

Investigation report 28736

Pelt, 2020 April 19th

Commissioned by Laboratory Kotalla

Concerning: **Investigation of a Chinese bronze head**



Front side



Back side

Culture / Period: China, archaic

Description:

Bronze head with a tipped neck at the front side.

At the top of the head, there is a slightly ellipsoid hole. At the forehead is a rectangular hole.

The flat shaped ears, bulging eyes, heavy eyebrows, wide nose, and flat mouth are typical features of bronze heads from the Chinese Sanxingdui culture.

Origin of the shape: Bronze Age, Sanxingdui culture (1600 BC) during the Shang Dynasty.



References of Sanxingdui bronze statues
(Sanxingdui Museum, China)
(found in the Sanxingdui of the Sichuan
Province)

Measurements:

Height	:	380	mm
Width	:	260	mm
Thickness	:	2.5 -3.2	mm
Weight	:	1941	g
Rectangular hole	:	2 cm x 2 cm	
Elipsoid hole	:	5.5 cm x 6.0 cm	
Mouth length	:	9 cm	

Used technique:

Single casting with the piece mold casting technique. No seams on the inside or outside can be noticed.

Note: In the Bronze Age of China, during Shang and Zhou Dynasties (1600 – 300 BC), the piece mold casting technique was in use.

Observations:



Typical protruded eyes, eyebrows, and ears on Sanxingdui culture masks and heads.

This type has never been used by other Chinese cultures, even not in the Shang or Zhou Dynasties.

The Sanxingdui culture was completely forgotten until the first discovery in 1929. Later excavations in 1986.

This type of archaic bronzes was unknown before 1929.



Nose and mouth are wide



The nostrils are open.



Protruding or bulging eyes, pronounced eyebrows, and flat-tipped ears are typical for Sanxingdui heads and masks



The hand-carved square hole in the forehead has been seen in several Sanxingdui heads (see references) This opening in the forehead, which has particularly heavy scorings visible at its corners, must have held an appendage.



Reference

View of the ellipsoid hole at the top of the head. Top headed holes are also seen on other Sanxingdui bronzes. The hole has been made by hand after pouring.



Backside view of the object. The shape is similar to the reference (right-hand side).



Inside view (bottom to top. One of the nostrils can be seen.
The inside is mainly covered with soil caused by the burial of the object.

Microscopic observations

Oxidation layers



Typical oxidation of bronze after long time burial (thousands of years).

Several corrosion layers are observed outside as well inside the object.

There are white, grey, red, green and blue corrosion layers on the surface of the bronze.

The minor white and grey and major red layers are directly in contact with the metal surface as they were formed at the first.

By use of a metallographic microscope, one can see that the corrosion is incrustated into the metal surface.

Further, the green layers are formed later out of the red layers.

At least the blue corrosion crystals are formed on top of the green corrosion layer.



Weathering layers of low tin bronze, incrustated with soil particles.

Oxidation of copper: cuprite (brown, red), malachite (green) and azurite (blue).

Oxidation of lead: cerussite (white).

Oxidation of tin: cassiterite (gray)

White layer



magnification x250

A mixture of cerussite (white) and cassiterite (grey) by oxidation of lead and tin at the surface of the bronze.

Determination of the white layer by ICP (Inductive Coupled Plasma Spectrometry) after dissolution with tartaric acid / nitric acid.

