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 II: Stream sediments

by

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This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.

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ABSTRACT

Fifty-two stream-sediment samples, collected from an area south of Helena, Jefferson County, Montana, were sieved into two size fractions (<88 µm, and between 88 and 149 µm) and analyzed for 80 different chemical species. Of these species, 43 showed detectable variation over the area, 31 were subjected to correlation analysis for the fine size fraction, and 30 for the coarse-size fraction.

Two populations distinguished in the surface water samples of this study (Suits and Wenrich, 1981) are not as clearly evident in the stream sediments. However, stream-sediment samples from streams draining the Boulder batholith and from streams draining volcanics and volcanogenic sediments (referred to only as volcanics) do show differences in their geochemical relationships, especially between SiO_2, Al_2O_3 and Na_2O versus U. Thus, the sediments were also treated statistically as two lithologic populations as well as two populations based on size fraction.

In the fine fraction samples, U ranged from 1.3 to 78 ppm, averaging 25 ppm for the Boulder batholith samples and 8 ppm for the volcanics samples. The range for the coarse fraction was 1.9 to 55 ppm with an average of 17 for the Boulder batholith group and 7 for the volcanics group. High U values (>50

ppm for the fine fraction) were encountered in samples from the Warm Springs Creek drainage area, along Prickly Pear Creek near Weimer and Golconda Creeks and along Muskrat Creek.

All groups showed a significant correlation at the 99 percent confidence level (r between 0.73 and 0.77) between U and Th. Uranium was found to correlate significantly only with Th (as mentioned above) and with -Ni in the fine fraction of the volcanics group. U correlates significantly with $-Al_2O_3$, Ba, organic C, $-K_2O$, -Sr and Y in both size fractions for the Boulder batholith. Correlations between U and each of several elements differ for the fine and coarse fractions of the Boulder batholith group, suggesting that the U distribution in these stream sediments is in large part controlled by grain size. Correlations were found between U and CaO, Cr, Fe_2O_3, $-Na_2O$, Sc, $-SiO_2$, TiO_2, Yb and Zr in the coarse fraction but not in the fine fraction. U correlates weakly (to the 90% confidence level, ¢r¢< .37) with -Co and -Cu in the fine but not the coarse fraction. These results are compared to a previous study in the northern Absaroka mountains. Correlation coefficients between all other elements determined from these samples are also shown in Tables 12 to 15.

INTRODUCTION

This report presents chemical analyses and preliminary statistical evaluation of 52 stream-sediment 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 topographic quadrangles, Jefferson County (fig. 1). Additional, samples were collected within the boundaries of Helena and Deerlodge National Forests to the east and

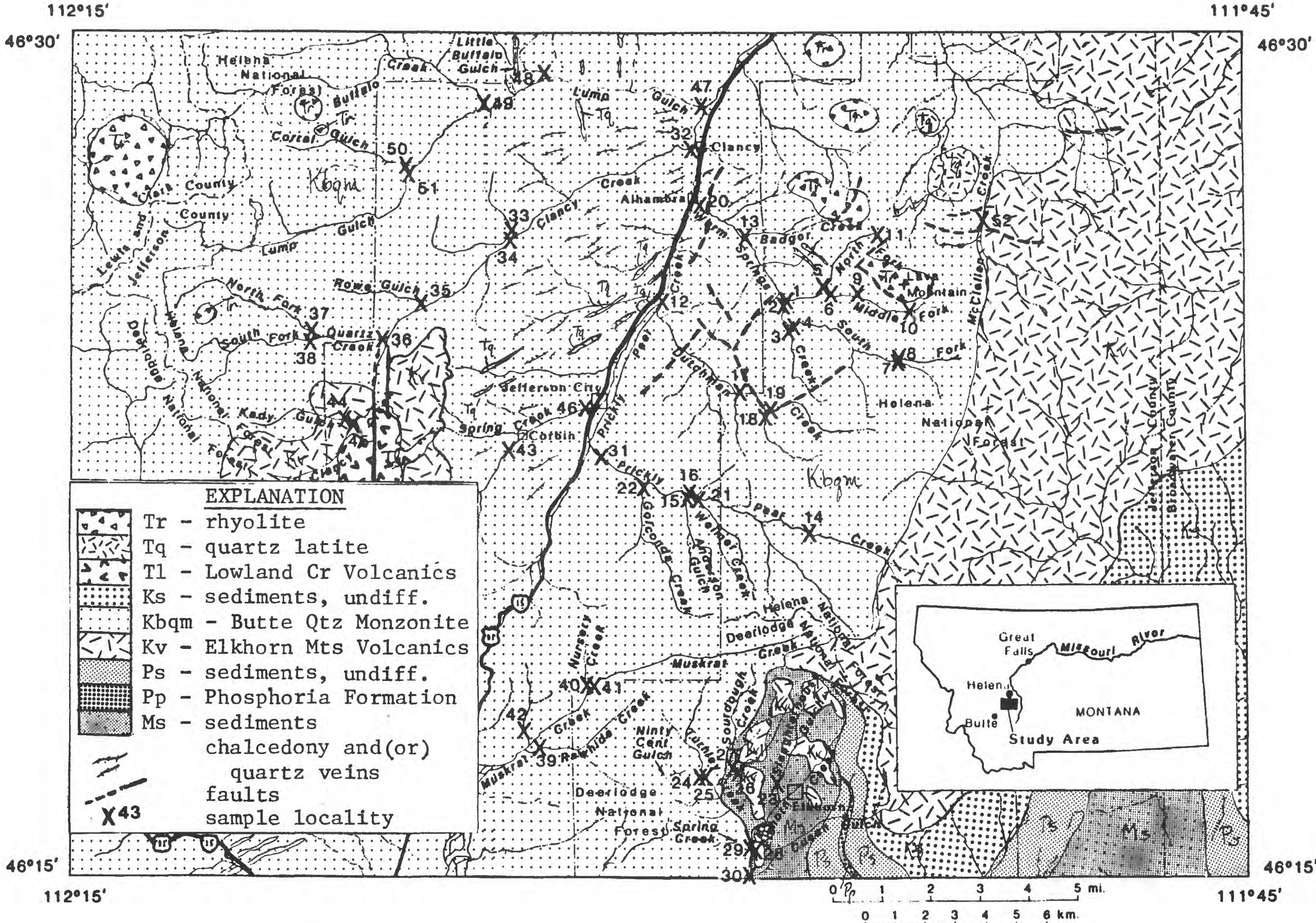

Figure 1.--Generalized geologic map, modified from Becraft and others (1963), Klepper and others (1957) and Smedes (1966). Samples whose geochemistry indicates drainage of volcanic terrane are 11, 23, 28, 30, 43-46 and 52. All other samples represent drainages in the Boulder batholith. Tr, Tq, Tl are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

west. Analyses of surface-water samples taken concurrently with these sediment samples are reported in Suits and Wenrich-Verbeek (1980).

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:

(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 U concentrations 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 ρCi/ℓ), 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. This report is a preliminary presentation of findings.

GENERAL GEOLOGY

Previous studies in the area include Roberts and Gude (1953), Becraft and others (1963), Smedes (1966), Klepper and others (1957), and USGS and USBM (1978). Most of these studies discuss the general geology, whereas Roberts and Gude (1953) concentrate on the U occurrences of the Clancy district, and USGS and USBM (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 other intrusive rocks associated with the Boulder batholith, emplaced 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, and 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. Many 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 this unit. 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, and 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 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 in figure 2. A list of the locations by name appears in table 1.

Silt- to clay-sized particles were sought in the stream channels to comprise the analytical portion of each sediment sample. The importance of this size fraction (<88 μm, 170 mesh) for geochemical exploration of U is discussed in Wenrich-Verbeek (1980). Samples were collected and stored in polyethylene bags before analysis to avoid outside contamination and escape of fine material.

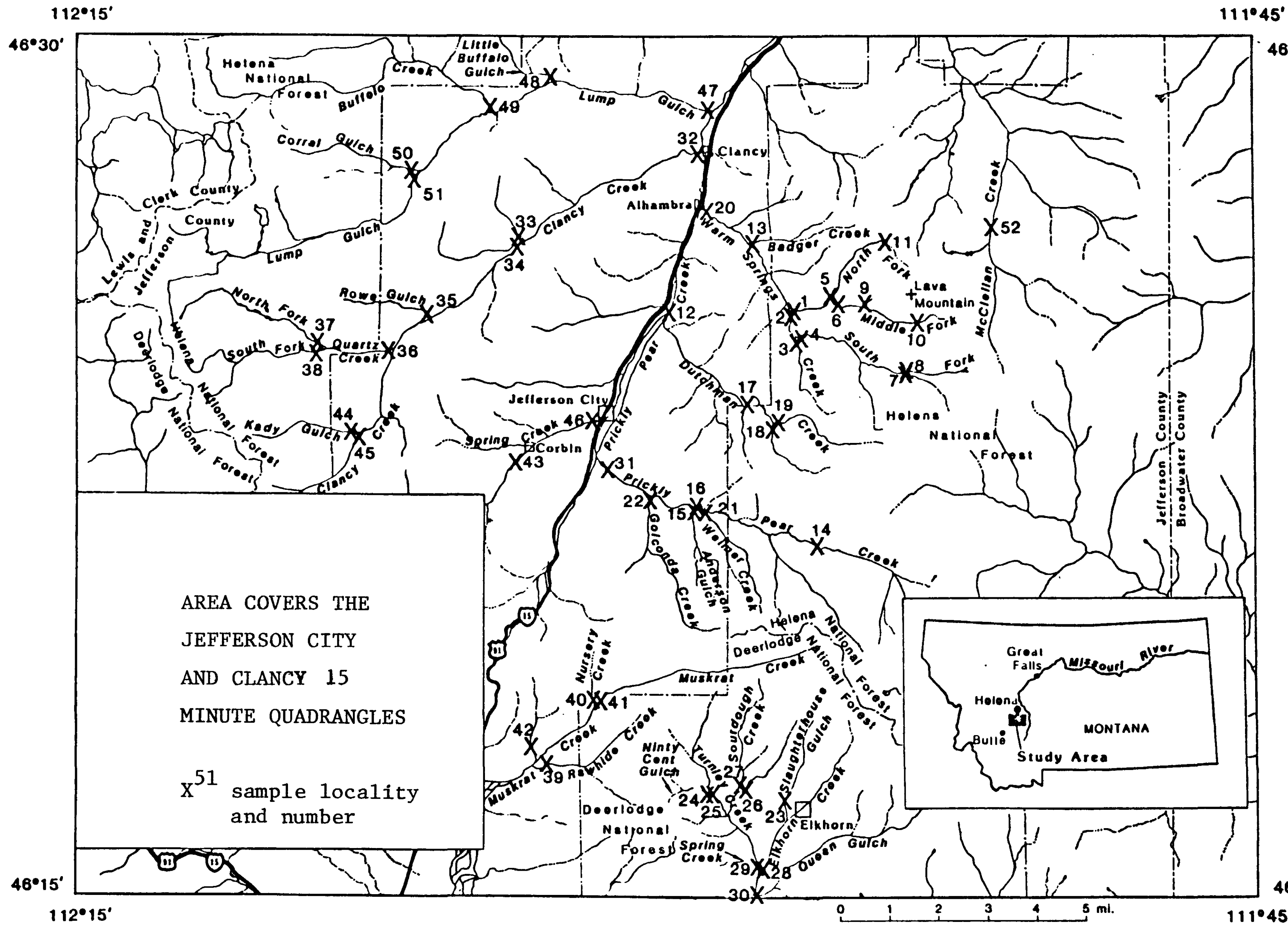

Figure 2.--Map showing location of the study area and sample localities.

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

CHEMICAL ANALYSES

Sediment samples were prepared for analysis by drying them in an oven at less than 100°F (38°C); they were then passed through solderless, stainless steel sieves and divided into three size fractions: (1) <88 µm, (2) between 88 and 149 µm, and (3) >149 µm. The >149 µm fraction was discarded. The two remaining finer size fractions were then submitted separately to the U.S. Geological Survey (USGS) analytical laboratories for analysis of the elements listed in table 2. Ten percent of the stream-sediment samples were divided by a sample splitter into two portions; both of these were submitted as separate samples in order to measure the analytical precision of laboratory results. All samples (including replicate samples) were randomly renumbered to insure that the replicate samples and the two size fractions for one location were treated without a biased association by the chemical analyst.

PRESENTATION OF CHEMICAL DATA

Stream-sediment chemical analyses are listed in table 3; the units are in either parts per million (ppm) or percent (%) and are indicated in the column header. Abbreviations used in table 3 are explained in table 2.

Thirty-two of the variables in the chemical analysis showed quantities that were at or below the analytical detection limit for most or all samples analyzed. They are As, Au, Bi, Cd, Ce, Dy, Er, Eu, Gd, Ge, Hf, Ho, In, Li, Lu, Mo, Nb, Nd, P, Pd, Pr, Pt, Re, Sb, Sm, Sn, Ta, Tb, Te, Tl, Tm, and W. In addition, measurements of Al and Si were found to be greater than or at their respective upper detection limits for all samples. None of these variables are shown on table 3.

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

ABBREV	EXPLANATION	UNITS OR CODE	LOWER DETECTION LIMIT (unless noted)	ANALYTICAL PROCEDURE
Latt	Latitude of sample location	deg,min,sec		
Long	Longitude sample location	deg,min,sec		
SizeFrac	Size fraction of sediment analyzed	8: 88µm-149µm 9: <88µm		Sieved in laboratory with stainless-steel sieves
U ppm N	Parts uranium (U) per million	ppm	0.3	Delayed neutron analysis
**U ppm S	Parts uranium (U) per million	ppm	500	Semi-quantitative emission spectrographic analysis
TH ppm N	Parts thorium (Th) per million	ppm	†	Delayed neutron analysis
**TH ppm S	Parts thorium (Th) per million	ppm	200	Semi-quantitative emission spectrographic analysis
TH / U	Thorium to uranium ratio	—	--	Calculated from U, Th delayed neutron values
Coef %TH	Thorium coefficient of variation	%	—	Calculated from Th delayed neutron values
Coef %U	Uranium coefficient of variation	%	—	Calculated from U delayed neutron values
AG ppm S	Parts silver (Ag) per million	ppm	.5	Semi-quantitative emission spectrographic analysis
**AL % S	Percent aluminum (Al)	%	10*	Semi-quantitative emission spectrographic analysis
AL2O3% X	Percent aluminum oxide (Al_2O_3)	%	.02	X-ray spectroscopy
AS ppm A	Parts arsenic (As) per million	ppm	0.1	Atomic absorption - graphite furnace
**AS ppm S	Parts arsenic (As) per million	ppm	1000	Semi-quantitative emission spectrographic analysis
**AU ppm S	Parts gold (Au) per million	ppm	20	Semi-quantitative emission spectrographic analysis
B ppm S	Parts boron (B) per million	ppm	20	Semi-quantitative emission spectrographic analysis
BA ppm S	Parts barium (Ba) per million	ppm	2	Semi-quantitative emission spectrographic analysis
BE ppm S	Parts beryllium (Be) per million	ppm	1.5	Semi-quantitative emission spectrographic analysis
**BI ppm S	Parts bismuth (Bi) per million	ppm	10	Semi-quantitative emission spectrographic analysis
Total C%	Percent total carbon (C)	%	.01	Combustion-thermal-conductivity detection
Inorg C%	Percent inorganic carbon (C)	%	.01	Gasometric determinstion
Org C %	Percent organic carbon (C)	%	—	Calculated from total C minus inorganic C
CA % S	Percent calcium (Ca)	%	.002	Semi-quantitative emission spectrographic analysis
CAO % X	Percent CaO	%	.0028	X-ray spectroscopy
**CD ppm S	Parts cadmium (Cd) per million	ppm	50	Semi-quantitative emission spectrographic analysis
**CE ppm S	Parts cerium (Ce) per million	ppm	200	Semi-quantitative emission spectrographic analysis
CO ppm S	Parts cobalt (Co) per million	ppm	5	Semi-quantitative emission spectrographic analysis
CR ppm S	Parts chromium (Cr) per million	ppm	1	Semi-quantitative emission spectrographic analysis
CU ppm S	Parts copper (Cu) per million	ppm	1	Semi-quantitative emission spectrographic analysis
**DY ppm S	Parts dysprosium (Dy) per million	ppm	50	Semi-quantitative emission spectrographic analysis
**ER ppm S	Parts erbium (Er) per million	ppm	50	Semi-quantitative emission spectrographic analysis
**EU ppm S	Parts europium (Eu) per million	ppm	100	Semi-quantitative emission spectrographic analysis
FE % S	Percent iron (Fe)	%	10*	Semi-quantitative emission spectrographic analysis
FE2O3% X	Percent ferric oxide (Fe_2O_3)	%	.0027	X-ray spectroscopy

*Upper detection limit.

**All analytical results are below the lower or above the upper detection limit; element is not discussed further in this report.

† Limit of analytical technique based on Th/U ratio in each case. A ratio >2 indicates useful Th vslues; Th data is ignored for ratios <1.

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

- A Atomic absorption
- F Fluorimetric method
- Fld Field measurement
- L Unspecified laboratory method
- S Emission spectrographic analysis

Table 2, continued

ABBREV	EXPLANATION	UNITS OR CODE	LOWER DETECTION LIMIT (unless noted)	ANALYTICAL PROCEDURE
GA ppm S	Parts gallium (Ga) per million	ppm	5	Semi-quantitative emission spectrographic analysis
**GD ppm S	Parts gadolinium (Gd) per million	ppm	50	Semi-quantitative emission spectrographic analysis
**GE ppm S	Parts germanium (Ge) per million	ppm	10	Semi-quantitative emission spectrographic analysis
**HF ppm S	Parts hafnium (Hf) per million	ppm	100	Semi-quantitative emission spectrographic analysis
**HO ppm S	Parts holmium (Ho) per million	ppm	20	Semi-quantitative emission spectrographic analysis
**IN ppm S	Parts indium (In) per million	ppm	10	Semi-quantitative emission spectrographic analysis
K % S	Percent potassium (K)	%	.7	Semi-quantitative emission spectrographic analysis
K2O % X	Percent K_2O	%	.001	X-ray spectroscopy
LA ppm S	Parts lanthanum (La) per million	ppm	50	Semi-quantitative emission spectrographic analysis
**LI ppm S	Parts lithium (Li) per million	ppm	100	Semi-quantitative emission spectrographic analysis
**LU ppm S	Parts lutetium (Lu) per million	ppm	30	Semi-quantitative emission spectrographic analysis
MG % S	Percent magnesium (Mg)	%	.002	Semi-quantitative emission spectrographic analysis
MGO % X	Percent magnesium oxide (MgO)	%	.0205	X-ray spectroscopy
MN ppm S	Parts manganese (Mn) per million	ppm	1	Semi-quantitative emission spectrographic analysis
MNO % X	Percent manganese oxide (MnO)	%	.001	X-ray spectroscopy
**MO ppm S	Parts molybdenum (Mo) per million	ppm	3	Semi-quantitative emission spectrographic analysis
NA % S	Percent sodium (Na)	%	.05	Semi-quantitative emission spectrographic analysis
NA2O % X	Percent sodium oxide (Na_2O)	%	.0639	X-ray spectroscopy
**NB ppm S	Parts niobium (Nb) per million	ppm	10	Semi-quantitative emission spectrographic analysis
**ND ppm S	Parts neodymium (Nd) per million	ppm	70	Semi-quantitative emission spectrographic analysis
NI ppm S	Parts nickel (Ni) per million	ppm	5	Semi-quantitative emission spectrographic analysis
**P % S	Percent phosphorous (P)	%	.2	Semi-quantitative emission spectrographic analysis
P2O5 % X	Percent P_2O_5	%	.005	X-ray spectroscopy
PB ppm S	Parts lead (Pb) per million	ppm	10	Semi-quantitative emission spectrographic analysis
**PD ppm S	Parts palladium (Pd) per million	ppm	2	Semi-quantitative emission spectrographic analysis
**PR ppm S	Parts praseodymium (Pr) per million	ppm	100	Semi-quantitative emission spectrographic analysis
**PT ppm S	Parts platinum (Pt) per million	ppm	50	Semi-quantitative emission spectrographic analysis
**RE ppm S	Parts rhenium (Re) per million	ppm	50	Semi-quantitative emission spectrographic analysis
**RH ppm S	Parts rhodium (Rh) per million	ppm	2	Semi-quantitative emission spectrographic analysis
**SB ppm S	Parts antimony (Sb) per million	ppm	200	Semi-quantitative emission spectrographic analysis
SC ppm S	Parts scandium (Sc) per million	ppm	5	Semi-quantitative emission spectrographic analysis
SE ppm X	Parts selenium (Se) per million	ppm	0.1	X-ray fluorescence
**SI % S	Percent silicon (Si)	%	10*	Semi-quantitative emission spectrographic analysis
SIO2 % X	Percent silica (SiO_2)	%	.0124	X-ray spectroscopy
**SM ppm S	Parts samarium (Sm) per million	ppm	100	Semi-quantitative emission spectrographic analysis
**SN ppm S	Parts tin (Sn) per million	ppm	10	Semi-quantitative emission spectrographic analysis
SR ppm S	Parts strontium (Sr) per million	ppm	5	Semi-quantitative emission spectrographic analysis
**TA ppm S	Parts tantalum (Ta) per million	ppm	50	Semi-quantitative emission spectrographic analysis
**TB ppm S	Parts terbium (Tb) per million	ppm	300	Semi-quantitative emission spectrographic analysis
**TE ppm S	Parts tellurium (Te) per million	ppm	2000	Semi-quantitative emission spectrographic analysis
TI % S	Percent titanium (Ti)	%	.0002	Semi-quantitative emission spectrographic analysis
TIO2 % X	Percent titanium oxide (TiO_2)	%	.0023	X-ray spectroscopy
**TL ppm S	Parts thallium (Tl) per million	ppm	50	Semi-quantitative emission spectrographic analysis
**TM ppm S	Parts thulium (Tm) per million	ppm	20	Semi-quantitative emission spectrographic analysis
V ppm S	Parts vanadium (V) per million	ppm	7	Semi-quantitative emission spectrographic analysis
**W ppm S	Parts tungsten (W) per million	ppm	100	Semi-quantitative emission spectrographic analysis
Y ppm S	Parts yttrium (Y) per million	ppm	10	Semi-quantitative emission spectrographic analysis
YB ppm S	Parts ytterbium (Yb) per million	ppm	1	Semi-quantitative emission spectrographic analysis
ZN ppm A	Parts zinc (Zn) per million	ppm	.05	Atomic absorption - oxydizing flame
ZN ppm S	Parts zinc (Zn) per million	ppm	300	Semi-quantitative emission spectrographic analysis
ZR ppm S	Parts zirconium (Zr) per million	ppm	10	Semi-quantitative emission spectrographic analysis

Figures 3-1 through 3-16 are locality maps from the stream-sediment samples and show data for those variables that have a significant correlation with U and have significant variation through the drainage basin, or are of special interest. Because most geochemical data follow lognormal distributions, the data are divided by approximate geometric intervals. Explanations on each map show the intervals used. The values plotted for each locality, except for the variable Fe_2O_3, are for the finest size fraction (<88 μm) from that site because the concentration of most elements is greater in the finer fraction. Replicate samples are not plotted.

RESULTS FROM DATA MAPS

High U values (>50 ppm) occur in the fine fraction samples collected in the Warm Springs Creek drainage area, along Prickly Pear Creek near Weimer and Golconda Creek, and along Muskrat Creek. These areas also show high Th concentrations and high U in the corresponding surface-water samples (Suits and Wenrich, 1981).

A previous stream-sediment survey (USGS and USBM, 1978) also located high U values along the Warm Springs Creek drainage area. Warm Springs Creek, Golconda Creek and Prickly Pear Creek were chosen by Duval and others (1978) as areas of possible U mineralization. However, they also chose Dutchman Creek and the mouth of Lump Gulch as possibilities, neither of which show high U in the stream sediments.

Previously discovered high radon in the waters of Warm Spring Creek and Muskrat Creek corresponds to high U in the stream sediments. However, the high radon in Dutchman Creek water does not.

High U values were found in the water samples from this study area (Suits and Wenrich, 1981) from Badger Creek, Rawhide Creek, Little Buffalo Gulch and an unnamed tributary to Clancy Creek (sites 13, 39, 33 and 48). Stream sediment samples from these sites do not have correspondingly anomalous U concentrations.

Mo values in the stream sediments were below or near the detection limit of 3 ppm throughout most of the study area. However, the high Mo values found in the surface waters at Prickly Pear Creek just below Weimer Creek, Corral Gulch, Buffalo Creek and Lump Gulch correspond to the sites where stream-sediment samples have detectable Mo concentrations (except Lump Gulch). In fact, Mo values of 15 and 10 ppm occurring in samples from Buffalo Creek and Corral Gulch, respectively, warrant attention. The Elkhorn Wilderness Study Area project (USGS and USBM, 1978) concluded that the entire area has potential for Mo mineralization. The results of 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. Therefore, the Mo potential near Corral Gulch, Buffalo Creek and Lump Gulch may be added to the areas that merit further study.

The fine fraction samples from the Middle Fork of Warm Springs Creek contained high As, Pb and Zn (>500 ppm, >1000 ppm and >1000 ppm, respectively, compared to averages of about 41, 71 and 200). Fine fraction samples from Spring Creek near Corbin and near Jefferson City also contained some of the highest concentrations of these elements, plus high Cu (700 and 2000 ppm, respectively, compared to an average of about 120). A Cu value of 2000 ppm was found in the coarse fraction sample from Slaughterhouse Gulch (#23). This site is downstream from several gold-silver mines that are associated with copper minerals (Klepper and others, 1957). High values of Pb and Zn occur below Elkhorn and near the mouth of Quartz 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: In the accompanying report on surface water in this area (Suits and Wenrich, 1981), samples were separated into two groups representing populations draining areas of different lithology. One group was found to be from water which drains the Boulder batholith, the other represents drainage areas of volcanic rocks and volcanogenic sediments (sample sites 11, 23, 28, 30, 43, 44, 45, 46 and 52, see figure 2). Similar differences based on lithology were previously delineated with panned concentrates from this area (USGS and USBM, 1978). These groups did not seem to be as well segregated by stream-sediment samples as by water samples. The scatter diagrams for the stream sediments show that for most elements the Boulder batholith and volcanic population are not as discretely different from each other as they are in the water samples. Nevertheless, both rock types were treated as different populations. The same sites were used to separate the groups as in the surface-water study, with the exception of sample #28. This sample was eliminated from both populations due to its anomalous character and proximity to mine tailings.

In addition, the sediment populations were further divided into sets based on size fraction. This separation is necessary because the fine-size fraction samples generally contain higher concentrations of most elements, except silica, than those of the coarser fraction, resulting in two different statistical populations.

Problem of censored populations: Some of the data contained qualified values that were 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, not detected at, or greater than that limit). Populations that were singly-censored necessitated use of Cohen's method of estimations of means and standard deviations (see Cohen, 1959, Miesch, 1967, Suits and Wenrich-Verbeek, 1980). Censored values were treated by the "replacement" method before correlation analysis. This method assigns a value of 3/4 the lower limit of detection for each qualified data point if the value is reported as less than the limit, a value of 1/2 the limit if it is reported as not detected, and a value of 4/3 the limit if it is reported as greater than the limit. Elements with a population that is greater than 50 percent censored were generally not used in correlation analysis.

Histograms: Histograms of the logarithms of most variables exhibited greater unimodal symmetry than did those of the raw data. Histograms of both log and raw data for U and Th are shown in table 4, and are separated into fine- and coarse-size fractions but not into the different lithologic groups. Because there are essentially four populations for each element, the number of histograms required to present all the data precluded inclusion of them in this report; these other histograms, discussed below, are available from the authors upon request.

For each variable in each size fraction, the corresponding histograms were judged to represented a population that was either more normal or lognormal in distribution. Data that were judged to come from lognormal populations were transformed to logs before statistical analysis; those that were judged to come from normally distributed populations were not transformed before analysis.

The judgements were made after inspection of three different histogram plots for each size fraction: those including (1) all samples of that size fraction, (2) all samples except #28 (due to its extreme value in most cases), and (3) only Boulder batholith samples. The volcanics group is composed of only eight samples and thus cannot be adequately represented by a histogram.

Table of means and standard deviations: Tables 5, 6, 7, and 8 give the means, standard deviations and minimum and maximum data values for the variables studied in the Boulder batholith samples and volcanic samples for each size fraction.

Like most geochemical data, the distributions of most variables in stream sediments were judged to come from populations that are more closely lognormally distributed than normally distributed (see tables 5-8). Thus in most cases, the log data were used in the statistical analysis. The geometric mean and geometric deviation (antilogs 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 or singly-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 through 8.

(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 that is qualified is shown under the "qualified" column (tables 5-8).

Analysis of analytical precision: The variance between replicate samples (error variance) was compared to the variation in analytical results for all non-replicate samples (total variance). The analytical error is reported separately for each size fraction and for each lithologic group (tables 9-11) as a percentage of the total variation due to analytical imprecision.

There are more replicates of the fine-size fraction samples than of the coarse fraction samples due to limited quantities of the latter. By inspection of the chemical results, the replicate for the coarse fraction sample at site #43 was judged to have encountered problems in sample preparation. Therefore, analytical precision could not be determined for the coarse fraction of the volcanics group. In addition, there were only two pairs of replicates for the fine-fraction samples of the volcanics group and for the coarse fraction of the Boulder batholith group. Thus the statistics adequately determine the analytical precision only for the fine fraction of the Boulder batholith group.

Variables that resulted in an analytical error of greater than 50 percent are marked with an asterisk on tables 9, 10 and 11. Problems are noted for Co in the coarse fraction of the Boulder batholith group and for Th, Ba, Co, Se, Y and Zr for the fine fraction of the volcanics group. However, because in both tables 10 and 11 a maximum of only two pairs were used to calculate the error variance, these results are inconclusive and thus none of these elements were left out of further analysis.

Problems arise in the fine-fraction samples of the Boulder batholith group for Fe, Mg and Sr, which were all analyzed by semi-quantitative spectroscopy (table 9). Fe and Mg were left out of correlation analysis, although Sr was not. Fe and Mg can be examined in oxide form as Fe_2O_3 and MgO, which have good analytical precision, whereas Sr was not analyzed in a corresponding form.

In all cases where an element was analyzed by itself and as an oxide by X-ray fluorescence, the latter was chosen instead of the former for correlation analysis. The oxide data was more desirable in all cases because (1) this form was analyzed with good precision and (2) it is reported quantitatively instead of semi-quantitatively.

Correlation analysis: Tables 12, 13, 14 and 15 show correlation matrices of variables determined for the Boulder batholith group for each size fraction and the volcanics group for each size. The variables chosen for correlation analysis on the basis of analytical precision are discussed in the preceding section. Sample #28 frequently had extreme values in both size fractions. Because of these eccentric analytical results probably caused by a mine tailings pile just upstream from this site, sample #28 (both size fractions) was not used in correlation analysis.

Chemical species with little variation in their distributions were not used in any statistical analyses and are noted at the bottoms of tables 5-8. All qualified data were treated before correlation analysis by the "replacement" method, discussed earlier.

Figures 4-1 through 4-12 and figures 5-1 through 5-18 are scatter diagrams of U concentration plotted against those variables appearing in tables 12-15 having significant correlations with U. The two size fractions are plotted on different figures, and the two lithologic groups are displayed as two different symbols on each plot. The value for sample #28 is represented by a third symbol. No qualified values are plotted. The correlation coefficient, r, from tables 12-15 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, nor sample #28.

RESULTS OF CORRELATION ANALYSIS

Conclusions of correlation trends with U are based on the correlation coefficients, r from tables 12-15 and the scatter diagrams (figures 4-1 through 4-12 and 5-1 through 5-18). The scatter diagrams provide the best evidence of correlation trends for this study area due to the different types of populations involved.

Unlike the corresponding surface-water samples, the stream-sediment results could not be divided as successfully into two groups from the two unique lithologic drainage basins. Nevertheless, stream-sediment samples that were judged to be from streams which drain volcanics and sediments were plotted on the scatter diagrams with different symbols from the rest of the samples and are called volcanics samples (8 samples). The rest of the samples are called Boulder batholith samples.

A correlation significant to the 99-percent confidence level is evident in all samples for both lithologic groups and both size fractions between U and Th with correlation coefficients between 0.73 and 0.77. Both size fractions of the Boulder batholith samples support correlations significant to the 99-percent level (except where noted) between U and $-Al_2O_3$ (a "-" indicates an inverse correlation with uranium), -Ba, organic C, $-K_2O$, MgO (95-percent confidence level), -Sr (note there were analytical problems with the coarse fraction) and Y (95-percent level in fine fraction). U correlates significantly with CaO (95-percent level), Cr (95-percent level), Fe_2O_3, $-Na_2O$, Sc, $-SiO_2$, TiO_2, V (95-percent level), Yb and Zr in the coarse fraction of the Boulder batholith group, while in the fine fraction it does not (with the exception of correlation with Sc, which had insignificant variation in the fine fraction). U correlates significantly to the 95-percent level with Se, -Co and -Cu in the fine fraction but does not correlate in the coarse fraction.

Due to the small number of samples a statistically significant correlation to the 95-percent confidence level could be determined in the volcanics samples (aside from Th) for only -Ni in the fine fraction. However, there is a suggestion of a negative linear trend in the diagram of SiO_2.

There are some notable differences and some important similarities between these results and those of a previous study in the northern Absaroka mountains (Suits and Wenrich-Verbeek, 1980). The previous study covered an area of generally gneissic terrane where concentrations of U were found to be most closely related to organic carbon, and with some U tied up in minerals like xenotime. Likewise in this study, with the exception of Th-enriched minerals, the uranium appears to be most strongly controlled by organic carbon. Correlations of U with $-K_2O$, $-Na_2O$ and Zr are present in these results for the Boulder batholith coarse fraction samples and not in the Absaroka area results. In addition, U was found to correlate negatively with Fe_2O_3 in the Absaroka area and positively in this study area.

The presence of correlations with U and Fe_2O_3, $-Na_2O$, $-SiO_2$, TiO_2, Y, Yb and Zr in only the coarse fraction of the Boulder batholith group and the lack of such correlations in the fine fraction suggest that minerals containing these elements were generally greater than 88 µm in diameter.

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Table 3.--Chemical analyses of stream-sediment samples.*

sample**	Lat	Long	SizeFrac	U ppm N	TH ppm N*	TH / U*	Coef %TH*	Coef %U	AG ppm S	AL2O3% X
01-02E77	46°25'15"	111°56'42"	coarse	12.0	39.0	3.17	6	2	N	13.50
01-03E77	46°25'15"	111°56'42"	fine	20.0	40.0	1.99	7	2	1.0	13.56
02-02E77	46°25'12"	111°56'47"	coarse	23.0	74.0	3.18	4	2	N	14.11
02-03E77	46°25'12"	111°56'47"	fine	37.0	59.0	1.60	7	1	N	13.58
03-02E77	46°24'56"	111°56'38"	coarse	36.0	110.0	3.06	4	1	N	14.78
03-03E77	46°24'56"	111°56'38"	fine	56.0	88.0	1.56	6	1	N	13.24
04-02E77	46°24'58"	111°56'32"	coarse	33.0	61.0	1.85	6	1	N	13.81
04-03E77	46°24'58"	111°56'32"	fine	59.0	--	--	--	1	N	13.09
05-02E77	46°25'41"	111°55'45"	coarse	13.0	39.0	2.94	6	2	N	15.14
05-03E77	46°25'41"	111°55'45"	fine	20.0	39.0	1.94	9	2	N	13.81
06-02E77	46°25'36"	111°55'44"	coarse	13.0	31.0	2.40	7	2	1.0	13.29
06-03E77	46°25'36"	111°55'44"	fine	17.0	35.0	2.01	8	2	1.0	13.09
07-02E77	46°24'18"	111°53'52"	coarse	35.0	110.0	3.10	4	1	N	14.24
07-03E77	46°24'18"	111°53'52"	fine	41.0	68.0	1.68	7	1	N	13.15
07-R3E77	46°24'18"	111°53'52"	fine	41.0	62.0	1.53	7	1	N	12.98
08-02E77	46°24'21"	111°53'52"	coarse	40.0	45.0	1.15	11	1	N	13.80
08-03E77	46°24'21"	111°53'52"	fine	64.0	--	--	--	1	N	13.31
09-02E77	46°25'31"	111°54'51"	coarse	55.0	130.0	2.33	5	1	N	13.50
09-03E77	46°25'31"	111°54'51"	fine	72.0	--	--	--	1	N	13.25
10-02E77	46°25'12"	111°53'28"	coarse	19.0	40.0	2.15	7	2	N	13.53
10-03E77	46°25'12"	111°53'28"	fine	34.0	49.0	1.43	8	1	N	12.73
11-02E77	46°26'39"	111°54'22"	coarse	13.0	27.0	2.11	12	3	N	10.58
11-03E77	46°26'39"	111°54'22"	fine	15.0	24.0	1.57	13	2	N	9.84
12-02E77	46°25'21"	111°59'52"	coarse	13.0	48.0	3.62	5	2	N	15.74
12-03E77	46°25'21"	111°59'52"	fine	21.0	45.0	2.16	7	2	N	14.57
12-R3E77	46°25'21"	111°59'52"	fine	22.0	47.0	2.15	6	2	N	14.62
13-02E77	46°26'37"	111°57'45"	coarse	28.0	54.0	1.92	8	2	N	14.51
13-03E77	46°26'37"	111°57'45"	fine	35.0	46.0	1.32	10	2	N	12.48
14-02E77	46°21'11"	111°56' 7"	coarse	21.0	--	--	--	2	N	12.69
14-03E77	46°21'11"	111°56' 7"	fine	33.0	--	--	--	1	N	12.82
15-02E77	46°21'49"	111°59'17"	coarse	23.0	36.0	1.54	9	2	N	15.71
15-03E77	46°21'49"	111°59'17"	fine	49.0	67.0	1.37	8	1	N	14.15
16-02E77	46°21'53"	111°59'11"	coarse	11.0	33.0	2.88	6	2	N	13.65
16-03E77	46°21'53"	111°59'11"	fine	22.0	56.0	2.57	5	2	N	13.96
17-02E77	46°23'44"	111°57'54"	coarse	36.0	160.0	4.38	3	1	N	12.85
17-03E77	46°23'44"	111°57'54"	fine	44.0	98.0	2.22	5	1	N	12.66
18-02E77	46°23'21"	111°57'14"	coarse	27.0	120.0	4.42	3	1	N	13.32
18-03E77	46°23'21"	111°57'14"	fine	42.0	97.0	2.34	5	1	N	12.99
19-02E77	46°23'25"	111°57' 8"	coarse	25.0	70.0	2.80	5	1	N	14.62
19-03E77	46°23'25"	111°57' 8"	fine	42.0	69.0	1.65	6	1	N	14.30

*The symbol "--" indicates the sample was not analyzed for the appropriate variable, "<" and ">" indicate the value was reported as less than or greater than the adjacent value, respectively. "N" means not detected.
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); "R" represents a replicate sample; 3 indicates the <88μm size fraction, 2 the fraction between 88μm and 149μm. the last three characters refer to the study code and year of collection.

