Reconnaissance for Uranium-Bearing Carbonaceous Rocks in New Mexico, 1952

By G. O. Bachman, E. H. Baltz, and R. B. O'Sullivan

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RECONNAISSANCE FOR URANIUM-BEARING CARBONACEOUS ROCKS IN NEW MEXICO, 1952*

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RECONNAISSANCE FOR URANIUM-BEARING CARBONACEOUS ROCKS IN NEW MEXICO, 1952

By

G. O. Bachman, E. H. Baltz, and R. B. O'Sullivan

ABSTRACT

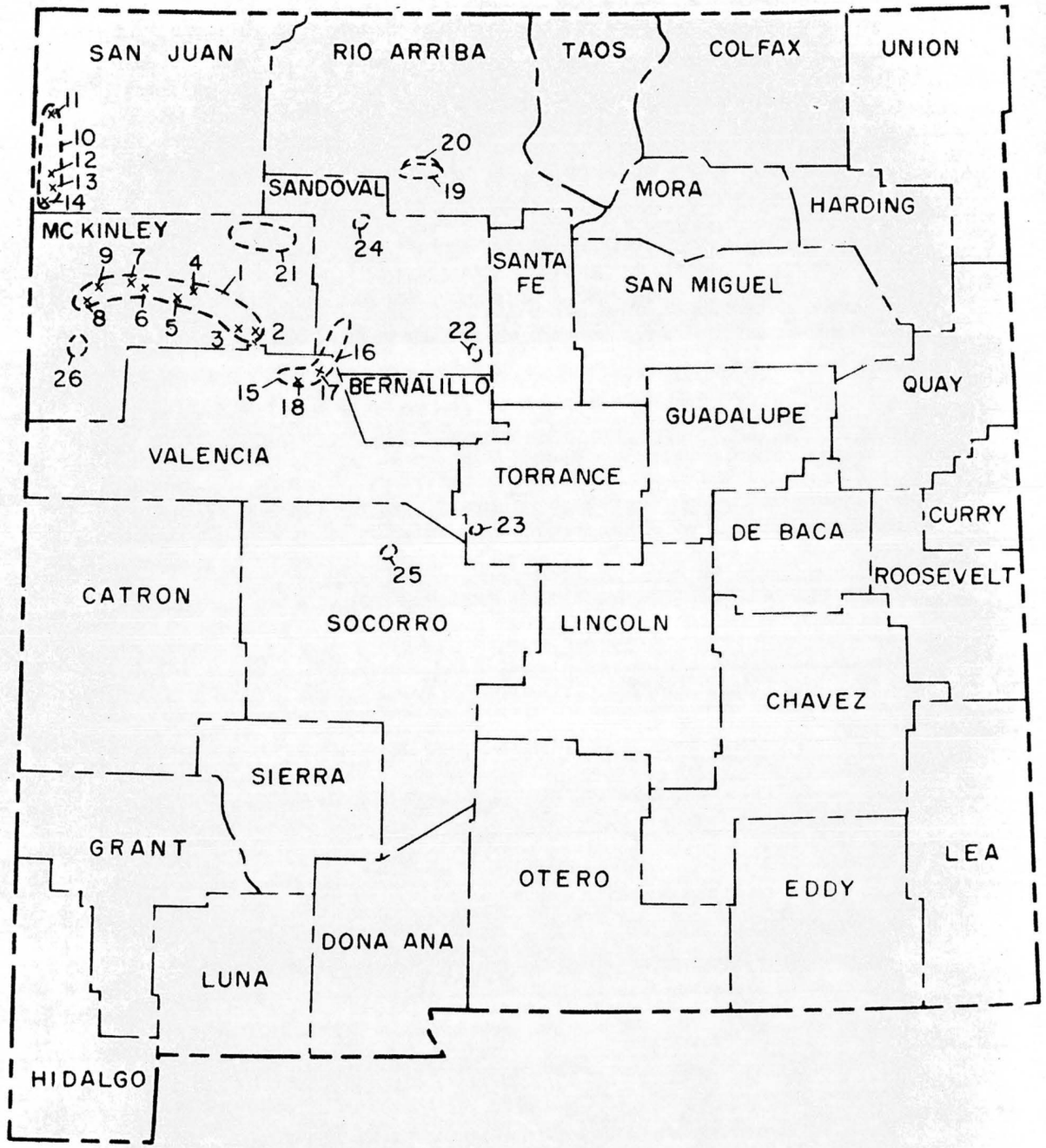
Reconnaissance for uranium in coal and black shale in New Mexico during 1952 was largely an extension of work initiated during the 1951 field season. No uranium deposits of economic interest were found, although minor amounts of uranium were noted at several localities.

