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GEOLOGY AND MINERALOGY

AIRBORNE RADIOMETRIC RECONNAISSANCE IN THE WIND RIVER BASIN, WYOMING, 1954

By
Tom H. W. Loomis
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June 1957

Denver Branch Office, AEC
Division of Raw Materials
Denver, Colorado

UNITED STATES ATOMIC ENERGY COMMISSION
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ABSTRACT

A program of airborne radiometric reconnaissance for uranium was conducted in eastern Fremont and western Natrona Counties, in central Wyoming, during the summer and fall of 1954, by the U. S. Atomic Energy Commission.

Rocks ranging in age from Precambrian to Quaternary were surveyed for radioactivity. The upper part of the Wind River formation of Eocene age was found to be the most favorable for uranium deposits. Uranium minerals found at the anomalies included meta-autunite, autunite, phosphuranylite, uraniferous opal, torbernite, uraniferous carbonate-fluorapatite, uraniferous asphaltite, uranophane, dewindtite, and renardite.

Over 350 flying hours were logged by the Commission aircraft. A total of 204 anomalies was reported by the aircrew. Drilling on two of these anomalies discovered ore which is being mined. Surface features which may indicate other ore bodies warrant further investigations.

INTRODUCTION

Geography

The Wind River Basin (fig. 1) is located in parts of Fremont, Natrona, and Hot Springs Counties of central Wyoming. The area is served by U. S. Highway Nos. 20 and 26 which connect several of the major cities in the State. County roads and numerous ranch roads make most of the area accessible by car. Railroads provide freight and passenger service to several of the towns. Riverton, the largest town in the basin, is also served by Frontier Airlines.

The basin, a northwest-trending structure nearly surrounded by mountains, comprises an area of 7,800 square miles. Relief is moderate in the central parts and becomes greater near the margins. Beaver Rim, the southern edge of the basin, is a well-defined erosional escarpment ranging from 300 to 1,000 feet in relief. Rock outcrops are plentiful along the basin margins, around the major structures, and in areas which have been deeply incised by erosion.

This semiarid region has short dry summers and long cold winters. Strong southwest winds prevail throughout the year.

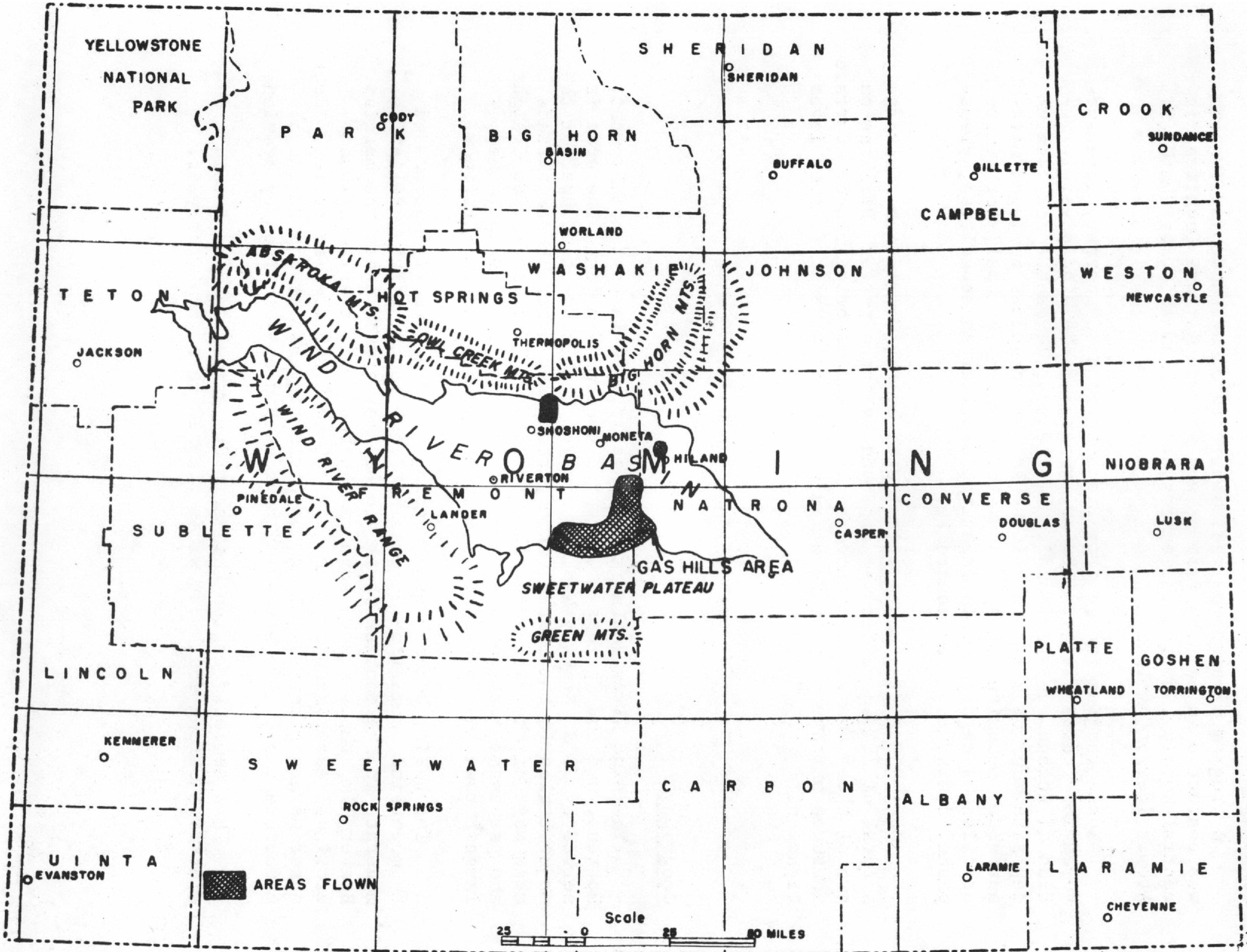

FIG. 1-INDEX MAP OF WYOMING SHOWING AREAS FLOWN

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Drifting snow and severe storm conditions make work difficult during the winter months. Sparse vegetation consisting principally of sagebrush occupies most of the open ground within the basin. Cottonwood trees grow extensively in the river bottoms and evergreen trees are restricted to the higher slopes of the mountain ranges.

The drainage is by the Wind River and its tributaries, the Little Wind and Popo Agie Rivers. Numerous smaller intermittent streams drain the southern and eastern parts of the area. Water is generally in short supply and the intermittent streams flow only during the spring run-off or as flash floods during the summer months. A number of springs are present, but few in the eastern basin can be used for drinking water.

History

The first discovery of uranium in the Wind River Basin was made by Neil McNeice of Riverton, Wyoming, on September 9, 1953 (Grutt, 1954). Since then, considerable work has been done in the area by numerous individuals, companies, and Government agencies.

