescriptionLivermore Area

- X89558 - Livermore Warm Spring
- Water issues from bedding crack in gray sandy limestone.
 - Said to flow year round; in winter, steam visible over adjacent pool.
 - Very mild sulphurous odor, bitter taste, colorless
 - Discharge about 2 l/m
 - Temperature 21°C - 12/11/73
 - 24°C - 2/15/74 by A. Lange
- X89559 - Caldera Spring
- Water issues from crack in brown volcanic rock; many such cracks are present often filled with white to tan siliceous material.
 - Odorless, tasteless and colorless
 - Said to flow year round
 - Discharge about 2 l/m
 - Temperature = 18°C, - 12-11-73
- X89560 - Leaf Spring
- Water issues out of soil and fills small pool about 1 foot square; pool filled with soil, green algae, and leaves
 - Odorless, tasteless and colorless
 - Discharge about 4 l/m
 - Temperature = 18°C - 12/11/73
- X89561 - Van Ness Creek
- Taken as control
 - Sampled about 40 feet from Leaf Spring (X89560)
- X89562 - Creek Bank Spring
- Issues from brown volcanic rock (appears similar to that mentioned for Caldera Spring (X89559))
 - Odorless, colorless, tasteless
 - Discharge is about 2 l/m
 - Temperature = 15°C - 12/11/73

- X89563 - Livermore Drinking Spring
- Issues into bottom of 10 foot by 5 foot brickwork pool
 - Used by Livermores for drinking water
 - Odorless, colorless and tasteless
 - Discharge is about 25 l/m
 - Temperature = 12.5°C - 12/11/73

- X89570 - Anderson Spring
- Water issues from redish-brown travertine in small canyon, SE of Signal Oil Geothermal Field
 - Sulpherous odor, bitter taste, light orange color.
 - Pool (5'x5') lined with red gelatinous material.
 - Some elementary sulphur
 - Discharge is about 5 l/m
 - Temperature = 33°C - 12/13/73

Bieber Area

- X89564 - Bassett Hot Spring
- Issues out of S.S. and fills warm pond about 50 feet by 25 feet.
 - Much white and yellowish salt, some elemental sulphur
 - Strong sulpherous odor
 - Vigorous bubbling locally
 - Water used for heating Packwoods home (\$1.50 per month), watering cattle.
 - Many Indian artifacts found in pool bottom
 - Discharge about 750 l/m
 - Temperature = 81.5°C - 12/12/73
78°C - 2/16/74

owned by Gerrald Packwood
Rt. 229
Bieber, California

- X89565 - Kellog Hot Spring West
- Water issues in bottom of cement pool (6 foot diameter, 9 foot depth).
 - Much salt present (white and yellow)
 - Strong sulpherous odor
 - Bubbling locally
 - Adjacent to old spa
 - Discharge about 750 l/m
 - Temperature = 77.5°C - 12/12/73
88°C - 2/16/74

- X89566 - Kellog Hot Spring East
- Water issues out of valley fill to supply two pools about 20 feet in diameter.
 - Sulpherous odor
 - Bubbling locally
 - Discharge about 750 l/m
 - Temperature = 58°C - 12/12/73
 - 61°C - 2/16/74
- X89567 - Richman Spring
- Taken as control
 - Water issues out of iron pipe
 - Used to water cattle
 - Discharge about 2 l/m
 - Temperature = 11°C - 12/12/73
- X89568 - Vestal Warm Spring
- Issues into bottom of large pond bordered on southern side by cattle pens and on the east by Cenozoic Basalt Ridge.
 - Salt on basalt near water line near point of inflow.
 - Sample should show contamination and extreme dilution
 - Discharge is unknown
 - Temperature = 17°C - 12/12/73
- owned by family of June Vestal, MacArthur, California
- X89569 - Little Hot Spring
- Water issues out of pool (10 feet square) in meadow at base of basalt ridge.
 - Strong sulpherous odor.
 - Vigorous bubbling locally
 - Seen steaming from road
 - Discharge about 100 l/m
 - Temperature = 71°C - 12/12/73

