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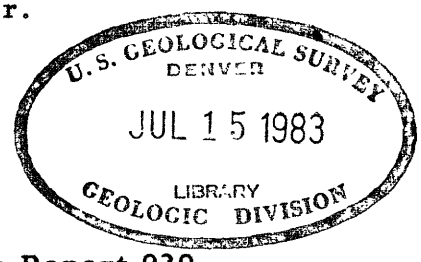
GEOLOGICAL SURVEY

A RECONNAISSANCE FOR URANIUM IN PARTS OF NEW MEXICO AND COLORADO, 1954*

By

Elmer H. Baltz, Jr.

June 1955



Trace Elements Memorandum Report 929

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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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A RECONNAISSANCE FOR URANIUM IN PARTS OF NEW MEXICO AND COLORADO, 1954

By Elmer H. Baltz, Jr.

ABSTRACT

Reconnaissance investigations for uranium in parts of New Mexico and Colorado were undertaken in 1954 with portable Geiger counters and scintillators and with carborne scintillation equipment.

Samples of copper-bearing arkosic sandstone of the Cutler formation collected in the northwestern part of the Jemez Plateau, Rio Arriba County, N. Mex. contain 0.002-0.10 percent uranium. The Bandelier tuff of Pleistocene age contains traces of radioactive material throughout much of this region.

Samples of intrusive and extrusive igneous rocks of Tertiary and Quaternary ages from the Chico Hills, eastern Colfax County, N. Mex., contain 0.0016-0.0024 percent uranium. Radioactivity was detected in igneous rocks of intermediate composition at all localities examined, but no radioactivity was detected in basic igneous rocks or in sedimentary rocks which enclose the intrusives.

Precambrian, Pennsylvanian, Permian, and Tertiary rocks were examined at places in the Sangre de Cristo Mountains, northern New Mexico. A sample of limonite from a fracture in Precambrian metamorphic and igneous rocks in Gallinas Canyon, San Miguel County, contains 0.022 percent uranium.

Samples of carbonaceous sandstone and conglomerate of the Chinle formation of Triassic age collected south of the Canadian Escarpment, San Miguel County, N. Mex., contain 0.004-0.070 percent uranium. Several prospects near the town of Sabinoso contain uranium deposits of possible economic value. Extent of these deposits has not been determined.

No significant radioactivity was detected in Permian, Cretaceous and Quaternary sedimentary rocks and Tertiary intrusive rocks examined at places in Lincoln and Otero Counties, N. Mex.

Radioactivity estimated to be 0.008 percent equivalent uranium was detected in limestone of the Wanakah formation of Jurassic age near Cuchara Camps, Huerfano County, Colo. A sample of acidic tuff of the Devil's Hole formation of Miocene (?) age collected in northern Huerfano County contains 0.0011 percent uranium.

INTRODUCTION

Reconnaissance for uranium in parts of New Mexico and Colorado was undertaken in 1954 by the U. S. Geological Survey on behalf of the Raw Materials Division of the Atomic Energy Commission. Rocks ranging in age from Precambrian to Quaternary were examined by portable Geiger counters and scintillators, and traverses across some of these rocks were made with carborne scintillation equipment.

Emphasis was placed on examination of coal-bearing rocks and carbonaceous shale; however, other rocks were examined also. Although no new deposits of apparent economic interest were discovered, several areas were examined in which small amounts of uranium occur suggesting that these may be favorable for prospecting.

The index map of New Mexico (fig. 1) shows roads traversed by carborne scintillator, location of geologic maps (figs. 2, 3, and 4), and other localities in New Mexico examined for radioactivity. Localities examined for radioactivity in Colorado are shown on figure 5.

The writer was assisted during part of the field work by John J. Musser. Radioactivity measurements and chemical analyses of rock samples were made by the U. S. Geological Survey Washington Laboratory. Chemical analyses of water samples were made by the U. S. Geological Survey Denver Laboratory.

GALLINA AREA, RIO ARRIBA COUNTY, NEW MEXICO

The Gallina area is in south-central Rio Arriba and northern Sandoval Counties, N. Mex. (fig. 2). The southern part of the area is mountainous and has considerable topographic relief. Altitudes range from more than 6,000 feet at Gallina to more than 10,000 feet on San Pedro Mountain and more than 9,000 feet on the Jemez Plateau. The northern two-thirds of the area is a region of high mesas dissected by deep canyons of the Rio Chama and its tributaries.

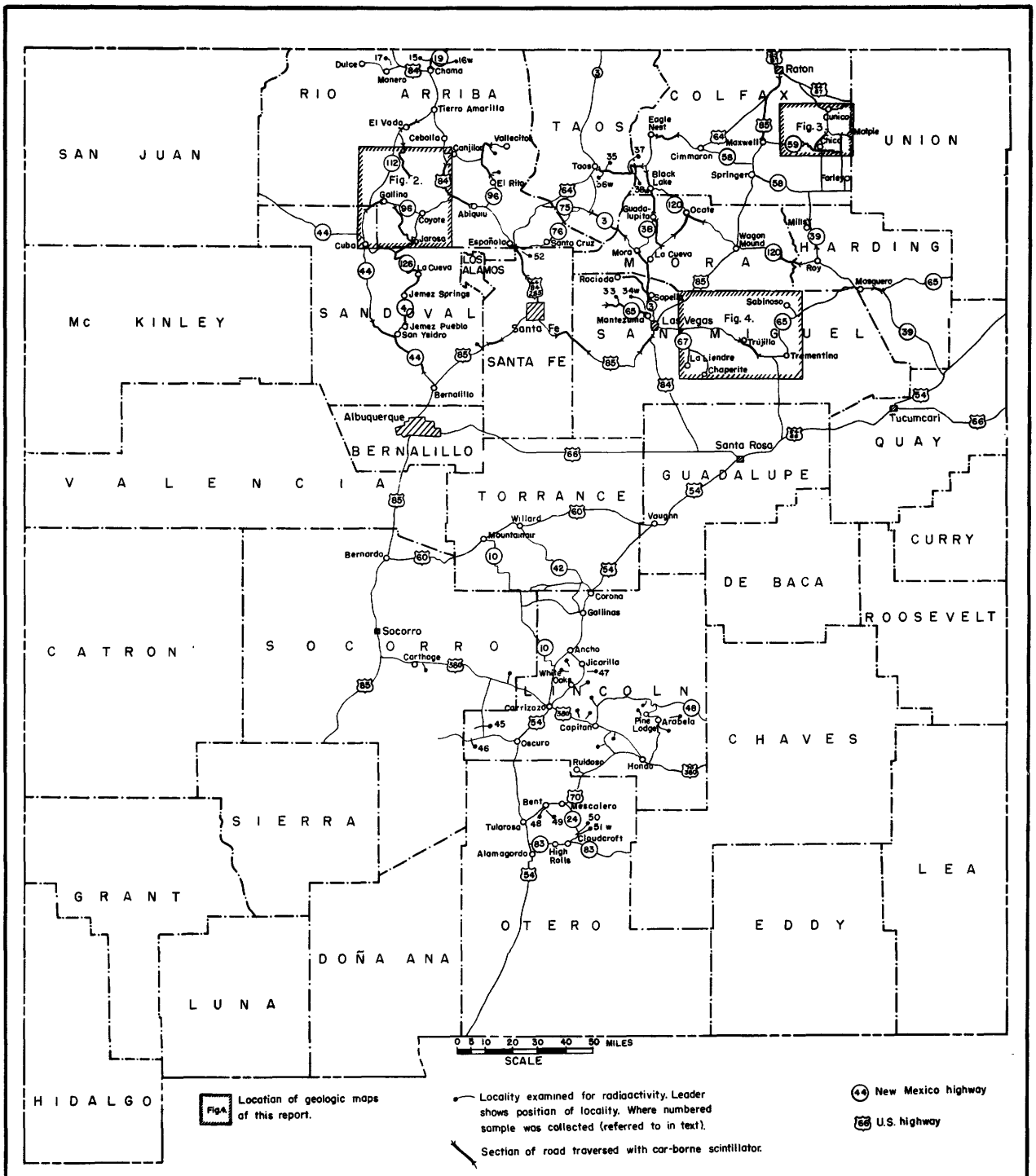

Figure 1. Index map of New Mexico showing localities examined for radioactivity and roads traversed with car-borne scintillator in 1954.

