UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Analytical data on uranium ore-bearing samples collected in the southern part of the Powder River Basin, Wyoming--1972-1979

By

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Contents

Page

Introduction.....1

Analytical methods.....4

Presentation of data.....4

Explanation of illustrations.....7

Sample description.....7

References cited.....8

Sample locations, descriptions, and analytical results.....10

Teton mine

Sample suites ET-1, ET-2, and ET-6.....11

Misc. sample ET-8.....68

Highland Mine

Sample Suites EP-4H, EP-5H, EP-7H, EH-20, EP-17

UX-1, and OX-1.....18

Misc samples EP-2H, EP-6H, EH-21, EH-22.....68

Mrak No. 2 Mine

Sample Suites BMK-1-11, BMK-20-39, and BMK-40-47.....50

Misc samples BMK 48-60.....70

Diamond drill core

Sample suites EP-9 and EP-10.....62

Illustrations

Page

Figure 1. Index map showing the location of sample sites.....2

2. Sample suite ET-1.....11

3. Sample suite ET-2.....14

4. Sample suite EP-4H.....19

5. Sample suite EP-5H.....21

6. Sample suite EP-7H.....25

7. Sample suite EH-20.....28

8. Sample suite EP-17.....31

9. Sample suite UX-1.....35

10. Sample suite OX-1 location.....42

11. Sample suite OX-1.....43

12. Sample suite OX-1.....44

13. Sample suite BMK-1 location.....51

14. Sample suite BMK-1.....52

15. Sample suites BMK-20 and BMK-40 location.....55

16. Sample suite BMK-20.....56

17. Sample suite BMK-40.....60

18. Sample suites EP-9.....63

19. Sample suite EP-10.....66

Tables

Table 1. List of analysts.....3

2. Lower limits of detection, spectrographic analyses.....5

Analytical data on uranium ore-bearing samples collected in the southern part of the Powder River Basin, Wyoming--1972-1979

By Elmer S. Santos

Introduction

Members of the U.S. Geological Survey collected 170 samples of ore-bearing and adjacent host rocks in the southern part of the Powder River Basin, Wyoming (fig. 1), and all the analytical data derived from these samples are being made public here. Prior to 1965, A. P. Butler collected 52 samples from the Mrak No. 2 Mine, and during the period 1972 through 1979, the author collected 118 samples from other mines and from diamond drill cores in the area.

This compilation is intended to be purely descriptive and no interpretation is attempted. The report was prepared so that anyone interested in the study of uranium geology, particularly that of roll-front uranium deposits, may have access to these analytical data.

For descriptions of the geologic setting in the southern part of the Powder River Basin, the reader is referred to Sharp and Gibbons (1964), Sharp and others (1964). In both of these publications, as well as in one by Mrak (1958), the near-surface uranium deposits in the area are described. Davis (1969) described the overall characteristics of the subsurface roll-front deposits, and Langen and Kidwell (1974), as well as Dahl and Hagmaier (1976), described various aspects of the Highland Mine deposits. Analytical data from some of the samples collected by A. P. Butler were used in two reports by Rosholt, Butler, and others (1965) and Rosholt, Tatsumoto, and Dooley (1965).

Permission to sample and report the results of analyses was graciously extended by the officials of mining companies involved in the sampling program. To them I express my sincerest appreciation. Analysts are listed in table 1.

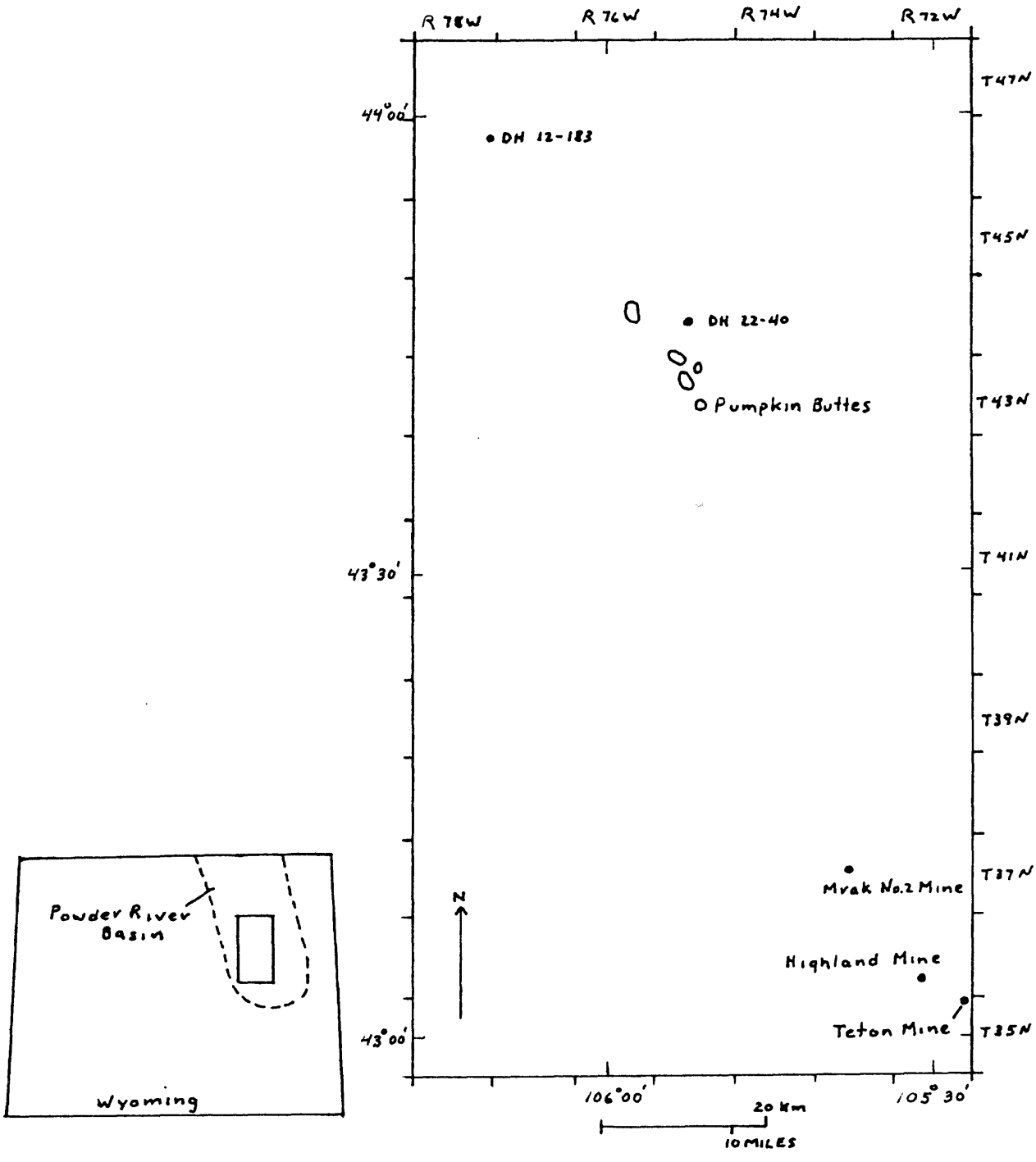

Figure 1. Index map showing localities sampled

Table 1.

List of analysts

Analyzed for[1]	Analysts
U	H. H. Lipp; E. J. Fennelly
U[2]	H. T. Millard; C. M. Ellis; C. McFee
eU[3]	H. G. Neiman; E. J. Fennelly; G. D. Shipley; H. H. Lipp; L. Lee
V	J. Burrows
Se	G. T. Burrows;
Se[4]	A. Bartel
S	I. C. Frost; P. H. Briggs
C	V. Shaw
As	J. G. Crock; G. Riddle; E. J. Fennelly
Fe (total)	V. Merritt
66 elements[5]	H. G. Neiman; M. J. Malcolm; L. A. Shipley; L. A. Bradley

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[1] Wet, chemical or fluorimetric analyses with the following exceptions:

[2] By delayed neutron.

[3] By beta-gamma scaler.

[4] By X-ray fluorescence.

[5] By six-step semiquantitative spectrographic means.

Analytical Methods

All samples were analyzed in the Denver laboratories of the U.S. Geological Survey. The procedures followed were standard procedures in practice at the time the samples were submitted.

Results of the semiquantitative spectrographic analyses are to be identified with geometric brackets whose boundaries are 1.2, 0.83, 0.56, 0.38, 0.26, 0.18, 0.12, etc., but are reported arbitrarily as mid-points of these brackets, 1.0, 0.7, 0.5, 0.3, 0.2, 0.15, 0.1 etc. The precision of the reported value is approximately plus or minus one bracket at 68 perceent, or two brackets at 95 percent confidence.

The symbol N indicates the element was not detected at the limit of detection or at the value shown; the symbol L indicates the element was detected, but below the limit of determination or below the value shown. Table 2 gives the lower limits of detection for spectrographic analyses at the Denver laboratories. Elements not shown in the list are those which were not detected in any of the samples. Silicon occurs in all samples in indeterminate amounts greater than 10 percent.

Presentation of data

Each sample and sample suite is described in terms of sample locality, physical properties, and chemical composition. Wherever a sample suite has some continuity and seems to show some significant relationship between element distribution and geologic features, it has been illustrated and described as a suite. The distribution of selected elements in the suite is shown by means of a graph. Isolated samples are described separately as miscellaneous samples. In addition to being identified by their field number, each sample is also identified by a serial number assigned by the analytical laboratories. Splits of samples retained by the laboratories are catalogued

Table 2. Approximate visual lower limits of determination for the elements analysed by the 6-step Spectrographic Method at the Denver Laboratory

[from Meyers and others, 1961]

REVISED December 1967

Element	%
Si	0.002
Al	0.001
Fe	0.001
Mg	0.002
Ca	0.002
Na	0.05
K	0.7
Ti	0.0002
P	0.2

Element	ppm
Mn	1
Ag	0.5
As	1000
Au	20
B	20
Ba	1.5
Be	1
Bi	10
Cd	20
Ce	150
Co	3
Cr	1
Cu	1
Dy	50
Er	50
Eu	100
Ga	5
Gd	50
Ge	10
Hf	100
Ho	20
In	10
Ir	50
La	30
Li	50
Lu	30
Mo	3
Nb	10
Nd	70
Ni	5
Os	50
Pb	10
Pd	1
Pr	100
Pt	30
Re	30
Rh	2
Ru	10
Sb	150
Sc	5
Sn	10
Sr	5
Sm	100
Ta	200
Tb	300
Te	2000
Th	200
Tl	50
Tm	20
U	500
V	7
W	100
Y	10
Yb	1
Zn	200
Zr	10

NOTE: Some combinations of elements affect the limits of determination. Approximate values are given. In unusually favorable materials, concentrations somewhat lower than the values given may be detected. In unfavorable materials the given limits of determination may not be attained for some of the elements.

GPO 841-910

and stored according to their serial number. On the sample location sketch maps grab samples are designated by "x" and channel samples by line intervals.

Because of the variety of process that have acted on the rocks since the ore deposits formed, as well as original differences, the samples cannot all be considered to be geologically similar and care should be exercised in dealing statistically with these data.

Samples that could be grouped and considered as separate classes are those from below and those from above the water table. These two classes could be subdivided between those from oxidized and those from unoxidized rocks. The resulting categories of samples could then be differentiated on the basis of their uranium content, between those that are nearly barren and those that are high-grade.

Suites EP-4H, EP-5H, EP-7H, EP-9, EP-10, EP-17, EH-20, UX-1, and OX-1 are from below the water table; suites ET-1, ET-2, ET-6, BMK-1-11, BMK-20-39, and BMK-40-47 are from above the water table. All suites from below the water table contain both oxidized and unoxidized rock except for suite EP-9 which, apparently, has only unoxidized rock. Of the suites from above the water table, ET-1, ET-2, and ET-6 have been affected by recent near-surface oxidation whereas the BMK suites have not, apparently, been so affected. Of the miscellaneous samples, EP-2H, EP-6H, EH-21, and EH-22 are from below the water table and samples BMK-48-57, BMK-58-6, and ET-8 are from above the water table.

Explanation of illustrations

Most of the illustrations consist of a geologic diagram and one or two graphs. The geologic diagrams, drawn to scale, depict, either in plan view or in vertical section, the color changes in the vicinity of the sample site. The accompanying graphs show plots of analytical data for selected elements in the sample suite. A logarithmic scale, shown as the abscissa on some and as the ordinate (vertical) on other graphs, indicates the amounts in ppm of the selected elements plotted. Normal to the scale on each graph, the position of the samples are shown to scale.

The plotted elements commonly occupy about the same range of values so that many of the graphs would be overly cluttered if all elements were shown on one graph. To circumvent this problem, two graphs accompany some of the diagrams and the relation of separate groups of elements to uranium are shown on each.

Sample descriptions

Sample descriptions are based entirely on megascopic and microscopic examination at magnification of 45x or less. Nearly all sandstone samples are feldspathic and arkosic, contain a small but conspicuous amount of hornblende, and contain some quantity of interstitial clay. Grain size was determined by direct comparison with a grain-size chart containing examples of size classifications corresponding to the Wentworth scale as given in modified form in Krumbein and Pettijohn (1938, p. 80). Color was determined by direct comparison with the Rock-color Chart (Goddard and others, 1948).

Although the descriptions of individual suites and the lists of analytical data are actually tables, in following the format of previous publications of this kind, I have not designated nor listed them in the table of contents as such. Blank spaces on the lists of analytical data indicate

that no analysis was made; dashes indicate that the substance was not detected by analysis.

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Suite No. ET-1 (1 through 5)

Serial No. D165495 through D165499

Mine Teton open pit mine

Sec. 1, T. 35 N., R. 72 W.

Sample description

1. Sandstone, pale red (10 R 6/2, medium- to very fine-grained, silty, poorly sorted.
2. Sandstone, very pale orange (10 YR 8/2), very coarse- to very fine-grained, poorly sorted. Scattered small fragments of black carbonaceous matter.
3. Sandstone, pale orange (10 YR 7/2), grain size same as ET-1-1, calcareous with yellow and green uranium minerals coating grains.
4. Sandstone, moderate orange (10 R 7/4) very coarse- to very fine-grained, poorly sorted, some black carbonaceous fragments.
5. Lignite, brown.

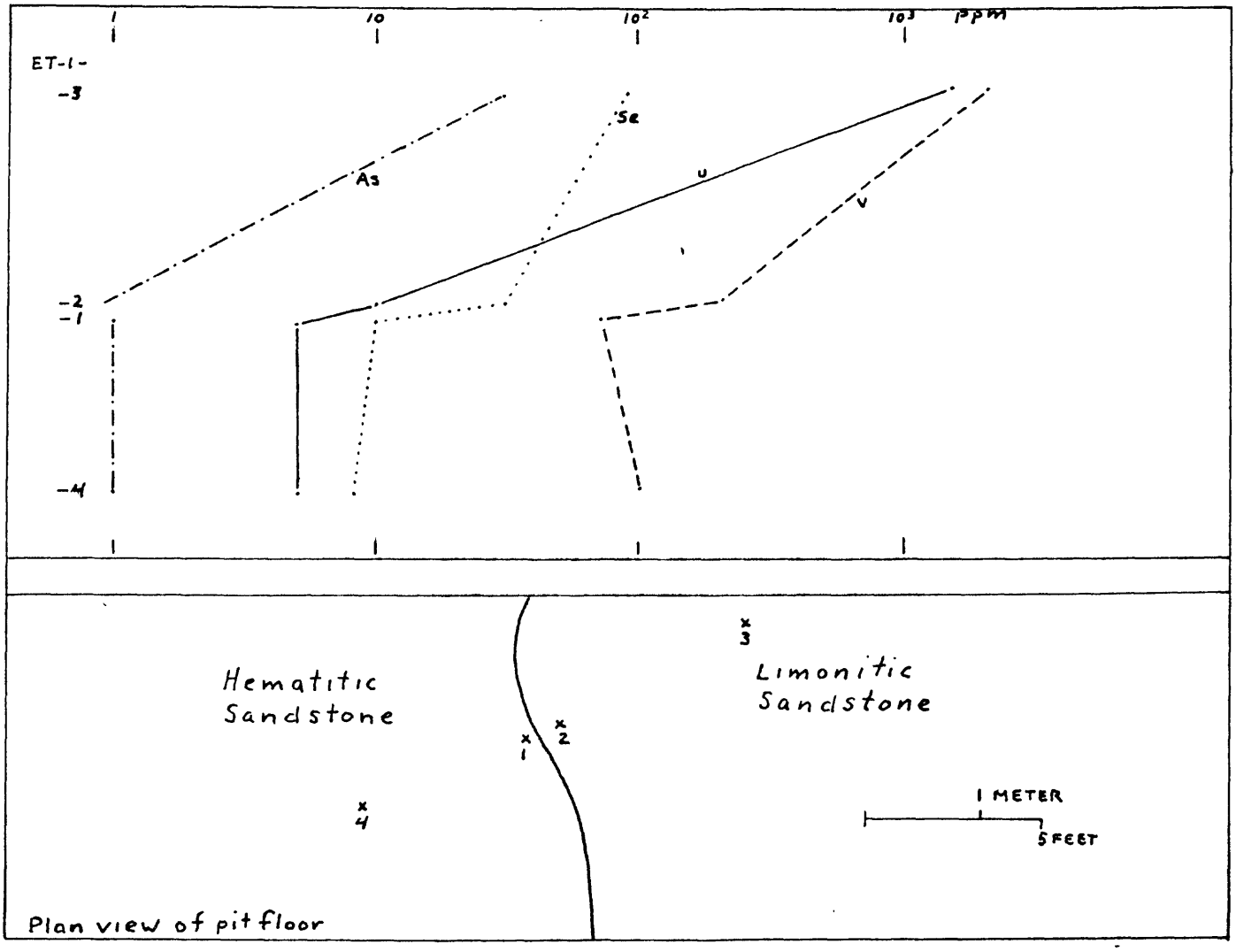


Figure 2. Sample suite ET-1-1-5

Suite No. ET-1-5

Serial No.	D165 495	496	497	498	499					
Field No.	1	2	3	4	5 [1]					
U	–	10	1500	–	1600					PPM
eU	30	50	1500	30	1100					PPM
Se	10	30	90	8	20					PPM
As	1	<1	30	1	15					PPM
S--										%
Org. C										%
Al	5.	5.	5.	5.	5.					%
Ca	.5	.7	3.	.5	.5					
Fe	1.	.7	1.5	.7	1.5					
K	3.	3.	3.	3.	3.					
Mg	.5	.5	.5	.3	.5					
Na	1.5	1.5	2.	2.	.7					
Ti	.1	.07	.1	.1	.2					
B	L	L	L	20	30					PPM
Ba	700	500	700	700	500					
Be	N	N	2	N	1.5					
Co	10	7	20	5	10					
Cr	30	30	30	30	70					
Cu	3	3	3	3	30					
Ga	10	7	15	10	15					
Ge	N	N	N	N	N					
La	N	N	70	N	70					
Mn	200	150	1000	150	70					
Mo	3	N	N	N	3					
Nb	10	10	10	L	20					
Ni	15	20	30	7	15					
Pb	30	30	50	30	30					
Sc	7	7	7	5	15					
Sr	100	100	150	100	100					
V	70	100	2000	100	150					
Y	10	15	20	15	15					
Yb	1	1.5	–	1.5	2					
Zr	100	150	150	70	200					

[1] Lignite

Suite No. ET-2 (1 through 5)

Serial No. D165500 through D165504

Mine Teton open pit mine

Sec. 1, T. 35 N., R. 72 W.

