UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Chemical and statistical analyses from a uranium hydrogeochemical and stream-sediment survey in the North Absaroka study area, Park and Sweet Grass Counties, Montana

Part II: Stream Sediments

by

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Open-File Report 80-1091

1980

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

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ABSTRACT

Sixty-one stream-sediment samples, collected from a portion of the North Absaroka study area, Montana in July 1977, were separated into two size fractions (<88 μm, and between 88 and 149 μm), and analyzed for 80 different elements. Of these elements, 47 showed some variation over the area; 36 met the proper statistical criteria and were subjected to correlation analysis.

Uranium values in the fine-size fraction (<88 μm) ranged from 2.1 parts per million (ppm) to 430 ppm, with a typical sample containing about 42 ppm U. High values (above 100 ppm U) were observed along Speculator Creek and Bramble Creek, and in drainages on the northwestern and western side of Mt. Douglas. Two high values were found in samples from Falls Creek (north of Boulder Mountain). Fine-size-fraction sediments containing 410 ppm and 430 ppm, the highest U values in the area, were collected from Speculator Creek.

The distribution of U concentration from this study is somewhat bimodal in both size fractions. Nevertheless, U shows a strong correlation with organic C (the major component of total C in the area) and good correlations with Th, $-Al_2O_3$, -Ca, $-Fe_2O_3$, La, -Mg, Pb, -Sc, Se, -Sr, -V, Y, and Yb. Uranium also correlates significantly (at the 99-percent confidence level) with As and -Cr, although the trends are not as well defined as with the elements mentioned above. Uranium decidedly does not correlate with Cu, K,

Mn, Na_2O, SiO_2, and Zr. These correlations and the bimodal nature of the U suggest that much of the U is in a leachable form, hence the extremely strong correlation with organic carbon, and that some is tied up in resistate minerals such as xenotime, hence the good correlations with Y, Th, Yb, and La.

High Mo was evident in some of the same samples that contained high U. However, although Mo is a good pathfinder for U in the water of this area, it is not a good indicator of U in the stream sediments.

INTRODUCTION

This report presents the chemical analyses and preliminary statistical evaluation of 61 stream-sediment samples collected in south-central Montana during July 1977. Sampling covered a part of a proposed primitive area in the northern Absaroka Mountains referred to as the North Absaroka study area by the U.S. Geological Survey and U.S. Bureau of Mines (USGS and USBM, 1977), and located within Park and Sweet Grass Counties (fig. 1). The Absaroka primitive area is to the south, the Beartooth primitive area to the southeast. Analyses of surface-water samples taken concurrently with these sediment samples are reported in Suits and Wenrich-Verbeek (1980).

The North Absaroka study area and vicinity has few known U occurrences and no previous designation of potential U (USGS and USBM, 1977; Simons and others, 1973; and Wedow and others, 1975). Therefore, the discovery of U values in the range 142-427 ppm in stream-sediment samples collected by the USGS and USBM (1977), in addition to high U-bearing stream sediments collected by Johns-Manville, Inc. (S. Ellingwood and J. Schutt, oral commun., 1977), elicited further investigation. The present geochemical sampling study was designed to provide a basis for delineating the source for the anomalous stream sediments.

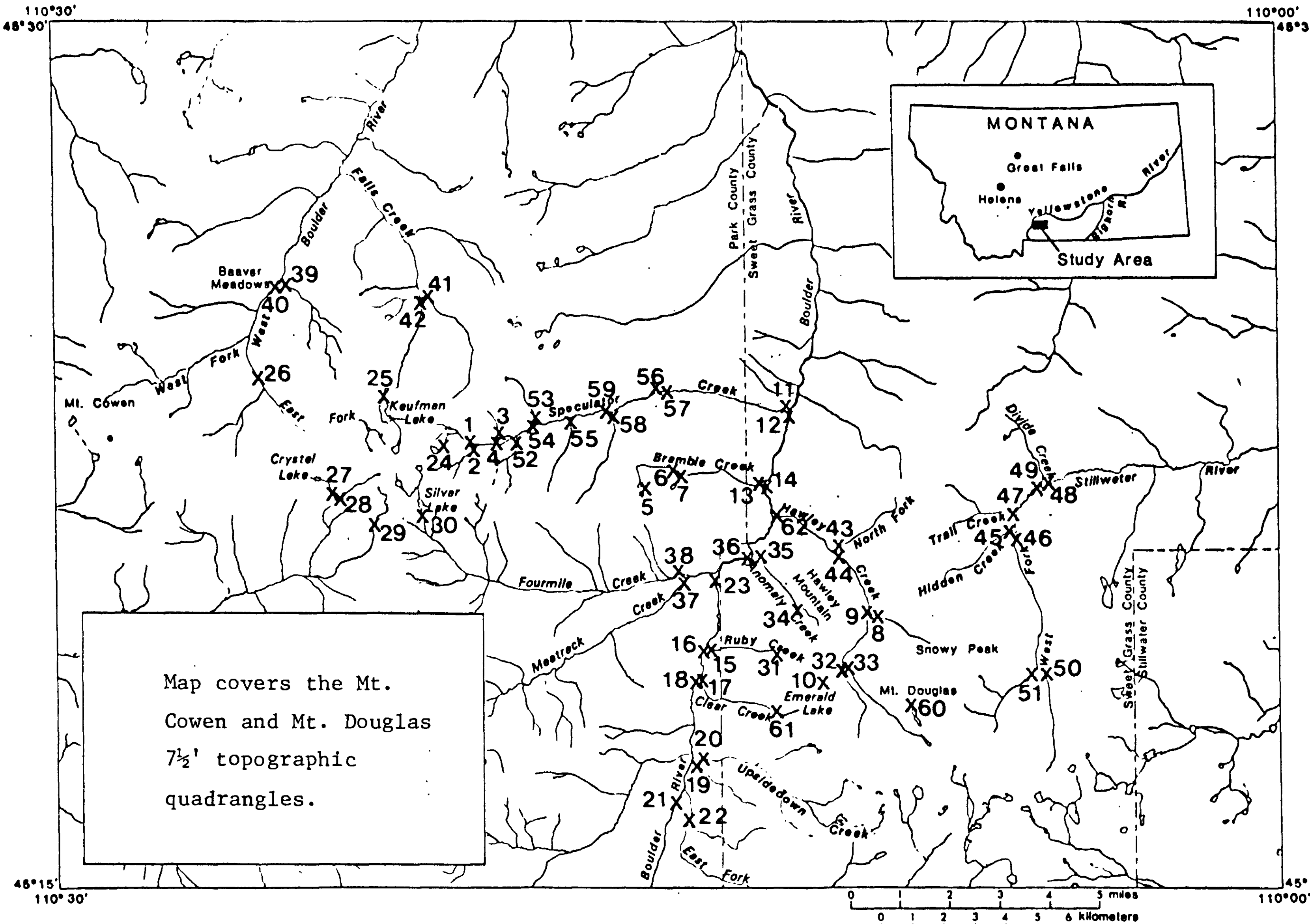

Figure 1.--Map of study area and sample localities. No sediment sample collected at site #34.

GEOLOGIC BACKGROUND

The study area is located in the western part of the Beartooth uplift in the North Absaroka Mountains. The area is sparsely populated and mountainous. Because access to the high country is limited to a few footpaths, the use of a helicopter was necessary for this survey.

Several authors have described the geology near this study area in detail, especially in the vicinity of mining districts located just outside the area. Reid and others (1975), and Richards (1957) described the geology of larger regions which encompass the study area. The most extensive description of the geology as well as the economic history and potential of this area, was given by USGS and USBM, 1977.

The Precambrian gneisses of Falls Creek and Mt. Cowen are the predominant formations in the study area. Small areas of Precambrian metasediments occur in the northwestern and northeastern parts of the area. Tertiary intrusives and volcanics an well as nonextensive Cambrian sediments are present south of Meatrack Creek (fig. 1).

Faults generally follow west-northwest or north-northeast trends. The Mill Creek-Stillwater fault is west-trending near the southern boundary of the study area, and the northeast-trending West Boulder fault is traced by the West Boulder River (Reid and others, 1975).

Southwest of the study area, and associated with the Absaroka-Gallatin volcanic province, are several gold, silver, and copper mining districts: Emigrant-Mill Creek, Boulder, Independence, and Cooke City. Northeast of the area, the Archean Stillwater Complex hosts platinum, chromium, copper, and nickel (USGS and USBM, 1977).

The two Precambrian gneisses are of primary interest with respect to U exploration and to this study. The streams that concentrated the U-rich sediments derive their material from one or both of these gneisses. USGS and USBM (1977) found high U as well as high Th in samples of a dark mineral layer in the gneiss of Falls Creek. Half of the minerals in the zone are biotite and magnetite, half are quartz, feldspar, and accessories. Among the accessories, sphene is the presumed host of the U and Th (USGS and USBM, 1977).

SAMPLING PROCEDURE

High U values were discovered by USGS and USBM (1977) and by Johns-Manville personnel (S. Ellingwood and J. Schutt, oral commun., 1977) in sediments from Speculator Creek and from a previously unnamed creek now known locally as "Anomaly Creek" (fig. 1). Therefore, water and stream-sediment samples for this study were collected near those two drainages, though the Speculator Creek drainage was favored due to easier access. Figure 1 shows the location of the study area and the sampling sites; table 1 lists the sampling sites by location name.

Silt- to clay-size particles were sought in the stream channels to compose 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 (1976). In the high terrain of this study area, such a small size fraction often appeared to be nonexistent due to high stream gradients. However, sufficient material for analysis was scooped up by hand from under and behind boulders, and in rare out-of-the-way pools. Sample sediment was collected and stored in polyethylene plastic bags to avoid outside contamination and escape of fine material.

Table 1.--List of sample localities and dates (1977) of collection.

SAMPLE	LAT	LONG	MO/DAY	LOCATION NAME
1	45°22'48"	110°19'38"	7/7	Westernmost north fork to Speculator Creek
2	45°22'45"	110°19'38"	7/7	Westernmost south fork to Speculator Creek
3	45°22'50"	110°19' 1"	7/7	North trib to Speculator Creek
4	45°22'45"	110°19' 1"	7/7	Speculator Creek
5	45°21'53"	110°15'26"	7/8	Bramble Creek below southernmost glacial lake
6	45°22' 9"	110°14'49"	7/8	Bramble Creek
7	45°22' 6"	110°14'42"	7/8	Trib to Bramble Creek
8	45°19'44"	110°10' 0"	7/8	Trib from Snowy Peak to Hawley Creek
9	45°19'47"	110°10' 3"	7/8	Hawley Creek
10	45°18'29"	110°11'13"	7/8	Stream from lake on west side of Hawley Mountain
11	45°23'21"	110°11'53"	7/9	Speculator Creek at mouth
12	45°23'19"	110°11'53"	7/9	Boulder River above Speculator Creek
13	45°22' 4"	110°12'41"	7/9	Bramble Creek at mouth
14	45°22' 1"	110°12'37"	7/9	Boulder River above mouth Bramble Creek
15	45°19'10"	110°14' 1"	7/9	Ruby Creek at mouth
16	45°19'10"	110°14' 5"	7/9	Boulder River above Ruby Creek
17	45°18'39"	110°14'12"	7/10	Clear Creek at mouth
18	45°18'39"	110°14'16"	7/10	Boulder River above Clear Creek
19	45°17' 9"	110°14'23"	7/10	Creek south of Upsidedown Creek
20	45°17'14"	110°14'23"	7/10	Upsidedown Creek at mouth
21	45°16'22"	110°14'56"	7/10	West fork Boulder River
22	45°16' 7"	110°14'34"	7/10	East Fork Boulder River
23	45°20'20"	110°13'50"	7/10	Boulder River above Fourmile Creek
24	45°22'37"	110°20'26"	7/11	Tarn lake north of head of Speculator Creek
25	45°23'29"	110°21'57"	7/11	Stream from Kaufman Lake
26	45°23'52"	110°25' 0"	7/11	West Boulder River below junction of East Fork & trib
27	45°21'48"	110°23'10"	7/11	Stream draining Crystal Lake above junction with trib
28	45°21'46"	110°23' 3"	7/11	Trib to stream draining Crystal Lake
29	45°21'27"	110°12' 4"	7/11	Stream draining cirque east of Crystal Lake
30	45°21'35"	110°20'59"	7/12	Stream draining Silver Lake
31	45°19' 8"	110°12'23"	7/12	Headwaters of Ruby Creek
32	45°18'45"	110°10'44"	7/12	West fork of Hawley Creek
33	45°18'45"	110°10'40"	7/12	East fork of Hawley Creek
34	45°19'47"	110°11'53"	7/12	Drainage above tarn lake on west side of Hawley Mountain
35	45°20'49"	110°12'52"	7/12	Mouth of "Anomaly Creek"
36	45°20'46"	110°12'55"	7/12	Boulder River above mouth of "Anomaly Creek"
37	45°20'23"	110°14'31"	7/13	Meatrack Creek above junction with Fourmile Creek
38	45°20'28"	110°14'31"	7/13	Fourmile Creek above junction with Meatrack Creek
39	45°25'28"	110°24'20"	7/13	Trib into West Boulder River
40	45°25'28"	110°24'24"	7/13	West Boulder River at Beaver Meadows
41	45°25'12"	110°20'55"	7/13	East fork to Falls Creek
42	45°25'10"	110°20'59"	7/13	Middle fork to Falls Creek
43	45°20'51"	110°10'56"	7/14	North Fork Hawley Creek
44	45°20'49"	110°10'55"	7/14	Hawley Creek above North Fork
45	45°21' 9"	110° 6'28"	7/14	Hidden Creek
46	45°21' 7"	110° 6'24"	7/14	West Fork Stillwater River
47	45°21'27"	110° 6'28"	7/14	Trail Creek at mouth
48	45°21'58"	110° 5'51"	7/14	Divide Creek at mouth
49	45°22' 1"	110° 5'47"	7/14	West Fork Stillwater River above Divide Creek
50	45°18'47"	110° 5'55"	7/15	East fork of West Fork Stillwater River
51	45°18'47"	110° 5'58"	7/15	West fork of West Fork Stillwater River
52	45°22'50"	110°18'40"	7/15	Trib from south to Speculator Creek
53	45°23' 3"	110°18'10"	7/15	Trib from north to Speculator Creek
54	45°22'60"	110°18'10"	7/15	Speculator Creek
55	45°23' 6"	110°17'16"	7/15	Trib from south to Speculator Creek
56	45°23'37"	110°15'18"	7/15	Unmarked trib from north to Speculator Creek
57	45°23'37"	110°15'15"	7/15	Speculator Creek below unmarked trib
58	45°23'13"	110°16'17"	7/15	Trib from south to Speculator Creek
59	45°23'16"	110°16'20"	7/15	Speculator Creek
60	45°18' 7"	110° 8'56"	7/16	Tarn lake south of Mt Douglas
61	45°18' 2"	110°12'19"	7/16	Clear Creek below Emerald Lake
62	45°21'27"	110°12'23"	7/16	Hawley Creek at mouth

*No sediment sample taken.

CHEMICAL ANALYSES

Sediment samples were prepared for analysis by drying them in an oven at <100°F (38°C); they were then passed through solderless, stainless-steel sieves 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 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. Of the stream-sediment samples, 10 percent 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 systematic bias by the chemical analyst.

PRESENTATION OF CHEMICAL DATA

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

Figures 2-1 through 2-19 are locality maps for stream-sediment samples and show data for those elements that have a 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 CaO, 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.

High U values can be seen on figure 2-1 along Speculator Creek, Bramble

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: 88 μm–149 μm 9: <88 μm		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
AL203% 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 determination
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
FE203% 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 values; Th data is ignored for ratios <1.

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

- A Atomic absorption
- N Delayed neutron analysis
- X X-ray spectroscopy
- S Semi-quantitative 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

Creek, in drainages on the northwestern and western side of Mt. Douglas, and along Falls Creek north of Boulder Mountain. Of the other elements plotted on maps, Sr is notable and appears to be high only in the sediments of the Boulder River.

STATISTICAL ANALYSIS

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

Character of the data: Results from the two size fractions of sediment samples were treated separately in the statistical analysis. However, the following characteristics assessed from the analytical results of both fractions were similar:

(1) Histograms of most variables (table 4) exhibited greater unimodal symmetry when the logarithms of the data were used than when they were not. Thus the represented populations were judged to be lognormal and, therefore, the logarithms of the data were used in statistical calculations. Uranium obtained the most symmetry after log transformation, although it retained a bimodal character in both size fractions. Other bimodal elements as well as U were used in correlation analysis because the scatter diagrams show the trend suggested by the correlation coefficient, r. A bimodal character was sometimes observed in only one size fraction; these instances are annotated in tables 4, 5, and 6.

(2) Histograms that were more symmetrical and unimodal when the logarithms of the data were not used were deemed to represent a normally distributed population, and so the untransformed data were used in statistical analysis.

(3) Where elements were determined through different analytical methods (in either element form or oxide form), the results from the most precise method were chosen for statistical analysis. The oxide forms of elements (if applicable) were included in the scatter plots and locality maps because the method by which they were determined was quantitative rather than semiquantitative.

(4) The analytical results for some variables included qualified values ("less than" a certain number). A less than value, coded with an "L", means the element concentration was less than the limit of detection. For those elements determined by semiquantitative emission spectroscopy some data are coded by an "N". N means the element was not detected at all, as opposed to an "L" which means the element was in detectable amounts but at less than the limit of detection. All "less than" and "N" values are associated with one number for one variable (singly-censored).

Problems of censored data: Meisch (1967, 1976) discussed the problem of singly-censored sample populations. In the present study singly-censored variables were treated in the following ways:

(1) Cohen's (1959) method was used to estimate means and standard deviations from the truncated distributions (Cohen, 1959; Miesch, 1967). Tests conducted during this study on artificially censored data sets verified the accuracy of Cohen's method for sample populations that are approximately unimodal and symmetric. Results from Cohen's method using bimodal distribution curves (e.g., Se) are not reliable, but are better estimates than parameters calculated from only the unqualified data without use of any estimator.

(2) The "replacement" method was used before correlation analysis. This method assigns an arbitrary (educated guess) number to qualified values. In

this report "less than" and "N" values are assigned three-fourths and half of their corresponding detection limits, respectively. Although this method is inferior to Cohen's estimation method for means and standard deviations, Cohen's estimation does not apply to calculation of the correlation coefficient. The censoring tests conducted in the present study revealed the "replacement" method to be superior to that of omitting all qualified values from the data matrix before parameter calculation. This conclusion was emphasized by Miesch (1976).

(3) Based on skepticism of the reliability of any method that deals with censoring, the authors placed a limit on how many qualified values would be allowed in the data for one variable before the data were considered inadequate for statistical analysis. The arbitrary limit was set at 50-percent qualified values. If more than half the data for one variable were censored, the variable was not used in correlation analysis.

Frequency distributions: Histograms of the various parameters determined for the fine-size fraction of the sediment samples are shown in table 4. Like most geochemical data, the distributions of all parameters in stream sediments--except Al_2O_3, Na_2O, and SiO_2--are more closely lognormally distributed than normally distributed (in most cases easily determined by visual comparison of the diagrams), so that the frequency diagram of their log-data is presented (shown with a prefix of L- before the element name), and the log-data were used in the statistical analysis.

The qualified data for each element are described in table 4 (directly beneath the histograms) according to the codes explained at the top of the table. The histograms themselves comprise the frequencies of the unqualified data values and do not include replicate samples. An appearance or lack of bimodality in the coarser size fraction is noted where applicable.

Some of the histograms indicate that the populations from which the data were drawn are definitely not normal (e.g., Ni). Other histograms are not shown in this section because either (1) analytical results are greater than 50-percent qualified values, or (2) the distributions consist of only a few different values.

Table 4 also shows the maximum and minimum values in the results for the fine-size fraction and their means and standard deviations. The latter two parameters were calculated differently depending on (1) the use of the untransformed data or the logarithms of the data, and (2) the presence or absence of singly-censored data.

Variables that remain untransformed had means and standard deviations calculated directly. If singly-censored data were present, Cohen's (1959) equations were used to estimate the arithmetic mean and standard deviation.

The geometric mean and geometric deviation (anti-logs of the arithmetic mean and standard deviation, respectively, of the log-data) were calculated for sample populations approximating a lognormal distribution. When singly-censored data are present, Cohen's equation was used on the logs of the data values to find the estimated arithmetic mean and estimated standard deviation. The anti-logs of these values then gave the geometric mean and geometric deviation.

Correlation analysis: Tables 5 and 6 show correlation matrices of variables determined in the fine-size fraction (<88 μm) and coarse-size fraction (between 88 and 149 μm), respectively. Only variables listed in table 4 which approximate normal or lognormal distributions were used in correlation analysis. In addition, where an element was determined analytically by two methods (generally by emission spectroscopy and X-ray fluorescence), only data acquired by the most precise method (from table 7) were used in the calculations. All censored data to be entered into the correlation analysis were treated beforehand by the "replacement" method, as described previously.

Scatter diagrams: Scatter diagrams were plotted for several variables versus U (figs. 3-1 through 3-21). The variables plotted all have statistically significant correlations with U (to at least the 95-percent confidence level) or have plots that visually show linear trends. Data from the coarse fraction for Ni did not appear to be unimodal in its histogram and therefore does not have a calculated correlation coefficient.

Where the calculated correlation coefficients, r, of the two size fractions did not differ greatly, a regression line was calculated and drawn using the data of the two size fractions together. Where the fractions were plotted with different symbols and separate regression lines (if applicable) were visually drawn.

Analysis of analytical precision: The variance between replicate samples (error variance) is compared to the variation in analytical results for all nonreplicate samples (total variance) in table 7. Both size fractions were used in the calculations. The percentage of total variation that is due to analytical imprecision for each variable appears in the third column.

Of the 38 elements studied, 6 showed large analytical problems. Two of these, CaO and Fe, were also determined by alternate methods as Ca and Fe_2O_3 with little analytical imprecision. The latter two were used in interpretation in place of the former two. The other four elements with significant analytical variance are Al_2O_3, P_2O_5, Yb, and Zr. The replicate samples analyzed for Al_2O_3 and P_2O_5 closely match their original counterparts in all but two analyses (see table 3). The discrepancies in these two analyses cause the expression of analytical error in table 7. In order to use these two variables in the geochemical interpretation, one must assume that amid the consistently precise results, the erratic values are few and negligibly affect the interpretation as a whole.

STATISTICAL INTERPRETATION

Due to the bimodality of U in both size fractions in this study area, the correlation coefficients, r, between U and other elements were treated with some skepticism. Subjective judgments of the scatter diagrams in light of the calculated r and amount of analytical imprecision involved, formed the basis for final interpretation. Often a few extreme values lowered the magnitude of r, although the linear trend remained quite apparent in the scatter plot (e.g., the disparity between r's in the two size fractions for La). For the most part, as can be observed from the scatter diagrams, the bimodality of uranium has little effect on the correlation coefficients. On the other hand, the appearance of the scatter plot of U versus Ni, for instance, might convince one that the bimodality of U causes some misleading correlation results.

Based on all these considerations, U was found to correlate strongly (significant at the 99-percent confidence level) with organic C (the major component of total C in the area). Good correlations were apparent between U and Th, $-Al_2O_3$, -Ca, $-Fe_2O_3$, La, -Mg, Pb, -Sc, Se, -Sr, -V, Y, and Yb. High analytical imprecision may have caused the scatter of points on the plots of U versus Al_2O_3, P_2O_5, and Yb. Al_2O_3 and Yb show linear trends despite the scatter. However, even though a linear trend seems apparent for P_2O_5 as well, the high analytical imprecision and low variation in P_2O_5 values creates the possibility of a visually misleading trend.

The correlation coefficient of Th versus U for the fine fraction was not statistically significant (at the 95-percent confidence level) due to a paucity of Th determinations. This paucity was caused by low Th to U ratios in the samples, which precludes good Th determinations by delayed neutron analysis. Nevertheless, a good linear trend is evident on the scatter diagram.

U also correlates significantly at the 99-percent confidence level with As and -Cr, although the relationships are not as well defined by the scatter plots as the above-mentioned elements. Uranium correlates at the 95-percent confidence level with -Ba, -Co and -Ni, but the scatter diagrams show such scatter and poor trends that there appears to be little basis for the correlation.

The plot of U versus Ca (fig. 3-8) suggests two different linear relationships between U and Ca. A low U-high Ca relationship seems to hold along the Boulder River and Meatrack Creek.

Molybdenum data were too greatly censored to calculate an r versus U, or to observe any trend on a scatter plot. A comparison of the maps for U (fig. 2-1) and Mo (fig. 2-14) show high Mo at some of the same localities where high U was found. However, the correspondence is not good and Mo cannot be used as an indicator of U in stream sediments of this area.

There are several elements that notably do not correlate with U: they are Cu, K, Mn, Na_2O, SiO_2, and Zr.

The extremely good correlation between U and organic carbon suggests that much of the U is in the stream sediments in a leachable form. This, plus the negative (nonsignificant) correlation between U and Ti, questions sphene, suggested by USGS and USBM (1977) as a significant host for the U in the North Absaroka area. The negative correlation between Al and U implies that clays are not contributing significantly, if at all, to adsorption of soluble U. Some of the U is tied up in resistate minerals, such as xenotime, as suggested by possible correlations with Y, Th, Yb, and La. The noncorrelation with Zr shows that zircon is not a significant contributor to the U variation.

ACKNOWLEDGMENTS

The authors are indebted to Joseph F. Mascarenas for help in sample collection and in sample preparation, and to Barbara V. Dodge, for invaluable assistance in the applied-computer realm of this report. We are grateful to Stan Ellingwood and John Schutt of Johns-Manville, Inc., who provided scientific background and valuable logistical assistance for the study.

We also acknowledge the following U.S. Geological Survey personnel who are responsible for the chemical analyses of our sediment samples: J. W. Baker, A. J. Bartel, P. H. Briggs, J. G. Crock, C. M. Ellis, H. N. Elsheimer, D. Hopping, M. J. Malcolm, C. McFee, V. Merritt, H. T. Millard, Jr., George Riddle, V. E. Shaw, M. Villarreal, and J. S. Wahlberg.

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

sample**	Latt	Long	SizeFrac	U ppm N	TH ppm N*	TH / U*	Coef %TH*	Coef %U	AL % S	AL2O3% X	AS ppm A
1-02D77	45°22'48"	110°19'38"	coarse	37.0	--	--	--	1	>10	12.86	13.0
1-03D77	45°22'48"	110°19'38"	fine	71.0	--	--	--	1	>10	13.85	26.0
2-02D77	45°22'45"	110°19'38"	coarse	42.0	--	--	--	1	7	15.30	20.0
2-R2D77	45°22'45"	110°19'38"	coarse	43.0	--	--	--	1	10	11.59	15.0
2-03D77	45°22'45"	110°19'38"	fine	85.0	--	--	--	1	>10	13.75	31.0
3-02D77	45°22'50"	110°19' 0"	coarse	27.0	28.0	1.02	11	1	7	12.85	25.0
3-03D77	45°22'50"	110°19' 0"	fine	44.0	--	--	--	1	10	13.79	10.0
4-02D77	45°22'45"	110°19' 0"	coarse	25.0	--	--	--	1	10	11.90	17.0
4-03D77	45°22'45"	110°19' 0"	fine	54.0	--	--	--	1	10	12.96	26.0
5-02D77	45°21'53"	110°15'26"	coarse	23.0	52.0	2.25	6	2	10	11.24	12.0
5-03D77	45°21'53"	110°15'26"	fine	36.0	76.0	2.09	6	1	10	14.04	24.0
6-02D77	45°22' 9"	110°14'48"	coarse	70.0	--	--	--	1	7	11.88	9.0
6-03D77	45°22' 9"	110°14'48"	fine	120.0	--	--	--	1	10	13.19	14.0
7-02D77	45°22' 5"	110°14'42"	coarse	110.0	--	--	--	1	7	12.03	27.0
7-03D77	45°22' 5"	110°14'42"	fine	140.0	--	--	--	1	10	13.07	19.0
8-02D77	45°19'44"	110°10' 0"	coarse	43.0	--	--	--	1	10	13.15	4.3
8-03D77	45°19'44"	110°10' 0"	fine	98.0	--	--	--	1	>10	14.13	6.7
9-02D77	45°19'47"	110°10' 3"	coarse	46.0	--	--	--	1	10	12.88	12.0
9-03D77	45°19'47"	110°10' 3"	fine	110.0	--	--	--	1	10	13.71	18.0
9-R3D77	45°19'47"	110°10' 3"	fine	110.0	--	--	--	1	10	13.69	11.0
10-02D77	45°18'29"	110°11'12"	coarse	240.0	--	--	--	1	10	12.99	26.0
10-03D77	45°18'29"	110°11'12"	fine	320.0	--	--	--	1	7	12.21	34.0
11-02D77	45°23'21"	110°11'53"	coarse	25.0	25.0	1.00	13	2	>10	12.74	5.7
11-03D77	45°23'21"	110°11'53"	fine	61.0	--	--	--	1	>10	14.80	7.4
12-02D77	45°23'19"	110°11'53"	coarse	5.1	21.0	4.09	7	3	>10	12.59	3.5
12-03D77	45°23'19"	110°11'53"	fine	7.8	11.0	1.40	13	2	10	13.24	12.0
13-02D77	45°22' 4"	110°12'41"	coarse	57.0	--	--	--	1	7	12.50	1.7
13-03D77	45°22' 4"	110°12'41"	fine	138.0	--	--	--	1	10	16.06	18.0
14-02D77	45°22' 0"	110°12'37"	coarse	4.4	12.0	2.62	12	4	>10	14.63	3.7
14-03D77	45°22' 0"	110°12'37"	fine	7.7	9.4	1.22	17	2	>10	15.68	10.0
15-02D77	45°19' 9"	110°14' 1"	coarse	43.0	64.0	1.48	7	1	10	12.65	.7
15-03D77	45°19' 9"	110°14' 1"	fine	110.0	44.0	--	--	1	10	14.28	4.8
16-02D77	45°19' 9"	110°14' 5"	coarse	3.1	7.4	2.41	14	4	>10	14.68	3.4
16-03D77	45°19' 9"	110°14' 5"	fine	5.3	9.4	1.77	14	3	>10	14.74	4.3
17-02D77	45°18'38"	110°14'12"	coarse	20.0	--	--	--	2	7	11.76	4.4
17-03D77	45°18'38"	110°14'12"	fine	43.0	--	--	--	1	7	12.76	18.0
18-02D77	45°18'38"	110°14'16"	coarse	3.5	12.0	3.45	10	4	>10	13.87	3.4
18-03D77	45°18'38"	110°14'16"	fine	4.3	8.8	2.06	15	4	>10	14.76	3.5
19-02D77	45°17' 8"	110°14'23"	coarse	120.0	--	--	--	1	7	13.27	7.0
19-03D77	45°17' 8"	110°14'23"	fine	140.0	--	--	--	1	10	13.28	13.0

The symbol "--" indicates the sample was not analyzed for the appropriate variable, "<" and ">" mean the value is less than or greater than, respectively, the adjacent value, and "N" means the element was not detected at the lower limit.
See Table 2 for explanation of abbreviations, analytical methods and detection limits.
*Values were deleted where TH/U <1.0.
**The first two digits of the sample number describe the sample location number (see Table 1); the two digits are either 02 or 03, indicating the coarse- (between 88 & 149 µm) or the fine-size fraction (<88 µm), respectively.

Table 3--continued

sample	Latt	Long	SizeFrac	U ppm N	TH ppm N*	TH / U*	Coef %TH*	Coef %U	AL % S	AL2O3% X	AS ppm A
19-R3D77	45°17' 8"	110°14' 3"	fine	140.0	--	--	--	1	>10	13.03	11.0
20-02D77	45°17'14"	110°14' 3"	coarse	4.3	11.0	2.45	12	3	>10	14.65	4.0
20-03D77	45°17'14"	110°14' 3"	fine	8.1	10.0	1.30	16	2	>10	16.57	5.3
21-02D77	45°16'22"	110°14' 6"	coarse	2.2	4.2	1.92	25	6	>10	15.26	11.0
21-03D77	45°16'22"	110°14' 6"	fine	2.1	6.1	2.87	16	5	10	14.98	12.0
22-02D77	45°16' 7"	110°14' 4"	coarse	5.5	17.0	3.04	9	3	>10	15.12	3.6
22-03D77	45°16' 7"	110°14' 4"	fine	12.0	--	--	--	2	>10	15.41	5.9
23-02D77	45°20'20"	110°13' 0"	coarse	2.9	10.0	3.57	11	5	>10	15.07	3.1
23-03D77	45°20'20"	110°13' 0"	fine	4.9	7.9	1.62	16	3	>10	15.08	2.2
23-R3D77	45°20'20"	110°13' 0"	fine	5.1	7.5	1.47	19	3	>10	11.63	4.1
24-02D77	45°22'36"	110°20' 6"	coarse	58.0	--	--	--	1	10	13.10	34.0
24-03D77	45°22'36"	110°20' 6"	fine	110.0	--	--	--	1	10	13.71	40.0
25-02D77	45°23'29"	110°21' 6"	coarse	100.0	--	--	--	1	7	12.79	34.0
25-03D77	45°23'29"	110°21' 6"	fine	82.0	--	--	--	1	10	12.62	27.0
26-02D77	45°23'52"	110°25' 0"	coarse	12.0	16.0	1.38	13	2	7	12.77	19.0
26-R2D77	45°23'52"	110°25' 0"	coarse	11.0	20.0	1.81	11	2	7	13.12	21.0
26-03D77	45°23'52"	110°25' 0"	fine	25.0	--	--	--	1	10	14.48	17.0
26-R3D77	45°23'52"	110°25' 0"	fine	25.0	--	--	--	2	10	14.37	13.0
27-02D77	45°21'47"	110°23' 0"	coarse	21.0	--	--	--	2	7	12.93	18.0
27-03D77	45°21'47"	110°23' 0"	fine	33.0	--	--	--	1	7	13.39	27.0
28-02D77	45°21'46"	110°23' 3"	coarse	35.0	--	--	--	1	7	12.50	30.0
28-03D77	45°21'46"	110°23' 3"	fine	61.0	--	--	--	1	10	13.37	21.0
29-02D77	45°21'27"	110°12' 4"	coarse	16.0	--	--	--	2	10	13.63	27.0
29-03D77	45°21'27"	110°12' 4"	fine	26.0	--	--	--	2	10	13.90	29.0
30-02D77	45°21'35"	110°20' 9"	coarse	21.0	22.0	1.02	13	2	10	14.28	27.0
30-03D77	45°21'35"	110°20' 9"	fine	44.0	--	--	--	1	>10	15.49	55.0
31-02D77	45°19' 8"	110°12' 3"	coarse	15.0	39.0	2.63	7	2	10	15.26	8.0
31-03D77	45°19' 8"	110°12' 3"	fine	23.0	34.0	1.50	10	2	10	14.92	7.6
32-02D77	45°18'45"	110°10' 4"	coarse	95.0	--	--	--	1	7	13.11	10.0
32-03D77	45°18'45"	110°10' 4"	fine	160.0	--	--	--	1	10	13.06	12.0
33-02D77	45°18'45"	110°10' 0"	coarse	64.0	--	--	--	1	7	14.86	16.0
33-03D77	45°18'45"	110°10' 0"	fine	131.0	--	--	--	1	>10	12.98	9.0
33-R3D77	45°18'45"	110°10' 0"	fine	130.0	--	--	--	1	>10	13.13	9.0
35-02D77	45°20'48"	110°12' 1"	coarse	37.0	--	--	--	1	>10	14.12	16.0
35-03D77	45°20'48"	110°12' 1"	fine	97.0	--	--	--	1	>10	15.12	27.0
36-02D77	45°20'46"	110°12' 5"	coarse	2.9	14.0	4.74	8	5	>10	14.20	21.0
36-03D77	45°20'46"	110°12' 5"	fine	5.5	11.0	1.97	12	3	>10	15.07	3.8
37-02D77	45°20'23"	110°14' 0"	coarse	1.8	6.4	3.63	15	7	>10	15.69	4.3
37-03D77	45°20'23"	110°14' 0"	fine	2.3	10.0	4.41	11	6	>10	15.47	12.0
37-R3D77	45°20'23"	110°14' 0"	fine	2.6	6.2	2.37	20	5	>10	15.59	5.8

