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SEARCH FOR AND APPRAISAL OF RADIOACTIVE DEPOSITS

TRACE ELEMENTS MONTHLY REPORT

Prepared for U.S. Atomic Energy Commission

Monthly Report

April 1956

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HIGHLIGHTS OF THE TRACE ELEMENTS PROGRAM

APRIL, 1956

Uranium in sandstone-type deposits

Colorado Plateau district
by H. Kirkemo

Drilling on the Monogram Mesa No. 3 contract was terminated in April 1956 (fig. 1). This completes the Survey's Colorado Plateau exploration drilling program which was started in November 1947.

A special investigative drilling project requiring about 15 holes totaling 1,200 to 1,800 feet of diamond drilling is planned to start in late May or early June on Government-owned claims in the Slick Rock district, San Miguel County, Colorado. The purpose of this drilling is to obtain samples of unmineralized host rock at varying horizontal and vertical distances from a known ore body for studies by the Distribution of elements project.

Bull Canyon district, Montrose and San Miguel Counties, Colorado

The third and final Monogram Mesa drilling contract was terminated April 24, 1956, after 5,788 feet had been drilled during the month and 20,373 feet had been drilled on the contract. Seven holes were completed in the Dry Creek Basin area during the month (fig. 2).

Results of the drilling in Dry Creek Basin indicate that: (1) lithologic units in the Salt Wash member of the Morrison formation exposed on the northeast flank of Gypsum Valley are difficult to correlate with the strata cut by the drill holes 3,500 to 5,000 feet northeast of the outcrop; (2) there is an abrupt thickening of the Morrison formation

