Implications of changing climate on environmental effects of uranium mining, northern Arizona, USA

KATIE WALTON-DAY[1], CARLETON BERN[1], MICHAEL C. DUNIWAY[2], BRIAN ANDRASKI[3], CHRIS GREEN[4]

[1]U.S. Geological Survey, Denver Federal Center, Box 25046, MS 415, Denver, Colorado 80225 kwaltond@usgs.gov, cbern@usgs.gov

[2]U.S. Geological Survey, 2290 SW Resource Blvd., Moab, UT 84532 mduniway@usgs.gov

[3]U.S. Geological Survey, 2730 N. Deer Run Road, Carson City, NV 89701 andraski@usgs.gov

[4]U.S. Geological Survey, P.O. Box 158, Moffett Field, CA 94035 CA 94025 ctgreen@usgs.gov

Environmental effects of underground mining of breccia-pipe uranium (U) deposits in the Grand Canyon region of northern Arizona are being studied by comparing mine sites at different points in the mine-life cycle (pre- mining, active mining, post-mining, and post-reclamation). Common surface geology and climate make such comparisons relevant. Changing climate may affect two processes that redistribute ore-derived elements (e.g. U and arsenic) in the near-surface environment during the mine-life cycle. First, aeolian sediment dispersion occurs during surface storage of ore and waste rock. This process creates a halo of elevated concentrations of ore-derived elements (up to 50 times pre-mining concentrations but generally less than non-residential soil screening levels) and gamma radiation (up to 10 times pre-mining amounts) around the mine perimeter during and after mining and reclamation. A drier, windier climate could increase aeolian sediment dispersion. For example, the reclaimed site had mine waste stored at the surface and exposed to wind three times longer than the post-mining site. Consequently, the aeolian sediment dispersion halo at the reclaimed site had greater concentrations and gamma radiation than at the post-mining site. Second, infiltration (from precipitation events) and bioturbation move elements into the vadose zone within and outside the mine perimeter. For U, these amounts increased from 0 grams/meter^2 (g/m^2) pre-mining up to 4.6 g/m^2 post-reclamation. Element movement into the subsurface could increase or decrease with drier climate, depending on the frequency of extreme precipitation events. Understanding how the forces (wind and precipitation) driving the environmental effects (aeolian sediment dispersion and infiltration) vary with climate has implications for mine-waste management. For instance, drier climate may warrant on-site dust control using something other than water to minimize both dust transport and infiltration.