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GEOLOGICAL SURVEY

A Hydrogeochemical Survey in East-Central Nevada

by

J. B. McHugh, W. R. Miller,

and W. H. Ficklin

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CONTENTS

ILLUSTRATIONS

TABLES

ABSTRACT

A hydrogeochemical survey utilizing waters from springs and wells was conducted in east-central Nevada. None of the trace elements commonly associated with mineralization were found to be highly anomalous in the study area. Slightly anomalous values for some elements were found in the southern valleys of the study area and in a few scattered areas that contained old mines. Data from this study revealed no new areas of significant mineralization.

INTRODUCTION

The U.S. Geological Survey's Mineral Assessment Program for the Richfield, Utah 1° x 2° quadrangle presented the possibility of beryllium, molybdenum, and tin mineralization associated with Tertiary rhyolites (Motooka and others, 1979; Miller and others, 1980; McHugh and others, 1981). The Wilson Creek Range and White Rock Mountains, Nev., adjacent to the Richfield 1° x 2° quadrangle, are underlain by Tertiary volcanic rock, which may be similar to the mineralized areas in the Richfield quadrangle. To evaluate this area for potential mineralization, a hydrogeochemical survey was conducted, using samples of water from various springs and wells in the study area. The use of water for geochemical exploration will vary, depending on the geological and geochemical environment, climates, and types of expected mineralization. Review papers that describe the use of water for geochemical exploration include Boyle and others (1971), Cameron (1978), Dyck (1979), and Miller (1979).

Fifty water samples were collected in the study area from forty-four springs and six wells during June of 1982. The analytical results for these samples and a discussion are given in this report.

STUDY AREA

The study area, which includes the Wilson Creek Range and White Rock Mountains, is located in east-central Nevada and a small part of adjacent Utah (fig. 1). The area is in the eastern part of the Great Basin section of the Basin and Range physiographic province. A geologic map with explanation of the study area (Ekren and others, 1977) is shown in figure 2. The Wilson Creek Range, which makes up the west side, and the White Rock Mountains on the east side of the study area, are predominately Tertiary volcanic rocks, but with some sandstones and shales of Paleozoic and Tertiary age. The Spring, Eagle, Rose, and Dry valleys make up the central and southern part of the study area. These valleys are mainly lacustrine and alluvium deposits of Tertiary and Quaternary age.

The flow of most ground water and surface water within the study area is generally toward the south to the Colorado River, except on the northern and eastern margins where the flow is into Hamlin Valley.

The Tertiary and Quaternary alluvium sediments of the central and southern valleys yield small to moderate supplies of water to wells, whereas the younger Quaternary flood-plain alluvium sediments of the center of these valleys yield moderate to large supplies of water to wells (Rush, 1964). The Paleozoic sedimentary and Tertiary volcanic rocks of Wilson Creek Range and White Rock Mountains yield only a small amount of water to numerous springs, which at times dry up in the summer (Rush, 1964).

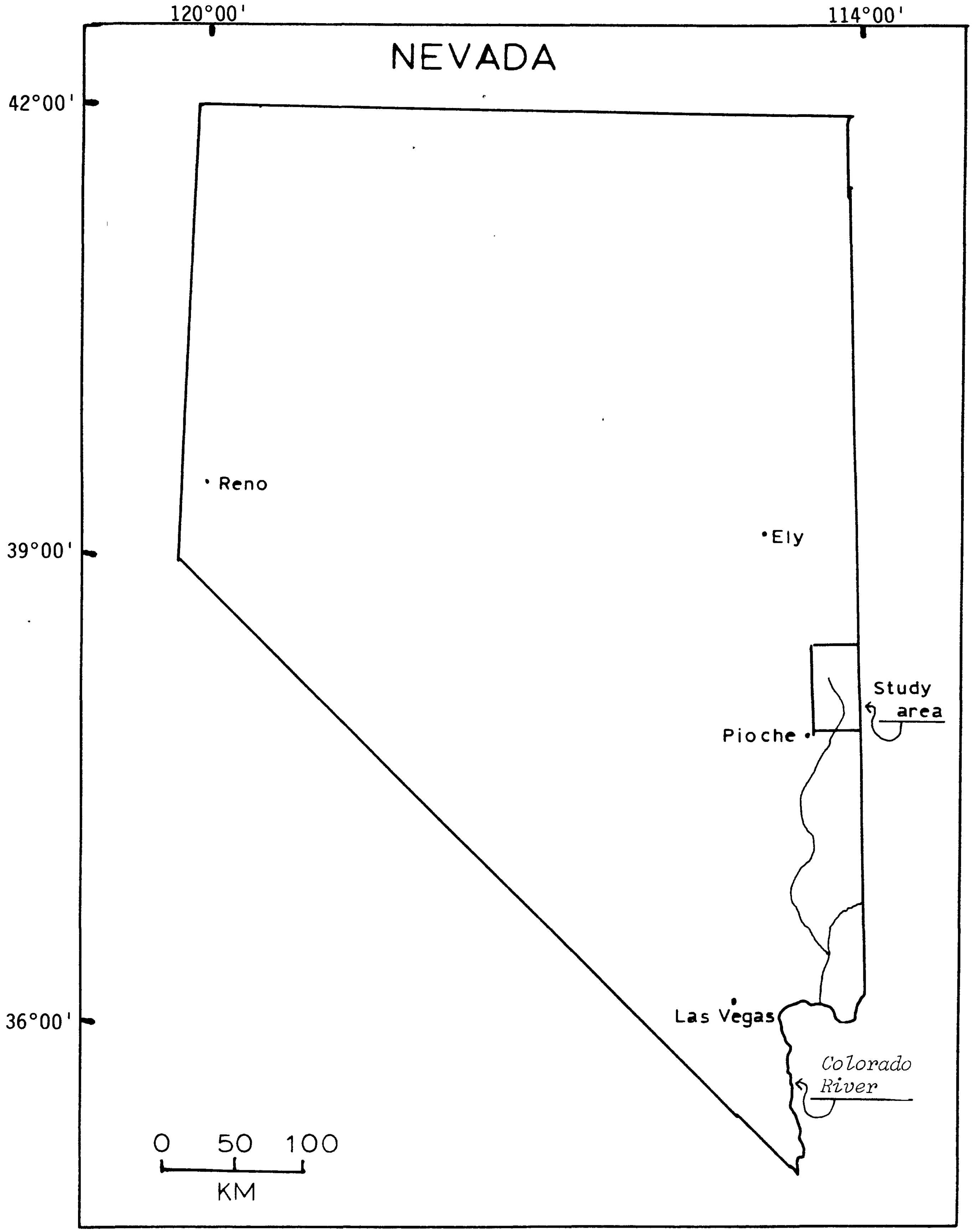

Figure 1. Index map of study area

Most of the spring localities that were sampled lie on or near major fault zones or contact zones, whereas the six well localities occur in the Quaternary deposits (fig. 2).

Elevations of the central and southern valleys ranges from 5,200 feet to 6,200 feet, with an average annual precipitation of 6 to 12 inches. Elevations of Wilson Creek and White Rock Mountains ranges from 7,000 feet to 9,200 feet, with an average annual precipitation range from 10 to 20 inches (Rush, 1964).

SAMPLE COLLECTION AND ANALYTICAL METHODS

Water samples were collected from 50 localities within the study area, forty-four from springs and six from wells (table 1). At each locality, a 60-mL sample was collected and filtered through a 0.45-μm membrane filter and acidified with reagent-grade concentrated nitric acid to pH <2. An untreated 500-mL sample was also collected. The samples were stored in acid-rinsed polyethylene bottles.

Water temperature and pH were measured at each sample site. The chemical analyses were completed at the U.S. Geological Survey laboratory in Denver, Colo. Alkalinity, specific conductance, sulfate, chloride, fluoride, nitrate, bromide, and uranium were determined using the untreated samples. Calcium, magnesium, sodium, potassium, silica, lithium, zinc, copper, molybdenum, silver, arsenic, iron, manganese, and aluminum were determined using the 0.45-μm filtered and acidified samples. The analytical methods used for these determinations are shown in table 2.

RESULTS AND DISCUSSION

Forty-four samples were collected from springs, and six samples were collected from irrigation wells located in the four valleys of the study area (fig. 3). The analytical results are shown in table 3. A summary of statistical parameters for the chemical analyses is shown in table 4. Correlation coefficients of the logarithm (base 10) of concentration of ions are shown in table 5. Many pairs of significant correlations are present. A Q-mode factor analysis was not applied to the water data and no interpretation was made based on the Q-mode factor analysis.

The results of the charge balance of the cations and anions for the 50 samples are shown in table 3. Ionic solutions are electrically neutral. Therefore, accuracy of analyses can be checked by comparing the sums of the charges for cations against anions. Thirty-six of the samples are within 5 percent, seven within 10 percent, and the remaining seven within 13 percent.

Highest concentration of dissolved salts in the study area, as measured by specific conductance at 25°C, occurs in the southern part of the study area (fig. 4), and may be due to evaporative effects and(or) the concentration of salts by irrigation. Samples 16, 17, 19, and 20 are from irrigation wells in Rose, Dry, and Eagle valleys, respectively, and have conductance values of 880, 650, 660, and 690 μmhos/Cm, respectively.

