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Results of Exploration at the Old Leyden Coal Mine, Jefferson County, Colorado

By
A. J. Gude, 3rd, and F. A. McKeown

Trace Elements Memorandum Report 292

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

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UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

RESULTS OF EXPLORATION AT THE OLD LEYDEN COAL MINE,
JEFFERSON COUNTY, COLORADO*

By

A. J. Gude, 3rd and F. A. McKeown

December 1952

Trace Elements Memorandum Report 292

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Part I

CONTENTS

	Page
Abstract	4
Introduction.	5
Geology	7
Results of diamond drilling	8
Holes LE-1 and LE-2	10
Holes LE-3, LE-4, and LE-5	11
Hole LE-6	12
Conclusions.	12
References cited	14

ILLUSTRATIONS

- Figure 1. Index map showing the Old Leyden coal mine, sec. 28, T. 2 S., R. 70 W., Jefferson County, Colorado 6
2. Geologic map of the Old Leyden coal mine area, Jefferson County, Colorado. In envelope
3. Section through diamond drill holes LE-1 and LE-2, Old Leyden coal mine, Jefferson County, Colorado. In envelope
4. Section through the Old Leyden mine adit, and diamond drill holes LE-3 and MC-2, Jefferson County, Colorado. In envelope
5. Section through diamond drill hole LE-6, Old Leyden coal mine, Jefferson County, Colorado In envelope
6. Diamond drill hole LE-1, Old Leyden coal mine, Jefferson County, Colorado. In envelope
7. Diamond drill hole LE-2, Old Leyden coal mine, Jefferson County, Colorado. In envelope
8. Diamond drill hole LE-3, Old Leyden coal mine, Jefferson County, Colorado. In envelope
9. Diamond drill hole LE-4, Old Leyden coal mine, Jefferson County, Colorado. In envelope
10. Diamond drill hole LE-5, Old Leyden coal mine, Jefferson County, Colorado. In envelope
11. Diamond drill hole LE-6, Old Leyden coal mine, Jefferson County, Colorado. In envelope

RESULTS OF EXPLORATION AT THE OLD LEYDEN COAL MINE,
JEFFERSON COUNTY, COLORADO

By A. J. Gude, 3rd and F. A. McKeown

ABSTRACT

Six diamond-core holes totaling 2,201 feet were drilled by the U. S. Bureau of Mines under contract to the U. S. Atomic Energy Commission at the Old Leyden coal mine, Jefferson County, Colo. The holes were spotted on the basis of geologic mapping by the U. S. Geological survey and were drilled to explore the lateral and downward extent of a uranium-bearing coal and the associated carnotite deposits in the adjacent sandstone. The data obtained from the diamond-core holes helped to explain the geology and structural control of the deposit. The uranium is most abundant in a coal bed that in places has been brecciated by shearing, and then altered to a hard, dense, and silicified rock. The uraniferous coal is in the nearly vertical beds of the Laramie formation of Upper Cretaceous age.

Small lenticular bodies of uraniferous material, 50 feet long, 25 to 30 feet wide, and 2 to 4 feet thick, occur at intervals in the coal and silicified coal over a strike length of about 800 feet. These bodies contain 0.10 to 0.50 percent uranium. Data obtained from the drilling indicate a discontinuous radioactive zone between these higher-grade bodies; assays of samples from the cores range from 0.001 to 0.10 percent uranium. All drill holes were probed by Survey and A. E. C. logging equipment and showed anomalies where the core assayed more than 0.005 percent uranium.

Material of ore grade--0.10 percent uranium--was found in one core; the rock in the other five holes was of lower grade. The presence of the radioactive zone in all holes suggests, however, that uranium is distributed irregularly in a southerly plunging deposit which is exposed in the adit, on the outcrop, and in other diamond-drill holes that were put down by the lessee.