Purpose and scope

This systematic aerial survey was undertaken to assist in the exploration and evaluation of the known areas of uranium deposition. Ore controls, trends, and prospecting guides were sought.

Airborne radiometric reconnaissance was conducted by the U.S. Atomic Energy Commission from June 17 through December 23, 1954. Grid and rim flying was used to locate and delimit anomalous areas, which were later checked on the ground by a geologist.

GENERAL GEOLOGY

Stratigraphy

Rocks ranging in age from Precambrian granites and gneisses in the core of the mountain ranges to late Tertiary sedimentary rocks and rocks of volcanic origin are present in the area (Love, 1954, and Tourtelot, 1953). The upper Tertiary rocks contain abundant tuffaceous material which originated in the Absaroka volcanic field. The greater proportion of the uranium deposits has been found in the Wind River formation of Eocene age (table 1).

TABLE 1 - STRATIGRAPHIC COLUMN OF THE WIND RIVER BASIN
(Adapted from Grutt, 1954)

SYSTEM	SERIES		FORMATION	MEMBER OR TONGUE	THICKNESS IN FEET
Quaternary					?
Tertiary	Oligocene		White River fm.		
	Eocene	Upper	Unnamed		0 - 609
	Eocene	Middle	Unnamed		100
	Eocene	Lower	Wind River fm.	Lost Cabin	170 - 900
				Lysite	250 - 560
	Eocene	Early lower	Unnamed		0 - 385
	Paleocene		Fort Union fm.		?
Cretaceous	Upper		Post-Frontier formations		2750 - 6700
			Frontier fm.		650 - 1000
	Lower		Mowry shale		250 - 500
			Muddy sandstone		0 - 150
			Thermopolis fm.		100 - 200
			Cloverly fm.		100 - 350
Jurassic	Upper		Morrison fm.		90 - 240
			Sundance fm.	Upper	100 - 200
				Lower	80 - 235
	Middle		Gypsum Spring		0 - 250
	Lower		Nugget sandstone		0 - 500
Triassic			Chugwater fm.	Popo Agie	100 - 200
				Alcova limestone	0 - 15
				Red Peak	800 - 1000
			Dinwoody fm.		50 - 250
Permian			Phosphoria fm.		0 - 350
Pennsylvanian			Tensleep sandstone		150 - 400
			Amsden fm.		200 - 280
Mississippian			Madison limestone		500 - 650
Devonian			Darby fm.		5 - 380
Ordovician			Bighorn dolomite		140 - 200
Cambrian			Gallatin limestone		250 - 500
			Gros Ventre fm.		300 - 700
			Flat Head sandstone		170 - 350

Paleozoic sedimentary rocks

Several thousand feet of Paleozoic rocks consisting of limestones, dolomites, sandstones, and shales are present in the basin. The section is thickest in the western part of the area and is best exposed on the flanks of the mountain ranges.

Mesozoic sedimentary rocks

A lithologic change and a slight beveling of the Permian strata mark the Paleozoic-Mesozoic contact. The Mesozoic rocks dip into the basin and are well exposed on the flanks of the surrounding mountains and in some of the breached anticlines within the basin.

Uranium minerals have been found in small quantities in the Morrison sandstone of Jurassic age, in Jurassic shale, and in the Thermopolis shale of Cretaceous age.

Tertiary sedimentary rocks

Eocene rocks comprise the greater part of the basin and younger Tertiary strata are exposed on Beaver Rim, along the southern edge. The Fort Union formation crops out on the flanks of some of the mountain ranges ringing the basin and on several anticlines within the basin. This shale is unconformable with the younger and older rocks.

The Wind River formation, host to most of the uranium mineralization in the basin, is locally divided into an upper and lower unit. The thickness of the formation is variable, ranging from 300 feet in the Beaver Divide area to over 1,000 feet in the northeastern part of the basin.

The lower part of the Wind River formation unconformably overlies the Cretaceous and older rocks. The section is composed of light-gray, green, and brown mudstones; light-colored sandy mudstones; and red siltstones. This shaly or silty phase does not contain significant amounts of uranium.

The upper part of the Wind River formation is fluviatile in origin and contains lenticular, buff to dark-brown, very coarse-grained to conglomeratic, arkosic sandstones. Interbedded shales, mudstones, and conglomerate lenses are common. The strata cannot be correlated easily, as the lithology changes within short distances both laterally and vertically. Ancient stream channels, scour and fill structures, and torrential crossbedding are discernable. In the Gas Hills area, some of these rocks are strongly fractured in an east-trending direction. Most of the uranium deposits in the basin occur in this upper coarse-sandstone phase of the Wind River formation.

Structure

The Wind River Basin is a structural and topographic basin bounded on the north by the Owl Creek, Absaroka, and Big Horn Mountains and on the south by the Rattlesnake and Wind River Mountains and Beaver Rim. A saddle of low relief delimits the basin on the east.

Older folded rocks are exposed in several breached and deeply eroded, asymmetrical anticlines within the basin. These older rocks also form steep to gentle dip slopes on the sides of the surrounding mountains. Little folding is present in the Tertiary formations.

Thrust and normal faulting, involving rocks from Precambrian to late Tertiary age, is common along the edges of the basin. Deformation started during the Laramide revolution which marked the closing phase of the Mesozoic era. Many faults of upper Tertiary age have been observed in the Wind River and younger formations throughout the basin.

URANIUM DEPOSITS

Distribution

The ore bodies vary from small scattered surface pods containing a few tons to large subsurface deposits containing thousands of tons of ore. These lenticularly bedded horizontal ore bodies are confined to channels and favorable sandstone beds in the upper part of the Wind River formation north of the Beaver Rim. East-trending fractures and faults have influenced uranium deposition.

Mineralogy

The uranium minerals of the Wind River Basin include phosphates, carbonates, silicates, arsenates, and oxides. The common ore minerals are meta-autunite, autunite, and phosuranylite in the oxidized zone and uraninite and coffinite in the unoxidized zone. Uraniferous carbonate-fluorapatite, uraniferous opal, uraniferous asphaltite, liebigite, uranospinite, uranocircite, uranophane, torbernite, and other uranium minerals also are found in the basin.

Gypsum, calcite, iron-oxide stain, jarosite, pyrite, barite, manganese oxide, selenium, and molybdenum minerals occur as gangue minerals.

The U. S. Geological Survey has done considerable sampling of springs and wells in the area. Some samples have given abnormally high assays for uranium (at least one sample contains more than 300 parts per billion), arsenic, and selenium. Assays of 20 to

1,300 parts per billion of uranium have been found in samples of water in the immediate vicinity of uranium deposits.

