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The Environmental Legacy of California's Gold Rush: Arsenic and Mercury Contamination from Historic Mining

California's mid-19th century gold (Au) rush produced incredible wealth and left a rich historical legacy. However, the contamination of water, sediment, and biota by arsenic and mercury is part of the environmental legacy associated with historic mining in California, and remains an important concern (and cost burden to taxpayers) today. Synchrotron-based X-ray spectroscopic techniques have been and continue to be important for understanding and mitigating the negative environmental impacts of these two elements, in California and around the world.

A major environmental legacy of the CA gold rush are the fish consumption advisories in place for most of the state's water bodies that received sediment from mercury (Hg) mining operations in the California Coast Range mountains and/or early Au mining operations in the Sierra Nevada (at which Hg was used to recover Au by amalgamation). The sediment contained elemental mercury [Hg(0)] as well as more soluble Hg minerals; all of these can be transformed to organic methylmercury under specific environmental conditions. Methylmercury is a potent neurotoxin that biomagnifies up the food chain, creating health risks for consumers of high-trophic level fish. Synchrotron-based methods have proved key to the identification of the forms of mercury at historic Hg mines and have also helped to elucidate the physiological mechanisms of Hg toxicity in lab studies.

A second environmental legacy of the CA gold rush is the contamination of large areas of mined land in the Sierra Foothills region by arsenic (As), which is a known carcinogen in its *dissolved*, inorganic forms. Unlike the case for Hg, which was purposefully introduced at the Au mines, As naturally occurs in close association with Au in the deposits that were mined extensively in the Sierra Foothills during the gold rush. Ingestion and/or inhalation of As-rich particles are important pathways of human exposure to the element in the vicinity of historic mine sites, but knowledge of the specific forms of particulate As present is required in order to model the As-specific health risk. Because this information is difficult to obtain, site-specific assessments of arsenic bioavailability (in animal models) can be required in order to redevelop historically-mined lands in this region. The high cost of these studies can often slow or halt the redevelopment of these lands, and the lack of such testing has resulted in several high-profile lawsuits and expensive cleanup operations in the past. Synchrotron-based methods have been used extensively to describe the forms of arsenic present at individual CA mines, and are currently being used to develop a more streamlined, economical approach to assessing the human health risks related to particulate arsenic at historic mine sites in the Sierra Foothills region.

Biography: Andrea L. Foster was born in Indiana and spent most of her childhood there (with brief stays in Connecticut and Kentucky). She obtained her B.S. (honors) in Geology from Indiana University (Bloomington) in 1992 and her PhD from Stanford University in 1999. The same year, Foster accepted an appointment with the USGS Mineral Resources Program in Menlo Park. Her work investigating the environmental chemistry of arsenic at California mine sites began with PhD research and continues to this day. However, she has also participated in mineral resource and/or environmental investigations of other elements including cadmium, chromium, copper, gallium, selenium, tellurium, and zinc; many of these studies were focused on sites in CA. Foster has primarily used synchrotron X-ray techniques in her research, but is actively developing in-house Raman spectroscopic methods to augment her synchrotron studies.