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Geochemical and mineralogic data from the Lamprecht and Felder uranium deposits, Live Oak County, Texas

By

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Introduction

The uranium deposits in the Lamprecht and Felder mines are parts of a continous roll-type orebody in the Miocene Oakville Sandstone, Ray Point uranium district, Live Oak County, south Texas (fig. 1). Published studies of these deposits (Klohn and Pickens, 1970; Galloway, 1977; Galloway and others, 1979; Goldhaber and others, 1979, 1982; Reynolds and others, 1980, 1982; Ludwig and others, 1982) have focused primarily on depositional environment of the host beds, on stratigraphic and structural settings, on the geochemistry of modern ground waters, on abundances, distribution, and textures of the iron disulfide (FeS_2) minerals, on uranium-lead and sulfur isotope systematics, and on sulfidization and mineralization processes. Genetic models for uranium mineralization of the Felder and Lamprecht deposits are given by Galloway (1981) and by Goldhaber and others (1982).

We present here the full data set of geochemical analyses and mineralogic data for samples from the Lamprecht and Felder deposits. These analyses were made in the Analytical Laboratories of the U.S. Geological Survey, in Denver, or in commercial laboratories. Analyses from commercial laboratories were made available to us by the Wyoming Mineral Corporation (WMC). In addition, the relative abundances of pyrite and marcasite are listed for all samples from the Felder deposit and most samples from the Lamprecht deposit. This report complements our earlier studies of the Felder and Lamprecht deposits which summarize some of the analytical data but which, for the most part, do

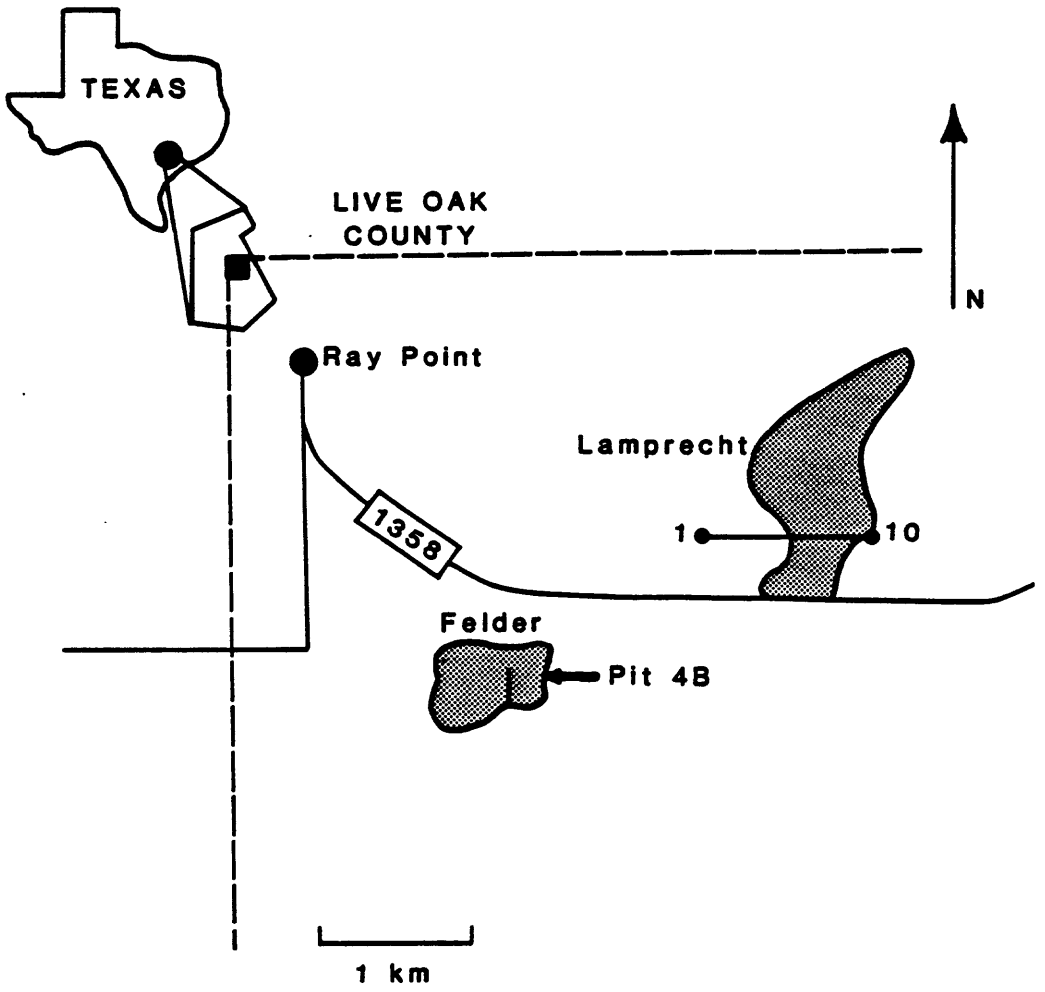

Figure 1.--Location map of the Felder uranium deposit, pit 4B, and the Lamprecht uranium deposit. Stippled areas represent the extent of uranium mineralization of each deposit. Core fence between cores 1 and 10 in the Lamprecht deposit is shown by line across the deposit. (Modified from Galloway and others, 1979).

not contain complete data sets of the analytical results. In particular, this report is intended to supplement the paper by Goldhaber and others (1982) in which the origin of the uranium deposits in the Ray Point district is discussed.

Sampling and analytical methods

Samples of the Oakville Sandstone in the vicinity of the Lamprecht deposit were obtained by core drilling methods. Ten cores along a line that spanned 1.6 km across the deposit (fig. 2) yielded 195 samples. Sixty-four samples from the Felder deposit were collected from the wall of open pit 4B and represent a transect of about 105 m across the deposit (fig. 3).

Results for samples from the Lamprecht deposit are given in Tables 1 through 4. Sulfur (S), molybdenum (Mo), selenium (Se), and uranium (U) contents, sulfur isotopic composition[1], and relative abundances (visually estimated) of pyrite and marcasite in numerous samples are listed in Tables 1-1 through 1-10 for cores 1 through 10 respectively. Actual uranium values for the Lamprecht deposit are not given at the request of WMC but rather are listed as greater than or less than 50 ppm with samples containing greater than 50 ppm U arbitrarily defined as mineralized.

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[1]The sulfur isotopic compositions ($\delta^{34}S$) are expressed as the per mil variation between the ratio of $^{32}S/^{34}S$ in the sample to that of a standard (Cañon Diablo troilite) as determined from the relationship

$$\delta^{34}S_{\text{sample}} = \left[\frac{\left(^{32}S/^{34}S\right)_{\text{sample}}}{\left(^{32}S/^{34}S\right)_{\text{standard}}} - 1 \right] \times 1000$$