INTRODUCTION

Captain E. L. Berthoud (Berthoud, 1875) discovered uranium minerals in the Old Leyden coal mine, sec. 28, T. 2S., R. 70 W., Jefferson County, Colo. (fig. 1) in 1874. No uranium ore was mined, however, until 1950 when Ray A. Bennett of the Moreno-Cripple Creek Corporation, Denver, Colo., leased the property from the owner, George W. Lindsay of Denver, Colo. Mr. Bennett reopened the old adit and recovered a few tons of silicified coal that assayed about 0.15 percent uranium. Geologic studies of this occurrence by the U. S. Geological Survey (McKeown and Gude, 1951) lead to a diamond-drilling exploration project by the U. S. Bureau of Mines on the property on behalf of the U. S. Atomic Energy Commission. Six drill holes were spotted on the basis of previous geologic mapping and the cores were logged by the Survey. The holes were cored to explore the uraniferous deposit in and adjacent to the mine, and to obtain the geologic, structural, and mineralogic setting of this unique deposit.

The holes were radiometrically logged with portable gamma-ray, long-cable probes and recording equipment of the Geological Survey and the Atomic Energy Commission. The Survey truck-mounted unit ("Barnaby"), under the supervision of K. G. Bell, U. S. Geological Survey, was used in holes LE-1, LE-2, and LE-6. Holes LE-2, LE-3, LE-4, and LE-5 were probed with the A. E. C. long-cable field counter operated by Kenneth Baker of the Atomic Energy Commission. In addition to radiometric logging of the holes, all the core was scanned with portable field counters before sampling.

Samples of the cores selected on the basis of the field radiometric tests were split and analyzed radiometrically, chemically, and spectrographically in the Geological Survey Trace Elements Section Denver Laboratory, under the supervision of L. F. Rader, Chief. Core from 19 coal-bearing intervals in holes LE-1 through LE-4 was sent to the Survey's Coal Geology Laboratory, Columbus, Ohio, where the samples were examined petrographically and paleobotanically by J. M. Schopf, Geologist-in-charge. He sent splits of the coal to the U. S. Bureau of Mines laboratory in Pittsburgh, Pa., for proximate analyses.

FIGURE 1.-- INDEX MAP SHOWING THE OLD LEYDEN COAL MINE,
SEC. 28, T. 2 S., R. 70 W., JEFFERSON COUNTY, COLORADO.

Particular acknowledgment is made of the cooperation given the writers by Ray A. Bennett of the Morenci-Cripple Creek Corporation who gave us the cores and analyses of the three AX diamond core holes MC-1, MC-2, and MC-3 (fig. 2), drilled for him in the adit. Lewis Harmon of Denver and Christopher Bennetts of Leyden supplied valuable information about the Independence mine, which is adjacent to the Old Leyden coal mine and is now caved and inaccessible.

GEOLOGY

Uranium in the Old Leyden coal mine occurs in a brecciated, silicified coal bed and an overlying silicified sandstone in the Laramie formation of Upper Cretaceous age. The sandstone forms Leyden Ridge hogback; prominent cliffs characterize the eastern and western side of the ridge. These rocks are part of a monoclinical fold on the western flank of the Denver basin (Van Tuyl, et al., 1938, p. 22). The beds strike N. 4° E. and range in dip from about 60° SE. though vertical to 75° NW. Bedding-plane and low-angle reverse faults have sheared and brecciated the rocks in the vicinity of the Old Leyden coal mine.

The strata in the Laramie formation are typically discontinuous within distances of several hundred to a thousand feet. The silicified sandstone unit, which forms the crest of Leyden Ridge, provides the best and most distinctive stratigraphic marker horizons. The top and bottom of this unit can be determined with little difficulty and are the only horizons that could be determined with certainty in the cores.

A generalized vertical section through holes LE-1 and LE-2 (fig. 3) shows the irregularity and discontinuity of the beds in the Laramie formation.

The low-angle reverse fault (fig. 3) was inferred from the offset of the silicified sandstone unit to the east from its expected position, as projected downward from the cliff outcrop. It is further confirmed by the described location of the underground workings of the Independence mine (personal communication, Lewis Harmon, Denver) which is about 800 feet south of the Old Leyden mine. The underground workings of the Independence mine are shown projected into the plane of the section 100 feet north of their approximate location. Both of the reverse faults shown on figure 3 are diagrammatic. These faults actually

consist of zones of many small closely-spaced offsets, the sum total of which is a displacement of many feet.