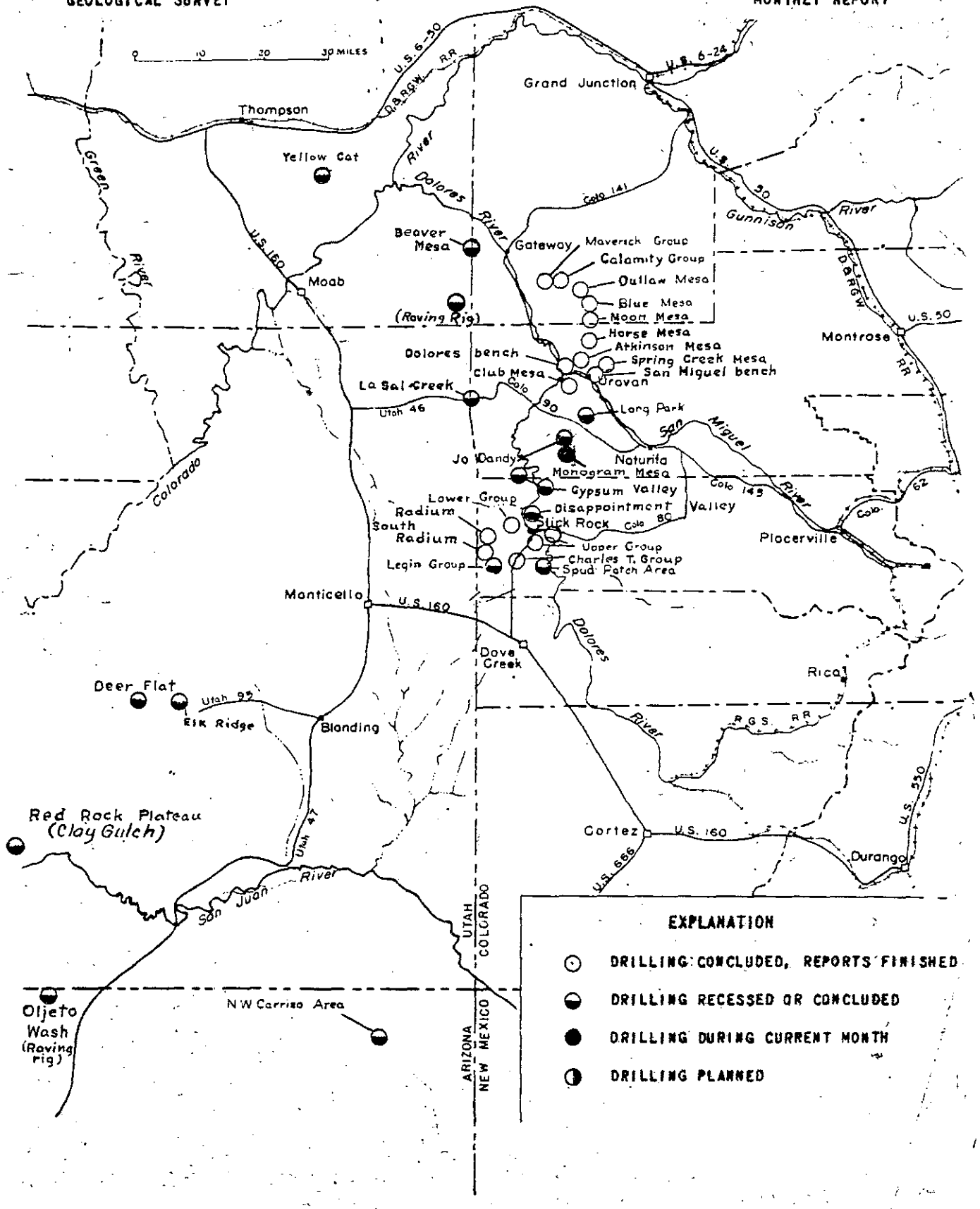

Figure 1. MAP OF PART OF THE COLORADO PLATEAU, SHOWING THE AREAS OF DRILLING

APRIL 1956

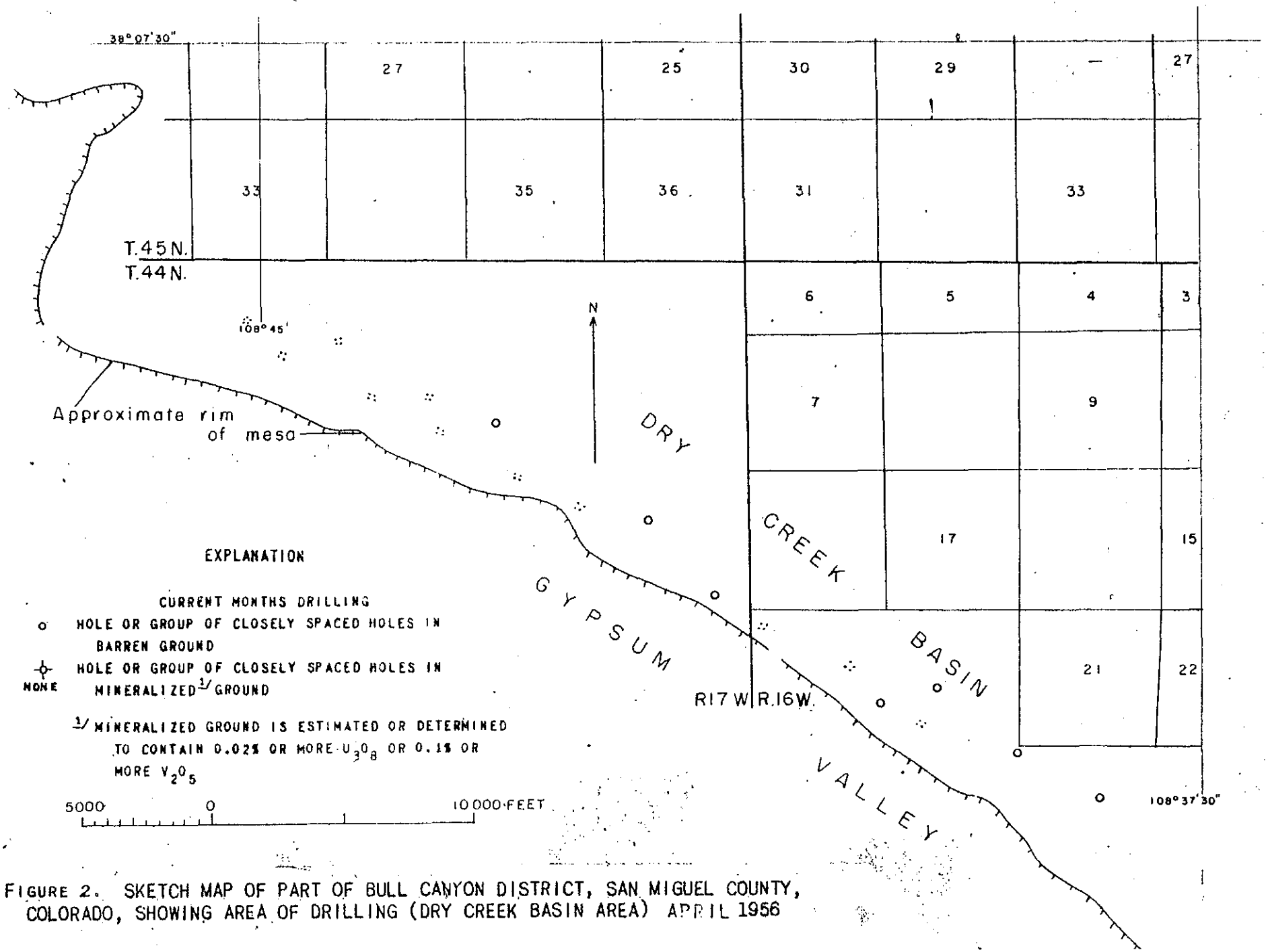

FIGURE 2. SKETCH MAP OF PART OF BULL CANYON DISTRICT, SAN MIGUEL COUNTY, COLORADO, SHOWING AREA OF DRILLING (DRY CREEK BASIN AREA) APRIL 1956

down-dip from the Gypsum Valley rim; (3) it is difficult to correlate lithologic units cut in adjacent holes drilled in a line parallel to the Gypsum Valley rim; and (4) southeastward from Hamm Canyon there is an increase in the calcite content of the Morrison formation, an increase in number of green mudstone units in the Salt Wash member, and an increase in the degree of alteration of the constituent minerals of the Salt Wash sandstone units. These alteration effects may be due to unusual ground water conditions, to activity related to igneous rocks exposed 8 to 10 miles to the south, or to a combination of these factors.

Slick Rock district, Colorado

Invitations to bid have been prepared for a contract requiring about 15 diamond drill holes totaling 1,200 to 1,800 feet at the Frenchie Incline ore body on Government-owned claims in the Legin area, Slick Rock district, Colorado. It is hoped that drilling can begin on this project in late May or early June. Twelve vertical holes drilled from the surface and three horizontal holes drilled from underground mine workings are planned. Funds for the project are available from surplus remaining from the recently-terminated Monogram Mesa No. 3 contract.

This drilling is planned to provide samples for the Distribution of elements project. Trace element studies of the Frenchie Incline ore body are a major part of this program. The drilling planned is for the purpose of obtaining core samples of unmineralized host rock at varying horizontal and vertical distances away from the ore. The samples will be analyzed to detect trace element anomalies, or trace elements whose presence may be related to the ore. The primary purpose of the study is to determine whether the anomalies are sufficiently large and pronounced to be used as guides to ore.

