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PS Hydrostratigraphic Controls from Uranium Mineralization - Example: The Nebraska Panhandle*

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Abstract

The Nebraska Panhandle is arguably one of the most overlooked uranium provinces in the US. Since 1991, the Crow Butte mine in Northwest Nebraska has produced a little over 13 million pounds of U_3O_8 utilizing ISR technology. Demand and price increases indicate the possibility for additional exploration, exploration that may be enhanced by an improved understanding of the hydrostratigraphic controls on the uranium deposits. Uranium at the Crow Butte deposit occurs in the basal sandstone of the Chamberlain Pass Formation (CPF). New stratigraphic models can be used to reconstruct the paleohydrogeology of the White River Group (WRG) and provide direction for exploration.

The CPF consists of a basal white to greenish white sandstone composed of coarse grains of quartz, quartzite and chert. Extensive chemical weathering including the removal of iron and kaolinization give the sandstone a “bleached” appearance. The sandstone thickness varies from 0 to 350 feet and unconformably overlies the Cretaceous Pierre Shale or the Yellow Mounds Paleosol. The uppermost part of the CPF is the bright red Interior Paleosol Series and the laterally equivalent light green Weta Paleosol Series. The Chadron Formation unconformably overlies these paleosols and consists of bluish green mudstones; thin, interbedded, lacustrine limestone beds and localized channel sandstone deposits. The Chadron Formation sandstones are arkosic and contain more weatherable minerals than the CPF. Differentiation of the two sandstones is likely a critical factor in exploring for uranium.

The tuffaceous WRG rocks have long been considered the source of uranium in the Tertiary basins of Wyoming. Although the overlaying Chadron Formation bentonitic mudstones might be considered a source of uranium, evidence from paleohydrogeology [tufas, lacustrine limestone, reducing paleosols] suggests that groundwater table was high and groundwater discharge was largely local. In contrast, groundwater during the development of the Interior-Weta Paleosol Series was largely oxidizing and groundwater flow was downward into the underlying aquifers [CPF and older units]. Thus the initial uranium mineralization at Crow Butte probably occurred during the development of the Interior-Weta Paleosol Series at the CPF-Chadron Formation unconformity. Exploration efforts in Nebraska should consider these hydrostratigraphic relationships and be directed to permeable formations underlying the Interior-Weta Paleosol Series.

References

Catuneanu, O.C., 2006, Principles of Sequence Stratigraphy, Amsterdam, Elsevier, 375 p.

Clark, J., et al., 1967, Oligocene sedimentation, stratigraphy, paleoecology and paleoclimatology in the Big Badlands of South Dakota, Field Museum of Natural History, Fieldiana Geology Memoirs, v. 5, p. 158.

Dickinson, K., 1991, Uranium and diagenesis in evaporitic lacastrine mudstone of the Oligocene White River Group, Dawes County, Nebraska, USGS Bulletin 1956.

Evans, J.E., 1996, Evidence for Late Eocene unroofing of the Black Hills Uplift, Geological Society of America Abstracts with Programs, v. 28, no. 7, p. A373.

Evans, J.E. and L.C. Welzenbach, 1998, Episodes of carbonate deposition in a siliciclastic dominated fluvial sequence, Eocene-Oligocene White River Group, South Dakota and Nebraska in Geological Society of America Special Paper 325, Depositional Environments, Lithostratigraphy, and Arikaree Groups (Late Eocene to Early Miocene, North America).

Gjelsteen, T.W. and S.P. Collings, 1988, Relationship between groundwater flow and uranium mineralization in the Chadron Formation, Northwest Nebraska in Wyoming Geological Association Guidebook, 1988, Eastern Powder River Basin Black Hills.

Larson, E.E. and E. Evanoff, 1998, Tephrostratigraphy and source of the tuffs of the White River sequence in Geological Society of America Special Paper 325, Depositional Environments, Lithostratigraphy, and Arikaree Groups (Late Eocene to Early Miocene, North America).

Swinehart, J.B., V.L. Souders, H.M. DeGraw, and R.F. Diffendal, Jr., 1985, Cenozoic paleogeography of Western Nebraska, *in* R.M. Flores and S. Kaplan eds., Cenozoic paleogeography of the West-Central United States, Special Publication, Rocky Mountain Section, Tulsa, Society of Economic Paleontologists and Mineralogists, p. 209-229.

Terry, D.O., 1998, Lithostratigraphic revision and correlation of the lower part of the White River Group, South Dakota to Nebraska in Geological Society of America Special Paper 325, Depositional Environments, Lithostratigraphy, and Arikaree Groups (Late Eocene to Early Miocene, North America).

Terry, D.O. and J.E. Evans, 1994, Pedogenesis and paleoclimatic implications of the Chamberlain Pass Formation, Basal White River Group, Badlands of South Dakota, Palaeogeography, Palaeoclimatology, Palaeoecology, v. 110, p. 197-215.

Zielinski, R.A., 1983, Tuffaceous sediments as source rocks for uranium: a case study of the White River Formation, Wyoming, Journal of Geochemical Exploration, v.8, p. 285-306.