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Analytical data on the Schwartzwalder uranium deposit, Jefferson County, Colorado

By

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Contents

Introduction

This set of 18 tables summarizes analytical data collected by the author during a study of the Schwartzwalder uranium deposit. In tables 5, 11, and 13 the following symbols for rock units, all of which are from the Idaho Springs Formation (Precambrian X), are used: Xp, pegmatite; Xs, mica schist; Xgs, garnetiferous mica schist; Xq, quartzite; Xh, hornblende gneiss; Xgg, granite gneiss; Xm, magnetite and quartz layer. These data will be most useful in conjunction with, and will help to amplify, earlier reports by Young (1977, 1979).

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Table 1.--Chemical analyses (in percent), felsic-mafic indices[1] and specific gravity[2] of the Ralston dike and associated sill

[G22, G7, and 149011 were analyzed by P. L. D. Elmore, K. E. White, and S. D. Botts using methods similar to those described by Shapiro and Brannock (1956). RD-1 and RD-2 were analyzed by Z. A. Hamlin using the "single solution" method of Shapiro (1967). Sample localities shown in table 2]

Sample No. / Lab. No.	G22 [3]149010	G7 [3]149012	-- [4]149011	RD-1 D-186318W	RD-2 D-186319W
SiO_2	54.0	52.4	51.4	54.7	54.9
Al_2O_3	17.0	15.2	16.2	16.7	14.9
Fe_2O_3	4.1	4.4	6.2	4.0	4.1
FeO	4.2	4.5	2.9	4.8	5.0
MgO	3.2	6.8	3.6	3.7	6.4
CaO	6.2	7.0	6.4	6.5	7.3
Na_2O	3.5	2.7	3.3	3.3	2.8
K_2O	4.7	3.3	4.5	4.3	3.0
TiO_2	0.82	0.82	0.90	0.90	0.82
P_2O_5	0.56	0.45	0.58	0.60	0.44
MnO	0.16	0.15	0.18	0.16	0.15
H_2O^+				0.43	0.73
H_2O^-	1.3	2.2	3.6	0.30	0.62
CO_2	0.05	0.08	0.36	0.01	0.01
Sum	100.0	100.0	100.12	101.0	101.0
Felsic-mafic index[1]	3.51	2.57	3.09	3.28	2.66
Rock name according to felsic-mafic index	Monzonite	Diorite	Monzonite	Monzonite	Diorite
Specific gravity	--	--	--	2.911	2.933

[1]The felsic-mafic index is

$$\frac{SiO_2 + Na_2O + K_2O}{FeO + Fe_2O_3 + MgO + CaO}$$

from Segerstrom and Young (1972), p. 35.

[2]Powder specific gravity; determined by air pycnometer method.

[3]From Van Horn (1976), p. 47.

[4]From Sheridan and others (1967), p. 51.

Table 2.--Localities of samples shown in table 1

Sample number	Locality
	T. 3 S., R. 70 W.
G22	NW1/4SE1/4 sec. 9, south of Ralston dike.
G7	NE1/4NE1/4 sec. 5, Ralston dike.
149011	NE1/4NW1/4 sec. 32, from a sill.
RD-1	NE1/4SE1/4 sec. 5, Ralston dike.
RD-2	SE1/4NE1/4 sec. 5, Ralston dike.

Table 3.--Spectrographic analyses and delayed neutron determinations for U and Th (in ppm) of the Ralston dike

[Emission spectrographic analyses by L. Mei. U and Th determinations by H. T. Millard, Jr., A. J. Bartel, P. J. Knight, C. L. Shields, C. M. Ellis, R. L. Nelms, C. A. Ramsey. Numbers in parentheses are coefficients of variation which are equal to one standard deviation, based on counting statistics, expressed as percentage of concentration. The following elements (with detection limits in ppm in parentheses) were looked for and not found: Ag (0.1), As (150), Au (10), Bi (22), Cd (32), Dy (32), Er (10), Ge (4.6), Hf (100), Ho (6.8), In (6.8), Ir (15), Li (68), Lu (22), Nd (46), Os (10), Pd (1.5), Pr (68), Pt (6.8), Re (10), Rh (1), Ru (3.2), Sb (100), Sm (46), Sn (6.8), Ta (320), Tb (32), Th (22), Tl (10), Tm (4.6), U (320), W (10)]

Sample No. Lab. No.	RD-1 D-186318W	RD-2 D-186319W
Th	14.53(8)	6.00(18)
U	4.83(3)	4.54(3)
Th/U	3.01	1.32
B	33.	12.
Ba	770.	530.
Be	3.1	1.6
Ce	100.	73.
Co	22.	24.
Cr	49.	280.
Cu	81.	85.
Eu	2.1	<1.5
Ga	26.	21.
Gd	<10.	<6.8
La	44.	33.
Mn	1700.	1400.
Mo	3.6	<2.2
Nb	19.	10.
Ni	18.	95.
Pb	23.	18.
Sc	25.	23.
Sr	770.	610.
V	160.	150.
Y	19.	19.
Yb	3.2	2.8
Zn	120.	91.
Zr	220.	130.

Table 4.--Analytical data (in ppm) on 12 samples taken across a high-grade pitchblende ore sample

[Photograph and autoradiograph of specimen are shown in figs. 1 and 2. Cu, Pb, and Zn determined by atomic absorption by R. L. Rahill. U determined volumetrically by Wayne Mountjoy. Other elements determined spectrographically by Ray Havens and Leon A. Bradley. The following elements (with their detection limits in parentheses) were looked for and not found: Cd (500), La (500), Nb (100), Sc(50), Sn (100), Ce (2000), Th (2000). Number following < is detection limit]

Sample No.	Sch-7-1	Sch-7-2	Sch-7-3	Sch-7-4	Sch-7-5	Sch-7-6
Lab No.	D163983	D163984	D163985	D163986	D163987	D163988
Cu	88	58	94	92	190	190
Pb	14,600	14,600	14,400	13,500	17,900	9,250
Zn	188	192	114	146	114	76
U	485,000	599,000	576,000	604,000	466,000	318,000
Ag	7	2	5	5	10	10
Bi	<300	<300	<300	<300	<200	<150
Co	<300	<300	<300	<300	<300	<300
Cr	70	70	30	30	30	30
Mo	5,000	2,000	3,000	3,000	7,000	3,000
Ni	150	150	150	150	150	150
Sb	3,000	2,000	2,000	2,000	2,000	1,000
Tl	<500	<500	<500	<500	2,000	<500
V	700	300	300	300	300	300
W	7,000	7,000	7,000	7,000	5,000	2,000
Zr	3,000	3,000	3,000	3,000	3,000	2,000

