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ANALYSES OF SOME UPPER PALEOZOIC BLACK SHALES AND ASSOCIATED ROCKS

by James D. Vine, 1921-

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ANALYSES OF SOME UPPER PALEOZOIC BLACK SHALES AND ASSOCIATED ROCKS

by James D. Vine

This report contains the tabulated spectrographic and chemical analyses of 155 samples of black shale and some associated strata. These samples comprise four sample sets representing four geologic formations, and include several rock types and environments of deposition. Each sample set includes emission spectrographic analyses for various major and minor elements and chemical analyses for organic or total carbon. Some sets also include chemical analyses for mineral carbon, P_2O_5, uranium, lithium, Na_2O, K_2O, CaO, MgO, sulfur, chlorine, selenium, and radiometric analyses for equivalent uranium (eU).

This is the second of a series of open-file reports intended to make available the analytical data resulting from a study of the distribution of minor elements in black shale. The first of these reports (Vine, 1965) included analyses of sample sets 1-4. This report includes the analyses of sample sets 5-8. The first open-file report was followed by a U.S. Geological Survey bulletin chapter that includes a summary and interpretation of the analytical data (Vine, 1966). A similar summary and interpretation chapter is in preparation for sample sets 5-8.

Sample sets 5-8 comprise the following samples:

Set 5.--Pennsylvanian black shale from outcropping strata in southeastern Kansas and northeastern Oklahoma; 40 samples.

Set 6.--Meade Peak Phosphatic Shale Member of the Phosphoria Formation; black siltstone, phosphorite, and carbonate rock from a mine adit in Sublette Ridge in western Wyoming; 43 samples.

Set 7.--Chattanooga Shale; dark-gray to black silty shale from 5 core holes in south-central Tennessee and northern Alabama; 51 samples.

Set 8.--Paradox Member of the Hermosa Formation; dark-gray to black shale from the "saline facies" of the Paradox Basin, Grand County, Utah; 21 core samples.

Set 5 consists of 40 samples of black shale from 13 individual beds in the lower part of the outcropping Pennsylvanian strata of the Western Interior coal province. In physical appearance, most beds are dark-gray to black fissile shale containing scattered fish scales, conodonts, and brachiopods. Many, including the Excello Formation of Searight and others (1953), are characterized by phosphate nodules 1-2 cm across. The black shale beds are commonly 1-3 feet thick, and form the interval between a coal bed below and a limestone above. There are exceptions, however, for the black shale in the Pleasanton Group was as much as 15 feet thick in the

area sampled, and the Eudora Shale Member (Condra, 1930) lies between two limestone beds in the Stanton Limestone. The stratigraphic sequence and number of samples collected from each black shale unit is shown in the following chart for set 5. The stratigraphic names shown from areas in southeastern Kansas and northeastern Oklahoma are only those from which samples were collected and do not include the formation and member names of intervening members or formations of limestone, coal, and shale that were not sampled.

System	Provincial series	Group	Formation		Member	No. of samples
PENNSYLVANIAN	Missouri	Lansing	Stanton Limestone		Eudora Shale	2
		Kansas City	Iola Limestone		Muncie Creek Shale	2
		Pleasanton				3
		Marmaton	Pawnee Limestone		Mine Creek Shale	1
					Anna Shale	2
			Fort Scott Limestone		Little Osage Shale of Jewett (1941)	3
	Des Moines	Cherokee	Cabaniss	Excello of Searight and others (1953)		14
					Verdigris Limestone	3
				Croweburg of Abernathy (1937)		1
				Scammon of Abernathy (1937)	Tiawah Limestone of Searight and others (1953)	3
				Tebo of McQueen (1943)		3
			Krebs		Bluejacket Sandstone	1
			McAlester Shale		Warner Sandstone	2

Set 6 includes samples from the entire sequence of black siltstone, phosphorite, dolomite, and limestone from the Meade Peak Phosphatic Shale Member of the Phosphoria Formation of Permian age exposed in a mine opening at Raymond Canyon in Sublette Ridge, Lincoln County, Wyo. The strata in this part of the Western Wyoming fold belt are essentially vertical, strike approximately north and dip east. The main adit is timbered and extends along the strike of the beds. Open crosscuts perpendicular to the strike of the beds provide easy access to nearly the full thickness of the Meade Peak. Because all the samples were collected underground, they are unweathered and show no evidence of the fissility that is characteristic of many of the silty beds in outcrop. The samples were collected from individual beds 0.4-8.5 feet thick and were intended to represent the various lithologies present. The various lithologies in the Meade Peak grade into each other in all proportions, so that in thin section, many samples contain recognizable amounts of carbonaceous matter, silt grains, phosphate oolites, and carbonate minerals. Relatively pure siltstone, dolomite, and phosphorite are less common than the mixed lithologies. Several samples examined by the X-ray diffraction technique of mineral identification showed major amounts of quartz, dolomite, and carbonate-fluorapatite plus minor amounts of calcite, mica, feldspar, and very small amounts of clay minerals. The stratigraphic sequence, petrology, mineralogy, and chemistry of the Meade Peak Phosphatic Shale Member at Coal Canyon, Wyoming (near Raymond Canyon), were described by Gulbrandsen (1960).

Set 7 consists of the complete section of Chattanooga Shale of Late Devonian age penetrated in 5 core holes located in the Interior low plateau of central Tennessee and northern Alabama. These 5 cores were selected from about 75 that were drilled by the U.S. Geological Survey and Bureau of Mines on behalf of the U.S. Atomic Energy Commission. The selection was made on the basis of availability and wide geographic distribution of representative localities. The standard section of the Chattanooga Shale as exposed in a roadcut near Sligo Bridge, 7 miles east of Smithville, DeKalb County, Tenn., was described by Conant and Swanson (1961, p. 24) as consisting of 5 major units; 3 of these--the upper, middle, and lower units--consist chiefly of black silty shale. The other two units each contain some gray, as well as black, laminae, and separate the upper from the middle unit and the middle from the lower unit. This standard section is divided into two members--the Dowelltown Member consisting of the two lower units, and the Gassaway Member consisting of the three upper units. The 5 cores were sampled and geologic units identified by various members of the Chattanooga Shale project from 1948 to 1953, including L. C. Conant, T. M. Kehn, Andrew Brown, and Lynn Glover. In only one core, C-12, were all five units of the Dowelltown and Gassaway Members identified by the samplers. This core, 33.36 feet thick, drilled near the standard section, was divided into 28 samples ranging from 0.44 to 2.58 feet in thickness. In two cores, only the Gassaway Member was recognized, whereas in the other two cores both members were recognized but individual units were not. The 23 samples from core holes C-53, C-47, C-60, and C-65 represent a total thickness of more than 69 feet, and the individual samples range from 0.80 to 5.36 feet thick.

Set 8 consists of 21 core samples of black shale from the "saline facies" of the Paradox Member of the Hermosa Formation of Pennsylvanian age, near the crest of the Cane Creek anticline about 7 miles southwest of Moab, Utah. The "saline facies," as defined by Hite (1960, 1961), consists of a sequence of at least 29 evaporite cycles (numbered from the top down). Each complete cycle includes black shale, limestone, dolomite, anhydrite, and halite. The beds of limestone and dolomite tend to thicken and merge at the expense of the anhydrite and halite toward the southwest; the halite is thickest in the central and northeastern parts of the basin. Beds of black shale commonly extend the entire width of the basin. Twelve of the black shale core samples in set 8 were collected from the interval between salt beds 3 and 4, and 9 of the core samples were collected from the interval between salt beds 4 and 5. Individual samples averaged about 0.1 foot thick.

X-ray diffraction analyses of several black shale samples indicate that the major minerals are quartz, calcite, dolomite, and mica. Minor amounts of anhydrite and halite are present in some samples. In thin section, carbonate and mica grains less than 0.05 mm across can be distinguished, but most of the quartz seems to be extremely fine grained. The samples have a nearly homogeneous texture, the faint indication of lamination resulting from horizontal lenses of pyrite, calcite, and carbonaceous matter. Some calcite lenses are flattened whole brachiopod shells with the interior cavity filled with pyrite and sphalerite.

Persons using and interpreting these analyses should bear in mind that the four sets 5-8 are not directly comparable in several significant respects. Some pertinent differences are summarized in the following table.

Set No.	No. samples	No. localities	Area or region	Sample description (generalized)	Degree of weathering	Age	Depositional environment
5	40	21	Western Interior coal province	0.2 to 2.0 ft coaly shale; outcrop	Slightly weathered	Pennsylvanian	Transgressive brackish or marine shelf
6	43	1	Western Wyoming fold belt	0.4 to 8.5 ft black siltstone, dolomite, and phosphorite; mine adit	Unweathered	Permian	Open-water marine shelf
7	51	5	Interior low plateau	0.44 to 5.36 ft black shale; core	do.	Devonian	Open-water marine shelf
8	21	1	Paradox basin	0.1 ft calcareous black shale; core	do.	Pennsylvanian	Restricted marine evaporite basin

The tabulated analyses for each set are reproduced directly from the machine print-out of the U.S. Geological Survey's geochemical data coding and retrieval cards in order to minimize the chances for error. Brief locality and sample descriptions are listed separately in the four accompanying tables.

The approximate lower limits of detection for elements determined by the six-step spectrographic method are as follows:

Si--- 0.002	K---- 0.7	Ba--- 0.0002	La--- 0.002	V---- 0.001
Al--- .001	Ti--- .0002	Be--- .0001	Mo--- .0005	Y---- .001
Fe--- .0008	P---- .2	Co--- .0005	Ni--- .0003	Zn--- .02
Mg--- .0005	Mn--- .0002	Cr--- .0001	Pb--- .001	Zr--- .001
Ca--- .005	Ag--- .0001	Cu--- .0001	Sc--- .0005	
Na--- .05	B---- .002	Ga--- .0002	Sr--- .0002	

Among the many people who contributed directly or indirectly to the collection and analysis of the samples and the processing of the data used in this report, I wish to thank Frank C. Foley, State Geologist of Kansas and the members of his staff for their suggestions and encouragement in collecting the samples from southeastern Kansas, and J. David Love, from the Laramie office of the U.S. Geological Survey, who was instrumental in helping me get the key and permission to enter the mine adit from which the Phosphoria samples were collected. James I. Reese assisted me in collecting the Phosphoria samples. Locality and sample descriptions of the Chattanooga Shale cores were taken from notes on the economic potential of the Chattanooga by the late Andrew Brown of the U.S. Geological Survey. Analyses of the Paradox Member samples were provided by Omer B. Raup and Robert J. Hite, of the U.S. Geological Survey, who are investigating the resources of potash and other possible mineral commodities in the Paradox basin.

Except for the uranium and equivalent uranium analyses of the Chattanooga Shale, which were made in the Washington laboratory of the U.S. Geological Survey, all other spectrographic and chemical analyses listed here were made in the Denver laboratory of the U.S. Geological Survey. Individual analysts are credited in the headnotes that accompany each set of analyses. The analytical data were transcribed to data-coding and retrieval cards by Mary S. Niles and Patricia Zimmerman. Ralph Eicher provided the data transformation and machine print-out.