Sample description

1. Sandstone, very pale orange (10 YR 8/2) and light brown (5 YR 5/6), very coarse- to very fine-grained, silty, poorly sorted.
2. Sandstone, yellowish gray (5 Y 7/2), coarse- to very fine-grained, silty, poorly sorted. Scattered specks of black carbonaceous material.
3. Sandstone, pale orange (10 YR 7/2), medium- to very fine-grained, silty, poorly sorted. Scattered specks of black carbonaceous material.
4. Sandstone, yellowish gray (5 Y 7/2), medium- to fine-grained, same as ET-2-2.
5. Sandstone, same as ET-2-4.

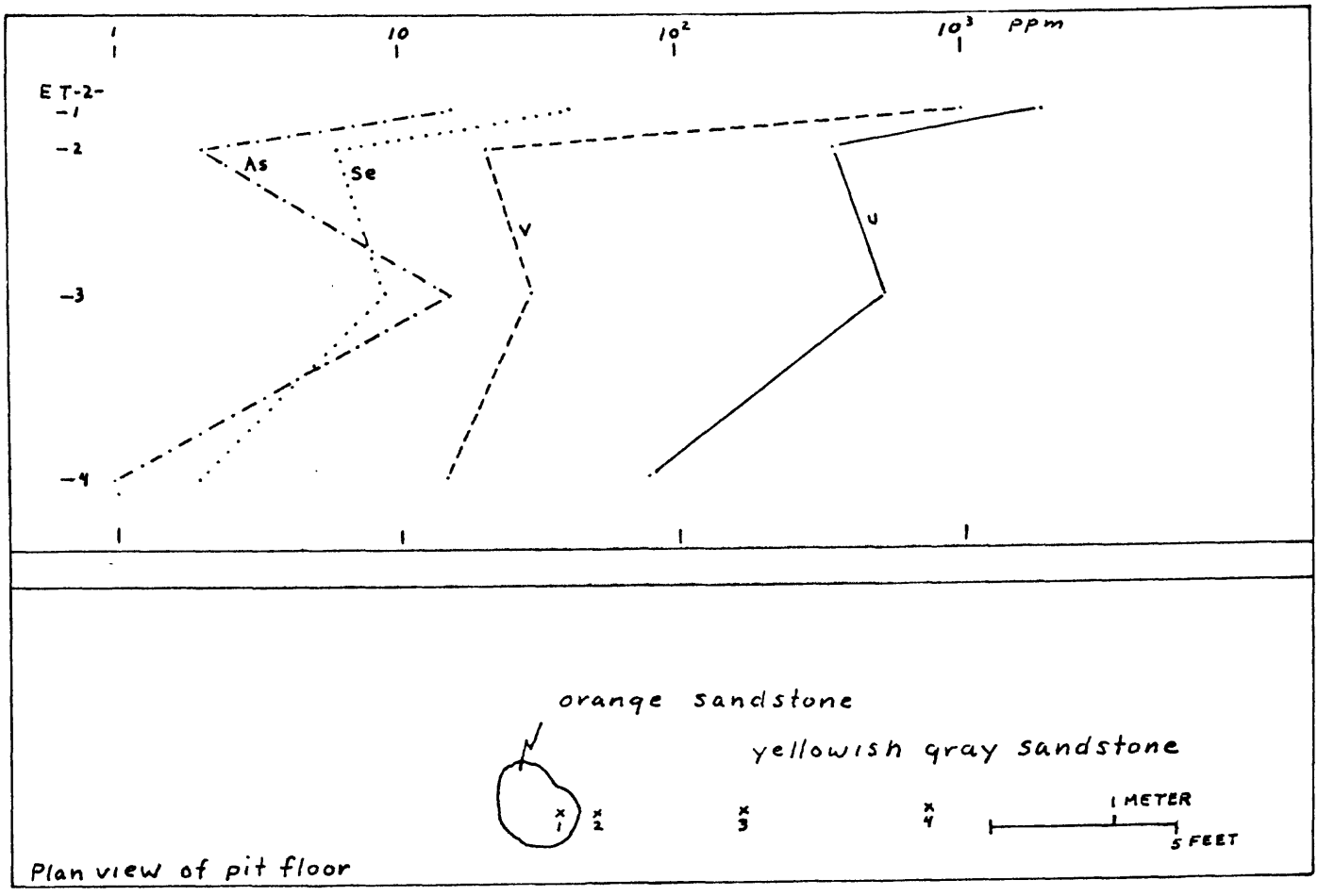


Figure 3. Sample suite ET-2-1-4

Suite No. ET2-1-5

Serial No.	D165 500	501	502	503	504					
Field No.	1	2	3	4	5					
U	1900	350	530	80	40					PPM
eU	1900	700	600	300	100					PPM
Se	40	6	9	2	3					PPM
As	15	2	15	1	1					PPM
S^{--}										%
Org. C										%
Al	5.	5.	5.	5.	5.					%
Ca	1.	.7	3.	.7	.7					
Fe	1.5	.7	1.	1.	.7					
K	3.	3.	3.	3.	3.					
Mg	.5	.3	.3	.5	.3					
Na	1.5	1.5	1.5	1.0	1.5					
Ti	.07	.1	.1	.15	.05					
B	L	L	L	L	L					PPM
Ba	700	500	500	500	500					
Be	N	N	N	L	N					
Co	7	7	15	7	7					
Cr	20	30	30	30	15					
Cu	3	3	7	3	3					
Ga	10	10	10	10	15					
Ge	N	N	N	N	N					
La	N	L	L	L	N					
Mn	100	150	1000	200	150					
Mo	N	3	N	N	L					
Nb	L	L	L	10	L					
Ni	10	15	20	15	15					
Pb	30	30	30	30	30					
Sc	5	5	7	7	L					
Sr	150	100	100	150	150					
V	1000	200	300	150	150					
Y	L	L	50	10	L					
Yb	2	1.5	5	1.5	1					
Zr	70	70	70	70	50					

Suite No. ET-6 (1 through 4)

Serial No. D165505 through D165508

Mine Teton open pit mine, west wall

Sec. 1, T. 35 N., R. 72 W.

Sample description

1. Sandstone, pale orange (10 YR 7/2), very coarse- to very fine-grained, poorly sorted, arkosic, scattered specks of black carbonaceous material.
2. Sandstone, same as ET-6-1.
3. Sandstone, grayish orange (10 YR 7/4), otherwise same as ET-6-1.
4. Sandstone, pale orange (10 YR 7/2), same as ET-6-1.

Suite No. ET6

Serial No.	D165 505	506	507	508						
Field No.	1	2	3	4						
U	40	30	-	80						PPM
eU	50	50	40	300						PPM
Se	7	3	3	3						PPM
As	1	<1	<1	1						PPM
S^{--}										%
Org. C										%
Al	5.	3.	5.	5.						%
Ca	.7	.7	.7	2.						
Fe	1.	1.	1.	.7						
K	3.	3.	3.	3.						
Mg	.5	.5	.5	.3						
Na	1.5	1.5	1.5	1.5						
Ti	.15	.15	.1	.15						
B	L	L	L	L						PPM
Ba	700	700	700	500						
Be	N	N	N	L						
Co	7	7	7	7						
Cr	30	30	30	30						
Cu	3	3	2	3						
Ga	15	10	15	7						
Ge	N	N	N	N						
La	N	N	N	N						
Mn	150	200	150	300						
Mo	7	L	N	N						
Nb	L	L	L	L						
Ni	10	10	15	15						
Pb	30	30	30	30						
Sc	5	5	5	7						
Sr	100	100	100	150						
V	70	50	70	150						
Y	L	10	L	15						
Yb	1	1.5	1.5	1.5						
Zr	100	150	150	150						

Suite No. EP-4H (1 through 5)

Serial No. D165481 through D165488

Mine Highland open pit mine, pit 1 south Elev. 5080

Sec. 28, T. 36 N., R. 72 W.

Top limb of upper ore deposit

Sample description

1. Mudstone, medium gray (N 5).
2. Sandstone, medium gray (N 5), medium- to very coarse-grained abundant calcite cement, abundant pyrite.
3. Sandstone, moderate yellowish brown (10 YR 5/4), medium- to very coarse-grained, some iron sulfides, calcite cement.
4. Sandstone, pale yellowish orange (10 YR 8/4) coarse-grained, very friable.
5. Sandstone, same as EP-4H-4.

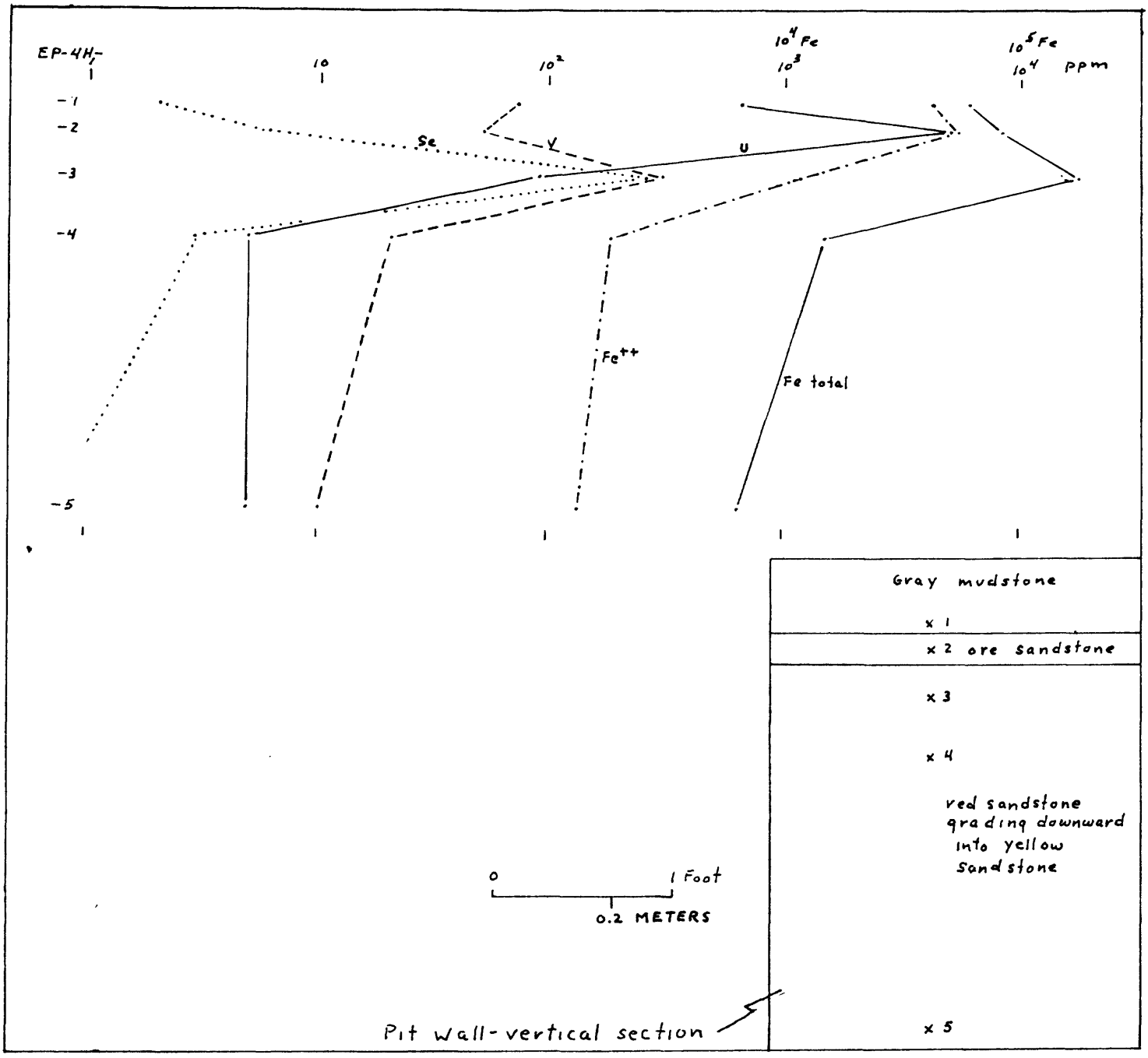


Figure 4. Sample suite EP-4H-1-5

Suite No. EP-4H

Serial No.	D158 943	944	945	946	947					
Field No.	1 1/	2	3	4	5					
U	650	5000	90	-	-					PPM
eU	500	2900	420	40	20					PPM
Se	2	6	270	3	0.5					PPM
As										PPM
S^{--}	-	-	-	-	-					%
Org. C										%
Al	7.	5.	2.	3.	2.					%
Ca	.5	.5	.3	.2	.2					
Fe	5.	5.	10.	1.	.3					
K	2.	2.	2.	2.	2.					
Mg	.7	1.	.7	.2	.1					
Na	.3	.7	.7	1.	1.					
Ti	.2	.02	.007	.02	.015					
B	20	N	N	N	N					PPM
Ba	500	500	1000	2000	700					
Be	L	N	L	N	N					
Co	7	10	N	N	N					
Cr	70	10	30	7	10					
Cu	20	3	2	3	1.5					
Ga	20	20	20	10	10					
Ge	N	N	N	N	N					
La	N	N	N	N	30					
Mn	150	200	200	100	50					
Mo	N	N	N	N	N					
Nb	N	L	N	N	N					
Ni	15	5	L	L	L					
Pb	15	10	10	15	15					
Sc	7	N	N	N	N					
Sr	150	100	100	100	70					
V	70	50	300	20	10					
Y	20	10	N	N	20					
Yb	3	N	N	N	3					
Zr	150	50	10	50	30					