Sample No.	Sch-7-7	Sch-7-8	Sch-7-9	Sch-7-10	Sch-7-11	Sch-7-12
Lab No.	D163989	D163990	D163991	D163992	D163993	D163994
Cu	180	132	110	72	108	127
Pb	10,000	9,500	7,880	5,190	460	114
Zn	44	62	86	106	90	141
U	422,000	278,000	269,000	128,000	3,000	2,000
Ag	10	7	5	3	3	1
Bi	<200	<150	<150	<100	<100	<100
Co	<300	<300	<100	<100	<50	<50
Cr	30	20	30	30	30	30
Mo	3,000	3,000	3,000	2,000	1,000	500
Ni	150	150	150	100	150	70
Sb	1,500	1,000	<2,000	<2,000	<2,000	<2,000
Tl	<500	<500	<500	<500	<500	<500
V	300	300	300	300	300	100
W	5,000	2,000	2,000	1,000	<1,000	<1,000
Zr	3,000	2,000	1,500	1,500	150	100

Figure 1.--High-grade pitchblende ore sample from RB stope on seventh level of Schwartzwalder mine. Left edge of specimen tilted 10^{o} towards camera to give specular effect. Light-gray portion at bottom results from greater reflectivity of richer pitchblende (60 percent U). Very light grains are pyrite. Note brecciated texture. The twelve rectangular areas are actual sites of samples described in table 4. Each sample was approximately 6 mm x 4.5 mm x 10 mm (thickness). Magnified 1 1/2 times.

Figure 2.--Autoradiograph of high-grade pitchblende ore sample (see fig. 1); two days exposure; actual size. Lightest areas are most uraniferous.

TOP

Table 5.--Analytical data on ore samples of pitchblende from the Schwartzwalder mine

[Spectrographic analyses by Leon A. Bradley, except for samples Sch-Y, 11A05(A), Sch-Z, Sch-Z', and Sch-ZZ, which were analyzed by Merlyn W.Solt. Leaders (--) indicate no analysis. The following elements (with detection limits in ppm in parentheses) were looked for and not found: Bi (10), Cd (50), Ce (200), Ge (10), Hf (100), In (10), Li (100), Nd (70), Pd (2), Pt (50), Re (50), Sn (10), Ta (500), Te (2000), Th (200). Number following < is detection limit; number following > is upper spectrographic limit above which values are unreliable]

Sample No.	Sch-1	Sch-2	Sch-3	Sch-6	Sch-7
Lab No.	D158718	D158719	D158720	D158721	D158722
	In percent (%)				
U	2.0	10.0	>10.0	>10.0	>10.0
Fe	0.7	1.5	0.7	1.5	1.0
Mg	0.1	0.7	0.7	0.2	0.3
Ca	1.0	3.0	7.0	1.5	3.0
Ti	0.02	0.5	0.2	0.5	0.2
Al	7.0	2.0	2.0	3.0	1.5
Na	--	--	--	--	--
K	<7.0	<7.0	<7.0	<7.0	<7.0
	In parts per million (ppm)				
Ag	7	300	20	15	20
As	<10,000	<10,000	<10,000	<10,000	<10,000
B	<200	<200	<200	<200	<200
Ba	70	200	70	300	150
Be	70	20	30	<15	30
Co	--	--	--	--	--
Cr	<10	20	20	30	20
Cu	300	7,000	700	300	150
Ga	<50	--	--	--	--
Mn	300	700	1,000	300	700
Mo	3,000	15,000	10,000	10,000	3,000
Nb	<100	150	300	150	500
Ni	<50	500	150	300	--
Pb	2,000	30,000	15,000	30,000	10,000
Sb	<2,000	<2,000	<2,000	<2,000	<2,000
Sc	<50	<50	<50	<50	<50
Sr	300	300	300	200	300
Tl	<500	--	--	--	--
V	<70	300	300	300	300
W	<1,000	[1]1,300	[1]1,200	[1]1,700	[1]4,500
Y	<100	<100	<100	<100	<100
Zn	<3,000	<3,000	<3,000	10,000	<3,000
Zr	300	1,500	2,000	1,500	3,000

[1]Tungsten analyses by Philip J. Aruscavage using a spectrophotometric isotope dilution technique.

Table 5.--Analytical data on ore samples of pitchblende from the Schwartzwalder mine--Continued

Sample No. / Lab No.	Sch-14 D158723	Sch-15 D158724	Sch-16 D158725	Sch-18 D158726	Sch-22 D158727
			In percent (%)		
U	3.0	>10.0	1.5	2.0	3.0
Fe	7.0	1.5	>10.0	10.0	5.0
Mg	1.5	1.0	2.0	1.0	1.0
Ca	7.0	5.0	1.0	3.0	5.0
Ti	0.15	0.1	0.1	0.1	0.3
Al	3.0	3.0	3.0	3.0	7.0
Na	--	--	--	--	--
K	<7.0	<7.0	<7.0	7.0	10.0
			In parts per million (ppm)		
Ag	<5	7	7	30	30
As	<10,000	<10,000	<10,000	<10,000	<10,000
B	<200	<200	<200	<200	<200
Ba	150	150	50	150	200
Be	<15	15	<15	<15	15
Co	--	--	--	--	--
Cr	30	10	20	20	70
Cu	200	100	100	700	500
Ga	<50	--	--	--	--
Mn	1,500	1,000	15,000	5,000	700
Mo	3,000	10,000	150	7,000	3,000
Nb	<100	200	<100	<200	200
Ni	70	<50	200	150	70
Pb	2,000	5,000	5,000	15,000	2,000
Sb	<2,000	<2,000	<2,000	<2,000	<2,000
Sc	<50	<50	<50	<50	<50
Sr	150	150	<50	150	300
Tl	<500	--	<500	500	--
V	300	150	70	300	300
W	<1,000	<1,000	<1,000	<1,000	<1,000
Y	<100	<100	<100	<100	<100
Zn	<3,000	3,000	70,000	7,000	<3,000
Zr	500	1,500	<100	300	500

Table 5.--Analytical data on ore samples of pitchblende from the Schwartzwalder mine--Continued

Sample No. / Lab No.	Sch-23 D158728	Sch-49 D158729	Sch-53 D158730	Sch-67 D158731	Sch-82 D158732
			In percent (%)		
U	>10.0	10.0	7.0	3.0	3.0
Fe	0.5	2.0	2.0	5.0	7.0
Mg	0.05	2.0	1.0	3.0	2.0
Ca	5.0	7.0	5.0	7.0	7.0
Ti	0.15	0.15	0.5	0.3	0.1
Al	5.0	1.5	7.0	3.0	3.0
Na	--	--	--	--	--
K	<7.0	<7.0	<7.0	<7.0	<7.0
			In parts per million (ppm)		
Ag	15	150	50	<5	<5
As	<10,000	<10,000	<10,000	<10,000	<10,000
B	<200	<200	<200	<200	<200
Ba	150	150	200	70	70
Be	30	<15	15	20	<15
Co	--	--	--	--	--
Cr	20	15	15	70	20
Cu	200	5,000	1,000	70	300
Ga	--	--	--	--	--
Mn	700	1,500	1,000	1,500	3,000
Mo	7,000	7,000	3,000	1,000	3,000
Nb	200	150	200	300	<200
Ni	100	300	<50	<50	<50
Pb	10,000	10,000	3,000	700	2,000
Sb	<2,000	<2,000	<2,000	<2,000	<2,000
Sc	<50	<50	<50	<50	<50
Sr	200	150	200	300	200
Tl	--	--	--	--	--
V	300	150	300	700	300
W	<1,000	<1,000	<1,000	<1,000	<1,000
Y	<100	<100	<100	<100	<100
Zn	<3,000	<3,000	<3,000	<3,000	<3,000
Zr	1,500	1,000	1,000	300	500