Table 3--continued

sample	Latt	Long	SizeFrac	U ppm N	TH ppm N*	TH / U*	Coef %TH*	Coef %U	AL % S	AL2O3% X	AS ppm A
38-02D77	45°20'28"	110°14'30"	coarse	6.5	27.0	4.17	6	3	>10	14.36	5.6
38-03D77	45°20'28"	110°14'30"	fine	13.0	28.0	2.18	8	2	>10	15.45	9.0
39-02D77	45°25'27"	110°24'20"	coarse	41.0	--	--	--	1	10	12.89	12.0
39-03D77	45°25'27"	110°24'20"	fine	86.0	--	--	--	1	10	13.19	8.0
40-02D77	45°25'27"	110°24'24"	coarse	15.0	22.0	1.46	12	2	7	12.47	11.0
40-03D77	45°25'27"	110°24'24"	fine	27.0	--	--	--	2	10	13.66	16.0
41-02D77	45°25'12"	110°20'55"	coarse	120.0	--	--	--	1	7	12.71	10.0
41-R2D77	45°25'12"	110°20'55"	coarse	120.0	--	--	--	1	7	12.72	15.0
41-03D77	45°25'12"	110°20'55"	fine	220.0	--	--	--	1	10	14.12	2.6
41-R3D77	45°25'12"	110°20'55"	fine	210.0	--	--	--	1	10	14.18	17.0
42-02D77	45°25' 9"	110°20'59"	coarse	110.0	--	--	--	1	10	13.14	33.0
42-03D77	45°25' 9"	110°20'59"	fine	220.0	--	--	--	1	10	13.74	12.0
43-02D77	45°20'51"	110°10'56"	coarse	3.5	14.0	4.13	9	4	7	15.42	10.0
43-03D77	45°20'51"	110°10'56"	fine	4.0	14.0	3.53	10	4	>10	16.16	7.0
44-02D77	45°20'48"	110°10'54"	coarse	4.6	26.0	5.70	5	3	7	11.54	21.0
44-03D77	45°20'48"	110°10'54"	fine	6.4	19.0	2.94	9	3	10	12.28	6.6
45-02D77	45°21' 9"	110° 6'28"	coarse	7.9	64.0	8.02	3	3	10	12.47	3.6
45-03D77	45°21' 9"	110° 6'28"	fine	12.0	43.0	3.48	5	2	>10	14.91	10.0
46-02D77	45°21' 6"	110° 6'24"	coarse	62.0	--	--	--	1	10	12.86	12.0
46-03D77	45°21' 6"	110° 6'24"	fine	150.0	--	--	--	1	10	13.96	20.0
47-02D77	45°21'27"	110° 6'28"	coarse	3.6	16.0	4.52	9	4	10	11.08	10.0
47-03D77	45°21'27"	110° 6'28"	fine	4.3	16.0	3.83	10	4	>10	13.41	13.0
48-02D77	45°21'58"	110° 5'51"	coarse	4.5	14.0	3.09	11	4	7	13.54	21.0
48-03D77	45°21'58"	110° 5'51"	fine	6.9	15.0	2.15	13	3	10	14.44	22.0
49-02D77	45°22' 0"	110° 5'47"	coarse	19.0	30.0	1.65	8	2	10	12.24	8.0
49-03D77	45°22' 0"	110° 5'47"	fine	35.0	--	--	--	1	10	13.97	18.0
50-02D77	45°18'47"	110° 5'55"	coarse	41.0	--	--	--	1	10	13.70	9.0
50-03D77	45°18'47"	110° 5'55"	fine	84.0	--	--	--	1	10	13.73	24.0
51-02D77	45°18'47"	110° 5'57"	coarse	72.0	--	--	--	1	7	13.45	11.0
51-03D77	45°18'47"	110° 5'57"	fine	91.0	--	--	--	1	>10	13.79	9.0
52-02D77	45°22'50"	110°18'40"	coarse	19.0	--	--	--	2	7	12.83	9.0
52-03D77	45°22'50"	110°18'40"	fine	34.0	--	--	--	1	10	15.39	20.0
53-02D77	45°23' 3"	110°18'10"	coarse	170.0	--	--	--	1	10	12.49	9.0
53-03D77	45°23' 3"	110°18'10"	fine	410.0	--	--	--	1	10	13.38	15.0
54-02D77	45°22'59"	110°18'10"	coarse	25.0	--	--	--	1	10	12.34	11.0
54-03D77	45°22'59"	110°18'10"	fine	53.0	--	--	--	1	10	14.16	25.0
55-02D77	45°23' 6"	110°17'16"	coarse	60.0	--	--	--	1	7	12.02	15.0
55-03D77	45°23' 6"	110°17'16"	fine	88.0	--	--	--	1	>10	14.38	21.0
56-02D77	45°23'37"	110°15'18"	coarse	260.0	--	--	--	1	7	12.81	23.0
56-03D77	45°23'37"	110°15'18"	fine	430.0	--	--	--	1	7	12.25	22.0

Table 3--continued

sample	Latt	Long	SizeFrac	U ppm N	TH ppm N*	TH / U*	Coef %TH*	Coef %U	AL % S	AL2O3% X	AS ppm A
57-02D77	45°23'37"	110 15'15"	coarse	34.0	34.0	1.00	11	1	10	12.31	6.8
57-03D77	45 23'37"	110 15'15"	fine	71.0	--	--	--	1	>10	13.46	11.0
58-02D77	45 23'12"	110 16'17"	coarse	48.0	--	--	--	1	>10	12.77	7.6
58-03D77	45 23'12"	110 16'17"	fine	110.0	--	--	--	1	10	13.85	10.0
59-02D77	45 23'16"	110 16'20"	coarse	49.0	--	--	--	1	7	12.03	7.0
59-03D77	45 23'16"	110 16'20"	fine	110.0	--	--	--	1	>10	13.67	16.0
60-02D77	45 18' 6"	110 8'56"	coarse	89.0	--	--	--	1	10	13.39	5.4
60-03D77	45 18' 6"	110 8'56"	fine	120.0	--	--	--	1	>10	13.87	6.1
60-R3D77	45 18' 6"	110 8'56"	fine	120.0	--	--	--	1	>10	14.09	6.1
61-02D77	45 18' 2"	110 12'19"	coarse	220.0	--	--	--	1	3	11.06	23.0
61-03D77	45 18' 2"	110 12'19"	fine	250.0	--	--	--	1	2	9.29	24.0
62-02D77	45 21'27"	110 12'23"	coarse	15.0	35.0	2.32	7	2	10	12.58	13.0
62-R2D77	45 21'27"	110 12'23"	coarse	15.0	34.0	2.23	7	2	10	12.37	6.1
62-03D77	45 21'27"	110 12'23"	fine	28.0	--	--	--	1	>10	13.99	9.0

Table 3--continued

sample	B ppm S	BA ppm S	BE ppm S	Total C%	Inorg C%	Org C %	CA % S	CAO % X	CE ppm S	CO ppm S	CR ppm S
1-02D77	N	1,000	1.5	3.19	<.01	3.19	2.0	2.33	<200	15	50
1-03D77	N	1,000	1.5	5.15	.07	5.08	1.5	1.93	<200	15	70
2-02D77	N	300	<1.5	1.14	<.01	1.14	1.0	5.41	N	30	150
2-R2D77	N	300	1.5	1.13	.10	1.03	1.5	1.66	N	20	150
2-03D77	N	500	1.5	2.39	<.01	2.39	1.5	1.69	N	30	150
3-02D77	N	700	1.5	2.42	<.01	2.42	3.0	5.84	N	30	70
3-03D77	N	700	2.0	4.23	<.01	4.23	3.0	5.07	N	30	70
4-02D77	N	500	1.5	1.40	.07	1.33	2.0	2.59	N	20	70
4-03D77	N	700	1.5	3.04	<.01	3.04	2.0	2.53	N	50	150
5-02D77	N	1,500	2.0	2.55	<.01	2.55	2.0	2.17	<200	10	30
5-03D77	<20	1,500	3.0	4.30	<.01	4.30	1.5	2.09	200	10	50
6-02D77	N	1,500	2.0	4.11	.14	3.97	1.5	1.68	200	10	30
6-03D77	N	1,000	3.0	6.39	<.01	6.39	1.5	1.89	300	10	70
7-02D77	N	700	2.0	6.25	.07	6.18	.7	1.61	200	10	30
7-03D77	N	1,000	5.0	8.67	<.01	8.67	1.5	1.72	300	20	100
8-02D77	N	300	1.5	1.15	.12	1.03	1.5	2.69	N	15	150
8-03D77	N	700	2.0	2.48	<.01	2.48	1.5	2.37	N	15	150
9-02D77	N	300	<1.5	1.57	<.01	1.57	2.0	2.91	N	20	150
9-03D77	N	500	1.5	3.52	<.01	3.52	2.0	2.76	<200	20	150
9-R3D77	<20	500	1.5	3.52	<.01	3.52	1.5	2.76	<200	20	150
10-02D77	N	500	2.0	6.63	.07	6.56	1.5	2.76	<200	70	150
10-03D77	N	500	2.0	8.99	<.01	8.99	2.0	2.25	N	70	150
11-02D77	N	700	2.0	.99	<.01	.99	1.5	2.27	N	30	150
11-03D77	N	1,000	2.0	2.57	<.01	2.57	2.0	2.18	200	50	200
12-02D77	N	1,500	N	.32	.06	.26	5.0	6.27	N	50	300
12-03D77	N	1,500	N	.78	.06	.72	3.0	2.81	N	30	200
13-02D77	N	700	2.0	2.40	<.01	2.40	1.5	2.23	<200	5	50
13-03D77	N	1,000	3.0	5.57	<.01	5.57	1.5	2.50	300	15	70
14-02D77	N	1,500	N	.53	<.01	.53	5.0	5.97	N	30	150
14-03D77	N	1,500	N	.99	<.01	.99	3.0	4.86	N	30	150
15-02D77	N	700	1.5	1.18	<.01	1.18	2.0	3.45	<200	10	70
15-03D77	N	1,000	1.5	3.26	<.01	3.26	1.5	3.11	<200	15	70
16-02D77	N	1,500	N	.47	<.01	.47	5.0	6.60	N	50	150
16-03D77	N	1,500	N	1.08	<.01	1.08	3.0	5.45	N	30	150
17-02D77	N	300	N	2.23	<.01	2.23	1.0	2.31	N	10	70
17-03D77	N	500	1.5	5.06	<.01	5.06	1.5	2.55	N	15	100
18-02D77	N	1,500	N	.88	<.01	.88	5.0	6.43	N	30	200
18-03D77	N	1,500	N	1.27	.07	1.20	5.0	5.00	N	30	150
19-02D77	<20	700	1.5	7.02	<.01	7.02	2.0	3.92	N	15	100
19-03D77	<20	700	<1.5	8.25	.07	8.18	2.0	3.55	N	15	100

Table 3--continued

sample	B ppm S	BA ppm S	BE ppm S	Total C%	Inorg C%	Org C %	CA % S	CAO % X	CE ppm S	CO ppm S	CR ppm S
19-R3D77	N	700	N	8.08	.07	8.01	3.0	3.46	N	15	100
20-02D77	N	1,500	N	.32	<.01	.32	3.0	3.01	N	30	30
20-03D77	N	1,000	N	.82	.14	.68	2.0	3.44	N	20	50
21-02D77	N	1,500	N	.56	.07	.49	5.0	6.67	N	50	200
21-03D77	N	1,500	N	.69	.07	.62	3.0	4.79	N	30	150
22-02D77	N	1,500	N	.78	<.01	.78	3.0	4.26	N	20	150
22-03D77	N	1,500	1.5	1.87	<.01	1.87	3.0	3.68	<200	30	150
23-02D77	N	1,500	N	.39	<.01	.39	5.0	6.34	N	30	150
23-03D77	N	1,500	N	.72	<.01	.72	3.0	5.31	N	30	150
23-R3D77	N	1,500	N	.72	<.01	.72	3.0	1.69	N	30	200
24-02D77	N	200	N	1.90	<.01	1.90	3.0	6.33	N	30	100
24-03D77	20	500	<1.5	2.51	<.01	2.51	2.0	3.22	N	30	70
25-02D77	N	700	1.5	7.28	<.01	7.28	1.0	1.97	N	15	50
25-03D77	20	700	2.0	5.66	<.01	5.66	1.5	1.71	<200	15	70
26-02D77	N	300	N	1.06	<.01	1.06	2.0	3.33	N	20	150
26-R2D77	N	500	N	1.01	<.01	1.01	1.5	3.42	<200	15	200
26-03D77	<20	300	N	2.54	<.01	2.54	1.5	3.16	N	20	150
26-R3D77	<20	700	<1.5	2.44	<.01	2.44	2.0	3.20	N	20	150
27-02D77	N	500	N	3.68	<.01	3.68	3.0	4.10	N	20	150
27-03D77	<20	500	<1.5	5.83	<.01	5.83	1.5	2.77	N	20	100
28-02D77	N	300	N	2.38	<.01	2.38	2.0	3.79	N	20	150
28-03D77	<20	700	1.5	3.82	<.01	3.82	1.5	2.80	<200	20	150
29-02D77	N	1,000	1.5	2.23	<.01	2.23	3.0	4.85	N	30	70
29-03D77	<20	1,000	1.5	3.41	<.01	3.41	2.0	3.44	N	20	70
30-02D77	N	700	N	2.12	.13	1.99	1.5	2.11	N	20	20
30-03D77	N	1,000	1.5	3.95	.07	3.88	1.5	1.97	<200	50	100
31-02D77	N	700	2.0	1.19	<.01	1.19	1.0	1.68	N	20	150
31-03D77	<20	1,000	2.0	1.82	.07	1.75	1.0	1.65	N	15	150
32-02D77	N	500	N	4.75	<.01	4.75	1.5	2.05	N	30	100
32-03D77	<20	700	<1.5	7.63	.07	7.56	1.5	2.13	N	30	150
33-02D77	N	500	N	2.11	<.01	2.11	1.5	4.79	N	15	150
33-03D77	N	500	1.5	4.42	.07	4.35	2.0	2.76	N	15	100
33-R3D77	<20	500	2.0	4.40	<.01	4.40	3.0	2.85	N	20	150
35-02D77	N	1,500	N	.75	<.01	.75	3.0	5.36	<200	20	150
35-03D77	N	1,500	1.5	2.04	<.01	2.04	3.0	4.20	200	20	150
36-02D77	N	1,500	N	.35	.06	.29	5.0	6.54	N	20	200
36-03D77	N	1,500	N	.84	<.01	.84	5.0	5.35	N	30	150
37-02D77	N	1,500	N	.58	<.01	.58	3.0	5.93	N	30	150
37-03D77	N	1,500	N	1.21	.14	1.07	5.0	5.30	N	20	150
37-R3D77	N	1,500	N	1.19	.14	1.05	3.0	5.28	N	30	150

Table 3--continued

sample	B ppm S	BA ppm S	BE ppm S	Total C%	Inorg C%	Org C %	CA % S	CAO % X	CE ppm S	CO ppm S	CR ppm S
38-02D77	N	1,500	N	.35	<.01	.35	2.0	3.41	<200	20	150
38-03D77	N	1,500	2.0	1.55	<.01	1.55	3.0	3.19	<200	30	200
39-02D77	N	700	N	2.49	.14	2.35	2.0	3.58	N	15	150
39-03D77	<20	500	N	4.77	<.01	4.77	1.5	3.10	N	10	100
40-02D77	N	500	1.5	2.13	<.01	2.13	3.0	3.70	N	20	150
40-03D77	N	500	N	4.45	<.01	4.45	2.0	3.22	<200	20	150
41-02D77	N	1,000	1.5	2.33	<.01	2.33	1.5	2.66	<200	10	70
41-R2D77	N	700	1.5	2.41	<.01	2.41	1.5	2.65	<200	15	70
41-03D77	N	700	2.0	4.27	<.01	4.27	1.5	2.41	<200	15	50
41-R3D77	<20	1,000	1.5	4.22	<.01	4.22	1.5	2.40	200	20	70
42-02D77	N	1,500	1.5	1.74	<.01	1.74	2.0	3.20	N	10	70
42-03D77	<20	1,000	<1.5	3.42	<.01	3.42	2.0	2.94	<200	10	70
43-02D77	70	300	1.5	1.19	.14	1.05	.7	1.62	N	20	200
43-03D77	70	500	1.5	1.53	.28	1.25	1.5	1.92	N	15	150
44-02D77	20	300	N	1.35	.71	.64	3.0	3.81	N	10	70
44-03D77	30	300	<1.5	3.18	1.96	1.22	5.0	7.57	--	15	70
45-02D77	N	700	2.0	.67	<.01	.67	.7	1.33	<200	5	20
45-03D77	<20	1,000	2.0	1.70	<.01	1.70	1.5	1.58	N	20	50
46-02D77	N	500	1.5	1.52	<.01	1.52	2.0	2.23	200	20	100
46-03D77	<20	700	1.5	3.60	<.01	3.60	1.5	2.06	<200	20	150
47-02D77	50	500	1.5	1.03	.25	.78	2.0	2.14	N	20	150
47-03D77	70	700	1.5	1.54	.36	1.18	2.0	2.66	N	20	100
48-02D77	N	200	N	2.00	<.01	2.00	.7	1.44	N	30	200
48-03D77	<20	500	N	4.52	.07	4.45	1.0	1.62	N	50	300
49-02D77	N	500	1.5	.77	<.01	.77	1.0	1.74	N	15	150
49-03D77	20	700	1.5	1.68	<.01	1.68	1.0	1.75	N	20	150
50-02D77	<20	300	N	1.56	<.01	1.56	.7	1.32	N	10	100
50-03D77	20	300	<1.5	1.05	<.01	1.05	1.0	1.43	N	20	150
51-02D77	<20	500	<1.5	2.99	<.01	2.99	1.5	2.11	N	15	100
51-03D77	20	700	2.0	3.70	<.01	3.70	1.5	1.94	N	15	100
52-02D77	N	700	1.5	1.31	<.01	1.31	2.0	3.07	N	100	70
52-03D77	N	500	N	2.35	<.01	2.35	2.0	2.84	N	150	100
53-02D77	N	1,500	2.0	2.56	<.01	2.56	1.5	2.64	<200	10	30
53-03D77	N	1,500	3.0	6.75	<.01	6.75	1.5	2.58	200	10	70
54-02D77	N	700	N	1.62	<.01	1.62	2.0	3.10	N	50	70
54-03D77	N	700	N	3.48	<.01	3.48	2.0	2.98	N	70	100
55-02D77	N	1,000	1.5	2.57	<.01	2.57	1.5	2.58	<200	20	30
55-03D77	<20	1,500	1.5	3.46	<.01	3.46	1.5	2.39	300	20	100
56-02D77	<20	700	N	5.10	.07	5.03	2.0	2.81	N	15	100
56-03D77	N	700	1.5	8.16	<.01	8.16	2.0	2.99	N	10	70

Table 3--continued

sample	B ppm S	BA ppm S	BE ppm S	Total C%	Inorg C%	Org C %	CA % S	CAO % X	CE ppm S	CO ppm S	CR ppm S
57-02D77	N	700	1.5	.92	<.01	.92	1.5	2.59	N	20	50
57-03D77	N	1,000	2.0	1.91	<.01	1.91	3.0	2.79	<200	30	70
58-02D77	N	1,500	2.0	1.34	<.01	1.34	2.0	1.98	200	7	30
58-03D77	N	1,500	2.0	3.09	<.01	3.09	1.0	2.08	200	10	30
59-02D77	N	700	N	1.78	<.01	1.78	2.0	2.78	<200	30	70
59-03D77	N	1,000	2.0	3.65	<.01	3.65	1.5	2.69	200	50	70
60-02D77	N	500	1.5	2.65	<.01	2.65	2.0	3.10	N	15	70
60-03D77	N	500	2.0	3.58	<.01	3.58	2.0	2.60	N	15	100
60-R3D77	N	500	1.5	3.67	<.01	3.67	2.0	2.57	N	15	100
61-02D77	N	300	N	15.93	<.01	15.93	1.0	1.79	N	15	70
61-03D77	N	300	N	18.17	.07	18.10	.7	2.85	200	10	50
62-02D77	30	300	N	2.96	<.01	2.96	1.5	2.03	N	20	150
62-R2D77	20	500	1.5	.76	<.01	.76	1.5	1.96	<200	15	100
62-03D77	50	700	2.0	1.76	<.01	1.76	1.5	1.92	<200	20	150

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	MNO % X
1-02D77	30	3	4.68	30	5.0	3.29	70	.7	1.32	1,500	.117
1-03D77	30	3	5.11	20	3.0	3.37	100	.7	1.17	1,500	.257
2-02D77	50	5	7.92	30	3.0	1.89	N	1.5	3.62	700	.120
2-R2D77	100	5	6.04	30	2.0	2.12	N	1.5	1.78	700	.085
2-03D77	70	7	7.13	30	3.0	2.25	50	1.0	2.06	1,000	.137
3-02D77	70	7	12.47	30	3.0	1.64	70	1.5	3.42	1,000	.207
3-03D77	100	7	9.93	20	2.0	1.70	100	2.0	3.03	1,000	.182
4-02D77	20	5	6.46	30	3.0	2.36	N	1.0	1.81	1,000	.131
4-03D77	50	7	7.99	30	3.0	2.43	70	1.5	1.94	1,500	.190
5-02D77	20	5	5.04	30	3.0	2.49	100	.5	1.79	1,000	.130
5-03D77	30	5	5.29	30	3.0	2.97	150	.7	1.14	1,000	.187
6-02D77	15	3	4.01	30	3.0	3.28	300	.5	.78	700	.129
6-03D77	30	3	4.40	30	5.0	3.06	300	.5	1.04	1,500	.191
7-02D77	20	3	4.63	20	5.0	3.15	150	.5	.77	1,500	.322
7-03D77	50	3	5.03	30	3.0	3.17	300	.5	.97	3,000	.452
8-02D77	30	3	5.10	30	2.0	2.01	50	1.5	2.51	700	.089
8-03D77	70	5	5.19	30	3.0	2.28	70	1.5	2.37	700	.090
9-02D77	30	5	4.92	20	2.0	1.72	70	1.5	2.18	1,000	.147
9-03D77	50	5	5.41	30	3.0	1.91	100	1.0	2.27	1,000	.134
9-R3D77	50	3	5.46	30	3.0	1.91	150	1.5	2.27	1,000	.134
10-02D77	150	7	9.27	20	2.0	1.34	70	1.5	2.61	3,000	.496
10-03D77	100	7	9.11	20	1.5	1.53	100	1.5	2.47	5,000	.602
11-02D77	50	7	6.76	20	3.0	2.20	70	1.5	2.16	1,000	.108
11-03D77	70	7	7.29	30	3.0	2.58	150	1.5	2.64	700	.124
12-02D77	50	10	12.98	20	1.5	1.48	50	5.0	5.08	1,500	.158
12-03D77	30	7	5.13	20	3.0	1.68	50	1.5	2.24	700	.109
13-02D77	15	3	3.92	20	3.0	2.96	150	.7	1.06	700	.099
13-03D77	30	3	4.82	20	5.0	3.29	300	.7	1.52	700	.166
14-02D77	30	10	8.55	30	2.0	1.87	N	3.0	3.96	1,000	.128
14-03D77	30	7	7.41	20	3.0	2.08	50	1.5	3.25	700	.144
15-02D77	15	5	6.56	20	2.0	1.89	150	1.0	1.82	700	.107
15-03D77	20	3	5.86	20	3.0	2.28	100	1.0	1.95	500	.104
16-02D77	30	7	7.87	20	2.0	1.72	N	3.0	4.22	1,000	.115
16-03D77	50	10	8.46	30	2.0	1.84	50	3.0	3.78	1,000	.137
17-02D77	30	3	4.12	20	3.0	2.01	70	.7	1.48	700	.093
17-03D77	50	3	4.95	15	3.0	2.08	70	1.0	1.90	500	.125
18-02D77	70	10	10.15	30	2.0	1.63	N	5.0	4.36	1,500	.137
18-03D77	70	10	7.98	30	2.0	1.88	50	3.0	3.70	1,500	.131
19-02D77	100	5	6.28	20	3.0	1.82	50	1.5	2.48	700	.135
19-03D77	100	3	5.15	20	3.0	1.92	100	1.0	2.15	700	.128

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	MNO % X
19-R3D77	100	5	5.48	20	2.0	1.91	50	1.0	2.05	700	.121
20-02D77	70	7	8.56	30	3.0	2.42	<50	1.5	1.96	1,000	.109
20-03D77	70	7	7.26	30	3.0	2.31	N	1.5	2.43	1,000	.153
21-02D77	30	7	8.32	20	2.0	1.78	N	2.0	4.30	700	.120
21-03D77	50	5	7.59	20	2.0	2.14	N	2.0	3.97	700	.147
22-02D77	20	5	5.63	20	2.0	1.83	50	1.5	2.69	700	.111
22-03D77	30	5	5.89	30	2.0	1.93	70	1.5	2.66	1,500	.166
23-02D77	30	7	7.93	20	2.0	1.77	70	3.0	3.89	700	.110
23-03D77	30	7	7.99	20	2.0	1.86	<50	2.0	3.61	700	.121
23-R3D77	50	7	5.92	30	2.0	2.14	N	3.0	1.95	1,000	.084
24-02D77	50	7	10.65	20	2.0	1.34	N	1.5	4.48	1,500	.275
24-03D77	100	5	6.96	20	3.0	1.98	N	1.5	2.54	3,000	.362
25-02D77	70	3	5.04	20	3.0	2.24	70	.7	1.46	1,500	.284
25-03D77	70	3	4.43	20	3.0	2.26	100	1.0	1.29	1,500	.222
26-02D77	50	7	7.78	20	1.5	1.37	N	1.5	2.93	1,000	.127
26-R2D77	30	5	7.73	20	2.0	1.40	150	1.5	2.76	700	.132
26-03D77	100	7	7.55	30	3.0	1.86	50	1.5	2.95	1,000	.126
26-R3D77	100	5	7.52	30	3.0	1.85	50	1.5	2.92	1,000	.125
27-02D77	70	7	7.50	20	1.0	1.21	50	1.5	2.76	1,500	.160
27-03D77	70	5	5.99	30	2.0	1.71	70	1.0	2.28	1,000	.170
28-02D77	50	5	7.00	30	2.0	1.34	N	1.5	3.74	1,000	.132
28-03D77	50	5	6.14	20	3.0	1.89	70	1.5	2.65	700	.140
29-02D77	30	5	7.84	30	2.0	1.59	70	1.5	2.93	1,500	.189
29-03D77	50	5	6.61	20	3.0	1.97	70	1.0	2.26	1,000	.229
30-02D77	15	3	2.97	30	5.0	3.43	N	.3	.78	3,000	.428
30-03D77	30	3	3.64	30	5.0	3.45	100	.5	.96	10,000	1.070
31-02D77	70	7	8.06	30	3.0	2.43	70	1.5	2.36	700	.096
31-03D77	70	7	7.14	30	3.0	2.28	100	1.0	1.93	500	.090
32-02D77	70	5	6.78	20	2.0	1.72	50	1.5	2.08	1,500	.229
32-03D77	150	5	5.19	30	3.0	2.15	100	1.0	1.93	1,500	.098
33-02D77	20	3	7.90	20	2.0	1.94	N	1.5	4.19	700	.130
33-03D77	70	3	5.18	30	3.0	1.76	70	1.5	2.22	700	.111
33-R3D77	50	5	5.06	30	2.0	1.77	50	1.5	2.27	700	.114
35-02D77	15	5	6.22	20	3.0	2.30	100	1.5	3.17	700	.090
35-03D77	30	5	6.46	20	3.0	2.44	150	1.5	2.59	500	.084
36-02D77	30	7	9.02	20	1.5	1.69	N	5.0	4.60	700	.125
36-03D77	50	7	8.30	20	2.0	1.88	70	3.0	3.68	1,000	1.290
37-02D77	20	5	6.79	20	2.0	1.98	<50	2.0	3.84	700	.132
37-03D77	50	10	7.34	30	2.0	2.01	50	3.0	3.69	1,500	.167
37-R3D77	30	7	7.18	20	2.0	2.03	50	2.0	3.50	700	.163

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	MNO % X
38-02D77	20	5	4.95	20	3.0	2.34	100	1.5	1.81	700	.091
38-03D77	30	7	5.82	30	3.0	2.57	150	1.5	1.74	1,000	.126
39-02D77	30	5	6.07	20	2.0	1.54	70	1.5	2.80	700	.093
39-03D77	50	3	5.07	20	3.0	1.85	50	1.0	2.11	500	.081
40-02D77	50	7	8.01	20	2.0	1.37	70	1.5	3.00	700	.132
40-03D77	100	7	7.03	30	3.0	1.79	100	1.5	2.79	1,000	.106
41-02D77	15	3	5.22	20	3.0	2.54	100	1.0	1.68	700	.112
41-R2D77	20	3	5.27	20	3.0	2.54	100	1.0	1.70	700	.111
41-03D77	30	3	5.18	20	3.0	2.54	150	.7	1.59	700	.132
41-R3D77	50	5	4.73	30	5.0	2.60	200	1.0	1.78	700	.141
42-02D77	15	3	4.79	20	3.0	2.35	100	1.0	1.74	500	.094
42-03D77	30	5	4.46	30	3.0	2.45	150	1.0	1.59	1,000	.092
43-02D77	100	5	7.55	30	5.0	3.95	50	1.0	2.34	500	.098
43-03D77	50	5	6.55	20	7.0	4.67	50	1.0	2.20	500	.100
44-02D77	30	3	4.91	20	5.0	2.83	50	1.0	2.13	700	.117
44-03D77	30	3	5.06	20	5.0	3.63	70	1.5	3.58	1,000	.130
45-02D77	7	2	2.69	20	3.0	3.15	70	.2	.47	1,000	.098
45-03D77	20	3	3.92	30	3.0	3.00	50	.5	.88	1,000	.161
46-02D77	30	5	5.50	20	3.0	2.22	150	1.5	1.65	700	.119
46-03D77	30	5	6.36	30	3.0	2.34	100	1.0	1.94	700	.168
47-02D77	50	5	5.00	20	3.0	2.49	50	1.5	1.76	700	.130
47-03D77	50	3	5.09	20	5.0	3.50	50	1.0	2.38	1,000	.176
48-02D77	150	7	7.70	20	2.0	1.63	N	1.5	2.76	1,000	.127
48-03D77	150	7	8.19	30	3.0	1.85	N	1.5	3.04	1,000	.160
49-02D77	30	5	5.60	15	2.0	2.21	50	1.0	1.72	700	.124
49-03D77	50	5	6.80	20	5.0	2.80	70	1.0	2.04	700	.178
50-02D77	30	3	5.13	20	2.0	2.04	N	1.0	1.75	500	.079
50-03D77	50	5	5.94	30	3.0	2.15	50	1.0	2.06	1,000	.109
51-02D77	50	5	6.60	30	3.0	1.92	70	1.0	2.04	1,000	.263
51-03D77	50	5	5.34	30	3.0	2.34	70	1.5	1.94	700	.096
52-02D77	70	5	6.64	30	2.0	1.60	70	1.5	2.59	500	.093
52-03D77	100	7	7.06	30	3.0	2.01	100	2.0	2.99	700	.099
53-02D77	15	5	5.78	20	5.0	3.76	100	.5	1.16	700	.106
53-03D77	20	3	4.25	20	5.0	3.47	200	.3	1.06	1,000	.150
54-02D77	50	5	6.47	20	2.0	1.93	50	1.5	2.11	700	.116
54-03D77	70	5	6.61	30	3.0	2.26	100	1.0	2.45	1,000	.145
55-02D77	50	3	6.40	20	3.0	2.46	200	1.0	1.65	500	.088
55-03D77	70	5	6.42	30	3.0	2.71	300	1.0	1.89	700	.095
56-02D77	30	3	3.59	30	3.0	2.34	N	1.0	1.70	700	.071
56-03D77	30	3	4.00	30	3.0	2.29	50	1.0	1.47	500	.071

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	MNO % X
57-02D77	30	3	5.44	20	3.0	2.69	70	1.0	1.51	500	.084
57-03D77	50	5	5.77	30	3.0	2.81	150	1.5	1.78	700	.097
58-02D77	15	5	4.56	20	3.0	3.20	150	.7	.94	700	.084
58-03D77	30	3	5.03	20	3.0	3.15	150	.7	1.20	700	.133
59-02D77	30	5	6.20	20	3.0	2.61	70	1.0	1.72	700	.120
59-03D77	50	5	6.63	30	3.0	2.72	150	1.0	1.92	1,000	.177
60-02D77	50	5	6.66	30	2.0	1.51	70	1.5	2.55	700	.110
60-03D77	50	7	6.43	30	2.0	1.78	70	1.5	2.59	700	.097
60-R3D77	50	5	6.65	30	2.0	1.76	N	1.5	2.59	700	.097
61-02D77	150	3	5.39	10	1.0	1.52	100	.7	1.44	3,000	.550
61-03D77	100	2	8.68	10	1.0	1.83	100	.5	1.55	2,000	.790
62-02D77	30	5	5.39	30	5.0	2.65	70	1.5	1.80	1,000	.112
62-R2D77	30	3	5.53	20	3.0	2.60	100	1.0	1.66	700	.117
62-03D77	50	5	6.04	20	3.0	3.19	70	1.0	1.90	700	.125

Table 3--continued

sample	MO ppm S	NA % S	NA2O % X	NB ppm S	ND ppm S	NI ppm S	P2O5 % X	PB ppm S	SC ppm S	SE ppm X	SIO2 % X
1-02D77	N	3.0	2.57	<10	N	30	.14	50	15	.5	63.61
1-03D77	N	3.0	2.47	<10	<70	50	.15	50	15	2.1	57.42
2-02D77	N	3.0	2.94	<10	--	70	.34	30	15	.3	56.16
2-R2D77	N	3.0	2.95	<10	--	70	.11	30	15	.7	68.06
2-03D77	N	3.0	2.88	<10	N	70	.19	50	20	.7	59.70
3-02D77	N	2.0	2.31	<10	N	70	.20	20	30	.9	51.99
3-03D77	N	2.0	2.27	<10	100	70	.14	30	30	1.5	51.07
4-02D77	N	3.0	2.71	N	--	50	.10	30	15	1.0	66.10
4-03D77	<3	3.0	2.57	<10	<70	100	.15	50	20	.8	59.24
5-02D77	5	3.0	.90	10	<70	10	.16	50	15	.7	69.84
5-03D77	10	3.0	2.17	10	100	15	.28	50	15	4.8	53.53
6-02D77	5	3.0	2.45	10	200	10	.26	50	10	1.3	63.98
6-03D77	7	5.0	2.19	10	300	50	.26	50	15	2.3	56.12
7-02D77	5	3.0	2.29	<10	150	15	.41	50	10	2.8	58.58
7-03D77	10	3.0	2.24	10	300	100	.34	70	15	3.8	50.63
8-02D77	N	3.0	2.71	<10	N	70	.10	50	10	.8	65.93
8-03D77	N	3.0	2.52	<10	N	50	.15	50	15	.4	61.20
9-02D77	N	3.0	2.58	<10	100	70	.17	50	15	.4	66.26
9-03D77	<3	3.0	2.25	<10	<70	70	.22	70	15	1.2	59.96
9-R3D77	<3	3.0	2.15	<10	100	70	.22	70	15	1.1	59.98
10-02D77	7	3.0	1.68	<10	N	150	.26	70	20	2.9	49.00
10-03D77	7	2.0	1.27	N	<70	100	.34	50	20	3.1	44.81
11-02D77	N	3.0	2.37	<10	N	70	.16	20	15	.3	65.80
11-03D77	7	3.0	2.30	<10	100	150	.14	30	20	1.4	58.87
12-02D77	N	3.0	2.72	<10	N	70	.19	20	30	.7	53.19
12-03D77	N	2.0	2.72	N	N	70	.15	20	20	.2	64.97
13-02D77	N	3.0	2.91	<10	100	20	.16	30	10	.9	67.09
13-03D77	7	3.0	2.74	10	300	50	.19	50	15	1.9	62.84
14-02D77	N	3.0	3.06	N	--	150	.16	20	20	.2	57.04
14-03D77	N	3.0	2.84	N	N	70	.24	20	20	<.1	57.39
15-02D77	N	3.0	3.18	<10	70	20	.26	30	15	1.5	65.43
15-03D77	5	3.0	2.96	<10	70	20	.19	30	10	.8	58.93
16-02D77	N	3.0	3.15	<10	--	70	.16	20	30	.3	56.62
16-03D77	N	3.0	2.89	N	N	100	.21	30	20	.3	55.34
17-02D77	N	3.0	2.70	<10	N	50	.13	30	7	.5	68.29
17-03D77	N	3.0	2.38	<10	N	50	.19	30	10	.9	60.06
18-02D77	N	3.0	3.10	N	--	150	.18	20	30	.2	54.28
18-03D77	N	3.0	2.85	N	N	150	.21	20	20	.4	54.67
19-02D77	10	3.0	2.00	<10	N	50	.22	20	15	2.4	51.02
19-03D77	15	2.0	1.72	<10	N	50	.27	20	10	2.9	51.12

Table 3--continued

sample	MO ppm S	NA % S	NA2O % X	NB ppm S	ND ppm S	NI ppm S	P2O5 % X	PB ppm S	SC ppm S	SE ppm X	SIO2 % X
19-R3D77	15	3.0	1.80	<10	N	50	.23	20	15	2.6	50.29
20-02D77	10	3.0	2.80	<10	N	15	.17	20	10	.3	61.50
20-03D77	N	3.0	2.53	<10	--	20	.28	20	15	1.0	56.94
21-02D77	N	3.0	3.04	N	--	100	.23	20	30	<.1	54.83
21-03D77	N	2.0	2.72	N	--	70	.24	20	20	.4	55.08
22-02D77	N	3.0	3.69	<10	N	70	.15	20	15	.4	61.36
22-03D77	N	3.0	3.52	<10	N	70	.22	30	15	.5	58.85
23-02D77	N	3.0	3.13	N	N	70	.17	30	20	.2	57.26
23-03D77	N	2.0	3.08	N	N	70	.20	20	20	4.7	55.69
23-R3D77	N	3.0	2.76	10	--	70	.13	30	30	<.1	67.20
24-02D77	N	2.0	1.88	N	--	70	.19	70	30	.6	53.61
24-03D77	N	2.0	1.61	<10	--	70	.34	100	15	1.0	57.28
25-02D77	N	2.0	1.76	<10	N	20	.34	70	10	1.3	60.80
25-03D77	N	3.0	1.68	<10	N	30	.30	70	15	.8	60.80
26-02D77	N	3.0	2.22	N	--	70	.16	20	15	.6	63.87
26-R2D77	N	3.0	2.26	N	<70	70	.16	20	20	.2	64.27
26-03D77	N	3.0	2.29	<10	N	100	.20	30	15	.7	57.58
26-R3D77	N	3.0	2.20	<10	N	100	.19	30	20	1.1	57.92
27-02D77	N	3.0	2.39	<10	N	70	.18	50	15	.6	57.98
27-03D77	N	3.0	2.12	<10	N	100	.21	50	15	.9	54.99
28-02D77	N	3.0	2.18	N	--	150	.17	30	10	.4	60.40
28-03D77	N	3.0	2.16	<10	N	70	.21	50	15	1.0	57.64
29-02D77	N	3.0	2.39	<10	N	50	.29	50	15	.6	57.72
29-03D77	N	3.0	2.38	<10	<70	50	.28	50	15	1.3	56.67
30-02D77	N	5.0	3.71	N	--	20	.13	70	5	.4	66.22
30-03D77	7	5.0	3.23	<10	N	70	.25	100	15	.8	57.56
31-02D77	7	3.0	2.38	<10	N	100	.14	50	15	.6	60.28
31-03D77	10	3.0	2.04	<10	<70	50	.13	50	20	.5	59.67
32-02D77	<3	2.0	1.96	N	N	70	.15	100	15	1.5	56.64
32-03D77	<3	3.0	2.29	<10	<70	100	.18	70	15	2.5	62.52
33-02D77	N	3.0	2.62	N	--	50	.21	30	15	.5	55.40
33-03D77	N	3.0	2.27	<10	N	70	.19	50	15	1.3	58.43
33-R3D77	N	3.0	2.41	<10	N	70	.21	50	15	1.4	59.08
35-02D77	N	2.0	2.68	<10	<70	70	.46	20	20	<.1	62.07
35-03D77	3	3.0	2.68	10	150	70	.24	30	20	.7	57.27
36-02D77	N	2.0	2.96	N	--	70	.17	15	30	<.1	56.14
36-03D77	N	3.0	2.93	<10	N	70	.21	20	30	2.6	56.09
37-02D77	N	2.0	3.22	<10	N	70	.17	20	20	.1	56.86
37-03D77	N	3.0	2.78	<10	N	100	.22	20	20	.2	55.55
37-R3D77	N	2.0	2.78	N	N	70	.21	20	20	.2	55.94

