

Elemental Analysis of Etruscan Loom Weights using X-Ray Fluorescence



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Abstract

Loom weights excavated from Cavità 254 in Orvieto, Italy were analyzed by portable energy dispersive x-ray fluorescence spectrometry (EDXRF). This study sought to identify the elements present in these ancient Etruscan loom weights and to identify statistical differences among the compositions of the clay materials used to make the objects. Statistical differences were identified based upon visual color and inscription type. Elements associated with the color categories (red, white, black, and black-spotted) and were determined.

History and Anthropological Theory

Loom weights (Figure 1) were used by the ancient Etruscans to hold tension on thread while weaving tapestries on a warped-weighted loom (Figure 2). The elongated shape of the loom weights allowed many strings to be tied to one loom weight and also to allow many loom weights to hang side by side while keeping the threads of the loom straight. Loom weights in this study had weights ranging from 200-600 grams.

A proposed theory regarding loom weight usage and ownership is that a loom weight would be made locally and then sometimes marked. Markings may have made the loom weights identifiable based on the owner or the local workshop that made them. It is also thought that loom weights may have been passed down from mother to daughter to keep in the family and may have travelled with brides to their new homes after marriage. If the loom weights were made in different workshops, some of which may have been local to Orvieto but others in other Etruscan communities in the region, then groupings of similar chemical compositions should be observed within the EDXRF data.



Figure 1: Loom weights

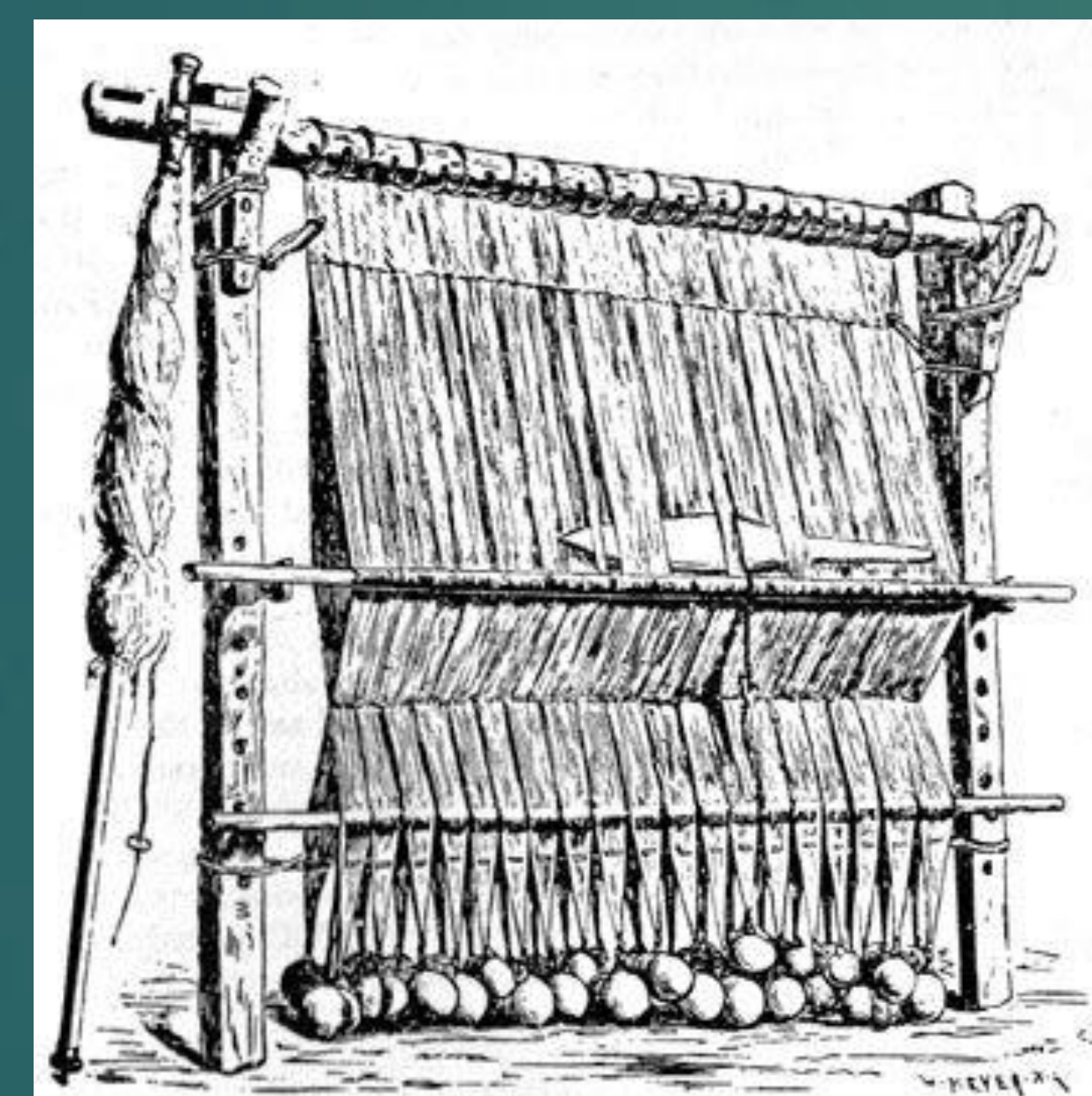


Figure 2: Warp-Weighted Loom (Photo from Pinterest)

