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Arsenic as a mining remediation and restoration challenge in the Salmon River Mountains, Idaho, U.S.A.

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The Salmon River Mountains, encompassing approximately 23,000 km^2 at the headwaters of the Columbia River, provide critical habitat for Chinook salmon (*O. tshawytscha*), steelhead (*O. mykiss*), and bull trout (*S. confluentus*) fisheries within the ceded lands of the Nez Perce and Shoshone-Bannock Tribes. Over a century of mining has affected fishery health through the mobilization of arsenic and mercury associated with gold-antimony and cobalt-copper mineral deposits. As antimony, copper, cobalt, and rare earth elements come into increasing demand to support the transition to “carbon-neutral” energy sources and vehicles, re-extracting mine waste is becoming economically feasible as a mechanism for remediation. Rock and stream sediments collected in the Salmon River Mountains through U.S. Geological Survey Idaho Primitive Area studies show elevated geological background concentrations of arsenic associated with mineralization. Arsenic is further concentrated in mine waste, resulting in stream water concentrations exceeding the U.S. EPA drinking water limit of 10 ng/L As directly downstream from historical mining. Multiple active mining operations use onsite treatment of mine waters through ion exchange and pH adjustment prior to the discharge of these waters into complexes of riparian wetlands and streams. Identifying placer mining sites along streams and avoiding constructed wetlands at these locations can help mitigate unintended increases in arsenic and mercury associated with these stream reaches. Developing a restoration plan that can stabilize wetlands with fluctuating stream flow associated with highly variable snowpack levels under climate change can further sustain long-term remediation of modern and historical mine sites.