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Favorable areas for uranium in the Oligocene White River beds of southwestern South Dakota, southeastern Wyoming and northwestern Nebraska

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INTRODUCTION

Uranium occurrences have been found in both the Brule and Chadron Formations of the White River Group in northwestern Nebraska and in southwestern South Dakota and in correlative rocks in southwestern Wyoming.

Uranium is being produced commercially from the Crow Butte deposit near Crawford, Nebraska (Collings and Knode, 1984; Gjelsteen and Collings, 1988, Hansley and Dickinson, 1990). The uranium at the Crow Butte deposit is in oxidation-reduction roll fronts in the basal sandstone of the Chadron Formation. The basal sandstone was deposited in channels eroded into underlying rocks, mostly the Upper Cretaceous Pierre Shale.

Minor commercial uranium production took place from the Chadron Formation in the Hart Table area southwest of Scenic, South Dakota. Uranium is found in small channel sandstones at Hart Table near the top of the Chadron (Moore and Levish, 1955), and at nearby Indian Creek where it is found in a basal channel sandstone deposited in a paleovalley called the "Red River Valley" (Clark, 1937). The uranium deposits in the Indian Creek area are associated with molybdenum (Raymond, 1982).

A syngenetic uranium deposit of apparent sub-commercial size was found in a lacustrine facies of the Brule Formation about 12 miles northeast of Chadron, Nebraska (Dickinson, 1991; Dunham, 1955).

The purpose of this report is to define favorable areas for uranium in the Oligocene White River Formation (Group) in the study area, which consists of the Newcastle, Torrington, Hot Springs, and Alliance 1X2-degree quadrangles.

STRATIGRAPHY

South Dakota

In South Dakota the White River Group is divided into the Chadron Formation below and the Brule Formation above. In the Badlands area of southeastern South Dakota the Chadron Formation is divided, in ascending order, into the Ahearn, Crazy Johnson, and Peanut Peak Members, and the Brule is divided into the lower Scenic and upper Poleside Members. The basal sandstone member, the Ahearn, was deposited in a paleovalley called the "Red River Valley" by Clark (1937). The Ahearn Member was correlated with the early Oligocene Yoder Formation in southeastern Wyoming by Clark and Others, (1967). The relation between the Ahearn

Member of the Chadron in South Dakota and the basal sandstone of the Chadron in Nebraska is unknown. The Ahearn Member was apparently eroded before deposition of the overlying Chadron sediments, and the Ahearn is probably older than the basal sandstone of the Chadron in Nebraska.

Nebraska

In Nebraska the White River Group is also divided into the lower Chadron and the upper Brule Formations. In this state the Chadron is not divided into formal members, but in much of the area it contains a basal sandstone deposited in the channels of a braided stream system that extends through much of the western half of the Alliance quadrangle (Seeland, 1985; plate 1). The channel sandstone beds occupy a 20-mile wide belt that extends from the northwestern part of the quadrangle, eastward for about 25 miles to the vicinity of Crawford and then extends southeastward. A smaller belt of basal sandstone extends through the southeastern corner of the Alliance quadrangle and connects northward to a north-trending belt in Wyoming and southward to a south-trending belt south of the Alliance quadrangle (plate 1). Seeland,(1985) shows a topographically inferred eastward drainage on the east side of the Chadron Arch (plate 1), but little or no basal sandstone was deposited in these channels.

In Nebraska the Brule consists, in ascending order, of the Orella, Whitney, and Brown Siltstone Members (Swinehart and others, 1985).

Wyoming

In Wyoming the White River Formation has not been given group status. In southeastern Wyoming the White River Formation is divided into the Chadron and Brule Members (Love and Christiansen, 1985)

URANIUM OCCURRENCES

For the Torrington, New Castle, and Hot Springs 1X2-degree quadrangles uranium occurrences are described in the National Uranium Resource Evaluation reports (Seeland, 1982; Santos, 1982; and Truesdell and others, 1982). For uranium occurrences in the Alliance quadrangle, see Dunham (1955), Dickinson (1990) Collings and Knode (1984) and Gjelsteen and Collings (1988)

FAVORABLE AREAS

The favorable areas are shown on plate 1 and the sizes of each in square miles are given in table 1.

Favorable Area I

Favorable area I is the most favorable area for uranium in the White River Group in the study area. It is defined by the distribution and thickness of the basal sandstone of the Chadron Formation. It generally includes that part of the channel sandstone where the channel center thickness

exceeds 200 feet (plate 1), which also generally includes the area of the Crawford basin (DeGraw, 1969). This area contains the Crow Butte uranium deposit near Crawford, Nebraska (Collings and Knode, 1964; plate one). The Crow Butte uranium deposit is reported to contain in excess of 30 million pounds U_3O_8 with an average grade in excess of 0.25%. Roll-front uranium deposits are known to occur along much of the northern, eastern and southern margins of the Crawford basin (Gjelsteen and Collings, 1987).

TABLE 1

Favorable Area	Size (in square miles)
I	616
II	158
III	
A	272
B	1482
C	623
Total area III	2,394
IV	343
Total all areas	3,484

Favorable Area II

Favorable area II is the area of the "Red River Valley" in South Dakota (Clark, 1937). The sandstone deposited in the "Red River" channel formed the Ahearn Member of the Chadron as discussed above. Two hundred six tons of ore averaging .2% uranium were mined from the Baxter lease in this area (Truesdell and others, 1982). Uranium occurrences in the smaller channels higher in the Chadron were described by Moore and Levish (1955), who found grades as high as 0.25 U_3O_8.

Favorable Area III

Favorable area III includes areas IIIA, IIIB, and IIIC shown on plate 1. Favorable area III, less favorable than areas I and II, includes that part of Chadron Formation where a basal channel sandstone is present, but where the maximum thickness of the basal sandstone is about 100 feet or less. Area IIIA includes an area of basal Chadron sandstone in the Douglas, Wyoming area. Two uranium occurrences were reported in this area by Seeland (1982) and one by Gruner and others, 1956). Area IIIB is an area in the south and central parts of the study area, where basal Chadron sandstone is present (Dickinson and Wise, 1990). Uranium occurrences have been reported along the northern boundary of this area (Bromley, 1955; Santos, 1982). Area IIIC includes a north-south belt south of the Crawford basin in Nebraska. No uranium occurrences have been reported from this area, where the White River Group is entirely in the subsurface (Dickinson, 1990).

Favorable Area IV

Favorable area IV includes an area where smaller channel sandstones are likely to be present in the Chadron Formation similar to the uraniferous smaller channel sandstones exposed in favorable area I along the south end of Hart Table near Scenic, South Dakota. A southeastward flowing channel was mapped in this area by Seeland (1985). The potential host rocks in this area are not exposed and no uranium occurrences are known there.

Other Favorable Areas

The remainder of the White River Group, not including the channel sandstones, is somewhat favorable for uranium because it may contain syngenetic lacustrine uranium deposits similar to the sub-commercial one exposed near Chadron (Dunham, 1955, Dickinson, 1990). If deposits of this kind exist elsewhere, they are buried in the subsurface and they may be small and of low grade.

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