Figure 4 is an east-west vertical section showing hole LE-3, the Old Leyden mine adit, and hole MC-2, projected into the plane of the section. Hole MC-2 is an AX diamond core hole drilled by the mine operator. The inferred faults shown on this drawing are assumed to be the same as, or related to, the steeply dipping reverse fault shown in figure 3.

The uranium is localized where the zone of coal or carbonaceous clay that underlies the silicified sandstone unit is in or adjacent to the shear zones associated with the faulting shown in figures 2-5. The only identified uranium mineral found at this locality is carnotite (Wilson, 1925). Uranium and vanadium analyses of the uraniferous coal, silicified coal, and silicified sandstone, however, show that there is more uranium present than can be accounted for in carnotite alone. The excess uranium present may be an unidentified oxide. Field studies indicate that the carnotite is probably a secondary mineral. It usually occurs in openings in the brecciated, silicified coal or as coatings around sand grains and along fractures in the overlying silicified sandstone.

The unidentified uraniferous material is associated with coal, silicified coal, and carbonaceous clay. Autoradiographs of specimens from the cores and from the exposure in the Old Leyden adit show that the radioactivity, other than that associated with the carnotite, is higher in intensity where the coal has been crushed and is adjacent to silicified coal. This is also borne out by the gamma-ray logs of holes LE-1, LE-2, and LE-6.

RESULTS OF DIAMOND DRILLING

At the start of the drilling program, the inferred size of the known ore body was described as follows (McKeown and Gude, 1951): "The known deposit is a nearly vertical, tongue-shaped body approximately 280 feet long, 110 feet wide, and 4 feet in average thickness." The objectives of the drilling were not limited to exploration of this inferred body because the coal bed, 2 to 12 feet thick, immediately under the silicified sandstone appeared to be the locus for other uranium deposits. It was expected that the more uraniferous parts of the coal would be small-- on the order of lenses not over 50 feet in their

longest dimension, 25 to 30 feet wide and 2 to 4 feet thick.

Four holes--LE-3, LE-4, LE-5, and LE-6 were drilled to explore the coal bed along strike and down dip from the deposit exposed in the mine, on the outcrop above the mine, and in the lessee's core holes (figs. 2, 4). Specimens of silicified uraniferous coal found in dump rock from the Independence mine indicated that similar deposits had been exposed in this mine. Because no reliable descriptions of the workings were available, holes LE-1 and LE-2 were placed so as to penetrate the uraniferous coal bed below the lowest known level of the mine.

The six NX-BX core holes were drilled from sites on opposite sides of Leyden Ridge. The first two holes--LE-1 and LE-2--and the last--LE-6--penetrated the rocks from the west side of the ridge; and holes LE-3, LE-4, and LE-5 from the east side. A total length of 2,201 feet was drilled, of which 1,846.4 feet was cored. General drilling data for each hole are given below and detailed descriptive logs of the holes and graphic sections are shown in figures 5-10.

Hole number	Bearing	Inclination	Elevation (feet)		Length (feet)	
			Collar	Bottom	Drilled	Cored
LE-1	N. 89° E.	-45°	5905	5688	305.0	275.0
LE-2	N. 89° E.	-55°	5905	5535	451.3	421.3
LE-3	S. 74° W.	-53°	5959	5651	387.0	332.2
LE-4	S. 55° W.	-45°	5959	5674	402.7	312.9
LE-5	N. 63° W.	-62°	5959	5605	401.0	281.0
LE-6	N. 78° E.	-45°	5888	5709	254.0	224.0
Totals:					2,201.0	1,846.4

Only one of these six drill holes--LE-1--penetrated uraniferous material of ore grade. The presence of abnormal radioactivity ("highs") in all holes except LE-5, showed that uranium, although not of ore grade, is disseminated along the coal seam beyond the limits of the exposed deposit. Holes MC-1 and MC-2, drilled from the mine, cut ore in the coal and silicified coal directly below the adit that assayed as much as 0.70 percent uranium.

