THE TOXIC EFFECTS OF CALIFORNIA'S GOLD RUSH LEGACY: PROFILING A MAJOR NORTHERN CALIFORNIA WATERSHED FOR ARSENIC USING HAND-HELD XRF

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Field portable ED-XRF instruments have greatly reduced the time and effort required to screen for ppm and higher levels of various metals in environmental samples. While these instruments have been widely used in the mining industry and environmental remediation studies, they have rarely been applied to the determination of toxic elements in water. This is primarily due to the fact that XRF limits of detection (LODs) for many toxic elements are in the low ppm range, whereas the typical concentrations of toxic elements in drinking and surface water samples are much lower. Note that both the EPA and WHO limit for arsenic in drinking water is 10 ppb. The use of field portable ED-XRF instruments for this application would enable on-site quantitative analysis, eliminate the need to collect and transport samples back to the laboratory, and permit faster and cheaper investigations of potentially contaminated water sources. The biggest challenge here is lowering the LODs by as much as four orders of magnitude so as to detect and quantify environmentally significant levels of toxic elements such as arsenic.

We recently described the development of a simple method for determination of ppb levels arsenic in water samples (Baker et al, DXC, 2008). This method relies on the use of an ion exchange resin to concentrate arsenic from water samples, followed by direct XRF determination of arsenic on the resin. Typical LODs for this method are on the order of 10 ppb using sample volumes on the order of 50 mL. In the first field test of this new method, it was used to survey arsenic levels in the Grass Valley watershed near Sacramento, California. This area is known to contain thousands of abandoned mines, many of which are in close proximity to streams that eventually drain into reservoirs that are used for supplying drinking water. The finely ground mine tailings near these sites accelerate natural erosion of arsenic from the mineral form into the highly toxic aqueous forms of arsenate and arsenite. By testing the arsenic contribution from each of the tributaries that converge into a single river, we can identify those containing significant levels of arsenic contamination and theoretically trace these back to specific sources.

This presentation will review California's mining legacy and how this has contributed to the arsenic contamination of water sources. It will include a discussion of the experimental design used to locate the source(s) of arsenic entry into the watershed as well as results from the field studies. Most importantly, it will demonstrate the utility of this new XRF method for rapid and reliable determination of arsenic in drinking water.