Piercey SJ, Devine MC, 2014, Analysis of powdered reference materials and known samples with a benchtop, field portable X-ray fluorescence (pXRF) spectrometer: evaluation of performance and potential applications for exploration lithogeochemistry, Geochemistry: Exploration, Environment, Analysis, 14, 139-148

Powdered international reference materials and samples with previously obtained conventional geochemical data were analysed using a benchtop portable X-ray fluorescence (pXRF) spectrometer to test the abilities of pXRF in silicate rock lithogeochemistry. Results from international reference materials illustrate that pXRF can provide very precise data for many major, minor, and trace elements, generally with RSD values of <7.5 % and many <5 %, except at very low concentrations (i.e. approaching the limit of detection). Despite good precision, accuracy is highly variable and ranges from excellent to reasonable for many major and minor elements (±15–20 % relative difference, RD, for Al_2O_3, SiO_2, K_2O, CaO, Fe_2O_3, TiO_2, and MnO±S), base metals (±20 % for Cu, Zn), the low field strength (LFSE) and high field strength elements (HFSE) (±15 % RD for Rb, Ba, Zr; ±20 % RD for Nb). Poor accuracy was obtained for MgO, P_2O_5, and the transition elements (V, Cr, Ni); Sr shows variable accuracy. Comparison of pXRF results to independent samples with data from conventional analyses illustrates very poor correlation for MgO, P_2O_5, V, Cr, and Ni, suggesting they have poor accuracy by pXRF. Aluminum (Al_2O_3), SiO_2, and Zn have r^2 values of c. 0.6–0.7 illustrating reasonable correlation, whereas most other elements (S, K_2O, CaO, TiO_2, MnO, Fe_2O_3, Co, Cu, Pb, Rb, Sr, Ba, Zr, Nb, U, As, and Mo) have very good to excellent correlation between pXRF data and conventional analysis (i.e. r^2 >0.80). In addition, many of the elements with r^2 >0.8 have slopes that are close to 1 or within 20 % of ideal, indicating that pXRF is replicating the results of conventional analyses and likely within ±20 % of what can be obtained by conventional methods. Down-hole profiles of pXRF data and element ratios replicate the geometry of the profiles from conventional analyses and illustrate the ability of the pXRF to discriminate rock type, alteration, and mineralization in unknown samples. Portable XRF can provide fit-for-purpose data that is useful in discriminating lithogeochemical variations related to lithology, alteration, and mineralization. However, pXRF should be considered a preliminary screening tool for sample selection and not a substitute for conventional lithogeochemical methods (e.g. XRF, fusion ICP-ES and ICP-MS), particularly when important economic decisions are to be made using such data (e.g. NI-43-101 resource calculations).

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