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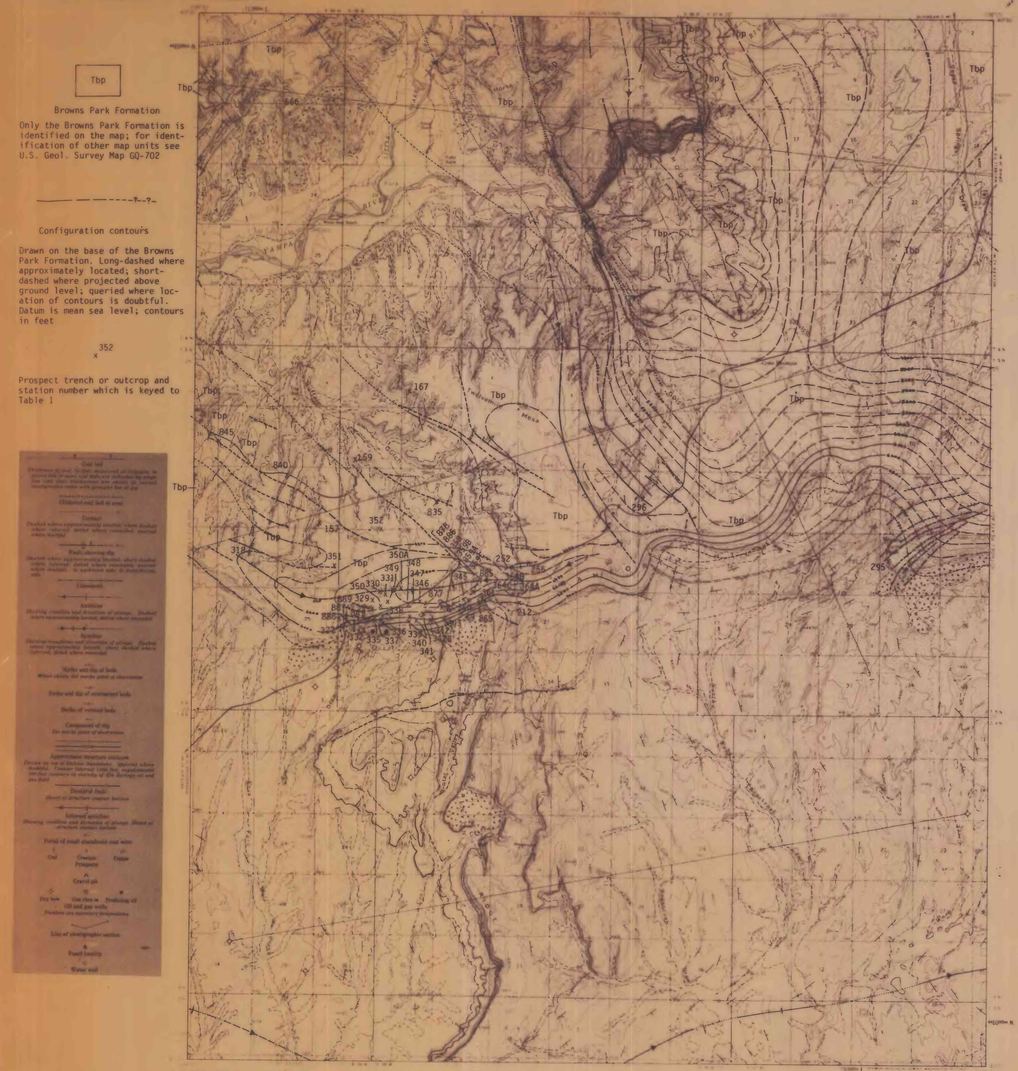

SELECTED FIELD NOTES AND RADIOMETRIC DATA ON THE BROWNS PARK FORMATION IN THE ELK SPRINGS QUADRANGLE, MOFFAT COUNTY, COLORADO

By

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INTRODUCTION

Because of current interest in exploration for uranium in the Browns Park Formation (Miocene) in northwestern Colorado, selected field notes and radiometric measurements made on the formation in the Elk Springs Quadrangle, Moffat County, Colorado, are being made available to the public by this open-file report.