References cited

Abernathy, G. E., 1937, Cyclical sedimentation of the Cherokee, in Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., southeastern Kansas, northeastern Oklahoma: p. 18-22.

Conant, L. C., and Swanson, V. E., 1961, Chattanooga shale and related rocks of central Tennessee and nearby areas: U.S. Geol. Survey Prof. Paper 357, 91 p.

Condra, G. E., 1930, Correlation of the Pennsylvanian beds in the Platte and Jones Point sections of Nebraska: Nebraska Geol. Survey 2d ser. Bull. 3, 57 p.

Gulbrandsen, R. A., 1960, Petrology of the Meade Peak phosphatic shale member of the Phosphoria formation at Coal Canyon, Wyoming: U.S. Geol. Survey Bull. 1111-C, p. 71-146. [1961].

Hite, R. J., 1960, Stratigraphy of the saline facies of the Paradox member of the Hermosa formation of southeastern Utah and southwestern Colorado, in Geology of the Paradox basin fold and fault belt: Four Corners Geol. Soc. Guidebook, 3d field conf., p. 86-89.

_____1961, Potash-bearing evaporite cycles in the salt anticlines of the Paradox basin, Colorado and Utah, in Short papers in the geologic and hydrologic sciences: U.S. Geol. Survey Prof. Paper 424-D, p. D135-D138.

Jewett, J. M., 1941, Classification of the Marmaton group, Pennsylvanian, in Kansas: Kansas State Geol. Survey Bull. 38, Pt. II, p. 285-344.

McQueen, H. S., 1943, Geology of the fire clay districts of east-central Missouri: Missouri Geol. Survey and Water Res., 2d ser., v. 28, 250 p.

Moore, R. C., 1932, A reclassification of the Pennsylvanian system in the northern Midcontinent region, p. 79-98, in Kansas Geol. Soc. Guidebook 6th Ann. Field Conf.: 125 p.

Rader, L. F., and Grimaldi, F. S., 1961, Chemical analyses for selected minor elements in Pierre Shale: U.S. Geol. Survey Prof. Paper 391-A, p. A1-A45.

Searight, W. V., Howe, W. B., Moore, R. C., Jewett, J. M., Condra, G. E., Oakes, M. C., and Branson, C. C., 1953, Classification of Desmoinesian (Pennsylvanian) of northern Midcontinent: Am. Assoc. Petroleum Geologists Bull., v. 37, p. 2747-2749.

Shapiro, Leonard, and Brannock, W. W., 1962, Rapid analysis of silicate, carbonate, and phosphate rocks: U.S. Geol. Survey Bull. 1144-A, p. A1-A56.

References cited--Continued

Smith, C. D., 1928, in Woodruff, E. G., and Cooper, C. L., Oil and gas in Oklahoma; Geology of Rogers County: Oklahoma Geol. Survey Bull. 40-U, 24 p.

Vine, J. D., 1965, Spectrographic analyses of Paleozoic black shale samples: U.S. Geol. Survey open-file report, 5 p.

_____ 1966, Element distribution in some shelf and eugeosynclinal black shales: U.S. Geol. Survey Bull. 1214-E (in press).

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LOCALITY AND SAMPLE DESCRIPTION OF 21 CORE SAMPLES OF BLACK SHALE FROM THE PARADOX MEMBER OF THE HERMOSA FORMATION, GRAND COUNTY, UTAH (SET 8)

Locality description: Drill core from a potash test well on the crest of the Cane Creek anticline, about 7 miles southwest of Moab, Utah.

Sample No.	Depth (ft)
Black shale below salt bed 3	
D114861	2390.3
62	2394.5
63	2397.5
64	2399.7
65	2401.4
66	2404.0
67	2406.1
68	2410.7
69	2416.5
70	2421.3
71	2427.5
72	2432.3
Black shale below salt bed 4	
73	2645.9
74	2647.2
75	2648.1
76	2648.8
77	2651.6
78	2658.6
79	2661.3
80	2663.1
81	2665.0

LOCALITY REGISTER AND SAMPLE DESCRIPTION OF 51 CORE SAMPLES OF BLACK SHALE FROM THE CHATTANOOGA SHALE IN TENNESSEE AND ALABAMA (SET 7)

ity descriptions:

hole C-12, Sligo Bridge quadrangle, DeKalb County, Tenn. Drill site about 2.0 miles south of west end of go Bridge. Depth to top of Chattanooga Shale, 187 feet.

hole C-53, Bellview quadrangle, Davidson County, Tenn. Drill site on west side of Buffalo Road, 1.6 miles th of its junction with U.S. Highway 70, northeast of junction with unimproved road leading to northeast. th to top of Chattanooga Shale, 51 feet.

hole C-47, Ketner Gap quadrangle, Marion County, Tenn. Drill site in east wall of Sequatchie Valley near nessee Route 27, about 1 mile south of Kelly Chapel, on jeep road leading southwest to the valley from rpin turn in highway. Depth to top of Chattanooga Shale, 294 feet.

hole C-60, Carthage quadrangle, Macon County, Tenn. Drill site on north side of Jennings Creek road about road miles east of road junction at Willimette. Depth to top of Chattanooga Shale, 59 feet.

hole C-65, Blount County, Ala. Drill site about 500 feet north of road intersection on dirt road 1.4 miles t-southeast of Alabama Route 38, at a point 2.3 miles northeast of Blountsville. Depth to top of ttanooga Shale, 23 feet.

ple No.	Description	Thickness (feet)
	Drill hole C-12 (sampled by L. C. Conant and T. M. Kehn)	
11237	Upper unit, Gassaway Member	1.00
38	do.	1.00
39	do.	1.00
40	do.	1.00
41	do.	1.00
42	do.	1.00
43	do.	.44
44	Middle unit, Gassaway Member	1.12
45	do.	1.12
46	Lower unit, Gassaway Member	1.00
47	do.	1.00
48	do.	1.00
49	do.	1.00
50	do.	1.00
51	do.	1.00
52	do.	1.00
53	do.	.97
54	Upper unit, Dowelltown Member	2.00
55	do.	2.00
56	do.	2.00
57	do.	2.00
58	do.	2.58
59	Lower unit, Dowelltown Member	1.00
60	do.	1.00
61	do.	1.00
62	do.	1.00
63	do.	1.00
64	do.	1.13
	Drill hole C-53 (sampled by T. M. Kehn and Julian Soren)	
W115862	Gassaway Member	4.00
63	do.	4.00
64	do.	5.36
	Drill hole C-47 (sampled by Lynn Glover)	
W115780	Gassaway Member	3.16
81	do.	3.17
82	do.	.80
83	do.	3.76
	Drill hole C-60 (sampled by T. M. Kehn and Andrew Brown)	
W155889	Gassaway Member	1.72
90	do.	2.23
91	do.	1.95
92	do.	2.30
93	do.	2.85
94	do.	2.92
95	Dowelltown Member	2.00
96	do.	1.67
	Drill hole C-65 (sampled by Lynn Glover)	
W120191	Gassaway Member	4.29
92	do.	2.71
93	do.	3.59
94	do.	3.84
95	do.	2.85
96	do.	2.84
97	Dowelltown Member	4.11
98	do.	2.96

LOCALITY REGISTER AND SAMPLE DESCRIPTION OF PENNSYLVANIAN ROCKS EXPOSED IN SOUTHEAST KANSAS AND NORTHEAST OKLAHOMA (SET 5)

le No.	Sample sequence and thickness (in.)	Stratigraphic position	County	Quadrangle (7½ min.)	Location
		KANSAS			
4621 4574	Upper 12 Lower 12	Eudora Shale Member of Stanton Limestone	Franklin	Peoria	SW SW sec. 6, T. 17 S., R. 20 E.
75 76 77	Upper 20 Middle 10 Lower 12	Little Osage Shale Member, of Jewett (1941); of Fort Scott Limestone	Bourbon	Fort Scott	NE NE sec. 34, T. 25 S., R. 25 E.
78 79 80	Upper 12 Middle 12 Lower 9	Excello Formation[1/]	---do---	---do-------	NE NW sec. 34, T. 25 S., R. 25 E.
81 82 83	Upper 12 Middle 12 Lower 12	--------do----------	---do---	---do-------	SW SW sec. 21, T. 26 S., R 25 E.
84 85 86	Upper 12 Middle 12 Lower 12	--------do----------	---do---	Cato	W line sec. 18, T. 27 S., R. 25 E.
87 88 89	Upper 12 Middle 12 Lower 16	Verdigris Limestone Member of Cabaniss Formation	Crawford	SW1/4 Cherokee	SE SE sec. 16, T. 31 S., R. 23 E.
90 91	Upper 12 Lower 16	Excello Formation[1/]	---do---	---do-------	SE SW sec. 16, T. 31 S., R. 23 E.
92	12	Mine Creek Shale Member of Pawnee Limestone	---do---	NE1/4 McCune	NW NE sec. 23, T. 30 S., R. 21 E.
93 94	Upper grab Lower grab	Pleasanton Group	Neosho	----------	NE NE sec. 20, T. 29 S., R. 20 E.
95 96 97	Upper 3 Middle 2 Lower 3	Tebo Formation of McQueen (1943)	Crawford	Pittsburg	Sec. 35, T. 30 S., R. 25 E.
98	Grab	Bluejacket(?) Sandstone Member of Krebs Formation	Cherokee	Neutral	NE NE sec. 12, T. 34 S., R. 23 E.
607	24	Excello Formation[1/]	Labette	SW1/4 Oswego	SW sec. 35, T. 34 S., R. 20 E.
08 09	Upper 24 Lower	Anna Shale Member of Pawnee Limestone	---do---	NW1/4 Oswego	CWL sec. 3, T. 33 S., R. 20 E.
10	Grab	Pleasanton Group	---do---	SE1/4 Parsons	EL SE sec. 17, T. 32 S., R. 19 E.
11 12	Upper 24 Lower 24	Muncie Creek Shale Member of Iola Limestone	Wilson	Morehead	SL NW sec. 29, T. 29 S., R. 17 E.
		OKLAHOMA			
D114599 D114600	Upper 24 Lower 24	Warner Sandstone of McAlester Shale	Ottawa	Miami NW	W SE sec. 5, T. 28 N., R. 22 E.
01	Grab	Tiawah Limestone Member of Scammon Formation[1/]	Craig	----------	NW sec. 15, T. 28 N., R. 20 E.
02	---do---	Excello Formation	---do---	----------	Sec. 12, T. 28 N., R. 19 E.
03 04	Upper 12 Lower 12	Tiawah Limestone Member of Scammon Formation[1/]	---do---	----------	SE SE sec. 23, T. 27 N., R. 19 E.
05	12	Croweburg Formation of Abernathy (1937)	---do---	----------	S sec. 17, T. 28 N., R. 20 E.
06	Grab	Excello Formation[1/]	---do---	----------	SE sec. 7, T. 28 N., R. 20 E.

1/ Of Searight and others (1953).

LOCALITY AND SAMPLE DESCRIPTION OF ROCKS FROM THE MEADE PEAK PHOSPHATIC SHALE MEMBER OF THE PHOSPHORIA FORMATION, RAYMOND CANYON, WYOMING (SET 6).

