# Elucidating the role of non-crystalline U(IV) in uranium roll-front formation

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Uranium ore in sandstone-hosted roll-front deposits is often assumed to consist primarily of uraninite ($UO_2$). A multi-discipline study of uranium roll-fronts at Smith Ranch Highlands, Wyoming has provided information on how microbially-mediated precipitation of non-crystalline, monomeric U(IV) may play an important role in ore genesis. Specifically, this study describes the composition of U within roll-front deposits using an array of biogeochemical techniques, including X-ray absorption spectroscopy, $^{238}U/^{235}U$ isotope ratio analyses by MC-ICP-MS, and DNA-based (16S rRNA) microbial community analysis. Molecular-scale spectroscopic data indicate between 58 and 92% of U(IV) in the ore zone is composed of non-crystalline U(IV). U isotope analyses reveal that non-crystalline U(IV) was predominantly enriched in $^{238}U$, indicating that the deposit was primarily formed via biotic reduction of U(VI) [1]. Microbial community analysis using 16S-rRNA sequencing data indicated the presence of microorganisms (such as *Pseudomonas*, *Clostridium* and *Geobacter)*, capable of reducing U(VI) to form non-crystalline U(IV) within these roll-fronts. We present a new conceptual model which depicts the distinct reduction pathways leading to the formation of reduced U(IV) species during roll front deposit genesis.

[1] Stylo et al. (2015), PNAS, in revision or Stylo M., et al. (2014) *Goldschmidt Conference Abstract* #**2404**.