These data were obtained by the author while mapping the geology of the Elk Springs Quadrangle in 1961-63 (Dyni, 1968). These data have not been updated with new information that may have become available since that time.

BROWNS PARK FORMATION

The Browns Park Formation occupies an area of about 69 square miles (180 km^2), in the northern half of the Elk Springs Quadrangle. The formation is divisible into a lower unit of conglomerate and an upper unit of white sandstone.

The lower conglomerate unit, of probable fluvial origin, consists of poorly consolidated pebbles, cobbles, boulders, and lenses of sand, derived from older Mesozoic, Paleozoic, and Precambrian rocks, which crop out on nearby Cross Mountain and in the Diena Mountain uplift just west of the quadrangle. The lower conglomerate unit lies on an erosion surface having several hundred feet of relief. The conglomerate ranges from 0 to 135 feet (0 to 41 m) in thickness, but more commonly it is about 40 to 90 feet (12 to 27 m) thick. The best exposures of the lower conglomerate unit are in the northwestern part of the quadrangle in the drainage basin of the Yampa River where it overlies the Upper Cretaceous Mancos Shale. Elsewhere in the quadrangle, the lower conglomerate unit is either buried by sandstone of the upper unit or is largely concealed by slope wash. *In places where the conglomerate overlies the Mancos Shale, the lower few ft of the conglomerate are firmly cemented with calcite and forms an outcropping ledge, which is useful in locating the base of the formation.* Clasts in the lower unit are moderately well rounded and occur in moderately grained and sorted beds.

The upper sandstone unit of the Browns Park Formation consists of white, friable, crossbedded, fine-grained sandstone of probable eolian origin. In places, the unit contains lenses of conglomerate similar in composition to the lower unit. Where it is well exposed, especially in road cuts along U.S. Highway 40, the upper sandstone unit displays abundant large-scale tangential, and some angular, cross-stratification. Sets of cross-strata range from about 1 to 11 feet (0.30 to 3.4 m) thick and extend laterally for many tens of feet. Individual crosssets within a set are as much as 50 ft (15 m) long. Locally, the unit contains sandy, calcitic concretions and thin, horizontal beds of white, sandy limestone, which are probably interdunal pond deposits.* Little, if any, carbonaceous material (i.e., fossil plant remains) has been found in either the lower or upper units in the quadrangle.

Because the top of the formation is an erosion surface, the formation's original maximum thickness is unknown. The maximum thickness of the formation, estimated from incomplete subsurface information, may be as much 1,000 feet (300 m) at Elk Springs, and as much as 1,600 feet (500 m) east of Cross Mountain.

Overlying the Browns Park Formation is a blanket of brown, sandy colluvium. The colluvium usually forms a discontinuous, thin veneer to a layer several feet thick; locally, however, it may be a few tens of feet thick. In places, the contact between the colluvium and upper sandstone unit is marked by a zone of pebbles lithologically similar to the lower conglomerate unit. Most of the colluvium is reworked sandstone of the Browns Park. The age of the colluvium is uncertain but could be as old as Pleistocene. Because of its variable thickness and difficulty in differentiating it from the underlying sandstone, the colluvium was not mapped separately in the Elk Springs Quadrangle.

STRUCTURE

During the Laramide orogeny of Late Cretaceous to Eocene time, the Precambrian and Phanerozoic rocks in the quadrangle, including those as young as the Paleocene and Eocene Wasatch Formation were strongly folded and faulted. An erosion surface of high topographic relief was incised into these older, folded rocks prior to deposition of the Browns Park Formation. Subsequently, the Browns Park Formation was structurally deformed by monoclinal folding probably over normal, growth faults at depth, and accompanied or perhaps followed, by normal faulting that involved the upper sandstone unit during Neogene time. The structure of the Browns Park Formation bears no resemblance to the structure of the pre-Browns Park rocks. In places, structural attitudes in Browns Park rocks and older rocks are in opposite directions.

