Geology of the Buss Pit roll-front uranium deposit, Gas Hills, Wyoming*

Corresponding author: Jena M. Long, Colorado School of Mines, Department of Geology and Geological Engineering, long.jenamarie@gmail.com

Co-authors:
Thomas Monecke, Colorado School of Mines, Department of Geology and Geological Engineering, tmonecke@mines.edu

Sandstone-hosted roll-front deposits represent a significant portion of the world’s uranium resources and are attractive exploration targets as they are amenable to in-situ mining. These deposits form when oxidized, uranium-bearing groundwater encounters a redox boundary creating a crescent-shaped ore body. Reducing conditions downstream of the roll-front are typically thought to be related to the presence of pyrite or organic material within the aquifer. However, at least some roll-front deposits occur within aquifers that contain only low amounts of in-situ reductants. It is possible that the leakage of reduced fluids along faults creates the necessary chemical trap for their formation.

The Buss Pit deposit in the Gas Hills district of Wyoming represents a roll-front deposit that is hosted by sandstones of the Wind River Formation that have a low organic carbon content and contain little diagenetic pyrite, possibly providing an inadequate amount of reductant to form a major uranium deposit. However, the Gas Hills district is known for the surface discharge of hydrocarbons that are derived from deeper in the Wind River Basin. To test whether there is a potential connection between the location of uranium ore at the Buss Pit and deep-seated faults that may control upflow of mobile reductants, a three-dimensional model of the deposit area has been developed.

Geophysical logs with gamma ray and resistance curves were used to reconstruct the deposit stratigraphy, the shape of ore zones, and the location of faults. The stratigraphy of the Wind River Formation was modeled by correlating geophysical logs across the study area. The shape of the ore zones and the grade distribution were derived by digitizing gamma ray curves and calculating equivalent percent uranium oxide grades for each log. The interpreted geophysical dataset was combined to create a three-dimensional model that shows resistive and non-resistive lithologies, ore zones, and major faults. The host rock succession is composed primarily of fining-up sequences of dominantly arkosic conglomerate to sandstone with variably discontinuous siltstone to clay interbeds. This sedimentary package has six fining-up sequences that dip gently to the south. The steeply dipping, normal Buss fault strikes E-SE, bisecting the deposit area and historic open pit. The ore zones were modeled into three grade shells and generally occur in resistive lithologies in the southwest quadrant of the study area. The grade shells define an intricate collection of planar and crescent-shaped ore bodies dipping to the west.

The three-dimensional deposit model establishes a spatial relationship between the ore zones of the Buss Pit deposit and the Buss fault. The complex morphologies of the ore zones give insight into paleoflow direction and the significance of the faults in delivering reductants. The study reveals potential large scale structural controls on the formation of roll-front uranium deposits. It is shown that three-dimensional modeling of geologically complex uranium deposits can provide important insights for near-field exploration and in-situ extraction.