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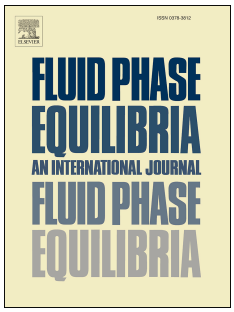

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Effect of the Ionic Strength and Temperature on the Arsenic(V) -Fe^{3+} and -Al^{3+} interactions in aqueous solution

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Abstract

Interactions between arsenic(V) and Fe^{3+} and Al^{3+} in aqueous solution were studied by potentiometry and, for Fe^{3+} system, by UV spectrophotometry too. Potentiometric measurements have evidenced the formation of $FeAsO_4^0$, $AlAsO_4^0$ and $Al(AsO_4)OH^-$ species with formation constant values log β = 17.77, 12.68 and 8.29, respectively, at I = 0.1 mol L^{-1} and T = 298.15 K. In order to applied speciation study to different kind of natural waters, the effect of the ionic strength on the thermodynamic parameters was analysed in the $0.1 \leq I \leq 0.7$ mol L^{-1} range and modeled by a Debye-Hückel type equation. In addition, the formation enthalpy changes of the species were determined by direct calorimetric titrations, in order to define the effect of temperature on the strength of interactions. Examples of distribution of species were reported in different experimental conditions. Finally, the ability of arsenate "to sequester" Fe^{3+} and Al^{3+} cations was evaluated by $pL_{0.5}$ empiric parameter, that represent the ligand concentration required to sequester 50% of the metal cation present in traces.

Keywords: As(V) interaction; thermodynamic parameters; ionic strength dependence; temperature dependence; sequestering ability

1. Introduction

Arsenic is the 20th most abundant element in the Earth's crust in amount of about 1.5-3 mg kg^{-1}, although its concentration is variable and depending on the type of rocks present [1, 2]. It is an ubiquitous element present in trace in all environmental compartments and in living organisms where it can exist in several forms. Between the inorganic forms, the most commons are arsenate (As(V)) and arsenite (As(III)), while the best known organic forms are the monomethylarsonic acid (MMA), the dimethylarsinic acid (DMA) and the methylated forms of arsine [3-6]. About 60% of arsenic is released by natural sources, as volcanic activity, but it is also due to human activities: arsenic compounds, in fact, are used as pesticides in agriculture and for wood preservation. Its toxicity, bioavailability and mobility depend on the speciation which is influenced by different parameters such as pH, redox potential, temperature, ionic strength. It should be remembered that the International Agency for Research on Cancer (IARC) has classified the arsenic as carcinogen class 1 that shows acute and chronic toxicity in relation to the kind of exposure. Usually, the

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