Table 5.--Analytical data on ore samples of pitchblende from the Schwartzwalder mine--Continued

Sample No. Lab No.	Sch-97 D158733	Sch-104 D158735	Sch-105 D158736	Sch-106 D158737	Sch-113 D158738
			In percent (%)		
U	7.0	7.0	>10.0	>10.0	7.0
Fe	7.0	10.0	2.0	0.7	2.0
Mg	0.5	2.0	0.5	0.5	1.0
Ca	1.0	5.0	3.0	3.0	7.0
Ti	0.1	0.07	0.2	0.15	0.1
Al	3.0	3.0	5.0	3.0	3.0
Na	--	--	--	--	--
K	<7.0	<7.0	<7.0	<7.0	<7.0
			In parts per million (ppm)		
Ag	20	150	7	10	<5
As	<10,000	<10,000	<10,000	<10,000	<10,000
B	<200	<200	<200	<200	<200
Ba	150	70	300	700	300
Be	<15	<15	15	15	15
Co	--	--	--	--	--
Cr	70	10	30	30	30
Cu	2,000	3,000	100	200	70
Ga	--	--	--	--	--
Mn	500	5,000	500	700	1,000
Mo	2,000	7,000	7,000	7,000	2,000
Nb	<200	<100	100	100	100
Ni	150	200	150	150	<50
Pb	15,000	15,000	10,000	5,000	3,000
Sb	<2,000	<2,000	<2,000	<2,000	<2,000
Sc	<50	<50	<50	<50	<50
Sr	70	200	150	150	150
Tl	--	--	--	--	--
V	300	100	300	300	300
W	<1,000	<1,000	<1,000	<1,000	<1,000
Y	<100	<100	<100	<100	<100
Zn	7,000	<3,000	<3,000	<3,000	<3,000
Zr	150	700	1,500	1,500	700

Table 5.--Analytical data on ore samples of pitchblende from the Schwartzwalder mine--Continued

Sample No. Lab No.	Sch-124 D158740	Sch-125 D158741	Sch-173 D164639	Sch-Y D168291	11A05(A) D168292
			In percent (%)		
U	7.0	10.0	7.0	[2]0.55 eU0.49	[2]0.62 eU0.61
Fe	>10	7.0	5.0	3.0	10.0
Mg	1.5	0.5	1.5	1.5	1.5
Ca	7.0	5.0	5.0	7.0	2.0
Ti	0.15	0.15	0.2	0.015	0.2
Al	1.5	3.0	3.0	0.5	5.0
Na	--	--	--	--	--
K	<7.0	<7.0	7.0	<7.0	7.0
			In parts per million (ppm)		
Ag	70	7	--	2	70
As	<10,000	<10,000	--	<1,000	<1,000
B	<200	<200	<200	<20	30
Ba	150	500	200	50	150
Be	15	15	7	2	10
Co	--	--	--	10	100
Cr	30	20	30	7	50
Cu	1,000	300	300	100	2,000
Ga	--	--	--	<5	15
Mn	10,000	1,000	1,500	1,000	1,500
Mo	15,000	5,000	10,000	200	7,000
Nb	<100	100	150	<10	<10
Ni	150	<50	70	15	150
Pb	15,000	3,000	15,000	700	20,000
Sb	<2,000	<2,000	--	<200	700
Sc	<50	<50	10	<5	10
Sr	150	150	150	200	150
Tl	--	--	--	<50	--
V	300	300	500	200	200
W	<1,000	<1,000	<200	<100	<100
Y	<100	<100	100	10	20
Zn	<3,000	<3,000	2,000	<300	2,000
Zr	1,000	1,000	1,000	70	150

[2]Uranium determined fluorimetrically by E. J. Fennelly. Corresponding equivalent uranium determined with Beta-gamma scaler by E. J. Fennelly and Lorraine Lee.

Table 5.--Analytical data on ore samples of pitchblende from the Schwartzwalder mine--Continued

Sample No.	Sch-Z	Sch-Z'	Sch-ZZ	Sch-174	Sch-175
Lab No.	D168293	D168294	D168295	D171359	D171360
			In percent (%)		
	[2]19.0	[2]0.13	[2]0.95	[2]6.3	[2]60.0
U	eU19.0	eU0.12	eU0.93	eU5.3	eU64.0
Fe	5.0	10.0	5.0	1.5	1.5
Mg	2.0	1.5	1.5	0.5	0.5
Ca	5.0	2.0	5.0	2.0	3.0
Ti	0.2	0.1	0.2	0.07	0.3
Al	1.5	2.0	5.0	1.5	0.3
Na	<0.05	0.15	0.2	<0.1	<0.1
K	<2.0	5.0	7.0	1.5	<1.5
			In parts per million (ppm)		
Ag	7	7	30	70	30
As	1,500	<1,000	<1,000	<1,000	<1,000
B	<20	<20	20	--	--
Ba	1,000	20	300	100	200
Be	15	10	3	5	30
Co	--	15	30	150	<50
Cr	30	30	50	10	20
Cu	500	150	200	3,000	1,500
Ga	20	15	15	--	--
Mn	2,000	5,000	700	700	1,000
Mo	5,000	1,000	10,000	5,000	20,000
Nb	300	<10	20	50	<200
Ni	50	50	100	150	150
Pb	10,000	5,000	5,000	5,000	15,000
Sb	700	<200	300	300	3000
Sc	<10	<5	15	<10	<10
Sr	300	150	200	70	300
Tl	--	<50	200	<50	1,500
V	300	150	500	150	150
W	1,000	<100	<100	200	2,000
Y	100	10	20	70	300
Zn	<300	1,500	<300	<300	<700
Zr	1,500	50	150	700	5,000

[2]Uranium determined fluorimetrically by E. J. Fennelly. Corresponding equivalent uranium determined with Beta-gamma scaler by E. J. Fennelly and Lorraine Lee.

