UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Multielement chemical and statistical analyses from a uranium hydrogeochemical and stream-sediment survey in and near the Elkhorn Mountains, Jefferson County, Montana
Part I: Surface Water

by

Vivian J. Suits and Karen J. Wenrich

Open-File Report 82-203A

1982

Contents

Figures

Tables

Multielement chemical and statistical analyses from a uranium hydrogeochemical and stream-sediment survey in and near the Elkhorn Mountains, Jefferson County, Montana

Part I: Surface water

by

Vivian J. Suits and Karen J. Wenrich

ABSTRACT

Fifty-two surface-water samples, collected from an area south of Helena, Jefferson County, were analyzed for 51 chemical species. Of these variables, 35 showed detectable variation over the area, and 29 were utilized in a correlation analysis.

Two populations are distinguished in the collected samples and are especially evident in the plot of Ca versus U. Samples separated on the basis of U versus Ca proved to represent drainage areas of two differing lithologies. One group was from waters that drain the Boulder batholith, the other from those that drain the Elkhorn Mountains volcanic rocks. These two groups of samples, in general, proved to have parallel but different linear trends between U and other elements. Therefore, the two groups of samples were treated separately in the statistical analyses.

Over the area that drains the Boulder batholith, U concentrations in water ranged from 0.37 to 13.0 μg/ℓ , with a mean of 1.9 μg/ℓ. The samples from streams draining volcanic areas ranged from 0.04 to 1.5 μg/ℓ, with a mean of 0.42 μg/ℓ. The highest U values (12 and 13 μg/ℓ) occur along Badger Creek, Rawhide Creek, Little Buffalo Gulch, and an unnamed tributary to Clancy Creek.

Conductivity, hardness, Ba, Ca, Cl, K, Mg, Na and Sr are significantly correlated with U at or better than the 95 percent confidence limit in both populations. For water draining the Boulder batholith, uranium correlates significantly with akalinity, pH, bicarbonate, Li, Mo, NO_2+NO_3, PO_4, SiO_2, SO_4, F, and inorganic carbon. These correlations are similar to those found in a previous study of water samples in north-central New Mexico (Wenrich-Verbeek, 1977b). Uranium in water from the volcanic terrane does not show correlations with any of the above constituents, but does correlate well with V. This relationship with V is absent within the Boulder batholith samples.

INTRODUCTION

This report presents chemical analyses and preliminary statistical evaluation of 52 surface-water samples collected in west-central Montana during July 1977. Geochemical sampling covers an area south of Helena, Montana located in the Jefferson City and Clancy 15-minute quadrangles, Jefferson County (fig. 1). Additional samples were collected within the boundaries of Helena and Deerlodge National Forests to the east and west. Analyses of stream-sediment samples taken concurrently with these water samples are reported in Suits and Wenrich (1981).

Uranium was reported in the Clancy mining district in 1949 (Roberts and Gude, 1953), but the principal prospecting interest and production has been in silver, gold, lead, zinc and copper. The present study area was combed by U prospectors in the early 1950's, and on this basis Smedes (1966) dismisses the possibility of any major U discovery. However, the following evidence for U occurrences led to this study:

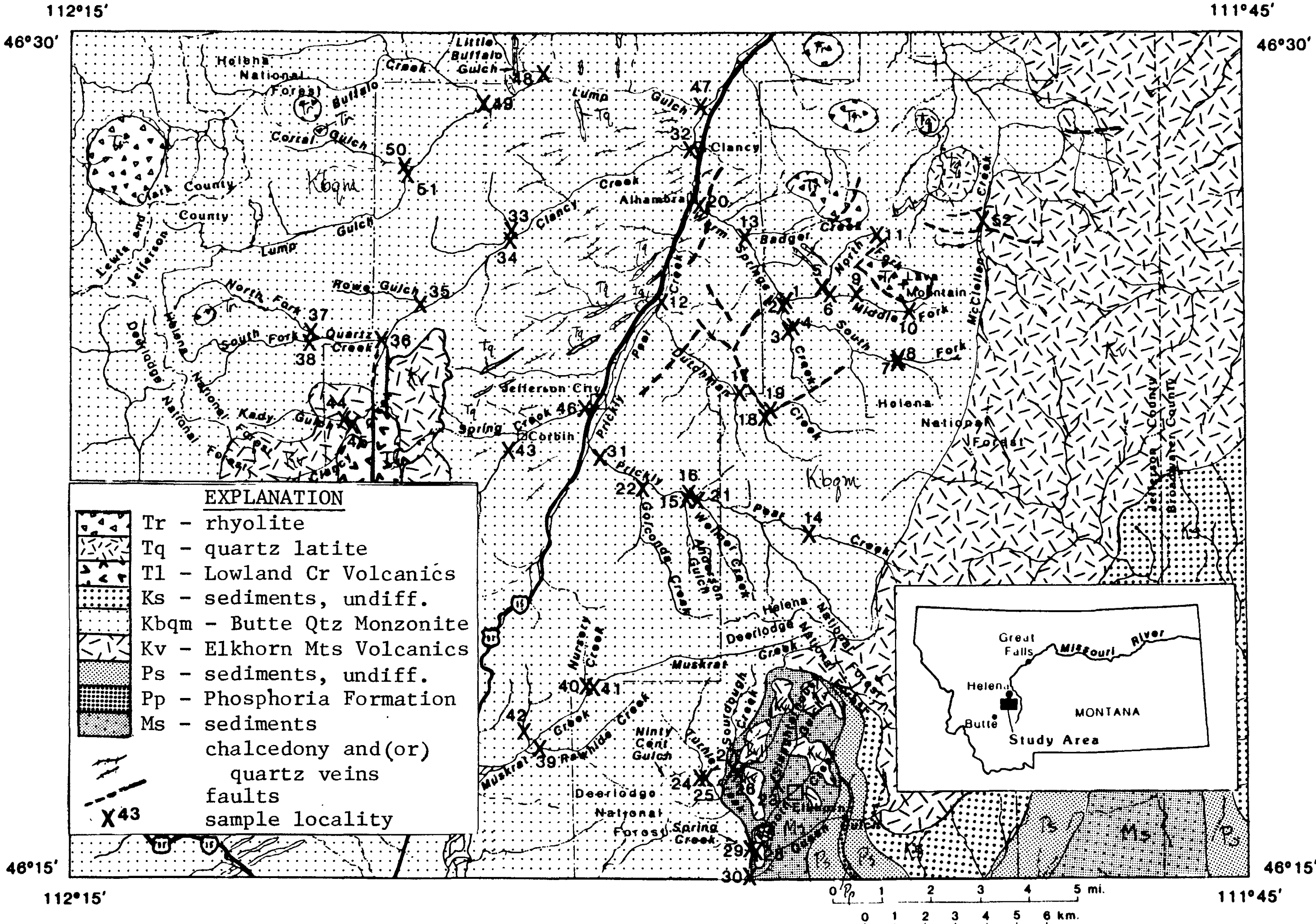

Figure 1.--Generalized geologic map, modified from Becraft and others (1963), Klepper and others (1957) and Smedes (1966). Samples whose geochemistry indicates drainage of volcanic terrane are 11, 23, 28, 30, 43-46 and 52. All other samples represent drainages in the Boulder batholith. Tr, Tq, Tl are of Tertiary age; Ks, Kbqm, Kv are of Cretaceous age; Ps and Pp are Permian age; Ms is Mississippian age.

(1) Uranium occurs as pitchblende and secondary minerals located near silicified fracture zones in the quartz monzonite of the Boulder batholith or the younger alaskitic dike rocks. The uranium minerals are usually in silica stringers, along fractures, or in pore spaces of the altered host rock (Roberts and Gude, 1953).

(2) The Warm Springs Creek drainage area showed high concentrations of U in panned concentrates of stream sediments (U.S. Geological Survey and U.S. Bureau of Mines (USGS and USBM), 1978).

(3) High radon (3,000-37,000 $\rho Ci/\ell$), among the highest found in the United States, occurs in hot springs near Alhambra presumably associated with nearby U occurrences (Leonard and Janzer, 1977). Surface waters from Dutchman Creek, Warm Springs Creek and Muskrat Creek also contain high radon (USGS and USBM, 1978).

(4) Based on an aerial gamma-ray survey, Duval and others (1978), suggested possible U mineralization in areas near Alhambra and Clancy along Warm Springs Creek, Dutchman Creek, Golconda Creek, Prickly Pear Creek and near the mouth of Lump Gulch.

The purpose of the present study was to delineate, through hydrogeochemical sampling, those areas that are favorable for U ore.

GENERAL GEOLOGY

Previous studies in the area include Roberts and Gude (1953), Becraft and others (1963), Smedes (1966), Klepper and others (1957), and U.S. Geological Survey and U.S. Bureau of Mines (1978). Most of these studies discuss the general geology, whereas Roberts and Gude (1953) concentrate on the U occurrences of the Clancy district, and U.S. Geological Survey and U.S. Bureau of Mines (1978) present a study of the potential resources of the Elkhorn Wilderness Study Area.

Most of the area sampled in this survey is underlain by Upper Cretaceous Butte Quartz Monzonite and intrusives associated with the emplacement of the Boulder batholith in Late Cretaceous-Tertiary time. The eastern edge of the batholith trends approximately north-south along McClellan Creek in the north (fig. 1). Along most of this boundary, quartz monzonite is in contact with and intrudes Upper Cretaceous Elkhorn Mountains Volcanics. A roof remnant of this formation is located in the center of the western half of the study area (Becraft and others, 1963). The Elkhorn Mountains Volcanics consist of basaltic, andesitic, quartz latitic and rhyolitic tuffs, lavas and pyroclastic rocks. Paleozoic sedimentary rocks, including the Permian Phosphoria Formation, crop out in the southern portion of the study area. Tertiary rhyolite comprises Lava Mountain, Burnt Mountain, Strawberry Butte and Shingle Butte in the north. Quartz latite and associated dacite dikes intruded the area in Tertiary time (Becraft and others, 1963; Smedes, 1966).

A period of major tectonism before emplacement of the Boulder batholith is manifested in folds and faults in the Paleozoic sedimentary rocks and Elkhorn Mountains Volcanics. Structure is expressed within the batholith itself as fracture zones and faults which generally trend north-northeast. Silicic veins and Tertiary dikes are aligned with these structures. Faults in

the batholith are located near the junction of Clancy Creek and Kady Gulch, at the northern margin of a roof remnant of Elkhorn Mountains Volcanics, in the Dutchman Creek area, near Alhambra, and evident in east-west alignment across McClellan Creek, north of Lava Mountain (Klepper and others, 1957, and Smedes, 1966).

Mining districts located in or near the area are the Elkhorn, Tizer-Wilson, Beaver Creek, Warm Springs, Park, Clancy, Rimini (or Vaughn), and Wickes districts. Most ore from these districts produced silver and lesser amounts of gold, lead, zinc, and copper. The metals were mined from quartz veins associated with zones of shear and brecciation (Becraft and others, 1963). Some U ore was mined from the W. Wilson Claim in the Clancy district (Roberts and Gude, 1953).

Butte Quartz Monzonite was of primary interest to this study since the known U occurs in chalcedony and quartz veins and fracture zones located in the quartz monzonitic areas of the batholith. This rock type has only slight variations in chemical and mineralogic composition over its exposure (Becraft and others, 1963). A period of intrusion of alaskite, alaskite porphyry, aplite and pegmatite dikes occurred during the later stages of emplacement of the batholith (Smedes, 1966; W. R. Miller, USGS, written commun.,1981). Post-batholitic silicification of the quartz monzonite and alaskite resulted in numerous chalcedony and quartz veins. Coarse-grained, metalliferous quartz veins follow fracture systems and have produced precious and base metals in economic amounts. The chalcedony veins (locally known as reefs) align themselves with north-northeast trending fracture systems in a belt paralleling and extending westward from Prickly Pear Creek. Unlike the metalliferous quartz veins, the chalcedony veins are almost devoid of sulfides. Several occurrences of primary U minerals appear in the chalcedony

veins. High radioactivity has been detected in many of these veins and in some of the metalliferous quartz veins as well (Smedes, 1966; Becraft and others, 1963; and Roberts and Gude, 1953).

SAMPLING PROCEDURE

This uranium hydrogeochemical survey was designed to follow-up the results of previous studies. Thus, samples were collected from drainages known to have high U or Rn concentrations in the water. The resulting distribution of sample sites is shown on figure 2. A list of the locations by name appears in table 1.

Water was collected in a flint glass bottle from the thalwegs of streams. The water was then filtered through 0.45 μm membrane into polyethylene bottles and acidifed with nitric acid to a pH below 2. These filtered-acidifed samples were used for analysis of U and all elements listed in table 2 except bicarbonate, alkalinity, organic and inorganic C, SiO_2, F, Cl, SO_4, PO_4 and NO_2 + NO_3. Bicarbonate and alkalinity were determined from a raw sample, SiO_2, F, Cl and SO_4 from a filtered-unacidified sample, and PO_4, NO_2 + NO_3, and inorganic and organic carbon from a filtered-unacidified chilled sample. In situ measurements were made to determine conductivity, water temperature, pH and Eh. Further details on sampling procedures can be found in Wenrich-Verbeek (1980). Samples were randomized before submittal to the analytical laboratories to preclude any systematic bias in data results.

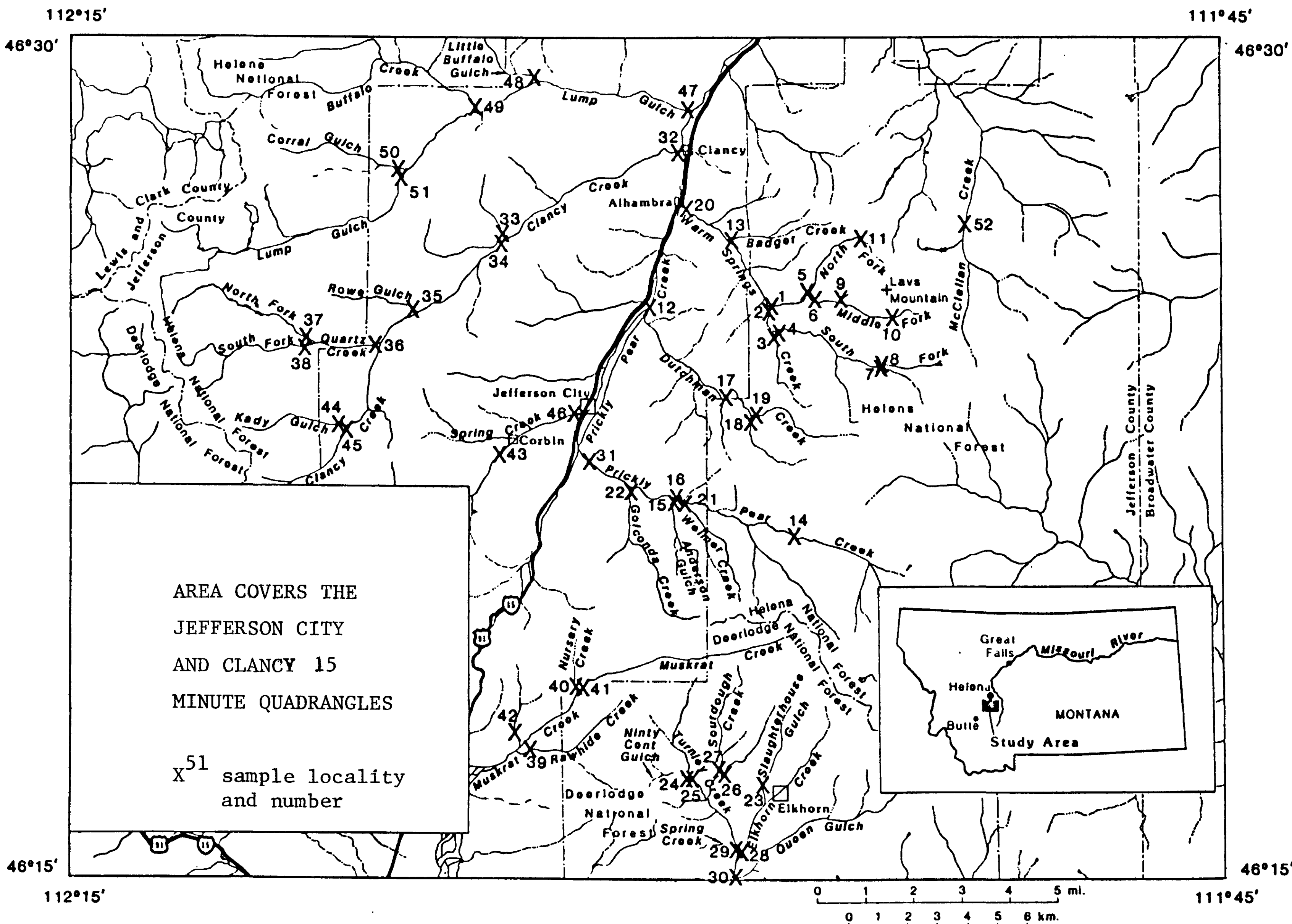

Figure 2.--Map showing location of the study area and sample localities.

Table 1.--List of sample site localities and dates of collection.

SITE NO.	DATE (1977)	LATITUDE	LONGITUDE	LOCATION NAME
1-E77	7/20	46°25'15"	111°56'42"	Warm Springs Creek
2-E77	7/20	46°25'12"	111°56'47"	South Fork Warm Springs Creek
3-E77	7/20	46°24'56"	111°56'38"	Unnamed trib to South Fork Warm Springs Creek
4-E77	7/20	46°24'58"	111°56'32"	South Fork Warm Springs Creek above trib
5-E77	7/20	46°25'41"	111°55'45"	North Fork Warm Springs Creek
6-E77	7/20	46°25'37"	111°55'44"	Middle Fork Warm Springs Creek
7-E77	7/21	46°24'16"	111°53'52"	Trib to South Fork Warm Springs Creek
8-E77	7/21	46°24'21"	111°53'52"	South Fork Warm Springs Creek
9-E77	7/21	46°25'31"	111°54'51"	Trib to Middle Fork Warm Springs Creek
10-E77	7/21	46°25'12"	111°53'28"	Upper part of Middle Fork Warm Springs Creek
11-E77	7/21	46°26'39"	111°54'22"	Upper part of North Fork Warm Springs Creek
12-E77	7/22	46°25'21"	111°59'52"	Dutchman Creek near mouth
13-E77	7/22	46°26'37"	111°57'45"	Badger Creek
14-E77	7/22	46°21'12"	111°56' 7"	Upper part of Prickly Pear Creek
15-E77	7/23	46°21'49"	111°59'17"	Anderson Gulch
16-E77	7/23	46°21'53"	111°59'11"	Prickly Pear Creek above junction with Anderson Creek
17-E77	7/24	46°23'45"	111°57'54"	Dutchman Creek above trib at horseshoe curve
18-E77	7/24	46°23'22"	111°57'14"	Unnamed trib to Dutchman Creek
19-E77	7/24	46°23'25"	111°57' 8"	Dutchman Creek
20-E77	7/24	46°27' 9"	111°58'54"	Warm Springs Creek at Alhambra
21-E77	7/24	46°21'50"	111°59' 1"	Weimer Creek
22-E77	7/24	46°22' 2"	112° 0'25"	Golconda Creek
23-E77	7/25	46°16'41"	111°57' 1"	Slaughterhouse Gulch
24-E77	7/25	46°16'49"	111°58'54"	Ninety Cent Gulch
25-E77	7/25	46°16'49"	111°58'48"	Turnley Creek
26-E77	7/25	46°16'56"	111°58' 3"	Unnamed trib to Sourdough Creek
27-E77	7/25	46°16'56"	111°58'10"	Sourdough Creek
28-E77	7/25	46°15'29"	111°57'35"	Elkhorn Creek
29-E77	7/25	46°15'30"	111°57'44"	Sourdough Creek
30-E77	7/26	46°15' 3"	111°57'44"	Queen Gulch
31-E77	7/26	46°22'35"	112° 1'26"	Prickly Pear Creek near junction above Jefferson City
32-E77	7/26	46°28'10"	111°59' 8"	Clancy Creek at Clancy
33-E77	7/26	46°26'43"	112° 3'42"	Small trib to Clancy Creek
34-E77	7/26	46°26'36"	112° 3'45"	Clancy Creek above trib
35-E77	7/26	46°25'22"	112° 5'58"	Rowe Gulch
36-E77	7/26	46°24'45"	112° 7' 0"	Quartz Creek near mouth
37-E77	7/26	46°24'53"	112° 8'49"	North Fork Quartz Creek
38-E77	7/26	46°24'41"	112° 8'52"	South Fork Quartz Creek
39-E77	7/26	46°17'22"	112° 3' 1"	Rawhide Creek
40-E77	7/27	46°18'28"	112° 1'51"	Nursery Creek
41-E77	7/27	46°18'27"	112° 1'42"	Muskrat Creek
42-E77	7/27	46°17'41"	112° 3'27"	Unnamed trib to Muskrat Creek
43-E77	7/28	46°22'43"	112° 3'47"	Spring Creek above Corbin
44-E77	7/28	46°23'16"	112° 7'58"	Kady Gulch
45-E77	7/28	46°23'10"	112° 7'48"	Clancy Creek above junction with Kady Gulch
46-E77	7/28	46°23'31"	112° 1'41"	Spring Creek at Jefferson City
47-E77	7/29	46°28'42"	111°58'48"	Lump Gulch near mouth
48-E77	7/29	46°29'33"	112° 2'49"	Little Buffalo Gulch near mouth
49-E77	7/29	46°29' 1"	112° 4'23"	Buffalo Creek near mouth
50-E77	7/29	46°27'53"	112° 6'26"	Corral Gulch near mouth
51-E77	7/29	46°27'49"	112° 6'22"	Lump Gulch above junction with Corral Gulch
52-E77	7/29	46°26'53"	111°51'38"	McClellan Creek

Table 2. Abbreviations used in table 3, analytical procedures and detection limits for variables presented in this study.

ABBREV	EXPLANATION	UNITS SYMBOLS	LOWER DETECTION LIMIT	ANALYTICAL PROCEDURE
sample	Sample identification number			
Latt	Latitude of location	deg,min,sec		
Long	Longitude of location	deg,min,sec		
Cond-Fld	Conductivity in micromhos per centimeter	µmhos/cm	—	*In situ* field measurement, Beckman† conductivity probe
U - F	Dissolved uranium (U) in micrograms per liter	µg/L	.01	Direct and extraction flourimetry (see text)
U/Cond	Uranium/conductivity x 100 to normalize U(see text)		--	
Alk- L	Total alkalinity in milligrams per liter as $CaCO_3$	mg/L	1	Direct titration with hydrochloric acid
Eh-Fld	Eh in millivolts	mv	—	*In situ* field measurement, Orion† specific ion meter
Hardness	Total hardness in milligrams per liter as $CaCO_3$	mg/L	1	Calculated from Ca, Mg values
HardNonC	Total non-carbonate hardness in milligrams per liter	mg/L	.5	Calculated from hardness, carbonate and bicarbonate values
pH-Fld	pH in standard units	pH units	—	*In situ* field measurement, Orion† specific ion meter
SAR	Sodium absorption ratio		—	Calculated from Na
H2O temp	Water temperature in degrees centigrade	°C	—	*In situ* field measurement, thermometer
*Ag - S	Dissolved silver (Ag) in micrograms per liter	µg/L	**	Emission spectrographic analysis
*Al - A	Dissolved aluminum (Al) in micrograms per liter	µg/L	30	Atomic absorption and chelation extraction
As - A	Dissolved arsenic (As) in micrograms per liter	µg/L	1.0	Flameless atomic absorption
B - S	Dissolved boron (B) in micrograms per liter	µg/L	**	Emission spectrographic analysis
Ba - S	Dissolved barium (Ba) in micrograms per liter	µg/L	**	Emission spectrographic analysis
*Be - S	Dissolved beryllium (Be) in micrograms per liter	µg/L	**	Emission spectrographic analysis
*Bi - S	Dissolved bismuth (Bi) in micrograms per liter	µg/L	**	Emission spectrographic analysis
Bicarb	Bicarbonate ion in milligrams per liter as HCO_3	mg/L	1	Automated titration with sulfuric acid
InorgC	Dissolved inorganic carbon (C) in milligrams per liter	mg/L	1	Persulfate oxidation and IR gas analyzer
Org C	Dissolved organic carbon (C) in milligrams per liter	mg/L	1	Persulfate oxidation and IR gas analyzer
Ca - A	Dissolved calcium (Ca) in milligrams per liter	mg/L	.1	Atomic absorption - direct aspiration with lanthanum chloride matrix
*Cd - A	Dissolved cadmium (Cd) in micrograms per liter	µg/L	1.0	Atomic Absorption - direct aspiration or chelation extraction
Cl - L	Dissolved chloride (Cl) in milligrams per liter	mg/L	.1	Technicon Autoanalyzer†- ferric thiocyanate colormetric
*Co - S	Dissolved cobalt (Co) in micrograms per liter	µg/L	**	Emission spectrographic analysis
*Cr - S	Dissolved chromium (Cr) in micrograms per liter	µg/L	**	Emission spectrographic analysis
Cu - S	Dissolved copper (Cu) in micrograms per liter	µg/L	**	Emission spectrographic analysis
F - L	Dissolved fluoride (F) in milligrams per liter	mg/L	.1	Technicon Autoanalyzer† - specific ion electrode
Fe - L	Dissolved iron (Fe) in micrograms per liter	µg/L	10	Technicon Autoanalyzer† - 2-2' bypridine colormetric
*Ga - S	Dissolved gallium (Ga) in micrograms per liter	µg/L	**	Emission spectrographic analysis
*Ge - S	Dissolved germanium (Ge) in micrograms per liter	µg/L	**	Emission spectrographic analysis

*All analytical results are below this detection limit; element is not discussed further in this report.

**Detection limit varies with amount of residue upon evaporation.

†Use of brand names does not imply endorsement by the U.S. Geological Survey.

The letter code scheme for designating method of analyisis is as follows:

- A Atomic absorption
- F Flourimetric method
- Fld Field measurement
- L Other laboratory method
- S Emission spectrographic analysis

Note: Dissolved material is that which is measured after passing through a 0.45 µm membrane filter.
Total material is dissolved + suspended material.

Table 2, continued

ABBREV	EXPLANATION	UNITS SYMBOLS	LOWER DETECTION LIMIT	ANALYTICAL PROCEDURE
*Hg - A	Dissolved mercury (Hg) in micrograms per liter	µg/L	.01	Atomic Absorption - $KMnO_4$ digestion and direct aspiration of cold vapor
K - A	Dissolved potassium (K) in milligrams per liter	mg/L	.1	Atomic Absorption - direct aspiration
Li - A	Dissolved lithium (Li) in micrograms per liter	µg/L	5	Atomic absorption - air-acetylene flame
Mg - A	Dissolved magnesium (Mg) in milligrams per liter	mg/L	.1	Atomic Absorption - direct aspiration with lanthanum chloride matrix
*Mn - A	Dissolved manganese (Mn) in micrograms per liter	µg/L	.5	Atomic absorption - chelation extraction
Mo - S	Dissolved molybdenum (Mo) in micrograms per liter	µg/L	**	Emission spectrographic analysis
Na - A	Dissolved sodium (Na) in milligrams per liter	mg/L	.1	Atomic absorption - direct aspiration
Na %	Percent sodium of total cations	%	**	Calculated from Na and total cations
Ni - S	Dissolved nickel (Ni) in micrograms per liter	µg/L	**	Emission spectrographic analysis
NO2+ NO3	Total NO_2 + NO_3 in milligrams per liter as N	mg/L	.005	Technicon Autoanalyzer† - Diazo dye-cadmium reduction
P - L	Total phosphorous (P) in milligrams per liter	mg/L	.005	Technicon Autoanalyzer† - persulfate digestion - phosphomolybdate blue reduction
*Pb - S	Dissolved lead (Pb) in micrograms per liter	µg/L	**	Emission spectrographic analysis
PO4- L	Total phosphate (PO_4) in milligrams per liter	mg/L	.005	Technicon Autoanalyzer† - persulfate digestion - phosphomolybdate blue reduction
*Se - A	Dissolved selenium (Se) in micrograms per liter	µg/L	2	Flameless atomic absorption
SiO2-L	Dissolved silica (SiO_2) in milligrams per liter	mg/L	.1	Technicon Autoanalyzer† - molybdate blue reduction
*Sn - S	Dissolved tin (Sn) in micrograms per liter	µg/L	**	Emission spectrographic analysis
SO4- L	Dissolved sulfate (SO_4) in milligrams per liter	mg/L	1	Technicon Autoanalyzer† - $BaCl_2$ + methythymol blue colormetric complex
Sr - S	Dissolved strontium (Sr) in micrograms per liter	µg/L	**	Emission spectrographic analysis
*Ti - S	Dissolved titanium (Ti) in micrograms per liter	µg/L	**	Emission spectrographic analysis
V - S	Dissolved vanadium (V) in micrograms per liter	µg/L	**	Emission spectrographic analysis
Zn - A	Dissolved zinc (Zn) in micrograms per liter	µg/L	20	Atomic absorption - air-acetylene flame
*Zr - S	Dissolved zirconium (Zr) in micrograms per liter	µg/L	**	Emission spectrographic analysis

ready 07/02/80 19:07 Cost: $0.35

CHEMICAL ANALYSES

Table 2 is a list of variables determined in the waters of the study area, and shows the analytical method used and the corresponding detection limit. All water samples were analyzed by the U.S. Geological Survey. Dissolved solid residues obtained by evaporation of water samples were used for emission spectrographic analysis. The detection limits for these elements tend to vary from sample to sample because of their dependence upon the concentration of dissolved solids in the water--the greater the mg/ℓ of dissolved solids, the higher the detection limit. Two methods of fluorimetry were used for U determinations: (1) direct fluorimetry with a detection limit of 0.4 μg/ℓ and (2) extraction fluorimetry with a detection limit of 0.01 μg/ℓ. The second method was used only on those samples with a U concentration less than 0.4 μg/ℓ.

PRESENTATION OF CHEMICAL DATA

The results of the chemical analysis of the water samples are shown in table 3. Those elements which were consistently below the detection limit are not listed in table 3, but are shown with their corresponding detection limit in table 2. These elements are: Ag, Al, Be, Bi, Cd, Co, Cr, Ga, Ge, Hg, Pb, Se, Sn, Ti, and Zr. Columns including the word "norm" are normalized data for that element. A normalized element is the element concentration of the sample divided by the conductivity at the site where the sample was collected; then this result is multiplied by 100 (for ease of comparison).

Normalization reduces the element data to relative values for comparison over different drainage systems or between periods of fluctuating discharge. The factor desired to normalize water data must minimize the dilution effect of periods of high runoff versus low runoff and reduce the concentrating

effect of differing amounts and kinds of groundwater contributions. Usually conductivity is used as the normalizing factor since it is a relative measure of the total dissolved solids (at these low concentration levels) in the water (see Wenrich-Verbeek, 1977a).

In this study area, there appear to be several different populations of water types delineated by differences in the geologic terrane, which are reflected in the conductivity (see table 4 for example). These populations were divided into two data sets and treated with separate statistical analyses. The histograms of elements were inspected for a dependence on conductivity (thus requiring normalization). Normalized data were retained in the basic statistics for those elements whose histograms acquired a unimodal character after normalization by conductivity. Both the reported data and the normalized data (where applicable) are presented side-by-side in table 3.

Figures 3-1 through 3-15 are data maps for the water samples and show values for those variables that have a significant variation across the drainage basin. Normalized data are plotted for those elements which correlate with conductivity over the study area with the exception of Ca and Mg. Their raw data maps are of more interest since they are elements that were used to delineate lithologic groups. Maps of normalized data then give a feel for the relative concentrations of elements in the surface water. U data as reported from the laboratory as well as normalized values are plotted since it is the element of primary interest to this study.

Because most of this geochemical data represent lognormally distributed populations, the data are plotted by approximate geometric intervals based on those established and used by the Geological Survey of Canada for their hydrogeochemical surveys. Explanations on each map show the intervals used.

Because pH values are logarithmic and thus fall within one class, the pH data are plotted as numeric values.

RESULTS FROM DATA MAPS

High U values (>7.5 μg/ℓ) occur along Badger Creek, an unnamed tributary to Clancy Creek, Rawhide Creek and Little Buffalo Gulch (samples 13, 33, 39 and 48, respectively). These samples remain anomalous after normalization (figs. 3-2 and 3-3).

Previously reported high radon values (USGS and USBM, 1978) corresponds with high U values in the Warm Springs Creek area (Badger Creek) and Muskrat Creek (to which Rawhide Creek is a tributary). Although Dutchman Creek has high radon in its waters, this study shows moderate to low U concentrations (figs. 3-2 and 3-3) and in the corresponding stream sediments (Suits and Wenrich-Verbeek, 1980).

The aerial gamma-ray survey conducted by Duval and others (1978) identifies Warm Springs Creek, Dutchman Creek, Golconda Creek, Prickly Pear Creek and near the mouth of Lump Gulch as areas of possible and as yet unknown U mineralization. These areas seem to correspond better to areas of high Th concentration found in the stream sediments of this study and in the panned concentrates collected in the Elkhorn Wilderness Study Area (USGS and USBM, 1978) than with U.

High Mo values from the normalized data can be seen in figure 3-11 in Prickly Pear Creek just below Weimer Creek, Corral Gulch, Buffalo Creek and Lump Gulch. The only detectable concentrations of Mo in stream sediments occurred at these sites (except Lump Gulch) and include Warm Springs Creek as well (Suits and Wenrich-Verbeek, 1980). The U.S. Geological Survey and U.S. Bureau of Mines (1978) concluded that the entire area has potential for Mo

mineralization. Their panned concentrates delineated Weimer Creek, Prickly Pear Creek and Warm Springs Creek, among others, as areas of anomalous Mo, but did not cover ground west of Alhambra. The Mo potential near Corral Gulch, Buffalo Creek and Lump Gulch merits further study. High Sr, which remains high after normalization, was also found in the Prickly Pear Creek just below Weimer Creek (fig. 3-15).

There was insufficient range in the data for either Zn or V to warrant data maps. However, a high V value of 2.5 μg/ℓ as compared to an average value of 0.32 for all samples resulted at sample site 16. High values of dissolved Zn occur in the water at sample sites 1, 6, 9 and 28 (190, 290, 120 and 160 μg/ℓ, respectively) while at most other sites, Zn values fall below the detection limit of 20 μg/ℓ. Samples 1, 6 and 9 were all collected along Middle Fork of Warm Springs Creek.

STATISTICAL ANALYSIS

The sequence of statistical treatment followed in this report is based on Miesch (1967 and 1976), Cohen (1959) and formulations by the authors. Judgements throughout the sequence were guided by the character of the sample populations.

Sample populations: Based on the scatter diagram of Ca versus U, samples were separated into two groups representing populations draining different lithologic areas. The samples selected from figure 4-9 are in agreement with the generalized geologic map of figure 2. One group represents water which drains the Boulder batholith, the other represents water from drainage areas of volcanics and sediments (sample sites 11, 23, 28, 30, 43, 44, 45, 46 and 52). Correlation analyses were run separately for the two groups. Similar differences based on lithology were previously discovered with panned

concentrates from this area (USGS and USBM, 1978), and are borne out (to a certain extent) in the stream-sediment samples collected in conjunction with these water samples (Suits and Wenrich, 1981).