Uranium in Phosphates

Southeast phosphate

Exploration, by W. L. Emerick

During April no company prospect drill holes were logged with the gamma-ray unit. Six water wells penetrating phosphate-bearing formations were logged in Polk County for a total footage of 1,529 feet. The cumulative totals for the gamma-ray unit are 3,690 holes totaling 141,239 feet.

Geologic studies, by G. H. Espenshade

Four core drill holes having a total depth of 700 feet were completed during April; each hole cut the Hawthorn formation. Lean phosphate was found in sandy clay and sandy dolomite; some zones showed minor radioactive anomalies. Rather strong anomalies were found in two drill holes at the top of the phosphorite; these anomalies are probably in leached zone material.

Four to six more drill holes will be drilled in the Hawthorn belt farther north.

Correlation of airborne radioactivity data and areal geology

by W. J. Dempsey

Texas Coastal Plain

Six days were spent in Texas in a planning conference on the Texas Coastal Plain project and a cursory investigation of the correlation between radioactivity data and areal geology in the area flown last year.

It was decided at the conference that Tolozko will correlate airborne data and the detailed geology of the ore deposits, working with the Mineral Deposits Branch representative. Guillou is to work with Eargle of Fuels Branch and will be concerned with the relation between airborne radioactivity data and regional geology and stratigraphy. Preliminary interpretation of the airborne data is to be completed before the start of field work on the ground, about the middle of September.

Two days were spent in checking the correlations obtained in 1955 (Area A). The limited amount of time available, the paucity of outcrops, lack of knowledge of the detailed geology, and the relatively low-sensitivity hand counter used, precluded more than a brief study. Geologic expression for the cross-formational high which is so conspicuous on the isorad map was not found. A pronounced high near the top of the Wilcox Group in most of the area was found to coincide with a zone of red sandy soil. If the red color is due to weathered glauconite, as it is in some other formations in the area, a marine

origin is indicated for the more radioactive portion of the Wilcox Group. A tracing of a preliminary geologic map of Wilson County was obtained from Ground Water geologists in Austin and an encouraging correlation was apparent between this map and the map with formations sketched on the basis of radioactivity.

The plane began work in Texas on April 12 and has completed 2,200 traverse miles or approximately one-fourth of the planned flying. Higher background is apparently associated mostly with the Reklaw and Queen City formations. The magnetic record has shown no anomalies, a regional gradient only being observed.

East Pine Ridge Escarpment area,
Niobrara County, Wyoming

The correlation between airborne radioactivity data and areal geology in the East Pine Ridge Escarpment area was studied in April. Most of the correlation is being based on rectified and nested uncompensated profiles but compensated tapes and altimeter tapes are being studied to determine the effect of terrain. Some formational differences have been detected.

Marquette and Dickinson Counties, Michigan

Topographic map coverage for part of the area has been received and coverage for the rest of the area and ozalid copies of the nested profiles have been ordered. Profiles are being scanned for radioactive units and features that carry through for a mile or more. Topographic maps will be used to determine swampy and drift-covered areas.

Reconnaissance for uranium in Alaska
by J. J. Matzko

At the College, Alaska, Radioactivity Testing Laboratory preparations were made for the summer session and except for one defective scaler the laboratory is prepared for the usual summer rush of prospector inquiries and samples for radiometric assaying. Of significance during the past month were three samples from Mr. A. C. Wolk of Skagway, Alaska. The samples, from claims within or very near the city limits of Skagway, were tested and gave results of 0.77, 0.22 and 0.21 percent eU. Nearly 50 claims are reported to have been staked in the area.

At Menlo Park, California, work continues on the completion of reports and preparation for the coming field season. "Reconnaissance for radioactive deposits in selected areas of southeastern Alaska, 1952" by Houston, Bates, Velikanje and Wedow (TEI-293) has been submitted for bulletin release. "Summary of reconnaissance for radioactive deposits in Alaska by the Geological Survey during the period 1945 to 1954", by Wedow has been submitted on mats for release as TEI-577.

Laboratory research
by H. H. Waesche

As a part of studies on the occurrence of uranium in veins and igneous rocks, essentially all samples scheduled under leaching techniques have been analyzed. This includes 442 samples covering a broad variety of rock types ranging from meteorites to extreme alkalic rocks. Evaluation of these data, coupled with testing of analytical reproducibility was started.

Two gamma-ray spectrometers are now in operation on equilibrium studies. Preliminary measurements suggest that Th^{230} movements may be the cause of a large proportion of the disequilibrium in samples from the Wind River Basin, Wyoming.

Preliminary experiments indicate that phosphate can be effectively removed from a solution of rock phosphate by precipitation with zirconium. Excess zirconium is then removed as the hydroxide. Versene titrations of calcium after the phosphate removal give quantitative recoveries. Magnesium recovery after phosphate removal is now being investigated. Tests show that 5 mg of CaO may be determined in the presence of 100 mg of aluminum and 3.5 mg of MgO may be determined in the presence of 20 mg of aluminum without incurring an error of more than 1.0 percent. Interferences from phosphate and iron were reported previously.

Carbon and hydrogen analyses for approximately 23 samples of coalified wood were completed. If the uranium content (0.001 to 7.7 percent) is plotted on a log scale against its hydrogen content (3.3 to 7.5 percent) on a linear scale, a linear inverse relationship for all the samples containing more than 0.04 percent U is apparent. From samples containing 0.001 to 0.04 percent U no such correlation can be detected, presumably because changes in hydrogen content for such small quantities of uranium cannot be determined analytically.