High-sulfate values can indicate areas of weathering sulfides particularly pyrite, evaporite deposits, or concentrations of sulfate in water by evaporation or irrigation. The concentration of sulfate in waters in the study area ranges from 3.1 to 62 mg/L (table 4) and has a geometric mean of 9.34 mg/L. The

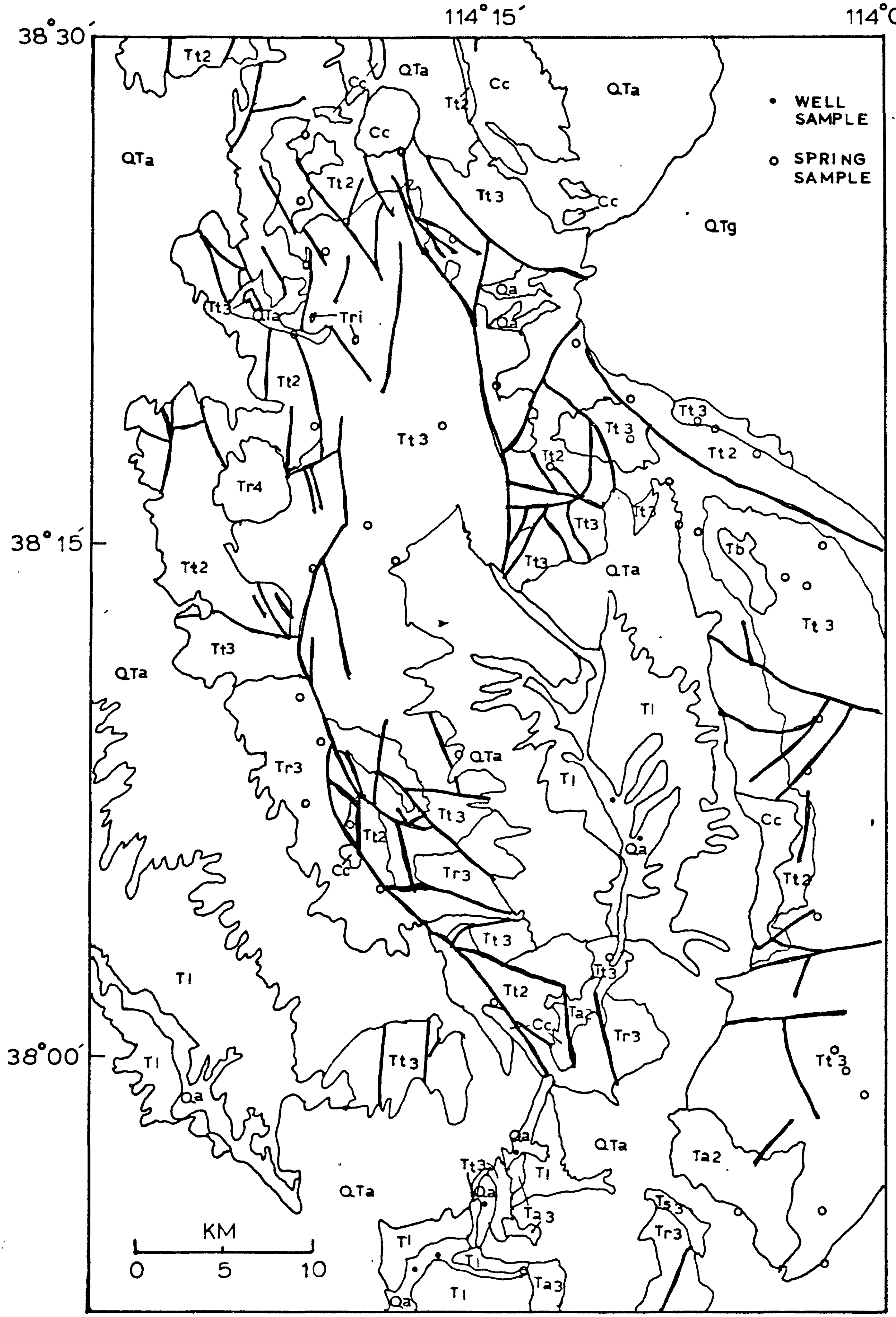

Figure 2. GEOLOGIC MAP OF STUDY AREA

Figure 2.--Map explanation

Symbol	Age	Description
Qa	Quaternary	Alluvium, stream sands and gravels, including lake-bed deposits
QTa	Quaternary to Pliocene	Alluvium, older stream sands and gravels
QTg	Quaternary to Miocene	Weakly cemented older gravels
Tl	Pliocene to Miocene	Older lake-bed deposits, siltstone, sandstones, and mudstones
Tb	Miocene	Basalt flows
Tr4	Miocene	Younger rhyolite lavas
Tr3	Miocene	Older rhyolite lavas
Tri	Miocene to Oligocene	Rhyolite plugs and dikes
Tt3	Miocene	Middle ash-flow tuffs
Ta3	Miocene	Intermediate lavas ranging from basaltic andesite to quartz latite
Ts3	Miocene	Bedded tuff, reworked rhyolite and quartz latite
Tt2	Oligocene	Oldest welded tuffs
Ta2	Oligocene	Altered andesite and dacite lava
Cc	Devonian to Cambrian	Sedimentary rocks, limestone, dolomite, shale, and siltstone

TABLE 1.--Sample source of 50 water samples, east-central Nevada

Sample No.	Source of Sample
NEV 1	Spring feed creek at the Hermitage
2	Whiskey Spring
3	Spring feed creek from Alexander and Gleason Basin
4	Ripgut Spring
5	White Rock Cabin Spring
6	Lake Spring
7	Log Cabin Spring
8	Mud Spring, Utah
9	Spring in Chokecherry Creek
10	Spring in Rice Canyon
11	Spring in Johnny Canyon
12	Morman Gulch Spring
13	Gold Spring
14	Spring Diefendorf Ranch
15	Spring in Deer Lodge Canyon
16	Irrigation well in Rose Valley
17	Irrigation well in Dry Valley
18	Spring in Flatnose Wash
19	Irrigation well in Dry Valley
20	Irrigation well in Eagle Valley
21	Spring in Spring Valley
22	White Rock Well
23	White Rock Well No. 1
24	Big Jack Ranch Spring
25	Horsethief Spring

TABLE 1. (Continued)

Sample No.	Source of Sample
NEV 26	Coal Burner Spring
27	Lower Tower Spring
28	Open pit Mine Seep
29	Bailey Spring
30	Spring near Winz Creek
31	White Rock-Bailey Spring
32	Silver Park Spring
33	Bradshaw Spring
34	Spring in Rosencrans Creek
35	Spring in Winz Creek
36	Blue Rock Spring
37	Spring in Hulse Canyon
38	Frenchman Spring
39	Tunnel Spring
40	Spring in Pine Creek
41	Little White Rock Spring
42	Parsnip Spring
43	Spring in Burnt Canyon
44	Spring in Miller Canyon
45	Spring in Miller Creek
46	Rattlesnake Spring
47	South Monumental Spring
48	Lion Spring
49	Mud Spring Nevada
50	Spring in Cobb Creek

Table 2. --Analytical methods used for water analysis, east-central Nevada.

Constituent	Method	Reference
Alkalinity	Gran's plot potentiometric titration	Orion Research, Inc. (1975).
Sulfate	Ion chromatography	Fishman and Pyen, (1979).
Chloride	---do	Do.
Fluoride	---do	Do.
Nitrate	---do	Do.
Bromide	---do	Do.
Calcium	Flame atomic absorption spectrophotometry	Perkin-Elmer Corp. (1976).
Magnesium	---do	Do.
Sodium	---do	Do.
Potassium	---do	Do.
Lithium	---do	Do.
Silica	---do	Do.
Zinc	---do	Do.
Copper	Flameless atomic absorption spectrophotometry	Perkin-Elmer Corp. (1977).
Silver	---do	Do.
Molybdenum	---do	Do.
Arsenic	---do	Do.
Iron	---do	Do.
Manganese	---do	Do.
Aluminum	---do	Do.
Uranium	Laser-excited fluorescence	Scintrex Corp. (1978).
Specific conductance	Conductivity bridge	Brown, Skougstad, and Fishman (1970) p. 28-29.