Problem of censored populations: Some of the data contained qualified values which censor the data in two different ways: (1) singly censored (a sample population of one element with values which fall below or above a certain, fixed limit and are expressed as less than or greater than that limit), and (2) multiply censored (a sample population of one element with values below or above certain variable limits). Populations that were singly censored necessitated use of Cohen's method of estimation of means and standard deviations (see Cohen, 1959; Miesch, 1967; Suits and Wenrich-Verbeek, 1980). Populations which are less than 30 percent multiply censored were treated by the "replacement" method. This method assigns a value at 3/4 of the lower limit of detection for each qualified data point if the value looks reasonable with respect to the unqualified data (see Suits and Wenrich-Verbeek, 1980). Elements with a population that is greater than 50 percent singly censored or 30 percent multiply censored were discarded before correlation analysis.

Histograms: Histograms of most variables exhibited greater unimodal symmetry using log-transformed data normalized by conductivity. Although the log-data were used for correlation analysis, normalization was not necessary because in correlation calculation, fluctuations in the data due to environmental conditions affect all variables and are cancelled out. The histograms of U and normalized U are shown for comparison (table 4). Histograms for the remainder of the chemical species for which correlation coefficients were calculated are shown for both the Boulder Batholith and volcanic populations, but only for the raw or log data depending on which was

most normal. Boulder batholith water data whose histograms were judged to represent normally distributed populations remain as nonlog data for the statistical calculations. Those that appear to be from lognormal populations were transformed to log data. The transformation judgements made for the Boulder batholith samples were applied to the volcanics samples for statistical analysis. Histograms not included in this report, such as chemical species normalized by conductivity, are available from the authors by request.

Table of means and standard deviations: Tables 5 and 6 give the means, standard deviations and minimum and maximum data values for the variables studied in the Boulder batholith samples and volcanic samples, respectively.

Like most geochemical data, the distributions of all variables in water--except alkalinity, Eh, pH, water temperature, bicarbonate, inorganic C, Ca, Cl, and K--come from populations that are more closely lognormally distributed than normally distributed. Thus in most cases (with the exception of those variables listed above), the log data were used in the statistical analysis. The geometric mean and geometric deviation (anti-logs of the arithmetic mean and standard deviation, respectively, of the log data) were calculated for sample populations exhibiting lognormal distribution. In addition, elements were treated differently in the statistical analysis depending on whether they were uncensored, singly censored or multiply censored.

(1) Uncensored populations: means and standard deviations were calculated directly. The number of samples used in the calculations are shown under "valid values" in tables 5 and 6.

(2) Singly censored populations: Cohen's (1959) method of estimating statistics in the censored as well as uncensored

region was used to calculate means and standard deviations. The number of unqualified data are listed under "valid values" and the percentage of the sample population, which is qualified, is shown under the "qualified" column (tables 5 and 6).

(3) Multiply censored populations: means and standard deviations were calculated using the unqualified data and the assigned values determined from the "replacement" method (see the section "Problem of Censored Populations"). The total number of unqualified and assigned data are listed under "valid values" and the percentage of that number which are assigned values is shown under the "assigned" column (tables 5 and 6).

Correlation analysis: Tables 7 and 8 show correlation matrices of elements determined in water for the two lithologically different populations. Figures 4-1 through 4-21 are scatter diagrams of U concentration plotted against those variables appearing in tables 7 and 8. No qualified values are plotted. The correlation coefficient, r, from tables 7 and 8 and the corresponding number of data pairs (n) appear on the diagram. Significance of correlation at the 99 percent confidence level is indicated by a double asterisk next to the value of r, and at the 95 percent confidence level by one asterisk. A regression line is plotted on the diagram only if it is associated with a statistically significant r (at least to the 95 percent confidence level). The calculations of the regression lines did not include qualified values.

RESULTS OF CORRELATION ANALYSIS

Evidence for correlation between U and other variables can be found in the correlation coefficients, r, from tables 7 and 8 and the scatter diagrams (figs. 4-1 through 4-20). The scatter diagrams provide the best evidence of correlation trends for this study area as they delineate the two populations.

Two populations were isolated on the basis of U-Ca relationships. The samples defining the separate trends are related to lithologic differences in drainage areas. One group of samples come from waters which drain the Boulder batholith, the other group from those which drain Elkhorn Mountain Volcanics and (or) Tertiary volcanics. Most of the samples collected fall in the first lithologic group, with only nine samples in the second. Unfortunately the two populations are not always well delineated. With only 9 samples draining the volcanic terrane, any analytical imprecision destroys the trend. Also, the drainage areas overlap and are not clearcut. The Boulder batholith group, then, provides better statistical estimates of correlation coefficients than the volcanics group. Therefore, correlations which are not very strong may be defined in the former group but not in the latter.

In both lithologic groups, U correlates with conductivity, hardness, Ba, Ca, K and Mg at the 99 percent confidence level and with Cl, Na and Sr to at least the 95 percent level. This linearity in the relationships is well-defined on the scatter plots. Alkalinity, pH, bicarbonate and inorganic C all correlate significantly (99 percent confidence level) with U in the Boulder batholith population only. Among the volcanic population, alkalinity, bicarbonate, and inorganic C appear to form linear trends on the scatter diagrams even though they are not statistically significant. Organic C, Eh, B, Cr, Cu, Fe, Mn and Ni do not correlate with U in either population. In addition Li, Mo, $NO_2 + NO_3$, PO_4, SiO_2 and SO_4 correlate with U at the 99

percent confidence level in the Boulder batholith samples. F correlates at the 95 percent level. None of these variables show any relation to U in the volcanic samples although correlation coefficients for Li and Mo could not be determined due to large numbers of qualified values. V correlates significantly (at the 95 percent confidence level) with U in the volcanics population but displays no correlation with U in the Boulder batholith population.

Correlation of U with the alkali and alkaline earths as well as with F in the Ojo Caliente, New Mexico, area is discussed in Wenrich-Verbeek (1977b). The U-alkali and U-alkaline earth relationship holds for both lithologically different areas in this study. While the U-F correlation appears to exist on the scatter plots for the Boulder batholith samples, it is significant only at the 95 percent confidence level and is nonexistent for the volcanics samples. Arsenic and B, which are frequently related to U in surface waters (Wenrich-Verbeek, 1977b), do not show such a correlation in this study area. Molybdenum was found to be the only element correlating with U in a previous surface-water study in the Absaroka Mountains, Montana (Suits and Wenrich-Verbeek, 1980). The same significant correlation with Mo exists in the Boulder batholith population, but is undetermined for the volcanics samples due to small sample-population size.

ACKNOWLEDGEMENTS

The authors are indebted to Joseph F. Mascarenas for help in sample collection and in sample preparation, and to Barbara V. Dodge, whose assistance in the applied-computer realm of this report was invaluable. We are grateful to Bill Greenwood and Steve Ludington of the U.S. Geological Survey who provided valuable scientific background and support and to William R. Miller for his constructive comments. Our thanks also goes to members of Water Resources Division who analyzed our samples and special thanks to Earl Skinner who helped with the description of analytical methods and detection limits.

REFERENCES

Becraft, G. E., Pinckney, D. M., and Rosenblum, Sam, 1963, Geology and mineral deposits of the Jefferson City quadrangle, Jefferson and Lewis and Clark Counties, Montana: U.S. Geological Survey Professional Paper 428, 101 p.

Cohen, A. C., Jr., 1959, Simplified estimators for normal distribution when samples are singly censored or truncated: Technometrics, v. 1, no. 3, p. 217-237.

Duval, J. S., Pitkin, J. A., and Macke, D. L., 1978, Aerial gamma-ray survey in the northern part of the Boulder batholith, Jefferson County, Montana: U.S. Geological Survey Open-File Report 78-180, 16 p.

Klepper, M. R., Weeks, R. A., and Ruppel, E. T., 1957, Geology of the southern Elkhorn Mountains, Jefferson and Broadwater Counties, Montana: U.S. Geological Survey Professional Paper 292, 82 p.

Leonard, R. B., and Janzer, V. J., 1977, Natural radioactivity in geothermal waters, Alhambra Hot Springs and nearby areas, Jefferson County, Montana: U.S. Geological Survey Open-File Report 77-624, 20 p.

Miesch, A. T., 1967, Methods of computation for estimating geochemical abundance: U.S. Geological Survey Professional Paper 574-B, 15 p.

______, 1976, Sampling designs for geochemical surveys - syllabus for a short course: U.S. Geological Survey Open-File Report 76-772, 128 p.

Roberts, W. A., and Gude, A. J., 1953, Uranium-bearing deposits west of Clancy, Jefferson County, Montana: U.S. Geological Survey Bulletin, 988-F, p. F69-F85.

Smedes, H. W., 1966, Geology and igneous petrology of the northern Elkhorn Mountains, Jefferson and Broadwater Counties, Montana: U.S. Geological Survey Professional Paper 510, 116 p.

Suits, V. J., and Wenrich-Verbeek, K. J., 1980, Chemical and statistical analyses from a uranium hydrogeochemical and stream-sediment survey in the North Absaroka study area, Park and Sweet Grass Counties, Montana, Part I--Surface Water: U.S. Geological Survey Open-File Report 80-1090.

Suits, V. J., and Wenrich, K. J., 1981, Chemical and statistical analyses from a uranium hydrogeochemical and stream-sediment survey in and near the Elkhorn Mountains, Jefferson County, Montana, Part II--Stream sediments: U.S. Geological Survey Open-File Report 82-203B, 108 p.

U. S. Geological Survey and the U. S. Bureau of Mines, 1978, Mineral resources of the Elkhorn wilderness study area, Montana: U.S. Geological Survey Open-File Report 78-325, 342 p.

Wenrich-Verbeek, K. J., 1977a, Uranium and co-existing element behaviour in surface waters and associated sediments with varied sampling techniques used for uranium exploration: Journal of Geochemical Exploration, v. 8, p. 337-355.

______,1977b, Anomalous uranium in the waters of the Rio Ojo Caliente, New Mexico, in Campbell, John A., editor, Short papers of the U. S. Geological Survey uranium-thorium symposium, 1977: U.S. Geological Survey Circular 753, p. 73-75.

______,1980, Geochemical exploration for uranium utilizing water and stream sediments: U.S. Geological Survey Open-File Report 80-359, 32 p.

Table 3.--Chemical analyses of surface-water samples.*

sample**	Lat	Long	Cond-Fld µmhos/cm	U - F µg/L	Norm U	Alk- L mg/L	Norm Alk	Eh-Fld mv	Hardness mg/L	NormHard	HardNonC mg/L
01 - E77	46° 25′15″	111° 56′42″	280	4.50	1.6071	72	25.7143	55	120	42.8571	53.0
02 - E77	46° 25′12″	111° 56′47″	105	1.00	.9524	34	32.3810	45	36	34.2857	1.0
03 - E77	46° 24′56″	111° 56′38″	155	1.90	1.2258	48	30.9677	85	51	32.9032	3.0
04 - E77	46° 24′58″	111° 56′32″	90	.83	.9222	30	33.3333	95	34	37.7778	5.0
05 - E77	46° 25′41″	111° 55′45″	260	2.70	1.0385	90	34.6154	85	110	42.3077	23.0
06 - E77	46° 25′36″	111° 55′44″	260	3.40	1.3077	62	23.8462	105	110	42.3077	51.0
07 - E77	46° 24′18″	111° 53′52″	205	3.20	1.5610	--	--	60	--	--	--
08 - E77	46° 24′20″	111° 53′52″	75	.61	.8133	--	--	60	--	--	--
09 - E77	46° 25′31″	111° 54′51″	120	.51	.4250	30	25.0000	145	41	34.1667	11.0
10 - E77	46° 25′12″	111° 53′28″	150	.90	.6000	43	28.6667	110	53	35.3333	10.0
+ 11 - E77	46° 26′39″	111° 54′22″	300	1.40	.4667	160	53.3333	140	160	53.3333	4.0
12 - E77	46° 25′21″	111° 59′52″	130	1.10	.8462	39	30.0000	85	49	37.6923	10.0
13 - E77	46° 26′37″	111° 57′45″	280	13.00	4.6429	120	42.8571	90	130	46.4286	3.0
14 - E77	46° 21′11″	111° 56′ 7″	80	.51	.6375	24	30.0000	80	34	42.5000	10.0
15 - E77	46° 21′49″	111° 59′17″	130	.52	.4000	25	19.2308	55	37	28.4615	12.0
16 - E77	46° 21′53″	111° 59′11″	95	1.10	1.1579	33	34.7368	55	41	43.1579	8.0
17 - E77	46° 23′44″	111° 57′54″	90	.65	.7222	30	33.3333	45	34	37.7778	4.0
18 - E77	46° 23′21″	111° 57′14″	95	.55	.5789	28	29.4737	80	31	32.6316	3.0
19 - E77	46° 23′25″	111° 57′ 8″	85	.86	1.0118	28	32.9412	90	30	35.2941	2.0
20 - E77	46° 27′ 9″	111° 58′54″	297	3.20	1.0774	110	37.0370	100	76	25.5892	<.5
21 - E77	46° 21′50″	111° 59′ 1″	84	1.00	1.1905	28	33.3333	95	36	42.8571	8.0
22 - E77	46° 22′ 2″	112° 0′24″	96	.59	.6146	26	27.0833	140	37	38.5417	11.0
+ 23 - E77	46° 16′41″	111° 57′ 1″	264	.52	.1970	130	49.2424	50	140	53.0303	8.0
24 - E77	46° 16′49″	111° 58′54″	248	5.50	2.2177	98	39.5161	75	110	44.3548	16.0
25 - E77	46° 16′49″	111° 58′48″	127	.57	.4488	48	37.7953	75	56	44.0945	8.0
26 - E77	46° 16′56″	111° 56′ 3″	216	1.40	.6481	90	41.6667	75	100	46.2963	14.0
27 - E77	46° 16′56″	111° 58′ 9″	82	.37	.4512	31	37.8049	75	36	43.9024	5.0
+ 28 - E77	46° 15′29″	111° 57′35″	350	.83	.2371	150	42.8571	120	160	45.7143	11.0
29 - E77	46° 15′29″	111° 57′44″	147	1.30	.8844	62	42.1769	105	67	45.5782	5.0
+ 30 - E77	46° 15′ 2″	111° 57′44″	170	.13	.0765	70	41.1765	135	76	44.7059	7.0
31 - E77	46° 22′35″	112° 1′26″	106	1.20	1.1321	37	34.9057	100	43	40.5660	6.0
32 - E77	46° 28′ 9″	111° 59′ 8″	292	3.50	1.1986	98	33.5616	60	130	44.5205	34.0
33 - E77	46° 26′43″	112° 3′42″	451	13.00	2.8825	--	--	120	--	--	--
34 - E77	46° 26′35″	112° 3′45″	267	2.50	.9363	82	30.7116	115	110	41.1985	33.0
35 - E77	46° 25′29″	112° 5′57″	386	6.40	1.6580	160	41.4508	135	170	44.0415	12.0
36 - E77	46° 24′45″	112° 7′ 0″	189	1.80	.9524	82	43.3862	140	87	46.0317	5.0
37 - E77	46° 24′53″	112° 8′48″	137	1.20	.8759	62	45.2555	105	62	45.2555	<.5
38 - E77	46° 24′41″	112° 8′52″	172	.88	.5116	80	46.5116	165	79	45.9302	<.5
39 - E77	46° 17′21″	112° 3′ 1″	270	13.00	4.8148	110	40.7407	85	130	48.1481	12.0
40 - E77	46° 18′28″	112° 1′50″	411	4.10	.9970	--	--	120	--	--	--

*The symbol "--" indicates the sample was not analyzed for the appropriate variable, and "<" indicates the value was reported as less than the adjacent value. See table 2 for explanation of abbreviations, analytical methods and detection limits.

**The first two digits of the sample number describe the sample location number (see table 1); the last three characters refer to the study code and year of collection.

+ Samples [illegible] , volcanic terranes

Table 3--continued

sample	Lat	Long	Cond-Fld	U - F	Norm U	Alk- L	Norm Alk	Eh-Fld	Hardness	NormHard	HardNonC
41 - E77	46° 18'27"	112° 1'41"	112	4.20	3.7500	46	41.0714	110	50	44.6429	4.0
42 - E77	46° 17'41"	112° 3'27"	308	6.20	2.0130	120	38.9610	120	140	45.4545	19.0
43 - E77	46° 22'43"	112° 3'47"	401	1.40	.3491	69	17.2070	125	160	39.9002	92.0
44 - E77	46° 23'16"	112° 7'58"	163	.29	.1779	44	26.9939	120	110	67.4847	62.0
45 - E77	46° 23'10"	112° 7'48"	244	.22	.0902	55	22.5410	120	110	45.0820	51.0
46 - E77	46° 23'30"	112° 1'41"	378	1.50	.3968	57	15.0794	130	160	42.3280	100.0
47 - E77	46° 28'41"	111°58'48"	270	5.40	2.0000	90	33.3333	70	110	40.7407	15.0
48 - E77	46° 29'33"	112° 2'48"	450	12.00	2.6667	130	28.8889	75	190	42.2222	59.0
49 - E77	46° 29' 1"	112° 4'23"	339	3.70	1.0914	75	22.1239	115	130	38.3481	56.0
50 - E77	46° 27'53"	112° 6'26"	241	4.00	1.6598	90	37.3444	100	98	40.6639	7.0
51 - E77	46°27'49"	112° 6'22"	136	.61	.4485	54	39.7059	95	60	44.1176	6.0
52 - E77	46°26'53"	111°51'38"	108	.04	.0370	24	22.2222	37	34	31.4815	10.0

Table 3--continued

sample	NrmHrdNC	pH-Fld standard units	SAR	Norm SAR	H20 Temp °C	As - A µg/L	Norm As	B - S µg/L	Norm B	Ba - S µg/L	Norm Ba
01 - E77	18.9286	8.00	.3	.1071	19.0	54	19.2857	1.60	.5714	39.0	13.9286
02 - E77	.9524	8.00	.3	.2857	16.0	<1	<.9524	2.40	2.2857	10.0	9.5238
03 - E77	1.9355	7.90	.3	.1935	12.5	<1	<.6452	2.00	1.2903	8.8	5.6774
04 - E77	5.5556	7.90	.3	.3333	13.0	<1	<1.1111	1.10	1.2222	3.3	3.6667
05 - E77	8.8462	7.80	.3	.1154	15.5	2	.7692	2.70	1.0385	61.0	23.4615
06 - E77	19.6154	8.10	.3	.1154	17.0	66	25.3846	<1.00	<.3846	12.0	4.6154
07 - E77	--	7.70	--	--	10.0	--	--	--	--	--	--
08 - E77	--	7.85	--	--	9.5	--	--	--	--	--	--
09 - E77	9.1667	7.60	.2	.1667	13.5	8	6.6667	3.90	3.2500	8.7	7.2500
10 - E77	6.6667	7.80	.3	.2000	10.5	2	1.3333	2.00	1.3333	9.5	6.3333
11 - E77	1.3333	8.10	.2	.0667	25.0	2	.6667	<1.60	<.5333	38.0	12.6667
12 - E77	7.6923	7.90	.3	.2308	15.0	<1	<.7692	5.40	4.1538	26.0	20.0000
13 - E77	1.0714	8.30	.3	.1071	21.0	2	.7143	4.00	1.4286	70.0	25.0000
14 - E77	12.5000	7.60	.2	.2500	11.5	<1	<1.2500	2.00	2.5000	6.2	7.7500
15 - E77	9.2308	7.60	.3	.2308	13.5	<1	<.7692	1.40	1.0769	8.2	6.3077
16 - E77	8.4211	7.70	.2	.2105	14.5	<1	<1.0526	13.00	13.6842	42.0	44.2105
17 - E77	4.4444	7.60	.3	.3333	12.5	<1	<1.1111	2.00	2.2222	7.7	8.5556
18 - E77	3.1579	7.90	.3	.3158	11.5	<1	<1.0526	1.90	2.0000	8.7	9.1579
19 - E77	2.3529	7.90	.3	.3529	11.5	2	2.3529	2.20	2.5882	8.0	9.4118
20 - E77	<.1684	7.90	1.6	.5387	24.0	32	10.7744	13.00	4.3771	34.0	11.4478
21 - E77	9.5238	7.90	.3	.3571	13.5	<1	<1.1905	2.30	2.7381	3.7	4.4048
22 - E77	11.4583	7.60	.3	.3125	14.5	<1	<1.0417	2.10	2.1875	11.0	11.4583
23 - E77	3.0303	8.40	.1	.0379	10.5	6	2.2727	3.30	1.2500	23.0	8.7121
24 - E77	6.4516	8.30	.2	.0806	10.5	<1	<.4032	6.40	2.5806	25.0	10.0806
25 - E77	6.2992	8.00	.2	.1575	13.0	<1	<.7874	5.10	4.0157	9.5	7.4803
26 - E77	6.4815	8.50	.1	.0463	12.5	4	1.8519	4.20	1.9444	14.0	6.4815
27 - E77	6.0976	7.90	.2	.2439	12.0	<1	<1.2195	1.40	1.7073	5.4	6.5854
28 - E77	3.1429	8.30	.3	.0857	14.0	13	3.7143	14.00	4.0000	57.0	16.2857
29 - E77	3.4014	7.90	.2	.1361	14.5	<1	<.6803	1.90	1.2925	8.4	5.7143
30 - E77	4.1176	7.10	.2	.1176	10.0	7	4.1176	2.20	1.2941	12.0	7.0588
31 - E77	5.6604	7.80	.2	.1887	14.0	<1	<.9434	1.60	1.5094	7.6	7.1698
32 - E77	11.6438	8.10	.4	.1370	15.0	10	3.4247	3.30	1.1301	56.0	19.1781
33 - E77	--	8.65	--	--	15.0	--	--	--	--	--	--
34 - E77	12.3596	8.30	.3	.1124	16.0	23	8.6142	2.10	.7865	46.0	17.2285
35 - E77	3.1088	8.50	.4	.1036	15.5	<1	<.2591	<1.70	<.4404	120.0	31.0881
36 - E77	2.6455	8.30	.2	.1058	13.5	<1	<.5291	<.73	<.3862	27.0	14.2857
37 - E77	<.3650	8.30	.2	.1460	14.0	2	1.4599	.86	.6277	24.0	17.5182
38 - E77	<.2907	8.30	.2	.1163	16.0	<1	<.5814	1.30	.7558	30.0	17.4419
39 - E77	4.4444	8.10	.3	.1111	9.0	2	.7407	2.70	1.0000	34.0	12.5926
40 - E77	--	8.30	--	--	9.0	--	--	--	--	--	--

Table 3--continued

sample	NrmHrdNC	pH-Fld	SAR	Norm SAR	H20 Temp	As - A	Norm As	B - S	Norm B	Ba - S	Norm Ba
41 - E77	3.5714	8.10	.2	.1786	10.5	<1	<.8929	1.00	.8929	7.1	6.3393
42 - E77	6.1688	8.10	.2	.0649	9.0	<1	<.3247	1.90	.6169	94.0	30.5195
43 - E77	22.9426	7.70	.4	.0998	11.5	13	3.2419	2.20	.5486	37.0	9.2269
44 - E77	38.0368	7.90	.2	.1227	13.5	<1	<.6135	3.20	1.9632	15.0	9.2025
45 - E77	20.9016	7.90	.2	.0820	15.0	<1	<.4098	1.10	.4508	16.0	6.5574
46 - E77	26.4550	9.30	.4	.1058	19.0	17	4.4974	1.50	.3968	24.0	6.3492
47 - E77	5.5556	7.90	.5	.1852	15.5	<1	<.3704	6.80	2.5185	57.0	21.1111
48 - E77	13.1111	8.10	.5	.1111	11.5	<1	<.2222	3.70	.8222	94.0	20.8889
49 - E77	16.5192	7.90	.5	.1475	15.0	<1	<.2950	<1.40	<.4130	29.0	8.5546
50 - E77	2.9046	8.20	.4	.1660	14.0	<1	<.4149	1.70	.7054	30.0	12.4481
51 - E77	4.4118	8.10	.3	.2206	17.0	2	1.4706	1.80	1.3235	46.0	33.8235
52 - E77	9.2593	7.80	.2	.1852	15.0	<1	<.9259	.91	.8426	7.8	7.2222

Table 3--continued

sample	Bicarb mg/L	NrmBicar	InorgC mg/L	Norm InC	Org C mg/L	Ca - A mg/L	Norm Ca	Cl - C mg/L	Norm Cl	Cu - S µg/L	F - L mg/L
01 - E77	88	31.4286	16.0	5.7143	1.6	35.0	12.5000	2.0	.7143	2.20	.3
02 - E77	42	40.0000	7.8	7.4286	1.3	11.0	10.4762	.4	.3810	.66	.1
03 - E77	58	37.4194	10.0	6.4516	1.1	15.0	9.6774	.7	.4516	.29	.1
04 - E77	36	40.0000	6.5	7.2222	1.2	11.0	12.2222	.4	.4444	.79	.1
05 - E77	110	42.3077	21.0	8.0769	2.2	32.0	12.3077	1.7	.6538	.97	.2
06 - E77	75	28.8462	1.6	.6154	1.6	33.0	12.6923	.7	.2692	1.20	.3
07 - E77	--	--	--	--	--	--	--	--	--	--	--
08 - E77	--	--	--	--	--	--	--	--	--	--	--
09 - E77	36	30.0000	8.0	6.6667	1.3	12.0	10.0000	.6	.5000	1.30	.5
10 - E77	53	35.3333	--	--	1.8	16.0	10.6667	.6	.4000	3.50	.1
11 - E77	190	63.3333	33.0	11.0000	4.4	46.0	15.3333	1.2	.4000	.80	.1
12 - E77	48	36.9231	11.0	8.4615	1.9	15.0	11.5385	.7	.5385	2.00	.1
13 - E77	150	53.5714	26.0	9.2857	2.3	37.0	13.2143	2.1	.7500	.78	.8
14 - E77	29	36.2500	5.4	6.7500	1.6	11.0	13.7500	.4	.5000	1.60	.1
15 - E77	30	23.0769	5.4	4.1538	1.0	12.0	9.2308	.5	.3846	1.60	.1
16 - E77	40	42.1053	8.0	8.4211	1.0	14.0	14.7368	.4	.4211	6.40	.1
17 - E77	37	41.1111	7.4	8.2222	1.5	11.0	12.2222	.4	.4444	.89	.1
18 - E77	34	35.7895	6.6	6.9474	2.0	10.0	10.5263	.5	.5263	1.40	.1
19 - E77	34	40.0000	6.8	8.0000	1.2	8.9	10.4706	.5	.5882	1.80	<.5
20 - E77	130	43.7710	27.0	9.0909	1.9	23.0	7.7441	2.1	.7071	.59	1.2
21 - E77	34	40.4762	6.5	7.7381	.8	12.0	14.2857	.3	.3571	1.90	.1
22 - E77	32	33.3333	5.8	6.0417	1.6	12.0	12.5000	.4	.4167	.66	<.5
23 - E77	160	60.6061	28.0	10.6061	.5	43.0	16.2879	.5	.1894	1.20	<.5
24 - E77	120	48.3871	21.0	8.4677	1.1	33.0	13.3065	1.2	.4839	.83	.1
25 - E77	58	45.6693	11.0	8.6614	1.3	17.0	13.3858	.4	.3150	1.20	.1
26 - E77	110	50.9259	19.0	8.7963	1.1	26.0	12.0370	.6	.2778	2.30	.1
27 - E77	38	46.3415	8.4	10.2439	1.2	11.0	13.4146	.4	.4878	.63	.1
28 - E77	180	51.4286	31.0	8.8571	.8	48.0	13.7143	2.1	.6000	4.00	.1
29 - E77	75	51.0204	14.0	9.5238	2.3	18.0	12.2449	.6	.4082	1.50	.1
30 - E77	85	50.0000	16.0	9.4118	1.0	23.0	13.5294	.8	.4706	1.30	.1
31 - E77	45	42.4528	8.0	7.5472	1.0	14.0	13.2075	.5	.4717	2.20	.1
32 - E77	120	41.0959	21.0	7.1918	.8	39.0	13.3562	2.2	.7534	5.40	.1
33 - E77	--	--	--	--	--	--	--	--	--	--	--
34 - E77	100	37.4532	19.0	7.1161	.9	35.0	13.1086	1.5	.5618	2.50	.2
35 - E77	190	49.2228	33.0	8.5492	1.7	49.0	12.6943	3.3	.8549	1.20	.3
36 - E77	100	52.9101	17.0	8.9947	2.3	26.0	13.7566	1.0	.5291	1.90	.1
37 - E77	76	55.4745	14.0	10.2190	4.1	19.0	13.8686	.6	.4380	3.90	.1
38 - E77	98	56.9767	18.0	10.4651	1.9	25.0	14.5349	.6	.3488	.72	.1
39 - E77	140	51.8519	26.0	9.6296	.9	38.0	14.0741	1.9	.7037	.40	.1
40 - E77	--	--	--	--	--	--	--	--	--	--	--

Table 3--continued

sample	Bicarb	NrmBicar	InorgC	Norm InC	Org C	Ca - A	Norm Ca	Cl - C	Norm Cl	Cu - S	F - L
41 - E77	56	50.0000	11.0	9.8214	.9	15.0	13.3929	.5	.4464	1.10	.1
42 - E77	150	48.7013	26.0	8.4416	1.1	37.0	12.0130	2.0	.6494	.83	.1
43 - E77	84	20.9476	16.0	3.9900	1.1	52.0	12.9676	1.7	.4239	.78	.2
44 - E77	54	33.1288	9.5	5.8282	1.0	32.0	19.6319	.7	.4294	2.20	.1
45 - E77	67	27.4590	13.0	5.3279	.7	33.0	13.5246	.7	.2869	2.00	.2
46 - E77	64	16.9312	12.0	3.1746	.8	52.0	13.7566	1.7	.4497	4.90	.1
47 - E77	110	40.7407	20.0	7.4074	3.3	31.0	11.4815	2.8	1.0370	3.00	.3
48 - E77	160	35.5556	28.0	6.2222	2.2	58.0	12.8889	3.7	.8222	1.20	.2
49 - E77	91	26.8437	16.0	4.7198	5.5	39.0	11.5044	2.4	.7080	6.40	.3
50 - E77	110	45.6432	20.0	8.2988	4.8	29.0	12.0332	1.7	.7054	3.10	.2
51 - E77	66	48.5294	12.0	8.8235	3.0	18.0	13.2353	.8	.5882	3.10	.1
52 - E77	29	26.8519	5.3	4.9074	.6	11.0	10.1852	.4	.3704	.24	.1

Table 3--continued

sample	Norm F	Fe - C µg/L	Norm Fe	K - A mg/L	Norm K	Li - A µg/L	Norm Li	Mg - A mg/L	Norm Mg	Mn - A µg/L
01 - E77	.1071	30	10.7143	2.9	1.0357	14	5.0000	9.1	3.2500	40.0
02 - E77	.0952	40	38.0952	1.2	1.1429	6	5.7143	2.0	1.9048	<.5
03 - E77	.0645	20	12.9032	1.5	.9677	7	4.5161	3.2	2.0645	<.5
04 - E77	.1111	10	11.1111	1.0	1.1111	<5	<5.5556	1.7	1.8889	<.5
05 - E77	.0769	40	15.3846	4.2	1.6154	15	5.7692	8.0	3.0769	30.0
06 - E77	.1154	20	7.6923	2.6	1.0000	12	4.6154	7.2	2.7692	30.0
07 - E77	--	--	--	--	--	--	--	--	--	--
08 - E77	--	--	--	--	--	--	--	--	--	--
09 - E77	.4167	20	16.6667	2.2	1.8333	8	6.6667	2.6	2.1667	<.5
10 - E77	.0667	40	26.6667	1.7	1.1333	8	5.3333	3.2	2.1333	<.5
+11 - E77	.0333	60	20.0000	2.0	.6667	12	4.0000	11.0	3.6667	50.0
12 - E77	.0769	50	38.4615	1.4	1.0769	8	6.1538	2.8	2.1538	<.5
13 - E77	.2857	10	3.5714	3.9	1.3929	12	4.2857	8.2	2.9286	<.5
14 - E77	.1250	10	12.5000	1.1	1.3750	<5	<6.2500	1.6	2.0000	<.5
15 - E77	.0769	20	15.3846	1.1	.8462	<5	<3.8462	1.7	1.3077	<.5
16 - E77	.1053	40	42.1053	1.2	1.2632	<5	<5.2632	1.5	1.5789	<.5
17 - E77	.1111	50	55.5556	1.1	1.2222	<5	<5.5556	1.7	1.8889	<.5
18 - E77	.1053	20	21.0526	1.1	1.1579	<5	<5.2632	1.5	1.5789	<.5
19 - E77	<.5882	20	23.5294	1.1	1.2941	8	9.4118	1.9	2.2353	<.5
20 - E77	.4040	170	57.2391	3.2	1.0774	68	22.8956	4.4	1.4815	40.0
21 - E77	.1190	40	47.6190	.8	.9524	<5	<5.9524	1.5	1.7857	4.0
22 - E77	<.5208	20	20.8333	1.0	1.0417	<5	<5.2083	1.7	1.7708	<.5
+23 - E77	<.1894	10	3.7879	.9	.3409	<5	<1.8939	7.7	2.9167	<.5
24 - E77	.0403	20	8.0645	1.3	.5242	<5	<2.0161	7.7	3.1048	4.0
25 - E77	.0787	20	15.7480	1.2	.9449	<5	<3.9370	3.2	2.5197	<.5
26 - E77	.0463	10	4.6296	1.6	.7407	<5	<2.3148	9.6	4.4444	<.5
27 - E77	.1220	30	36.5854	1.1	1.3415	<5	<6.0976	2.1	2.5610	<.5
+28 - E77	.0286	20	5.7143	2.4	.6857	<5	<1.4286	9.5	2.7143	20.0
29 - E77	.0680	100	68.0272	1.2	.8163	<5	<3.4014	5.3	3.6054	<.5
+30 - E77	.0588	10	5.8824	.8	.4706	<5	<2.9412	4.6	2.7059	<.5
31 - E77	.0943	30	28.3019	1.2	1.1321	<5	<4.7170	2.0	1.8868	<.5
32 - E77	.0342	50	17.1233	3.1	1.0616	12	4.1096	8.5	2.9110	8.0
33 - E77	--	--	--	--	--	--	--	--	--	--
34 - E77	.0749	70	26.2172	2.4	.8989	<5	<1.8727	6.6	2.4719	20.0
35 - E77	.0777	50	12.9534	4.2	1.0881	15	3.8860	11.0	2.8497	<.5
36 - E77	.0529	40	21.1640	1.9	1.0053	<5	<2.6455	5.3	2.8042	4.0
37 - E77	.0730	340	248.1752	1.3	.9489	6	4.3796	3.6	2.6277	<.5
38 - E77	.0581	210	122.0930	1.4	.8140	<5	<2.9070	3.9	2.2674	10.0
39 - E77	.0370	50	18.5185	1.5	.5556	8	2.9630	7.7	2.8519	<.5
40 - E77	--	--	--	--	--	--	--	--	--	--

Table 3--continued

sample	Norm F	Fe - C	Norm Fe	K - A	Norm K	Li - A	Norm Li	Mg - A	Norm Mg	Mn - A
41 - E77	.0893	20	17.8571	1.2	1.0714	<5	<4.4643	3.0	2.6786	<.5
42 - E77	.0325	20	6.4935	2.4	.7792	6	1.9481	12.0	3.8961	4.0
43 - E77	.0499	20	4.9875	2.1	.5237	9	2.2444	7.6	1.8953	60.0
44 - E77	.0613	70	42.9448	1.5	.9202	<5	<3.0675	6.3	3.8650	230.0
45 - E77	.0820	30	12.2951	1.5	.6148	6	2.4590	5.7	2.3361	230.0
46 - E77	.0265	10	2.6455	2.2	.5820	8	2.1164	7.7	2.0370	20.0
47 - E77	.1111	120	44.4444	3.6	1.3333	15	5.5556	6.8	2.5185	50.0
48 - E77	.0444	20	4.4444	4.6	1.0222	15	3.3333	11.0	2.4444	4.0
49 - E77	.0885	190	56.0472	5.1	1.5044	15	4.4248	8.1	2.3894	<.5
50 - E77	.0630	30	12.4481	4.2	1.7427	11	4.5643	6.1	2.5311	<.5
51 - E77	.0735	240	176.4706	1.7	1.2500	7	5.1471	3.6	2.6471	<.5
52 - E77	.0926	20	18.5185	.9	.8333	<5	<4.6296	1.6	1.4815	4.0