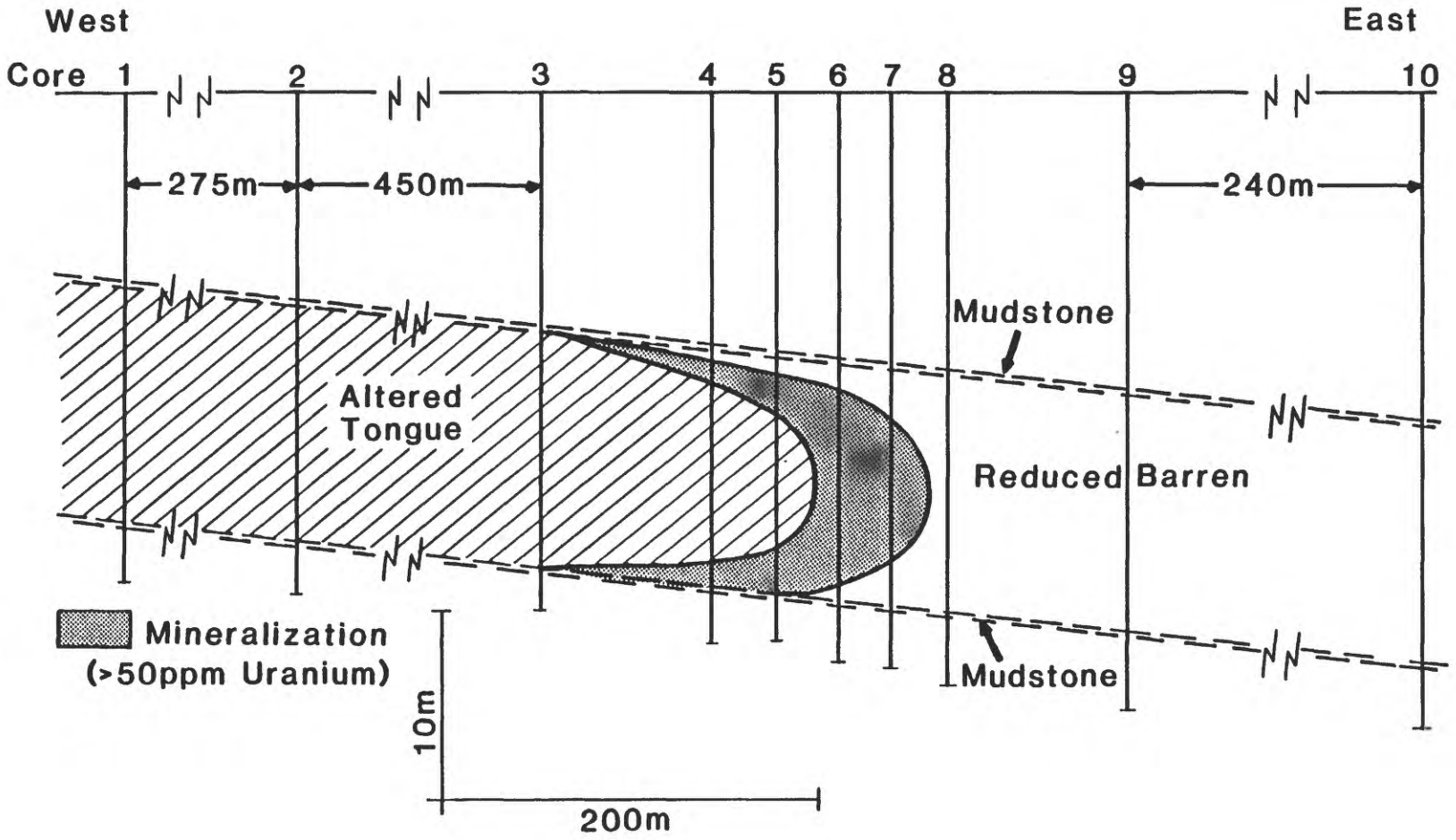

Figure 2.--Cross section of the Lamprecht deposit showing core holes and major geochemical zones. Mineralized ground is arbitrarily defined as that containing greater than 50 ppm uranium.

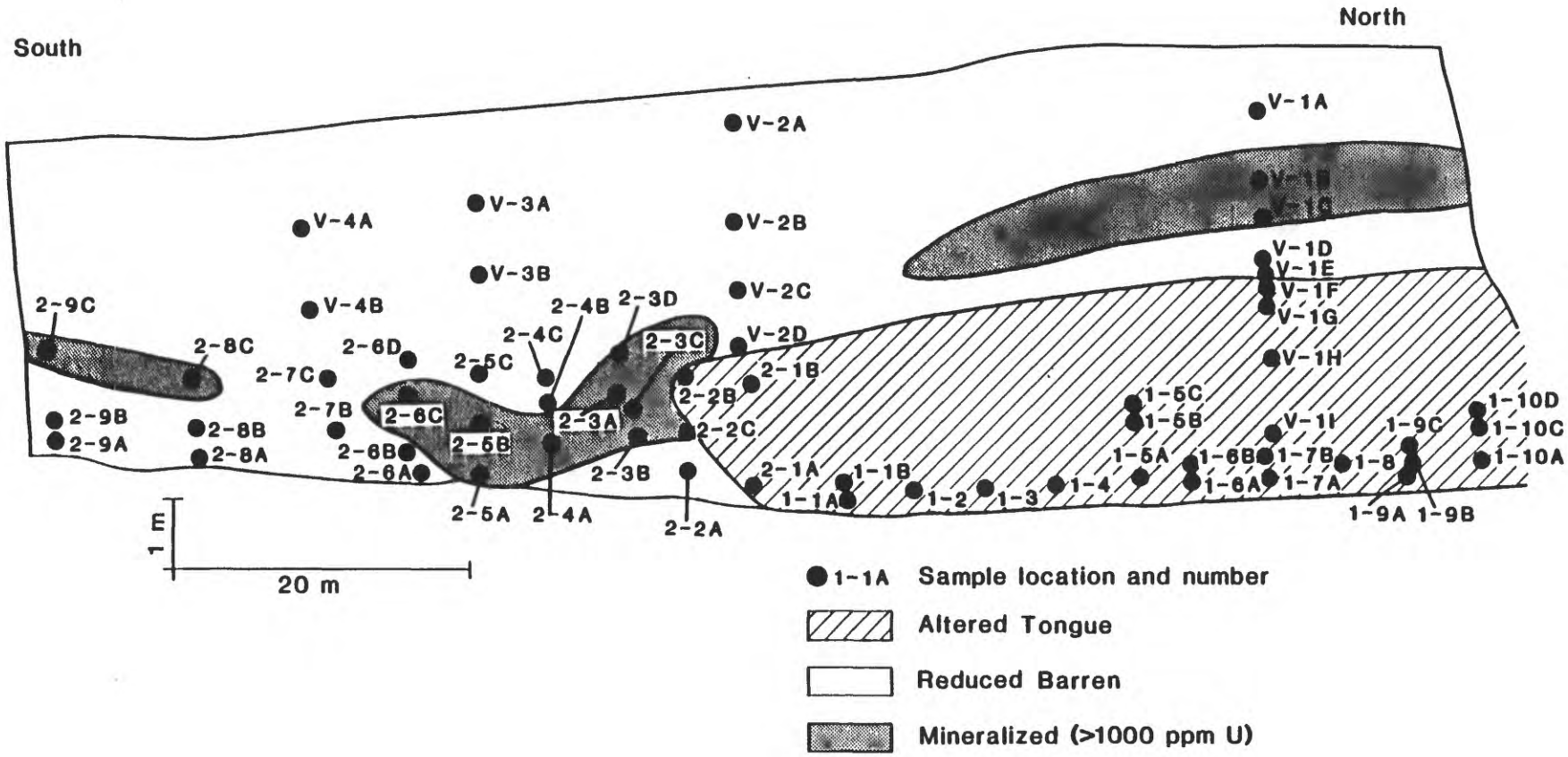

Figure 3.--Cross section of pit 4B in the Felder deposit showing sampling locations, sample numbers, and major geochemical zones. Mineralized ground is arbitrarily defined as that containing greater than 1000 ppm uranium.

