



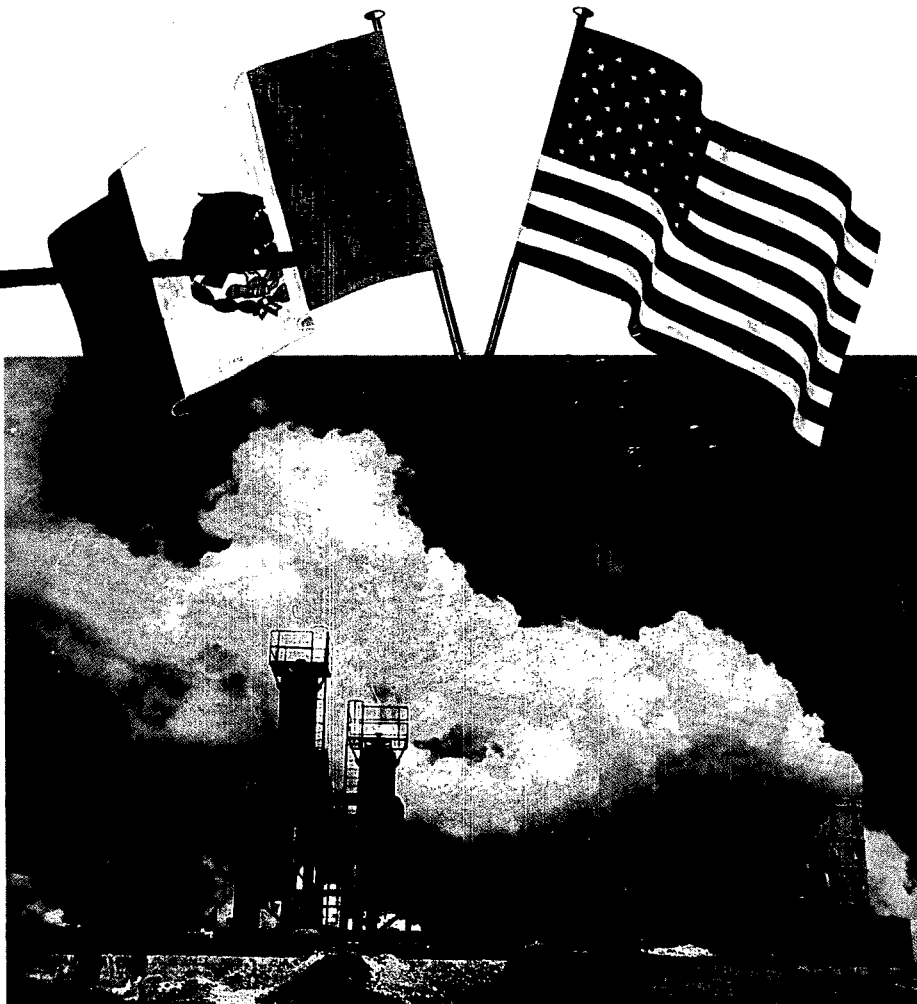
**CUARTO SIMPOSIO
SOBRE EL CAMPO GEOTERMICO DE CERRO PRIETO
BAJA CALIFORNIA, MEXICO**



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TRACE ELEMENT AND ISOTOPIC CHEMISTRY OF THE SURFICIAL HYDROTHERMAL WATERS
IN THE CERRO PRIETO GEOTHERMAL FIELD, MEXICO.

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EXTENDED ABSTRACT

In the Cerro Prieto Geothermal Field, five kinds of surface emissions were discovered ~~1-2-3~~ spring, mud pot, geysers, fumarole, and cool pool.

The major element composition of the 163 fluid samples collected in 1979, was previously performed.

This study ~~has been~~ recently completed by a determination of trace element concentrations, deuterium and oxygen isotope ratios (Tab. 1).

This geochemical analysis shows, as the major elements do, that each type of surficial emission is characterized by its own unique chemistry.

Hot Spring: Hot spring are characterized by high Ba (14.5 mg/l), Al (27 pg/l), Zn (0.005 ug/l), V (0.3 ug/l). Deuterium and oxygen isotope ratios are as low as - 7.65% for $\delta^{18}O$ and - 94% for δD .

Mud Pot: In this category, values equal to 42 mg/l are frequent for Sr; 8 mg/l for B, 0.44 mg/l for Mn, 62 ug/l for Al and 4.5 ug/l for Cu are also very common. The isotopic ratios are often about - 7.05% for $\delta^{18}O$ and - 86% for δD for the fluid sampled in the Mud Pot.

Geyser: High contents in SiO_2 (205 mg/l), Fe (36 mg/l), Al (32 mg/l), Cu (22 ug/l), Zn (233 ug/l) and V (41 ug/l) are characteristics. This kind of emission presents the higher isotopic ratios of all the surface emissions: about - 3.07% for $\delta^{18}O$ and - 64.5% for δD .

