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URANIUM CONTENT OF CHATTANOOGA SHALE IN EAST-CENTRAL TENNESSEE AND SOUTHERN KENTUCKY *

By

Louis C. Conant and Vernon E. Swanson

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Trace Elements Investigations Report 224

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* This report concerns work done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission

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URANIUM CONTENT OF CHATTANOOGA SHALE IN EAST-CENTRAL TENNESSEE AND SOUTHERN KENTUCKY

By

Louis C. Conant and Vernon E. Swanson

ABSTRACT

Uranium assays of all the samples collected by the Geological Survey from the Chattanooga shale in east-central Tennessee and southern Kentucky from 1947 to 1949 are assembled here, and conclusions are drawn concerning the distribution of the uranium. The 1108 assays from 80 localities provide reasonably reliable information on the stratigraphic and regional variations of the uranium content.

The area of highest uranium concentration in the Chattanooga shale found to date is in the structurally complex Walden Ridge area of southeastern Tennessee, but mining there would be a precarious venture. Only slightly less uranium is in the flat-lying shale along parts of the Eastern Highland Rim of east-central Tennessee, where a new reservoir would facilitate collection and transportation of the ore. Northward and westward the uranium content appears to be lower.

Several stratigraphic units of the Chattanooga shale, having a total thickness of about 30 feet, have been recognized and traced considerable distances along much of the eastern edge of

the Nashville Basin. In DeKalb County the unit at the top of the formation that is about 6 feet thick contains about 0.007 to 0.008 percent uranium; the three successive units at the top that have an aggregate thickness of about 16 feet contain 0.006 to 0.007 percent uranium. The other units have considerably less uranium. Assays of many of the routine samples, however, are believed to indicate somewhat less than the actual uranium content of the rock.

Re-appraisals of the uranium reserves, using additional assays, suggests a slightly smaller uranium reserve in Block 1 than had been previously calculated, but the validity of the re-appraisal is questioned.

INTRODUCTION

This report assembles all uranium assays of samples of Chattanooga shale ("black shale") that were collected in east-central Tennessee and southern Kentucky by a U. S. Geological Survey party from 1947 to 1949. This work was done on behalf of the Division of Raw Materials of the Atomic Energy Commission. An earlier report [3] 1/ on this area was presented in 1950 when 40 percent of the samples were still unassayed. Work on the remaining ones had been indefinitely postponed, but a renewal of interest in

1/ Numbers in brackets designate references at end of report.

black shale in 1951 prompted the assaying of those samples. This report brings together the earlier assays and the new ones in order to have in one place a complete record of assays of the Chattanooga shale samples from the Eastern Highland Rim area of east-central Tennessee and nearby valley regions of southern Kentucky.

This report also presents deductions concerning the distribution of uranium in the Chattanooga shale; such deductions have been presented previously [3], but in this report they are based on considerably more factual information derived from both the additional assay work and continued geologic study.

Two other reports by the same Geological Survey party have been submitted giving all assays from the Sequatchie Valley of Tennessee and some nearby outcrops [7], and from northern Kentucky [8]. Those areas are not duplicated here.

Plate 1 shows the sampled localities in Tennessee, and plate 4 shows the sampled localities in southern Kentucky. Larger scale maps of the Tennessee areas may be found in earlier reports [3, 7]. Plates 3 and 4 show the uranium content of different stratigraphic units of the shale.

OTHER REPORTS

During the period 1944 to 1946 Slaughter [9] and Brill [6] did reconnaissance work on the Chattanooga shale, and sampled widely scattered outcrops over large areas, chiefly in Tennessee, Kentucky, and Alabama. Most of their assays were radiometric (Geiger counter readings in either the field or the laboratory), though a few chemical assays were made. This earlier work was of much assistance to the later investigations reported here. Many of the Slaughter and Brill localities within the area of the present investigation were resampled.

Previous reports by members of the present party [1, 3, 7, 8] have described the methods of sampling, the regional setting, and the salient geologic features of the Chattanooga shale. Those topics are treated here only briefly.

Several classified reports have been submitted to the Atomic Energy Commission by laboratories that have studied various problems relating to uranium in the shale, and the problems of its extraction.

A much longer and more detailed geologic report is in preparation by L. C. Conant and others on the geology of the Chattanooga shale and related rocks of central Tennessee and nearby areas. That report is planned for formal publication by the U. S. Geological Survey.

GEOLOGIC AND GEOGRAPHIC CONDITIONS

The Chattanooga shale is about 30 feet thick in most of the area discussed in this report. In the southern part of Tennessee it thins markedly so that in many places it is only about 5 feet thick, and in some places it is absent. Northward in Kentucky it is somewhat thicker, so that in the Cumberland River valley it is about 40 feet thick.

The nearly jet-black color of the rock, as well as its shaly appearance, sets it apart from the rocks that are above or below it, so that, once one has seen it at a few places, it is easily recognized in road cuts. The shale is tough when fresh, but becomes fissile and breaks into small flakes when weathered.

The Chattanooga shale was formed in a sea that flooded a large section of North America during Devonian time. In some parts of the continent the black shale and related rocks accumulated to thicknesses of hundreds and thousands of feet, but the black shale of equivalent age in the area of this study has thicknesses measurable only in tens of feet, or less. The shale accumulated with extreme slowness in a body of marine water that was probably only a few tens of feet deep, despite the great extent of the sea. The shale has been determined by Hass [unpublished investigations] to be of Late Devonian age, and seems to have been accumulating during most of that time, some 10 to 20 million years.

An average mineral composition of the shale has never been accurately determined, but appears to be about 30 to 35 percent quartz, 30 to 35 percent clay and mica, 20 percent organic matter, 10 percent pyrite, and minor amounts of other constituents, including calcite and phosphate. All attempts thus far to determine the association of the uranium with any constituent of the shale have been unsuccessful.

The Chattanooga shale is readily divisible into five distinct stratigraphic units that can be traced for at least several tens of miles. Some of the units can be traced with a fair degree of certainty for 100 miles or more. For convenience in field work, and pending the establishment of a more formal nomenclature, these units were termed as follows:

Maury formation	
Chattanooga shale	
Top Black shale	Upper Black shale (Gassaway member)
Upper siltstone	
Middle Black shale	
Middle Gray siltstone	(Dowelltown member)
Lower Black shale	

The more formal terms, Gassaway and Dowelltown members, will be used in forthcoming reports designed for publication, but the lithologic terminology is retained here as it has been used in previous reports [3, 7]. Subsequent petrographic studies have shown that the two "siltstone" units could better have been termed claystone, but for ease of comparison of the several reports submitted on this investigation the earlier terminology

is retained. In the northern part of Tennessee and in southern Kentucky the uppermost few feet of the Top Black shale contains scattered nodules of phosphate commonly a few inches in diameter.

The Maury formation (pronounced "Murray"), immediately above the shale, is about 1 to 3 feet thick. It consists of an upper greenish claystone unit having many spherical phosphate nodules about 1 inch in diameter, and, in most places, has a conspicuous basal unit, usually less than 1 foot thick, composed chiefly of irregular and tightly packed phosphate nodules several inches or more in diameter.

In most of Tennessee the Chattanooga shale and Maury formation are overlain by the extremely tough and massive Fort Payne chert, commonly 150 to 200 feet thick. In most of Kentucky the Chattanooga and Maury are overlain by the New Providence shale, a dark-gray calcareous shale that is much less tough than either the Chattanooga shale or Fort Payne chert. In northern Tennessee similar overlying shale has been termed by some writers the Ridgetop shale.

Beneath the Chattanooga shale are limestones and shales of many formations, which are easily distinguished from the Chattanooga.

Topographically central Tennessee is a fertile lowland, commonly known as the Nashville Basin, or the Central Basin, surrounded by a fairly smooth upland, known as the Highland Rim.

Between the Basin floor and the Rim is a steep slope several hundred feet high. The Chattanooga shale is well exposed in most road cuts and creek beds that cross this slope. The Eastern Highland Rim, about 25 miles wide, is bounded on the east by the Cumberland Plateau, which rises abruptly about 1,000 feet above the Rim.

Structurally central Tennessee is a broad dome in which the rocks dip gently away from the center at rates of less than 1°. Many small folds superimposed on this regional structure have dips as high as 10°, but most of them are very local, commonly less than a mile in extent.

About 50 miles southeast of the Nashville Basin a sharp anticline, which is also strongly faulted, has been deeply eroded to form the Sequatchie Valley, a steep-walled valley 1,000 feet or more deep, 3 to 5 miles wide, and 150 miles long. The Chattanooga shale is not exposed along most of the west edge of this valley because of the fault, but is present along the east edge where it is well exposed in a few highway cuts and creek beds. A few miles farther east the shale is exposed on the flanks of some of the Appalachian folds, especially in the vicinity of Chattanooga. In both the Sequatchie anticline and the more eastern folds the shale has been so badly contorted and sheared by the folding forces that any attempt to mine it would probably encounter many difficulties and unpredictable conditions.

SAMPLING AND ASSAYING

This report is based on uranium assays of 1108 samples from 80 localities; assays of 442 of the samples are reported here for the first time. Many of the samples have been assayed two or three times. The sample localities are distributed as follows: 71 along or near the eastern edge of the Nashville Basin, 2 wells on the Eastern Highland Rim and the Cumberland Plateau of Tennessee, 6 outcrops in the eastern valley of the Cumberland River of southern Kentucky, and 1 in the Green River Valley of central Kentucky.

Most of the localities are about 5 miles apart, but some are much more closely spaced to test for possible short-distance differences in uranium content. Nearly all the sample localities are highway and road cuts, but a few are stream exposures.

The outcrops were chipped clean and channeled crudely with ordinary geology hammers. As a rule, each sample represents a 2-foot thickness of shale and weighs about 20 pounds. Several other samples ranging from a few grams to about 10 tons were taken for special studies and examination.

To facilitate comparisons of assays from different localities, distinctive numbers were allotted to each lithologic unit, making it possible to tell from a sample number what part of the formation it represents. The system used is shown below.

Stratigraphic unit	Allotted numbers	Remarks
Maury formation	1-10	Usually only one sample.
Chattanooga shale		
Phosphatic beds (including basal phosphate bed of the Maury)	11	Commonly not used where phosphate nodules are absent. Where such beds are thick, letters A, B, etc., are added.
Top Black shale (non-phosphatic)	12-20	
Upper siltstone	21-30	Usually only one or two samples.
Middle Black shale	31-40	
Middle Gray siltstone	41-50	Base of sample 41 usually base of a bentonite bed.
Lower Black shale	51-60	

This numbering system was modified somewhat from place to place to fit special needs or changing ideas. For example, sample number 11 was reserved, after a few outcrops had been sampled, for a conspicuous phosphate nodule layer near the top of the black shale and base of the Maury; at first it was considered part of the Chattanooga shale, but later it was assigned to the Maury formation. At some places where phosphate nodules are scattered through more than 2 feet of the uppermost Chattanooga, the 2-foot samples of phosphatic shale were numbered 11A, 11B, etc. In some areas, chiefly in Kentucky, where the standard stratigraphic units could not be recognized with certainty, a straight sequence of numbers

was used starting with 1.

The area of investigations was divided arbitrarily into Blocks, shown on plate 1 (Blocks 1, 4, 5, 6, and 7, plus the indicated area in Kentucky are covered in this report), and localities in each Block were assigned numbers having distinctive prefixes that indicated a specific locality within a certain area. Early sample localities in Block 1 and a few nearby localities have the prefix LC, and those in Block 5 have the prefix R-C. Later localities have prefixes indicating the 15-minute quadrangle in which they lie. Plate 1 illustrates this system. Locality numbers are followed by numbers indicating the stratigraphic units represented by the individual samples, as already explained. Thus, sample 13M-10-14 is from locality 10 in quadrangle 13M, and from the Top Black shale.

By far the largest number of samples were assayed for their uranium content in the Trace Elements Section Washington Laboratory of the U. S. Geological Survey. A few of the samples were assayed and studied in greater detail at Battelle Memorial Institute and at the Y-12 laboratories at Oak Ridge. Assays reported by the Battelle and Y-12 laboratories have been summarized previously [3]. All the assays reported here were made by fluorimetric methods in the laboratory of the Geological Survey.

