ARSENIC IN WATERS AFFECTED BY MILL TAILINGS AT THE LAVA CAP MINE, NEVADA COUNTY, CALIFORNIA

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The Lava Cap mine in the Nevada City mining district, Nevada County, is one of more than 4000 productive lode gold mines in the Sierra Nevada region of California. It exploited a quartz-carbonate vein system. The main period of production was 1934-1943. Ore was processed in a flotation mill, and sulfide concentrates shipped to a smelter off-site. A log tailings dam was built 0.4 km below the mill on Little Clipper Creek, and later a larger rip-rap tailings dam, now the site of Lost Lake, was built 2 km farther downstream. During a heavy storm on 31 December 1996 the log tailings dam broke, releasing about 20,000 yd^3 of tailings into Little Clipper Creek and Lost Lake.

The released tailings were mostly very fine grained and included unoxidized sulfide minerals, which contained arsenic and lesser amounts of zinc, copper, lead, antimony, silver, and cadmium. The sulfides oxidized rapidly and released metals and sulfate to the stream and lake waters. In the northern lobe of Lost Lake, where flood water containing fine-grained tailings was trapped, arsenic concentrations in the lake water increased more than 30-fold during the summer of 1997. Pore waters in fine-grained reduced tailings immediately below the sediment-water interface in Lost Lake have high concentrations of arsenic, dominated by As(III). Suboxic water that seeps out under Lost Lake dam has much lower arsenic concentrations (also As(III)), even though it has presumably traversed a thick section of tailings impounded behind the dam. In addition to arsenic from tailings, Little Clipper Creek receives arsenic from mine drainage, about half of which is always As(III). As(V) is dominant in Lost Lake surface water and in Little Clipper Creek away from tailings, and significant methylation of arsenic occurs in the water column of Lost Lake.

Bacterial mats that accumulate Fe(III) and arsenic form at sites where oxygen-depleted waters, which have been in contact with tailings, are exposed to the air. The mats are composed of a community of iron-oxidizers, dominated in biomass by Leptothrix ochracea. We used X-ray absorption spectroscopy (XAS) to evaluate arsenic speciation in these mats. As(V) appears to be the only form of arsenic in the mats, even where As(III) dominates in the surrounding water. One mat contained more than 5000 ppm arsenic, a significant accumulation relative to the water in contact with it, which had about 100 ppb arsenic.

Progressive oxidation from arsenopyrite/arsenian pyrite to scorodite-like secondary phases, and then to sorption/coprecipitation complexes on iron oxyhydroxides, can be observed at Lava Cap/Lost Lake by following arsenic speciation in solid-phase products using XAS.