Improving X-ray Fluorescence Factory Performance to Optimize Geological Samples Matrices

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Abstract

Geological materials are highly variable in terms of mineralogy and geochemistry, making it difficult to develop X-Ray Fluorescence (XRF) calibration methods for them. However, manufacturers of XRF instruments have worked to enhance the range and performance of applications over the last decade to fit a wide range of materials including geological samples, giving quantitative to semi-quantitative analysis for a variety of matrices using empirical and fundamental calibrations.

This study highlights Energy Dispersive X-Ray Fluorescence (ED-XRF) technology calibrations used to determine the elemental compositions of geological samples. Lab instruments are commonly provided by the manufacturers with calibration method to cover a range of materials (e.g. steel, soil, rock etc.), but had to refine this to produce two separate lithology-dependent calibration methods. The first method was developed for clastic sedimentary rock (SSS method), whilst the other was produced for carbonate and organic-rich carbonate matrices (Carbonate method). Other improvements were also made to the calibration datasets including element shells and detection limits as well as the sample preparation.

Thirty-two geological reference materials were used to calibrate the analyzer for the SSS method, while twenty-six reference materials were deployed to calibrate the instrument for the carbonate method. Strong linear relationships were found between ED-XRF measurements and Certified Reference Materials (CRMs). The relative standard deviations (RSD) of geological reference materials measured by ED-XRF were over 5% for all elements.

Compared to analyses performed with an Inductively Coupled Plasma spectrometer (ICP), this study shows that analyses done with the ED-XRF are faster and the results obtained with both techniques are comparable for most elements. For some elements, a variation of less than 10% in concentration values was occasionally observed between both techniques. Therefore, this study confirms that the ED-XRF technique can be used routinely for quick and relatively accurate multi-element analyses.