1/ mudstone

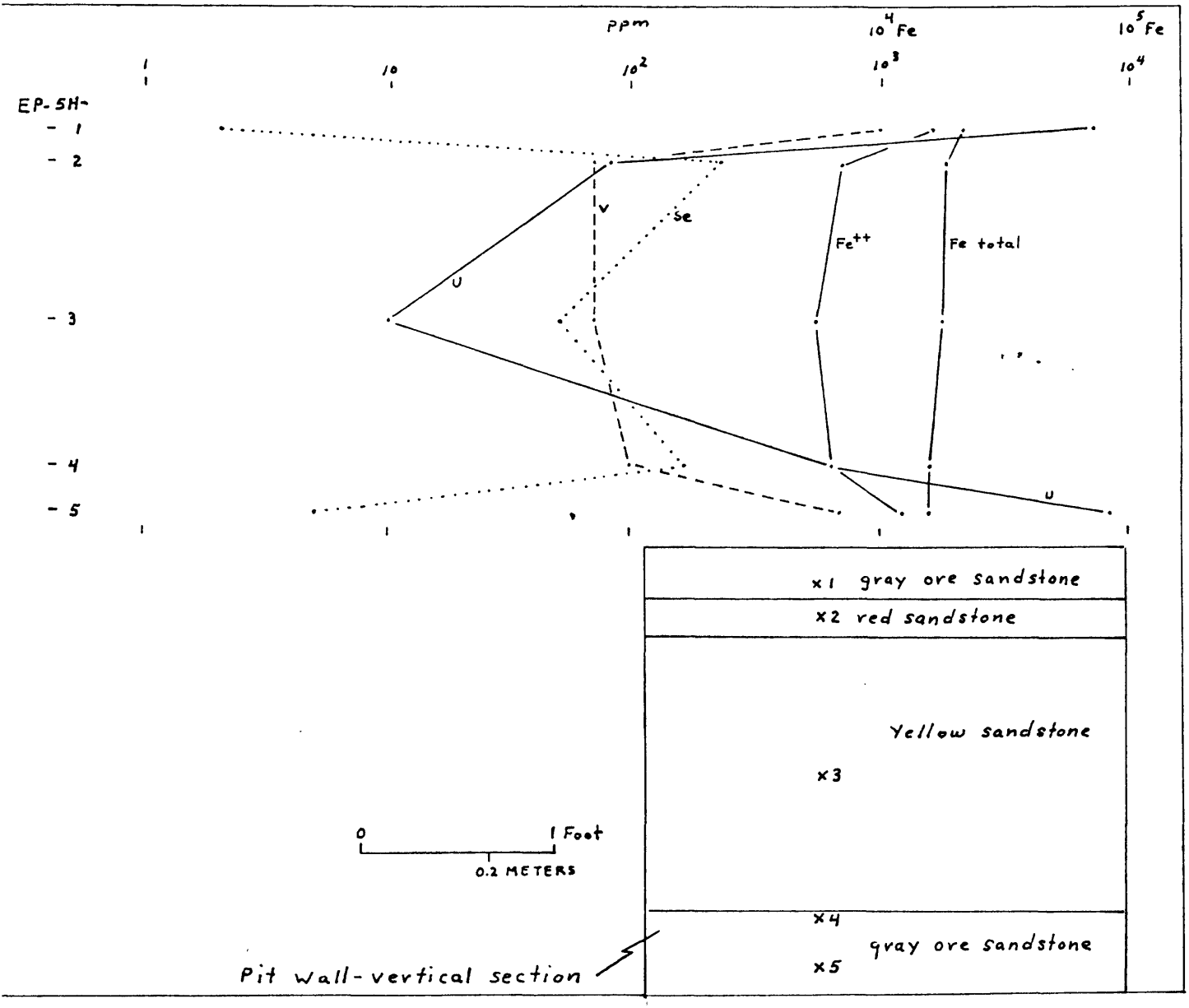


Figure 5 Sample suite EP-5H-1-5

Suite No. EP-5H

Serial No.	D158 948	949	950	951	952	953	954			
Field No.	1	2	3	4	5	6	7			
U	7000	80	10	630	8300	9000	280			PPM
eU	4400	320	150	750	7200	6100	300			PPM
Se	2	230	50	165	5	0.5	4			PPM
As										PPM
S--	.53	–	–	–	–	.19	.56			%
Org. C										%
Al	5.	5.	3.	3.	3.	3.	5.			%
Ca	.3	.5	.5	.7	.5	.5	1.			
Fe	1.5	1.0	1.	1.	1.	1.5	1.			
K	2.	2.	2.	2.	2.	2.	2.			
Mg	.3	.3	.3	.5	.2	.5	.2			
Na	1.	1.	1.	1.	.7	.7	1.			
Ti	.1	.1	.1	.15	.1	.1	.05			
B	N	N	N	N	N	N	N			PPM
Ba	1000	700	1000	700	700	500	700			
Be	N	N	N	N	N	N	N			
Co	10	5	5	5	15	15	5			
Cr	30	30	50	50	30	30	20			
Cu	5	3	7	5	5	7	2			
Ga	7	10	10	10	7	7	7			
Ge	N	N	N	N	N	N	N			
La	N	N	N	N	N	N	N			
Mn	70	100	100	150	100	100	150			
Mo	N	N	N	N	N	N	N			
Nb	N	N	N	N	N	N	N			
Ni	7	7	10	10	10	15	20			
Pb	15	15	15	15	10	10	15			
Sc	5	5	5	5	3	5	N			
Sr	100	100	100	100	100	100	100			
V	1000	70	70	100	700	200	15			
Y	N	N	15	10	10	10	10			
Yb	5	1	2	1.5	–	–	N			
Zr	100	70	70	150	70	200	50			

Suite No. EP-5H (1 through 7)

Serial No. D158948 through D158954

Mine Highland Mine open pit 1 south

Top limb upper ore deposit

Sec. 28, T. 36 N., R. 72 W.

Sample description

1. Sandstone, light olive gray (5Y 6/1) medium fine-grained, scattered coarse grains, scattered specks of black carbonaceous material, calcite cement.
2. Sandstone, moderate red (5 R 5/4) medium fine-grained, calcite cemented.
3. Sandstone, grayish orange (10 YR 7/4), otherwise same as EP-5H-2.
4. Sandstone, yellowish gray (5 Y 8/1), medium fine-grained, scattered black specks of carbonaceous material, calcite cemented.
5. Sandstone, light olive gray (5 Y 6/1), medium fine-grained, calcite cemented.
6. Sandstone, same as EP-5H-1.
7. Sandstone, light gray (N 7), medium coarse-grained, calcareous.

Suite No. EP-7H (1 through 5)

Serial No. D158956 through D158960

Mine Highland Mine open pit 1 south

Top limb of upper ore deposit

Sec. 28, T. 36 N., R. 72 W.

Sample description

1. Sandstone, light olive gray (5 Y 7/1), medium coarse-grained, scattered specks of carbonaceous material, calcite cemented.
2. Sandstone, light gray (N 7), otherwise same as EP-7H-1.
3. Sandstone, grayish orange (10 YR 7/4), coarse- to very coarse-grained, scattered large chert pebbles, calcite cemented.
4. Sandstone, same as EP-7H-3.
5. Sandstone, yellowish gray (5 Y 8/1) fine- to coarse-grained, poorly sorted, scattered specks of black carbonaceous material, calcite cemented.

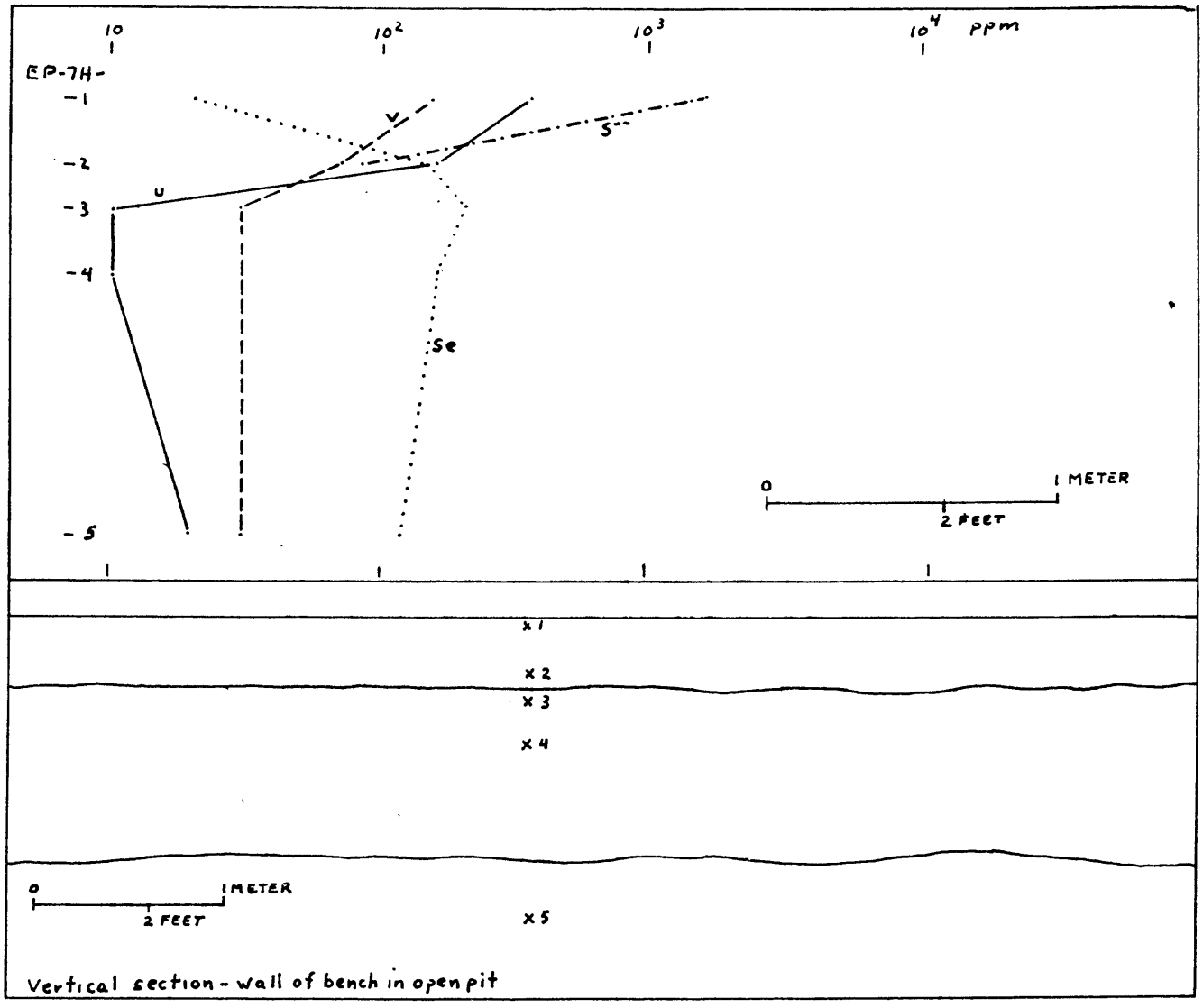


Figure 6. Sample suite EP-7H-1-5

Suite No. EP-7H

Serial No.	D158 956	957	958	959	960					
Field No.	1	2	3	4	5					
U	350	160	10	10	20					PPM
eU	300	160	50	50	50					PPM
Se	20	150	200	160	120					PPM
As										PPM
S^{--}	—	.16	—	—	—					%
Org. C										%
Al	5.	5.	5.	5.	5.					%
Ca	.5	.5	.3	.3	.3					
Fe	.5	.7	.7	.7	.7					
K	3.	3.	3.	3.	2.					
Mg	.15	.2	.15	.15	.2					
Na	1.	1.	1.	1.	1.					
Ti	.07	.05	.03	.03	.05					
B	N	N	N	N	N					PPM
Ba	700	700	700	700	700					
Be	N	N	N	N	N					
Co	N	10	5	5	5					
Cr	30	30	20	20	30					
Cu	5	2	1.5	1.5	2					
Ga	10	10	10	10	10					
Ge	N	N	N	N	N					
La	N	N	N	N	N					
Mn	70	70	50	70	70					
Mo	N	N	N	N	N					
Nb	N	N	N	N	N					
Ni	3	30	15	15	7					
Pb	15	15	15	15	15					
Sc	N	N	N	N	3					
Sr	100	100	100	100	100					
V	150	70	30	30	30					
Y	10	10	N	N	N					
Yb	1	1	N	N	N					
Zr	70	100	50	50	100					

Suite No. EH-20 (1 through 4)

Serial No. D165489 through D165492

Mine Highland Mine

Upper ore sandstone

Sec. 28, T. 36 N., R. 72 W.

Sample description

1. Sandstone, light gray (N 7), medium- to medium coarse-grained scattered thin seams and specks of black carbonaceous material, calcite cemented.
2. Sandstone, moderate yellow (5 Y 7/6), medium- to very coarse-grained, very friable.
3. Sandstone, light gray (N 7), very fine- to medium-grained, otherwise the same as EH-20-1.
4. Sandstone, same as EH-20-2.

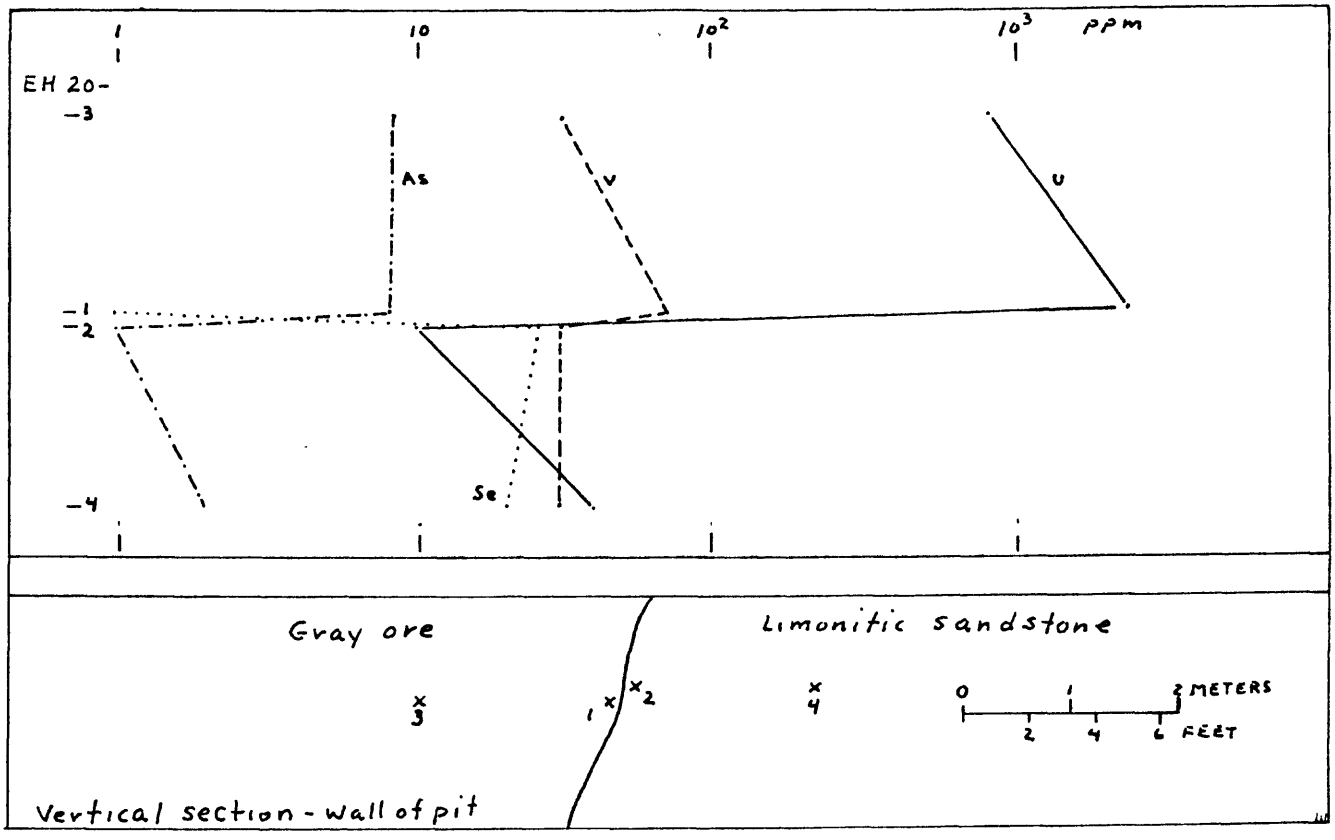


Figure 7. Sample suite EH 20-1-4

Suite No. EH 20

Serial No.	D165 489	490	491	492						
Field No.	1	2	3	4						
U	2300	10	800	40						PPM
eU	1600	300	800	100						PPM
Se	1	25	0.5	20						PPM
As	8	1	8	2						PPM
S^{--}										%
Org. C										%
Al	5.	5.	3.	5.						%
Ca	.5	.5	.3	.5						
Fe	1.	.7	.7	.7						
K	3.	3.	3.	3.						
Mg	.3	.3	.3	.3						
Na	1.5	2.	1.	2.						
Ti	.15	.1	.07	.1						
B	L	L	20	L						PPM
Ba	700	700	700	700						
Be	N	N	N	N						
Co	15	5	7	L						
Cr	30	20	20	15						
Cu	7	2	3	3						
Ga	15	10	10	15						
Ge	15	N	N	N						
La	L	N	N	N						
Mn	70	70	100	70						
Mo	N	N	N	N						
Nb	10	L	L	L						
Ni	15	10	15	7						
Pb	20	15	15	150						
Sc	5	L	L	L						
Sr	100	150	70	100						
V	70	30	30	30						
Y	10	L	10	L						
Yb	–	1.	1.5	1.						
Zr	100	70	100	70						

Suite No. EP-17 (1 through 8)

Serial No. D165481 through D165488

Mine Highland open pit mine, No. 1 south

Sec. 28, T. 36 N., R. 72 W.