VALIDITY OF ASSAY DATA

Assays of samples having such low concentrations of uranium as the black shale must not be taken entirely at their face value. The early assays were believed by the laboratory to be subject to probable errors of about ± 0.002 percent, and later assays are believed to be subject to only about half that error. Where assays are on the order of 0.005 to 0.008 percent and each is subject to an error of ± 0.001 or 0.002, it is obvious that direct comparisons of individual assays are not warranted. But in averaging several assays of the same sample, or a number of samples from the same stratigraphic interval, these errors may cancel one another, and comparisons may be more warranted. In the following sections conclusions regarding the uranium content of the different stratigraphic units and of the different areas are based on the questionable assumption that such averages are reliable.

Other factors that may cause unreal differences in the apparent uranium content of the shale are the character of the outcrop and the human errors of sampling. Some outcrops are weathered more than others, and this may affect the uranium content of the rock close to the surface, where the samples had to be taken. No systematic effect of weathering on the uranium content has been noted; in fact, it is suspected that at some outcrops weathering has caused a slight enrichment of uranium,

while at others it has caused a partial removal of uranium.

Sampling of such tough rock as the black shale by using only geology hammers could introduce accidental errors, such as the collection of too much or too little of some beds within a 2-foot sample interval. Had it been practicable to use power saws to cut true channel samples from the freshest available surfaces, this factor of uncertainty would have been considerably reduced.

Significant sampling errors may have been introduced in the drill cores, as the few cores obtained in a brief drilling program [2] were badly fractured and split. There is some reason to believe that much of the uranium is associated with the bituminous matter in the shale [3, p. 54]. If this is so, the low assays of the cores may well result from the fracturing and splitting of the cores, which permitted bituminous and other light-weight organic-rich laminae to wash away. Splitting of the shale was perhaps excessive because the drills were the metal-tipped type. The U. S. Engineers, by using diamond bits, have obtained excellent cores of the Chattanooga shale at several places.

Reruns of several sets of samples have given significantly higher or lower assays than did the original determinations, and for most localities both sets of assays are shown in the graphs at the end of this report. The following table compares the weighted average assays of the Upper Black unit for those localities where duplicate assays have been made.

Table 1.--Comparisons of duplicate assays
(except as noted, all assays are fluorimetric)

Locality number	Sample number	Thickness	Average based on assays in TEIR 62	Average based on later assays	Difference
			Block 1		
LC-4	12-34	18.2	0.0066	0.0067	+.0001
LC-10	11-35	18.4	.0091	.0061	-.003
LC-15	12-33	15.1	.0057 a	.0064	+.0007
LC-17	11-34	17.0	.0065	.0063	-.0002
LC-50	12-35	18.3	.010	.0063	-.0037
LC-56	11-34	16.4	.0078 b	.006	-.0018 b
			Block 4		
13L-11	11A-33	17.3	.0038	.0053	+.0015
13L-20	11-33	17.6	.0043	.0057	+.0014
13L-22	11B-31	15.8	.0042 a b	.0053	+.0011
13M-5	11-34	16.4	.0037	.0058	+.0021
13M-10	11B-34	21.3	.0051 a	.0058	+.0007
13M-19	11-32	17.2	.0038	.0053	+.0015
13M-23	11-32	17.9	.0034	.0052	+.0018
			Block 5		
R-C2	12-34	12.3	.0072 b	.0035 .0061	-.0037 -.0011

a Average given in TEIR 62 included phosphate nodule bed (sample 11), not included in this average.
b Tracerlab assays.

If any conclusions can be drawn from these comparisons they would seem to be:

1) Assays of shale having only a few thousandths of 1 percent of uranium must be accepted provisionally, especially individual assays that are abnormally high or low.

2) Those samples that gave abnormally high or low assays

on the original determinations gave more nearly average assays on the second determinations.

3) The greater the mass of available data, the more uniform the uranium content of the shale seems to be from place to place.

It has often been wondered whether or not outcrop samples of the shale can safely be considered representative of the fresher rock underground. Insufficient evidence is available to give a definite answer, but in Block 1, drill hole LC-102, the adit (LC-201), and outcrops LC-10 and LC-55, are close together and are worthy of comparison. In the core the assays were slightly lower than both the outcrops, but several large samples from the adit that were assayed at Battelle Memorial Institute and the Y-12 research unit at Oak Ridge, gave assays slightly higher than the nearby outcrops and the drill core. These differences could be interpreted to reflect 1) true differences in the uranium content of the fresh rock, 2) weathering, 3) removal of uranium from the core by circulating drill water, 4) errors in sampling, or 5) errors in assay. Until far more information is available, none of these explanations can be safely deduced.

From several places much larger samples were taken for special study at Battelle and Y-12. These samples, some of which were several tons in weight, were composed of somewhat fresher rock than were the routine samples, and the uranium content of them was presumably determined more carefully than was the case

with the routine samples. Details concerning these samples have been presented previously [3, table 6], but some of that information is repeated here in table 2 and compared with assays of routine samples from the same or nearby outcrops. Such comparisons afford at least suggestions as to the dependability of routine assays of outcrop samples.

Comparisons at the first four of these localities show significantly higher assays of the special samples. At the other six the differences are less than 0.001 percent, and are believed to be insignificant. Of the four where the special samples are significantly higher, three are from road cuts and one (LC-6) from a small gorge wall near a waterfall; at all four there has been opportunity for leaching of the outcrop by surface water or mist. The other six are also from road cuts, and stream walls, and seemingly have been equally exposed to leaching.

If any conclusions can be drawn from these comparisons it would seem to be that some outcrops have lost part of their uranium through weathering, and that in general the fresh rock contains as much uranium, if not more, than the nearby outcrops. Many of the special samples were taken from road outcrops, but extended a foot or more back from the surface, so it would also seem that one does not need to get far back from the exposed surface to obtain representative samples.

Table 2.--Comparisons of assays of routine and special samples (all USGS assays are fluorimetric, others are by fluorimetric or other chemical means)

Locality	Routine samples		Special samples			Difference
	Sample number [a]	Assay	Sample number	Assay	Laboratory	
14M-2	11A-12	0.0024	S-100	0.0061	BMI	+.0037
			S-100	.0042	Y-12	+.0018
14M-2	11A-14	.0047	S-100(1-9)	.0038	USGS	-.0009
				.0063	USGS	+.0016
				.0073	USGS	+.0023
R-C2	13	.0075	R-C2-113B	.0092	BMI	+.0017
	.0075		-113L	.0090	Y-12	+.0015
R-C2	13	.0075	-213B	.0097	BMI	+.0022
R-C4	13	.007	R-C4-113B	.0083	BMI	+.0013
LC-6	(13-14)	.006	LC-6-B	.007	BMI	+.001
			-L	.0065	Y-12	+.0005
			-M	.007	USGS	+.001
LC-10	(13-15)	.008	LC-10-B	.008	BMI	none
			-M	.008	USGS	none
LC-10	12-15	.0081	LC-201	.0083	b	+.0002
LC-11	31	.006	LC-11-B	.006	BMI	none
			-L	.0057	Y-12	-.0003
			-M	.006	USGS	none
LC-11	13	.005	LC-11-102B	.0045	BMI	-.0005
			-102L	.0038	Y-12	-.0012
LC-15	(14-15)	.008	LC-15-A	.008	USGS	none
			-B	.008	Y-12	none
			-C	.0075	BMI	-.0005
LC-15	(12-15)	.0075	-101	.0078	BMI	+.0003
LC-17	(13-14)	.008	LC-17-B	.0075	BMI	-.0005
			-M	.008	USGS	none
LC-33	13	.009	LC-33-B	.0087	BMI	-.0003
LC-55	12-34	.0063	LC-55-101	.007	Y-12	+.0007

a Where the special samples do not coincide exactly with the routine samples, the routine sample numbers are in parentheses. In such instances, the indicated routine assay has been calculated by combining the individual assays in suitable proportions.

b Assay of special sample LC-201 is average of 6 assays by BMI and Y-12; one abnormally low assay of 0.005 by USGS is not included.

STRATIGRAPHIC DISTRIBUTION OF URANIUM

The most definite fact shown by the assays is that the uranium content of the several stratigraphic units is distinctly different. Of the five units that have been recognized in the Chattanooga shale, the Top Black shale consistently contains the most uranium, and this is followed, in order of decreasing uranium content, by the Middle Black shale, the Upper siltstone, the Lower Black shale, and the Middle Gray siltstone. Throughout the entire area of the investigation this relative uranium content of the several stratigraphic units is essentially constant. Plate 2 shows the approximate average uranium content of these units in east-central Tennessee.

From the mining standpoint the three uppermost units, having a total thickness of about 16 feet, is the most attractive, and would probably constitute a single mining unit.

The explanation for this stratigraphic control of the uranium content is not known. In general, the upper part of the formation is distinctly more massive than the lower part, and has far less of the gray siltstone (claystone) beds. The more highly uraniferous beds are also the most massive in their appearance. Microscopic study of the shale and claystone shows that the most massive shales exhibit the most pronounced sorting of the component grains and the most highly developed lamination. Consideration of

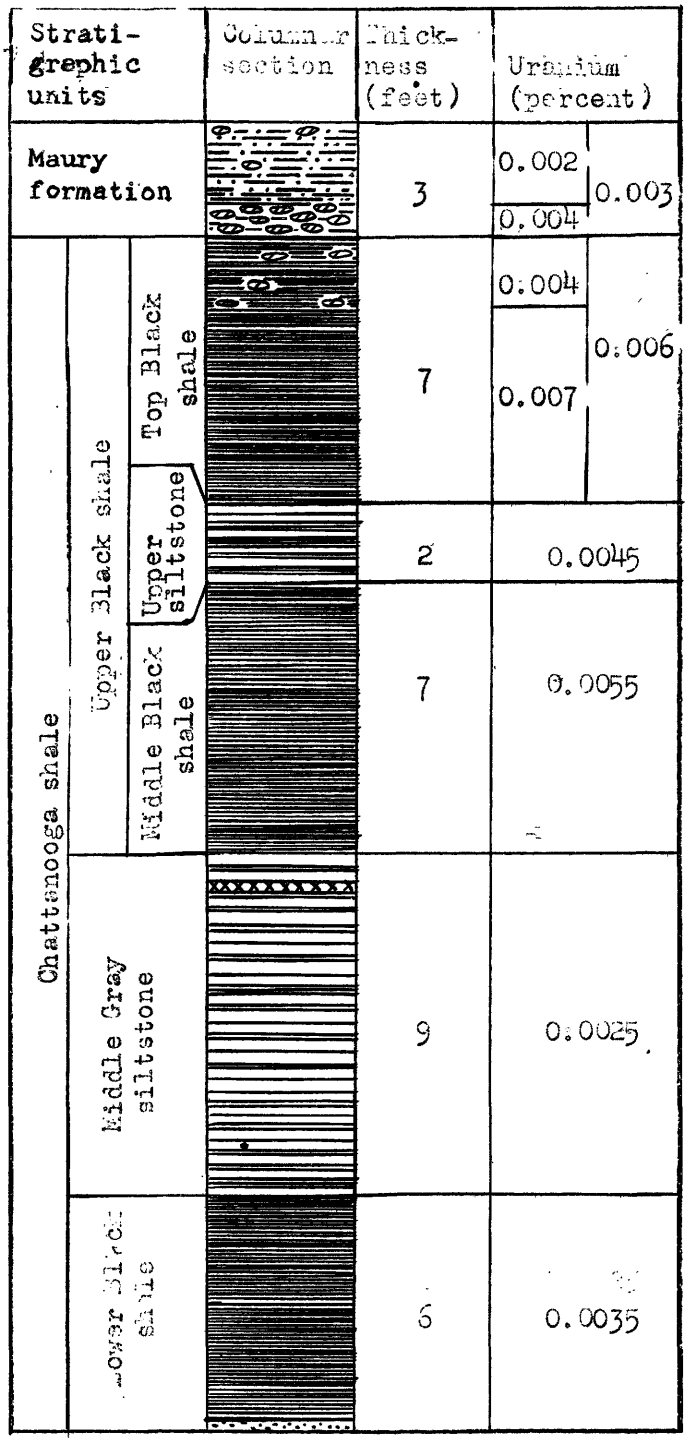


Plate 2. Generalized stratigraphic section of the Chattanooga shale and Maury formation in east-central Tennessee. The average thickness and average uranium content of the stratigraphic units are necessarily generalized.

all known facts suggests that either the upper three units of the shale accumulated more slowly, permitting relatively greater concentration of uranium by direct precipitation at a constant rate, or that the sediments were worked and reworked repeatedly by mild disturbances of the water, permitting one or more constituents of the mud more opportunity to absorb uranium from the sea water.

