

Laser ablation of silicate rock pressed powders as an efficient trace-element analysis method

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Whole-rock powder pressed pellets analysed by LA-ICP-MS offer an alternative to whole-rock powder or lithium borate fused bead dissolution methods for trace element analysis. In addition to reducing the need to use strong acids and pressurised bombs, powder pellets offer the opportunity to quantify Li, B, and trace elements with minimal dilution. Previous work^{1,2} in this area has emphasised spot analyses, achieving sufficient sample homogeneity through wet-grinding powders to nanoparticulate sizes, a time-intensive process. Here, we demonstrate that using a larger laser spot size and line-scan analyses reduces the restriction to moderate particle sizes ($\leq 100 \mu\text{m}$), which can be accomplished more efficiently. We present data for 53 major and trace element analytes collected from nine USGS and GSJ geologic reference materials prepared with this method. The majority of the analytes tested by this method can be measured precisely, with standard errors below 10% rel., and accurately, to within 10% of accepted values. These elements include Li, Be, Na, Mg, Al, Si, Ca, Sc, Ti, V, Mn, Co, Ni, Ga, Rb, Sr, Y, Zr, Nb, Cs, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, Th, and U. The limits of detection for the elements heavier than Co are $<0.5 \mu\text{g/g}$, with most below $0.02 \mu\text{g/g}$. Analytes that should be measured with caution include B, Cr, Cu, Fe, Sn, and Pb. Elements that were not suitably measured by this LA-ICP-MS method include Zn, As, Ag, and W. This sample preparation is also compatible with analysis by XRF, allowing for the measurement of F, Cl, and S, down to concentrations of 110, 30, and $10 \mu\text{g/g}$, respectively. This method is a reliable and inexpensive way to analyse large numbers of geochemical samples over a wide range of compositions.

[1] Garbe-Schönberg and Müller (2014), *Journal of Analytical Atomic Spectrometry* 29, 990-1000.

[2] Guldris Leon, et al. (2022), *Minerals* 12, 869.