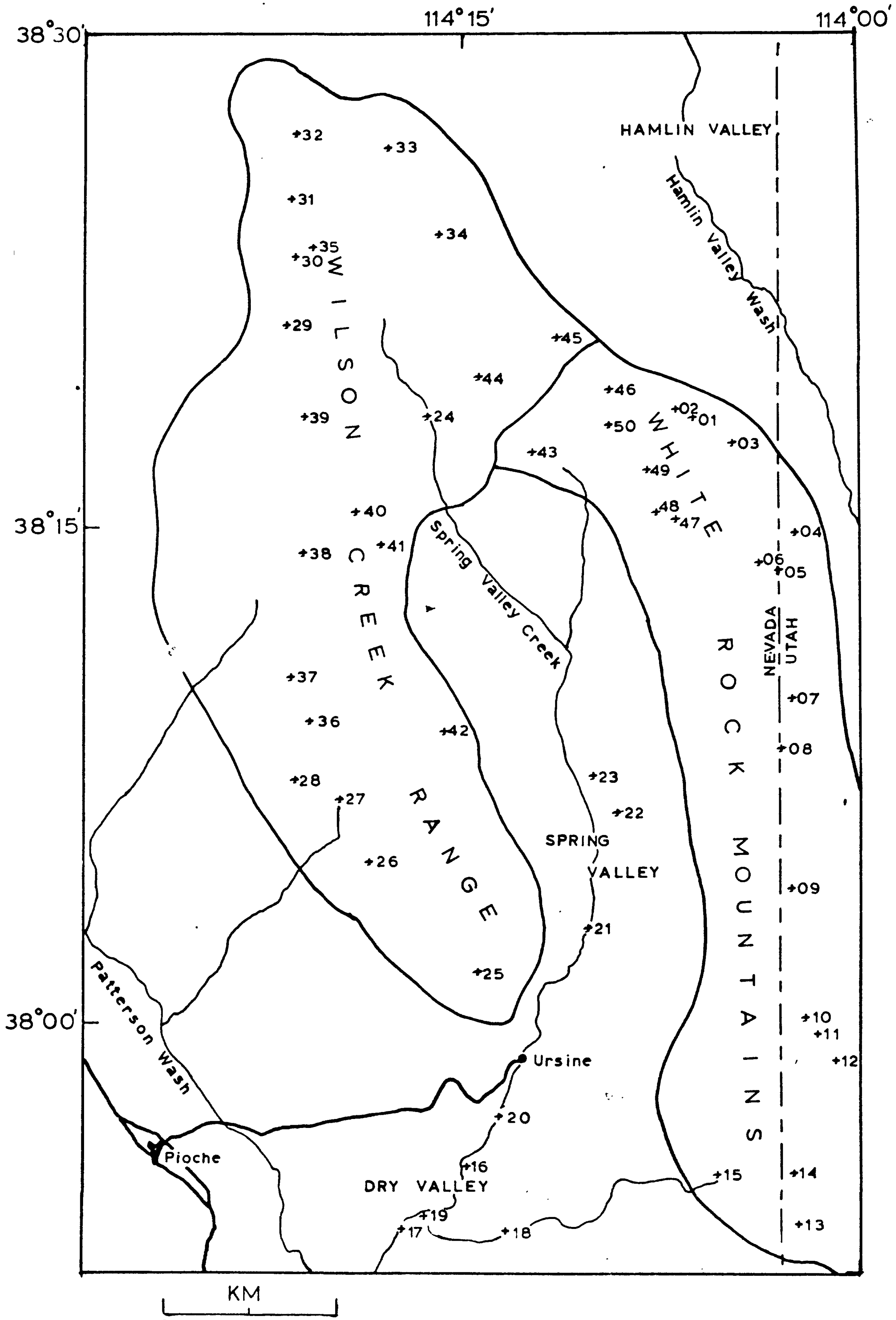

Figure 3. SAMPLE LOCATION MAP, EAST-CENTRAL NEVADA
(Prefix NEV omitted)

Table 3.--- CHEMICAL ANALYSES OF WATER SAMPLES, EAST CENTRAL NEVADA

Sample	latitude	longtude	CA(mg/L)	MG(mg/L)	NA(mg/L)	K(mg/L)	LI(ug/L)	SIO2(mg/L)	ALK(mg/L)	SO4(mg/L)
NEV01	38 18 24	114 6 17	74	17.0	32.0	2.10	32	52	357	10.0
NEV02	38 18 39	114 6 58	52	4.7	22.0	1.70	18	40	199	5.8
NEV03	38 17 37	114 4 46	27	5.3	12.0	2.40	18	41	102	7.5
NEV04	38 14 53	114 2 20	25	4.4	18.0	7.50	16	60	114	4.2
NEV05	38 13 45	114 2 59	19	3.3	12.0	4.30	15	54	83	3.1
NEV06	38 13 59	114 3 45	20	4.6	9.2	1.30	12	19	72	4.1
NEV07	38 9 52	114 2 28	45	5.5	22.0	2.70	24	67	158	9.1
NEV08	38 8 20	114 2 54	13	7.1	17.0	.07	20	25	75	6.7
NEV09	38 4 7	114 2 31	71	13.0	20.0	.54	18	21	280	17.0
NEV10	38 0 12	114 1 58	37	6.9	11.0	2.00	17	22	138	11.0
NEV11	37 59 42	114 1 31	12	2.9	7.8	1.50	16	21	48	6.1
NEV12	37 58 54	114 0 50	15	2.9	7.9	2.20	20	27	52	7.6
NEV13	37 53 56	114 2 16	50	8.4	14.0	1.60	18	30	195	11.0
NEV14	37 55 30	114 2 27	30	5.0	13.0	2.20	25	30	112	7.9
NEV15	37 55 27	114 5 25	87	14.0	17.0	1.50	42	26	310	29.0
NEV16	37 55 43	114 15 5	127	17.0	59.0	11.00	47	59	463	62.0
NEV17	37 53 50	114 17 37	86	12.0	47.0	8.90	45	60	290	15.0
NEV18	37 53 47	114 13 35	26	3.5	37.0	5.60	65	58	148	14.0
NEV19	37 54 13	114 16 45	78	12.0	58.0	10.00	41	54	328	22.0
NEV20	37 57 14	114 13 51	93	15.0	45.0	8.40	30	52	381	27.0
NEV21	38 2 56	114 10 25	44	3.9	18.0	5.20	15	65	158	7.3
NEV22	38 6 26	114 9 17	31	5.3	18.0	3.40	22	62	118	7.3
NEV23	38 7 33	114 10 13	67	9.6	20.0	4.10	46	56	204	16.0
NEV24	38 18 27	114 16 36	36	5.9	15.0	1.60	22	37	129	5.3
NEV25	38 1 36	114 14 39	55	7.5	17.0	.96	15	48	212	10.0
NEV26	38 4 58	114 18 53	64	15.0	25.0	1.20	15	56	295	14.0
NEV27	38 6 51	114 20 1	39	7.6	20.0	3.10	16	42	162	12.0
NEV28	38 7 26	114 21 44	18	3.1	17.0	1.80	10	78	96	5.5
NEV29	38 21 12	114 22 4	42	7.9	17.0	1.50	20	32	123	15.0
NEV30	38 23 16	114 21 43	30	6.0	25.0	6.50	18	64	146	9.0
NEV31	38 25 1	114 21 53	32	5.9	28.0	9.10	20	63	147	9.8
NEV32	38 26 59	114 21 42	58	9.2	28.0	4.40	25	50	257	15.0
NEV33	38 26 34	114 18 8	58	11.0	27.0	2.20	26	39	228	14.0
NEV34	38 23 57	114 16 9	39	7.4	15.0	1.00	20	28	167	8.6
NEV35	38 23 33	114 21 3	50	11.0	27.0	3.50	28	43	241	10.0
NEV36	38 9 13	114 21 9	21	4.7	9.0	3.50	8	55	83	3.5
NEV37	38 10 33	114 21 53	20	4.2	9.2	3.30	8	39	57	11.0
NEV38	38 14 18	114 21 24	14	3.0	7.9	.74	7	28	49	5.5
NEV39	38 18 26	114 21 21	49	8.7	19.0	1.40	18	30	182	10.0
NEV40	38 15 33	114 19 23	27	2.5	14.0	1.70	12	31	112	3.8
NEV41	38 14 33	114 18 24	33	7.5	12.0	3.50	12	53	136	6.5
NEV42	38 8 53	114 15 57	14	2.4	11.0	2.10	8	37	51	5.2
NEV43	38 17 22	114 12 31	43	8.2	9.0	.21	14	39	178	5.6
NEV44	38 19 39	114 14 36	46	9.7	21.0	1.10	15	40	199	11.0
NEV45	38 20 50	114 11 35	51	9.2	24.0	.70	26	41	216	9.7

Table 3. CHEMICAL ANALYSES OF WATER SAMPLES, EAST CENTRAL NEVADA—continued

Sample	CL(mg/L)	F(mg/L)	NO3(mg/L	BR(mg/L)	ZN(ug/L)	CU(ug/L)	MO(ug/L)	AG(ug/L)	AS(ug/L)
NEV01	15.00	.38	<.10	.19	7	4	2	<.01	8.9
NEV02	14.00	.14	3.20	<.10	4	2	<1	.01	2.8
NEV03	8.70	.13	<.10	.10	2	2	<1	.01	1.7
NEV04	12.00	.16	<.10	<.10	2	2	1	<.01	2.8
NEV05	6.40	.10	<.10	<.10	3	2	<1	.01	1.7
NEV06	6.90	.17	<.10	<.10	1	2	<1	<.01	<1.0
NEV07	25.00	.16	<.10	.23	2	2	<1	.01	1.4
NEV08	7.00	.18	<.10	.10	3	3	1	.01	2.2
NEV09	13.00	.21	<.10	.10	3	2	<1	.01	<1.0
NEV10	.70	.20	<.10	<.10	3	2	1	.01	<1.0
NEV11	3.00	.22	<.10	<.10	2	8	<1	.01	<1.0
NEV12	3.20	<.10	<.10	.15	4	3	<1	<.01	<1.0
NEV13	9.40	.35	<.10	.24	3	2	1	.01	1.2
NEV14	.12	.39	<.10	<.10	2	2	1	.01	1.0
NEV15	11.00	.69	<.10	.10	20	2	2	.01	1.6
NEV16	58.00	.64	<.10	.30	11	2	5	.01	3.1
NEV17	66.00	.58	2.00	.25	118	2	3	.01	2.6
NEV18	.03	1.20	2.30	<.10	12	1	3	<.01	3.9
NEV19	48.00	.71	9.60	.48	6	2	6	.02	2.2
NEV20	50.00	<.10	<.10	.45	7	1	4	.01	2.1
NEV21	15.00	.22	4.30	<.10	5	1	2	.01	1.4
NEV22	11.00	<.10	<.10	.21	15	3	2	.01	1.7
NEV23	49.00	<.10	<.10	.44	95	4	3	.01	1.3
NEV24	16.00	.66	2.30	.10	21	1	1	.01	<1.0
NEV25	14.00	.77	1.90	.10	12	2	<1	.01	1.2
NEV26	16.00	.24	.35	.10	12	2	1	<.01	3.5
NEV27	15.00	.26	<.10	<.10	6	2	1	.02	2.9
NEV28	1.40	.57	<.10	<.10	4	3	3	.01	4.7
NEV29	32.00	1.80	4.60	.15	7	2	2	.02	3.6
NEV30	17.00	.16	3.80	.26	7	2	1	.01	4.8
NEV31	24.00	.12	1.90	.10	5	2	1	.01	4.0
NEV32	17.00	.33	<.10	.11	4	2	9	.02	24.0
NEV33	29.00	.31	8.70	.15	5	2	1	.01	4.8
NEV34	9.40	.24	<.10	<.10	4	2	<1	.01	3.4
NEV35	18.00	.41	.25	<.10	3	2	1	.01	7.8
NEV36	5.70	.14	<.10	<.10	4	2	<1	.01	1.9
NEV37	6.50	.13	7.20	<.10	3	2	<1	<.01	2.3
NEV38	3.70	.11	<.10	<.10	4	1	<1	.01	1.7
NEV39	19.00	.24	2.60	.10	7	1	<1	.02	2.7
NEV40	5.30	.12	2.70	<.10	2	2	<1	.01	2.3
NEV41	11.00	.27	4.80	.15	4	1	<1	<.01	4.1
NEV42	4.70	.10	.74	<.10	6	2	<1	.02	2.0
NEV43	4.80	.11	<.10	<.10	8	2	<1	.01	2.0
NEV44	15.00	.23	<.10	.12	3	2	1	.01	4.7
NEV45	20.00	.29	<.10	<.10	3	2	<1	.01	3.6