Sample description

1. Sandstone, moderate pink (5 R 7/4) very fine to very coarse, poorly sorted. Red color concentrated in fine fraction. Spotty hematite stain on some large grains. Slightly calcareous.
2. Sandstone, same as EP-17-1 with few chert pebbles 1" in diameter.
3. Sandstone, moderate reddish orange (10 R 6/6), medium- to fine-grained with abundant interstitial silt and scattered chert pebbles.
4. Sandstone, very pale orange (10 YR 8/2), very fine- to medium-grained, silty with scattered coarse grains, calcareous cement.
5. Sandstone, pinkish gray (5 YR 8/1), medium- to fine-grained, silty, poorly sorted, calcite cemented.
6. Sandstone, pinkish gray (5 YR 8/1) with yellowish brown stain on part, very fine- to very coarse, poorly sorted.
7. Sandstone, light olive gray (5 Y 6/1), medium- to very fine-grained, silty, poorly sorted, abundant black fragments of coaly material.
8. Sandstone, same as EP17-7, but with some very coarse grains.

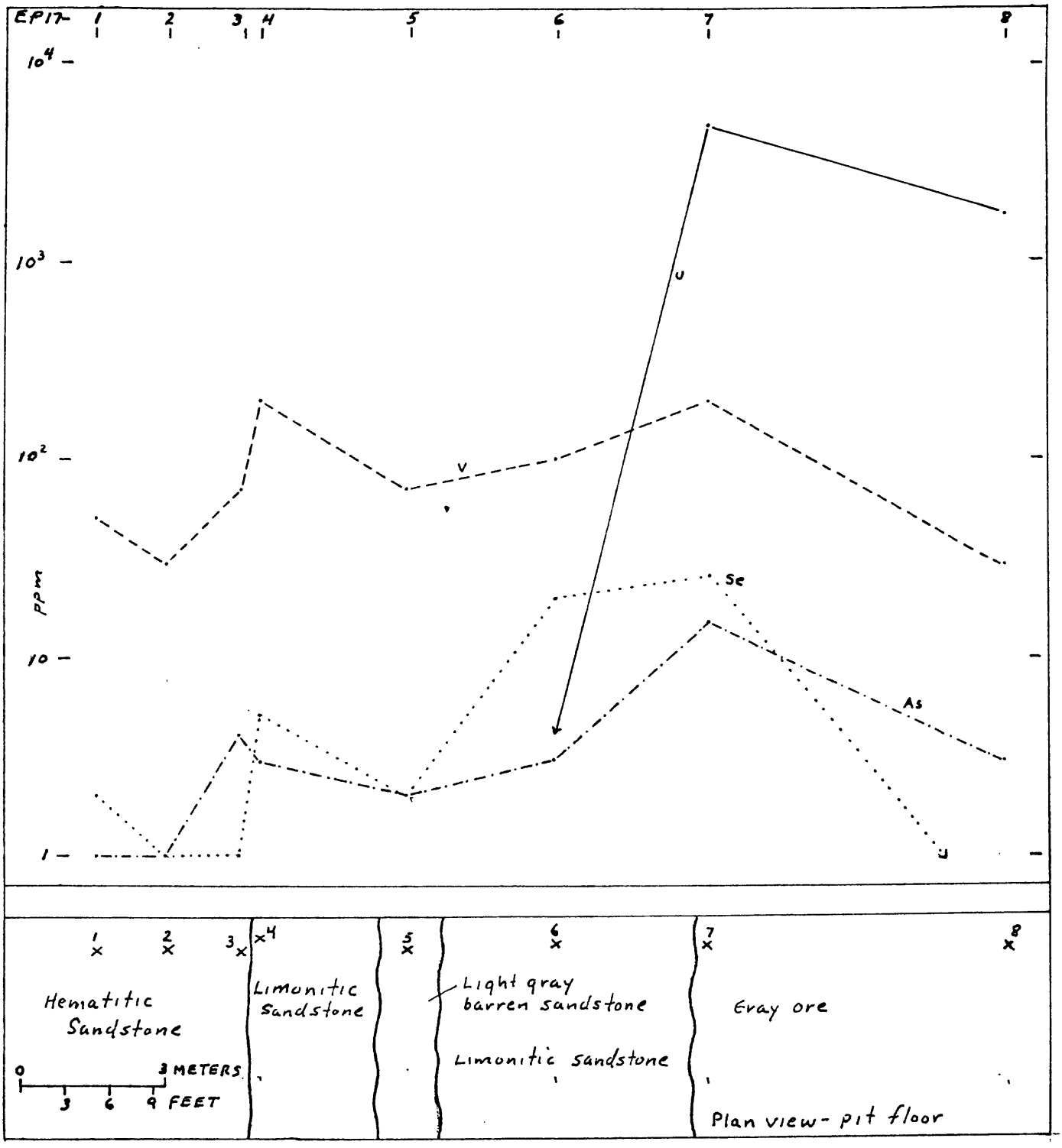


Figure 8. Sample suite EP17-1-8

Suite No. EP-17

Serial No.	D165 481	482	483	484	485	486	487	488		
Field No.	1	2	3	4	5	6	7	8		
U	<10	<10	<10	<10	<10	<10	4900	1700		PPM
eU	30	20	20	10	40	30	3300	1300		PPM
Se	2	1	1	5	2	20	25	0.5		PPM
As	1	1	4	3	2	3	15	3		PPM
S^{--}										%
Org. C										%
Al	5.	5.	5.	5.	5.	3.	5.	5.		%
Ca	.7	.5	.5	3.	.5	.5	.5	.5		
Fe	1.	.7	1.5	1.	.7	.7	1.5	.7		
K	3.	3.	3.	3.	3.	3.	3.	3.		
Mg	.3	.3	.5	.3	.3	.3	.5	.3		
Na	1.5	1.5	.7	1.	1.5	1.	1.	2.		
Ti	.15	.1	.15	.15	.15	.15	.15	.1		
B	L	L	20	30	20	L	20	L		PPM
Ba	700	700	700	700	700	700	700	700		
Be	N	N	1.5	N	N	N	1.5	N		
Co	7	7	10	7	5	L	15	7		
Cr	70	150	50	30	30	30	50	30		
Cu	2	2	3	3	3	3	7	3		
Ga	10	15	15	10	15	10	15	15		
Ge	N	N	N	N	N	N	150	30		
La	N	N	L	L	N	L	L	N		
Mn	150	70	150	300	100	150	100	100		
Mo	N	N	N	N	N	N	N	N		
Nb	10	L	L	L	L	10	10	L		
Ni	15	15	15	15	10	7	30	10		
Pb	15	15	20	15	15	15	20	15		
Sc	5	L	7	7	5	L	7	L		
Sr	150	150	100	150	100	100	100	150		
V	50	30	70	150	70	100	200	30		
Y	10	15	L	15	L	10	15	L		
Yb	1.5	1.5	1.5	L	1	1.5	N	1.5		
Zr	70	150	100	300	100	150	100	70		

Suite No. UX-1 (1 through 17)

Serial No. D192879 through D192895

Mine Highland Mine underground 3 W.45 N., drift, elevation 4841′

Sec. 17, T. 36, R. 72

Sample description

1. Sandstone, grayish orange pink (5 YR 8/2), medium coarse- to coarse, poorly sorted, spotty concentrations of hematite and limonite, very friable.
2. Sandstone, very light gray (N 8), medium coarse- to fine-grained, poorly sorted, very friable.
3. Sandstone, very light gray (N 8), same as UX-1-2.
4. Sandstone, same as UX-1-2.
5. Sandstone, same as UX-1-2.
6. Sandstone, light gray (N 7), medium- to fine-grained.
7. Sandstone, medium light gray (N 6), fine- to very coarse-grained, poorly sorted, some brownish stain.
8. Sandstone, same as UX-1-7.
9. Sandstone, light gray (N 7), very coarse- to fine-grained, poorly sorted.
10. Sandstone, light gray (N 7), medium-grained with some scattered coarse grains.
11. Sandstone, light gray (N 7), medium coarse- to coarse-grained.
12. Sandstone, light gray (N 7), very coarse- to fine-grained, poorly sorted, some interstitial red clay.
13. Sandstone, light gray (N 7), coarse- to very coarse-grained.

Sample description

UX-1-17, continued

14. Sandstone, same as UX-1-13, very friable.

15. Sandstone, same as UX-1-13.

16. Sandstone, light gray (N 7), medium- to medium fine-grained, sparce greenish-yellow stain.

17. Sandstone, very light gray (N 8), coarse- to fine-grained, poorly sorted.

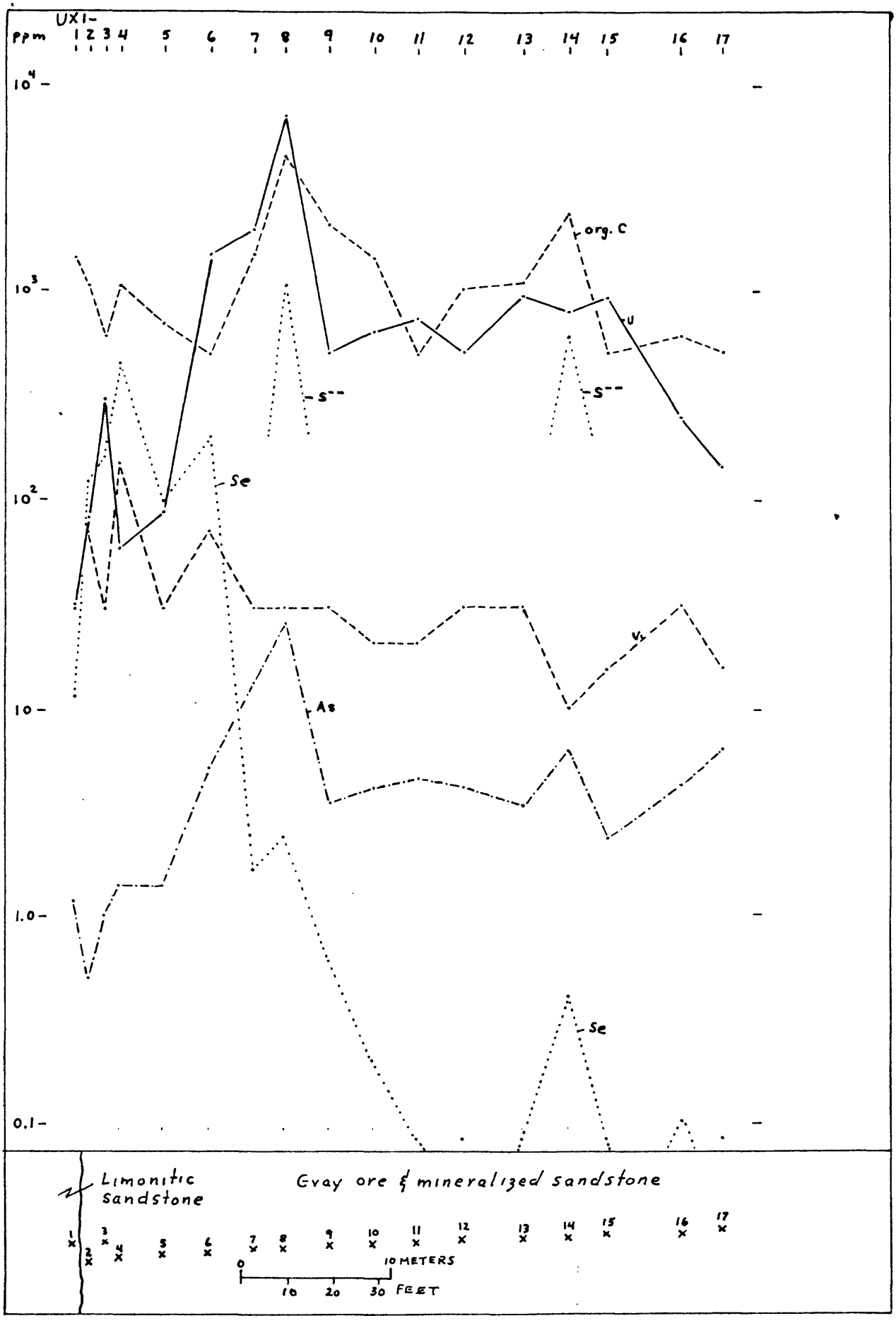


Figure 9. Sample suite UX-1-1-17

Suite No. UX-1

Serial No.	192 879	880	881	882	883	884	885	886	887	
Field No.	1	2	3	4	5	6	7	8	9	
U [1]	32	81	131	58	86	1585	2007	7212	515	PPM
eU	60	220	140	60	230	1300	1800	6200	440	PPM
Se	12	120	160	450	98	198	1.7	2.4	.6	PPM
As	1.2	.5	1.	1.4	1.4	5.1	13.	26.	3.4	PPM
S--	—	—	—	—	—	—	—	.11	—	%
Org. C	.14	.11	.06	.11	.07	.05	.15	.45	.21	%
Al	5.	5.	7.	7.	7.	5.	5.	7.	5.	%
Ca	.5	.5	.3	.5	.3	.3	.7	.5	.5	
Fe	.7	.5	.5	.7	.5	.5	.7	1.	.7	
K	3.	3.	3.	3.	3.	3.	3.	3.	3.	
Mg	.3	.3	.3	.5	.3	.3	.5	.3	.2	
Na	1.	1.	1.	1.	1.	1.	1.	1.	1.	
Ti	.07	.05	.05	.07	.07	.07	.1	.05	.07	
B	L	L	L	L	L	L	L	L	L	PPM
Ba	500	500	700	500	700	500	500	700	500	
Be	N	N	N	N	N	N	N	N	N	
Co	L	L	L	5	L	10	5	15	L	
Cr	15	15	15	20	15	50	15	15	15	
Cu	2	2	2	2	3	2	2	5	3	
Ga	15	15	15	15	15	15	15	15	15	
Ge	N	N	N	N	N	N	N	N	N	
La	N	N	N	N	N	N	N	N	N	
Mn	100	100	70	100	70	70	150	150	200	
Mo	N	N	N	N	N	N	N	N	N	
Nb	L	N	N	N	N	N	L	N	L	
Ni	10	10	7	10	7	10	10	10	5	
Pb	15	15	30	20	15	20	15	20	15	
Sc	L	L	L	5	L	L	L	L	L	
Sr	70	70	70	70	70	70	70	100	70	
V	30	70	30	150	30	70	30	30	30	
Y	L	L	L	L	10	L	L	L	L	
Yb	L	L	L	1	1	1.5	1.5	—	1.5	
Zr	100	50	30	50	50	50	100	50	100	

[1] Delayed neutron analyses

Suite No. UX-1 continued

Serial No.	192 888	889	890	891	892	893	894	895		
Field No.	10	11	12	13	14	15	16	17		
U [1/]	653	753	510	968	808	918	259	142		PPM
eU	660	690	540	810	720	690	230	150		PPM
Se	.2	<.1	<.1	<.1	.4	<.1	.1	<.1		PPM
As	4.	4.4	4.0	3.3	6.2	2.3	4.1	6.2		PPM
S^{--}	—	—	—	—	.06	—	—	.04		%
Org. C	.14	.05	.1	.11	.24	.05	.06	.05		%
Al	5.	7.	5.	5.	5.	5.	7.	7.		%
Ca	.3	.3	.3	.5	.7	.3	.3	.2		
Fe	.5	1.	.7	1.	.5	.5	1.	.5		
K	3.	3.	3.	3.	3.	3.	3.	3.		
Mg	.3	.7	.3	.5	.15	.2	.5	.2		
Na	1.	1.	.7	1.	1.	1.	1.	1.		
Ti	.05	.07	.1	.1	.03	.05	.07	.05		
B	L	L	20	L	L	L	L	L		PPM
Ba	500	500	500	500	500	500	500	500		
Be	N	N	N	N	N	N	N	N		
Co	5	5	5	5	5	5	5	L		
Cr	15	15	15	20	7	15	30	15		
Cu	2	2	3	3	2	2	5	2		
Ga	15	15	15	15	15	15	15	15		
Ge	N	N	N	N	N	N	N	N		
La	N	N	N	N	L	N	N	N		
Mn	100	100	150	150	200	70	100	50		
Mo	N	N	N	N	N	N	N	N		
Nb	L	N	L	L	L	L	L	L		
Ni	7	10	10	10	10	10	10	10		
Pb	20	20	15	20	20	15	15	15		
Sc	L	5	L	5	L	L	5	L		
Sr	70	100	70	100	70	70	70	70		
V	20	20	30	30	10	15	30	15		
Y	L	L	10	10	L	L	L	10		
Yb	L	1.5	1.5	1.5	L	L	1	L		
Zr	50	100	100	200	50	70	100	100		

1/ Delayed neutron analyses

Suite No. OX-1 (1 through 48)

Serial No. D199561 through D199598

Mine Highland Mine open pit, Elevation 5016

Upper ore deposit

Sec. 29, T. 36 N., R. 72 W.