Table 3--continued

sample	MO ppm S	NA % S	NA2O % X	NB ppm S	ND ppm S	NI ppm S	P2O5 % X	PB ppm S	SC ppm S	SE ppm X	SIO2 % X
38-02D77	N	3.0	3.36	<10	<70	70	.26	30	15	.6	65.17
38-03D77	7	3.0	3.42	<10	100	150	.18	30	20	.2	60.38
39-02D77	N	3.0	2.36	N	N	70	.20	20	15	.3	62.24
39-03D77	N	3.0	2.33	<10	N	50	.19	30	10	1.3	57.78
40-02D77	N	3.0	2.28	<10	N	100	.23	20	20	.5	61.17
40-03D77	N	3.0	2.01	<10	<70	70	.24	30	15	.5	56.05
41-02D77	7	3.0	2.35	<10	70	20	.19	30	15	1.8	64.51
41-R2D77	7	3.0	2.45	<10	<70	20	.21	30	10	.6	63.92
41-03D77	N	2.0	2.29	10	100	20	.21	30	15	.9	57.98
41-R3D77	10	3.0	2.32	10	150	30	.23	50	15	.9	58.36
42-02D77	3	2.0	2.53	<10	<70	30	.22	50	20	.3	66.22
42-03D77	<3	3.0	2.58	10	100	30	.22	30	15	.7	61.32
43-02D77	N	1.0	.71	<10	N	70	.16	15	15	.6	60.12
43-03D77	N	.7	.50	<10	N	70	.15	10	15	.6	58.51
44-02D77	N	2.0	2.00	<10	N	30	.19	20	15	<.1	66.23
44-03D77	N	2.0	1.16	<10	N	30	.13	20	15	.3	54.69
45-02D77	N	3.0	3.03	15	N	10	.08	30	10	.5	72.12
45-03D77	N	3.0	2.99	<10	N	20	.12	50	15	.3	66.27
46-02D77	5	3.0	3.03	<10	100	50	.14	30	15	.6	66.22
46-03D77	7	3.0	2.44	<10	<70	70	.17	50	15	1.1	58.79
47-02D77	N	1.0	.87	<10	N	70	.15	15	15	1.0	69.38
47-03D77	N	1.0	.80	<10	N	70	.19	15	15	.7	62.88
48-02D77	N	3.0	1.90	N	--	150	.10	20	10	.5	63.52
48-03D77	N	3.0	1.71	<10	--	100	.16	30	15	.9	56.60
49-02D77	N	2.0	2.22	<10	N	70	.11	20	10	.3	69.68
49-03D77	3	3.0	1.84	<10	<70	70	.15	20	15	.8	62.05
50-02D77	N	3.0	3.43	N	--	70	.13	20	7	1.2	65.73
50-03D77	N	3.0	2.43	10	N	70	.21	30	15	.9	61.37
51-02D77	N	3.0	1.60	<10	N	70	.23	50	15	.3	51.03
51-03D77	N	3.0	2.09	<10	N	50	.20	70	15	.5	58.90
52-02D77	N	3.0	2.52	<10	N	50	.14	30	15	.3	63.98
52-03D77	N	3.0	2.32	10	<70	100	.18	30	15	.6	58.22
53-02D77	10	3.0	2.50	10	70	10	.26	30	10	--	63.38
53-03D77	15	3.0	2.54	<10	150	30	.18	30	7	--	55.14
54-02D77	N	2.0	2.70	<10	N	30	.15	30	15	.4	64.53
54-03D77	<3	3.0	2.32	<10	<70	50	.24	30	15	.7	58.80
55-02D77	N	3.0	2.13	<10	150	15	.40	50	15	.9	62.78
55-03D77	3	3.0	2.02	10	200	20	.32	50	15	.6	56.53
56-02D77	10	3.0	2.34	<10	--	50	.16	20	7	1.8	62.31
56-03D77	10	3.0	2.39	<10	N	30	.15	20	10	3.2	55.20

Table 3--continued

sample	MO ppm S	NA % S	NA2O % X	NB ppm S	ND ppm S	NI ppm S	P2O5 % X	PB ppm S	SC ppm S	SE ppm X	SIO2 % X
57-02D77	N	2.0	2.71	<10	N	20	.21	30	10	.9	68.05
57-03D77	7	3.0	2.65	10	100	30	.19	30	15	.7	62.75
58-02D77	5	3.0	2.58	10	150	10	.28	50	15	.6	69.18
58-03D77	7	3.0	2.42	10	150	10	.24	30	15	1.3	60.74
59-02D77	N	2.0	2.56	<10	N	30	.20	20	15	.5	64.77
59-03D77	7	3.0	2.41	<10	100	50	.20	30	15	.9	57.89
60-02D77	5	3.0	3.14	<10	N	50	.14	50	30	.5	60.20
60-03D77	<3	3.0	2.29	<10	N	50	.18	30	20	.5	57.07
60-R3D77	N	3.0	2.33	<10	--	50	.18	30	20	2.0	56.72
61-02D77	<3	1.5	1.06	N	<70	150	.45	70	7	4.0	44.84
61-03D77	N	.7	.24	N	70	100	.64	70	7	1.2	45.58
62-02D77	N	3.0	2.28	<10	N	70	.15	30	15	<.1	68.98
62-R2D77	N	3.0	2.24	<10	<70	70	.11	30	15	.5	69.13
62-03D77	N	3.0	1.85	<10	N	70	.15	30	15	1.1	63.82

Table 3--continued

sample	SN ppm S	SR ppm S	TI % S	TIO2 % X	V ppm S	Y ppm S	YB ppm S	ZN ppm A	ZR ppm S
1-02D77	N	200	.30	.52	100	30	2.0	82	100
1-03D77	30	200	.30	.54	100	30	2.0	109	150
2-02D77	N	100	.50	.87	100	20	2.0	69	100
2-R2D77	N	150	.50	.62	100	20	2.0	68	100
2-03D77	N	200	.30	.68	150	30	5.0	99	150
3-02D77	N	150	.70	1.96	150	30	3.0	121	150
3-03D77	N	200	.50	1.16	200	50	5.0	115	200
4-02D77	N	150	.50	.77	150	20	1.5	67	100
4-03D77	30	200	.50	.75	150	30	3.0	96	150
5-02D77	N	300	.70	.55	70	20	3.0	80	500
5-03D77	10	300	.30	.82	100	20	3.0	111	300
6-02D77	N	200	.30	.65	70	70	5.0	69	150
6-03D77	30	300	.30	.69	70	70	5.0	90	500
7-02D77	10	150	.20	.69	50	50	3.0	83	300
7-03D77	70	150	.30	.62	70	50	5.0	105	300
8-02D77	N	150	.30	.41	70	15	1.5	70	50
8-03D77	N	200	.30	.57	100	70	7.0	91	200
9-02D77	N	300	.30	.53	100	30	5.0	78	150
9-03D77	N	300	.30	.64	100	50	5.0	100	150
9-R3D77	N	200	.30	.65	100	50	5.0	103	150
10-02D77	N	200	.30	.61	150	30	3.0	182	100
10-03D77	N	150	.30	.65	150	30	3.0	188	70
11-02D77	N	200	.50	.68	100	30	3.0	62	300
11-03D77	50	200	.50	.75	150	30	3.0	82	300
12-02D77	N	1,000	1.00	1.36	300	20	2.0	108	150
12-03D77	N	1,000	.50	.52	200	15	2.0	97	150
13-02D77	N	150	.30	.55	50	50	5.0	43	300
13-03D77	30	200	.30	.71	70	70	5.0	70	200
14-02D77	N	1,000	.70	.90	200	15	--	82	150
14-03D77	10	1,000	.50	.80	200	10	2.0	89	100
15-02D77	N	300	.30	.59	70	30	3.0	53	700
15-03D77	N	500	.30	.67	70	20	3.0	79	300
16-02D77	N	1,500	.70	.82	150	15	1.5	79	100
16-03D77	N	1,000	.70	.94	200	20	--	95	200
17-02D77	N	150	.15	.39	50	10	1.5	69	70
17-03D77	N	200	.20	.53	70	20	2.0	99	100
18-02D77	N	1,500	.70	1.06	300	10	--	89	200
18-03D77	N	1,500	.70	.85	150	10	--	90	150
19-02D77	N	300	.30	.60	100	20	2.0	75	100
19-03D77	N	300	.30	.64	70	30	5.0	79	200

Table 3--continued

sample	SN ppm S	SR ppm S	TI % S	TIO2 % X	V ppm S	Y ppm S	YB ppm S	ZN ppm A	ZR ppm S
19-R3D77	N	300	.30	.63	100	30	3.0	78	150
20-02D77	N	700	.50	.62	150	10	2.0	66	70
20-03D77	N	700	.30	.65	150	20	1.5	77	150
21-02D77	N	1,000	.50	.90	200	10	1.5	82	100
21-03D77	N	1,000	.30	.80	150	10	1.5	84	100
22-02D77	N	1,000	.50	.68	150	10	1.0	70	100
22-03D77	N	1,000	.50	.71	150	20	2.0	94	200
23-02D77	N	1,500	.70	.81	200	20	2.0	77	100
23-03D77	N	1,500	.50	.86	200	10	1.0	86	150
23-R3D77	N	1,500	.70	.63	200	20	2.0	87	150
24-02D77	N	150	.30	.89	150	20	2.0	146	50
24-03D77	N	200	.50	.78	150	30	3.0	157	300
25-02D77	N	200	.30	.68	70	20	2.0	129	200
25-03D77	N	200	.70	.76	70	30	3.0	122	200
26-02D77	N	150	.30	.83	100	15	1.5	80	50
26-R2D77	N	200	.20	.84	100	20	2.0	83	300
26-03D77	N	200	.50	.90	100	30	7.0	102	100
26-R3D77	N	200	.30	.91	150	20	3.0	101	300
27-02D77	N	200	.50	.78	100	15	2.0	117	70
27-03D77	N	300	.30	.81	100	20	2.0	120	150
28-02D77	N	200	.20	.64	70	15	1.5	109	70
28-03D77	N	300	.30	.71	100	15	1.5	116	150
29-02D77	N	500	.50	.86	150	30	2.0	115	100
29-03D77	N	500	.50	.86	100	20	2.0	128	150
30-02D77	N	150	.15	.25	30	100	7.0	129	100
30-03D77	50	200	.15	.39	70	50	2.0	249	150
31-02D77	N	150	.30	.79	100	15	1.5	105	150
31-03D77	N	300	.50	.92	150	30	3.0	93	500
32-02D77	N	150	.30	.54	100	30	2.0	154	70
32-03D77	N	150	.30	.56	150	50	3.0	164	100
33-02D77	N	300	.20	.83	100	15	1.0	83	50
33-03D77	N	200	.50	.60	100	20	2.0	100	100
33-R3D77	N	200	.30	.61	70	20	2.0	98	150
35-02D77	N	1,000	.50	.86	150	30	3.0	61	200
35-03D77	N	700	.50	.94	150	50	5.0	73	300
36-02D77	N	1,500	.50	.91	200	10	--	81	100
36-03D77	N	1,000	.70	.90	200	20	2.0	95	150
37-02D77	N	1,000	.50	.71	150	10	1.5	75	100
37-03D77	N	1,000	.70	.81	150	20	--	86	150
37-R3D77	N	1,500	.50	.78	150	10	1.0	93	200

Table 3--continued

sample	SN ppm S	SR ppm S	TI % S	TIO2 % X	V ppm S	Y ppm S	YB ppm S	ZN ppm A	ZR ppm S
38-02D77	20	700	.50	.59	100	20	2.0	56	500
38-03D77	100	1,000	.50	.65	150	30	3.0	76	300
39-02D77	N	200	.30	.60	100	20	2.0	87	100
39-03D77	N	300	.30	.67	100	15	1.5	80	150
40-02D77	N	200	.50	.90	150	20	3.0	97	500
40-03D77	N	300	.30	.94	100	30	5.0	104	300
41-02D77	N	200	.30	.60	70	20	2.0	65	70
41-R2D77	N	200	.30	.59	70	20	2.0	66	150
41-03D77	N	200	.50	.72	100	30	2.0	74	200
41-R3D77	N	300	.30	.74	100	50	5.0	80	200
42-02D77	N	300	.30	.66	100	20	3.0	70	300
42-03D77	N	300	.50	.72	70	30	3.0	76	700
43-02D77	N	150	.30	.77	70	15	1.5	74	100
43-03D77	N	200	.30	.74	70	15	2.0	80	100
44-02D77	N	150	.20	.50	70	20	2.0	57	70
44-03D77	N	200	.30	.58	70	50	3.0	64	150
45-02D77	N	150	.20	.41	30	20	2.0	38	200
45-03D77	N	200	.30	.57	70	20	3.0	70	300
46-02D77	N	150	.30	.55	100	30	3.0	65	200
46-03D77	10	200	.30	.68	100	30	3.0	90	150
47-02D77	N	150	.30	.54	70	20	2.0	68	150
47-03D77	N	200	.30	.68	70	30	7.0	84	200
48-02D77	N	100	.20	.63	70	10	1.5	123	70
48-03D77	N	150	.30	.80	150	30	5.0	153	200
49-02D77	N	150	.30	.55	70	15	1.5	61	100
49-03D77	10	200	.30	.68	100	20	2.0	90	200
50-02D77	N	200	.30	.57	70	20	1.5	69	70
50-03D77	10	200	.30	.72	100	20	2.0	96	300
51-02D77	N	150	.30	.64	70	20	1.5	94	100
51-03D77	N	300	.30	.63	100	20	2.0	107	150
52-02D77	N	200	.30	.63	70	20	1.5	87	70
52-03D77	N	300	.30	.80	150	30	2.0	99	150
53-02D77	N	300	.50	.72	70	50	5.0	66	700
53-03D77	20	200	.30	.67	70	50	5.0	84	200
54-02D77	N	200	.50	.78	150	20	1.5	74	500
54-03D77	N	200	.50	.80	150	30	3.0	96	200
55-02D77	N	200	.30	.79	70	30	3.0	81	200
55-03D77	N	500	.30	.89	100	50	3.0	95	200
56-02D77	N	150	.30	.47	70	10	1.0	54	70
56-03D77	N	200	.50	.64	70	20	2.0	58	150

Table 3--continued

sample	SN ppm S	SR ppm S	TI % S	TIO2 % X	V ppm S	Y ppm S	YB ppm S	ZN ppm A	ZR ppm S
57-02D77	N	150	.50	.72	100	20	1.5	58	150
57-03D77	N	200	.70	.80	150	30	3.0	73	300
58-02D77	N	200	.50	.61	70	50	5.0	58	500
58-03D77	N	300	.30	.78	70	30	5.0	80	500
59-02D77	N	150	.30	.78	100	20	2.0	66	200
59-03D77	N	300	.50	.80	150	30	3.0	91	300
60-02D77	N	200	.70	1.09	150	30	3.0	86	100
60-03D77	N	300	.70	1.03	150	20	2.0	97	150
60-R3D77	N	300	.50	1.00	150	20	2.0	91	150
61-02D77	N	70	.15	.38	30	50	3.0	387	50
61-03D77	N	70	.10	.56	30	30	3.0	357	50
62-02D77	N	150	.30	.55	70	30	3.0	54	200
62-R2D77	N	150	.30	.53	70	30	2.0	54	300
62-03D77	N	200	.30	.64	100	30	3.0	72	200

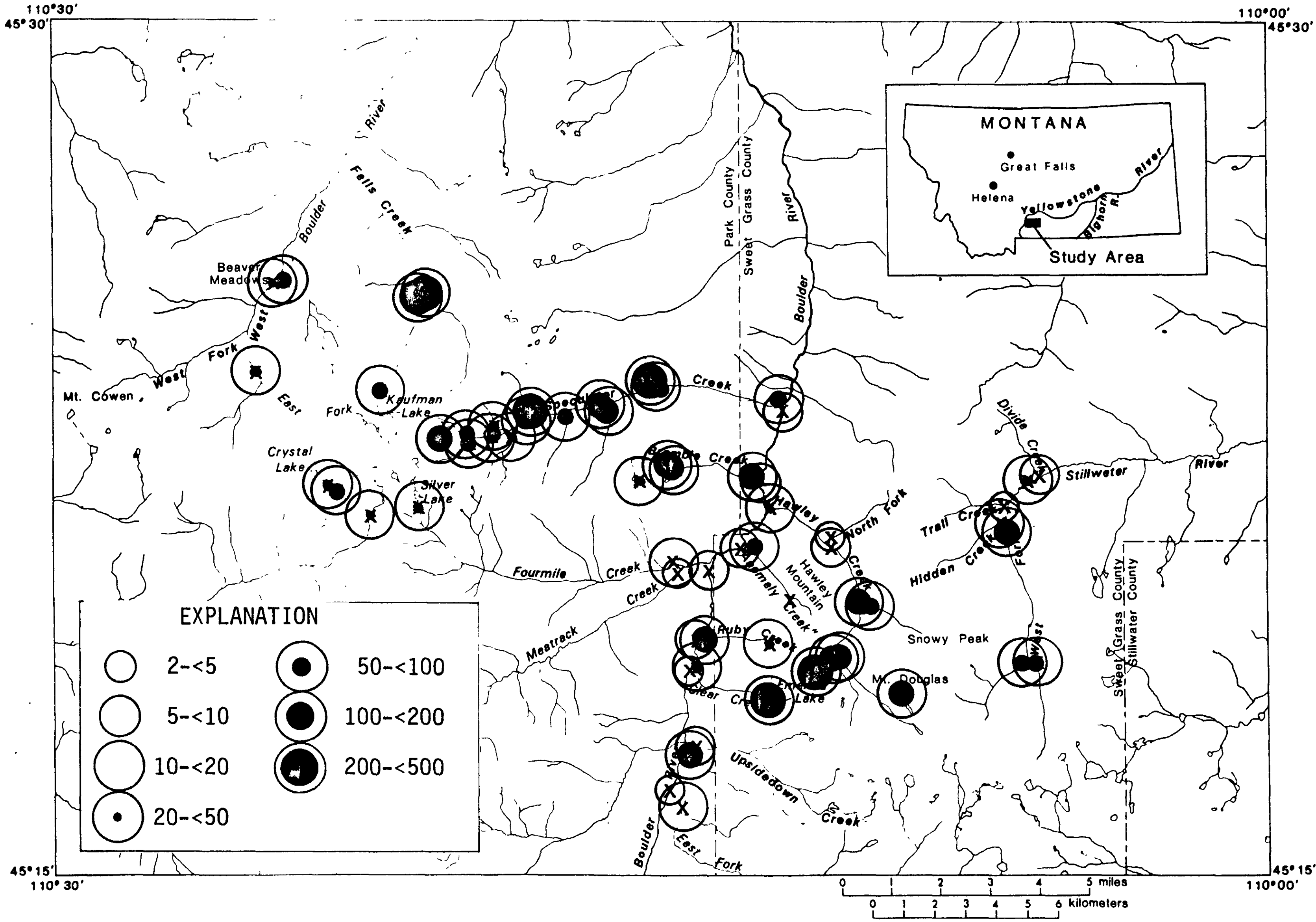

Figure 2-1.--Uranium data (ppm) at sample sites ("X").

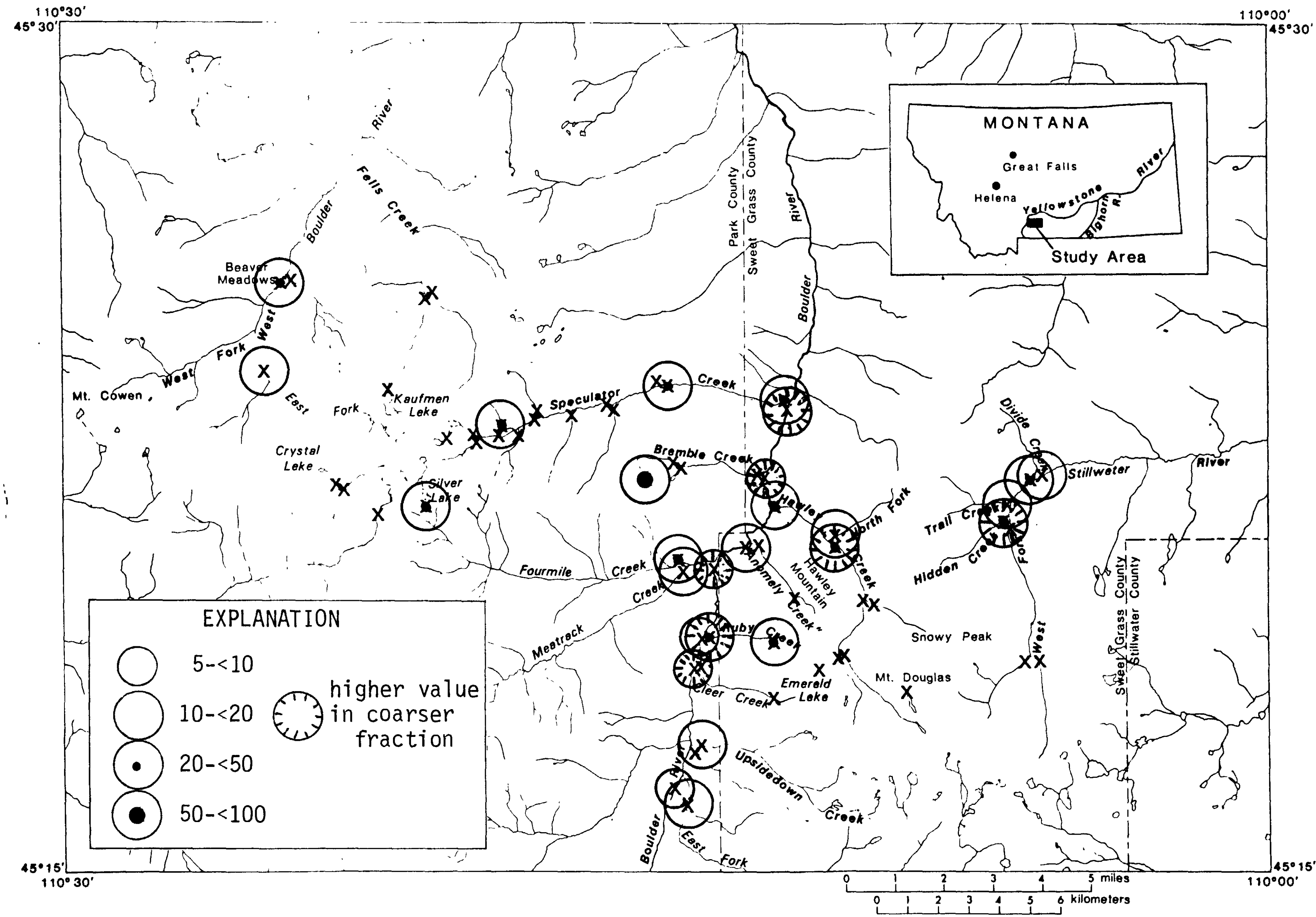

Figure 2-2.--Thorium data (ppm) at sample sites ("X").

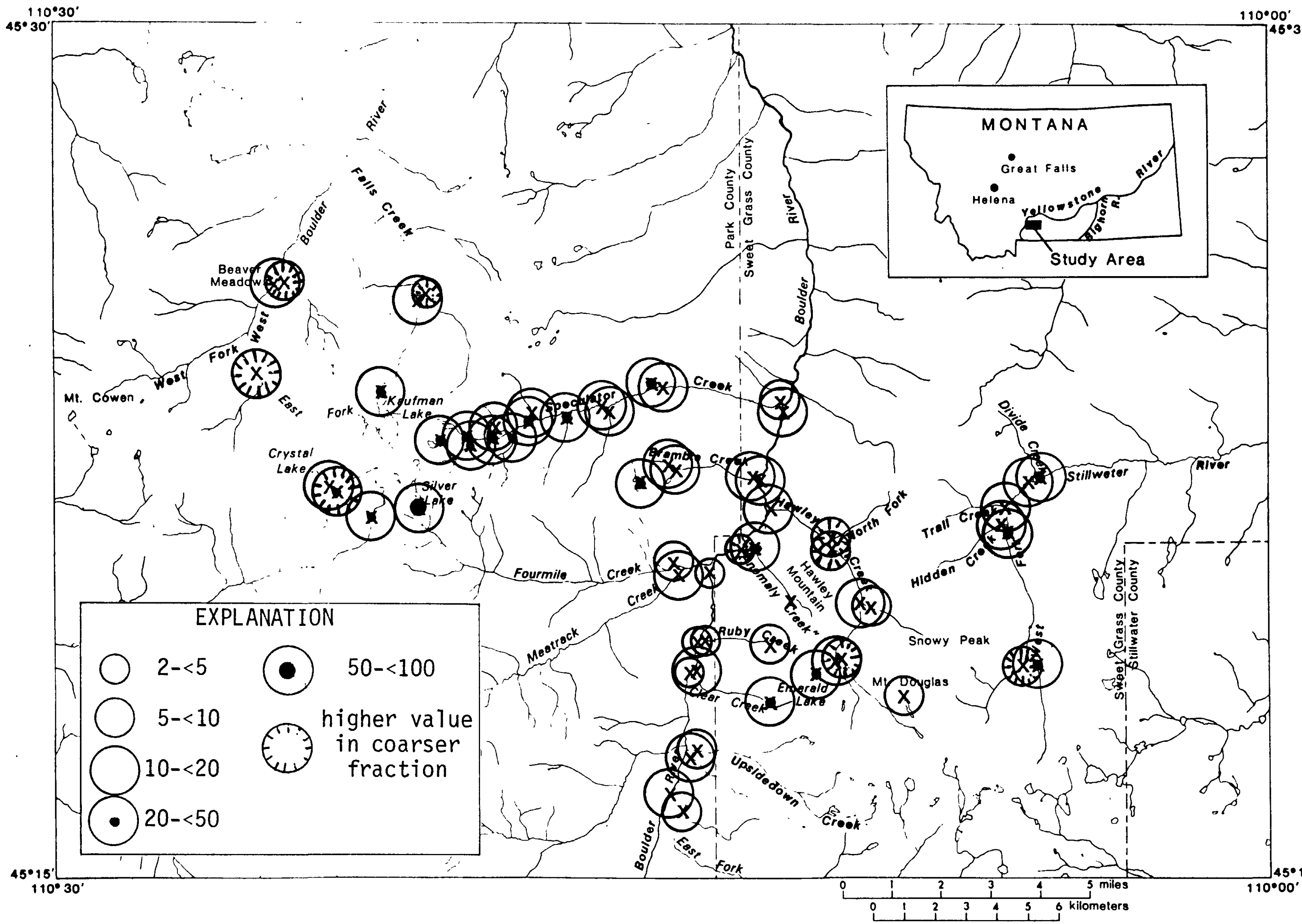

Figure 2-3.--Arsenic data (ppm) at sample sites ("X").

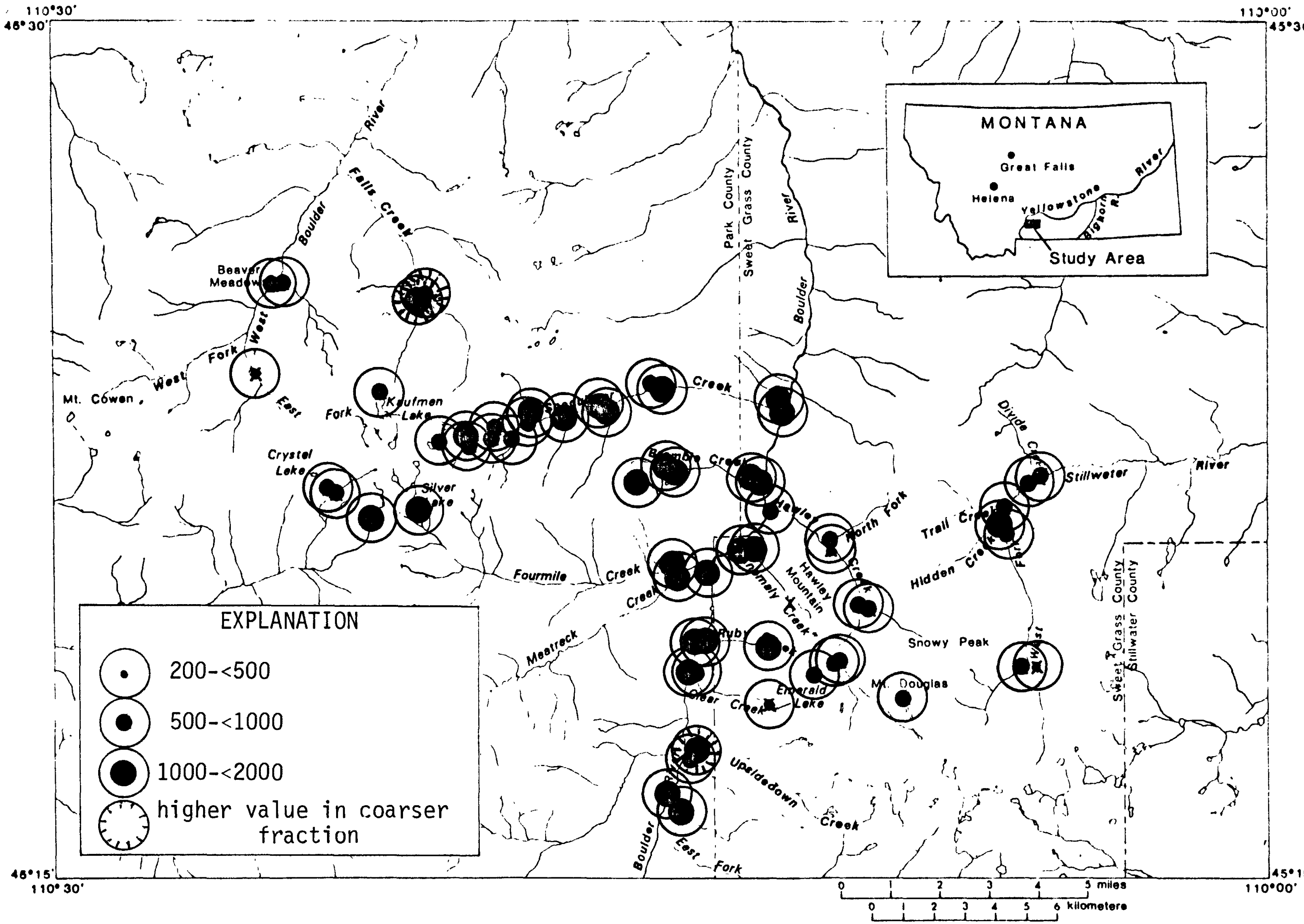

Figure 2-4.--Barium data (ppm) at sample sites ("X").

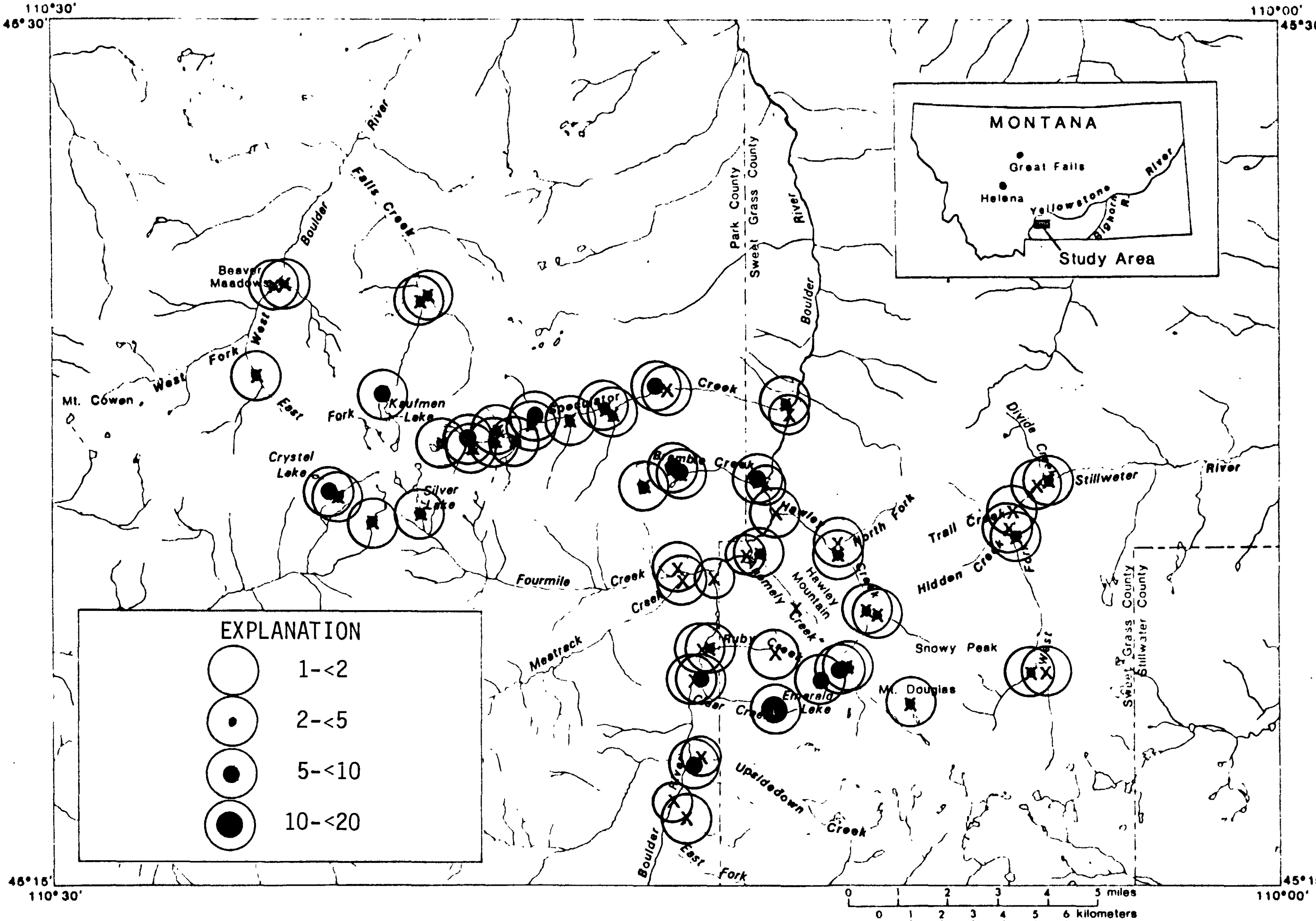

Figure 2-5.--Total carbon data (%) at sample sites ("X").

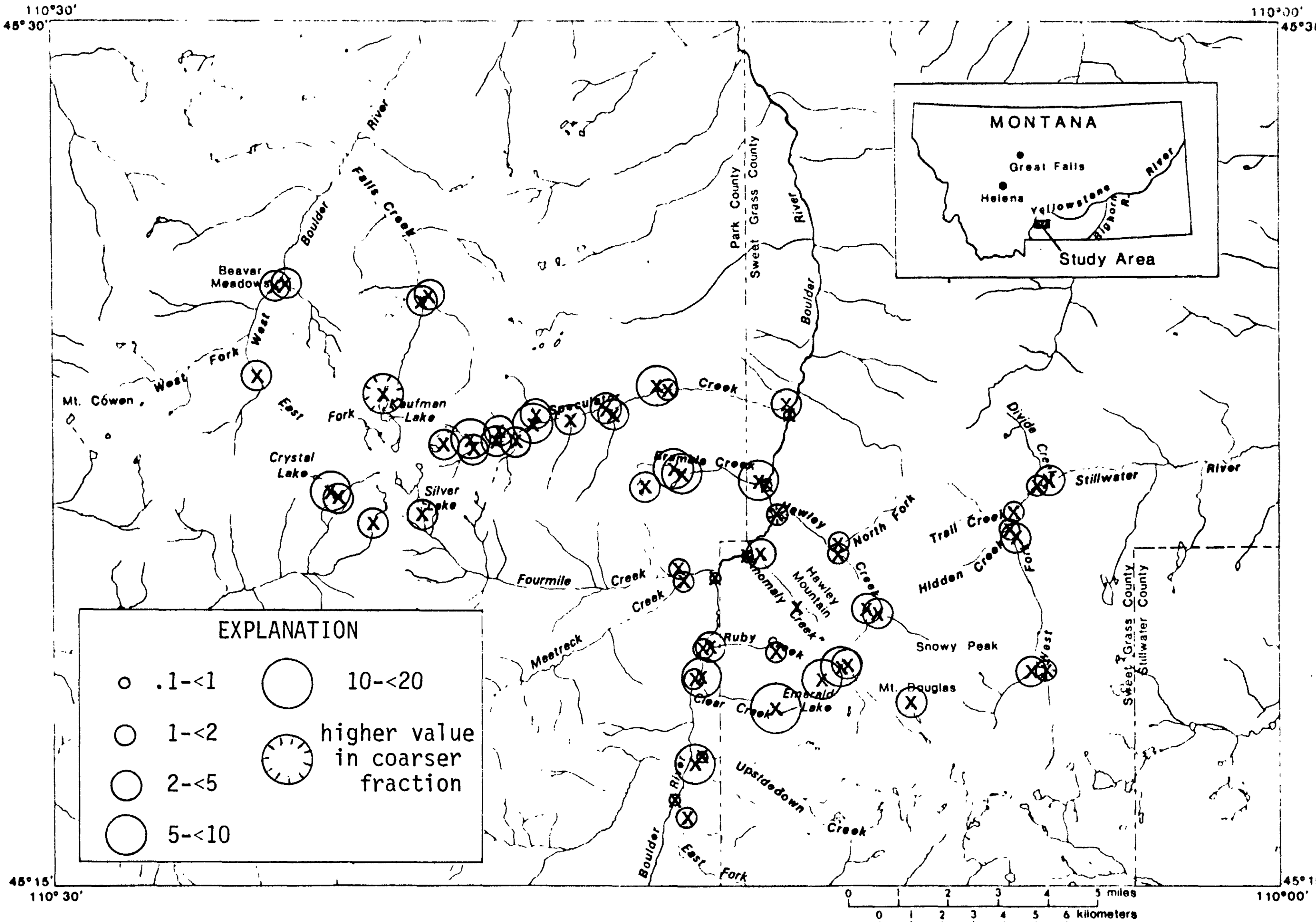

Figure 2-6.--Organic carbon data (%) at sample sites ("X").