The distribution of rock units in the cores, obtained from both Government and private drilling, indicates the presence of the three interconnected, north-trending faults and the N. 23° E. reverse fault

zone which is also recognized on the surface (fig. 2). Uraniferous rocks in the cores are either on or near these faults, and rock of ore grade (0.10 percent or more) is most abundant in brecciated and silicified parts of the coal bed that are adjacent to faults. In the unbrecciated coal, only one sample--FK-89--contained 0.10 percent uranium over a core length of 0.2 feet. This sample came from the east (upper) contact of the uraniferous coal bed in drill hole LE-1 and is separated from the main north-trending fault by 15 feet of porous sandstone. All samples containing smaller, but appreciable, amounts of uranium are either near this same contact or at the contact of minor coal and claystone lenses within this same faulted sandstone bed.

This relationship of uranium concentrations to stratigraphic and structural controls was not apparent until after drilling was completed. It was impossible, therefore, to outline closely by drilling the most favorable area for ore deposits, namely, the area where coal is adjacent to the north-trending faults. The drilling, however, is sufficiently closely spaced to show: (1) that the coal is not continuously uraniferous and (2) that, in general, the most favorable zone for deposits of ore grade is the coal bed above and to the north of the government drill holes.

The nonuraniferous coal seams and carbonaceous clay beds can be distinguished from sandstone and claystone beds by the intensity of gamma radiation shown on the Barnaby logs. In general, the coal and carbonaceous clay are distinctively less radioactive than sandstone or claystone. Sandstone and claystone can not be distinguished on the logs.

Holes LE-1 and LE-2

Holes LE-1 and LE-2 were drilled from the same site (figs. 2 and 3) on the west side of Leyden Ridge, about 1,300 feet south of the Old Leyden mine portal. Both were collared within a foot of each other and drilled along the same bearing--N. 89° E. Approximately 30 feet of surficial debris was drilled in each hole before starting the coring.

Hole LE-1 (fig. 6), inclined at -45°, penetrated twelve recognizable coal beds. These beds were

readily distinguished from the very dark carbonaceous claystone facies of the coal. The hole was bottomed in massive silicified sandstone at 305 feet. Two anomalous radioactivity highs were recorded near the bottom of this hole with Barnaby, but no uranium minerals were observed in the core. The coal from the core in the lower seven seams was shipped to the Coal Geology Laboratory at Columbus for study, but no differences in composition in the various beds were found that could explain the selective deposition of uranium in one coal and not in the others. Assays of core through the radioactive intervals ranged from 0.001 up to 0.10 percent uranium. The most radioactive core segment, sample FK-89 (fig. 3), was a 0.2-foot segment of coal that contained 0.10 percent uranium and 0.074 percent equivalent uranium.

Hole LE-2 (fig. 7), inclined at -55° , was also bottomed in silicified sandstone at 451.3 feet. This hole cut 19 coal beds. One radioactivity high--at 407.0 feet--was found and a second high was found at 414.0 feet. Samples from the two anomalous intervals contained as much as 0.028 percent uranium, the highest being a 1-foot sample of silicified sandstone, number FK-72 (fig. 3) containing 0.028 percent uranium and 0.042 percent equivalent uranium. Six coal beds between 225 and 390 feet were sampled for the Columbus laboratory, but as in hole LE-1 there were no significant results.

Holes LE-3, LE-4, and LE-5

Holes LE-3, LE-4, and LE-5 (figs. 8, 9, and 10) were drilled from the same site on the east flank of the hogback, nearly opposite the portal of the Old Leyden mine. These holes were drilled at different inclinations and bearings to fan out under the deposit in the mine. Barnaby was not available to survey any of these holes; all were logged with the A. E. C. equipment. Very weak radioactivity anomalies were detected in the lower 150 feet of holes LE-3 and LE-4, but no anomalies were found in hole LE-5. All the assays of samples are correspondingly low, ranging up to 0.014 percent uranium. The intensity of the radioactivity in these holes is low compared to that in holes LE-1 and LE-2.