Table 3--continued

sample	Norm Mn	Mo - S µg/L	Norm Mo	Na - A mg/L	Norm Na	Na %	Ni - S µg/L	NO2+ NO3 mg/L	NormN2N3	P - L mg/L
01 - E77	14.2857	1.40	.5000	7.1	2.5357	11	<.37	.410	.1464	.02
02 - E77	<.4762	.91	.8667	4.1	3.9048	19	<.16	<.005	<.0048	.01
03 - E77	<.3226	.63	.4065	5.5	3.5484	19	<.17	.010	.0065	.02
04 - E77	<.5556	.65	.7222	3.6	4.0000	18	<.12	.010	.0111	.01
05 - E77	11.5385	1.40	.5385	6.9	2.6538	11	<.32	.080	.0308	.04
06 - E77	11.5385	<.47	<.1808	6.2	2.3846	10	<.32	.190	.0731	.03
07 - E77	--	--	--	--	--	--	--	--	--	--
08 - E77	--	--	--	--	--	--	--	--	--	--
09 - E77	<.4167	.81	.6750	3.3	2.7500	14	.22	<.005	<.0042	.04
10 - E77	<.3333	.66	.4400	4.7	3.1333	16	<.15	.010	.0067	.02
11 - E77	16.6667	1.20	.4000	6.6	2.2000	8	2.20	<.005	<.0017	.03
12 - E77	<.3846	2.10	1.6154	5.2	4.0000	18	<.18	<.005	<.0038	.01
13 - E77	<.1786	5.30	1.8929	8.8	3.1429	13	<.45	.010	.0036	.05
14 - E77	<.6250	.31	.3875	2.8	3.5000	15	<.10	<.005	<.0063	.01
15 - E77	<.3846	2.80	2.1538	4.6	3.5385	21	.19	.020	.0154	.02
16 - E77	<.5263	12.00	12.6316	3.1	3.2632	14	<1.30	<.005	<.0053	.01
17 - E77	<.5556	.33	.3667	4.0	4.4444	20	<.15	.010	.0111	.02
18 - E77	<.5263	.24	.2526	3.9	4.1053	21	.26	.010	.0105	.03
19 - E77	<.5882	.60	.7059	3.7	4.3529	20	.46	.010	.0118	.01
20 - E77	13.4680	1.90	.6397	32.0	10.7744	47	<.39	.010	.0034	.02
21 - E77	4.7619	3.30	3.9286	3.6	4.2857	17	<.11	<.005	<.0060	.02
22 - E77	<.5208	1.20	1.2500	3.6	3.7500	17	<.11	.010	.0104	.01
23 - E77	<.1694	<.63	<.2386	2.3	.8712	3	<.43	.010	.0038	.01
24 - E77	1.6129	1.10	.4435	5.2	2.0968	9	<.35	.010	.0040	.01
25 - E77	<.3937	.90	.7087	4.0	3.1496	13	<.20	.010	.0079	.01
26 - E77	<.2315	.55	.2546	3.4	1.5741	7	<.27	<.005	<.0023	.01
27 - E77	<.6098	.61	.7439	3.4	4.1463	16	<.11	<.005	<.0061	.01
28 - E77	5.7143	2.10	.6000	10.0	2.8571	12	<.48	.030	.0086	.02
29 - E77	<.3401	.61	.4150	4.0	2.7211	11	.35	.010	.0068	.01
30 - E77	<.2941	<.32	<.1882	3.2	1.8824	8	<.22	.040	.0235	.04
31 - E77	<.4717	2.10	1.9811	3.5	3.3019	15	.27	.080	.0755	.01
32 - E77	2.7397	2.30	.7877	9.5	3.2534	13	.44	.070	.0240	.01
33 - E77	--	--	--	--	--	--	--	--	--	--
34 - E77	7.4906	1.60	.5993	6.2	2.3221	10	<.37	.060	.0225	.03
35 - E77	<.1295	<.80	<.2073	12.0	3.1088	13	<.55	.040	.0104	.04
36 - E77	2.1164	.47	.2487	3.7	1.9577	8	.51	.060	.0317	.01
37 - E77	<.3650	.48	.3504	3.2	2.3358	10	.89	.010	.0073	.02
38 - E77	5.8140	1.10	.6395	3.2	1.8605	8	.81	<.005	<.0029	.01
39 - E77	<.1852	4.40	1.6296	7.1	2.6296	11	<.38	.080	.0296	.02
40 - E77	--	--	--	--	--	--	--	--	--	--

Table 3--continued

sample	Norm Mn	Mo - S	Norm Mo	Na - A	Norm Na	Na %	Ni - S	NO2+ NO3	NormN2N3	P - L
41 - E77	<.4464	1.30	1.1607	3.3	2.9464	12	.23	.010	.0089	.01
42 - E77	1.2987	2.80	.9091	6.1	1.9805	8	1.10	.050	.0162	.02
43 - E77	14.9626	<.69	<.1721	11.0	2.7431	13	<.47	.310	.0773	.04
44 - E77	141.1043	<.24	<.1472	4.6	2.8221	9	.41	.010	.0061	.01
45 - E77	94.2623	<.41	<.1680	4.8	1.9672	9	<.28	.040	.0164	.01
46 - E77	5.2910	.74	.1958	11.0	2.9101	13	<.43	.010	.0026	.01
47 - E77	18.5185	7.50	2.7778	11.0	4.0741	18	<.37	.040	.0148	.02
48 - E77	.8689	3.30	.7333	15.0	3.3333	14	<.61	.210	.0467	.05
49 - E77	<.1475	27.00	7.9646	13.0	3.8348	17	.51	.060	.0177	.05
50 - E77	<.2075	13.00	5.3942	9.4	3.9004	17	1.30	.020	.0083	.06
51 - E77	<.3676	.41	.3015	4.5	3.3088	14	.42	.010	.0074	.01
52 - E77	3.7037	<.19	<.1759	3.3	3.0556	17	<.13	.020	.0185	.02

Table 3--continued

sample	Norm P	P04- L mg/L	Norm P04	Si02-L mg/L	S04- L mg/L	Norm S04	Sr - S µg/L	Norm Sr	V - S µg/L	Zn - A µg/L
01 - E77	.0071	.06	.0214	21	61.0	21.7857	230	82.1429	.35	190
02 - E77	.0095	.03	.0286	19	10.0	9.5238	49	46.6667	.62	<20
03 - E77	.0129	.06	.0387	23	13.0	8.3871	50	32.2581	.41	<20
04 - E77	.0111	.03	.0333	19	9.1	10.1111	29	32.2222	.32	<20
05 - E77	.0154	.12	.0462	23	33.0	12.6923	270	103.8462	.79	<20
06 - E77	.0115	.09	.0346	22	66.0	25.3846	120	46.1538	<.22	290
07 - E77	--	--	--	--	--	--	--	--	--	<20
08 - E77	--	--	--	--	--	--	--	--	--	<20
09 - E77	.0333	.12	.1000	24	15.0	12.5000	32	26.6667	.24	120
10 - E77	.0133	.06	.0400	21	18.0	12.0000	29	19.3333	.32	<20
11 - E77	.0100	.09	.0300	19	8.7	2.9000	280	93.3333	.55	<20
12 - E77	.0077	.03	.0231	20	14.0	10.7692	60	46.1538	.86	<20
13 - E77	.0179	.15	.0536	32	26.0	9.2857	100	35.7143	.40	<20
14 - E77	.0125	.03	.0375	16	7.8	9.7500	24	30.0000	.41	<20
15 - E77	.0154	.06	.0462	21	21.0	16.1538	100	76.9231	.24	<20
16 - E77	.0105	.03	.0316	16	7.4	7.7895	500	526.3158	2.50	<20
17 - E77	.0222	.06	.0667	15	7.7	8.5556	45	50.0000	.43	<20
18 - E77	.0316	.09	.0947	21	7.2	7.5789	61	64.2105	.48	<20
19 - E77	.0118	.03	.0353	19	7.8	9.1765	52	61.1765	.61	<20
20 - E77	.0067	.06	.0202	26	33.0	11.1111	390	131.3131	<.27	<20
21 - E77	.0238	.06	.0714	18	9.3	11.0714	26	30.9524	.20	<20
22 - E77	.0104	.03	.0313	17	15.0	15.6250	48	50.0000	.16	<20
23 - E77	.0038	.03	.0114	15	8.9	3.3712	160	68.1818	.76	<20
24 - E77	.0040	.03	.0121	16	24.0	9.6774	210	84.6774	.45	<20
25 - E77	.0079	.03	.0236	18	11.0	8.6614	56	44.0945	.16	<20
26 - E77	.0046	.03	.0139	20	17.0	7.8704	120	55.5556	.86	<20
27 - E77	.0122	.03	.0366	17	7.0	8.5366	45	54.8780	.19	<20
28 - E77	.0057	.06	.0171	20	35.0	10.0000	330	94.2857	.61	160
29 - E77	.0068	.03	.0204	18	10.0	6.8027	88	59.8639	.21	<20
30 - E77	.0235	.12	.0706	15	13.0	7.6471	120	70.5882	.29	<20
31 - E77	.0094	.03	.0283	16	12.0	11.3208	63	59.4340	.25	<20
32 - E77	.0034	.03	.0103	18	45.0	15.4110	330	113.0137	.29	23
33 - E77	--	--	--	--	--	--	--	--	--	<20
34 - E77	.0112	.09	.0337	17	44.0	16.4794	380	142.3221	<.25	29
35 - E77	.0104	.12	.0311	24	45.0	11.6580	570	147.6684	<.37	<20
36 - E77	.0053	.03	.0159	15	12.0	6.3492	150	79.3651	<.16	<20
37 - E77	.0146	.06	.0438	14	6.1	4.4526	130	94.8905	<.15	<20
38 - E77	.0058	.03	.0174	14	6.6	3.8372	380	220.9302	.33	<20
39 - E77	.0074	.06	.0222	19	21.0	7.7778	280	103.7037	.53	<20
40 - E77	--	--	--	--	--	--	--	--	--	<20

Table 3--continued

sample	Norm P	PO4- L	Norm PO4	SiO2-L	SO4- L	Norm SO4	Sr - S	Norm Sr	V - S	Zn - A
41 - E77	.0089	.03	.0268	15	7.7	6.8750	53	47.3214	.13	<20
42 - E77	.0065	.06	.0195	21	33.0	10.7143	410	133.1169	.66	<20
+43 - E77	.0100	.12	.0299	21	120.0	29.9252	640	159.6010	<.32	60
+44 - E77	.0061	.03	.0184	16	30.0	18.4049	50	30.6748	.15	<20
+45 - E77	.0041	.03	.0123	15	60.0	24.5902	290	118.8525	<.19	<20
+46 - E77	.0026	.03	.0079	18	120.0	31.7460	660	174.6032	.38	<20
47 - E77	.0074	.06	.0222	21	37.0	13.7037	260	96.2963	.39	<20
48 - E77	.0111	.15	.0333	29	90.0	20.0000	640	142.2222	.57	<20
49 - E77	.0147	.15	.0442	31	81.0	23.8938	420	123.8938	<.30	<20
50 - E77	.0249	.18	.0747	24	27.0	11.2033	150	62.2407	<.22	<20
51 - E77	.0074	.03	.0221	15	10.0	7.3529	49	36.0294	.20	<20
+52 - E77	.0185	.06	.0556	17	14.0	12.9630	66	61.1111	.10	<20

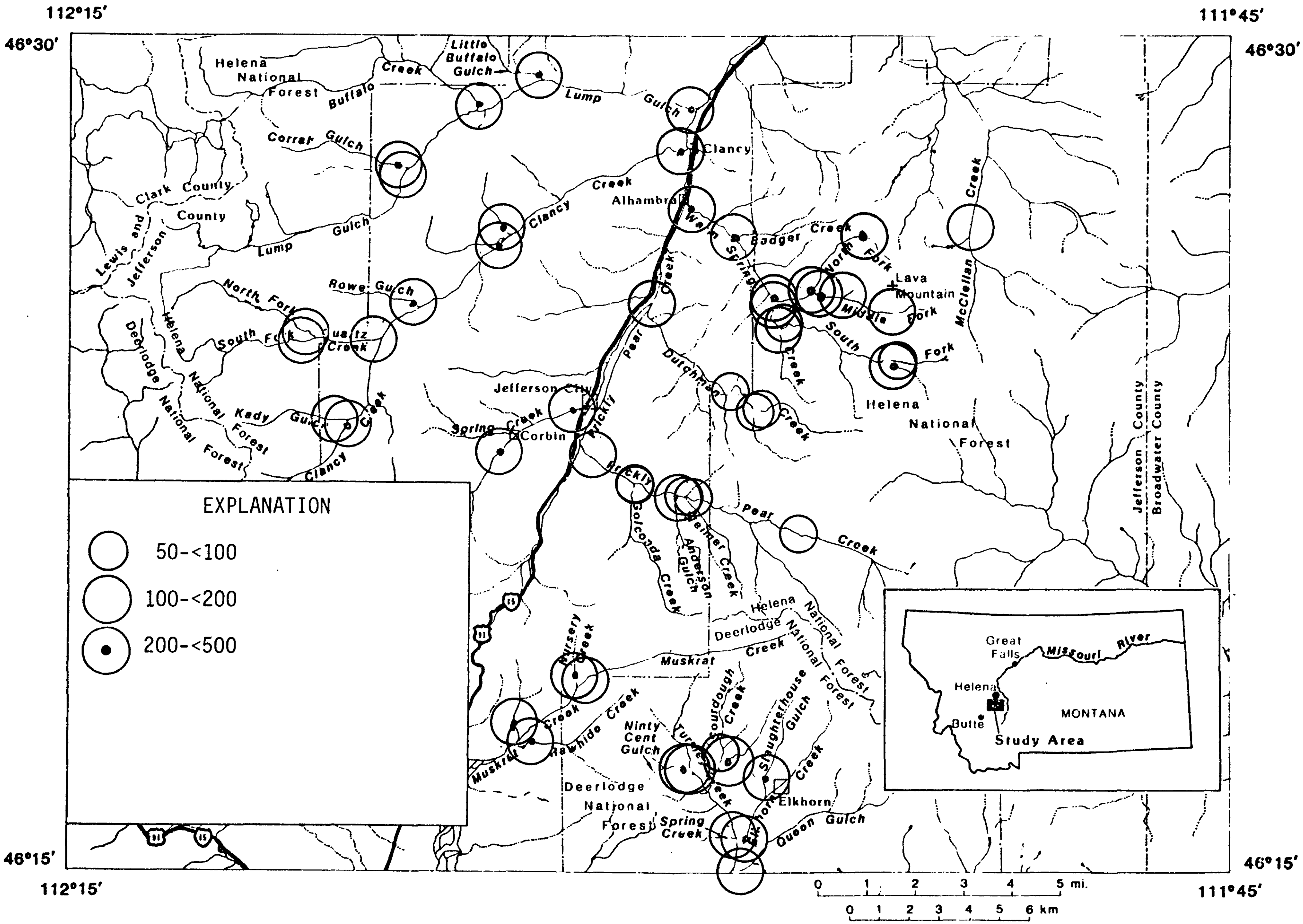

Figure 3-1.--Conductivity data (µmhos/cm).

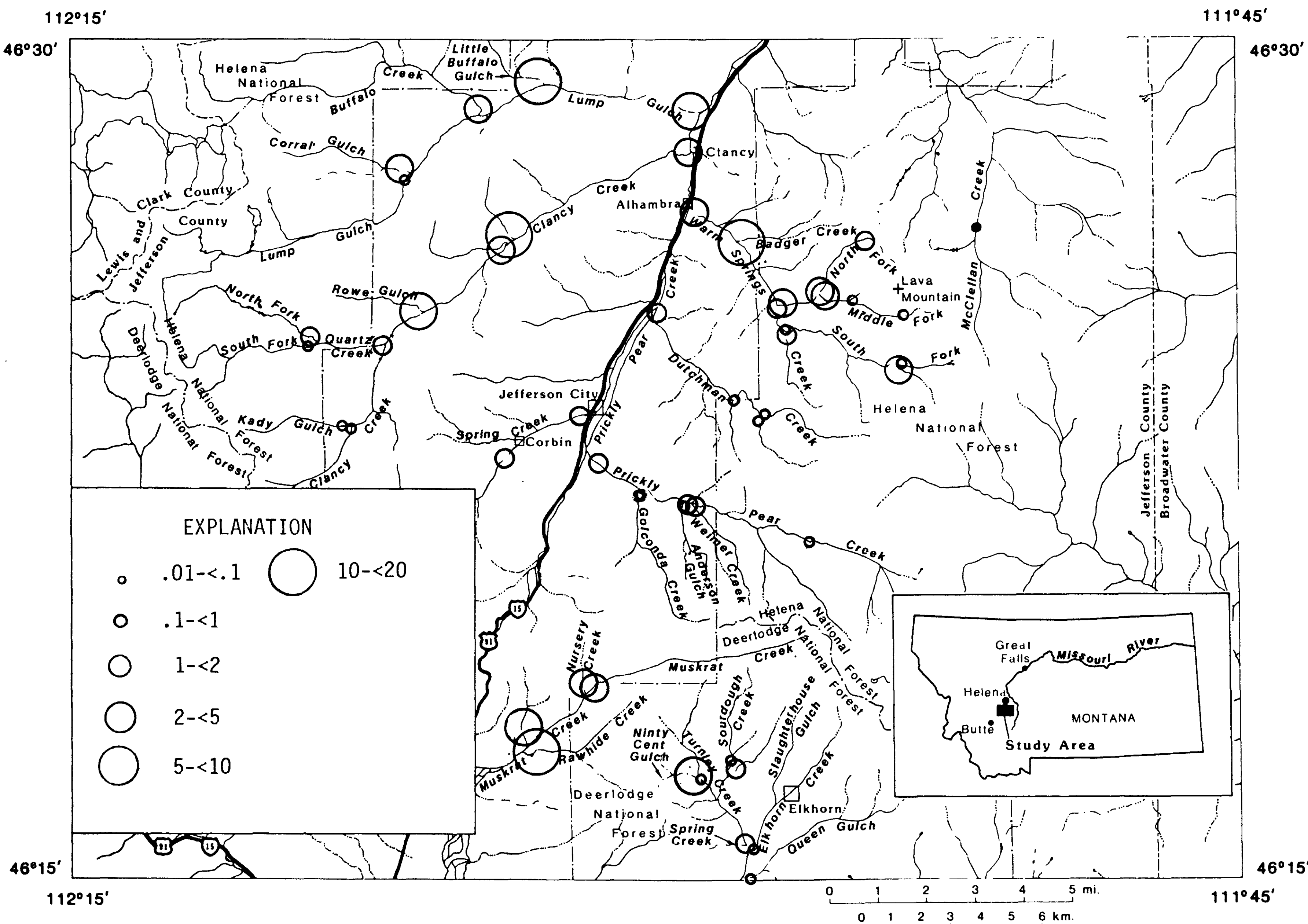

Figure 3-2.--Uranium data (µg/L).

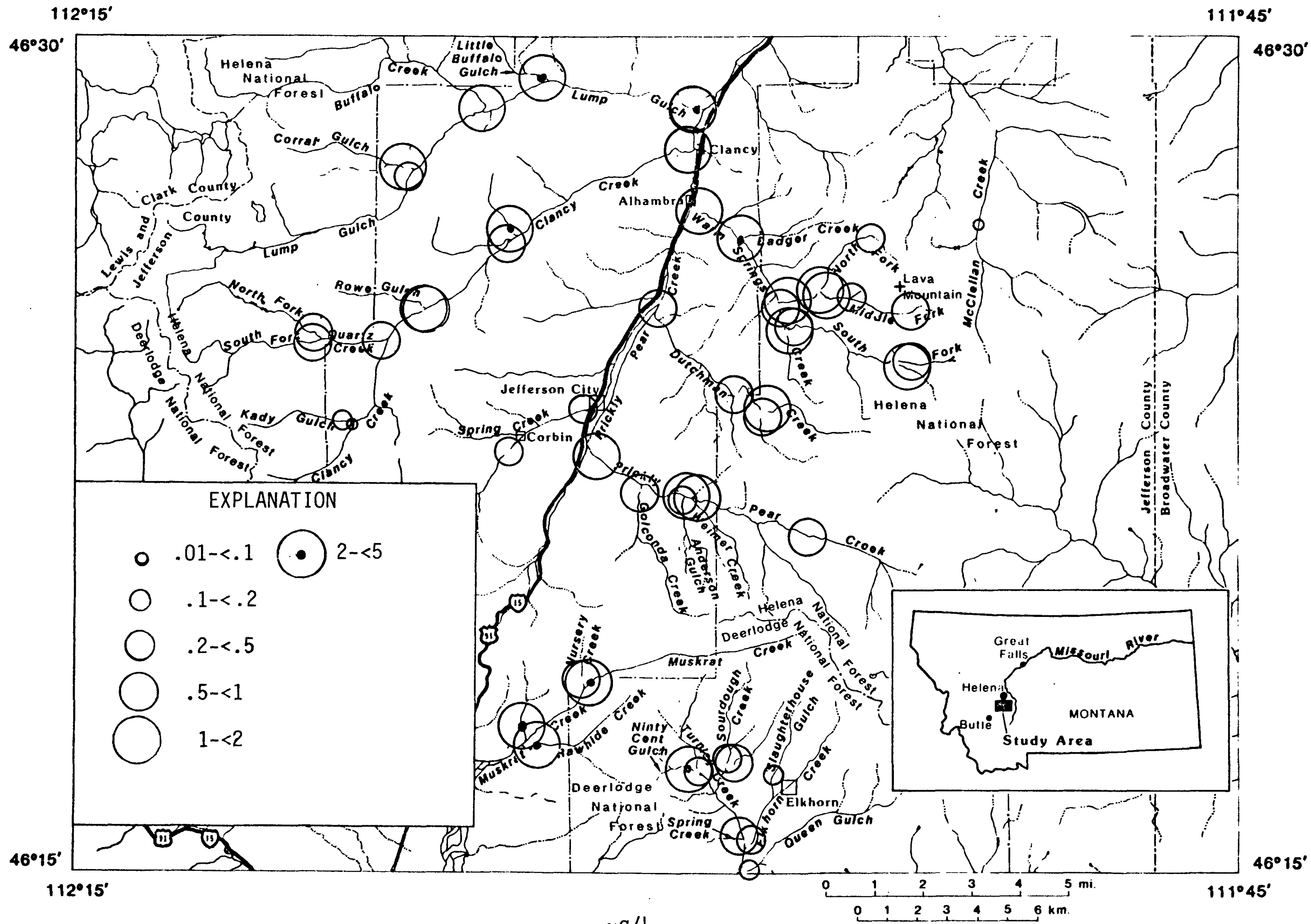

Figure 3-3.--Normalized uranium data $\left(\frac{\mu g/L}{\mu mhos/cm} \times 100\right)$.

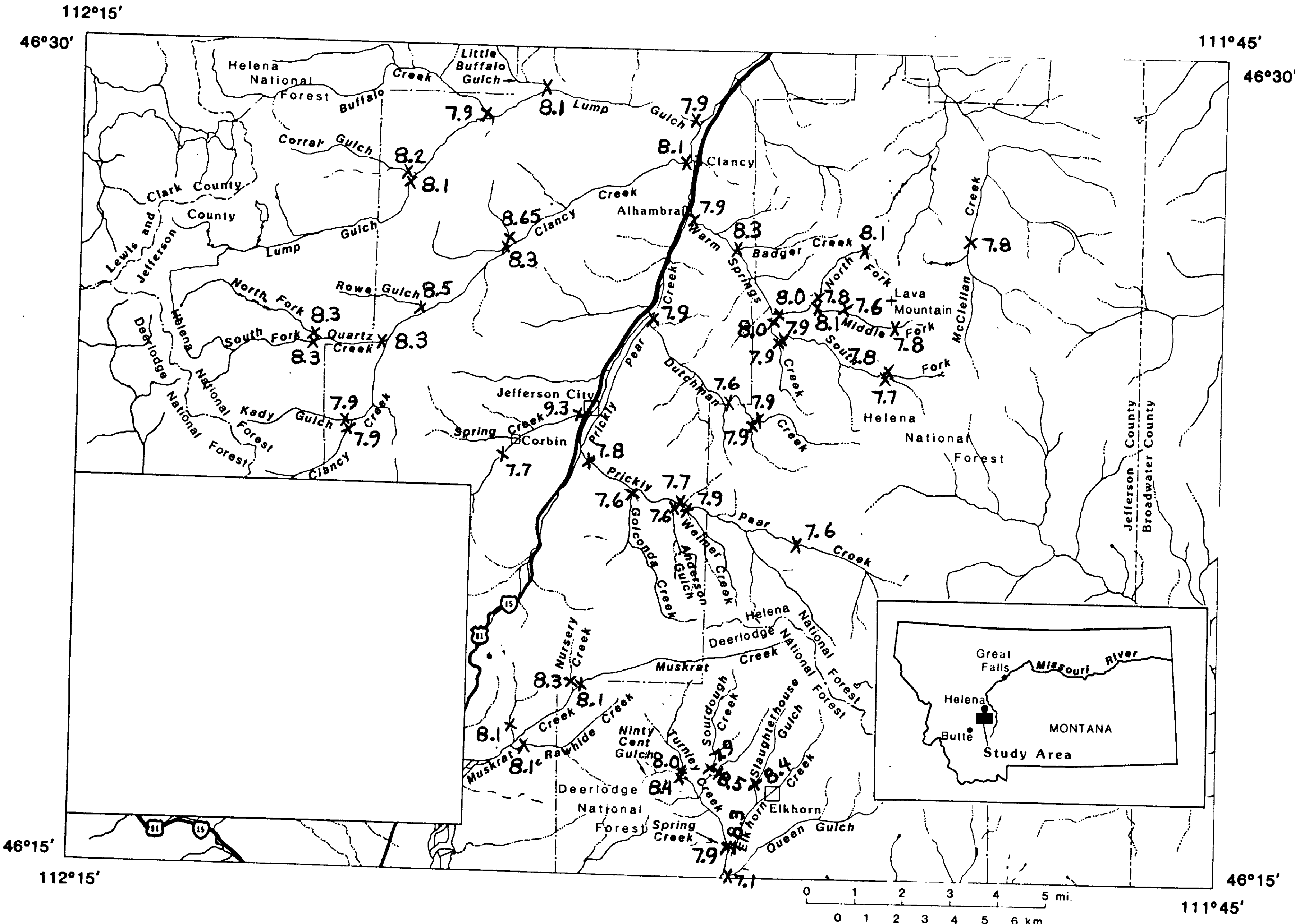

Figure 3-4.--pH data.

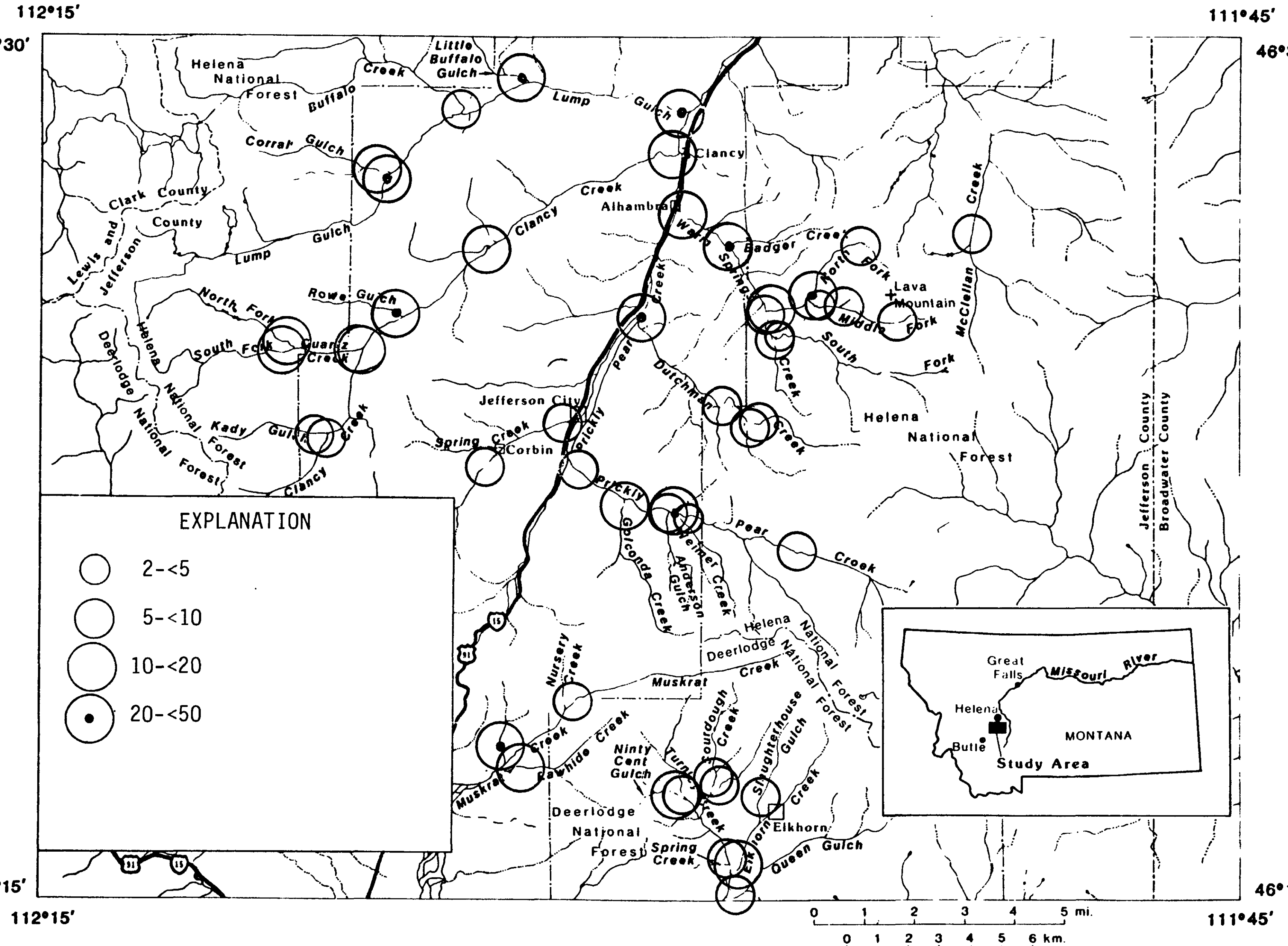

Figure 3-5.--Normalized barium data $\left(\frac{\mu g/L}{\mu mhos/cm} \times 100\right)$.

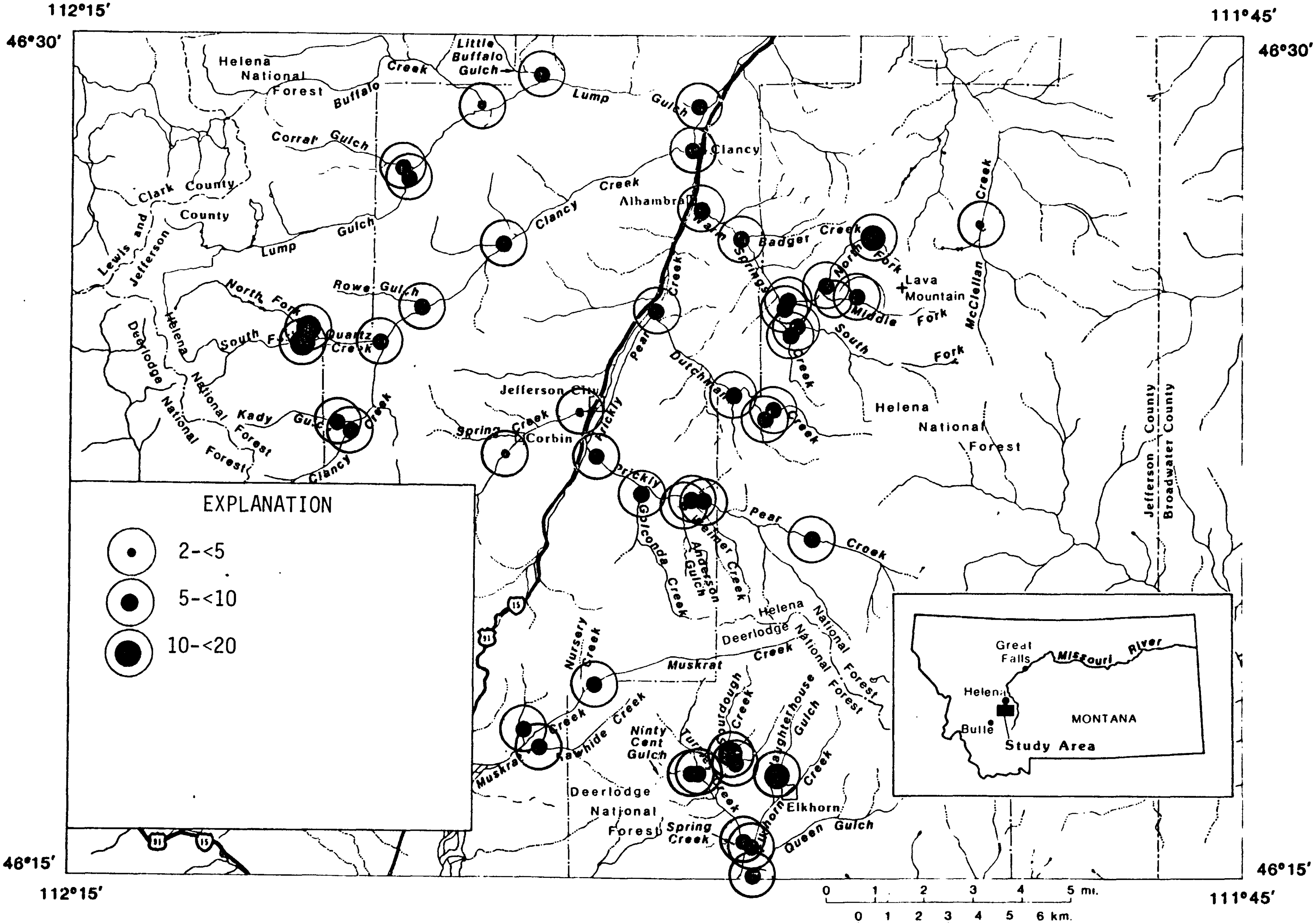

Figure 3-6.--Inorganic carbon data (mg/L).

