Abstract
Glass beads manufactured in Europe were brought to North America and used in trade with native American peoples. The style and composition of glass beads can be used to trace intercontinental connections between the 16th and 20th centuries. To date, no connections have been made between beads recovered in North America and their site of manufacture in France. Here, we characterize a series of distinctly blue 18th century glass artifacts provided by the Musée du Verrier in Saint-Nicolas-des-Biefs, Auvergne-Rhône-Alpes, France in order to characterize their chemical composition. We use x-ray spectroscopy to quantify their major and trace element composition and Fourier Transform infrared spectroscopy to characterize the total water and hydroxyl speciation of the glass. The amount of water incorporated inside the glass is a direct measure of the humidity level that was present within the furnace when it was fired, and the speciation can be used to determine how quickly the glass cooled when it was quenched. Both sets of chemical information are potentially useful for pinpointing the precise location of manufacture in Europe. We compare our measurements with those of blue-colored glass artifacts collected at Ft. Mackinac, an 18th century French trading post located in northern Michigan.

Background Information

Motivation for Study
- Glass artifacts recovered from historical sites in the glassmaking region of 17th and 18th century Bourbonnais share a common color and character to glass artifacts recovered from the French Trading Post at Ft. Mackinac, MI.
- To date, no North American glass trade beads have been sourced to their precise site of manufacture in Europe.
- The chemical composition of glasses can be used to trace their place of origin. Major and minor elements, trace constituents used for coloration, and the constituent hydroxyl species are all diagnostic of the material used to manufacture the glass.

Results

French Glass Artifacts Recovered from the Bourbonnais, France

Marcel
Liliane-B
Ft. Mackinac Trade Bead
Bead 'E'

Infrared Spectroscopy

SEM Energy Dispersive Detector

Comparison to 18th Century Glass Artifacts Excavated From Fort Mackinac, Michigan

Bead 'E'

Discussion

Characterization of Methods Used to Analyze Glass Artifacts

Point vs Diffusive Electron Beam

Two techniques for analyzing elemental abundances in glass artifacts (high vacuum vs. variable pressure) show similar results. Thus, carbon coating is not required to determine glass compositions when using the energy dispersive detector on the SEM.

Ft. Mackinac beads show a loss in Na between point and diffuse electron analyses under high energy.

- Ft. Mackinac beads are homogeneous in elemental abundance.

Characterization of 18th Century Glass Artifacts Collected From Auvergne

- French glasses show variation in chemical abundance.
- Some glass artifacts (e.g., Marcel) are inhomogeneous in elemental composition.
- Some glass artifacts are homogeneous (Liliane-B) in elemental composition.
- Glass artifacts collected from around Saint-Nicolas-des-Biefs show similar bulk compositions, with the exception of Al (see companion poster).

Methods

- Infrared spectroscopy measures the concentration of chemical components bonded as hydroxyl species (O-H).
- Scanning electron microscopy (SEM) measures the concentration of major and minor elements.

Conclusions

- Chemical variation of different bead types show promise for fingerprinting trade beads to their source and subsequent distribution.
- Chemical analyses show that glass samples from Saint-Nicolas-des-Biefs, France are not the source material of glass trade beads found at Ft. Mackinac.
- The Variable Pressure (non-carbon coated) method on the SEM provides results that are identical to results obtained using the High Vacuum (carbon coated) method. Therefore, samples do not need carbon coating prior to analysis using energy dispersive scanning electron microscopy.

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Bibliography