The phosphate-bearing beds at the top of the black shale contain distinctly less uranium than do the black shale beds immediately below. For two reasons this is somewhat surprising: 1) in some other parts of the United States phosphate beds contain notable concentrations of uranium, and 2) present phosphate accumulations on the sea floor, according to the best available information, are at places where sedimentation is taking place at abnormally slow rates [4].

REGIONAL DISTRIBUTION OF URANIUM

Regionally the uranium content of any given stratigraphic unit of the Chattanooga shale tends to be fairly constant over distances measurable in several miles. In fact, the essential similarity of the uranium content of outcrops within a few miles of one another is one of the striking facts indicated by the present investigations. The assays, however, do show a distinct regional trend, some areas being consistently high, and some consistently low. Thus it has

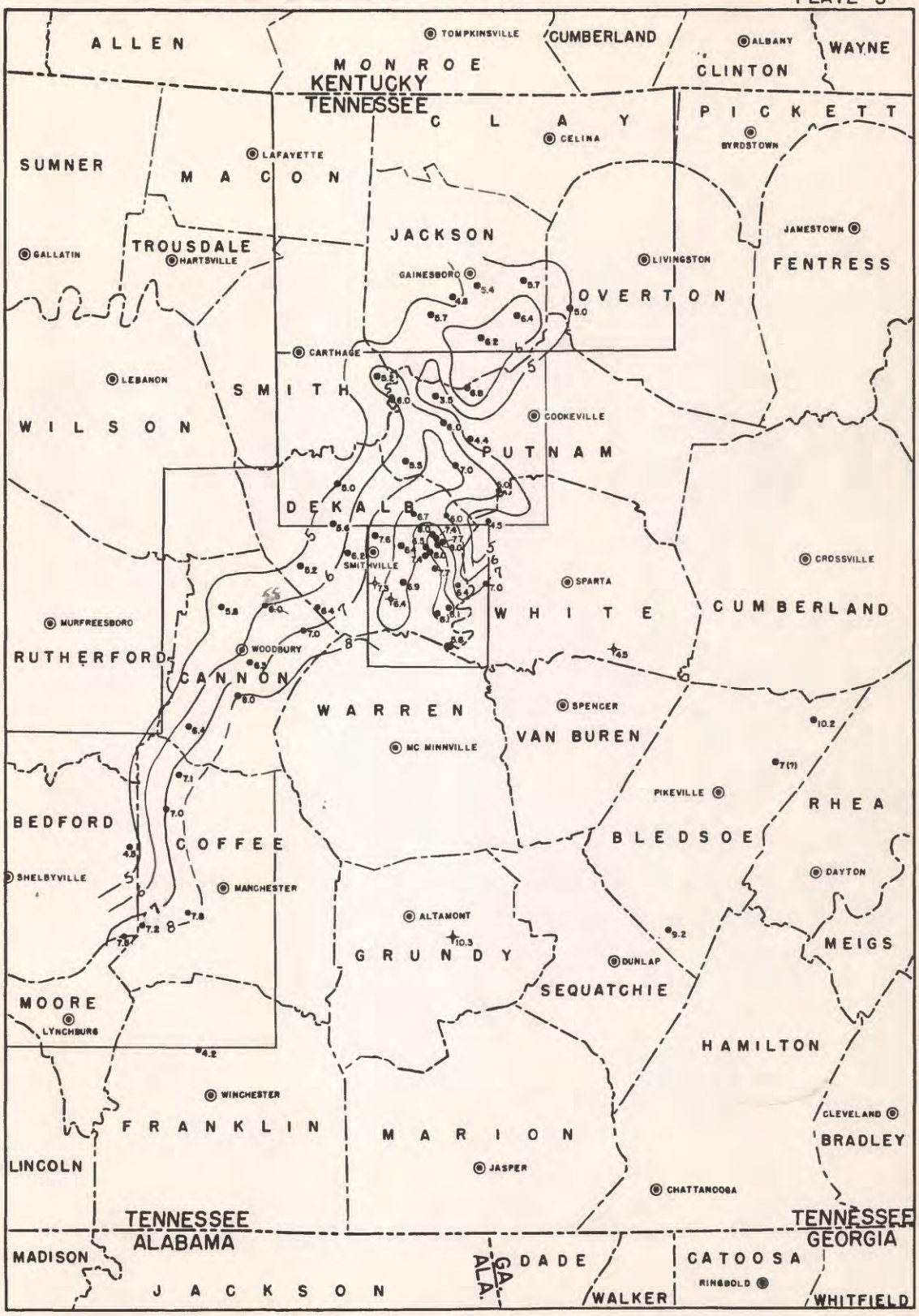
been shown [7] that in the Walden Ridge area of southeast Tennessee the uranium content is generally high, whereas in northern Kentucky [8] it is consistently low.

Along the Eastern Highland Rim of Tennessee the uranium content is moderately high, but decreases northward and westward, although somewhat irregularly. Plates 3 and 4 show these regional variations in the uranium content in certain stratigraphic units, as indicated by the assays, and as interpreted by the writers of this report. In both plates the phosphatic upper part of the shale has been excluded.

Plate 3 presents the data on the non-phosphatic part of the Top Black shale, a unit that is customarily about 7 feet thick. Plate 4 presents the data on the three units (excluding the phosphatic beds) that have been lumped together and termed the Upper Black shale, a unit about 16 feet thick in the areas of greater interest. The 7-foot Top Black unit of plate 3 is included in the thicker unit of plate 4. As the Top Black unit cannot be distinguished with certainty in northern Tennessee and in Kentucky, the area shown on plate 3 does not extend as far north as the area shown on plate 4.

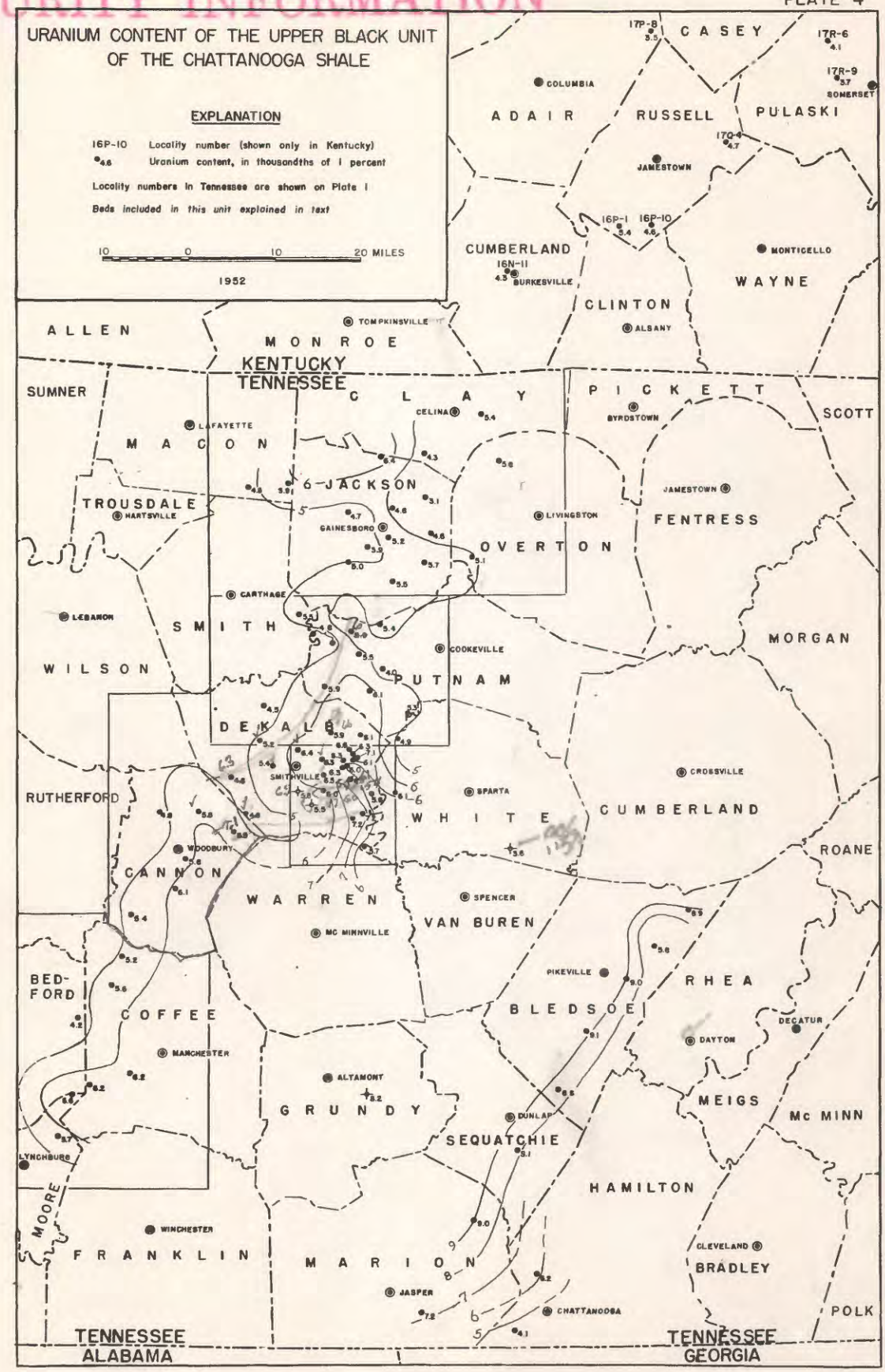
In the Top Black shale the highest uranium content thus far found along the Eastern Highland Rim (pl. 3) is chiefly in the eastern part of DeKalb County, but two widely scattered localities to the southwest show comparable amounts of uranium (about 0.008

PLATE 3



URANIUM CONTENT OF THE TOP BLACK UNIT
OF THE CHATTANOOGA SHALE
(Expressed in thousandths of 1 percent)
1952

PLATE 4



URANIUM CONTENT OF THE UPPER BLACK UNIT
OF THE CHATTANOOGA SHALE
(Expressed in thousandths of 1 percent)
1952

percent). It appears that from west to east along the Rim the grade increases somewhat, and this suggestion is supported by assays of the shale from the well in Grundy County where the Top Black shale has its highest indicated uranium content, about 0.01 percent. How the high-uranium areas of Walden Ridge, DeKalb County, and the Grundy County well may be related is unknown. As the assays of the Grundy County well were on an imperfect core, taken with a cable tool drill rig, their accuracy is open to question.

In Putnam County the uranium content of the sampled outcrops (pl. 3) is somewhat more erratic, and from there to the north, chiefly in Jackson County, the indicated uranium content is sufficiently erratic that no system in its distribution is obvious, and isograde lines are probably of little significance. The most notable irregularity is in western Putnam County where samples from two outcrops (13M-24 and 13M-7) yielded abnormally low uranium assays. This is a striking exception to the apparent principle of uniformity of uranium content of outcrops a few miles apart. Other notable exceptions are two outcrops (13M-4 and LC-11) near the White-DeKalb County line, and a drill hole (LC-113A) in southeastern White County. In the case of the outcrop samples it is suspected that somewhat unusual conditions of weathering may have removed the uranium from the surface of the outcrop, where the samples were taken. In any future investigation it

would be well to re-sample one of these outcrops, preferably 13M-24 in northwestern Putnam County. (LC-11 is a river-bank outcrop now submerged beneath Center Hill Reservoir, 13M-4 is in a waterfall and somewhat difficult of access, and 13M-7 is in a stream valley difficult to reach.) Several special samples from LC-11 gave erratic assays, and it is suspected that leaching by ground or flood water may have removed the uranium in some parts more than in others.