Collation of data on a standard coal analysis chart for numerous samples of coalified wood, pellets, and isolates from impregnated sandstones has led to a number of observations, the most important of which are listed.

(1) The broad scatter of points shows the diagenetic changes that occur when wood undergoes abnormal coalification. Wood on the Plateau was not coalified under "normal" conditions; the effect of such preservation, when compared to true coalification, had been noted by Schopf in his detailed examination of nine of these samples.

(2) Carbonaceous pellets, organic impregnations, and coalified wood samples cannot be distinguished from one another on the coal curve. The pellets and impregnations were previously reported to be derived from coalified wood.

(3) The coalified wood samples were randomly chosen and represent many parts of the Plateau. There are no apparent groupings of analyses and the evidence indirectly points to a lack of correlation between botanical species and uranium content.

(4) Several specimens of the coalified wood show no cellular structure. Loss of structure is not related to uranium mineralization.

(5) Rank of coalified wood is lignite or subbituminous; in no instance does coalified wood or pelletal material contain more than 84 percent C thus reflecting an absence of a dynamochemical phase of coalification.

(6) The only carbonaceous material from the Plateau thus far examined that contains more than 84 percent C is an organic isolate from impregnated sandstone from the Black King mine, Placerville, Colorado. This material contains 90.6 percent C and is thought to represent a coal extract that has been dynamochemically altered to higher-rank coal (bituminous) as a result of shear action in the fault

zone in which it occurs.

(7) No correlation has been detected to date between uranium and any of the trace or constituent elements of the coal with the exception of hydrogen.

In studies on distribution of uranium in igneous rocks, alpha activity measurements on 20 zircon separates from a wide range of rock types indicates that zircon from the more siliceous rocks are generally higher in activity than those of the more mafic rocks.

Analytical work on the last Blind River sample in a preliminary group was completed. Maximum ages of approximately 400 million years from the Pb^{206}/U^{238} and Pb^{208}/Th^{232} ratios were obtained.

Table 1.--ANALYTICAL WORK COMPLETED AND SAMPLE INVENTORY, April 1956

Source of Samples	Analytical Data: Chemical determinations U	Chemical determinations Others	Radioactivity determinations	Spectrographic determinations	X-ray determinations	Mineralogic dets.	Thin and pol. sec.	Number of Samples: On Hand 3/20	Rec'd in April	Comp. in April	On Hand 4/20/56
Washington Laboratory											
AEC	18	6	22	2	10	15	---	45	9	42	12
Sandstone-Colo. Plat.	7	56	7	---	---	---	---	514	53	7	560
Sandstone-Other than Plateau	---	---	---	---	3	---	105	189	---	49	140
Veins, Igneous Rocks	---	---	---	---	6	---	1	22	---	4	18
Carbonaceous Rocks	222	134	215	74	1	2	26	712	156	192	676
Southeast Phosphates	8	---	4	6	---	---	---	24	---	10	14
Northwest Phosphates	---	---	---	---	---	---	---	180	---	---	180
Alaskan	---	13	---	---	---	---	---	18	15	13	20
Public Samples	14	---	19	4	7	183	---	73	178	183	68
Mineralogical Projects	320	71	---	24	60	---	39	383	184	219	348
Geochemistry of U	41	126	1	8	22	---	27	517	205	190	532
Miscellaneous	6	468	5	25	5	8	---	193	22	78	137
Total	636	874	273	143	114	208	198	2,870	822	987	2,705
Denver Laboratory											
AEC	175	108	326	70	30	---	1	576	435	158	853
Plants and Soils	19	---	5	---	---	---	---	272	19	179	112
Sandstones-Colo. Plat.	203	140	12	28	1	---	131	2,186	127	439	1,874
Sandstones-Other than Plateau	44	95	17	27	26	1	69	736	58	229	565
Veins, Igneous Rocks	13	76	45	4	---	---	43	237	156	61	332
Carbonaceous Rocks	76	147	26	21	6	---	---	236	50	62	224
Phosphates	---	---	---	---	---	---	---	19	---	---	19
Waters	3	7	---	---	---	---	---	63	2	---	65
Public Samples	3	4	10	---	---	2	---	49	13	21	41
Geochemistry of U	1	---	---	---	---	---	---	22	15	---	37
Miscellaneous	13	239	142	9	6	5	107	1,073	128	265	936
Total	550	816	583	159	69	8	351	5,469	1,003	1,414	5,058
Grand Total	1,186	1,690	856	302	183	216	549	8,339	1,825	2,401	7,763

REPORTS ISSUED AND PROCESSED FOR PUBLICATION

by Donna Bowman and Dora Conklin

TEI Reports issued

320--"Occurrence and chemical character of ground water in the Morrison formation in southwestern Colorado and southeastern Utah," by D. A. Phoenix, 23 p., 1 table, April 13, 1956. (Unclassified).

426--"Distribution of uranium in the Bisbee district, Cochise County, Arizona," by S. R. Wallace, 33 p., 2 figs., April 13, 1956. (Official use only; company confidential).

427--"Preliminary study of radioactive limonite localities in Colorado, Utah, and Wyoming," by T. G. Lovering and E. P. Beroni, 61 p., April 27, 1956. (Unclassified).

432--"Geology and ore deposits of the Chicago Creek area, Clear Creek County, Colorado," by J. E. Harrison and J. D. Wells, 6 p., April 11, 1956. (Official use only).