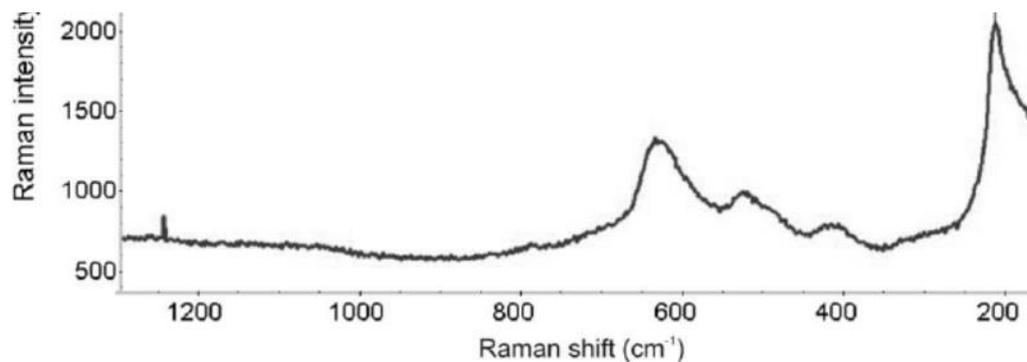
Results:	Tin (Sn)	15 %
	Lead (Pb)	45 %

Red Layer



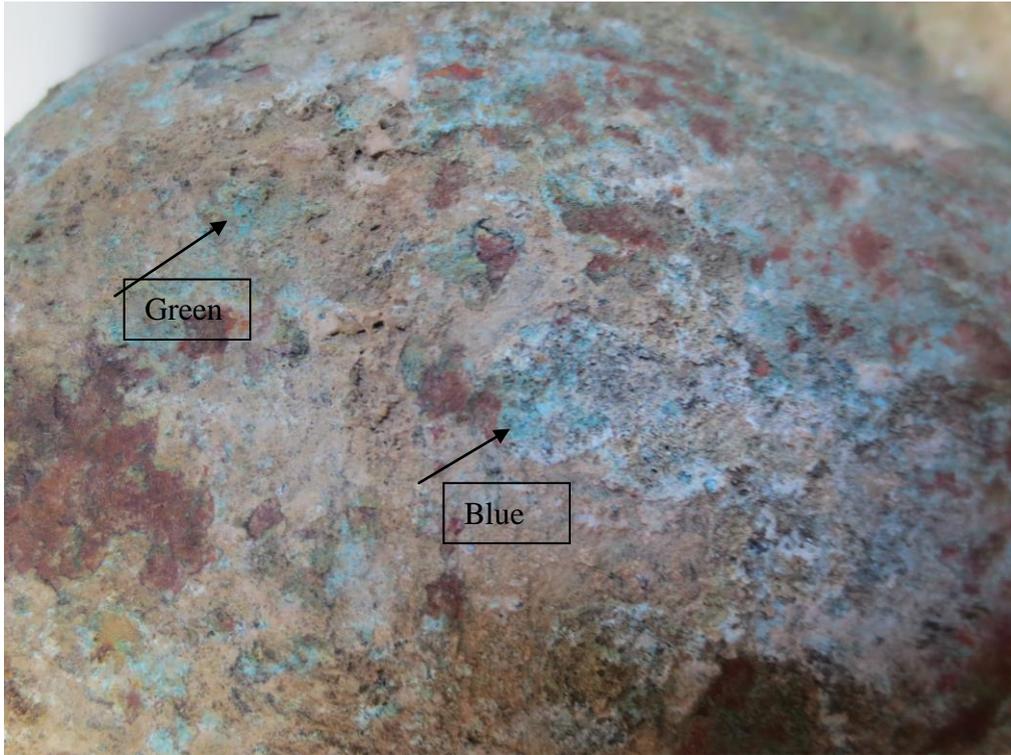
magnification x250

Red copper oxide cuprite (Cu_2O) directly in contact with the metal surface.



Raman spectrum of the red layer (also few little peaks of lead white)