The uranium content of the Upper Black unit (pl. 4), which contains the Top Black unit, and which is about 16 feet thick in most of the area, has a distribution pattern strikingly similar to that of the Top Black unit. Although inclusion of the Top Black unit within the thicker unit tends to cause a similarity in the distribution patterns, that is not the whole cause. In reality, there is a tendency for the uranium content of each of the three units to vary in the same direction from region to region. Plate 5 shows this relationship of the uranium content of the three uppermost units that together constitute the Upper Black unit.

As with the Top Black unit, the more inclusive Upper Black seems to be richest in uranium in the eastern part of DeKalb County, and to increase in grade from west to east, approaching a maximum in the vicinity of the Grundy County well (pl. 4). Northward, in Putnam and Jackson Counties, the grade diminishes in a somewhat

irregular manner. As with the Top Black unit, the most anomalous set of assays is from outcrops 13M-24 and 13M-7 in Putnam County, but the assays of the core samples from southeastern White County (LC-113A) also show an abnormally small amount of uranium.

The uranium content of the Upper Black unit in the Cumberland Valley of Kentucky, as shown in plate 4, is not entirely meaningful, as the stratigraphic units have not been differentiated there with any certainty, and the uranium content differs so little throughout the section that it does not serve as a criterion for identifying the units, as it does in central Tennessee. As can be seen from the graphs of the assays, the uranium content in the northern outcrops is fairly uniform throughout most of the thickness. The chief exceptions to this uniformity are in the top two or three samples that contain scattered phosphate nodules, and in the lower two or three samples at most outcrops. As in Tennessee, the phosphatic beds have a lower uranium content and are not included in the plotted averages. It is known from geologic evidence that the lower few feet of the Chattanooga shale in most of the Kentucky outcrops should be correlated with the lower two units in Tennessee, which also have smaller quantities of uranium. Those lower samples, where they contain smaller amounts of uranium, have not been included in the averages plotted on the map.

In Oklahoma Gott [5] has concluded, from a study of gamma ray logs of a large number of oil test wells, that the radioactive

ingredients of the Woodford shale, which is a partial correlate of the Chattanooga shale, are very irregularly distributed. In the east-central Tennessee area of this report, where most of the sampled outcrops are spaced somewhat more widely than the wells studied by Gott, most of the data point to an essential uniformity of the uranium content over areas of many tens of square miles, or more.

The apparent relationship of uranium content of the three upper units of the Chattanooga shale, as shown in plate 5, is not easily explained, yet is of real economic interest. Seemingly some unknown conditions favorable to the accumulation of uranium existed in greater degree in some parts of the Chattanooga sea than in other parts, and the locations of these favorable conditions did not shift much during the time represented by the three uppermost units. Weathering has been suspected to be the cause of the few sets of abnormally low assays, although it is somewhat surprising if the entire thickness of the Upper Black unit has been so uniformly leached, as would be the case at most of the localities that are abnormally low in uranium. No submarine or subterranean agencies that might have operated on the shale after it was deposited could be expected to have affected its uranium so uniformly, yet left no visible effect on the rocks.

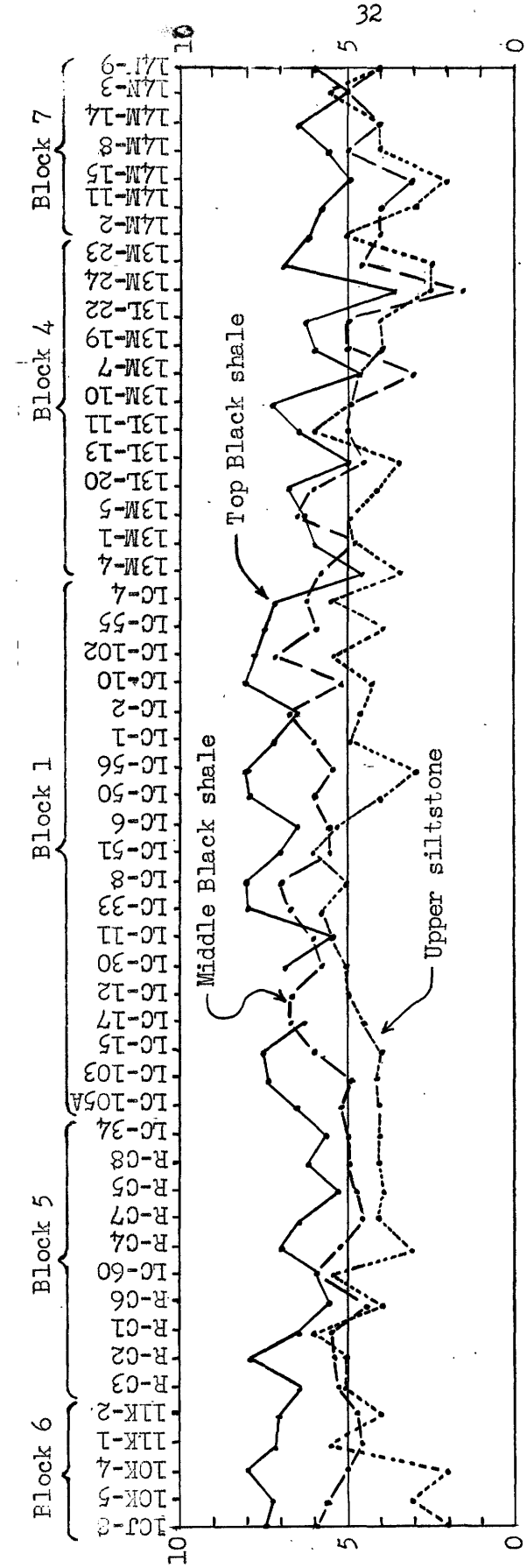


Plate 5.--Average uranium content of the three uppermost units of the Chattanooga shale at sample localities in east-central Tennessee. Data are shown only where the three units are definitely or probably present. The phosphate-bearing beds at the top of the Top Black shale have been excluded. With few exceptions, the Top Black shale contains the most uranium, and the Upper siltstone the least of the three shown here. Regionally all three curves tend to vary in the same direction. Uranium content is shown in thousandths of a percent.

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RE-APPRAISAL OF URANIUM RESERVES

Block 1

In a previous report [3] an attempt was made to calculate the uranium tonnage of the Upper Black unit in the Block 1 area, based on the assays then available. Later duplicate assays on some of the samples from that area have differed appreciably from the earlier ones, as already pointed out, so it has seemed desirable to re-appraise the uranium tonnage, using the most recent assays. That has been done by the same two methods that were used in the original calculations: 1) by multiplying an average of the uranium content at all the sampled localities in the Block by the estimated tonnage of the shale for the interval involved, and 2) by making similar calculations for numerous small polygonal areas. Both methods have yielded essentially the same figure, about 184,000 tons of metallic uranium for the 93.5 square miles in Block 1 calculated to be underlain by the shale. Previous estimates [3] had indicated the presence of about 200,000 tons in the same area. The average of the routine assays of the entire Upper Black shale, about 16 feet thick, for the entire Block is now 0.0063 percent instead of 0.0069 as given previously, and the smaller figure is used in the present calculation. As already pointed out, however, there is good reason to suspect that these assays are somewhat lower than the uranium content of the fresh

rock, and that a somewhat higher average uranium content may be expected.

Block 4

In the previous report on the Eastern Highland Rim [3] no tonnage estimates were made for the other Blocks because available assays were either too conflicting or too few. In table 1 of this report it has been shown that duplicate assays of the samples from Block 4 have consistently shown an appreciably greater uranium content than did the earlier assays. These are still consistently somewhat lower than those of nearby Block 1, so it must be assumed, pending other assays, that the Upper Black unit of the shale in Block 4 contains a somewhat lower percentage of uranium than in Block 1. As no large samples have been taken from Block 4, no assays are available of the somewhat fresher rock that characterizes the large samples. It still seems reasonable to believe that the Upper Black shale in the southern part of Block 4 will be found eventually to contain about the same percentage of uranium as in the nearby part of Block 1. The average uranium content of the Upper Black unit in Block 4, determined from the averages given in the graphs at the end of this report, appears to be about 0.005 percent.

Other areas

Assays of the samples collected from Blocks 5, 6, and 7, average only about 0.005 or 0.0055 percent. As in the case of Block 1, special samples have yielded distinctly higher assays than have the routine samples (see localities 14M-2 for Block 7, and R-C2 and R-C4 for Block 5 in table 2). These assays are so consistently higher than the routine samples that one is forced to suspect that the true uranium content is on the order of 0.001 percent higher than indicated by the averages.

MINING CONDITIONS

The most favorable area for mining the shale for its uranium, as indicated by the available data, is along the Caney Fork River Valley in eastern DeKalb County. Except for a slightly greater uranium content in the Walden Ridge area [7], where the structure is complicated, the Caney Fork area affords a combination of the highest uranium content, nearly flat structure, and lake transportation. Horizontal entrances along the shale could be made at many places on the steep slopes bordering the Center Hill Reservoir on the Caney Fork, the rock could be dropped 25 to 250 feet to reservoir level, and barges could carry it to processing mills, presumably at the dam, about 20 miles away. Three 45,000 kw generators have been installed at the dam by the Corps of Engineers.

The Chattanooga shale and Maury formation in the area best suited for mining are overlain by about 100 to 200 feet of the tough Fort Payne chert.

A 100-foot experimental adit was driven in the Top Black shale (locality LC-201, pl. 1) along the reservoir in order to obtain several bulk samples of fresh shale and in order to learn something of the probable mining conditions. A brief description of the adit was given in the earlier report [3], and a more complete description has been given by Brown [1].

RECOMMENDATIONS FOR FURTHER INVESTIGATIONS

Most of the samples taken in these investigations are from the freshest road cuts and stream exposures that were found. Additional outcrop sampling would necessarily be on other road or stream exposures that, for the most part, would be more weathered or, in the case of stream exposures, more difficult of access. In order to assure freshness of samples, it is recommended, therefore, that any future large-scale sampling be done by drilling. At many places a small light drill could operate beside the road and get fresh samples of the entire Chattanooga shale beneath an overburden of only a few feet. It seems certain that the shale, even where protected by only a few feet of overlying rocks, would be unweathered and would yield samples typical of more deeply buried shale.