Nine coal beds were cored in hole LE-3 of which three, between 230 feet and the bottom at 387 feet, were sampled for the Coal Geology Laboratory. As in holes LE-1 and LE-2 the coal from holes LE-3

and LE-4 did not show any variations in composition. The coal bed, 40 feet stratigraphically above the massive silicified sandstone, is weakly radioactive, and assayed 0.001 percent equivalent uranium. A second radioactivity high is present in the sandstone near the lower contact of the main uraniferous coal and clay.

Holes LE-4 and LE-5 cut five coal beds. Three of these, between 270 and 380 feet, were sampled in hole LE-4. The radioactivity in hole LE-4 was similar in intensity and distribution to that in hole LE-3. Hole LE-5, however, showed no abnormal radioactivity either by logging or by the assaying of samples from an interval where a field counter showed a very weak anomaly.

Hole LE-6

Hole LE-6 (fig. 11) was drilled to core the main uraniferous coal bed midway between the other two drill sites. It was drilled at an inclination of $\sim 45^\circ$ on the west side of the ridge, about 400 feet south of the Old Leyden adit (fig. 2). This hole was bottomed in silicified sandstone about 80 feet beyond the lower sandstone-claystone contact. Ten coal seams were penetrated; they correlate roughly with those in hole LE-1, although these correlations are poor at best. The hole was radiometrically probed with Barnaby and two weak anomalies were measured. The geologic location of these anomalies agrees closely with the radioactivity highs in the other holes. Assays of samples from the radioactive intervals are less than 0.005 percent uranium.

CONCLUSIONS

Data obtained from the six diamond-core holes drilled at the Old Leyden mine area helped to explain the geology and structural control of the deposit. Although ore-grade material was found in only one hole, 0.10 percent uranium in LE-1, the indications of radioactivity show that the uranium deposit is more extensive than previously known (McKeown and Gude, 1951). The principal bedding-plane and cross faults (figs. 2, 3, 4, and 5) caused brecciation where the coal and silicified sandstone were sheared. These areas in the main uraniferous coal bed are the favorable ore loci. Holes LE-1 and LE-2 showed the highest

uranium assays although they were drilled farthest from the mine. This fact seems to indicate that the uranium is concentrated in a body that tapers downward and to the south from the exposures near the mine.

A complete and representative section through the lower 420 feet of the Laramie formation is exposed in the composite drill-core records. The irregularity and discontinuity of the individual lithologic units is immediately apparent upon examination of the logs. This heterogeneity is characteristic of near-shore, continental sediments such as the Laramie formation. Faulting, such as found in this area, is common to sedimentary rocks that have been folded during mountain-building processes. It is not surprising, therefore, that the occurrences of uranium deposits are also heterogeneous, and spottily and weakly exposed in the drill core. The six holes sampled only a very small portion of the structure, but the indications are that more extensive exploration by mining should find uraniferous coal or silicified coal above holes LE-3, LE-4, LE-5, and LE-6 and to the north of holes LE-1 and LE-2 in the zone within or immediately underlying the massive silicified sandstone, that is, where the beds have been sheared and brecciated by the north-trending faults.

Because of the erratic distribution of the uranium in the sheared and irregularly bedded Laramie formation, diamond drilling should not be used to block out deposits of ore-grade material. Diamond drilling should only be used in conjunction with exploratory mining.

REFERENCES CITED

- Berthoud, E. L., 1875, On the occurrence of uranium, silver, iron, etc., in the Tertiary formation of Colorado Territory: Acad. Nat. Sci. Philadelphia Proc., vol. 27, pt. 2, pp. 363-366.
- Harrer, C. M., Bolmer, R. L., and Gude, A. J., 3rd, 1952, Old Leyden mine, Moreno-Cripple Creek Corp., Jefferson County, Colorado: DMEA docket 2328, report of examination by field team, region IV, Defense Minerals Exploration Administration.
- McKeown, F., and Gude, A. J., 3rd, 1951, Preliminary report on the carnotite deposits of the Old Leyden coal mine, Jefferson County, Colorado: U. S. Geol. Survey Trace Elements Memorandum Rept, 308.
- Wilson, J. H., 1925, An occurrence of carnotite near Denver: Eng. and Min. Jour. Press, vol. 116, no 6, pp. 239-240.
- Van Tuyl, F. M., Johnson, J. H., Waldschmidt, W. A., Boyd, J., and Parker, B. H., 1938, Guide to the geology of the Golden area: Colorado School of Mines Quart., vol. 33, no. 3.

