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Compositional mean-centering increases the interpretation space of phytogeochemical datasets

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It is known that different plant species and their various tissue types have very different element patterns [1]. However, acquiring field data in environmental geochemistry is not only time-consuming and costly but also challenging. Particularly, when it comes to collecting omnipresent species in the study area. Often, some plant species are not present everywhere usually due to anthropogenic activities. Therefore, we have investigated a possibility of mapping out changes in geological or environmental parameters without being specific to one plant species or tissue. Consequently, the interpretation space of phytogeochemical datasets is increased as we can distinguish between elements depended on certain species (e.g., Ca in Common juniper) and elements that relate to external variables.

The inherent differences between various sampling materials (e.g., plant species and tissues) are accounted for by following the principles of compositional data analysis [2]. The plant multivariate data is normalized to a compositional mean specific to species and tissues compared to a non-compositional mean based on concentration values, to account for the interrelation of the elements among each other [3]. Following normalization, the differences in elemental patterns originating from species and tissue types are either eliminated or significantly diminished, enabling the investigation of effects stemming from environmental and geological parameters.

Our results show that expanding the dataset with other sample materials helps to reveal element ratios that discriminate plant chemistry between different lithological units even when not all sample materials are available. Figure below shows a distinction of individual element ratios between various plant species and their tissues over respective rock types.

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