AIRBORNE RADIOMETRIC SURVEYING

Coverage

During this project, 340 square miles and 77 linear miles were surveyed (pl. 1). Particular attention was given to the upper member of the Wind River formation and to faults, folds, and other structural features which seem to be favorable for the localization of uranium deposits. The terms "Lost Cabin" and "Lysite" apply on the north side of the Wind River Basin but they cannot be carried across as lithologic and time units to the south side according to USGS geologists who were working in the area at the time. Therefore, the terms upper and lower member are used locally.

Grid and rim flying were done at an average elevation of 50 feet. Coverage of the areas flown varied from 10 to 50 percent, probably averaging 20 to 25 percent. Flying across the grid was done where the locations of anomalies were difficult to determine.

Flying time totaled 358:40 hours and was divided as follows:

Rim and grid	153:35
Reconnaissance	61:50
Cross country	143:15

A Piper PA-18 135-horsepower aircraft fitted with a scintillation counter was used for the survey.

Results

During this program, 204 anomalies were located and assigned reference numbers. Included in the total are 14 anomalies previously reported by Commission geologists, and 26 anomalies which cound not be located on the ground after they had been discovered from the air.

Interest was stimulated in the area by the presence of the Commission plane, and the unusually large number of anomalies posted each month. Several private aircraft equipped with scintillation counters were active during the summer and fall.

Turbulence and strong winds limited flying on 43 days and prevented flying for 6 days during the project. The best flying conditions prevail during the summer.

GROUND INVESTIGATIONS

Instruments and methods

The anomalies were located on the ground with scintillation counters. Geiger counters were used to check the walls of pits, trace thin mineralized strata, and to select spots for sampling. On the basis of the ground investigations, the anomalies have been divided into four groups:

1. Anomalous areas containing abundant uranium minerals or those extending known radioactive areas. These often had visible uranium minerals and/or ore-grade material at the surface. Some are now being mined or are in active mining areas.

2. Areas containing some visible uranium mineral or abundant radioactivity, often over a broad area. Occasional ore-grade samples are found.

3. Areas of low or spotty radioactivity. Some of these are the result of lithologic variation.

4. This group includes the remaining anomalies not found by ground reconnaissance, those cancelled for various reasons, and very weak anomalous spots in the alluvium.

Anomalies listed in the first two groups warrant further work, which in most cases has been planned or accomplished by the owners. The anomalies in the last two groups warrant no additional work except in a few cases where trends were indicated. These were investigated by pitting or drilling and proved of no further interest.

Claims at most of the anomalies were staked by companies and individuals before the anomalies were checked by the ground crew. Only sufficient work was done on these to give a reasonably accurate evaluation in as short a time as practical. Close association was maintained with the operators regarding some of the more favorable anomalies.

ANOMALIES

(Tables 2 and 3)

Anomalies Nos. 62-64

Scintillation readings of more than 200 counts per second were obtained in a very broad area, with local radioactive highs measuring 1,000 to 3,500 counts per second. Uranium minerals were found in surface debris and shallow pits. The claims were drilled by the owner and mining has started.

The uranium minerals are in a light-buff, friable to very resistant, very coarse-grained to conglomeratic, poorly sorted arkosic sandstone. This sandstone is in the upper part of the Wind River formation and contains some limonite specks and stains, sparse manganese specks, and calcium-carbonate cement. Some of the rock appears to contain concretionary remnants.

The uranium minerals are meta-autunite and phosphuranylite. Meta-autunite, occurring as light apple-green, disseminated, micaceous flakes and streaks, fills the interstices of the sandstone. The phosphuranylite, a canary-yellow amorphous uranium mineral, is present as coatings on the granite and quartz pebbles in the strata and as interstitial fillings on a 2- to 4-inch band adjacent to limonite and manganese-oxide halos in the concretionary remnants.

Anomalies Nos. 48-52, 54, and 191

Anomalous radioactivity and uranium minerals were previously discovered in this area by ground reconnaissance. The airborne survey revealed additional radioactive anomalies and gave more information on the probable extent of the area. This region has 6 to 8 times normal background radioactivity, with a "high" of more than 20 MR/hr. in areas containing visible uranium minerals.

The uranium minerals replace wood (Anomaly No. 49) and as interstitial fillings form halos around woody material. These deposits were found in a 2- to 3-foot flat-lying bed of light buff-gray, very coarse-grained to conglomeratic sandstone. Underlying this sandstone are at least 4 feet of poorly sorted, sandy conglomerate, which contains uranium minerals as coatings concentrated on the upper sides of cobbles and boulders, as streaks and as interstitial fillings. The conglomerate consists of fairly well-rounded granite, quartz, and chert pebbles up to 1 foot in diameter. These friable lenses underly more resistant sandstone beds 1 to 8 feet thick which crop out in the central part of the area. The exposed arkosic rocks are in the upper part of the Wind River formation.

The uranium minerals which have replaced wood and possibly bone are canary-yellow nonfluorescent phosphuranylite and uranophane (John Gruner, written communication, 1954; Robert Coleman, verbal communication, 1955) and less commonly, apple-green fluorescent meta-autunite. The streaks and coatings in the conglomeratic rocks are canary- to lemon-yellow phosphuranylite and a colorless, fluorescent (apple-green) mineral thought to be uraniferous opal. The halos about the wood replacement and the streaks and disseminated grains in the sandstone are meta-autunite, phosphuranylite, dewindtite, and renardite (X-ray identification, U.S.G.S.). Limonite streaks and stains are present in the sandstone and the conglomerates.

Anomalies Nos. 129 and 131

These anomalies extend a previously known area of uranium mineralization, which lies one-half mile to the south. Commission personnel examined radioactive highs where were drilled with favorable results during the Wind River drilling program in 1954.

Excavation by the owners in the area of anomaly No. 129 revealed small lenses of very light-buff arkosic pebble conglomerate containing meta-autunite as coatings and disseminated specks. Torbernite occurs rarely as fracture coatings in cobbles. At 35 feet below the surface, 2 to 4 feet of gray silty-sandstone ore contain pyrite grains, carbon specks, and microscopic specks of uraninite.

Deer Creek area

Anomalous radioactivity occurs in erosional remnants near the crests of low rounded ridges and knolls at anomalies No. 102, 106, 107, 110, 116, 118, 119, 163, and 3G. The area has a background of 0.025 to 0.04 MR/hr. Radiometric "highs" of 0.30 to 3.5 MR/hr. were obtained over areas several feet in diameter.

The host rock is a light-buff, very coarse-grained to conglomeratic, generally poorly sorted, arkosic sandstone in the upper part of the Wind River formation. It is locally crossbedded, contains small amounts of limonitic staining, and often is cemented with calcareous and phosphatic material. A grayish-brown stain usually accompanies the radioactive mineral in these samples.