433--"Paragenesis and structure of pitchblende-bearing veins, Central City district, Gilpin County, Colorado," by P. K. Sims, 32 p., April 18, 1956. (Unclassified).

446--"Elemental composition of Colorado Plateau sandstone-type uranium deposits," by E. M. Shoemaker, A. T. Miesch, W. L. Newman, and L. B. Riley, 65 p., April 30, 1956. (Unclassified).

574--"Some uranium occurrences in west Texas," by D. Hoye Eargle, 32 p., April 27, 1956. (Unclassified).

579--"Rapid-scanning microphotometry," by A. W. Helz, 12 p., April 9, 1956. (Unclassified).

582--"Duttonite, a new quadrivalent vanadium oxide from the Peanut mine, Montrose County, Colorado," by M. E. Thompson, C. H. Roach, and Robert Meyrowitz, 13 p., April 9, 1956. (Unclassified).

583--"Summary of the mineralogy of the Colorado Plateau uranium ores," by A. D. Weeks, R. G. Coleman, and M. E. Thompson, 50 p., April 2, 1956. (Unclassified).

585--Rare earths and thorium at Morro do Ferro, Poços de Caldas Plateau, Brazil," by Helmuth Wedow, 37 p., April 16, 1956. (Official use only).

TEM Reports issued

646--"Some structural relations at the Monument No. 2 mine, Apache County, Arizona," by T. L. Finnell, 25 p., April 11, 1956. (Unclassified).

933--"Photogeologic map, White Canyon-4 quadrangle, Garfield and San Juan Counties, Utah," by P. P. Orkild, 2 p., 1 fig., April 30, 1956. (Unclassified).

946--"Tectonic map of western North Dakota, showing the distribution of uranium deposits," by F. W. Osterwald, 12 p., 2 figs., April 3, 1956. (Official use only).

956--"Photogeologic map, Lees Ferry SE quadrangle, Coconino County, Arizona," by Kathleen McQueen, 2 p., 1 fig., April 30, 1956. (Unclassified).

957--"Photogeologic map, Paria Plateau SW quadrangle, Coconino County, Arizona," by J. P. Minard, 2 p., 1 fig., April 30, 1956. (Unclassified).

963--"Photogeologic map, Paria Plateau NW quadrangle, Coconino County, Arizona," by J. P. Minard, 2 p., 1 fig., April 25, 1956. (Unclassified).

TEI Reports in process in TEPCO, May 1, 1956
(titles subject to change)

177--"Uranium content of Sharon Springs member of Pierre shale, Chadron area, Nebraska and South Dakota," by R. J. Dunham and T. M. Kehn.

193--"The half-life of Th^{232} and the branching ratio of Bi^{212}," by F. E. Senftle, T. A. Farley, and N. Lazar.

227--"Geology and uranium ocurrences in the Miller Hill area, Carbon County, Wyoming," by J. D. Vine and G. E. Prichard.

240--"Uranium deposit at the North Point claim, White Canyon area, San Juan County, Utah," by A. F. Trites, Jr.

302--"Geology of the Lost Creek schroeckingerite deposits, Sweetwater County, Wyoming," by D. M. Sheridan, C. H. Maxwell, and J. T. Collier.

306--"Reconnaissance for radioactivity in the metal-mining districts of the San Juan Mountains, Colorado," by C. T. Pierson, W. F. Weeks, and F. J. Kleinhampl.

TEI Reports in process in TEPCO, May 1, 1956--Continued

392--"Search for radioactive intrusive rocks in New Jersey, New York, and New England," by R. R. Coats.

395--"Geology of uranium deposits in Triassic rocks of the Colorado Plateau," by W. I. Finch.

397--"Stratigraphy of Triassic and associated formations in part of the Colorado Plateau region--an interim report," by G. A. Williams, J. H. Stewart, H. F. Albee, and O. B. Raup, with a section on Sedimentary Petrology by R. A. Cadigan.

423--Geology and uranium deposits of part of the Browns Park formation, Colorado, Wyoming, and Utah--a preliminary report," by P. K. Theobald, Jr., and R. T. Chew, III.

447--"Redefinition of Upper Triassic rocks, and stratigraphy of new Moss Back member of Chinle formation in southwestern Utah," by J. H. Stewart, G. A. Williams, H. F. Albee, and O. B. Raup.

477--"Uranium-bearing coal in the central part of the Great Divide Basin, Sweetwater County, Wyoming," by G. N. Pipiringos.

480--"Evolution of hypotheses concerning the origin of uranium deposits in sandstone in the United States," by R. E. Melin.

481--"Exploring for ancient channels with the refraction seismograph," by L. C. Pakiser and R. A. Black.

482--"Radium-uranium equlibrium and radium-uranium ages of some Colorado Plateau secondary minerals," by T. W. Stern and L. R. Stieff.

483--"A study of precision of uranium analyses of samples of the Phosphoria formation," by E. R. Cressman and L. D. Carswell.

484--"Quantitative radiochemical methods for the determination of the sources of natural radioactivity, Part II," by J. N. Rosholt, Jr.

521--"Preliminary report on geology and uranium occurrences of Upper Alamosa Creek Valley, Catron County, New Mexico," by G. O. Bachman, E. H. Baltz, Jr., and R. L. Griggs.

529--"Notes of the geology of uranium," by M. R. Klepper and D. G. Wyant with contributions by D. C. Duncan, Walter Danilchik, M. H. Staatz, Harley Barnes, and V. E. McKelvey.