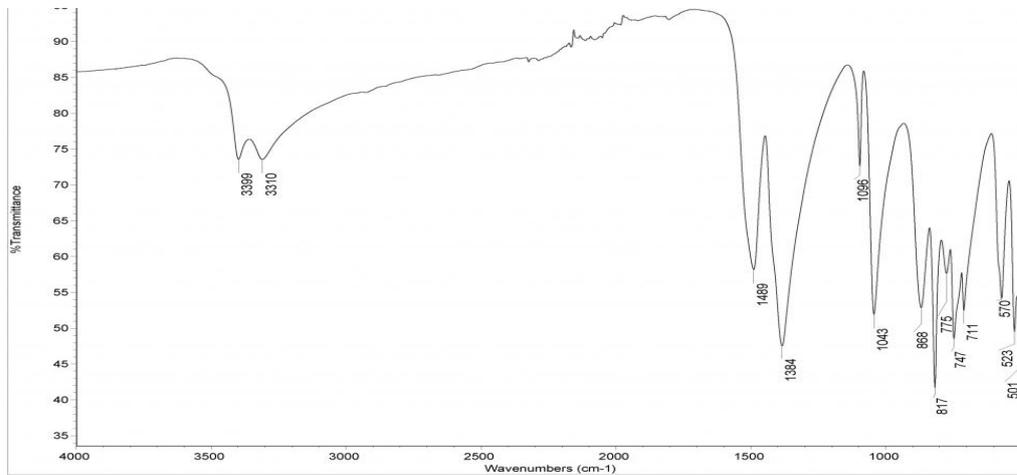
Green and blue layers



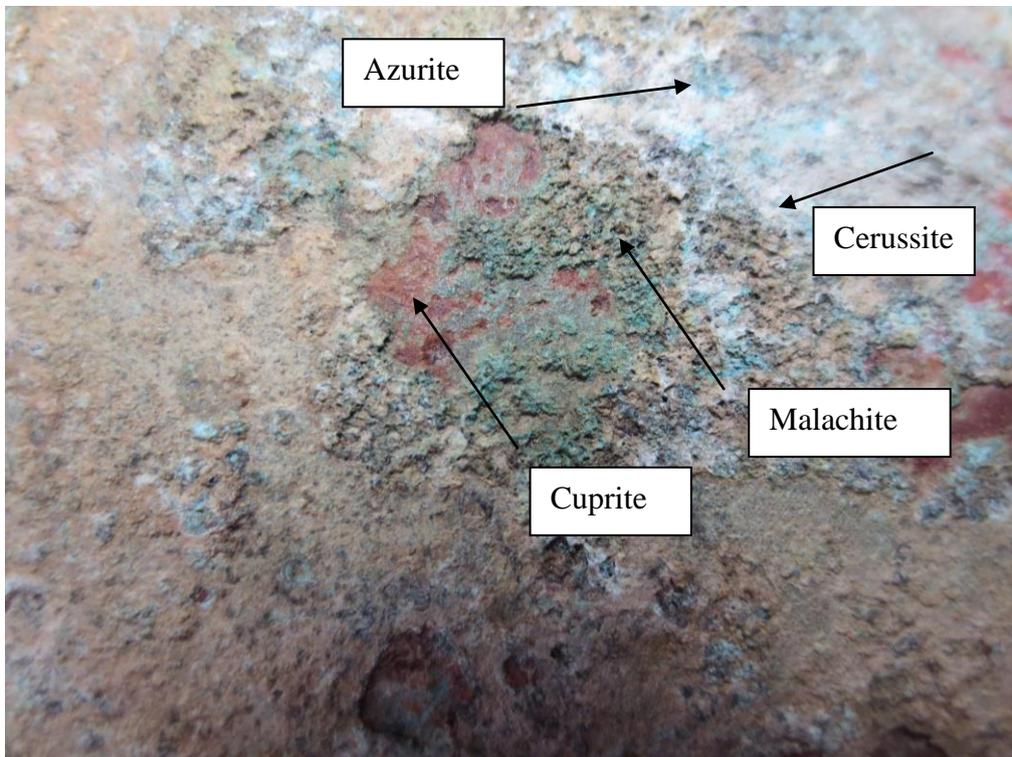
Green layers are malachite ($\text{Cu}_2(\text{CO}_3)(\text{OH})_2$)

Blue layers are azurite ($\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2$)

The green oxidation layer is formed by the reaction of water and carbon dioxide (air) with the red copper oxide. The blue oxidation layer is formed by the hydrolysis of the green malachite layer. This is the last copper oxidation status.

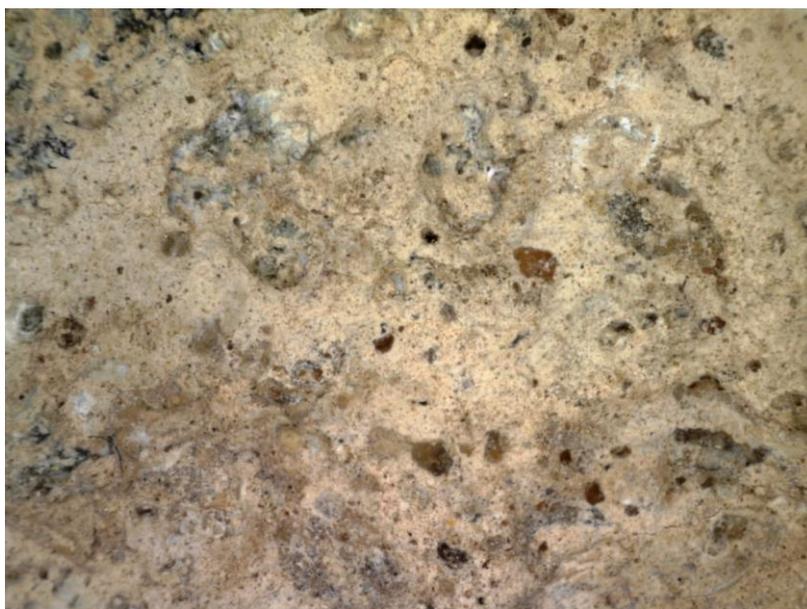


FTIR spectrum of the blue layer (mixed spectra of malachite and azurite)



View of all the oxidation layers formed by burial.

Inside surface: endoscopic observations



The inside surface is also weathered. The oxidation layers are covered by soil rests.

Magn. X250 Soil rests at the inside

UV observation

Observation under UV-radiation of 385 nm: total absorbance, no fluorescence detected.
No use of synthetic binders.

Elemental composition:

Analysis of the metal surface by EDXRF (Energy Dispersive X-Ray Fluorescence Spectrometry)

element		%
Pb	Lead	7.52
Fe	Iron	0.80
Sn	Tin	2.73
Cu	Copper	84.9
Zn	Zinc	4.06

References for comparison: composition of archaic bronze alloy from the Bronze Age
(source: Dept. of MSEM College of Engineering and Computer Science, California State University, Northridge, 2006 Sep)

Elemental composition of bronzes from early Bronze Age

	Date BC	Objects analyzed	% Cu	% Sn	% Pb
Erlitou	1500	32	35-99+	0.04-23	0.03-6.1
Zhengzhou	1500-1300	5	53-80	0.53-18	6-41
Sanxingdui	1200	24	64-98	0.03-12	0.03-33

The metal composition of the object compares to the references of the Sanxingdui culture.

Statement

None of the observations or analyses give rise to a suspicion of forgery or contemporary copy. On the contrary, they are in full compliance with references of archaic bronze objects from the Chinese Sanxingdui culture (12th – 11th BCE).

This statement is an opinion and therefore gives no right to redress or liability of any kind.

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RJM. Bové

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