Table 3--continued

sample	Lat	Long	SizeFrac	U ppm N	TH ppm N*	TH / U*	Coef %TH*	Coef %U	AG ppm S	AL2O3% X
20-02E77	46°27' 9"	111°58'54"	coarse	13.0	52.0	4.12	4	2	N	15.35
20-03E77	46°27' 9"	111°53'30"	fine	22.0	52.0	2.40	6	2	N	13.80
21-02E77	46°21'50"	111°59' 1"	coarse	48.0	140.0	2.95	3	1	N	14.12
21-03E77	46°21'50"	111°59' 1"	fine	78.0	110.0	1.43	6	1	1.0	13.98
22-02E77	46°22' 2"	112° 0'24"	coarse	38.0	84.0	2.20	5	1	N	13.92
22-03E77	46°22' 2"	112° 0'24"	fine	54.0	75.0	1.39	8	1	1.0	13.14
23-02E77	46°16'41"	111°57' 1"	coarse	7.0	10.0	1.46	14	2	1.5	9.48
23-03E77	46°16'41"	111°57' 1"	fine	7.6	15.0	1.98	10	2	1.0	10.61
23-R3E77	46°16'41"	111°57' 1"	fine	8.1	10.0	1.27	16	2	1.0	10.40
24-02E77	46°16'49"	111°58'54"	coarse	21.0	36.0	1.73	9	2	N	11.99
24-03E77	46°16'49"	111°58'54"	fine	21.0	24.0	1.12	14	2	N	12.19
24-R3E77	46°16'49"	111°58'54"	fine	20.0	29.0	1.44	11	2	N	11.85
25-02E77	46°16'49"	111°58'48"	coarse	22.0	45.0	2.06	7	2	N	14.28
25-03E77	46°16'49"	111°58'48"	fine	30.0	45.0	1.52	8	1	N	13.28
25-R3E77	46°16'49"	111°58'48"	fine	30.0	36.0	1.18	12	2	N	13.46
26-02E77	46°16'56"	111°58' 3"	coarse	5.5	16.0	2.98	10	3	N	13.99
26-03E77	46°16'56"	111°58' 3"	fine	8.6	--	2.57	9	3	N	13.24
27-02E77	46°16'56"	111°58' 9"	coarse	22.0	40.0	1.79	7	1	N	13.03
27-03E77	46°16'56"	111°58' 9"	fine	36.0	57.0	1.57	7	1	N	12.61
28-02E77	46°15'29"	111°57'35"	coarse	1.9	--	--	--	6	70.0	4.78
28-03E77	46°15'29"	111°57'35"	fine	1.3	2.3	1.82	39	8	50.0	1.94
29-02E77	46°15'29"	111°57'44"	coarse	17.0	27.0	1.57	11	2	N	14.31
29-03E77	46°15'29"	111°57'44"	fine	22.0	34.0	1.56	10	2	N	12.99
30-02E77	46°15' 2"	111°57'44"	coarse	3.3	10.0	3.11	13	5	7.0	13.69
30-03E77	46°15' 2"	111°57'44"	fine	3.6	12.0	3.39	12	5	10.0	13.49
31-02E77	46°22'35"	112° 1'26"	coarse	13.0	27.0	2.05	8	2	N	13.90
31-03E77	46°22'35"	112° 1'26"	fine	31.0	34.0	1.08	11	1	N	13.65
32-02E77	46°28' 9"	111°59' 8"	coarse	4.2	29.0	6.76	5	4	N	18.03
32-03E77	46°28' 9"	111°59' 8"	fine	10.0	41.0	3.93	5	2	1.0	15.46
33-02E77	46°26'43"	112° 3'42"	coarse	12.0	80.0	6.65	3	2	N	15.59
33-03E77	46°26'43"	112° 3'42"	fine	13.0	59.0	4.42	5	2	N	15.88
34-02E77	46°26'35"	112° 3'45"	coarse	5.1	18.0	3.43	9	4	1.5	17.06
34-03E77	46°26'35"	112° 3'45"	fine	8.3	25.0	3.01	7	3	2.0	16.17
34-R3E77	46°26'35"	112° 3'45"	fine	8.4	28.0	3.33	7	3	7.0	16.02
35-02E77	46°25'22"	112° 5'57"	coarse	6.4	35.0	5.56	5	3	N	17.80
35-03E77	46°25'22"	112° 5'57"	fine	9.2	31.0	3.37	7	3	N	16.99
36-02E77	46°24'45"	112° 7' 0"	coarse	14.0	21.0	1.51	13	2	2.0	15.22
36-03E77	46°24'45"	112° 7' 0"	fine	13.0	22.0	1.68	11	2	7.0	14.61
37-02E77	46°24'53"	112° 8'48"	coarse	13.0	25.0	1.93	9	2	N	16.46
37-03E77	46°24'53"	112° 8'48"	fine	23.0	31.0	1.32	10	2	N	15.70

Table 5--continued

sample	Lat	Long	SizeFrac	U ppm N	TH ppm N*	TH / U*	Coef %TH*	Coef %U	AG ppm S	AL2O3% X
38-02E77	46°24'41"	112° 8'52"	coarse	12.0	37.0	3.14	7	2	1.0	14.30
38-03E77	46°24'41"	112° 8'52"	fine	15.0	32.0	2.08	9	2	1.0	11.74
39-02E77	46°17'21"	112° 3' 1"	coarse	23.0	95.0	4.12	4	2	N	14.22
39-03E77	46°17'21"	112° 3' 1"	fine	31.0	79.0	2.59	5	1	N	12.85
40-02E77	46°18'28"	112° 1'50"	coarse	13.0	34.0	2.60	8	2	N	14.43
40-03E77	46°18'28"	112° 1'50"	fine	15.0	40.0	2.58	8	2	N	16.92
41-02E77	46°18'27"	112° 1'41"	coarse	35.0	37.0	1.06	11	1	N	14.66
41-R2E77	46°18'27"	112° 1'41"	coarse	34.0	52.0	1.52	7	1	N	14.74
41-03E77	46°18'27"	112° 1'41"	fine	51.0	--	--	--	1	N	14.40
42-02E77	46°17'41"	112° 3'27"	coarse	9.2	46.0	4.99	5	3	N	16.02
42-03E77	46°17'41"	112° 3'27"	fine	17.0	37.0	2.22	8	2	5.0	14.63
43-02E77	46°22'43"	112° 3'47"	coarse	6.3	14.0	2.18	12	3	7.0	15.57
43-R2E77	46°22'43"	112° 3'47"	coarse	6.1	11.0	1.81	14	3	7.0	15.24
43-03E77	46°22'43"	112° 3'47"	fine	8.7	16.0	1.81	13	3	15.0	14.91
43-R3E77	46°22'43"	112° 3'47"	fine	8.7	14.0	1.60	15	3	15.0	14.54
44-02E77	46°23'16"	112° 7'58"	coarse	9.3	16.0	1.75	12	3	N	13.34
44-03E77	46°23'16"	112° 7'58"	fine	13.0	20.0	1.58	12	2	1.0	14.55
45-02E77	46°23'10"	112° 7'48"	coarse	4.9	8.3	1.67	19	4	2.0	14.40
45-03E77	46°23'10"	112° 7'48"	fine	5.3	13.0	2.50	13	4	3.0	13.85
46-02E77	46°23'30"	112° 1'41"	coarse	5.7	14.0	2.54	10	3	50.0	9.78
46-03E77	46°23'30"	112° 1'41"	fine	9.0	23.0	2.55	9	3	70.0	10.38
47-02E77	46°28'42"	111°58'48"	coarse	9.9	41.0	4.18	5	2	N	15.97
47-R2E77	46°28'42"	111°58'48"	coarse	10.0	36.0	3.61	6	2	N	15.67
47-03E77	46°28'42"	111°58'48"	fine	19.0	43.0	2.22	7	2	N	14.99
48-02E77	46°29'33"	112° 2'48"	coarse	6.0	25.0	4.19	7	3	N	15.86
48-03E77	46°29'33"	112° 2'48"	fine	13.0	43.0	3.36	5	2	N	14.14
49-02E77	46°29' 1"	112° 4'23"	coarse	11.0	35.0	3.32	6	2	N	14.49
49-03E77	46°29' 1"	112° 4'23"	fine	18.0	29.0	1.64	11	2	N	13.53
50-02E77	46°27'53"	112° 6'26"	coarse	8.9	38.0	4.28	5	2	N	16.83
50-03E77	46°27'53"	112° 6'26"	fine	16.0	42.0	2.71	7	2	N	15.21
51-02E77	46°27'49"	112° 6'22"	coarse	19.0	41.0	2.16	7	2	N	14.35
51-03E77	46°27'49"	112° 6'22"	fine	22.0	28.0	1.24	13	2	N	13.95
52-02E77	46°26'53"	111°51'38"	coarse	7.2	10.0	1.44	18	3	N	14.65
52-03E77	46°26'53"	111°51'38"	fine	11.0	13.0	1.18	17	2	N	14.55

Table 3--continued

sample	AS ppm A	B ppm S	BA ppm S	BE ppm S	Inorg C%	Org C %	CA % S	CAU % X	CO ppm S	CR ppm S
01-02E77	410.0	20	300	2.0	<.01	1.16	3.0	2.900	15	30
01-03E77	650.0	20	700	2.0	.14	2.28	1.5	2.880	20	50
02-02E77	11.0	N	500	1.5	<.01	1.22	3.0	4.420	15	50
02-03E77	22.0	<20	500	1.5	<.01	3.46	2.0	4.140	10	50
03-02E77	62.0	N	500	2.0	<.01	2.08	3.0	4.440	15	30
03-03E77	20.0	<20	500	1.5	<.01	5.38	3.0	4.390	10	30
04-02E77	16.0	20	300	1.5	<.01	2.55	3.0	4.620	15	50
04-03E77	26.0	<20	500	1.5	<.01	6.03	3.0	4.500	15	70
05-02E77	12.0	<20	700	3.0	<.01	2.17	3.0	3.300	15	30
05-03E77	27.0	N	700	3.0	<.01	4.29	2.0	3.130	20	50
06-02E77	816.0	20	500	2.0	.06	1.01	2.0	2.780	15	30
06-03E77	920.0	30	500	2.0	<.01	1.70	3.0	2.800	20	50
07-02E77	9.0	N	300	2.0	<.01	2.50	3.0	4.130	15	50
07-03E77	25.0	<20	500	1.5	<.01	3.47	2.0	3.740	10	50
07-R3E77	7.2	20	500	2.0	<.01	3.45	3.0	3.760	10	50
08-02E77	23.0	<20	300	1.5	<.01	3.91	2.0	4.590	15	50
08-03E77	19.0	20	500	N	<.01	6.61	3.0	4.330	15	50
09-02E77	122.0	N	500	3.0	<.01	5.43	2.0	3.320	20	70
09-03E77	157.0	N	300	2.0	.07	8.54	3.0	3.520	15	70
10-02E77	25.0	<20	500	1.5	.07	1.50	3.0	3.990	15	70
10-03E77	37.0	20	500	2.0	.07	4.26	3.0	4.100	20	50
11-02E77	74.0	N	300	N	.07	13.26	1.5	3.340	15	20
11-03E77	84.0	N	300	N	.07	12.88	1.5	3.090	15	15
12-02E77	3.8	N	700	2.0	<.01	.90	3.0	3.770	10	30
12-03E77	7.1	20	700	2.0	<.01	2.19	3.0	3.660	15	50
12-R3E77	11.0	<20	700	1.5	<.01	2.09	2.0	3.720	10	50
13-02E77	12.0	N	500	3.0	<.01	5.88	2.0	3.200	10	30
13-03E77	24.0	20	500	3.0	<.01	7.91	2.0	3.030	10	30
14-02E77	11.0	20	500	1.5	<.01	2.46	3.0	4.290	15	150
14-03E77	16.0	30	700	1.5	<.01	4.08	3.0	4.400	20	150
15-02E77	11.0	<20	500	2.0	<.01	1.99	3.0	4.080	10	15
15-03E77	11.0	20	500	2.0	<.01	4.49	3.0	4.200	10	30
16-02E77	3.9	20	500	1.5	<.01	.42	3.0	4.550	15	70
16-03E77	6.4	20	500	1.5	<.01	1.23	3.0	5.470	15	70
17-02E77	5.4	N	300	2.0	<.01	.77	5.0	4.710	15	70
17-03E77	16.0	<20	300	1.5	<.01	2.91	3.0	4.840	15	30
18-02E77	20.0	N	300	1.5	<.01	1.15	3.0	4.720	15	70
18-03E77	23.0	<20	300	1.5	<.01	3.80	3.0	4.870	15	70
19-02E77	11.0	N	500	2.0	<.01	1.02	5.0	4.760	15	50
19-03E77	13.0	<20	500	1.5	<.01	2.68	3.0	1.900	20	50

Table 3--continued

sample	AS ppm A	B ppm S	BA ppm S	BE ppm S	Inorg C%	Org C %	CA % S	CAO % X	CO ppm S	CR ppm S
20-02E77	75.0	<20	500	2.0	.07	.81	3.0	2.280	15	30
20-03E77	136.0	20	500	3.0	.12	2.17	3.0	4.060	15	50
21-02E77	17.0	N	300	2.0	<.01	1.65	2.0	3.380	10	70
21-03E77	16.0	<20	300	2.0	.07	4.39	3.0	3.530	10	30
22-02E77	34.0	N	300	1.5	<.01	2.61	2.0	3.810	10	30
22-03E77	36.0	20	700	2.0	<.01	4.79	3.0	3.500	15	30
23-02E77	300.0	50	200	1.5	.12	.84	7.0	10.800	15	30
23-03E77	230.0	30	500	N	<.01	1.56	7.0	9.400	20	50
23-R3E77	235.0	20	300	N	<.01	1.57	7.0	9.790	15	50
24-02E77	12.0	20	500	N	<.01	5.95	3.0	3.950	15	100
24-03E77	21.0	20	500	N	<.01	6.93	2.0	3.610	15	70
24-R3E77	12.0	20	500	1.5	<.01	6.78	3.0	3.600	10	50
25-02E77	24.0	20	500	1.5	<.01	3.80	3.0	4.010	15	50
25-03E77	22.0	<20	700	1.5	<.01	5.44	2.0	3.580	15	70
25-R3E77	21.0	20	500	1.5	<.01	5.35	3.0	3.650	15	70
26-02E77	43.0	20	700	2.0	<.01	1.67	3.0	4.080	20	100
26-03E77	50.0	30	700	2.0	<.01	2.29	3.0	3.620	20	70
27-02E77	25.0	20	500	1.5	<.01	2.01	3.0	5.090	30	150
27-03E77	37.0	30	500	1.5	<.01	4.77	3.0	4.840	20	100
28-02E77	230.0	100	150	N	5.89	.51	7.0	16.100	N	15
28-03E77	150.0	20	50	N	7.88	.09	10.0	21.000	N	7
29-02E77	30.0	20	700	1.5	<.01	3.17	3.0	5.220	15	100
29-03E77	35.0	20	700	N	.07	4.83	3.0	4.310	15	100
30-02E77	655.0	100	500	1.5	.07	2.94	3.0	4.890	15	70
30-03E77	460.0	100	700	1.5	<.01	3.30	3.0	3.490	15	100
31-02E77	17.0	<20	700	1.5	<.01	.99	3.0	3.840	10	50
31-03E77	9.0	20	500	2.0	<.01	2.68	3.0	4.510	15	70
32-02E77	42.0	20	1,000	2.0	<.01	.53	3.0	3.346	15	20
32-03E77	90.0	20	700	2.0	1.77	1.84	3.0	3.580	15	30
33-02E77	6.9	N	500	2.0	<.01	.58	3.0	3.590	20	70
33-03E77	17.0	N	700	1.5	<.01	1.99	2.0	3.780	15	50
34-02E77	108.0	N	1,000	1.5	<.01	.78	3.0	2.780	15	30
34-03E77	193.0	20	700	1.5	<.01	1.26	2.0	2.800	15	30
34-R3E77	197.0	20	700	2.0	<.01	1.19	1.5	2.760	15	30
35-02E77	12.0	N	1,000	1.5	<.01	1.15	3.0	3.030	7	50
35-03E77	14.0	20	700	2.0	<.01	3.17	2.0	2.870	15	30
36-02E77	147.0	<10	700	1.5	.07	4.07	2.0	2.910	15	20
36-03E77	204.0	20	700	1.5	<.01	2.50	2.0	2.750	15	30
37-02E77	20.0	N	700	2.0	<.01	2.38	3.0	2.980	15	30
37-03E77	23.0	<20	700	2.0	<.01	4.71	3.0	3.140	10	30

Table 3--continued

sample	AS ppm A	B ppm S	BA ppm S	BE ppm S	Inorg C%	Org C %	CA % S	CAO % X	CO ppm S	CR ppm S
38-02E77	50.0	N	1,000	1.5	<.01	2.57	2.0	3.210	20	30
38-03E77	89.0	N	1,500	N	.65	5.67	3.0	4.370	20	30
39-02E77	15.0	N	700	1.5	<.01	2.06	2.0	4.140	15	70
39-03E77	12.0	20	700	N	<.01	4.12	3.0	4.090	15	50
40-02E77	16.0	N	700	1.5	.11	5.50	2.0	3.980	10	30
40-03E77	20.0	<20	500	N	.14	6.81	3.0	3.570	10	30
41-02E77	15.0	<20	700	1.5	<.01	2.46	3.0	4.240	15	70
41-R2E77	11.0	20	500	2.0	<.01	2.47	3.0	4.280	15	70
41-03E77	13.0	20	500	1.5	<.01	3.69	3.0	4.470	10	70
42-02E77	6.8	N	700	1.5	<.01	1.61	3.0	3.320	15	50
42-03E77	30.0	<20	700	1.5	<.01	5.89	2.0	3.460	15	50
43-02E77	610.0	20	1,000	1.5	<.01	1.61	1.5	6.810	10	50
43-R2E77	525.0	30	1,000	1.5	.07	1.57	2.0	2.310	10	30
43-03E77	990.0	50	700	1.5	<.01	2.53	1.5	2.150	20	30
43-R3E77	945.0	50	700	1.5	.07	2.50	1.5	2.160	15	30
44-02E77	43.0	50	700	1.5	<.01	3.15	1.5	4.720	15	30
44-03E77	74.0	20	1,000	1.5	.14	4.89	1.5	2.170	15	50
45-02E77	68.0	30	700	N	<.01	4.02	1.5	2.140	20	50
45-03E77	88.0	30	700	1.5	.14	4.92	1.5	2.440	20	70
46-02E77	550.0	50	500	N	.69	.29	1.0	2.070	10	15
46-03E77	985.0	70	500	2.0	.75	.91	1.5	2.260	20	20
47-02E77	4.2	N	700	1.5	<.01	1.08	3.0	3.960	15	30
47-R2E77	12.0	N	700	2.0	.06	.97	3.0	3.980	10	30
47-03E77	12.0	<20	700	2.0	<.01	2.61	3.0	4.040	20	50
48-02E77	3.1	N	500	2.0	<.01	.99	5.0	5.140	15	20
48-03E77	5.4	N	300	1.5	<.01	2.33	3.0	5.690	20	50
49-02E77	10.0	N	500	2.0	<.01	1.86	3.0	4.090	20	30
49-03E77	20.0	<20	700	2.0	.14	4.20	3.0	4.230	50	50
50-02E77	11.0	N	700	1.5	<.01	1.57	3.0	3.610	15	15
50-03E77	19.0	<20	700	2.0	<.01	3.48	3.0	3.300	20	30
51-02E77	43.0	N	700	1.5	.06	2.79	2.0	2.790	15	50
51-03E77	54.0	N	1,000	1.5	<.01	5.12	2.0	3.110	20	30
52-02E77	27.0	50	700	N	<.01	3.08	2.0	3.640	15	50
52-03E77	22.0	50	700	1.5	<.01	4.99	3.0	3.570	20	70

Table 3--continued

sample	CU ppm S	FE % S	FE2O3% X	GA ppm S	K % S	K2O % X	LA ppm S	MG % S	MGO % X	MN ppm S
01-02E77	100	7.0	7.27	20	3.0	3.03	70	.7	1.74	2,000
01-03E77	150	5.0	6.16	20	3.0	2.71	100	1.0	1.60	3,000
02-02E77	30	>10.0	11.47	--	3.0	2.26	70	1.5	2.35	1,000
02-03E77	50	5.0	7.66	15	2.0	2.13	50	1.0	2.30	700
03-02E77	50	7.0	8.34	30	3.0	2.43	150	1.5	2.28	700
03-03E77	70	5.0	6.39	30	3.0	2.03	100	1.5	2.30	700
04-02E77	30	7.0	10.95	20	3.0	2.22	N	1.5	2.83	1,000
04-03E77	70	5.0	7.30	15	2.0	1.94	50	1.5	2.32	1,500
05-02E77	70	7.0	7.15	30	5.0	3.13	70	1.0	1.27	1,000
05-03E77	150	5.0	5.99	30	5.0	2.74	150	1.0	1.71	2,000
06-02E77	150	7.0	6.91	20	3.0	3.22	70	1.0	1.54	3,000
06-03E77	200	7.0	6.44	30	5.0	2.64	100	1.5	1.81	3,000
07-02E77	50	7.0	8.50	30	3.0	2.53	70	1.5	2.19	1,000
07-03E77	70	5.0	5.86	20	3.0	2.18	50	1.0	2.11	1,000
07-R3E77	70	.5	5.82	20	3.0	2.20	70	1.5	2.18	1,000
08-02E77	50	5.0	9.36	20	3.0	2.19	<50	1.5	2.86	1,000
08-03E77	70	5.0	6.68	20	2.0	1.88	50	1.5	2.35	1,000
09-02E77	70	10.0	11.98	30	5.0	2.52	150	.7	2.05	700
09-03E77	70	7.0	8.80	20	3.0	2.41	100	.7	1.86	1,500
10-02E77	50	7.0	11.13	30	3.0	3.04	150	1.5	2.61	1,500
10-03E77	100	7.0	7.97	30	3.0	2.22	70	1.5	2.55	2,000
11-02E77	70	5.0	10.81	15	1.0	1.78	N	.7	1.44	3,000
11-03E77	70	5.0	11.96	15	1.0	1.59	50	.7	1.68	3,000
12-02E77	50	5.0	5.76	20	3.0	2.69	70	1.0	1.52	700
12-03E77	70	5.0	5.30	20	3.0	2.41	100	1.5	1.91	700
12-R3E77	70	3.0	5.21	20	3.0	2.43	70	1.0	1.70	500
13-02E77	100	5.0	6.58	30	3.0	2.83	50	.5	1.04	500
13-03E77	150	3.0	4.63	20	3.0	2.49	100	.7	1.38	700
14-02E77	50	7.0	9.53	20	3.0	2.65	70	1.5	3.40	700
14-03E77	100	7.0	7.16	20	3.0	2.16	70	2.0	3.12	1,000
15-02E77	70	3.0	4.80	20	3.0	3.07	70	1.5	2.06	700
15-03E77	100	5.0	5.01	30	3.0	2.46	70	1.5	2.00	1,500
16-02E77	20	7.0	6.21	20	3.0	2.91	100	1.5	2.54	1,000
16-03E77	70	7.0	6.29	30	3.0	2.35	70	1.5	3.23	1,000
17-02E77	30	>10.0	16.17	20	2.0	1.97	150	1.5	2.77	1,000
17-03E77	70	7.0	9.62	20	3.0	1.87	70	1.5	2.76	1,000
18-02E77	50	10.0	12.96	30	3.0	2.20	50	1.5	2.67	1,000
18-03E77	70	7.0	8.94	20	3.0	1.94	70	1.5	2.80	700
19-02E77	50	10.0	8.93	30	2.0	2.24	100	1.5	2.74	1,500
19-03E77	70	7.0	5.77	20	3.0	3.88	100	1.5	1.29	1,000

Table 3--continued

sample	CU ppm S	FE % S	FE2O3% X	GA ppm S	K % S	K2O % X	LA ppm S	MG % S	MGO % X	MN ppm S
20-02E77	30	7.0	6.10	20	3.0	3.39	150	1.0	1.16	700
20-03E77	100	5.0	7.01	30	3.0	2.52	150	1.5	1.88	1,000
21-02E77	100	7.0	10.60	20	3.0	3.00	150	.7	1.46	700
21-03E77	200	5.0	5.02	20	3.0	2.55	100	1.0	1.73	1,500
22-02E77	70	7.0	10.00	20	3.0	2.69	70	1.0	2.02	700
22-03E77	150	7.0	6.42	20	3.0	2.43	70	1.0	1.82	1,000
23-02E77	2,000	>10.0	23.37	20	2.0	1.34	N	1.5	3.39	1,000
23-03E77	1,000	>10.0	17.96	20	2.0	1.60	50	2.0	3.77	1,500
23-R3E77	1,000	>10.0	18.20	20	2.0	1.61	50	2.0	3.69	1,000
24-02E77	100	10.0	11.61	20	5.0	2.46	50	1.5	2.95	3,000
24-03E77	100	5.0	6.54	20	3.0	2.12	N	1.5	2.26	1,500
24-R3E77	100	5.0	6.61	20	3.0	2.19	70	1.0	2.05	2,000
25-02E77	70	7.0	8.63	30	5.0	2.79	N	1.5	2.77	1,500
25-03E77	70	5.0	7.39	30	3.0	2.13	50	1.0	2.22	1,000
25-R3E77	100	7.0	7.40	20	3.0	2.11	70	1.5	2.45	1,500
26-02E77	300	7.0	7.09	20	3.0	3.34	50	1.5	3.10	1,000
26-03E77	300	5.0	6.28	20	3.0	2.73	50	1.5	2.66	1,000
27-02E77	100	10.0	12.14	30	3.0	2.61	70	1.5	3.39	1,500
27-03E77	150	7.0	8.21	20	3.0	2.16	100	1.5	3.08	1,500
28-02E77	300	1.5	3.16	7	1.0	1.26	N	7.0	10.72	1,000
28-03E77	200	.7	1.76	5	N	.69	N	7.0	14.11	1,000
29-02E77	150	5.0	6.89	20	3.0	2.54	50	1.5	3.16	1,500
29-03E77	200	5.0	6.60	20	3.0	2.11	70	1.0	2.56	1,500
30-02E77	100	5.0	6.86	20	2.0	2.01	50	1.5	2.57	1,500
30-03E77	150	7.0	5.64	20	3.0	2.29	50	1.5	2.38	1,000
31-02E77	50	5.0	4.60	20	3.0	3.26	70	1.5	1.92	700
31-03E77	100	5.0	5.64	20	3.0	2.66	100	1.5	2.66	1,500
32-02E77	50	5.0	4.93	30	3.0	3.20	70	1.0	1.49	700
32-03E77	150	7.0	6.62	30	3.0	2.65	100	1.0	1.92	2,000
33-02E77	70	>10.0	15.27	--	3.0	2.44	100	.7	1.36	700
33-03E77	100	5.0	8.64	30	5.0	2.60	70	1.0	1.97	700
34-02E77	150	7.0	5.38	30	5.0	3.42	50	1.0	1.41	700
34-03E77	150	5.0	5.17	20	3.0	2.78	70	1.0	1.27	1,000
34-R3E77	150	5.0	5.17	20	3.0	2.81	70	.7	1.38	1,000
35-02E77	20	10.0	8.93	30	3.0	2.51	70	.5	.90	500
35-03E77	70	7.0	5.50	30	3.0	2.55	70	.7	1.11	1,000
36-02E77	150	5.0	6.80	30	5.0	3.20	50	1.0	2.01	3,000
36-03E77	200	5.0	5.90	20	3.0	3.01	50	1.0	1.48	3,000
37-02E77	30	7.0	7.86	30	3.0	2.71	70	.7	1.21	1,500
37-03E77	70	5.0	6.04	30	3.0	2.32	70	1.0	1.41	3,000

Table 3--continued

sample	CU ppm S	FE % S	FE2O3% X	GA ppm S	K % S	K2O % X	LA ppm S	MG % S	MGO % X	MN ppm S
38-02E77	70	5.0	10.54	20	3.0	2.84	70	.7	1.21	15,000
38-03E77	150	10.0	11.23	15	3.0	2.14	70	.5	1.41	>20,000
39-02E77	50	7.0	11.53	30	5.0	3.02	70	1.5	2.63	700
39-03E77	50	5.0	7.10	20	3.0	2.56	70	1.5	2.30	1,000
40-02E77	70	5.0	7.00	20	5.0	3.42	50	1.0	1.96	500
40-03E77	70	3.0	5.96	20	3.0	3.34	50	.7	1.17	300
41-02E77	50	7.0	7.70	30	5.0	2.99	70	1.5	2.45	700
41-R2E77	70	7.0	7.80	30	3.0	2.98	70	1.5	2.48	1,000
41-03E77	70	5.0	6.31	30	3.0	2.33	50	1.5	2.83	1,000
42-02E77	50	10.0	9.70	20	3.0	2.94	70	1.0	1.37	700
42-03E77	100	5.0	6.61	20	5.0	2.50	100	1.0	1.79	1,000
43-02E77	500	5.0	11.66	30	5.0	.12	N	.7	5.84	2,000
43-R2E77	500	7.0	6.07	20	5.0	3.32	70	.7	1.28	2,000
43-03E77	700	7.0	6.82	30	5.0	3.10	50	.7	1.27	3,000
43-R3E77	700	7.0	6.68	30	5.0	3.08	50	.5	1.38	3,000
44-02E77	100	7.0	7.54	20	5.0	1.94	70	.7	2.64	10,000
44-03E77	100	5.0	6.50	20	5.0	3.06	50	.5	1.41	15,000
45-02E77	200	7.0	7.26	20	3.0	2.96	50	1.0	1.60	7,000
45-03E77	200	5.0	7.14	20	5.0	2.57	50	.7	1.58	10,000
46-02E77	1,000	3.0	6.04	15	2.0	2.40	<50	.3	.71	20,000
46-03E77	2,000	5.0	7.49	20	3.0	2.22	50	.5	1.15	>20,000
47-02E77	30	7.0	7.49	20	3.0	2.81	70	1.0	1.83	700
47-R2E77	30	5.0	7.64	20	3.0	2.78	70	1.0	1.66	500
47-03E77	100	7.0	6.87	30	3.0	2.57	100	1.5	2.40	700
48-02E77	20	5.0	6.20	30	3.0	2.83	50	1.5	2.87	700
48-03E77	50	7.0	7.77	30	3.0	2.35	70	2.0	3.42	1,500
49-02E77	70	7.0	8.26	20	3.0	2.52	70	1.5	1.98	1,500
49-03E77	200	5.0	6.72	20	5.0	2.34	70	1.0	2.15	7,000
50-02E77	50	3.0	5.96	30	5.0	3.36	70	.7	1.02	1,000
50-03E77	100	7.0	6.62	20	5.0	2.92	70	1.0	1.62	3,000
51-02E77	70	10.0	14.42	30	3.0	2.49	50	.5	1.06	3,000
51-03E77	100	5.0	7.81	30	3.0	2.38	50	.7	1.17	10,000
52-02E77	50	5.0	7.83	20	5.0	2.51	<50	1.0	2.10	700
52-03E77	100	5.0	6.42	20	3.0	2.17	70	1.5	2.25	1,500

Table 3--continued

sample	MNO % X	NA % S	NA2O % X	NI ppm S	P2O5 % X	PB ppm S	SC ppm S	SE ppm X	SIO2 % X
01-02E77	.2600	2.0	2.330	15	.22	200	20	<.1	64.79
01-03E77	.5310	2.0	2.000	15	.37	200	15	.4	61.18
02-02E77	.1330	3.0	2.880	15	.31	20	30	<.1	57.01
02-03E77	.1440	2.0	2.320	10	.42	30	20	.4	57.06
03-02E77	.1230	3.0	3.150	10	.27	20	30	<.1	58.96
03-03E77	.1610	3.0	2.640	15	.37	30	30	.4	54.58
04-02E77	.1760	3.0	2.510	15	.30	30	30	.1	55.50
04-03E77	.2100	3.0	1.940	15	.45	30	20	1.6	52.54
05-02E77	.1520	3.0	3.250	10	.22	30	10	<.1	60.36
05-03E77	.0316	3.0	2.400	20	.36	50	30	.3	56.42
06-02E77	.2850	2.0	2.370	10	.20	200	15	<.1	64.03
06-03E77	.3520	3.0	1.990	15	.34	500	30	<.1	61.83
07-02E77	.1470	3.0	2.630	15	.30	20	30	<.1	55.68
07-03E77	.1500	3.0	2.200	15	.35	20	30	.5	58.94
07-R3E77	.1510	3.0	2.200	10	.34	20	30	.2	59.60
08-02E77	.1980	2.0	2.180	15	.24	30	20	1.0	53.16
08-03E77	.2110	2.0	1.820	15	.36	70	15	1.4	52.06
09-02E77	.1670	5.0	2.400	20	.36	200	20	.4	50.57
09-03E77	.2440	3.0	2.000	20	.46	200	20	.3	46.12
10-02E77	.2000	3.0	2.380	15	.24	50	30	.4	57.57
10-03E77	.2580	3.0	1.960	15	.33	50	30	.3	54.21
11-02E77	.7260	2.0	1.340	7	.64	30	10	1.7	36.42
11-03E77	.8720	.7	1.030	10	.83	30	10	1.3	35.94
12-02E77	.0930	3.0	3.560	7	.24	15	15	<.1	62.14
12-03E77	.0950	3.0	2.650	10	.39	20	20	.2	61.51
12-R3E77	.0960	3.0	2.780	10	.44	20	20	.3	61.68
13-02E77	.0900	3.0	3.030	10	.22	50	10	.2	54.71
13-03E77	.1150	3.0	2.170	15	.28	50	15	.1	53.04
14-02E77	.1640	2.0	2.060	30	.42	50	20	.7	56.76
14-03E77	.1640	3.0	2.000	50	.48	70	30	.6	55.44
15-02E77	.1380	3.0	2.880	10	.17	30	20	<.1	61.39
15-03E77	.1940	3.0	2.600	10	.29	70	30	.4	57.31
16-02E77	.1200	3.0	2.830	20	.29	20	30	<.1	63.66
16-03E77	.1600	3.0	2.800	30	.46	20	30	<.1	59.35
17-02E77	.1510	2.0	2.800	20	.35	15	30	.2	54.98
17-03E77	.1480	3.0	2.360	20	.57	20	30	<.1	54.48
18-02E77	.1620	3.0	2.700	20	.33	20	30	<.1	54.99
18-03E77	.1820	2.0	2.320	20	.57	30	30	.8	53.06
19-02E77	.1400	3.0	2.910	10	.23	20	30	<.1	58.83
19-03E77	1.1500	3.0	1.490	15	.24	20	30	.4	59.43

Table 3--continued

sample	MNO % X	NA % S	NA2O % X	NI ppm S	P2O5 % X	PB ppm S	SC ppm S	SE ppm X	SIO2 % X
20-02E77	.2330	2.0	2.580	10	.27	50	20	<.1	62.65
20-03E77	.1510	3.0	2.400	20	.52	100	20	<.1	59.73
21-02E77	.1300	3.0	2.840	10	.22	30	20	.6	58.24
21-03E77	.1660	3.0	2.460	10	.26	70	20	.9	58.39
22-02E77	.1490	3.0	2.820	10	.30	100	20	.2	56.26
22-03E77	.1730	3.0	2.230	15	.36	150	30	.6	56.76
23-02E77	.1920	1.0	1.340	10	.20	50	10	.5	42.38
23-03E77	.1830	1.0	1.190	10	.31	70	15	.5	47.91
23-R3E77	.1810	1.0	1.420	10	.34	50	15	1.0	46.24
24-02E77	.2540	5.0	1.720	20	.28	20	20	.3	47.91
24-03E77	.2520	2.0	1.640	15	.30	30	15	.7	53.02
24-R3E77	.2590	3.0	1.840	15	.29	30	15	.6	53.17
25-02E77	.2110	3.0	2.200	20	.22	20	20	.6	53.38
25-03E77	.2340	2.0	1.790	20	.35	20	20	.9	52.75
25-R3E77	.2250	3.0	1.820	15	.33	20	20	.6	52.58
26-02E77	.1480	3.0	2.090	30	.25	30	15	.6	59.52
26-03E77	.1550	2.0	1.730	20	.28	30	15	<.1	61.11
27-02E77	.1900	3.0	2.360	50	.31	20	30	.1	52.52
27-03E77	.2400	2.0	2.150	50	.44	30	30	.5	52.70
28-02E77	.2720	.7	1.340	7	.25	2,000	N	<.1	37.48
28-03E77	.2460	.3	.900	N	.31	1,500	N	.4	31.04
29-02E77	.2340	3.0	2.440	30	.30	20	30	.6	56.08
29-03E77	.2760	3.0	2.040	20	.32	20	20	.9	54.92
30-02E77	.1730	2.0	1.150	20	.22	3,000	15	.2	58.22
30-03E77	.1570	2.0	1.230	30	.31	1,500	15	.6	58.66
31-02E77	.1050	3.0	2.750	15	.30	50	15	<.1	64.63
31-03E77	.1520	3.0	2.450	20	.39	70	30	.4	60.03
32-02E77	.1270	3.0	3.700	10	.19	100	15	<.1	63.24
32-03E77	.2820	3.0	2.730	15	.51	200	20	<.1	59.29
33-02E77	.0900	5.0	3.580	20	.38	20	15	<.1	53.22
33-03E77	.1640	3.0	3.040	20	.54	30	20	.3	55.92
34-02E77	.1430	3.0	3.220	15	.20	200	15	<.1	61.93
34-03E77	.1780	3.0	2.940	10	.40	200	15	<.1	61.39
34-R3E77	.1840	3.0	2.840	15	.38	500	15	.4	61.84
35-02E77	.0730	5.0	4.520	10	.25	20	7	<.1	58.32
35-03E77	.1520	3.0	3.160	15	.33	30	15	.3	56.96
36-02E77	.4390	3.0	2.510	15	.25	300	15	<.1	54.82
36-03E77	.4030	3.0	2.330	15	.35	700	20	.2	60.12
37-02E77	.2020	3.0	3.450	10	.23	50	15	<.1	58.32
37-03E77	.3740	3.0	.282	10	.34	70	15	<.1	54.72

Table 3--continued

sample	MNO % X	NA % S	NA2O % X	NI ppm S	P2O5 % X	PB ppm S	SC ppm S	SE ppm X	SIO2 % X
38-02E77	1.5200	3.0	2.430	20	.34	100	15	.2	54.47
38-03E77	4.6600	2.0	1.570	20	.48	200	15	.9	39.32
39-02E77	.1420	3.0	2.620	15	.26	20	30	.5	53.75
39-03E77	.1610	2.0	2.260	15	.36	20	30	<.1	55.46
40-02E77	.0940	3.0	2.550	15	.29	30	15	.6	51.27
40-03E77	.1770	3.0	3.440	10	.35	30	15	.5	60.40
41-02E77	.1410	3.0	2.780	20	.24	50	20	<.1	56.65
41-R2E77	.1400	3.0	2.600	20	.22	30	20	<.1	56.97
41-03E77	.1600	3.0	2.370	15	.31	50	20	<.1	55.27
42-02E77	.1110	3.0	3.460	10	.27	30	15	<.1	57.15
42-03E77	.2220	3.0	2.160	15	.44	30	20	1.2	51.94
43-02E77	.0188	3.0	4.300	10	.22	1,500	10	.2	46.34
43-R2E77	.2260	3.0	2.520	10	.26	2,000	15	.2	62.27
43-03E77	.3760	3.0	2.080	15	.39	2,000	15	.6	59.39
43-R3E77	.3610	3.0	2.010	15	.33	2,000	15	.7	58.91
44-02E77	.1500	2.0	2.460	15	.48	150	10	.6	56.62
44-03E77	1.9800	2.0	1.070	15	.29	200	15	.5	52.72
45-02E77	1.0400	1.0	1.200	20	.30	200	15	1.1	55.47
45-03E77	1.6400	1.0	1.130	20	.38	100	15	1.8	52.81
46-02E77	3.0000	1.0	1.470	5	.14	3,000	5	.3	66.00
46-03E77	4.1000	1.5	1.420	15	.26	5,000	10	.9	57.02
47-02E77	.0860	3.0	3.360	10	.24	20	20	<.1	60.57
47-R2E77	.0870	3.0	3.530	10	.22	15	15	.1	61.17
47-03E77	.1210	3.0	2.470	15	.49	30	30	<.1	58.16
48-02E77	.1470	3.0	3.210	10	.23	20	30	<.1	60.02
48-03E77	.2100	3.0	2.780	15	.55	20	30	.3	56.70
49-02E77	.2880	3.0	2.930	15	.25	20	20	<.1	58.53
49-03E77	.8770	3.0	2.200	30	.48	20	20	.9	54.39
50-02E77	.1760	3.0	3.540	7	.29	30	15	.2	60.18
50-03E77	.3610	3.0	2.470	15	.47	50	20	.4	56.49
51-02E77	.4270	3.0	3.050	10	.36	30	10	.2	52.84
51-03E77	1.1100	3.0	2.610	15	.42	70	15	<.1	51.82
52-02E77	.1830	3.0	2.180	10	.31	30	20	1.0	55.98
52-03E77	.2390	2.0	1.710	15	.43	70	20	.9	54.94

Table 3--continued

sample	SR ppm S	TI % S	TIO2 % X	V ppm S	Y ppm S	YB ppm S	ZN ppm A	ZN ppm S	ZR ppm S
01-02E77	300	.70	.79	150	50	5.0	1,475	1,000	1,000
01-03E77	300	.50	.80	150	50	5.0	2,913	1,500	500
02-02E77	500	.70	1.04	200	50	--	81	N	2,000
02-03E77	500	.50	.96	150	30	3.0	101	N	700
03-02E77	700	.70	.87	200	70	7.0	83	N	1,000
03-03E77	500	.70	.83	150	50	7.0	191	N	1,500
04-02E77	300	.70	1.06	150	30	5.0	103	N	700
04-03E77	500	.30	.91	150	30	3.0	123	N	500
05-02E77	500	.50	.68	150	50	7.0	97	N	700
05-03E77	500	.50	.82	150	70	7.0	166	N	700
06-02E77	500	.70	.82	150	50	5.0	56	1,500	500
06-03E77	300	.70	.82	150	70	7.0	3,050	2,000	700
07-02E77	500	.70	.93	150	70	7.0	86	N	1,000
07-03E77	300	.50	.80	150	50	5.0	92	N	1,000
07-R3E77	500	.50	.84	150	50	7.0	60	N	1,000
08-02E77	300	.50	1.04	200	30	3.0	124	N	200
08-03E77	300	.50	.91	150	30	5.0	101	N	300
09-02E77	700	.50	.85	300	200	20.0	1,300	700	1,500
09-03E77	300	.50	.84	150	300	20.0	1,875	1,000	700
10-02E77	500	1.00	1.25	300	50	5.0	124	N	300
10-03E77	500	.70	1.06	150	50	7.0	78	N	1,000
11-02E77	200	.20	.64	70	30	2.0	143	N	200
11-03E77	150	.15	.71	70	20	1.5	170	N	100
12-02E77	700	.50	.70	150	30	5.0	59	N	700
12-03E77	700	.70	.81	150	50	5.0	71	N	1,000
12-R3E77	500	.50	.79	150	30	5.0	81	N	500
13-02E77	500	.20	.51	150	70	7.0	95	N	700
13-03E77	300	.30	.65	70	100	7.0	84	N	700
14-02E77	500	.70	1.17	150	20	3.0	108	N	300
14-03E77	500	.70	.95	150	30	5.0	211	N	500
15-02E77	500	.50	.70	100	50	5.0	92	N	200
15-03E77	500	.70	.80	150	50	5.0	76	500	700
16-02E77	700	.70	.92	150	50	7.0	81	N	500
16-03E77	500	.70	.91	150	50	7.0	116	N	700
17-02E77	500	1.00	1.26	300	70	10.0	164	N	3,000
17-03E77	300	.70	1.05	150	50	7.0	95	N	2,000
18-02E77	700	.70	1.16	300	50	7.0	93	N	1,000
18-03E77	500	.50	1.04	200	50	5.0	107	N	1,000
19-02E77	500	.70	.96	200	50	5.0	386	N	1,000
19-03E77	700	.70	.77	150	50	7.0	94	N	2,000