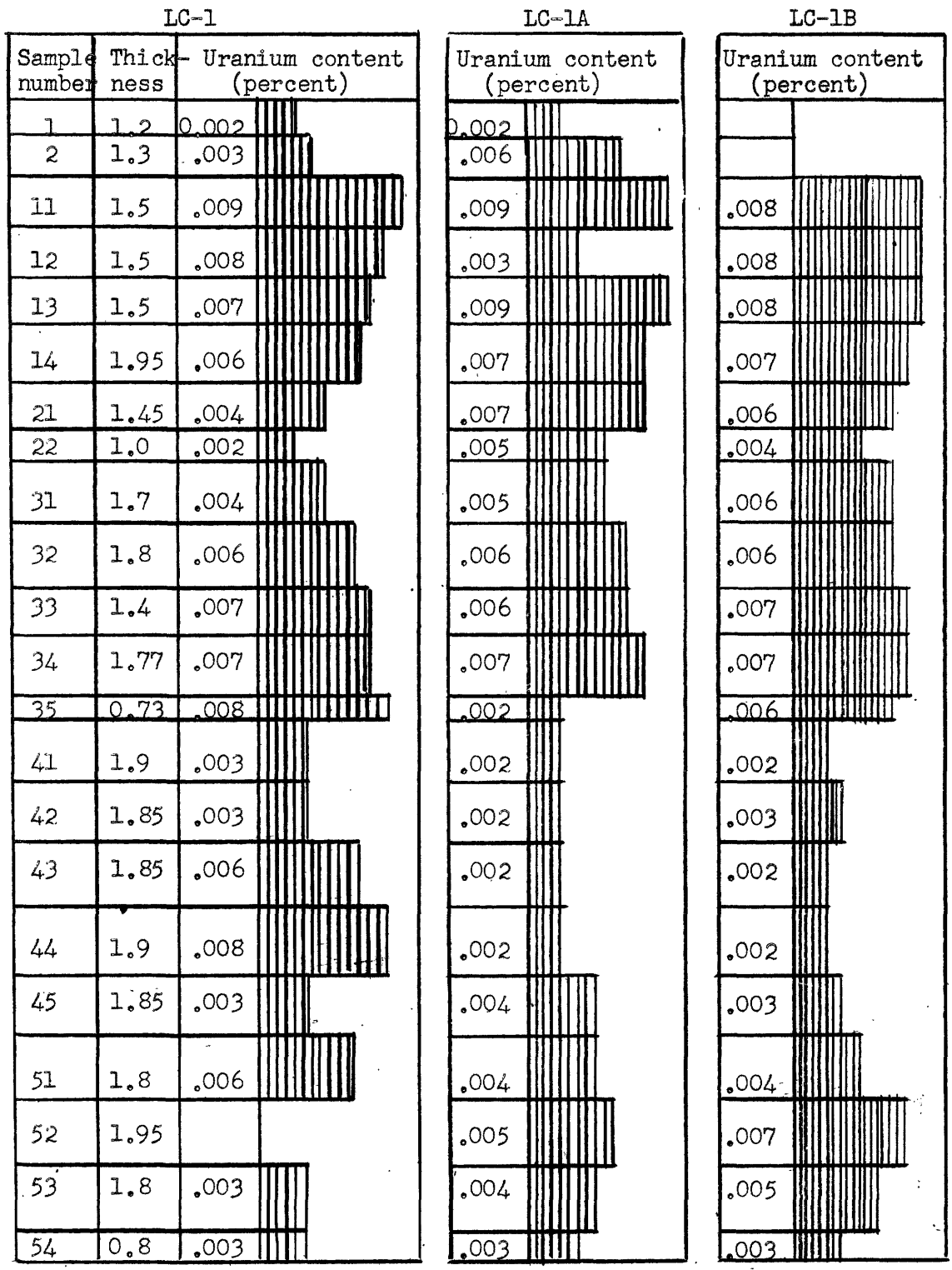
ASSAY GRAPHS

The remaining pages of this report present in graphic form the uranium content of all the samples that have been assayed from east-central Tennessee and the nearby Cumberland Valley of southern Kentucky. All the assays were by fluorimetric methods. Many of the samples were assayed more than once; in most such instances the later assays are shown, in a few instances two sets of assays are plotted, and in a few other instances, where the differences were slight, they have been averaged. The numbering system for the samples is explained in the section on sampling and assaying.

Below each column is a summary showing the sample numbers, the thickness, and the average of the uranium assays for that part of the shale (chiefly the Upper Black unit) that is here considered as a logical mining unit. In some averages the phosphate nodule layer is not included as it is low in uranium, in other averages the nodule bed is included either because it is not enough lower in uranium to warrant separation, or because it was not sampled separately from the adjoining black shale. Whether or not a mining method could be devised that would leave the phosphate nodule bed is not known, though it was left without difficulty in the experimental adit [1].

LC-1

Cut on Tennessee Highway 26, 0.5 mile southwest of Sligo bridge over Center Hill Reservoir, DeKalb County. Road abandoned in 1948 and exposure now covered by debris from new highway above. Three sets of samples taken at different parts of outcrop.



Sample number	Thickness	LC-1 Uranium content (percent)	LC-1A Uranium content (percent)	LC-1B Uranium content (percent)
1	1.2	0.002	0.002	
2	1.3	.003	.006	
11	1.5	.009	.009	.008
12	1.5	.008	.003	.008
13	1.5	.007	.009	.008
14	1.95	.006	.007	.007
21	1.45	.004	.007	.006
22	1.0	.002	.005	.004
31	1.7	.004	.005	.006
32	1.8	.006	.006	.006
33	1.4	.007	.006	.007
34	1.77	.007	.007	.007
35	0.73	.008	.002	.006
41	1.9	.003	.002	.002
42	1.85	.003	.002	.003
43	1.85	.006	.002	.002
44	1.9	.008	.002	.002
45	1.85	.003	.004	.003
51	1.8	.006	.004	.004
52	1.95		.005	.007
53	1.8	.003	.004	.005
54	0.8	.003	.003	.003
11-35	16.3	0.0063	0.0062	0.0067

LC-2

Cut on long-abandoned highway on northwest side of Short Creek, about 0.5 mile west of Sligo, DeKalb County.

Sample number	Thickness	Uranium content (percent)
1	0.9	.002
2	1.4	.002
11	0.26	.006
12	1.63	.007
13	2.0	.007
14	1.49	.007
15	1.57	.005
21	1.65	.005
22	0.84	.004
31	1.95	.007
32	1.70	.007
33	1.70	.007
34	1.84	.006
41	0.82	.003
42	2.0	.004
43	2.0	.003
44	2.0	.003
45	2.0	.003
46	0.63	.004
51	2.0	.004
52	2.0	.003
53	1.19	.005
54	2.0	.005

11-34 16.6 0.0065

LC-6

Waterfall on small stream a few hundred feet from Center Hill Reservoir, 4 airline miles south of Tennessee Highway 26 at county line, White County.

Sample number	Thickness	Uranium content (percent)
1	0.95	.004
11	.37	.005
12	1.85	.007
13	1.90	.006
14	1.15	.006
21	1.94	.005
22	0.90	.006
31	2.08	.003
32	1.50	.005
33	1.65	.007
34	1.50	.007
35	2.00	.007
41	1.22	.004
42	1.93	.003
43	1.91	.002
44	1.45	.002
45	1.76	.003
46	1.46	.003
47	0.92	.002
51	1.64	.003
52	2.00	.007
53	1.30	.005
54	1.78	.004

12-35 16.47 0.0058

LC-4

On farm road about 0.75 mile northwest of Tennessee Highway 26, about 3 miles west of DeKalb-White County line, DeKalb County.

Sample number	Thickness	Uranium content (percent)	Uranium content (percent)
1	1.12	.002	
2	0.95	.003	
11	0.3	.005	
12	1.22	.009	.005
13	2.0	.008	.009
14	1.04	.008	.008
15	2.0	.008	.006
16	1.43	.007	.008
21	2.0	.006	
22	0.87	.004	
31	1.83	.003	.006
32	2.0	.007	.006
33	2.0	.008	.006
34	1.84	.004	.007
41	0.78	.006	
42	1.44	.004	
43	1.55	.003	
44	1.96	.003	
45	1.82	.004	
46	1.62	.002	
47	0.6	.003	
51	2.0	.004	
52	1.83	.005	
53	1.31	.005	
54	1.63	.003	
12-34	18.2	0.0066	0.0067

LC-8

Bed of south-flowing tributary of Sink Creek, at edge of Center Hill Reservoir, DeKalb County.

Sample number	Thickness	Uranium content (percent)
12	0.83	0.008
13	2.03	.009
14	2.00	.008
15	1.39	.007
21	1.00	.005
22	1.49	.005
31	2.00	.005
32	2.00	.007
33	2.00	.008
34	1.52	.008
35	1.18	.009
12-35	17.44	0.0072

LC-11

South bank of Caney Fork River at northernmost point of Horseshoe Bend, 4 3/4 airline miles west-northwest of U. S. Highway 70S at Walling, White County. Now submerged by Center Hill Reservoir.

Sample number	Thickness	Uranium content (percent)
1	2.03	0.004
12	2.0	.007
13	2.0	.005
14	1.38	.005
15	1.0	.005
21	2.0	.005
22	1.67	.006
31	2.0	.006
32	1.37	.006
41	1.32	.003
42	1.62	.003
43	1.33	.003
44	1.44	.002
51	1.23	.001
52	1.25	.003
12-32	13.42	0.0057

LC-10

Cut on north side of old Tennessee Highway 26, abandoned in 1948 but now used as a boat-landing road; 0.5 mile east of Sligo bridge, DeKalb County.

Sample number	Thickness	Uranium content (percent)	Uranium content (percent)
1	2.06	0.002	
11	0.5	.006	.006
12	1.6	.011	.008
13	1.6	.012	.008
14	1.5	.011	.007
15	2.0	.009	.009
21	2.2	.006	.005
22	1.15	.005	.003
31	0.7	.006	.005
32	1.8	.009	.006
33	1.4	.009	.003
34	2.0	.008	.006
35	2.0	.009	.005
41	2.0	.001	
42	2.0	.004	
43	2.0	.001	
44	2.0	.003	
45	1.7	.001	
51	1.25	.002	
52	1.5	.005	
53	1.15	.004	
54	0.9	.003	
11-35	18.45	0.0091	0.0061

LC-12

Small waterfall on Jake Poss farm, 900 ft. down stream from main falls of Fall Creek on south side of gorge, $2\frac{1}{2}$ miles east-southeast of Smithville, DeKalb County.

Sample number	Thickness	Uranium content (percent)
1	1.95	
11	0.15	
12	2.00	
13	2.00	
14	1.90	
15	0.82	0.006
21	1.90	.005
22	0.29	.004
31	1.88	.007
32	1.47	.007
33	1.90	.006
34	2.06	.007
41	0.70	.004
42	0.90	
43	1.85	.002
44	1.85	.002
45	1.85	.003
46	1.85	.003
51	0.74	.005
52	2.00	
53	2.00	.004
54	2.00	.004
15-34	10.32	0.0063

LC-15

Cut on Holmes Creek road, 1.6 miles north of Smithville, DeKalb County.

Sample number	Thickness	Uranium content (percent)
1	1.32	0.003
11	0.50	.005
12	1.06	.007
13	2.00	.007
14	1.88	.008
15	2.00	.008
21	1.97	.004
31	2.25	.005
32	1.93	.006
33	2.00	.007
41	1.40	.004
42	2.00	.003
43	1.83	.002
44	1.96	.002
45	1.79	.004
51	2.10	.005
52	2.00	.005
53	2.00	.005
11-33	15.59	0.0064

44

LC-17

Cut on farm road, 1 mile north of Tennessee Highway 26 at Pomeroy Chapel and 3½ airline miles east of Smithville, DeKalb County.

Sample number	Thickness	Uranium content (percent)	Uranium content (percent)
1	1.97	0.002	
11	0.10	.007	
12	2.00	.005	.006
13	2.00	.005	.006
14	1.70	.009	.007
15	1.30	.008	.007
21	1.33	.007	.005
22	1.03	.006	.004
31	2.00	.006	.006
32	2.00	.005	.008
33	2.00	.005	.005
34	1.55	.008	.008
41	0.70	.004	
42	1.85	.004	
43	1.85	.004	
44	1.85	.004	
45	1.85	.004	
46	1.19	.002	
51	1.95	.005	
52	2.00	.008	
53	2.00	.008	
11-34	17.01	0.0062	0.0063

LC-30

Main waterfall on Pine Creek, DeKalb County.

Sample number	Thickness	Uranium content (percent)
1	1.88	0.002
12	1.33	.009
13	2.00	.007
14	1.63	.005
21	1.19	.005
22	1.31	.005
31	2.06	.005
32	2.02	.005
33	2.00	.006
34	1.65	.007
41	1.70	.004
42	2.00	.003
43	2.00	.003
44	1.67	.003
45	1.90	.003
51	1.83	.003
52	1.68	.006

12-34 15.19 0.006

LC-33

Bluffs on Sink Creek, 2½ miles east of Keltonburg, DeKalb County.

Sample number	Thickness	Uranium content (percent)
1	1.37	
12	1.61	.007a
13	2.10	.011a
14	1.41	.009a
21	1.58	.007
22	1.27	.004
31	1.97	.006
32	1.52	.005
33	1.92	.007
34	1.62	.008
35	1.50	.007
41	1.26	.004
42	1.93	.005
43	1.37	.002
44	1.93	.003
45	1.76	.003
46	2.18	.003
51	1.69	.004
52	1.50	.006
53	2.00	.008
54	1.28	.004

12-35 16.50 0.0072

a/ Later assays of samples 12, 13, and 14 give .007, .009, and .008.