Cool Pool: These emissions are characterized by high values in SiO_2 (ma = 320 mg/l), B (ma = 110 mg/l) Fe (max = 1468 mg/l) and Mn (max=1790 mg/l) and low concentration in Ba (0.5 mg/l). The isotopic ratios are generally close to - 66% for δD and -2.50% for $\delta^{18}O$.

Fumaroles: They presents concentrations in Mn as high as 3.67 ug/l, Al close to 1758 ug/l and V of about 7.70 ug/l.

As proposed previously, each category of surface emission appears to result from different processes; trace chemistry as well as isotope composition confirm the various origins of the different surface hydrothermal fluid.

LIMITED REFERENCES

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2. Mercado, S., 1968, Localización de zonas de máxima actividad hidrotermal por medio de proporciones químicas, Campo Geotérmico de Cerro Prieto, México Tercer Congreso Mexicano de Química, México, Sociedad Mexicana de Química Pura y Aplicada, 32 p.
3. Valette, J. N., and Esquer Patiño, I. Geochemistry of the surface emission in the Cerro Prieto geothermal field in Proceedings, Second Symposium on the Cerro Prieto, Mexicali, Baja California, México, October 17-19, 1979, p. 241-250.

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Table 1. Trace element and isotopic compositions of surface emission hydrothermal fluids.