Locality description: This set of 43 samples of black siltstone, phosphorite, dolomite, and limestone was collected from a mine opening on north side of Raymond Canyon, in Sublette Ridge, Lincoln County, Wyo.

mple No.[1]	Lithology	Depth below top of Meade Peak Phosphatic Shale Member (ft)	Interval (ft)
	East crosscut		
)008531	Siltstone, micaceous, carbonaceous	0 - 1.6	1.6
32	Dolomite, microcrystalline	1.6 - 2.9	1.3
33	Phosphorite, 0.5 - 2.0 mm oolites	2.9 - 5.9	3.0
34	Phosphorite, sparse oolites	5.9 - 6.5	0.6
35	Phosphorite, small oolites	6.5 - 7.2	0.7
36	Do.	7.2 - 8.4	1.2
37	Phosphorite, 0.1 - 0.2 mm oolites, silty	8.4 - 8.8	0.4
38	Dolomite, microcrystalline	8.8 - 12.1	3.3
39	Phosphorite, 0.2 - 0.5 mm oolites	12.1 - 13.5	1.4
40	Do.	13.5 - 15.0	1.5
41	Phosphorite, 0.1 - 0.2 mm oolites	15.0 - 16.8	1.8
42	Phosphorite, silty, 0.1 - 0.2 mm oolites	16.8 - 18.9	2.1
43	Do.	18.9 - 21.2	2.3
44	Siltstone, phosphatic, carbonaceous	21.2 - 21.6	0.4
45	Siltstone, phosphatic, with scattered 0.1 - 0.2 mm oolites	21.6 - 23.0	1.4
46	Siltstone, dolomitic, phosphatic, and carbonaceous	23.0 - 26.3	3.3
47	Phosphorite, silty, 0.2 - 0.5 mm oolites	26.3 - 28.5	2.2
	Timbered adit		
48	Siltstone, calcareous, phosphatic	28.5 - 34.5	6.0
	West crosscut		
49	Siltstone, calcareous, phosphatic, carbonaceous	34.5 - 41.7	7.2
50	Limestone, silty, phosphatic, carbonaceous	41.7 - 46.2	4.5
51	Dolomite, phosphatic	46.2 - 49.4	3.2
52	Phosphorite, silty, carbonaceous	49.4 - 52.4	3.0
53	Limestone, silty, carbonaceous	52.4 - 55.9	3.5
54	Limestone, silty, phosphatic, carbonaceous	55.9 - 59.4	3.5
55	Phosphorite, carbonaceous	59.4 - 59.9	0.5
56	Do.	59.9 - 60.7	0.8
57	Limestone, phosphatic, carbonaceous, dolomitic	60.7 - 61.3	0.6
58	Phosphorite, dolomitic, with scattered oolites as much as 3 mm	61.3 - 62.1	0.8
59	Dolomite, carbonaceous, phosphatic	62.1 - 63.5	1.4
60	Phosphorite, carbonaceous	63.5 - 64.7	1.2
61	Do.	64.7 - 66.5	1.8
62	Dolomite, phosphatic, microcrystalline	66.5 - 69.0	2.5
63	Phosphorite, silty, calcareous	69.0 - 77.5	8.5
64	Siltstone, phosphatic	77.5 - 80.5	3.0
65	Phosphorite, silty, carbonaceous	80.5 - 81.5	1.0
66	Do.	81.5 - 84.5	3.0
67	Phosphorite, silty, carbonaceous; contains secondary calcite	84.5 - 88.5	4.0
68	Dolomite, phosphatic, carbonaceous, microcrystalline	88.5 - 90.5	2.0
69	Dolomite; average grain size about 0.1 mm	90.5 - 91.5	1.0
70	Phosphorite, silty	91.5 - 92.5	1.0
71	Silstone, phosphatic, carbonaceous	92.5 - 99.5	7.0
72	Siltstone, calcareous	99.5 -105.0	5.5
73	Dolomite	105.0 -109.0	4.0

1/ Each sample is composed of a composite of chips collected from the interval indicated and is intended to be representative of that interval. However, the sample from the timbered adit (No. D0008548) may be less representative than the others because of the difficulty of working around the timbers.

SET NO. 5, 40 OUTCROP SAMPLES OF BLACK SHALE FROM PENNSYLVANIAN ROCKS IN SOUTHEASTERN KANSAS AND NORTHEASTERN OKLAHOMA

/All analyses (except organic carbon) by the six-step spectrographic method, A. L. Sutton, Jr., analyst. Results are reported in percent to the nearest number in the series 1, 0.7, 0.5, 0.3, 0.2, 0.15, and 0.1, etc., which represent approximate midpoints of group data on a geometric scale. The assigned group will include the quantitative value about 30 percent of the time. Organic carbon analyses by I. C. Frost, calculated by difference between total carbon and mineral carbon. Symbols used are as follows: G, greater than value indicated; N, not detected, or less than the limit of detection./

SAMPLE NUMBER	ELEMENT									
	AL	FE	MG	CA	NA	K	TI	P	MN	AG
D114621	7.00000	1.00000	.700000	1.50000	1.00000	2.00000	.150000	.500000	.010000	.000100
D114574	7.00000	1.00000	.700000	2.00000	1.00000	2.00000	.100000	.700000	.015000	.000150
D114575	7.00000	1.50000	1.00000	1.50000	1.00000	2.00000	.100000	.000000N	.015000	.000000N
D114576	7.00000	1.00000	.700000	3.00000	.700000	2.00000	.100000	.700000	.015000	.000150
D114577	7.00000	1.50000	1.00000	10.0000G	.700000	2.00000	.070000	1.50000	.015000	.000200
D114578	5.00000	1.00000	.700000	2.00000	.700000	2.00000	.070000	1.50000	.002000	.000200
D114579	5.00000	1.00000	.700000	3.00000	.300000	2.00000	.070000	1.00000	.010000	.000200
D114580	7.00000	1.00000	.700000	2.00000	1.00000	2.00000	.100000	1.50000	.010000	.000000N
D114581	7.00000	1.00000	.700000	3.00000	.700000	2.00000	.070000	1.50000	.010000	.000200
D114582	7.00000	1.50000	.700000	3.00000	.700000	2.00000	.100000	1.00000	.010000	.000200
D114583	7.00000	1.50000	1.00000	3.00000	.700000	2.00000	.100000	.700000	.010000	.000200
D114584	10.0000G	1.50000	.700000	.700000	.700000	2.00000	.150000	.000000N	.010000	.000100
D114585	7.00000	1.50000	.700000	2.00000	.500000	2.00000	.100000	.700000	.007000	.000200
D114586	7.00000	1.50000	.700000	3.00000	.700000	2.00000	.100000	1.00000	.005000	.000200
D114587	7.00000	1.00000	.700000	10.0000G	.700000	2.00000	.100000	.000000N	.020000	.000000N
D114588	7.00000	1.00000	1.00000	7.00000	.700000	2.00000	.100000	.000000N	.030000	.000000N
D114589	7.00000	1.00000	.700000	3.00000	.700000	2.00000	.100000	.500000	.015000	.000000N
D114590	7.00000	1.50000	.700000	3.00000	.300000	2.00000	.100000	1.00000	.007000	.000200
D114591	7.00000	3.00000	.700000	.700000	.300000	2.00000	.150000	.000000N	.010000	.000500
D114592	7.00000	3.00000	1.00000	3.00000	.700000	2.00000	.150000	.700000	.015000	.000200
D114593	7.00000	1.50000	.700000	.700000	.700000	1.50000	.100000	.500000	.007000	.000500
D114594	5.00000	2.00000	.700000	1.00000	.700000	2.00000	.100000	.500000	.003000	.000700
D114595	10.0000G	2.00000	.700000	.300000	.300000	3.00000	.200000	.000000N	.050000	.000000N
D114596	10.0000G	2.00000	.700000	.200000	.300000	3.00000	.200000	.000000N	.050000	.000000N
D114597	10.0000G	2.00000	.700000	.200000	.300000	2.00000	.200000	.000000N	.010000	.000000N
D114598	10.0000G	.700000	.300000	.020000	.200000	2.00000	.200000	.000000N	.002000	.000000N
D114599	10.0000G	2.00000	.500000	.700000	.500000	2.00000	.200000	.000000N	.030000	.000000N
D114600	10.0000G	2.00000	.700000	.500000	.300000	2.00000	.200000	.000000N	.015000	.000000N
D114601	10.0000G	2.00000	.700000	.150000	.700000	2.00000	.200000	.000000N	.010000	.000000N
D114602	7.00000	1.50000	.500000	1.50000	1.00000	2.00000	.150000	1.00000	.002000	.000200
D114603	7.00000	2.00000	.700000	3.00000	1.00000	2.00000	.150000	1.50000	.030000	.000100
D114604	7.00000	2.00000	.700000	.200000	1.00000	3.00000	.150000	.000000N	.010000	.000000N
D114605	7.00000	2.00000	.700000	10.0000G	.300000	2.00000	.100000	.000000N	.050000	.000000N
D114606	7.00000	2.00000	.700000	.700000	.300000	2.00000	.100000	.200000	.003000	.000700
D114607	7.00000	1.50000	.700000	1.00000	.300000	2.00000	.100000	.700000	.007000	.000200
D114608	7.00000	1.50000	.700000	.500000	.700000	2.00000	.150000	.000000N	.007000	.000200
D114609	7.00000	1.50000	.700000	.500000	1.00000	2.00000	.150000	.000000N	.007000	.000200
D114610	5.00000	1.50000	.700000	1.00000	.700000	2.00000	.100000	.500000	.007000	.000500
D114611	10.0000G	2.00000	.700000	.700000	1.00000	3.00000	.200000	.000000N	.007000	.000200
D114612	.700000	.700000	.070000	1.00000	.100000	.000000N	.030000	.000000N	.000700	.000000N

SET NO. 5, 40 OUTCROP SAMPLES OF BLACK SHALE FROM PENNSYLVANIAN ROCKS IN SOUTHEASTERN KANSAS AND NORTHEASTERN OKLAHOMA.--Continued.