INTRODUCTION

During the 1952 field season the writers made a geologic reconnaissance search for uranium in coal and black shale (fig. 1). The work was chiefly a continuation of reconnaissance studies initiated in 1951 (Bachman and Read, 1952). Several areas outlined for study in 1951, were examined more thoroughly during 1952, and several new occurrences of uranium were found. Analyses were made in the Denver and Washington Trace Elements Laboratories of the Geological Survey. This work was done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

SOUTH MARGIN OF SAN JUAN BASIN, McKINLEY COUNTY

Upper Cretaceous rocks form the southern rim of the San Juan Basin, McKinley County. These rocks were examined between Grants and Gallup, a distance of about 60 miles, in July 1952. Upper Cretaceous rocks listed in ascending order are the Dakota sandstone, the Mancos shale, and the Mesaverde formation. The Mesaverde formation and the upper part of the Mancos shale



Index Map of New Mexico

0 10 30 50 MILES
SCALE

EXPLANATION

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FIGURE 1

have been subdivided into several members by Sears (1934).

The structure of the southern part of the San Juan Basin is relatively simple. From the southern rim of the basin, which is arbitrarily defined as the southern line of outcrop of the Dakota sandstone, strata dip 3° to 10° northward into the basin. Mount Taylor, a late Tertiary volcano, and the Zuni uplift are prominent geographic and structural features at the south edge of the basin.

Carbonaceous material occurs in the Dakota sandstone and in the Gallup, Dilco, and Gibson members of the Mesaverde formation (Sears, 1934). Outcrops were given careful examination for several miles at many places. Radioactivity was found in carbonaceous material in the Dakota sandstone and in the lower Gibson member of the Mesaverde formation.

Radioactivity in the lower Gibson member occurs in discontinuous zones of shale, coal, and carbonaceous material near the contact of the lower Gibson member with the overlying Hosta sandstone. The lower Gibson member and the Hosta sandstone member of the Mesaverde formation crop out at San Mateo dome, about 5 miles north of San Mateo. This zone was examined carefully for a distance of about 3 miles along the south edge of the dome without finding abnormal radioactivity.

At the head of Canyon Mulatto, 6 miles northwest of the San Mateo dome, in the NW¼, sec. 24, T. 14 N., R. 9 W., radioactivity was found in the lower Gibson member directly below its contact with the overlying Hosta sandstone. A lens of coaly material about 3 inches thick contains 0.035 percent uranium (BONM-5)1/. A sample from the basal portion of the Hosta sandstone

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1/ Sample numbers are listed by area in the Appendix.

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at this locality contained 0.005 percent equivalent uranium and 0.002 percent uranium (BONM-13).

On the north side of Canyon Mulatto in the N½ sec. 14, T. 14 N., R. 9 W., uranium was found in a discontinuous lens of shale 2½ inches thick at the base of the Hosta sandstone. The shale contains 0.020 percent equivalent uranium and 0.014 percent uranium (BONM-6). A grab sample taken from the Gibson member at the contact with the Hosta sandstone about 85 feet west of this locality contained 0.007 percent uranium (BONM-7).

