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Reconnaissance survey of helium in soil gas in the eastern half of the Richfield, Utah 1°x2° quadrangle

By

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A reconnaissance survey of helium in soil gas was conducted October 11-13, 1979 in the eastern half of the Richfield 1°x2° quadrangle, Utah. This survey was made in support of several investigations of the geology and mineral resources in the Richfield quadrangle being made by the U.S. Geological Survey and others. One hundred sixteen samples were collected with the greatest sample density near Beaver, Utah where other investigations (Cunningham and Steven, 1979) have indicated a possibly high potential for the occurrence of uranium deposits. Sample spacing averaged one sample every 120 km^2 except near Beaver, where sample spacing averaged one sample every 10 km^2. This report presents the data from the survey.

Samples were collected from a 1 meter depth using hollow steel probes driven into the ground (Reimer and Bowles, 1979), and analyzed with the U.S. Geological Survey's mobile helium analyzer (Reimer, 1976) within 6 hours of the time they were collected. All samples were collected from within 50 m of roads or trails. A map showing the sample numbers and localities is presented in figure 1. Analyzed helium values are shown in table 1. Figure 2 is a contour map derived by averaging all values within a radius of 6 km from a specified grid point (Reimer and Dean, 1979).

Elsewhere, positive helium anomalies have been found associated with structural features (Reimer, 1979), oil and gas deposits (Roberts and others, 1976), geothermal reservoirs (Denton, 1977), as well as uranium deposits (Reimer and others, 1979). Helium soil gas concentrations, to a large extent, are a reflection of the helium concentration in ground water (Reimer and

Figure 1. Map showing location of soil-gas samples collected in the Richfield 1°x2° quadrangle, Utah. All samples were collected within 50-m of roads.