SAMPLE NUMBER	ELEMENT									
	B	BA	BE	CO	CR	CU	GA	LA	MO	NI
D114621	.003000	.030000	.000150	.000700	.030000	.007000	.001500	.005000	.000700	.010000
D114574	.003000	.020000	.000200	.000700	.050000	.007000	.002000	.003000	.001000	.015000
D114575	.005000	.020000	.000200	.001000	.015000	.007000	.002000	.003000	.001000	.010000
D114576	.003000	.020000	.000200	.000700	.030000	.007000	.001500	.003000	.001500	.015000
D114577	.002000	.020000	.000150	.000700	.050000	.007000	.001000	.005000	.005000	.015000
D114578	.003000	.020000	.000150	.000500	.030000	.010000	.001500	.003000	.002000	.005000
D114579	.002000	.020000	.000200	.001000	.050000	.010000	.001000	.003000	.005000	.030000
D114580	.005000	.020000	.000200	.000700	.015000	.007000	.001500	.005000	.000700	.010000
D114581	.003000	.020000	.000150	.001000	.030000	.007000	.001000	.003000	.001500	.015000
D114582	.002000	.020000	.000150	.001000	.020000	.010000	.001000	.003000	.001500	.015000
D114583	.003000	.020000	.000150	.000700	.050000	.010000	.001000	.003000	.005000	.015000
D114584	.005000	.020000	.000200	.001000	.020000	.010000	.002000	.003000	.001000	.010000
D114585	.002000	.020000	.000150	.001000	.020000	.010000	.001500	.003000	.001000	.015000
D114586	.003000	.020000	.000150	.000500	.050000	.010000	.001500	.005000	.003000	.015000
D114587	.003000	.020000	.000150	.001000	.010000	.007000	.001500	.003000	.000000N	.005000
D114588	.003000	.020000	.000150	.000700	.010000	.007000	.001500	.003000	.000000N	.007000
D114589	.003000	.020000	.000150	.000700	.010000	.010000	.001500	.003000	.000500	.007000
D114590	.003000	.020000	.000150	.000000N	.030000	.007000	.001500	.005000	.000700	.010000
D114591	.003000	.020000	.000200	.001000	.050000	.010000	.001500	.002000	.002000	.015000
D114592	.003000	.020000	.000200	.001000	.050000	.010000	.001500	.005000	.003000	.020000
D114593	.002000	.020000	.000100	.000000N	.050000	.007000	.001000	.003000	.002000	.010000
D114594	.002000	.070000	.000150	.000000N	.030000	.007000	.001500	.005000	.007000	.007000
D114595	.003000	.050000	.000200	.001000	.015000	.003000	.002000	.005000	.000000N	.005000
D114596	.003000	.030000	.000200	.001000	.015000	.003000	.002000	.005000	.000000N	.005000
D114597	.003000	.030000	.000200	.001000	.010000	.001500	.002000	.005000	.000000N	.005000
D114598	.005000	.020000	.000200	.000500	.010000	.003000	.002000	.005000	.000000N	.001500
D114599	.005000	.020000	.000150	.001000	.007000	.002000	.002000	.005000	.000000N	.005000
D114600	.005000	.020000	.000200	.001000	.007000	.003000	.002000	.005000	.000000N	.005000
D114601	.003000	.030000	.000300	.001000	.010000	.003000	.002000	.005000	.000000N	.005000
D114602	.003000	.020000	.000150	.000500	.030000	.010000	.001500	.005000	.002000	.007000
D114603	.003000	.020000	.000200	.001000	.020000	.007000	.001500	.005000	.000700	.015000
D114604	.005000	.020000	.000200	.001000	.010000	.005000	.002000	.005000	.000500	.015000
D114605	.000000N	.015000	.000150	.001000	.007000	.007000	.001000	.002000	.001000	.005000
D114606	.002000	.030000	.000150	.000000N	.050000	.005000	.001000	.003000	.003000	.010000
D114607	.003000	.030000	.000200	.000500	.030000	.007000	.001500	.003000	.001000	.010000
D114608	.003000	.020000	.000200	.000700	.050000	.007000	.001500	.003000	.002000	.015000
D114609	.003000	.020000	.000200	.000700	.050000	.007000	.001500	.005000	.001000	.015000
D114610	.002000	.020000	.000100	.000500	.070000	.010000	.001000	.003000	.003000	.015000
D114611	.003000	.050000	.000200	.000700	.050000	.007000	.002000	.005000	.003000	.015000
D114612	.000000N	.007000	.000000N	.000000N	.002000	.003000	.000000N	.000000N	.000000N	.001000

SET NO. 5, 40 OUTCROP SAMPLES OF BLACK SHALE FROM PENNSYLVANIAN ROCKS IN SOUTHEASTERN KANSAS AND NORTHEASTERN OKLAHOMA.--Continued.

SAMPLE NUMBER	ELEMENT							
	PB	SC	SR	V	Y	ZN	ZR	ORG C
D114621	.010000	.001000	.020000	.010000	.003000	.070000	.003000	15.0000
D114574	.010000	.001000	.020000	.015000	.003000	.100000	.005000	14.0000
D114575	.002000	.001000	.015000	.010000	.001500	.000000N	.007000	4.60000
D114576	.002000	.001000	.020000	.020000	.003000	.030000	.003000	16.0000
D114577	.007000	.001000	.030000	.100000	.003000	.030000	.003000	19.0000
D114578	.005000	.001000	.015000	.020000	.003000	.050000	.003000	4.80000
D114579	.005000	.001000	.020000	.070000	.003000	.030000	.003000	24.0000
D114580	.003000	.001000	.020000	.015000	.005000	.000000N	.005000	12.0000
D114581	.002000	.001000	.020000	.015000	.003000	.070000	.002000	15.0000
D114582	.005000	.001000	.020000	.015000	.003000	.050000	.003000	16.0000
D114583	.003000	.001000	.020000	.050000	.003000	.030000	.005000	22.0000
D114584	.003000	.001500	.015000	.010000	.002000	.000000N	.005000	9.30000
D114585	.005000	.001000	.020000	.015000	.003000	.000000N	.003000	17.0000
D114586	.005000	.001000	.020000	.050000	.003000	.100000	.003000	20.0000
D114587	.001500	.001000	.030000	.010000	.003000	.000000N	.003000	3.00000
D114588	.002000	.001000	.020000	.007000	.003000	.000000N	.003000	4.60000
D114589	.002000	.001000	.020000	.007000	.003000	.000000N	.003000	7.70000
D114590	.003000	.001000	.030000	.020000	.003000	.030000	.003000	11.0000
D114591	.005000	.001000	.020000	.050000	.002000	.030000	.003000	18.0000
D114592	.010000	.001500	.050000	.050000	.003000	.100000	.005000	20.0000
D114593	.002000	.001000	.020000	.050000	.002000	.100000	.003000	11.0000
D114594	.003000	.000700	.050000	.070000	.005000	.200000	.005000	15.0000
D114595	.001500	.001500	.020000	.010000	.003000	.000000N	.007000	3.00000
D114596	.001000	.001500	.015000	.010000	.003000	.000000N	.010000	3.40000
D114597	.001500	.001500	.015000	.010000	.005000	.000000N	.010000	3.00000
D114598	.001000	.002000	.020000	.010000	.003000	.000000N	.015000	.080000
D114599	.001000	.001500	.020000	.007000	.003000	.000000N	.010000	1.60000
D114600	.001000	.001500	.015000	.007000	.003000	.000000N	.010000	1.50000
D114601	.001500	.002000	.020000	.015000	.002000	.000000N	.010000	2.00000
D114602	.005000	.001000	.020000	.030000	.005000	.000000N	.003000	17.0000
D114603	.005000	.001000	.020000	.050000U	.005000	.100000	.005000	15.0000
D114604	.005000	.001500	.015000	.010000	.002000	.000000N	.007000	13.0000
D114605	.005000	.001000	.050000	.020000	.003000	.000000N	.002000	6.40000
D114606	.003000	.001000	.015000	.050000	.002000	.000000N	.005000	17.0000
D114607	.005000	.001000	.020000	.020000	.003000	.000000N	.005000	13.0000
D114608	.007000	.001500	.015000	.020000	.002000	.000000N	.007000	15.0000
D114609	.010000	.001500	.020000	.020000	.002000	.000000N	.005000	19.0000
D114610	.002000	.000700	.020000	.070000	.003000	.070000	.005000	16.0000
D114611	.015000	.001500	.015000	.050000	.003000	.050000	.007000	6.70000
D114612	.002000	.000000N	.007000	.003000	.001500	.000000N	.001000	52.0000

SET NO. 6, 43 SAMPLES OF BLACK SHALE, PHOSPHORITE, AND DOLOMITE REPRESENTING THE ENTIRE MEADE PEAK PHOSPHATIC SHALE MEMBER OF THE PHOSPHORIA FORMATION, FROM A MINE ADIT AT RAYMOND CANYON, WYOMING

/All analyses (except selenium, mineral carbon, organic carbon, P_2O_5, and equivalent uranium) by the six-step spectrographic method, J. C. Hamilton, analyst. Results are reported in percent to the nearest number in the series 1, 0.7, 0.5, 0.3, 0.2, 0.15, and 0.1, etc., which represent approximate midpoints of group data on a geometric scale. The assigned group will include the quantitative value about 30 percent of the time. Selenium analyses determined volumetrically or nephalometrically by G. T. Burrow; mineral carbon determined gasometrically by E. J. Fennelly; total carbon determined by induction furnace and organic carbon, then calculated by difference by I. C. Frost; P_2O_5 determined volumetrically by D. L. Skinner; and eU determined with a beta gamma scaler by E. J. Fennelly. Symbols used are as follows: G, greater than value indicated; N, not detected; and L, less than value indicated./