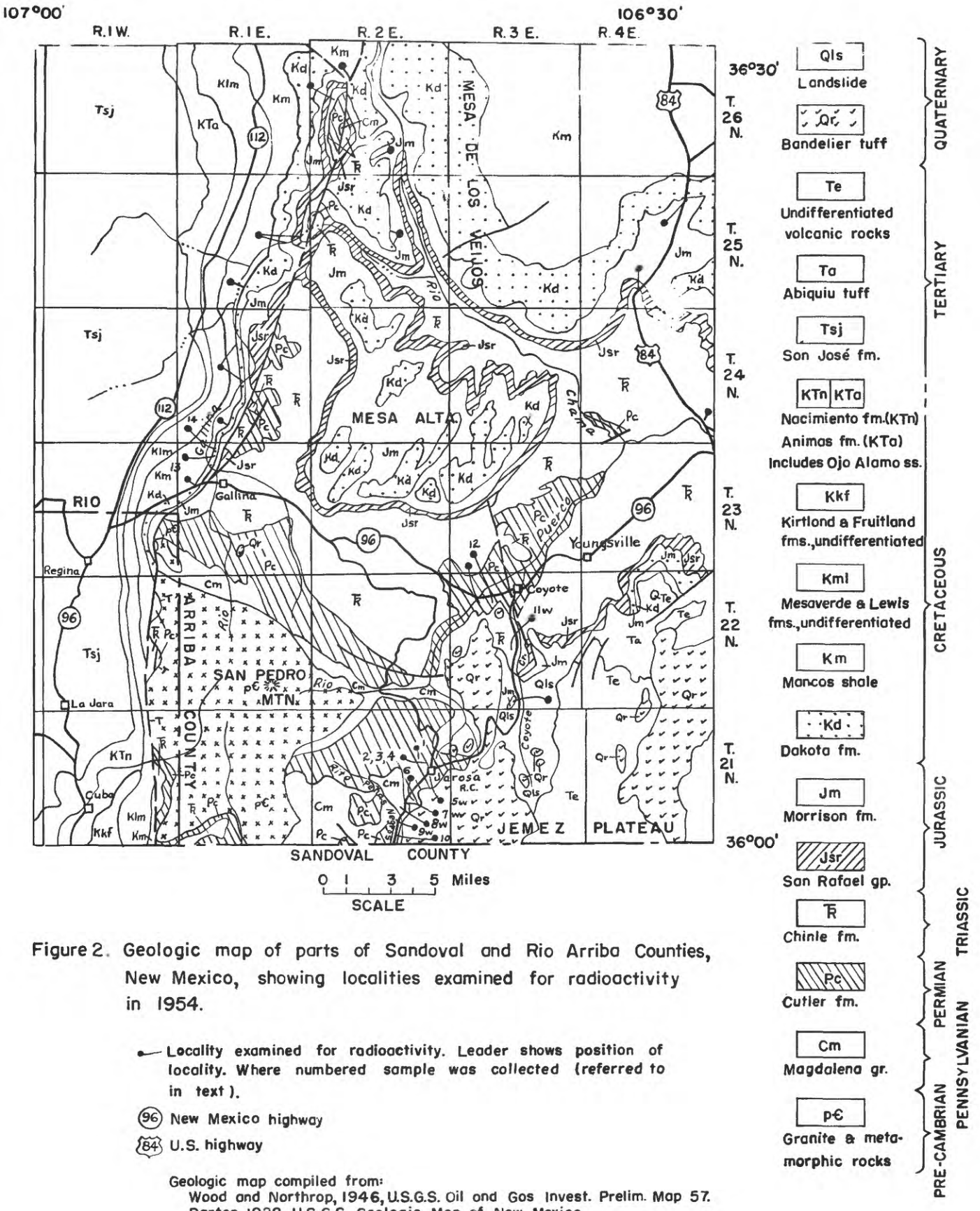

Figure 2. Geologic map of parts of Sandoval and Rio Arriba Counties, New Mexico, showing localities examined for radioactivity in 1954.

- Locality examined for radioactivity. Leader shows position of locality. Where numbered sample was collected (referred to in text).
- (96) New Mexico highway
- (84) U.S. highway

Geologic map compiled from:
Wood and Northrop, 1946, U.S.G.S. Oil and Gas Invest. Prelim. Map 57.
Darton, 1928, U.S.G.S. Geologic Map of New Mexico.
Unpublished sources.

Precambrian, Pennsylvanian, Permian, Triassic, Jurassic, Cretaceous, Tertiary, and Quaternary rocks are present in the area. Nomenclature and distribution of these rocks are shown on figure 2.

The westernmost part of the area lies within the San Juan Basin. San Pedro Mountain has been elevated along eastward-dipping thrust faults. North of San Pedro Mountain is a north-trending belt of sharply folded and faulted anticlines. East of the belt of anticlines is the Chama basin, an uplifted structural platform which is a sub-basin or embayment of the San Juan Basin. The Jemez Plateau is capped by volcanic rocks, most of which came from volcanic centers east and southeast of the area of figure 2.

Rocks examined for radioactivity

Cutler formation

The Cutler formation of Permian age was examined in detail at places in the northwest part of the Jemez Plateau, and near the town of Coyote (fig. 2). During a traverse with the carborne scintillator along New Mexico Highways 44 and 126 between San Ysidro and Gallina (fig. 1) radioactivity 1 1/2 to 2 times background was detected at places in the Cutler formation, and in equivalent beds of the Abo formation which are present in the vicinity of Jemez Pueblo.

At least 6 prospect pits have been opened in copper-bearing arkosic sandstone and shale of the Cutler formation in the southeastern part of T. 21 N., R. 2 E. The prospects are located near the Rito Peñas Negras-Jarosa Road in the northwestern part of the Jemez Plateau.

Two prospects located a few hundred feet west of Jarosa Forest Service Cabin (sec. 14, T. 21 N., R. 2 E.) were examined and four samples were collected. Sample 1, collected from a tunnel in thick sandstone of the Cutler formation, consists of copper-bearing arkose and chalcocite-replaced fossil wood and contains 0.010 percent uranium. Samples 2, 3, and 4 were collected from a shallow surface prospect. Sample 2 consists of arkosic sandstone 2 feet thick and contains 0.050 percent uranium. Sample 3, consists of sandy clay shale, 2 1/2 feet thick, and contains 0.005 percent uranium. Sample 4, consists of highly ferruginous, feldspathic, conglomeratic sandstone, at least 2 feet thick, and contains 0.002 percent uranium. Total thickness of uranium-bearing rocks at this locality is more than 6 feet. Anomalous radioactivity was detected by scintillator in an area of about 1 1/2 acres.

Water sample 5W from a well at Jarosa Cabin contains 0.018 parts per million uranium. The well is in alluvium overlying the Cutler formation.

Traces of radioactivity were detected at several other prospects south of Jarosa Cabin. Two representative samples were collected. Sample 6, from a shallow prospect in the NW 1/4 sec. 23, T. 21 N., R. 2 E., consists of copper-bearing, arkosic sandstone, and contains 0.011 percent uranium. Sample 10 from a shallow prospect in the NE 1/4 sec. 34, T. 21 N., R. 2 E., consists of copper-bearing arkosic sandstone, limestone pebble conglomerate, and chalcocite-replaced fossil wood, which contains 0.004 percent uranium.

Water samples 7W and 8W, collected from springs in the lower part of the Cutler, contain, respectively, 0.005 and 0.001 parts per million uranium. Sample 9W collected from Rito Peñas Negras contains less than 0.001 parts per million uranium.

Two large prospects in sec. 8, T. 22 N., R. 2 E., 1 1/2 miles west of Coyote were examined. In the NE 1/4 sec. 8 a tunnel, about 30 feet long, has been driven into a thick arkosic sandstone in the upper part of the Cutler formation. Samples were collected from two lenses of highly ferruginous sandy clay shale, each about 2 1/2 inches thick and 3 feet long. Sample 12, collected at a point about 12 feet inside the tunnel,contains 0.10 percent uranium. Sample 12a, collected at a point about 25 feet inside the tunnel,contains 0.095 percent uranium. In the NW 1/4 sec. 8, a large prospect has been excavated in sandstone and shale of the Cutler formation. Thin, highly ferruginous lenses of sandstone and siltstone occur at the base of a thick arkose which is probably the same bed as the sandstone in which the tunnel has been driven. Radioactivity of some of the ferruginous material is estimated to be as much as 0.1 percent equivalent uranium. Small stock piles are present at each prospect and yellow uranium minerals associated with malachite are visible in rock on the stock piles.

Much drilling has been done in Cutler beds south of Gallina in the SW 1/4 T. 23 N., R. 1 E. Brief examination of core samples and stock piles at several localities indicated that only a small amount of radioactive

material is present at these localities. Estimates based on Geiger-Mueller counter readings ranged from less than 0.003 percent equivalent uranium to 0.008 percent equivalent uranium.