Instrumentation

- Bruker Tracer III-V+ Handheld X-Ray Fluorescence Spectrometer
- Instrument settings: 3 μ A current at 40 kV x-ray tube energy
- Analysis time: 120 seconds in duplicate
- Analyses conducted at 5 locations on each of 47 loom weights
- Filter: Yellow



Figure 3: XRF Setup and Loom Weight

Results

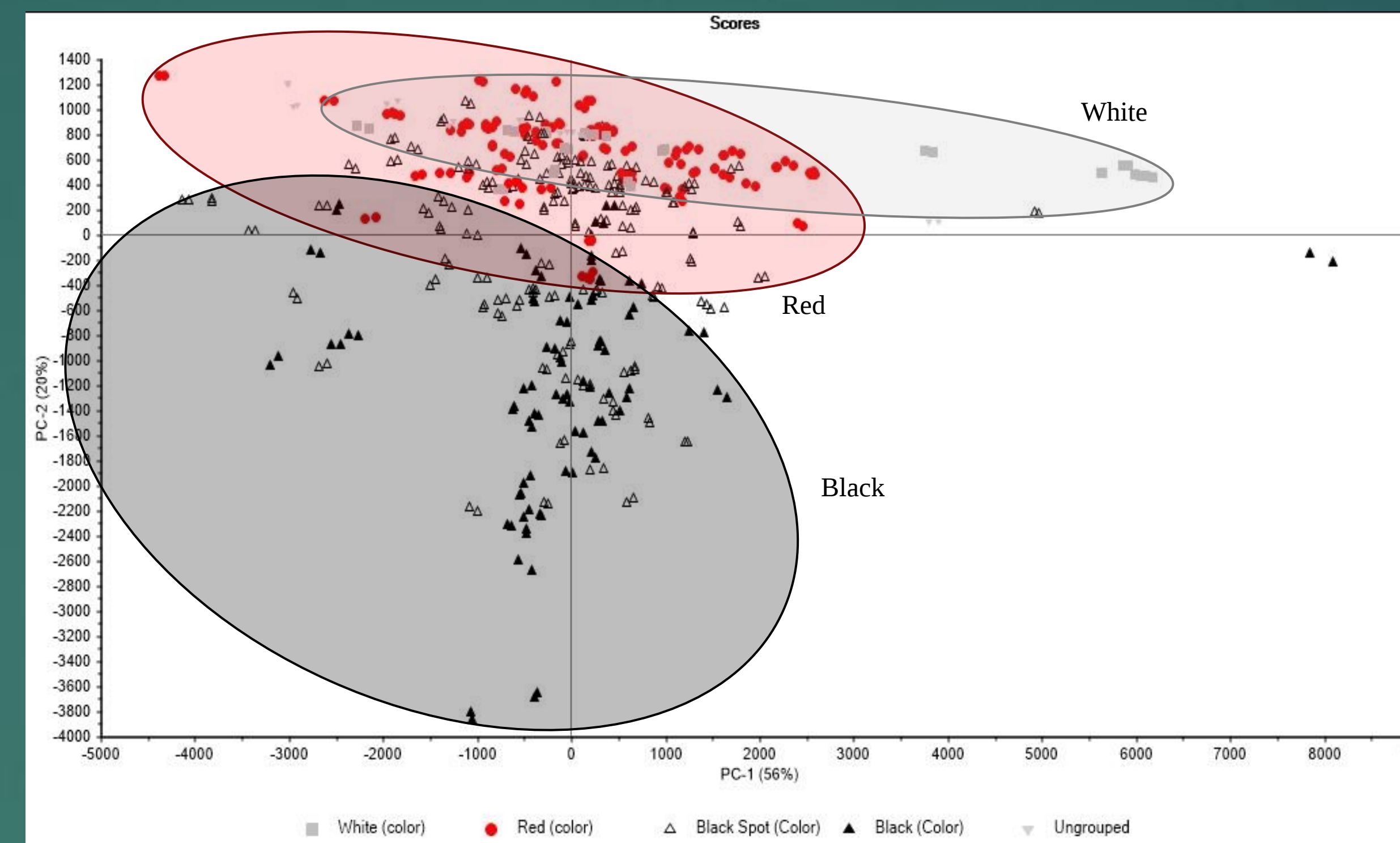


Figure 4: Scores Plot (75.7% of variance explained in first two PCs) labeled by loom weight visual color. Shows that there are clusters based upon the visual color and elemental composition. Elements contributing to variance were Fe and Ca (PC1) and Mn (PC2).