Part II

CONTENTS

	Page
Abstract	16
Introduction	17
Reserves	17
Further work and recommendations.	18

ILLUSTRATIONS

- Figure 12. Section in plane of uranium-bearing coal bed, Old Leyden mine,
Jefferson County, Colorado In envelope

P a r t I I

ABSTRACT

Uranium-bearing rock of ore grade (0.1 percent uranium) has been found at the Old Leyden mine as a result of the diamond drilling by the lessee and the U. S. Bureau of Mines, as well as from underground work. A tabular block of inferred ore, triangularly-shaped, 540 feet long, 260 feet high, and 4 feet thick, is estimated to contain 17,550 tons of rock with an average assay of 0.2 percent uranium; and a rectangular block below the triangular block contains 16,875 tons which may assay between 0.1 and 0.2 percent uranium. The Moreno-Cripple Creek Corporation, lessee of the property, began exploratory mining of the property under a DMEA contract. If this work shows the Old Leyden mine deposit to be of economic value, other known uraniferous localities in the same hogback may be recommended for more thorough exploration by mining and diamond drilling.

INTRODUCTION

The radioactivity measured and logged in the drill holes is an indication of the extent and location of an inferred uraniferous ore body. Measurements in only one of the holes and on the cores showed material of ore grade (greater than 0.10 percent uranium). The presence of radioactivity highs in each hole, however, suggests that the uranium, although spottily concentrated, is present along the favorable structural and lithologic units. These favorable units are apparently coal or carbonaceous claystone beds in or immediately adjacent to the massive, silicified sandstone where shearing and brecciation has taken place along north-trending irregular bedding plane, and associated reverse cross faults.

RESERVES

At the Old Leyden coal mine uranium-bearing rock of ore grade (0.1 percent uranium or more) has been found in the coal and silicified coal in the following locations shown in figure 12.

- (a) Carnotite in sandstone cropping out on ridge above adit; grab sample, 0.71 percent uranium; outcrop length, 30 feet.
- (b) Coal and silicified coal in Old Leyden adit; channel samples weighted across 3 feet, 0.19 percent uranium.
- (c) Diamond-drill hole MC-1; 0.19 percent uranium, assay reported by Mr. Ray A. Bennett, length not known.
- (d) Diamond-drill hole MC-2; 0.14 percent uranium, weighted across 8 feet of coal.
- (e) "Dike" in coal drift (Berthoud, 1875); dump sample 0.10 percent uranium.
- (f) "Dike" or "fault" in coal drift in Independence mine (personal communication, Mr. Lewis Harmon, Denver); dump sample, 0.10 percent uranium.

These occurrences have been used to outline a tabular block of inferred ore, triangular in outline, that is 540 feet along the base, 260 feet high, and 4 feet thick. Figure 12 is a vertical section approximately in the plane of the uranium-bearing coal bed. The inferred block ABC contains 280,800 cubic feet of rock having an estimated average grade of about 0.20 percent uranium. This grade is estimated on

the basis of assays of the channel samples taken in the Old Leyden adit. Rock tonnages may vary from 11,700 tons--if all the ore is coal--to 23,400 tons--if all the ore is brecciated and silicified coal. An average value of 17,550 tons is assumed because the material is expected to vary in composition between the coal and silicified coal.

An additional block of favorable ground, ACDE (fig. 12), lies below block ABC. This block contains 270,500 cubic feet of rock and varies from 11,250 tons to 22,500 tons depending on the degree of replacement of coal by silica. An average of 16,875 tons may be assumed for this block, and an inferred assay of 0.10 to 0.20 percent uranium. The assay value is predicted from the results of the diamond drilling done by the lessee and the holes drilled during the present project. The total average tonnage for the inferred and projected blocks is 34,425 tons. The tabular body assumed for the ore blocks is probably composed of scattered high-grade ore masses with more or less non-uraniferous coal between.