Chinle formation

The Chinle formation of Triassic age was traversed by carborne scintillator on Poleo Mesa in T. 22 N., R. 2 E., and T. 23 N., R. 2 E.; at the north end of Gallina Mountain anticline, W. 1/2 T. 26 N., R. 2 E.; and along U. S. Highway 84 in T. 23 N., R. 5 E., and T. 24 N., R. 4 E. (fig. 1). No radioactivity greater than background was detected. Water sample 11W collected in the NW 1/4 sec. 22, T. 22 N., R. 3 E., from a spring in the Poleo sandstone member of the Chinle formation, contains less than 0.001 parts per million uranium.

Dakota formation

Carbonaceous shale and thin coal beds of the Dakota formation of Cretaceous age were examined for radioactivity on the hogback ridges north of Gallina in the northwestern part of the area, and at the south edge of Mesa de los Viejos in the northeast part of the area.

Radioactivity slightly above background was detected in carbonaceous siltstone and clay shale of the Dakota formation at two localities in T. 23 N., R. 1 E. north of Gallina. Sample 13 consisting of black carbonaceous silty clay shale collected in sec. 4 (?) from a bed 3 feet thick contains 0.001 percent uranium. This bed was traced northward for about 3/4 mile and slight radioactivity was detected at several places. Two

samples were collected at locality 14 in the NW 1/4 sec. 4. Sample 14 contains 0.001 percent uranium and sample 14a contains 0.002 percent uranium. The bed could not be traced farther to the north.

Bandelier tuff

The Bandelier tuff, a sequence of acidic volcanic rocks of Pleistocene age, was examined in detail at places in the northwest part of the Jemez Plateau, and was traversed by carborne scintillator on New Mexico Highway 126 and the Rito Penas Negras-Jarosa road from La Cueva through Jarosa into the Canyon of Coyote Creek south of Coyote. Radioactivity 1 1/2 to 4 times background is common at most places. The high background is apparently due to mass effect of uranium widely disseminated in the Bandelier. Numerous rock samples were removed to some distance from the outcrop and examined with Geiger-Mueller counter and the amount of radioactivity was considerably lower than that measured on the outcrop.

Radioactivity is sufficiently high to have induced the staking of numerous claims in Bandelier rocks. No samples were collected. Samples of Bandelier tuff collected in the southwestern part of the Jemez Plateau contain 0.003 percent uranium and 0.003 to 0.006 percent equivalent uranium (Vine, Bachman, Read, and Moore, 1953, written communication).

Outcrops of the Bandelier are present 1/4 to 1/2 miles east of the Rito Peñas Negras-Jarosa Road, and at one time these volcanic rocks undoubtedly extended for some distance to the west across the bevelled Cutler beds that contain the uranium deposits in T. 21 N., R. 2 E.

Small outliers of Bandelier tuff are preserved in the vicinity of the uranium deposits in the Cutler formation at locality 12 (sec. 8, T. 22 N., R. 2 E.), and in the vicinity of the deposits south of Gallina (SW 1/4 T. 23 N., R. 1 E.).

CHAMA-MONERO AREA, RIO ARRIBA COUNTY, NEW MEXICO

The Chama-Monero area in north-central Rio Arriba County, N. Mex., is in the northern part of the Chama structural basin. The Dakota formation, Mancos shale, and Mesaverde formation, all of Cretaceous age, are present in the region.

Rocks examined for radioactivity

Carbonaceous shale of the Dakota formation was examined in the vicinity of El Vado and in the canyon of the Chama River north of Chama. Slight radioactivity was detected in shaly bedded carbonaceous siltstone, claystone, and fine-grained sandstone of the Dakota at locality 15 (fig. 4) on the west side of the Chama River about 3 miles north of Chama (T. 32 N., R. 3 E., unsurveyed). A channel sample of 5 feet of carbonaceous shale collected at this locality contains 0.001 percent uranium. Water sample 16W collected from a spring in the Dakota formation on New Mexico Highway 19 near locality 15 contains less than 0.001 parts per million uranium.

Slight radioactivity was detected in thin beds of coaly shale in the middle of the Mesaverde formation of Cretaceous age at locality 17 (NW 1/4 sec. 15, T. 31 N., R. 1 E.) north of Amargo Arroyo. A channel sample of impure coal 1 foot thick contains less than 0.001 percent uranium.

A sample (no. 18, not shown on map) of carbonaceous clay shale and siltstone was collected from the Mesaverde formation in the NE 1/4 sec. 6, T. 32 N., R. 1 E., about 2 miles south of Chromo, Archuleta County, Colo. This sample contains less than 0.001 percent uranium.

CHICO HILLS, COLFAX COUNTY, NEW MEXICO

The Chico Hills are in eastern Colfax County, N. Mex. The area is part of the High Plains and is characterized by broad rolling hills, mesas, and steep-sided conical mountains each several miles in diameter. Elevations range from about 6,000 feet to 9,000 feet above sea level.

Sedimentary rocks of Triassic, Jurassic, Cretaceous, and Tertiary ages are exposed in the Chico Hills area. Sills of intermediate composition, considered to be of Tertiary age (Wood, Northrop, and Griggs, 1953), have been intruded into Upper Cretaceous shale of the Benton and Niobrara formations. Several conical mountains composed of dacitic rocks are extrusive domes of Quaternary age. Basaltic dikes and sills are common and basaltic volcanoes and lava flows are the surface rocks in much of the region.

Nomenclature and distribution of rocks in the Chico Hills are shown in figure 3.

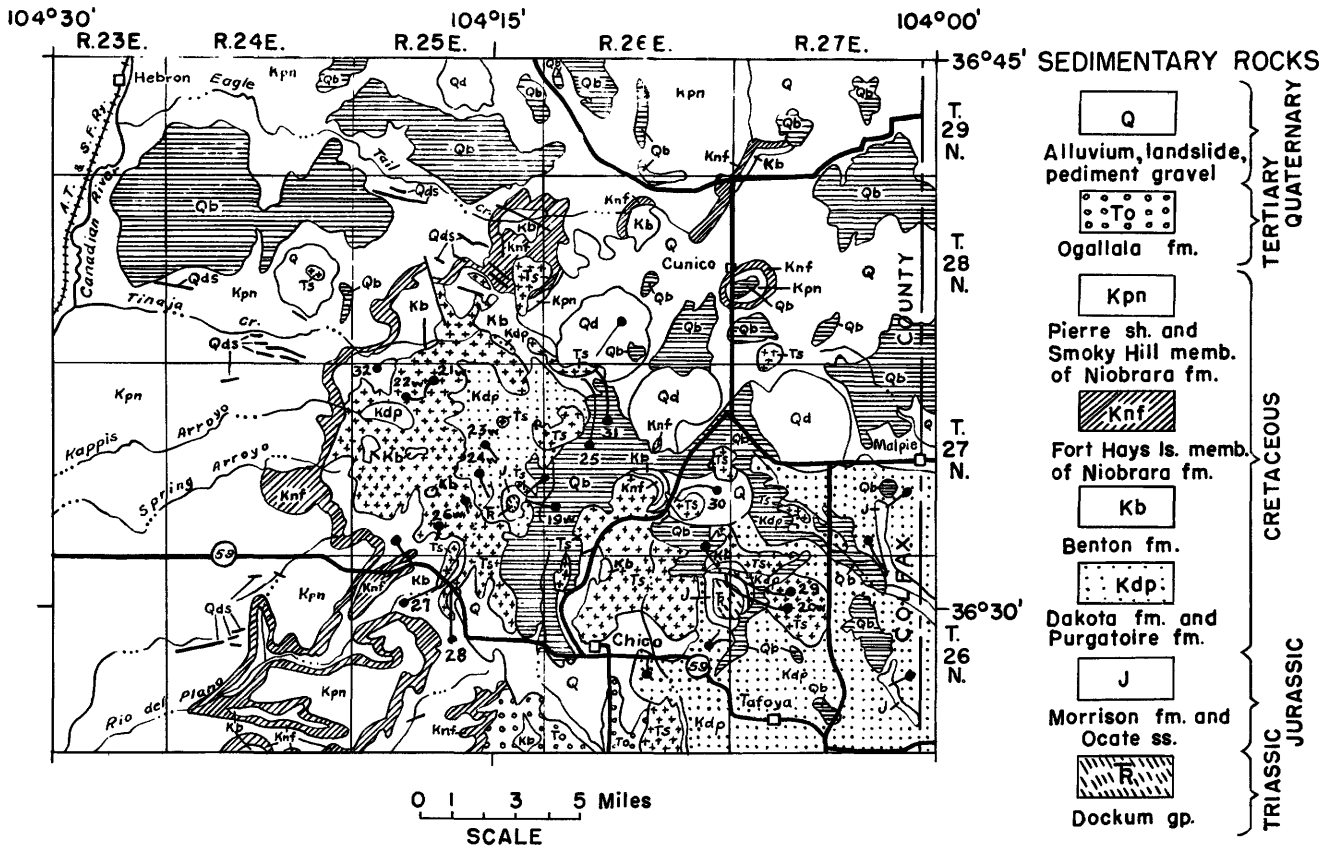

Figure 3. Geologic map of the east-central part of Colfax County, New Mexico, showing localities examined for radioactivity in 1954.