Table 3. CHEMICAL ANALYSES OF WATER SAMPLES, EAST CENTRAL NEVADA--continued

Sample	FE(mg/L)	MN(mg/L)	AL(mg/L)	U(ug/L)	SP.COND. (umhos/cm)	pH	TEMP.(C°)	CHAR BAL
NEV01	.04	.12	<.10	2.20	550	8.43	18	.42
NEV02	.01	<.01	<.10	2.40	340	7.90	18	2.00
NEV03	.01	<.01	<.10	.28	200	8.51	14	6.50
NEV04	.01	<.01	<.10	1.60	230	8.06	19	5.70
NEV05	.01	<.01	<.10	1.10	160	7.35	18	7.00
NEV06	.17	<.01	<.10	<.10	160	7.85	21	10.50
NEV07	.03	<.01	<.10	1.30	330	8.55	24	3.30
NEV08	.05	<.01	.12	.68	160	8.04	19	11.40
NEV09	<.01	<.01	<.10	1.30	450	7.92	14	1.80
NEV10	.01	<.01	<.10	.84	250	7.62	12	7.90
NEV11	.46	.02	1.80	.10	100	7.29	18	9.20
NEV12	.59	.01	2.60	.42	110	7.03	14	11.40
NEV13	<.01	<.01	.10	1.60	310	8.28	15	1.80
NEV14	<.01	<.01	<.10	2.60	220	9.09	20	11.20
NEV15	.09	.10	<.10	1.50	500	7.78	18	2.10
NEV16	.02	1.30	<.10	7.00	880	7.87	14	.25
NEV17	.03	<.01	<.10	5.80	650	7.45	13	3.90
NEV18	<.01	<.01	<.10	4.00	290	8.17	25	4.00
NEV19	<.01	<.01	<.10	4.80	660	7.74	10	1.90
NEV20	<.01	.02	<.10	4.20	690	7.70	12	-1.00
NEV21	<.01	<.01	<.10	3.00	300	7.86	15	2.90
NEV22	<.01	<.01	<.10	.68	260	8.25	15	8.50
NEV23	.12	<.01	<.10	4.80	470	8.12	15	.56
NEV24	<.01	<.01	<.10	6.00	260	7.40	15	4.10
NEV25	<.01	<.01	<.10	2.30	360	7.17	15	-.15
NEV26	.01	<.01	<.10	2.50	470	7.35	12	-.23
NEV27	<.01	<.01	<.10	2.50	320	8.34	12	2.30
NEV28	.08	<.01	1.30	.12	160	9.65	24	5.00
NEV29	<.01	<.01	<.10	3.20	330	8.13	17	1.90
NEV30	<.01	<.01	<.10	3.20	290	7.50	15	1.90
NEV31	.01	<.01	<.10	1.60	320	8.32	22	3.00
NEV32	.03	.01	<.10	1.30	430	8.82	22	-.30
NEV33	.03	<.01	<.10	4.00	450	7.75	12	.40
NEV34	.01	<.01	<.10	1.10	280	8.40	13	.75
NEV35	.02	.01	<.10	1.40	410	9.10	18	-.16
NEV36	<.01	<.01	<.10	.12	170	8.34	14	5.90
NEV37	.01	<.01	<.10	.10	170	7.26	10	11.00
NEV38	.01	<.01	<.10	<.10	110	7.43	11	12.10
NEV39	<.01	<.01	<.10	3.00	360	7.20	11	3.20
NEV40	<.01	<.01	<.10	1.60	200	8.64	14	2.20
NEV41	<.01	<.01	<.10	1.20	260	7.43	11	2.10
NEV42	.22	<.01	<.10	.76	130	7.00	12	13.30
NEV43	.01	.01	<.10	1.60	280	7.11	15	.83
NEV44	.01	.01	<.10	3.20	350	8.30	19	.51
NEV45	<.01	<.01	<.10	3.20	380	8.40	19	.62

Table 3. CHEMICAL ANALYSES OF WATER SAMPLES, EAST CENTRAL NEVADA--continued

Sample	latitude	longtude	CA(mg/L)	MG(mg/L)	NA(mg/L)	K(mg/L)	LI(ug/L)	SIO2(mg/L)	ALK(mg/L)	SO4(mg/L)
NEV46	38 19 16	114 9 33	43	4.6	22.0	1.10	14	40	171	5.9
NEV47	38 15 18	114 6 58	27	5.1	14.0	5.60	8	54	107	7.8
NEV48	38 15 31	114 7 44	37	6.8	17.0	3.80	10	49	110	11.0
NEV49	38 16 49	114 8 5	60	11.0	21.0	2.30	18	42	265	12.0
NEV50	38 18 12	114 9 34	43	6.4	16.0	2.40	6	38	160	6.6

Table 3. CHEMICAL ANALYSES OF WATER SAMPLES, EAST CENTRAL NEVADA--continued

Sample	CL(mg/L)	F(mg/L)	NO3(mg/L	BR(mg/L)	ZN(ug/L)	CU(ug/L)	MO(ug/L)	AG(ug/L)	AS(ug/L)
NEV46	15.00	.13	2.60	<.10	3	2	<1	.02	3.2
NEV47	16.00	.10	<.10	<.10	3	1	<1	.01	2.9
NEV48	43.00	.12	<.10	.12	30	1	<1	.01	2.7
NEV49	22.00	.24	.78	.11	5	3	1	.02	8.6
NEV50	25.00	<.10	<.10	.28	4	2	<1	.01	3.4

Table 3. CHEMICAL ANALYSES OF WATER SAMPLES, EAST CENTRAL NEVADA--continued

Sample	FE(mg/L)	MN(mg/L)	AL(mg/L)	U(ug/L)	SP.COND. (umhos/cm)	pH	TEMP.(C°)	CHAR BAL
NEV46	<.01	<.01	<.10	1.80	310	7.86	17	1.70
NEV47	<.01	<.01	<.10	.70	230	8.60	16	3.00
NEV48	<.01	<.01	<.10	2.10	310	7.17	13	-.05
NEV49	.05	.09	<.10	2.00	450	8.66	22	-3.50
NEV50	<.01	.01	<.10	.92	310	8.36	19	-.45

Table 4.--Summary of chemical analyses of 50 water samples, east-central Nevada [Values qualified with < were replaced with seven-tenths of the qualified value in the determination of means, etc.]

Variable	Minimum	Maximum	Mean	Geometric Mean	Standard Deviation	Geometric Deviation
Ca (mg/L)	12.0	127.	43.6	37.7	23.8	1.75
Mg (mg/L)	2.4	17.	7.50	6.59	3.86	1.68
Na (mg/L)	7.8	59.	20.5	18.1	11.6	1.64
K (mg/L)	.07	11.	3.21	2.25	2.66	2.59
Li (µg/L)	6.0	65.	20.8	18.2	12.0	1.69
SiO_2 (mg/L)	19.0	78.	44.0	41.6	14.4	1.42
Alk.(mg/L)	48.0	463.	173.	150.	93.3	1.75
SO_4 (mg/L)	3.1	62.	11.2	9.34	9.07	1.74
Cl (mg/L)	3.0	66.	17.2	10.2	15.3	4.06
F (mg/L)	<0.10	1.8	0.308	0.221	0.315	2.17
NO_3(mg/L)	<0.10	9.6	1.37	0.285	2.29	6.29
Br (mg/L)	<0.10	0.48	0.137	0.113	0.103	1.78
Zn (µg/L	1.0	118.	10.2	5.33	20.7	2.51
Cu (µg/L)	1.0	8.0	2.12	1.94	1.08	1.50
Mo (µg/L)	<1.0	9.0	1.52	1.14	1.59	1.95
Ag (µg/L)	<0.01	0.02	0.011	0.011	0.004	1.36
As (µg/L)	<1.0	24.	3.21	2.38	3.53	2.08
Fe (mg/L)	<0.01	0.59	0.046	0.016	0.108	3.28
Mn (mg/L)	<0.01	1.3	0.040	0.010	0.183	2.63
Al (mg/L)	<0.10	2.6	0.181	0.087	0.458	2.19
U (µg/L)	<.10	7.0	2.10	1.32	1.65	3.30
Sp.Cond	100.	880.	327.	292.	162.	1.63
pH	7.00	9.65	7.97	--.	0.598	--.
Temp (C°)	10.0	25.0	16.0	15.6	3.86	1.27

Table 5. Matrix of correlation coefficients of the log-transformed original data (number of valid pairs are shown below diagonal)

