Trace elements in plants - correction methods for adhering particles to get real plant uptake

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Plant samples collected from open field trials for total trace element analysis (ICP-OES, ICP-MS) are prone to adhering dust or soil particles on the plant surface. These can lead to misinterpretation of trace element concentration in plant tissues and is important in phytoremediation, phytomining, provenance studies etc.

In general, elements with a very low concentration in the plant tissue such as Al, Cd, Co, Cr, Fe, Mn, Ni, Pb, REEs, Ti and U may show significantly altered concentrations due to adhering particles. This influence is negligible for elements which are enriched in the plant tissue (e.g. main or minor nutrient elements such as P, K, Ca, Mg, S, Mn, Cu, Mo, Zn). Washing the samples often cannot remove all particles.

In this study we show three different mathematical methods based on total element concentrations in plants and soils to subtract the influence of the adhering particles. These are based on soil to plant transfer factors of elements with a very low uptake ("adhering particle indicator elements", El_{ind}), and include either one El_{ind} or the median of several elements with a low uptake to reduce the uncertainty. These methods were tested on a large element dataset of over 1000 samples of different plant species and locations. Conventional methods (scatter plots) and multivariate methods (covariance biplots) show the effectiveness of the correction methods. The ratios of corrected to total (uncorrected) element concentrations for two plant species and selected elements are shown in figure 1.

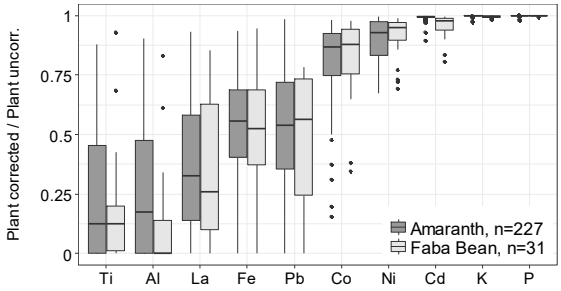

Figure 1: Corrected to uncorrected element concentrations for two plant species.