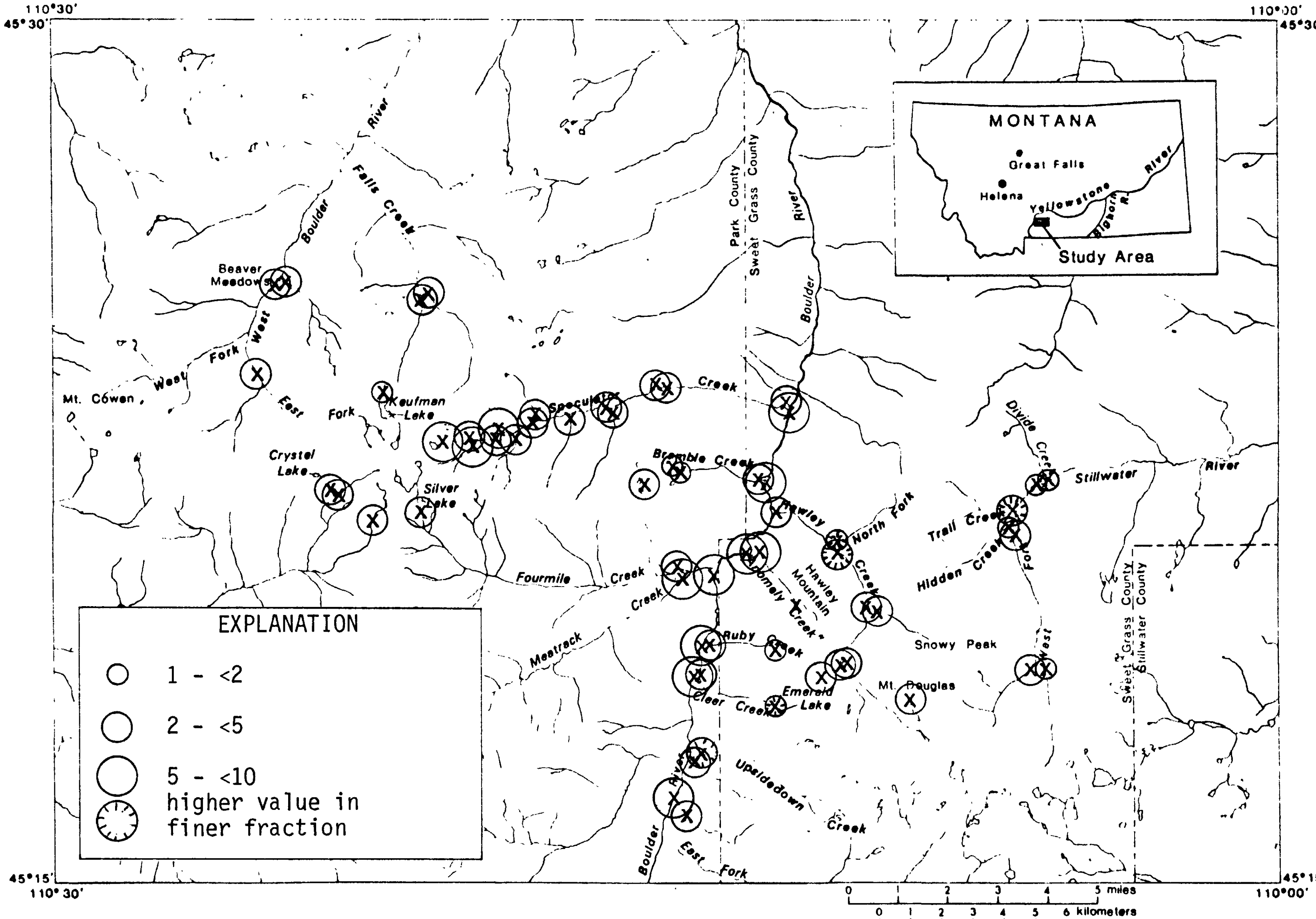

Figure 2-7.--CaO data (%) at sample sites ("X"). Coarser fraction data plotted.

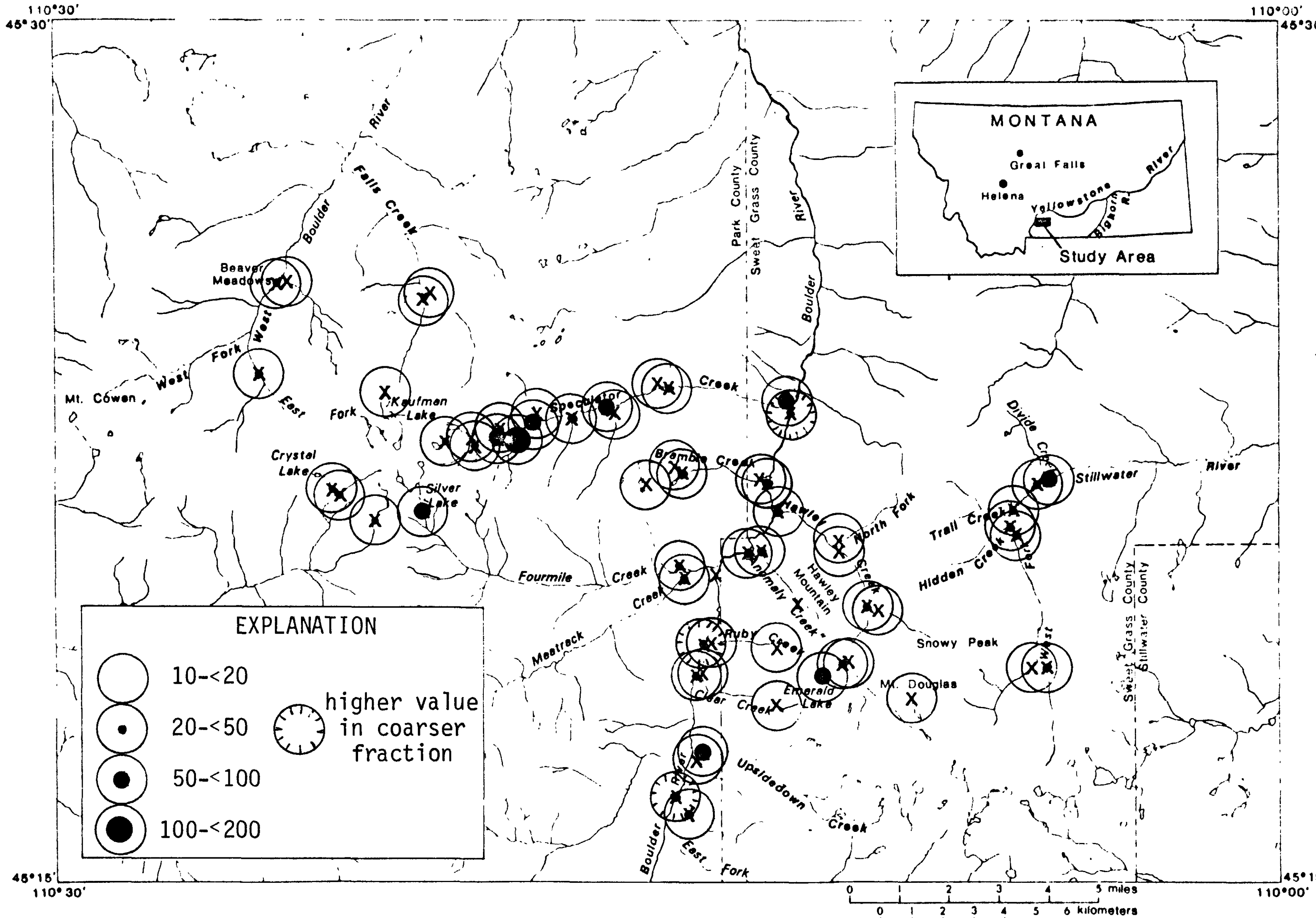

Figure 2-8.--Cobalt data (ppm) at sample sites ("X").

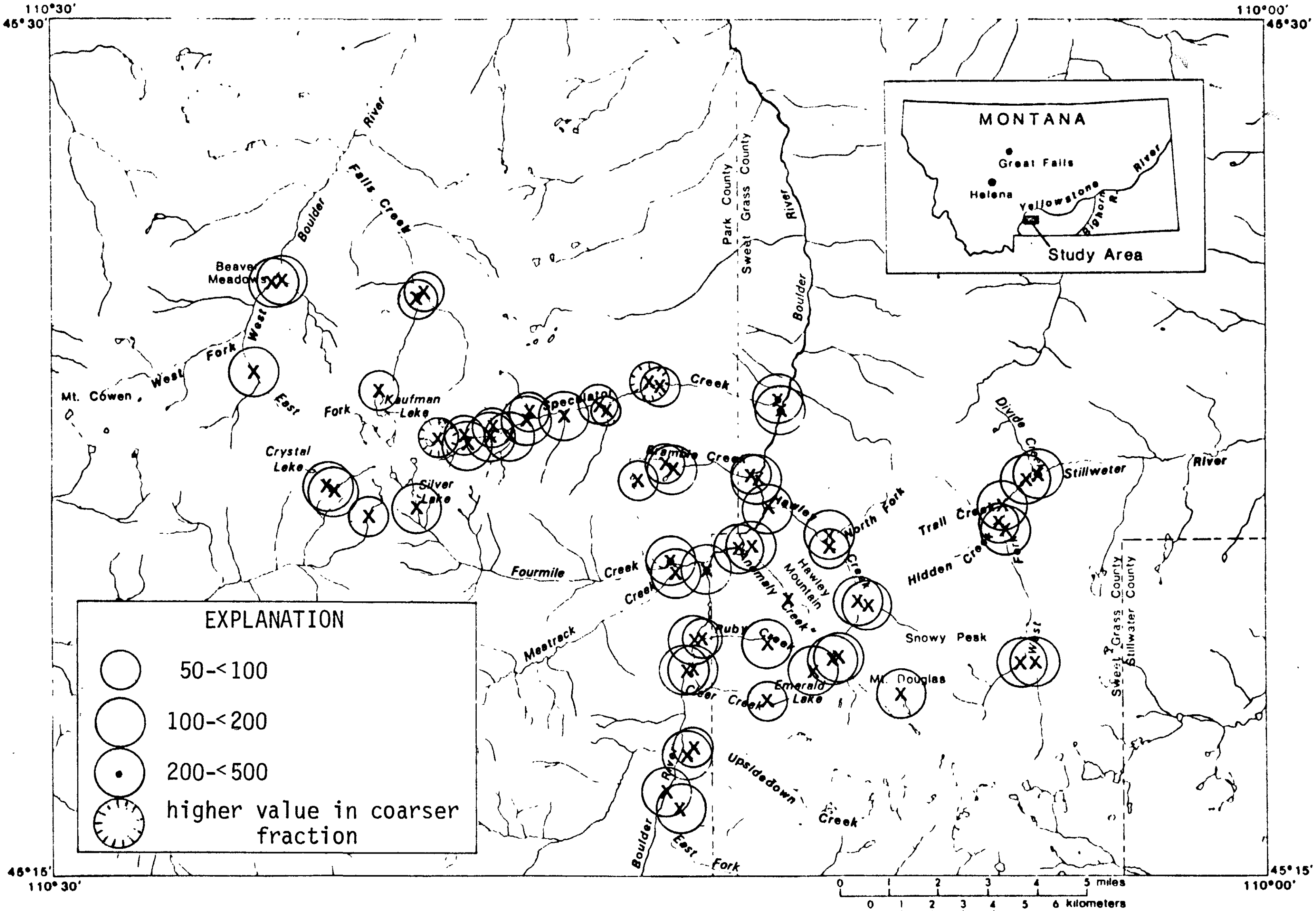

Figure 2-9.--Chromium data (ppm) at sample sites ("X").

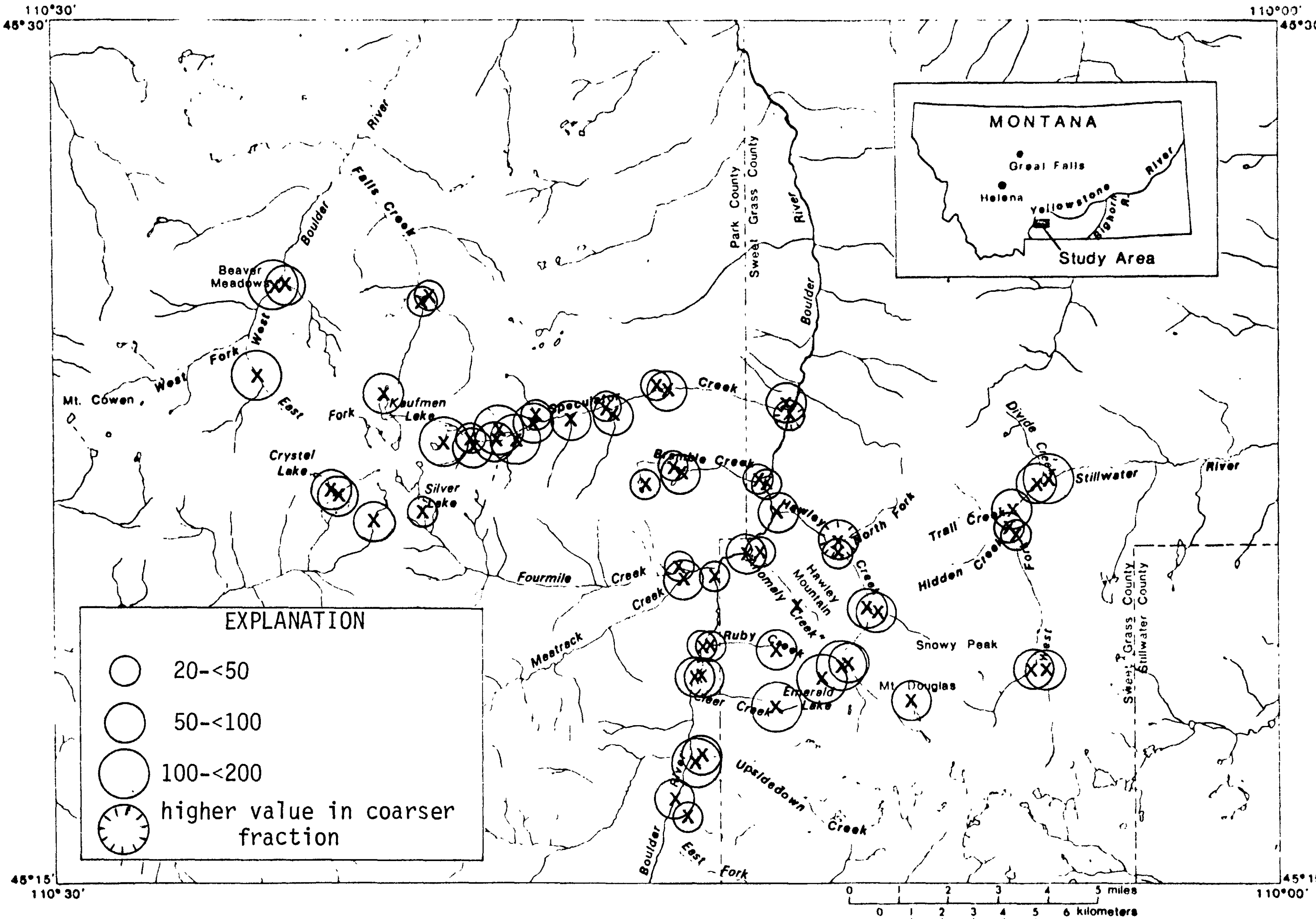

Figure 2-10.--Copper data (ppm) at sample sites ("X").

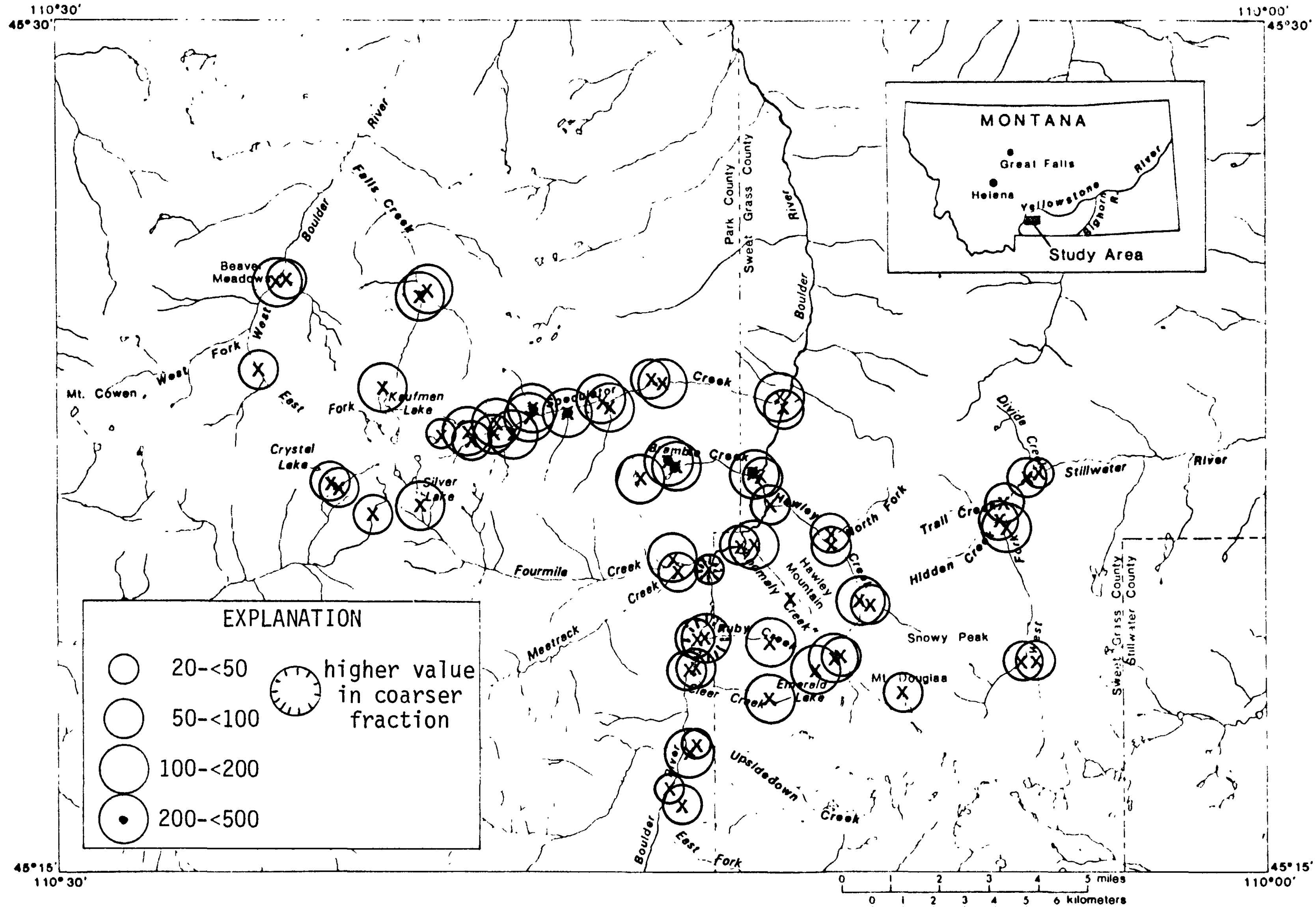

Figure 2-11.--Lanthanum data (ppm) at sample sites ("X").

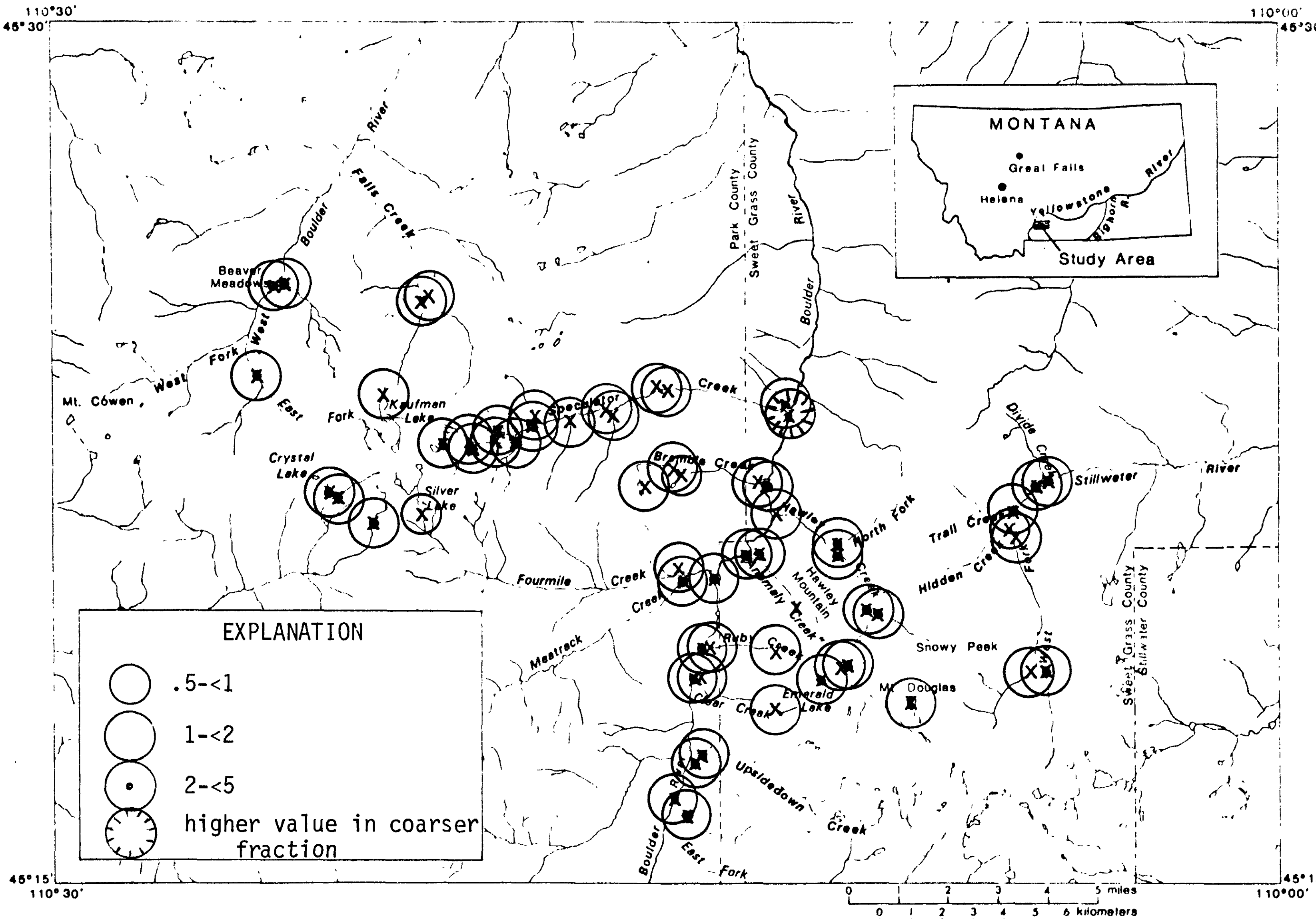

Figure 2-12.--MgO data (%) at sample sites ("X").

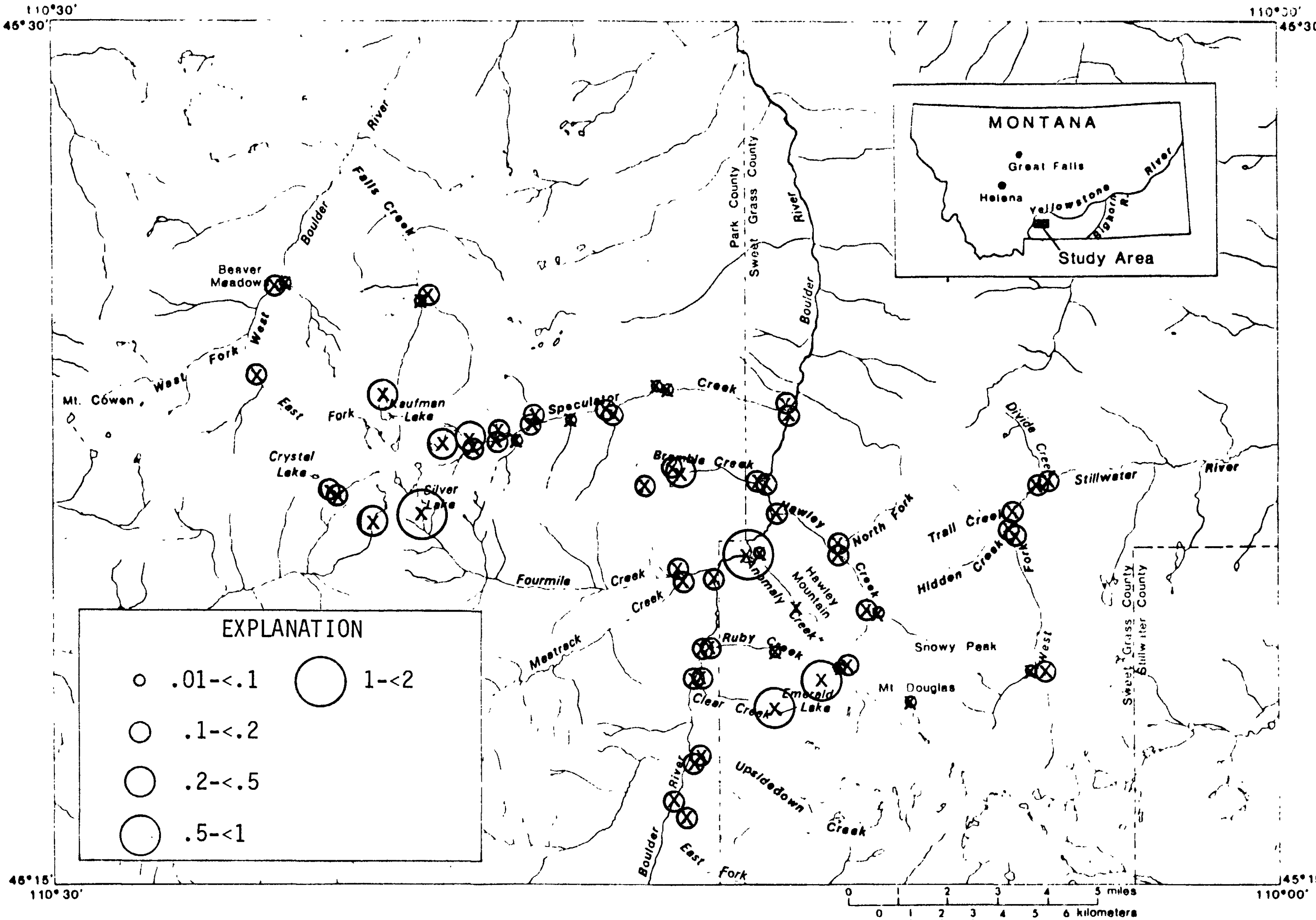

Figure 2-13.--MnO data (%) at sample sites ("X").

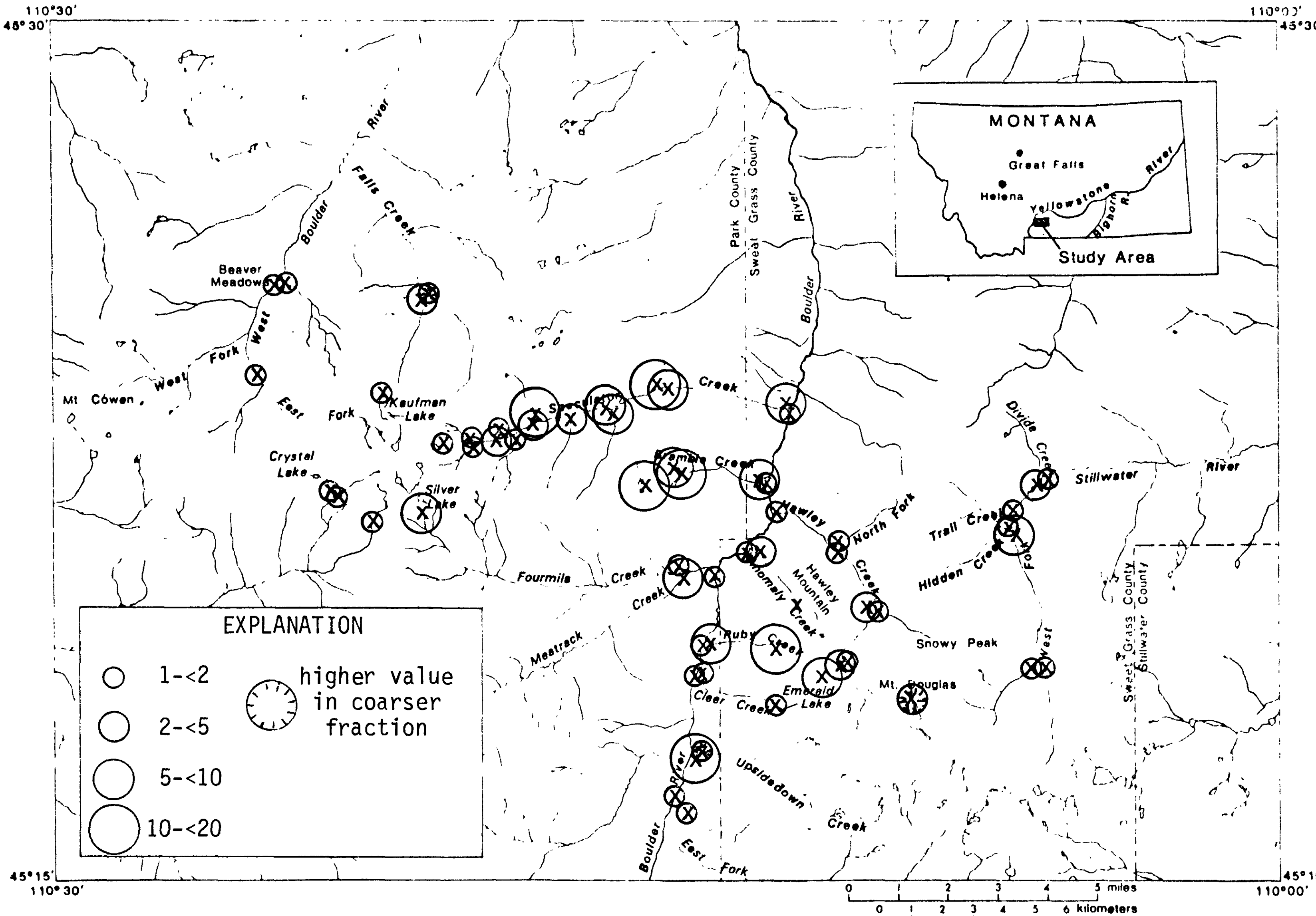

Figure 2-14.--Molybdenum data (ppm) at sample sites ("X").

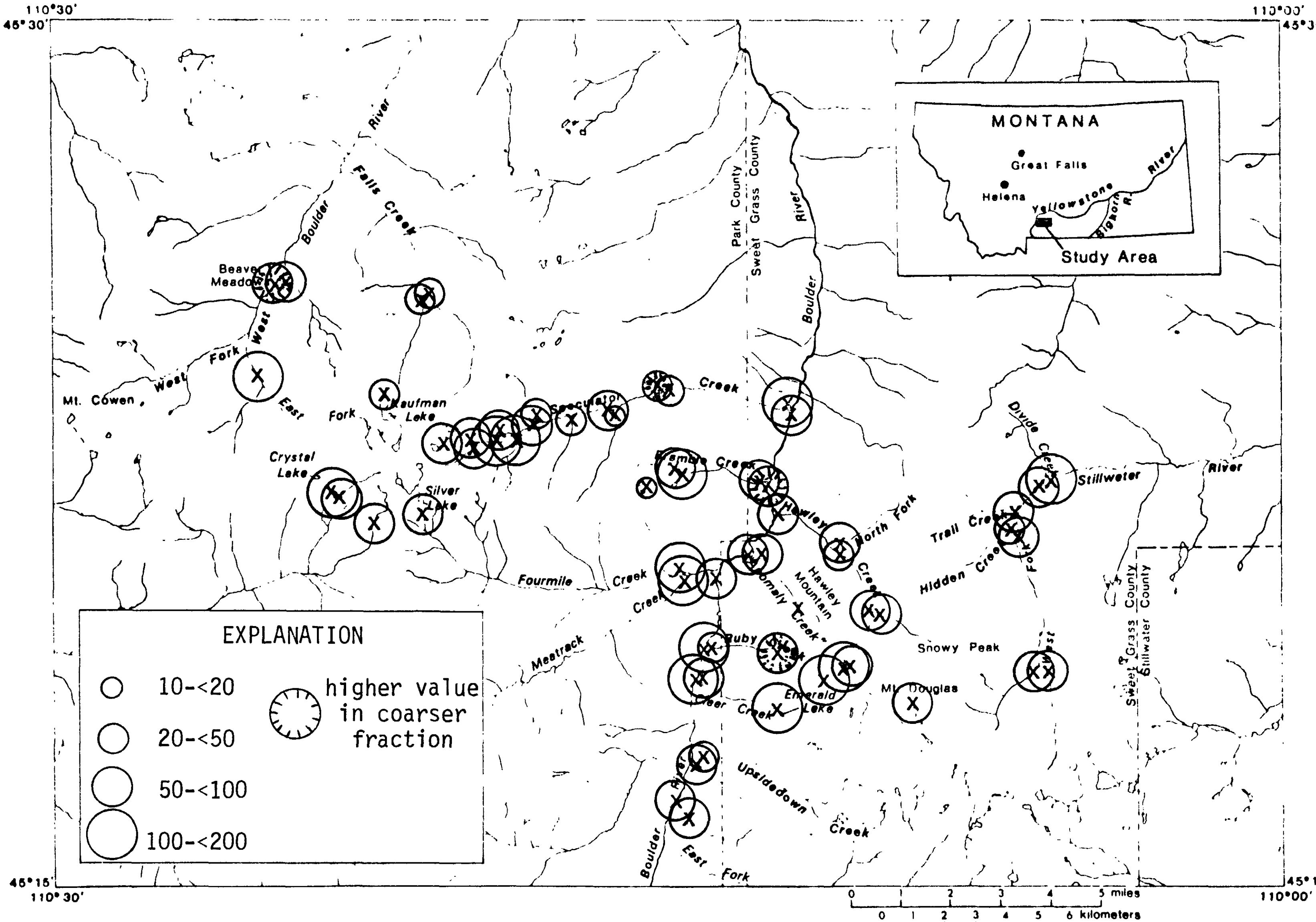

Figure 2-15.--Nickel data (ppm) at sample sites ("X").