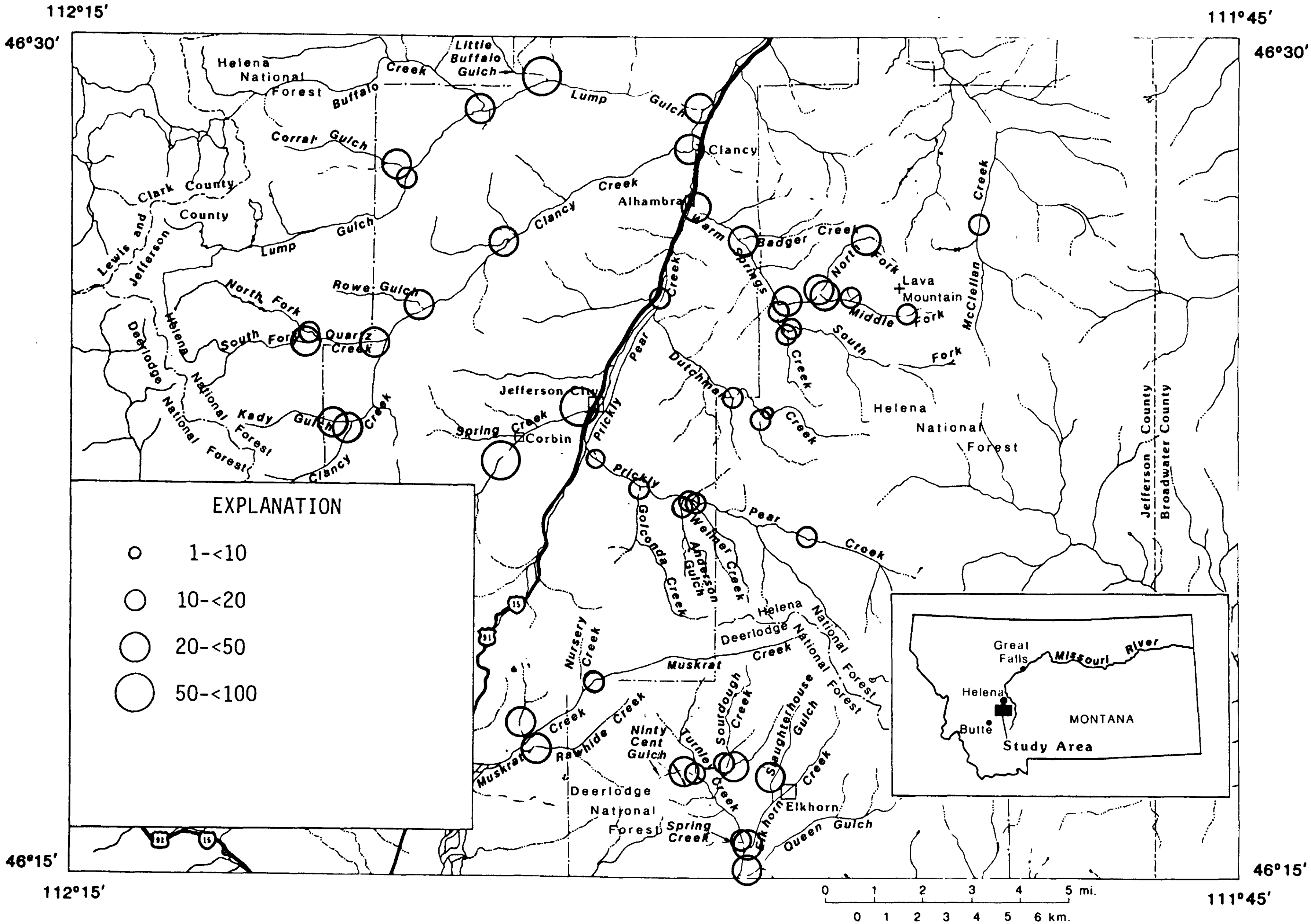

Figure 3-7.--Calcium data (mg/L).

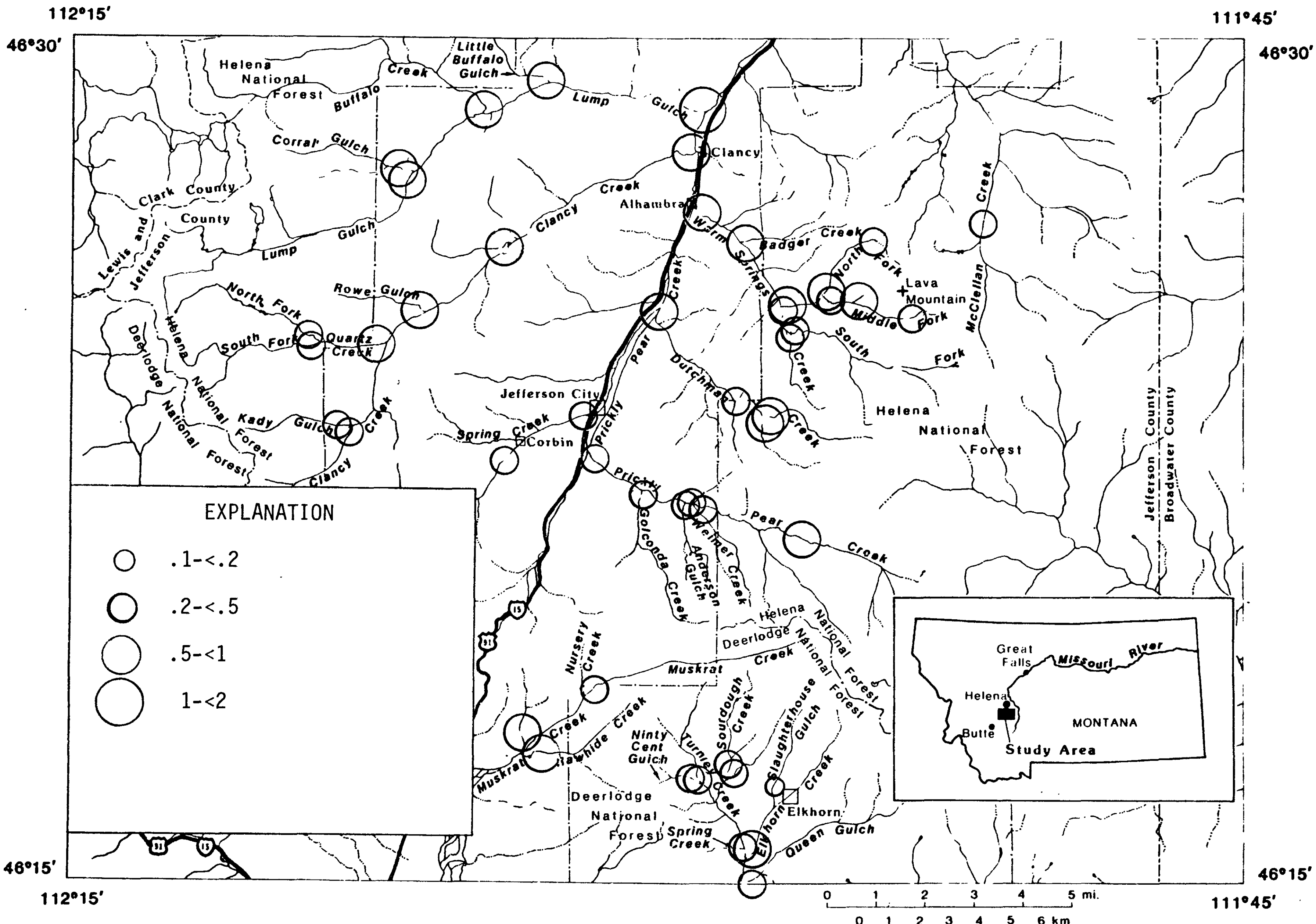

Figure 3-8.--Normalized chloride data ($\frac{mg/L}{\mu mhos/cm}$ x 100).

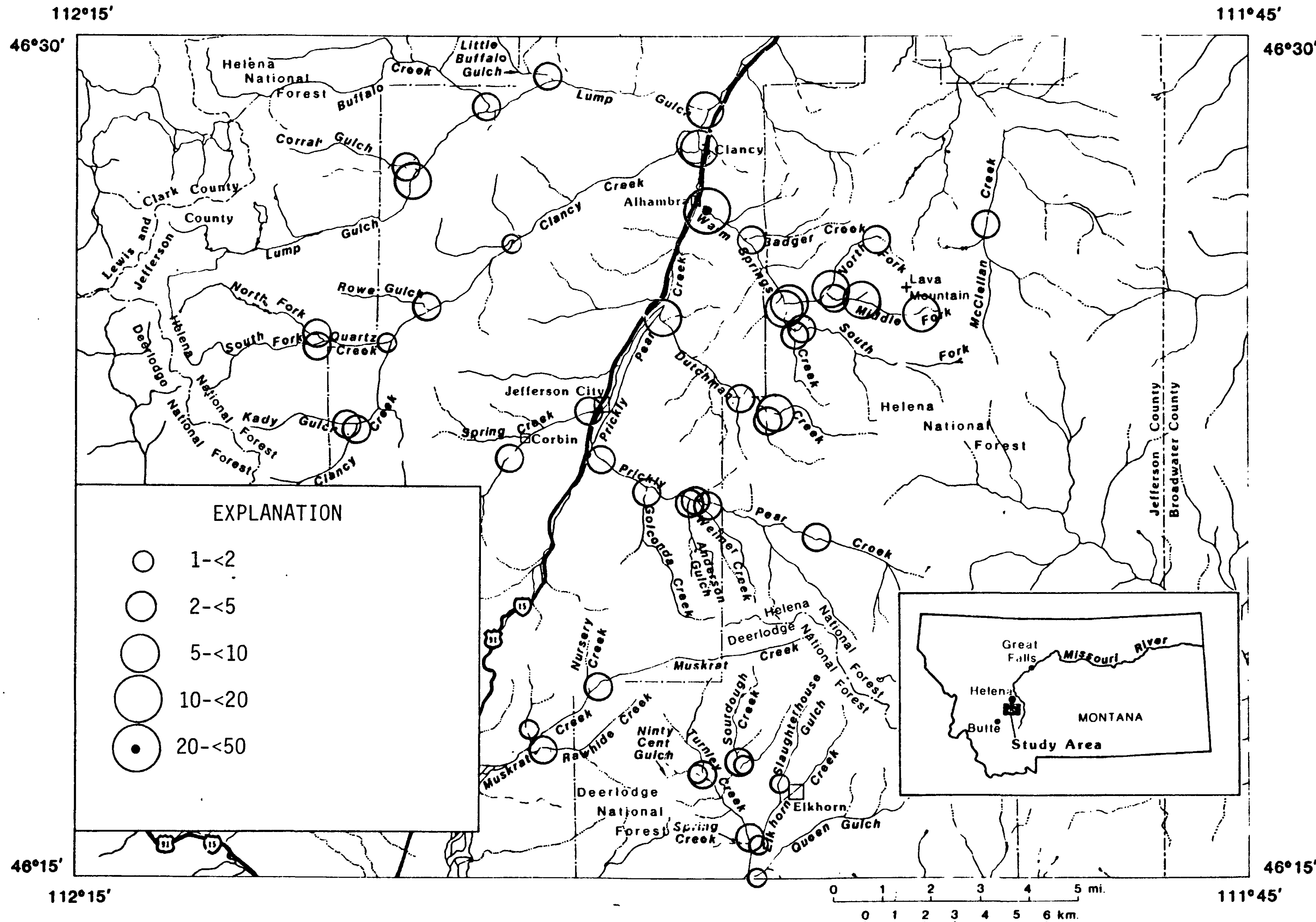

Figure 3-9.--Normalized lithium data($\frac{\mu g/L}{\mu mhos/cm}$ x 100).

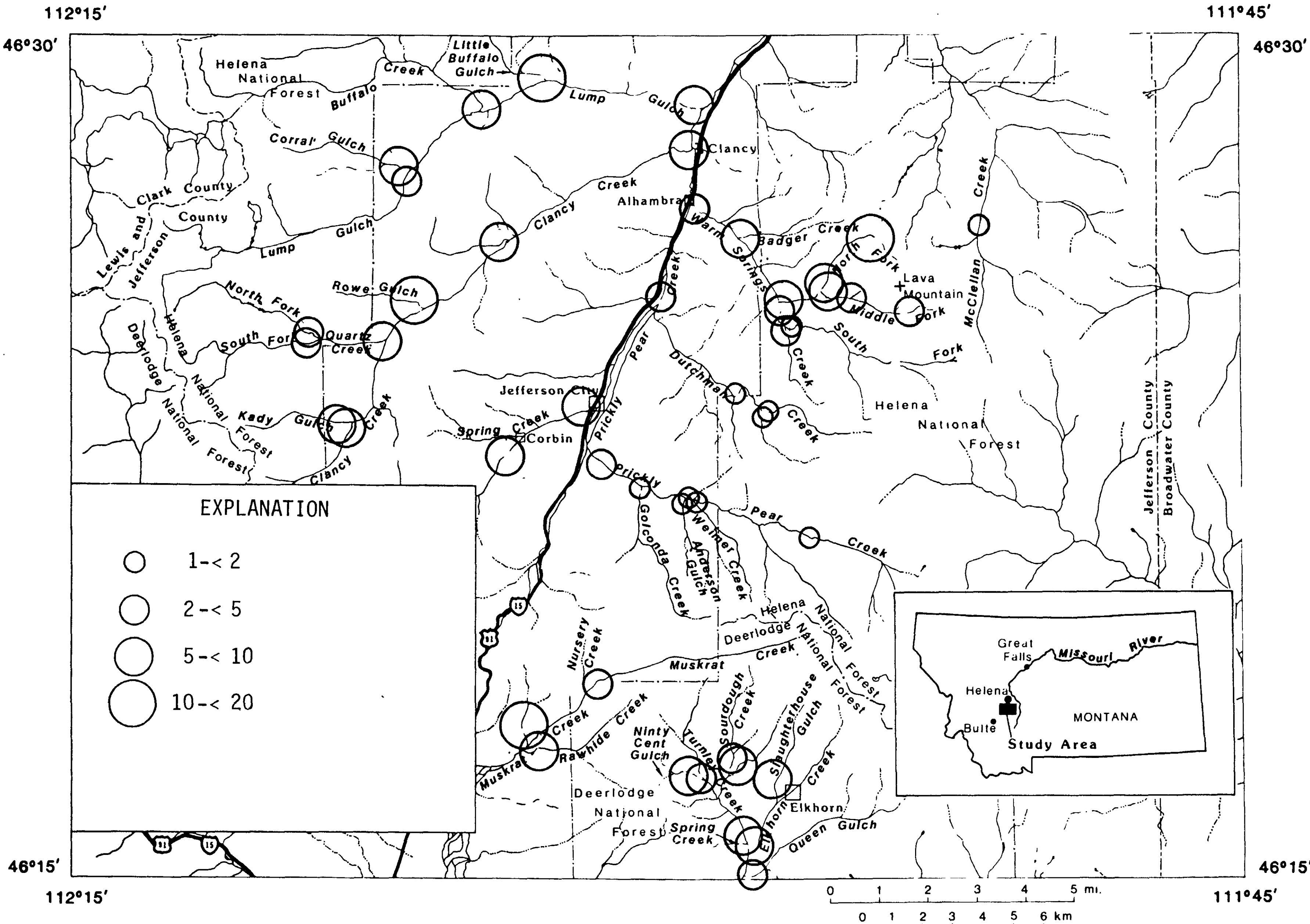

Figure 3-10.--Magnesium data (mg/L).

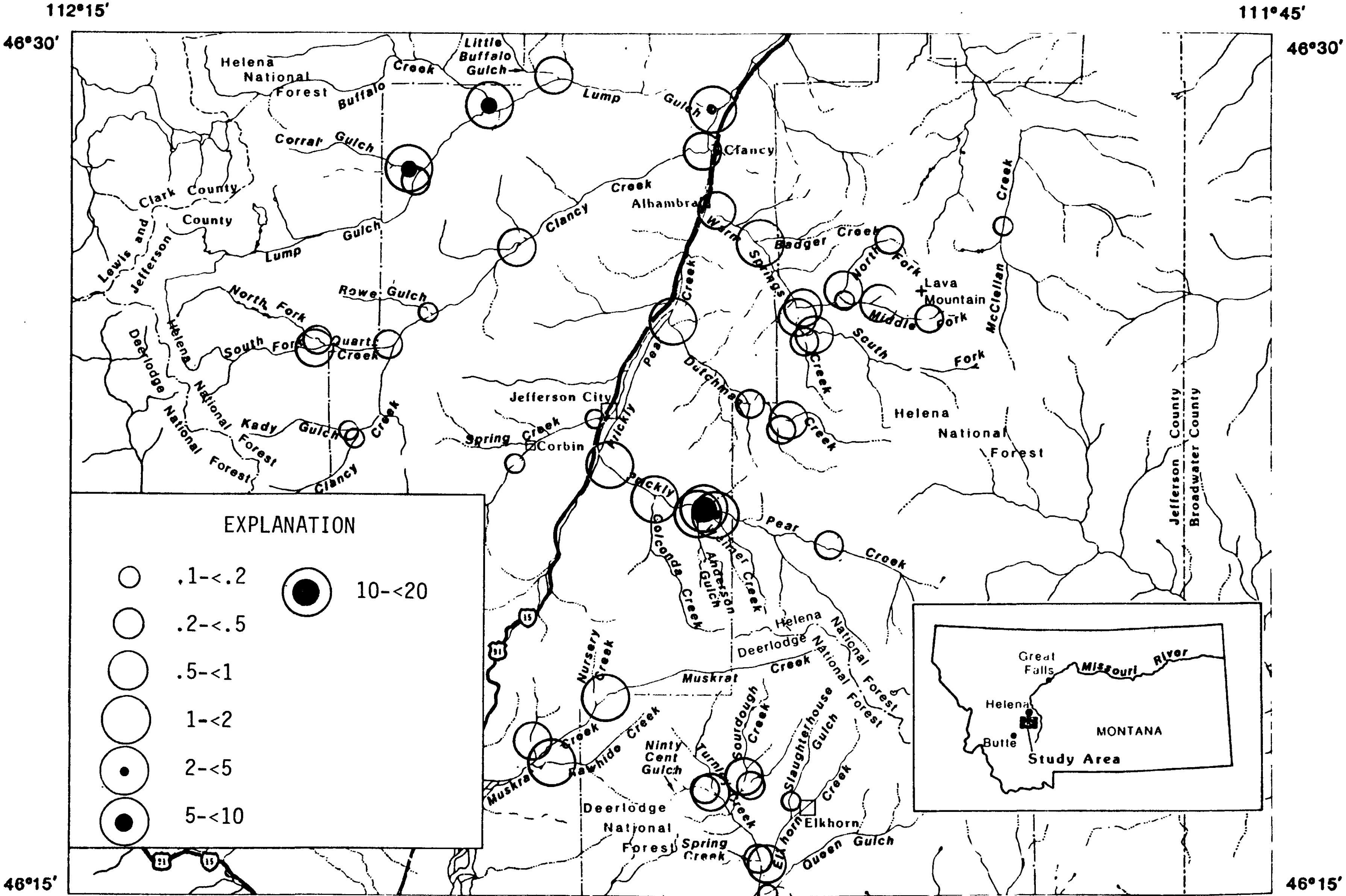

Figure 3-11.--Normalized molybdenum data ($\frac{\mu g/L}{\mu mhos/cm}$ x 100).

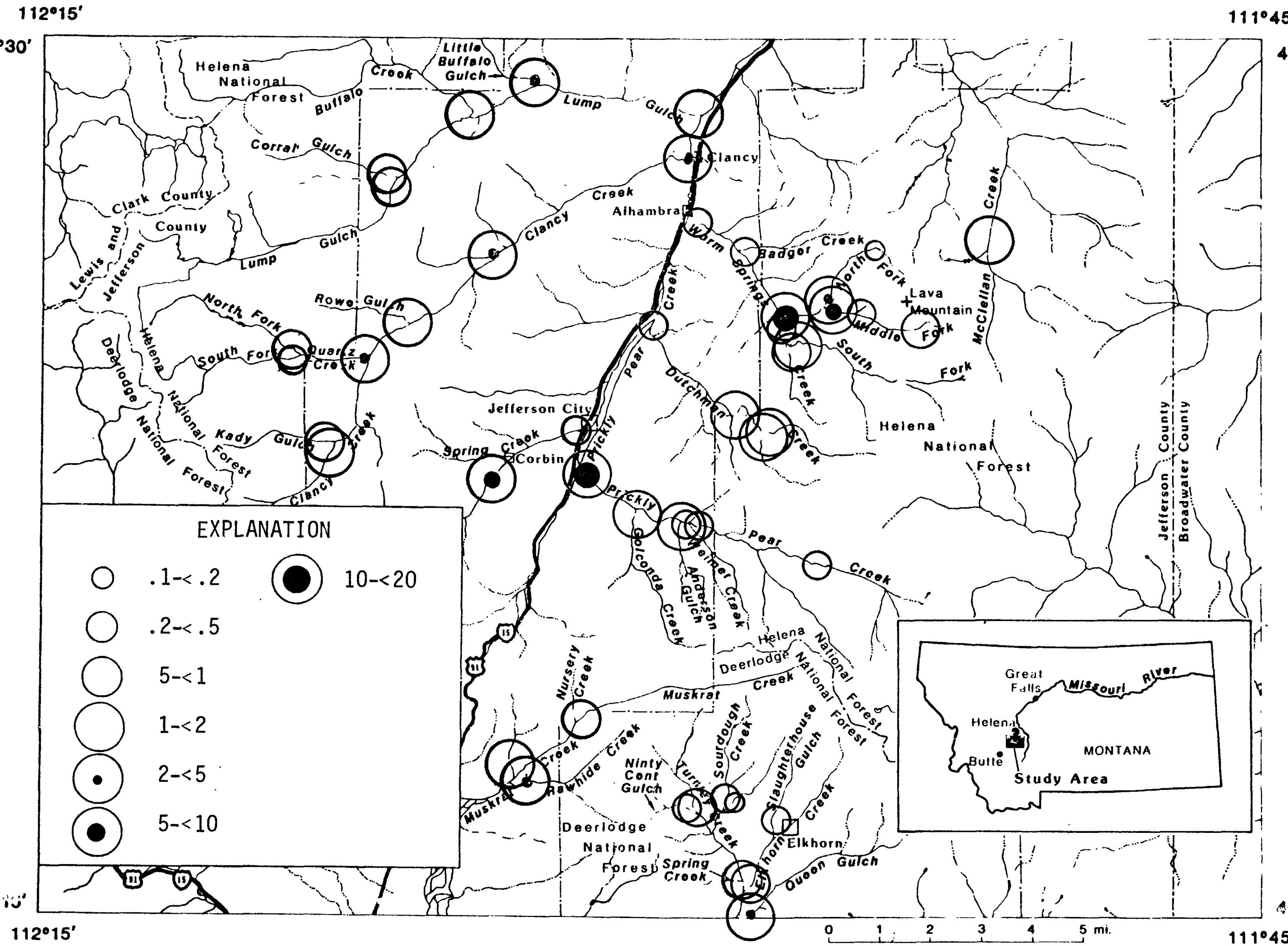

Figure 3-12.--Normalized nitrite + nitrate data ($\frac{mg/L}{\mu mhos/cm}$ x 100).

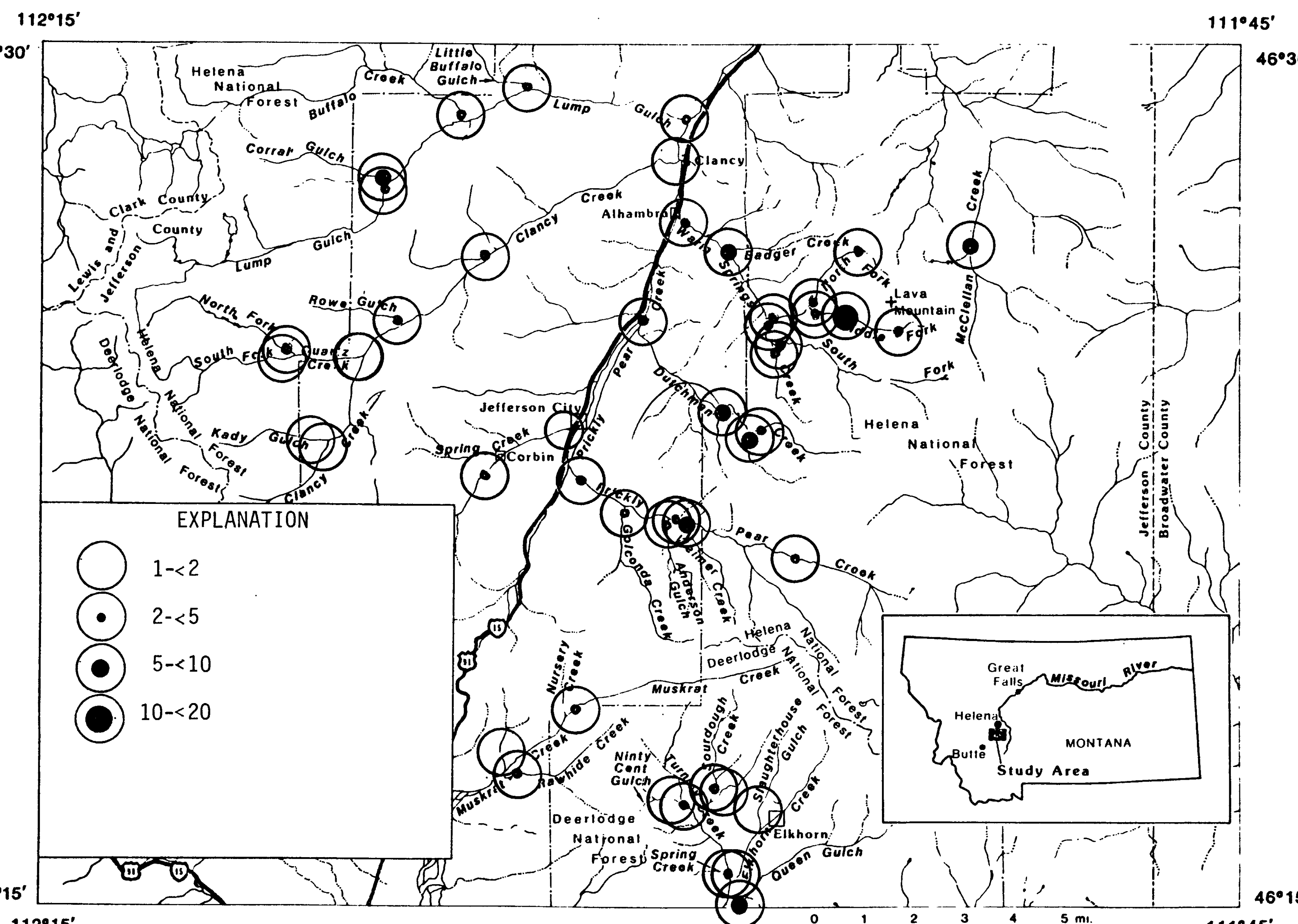

Figure 3-13.--Normalized phosphate data ($\frac{mg/L}{\mu mhos/cm} \times 100$).

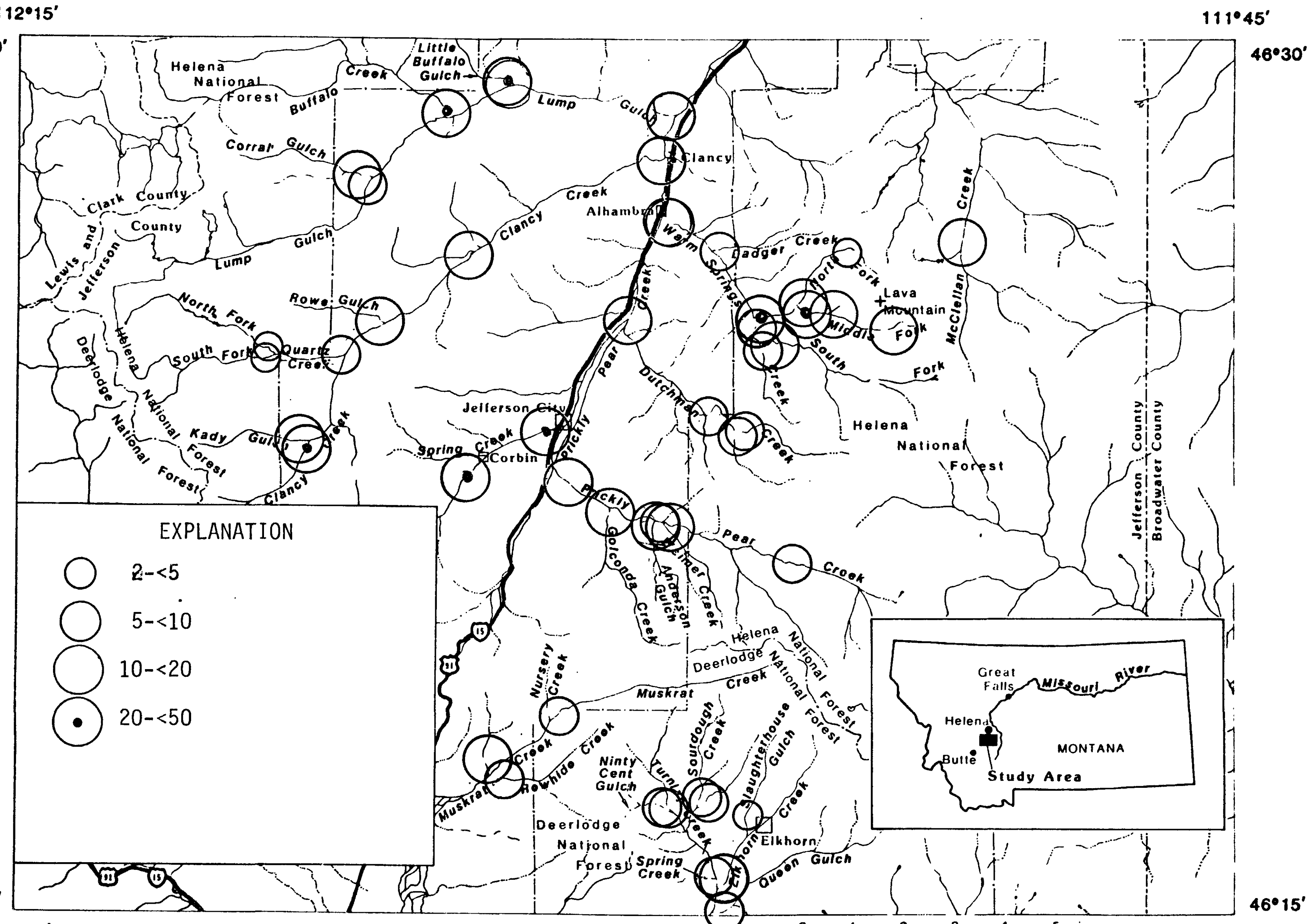

Figure 3-14.--Normalized sulfate data ($\frac{mg/L}{\mu mhos/cm} \times 100$).

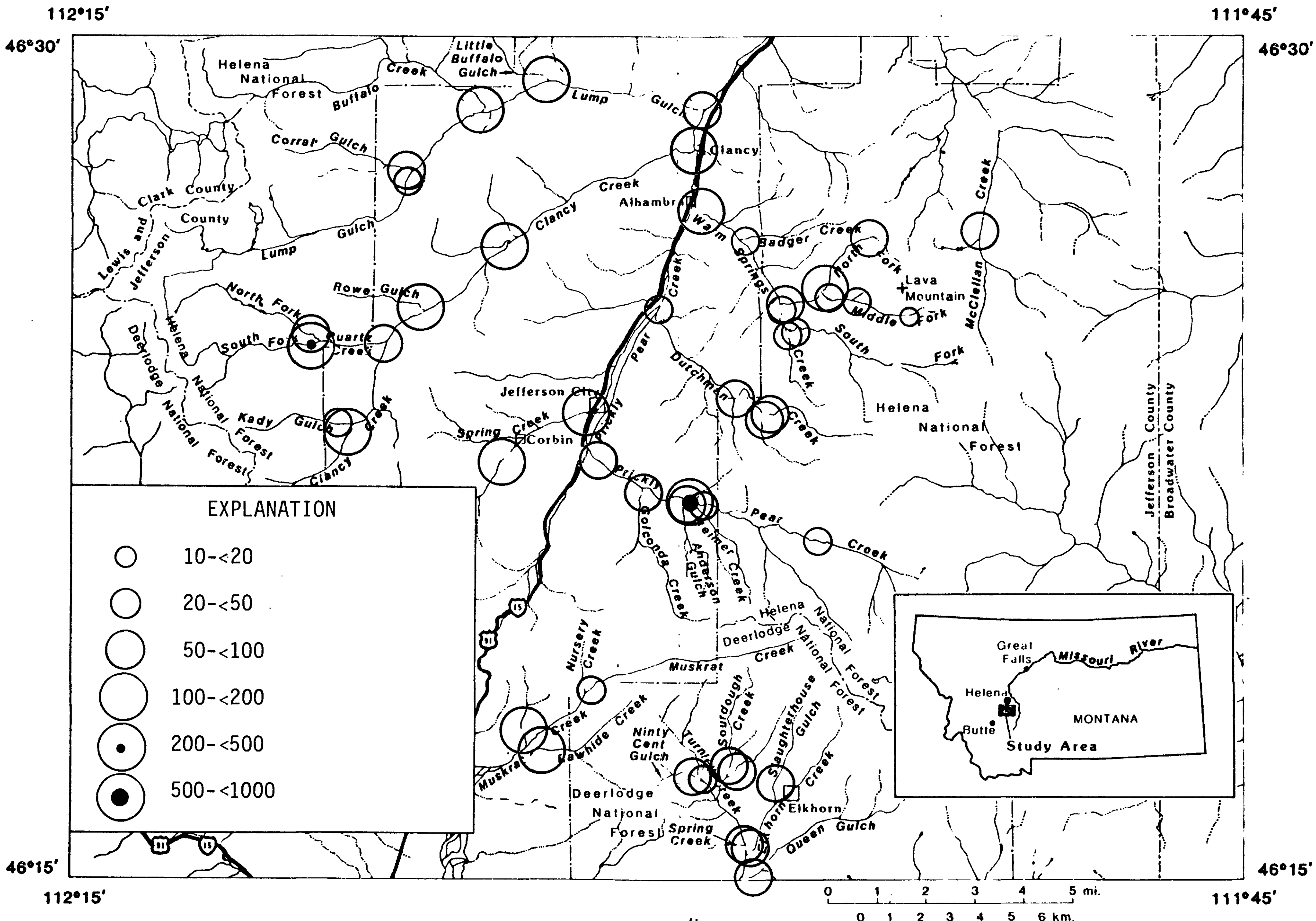

Figure 3-15.--Normalized strontium data ($\frac{\mu g/L}{\mu mhos/cm} \times 100$).