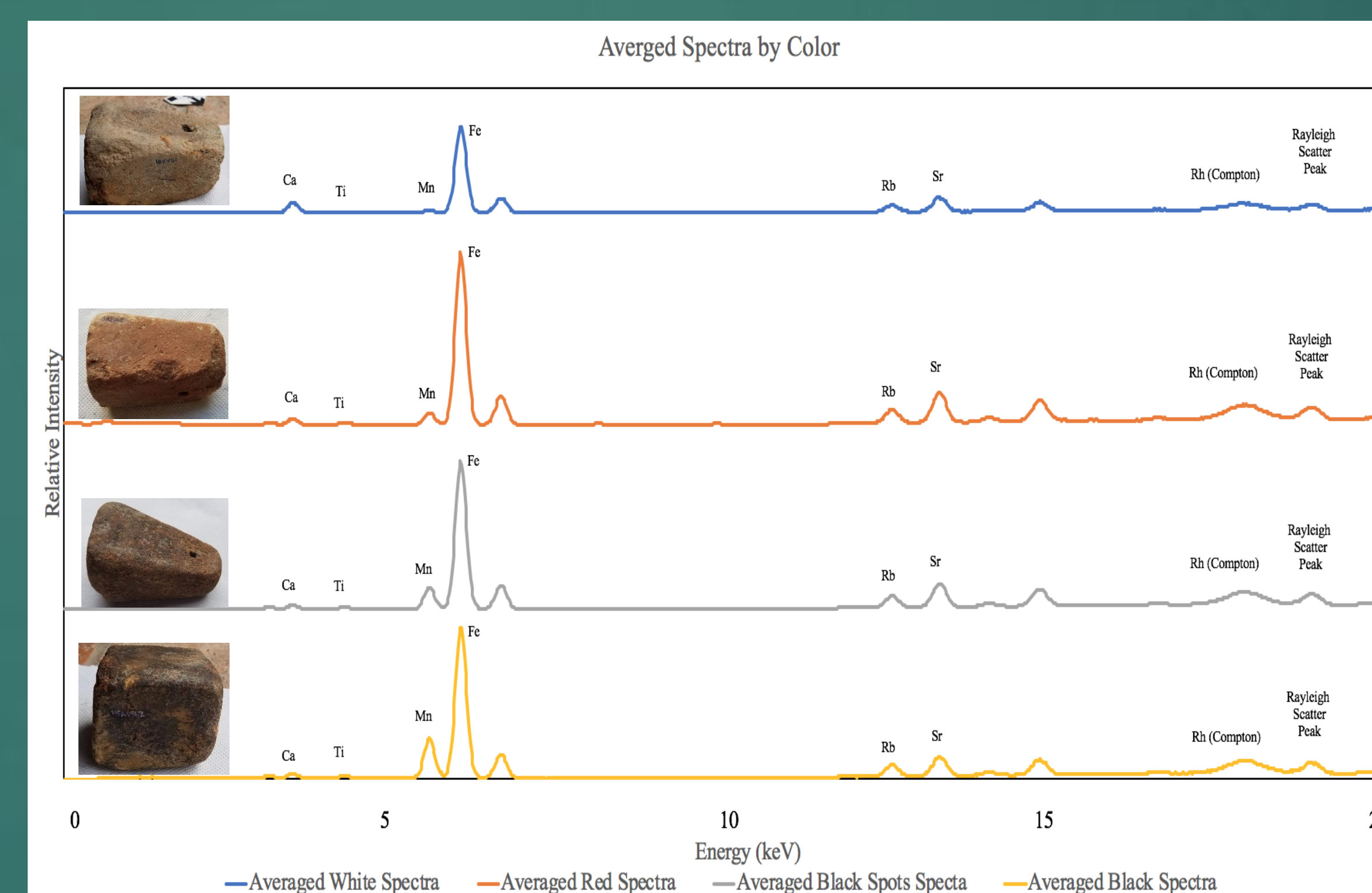


Figure 5: Average spectra based on visual color.

Summary of Results based on Visual Color

- Loom weights designated “white” showed elevated amounts of calcium
- Loom weights designated “red” showed elevated amounts of iron and manganese
- Loom weights designated “black” showed elevated amounts of manganese, likely MnO_2 , which is a black pigment
- Loom weights designated “black spots” did not cluster in one group but instead were dispersed throughout the “red” and “black” samples and appear to represent an elemental composition in between the red and black loom weights

Results (cont.)

