

Nicole Ledoux

UCLA/Getty Conservation Program

Treatment and Technical Study of a Lakota Beaded Hide

Abstract

This paper discusses the conservation and technical study of a Lakota (est.) beaded hide object in very poor condition. The piece, whose original function is not known, was reported as collected in the late 19th or early 20th century by John Anderson, a photographer living on the Rosebud reservation in South Dakota. It was passed down through family lines until it was recently donated to the UCLA/Getty conservation program. At some point in its history, the piece suffered liquid damage that has drastically altered more than half of the hide area, causing darkening, embrittlement, and fragmentation, as well as damage to the associated beadwork, including localized staining resulting in part from bead corrosion. In order to better understand these alterations and their implications for conservation treatment, a technical study has been undertaken that includes both morphological characterization and materials analysis of the hide and tannins. Continued work has included identification of bead composition and characterization of the various alteration products, as well as consultation with tribal and museum experts about original function and appropriate loss compensation. This object provides an interesting case study for investigating the deterioration of hide and the approach taken in treating such significantly altered material.

1. Introduction

This paper discusses ongoing work studying and treating a circular beaded hide with fringe that is in very poor condition. This piece (Figures 1 and 2) suffered severe damage at some point in its history that appears to have involved contact with liquid, resulting in losses, fragmentation, and alteration of over half of the hide area. The technical study undertaken aims to determine the nature and possible sources of this alteration, and to better characterize and document the materials used in its fabrication. The information gathered through this research, in combination with insights gained through consultation with tribal and museum experts, has placed this piece in a larger context and informed approaches to its conservation treatment, which is currently underway.

2. Historical and Cultural Context

The development of the Plains beadwork tradition dates back to the introduction of European-made glass beads to the region through trade in the early 19th century. Prior to this



Figure 1: Front of circular beaded hide before treatment.
Dimensions = 62 cm (max. diameter) x 1 mm (average thickness)

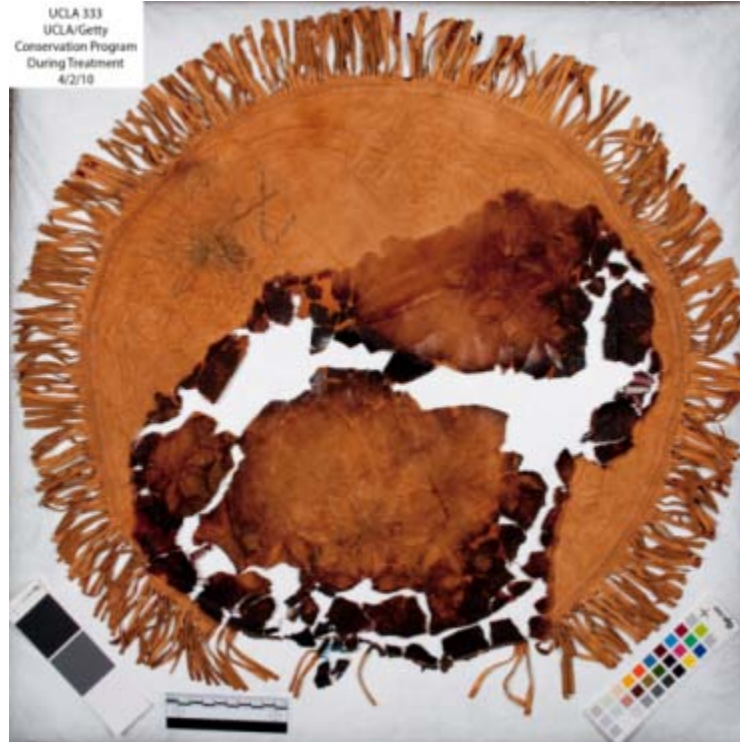


Figure 2: Back of circular beaded hide before treatment.

period, decorative embroidery used primarily dyed quills. Beadwork built upon this tradition of quill embroidery, and this influence can be observed in the banded patterning used in Plains beadwork designs. A variety of hide objects were commonly beaded, including pipe bags, clothing, and moccasins. The style of beadwork and types of glass beads used can often be helpful for dating beaded materials (Lyford 1940; Conn 1986).