SAMPLE NUMBER	ELEMENT									
	SI	AL	FE	MG	CA	NA	K	TI	MN	AG
D0008531	10.0000G	3.00000	1.50000	1.50000	5.00000	1.50000	2.00000	.200000	.020000	.000500
D0008532	7.00000	1.50000	.700000	5.00000	10.0000G	2.00000	2.00000	.070000	.050000	.000300
D0008533	3.00000	.700000	.500000	.700000	10.0000G	1.00000	.000000N	.070000	.007000	.000300
D0008534	7.00000	3.00000	1.50000	.700000	10.0000G	1.00000	1.00000	.100000	.007000	.000700
D0008535	3.00000	.700000	.300000	.500000	10.0000G	1.00000	.000000N	.050000	.005000	.000500
D0008536	3.00000	.700000	.300000	.300000	10.0000G	.700000	.000000N	.050000	.002000	.000300
D0008537	7.00000	1.50000	.700000	.300000	10.0000G	.700000	.000000N	.100000	.003000	.000500
D0008538	7.00000	1.50000	1.00000	5.00000	10.0000G	1.50000	2.00000	.150000	.030000	.000500
D0008539	3.00000	.700000	.500000	.200000	10.0000G	1.00000	.000000N	.100000	.003000	.000300
D0008540	7.00000	3.00000	1.50000	.500000	10.0000G	.700000	1.00000	.150000	.007000	.000700
D0008541	7.00000	1.50000	1.50000	.500000	10.0000G	.700000	1.00000	.150000	.007000	.001000
D0008542	10.0000G	1.50000	1.50000	.500000	10.0000G	.700000	1.00000	.150000	.010000	.001000
D0008543	10.0000G	3.00000	1.50000	3.00000	7.00000	2.00000	2.00000	.200000	.020000	.000700
D0008544	7.00000	3.00000	2.00000	.700000	10.0000G	.300000	1.00000	.100000	.007000	.001500
D0008545	10.0000G	3.00000	2.00000	1.00000	10.0000G	1.00000	2.00000	.200000	.015000	.001000
D0008546	7.00000	3.00000	2.00000	1.50000	10.0000G	1.00000	2.00000	.150000	.010000	.002000
D0008547	1.50000	.300000	.500000	1.00000	10.0000G	.700000	.000000N	.020000	.015000	.000200
D0008548	10.0000G	3.00000	1.50000	1.50000	10.0000G	1.00000	3.00000	.150000	.015000	.000700
D0008549	10.0000G	3.00000	2.00000	2.00000	10.0000G	.700000	2.00000	.200000	.015000	.001000
D0008550	3.00000	1.50000	1.00000	2.00000	10.0000G	.700000	2.00000	.100000	.015000	.001500
D0008551	7.00000	1.50000	1.50000	7.00000	10.0000G	1.50000	2.00000	.100000	.015000	.000500
D0008552	10.0000G	3.00000	2.00000	1.50000	10.0000G	.500000	3.00000	2.00000	.010000	.002000
D0008553	10.0000G	3.00000	2.00000	1.50000	10.0000G	.500000	2.00000	.200000	.015000	.002000
D0008554	3.00000	1.50000	.700000	3.00000	10.0000G	.700000	3.00000	.070000	.010000	.001000
D0008555	7.00000	3.00000	1.50000	1.00000	10.0000G	.700000	2.00000	.100000	.005000	.002000
D0008556	7.00000	3.00000	1.50000	1.00000	10.0000G	.700000	1.50000	.100000	.005000	.001500
D0008557	1.50000	.700000	.700000	5.00000	10.0000G	.500000	1.00000	.050000	.007000	.000700
D0008558	3.00000	.700000	.700000	5.00000	10.0000G	.700000	1.00000	.050000	.007000	.001000
D0008559	3.00000	.700000	.500000	5.00000	10.0000G	.500000	2.00000	.070000	.010000	.000700
D0008560	1.50000	.300000	.500000	.150000	10.0000G	.700000	.000000N	.050000	.000500	.000700
D0008561	3.00000	1.50000	.700000	.300000	10.0000G	.700000	.000000N	.070000	.001500	.001500
D0008562	7.00000	1.50000	.700000	5.00000	10.0000G	.500000	2.00000	.070000	.010000	.001500
D0008563	10.0000G	1.50000	.700000	3.00000	10.0000G	.700000	3.00000	.100000	.007000	.002000
D0008564	10.0000G	1.50000	1.50000	3.00000	10.0000G	.500000	3.00000	.150000	.020000	.001000
D0008565	7.00000	1.50000	.700000	.500000	10.0000G	.700000	1.00000	.100000	.005000	.001500
D0008566	7.00000	1.50000	.700000	1.50000	10.0000G	.700000	1.00000	.100000	.005000	.001000
D0008567	7.00000	1.50000	.700000	1.50000	10.0000G	1.00000	1.50000	.070000	.005000	.001000
D0008568	7.00000	1.50000	.700000	5.00000	10.0000G	.700000	3.00000	1.00000	.010000	.001000
D0008569	7.00000	1.50000	.500000	7.00000	10.0000G	.500000	3.00000	.050000	.015000	.000700
D0008570	10.0000G	1.50000	.700000	3.00000	10.0000G	.500000	2.00000	.070000	.015000	.001500
D0008571	10.0000G	1.50000	1.50000	3.00000	10.0000G	.500000	2.00000	.100000	.015000	.001000
D0008572	10.0000G	3.00000	1.50000	2.00000	5.00000	.200000	5.00000	.200000	.015000	.000700
D0008573	1.50000	.150000	.150000	10.0000G	10.0000G	.300000	.000000N	.020000	.010000	.000000N

SET NO. 6, 43 SAMPLES OF BLACK SHALE, PHOSPHORITE, AND DOLOMITE REPRESENTING THE ENTIRE MEADE PEAK PHOSPHATIC SHALE MEMBER OF THE PHOSPHORIA FORMATION, FROM A MINE ADIT AT RAYMOND CANYON, WYOMING.--Continued.

SAMPLE NUMBER	ELEMENT									
	B	BA	BE	CO	CR	CU	GA	LA	MO	NI
D0008531	.015000	.020000	.000000N	.000700	.030000	.005000	.001500	.003000	.001500	.007000
D0008532	.000000N	.007000	.000000N	.000000N	.020000	.003000	.000500	.000000N	.001500	.002000
D0008533	.000000N	.015000	.000000N	.000000N	.100000	.005000	.000200	.015000	.001500	.007000
D0008534	.003000	.015000	.000150	.000000N	.150000	.015000	.001500	.010000	.030000	.050000
D0008535	.000000N	.010000	.000000N	.000000N	.150000	.010000	.000300	.010000	.007000	.015000
D0008536	.000000N	.010000	.000000N	.000000N	.150000	.007000	.000300	.010000	.007000	.020000
D0008537	.000000N	.015000	.000000N	.000000N	.150000	.005000	.000300	.010000	.005000	.015000
D0008538	.000000N	.010000	.000000N	.000000N	.030000	.005000	.000700	.000000N	.003000	.005000
D0008539	.000000N	.007000	.000000N	.000000N	.100000	.005000	.000300	.015000	.005000	.015000
D0008540	.000000N	.015000	.000000N	.000000N	.200000	.010000	.000300	.020000	.003000	.015000
D0008541	.000000N	.015000	.000000N	.000000N	.150000	.010000	.000700	.030000	.002000	.015000
D0008542	.000000N	.015000	.000000N	.000000N	.100000	.007000	.000700	.020000	.010000	.015000
D0008543	.005000	.020000	.000000N	.000000N	.050000	.007000	.001000	.005000	.003000	.007000
D0008544	.005000	.010000	.000150	.000000N	.700000	.020000	.001500	.050000	.020000	.070000
D0008545	.005000	.020000	.000000N	.000000N	.150000	.010000	.001000	.020000	.007000	.020000
D0008546	.005000	.015000	.000000N	.000000N	.300000	.015000	.001500	.020000	.010000	.030000
D0008547	.000000N	.005000	.000000N	.000000N	.050000	.003000	.000000N	.015000	.001500	.005000
D0008548	.005000	.015000	.000000N	.000000N	.100000	.010000	.002000	.007000	.003000	.020000
D0008549	.007000	.020000	.000000N	.000000N	.150000	.010000	.001500	.020000	.005000	.030000
D0008550	.000000N	.010000	.000000N	.000000N	.150000	.015000	.002000	.010000	.002000	.030000
D0008551	.000000N	.007000	.000000N	.000000N	.030000	.005000	.000700	.000000N	.015000	.007000
D0008552	.007000	.020000	.000150	.000700	.300000	.030000	.002000	.010000	.020000	.030000
D0008553	.010000	.020000	.000200	.000700	.300000	.030000	.002000	.070000	.020000	.070000
D0008554	.000000N	.010000	.000000N	.000000N	.100000	.010000	.001500	.007000	.003000	.015000
D0008555	.007000	.015000	.000150	.000000N	.700000	.020000	.002000	.030000	.015000	.070000
D0008556	.005000	.015000	.000150	.000000N	.300000	.030000	.002000	.030000	.020000	.050000
D0008557	.000000N	.005000	.000000N	.000000N	.100000	.010000	.000700	.010000	.005000	.015000
D0008558	.000000N	.005000	.000000N	.000000N	.150000	.007000	.000500	.015000	.002000	.015000
D0008559	.000000N	.005000	.000000N	.000000N	.070000	.007000	.000700	.005000	.001500	.010000
D0008560	.000000N	.007000	.000000N	.000000N	.100000	.010000	.000700	.030000	.002000	.010000
D0008561	.000000N	.010000	.000150	.000000N	.300000	.020000	.002000	.070000	.007000	.015000
D0008562	.000000N	.007000	.000000N	.000000N	.070000	.005000	.001500	.007000	.003000	.010000
D0008563	.003000	.010000	.000000N	.000000N	.070000	.007000	.003000	.007000	.005000	.010000
D0008564	.003000	.015000	.000000N	.001000	.070000	.007000	.002000	.005000	.010000	.020000
D0008565	.000000N	.010000	.000150	.000000N	.100000	.010000	.002000	.010000	.007000	.020000
D0008566	.000000N	.010000	.000150	.000000N	.070000	.005000	.001000	.007000	.007000	.015000
D0008567	.000000N	.010000	.000150	.000000N	.150000	.010000	.001500	.010000	.015000	.030000
D0008568	.000000N	.010000	.000000N	.000000N	.070000	.007000	.001500	.007000	.005000	.015000
D0008569	.000000N	.005000	.000000N	.000000N	.030000	.003000	.001500	.005000	.001000	.010000
D0008570	.000000N	.010000	.000000N	.000000N	.100000	.010000	.003000	.010000	.002000	.010000
D0008571	.005000	.010000	.000000N	.000000N	.050000	.007000	.003000	.005000	.007000	.015000
D0008572	.015000	.020000	.000000N	.000700	.030000	.005000	.002000	.000000N	.015000	.015000
D0008573	.000000N	.002000	.000000N	.000000N	.007000	.001000	.001000	.005000	.001000	.001500

SET NO. 6, 43 SAMPLES OF BLACK SHALE, PHOSPHORITE, AND DOLOMITE REPRESENTING THE ENTIRE MEADE PEAK PHOSPHATIC SHALE MEMBER OF THE PHOSPHORIA FORMATION, FROM A MINE ADIT AT RAYMOND CANYON, WYOMING.--Continued.

SAMPLE NUMBER	ELEMENT								
	PB	SC	SR	V	Y	ZN	ZR	ND	SE
D0008531	.001000	.000700	.020000	.010000	.003000	.030000	.020000	.000000N	.005000
D0008532	.001500	.000000N	.050000	.007000	.001500	.000000N	.005000	.000000N	.003000
D0008533	.002000	.000700	.150000	.050000	.020000	.100000	.007000	.015000	.003000
D0008534	.001000	.001000	.200000	.150000	.020000	1.00000	.010000	.050000L	.010000
D0008535	.001000	.000700	.200000	.150000	.020000	.700000	.007000	.050000L	.003500
D0008536	.001000	.000700	.200000	.100000	.020000	.500000	.007000	.050000L	.003500
D0008537	.001000	.001000	.200000	.070000	.020000	.300000	.007000	.050000L	.003500
D0008538	.001000	.000700	.030000	.015000	.002000	.030000	.010000	.000000N	.006000
D0008539	.000000N	.000700	.200000	.050000	.030000	.070000	.007000	.020000	.003000
D0008540	.000000N	.001500	.150000	.030000	.050000	.100000	.010000	.015000	.004500
D0008541	.000000N	.001500	.150000	.020000	.050000	.100000	.015000	.030000	.004500
D0008542	.000000N	.001000	.150000	.030000	.030000	.100000	.015000	.015000	.008500
D0008543	.000000N	.000700	.030000	.020000	.005000	.000000N	.015000	.000000N	.005000
D0008544	.001000	.001500	.150000	.150000	.070000	.500000	.007000	.030000	.015000
D0008545	.000000N	.001500	.100000	.050000	.020000	.070000	.010000	.015000	.006000
D0008546	.000000N	.001500	.100000	.070000	.030000	.200000	.007000	.015000	.010000
D0008547	.000000N	.000000N	.200000	.030000	.020000	.150000	.003000	.015000	.004000
D0008548	.001000	.001000	.070000	.020000	.010000	.070000	.007000	.000000N	.008500
D0008549	.001000	.001500	.070000	.020000	.015000	.150000	.010000	.015000	.006000
D0008550	.000000N	.000700	.150000	.100000	.015000	.150000	.005000	.000000N	.010500
D0008551	.002000	.000000N	.050000	.020000	.003000	.000000N	.005000	.000000N	.006000
D0008552	.002000	.001000	.100000	.100000	.015000	.200000	.007000	.015000	.016500
D0008553	.002000	.001500	.100000	.100000	.020000	.300000	.010000	.030000	.008500
D0008554	.000000N	.000000N	.100000	.020000	.010000	.100000	.003000	.000000N	.010500
D0008555	.001000	.002000	.200000	.070000	.030000	.500000	.007000	.030000	.019500
D0008556	.001000	.002000	.200000	.100000	.050000	.500000	.010000	.030000	.016000
D0008557	.000000N	.000000N	.070000	.020000	.010000	.150000	.002000	.000000N	.008000
D0008558	.000000N	.000700	.150000	.020000	.020000	.100000	.003000	.000000N	.010000
D0008559	.000000N	.000000N	.050000	.020000	.005000	.000000N	.005000	.000000N	.010500
D0008560	.000000N	.000700	.300000	.070000	.050000	.150000	.005000	.030000	.005000
D0008561	.001500	.002000	.300000	.200000	.100000	.150000	.010000	.070000	.012000
D0008562	.000000N	.000700	.050000	.020000	.010000	.100000	.003000	.000000N	.002000
D0008563	.000000N	.000700	.070000	.030000	.007000	.150000	.007000	.000000N	.005000
D0008564	.000000N	.000700	.070000	.100000	.005000	.200000	.015000	.000000N	.006500
D0008565	.001500	.000700	.200000	.200000	.015000	1.00000	.007000	.015000	.007000
D0008566	.001500	.000700	.200000	.150000	.010000	.700000	.007000	.000000N	.004500
D0008567	.001500	.000700	.200000	.150000	.015000	1.00000	.007000	.000000N	.005000
D0008568	.001000	.000700	.070000	.030000	.007000	.300000	.007000	.000000N	.005000
D0008569	.001000	.000000N	.050000	.010000	.003000	.000000N	.003000	.000000N	.002000
D0008570	.001500	.000700	.200000	.015000	.010000	.150000	.007000	.000000N	.002000
D0008571	.002000	.000700	.100000	.050000	.005000	.200000	.010000	.000000N	.012500
D0008572	.002000	.000700	.070000	.050000	.002000	.150000	.020000	.000000N	.002000
D0008573	.000000N	.000000N	.100000	.007000	.007000	.000000N	.003000	.000000N	.000500