Select and grab samples from six of the anomalies assayed 0.12 to 0.30 percent U_3O_8. The eU:U ratio is 2:3. Erosional remnants containing abnormal radioactivity are scattered sporadically over an area of several square miles. Drilling has revealed some abnormal radioactivity at depth.

Anomalies Nos. 20-23, 1G, and 2G

These anomalies are in secs. 8 and 9, T.33 N., R. 89 W. Scattered occurrences of radioactivity are found on rounded ridges and spurs in this area of low relief. Exploration in the area of these anomalies produced one indication of ore-grade mineralization 9 feet thick.

Meta-autunite and phosphuranylite occur as coatings, disseminated specks, and as interstitial fillings in the very coarse-grained arkosic sandstones and conglomerate lenses.

Small patches of very fine-grained and very coarse-grained, well-sorted, concretionary arkosic-sandstone lenses, cemented with abundant ferruginous material, often have 3 to 4 times background radioactivity (Anomalies Nos. 20-22 and 1G). Samples from these scattered patches of radioactively anomalous rock show traces of uranium minerals and occasional bright specks of green fluorescence under ultraviolet light.

Some reconnaissance and drilling was carried out during the summer field season, 1955.

Anomalies Nos. 179 and 5G

Excavation in the vicinity of these anomalies revealed a very coarse-grained, resistant, arkosic-sandstone bed containing uraniferous carbonate-fluorapatite similar to that found elsewhere in the basin. Drilling by the operator failed to reveal minable quantities of ore.

Anomaly No. 75

In this area, spotty radioactivity is widespread in friable shaly sandstones, some of which are locally carbonaceous. These rocks overlie a bed of light-gray, very coarse-grained, slightly calcareous sandstone one-half foot thick. Meta-autunite is present as disseminated specks in a light-buff, coarse-grained sandstone layer and is the interstitial filling and coating in the limonite zones near the top and base of the sandstone layer. These rocks are in the upper part of the Wind River formation.

Anomalies Nos. 186-190

Anomalous radioactivity is associated with scattered concretions near the rim of a large rounded ridge in secs. 6, 7, and 8, T.32 N., R.90 W. Several select samples assayed ore grade.

DISCUSSION OF ANOMALIES

Additional work consisting of isorad mapping, pitting, sampling, and more detailed reconnaissance was done on some of the other anomalies during the summer of 1955. Some additional low-grade uranium deposits were found.

Anomalies Nos. 2, 179, 183, and 5G show a possible depositional trend of uraniferous carbonate-fluorapatite which should be investigated. Moe detailed reconnaissance mapping and drilling may reveal other ore bodies. Additional ore was discovered by the owners after drilling in the vicinity of Anomaly No. 2.

The anomalies in the Deer Creek area, Nos. 106, 107, 110, 112, 116, 118, 119, 163, and 3G, indicate that detailed reconnaissance may reveal a trend to mineral deposition. Part of the area has been drilled by the Commission and private operators and some uranium mineralization was located. Samples from several of the anomalies were determined by assays to be of ore grade, with the eU:U ratio being 2:3.

Nineteen anomalies could not be located on the ground even through intensive ground reconnaissance was done in the areas indicated on anomaly maps. The immediate areas of several unlocated anomalies were reflown in an effort to pinpoint the radioactivity. Failure to find these resulted in the elimination of seven anomalies.

Of the 204 anomalies located during this highly successful program, 52 warranted some further work after preliminary ground investigations. The work of the Commission resulted in the opening of two new mines in the area. Private companies working immediately adjacent to other anomalous areas found at least two other ore bodies.

CONCLUSIONS

The Wind River Basin offers considerable promise for the discovery of additional significant uranium deposits. Several properties are shipping substantial amounts of ore, and other claims are being rapidly developed.

The upper part of the Wind River formation is the most favorable uranium host rock in the basin area, possibly because of its coarse arkosic sandstones and interbedded siltstones. Insufficient work has been done to establish definitely the size ranges of the ore bodies in this formation. Near the surface, the uranium minerals are usually localized in small lenses, concretions, or pods containing a few hundred pounds to thousands of tons of uranium ore.

Some degree of fracture control may have influenced the concentration of uranium minerals. A primary control in the basin areas seems to be channels trending northward from the Beaver Rim.

None of the anomalies in the area north of Shoshoni (pl. 1) have much promise. Some of the anomalies are in areas of granitic rocks which have higher radioactivity than the surrounding sediments.

The areas away from the major activity and outside of the areas flown in this project offer the most unclaimed ground for prospecting. Much of the Wind River formation remains to be prospected.

Rapid evaluation of the undeveloped areas can best be done by airborne radiometric surveying at altitudes about 200 feet above the ground. All anomalous areas should be examined by more detailed airborne radiometric surveys at lower altitudes followed by ground reconnaissance. Ground reconnaissance would be more profitable if preceded by a detailed study of available geologic maps, with prospecting being limited to the most favorable areas.

Particularly worthy of note would be channels in the Wind River formation trending northward from Beaver Rim into the basin.

TABLE 2

CHARACTERISTICS OF FAVORABLE ANOMALIES

DESCRIPTION	LOCATION	HOST ROCKS	RADIO-ACTIVITY	URANIUM MINERALS	RESULTS AND REMARKS
Anomalies Nos. 62-64	Sec.19,T.33N., R.90 W. Sec.30,T.33N., R.90 W.	Twdr*; conglomerate and arkosic sandstone	200-3500 cps	Meta-autunite, phosphuranylite	Drilled by owner and mining started. Extension of previously known area.
Anomalies Nos. 48-52, 54, and 191	Sec.6,T.32N., R.90 W. Sec.1,T.32N., R.91 W.	Twdr; conglomerate and arkosic sandstone	6 x BG.-more than 20 MR/hr.	Meta-autunite, autunite, phosphuranylite, uraniferous opal, dewindtite, and renardite	Area of known radioactivity was extended.
Anomalies Nos. 129 and 131	Sec.15,T.33N., R.89 W.	Twdr; arkosic sandstone	0.35 - 1.1 MR/hr.	None visible	Adjacent to a known area, drilled by AEC. Owners now mining an ore body.
Anomalies Nos. 102, 107, 110, 116, 118, 119, 163, and 3G	Sec.11,T.35N., R.89 W. Sec.15,T.35N., R.89 W. Sec.22,T.35N., R.89 W.	Twdr; arkosic sandstone and conglomerate	0.3-3.5 MR/hr.	Uraniferous asphaltite and uraniferous carbonate-fluorapatite	Uranium deposition appears in resistant erosional remna of arkosic sandstone scatter over area of several square miles.
Anomalies Nos. 20-23, and ground anomalies Nos. 1G and 2G	Sec.8,T.33N., R.89 W.	Twdr; arkosic sandstone and sandy mudstone	0.2-2.0 MR/hr.	Meta-autunite	Potential ore body exposed b shallow cut in immediate vicinity of these anomalies.