LC-34

South side of Tennessee Highway 26, 3.1 miles east of Dowelltown, DeKalb County.

Sample number	Thickness	Uranium content (percent)
12	1.34	0004
13	1.84	.006
14	1.88	.006
15	1.88	.006
21	2.17	.004
31	2.02	.004
32	0.70	.006
33	1.50	.006
41	1.60	
42	2.17	
43	2.01	
44	2.15	
51	1.53	.004
52	1.76	.004
53	1.80	.004
12-33	13.33	0.0052

LC-51

Bluff at site of old Lunas Mill at junction of Cedar and Falling Water Creeks, White County.

Sample number	Thickness	Uranium content (percent)
1	1.24	
12	1.75	.007
13	1.80	.007
14	1.98	.007
21	1.58	.006
22	1.40	.006
31	1.82	.006
32	1.84	.005
33	1.71	.007
34	1.47	.006
35	1.60	.004
41	1.92	
42	1.83	
43	1.58	
44	2.04	
45	1.38	
46	1.76	
51	1.55	
52	1.70	
53	1.76	
54	1.69	
12-35	16.95	0.0061

West-facing waterfall in branch of Short Creek, 2¼ airline miles south of Sligo bridge, 1½ miles northeast of Youngs Bend School, DeKalb County.

Sample number	Thickness	Uranium content (percent)	Uranium content (percent)
1	1.80	0.003	
12	1.82	.011	.008
13	2.00	.009	.009
14	1.85	.011	.006
21	1.35	.009	.005
22	1.22	.007	.003
31	2.01	.009	.006
32	2.01	.009	.005
33	2.01	.009	.007
34	2.01	.010	.006
35	2.01	.011	.006
41	0.87	.003	
42	2.00	.004	
43	2.00	.002	
44	2.00	.002	
45	2.00	.004	
46	1.89	.001	
51	1.64	.004	
52	1.81	.006	
53	1.80	.004	
54	1.80	.003	
12-35	18.29	0.010	0.0063

LC-55

Cut on new Tennessee Highway 26, at east approach to new Sligo bridge, DeKalb County.

Sample number	Thickness	Uranium content (percent)
1	1.8	
11	.8	
12	1.3	0.008
13	1.35	.007
14	1.75	.008
15	1.2	.007
16	1.2	.007
21	2.1	.004
31	1.9	.005
32	1.9	.005
33	2.0	.007
34	1.9	.007
41	.5	.003
42	2.0	.002
43	2.0	.002
44	2.0	.002
45	2.0	.002
51	2.0	
52	1.9	
53	1.8	

12-34 16.6 0.0063

LC-60

Cuts on Tennessee Highway 53, 5.0 and 5.4 miles south of Gassaway, on north-south sides of ridge, Cannon County.

Sample number	Thickness	Uranium content (percent)
1	2.52	
2	1.69	
12	1.56	0.006
13	2.00	.006
14	2.00	.006
21	2.29	.005
31	1.77	.006
32	2.10	.006
33	2.30	.006
41	1.90	
42	2.07	
43	2.28	
44	2.24	
51	1.11	
52	1.87	
53	1.69	
54	1.73	

12-33 14.02 0.0058

LC-56

Cut on new Tennessee Highway 26, at west approach to new Sligo bridge, DeKalb County.

Sample number	Thickness	Uranium content (percent)	Uranium content (percent)
11	2.00	0.007	
12	2.00	.003	.009
13	2.25	.005	.008
21	2.50	.002	.003
31	2.00	.003	.005
32	2.00	.001	.005
33	2.00	.004	.005
34	1.65	.004	.007
Middle Gray	8.82		
51	2.09	.001	
52	2.09	.003	
53	2.10	.002	
11-34	16.40	0.0035	0.006

LC-101

On east side of Tennessee Highway 56, 1.1 miles south of courthouse at Smithville, DeKalb County.

Sample number	Thickness	Uranium content (percent)
14	4.0	0.009
15	1.5	.006
21	2.0	.005
14-21	7.5	0.0073

LC-201

Adit, about 140 feet northwest of LC-10. Assays of a series of samples taken at intervals of 5 and 10 feet along a 6-inch bed, from the extreme outer end (no. 131) to the inner end. DeKalb County.

Sample number	Thickness	Uranium content (percent)
131	0.5	0.005
132	0.5	.006
133	0.5	.003
134	0.5	.004
135	0.5	.003
136	0.5	.005
137	0.5	.004
138	0.5	.008
139	0.5	.004
140	0.5	.006
141	0.5	.004
142	0.5	.004
143	0.5	.005
144	0.5	.003
145	0.5	.004
146	0.5	.005
131-146	0.5	0.0048

LC-102

About 100 ft. west and 30 ft. above old Tennessee Highway 26, about 1,800 ft. southeast of Sligo bridge, in field road along ridge, DeKalb County.

Sample number	Thickness	Uranium content (percent)
11	0.50	.003
12	1.95	.007
13	2.00	.009
14	1.90	.007
21	1.30	.006
22	1.20	.005
31	1.80	.007
32	1.50	.007
33	1.80	.007
34	2.00	.008
41	2.00	.002
42	1.80	.003
43	2.00	.003
44	2.00	.003
45	1.81	.003
51	1.24	.004
52	1.90	.004
53	2.60	.004
12-34	15.45	0.0071

LC-103

West side of Tennessee Highway 56, 725 ft. south of road intersection at Shining Rock and 3.7 miles south of courthouse at Smithville, DeKalb County.

Sample number	Thickness	Uranium content (percent)
1	0.5	0.002
12	2.5	.009
13	2.0	.007
14	1.7	.005
21	1.1	.004
31	1.9	.004
32	3.1	.005
33	2.0	.005
41	1.9	.002
42	2.3	.002
43	2.3	.001
44	2.5	.001
51	1.9	.003
52	2.0	.004
53	1.0	.004
54	1.5	.003
12-33	14.3	0.0058

9
8
54
40
50
60
70

LC-105A

In road fork about 450 feet south of Cantrell Branch, and 1 mile east of Tennessee Highway 56. About 2½ miles airline southeast of LC-103. DeKalb County.

Sample number	Thickness	Uranium content (percent)
1	1.25	0.001
12	1.60	.006a
13	1.15	.006a
14	1.20	.005a
15	1.05	.004a
21	1.35	.004
31	2.10	.005
32	1.70	.005
33	1.30	.007
34	1.60	.004
35	0.95	.006
41	2.05	.002
42	2.10	.001
43	2.00	.001
44	2.05	.001
45	1.40	.001
51	1.95	.002
52	2.00	.003
53	1.90	.002
12-35	14.0	0.0055

a/ Average of three assays.

LC-113A

About 100 feet east of Caney Fork River and 75 feet north of road at Dodsons store, in southeastern DeKalb County.

Sample number	Thickness	Uranium content (percent)
12	2.1	.004a
13	1.1	.004a
14	2.5	.002
15	1.0	.004a
16	2.0	.004a
17	1.0	.005a
18	1.8	.003a
41	1.3	.001
42	2.0	.001
43	1.5	.001
44	1.6	.001
45	2.0	.001
51	2.0	.002
12-18	11.5	0.0038

a/ Average of three assays.

R-C1

Cut on Tennessee Highway 53, 2½ miles south of Woodbury, Cannon County.

Sample number	Thickness	Uranium content (percent)
12	1.50	0.006
13	1.50	.007
14	1.50	.006
21	1.34	.006
31	1.90	.004
32	2.00	.006
33	2.00	.005
34	2.00	.007
12-34	13.74	0.0058

R-C3

Cut on west side of road, 2.9 miles south of Bradyville Church and 3.7 miles west of Hollow Springs cross-roads, Cannon County.

Sample number	Thickness	Uranium content (percent)
12	1.20	0.006
13	0.80	.007
21	1.24	.005
31	1.58	.006
32	1.58	.005
33	1.50	.006
34	1.80	.004
41	0.51	.002
42	0.57	.003
43	1.97	.002
44	1.35	.002
45	0.97	.003
46	1.25	.000
47	1.08	.000
51	2.00	.003
52	1.94	.003
53	1.41	.002
54	2.00	.004
55	1.54	.002
12-34	9.70	0.0054

R-C2

Cut on county road 1.4 miles by road west of Tennessee Highway 53 at Sheboygan, Cannon County.

Sample number	Thickness	Uranium content (percent)	Uranium content (percent)
12	0.94	.002	.008
13	1.50	.007	.008
14	1.50	.005	.008
21	1.22	.001	.005
31	2.00	.002	.005
32	2.00	.003	.005
33	2.00	.001	.006
34	1.10	.002	.005
Middle Gray	9.45		
51	2.00	.001	
52	2.00	.002	
53	1.50	.003	
54	0.98	.002	
12-34	12.26	0.0028	0.0061

R-C4

Small waterfall, south side of east-west road south of Short Mountain, 6.8 miles north of U. S. Highway 70S, along Short Mt. road, Cannon County.

Sample number	Thickness	Uranium content (percent)
12	1.36	0.007
13	1.80	.007
14	0.96	.007
21	1.93	.0035
31	1.35	.0035
32	1.50	.0055
33	1.50	.011
34	1.65	.005
35	2.00	.003
51	1.30	.005
52	1.97	.003
53	1.50	.003
12-35	14.05	0.0055

R-C5

About 2 miles east of Gassaway on north side of gravel road to Pea Ridge, DeKalb County.

Sample number	Thickness	Uranium content (percent)
11	0.65	.002
12	1.26	.006
13	1.14	.006
14	1.61	.004
21	1.50	.004
31	2.04	.004
32	1.75	.005
33	1.16	.005
34	1.04	.005
Middle Gray	8.23	
51	1.71	.003
52	1.50	.004
53	1.50	.003
12-34	11.5	0.0048

R-C6

West side of Auburntown road about 3 miles north of its junction with U. S. Highway 70S on west edge of Woodbury, Cannon County.

Sample number	Thickness	Uranium content (percent)
12	1.75	0.003
13	1.50	.006
14	1.50	.007
15	1.27	.007
21	1.22	.004
31	1.50	.004
32	1.57	.005
33	1.50	.004
34	1.54	.004
Middle Gray	7.82	
51	2.00	.002
52	2.00	.008
53	1.50	.009
54	1.83	.001
12-34	13.35	0.0048

R-C7

At English Falls, near head of Dry Creek, 1.8 miles north of Cripps Store and about 5 airline miles southeast of Gassaway, DeKalb County, near Cannon County line.

Sample number	Thickness	Uranium content (percent)
12	1.06	.006
13	1.35	.007
14	0.74	.006
21	1.77	.004
31	1.20	.004
32	1.79	.004
33	1.67	.004
34	1.50	.005
Middle Gray	9.15	
51	1.94	.005
52	1.98	.006
53	1.98	.004
12-34	11.08	0.0048

R-C8

At Egypt Falls on tributary of Dry Creek, 5½ airline miles southeast of Dowelltown and 3 airline miles west of Smithville, DeKalb County.

Sample number	Thickness	Uranium content (percent)
11	0.84	.003
12	1.82	.006
13	1.24	.007
14	1.10	.006
15	1.17	.006
21	1.85	.004
31	1.65	.006
32	1.84	.004
33	1.10	.005
34	0.95	.005
Middle Gray	8.60	
51	1.10	.004
52	2.00	.008
53	2.01	.004
12-34	12.72	0.0054

10J-8

Road cut and exposure below dam at Ledsford Mill, 3.0 miles by county road northeast of junction of Tennessee Highways 16 and 55, northeast corner of Moore County.

Sample number	Thickness	Uranium content (percent)
12	2.17	.007
13	2.15	.008
14	2.15	.008
15	2.15	.007
21	.73	.002
31	2.12	.005
32	2.10	.006
33	2.10	.007
41	1.95	.002
42	2.03	.003
51	1.07	.004

12-33 15.67 0.0066

10J-9

Hurricane Creek just below large dam at Cumberland Springs, Moore County.

