GUIDES TO URANIUM DEPOSITS IN THE MORRISON FORMATION, GALLUP-LAGUNA AREA NEW MEXICO

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ABSTRACT

Uranium ore production from New Mexico constitutes a significant part of the total production from the Colorado Plateau. About 90 percent of the ore from New Mexico has come from the area that extends from Gallup to Laguna, in McKinley and Valencia Counties; and over 95 percent of the area's production has come from the Todilto limestone and Morrison formation of Jurassic age. Although the area's first production came from the Todilto limestone, the production from the Morrison rose rapidly from 1951 to 1954, and by September 1954 it exceeded that from the Todilto. In September 1954 the reserves in the Morrison in the Gallup-Laguna area constituted most of the reserves in New Mexico and an important part of the reserves of the Colorado Plateau.

Until recently the deposits in the Morrison formation were believed to be distributed almost equally through the three members of the formation in the area. From base to top, these are the Recapture, Westwater Canyon, and Brushy Basin members. Recent work shows, however, that most of the deposits in the Morrison—in fact, all the larger deposits—are in the Brushy Basin member. The Brushy Basin generally consists of claystone with subordinate amounts of sandstone, conglomerate, and some relatively thin limestone lenses; it ranges from a knife edge to about 375 feet in thickness. Preliminary work by the writers shows that the larger deposits in the Brushy Basin member generally occur in coarse-grained sandstone units where the units are thicker. Preliminary ore guides and methods of prospecting have been developed for two of these sandstones, the so-called Poison Canyon and so-called Jackpile sandstone units. Because of their relatively great uranium potential, these units and others of the same type in the Brushy Basin member perhaps should be primary exploration targets in the search for uranium in the Gallup-Laguna area.

INTRODUCTION

In the Gallup-Laguna area (fig. 90) of New Mexico, productive uranium deposits are in the Todilto limestone, Summerville formation, Morrison formation, and Dakota sandstone. Between 1953 and 1955, the Morrison formation in this area increased greatly in significance because of new discoveries.

Fieldwork by the writers in 1954 indicates that the larger known uranium deposits in the Morrison formation in the Gallup-Laguna area are confined to specific sandstone units in the Brushy Basin member. This paper presents a preliminary description of the general characteristics of two of these sandstone units and points out how these characteristics can be used as guides to ore.

Many of the data presented are based on information provided by mining men in New Mexico and personnel of the U. S. Atomic Energy Commission. Special acknowledgments and thanks for assistance are due personnel of the Lea Exploration Co., Anaconda Copper Mining Co., Haystack Mountain Development Co., and the St. Anthony Uranium Co.

GENERAL GEOLOGY

Productive uranium deposits in the Gallup-Laguna area (fig. 90) are in sedimentary rocks of Jurassic and Cretaceous ages. These rocks generally dip northward at a low angle and form an almost continuous outcrop for about 80 miles, extending from Gallup to the west side of the Rio Grande valley. Locally the rocks are folded broadly and broken by faults; and north of U. S. Highway 66, between the towns of Grants and Laguna, they are intruded and largely buried by the Mount Taylor volcanic field.

The sequence of sedimentary rocks containing the productive deposits are, in ascending order, the Todilto limestone, Summerville formation, Bluff sandstone, and Morrison formation, all of Jurassic age; the sequence is unconformably overlain by the Dakota sandstone of Cretaceous age. All these rocks except the Bluff sandstone, contain uranium deposits. In September 1954, the Todilto, Morrison, and Dakota were the only formations in the Gallup-Laguna area that were known to contain significant deposits.

The Morrison formation in this area is divided, from base to top, into the Recapture shale member, Westwater Canyon sandstone member, and Brushy Basin shale member. The Recapture is a fine- to medium-grained friable sandstone that contains some beds of silty claystone. It ranges from about 20 to 185 feet in thickness and has distinctive alternating light-gray and reddish-brown units.

