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Investigation of V(V) interaction with Humic Acid in aqueous solution using anion-exchange Ion Chromatography

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The distribution of V chemical species in natural waters has been scarcely studied mainly due to its high reactivity and wide variety of co-existing forms depending on number of factors including metal concentration, pH, Eh, ionic strength, the presence of complexing ligands etc. ¹ Importance of V speciation studies lies in the dependence of toxicity and bioavailability upon different chemical species that V takes form of in natural waters, with V(V) being most toxic and soluble ⁴. Although thermodynamic calculations predict V(V) as dominant species in well oxidized marine environments, V(IV) is also reported to be present due to its ability to form stable complexes with Dissolved Organic Matter (DOM) related ligands found in natural waters ²⁻⁶. Furthermore, previous research report that Humic Acid (HA) acts as an adsorbent and complexing agent for many trace metals (Cu²⁺, Zn²⁺, Cd²⁺, Fe²⁺). However, HA impact on V speciation and potential removal from the water column of natural aquatic systems is still unclear ⁷.

Interaction of V(V) with HA was investigated in model solutions under different conditions using anion-exchange based Ion Chromatography with UV/Vis detection system. The goal of the research was to mimic natural conditions, as experimentally possible, in order to assess likely contribution of HA to changes in V speciation and potential removal from the solution by adsorption on HA colloids. Temporal study on V(V) reduction kinetics was conducted using strong chelator (EDTA) which was added in the filtrated solution prior to measurement in order to stabilize distribution of V species in the model solutions. Removal of V(V) from the solution on HA particles was quantified using calibration curves. Desorption experiments were performed with the addition of EDTA in un-filtrated solutions 24 hours before measurement.

Research showed that V interaction with HA is highly dependant on ionic strength of solution as well as ratios between V(V) and HA present in the solution. Desorption experiments showed almost complete recovery of V in the solutions with higher ionic strength, mainly in the form of V(IV). Observed reduction and removal of V(V) from the solution on the pH of natural waters suggest high impact of DOM on V speciation and consequently its toxicity and bioavailability.

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