Table 6.--Localities of samples shown in table 5

[The following elements (with detection limits in ppm in parentheses) were looked for and not found: Bi (10), Cd (50), Ce (200), Ge (10), Hf (100), In (10), Li (100), Nd (70), Pd (2), Pt (50), Re (50), Sn (10), Ta (500), Te (2000), Th (200). Number following < is detection limit; number following > is upper spectrographic limit above which values are unreliable]

Sample number	Level	Host rock
Sch-1	6	Xp
Sch-2	7	Xs
Sch-3	7 (RB stope)	Xs
Sch-6	7 Do.	Xs
Sch-7	7 Do.	Xs
Sch-14	7 Do.	Xs
Sch-15	6	Xp
Sch-16	Steve + 46 ft (14.1m)	Xgs
Sch-18	Minnesota	Xgs
Sch-22	5 - 20 ft (6.1m)	Xp
Sch-23	6 + 30 ft (9.2m)	Xp
Sch-49	7	Xq
Sch-53	7	Xs
Sch-67	Montana	Xh
Sch-82	5	Xq
Sch-97	4	Xs
Sch-104	4	Xq
Sch-105	4	Xs
Sch-106	4	Xs
Sch-113	3	Xs
Sch-124	3	Xgs
Sch-125	3	Xs
Sch-173	9	Xs
Sch-Y	8 + 20 ft (6.1m)	Xq
11A05(A)	Below 11 (core)	Xgs
Sch-Z	8 + 20 ft (6.1m)	Xq
Sch-Z'	8 (same vein as Z)	Xq
Sch-ZZ	9	Xs
Sch-174	Between 9 and 10	Xq
Sch-175	9 - 30 ft (9.2m)	Xs

Table 7.--Spectrochemical analyses of 13 typical ore pulps from the Schwartzwalder mine (courtesy of Cotter Corporation)

[Spectrographic analyses by Nancy M. Conklin. The following elements (with their detection limits in ppm in parentheses) were looked for and not found: Bi (10), Cd (200), Sn (10), Th (300). Number following < is detection limit]

Sample No.	1-17-75(1)	1-17-75(2)	1-17-75(3)	1-17-75(4)	1-17-75(5)
Lab No.	MAM474	MAM475	MAM476	MAM477	MAM478[1]
	In percent (%)				
	[2]0.24	[2]0.06	[2]1.21	[2]0.26	[2]1.43
U	0.28	0.062	1.87	0.32	2.17
Fe	15.0	7.0	7.0	7.0	7.0
Mg	1.5	3.0	1.5	1.5	1.5
Ca	3.0	7.0	2.0	3.0	3.0
Ti	0.3	0.5	0.15	0.15	0.15
S[3]	2.48	0.42	1.67	1.88	3.02
	In parts per million (ppm)				
Ag	7	1	2	2	15
As	<1,000	<1,000	<1,000	<1,000	<1,000
B	70	<20	70	70	700
Ba	300	150	200	150	200
Be	7	<1.5	5	5	3
Co	50	50	<70	30	<70
Cr	150	150	150	150	150
Cu	700	200	300	300	500
La	70	<50	50	<50	30
Mn	7,000	1,500	700	1,000	1,000
Mo	1,500	200	2,000	1,500	2,000
Nb	<10	<10	15	10	10
Ni	150	100	150	150	150
Pb	1,000	150	1,000	700	1,500
Sb	<200	<200	<200	<200	<200
Sc	15	30	15	15	15
Sr	70	150	150	150	150
V	200	300	200	200	200
W	<500	<500	<500	<500	<500
Y	30	20	30	15	70
Zn	1,000	<300	700	700	1,000
Zr	70	70	150	150	200
F[4]	1,400	700	1,600	1,300	1,100
Se[8]	2	0.4	0.8	2.5	5

Table 7.--Spectrochemical analyses of 13 typical ore pulps from the Schwartzwalder mine--Continued

Sample No.	2-28-75(6)	[6]2-28-75(7)	[7]2-28-75(8)
Lab No.	MAM484	MAM485	MAM486
	In percent (%)		
	[2]0.43	[2]0.37	[2]5.67
U	0.57	0.40	3.50
Fe	7.0	7.0	7.0
Mg	1.5	3.0	1.5
Ca	3.0	7.0	3.0
Ti	0.3	0.15	0.15
S[3]	2.58	0.68	2.33
	In parts per million (ppm)		
Ag	7	7	50
As	<1,000	<1,000	1,000
B	70	30	70
Ba	300	150	300
Be	7	3	10
Co	50	30	<200
Cr	100	150	100
Cu	700	300	5,000
La	20	<50	<50
Mn	3,000	1,000	1,000
Mo	1,000	1,500	5,000
Nb	<10	15	50
Ni	150	100	150
Pb	1,000	500	5,000
Sb	<200	<200	<200
Sc	15	10	10
Sr	100	200	150
V	200	300	150
W	<500	<500	<500
Y	30	15	100
Zn	700	300	<1,000
Zr	150	70	500
F[4]	1,200	700	1,000
Se[8]	2.3	1.5	1.5

[1]Instrumental analysis for Hg by C. A. Curtis gave 2.5 ppm.

[2]Numerator is equivalent uranium furnished by Cotter Corporation. Denominator is equivalent uranium determined by J. C. Negri using a Beta-gamma scaler.

[3]Titrametric analyses for S by J. C. Negri.

[4]Ion electrode analyses for F by D. M. Hopkins.

[5]Instrumental analysis for Hg by C. A. Curtis gave 3.0 ppm.

[6]30 ppm Bi reported by N. M. Conklin.

[7]Th not detected at 1000 ppm.

[8]Fluorometer analysis for Se by G. L. Crenshaw.

Table 7.--Spectrochemical analyses of 13 typical ore pulps from the Schwartzwalder mine--Continued

Sample No.	2-28-75(1)	2-28-75(2)	2-28-75(3)	2-28-75(4)	[5]2-28-75(5)
Lab No.	MAM479	MAM480	MAM481	MAM482	MAM483
	In percent (%)				
	[2]0.14	[2]0.08	[2]Nil	[2]0.07	[2]0.37
U	0.30	0.15	0.02	0.08	0.62
Fe	15.0	7.0	7.0	7.0	15.0
Mg	1.5	3.0	3.0	3.0	3.0
Ca	3.0	7.0	7.0	7.0	3.0
Ti	0.15	0.3	1.5	0.3	0.3
[3]S	1.82	0.52	0.09	0.37	2.65
	In parts per million (ppm)				
Ag	7	1.5	<1	3	7
As	<1,000	<1,000	<1,000	<1,000	<1,000
B	50	<20	<20	<20	30
Ba	300	150	150	150	300
Be	3	2	1.5	1	7
Co	50	50	70	50	70
Cr	150	150	150	200	150
Cu	300	300	150	300	700
La	20	<50	<50	<50	30
Mn	3,000	1,500	1,500	2,000	5,000
Mo	700	300	100	500	3,000
Nb	10	<10	<10	<10	10
Ni	150	150	150	150	200
Pb	500	200	70	200	1,500
Sb	<200	<200	<200	<200	<200
Sc	15	30	30	30	15
Sr	70	150	150	150	150
V	200	300	500	300	200
W	<500	<500	<500	<500	<500
Y	20	30	15	15	30
Zn	700	<300	<300	<300	700
Zr	150	100	100	70	150
[4]F	1,300	700	700	1,000	1,300
[8]Se	2.2	1.5	0.2	0.7	2.3