Table 4.--Frequency distributions.

```
   HISTOGRAM FOR VARIABLE      OBS
                               FREQ    1 (Cond-Fld) BOULDER BATHOLITH

 7.500E+01 -  1.290E+02        15  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 1.290E+02 -  1.830E+02         8  XXXXXXXXXXXXXXXXXXX
 1.830E+02 -  2.370E+02         3  XXXXXXX
 2.370E+02 -  2.910E+02         9  XXXXXXXXXXXXXXXXXXXXX
 2.910E+02 -  3.450E+02         4  XXXXXXXXX
 3.450E+02 -  3.990E+02         1  XX
 3.990E+02 -  4.530E+02         3  XXXXXXX
```

```
HISTOGRAM FOR VARIABLE      OBS
                            FREQ    1 (Cond-Fld)    VOLCANIC

1.080E+02 -  1.670E+02        2  XXXXXXXXXXXXXXXXXXXXXX
1.670E+02 -  2.260E+02        1  XXXXXXXXXXX
2.260E+02 -  2.850E+02        2  XXXXXXXXXXXXXXXXXXXXXX
2.850E+02 -  3.440E+02        1  XXXXXXXXXXX
3.440E+02 -  4.030E+02        3  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

```
HISTOGRAM FOR VARIABLE     OBS
                           FREQ      55 (Log -  U)  BOULDER BATHOLITH

-4.318E-01 - -2.118E-01      9  XXXXXXXXXXXXXXXXXXXXX
-2.118E-01 -  8.202E-03      7  XXXXXXXXXXXXXXXX
 8.202E-03 -  2.282E-01      6  XXXXXXXXXXXXXX
 2.282E-01 -  4.482E-01      4  XXXXXXXXX
 4.482E-01 -  6.682E-01      9  XXXXXXXXXXXXXXXXXXXXX
 6.682E-01 -  8.882E-01      4  XXXXXXXXX
 8.882E-01 -  1.108E+00      1  XX
 1.108E+00 -  1.328E+00      3  XXXXXXX
```

```
Histogram for:  L- NormU

-3.979E-01 - -2.479E-01   6  XXXXXXXXXXXXXX
-2.479E-01 - -9.794E-02   6  XXXXXXXXXXXXXX
-9.794E-02 -  5.206E-02  13  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 5.206E-02 -  2.021E-01   7  XXXXXXXXXXXXXXXX
 2.021E-01 -  3.521E-01   6  XXXXXXXXXXXXXX
 3.521E-01 -  5.021E-01   2  XXXXX
 5.021E-01 -  6.521E-01   1  XX
 6.521E-01 -  8.021E-01   2  XXXXX
```

```
HISTOGRAM FOR VARIABLE     OBS
                           FREQ     55 (Log -  U)    VOLCANIC

-1.398E+00 - -1.088E+00      1  XXXXXXXXXXX
-1.088E+00 - -7.779E-01      1  XXXXXXXXXXX
-7.779E-01 - -4.679E-01      2  XXXXXXXXXXXXXXXXXXXXXX
-4.679E-01 - -1.579E-01      1  XXXXXXXXXXX
-1.579E-01 -  1.521E-01      3  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 1.521E-01 -  4.621E-01      1  XXXXXXXXXXX
```

```
HISTOGRAM FOR VARIABLE     OBS    4 (  Alk- L)      BOULDER BATHOLITH
                           FREQ

2.400E+01 -  4.300E+01     15 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
4.300E+01 -  6.200E+01      7 XXXXXXXXXXXXXXXXX
6.200E+01 -  8.100E+01      3 XXXXXXXX
8.100E+01 -  1.000E+02      8 XXXXXXXXXXXXXXXXXXXX
1.000E+02 -  1.190E+02      2 XXXXX
1.190E+02 -  1.380E+02      3 XXXXXXXX
1.380E+02 -  1.570E+02      0
1.570E+02 -  1.760E+02      1 XXX
```

```
                           OBS
HISTOGRAM FOR VARIABLE     FREQ    4 (  Alk- L)        VOLCANIC

2.400E+01 -  5.100E+01      2 XXXXXXXXXXXXXXXXXXXXXXX
5.100E+01 -  7.800E+01      4 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
7.800E+01 -  1.050E+02      0
1.050E+02 -  1.320E+02      1 XXXXXXXXXXX
1.320E+02 -  1.590E+02      1 XXXXXXXXXXX
1.590E+02 -  1.860E+02      1 XXXXXXXXXXX
```

```
                           OBS
HISTOGRAM FOR VARIABLE     FREQ    5 (  Eh-Fld)     BOULDER BATHOLITH

4.500E+01 -  6.200E+01      8 XXXXXXXXXXXXXXXXXXX
6.200E+01 -  7.900E+01      6 XXXXXXXXXXXXXX
7.900E+01 -  9.600E+01     11 XXXXXXXXXXXXXXXXXXXXXXXXXX
9.600E+01 -  1.130E+02      8 XXXXXXXXXXXXXXXXXXX
1.130E+02 -  1.300E+02      5 XXXXXXXXXXXX
1.300E+02 -  1.470E+02      4 XXXXXXXXX
1.470E+02 -  1.640E+02      0
1.640E+02 -  1.810E+02      1 XX
```

```
                           OBS
HISTOGRAM FOR VARIABLE     FREQ    5 (  Eh-Fld)  VOLCANIC

3.700E+01 -  5.800E+01      2 XXXXXXXXXXXXXXXXXXXXXXX
5.800E+01 -  7.900E+01      0
7.900E+01 -  1.000E+02      0
1.000E+02 -  1.210E+02      3 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.210E+02 -  1.420E+02      4 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

```
                                  OBS
HISTOGRAM FOR VARIABLE            FREQ      59 (Log-Hard)     BOULDER BATHOLITH

1.477E+00 -   1.587E+00           10 XXXXXXXXXXXXXXXXXXXXXXXXXX
1.587E+00 -   1.697E+00            4 XXXXXXXXXX
1.697E+00 -   1.807E+00            6 XXXXXXXXXXXXXXX
1.807E+00 -   1.917E+00            3 XXXXXXXX
1.917E+00 -   2.027E+00            3 XXXXXXXX
2.027E+00 -   2.137E+00           10 XXXXXXXXXXXXXXXXXXXXXXXXXX
2.137E+00 -   2.247E+00            2 XXXXX
2.247E+00 -   2.357E+00            1 XXX
```

```
                                  OBS
HISTOGRAM FOR VARIABLE            FREQ      59 (Log-Hard)     VOLCANIC

1.531E+00 -   1.661E+00            1 XXXXXXXXXXX
1.661E+00 -   1.791E+00            0
1.791E+00 -   1.921E+00            1 XXXXXXXXXXX
1.921E+00 -   2.051E+00            2 XXXXXXXXXXXXXXXXXXXXXX
2.051E+00 -   2.181E+00            1 XXXXXXXXXXX
2.181E+00 -   2.311E+00            4 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

```
                                  OBS
HISTOGRAM FOR VARIABLE            FREQ      60 (Log-HdNC)     BOULDER BATHOLITH

0.000E+00 -   2.500E-01            1 XXX
2.500E-01 -   5.000E-01            4 XXXXXXXXXX
5.000E-01 -   7.500E-01            6 XXXXXXXXXXXXXXX
7.500E-01 -   1.000E+00            6 XXXXXXXXXXXXXXX
1.000E+00 -   1.250E+00           11 XXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.250E+00 -   1.500E+00            2 XXXXX
1.500E+00 -   1.750E+00            5 XXXXXXXXXXXXX
1.750E+00 -   2.000E+00            1 XXX
```

```
                                  OBS
HISTOGRAM FOR VARIABLE            FREQ      60 (Log-HdNC)     VOLCANIC

6.021E-01 -   8.821E-01            2 XXXXXXXXXXXXXXXXXXXXXX
8.821E-01 -   1.162E+00            3 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.162E+00 -   1.442E+00            0
1.442E+00 -   1.722E+00            1 XXXXXXXXXXX
1.722E+00 -   2.002E+00            3 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

```
                                OBS
HISTOGRAM FOR VARIABLE          FREQ       8 (  pH-Fld)     BOULDER  BATHOLITH

7.600E+00 -  7.750E+00           7 XXXXXXXXXXXXXXXX
7.750E+00 -  7.900E+00          15 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
7.900E+00 -  8.050E+00           3 XXXXXXX
8.050E+00 -  8.200E+00           8 XXXXXXXXXXXXXXXXXXX
8.200E+00 -  8.350E+00           7 XXXXXXXXXXXXXXXX
8.350E+00 -  8.500E+00           2 XXXXX
8.500E+00 -  8.650E+00           1 XX
8.650E+00 -  8.800E+00           0
```

```
                                OBS
HISTOGRAM FOR VARIABLE          FREQ       8 (  pH-Fld)          VOLCANIC

7.100E+00 -  7.540E+00          1  XXXXXXXXXXX
7.540E+00 -  7.980E+00          4  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
7.980E+00 -  8.420E+00          3  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
8.420E+00 -  8.860E+00          0
8.860E+00 -  9.300E+00          1  XXXXXXXXXXX
```

```
                                OBS
HISTOGRAM FOR VARIABLE          FREQ       10 (H20 Temp)    BOULDER BATHOLITH

9.000E+00 -  1.110E+01           8 XXXXXXXXXXXXXXXXXXX
1.110E+01 -  1.320E+01          10 XXXXXXXXXXXXXXXXXXXXXXX
1.320E+01 -  1.530E+01          14 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.530E+01 -  1.740E+01           8 XXXXXXXXXXXXXXXXXXX
1.740E+01 -  1.950E+01           1 XX
1.950E+01 -  2.160E+01           1 XX
2.160E+01 -  2.370E+01           0
2.370E+01 -  2.580E+01           1 XX
```

```
                                OBS
HISTOGRAM FOR VARIABLE          FREQ     10 (H20 Temp)          VOLCANIC

1.000E+01 -  1.300E+01          3  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.300E+01 -  1.600E+01          4  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.600E+01 -  1.900E+01          1  XXXXXXXXXXX
1.900E+01 -  2.200E+01          0
2.200E+01 -  2.500E+01          1  XXXXXXXXXXX
2.500E+01 -  2.800E+01          0
```

```
                                  OBS
HISTOGRAM FOR VARIABLE            FREQ       66 (Log - As)        VOLCANIC

3.010E-01 -  4.910E-01             1 XXXXXXXXXXX
4.910E-01 -  6.810E-01             0
6.810E-01 -  8.710E-01             2 XXXXXXXXXXXXXXXXXXXXXX
8.710E-01 -  1.061E+00             0
1.061E+00 -  1.251E+00             3 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

```
                                  OBS
HISTOGRAM FOR VARIABLE            FREQ       67 (Log -  B)        BOULDER BATHOLITH

-6.550E-02 -  1.045E-01            3  XXXXXXXX
 1.045E-01 -  2.745E-01            7  XXXXXXXXXXXXXXXXXX
 2.745E-01 -  4.445E-01           14  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 4.445E-01 -  6.145E-01            4  XXXXXXXXXX
 6.145E-01 -  7.845E-01            3  XXXXXXXX
 7.845E-01 -  9.545E-01            2  XXXXX
 9.545E-01 -  1.124E+00            2  XXXXX
```

```
                                  OBS
HISTOGRAM FOR VARIABLE            FREQ       67 (Log -  B)        VOLCANIC

-4.096E-02 -  1.990E-01            3 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 1.990E-01 -  4.390E-01            2 XXXXXXXXXXXXXXXXXXXXXX
 4.390E-01 -  6.790E-01            2 XXXXXXXXXXXXXXXXXXXXXX
 6.790E-01 -  9.190E-01            0
 9.190E-01 -  1.159E+00            1 XXXXXXXXXXX
```

```
HISTOGRAM FOR VARIABLE      OBS
                            FREQ     68 (Log - Ba)     BOULDER BATHOLITH

5.185E-01 -  7.385E-01       3 XXXXXXXX
7.385E-01 -  9.585E-01      10 XXXXXXXXXXXXXXXXXXXXXXXXXX
9.585E-01 -  1.179E+00       6 XXXXXXXXXXXXXXX
1.179E+00 -  1.399E+00       2 XXXXX
1.399E+00 -  1.619E+00       8 XXXXXXXXXXXXXXXXXXXXX
1.619E+00 -  1.839E+00       6 XXXXXXXXXXXXXXX
1.839E+00 -  2.059E+00       3 XXXXXXXX
2.059E+00 -  2.279E+00       1 XXX
```

```
HISTOGRAM FOR VARIABLE      OBS
                            FREQ     68 (Log - Ba)     VOLCANIC

8.921E-01 -  1.062E+00       1 XXXXXXXXXXX
1.062E+00 -  1.232E+00       3 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.232E+00 -  1.402E+00       2 XXXXXXXXXXXXXXXXXXXXXX
1.402E+00 -  1.572E+00       1 XXXXXXXXXXX
1.572E+00 -  1.742E+00       1 XXXXXXXXXXX
1.742E+00 -  1.912E+00       1 XXXXXXXXXXX
```

```
HISTOGRAM FOR VARIABLE      OBS
                            FREQ     18 (  Bicarb)     BOULDER BATHOLITH

2.900E+01 -  5.200E+01      14 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
5.200E+01 -  7.500E+01       7 XXXXXXXXXXXXXXXXXX
7.500E+01 -  9.800E+01       4 XXXXXXXXXX
9.800E+01 -  1.210E+02       8 XXXXXXXXXXXXXXXXXXXXX
1.210E+02 -  1.440E+02       2 XXXXX
1.440E+02 -  1.670E+02       3 XXXXXXXX
1.670E+02 -  1.900E+02       1 XXX
1.900E+02 -  2.130E+02       0
```

```
HISTOGRAM FOR VARIABLE      OBS
                            FREQ     18 (  Bicarb)     VOLCANIC

2.900E+01 -  6.100E+01       2 XXXXXXXXXXXXXXXXXXXXXX
6.100E+01 -  9.300E+01       4 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
9.300E+01 -  1.250E+02       0
1.250E+02 -  1.570E+02       0
1.570E+02 -  1.890E+02       2 XXXXXXXXXXXXXXXXXXXXXX
1.890E+02 -  2.210E+02       1 XXXXXXXXXXX
```

```
                                OBS
HISTOGRAM FOR VARIABLE          FREQ     19 (  InorgC)    BOULDER BATHOLITH

 1.600E+00 -  6.100E+00          4 XXXXXXXXXXX
 6.100E+00 -  1.060E+01         11 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 1.060E+01 -  1.510E+01          6 XXXXXXXXXXXXXXXX
 1.510E+01 -  1.960E+01          6 XXXXXXXXXXXXXXXX
 1.960E+01 -  2.410E+01          5 XXXXXXXXXXXXX
 2.410E+01 -  2.860E+01          5 XXXXXXXXXXXXX
 2.860E+01 -  3.310E+01          1 XXX
```

```
                                OBS
HISTOGRAM FOR VARIABLE          FREQ     19 (  InorgC)    VOLCANIC

 5.300E+00 -  1.080E+01         2 XXXXXXXXXXXXXXXXXXXXXX
 1.080E+01 -  1.630E+01         4 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 1.630E+01 -  2.180E+01         0
 2.180E+01 -  2.730E+01         0
 2.730E+01 -  3.280E+01         2 XXXXXXXXXXXXXXXXXXXXXX
 3.280E+01 -  3.830E+01         1 XXXXXXXXXXX
```

```
                                OBS
HISTOGRAM FOR VARIABLE          FREQ     73 (Log-OrgC)    BOULDER BATHOLITH

-9.691E-02 -  2.309E-02          8 XXXXXXXXXXXXXXXXXXXXX
 2.309E-02 -  1.431E-01         10 XXXXXXXXXXXXXXXXXXXXXXXXXX
 1.431E-01 -  2.631E-01          7 XXXXXXXXXXXXXXXXXX
 2.631E-01 -  3.831E-01          9 XXXXXXXXXXXXXXXXXXXXXXX
 3.831E-01 -  5.031E-01          1 XXX
 5.031E-01 -  6.231E-01          2 XXXXX
 6.231E-01 -  7.431E-01          2 XXXXX
```

```
                                OBS
HISTOGRAM FOR VARIABLE          FREQ     73 (Log-OrgC)    VOLCANIC

-3.010E-01 - -1.110E-01         3 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
-1.110E-01 -  7.897E-02         5 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 7.897E-02 -  2.690E-01         0
 2.690E-01 -  4.590E-01         0
 4.590E-01 -  6.490E-01         1 XXXXXXXXXXX
```

```
                                      OBS
HISTOGRAM FOR VARIABLE                FREQ      21 (  Ca - A)     BOULDER BATHOLITH

8.900E+00 -  1.590E+01      16   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.590E+01 -  2.290E+01       5   XXXXXXXXXXXXX
2.290E+01 -  2.990E+01       5   XXXXXXXXXXXXX
2.990E+01 -  3.690E+01       6   XXXXXXXXXXXXXXX
3.690E+01 -  4.390E+01       5   XXXXXXXXXXXXX
4.390F+01 -  5.090E+01       1   XXX
5.090E+01 -  5.790E+01       0
5.790E+01 -  6.490E+01       1   XXX
```

```
                                      OBS
HISTOGRAM FOR VARIABLE                FREQ      21 (  Ca - A)   VOLCANIC

1.100E+01 -  1.920E+01       1 XXXXXXXXXXX
1.920E+01 -  2.740E+01       1 XXXXXXXXXXX
2.740E+01 -  3.560E+01       2 XXXXXXXXXXXXXXXXXXXXXX
3.560E+01 -  4.380E+01       1 XXXXXXXXXXX
4.380E+01 -  5.200E+01       2 XXXXXXXXXXXXXXXXXXXXXX
5.200E+01 -  6.020E+01       2 XXXXXXXXXXXXXXXXXXXXXX
```

```
                                      OBS
HISTOGRAM FOR VARIABLE                FREQ      23 (  Cl - C)   BOULDER BATHOLITH

3.000E-01 -  7.900E-01      23XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
7.900E-01 -  1.280E+00       3XXXXXXXX
1.280E+00 -  1.770E+00       3XXXXXXXX
1.770E+00 -  2.260E+00       6XXXXXXXXXXXXXXX
2.260E+00 -  2.750E+00       1XXX
2.750E+00 -  3.240E+00       1XXX
3.240E+00 -  3.730E+00       2XXXXX
```

```
                                      OBS
HISTOGRAM FOR VARIABLE                FREQ      23 (  Cl - C)     VOLCANIC

4.000E-01 -  7.400E-01       4 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
7.400E-01 -  1.080E+00       1 XXXXXXXXXXX
1.080E+00 -  1.420E+00       1 XXXXXXXXXXX
1.420E+00 -  1.760E+00       2 XXXXXXXXXXXXXXXXXXXXXX
1.760E+00 -  2.100E+00       1 XXXXXXXXXXX
2.100E+00 -  2.440E+00       0
```

```
HISTOGRAM FOR VARIABLE     OBS      79 (Log - Cu)    BOULDER BATHOLITH
                           FREQ

-5.376E-01 - -3.476E-01     2   XXXXX
-3.476E-01 - -1.576E-01     4   XXXXXXXXXX
-1.576E-01 -  3.240E-02     7   XXXXXXXXXXXXXXXXX
 3.240E-02 -  2.224E-01    10   XXXXXXXXXXXXXXXXXXXXXXXXX
 2.224E-01 -  4.124E-01     8   XXXXXXXXXXXXXXXXXXXX
 4.124E-01 -  6.024E-01     5   XXXXXXXXXXXXX
 6.024E-01 -  7.924E-01     1   XXX
 7.924E-01 -  9.824E-01     2   XXXXX
```

```
HISTOGRAM FOR VARIABLE     OBS      79 (Log - Cu)    VOLCANIC
                           FREQ

-6.198E-01 - -3.598E-01     1   XXXXXXXXXXX
-3.598E-01 - -9.979E-02     1   XXXXXXXXXXX
-9.979E-02 -  1.602E-01     3   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 1.602E-01 -  4.202E-01     2   XXXXXXXXXXXXXXXXXXXXXX
 4.202E-01 -  6.802E-01     1   XXXXXXXXXXX
 6.802E-01 -  9.402E-01     1   XXXXXXXXXXX
```

```
HISTOGRAM FOR VARIABLE     OBS      80 (Log - F)    BOULDER BATHOLITH
                           FREQ

-1.000E+00 - -8.500E-01    25   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
-8.500E-01 - -7.000E-01     0
-7.000E-01 - -5.500E-01     4   XXXXXXXXXX
-5.500E-01 - -4.000E-01     5   XXXXXXXXXXXXX
-4.000E-01 - -2.500E-01     1   XXX
-2.500E-01 - -1.000E-01     0
-1.000E-01 -  5.000E-02     1   XXX
 5.000E-02 -  2.000E-01     1   XXX
```

```
HISTOGRAM FOR VARIABLE     OBS      80 (Log - F)    VOLCANIC
                           FREQ

-1.000E+00 - -9.400E-01     6   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
-9.400E-01 - -8.800E-01     0
-8.800E-01 - -8.200E-01     0
-8.200E-01 - -7.600E-01     0
-7.600E-01 - -7.000E-01     0
-7.000E-01 - -6.400E-01     2   XXXXXXXXXXXXXXXXXXXXXX
```

```
HISTOGRAM FOR VARIABLE   OBS
                         FREQ   81 (Log - Fe)     BOULDER BATHOLITH

1.000E+00 - 1.220E+00     4 XXXXXXXXXX
1.220E+00 - 1.440E+00    12 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.440E+00 - 1.660E+00    10 XXXXXXXXXXXXXXXXXXXXXXXXXX
1.660E+00 - 1.880E+00     6 XXXXXXXXXXXXXXX
1.880E+00 - 2.100E+00     2 XXXXX
2.100E+00 - 2.320E+00     2 XXXXX
2.320E+00 - 2.540E+00     3 XXXXXXXX
```

```
HISTOGRAM FOR VARIABLE   OBS
                         FREQ   81 (Log - Fe)     VOLCANIC

1.000E+00 - 1.170E+00     3 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.170E+00 - 1.340E+00     3 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.340E+00 - 1.510E+00     1 XXXXXXXXXXX
1.510E+00 - 1.680E+00     0
1.680E+00 - 1.850E+00     2 XXXXXXXXXXXXXXXXXXXXXX
```

```
HISTOGRAM FOR VARIABLE   OBS
                         FREQ   32 ( K - A)       BOULDER BATHOLITH

8.000E-01 - 1.410E+00    19 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.410E+00 - 2.020E+00     6 XXXXXXXXXXXXXXX
2.020E+00 - 2.630E+00     4 XXXXXXXXXX
2.630E+00 - 3.240E+00     3 XXXXXXXX
3.240E+00 - 3.850E+00     1 XXX
3.850E+00 - 4.460E+00     4 XXXXXXXXXX
4.460E+00 - 5.070E+00     1 XXX
5.070E+00 - 5.680E+00     1 XXX
```

```
HISTOGRAM FOR VARIABLE   OBS
                         FREQ   32 ( K - A)       VOLCANIC

8.000E-01 - 1.120E+00     3 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.120E+00 - 1.440E+00     0
1.440E+00 - 1.760E+00     2 XXXXXXXXXXXXXXXXXXXXXX
1.760E+00 - 2.080E+00     1 XXXXXXXXXXX
2.080E+00 - 2.400E+00     3 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
2.400E+00 - 2.720E+00     0
```

```
                                OBS
HISTOGRAM FOR VARIABLE          FREQ       86 (Log - Li)
```
BOULDER BATHOLITH

```
7.782E-01 -  9.582E-01     10  XXXXXXXXXXXXXXXXXXXXXXXXX
9.582E-01 -  1.138E+00      4  XXXXXXXXXX
1.138E+00 -  1.318E+00      6  XXXXXXXXXXXXXXX
1.318E+00 -  1.498E+00      0
1.498E+00 -  1.678E+00      0
1.678E+00 -  1.858E+00      1  XXX
```

```
                                OBS
HISTOGRAM FOR VARIABLE          FREQ       87 (Log - Mg)
```
BOULDER BATHOLITH

```
1.761E-01 -  3.061E-01     11  XXXXXXXXXXXXXXXXXXXXXXXXXXX
3.061E-01 -  4.361E-01      2  XXXXX
4.361E-01 -  5.661E-01      7  XXXXXXXXXXXXXXXXX
5.661E-01 -  6.961E-01      2  XXXXX
6.961E-01 -  8.261E-01      4  XXXXXXXXXX
8.261E-01 -  9.561E-01      8  XXXXXXXXXXXXXXXXXXXX
9.561E-01 -  1.086E+00      5  XXXXXXXXXXXX
```

```
                                OBS
HISTOGRAM FOR VARIABLE          FREQ       87 (Log - Mg)
```
VOLCANIC

```
2.041E-01 -  3.741E-01      1 XXXXXXXXXXX
3.741E-01 -  5.441E-01      0
5.441E-01 -  7.141E-01      1 XXXXXXXXXXX
7.141E-01 -  8.841E-01      3 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
8.841E-01 -  1.054E+00      4 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

```
                                  OBS
HISTOGRAM FOR VARIABLE            FREQ        89 (Log - Mo)    BOULDER BATHOLITH

-6.198E-01 - -3.298E-01            4     XXXXXXXXXX
-3.298E-01 - -3.979E-02           12     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
-3.979E-02 -  2.502E-01            7     XXXXXXXXXXXXXXXXX
 2.502E-01 -  5.402E-01            8     XXXXXXXXXXXXXXXXXXXX
 5.402E-01 -  8.302E-01            2     XXXXX
 8.302E-01 -  1.120E+00            3     XXXXXXXX
 1.120E+00 -  1.410E+00            0
 1.410E+00 -  1.700E+00            1     XXX
```

```
                                  OBS
HISTOGRAM FOR VARIABLE            FREQ        90 (Log - Na)    BOULDER BATHOLITH

4.472E-01 -  5.972E-01            15 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
5.972E-01 -  7.472E-01            10 XXXXXXXXXXXXXXXXXXXXXXXXX
7.472E-01 -  8.972E-01             6 XXXXXXXXXXXXXXX
8.972E-01 -  1.047E+00             4 XXXXXXXXXX
1.047E+00 -  1.197E+00             3 XXXXXXXX
1.197E+00 -  1.347E+00             0
1.347E+00 -  1.497E+00             0
1.497E+00 -  1.647E+00             1 XXX
```

```
                                  OBS
HISTOGRAM FOR VARIABLE            FREQ        90 (Log - Na)
                                                          VOLCANIC

3.617E-01 -  5.017E-01             1   XXXXXXXXXXX
5.017E-01 -  6.417E-01             2   XXXXXXXXXXXXXXXXXXXXXX
6.417E-01 -  7.817E-01             2   XXXXXXXXXXXXXXXXXXXXXX
7.817E-01 -  9.217E-01             1   XXXXXXXXXXX
9.217E-01 -  1.062E+00             3   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

```
HISTOGRAM FOR VARIABLE         OBS
                               FREQ        93 (Log-N2N3)        BOULDER BATHOLITH

-2.000E+00 - -1.770E+00        15  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
-1.770E+00 - -1.540E+00         2  XXXXX
-1.540E+00 - -1.310E+00         2  XXXXX
-1.310E+00 - -1.080E+00         8  XXXXXXXXXXXXXXXXXXXX
-1.080E+00 - -8.500E-01         0
-8.500E-01 - -6.200E-01         2  XXXXX
-6.200E-01 - -3.900E-01         0
-3.900E-01 - -1.600E-01         1  XXX
```

```
HISTOGRAM FOR VARIABLE         OBS
                               FREQ        93 (Log-N2N3)        VOLCANIC

-2.000E+00 - -1.700E+00         3  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
-1.700E+00 - -1.400E+00         2  XXXXXXXXXXXXXXXXXXXXX
-1.400E+00 - -1.100E+00         2  XXXXXXXXXXXXXXXXXXXXX
-1.100E+00 - -8.000E-01         0
-8.000E-01 - -5.000E-01         1  XXXXXXXXXXX
```

```
HISTOGRAM FOR VARIABLE         OBS
                               FREQ        96 (Log -P04)
                                                                BOULDER BATHOLITH

-1.523E+00 - -1.413E+00        18  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
-1.413E+00 - -1.303E+00         0
-1.303E+00 - -1.193E+00        11  XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
-1.193E+00 - -1.083E+00         0
-1.083E+00 - -9.729E-01         3  XXXXXXXX
-9.729E-01 - -8.629E-01         3  XXXXXXXX
-8.629E-01 - -7.529E-01         3  XXXXXXXX
-7.529E-01 - -6.429E-01         1  XXX
```

```
HISTOGRAM FOR VARIABLE         OBS
                               FREQ        96 (Log -P04)        VOLCANIC

-1.523E+00 - -1.403E+00        4XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
-1.403E+00 - -1.283E+00        0
-1.283E+00 - -1.163E+00        2XXXXXXXXXXXXXXXXXXXXXX
-1.163E+00 - -1.043E+00        1XXXXXXXXXXX
-1.043E+00 - -9.229E-01        0
-9.229E-01 - -8.029E-01        2XXXXXXXXXXXXXXXXXXXXXX
```

```
                              OBS
HISTOGRAM FOR VARIABLE        FREQ      99 (Log-Si02)       BOULDER BATHOLITH

1.146E+00 -  1.197E+00         6    XXXXXXXXXXXXXXX
1.197E+00 -  1.248E+00         7    XXXXXXXXXXXXXXXXXX
1.248E+00 -  1.299E+00         8    XXXXXXXXXXXXXXXXXXXXX
1.299E+00 -  1.350E+00         9    XXXXXXXXXXXXXXXXXXXXXXX
1.350E+00 -  1.401E+00         5    XXXXXXXXXXXXX
1.401E+00 -  1.452E+00         1    XXX
1.452E+00 -  1.503E+00         2    XXXXX
1.503E+00 -  1.554E+00         1    XXX
```

```
                              OBS
HISTOGRAM FOR VARIABLE        FREQ      99 (Log-Si02)       VOLCANIC

1.176E+00 -  1.205E+00         4   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.205E+00 -  1.234E+00         1   XXXXXXXXXXX
1.234E+00 -  1.263E+00         1   XXXXXXXXXXX
1.263E+00 -  1.292E+00         1   XXXXXXXXXXX
1.292E+00 -  1.321E+00         1   XXXXXXXXXXX
1.321E+00 -  1.350E+00         1   XXXXXXXXXXX
```

```
                              OBS
HISTOGRAM FOR VARIABLE        FREQ      101 (Log -S04)      BOULDER BATHOLITH

7.853E-01 -  9.553E-01         9  XXXXXXXXXXXXXXXXXXXXXXX
9.553E-01 -  1.125E+00         9  XXXXXXXXXXXXXXXXXXXXXXX
1.125E+00 -  1.295E+00         5  XXXXXXXXXXXXX
1.295E+00 -  1.465E+00         5  XXXXXXXXXXXXX
1.465E+00 -  1.635E+00         4  XXXXXXXXXX
1.635E+00 -  1.805E+00         4  XXXXXXXXXX
1.805E+00 -  1.975E+00         3  XXXXXXXX
```

```
                              OBS
HISTOGRAM FOR VARIABLE        FREQ      101 (Log -S04)      VOLCANIC

9.395E-01 -  1.170E+00         4   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.170E+00 -  1.400E+00         0
1.400E+00 -  1.630E+00         2   XXXXXXXXXXXXXXXXXXXXXX
1.630E+00 -  1.860E+00         1   XXXXXXXXXXX
1.860E+00 -  2.090E+00         2   XXXXXXXXXXXXXXXXXXXXXX
```

```
HISTOGRAM FOR VARIABLE        OBS
                              FREQ    102 (Log - Sr)    BOULDER BATHOLITH

 1.380E+00 -  1.580E+00        5   XXXXXXXXXXXXX
 1.580E+00 -  1.780E+00       10   XXXXXXXXXXXXXXXXXXXXXXXXX
 1.780E+00 -  1.980E+00        3   XXXXXXXX
 1.980E+00 -  2.180E+00        7   XXXXXXXXXXXXXXXXXX
 2.180E+00 -  2.380E+00        2   XXXXX
 2.380E+00 -  2.580E+00        6   XXXXXXXXXXXXXXX
 2.580E+00 -  2.730E+00        5   XXXXXXXXXXXXX
 2.780E+00 -  2.980E+00        1   XXX


HISTOGRAM FOR VARIABLE        OBS
                              FREQ    102 (Log - Sr)    VOLCANIC

 1.699E+00 -  1.919E+00        2   XXXXXXXXXXXXXXXXXXXXXX
 1.919E+00 -  2.139E+00        1   XXXXXXXXXXX
 2.139E+00 -  2.359E+00        1   XXXXXXXXXXX
 2.359E+00 -  2.579E+00        3   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 2.579E+00 -  2.799E+00        0
 2.799E+00 -  3.019E+00        2   XXXXXXXXXXXXXXXXXXXXXX


HISTOGRAM FOR VARIABLE        OBS
                              FREQ    104 (Log -  V)    BOULDER BATHOLITH

-8.861E-01 - -7.061E-01        4   XXXXXXXXXX
-7.061E-01 - -5.261E-01        7   XXXXXXXXXXXXXXXXXX
-5.261E-01 - -3.461E-01       10   XXXXXXXXXXXXXXXXXXXXXXXXXX
-3.461E-01 - -1.661E-01        6   XXXXXXXXXXXXXXX
-1.661E-01 -  1.394E-02        3   XXXXXXXX
 1.394E-02 -  1.939E-01        0
 1.939E-01 -  3.739E-01        0
 3.739E-01 -  5.539E-01        1   XXX


HISTOGRAM FOR VARIABLE        OBS
                              FREQ    104 (Log -  V)    VOLCANIC

-1.000E+00 - -8.200E-01        2   XXXXXXXXXXXXXXXXXXXXXX
-8.200E-01 - -6.400E-01        0
-6.400E-01 - -4.600E-01        1   XXXXXXXXXXX
-4.600E-01 - -2.800E-01        1   XXXXXXXXXXX
-2.800E-01 - -1.000E-01        3   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

Table 5.--Population statistics for Boulder batholith samples.

VARIABLE	TRANS-FORMATION	UNITS	MINIMUM	MAXIMUM	MEAN OR GEOM. MEAN	STANDARD OR GEOM. DEV.	VALID VALUES	PERCENT ASSIGNED	PERCENT QUALIFIED
Cond-Fld[1]	None	µmhos/cm	75.00	451.00	198.12	107.24	43	0	0
U - F	Log	µg/L	0.37	13.00	1.86	2.80	43	0	0
Norm U	Log	--	0.49	4.81	1.08	1.87	43	0	0
Alk- L[1]	None	mg/L	24.00	160.00	65.26	35.44	39	0	0
Norm Alk	None	--	19.23	46.51	34.40	6.59	39	0	0
Eh-Fld	None	mv	45.00	165.00	92.91	28.18	43	0	0
Hardness	Log	mg/L	30.00	190.00	67.33	1.74	39	0	0
NormHard	Log	--	25.59	48.15	40.36	1.15	39	0	0
HardNonC	Log	mg/L	0.50*	59.00	7.36**	3.71**	36	0	7.69
NrmHrdNC	Log	--	0.13	19.62	4.48	3.18	39	7.69	0
pH-Fld	None	units	7.60	8.65	8.00	0.26	43	0	0
H2O Temp	None	°C	9.00	24.00	13.76	3.08	43	0	0
As - A	Log	µg/L	1.00*	66.00	0.40**	13.63**	14	0	64.10
Norm As	Log	--	0.17	25.38	0.96	3.33	39	64.10	0
B - S	Log	µg/L	0.55	13.00	2.27	2.02	39	10.26	0
Norm B	Log	--	0.29	13.68	1.36	2.28	39	10.26	0
Ba - S	Log	µg/L	3.30	120.00	18.94	2.62	39	0	0
Norm Ba	Log	--	3.67	44.21	11.36	1.87	39	0	0
Bicarb	None	mg/L	29.00	190.00	79.72	45.40	39	0	0
Nrmbicar	None	--	23.08	56.98	41.99	8.18	39	0	0
InorgC	None	mg/L	1.60	33.00	14.45	7.90	38	0	0
Norm InC	None	--	0.62	10.47	7.75	1.88	38	0	0
Org C	Log	mg/L	0.30	5.50	1.59	1.62	39	0	0
Ca - A	None	mg/L	8.90	58.00	23.28	12.35	39	0	0
Norm Ca	None	--	7.74	14.74	12.32	1.55	39	0	0
Cl - C	None	mg/L	0.30	3.70	1.13	0.90	39	0	0
Norm Cl	None	--	0.27	1.04	0.54	0.17	39	0	0
Cu - S	Log	µg/L	0.29	6.40	1.46	2.07	39	0	0
F - L	Log	mg/L	0.50*	1.20	0.16**	2.06**	37	0	5.13
Norm F	Log	--	0.03	0.44	0.09	1.93	39	5.13	0
Fe - C	Log	µg/L	10.00	340.00	37.30	2.48	39	0	0
Norm Fe	Log	--	3.57	248.18	22.37	2.58	39	0	0
K - A	None	mg/L	0.80	5.10	2.06	1.21	39	0	0
Norm K	None	--	0.52	1.83	1.11	0.28	39	0	0
Li - A	Log	µg/L	5.00*	68.00	5.52**	2.46**	21	0	46.15
Norm Li	Log	--	1.49	22.90	3.97	1.65	39	46.15	0
Mg - A	Log	mg/L	1.50	12.00	3.97	1.99	39	0	0
Norm Mg	Log	--	1.31	4.44	2.38	1.30	39	0	0
Mo - S	Log	µg/L	0.24	27.00	1.33	3.03	39	5.13	0
Norm Mo	Log	--	0.14	12.63	0.80	2.77	39	5.13	0
Na - A	Log	mg/L	2.80	32.00	5.31	1.71	39	0	0
Norm Na	Log	--	1.57	10.77	3.19	1.39	39	0	0
NO2+NO3	Log	mg/L	0.01*	0.41	0.02**	3.68**	30	0	23.08
NormN2N3	Log	--	0.00	0.15	0.01	2.78	39	23.08	0
PO4- L	Log	mg/L	0.03	0.18	0.05	1.82	39	0	0
Norm PO4	Log	--	0.01	0.10	0.03	1.69	39	0	0
SiO2-L	Log	mg/L	14.00	32.00	19.44	1.23	39	0	0
SO4- L	Log	mg/L	6.10	90.00	17.39	2.17	39	0	0
Norm SO4	Log	--	3.84	25.38	10.43	1.51	39	0	0
Sr - S	Log	µg/L	24.00	640.00	113.58	2.70	39	0	0
Norm Sr	Log	--	19.33	526.32	68.11	1.92	39	0	0
V - S	Log	µg/L	0.11	2.50	0.32	1.91	39	20.51	0

*Lower or upper limit of detection
**Parameters calculated from censored populations
"Norm" indicates normalized data were used

1 bimodal
2 skewed
3 insufficient data for further analysis

Table 6.--Population statistics for volcanics samples.

