# Binding Mechanisms of Heavy Metals in Soils after Long-Term Fertilization Treatment

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## Introduction

The fate of potentially toxic metals in the environment is controlled by their binding in soils. Here, we demonstrate how combining two-dimensional correlation spectroscopy (2DCOS) and synchrotron-based spectromicroscopies can be used to define the binding characteristics of heavy metals to soil DOM and nanominerals as part of a long-term (23 years) fertilization experiment [1, 2].
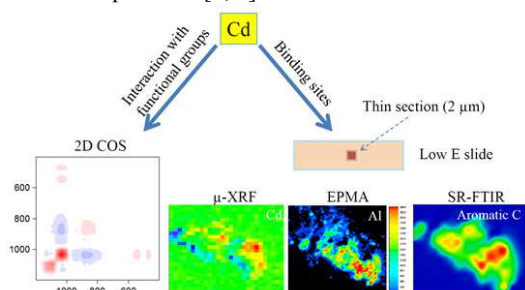


**Figure 1:** Integrated analysis methods for assessing Cd binding to soil DOM and nanominerals.

## Results and Discussion

2DCOS integrated with FTIR, $^{29}$Si nuclear magnetic resonance (NMR), $^{27}$Al NMR, and synchrotron-based FTIR and XRF spectromicroscopies enabled determination of different metal-soil binding mechanisms for different long-term fertilization treatments. With inorganic fertilizer treatment, Cu and Cd were bound to aliphatic C, whereas in a manure treatment, Si-O groups had higher affinity toward Cu and Cd than aliphatic C. Also, the sequences of metal binding to soil functional groups were modified by the fertilization treatments. Results suggest that different fertilization treatments can govern metal mobility in soils, and moreover, the coupled approaches employed here show wide utility for exploring the interactions among heavy metals, minerals and organic components in soils.

[1] Fusheng Sun et al. (2017) *J Hazard Mater* **326** 18-25.
[2] Fusheng Sun et al. (2017) *Environ Pollut* **223** 457-465.