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Distribution of precious metals in lead buttons: an application study with SPARK optical emission spectrometry

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About MKS PAMP

MKS PAMP GROUP

The MKS PAMP GROUP is an industrial and trading services group specializing in all aspects of the precious metals business

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MKS PAMP provides financial & physical trading services and operates a state-of-the-art precious metals refinery

Summary

1. Background
2. Objectives
3. Materials and Methods
4. Action Plan
5. Results and Discussion
6. Conclusions
7. Future Perspective

1. Background

Traditional Methods: Limitations of Cupellation

Time-consuming

Detection limits

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Scale sensitivity vs.
Instrument sensitivity

Lead exposure & high energy consumption

1. Background

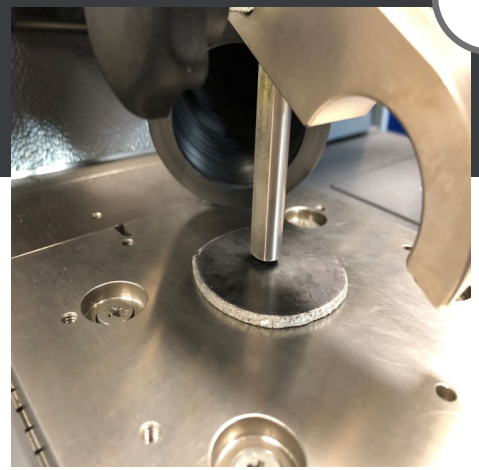
Why SPARK – OES?

SIST ENV 12908:2000

Lead and lead alloys - Analysis by Optical Emission Spectrometry (OES) with spark excitation