Sample description

1. Sandstone, moderate orange pink (10 R 7/4), fine- to medium-grained, poorly sorted with scattered coarse grains, very friable.
10. Sandstone, color same as OX-1-1, medium- to medium coarse-grained, very friable.
11. Sandstone, very light gray (N 8), medium- to coarse-grained, very friable.
12. Sandstone, same color as OX-1-11, medium- to very coarse-grained.
13. Sandstone, yellowish gray (5 Y 8/1), medium to very coarse-grained, poorly sorted, very friable, sparse specks of hematite.
14. Sandstone, same as OX-1-13.
15. Sandstone, very light gray (N 8), medium-grained with sparse scattered coarse grains.
16. Sandstone, light olive gray (5 Y 6/1), medium- to very coarse-grained, poorly sorted, moderately indurated.
17. Sandstone, very light gray (N 8), medium- to medium fine-grained,moderately indurated.
18. Sandstone, light gray (N 6), medium- to medium fine-grained, moderately indurated, sparse thin seams of black carbonaceous material.

Sample description

OX-1-1 through 48, continued

19. Sandstone, medium light gray (N 6), medium-grained, moderately indurated, some black carbonaceous flakes.

20. Sandstone, light gray (N 7), fine- to medium fine-grained, moderately indurated.

21. Sandstone, medium light gray (N 6), medium- to medium fine-grained with scattered coarse grains, moderately indurated, some paper-thin carbonaceous seams.

22. Sandstone, light gray (N 7), medium- to medium coarse-grained, poorly sorted, moderately indurated, some scattered black coal fragments and flakes.

23. Sandstone, yellowish gray (5 Y 7/1), medium fine- to medium coarse-grained, poorly sorted, some spotty limonite stains, sparse hematite specks, moderately indurated.

24. Sandstone, yellowish gray (5 Y 7/1), very fine- to very coarse-grained, poorly sorted, moderately indurated, some limonite stain, some black coaly flakes.

25. Sandstone, light olive gray (5 Y 6/1), very fine- to coarse-grained, poorly sorted, moderately indurated, spotty limonite stains, sparse specks of hematite, sparse coal fragments.

26. Sandstone, medium gray (N 5), medium fine- to coarse-grained, poorly sorted, moderately indurated, sparse hematite specks, sparse small coal fragments.

29. Sandstone, medium light gray (N 6), fine- to very coarse-grained, poorly sorted, moderately indurated, sparse hematite specks, some black coaly debris.

Sample description

OX-1-1 through 48, continued

30. Sandstone, medium gray (N 5), medium coarse- to coarse-grained, moderately indurated, sparse hematite specks.

31. Sandstone, light gray (N 7), fine- to very coarse-grained, poorly sorted, very friable, sparse hematite specks.

32. Sandstone, light gray (N 7), same as OX-1-31 with some coal fragments and more hematite specks.

33. Sandstone, medium gray (N 6), medium- to very coarse-grained, poorly sorted, very friable, sparse red mudstone pebbles.

34. Sandstone, light gray (N 7), fine- to very coarse-grained, poorly sorted, very friable.

35. Sandstone, light gray (N 7), medium- to very coarse-grained, poorly sorted, moderately indurated, very fine black specks scattered throughout, sparse limonite spots.

36. Sandstone, very light gray (N 8), medium- to very coarse-grained, poorly sorted, very friable.

37. Sandstone, yellowish gray (5 Y 7/1), medium- to very coarse-grained, poorly sorted, very friable.

38. Sandstone, light gray (N 7), medium- to very coarse-grained, poorly sorted, moderately indurated, fewer black specks than OX-1-35.

39. Sandstone, light gray (N 7), medium- to very coarse-grained, poorly sorted, very friable with a seam of light gray siltstone with scattered black and yellow specks.

40. Sandstone, yellowish gray (5 Y 7/1), medium- to very coarse-grained, poorly sorted, very friable, coal fragments and hematite specks common.

Sample description

OX-1-1 through 48, continued

41. Sandstone, yellowish gray (5 Y 7/1), fine- to medium-grained moderately indurated, sparse hematite specks, some coal fragments.

42. Sandstone, yellowish gray (5 Y 7/1), fine- to coarse-grained, poorly sorted, very friable, some siltstone fragments, many very fine black specks, hematite stain on siltstone fragments.

43. Sandstone, light gray (N 7) fine- to coarse-grained with very large light gray siltstone clasts, poorly sorted, rock is 50 percent siltstone.

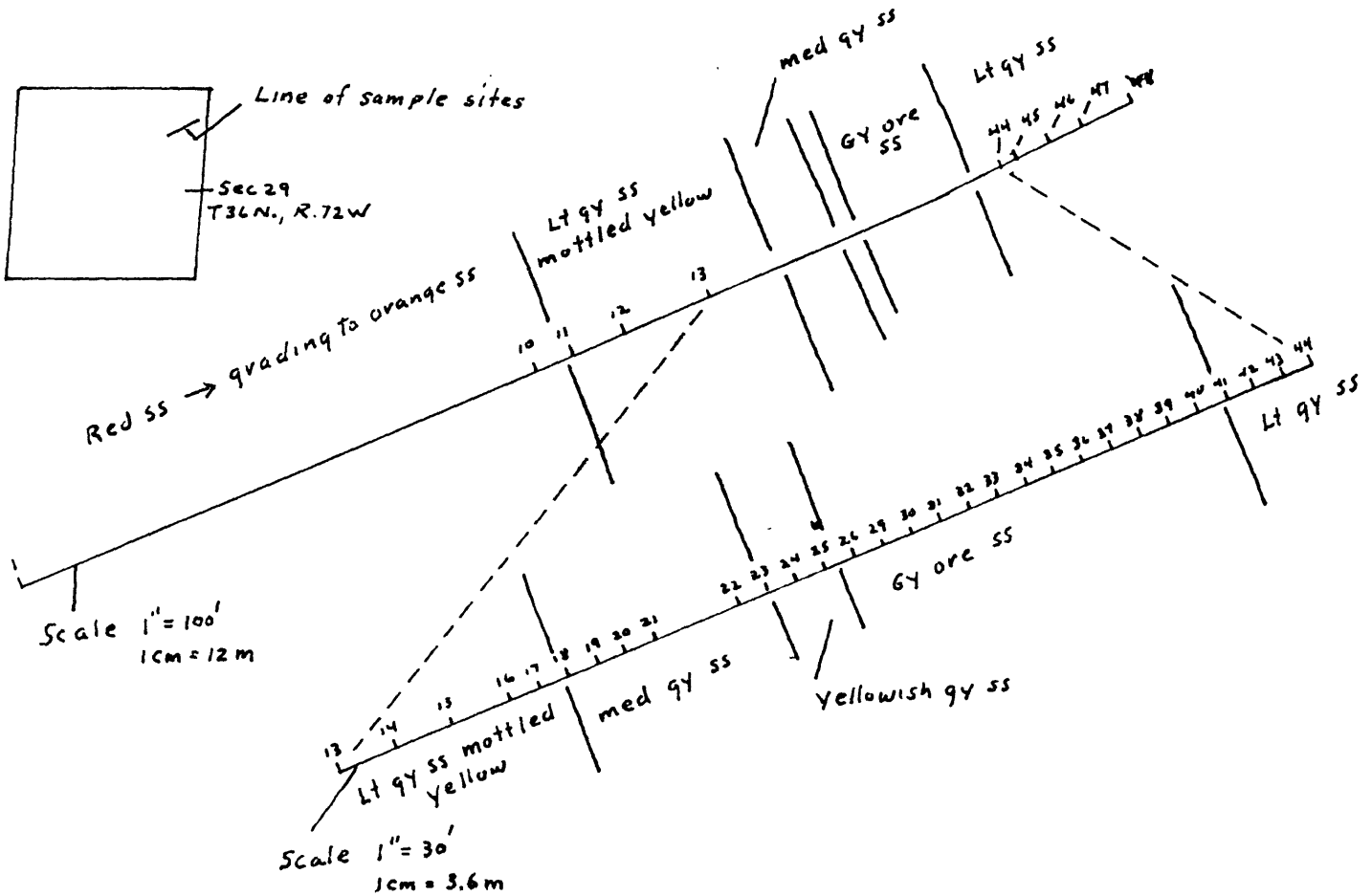
44. Sandstone, same as OX-1-43.

45. Sandstone, same as OX-1-43.

46. Sandstone, very light gray (N 8), very fine-grained, silty with streaks of medium-grained sandstone, moderately indurated.

47. Sandstone, very light gray (N 8), same as OX-1-46 with paper-thin seams of coaly material and coaly fragments.

48. Sandstone, light olive gray (5 Y 7/1), medium fine- to medium-grained with mudstone and siltstone clasts, sparse limonite stain.



Plan view of pit floor, Highland Mine

Figure 10. Sample suite OX-1-1-48 location

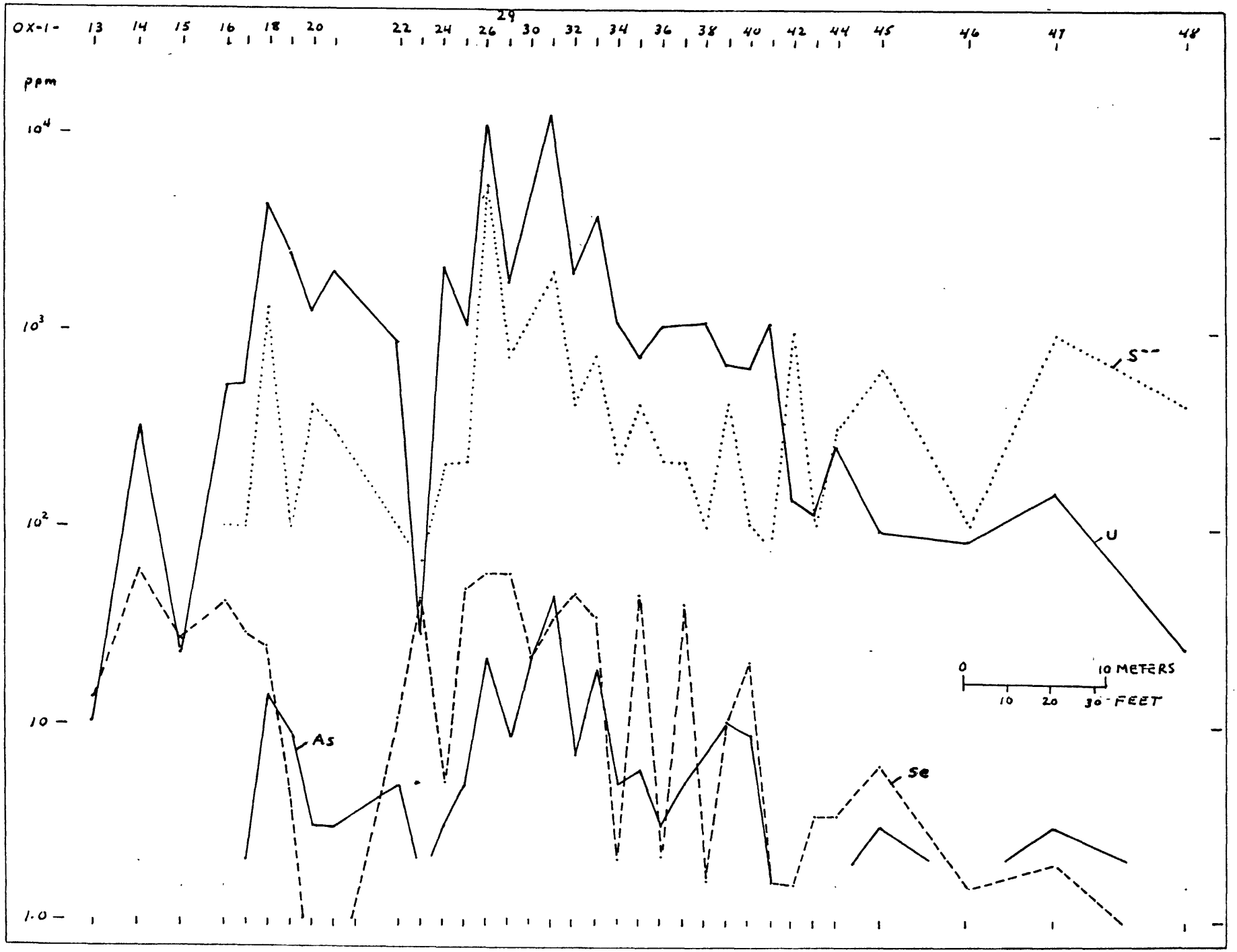


Figure 11. Sample suite OX-1-13-48

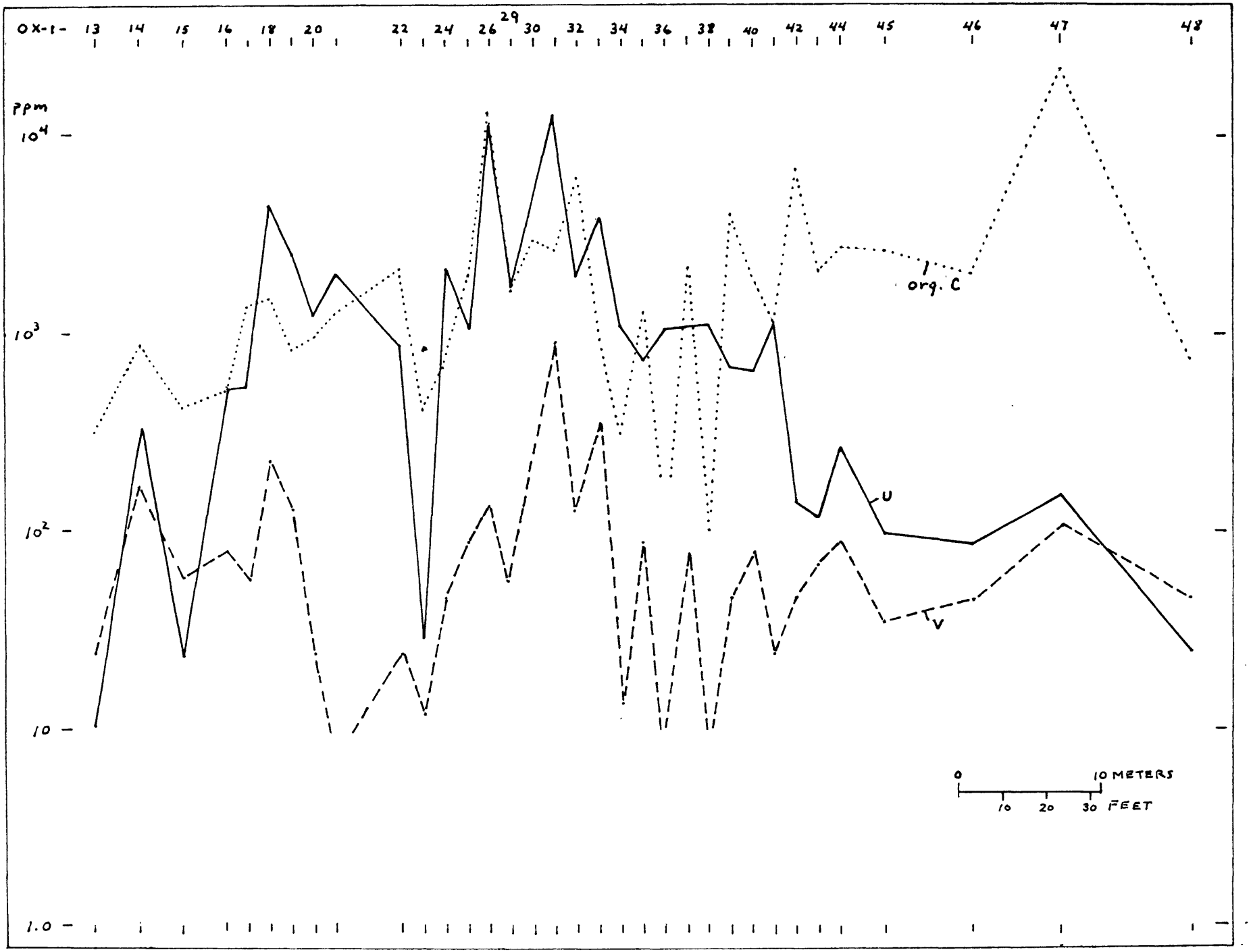


Figure 12. Sample suite OX-1-13-48

Suite No. OX-1

Serial No.	D199 561	562	563	564	565	566	567	568	569	
Field No.	1	10	11	12	13	14	15	16	17	
U [1]	5.5	12	4.2	17.3	11.0	392	23	625	603	PPM
eU	20	30	20	30	30	320	60	510	520	PPM
Se	.9	2.1	.4	20	13	59	26	40	29	PPM
As	4	<2	<2	<2	<2	2	<2	<2	2	PPM
S^{--}	<.01	<.01	<.01	<.01	<.01	<.01	<.01	.01	.01	%
Org. C	.04	.03	.05	.02	.03	.08	.04	.05	.13	%
Al										%
Ca										
Fe										
K										
Mg										
Na										
Ti										
B										PPM
Ba										
Be										
Co										
Cr										
Cu										
Ga										
Ge										
La										
Mn										
Mo										
Nb										
Ni										
Pb										
Sc										
Sr										
[2] V	275	72	33	82	23	167	54	74	54	
Y										
Yb										
Zr										

