

# Isotope fractionation and composition variations in double chamber hunting munition by ICP-MS

Andrea Ulrich<sup>1</sup>, Adrian Wichser<sup>1</sup>, Max Vogler<sup>2</sup>

<sup>1</sup> Empa, Swiss Federal Laboratories for Material Testing and Research, Laboratory for Analytical Chemistry, CH-8600 Dübendorf

<sup>2</sup> Wissenschaftlicher Dienst der Stadtpolizei Zürich, Zeughausstrasse 11, CH-8004 Zürich

Twin-core projectiles belong to recent generation of high performance cartridge hunting munitions and consist from two lead cores with different hardness, coated by Tombak or steel jackets. Some back tail cores are additionally jacketed for separation from the softer tip core. The core weight ratio is mostly 50:50. A tail groove at the rear end of the projectile reliably bonds the tail core with the external jacket. The shooting velocity varies for twin-core types between 800 and 900 m/s at shooting start with an average decrease by 10- 15 m/s. Due to friction and collision energy the lead is exposed to high temperature which can reach even melting temperature. Thus, transformations or enrichment or depletion effects are likely, which could change composition in fragments and residuals. The presented study investigates, if an effect on trace element patterns or lead isotope ratios occurs by comparison of new and fired projectiles of the same munitions type and manufacturing lot.

### Samples, Ballistic, Sample Preparation

- Anvil ignition
- Nitrocellulose powder
- Case
- Projectile

- Longer projectile cylinder
- Tombak inner jacket
- Harder tail core
- Tail groove
- Sharp rim / specific breaking point
- Tombak jacket
- Softer tip core

*Principle of high performance hunting ammunition cartridge and projectile*

*A gelatin block shot and a typical trajectory curve for a high performance cartridges (RWS 7x64)*

Identification	Ballistic Characterisation			Jacket material	
Caliber	Type	Weight [g] projectile / ammunition	Velocity [m/s] at 100m	Energy [J] at 100m	
RWS 30-06	TUG	11.7 / 180	830	3335	zinc plated steel
Blaser 30-06	CDP	10.7 / 165	850	3107	tombak
RWS 7x64	DK	10.0 / 154	860	3152	tombak
Blaser 7x65 R	CDP	10.0 / 154	860	2708	tombak

*Characteristics of projectile deformation and sample description*

### Effects on composition

#### Antimony

*Sb concentration in tip core alloy (new/shot projectiles)*

*Changes in elemental composition for selected elements in tip core alloy*

*Composition of tail core alloy is less effected*

### Fractionation Effects

*Pb207/Pb206 isotope ratio in tip core alloy (new/shot)*

*Pb208/Pb206 isotope ratio in tip core alloy (new/shot)*

*Depletion factor versus shooting energy [J]*

## Conclusion

Effects of melting processes due to high friction and collision energy

- Tip core lead: Certain elements clearly show a trend to depletion, e.g. Sb and As. Others element concentrations remain stable (e.g. Ag, Bi).
- Tail core lead: No effect on composition detectable
- No isotopic fractionation for lead isotopes

## Literature:

A. Ulrich; Ch. Moor, H. Vonmont, H.-R. Jordi, M. Lory: ICP-MS trace-element analysis as a forensic tool, Analytical and Bioanalytical Chemistry, Vol. 378, No. 4, 2004, pp. 1059 – 1068.

Contact: A. Ulrich, andrea.ulrich@empa.ch

## Presented at:

European Winter Conference on Plasma Spectrometry 2007, 17.2.2007 – 23.2.2007 in Taormina, Italy