

Adoption of Eu(III) onto minerals in the presence of humic acids: effects of various solution parameters and sorptive fractionation on modelling and spectroscopy

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Adsorption of metals on minerals with humic acids is always under predicted [1]. The case of Eu(III) in ternary system including purified Aldrich humic acid (PAHA) and α -Al₂O₃ was measured, modelled and probed using time-resolved laser-induced luminescence spectroscopy (TRLS). Each binary system was studied independently [2,3,4], and the luminescence properties of Eu(III), luminescence spectra and decay times (τ), were acquired and compared [5]. Influence of ionic strength and PAHA concentration was also evaluated. The typical luminescence behaviour of Eu(III)-HA system, showing a bi-exponential decay, was also found in the ternary system Eu(III)/PAHA/ α -Al₂O₃, but with marked differences. Luminescence spectra and faster decay τ_1 are the same in both system at pH < 6, but with higher τ_2 indicating a rigid environment for Eu(III). For pH > 6, modifications of Eu(III) luminescence spectra and decrease of τ_2 are showing a progressive influence of α -Al₂O₃. The non-variation of τ_1 suggests the on-going influence of PAHA, notwithstanding its progressive desorption.

Comparing with previous data on sorptive fractionation of PAHA [2,3,6], and with the TRLS evolution of the system [5], an operational modelling was proposed [4], which implies that alumina-sorbed PAHA is showing a stronger interaction towards Eu(III) compared with non-sorbed PAHA even at pH > 7. This stronger interaction is due to the sorptive fractionation which reveals stronger binding sites [1,4,7].

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Geochemistry of European bottled water

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To obtain a first impression of the geochemistry and quality of ground water at the European scale bottled mineral water was used as a sampling medium. In total, 1785 bottled waters were purchased from supermarkets of forty European countries, representing 1247 wells/drill holes/springs at 884 locations. All bottled waters were analysed for 72 parameters at the laboratories of the Federal Institute for Geosciences and Natural Resources (BGR) in Germany. The result provide a first impression of the natural variation of chemical elements in ground water at the European scale. Maps demonstrate that geology is one of the key factors influencing the observed element concentrations for a significant number of elements. Examples include high values of (i) Cr clearly related to the occurrence of ophiolites; (ii) Li (Be, Cs) associated with areas underlain by Hercynian granites; (iii) F (K, Si) related to the occurrence of alkaline rocks, especially near the volcanic centres in Italy, and (iv) V indicating the presence of active volcanism and basaltic rocks. The natural variation of element concentrations in the bottled water covers usually between three to four orders of magnitude and reaches up to 7 orders of magnitude for a few elements (e.g., Li, U). A comparison with the chemistry of European tap water, surface water and Norwegian ground water shows surprising similarities in terms of median and variation. This proves that bottled water can be taken as a proxy for European ground water quality for the majority of elements/parameters. The bottled water samples showed, however, exceptionally high concentrations for a few elements typical for deep, hydrothermal sources (e.g., B, Be, Br, Cs, F, Ge, Li, Rb, Te and Zr).

Fortunately less than one percent of all samples returned values that were above the currently valid European maximum admissible concentrations (MACs) for drinking and/or bottled water (e.g., for As, Ba, F, Se, NO₃ and NO₂). It is, however, an important observation that currently there exist no water action levels for some of the elements that show an exceptionally high natural variation (e.g., Li and U).