



	Coordination environment of arsenic adsorbed on filters.	Experiment number: ME-1298
Beamline: BM30B FAME	Date of experiment: from: 16/11/2005 to: 20/11/2005	Date of report: 11/02/2006
Shifts: 12	Local contact(s): PALANCHE Hervé	<i>Received at ESRF:</i>
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The aim of this study was to determine the environment (coordination, length of bond) of arsenic adsorbed on filter. This information should help to develop new filtration process to decrease level of arsenic in drinking water.

Occurrence of arsenic in natural water is common. However inorganic arsenic is a well-documented carcinogen, and human exposure is associated with an increased risk of developing tumours of the skin, bladder, liver, kidney, or lung. The maximum recommended value level of arsenic preconised by WHO is 10µg/L of water. Bangladesh, a poor country in east of India, is affected by arsenic natural pollution of groundwater. About 60 millions pepole are living in a risk area. So development of filtration to treat water is an urgent need for Bangladesh population.

Synthetic water was made to simulate natural water. Adding base (KOH and limestone) was tested in order to make precipitate of iron-arsenic complex. Natural water from Bangladesh, acidified, and up in pH to 7-8 was used. After 20 min of contact between arsenic solution and base (KOH or limestone), solution was filtered on 0.45µm with a vaccum pump. Filters were dried for 1 hour at 60°C. Concentration of arsenic in water before and after formation of complex was measured by atomic absorption spectroscopy coupled with graphite furnace. Each precipitate catch in filter is over 100 ppm of arsenic. Analysis was done directly on filters or in pellets of residual over filter mix with boron nitride.

X-ray absorption spectroscopy (XANES and EXAFS) was performed with a monochromatic beam, around As absorption K-edge (11867 eV) and Fe adsorption K-edge (7112 eV) using XAS CRG BM-30b French beamline (FAME). The Si(111) monochromator was used. The beam was focused vertically on the sample using the second mirror and horizontally with the second crystal of the monochromator. The spot size was 200 µm * 200 µm. Analysis at Fe K-edge was done at ambient temperature. As K-edge was measured in cryostat at 100 Kn to reduce sample modification induced by high X-ray photon beam. Minimum of 3 spectra were done on each sample and no modification of K-edge was observed during repeated analyses. Detection was done in fluorescence mode with a 30-element solid state fluorescence detector for diluted samples and in transmission mode for standard and concentrated samples. Energy calibration was done using iron(0) foil for Fe K-edge and using Au-L₃ absorption edge for As K-edge.

XANES spectra show that arsenic is mainly in +5 oxidation state and iron is in +3 oxidation state in every case. Synthetic water present minor part of arsenic +3 (peak is visible on XANES derivative) which does not appear in natural water. Partial EXAFS spectra have been treated. At As K-edge a peak appears in natural water around 2.4 Å, very probably due to As-S binding. At Fe K-edge we noticed a difference in R-space a Fe-Fe binding which does not appear in natural water.

Our results suggest that As is mainly binding to oxydes but in natural water we also observe As-S binding, ressembling arsenopyrite standard. Major difference have been seen in precipitate made by adding base between natural water and our synthetic water. EXAFS treatment is in process for more precise results.

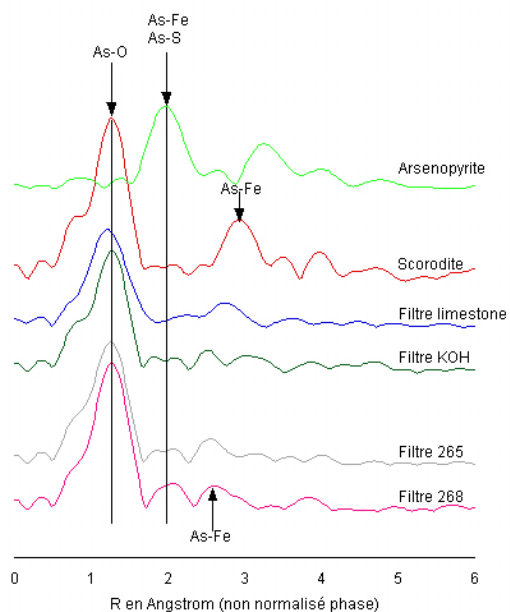


Figure 1. Oscillation in R space at As K-absorption edge.

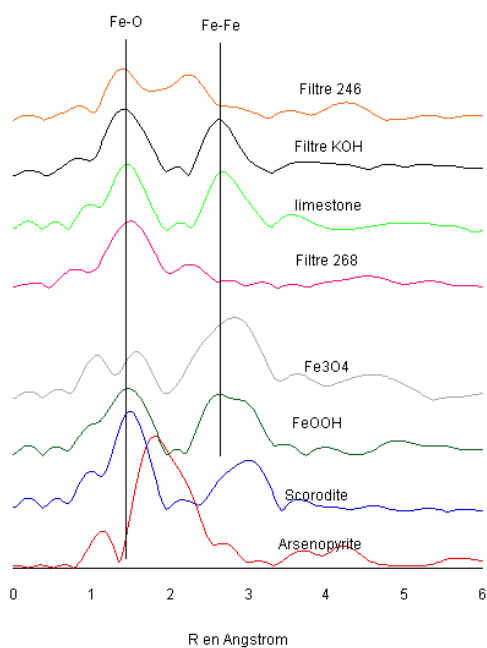


Figure 2. Oscillation in R space at Fe K-absorption edge.