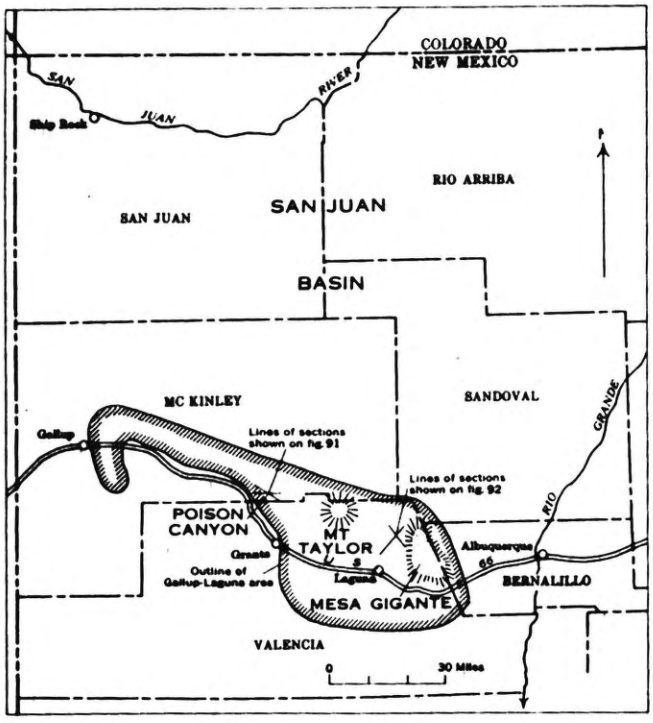

FIGURE 90.—Index map of northwest New Mexico showing Gallup-Laguna area and locations of figures 91 and 92.

The Westwater Canyon is predominantly a medium- to coarse-grained pebbly sandstone that contains some thin units of claystone. The Westwater Canyon ranges from a knife edge to about 200 feet in thickness and from yellowish gray to reddish brown. It locally interfingers with the underlying Recapture and overlying Brushy Basin members. In the eastern part of the area, it is locally absent, and there the Brushy Basin rests directly on the Recapture member.

The Brushy Basin member is predominantly a grayish-green claystone with subordinate lenses of hard medium-grained locally calcareous green sandstone. These lenses, generally ranging from a few inches to a few feet in thickness, are chiefly quartz grains and abundant interstitial clay. Locally, however, the Brushy Basin contains relatively thick lenses or units of coarser grained sandstone that generally range from several feet to 175 feet in thickness. The Brushy Basin ranges from a knife edge near Gallup to a thickness of about 375 feet north of Laguna. The differences in thickness are mainly the result of pre-Dakota erosion after broad folding.

ORE-BEARING SANDSTONE UNITS

In the Gallup-Laguna area nearly all the known uranium deposits in the Morrison formation are in the relatively thick, coarse-grained sandstone units of the Brushy Basin member which can be distinguished from the thinner lenses of hard medium-grained green sandstone.

The ore-bearing units range from white to moderate brown but are generally yellowish orange. Near deposits, they are yellowish gray. The units are composed mostly of quartz, some pink feldspar, and a few other minor accessory minerals; white specks, probably kaolin, are common. These sandstone units are locally conglomeratic, crossbedded, show scour-and-fill features, and are quite friable. Carbonaceous debris—such as small logs, tree limbs, and reeds—and claystone lenses and galls are present at certain places and are most abundant near deposits. The general features of these sandstone units indicate a fluvial origin, as do the many channels filled with the sandstones in the underlying claystone.

Two of these sandstone units in the Brushy Basin contain all the larger deposits.[1] The unit in the vicin-

[1] In 1955, after this paper was written, significant uranium deposits were discovered in T. 14 N., R. 10 W., about 8 miles northwest of Poison Canyon. These deposits are in the Westwater Canyon member of the Morrison formation. Although the Brushy Basin member is present at this locality, it is predominantly claystone, and the so-called Poison Canyon sandstone is absent.