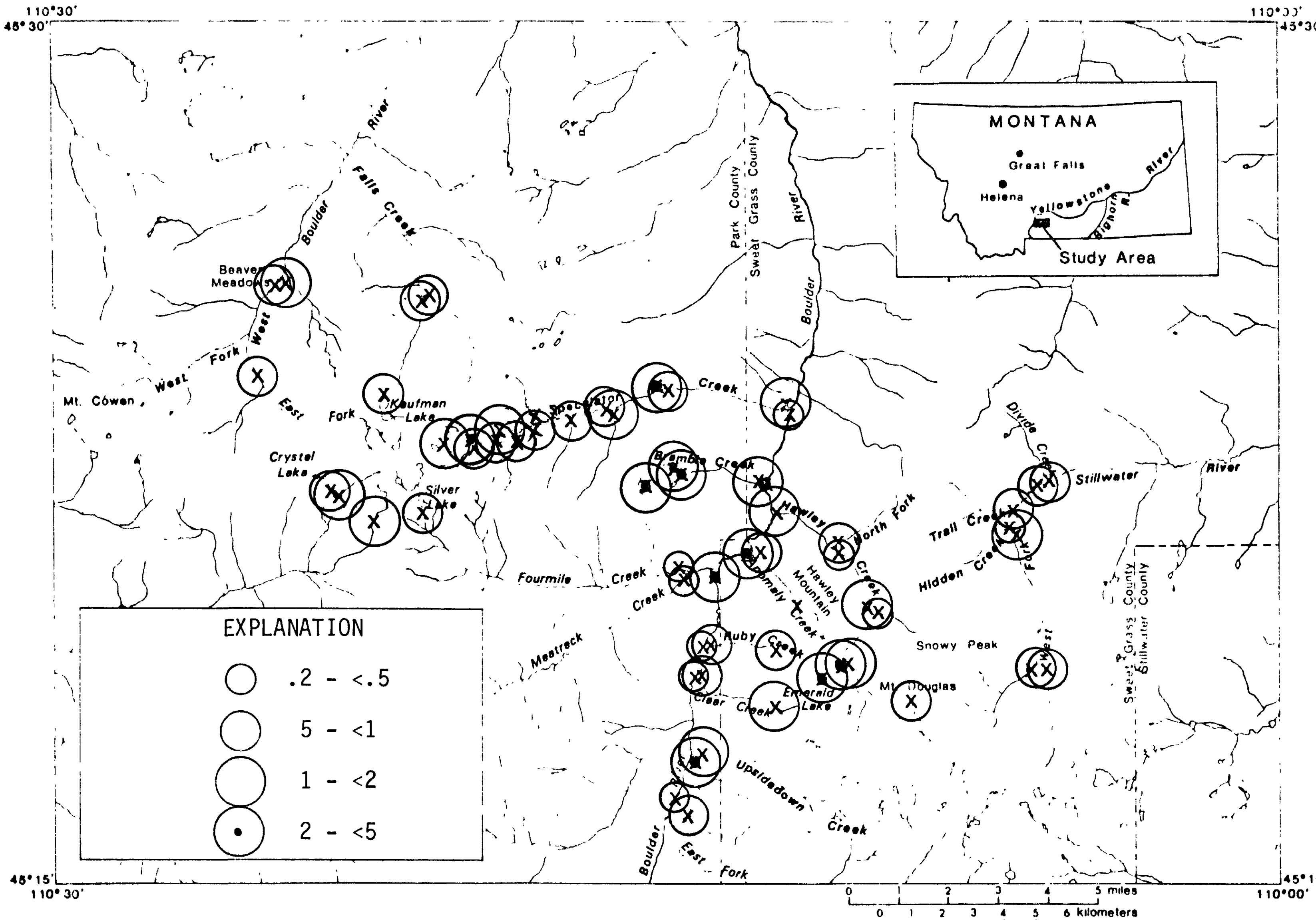

Figure 2-16.--Selenium data (ppm) at sample sites ("X").

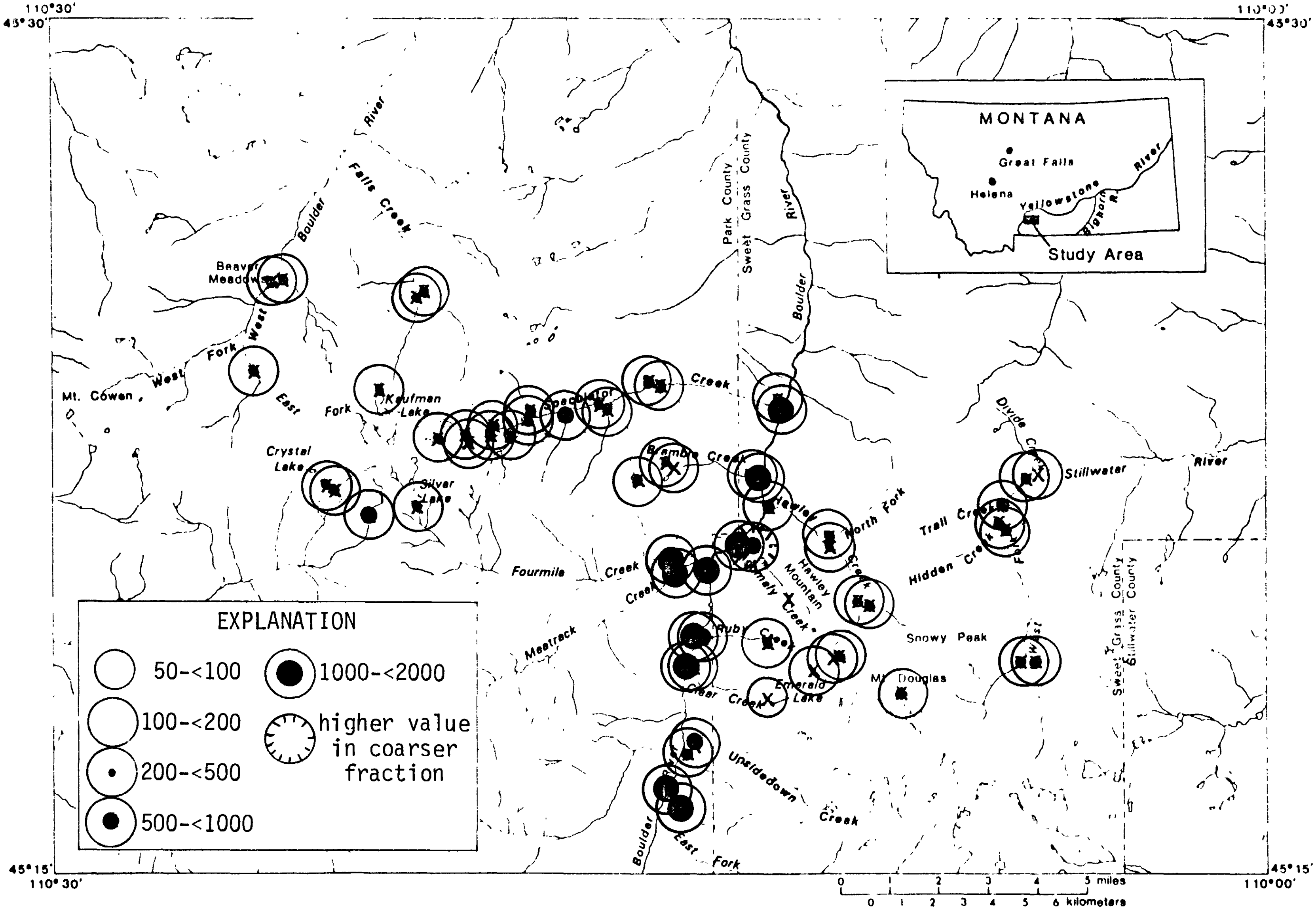

Figure 2-17.--Strontium data (ppm) at sample sites ("X").

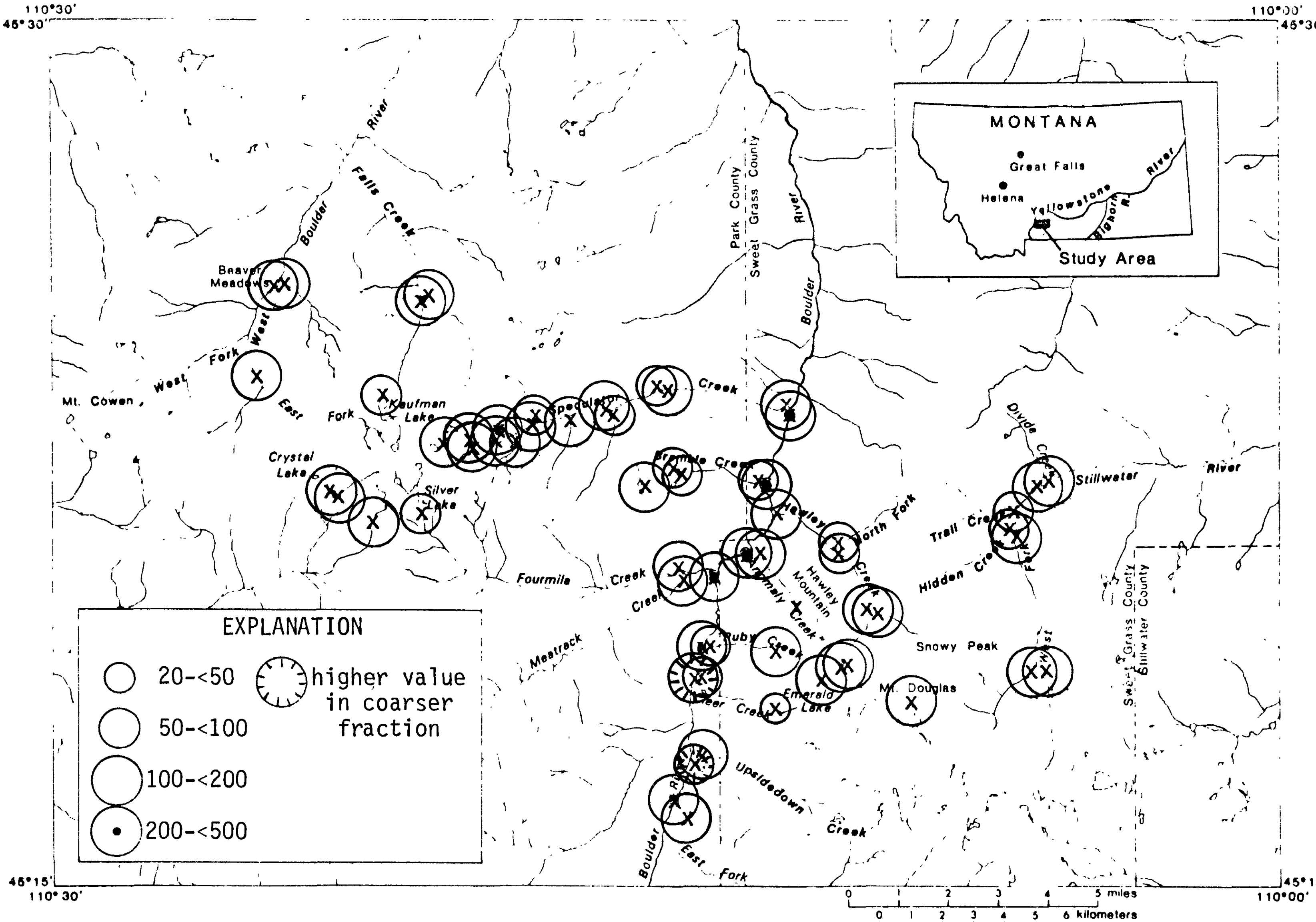

Figure 2-18.--Vanadium data (ppm) at sample sites ("X").

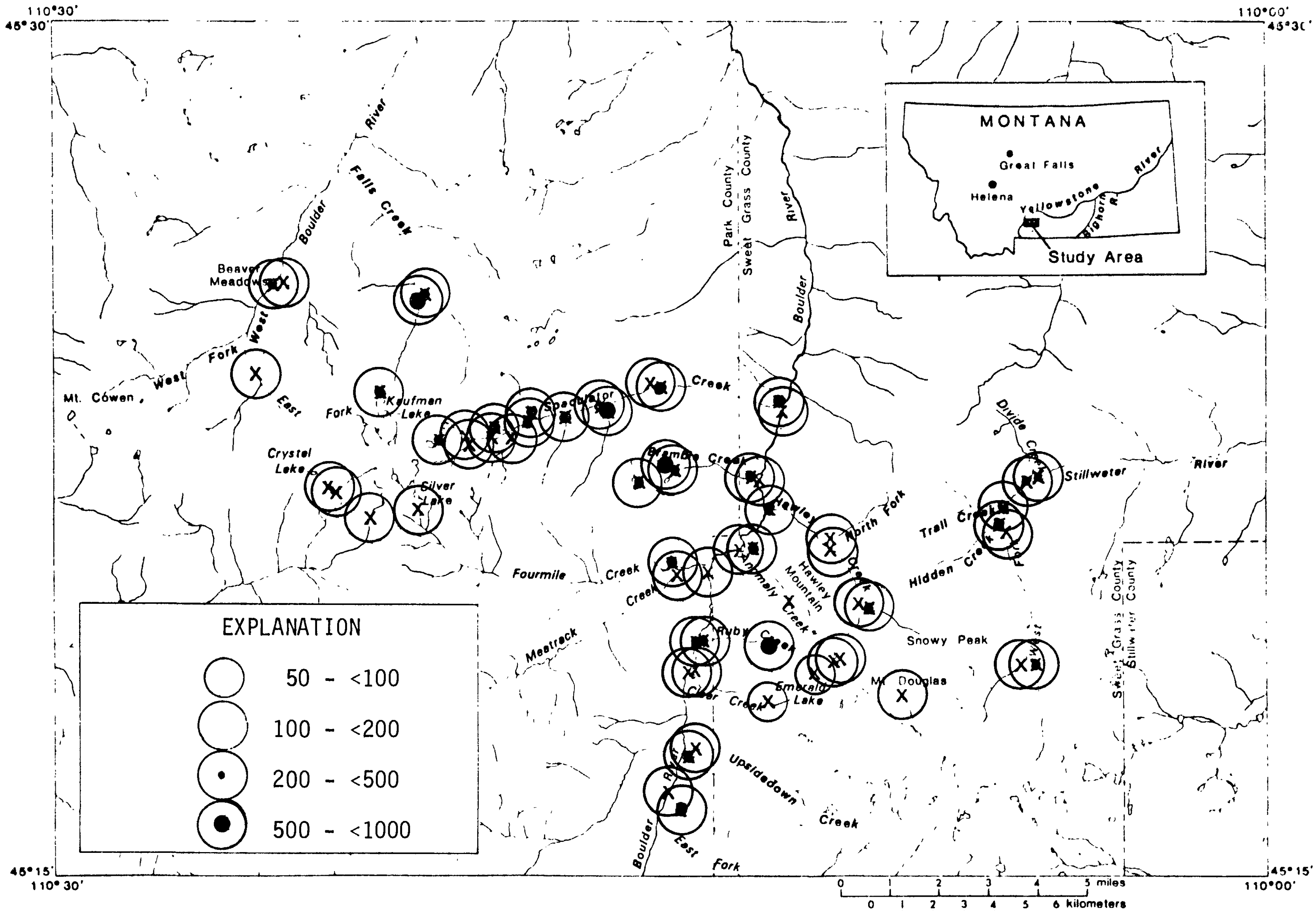

Figure 2-19.--Zirconium data (ppm) at sample sites ("X").

Table 4.--Frequency distributions and population statistics for fine fraction (<88 μm).

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.
Bimodalities of coarse fraction noted where applicable.

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
3.222E-01 -	6.122E-01	3	3	4.92	4.92	4.672E-01 XXXXX
6.122E-01 -	9.022E-01	9	12	14.75	19.67	7.572E-01 XXXXXXXXXXXXXXX
9.022E-01 -	1.192E+00	4	16	6.56	26.23	1.047E+00 XXXXXXX
1.192E+00 -	1.482E+00	5	21	8.20	34.43	1.337E+00 XXXXXXXX
1.482E+00 -	1.772E+00	9	30	14.75	49.18	1.627E+00 XXXXXXXXXXXXXXX
1.772E+00 -	2.062E+00	17	47	27.87	77.05	1.917E+00 XXXXXXXXXXXXXXXXXXXXXXXXXXXX
2.062E+00 -	2.352E+00	10	57	16.39	93.44	2.207E+00 XXXXXXXXXXXXXXXX
2.352E+00 -	2.642E+00	4	61	6.56	100.00	2.497E+00 XXXXXXX

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

0.00% of total values (61) are qualified

Minimum	=	2.10
Maximum	=	430.00 (ppm)
Geom mean	=	41.78
Geom dev	=	3.93

Table 4, continued

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

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum	Histogram
2.553E-01 -	5.253E-01	5	5	8.20	8.20	3.903E-01 XXXXXXXX
5.253E-01 -	7.953E-01	9	14	14.75	22.95	6.603E-01 XXXXXXXXXXXXXX
7.953E-01 -	1.065E+00	2	16	3.28	26.23	9.303E-01 XXX
1.065E+00 -	1.335E+00	10	26	16.39	42.62	1.200E+00 XXXXXXXXXXXXXXXX
1.335E+00 -	1.605E+00	9	35	14.75	57.38	1.470E+00 XXXXXXXXXXXXXXX
1.605E+00 -	1.875E+00	15	50	24.59	81.97	1.740E+00 XXXXXXXXXXXXXXXXXXXXXXXXX
1.875E+00 -	2.145E+00	7	57	11.48	93.44	2.010E+00 XXXXXXXXXXX
2.145E+00 -	2.415E+00	4	61	6.56	100.00	2.280E+00 XXXXXXX

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

0.00% of total values (61) are qualified

Minimum	=	1.80
Maximum	=	260.00 (ppm)
Geom mean	=	24.01
Geom dev	=	3.69

Frequency Table for: L-THppmN — Histogram for: L-THppmN

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum	Histogram
7.853E-01 -	9.653E-01	3	3	16.67	16.67	8.753E-01 XXXXXXXXXXXXXXXX
9.653E-01 -	1.145E+00	6	9	33.33	50.00	1.055E+00 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.145E+00 -	1.325E+00	4	13	22.22	72.22	1.235E+00 XXXXXXXXXXXXXXXXXXXXX
1.325E+00 -	1.505E+00	1	14	5.56	77.78	1.415E+00 XXXXXX
1.505E+00 -	1.685E+00	3	17	16.67	94.44	1.595E+00 XXXXXXXXXXXXXXXX
1.685E+00 -	1.865E+00	0	17	0.00	94.44	1.775E+00
1.865E+00 -	2.045E+00	1	18	5.56	100.00	1.955E+00 XXXXXX

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	43	0	18

0.00% of total values (18) are qualified

Minimum	=	6.10
Maximum	=	76.00 (ppm)
Geom mean	=	15.84
Geom dev	=	2.02

fine fraction bimodal
coarse fraction unimodal

Table 4, continued

Frequency Table for: AL203% X

Interval Limits lower		upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
9.290E+00	-	1.020E+01	1	1	1.64	1.64
1.020E+01	-	1.111E+01	0	1	0.00	1.64
1.111E+01	-	1.202E+01	0	1	0.00	1.64
1.202E+01	-	1.293E+01	5	6	8.20	9.84
1.293E+01	-	1.384E+01	22	28	36.07	45.90
1.384E+01	-	1.475E+01	16	44	26.23	72.13
1.475E+01	-	1.566E+01	13	57	21.31	93.44
1.566E+01	-	1.657E+01	4	61	6.56	100.00
1.657E+01	-	1.748E+01	0	61	0.00	100.00

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

Minimum	=	9.29	
Maximum	=	16.57	(%)
Mean	=	14.01	
Std dev	=	1.16	

Histogram for: AL203% X

```
9.745E+00 XX
1.065E+01
1.157E+01
1.248E+01 XXXXXXXX
1.338E+01 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.430E+01 XXXXXXXXXXXXXXXXXXXXXXXXXX
1.521E+01 XXXXXXXXXXXXXXXXXXXXX
1.612E+01 XXXXXXX
1.702E+01
```

0.00% of total values (61) are qualified

Frequency Table for: L-ASppmA

Interval Limits lower		upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
3.424E-01	-	5.124E-01	2	2	3.28	3.28
5.124E-01	-	6.824E-01	4	6	6.56	9.84
6.824E-01	-	8.524E-01	6	12	9.84	19.67
8.524E-01	-	1.022E+00	11	23	18.03	37.70
1.022E+00	-	1.192E+00	10	33	16.39	54.10
1.192E+00	-	1.362E+00	14	47	22.95	77.05
1.362E+00	-	1.532E+00	12	59	19.67	96.72
1.532E+00	-	1.702E+00	1	60	1.64	98.36
1.702E+00	-	1.872E+00	1	61	1.64	100.00

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

Minimum	=	2.20	
Maximum	=	55.00	(ppm)
Geom mean	=	12.92	
Geom dev	=	1.98	

Histogram for: L-ASppmA

```
4.274E-01 XXX
5.974E-01 XXXXXXX
7.674E-01 XXXXXXXXXX
9.374E-01 XXXXXXXXXXXXXXXXXX
1.107E+00 XXXXXXXXXXXXXXXX
1.277E+00 XXXXXXXXXXXXXXXXXXXXXXX
1.447E+00 XXXXXXXXXXXXXXXXXXXX
1.617E+00 XX
1.787E+00 XX
```

0.00% of total values (61) are qualified

Table 4, continued

Frequency Table for: BA ppm S

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
2.6E+02 -	3.8E+02	4	4	6.56	6.56
3.8E+02 -	5.6E+02	13	17	21.31	27.87
5.6E+02 -	8.3E+02	15	32	24.59	52.46
8.3E+02 -	1.2E+03	14	46	22.95	75.41
1.2E+03 -	1.8E+03	15	61	24.59	100.00

Histogram for: BA ppm S

```
3.0E+02 XXXXXXX
5.0E+02 XXXXXXXXXXXXXXXXXXXXX
7.0E+02 XXXXXXXXXXXXXXXXXXXXXXXXX
1.0E+03 XXXXXXXXXXXXXXXXXXXXXXX
1.5E+03 XXXXXXXXXXXXXXXXXXXXXXXXX
```

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

0.00% of total values (61) are qualified

Minimum = 300.00
Maximum = 1500.00 (ppm)
Geom mean = 806.81
Geom dev = 1.61

fine fraction unimodal
coarse fraction bimodal

Frequency Table for: L-TotalC

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
-1.612E-01 -	1.885E-02	6	6	9.84	9.84
1.885E-02 -	1.988E-01	7	13	11.48	21.31
1.988E-01 -	3.788E-01	9	22	14.75	36.07
3.788E-01 -	5.588E-01	15	37	24.59	60.66
5.588E-01 -	7.388E-01	13	50	21.31	81.97
7.388E-01 -	9.188E-01	8	58	13.11	95.08
9.188E-01 -	1.099E+00	2	60	3.28	98.36
1.099E+00 -	1.279E+00	1	61	1.64	100.00

Histogram for: L-TotalC

```
-7.115E-02 XXXXXXXXXX
 1.088E-01 XXXXXXXXXXX
 2.888E-01 XXXXXXXXXXXXXXX
 4.688E-01 XXXXXXXXXXXXXXXXXXXXXXXXX
 6.488E-01 XXXXXXXXXXXXXXXXXXXXX
 8.288E-01 XXXXXXXXXXXXX
 1.009E+00 XXX
 1.189E+00 XX
```

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

0.00% of total values (61) are qualified

Minimum = 0.69
Maximum = 18.17 (%)
Geom mean = 2.90
Geom dev = 2.04

Table 4, continued

Frequency Table for: L- Org C

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
-2.076E-01 -	-2.761E-02	5	5	8.20	8.20
-2.761E-02 -	1.524E-01	8	13	13.11	21.31
1.524E-01 -	3.324E-01	8	21	13.11	34.43
3.324E-01 -	5.124E-01	8	29	13.11	47.54
5.124E-01 -	6.924E-01	19	48	31.15	78.69
6.924E-01 -	8.724E-01	7	55	11.48	90.16
8.724E-01 -	1.052E+00	5	60	8.20	98.36
1.052E+00 -	1.232E+00	0	60	0.00	98.36
1.232E+00 -	1.412E+00	1	61	1.64	100.00

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

Minimum	=	0.62	
Maximum	=	18.10	(%)
Geom mean	=	2.80	
Geom dev	=	2.10	

Histogram for: L- Org C

```
-1.176E-01 XXXXXXXX
 6.239E-02 XXXXXXXXXXXXX
 2.424E-01 XXXXXXXXXXXXX
 4.224E-01 XXXXXXXXXXXXX
 6.024E-01 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 7.824E-01 XXXXXXXXXXX
 9.624E-01 XXXXXXXX
 1.142E+00
 1.322E+00 XX
```

0.00% of total values (61) are qualified

Frequency Table for: CA % S

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
8.3E-01 -	1.2E+00	5	5	8.20	8.20
1.2E+00 -	1.8E+00	25	30	40.98	49.18
1.8E+00 -	2.6E+00	16	46	26.23	75.41
2.6E+00 -	3.8E+00	10	56	16.39	91.80
3.8E+00 -	5.6E+00	4	60	6.56	98.36

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

Minimum	=	0.70	
Maximum	=	5.00	(%)
Geom mean	=	1.87	
Geom dev	=	1.51	

Histogram for: CA % S

```
1.0E+00 XXXXXXXX
1.5E+00 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
2.0E+00 XXXXXXXXXXXXXXXXXXXXXXXXXX
3.0E+00 XXXXXXXXXXXXXXXX
5.0E+00 XXXXXXX
```

0.00% of total values (61) are qualified

Table 4, continued

Frequency Table for: CO ppm S

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
8.3E+00 -	1.2E+01	8	8	13.11	13.11
1.2E+01 -	1.8E+01	14	22	22.95	36.06
1.8E+01 -	2.6E+01	17	39	27.87	63.93
2.6E+01 -	3.8E+01	14	53	22.95	86.88
3.8E+01 -	5.6E+01	5	58	8.20	95.08
5.6E+01 -	8.3E+01	2	60	3.28	98.36
8.3E+01 -	1.2E+02	0	60	0.00	98.36
1.2E+02 -	1.8E+02	1	61	1.64	100.00

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

Minimum	=	10.00	
Maximum	=	150.00	(ppm)
Geom mean	=	21.78	
Geom dev	=	1.74	

Histogram for: CO ppm S

```
1.0E+01 XXXXXXXXXXXXX
1.5E+01 XXXXXXXXXXXXXXXXXXXXXXX
2.0E+01 XXXXXXXXXXXXXXXXXXXXXXXXXXXX
3.0E+01 XXXXXXXXXXXXXXXXXXXXXXX
5.0E+01 XXXXXXXX
7.0E+01 XXX
1.0E+02
1.5E+02 XX
```

0.00% of total values (61) are qualified

Frequency Table for: CR ppm S

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
2.6E+01 -	3.8E+01	1	1	1.64	1.64
3.8E+01 -	5.6E+01	5	6	8.20	9.84
5.6E+01 -	8.3E+01	14	20	22.95	32.79
8.3E+01 -	1.2E+02	13	33	21.31	54.10
1.2E+02 -	1.8E+02	24	57	39.34	93.44
1.8E+02 -	2.6E+02	3	60	4.92	98.36
2.6E+02 -	3.8E+02	1	61	1.64	100.00

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

Minimum	=	30.00	
Maximum	=	300.00	(ppm)
Geom mean	=	105.47	
Geom dev	=	1.57	

Histogram for: CR ppm S

```
3.0E+01 XX
5.0E+01 XXXXXXXX
7.0E+01 XXXXXXXXXXXXXXXXXXXXXXX
1.0E+02 XXXXXXXXXXXXXXXXXXXXX
1.5E+02 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
2.0E+02 XXXXX
3.0E+02 XX
```

0.00% of total values (61) are qualified

Table 4, continued

Frequency Table for: CU ppm S

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
1.8E+01 -	2.6E+01	3	3	4.92	4.92
2.6E+01 -	3.8E+01	17	20	27.87	32.79
3.8E+01 -	5.6E+01	20	40	32.79	65.58
5.6E+01 -	8.3E+01	11	51	18.03	83.61
8.3E+01 -	1.2E+02	8	59	13.11	96.72
1.2E+02 -	1.8E+02	2	61	3.28	100.00

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

Minimum	=	20.00	
Maximum	=	150.00	(ppm)
Geom mean	=	50.01	
Geom dev	=	1.63	

Histogram for: CU ppm S

```
2.0E+01 XXXXX
3.0E+01 XXXXXXXXXXXXXXXXXXXXXXXXXXXX
5.0E+01 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
7.0E+01 XXXXXXXXXXXXXXXXXX
1.0E+02 XXXXXXXXXXXXX
1.5E+02 XXX
```

0.00% of total values (61) are qualified

Frequency Table for: L-FE203%

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
5.611E-01 -	6.151E-01	3	3	4.92	4.92
6.151E-01 -	6.691E-01	4	7	6.56	11.48
6.691E-01 -	7.231E-01	14	21	22.95	34.43
7.231E-01 -	7.771E-01	8	29	13.11	47.54
7.771E-01 -	8.311E-01	11	40	18.03	65.57
8.311E-01 -	8.851E-01	12	52	19.67	85.25
8.851E-01 -	9.391E-01	7	59	11.48	96.72
9.391E-01 -	9.931E-01	1	60	1.64	98.36
9.931E-01 -	1.047E+00	1	61	1.64	100.00

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

Minimum	=	3.64	
Maximum	=	9.93	(%)
Geom mean	=	6.06	
Geom dev	=	1.25	

Histogram for: L-FE203%

```
5.881E-01 XXXXX
6.421E-01 XXXXXXX
6.961E-01 XXXXXXXXXXXXXXXXXXXXXXX
7.501E-01 XXXXXXXXXXXXX
8.041E-01 XXXXXXXXXXXXXXXXXX
8.581E-01 XXXXXXXXXXXXXXXXXXXX
9.121E-01 XXXXXXXXXXX
9.661E-01 XX
1.020E+00 XX
```

0.00% of total values (61) are qualified

fine fraction bimodal
coarse fraction unimodal

Table 4, continued

Frequency Table for: K % S

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
8.3E-01 -	1.2E+00	1	1	1.64	1.64
1.2E+00 -	1.8E+00	1	2	1.64	3.28
1.8E+00 -	2.6E+00	10	12	16.39	19.67
2.6E+00 -	3.8E+00	41	53	67.21	86.88
3.8E+00 -	5.6E+00	7	60	11.48	98.36
5.6E+00 -	8.3E+00	1	61	1.64	100.00

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

Minimum = 1.00
Maximum = 7.00 (%)
Geom mean = 2.93
Geom dev = 1.37

Histogram for: K % S

```
1.0E+00 XX
1.5E+00 XX
2.0E+00 XXXXXXXXXXXXXXX
3.0E+00 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
5.0E+00 XXXXXXXXXXX
7.0E+00 XX
```

0.00% of total values (61) are qualified

Frequency Table for: LA ppm S

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
3.8E+01 -	5.6E+01	13	13	21.31	21.31
5.6E+01 -	8.3E+01	14	27	22.95	44.26
8.3E+01 -	1.2E+02	15	42	24.59	68.85
1.2E+02 -	1.8E+02	9	51	14.75	83.60
1.8E+02 -	2.6E+02	1	52	1.64	85.24
2.6E+02 -	3.8E+02	4	56	6.56	91.80

	N	H	L	G	B	T	Unqualified
No. of values:	4	0	1	0	0	0	56

Lower limit = 50.00
Maximum = 300.00 (ppm)
Est geom mean = 84.59
Est geom dev = 1.74

Histogram for: LA ppm S

```
5.0E+01 XXXXXXXXXXXXXXXXXXXX
7.0E+01 XXXXXXXXXXXXXXXXXXXXXX
1.0E+02 XXXXXXXXXXXXXXXXXXXXXXXX
1.5E+02 XXXXXXXXXXXXXX
2.0E+02 XX
3.0E+02 XXXXXXX
```

8.20% of total values (61) are qualified

Table 4, continued

Frequency Table for: MG % S

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
8.3E-01 -	1.2E+00	22	22	36.07	36.07
1.2E+00 -	1.8E+00	20	42	32.79	68.86
1.8E+00 -	2.6E+00	4	46	6.56	75.42
2.6E+00 -	3.8E+00	4	50	6.56	81.98

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

Minimum	=	0.30	
Maximum	=	3.00	(%)
Geom mean	=	1.16	
Geom dev	=	1.60	

Histogram for: MG % S

```
1.0E+00 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.5E+00 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
2.0E+00 XXXXXXX
3.0E+00 XXXXXXX
```

0.00% of total values (61) are qualified

Frequency Table for: MN ppm S

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
3.8E+02 -	5.6E+02	7	7	11.48	11.48
5.6E+02 -	8.3E+02	20	27	32.79	44.27
8.3E+02 -	1.2E+03	21	48	34.43	78.70
1.2E+03 -	1.8E+03	8	56	13.11	91.81
1.8E+03 -	2.6E+03	1	57	1.64	93.45
2.6E+03 -	3.8E+03	2	59	3.28	96.73
3.8E+03 -	5.6E+03	1	60	1.64	98.37
5.6E+03 -	8.3E+03	0	60	0.00	98.37
8.3E+03 -	1.2E+04	1	61	1.64	100.01

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

Minimum	=	500.00	
Maximum	=	10000.00	(ppm)
Geom mean	=	968.71	
Geom dev	=	1.73	

Histogram for: MN ppm S

```
5.0E+02 XXXXXXXXXXX
7.0E+02 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.0E+03 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.5E+03 XXXXXXXXXXXXX
2.0E+03 XX
3.0E+03 XXX
5.0E+03 XX
7.0E+03
1.0E+04 XX
```

0.00% of total values (61) are qualified

Table 4, continued

Frequency Table for: NA2O % X

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
2.400E-01 -	6.500E-01	2	2	3.28	3.28
6.500E-01 -	1.060E+00	1	3	1.64	4.92
1.060E+00 -	1.470E+00	2	5	3.28	8.20
1.470E+00 -	1.880E+00	6	11	9.84	18.03
1.880E+00 -	2.290E+00	16	27	26.23	44.26
2.290E+00 -	2.700E+00	19	46	31.15	75.41
2.700E+00 -	3.110E+00	12	58	19.67	95.08
3.110E+00 -	3.520E+00	3	61	4.92	100.00
3.520E+00 -	3.930E+00	0	61	0.00	100.00

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

Minimum = 0.24 (%)
Maximum = 3.52
Mean = 2.30
Std dev = 0.61

Histogram for: NA2O % X

```
4.450E-01 XXX
8.550E-01 XX
1.265E+00 XXX
1.675E+00 XXXXXXXXXX
2.085E+00 XXXXXXXXXXXXXXXXXXXXXXXXXX
2.495E+00 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
2.905E+00 XXXXXXXXXXXXXXXXXXXX
3.315E+00 XXXXX
3.725E+00
```

0.00% of total values (61) are qualified

Frequency Table for: NI ppm S

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
8.3E+00 -	1.2E+01	1	1	1.64	1.64
1.2E+01 -	1.8E+01	1	2	1.64	3.28
1.8E+01 -	2.6E+01	5	7	8.20	11.48
2.6E+01 -	3.8E+01	6	13	9.84	21.32
3.8E+01 -	5.6E+01	13	26	21.31	42.63
5.6E+01 -	8.3E+01	21	47	34.43	77.06
8.3E+01 -	1.2E+02	11	58	18.03	95.09
1.2E+02 -	1.8E+02	3	61	4.92	100.01

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

Minimum = 10.00 (ppm)
Maximum = 150.00
Geom mean = 56.57
Geom dev = 1.79

Histogram for: NI ppm S

```
1.0E+01 XX
1.5E+01 XX
2.0E+01 XXXXXXXX
3.0E+01 XXXXXXXXXX
5.0E+01 XXXXXXXXXXXXXXXXXXXXX
7.0E+01 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.0E+02 XXXXXXXXXXXXXXXXXX
1.5E+02 XXXXX
```

0.00% of total values (61) are qualified

fine fraction unimodal
coarse fraction not symmetrical

Table 4, continued

Frequency Table for: L-P205%X

Interval Limits lower		upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
-9.208E-01	-	-8.298E-01	5	5	8.20	8.20
-8.298E-01	-	-7.388E-01	15	20	24.59	32.79
-7.388E-01	-	-6.478E-01	23	43	37.70	70.49
-6.478E-01	-	-5.568E-01	9	52	14.75	85.25
-5.568E-01	-	-4.658E-01	8	60	13.11	98.36
-4.658E-01	-	-3.748E-01	0	60	0.00	98.36
-3.748E-01	-	-2.838E-01	0	60	0.00	98.36
-2.838E-01	-	-1.928E-01	1	61	1.64	100.00

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

Minimum	=	0.12	
Maximum	=	0.64	(%)
Geom mean	=	0.21	
Geom dev	=	1.34	

Histogram for: L-P205%X

```
-8.753E-01 XXXXXXXX
-7.843E-01 XXXXXXXXXXXXXXXXXXXXXXXXX
-6.933E-01 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
-6.023E-01 XXXXXXXXXXXXXXX
-5.113E-01 XXXXXXXXXXXXX
-4.203E-01
-3.293E-01
-2.383E-01 XX
```

0.00% of total values (61) are qualified

fine fraction unimodal
coarse fraction bimodal

Frequency Table for: PB ppm S

Interval Limits lower		upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
8.3E+00	-	1.2E+01	1	1	1.64	1.64
1.2E+01	-	1.8E+01	1	2	1.64	3.28
1.8E+01	-	2.6E+01	12	14	19.67	22.95
2.6E+01	-	3.8E+01	23	37	37.70	60.65
3.8E+01	-	5.6E+01	16	53	26.23	86.88
5.6E+01	-	8.3E+01	6	59	9.84	96.72
8.3E+01	-	1.2E+02	2	61	3.28	100.00

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

Minimum	=	10.00	
Maximum	=	100.00	(ppm)
Geom mean	=	34.77	
Geom dev	=	1.61	

Histogram for: PB ppm S

```
1.0E+01 XX
1.5E+01 XX
2.0E+01 XXXXXXXXXXXXXXXXXXXX
3.0E+01 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
5.0E+01 XXXXXXXXXXXXXXXXXXXXXXXXXX
7.0E+01 XXXXXXXXXX
1.0E+02 XXX
```

0.00% of total values (61) are qualified

Table 4, continued

Frequency Table for: SC ppm S

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
5.6E+00 -	8.3E+00	2	2	3.28	3.28
8.3E+00 -	1.2E+01	5	7	8.20	11.48
1.2E+01 -	1.8E+01	37	44	60.66	72.14
1.8E+01 -	2.6E+01	15	59	24.59	96.73
2.6E+01 -	3.8E+01	2	61	3.28	100.01

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

Minimum = 7.00
Maximum = 30.00 (ppm)
Geom mean = 15.54
Geom dev = 1.30

Histogram for: SC ppm S

```
7.0E+00 XXX
1.0E+01 XXXXXXXX
1.5E+01 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
2.0E+01 XXXXXXXXXXXXXXXXXXXXXXXX
3.0E+01 XXX
```

0.00% of total values (61) are qualified

Frequency Table for: L-SEppmX

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
-6.990E-01 -	-5.290E-01	3	4	5.00	6.67
-5.290E-01 -	-3.590E-01	6	10	10.00	16.67
-3.590E-01 -	-1.890E-01	8	18	13.33	30.00
-1.890E-01 -	-1.897E-02	18	36	30.00	60.00
-1.897E-02 -	1.510E-01	12	48	20.00	80.00
1.510E-01 -	3.210E-01	2	50	3.33	83.33
3.210E-01 -	4.910E-01	5	55	8.33	91.67
4.910E-01 -	6.610E-01	3	58	5.00	96.67
6.610E-01 -	8.310E-01	2	60	3.33	100.00

