

Trace Metal Binding to Natural Organic Matter: Insights from UV-Vis Differential Absorbance Spectroscopy

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The concentration of trace metals in the environment is increasing due to anthropogenic activities. These elements can accumulate in wildlife and crops, potentially exerting negative effects. The fate of trace metals in the environment is largely governed by sorption processes in soil and aquatic systems with natural organic matter (NOM) serving as the primary sorbent. The affinity of trace metals for NOM is determined by its concentration of functional groups, particularly carboxylates and phenolates, and the proton- and metal-binding affinity of these groups. However, due to its heterogeneous and polydisperse nature, characterizing NOM functional group remains challenging, especially in environmental conditions [1].

UV-Vis differential absorbance spectroscopy (DAS) provides a powerful tool for studying the binding of trace metals to specific NOM functional groups at environmentally relevant concentrations, without requiring harsh purification procedures. A novel data processing approach was developed to deconvolute the DAS signal across the UV-Vis range, separating contributions from carboxylic and phenolic functional groups. This method offers additional insights into the mechanism of trace metal binding to NOM, and their relationship to NOM characteristics, improving our understanding of metal-NOM interactions in natural systems. In this study, copper and cadmium binding to leonardite humic acid (LHA) was investigated across varying pH and metal concentrations. LHA absorbance decreases in the presence of increasing trace metal concentrations, while other humic substances have been reported to increase with higher trace metal concentrations [2], [3]. Additionally, DAS was used to examine copper binding to water-extracted NOM from agricultural organic amendments, providing insights into the behaviour of copper binding to environmental NOM samples relevant to an agricultural context.

References

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