Discovery of these deposits greatly enhances the uranium potential of the Westwater Canyon member in the Gallup-Laguna area. Preliminary and somewhat meager information indicates these deposits are where the Westwater Canyon member is thicker and where it has the same other characteristics as those given in this paper for the so-called Poison Canyon and so-called Jackpile sandstone units in the vicinity of deposits.

ity of Poison Canyon (fig. 90), northwest of Grants, is referred to as the so-called Poison Canyon sandstone. The second unit, which contains the Jackpile mine, is referred to as the so-called Jackpile sandstone.

SO-CALLED POISON CANYON SANDSTONE UNIT

The so-called Poison Canyon sandstone crops out at the head of Poison Canyon and is exposed for about 2 miles to the eastward and also to the westward from Poison Canyon. From drill-hole information the so-called Poison Canyon sandstone is known to extend northward from the outcrop for at least half a mile. This unit merges with the Westwater Canyon about 2 miles northwest of Poison Canyon. Eastward from the point where it merges with the Westwater Canyon, it rests upon a 15- to 25-foot-thick unit of the Brushy Basin shale member, and is assigned by the writers to the Brushy Basin. The thickness of the so-called Poison Canyon sandstone ranges from 35 to 90 feet, but most of the deposits occur where this sandstone is more than 50 feet thick. The relatively thick parts of the sandstone generally range from about 500 to 1,000 feet wide and from 1,000 to 2,500 feet long, they have a dominant eastward trend. Two generalized cross sections (fig. 91), compiled from drill-hole information and outcrops, show the relationship of the deposits to the sandstone thickness.

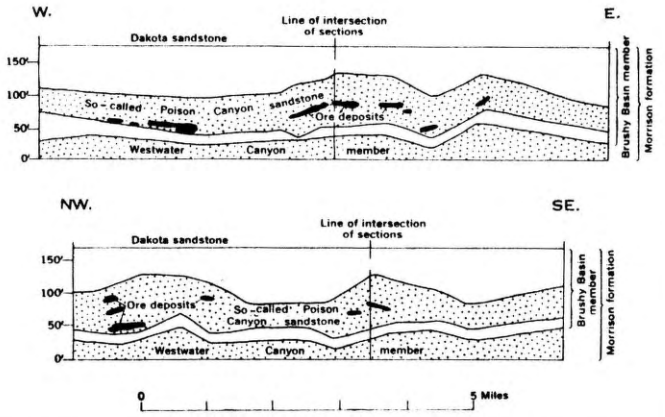

FIGURE 91.—Generalized geologic sections showing the stratigraphic relations of the uranium deposits in the Morrison formation, northwest of Grants, N. Mex.

SO-CALLED JACKPILE SANDSTONE UNIT

The so-called Jackpile sandstone constitutes the upper part of the Brushy Basin and is unconformably overlain by the Dakota sandstone. The so-called Jackpile sandstone is present throughout an area of at least 200 square miles, but its limits are not known. It is best exposed north of Laguna (fig. 90) between Mesa Gigante and the eastern edge of the Mount Taylor volcanic field, where it generally ranges from about 60 to 175 feet in thickness. About 7 miles northeastward from Laguna, it thickens to a maximum of about 175 feet. It appears significant that all the known deposits in the area north of Laguna and between Mesa Gigante and the eastern edge of the Mount Taylor volcanic field are in the vicinity of this maximum thickness where the sandstone generally exceeds 150 feet in thickness. Two generalized cross sections (fig. 92), drawn from outcrops and drill-hole data, show this relationship. Moreover, beneath the thicker part of the so-called Jackpile sandstone, the rest of the Brushy Basin member is largely sandstone which is lithologically similar to the so-called Jackpile sandstone.