This zone of radioactivity was examined continuously from locality BONM-6 eastward into the south half of section 12 and the north half of section 13 on both sides of the canyon. On the north rim of Canyon Mulatto in the SE¼, sec. 12, T. 14 N., R. 12 W. a 1-foot bed of carbonaceous shale in the lower Gibson member was sampled directly below the contact of the lower Gibson member with the Hosta sandstone. The sample contained 0.014 percent equivalent uranium and 0.005 percent uranium (BONM-14). The radioactivity was in the trough of a minor syncline. The syncline is approximately 150 feet wide, and its axis trends nearly north.

The Mesaverde formation was examined at many places west of Canyon Mulatto. In secs. 27 and 28, T. 15 N., R. 10 W. the stratigraphic section was examined carefully in the vicinity of the Ambrosia Fault (Hunt, pl. 18, 1936). Particular attention was given to the lower Gibson-Hosta contact in the W½ sec. 27 and in sec. 28. No abnormal radioactivity was noted in this area and no samples were collected.

Lower Gibson and Hosta rocks are exposed for a distance of about 5 miles on the sides of a prominent cuesta that extends from sec. 31, T. 16 N., R. 11 W. westward to Satan Pass. These exposures were examined throughout most

of their length but radioactivity was found only at one locality east of the Thoreau-Crown Point road. In sec. 32, T. 16 N., R. 12 W. a radioactive coal bed 1-foot thick was found near the lower Gibson-Hosta contact. The uranium content of the coal apparently is discontinuous as different points on any one horizon examined did not show equal radioactivity. The coal contained 0.003 percent equivalent uranium, 0.005 percent uranium, and 0.034 percent uranium in the ash (BONM-9). Carbonaceous shale at the same locality contained 0.003 percent equivalent uranium (BONM-10). A channel sample of the upper foot of a coal bed 3 feet thick, also in sec. 32, contained 0.014 percent equivalent uranium, 0.019 percent uranium, and 0.054 percent uranium in the ash (BONM-11). The strata are deformed from slumping but all samples were collected from strata which are within a few feet stratigraphically of the lower Gibson-Hosta contact.

Outcrops of these rocks were examined at close intervals to the north through Satan Pass on both sides of the Canyon as far as sec. 16, T. 16 N., R. 12 W. but no abnormal radioactivity was noted. An examination was made of the lower Gibson-Hosta contact south of Crown Point in secs. 29 and 30, T. 17 N., R. 12 W. and of the Gallup sandstone in T. 15 N., R. 12 W., but no radioactivity was detected.

The Hosta sandstone forms the caprock of Hosta Butte in secs. 26 and 27, T. 16 N., R. 13 W. The Hosta sandstone and underlying lower Gibson member, which are exposed on the east side of the butte, were examined, but no radioactivity was discovered except near the lower Gibson-Hosta contact. There, a thin stratum of radioactive coaly material which does not exceed 3 inches in thickness, occurs in the lower Gibson member 2½ feet below the lower Gibson-Hosta contact. This material contained 0.012 percent equivalent uranium, 0.013 percent uranium, and 0.033 percent uranium in the ash (BONM-8).

The lower Gibson member and the Hosta sandstone were examined about 8 miles west of Satan Pass near the south entrance to Mariana Pass in sec. 8, T. 16 N., R. 13 W., but no radioactivity was detected. The scarps on both sides of the pass were examined also, but no abnormal radioactivity was noted. In the NE¼, SW¼, sec. 5, T. 16 N., R. 13 W. a lens of carbonaceous shale 1.8 feet thick contained 0.009 percent uranium (BONM-12). In the NW¼, sec. 2, T. 16 N., R. 14 W. a bed of carbonaceous shale 0.7 feet thick contained 0.013 percent equivalent uranium and 0.016 percent uranium (BONM-16). Both of these shale beds are at the lower Gibson-Hosta contact.