Table 8.--Localities of samples shown in table 7

Sample number		Locality
1-17-75	(1)	Shaft No.1
1-17-75	(2)	Shaft No. 2, Waste
1-17-75	(3)	Level 10
1-17-75	(4)	Level 11
1-17-75	(5)	Level 11
2-28-75	(1)	Unspecified
2-28-75	(2)	Unspecified
2-28-75	(3)	Shaft No. 2, Waste
2-28-75	(4)	Shaft No. 2, Waste
2-28-75	(5)	Level 10
2-28-75	(6)	Level 10
2-28-75	(7)	Unspecified
2-28-75	(8)	Level 11

Table 9.--Relative abundance of elements in Schwartzwalder pitchblende ore (data compiled from tables 4 and 5)

Element	No. of samples	Average percent	Crustal abundance[1] in percent	Concentration factor = average percent ÷ crustal abundance
U	42	17.67	0.00025	70,700
Mo	42	0.53	0.00011	4,800
Sb	41	0.11	0.00005	2,200
W	42	0.15	0.00013	1,150
Pb	42	0.96	0.0016	600
Ag	41	0.0029	0.000007	410
Tl	21	0.04	0.0001	400
Zn	42	0.26	0.0083	30
Cu	42	0.077	0.0047	16
Zr	42	0.135	0.0170	8
Nb	42	0.009	0.0020	5
Be	30	0.0015	0.00038	4
Co	5	0.006	0.0018	3
Y	8	0.0079	0.0029	3
V	42	0.028	0.0090	3
Mn	30	0.22	0.1	2
Ni	41	0.012	0.0058	2
Ca	30	4.32	2.96	1.5
Fe	30	4.84	4.65	1
Sr	30	0.0200	0.0340	0.6
Mg	30	1.12	1.87	0.6
Ti	30	0.2	0.45	0.4
Al	30	3.1	8.05	0.4
Cr	42	0.0030	0.0083	0.4
Ba	30	0.0210	0.0650	0.3

[1]Vinogradov (1962).

Table 10.--Relative abundance of elements in Schwartzwalder ore pulps (data compiled from table 7)

[Averages based on 9 samples, except for Hg (based on 2). Crustal abundances same as in table 9, but also including, in ppm: F, 660; S, 470; La, 29; Th, 13; B, 12; Sc, 10; Hg, 0.08; Bi, 0.009; Se, 0.05. The following elements were not detected at the limits shown in ppm in parentheses: Sb (200), W (500), Bi (10), Th (300). Hence their concentration factors in the pulps are: Sb, <400; W, <380; Bi, <1000; Th, <23.

Element	Average percent	Concentration factor = average percent ÷ crustal abundance
U[1]	1.12	4480
Mo	0.20	1800
Ag	0.0012	170
Pb	0.14	90
S	2.12	45
Se	0.000223	45
Hg	0.00028	35
Cu	0.0980	21
B	0.0130	11
Zn	0.070	8
Co	0.0050	2.8
Ni	0.0150	2.6
Mn	0.25	2.5
V	0.021	2.3
Fe	10.	2.2
F	0.12	1.8
Cr	0.014	1.7
Be	0.00055	1.4
Y	0.0038	1.3
La	0.0034	1.2
Zr	0.0180	1
Mg	1.8	1
Ca	3.0	1
Sc	0.0011	1
Nb	0.0014	0.7
Ti	0.20	0.4
Ba	0.024	0.4
Sr	0.013	0.4

[1]Equivalent uranium.

Table 11.--Analytical data showing minimum, average, and maximum elemental composition of underground host rocks of the Schwartzwalder deposit

[Spectrographic analyses by E. F. Cooley. Sulfur analyses (titrametric) by Z. C. Stephenson. Equivalent uranium (eU) analyses by Z. C. Stephenson using a Beta-gamma scaler. Ion electrode analyses for F by D. M. Hopkins. Instrumental analyses for Hg by C. A. Curtis. Fluorometer analyses for Se by G. L. Crenshaw. The following elements (with their detection limits in ppm in parentheses) were looked for and not found: As(200), Au (10), Cd (20), Nb (20), Sb (100), Sn (10), W (50). Number following < is detection limit]

Rock type	Xs			Xgs			Xh			Xq		
No. of samples	10			5			6			4		
	Min.	Aver.	Max.	Min.	Aver.	Max	Min.	Aver.	Max.	Min.	Aver.	Max.
					In percent (%)							
Fe	3.	9.	20.	10.	12.	15.	5.	9.	10.	3.	10.	20.
Mg	1.	1.7	2.	1.5	1.7	2.	1.5	1.8	2.	0.1	0.9	2.
Ca	0.3	1.1	5.	0.2	0.6	1.	2.	3.7	5.	0.07	1.4	5.
Ti	0.2	0.3	0.7	0.2	0.26	0.5	0.2	0.4	0.7	0.02	0.12	0.30
S	0.01	2.0	7.0	0.18	1.1	3.2	0.01	0.17	0.74	0.31	0.53	0.77
					In parts per million (ppm)							
eU	<30.	80.	530.	<30.	30.	40.	<30.	~30	60.	<30.	~50	150.
Ag	<0.5	0.6	2.	<0.5	0.3	1.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
B	20.	60.	100.	20.	42.	100.	15.	20.	20.	10.	500.	>2000.
Ba	150.	360.	1000.	70.	510.	1000.	50.	180.	500.	20.	43.	70.
Be	<1.	3.	5.	1.	1.6	2.	<1.	1.	2.	1.5	1.9	2.
Bi	<10.	<10.	10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
Co	10.	30.	70.	10.	26.	50.	20.	45.	50.	<5.	~15	50.
Cr	<10.	70.	150.	10.	26.	50.	30.	83.	100.	<10.	~20	50.
Cu	<5.	130.	500.	20.	52.	100.	5.	70.	300.	20.	75.	200.
F	600.	1830.	3500.	475.	1500.	2250.	525.	820.	1600.	220.	630.	1200.
Hg	0.04	0.15	0.65	0.04	0.09	0.14	0.04	0.06	0.08	0.08	0.19	0.40
La	20.	43.	50.	30.	50.	70.	20.	23.	30.	20.	30.	50.
Mn	500.	2220.	5000.	300.	~5000	>5000.	500.	920.	1000.	100.	580.	1000.
Mo	<5.	<5.	10.	<5.	<5.	7.	<5.	<5.	<5.	<5.	~8	10.
Ni	10.	70.	100.	30.	54.	70.	50.	70.	100.	10.	30.	70.
Pb	10.	42.	100.	15.	97.	300.	<10.	28.	100.	<10.	23.	50.
Sc	15.	22.	30.	15.	19.	30.	15.	26.	30.	<5.	~10	30.
Sr	<100.	145.	500.	<100.	~80	200.	100.	300.	1000.	<100.	<100.	100.
V	50.	160.	200.	100.	170.	200.	100.	130.	200.	20.	160.	300.
Y	20.	26.	30.	20.	28.	30.	10.	24.	30.	<10.	~12	20.
Zn	<200.	350.	1000.	500.	800.	1500.	<200.	130.	200.	<200.	~220	300.
Zr	100.	150.	200.	150.	220.	300.	70.	130.	200.	20.	73.	150.
Se	0.2	1.5	6.	0.7	1.0	1.5	0.2	1.9	5.0	0.2	0.6	0.8