SPARK-OES

15 min



Direct analysis via SPARK-OES measurement

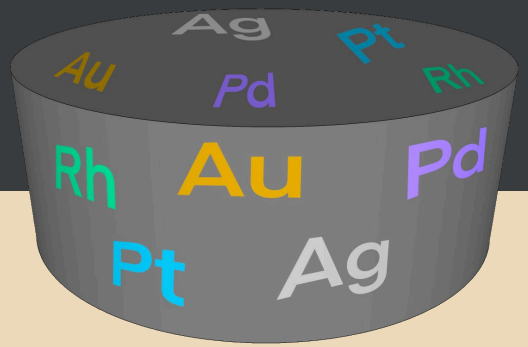
CUPELLATION

2 h

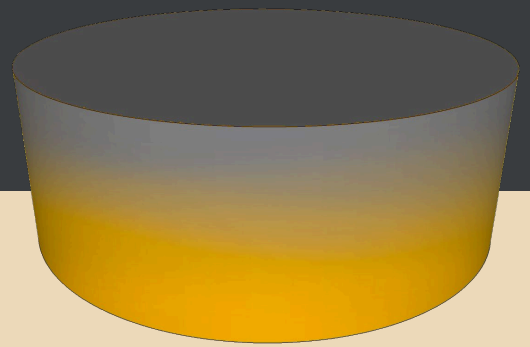
Lead removal at high temperature

Final bead: Further processing required

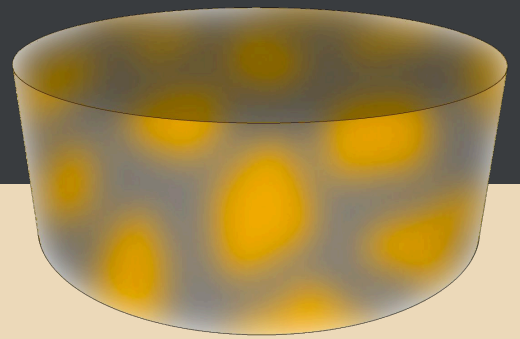
2. Objectives



Analyze metals distribution



Identify concentration gradients



Optimize sample preparation

3. Materials and Methods

SPARK - OES Analysis: Setup and Standards

SPECKTROLAB S AMETEK

Conditions	Time / s	Frequency / Hz
Pre Spark	4.0	300
Spark	8.0	200

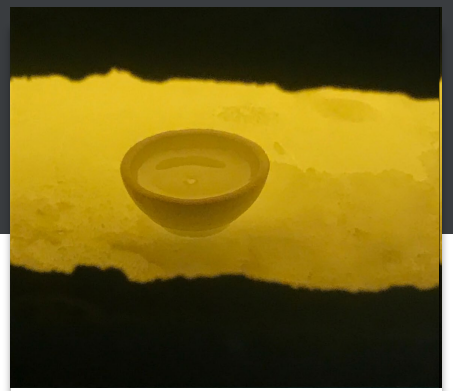
Standard Name	[Au/Ag] / ‰	[PGMs] / ‰
CRM 1	-	Pt 1.41 Pd 1.60 Rh 0.21
CRM 2	Au 1.79 Ag 0.87	-