[1] Delayed neutron analyses

[2] Chemical analyses

Suite No. OX-1 continued

Serial No.	D199 570	571	572	573	574	575	576	577	578	
Field No.	18	19	20	21	22	23	24	25	26	
1/ U	5370	3450	1260	2380	832	28.3	2000	1070	5620	PPM
eU	4200	2400	1200	1900	720	210	1600	890	10000	PPM
Se	25	4.8	0.3	0.4	11.	41	5	47	58	PPM
As	14	9	3	3	5	<2	3	5	23	PPM
S^{--}	.13	.01	.04	.03	.01	<.01	.02	.02	.51	%
Org. C	.14	.08	.09	.12	.15	.04	.07	.18	1.22	%
Al										%
Ca										
Fe										
K										
Mg										
Na										
Ti										
B										PPM
Ba										
Be										
Co										
Cr										
Cu										
Ga										
Ge										
La										
Mn										
Mo										
Nb										
Ni										
Pb										
Sc										
Sr										
2/ V	223	127	23	<10	23	12	44	83	130	
Y										
Yb										
Zr										

1/ Delayed neutron analyses

2/ Chemical analyses

Suite No. OX-1 continued

Serial No.	D199 579	580	581	582	583	584	585	586	587	
Field No.	29	30	31	32	33	34	35	36	37	
1/ U	2230	5950	9600	2340	5580	1590	698	996	1080	PPM
eU	1700	4300	12000	1800	3700	1100	600	890	880	PPM
Se	57	22	34	45	35	2	44	2.3	39	PPM
As	9	23	44	7	19	5	6	3	5	PPM
S^{--}	.07	.11	.17	.04	.07	.02	.04	.02	.02	%
Org. C	.16	.28	.26	.59	.09	.03	.13	<.01	.21	%
Al										%
Ca										
Fe										
K										
Mg										
Na										
Ti										
B										PPM
Ba										
Be										
Co										
Cr										
Cu										
Ga										
Ge										
La										
Mn										
Mo										
Nb										
Ni										
Pb										
Sc										
Sr										
2/ V	54	357	388	121	342	13	83	<10	73	
Y										
Yb										
Zr										

1/ Delayed neutron analyses

2/ Chemical analyses

Suite No. OX-1 continued

Serial No.	D199 588	589	590	591	592	593	594	595	596	
Field No.	38	39	40	41	42	43	44	45	46	
1/ U	1130	659	621	1130	135	120	271	96.3	84	PPM
eU	800	560	550	910	160	110	250	110	110	PPM
Se	1.6	//	21	1.6	7.5	3.4	3.3	6.2	1.4	PPM
As	< 2	//	9	< 2	< 2	< 2	< 2	3	< 2	PPM
S^{--}	.01	.04	.01	< .01	.09	.01	.03	.06	.01	%
Org. C	.01	.38	.18	.10	.63	.19	.26	.25	.18	%
Al										%
Ca										
Fe										
K										
Mg										
Na										
Ti										
B										PPM
Ba										
Be										
Co										
Cr										
Cu										
Ga										
Ge										
La										
Mn										
Mo										
Nb										
Ni										
Pb										
Sc										
Sr										
2/ V	< 10	44	73	23	44	63	83	34	44	
Y										
Yb										
Zr										

1/ Delayed neutron analyses

2/ Chemical analyses

Suite No. OX-1 continued

Serial No.	D199 597	598								
Field No.	47	48								
1/ U	150	24.7								PPM
eU	180	40								PPM
Se	1.9	.5								PPM
As	3	< 2								PPM
S^{--}	.09	.04								%
Org. C	1.97	.07								%
Al										%
Ca										
Fe										
K										
Mg										
Na										
Ti										
B										PPM
Ba										
Be										
Co										
Cr										
Cu										
Ga										
Ge										
La										
Mn										
Mo										
Nb										
Ni										
Pb										
Sc										
Sr										
2/ V	102	44								
Y										
Yb										
Zr										

1/ Delayed neutron analyses

2/ Chemical analyses

Suite No. BMK (1 through 60)

Serial No. D165495 through D165499

Mine Teton open pit mine

Sec. 16, T. 37 N., R. 73 W., NE/4

Sample description

All BMK samples, 1 through 60, were described as either light, medium or dark gray. Samples from within the ore zone are medium to dark gray; samples beyond the ore zone on either side are light gray. Some samples were described as light olive gray (5 Y 6/1) and pale yelllowish brown (10 YR 6/2). Grain sizes were not recorded except for three samples; BMK 1 and 6 are coarse-grained and BMK-21 ranges from very fine-grained to very coarse-grained and silty.

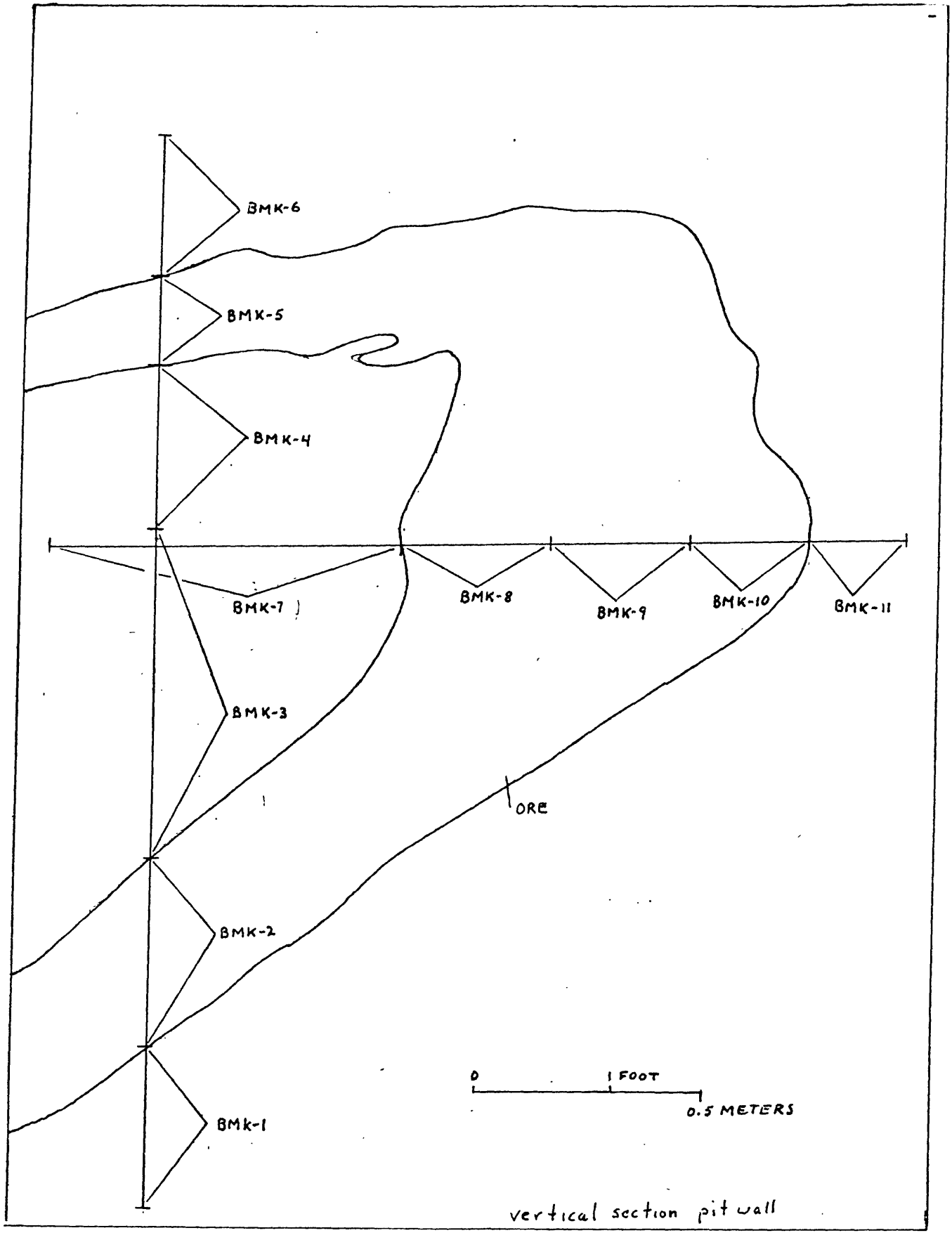


Figure 13. Sample suite BMk-1-11 - location

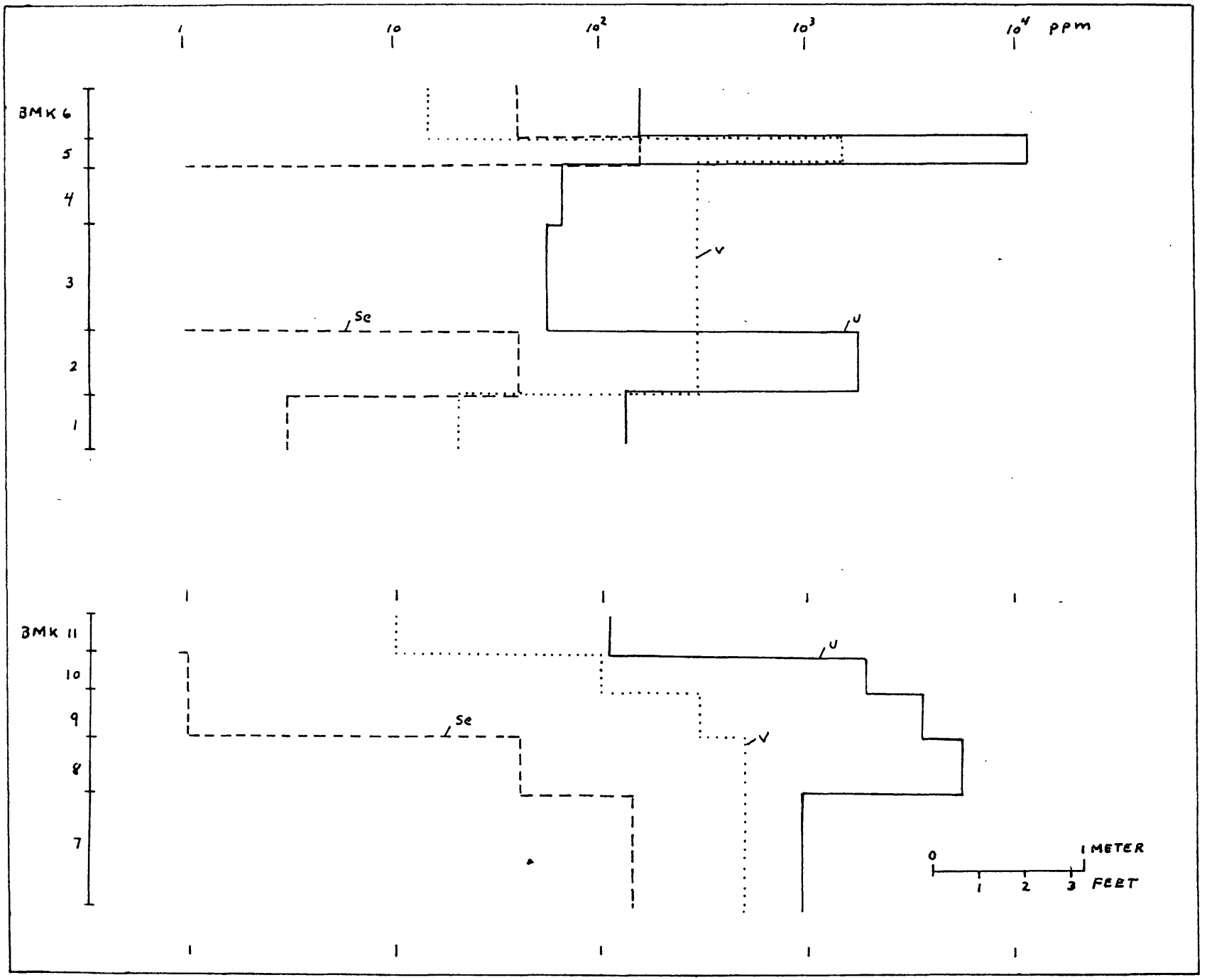


Figure 14. Sample suite BMK-1-11

Suite No. BMK 1-11

Serial No.	301 704	705	706	707	708	709	710	711	712	
Field No.	1	2	3	4	5	6	7	8	9	
U	130	1700	560	650	12 100	160	960	5700	3700	PPM
eU	130	420	440	480	6000	150	710	2700	1900	PPM
Se	3	40	—	—	160	40	1400	40	1	PPM
As										PPM
S^{--}										%
Org. C										%
Al	3.	7.	7.	7.	7.	3.	7.	7.	7.	%
Ca	7.	7.	5.	5.	0.7	7.	0.7	0.3	0.3	
Fe	1.	1.	1.5	1.	1.	0.5	1.	0.5	0.7	
K	3.	2.	3.	3.	5.	5.	5.	5.	5.	
Mg	.3	.3	.2	.5	.2	.2	.3	.2	.2	
Na	1.	2.	2.	1.5	1.5	2.	2.	2.	2.	
Ti	.1	.05	.05	.02	.02	.015	.03	.03	.02	
B	N	N	N	N	N	N	N	N	N	PPM
Ba	700	1000	1500	1500	1500	700	1000	1000	1000	
Be	N	1.5	2	N	2	N	2	2	2	
Co	N	N	N	N	L	N	N	L	L	
Cr	15	7	70	7	7	5	7	5	5	
Cu	3	2	3	3	5	5	5	5	5	
Ga	100	150	150	150	1000	150	150	200	150	
Ge	N	N	N	N	N	N	N	N	N	
La	N	N	N	N	N	100	N	N	N	
Mn	500	500	500	300	100	500	70	70	50	
Mo	7	10	7	10	10	10	10	10	7	
Nb	N	N	N	N	N	N	N	N	N	
Ni	20	N	N	N	N	N	5	N	N	
Pb	20	30	20	20	30	20	30	50	30	
Sc	N	N	N	N	N	N	N	N	N	
Sr	100	150	150	150	150	150	150	150	150	
V	20	300	300	300	1500	15	500	500	300	
Y	15	15	20	N	N	15	20	15	15	
Yb	1.5	1.5	3	N	N	1.5	N	N	2	
Zr	150	50	30	30	50	20	50	70	70	

Suite No. BMK I-II continued

Serial No.	301 713	714								
Field No.	10	11								
U	1900	110								PPM
eU	900	100								PPM
Se	1	< .5								PPM
As										PPM
S--										%
Org. C										%
Al	7.	7.								%
Ca	.7	7.								
Fe	.7	.7								
K	5.	5.								
Mg	.3	.3								
Na	1.5	1.5								
Ti	.05	.02								
B	N	N								PPM
Ba	1000	1000								
Be	1.5	2								
Co	L	N								
Cr	7	7								
Cu	7	5								
Ga	15	15								
Ge	N	N								
La	N	N								
Mn	70	500								
Mo	10	7								
Nb	N	N								
Ni	N	N								
Pb	30	20								
Sc	N	N								
Sr	150	150								
V	100	10								
Y	15	15								
Yb	2	1.5								
Zr	50	30								