533--"Selected annotated bibliography of the geology of uranium-bearing coal and carbonaceous shale in the United States," by T. M. Kehn.

TEI Reports in process in TEPCO, May 1, 1956--Continued

546--"Geology and uranium resources of the San Rafael district, Emery County, Utah," by H. S. Johnson, Jr.

563--"Chattanooga shale in the folded belt of Alabama, Georgia, and Tennessee," by Lynn Glover.

576--"Results of geologic drilling, 1953, land-pebble phosphate district, Florida," by J. B. Cathcart and L. J. McGreevy.

577--"Summary of reconnaissance for radioactive deposits in Alaska, 1945-1954, an appraisal of Alaskan uranium possibilities," by Helmuth Wedow, Jr.

578--"Machine for preparing phosphors for the fluorimetric determination of uranium," by R. E. Stevens, W. H. Wood, K. G. Goetz, and C. A. Horr.

580--"Bibliography and index of literature on uranium and thorium and radioactive occurrences in the United States - Part 5: Northeastern section," by Margaret Cooper.

581--"Uranium in carbonaceous rocks in the Townsend and Helena Valleys, Montana," by G. E. Becraft.

586--"Oxidation potential and state of some vanadium ores and the relation of woody material to their deposition," by A. M. Pommer.

587--"Uranium in the Sharon Springs member of the Pierre shale in South Dakota and northeastern Nebraska," by R. C. Kepferle.

594--"Directional resistivity measurements in exploration for uranium deposits on the Colorado Plateau," by G. V. Keller.

595--"On the air-scattering of gamma rays from thick uranium sources," by A. Y. Sakakura.

TEM Reports in process in TEPCO, May 1, 1956
(titles subject to change)

329--"Radiometric investigations along the Taylor Highway and part of the Tanana River, Alaska," by M. G. White, A. E. Nelson, and J. J. Matzko.

357--"Radiometric traverse along the Yukon River from Fort Yukon to Ruby, Alaska," by M. G. White, J. M. Stevens, and J. J. Matzko.

TEM Reports in process in TEPCO, May 1, 1956--Continued

741--"An occurrence of metatorbernite, Baraga County, Michigan," by R. C. Vickers.

785--"A comparison among caliper log, gamma-ray log and other diamond-drill hole data," by C. M. Bunker, U. S. Geological Survey and H. C. Hamontre, U. S. Bureau of Mines.

800--"Temple Mountain member--a new member of the Chinle formation in the San Rafael Swell, Utah," by R. C. Robeck.

832--"Comparison of the pebbles of the Shinarump and Moss Back members of the Chinle formation," by H. F. Albee.

880--"Seismic investigations on Holiday Mesa, Monument Valley area, San Juan County, Utah," by R. M. Hazelwood.

930--"Eastern and central Montana as a possible source area of uranium," by F. C. Armstrong.

931--"Photogeologic map, White Canyon-3 quadrangle, Garfield and San Juan Counties, Utah," by P. P. Orkild.

939--"Photogeologic map, Tanner Wash NW quadrangle, Coconino County, Arizona," by J. P. Minard.

940--"Photogeologic map, Navajo Mountain-1 quadrangle, San Juan County, Utah," by A. B. Olson.

941--"Geologic features of areas of abnormal radioactivity south of Ocala, Marion County, Florida," by G. H. Espenshade.

943--"Preliminary report on the thorium - rare earth - niobium veins in the Laughlin Peak area, Chico Hills, Colfax County, New Mexico," by C. M. Tschanz.

947--"Tectonic map of eastern Montana showing the distribution of uranium deposits," by F. W. Osterwald.

948--"Tectonic map of western South Dakota showing the distribution of uranium deposits," by F. W. Osterwald and B. G. Dean.

952--"An indicated uranium deposit, Cobra claim, Cerrillos mining district, Santa Fe County, New Mexico," by C. M. Tschanz.

953--"Simplified geologic map showing the distribution of uranium deposits and the principal ore-bearing formations of the North Central Cordilleran Foreland region, with a geologic discussion of the uranium deposits," by T. L. Finnell and I. S. Parrish.

TEM Reports in process in TEPCO, May 1, 1956--Continued

954--"Photogeologic map, Lees Ferry NW quadrangle, Coconino County, Arizona," by Kathleen McQueen.

955--"Photogeologic map, Emmett Wash NW quadrangle, Coconino County, Arizona," by J. P. Minard.

959--"Photogeologic map, Jacob Lake NE quadrangle, Coconino County, Arizona," by C. H. Marshall.

964--"Photogeologic map, Paria Plateau NE quadrangle, Coconino County, Arizona," by Kathleen McQueen.

965--"Photogeologic map, House Rock Spring SE quadrangle, Coconino County, Arizona," by Kathleen McQueen.

968--"Photogeologic map, House Rock Spring NE quadrangle, Coconino County, Arizona," by J. P. Minard.

980--"Application of punched cards to geologic data concerning uranium deposits in sandstone," by W. I. Finch.

