GEOLOGY OF THE PUMPKIN BUTTES AREA OF THE POWDER RIVER BASIN, CAMPBELL AND JOHNSON COUNTIES, WYOMING

By W. N. Sharp and A. M. White

Trace Elements Memorandum Report 899

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON 25, D. C.

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February 8, 1956

Mr. Robert D. Nininger, Assistant Director
Division of Raw Materials
U. S. Atomic Energy Commission
Washington 25, D. C.

Dear Bob:

Transmitted herewith are three copies of TEM-899, "Geology of the Pumpkin Buttes area of the Powder River Basin, Campbell and Johnson Counties, Wyoming," by W. N. Sharp and A. M. White, January 1956.

We are asking Mr. Hosted to approve our plan to publish this report as a Mineral Investigations field studies map.

Sincerely yours,

John H. Eric

for W. H. Bradley
Chief Geologist

Geology and Mineralogy

This document consist of 12 pages,
plus 2 plates.
Series A

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

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This preliminary report is distributed without editorial and technical review for conformity with official standards and nomenclature. It is not for public inspection or quotation.

*This report concerns work done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

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GEOLOGY OF THE PUMPKIN BUTTES AREA OF THE POWDER RIVER BASIN, CAMPBELL AND JOHNSON COUNTIES, WYOMING

By W. N. Sharp and A. M. White

ABSTRACT

About 200 uranium occurrences have been examined in the Pumpkin Buttes area, Wyoming. Uranium minerals are visible at most of these places and occur in red and buff sandstone lenses in the Wasatch formation of Eocene age. The uranium minerals are disseminated in buff sandstone near red sandstone, and also occur in red sandstone in manganese oxide concretions and uraninite concretions.

INTRODUCTION

The Pumpkin Buttes area comprises about 450 square miles in Campbell and Johnson Counties and includes several prominent buttes known as Pumpkin Buttes (fig. 1). The area is near the center of the Powder River Basin, a large physiographic unit of prairie and sculptured terrain that occupies approximately 12,000 square miles of northeastern Wyoming. The basin is bounded on the east by the Black Hills, on the south by the Laramie Range, and on the west by the Big Horn Mountains. The northern end is more or less open into Montana. Much of the basin ranges in altitude from 4,000 to 5,000 feet above sea level, but in the central part, about 40 miles southwest of Gillette, the Pumpkin Buttes rise abruptly to an altitude of 6,000 feet.

Secondary uranium minerals were discovered in the vicinity of Pumpkin Buttes in October 1951 (Love, 1952.) The following spring, a study of the area and the uranium

