	X-ray absorption spectroscopy study of iron short-range order environment and lead speciation in base metal slag from S. Domingos abandoned mine (Portugal)	Experiment number: EC-7
Beamline: BM29	Date of experiment: from: 18/05/2006 to: 22/05/2006	Date of report: <i>Received at ESRF:</i> 20-04-2007
Shifts: 12	Local contact(s): Dr. Simone De Panfilis	
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Report:

The mining activity on the Iberian Pyritic Belt (Portugal and Spain) is known since Phoenician times, and was more intense during the Roman occupation of the Iberian Peninsula (for Gold) and after the industrial revolution (for gold, copper, zinc, lead and sulphur).

The commonest ore of this region is a massive polymetallic sulphide accumulation, where pyrite (FeS_2) is the main mineral, with variable concentrations of chalcopyrite (CuFeS_2), sphalerite (ZnS), galena (PbS), arsenopyrite (FeAsS_2) and other sulphides and sulfosalts. Furthermore, the ore compositions include several minor elements like Mn, Co, Ni, Se, Cd, Sb, Te, Hg and Bi. Some of the main and minor elements of these ores are hazardous and the drainage basins of pollutant source areas often induce health concerns in the resident population [1].

The problem is particularly serious at the abandoned mine of S. Domingos (southern Portugal) where the acid mine drainage is very intense. Moreover, since the main exploration purpose was the extraction of sulphur, large piles of metals-enriched slag were left “in-situ” for at least forty years. The soil contamination is so strong that several square kilometres exhibit a complete depletion of vegetation resembling a desert-area or display small clusters of metal hyper-accumulator plant species.

The present experiment focuses on iron and lead elements and on slags and their weathering products. The first element is a major constituent of these materials and its speciation must constrain the behaviour of pollutant cations. The lead is a hazardous element, highly mobile that harmful consequences on live is well-known.

The instrumental set-up of BM-29 beamline was used to collect absorption spectra in transmission and fluorescence mode at Fe K and Pb L_{III} edges. Slags (come apart by grain size) and their weathering products are the main centre of our attention in this experiment. But in order to modelling the various speciations of both metals, spectra was collected in model compounds (glass, Pb-jarosite, jarosite and others oxy-hydroxides, oxides and sulphate minerals phases) with known environment of iron and lead ions, figuring out different geometries and bond distances of oxygen, hydroxyls and water molecules. The samples was crushed and pelletized with BN.

A total of 91 useful summed EXAFS Fe K and Pb L_{III} edges spectra were collected from model compounds, slags, weathering products and sediments.

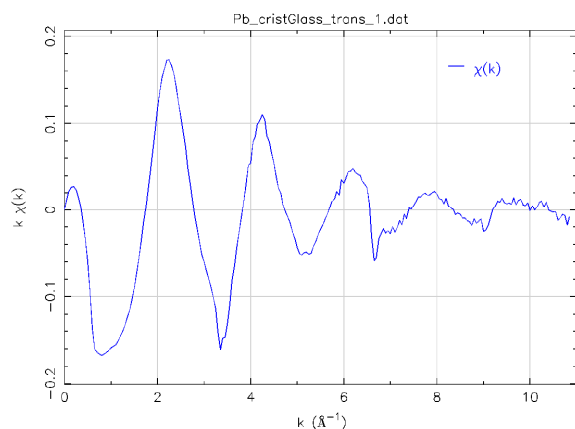


Fig. 1

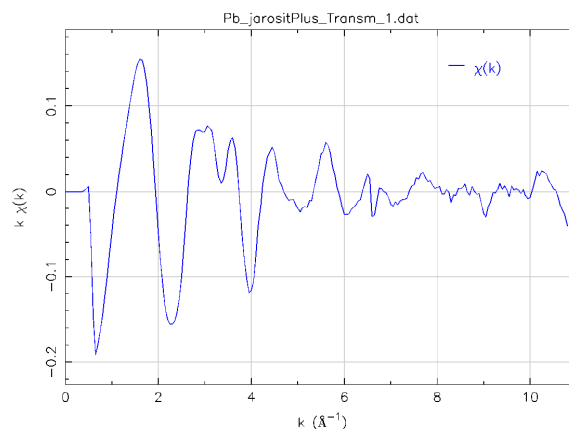


Fig. 2

The model compound glass (Fig. 1) and Pb-Jarosite (fig. 2) seems constrain almost all the variability of the Pb speciation on the abandoned nine of S. Domingos materials.

The slags are granulometrically sieved, in the fraction where the grain is bigger than 0,5 mm (fig. 3), the Pb shows an X-ray absorption pattern similar to Pb in glass (fig. 3). By the other side, the fraction inferior to 45 μm is similar to Pb-jarosite in what concern to Pb- L_{III} X-ray absorption (fig. 4). But it is clearly that each spectrum must have others contributions.

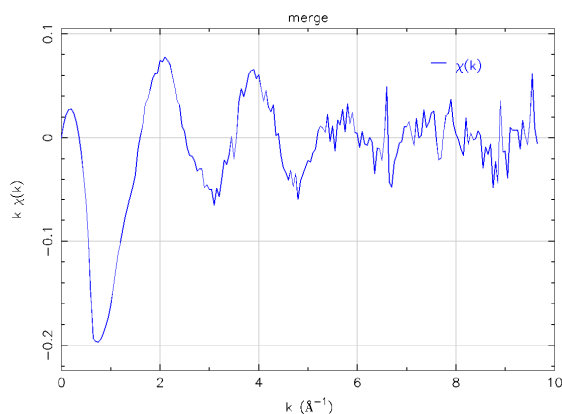


Fig. 3

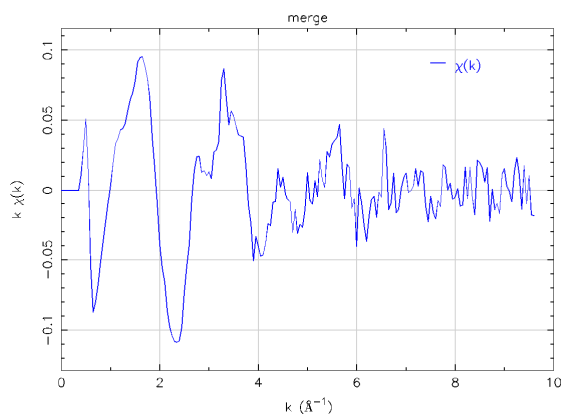


Fig. 4

The sediment transported by the drainage system shows also Pb- L_{III} spectra (fig. 5) that resembles the Pb-jarosite spectra. This aspect support the hypothesis that jarosite is the main Pb retainer in the region of S. Domingos abandoned mine, after the slags weathering

Further work on Fe K -edge Pb L_{III} -edge is in progress. The reliability of data in other samples is been tested and Linear combination fitting is carrying out.

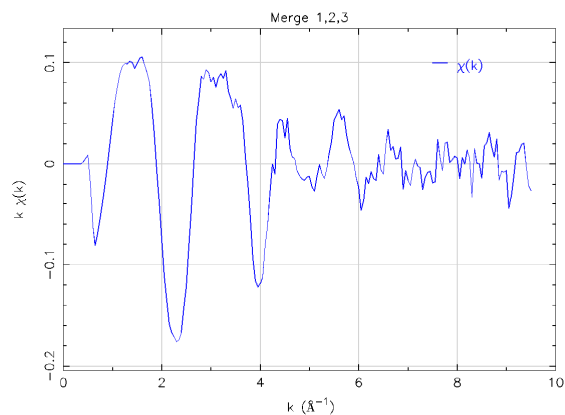


Fig. 5