Characterization of Ancient Roman Bronze Coins via Flame Atomic Absorption Spectroscopy

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Introduction

Metallic analysis of a visually corroded coin is useful in gaining insight into identities, as measured minor metal content can be compared to published values for visually identifiable coins. Flame atomic absorption spectroscopy (FAAS) was chosen in analyzing non-visually identifiable coins provided by the Saint Anselm Classics Dept. because although a destructive technique, FAAS gives a better idea of the whole composition of the coin compared with surface measurements. Previous coin analyses provided data for lead, tin, and silver, but the silver data was incomplete. Acid digestion of coins followed by a six-point external calibration with acid-matched standards was performed with correlation coefficients ranging from 0.9996 to 0.9999. Standards were made daily due to light sensitivity of silver. For method validation, *NIST* SRM 872 was spiked with a silver solution and had a percent recovery of 108(3)%.

Instrumentation

- SCP Science DigiPREP Jr. digestion system with 50-mL volumetric digestion vessels
- Thermo Elemental S Series Atomic Absorption Spectrophotometer with a silver hollow cathode lamp

Data

Figure 1: External Ag Calibration (from 11/9)

$y = 0.0368x - 1E-05$
$R^2 = 0.9999$
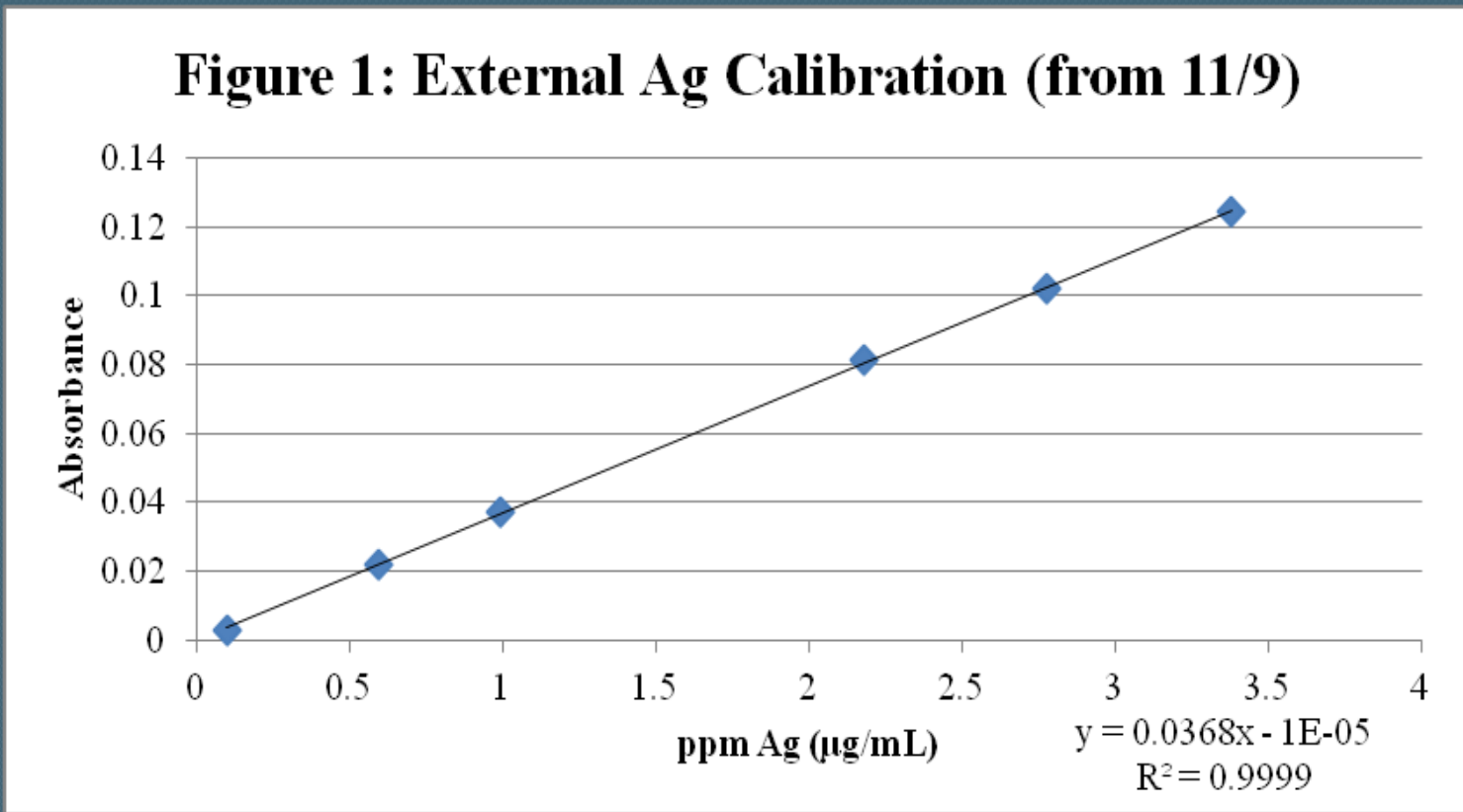
Results

Table 1: Consolidation of Coin Data

Coin	A. Dumas Analyses[1]		Donais, Whissel[2], Pb	Lebel Sn Analysis[3]	Frano, Ag Analysis
	% Pb	% Ag		%Sn	% Ag
1	1.97	0.037	-	-	0.036
2	1.59	0.022	1.43	0.62	0.022
3	0.26	0.016	0.251	<.029	0.017
4	1.94	0.030	1.94	<.029	0.033
5	9.84	0.031	9.75	-	0.0316
6	13.83	0.049	13.83	5.49	0.0526
7	-	-	-	0.21	0.107
8	-	-	-	2.44	0.0507
9	-	-	-	0.52	0.152
10	-	-	-	-	0.091
11	-	-	-	-	0.039
			K. Golden Pb Analysis[4]		Frano, Ag Analysis
8 Fall 06	-	-	11.31	-	0.083
9 Fall 06	-	-	24.51	-	0.250
10 Fall 06	-	-	7.08	0.56	<.002
11 Fall 06	-	-	17.73	1.92	<.042

Table 2: Probable Coin Identities Based on Comparison with Literature Values[5]

Coin	Mint	Obv Leg	Reverse	Emperor	Mint Date
2	Rome	IMP C CLAVDIVS AVG	SALVS AVG	Cladius II	268-270
3	Unmarked	IMP CARAVSIVS P F AVG	PAX AVG	Carausius	286-293
4	C	IMP CARAVSIVS P F AVG	MONETA AVG	Carausius	286-293
5	Rome	IMP C CLAVDIVS AVG	SALVS AVG	Cladius II	268-270
6	Imitation	DIVO CLAVDIO	CONSECRATIO, eagle	Cladius II	-

Conclusions

- Coin matching agreed nicely with published literature values, matching was attempted within 0.05% of published value
- Table 2 shows the proposed identity of the coins that have complete data sets for lead, silver, and tin
- Future plans include further lead and tin analyses for the coins that lack complete data sets and nondestructive analyses of coins using portable x-ray fluorescence (pXRF) to compliment the destructive FAAS method

Acknowledgements

References

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4. Golden, K. Investigation to Improve Digestion Method for Bronze Coin Analysis. Saint Anselm College, Chemistry Dept., Manchester, NH, Fall 2006.
5. Cope, L. H., King, C.E., Northover, J.P., Metal Analysis of Roman Coins Minted Under the Empire. 1997.