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	1	0	1	0	59

Lower limit = 1.00
Maximum = 4.80 (ppm)
Est geom mean = 0.91
Est geom dev = 2.12

Histogram for: L-SEppmX

```
-6.140E-01 XXXXX
-4.440E-01 XXXXXXXXXX
-2.740E-01 XXXXXXXXXXXXX
-1.040E-01 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 6.603E-02 XXXXXXXXXXXXXXXXXXXX
 2.360E-01 XXX
 4.060E-01 XXXXXXXX
 5.760E-01 XXXXX
 7.460E-01 XXX
```

1.67% of total values (60) are qualified

fine fraction bimodal
coarse fraction unimodal

Table 4, continued

Frequency Table for: SIO2 % X

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
4.481E+01 -	4.751E+01	2	2	3.28	3.28
4.751E+01 -	5.021E+01	0	2	0.00	3.28
5.021E+01 -	5.291E+01	3	5	4.92	8.20
5.291E+01 -	5.561E+01	9	14	14.75	22.95
5.561E+01 -	5.831E+01	20	34	32.79	55.74
5.831E+01 -	6.101E+01	16	50	26.23	81.97
6.101E+01 -	6.371E+01	8	58	13.11	95.08
6.371E+01 -	6.641E+01	3	61	4.92	100.00

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

Minimum = 44.81 (%)
Maximum = 66.27
Mean = 57.73
Std dev = 3.92

Histogram for: SIO2 % X

```
4.616E+01 XXX
4.886E+01
5.156E+01 XXXXX
5.426E+01 XXXXXXXXXXXXXXX
5.696E+01 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
5.966E+01 XXXXXXXXXXXXXXXXXXXXXXXXXX
6.236E+01 XXXXXXXXXXXXX
6.506E+01 XXXXX
```

0.00% of total values (61) are qualified

Frequency Table for: SR ppm S

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
5.6E+01 -	8.3E+01	1	1	1.64	1.64
8.3E+01 -	1.2E+02	0	1	0.00	1.64
1.2E+02 -	1.8E+02	4	5	6.56	8.20
1.8E+02 -	2.6E+02	26	31	42.62	50.82
2.6E+02 -	3.8E+02	15	46	24.59	75.41
3.8E+02 -	5.6E+02	3	49	4.92	80.33
5.6E+02 -	8.3E+02	2	51	3.28	83.61
8.3E+02 -	1.2E+03	8	59	13.11	96.72
1.2E+03 -	1.8E+03	2	61	3.28	100.00

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

Minimum = 70.00 (ppm)
Maximum = 1500.00
Geom mean = 306.50
Geom dev = 1.96

Histogram for: SR ppm S

```
7.0E+01 XX
1.0E+02
1.5E+02 XXXXXXX
2.0E+02 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
3.0E+02 XXXXXXXXXXXXXXXXXXXXXXXXX
5.0E+02 XXXXX
7.0E+02 XXX
1.0E+03 XXXXXXXXXXXXX
1.5E+03 XXX
```

0.00% of total values (61) are qualified

both size fractions bimodal

Table 4, continued

Frequency Table for: L-TIO2%X

Interval Limits lower		upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
-4.089E-01	-	-3.499E-01	1	1	1.64	1.64
-3.499E-01	-	-2.909E-01	0	1	0.00	1.64
-2.909E-01	-	-2.319E-01	8	9	13.11	14.75
-2.319E-01	-	-1.729E-01	13	22	21.31	36.07
-1.729E-01	-	-1.139E-01	15	37	24.59	60.66
-1.139E-01	-	-5.494E-02	15	52	24.59	85.25
-5.494E-02	-	4.065E-03	7	59	11.48	96.72
4.065E-03	-	6.306E-02	1	60	1.64	98.36
6.306E-02	-	1.221E-01	1	61	1.64	100.00

Histogram for: L-TIO2%X

-3.794E-01	XX
-3.204E-01	
-2.614E-01	XXXXXXXXXXXXX
-2.024E-01	XXXXXXXXXXXXXXXXXXXXX
-1.434E-01	XXXXXXXXXXXXXXXXXXXXXXXXX
-8.444E-02	XXXXXXXXXXXXXXXXXXXXXXXXX
-2.544E-02	XXXXXXXXXXX
3.356E-02	XX
9.256E-02	XX

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

0.00% of total values (61) are qualified

Minimum	=	0.39	
Maximum	=	1.16	(%)
Geom mean	=	0.72	
Geom dev	=	1.21	

Frequency Table for: V ppm S

Interval Limits lower		upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
2.6E+01	-	3.8E+01	1	1	1.64	1.64
3.8E+01	-	5.6E+01	0	1	0.00	1.64
5.6E+01	-	8.3E+01	16	17	26.23	27.87
8.3E+01	-	1.2E+02	18	35	29.51	57.38
1.2E+02	-	1.8E+02	20	55	32.79	90.17
1.8E+02	-	2.6E+02	6	61	9.84	100.01

Histogram for: V ppm S

3.0E+01	XX
5.0E+01	
7.0E+01	XXXXXXXXXXXXXXXXXXXXXXXXXX
1.0E+02	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.5E+02	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
2.0E+02	XXXXXXXXXX

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

0.00% of total values (61) are qualified

Minimum	=	30.00	
Maximum	=	200.00	(ppm)
Geom mean	=	109.18	
Geom dev	=	1.48	

Table 4, continued

Frequency Table for: Y ppm S

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
8.3E+00 -	1.2E+01	4	4	6.56	6.56
1.2E+01 -	1.8E+01	4	8	6.56	13.12
1.8E+01 -	2.6E+01	17	25	27.87	40.99
2.6E+01 -	3.8E+01	24	49	39.34	80.33
3.8E+01 -	5.6E+01	9	58	14.75	95.08
5.6E+01 -	8.3E+01	3	61	4.92	100.00

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

Minimum	=	10.00	
Maximum	=	70.00	(ppm)
Geom mean	=	26.78	
Geom dev	=	1.60	

Histogram for: Y ppm S

```
1.0E+01 XXXXXXX
1.5E+01 XXXXXXX
2.0E+01 XXXXXXXXXXXXXXXXXXXXXXXXXXXX
3.0E+01 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
5.0E+01 XXXXXXXXXXXXXXX
7.0E+01 XXXXX
```

0.00% of total values (61) are qualified

Frequency Table for: YB ppm S

Interval Limits lower	upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
8.3E-01 -	1.2E+00	1	1	1.72	1.72
1.2E+00 -	1.8E+00	4	5	6.90	8.62
1.8E+00 -	2.6E+00	18	23	31.03	39.65
2.6E+00 -	3.8E+00	20	43	34.48	74.13
3.8E+00 -	5.6E+00	12	55	20.69	94.82
5.6E+00 -	8.3E+00	3	58	5.17	99.99

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	3	0	58

Minimum	=	1.00	
Maximum	=	7.00	(ppm)
Geom mean	=	2.87	
Geom dev	=	1.56	

Histogram for: YB ppm S

```
1.0E+00 XX
1.5E+00 XXXXXXX
2.0E+00 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
3.0E+00 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
5.0E+00 XXXXXXXXXXXXXXXXXXXXX
7.0E+00 XXXXX
```

0.00% of total values (58) are qualified

Table 4, continued

Frequency Table for: L-ZNppmA

Interval Limits lower		upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
1.763E+00	-	1.862E+00	5	5	8.20	8.20
1.862E+00	-	1.961E+00	24	29	39.34	47.54
1.961E+00	-	2.060E+00	21	50	34.43	81.97
2.060E+00	-	2.159E+00	5	55	8.20	90.16
2.159E+00	-	2.258E+00	3	58	4.92	95.08
2.256E+00	-	2.357E+00	1	59	1.64	96.72
2.357E+00	-	2.456E+00	1	60	1.64	98.36
2.456E+00	-	2.555E+00	1	61	1.64	100.00

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

Minimum	=	58.00	
Maximum	=	357.00	(ppm)
Geom mean	=	97.26	
Geom dev	=	1.35	

Histogram for: L-ZNppmA

```
1.813E+00 XXXXXXXX
1.912E+00 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
2.011E+00 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
2.110E+00 XXXXXXXX
2.209E+00 XXXXX
2.308E+00 XX
2.407E+00 XX
2.506E+00 XX
```

0.00% of total values (61) are qualified

Frequency Table for: ZR ppm S

Interval Limits lower		upper	Obs Freq	Cum Freq	Percent Freq	%Freq Cum
3.8E+01	-	5.6E+01	1	1	1.64	1.64
5.6E+01	-	8.3E+01	1	2	1.64	3.28
8.3E+01	-	1.2E+02	7	9	11.48	14.76
1.2E+02	-	1.8E+02	21	30	34.43	49.19
1.8E+02	-	2.6E+02	15	45	24.59	73.78
2.6E+02	-	3.8E+02	12	57	19.67	93.45
3.8E+02	-	5.6E+02	3	60	4.92	98.37
5.6E+02	-	8.3E+02	1	61	1.64	100.01

	N	H	L	G	B	T	Unqualified
No. of values:	0	0	0	0	0	0	61

Minimum	=	50.00	
Maximum	=	700.00	(ppm)
Geom mean	=	185.89	
Geom dev	=	1.62	

Histogram for: ZR ppm S

```
5.0E+01 XX
7.0E+01 XX
1.0E+02 XXXXXXXXXXX
1.5E+02 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
2.0E+02 XXXXXXXXXXXXXXXXXXXXXXXXX
3.0E+02 XXXXXXXXXXXXXXXXXXXX
5.0E+02 XXXXX
7.0E+02 XX
```

0.00% of total values (61) are qualified

Table 5.--Correlation coefficients, r, and numbers of pairs, (n), of selected elements for fine-size fraction.

	L-U ppmN*	L-THppmN*	AL2O3% X	L-ASppmA	L-BAppmS	AS ppm A	L- Org C	L-Ca % S	L-COppmS	L-CRppmS
*L-U ppmN		0.40(18)	-0.53(61)	0.38(61)	-0.28(61)	0.33(61)	0.79(61)	-0.53(61)	-0.27(61)	-0.38(61)
*L-THppmN			-0.21(18)	0.28(18)	-0.15(18)	0.25(18)	0.47(18)	-0.50(18)	-0.64(18)	-0.49(18)
AL2O3% X				-0.32(61)	0.49(61)	-0.23(61)	-0.62(61)	0.31(61)	0.29(61)	0.25(61)
L-ASppmA					-0.29(61)	0.92(61)	0.47(61)	-0.39(61)	0.15(61)	-0.04(61)
L-BAppmS						-0.24(61)	-0.35(61)	0.40(61)	0.03(61)	-0.01(61)
AS ppm A							0.40(61)	-0.32(61)	0.24(61)	-0.05(61)
L- Org C								-0.54(61)	-0.25(61)	-0.34(61)
L-Ca % S									0.28(61)	0.23(61)
L-COppmS										0.45(61)
L-CRppmS										
L-CUppmS										
*L-FE2O3%										
L- K % S										
L-LAppmS										
L-MG % S										
L-MNppmS										
NA2O % X										
NI ppm S										
L-P2O5%X										
L-PBppmS										
L-SCppmS										
*L-SEppmX										
SIO2 % X										
*L-SRppmS										
L-TIO2%X										
L-V ppmS										
L-Y ppmS										
L-YBppmS										
L-ZNppmA										
L-ZRppmS										

*bimodal in appearance

Table 5, continued

	L-CUppmS	L-FE203%*	L- K % S	L-LAppmS	L-MG % S	L-MNppmS	NA2O % X	NI ppm S	L-P205%X	L-PBppmS
*L-U ppmN	0.01(61)	-0.36(61)	0.03(61)	0.57(61)	-0.55(61)	0.08(61)	-0.13(61)	-0.28(61)	0.23(61)	0.54(61)
*L-THppmN	-0.37(18)	-0.61(18)	0.34(18)	0.58(18)	-0.69(18)	-0.16(18)	-0.09(18)	-0.45(18)	-0.28(18)	0.52(18)
AL203% X	-0.20(61)	0.13(61)	0.25(61)	-0.16(61)	0.31(61)	-0.17(61)	0.52(61)	0.07(61)	-0.29(61)	-0.32(61)
L-ASppmA	0.20(61)	-0.15(61)	0.13(61)	0.15(61)	-0.38(61)	0.42(61)	-0.23(61)	0.03(61)	0.31(61)	0.52(61)
L-BAppmS	-0.49(61)	-0.06(61)	-0.03(61)	0.20(61)	0.09(61)	-0.05(61)	0.60(61)	-0.08(61)	0.00(61)	-0.17(61)
AS ppm A	0.16(61)	-0.11(61)	0.08(61)	0.06(61)	-0.33(61)	0.59(61)	-0.14(61)	0.05(61)	0.38(61)	0.57(61)
L- Org C	0.21(61)	-0.29(61)	-0.07(61)	0.52(61)	-0.57(61)	0.25(61)	-0.32(61)	-0.09(61)	0.33(61)	0.57(61)
L-Ca % S	-0.14(61)	0.24(61)	-0.19(61)	-0.19(61)	0.69(61)	0.01(61)	0.37(61)	0.23(61)	-0.13(61)	-0.43(61)
L-COppmS	0.37(61)	0.48(61)	-0.17(61)	-0.16(61)	0.44(61)	0.31(61)	0.20(61)	0.52(61)	-0.07(61)	-0.01(61)
L-CRppmS	0.30(61)	0.41(61)	-0.07(61)	-0.30(61)	0.51(61)	-0.05(61)	0.13(61)	0.67(61)	-0.28(61)	-0.19(61)
L-CUppmS		0.52(61)	-0.31(61)	-0.24(61)	0.34(61)	0.17(61)	-0.44(61)	0.42(61)	0.22(61)	0.15(61)
*L-FE203%			-0.55(61)	-0.35(61)	0.64(61)	-0.00(61)	-0.11(61)	0.50(61)	0.14(61)	-0.22(61)
L- K % S				0.21(61)	-0.41(61)	-0.15(61)	-0.10(61)	-0.30(61)	-0.39(61)	-0.11(61)
L-LAppmS					-0.49(61)	0.05(61)	0.03(61)	-0.15(61)	0.14(61)	0.31(61)
L-MG % S						-0.17(61)	0.20(61)	0.42(61)	-0.16(61)	-0.39(61)
L-MNppmS							-0.04(61)	0.29(61)	0.46(61)	0.50(61)
NA2O % X								0.02(61)	-0.24(61)	0.01(61)
NI ppm S									-0.00(61)	-0.01(61)
L-P205%X										0.34(61)
L-PBppmS										
L-SCppmS										
*L-SEppmX										
SIO2 % X										
*L-SRppmS										
L-TIO2%X										
L-V ppmS										
L-Y ppmS										
L-YBppmS										
L-ZNppmA										
L-ZRppmS										

Table 5, continued

	L-SCppmS	L-SEppmX*	SIO2 % X	L-SRppmS*	L-TIO2%X	L-V ppmS	L-Y ppmS	L-YBppmS	L-ZNppmA	L-ZRppmS
*L-U ppmN	-0.47(61)	0.48(60)	-0.12(61)	-0.61(61)	-0.22(61)	-0.41(61)	0.51(61)	0.26(58)	0.17(61)	0.14(61)
*L-THppmN	-0.46(18)	0.19(18)	0.28(18)	-0.46(18)	-0.24(18)	-0.54(18)	0.40(18)	0.45(15)	-0.03(18)	0.80(18)
AL2O3% X	0.46(61)	-0.31(60)	0.33(61)	0.56(61)	0.27(61)	0.46(61)	-0.18(61)	-0.15(58)	-0.39(61)	0.21(61)
L-ASppmA	-0.22(61)	0.17(60)	-0.11(61)	-0.48(61)	-0.20(61)	-0.26(61)	0.33(61)	0.24(58)	0.48(61)	-0.07(61)
L-BAppmS	0.31(61)	-0.12(60)	0.11(61)	0.69(61)	0.16(61)	0.34(61)	-0.16(61)	-0.11(58)	-0.30(61)	0.34(61)
AS ppm A	-0.14(61)	0.21(60)	-0.18(61)	-0.40(61)	-0.24(61)	-0.19(61)	0.28(61)	0.09(58)	0.59(61)	-0.11(61)
L- Org C	-0.55(61)	0.53(60)	-0.38(61)	-0.67(61)	-0.22(61)	-0.54(61)	0.48(61)	0.31(58)	0.43(61)	-0.06(61)
L-Ca % S	0.54(61)	-0.30(60)	-0.10(61)	0.67(61)	0.26(61)	0.54(61)	-0.25(61)	-0.17(58)	-0.34(61)	-0.09(61)
L-COppmS	0.46(61)	-0.15(60)	-0.02(61)	0.14(61)	0.13(61)	0.62(61)	-0.05(61)	-0.11(58)	0.23(61)	-0.17(61)
L-CRppmS	0.41(61)	-0.27(60)	0.09(61)	0.28(61)	0.10(61)	0.51(61)	-0.19(61)	-0.02(58)	0.04(61)	-0.22(61)
L-CUppmS	0.10(61)	0.13(60)	-0.29(61)	-0.29(61)	0.24(61)	0.21(61)	0.10(61)	0.19(58)	0.48(61)	-0.30(61)
*L-FE2O3%	0.49(61)	-0.10(60)	-0.42(61)	0.25(61)	0.61(61)	0.58(61)	-0.29(61)	-0.07(58)	0.23(61)	-0.30(61)
L- K % S	-0.20(61)	-0.05(60)	0.49(61)	-0.24(61)	-0.28(61)	-0.30(61)	0.32(61)	0.21(58)	-0.37(61)	0.30(61)
L-LAppmS	-0.15(61)	0.26(60)	-0.05(61)	-0.25(61)	-0.03(61)	-0.33(61)	0.62(61)	0.38(58)	-0.06(61)	0.39(61)
L-MG % S	0.63(61)	-0.34(60)	-0.06(61)	0.58(61)	0.48(61)	0.72(61)	-0.42(61)	-0.25(58)	-0.14(61)	-0.20(61)
L-MNppmS	0.07(61)	0.16(60)	-0.37(61)	-0.19(61)	-0.31(61)	-0.07(61)	0.27(61)	0.11(58)	0.67(61)	-0.12(61)
NA2O % X	0.32(61)	-0.19(60)	0.32(61)	0.58(61)	0.04(61)	0.46(61)	-0.15(61)	-0.19(58)	-0.32(61)	0.25(61)
NI ppm S	0.34(61)	-0.13(60)	-0.21(61)	0.14(61)	0.07(61)	0.34(61)	-0.11(61)	0.05(58)	0.30(61)	-0.29(61)
L-P2O5%X	-0.25(61)	0.23(60)	-0.56(61)	0.01(61)	0.02(61)	-0.25(61)	0.04(61)	0.02(58)	0.55(61)	-0.16(61)
L-PBppmS	-0.14(61)	0.25(60)	-0.06(61)	-0.43(61)	-0.27(61)	-0.22(61)	0.46(61)	0.16(58)	0.58(61)	0.04(61)
L-SCppmS		-0.21(60)	0.08(61)	0.45(61)	0.47(61)	0.75(61)	-0.13(61)	-0.06(58)	-0.11(61)	0.09(61)
*L-SEppmX			-0.34(60)	-0.36(60)	-0.06(60)	-0.23(60)	0.23(60)	0.03(57)	0.18(60)	0.02(60)
SIO2 % X				0.03(61)	-0.18(61)	0.07(61)	0.00(61)	-0.01(58)	-0.44(61)	0.34(61)
*L-SRppmS					0.33(61)	0.55(61)	-0.52(61)	-0.39(58)	-0.33(61)	0.06(61)
L-TIO2%X						0.48(61)	-0.17(61)	0.10(58)	-0.20(61)	0.23(61)
L-V ppmS							-0.29(61)	-0.24(58)	-0.12(61)	-0.02(61)
L-Y ppmS								0.73(58)	0.12(61)	0.29(61)
L-YBppmS									-0.02(58)	0.32(58)
L-ZNppmA										-0.41(61)
L-ZRppmS										

Table 6.--Correlation coefficients, r, and numbers of pairs, (n), of selected elements for coarse-size fraction.

	L-U ppmN*	L-THppmN	AL2O3% X	L-ASppmA	L-BAppmS*	L-TotalC	L- Org C	L-Ca % S	L-COppmS	L-CRppmS
*L-U ppmN		0.50(27)	-0.45(61)	0.33(61)	-0.24(61)	0.78(61)	0.80(61)	-0.45(61)	-0.33(61)	-0.39(61)
L-THppmN			-0.60(27)	-0.04(27)	-0.31(27)	0.34(27)	0.33(27)	-0.53(27)	-0.74(27)	-0.46(27)
AL2O3% X				-0.17(61)	0.27(61)	-0.49(61)	-0.45(61)	0.25(61)	0.34(61)	0.41(61)
L-ASppmA					-0.33(61)	0.49(61)	0.46(61)	-0.19(61)	0.10(61)	-0.05(61)
*L-BAppmS						-0.40(61)	-0.37(61)	0.53(61)	0.06(61)	-0.19(61)
L-TotalC							0.99(61)	-0.47(61)	-0.26(61)	-0.33(61)
L- Org C								-0.48(61)	-0.25(61)	-0.33(61)
L-Ca % S									0.43(61)	0.32(61)
L-COppmS										0.49(61)
L-CRppmS										
L-CUppmS										
L-FE2O3%										
L- K % S										
L-LAppmS										
L-MG % S										
L-MNppmS										
NA2O % X										
*L-P2O5%X										
L-PBppmS										
L-SCppmS										
L-SEppmX										
SIO2 % X										
*L-SRppmS										
L-TIO2%X										
L-V ppmS										
L-Y ppmS										
L-YBppmS										
L-ZNppmA										
L-ZRppmS										

*bimodal in appearance

Table 6, continued

	L-CUppmS	L-FE2O3%	L- K % S	L-LAppmS	L-MG % S	L-MNppmS	NA2O % X	L-P2O5%X*	L-PBppmS	L-SCppmS
*L-U ppmN	0.00(61)	-0.30(61)	0.12(61)	0.41(61)	-0.46(61)	0.14(61)	-0.23(61)	0.36(61)	0.58(61)	-0.35(61)
L-THppmN	-0.31(27)	-0.43(27)	0.35(27)	0.70(27)	-0.57(27)	0.02(27)	-0.20(27)	-0.13(27)	0.40(27)	-0.41(27)
AL2O3% X	0.03(61)	0.36(61)	-0.09(61)	-0.45(61)	0.43(61)	-0.13(61)	0.45(61)	-0.04(61)	-0.21(61)	0.30(61)
L-ASppmA	0.26(61)	0.02(61)	0.09(61)	-0.17(61)	-0.16(61)	0.31(61)	-0.43(61)	0.26(61)	0.30(61)	-0.09(61)
*L-BAppmS	-0.41(61)	0.04(61)	0.06(61)	0.22(61)	0.15(61)	-0.12(61)	0.38(61)	0.24(61)	-0.14(61)	0.32(61)
L-TotalC	0.28(61)	-0.28(61)	0.11(61)	0.31(61)	-0.47(61)	0.36(61)	-0.51(61)	0.30(61)	0.56(61)	-0.38(61)
L- Org C	0.27(61)	-0.26(61)	0.08(61)	0.31(61)	-0.47(61)	0.36(61)	-0.47(61)	0.30(61)	0.58(61)	-0.38(61)
L-Ca % S	-0.05(61)	0.50(61)	-0.33(61)	-0.24(61)	0.67(61)	0.03(61)	0.32(61)	0.06(61)	-0.28(61)	0.69(61)
L-COppmS	0.55(61)	0.67(61)	-0.34(61)	-0.40(61)	0.64(61)	0.20(61)	0.04(61)	-0.01(61)	-0.14(61)	0.46(61)
L-CRppmS	0.40(61)	0.58(61)	-0.48(61)	-0.45(61)	0.80(61)	-0.08(61)	-0.01(61)	-0.13(61)	-0.44(61)	0.47(61)
L-CUppmS		0.56(61)	-0.33(61)	-0.24(61)	0.39(61)	0.30(61)	-0.50(61)	0.06(61)	0.03(61)	0.13(61)
L-FE2O3%			-0.45(61)	-0.36(61)	0.78(61)	0.10(61)	-0.07(61)	0.14(61)	-0.24(61)	0.71(61)
L- K % S				0.28(61)	-0.52(61)	-0.17(61)	-0.08(61)	0.03(61)	0.01(61)	-0.27(61)
L-LAppmS					-0.42(61)	-0.15(61)	-0.17(61)	0.40(61)	0.35(61)	-0.12(61)
L-MG % S						-0.08(61)	0.18(61)	-0.03(61)	-0.41(61)	0.69(61)
L-MNppmS							-0.17(61)	0.12(61)	0.49(61)	-0.06(61)
NA2O % X								-0.18(61)	-0.17(61)	0.08(61)
*L-P2O5%X									0.23(61)	0.10(61)
L-PBppmS										-0.21(61)
L-SCppmS										
L-SEppmX										
SIO2 % X										
*L-SRppmS										
L-TIO2%X										
L-V ppmS										
L-Y ppmS										
L-YBppmS										
L-ZNppmA										
L-ZRppmS										

Table 6, continued

	L-SEppmX	SIO2 % X	L-SRppmS*	L-TIO2%X	L-V ppmS	L-Y ppmS	L-YBppmS	L-ZNppmA	L-ZRppmS
*L-U ppmN	0.64(60)	-0.06(61)	-0.57(61)	-0.23(61)	-0.40(61)	0.52(61)	0.32(58)	0.19(61)	0.07(61)
L-THppmN	0.45(27)	0.63(27)	-0.56(27)	-0.30(27)	-0.57(27)	0.48(27)	0.36(24)	-0.33(27)	0.55(27)
AL2O3% X	-0.42(60)	-0.34(61)	0.55(61)	0.27(61)	0.43(61)	-0.38(61)	-0.30(58)	-0.02(61)	-0.21(61)
L-ASppmA	0.07(60)	-0.19(61)	-0.38(61)	0.01(61)	-0.14(61)	0.13(61)	0.03(58)	0.47(61)	-0.27(61)
*L-BAppmS	-0.22(60)	-0.04(61)	0.73(61)	0.26(61)	0.40(61)	0.01(61)	0.17(58)	-0.24(61)	0.43(61)
L-TotalC	0.61(60)	-0.20(61)	-0.64(61)	-0.28(61)	-0.48(61)	0.45(61)	0.25(58)	0.46(61)	-0.08(61)
L- Org C	0.63(60)	-0.20(61)	-0.62(61)	-0.26(61)	-0.47(61)	0.44(61)	0.25(58)	0.46(61)	-0.06(61)
L-Ca % S	-0.47(60)	-0.31(61)	0.75(61)	0.48(61)	0.76(61)	-0.26(61)	-0.03(58)	0.01(61)	0.01(61)
L-COppmS	-0.23(60)	-0.45(61)	0.32(61)	0.42(61)	0.60(61)	-0.29(61)	-0.29(58)	0.40(61)	-0.24(61)
L-CRppmS	-0.33(60)	-0.36(61)	0.32(61)	0.36(61)	0.55(61)	-0.56(61)	-0.49(58)	0.15(61)	-0.30(61)
L-CUppmS	0.21(60)	-0.56(61)	-0.20(61)	0.23(61)	0.19(61)	-0.24(61)	-0.24(58)	0.65(61)	-0.37(61)
L-FE2O3%	-0.19(60)	-0.65(61)	0.38(61)	0.80(61)	0.77(61)	-0.37(61)	-0.27(58)	0.40(61)	-0.17(61)
L- K % S	-0.05(60)	0.42(61)	-0.25(61)	-0.25(61)	-0.36(61)	0.34(61)	0.28(58)	-0.45(61)	0.33(61)
L-LAppmS	0.31(60)	0.26(61)	-0.21(61)	-0.13(61)	-0.32(61)	0.58(61)	0.57(58)	-0.15(61)	0.54(61)
L-MG % S	-0.39(60)	-0.46(61)	0.61(61)	0.60(61)	0.83(61)	-0.53(61)	-0.39(58)	0.15(61)	-0.21(61)
L-MNppmS	0.26(60)	-0.43(61)	-0.07(61)	-0.15(61)	-0.05(61)	0.31(61)	0.26(58)	0.69(61)	-0.18(61)
NA2O % X	-0.34(60)	0.14(61)	0.48(61)	0.07(61)	0.28(61)	-0.05(61)	0.02(58)	-0.38(61)	0.09(61)
*L-P2O5%X	0.16(60)	-0.42(61)	0.09(61)	0.23(61)	0.03(61)	0.36(61)	0.32(58)	0.27(61)	0.27(61)
L-PBppmS	0.41(60)	-0.11(61)	-0.36(61)	-0.30(61)	-0.32(61)	0.53(61)	0.38(58)	0.47(61)	-0.01(61)
L-SCppmS	-0.39(60)	-0.41(61)	0.54(61)	0.76(61)	0.80(61)	-0.26(61)	-0.06(58)	0.06(61)	0.09(61)
L-SEppmX		-0.12(60)	-0.49(60)	-0.19(60)	-0.37(60)	0.35(60)	0.10(57)	0.30(60)	0.00(60)
SIO2 % X			-0.26(61)	-0.44(61)	-0.41(61)	0.10(61)	0.15(58)	-0.69(61)	0.35(61)
*L-SRppmS				0.39(61)	0.69(61)	-0.35(61)	-0.12(58)	-0.13(61)	0.11(61)
L-TIO2%X					0.76(61)	-0.23(61)	-0.14(58)	0.09(61)	0.11(61)
L-V ppmS						-0.42(61)	-0.26(58)	0.06(61)	-0.01(61)
L-Y ppmS							0.85(58)	0.13(61)	0.36(61)
L-YBppmS								0.04(58)	0.52(58)
L-ZNppmA									-0.37(61)
L-ZRppmS									

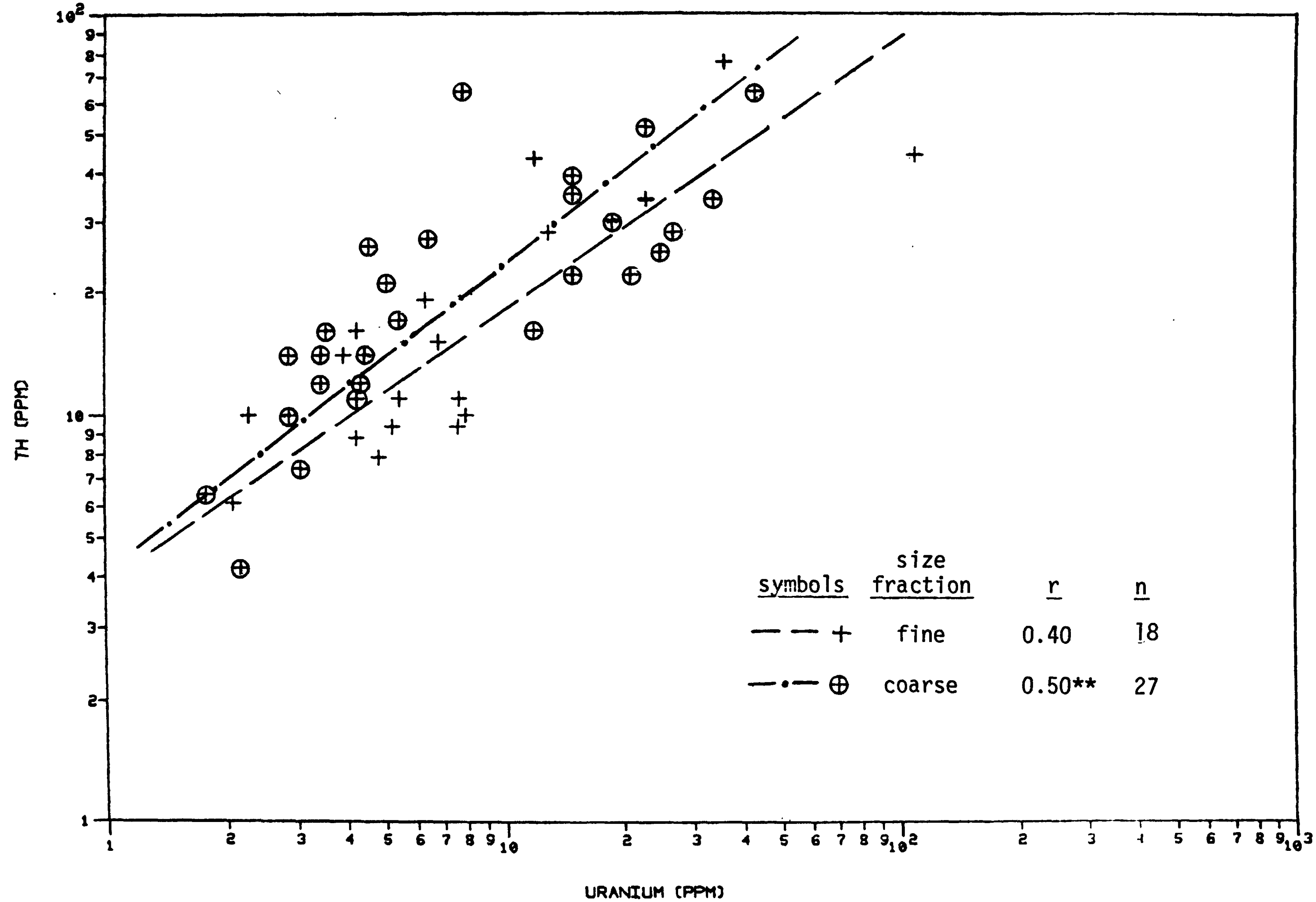

Figure 3-1.--Scatter diagram of thorium versus uranium. Regression lines are shown for each data set. * = Correlation is significant at the 95-percent confidence limit, ** = correlation is significant at the 99-percent confidence limit, r = correlation coefficient from table 5 for the fine-size fraction (<88 μm) and from table 6 for the coarse-size fraction (between 88μm and 120μm), n = number of sample pairs.

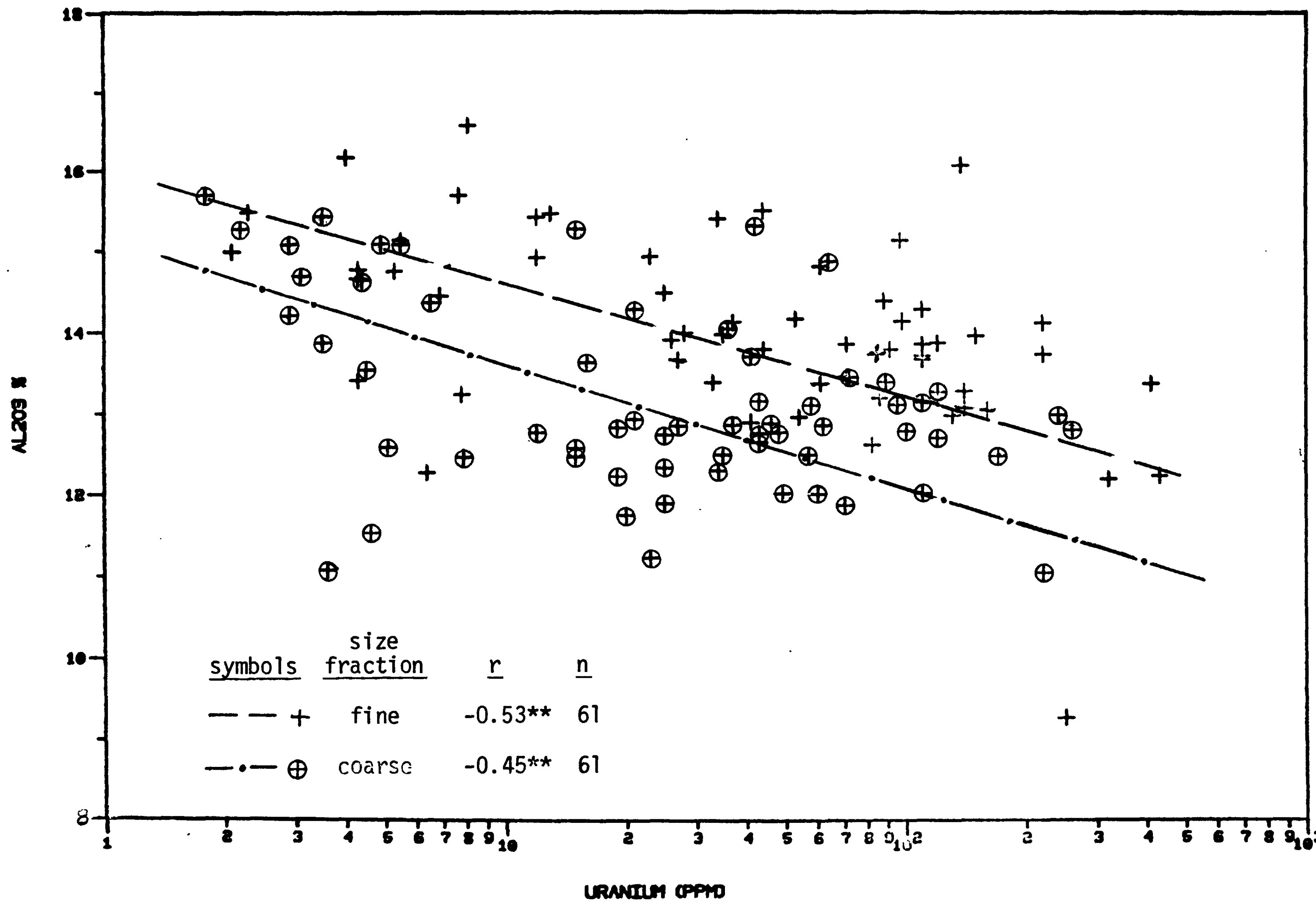

Figure 3-2.--Scatter diagram of Al_2O_3 versus uranium.