The lower Gibson and Hosta rocks were examined in Dalton Pass, about 4 miles west of Mariana Pass. For about 6 miles to the west no radioactivity was detected except at a ridge due north and across the valley from Dalton Pass, approximately in sec. 28, T. 17 N., R. 14 W. There the Hosta sandstone rests directly on a lens of impure coal that is about 3 inches thick and contains 0.025 percent uranium with 0.038 percent uranium in the ash (BONM-15).

Two occurrences of uranium are known in the Dakota hogback about 3 miles east of Gallup. One of these, about 1½ miles north of U.S. Highway 66, is in carbonaceous shale. The other occurrence is more closely associated with sandstone. Because of the association of uranium with carbonaceous material some attention was given to other Upper Cretaceous carbonaceous rocks in this area. Coal and carbonaceous shale in the Gallup, Gibson, and Dilco members of the Mesaverde formations in the northern part of T. 16 N., R. 18 W. and in the northwestern part of T. 16 N., R. 17 W. were examined, but no abnormal radioactivity was detected.

The caprock of Pyramid rock, in the SE¼ sec. 3, T. 15 N., R. 17 W., consists of Dakota sandstone that contains a small quantity of interbedded carbonaceous shale. The shale is slightly radioactive but no samples were collected. Radioactivity was found in a bed of carbonaceous shale 4 feet thick in the Dakota sandstone above Kit Carson's Cave which is about 2 miles east of Pyramid Rock. The upper 1.5 feet of the shale contains 0.012 percent equivalent uranium and 0.008 percent uranium (BONM-17A), and the lower 2.5 feet contained 0.004 percent equivalent uranium (BONM-17B).

Parts of the southern San Juan Basin were surveyed by airborne detection equipment under the direction of J. Meuschke of the Geological Survey. Seven east-west flight lines, each about 25 miles long, were flown in T. 16 N., R. 14 to 18 W. No radioactivity anomalies were recorded.

CHUSKA MOUNTAIN AREA

During the reconnaissance work carried on during 1951, radioactive coal was discovered in the Tocito sandstone of Late Cretaceous age on Beautiful Mountain in San Juan County, New Mexico (Bachman and Read, 1952). Because of this occurrence of uranium-bearing coal, the Chuska Mountain area was examined during the 1952 season. However, exposures in many parts of the Chuska Mountains are too poor for effective reconnaissance with radioactivity detecting instruments.

In a hogback east of Toadlena, the Tocito sandstone contains abundant interbedded carbonaceous material. These rocks were examined carefully from the Newcomb-Toadlena road southward for a distance of about 4 miles to the point where they are covered by Tertiary rocks. The Dakota sandstone and the Todilto limestone also were examined at closely spaced points along the hogback. No abnormal radioactivity was detected.

In Washington Pass, Tertiary igneous rocks are slightly radioactive. A grab sample (BONM-28) of gray tuff contained 0.0037 percent equivalent uranium and 0.0001 percent uranium. A sample (BONM-29) of diabase contained 0.0056 percent equivalent uranium and 0.0005 percent uranium.

Isolated exposures of the Morrison formation and the Todilto limestone were examined east and south of Crystal, but no radioactivty was detected.

MOUNT TAYLOR AND VICINITY

Mount Taylor is flanked by Mesa Chivato, a basalt-capped plateau which extends northward and northeastward for several miles in southeastern McKinley County (Hunt, 1936). Reconnaissance was undertaken along the east side of Mesa Chivato where a relatively thick sequence of Upper Cretaceous strata containing carbonaceous material is well exposed. Upper Cretaceous rocks that crop out east of Mount Taylor include in ascending order, the Dakota sandstone, the Mancos shale, and the Mesaverde formation. In general, these strata dip gently westward into the Mount Taylor syncline.

Coal and carbonaceous material in the lower Gibson member of the Mesaverde formation on the north side of Seboyeta Canyon were examined, but no radioactivity was detected. The line of cliffs from Seboyeta north to Marquez, a distance of about 6 miles, was examined and found to be non-radioactive.

