

## Oxidation of natural groundwater from Bangladesh: Arsenic speciation evolution assessed by XAS

S. THORAL<sup>1</sup>, J. ROSE<sup>1</sup>, L. VAN GEEN<sup>2</sup>, J.M. GARNIER<sup>1</sup>,  
V. CHAPON<sup>3</sup>, J.L. HAZEMAN<sup>4</sup>, T. HEULIN<sup>3</sup>  
AND J.Y. BOTTERO<sup>1</sup>

<sup>1</sup>CEREGE CNRS-Univ P. Cézanne. Europole de l'Arbois,  
BP80. 13545 Aix en Provence. France

<sup>2</sup>Lamont-Doherty Earth Observatory. Columbia Univ.  
Palisades, NY 10964 USA

<sup>3</sup>LEMIR UMR 163 CNRS-CEA. Cadarache. 13108 Saint Paul  
lez Durance. France

<sup>4</sup>Laboratoire de Cristallographie. BP166. 38042 Grenoble  
Cedex 9. France

Arsenic poses a grave threat to human health in the southern portions of Bangladesh, where Arsenic concentrations are above 10 µg/l in over 50% of the wells, placing an estimated 20 million people at risk of developing neurological, skin diseases and cancer. The aim of our experiments was to determine As speciation in complex environment where Fe<sup>II</sup>, Fe<sup>III</sup>, Si and P contribute to As mobilization.

Fe and As K-edge XAS experiments have been carried out on the new XAS CRG French beamline (FAME) and on the D42 beamline of the LURE synchrotron.

XAS results confirm water oxidation kinetics that were realized on field which highlight that phosphates, silicates and natural organic matter may inhibit As-Fe complexation. The low intensity of the Fourier transforms peaks at As K-edge in the 2-4 Å range for the natural samples strongly suggests that the As-Fe interaction is not as important as believed and that the As mobility is not totally controlled by Fe. One interesting point is that Fe oxidation is catalyzed by the presence of As(III) in solution. But the most unexpected point is concerned with the highly probable As-Si interaction.

## Geochemical and mineralogical controls on arsenic release from uranium mine tailings

BRETT MOLDOVAN<sup>1,2</sup>, M. JIM HENDRY<sup>1</sup>,  
DE-TONG JIANG<sup>3</sup> AND GLENN HARRINGTON<sup>1</sup>

<sup>1</sup>Department of Geological Sciences, University of  
Saskatchewan, Saskatoon, Saskatchewan, Canada

<sup>2</sup> Cameco Corporation Ltd., Saskatoon, Saskatchewan, Canada

<sup>3</sup>Canadian Light Source Inc., Saskatoon, Saskatchewan,  
Canada

One of the most important environmental issues facing the uranium mining industry in Saskatchewan, Canada is the long-term stability of arsenic in its mine wastes. Decommissioning of these mine wastes requires that the long-term source contaminant potential of these primary contaminants of concern to the regional groundwater be known. Arsenic-rich uranium mine tailings from the Rabbit Lake in-pit tailings management facility (RLITMF) in northern Saskatchewan were investigated to determine the mineralogy and long-term stability of secondary arsenic precipitates. Tailings material was continuously sampled from the RLITMF to a depth of 72 m below the tailings surface. Detailed characterization of the geochemical parameters; pH, Eh and temperature, as well as solid- and pore-fluid chemistry and arsenic mineralogy were completed on the tailings samples.

Total arsenic concentrations in the mine tailings and their associated pore fluids ranged from 56 to 9,871 µg/g and 0.24 to 140 mg/l, respectively. Synchrotron-based X-ray absorption spectroscopic studies of tailings material showed that the arsenic in iron-rich areas of the tailings existed as the stable As<sup>5+</sup> and was adsorbed to 2-line ferrihydrite through inner sphere bidentate linkages. Single reservoir diffusion cell test work and synchrotron based X-ray absorption spectroscopic studies showed that aged tailings (up to 10 years) continue to adsorb arsenic via inner sphere bidentate linkages. Using results from field- and laboratory-based studies, the redistribution (via diffusion) and attenuation (via adsorption) of arsenic in the RLITMF was modelled using a three-dimensional mass transport model (MT3DVS) to provide the source term (mass flux) of arsenic migration from the tailings to the regional groundwater systems over the next millennia.