*Twdr - Wind River formation.

DESCRIPTION	LOCATION	HOST ROCK	RADIO-ACTIVITY	URANIUM MINERALS	RESULTS AND REMARKS
Anomalies Nos. 179 and 5G	Sec.4,T.32N., R.90 W.	Twdr; arkosic sandstone	0.15-1.5 MR/hr.	None visible	Small amount of uraniferous carbonate-fluorapatite shipped from areas adjacent to these anomalies.
Anomaly No. 75	Sec.13,T.32N., R.91 W.	Twdr; arkosic sandstone	0.15-0.6 MR/hr.	Meta-autunite	Spotty, widespread mineralization. Further exploration warranted.
Anomalies Nos. 186-190	Sec.6,T.32N., R.90 W. Sec.7,T.32N., R.90 W. Sec.8,T.32N., R.90 W.	Twdr; arkosic sandstone	0.12-2.5 MR/hr.	None visible	Anomalous radioactivity found in scattered conretions along a ridge.
Anomaly No. 136	Sec.25,T.34N., R.89 W.	Twdr; arkosic sandstone	0.1-1.0 MR/hr.	Torbernite	Area of very widespread surface radioactivity warranting further exploration.
Anomalies Nos. 2 and 183	Sec.34,T.33N., R.90 W.	Twdr; arkosic sandstone	0.2-5.0 MR/hr.	Uraniferous carbonate-fluorapatite	Both anomalies consist of a few scattered resistant sandstone remnants. No. 2 was previously known and has been mined.
Anomaly No. 167	Sec.22,T.23N., R.89 W.	Twdr; arkosic sandstone	0.2--more than 5 MR/hr.	None visible	Adjacent area drilled and ore-grade material reported.
Anomaly No. 88	Sec.14,T.32N., R.91 W.	Twdr; arkosic sandstone	0.1 - 1.2 MR/hr.	Meta-auntunite	Small area of surface mineralization.

TABLE 3

REPORTED ANOMALIES

ANOMALY NO.	LOCATION	RADIOACTIVITY BACKGROUND	RADIOACTIVITY MAXIMUM	ROCK TYPE
1	Sec. 34,T.33n.,R.90 W.	100 cps	200 cps	Very light-buff, coarse to very coarse friable massive sandstone of Wind River formation.
2	do.	do.	do.	do.
3	Sec.22,T.33N.,R.90 W.	do.	350 cps	Light-buff, very coarse-grained, friable, massive arkosic sandstone of Wind River formation.
4	do.	do.	do.	do.
5	do.	do.	do.	do.
6	do.	do.	do.	do.
7	Sec.25,T.33N.,R.90 W. Sec.26,T.33N.,R.90 W.	Could not be located by ground reconnaissance.		
8	Sec.24,T.33N.,R.90 W.	100 cps	250 cps.	Brown to dark-brown shaly mudstone of Triassic age.
9	Sec.14,T.33N.,R.90 W.	0.03 MR/hr.	0.1 MR/hr.	Light to dark-buff, very coarse-grained conglomerate; arkosic resistant sandstone of Wind River formation.
11	Sec.25,T.33N.,R.90 W.	100 cps	160 cps	Gray-brown, medium- to very coarse-grained friable, massive muddy sandstone of Wind River formation.

ANOMALY NO.	LOCATION	RADIOACTIVITY BACKGROUND	RADIOACTIVITY MAXIMUM	ROCK TYPE
12	Sec.25,T.33N.,R.90 W.	100 cps	150 cps	Gray-brown, medium- to very coarse-grained, friable, massive muddy sandstone of Wind River formation.
13	Sec.19,T.33N.,R.89 W.	0.03 MR/hr.	0.1 MR/hr.	Dark-buff, coarse-grained, friable, fairly well-sorted, massive muddy sandstone of Wind River formation.
14	do.	0.025 MR/hr.	0.05 MR/hr.	Buff, very coarse-grained, resistant massive sandstone of Wind River formation.
15	do.	80 cps	125 cps	Brown-gray, medium- to coarse-grained, poorly sorted, friable, massive sandy mudstone of Wind River formation.
16	do.	do.	150 cps	do.
17	Sec.21,T.33N.,R.89 W.	0.025 MR/hr.	0.08 MR/hr.	Buff-brown sandy mudstone of Wind River formation.
18	do.	do.	0.14 MR/hr.	Buff-gray,ferruginous sandy mudstone; dark-brown shaly mudstone of Wind River formation.
19	do.	do.	do.	do.
20	Sec.9,T.33N.,R.89 W.	0.03 MR/hr.	0.1 MR/hr.	Buff, very fine- to very coarse-grained, well-sorted, resistant ferruginous sandstone of Wind River formation.
21	do.	do.	do.	do.
22	Sec.8,T.33N.,R.89 W.	do.	do.	do.

ANOMALY NO.	LOCATION	RADIOACTIVITY		ROCK TYPE
		BACKGROUND	MAXIMUM	
23	Sec.8,T.33N.,R.89 W.	0.03 MR/hr.	0.1 MR/hr.	Buff, very fine- to very coarse-grained well-sorted, resistant ferruginous sandstone of Wind River formation.
24	do.	do.	0.05 MR/hr.	Brown, medium- to coarse-grained, poorly sorted sandstone of Wind River formation.
25	Sec.17,T.33N.,R.89 W.	100 cps	300 cps	Light-buff to buff, medium-grained, fairly well-sorted friable sandstone; brown carbonaceous mudstone of Wind River formation.
26	Sec.18,T.33N.,R.89 W.	0.025 MR/hr.	0.08 MR/hr.	Brown-buff, coarse-grained muddy sandstone of Wind River formation.
27	do.	do.	do.	do.
28	do.	do.	do.	do.
29	do.	do.	do.	do.
30	do.	do.	do.	do.
31	do.	do.	do.	do.
32	do.	do.	do.	do.
33	do.	do.	do.	do.
34	Sec.13,T.33N.,R.90 W.	85 cps	250 cps	Blue-gray, limonite-streaked mudstone of Wind River formation.
35	do.	80 cps	125 cps	Gray-brown, medium-grained, friable muddy sandstone of Wind River formation.