Unfortunately, there is only a limited amount of background information available about the circular beaded hide discussed here. It was donated to the UCLA/Getty Conservation Program by the grandnephew of John Anderson, a photographer that lived on the Rosebud Reservation in South Dakota (Figure 3) during the late 19th to early 20th centuries (Hamilton and Hamilton 1971). The piece is reported to have been passed down through family lines, and was recently rediscovered in a trunk which contained other Plains Indian items. Anderson was known to have accepted cultural items as compensation for the goods that he sold on the reservation (Thornton 2007), but little else is known about its origins and there is no accompanying documentation.

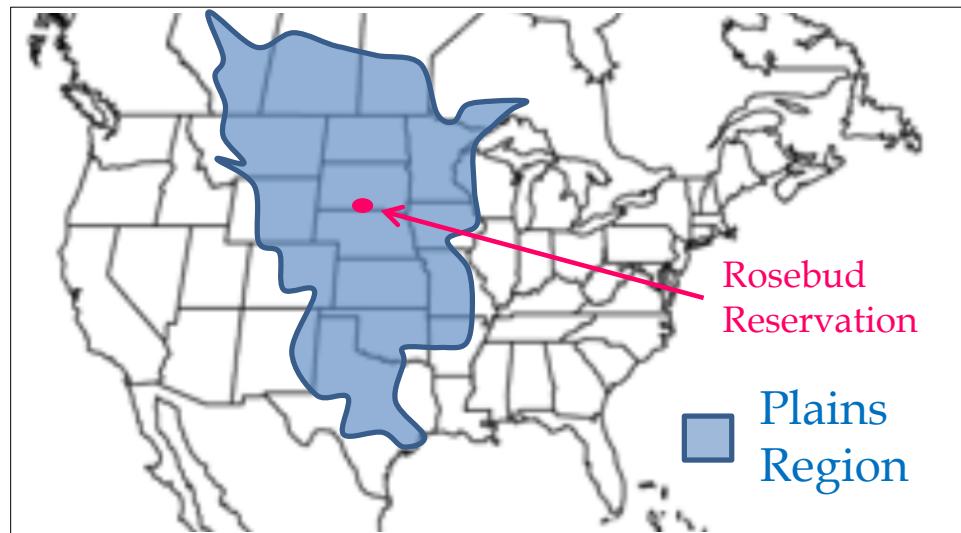


Figure 3: Location of Rosebud Reservation

To find out more about the possible origin and function of this object, the published literature and online museum catalogues were searched for comparative examples, but with little success. Most of the information gathered about this piece has derived from correspondences with Lakota members and museum curators with expertise in Plains Indian art. These consultants provided many suggestions regarding the possible use or function of this piece, ranging from a

tablecloth, to a parasol cover, to a teepee door (see Figure 4 and Table 1). However, the general consensus was that this piece is a product of the blending of native and European styles that emerged with the establishment of the reservation system in the latter half of the 19th century. It was likely made for sale as a tourist souvenir or as an item to furnish new types of living spaces.



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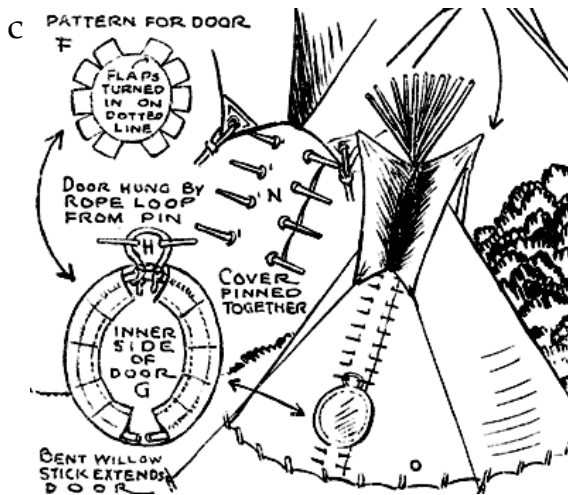


Figure 4: Examples illustrating possible functions of beaded hide object.

a) Sisitonwan Dakota Tablecloth. Image courtesy National Museum of the American Indian, Smithsonian Institution, 12/814.

b) Sioux Parasol, National Museum of the American Indian, Smithsonian Institution. Image courtesy Heth et al. (2005).

c) Pattern for Teepee Door. Image courtesy Jaeger (1992).

