Scientific Analysis of a Lakota Artifact

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Introduction

The counterfeiting of Native American Art is a multi-billion dollar industry. Over 80% of this counterfeiting occurs primarily in Asia where they do the fabricating of the items and import them into the U.S. Counterfeits are taking away from the cultural significance that the art embodies and the Native American artists that use their art to provide for their families. The authentication of Native American art and artifacts is a rapidly emerging topic of local and national significance. The research presented here involves forensic analysis and authentication of a 1800s Native American hide scraper on loan from the Heritage Center at Red Cloud Indian School. The artifact was analyzed using several scientific tools including laser-induced breakdown spectroscopy, X-ray fluorescence, micro X-ray computed tomography, and DNA analysis. Research such as this, the authentication of artifacts, and advancements in security printing and anti-counterfeiting technology will have a huge impact on the Native America people, both artistically and culturally. The security printing technology will serve as protection for future Native American artwork. The authentication of artifacts will serve as protection for the older artifacts that have historical or cultural significance. Cultural, historical, and geographical analysis was also conducted in order to help put the scientific analysis into context.

Objectives

- The goal of this research is to verify the authentication of a Lakota (Sioux) artifact, a hide scraper (*Figure 1*), through the use of various analysis.

Figure 1. Top view of the Lakota hide scraper provided for this project by the Heritage Center at Red Cloud Indian School.

- Non-destructive analysis of the hide scraper was performed in order to preserve it's cultural significance and it's antiquity.
- Analysis of the materials (steel, leather, and antler) that compose the hide scraper and determining their relevance to the time frame and geographical location.
- Testing the feasibility of printing fluorescent inks onto unique substrates, such as quillwork and beadwork, for future security printing applications.

Methodology

- Collect artifact from Red Cloud Heritage Center
- Conduct cultural/historical analysis to determine the item's relevance
- Conduct non-pervasive scientific analysis
  1. Laser-induced Laser Spectroscopy (LIBS) (*Figures 2 & 3*)
  2. X-ray Fluorescence (XRF) (*Figures 4 & 5*)
  3. Micro X-ray Computed Tomography (*Figure 6*)
- Collect and send (antler and leather) samples to Dr. Hugh Britten at the University of South Dakota for DNA analysis
- Conduct historical analysis of the materials used to create the item and determine their relevance to the time and location
- Formulate possible fluorescent-based inks and try to print on substrates

Figures 2 & 3. Laser-induced Breakdown Spectrometer

Figures 4 & 5. X-ray Fluorescence Spectrometer

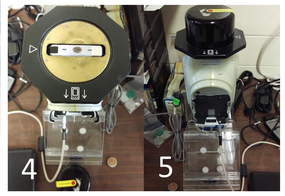

Figure 6. Xradia MicroXCT-400 high-res 3D X-ray microscope

Security Printing

To combat counterfeit Native American art, we developed a fluorescein-based ink (*Figure 9)* that down-converts ultraviolet (UV) light. In previous years, a proof of concept was done to print security marks on unusual substrates. The experiment had such success that we will be testing more unusual substrates. If we can print covert authentication marks on a variety of substrates, it will defend the integrity of the items created by Native artists and provide more information about the production to consumers. This should reverse the negative effect the counterfeit industry has on the Native American communities in North America.

Figure 7. Fluorescein Dye utilized in creating up-converting inks

Figure 8. Optomec Aerosol Jet Deposition System (DWL)

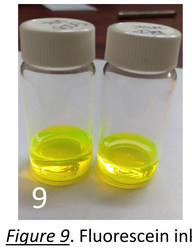

Figure 9. Fluorescein inks formulated for security printing

Acknowledgements

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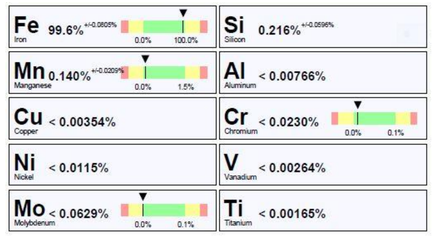
Results & Discussion

➢ Laser-induced Breakdown Spectroscopy (*Figures 10 & 11*)



Figures 10 & 11. are visual representations of the laser-induced breakdown spectroscopy. They show the chemical composition of the metal. The LIBS data indicates that there is low Manganese (not modern). No sulfur and phosphorus.

➢ X-ray Fluorescence (*Figure 12*)

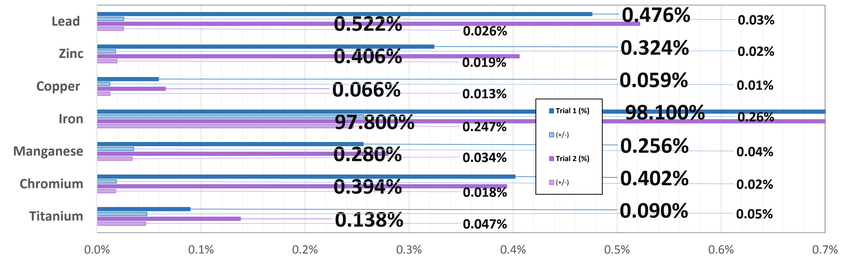


Figure 12. is a graph representing the two trails ran with the XRF. We used this data to verify the LIBS data above but there are some differences. It's strange that Sulfur & Phosphorus (steel-making contaminants) didn't show up in all tests. They were common in the early steel-making process. Either test didn't detect carbon because it's density is too low to pick up.

➢ Micro X-ray Computer Tomography (*Figures 13, 14, & 15*)

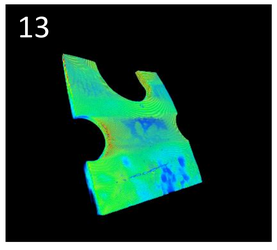
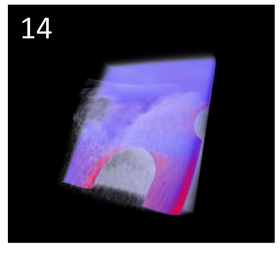


Figure 13. is a 3-D image of just the metal. The precisely-cut circles indicate that this metal was reused by Native Americans

Figure 14. begins to show the antler and leather wrapping around the metal in order to keep the metal in one place.



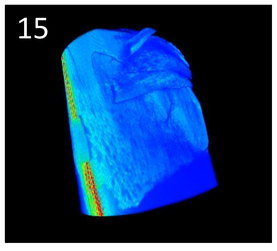


Figure 15. is a 3-D image of the metal (red) secured by antler (blue). It looks like the metal was inserted into a separation at the end of the antler.

Conclusion

- The hide scarper is an historical example of Native American resourcefulness on the Great Plains.
- LIBS and XRF data shows that there is no evidence that the blade is of modern steel-making. Chemical composition consistent with that of a 1800s steel.
- The tomography image shows that it may have been a piece of steel that was recycled by the Native Americans due to the precision of the circles in the steel under the leather wrapping.