FURTHER WORK AND RECOMMENDATIONS

At present, the Moreno-Cripple Creek Corporation is carrying out a program of mining and underground short-hole diamond drilling under a DMEA contract (Harrer, Bolmer, and Gude, 1952). This work was begun in July 1952 and will explore the area shown in figure 12. Under the terms of the DMEA contract, a shaft will be sunk 185 feet to bottom in the coal bed just west of the massive, silicified sandstone. Drifts will be driven north and south in the coal on the 175-foot level and a raise will be made to connect with the existing workings of the Old Leyden coal mine. Short diamond-drill holes will be put down to explore and sample the whole width of the coal bed where the drift width does not expose the entire bed.

If the present mining exploration at the Old Leyden mine exposes an economic deposit, further exploration by the government may be recommended of the three radioactive localities in the immediate area and in the same geologic environment (McKeown and Gude, 1951): 1) carbonaceous clay seam 1,300 feet north of the Old Leyden adit, 2) carbonaceous clay seam 2,100 feet north of the Old Leyden adit, and 3) the Coors-Biggins coal mine, 1-1/2 miles to the north, that is in unaltered coal and assays 0.007 percent uranium. The exact quantity of coal and uraniferous coal at this mine is not known, but there is probably more than 50,000 tons of coal left in the mine.

FIGURE 2.-- GEOLOGIC MAP OF THE OLD LEYDEN COAL MINE AREA, JEFFERSON COUNTY, COLORADO

Geology and topography by F. A. McKeown and A. J. Gude 3rd,

FIGURE 3.--SECTION THROUGH DIAMOND DRILL HOLES LE-1 AND LE-2, OLD LEYDEN COAL MINE, JEFFERSON COUNTY, COLORADO

FIGURE 5.--SECTION THROUGH DIAMOND DRILL HOLE LE-6, OLD LEYDEN COAL MINE, JEFFERSON COUNTY, COLORADO

FIGURE 6
DIAMOND DRILL HOLE LE-1
OLD LEYDEN COAL MINE, JEFFERSON COUNTY, COLORADO
DRILLED AUGUST 31 TO SEPTEMBER 10, 1951Collar elevation: 5905 feet
Bottom elevation: 5688 feet
Bottom 217 feet below collar
Hole bearing: N.89°E.
Hole inclination: -45°Length of hole: 305.0 feet
Length of core: 275.0 feet
Core recovery: 94.6 percent
Shifts drilled: 16

*Core examined and analyzed by James M. Schopf, U. S. Geological Survey, Coal Geology Laboratory, Columbus, Ohio.

Geology by A. J. Gude, 3rd

Figure 6.-- BLOCK DIAGRAM SHOWING LOCATION OF HOLE LE-1

FIGURE 7
DIAMOND DRILL HOLE LE-2
OLD LEYDEN COAL MINE, JEFFERSON COUNTY, COLORADO
DRILLED SEPTEMBER 11 TO 27, 1951

Collar elevation: 5905 feet
Bottom elevation: 5535 feet
Bottom 370 feet below collar

Length of hole: 451.3 feet
Length of core: 421.3 feet

Hole bearing: N. 89° E.
Hole inclination: -55°

Core recovery: 97.7 percent
Shifts drilled: 27

* Core examined and analyzed by James M. Schopf, U. S. Geological Survey Geology by A. J. Gude, 3rd coal Geology Laboratory, Columbus, Ohio.