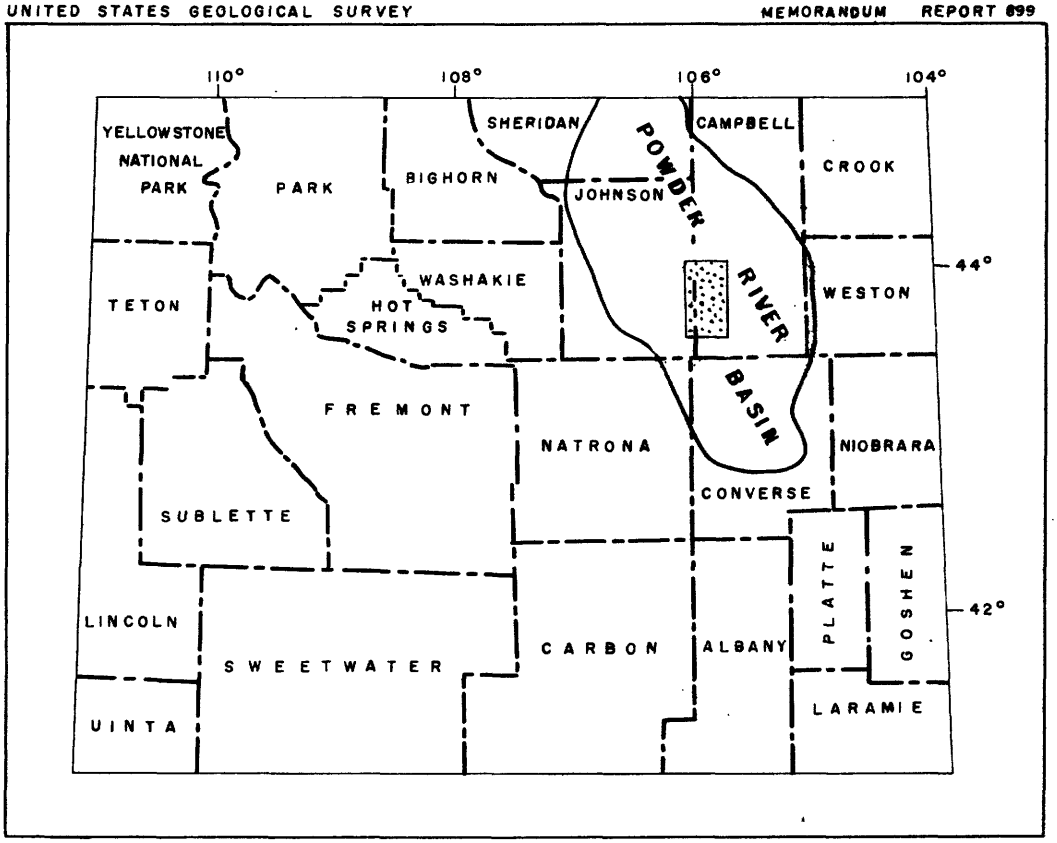

FIGURE 1—INDEX MAP OF WYOMING, SHOWING POWDER RIVER BASIN AND PUMPKIN BUTTES AREA

occurrences was begun by the Geological Survey on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission. Preliminary results were reported by Troyer and others (1954). The accompanying map (pl. 1), which shows distinguishable lithologic units and occurrences of uranium in outcrops, is a result of the continuation of this study.

GENERAL GEOLOGY

The Powder River Basin is an asymmetrical syncline with its deepest part and greatest thickness of sedimentary rocks close to the Big Horn Mountains on the west. The strata on the east side of the basin dip to the west at low angles, whereas those near the Big Horns dip relatively steeply toward the east. Faulting is prominent at a few places around the rim of the basin; but only a few small faults, with 2 to 10 feet displacement, have been observed in the younger rocks near the center of the basin.

The Pumpkin Buttes lie along the axis of a broad, low-amplitude anticlinal fold that plunges to the northwest at a low angle. (See pl. 2.) Regional dip in the area, which is east of the basin axis, is only 30 to 100 feet per mile, or generally less than 1° to the northwest.

The Powder River Basin is underlain by stream-deposited clastic rocks assigned to the Wasatch formation of Eocene age, deposited 40 to 50 million years ago. These rocks form the major part of the Pumpkin Buttes area. Unconformably overlying the Wasatch and only capping the Pumpkin Buttes are remnants, less than 100 feet thick, of very coarse-grained siliceous sandstone and conglomerate of the White River formation of Oligocene age, which are 28 to 40 million years old. Older rock units that underlie the Wasatch are exposed around the periphery of the basin.

In the Pumpkin Buttes area the Wasatch formation is about 1,200 feet thick, about one-third of which is quartz-feldspar sandstone. This sandstone occurs in lenses that range from 500 feet to several miles in width, from 1 to 8 miles in length, and from 10 to 100 feet in thickness. Such lenses are dispersed at random throughout a sequence of drab siltstone, claystone, and carbonaceous shale beds. The orientation of sedimentary structures such as crossbedding, the orientation of the long dimensions of the sandstone lenses, the direction of scour channels, and the mineral components of the sandstone indicate that the sediments were derived from a source area to the southeast.

Most of the sandstone lenses in the vicinity of the buttes are in whole or in part reddish. This coloring ranges from dark red-brown to pink and contrasts sharply with the buff or gray sandstone in the Wasatch formation in other parts of the Powder River Basin. The contact between the red and buff colors in a partly red sandstone lens generally is very sharp and transects both sedimentary structures and all types of lithology within the lens. The red color does not extend into the adjacent claystone and siltstone.

The sandstone generally is friable and poorly sorted, ranging from very fine to coarse grained. Fragments of coalified wood and clay chips generally are scattered thinly throughout. Festoon crossbedding is the most conspicuous sedimentary structure. At many places, however, the crossbeds are extremely contorted, and debris such as coalified wood and clay galls is abundant. Sandstone concretions, the so-called "cannonballs" or "pumpkins" from which the buttes get their name, are another characteristic

feature of the sandstone. The concretions comprise sand grains cemented with calcite. They range from spheres a quarter of an inch to 3 feet in diameter to cigar-shaped masses 30 feet long.

URANIUM MINERAL OCCURRENCES

About 200 uranium occurrences which includes several deposits have been examined in the Pumpkin Buttes area. Uranium minerals are visible at most of these places. A few localities are not visibly mineralized but have anomalous radioactivity. Most of the mineralized outcrops are small, and only a few have been explored sufficiently to determine their potential. The boundary of the area in which uranium is found coincides with the extent of the red sandstone in the Wasatch formation. In other words, uranium occurrences are closely associated with the red sandstone. Sandstone lenses that contain uranium are in the lower half of the exposed interval of Wasatch.