Table 3--continued

sample	SR ppm S	TI % S	TIO2 % X	V ppm S	Y ppm S	YB ppm S	ZN ppm A	ZN ppm S	ZR ppm S
20-02E77	700	.50	.62	200	50	5.0	395	300	1,500
20-03E77	500	.50	.88	150	70	7.0	79	1,000	2,000
21-02E77	500	.50	.94	300	50	7.0	208	N	1,500
21-03E77	300	.50	.79	100	30	5.0	305	N	1,000
22-02E77	300	.30	.82	150	30	5.0	423	<300	700
22-03E77	500	.50	.79	150	50	5.0	525	300	700
23-02E77	200	.50	.72	70	20	--	97	500	100
23-03E77	300	.50	.72	100	30	--	90	500	300
23-R3E77	300	.50	.71	100	20	3.0	310	N	300
24-02E77	500	.70	1.25	200	30	5.0	135	N	700
24-03E77	300	.50	.94	150	30	3.0	129	N	500
24-R3E77	300	.50	.95	150	30	3.0	195	N	300
25-02E77	300	.50	.97	150	20	3.0	111	N	300
25-03E77	500	.50	.96	150	30	3.0	124	N	500
25-R3E77	300	.70	.94	150	30	5.0	118	N	500
26-02E77	500	.70	.82	150	30	3.0	76	N	200
26-03E77	500	.70	.82	100	30	5.0	124	N	500
27-02E77	500	.70	1.28	200	50	7.0	124	N	700
27-03E77	300	.70	1.03	150	30	5.0	134	N	1,000
28-02E77	100	.07	.24	30	<10	1.0	98	7,000	50
28-03E77	70	.05	.13	15	N	N	7,425	5,000	30
29-02E77	500	.70	1.06	150	30	3.0	122	N	300
29-03E77	500	.30	.94	150	30	3.0	141	N	300
30-02E77	500	.70	.77	150	20	2.0	57	500	150
30-03E77	500	.50	.78	100	20	3.0	474	300	200
31-02E77	500	.50	.62	100	30	3.0	179	N	200
31-03E77	500	.70	.81	150	30	5.0	117	N	700
32-02E77	700	.50	.57	150	20	2.0	119	500	100
32-03E77	500	.70	.82	150	30	5.0	65	1,000	1,500
33-02E77	700	.30	.67	300	30	--	78	N	3,000
33-03E77	700	.50	.86	150	30	3.0	121	N	700
34-02E77	700	.50	.66	150	15	2.0	78	700	200
34-03E77	700	.50	.82	100	30	5.0	950	700	700
34-R3E77	700	.50	.74	100	30	3.0	1,013	700	500
35-02E77	1,000	.30	.45	200	30	5.0	60	N	1,000
35-03E77	700	.30	.67	150	30	5.0	97	N	1,000
36-02E77	500	.70	.81	150	20	3.0	130	700	150
36-03E77	500	.50	.79	150	30	3.0	825	700	300
37-02E77	700	.50	.55	150	20	3.0	65	N	700
37-03E77	700	.50	.66	150	50	5.0	81	N	700

sample	SR ppm S	TI % S	TIO2 % X	V ppm S	Y ppm S	YB ppm S	ZN ppm A	ZN ppm S	ZR ppm S
38-02E77	700	.50	.94	150	30	3.0	1,913	1,000	700
38-03E77	700	.30	.70	100	30	5.0	3,850	2,000	700
39-02E77	500	.70	1.04	300	30	5.0	108	N	700
39-03E77	500	.50	1.01	150	50	7.0	116	N	1,000
40-02E77	500	.30	.75	150	20	2.0	152	N	150
40-03E77	500	.30	.56	100	30	3.0	163	N	300
41-02E77	700	.50	.83	150	30	5.0	97	N	500
41-R2E77	700	.50	.84	150	50	5.0	70	N	300
41-03E77	500	.50	.84	100	30	3.0	69	N	300
42-02E77	1,000	.50	.76	200	30	3.0	90	N	500
42-03E77	700	.50	.88	150	30	3.0	169	N	700
43-02E77	700	.30	1.66	100	10	1.0	2,213	1,500	150
43-R2E77	700	.50	.61	150	30	5.0	2,000	1,500	300
43-03E77	500	.50	.69	100	30	3.0	2,750	2,000	300
43-R3E77	700	.30	.69	100	20	3.0	2,725	2,000	700
44-02E77	300	.50	.95	100	20	2.0	1,000	700	150
44-03E77	500	.30	.73	100	30	3.0	99	1,000	300
45-02E77	300	.30	.69	100	20	2.0	1,050	700	100
45-03E77	500	.30	.72	100	50	3.0	1,375	1,000	150
46-02E77	200	.15	.46	70	10	2.0	7,825	5,000	200
46-03E77	200	.30	.53	70	50	5.0	88	15,000	200
47-02E77	700	.30	.63	150	30	5.0	69	N	300
47-R2E77	700	.30	.63	150	30	3.0	112	N	200
47-03E77	700	.50	.82	150	70	7.0	92	N	1,000
48-02E77	700	.50	.69	150	30	5.0	76	N	200
48-03E77	500	.30	.86	150	50	7.0	95	N	500
49-02E77	500	.50	.82	200	30	5.0	104	N	300
49-03E77	700	.50	.86	150	30	3.0	168	N	500
50-02E77	700	.30	.55	150	30	3.0	72	N	300
50-03E77	700	.50	.82	150	30	5.0	120	N	500
51-02E77	500	.30	.53	300	20	3.0	638	N	1,000
51-03E77	700	.30	.66	150	30	5.0	86	1,000	500
52-02E77	500	.30	.89	150	15	2.0	147	N	150
52-03E77	500	.50	.89	150	30	2.0	76	N	200

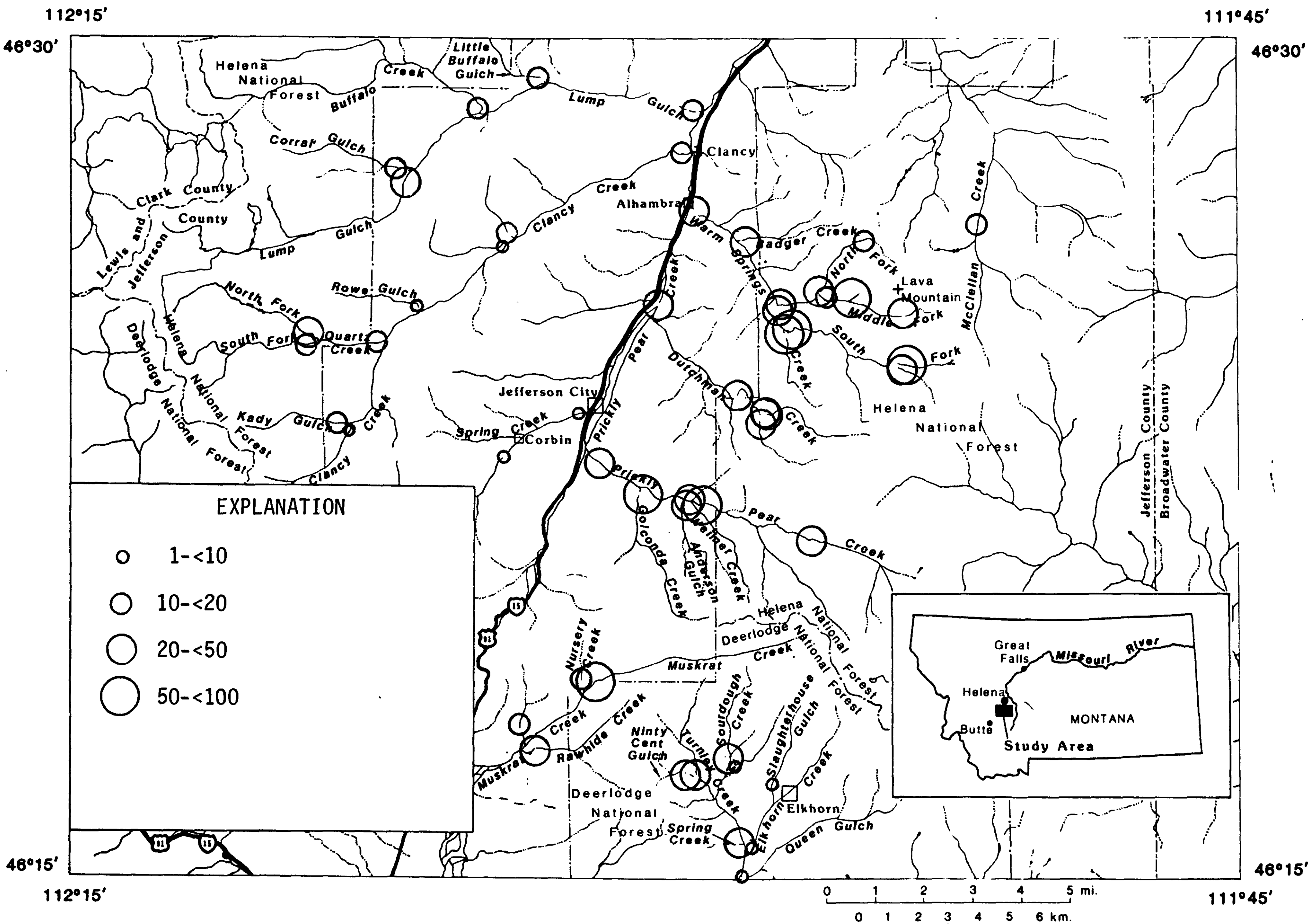

Figure 3-1.--Uranium data (ppm) from fine size fraction.

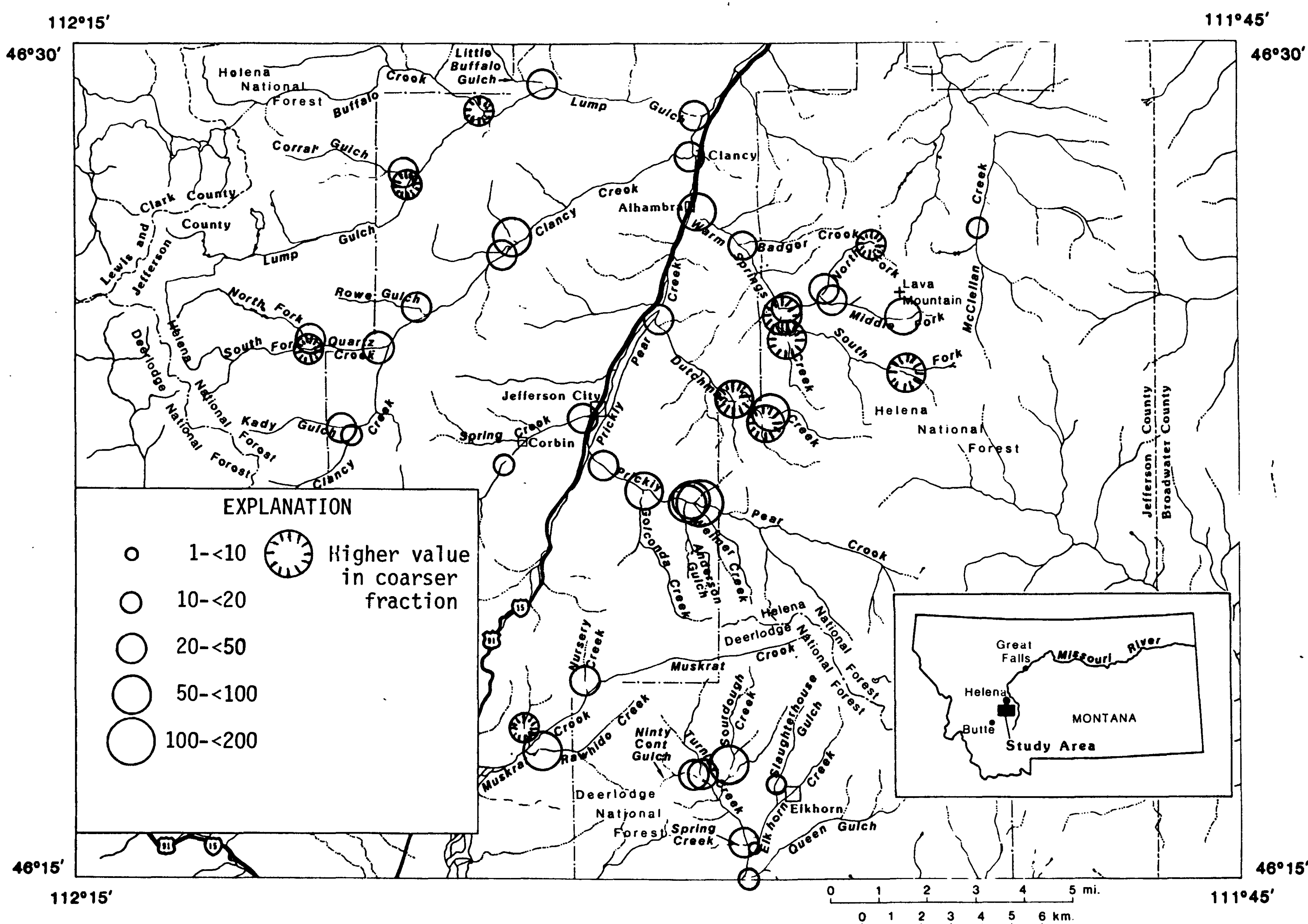

Figure 3-2.--Thorium data (ppm) from fine size fraction.

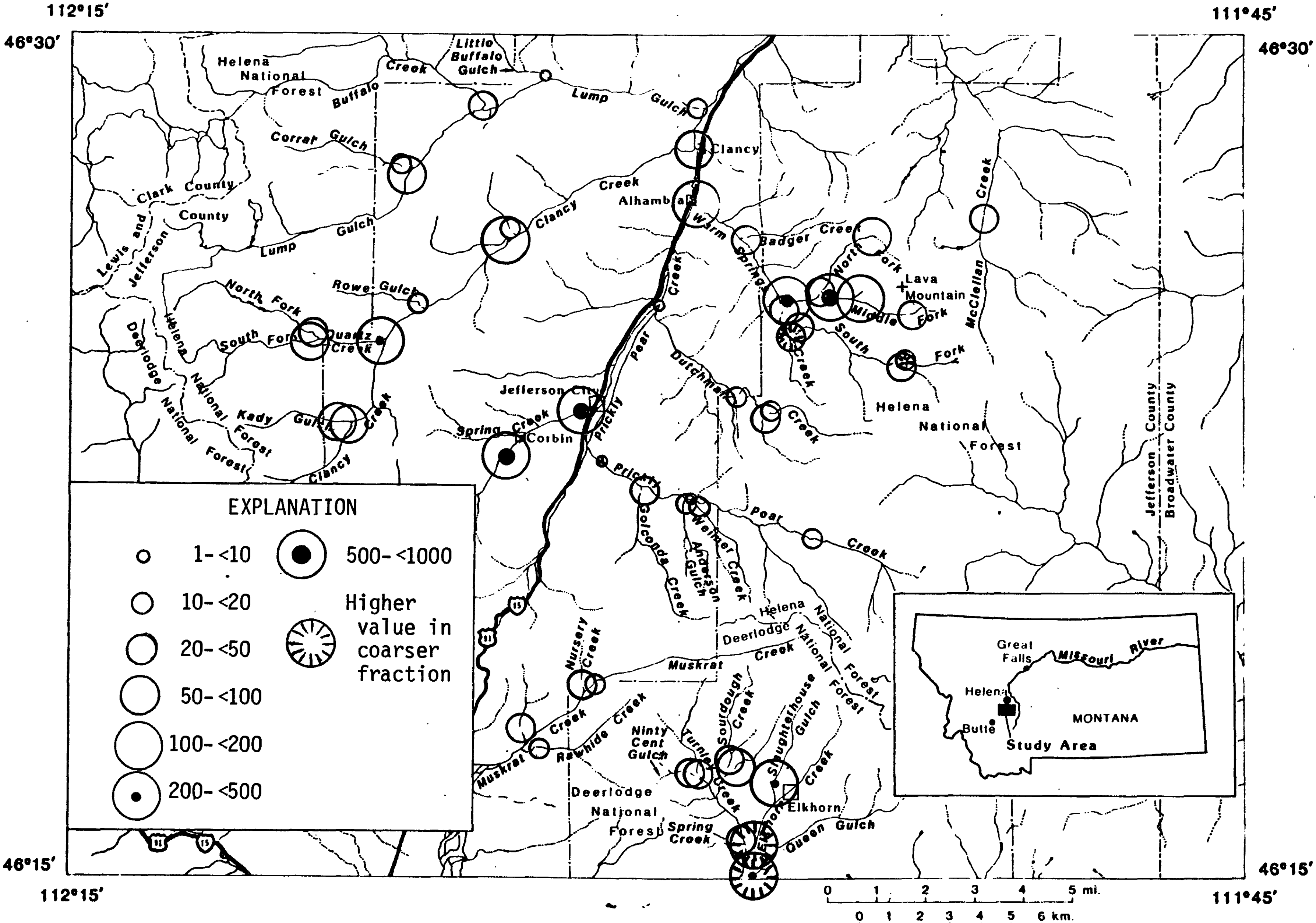

Figure 3-3.--Arsenic data (ppm) from fine size fraction.

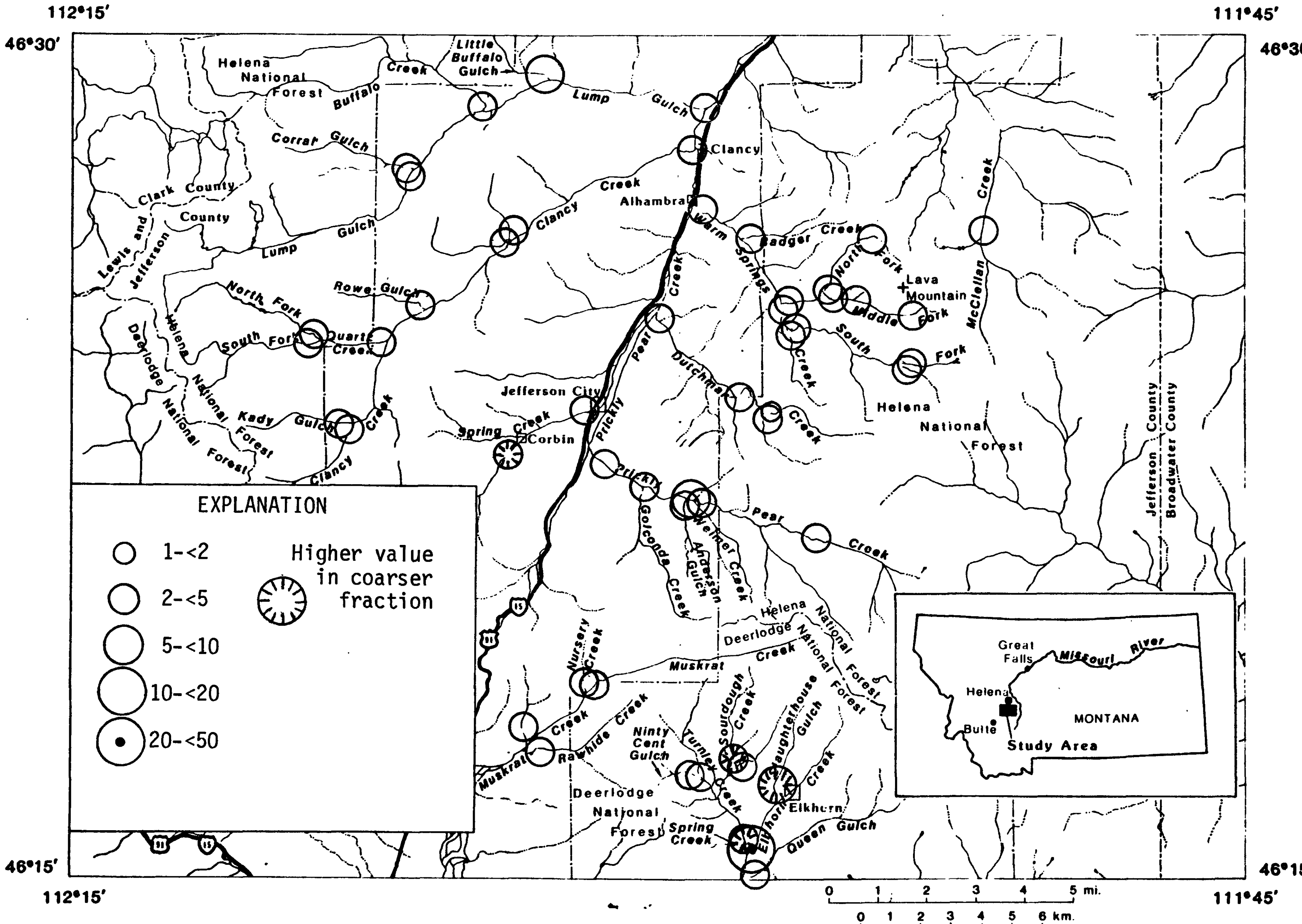

Figure 3-4.--CaO data (%) from fine size fraction.

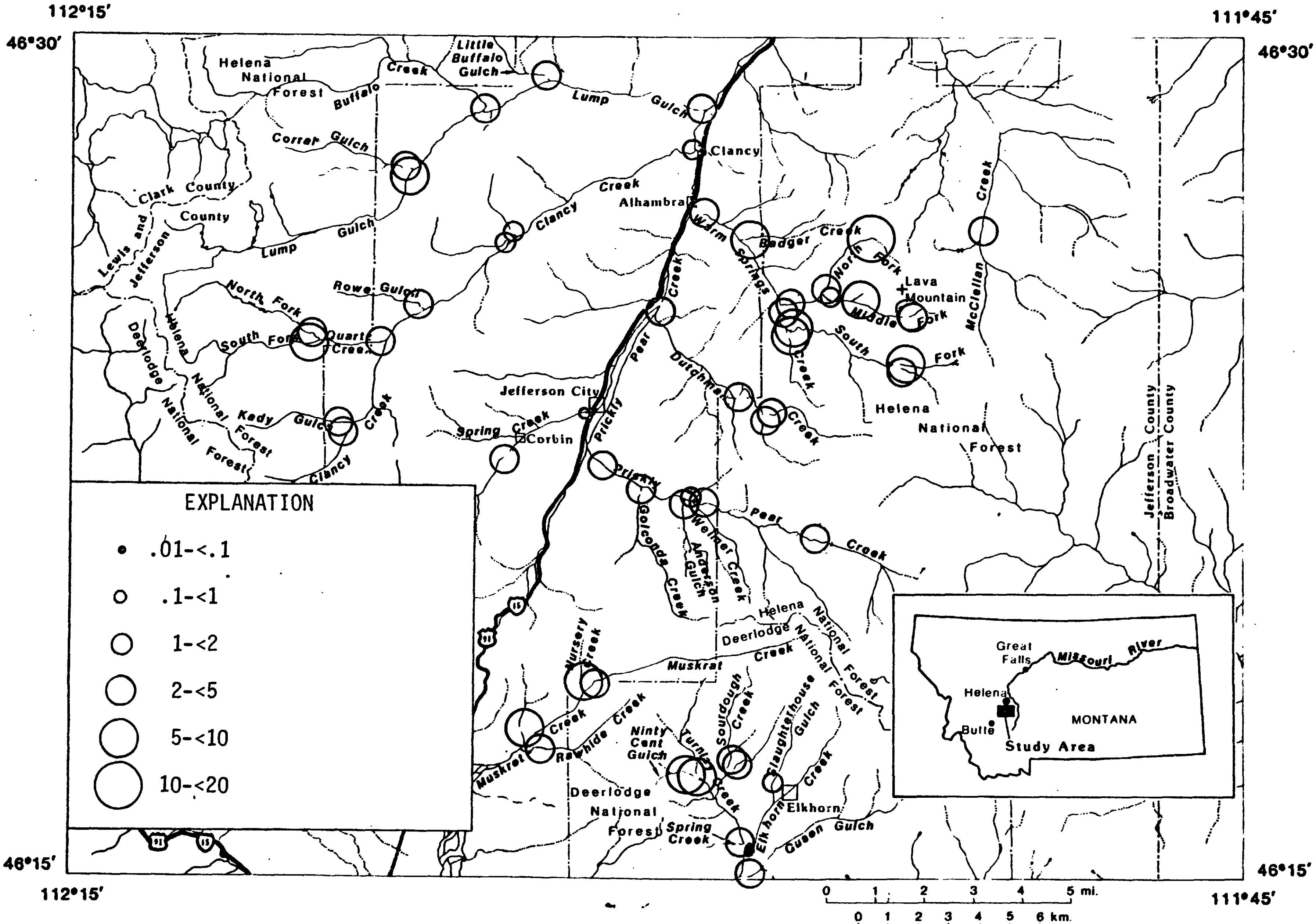

Figure 3-5.--Organic carbon data (%) from fine size fraction.

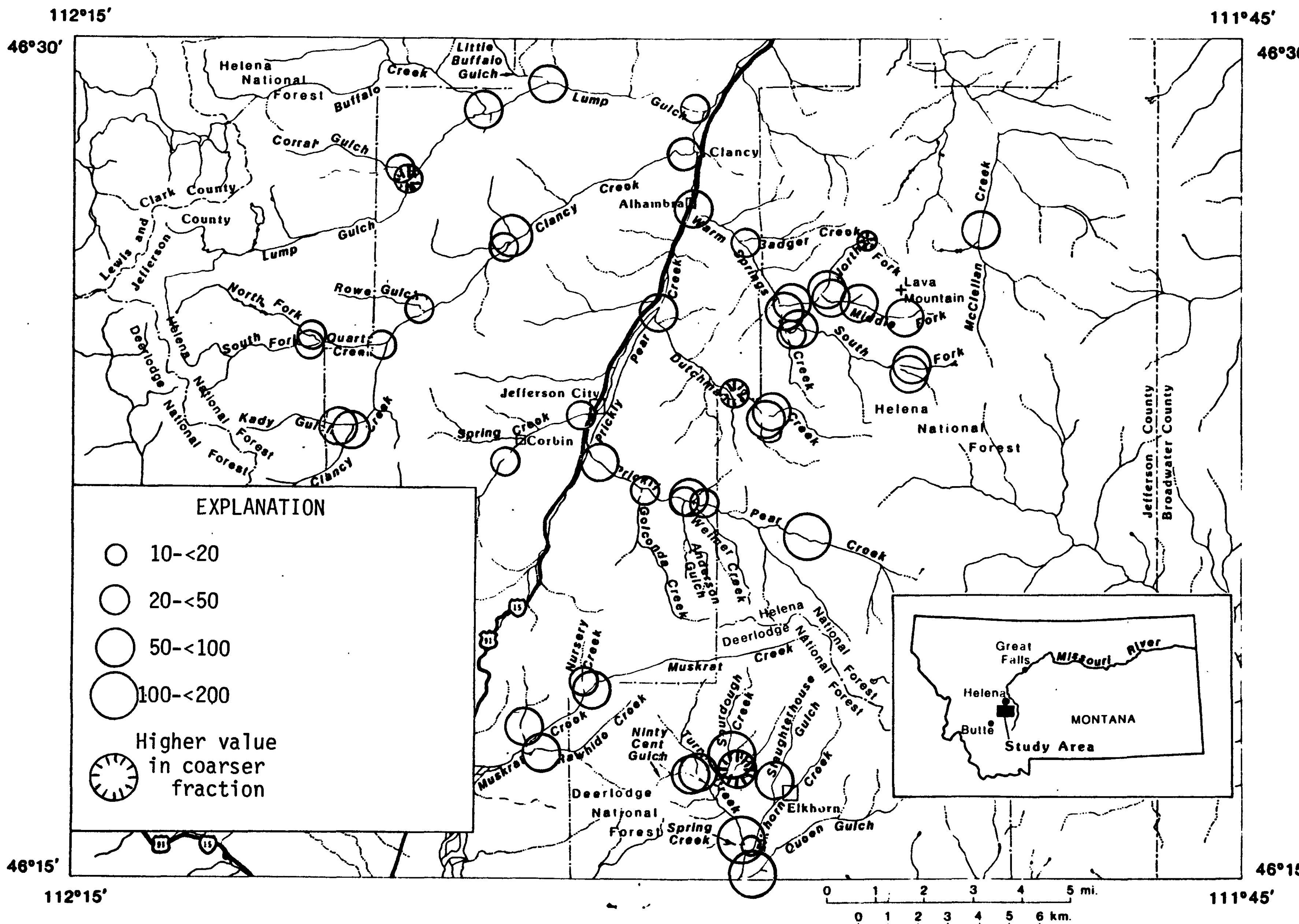

Figure 3-6.--Chromium data (ppm) from fine size fraction.

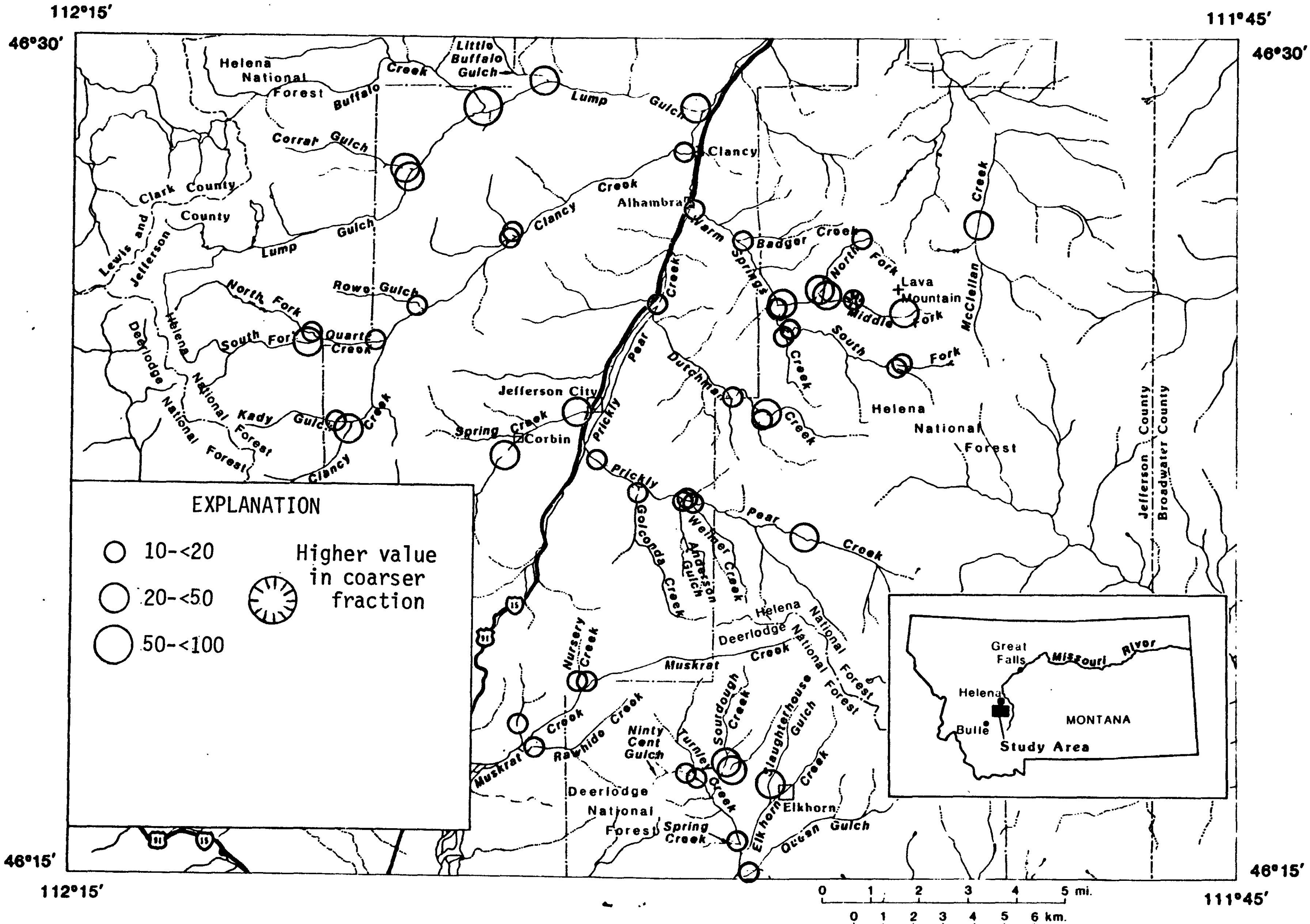

Figure 3-7.--Cobalt data (ppm) from fine size fraction.

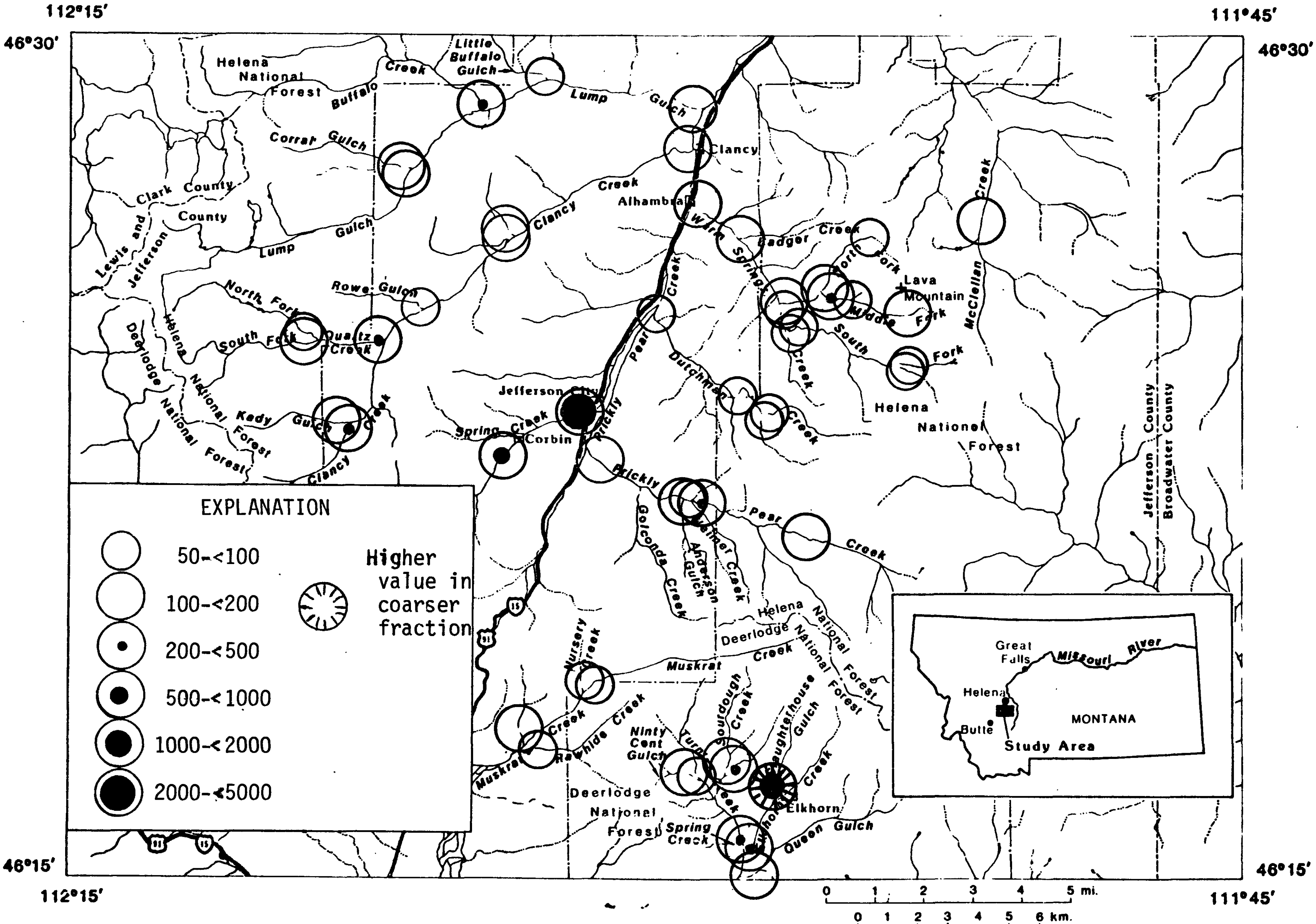

Figure 3-8.--Copper data (ppm) from fine size fraction.

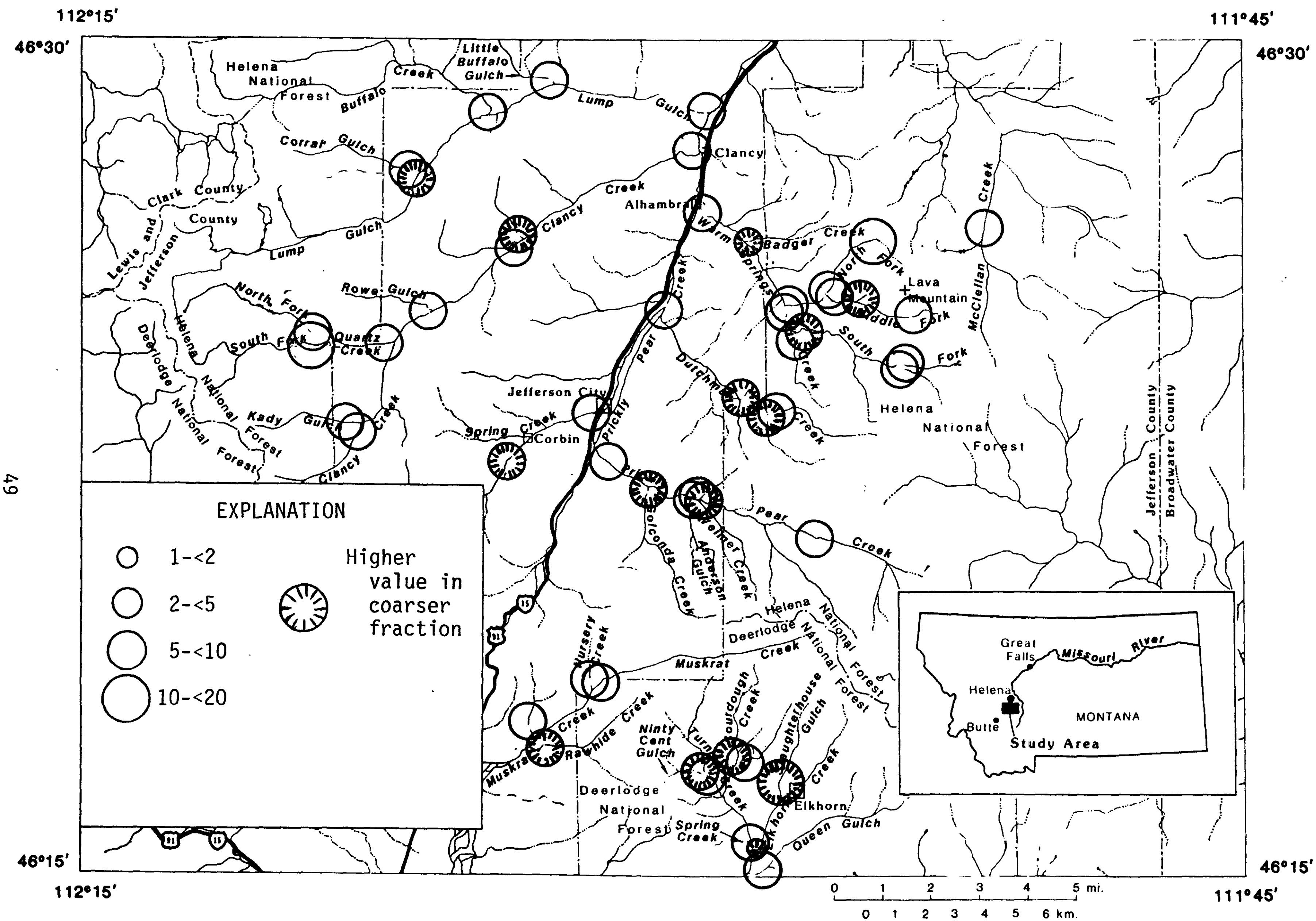

Figure 3-9.--Fe_2O_3 data (%) from coarse size fraction.

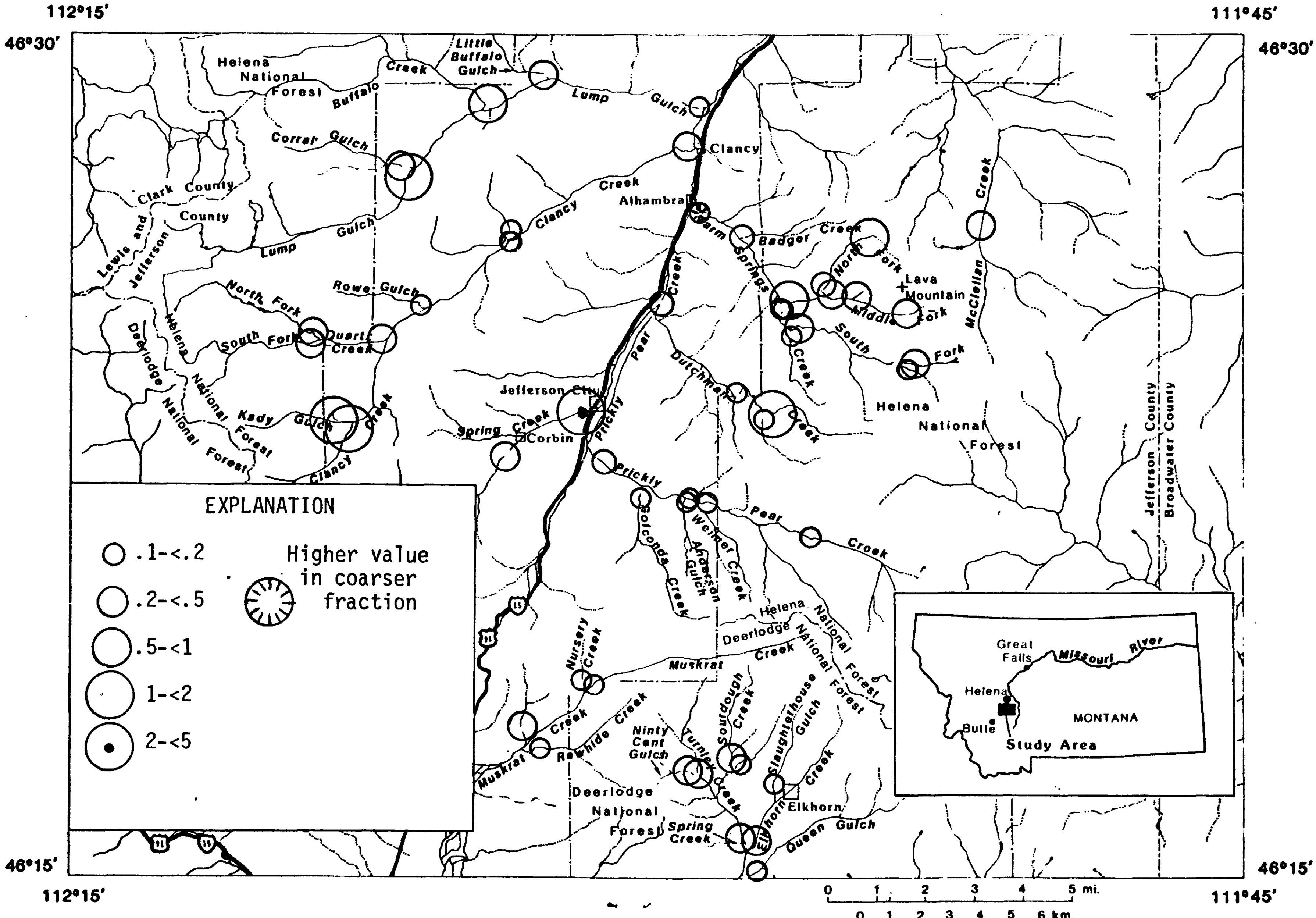

Figure 3-10. --MnO data (%) from fine size fraction.