In numerous samples, sulfur was determined by induction furnace techniques; those samples are noted in Tables 1-1 through 1-10 with an asterisk (*). Sulfur contents in the remaining samples were calculated from the weight percent FeS_2 in a heavy mineral separate (determined by WMC) using equation (1):

$$\%S = \%FeS_2 \times \frac{64g\ S/_{mole\ FeS_2}}{120g\ FeS_{2/mole\ FeS_2}} \qquad (1)$$

where % S is the weight percent sulfur in the sample, % FeS_2 is the weight percent pyrite in the heavy mineral separate. Results from those samples in which sulfur was determined by both methods reveal that most calculated values are less than the sulfur content determined by induction furnace techniques.

Major elements determined by X-ray fluoresence in 26 Lamprecht samples are listed in Table 2; pyrite-marcasite ratios by X-ray diffraction analyses in Table 3; and organic carbon by induction furnace techniques in Table 4.

Results for samples from the Felder deposit are given in Tables 5 and 6. Uranium contents, determined by delayed neutron techniques, organic carbon (carbonate carbon removed by acid leach prior to analyses) and sulfur determinations by induction furnace techniques, relative pyrite-marcasite abundances by visual estimations, and sulfur isotopic compositions, are given in Table 5. Mineralized samples listed in Table 5 are arbitrarily defined as containing more than 1000 ppm uranium. Data from semiquantitative 6-step spectroscopy are listed in Table 6. Semiquantitative spectrographic analytical determinations are identified with geometric brackets, the boundaries of which 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. Reported value precision is approximately plus or minus one bracket at 68 percent, or two brackets at 95 percent confidence.

In Table 6, the symbol "N" indicates the element was not detected at the limit of determination or at the value shown; and "L" indicates that although the element was detected, it was below the limit of determination or below the value shown. The detection limits for spectrographic analyses in the USGS laboratories are shown in Table 7.

Silicon content in all of the samples occurred in indeterminate amounts greater than 10 percent. The following elements were not detected by semiquantitative spectrographic means in any of the Felder samples; phosphorous, silver, arsenic, gold, bismuth, cadmium, palladium, platinum, antimony, tellurium, tungsten, zinc, cerium, germanium, hafnium, indium, lithium, rhenium, tantalum, thorium, and thallium.

Acknowledgments

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Table 1-1.--Analyses of sample from Core 1, Lamprecht deposit, south Texas
[--, not determined; S, sandstone; r, reduced barren rock; **, percent pyrite of the iron disulfide mineral population]

Sample Description			U	Se	Mo	S	$\delta^{34}S$	Pyrite**
Number	Depth (m)	Lithology and Geochemical zone	ppm			%	per mil	
GP-1-20	65.2-66.1	Sr	<50	2	2	0.83	-13.5	50

Table 1-2.--Analyses of samples from Core 2, Lamprecht deposit, south Texas
[--, not determined; S, sandstone; M, mudstone; r, reduced barren; m, mineralized; a, altered tongue; *, sulfur contents determined by induction furnace techniques; **, percent pyrite of the iron disulfide mineral population]

Sample Description			U	Se	Mo	S	$\delta^{34}S$	Pyrite**
Number	Depth (m)	Lithology and Geochemical zone	ppm			%	per mil	
GP-2-1	66.4-67.1	Sa	<50	<2	2	0.69*	+19.2	90
2-2	67.1-67.7	Sr	<50	2	2	1.19	-3.4	60
2-3	67.7-67.8	Sr	<50	3	2	0.71	--	40
2-4	67.8-68.6	Mm	>50	100	16	0.76	-18.3	50

Table 1-3.--Analyses of samples from Core 3, Lamprecht deposit, south Texas

[--, not determined; S, sandstone; M, mudstone; r, reduced barren; m, mineralized; a, altered tongue; *, sulfur contents determined by induction furnace techniques; **, percent pyrite of the iron disulfide mineral population]

Sample Description			U	Se	Mo	S	$\delta^{34}S$	Pyrite**
Number	Depth (m)	Lithology and Geochemical zone	ppm			%	per mil	
GP-3-8	62.5-63.1	Mr	<50	<2	2	0.34	--	90
3-9	63.1-63.7	Mr	<50	<2	2	0.17	--	100
3-10	63.7-64.0	Mr	<50	<2	2	1.00	--	90
3-11	64.0-64.6	Sr	<50	<2	6	0.43	--	70
3-12	64.6-64.9	Mr	<50	<2	2	1.00	--	80
GP-3-13	64.9-65.5	Sr	<50	2	6	0.56	--	40
3-14	65.5-65.8	Sr	<50	2	8	0.68	--	35
3-15	65.8-66.4	Sr	<50	3	16	1.31*	-18.1	15
3-16	66.4-67.1	Sr	<50	8	24	1.39	--	15
3-17	67.1-67.5	Sm	>50	15	80	0.93	--	20
GP-3-18	67.5-68.3	Sa	<50	200	4	0.85*	+2.8	45
3-19	68.3-68.9	Sa	<50	100	4	0.28	--	65
3-20	68.9-69.5	Sa	<50	60	<2	0.30	+26.6	80
3-21	69.5-70.1	Sa	<50	30	<2	0.81		90
3-22	70.1-70.7	Sa	<50	15	<2	0.06	--	85
GP-3-23	70.7-71.3	Sa	<50	12	2	0.29	--	85
3-24	71.3-71.9	Sa	<50	12	2	0.15	--	80
3-25	71.9-72.5	Sa	<50	10	2	0.56*	+17.5	85
3-26	73.0-73.8	Sa	<50	10	4	0.63	+16.3	90
3-27	73.8-74.4	Sa	<50	8	2	0.20	--	70
GP-3-28	74.4-75.2	Sr	<50	20	12	0.31	--	50
3-29	75.2-75.6	Mm	>50	150	46	2.65*	-44.75	45
3-30	75.6-75.9	Mr	<50	3	4	0.14	--	65

Table 1-4.--Analyses of samples from Core 4, Lamprecht deposit, south Texas

[--, not determined; S, sandstone; M, mudstone; r, reduced barren; m, mineralized; a, altered tongue; *, sulfur contents determined by induction furnace techniques; **, percent pyrite of the iron disulfide mineral population]

Sample Description			U	Se	Mo	S	$\delta^{34}S$	Pyrite**
Number	Depth (m)	Lithology and Geochemical zone	ppm			%	per mil	
GP-4-1	62.8-63.4	Sr	<50	<2	<2	0.51*	--	60
4-2	63.4-64.0	Sr	--	--	--	0.25	--	--
4-3	64.4-64.2	Sr	<50	<2	2	1.58*	--	10
4-4	64.2-65.1	Sr	<50	<2	4	0.38	--	70
4-5	65.1-65.7	Mr	<50	<2	4	2.18*	-34.2	95
GP-4-6	65.7-66.3	Mr	<50	<2	4	0.73	--	95
4-7	66.3-66.8	Mr	<50	<2	2	2.11*	--	90
4-8	66.8-67.5	Sr	<50	<2	4	0.68	-25.9	60
4-9	67.5-68.1	Sr	<50	<2	12	1.51*	-27.9	20
4-10	68.1-68.7	Sr	<50	<2	8	0.94	-28.0	20
GP-4-11	68.7-69.3	Sr	<50	<2	10	1.60*	--	40
4-12	69.3-70.0	Sm	>50	5	30	0.94	--	30
4-13	70.0-70.4	Sr	<50	12	26	1.75*	-27.5	25
4-14	70.4-71.0	Sm	>50	20	18	0.51	--	30
4-15	71.0-71.6	Sa	<50	300	2	0.59*	+9.9	90
GP-4-16	71.6-72.2	Sa	<50	400	6	0.15	--	--
4-17	72.2-72.8	Sa	<50	200	2	1.75*	+19.2	80
4-18	72.8-73.5	Sa	<50	80	<2	0.73	--	95
4-19	73.6-74.1	Sa	<50	70	<2	0.58	+26.1	95
4-20	74.1-74.7	Sa	<50	100	2	0.17	--	95
GP-4-21	74.7-75.1	Sa	<50	30	2	0.99*	+15.0	95
4-22	75.1-75.7	Sa	<50	100	10	0.21	--	90
4-23	75.7-76.5	Sa	<50	100	2	0.59*	+17.1	80
4-24	76.5-77.1	Sa	<50	200	6	0.40	--	65
4-25	77.1-77.4	Sr	<50	600	4	1.07*	-37.0	50
GP-4-26	77.4-77.7	Sm	>50	120	610	0.101	-28.8	50
4-27	77.7-78.3	Sm	>50	12	100	1.07*	-31.9	70