- Locality examined for radioactivity. Leader shows position of locality. Where numbered sample was collected (referred to in text).
- (59) New Mexico highway

Geologic map modified from:
Wood, Northrop, and Griggs, 1953,
U.S.G.S. Oil and Gas Invest., Map 141, sheet 1.

Rocks examined for radioactivity

Red shale and sandstone of the Dockum group of Triassic age were examined at Joyce dome (SW 1/4 T. 27 N., R. 25 E.) and Temple dome (NE 1/4 T. 26 N., R. 26 E., and NW 1/4 T. 26 N., R. 27 E.) No radioactivity was detected in these rocks. Water sample 19W was collected from a well in alluvium overlying the Dockum group in Joyce dome (NE 1/4 sec. 26, T. 27 N., R. 25 E.). Sample 19W contains 0.002 parts per million uranium.

The Ocate sandstone and the Morrison formation of Jurassic age were examined at a few localities on Joyce and Temple domes. The Morrison formation was examined also in the southeastern part of the area where it is poorly exposed in several shallow washes. No radioactivity was detected at any of the localities examined.

The Purgatoire and Dakota formations of Cretaceous age were examined in the southeastern and central parts of the Chico Hills area. No radioactivity was detected in these rocks. Water samples 20W-24W were collected from wells and springs in Dakota-Purgatoire rocks or in alluvium overlying these rocks. The uranium content of samples 20W-24W ranges from 0.002 to 0.010 parts per million uranium.

Carbonaceous shale and limestone of the Benton and Niobrara formations of Cretaceous age were examined at many places in the Chico Hills, especially in places where these rocks are in contact with intrusive rocks of the sill complex. No radioactivity was detected in Benton or Niobrara rocks. Sample 25 was collected from the Greenhorn limestone member of the Benton formation in an altered zone adjacent to a dike in the SW 1/4 sec. 5, T. 27 N., R. 26 E. Sample 25 contains less than 0.001 percent uranium.

Water sample 26W collected from a spring near the contact of the Carlile shale and Greenhorn limestone members of the Benton formation in the SE 1/4 sec. 33, T. 27 N., R. 25 E. contains 0.004 parts per million uranium.

Radioactivity of Tertiary sills of intermediate composition in the Chico Hills was reported by Griggs (1954). Radioactivity was detected by the present writer in Tertiary sills and dikes of intermediate composition at all localities examined in the Chico Hills. No radioactivity was detected in basic igneous rocks. Content of uranium in samples collected at localities 27-32 varies from 0.0016 percent uranium to 0.0024 percent uranium. As previously mentioned, no radioactivity was detected in enclosing sedimentary rocks on contacts with sills or at a distance from the sills.

SANGRE DE CRISTO MOUNTAINS, NEW MEXICO

The Sangre de Cristo Mountains are in parts of Taos, Colfax, Mora, Santa Fe, and San Miguel Counties, north-central New Mexico. The north-trending range is part of the Southern Rocky Mountains.

The central part of the range is composed of Precambrian, Mississippian (?), and Pennsylvanian rocks. Permian, Triassic, Jurassic, and Cretaceous rocks are exposed in the band of hogback ridges on the east side of the range.

Areas examined for radioactivity are shown on figure 1.

Rocks examined for radioactivity

Precambrian metasediments, granite, and pegmatite were traversed with carborne scintillator on New Mexico Highway 65 in the Gallinas River canyon, northwest of Las Vegas, San Miguel County, N. Mex. Radioactivity 3-4 times background was detected in a small prospect at locality 33 (fig. 4) on the north side of New Mexico Highway 65 in the NW 1/4 sec. 14, T. 17 N., R. 14 E. Two veins of alaskite pegmatite 3-4 feet in width in vertically dipping quartzite and amphibolite schist contain small amounts of uranium. According to the owner, laths of uraninite less than 1 inch long were removed from the pegmatite. No uraninite was observed by the writer. Sample 33 collected from a limonite-filled fracture, 1/4 inch wide, between medium-grained alaskite and coarse-grained biotite quartzite contains 0.022 percent uranium.

Water sample 34W was collected from a small stream flowing on Precambrian rocks in Water Canyon, about 1 mile north of Montezuma, northwestern San Miguel County. Sample 34W contains 0.002 parts per million uranium.

Black shale, sandstone, and limestone of the Magdalena group of Pennsylvanian age was traversed by carborne scintillator between Sapello and Rociada in northwestern San Miguel County; on New Mexico Highway 3 in western Mora County and southeastern Taos County, and on U. S. Highway 64 east of Taos (fig. 4). Metamorphosed black shale considered to be of Pennsylvanian age (C. B. Read, oral communication) was traversed on U. S. Highway 64 east of Eagle Nest, Colfax County.

Radioactivity slightly above background in Magdalena rocks was found at locality 35 (SE 1/4 sec. 22, T. 25 N., R. 13 E.) east of Taos on the north side of U. S. Highway 64. Sample 35 consisting of gray carbonaceous silty and sandy shale contains 0.001 percent uranium. Water sample 36W from the Rio Fernando de Taos (NE 1/4 sec. 27, T. 25 N., R. 13 E.) contains 0.001 parts per million uranium.

Radioactivity 2-2 1/2 times background was detected by carborne scintillator about 1/2 mile north of the town of Black Lake on New Mexico Highway 120 in southwestern Colfax County. The source of the radioactivity is probably in beds of the Sangre de Cristo formation of Permian and Pennsylvanian age. The source could not be located because of extensive soil and basaltic lava flows which cover the bedrock.

Three samples of water-laid acidic tuff and tuffaceous sandstone of Tertiary age overlying gray Magdalena shale were collected at locality 37 (SE 1/4 sec. 20, T. 25 N., R. 15 E.). These samples contain 0.0006-0.0009 percent uranium. Water sample 38W collected from a spring near the contact of the Magdalena and the tuff near locality 37 contains 0.001 parts per million uranium.

CHAPERITO-SABINOSO AREA, SAN MIGUEL COUNTY, NEW MEXICO

The Chaperito-Sabinoso area is in central San Miguel County, N. Mex. The northwestern part of the area is part of the broad Las Vegas Plateau. The southeastern edge of the Las Vegas Plateau is an abrupt erosional escarpment known as the Canadian Escarpment. The region southeast of the Escarpment is rolling and hilly and cut by steep-walled canyons at places.

Cretaceous rocks cap the Las Vegas Plateau, Jurassic rocks are exposed along the Canadian Escarpment, and Triassic rocks are exposed along the Escarpment and in the broad area to the southeast. Quaternary basalt flows are present in the canyons of the Mora and Canadian Rivers in the northeastern part of the area. Nomenclature and distribution of these rocks is shown on figure 4. Beds in the region are generally horizontal or dip gently westward or northwestward.

Rocks examined for radioactivity

The principal rocks examined in the area were in the Chinle formation of Triassic age, but at a few places the Morrison formation of Jurassic age, and the Purgatoire and Dakota formations of Cretaceous age were examined and found to be nonradioactive.