	Ca	Mg	Na	K	Li	Si02	AlK.	S04	Cl	F	N03	Br	Zn	Cu	Mo	Ag	As	Fe	Mn	Al	U	Cond	pH	Temp
Ca	1.00	0.84	0.67	0.30	0.51	0.19	0.92	0.64	0.67	0.29	0.10	0.40	0.32	-0.21	0.40	0.09	0.19	-0.45	0.47	-0.50	0.65	0.92	0.08	-0.11
Mg	50	1.00	0.58	0.19	0.44	0.05	0.86	0.60	0.59	0.23	0.10	0.24	0.25	-0.09	0.22	0.07	0.25	-0.45	0.38	-0.92	0.50	0.84	0.05	-0.15
Na	50	50	1.00	0.62	0.68	0.48	0.80	0.59	0.71	0.36	0.11	0.53	0.28	-0.17	0.56	0.18	0.27	-0.45	0.54	-0.79	0.71	0.85	0.21	0.11
K	50	50	50	1.00	0.33	0.61	0.23	0.33	0.47	0.12	0.29	0.55	0.24	-0.15	0.40	0.07	0.11	-0.04	0.49	0.60	0.30	0.36	0.09	-0.04
Li	50	50	50	50	1.00	0.15	0.62	0.54	0.45	0.52	0.09	0.43	0.40	0.11	0.42	0.00	0.13	-0.06	0.48	-0.08	0.64	0.65	0.11	0.18
Si02	50	50	50	50	50	1.00	0.24	0.13	0.38	0.06	0.01	0.40	0.23	-0.21	0.32	0.04	0.12	-0.42	0.42	-0.03	0.25	0.31	0.20	0.15
AlK.	50	50	50	50	50	50	1.00	0.60	0.59	0.27	-0.01	0.36	0.23	-0.18	0.43	0.08	0.29	-0.50	0.41	-0.73	0.61	0.91	0.18	0.00
S04	50	50	50	50	50	50	50	1.00	0.63	0.44	0.35	0.41	0.26	-0.07	0.50	0.12	0.15	-0.17	0.71	-0.38	0.54	0.83	0.01	-0.17
Cl	50	50	50	50	50	50	50	50	1.00	-0.09	0.18	0.57	0.28	-0.06	0.17	0.17	0.09	-0.32	0.48	-0.65	0.32	0.54	-0.14	-0.30
F	45	45	45	45	45	45	45	45	45	1.00	0.13	0.29	0.27	0.02	0.36	0.16	0.14	0.00	0.51	0.19	0.57	0.50	0.17	0.16
N03	20	20	20	20	20	20	20	20	20	20	1.00	0.54	-0.06	-0.26	0.47	0.00	-0.44	-0.22	1.00	****[1]	0.24	-0.02	-0.27	-0.31
Br	28	28	28	28	28	28	28	28	28	23	12	1.00	0.31	0.17	0.36	0.08	-0.23	0.08	0.34	-0.05	0.42	0.49	0.07	-0.24
Zn	50	50	50	50	50	50	50	50	50	45	20	28	1.00	-0.06	0.17	0.03	-0.09	-0.09	0.42	0.15	0.59	0.48	-0.31	-0.24
Cu	50	50	50	50	50	50	50	50	50	45	20	28	50	1.00	-0.06	0.01	0.15	0.57	-0.09	0.47	-0.28	-0.05	0.18	0.26
Mo	27	27	27	27	27	27	27	27	27	24	12	19	27	27	1.00	0.29	0.34	0.34	0.36	1.00	0.33	0.56	0.05	0.00
Ag	42	42	42	42	42	42	42	42	42	38	16	24	42	42	23	1.00	0.37	0.16	-0.14	****[2]	0.05	0.11	-0.04	-0.08
As	44	44	44	44	44	44	44	44	44	40	19	25	44	44	25	38	1.00	-0.17	-0.17	0.90	-0.01	0.22	0.31	0.31
Fe	28	28	28	28	28	28	28	28	28	26	9	15	28	28	16	22	24	1.00	-0.20	0.91	-0.13	-0.17	-0.13	0.17
Mn	12	12	12	12	12	12	12	12	12	9	2	9	12	12	8	10	10	10	1.00	-1.00	0.68	0.73	0.02	-0.13
Al	5	5	5	5	5	5	5	5	5	4	0	3	5	5	3	4	3	4	2	1.00	-0.81	-0.78	-0.23	0.10
U	48	48	48	48	48	48	48	48	48	43	20	28	48	48	27	41	43	26	12	5	1.00	0.67	-0.12	-0.07
Sp.Cond.	50	50	50	50	50	50	50	50	50	45	20	28	50	50	27	42	44	28	12	5	48	1.00	0.11	-0.06
pH	50	50	50	50	50	50	50	50	50	45	20	28	50	50	27	42	44	28	12	5	48	50	1.00	0.58
Temp.	50	50	50	50	50	50	50	50	50	45	20	28	50	50	27	42	44	28	12	5	48	50	50	1.00

1. no valid pairs
2. indeterminate

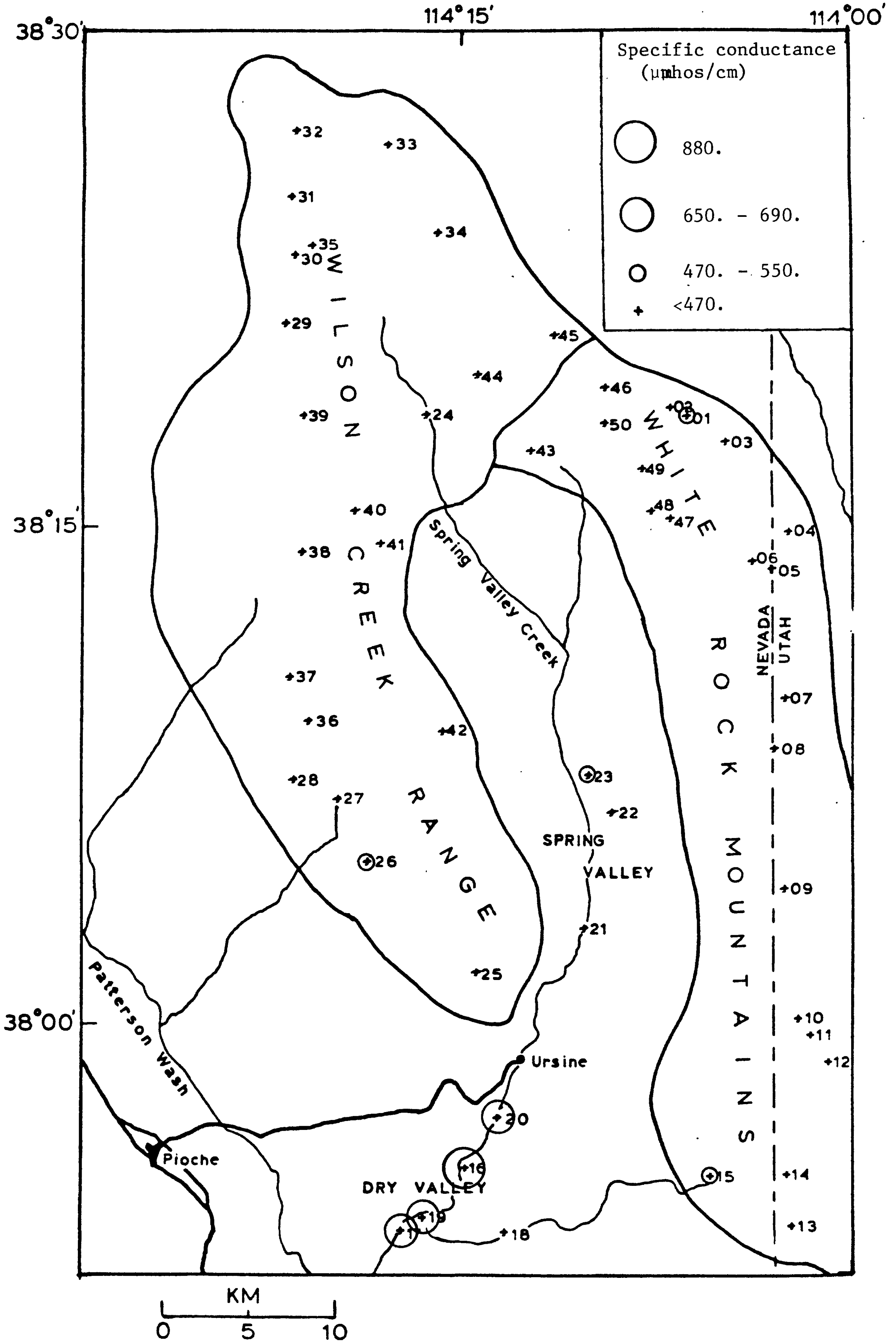

Figure 4. Distribution of specific conductance

highest concentrations of sulfate are in the southern part of the study area (fig. 5), similar to that of specific conductance, and probably due to evaporation and(or) irrigation. Samples 16, 20, 19, 23, and 17 have 62, 27, 22, 16, and 15 mg/L sulfate, respectively. Sample 15 and 32 are in areas of old mines.

Slightly anomalous concentrations of zinc, copper, and molybdenum (fig. 6) occur in waters of the southern part of the study area, except for a few samples that occur in old mine areas. The concentration of zinc in water in the study area ranges from 1 to 118 µg/L (table 4), with a geometric mean of 5.33 µg/L. The highest concentration of zinc is in samples 17 and 23, which occur in Dry and Spring valleys, with 118 and 95 µg/L. Sample 17 was obtained from a galvanized pipe, and probably has some zinc contamination. The concentration of copper in water in the study area ranges from 1 to 8 µg/L (table 4), with geometric mean of 1.94 µg/L. Sample 11 from an old mine area has the highest concentration of copper with 8 µg/L. The concentration of molybdenum in water in the study area ranges from <1 to 9 µg/L (table 4), with a geometric mean of 1.4 µg/L. Sample 32, which is from an old mine area, has the highest molybdenum concentration of 9 µg/L. High-fluoride concentrations are scattered throughout the study area (fig. 7). Fluoride values range from <0.1 to 1.8 mg/L (table 4), with geometric mean of 0.221 mg/L.