VARIABLE	TRANS-FORMATION	UNITS	MINIMUM	MAXIMUM	MEAN OR GEOM. MEAN	STANDARD OR GEOM. DEV.	VALID VALUES	PERCENT ASSIGNED	PERCENT QUALIFIED
Cond-Fld	None	µmhos/cm	108.00	401.00	264.22	102.61	9	0	0
U - F	Log	µg/L	0.04	1.50	0.42	3.49	9	0	0
Norm U	Log	--	0.04	0.47	0.17	2.33	9	0	0
Alk- L	None	mg/L	24.00	160.00	84.33	49.29	9	0	0
Norm Alk	None	--	15.08	53.33	32.29	14.44	9	0	0
Eh-Fld	None	mv	37.00	140.00	108.56	37.68	9	0	0
Hardness	Log	mg/L	34.00	160.00	112.42	1.68	9	0	0
NormHard	Log	--	31.48	67.48	46.07	1.24	9	0	0
HardNonC	Log	mg/L	4.00	100.00	20.76	3.48	9	0	0
NrmHrdNC	Log	--	1.33	36.04	8.51	3.29	9	0	0
pH-Fld	None	units	7.10	9.30	8.06	0.60	9	0	0
H2O Temp	None	°C	10.00	25.00	14.83	4.70	9	0	0
As - A	Log	µg/L	1.00*	17.00	2.84**	5.21**	6	0	33.33
Norm AS	Log	--	0.31	4.50	1.48	2.68	9	33.33	0
B - S	Log	µg/L	0.91	14.00	2.22	2.29	9	11.11	0
Norm B	Log	--	0.40	4.00	0.91	2.23	9	11.11	0
Ba - S	Log	µg/L	7.80	57.00	21.53	1.88	9	0	0
Norm Ba	Log	--	6.55	16.29	8.82	1.37	9	0	0
Bicarb	None	mg/L	29.00	190.00	101.44	59.27	9	0	0
NrmBicar	None	--	16.93	63.33	38.97	17.54	9	0	0
InorgC	None	mg/L	5.30	33.00	18.20	9.98	9	0	0
Norm InC	None	--	3.17	11.00	7.01	2.97	9	0	0
Org C	Log	mg/L	0.50	4.40	0.95	1.87	9	0	0
Ca - A	None	mg/L	11.00	52.00	37.78	14.12	9	0	0
Norm Ca	None	--	10.19	19.63	14.33	2.60	9	0	0
Cl - C	None	mg/L	0.40	2.10	1.09	0.61	9	0	0
Norm Cl	None	--	0.19	0.60	0.40	0.12	9	0	0
Cu - S	Log	µg/L	0.24	4.90	1.40	2.51	9	0	0
F - L	Log	mg/L	0.50*	0.20	0.14**	1.83**	8	0	11.11
Norm F	Log	--	0.03	0.14	0.06	1.76	9	11.11	0
Fe - C	Log	µg/L	10.00	70.00	21.56	2.09	9	0	0
Norm Fe	Log	--	2.65	42.94	8.84	2.49	9	0	0
K - A	None	mg/L	0.80	2.40	1.59	0.62	9	0	0
Norm K	None	--	0.34	0.92	0.63	0.18	9	0	0
Li - A	Log	µg/L	5.00*	12.00	4.74**	1.67**	4	0	55.56
Norm Li	Log	--	1.07	4.00	2.21	1.49	9	55.56	0
Mg - A	Log	mg/L	1.60	11.00	6.14	1.76	9	0	0
Norm Mg	Log	--	1.48	3.87	2.52	1.36	9	0	0
Mo - S	Log	µg/L	0.14	2.10	0.46	2.43	9	66.67	0
Norm Mo	Log	--	0.11	0.60	0.19	1.79	9	66.67	0
Na - A	Log	mg/L	2.30	11.00	5.46	1.79	9	0	0
Norm Na	Log	--	0.87	3.06	2.24	1.49	9	0	0
NO2+ NO3	Log	mg/L	0.01*	0.31	0.02**	3.44**	8	0	11.11
NormN2N3	Log	--	0.00	0.08	0.01	3.53	9	11.11	0
PO4- L	Log	mg/L	0.03	0.12	0.05	1.63	9	0	0
Norm PO4	Log	--	0.01	0.07	0.02	2.08	9	0	0
SiO2-L	Log	mg/L	15.00	21.00	17.20	1.14	9	0	0
SO4- L	Log	mg/L	8.70	120.00	28.60	2.82	9	0	0
Norm SO4	Log	--	2.90	31.75	11.72	2.44	9	0	0
Sr - S	Log	µg/L	50.00	660.00	210.37	2.49	9	0	0
Norm Sr	Log	--	30.67	174.60	86.21	1.70	9	0	0
V - S	Log	µg/L	0.10	0.76	0.29	2.04	9	22.22	0

*Lower or upper limit of detection
**Parameters calculated from censored populations
"Norm" indicates the data are normalized by conductivity.

Table 7.--Correlation coefficients, r, and numbers of pairs, (n), of Boulder Batholith samples

	Cond-Fld	U - F*	Alk- L	Fh-Fld	Hardness*	HardNonC*	pH-Fld	H20 Temp	B - S*	Ba - S*
Cond-Fld		0.85(43)	0.91(39)	0.21(43)	0.94(39)	0.46(39)	0.60(43)	0.18(43)	0.11(39)	0.80(39)
* U - F			0.84(39)	0.09(43)	0.86(39)	0.34(39)	0.57(43)	0.13(43)	0.12(39)	0.70(39)
Alk- L				0.19(39)	0.92(39)	0.21(39)	0.69(39)	0.22(39)	0.14(39)	0.83(39)
Fh-Fld					0.15(39)	-0.15(39)	0.34(43)	0.07(43)	-0.38(39)	0.09(39)
*Hardness						0.46(39)	0.65(39)	0.21(39)	0.05(39)	0.83(39)
*HardNonC							-0.05(39)	-0.19(39)	0.00(39)	0.26(39)
pH-Fld								0.12(43)	-0.16(39)	0.49(39)
H20 Temp									0.21(39)	0.32(39)
* B - S										0.25(39)
* Ba - S										
Bicarb										
InorgC										
* Org C										
Ca - A										
Cl - C										
* Cu - S										
* F - L										
* Fe - C										
K - A										
* Li - A										
* Mg - A										
* Mo - S										
* Na - A										
*NO2+ NO3										
* PO4- L										
* SiO2-L										
* SO4- L										
* Sr - S										
* V - S										

*Log data were used in calculation
See Table 2 for explanation of abbreviations

See Table 5 for description of sample distribution shapes. Measurements of variables which are not distributed normally or lognormally may not be useable to determine the significance of correlation with other variables.

Table 7, continued

	Bicarb	InorgC	Org C*	Ca - A	Cl - C	Cu - S*	F - L*	Fe - C*	K - A	Li - A*
Cond-Flo	0.91(39)	0.84(38)	0.27(39)	0.96(39)	0.93(39)	0.05(39)	0.43(39)	0.15(39)	0.85(39)	0.67(39)
* U - F	0.85(39)	0.76(38)	0.13(39)	0.86(39)	0.81(39)	-0.07(39)	0.35(39)	0.02(39)	0.68(39)	0.55(39)
Alk- L	1.00(39)	0.96(38)	0.22(39)	0.91(39)	0.86(39)	-0.07(39)	0.34(39)	0.17(39)	0.72(39)	0.56(39)
Eh-Fld	0.18(39)	0.17(38)	0.22(39)	0.11(39)	0.03(39)	-0.08(39)	0.24(39)	0.22(39)	0.11(39)	-0.01(39)
*Hardness	0.93(39)	0.84(38)	0.27(39)	0.97(39)	0.84(39)	0.09(39)	0.29(39)	0.18(39)	0.77(39)	0.53(39)
*HardNonC	0.22(39)	0.12(38)	-0.10(39)	0.51(39)	0.41(39)	0.30(39)	0.03(39)	-0.30(39)	0.41(39)	0.10(39)
pH-Fld	0.69(39)	0.62(38)	0.12(39)	0.59(39)	0.38(39)	0.02(39)	-0.01(39)	0.14(39)	0.29(39)	0.10(39)
H20 Temp	0.20(39)	0.18(38)	0.31(39)	0.15(39)	0.24(39)	0.07(39)	0.64(39)	0.36(39)	0.39(39)	0.57(39)
* B - S	0.14(39)	0.25(38)	-0.17(39)	0.04(39)	0.18(39)	0.01(39)	0.26(39)	-0.04(39)	0.08(39)	0.28(39)
* Ba - S	0.84(39)	0.82(38)	0.32(39)	0.82(39)	0.81(39)	0.19(39)	0.32(39)	0.33(39)	0.72(39)	0.55(39)
Bicarb		0.96(38)	0.21(39)	0.91(39)	0.86(39)	-0.08(39)	0.33(39)	0.16(39)	0.71(39)	0.55(39)
InorgC			0.21(38)	0.83(38)	0.84(38)	-0.06(38)	0.30(38)	0.22(38)	0.67(38)	0.55(38)
* Org C				0.22(39)	0.32(39)	0.31(39)	0.29(39)	0.49(39)	0.53(39)	0.40(39)
Ca - A					0.90(39)	0.08(39)	0.30(39)	0.12(39)	0.80(39)	0.53(39)
Cl - C						0.08(39)	0.47(39)	0.18(39)	0.87(39)	0.71(39)
* Cu - S							-0.09(39)	0.32(39)	0.21(39)	0.03(39)
* F - L								0.03(39)	0.58(39)	0.72(39)
* Fe - C									0.17(39)	0.29(39)
K - A										0.77(39)
* Li - A										
* Mg - A										
* Mo - S										
* Na - A										
*NO2+ NO3										
* PO4- L										
* SiO2-L										
* SO4- L										
* Sr - S										
* V - S										

Table 7, continued

	Mg - A*	Mo - S*	Na - A*	NO2+ NO3*	PO4- L*	SiO2-L*	SO4- L*	Sr - S*	V - S*
Cond-Fld	0.90(39)	0.41(39)	0.83(39)	0.68(39)	0.59(39)	0.60(39)	0.89(39)	0.81(39)	0.05(39)
* U - F	0.82(39)	0.50(39)	0.70(39)	0.62(39)	0.48(39)	0.48(39)	0.71(39)	0.68(39)	0.11(39)
Alk- L	0.90(39)	0.31(39)	0.72(39)	0.50(39)	0.44(39)	0.43(39)	0.67(39)	0.79(39)	0.06(39)
Eh-Fld	0.15(39)	-0.08(39)	-0.05(39)	-0.01(39)	0.13(39)	-0.02(39)	-0.00(39)	0.08(39)	-0.45(39)
*Hardness	0.96(39)	0.38(39)	0.68(39)	0.67(39)	0.48(39)	0.43(39)	0.81(39)	0.80(39)	0.01(39)
*HardNonC	0.44(39)	0.29(39)	0.23(39)	0.60(39)	0.30(39)	0.32(39)	0.68(39)	0.26(39)	0.13(39)
pH-Fld	0.66(39)	-0.02(39)	0.22(39)	0.20(39)	0.10(39)	0.01(39)	0.24(39)	0.46(39)	-0.13(39)
H2O Temp	0.17(39)	0.15(39)	0.48(39)	0.10(39)	0.19(39)	0.30(39)	0.30(39)	0.25(39)	-0.16(39)
* B - S	0.03(39)	0.34(39)	0.30(39)	-0.26(39)	-0.05(39)	0.21(39)	0.10(39)	0.20(39)	0.55(39)
* Ba - S	0.77(39)	0.42(39)	0.64(39)	0.50(39)	0.41(39)	0.33(39)	0.63(39)	0.84(39)	0.24(39)
Bicarb	0.90(39)	0.32(39)	0.71(39)	0.51(39)	0.44(39)	0.43(39)	0.67(39)	0.78(39)	0.07(39)
InorgC	0.82(38)	0.35(38)	0.70(38)	0.39(38)	0.40(38)	0.40(38)	0.57(38)	0.76(38)	0.11(38)
* Org C	0.20(39)	0.17(39)	0.34(39)	0.12(39)	0.42(39)	0.31(39)	0.19(39)	0.18(39)	-0.23(39)
Ca - A	0.91(39)	0.39(39)	0.70(39)	0.70(39)	0.53(39)	0.48(39)	0.83(39)	0.81(39)	0.06(39)
Cl - C	0.78(39)	0.48(39)	0.86(39)	0.64(39)	0.59(39)	0.61(39)	0.81(39)	0.75(39)	0.08(39)
* Cu - S	0.06(39)	0.31(39)	-0.01(39)	0.13(39)	0.04(39)	-0.07(39)	0.14(39)	0.17(39)	-0.01(39)
* F - L	0.28(39)	0.25(39)	0.61(39)	0.22(39)	0.52(39)	0.64(39)	0.50(39)	0.25(39)	-0.12(39)
* Fe - C	0.14(39)	0.16(39)	0.26(39)	0.05(39)	0.03(39)	-0.19(39)	0.02(39)	0.36(39)	-0.25(39)
K - A	0.73(39)	0.51(39)	0.82(39)	0.58(39)	0.75(39)	0.74(39)	0.82(39)	0.64(39)	-0.00(39)
* Li - A	0.52(39)	0.33(39)	0.88(39)	0.42(39)	0.54(39)	0.69(39)	0.67(39)	0.46(39)	0.02(39)
* Mg - A		0.28(39)	0.63(39)	0.63(39)	0.43(39)	0.43(39)	0.77(39)	0.72(39)	0.01(39)
* Mo - S			0.48(39)	0.25(39)	0.36(39)	0.43(39)	0.45(39)	0.50(39)	0.19(39)
* Na - A				0.52(39)	0.58(39)	0.71(39)	0.80(39)	0.64(39)	-0.01(39)
*NO2+ NO3					0.42(39)	0.30(39)	0.76(39)	0.55(39)	-0.13(39)
* PO4- L						0.75(39)	0.61(39)	0.35(39)	-0.06(39)
* SiO2-L							0.67(39)	0.27(39)	0.15(39)
* SO4- L								0.64(39)	-0.00(39)
* Sr - S									0.22(39)
* V - S									

Table 8.--Correlation coefficients, r, and numbers of pairs, (n), of volcanic samples.

	Cond-Fld	U - F*	Alk- L	Fh-Fld	Hardness*	HardNonC*	pH-Fld	H2O Temp	As - A*	B - S*
Cond-Fld	—	0.92(9)	0.46(9)	0.46(9)	0.84(9)	0.35(9)	0.54(9)	0.23(9)	0.75(9)	0.30(9)
* U - F	—	—	0.58(9)	0.55(9)	0.95(9)	0.26(9)	0.55(9)	0.38(9)	0.62(9)	0.30(9)
Alk- L	—	—	—	0.19(9)	0.61(9)	-0.58(9)	0.20(9)	0.30(9)	0.37(9)	0.50(9)
Fh-Fld	—	—	—	—	0.58(9)	0.27(9)	-0.03(9)	0.31(9)	0.29(9)	0.12(9)
*Hardness	—	—	—	—	—	0.26(9)	0.48(9)	0.22(9)	0.55(9)	0.43(9)
*HardNonC	—	—	—	—	—	—	0.30(9)	-0.14(9)	0.10(9)	-0.09(9)
pH-Fld	—	—	—	—	—	—	—	0.44(9)	0.34(9)	0.09(9)
H2O Temp	—	—	—	—	—	—	—	—	-0.17(9)	-0.38(9)
* As - A	—	—	—	—	—	—	—	—	—	0.48(9)
* B - S	—	—	—	—	—	—	—	—	—	—
* Ba - S	—	—	—	—	—	—	—	—	—	—
Bicarb	—	—	—	—	—	—	—	—	—	—
InorgC	—	—	—	—	—	—	—	—	—	—
* Org C	—	—	—	—	—	—	—	—	—	—
Ca - A	—	—	—	—	—	—	—	—	—	—
Cl - C	—	—	—	—	—	—	—	—	—	—
* Cu - S	—	—	—	—	—	—	—	—	—	—
* F - L	—	—	—	—	—	—	—	—	—	—
* Fe - C	—	—	—	—	—	—	—	—	—	—
K - A	—	—	—	—	—	—	—	—	—	—
* Mg - A	—	—	—	—	—	—	—	—	—	—
* Na - A	—	—	—	—	—	—	—	—	—	—
*NO2+ NO3	—	—	—	—	—	—	—	—	—	—
* PO4- L	—	—	—	—	—	—	—	—	—	—
* SiO2-L	—	—	—	—	—	—	—	—	—	—
* SO4- L	—	—	—	—	—	—	—	—	—	—
* Sr - S	—	—	—	—	—	—	—	—	—	—
* V - S	—	—	—	—	—	—	—	—	—	—

*Log data were used in calculation
See Table 2 for explanation of abbreviations

Table 8, continued

	Ba - S*	Bicarb	InorgC	Org C*	Ca - A	Cl - C	Cu - S*	F - L*	Fe - C*	K - A
Cond-Fld	0.86(9)	0.44(9)	0.47(9)	0.21(9)	0.95(9)	0.85(9)	0.48(9)	0.20(9)	-0.18(9)	0.82(9)
* U - F	0.88(9)	0.56(9)	0.58(9)	0.44(9)	0.98(9)	0.75(9)	0.51(9)	0.14(9)	0.05(9)	0.80(9)
Alk- L	0.77(9)	1.00(9)	1.00(9)	0.45(9)	0.56(9)	0.39(9)	0.20(9)	0.15(9)	0.06(9)	0.36(9)
Fh-Fld	0.45(9)	0.17(9)	0.19(9)	0.60(9)	0.47(9)	0.57(9)	0.55(9)	-0.40(9)	0.27(9)	0.59(9)
*Hardness	0.86(9)	0.60(9)	0.62(9)	0.33(9)	0.96(9)	0.65(9)	0.66(9)	0.26(9)	0.07(9)	0.71(9)
*HardNonC	0.01(9)	-0.59(9)	-0.56(9)	-0.29(9)	0.31(9)	0.27(9)	0.40(9)	0.08(9)	0.03(9)	0.38(9)
pH-Fld	0.38(9)	0.18(9)	0.16(9)	-0.12(9)	0.59(9)	0.40(9)	0.53(9)	0.04(9)	-0.18(9)	0.51(9)
H2O Temp	0.27(9)	0.27(9)	0.26(9)	0.71(9)	0.26(9)	0.22(9)	0.02(9)	-0.43(9)	0.47(9)	0.48(9)
* As - A	0.60(9)	0.36(9)	0.39(9)	-0.06(9)	0.67(9)	0.73(9)	0.43(9)	0.09(9)	-0.66(9)	0.44(9)
* B - S	0.56(9)	0.51(9)	0.50(9)	-0.19(9)	0.36(9)	0.51(9)	0.53(9)	0.01(9)	-0.10(9)	0.34(9)
* Ba - S		0.76(9)	0.77(9)	0.39(9)	0.89(9)	0.82(9)	0.45(9)	0.10(9)	0.09(9)	0.82(9)
Bicarb			1.00(9)	0.43(9)	0.55(9)	0.37(9)	0.19(9)	0.18(9)	0.06(9)	0.34(9)
InorgC				0.44(9)	0.57(9)	0.38(9)	0.19(9)	0.20(9)	0.04(9)	0.34(9)
* Org C					0.28(9)	0.25(9)	-0.11(9)	-0.40(9)	0.58(9)	0.39(9)
Ca - A						0.76(9)	0.56(9)	0.24(9)	-0.04(9)	0.79(9)
Cl - C							0.54(9)	-0.26(9)	-0.09(9)	0.90(9)
* Cu - S								-0.10(9)	-0.11(9)	0.53(9)
* F - L									-0.29(9)	-0.26(9)
* Fe - C										0.25(9)
K - A										
* Mg - A										
* Na - A										
*NO2+ NO3										
* PO4- L										
* SiO2-L										
* SO4- L										
* Sr - S										
* V - S										

Table 8, continued

	Mg - A*	Na - A*	NO2+ NO3*	PO4- L*	SiO2-L*	SO4- L*	Sr - S*	V - S*
Cond-Fld	0.75(9)	0.80(9)	0.25(9)	0.10(9)	0.69(9)	0.59(9)	0.94(9)	0.58(9)
* U - F	0.90(9)	0.71(9)	-0.04(9)	0.03(9)	0.61(9)	0.40(9)	0.78(9)	0.67(9)
Alk- L	0.72(9)	0.15(9)	-0.31(9)	0.19(9)	0.32(9)	-0.39(9)	0.34(9)	0.88(9)
Eh-Fld	0.62(9)	0.62(9)	0.11(9)	0.29(9)	0.30(9)	0.41(9)	0.44(9)	0.16(9)
*Hardness	0.98(9)	0.56(9)	-0.03(9)	-0.10(9)	0.40(9)	0.36(9)	0.70(9)	0.69(9)
*HardNonC	0.06(9)	0.50(9)	0.42(9)	-0.36(9)	0.15(9)	0.91(9)	0.33(9)	-0.41(9)
pH-Fld	0.38(9)	0.42(9)	-0.45(9)	-0.61(9)	0.23(9)	0.34(9)	0.48(9)	0.42(9)
H2O Temp	0.28(9)	0.39(9)	-0.60(9)	-0.03(9)	0.35(9)	-0.06(9)	0.25(9)	0.15(9)
* As - A	0.49(9)	0.50(9)	0.30(9)	0.29(9)	0.47(9)	0.34(9)	0.69(9)	0.67(9)
* B - S	0.45(9)	0.22(9)	0.12(9)	-0.01(9)	0.26(9)	0.03(9)	0.07(9)	0.52(9)
* Ba - S	0.86(9)	0.69(9)	0.07(9)	0.18(9)	0.71(9)	0.25(9)	0.71(9)	0.73(9)
Bicarb	0.71(9)	0.12(9)	-0.30(9)	0.19(9)	0.30(9)	-0.41(9)	0.32(9)	0.88(9)
InorgC	0.72(9)	0.13(9)	-0.27(9)	0.21(9)	0.30(9)	-0.38(9)	0.36(9)	0.88(9)
* Org C	0.45(9)	0.35(9)	-0.30(9)	0.49(9)	0.42(9)	-0.21(9)	0.17(9)	0.23(9)
Ca - A	0.89(9)	0.70(9)	0.04(9)	-0.05(9)	0.58(9)	0.46(9)	0.82(9)	0.68(9)
Cl - C	0.60(9)	0.92(9)	0.27(9)	0.27(9)	0.82(9)	0.58(9)	0.75(9)	0.45(9)
* Cu - S	0.63(9)	0.45(9)	-0.12(9)	-0.45(9)	0.01(9)	0.47(9)	0.40(9)	0.39(9)
* F - L	0.16(9)	-0.33(9)	0.25(9)	-0.26(9)	-0.27(9)	-0.01(9)	0.22(9)	0.23(9)
* Fe - C	0.16(9)	0.12(9)	-0.27(9)	-0.04(9)	0.16(9)	-0.10(9)	-0.31(9)	-0.30(9)
K - A	0.66(9)	0.95(9)	0.09(9)	0.05(9)	0.31(9)	0.61(9)	0.71(9)	0.32(9)
* Mg - A		0.50(9)	-0.14(9)	-0.03(9)	0.35(9)	0.19(9)	0.60(9)	0.74(9)
* Na - A			0.27(9)	0.18(9)	0.84(9)	0.74(9)	0.73(9)	0.16(9)
*NO2+ NO3				0.45(9)	0.28(9)	0.55(9)	0.31(9)	-0.30(9)
* PO4- L					0.46(9)	-0.15(9)	0.13(9)	0.06(9)
* SiO2-L						0.40(9)	0.57(9)	0.24(9)
* SO4- L							0.61(9)	-0.24(9)
* Sr - S								0.46(9)
* V - S								

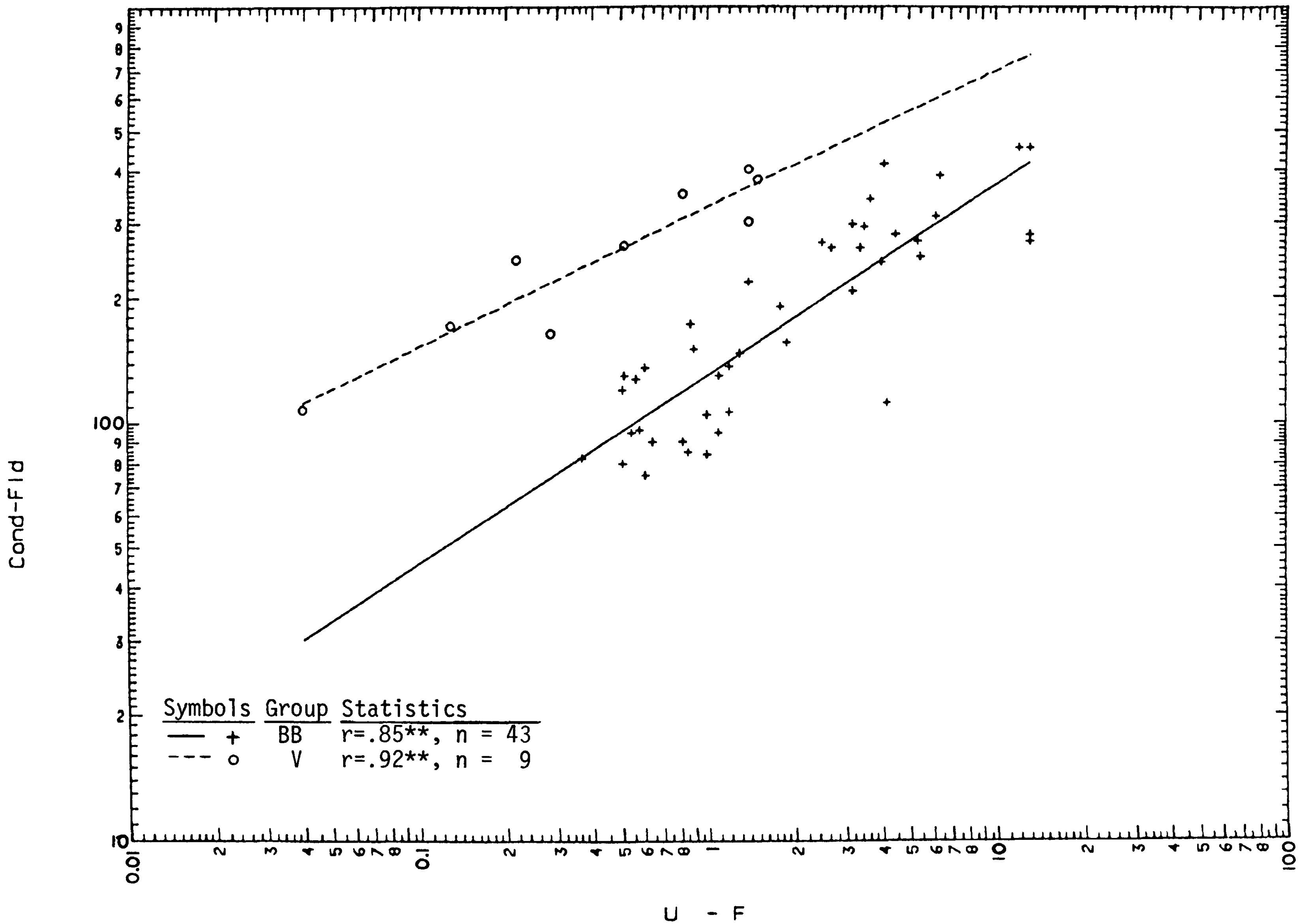

Figure 4-1.--Conductivity (μmhos/cm) plotted versus U (μg/ℓ). The Boulder batholith sample group (BB) and the group draining volcanic terrane (V) are plotted with different symbols. The number of pairs n and the correlation coefficient, r, are listed separately for each group. One or two asterisks by an r value means the correlation is significant to the 95% or 99% confidence level, respectively. Regression lines, when plotted, correspond only to significant r's.

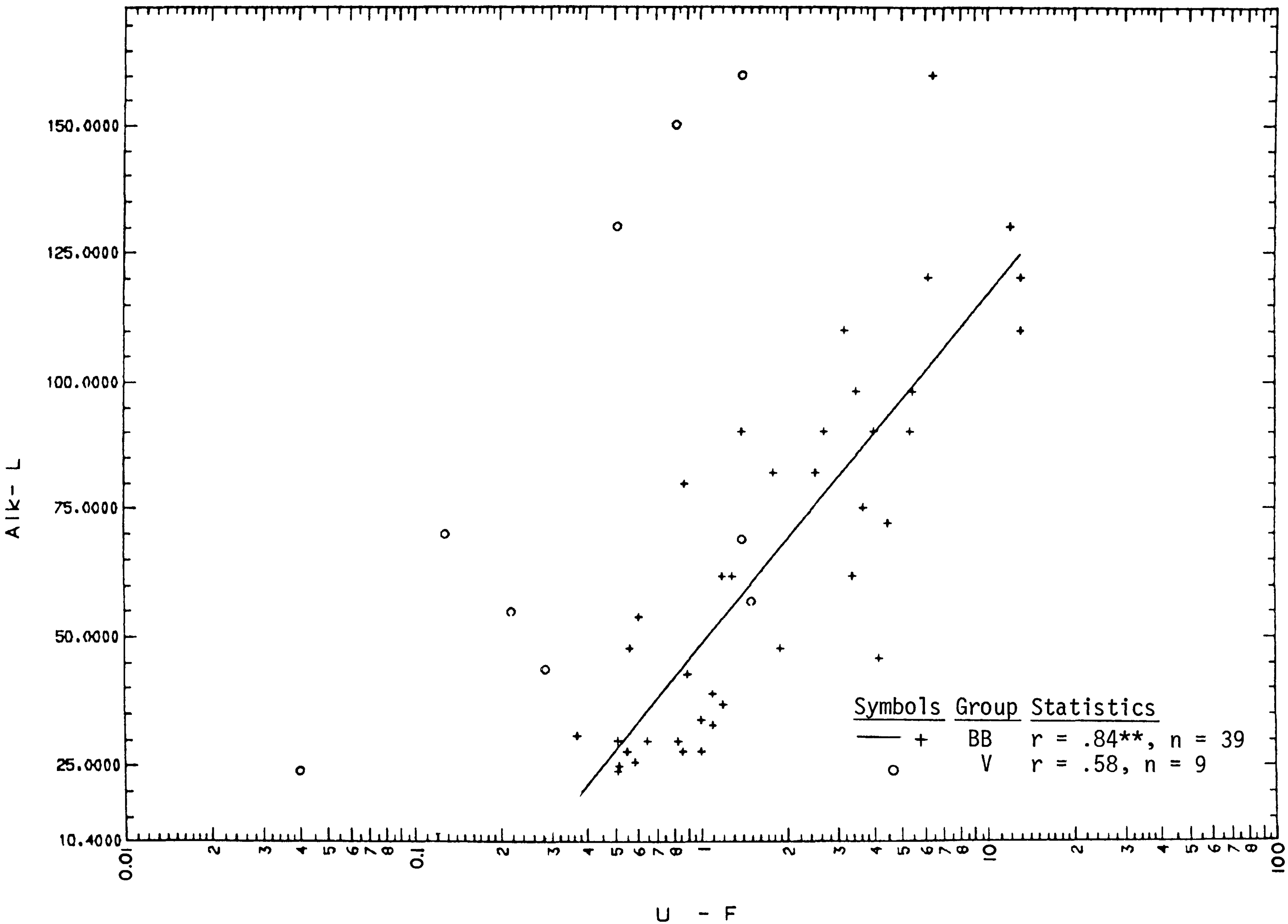

Figure 4-2.--Alkalinity (mg/ℓ) plotted versus U (μg/ℓ).

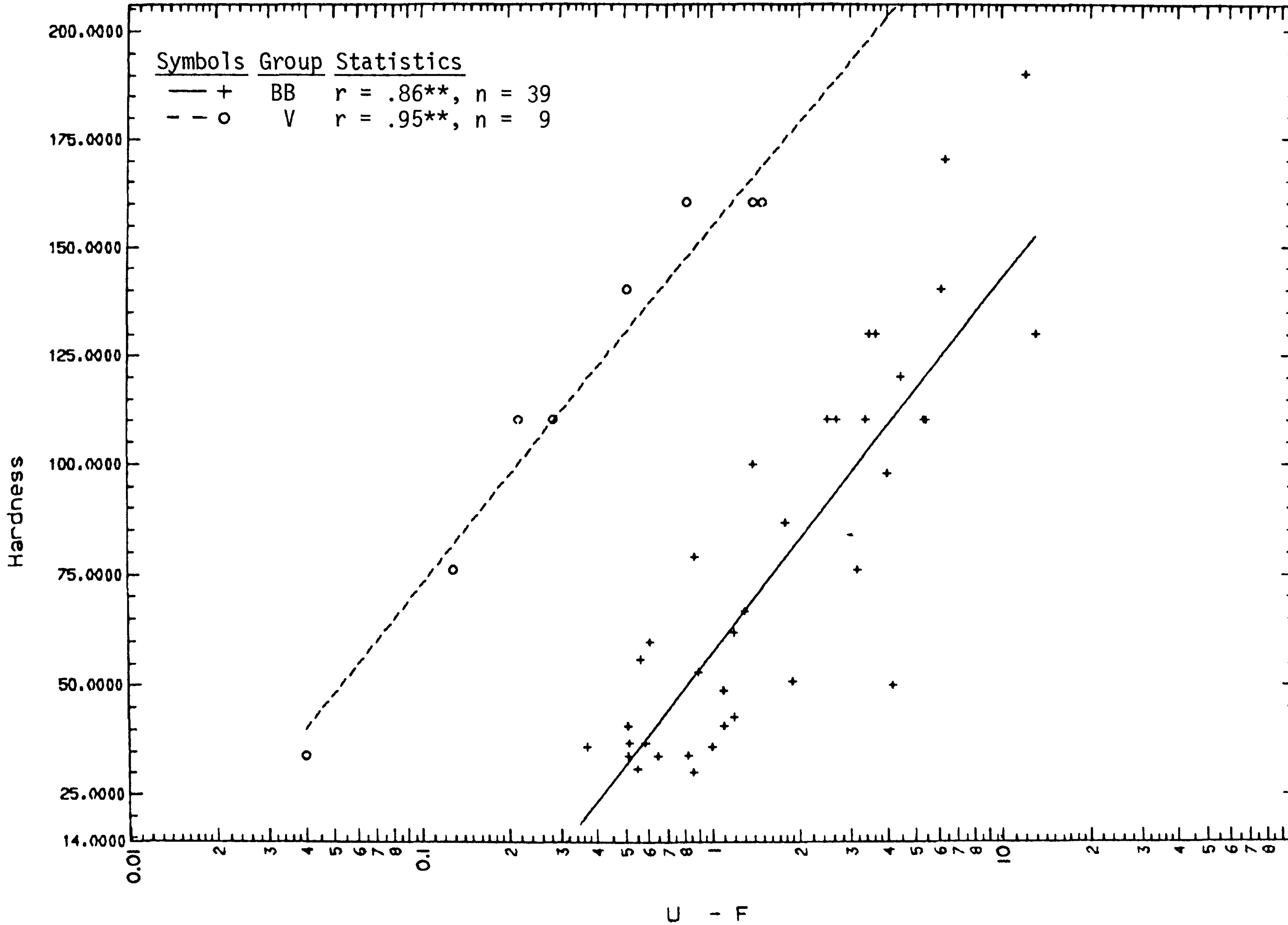

Figure 4-3.--Total hardness (mg/ℓ) plotted versus U (μg/ℓ).

