

10.811 13 B Boron	12.0107 14 Si Silicon	30.973762 15 P Phosphorus	32.065 16 S Sulfur	35.453 17 Cl Chlorine	
26.9815386 13 Al Aluminium	28.0855 32 Ge Germanium	74.9216 33 As Arsenic	78.96 34 Se Selenium	79.904 35 Br Bromine	
65.38 30 Zn Zinc	69.723 31 Ga Gallium	72.64 50 Sn Tin	127.6 52 Te Tellurium	126.90447 53 I Iodine	
112.411 48 Cd Cadmium	114.818 49 In Indium	118.71 82 Pb Lead	208.9804 83 Bi Bismuth	[210] 85 At Astatine	
200.59 80 Hg Mercury	204.3833 81 Tl Thallium	207.2 82 Pb Lead	[209] 84 Po Polonium	[210] 85 At Astatine	
112 112 Uut	113 113 Uuq	114 114 Uuq	115 115 Uup	116 116 Uuh	117 117 Uus

# XRF and CSI

Prepared by: Lee Drake, Senior Application Scientist  
February 24, 2014

## BRUKER TEST RESULTS

### Objective

The goal of the present paper is to illustrate simple examples on the application of x-ray fluorescence (XRF) technology on identifying residues and assistance with crime scene investigations.

### Method

Data was gathered from controlled parameters (bullet fired at shirt, trace residues, etc.). While this data is not comprehensive, it does provide a brief survey of how to identify elements that can be of assistance in investigations. Data were collected at 40 keV with a current of 30  $\mu$ A in dry air conditions with a 0.0254mm Ti/0.3048mm Al filter. A second set of data were gathered using 15 keV, a current of 25  $\mu$ A, no filter, and under both vacuum and helium conditions.

Data included two forms. The first type of data was a t-shirt which had been shot with a bullet with unknown (to the researcher) composition. The second type of data was determining the minimum detectable concentration of Magnesium in soil detectable with portable XRF. The purpose of these two experiments were to validate a) how detectable are metal residues, and b) how low can detection be?

### Background

It is impossible to predict what elements will be useful in advance - any material with any composition can be used as a weapon. This is particularly true for ammunition, where any element from Magnesium (12) to Uranium (92), even in the form of a residue, can provide critical information. In this case, the most important ability to have with a portable XRF spectrometer is the ability to see the spectra, the original data produced by the equipment. In these cases, it is possible to authenticate the presence of an unanticipated material.

### Results

The residue from the bullet was clearly visible, each sample measured had a strong signal from lead. Magnesium, being a much lighter element, can present more of a challenge. However, when a vacuum is used, the attenuation of the Magnesium signal is lessened considerably.