SET NO. 6, 43 SAMPLES OF BLACK SHALE, PHOSPHORITE, AND DOLOMITE REPRESENTING THE ENTIRE MEADE PEAK PHOSPHATIC SHALE MEMBER OF THE PHOSPHORIA FORMATION, FROM A MINE ADIT AT RAYMOND CANYON, WYOMING.--Continued.

SAMPLE NUMBER	TOTAL C	ORG C	P2O5	ELEMENT EU
D0008531	3.44000	1.80000	2.81000	.003000
D0008532	8.42000	.800000	1.43000	.001000L
D0008533	2.70000	1.40000	31.1100	.016000
D0008534	8.14000	7.40000	23.0900	.039000
D0008535	7.08000	6.00000	30.9300	.024000
D0008536	5.95000	5.20000	33.1700	.017000
D0008537	5.84000	5.20000	29.1500	.013000
D0008538	8.14000	1.80000	2.52000	.001000
D0008539	5.44000	4.60000	30.1000	.009000
D0008540	5.48000	4.60000	28.2700	.006000
D0008541	6.24000	5.20000	26.1200	.006000
D0008542	5.46000	3.80000	23.7100	.007000
D0008543	6.39000	3.40000	4.16000	.001000
D0008544	16.6800	14.5000	17.7800	.014000
D0008545	8.74000	5.90000	12.3400	.003000
D0008546	12.5800	9.10000	13.7000	.003000
D0008547	6.03000	1.40000	26.2400	.008000
D0008548	9.57000	5.70000	7.98000	.002000
D0008549	9.76000	7.10000	9.99000	.003000
D0008550	15.0000	10.6000	13.7900	.005000
D0008551	11.2900	3.70000	5.07000	.002000
D0008552	14.0200	12.9000	12.6800	.002000
D0008553	12.5800	6.30000	8.13000	.002000
D0008554	13.6400	7.80000	12.0400	.003000
D0008555	15.9200	15.0000	19.9300	.006000
D0008556	15.7400	15.0000	23.2600	.007000
D0008557	17.1000	10.1000	10.7300	.003000
D0008558	8.87000	6.80000	23.8400	.003000
D0008559	15.8600	8.60000	7.78000	.001000
D0008560	5.37000	5.10000	36.3200	.008000
D0008561	8.20000	7.80000	31.6700	.022000
D0008562	7.89000	1.80000	11.9100	.003000
D0008563	6.30000	3.20000	16.7900	.004000
D0008564	9.25000	5.70000	12.9100	.006000
D0008565	7.46000	6.80000	29.2900	.016000
D0008566	6.48000	5.20000	28.7200	.009000
D0008567	6.52000	5.60000	31.5100	.011000
D0008568	9.18000	4.70000	14.0200	.001000
D0008569	10.7400	2.30000	7.18000	.002000
D0008570	5.78000	3.00000	18.9900	.006000
D0008571	6.91000	2.90000	12.7800	.004000
D0008572	4.92000	2.20000	1.23000	.004000
D0008573	11.0500	1.00000	7.98000	.001000L

SET NO. 7, 51 CORE SAMPLES OF BLACK SHALE FROM THE CHATTANOOGA SHALE IN TENNESSEE AND ALABAMA

[All analyses (except organic carbon and uranium) by the six-step spectrographic method, A. L. Sutton, Jr., analyst. Results are reported in percent to the nearest number in the series 1, 0.7, 0.5, 0.3, 0.2, 0.15, and 0.1, etc., which represent approximate midpoints of group data on a geometric scale. The assigned group will include the quantitative value about 30 percent of the time. Organic carbon analyses by I. C. Frost, calcuated by difference between total carbon and mineral carbon; uranium analyses by Carmen Hoy, Joseph Budinsky, B. A. McCall, M. A. Joslyn, J. H. Goode, J. Smith, and J. J. Warr. Drill cores were sampled by L. C. Conant, T. M. Kehn, Lynn Glover, Andrew Brown, and Julian Soren. Symbols used are as follows: G, greater than value indicated; N, not detected, or less than the limit of detection.]

SAMPLE NUMBER	ELEMENT									
	AL	FE	MG	CA	NA	K	TI	P	MN	B
W111237	7.00000	5.00000	.700000	.300000	1.00000	5.00000	.150000	.000000N	.010000	.003000
W111238	5.00000	5.00000	.700000	.150000	1.00000	3.00000	.200000	.000000N	.007000	.003000
W111239	7.00000	5.00000	.700000	.150000	1.00000	3.00000	.200000	.000000N	.007000	.005000
W111240	7.00000	5.00000	.700000	.150000	1.00000	3.00000	.200000	.000000N	.010000	.005000
W111241	7.00000	5.00000	.700000	.200000	1.00000	3.00000	.200000	.000000N	.010000	.005000
W111242	7.00000	3.00000	.700000	.200000	1.00000	3.00000	.200000	.000000N	.010000	.005000
W111243	7.00000	3.00000	.700000	.150000	1.00000	3.00000	.200000	.000000N	.010000	.005000
W111244	7.00000	3.00000	.700000	.200000	1.00000	3.00000	.200000	.000000N	.010000	.005000
W111245	7.00000	2.00000	1.00000	1.00000	1.00000	3.00000	.300000	.000000N	.015000	.010000
W111246	7.00000	2.00000	.700000	.700000	1.00000	3.00000	.200000	.000000N	.010000	.007000
W111247	7.00000	3.00000	.700000	.500000	1.00000	3.00000	.200000	.000000N	.010000	.007000
W111248	7.00000	3.00000	.700000	.300000	1.00000	3.00000	.200000	.000000N	.010000	.007000
W111249	7.00000	3.00000	.700000	.300000	1.00000	3.00000	.200000	.000000N	.010000	.007000
W111250	7.00000	3.00000	.700000	.200000	1.00000	3.00000	.200000	.000000N	.010000	.007000
W111251	7.00000	3.00000	.700000	.150000	1.00000	3.00000	.200000	.000000N	.010000	.007000
W111252	7.00000	3.00000	.700000	.200000	1.00000	3.00000	.150000	.000000N	.010000	.007000
W111253	7.00000	3.00000	.700000	.200000	1.00000	3.00000	.200000	.000000N	.010000	.007000
W111254	10.0000G	2.00000	1.00000	.500000	1.00000	3.00000	.200000	.000000N	.015000	.010000
W111255	10.0000G	2.00000	1.00000	.700000	1.00000	3.00000	.200000	.000000N	.015000	.010000
W111256	10.0000G	2.00000	1.00000	.500000	1.00000	3.00000	.200000	.000000N	.015000	.010000
W111257	10.0000G	2.00000	1.50000	.700000	1.00000	3.00000	.200000	.000000N	.015000	.007000
W111258	10.0000G	2.00000	1.50000	.700000	1.00000	3.00000	.200000	.000000N	.030000	.010000
W111259	10.0000G	2.00000	1.50000	.700000	1.00000	3.00000	.200000	.000000N	.020000	.007000
W111260	7.00000	2.00000	1.00000	.300000	1.00000	3.00000	.150000	.000000N	.015000	.007000
W111261	10.0000G	2.00000	1.00000	.200000	1.00000	3.00000	.150000	.000000N	.010000	.010000
W111262	7.00000	2.00000	1.00000	.300000	1.00000	3.00000	.150000	.000000N	.015000	.010000
W111263	7.00000	2.00000	1.00000	.300000	1.00000	3.00000	.150000	.000000N	.015000	.010000
W111264	10.0000G	2.00000	1.50000	.700000	1.00000	3.00000	.200000	.000000N	.015000	.010000
W115862	7.00000	3.00000	.700000	.300000	.700000	3.00000	.150000	.000000N	.010000	.007000
W115863	7.00000	3.00000	.700000	.700000	1.00000	3.00000	.150000	.000000N	.010000	.005000
W115864	7.00000	3.00000	.700000	.500000	1.00000	3.00000	.150000	.000000N	.010000	.007000
W115780	7.00000	3.00000	.700000	.700000	1.00000	5.00000	.150000	.000000N	.020000	.007000
W115781	7.00000	3.00000	.700000	.700000	1.00000	3.00000	.150000	.000000N	.020000	.007000
W115782	7.00000	3.00000	.700000	1.00000	1.00000	3.00000	.150000	.000000N	.020000	.007000
W115783	7.00000	3.00000	.700000	.700000	1.00000	3.00000	.150000	.000000N	.015000	.007000
W155889	7.00000	3.00000	.700000	2.00000	1.00000	2.00000	.150000	1.50000	.015000	.007000
W155890	7.00000	2.00000	.700000	.200000	1.00000	3.00000	.150000	.000000N	.010000	.007000
W155891	7.00000	2.00000	.700000	.300000	.700000	2.00000	.150000	.000000N	.010000	.007000
W155892	7.00000	3.00000	.700000	.200000	1.00000	3.00000	.150000	.000000N	.010000	.007000
W155893	7.00000	3.00000	.700000	.300000	.700000	3.00000	.150000	.000000N	.010000	.005000
W155894	7.00000	3.00000	.700000	.500000	1.00000	3.00000	.150000	.000000N	.010000	.005000
W155895	7.00000	2.00000	1.00000	.700000	1.00000	3.00000	.150000	.000000N	.030000	.007000
W155896	7.00000	2.00000	1.00000	.700000	1.00000	3.00000	.200000	.000000N	.030000	.007000
W120191	7.00000	2.00000	.700000	.050000	.300000	3.00000	.200000	.000000N	.003000	.007000
W120192	7.00000	2.00000	.700000	.015000	.300000	3.00000	.200000	.000000N	.003000	.007000
W120193	7.00000	2.00000	.700000	.015000	.300000	3.00000	.200000	.000000N	.005000	.007000
W120194	7.00000	2.00000	.700000	.015000	.300000	3.00000	.200000	.000000N	.005000	.007000
W120195	7.00000	2.00000	.700000	.015000	.300000	3.00000	.200000	.000000N	.005000	.007000
W120196	7.00000	2.00000	.700000	.015000	.300000	3.00000	.200000	.000000N	.005000	.007000
W120197	7.00000	2.00000	.700000	.020000	.200000	3.00000	.300000	.000000N	.005000	.007000
W120198	7.00000	2.00000	.700000	.030000	.700000	3.00000	.200000	.000000N	.007000	.007000

SET NO. 7, 51 CORE SAMPLES OF BLACK SHALE FROM THE CHATTANOOGA SHALE IN TENNESSEE AND ALABAMA.--Continued.