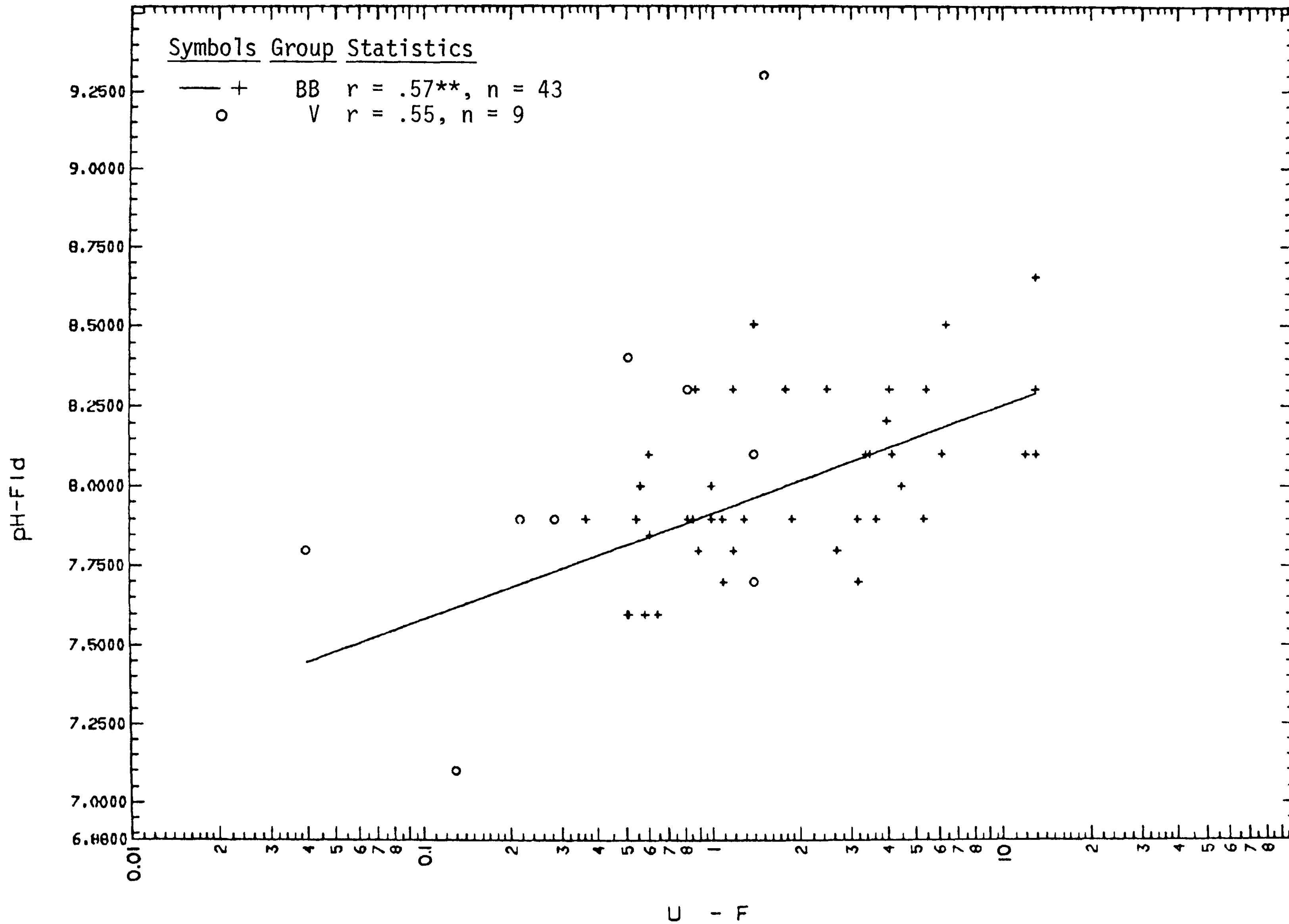

Figure 4-4.--pH (standard units) plotted versus U (μg/ℓ).

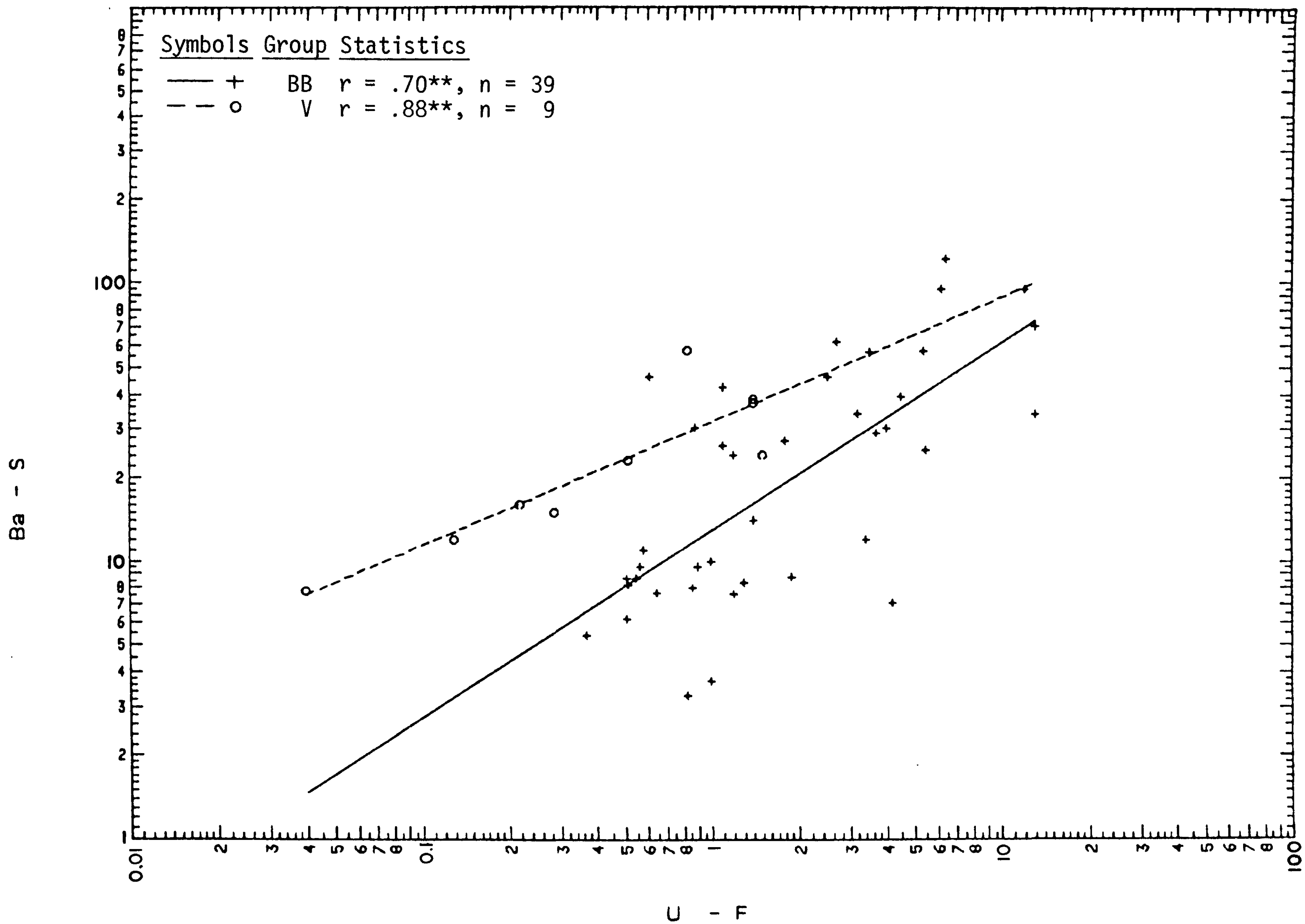

Figure 4-5.--Barium (μg/ℓ) plotted versus U (μg/ℓ).

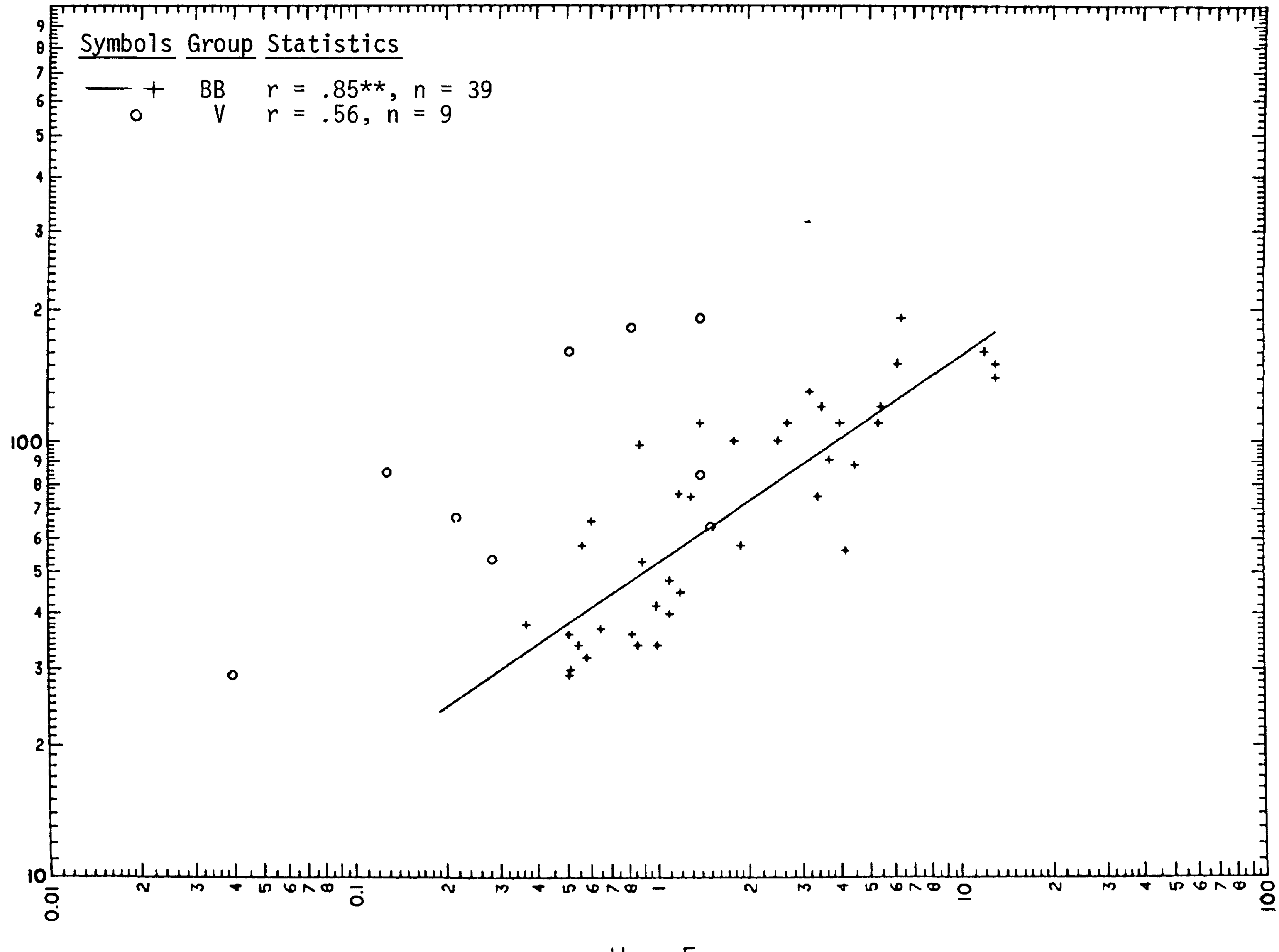

Figure 4-6.--Bicarbonate ion (mg/ℓ) plotted versus U (μg/ℓ).

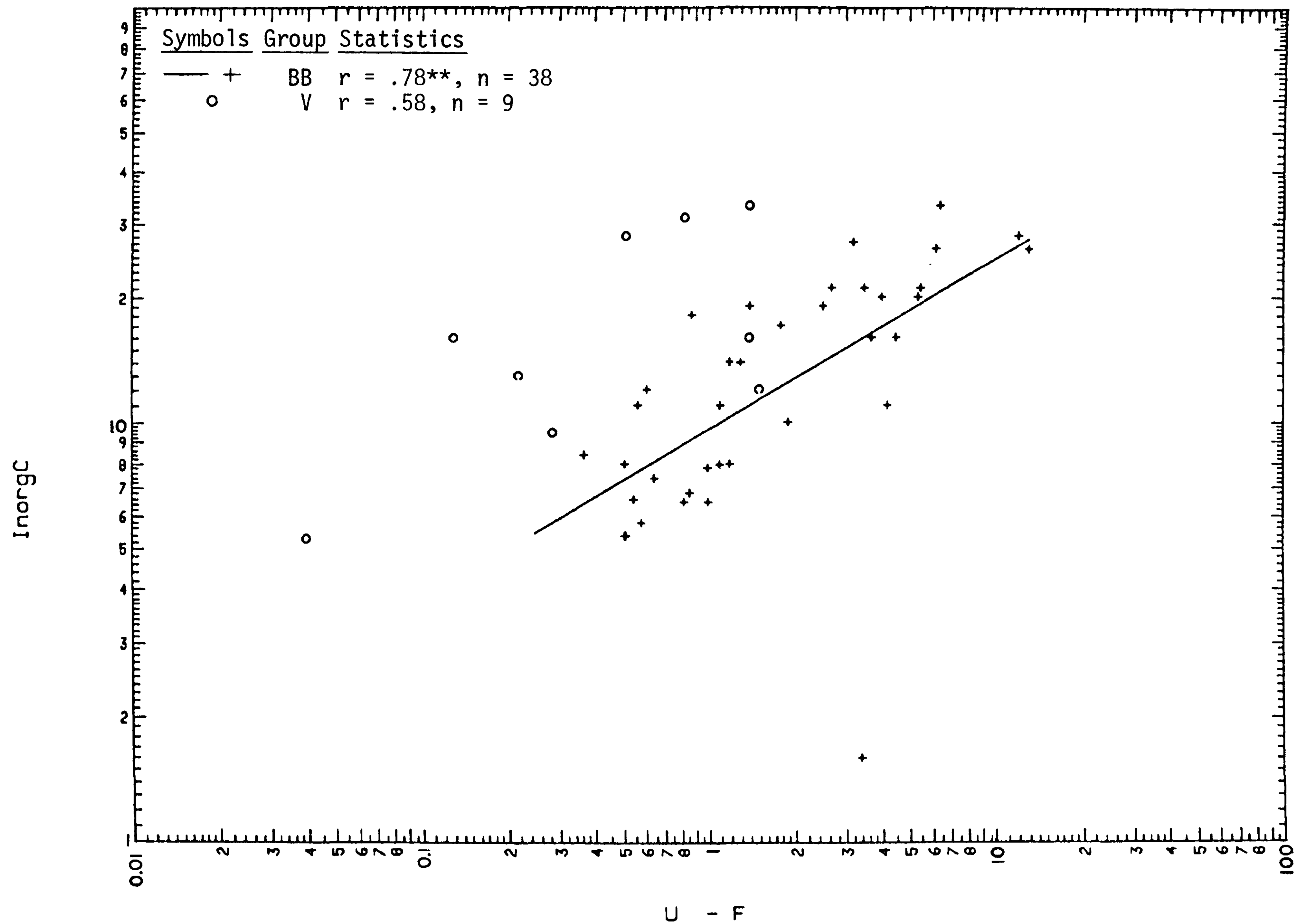

Figure 4-7.--Inorganic carbon (mg/ℓ) plotted versus U (μg/ℓ).

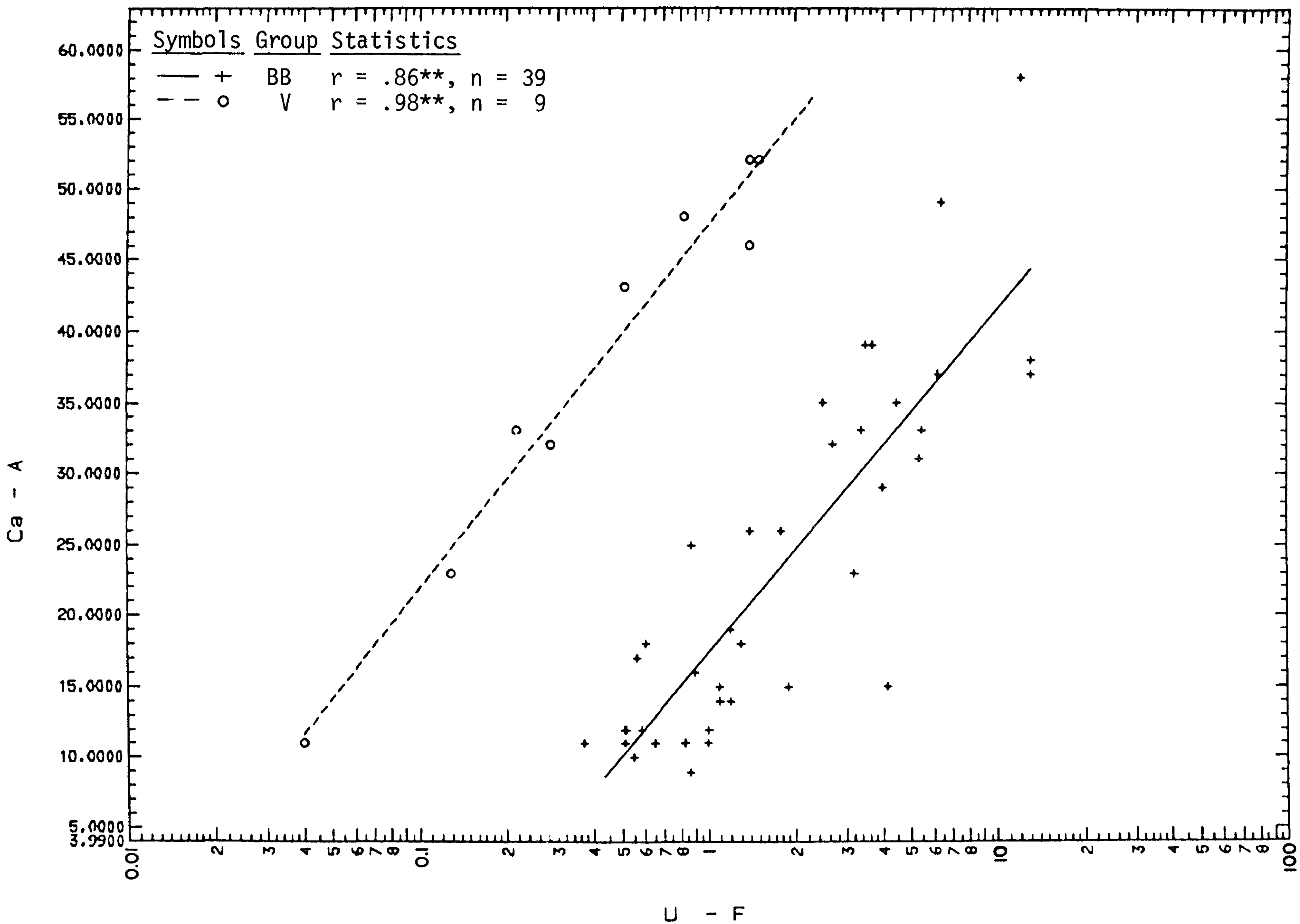

Figure 4-8.--Calcium (mg/ℓ) plotted versus U (μg/ℓ).

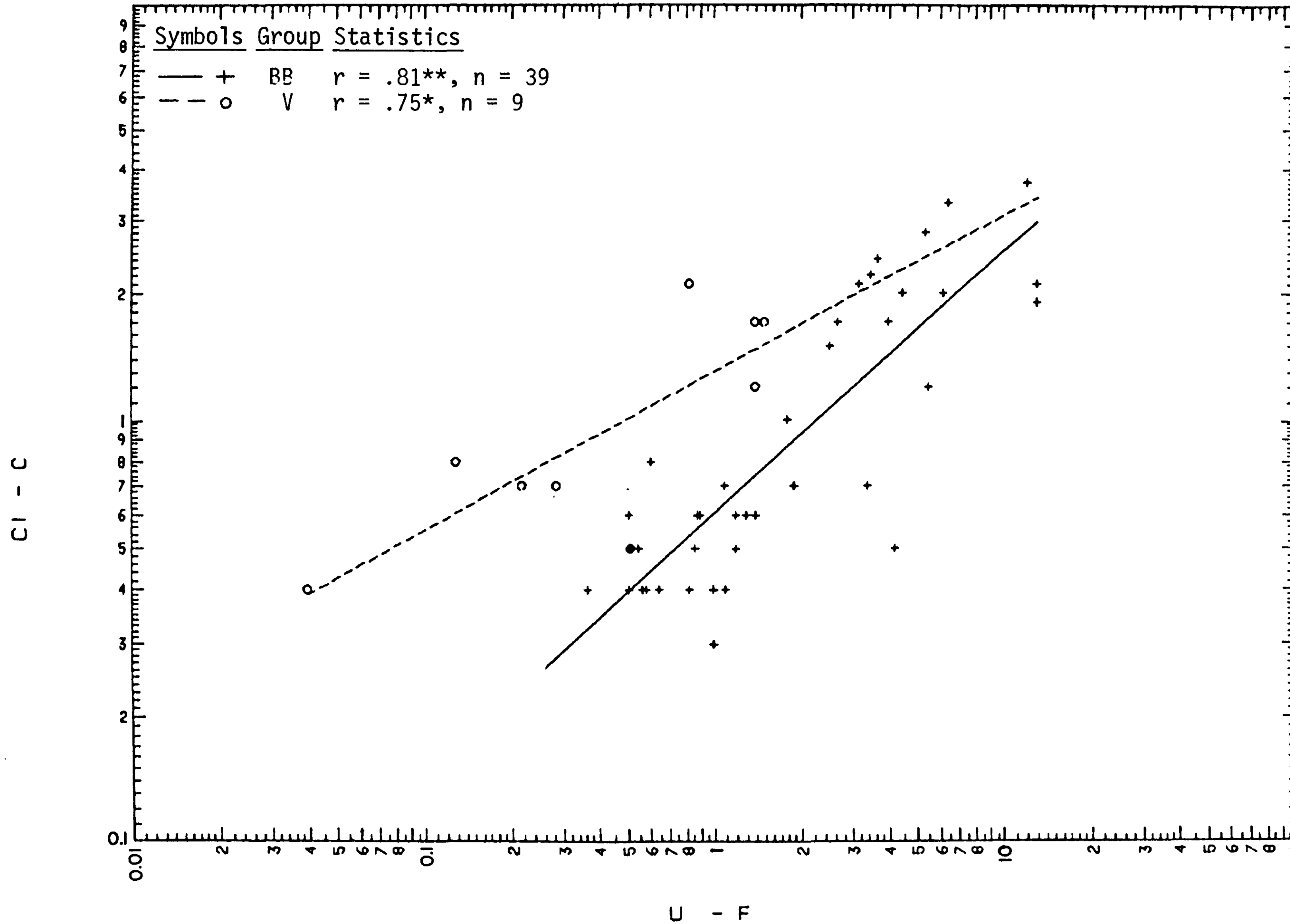

Figure 4-9.--Chloride ion (mg/ℓ) plotted versus U (μg/ℓ).

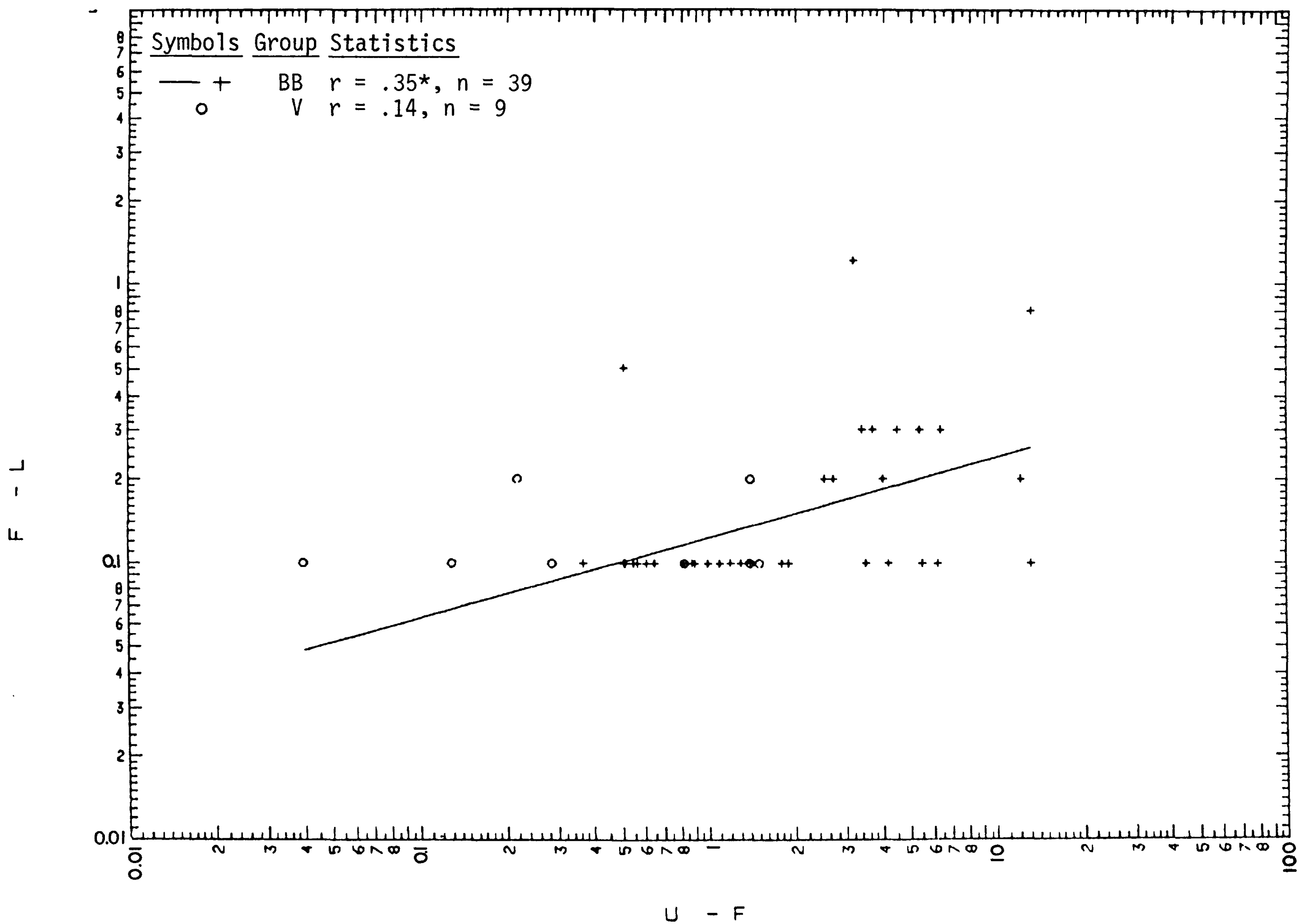

Figure 4-10.--Fluoride ion (mg/ℓ) plotted versus U (μg/ℓ).

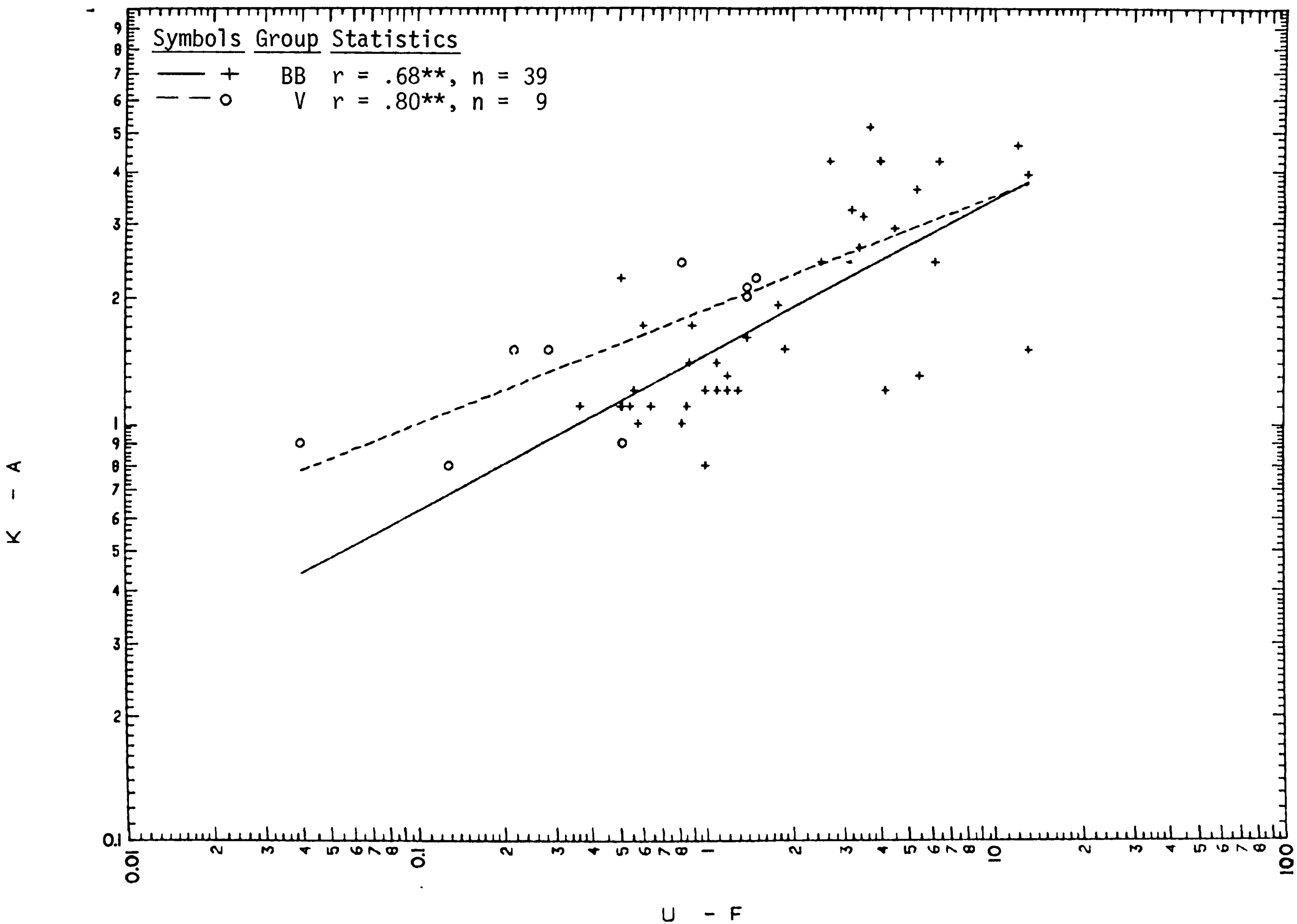

Figure 4-11. Potassium (mg/ℓ) plotted versus U (μg/ℓ).

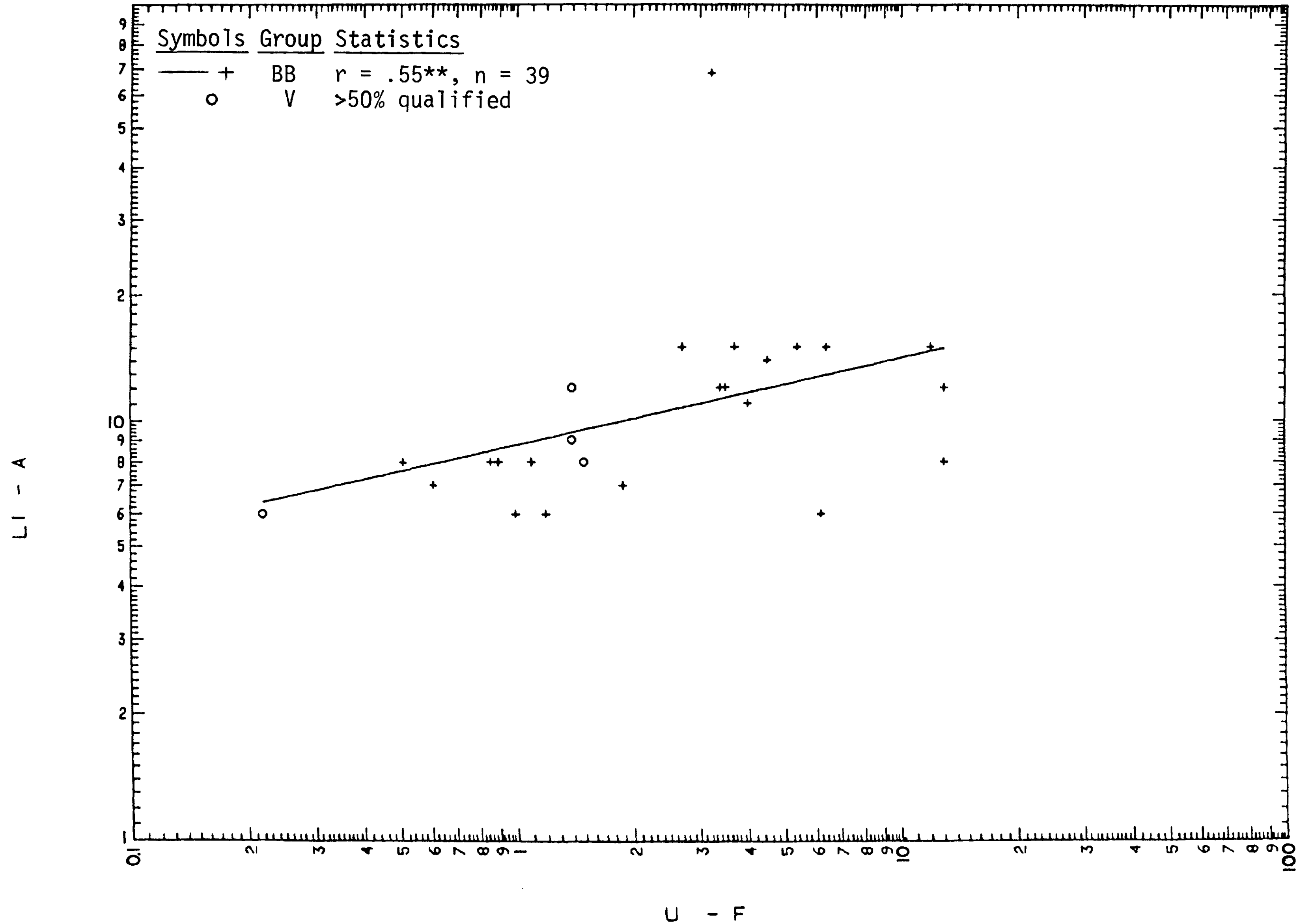

Figure 4-12.--Lithium (μg/ℓ) plotted versus U (μg/ℓ).

