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Unravelling bedrock-soil element transfer: insights from GIS-based modelling

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Chemically quantifying bedrock supports not only risk assessments of e.g., natural toxic compounds and anthropogenic activity, but also sheds lights on mineral exploration while minimising the impact on the environment. However, this geochemical mission is hampered by the difficulty to access bedrock in many areas. By contrast, soils developed over these rocks are relatively accessible and can be used as tracers to explore the underlying rocks on a continental scale.

Our research applies GIS-based geochemical modelling of (ideally) open-access data to estimate the geochemical influence of the bedrock on the subsoil and topsoil. This modelling strategy shows promising results for quantifying the mobility of critical elements from the bedrock to the subsoil and topsoil. Subsoil data are better suitable to predict the bedrock characteristics (e.g., local geochemical variations and element abundance). However, the method is thus far strongly limited by data availability, accessibility, and density as well as by uncertainties attributed to different chemical analytical protocols.

Generally, the spatial coverage for soil data is better than for bedrock data. Chemical analyses for bedrock are spatially biased towards metamorphic and igneous areas such as mountain ranges, (historic) mining areas, and volcanic areas. By contrast, bedrock data from recent sedimentary basins and sedimentary rocks are limited, even though these regions are important for agricultural practices. Clearly, understanding the element composition and fluxes from bedrock to soil is needed to underpin a variety of scientific disciplines. In addition, the elements of interest for bedrock and soil chemistry may differ, e.g., it is common practice to omit Si in soil data, resulting in a knowledge gap. Hence, we propose a standardised protocol for both bedrock and soils to facilitate the GIS-based modelling strategy in various fields of environmental science.

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