4. Action Plan

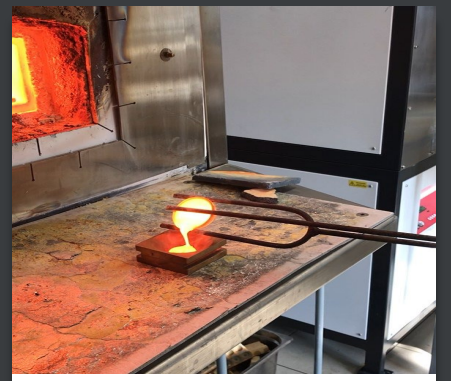
Scorification Process

CRM + Lead in scorifier

Oxidizing fusion at 1100°C



Slag forms, Pb collects precious metals



Casting in mold: Pb button solidifies

Breaking the scorifier: Extracting the Pb button

4. Action Plan

Sample Preparation for SPARK-OES

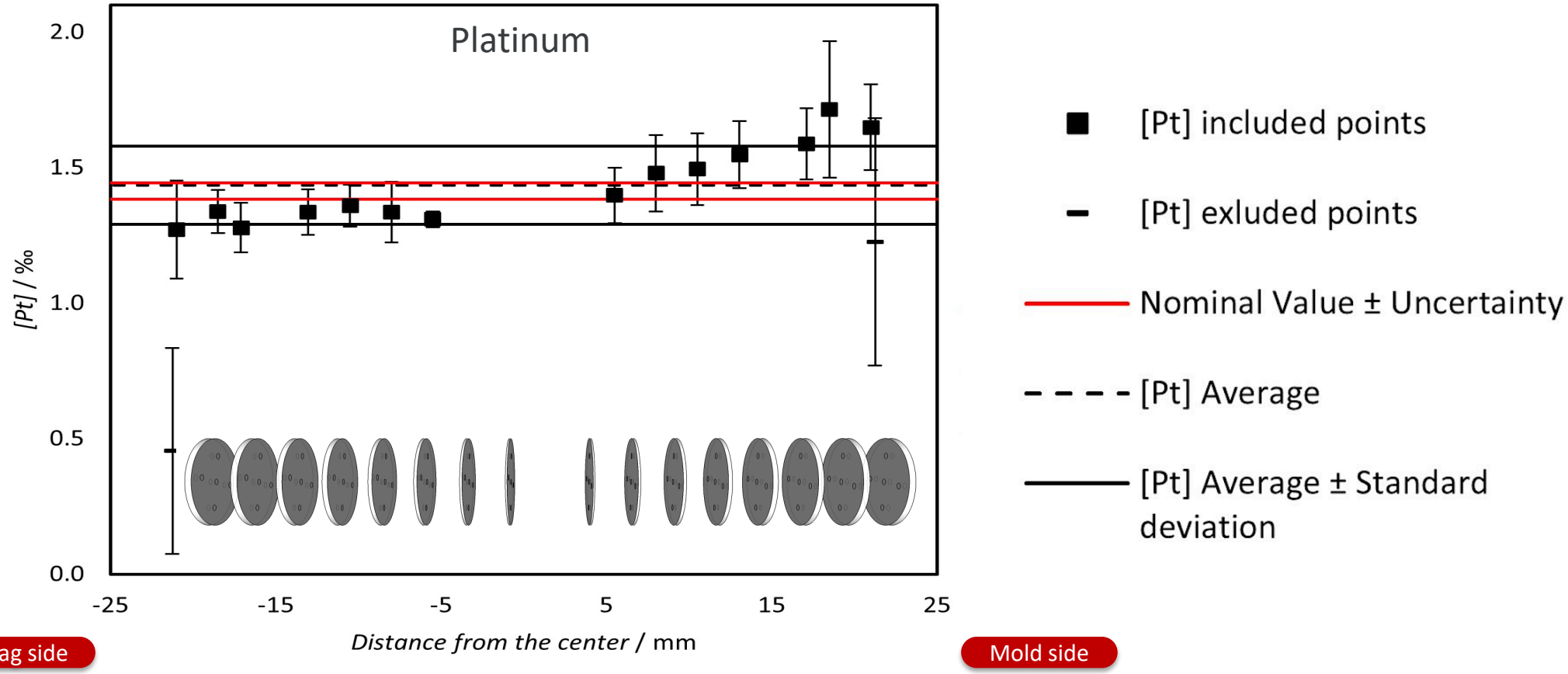
Thickness measured at each step

Five measurements per side

Surface progressively polished

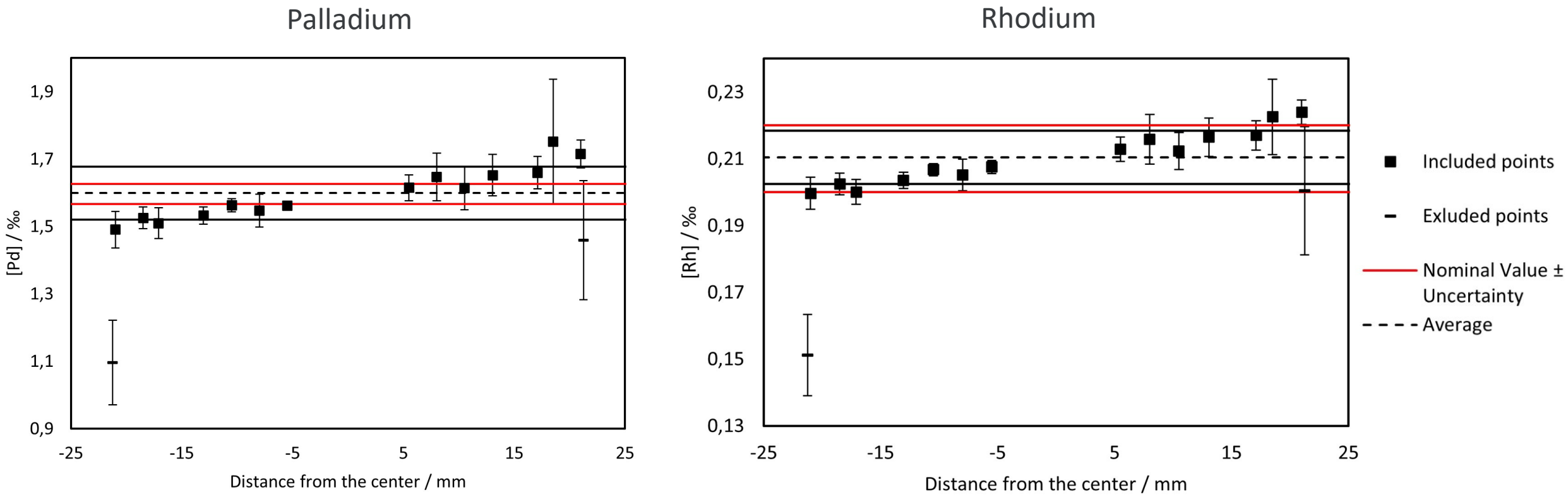
5. Results and Discussion

Analysis of CRM 1: Platinum



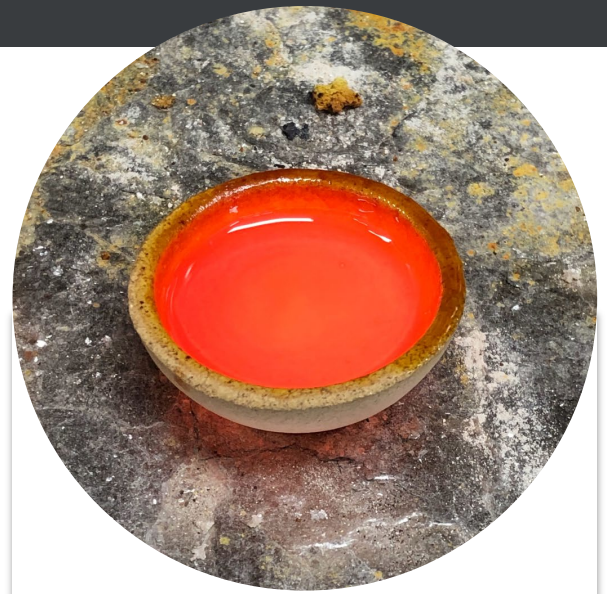