Uranium occurrences may be conveniently classified according to their habits and mineralogical associations into three main types: 1) oxidized uranium minerals disseminated in porous sandstone or concentrated around calcite-cemented sandstone; 2) oxidized uranium minerals enclosed in manganese oxide concretions or intimately mixed with the concretionary material; and 3) uraninite concretions.

Recent mining operations have been principally in the northern part of the area near the edge of the red sandstone zone. These operations show that both disseminated and concretionary types occur in the same uranium deposit. In detail, however, manganese oxide concretions are separated from disseminated minerals and uraninite concretions.

In general, disseminated uranium minerals are found almost exclusively in buff to gray sandstone at or near the red-buff color contact in the sandstone lenses. The largest concentrations are found where the color contact is irregular and elongate extensions of red sandstone have formed. Calcite also is concentrated interstitially in the buff sandstone near the contact. Concretionary forms, both those that contain secondary minerals with manganese oxides and those that contain uraninite, are in the red sandstone.

Disseminated habit

Disseminated uranium minerals are yellow to greenish-yellow and are principally metatyuyamunite and carnotite. Rarely liebigite and uranophane are found. Irregularities in a generally straight red-buff color contact seem favorable for the concentration of calcite, which, at places, forms elongate concretionary masses in the buff sandstone. Yellow uranium minerals are localized around such calcite-rich zones and commonly saturate the sandstone between closely spaced concretions. Locally yellow minerals occur in narrow zones, several inches to several feet wide, conforming to the configuration of the red-buff contact. At other places yellow minerals are distributed throughout extensions of buff sandstone into red sandstone. A similar condition exists where the red sandstone meets underlying claystone at a low angle, leaving a wedge of buff sandstone between the two units. Such wedges may contain uranium minerals throughout.

Lignites and carbonaceous shales throughout the area are generally nonradioactive. Under some conditions, however, coalified material may concentrate uranium minerals. For example, a carbonaceous shale underlying a uranium-bearing sandstone may contain considerable carnotite along the zone of contact.

Concretionary habit

Manganese oxide concretions

Most of the uranium occurrences in the Pumpkin Buttes area contain secondary uranium minerals associated with manganese oxide concretions. These concretions are essentially irregularly shaped masses of sandstone cemented and replaced by black iron-bearing manganese oxides - manganite, pyrolusite, and psilomelane. Some concretions are spherical or tubular and have a core of gray sandstone speckled with manganese oxide and abundant secondary uranium minerals, principally uranophane and orange carnotite. Other concretions are relatively flat to irregular in shape and contain uranium minerals mixed with specks of manganese oxide in zones peripheral to the black mass. Manganese oxides with secondary uranium minerals commonly are observed in isolated, discrete concretions which seem to have no consistent areal or stratigraphic pattern of distribution within individual sandstone lenses. At places, however, coalescing spheroidal masses of manganese oxides with secondary uranium minerals form ledges up to 10 feet across. Generally the manganese oxide is associated with ferruginous or coalified woody material.

Uraninite concretions

Rounded to elongate black concretionary masses of sandstone cemented by uraninite have been found at two mines in the northeastern part of the Pumpkin Buttes area at depths of 20 to 30 feet below the surface. These concretions are in the red sandstone near the red-buff contact. They commonly contain pyrite either as the core of the concretion or disseminated as blebs within or at the edge of the mass. Locally coalified woody material is found in contact with, or nearly surrounded by, uraninite; no pyrite is visible. Inasmuch as all uraninite found has been relatively close to the surface, the masses are surrounded by a thick layer of oxidized uranium minerals - carnotite and metatyuyamunite. Some of these masses are more than a foot across.

At one place in the Pumpkin Buttes area paramontroseite, a vanadium mineral similar to uraninite, forms concretionary masses similar to those formed by uraninite. Other vanadium minerals in the deposits are hewettite and pascoite.

Guides to ore

The foregoing data may be summarized to outline the best guides to possible ore-grade material. Uranium occurs in sandstone lenses in an area where the lenses are red or partly red in color. Uranium occurrences are spatially related to the red sandstone. Disseminated uranium minerals are found in buff sandstone close to red-buff color contacts. Uraninite and manganese oxide concretions are in the red sandstone; uraninite concretions are close to the red color contact, and manganese oxide concretions are more randomly spaced.

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