Sample 29, from the northern part of the Wilson Creek Range and sample 18, from Dry Valley, have the highest fluoride concentrations with 1.8 and 1.2 mg/L, respectively. The concentration of arsenic in waters in the study area ranges from <1 to 24 µg/L (table 4), with geometric mean of 2.38 µg/L. The highest concentrations of arsenic (fig. 8) occur mainly in the northern Wilson Creek Range and White Rock Mountains, with samples 32, 1, 49, and 35 with 24, 8.9, 8.6, and 7.8 µg/L, respectively. Sample 32, Silver Park Springs, is near an old gold-silver mining area.

The concentration of uranium in waters in the study area ranges from <0.1 to 7 µg/L (table 4), with geometric mean of 1.32 µg/L. High concentrations of uranium are found mainly in lacustrine deposits in Dry, Rose, and Spring valleys (fig. 9), with the highest values from samples 16, 24, 17, with 7, 6, and 5.8 µg/L, respectively. The concentration of lithium in water in the study area ranges from 6 to 65 µg/L (table 4), with geometric mean of 18.2 µg/L. High concentrations of lithium are found mainly in lacustrine deposits (fig. 9). Sample 18, in Dry Valley, had the highest lithium concentration of 65 µg/L.

The pH of water from the study area (fig. 10) ranges from 7.00 to 9.65 (table 4), with a mean value of 7.97. Some spring samples have a pH of approximately 8.00 at their opening and a pH of 11 at their holding ponds a few feet away, which may be due to photosynthesis by aquatic organisms which take up dissolved carbon dioxide during daylight hours and increases the pH (Hem, 1970). Many of the low-pH waters are associated with high-iron concentration; the weathering of iron minerals such as pyrite probably cause the low pH.

Samples 11 and 12 are spring waters that are in the State Line mine district. These waters carry a high amount of iron, 0.46 and 0.59 mg/L, respectively, and aluminum, 1.8 and 2.6 mg/L, respectively, and were probably originally acidic. When the ground water mixes with the alkaline surface water, the pH raises slightly and white aluminum hydroxide precipitates.