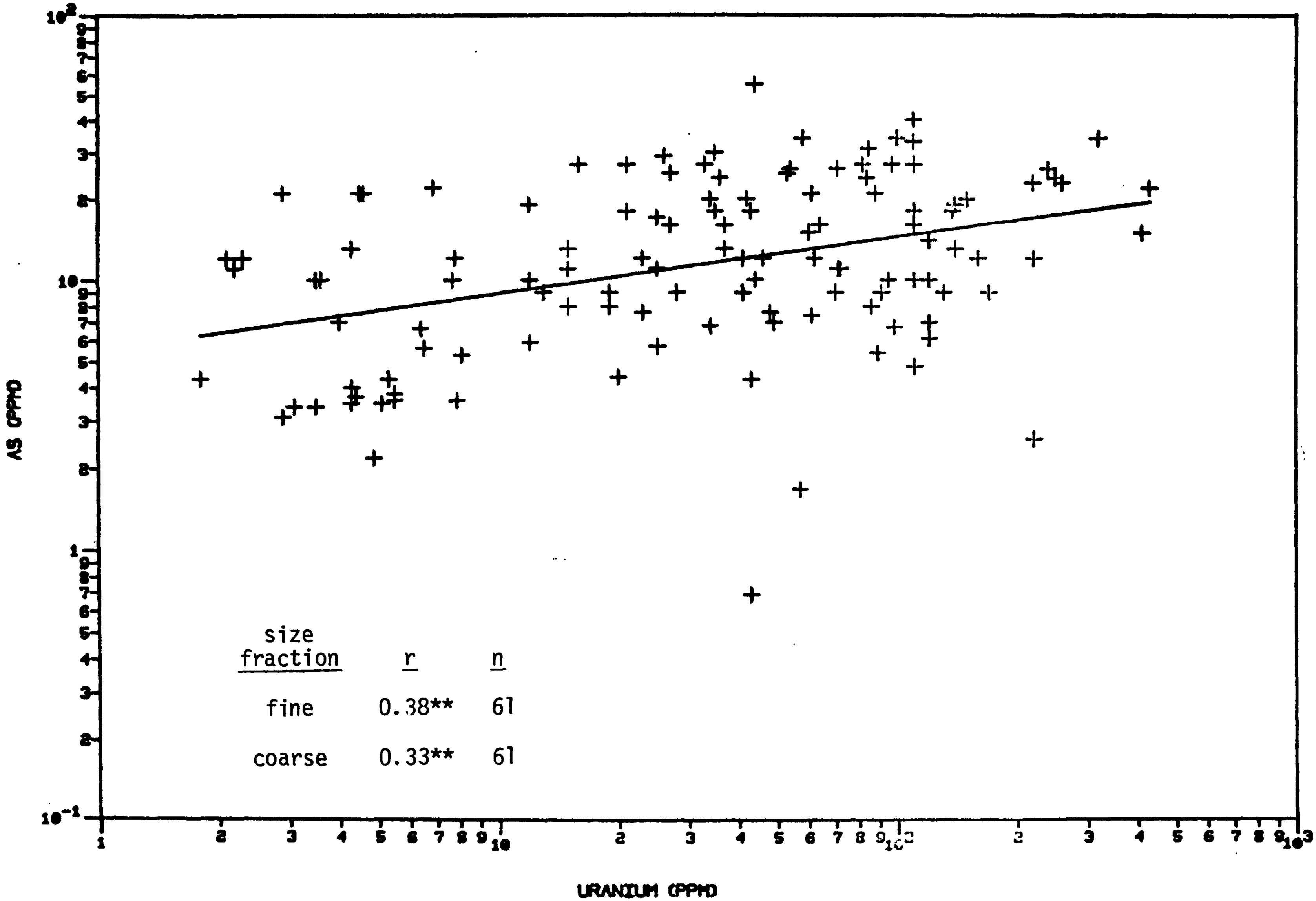

Figure 3-3. --Scatter diagram of arsenic versus uranium. Line drawn from both size fractions.

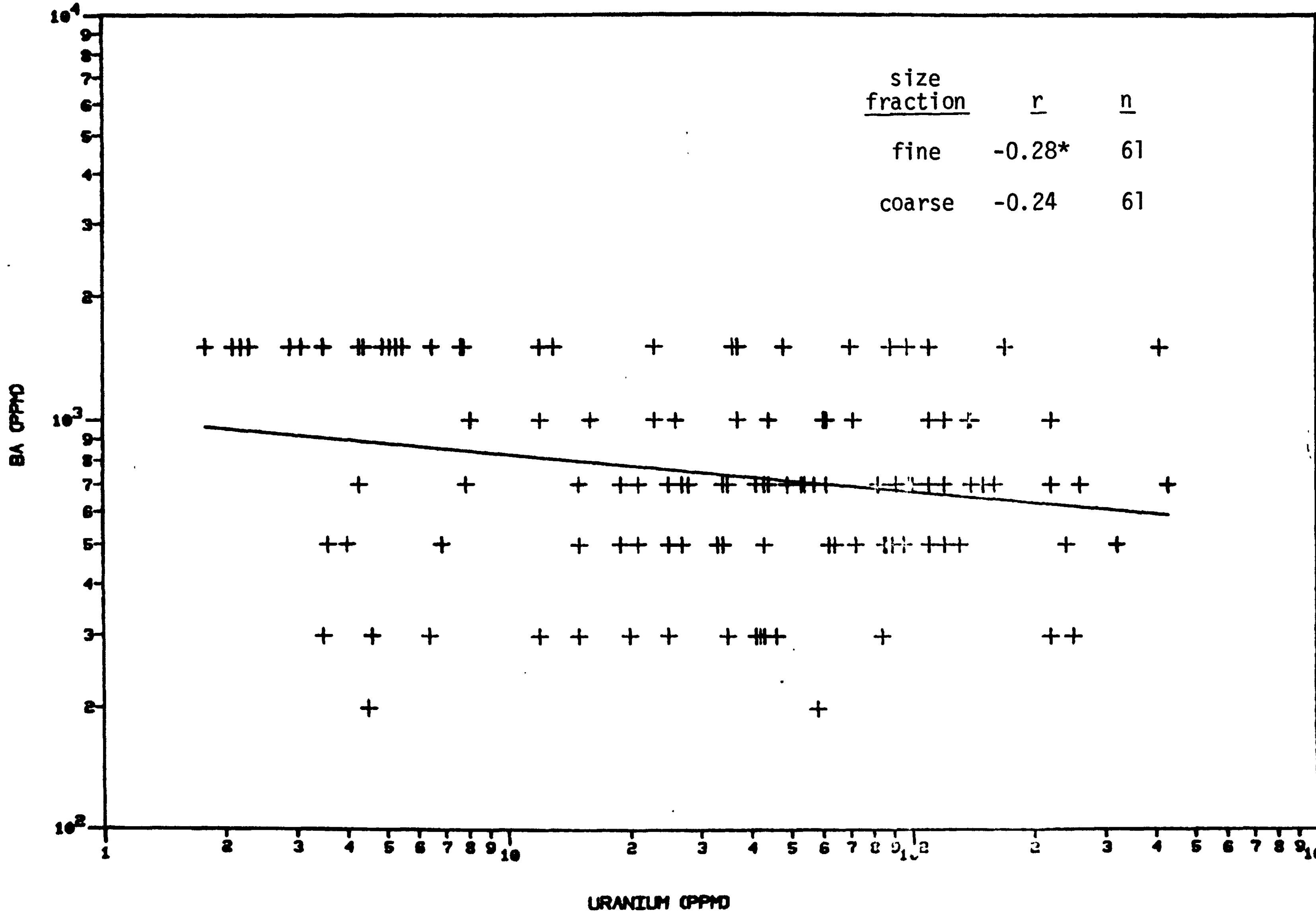

Figure 3-4.--Scatter diagram of barium versus uranium. Line drawn from both size fractions.

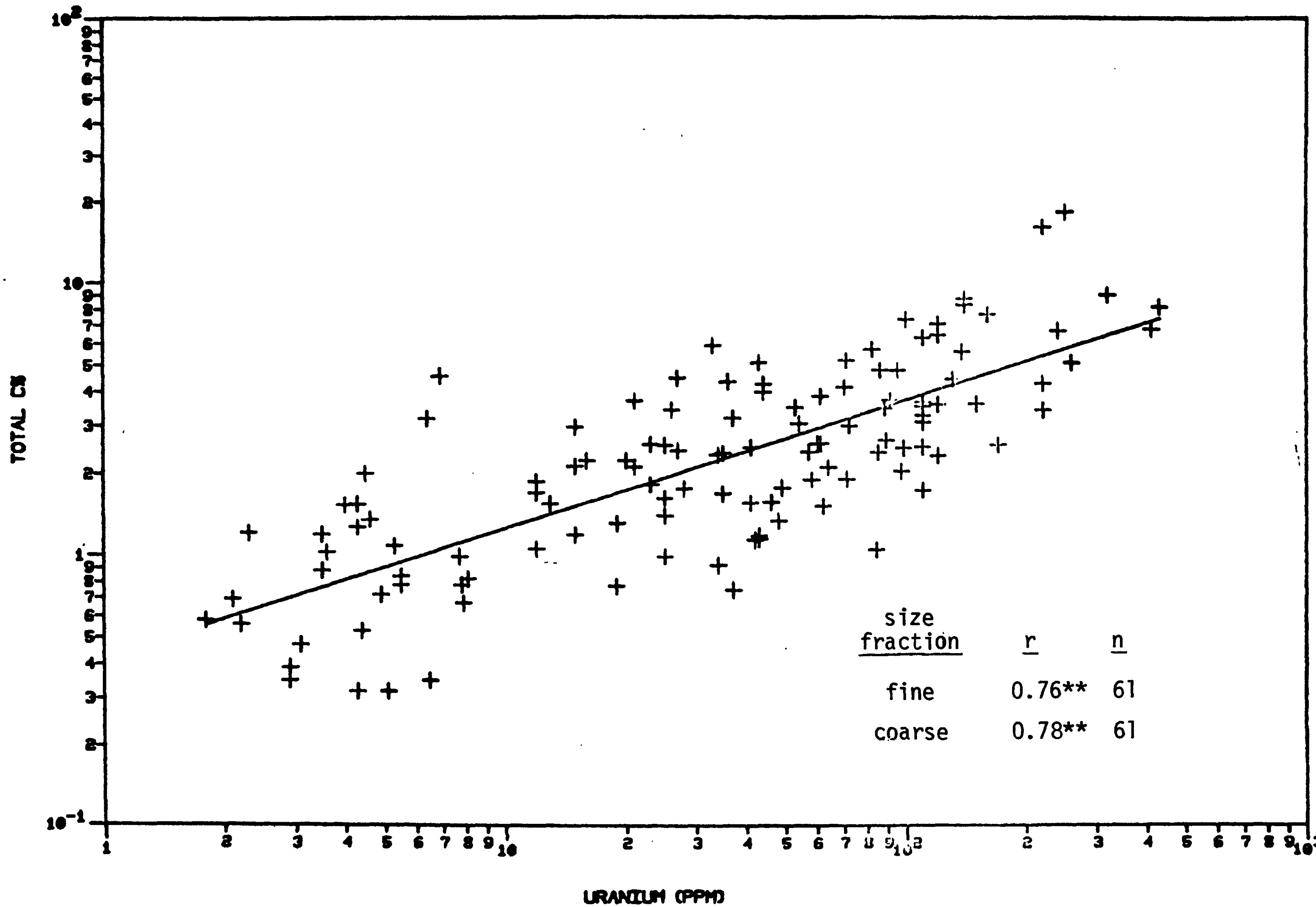

Figure 3-5.--Scatter diagram for total carbon versus uranium. Line drawn from both size fractions.

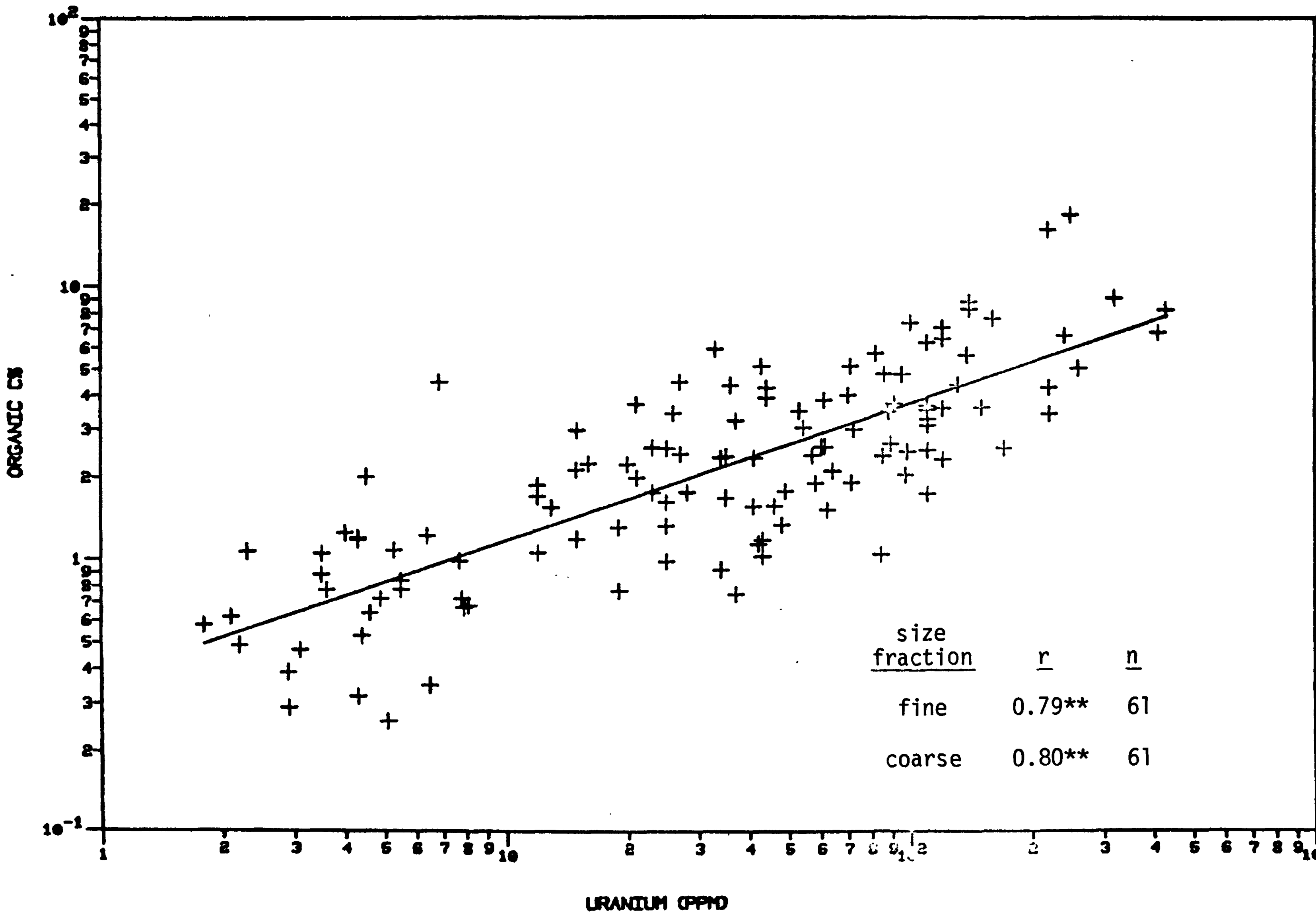

Figure 3-6.--Scatter diagram for organic carbon versus uranium. Line drawn from both size fractions.

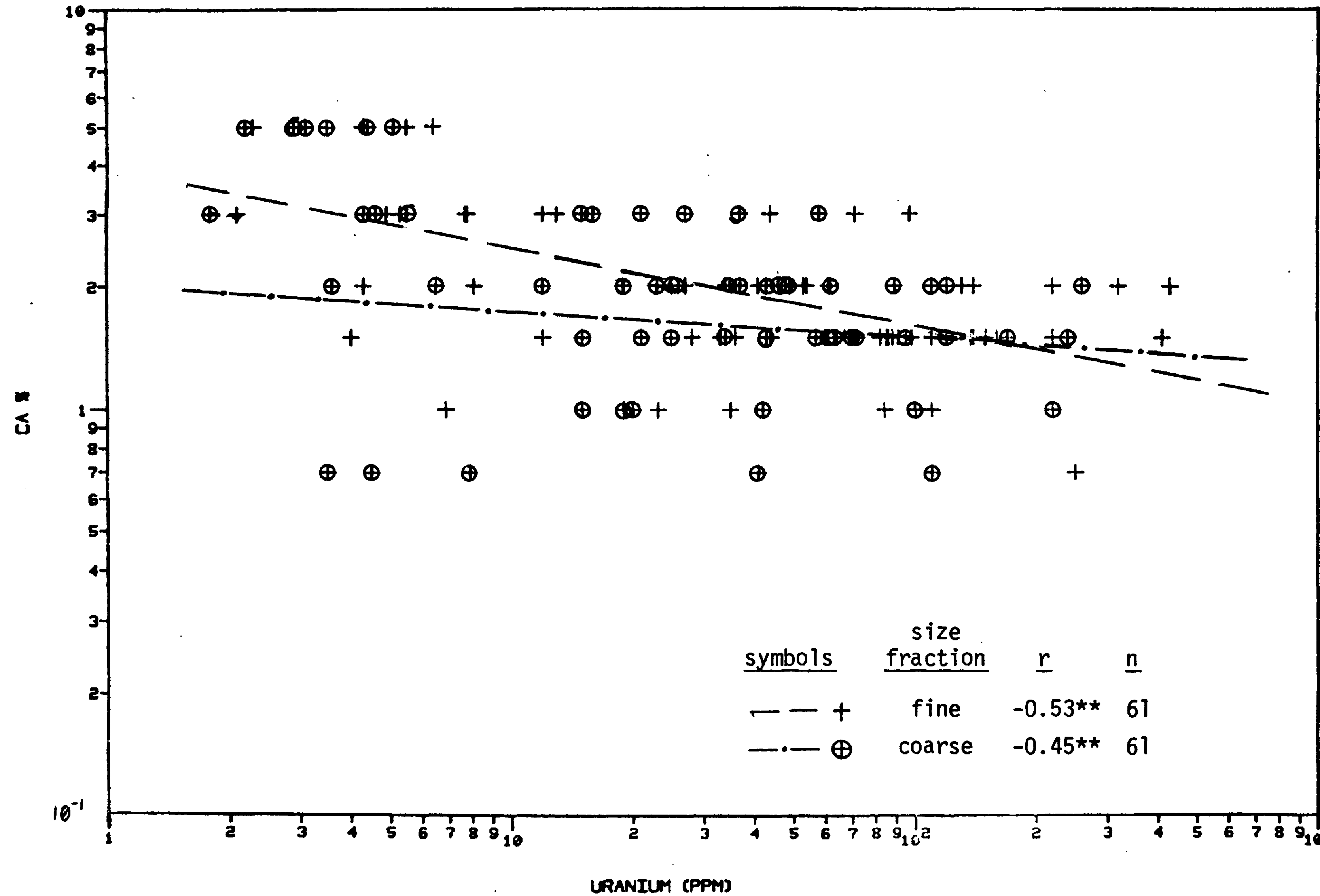

Figure 3-7.--Scatter diagram of percent calcium versus uranium.

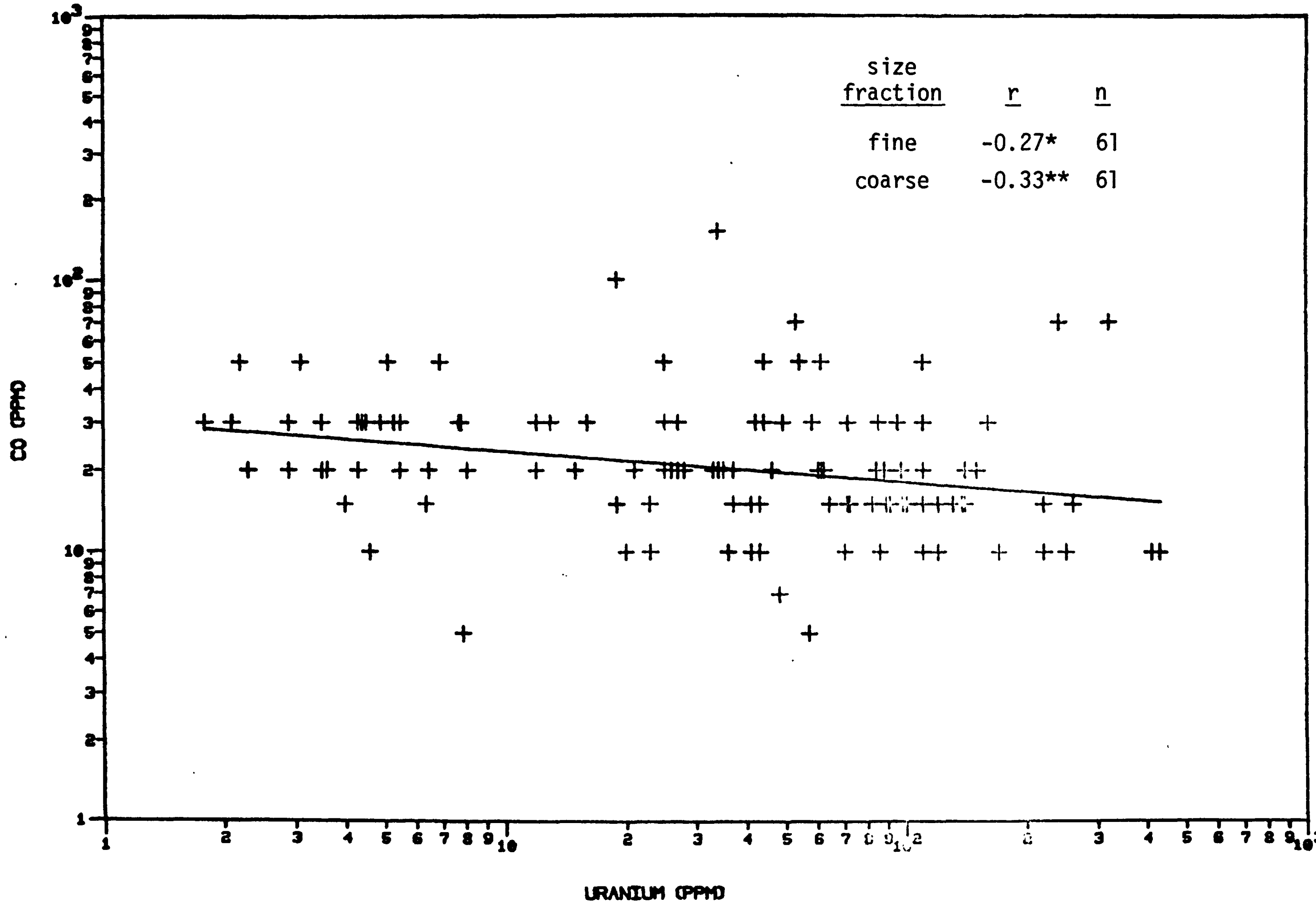

Figure 3-8.--Scatter diagram for cobalt versus uranium. Line drawn from both size fractions.

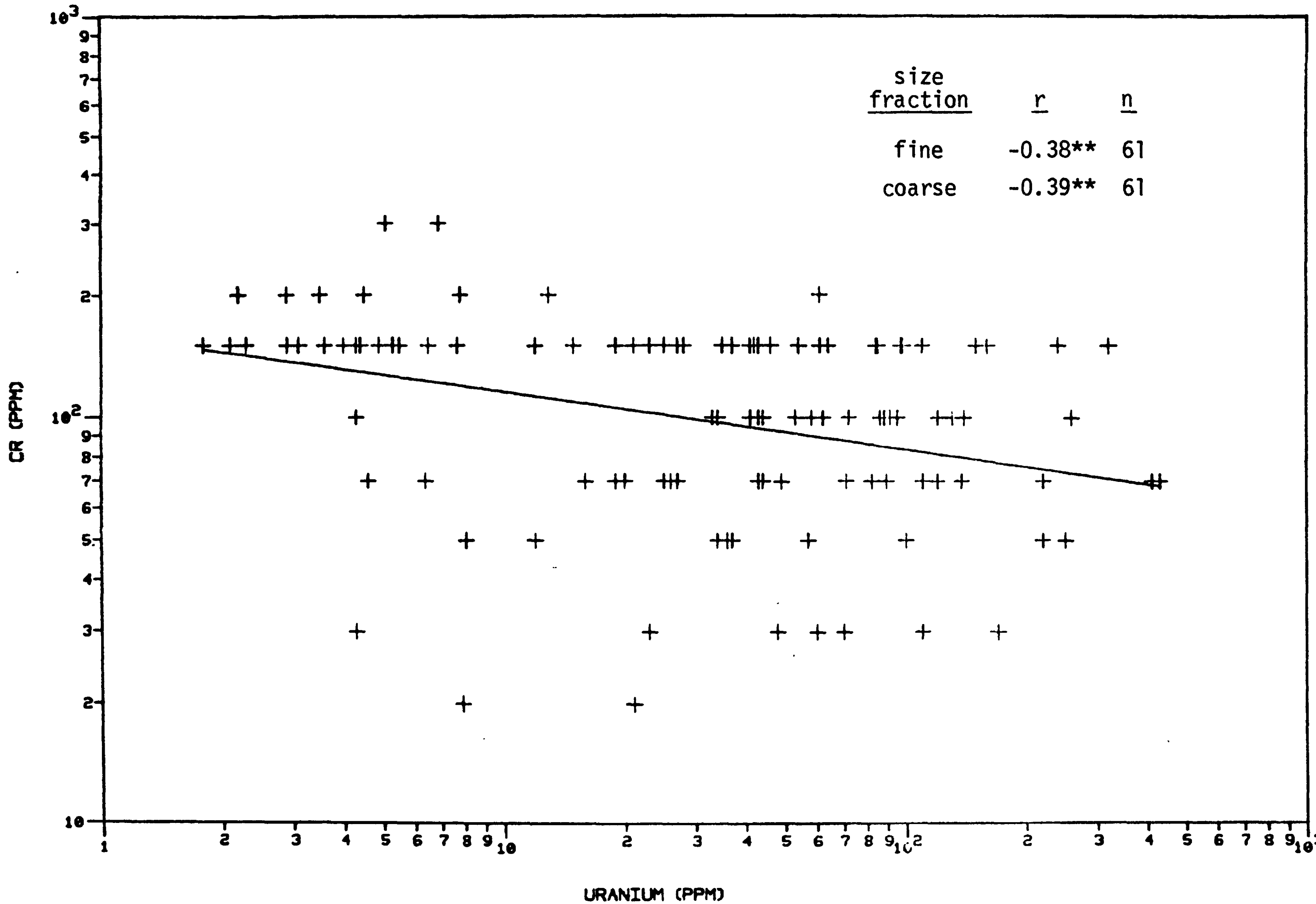

Figure 3-9.--Scatter diagram of chromium versus uranium. Line drawn from both size fractions.

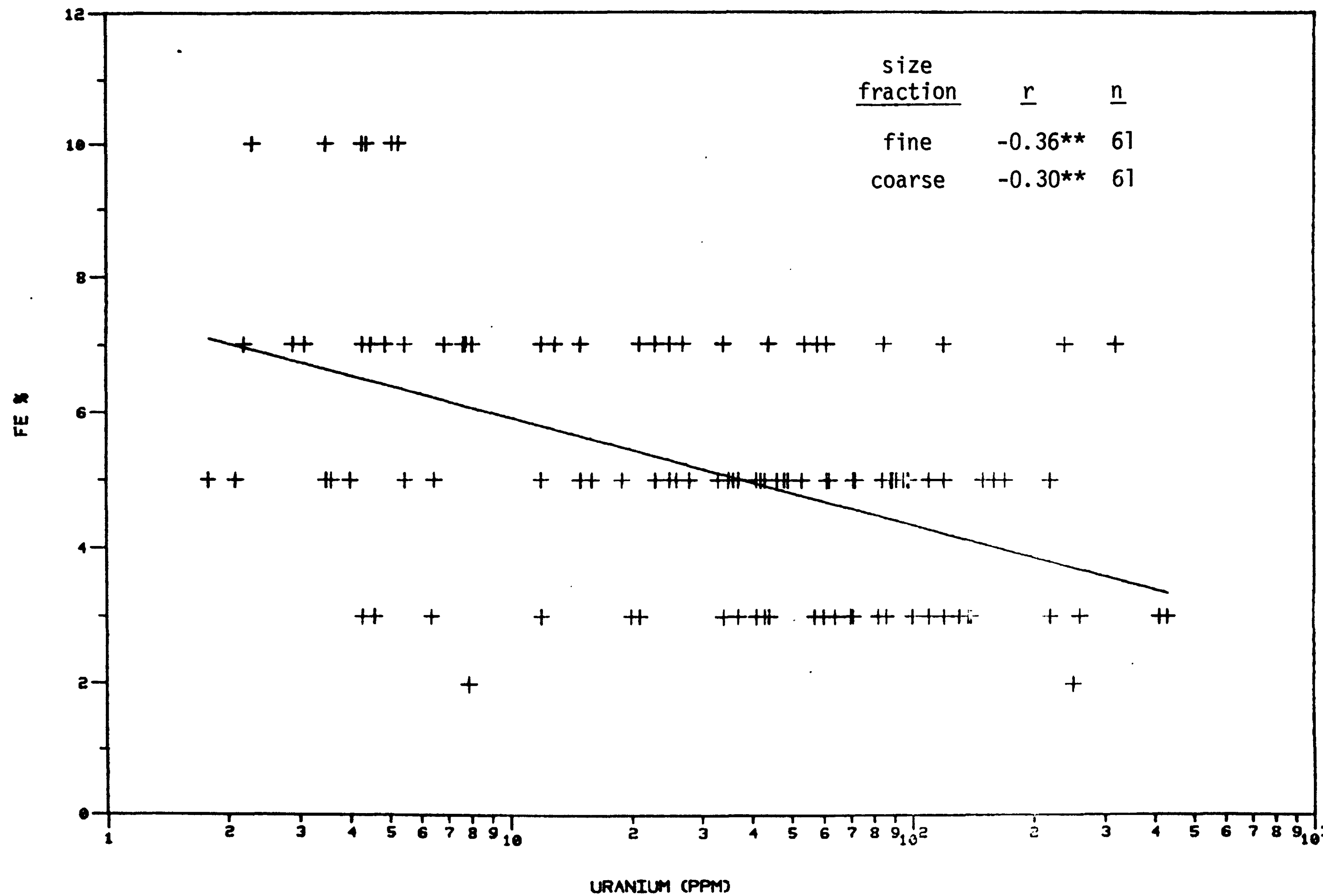

Figure 3-10.--Scatter diagram of percent iron versus uranium. Line drawn from both size fractions.

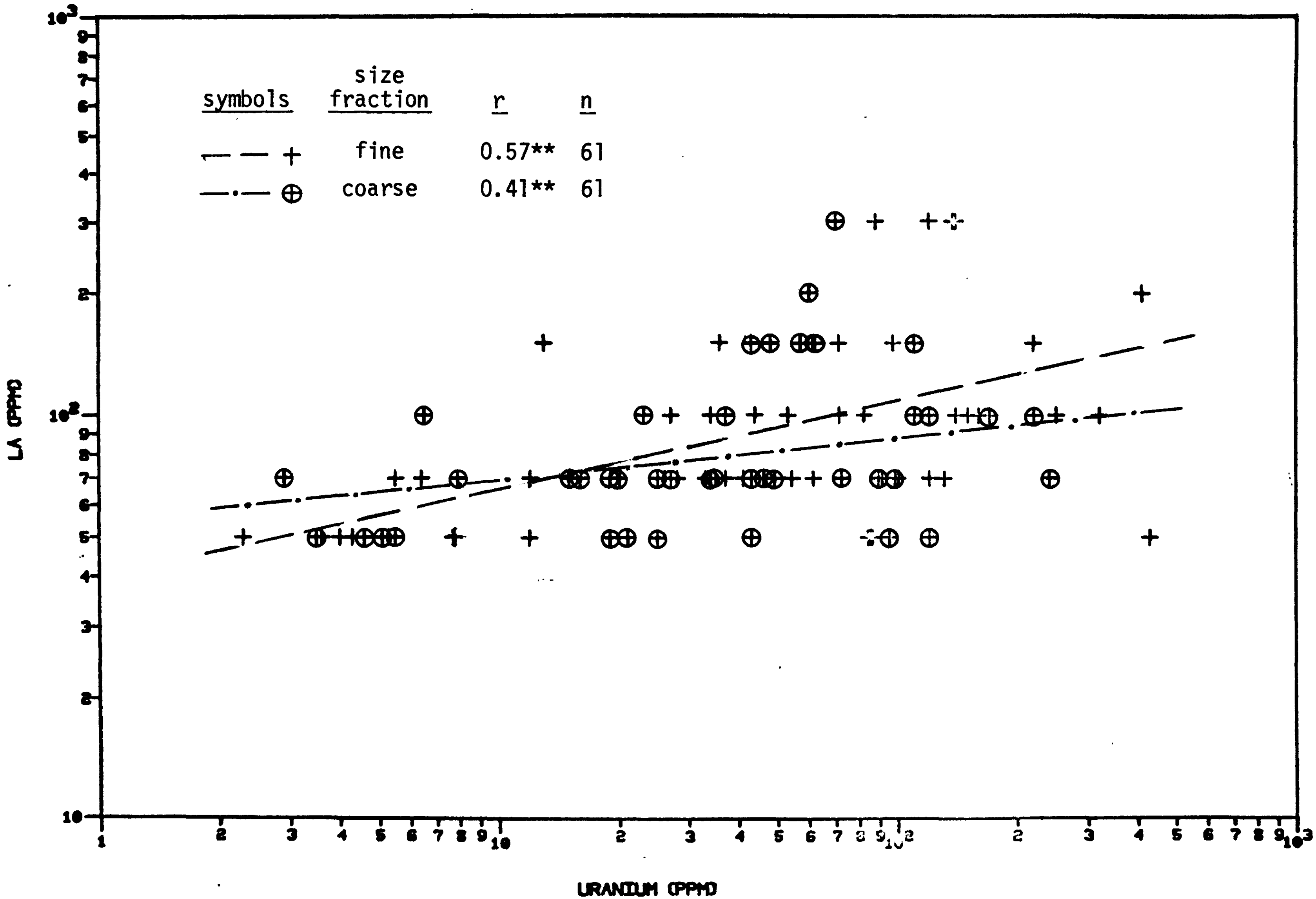

Figure 3-11.--Scatter diagram of lanthanum versus uranium.

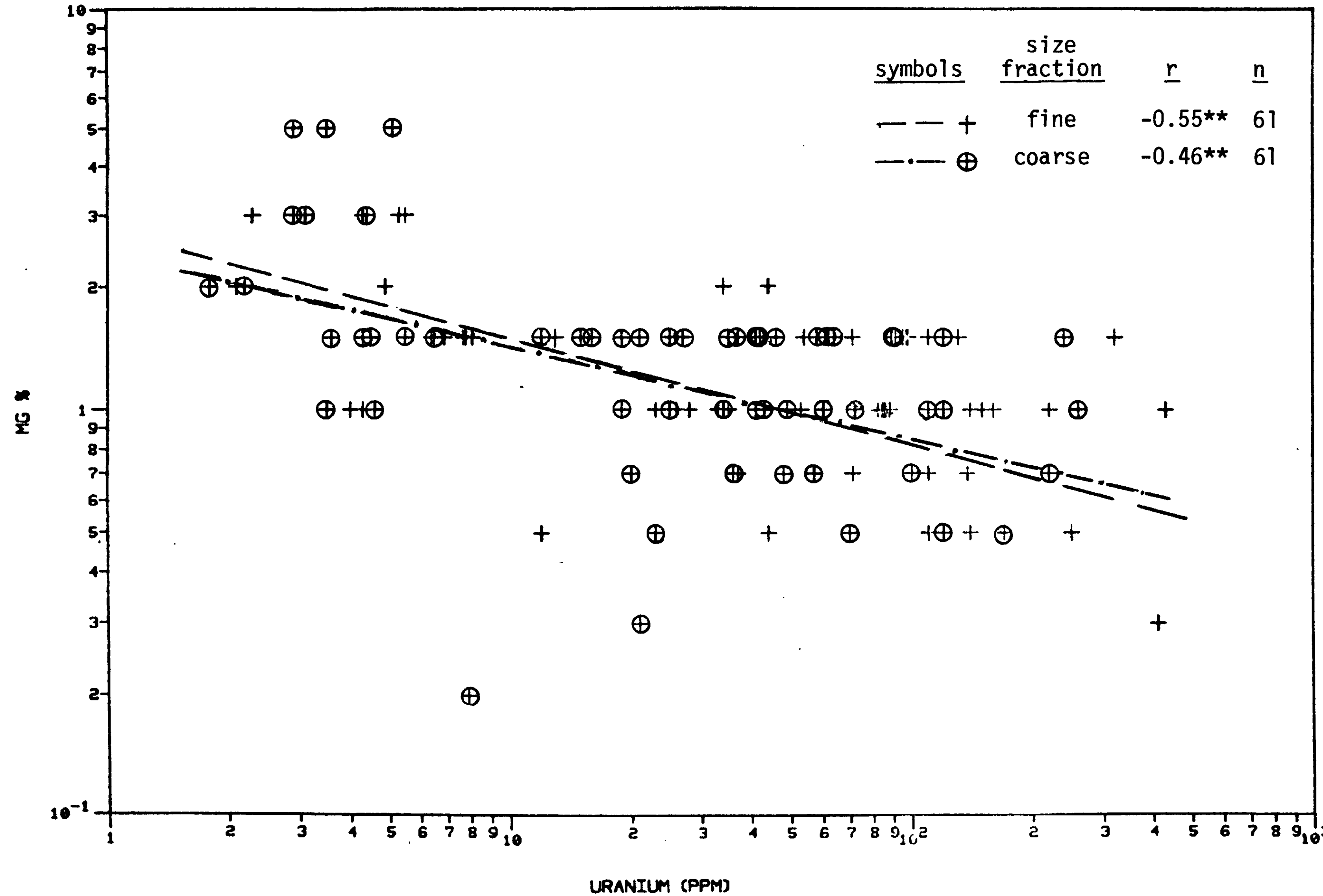

Figure 3-12.--Scatter diagram of magnesium versus uranium.