Table 1-5.--Analyses of samples from Core 5, Lamprecht deposit, south Texas

[--, not determined; S, sandstone; M, mudstone; r, reduced barren; m, mineralized; a, altered tongue; *, sulfur contents determined by induction furnace techniques; **, percent pyrite of the iron disulfide mineral population]

Sample Description			U	Se	Mo	S	$\delta^{34}S$	Pyrite**
Number	Depth (m)	Lithology and Geochemical zone	ppm			%	per mil	
GP-5-1	66.1-67.1	Mr	<50	<2	4	0.24	--	90
5-2	67.1-67.7	Mr	<50	<2	2	1.99*	--	60
5-3	67.7-68.3	Mr	<50	<2	4	0.24	--	75
5-4	68.3-68.9	Sr	<50	<2	6	1.13*	-26.8	30
5-5	68.9-69.5	Sr	<50	<2	12	0.91	--	20
GP-5-6	69.5-70.1	Sr	<50	<2	12	0.68	--	30
5-7	70.1-70.7	Sr	<50	2	26	0.94	--	30
5-8	70.7-71.3	Sm	>50	8	60	1.65*	-33.5	20
5-9	71.3-71.6	Sm	>50	12	44	0.52	--	20
5-10	71.6-72.2	Sm	>50	25	36	0.41	--	15
GP-5-11	72.2-72.8	Sa	<50	300	14	0.37	--	85
5-12	72.8-73.5	Sa	<50	250	6	0.87*	+8.3	80
5-13	73.5-74.1	Sa	<50	600	4	1.07	--	75
5-14	74.1-74.7	Sa	<50	600	6	0.57	--	85
5-15	74.7-75.3	Sa	<50	200	4	1.29*	+18.7	90
GP-5-16	75.3-75.9	Sa	<50	100	2	0.12	--	90
5-17	75.9-76.5	Sm	>50	200	2	0.20	--	95
5-18	76.5-77.1	Sa	<50	250	8	0.58	--	95
5-19	77.1-77.4	Sm	>50	250	10	0.36	--	85
5-20	77.4-77.7	Sm	>50	800	12	0.26	--	75
GP-5-21	77.7-78.0	Sm	>50	800	16	0.30	--	35
5-22	78.0-78.6	Sm	>50	100	200	2.40*	-44.5	35
5-23	78.6-79.2	Mm	>50	10	14	0.06	--	55

Table 1-6.--Analyses of samples from Core 6, Lamprecht deposit, south Texas
[--, not determined; S, sandstone; M, mudstone; r, reduced barren; m, mineralized; *, sulfur contents determined by induction furnace techniques; **, percent pyrite of the iron disulfide population]

Sample Description			U	Se	Mo	S	$\delta^{34}S$	Pyrite**
Number	Depth (m)	Lithology and Geochemical zone	ppm			%	per mil	
GP-6-4	69.2-69.8	Sr	<50	15	8	1.08*	--	55
6-5	69.8-70.4	Sr	<50	15	8	0.69	-27.7	50
6-6	70.4-71.0	Sr	<50	8	60	1.88*	-26.1	25
6-7	71.0-71.6	Sm	>50	2	65	0.15	--	30
6-8	71.6-72.2	Sm	>50	8	18	0.91	-28.7	25
GP-6-9	72.2-72.8	Sm	>50	<2	20	0.51	--	30
6-10	72.8-73.5	Sm	>50	10	120	1.39*	-36.7	45
6-11	73.5-74.1	Sm	>50	10	95	1.05	-43.9	45
6-12	74.1-74.7	Sm	>50	2	65	2.33*	--	35
6-13	74.7-75.3	Sm	>50	8	85	0.78	--	35
GP-6-14	75.3-75.9	Sm	>50	10	180	1.00*	-44.2	25
6-15	75.9-76.5	Sm	>50	10	100	0.15	--	30
6-16	76.5-77.1	Sm	>50	5	70	0.72*	--	25
6-17	77.1-77.7	Sm	>50	8	200	0.22	--	45
6-18	77.9-78.6	Sm	>50	2	50	0.95*	--	--
GP-6-19	78.6-79.2	Sm	>50	2	100	0.52	--	50
6-20	79.2-79.6	Mm	>50	<2	210	2.25*	--	35

Table 1-7.--Analyses of samples from Core 7, Lamprecht deposit, south Texas

[--, not determined; S, sandstone; M, mudstone; r, reduced barren; m, mineralized; *, sulfur contents determined by induction furnace techniques; **, percent pyrite of the iron disulfide population]

Sample Description			U	Se	Mo	S	$\delta^{34}S$	Pyrite**
Number	Depth (m)	Lithology and Geochemical zone	ppm			%	per mil	
GP-7-1	67.1-67.4	Sr	<50	8	2	1.45*	--	30
2	67.4-68.0	Mr	<50	<2	2	0.89	--	65
3	68.0-68.6	Mr	<50	<2	2	0.25	--	75
4	68.6-69.2	Mr	<50	2	4	2.90*	-26.8	75
5	69.2-69.8	Sr	<50	<2	10	0.67	--	60
GP-7-6	69.8-70.4	Sr	<50	2	4	1.14	--	30
7	70.4-71.0	Sr	<50	2	6	1.04*	--	25
8	71.0-71.6	Sm	>50	<2	26	0.31	--	15
9	71.6-72.2	Sm	>50	<2	320	0.79	--	15
10	72.8-73.5	Sm	>50	<2	60	1.55*	--	15
GP-7-11	73.5-74.1	Sm	>50	<2	80	0.46	--	10
12	74.1-74.7	Sm	>50	<2	150	1.20	--	35
13	74.7-75.3	Sm	>50	2	44	1.20*	--	35
14	75.3-75.6	Sm	>50	2	110	1.82	--	50
15	75.6-76.2	Sm	>50	2	240	0.56	-46.0	10
GP-7-16	76.8-77.4	Sm	>50	<2	65	0.85*	--	30
17	77.4-78.0	Sm	>50	2	65	1.69	--	30
18	78.0-78.6	Sm	>50	<2	120	0.24	--	30
19	78.6-79.2	Sm	>50	<2	46	1.09*	-39.2	40
20	79.2-79.9	Sr	<50	<2	32	0.16	--	25
GP-7-21	79.9-80.5	Sr	<50	<2	42	0.20	--	30
22	80.5-81.2	Sr	<50	2	18	1.31*	--	20
23	81.2-81.4	Mr	<50	<2	6	0.15	--	40