Consultant	Function/Significance
Candace Greene, Ethnologist, Smithsonian Institution	Decorative mat, a traditional art applied to a new type of object designed for new types of living spaces, such as a parlor
Nancy Rosoff, Curator, Brooklyn Museum of Art	Parasol cover
Diane Tells His Name, Lakota Member and Museum Professional	Teepee door cover with floral wedding design, or object made for tourists
Emil Her Many Horses, Curator, National Museum of the American Indian	Table cover or cloth, closest to Eastern Sioux beadwork style, example of a transitional item that emerges when Native people begin incorporating new items into their culture
Steven Tamayo, Lakota Member, Rosebud Reservation	Does not follow Lakota design patterns, likely made as tourist souvenir, looks commercially tanned

Table 1: Results of consultation with tribal and museum experts.

The transitional nature of this piece complicates assigning a cultural attribution. It was initially assumed that since this piece was acquired by a resident of a Lakota reservation, that it was likely made by a member of this cultural group. However, two Lakota members, Emil Her Many Horses, curator at the National Museum of the American Indian, and Steven Tamayo, a Rosebud regalia-maker, felt that this design is atypical for a Lakota piece. The design elements repeat in multiples of three and six, unlike Lakota patterns that repeat in multiples of four or seven. Also, floral designs were more common in the Eastern Sioux and Great Lakes regions than in the Central Plains, though they were executed in a less abstracted and geometric style (Conn 1986). The fact that this beaded hide object seems to defy the conventional styles of any particular tribal group may explain the lack of similar examples in the published literature, since these types of hybrid objects, though fascinating, are difficult to classify and are therefore rarely published.

3. Technical Study

3.1 Materials and Fabrication Techniques

The hide is composed of five separate pieces: the circular center and four equal lengths of fringe (Figure 5). The seams between these elements were sewn with cotton thread. The beadwork was executed using the lane stitch (aka lazy stitch) technique that is common in Plains beadwork. This technique creates patterns by securing beads in parallel rows, each composed of one long stitch with multiple beads (Lyford 1940). Sinew was used as the beading thread, though small cotton thread tacking stitches were also used in some areas to secure the centers of long rows.