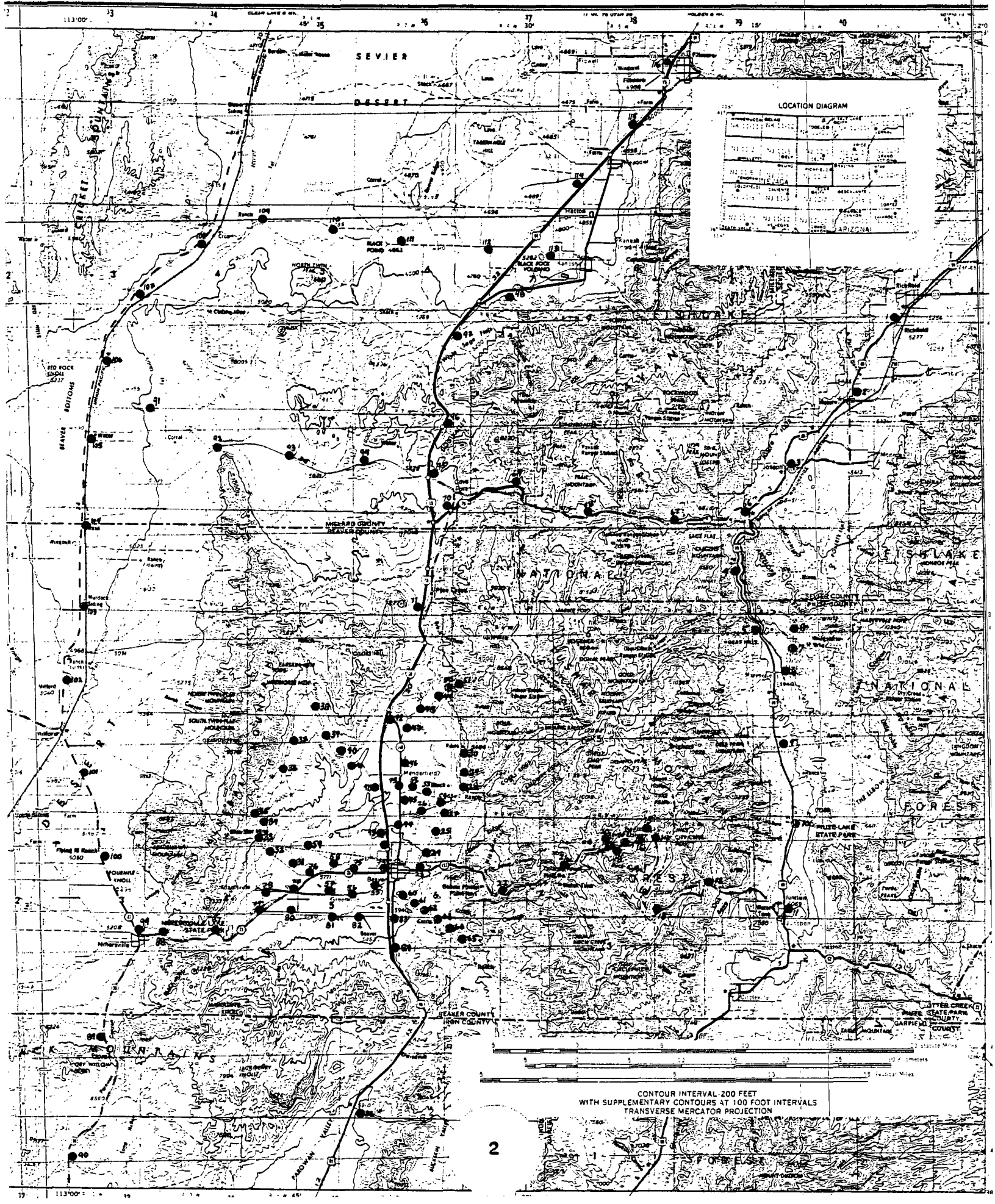

Table 1. Helium concentrations of soil-gas samples collected in the eastern part of the Richfield $1^{o}x2^{o}$ quadrangle, Utah. Sample numbers are keyed to the localities shown in figure 1. The helium concentrations are in parts per billion (ppb) with respect to the base line helium concentration of ambient air (5240 ppb).

Sample No.	Helium (in ppb)	Sample No.	Helium (in ppb)	Sample No.	Helium (in ppb)
1	40	41	20	81	110
2	20	42	60	82	75
3	40	43	20	83	87
4	30	44	48	84	75
5	-90	45	20	85	43
6	30	46	65	86	65
7	0	47	20	87	107
8	0	48	20	88	76
9	-33	49	20	89	38
10	40	50	20	90	66
11	0	51	20	91	76
12	20	52	10	92	40
13	20	53	20	93	30
14	0	54	65	94	40
15	0	55	10	95	0
16	0	56	-20	96	0
17	0	57	0	97	38
18	0	58	20	98	40
19	40	59	20	99	76
20	0	60	20	100	76
21	20	61	20	101	38
22	-20	62	20	102	81
23	20	63	40	103	70
24	20	64	20	104	39
25	19	65	-60	105	36
26	43	66	100	106	60
27	-22	67	100	107	36
28	10	68	56	108	36
29	0	69	45	109	73
30	0	70	90	110	95
31	37	71	45	111	95
32	100	72	22	112	32
33	70	73	45	113	63
34	46	74	105	114	42
35	0	75	85	115	32
36	20	76	64	116	32
37	80	77	64		
38	60	78	43		
39	46	79	75		
40	40	80	130		

