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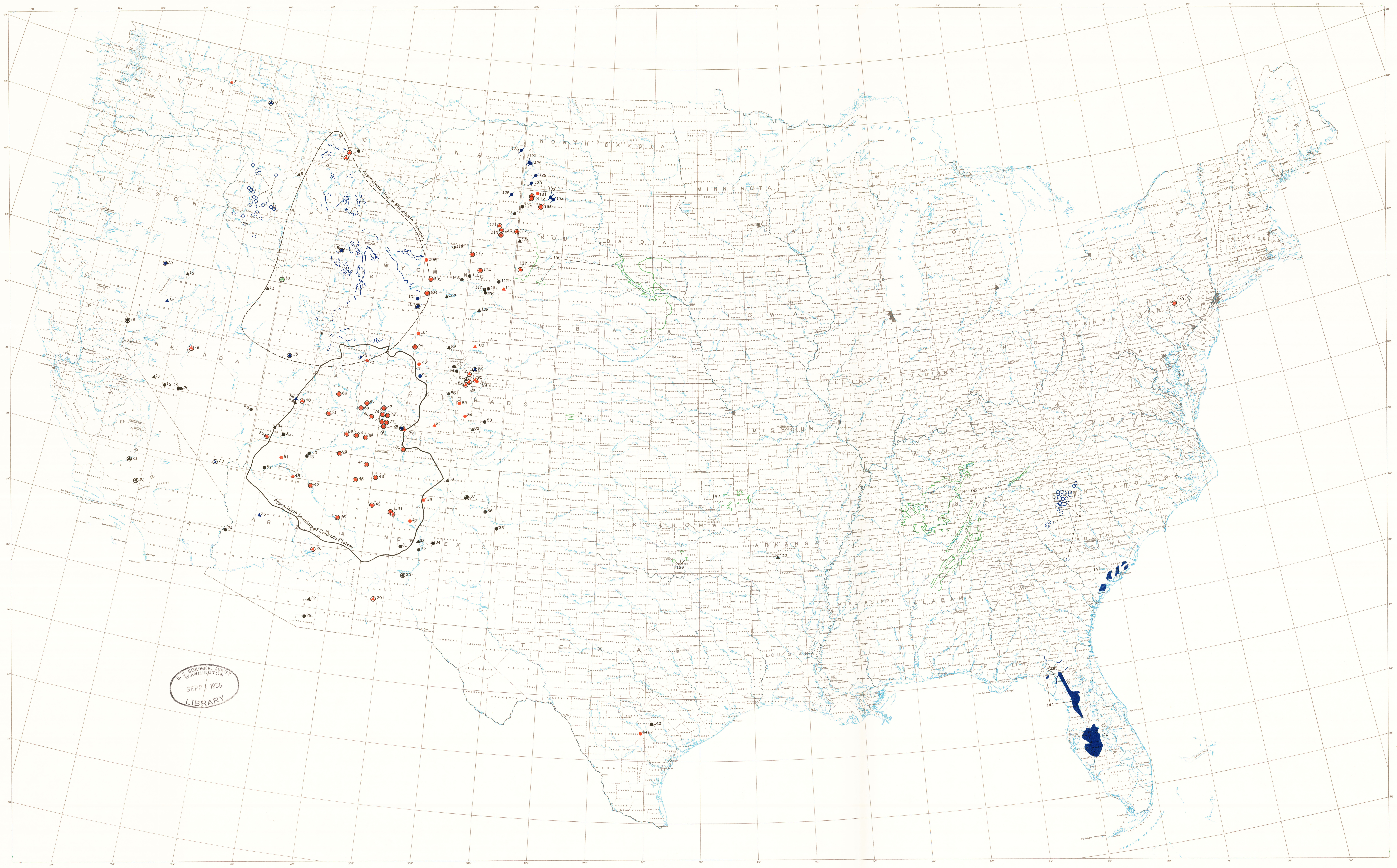