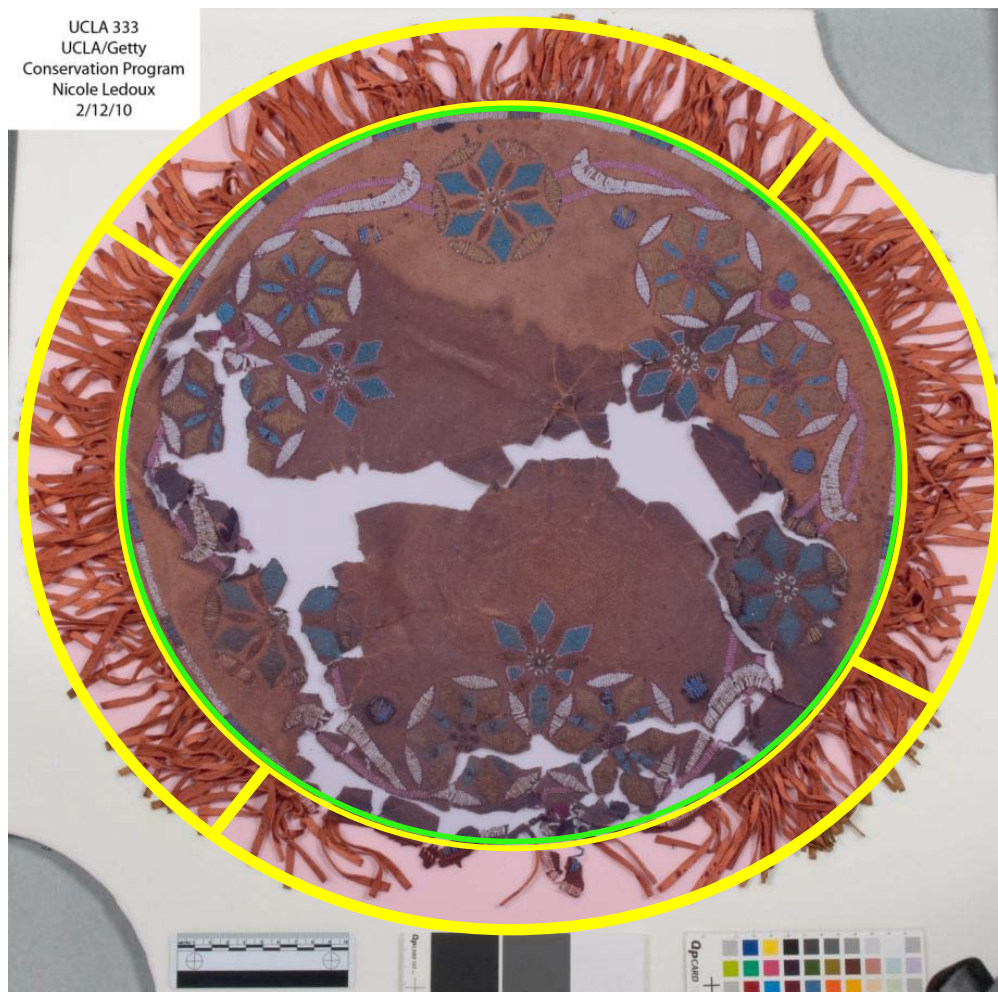


Figure 5: Location of seams between separate hide elements.

3.2 Hide Characterization

The type of hide used, and its tanning and preparation, have proven difficult to determine. Examination of a skin's follicle pattern can be helpful for identifying the source animal (Haines 1981). However, the follicle patterns on this hide cannot be easily matched to a particular animal species, and do not have a consistent appearance across different portions of the hide (Figure 6).

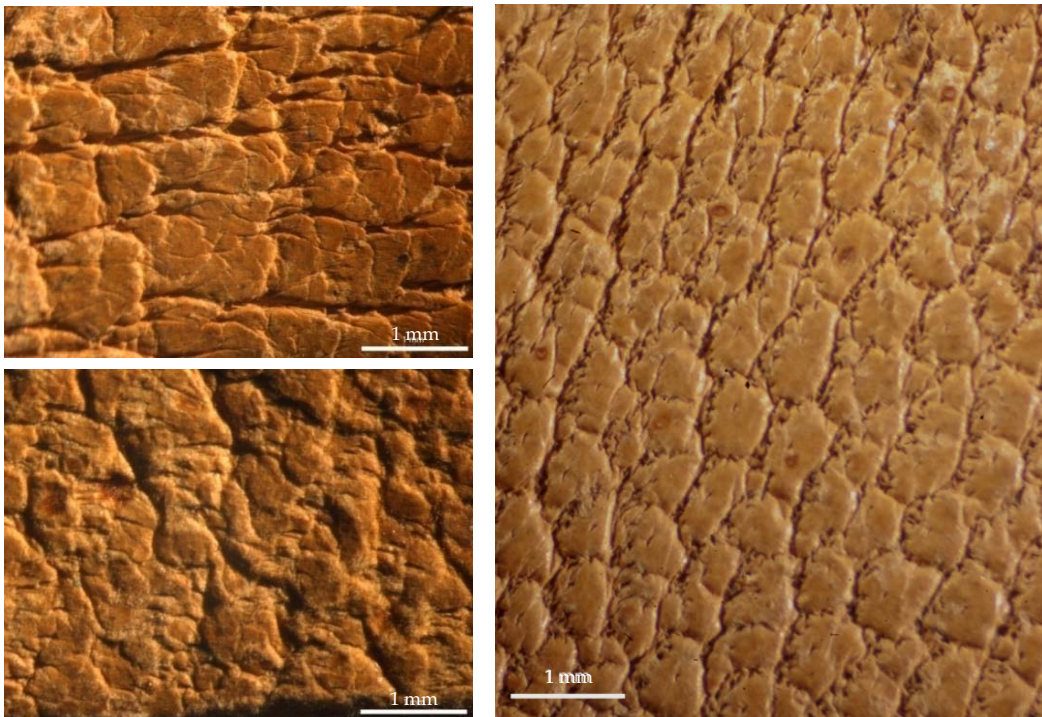


Figure 6: Follicle patterns from fringes (top and bottom left) and center circle (right).