Along Elk Springs Ridge from Elk Springs eastward to Wapiti Peak, the Browns Park is downwarped to the north into a monoclinal fold. The lower conglomerate unit along the ridge dips to the north by as much as 26°. Near Elk Springs, a narrow, eastward-trending synclise (graben?), contains a surprising thickness of Browns Park rocks, perhaps as much as 600-1,000 feet (180-300 m). A trough formed by the south flank of Cross Mountain (probably part of the pre-Browns Park erosion surface) and the monocline along Elk Springs Ridge extends eastward into a large, sedimentary-structural basin filled with as much as 1,700 feet (500 m) of Browns Park sediments just east of the Elk Springs Quadrangle. Evidence of folding in the upper sandstone unit of the Browns Park Formation is not clear owing to poor exposures and to the crossbedded character of the unit. It is conceivable that the lower conglomerate unit was folded before or during early deposition of the upper sandstone unit.

In the northwestern part of the quadrangle, a series of predominantly northwest trending, high-angle normal faults cut the upper sandstone unit. The throw on these faults is not more than a few feet or tens of feet. In parts of T. 5 N., Rs. 98 and 99 W., the faults form a series of scarps and terraces that can be detected on airphotos. Colluvium may conceal additional faults in Browns Park rocks cropping out south and east of Cross Mountain. A series of parallel, northeast-trending lineaments, possibly faults, were mapped on Wapiti Peak. At the surface, these lineaments are narrow ravines that are oriented transverse to the normal northward-trending surface drainage in the area.

URANIUM EXPLORATION

During the 1950's, many prospect trenches were bulldozed in the Browns Park Formation in search for uranium deposits. During the course of geologic mapping, the author examined many of these trenches with a handheld scintillometer. The average background radiation in areas underlain by the upper sandstone unit of the Browns Park Formation was about 0.015 milliroentgens per hour (mr/hr). In several trenches exposing the lower conglomerate unit, lower-than-background readings of 0.010 to 0.012 mr/hr were noted. Anomalous higher-than-background values were noted in several trenches exposing the upper sandstone unit. The highest reading for all the trenches examined was 0.10 mr/hr in a trench near Elk Springs, in which sandstone stained with hydrocarbons was exposed. A sample of this sandstone analyzed 0.009 percent uranium (see station 338 in table 1). No attempt was made to systematically survey the entire outcrop area of the Browns Park Formation in the quadrangle nor were spring or well waters analyzed for their uranium content.

A summary of the author's field notes, his radiometric survey, and some laboratory analyses for uranium are presented in table 1.

REFERENCES CITED

Dyni, J. R., 1968, Geologic map of the Elk Springs quadrangle, Moffat County, Colorado: U.S. Geological Survey Geologic Quadrangle Map GQ-702.

Rader, L. F., and Grimaldi, F. S., 1961, Chemical analyses for selected minor elements in Pierre Shale: U.S. Geological Survey Professional Paper 391-A, 45 p.

Table 1.-- *Summary of field notes and radiometric survey on the Browns Park Formation*
[Tbpu = upper sandstone unit; Tbpl = lower conglomerate unit; mr/hr = milliroentgens per hour]