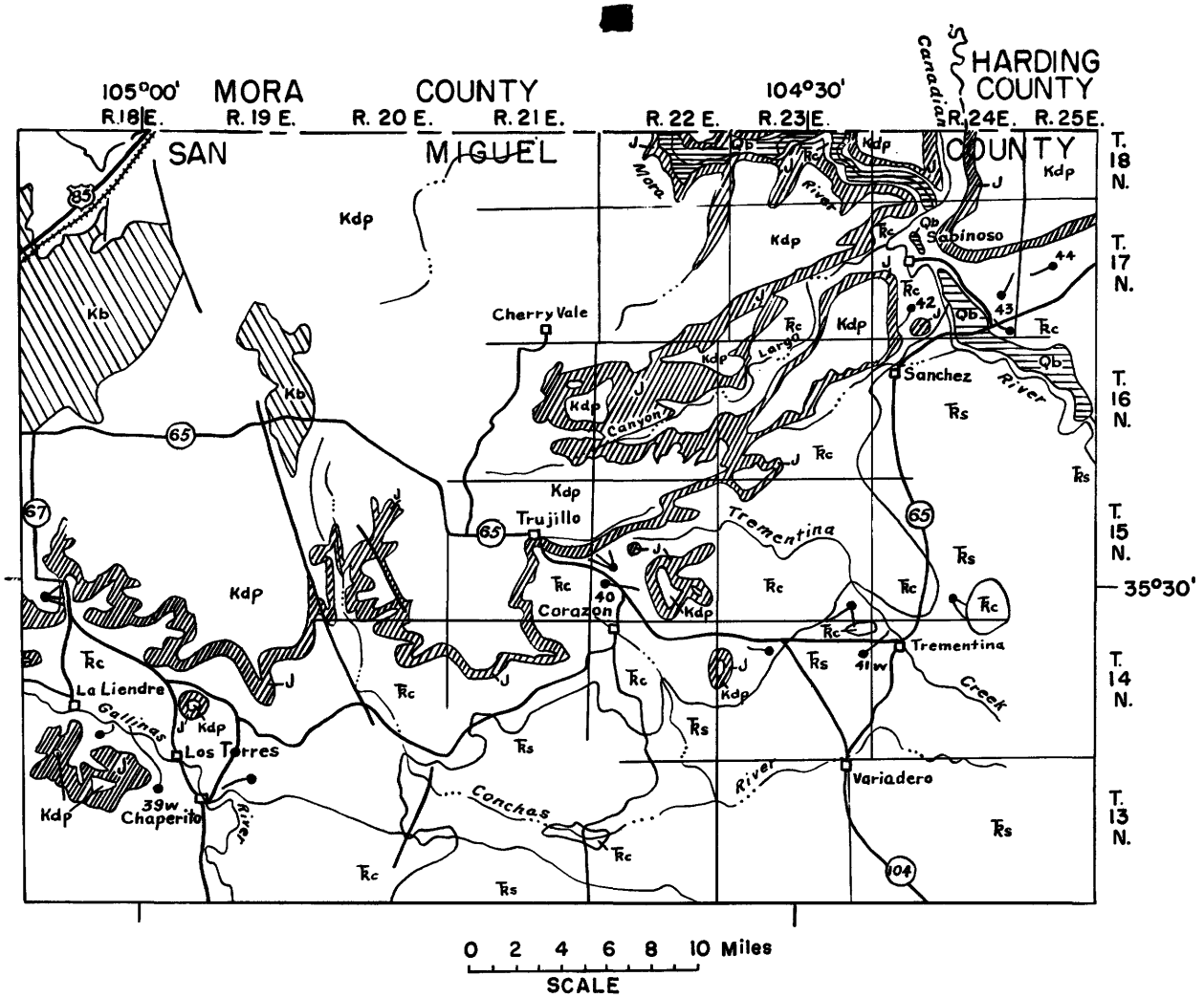

Figure 4. Geologic map of the north-central part of San Miguel County, New Mexico, showing localities examined for radioactivity in 1954.

- Locality examined for radioactivity. Leader shows position of locality. Where numbered sample was collected (referred to in text).
- (68) New Mexico highway
- (85) U.S. highway

Geologic map modified from:

Northrop, et al., 1946, U.S.G.S. Oil and Gas Invest. Prelim. Map 54.

Darton, 1928, U.S.G.S. Geologic Map of New Mexico.

QUATERNARY
- Qb — Basalt flows

CRETACEOUS
- Kb — Benton fm.
- Kdp — Dakota and Purgatoire (?) fms.

JURASSIC
- J — Morrison fm. and Ocate ss.

TRIASSIC
- Trc — Chinle fm.
- Trs — Santa Rosa ss.

Stream channel deposits in the middle sandstone member of the Chinle formation of Triassic age were examined in detail in the vicinity of La Liendre, Chaperito, Hilario, Tementina, and Sabinoso, San Miguel County. Slight radioactivity estimated to be 0.005-0.008 percent equivalent uranium was detected on the south side of the Gallinas River about 1 1/2 miles east of La Liendre (sec. 28(?), T. 12 N., R. 18 E.) in carbonized fossil logs in channel sandstone. Water sample 39W, collected from a spring issuing from thick channel sandstone in a canyon tributary to the Gallinas River (sec. 27, T. 12 N., R. 18 E.),contains 0.002 parts per million uranium.

Fossil twigs replaced by chalcocite, and carbonized fossil plant material in stream channel deposits of the middle sandstone member of the Chinle formation in the cliff north of New Mexico Highway 65 (sec. 24(?), T. 15 N., R. 21 E.) contain an estimated 0.005 percent equivalent uranium.

A sample of carbonaceous sandstone, shale and limestone pebble conglomerate collected at locality 40 (SW 1/4 sec. 28, T. 15 N., R. 22 E.) contains 0.004 percent uranium. The sample was collected from an 8-inch bed enclosed in thick, brown channel sandstone of the middle member of the Chinle. Slight radioactivity was detected in spots for about 200 feet along the conglomerate bed.

Water sample 41W collected from springs issuing from the middle sandstone member in Trementina Creek (SW 1/4 sec. 5, T. 14 N., R. 24 E.) contains 0.003 parts per million uranium.

Uranium deposits in the vicinity of Sabinoso were examined and several samples were collected. A prospect on a small mesa about 3 miles southwest of Sabinoso in sec. 29 (?), T. 17 N., R. 24 E., contains uranium of possible economic value. The prospect is located in a thick channel sandstone near the middle of the Chinle formation. A sample of carbonaceous feldspathic sandstone 3.2 feet thick collected by the writer in 1953 (Baltz, 1955) contains 0.22 percent uranium. A sample of the middle 8 inches of the sandstone contains 0.88 percent uranium. Selected specimens collected by the present operator, M. C. L. Guy, are said to contain 1.0-2.78 percent uranium and 1.0-5.0 percent vanadium. Lateral extent of the deposit is undetermined. The writer examined outcrops of the channel sandstone for at least 150 feet south of the prospect. Highest radioactivity was detected in weathered fossil logs in the sandstone. Several small prospects are present on the south rim of the mesa about 1/4 mile south of the Guy prospect. Yellow uranium minerals associated with malachite and other copper minerals are visible in these prospects.

A sample (42) of conglomerate composed of sandstone, limestone, and shale fragments, and carbonized fossil logs was collected from a channel sandstone 2 feet thick in the middle of the Chinle formation at locality 42 (sec. 29(?), T. 17 N., R. 24 E.). Sample 42 contains 0.005 percent uranium.

Deposits on the Lujan ranch east of the Canadian River were examined. Prospects are located on the rim of a low sandstone-capped mesa more than 2 miles long and 1/2 mile wide. The sandstone appears to be a stream channel deposit near the middle of the Chinle formation at about the same stratigraphic position as the channel sandstone at the Guy prospect to the west. Beds on the mesa are horizontal. Prospects on the south side and the east end of the mesa were visited. According to Mr. James Lujan, radioactivity has been detected at localities on the north side of the mesa also.

Locality 43 (sec. 24 (?), T. 17 N., R. 24 E.) is a large prospect in a limestone pebble conglomerate 8 feet thick which lies beneath the sandstone that caps the mesa. Radioactivity above background was detected throughout the entire stratigraphic interval of the conglomerate. Carbonized fossil logs are numerous in the middle 2 1/2 feet. Yellow uranium minerals, malachite, and some pyrite are visible. A channel sample of the middle 2 1/2 feet of the conglomerate bed contains 0.070 percent uranium. Radioactivity above background was detected in the conglomerate bed for about 80 feet south of the prospect.

A shallow prospect is in sandstone on the top of the mesa at locality 44 (sec. 19(?), T. 17 N., R. 25 E.). The prospect is in thin, platy-bedded arkosic, conglomeratic sandstone containing carbonaceous material. The sandstone also contains malachite-coated mica flakes. Beds containing radioactive material are 2-2 1/2 feet thick. Sample 44 from the prospect contains 0.028 percent uranium.

Other prospects were examined on the south side of the mesa and yellow uranium minerals were observed at several localities but no samples were collected.

LINCOLN COUNTY, NEW MEXICO

Rocks examined for radioactivity

Abandoned copper prospects and mines in the Abo formation of Permian age were examined in the Estey district in southwestern Lincoln County. No radioactivity was detected. Sample 45 (fig. 1) consisting of copper-bearing carbonaceous graywacke from a prospect pit in the NE 1/4 sec. 8 (?), T. 9 S., R. 7 E. contains 0.001 percent uranium. Sample 46 consisting of copper-bearing graywacke from a shallow prospect south of the Mockingbird Gap road in the NE 1/4 sec. 34 (?), T. 9 S., R. 6 E., contains 0.001 percent uranium.