Table 1-8.--Analyses of samples from Core 8, Lamprecht deposit, south Texas

[--, not determined; S, sandstone; M, mudstone; r, reduced barren; m, mineralized; *, sulfur contents determined by induction furnace techniques; **, percent pyrite of the iron disulfide mineral population]

Sample Description			U	Se	Mo	S	$\delta^{34}S$	Pyrite**
Number	Depth (m)	Lithology and Geochemical zone	ppm			%	per mil	
GP-8-1	67.1-68.0	Sr	<50	<2	2	0.05	--	40
2	68.0-68.1	Sr	<50	<2	2	0.07	--	--
3	68.1-68.9	Mr	<50	<2	2	0.60	--	55
4	68.9-69.8	Mr	<50	<2	4	0.43	--	85
5	69.8-70.2	Mr	<50	<2	4	0.44	--	70
GP-8-6	70.2-70.7	Sr	<50	2	4	0.93*	-24.4	75
7	70.7-71.6	Sr	<50	2	4	1.07	--	45
8	71.6-71.9	Sr	<50	2	8	1.13	--	15
9	71.9-73.5	Sr	<50	<2	18	1.15	-38.2	5
10	73.0-73.3	Sm	>50	<2	50	0.51		5
GP-8-11	73.3-73.8	Sm	>50	2	100	1.38*	-38.1	30
12	73.8-75.0	Sm	>50	<2	180	0.95	--	30
13	75.0-75.7	Sm	>50	2	70	0.54	--	30
14	75.7-76.4	Sm	>50	2	50	1.39	--	20
15	76.4-77.1	Sm	>50	<2	50	0.83*	-43.6	45
GP-8-16	77.1-77.3	Sm	>50	2	70	0.51	-45.5	30
17	77.3-78.0	Sm	>50	<2	60	0.42	-44.8	30
18	78.0-78.6	Sm	>50	<2	100	0.73	-46.3	15
19	78.6-79.1	Sm	>50	<2	100	0.65	-40.2	20
20	79.1-79.7	Sr	<50	2	80	0.95*		30
GP-8-21	79.7-80.3	Sm	>50	<2	40	0.30	--	20
22	80.3-80.9	Sr	<50	2	44	0.28	--	25
23	80.9-81.4	Sr	<50	<2	36	0.58	--	20
24	81.4-81.8	Sr	<50	<2	26	1.44	--	35
25	81.8-81.9	Sr	<50	<2	40	1.22	-42.2	45
GP-8-26	81.9-82.6	Mr	<50	<2	4	0.07	--	10

Table 1-9.--Analyses of samples from Core 9, Lamprecht deposit, south Texas
[--, not determined; S, sandstone; M, mudstone; r, reduced barren; m, mineralized; *, sulfur contents determined by induction furnace techniques; **, percent pyrite of the iron disulfide mineral population]

Sample Description			U	Se	Mo	S	$\delta^{34}S$	Pyrite**
Number	Depth (m)	Lithology and Geochemical zone	ppm			%	per mil	
GP-9-1	38.6-39.3	Sr	<50	<2	2	1.04*	--	70
2	39.3-40.2	Sr	<50	<2	<2	0.41	--	90
3	57.0-57.9	Sr	<50	<2	6	0.70	--	25
4	57.9-58.5	Sr	<50	<2	6	0.75	--	25
5	68.3-69.2	Sr	<50	<2	<2	0.31	--	25
GP-9-6	69.2-70.1	Sr	<50	2	2	0.14	-25.2	20
7	70.1-70.9	Sr	<50	<2	2	0.64*		20
8	70.9-71.3	Mr	<50	2	2	1.27	--	75
9	71.3-71.9	Mr	<50	<2	4	0.48	--	80
10	71.9-72.8	Sr	<50	<2	4	0.82	--	40
GP-9-11	72.8-73.8	Sr	<50	2	2	1.48	--	25
12	73.8-74.4	Sr	<50	<2	6	1.20	--	15
13	74.4-75.3	Sr	<50	<2	8	0.95	--	15
14	75.3-75.9	Sr	<50	2	6	1.31	--	20
15	75.9-76.8	Sr	<50	<2	18	0.89	-0.6	60
GP-9-16	76.8-77.4	Sm	>50	<2	70	1.86*	-14.1	45
17	77.4-78.3	Sr	<50	2	22	0.57	--	25
18	78.3-78.9	Sr	<50	5	30	0.42	--	25
19	78.9-79.9	Sr	<50	2	42	1.69	--	18
20	79.9-80.5	Sr	<50	<2	34	1.60*	--	18
GP-9-21	80.5-80.9	Sr	<50	<2	50	0.24	--	30
22	80.9-81.4	Sr	<50	<2	110	0.14	--	50
23	81.4-82.0	Sr	<50	<2	20	0.28	--	20
24	82.0-82.9	Sr	<50	<2	10	0.39	--	25
25	82.9-83.5	Sr	<50	<2	10	1.10*	-49.4	70
GP-9-26	83.5-84.1	Sr	<50	<2	100	0.52	--	25
27	84.1-84.4	Sr	<50	2	22	0.52	--	40
28	84.4-85.0	Mr	<50	<2	14	0.17	--	40

Table 1-10.--Analyses of samples from Core 10, Lamprecht deposit, south Texas

[--, not determined; S, sandstone; M, mudstone; C, calcareous mudstone; r, reduced barren; *, sulfur contents determined by induction furnace techniques; **, percent pyrite of the iron disulfide mineral population]

Sample Description			U	Se	Mo	S	$\delta^{34}S$	Pyrite**
Number	Depth (m)	Lithology and Geochemical zone	ppm			%	per mil	
GP-10-1	75.3-75.4	Cr	<50	<2	6	0.47	--	15
2	75.7-76.0	Cr	<50	<2	2	0.43	--	40
3	76.2-77.0	Sr	<50	<2	4	0.08	--	45
4	77.1-77.7	Mr	<50	<2	6	0.56	--	50
5	77.7-78.3	Mr	<50	<2	2	0.96	-27.1	85
GP-10-6	78.3-78.9	Mr	<50	<2	2	0.42	--	80
7	78.9-79.6	Sr	<50	<2	2	0.28	--	70
8	79.6-80.2	Sr	<50	<2	2	0.55	--	35
9	80.2-80.8	Sr	<50	<2	2	0.64	--	25
10	80.8-81.4	Sr	<50	<2	2	1.07*	-24.1	20
GP-10-11	81.4-82.0	Sr	<50	<2	4	1.13	--	10
12	82.0-82.9	Sr	<50	<2	2	1.05	--	5
13	82.9-83.4	Sr	<50	<2	4	1.20*	-25.5	15
14	83.4-83.7	Cr	<50	<2	4	0.85	--	5
15	83.8-84.4	Sr	<50	<2	8	0.16	--	15
GP-10-16	84.4-85.0	Sr	<50	<2	6	0.13	--	15
17	85.0-85.6	Sr	<50	<2	14	0.55	--	10
18	85.6-86.3	Sr	<50	<2	30	1.46*	-32.2	15
19	86.3-86.7	Sr	<50	8	16	0.72	--	5
20	87.5-88.1	Sr	<50	2	24	0.35	--	10
GP-10-21	88.7-89.6	Sr	<50	10	36	1.51*	-44.2	30
22	90.5-90.9	Sr	<50	<2	8	1.08*	-41.7	40
23	90.9-91.1	Mr	<50	<2	16	0.16	--	50

Table 2.--Major element analyses from select samples, Lamprecht deposit, south Texas