5. Results and Discussion

Analysis of CRM 1: Palladium and Rhodium



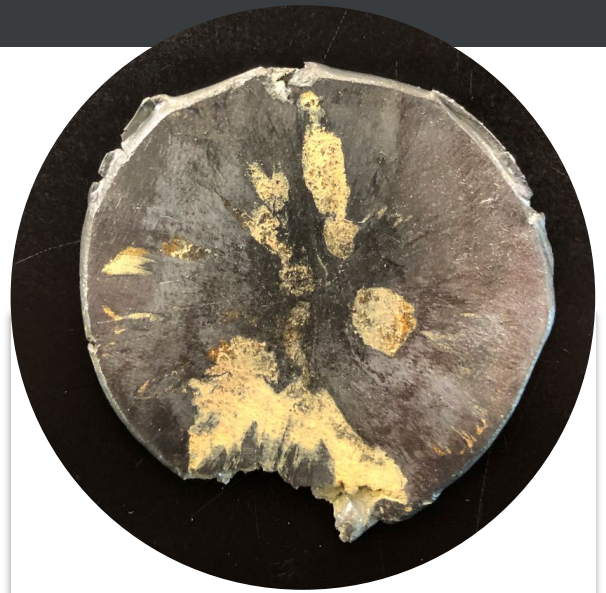
5. Results and Discussion

Remelting Process & Observations



Lead CRM melted at 1000°C for 5 minutes in a crucible

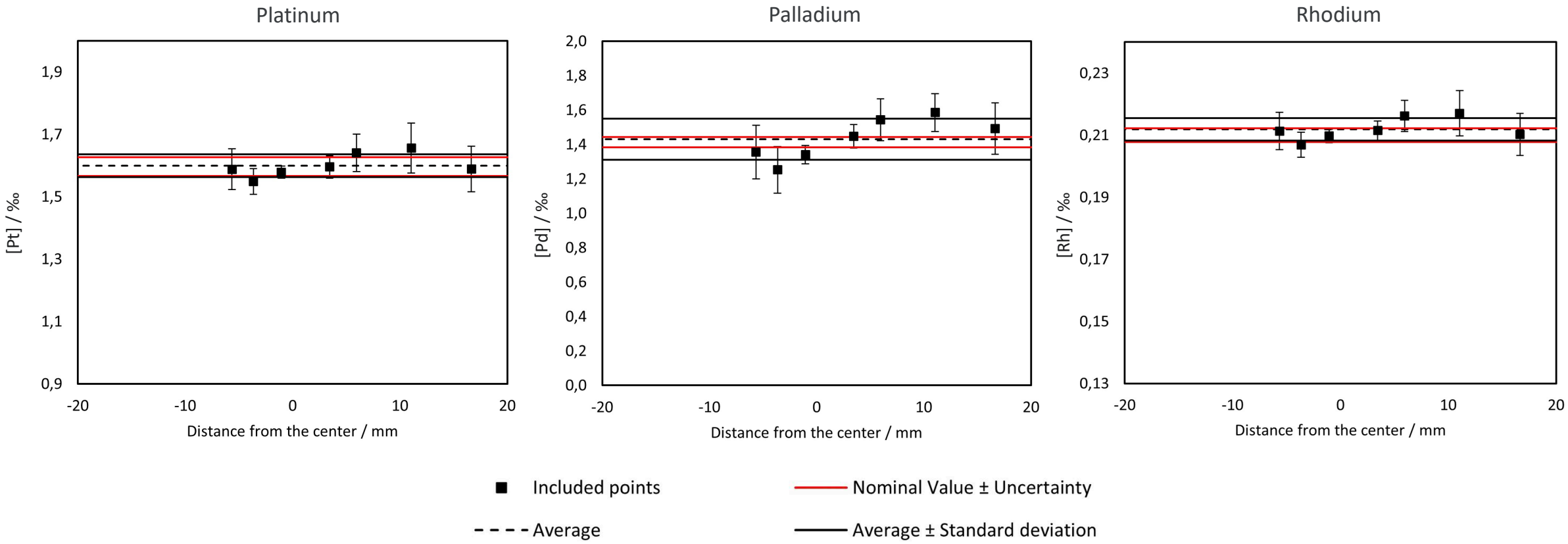
Sample preparation and analysis



