Practical Applications of Portable XRF in Mineral Exploration: Confessions of a Geochemist

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Portable XRF is now a well-established tool in mineral exploration. However, strategies for data collection depend upon how the data are to be used. Two broad philosophical approaches are generally available to the mineral explorationist.

The use of portable XRF to generate analyses for public reporting purposes requires careful consideration of sampling methodologies to obtain representative data, estimation of realistic lower limits of detection for key elements, and calibration of the instrument. Sampling considerations include the mass of material examined during analysis, sample preparation requirements, and the grain size and distribution of minerals of interest. Different sampling strategies having variable accuracy and precision can be employed to obtain representative analyses depending on the style of mineralization. The objective is to obtain data that are "fit for purpose". Lower limits of detection are highly variable depending on the element under consideration and its atomic weight, but can be calculated for individual data sets. Portable XRF instrumentation can be calibrated either using matrix-appropriate certified reference materials or project-specific samples that have been analyzed for total concentrations of the elements of interest. Factory calibrations are seldom adequate for most commodity elements. Geoscientists should also be aware of common interferences and limitations in the use of the technology.

In contrast to the care required to generate publicly reportable results, portable XRF data can also be used to generate percentile gridded images and thematic maps that show relative concentration variations of interest to mineral exploration. Within this context, consistency and repeatability are more relevant than accuracy, and quality control procedures can be focused on detecting instrumental drift within a data set. Samples may be successfully analyzed with minimal to no sample preparation or calibration of the instrument in some circumstances. Analyses of soil samples directly through sample bags is demonstrated to provide a rapid assessment of the relative distribution of some elements, although the effects of secondary X-ray attenuation, particularly of light elements, should be considered when comparing portable XRF data to laboratory analyses. The main advantage under this scenario is the ability to obtain data quickly while field crews are in place and modify programs on the fly.

Sampling and analytical strategies for portable XRF in mineral exploration are therefore dependent upon the end use for the data. The adoption of "boiler plate" approaches may be counter-productive. Rigorous protocols for sampling, instrument calibration and quality control required for public reporting of portable XRF data are unnecessary where defining relative differences in key elements is the objective.