

Data precision of X-ray fluorescence (XRF) scanning of discrete samples with the ITRAX XRF core-scanner exemplified on loess-paleosol samples

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XRF-scanning is the state-of-the-art technique for geochemical analyses in marine and lacustrine sedimentology for more than a decade. However, little attention has been paid to data precision and technical limitations so far. Using homogenized, dried and powdered samples (certified geochemical reference standards and samples from a lithologically-contrasting loess-paleosol sequence) minimizes many adverse effects that influence the XRF-signal when analyzing wet sediment cores. This allows the investigation of data precision under ideal conditions and documents a new application of the XRF core-scanner technology at the same time.

Reliable interpretations of XRF results require data precision evaluation of single elements as a function of X-ray tube, measurement time, sample compaction and quality of peak fitting. Ten-fold measurement of each sample constitutes data precision. Data precision of XRF measurements theoretically obeys Poisson statistics. Fe and Ca exhibit largest deviations from Poisson statistics. The same elements show the least mean relative standard deviations in the range from 0.5% to 1%. This represents the technical limit of data precision achievable by the installed detector. Measurement times ≥ 30 s reveal mean relative standard deviations below 4% for most elements. The quality of peak fitting is only relevant for elements with overlapping fluorescence lines such as Ba, Ti and Mn or for elements with low concentrations such as Y, for example. Differences in sample compaction are marginal and do not change mean relative standard deviation considerably.

Data precision is in the range reported for geochemical reference standards measured by conventional techniques. Therefore, XRF scanning of discrete samples provide a cost- and time-efficient alternative to conventional multi-element analyses. As best trade-off between economical operation and data quality, we recommend a measurement time of 30 s resulting in a total scan time of 30 minutes for 30 samples.