Trace Elements Reports published by the Survey

I 152 "Photogeologic map of the Elk Ridge-5 quadrangle, San Juan County, Utah," by V. H. Sable. (TEM-894)

I 153 "Photogeologic map of the Short Creek SE quadrangle, Mohave County, Arizona," by C. H. Marshall. (TEM-908)

I 154 "Photogeologic map of the Desert Lake-13 quadrangle, Emery County, Utah," by C. H. Marshall. (TEM-766)

I 157 "Photogeologic map of the Mt. Peale-9 quadrangle, San Juan County, Utah, and Montrose and San Miguel Counties, Colorado," by R. J. Hackman. (TEM-450-A)

I 158 "Photogeologic map of the Mt. Peale-10 quadrangle, San Juan County, Utah," by R. J. Hackman. (TEM-451-A)

I 159 "Photogeologic map of the Mt. Peale-11 quadrangle, San Juan County, Utah," by R. J. Hackman and G. E. Tolbert. (TEM-380-B)

I 160 "Photogeologic map of the Fredonia SW quadrangle, Mohave County, Arizona," by C. H. Marshall. (TEM-912)

Trace Elements Reports published by the Survey--Continued

I 161 "Photogeologic map of the Virgin NE quadrangle, Washington County, Utah," by C. H. Marshall. (TEM-907)

I 162 "Photogeologic map of the Tidwell-2 quadrangle, Emery and Grand Counties, Utah," by V. H. Sable. (TEM-842)

I 163 "Photogeologic map of the White Canyon-7 quadrangle, San Juan County, Utah," by P. P. Orkild. (TEM-910)

I 164 "Photogeologic map of the Johnson SW quadrangle, Kane County, Utah," by J. S. Detterman. (TEM-905)

Circular 375 "Stratigraphic sections of the Phosphoria formation, 1953," by R. W. Swanson, L. D. Carswell, R. P. Sheldon, and T. M. Cheney. (TEM-570)

Trace Elements Reports published outside the Survey

Stern, T. W., Stieff, L. R., Girhard, M. N., and Meyrowitz, Robert, The occurrence and properties of metatyuyamunite $Ca(UO_2)_2(VO_4)_2 \cdot 3\text{-}5H_2O$: Am. Mineralogist, v. 41, nos. 3 and 4, p. 187-201, 1956. (TEI-457)

Walker, G. W., Lovering, T. G., and Stephens, H. G., Radioactive deposits in California: Calif. Div. of Mines Spec. Report 49, Jan. 1956, 38 p. (TEI-229)

Table 2.--Status of Trace Elements Investigations, April 1956

Investigation	Status of 1/ investigation
I. INVESTIGATIONS IN PROGRESS DURING FISCAL YEAR 1956 BUT NOT COMPLETED	
Uranium in sandstone-type deposits	
Colorado Plateau	
Drilling	A
Gamma-ray logging	A
Geologic mapping	
Elk Ridge, Utah	B 6/1/56
San Rafael Swell, Utah	A
Lisbon Valley, Utah-Colo.	A
Inter-river area, Utah	B 5/28/56
Circle Cliffs, Utah	A
Abajo Mountains, Utah	A
Sage Plain, Utah	B 6/1/56
Western San Juan Mountains, Colo.	A
Ute Mountains, Colo.	B 5/14/56
Orange Cliffs, Utah	B 5/7/56
East Vermillion Cliffs, Ariz.-Utah	B 5/14/56
Grants district, N. Mex.	A
Hopi Buttes, Ariz.	B 3/1/56
Laguna district, N. Mex.	A
Uravan, Colo.	A
Bull Canyon, Colo.	A
Slick Rock, Colo.	A
Beaver Mesa, Utah-Colo.	A
La Sal Creek, Utah	A
Deer Flat, Utah	C
Photogeologic mapping	A
Stratigraphic studies	
Sedimentary petrology laboratory	A
Triassic studies	B 6/1/56
Entrada study	A
Comprehensive study	A
Ground-water studies	C
Botanical studies	
Research	B
Prospecting	C
Mineralogic studies	
Ore mineralogy	A
Clay mineralogy	A
General studies	A
Distribution of elements study	A

Table 2.—Continued

Investigation	Status of 1/ investigation
Regional synthesis	
Northwest New Mexico	A
Northeastern Utah-western Colorado	A
Southern Utah-northern Arizona	B 6/1/56
Geophysical investigations	
District studies	A
Regional studies	A
Original-state core studies	A
Powder River Basin, Wyo.-Mont.	
Southern Powder River Basin, Wyo.	A
Black Hills Uplift, Wyo.-S. Dak.	
Devils Tower, Wyo.	A
Carlile quadrangle, Wyo.	A
Storm Hill quadrangle, Wyo.	A
Southern Black Hills, S. Dak.	A
Wind River Basin, Wyo.	
Gas Hills area	A
Hiland area	A
Washakie Basin, Wyo.-Colo.	
Poison Basin-Maybell-Lay areas	A
Great Divide Basin, Wyo.	
Crooks Gap area	A
New Mexico	
Tucumcari-Sabinoso areas	A
Appalachian region	
Mauch Chunk, Pa.	A
Uranium in veins, igneous rocks and related deposits	
Colorado Front Range	A
Ralston Buttes quadrangle, Colo.	A
Southern Stevens County, Wash.	A
Thomas Range, Utah	A
Jarbidge quadrangle, Nev.	B
Kern River Canyon, Calif.	A
Uranium in carbonaceous rocks	
Lignite investigations	
Harding and Perkins Counties, S. Dak.	A
Regional synthesis, Mont. and Dakotas	A
Carbonaceous rock investigations	
Devonian and lower Mississippian shales	A
Pennsylvanian shales, Midcontinent	A
Black shale and limestone, Texas	A
Appalachian Basin shales	A