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# RESULTS

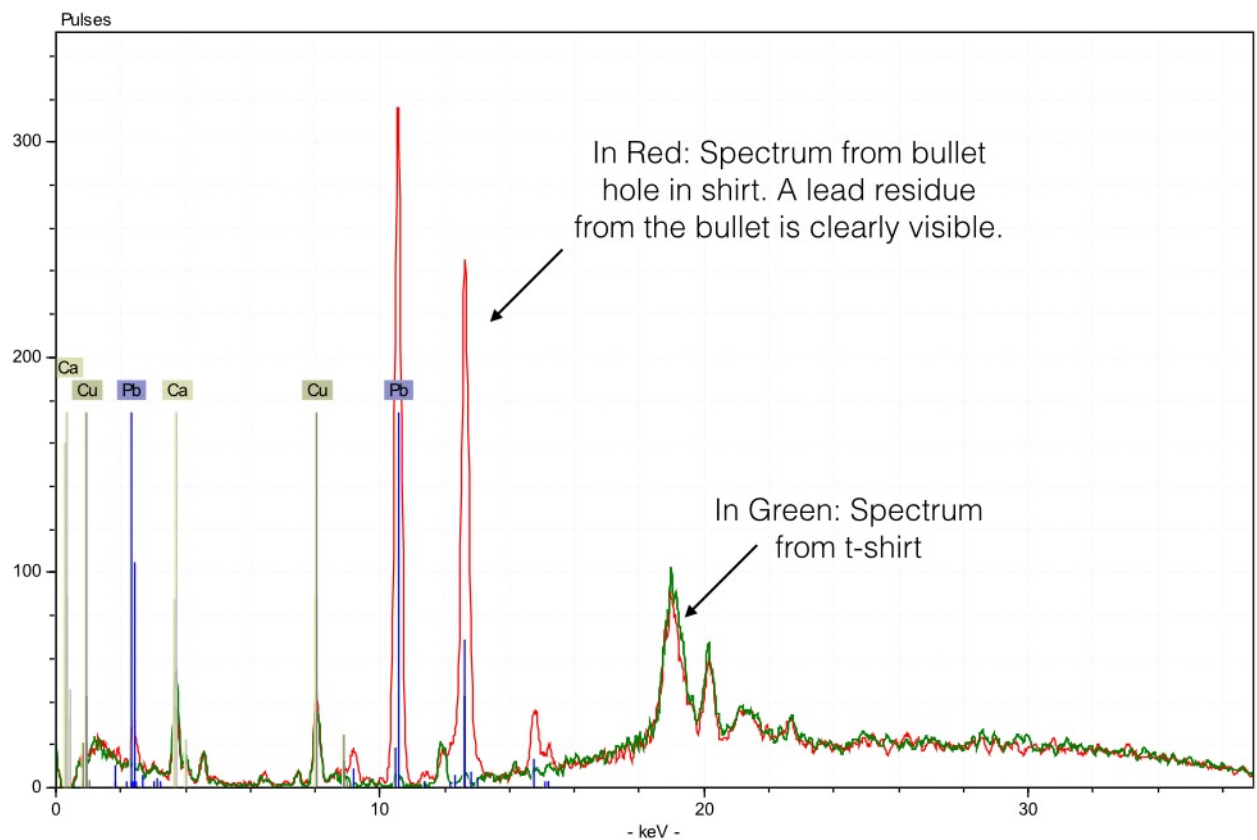


Figure 1: The regular shirt (green spectrum) shows no dominant elements - some copper and some calcium.

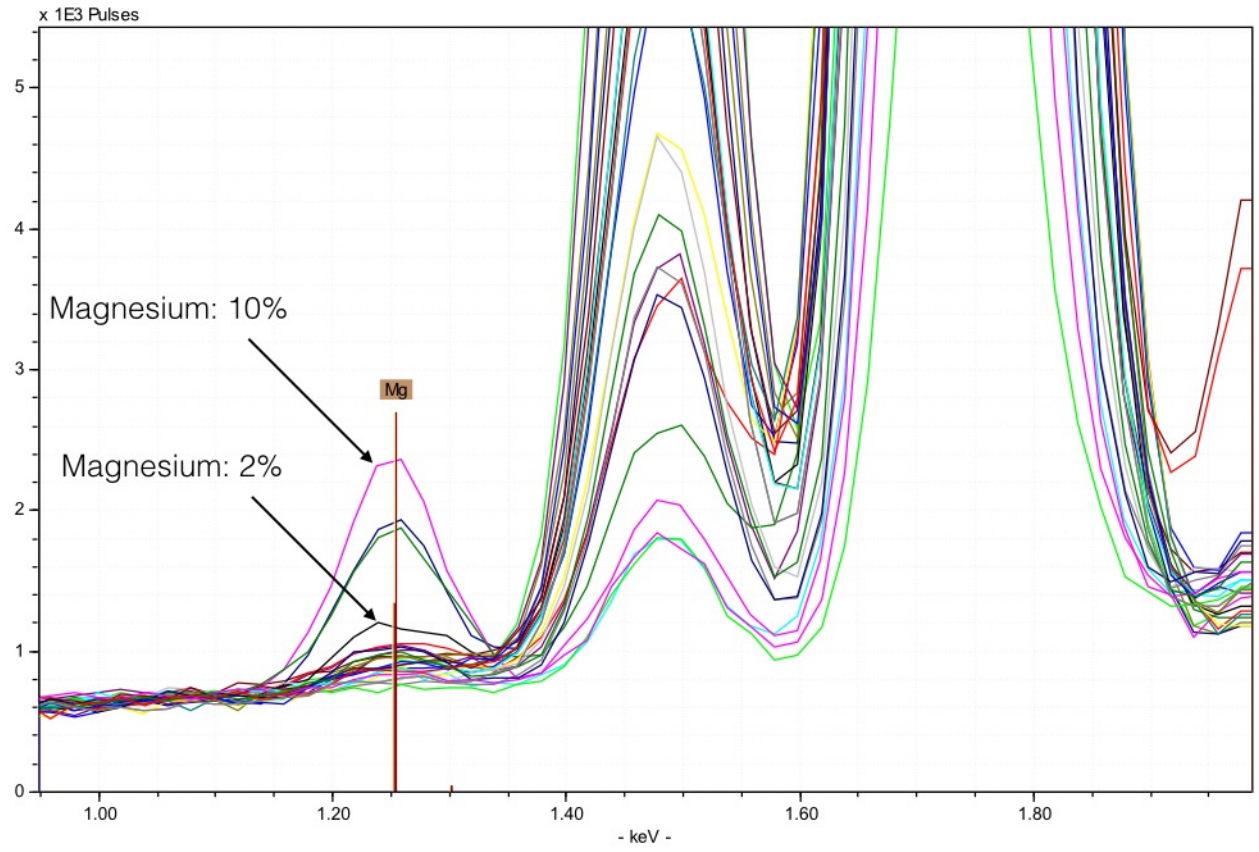


Table 1: Bayesian Deconvolution and quantitative results from NAA/ICP-MS