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Quantitative geochemical characterization of sediments, soils, and rocks for environmental studies using X-Ray Fluorescence core scanning

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Geochemical profiling of sediments, soils, and rocks is performed for multiple purposes, such as characterization of buffering capacity to pollutants, forecast geochemical behavior to technology implementation (e.g. thermal heat storage, aquifer recharge, etc.), and deduction of natural composition and variation therein. For these objectives, multi-element analysis of discrete samples is used routinely as a procedure, geochemically characterizing sediments, soils, and rocks. Over the last 2 decades, X-Ray Fluorescence (XRF) core scanning has been established as a fast and relatively inexpensive tool to obtain geochemical data from geological material. Novel developments now allow XRF core scanning to be used to provide data of trace, minor, and major elements quantitatively with sophisticated multivariate log-ratio calibration. We aimed to investigate the suitability of quantitative XRF core scanning for routine environmental geochemical characterization of sediments, soils, and rocks. For this purpose we cross compare XRF-core-scan data to conventional geochemical methods, using grab samples from four cores with distinctly different lithologies (clay, sand, peat and calcareous layers). Specific focus lies on quantification of organic matter content, total reactive iron, calcium carbonate, and potential elemental pollutants (e.g., Ni, Zn, As), which are of pivotal importance for environmental studies. Ultimately, we show that quantified XRF core scanning is a promising technique to rapidly obtain robust multi-element data for environmental purposes.