Petroliferous beds of the San Andres limestone of Permian age were examined in the Jicarilla and Carrizo Mountains, south of Capitan and east of Arabella. No radioactivity was detected. Sample 47 consisting of copper-bearing dolomitic marble was collected near the contact of the San Andres and granite porphyry at the east edge of Jicarilla Mountain (SW 1/4 sec. 36, T. 5 S., R. 12 E.). Sample 47 contains less than 0.001 percent uranium.

The Dakota and Mesaverde formations of Cretaceous age were examined at localities east and west of Capitan. No radioactivity was detected.

No radioactivity was detected in acidic intrusive rocks examined at Capitan Mountain, and in the Jicarilla and Carrizo Mountains.

NORTHERN SACRAMENTO MOUNTAINS, OTERO COUNTY, NEW MEXICO

Rocks examined for radioactivity

The abandoned Virginia copper mine near Bent in northern Otero County was examined radiometrically. No radioactivity above background was detected. Sample 48 (fig. 1), consisting of copper-bearing fine-grained sandstone of the Abo formation, was collected from a large stope in the NW 1/4 sec. 26, T. 13 S., R. 11 E. The sample contains 0.001 percent uranium.

Radioactivity about two times background was detected in conglomeratic granite wash near the base of the Abo formation at locality 49 (NW 1/4 sec. 36, T. 13 S., R. 11 E.). Sample 49 contains 0.001 percent uranium.

Radioactivity two times background was detected in Quaternary peat beds in the valley of Spring Creek north of Cloudcroft. Sample 50 consisting of silty, sandy peat collected in the E 1/2 sec. 29, T. 15 S., R. 13 E. contains 0.001 percent uranium. Water sample 51W collected from springs seeping from the peat beds at locality 50 contains 0.006 parts per million uranium.

NORTHERN SANTA FE COUNTY, NEW MEXICO

Radioactivity higher than background was detected in an acidic volcanic tuff bed, 2 1/2 feet thick, in the Santa Fe formation (of Miocene and Pliocene age) about 1/2 mile east of U. S. Highway 84 about two miles south of Espanola. Sample 52 (fig. 1), which consists of white, fine-grained tuff collected in the SE 1/4 sec. 12, T. 20 N., R. 10 E., contains 0.0010 percent uranium.

HUERFANO PARK-SPANISH PEAKS, SOUTHEASTERN COLORADO

A brief reconnaissance examination was conducted in the Huerfano Park-Spanish Peaks region, Las Animas, Huerfano, and Costilla Counties, Colo. Roads traversed with carborne scintillator and localities sampled are shown on figure 5.

Pennsylvanian, Permian, Jurassic, and Cretaceous rocks were traversed by carborne scintillator on Colorado Highway 11 between Stonewall, Las Animas County, and La Veta, Huerfano County. Radioactivity estimated to be about 0.008 percent equivalent uranium was detected in a thin petroliferous limestone of the Wanakah formation of Jurassic age in a road cut north of Cuchara Camps in the NW 1/4 sec. 35, T. 30 S., R. 69 W. No samples were collected.

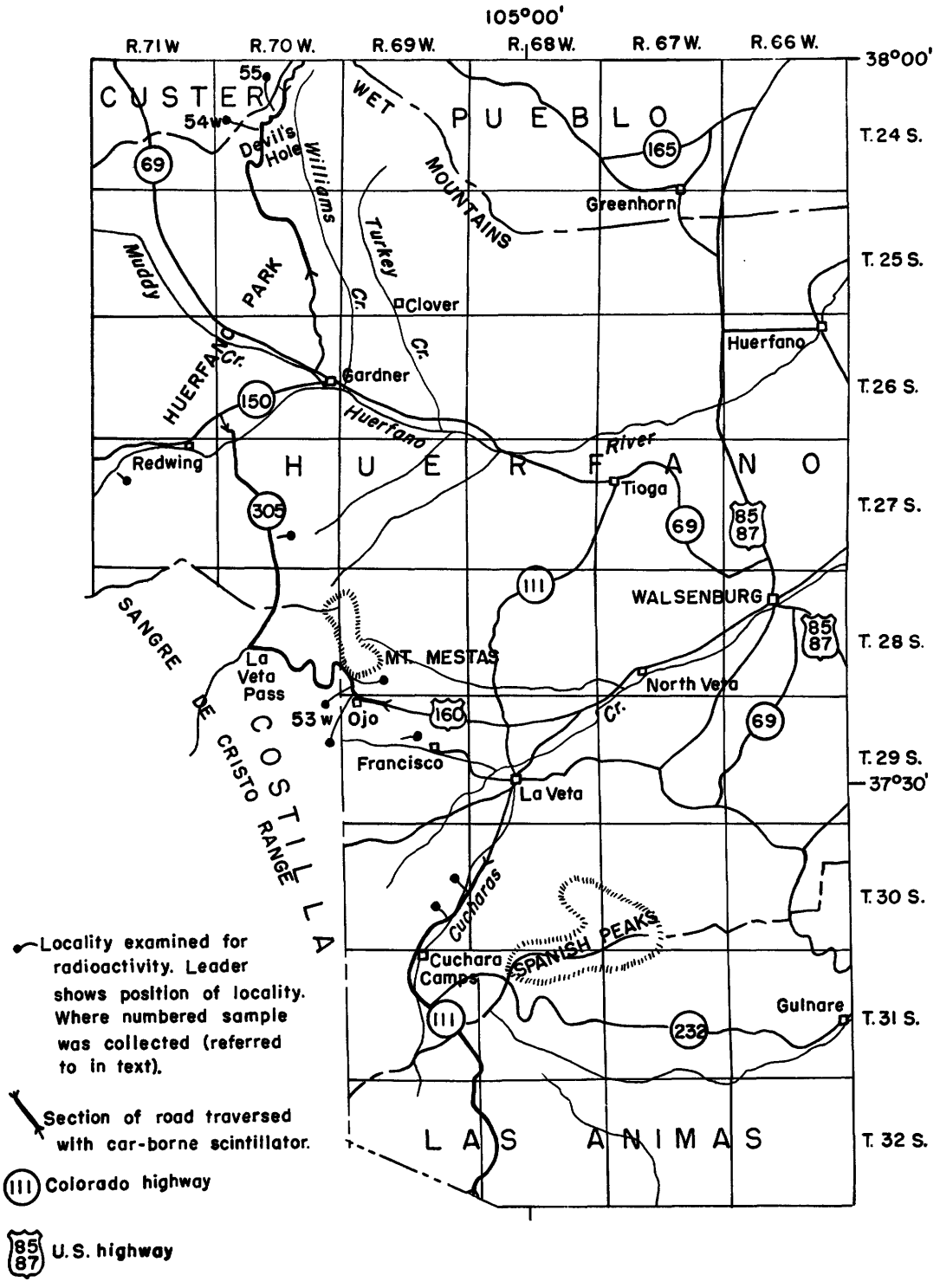

Figure 5. Index map of part of southeastern Colorado showing localities examined for radioactivity in 1954.

Permian and Cretaceous rocks were traversed on U. S. Highway 160 from Ojo, Huerfano County, to the top of La Veta Pass, Costilla County, and on Colorado Highway 305 into Huerfano Park. Intrusive acidic igneous rocks were examined in the vicinity of Ojo and on Pass Creek north of La Veta Pass. No radioactivity was detected. Water sample 53W from Ojo Spring (SW 1/4 sec. 31, T. 28 S., R. 69 W.) contains less than 0.001 parts per million uranium.

Tertiary sedimentary and volcanic rocks were traversed on the Forest Service road north of Gardner, Huerfano County. Water sample 54W, collected from Blue Spring (NW 1/4 sec. 21, T. 24 S., R. 70 W.) contains less than 0.001 parts per million uranium. The spring issues from the upper part of the Devil's Hole formation of Miocene(?) age (R. B. Johnson, personal communication). A sample of acidic tuff and tuffaceous sandstone of the Devil's Hole formation collected at locality 55 (NE 1/4 sec. 16, T. 24 N., R. 70 W.) contains 0.0011 percent uranium. Acidic tuff beds of the Devil's Hole formation may be more than 1000 feet thick and they overlap the truncated edges of older sedimentary rocks on the west flank of the Wet Mountains in Huerfano County (R. B. Johnson, personal communication). Carbonaceous rocks of the Dakota formation, Graneros shale, Greenhorn limestone, Carlile shale, Niobrara formation, and Pierre shale are overlapped by the Devil's Hole formation in the west part of T. 25 S., R. 70 W., Huerfano County. The areas of overlap were not examined.