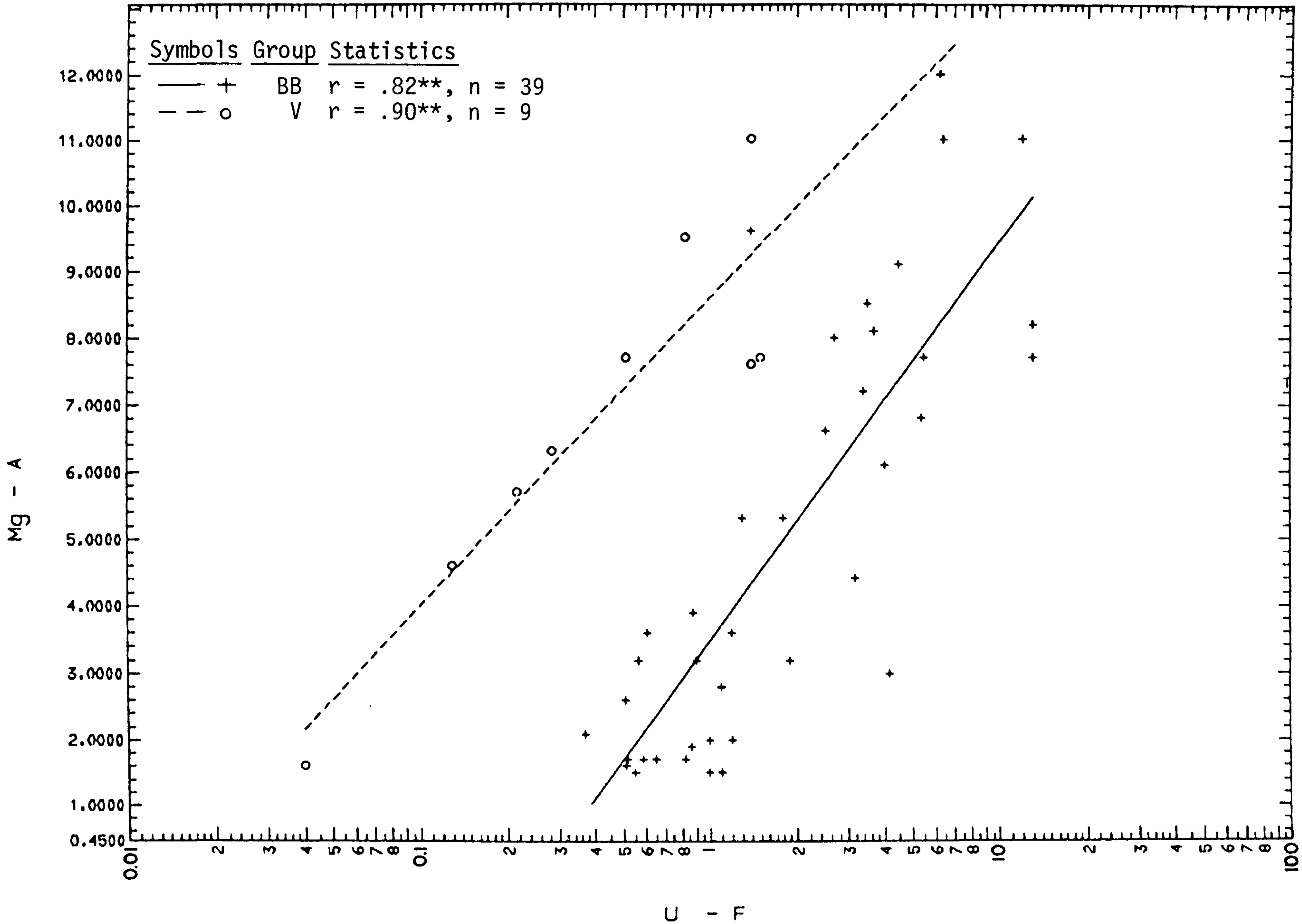

Figure 4-13.--Magnesium (mg/ℓ) plotted versus U (μg/ℓ).

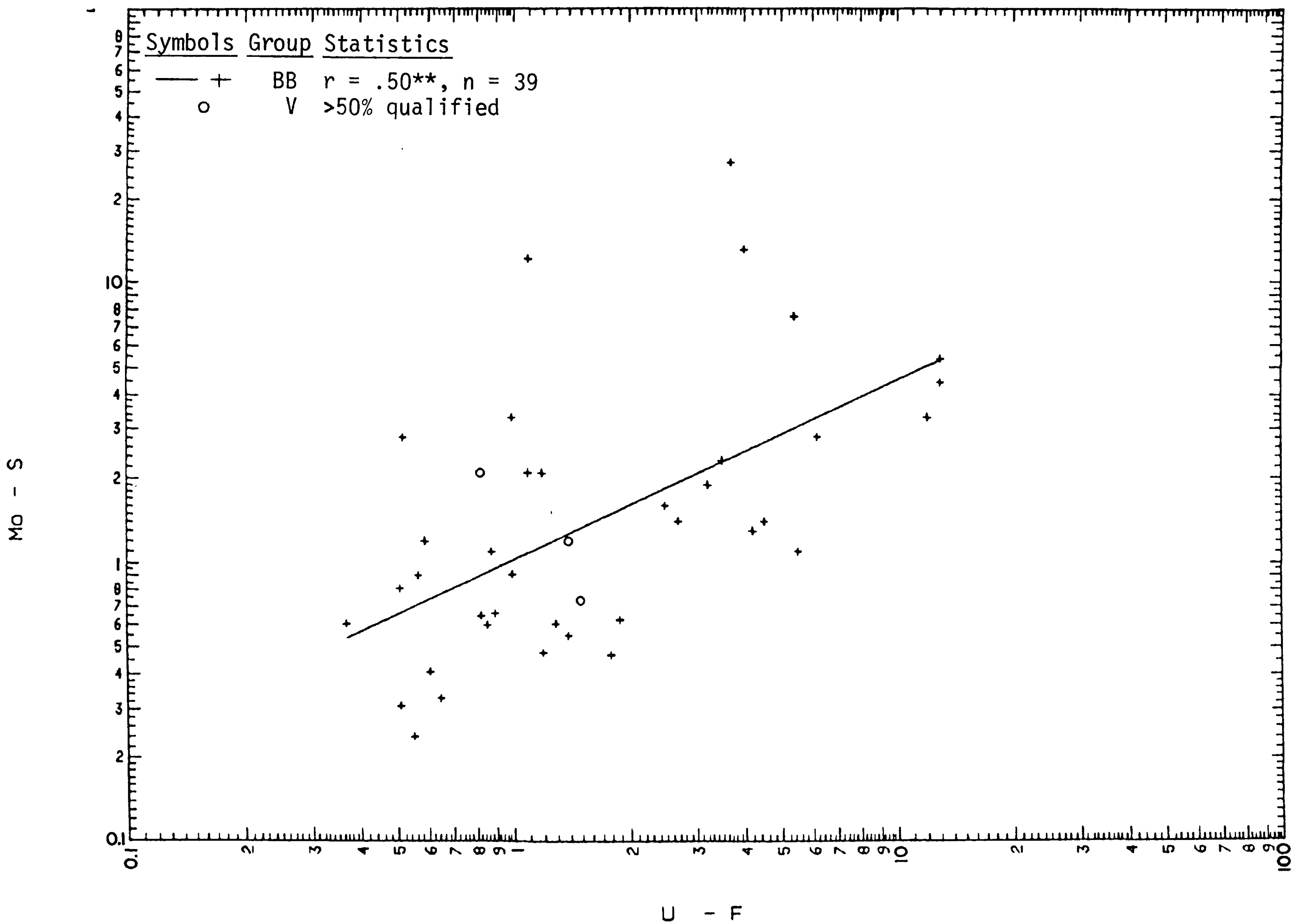

Figure 4-14.--Molybdenum (μg/ℓ) plotted versus U (μg/ℓ).

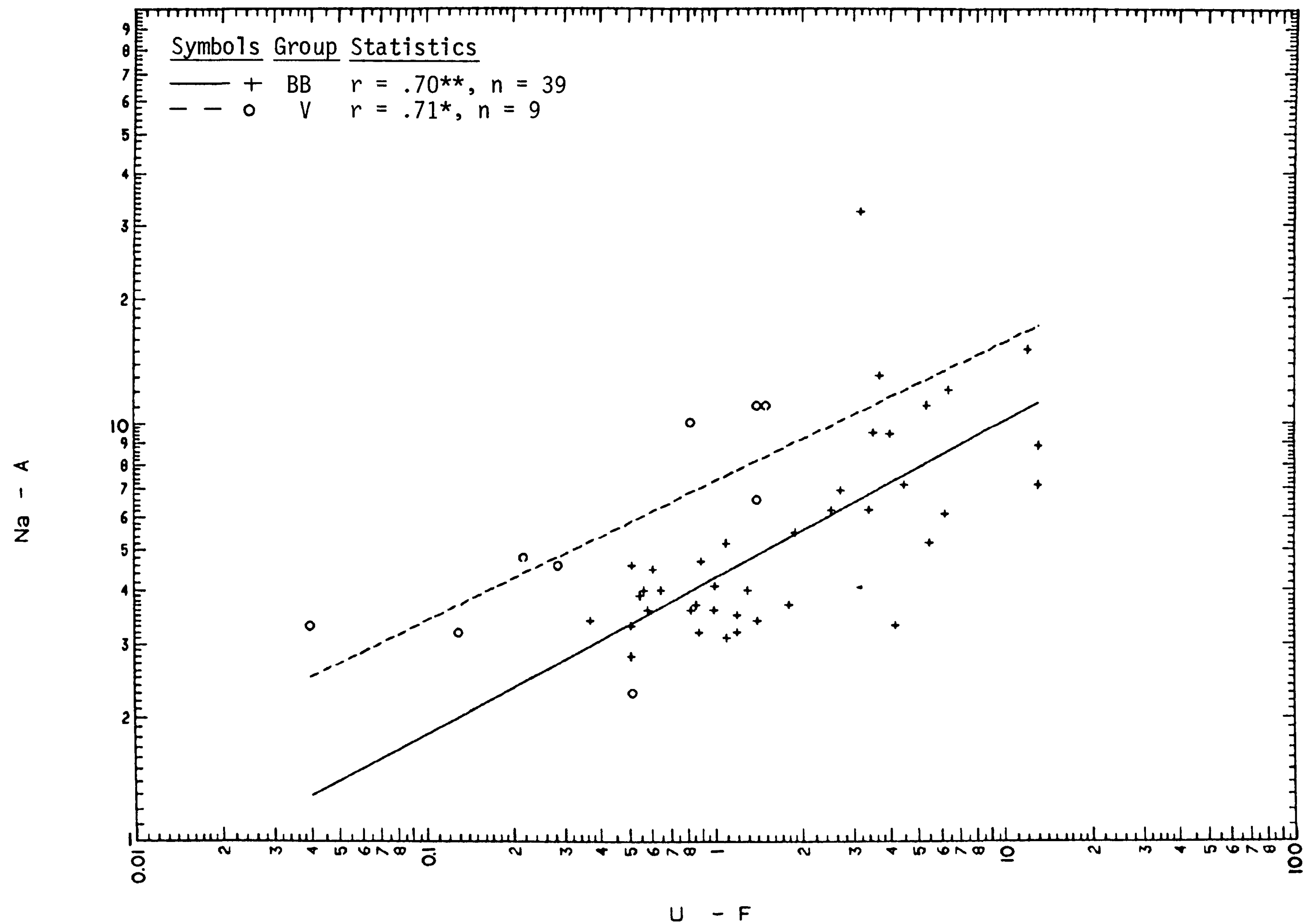

Figure 4-15.--Sodium (%) plotted versus U (μg/ℓ).

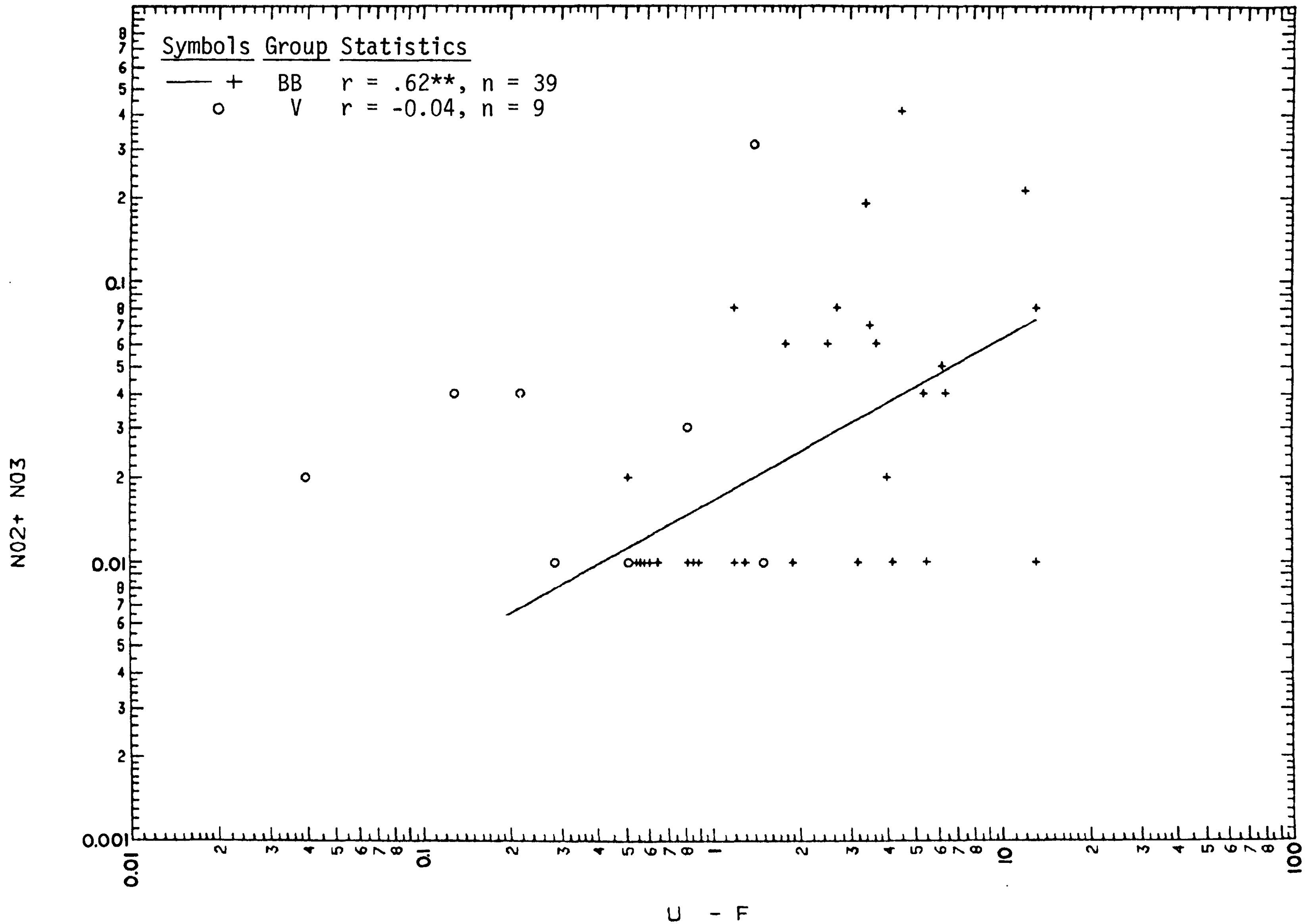

Figure 4-16.--$NO_2 + NO_3$ (%) plotted versus U (μg/ℓ).

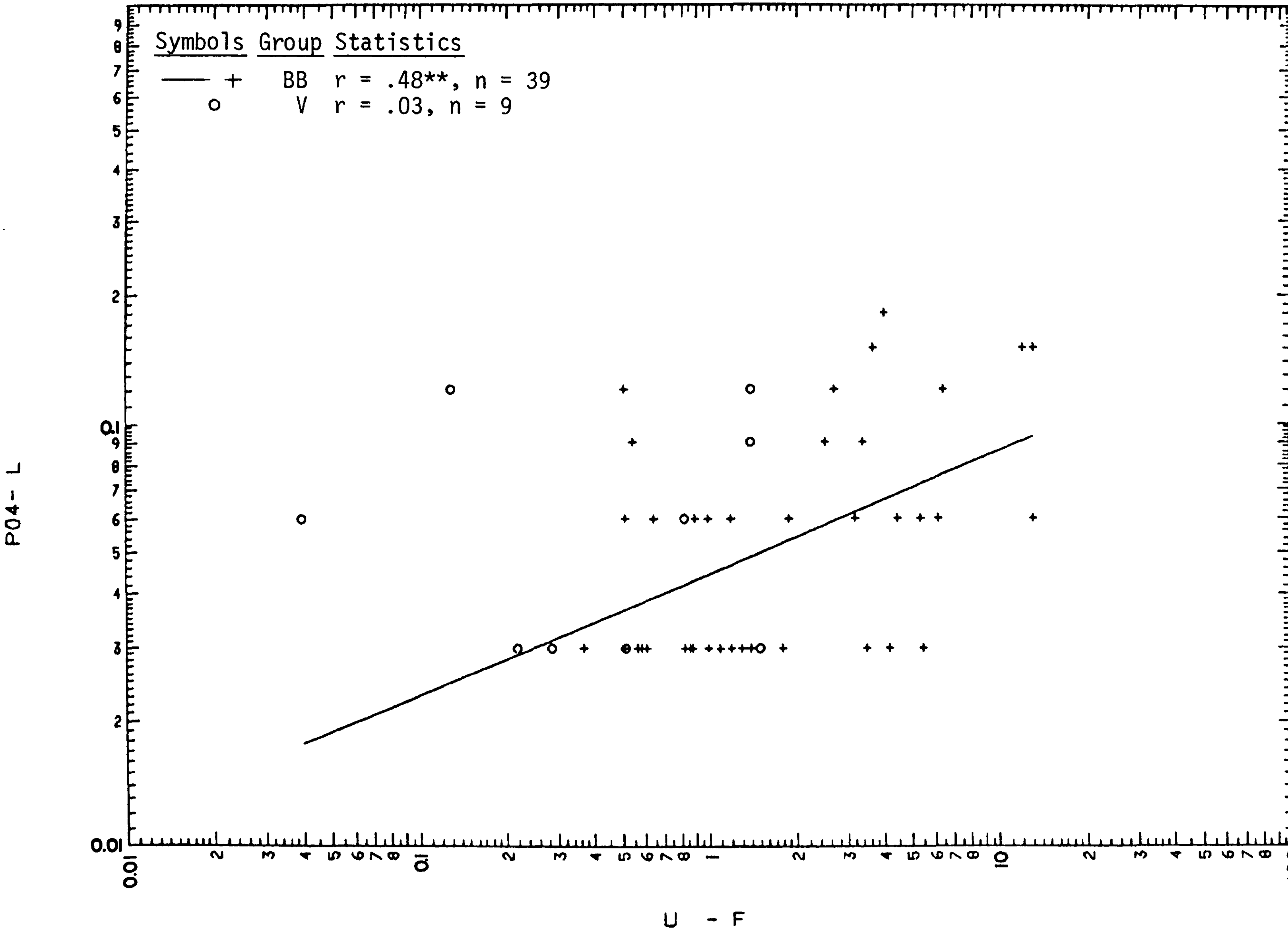

Figure 4-17.--Phosphate (mg/ℓ) plotted versus U (μg/ℓ).

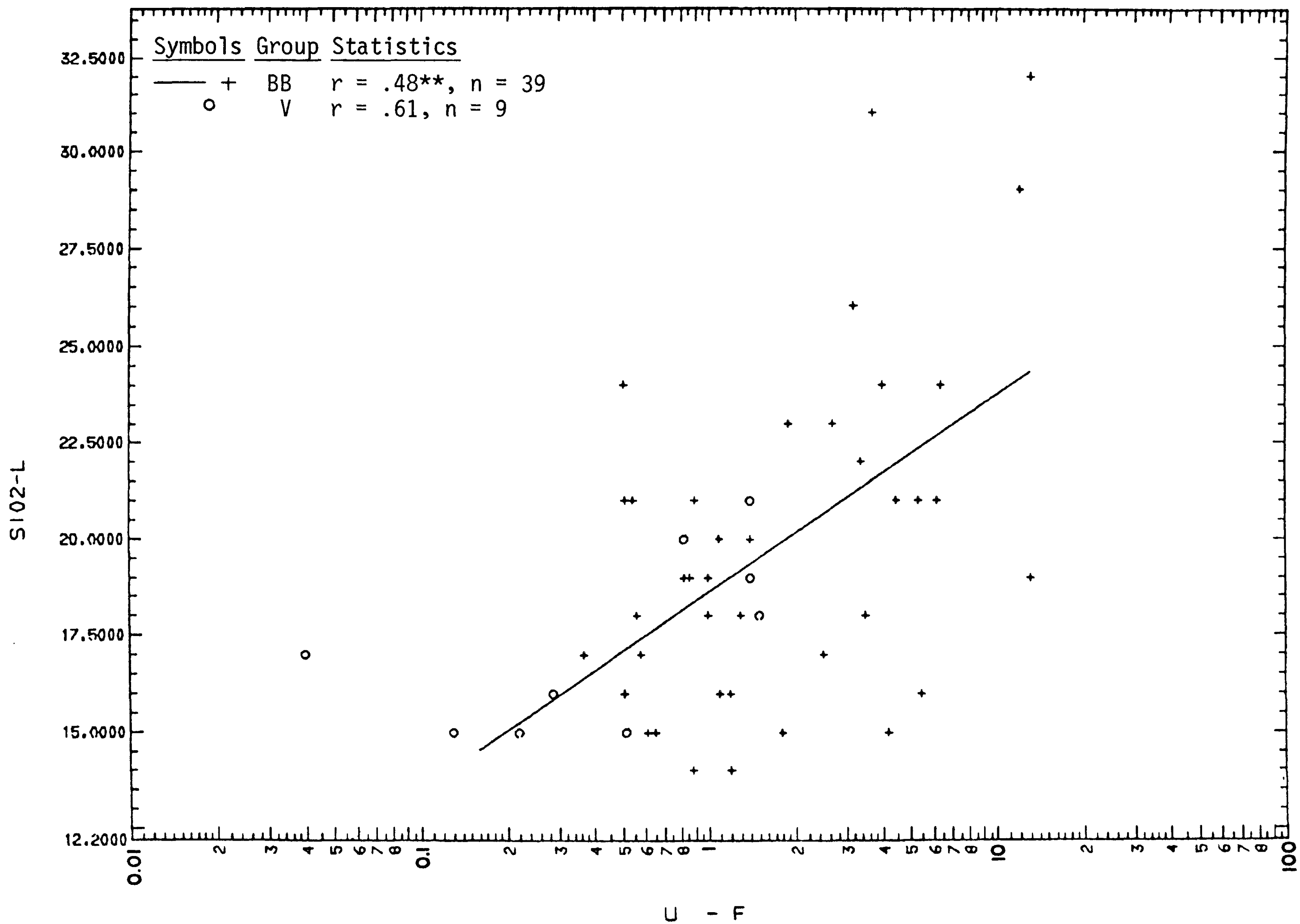

Figure 4-18.--Silica (mg/ℓ) plotted versus U (μg/ℓ).

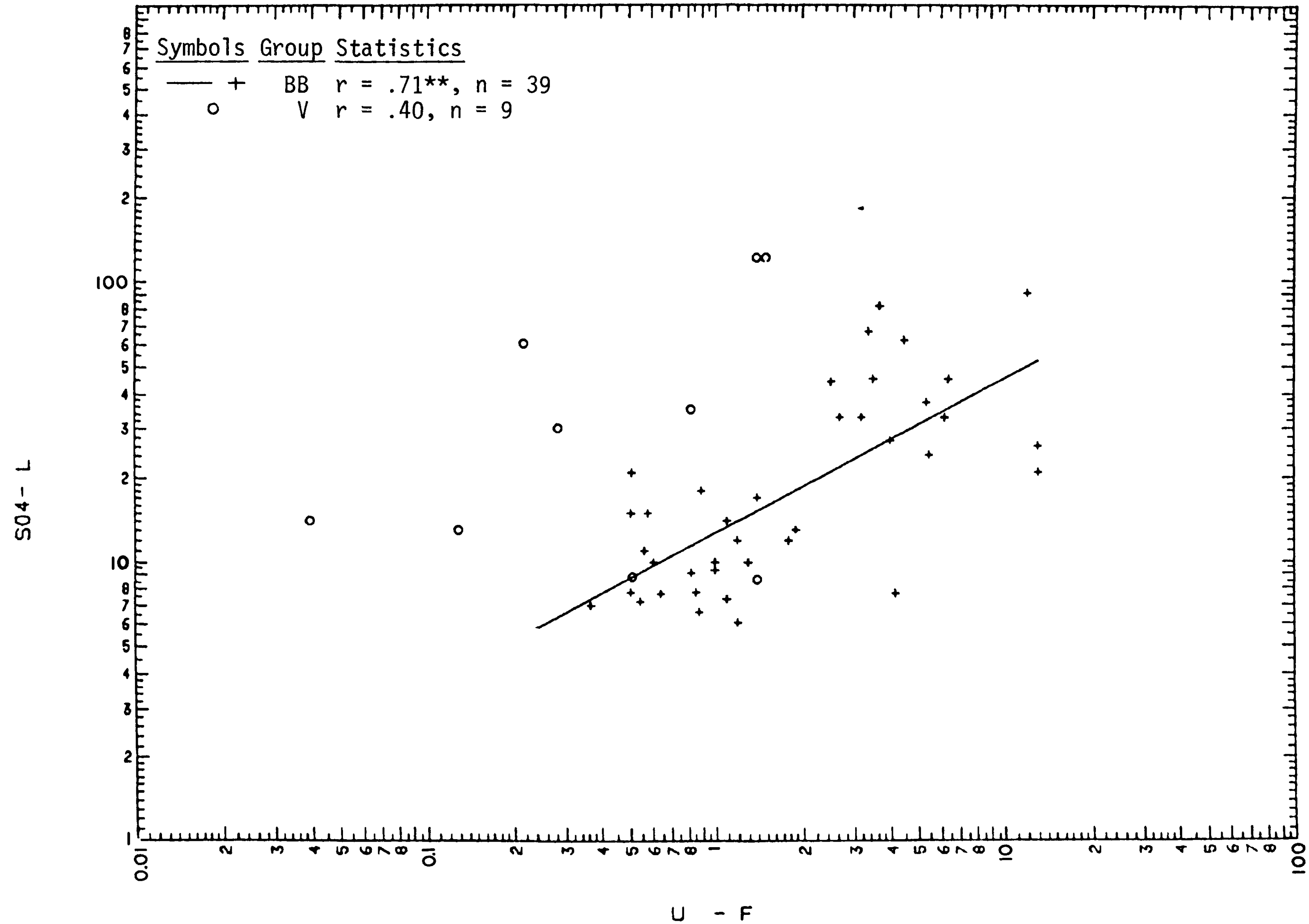

Figure 4-19.--Sulfate (mg/ℓ) plotted versus U (μg/ℓ).

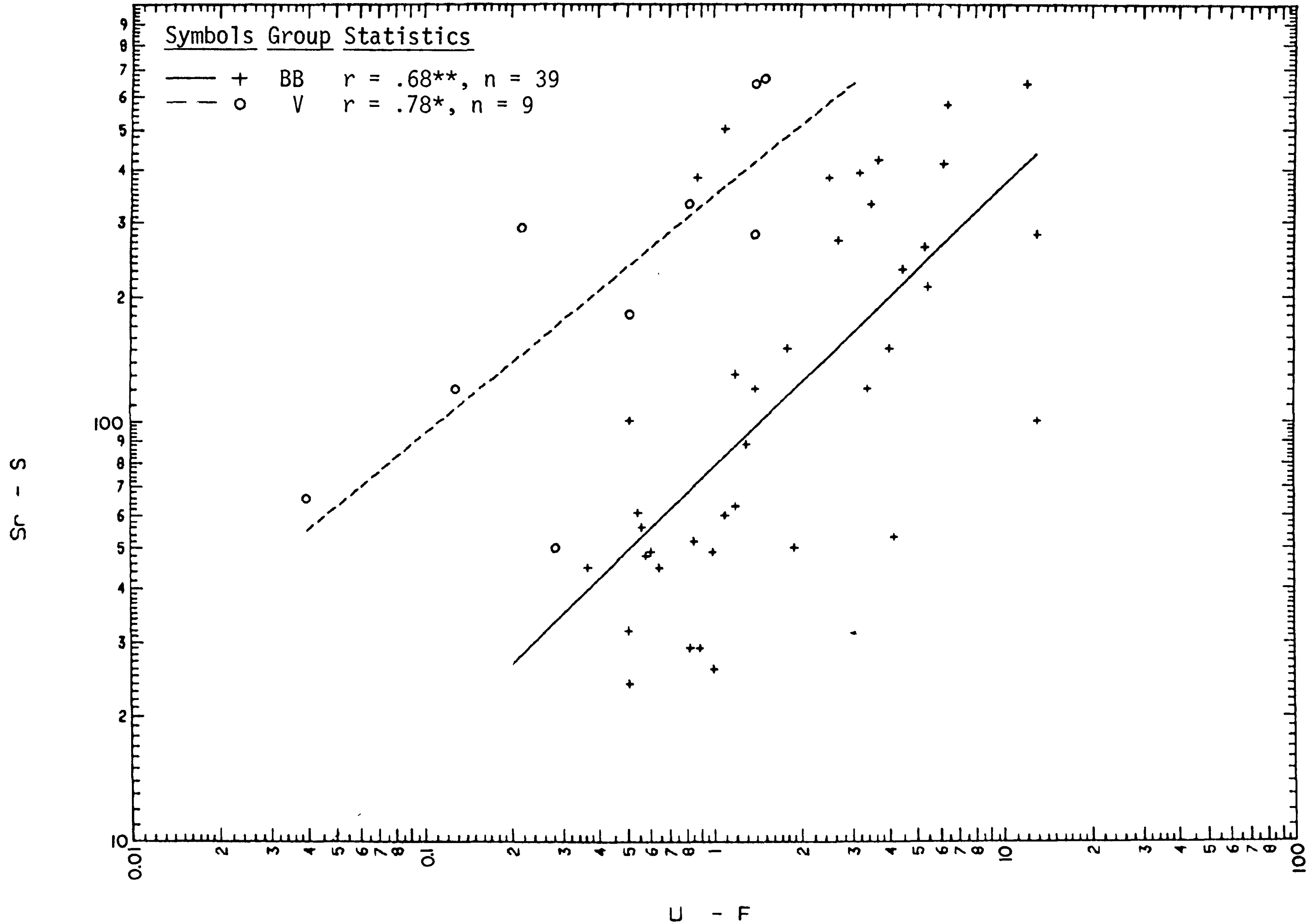

Figure 4-20.--Strontium (μg/ℓ) plotted versus U (μg/ℓ).

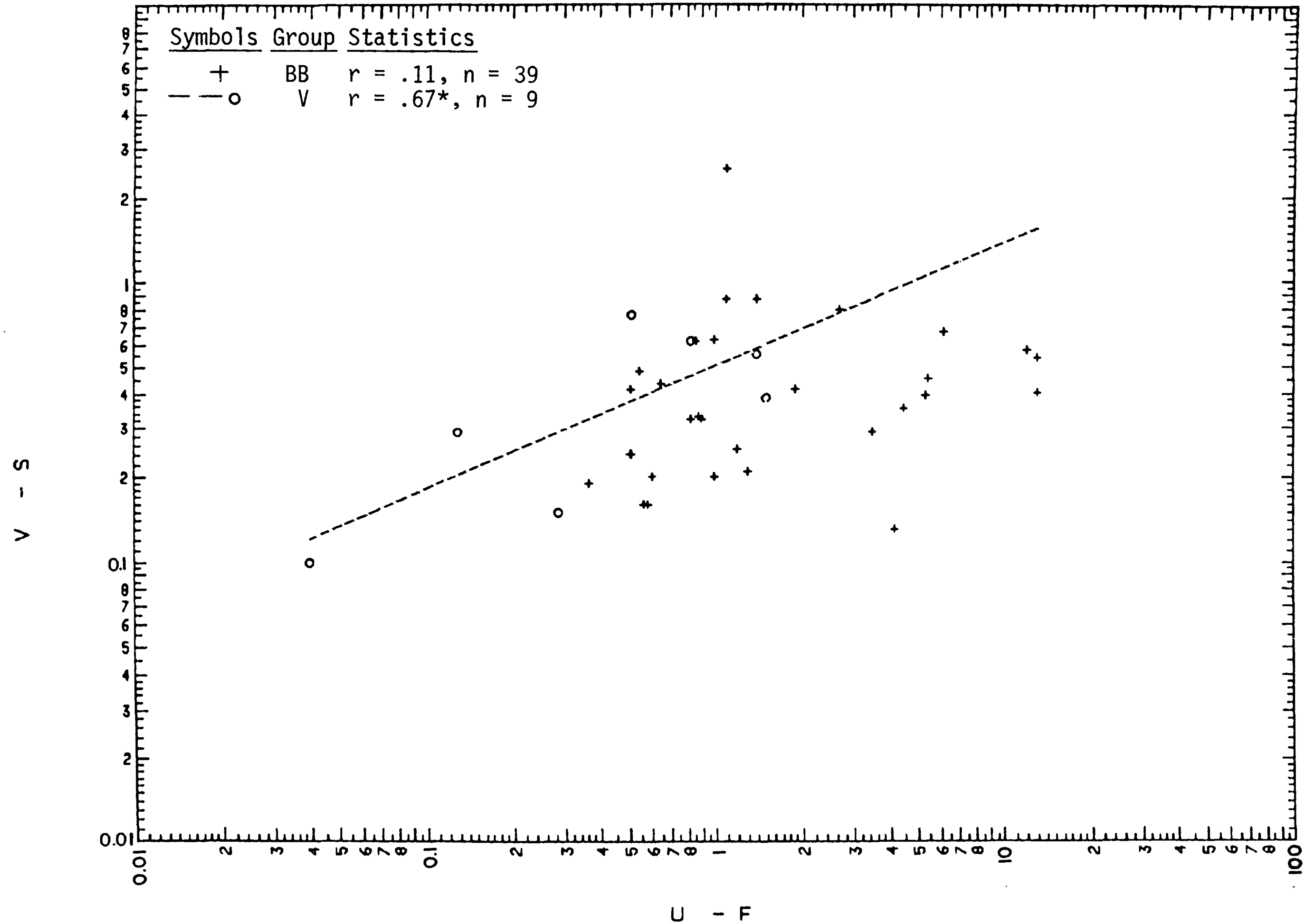

Figure 4-21.--Vanadium (μg/ℓ) plotted versus U (μg/ℓ).