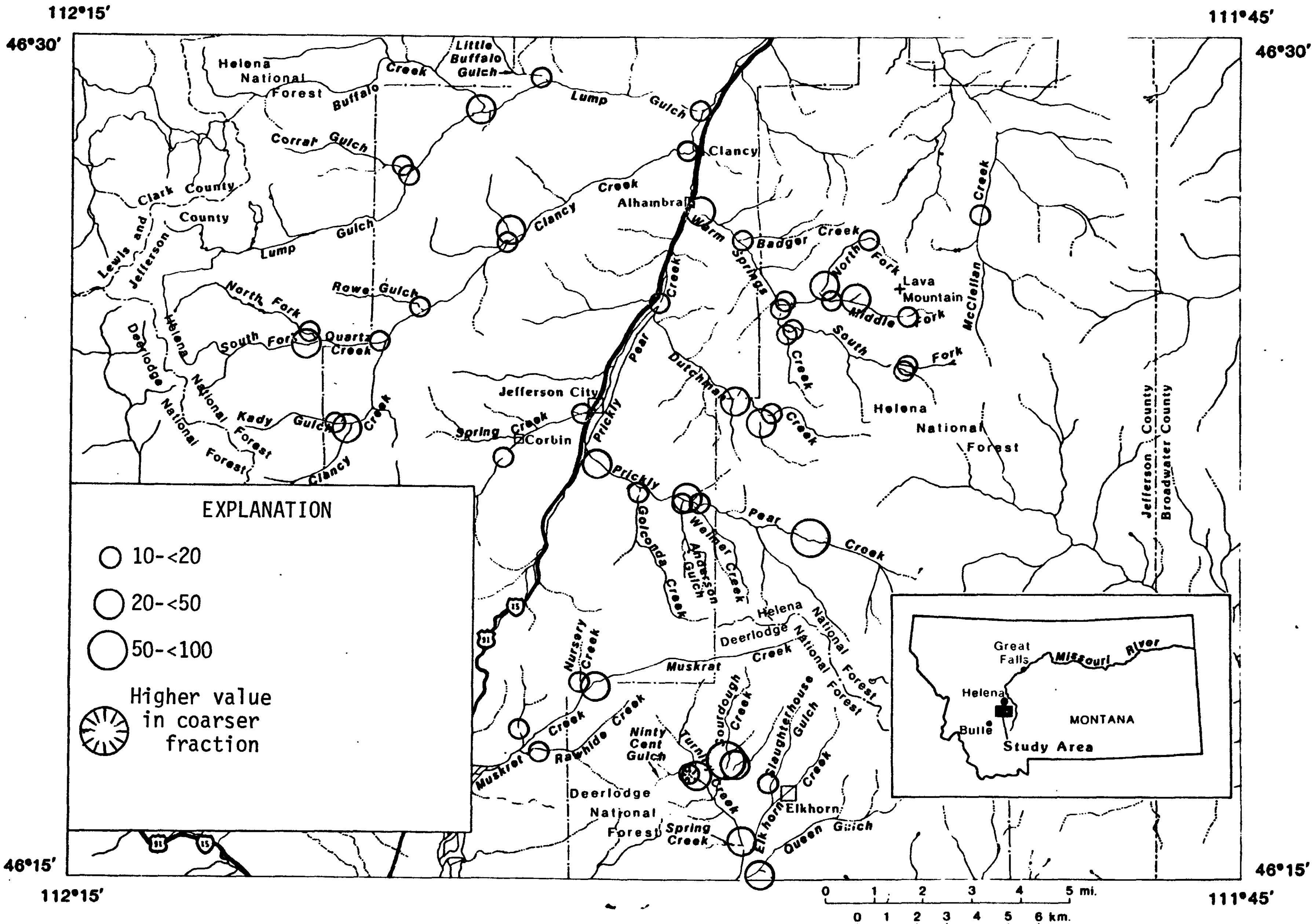

Figure 3-11.--Nickel data (ppm) from fine size fraction.

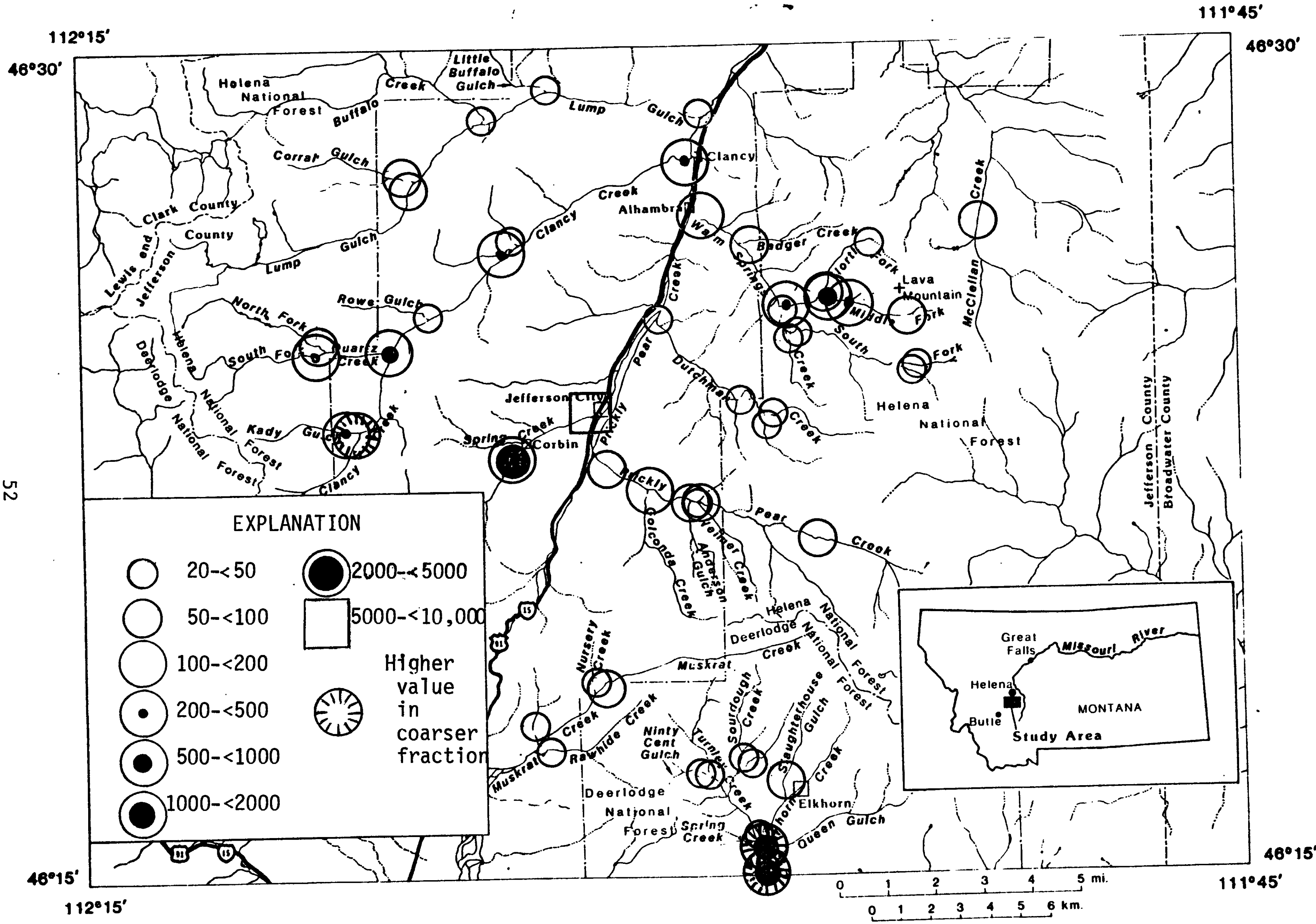

Figure 3-12.--Lead data (ppm) from fine size fraction.

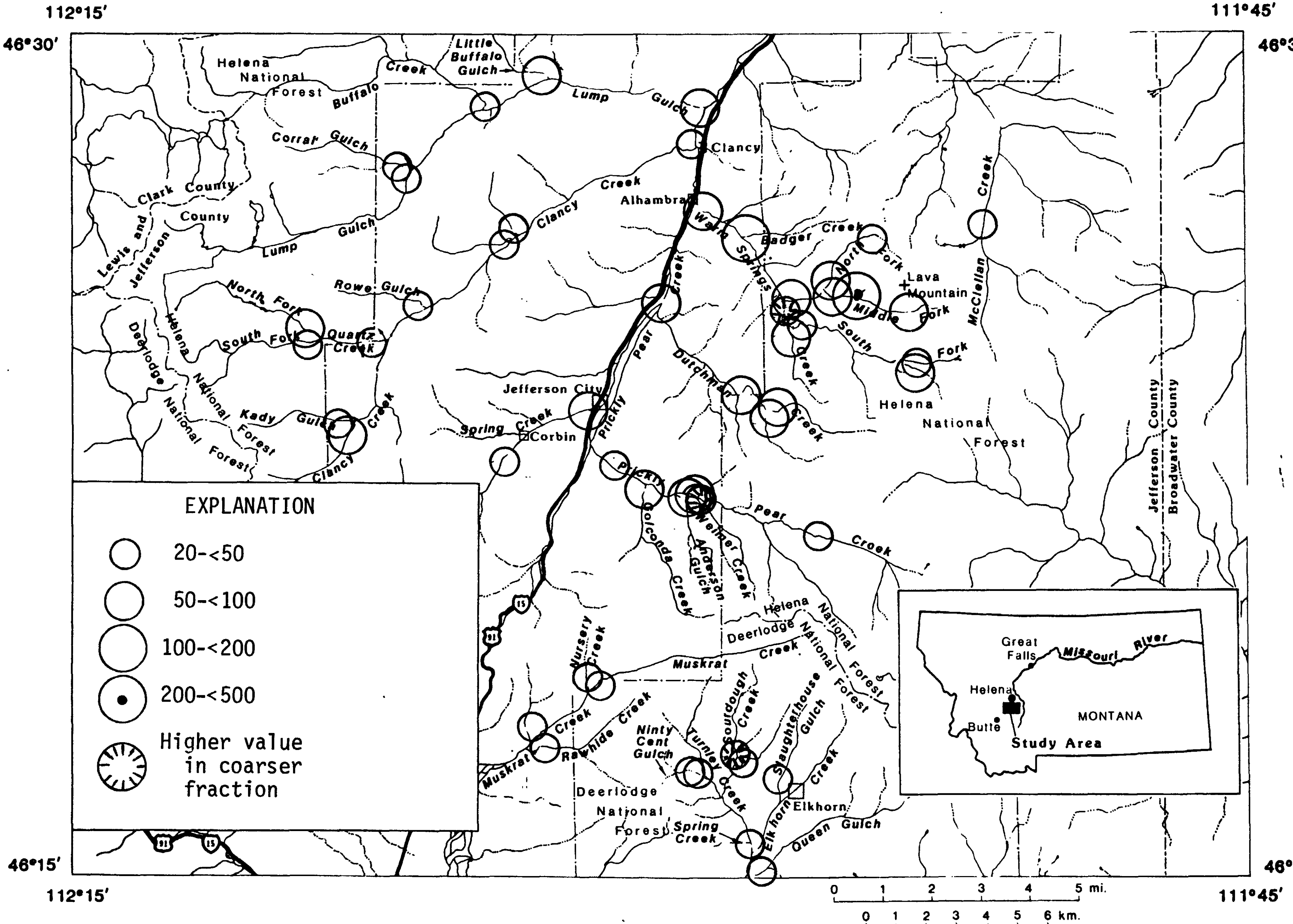

Figure 3-13.--Yttrium data (ppm) from fine size fraction.

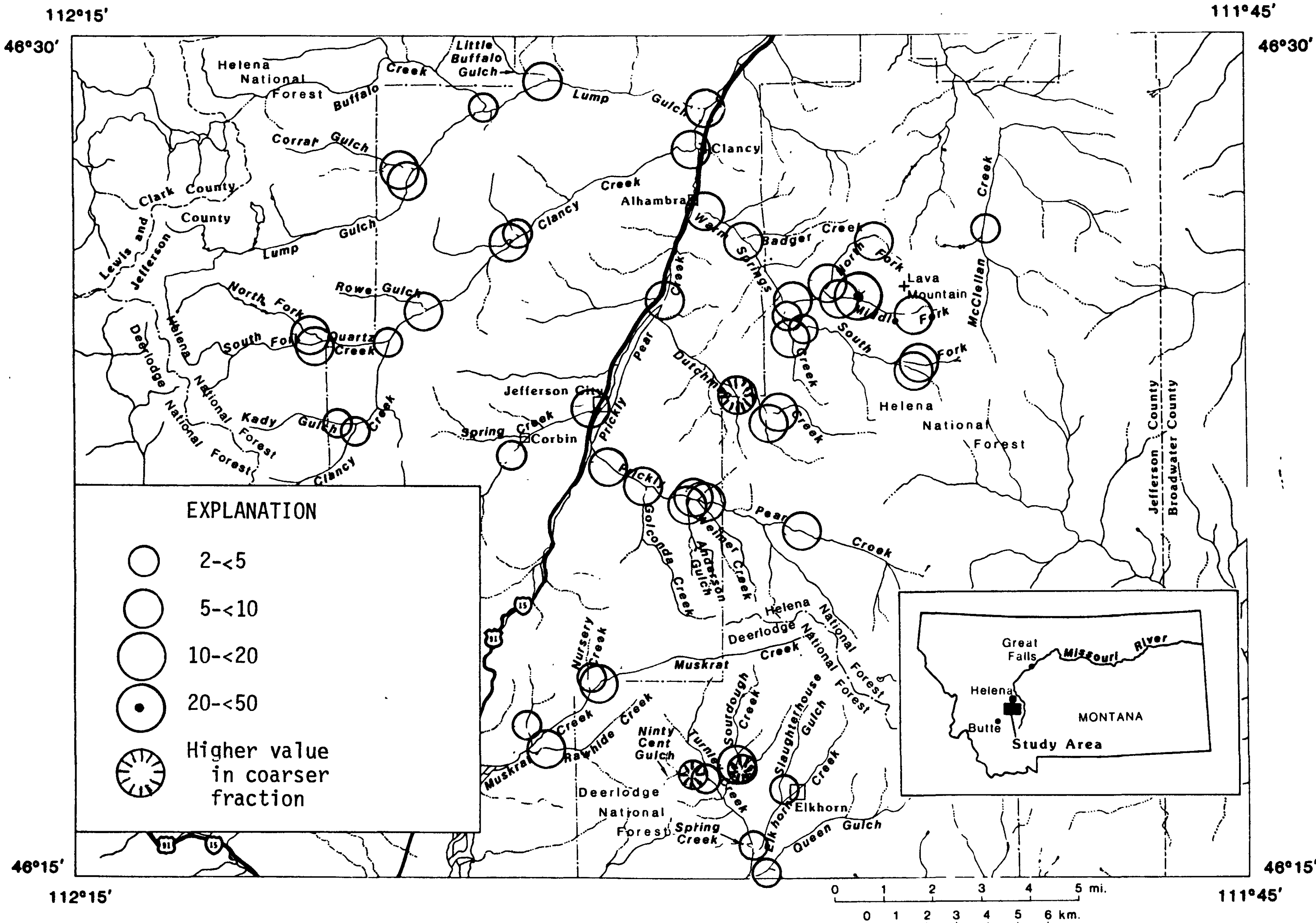

Figure 3-14.--Ytterbium data (ppm) from fine size fraction.

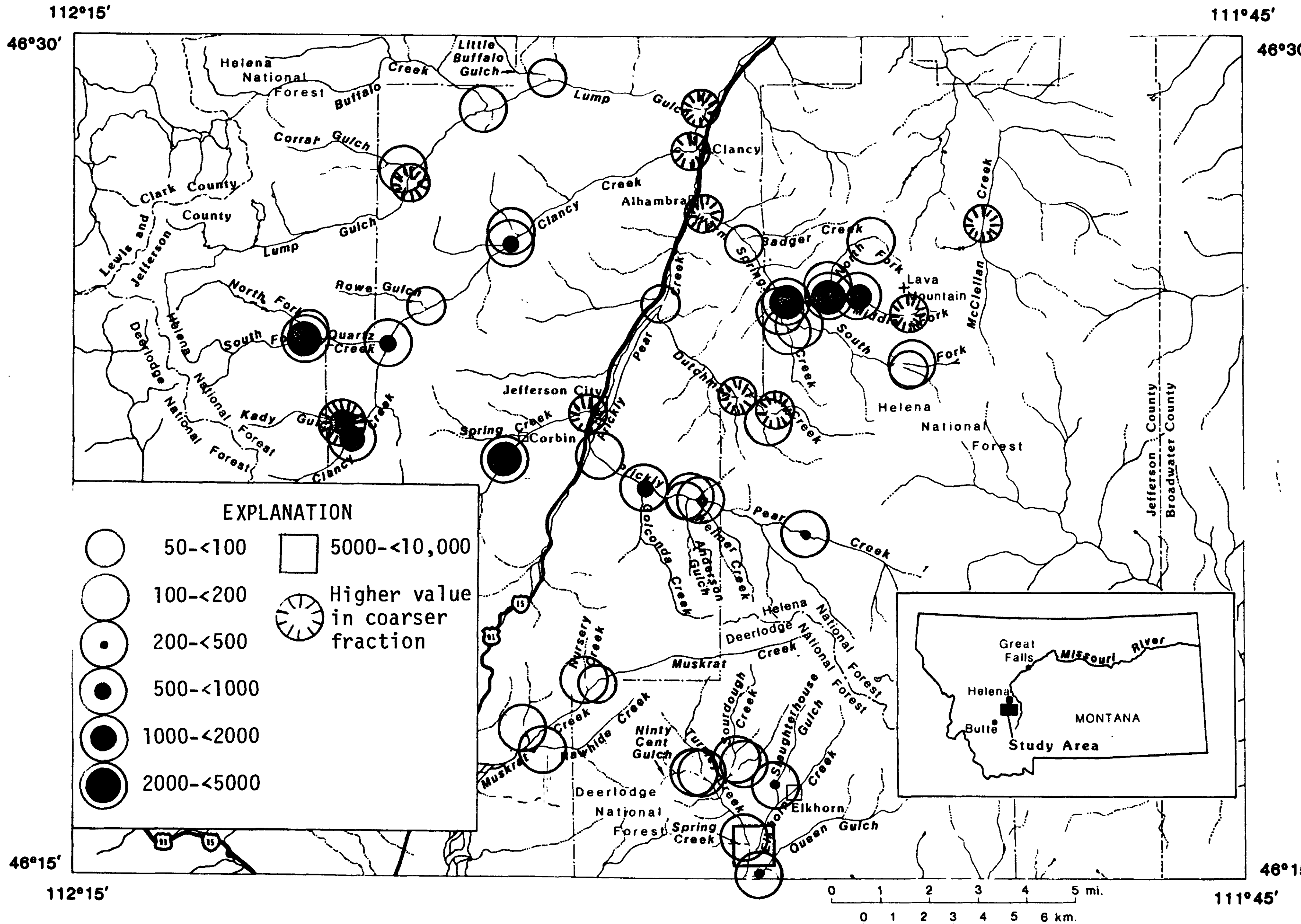

Figure 3-15.--Zinc data (ppm) from fine size fraction.

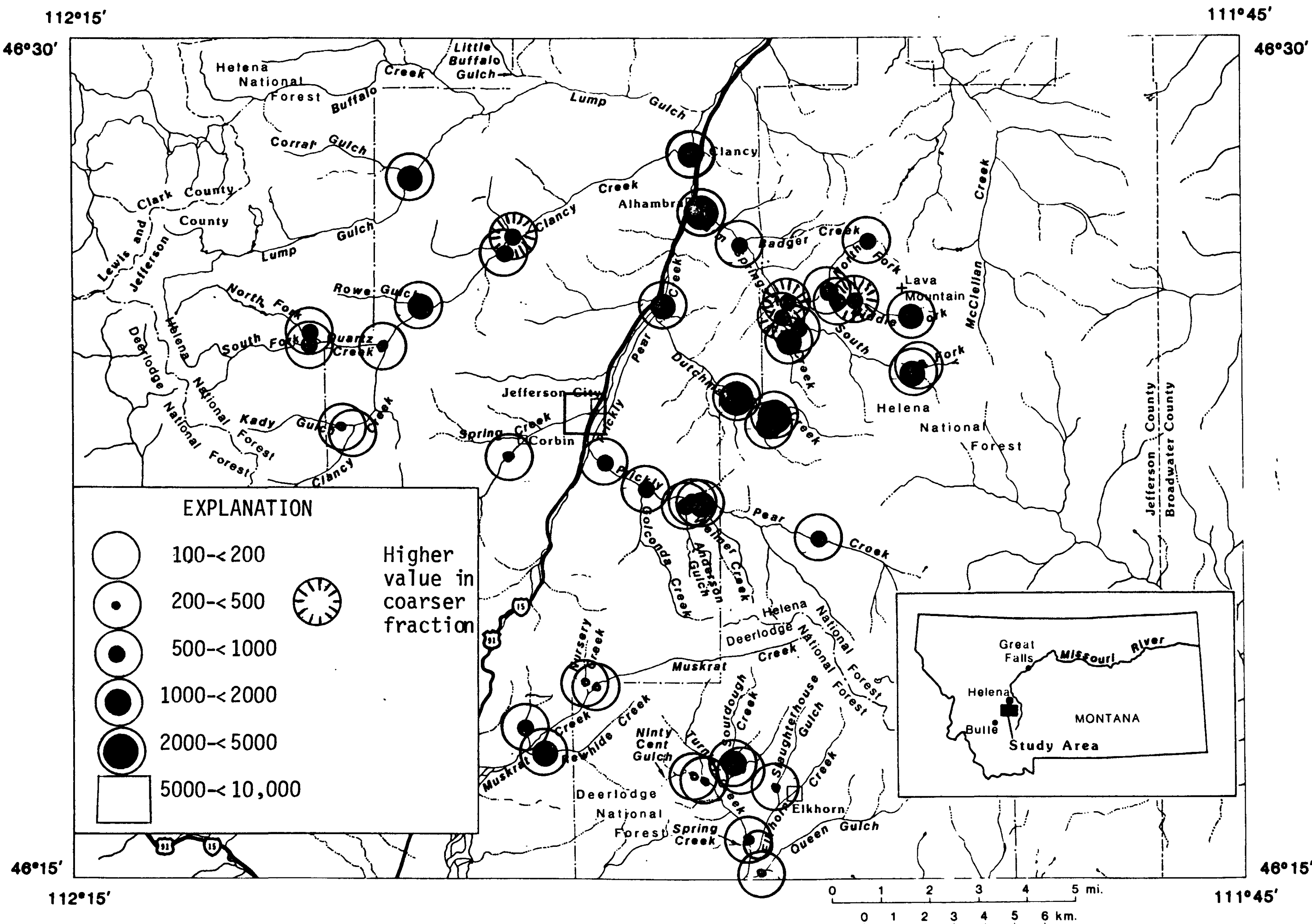

Figure 3-16.--Zirconium data (ppm) from fine size fraction.

Table 4.--Frequency distributions for U and Th.

Symbols for Qualified Values

N not detected
L detected, but less than lower detection limit
H no data because of analytical interference
T trace amount present
G greater than upper detection limit
B no analysis performed

See Table 2 for list of elements and symbols.
Elements appearing with a prefix of L- mean that the log of the data for that element is used in the histogram.

Frequency Table for: L-U ppmN — fine fraction — Histogram for: L-U ppmN

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum	Histogram
1.139E-01 -	3.339E-01	1	1	1.92	1.92	2.239E-01 XX
3.339E-01 -	5.539E-01	0	1	0.00	1.92	4.439E-01
5.539E-01 -	7.739E-01	2	3	3.85	5.77	6.639E-01 XXXX
7.739E-01 -	9.939E-01	6	9	11.54	17.31	8.839E-01 XXXXXXXXXXXX
9.939E-01 -	1.214E+00	10	19	19.23	36.54	1.104E+00 XXXXXXXXXXXXXXXXXXX
1.214E+00 -	1.434E+00	13	32	25.00	61.54	1.324E+00 XXXXXXXXXXXXXXXXXXXXXXXXX
1.434E+00 -	1.654E+00	12	44	23.08	84.62	1.544E+00 XXXXXXXXXXXXXXXXXXXXXXX
1.654E+00 -	1.874E+00	7	51	13.46	98.08	1.764E+00 XXXXXXXXXXXXX
1.874E+00 -	2.094E+00	1	52	1.92	100.00	1.984E+00 XX

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	52

0.00% of total values (52) are qualified

Minimum = 1.30
Maximum = 78.00
Geom mean = 20.38
Geom.dev = 2.22

Table 4, continued

Frequency Table for: L-THppmN — fine fraction

Interval Limits lower		upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
3.617E-01	-	5.717E-01	1	1	2.17	2.17
5.717E-01	-	7.817E-01	0	1	0.00	2.17
7.817E-01	-	9.917E-01	0	1	0.00	2.17
9.917E-01	-	1.202E+00	4	5	8.70	10.87
1.202E+00	-	1.412E+00	7	12	15.22	26.09
1.412E+00	-	1.622E+00	13	25	28.26	54.35
1.622E+00	-	1.832E+00	13	38	28.26	82.61
1.832E+00	-	2.042E+00	8	46	17.39	100.00

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	6	0	46

Minimum	=	2.30
Maximum	=	110.00
Geom mean	=	36.27
Geom dev	=	2.00

Histogram for: L-THppmN

```
4.667E-01 XX
6.767E-01
8.867E-01
1.097E+00 XXXXXXXXX
1.307E+00 XXXXXXXXXXXXXXX
1.517E+00 XXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.727E+00 XXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.937E+00 XXXXXXXXXXXXXXXXX
```

0.00% of total values (46) are qualified

Frequency Table for: L-U ppmN — coarse fraction

Interval Limits lower		upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
2.788E-01	-	4.588E-01	1	1	1.92	1.92
4.588E-01	-	6.388E-01	2	3	3.85	5.77
6.388E-01	-	8.188E-01	7	10	13.46	19.23
8.188E-01	-	9.988E-01	6	16	11.54	30.77
9.988E-01	-	1.179E+00	14	30	26.92	57.69
1.179E+00	-	1.359E+00	7	37	13.46	71.15
1.359E+00	-	1.539E+00	7	44	13.46	84.62
1.539E+00	-	1.719E+00	7	51	13.46	98.08
1.719E+00	-	1.899E+00	1	52	1.92	100.00

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	52

Minimum	=	1.90
Maximum	=	55.00
Geom mean	=	13.91
Geom dev	=	2.09

Histogram for: L-U ppmN

```
3.688E-01 XX
5.488E-01 XXXX
7.288E-01 XXXXXXXXXXXXX
9.088E-01 XXXXXXXXXXXX
1.089E+00 XXXXXXXXXXXXXXXXXXXXXXXXXXX
1.269E+00 XXXXXXXXXXXXX
1.449E+00 XXXXXXXXXXXXX
1.629E+00 XXXXXXXXXXXXX
1.809E+00 XX
```

0.00% of total values (52) are qualified

Table 4, continued

Frequency Table for: L-THppmN — coarse fraction

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
9.191E-01 -	1.079E+00	4	4	8.00	8.00
1.079E+00 -	1.239E+00	4	8	8.00	16.00
1.239E+00 -	1.399E+00	4	12	8.00	24.00
1.399E+00 -	1.559E+00	11	23	22.00	46.00
1.559E+00 -	1.719E+00	14	37	28.00	74.00
1.719E+00 -	1.879E+00	4	41	8.00	82.00
1.879E+00 -	2.039E+00	3	44	6.00	88.00
2.039E+00 -	2.199E+00	5	49	10.00	98.00
2.199E+00 -	2.359E+00	1	50	2.00	100.00

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	2	0	50

Minimum	=	8.30
Maximum	=	160.00
Geom mean	=	37.76
Geom dev	=	2.05

Histogram for: L-THppmN

```
9.991E-01 XXXXXXXX
1.159E+00 XXXXXXXX
1.319E+00 XXXXXXXX
1.479E+00 XXXXXXXXXXXXXXXXXXXXXX
1.639E+00 XXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.799E+00 XXXXXXXX
1.959E+00 XXXXXX
2.119E+00 XXXXXXXXXX
2.279E+00 XX
```

0.00% of total values (50) are qualified

Table 5.--Population statistics for Boulder batholith samples, fine fractions.

VARIABLE[6]	TRANS-FORMATION	MINIMUM	MAXIMUM	MEAN OR GEOM. MEAN	STANDARD OR GEOM. DEV.	VALID VALUES	PERCENT QUALIFIED
U ppm N[5]	Log	8.30	78.00	25.63	1.81	43	0
TH ppm N[5]	Log	22.00	110.00	46.36	1.51	37	0
AL2O3% X	Log	11.74	16.99	13.83	1.09	43	0
AS ppm A	Log	5.40	920.00	29.70	3.07	43	0
BA ppm S	Log	300.00	1500.00	569.95	1.38	43	0
Org C %[5]	Log	1.23	8.54	3.63	1.61	43	0
CAO % X	None	1.90	5.69	3.83	0.77	43	0
CO ppm S	Log	10.00	50.00	15.46	1.36	43	0
CR ppm S[4]	Log	30.00	150.00	47.56	1.50	43	0
CU ppm S	Log	50.00	300.00	100.88	1.56	43	0
FE % S[3]	Log	3.00	10.00	5.58	1.26	43	0
FE2O3% X	Log	4.63	11.23	6.68	1.20	43	0
K2O % X	Log	1.87	3.88	2.42	1.16	43	0
LA ppm S	Log	3.00[1]	150.00	69.38[2]	1.78[2]	42	2.33
MG % S[3]	Log	0.50	2.00	1.17	1.37	43	0
MGO % X[5]	Log	1.11	3.42	2.00	1.34	43	0
MN ppm S	Log	300.00	20000.00[1]	1415.65[2]	2.17[2]	42	2.33
MNO % X	Log	0.03	4.66	0.23	2.19	43	0
NA2O % X	None	0.28	3.44	2.26	0.52	43	0
NI ppm S[4]	Log	10.00	50.00	16.51	1.44	43	0
P2O5 % X[5]	None	0.24	0.57	0.40	0.09	43	0
PB ppm S[5]	Log	20.00	700.00	50.85	2.52	43	0
SE ppm X	Log	0.10[1]	1.60	0.29[2]	2.91[2]	33	23.26
SIO2 % X	None	39.32	61.83	55.96	4.28	43	0
SR ppm S[3]	Log	300.00	700.00	487.71	1.36	43	0
TIO2 % X[5]	Log	0.56	1.06	0.84	1.15	43	0
V ppm S	Log	70.00	200.00	140.19	1.20	43	0
Y ppm S	Log	30.00	300.00	41.59	1.58	43	0
YB ppm S	Log	3.00	20.00	4.98	1.47	43	0
ZN ppm A[4]	Log	65.00	3850.00	173.05	2.94	43	0
ZR ppm S	Log	300.00	2000.00	704.62	1.64	43	0

[1]Lower or upper limit of detection
[2]Parameters calculated from censored populations
[3]Analytical problems, see table 9
[4]skewed
[5]bimodal
[6]See table 2 for abbreviations

Table 6.--Population statistics for Boulder batholith samples, coarse fraction.

VARIABLE[6]	TRANS-FORMATION	MINIMUM	MAXIMUM	MEAN OR GEOM. MEAN	STANDARD OR GEOM. DEV.	VALID VALUES	PERCENT QUALIFIED
U ppm N[4]	Log	4.20	55.00	16.75	1.88	43	0
TH ppm N	Log	16.00	160.00	46.42	1.76	42	0
AL2O3% X	Log	11.99	18.03	14.57	1.09	43	0
AS ppm A	Log	3.10	816.00	20.72	3.26	43	0
BA ppm S	Log	300.00	1000.00	541.10	1.43	43	0
Org C %[4]	Log	0.42	5.95	1.75	1.94	43	0
CAO % X	Log	2.28	5.22	3.78	1.22	43	0
CO ppm S[3]	Log	7.00	30.00	14.50	1.28	43	0
CR ppm S	Log	15.00	150.00	44.51	1.76	43	0
CU ppm S	Log	20.00	300.00	59.12	1.80	43	0
FE % S	Log	3.00	10.00[1]	6.89[2]	1.38[2]	40	6.98
FE2O3% X	Log	4.60	16.17	8.41	1.37	43	0
K2O % X[4]	None	1.97	3.42	2.79	0.38	43	0
LA ppm S[4]	Log	50.00[1]	150.00	71.09[2]	1.46[2]	40	6.98
MG % S[5]	Log	0.50	1.50	1.11	1.44	43	0
MGO % X[4]	Log	0.90	3.40	1.94	1.45	43	0
MN ppm S	Log	500.00	15000.00	1059.64	1.90	43	0
MNO % X	Log	0.07	1.52	0.17	1.70	43	0
NA2O % X	Log	1.72	4.52	2.78	1.20	43	0
NB ppm S[5]	Log	10.00[1]	30.00	10.29[2]	1.33[2]	31	27.91
NI ppm S	Log	7.00	50.00	14.27	1.52	43	0
P2O5 % X[4]	Log	0.17	0.42	0.27	1.22	43	0
PB ppm S[4]	Log	15.00	300.00	37.16	2.25	43	0
SC ppm S[5]	Log	7.00	30.00	19.27	1.45	43	0
SE ppm X[4]	Log	0.10[1]	1.00	(0.08[2])	(4.51[2])	18	58.14
SIO2 % X	None	47.91	64.79	57.48	4.04	43	0
SR ppm S	Log	300.00	1000.00	547.20	1.34	43	0
TI % S	Log	0.20	1.00	0.53	1.43	43	0
TIO2 % X[4]	Log	0.45	1.28	0.82	1.31	43	0
V ppm S[5]	Log	100.00	300.00	179.04	1.34	43	0
Y ppm S	Log	15.00	200.00	36.04	1.62	43	0
YB ppm S	Log	2.00	20.00	4.52	1.59	41	0
ZN ppm A	Log	56.00	1913.00	136.68	2.36	43	0
ZR ppm S[4]	Log	100.00	3000.00	541.03	2.28	43	0

[1] Lower or upper limit of detection
[2] Parameters calculated from censored populations
Parentheses indicate data are greater than 50% qualified.
[3] Analytical problems, see table 10.
[4] bimodal
[5] skewed
[6] See table 2 for abbreviations

Table 7.--Population statistics for volcanic samples, fine fraction.

VARIABLE[4]	TRANS-FORMATION	MINIMUM	MAXIMUM	MEAN OR GEOM. MEAN	STANDARD OR GEOM. DEV.	VALID VALUES	PERCENT QUALIFIED
U ppm N	Log	3.60	15.00	8.38	1.60	8	0
TH ppm N[3]	Log	12.00	24.00	16.45	1.31	8	0
AL2O3% X	Log	9.84	14.91	12.61	1.19	8	0
AS ppm A	Log	22.00	990.00	182.70	3.91	8	0
B ppm S	Log	20.00[1]	100.00	38.15[2]	1.91[2]	7	12.50
BA ppm S[3]	Log	300.00	1000.00	605.25	1.43	8	0
Org C %	Log	0.91	12.88	3.41	2.25	8	0
CA % S	Log	1.50	7.00	2.16	1.77	8	0
CAO % X	None	2.15	9.40	3.57	2.43	8	0
CO ppm S[3]	Log	15.00	20.00	17.95	1.16	8	0
CR ppm S	Log	15.00	100.00	42.69	1.94	8	0
CU ppm S	Log	70.00	2000.00	271.36	3.48	8	0
FE % S	Log	5.00	10.00[1]	6.01[2]	1.33[2]	7	12.50
FE2O3% X	Log	5.64	17.96	8.09	1.48	8	0
GA ppm S	Log	15.00	30.00	20.30	1.21	8	0
K % S	Log	1.00	5.00	3.01	1.74	8	0
K2O % X	Log	1.59	3.10	2.26	1.29	8	0
LA ppm S	Log	50.00	70.00	52.15	1.13	8	0
MG % S	Log	0.50	2.00	0.89	1.72	8	0
MGO % X	Log	1.15	3.77	1.80	1.48	8	0
MN ppm S	Log	1000.00	20000.00[1]	4277.86[2]	3.55[2]	7	12.50
MNO % X	Log	0.16	4.10	0.65	3.40	8	0
NA2O % X	None	1.03	2.08	1.36	0.37	8	0
NI ppm S	Log	10.00	30.00	15.32	1.43	8	0
P2O5 % X	None	0.26	0.83	0.40	0.18	8	0
PB ppm S	Log	30.00	5000.00	285.47	6.62	8	0
SC ppm S	Log	10.00	20.00	14.05	1.26	8	0
SE ppm X[3]	Log	0.50	1.80	0.80	1.60	8	0
SIO2 % X	None	35.94	59.39	52.42	7.63	8	0
SR ppm S	Log	150.00	500.00	359.86	1.63	8	0
TI % S	Log	0.15	0.50	0.36	1.54	8	0
TIO2 % X	Log	0.53	0.89	0.71	1.16	8	0
V ppm S	Log	70.00	150.00	96.22	1.27	8	0
Y ppm S[3]	Log	20.00	50.00	30.80	1.42	8	0
YB ppm S	Log	1.50	5.00	2.76	1.46	7	0
ZN ppm A	Log	76.00	2750.00	255.49	4.03	8	0
ZR ppm S	Log	100.00	300.00	205.98	1.47	8	0

[1]Lower or upper limit of detection
[2]Parameters calculated from censored populations
[3]May have analytical problems, see table 11.
Not enough samples to determine bimodality or skewedness from histograms.
[4]See table 2 for abbreviations

Table 8.--Population statistics for volcanic samples, coarse fraction.

VARIABLE[3]	TRANS-FORMATION	MINIMUM	MAXIMUM	MEAN OR GEOM. MEAN	STANDARD OR GEOM. DEV.	VALID VALUES	PERCENT QUALIFIED
U ppm N	Log	3.30	13.00	6.59	1.51	8	0
TH ppm N	Log	8.30	27.00	12.76	1.46	8	0
AL2O3% X	Log	9.48	15.57	12.48	1.22	8	0
AS ppm A	Log	27.00	655.00	157.84	3.69	8	0
B ppm S	Log	20.00[1]	100.00	39.17[2]	1.83[2]	7	12.50
BA ppm S	Log	200.00	1000.00	517.52	1.69	8	0
Org C %	Log	0.29	13.26	2.22	3.12	8	0
CA % S	Log	1.00	7.00	1.95	1.83	8	0
CAO % X	Log	2.07	10.80	4.17	1.75	8	0
CO ppm S	Log	10.00	20.00	14.05	1.26	8	0
CR ppm S	Log	15.00	70.00	35.21	1.69	8	0
CU ppm S	Log	50.00	2000.00	226.80	3.82	8	0
FE % S	Log	3.00	10.00[1]	5.69[2]	1.48[2]	7	12.50
FE2O3% X	Log	6.04	23.37	9.22	1.55	8	0
GA ppm S	Log	15.00	30.00	19.58	1.24	8	0
K % S	Log	1.00	5.00	2.72	1.80	8	0
K2O % X	None	0.12	2.96	1.88	0.87	8	0
LA ppm S	Log	50.00[1]	70.00	44.70[2]	1.29[2]	3	62.50
MG % S	Log	0.30	1.50	0.83	1.68	8	0
MGO % X	Log	0.71	5.84	2.15	1.87	8	0
MN ppm S	Log	700.00	20000.00	3113.03	3.25	8	0
MNO % X	Log	0.02	3.00	0.28	4.64	8	0
NA % S	Log	1.00	3.00	1.71	1.61	8	0
NA2O % X	Log	1.15	4.30	1.74	1.58	8	0
NI ppm S	Log	5.00	20.00	10.97	1.63	8	0
P2O5 % X	Log	0.14	0.64	0.28	1.64	8	0
PB ppm S	Log	30.00	3000.00	255.61	7.24	8	0
SC ppm S	Log	5.00	20.00	11.07	1.51	8	0
SE ppm X	Log	0.20	1.70	0.54	2.24	8	0
SIO2 % X	None	36.42	66.00	52.18	9.64	8	0
SR ppm S	Log	200.00	700.00	325.50	1.63	8	0
TI % S	Log	0.15	0.70	0.33	1.66	8	0
TIO2 % X	Log	0.46	1.66	0.79	1.45	8	0
V ppm S	Log	70.00	150.00	96.81	1.37	8	0
Y ppm S	Log	10.00	30.00	17.07	1.46	8	0
YB ppm S	Log	1.00	2.00	1.81	1.30	7	0
ZN ppm A	Log	57.00	7825.00	463.04	5.71	8	0
ZR ppm S	Log	100.00	200.00	145.65	1.30	8	0

[1]Lower or upper limit of detection
[2]Parameters calculated from censored populations
Parentheses indicate data are greater than 50% qualified
Not enough samples to determine bimodality or skewedness from histograms.
Not enough replicates to determine analytical precision.
[3]See table 2 for abbreviations

Table 9.--Percent of total sample variation due to analytical error, Boulder batholith samples, fine fraction.

