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Biogeochemical controls of dissolved uranium bioavailability across multiple mining environments

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Dissolved uranium (U) is bioavailable to aquatic invertebrates, although the extent of bioavailability varies among species and geochemical conditions (e.g., pH, water hardness and presence of natural organic matter). Experimental U exposures combined with speciation modeling that included formation constants for ternary Ca-U-carbonato complexes showed that dicarbonato U species (e.g., $UO_2(CO_3)_2^{-2}$) best predict U bioavailability to a model freshwater invertebrate (*Lymnaea stagnalis*) [1]. Additionally, correlations between U accumulated by aquatic insects and total dissolved U species in the field were stronger when based on modeled concentrations of dicarbonato U complexes than total dissolved concentrations [2]. Both experimental and field study results point to the low bioavailability, and likely low toxicity, of ternary U complexes, which has also been reported in humans chronically exposed to U in drinking water. Here we ask whether the geochemical drivers of U bioavailability are broadly applicable across different types of U deposits. We analyzed U in surface water, sediment, and endemic insect larvae in the Cove area of Navajo Nation (NM), near sandstone-hosted U deposits. Next, we will calculate aqueous speciation and characterize U exposure from the dissolved phase using species fractions of total U and concentrations of selected U species. We will combine results with data collected in the Grand Canyon Region (solution-collapse breccia pipes U deposits) as well as in the Gas Hills mining district [3] in central Wyoming (roll-front deposits), to assess whether dicarbonato complexes best predict bioavailability across mineral deposits.

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