B12 Trace Element Profiles of Float Glass Fragments Determined by Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS)

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The goal of this presentation is to present a method for forensic glass analysis by LA-ICP-MS for comparison and standardization of this new application.

LA-ICP-MS in forensic science is highly promising new technique for the rapid discrimination of glass fragments by elemental composition. The relatively quick, non-destructive nature of LA, coupled with the sensitivity of ICP-MS makes the method well suited for glass analyses. Development of a protocol for the equipment in this study sets the groundwork for implementing a standard inter-laboratory technique. The results from this study can be compared with those from other laboratories, aiding in the standardization of the method and validating the technique for casework.

The importance of glass as trace evidence, coupled with increasing physical and chemical homogeneity of float glass, has prompted the use of innovative techniques for discriminating between samples. Inductively coupled plasma mass spectrometry (ICP-MS) is becoming a widely used method for elemental analyses of glass fragments, with laser ablation (LA) of solid samples being the most efficient introduction system for forensic applications (Trejos et al., 2003; Watling et al., 1997). LA-ICP-MS requires almost no sample preparation and consumes extremely small amounts of sample, making it a virtually non-destructive technique.

This poster will outline an instrumental protocol for forensic glass analysis developed at the ICP-MS Laboratory at Michigan State University. Using a Cetac LSX 200 Plus Nd:YAG laser (266 nm) attached to a Micromass Platform quadrupole ICP-MS, a certified standard (NIST 612) and six unknown automobile float glass fragments provided by the Michigan State Police were used to optimize ablation parameters for acquiring eight trace elements (^{85}Rb, ^{88}Sr, ^{89}Y, ^{90}Zr, ^{98}Mo, ^{138}Ba, ^{139}La, and ^{140}Ce). The technique was optimized for the smallest spot size (best for forensic applications) that produced adequate signal above background for all isotopes. For both the standard NIST 612 and the unknown, these conditions were met with a spot size of 100 µm and depth profile z-rate of 1 µm/s for 30 s, fixing the crater depth at 30 µm. The detector was initiated before ablation and recorded for a total of 60 s. For each trial, a 1 s preablation burst of the laser was focused at the sample surface to ensure it was free of contaminants. Both the float and non-float sides of the unknown glass fragments were ablated five times to test the homogeneity of the samples and precision of the technique with this experimental setup. Similarly, a cross-sectional analysis of one fragment was conducted using the same parameters, with spot analyses 300 um apart, to ensure homogeneity and precision in the case of fragments without parallel sides.

Data were reduced by a standard gaussian integration of peaks, obtaining the maximum peak height above background for each element. The precision of the technique was evaluated by element using normalized peak heights. Overall, the precision of replicate analyses is very good (<10% RSD), within and between replicates on both the float and non-float sides of samples. Only two elements, Mo and Rb, which had the lowest peak heights, consistently show variation >10% RSD. The results of the experiments can be presented graphically on triangular plots of element ratios after Watling et al. (1997), demonstrating the discriminating power of the method. Using only six elements (^{88}Sr, ^{89}Y, ^{90}Zr, ^{138}Ba, ^{139}La, and ^{140}Ce) from the analyses, out of a total of 15 unique pairs, all glasses were distinguishable by this method.

Laser Ablation ICP-MS, Glass Fragments, Trace Elements

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