Station No.	Locality sec.	T.	R.	Unit	Description of Units	Radiometric Data Results
1	NW¼ SE¼	14,	S R.,	98 W.	Tbpu	Sandstone, white to very light gray, large-scale sweeping crossbeds, friable, fine-grained, scattered sandy calcareous concretions containing black manganese(?) dendrites; about 30 Ft (9.1 m) exposed in roadcut.	
69	SW¼ NW¼	28,	S R.,	98 W.	Tbpl	8 ft (2.4 m) of conglomerate exposed in prospect trench.	Background: 0.015 mr/hr; highest reading on floor of trench: 0.018 mr/hr
157	SW¼ SE¼	13,	S R.,	99 W.	Tbpl	6 ft (1.8 m) of conglomerate exposed in seismic trail. Base is channeled, erosion surface cut into underlying Mancos Shale.	
159	C-S½ SW¼	7,	S R.,	98 W.	Tbpl	16.5 ft (5.0 m) of conglomerate exposed in hillside.	
167	NW¼ SW¼	5,	S R.,	98 W.	Tbpl, Tbpu	62.5 ft (25.1 m) of conglomerate (Tbpl) overlain by sandstone (Tbpu) exposed in hillside.	
212	NW¼ NW¼	27,	S R.,	98 W.	Tbpu	9 ft (2.7 m) of white crossbedded sandstone; exposed in prospect trench; overlain by 7 ft (0.6 m) of brown, sandy soil; some white calcite(?) wisplets in sandstone.	Background: 0.015 mr/hr; highest reading in trench: 0.015 mr/hr
252	NE¼ SE¼	21,	S R.,	98 W.	Tbpu	About 72 ft (21.9 m) of white, soft, fine-grained, large-scale crossbedded sandstone exposed in roadcut.	
256	NW¼ SW¼	22,	S R.,	98 W.	Tbpl(?)	Poorly sorted lenses of gravel, boulders, and sand; boulders as large as 3 Ft (0.9 m) in diameter; rock types include gray, microcrystalline limestone, gray, fine- to medium-grained, cherty, fossiliferous limestone, red fine-grained sandstone, red quartzitic sandstone, light-yellowish-gray dolomite, and yellowish-brown sandstone.	
260	SW¼ SW¼	16,	S R.,	99 W.	Tbpl	Well-bedded alternating layers of poorly consolidated cobbles and gravel; 52 Ft (15.8 m) exposed in ridge; conglomerate overlain by brown sand. Locality in Indian Water Canyon Quadrangle.	
295	SW¼ NW¼	22,	S R.,	97 W.	Tbpl	Mostly rounded cobbles, pebbles, and sand with some boulders as much as 5 Ft (1.5 m) across; rock types include gray, fine-grained dolomitic limestone, light-gray, very fine grained calcitic sandstone, gray chert, brown cherty microcrystalline limestone, yellowish-brown, medium- to coarse-grained conglomeratic sandstone, and dark-red, fine- to medium-grained, hard, conglomeratic sandstone.	
296	SW¼ NW¼	13,	S R.,	98 W.	Tbpl, Tbpu	Tbpl exposed on east side of Mt-trending fault, and white sandstone (Tbpu) exposed on west side. Tbpl consists of well-stratified lenses of gravel and sand.	
318	SW¼ NE¼	23,	S R.,	99 W.	Tbpu	Soft, white, crossbedded sandstone with about 6 ft (1.8 m) of brown, sandy soil above.	