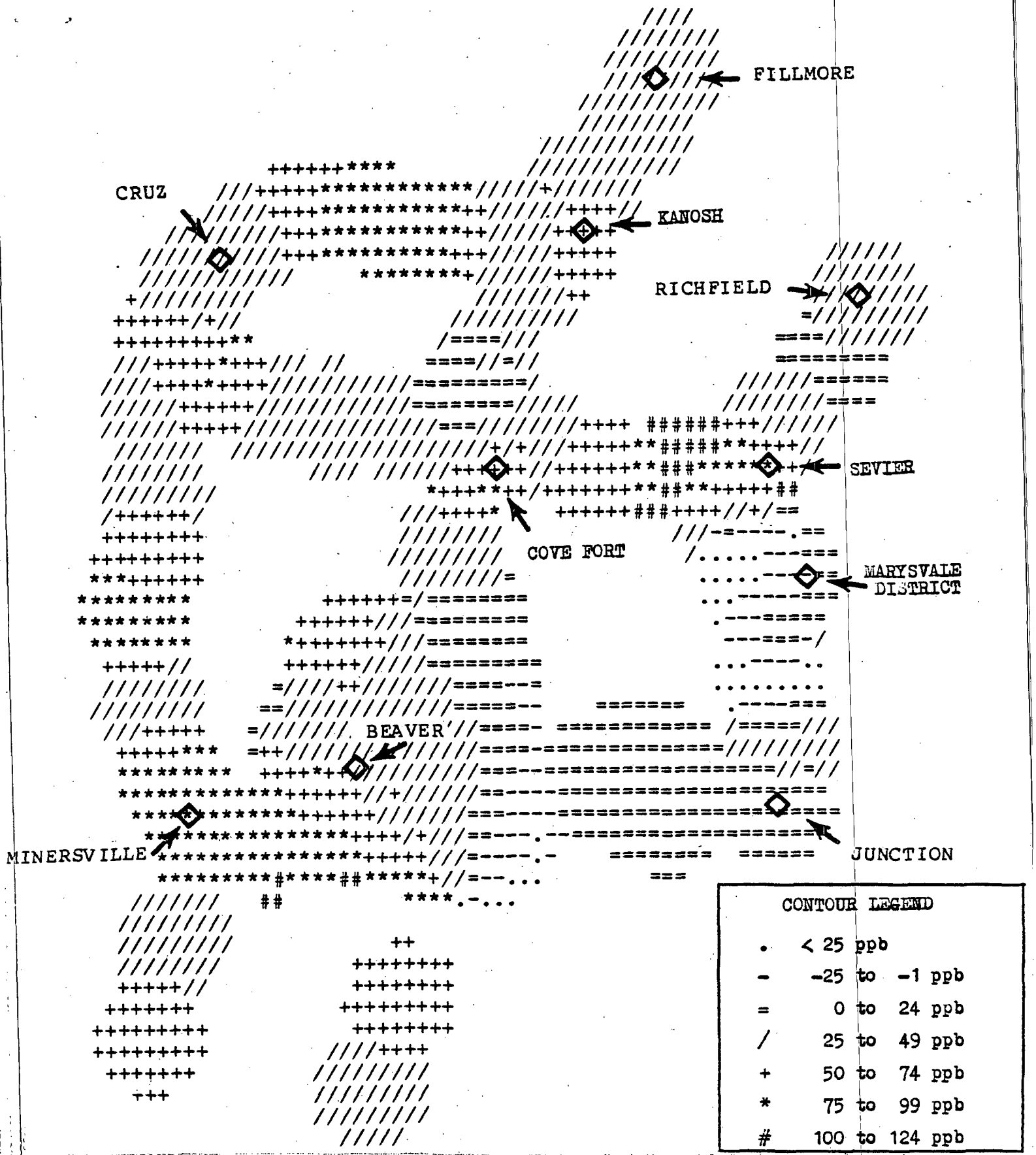

Figure 2. Map of the helium soil-gas concentrations for the eastern part of the Richfield, $1^{o}x2^{o}$ quadrangle, Utah. The various symbols on this generalized computer printout represent a contour interval of 25 ppb. The areas of highest helium concentration are represented by * and #. Approximate locations of towns are marked by diamonds (◇).

others, 1979), which, in turn, can indicate the flow pattern of ground water as well as its content of uranium.

The distribution of helium concentrations found in this study are not unlike the concentrations found in other reconnaissance studies for the western U.S. (Reimer, 1979). The highest concentrations for the Richfield survey, which are considered anomalous compared to the background average, are found in 3 areas (fig. 1): (1) mid-way on a traverse between Cruz and Kanosh; (2) immediately west of Sevier and east of Cove Fort on a traverse between those locations; and (3) in a grouping west-southwest of Beaver. There was no noticeable helium anomaly for the few samples collected near the Marysvale uranium mines.

Beaver Valley is a typical structural depression near the eastern margin of the Basin-Range province. It is filled by several thousand feet of fluviatile and lacustrine sediments, and is nearly surrounded by bedrock mountains. Both surface and underground water drain west and southwest toward an outlet at Minersville Canyon between the Mineral Mountains and the Black Mountains. There is a bedrock sill at shallow depths beneath this outlet and the Beaver Valley area upstream is a closed structural basin. Cunningham and Steven (1979) pointed out that the fill in this basin was derived in part from uranium-bearing igneous rocks in the surrounding uplands, and that a good potential exists for sandstone-type uranium deposits within this fill.

The highest concentrations of soil-gas helium found in the Beaver Valley were west and southwest of Beaver, toward the hydrologic outlet for both surface and ground water. The same area also contains the highest ground water uranium concentrations (<20 ppb) found during a recent survey of a limited number of samples (J. K. Otton, U.S. Geological Survey, personal communication, 1979). These high uranium and high helium concentrations are consistent with

the model of present day surface and ground water flow in that direction, and also with the suggestion that anomalous concentrations of uranium may occur in the basin fill of the valley (Cunningham and Steven, 1979). Detailed geological investigations by the U.S. Geological Survey are already underway to check this potential. Preliminary geochemical investigations have been made, but more detailed search for indicators of oxidizing or reducing conditions, as well as investigations of the overall water chemistry, could help greatly in pinpointing exploration targets.

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