PbO inclusions detected on the slag-side surface

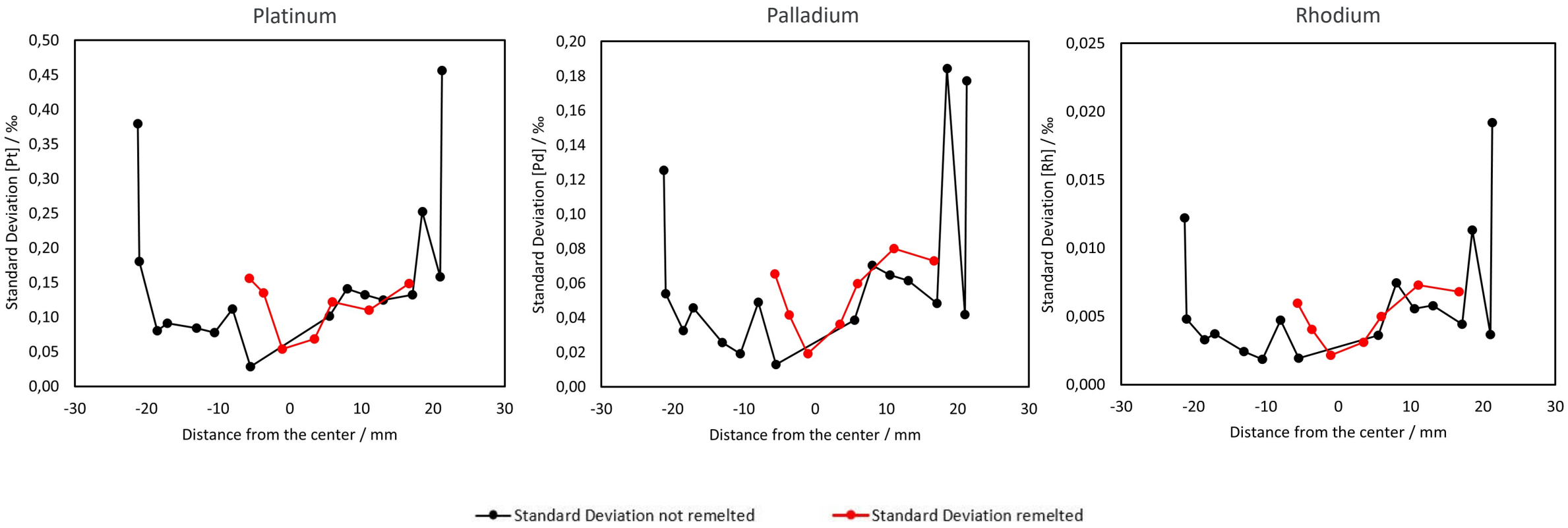
5. Results and Discussion

Effect of Remelting on CRM 1: Changes in Metal Distribution



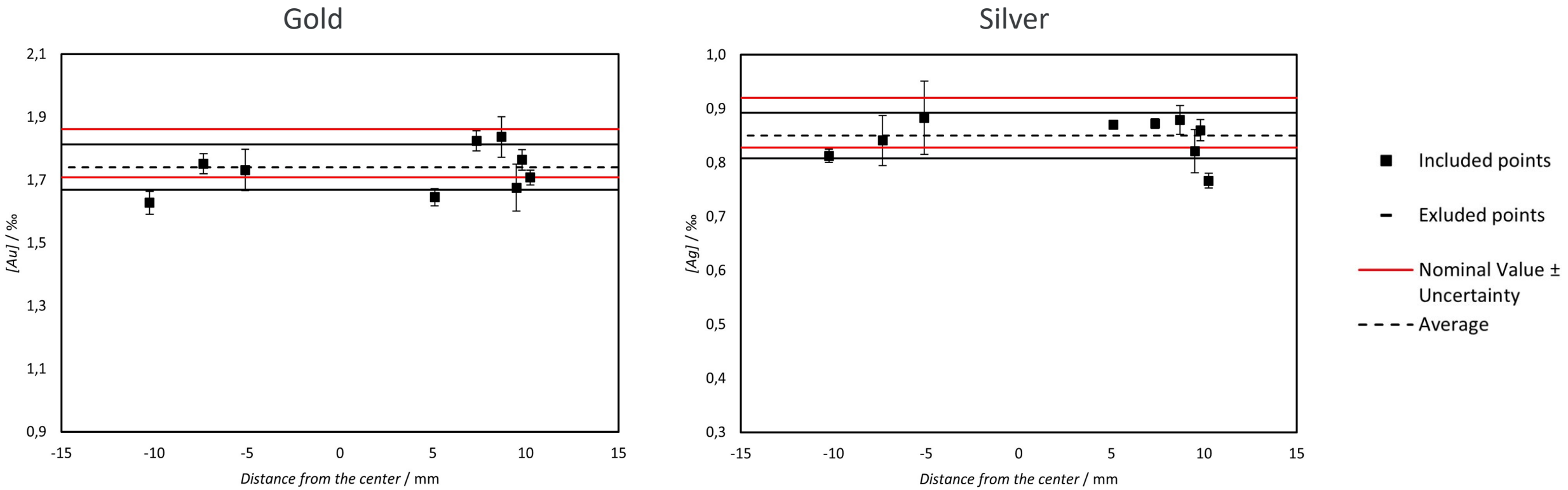
5. Results and Discussion

Variation of Standard Deviations on CRM 1: Comparison Between Samples



