Identification of oxidation states of trace-level arsenic in environmental water samples using PIXE

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Abstract

An enhanced sample preparation method for PIXE analysis is described allowing to separate and concentrate arsenic ions of different oxidation states in water samples. Arsenate ions are separated from arsenite ions by co-precipitating into 10 ppm indium hydroxide colloids that are generated at pH 4.0 in a 25 ml solution containing 1 ppm phosphate ions and 25 ppm sulfate ions. Arsenite ions are oxidized to the pentavalent state with permanganate ions and adsorbed by indium hydroxide colloids generated afterwards in solution. The standard procedure for collecting the colloids adsorbing arsenic ions on Nuclepore filter of 0.2 μm pores is based on an investigation of the pH-dependence of the recovery of dissolved arsenic ions and the obtained standard calibration curve covers the concentration range from 1 to 100 ppb for arsenic ions. The prepared targets were examined for 5 to 10 minutes by 3 MeV proton beam (0.7-4 nA beam currents). The lower detection limit of arsenic in a 25 ml aquatic sample is 0.3 ppb for the arsenic-precipitated targets based on the 3σ error of background counts integrated over the FWHM of arsenic peak in the PIXE spectrum. This sample preparation technique was then applied to analyze concentrations and oxidation states of arsenic in a river basin where hot springs are located upstream being possible sources for releasing arsenic in the river.