Table 11.--Analytical data showing minimum, average, and maximum elemental composition of underground host rocks of the Schwartzwalder deposit--Continued

Rock type	Xh+Xs (interlayered)			Xs+Xq (interlayered)			Fault gouge and breccia		
No. of samples	6			2			2		
	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.
	In percent (%)								
Fe	5.	6.5	10.	7.	11.	15.	7.	11.	15.
Mg	2.	2.	2.	1.	1.	1.	1.5	1.8	2.
Ca	2.	4.	5.	0.05	0.2	0.3	1.	3.	5.
Ti	0.2	0.4	0.5	0.2	0.2	0.2	0.2	0.2	0.2
S	0.01	0.02	0.05	3.3	4.0	4.8	0.19	2.5	4.8
	In parts per million (ppm)								
eU	<30.	<30.	<30.	<30.	~30	40.	500.	750.	1000.
Ag	<0.5	<0.5	<0.5	1.	1.	1.	<0.5	~0.8	1.5
B	15.	40.	100.	70.	85.	100.	10.	30.	50.
Ba	300.	530.	700.	500.	500.	500.	100.	200.	300.
Be	<1.	<1.	1.	2.	2.	2.	2.	3.5	5.
Bi	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
Co	20.	37.	70.	20.	25.	30.	10.	20.	30.
Cr	70.	96.	100.	50.	50.	50.	20.	25.	30.
Cu	10.	62.	200.	100.	125.	150.	10.	80.	150.
F	450.	960.	1400.	1500.	1880.	2250.	450.	780.	1100.
Hg	0.06	0.08	0.10	0.08	0.16	0.24	0.4	0.7	1.0
La	<20.	28.	50.	30.	40.	50.	20.	25.	30.
Mn	700.	980.	1500.	200.	1100.	2000.	3000.	3000.	3000.
Mo	<5.	<5.	<5.	5.	7.5	10.	50.	175.	300.
Ni	50.	68.	100.	70.	70.	70.	20.	45.	70.
Pb	<10.	~13	30.	70.	85.	100.	70.	135.	200.
Sc	20.	28.	30.	15.	18.	20.	10.	13.	15.
Sr	100.	120.	200.	<100.	<100.	100.	100.	200.	300.
V	100.	160.	200.	150.	150.	150.	200.	200.	200.
Y	20.	28.	30.	50.	60.	70.	20.	25.	30.
Zn	<200.	<200.	200.	500.	500.	500.	200.	850.	1500.
Zr	70.	150.	200.	150.	150.	150.	150.	150.	150.
Se	0.3	1.6	5.0	4.5	5.8	5.0	0.4	2.7	5.0

Table 12.--Localities of samples shown in table 11

Sample number	Level	Host rock
Sch- 5	Steve + 50 ft (15.3m)	Xgs
Sch-13A	3	Xs
Sch-13B	3	Xq
Sch-19	Minnesota	Xs
Sch-20	7	Xh + Xs
Sch-24	Steve	Xs + Xq
Sch-25	Above Steve	Xs
Sch-27	7	Xs
Sch-28	7	Xh + Xs
Sch-29	7	Xh + Xs
Sch-32	7	Xh
Sch-34	7	Xgs
Sch-36	7	Xgs
Sch-37	7	Fault gouge and breccia
Sch-40	7	Xq
Sch-41	7	Xh
Sch-45	7	Fault gouge and breccia
Sch-52	7	Xq
Sch-54	7	Xs
Sch-56	6	Xh + Xs
Sch-57	6	Xs
Sch-58	6	Xs
Sch-59	6	Xs
Sch-63	5	Xs
Sch-66	Montana	Xh
Sch-68	Do.	Xq
Sch-69	Do.	Xh
Sch-77	5	Xs + Xq
Sch-78	5	Xs
Sch-88	5	Xh + Xs
Sch-90	4	Xgs
Sch-92	4	Xh
Sch-110	3	Xh + Xs
Sch-119	3	Xgs
Sch-172	9	Xh

Table 13.--Analytical data showing minimum, average, and maximum elemental composition of surface country rocks in the Schwartzwalder area

[Spectrographic analyses by E. F. Cooley. Sulfur analyses (titrametric) by Z. C. Stephenson. Equivalent uranium (eU) analyses by Z. C. Stephenson using a Beta-gamma scaler. Ion electrode analyses for F by J. Sharkey. Instrumental analyses for Hg by C. A. Curtis. The following elements (with their detection limits in parentheses) were looked for and not found: As (200), Au (10), Cd (20), Nb (20), Sb (100), Sn (10), W (50). Number following < is detection limit. Number following > is upper spectrographic limit above which values are unreliable]

