Interpretation of soil-plant transfer factors: A log-ratio approach for multi-element data

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To describe the uptake of elements from soil to plant the ratio of element concentration of plant to soil is commonly used. This ratio is here called transfer factor (TF): TF = Plant/Soil. These are well-established tool in environmental geochemistry, to evaluate the magnitude of elemental mass uptake.

Elemental abundance is often only measurable as element concentrations and hence the values obtained are subject to constant sum constraints [1]. The classical approach of calculating the TFs as simple ratios of concentrations neglects this constant sum linkage. Depending on the research question, e.g. if the focus lies on interaction of elements during uptake or translocation within the plant, this classic TF might not be the most adequate tool.

One possibility to overcome the constraints of concentration data is to use a log-ratio method to calculate element TFs: For both data sets, soil and plant, the concentrations are transformed into real numbers by centred log-ratios (clr) [1] and then the TFs are calculated as differences of the clr-data. These clr-TFs happen to be regularisations of the log-transformed classical TFs, which takes into account the fact that one has measured relative concentrations and not absolute abundances. Moreover, the proposed tool is also intimately related to fractionation ratios used in other fields of geochemistry.

By means of a case study on the nature of geochemical transfers between soil and tea leaves, this contribution shows the caveats of the classical single-element TFs, and the potential of interpretation of the proposed tool.

[1] Aitchison (1986) *Chapman & Hall, Ltd. UK*