ANOMALY NO.	LOCATION	RADIOACTIVITY BACKGROUND	RADIOACTIVITY MAXIMUM	ROCK TYPE
36	Sec.13,T.33N.,R.90 W. Sec.14,T.33N.,R.90 W.	80 cps	150 cps	Arkosic sandstone of Wind River formation.
37	do.	0.04 MR/hr.	0.12 MR/hr.	do.
38	Sec.11,T.33N.,R.90 W.	0.025 MR/hr.	0.08 MR/hr.	do.
39	do.	do.	do.	do.
40	Sec.14,T.33N.,R.90 W.	80 cps	200 cps	do.
41	do.	0.03 MR/hr.	0.1 MR/hr.	Mudstone and sandstone of Wind River formation.
42	Sec.11,T.33N.,R.90 W.	60 cps	100 cps	do.
43	do.	do.	do.	do.
44	Sec.30,T.33N.,R.90 W.	100 cps	1500 cps	Askosic sandstone of Wind River formation.
45	Sec.29,T.33N.,R.90 W.	Not identified by ground reconnaissance.		
46	do.	0.03 MR/hr.	0.18 MR/hr.	Askosic sandstone of Wind River formation.
47	Sec.32,T.33N.,R.90 W.	do.	0.15 MR/hr.	do.
48	Sec.6,T.32N.,R.90 W.	0.1 MR/hr.	0.19 MR/hr.	Not determined.
49	Sec.1,T.32N.,R.91 W.	0.02 MR/hr.	5+ MR/hr.	Arkosic sandstone of Wind River formation.
50	do.	do.	do.	do.
51	do.	0.05 MR/hr.	0.3 MR/hr.	Sandy mudstone of Wind River formation.

ANOMALY NO.	LOCATION	RADIOACTIVITY BACKGROUND	RADIOACTIVITY MAXIMUM	ROCK TYPE
52	Sec.31,T.33N.,R.90 W.	0.04 MR/hr.	0.3 MR/hr.	Arkosic sandstone of Wind River formation.
53	do.	0.035 MR/hr.	0.11 MR/hr.	Sandstone of Wind River formation.
54	Sec.1,T.32N.,R.91 W.	0.03 MR/hr.	0.2 MR/hr.	Mudstone of Wind River formation.
55	do.	0.04 MR/hr.	0.25 MR/hr.	Arkosic sandstone remnant of Wind River formation.
56	do.	do.	do.	do.
57	Sec.13,T.32N.,R.91 W.	0.04 MR/hr.	0.14 MR/hr.	Sandy mudstone of Wind River formation.
58	Sec.11,T.32N.,R.91 W.	Could not be located by ground reconnaissance.		
59	Sec.1,T.32N.,R.91 W.	40 cps	70 cps	Arkosic sandstone of Wind River formation.
60	do.	0.03 MR/hr.	0.035 MR/hr.	do.
61	Sec.31,T.33N.,R.90 W.	Could not be located by ground reconnaissance.		
62	Sec.30,T.33N.,R.90 W. Sec.19,T.33N.,R.90 W.	100 cps	3500 cps	Arkosic sandstone of Wind River formation.
63	Sec.30,T.33N.,R.90 W.	do.	do.	do.
64	Sec.19,T.33N.,R.90 W.	Could not be located by ground reconnaissance.		
65	Sec.29,T.33N.,R.90 W.	0.035 MR/hr.	0.05 MR/[illegible].	Muddy sandstone of Wind River formation.
66	Sec.25,T.33N.,R.91 W.	0.03 MR/hr.	0.15MR/hr.	Sandstone of Wind River formation.
67	Sec.1,T.32N.,R.91 W. Sec.2,T.32N.,R.91 W.	43 cps	220 cps	Muddy sandstone of Wind River formation.

ANOMALY NO.	LOCATION	RADIOACTIVITY BACKGROUND	RADIOACTIVITY MAXIMUM	ROCK TYPE
68	Sec.11,T.32N.,R.91 W.	0.025 MR/hr.	0.08 MR/hr.	Arkosic sandstone of Wind River formation.
69	do.	do.	0.35 MR/hr.	Sandy mudstone of Wind River formation.
70	Sec.10,T.32N.,R.91 W. Sec.11,T.32N.,R.91 W.	do.	0.07 MR/hr.	Sandstone of Wind River formation.
71	Sec.2,T.32N.,R.91 W. Sec.11,T.32N.,R.91 W.	do.	0.3 MR/hr.	Sandy mudstone of Wind River formation.
72	Sec.29,T.32N.,R.90 W.	do.	0.03 MR/hr.	Conglomerate of Miocene age.
74	Sec.36,T.32N.,R.91 W.	do.	0.07 MR/hr.	Arkosic sandstone remnants of Wind River formation.
75	Sec.13,T.32N.,R.91 W.	0.05 MR/hr.	0.08 MR/hr.	Arkosic and shaly sandstone of Wind River formation.
76	Sec.25,T.32N.,R.91 W.	0.025 MR/hr.	0.045 MR/hr.	do.
77	Sec.29,T.32N.,R.91 W.	do.	0.28 MR/hr.	Arkosic sandstone of Wind River formation.
78	do.	do.	0.06 MR/hr.	Muddy sandstone of Wind River formation.
79	Sec.23,T.32N.,R.91 W.	do.	0.07 MR/hr.	do.
80	Sec.26,T.32N.,R.91 W.	do.	0.13 MR/hr.	do.
81	Sec.23,T.32N.,R.91 W.	do.	0.05 MR/hr.	Sandstone and conglomerate of Wind River formation.
82	Sec.22,T.32N.,R.91 W.	0.03 MR/hr.	0.07 MR/hr.	Arkosic sandstone of Wind River formation.
83	Sec.23,T.32N.,R.91 W.	20 cps	70 cps	Sandy mudstone and conglomerate of Wind River formation.

ANOMALY NO.	LOCATION	RADIOACTIVITY BACKGROUND	MAXIMUM	ROCK TYPE
84	Sec.22,T.32N.,R.91 W.	0.04 MR/hr.	0.5 MR/hr.	Arkosic sandstone of Wind River formation.
86	Could not be located by ground reconnaissance.			
87	Sec.16,T.32N.,R.91 W.	Could not be located by ground reconnaissance.		
88	Sec.14,T.32N.,R.91 W.	0.06 MR/hr.	1.0 MR/hr.	Sandy mudstone of Wind River formation.
89	Sec.34,T.32N.,R.91 W.	0.03 MR/hr.	0.2 MR/hr.	Arkosic sandstone of Wind River formation.
90	Sec.27,T.32N.,R.91 W. Sec.34,T.32N.,R.91 W.	0.025 MR/hr.	0.05 MR/hr.	do.
92	Sec.27,T.32N.,R.91 W.	do.	0.06 MR/hr.	Muddy sandstone and conglomerate of Wind River formation.
94	Sec.26,T.32N.,R.91 W.	do.	0.035 MR/hr.	Sandstone of Wind River formation.
95	Sec.17,T.32N.,R.91 W.	do.	0.3 MR/hr.	Mudstone and sandstone of Wind River formation.
96	Sec.18,T.32N.,R.91 W.	Could not be located by ground reconnaissance.		
97	Sec.14,T.32N.,R.92 W.	0.04 MR/hr.	0.15 MR/hr.	Conglomerate of Wind River formation.
99	Sec.29,T.35N.,R.89 W.	120 cps	200 cps	Sandstone of Wind River formation.
100	Secs.20&29,T.35N., R.89 W.	Could not be located by ground reconnaissance.		
101	Sec.10,T.35N.,R.89 W.	Could not be located by ground reconnaissance.		
102	Sec.15,T.35N.,R.89 W.	0.03 MR/hr.	0.35 MR/hr.	Arkosic sandstone of Wind River formation.