Rock type	Xs			Xgg			Xq			Xgs		
No. of samples	14			7			5			3		
	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.
					In percent (%)							
Fe	3.	5.	7.	2.	2.5	3.	2.	5.	10.	10.	10.	10.
Mg	0.2	0.8	1.	<0.02	0.5	1.5	0.02	0.5	1.	1.	1.2	1.5
Ca	<0.05	0.2	0.5	0.1	0.9	5.	0.2	0.4	0.7	0.3	0.4	0.7
Ti	0.2	0.26	0.3	0.01	0.14	0.3	0.005	0.2	0.5	0.2	0.23	0.3
S	<0.005	0.007	0.02	<0.005	0.12	0.77	0.005	0.007	0.01	<0.005	0.05	0.15
					In parts per million (ppm)							
eU	<30.	<30.	70.	<30.	30.	80.	<30.	<30.	<30.	<30.	<30.	<30.
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
B	10.	200.	2000.	<10.	10.	20.	10.	12.	20.	20.	30.	50.
Ba	200.	490.	700.	200.	560.	1000.	50.	200.	500.	300.	500.	700.
Be	1.	3.	20.	1.	1.7	2.	<1.	1.	2.	2.	2.	2.
Bi	<10.	<10.	10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
Co	5.	20.	30.	<5.	6.	10.	<5.	13.	20.	5.	12.	20.
Cr	<10.	90.	150.	<10.	20.	100.	<10.	80.	200.	50.	70.	100.
Cu	<5.	18.	50.	<5.	7.	20.	<5.	13.	70.	5.	30.	50.
F	1000.	2260.	7000.	1000.	1500.	2250.	600.	1700.	2250.	1900.	1970.	2000.
Hg	0.04	0.04	0.04	0.06	0.10	0.14	0.6	0.06	0.06	--	--	--
La	50.	60.	100.	20.	46.	50.	30.	50.	70.	50.	50.	50.
Mn	100.	740.	5000.	70.	260.	500.	100.	440.	1000.	1000.	2700.	500.
Mo	<5.	<5.	<5.	<5.	<5.	10	<5.	<5.	10.	<5.	<5.	<5.
Ni	<5.	55.	100.	<5.	7.	20.	5.	30.	50.	50.	50.	50.
Pb	<10.	30.	50.	10.	37.	70.	<10.	20.	50.	30.	40.	50.
Sc	10.	16.	20.	<5.	8.	15.	<15.	9.	15.	15.	18.	20.
Sr	<100.	100.	200.	100.	160.	200.	<100.	190.	500.	100.	230.	500.
V	<10.	100.	150.	<10.	50.	200.	30.	40.	100.	150.	150.	150.
Y	20.	30.	70.	<10.	30.	70.	<10.	20.	30.	20.	30.	50.
Zn	<200.	<200.	200.	<200.	<200.	200.	<200.	<200.	<200.	<200.	270.	500.
Zr	100.	200.	300.	50.	150.	200.	<10.	150.	300.	150.	180.	200.

Table 13.--Analytical data showing minimum, average, and maximum elemental composition of surface country rocks in the Schwartzwalder area--Continued

Rock Type	Xh			Xm			Fault breccia		
No. of Samples	3			2			9		
	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.
	In percent (%)								
Fe	5.	7.	10.	20.	>20.	>20.	5.	10.	20.
Mg	1.5	1.7	2.	0.05	0.08	0.1	<0.02	1.2	3.
Ca	1.	3.7	5.	0.1	0.15	0.2	<0.05	4.6	10.
Ti	0.2	0.3	0.5	0.05	0.05	0.05	0.015	0.24	0.5
S	0.005	0.008	0.01	0.005	0.005	0.005	<0.005	0.24	2.
	In parts per million (ppm)								
eU	<30.	<30.	<30.	<30.	<30.	<30.	<30.	<30.	60.
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.	10.
B	<10.	13.	20.	10.	10.	10.	<10.	20.	50.
Ba	70.	290.	500.	100.	200.	300.	20.	670.	5000.
Be	<1.	<1.	1.	<1.	<1.	<1.	1.	2.	3.
Bi	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
Co	50.	63.	70.	<10.	<10.	10.	<5.	32.	50.
Cr	20.	73.	100.	<10.	<10.	10.	<10.	60.	100.
Cu	20.	57.	100.	<5.	<5.	5.	5.	230.	1500.
F	800.	1300.	1900.	600.	700.	800.	500.	2430.	6000.
Hg	0.04	0.04	0.04	--	--	--	0.10	0.10	0.10
La	<20.	37.	50.	<20.	<20.	<20.	<20.	30.	100.
Mn	500.	730.	1000.	>5000.	>5000.	>5000.	70.	>1100.	>5000.
Mo	<5.	<5.	<5.	<5.	<5.	<5.	<5.	5.	20.
Ni	30.	77.	100.	10.	13.	15.	<5.	45.	70.
Pb	10.	33.	70.	<10.	<10.	<10.	10.	27.	50.
Sc	20.	23.	30.	<5.	<5.	5.	<5.	15.	20.
Sr	100.	230.	500.	<100.	<100.	<100.	<100.	200.	700.
V	150.	180.	200.	100.	100.	100.	50.	200.	300.
Y	20.	27.	30.	20.	25.	30.	<10.	25.	30.
Zn	<200.	<200.	<200.	<200.	<200.	<200.	<200.	<200.	200.
Zr	100.	120.	150.	50.	100.	150.	20.	90.	200.

[1]One fault breccia sample (RC-460) contained 20 ppm Nb.

Table 14.--Localities of samples shown in table 13

Sample number	Localities	Host rock
	T. 2 S., R. 71 W.	
Sch-60	NE1/4SE1/4 sec. 25	Xgg
RC-26	NW1/4SE1/4 sec. 25	Xh
RC-27	NW1/4SE1/4 sec. 25	Xgg (fine-grained lens in Xh)
RC-126	SW1/4NE1/4NW1/4 sec. 25	Xgg
RC-129	SW1/4NE1/4NW1/4 sec. 25	Xgg
RC-134	SW1/4SW1/4SW1/4 sec. 24	Xgg
RC-136	NW1/4NW1/4 sec. 25	Xgg
RC-138	SE1/4NW1/4NW1/4 sec. 25	Xgg
RC-139	SE1/4NW1/4NW1/4 sec. 25	Xs
RC-142	SW1/4NW1/4NW1/4 sec. 25	Xh
RC-314	SE1/4SW1/4 sec. 25	Xm
RC-315	SE1/4SW1/4 sec. 25	Xs
RC-315A	SE1/4SW1/4 sec. 25	Xm
RC-338	SE1/4NE1/4 sec. 35	Xq
RC-409	SW1/4SE1/4 sec. 25	Xgs
RC-454	NW1/4SW1/4 sec. 25	Fault breccia
RC-460	NE1/4NE1/4NW1/4 sec. 36	Do.
RC-464	SW1/4SW1/4NW1/4 sec. 25	Do.
RC-468	NE1/4NE1/4SE1/4 sec. 26	Do.
RC-469	NE1/4NE1/4SE1/4 sec. 26	Do.
RC-471	NE1/4NW1/4 sec. 36	Do.
RC-478	NW1/4NE1/4NE1/4 sec. 35	Xh
RC-481	SE1/4SE1/4 sec. 25	Fault breccia
RC-493	SW1/4SE1/4NE1/4 sec. 26	Do.
RC-504	NW1/4SE1/4NE1/4 sec. 26	Do.
	T. 3 S., R. 70 W.	
RC-3	NW1/4NE1/4 sec. 6	Xs
RC-71	NW1/4NE1/4 sec. 6	Xs
RC-87	NE1/4NW1/4 sec. 6	Xs
RC-119	SW1/4NW1/4 sec. 6	Xq
RC-181	NW1/4SE1/4 sec. 6	Xs
RC-183	NW1/4SE1/4 sec. 6	Xs
RC-201A	NW1/4SE1/4 sec. 6	Xs
RC-201B	NW1/4SE1/4 sec. 6	Xs
RC-220	NW1/4SE1/4 sec. 6	Xs
RC-114	SE1/4NW1/4 sec. 6	Xq
	T. 2 S., R. 70 W.	
RC-14	NW1/4NW1/4NW1/4 sec. 31	Xgs
RC-42	SW1/4NW1/4NW1/4 sec. 31	Xq
RC-52	NW1/4SW1/4NW1/4 sec. 31	Xgs
RC-66	SE1/4NW1/4NW1/4 sec. 31	Xq
RC-75	SE1/4SW1/4 sec. 31	Xs
RC-80	NW1/4SW1/4 sec. 31	Xs
RC-108	SW1/4NW1/4 sec. 31	Xs
	T. 3 S., R. 71 W.	
RC-258	NE1/4NE1/4 sec. 1	Xs