Table 2.—Continued

Investigation	Status of 1/ investigation
Geochemistry of uranium-bearing materials	A
Uranium in asphaltite and petroleum	A
Uranium in phosphates	
Northwest phosphate	A
Southeast phosphate	A
Uranium in natural waters	A
Uranium in placer deposits	A
Correlation of airborne radioactivity data and regional geology	A
Reconnaissance for uranium in Alaska	B 5/1/56
Analytical service and research on methods	
Radioactivity	A
Spectrography	A
Chemistry	A
Geochemical and petrologic research on basin principles	
Radon and helium studies*	A
Distribution of uranium in igneous complexes*	A
Weathering, transportation and redeposition of uranium*	A
Mineral synthesis*	A
Isotope geology and nuclear research	A
Geochemistry of uranium-bearing carbonaceous rocks*	A
Mineralogic and petrographic service and research on basic principles	
Properties of uranium-bearing minerals	A
Crystallography of uranium and associated minerals	A
Research on techniques for mineral separation	A

Table 2.—Continued

Investigation	Status of 1/ investigation
Geophysical services and research on methods and principles	
Maintenance and development of radiation equipment	A
Physical behavior of radon*	A
Gamma-ray absorption and scattering*	A
Resource and research studies	A
Uranium in Brazil	A
II. INVESTIGATIONS COMPLETED PRIOR TO FISCAL YEAR 1956, FINAL REPORTS PENDING	
Uranium in sandstone-type deposits	
Colorado Plateau	
Carrizo Mountains, Ariz.	C
Monument Valley, Ariz.	C
Monument Valley, Utah	C
Capitol Reef, Utah	C
White Canyon, Utah	C
Morrison stratigraphic studies	C
Ore distribution studies	C
Investigations of beryllium-bearing rocks	
Keystone district, S. Dak.	C
Beryllium in non-pegmatite rocks	C
Uranium in veins, igneous rocks and related deposits	
Copper King mine, Larimer County, Colo.	C
Garo, Colo.	C
Lost Creek, Wyo.	C
Placerville, Colo.	C
Relation of uranium to post-Cretaceous vulcanism*	C
Uranium in carbonaceous rocks	
Miller Hill, Wyo.	C
Red Desert, Wyo.	C

Table 2.--Continued

Investigation	Status of 1/ investigation
Reconnaissance for uranium in Alaska	
Summary of reconnaissance, 1945-1953	C
Reconnaissance, 1953	C
Uraniferous phosphate in the Brooks Range	C

* Supported by Division of Research, AEC.

1/ A. Field or laboratory work in progress.
B. Field or laboratory work recessed, probable date to be resumed given.
C. Field or laboratory work completed, report in preparation.
D. Investigation complete, final report transmitted during current fiscal year.

Summary of exploration, Colorado Plateau District, April 1956

Project or activity	Drilling, radiometric scanning, and sampling						Indicated and inferred reserves found by drilling (short tons)			Remarks
	Holes			Feet or samples (s)						
	Previous total	This month	Total	Previous total	This month	Total	Previous total	This month	Total	
Exploration										
Drilling concluded, reports finished, combined totals revised to April 30, 1956	6,000	106	6,106	1,226,400	18,036	1,244,436	1,102,345	15,300	1,117,645	
Drilling recessed or concluded:										
Carrizo Mtns, Apache Co., Ariz.	24	0	24	3,032	0	3,032	100	0	100	
Slick Rock dist., San Miguel Co., Colorado:										
Legin area	450	0	450	70,935	0	70,935	57,300	0	57,300	
Spud Patch area	436	0	436	78,591	0	78,591	20,500	0	20,500	
Disappointment Valley area	127	0	127	99,304	0	99,304	7,240	(- 540)	6,700	(TEM 881)
Gypsum Valley dist, San Miguel County, Colo.	485	0	485	76,140	0	76,140	36,885	515	37,400	(TEM 830)
Beaver Mesa area, Mesa Co., Colo.	212	0	212	101,202	0	101,202	18,000	17,000	35,000	(TEI 449)
La Sal Creek area, San Juan Co., Utah	505	0	505	123,371	0	123,371	103,270	11,970	115,240	(TEM 716)
Yellow Cat area, Grand Co., Utah	1,721	0	1,721	220,479	0	220,479	56,000	850	56,850	(TEI 448)
Long Park area, Montrose and San Miguel Counties, Colorado	1,402	0	1,402	489,566	0	489,566	220,000	30,800	250,800	(TEI 550)
Roving Rig:										
Clay Gulch area, San Juan Co., Utah	9	0	9	1,932	0	1,932	0	0	0	
Oljeto Wash area, Navajo Co. Ariz.	41	0	41	5,741	0	5,741	0	0	0	
Gateway area, Grand Co., Utah	7	0	7	2,914	0	2,914	0	0	0	
Disappointment Valley area, San Miguel County, Colo.	13	0	13	12,969	0	12,969	0	0	0	
Deer Flat area, San Juan Co., Utah	265	0	265	49,585	0	49,585	8,300	0	8,300	
Bull Canyon dist., Jo Dandy area, Montrose Co., Colo.	459	0	459	195,865	0	195,865	548,300	0	548,300	
Subtotal	6,156	0	6,156	1,531,626	0	1,531,626	1,075,895	60,595	1,136,490	
Drilling in progress:										
Bull Canyon dist., Monogram Mesa area, San Miguel Co., Colo.	257	7	264	191,218	5,788	197,006	17,000	0	17,000	
Subtotal	257	7	264	191,218	5,788	197,006	17,000	0	17,000	
Total drilling	12,413	113	12,526	2,949,244	23,824	2,973,068	2,195,240	75,895	2,271,135	
Gamma-ray field logging	13,601	5	13,606	2,421,031	4,212	2,425,243				
Radiometric core lab scanning	8,007	0	8,007	414,748	0	414,748				