A basalt-capped plateau also extends about 7 miles south from Mount Taylor. The plateau there is terminated by cliffs of Upper Cretaceous rocks that were examined at numerous localities but which are not radioactive. Numerous coal beds are well exposed in a fork of Guadalupe Canyon in sec. 15, T. 11 N., R. 8 W., but no radioactivity was detected.

Upper Cretaceous rocks are poorly exposed near the top of Mount Taylor and were examined but were not found to be radioactive.

GALLINA-COYOTE AREA

The Gallina-Coyote area, Rio Arriba County, is about 53 miles northwest of Santa Fe and 15 miles northeast of Cuba. The topography of the area is extremely varied, altitudes ranging from 6,700 feet at Coyote to more than 10,000 feet on San Pedro Mountain, about 5 miles south of Gallina. Pre-Cambrian metamorphic and igneous rocks, Tertiary igneous rocks, and sedimentary rocks that range in age from Pennsylvanian to Recent are exposed in the area. Most attention was given to rocks of Jurassic and Cretaceous age, although other rocks were examined briefly.

Along New Mexico State Highway 96, between Coyote and Gallina, sedimentary rocks are exposed. Permian "red beds" of the Cutler formation are overlain by the Chinle formation of Triassic age. Jurassic rocks include the Entrada sandstone and the Wanakah and Morrison formations. To the north of the highway, Mesa Alta is capped by the Dakota sandstone of Cretaceous age. To the west of Mesa Alta the stratigraphic sequence includes the Dakota sandstone, the Mancos shale, the Mesaverde formation, the Lewis shale, Pictured Cliffs sandstone, Fruitland-Kirtland formation, the Ojo Alamo sandstone, the Nacimiento group, and the Wasatch formation.

Exposures on Mesa Alta were examined in some detail. Along a line of cliffs at the south end of the mesa the Wanakah and Morrison formations were carefully examined in secs. 13, 14, 15, 22, 23, and 24, T. 23 N., R. 2 E. The Dakota sandstone was examined over much of Mesa Alta. However, slumping and vegetation cover much of the Dakota sandstone and good exposures are rare. No abnormal radioactivity was detected in the Dakota sandstone on Mesa Alta.

A series of hogbacks composed of Cretaceous rocks were examined west of Gallina. Carbonaceous shale and coal in both the Dakota sandstone and the

Mesaverde formation are well exposed at numerous places and were examined at selected points along the hogback for about 14 miles. No radioactivity was detected.

Other places in the Gallina-Coyote area where radioactivity surveys were made include Cerro Pedernal about 6 miles south of Coyote (carbonaceous material in the Dakota sandstone); the north and west sides of San Pedro Mountain (Cutler "red beds"); and Mesa Pinebestosa (the Madera formation). No abnormal radioactivity was detected, and no samples were collected.

CHACRA MESA, McKINLEY COUNTY

Upper Cretaceous and Tertiary rocks in the vicinity of Chacra Mesa, McKinley County (Dane, 1936) were briefly examined during 1952. The stratigraphic section was examined at many places from Crown Point northward to Whitehorse Trading Post, and from there eastward to Cabezon with a scintillation detector. No radioactivity was noted in this area except for a shale at the base of the Ojo Alamo sandstone about 1 mile southeast of Pueblo Bonito National Monument in Chaco Canyon. The shale (BONM-25) contains 0.001 percent equivalent uranium.

HAGEN BASIN, SANDOVAL COUNTY

Brief reconnaissance was done in the Hagen Basin in the southeast part of Sandoval County. Jurassic and Upper Cretaceous sedimentary rocks and Tertiary igneous rocks were examined. The Wanakah formation of Jurassic age was examined north of Golden and at other points on the east side of the Hagen Basin, but no radioactivity was detected. Coal in the Mesaverde formation of Upper Cretaceous age was examined at several localities in the

vicinity of the deserted town of Hagen but is not radioactive. A sill composed of quartz monzonite porphyry was sampled in the NE¼, sec. 4, T. 12 N., R. 6 E. about a quarter of a mile east of the Diamond Trail Ranch house. The sample contained 0.010 percent equivalent uranium and 0.002 percent uranium (BONM-1). The sill intrudes the Mancos shale of Late Cretaceous age. The upper contact of the sill with the Mancos shale was obscured by alluvium; however, shale immediately underlying the sill is baked and slightly radioactive. Two samples of the shale, BONM-2 and BONM-3, contained 0.004 and 0.002 percent equivalent uranium respectively.