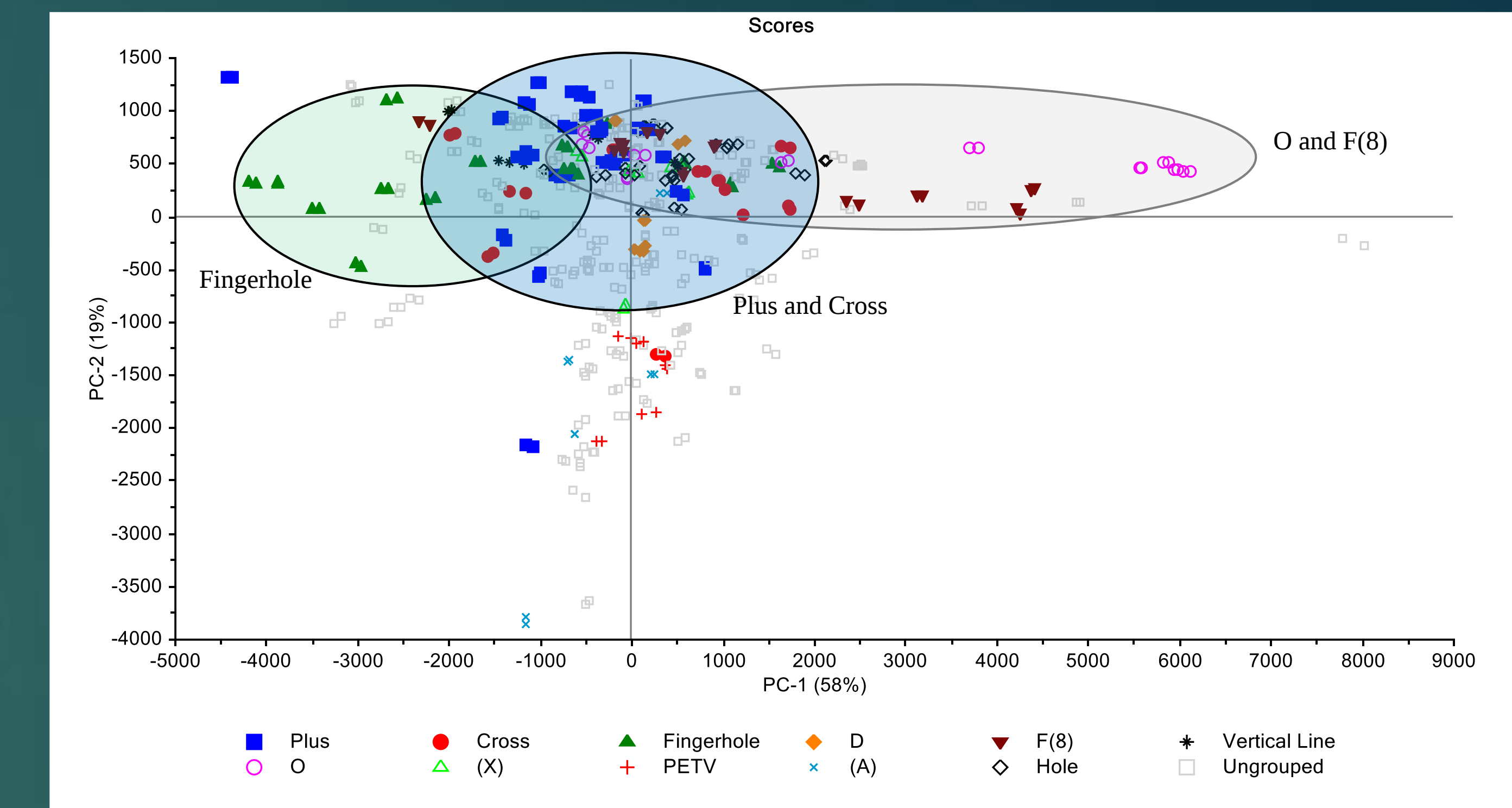


Figure 6: Scores Plot labeled by inscription type. Shows that there are some clusters based upon the inscription type and elemental composition of the loom weights. Small sample sets (1-2) for some inscription types makes data analysis challenging.

Representative Inscription Types



Figure 7: Thumbprint Inscription



Figure 8: 8 Inscription



Figure 9: Plus Inscription



Figure 10: X Inscription

Conclusions

From the statistical plots generated for the loom weight data, it can be determined that loom weights found in the Cavità have chemical differences that can be associated with visual color. Red loom weights were found to have high iron content, black with high manganese, and white with high calcium. There were also associations between inscription types and chemical composition. Future work will include expanding the data set by analyzing loom weights from other Etruscan sites in the region.

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