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Bioavailability of metals in soils and sedimentes affected by old mining actitvities. The study case of the Portman bay (SE, Spain)

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A study on metal (Zn, Pb, Cd, Cu and As) mobilization and analysis of the health risk represented by ingestion from contaminated sediments in Portman Bay (SE Spain) was carried out. This zone has suffered a great impact from mining activity, since million tons of mine tailings were dumped into the bay for a long period, giving as a result the filling of the bay with them.

The long-term deposition of metals in soils and sediments can lead to their accumulation and transport, while their toxicity depends on the mobility and bioavailability of a significant fraction of the metals. The ingestion of contaminated soil particles by grazing animals or young children may well represent a special exposure pathway for Pb, Cd and other hazardous metals.
The aim of this study was to determine the bioaccessibility of Zn, Pb, Cd, Cu and As ,and the extent to which bioaccessibility is influenced by mineralogy in materials from this mining site as an indicator of the potential risk that metals pose to both environmental and human health.
General analytical determinations (pH, particle size, organic matter, equivalent calcium carbonate content and mineralogical composition) were carried out to characterize the samples. The mineralogical composition was studied by X-ray diffraction (XRD), using a Philips PW3040 diffractometer with Cu-K.
To determine the total metal content, the samples were digested in a Milestone ETHOS PLUS microwave, Zn, Pb, Cu and Cd contents were determined by electrothermal atomization atomic absorption spectrometry, while As was analysed by HG- AFS using an automated continuous flow hydride generation spectrometer. To assess bioaccessibility, the gastric solution was prepared according to the Standard Operating Procedure (SOP) developed by the Solubility/Bioavailability Research Consortium (SBRC).
The mineralogical composition, corresponds to materials which have suffered a supergenic oxidation process which has been influenced by the presence of sea water. Unaltered minerals (phylosilicates, quartz, sulphides and magnetite) as well as those resulting of oxidation and carbonatation processes (iron oxihydroxides, hematite, siderite and jarosite) are identified. The results showed that the fraction of metals dissolved by the in vitro procedure is less than 100% in the gastric solution. The solubility of each metal under synthetic fluids depends on its chemical speciation and binding capacity to different soil and sediment materials
The data here obtained can be incorporated to the general protocol of risk analysis by ingestion applied to contaminated sites. This could be of interest since when risk assessments are adjusted to account for lower site-specific bioavailability, the resulting increase in cleanup levels can substantially reduce the cost of remediation in some cases