FIGURE 8
DIAMOND DRILL HOLE LE-3
OLD LEYDEN COAL MINE, JEFFERSON COUNTY, COLORADO
DRILLED OCTOBER 1 TO 10, 1951

Collar elevation: 5959 feet
Bottom elevation: 5651 feet
Bottom: 308 feet below collar
Hole bearing: S 74° W

Hole bearing : S.74° W.
Hole inclination:-53°

Length of hole: 387.0 feet
Length of core: 327.7 feet

Core recovery : 100 percent
Shifts drilled : 14

Figure 8.-- BLOCK DIAGRAM SHOWING LOCATION OF
HOLE LE-3

FIGURE 9
DIAMOND DRILL HOLE LE-4
OLD LEYDEN COAL MINE, JEFFERSON COUNTY, COLORADO
DRILLED OCTOBER 12 TO 19, 1951Collar elevation: 5959 feet
Bottom elevation: 5675 feet
Bottom 284 feet below collarLength of hole drilled: 402.7 feet
Length of core: 312.9 feetHole bearing: S. 55° W.
Hole inclination: - 45°Core recovery 99.0 percent
Shifts drilled 14 * Core examined and analyzed by James M. Schopf, U.S. Geological Survey, Geology by A. J. Gude, 3rd.
Coal Geology Laboratory, Columbus, Ohio.Figure 9.-- BLOCK DIAGRAM SHOWING LOCATION OF
HOLE LE-4

FIGURE 10
DIAMOND DRILL HOLE LE-5
OLD LEYDEN COAL MINE, JEFFERSON COUNTY, COLORADO
DRILLED OCTOBER 22 TO 31, 1951Collar elevation: 5959 feet
Bottom elevation: 5605 feet
Bottom: 354 feet below collarLength of hole drilled: 401.0 feet
Length of hole cored: 281.2 feetHole bearing: N. 63° W.
Hole inclination: - 62°Core recovery: 98.3 percent
Shifts drilled: 18

Geology by A. J. Gude, 3rd.

Figure 10.-- BLOCK DIAGRAM SHOWING LOCATION OF
HOLE LE-5

FIGURE II
DIAMOND DRILL HOLE LE-6
OLD LEYDEN COAL MINE, JEFFERSON COUNTY, COLORADO.
DRILLED NOVEMBER 5 TO 9, 1951.Collar elevation: 5888 feet
Bottom elevation: 5709 feet
Bottom: 179 feet below collarLength of hole drilled: 254.0 feet
Length of core: 224.0 feetHole bearing: N. 78°E.
Hole inclination: - 45°Core recovery: 99.1 percent
Shifts drilled: 7

Geology by A. J. Gude, 3rd

Figure II -- BLOCK DIAGRAM SHOWING LOCATION OF HOLE LE-6

Block ABC

Area of ABC = $1/2 (540 \times 260) = 70,200$ sq. ft.
Assumed thickness = 4 ft.

$$\frac{70,200}{280} = 250 \text{ cu ft.}$$

If ore is silicified coal, assume 12 cu. ft. per ton, then $\frac{280,800 \text{ cu. ft.}}{12 \text{ cu. ft./ton}} = 23,400$ tons

If ore is unsilicified coal, assume 24 cu. ft. per ton, then $\frac{280,800 \text{ cu. ft.}}{24 \text{ cu. ft./ton}} = 11,700$ tons

$$\frac{280,800}{2} = 140,400 \text{ cu. ft.}$$

Average tonnage if mixed silicified and unsilicified coal = $\frac{11,700 + 23,400}{2} = 17,550$ tons

Block ACDE

$$\begin{aligned} \text{Area of ACDE} &= \frac{1}{2} (120 + 130) 540 = 67,500 \text{ sq. ft.} \\ &\quad \times 4 \\ &\quad \underline{270,000 \text{ cu. ft.}} \\ &\quad \frac{270,000}{12} = 22,500 \text{ tons silicified coal} \\ &\quad \frac{270,000}{24} = 11,250 \text{ tons unsilicified coal} \\ &\quad \frac{11,250 + 22,500}{2} = 16,875 \text{ tons mixed} \end{aligned}$$

Note: See K_{Ic} on figure 2 for plane of section

Compiled by A.J. Gude
from DMEA docket 2328

FIGURE 12- SECTION IN PLANE OF URANIUM-BEARING COAL BED, OLD LEYDEN MINE, JEFFERSON COUNTY, COLORADO

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