VARIABLE	TRANS-FORMATION	ERROR VARIANCE	TOTAL VARIANCE	PAIRS	% ANALYTICAL ERROR
U ppm N	Log	0.88422E-04	0.67017E-01	5	0.13
TH ppm N	Log	0.20535E-02	0.32322E-01	5	6.35
AL2O3% X	Log	0.23565E-04	0.13490E-02	5	1.75
AS ppm A	Log	0.38796E-01	0.23797E+00	5	16.30
BA ppm S	Log	0.21353E-02	0.19786E-01	5	10.79
Org C %	Log	0.11773E-03	0.42519E-01	5	0.28
CAO % X	None	0.10600E-02	0.58648E+00	5	0.18
CO ppm S	Log	0.62016E-02	0.17811E-01	5	34.82
CR ppm S	Log	0.21353E-02	0.31406E-01	5	6.80
CU ppm S	Log	0.23995E-02	0.37142E-01	5	6.46
FE % S	Log	0.10706E+00	0.98022E-02	5	1092.42*
FE2O3% X	Log	0.85898E-05	0.62685E-02	5	0.14
K2O % X	Log	0.26617E-04	0.40908E-02	5	0.65
LA ppm S	Log	0.83377E-02	0.63067E-01	4	13.22
MG % S	Log	0.14803E-01	0.18789E-01	5	78.78*
MGO % X	Log	0.76880E-03	0.16492E-01	5	4.66
MN ppm S	Log	0.67971E-02	0.11310E+00	5	6.01
MNO % X	Log	0.66803E-04	0.11547E+00	5	0.06
NA2O % X	None	0.67800E-02	0.27247E+00	5	2.49
NI ppm S	Log	0.77626E-02	0.24817E-01	5	31.28
P2O5 % X	None	0.35000E-03	0.75759E-02	5	4.62
PB ppm S	Log	0.15836E-01	0.16109E+00	5	9.83
SE ppm X	Log	0.28107E-01	0.21563E+00	4	13.03
SIO2 % X	None	0.71840E-01	0.18332E+02	5	0.39
SR ppm S	Log	0.11979E-01	0.17700E-01	5	67.68*
TIO2 % X	Log	0.26592E-03	0.35538E-02	5	7.48
V ppm S	Log	0.00000E+00	0.65272E-02	5	0.00
Y ppm S	Log	0.49217E-02	0.39013E-01	5	12.62
YB ppm S	Log	0.11979E-01	0.27618E-01	5	43.37
ZN ppm A	Log	0.71178E-02	0.21946E+00	5	3.24
ZR ppm S	Log	0.16119E-01	0.46403E-01	5	34.74

*Greater than 50 percent of the variance seen in the data is related to analytical error rather than geological variation.
Variances are listed in log-form if appropriate and in FORTRAN E-format.
See table 2 for abbreviations.

Table 10.--Percent of total sample variation due to analytical error, Boulder batholith samples, coarse fraction.

VARIABLE	TRANS-FORMATION	ERROR VARIANCE	TOTAL VARIANCE	PAIRS	% ANALYTICAL ERROR
U ppm N	Log	0.44384E-04	0.74800E-01	2	0.06
TH ppm N	Log	0.62589E-02	0.59994E-01	2	10.43
AL2O3% X	Log	0.18354E-04	0.14945E-02	2	1.23
AS ppm A	Log	0.56504E-01	0.26371E+00	2	21.43
BA ppm S	Log	0.53384E-02	0.23918E-01	2	22.32
Org C %	Log	0.54488E-03	0.82434E-01	2	0.66
CAO % X	Log	0.53541E-05	0.71711E-02	2	0.07
CO ppm S	Log	0.77520E-02	0.11567E-01	2	67.02*
CR ppm S	Log	0.00000E+00	0.60010E-01	2	0.00
CU ppm S	Log	0.53384E-02	0.64894E-01	2	8.23
FE % S	Log	0.53384E-02	0.19859E-01	2	26.88
FE2O3% X	Log	0.26390E-04	0.18826E-01	2	0.14
K2O % X	None	0.25000E-03	0.14737E+00	2	0.17
LA ppm S	Log	0.00000E+00	0.26632E-01	2	0.00
MG % S	Log	0.00000E+00	0.24743E-01	2	0.00
MGO % X	Log	0.45522E-03	0.26275E-01	2	1.73
MN ppm S	Log	0.11337E-01	0.77476E-01	2	14.63
MNO % X	Log	0.86908E-05	0.52794E-01	2	0.02
NA2O % X	Log	0.32616E-03	0.65566E-02	2	4.97
NB ppm S	Log	0.00000E+00	0.15011E-01	2	0.00
NI ppm S	Log	0.00000E+00	0.32879E-01	2	0.00
P2O5 % X	Log	0.71399E-03	0.73399E-02	2	9.73
PB ppm S	Log	0.16207E-01	0.12347E+00	2	13.13
SC ppm S	Log	0.39024E-02	0.25585E-01	2	15.25
SIO2 % X	None	0.11560E+00	0.16314E+02	2	0.71
SR ppm S	Log	0.00000E+00	0.16229E-01	2	0.00
TI % S	Log	0.00000E+00	0.23881E-01	2	0.00
TIO2 % X	Log	0.67631E-05	0.13835E-01	2	0.05
V ppm S	Log	0.00000E+00	0.16404E-01	2	0.00
Y ppm S	Log	0.12304E-01	0.43953E-01	2	27.99
YB ppm S	Log	0.12304E-01	0.40299E-01	2	30.53
ZN ppm A	Log	0.16082E-01	0.13922E+00	2	11.55
ZR ppm S	Log	0.20056E-01	0.12819E+00	2	15.65

*Greater than 50 percent of the variance seen in the data could be related to analytical error rather than geological variation, although there may not be enough replicates to determine this.
Variances are listed in log-form if appropriate and in FORTRAN E-format.
See table 2 for abbreviations.

Table 11.--Percent of total sample variation due to analytical error, volcanic samples, fine fraction.

VARIABLE	TRANS-FORMATION	ERROR VARIANCE	TOTAL VARIANCE	PAIRS	% ANALYTICAL ERROR
U ppm N	Log	0.19143E-03	0.41645E-01	2	0.46
TH ppm N	Log	0.85928E-02	0.13817E-01	2	62.19*
AL2O3% X	Log	0.48619E-04	0.57012E-02	2	0.85
AS ppm A	Log	0.12385E-03	0.35122E+00	2	0.04
B ppm S	Log	0.77520E-02	0.78628E-01	2	9.86
BA ppm S	Log	0.12304E-01	0.24313E-01	2	50.61*
Org C %	Log	0.86346E-05	0.12454E+00	2	0.01
CA % S	Log	0.00000E+00	0.60980E-01	2	0.00
CAO % X	None	0.38050E-01	0.58850E+01	2	0.65
CO ppm S	Log	0.78048E-02	0.41812E-02	2	186.67*
CR ppm S	Log	0.00000E+00	0.82368E-01	2	0.00
CU ppm S	Log	0.00000E+00	0.29269E+00	2	0.00
FE % S	Log	0.00000E+00	0.15068E-01	1	0.00
FE2O3% X	Log	0.28595E-04	0.28859E-01	2	0.10
GA ppm S	Log	0.00000E+00	0.66130E-02	2	0.00
K % S	Log	0.00000E+00	0.58041E-01	2	0.00
K2O % X	Log	0.38059E-05	0.12214E-01	2	0.03
LA ppm S	Log	0.00000E+00	0.26692E-02	2	0.00
MG % S	Log	0.53384E-02	0.54926E-01	2	9.72
MGO % X	Log	0.34705E-03	0.29049E-01	2	1.19
MN ppm S	Log	0.77520E-02	0.30211E+00	2	2.57
MNO % X	Log	0.83845E-04	0.28294E+00	2	0.03
NA2O % X	None	0.14450E-01	0.13374E+00	2	10.80
NI ppm S	Log	0.00000E+00	0.23938E-01	2	0.00
P2O5 % X	None	0.11250E-02	0.33457E-01	2	3.36
PB ppm S	Log	0.53384E-02	0.67345E+00	2	0.79
SC ppm S	Log	0.00000E+00	0.10167E-01	2	0.00
SE ppm X	Log	0.23775E-01	0.41181E-01	2	57.73*
SIO2 % X	None	0.75482E+00	0.58172E+02	2	1.30
SR ppm S	Log	0.53384E-02	0.45395E-01	2	11.76
TI % S	Log	0.12304E-01	0.34930E-01	2	35.23
TIO2 % X	Log	0.92238E-05	0.39607E-02	2	0.23
V ppm S	Log	0.00000E+00	0.10966E-01	2	0.00
Y ppm S	Log	0.15504E-01	0.22772E-01	2	68.08*
YB ppm S	Log	0.00000E+00	0.26922E-01	1	0.00
ZN ppm A	Log	0.72128E-01	0.36699E+00	2	19.65
ZR ppm S	Log	0.33852E-01	0.28278E-01	2	119.71*

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*Greater than 50 percent of the variance seen in the data could be related to analytical error rather than geological variation, although there may not be enough replicates to determine this.
Variances are listed in log-form if appropriate and in FORTRAN E-format.
See table 2 for abbreviations.

Table 12.--Correlation coefficients, r, and numbers of pairs, (n), for Boulder batholith samples, fine fraction.

	U ppm N*	TH ppm N*	AL2O3% X*	AS ppm A*	BA ppm S*	Org C %*	CAO % X	CO ppm S*	CR ppm S*	CU ppm S*
*U ppm N		0.75(37)	-0.48(43)	-0.24(43)	-0.52(43)	0.51(43)	0.25(43)	-0.36(43)	0.18(43)	-0.33(43)
*TH ppm N			-0.25(37)	-0.36(37)	-0.57(37)	0.05(37)	0.34(37)	-0.35(37)	0.01(37)	-0.34(37)
*AL2O3% X				-0.10(43)	0.12(43)	-0.36(43)	-0.35(43)	-0.17(43)	-0.40(43)	-0.13(43)
*AS ppm A					0.21(43)	-0.15(43)	-0.46(43)	0.17(43)	-0.12(43)	0.53(43)
*BA ppm S						-0.05(43)	-0.34(43)	0.30(43)	-0.15(43)	0.33(43)
*Org C %							0.02(43)	-0.19(43)	0.03(43)	-0.14(43)
CAO % X								0.01(43)	0.39(43)	-0.31(43)
*CO ppm S									0.25(43)	0.36(43)
*CR ppm S										-0.05(43)
*CU ppm S										
*FE2O3% X										
*K2O % X										
*LA ppm S										
*MGO % X										
*MNO % X										
NA2O % X										
*NI ppm S										
P2O5 % X										
*PB ppm S										
*SE ppm X										
SIO2 % X										
†*SR ppm S										
*TIO2 % X										
*V ppm S										
*Y ppm S										
*YB ppm S										
*ZN ppm A										
*ZR ppm S										

*Log data were used in calculation
†Analytical problem, see table 9
See table 2 for explanation of abbreviations

Table 12, continued

	FE2O3% X*	K2O % X*	LA ppm S*	MGO % X*	MNO % X*	NA2O % X	NI ppm S*	P2O5 % X	PB ppm S*	SE ppm X*
*U ppm N	0.06(43)	-0.42(43)	0.05(43)	0.30(43)	-0.14(43)	-0.25(43)	0.02(43)	-0.17(43)	-0.14(43)	0.38(43)
*TH ppm N	0.13(37)	-0.23(37)	0.29(37)	0.38(37)	-0.31(37)	0.11(37)	0.03(37)	0.09(37)	-0.37(37)	0.20(37)
*AL2O3% X	-0.39(43)	0.56(43)	0.19(43)	-0.47(43)	-0.16(43)	0.46(43)	-0.42(43)	0.02(43)	0.03(43)	-0.31(43)
*AS ppm A	0.10(43)	0.17(43)	0.12(43)	-0.36(43)	0.33(43)	-0.17(43)	-0.02(43)	-0.02(43)	0.78(43)	-0.23(43)
*BA ppm S	0.01(43)	0.18(43)	0.01(43)	-0.41(43)	0.41(43)	-0.12(43)	0.05(43)	-0.08(43)	0.20(43)	-0.15(43)
*Org C %	0.15(43)	-0.34(43)	-0.26(43)	-0.10(43)	0.10(43)	-0.32(43)	-0.00(43)	-0.24(43)	-0.15(43)	0.49(43)
CAO % X	0.46(43)	-0.65(43)	-0.03(43)	0.82(43)	-0.17(43)	0.16(43)	0.41(43)	0.52(43)	-0.40(43)	0.26(43)
*CO ppm S	0.32(43)	0.10(43)	0.08(43)	0.11(43)	0.39(43)	-0.10(43)	0.53(43)	0.33(43)	0.01(43)	0.08(43)
*CR ppm S	0.24(43)	-0.29(43)	-0.13(43)	0.68(43)	-0.18(43)	-0.22(43)	0.65(43)	0.11(43)	-0.30(43)	0.23(43)
*CU ppm S	-0.20(43)	0.24(43)	0.10(43)	-0.17(43)	0.18(43)	-0.09(43)	0.19(43)	-0.22(43)	0.47(43)	-0.09(43)
*FE2O3% X		-0.47(43)	-0.05(43)	0.33(43)	0.36(43)	-0.15(43)	0.43(43)	0.67(43)	-0.05(43)	0.22(43)
*K2O % X			0.24(43)	-0.56(43)	0.09(43)	0.22(43)	-0.26(43)	-0.32(43)	0.24(43)	-0.37(43)
*LA ppm S				-0.09(43)	-0.10(43)	0.18(43)	0.09(43)	0.20(43)	0.15(43)	-0.19(43)
*MGO % X					-0.32(43)	-0.05(43)	0.50(43)	0.32(43)	-0.39(43)	0.18(43)
*MNO % X						-0.36(43)	0.07(43)	0.04(43)	0.28(43)	0.14(43)
NA2O % X							-0.09(43)	0.26(43)	-0.10(43)	-0.09(43)
*NI ppm S								0.39(43)	-0.13(43)	0.20(43)
P2O5 % X									-0.05(43)	0.05(43)
*PB ppm S										-0.27(43)
*SE ppm X										
SIO2 % X										
*SR ppm S										
*TIO2 % X										
*V ppm S										
*Y ppm S										
*YB ppm S										
*ZN ppm A										
*ZR ppm S										

Table 12, continued

	SIO2 % X	SR ppm S*†	TIO2 % X*	V ppm S*	Y ppm S*	YB ppm S*	ZN ppm A*	ZR ppm S*
*U ppm N	-0.29(43)	-0.47(43)	0.29(43)	0.11(43)	0.31(43)	0.22(43)	-0.11(43)	0.14(43)
*TH ppm N	0.04(37)	-0.31(37)	0.35(37)	0.12(37)	0.32(37)	0.37(37)	-0.26(37)	0.58(37)
*AL2O3% X	0.47(43)	0.52(43)	-0.49(43)	-0.03(43)	-0.19(43)	-0.18(43)	-0.19(43)	-0.05(43)
*AS ppm A	0.03(43)	-0.26(43)	-0.10(43)	-0.07(43)	0.19(43)	0.12(43)	0.74(43)	-0.06(43)
*BA ppm S	-0.14(43)	0.57(43)	-0.32(43)	-0.11(43)	-0.38(43)	-0.33(43)	0.19(43)	-0.22(43)
*Org C %	-0.68(43)	-0.23(43)	-0.11(43)	-0.13(43)	0.10(43)	-0.07(43)	-0.05(43)	-0.27(43)
CAO % X	-0.25(43)	-0.12(43)	0.52(43)	0.19(43)	-0.09(43)	-0.00(43)	-0.29(43)	-0.03(43)
*CO ppm S	-0.09(43)	0.24(43)	0.23(43)	0.27(43)	-0.07(43)	0.06(43)	0.20(43)	-0.05(43)
*CR ppm S	-0.07(43)	-0.19(43)	0.59(43)	0.28(43)	-0.01(43)	-0.07(43)	-0.10(43)	-0.21(43)
*CU ppm S	0.14(43)	-0.10(43)	-0.13(43)	-0.33(43)	-0.15(43)	-0.13(43)	0.42(43)	-0.17(43)
*FE2O3% X	-0.64(43)	0.02(43)	0.43(43)	0.33(43)	0.03(43)	0.09(43)	0.16(43)	0.09(43)
*K2O % X	0.52(43)	0.30(43)	-0.53(43)	-0.24(43)	0.05(43)	0.08(43)	0.14(43)	0.03(43)
*LA ppm S	0.15(43)	0.18(43)	-0.11(43)	-0.01(43)	0.32(43)	0.41(43)	0.10(43)	0.35(43)
*MGO % X	-0.03(43)	-0.28(43)	0.77(43)	0.31(43)	-0.03(43)	0.02(43)	-0.30(43)	-0.01(43)
*MNO % X	-0.42(43)	0.22(43)	-0.22(43)	-0.02(43)	-0.21(43)	-0.10(43)	0.41(43)	-0.10(43)
NA2O % X	0.35(43)	0.13(43)	-0.12(43)	-0.07(43)	-0.11(43)	-0.04(43)	-0.13(43)	0.04(43)
*NI ppm S	-0.26(43)	-0.12(43)	0.44(43)	0.22(43)	-0.02(43)	0.10(43)	0.03(43)	0.01(43)
P2O5 % X	-0.23(43)	0.19(43)	0.33(43)	0.39(43)	0.05(43)	0.11(43)	-0.01(43)	0.21(43)
*PB ppm S	0.03(43)	-0.16(43)	-0.27(43)	-0.13(43)	0.16(43)	0.18(43)	0.70(43)	-0.14(43)
*SE ppm X	-0.39(43)	-0.16(43)	0.26(43)	0.24(43)	-0.28(43)	-0.34(43)	0.08(43)	-0.20(43)
SIO2 % X	....	0.01(43)	-0.09(43)	0.04(43)	-0.10(43)	-0.09(43)	-0.17(43)	0.09(43)
*SR ppm S	....	....	-0.24(43)	0.10(43)	-0.32(43)	-0.26(43)	-0.21(43)	0.01(43)
*TIO2 % X	....	....	....	0.50(43)	-0.04(43)	0.00(43)	-0.15(43)	0.17(43)
*V ppm S	....	....	....	....	0.05(43)	0.05(43)	-0.15(43)	0.21(43)
*Y ppm S	....	....	....	....	....	0.82(43)	0.21(43)	0.33(43)
*YB ppm S	....	....	....	....	....	....	0.19(43)	0.50(43)
*ZN ppm A	....	....	....	....	....	....	....	-0.18(43)
*ZR ppm S	....	....	....	....	....	....	....	....

Table 13.--Correlation coefficents, r, and numbers of pairs, (n), for Boulder batholith samples, coarse fraction.

	U ppm N*	TH ppm N*	AL2O3% X*	AS ppm A*	BA ppm S*	Org C %*	CAO % X*	CO ppm S*†	CR ppm S*	CU ppm S*
*U ppm N		0.74(42)	-0.60(43)	-0.00(43)	-0.67(43)	0.48(43)	0.31(43)	-0.02(43)	0.34(43)	-0.02(43)
*TH ppm N			-0.34(42)	-0.17(42)	-0.62(42)	0.03(42)	0.22(42)	-0.03(42)	0.26(42)	-0.27(42)
*AL2O3% X				-0.13(43)	0.60(43)	-0.33(43)	-0.37(43)	-0.28(43)	-0.63(43)	-0.23(43)
*AS ppm A					0.02(43)	0.15(43)	-0.54(43)	0.18(43)	-0.13(43)	0.56(43)
*BA ppm S						-0.08(43)	-0.34(43)	-0.03(43)	-0.22(43)	0.09(43)
*Org C %							0.04(43)	-0.02(43)	0.11(43)	0.35(43)
*CAO % X								0.18(43)	0.41(43)	-0.20(43)
†*CO ppm S									0.32(43)	0.22(43)
*CR ppm S										0.11(43)
*CU ppm S										
*FE2O3% X										
K2O % X										
*LA ppm S										
*MGO % X										
*MNO % X										
*NA2O % X										
*NB ppm S										
*NI ppm S										
*P2O5 % X										
*PB ppm S										
*SC ppm S										
*SE ppm X										
SIO2 % X										
*SR ppm S										
*TIO2 % X										
*V ppm S										
*Y ppm S										
*YB ppm S										
*ZN ppm A										
*ZR ppm S										

*Log data were used in calculation
†Analytical problem, see table 10.
See table 2 for explanation of abbreviations.

Table 13, continued

	FE2O3% X*	K2O % X	LA ppm S*	MGO % X*	MNO % X*	NA2O % X*	NB ppm S*	NI ppm S*	P2O5 % X*	PB ppm S*
*U ppm N	0.51(43)	-0.53(43)	0.17(43)	0.35(43)	0.03(43)	-0.39(43)	0.27(43)	0.16(43)	0.29(43)	-0.12(43)
*TH ppm N	0.62(42)	-0.56(42)	0.44(42)	0.11(42)	-0.20(42)	0.01(42)	0.38(42)	-0.05(42)	0.42(42)	-0.28(42)
*AL2O3% X	-0.49(43)	0.35(43)	-0.03(43)	-0.62(43)	-0.28(43)	0.83(43)	-0.27(43)	-0.59(43)	-0.44(43)	0.05(43)
*AS ppm A	-0.09(43)	0.32(43)	0.01(43)	-0.14(43)	0.49(43)	-0.34(43)	-0.04(43)	0.08(43)	-0.17(43)	0.79(43)
*BA ppm S	-0.40(43)	0.49(43)	-0.08(43)	-0.41(43)	0.04(43)	0.38(43)	-0.31(43)	-0.11(43)	-0.17(43)	0.15(43)
*Org C %	0.19(43)	-0.10(43)	-0.37(43)	0.14(43)	0.29(43)	-0.48(43)	-0.12(43)	0.18(43)	0.12(43)	0.11(43)
*CAO % X	0.21(43)	-0.50(43)	-0.14(43)	0.81(43)	-0.24(43)	-0.22(43)	0.30(43)	0.43(43)	0.23(43)	-0.62(43)
†*CO ppm S	0.34(43)	-0.14(43)	0.04(43)	0.34(43)	0.45(43)	-0.35(43)	0.04(43)	0.57(43)	0.30(43)	0.05(43)
*CR ppm S	0.58(43)	-0.39(43)	0.08(43)	0.54(43)	-0.07(43)	-0.48(43)	0.09(43)	0.76(43)	0.53(43)	-0.31(43)
*CU ppm S	-0.08(43)	0.33(43)	-0.20(43)	0.05(43)	0.30(43)	-0.44(43)	-0.17(43)	0.31(43)	-0.16(43)	0.41(43)
*FE2O3% X		-0.68(43)	0.15(43)	0.21(43)	0.19(43)	-0.21(43)	0.19(43)	0.36(43)	0.62(43)	-0.26(43)
K2O % X			0.02(43)	-0.35(43)	0.01(43)	0.04(43)	-0.02(43)	-0.21(43)	-0.45(43)	0.47(43)
*LA ppm S				-0.16(43)	-0.13(43)	0.20(43)	0.38(43)	-0.13(43)	0.13(43)	0.03(43)
*MGO % X					-0.01(43)	-0.64(43)	0.24(43)	0.64(43)	0.18(43)	-0.27(43)
*MNO % X						-0.46(43)	0.08(43)	0.22(43)	0.16(43)	0.39(43)
*NA2O % X							-0.17(43)	-0.63(43)	-0.20(43)	-0.17(43)
*NB ppm S								0.09(43)	0.07(43)	-0.03(43)
*NI ppm S									0.47(43)	-0.05(43)
*P2O5 % X										-0.19(43)
*PB ppm S										
*SC ppm S										
*SE ppm X										
SIO2 % X										
*SR ppm S										
*TIO2 % X										
*V ppm S										
*Y ppm S										
*YB ppm S										
*ZN ppm A										
*ZR ppm S										

Table 13, continued

	SC ppm S*	SE ppm X*	SIO2 % X	SR ppm S*	TIO2 % X*	V ppm S*	Y ppm S*	YB ppm S*	ZN ppm A*	ZR ppm S*
*U ppm N	0.43(43)	0.28(43)	-0.50(43)	-0.44(43)	0.53(43)	0.35(43)	0.53(43)	0.57(41)	0.25(43)	0.47(43)
*TH ppm N	0.40(42)	0.04(42)	-0.34(42)	-0.09(42)	0.37(42)	0.62(42)	0.62(42)	0.68(40)	0.21(42)	0.74(42)
*AL2O3% X	-0.46(43)	-0.38(43)	0.41(43)	0.54(43)	-0.77(43)	-0.25(43)	-0.36(43)	-0.39(41)	-0.30(43)	-0.26(43)
*AS ppm A	-0.16(43)	0.08(43)	0.12(43)	-0.24(43)	-0.01(43)	-0.02(43)	0.08(43)	-0.10(41)	0.43(43)	-0.06(43)
*BA ppm S	-0.54(43)	-0.09(43)	0.16(43)	0.58(43)	-0.51(43)	-0.27(43)	-0.47(43)	-0.51(41)	-0.14(43)	-0.40(43)
*Org C %	-0.12(43)	0.57(43)	-0.70(43)	-0.38(43)	0.18(43)	-0.04(43)	0.02(43)	0.01(41)	0.21(43)	-0.13(43)
*CAO % X	0.70(43)	0.17(43)	-0.25(43)	-0.22(43)	0.61(43)	0.02(43)	0.12(43)	0.18(41)	-0.28(43)	-0.09(43)
†*CO ppm S	0.37(43)	0.00(43)	-0.23(43)	-0.01(43)	0.41(43)	0.25(43)	0.11(43)	0.10(41)	0.16(43)	0.08(43)
*CR ppm S	0.32(43)	0.41(43)	-0.44(43)	-0.10(43)	0.62(43)	0.44(43)	0.14(43)	0.23(41)	0.01(43)	0.31(43)
*CU ppm S	-0.22(43)	0.35(43)	-0.14(43)	-0.30(43)	0.12(43)	-0.09(43)	-0.08(43)	-0.21(41)	0.14(43)	-0.23(43)
*FE2O3% X	0.25(43)	0.22(43)	-0.70(43)	-0.13(43)	0.52(43)	0.80(43)	0.23(43)	0.40(41)	0.25(43)	0.66(43)
K2O % X	-0.38(43)	0.04(43)	0.47(43)	0.16(43)	-0.43(43)	-0.44(43)	-0.28(43)	-0.43(41)	-0.04(43)	-0.54(43)
*LA ppm S	0.17(43)	-0.19(43)	0.22(43)	0.40(43)	0.04(43)	0.43(43)	0.58(43)	0.51(41)	0.22(43)	0.47(43)
*MGO % X	0.77(43)	0.30(43)	-0.27(43)	-0.43(43)	0.81(43)	0.03(43)	0.10(43)	0.15(41)	-0.11(43)	-0.17(43)
*MNO % X	0.02(43)	0.14(43)	-0.20(43)	-0.22(43)	0.25(43)	0.02(43)	-0.12(43)	-0.17(41)	0.55(43)	-0.04(43)
*NA2O % X	-0.39(43)	-0.56(43)	0.38(43)	0.60(43)	-0.71(43)	-0.01(43)	-0.11(43)	-0.04(41)	-0.31(43)	0.11(43)
*NB ppm S	0.51(43)	0.18(43)	0.01(43)	-0.03(43)	0.46(43)	0.31(43)	0.35(43)	0.27(41)	0.09(43)	0.06(43)
*NI ppm S	0.36(43)	0.33(43)	-0.43(43)	-0.21(43)	0.64(43)	0.12(43)	0.03(43)	0.06(41)	0.10(43)	-0.00(43)
*P2O5 % X	0.18(43)	0.18(43)	-0.50(43)	0.06(43)	0.32(43)	0.39(43)	0.11(43)	0.18(41)	0.28(43)	0.43(43)
*PB ppm S	-0.30(43)	-0.03(43)	0.20(43)	-0.09(43)	-0.19(43)	-0.22(43)	-0.03(43)	-0.16(41)	0.43(43)	-0.23(43)
*SC ppm S	....	0.03(43)	-0.10(43)	-0.25(43)	0.75(43)	0.20(43)	0.32(43)	0.34(41)	-0.01(43)	0.14(43)
*SE ppm X	....	....	-0.50(43)	-0.40(43)	0.34(43)	0.20(43)	-0.11(43)	-0.18(41)	0.18(43)	-0.21(43)
SIO2 % X	....	....	....	0.18(43)	-0.41(43)	-0.47(43)	-0.03(43)	-0.14(41)	-0.17(43)	-0.23(43)
*SR ppm S	....	....	....	....	-0.41(43)	0.13(43)	0.03(43)	0.04(41)	-0.24(43)	0.08(43)
*TIO2 % X	....	....	....	....	....	0.32(43)	0.24(43)	0.27(41)	0.09(43)	0.15(43)
*V ppm S	....	....	....	....	....	....	0.32(43)	0.43(41)	0.19(43)	0.60(43)
*Y ppm S	....	....	....	....	....	....	....	0.89(41)	0.25(43)	0.55(43)
*YB ppm S	....	....	....	....	....	....	....	....	0.15(41)	0.70(41)
*ZN ppm A	....	....	....	....	....	....	....	....	....	0.27(43)
*ZR ppm S	....	....	....	....	....	....	....	....	....	....

Table 14.--Correlation coefficients, r, and numbers of pairs, (n), for volcanic samples, fine fraction.

	U ppm N*	TH ppm N*†	AL2O3% X*	AS ppm A*	B ppm S*	BA ppm S*†	Org C %*	CAO % X	CO ppm S*†	CR ppm S*
*U ppm N		0.73(8)	-0.23(8)	-0.38(8)	-0.67(8)	-0.28(8)	-0.32(8)	-0.13(8)	-0.10(8)	-0.66(8)
†*TH ppm N			-0.60(8)	0.16(8)	-0.52(8)	-0.49(8)	-0.03(8)	-0.24(8)	-0.26(8)	-0.90(8)
*AL2O3% X				-0.20(8)	0.32(8)	0.88(8)	0.15(8)	-0.40(8)	0.06(8)	0.64(8)
*AS ppm A					0.51(8)	-0.09(8)	-0.69(8)	-0.04(8)	0.15(8)	-0.28(8)
*B ppm S						0.40(8)	-0.65(8)	-0.07(8)	0.33(8)	0.45(8)
†*BA ppm S							-0.14(8)	-0.26(8)	0.04(8)	0.69(8)
*Org C %								-0.29(8)	-0.56(8)	-0.00(8)
CAO % X									0.22(8)	0.18(8)
†*CO ppm S										0.02(8)
*CR ppm S										
*CU ppm S										
*FE2O3% X										
*GA ppm S										
*K2O % X										
*LA ppm S										
*MGO % X										
*MNO % X										
NA2O % X										
*NI ppm S										
P2O5 % X										
*PB ppm S										
*SC ppm S										
†*SE ppm X										
SIO2 % X										
*SR ppm S										
*TIO2 % X										
*V ppm S										
†*Y ppm S										
*YB ppm S										
*ZN ppm A										
†*ZR ppm S										

*Log data were used in calculation
†May have analytical problems, see table 11.
See table 2 for explnation of abbreviations.

Table 14, continued

	CU ppm S*	FE203% X*	GA ppm S*	K20 % X*	LA ppm S*	MGO % X*	MNO % X*	NA20 % X	NI ppm S*	P205 % X
*U ppm N	-0.20(8)	0.26(8)	-0.25(8)	-0.13(8)	0.23(8)	-0.29(8)	0.35(8)	0.03(8)	-0.78(8)	0.49(8)
†*TH ppm N	0.13(8)	0.28(8)	-0.34(8)	-0.17(8)	-0.35(8)	-0.53(8)	0.67(8)	-0.22(8)	-0.60(8)	0.37(8)
*AL203% X	-0.31(8)	-0.73(8)	0.61(8)	0.82(8)	0.33(8)	-0.16(8)	-0.20(8)	0.45(8)	0.56(8)	-0.38(8)
*AS ppm A	0.76(8)	-0.02(8)	0.51(8)	0.18(8)	-0.63(8)	-0.27(8)	0.07(8)	0.32(8)	0.19(8)	-0.37(8)
*B ppm S	0.45(8)	-0.52(8)	0.52(8)	0.31(8)	0.17(8)	0.03(8)	-0.27(8)	0.49(8)	0.68(8)	-0.69(8)
†*BA ppm S	-0.10(8)	-0.66(8)	0.55(8)	0.83(8)	0.16(8)	-0.13(8)	-0.02(8)	0.23(8)	0.56(8)	-0.71(8)
*Org C %	-0.93(8)	-0.07(8)	-0.47(8)	-0.09(8)	0.19(8)	-0.02(8)	-0.07(8)	-0.31(8)	-0.07(8)	0.77(8)
CAO % X	0.29(8)	0.80(8)	-0.14(8)	-0.66(8)	-0.00(8)	0.88(8)	-0.56(8)	-0.20(8)	-0.42(8)	-0.11(8)
†*CO ppm S	0.65(8)	0.13(8)	0.49(8)	0.04(8)	0.29(8)	0.02(8)	-0.00(8)	0.56(8)	-0.17(8)	-0.35(8)
*CR ppm S	-0.27(8)	-0.38(8)	0.18(8)	0.27(8)	0.30(8)	0.49(8)	-0.49(8)	-0.05(8)	0.66(8)	-0.52(8)
*CU ppm S		0.26(8)	0.47(8)	-0.01(8)	-0.32(8)	-0.08(8)	0.15(8)	0.35(8)	-0.15(8)	-0.53(8)
*FE203% X			-0.35(8)	-0.78(8)	-0.24(8)	0.53(8)	-0.17(8)	-0.33(8)	-0.79(8)	0.32(8)
*GA ppm S				0.69(8)	-0.03(8)	-0.24(8)	-0.19(8)	0.81(8)	0.24(8)	-0.53(8)
*K20 % X					-0.07(8)	-0.61(8)	0.28(8)	0.41(8)	0.52(8)	-0.49(8)
*LA ppm S						0.23(8)	-0.33(8)	0.39(8)	-0.02(8)	0.07(8)
*MGO % X							-0.77(8)	-0.24(8)	-0.12(8)	-0.04(8)
*MNO % X								-0.28(8)	-0.11(8)	-0.04(8)
NA20 % X									0.05(8)	-0.18(8)
*NI ppm S										-0.45(8)
P205 % X										
*PB ppm S										
*SC ppm S										
† *SE ppm X										
SIO2 % X										
*SR ppm S										
*TIO2 % X										
*V ppm S										
†*Y ppm S										
*YB ppm S										
*ZN ppm A										
†*ZR ppm S										

Table 14, continued

	PB ppm S*	SC ppm S*	SE ppm X*†	SIO2 % X	SR ppm S*	TIO2 % X*	V ppm S*	Y ppm S*†	YB ppm S*	ZN ppm A*	ZR ppm S*†
*U ppm N	-0.38(8)	-0.24(8)	0.02(8)	-0.53(8)	-0.44(8)	-0.07(8)	-0.15(8)	-0.08(8)	-0.41(7)	-0.47(8)	-0.09(8)
†*TH ppm N	0.05(8)	-0.81(8)	0.06(8)	-0.49(8)	-0.77(8)	-0.65(8)	-0.77(8)	0.04(8)	0.02(7)	-0.37(8)	-0.22(8)
*AL2O3% X	0.14(8)	0.78(8)	-0.18(8)	0.65(8)	0.95(8)	0.53(8)	0.74(8)	0.05(8)	0.07(7)	0.46(8)	0.43(8)
*AS ppm A	0.84(8)	-0.44(8)	-0.33(8)	0.43(8)	-0.15(8)	-0.70(8)	-0.51(8)	0.13(8)	0.67(7)	0.38(8)	0.31(8)
*B ppm S	0.76(8)	0.30(8)	-0.28(8)	0.88(8)	0.42(8)	-0.08(8)	0.29(8)	0.20(8)	0.63(7)	0.18(8)	0.38(8)
†*BA ppm S	0.27(8)	0.69(8)	-0.39(8)	0.73(8)	0.91(8)	0.31(8)	0.62(8)	0.23(8)	0.40(7)	0.20(8)	0.65(8)
*Org C %	-0.68(8)	0.08(8)	0.42(8)	-0.59(8)	0.00(8)	0.58(8)	0.11(8)	-0.51(8)	-0.91(7)	0.10(8)	-0.60(8)
CAO % X	-0.38(8)	0.18(8)	-0.37(8)	-0.28(8)	-0.14(8)	0.18(8)	0.16(8)	-0.17(8)	-0.33(7)	-0.36(8)	0.29(8)
†*CO ppm S	0.14(8)	0.25(8)	0.16(8)	0.36(8)	0.12(8)	-0.19(8)	0.28(8)	0.71(8)	0.36(7)	0.15(8)	0.27(8)
*CR ppm S	-0.07(8)	0.81(8)	-0.20(8)	0.49(8)	0.83(8)	0.65(8)	0.76(8)	-0.03(8)	0.08(7)	0.13(8)	0.32(8)
*CU ppm S	0.60(8)	-0.27(8)	-0.25(8)	0.39(8)	-0.20(8)	-0.72(8)	-0.30(8)	0.55(8)	0.80(7)	0.05(8)	0.45(8)
*FE2O3% X	-0.51(8)	-0.30(8)	-0.05(8)	-0.70(8)	-0.60(8)	-0.14(8)	-0.31(8)	-0.12(8)	-0.46(7)	-0.33(8)	-0.07(8)
*GA ppm S	0.58(8)	0.41(8)	-0.42(8)	0.76(8)	0.60(8)	-0.07(8)	0.34(8)	0.25(8)	0.46(7)	0.59(8)	0.71(8)
*K2O % X	0.50(8)	0.33(8)	-0.18(8)	0.71(8)	0.71(8)	-0.02(8)	0.27(8)	0.31(8)	0.52(7)	0.51(8)	0.46(8)
*LA ppm S	-0.30(8)	0.61(8)	0.10(8)	0.13(8)	0.27(8)	0.61(8)	0.74(8)	-0.03(8)	-0.37(7)	-0.35(8)	-0.03(8)
*MGO % X	-0.48(8)	0.43(8)	-0.29(8)	-0.22(8)	0.09(8)	0.55(8)	0.42(8)	-0.40(8)	-0.49(7)	-0.31(8)	0.14(8)
*MNO % X	0.19(8)	-0.58(8)	0.41(8)	-0.08(8)	-0.34(8)	-0.69(8)	-0.57(8)	0.63(8)	0.45(7)	-0.10(8)	-0.23(8)
NA2O % X	0.45(8)	0.35(8)	-0.21(8)	0.58(8)	0.34(8)	0.04(8)	0.38(8)	0.11(8)	0.15(7)	0.38(8)	0.40(8)
*NI ppm S	0.49(8)	0.30(8)	0.02(8)	0.68(8)	0.61(8)	0.17(8)	0.25(8)	0.03(8)	0.42(7)	0.43(8)	0.03(8)
P2O5 % X	-0.58(8)	-0.37(8)	0.51(8)	-0.81(8)	-0.55(8)	0.19(8)	-0.30(8)	-0.49(8)	-0.85(7)	0.01(8)	-0.76(8)
*PB ppm S		-0.21(8)	-0.32(8)	0.76(8)	0.12(8)	-0.57(8)	-0.25(8)	0.25(8)	0.84(7)	0.29(8)	0.38(8)
*SC ppm S			-0.28(8)	0.45(8)	0.86(8)	0.79(8)	0.98(8)	-0.05(8)	-0.15(7)	0.11(8)	0.47(8)
†*SE ppm X				-0.35(8)	-0.28(8)	-0.07(8)	-0.21(8)	0.35(8)	-0.27(7)	0.21(8)	-0.84(8)
SIO2 % X					0.68(8)	-0.06(8)	0.41(8)	0.36(8)	0.72(7)	0.33(8)	0.60(8)
*SR ppm S						0.56(8)	0.79(8)	0.07(8)	0.16(7)	0.42(8)	0.53(8)
*TIO2 % X							0.81(8)	-0.52(8)	-0.67(7)	0.01(8)	-0.00(8)
*V ppm S								-0.05(8)	-0.21(7)	0.01(8)	0.39(8)
†*Y ppm S									0.66(7)	0.07(8)	0.14(8)
*YB ppm S										0.10(7)	0.53(7)
*ZN ppm A											-0.01(8)
†*ZR ppm S											

Table 15.--Correlation coefficients, r, and numbers of pairs, (n), for volcanic samples, coarse fraction.

