

The Lost Creek Roll-Front of Wyoming: Active or Fossil Deposit?

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Abstract

Roll-front deposits are important sources of uranium and whether these deposits are actively forming, or fossil deposits is currently unknown. To investigate this question, we analyzed pre-mining core as well as groundwater samples collected within the last 15 years from the Lost Creek deposit, hosted in the 55-47 Ma Battle Springs Formation in the northern Great Divide Basin, Wyoming. Four distinct zones of water chemistry are present in the deposit; from furthest up the hydrologic gradient to downgradient these are: oxidized, semi-oxidized, semi-reduced, and reduced zones. In the semi-oxidized and semi-reduced environments, it is inferred that pyrite dissolution produces several metastable sulfur species that disproportionate to $H_2S(aq)$ and SO_4^{2-} . In the upgradient oxidized zone, pyrite and uranium minerals are absent and aqueous sulfate and uranium concentrations (75-145ppm and 4-121ppb, respectively) are low. In the semi-oxidized zone, small amounts of pyrite and uranium minerals are present, aqueous sulfate exhibits a broader range of concentration (95-204ppm), and aqueous uranium concentrations are greater (273-844ppb). In the semi-reduced zone, the amount of pyrite has decreased due to oxidation by aqueous hexavalent uranium, as corroborated by an increase in tetravalent uranium minerals, a decrease in aqueous uranium concentrations (18-201ppb), and a slight increase in aqueous sulfate concentrations (161-259ppm). The amount of pyrite again increases whereas the amount of uranium minerals decreases in the reduced zone due to lessened aqueous uranium (6-184ppb) and a return to aqueous sulfate concentrations characteristic of the oxidized zone (71-144ppm). The patterns of mineralization and aqueous geochemistry are characteristic of an actively forming roll front deposit, and the Lost Creek roll-front is interpreted as being active within the last 15 years.