SCHOLLE COPPER DISTRICT

The Scholle copper district is in Abo Pass about 13 miles west of Mountainair, Torrance County. Copper minerals are associated with carbonaceous material in the Permian Abo formation. Prospects consisting of several trenches, an adit, and a shaft in a valley about three-fourths of a mile southeast of Scholle were examined for radioactivity. A sample of the most radioactive material observed, an arkose, contained 0.016 percent equivalent uranium and 0.008 percent uranium (BONM-19). The zone from which this sample was collected could not be followed because of a cover of alluvium. The Abo formation was examined from this point northward towards the south end of the Manzano Mountains for about 10 miles. Numerous abandoned copper mines and prospects were examined, but no abnormal radioactivity was detected.

CUBA MESA AREA

Cuba Mesa is 2 miles west of Cuba in Sandoval County. Rocks exposed on Cuba Mesa are of Tertiary age and are divided into two major units. The lower unit, the Nacimiento group, consists of 400 to 800 feet of shale and

and sandstone. The upper unit, the Wasatch formation, is approximately 1,000 feet in thickness and is composed of sandstone, shale, and conglomerate. The lower part of the Wasatch formation forms the caprock of Cuba Mesa, where it is about 200 feet thick.

The Wasatch formation was examined about 1½ miles north of Cuba along New Mexico State Highway 44, where carbonaceous shale and fragments of fossil wood were found to be radioactive. A sample of carbonaceous siltstone (BONM-20) contained 0.012 percent equivalent uranium and 0.002 percent uranium.

Exposures on Cuba Mesa were examined along the south and southwest part of the mesa in secs. 1, 2, and 10, T. 20 N., R. 2 W., and secs. 33 and 36, T. 21 N., R. 2 W. At a few localities sediments near the base of the cliff-forming Wasatch formation contained radioactive carbonaceous material. A sample of a sandstone near the base of the Wasatch formation in the NW¼, sec. 1, T. 20 N., R. 2 W. contained 0.006 percent equivalent uranium and 0.003 percent uranium (BONM-22). Talus has covered most of the zone where radioactivity has been found on Cuba Mesa; consequently an adequate appraisal could not be made of the potentialities of this area.

SAN ACACIA AREA

The Datil formation in the San Acacia area, Socorro County, consists of rhyolite, tuffaceous sandstone and clay, and conglomerate made up of volcanic rocks. A cobble (BONM-31) from a conglomerate in the Datil formation about 7 miles west of U.S. Highway 85 and about a mile south of the Rio Salado, contained 0.0042 percent equivalent uranium and 0.0002 percent uranium. The cobbles in the conglomerate here appear to be somewhat more basic in composition than in the Datil formation at other places. A sample (BONM-32) of a

white tuffaceous sandstone about half a mile south of the outcrop of conglomerate contained 0.0022 percent equivalent uranium and 0.0001 percent uranium. A sample (BONM-33) from a 1-foot clay bed overlain by the sandstone contained 0.0009 percent equivalent uranium and 0.0001 percent uranium.

GALLUP-ZUNI BASIN

A sample (BONM-26) of tuff of Tertiary age was collected about 15 miles south of Gallup, McKinley County, in a road cut on New Mexico State Highway 32. It contained 0.0051 percent equivalent uranium and 0.0003 percent uranium.

