Theme 9: Expanding Energy Frontiers on Earth, Moon, and Mars

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Abstract

In contrast to petroleum source rocks, identifying uranium source rocks has been more problematic. Potential source rocks that are relatively high in uranium include granite, tuffaceous sediments and carbonaceous marine shales. Uranium is released as U+6 in solution when these rocks are weathered under oxidizing conditions. Uranium [U+4] is insoluble under reducing conditions and uranium minerals can precipitate at the boundary between oxidizing and reducing conditions. A roll front uranium deposit can form in underlying aquifers at the interface between oxidizing groundwater and reducing groundwater. While the roll front model has been successfully applied in the discovery of many uranium deposits, there are significant sedimentary deposits where the roll front model is not applicable. Identifying oxidizing fossil soils [paleosols] depleted in uranium in comparison to parent material can be a key component for understanding the source, migration, and accumulation of uranium in the sedimentary environment. Tuffaceous sediments of the White River Group may have been the source of uranium found in roll front deposits formed in older Paleogene sediments in Wyoming and Nebraska. Recent test hole drilling by the Conservation and Survey Division of UNL has penetrated the entire White River Group section at a number of sites in Western Nebraska. Detailed sampling of drill cuttings and geophysical logs has shown that the Yellow Mounds Paleosol Series has anomalously low gamma readings compared to the parent material (Pierre Shale), and some geophysical logs showed a sharp gamma spike at the top of the unweathered shale. There were no noticeable low gamma readings in paleosols in the White River Group in the test holes possibly due to the relative thinness of the White River Group paleosols. The most likely candidates for source rocks are the Interior Paleosol Series, which formed at the unconformity at the top of the Chamberlain Pass Formation, and the paleosols of the lower part of the Chadron Formation. Whole rock chemical analyses quantifying thorium, uranium, and rare earth elements would help identify which paleosols were possible source rocks. Analyses of the lower White River Group paleosols will resolve some of the basic questions concerning the genesis of the deposit at the Crow Butte ISR mine that has recovered 18 million pounds of yellowcake [U3O8]. Identifying specific paleosols as uranium source rocks within the White River Group is important in developing strategies for exploration of uranium deposits in the sedimentary environment in other areas

Recognizing Uranium Source Rocks in the Sedimentary Environment

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