Creating a glass fusion method for determining trace element composition of rock powders using LA-ICP-MS: a preliminary evaluation

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The ability to produce homogeneous and compositionally precise glass samples from an aliquot of crushed rock powder is an invaluable but potentially difficult technique for any laboratory that performs routine trace element analysis on solid material. Traditional analysis of powders (e.g., XRF) may not reach the detection limits required for in-depth geochemical characterization of complex samples, while other techniques can be time consuming and costly. Trace element analysis of both natural and synthetic samples can be easily performed using LA-ICP-MS provided that at least one major element exists in known concentration in the sample. This technique allows for high precision, low detection limits, and high throughput at a reasonable cost. Although laser ablation requires the sample to be in a coalesced, solid state with a properly matrix-matched exterior standard, various methods to fuse rock powders into glass beads have been investigated and have shown to yield promising results.

Using a strip heater, powdered standard reference materials (USGS SRM's) have been mixed with a lithium meta/tetraborate flux and fused to produce glass beads with compositions that reflect the powdered sample. Once fused, these glass beads are analyzed via LA-ICP-MS and reduced using certified NIST glass standards (NIST610 and NIST612). Several such fusions have been analyzed using this technique over a wide range of elements (Be–U, 60 elements in all). Preliminary results show that USGS powders BCR-2 and GSP-2 can be fluxed and fused into glass beads that show minor heterogeneity and good reproducibility in trace element composition compared to their reference certificate. While some elements show a propensity to be highly variable and inaccurate (e.g., Ti, Zn, Zr), the rare earth elements (REEs) show promising reproducibility (RSD 5–10%) and concentrations that reflect the certificate value within 10%. Although several more steps are required to solidify this method, the strip heater fusion method coupled with LA-ICP-MS allows our laboratory to analyze a huge suite of samples quickly, and is a milestone in creating in-house standards to use for daily applications. Furthermore, the forthcoming addition of a bench-top micro-XRF system (Spring 2016) will enable the characterization of major elements of both powdered samples and flux-fused glasses using a calibration curve method.

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