[*, total iron; P_2O_5 content of all samples is less than one percent]

Sample Number	Al_2O_3	SiO_2	CaO	TiO_2	Fe*	K_2O
	%					
GP-1-21	13	57	3.2	0.50	4.2	2.4
2-2	4.9	74	5.3	0.20	1.5	1.5
2-4	13	57	3.8	0.5	5.4	2.3
2-5	15	59	2.8	0.6	3.9	2.4
3-13	6.6	57	8.6	0.4	1.9	1.6
GP-3-18	6.0	72	6.1	0.3	1.2	1.7
3-26	5.8	76	4.4	0.2	1.6	1.8
3-29	13	62	1.0	0.6	4.8	2.4
4-5	17	58	2.8	0.6	4.8	2.1
4-10	6	65	7.4	0.3	1.3	1.6
GP-4-13	6	67	7.8	0.3	1.5	1.6
4-15	5.9	72	8.8	0.2	0.7	1.6
4-17	5.0	72	3.8	0.1	1.3	1.6
4-21	5.1	71	4.9	0.2	1.4	1.7
4-23	5.1	75	3.2	0.2	0.8	1.7
GP-4-27	12	60	1.9	0.6	3.2	2.2
5-4	6.6	59	9.5	0.4	2.0	1.6
5-8	5.8	70	6.8	0.3	1.7	1.5
5-15	5.8	74	4.7	0.2	1.6	1.7
5-22	5.3	66	7.5	0.2	2.2	1.5
GP-9-6	5.2	62	9.0	0.2	0.7	1.6
9-7	5.9	70	8.5	0.2	1.0	1.7
9-25	5.5	72	4.6	0.2	1.1	1.8
10-13	4.9	64	9.8	0.3	1.7	1.4
10-21	5.4	71	4.8	0.2	1.6	1.5
GP-10-22	5.1	69	7.8	0.2	1.3	1.5

Table 3.--Comparison of visual and X-ray diffraction estimates of relative marcasite abundance

Deposit sample number	% Marcasite of total FeS_2	
	X-ray Diffraction[1/ 2/] Data	Visual Estimate[3/]
Felder		
F4B-1-5B	37 (7)	40
F4B-1-9A	66 (4)	60
F4B-1-10A	22 (4)	40
F4B-V-1H	4 (4)	5
Lamprecht		
GP-6-9	82 (7)	70
GP-6-10, 11	64 (5)	60
GP-10-11	93 (5)	90

[1/] Based on the marcasite peak at 51.9°2θ, and pyrite peak at 56.3°2θ (Cu Kα radiation). Raw data were corrected via a calibration plot prepared from known mixtures of pure pyrite and marcasite.

[2/] Numbers in parentheses are the number of X-ray traces run on a single mount that were averaged.

[3/] Average of three independent observers.

Table 4.--Analyses of organic carbon contents [1/] of select samples from the Lamprecht deposit, south Texas
[*amounts given as weight percentages]

Sample Number	Organic Carbon Content*
GP-1-21	.02
GP-2-2	.01
GP-2-4	.01
GP-2-5	<.01
GP-3-13	<.01
GP-3-18	<.01
GP-3-26	<.01
GP-3-29	<.01
GP-4-5	<.01
GP-4-13	<.01
GP-4-10	<.01
GP-4-15	<.01
GP-4-17	<.01
GP-4-21	<.01
GP-4-23	<.01
GP-4-27	<.01
GP-5-4	<.01
GP-5-8	<.01
GP-5-15	<.01
GP-5-22	<.01
GP-9-6	<.01
GP-9-7	<.01
GP-9-25	<.01
GP-10-13	<.01
GP-10-21	<.01
GP-10-22	<.01

1/Carbonate carbon removed by acid leach prior to analyses.

Table 5.--Analyses of samples from the Felder deposit, south Texas

[--, not determined; S, sandstone; M, mudstone; r, reduced barren; m, mineralized; a, altered tongue; **, percent pyrite of the iron disulfide mineral population; ***, organic carbon contents]

Sample Number	Lithology and Geochemical Zone	U ppm	C*** %	S %	$\delta^{34}S$ per mil	Pyrite**
F4B-1-1A	Mr	56	0.03	0.64	-28.8	40
1-1B	Mr	580	0.04	1.82	--	30
1-2	Ma	28	0.07	0.28	--	70
1-3A	Ma	50	0.05	0.38	+4.2	55
1-4	Sr	176	0.04	0.66	--	55
F4B-1-5A	Sa	7	0.01	0.22	--	70
1-5B	Sa	9	0.00	0.38	+1.5	60
1-5C	Ma	16	--	--	--	--
1-6A	Ma	10	0.02	0.14	--	60
1-6B	Sa	9	0.01	0.28	--	60
F4B-1-7A	Ma	5	0.02	0.16	+10.5	70
1-7B	Sa	10	0.00	0.16	+1.5	60
1-8	Sa	2	0.03	0.22	--	80
1-9A	Sa	7	0.02	0.22	-5.2	30
1-9B	Sa	9	0.01	0.26	--	70
F4B-1-9C	Sa	4	0.01	0.54	--	80
1-10A	Sa	2	0.04	0.20	+20.6	60
1-10C	Ma	8	0.01	0.28	--	60
1-10D	Ma	4	0.06	0.10	--	85
1-11	Sa	2	0.03	0.20	+12.2	80
F4B-2-1A	Mr	93	--	--	--	--
2-1B	Sa	42	0.04	0.30	--	55
2-2A	Mr	136	--	--	--	50
2-2B	Sr	37	0.00	0.38	--	60
2-2C	Sa	39	0.07	0.16	-5.2	50
F4B-2-3A	Sm	1410	0.01	2.26	--	15
2-3B	Sm	1830	0.11	0.44	--	50
2-3C	Sm	1550	0.00	1.12	--	20
2-3D	Mm	1620	--	--	--	30
2-4A	Sm	1320	0.06	1.07	-36.9	40
F4B-2-4B	Sr	467	0.00	0.40	--	25
2-4C	Mr	42	0.08	1.12	--	35
2-5A	Mm	1580	0.03	9.02	-44.2	10
2-5B	Sm	1120	0.06	1.16	--	15
2-5C	Mr	469	0.00	1.43	--	25

Table 5.--Analyses of samples from Felder deposit, south Texas--continued

Sample Number	Lithology and Geochemical Zone	U ppm	C*** %	S %	$\delta^{34}S$ per mil	Pyrite**
F4B-2-6A	Sr	322	0.03	1.66	-47.4	15
2-6B	Sr	297	0.02	2.40	--	10
2-6C	Sm	1880	0.03	5.42	-37.1	30
2-6D	Sr	152	0.01	0.74	--	35
2-7B	Sr	79	0.02	0.44	-34.7	20
F4B-2-7C	Mr	113	0.00	1.34	--	30
2-8A	Sr	536	0.02	0.82	-36.4	30
2-8B	Sr	315	0.05	1.01	-34.4	20
2-8C	Sm	2180	0.04	8.94	--	30
2-9A	Sr	80	0.01	1.38	-36.6	10
F4B-2-9B	Sr	86	0.04	1.30	--	35
2-9C	Mm	2020	--	--	--	30
F4B-V-1A	Sr	468	0.02	3.06	-36.6	15
V-1B	Sm	1300	0.01	--	-45.6	25
V-1C	Sm	1240	0.03	1.19	-30.7	20
F4B-V-1D	Sr	573	--	--	+13.2	35
V-1E	Sr	134	0.05	0.70	--	80
V-1F	Ma	32	--	--	--	--
V-1G	Ma	4	--	--	--	--
V-1H	Sa	7	0.02	0.22	+1.9	90
F4B-V-1I	Sa	6	0.02	0.24	--	65
V-2A	Sr	115	0.03	1.39	--	15
V-2B	Sr	100	0.02	1.46	--	25
V-2C	Sr	153	0.03	0.62	-33.9	30
V-2D	Sr	755	0.01	0.94	--	20
F4B-V-3A	Sr	93	0.02	1.96	--	25
V-3B	Sr	75	0.07	1.78	-35.5	20
V-4A	Sr	74	0.00	1.65	--	20
V-4B	Sr	56	0.05	1.36	-45.0	20

