Antimony speciation in shooting ranges and its association with iron oxides

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Antimony compounds are known as environmental pollutants that may pose a serious threat to human health. The toxicity and bioavailability depends on the speciation of Sb. Antimony salts are known to be more toxic than other Sb compounds, and Sb^{3+} is more toxic than Sb^{5+}. Sources of Sb contamination are smelters, emissions from the coal power plants, mining activities, vehicular traffic, and shooting activities. The bullets used for shooting practice contain Pb, Sb and Fe. In Switzerland alone, the estimated annual input of Sb into the environment by these activities is approximately 6 tons. Analyses of the soils at the shooting ranges revealed Sb concentrations of up to 5900 ppm, significantly above the estimated global average concentra-tion in soils of 0.5 ppm (Reimann and De Carritat, 1998). Knowledge about secondary Sb-bearing phases formed during weathering of the bullets is crucial in order to assess the mobility and bioavailability of Sb in these environments.

Our results on weathering crusts around bullets show that various major Sb-bearing phases can be distinguished depending on the soil chemical conditions. Fe-rich phases always represent a major Sb host in the crust irrespective of the sampling site. Element distribution maps and quantitative analyses with an electron microprobe showed a correlation between Sb and Fe. X-ray diffraction analyses revealed that the crystalline Fe oxides are goethite and lepidocrocite. Raman spectroscopy of individual Fe-rich areas confirm the XRD results. The elevated background in the XRD patterns is attributed to ferrihydrite and organic material. In which way Sb is bound to these Fe oxides is not known to date and cannot be solved by the above mentioned techniques.

Knowledge about the geometry and binding behavior of sorbed Sb on different Fe oxide surfaces will help to evaluate the mobility of Sb in this system. Therefore, we collected Sb K edge EXAFS spectra of synthetic goethite, lepidocrocite, and ferrihydrite with different Sb surface loadings relevant to our field samples. The evaluation of these spectra will provide information about the Sb complexes on the surface of the iron oxide minerals. The comparison of these results with the spectra of the natural samples will then allow to describe the behavior of Sb associated with Fe oxides in the weathering crusts of the corroding bullets. The EXAFS studies are also important to numerous other sites polluted by Sb (e.g., acid mine drainage sites) where Fe oxides are known to act as scavengers of pollutants, for example Sb.

Reference

Reimann, C., and de Carritat, P., (1998), *Chemical elements in the environment: The Factsheets for the Geochemist and Environmental Scientis*t. 398 p. Springer-Verlag Berlin Heidelberg.

Using oxygen isotope and magnetism to reconstruct the paleotemperature framework of ancient travertine deposits in Death Valley, CA

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In the light of astrobiology research, studies of modern and ancient hydrothermal systems have illuminated our understanding of the origin and early evolution of the biosphere and highlighted the potential for life to develop in such environments on Mars and beyond. The recent discovery of iron oxides by Mars Rover Mission excited us for existence of water in the past, and possibility to find fossil life form in rocks. Oxygen isotope study may give us important information to interpret the geological history on Mars surface. Comparative studies of the sedimentology magnetism and geochemistry of modern and ancient analog systems are important with the particular goal of evaluating the paleotemperature regime and diagenesis. Such proxies allow better understanding of capture and retention of fossil biosignatures.

We developed a method to reconstruct a paleotemperature regime of fossil (Plio-Pleistocene) hydrothermal system in the Furnace Creek area of Death Valley, CA, USA.

To estimate the formation temperature for each fabric type, we applied the empirical equation of Kim and O'Neil (1997). Results showed that isotopic signatures of the Death Valley travertine sinters were correlated with paleotemperature environment and we show that the qualitative temperature relationships between fabric types were preserved. In addition the fabric type paleotemperature indicators are compared with magnetic paleotemperature indicators.