5. Results and Discussion

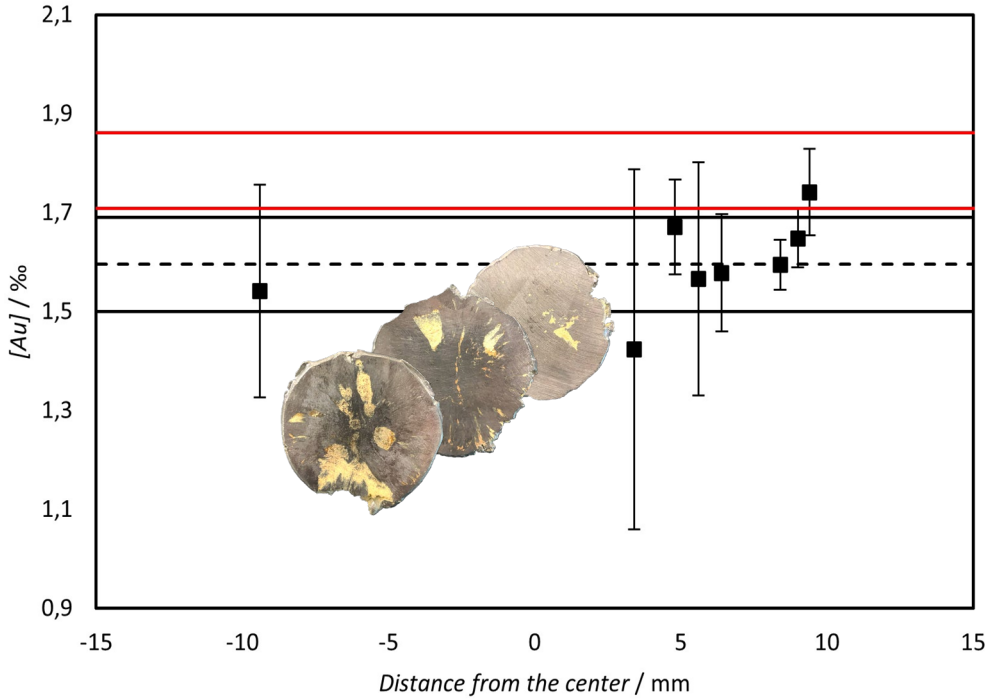
Analysis of CRM 2: Gold and Silver



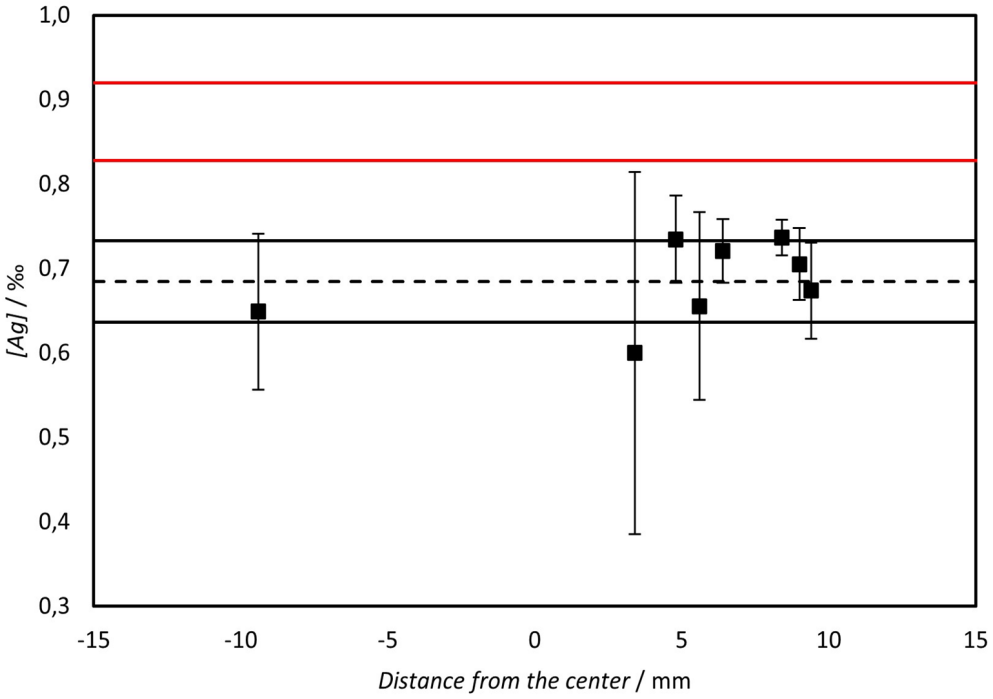
5. Results and Discussion

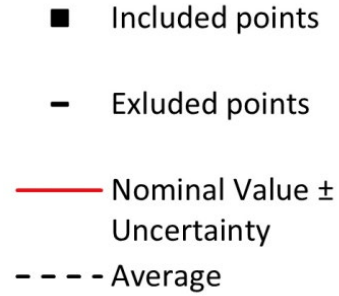
Effect of Remelting on CRM 2: Changes in Metal Distribution

