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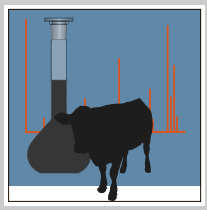

Highlights of Analytical Sciences in Switzerland

Division of Analytical Sciences

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Soil Contamination with Trace Metals: Quantification, Speciation, and Source Identification

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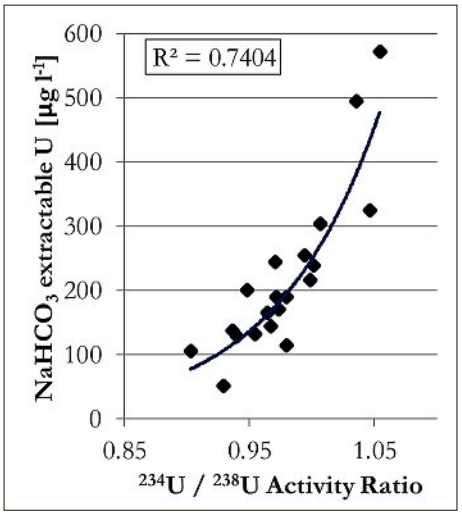
Keywords: High performance liquid chromatography (HPLC) · Inductively coupled plasma-mass spectrometry (ICP-MS) · Soil contamination · Speciation · Stable isotopes · Trace metal

Trace metals can naturally occur in soils or become enriched by anthropogenic activities. These compounds can be transferred to plants and ground or surface waters and therefore reach humans. However, only measuring total concentrations is not sufficient to assess and control exposure pathways of trace metals. New analytical tools such as speciation and heavy stable isotope ratios are also essential. Indeed, identification of sources and tracing of pollutants using isotopes are important for legal reasons and also to understand their fate while identification and quantification of the different forms of trace elements are necessary since they possess different toxicity and mobility.

As one example we investigated the role of mineral-phosphate fertilizers for uranium concentrations and isotope ratios in agricultural soils by ICP-MS analysis. We could show that arable sites and surface soils of arable sites show significantly higher concentrations than grasslands and subsoils. Finally, a correlation of mobile ($NaHCO_3$ extractable) uranium with the $^{234}U/^{238}U$ activity ratio (AR; fertilizer-derived U has an AR ≈ 1–1.05) implies that fertilizers significantly add to mobile uranium.

We also analysed the speciation of mercury (Hg) in a contaminated agricultural floodplain in Valais, by coupling HPLC to ICP-MS. We developed and validated a new method to easily screen soils, biota and sediments for methylmercury (MeHg) concentrations above 1 µg/kg. We found that in our studied area, MeHg concentrations in soils vary between <LOD and 8 µg/kg. We could also show that these concentrations can be multiplied by a factor of 5 when agricultural sites are flooded in the presence of organic matter (cow dung).



Relationship between the mobile U fraction and the U activity ratio in arable soils.

Developing new analytical techniques to measure heavy stable isotope ratios or to quantify the different species of trace metals present in the environment is essential to understand, ultimately prevent, and limit trace metal pollution in the environment.

Acknowledgement

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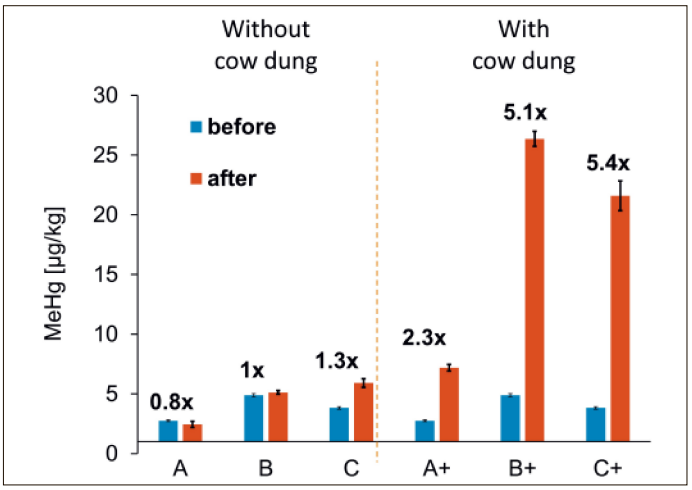
Reference

M. Bigalke, A. Rehmus, A. Keller, 'Belastung mineralisch gedüngter Böden mit Schadelementen (Arsen, Blei, Cadmium, Uran)', Bundesamt für Landwirtschaft, Bern, **2016**.

Sampling of arable soil for U isotope analysis.



Concentration of methylmercury (MeHg) in soils before and after an 11-day incubation under flooded conditions.

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