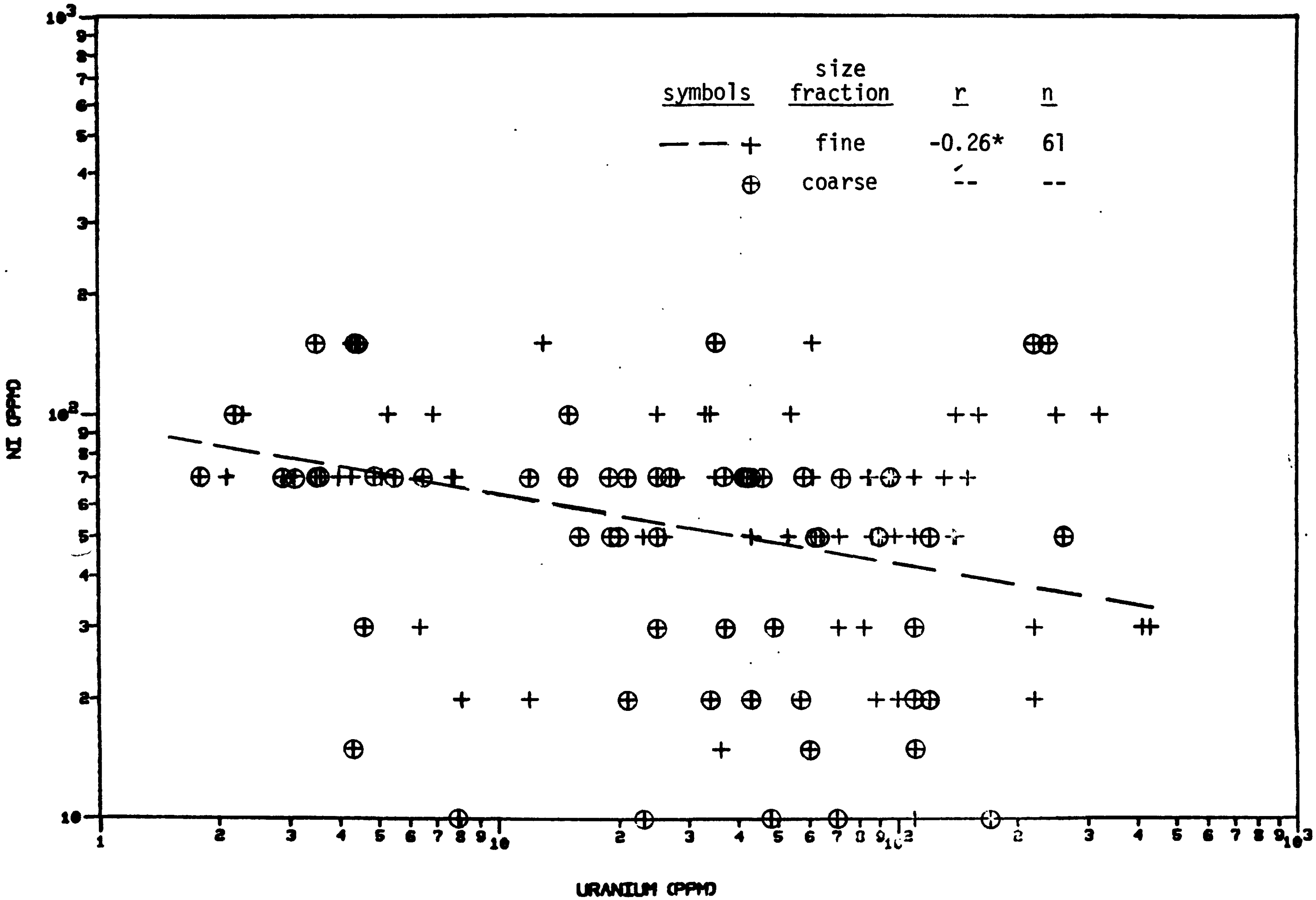

Figure 3-13.--Scatter diagram of nickel versus uranium. Coarse-fraction values had an asymmetric distribution, therefore r was not calculated for the coarse fraction.

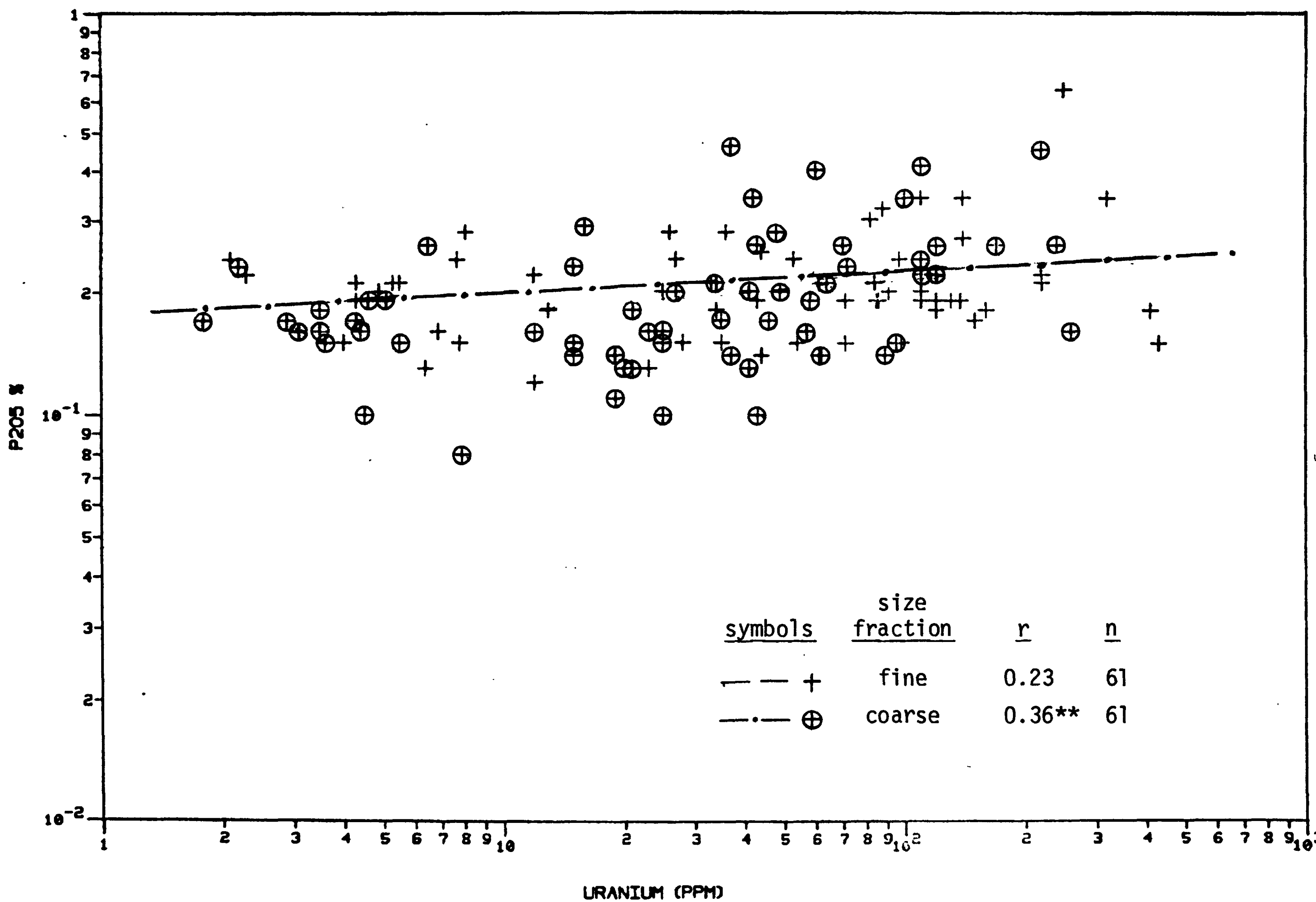

Figure 3-14.--Scatter diagram of P_2O_5 versus uranium. The r value for the fine-size fraction is not statistically significant, therefore no regression line was calculated for that fraction.

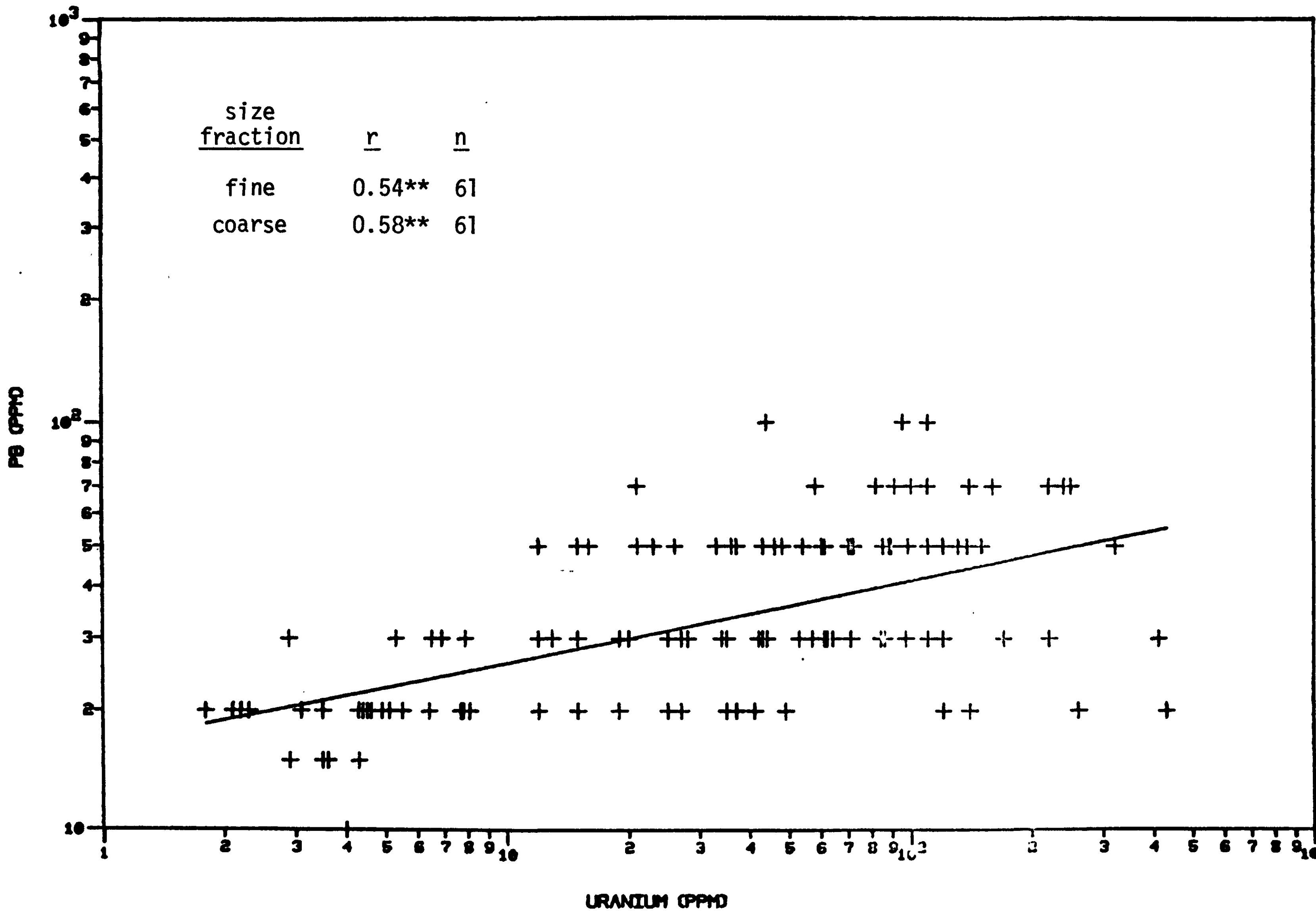

Figure 3-15.--Scatter diagram of lead versus uranium. Line was drawn from both size fractions.

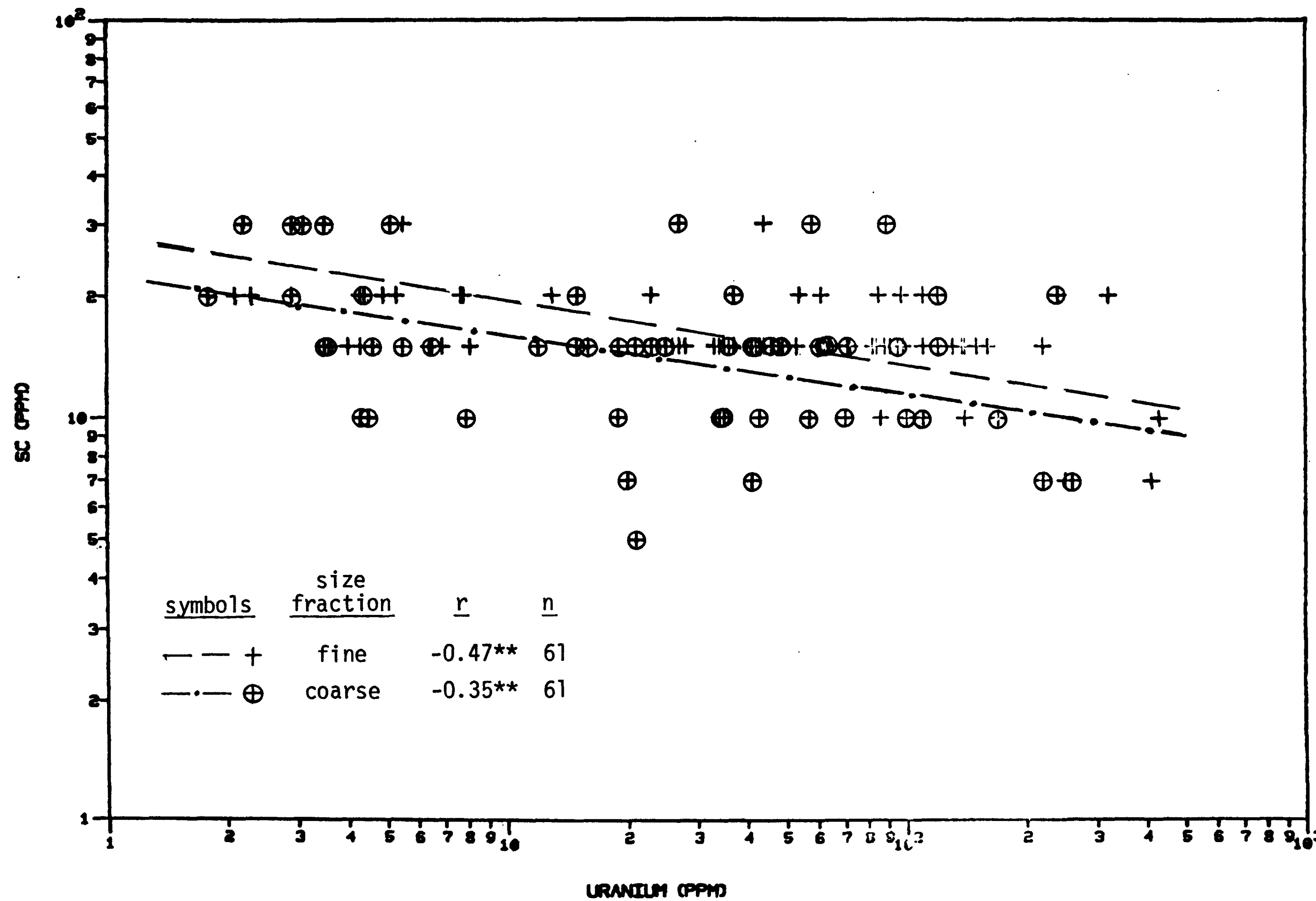

Figure 3-16.--Scatter diagram of scandium versus uranium.

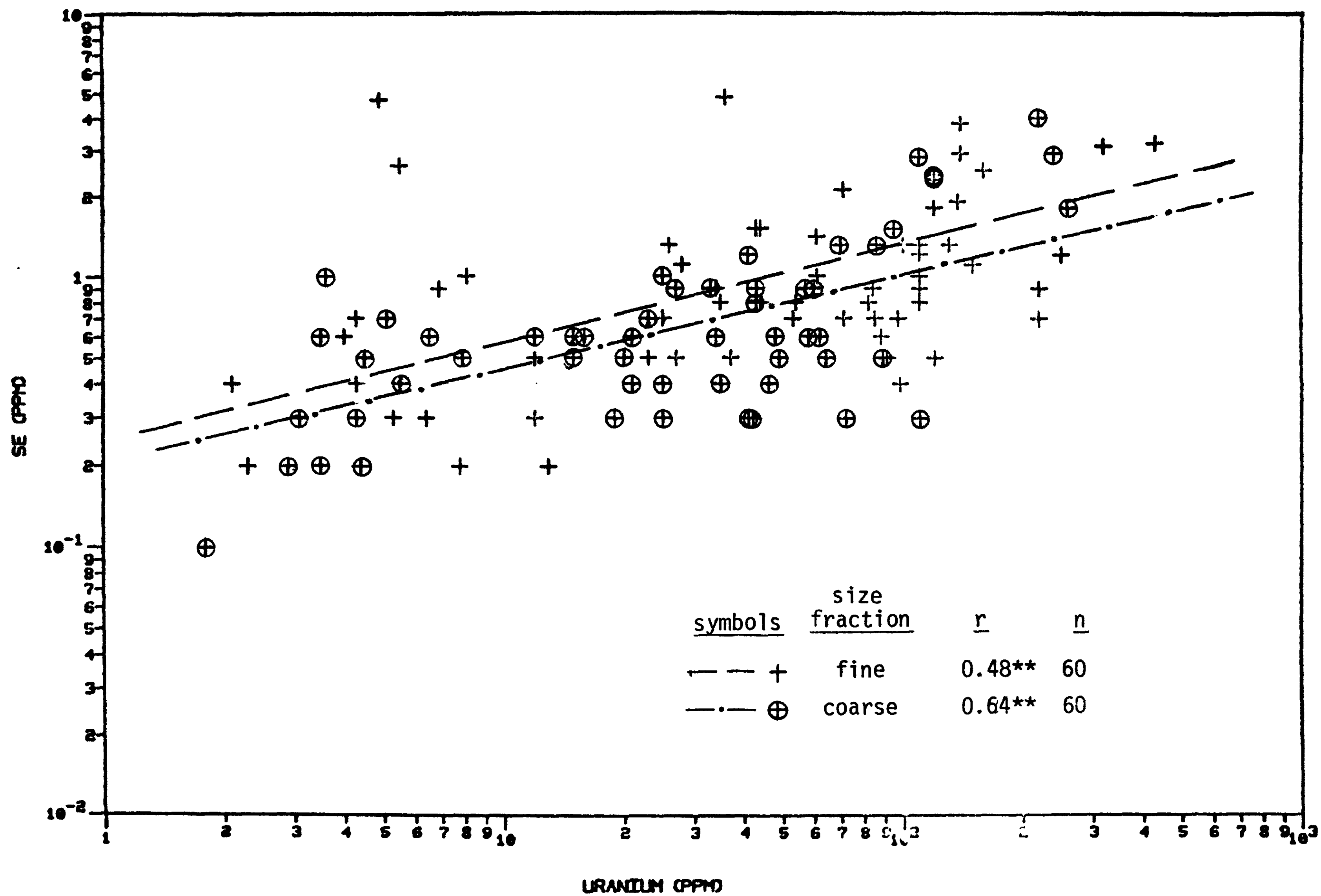

Figure 3-17.--Scatter diagram of selenium versus uranium.

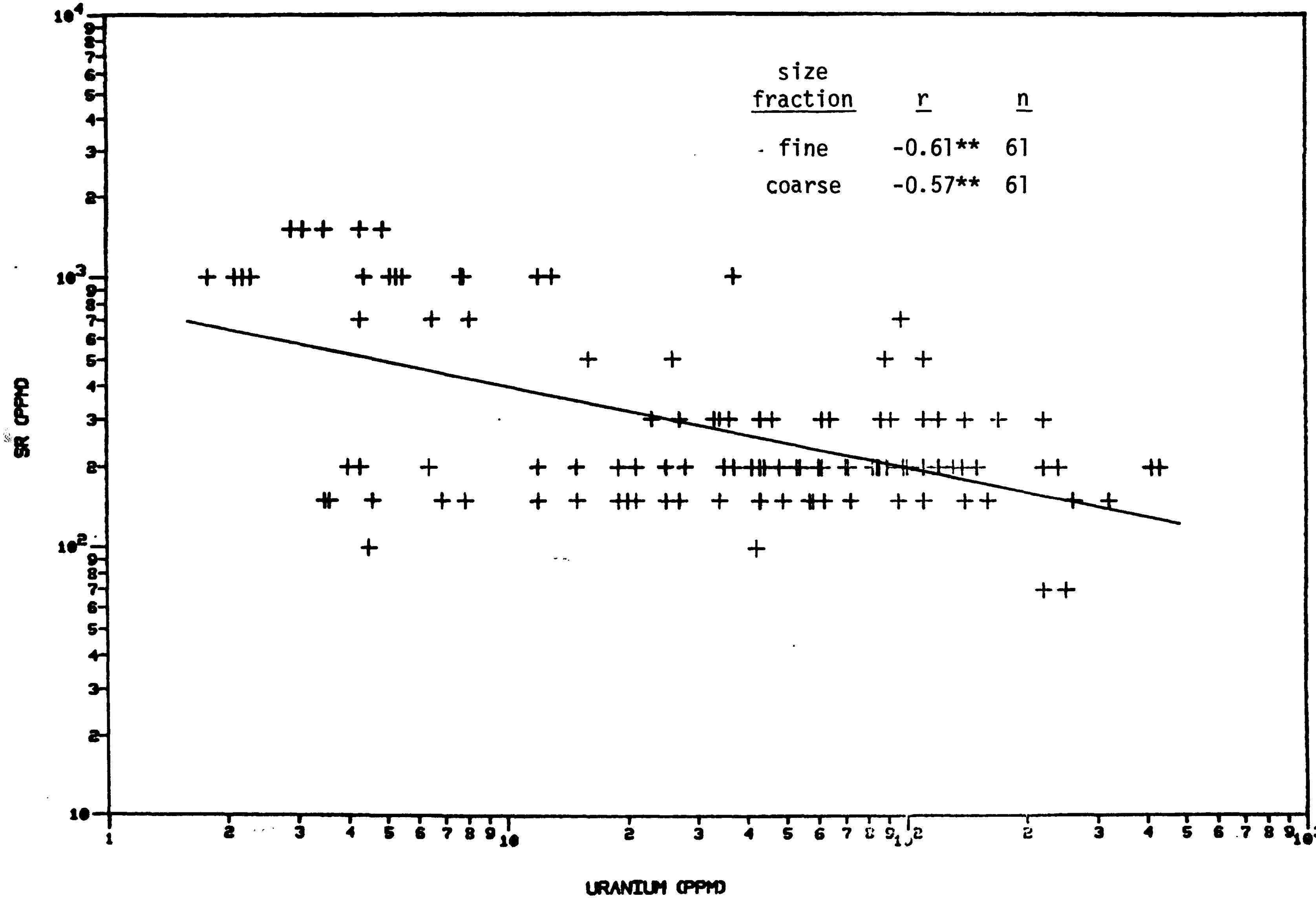

Figure 3-18.--Scatter diagram of strontium versus uranium. Line was drawn from both size fractions.

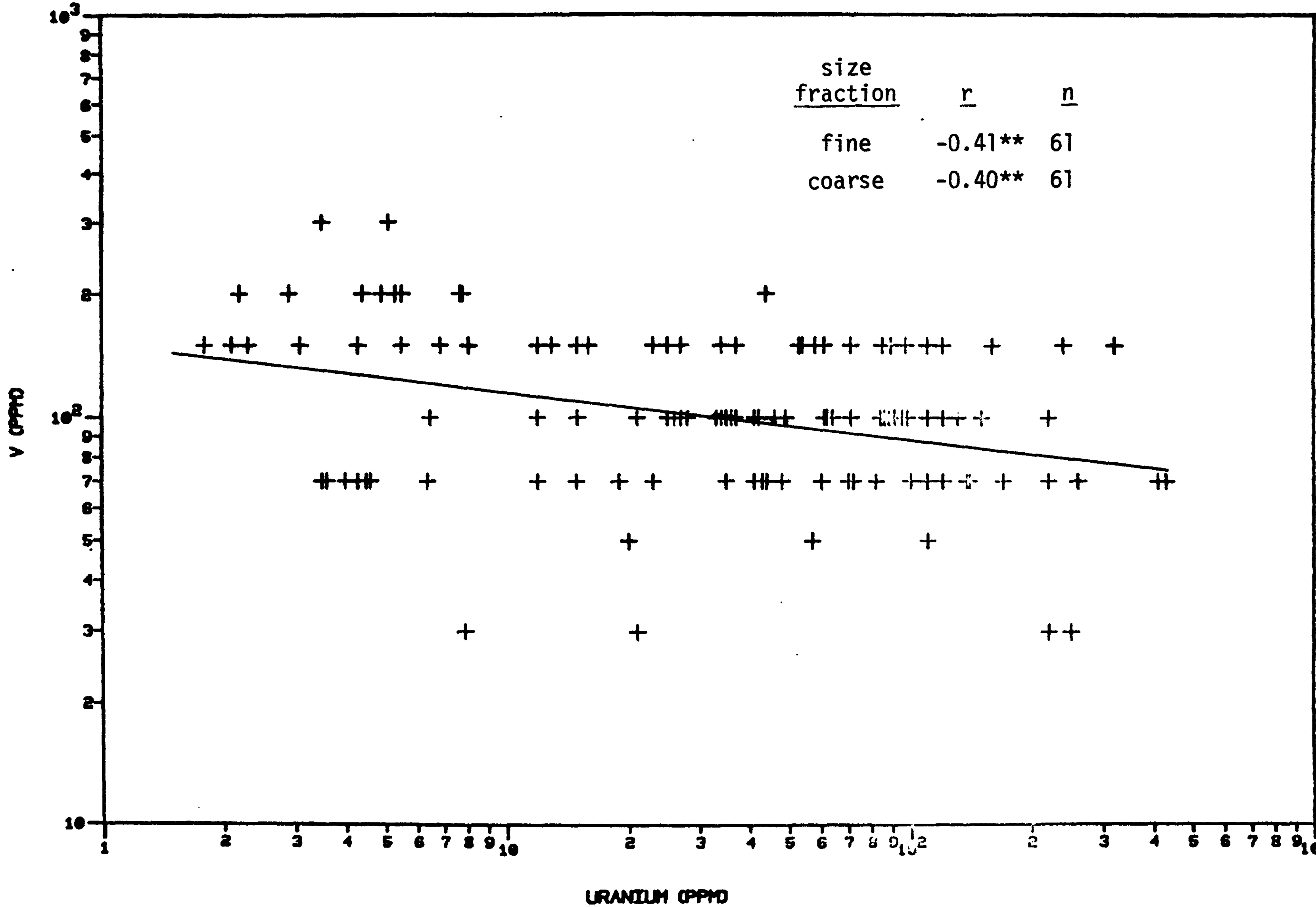

Figure 3-19.--Scatter diagram of vanadium versus uranium. Line was drawn from both size fractions.

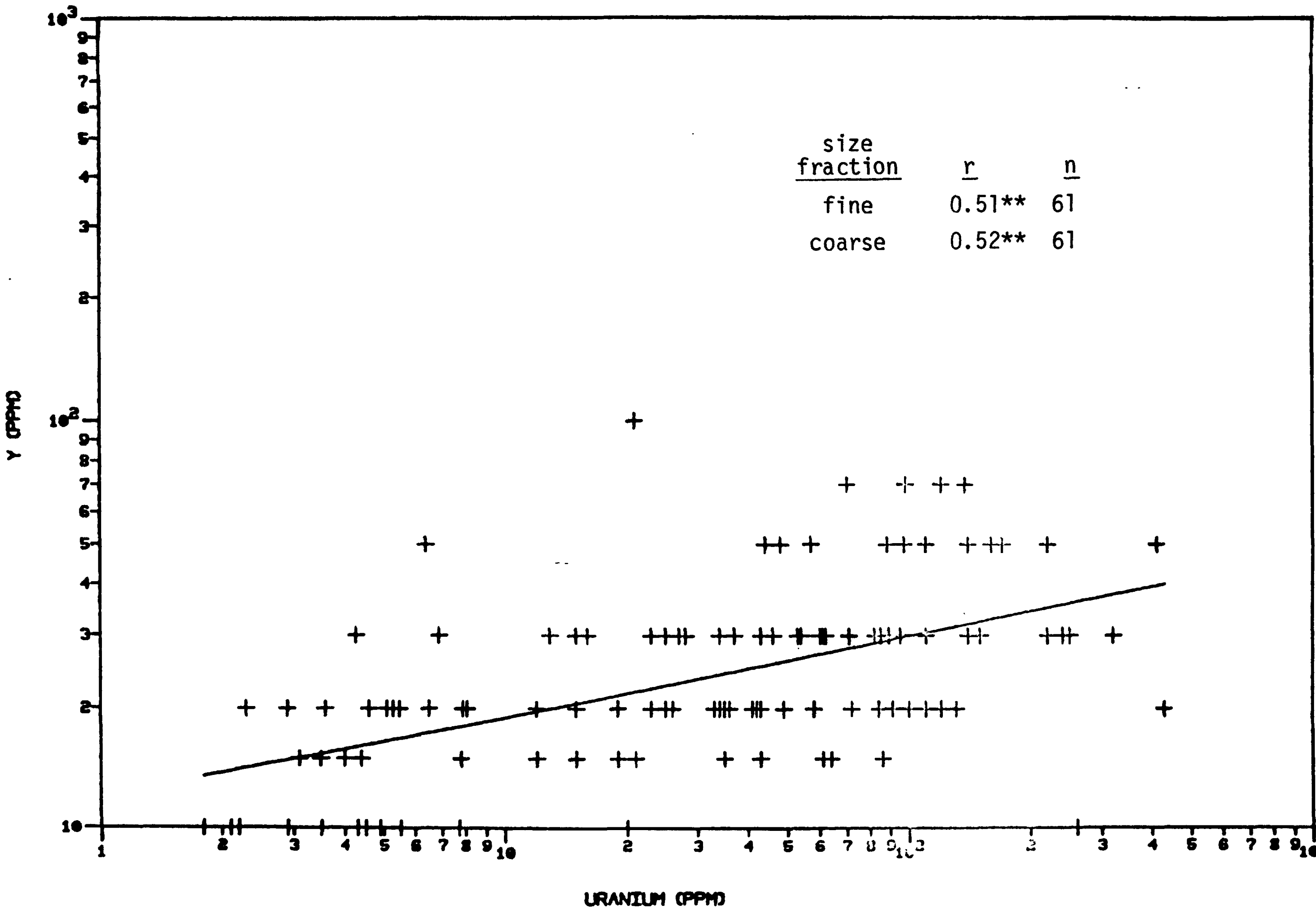

Figure 3-20. --Scatter diagram of yttrium versus uranium. Line was drawn from both size fractions.

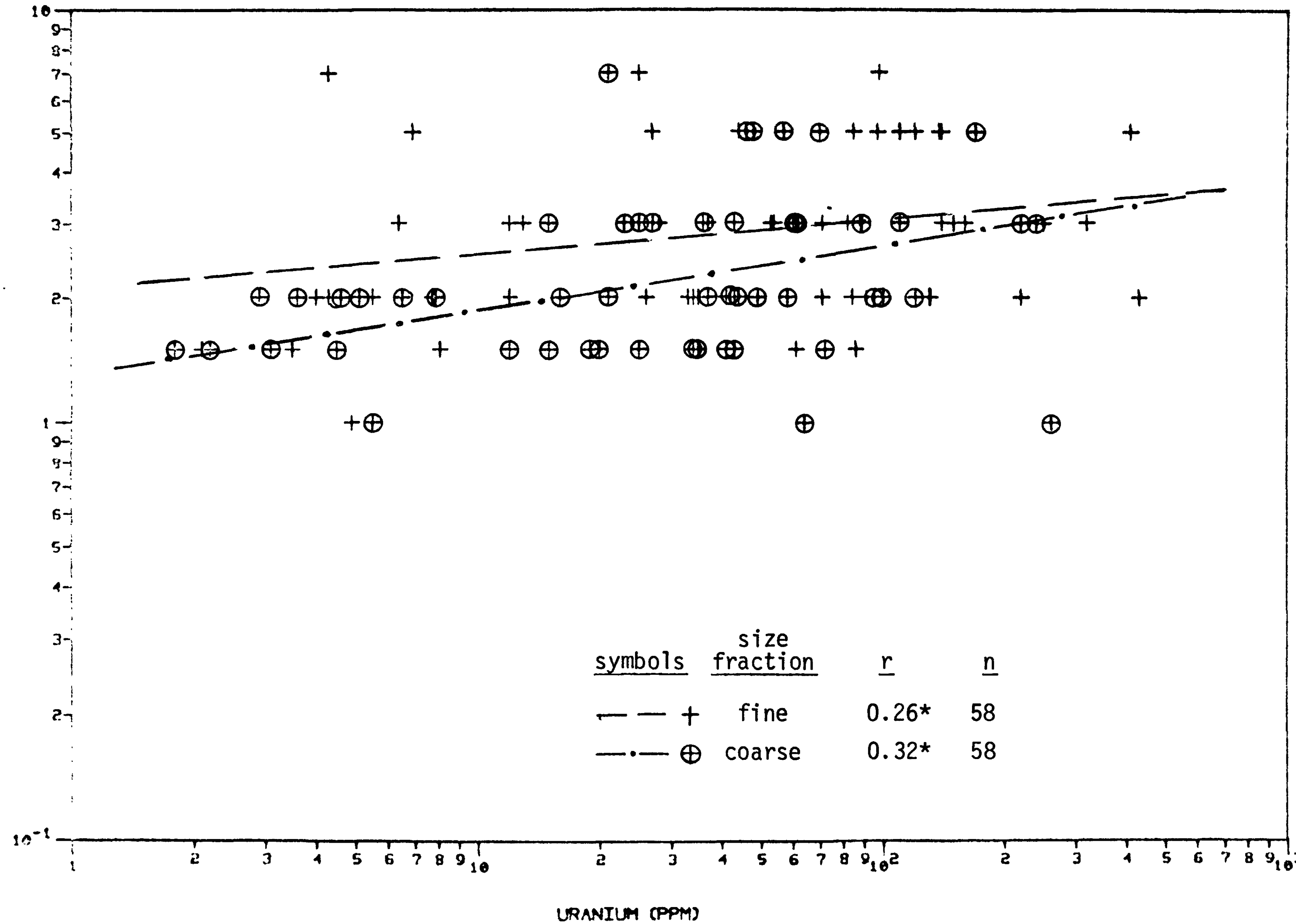

Figure 3-21.--Scatter diagram of ytterbium versus uranium.

Table 7.--Standard error of replicates as a measure of the percentage of total sample variance due to analytical imprecision

[Variances include both the fine- (< 88 μm) and coarse- (>88 μm but <149 μm) size fractions. A prefix of L- before the element name signifies use of log-data in the calculations and in this listing. A total of 12 replicate samples were submitted for analysis. N = delayed neutron analysis; S = semiquantitative emission spectroscopy; X = x-ray fluorescence; A = atomic absorption]

Element abbreviation	Error variance	Total variance	% error variance	Pairs
L - U N	0.00021	0.34894	0.61	12
L - Th N	.00665	.08828	7.53	4
Al_2O_3% X	1.0832	1.49847	73.96*	12
L - As A	.04412	.10709	41.20	12
L - Ba S	.01174	.05773	20.34	12
L-TotalC	.01458	.12997	11.22	12
L- Org C	.01466	.13821	10.65	12
L - Ca S	.00788	.04248	18.42	12
L - CaO	.02130	.03286	64.42*	12
L - Co S	.00648	.06070	10.72	12
L - Cr S	.00477	.05972	7.92	12
L - Cu S	.01352	.06841	19.63	12
L - Fe S	.01392	.02648	51.92*	12
L-Fe_2O_3X	.00140	.01370	10.20	12
L - K S	.00863	.02237	38.57	12
L- K_2O X	.00027	.01355	2.00	12
L - La S	.01141	.04289	26.61	8
L - Mg S	.00617	.05339	11.55	12
MgO % X	.26149	.90250	28.97	12
L - Mn S	.00756	.04511	16.77	12
L- MnO X	.00208	.05047	4.12	12
L - Mo S	.00000	.00000	.00	2
L - Na S	.00517	.01725	29.97	12
Na_2O % X	.00676	.39490	1.70	12
L - Ni S	.00229	.08723	2.63	12
L-P_2O_5 X	.01268	.02095	60.56*	12
L - Pb S	.00334	.04308	7.76	12
L - Sc S	.00518	.02199	23.54	12
L - Se X	.04982	.15582	31.97	10
SiO_2 % X	11.511	27.98895	41.13	12
L - Sr S	.00582	.10170	5.72	12
L - Ti S	.10113	.03142	32.19	12
L-TiO_2 X	.00171	.01274	13.41	12
L - V S	.00329	.03813	8.65	12
L - Y S	.01154	.04731	24.40	12
L - Yb S	.02183	.03964	55.07*	11
L - Zn A	.00016	.22577	6.90	12
L - Zr S	.04316	.07221	59.78*	12

*Greater than 50 percent of the variance seen in the data is related to analytical error rather than geological variation.