TABLE 1

Chemical Analyses, Calculated Ratios and Subsurface Temperatures for Samples

from the Livermore property, Anderson Spring, and the Bieber area

	LIVERMORE						BIEBER AREA						
	Livermore Warm Spring X89558 21°C	Caldera Spring X89559 18°C	Leaf Spring X89560 16°C	Van Ness Creek Water (Control) X89561 8.5°C	Creek Bank Spring X89562 15°C	Livermore Drinking Spring X89563 12.5°C	Anderson Spring X89570 33°C	Bassett Hot Spring X89564 81.5°C	Kellog Hot Spring West X89565 88°C	Kellog Hot Spring East X89566 61°C	Richman Spring (Control) X89567 11°C	Vestal Warm Spring X89568 17°C	Little Hot Spring X89569 71°C
Spring Temperature °C	21°C	18°C	16°C	8.5°C	15°C	12.5°C	33°C	81.5°C	88°C	61°C	11°C	17°C	71°C
pH	8.0	7.8	7.6	7.3	8.0	7.2	6.9	8.7	8.5	8.4	8.0	7.2	7.7
F (ppm)	0.20	0.13	0.10	< 0.10	< 0.10	< 0.10	0.17	2.1	2.8	2.9	0.10	0.13	1.7
Cl (ppm)	< 10	< 10	< 10	< 10	< 10	< 10	< 10	42	52	52	< 10	< 10	43
SO ₄ (ppm)	3	3	3	5	5	5	200	750	860	810	3	3	700
CaCO ₃ (ppm)	260	250	200	50	280	70	280	90	80	90	430	220	100
Na (ppm)	35	18	15	3	27	6	19	175	190	220	15	14	180
K (ppm)	3	3	3	2	5	3	5	4	7	7	5	4	7
SiO ₂ (ppm)	34	34	74	11	34	24	22	30	40	43	36	34	40
Ca (ppm)	4.4	11.8	9.4	2.8	9.8	3.0	42.0	22.4	22.2	23.4	22.9	8.0	35.2
Mg (ppm)	0.5	2.1	3.0	1.3	1.5	1.3	6.0	0.2	< 0.1	< 0.1	9.8	6.3	0.6
Li (ppm)	0.1	0.1	0.1	< 0.1	0.1	< 0.1	1.2	0.8	0.9	1.0	< 0.1	< 0.1	1.3
Zn (ppm)	0.1	0.2	0.2	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.1	0.1	0.1	< 0.1	< 0.1
Mo (ppb)	< 1	< 1	< 1	1	1	< 1	< 1	35	40	60	< 1	1	35
Cu (ppb)	< 1	1	4	2	< 1	3	< 1	< 1	< 1	2	< 1	< 1	< 1
Fe (ppb)	< 100	< 100	200	< 100	400	< 100	400	< 100	< 100	< 100	< 100	< 100	200
Mn (ppb)	< 10	< 10	< 10	< 10	< 10	< 10	90	< 10	< 10	< 10	< 10	< 10	< 10
TSiO ₂ °C	70°C	70°C	112°C		70°C	-	-	-	90°C	95°C		70°C	90°C
Na/K (atomic)	19.8	10.2	8.5		9.2	3.4	6.5	74.4	46.1	53.4		6.0	43.7
TNa/K °C	168°C	243°C	290°C		275°C	-	325°C	-	104°C	94°C		-	106°C
Na-K-Ca	1.17	1.04	0.97		0.92	0.62	0.92	0.99	0.80	0.88		0.81	1.42
TNa-K-Ca °C	220°C	230°C	240°C		245°C	290°C	245°C	237°C	260°C	248°C		258°C	180°C
Cl/F (atomic)	< 26	< 41	< 53		-	-	< 31	11	9.9	9.6		< 41	13
Na/Mg (atomic)	74	9.1	5.3		19.1	4.9	3.4	927	> 2014	> 2332		2.4	318
Na/Ca (atomic)	14	2.7	2.8		4.8	3.5	0.8	14	15	16		3.0	8.8