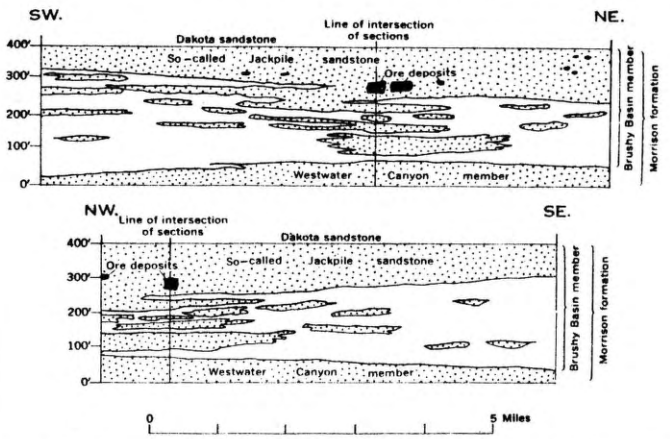

FIGURE 92.—Generalized geologic sections showing the stratigraphic relations of the uranium deposits in the Morrison formation, north of Laguna, N. Mex.

URANIUM DEPOSITS

The Morrison uranium deposits in the area consist of concentrations of black and yellow uranium minerals in tabular bodies. These bodies generally follow the bedding and range from about a foot to several tens of feet in thickness and from several feet to hundreds of feet in width and length. The amount of ore in these bodies ranges from a few tons to many hundreds of thousands of tons.

BRUSHY BASIN POTENTIAL FOR URANIUM

The so-called Poison Canyon and Jackpile sandstone units of the Brushy Basin shale member contain all the larger uranium deposits, and these two units and others of similar type in the Brushy Basin contain nearly all of the Morrison deposits in the Gallup-Laguna area. Some measure of the relatively great uranium potential of the Brushy Basin can be determined by comparing mine production and reserves of the Brushy Basin with production and reserves of other formational units in the Gallup-Laguna area, with the production and reserves of New Mexico, and with the production and reserves of the Colorado Plateau. The comparisons are based on figures that are applicable at the end of September 1954.

PRODUCTION AND RESERVES

About 98 percent of the ore produced from the Morrison formation in the Gallup-Laguna area has come from the Brushy Basin shale member, mostly from the so-called Poison Canyon and Jackpile sandstone units. This production represents 50 percent of the total ore produced from the area and about 45 percent of the total uranium ore produced in New Mexico.

The commercial significance of uranium in the Gallup-Laguna area was not realized until after the discoveries made in 1950. Between 1950 and 1952 little ore was produced, as this time was spent in prospecting and exploitation of ore bodies. The production from the Brushy Basin member (and other units in the Gallup-Laguna area), therefore, represents only about 2 years of mining effort. Even so, the Brushy Basin production from this area constitutes a significant part of the total from the Colorado Plateau.

Almost the entire reserves for the Morrison formation in the Gallup-Laguna area are in the Brushy Basin. These reserves represent about 90 percent of the total reserves in the Gallup-Laguna area and about 85 percent of the reserves for New Mexico. These Brushy Basin reserves, moreover, constitute an important part of the reserves in the Colorado Plateau. Almost all Brushy Basin reserves are in the so-called Poison Canyon and so-called Jackpile sandstone units.

Because only a small percentage of the Brushy Basin shale member in the Gallup-Laguna area has been explored, the potential reserves of this member are probably many times as great as the known reserves.

GUIDES TO ORE

The general characteristics of the so-called Poison Canyon and so-called Jackpile sandstones make it possible to recognize these units at the outcrop and to extend and define their limits by drilling. Also, these characteristics may have application in searching for and defining other similar units in the Brushy Basin of the Gallup-Laguna area.

In the so-called Poison Canyon and Jackpile sandstones, ore guides are summarized as follows:

1. Deposits are generally localized in the thicker parts of the units. In the so-called Poison Canyon sandstone they are found mostly in areas where the thickness exceeds 50 feet. Deposits are found in the so-called Jackpile sandstone where the thickness exceeds 150 feet.
2. Yellow-gray sandstone.
3. Abundant carbonaceous debris.
4. Abundant claystone lenses and galls.

The sandstone color and the abundance of carbonaceous debris and claystone are of limited use, because it has not been determined how far away from the deposits these features are found. However, when observed collectively with optimum thickness, they should indicate ground most favorable for ore deposits; and once a target area has been defined, drilling can give specific location of the deposit.