Sample number	Thickness	Uranium content (percent)
12	2.04	.006
13	1.72	.005
14	1.84	.007
15	1.78	.005
16	1.89	.005
17	1.83	.006
18	1.90	.006

12-18 13.0 0.0057

10K-4

Cut on county road leading to Crumpton Branch, 1.6 miles west of Mountview School, Coffee County.

Sample number	Thickness	Uranium content (percent)
12	1.59	0.007
13	1.95	.009
14	1.94	.009
15	1.95	.007
21	.86	.002
31	1.55	.003
32	1.68	.004
33	1.87	.006
34	1.65	.007
51	2.09	.002
52	2.09	.003
53	2.09	.005

12-34 15.04 0.0062

10K-5

Cut on Cascade Branch road, 2.5 miles west-northwest of Ovoca and 0.6 airline mile southwest of Bethany Church, Coffee County.

Sample number	Thickness	Uranium content (percent)
12	1.80	0.007
13	1.83	.006
14	1.74	.008
15	1.80	.008
21	0.79	.003
31	1.68	.004
32	2.00	.005
33	2.00	.007
Middle Gray	2.52	
51	2.09	.002
52	1.47	.002
53	1.77	.003
54	2.00	.004

12-33 13.64 0.0062

10K-6

On county road 0.3 mile south of church at Holland Hill, Coffee County. Only lower units sampled at this locality.

Sample number	Thickness	Uranium content (percent)
31	1.80	0.004
32	1.50	.005
33	1.85	.004
Middle Gray	8.72	
51	1.95	.002
52	2.00	.003
53	1.95	.004
31-33	5.15	0.0043

10K-11

River bluff where road approaches Elk River most closely, 0.4 mile northeast of Rock Creek bridge on county road, Franklin County.

Sample number	Thickness	Uranium content (percent)
12	1.82	0.003
13	1.96	.004
14	1.91	.003
15	1.82	.006
16	1.89	.005
12-16	9.40	0.0042

10M-1

Magnolia Petroleum Co's W. H. Patterson No. 1 well at Gruetli, Grundy Co., Tennessee, at depths of 1455-1478 feet.

Sample number	Thickness	Uranium content (percent)
1	2.00	0.012
2	1.5	.009
3	1.0	.011
4	1.5	.010
5	1.5	.009
6	2.0	.006
7	1.5	.007
8	2.0	.006
9	2.0	.006
10	2.5	.003
11	2.0	.003
12	2.0	.003
13	1.5	.002
1-13	23.0	0.0082

11J-6

On county road 1 mile west of crossroads at Shiloh cemetery, Bedford County. Only upper units sampled at this locality.

Sample number	Thickness	Uranium content (percent)
12	1.88	Q005
13	2.02	.004
21	1.48	.003
22	1.54	.004
12-22	6.92	0.0042

11K-1

Deep cut for U. S. Highway 41, 1 mile northwest of Noah, Coffee County.

Sample number	Thickness	Uranium content (percent)
12	2.11	0.008
13	2.11	.006
21	1.00	.006
22	1.75	.005
31	1.99	.005
32	1.95	.005
33	1.87	.004
Middle Gray	10.48	
51	2.00	.002
52	1.90	.003
53	1.96	.005
54	1.95	.003
12-33	12.78	0.0056

11K-2

Cut on McBride Branch road, 0.2 mile southwest of Wilsons Chapel School at Hoodoo, Coffee County.

Sample number	Thickness	Uranium content (percent)
12	1.48	0.008
13	1.32	.006
21	2.24	.004
31	1.58	.004
32	1.31	.006
33	1.53	.004
12-33	9.46	0.0052

12Q-1

About 0.9 mile west of Roddy in northern part of county; cut and ditch along side of road. Rhea County.

Sample number	Thickness	Uranium content (percent)
1	1.6	.002
2	1.6	.003
11	2.0	.007
12	2.0	.006
13	2.0	.006
14	2.0	.008
15	2.0	.006
16	2.0	.007
17	2.0	.007
18	2.0	.008
19	2.0	.009
20	2.0	.006
20A	2.0	.006
20B	2.0	.009
20C	2.0	.008
20D	2.0	.007
20E	2.0	.005
41	2.0	.006
42	2.0	.005
51	1.7	.006
52	1.7	.004

13L-8

On Buffalo Valley road 0.1 mile south of U. S. Highway 70N and 2½ airline miles southeast of Chestnut Mound, Smith County.

Sample number	Thickness	Uranium content (percent)
11	1.19	.003
12	1.95	.004
13	1.95	.007
14	1.95	.007
15	1.96	.006
21	1.50	.004
22	1.55	.004

11-22 12.05 0.0052

13L-11

Road cut about 2 airline miles west of Silver Point, on road from Silver Point to Center Hill Dam, Putnam County.

Sample number	Thickness	Uranium content (percent)	Uranium content (percent)
1	1.57	.001	
11A	1.17	.002	.002
11B	1.71	.003	.004
12	1.80	.004	.006
13	1.90	.003	.006
14	1.78	.005	.006
15	1.63	.005	.008
21	1.32	.005	.007
22	1.31	.002	.005
31	1.55	.004	.005
32	1.55	.004	.005
33	1.55	.004	.005
Middle Gray	8.07		
51	2.02	.002	.003
52	2.01	.002	.004
53	2.02	.002	.003
12-33	14.39	0.0040	0.0059

13L-13

Road cut on west side of Dale Ridge, 4 airline miles northeast of Dowelltown, DeKalb County.

Sample number	Thickness	Uranium content (percent)
12	1.73	0.005
13	1.70	.005
14	1.80	.005
21	1.46	.004
22	1.50	.003
31	1.45	.004
32	1.50	.005
Middle Gray	7.57	
51	1.80	.003
52	1.80	.003
53	1.80	.002
12-32	11.14	0.0045

13L-17

Road cut about 1 airline mile south of Gentry, 12½ airline miles west of Cookeville, Putnam County.

Sample number	Thickness	Uranium content (percent)
21	1.67	0.003
31	1.50	.004
32	1.50	.004
33	1.34	.003
Middle Gray	6.23	
51	1.33	.002
52	1.50	.003
53	1.50	.002
54	1.78	.001
21-33	6.01	0.0035

13L-20

Cut on old Tennessee Highway 56 on south side of Caney Fork River, about 0.5 mile north of Buckner School, DeKalb County.

Sample number	Thickness	Uranium content (percent)	Uranium content (percent)
11	1.65	.004	.004
12	2.20	.005	.006
13	2.20	.006	.007
14	2.20	.005	.007
21	1.92	.003	.005
22	1.30	.003	.003
31	2.04	.004	.006
32	2.04	.004	.006
33	2.04	.004	.006
Middle Gray	8.93		
51	1.53	.003	.003
52	1.60	.004	.004
53	1.70	.004	.003
54	1.70	.003	.004
11-33	17.59	0.0043	0.0057

13L-22

Cut on U. S. Highway 70N, 0.3 mile west of Chestnut Mound corporation limit sign, Smith County.

Sample number	Thickness	Uranium content (percent)	Uranium content (percent)
1	2.15	.001	
11A	1.04	.002	.002
11B	1.80	.003	.004
11C	1.79	.004	.005
12	1.83	.005	.006
13	1.89	.005	.006
14	1.76	.005	.007
15	1.76	.004	.006
21	1.52	.004	.005
22	1.50	.002	.003
31	2.00	.005	.005
41	1.76	.002	
42	1.88	.003	
43	1.65	.002	
51	2.01	.003	.003
52	2.01	.002	.002
53	2.02	.002	.002
11B-31	15.85	0.0042	0.0053

13M-1

At Burgess Falls, about 0.1 mile upstream from old Cookeville power plant on Falling Water River, Putnam County.

Sample number	Thickness	Uranium content (percent)
11A	0.72	.003
11B	1.98	.003
12	1.88	.004
13	2.00	.006
14	2.00	.006
15	2.00	.006
16	1.80	.006
21	0.85	.004
22	1.99	.005
31	1.94	.004
32	1.69	.005
33	1.69	.005
34	1.69	.005
Middle Gray	8.03	
51	2.07	.003
52	1.76	.003
53	1.76	.003
13-34	17.65	0.0053

13M-7

At Gentrys Bluff on upper part of Mine Lick Creek, about 2 miles east of Boma and 2¼ miles south of Baxter, Putnam County.

Sample number	Thickness	Uranium content (percent)
11	2.10	.005
12	1.80	.005
13	1.83	.003
14	1.84	.005
15	1.70	.005
16	1.70	.004
21	1.40	.006
22	1.47	.003
31	1.90	.003
32	1.90	.004
33	1.95	.002
Middle Gray	5.81	
51	1.65	.003
52	1.70	.002
53	1.80	.001
11-33	19.59	0.0041

13M-4

At Taylor Creek Falls, 9 airline miles northwest of Sparta and near northwest line of White County.

Sample number	Thickness	Uranium content (percent)	Uranium content (percent)
11A	1.37	.004	.004
11B	1.19	.004	.003
12	1.85	.006	.005
13	1.84	.004	.004
14	1.85	.005	.005
15	1.84	.005	.004
21	1.89	.003	.003
22	1.17	.004	.004
31	2.10	.005	.005
32	2.11	.006	.006
33	2.10	.006	.006
34	2.11	.006	.006
Middle Gray	9.39		
51	1.58	.004	.004
52	1.56	.005	.005
53	1.85	.005	.005
54	1.72	.003	.003
12-34	18.86	0.0051	0.0049

13M-5

Road cut 2 airline miles north of Laurel School and 6½ airline miles east of Smithville, DeKalb County.

Sample number	Thickness	Uranium content (percent)	Uranium content (percent)
11	1.55	.003	.003
12	1.53	.004	.007
13	1.38	.005	.006
14	1.25	.005	.006
15	1.32	.005	.006
21	1.35	.003	.006
22	1.34	.002	.004
31	1.66	.003	.007
32	1.67	.003	.005
33	1.67	.004	.007
34	1.67	.004	.007
Middle Gray	8.38		
51	1.63	.002	.002
52	1.64	.003	.004
53	1.64	.003	.003
54	1.64	.002	.002
12-34	14.84	0.0038	0.0061

13M-10

Road cut about 3 airline miles east of Silver Point on east side of Mine Lick Creek, Putnam County.

Sample number	Thickness	Uranium content (percent)	Uranium content (percent)
1	1.50	.002	
11A	1.19	.003	.003
11B	1.42	.004	.004
11C	1.30	.004	.004
12	1.94	.007	.006
13	1.87	.008	.007
14	1.97	.008	.007
15	1.85	.008	.009
16	1.84	.004	.007
21	1.88	.003	.006
22	1.12	.002	.003
31	1.67	.003	.004
32	1.88	.004	.005
33	1.27	.004	.005
34	1.26	.004	.006
41	1.72	.002	
42	.39	.002	
43	.76	.002	
44	2.25	.002	
45	1.48	.002	
46	1.47	.002	
51	1.50	.002	.003
52	1.89	.002	.003
53	1.87	.002	.003
54	1.23	.001	.001
12-34	18.55	0.0052	0.0061

13M-19

In stream bed 1½ airline miles northwest of Boma, Putnam County.

Sample number	Thickness	Uranium content (percent)	Uranium content (percent)
11	2.12	.003	.004
12	1.85	.004	.005
13	1.85	.005	.006
14	1.85	.006	.008
15	1.85	.003	.006
16	1.85	.003	.005
21	1.67	.003	.004
31	2.10	.003	.004
32	2.11	.004	.006
Middle Gray	6.04		
51	1.50	.002	.003
52	1.54	.002	.002
53	1.68	.002	.002
11-32	17.25	0.0038	0.0053

13M-23

Road cut 1½ airline miles northwest of Bloomington Springs, 0.5 mile south of Goose Creek, Putnam County.