327	NW¼ SW¼	30,	S R.,	98 W.	Tbpl	Pebbles, cobbles, and boulders in calcitic matrix; overlies Mancos Shale; basal 1.2 Ft (0.37 m) is well cemented. In rock quarry just north of Elk Springs locality, conglomerate is stratified and dips 11° to the north.	
329	NW¼ NE¼	30,	S R.,	98 W.	Tbpu	White, banded, coarse-grained, calcareous sandstone; forms small outcrop.	
330	NW¼ NE¼	30,	S R.,	98 W.	Tbpu	Tbpu poorly exposed in prospect trench 4 to 5 Ft (1.2 to 1.5 m) deep.	Highest reading: 0.011 mr/hr
331	NE¼ NE¼	30,	S R.,	98 W.	Tbpu	About 4 ft (1.2 m) of white sandstone, poorly exposed in prospect trench.	Highest reading: 0.014 mr/hr
332	NE¼ SW¼	30,	S R.,	98 W.	Tbpl	About 20 Ft (6.1 m) of cemented, bouldery gravel exposed in gravel pit. Several faults exposed. Strike and dip: N., 75° E., 21° N. Some rounded boulders of limestone and red quartzite as much as 2.5 ft (0.8 m) across. About 60 Ft (18.3 m) of Tbpl exposed.	Highest reading: 0.032 mr/hr
335	NW¼ SE¼	30,	S R.,	98 W.	Tbpu	About 4 ft (1.2 m) of white, crossbedded sandstone exposed in prospect trench.	Background: 0.015-0.020 mr/hr Highest reading: 0.028 mr/hr
336	NW¼ SE¼	30,	S R.,	98 W.	Tbpl, Tbpu	About 15 ft (4.6 m) of stratified boulders, cobbles, and gravel (Tbpl), lower 2 ft (0.6 m) are well cemented. Above is about 1 ft (0.30 m) of white, crossbedded sandstone (Tbpu). Strike and dip: N. 80° E., 25° N. Tbp exposed in prospect pit about 20 ft (6.1 m) deep.	Highest reading: 0.016 mr/hr in Tbpl
337	NW¼ SE¼	30,	S R.,	98 W.	Tbpl, Tbpu	About 8 ft (2.4 m) of Tbpl overlain by 2 ft (0.6 m) of Tbpu exposed in prospect trench about 10 ft (3.0 m) deep. Natural slope of hillside to south is about 25° N. and is probably a dip slope on the top of Tbpl.	Highest reading: 0.015 mr/hr
338	SW¼ NE¼	30,	S R.,	98 W.	Tbpu	Color-banded white and tan, fine- to medium-grained, soft, crossbedded sandstone well exposed in prospect trench 10 ft (3.0 m) deep. Crosssets measure as much as 40 ft (12.2 m) long. Sandstone at west end of trench is stained brown to black with hydrocarbons.	Highest reading: 0.10 mr/hr at west end of trench on south side in friable brown petrolliferous sandstone; 0-Ft (0.6 m) channel sample analyzed 0.005 percent eU and 0.009 percent U⁴. Uranium appears to be associated with hydrocarbon-bearing sandstone
339	SW¼ NW¼	29,	S R.,	98 W.	Tbpu	Tbpu poorly exposed in prospect trench 5 ft (0.9 m) deep.	Highest reading: 0.015 mr/hr
340	NE¼ SW¼	29,	S R.,	98 W.	Tbpu	Tbpu poorly exposed in prospect trench 2 ft (0.6 m) deep.	Highest reading: 0.016 mr/hr
341	SE¼ NW¼	29,	S R.,	98 W.	Tbpu	Tbpu poorly exposed in prospect trench 2 ft (0.6 m) deep.	Highest reading: 0.017 mr/hr