Table 6.--Semiquantitative 6-step spectrographic analyses of samples from the Felder deposit, south Texas

Sample number	F4B-1-1A	1-1B	1-2	1-3A	1-4	1-5A	1-5B	1-5C	1-6A
%									
Al	3	7	5	5	5	5	7	G	5
Na	1	1	1	1.5	1.5	1	1.5	1.5	1.5
K	2	3	2	3	2	2	3	3	2
Fe	1	7	1	1.5	2	1	5	7	1
Mg	0.1	0.5	0.15	0.15	0.2	0.1	0.2	1	0.1
Ca	10	2	5	G	7	5	7	2	10
Ti	0.15	0.3	0.2	0.15	0.15	1.5	0.2	0.5	0.15
ppm									
B	L	20	20	L	20	L	20	50	L
Ba	500	1500	700	500	1000	700	1500	500	500
Be	N	1.5	N	N	N	N	N	1.5	N
Co	L	20	5	5	5	N	5	15	N
Cr	15	50	15	15	20	10	30	100	15
Cu	5	15	7	7	7	3	10	15	3
Ga	7	15	10	10	10	10	15	30	10
La	N	L	N	N	N	N	L	L	N
Mn	300	150	150	200	150	100	200	100	200
Mo	7	20	N	N	7	N	L	L	N
Nb	L	L	L	L	L	L	L	10	L
Ni	5	20	5	7	7	L	7	30	L
Pb	10	20	15	15	15	20	15	15	15
Sc	L	7	L	5	5	L	7	15	5
Sr	100	200	200	100	100	200	150	300	100
V	30	100	30	50	50	30	70	200	30
Y	15	30	20	20	20	15	20	30	15
Yb	1.5	3	2	2	2	2	3	3	1.5
Zr	70	200	150	100	100	100	200	300	200

Table 6.--Semiquantitative 6-step spectrographic analyses of samples from the Felder deposit, south Texas--continued

Sample number	F48-1-6B	1-7A	1-7B	1-8	1-9A	1-9B	1-9C	1-10A	1-10C
%									
AT	5	5	5	5	5	3	7	5	5
Na	1	1.5	1.5	1	1	1	2	1	1
K	2	3	2	2	2	2	3	2	2
Fe	1	1	1.5	1	1	1	2	1	1
Mg	0.1	0.1	0.15	0.15	0.1	0.1	0.2	0.1	0.1
Ca	7	5	10	7	7	G	G	10	3
Ti	0.15	0.1	0.3	0.15	0.2	0.15	0.3	0.15	0.2
ppm									
B	L	20	20	20	20	L	30	L	L
Ba	700	1000	700	700	700	500	1000	700	1000
Be	N	N	N	N	N	N	N	N	N
Co	L	L	L	L	L	L	5	L	L
Cr	15	10	150	15	150	20	50	15	15
Cu	3	5	5	3	7	3	7	5	5
Ga	7	10	10	10	7	7	15	10	10
La	N	L	N	N	N	L	L	N	L
Mn	200	100	300	150	300	300	300	300	150
Mo	N	N	N	N	N	N	N	N	N
Nb	L	L	L	L	L	L	L	L	L
Ni	5	L	L	L	L	L	5	L	L
Pb	10	15	15	15	15	15	15	15	15
Sc	5	L	5	L	L	7	10	L	5
Sr	100	300	100	100	100	150	200	100	200
V	30	30	70	30	50	50	70	30	30
Y	15	15	15	15	10	20	20	20	15
Yb	1.5	2	2	2	2	2	3	2	1.5
Zr	100	100	300	100	150	500	200	100	100

Table 6.--Semiquantitative 6-step spectrographic analyses of samples from the Felder deposit, south Texas--continued

Sample number	F4B-1-10D	1-11	2-1A	2-1B	2-2A	2-2B	2-2C	2-3A	2-3B
%									
Al	7	5	G	5	G	5	5	3	7
Na	2	1	0.7	1.5	1	1	2	0.7	1
K	3	2	3	3	3	2	3	1.5	3
Fe	3	1.5	7	1	10	1	1.5	2	2
Mg	0.3	0.15	1	0.1	1	0.1	0.15	0.007	0.3
Ca	5	7	2	7	2	5	G	5	2
Ti	0.3	0.2	0.3	0.1	0.3	0.2	0.2	0.1	0.2
ppm									
B	30	20	50	L	50	L	L	L	20
Ba	1000	1000	500	700	300	700	700	700	1000
Be	N	N	1.5	N	1.5	N	N	N	N
Co	5	L	30	L	20	L	N	7	10
Cr	100	20	150	10	100	10	30	5	50
Cu	10	5	20	5	20	3	7	7	10
Ga	15	10	30	10	30	7	10	5	10
La	L	L	L	N	L	N	N	N	N
Mn	150	200	70	150	70	150	300	100	70
Mo	L	N	N	N	N	N	N	5	L
Nb	L	L	L	L	L	L	L	L	L
Ni	7	5	30	5	20	5	5	7	10
Pb	15	15	30	15	20	15	10	10	15
Sc	10	7	15	L	15	L	5	N	7
Sr	500	100	300	100	300	200	150	200	500
V	70	50	200	30	200	20	70	30	70
Y	30	30	30	15	30	20	20	15	20
Yb	3	2	3	1.5	3	2	2	1.5	2
Zr	300	150	200	70	150	70	100	70	200

Table 6.--Semiquantitative 6-step spectrographic analyses of samples from the Felder deposit, south Texas--continued

Sample number	F4B-2-3C	2-3D	2-4A	2-4B	2-4C	2-5A	2-5B	2-5C	2-6A
%									
Al	3	10	5	2	3	2	2	3	2
Na	1	0.7	0.7	0.7	1	0.7	0.7	0.7	0.7
K	1.5	3	1.5	1.5	2	1.5	1.5	1.5	1.5
Fe	2	5	2	0.7	0.7	7	1.5	2	2
Mg	0.15	0.7	0.15	0.07	0.15	0.07	0.07	0.1	0.07
Ca	G	1	3	7	G	3	5	5	7
Ti	0.2	0.2	0.15	0.1	0.15	0.1	0.15	0.2	0.15
ppm									
B	L	30	L	N	N	N	N	20	L
Ba	500	200	700	500	300	500	500	500	500
Be	N	N	N	N	N	N	N	N	N
Co	10	15	10	5	L	20	7	7	7
Cr	20	70	10	7	15	10	7	15	5
Cu	15	15	15	5	7	20	10	15	10
Ga	5	20	5	L	5	5	L	5	L
La	N	N	N	N	N	N	N	N	N
Mn	500	70	100	150	300	150	100	150	150
Mo	3	3	3	L	L	100	50	30	5
Nb	N	L	L	N	N	N	L	L	N
Ni	20	30	7	5	7	20	5	7	7
Pb	20	15	15	N	N	20	10	10	10
Sc	5	10	L	N	5	L	L	5	N
Sr	150	200	200	70	150	150	150	200	70
V	50	100	30	30	30	50	30	50	20
Y	20	20	15	10	20	20	10	15	10
Yb	2	2	2	1	1.5	2	1.5	2	1.5
Zr	150	100	100	70	70	100	100	200	100