SAMPLE NUMBER	ELEMENT									
	BA	BE	CO	CR	CU	GA	LA	MO	NI	PB
W111237	.020000	.000150	.005000	.005000	.015000	.001500	.003000	.010000	.020000	.005000
W111238	.020000	.000200	.003000	.005000	.015000	.001000	.003000	.010000	.010000	.003000
W111239	.020000	.000200	.003000	.005000	.015000	.001500	.003000	.010000	.007000	.002000
W111240	.030000	.000200	.003000	.005000	.015000	.002000	.003000	.010000	.007000	.002000
W111241	.020000	.000200	.003000	.005000	.015000	.001500	.003000	.010000	.010000	.002000
W111242	.030000	.000200	.003000	.007000	.015000	.002000	.003000	.010000	.010000	.003000
W111243	.020000	.000200	.002000	.007000	.015000	.002000	.003000	.010000	.010000	.003000
W111244	.030000	.000200	.002000	.007000	.015000	.002000	.003000	.010000	.010000	.003000
W111245	.050000	.000200	.002000	.010000	.007000	.002000	.005000	.005000	.007000	.002000
W111246	.030000	.000200	.002000	.007000	.010000	.002000	.003000	.005000	.007000	.005000
W111247	.030000	.000200	.002000	.007000	.010000	.002000	.003000	.005000	.010000	.003000
W111248	.020000	.000200	.002000	.007000	.010000	.002000	.003000	.005000	.007000	.003000
W111249	.030000	.000300	.002000	.007000	.010000	.002000	.005000	.005000	.007000	.003000
W111250	.030000	.000300	.002000	.007000	.010000	.002000	.003000	.005000	.007000	.003000
W111251	.030000	.000300	.002000	.007000	.010000	.002000	.003000	.005000	.007000	.005000
W111252	.020000	.000200	.002000	.007000	.010000	.002000	.003000	.005000	.007000	.003000
W111253	.030000	.000300	.001500	.007000	.010000	.002000	.003000	.005000	.010000	.005000
W111254	.030000	.000300	.001500	.007000	.007000	.002000	.005000	.002000	.007000	.003000
W111255	.030000	.000300	.001500	.007000	.007000	.002000	.005000	.001000	.005000	.002000
W111256	.030000	.000300	.001500	.007000	.007000	.002000	.005000	.001500	.007000	.002000
W111257	.020000	.000300	.001500	.010000	.007000	.002000	.005000	.001500	.007000	.003000
W111258	.030000	.000300	.001500	.007000	.007000	.002000	.005000	.001000	.007000	.002000
W111259	.030000	.000300	.001500	.010000	.010000	.002000	.005000	.003000	.010000	.005000
W111260	.020000	.000300	.001500	.010000	.010000	.002000	.003000	.005000	.010000	.005000
W111261	.030000	.000300	.001500	.010000	.010000	.002000	.003000	.007000	.010000	.002000
W111262	.030000	.000300	.001500	.010000	.010000	.002000	.003000	.003000	.010000	.003000
W111263	.030000	.000300	.001500	.010000	.010000	.002000	.003000	.005000	.010000	.003000
W111264	.030000	.000200	.001500	.010000	.010000	.002000	.003000	.001500	.007000	.002000
W115862	.020000	.000150	.003000	.007000	.015000	.002000	.005000	.010000	.015000	.002000
W115863	.020000	.000150	.002000	.005000	.010000	.001500	.003000	.010000	.007000	.002000
W115864	.020000	.000150	.003000	.007000	.010000	.001500	.003000	.010000	.010000	.002000
W115780	.030000	.000300	.005000	.007000	.015000	.001500	.003000	.010000	.010000	.002000
W115781	.030000	.000300	.005000	.005000	.010000	.002000	.005000	.010000	.010000	.002000
W115782	.020000	.000200	.002000	.007000	.020000	.001500	.003000	.007000	.010000	.003000
W115783	.030000	.000300	.005000	.007000	.015000	.001500	.005000	.010000	.010000	.002000
W155889	.030000	.000200	.001500	.007000	.010000	.001500	.005000	.010000	.015000	.007000
W155890	.020000	.000150	.001000	.007000	.010000	.002000	.005000	.003000	.010000	.002000
W155891	.020000	.000200	.001500	.005000	.007000	.002000	.003000	.010000	.010000	.002000
W155892	.070000	.000200	.003000	.005000	.007000	.002000	.003000	.010000	.010000	.002000
W155893	.050000	.000200	.003000	.005000	.001000	.002000	.005000	.010000	.007000	.002000
W155894	.030000	.000200	.003000	.005000	.007000	.002000	.005000	.010000	.007000	.003000
W155895	.020000	.000200	.001500	.007000	.015000	.002000	.005000	.003000	.010000	.002000
W155896	.020000	.000200	.001000	.007000	.015000	.002000	.003000	.003000	.010000	.002000
W120191	.050000	.000200	.000700	.007000	.010000	.002000	.005000	.010000	.005000	.005000
W120192	.030000	.000200	.003000	.007000	.015000	.002000	.003000	.010000	.010000	.005000
W120193	.030000	.000200	.001500	.007000	.015000	.002000	.003000	.005000	.007000	.003000
W120194	.030000	.000200	.002000	.007000	.015000	.002000	.003000	.010000	.010000	.005000
W120195	.030000	.000200	.002000	.007000	.015000	.002000	.003000	.007000	.010000	.003000
W120196	.030000	.000200	.002000	.007000	.015000	.001500	.005000	.015000	.010000	.005000
W120197	.030000	.000200	.001500	.007000	.015000	.001500	.005000	.003000	.007000	.003000
W120198	.030000	.000300	.001500	.010000	.015000	.001500	.005000	.010000	.007000	.003000

SET NO. 7, 51 CORE SAMPLES OF BLACK SHALE FROM THE CHATTANOOGA SHALE IN TENNESSEE AND ALABAMA.--Continued.

SAMPLE NUMBER	ELEMENT SC	SR	V	Y	ZN	ZR	U	ORG C
W111237	.000700	.010000	.015000	.005000	.030000	.007000	.009200	12.5000
W111238	.000700	.010000	.015000	.003000	.000000N	.007000	.008400	13.9000
W111239	.001000	.010000	.015000	.003000	.000000N	.010000	.008100	14.5000
W111240	.001000	.007000	.015000	.003000	.000000N	.010000	.008000	13.9000
W111241	.001000	.010000	.015000	.003000	.000000N	.010000	.007900	12.8000
W111242	.001000	.010000	.015000	.003000	.000000N	.010000	.007000	12.5000
W111243	.001500	.010000	.015000	.003000	.000000N	.010000	.005600	9.50000
W111244	.001500	.010000	.020000	.003000	.000000N	.010000	.004600	7.70000
W111245	.001500	.020000	.015000	.005000	.000000N	.010000	.003100	5.00000
W111246	.001500	.020000	.015000	.003000	.000000N	.010000	.004800	9.20000
W111247	.001500	.010000	.015000	.003000	.000000N	.010000	.005300	12.3000
W111248	.001500	.015000	.015000	.003000	.000000N	.010000	.004500	13.4000
W111249	.001500	.015000	.015000	.003000	.000000N	.010000	.005600	11.6000
W111250	.002000	.010000	.015000	.003000	.000000N	.010000	.005100	11.4000
W111251	.002000	.010000	.015000	.003000	.000000N	.010000	.005800	9.40000
W111252	.001500	.010000	.015000	.003000	.000000N	.010000	.005900	14.1000
W111253	.001500	.010000	.020000	.003000	.000000N	.010000	.005800	15.8000
W111254	.002000	.020000	.015000	.003000	.000000N	.010000	.001900	3.10000
W111255	.002000	.020000	.015000	.003000	.000000N	.010000	.000900	1.30000
W111256	.003000	.020000	.020000	.003000	.000000N	.010000	.000700	2.00000
W111257	.002000	.015000	.015000	.003000	.000000N	.010000	.000800	4.20000
W111258	.002000	.015000	.015000	.003000	.000000N	.010000	.000700	2.40000
W111259	.002000	.015000	.015000	.003000	.000000N	.010000	.003000	9.50000
W111260	.001500	.010000	.020000	.003000	.000000N	.007000	.003800	12.6000
W111261	.001500	.010000	.030000	.003000	.030000	.010000	.004200	11.8000
W111262	.001500	.015000	.030000	.003000	.030000	.010000	.003800	6.50000
W111263	.001500	.010000	.030000	.003000	.030000	.010000	.002100	10.4000
W111264	.002000	.015000	.020000	.003000	.000000N	.010000	.001200	3.30000
W115862	.001500	.010000	.020000	.005000	.030000	.010000	.004600	11.6000
W115863	.001000	.010000	.015000	.003000	.000000N	.010000	.005400	10.7000
W115864	.001000	.015000	.015000	.003000	.000000N	.010000	.005700	11.4000
W115780	.001500	.010000	.015000	.005000	.000000N	.010000	.006900	10.0000
W115781	.001000	.015000	.015000	.005000	.000000N	.010000	.009200	11.8000
W115782	.001000	.015000	.015000	.003000	.000000N	.010000	.005100	8.70000
W115783	.001000	.015000	.020000	.005000	.000000N	.010000	.008300	10.9000
W155889	.001000	.020000	.050000	.005000	.100000	.010000	.004500	15.5000
W155890	.001000	.010000	.050000	.005000	.000000N	.010000	.003200	11.2000
W155891	.001000	.007000	.050000	.003000	.050000	.010000	.006500	13.6000
W155892	.001000	.010000	.030000	.003000	.000000N	.010000	.006500	11.3000
W155893	.001000	.007000	.020000	.003000	.000000N	.010000	.007100	12.2000
W155894	.001000	.010000	.015000	.003000	.000000N	.010000	.004800	9.00000
W155895	.001500	.010000	.015000	.003000	.000000N	.010000	.002200	8.50000
W155896	.001000	.010000	.015000	.003000	.000000N	.010000	.001700	9.80000
W120191	.001500	.015000	.020000	.010000	.000000N	.015000	.007600	9.70000
W120192	.001500	.010000	.020000	.005000	.000000N	.010000	.005800	11.3000
W120193	.001000	.010000	.020000	.003000	.000000N	.010000	.003700	8.10000
W120194	.001500	.010000	.020000	.005000	.000000N	.015000	.005200	8.80000
W120195	.001500	.010000	.020000	.005000	.000000N	.015000	.005600	7.90000
W120196	.001000	.010000	.020000	.005000	.000000N	.015000	.006600	9.90000
W120197	.001500	.010000	.020000	.005000	.000000N	.020000	.002000	2.80000
W120198	.001000	.010000	.020000	.005000	.000000N	.015000	.002900	5.90000