EXPLANATION

KEY TO SYMBOLS

Type of deposit	Deposits actively or formerly mined for uranium or potentially minable under June 1955 market conditions.	Deposits too low in grade to be mined for uranium alone; some yield byproduct uranium.	Deposits of possible importance but unevaluated because of insufficient data.
A black circle around a symbol indicates a mining district or a group of mines or deposits.			
Sandstone-type deposits			
Vein and related deposits			
Deposits in limestone			
Deposits in coal			
Outcrop of uranium-bearing shale			
Uranium-bearing shale *Outcrop not shown.*			
Area underlain by uranium-bearing phosphorite			
Outcrop of uranium-bearing phosphorite			
Placer deposits *Mainly uranium-bearing thorium and rare-earth minerals.*			
Deposits in caliche			

LIST OF DEPOSITS

1. Spokane Indian Reservation, Wash.
2. Coeur d'Alene district, Idaho
3. Winston area, Mont.
4. Clancy area, Mont.
5. Boulder area, Mont.
6. North Fork-Shoup district, Idaho
7. Monazite placers, Idaho
8. Phosphoria formation, Mont., Wyo., Idaho, Utah, Colo., Nev.
9. Fall Creek area, Idaho
10. Goose Creek area, Idaho
11. Prince No. 1 claim, Nev.
12. Moonlight claims, Nev.
13. Virgin Valley opal district, Nev.
14. Majuba Hill deposit, Nev.
15. Red Rock district, Calif., Nev.
16. Early Day claims, Nev.
17. Silver Bell claims, Nev.
18. Blue Bird claims, Nev.
19. Silver Queen claims, Nev.
20. Foster, Jeep, and Lincoln claims, Nev.
21. Kern River area, Calif.
22. Rosamond area, Calif.
23. Erie to Arden area, Nev.
24. Red Knob claims, Ariz.
25. Hillside mine, Ariz.
26. Young-Cherry Creek area, Ariz.
27. Blue Rock claims, Ariz.
28. Duranium claims, Ariz.
29. White Signal district, N. Mex.
30. Monticello district, N. Mex.
31. Tietzen-Red Basin area, N. Mex.
32. Four Jokes claim, N. Mex.
33. Ladron Peak area, N. Mex.
34. Copper Girl mine, N. Mex.
35. Bell claims, N. Mex.
36. Sabinoso area, N. Mex.
37. Coyote mining district, N. Mex.
38. Tusas Mountain area, N. Mex.
39. La Ventana Mesa, N. Mex.
40. Jackpile mine, N. Mex.
41. Grants district, N. Mex.
42. Gallup area, N. Mex.
43. Chuska district, N. Mex.
44. Shiprock district, Ariz.
45. Chilchinbito district, Ariz.
46. Holbrook area, Ariz.
47. Cameron area, Ariz.
48. Orphan Lode claim, Ariz.
49. Jay Bird claim, Ariz.
50. Thomas No. 1 claim, Ariz.
51. Hacks Canyon mine, Ariz.
52. Copper House area, Ariz.
53. Lynn claims, Utah
54. Epsolon claims, Utah
55. Silver Reef district, Utah
56. White Cloud claims, Nev.
57. Thomas Range fluorite, Utah
58. Tushar Mountains area, Utah
59. North Creek area, Utah
60. Marysvale district, Utah
61. Henry Mountains area, Utah
62. White Canyon district, Utah
63. Monument Valley district, Utah and Ariz.
64. Blanding area, Utah