ANOMALY NO.	LOCATION	RADIOACTIVITY BACKGROUND	MAXIMUM	ROCK TYPE
103	Sec.27,T.35N.,R.89 W.	0.025 MR/hr.	0.15 MR/hr.	Arkosic sandstone and mudstone of Wind River formation.
104	Sec.34,T.35N.,R.89 W.	0.04 MR/hr.	0.3 MR/hr.	Arkosic sandstone of Wind River formation.
105	Sec.22,T.35N.,R.89 W.	0.03 MR/hr.	0.1 MR/hr.	do.
106	Sec.15,T.35N.,R.89 W.	20 cps	300 cps	Arkosic sandstone remnants of Wind River formation.
107	Sec.22,T.35N.,R.89 W.	0.04 MR/hr.	2.0 MR/hr.	do.
108	Sec.5,T.34N.,R.89 W.	0.025 MR/hr.	0.06 MR/hr.	Arkosic sandstone of Wind River formation.
109	do.	0.05 MR/hr.	0.2 MR/hr.	Arkosic sandstone and mudstone of Wind River formation.
110	Sec.15,T.35N.,R.89 W. Sec.22,T.35N.,R.89 W.	0.03 MR/hr.	0.4 MR/hr.	Arkosic sandstone of Wind River formation.
111	Sec.23,T.35N.,R.89 W.	0.04 MR/hr.	0.1 MR/hr.	do.
112	do.	0.03 MR/hr.	0.15 MR/hr.	Sandy mudstone of Wind River formation.
113	Sec.35,T.35N.,R.89 W.	do.	do.	Conglomerate of Wind River formation.
114	Sec.32,T.35N.,R.89 W.	Could not be located by grpund reconnaissance.		
115	Sec.36,T.35N.,R.89 W.	0.025 MR/hr.	0.1 MR/hr.	Siltstone and shale of Wind River formation.
116	Sec.15,T.35N.,R.89 W.	do.	3.5 MR/hr.	Arkosic sandstone of Wind River formation.
117	Secs.15 & 22, T.35N.,R.89 W.	Could not be located by ground reconnaissance.		

ANOMALY NO.	LOCATION	RADIOACTIVITY BACKGROUND	MAXIMUM	ROCK TYPE
118	Sec.15,T.35N.,R.89 W.	100 cps	2200 cps	Arkosic sandstone remnants of Wind River formation.
119	Sec.22,T.35N.,R.89 W.	0.04 MR/hr.	3.5 MR/hr.	do.
120	Sec.23,T.35N.,R.89 W.	0.03 MR/hr.	0.15 MR/hr.	Mudstone of Wind River formation.
121	Sec.11,T.33N.,R.89 W.	0.015 MR/hr.	0.1 MR/hr.	Arkosic sandstone of Wind River formation.
122	Sec.14,T.33N.,R.89 W.	0.03 MR/hr.	0.1 MR/hr.	do.
123	Sec.23,T.33N.,R.89 W.	0.015 MR/hr.	0.037 MR/hr.	do.
124	Sec.14,T.33N.,R.89 W.	0.03 MR/hr.	0.1 MR/hr.	do.
125	Sec.11,T.33N.,R.89 W.	0.025 MR/hr.	0.9 MR/hr.	Shaly mudstone of Wind River formation.
126	do.	do.	0.2 MR/hr.	Peaty, sandy mudstone of Wind River formation.
127	Sec.10,T.33N.,R.89 W.	100 cps	700 cps	Sandstone and mudstone of Wind River formation.
128	do.	do.	270 cps	Muddy sandstone of Wind River formation.
129	Gridded and included in No. 131.			
130	Sec.10,T.33N.,R.89 W. Sec.15,T.33N.,R.89 W.	0.03 MR/hr.	0.1 MR/hr.	Muddy sandstone of Wind River formation.
131	Sec.15,T.33N.,R.89 W.	0.02 MR/hr.	0.4 MR/hr.	Shaly mudstone of Wind River formation.

ANOMALY NO.	LOCATION	RADIOACTIVITY BACKGROUND	RADIOACTIVITY MAXIMUM	ROCK TYPE
132	Sec.15,T.33N.,R.89 W.	Could not be located by ground reconnaissance.		
133	Sec.4,T.33N.,R.89 W.		do.	
134	Sec.5,T.33N.,R.89 W.	0.03 MR/hr.	0.4 MR/hr.	Shale and sandstone of Wind River formation.
135	Sec.33,T.34N.,R.89 W.	0.02 MR/hr.	0.5 MR/hr.	Contact of Wind River conglomerate and Cody shale.
136	Sec.25,T.34N.,R.89 W.	0.04 MR/hr.	0.3 MR/hr.	Arkosic sandstone of Wind River formation.
137	Sec.11,T.33N.,R.90 W.	60 cps	150 cps	do.
138	Sec.8,T.33N.,R.88 W.	0.01 MR/hr.	0.03 MR/hr.	Chugwater sandstone and siltstone, Nugget sandstone, Precambrian granite.
139	do.	do.	do.	do.
140	do.	do.	do.	do.
141	Sec.23,T.40N.,R.94 W.	0.03 MR/hr.	0.11 MR/hr.	Ordovician or Cambrian arkosic sandstone.
142	Sec.31,T.40N.,R.93 W.	0.012 MR/hr.	0.034 MR/hr.	Precambrian debris.
143	Sec.32,T.40N.,R.93 W.	Could not be located by ground reconnaissance.		
144	Sec.29,T.40N.,R.93 W.		do.	
145	Sec.6,T.39N.,R.93 W.		do.	
146	Sec.32,T.40N.,R.93 W.	0.018 MR/hr.	0.5 MR/hr.	Precambrian debris.