Table 6.--Semiquantitative 6-step spectrographic analyses of samples from the Felder deposit, south Texas--continued

Sample number	F4B-2-6B	2-6C	2-6D	2-7B	2-7C	2-8A	2-8B	2-8C	2-9A
%									
Al	2	3	2	2	3	2	2	2	2
Na	0.7	0.7	0.7	1	0.7	0.7	0.7	0.7	0.7
K	1.5	2	2	2	1.5	2	2	2	2
Fe	5	3	1	0.7	1.5	1	1.5	7	2
Mg	0.07	0.1	0.07	0.07	0.1	0.07	0.1	0.15	0.1
Ca	7	5	7	G	5	5	7	3	3
Ti	0.1	0.15	0.1	0.1	0.15	0.15	0.1	2	0.15
ppm									
B	N	L	N	N	L	N	L	L	L
Ba	500	700	500	300	500	500	500	500	500
Be	N	N	N	N	N	N	N	N	N
Co	7	20	5	5	7	5	7	30	10
Cr	10	10	7	7	10	7	7	150	10
Cu	7	15	5	7	7	15	10	20	70
Ga	5	L	5	5	5	5	5	10	5
La	N	N	N	N	N	N	N	50	N
Mn	200	100	150	300	150	100	200	1500	150
Mo	20	1000	30	20	200	50	500	70	50
Nb	L	L	L	N	L	N	N	20	L
Ni	15	20	7	10	10	5	7	20	7
Pb	10	15	N	N	10	10	10	30	15
Sc	N	L	L	L	L	L	L	10	L
Sr	70	200	70	100	200	150	100	200	200
V	20	50	20	30	30	30	30	300	50
Y	10	10	10	10	15	15	15	30	10
Yb	1.5	1.5	1	1.5	2	1.5	1.5	5	1
Zr	70	150	70	70	150	70	100	1500	70

Table 6.--Semiquantitative 6-step spectrographic analyses of samples from the Felder deposit, south Texas--continued

Sample number	F4B-2-9B	2-9C	V-1A	V-1B	V-1C	V-1D	V-1E	V-1F	V-1G
%									
Al	3	7	5	5	5	5	7	G	G
Na	0.7	0.7	1	1	1	1	1.5	0.7	0.7
K	2	3	2	2	2	2	2	3	3
Fe	2	5	3	5	3	1.5	1.5	10	10
Mg	0.1	1	0.1	0.15	0.15	0.15	0.15	1.5	1
Ca	3	1	7	7	10	10	0.7	1.5	1.5
Ti	0.15	0.3	0.15	0.2	0.15	0.15	0.2	0.5	0.5
ppm									
B	L	50	20	20	20	20	20	50	30
Ba	500	300	1000	1000	1000	1000	1000	500	300
Be	N	1.5	N	N	N	N	N	1.5	1.5
Co	20	20	7	10	10	10	7	20	10
Cr	10	70	30	15	30	30	20	100	100
Cu	7	20	7	7	7	10	10	20	20
Ga	5	20	10	10	10	10	10	30	30
La	N	N	N	N	L	L	N	L	N
Mn	150	100	150	150	200	100	70	100	100
Mg	300	100	50	30	7	20	20	5	N
Nb	L	L	L	L	L	L	L	L	L
Ni	20	50	10	10	10	10	7	50	30
Pb	10	20	15	15	20	30	15	15	15
Sc	L	10	5	5	7	5	L	20	15
Sr	200	200	100	100	150	100	100	200	200
V	30	150	70	50	70	70	50	200	150
Y	15	30	15	15	20	15	20	20	20
Yb	1.5	3	2	2	2	2	2	3	3
Zr	100	100	200	70	200	100	150	150	100

Table 6.--Semiquantitative 6-step spectrographic analyses of samples from the Felder deposit, south Texas--continued

Sample number	F4B-V-1H	V-1I	V-2A	V-2B	V-2C	V-2D	V-3A	V-3B	V-4A
%									
Al	10	5	3	3	2	3	3	3	2
Na	3	1	1	0.7	1	1	0.7	0.7	1
K	3	2	2	2	2	2	1.5	2	2
Fe	3	1	2	1.5	1	1.5	2	2	2
Mg	0.3	0.1	0.01	0.01	0.007	0.01	0.07	0.1	0.1
Ca	10	7	5	5	10	7	7	7	5
Ti	0.3	0.1	0.15	0.15	0.15	0.15	0.1	0.15	0.15
ppm									
B	20	L	L	L	N	L	L	L	20
Ba	1000	1000	700	700	500	700	500	500	500
Be	N	N	N	N	N	N	N	N	N
Co	5	L	10	5	5	7	5	7	7
Cr	70	10	15	15	7	7	7	7	7
Cu	10	7	50	15	7	15	7	10	10
Ga	20	7	7	5	5	5	5	5	5
La	L	N	N	N	N	N	N	N	N
Mn	150	150	150	150	300	200	100	100	100
Mo	L	N	70	10	7	7	150	50	300
Nb	L	L	L	L	L	L	L	L	L
Ni	7	L	10	5	7	7	7	10	10
Pb	15	15	15	10	10	15	10	10	10
Sc	10	L	5	L	N	L	L	L	L
Sr	100	200	200	200	70	100	70	100	200
V	70	70	50	30	30	70	30	30	30
Y	20	15	30	15	10	15	15	15	15
Yb	3	1.5	3	2	1	1.5	1.5	1.5	1.5
Zr	150	70	100	100	100	150	70	100	70

Table 6.--Semiquantitative 6-step spectrographic analyses of samples from the Felder deposit, south Texas--continued

Sample number	F4B-V-4B
%	
Al	3
Na	0.7
K	2
Fe	1.5
Mg	0.1
Ca	7
Ti	0.15
ppm	
B	N
Ba	500
Be	N
Co	7
Cr	10
Cu	7
Ga	5
La	N
Mn	150
Mo	100
Nb	L
Ni	10
Pb	10
Sc	L
Sr	100
V	30
Y	10
Yb	1
Zr	100

Table 7.--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]

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Element	%	Element	ppm	Element	ppm
Si	0.002	Cr	1	Rh	2
Al	0.001	Cu	1	Ru	10
Fe	0.001	Dy	50	Sb	150
Mg	0.002	Er	50	Sc	5
Ca	0.002	Eu	100	Sn	10
Na	0.05	Ga	5	Sr	5
K	0.7	Gd	50	Sm	100
Ti	0.0002	Ge	10	Ta	200
P	0.2	Hf	100	Tb	300
		Ho	20	Te	2000
	ppm	In	10	Th	200
		Ir	50	Tl	50
Mn	1	La	30	Tm	20
		Li	50	U	500
Ag	0.5	Lu	30	V	7
As	1000				
Au	20	Mo	3	W	100
B	20	Nb	10	Y	10
Ba	1.5	Nd	70	Yb	1
		Ni	5	Zn	200
Be	1	Os	50	Zr	10
Bi	10				
Cd	20	Pb	10		
Ce	150	Pd	1		
Co	3	Pr	100		
		Pt	30		
		Re	30		