65. Monticello district, Utah
66. Moab district, Utah
67. Thompson district, Utah
68. Green River district, Utah
69. San Rafael Swell district, Utah
70. Fresh-water limestone from the Uinta formation, Utah
71. Eureka claims, Utah
72. Gateway district, Colo.
73. Uravan district, Colo.
74. Paradox district, Colo.
75. Gypsum Valley district, Colo.
76. Slick Rock district, Colo.
77. Bull Canyon district, Colo.
78. Placerville area, Colo.
79. Placerville thucholite, Colo.
80. Durango area, Colo.
81. Cochetopa Creek area, Colo.
82. Wetmore district, Colo.
83. Turkey Creek anticline, Colo.
84. Sunshine claims, Colo.
85. Shirley May (Garo) prospect, Colo.
86. St. Kevin district, Colo.
87. Lawson-Dumont district, Colo.
88. Georgetown-Central City district, Colo.
89. Old Leyden mine, Colo.
90. Ralston Creek area, Colo.
91. Fall River area, Colo.
92. Grand Island-Caribou district, Colo.
93. Jamestown district, Colo.
94. Beaver Creek area, Colo.
95. Troublesome Creek area, Colo.
96. Rifle mine, Colo.
97. Coal Creek anticline, Colo.
98. Maybell area, Colo.
99. Pedad prospect, Colo.
100. Copper King mine, Colo.
101. Poison Basin area, Wyo.
102. Red Desert area, Wyo.
103. Lost Creek schroeckingerite, Wyo.
104. Crooks Gap area, Wyo.
105. Gas Hills area, Wyo.
106. Owl Creek Mountains, Wyo.
107. Seminoe Mountains, Wyo.
108. Laramie Mountains, Wyo.
109. Glendo area, Wyo.
110. Betzer lease, Wyo.
111. Lost Springs district, Wyo.
112. Silver Cliff mine, Wyo.
113. Lance Creek area, Wyo.
114. Monument Hill area, Wyo.
115. Dry Lake claims, Wyo.
116. Glenrock area, Wyo.
117. Pumpkin Buttes, Wyo.
118. Mayoworth area, Wyo.
119. Carlile area, Wyo.
120. Barlow Canyon area, Wyo.
121. New Haven area, Wyo.
122. Aladdin area, Wyo.
123. Long Pine Hills area, Mont.
124. West Short Pine Hills area, S. Dak.
125. Ekalaka area, Mont.
126. Blue Buttes, Mont.
127. Sentinel Butte, N. Dak.
128. Flat Top Butte, N. Dak.
129. H. T. Butte, N. Dak.
130. Medicine Pole Hills area, N. Dak.
131. Tepee Butte, S. Dak.
132. Cave Hills area, S. Dak.
133. Johnson outlier, S. Dak.
134. Lodgepole area, S. Dak.
135. Slim Buttes area, S. Dak.
136. Bald Mountain district, S. Dak.
137. Edgemont district, S. Dak.
138. Sharon Springs member of the Pierre shale, S. Dak., Nebr., Kan.
139. Black shale in the Woodford chert, Okla.
140. Northern Karnes County, Tex.
141. Western Karnes County, Tex.
142. Wilson's Potash Sulphur Springs, Ark.
143. Chattanooga shale, Tenn., Ky., Ala., Ga., Okla., Mo., Ark.
144. Hardrock phosphate district, Fla.
145. Land-pebble phosphate district, Fla.
146. River-pebble phosphate deposits, Fla.
147. Phosphate deposits, S. C.
148. Southeastern monazite placers, N. C., S. C.
149. Jim Thorpe (Mauch Chunk) area, Pa.