Table 1.--Radioactivity measurements and chemical analyses of rock samples

Sample and locality number	Laboratory serial number	Location	Equivalent uranium (percent)	Chemical uranium (percent)	Description
1	138507	NE 1/4 sec. 14, T. 21 N., R. 2 E., Rio Arriba County, N. Mex.	0.009	0.010	Selected sample of copper-bearing arkose and chalcocite-replaced wood fossils from a tunnel in thick, very coarse-grained conglomeratic sandstone of the Cutler formation.
2	138510	NE 1/4 sec. 14, T. 21 N., R. 2 E., Rio Arriba County, N. Mex.	.060	.050	Channel sample of arkosic sandstone, 2 feet thick from shallow prospect in Cutler formation. Sandstone is very coarse-grained and contains much carbonized plant debris. Contains thin, black, platy, highly radioactive mineral, and disseminated chalcocite, malachite, chalcopyrite, pyrite.
3	138508	NE 1/4 sec. 14, T. 21 N., R. 2 E., Rio Arriba County, N. Mex.	.007	.005	Channel sample of greenish-gray sandy clay shale, 2 1/2 feet thick, from shallow prospect in Cutler formation. Shale is below sandstone of sample 2.
4	138509	NE 1/4 sec. 14, T. 21 N., R. 2 E., Rio Arriba County, N. Mex.	.004	.002	Channel sample of red, highly ferruginous conglomeratic sandstone, more than 2 feet thick, from shallow prospect in Cutler formation. Sandstone is below shale of sample 3. Sandstone is very coarse-grained, feldspathic, and contains small limestone pebbles.

Table 1.--Radioactivity measurements and chemical analyses of rock samples.--Continued

Sample and locality number	Laboratory serial number	Location	Equivalent uranium (percent)	Chemical uranium (percent)	Description
6	138511	NW 1/4 sec. 23, T. 21 N., R. 2 E., Rio Arriba County, N. Mex.	0.010	0.011	Selected sample of copper-bearing arkosic sandstone from a shallow prospect pit in the Cutler formation. Sandstone is coarse-grained and contains carbonized fossil wood. Sample is representative of rock in the prospect.
10	138512	NE 1/4 sec. 34, T. 21 N., R. 2 E., Rio Arriba County, N. Mex.	.005	.004	Selected sample of copper-bearing coarse-grained arkosic sandstone, limestone pebble conglomerate, and copper-replaced wood fossils from a prospect pit in the Cutler formation. Concretionary nodules of hematite scattered through sandstone are highly radioactive.
12	138513	NE 1/4 sec. 8, T. 22 N., R. 2 E., Rio Arriba County, N. Mex.	.17	.10	Channel sample of highly ferruginous sandy clay shale, 3 inches thick, enclosed in thick arkosic sandstone in Cutler formation. Streaks of yellow uranium minerals and malachite visible. Sample collected 12 feet in from entrance of tunnel driven in massive sandstone.
12a	138514	Same as 12 above	.11	.095	Channel sample. Same as sample 12 above. Collected 25 feet in from entrance of tunnel.

Table 1.--Radioactivity measurements and chemical analyses of rock samples.--Continued

Sample and locality number	Laboratory serial number	Location	Equivalent uranium (percent)	Chemical uranium (percent)	Description
13	139930	Sec. 4(?), T. 23 N., R. 1 E., Rio Arriba County, N. Mex.	0.002	0.001	Channel sample of black, carbonaceous, silty clay shale, 3 feet thick, in the middle of the Dakota formation. Bed is coaly, locally.
14	139943	NW 1/4 sec. 4, T. 23 N., R. 1 E., Rio Arriba County, N. Mex.	.003	.001	Grab sample of black clay shale from the Dakota formation. Same bed as sample 13. Locality 14 is about 3/4 mile north of locality 13.
14a	139944	Same as 14 above.	.003	.002	Grab sample. Same as sample 14 above. Sample 14a collected about 300 feet down dip slope from sample 14.
15	139948	T. 32 N., R. 3 E. (unsurveyed). 3 miles north of Chama on N. M. Hwy. 19, Rio Arriba County, N. Mex.	.002	.001	Channel sample of carbonaceous siltstone, claystone, and fine-grained sandstone, 5 feet thick, in the middle of the Dakota formation. Sample collected on west bank of Chama River.
17	139947	NW 1/4 sec. 15, T. 31 N., R. 1 E., Rio Arriba County, N. Mex.	<.001	<.001	Channel sample of impure coal, 1 foot thick, from middle of the Mesaverde formation. Coal underlies thick sandstone about 50 feet below top of the Mesa north of Amargo Arroyo.

Table 1.--Radioactivity measurements and chemical analyses of rock samples.--Continued

Sample and locality number	Laboratory serial number	Location	Equivalent uranium (percent)	Chemical uranium (percent)	Description
18	139949	NE 1/4 sec. 6, T. 32 N., R. 1 E., Archuleta County, Colo. (locality not shown on maps)	<0.001	<0.001	Channel sample of carbonaceous clay shale and siltstone, 2 1/2 feet thick, in massive, fine-grained sandstone of the Mesaverde formation. Exposed on cliff west of the Navajo River.
25	139936	SW 1/4 sec. 5, T. 27 N., R. 26 E., Colfax County, N. Mex.	<.001	<.001	Grab sample of altered Greenhorn limestone and yellowish-brown porphyritic igneous rock. Much limonite and manganese present in limestone and igneous rock.
27	139931	SE 1/4 sec. 4, T. 26 N., R. 25 E., Colfax County, N. Mex.	.006	.0019	Grab sample of light greenish-gray porphyritic igneous rock, probably syenite. Dike in Carlile shale.
28	139932	NW 1/4 sec. 10., T. 26 N., R. 25 E., Colfax County, N. Mex.	.006	.0016	Grab sample of light gray porphyritic igneous rock, probably monzonite. Sill in Carlile shale.
29	139933	C sec. 1, T. 26 N., R. 26 E., Colfax County, N. Mex.	.007	.0024	Grab sample of light bluish-gray aphanitic igneous rock, probably diorite. Sill between the Dakota formation and the Graneros shale.
30	139934	NE 1/4 sec. 27, T. 27 N., R. 26 E., Colfax County, N. Mex.	.008	.0026	Grab sample of greenish-gray porphyritic igneous rock, probably phonolite. Sill in the Greenhorn limestone and Carlile shale.

Table 1.--Radioactivity measurements and chemical analyses of rock samples.--Continued

Sample and locality number	Laboratory serial number	Location	Equivalent uranium (percent)	Chemical uranium (percent)	Description
31	139935	NW 1/4 sec. 5, T. 27 N., R. 26 E., Colfax County, N. Mex.	0.008	0.0031	Grab sample of gray porphyritic igneous rock, probably dacite. Sill in the Greenhorn limestone and Graneros shale.
32	139937	SW 1/4 sec. 32, T. 28 N., R. 25 E. Colfax County, N. Mex.	.006	.0018	Grab sample of olive porphyritic igneous rock, probably phonolite. Sill at the top of the Greenhorn limestone.
33	139955	NW 1/4 sec. 14, T. 17 N., R. 14 E., San Miguel County, N. Mex.	.049	.022	Grab sample of limonite-filled fracture, 1/4 inch thick, between medium-grained alaskite dike and coarse-grained biotite quartzite of Precambrian age.
35	139926	SW 1/4 sec. 22, T. 25 N., R. 13 E., Taos County, N. Mex.	.004	.001	Grab sample of carbonaceous silty and sandy shale of the Magdalena formation.
37a	139927	SE 1/4 sec. 20, T. 25 N., R. 15 E., Taos County, N. Mex.	.003	.0009	Grab sample of fine to medium-grained acidic tuffaceous sandstone. Sample from about 75 feet above base of unit.
37b	139928	Same as 37a above.	.002	.0009	Grab sample of fine to very coarse-grained water-laid acidic tuff. Sample from about 20 feet above base of unit.

Table 1.--Radioactivity measurements and chemical analyses of rock samples.--Continued

Sample and locality number	Laboratory serial number	Location	Equivalent uranium (percent)	Chemical uranium (percent)	Description
37c	139929	Same as 37a above	0.002	0.0006	Grab sample of fine-grained tuffaceous sandstone. Contains small fragments of rotten pumice. Sample from about 18 feet above base of unit. Tuffaceous unit lies unconformably on the Magdalena group.
40	139946	SW 1/4 sec. 28; T. 15 N., R. 22 E., San Miguel County, N. Mex.	.005	.004	Channel sample of conglomerate, 8 inches thick, composed of carbonaceous sandstone, shale and limestone pebbles. Conglomerate is near the middle of the Chinle formation.
42	139951	Sec. 29(?), T. 17 N., R. 24 E., San Miguel County, N. Mex.	.006	.005	Channel sample of conglomeratic sandstone, 2 feet thick, containing coarse-grained sand and pebbles of limestone, sandstone, shale, and quartzite. Contains carbonized fossil logs. Bed is near the middle of the Chinle formation.
43	139952	Sec. 24(?) T. 17 N., R. 24 E., San Miguel County, N. Mex.	.056	.070	Channel sample of carbonaceous limestone pebble conglomerate in a large prospect. Conglomerate contains many carbonized fossil logs. Yellow uranium minerals, malachite, and pyrite are visible. Sample taken from middle 2 1/2 feet of the conglomerate which is about 8 feet thick and is near the middle of the Chinle formation.