	U ppm N*	TH ppm N*	AL2O3% X*	AS ppm A*	B ppm S*	BA ppm S*	Org C %*	CAO % X*	CO ppm S*	CR ppm S*
*U ppm N		0.77(8)	-0.31(8)	-0.55(8)	-0.68(8)	-0.26(8)	0.38(8)	0.06(8)	-0.01(8)	-0.59(8)
*TH ppm N			-0.32(8)	-0.10(8)	-0.67(8)	-0.18(8)	0.34(8)	-0.07(8)	-0.32(8)	-0.63(8)
*AL2O3% X				-0.23(8)	0.06(8)	0.85(8)	0.37(8)	-0.05(8)	0.16(8)	0.80(8)
*AS ppm A					0.22(8)	-0.12(8)	-0.59(8)	0.28(8)	-0.61(8)	0.00(8)
*B ppm S						0.04(8)	-0.48(8)	0.13(8)	0.06(8)	0.34(8)
*BA ppm S							0.04(8)	-0.32(8)	-0.20(8)	0.45(8)
*Org C %								-0.09(8)	0.61(8)	0.29(8)
*CAO % X									-0.12(8)	0.27(8)
*CO ppm S										0.36(8)
*CR ppm S										
*CU ppm S										
*FE2O3% X										
*GA ppm S										
K2O % X										
*MGO % X										
*MNO % X										
*NA2O % X										
*NI ppm S										
*P2O5 % X										
*PB ppm S										
*SC ppm S										
*SE ppm X										
SIO2 % X										
*SR ppm S										
*TIO2 % X										
*V ppm S										
*Y ppm S										
*YB ppm S										
*ZN ppm A										
*ZR ppm S										

*Log data were used in calculation
Percent analytical error could not be determined for these samples.
See table 2 for abbreviations.

Table 15, continued

	CU ppm S*	FE2O3% X*	GA ppm S*	K2O % X	MGO % X*	MNO % X*	NA2O % X*	NI ppm S*	P2O5 % X*	PB ppm S*
*U ppm N	-0.19(8)	0.32(8)	-0.28(8)	-0.17(8)	-0.05(8)	0.02(8)	0.25(8)	-0.49(8)	0.70(8)	-0.70(8)
*TH ppm N	-0.22(8)	0.04(8)	-0.36(8)	-0.30(8)	-0.17(8)	0.07(8)	0.18(8)	-0.55(8)	0.57(8)	-0.17(8)
*AL2O3% X	-0.53(8)	-0.38(8)	0.70(8)	-0.07(8)	0.48(8)	-0.57(8)	0.51(8)	0.62(8)	0.16(8)	0.15(8)
*AS ppm A	0.64(8)	0.15(8)	0.21(8)	-0.49(8)	0.15(8)	-0.13(8)	-0.02(8)	-0.16(8)	-0.74(8)	0.79(8)
*B ppm S	0.10(8)	-0.26(8)	0.04(8)	0.31(8)	0.00(8)	-0.01(8)	-0.22(8)	0.38(8)	-0.54(8)	0.37(8)
*BA ppm S	-0.34(8)	-0.61(8)	0.55(8)	-0.02(8)	0.19(8)	-0.34(8)	0.64(8)	0.30(8)	-0.02(8)	0.39(8)
*Org C %	-0.80(8)	-0.05(8)	-0.03(8)	0.11(8)	0.14(8)	-0.13(8)	-0.08(8)	0.39(8)	0.89(8)	-0.52(8)
*CAO % X	0.33(8)	0.80(8)	0.55(8)	-0.74(8)	0.83(8)	-0.75(8)	0.32(8)	0.14(8)	-0.09(8)	-0.15(8)
*CO ppm S	-0.44(8)	0.01(8)	-0.17(8)	0.58(8)	-0.04(8)	0.21(8)	-0.55(8)	0.67(8)	0.50(8)	-0.56(8)
*CR ppm S	-0.34(8)	-0.07(8)	0.69(8)	-0.07(8)	0.62(8)	-0.60(8)	0.15(8)	0.81(8)	-0.05(8)	0.13(8)
*CU ppm S	....	0.51(8)	0.11(8)	-0.36(8)	0.06(8)	0.06(8)	-0.01(8)	-0.35(8)	-0.72(8)	0.31(8)
*FE2O3% X	....	....	0.26(8)	-0.59(8)	0.54(8)	-0.39(8)	0.07(8)	-0.14(8)	-0.01(8)	-0.45(8)
*GA ppm S	....	....	....	-0.64(8)	0.89(8)	-0.88(8)	0.71(8)	0.43(8)	-0.18(8)	0.21(8)
K2O % X	....	....	....	....	-0.75(8)	0.77(8)	-0.65(8)	0.18(8)	0.10(8)	-0.17(8)
*MGO % X	....	....	....	....	....	-0.96(8)	0.59(8)	0.43(8)	0.04(8)	-0.05(8)
*MNO % X	....	....	....	....	....	....	-0.73(8)	-0.32(8)	-0.05(8)	-0.03(8)
*NA2O % X	....	....	....	....	....	....	....	-0.12(8)	0.03(8)	0.09(8)
*NI ppm S	....	....	....	....	....	....	....	....	0.17(8)	0.06(8)
*P2O5 % X	....	....	....	....	....	....	....	....	....	-0.65(8)
*PB ppm S	....	....	....	....	....	....	....	....	....	....
*SC ppm S	....	....	....	....	....	....	....	....	....	....
*SE ppm X	....	....	....	....	....	....	....	....	....	....
SIO2 % X	....	....	....	....	....	....	....	....	....	....
*SR ppm S	....	....	....	....	....	....	....	....	....	....
*TIO2 % X	....	....	....	....	....	....	....	....	....	....
*V ppm S	....	....	....	....	....	....	....	....	....	....
*Y ppm S	....	....	....	....	....	....	....	....	....	....
*YB ppm S	....	....	....	....	....	....	....	....	....	....
*ZN ppm A	....	....	....	....	....	....	....	....	....	....
*ZR ppm S	....	....	....	....	....	....	....	....	....	....

Table 15, continued

	SC ppm S*	SE ppm X*	SIO2 % X	SR ppm S*	TIO2 % X*	V ppm S*	Y ppm S*	YB ppm S*	ZN ppm A*	ZR ppm S*
*U ppm N	-0.20(8)	0.64(8)	-0.59(8)	-0.42(8)	0.03(8)	-0.50(8)	0.35(8)	0.04(7)	-0.00(8)	0.33(8)
*TH ppm N	-0.46(8)	0.26(8)	-0.45(8)	-0.32(8)	-0.04(8)	-0.49(8)	0.25(8)	-0.06(7)	0.11(8)	0.74(8)
*AL2O3% X	0.66(8)	-0.12(8)	0.19(8)	0.88(8)	0.72(8)	0.80(8)	-0.19(8)	-0.45(7)	0.03(8)	-0.18(8)
*AS ppm A	-0.49(8)	-0.85(8)	0.09(8)	0.11(8)	0.02(8)	-0.19(8)	-0.46(8)	-0.46(7)	0.18(8)	0.09(8)
*B ppm S	0.15(8)	-0.51(8)	0.70(8)	0.17(8)	-0.15(8)	0.50(8)	-0.21(8)	0.34(7)	-0.16(8)	-0.25(8)
*BA ppm S	0.22(8)	-0.24(8)	0.48(8)	0.73(8)	0.56(8)	0.56(8)	-0.53(8)	-0.56(7)	0.51(8)	0.10(8)
*Org C %	0.60(8)	0.63(8)	-0.50(8)	0.14(8)	0.20(8)	0.27(8)	0.75(8)	0.18(7)	-0.51(8)	0.04(8)
*CAO % X	0.11(8)	-0.35(8)	-0.52(8)	0.22(8)	0.55(8)	-0.00(8)	0.06(8)	-0.60(7)	-0.45(8)	-0.37(8)
*CO ppm S	0.67(8)	0.64(8)	-0.15(8)	-0.17(8)	-0.20(8)	0.25(8)	0.78(8)	0.58(7)	-0.55(8)	-0.58(8)
*CR ppm S	0.82(8)	-0.24(8)	0.07(8)	0.81(8)	0.59(8)	0.84(8)	0.01(8)	-0.26(7)	-0.41(8)	-0.50(8)
*CU ppm S	-0.63(8)	-0.46(8)	-0.02(8)	-0.33(8)	-0.13(8)	-0.62(8)	-0.45(8)	-0.42(7)	0.37(8)	-0.30(8)
*FE2O3% X	-0.03(8)	0.05(8)	-0.78(8)	-0.20(8)	0.23(8)	-0.44(8)	0.21(8)	-0.58(7)	-0.38(8)	-0.44(8)
*GA ppm S	0.35(8)	-0.46(8)	-0.12(8)	0.80(8)	0.92(8)	0.42(8)	-0.39(8)	-0.81(7)	0.06(8)	-0.43(8)
K2O % X	0.22(8)	0.49(8)	0.54(8)	-0.36(8)	-0.70(8)	0.18(8)	0.28(8)	0.89(7)	-0.04(8)	-0.06(8)
*MGO % X	0.39(8)	-0.34(8)	-0.43(8)	0.63(8)	0.89(8)	0.32(8)	-0.05(8)	-0.72(7)	-0.29(8)	-0.43(8)
*MNO % X	-0.36(8)	0.40(8)	0.33(8)	-0.75(8)	-0.95(8)	-0.42(8)	0.18(8)	0.74(7)	0.22(8)	0.20(8)
*NA2O % X	-0.03(8)	-0.29(8)	-0.07(8)	0.61(8)	0.84(8)	0.17(8)	-0.56(8)	-0.79(7)	0.40(8)	0.16(8)
*NI ppm S	0.68(8)	-0.05(8)	0.13(8)	0.43(8)	0.32(8)	0.63(8)	0.35(8)	0.09(7)	-0.36(8)	-0.62(8)
*P2O5 % X	0.33(8)	0.73(8)	-0.49(8)	-0.12(8)	0.13(8)	0.02(8)	0.73(8)	0.25(7)	-0.32(8)	0.16(8)
*PB ppm S	-0.40(8)	-0.85(8)	0.58(8)	0.32(8)	0.04(8)	0.14(8)	-0.61(8)	-0.33(7)	0.48(8)	0.23(8)
*SC ppm S	....	0.31(8)	-0.11(8)	0.54(8)	0.36(8)	0.78(8)	0.37(8)	0.11(7)	-0.65(8)	-0.44(8)
*SE ppm X	....	....	-0.38(8)	-0.44(8)	-0.30(8)	-0.18(8)	0.64(8)	0.50(7)	-0.25(8)	-0.07(8)
SIO2 % X	....	....	....	0.15(8)	-0.28(8)	0.38(8)	-0.51(8)	0.33(7)	0.45(8)	0.12(8)
*SR ppm S	....	....	....	....	0.80(8)	0.80(8)	-0.40(8)	-0.63(7)	-0.06(8)	-0.05(8)
*TIO2 % X	....	....	....	....	....	0.41(8)	-0.26(8)	-0.80(7)	-0.01(8)	-0.18(8)
*V ppm S	....	....	....	....	....	....	-0.07(8)	0.02(7)	-0.35(8)	-0.12(8)
*Y ppm S	....	....	....	....	....	....	....	0.56(7)	-0.69(8)	-0.17(8)
*YB ppm S	....	....	....	....	....	....	....	....	-0.33(7)	0.04(7)
*ZN ppm A	....	....	....	....	....	....	....	....	....	0.24(8)
*ZR ppm S	....	....	....	....	....	....	....	....	....	....

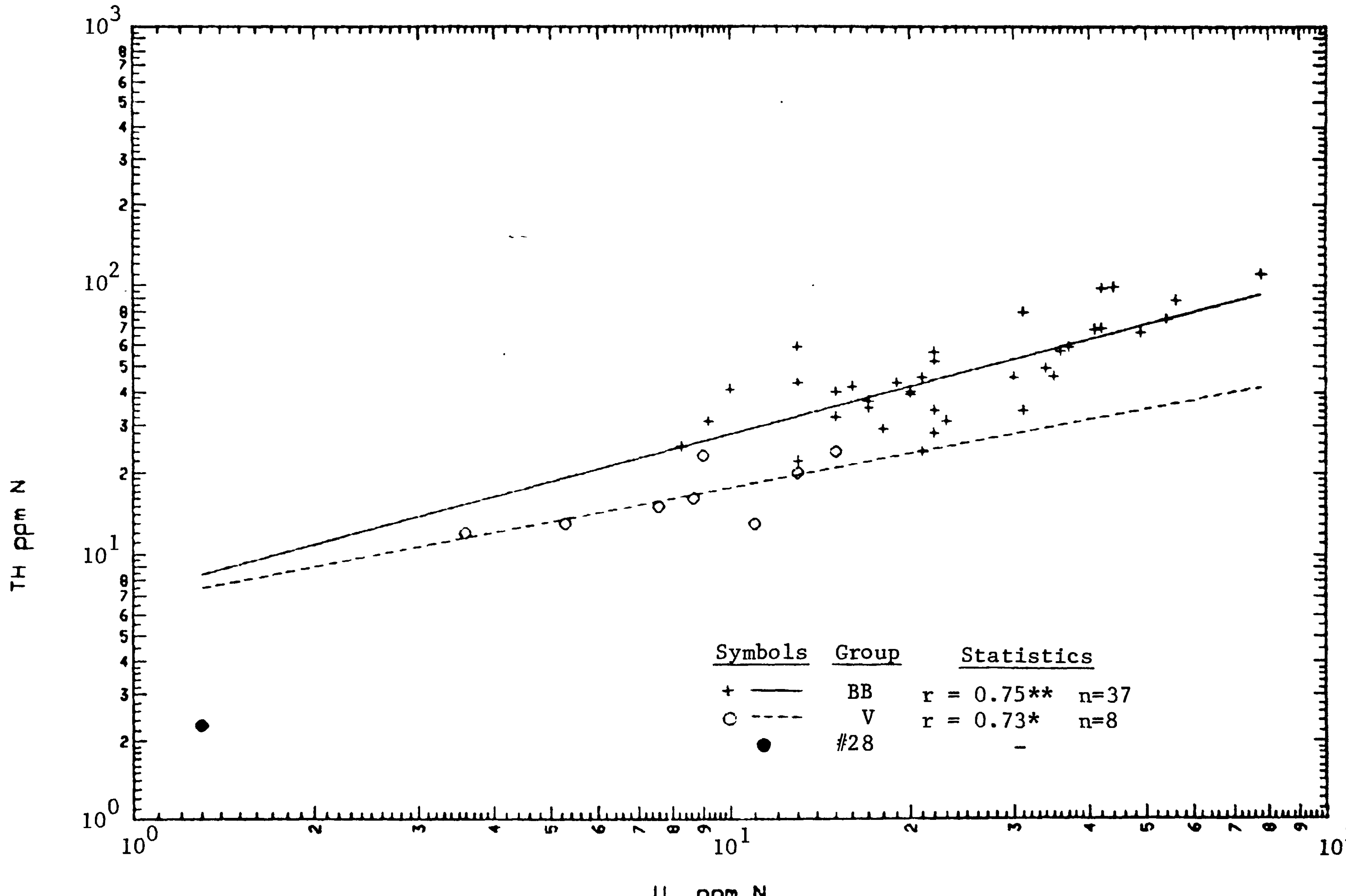

Figure 4-1.--Thorium plotted versus U (fine fraction). The Boulder batholith sample group (BB), the group draining volcanic terrane (V) and sample #28 are plotted with different symbols. The number of pairs, n, and the correlation coefficient, r, are listed separately for each group. One or two asterisks by an r value means the correlation is statistically significant to the 95 or 99% confidence level, respectively. Regression lines, where plotted, correspond only to significant r's. Refer to table 2 for explanation of codes used in axis labels.

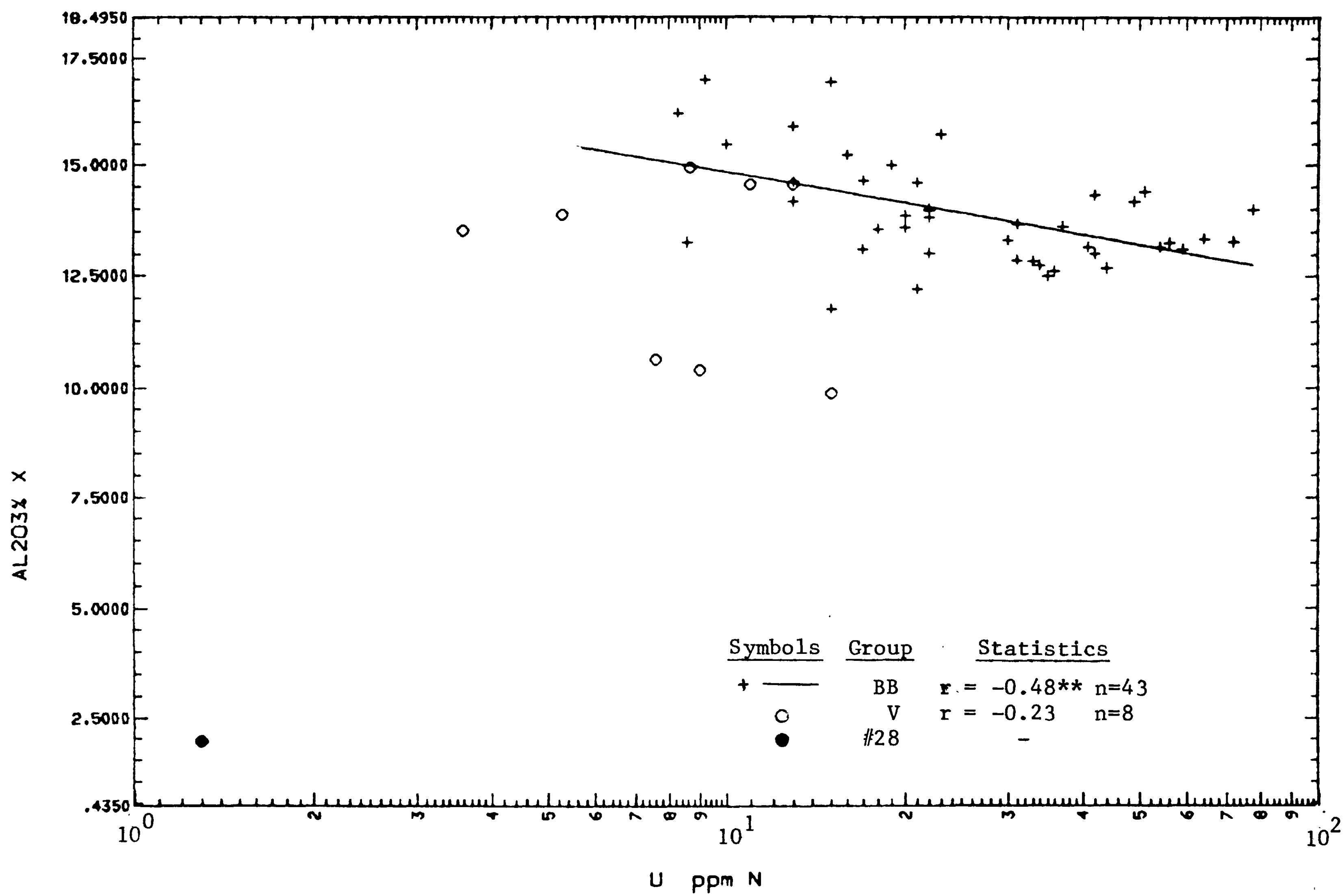

Figure 4-2.--Al_2O_3 plotted versus U (fine fraction).

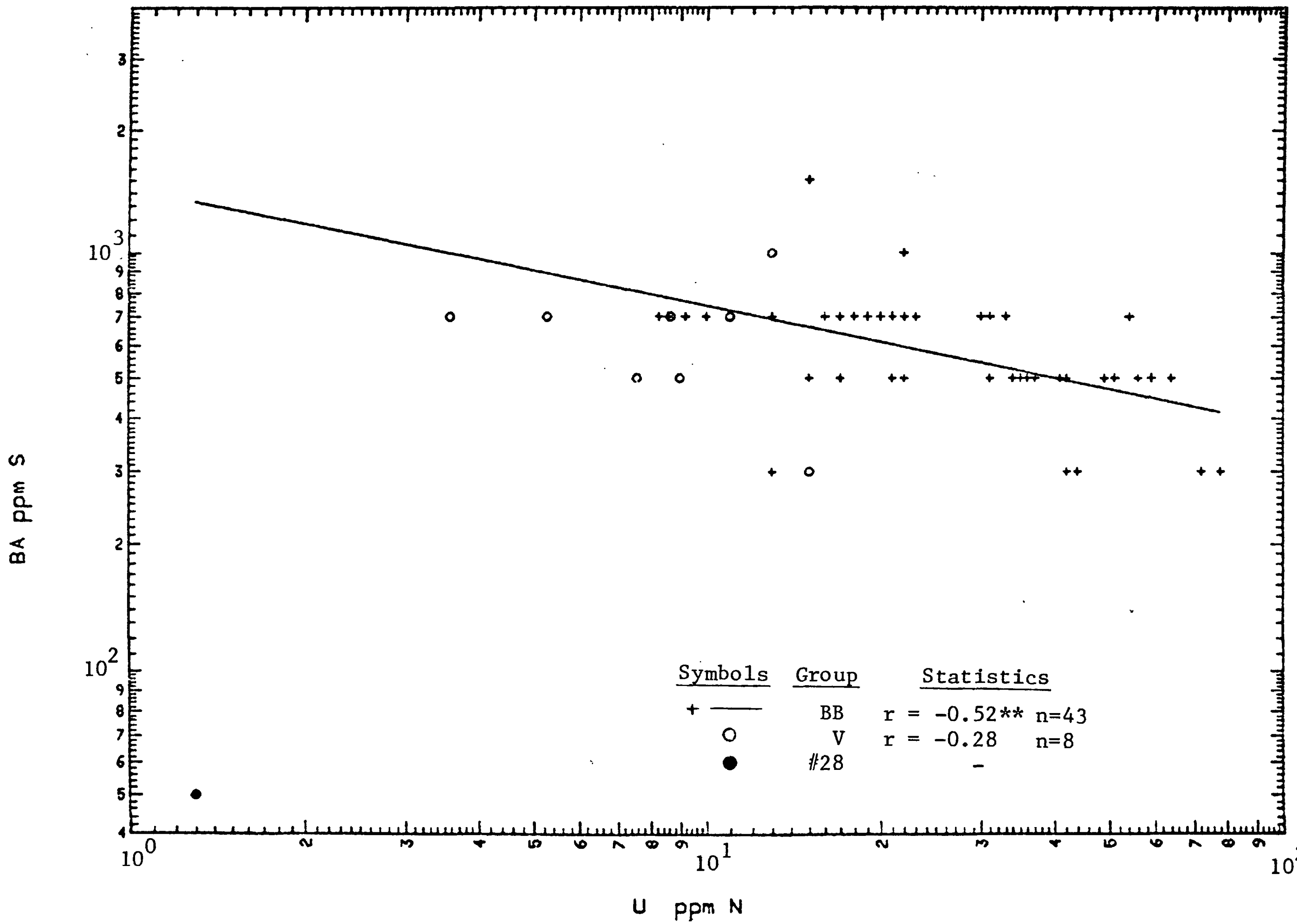

Figure 4-3.--Barium plotted versus U (fine fraction).

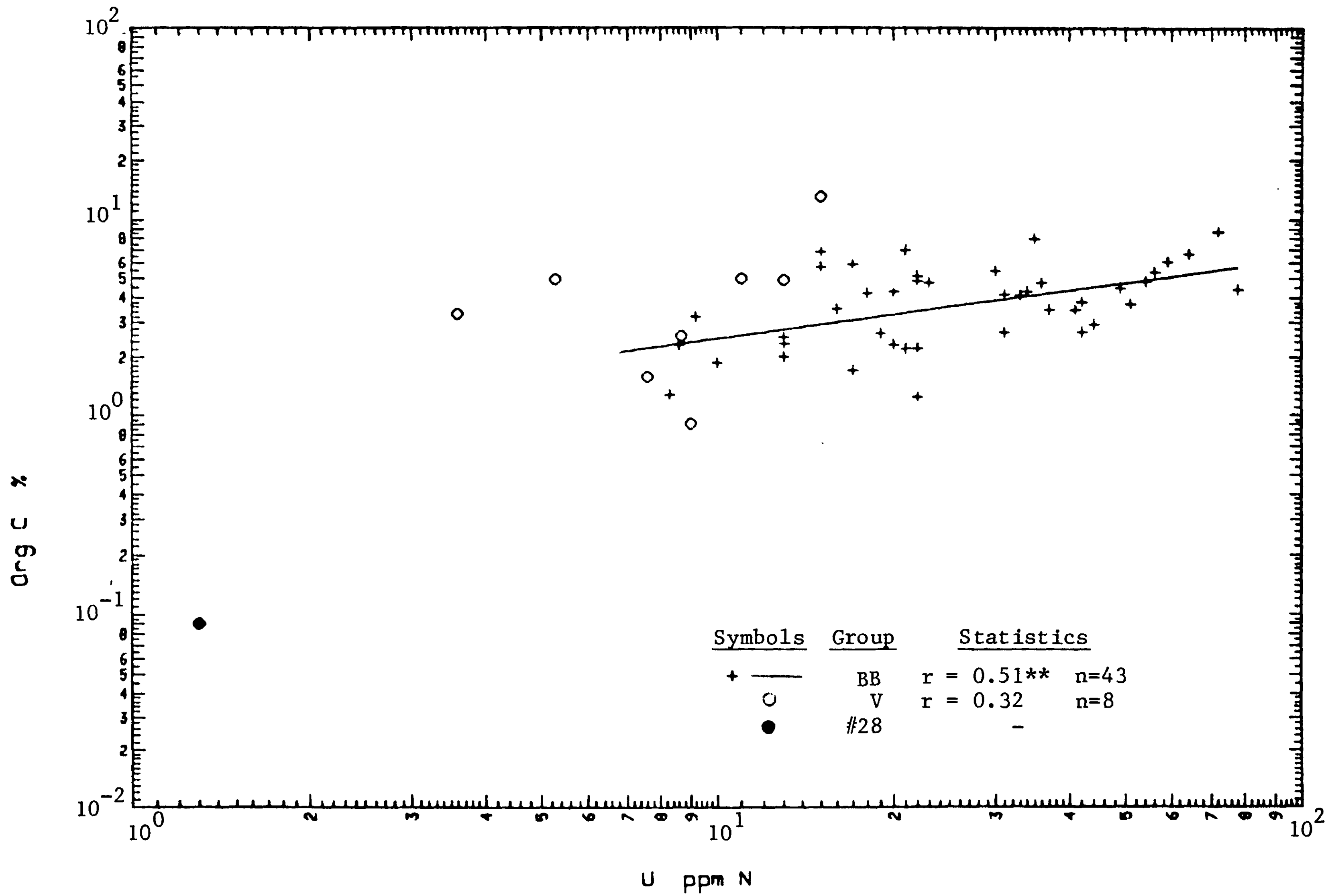

Figure 4-4.--Organic carbon plotted versus U (fine fraction).

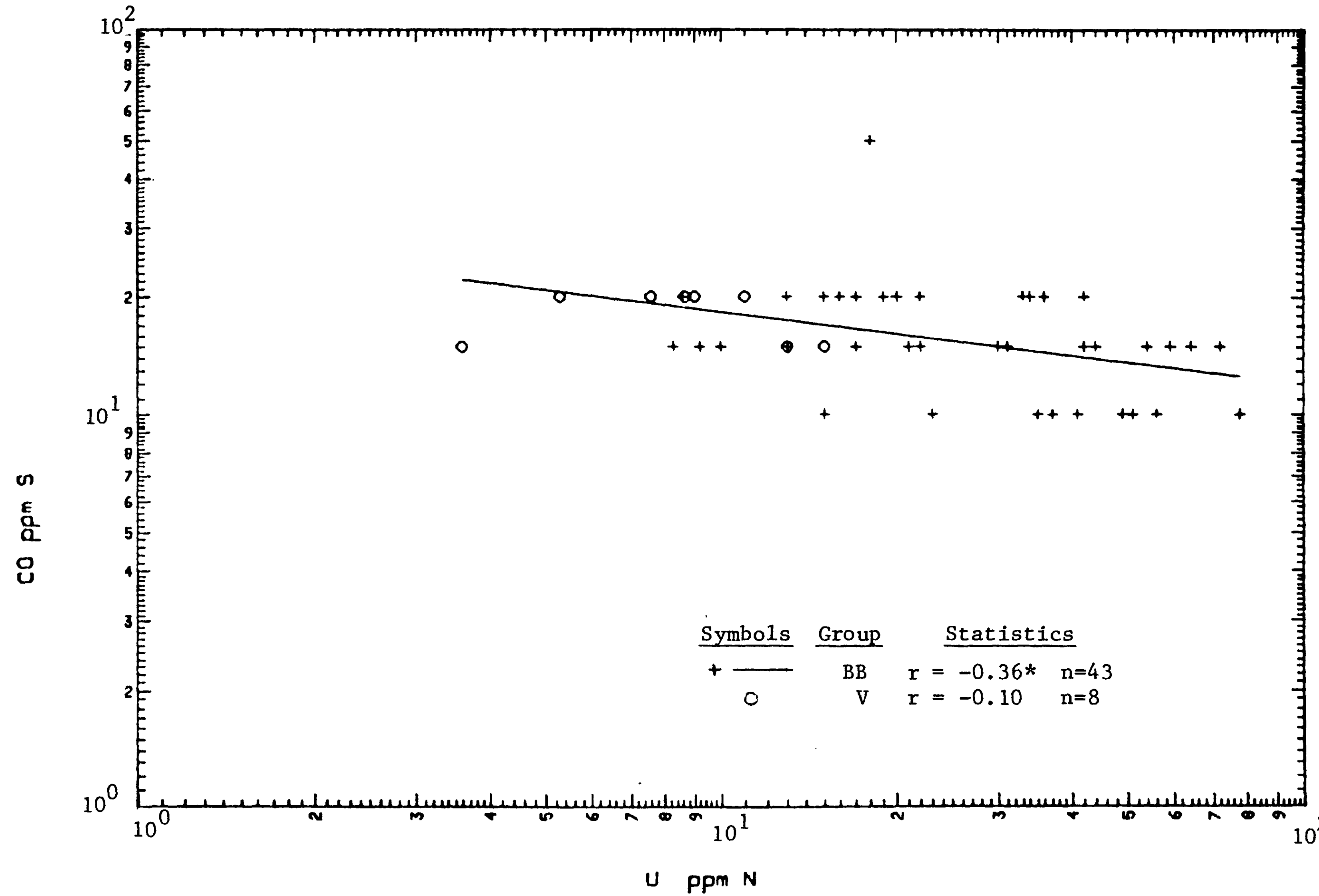

Figure 4-5.--Cobalt plotted versus U (fine fraction).

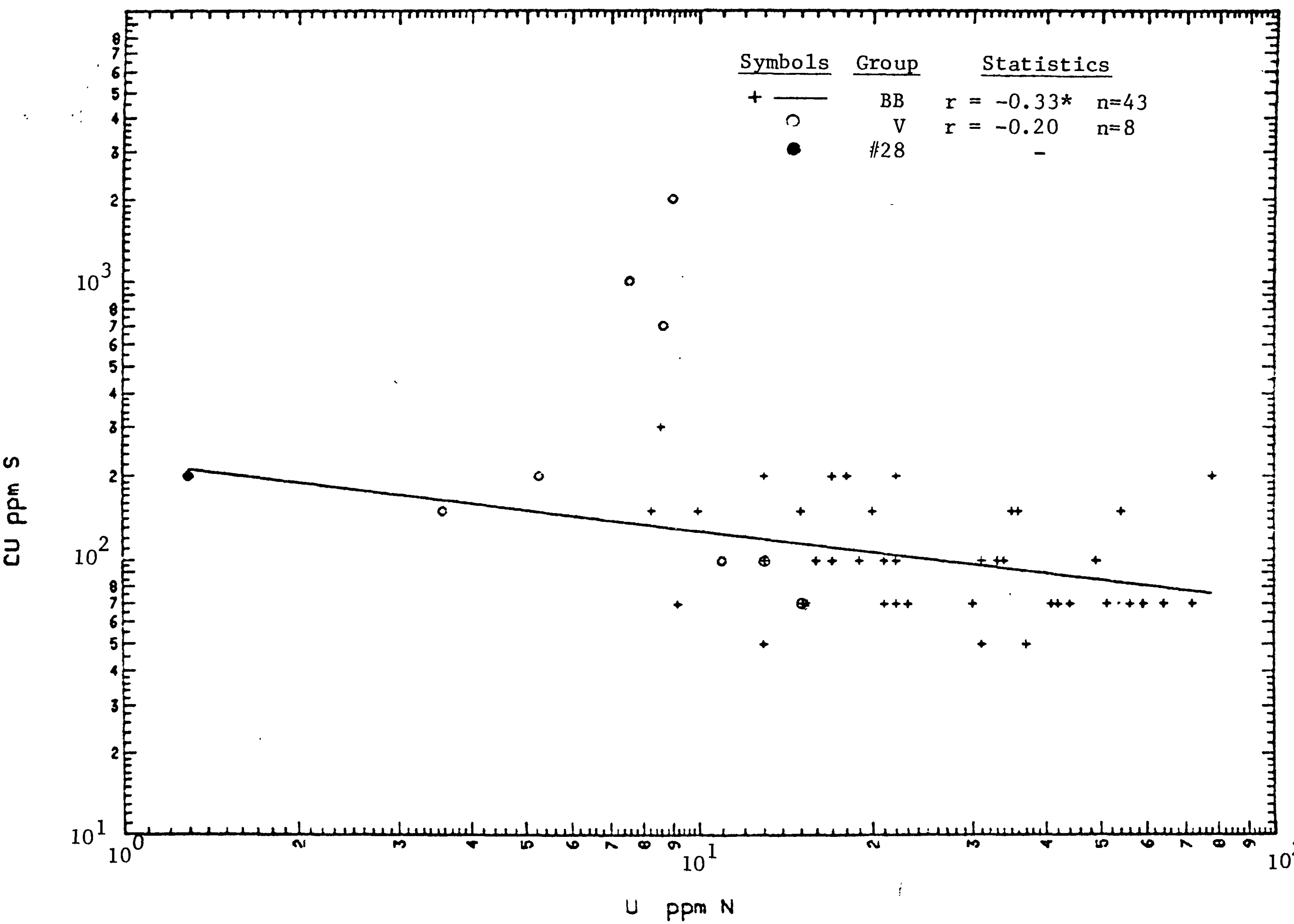

Figure 4-6.--Copper plotted versus U (fine fraction).

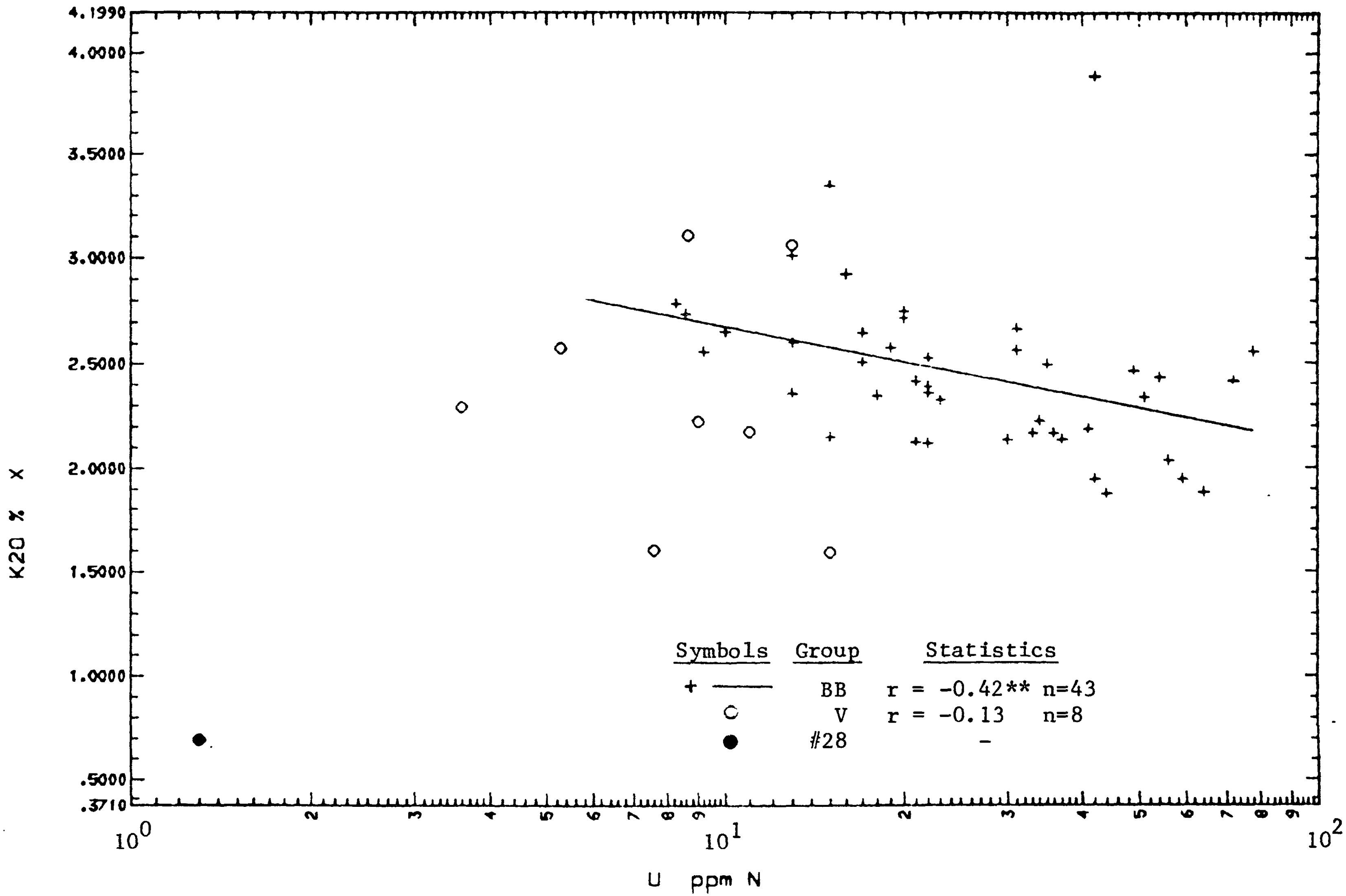

Figure 4-7.--K_2O plotted versus U (fine fraction).

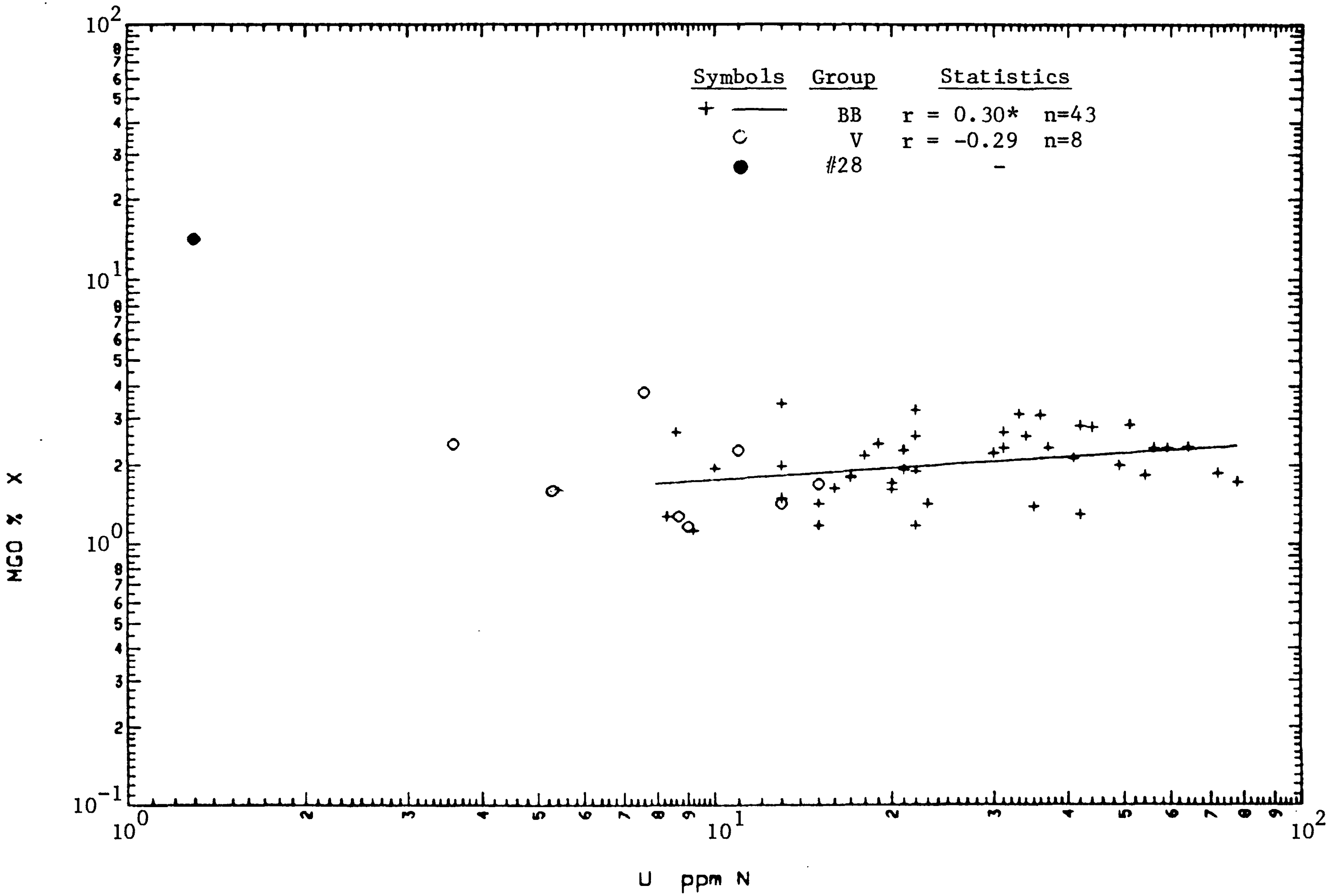

Figure 4-8.--MgO plotted versus U (fine fraction).