Gold



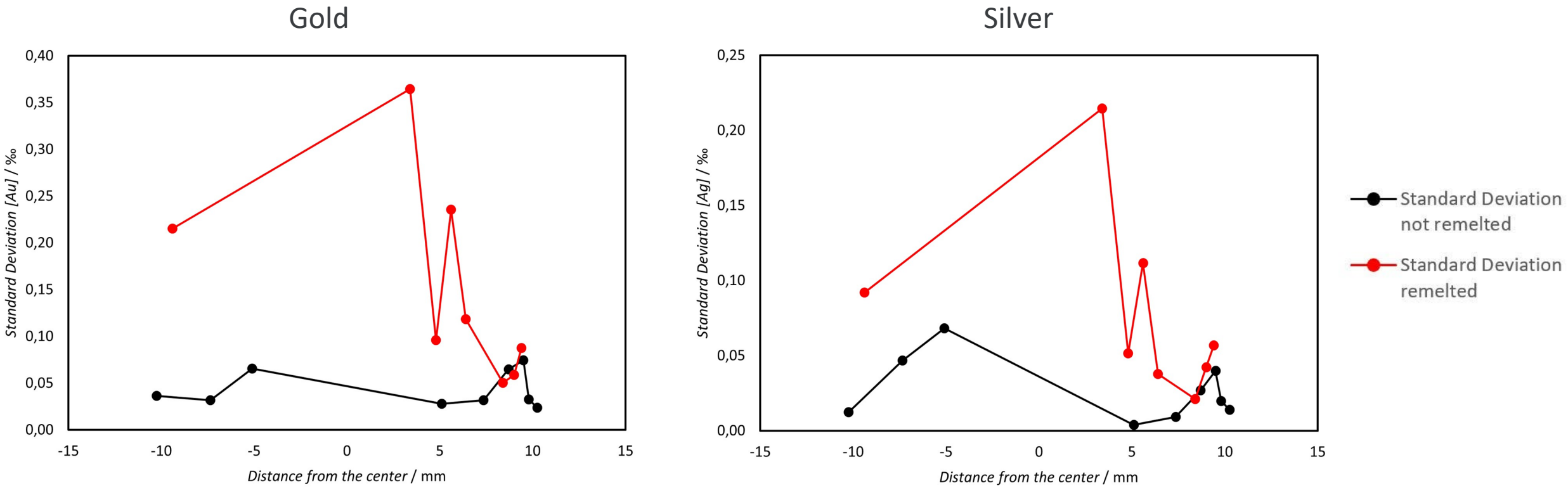
Silver





5. Results and Discussion

Variation of Standard Deviations on CRM 2: Comparison Between Samples

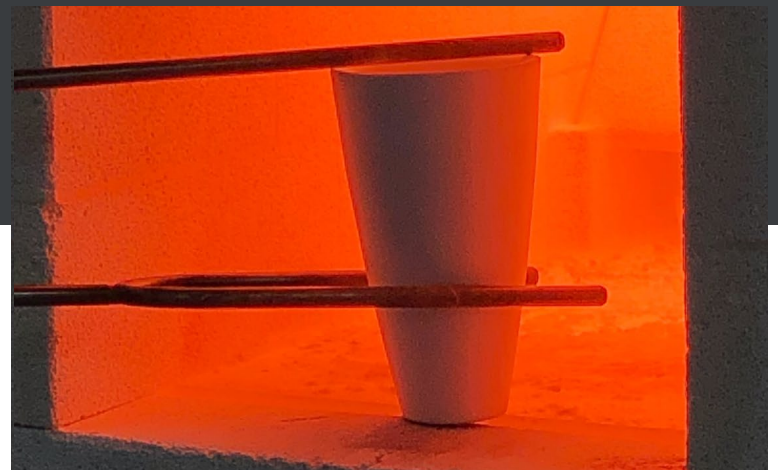


6. Conclusions

- **SPARK-OES is a reliable method** for the direct analysis of lead bead, providing results consistent with CRM nominal values.
- **Precious metals distribution** is more homogeneous in the central regions of the bead, while peripheral areas show greater variability.
- **Remelting has shown a slight homogenization effect**, but no significant variations. However, it has increased the formation of **PbO inclusions**, compromising measurement quality, especially for gold and silver.
- **SPARK-OES proves to be a fast and sustainable alternative**, while the effectiveness of remelting requires further evaluation to minimize undesired effects.

7. Future Perspective

OPTIMIZATION OF SAMPLE PREPARATION



Comparison between crucible assay and scorification

ALTERNATIVE THERMAL TREATMENTS

Improving homogeneity while minimizing oxide formation

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Thank you

I would like to express my thanks to:

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