342A	SW¼ NE¼	29,	S R.,	98 W.	Tbpu	Fair exposure of Tbpu in prospect trench 5 ft (1.5 m) deep. Abundant white calcite veins suggest Tbpu is faulted here.	Highest reading on north side of trench: 0.055 mr/hr; 1.5-foot (0.4 m) channel samples collected 4.7 ft (1.4 m) above base of trench on north side, analyzed 0.006 percent eU and 0.005 percent U⁴
342B	NW¼ SE¼	29,	S R.,	98 W.	Tbpu	Tbpu well exposed in prospect trench 10 ft (3.0 m) deep.	Highest reading: 0.028 mr/hr
343	SW¼ NE¼	29,	S R.,	98 W.	--	Only colluvium from Tbp exposed in prospect trench 3 ft (0.9 m) deep.	Highest reading: 0.016 mr/hr
345	NW¼ NW¼	28,	S R.,	98 W.	Tbpu	Fair exposure of Tbpu in prospect trench 6 ft (1.8 m) deep.	Background: 0.015 mr/hr, highest reading on west side of trench: 0.019 mr/hr
346	NE¼ NW¼	29,	S R.,	98 W.	Tbpu	Poorly exposed Tbpu in prospect trench 4 ft (1.2 m) deep.	Highest reading: 0.016 mr/hr
347	NW¼ NW¼	29,	S R.,	98 W.	Tbpu	Tbpu poorly exposed in prospect trench 5 ft (1.5 m) deep, brown, sandy soil above.	Highest reading: 0.013 mr/hr
348	NW¼ NW¼	29,	S R.,	98 W.	Tbpu	Brown soil exposed in prospect trench 6 ft (1.8 m) deep; some Tbpu on dump.	Highest reading: 0.013 mr/hr
349	NE¼ NE¼	30,	S R.,	98 W.	--	Brown, sandy soil, but no Tbpu exposed in prospect trench 2 ft (0.6 m) deep.	Highest reading: 0.012 mr/hr
350	SW¼ NE¼	30,	S R.,	98 W.	Tbpu	White, crossbedded sandstone containing network of calcite wisplets well exposed in prospect trench 6 ft (1.8 m) deep; brown sandy soil above.	Highest reading: 0.014 mr/hr
350A	SW¼ SW¼	20,	S R.,	98 W.	Tbpl(?)	Brown, sandy soil with about 0.5 ft (0.15 m) of Tbpl(?) exposed at base in prospect trench 6 ft (1.8 m) deep.	Highest reading: 0.015 mr/hr
351	NE¼ SE¼	24,	S R.,	99 W.	Tbpu, Tbpl	Contact between Tbpl and Tbpu poorly exposed in prospect trench 1 ft (0.3 m) deep.	Highest reading: 0.013 mr/hr
352	SW¼ SE¼	18,	S R.,	98 W.	--	Brown, sandy soil exposed in prospect trench 7 ft (2.1 m) deep.	Highest reading: 0.016 mr/hr
358	SE¼ NE¼	29,	S R.,	98 W.	Tbpu	Fractured and faulted sandstone exposed in prospect trench 6 ft (1.8 m) deep.	Highest reading: 0.021 mr/hr
359A	SE¼ NE¼	29,	S R.,	98 W.	Tbpl, Tbpu(?)	Mostly white to light-tan, sandy soil with 1 ft (0.30 m) of Tbpl at base exposed in prospect trench 9 ft (2.7 m) deep.	Highest reading: 0.016 mr/hr
359B	SE¼ NE¼	29,	S R.,	98 W.	Tbpu	White sandstone poorly exposed in prospect trench 2 ft (0.6 m) deep.	Highest reading: 0.014 mr/hr
359C	SE¼ NE¼	29,	S R.,	98 W.	Tbpu	White to yellowish sandstone exposed in prospect trench 2 ft (0.6 m) deep.	Highest reading in small pit just to west of trench: 0.032 mr/hr, highest reading in trench: 0.015 mr/hr