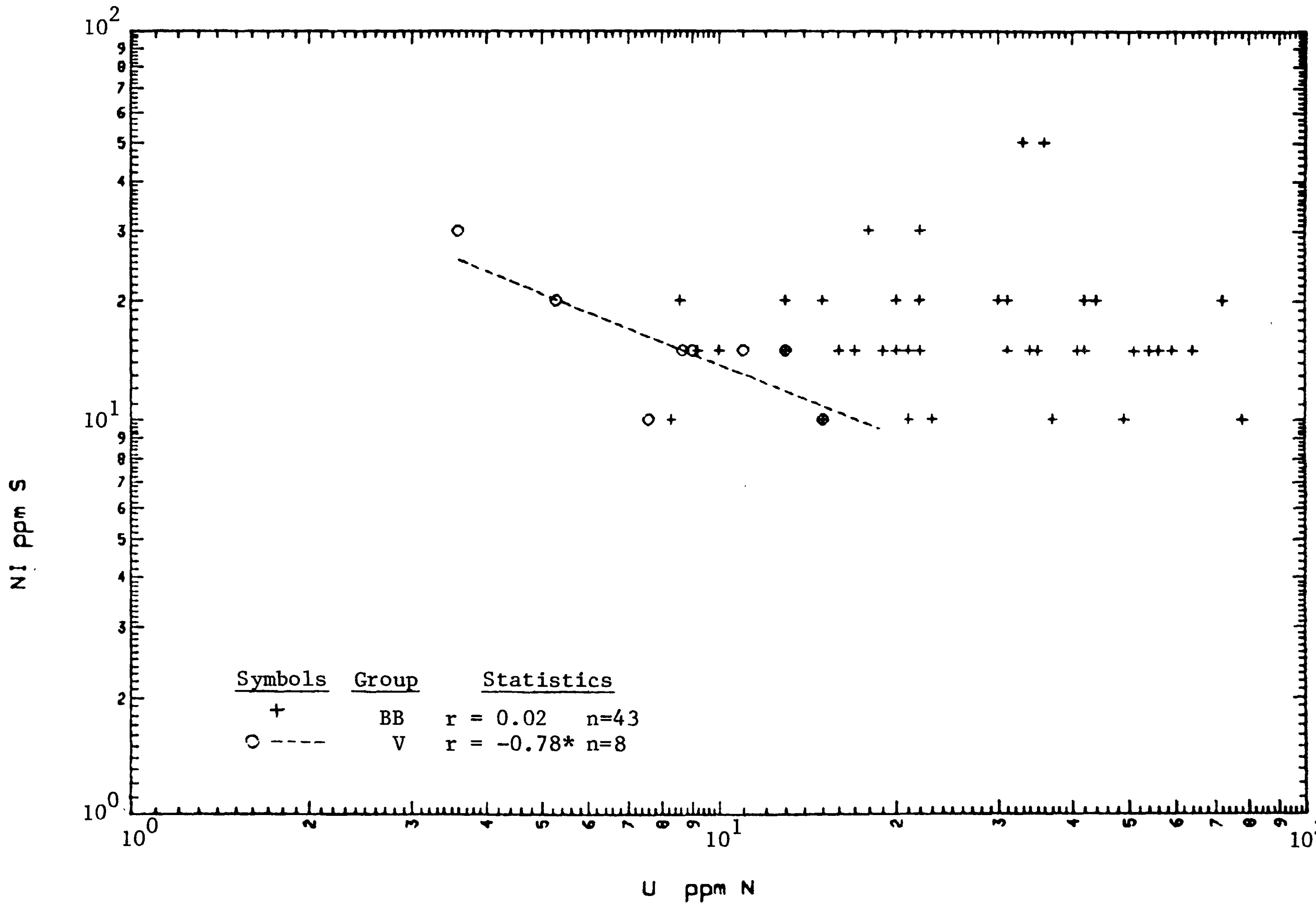

Figure 4-9.--Nickel plotted versus U (fine fraction).

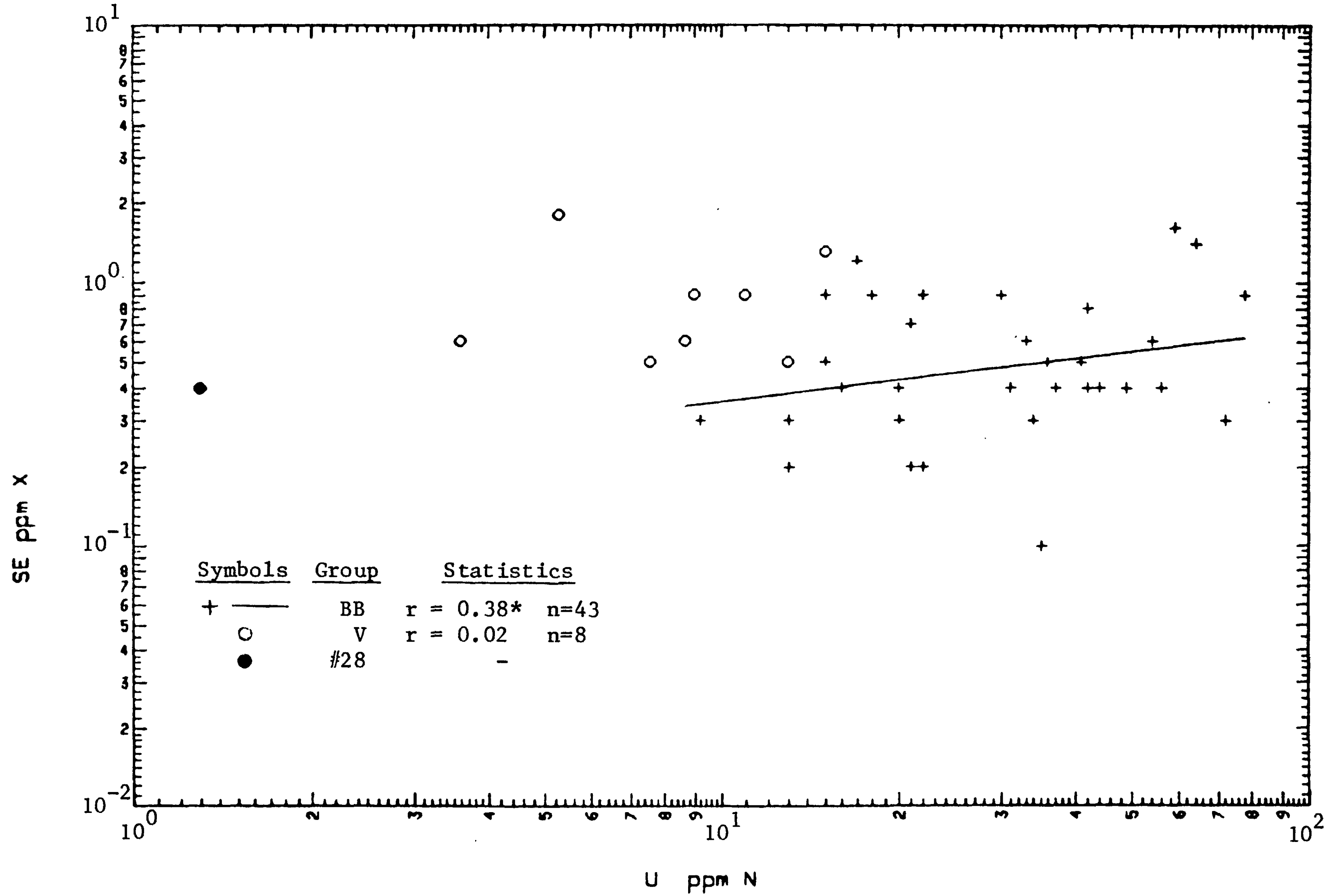

Figure 4-10.--Selenium plotted versus U (fine fraction).

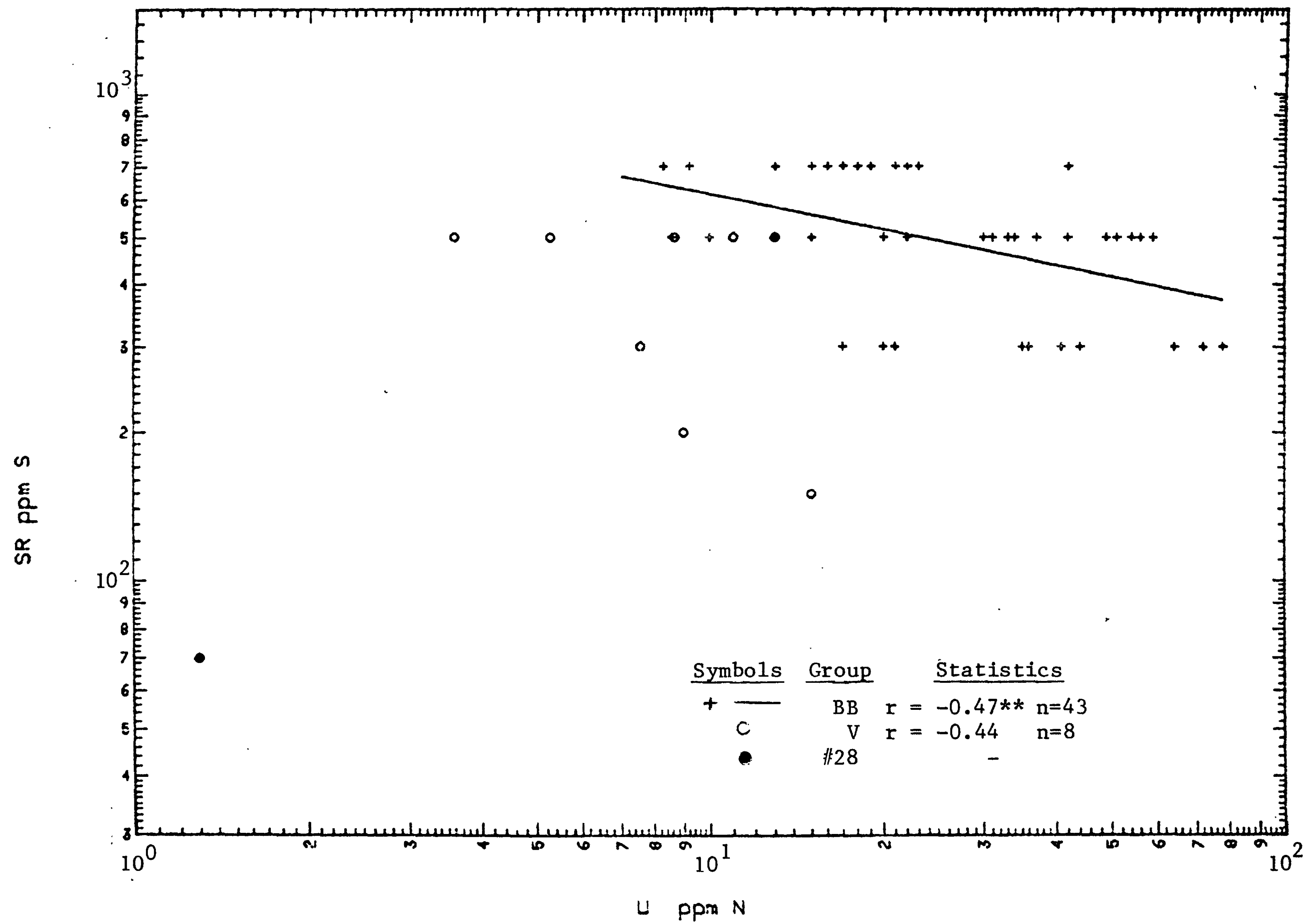

Figure 4-11.--Strontium plotted versus U (fine fraction).

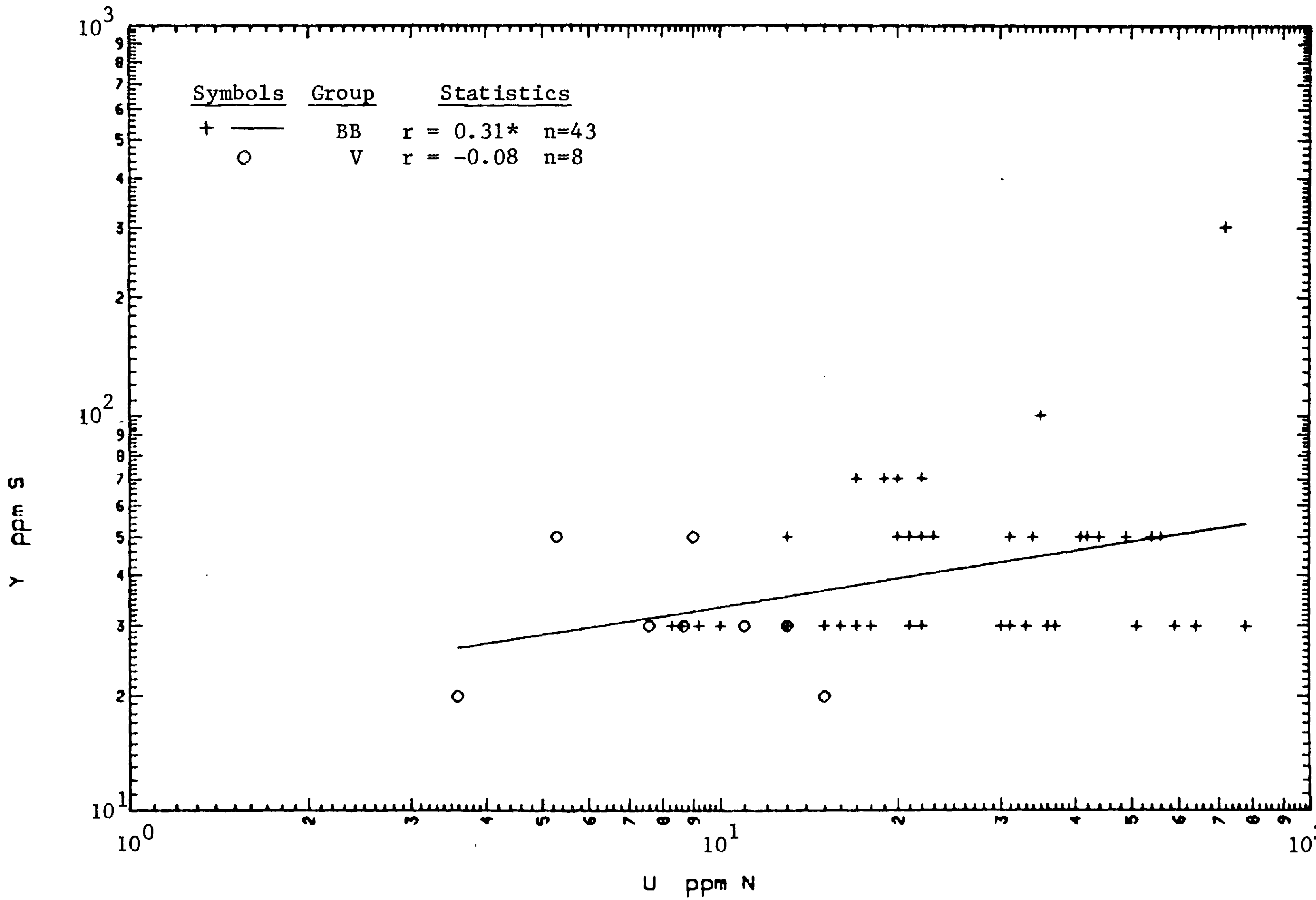

Figure 4-12.--Yttrium plotted versus U (fine fraction).

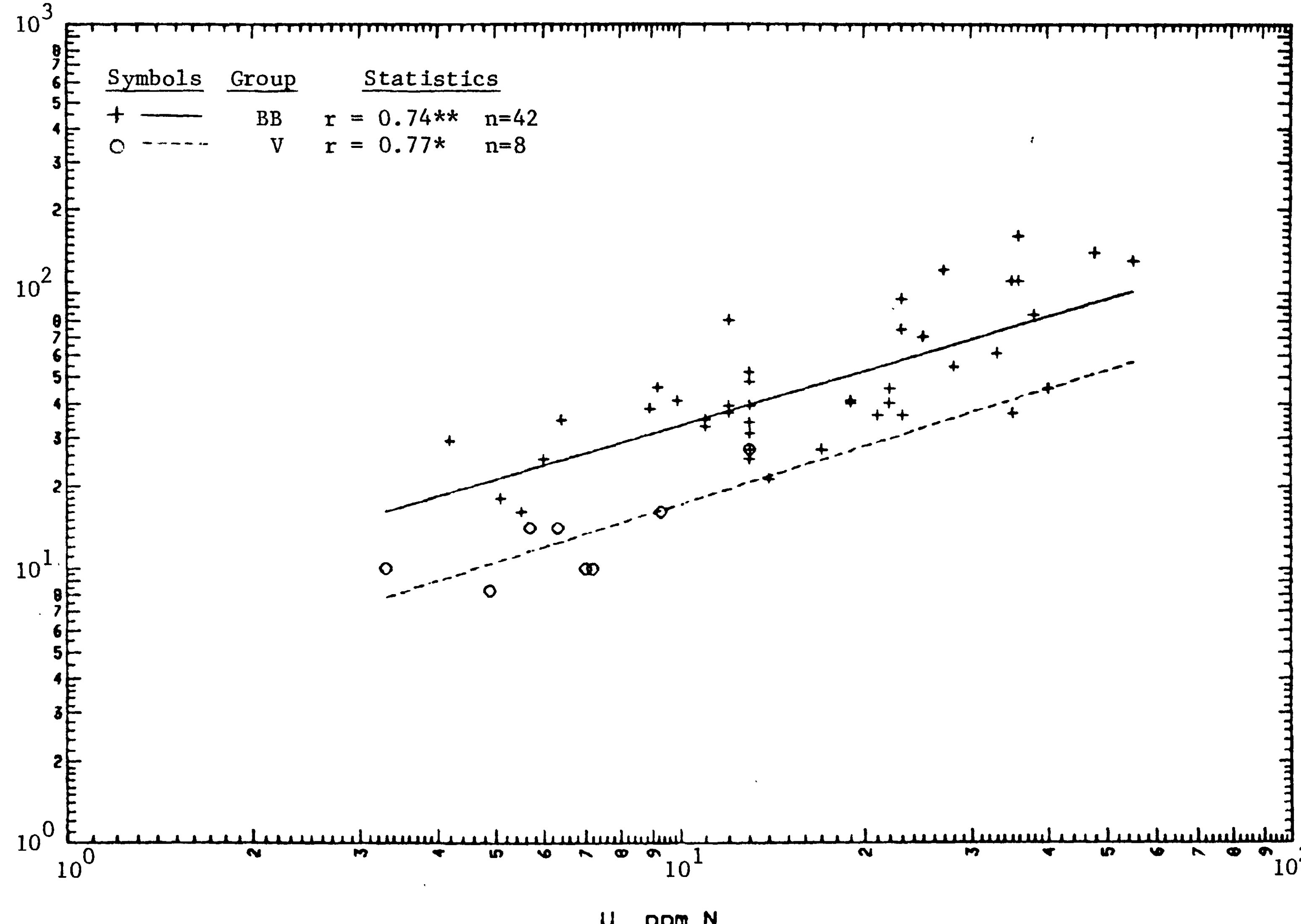

Figure 5-1.--Thorium plotted versus U (coarse fraction). The Boulder batholith sample group (BB), the group draining volcanic terrane (V) and sample #28 are plotted with different symbols. The number of pairs, n, and the correlation coefficient, r, are listed separately for each group. One or two asterisks by an r value means the correlation is statistically significant to the 95 or 99% confidence level, respectively. Regression lines, where plotted, correspond only to significant r's. Refer to table 2 for explanation of codes used in axis labels.

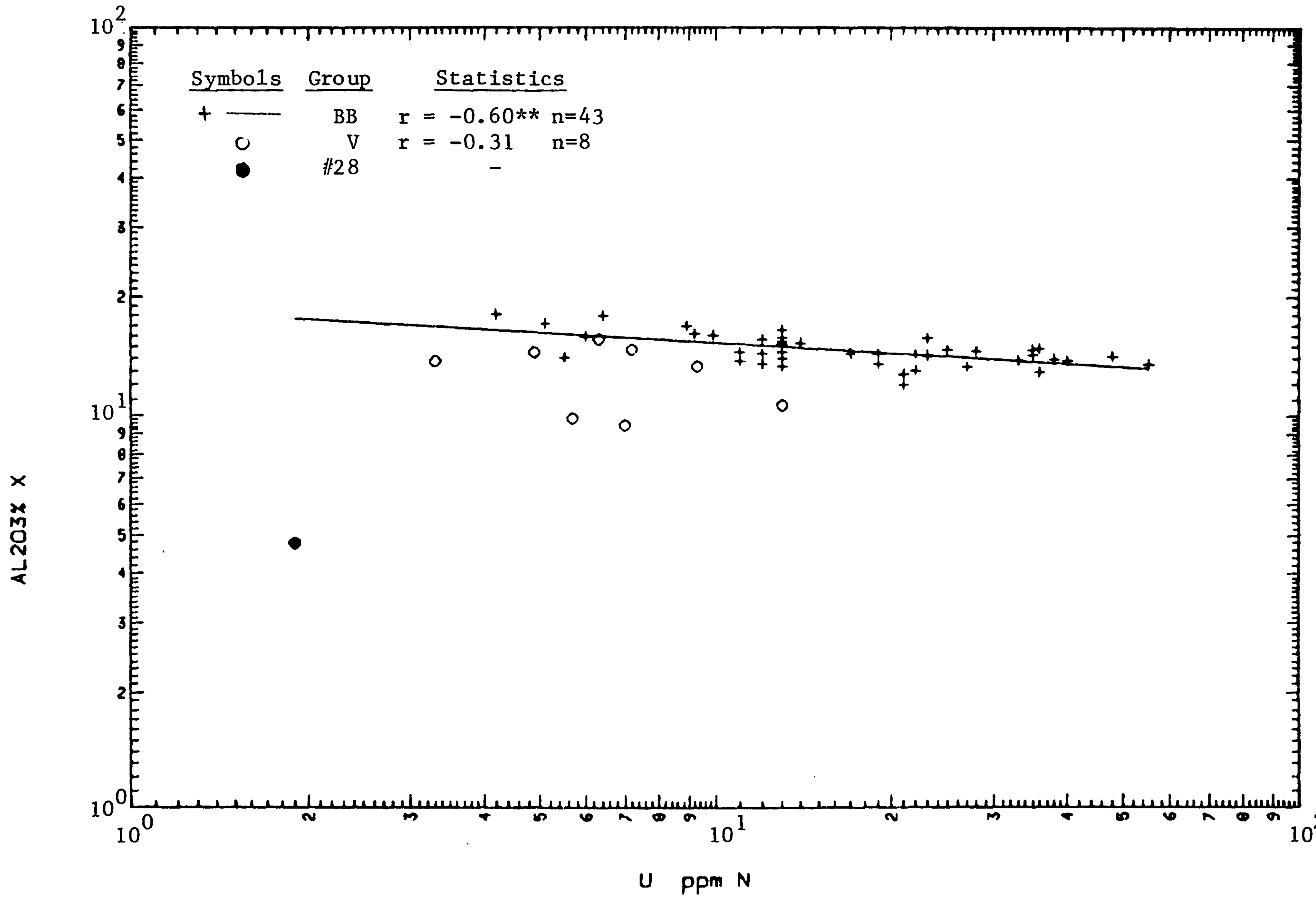

Figure 5-2.--Al_2O_3 plotted versus U (coarse fraction).

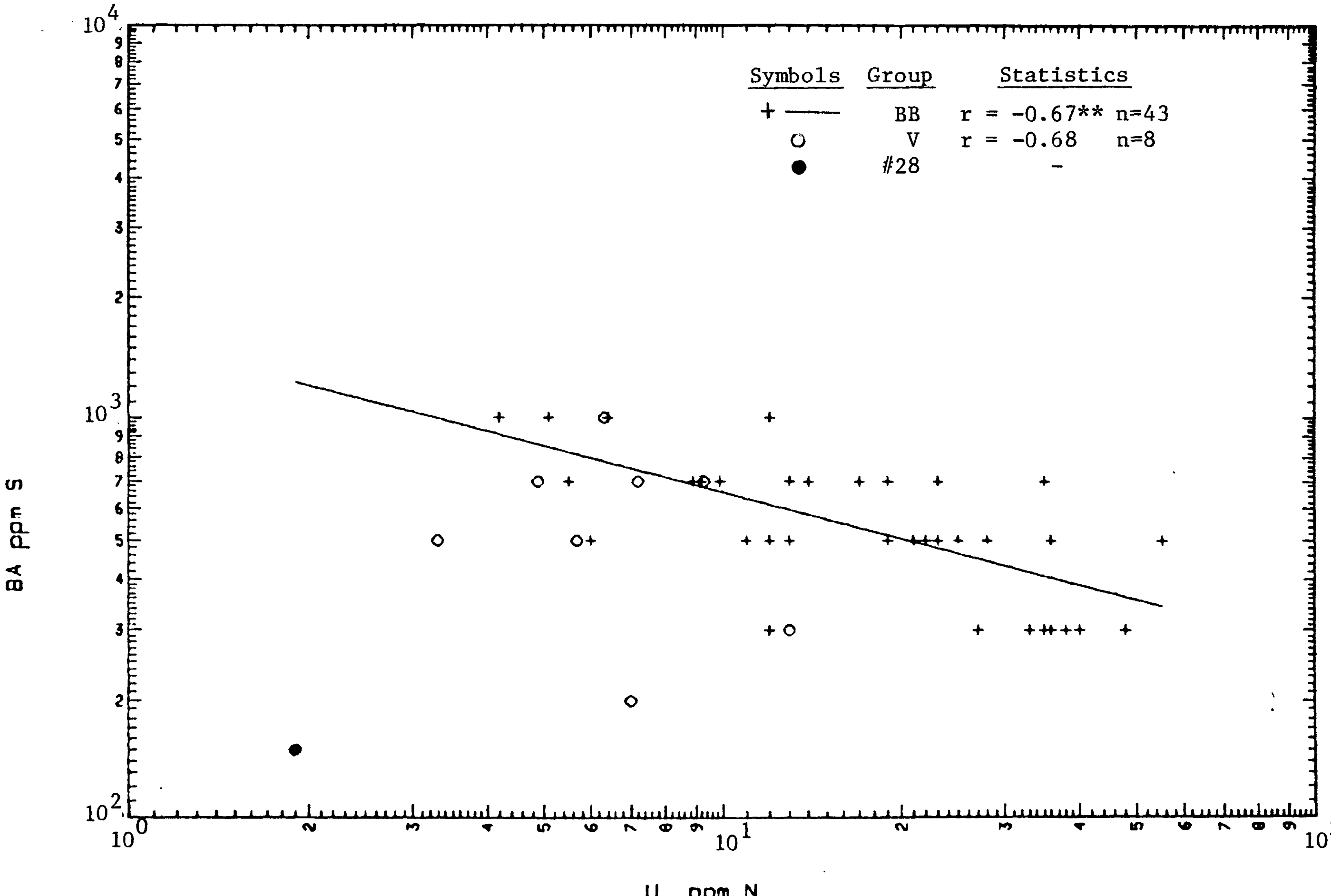

Figure 5-3.--Barium plotted versus U (coarse fraction).

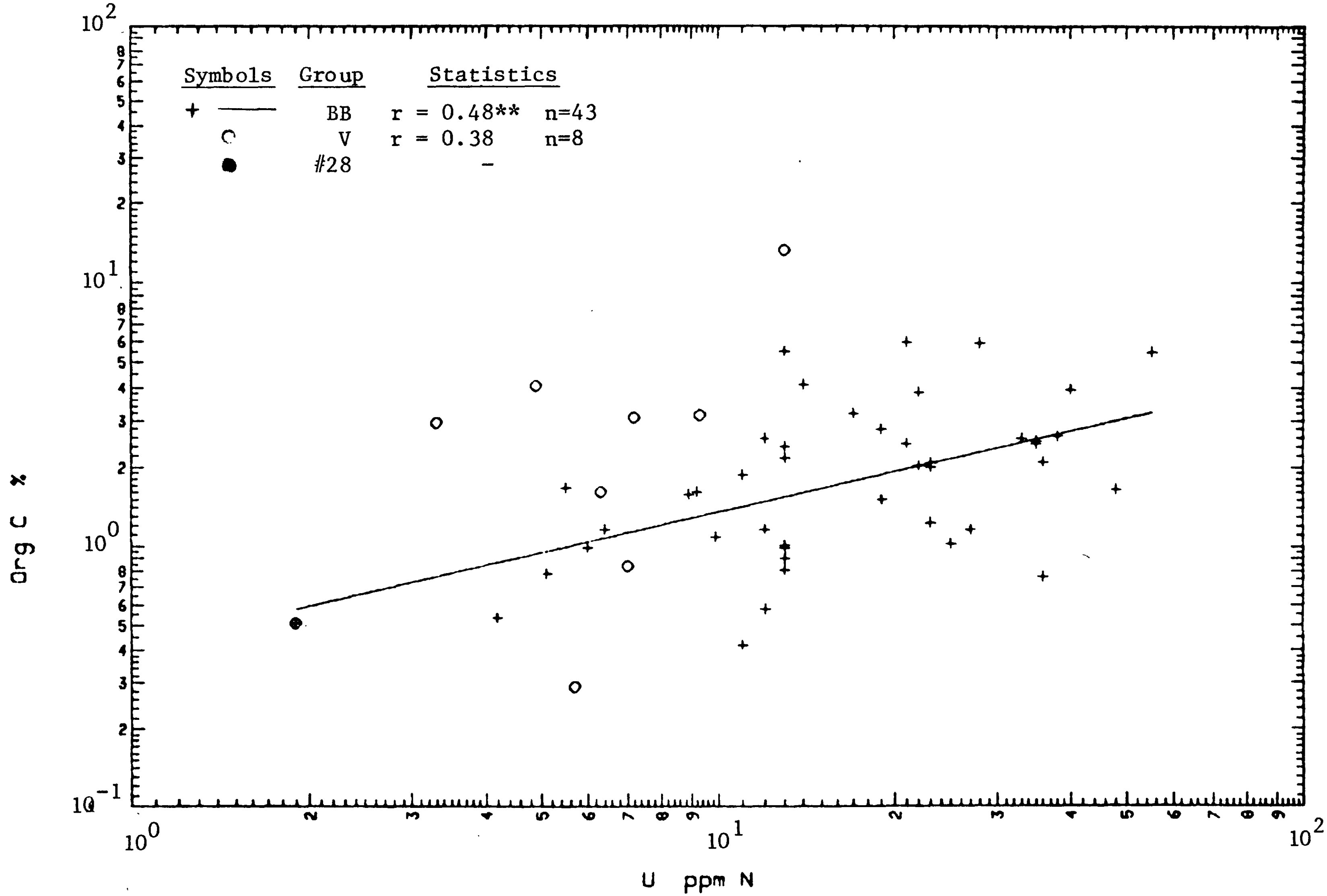

Figure 5-4.--Organic carbon plotted versus U (coarse fraction).

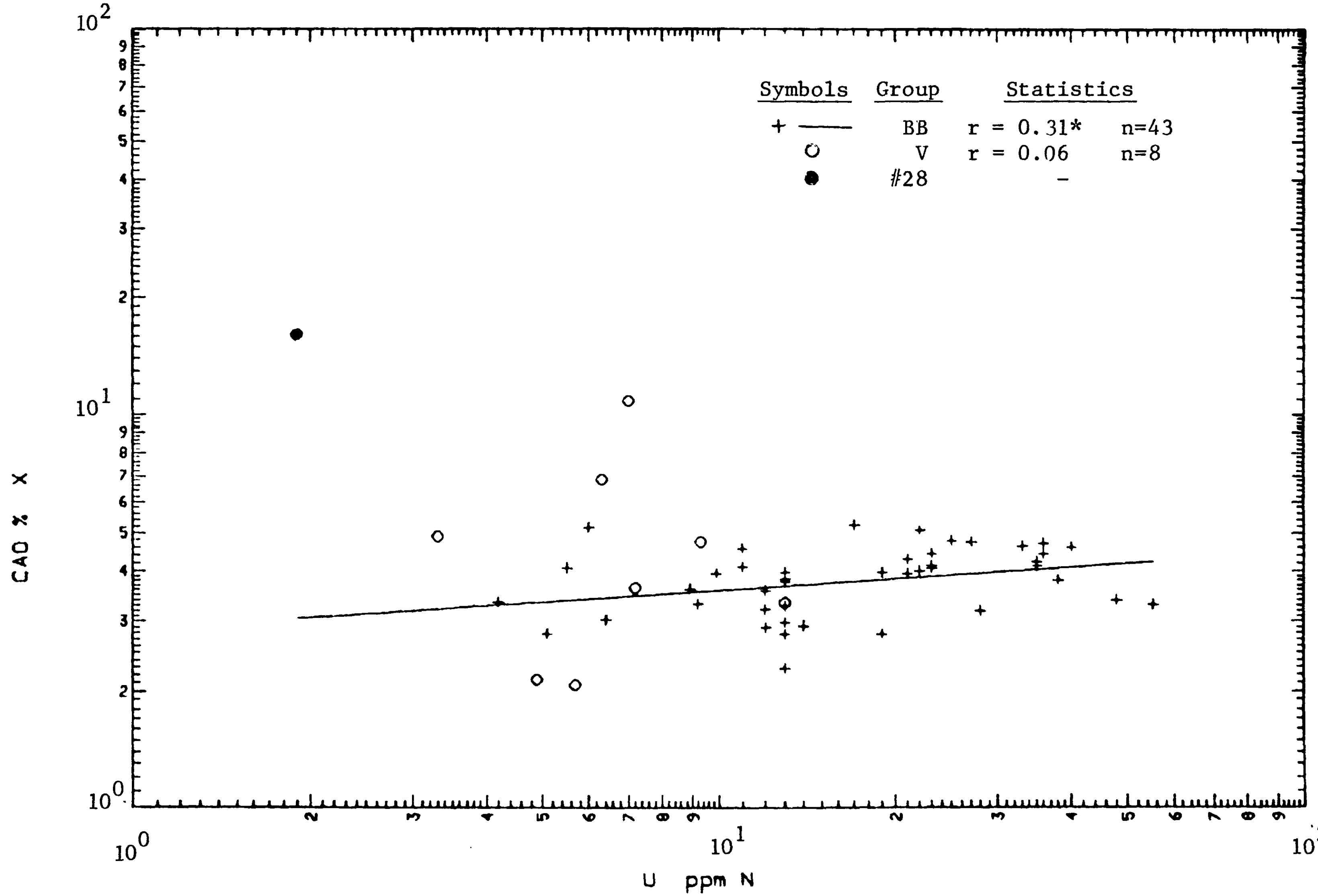

Figure 5-5.--CaO plotted versus U (coarse fraction).

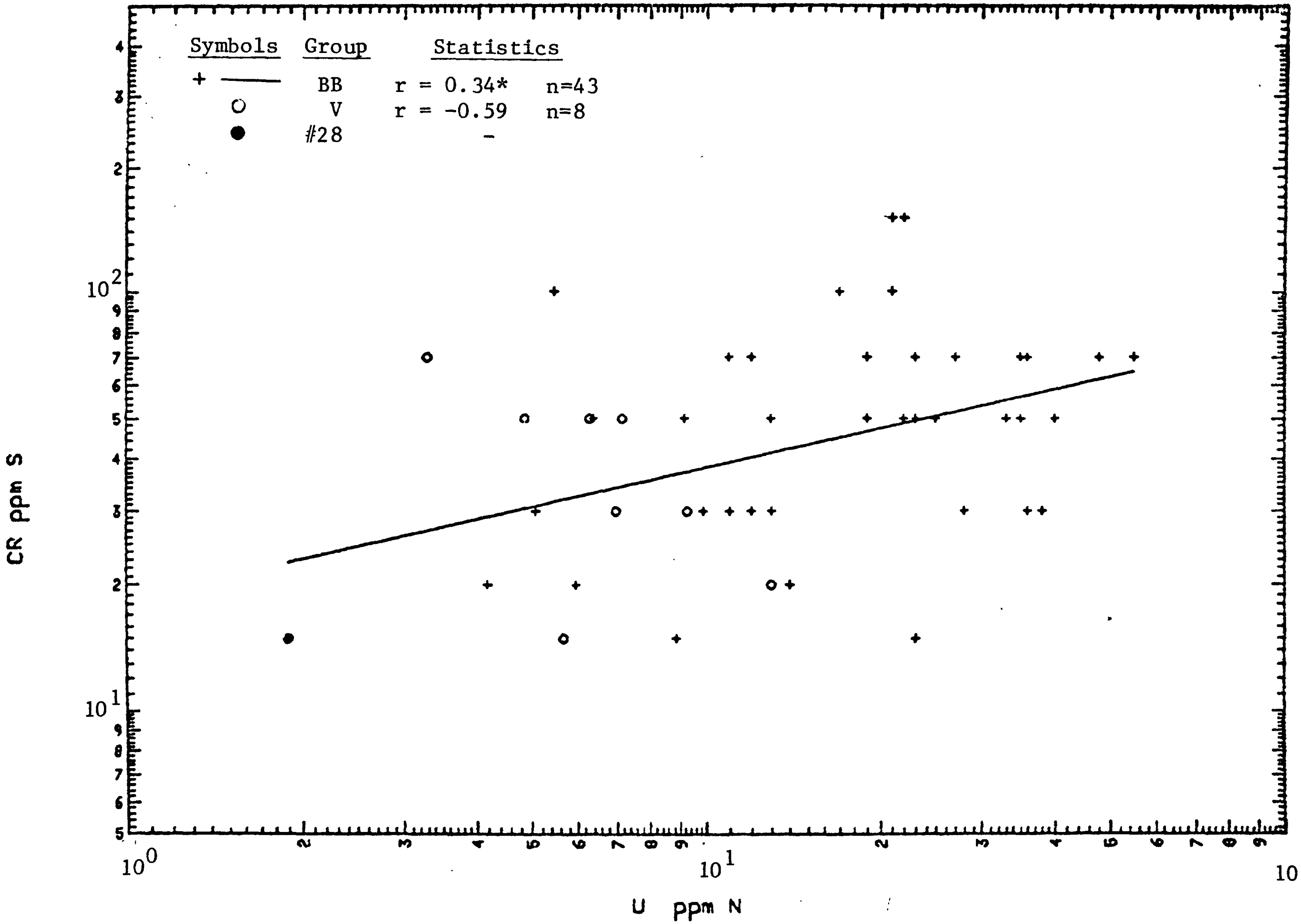

Figure 5-6.--Chromium plotted versus U (coarse fraction).

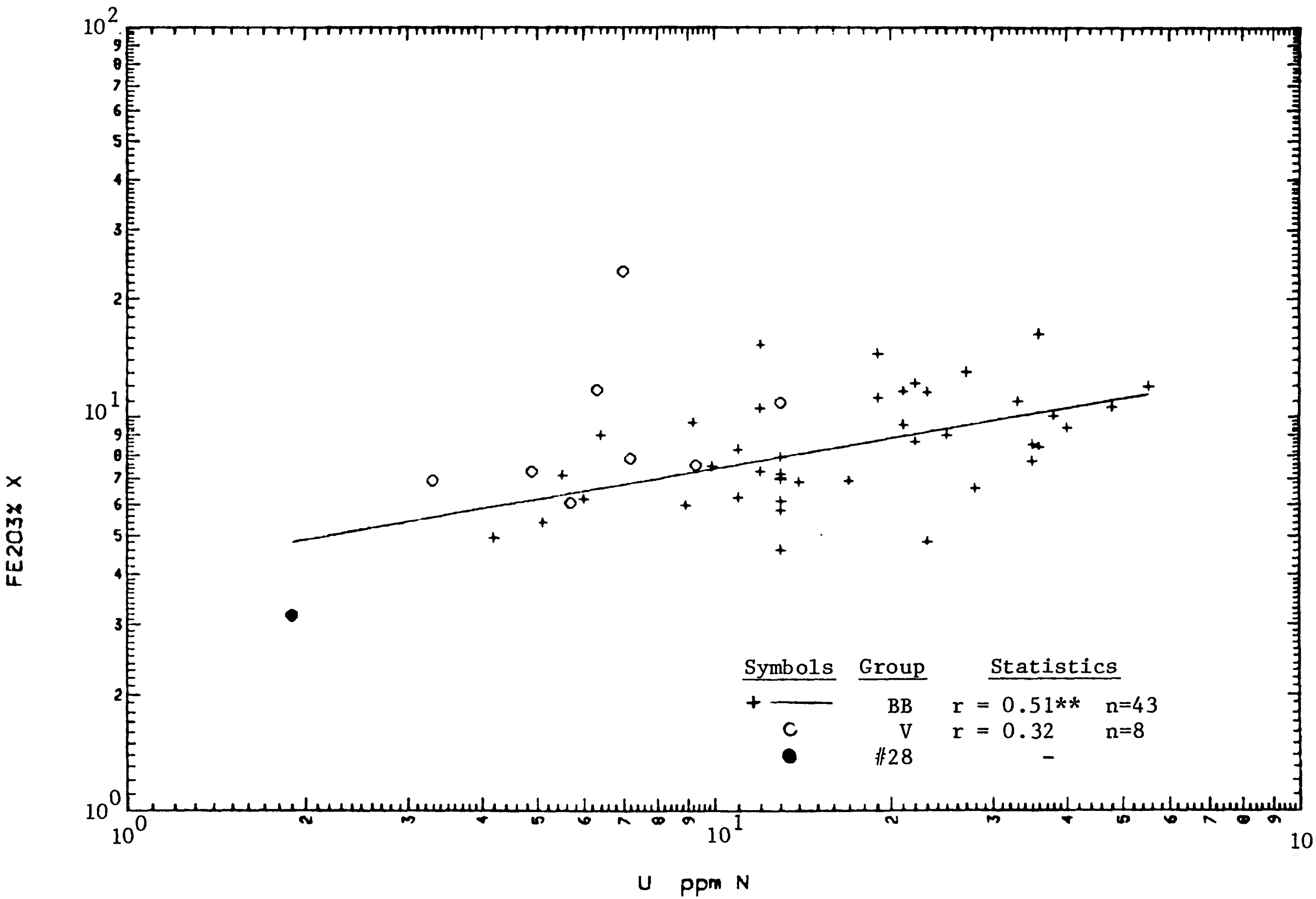

Figure 5-7.--Fe_2O_3 plotted versus U (coarse fraction).