Sample	SiO ₂	B	Ba	Sr	Al ³⁺	Fe	Mn	Cu ²⁺	Zn ²⁺	V ⁵⁺	Rb	Cs	F	δD	δO ¹⁸
N1	116	2	0.8	2.6	32	0.82	0.72	4	0	2.25	1.96	4.8	1.9	-76.0	-7.15
N2	103	24	8.0	40.0	141	0.93	0.96	4	144	0.55	-	-	-	-88.0	-7.15
N3	91	20	1.0	27.0	77	3.40	0.34	5	1	1.17	-	-	-	-92.5	-7.45
N3b	97	20	0.8	22.0	205	1.63	3.10	2	4	1.26	-	-	-	-	-
N4	104	22	6.0	28.0	105	2.40	2.0	6	16	1.43	4.47	1.11	1.5	-92.5	-7.45
N5	200	2	0.5	3.4	93510	53.00	1.76	12	300	171.00	-	-	-	-68.0	-3.70
N6	148	37	0.8	37.0	76141	89.00	2.50	81	725	116.00	-	-	-	-69.0	-2.50
N7	86	85	4.3	>120	246	2.40	3.72	2	1	1.54	-	-	-	-60.5	-2.60
N8	70	75	4.6	32.0	27	0.49	1.34	3	4	1.67	-	-	-	-89.0	-7.65
9	-	-	-	-	62	-	0.14	-	-	3.87	-	-	-	-	-
9bis	32	-	-	-	57	0.79	0.01	-	-	16.30	-	-	-	-	-
9ter	124	-	-	-	75	2.34	2.00	-	-	2.20	-	-	-	-	-
10-473	130	17	3.7	21.0	30	0.78	0.44	3	2	1.40	-	-	-	-	-
11	157	20	4.0	33.0	62	0.65	1.32	9	9	0.71	-	-	-	-94.5	-8.60
12POOL	285	20	0.5	14.0	67907	52.50	13	20	1922	60.00	-	-	-	-86.0	-8.85
12 M P	285	8	-	-	126466	185	11	-	-	135.00	-	-	-	-94.5	-10.50
13	131	110	1.5	>120	28234	26.60	6.11	4	192	37.00	-	-	-	-35.5	+5.75
14	248	27	1.0	43.0	57338	40.20	1.78	8	290	100.00	-	-	-	-66.5	-2.25
15	190	61	0.7	105.0	87378	66.70	7.42	4	600	102.00	-	-	-	-51.0	+0.80
16	46	72	1.3	>120	1481	9.38	2.25	26	75	6.10	-	-	-	-23.0	+2.85
17	133	21	0.7	31.0	45	0.65	4.00	4	16	4.00	-	-	-	-	-
18	231	50	0.8	48.0	922890	701.00	32.3	26	2900	1340.00	-	-	-	-45.0	+1.15
19	81	47	1.6	72	57.5	1.4	4.60	2	9	3.10	-	-	-	-92.5	-5.15
19 M P	18	-	-	-	104	0.12	0.64	-	-	4.27	-	-	-	-	-
20	89	21	2.5	15	43	0.34	0.26	8.5	9	3.43	-	-	-	-94.0	-8.70
21 M P	30	-	-	-	-	0.20	0.04	-	-	-	-	-	-	-	-
22	117	16	1.2	17	79.5	0.35	0.86	15	4	2.61	-	-	-	-93.5	-5.80
23	59	19	1.0	24	63	0.50	0.82	8	2	1.22	-	-	-	-95.5	-8.40
24	76	-	-	-	36	0.45	1.36	-	-	1.43	-	-	-	-	-
25	200	19	0.8	26	10354	6.20	1.21	45	62	15.60	-	-	-	-64.0	-1.15
26	121.5	18	3.5	16	46	0.18	0.04	6	6	1.02	2.20	0.4	0.39	-97.0	-8.50
27	108	16	4.7	14	47	0.50	1.24	6	9	0.28	2.2	1.4	1.10	-94.0	-8.30
28	82	19	1.7	17	45	0.22	1.02	89	236	0.30	-	-	-	-	-
29	73	19	3.0	17	34	0.35	0.08	4	2	4.05	2.3	1.4	1.4	-93.5	-7.85
30	137	18	2.7	12	38	0.41	0.11	27	32	0.31	2.8	1.8	1.2	-96.5	-9.30
31	173.5	-	-	-	29	0.63	0.42	<0.10	4	0.11	2.9	0.6	1.3	-	-
32A	264	75	1.5	84	282369	134.00	12.50	7	957	172	-	-	-	-31.5	+5.90
32B	-	-	-	-	126	-	22.21	3	970	2.41	-	-	-	-	-
33	320	-	-	-	-	1468.00	31.20	-	-	-	-	-	-	-	-
34	267	28	1.4	27	2583	38.8	2.58	11	47	11.93	-	-	-	-55.5	+0.55
35	260	56	2.7	96	48.5	1.61	3.40	6	2	5.75	-	-	-	-35.0	+3.35
36	116	5	1.0	<0.1	1471	3.71	0.40	3	23	7.90	-	-	-	-61.0	+2.55
37 M P	23	-	-	-	54	1.15	0.44	-	-	12.14	-	-	-	-66.0	+0.05
38B	185	-	-	-	153	111.0	4.08	-	-	2.74	-	-	-	-86.0	-7.05
38A	66	-	-	-	8145	1.49	0.15	-	-	8.65	-	-	-	-	-
39	25	-	-	-	57	0.52	0.26	-	-	4.34	-	-	-	-	-
40	147	13	0.6	13	29024	11.80	1.30	201	144	24	-	-	-	-96.5	-10.35
41	40	-	-	-	57	0.19	0.16	-	-	2.40	-	-	-	-93.5	-9.35
42	39	-	-	-	31744	4.04	0.45	-	-	153	-	-	-	-122.5	-14.50
43	77	15	3.1	13	32	0.74	0.21	9	3	0.46	-	-	-	-94.0	-9.50
44	228	36	0.8	23	171468	54.30	20.38	12	606	33	-	-	-	-51.0	+1.35
45	221	5.0	0.6	<0.1	50570	3.53	0.15	9	145	31	-	-	-	-95.0	-2.70
46	190	15	0.7	12	12781	141.0	2.52	21	422	79	-	-	-	-59.5	-5.45
47	261	30	0.8	44	83538	68.30	0.92	67	537	51	-	-	-	-69.0	-3.45
48	117	5	0.6	<0.1	125	1.26	0.18	14	32	2.10	-	-	-	-50.5	+5.40
49	192	18	1.6	17	4616	6.70	0.98	34	59	2.10	-	-	-	-88.0	-6.85
50B	143	-	-	-	102	0.54	0.50	-	-	0.32	-	-	-	-97.5	-9.10
50N	125	-	-	-	47	1.35	0.56	-	-	0.44	-	-	-	-	-
51V	101	27	2.3	21	96	0.71	0.14	8	13	2.2	-	-	-	-94.0	-7.95
51B	101	-	-	-	42	0.71	0.09	1	12	1.6	-	-	-	-	-
52S	110	14	1.3	4.4	72	0.95	0.98	23	81	0.86	-	-	-	-82.5	-3.45
52 M P	-	-	-	-	3597	-	3.24	-	-	12	-	-	-	-	-
53	75	13	1.1	11.0	55	0.54	1.94	59	237	1.15	-	-	-	-102.0	-11.0
A-54	266	8	0.8	11.0	61826	492	1790	297	1935	829	-	-	-	-73.5	-3.45
55-101	122	13	6.4	13.0	67.5	0.97	0.52	4	9	0.76	-	-	-	-94.0	-7.85
60	204	12	9.1	16.0	204	0.36	0.35	2	7	1.02	-	-	-	-97.5	-5.60
61	160	15	14.5	22.0	4616	3.83	1.04	7	38	0.35	-	-	-	-97.0	-9.80
Ni - Cr <0.10 mg/l ; Trace element values in mg/l ; * Values in µg/l ; δD δO ¹⁸ ‰															