Station No.	Locality sec.	T.	R.	Unit	Description of Units	Radiometric Data Results
360	NE¼ NE¼	29,	S R.,	98 W.	Tbpu	Weathered, tan sandstone in lower part of prospect trench 8 ft (2.4 m) deep.	
361	NW¼ NW¼	28,	S R.,	98 W.	Tbpu	White sandstone well exposed in prospect trench, 7 ft (2.1 m) deep. Sandstone is cut by many fractures filled with calcitic sandy material.	Background: 0.015 mr/hr; highest reading in upper part of west end of trench: 0.019 mr/hr
364A	NW¼ NW¼	27,	S R.,	98 W.	Tbpu	Sandstone poorly exposed in prospect trench 1 ft (0.30 m) deep.	Background: 0.015 mr/hr, highest reading in trench for a 0.5-foot (0.15 m) thick zone: 0.030 mr/hr. Sample from north side of trench analyzed 0.004 percent eU and 0.006 percent U⁴
364B	NE¼ NE¼	28,	S R.,	98 W.	Tbpu	Sandstone poorly exposed in prospect trench 1 ft (0.30 m) deep.	Background: 0.015 mr/hr; highest reading on north side of trench: 0.045 mr/hr
364C	NE¼ NE¼	28,	S R.,	98 W.	Tbpu	Sandstone poorly exposed in prospect trench 2 ft (0.6 m) deep.	Background: 0.015 mr/hr; highest reading in eastern 1/3 of trench: 0.061 mr/hr. Sample analyzed 0.004 percent eU and 0.005 percent U⁴
666	NW¼ NW¼	13,	S R.,	99 W.	Tbpl	135 ft (41.1 m) of Tbpl capped by 5 ft (1.5 m) of Tbpu exposed in bluff.	
835	NW¼ SE¼	17,	S R.,	98 W.	Tbpl	44 ft (13.4 m) of Tbpl well exposed in ravine.	
840	NW¼ NW¼	13,	S R.,	99 W.	Tbpl, Tbpu	17 ft (5.2 m) of Tbpl overlain by 5 ft (1.5 m) of Tbpu exposed in small landslide scarp; base of Tbpl not exposed.	
845	NW¼ SW¼	11,	S R.,	99 W.	Tbpl	Unconsolidated sandy gravel exposed in small ravine; base not exposed but underlying Mancos Shale probably just below; Tbpl is 20 Ft (6.1 m) thick and is overlain by white sand which may be Tbpu or possibly colluvium.	
849	NE¼ SW¼	30,	S R.,	98 W.	Tbpu	4 ft (1.2 m) of white sandstone with some yellow iron oxide stains exposed in prospect trench 4 ft (1.2 m) deep.	Highest reading in east 1/3 of trench, 0.050 mr/hr, 1-foot (0.30 m) channel sample analyzed 0.006 percent eU and 0.004 percent U⁴
865	NE¼ NW¼	28,	S R.,	98 W.	--	Colluvium derived from Tbpu in prospect trench 8 ft (2.4 m) deep.	Background: 0.015 mr/hr; highest reading: 0.015 mr/hr
877	NE¼ NW¼	29,	S R.,	98 W.	Tbpu	Brown and yellow sandstone exposed in prospect trench 5.5 ft (1.7 m) deep.	Highest reading: 0.015 mr/hr
878	NW¼ NE¼	29,	S R.,	98 W.	--	Sandy tan colluvium derived from Tbpu exposed in prospect trench 6 ft (1.8 m) deep.	Highest reading: 0.017 mr/hr
885	NW¼ NW¼	28,	S R.,	98 W.	Tbpu	White, crossbedded sandstone is poorly exposed in lower 5 ft (1.5 m) and tan colluvium is exposed in upper 6 ft (1.8 m) of prospect trench 10 ft (3.0 m) deep.	Highest reading: 0.017 mr/hr
886	SW¼ NE¼	29,	S R.,	98 W.	Tbpu	4 ft (1.2 m) of poorly exposed Tbpu overlain by 4 ft (1.2 m) of sandy and pebbly colluvium in prospect trench 8 ft (2.4 m) deep.	Highest reading in bottom of trench: 0.022 mr/hr
887	C-W ½ of S½	30,	S R.,	98 W.	Tbpl	Gravel pit; see note for station 327 for description.	Highest reading near Tbpl-Tbpu contact: 0.024 mr/hr
888	W¼ corner	30,	S R.,	98 W.	Tbpl (Doubtful location)	Gravel pit.	Highest reading: 0.010 mr/hr
889	SW¼ NE¼	30,	S R.,	98 W.	Tbpu	About 2 ft (0.6 m) of Tbpu overlain by tan, sandy colluvium in prospect trench 5.5 Ft (1.7 m) deep.	Highest reading: 0.014 mr/hr

¹eU = "equivalent" uranium determined by beta-gamma scaler. U = Uranium determined by fluorometric method of Rader and Grimaldi (1961, p. A-31-A33).

Analyses by Lorraine Lee and E. J. Fernelly, U.S. Geological Survey Denver Laboratories, June 30, 1964.