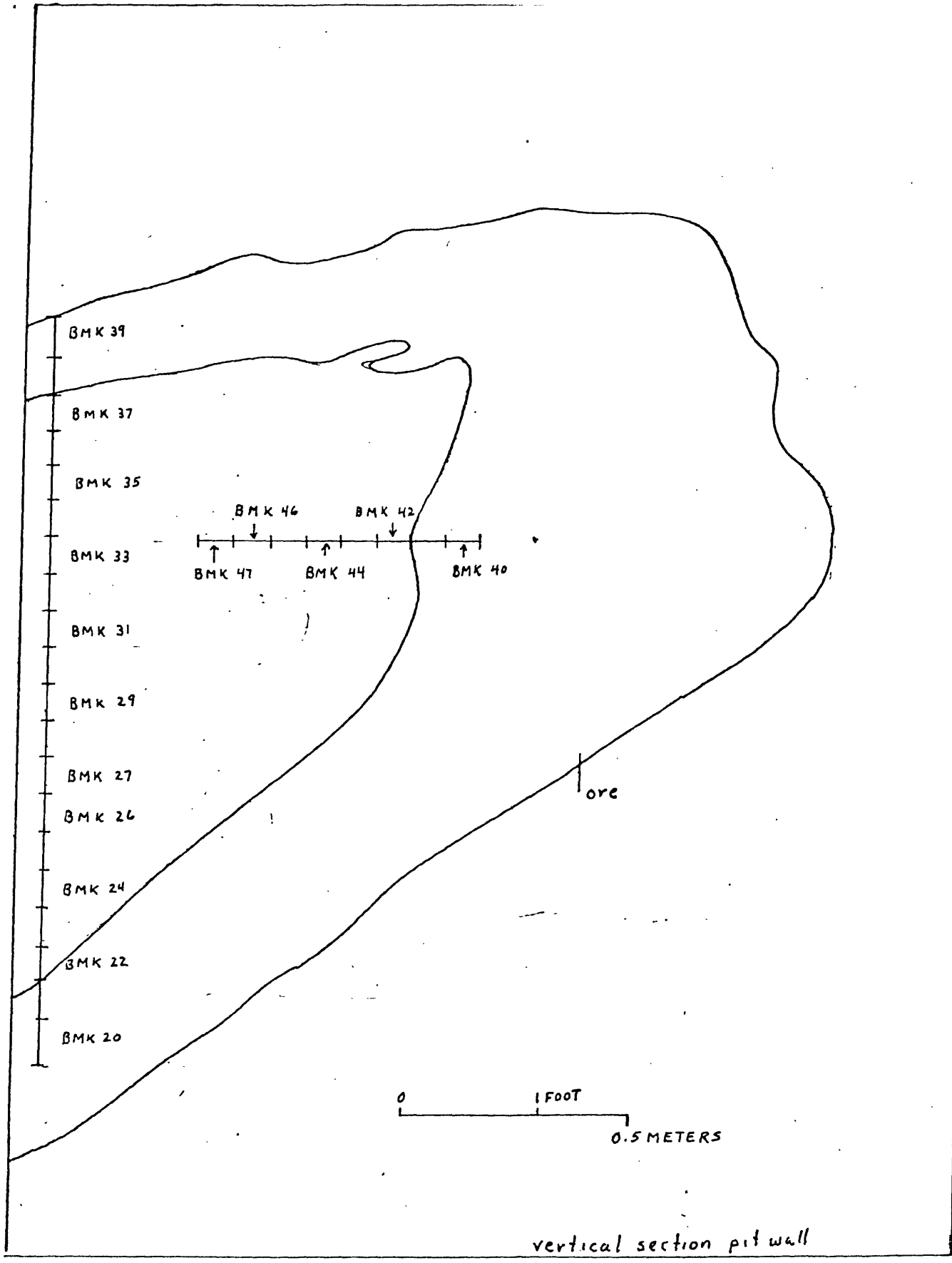


Figure 15. Sample suite BMK-20-39 - location

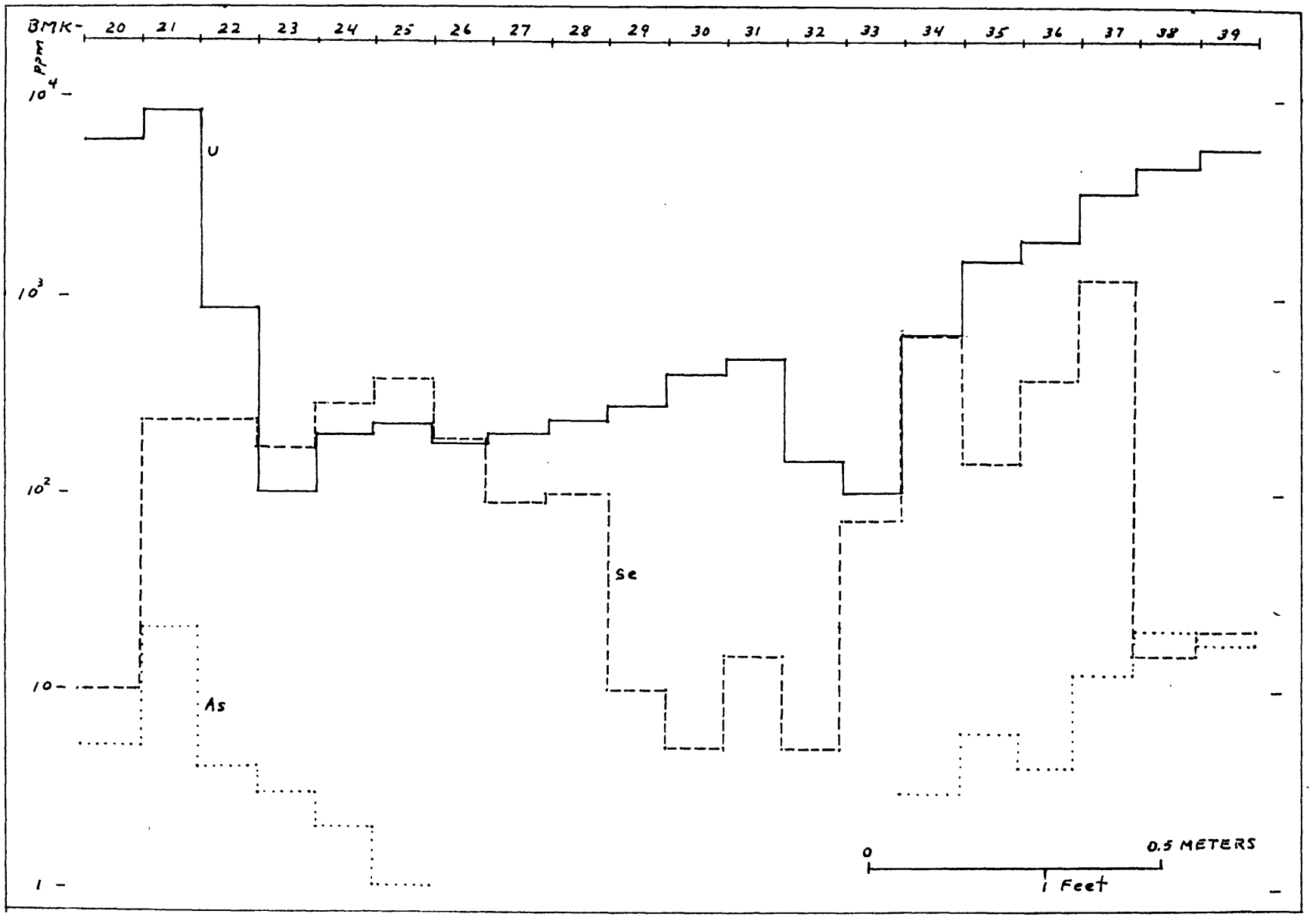


Figure 16. Sample suite BMK-20-39

Suite No. BMK 20-39

Serial No.	D119 601	602	603	604	605	606	D119 920	921	922	
Field No.	20	21	22	23	24	25	26	27	28	
U	6100	8400	880	100	200	220	170	200	220	PPM
eU	3900	5000	650	200	200	220	210	270	280	PPM
Se	10	240	240	175	290	390	185	90	100	PPM
As	5	21	4	3	2	1				PPM
S^{--}										%
Org. C										%
Al	7.	7.	7.	7.	7.	7.				%
Ca	.7	.5	.7	1.	.5	.3				
Fe	.5	1.5	.7	.5	.5	.7				
K	3.	3.	3.	3.	3.	3.				
Mg	.3	.3	.3	.3	.3	.3				
Na	1.5	1.5	1.5	1.5	1.5	1.				
Ti	.1	.15	.05	.07	.03	.1				
B	N	N	N	N	N	N				PPM
Ba	700	700	700	700	700	500				
Be	N	5	N	N	N	N				
Co	L	L	L	5	5	5				
Cr	15	20	10	15	7	15				
Cu	5	7	30	3	3	3				
Ga	20	20	20	20	20	20				
Ge	L	L	N	N	N	N				
La	100	100	N	30	N	N				
Mn	150	150	150	200	150	100				
Mo	N	N	N	N	N	N				
Nb	N	N	N	N	N	N				
Ni	3	7	5	5	5	3				
Pb	50	50	30	30	30	30				
Sc	N	N	N	N	N	N				
Sr	100	150	100	100	100	100				
V	300	700	300	200	150	100				
Y	30	30	10	10	N	10				
Yb	N	N	2	1.5	1	1.5				
Zr	200	150	50	150	50	100				

Suite No. BMK 20-39 continued

Serial No.	D119 923	924	925	926	927	D119 607	608	609	610	
Field No.	29	30	31	32	33	34	35	36	37	
U	280	310	390	140	230	650	1500	1900	3400	PPM
eU	330	330	390	230	340	680	1100	1400	2200	PPM
Se	10	5	15	5	120	660	140	390	1250	PPM
As						3	6	4	12	PPM
S^{--}										%
Org. C										%
Al						7.	7.	7.	7.	%
Ca						1.	1.5	1.	5.	
Fe						.7	.7	.7	1.	
K						3.	3.	3.	3.	
Mg						.5	.5	.5	.5	
Na						1.	1.	1.5	1.5	
Ti						.03	.03	.03	.02	
B						N	N	N	N	PPM
Ba						700	700	700	700	
Be						N	N	1.5	N	
Co						7	L	L	L	
Cr						7	5	5	7	
Cu						5	3	3	3	
Ga						15	20	20	15	
Ge						N	N	N	L	
La						N	N	N	N	
Mn						150	150	100	300	
Mo						N	N	N	N	
Nb						N	N	N	N	
Ni						3	3	3	3	
Pb						30	30	30	50	
Sc						N	N	N	N	
Sr						70	100	100	100	
V						200	150	200	300	
Y						15	10	N	15	
Yb						2	1.5	1	1.5	
Zr						50	50	30	50	

Suite No. BMK 20-39 continued

Serial No.	D119 611	612								
Field No.	38	39								
U	4600	5700								PPM
eU	2800	3200								PPM
Se	15	20								PPM
As	20	17								PPM
S^{--}										%
Org. C										%
Al	5.	7.								%
Ca	7.	3.								
Fe	.7	.7								
K	5.	3.								
Mg	.15	.3								
Na	1.5	1.5								
Ti	.02	.05								
B	N	N								PPM
Ba	700	700								
Be	N	N								
Co	L	L								
Cr	7	5								
Cu	2	3								
Ga	7	15								
Ge	L	L								
La	30	30								
Mn	500	200								
Mo	N	N								
Nb	N	N								
Ni	3	3								
Pb	30	50								
Sc	N	N								
Sr	100	150								
V	500	500								
Y	10	10								
Yb	N	N								
Zr	30	50								

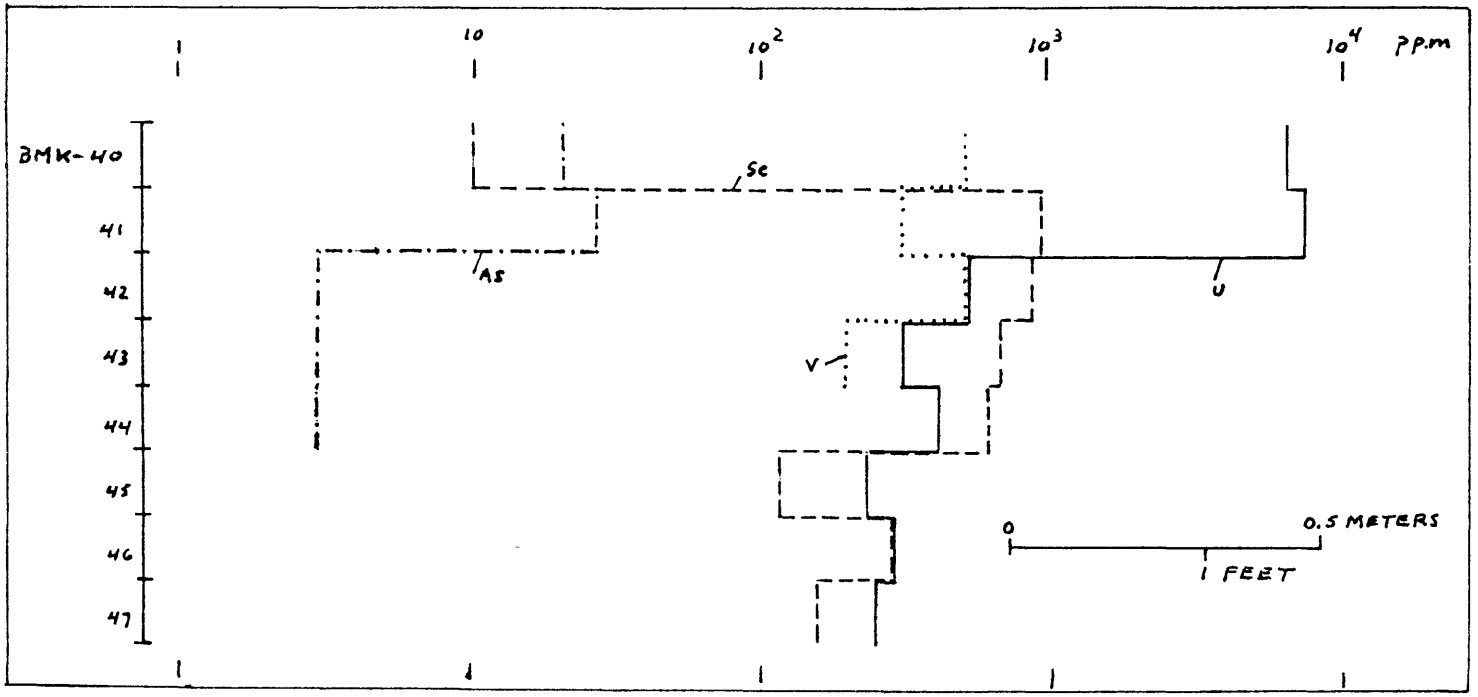


Figure 17. Sample suite BMK-40-47

Suite No. BMK 40-47

Serial No.	D119 613	614	615	616	617	D119 928	929	930		
Field No.	40	41	42	43	44	45	46	47		
U	6400	7200	510	310	410	230	280	260		PPM
eU	3500	4200	540	390	400	340	320	300		PPM
Se	10	915	870	675	625	120	290	155		PPM
As	21	27	3	3	3	—	—	—		PPM
S^{--}										%
Org. C										%
Al	7.	7.	7.	7.	5.					%
Ca	.7	.5	.3	.3	.3					
Fe	.7	.7	.7	.7	.7					
K	3.	3.	3.	3.	3.					
Mg	.3	.3	.3	.3	.3					
Na	1.5	1.5	1.5	1.5	1.					
Ti	.05	.05	.07	.03	.03					
B	N	N	N	N	N					PPM
Ba	700	700	700	500	700					
Be	3	3	N	N	N					
Co	L	L	5	N	N					
Cr	7	7	7	5	5					
Cu	5	5	3	3	5					
Ga	15	15	15	15	20					
Ge	L	L	N	N	N					
La	N	N	30	N	N					
Mn	100	100	100	70	70					
Mo	N	N	N	N	N					
Nb	N	N	N	N	N					
Ni	3	3	3	3	3					
Pb	50	50	30	30	20					
Sc	N	N	N	N	N					
Sr	100	150	150	150	100					
V	500	300	500	500	200					
Y	15	10	10	10	10					
Yb	N	N	N	N	1.5					
Zr	100	100	100	100	30					

Suite No. EP-9 (1 through 8)

Serial No. D161011 through D161018

Mine Core of drill hole 12-183, collar elevation 4275′

Sec. 12, T. 46 N., R. 78 W., 4300′FWL, 2350′FSL

Sample description

1. Sandstone, light olive gray (5Y 6/1), fine- to coarse-grained, poorly sorted, 432′-433′ depth.
2. Sandstone, same as EP-9-1 with a thin streak of limonite stain. 439′-445′ depth.
3. Sandstone, light olive gray (5 Y 6/1), fine- to very fine-grained, well sorted, sparse black carbonaceous material along bedding planes. 445′-449′.
4. Sandstone, same as EP-9-3 with abundant black carbonaceous material in thin seams along bedding planes. 455′-457′ depth.
5. Sandstone, light olive gray (5 Y 6/1), medium- to coarse-grained. 459′-464′ depth.
6. Sandstone, light olive gray (5 Y 6/1) fine-grained. 464′-474′ depth.
7. Sandstone, light olive gray (5 Y 6/1) fine-, medium-, and coarse grained, poorly sorted. 474′-484′ depth.
8. Sandstone, light olive gray (5 Y 6/1), very fine- to very coarse-grained with chips of gray mudstone. 484′-494′ depth.