Table 1. --Radioactivity measurements and chemical analyses of rock samples. --Continued

Sample and locality number	Laboratory serial number	Location	Equivalent uranium (percent)	Chemical uranium (percent)	Description
44	139953	Sec. 19(?), T. 17 N., R. 25 E., San Miguel County, N. Mex.	0.072	0.028	Grab sample of arkosic, conglomeratic sandstone containing carbonaceous material and malachite-coated mica flakes. Sandstone is exposed in a shallow prospect on the top of a small mesa. Beds containing radioactive material are 2-2 1/2 feet thick. Sandstone is near the middle of the Chinle formation.
45	139939	NE 1/4 sec. 8(?), T. 9 S., R. 7 E., Lincoln County, N. Mex.	.001	.001	Grab sample of medium to coarse-grained, copper-bearing, carbonaceous graywacke from a prospect pit. Bed sampled is in the Abo formation.
46	139938	NE 1/4 sec. 34(?), T. 9 S., R. 6 E., Lincoln County, N. Mex.	.002	.001	Grab sample of fine to coarse-grained, copper-bearing graywacke from a shallow prospect. Bed sampled is in the Abo formation.
47	139954	SW 1/4 sec. 36, T. 5 S., R. 12 E., Lincoln County, N. Mex.	<.001	<.001	Grab sample of copper-bearing dolomitic marble collected near the contact of the San Andres formation and granite porphyry at the east edge of the Jicarilla Mountain intrusive body.

Table 1.--Radioactivity measurements and chemical analyses of rock samples.--Continued

Sample and locality number	Laboratory serial number	Location	Equivalent uranium (percent)	Chemical uranium (percent)	Description
48	139940	NW 1/4 sec. 26, T. 13 S., R. 11 E., Otero County, N. Mex.	0.003	0.001	Grab sample of copper-bearing fine-grained quartz sandstone collected from stope of the abandoned Virginia mine near Bent. A dike of medium-grained diorite cuts the sandstone. Sampled bed is in the Abo formation.
49	139941	NW 1/4 sec. 36, T. 13 S., R. 11 E., Otero County, N. Mex.	.003	.001	Grab sample of conglomeratic granite wash. Conglomerate contains pebbles and cobbles of weathered granite and pink porphyry in coarse-grained arkose matrix. Bed is near the base of the Abo formation.
50	139942	E 1/2 sec. 29, T. 15 S., R. 13 E., Otero County,	.001	.001	Grab sample of silty, sandy peat more than 3 feet thick. Peat beds are in the valley of Spring Creek and are Quaternary in age.
52	139945	SE 1/4 sec. 12, T. 20 N., R. 10 E., Santa Fe County, N. Mex.	.004	.0010	Grab sample of fine-grained glassy acidic volcanic tuff 2 1/2 feet thick. Underlain by resistant tuffaceous sandstone. Tuff is in the Santa Fe formation.
55	139950	NE 1/4 sec. 16, T. 24 N., R. 70 W., Huerfano County, Colo.	.004	.0011	Grab sample of acidic volcanic tuff and tuffaceous sandstone. Sandstone contains pebbles, cobbles, and boulders of pumice, perlite, rhyolite, and granite. Sample is from the Devil's Hole formation.

Table 2. --Analyses of water samples

Sample and locality number	Laboratory serial number	Location	Uranium (parts per million)	pH	Description
5W	217771	SE 1/4 sec. 14, T. 21 N., R. 2 E., Rio Arriba County, N. Mex.	0.018	--	Clear water from well in Quaternary alluvium at Jarosa Forest Service cabin. Alluvium overlies Cutler formation.
7W	217772	SW 1/4 sec. 23, T. 21 N., R. 2 E., Rio Arriba County, N. Mex.	.005	--	Clear water from a spring which probably issues from the Cutler formation.
8W	217773	NE 1/4 sec. 27, T. 21 N., R. 2 E., Rio Arriba County, N. Mex.	.001	--	Clear water from a spring in Quaternary alluvium near the contact of the Madera limestone and the Cutler formation.
9W	217774	NE 1/4 sec. 27, T. 21 N., R. 2 E., Rio Arriba County, N. Mex.	<.001	--	Cloudy water from a beaver pond on Rito Peñas Negras.
11W	217775	NW 1/4 sec. 22, T. 22 N., R. 3 E., Rio Arriba County, N. Mex.	<.001	--	Clear water from a spring which issues from the Poleo sandstone member of the Chinle formation.
16W	223417	T. 32 N., R. 3 E., unsurveyed. 3 miles north of Chama, Rio Arriba County, N. Mex., on State Hwy. 17.	<.001	6.9	Cloudy water from a spring which issues from the Dakota formation.
19W	223411	NE 1/4 sec. 26, T. 27 N., R. 25 E., Colfax County, N. Mex.	.002	8.6	Clear water from a well in Quaternary alluvium overlying the Dockum group near the center of Joyce dome.

Table 2.--Analyses of water samples.--Continued

Sample and locality number	Laboratory serial number	Location	Uranium (parts per million)	pH	Description
20W	223407	NW 1/4 sec. 1, T. 26 N., R. 26 E., Colfax County, N. Mex.	0.007	7.8	Slightly muddy water from a spring which issues from the upper part of the Dakota formation.
21W	223408	NW 1/4 sec. 9, T. 27 N., R. 25 E., Colfax County, N. Mex.	.003	7.9	Clear water from a well in Quaternary alluvium overlying a sill in the Dakota formation and Graneros shale.
22W	223409	NW 1/4 sec. 9, T. 27 N., R. 25 E., Colfax County, N. Mex.	.010	7.9	Clear water from a spring on the contact of a sill and the Dakota formation.
23W	223410	NE 1/2 sec. 23, T. 27 N., R. 25 E., Colfax County, N. Mex.	.002	8.5	Clear water from a well in Quaternary alluvium overlying the Dakota formation.
24W	223412	NW 1/4 sec. 26, T. 27 N., R. 25 E., Colfax County, N. Mex.	.004	7.9	Clear water from a small stream flowing from a spring issuing from the top of the Dakota formation.
26W	223413	SE 1/4 sec. 33, T. 27 N., R. 25 E., Colfax County, N. Mex.	.004	8.1	Clear water from a spring issuing from the contact of the Carlile shale and Greenhorn limestone.
34W	223406	Water Canyon, 1 mile north of Montezuma, northwestern San Miguel County, N. Mex.	.002	8.1	Clear water from a small stream flowing on Precambrian rocks.

Table 2. -- Analyses of water samples. --Continued

Sample and locality number	Laboratory serial number	Location	Uranium (parts per million)	pH	Description
36W	223404	NE 1/4 sec. 27, T. 25 N., R. 13 E., Taos County, N. Mex.	0.001	7.9	Clear water from the Rio Fernando de Taos flowing on the Magdalena group.
38W	223405	SE 1/4 sec. 20, T. 25 N., R. 15 E., Taos County, N. Mex.	.001	7.9	Clear water from a spring which issues from tuffaceous rocks near the contact of the tuffaceous rocks and the underlying Magdalena group.
39W	223415	Sec. 27, T. 12 N., R. 18 E., San Miguel County, N. Mex.	.002	7.7	Muddy water from a spring which issues from massive sandstone near the middle of the Chinle formation.
41W	223416	SW 1/4 sec. 5, T. 14 N., R. 24 E., San Miguel County, N. Mex.	.003	8.1	Clear water from Trementina Creek which flows on massive sandstone near the middle of the Chinle formation. Springs issuing from the sandstone feed the creek in this area.
51W	223414	E 1/2 sec. 29, T. 15 S., R. 13 E., Otero County, N. Mex.	.006	7.7	Clear water from springs seeping from Quaternary peat in the valley of Spring Creek.
53W	223418	SW 1/4 sec. 31, T. 28 S., R. 69 W., Huerfano County, Colo.	<.001	6.8	Clear water from Ojo Spring which issues from acidic intrusive rocks of Tertiary age.
54W	223419	NW 1/4 sec. 21, T. 24 S., R. 70 W., Huerfano County, Colo.	<.001	7.7	Clear water from Blue Spring which issues from acidic volcanic tuff of the Devil's Hole formation.

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