THE URANIUM DEPOSITS OF THE UNITED STATES

By

Robert W. Schnabel

INTRODUCTION

The demand for raw materials in processes involving nuclear reactions has, in recent years, stimulated a widespread search for uranium ore. This map shows the location of the more important uranium deposits in the United States that have been discovered to June 1955, by private individuals, corporations, and Government agencies as a result of that search. Information regarding the deposits was compiled from published and unpublished reports of the U. S. Geological Survey and the U. S. Atomic Energy Commission and its contractors. This map was prepared by the Geological Survey on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission. Diane Curtis of the Geological Survey assisted in the preparation of this map.

Studies in recent years have shown that although trace amounts of uranium occur nearly everywhere under extremely varied geologic conditions, concentrations large enough to warrant mining are restricted mostly to the western United States. The deposits shown on the map have produced uranium ore, or—on the basis of present knowledge—are potential producers. For convenience, these deposits are classed by geologic environment. The reports listed in the selected bibliography at the end of the text give more detailed information about some of the individual deposits.

VEIN AND RELATED DEPOSITS

Much of the world supply of uranium has been produced from large, high-grade vein deposits in central Africa, northern Canada, and Czechoslovakia. No deposits comparable with these have been found in the United States, although uraniferous veins are known in many of the western States.

The mineralogy of veins is varied and includes most of the known uranium-bearing minerals. Commonly, the deeper parts of the vein deposits contain uraninite, or its colloform variety, pitchblende, whereas the near-surface parts contain brightly colored, secondary minerals such as autunite, torbernite, or uranophane. In some of the vein deposits of the United States, uranium minerals are associated with other metallic minerals, commonly sulfides of copper, lead, iron, and zinc; in other veins, uranium is the principal metallic element. The gangue of uranium-bearing veins commonly includes quartz, fluorite, or carbonate minerals.

Most of the uranium-bearing vein deposits in the Front Range of Colorado are typical of those in which uranium is associated with other metals. Veins and shear zones cutting Precambrian schist, gneiss, and granite contain pods or masses of pitchblende. Most of these pods or masses are small but some may contain 10 tons or more of pitchblende. In the Boulder batholith area of Montana, uranium commonly occurs in fracture zones filled mostly with chert and chalcedony, although locally some uranium is found in veins containing base-metal sulfides. In the Marysvale district, Utah, pitchblende occurs in quartz veins with minor amounts of fluorite, calcite, and pyrite.

Most of the ore produced from veins in the United States has come from the areas just mentioned, but vein deposits that appear to contain commercially important quantities of uranium ore have recently been discovered on the Spokane Indian Reservation in northeastern Washington and in the Cochetopa Creek area, Colorado. In addition, uranium occurs in minor amounts or as a subordinate constituent of the ore in vein deposits in many other areas.

The grade of material produced from vein deposits in the United States generally ranges from about 0.15 to 0.5 percent U_3O_8.

DEPOSITS IN IGNEOUS ROCKS

Uranium occurs in small amounts in many igneous rocks and most abundantly in granitic rocks; rarely do igneous rocks contain more than 0.2 percent uranium (McKelvey, 1955, p. 5). The uranium in igneous rocks is generally concentrated in such accessory minerals as pyrochlore, xenotime, monazite, zircon, sphene, and apatite. Two belts of granitic and gneissic rocks in Virginia, North Carolina, South Carolina, Georgia, and Alabama contain large quantities of thorium- and uranium-bearing monazite (Mertie, 1953) but in insufficient concentrations to be mined for their uranium content under present conditions. Igneous rocks that can be profitably mined for their uranium content alone have not been found in the United States.

DEPOSITS IN PEGMATITES

Many pegmatites, especially those rich in potash feldspar, contain uranium minerals. The amount of uranium in domestic pegmatites is generally too small for them to be mined for their uranium content alone. Where uranium-bearing pegmatites are mined for their other constituents, however, some uranium-bearing material may be recovered as a byproduct.

No pegmatite deposits are shown on this map because of the relatively small amount of uranium contained in them compared to the amount in other types of deposits.

DEPOSITS IN CLASTIC TERRESTRIAL SEDIMENTARY ROCKS

Deposits in clastic terrestrial sedimentary rocks are chiefly deposits in sandstone but may also be deposits in mudstone, arkose, conglomerate, and water-laid volcanic debris. For the purposes of this map and because most deposits of this type are found in impure quartz sandstones, they will be referred to here as sandstone-type deposits.

Sandstone-type uranium deposits on the Colorado Plateau have been the principal source of uranium in the United States in the past and constitute our major minable reserve of uranium at the present. Other sandstone-type uranium deposits found in the area marginal to the Black Hills in South Dakota and Wyoming, and in the Tertiary basins of Wyoming are sources of appreciable amounts of uranium ore. Other deposits are known in Texas, Nevada, and Pennsylvania.