SET NO. 8, 21 CORE SAMPLES OF BLACK SHALE FROM THE PARADOX MEMBER OF THE HERMOSA FORMATION PENETRATED IN A POTASH TEST WELL, GRAND COUNTY, UTAH

/All analyses (except lithium, MgO, CaO, Na_2O, K_2O, mineral carbon, organic carbon, equivalent uranium, chlorine, and sulfur) by the six-step spectrographic method, A. L. Sutton, Jr., analyst. Results are reported in percent to the nearest number in the series 1, 0.7, 0.5, 0.3, 0.2, 0.15, and 0.1, etc., which represent approximate midpoints of group data on a geometric scale. The assigned group will include the quantitative value about 30 percent of the time. Quantitative spectrographic analyses of lithium by Harriet Neiman; MgO, CaO, Na_2O, and K_2O determined by methods described in Shapiro and Brannock (1962); mineral and organic carbon determined by method described by Rader and Grimaldi (1961, p. 33-38); chlorine determined by volumetric titration; sulfur determined by versenate titration; eU determined by beta gamma scaler. Analysts were Wayne Mountjoy, J. D. Mensik, G. T. Burrow, I. C. Frost, and Lorraine Lee. Symbols used are as follows: G, greater than value indicated; N, not detected; and L, less than value indicated./

SAMPLE NUMBER	ELEMENT									
	SI	AL	FE	TI	P	MN	B	BA	BE	CO
D114861	7.00000	1.50000	.700000	.050000	.000000N	.015000	.005000	.015000	.000000N	.000000N
D114862	10.0000G	3.00000	1.00000	.070000	.000000N	.020000	.007000	.015000	.000000N	.000700
D114863	10.0000G	3.00000	1.00000	.050000	.000000N	.020000	.007000	.015000	.000000N	.000500
D114864	10.0000G	5.00000	2.00000	.070000	.000000N	.015000	.015000	.015000	.000150	.000500
D114865	10.0000G	7.00000	2.00000	.100000	.000000N	.015000	.020000	.015000	.000150	.000700
D114866	1.50000	.700000	.700000	.030000	.000000N	.015000	.005000	.005000	.000000N	.000000N
D114867	10.0000G	5.00000	1.50000	.070000	.000000N	.010000	.020000	.015000	.000100	.000500
D114868	1.50000	1.00000	.700000	.070000	.000000N	.015000	.005000	.005000	.000000N	.000000N
D114869	10.0000G	5.00000	1.50000	.070000	.000000N	.010000	.015000	.015000	.000100	.000500
D114870	10.0000G	7.00000	1.50000	.100000	.000000N	.015000	.020000	.030000	.000100	.000500
D114871	10.0000G	7.00000	1.50000	.100000	.000000N	.010000	.015000	.030000	.000100	.000500
D114872	10.0000G	7.00000	2.00000	.150000	.000000N	.015000	.020000	.030000	.000100	.000500
D114873	10.0000G	3.00000	1.00000	.100000	.000000N	.015000	.007000	.030000	.000000N	.000500
D114874	10.0000G	5.00000	1.00000	.100000	.000000N	.015000	.010000	.050000	.000000N	.000500
D114875	10.0000G	3.00000	1.00000	.070000	.000000N	.015000	.005000	.030000	.000000N	.000500
D114876	10.0000G	7.00000	1.00000	.100000	.000000N	.015000	.007000	.030000	.000000N	.000500
D114877	7.00000	2.00000	1.00000	.070000	.000000N	.015000	.005000	.020000	.000000N	.000000N
D114878	3.00000	2.00000	.700000	.050000	.000000N	.015000	.003000	.020000	.000000N	.000000N
D114879	10.0000G	5.00000	1.00000	.100000	.000000N	.015000	.005000	.050000	.000000N	.000000N
D114880	10.0000G	5.00000	1.00000	.100000	.000000N	.010000	.010000	.050000	.000000N	.000000N
D114881	10.0000G	5.00000	1.00000	.070000	.000000N	.015000	.007000	.030000	.000000N	.000700

SAMPLE NUMBER	ELEMENT									
	CR	CU	GA	LA	MO	NI	PB	SC	SR	V
D114861	.005000	.001000	.000700	.000000N	.000000N	.001500	.001500	.000000N	.030000	.003000
D114862	.005000	.001500	.001000	.003000	.000000N	.003000	.005000	.000700	.020000	.005000
D114863	.010000	.001500	.000700	.002000	.000000N	.005000	.000000N	.000700	.020000	.005000
D114864	.015000	.003000	.002000	.005000	.000000N	.005000	.001500	.001000	.020000	.007000
D114865	.020000	.003000	.002000	.003000	.000000N	.005000	.001000	.001500	.020000	.007000
D114866	.007000	.001000	.000500	.002000	.000000N	.001500	.000000N	.000000N	.015000	.002000
D114867	.020000	.002000	.001500	.002000	.000000N	.003000	.001000	.001000	.020000	.007000
D114868	.005000	.001000	.000700	.003000	.000000N	.001500	.000000N	.000000N	.015000	.002000
D114869	.015000	.002000	.001500	.005000	.000000N	.003000	.001000	.001000	.020000	.007000
D114870	.020000	.005000	.002000	.003000	.000700	.005000	.002000	.001000	.020000	.007000
D114871	.020000	.003000	.001500	.005000	.000500	.005000	.001000	.001500	.050000	.007000
D114872	.030000	.003000	.003000	.003000	.000500	.005000	.002000	.001500	.030000	.010000
D114873	.007000	.001500	.001000	.000000N	.000000N	.002000	.001000	.000700	.070000	.005000
D114874	.007000	.002000	.001500	.002000	.000000N	.003000	.001000	.000700	.100000	.007000
D114875	.005000	.001500	.001000	.002000	.000000N	.002000	.001000	.000700	.070000	.005000
D114876	.007000	.002000	.001500	.000000N	.000000N	.002000	.001000	.000700	.070000	.005000
D114877	.005000	.001500	.001000	.000000N	.000000N	.001500	.000000N	.000000N	.070000	.005000
D114878	.005000	.001000	.000700	.003000	.000000N	.001500	.000000N	.000000N	.070000	.005000
D114879	.005000	.000700	.001000	.002000	.000000N	.001500	.000000N	.000700	.070000	.005000
D114880	.005000	.000700	.001000	.005000	.000000N	.001500	.000000N	.000700	.050000	.005000
D114881	.005000	.002000	.000700	.000000N	.000700	.003000	.001000	.000700	.100000	.005000

SET NO. 8, 21 CORE SAMPLES OF BLACK SHALE FROM THE PARADOX MEMBER OF THE HERMOSA FORMATION PENETRATED IN A POTASH TEST WELL, GRAND COUNTY, UTAH.--Continued.

SAMPLE NUMBER	ELEMENT Y	YB	ZR	LI	MGO	CAO	NA2O	K2O
D114861	.002000	.000150	.005000	.002800	13.2000	18.6000	.580000	1.60000
D114862	.003000	.000200	.007000	.004200	13.6000	16.6000	.780000	1.60000
D114863	.003000	.000200	.007000	.003200	13.3000	16.6000	.540000	1.60000
D114864	.003000	.000200	.007000	.008500	6.70000	7.70000	.930000	2.90000
D114865	.003000	.000300	.007000	.009400	6.10000	9.90000	.960000	2.90000
D114866	.002000	.000150	.001000	.003800	17.0000	23.5000	.360000	.750000
D114867	.003000	.000200	.005000	.006400	4.90000	7.30000	.680000	2.20000
D114868	.003000	.000150	.001000	.004300	16.6000	23.2000	.390000	.920000
D114869	.003000	.000200	.003000	.006600	5.70000	12.6000	.760000	2.90000
D114870	.002000	.000150	.007000	.006200	5.60000	4.00000	1.10000	3.80000
D114871	.002000	.000200	.005000	.005100	5.10000	14.2000	.910000	4.20000
D114872	.002000	.000200	.005000	.005800	5.60000	7.40000	1.00000	5.10000
D114873	.001500	.000150	.010000	.002900	9.50000	15.2000	1.60000	3.30000
D114874	.002000	.000150	.005000	.003500	6.90000	17.7000	.270000	4.50000
D114875	.001500	.000150	.007000	.002600	9.30000	20.1000	.970000	2.90000
D114876	.001500	.000150	.010000	.003800	7.20000	17.1000	.210000	5.00000
D114877	.001000	.000100	.003000	.003000	13.5000	20.6000	.460000	2.50000
D114878	.001500	.000100	.003000	.003200	6.20000	32.4000	.260000	2.20000
D114879	.002000	.000200	.010000	.004600	9.40000	10.7000	5.90000	2.80000
D114880	.002000	.000150	.010000	.003500	8.20000	8.90000	6.20000	3.10000
D114881	.001500	.000150	.007000	.003000	8.80000	18.3000	3.50000	2.30000

SAMPLE NUMBER	ELEMENT TOTAL C	ORG C	EU	CL	S
D114861	7.83000	1.30000	.002000	1.41000	.110000
D114862	7.23000	1.10000	.001000	1.70000	.180000
D114863	8.37000	2.10000	.001000	1.12000	.140000
D114864	4.99000	3.30000	.002000	1.96000	1.44000
D114865	4.93000	2.70000	.003000	2.12000	.830000
D114866	10.7000	1.60000	.001000L	.690000	.100000L
D114867	4.96000	3.40000	.001000L	1.49000	.650000
D114868	9.86000	.800000	.001000L	.830000	.290000
D114869	5.99000	3.10000	.001000	1.52000	1.19000
D114870	3.54000	2.60000	.003000	2.50000	1.41000
D114871	5.40000	2.20000	.004000	1.88000	1.08000
D114872	4.76000	3.30000	.004000	2.21000	1.12000
D114873	5.56000	.800000	.002000	3.70000	.140000
D114874	8.06000	3.50000	.003000	3.20000	.100000L
D114875	6.65000	.900000	.002000	2.69000	.100000L
D114876	5.62000	2.10000	.003000	2.62000	.100000L
D114877	7.92000	.600000	.002000	2.46000	.100000L
D114878	9.07000	.900000	.002000	2.19000	.100000L
D114879	3.95000	.600000	.001000	7.59000	.100000L
D114880	3.27000	.200000L	.001000	8.13000	.100000L
D114881	4.41000	.400000	.001000	5.46000	3.64000