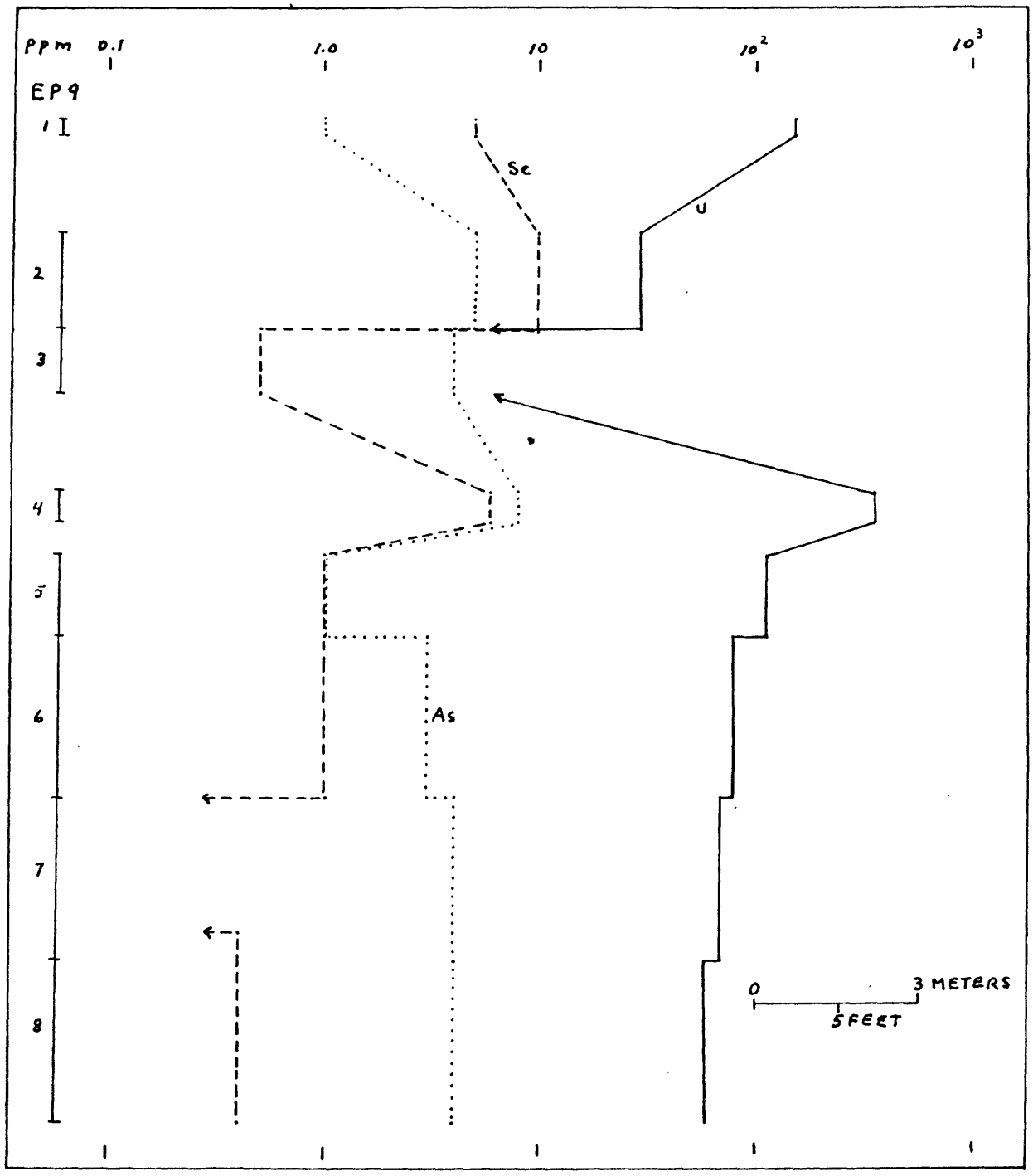


Figure 18. Sample suite EP9-1-8

Suite No. EP9

Serial No.	D161 011	012	013	014	015	016	017	018		
Field No.	1	2	3	4	5	6	7	8		
U	150	30	–	360	120	80	70	60		PPM
eU	150	100	20	300	150	80	70	70		PPM
Se	5	10	.5	6	1	1	<.5	.5		PPM
As	1	5	4	8	1	3	4	4		PPM
S^{--}										%
Org. C										%
Al	5.	5.	5.	3.	5.	5.	7.	7.		%
Ca	.5	.5	.3	.3	.3	.3	.3	.3		
Fe	1.	1.	2.	1.5	.7	1.5	1.	.7		
K	3.	3.	3.	3.	3.	3.	3.	3.		
Mg	.7	.5	.7	.7	.3	.7	.3	.5		
Na	1.	1.5	.7	.7	1.	.7	1.	1.		
Ti	.2	.1	.15	.15	.07	.15	.15	.15		
B	L	L	L	L	L	L	L	L		PPM
Ba	100	700	700	700	700	1000	1000	1000		
Be	1.5	1.5	1.5	1.5	1.5	1.5	L	1.5		
Co	5	5	7	7	L	7	7	5		
Cr	20	15	20	15	10	20	15	15		
Cu	3	3	10	7	1.5	7	3	15		
Ga	10	10	15	15	15	15	15	15		
Ge	N	N	N	N	N	N	N	N		
La	10	L	50	L	N	L	L	L		
Mn	300	150	200	200	150	150	150	150		
Mo	N	L	L	N	N	N	N	N		
Nb	10	L	L	10	L	10	L	L		
Ni	7	7	15	15	5	7	7	7		
Pb	20	20	20	30	20	15	15	20		
Sc	7	L	7	5	L	7	5	7		
Sr	150	150	150	150	150	150	150	150		
V	150	150	50	700	70	100	70	150		
Y	15	L	15	15	L	15	10	10		
Yb	2	1.5	1.5	2	L	1.5	1.	1.5		
Zr	500	70	100	100	50	150	150	100		

Suite No. EP-10 (2 through 8)

Serial No. D161019 through D161025

Mine Core of drill hole 22-40, collar elevation 5197′

Sec. 22, T. 44 N., R. 75 W., 1025 FWL, 855 FSL

Sample description

2. Sandstone, yellowish gray (5 Y 8/1), fine-grained. 76′-77′ depth.
3. Sandstone, orange between 10 YR 8/2 and 10 YR 7/4, fine- to coarse-grained, poorly sorted. 94′-95′ depth.
4. Sandstone, grayish orange (10 YR 7/4), fine-grained with thin seams of black carbonaceous material along bedding planes, calcite cemented. 101′-102′ depth.
5. Sandstone, light gray (N 7), fine-grained, scattered black specks of carbonaceous material. 102′-104′ depth.
6. Sandstone, medium light gray (N 6), otherwise like EP-10-5.
7. Siltstone, yellowish gray (5 Y 8/1). 109′-111′ depth.
8. Mudstone, silty, light olive gray (5 Y 6/1). 115′-117′ depth.

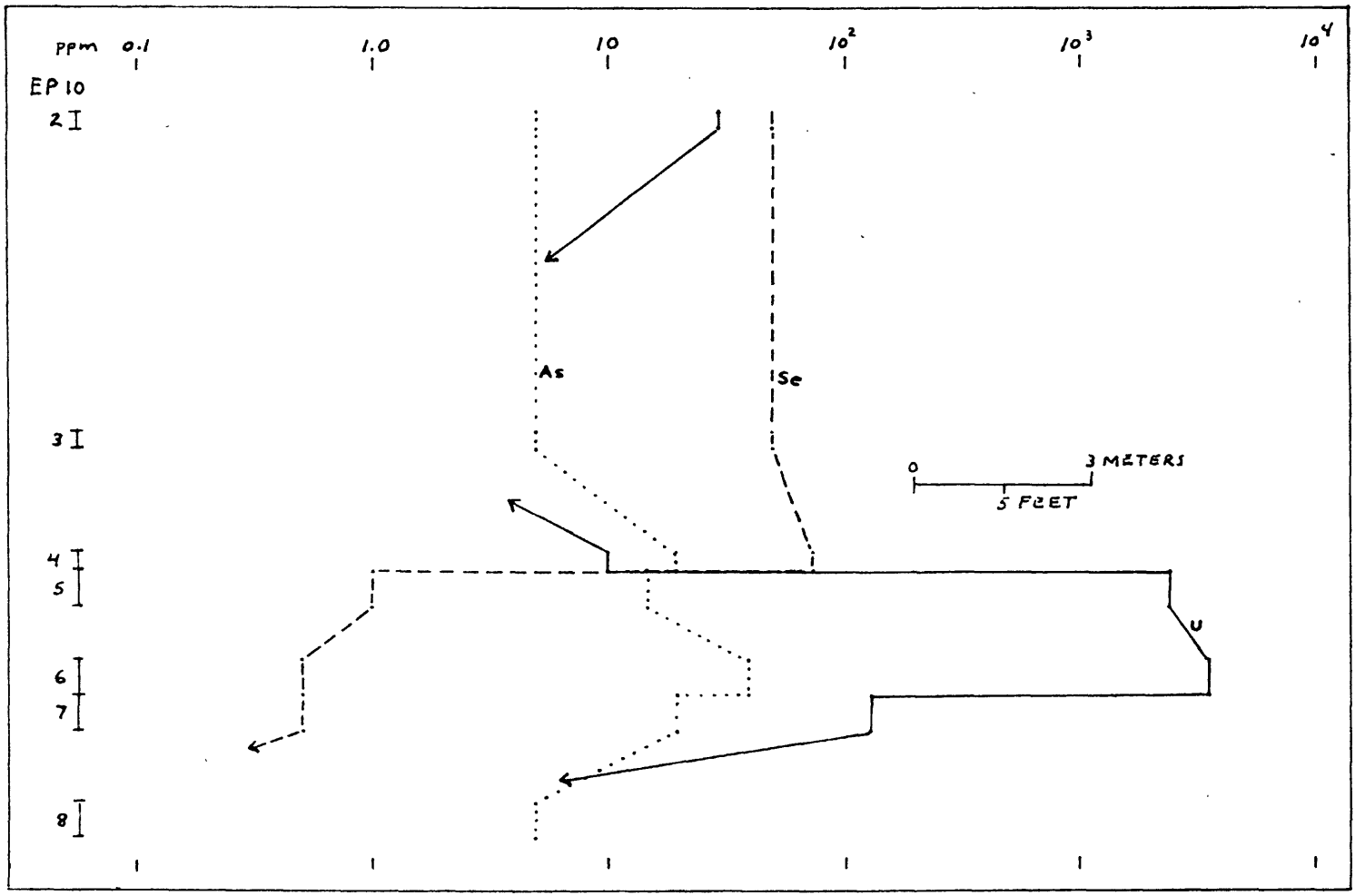


Figure 19. Sample suite EP10-2-8

Suite No. EP10

Serial No.	D161 019	020	021	022	023	024	025			
Field No.	2	3	4	5	6	7 [1]	8 [2]			
U	30	—	10	2400	3700	130	—			PPM
eU	70	20	200	2200	3600	100	20			PPM
Se	50	50	75	1	.5	.5	<.5			PPM
As	5	5	20	15	40	20	5			PPM
S^{--}										%
Org. C										%
Al	3.	5.	3.	3.	3.	7.	7.			%
Ca	.3	.7	3.	3.	.3	3.	3.			
Fe	1.	1.	1.5	1.	.7	1.5	2.			
K	2.	3.	3.	3.	2.	3.	3.			
Mg	.3	.5	.7	.3	.3	1.	1.			
Na	.5	.7	.7	.7	.7	.3	.5			
Ti	.15	.15	.15	.15	.15	.3	.2			
B	20	L	L	L	L	30	30			PPM
Ba	700	700	700	700	3000	700	700			
Be	L	L	L	L	L	1.5	1.5			
Co	7	5	7	7	7	7	7			
Cr	15	15	15	15	15	30	70			
Cu	5	3	7	3	3	30	30			
Ga	7	10	10	7	7	15	15			
Ge	N	N	N	N	N	N	N			
La	50	L	L	L	N	70	70			
Mn	150	150	300	300	150	200	150			
Mo	N	N	N	N	N	L	L			
Nb	10	L	L	L	L	L	L			
Ni	7	10	10	7	7	15	15			
Pb	15	20	15	15	15	15	20			
Sc	5	L	7	5	L	7	7			
Sr	70	150	150	150	150	150	200			
V	70	100	100	200	500	70	70			
Y	10	10	15	10	L	15	15			
Yb	1.5	1.5	1.5	1.5	1.5	2	2			
Zr	200	70	70	70	150	150	150			

[1] siltstone

[2] mudstone

Miscellaneous Samples

ET-8, serial No. D165509, Teton mine, Sec. 1, T. 35 N., R. 72 W. Sandstone, very pale orange (10 YR 8/2), medium- to medium coarse-grained, moderately indurated. Said by mine operator to be conspicuously out of equilibrium with high eU but no uranium.

EP-6H, serial No. D158955, Highland mine, Sec. 28, T. 36 N., R. 72 W. Sandstone and conglomerate, light gray (N 7) with grayish orange mottling, calcite cemented, contains a coaly seam 1/4" thick. High-grade ore sample.

EP-2H, serial No. D158942, Highland mine, Sec. 28, T. 36 N., R. 72 W. Sandstone, grayish orange (10 YR 7/4) mottled light gray (N 7), coarse- to very coarse-grained, calcite cemented. From just below upper limb ore of uppermost ore horizon.

EH-21, serial No. D165493, Highland mine, Sec. 28, T. 36 N., R. 72 W. Mudstone, pale olive (10 Y 6/2), from just above upper ore-bearing sandstone.

EH-22, serial No. D165494, Highland mine, Sec. 28, T. 36 N., R. 72 W. Sandstone, yellowish gray (5 Y 7/2), very fine-grained, silty, interbedded with mudstone of EH-21.

Suite No. Miscellaneous Samples

Serial No.	D165 493	494	509	D158 942	955					
Field No.	EH 21 1/	EH 22 2/	ET-8	EP-2H	EP-6H					
U	–	–	20	30	11500					PPM
eU	10	10	400	160	7500					PPM
Se	.5	.5	2	260	40					PPM
As	3	2	1							PPM
S^{--}										%
Org. C										%
Al	7.	5.	5.	3.	5.					%
Ca	.7	2.	.7	.3	.3					
Fe	2.	1.5	.7	5.	1.					
K	3.	3.	3.	2.	3.					
Mg	.7	.5	.3	.5	.2					
Na	.2	.3	1.5	.7	1.					
Ti	.3	.15	.15	.05	.05					
B	50	30	L	N	N					PPM
Ba	500	1500	700	150	700					
Be	2	L	N	N	N					
Co	15	10	10	N	20					
Cr	70	30	20	10	30					
Cu	30	15	2	20	3					
Ga	15	10	15	15	10					
Ge	N	N	N	N	N					
La	70	50	L	N	N					
Mn	70	500	200	200	50					
Mo	N	N	L	N	N					
Nb	15	10	15	N	N					
Ni	30	20	20	5	7					
Pb	50	50	30	10	15					
Sc	15	7	5	N	N					
Sr	150	100	100	100	100					
V	100	50	200	500	700					
Y	20	15	15	N	N					
Yb	3	2	1.5	1.5	–					
Zr	300	200	50	70	70					

1/ mudstone

2/ siltstone

Suite No. BMK 48-57

Serial No.	D119 931	932	D119 618	619	620	621	622	D119 933	934	
Field No.	48	49	50	51	52	53	54	55	56	
U	100	40	60	30	20	1100	13000	7600	420	PPM
eU	130	120	270	210	240	1000	7700	4400	820	PPM
Se	990	110	175	125	175	800	1050	80	1	PPM
As			5	1	1	13	90			PPM
S^{--}										%
Org. C										%
Al			7.	7.	7.	7.	5.	7.	7.	%
Ca			5.	.3	.2	.3	.3	.3	.3	
Fe			1.	.7	.7	.7	1.5	1.	.7	
K			3.	3.	3.	3.	5.	5.	5.	
Mg			.3	.3	.3	.3	.3	.3	.3	
Na			1.5	1.0	1.5	1.	1.5	1.5	2.	
Ti			.03	.03	.05	.05	.03	.03	.05	
B			N	N	N	N	N	N	N	PPM
Ba			700	700	700	700	1000	1000	1000	
Be			N	N	N	N	N	N	N	
Co			N	N	N	L	L	15	10	
Cr			7	7	7	10	10	3	3	
Cu			5	3	5	5	10	3	2	
Ga			15	20	20	15	20	15	20	
Ge			N	N	N	N	N	N	N	
La			N	N	N	N	70	50	N	
Mn			500	70	70	50	70	50	50	
Mo			N	N	N	N	N	N	N	
Nb			N	N	N	N	N	N	N	
Ni			3	2	2	3	20	7	5	
Pb			30	30	30	30	50	30	20	
Sc			N	N	N	N	N	N	N	
Sr			150	100	100	100	150	150	150	
V			300	200	200	700	700	500	500	
Y			15	N	N	10	20	10	10	
Yb			2	1	1	N	N	15	15	
Zr			30	50	50	100	50	50	50	

Suite No. BMK 48-57 continued

Serial No.	D 119 623									
Field No.	57									
U	180									PPM
eU	370									PPM
Se	6									PPM
As	27									PPM
S^{--}										%
Org. C										%
Al	5.									%
Ca	.2									
Fe	.7									
K	3.									
Mg	.3									
Na	1.5									
Ti	.05									
B	N									PPM
Ba	500									
Be	N									
Co	7									
Cr	7									
Cu	2									
Ga	15									
Ge	N									
La	N									
Mn	50									
Mo	N									
Nb	N									
Ni	5									
Pb	30									
Sc	N									
Sr	70									
V	15									
Y	10									
Yb	1.5									
Zr	30									

Suite No. BMK 58-60

Serial No.	D119 935	D119 624	625						
Field No.	58	59	60						
U	<20	20	3000						PPI
eU	60	80	1900						PP
Se	2	550	0.5						PPI
As									PPI
S^{--}									%
Org. C									%
Al		5.	5.						%
Ca		.5	1.						
Fe		.7	1.5						
K		2.	3.						
Mg		.3	.3						
Na		.7	1.						
Ti		.1	.07						
B		30	N						PPI
Ba		500	500						
Be		N	3						
Co		7	-						
Cr		15	15						
Cu		7	7						
Ga		15	20						
Ge		N	100						
La		N	30						
Mn		100	200						
Mo		N	N						
Nb		N	N						
Ni		5	7						
Pb		20	30						
Sc		N	N						
Sr		70	100						
V		200	300						
Y		15	30						
Yb		2	3						
Zr		100	200						