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# Can compositional analysis of plant biogeochemical data of different plant tissue types reveal signatures of lithology?

**LUCIJA DUJMOVIĆ**[1], SOLVEIG POSPIECH[2], RAIMON TOLOSANA-DELGADO[1], K. GERALD VAN DEN BOOGAART[1], JÖRG MATSCHULLAT[3] AND MAARIT MIDDLETON[4]

[1]Helmholtz Institute Freiberg, Helmholtz-Zentrum Dresden-Rossendorf

[2]Helmholtz-Zentrum Dresden-Rossendorf e.V., Institute of Resource Ecology

[3]Interdisciplinary Environmental Research Centre, TU Bergakademie Freiberg

[4]Geological Survey of Finland GTK

Presenting Author: l.dujmovic@hzdr.de

Plants are an important driving force for element cycling in the critical zone. Here, the interactions with bedrock, soil, water, and the atmosphere result in plant ionome bearing biogeochemical signatures that originate from different element sources. Therefore, analyzing biogeochemical plant data can be used as a cost-effective method for delineating covered mineralization with minimal environmental influence. However, plant ionome is tissue and species-specific. The physiological traits of plants such as metal uptake and accumulation overshadow the subtle geogenic signals in the plant geochemical data. In this work it is investigated how multivariate relative relationships of elements and elemental groups attribute to element patterns caused by lithology and geochemistry of (mineralized) bedrock, independently of sampled species or tissue type. This is achieved by minimizing the contribution of different plant species and tissue types (noise) through appropriate normalization using relative element ratios.

To achieve the goal of our study, we examine the plant geochemical data using compositional analysis techniques. We argue that only elements ratios and their anomalous spatial patterns are more informative in biogeochemical mineral exploration rather than the absolute element concentrations. Therefore, by using the compositional approach, the physiological biases can be disregarded, given they are constant for the whole dataset. This case study involves a compiled biogeochemical dataset of plant samples collected in brownfield regions over known mineralized lodes. The samples were acquired over different mineralization types but also over non-mineralized lithologies. The biogeochemical data is normalized with the (compositional) average [1] of each species and tissue type group samples collected over barren sites . Our results show that the compositional data approach successfully reduces the effect of the physiological patterns (artifacts). When the inherent plant signature is removed, only the variability of element ratios induced by other effects, e.g., from mineralization, remains to be investigated with respect to soil and bedrock properties. This noise-reduction technique helps visualize anomalous element ratios, especially for trace elements.

[1] Egozcue J J & Pawlowsky-Glahn V (2019) Compositional data: the sample space and its structure. *Test 28* (3), 599-638.