Most of the high nitrates values, >1.0 mg/L, may be caused by the use of

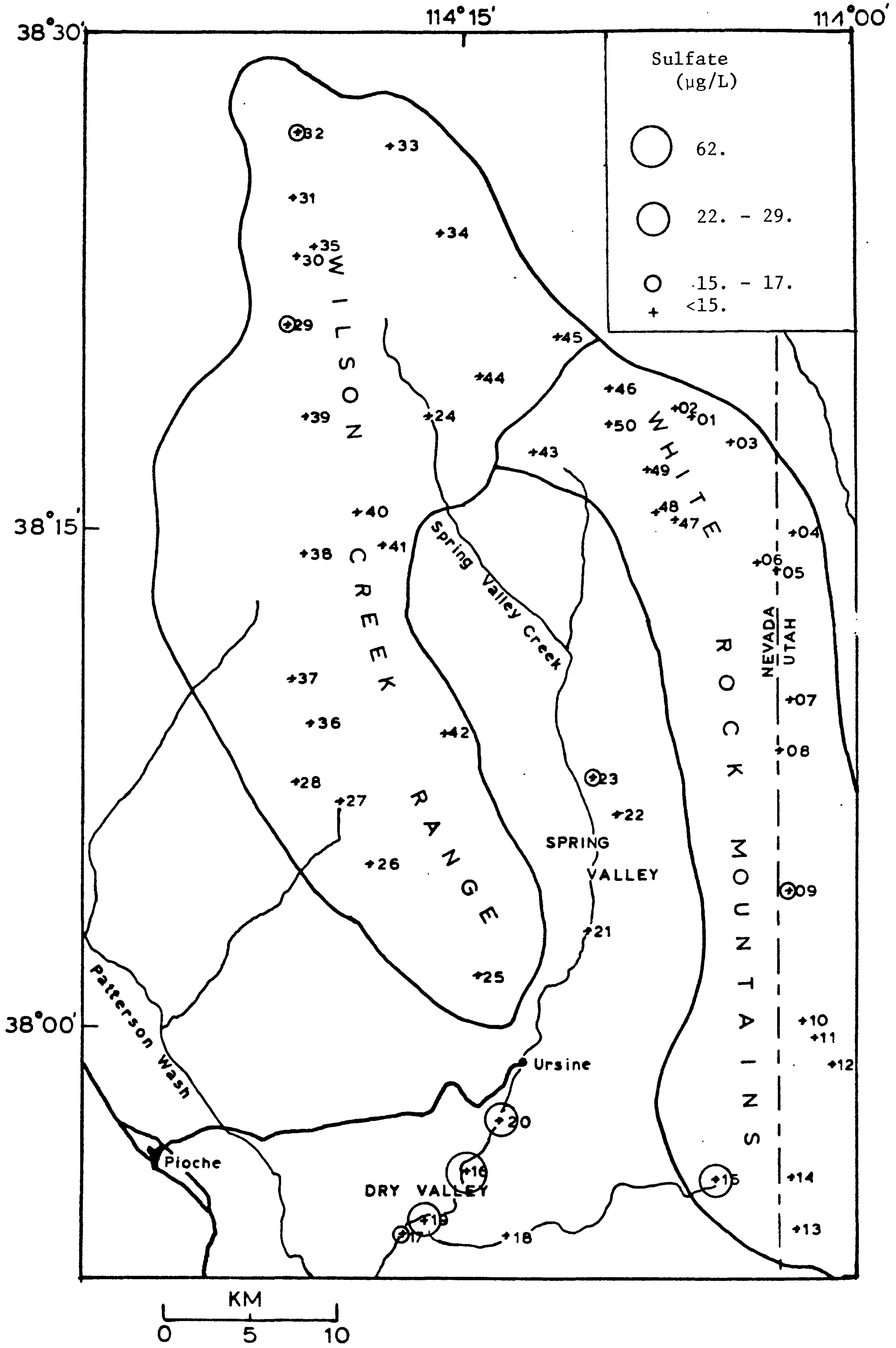

Figure 5. Distribution of sulfate

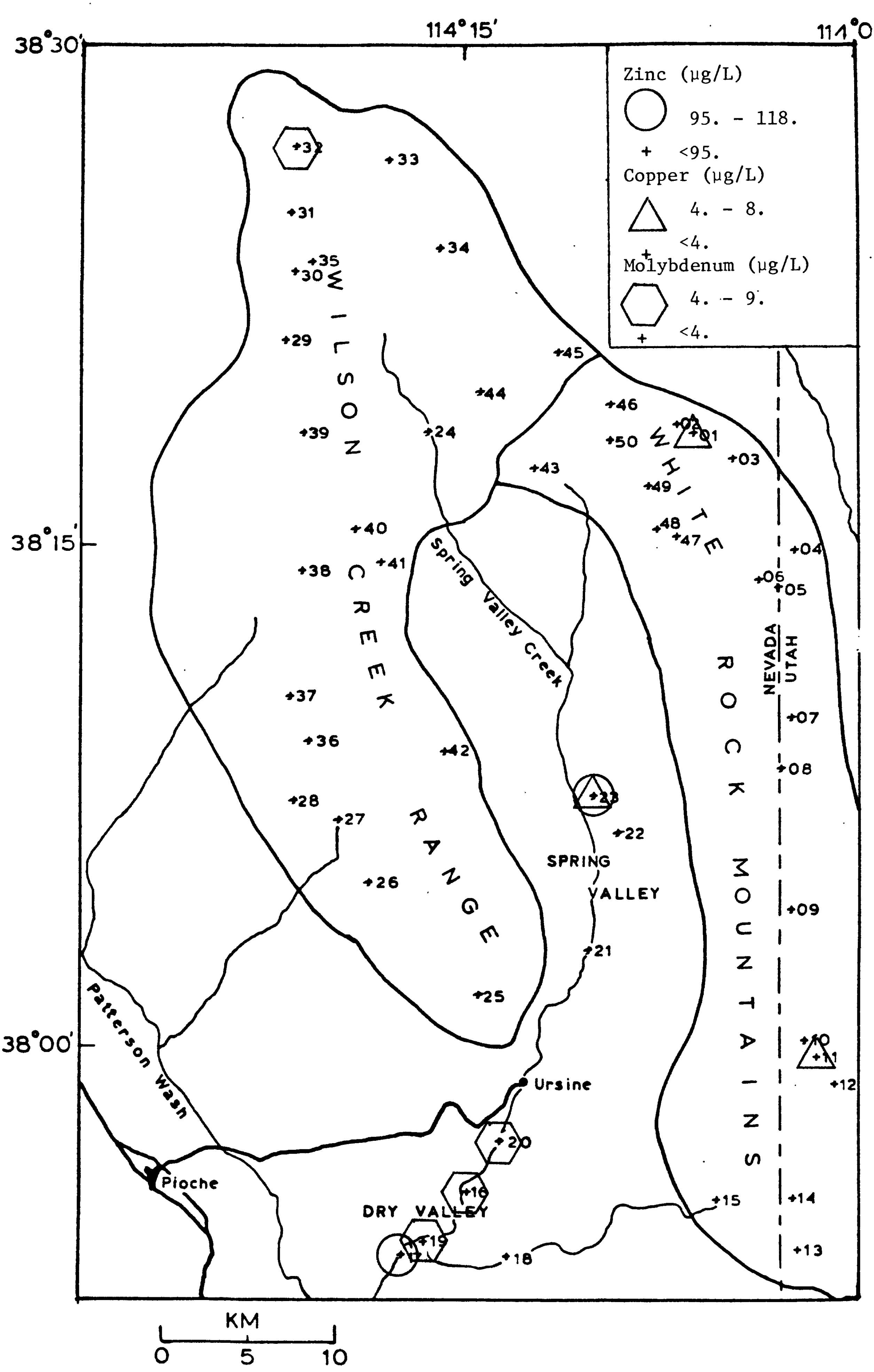

Figure 6. Distribution of zinc, copper, and molybdenum

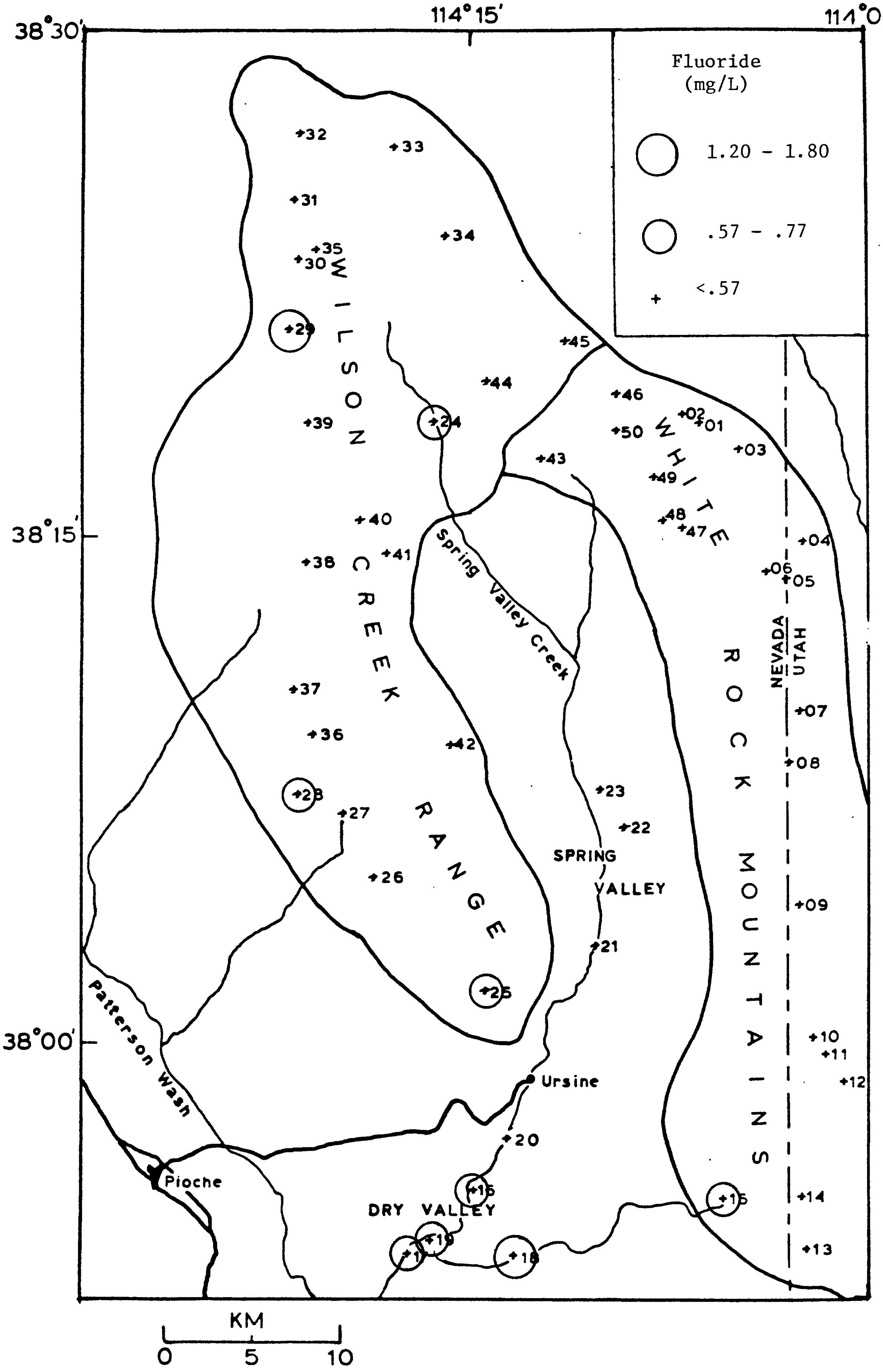

Figure 7. Distribution of fluoride

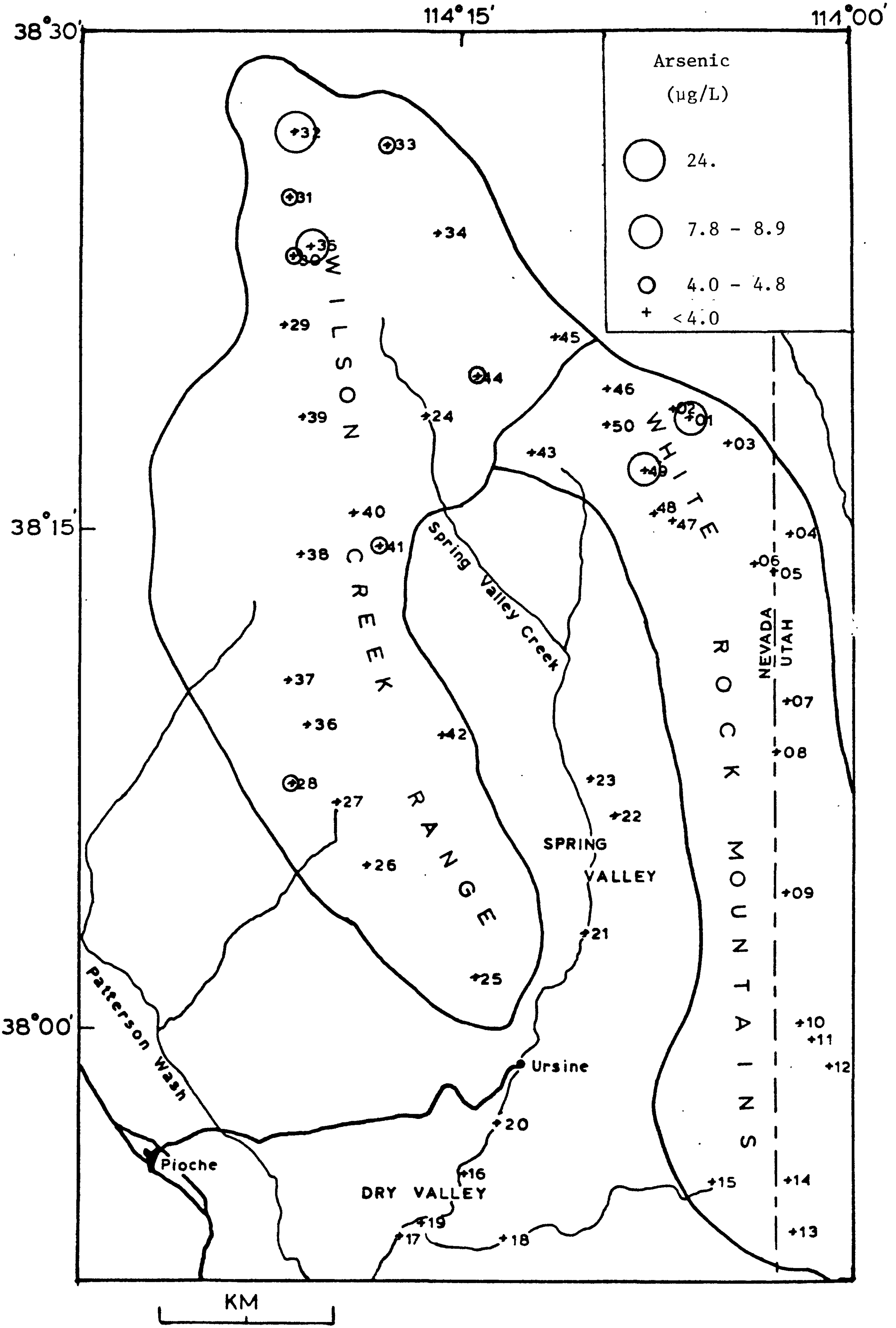

Figure 8. Distribution of arsenic

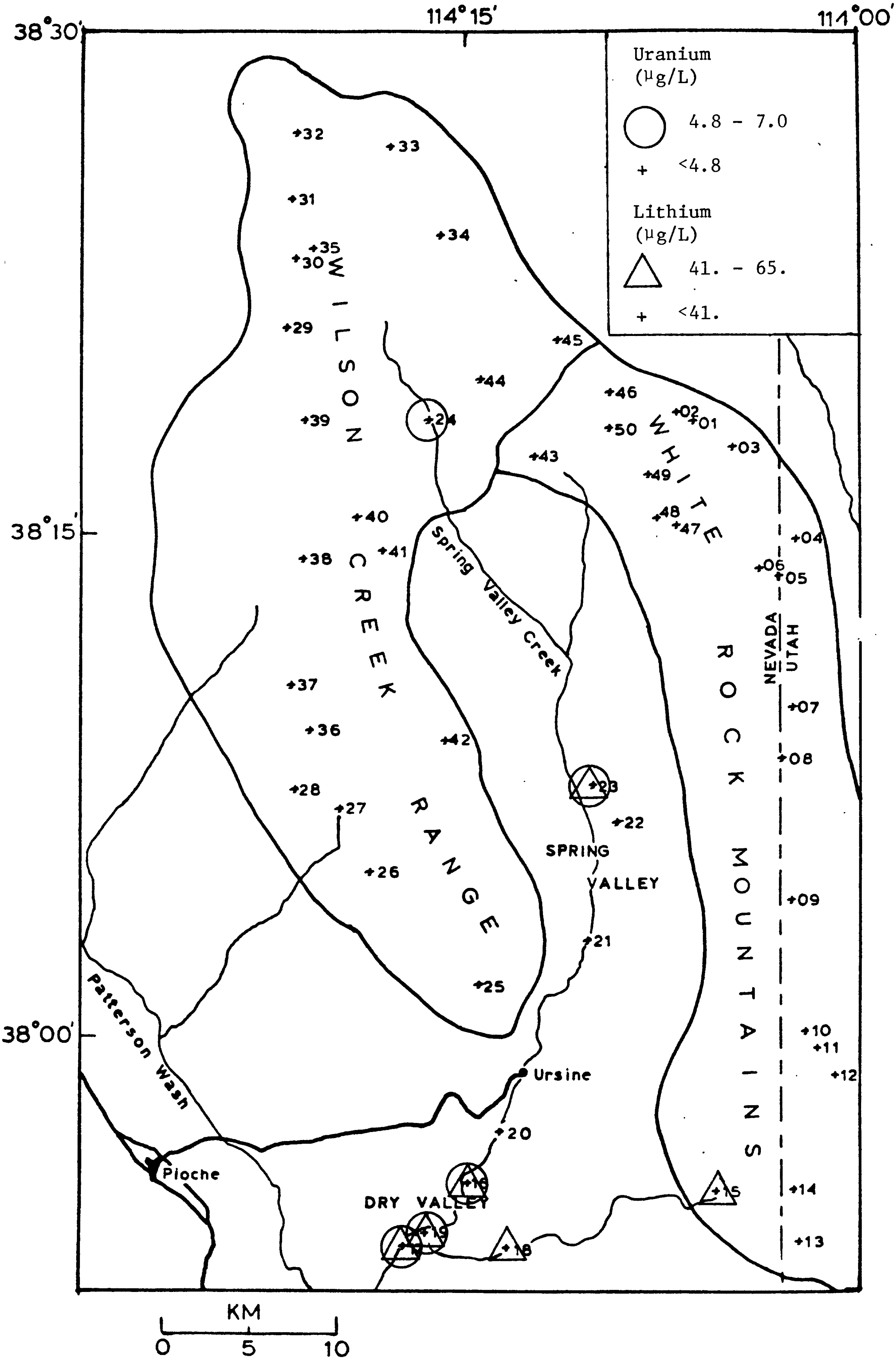

Figure 9. Distribution of uranium and lithium

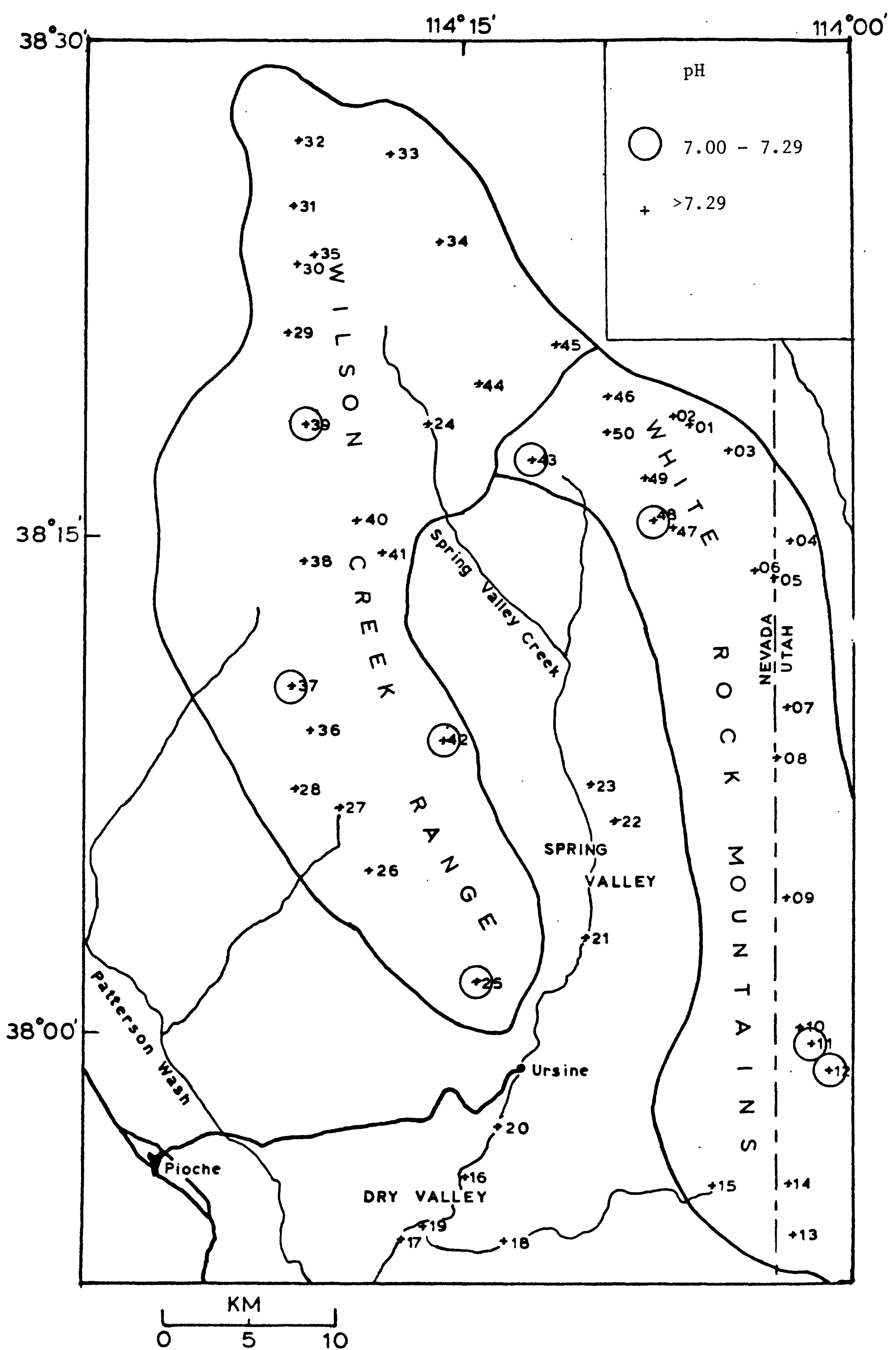

Figure 10. Distribution of pH

Table 6.--Geometric means of water samples by locality of rock type

Variable	Qa/Tl	Tr3	Tt3	Tt2
Ca (mg/L)	60.9	28.5	27.8	44.8
Mg (mg/L)	8.43	5.87	5.26	7.60
Na (mg/L)	33.9	14.8	14.1	19.1
K (mg/L)	6.54	2.39	1.80	1.76
Li (μg/L)	35.6	10.9	15.4	17.7
SiO_2 (mg/L)	58.1	52.4	34.8	42.1
Alk (mg/L)	236.	117.	112.	178.
SO_4 (mg/L)	17.0	9.71	6.93	9.37
Cl (mg/L)	14.7	6.68	6.59	16.4
F (mg/L)	.264	.230	.180	.238
NO_3 (mg/L)	.510	.244	.175	.450
Br (mg/L)	.228	.075	.101	.104
Zn (μg/L)	16.2	5.10	3.18	5.45
Cu (μg/L)	1.78	2.17	2.02	1.89
Mo (μg/L)	3.27	1.08	.826	1.00
Ag (μg/L)	.010	.010	.010	.012
As (μg/L)	2.15	2.91	1.68	3.74
Fe (mg/L)	.014	.013	.021	.012
Mn (mg/L)	.015	.007	.008	.010
Al (mg/L)	.070	.126	.103	.070
U (μg/L)	3.66	.390	.890	1.86
Sp.Cond.	479.	234.	220.	336.

nitrate fertilizers used in irrigated field crops, animal organic wastes, and(or) certain bacteria that are found in soils, especially those living on roots of legumes.

Sample 16 is unusual, being high in manganese, 1.3 mg/L, and low in iron, 0.02 mg/L. Calculation using thermodynamic data and the water analysis indicates that water is saturated with respect to rhodochrosite, suggesting that significant rhodochrosite is present in the subsurface.

Table 6 shows the geometric means for each chemical variable for the water samples by rock type. The samples were divided into four groups according to the rock type the water source was from. The eight samples from Quaternary alluvium and Tertiary lacustrine deposits (Qa/Tl in table 6) show the highest geometric mean concentrations for most of the variable, which is probably due to evaporative and(or) irrigation effects. The rhyolite lavas (Tr 3 in table 6) (five samples) and middle ash-flow tuffs (Tt 3 in table 6) (20 samples) generally had the lowest geometric means for each chemical variable with the exception of copper, iron, and aluminum. The geometric means for the oldest welded tuffs (Tt 2 in table 6) (16 samples) fell in between the other two groups except for chloride and arsenic, which were the highest for the four groups.

CONCLUSION

A hydrogeochemical survey was conducted in east-central Nevada. Dry, Rose, and Eagle valleys contain the most concentrated waters, probably due to evaporative and(or) irrigation effects. None of the trace elements commonly associated with mineralization such as copper, molybdenum, arsenic, and zinc were found to be highly anomalous. Slightly anomalous values for these elements were found in Dry, Rose, and Eagle valleys and in a few scattered areas that contained old mines. It is concluded that no new areas of significant mineralization were revealed by this hydrogeochemical survey.

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