Watershed effects of historic chromite mining in northern California, USA

JOANN M HOLLOWAY[1], CHRISOPHER MILLS[1], JOHANNA KRAUS[2] AND MARTIN B GOLDHABER[1]

[1]United States Geological Survey, Denver, CO 80225, USA
[2]United States Geological Survey, Fort Collins, CO 90526, USA

Ultramafic rocks in northern California host chromite ores associated with dunite and harzburgite in Glenn Counties and with serpentinite in Tehama County. Historic mining activities can result in the increased mobilization of trace metals associated with these ultramafic rocks, potentially resulting in enhanced mobilization of Cr, Ni, and other trace metals into stream sediment, soil, and water.

Water extracts yielded concentrations that are elevated above most natural background samples: 4-43 μg Cr(VI) kg^{-1} for soil and waste rock (1120-16,000 mg Cr kg^{-1}) associated with a dunite- and harzburgite-hosted chromite mining district, active through the 1940s. Stream water immediately down gradient from the mined site had 2 μg L^{-1} Cr, with 1μg L^{-1} Cr(VI). As chromite is poorly soluble, the water- extractable fraction of Cr is likely the effect of pore-scale redox processes rather than an outcome of bulk concentration.

The watershed-scale effects of mining were not readily distinguished from the geologic influences on water chemistry. Low-order streams in an unmined watershed have <0.5 to 2.8 μg Cr(VI) L^{-1}, with total Cr concentrations of120 to 920 mg Cr kg^{-1} in the sediments. An adjacent watershed with several small-scale historic mines had <0.5 to 1.7 μg Cr(VI) L^{-1} in low-order streams with total sediment concentrations of 1510 to 4400 mg Cr kg^{-1}, suggesting that mining impacts stream sediments more directly than water quality.

With respect to stream biota, Cr uptake by stoneflies tended to increase with Cr(VI) concentrations in streams, with no notable correlative relationship between stream water Cr concentrations and uptake of Cr in mayfly larvae or riparian spiders. This suggests that stoneflies may provide an effective indicator of Cr uptake into aquatic ecosystems.