dott. Andrea Ciaroni

Via Antonio Stoppani, 2
20129 Milano
+39.335.1347003
ciaroni@gmail.com
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Cat. XII - Preziosi Articoli d'Arte ed Antiquariato (18B, 18N)



Milano, 05.09.2025

Analysis report:

Object: Corean Goryeo bronze Client: Marco Polo Auctions

Date of analysis: 04.09.2025 Type of analysis: XRF analysis

Number of pages:

The Corean Goryeo lost wax technique bronze was examined with XRF to determine the alloy composition. Several tests were done with an Olympus Vanta VCR series (serial number 823330) portable XRF analyzer., equipped with 40 kV X-ray tube with rhodium (Rh) anode and SDD (Silicon Drift Detector). Running for 60 seconds .3. mm spotsize. Profile used are Geochem(2), AlloyPlus and Precious Metals.

Results

1. Base alloy, "bulk" point on the metal

Cu 74.791%, Sn 12.533%, Pb 7.368%, Fe 1.384%, As 1.259%. Silver 0.618% by weight. Historically consistent traces of Bi, Sb, Zn, Ba, Ti, Ni. The data comes from the Chemistry page of the Geochem(2) profile.

- 2. Same point, "surface" reading with AlloyPlus Cu 67.48%, Sn 10.159%, Pb 8.340%, with strong emergence of light surface elements, Si 6.237%, Al 2.52%, S 1.918%, P 0.863%. Silver 0.452%.
 - 3. Visible gilding on the robe, left side

Precious Metals detects Au 10.676% on the surface, Cu 75.94%, Sn 7.29%, Pb 3.879%. Typical modern galvanic interlayers Ni and Cr are absent within the LOD. Silver 0.459%.

4. Black lacquered hair, back of the neck

Thick lacquer signature: LE 63.32%, S 2.825%, Si 2.822%, Ca 2.071%, K 0.594%, P 0.174%, with Cu 18.92%, Sn 3.047%, Pb 3.077% attenuated by the organic film. Silver 0.140% due to shielding effect.

5. Face, whitish area on the chin Geochem shows Cu 53.312%, "W" 33.598%, Sn 7.737%, Pb 1.252%, Ag 0.427%. Here

the noble metal peak between 9.7 and 11 keV was labeled as W by the automatic fit. In light of test 3, it is actually Au residual from gilding.

Why silver matters here

Across independent profiles you consistently read silver around the half-percent level in the bronze matrix, for example 0.618 percent in the bulk test, 0.452 percent in AlloyPlus, 0.459 percent in the Precious Metals run, about 0.140 percent where lacquer is thick, about 0.427 percent on the gilded chin. This is the signature of preindustrial copper from argentiferous ores that was not fully desilvered by historic refining. In period, silver was precious and diverted to coinage and jewelry, so founders tried to remove as much as possible, yet residual Ag at the 0.3 to 0.7 percent level is common in older bronzes. With improved refining through the early modern period and the industrial 19th century, Ag in utility bronzes tends toward trace or below detection. Your readings, stable across methods and sites, are coherent with that older technology.

Alloy: a castable Cu–Sn–Pb bronze, Sn about 12 to 13 percent and Pb about 7 to 8 percent, with arsenic and bismuth in meaningful traces, fits a historic, not standardized, metallurgy.

Gilding: surface Au is present and widespread. No nickel or chromium interlayers typical of modern electroplating are detected.

Lacquer finishes: the black hair zone is a thick organic, mineral-charged coating that masks the substrate, exactly what you expect on an original finish

Dr. Andrea Ciaroni

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bibliography:

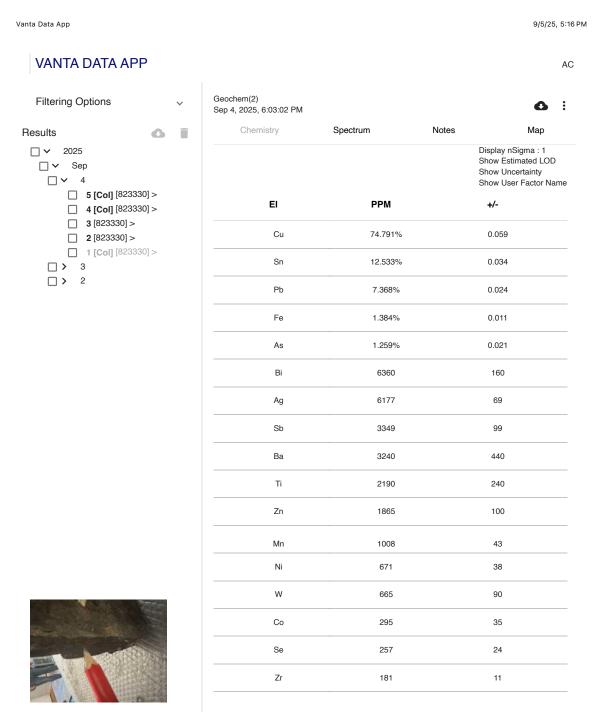
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Oddy A, Gilding of Metals in the Ancient World, British Museum Technical Research Bulletin