Sample number	Thickness	Uranium content (percent)	Uranium content (percent)
11A	1.11	.002	.003
11B	1.58	.003	.005
12	1.77	.005	.006
13	1.80	.003	.006
14	1.80	.005	.008
15	1.80	.006	.007
16	1.40	.003	.007
21	1.42	.002	.003
22	1.40	.002	.002
31	1.95	.002	.004
32	1.90	.003	.005
Middle Gray	5.01		
51	1.57	.003	.003
52	1.40	.002	.002
53	1.60	.002	.002

12-32 15.24 0.0035 0.0054

13M-24

Cut on county road about 0.5 mile north of U. S. Highway 70N, 0.25 mile east of Lafayette School, and 11 airline miles west of Cookeville, Putnam County.

Sample number	Thickness	Uranium content (percent)
11A	1.33	.002
11B	1.32	.003
12	1.72	.004
13	2.02	.004
14	2.02	.003
15	2.01	.003
21	1.85	.003
22	1.85	.002
31	1.25	.001
32	1.26	.002
Middle Gray	4.38	
51	2.12	.002
52	2.12	.005

12-32 13.98 0.0029

14L-1

Northwest side of Tennessee Highway 80, 4.3 miles southwest of Willette, and 0.5 mile northeast of Smith County line, Macon County.

Sample number	Thickness	Uranium content (percent)
11	1.83	.004
12	1.84	.003
13	2.00	.004
14	2.00	.006
15	2.00	.007
16	2.00	.004
17	2.00	.003
18	2.00	.002

11-18 15.67 0.0041

14L-5

East side of county road 2.2 miles east-southeast of Willette, and 0.4 mile south of Fairview School, Macon County.

Sample number	Thickness	Uranium content (percent)
11A	2.00	.003
11B	2.00	.003
11C	2.00	.004
11D	1.50	.007
11E	1.43	.010
12	2.15	.004
13	2.15	.005
21	1.80	.003
22	1.80	.002
23	1.81	.003

11D-13 7.23 0.0059

14M-2

Cut on north side of Flynn Creek road, 1 mile northwest of its junction with Tennessee Highway 56, Jackson County.

Sample number	Thickness	Uranium content (percent)
11A	1.50	.001
11B	1.50	.003
12	2.00	.003
13	2.00	.006
14	2.00	.009
15	1.78	.007
21	2.31	.005
22	2.32	.005
31	1.93	.004
51	1.65	.004
52	1.65	.000
53	1.64	.000

12-31 14.34 0.0055

14M-6

East side of Tennessee Highway 85, 3.2 miles north of Rough Point, 5 airline miles northwest of Gainesboro, Jackson County.

Sample number	Thickness	Uranium content (percent)
11	2.09	.001
12	2.09	.002
13	2.09	.004
14	2.09	.004
15	2.09	.004
21	2.17	.007
22	2.17	.002
23	2.17	.001

13-21 8.44 0.0047

14M-7

Cut on southeast side of Tennessee Highway 85, 0.6 mile east of Tennessee Highway 53 and about 3 miles northeast of Gainesboro, Jackson County.

Sample number	Thickness	Uranium content (percent)
11A	2.10	.002
11B	2.10	.003
11C	2.11	.003
11D	2.11	.005
11E	2.11	.005
12	2.00	.005
21	1.95	.004
22	1.95	.002
23	1.95	.002
24	1.95	.002

11D-21 8.17 0.0048

14M-8

Cut on west side of Tennessee Highway 56, 1.9 miles southeast of Gainesboro, Jackson County.

Sample number	Thickness	Uranium content (percent)
11A	1.51	.003
11B	1.50	.001
12	1.90	.005
13	1.90	.007
14	2.00	.007
15	2.00	.003
16	2.00	.004
17	1.97	.005
21	1.83	.002
22	1.83	.001
23	1.84	.001

12-17 11.77 0.0052

14M-9

Cut on southeast side of Roaring River road, 1.6 miles north of Sunny View School and about 6 airline miles east of Gainesboro, Jackson County.

Sample number	Thickness	Uranium content (percent)
11A	1.96	.002
11B	1.95	.003
11C	1.95	.007
11D	1.95	.005
12	1.95	.005
13	1.95	.004
14	1.95	.005
15	1.95	.003
21	1.66	.002
22	1.66	.001
23	1.66	.001

11C-15 11.70 0.0048

14M-10

Cut on west side Tennessee Highway 53, 14 miles northeast of Gainesboro and 1.8 miles northeast of Clay-Jackson County line, Clay County.

Sample number	Thickness	Uranium content (percent)
11A	2.12	.003
11B	2.11	.002
11C	2.11	.005
12	1.80	.003
13	2.00	.006
14	2.00	.003
21	1.76	.003
22	1.76	.002
23	1.76	.001

11C-14 7.91 0.0043

14M-11

Cut on west side Tennessee Highway 53, 7.6 miles southwest of Gainesboro and 1.4 miles southwest of junction of Highway 53 and Flynn Creek road, Jackson County.

Sample number	Thickness	Uranium content (percent)
11	2.05	.002
12	2.05	.004
13	2.06	.006
14	2.06	.007
15	2.06	.006
21	2.18	.003
31	2.09	.004

12-31 12.50 0.005

14M-13

Northwest side of Keeling Branch road, 4.1 miles north of Whitleyville, Jackson County.

Sample number	Thickness	Uranium content (percent)
11	2.00	.005
12	2.00	.005
13	2.00	.009
14	2.00	
15	2.00	
16	2.00	.006
17	1.00	.004
21	0.82	.003

11-21 13.82 0.0058
(samples 14 and 15 estimated)

14M-14

Cut on north side of county road, 1.2 miles east of Freewill School, west side of Blackman Creek, Jackson County.

Sample number	Thickness	Uranium content (percent)
11A	2.24	.002
11B	2.24	.003
12	2.23	.007
13	2.00	.007
14	2.00	.008
15	1.66	.007
16	1.67	.004
17	1.67	.005
18	1.66	.004
19	1.67	.004
20	1.67	.004
21	1.55	.004
31	1.79	.001
32	1.79	.001
33	1.79	.000

12-20 16.23 0.0057

14M-15

North side Shakerag Hollow road, 0.8 mile northwest of New Salem School, and about 2½ airline miles south-southwest of Gainesboro, Jackson County.

Sample number	Thickness	Uranium content (percent)
11	1.57	.001
12	1.57	.002
13	2.00	.005
14	2.00	.005
15	2.00	.005
16	2.00	.004
21	1.30	.002
22	1.30	.002
31	2.24	.003
51	2.02	.002
52	2.03	.002

13-31 12.84 0.0039

14M-16

East side Sugar Creek road, 4.5 miles (up valley) from [illegible] Jackson County.

Sample number	Thickness	Uranium content (percent)
11A	1.85	.001
11B	2.00	.002
12	2.00	.004
13	2.00	.003
14	2.00	.004
15	2.00	.002
16	2.00	.003
21	1.97	.002
22	2.00	.004
23	2.00	.001
24	2.00	.000

12-22 13.97 0.0031

14N-3

East side of Spring Creek at falls near Overton-Putnam County line about 11 airline miles east-southeast of Gainesboro, Overton County.

Sample number	Thickness	Uranium content (percent)
11	2.00	.002
12	2.00	.003
13	1.83	.004
14	2.00	.005
15	2.00	.005
16	2.00	.006
21	1.57	.005
22	1.57	.006
31	1.83	.005
32	1.83	.005
51	1.64	.002
52	1.63	.003
53	1.63	.002

13-32 14.63 0.0051

14N-4

West side of dam on Mill Creek in Standingstone State Park, 2 miles south-southwest of Timothy, Overton County.

Sample number	Thickness	Uranium content (percent)
11A	1.70	.003
11B	1.70	.003
11C	1.70	.004
12	1.76	.006
13	1.76	.005
14	1.76	.005
15	1.77	.007
16	1.77	.006
21	2.27	.004
22	2.26	.003

12-16 8.82 0.0058

15N-12

Cut on north side of road about 250 yards west of Dale Hollow Dam, Clay County.

Sample number	Thickness	Uranium content (percent)
11A	2.00	.003
11B	2.00	.005
11C	2.00	.006
11D	2.00	.005
11E	2.00	.004
11F	1.50	.006
11G	1.51	.007
12	1.82	.007
13	1.82	.004
21	1.18	.002
11B-13	14.65	0.0054

16N-11

Highway 90 just west of Burkesville, Cumberland County, Kentucky.

Sample number	Thickness	Uranium content (percent)
1	3.50	.002
2	2.00	.003
3	2.00	.004
4	2.00	.006
5	2.00	.004
6	2.00	.004
7	2.00	.003
8	2.00	.003
9	2.00	.004
10	2.00	.005
11	2.00	.005
12	2.90	.005
1-12	26.40	0.0039

16P-1

Wolf Creek Dam, Russell County, Kentucky. Section is at the southeast abutment of the dam before the concrete was laid. On the Cumberland River.

Sample number	Thickness	Uranium content (percent)
1	2.00	.003
2	2.00	.003
3	2.00	.003
4	2.00	.005
5	2.00	.006
6	2.00	.005
7	2.00	.005
8	2.00	.005
9	2.00	.005
10	2.00	.005
11	2.00	.005
12	2.00	.006
13	2.00	.006
14	2.00	.006
15	1.10	.006
4-15	23.10	0.0054

16P-10

Located at road cut on old State Highway 35 just south of Rowena ferry over Cumberland River, Russell County, Kentucky.

Sample number	Thickness	Uranium content (percent)
1	2.00	.003
2	3.05	.002
3	2.00	.005
4	2.00	.005
5	2.00	.005
6	2.00	.005
7	2.00	.005
8	2.00	.004
9	2.00	.003
10	2.00	.005
11	2.00	.005
12	2.00	.004
13	2.00	.005
14	2.00	.005
15	2.30	.005
3-15	26.30	0.0046

17P-8

State Highway 76, 4 miles west of Dunnville, Kentucky. Section in road cut and stream bank, Adair County.

Sample number	Thickness	Uranium content (percent)
1	2.00	0.004
2	2.00	.002
3	2.35	.002
4	2.00	.003
5	2.00	.003
6	2.00	.003
7	2.00	.005
8	2.00	.004
9	2.00	.003
10	2.00	.004
11	2.00	.004
12	2.00	.003
13	2.00	.004
14	2.00	.003
15	2.00	.003
16	1.50	.004
17	2.50	.002
18	2.50	.001
19	2.70	.002

4-16 25.50 0.0035

17Q-4

Wolf Creek at mouth of Alligator Creek, Russell County, Kentucky.

Sample number	Thickness	Uranium content (percent)
1	1.80	.002
2	2.00	.002
3	2.00	.003
4	2.00	.004
5	2.00	.003
6	2.00	.004
7	2.00	.004
8	2.00	.004
9	2.00	.005
10	2.00	.005
11	2.00	.004
12	2.00	.004
13	2.00	.005
14	2.00	.005
15	2.00	.005
16	2.00	.007
17	2.00	.007
18	2.00	.004
19	2.00	.002
20	1.40	.002

4-17 28.0 0.0047

17R-6

Hogue, Pulaski County, Kentucky.
Wolf Creek reservoir.

Sample number	Thickness	Uranium content (percent)
1	2.00	0.003
2	2.00	.003
3	2.00	.002
4	2.00	.004
5	2.00	.004
6	2.00	.004
7	2.00	.005
8	2.00	.003
9	2.00	.003
10	2.00	.004
11	2.00	.004
12	2.00	.004
13	2.00	.004
14	2.00	.004
15	2.00	.004
16	2.00	.004
17	2.00	.004
18	2.00	.005
19	2.50	.005
4-19	32.50	0.0041

17R-9

Big Clifty creek section in road cut and stream bank just above junction with Fishing Creek, Pulaski County, Kentucky.

Sample number	Thickness	Uranium content (percent)
1	2.00	0.002
2	2.00	.002
3	3.80	.002
4	2.00	.004
5	2.00	.004
6	2.00	.004
7	2.00	.004
8	2.00	.004
9	2.00	.004
10	2.00	.003
11	2.00	.003
12	4.00	.002
13	4.00	.003
14	4.00	.005
15	4.00	.005
16	5.20	.004
4-16	37.20	0.0037

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