

Hydrostratigraphic Controls on Uranium Mineralization – Example: The Nebraska Panhandle

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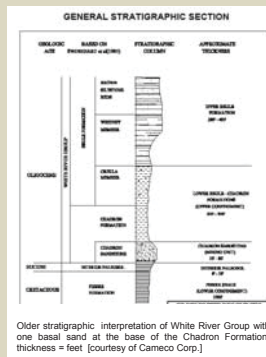
HISTORY AND PRODUCTION



Photo courtesy of Cameco Corp.

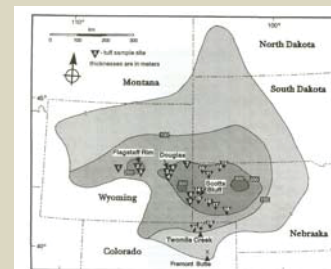
Crow Butte Uranium Deposit was discovered in 1981 with production beginning in 1991.

- Reserves ≥ 25 Million lbs U₃O₈, Grade ≥ 0.25%.
- Produces ~ 800,000 lbs/ year using In Situ Recovery [ISR].
- Total production to date ~ 13 million lbs.

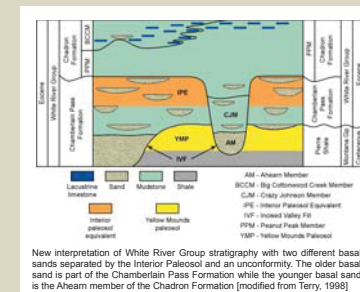


Older stratigraphic interpretation of White River Group with one basal sand at the base of the Chadron Formation, thickness = feet [courtesy of Cameco Corp.]

WHITE RIVER GROUP DISTRIBUTION AND STRATIGRAPHY



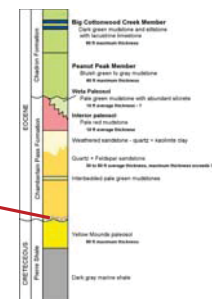
Distribution and thickness of White River Group - Larson & Evanoff (1998)



New interpretation of White River Group stratigraphy with two different basal sands separated by the Interior Paleosol and an unconformity. The older basal sand is part of the Chamberlain Pass Formation while the younger basal sand is the Ahearn member of the Chadron Formation [modified from Terry, 1998]



Pebble conglomerate of the Chamberlain Pass Formation near Whitehead Creek, Nebraska. Clasts consist of quartz, chert, and quartzite. The Chamberlain Pass Formation was deposited prior to the exposure of the Precambrian core of the Black Hills Uplift [Evans, 1996]. Uranium mineralization at Crow Butte is found in the Chamberlain Pass Formation.

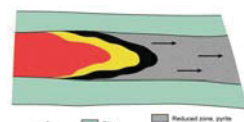


Composite stratigraphic column for the Chamberlain Pass Formation. Not all units are present in any one outcrop. The Weta Paleosol is the lateral equivalent of the Interior Paleosol.

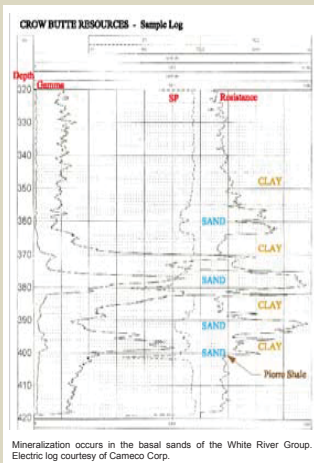


Chamberlain Pass Formation (CPF) type section, near Kadoka South Dakota. Geologist is standing on Yellow Mounds Paleosol. Resistant ledges are siltstone. Overlying the CPF is the Peanut Peak Member of the Chadron Formation which shows typical haystack weathering.

MINERALIZATION



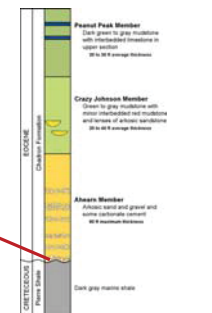
Uranium mineralization occurs in a typical roll front deposit. Uranium precipitates (carnotite) at the interface between oxygen rich groundwater and oxygen poor groundwater. This interface is also known as a "Redox Front". Iron minerals change from hematite to pyrite at the "Redox Front". The change in iron mineralization is often used as an exploration tool.



Mineralization occurs in the basal sands of the White River Group. Electric log courtesy of Cameco Corp.



Arkosic gravels of the Ahearn member of the Chadron Formation near Red Shirt, South Dakota. Clasts include granite and metamorphic rocks from the exposed Precambrian core of the Black Hills uplift. No significant uranium mineralization has been found to date in the Chadron Formation.

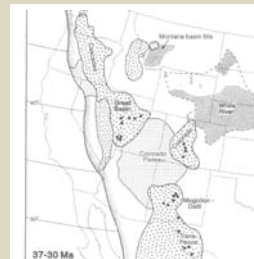


Stratigraphic column for the Chadron Formation in the Red River Paleovalley in South Dakota. [modified from Clark et al, 1967]

SOURCE OF URANIUM

Volcanic Glass + H₂O = Clay [montmorillonite] + SiO₂ + U⁴⁺ (in solution)

Tuffaceous sediments of the White River Group are likely the source of the uranium in the Gas-Hills, Crooks Gap, Shirley Basin, and Powder River Basins deposits of Wyoming. Zieleski (1983)



The Source of the White River Group tuffs has been shown to be from the calderas of the Great Basin in what is now eastern Nevada and western Utah. Larson & Evanoff (1998)

Roll front mineralization trends NW-SE. The groundwater flow direction during mineralization is shown by the arrow Gjelsteen and Collings, 1988. The area of well field development is east of the arrow and is 6 miles long and 1/4 mile wide.