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1) and 2) Chemistry of the rim under the base, test 1 and 2



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4 [Col] [823330] >		EI	%	+/-	
2 [823330] > 1 [Col] [823330] > > 3 > 2		Cu	67.48	0.1	7
		Sn 	10.159	0.04	14
		Pb	8.340	0.03	33
		Si	6.237	0.0	98
		Al	2.52	0.2	0
		S	1.918	0.03	32
		Fe	1.512	0.0	4
		Р	0.863	0.03	36
		Ag	0.452	0.00	06
		Sb	0.189	0.0	11
		w	0.117	0.0	0
		Bi	0.096	0.00)9

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Zn

Ni

Mn

Мо

ΕI

< LOD

0.046

0.038

0.023

0.005

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0.008

0.004

0.004

0.001

+/- 3σ

3) Lower left side, gilded vest

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Precious Metals

VANTA DATA APP

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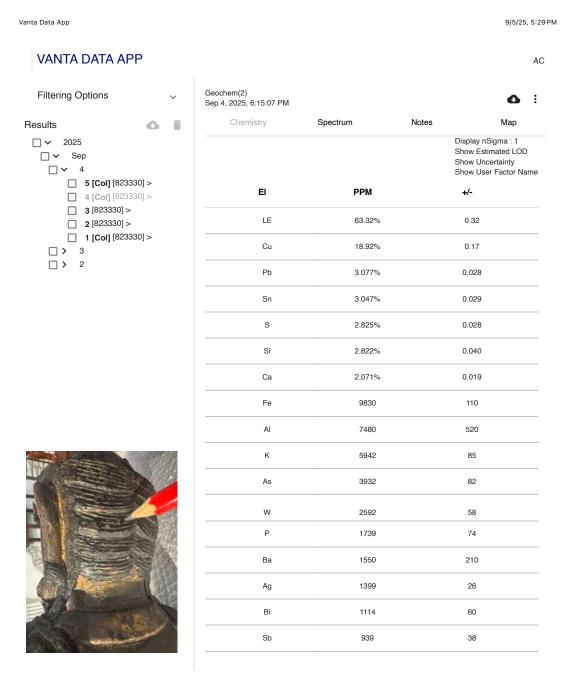
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Chemistry	Spectrum	Notes	Мар	
		5	Display nSigma : 1 Show Estimated LOD Show Uncertainty Show User Factor Name	
El	%		+/-	
Cu	75.94		0.12	
Au	10.676		0.058	
Sn	7.290		0.044	
Pb	3.879		0.032	
Os	1.09		0.13	
Fe	0.655		0.013	
Ag	0.459		0.012	
Mn	0.018		0.006	
< LOD				
EI	%	+/- 3σ	+/- 3σ	
Ti	ND	<0.03	<0.038	
Cr	ND	<0.01	<0.017	
Со	ND	<0.01	<0.016	
Ni	ND	<0.01	<0.013	
Zn	ND	<0.02	<0.029	
Ga	ND	<0.02	<0.022	
Ge	ND	<0.03	<0.034	
Zr	ND	<0.00	<0.005	



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4) Back side of the head, black hair



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5) Gilded face

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VANTA DATA APP AC Geochem(2) Filtering Options Sep 4, 2025, 6:16:25 PM Chemistry Spectrum Notes Мар Results 0 ☐ ✓ 2025 Display nSigma : 1 Show Estimated LOD Sep Show Uncertainty □ ∨ 4 Show User Factor Name **5 [Col]** [823330] > ΕI PPM +/-4 [Col] [823330] > **3** [823330] > Cu 53.312% 0.052 **2** [823330] > ☐ 1 [Col] [823330] > W 33.598% 0.054 Sn 7.737% 0.024 Pb 1.252% 0.012 Se 8959 93 Bi 5110 130 U 4986 65 4882 As 88 Rb 4329 39 Ag 4273 52 Ва 2420 320 Fe 1858 53 Sb 1814 74 Ti 1040 160 Mn 477 33 Cr 423 37 307 51

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