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APPENDIX

Field number	Lab. number	Rock type	Equivalent uranium (percent)	Uranium (percent)	Uranium in ash (percent)	Notes
Southern edge of San Juan Basin, McKinley County						
BONM-4	87743	Shale	0.007	0.008		Channel sample of 1.3' shale; NW¼, sec. 24, T. 14 N., R. 9 W. Immediately below Hosta-lower Gibson contact.
BONM-5	87744	Coal	0.038	0.035		Coal lenticle 3 inches thick selected from 1.3' channel sample BONM-4.
BONM-13	87752	Sandstone	0.005	0.002		Hosta ss. immediately above channel sample BONM-4.
BONM-6	87745	Siltstone and shale	0.020	0.014		N½, sec. 14, T. 14 N., R. 9 W.; shale and silty zone in Hosta ss. (at base). 5" thick.
BONM-7	87746	Shale	0.008	0.007		Grab sample 85' west of BONM-6. At lower Gibson-Hosta contact.
BONM-14	87753	Shale	0.014	0.005		Chip sample SW¼, sec. 12, T. 14 N., R. 9 W., 1 foot shale at base of Hosta ss.
BONM-9	87748	Coal	0.003	0.005	0.034	Channel sample, coal 1 foot thick. N½, sec. 32, T. 16 N., R. 12 W.
BONM-10	87749	Carb. shale	0.003			Grab sample carb. shale associated with BONM-9.
BONM-11	87750	Coal	0.014	0.019	0.054	Upper 1' of 3' bed. In slumped material near BONM-9.
BONM-8	87747	Coal	0.012	0.013	0.033	Impure coal 0.1' thick. 2.4' below base of Hosta ss. Hosta Butte, SW¼, sec. 26, T. 16 N., R. 13 W.

APPENDIX (CONT.)

Field number	Lab. number	Rock type	Equivalent uranium (percent)	Uranium (percent)	Uranium in ash (percent)	Notes
Southern edge of San Juan Basin, McKinley County (Cont.)						
BONM-12	87751	Carb. shale	0.008	0.009		
BONM-16	87755	Carb. shale	0.013	0.016		Carb. shale 0.7' thick at basal contact of Hosta ss. on point to west of Mariana Pass.
BONM-15	87754	Coal	0.022	0.025	0.038	Impure coal 0.2' thick on ridge due north and across valley from Dalton Pass.
BONM-17A	87756	Shale	0.012	0.008		Upper 1.5' of 4' carb. shale near base of Dakota ss. above Kit Carson's Cave.
BONM-17B	87757	Shale	0.004			Lower 2.5' of 4' carb. shale. Same locality as BONM-17A.
Chuska Mountain area						
BONM-28	D-75652	Tuff	0.0037	0.0001		Tuff at top of Washington Pass.
BONM-29	D-75653	Diabase	0.0056	0.0005		
BONM-27	D-75651	Tuff	0.0049	0.0002		In road cut west of Toadlena; may be in Chuska ss.
BONM-30	D-75654	Clay	0.0006	0.0001		
Chacra Mesa						
BONM-25	101936	Carb. shale	0.001			

APPENDIX (CONT.)

Field number	Lab. number	Rock type	Equivalent uranium (percent)	Uranium (percent)	Uranium in ash (percent)	Notes
Hagen Basin						
BONM-1	87740		0.010	0.002		
BONM-2	87741	Shale	0.004			Mancos shale contacting sill (BONM-1).
BONM-3	87742	Shale	0.002			Mancos shale below contact with sill.
Scholle Copper district						
BONM-19		Arkose	0.016	0.008		
Cuba Mesa area						
BONM-20	D-72617	Carb. siltstone	0.012	0.002		
BONM-22	D-72618	Sandstone	0.006	0.003		
San Acacia area						
BONM-31	D-76582	Andesite (?)	0.0042	0.0002		
BONM-32	D-76583	Tuffaceous sandstone	0.0022	0.0001		
BONM-33	D-76584	Clay	0.0009	0.0001		
Gallup-Zuni basin						
BONM-26	D-75650	Tuff	0.0051	0.0003		