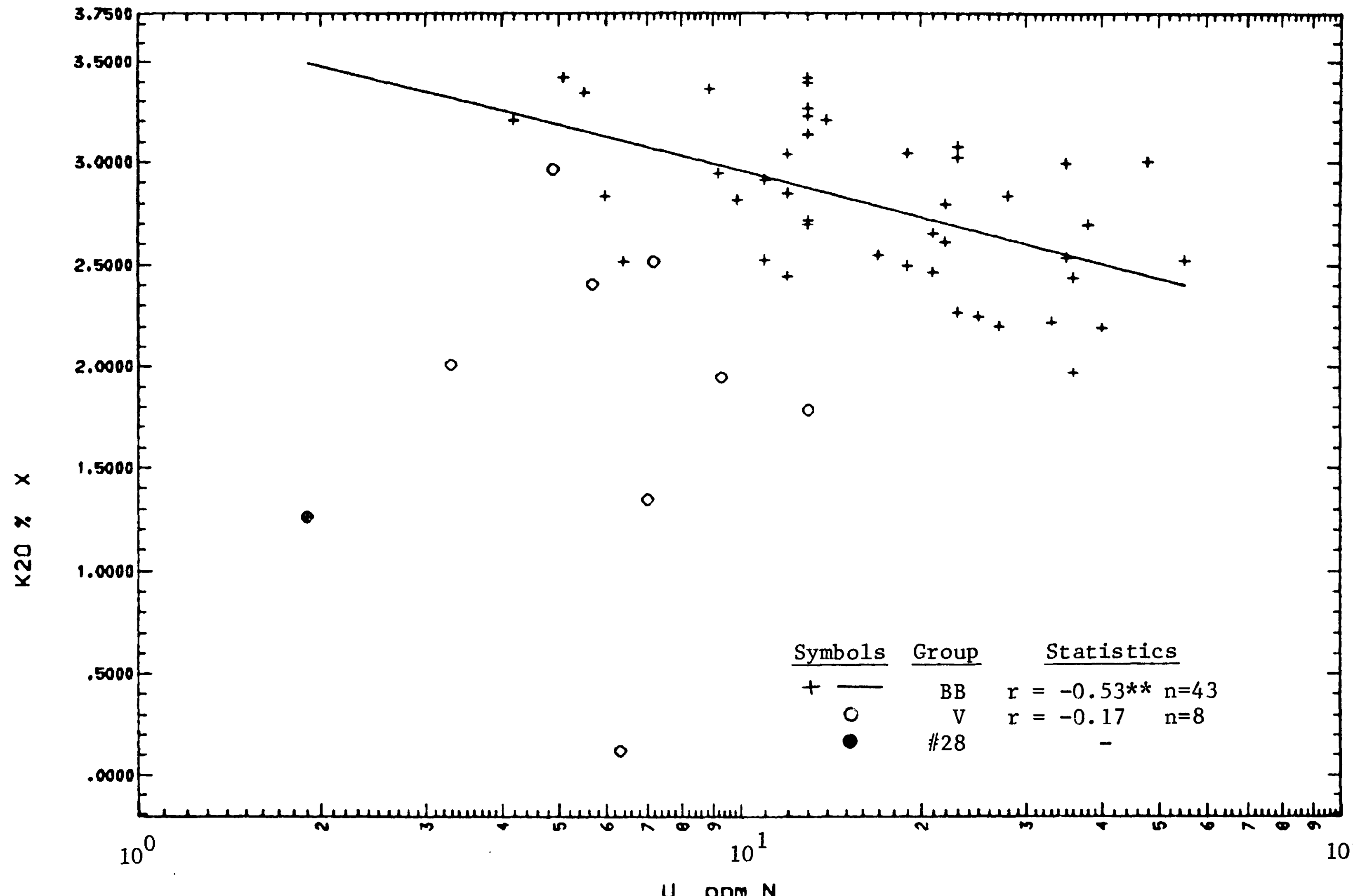

Figure 5-8.--K_2O plotted versus U (coarse fraction).

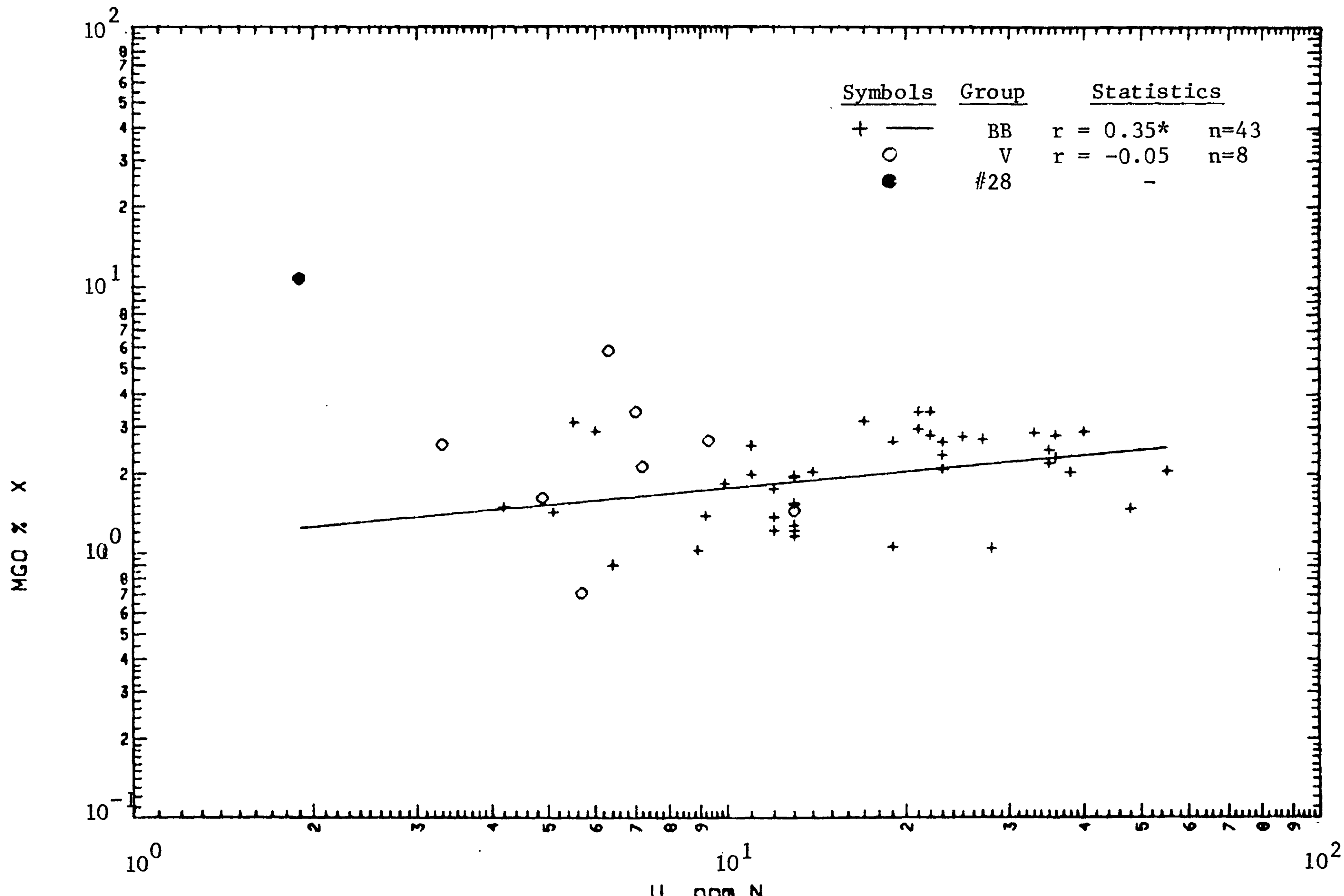

Figure 5-9.--MgO plotted versus U (coarse fraction).

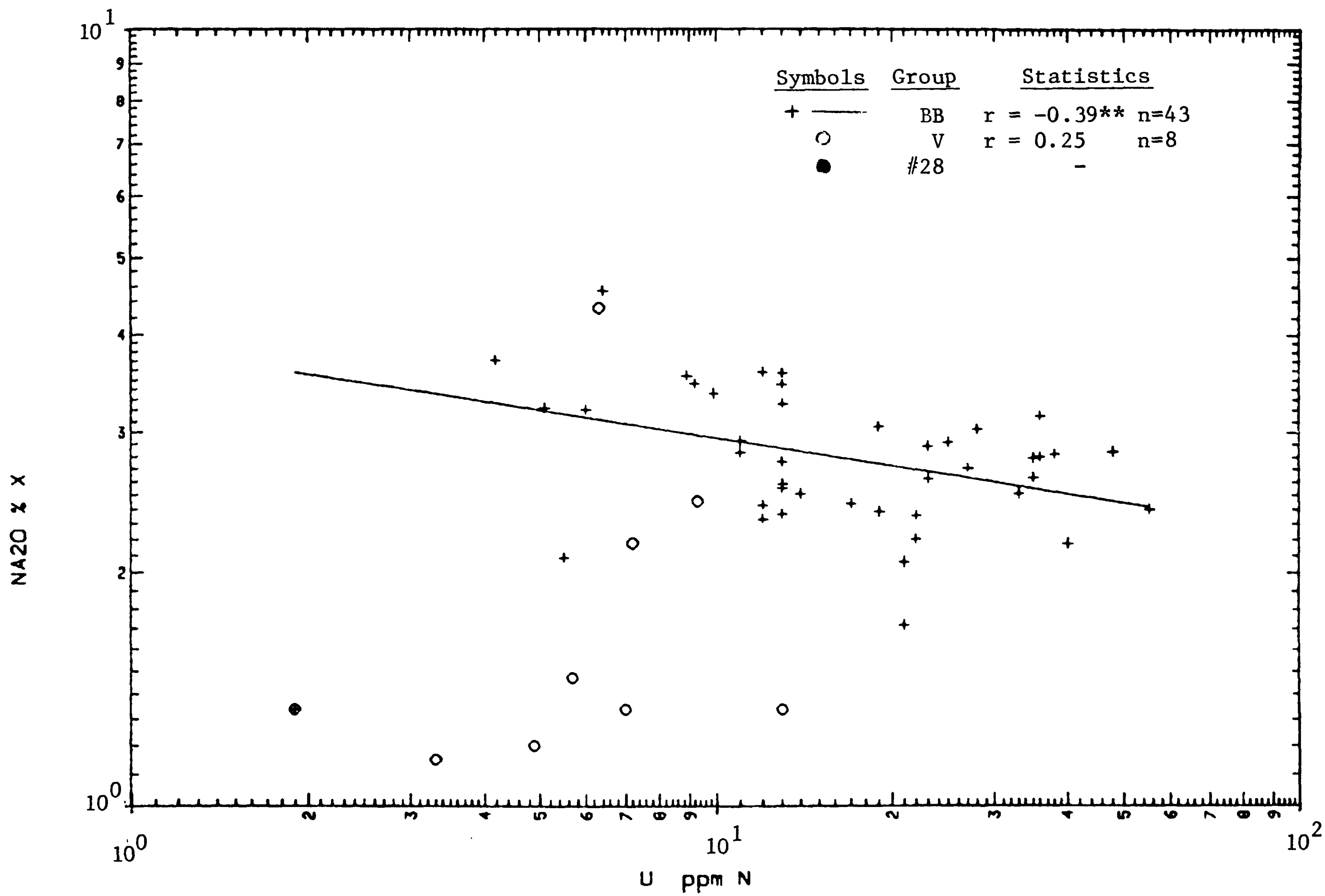

Figure 5-10.--Na_2O plotted versus U (coarse fraction).

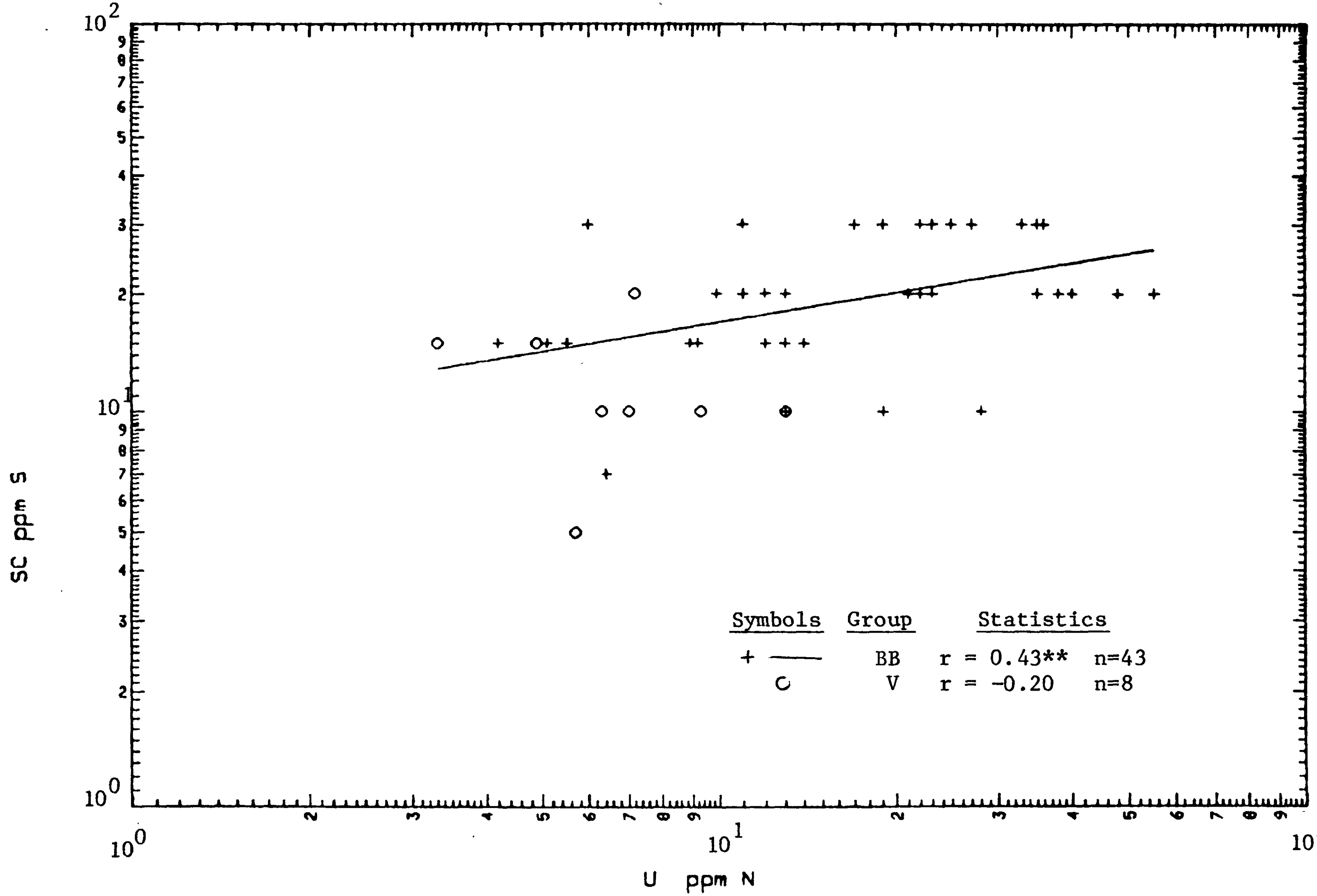

Figure 5-11.--Scandium plotted versus U (coarse fraction).

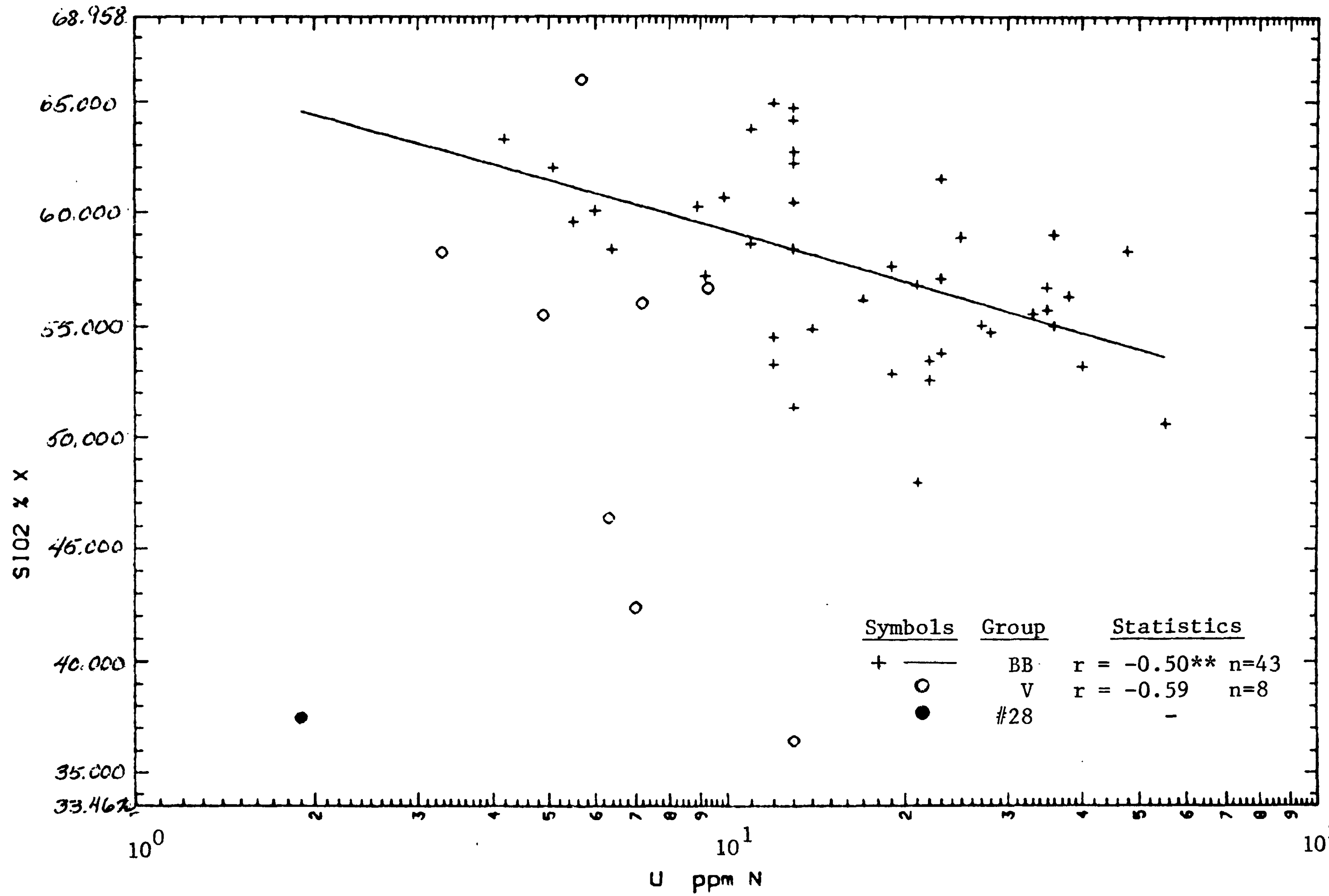

Figure 5-12.--SiO_2 plotted versus U (coarse fraction).

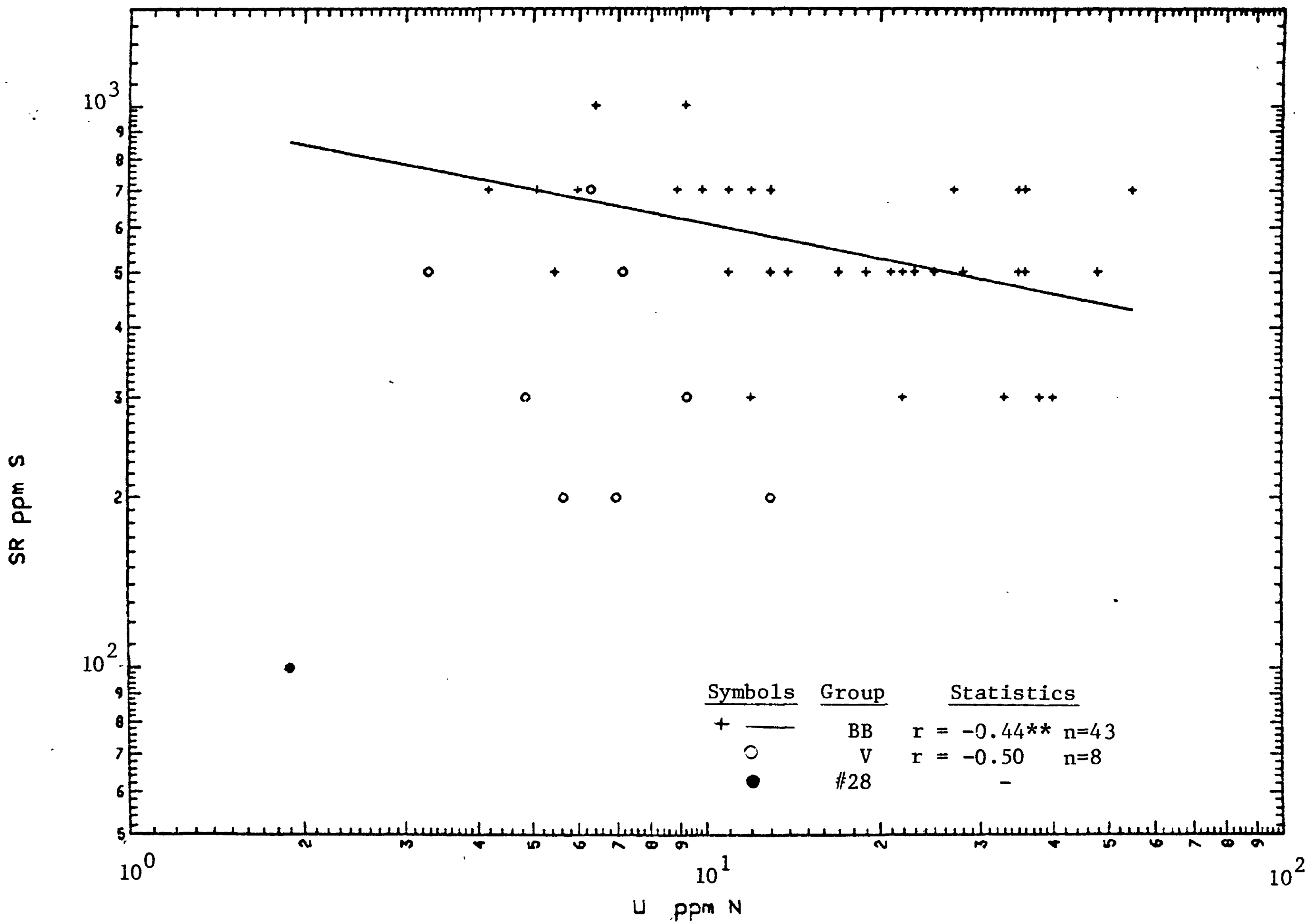

Figure 5-13.--Strontium plotted versus U (coarse fraction).

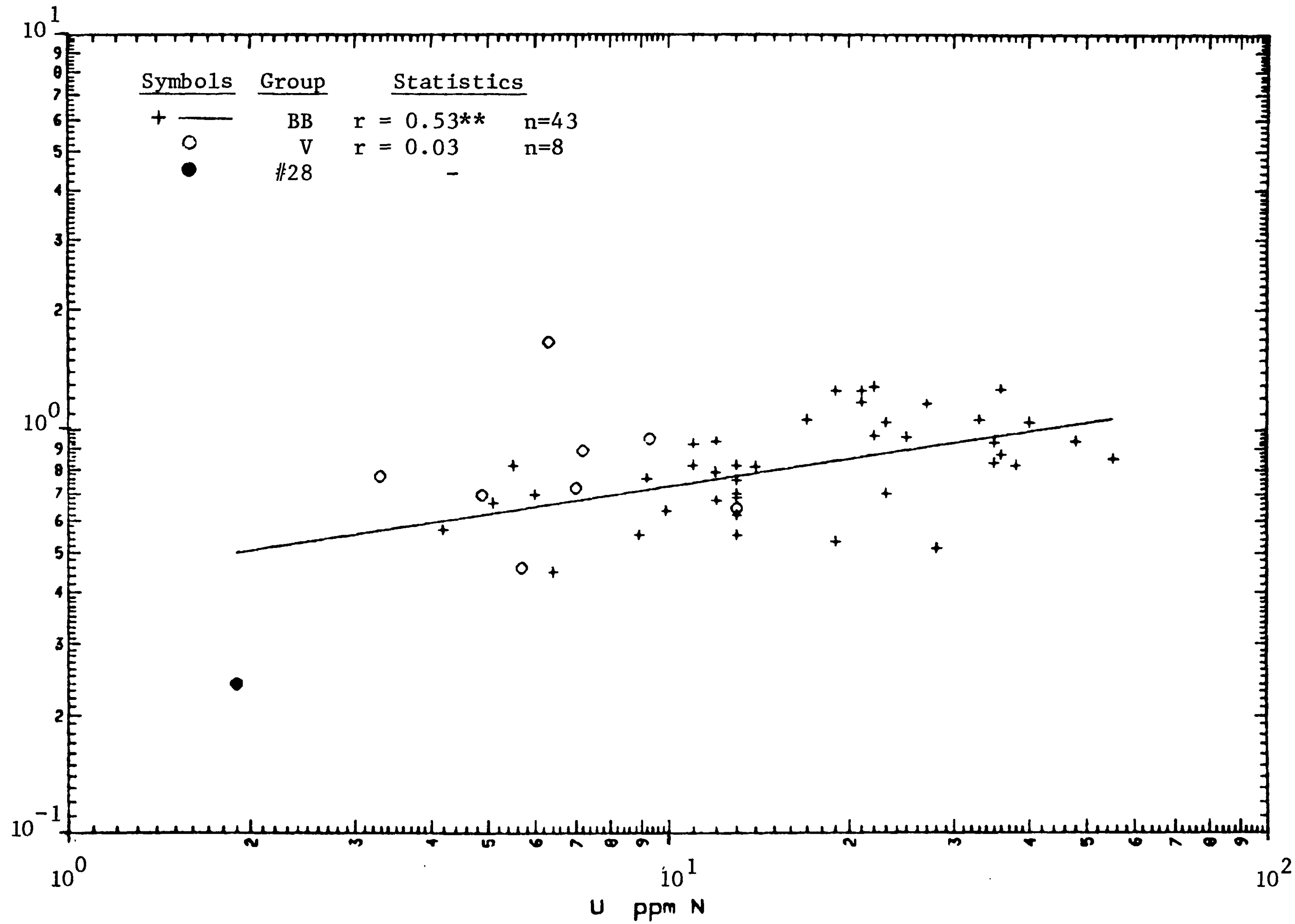

Figure 5-14.--TiO_2 plotted versus U (coarse fraction).

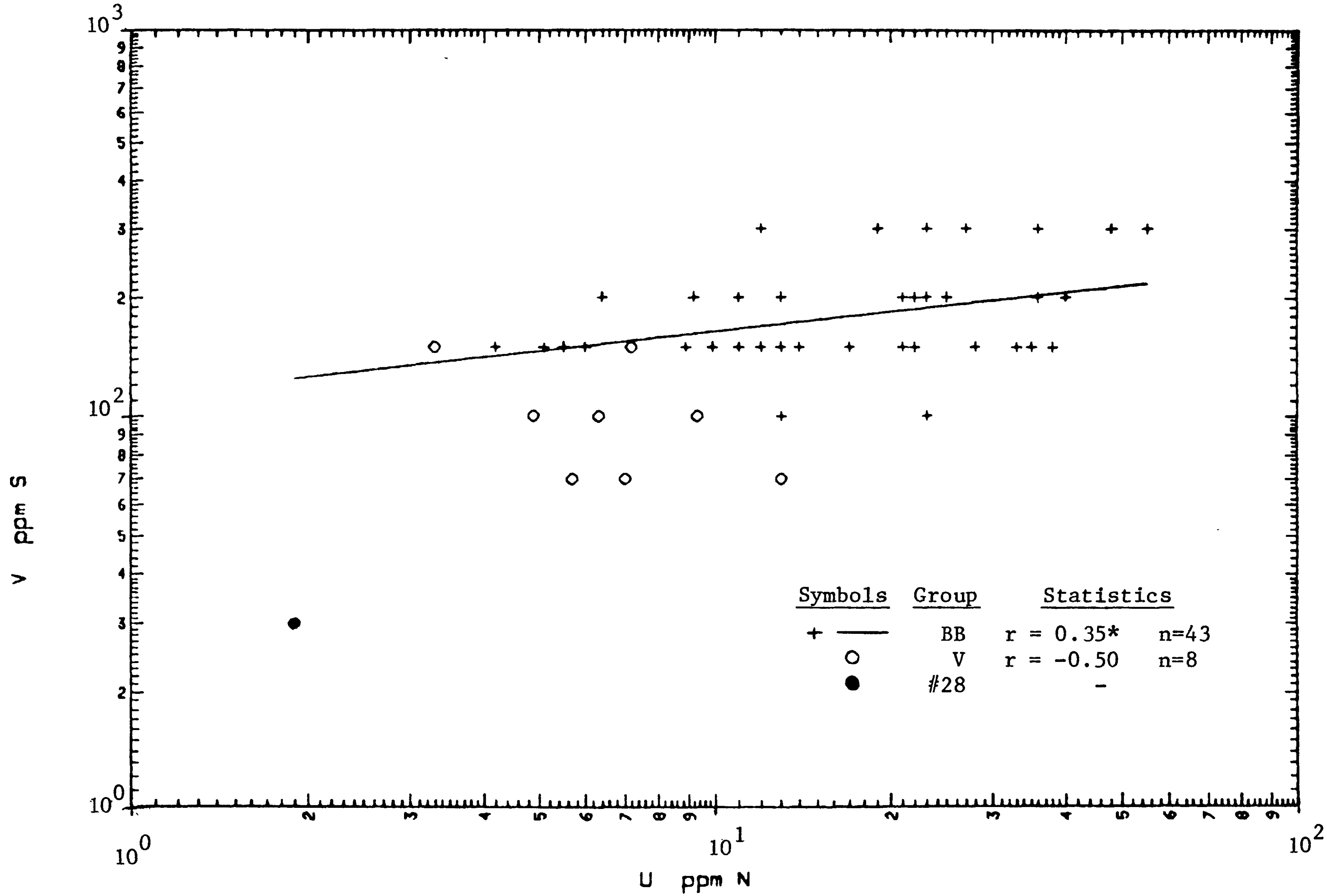

Figure 5-15.--Vanadium plotted versus U (coarse fraction).

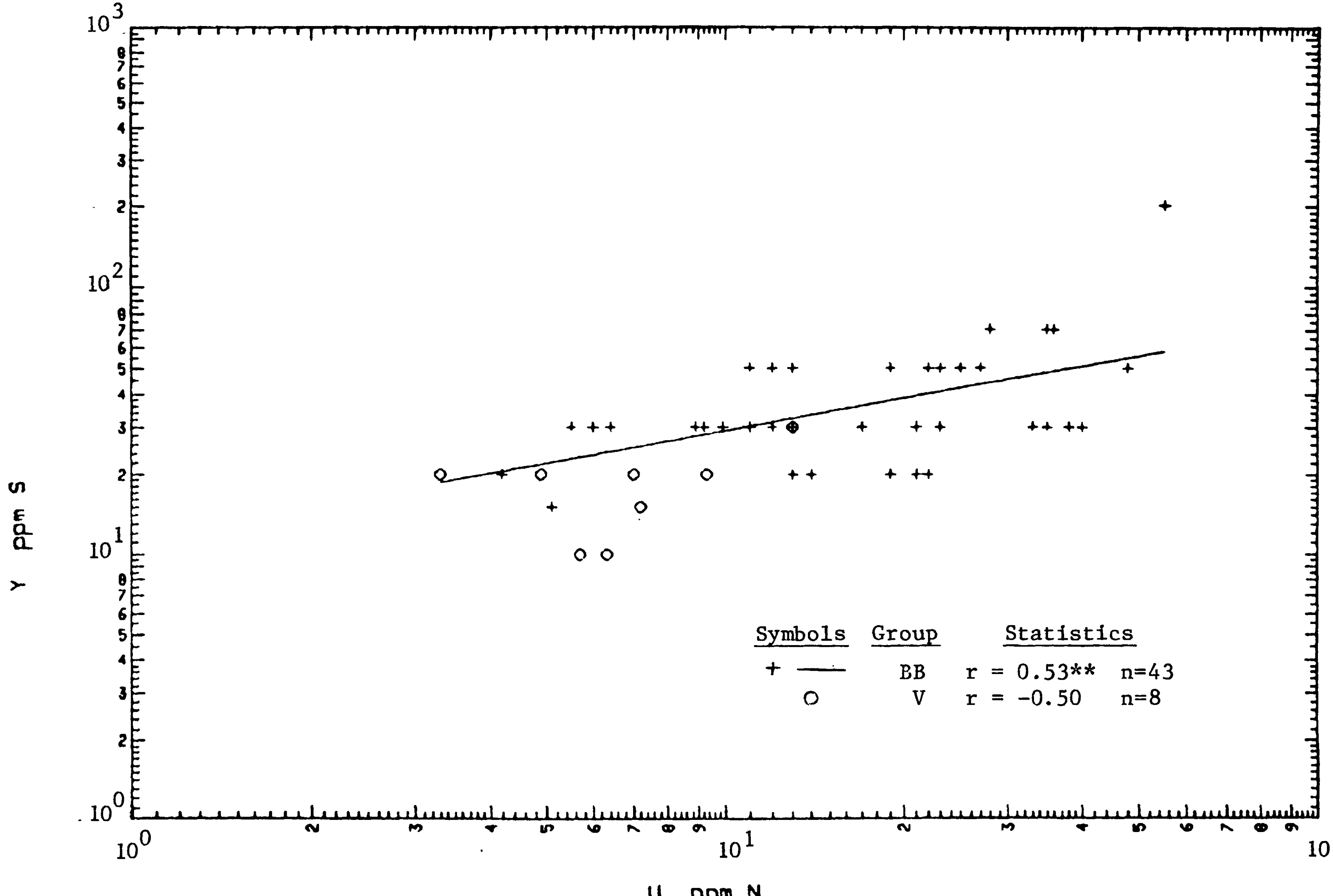

Figure 5-16.--Yttrium plotted versus U (coarse fraction).

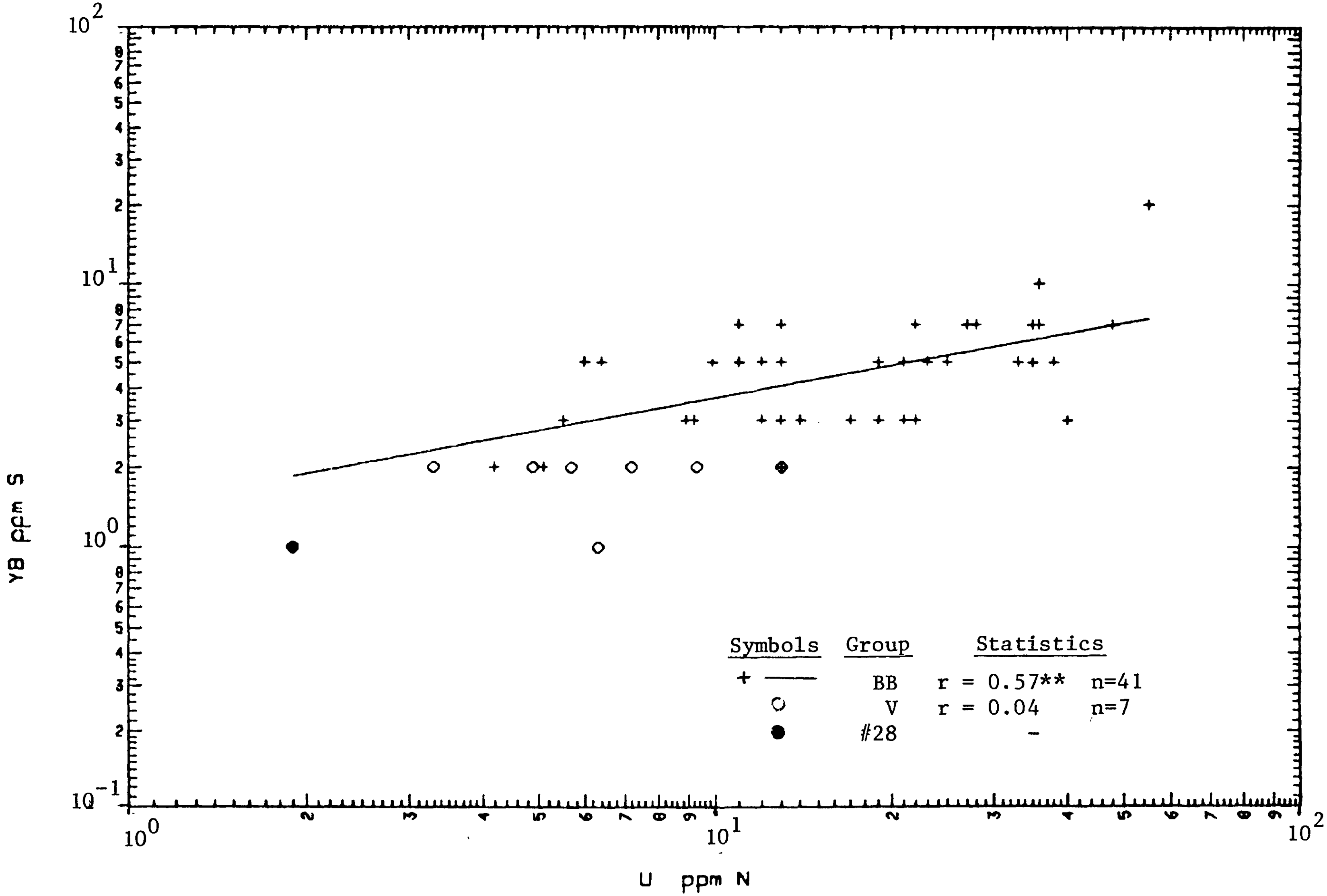

Figure 5-17.--Ytterbium plotted versus U (coarse fraction).

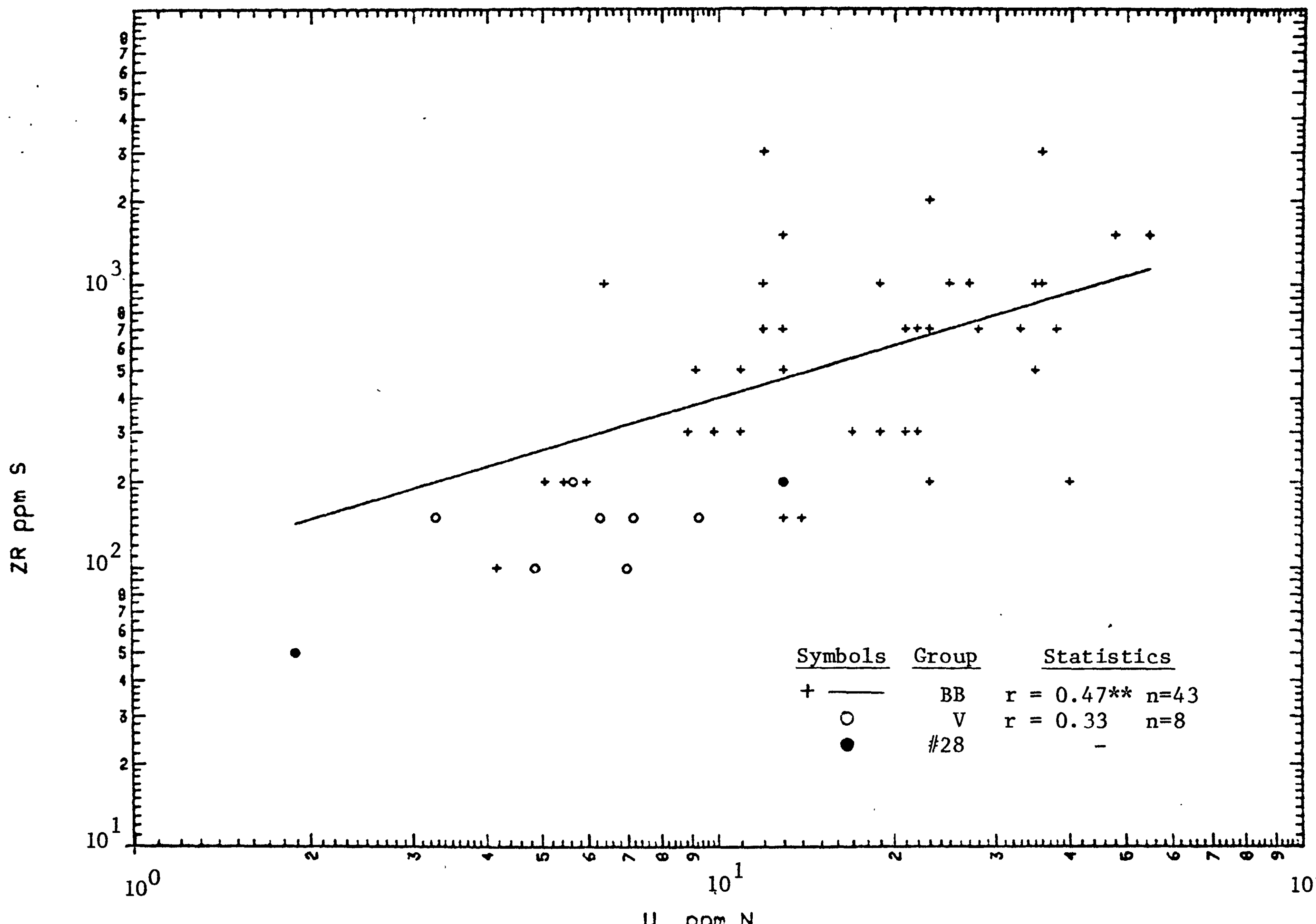

Figure 5-18.--Zirconium plotted versus U (coarse fraction).