Sandstone-type uranium deposits are found in rocks that range from Permian to Tertiary in age on the Colorado Plateau, but most of the production of uranium has come from the Entrada and Morrison formations of Jurassic age and the Shinarump conglomerate and the Chinle formation of Triassic age. In the Black Hills area most of the known deposits are in the Lakota sandstone and the Fall River sandstone, both of Early Cretaceous age. In the Tertiary basins of Wyoming most deposits are in rocks of Eocene age.

Sandstone-type uranium deposits vary in size; some deposits are bodies containing several hundreds of thousands of tons of uranium ore. Generally the deposits are tabular with the two longer dimensions roughly conformable to the bedding. In detail, however, ore bodies cross the bedding planes at low angles. The deposits are commonly found in lenticular sandstones or in fossil stream channels, and although most are confined to one stratigraphic unit, some occur in more than one lithologic type within that unit.

In most of the deposits, local concentrations of uranium minerals are associated with carbonaceous material, and some of these concentrations form the richest parts of the ore bodies.

On the basis of metal content, the sandstone-type uranium deposits may be divided into three groups: vanadium-uranium deposits, copper-uranium deposits, and deposits containing mainly uranium. Each of the first two groups may be further divided into oxidized and unoxidized types.

The oxidized vanadium-uranium deposits are the so-called carnotite deposits, of which the principal uranium-bearing mineral is carnotite; they also contain lesser amounts of tyuyamunite, rauvite, and uvanite. At depth and below the zone of oxidation the brightly colored secondary minerals give way to unoxidized dark minerals, locally called black ores. The principal uranium minerals of the unoxidized zone of the vanadium-uranium deposits are uraninite, or its colloform variety pitchblende, and coffinite.

The mineralogy of the oxidized copper-uranium deposits is variable, and uranium occurs in secondary minerals that include hydrated oxides, carbonates, sulfates, phosphates, arsenates, and silicates. None of the secondary uranium minerals are as common as carnotite in the vanadium-uranium deposits. In the unoxidized parts of the deposits, the uranium occurs chiefly as uraninite (pitchblende) associated with copper and other sulfide minerals. Pitchblende is the principal uranium mineral in deposits in which uranium is not associated with copper or vanadium.

Most of the ore produced on the Colorado Plateau contains from about 0.1 to 0.5 percent uranium (McKelvey, 1955, p. 10). Sandstone-type deposits being mined outside the Colorado Plateau generally contain material of comparable grade.

DEPOSITS IN LIMESTONE

The most noteworthy uranium deposits in limestone are those in the Grants district, N. Mex., which are currently being mined. The deposits in the Grants district are in the Jurassic Todilto limestone and are similar in form and size to the sandstone-type deposits on the Colorado Plateau. The ore bodies are generally small, discontinuous, irregular masses, which contain a few tons to several tens of thousands of tons of ore. The uranium minerals are most commonly disseminated through the limestone but locally are concentrated along small fractures. The principal uranium minerals are uranophane, carnotite, and tyuyamunite. Pitchblende is present in some of the deposits. The grade of the ore shipped from the deposits in the Grants district is comparable with that of the ore from the sandstone-type deposits in other areas in the Colorado Plateau.

DEPOSITS IN COAL

Many of the coal beds in the United States have been examined for uranium. In a few places in western United States, coal beds contain appreciable concentrations of uranium. The most extensive uraniferous deposits of this type are in lignitic beds in western South Dakota, western North Dakota, and eastern Montana. Although the widespread coal beds of eastern United States contain very small concentrations of uranium in a few places, none are known to contain amounts or concentrations comparable to those in the west.

Most of the uraniferous coal contains a few hundreths of a percent uranium, which may be concentrated in the ash of some coals by burning. In 1954, however, deposits were discovered in lignitic beds in northwestern South Dakota that are comparable in grade and size to the sandstone-type deposits of the Colorado Plateau.

Meta-autunite is present locally in the high-grade deposits; most of the uranium in the lower grade material, however, is not in discrete minerals but probably is contained in one or more of the organic compounds.