Table 15.--Relative abundance of elements in underground host rocks of the Schwartzwalder deposit (Data compiled from Table 11)

[Averages based on 35 samples. Crustal abundances same as in Table 10]

Element	Average percent	Concentration factor = average percent ÷ crustal abundance
Se	0.000138	27.6
S	1.19	25.
Mo	0.0012	11.
B	0.0097	8.
U[1]	0.0086	5.5
Ag	0.000035	5.
Zn	0.034	4.
Pb	0.0048	3.
Sc	0.0021	2.1
Mn	0.198	2.
Fe	9.3	2.
F	0.127	1.9
Cu	0.0088	1.9
V	0.0158	1.8
Co	0.0031	1.7
Hg	0.000012	1.5
La	0.0035	1.2
Ni	0.0061	1.1
Y	0.0027	1.
Zr	0.0150	0.9
Mg	1.64	0.88
Ti	0.0031	0.7
Cr	0.0061	0.7
Ca	1.72	0.6
Ba	0.0340	0.5
Be	0.00019	0.5
Sr	0.0150	0.4

[1]Equivalent uranium. Crustal abundance is based on 13 ppm Th and 2.5 ppm U.

Table 16.--Relative abundance of elements in surface country rocks near the Schwartzwalder deposit (data compiled from table 13)

[Averages based on 34 samples. Crustal abundances same as in table 10]

Element	Average percent	Concentration factor = average percent ÷ crustal abundance
B	0.0090	7.5
F	0.1820	2.8
Pb	0.0030	2.
La	0.0053	1.8
Fe	6.3	1.4
Mn	0.117	1.2
V	0.0092	1.
Co	0.0018	1.
Y	0.0028	1.
Zr	0.0168	1.
U[1]	<0.003	1. ?
Mo	<0.0005	1. ?
Cr	0.0066	0.8
Hg[2]	0.000006	0.8
Ni	0.004	0.7
S	0.034	0.7
Ba	0.043	0.7
Ti	0.22	0.5
Be	0.0002	0.5
Mg	0.8	0.4
Sr	0.015	0.4
Cu	0.0016	0.3
Ca	0.7	0.2

[1]Equivalent uranium. Crustal abundance is based on 13 ppm Th and 2.5 ppm U.

[2]The average percent for Hg is based on 29 samples.

Table 17.--Relative abundance of elements in surface fault breccias (of table 13) and underground fault breccias of Table 11

[Crustal abundances same as in table 10]

Element	Surface fault beccias		Underground fault breccias	
	Average percent	Concentration factor = average percent ÷ crustal abundance	Average percent	Concentration factor = average percent ÷ crustal abundance
U[1]	<0.003	∿1	0.075	300.
Mo	0.0005	4.5	0.0175	160.
Se	--	--	0.00027	54.
S	0.24	5.1	2.5	53.
Ag	0.0001	14.	0.00008	11.
Zn	<0.02	<2.4	0.085	10.2
Hg	0.00001	1.3	0.00007	8.8
Pb	0.0027	1.7	0.0135	8.
Mn	>0.1	>1.	0.3	3.
B	0.002	1.7	0.0030	2.5
Fe	10.	2.2	11.	2.4
V	0.02	2.2	0.02	2.2
Cu	0.023	4.9	0.008	1.7
Sc	0.0015	1.5	0.013	1.3
F	0.243	3.7	0.078	1.2
Co	0.0032	1.8	0.002	1.1
Mg	1.2	0.6	1.8	1.
Ca	4.6	1.6	3.	1.
La	0.003	1.	0.0025	0.9
Be	0.0002	0.5	0.00035	0.9
Zr	0.009	0.5	0.015	0.9
Y	0.0025	0.9	0.0025	0.9
Ni	0.0045	0.8	0.0045	0.8
Sr	0.02	0.6	0.02	0.6
Ti	0.24	0.5	0.2	0.4
Cr	0.006	0.7	0.0025	0.3
Ba	0.067	1.	0.02	0.3

[1]Equivalent uranium. For surface fault breccias crustal abundance is based on 13 ppm Th and 2.5 ppm U. For underground fault breccias most eU is caused by U, hence crustal abundance is based on 2.5 ppm U.

Table 18.--Geochemical summary of elements found in ore, rocks, and fault breccias listed in tables 4, 5, 7, 9, 10, 11, 13, 15, 16, and 17

Concentration factor = average percent ÷ crustal abundance	High-grade pitchblende ore	Ore pulps	Fault breccias (underground)	Host rocks (underground)	Fault breccias (surface)	Country rocks (surface)
>10,000	U					
1,000-10,000	Mo, Sb, W	U, Mo				
100-1,000	Pb, Ag, Tl	Sb, W, Ag	U, Mo			
10-100	Zn, Cu, (Se), (S)[1], (Hg)	Pb, S, Se, Cu, B, Hg	S, Ag, Zn, Se	S, Se		
3-10	Zr, Nb, Be, Co, Y, V	Zn, Co, Mn, Ni	Pb, Mn, B, Hg (Sb) (W)	U, Ag, B, Mo, Pb, Zn	Ag, Mo, Cu, F, S (Sb) (W)	B, F
0.5-2	Ni, Mn, Sr, Fe, Mg, Ca	Zr, Nb, F, Be, Cr, La, Fe, Mg, Ca, Sc, V Y	Cu, Zr, Nb, F, Be, Co, La, Fe, Mg, Ca, Sc, Sr, V, Y, Ni	Fe, Mg, Ca, Ti, Ba, Be, Co, Cr, Cu, F, Hg, La, Mn, Ni, Sc, V, Y, Zr	U, Pb, Zn?, Zr, Nb?, Be, Co, Cr, La, Mn?, Fe, Mg, Ca, Ti, B, Sr, V, Y, Ni	U, Mo, Cr, Mn, Pb, Sb?, V, Fe, W?, Ag?, Ti, S, Zr, Zn?, Hg, Ba, Be, La, Y
<0.5	Cr, Ti, Al, Ba	Ti, Ba, Sr	Cr, Ti, Ba	Sr		Cu, Ca, Sr, Mg

[1]Elements in broken parentheses, e.g. (S), are estimates. Elements with queries are not certain for postion.

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