ANOMALY NO.	LOCATION	RADIOACTIVITY BACKGROUND	MAXIMUM	ROCK TYPE
147	Sec.33,T.40N.,R.93 W.	0.015 MR/hr.	0.03 MR/hr.	Tertiary muddy sandstone.
148	Sec.32,T.40N.,R.93 W.	0.01 MR/hr.	0.032 MR/hr.	do.
149	Sec.33,T.40N.,R.93 W.	0.018 MR/hr.	0.035 MR/hr.	Tertiary mudstone.
150	Sec.28,T.40N.,R.93 W.	0.015 MR/hr.	do.	Tertiary sandstone.
151	Sec.32,T.40N.,R.93 W.	0.008 MR/hr.	0.15 MR/hr.	Triassic or Jurassic silicified limestone.
152	Sec.5,T.39N.,R.93 W.	0.01 MR/hr.	0.022 MR/hr.	Triassic or Jurassic arkosic sandstone.
153	do.	0.014 MR/hr.	0.034 MR/hr.	Sandy mudstone of Wind River formation.
154	Sec.8,T.39N.,R.93 W.	Could not be located by ground reconnaissance.		
155	Sec.6,T.39N.,R.93 W.	do.		
156	Sec.1,T.39N.,R.94 W.	do.		
157	do.	do.		
158	Sec.20,T.35N.,R.89 W.	do.		
159	Sec.12,T.33N.,R.90 W.	0.02 MR/hr.	0.25 MR/hr.	Arkosic sandstone of Wind River formation; contact with underlying Mowry shale.
160	Sec.3,T.33N.,R.90 W.	0.015 MR/hr.	0.028 MR/hr.	Muddy sandstone of Wind River formation.
161	do.	do.	0.03 MR/hr.	Debris of Frontier and Wind River formations, Mowry siltstone and sandstone.

ANOMALY NO.	LOCATION	RADIOACTIVITY		ROCK TYPE
		BACKGROUND	MAXIMUM	
162	Sec.13,T.35N.,R.89 W.	0.025 MR/hr.	0.07 MR/hr.	Mudstone of unknown age.
163	Sec.11,T.35N.,R.89 W.	0.03 MR/hr.	1.5 MR/hr.	Arkosic sandstone remnants of Wind River formation.
164	Sec.13,T.35N.,R.89 W.	0.025 MR/hr.	0.1 MR/hr.	Arkosic sandstone of Wind River formation.
165	Sec.36,T.33N.,R.90 W.	0.02 MR/hr.	do.	Sandstone of Wind River formation.
166	Could not be located by ground reconnaissance.			
167	Sec.22,T.33N.,R.89 W.	0.05 MR/hr.	5+ MR/hr.	Arkosic sandstone and mudstone of Wind River formation.
168	Could not be located by ground reconnaissance.			
169	Sec.30,T.36N.,R.88 W.	Could not be located by ground reconnaissance.		
170	Sec.22,T.33N.,R.89 W.	0.04 MR/hr.	0.12 MR/hr.	Arkosic sandstone of Wind River formation.
171	Sec.29,T.35N.,R.88 W.	0.02 MR/hr.	0.035 MR/hr.	Shaly mudstone and sandstone of unknown age.
172	Sec.5,T.34N.,R.88 W.	0.025 MR/hr.	0.2 MR/hr.	Arkosic sandstone of Fort Union formation.
173	do.	do.	do.	do.
174	Sec.28,T.35N.,R.88 W. Sec.29,T.35N.,R.88 W.	0.02 MR/hr.	0.035 MR/hr.	Arkosic sandstone and carbonaceous mudstone of Wind River formation.
175	Sec.34,T,32N.,R.89 W.	0.03 MR/hr.	0.05 MR/hr.	Arkosic sandstone of unknown age.
176	Sec.33,T.33N.,R.89 W.	0.018 MR/hr.	0.07 MR/hr.	Tertiary siltstone.

ANOMALY NO.	LOCATION	RADIOACTIVITY BACKGROUND	MAXIMUM	ROCK TYPE
177	Sec.36,T.33N.,R.90 W.	0.035 MR/hr.	0.25 MR/hr.	Conglomerate of Wind River formation.
178	Sec.25,T.33N.,R.90 W.	0.04 MR/hr.	0.15 MR/hr.	Mudstone of Wind River formation.
179	Sec.4,T.32N.,R.90 W.	0.03 MR/hr.	0.25 MR/hr.	Arkosic sandstone of Wind River formation.
180	Sec.36,T.33N.,R.90 W.	0.05 MR/hr.	0.2 MR/hr.	do.
181	Sec.10,T.32N.,R.90 W.	do.	0.1 MR/hr.	Recent stream alluvium.
183	Sec.34,T.33N.,R.90 W.	do.	2.0 MR/hr.	Arkosic sandstone of Wind River formation.
184	Sec.9,T.32N.,R.90 W.	do.	0.1 MR/hr.	Sandy mudstone of Wind River formation.
185	Sec.5,T.32N.,R.90 W.	Could not be located by ground reconnaissance.		
186	Sec.7,T.32N.,R.90 W.	0.05 MR/hr.	0.25 MR/hr.	Sandstone of Wind River formation.
187	Sec.6,T.32N.,R.90 W.	0.04 MR/hr.	2.5 MR/hr.	Arkosic sandstone of Wind River formation.
188	do.	do.	2.0 MR/hr.	do.
189	do.	do.	2.5 MR/hr.	do.
190	Sec.7,T.32N.,R.90 W.	0.05 MR/hr.	1.0 MR/hr.	do.
191	Sec.6,T.32N.,R.90 W.	do.	do.	do.
192	Sec.7,T.32N.,R.90 W.	do.	0.2 MR/hr.	do.
193	Sec.13,T.32N.,R.91 W.	do.	0.8 MR/hr.	Sandy mudstone of Wind River formation.
194	Sec.13,T.39N.,R.94 W.	0.025 MR/hr.	0.045 MR/hr.	Tertiary mudstone and sandstone.
195	Sec.16,T.33N.,R.91 W.	0.02 MR/hr.	0.05 MR/hr.	Arkosic sandstone of Wind River formation.

ANOMALY NO.	LOCATION	RADIOACTIVITY BACKGROUND	RADIOACTIVITY MAXIMUM	ROCK TYPE
196	Sec.21,T.33N.,R.91 W.	0.025 MR/hr.	0.045 MR/hr.	Muddy sandstone of Wind River formation.
197	do.	0.02 MR/hr.	0.07 MR/hr.	Arkosic sandstone of Wind River formation.
198	Sec.36,T.37N.,R.88 W.	do.	0.15 MR/hr.	do.
199	Sec.10,T.38N.,R.94 W.	0.025 MR/hr.	0.1 MR/hr.	Shaly lignite and mudstone of Wind River formation (?).
200	Sec.23,T.37N.,R.88 W.	0.015 MR/hr.	0.35 MR/hr.	Mudstone of Wind River formation (?).
201	Sec.18,T.33N.,R.91 W.	0.013 MR/hr.	0.032 MR/hr.	Shaly mudstone of Wind River formation.
202	Sec.8,T.38N.,R.93 W.	0.025 MR/hr.	0.45 MR/hr.	Peaty mudstone of Wind River formation (?).
203	Sec.27,T.37N.,R.88 W.	Could not be located by ground reconnaissance.		
204	Sec.9,T.34N.,R.89 W.	do.		

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WYOMING, 1954
PLATE I