DEPOSITS IN SHALE

Many domestic marine black shales contain small percentages of uranium (McKelvey and Nelson, 1950). Of these, the Chattanooga shale of Devonian and Mississippian age and the Sharon Springs member of the Pierre shale of Cretaceous age have the greatest potential as sources of uranium because of their wide lateral extent.

The Chattanooga shale crops out over wide areas in Tennessee, Kentucky, and Alabama and less extensively in Georgia, Oklahoma, and Arkansas. The Sharon Springs member of the Pierre shale is radioactive where it has been examined in South Dakota, Nebraska, and Kansas. A radioactive black shale in the Devonian and Mississippian Woodford chert crops out in southeastern Oklahoma. Radioactive black shales have been reported from many other areas in the United States, both from surface exposures and drill holes.

The uranium in black shales is probably associated with carbonaceous matter, because the uranium content from place to place within a bed varies directly with the carbon content. Many shales with a high carbon content, however, contain little or no uranium. Uranium minerals are not generally visible in most shales; rarely, however, small flakes of secondary uranium minerals can be seen along fractures and bedding planes.

The uranium content of shales is generally less than 0.01 percent, too low for them to be a commercial source of uranium at present. The volume of some shales can be measured in cubic miles and their contained uranium in many thousands of tons; thus they are important as a potential resource of uranium.

DEPOSITS IN PHOSPHORITE

All marine phosphorites that have been tested contain small amounts of uranium. The uranium content of the phosphorites ranges from about 0.003 to 0.03 percent and varies approximately with the phosphate content.

Much of the phosphate rock produced in the United States comes from the land-pebble phosphate district of central Florida where the Bone Valley formation of Pliocene age is the principal phosphate-bearing formation. The Phosphoria formation of Permian age, which is widespread in Idaho, Montana, Wyoming, and Utah, contains extensive deposits of uraniferous phosphate rock.

The uranium content of phosphate rocks is too low for them to be mined for their uranium content alone. Recently, however, processes have been devised whereby uranium may be recovered as a byproduct in the manufacture of certain phosphate fertilizers.

PLACER DEPOSITS

Most uranium minerals are soft and relatively soluble and therefore are not commonly concentrated in placer deposits. However, monazite, a thorium and rare-earth mineral, commonly contains a few tenths of a percent of uranium (Davidson, 1951, p. 355; Mertie, 1953, p. 12).

Monazite-bearing placers are known in central Idaho and North and South Carolina and in a few beach placers along the Atlantic and Pacific coasts. The uranium content of these placers is very small as compared with other types of deposits; but if the monazite is recovered from them, some uranium may be produced in processing the monazite for other metals contained in the monazite.

PROSPECTS FOR FUTURE DEVELOPMENT

The sandstone-type uranium deposits of the Colorado Plateau constitute the principal domestic reserves of uranium in the United States today and will probably continue to be the most important deposits for some years. Other sandstone-type deposits, especially those marginal to the Black hills in South Dakota and Wyoming and those in the Tertiary basins of Wyoming are being developed as sources of uranium ore.

Some uranium ore is being mined from domestic vein deposits, although no vein deposits comparable to those in foreign countries have been found in the United States. Deposits around Marysvale, Utah, for example, have provided a small but continuous supply of ore since shortly after their discovery and will probably continue to do so for several years. Recent discoveries of other vein deposits elsewhere in the United States may result in increasing production from this type of deposits in the future.

New discoveries of ore-grade material in lignitic beds in western North Dakota and western South Dakota may provide new sources of uranium in the near future. Some uranium is currently produced from Florida phosphorite as a byproduct in the manufacture of fertilizer, and it is expected that similar processes will be applied to the phosphorite from the Northwest.

Advances in technology or an increase in demand will be required before the large low-grade deposits in shale, coal, and igneous rock can compete economically with the smaller high-grade deposits. The large tonnages of these materials, however, indicate they may be an important source of uranium at some time in the future.

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Compiled by
Robert W. Schnabel

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