These differences may reflect variations in follicle pattern within a single species, or it could be that some hide components derive from different animal species. Another possibility is that it could result from variability in hide processing techniques.

Potential tanning and processing methods were investigated, as this information can also shed light on the object's origins, fabrication, and susceptibility to certain types of damage. At the turn of the 20th century, when this object was likely made, a variety of tanning methods were possible (Covington 2005). Brain tanning and smoking are traditional methods that Plains natives have used to preserve hides and modify their properties (Cobb, Hodson, and Tamayo 2008). In brain tanning, animal brain is applied to the hide as a paste, resulting in a soft, light-colored hide with an open collagen fiber structure. This process was often followed by smoking,

which introduces color and additional tannins that improve the hide's moisture resistance. Vegetable tanning is a method that uses plant material containing polyphenols to stabilize leather, and was already being practiced on an industrial scale beginning in the 19th century (Thomson 2005a; Ellsworth 1969). Mineral tanning treatments have also been used in large-scale commercial leather production. One example of this is chrome tanning, which produces highly durable, bluish-colored leather. Based on visual inspection alone, it is unclear whether this piece was tanned through traditional native methods or whether it was tanned through an industrial process. However, the crisp, straight edges of its fringes, as compared to the fringes found on other Plains items, have led some consultants to suggest that the hide was commercially produced.

Chemical tests were used to characterize tannins from samples of both the altered and unaltered portions of the hide (Thomson 2005b). The negative vanillin test¹ results suggest that condensed vegetable tannins were not used on this hide, but the inconclusive ferric sulfate test² cannot rule out the use of hydrolysable vegetable tannins (see Table 2). Shrinkage temperature measurements³, which indicate the hydrothermal stability of the collagen fibers, were also used to assess the deterioration of the hide samples (Larsen, Vest, and Nielsen 1993). The results were lower temperatures than would be expected for raw and semi-tanned hides, demonstrating that even the unaltered hide has lost any resistance to heat and moisture it may have once been imparted with. This result may explain its high susceptibility to liquid damage, but has limited usefulness for tannin characterization. Interestingly, the undamaged hide fibers shrank at a lower temperature, and more dramatically, than the altered hide fibers (Figure 7). This may be because the collagen fibers in the altered hide sample had already shrunk in response to the liquid damage (Pouliot 2010).

¹ Vanillin test was performed by placing a corium fiber sample on a glass slide and adding one drop of 1% vanillin in ethanol (w/v) to the sample, soaking up any excess solution. A cover slip was placed over the sample and one drop of concentrated HCl was added to its edge until the sample was enveloped. The development of a bright red stain indicates the presence of condensed vegetable tannins.

² Ferric sulfate test was performed by placing a corium fiber sample on a glass slide and covering with a cover slip. One drop of 1% ferric sulfate in distilled water (w/v) was added to the edge of the cover slip until the sample was enveloped. The development of a blue-black stain indicates the presence of vegetable tannins.

³ Shrinkage temperature was measured using a heated microscope stage. Placed corium fiber sample on a well slide, added 1-2 drops of distilled water, and covered with a cover slip. Placed temperature probe at edge of cover slip. Raised stage temperature by 2° C per minute and observed fiber microscopically. Added water to edge of cover slip periodically to prevent sample from drying out. The temperatures at which the fiber begins to contract and finishes contracting were recorded.

Hide Sample	Shrinkage Temperature (°C)	Ferric Sulfate (Veg. Tannin)	Vanillin (Condensed)	pH (Sample)
Unaltered	29.6 - 49	Inconclusive	Negative	4.0 - 4.5
Altered	40 – 43.5	Inconclusive	Negative	3.5

Table 2: Results of tannin characterization tests.



Figure 7: Corium fibers before and after shrinkage, unaltered (left) and altered (right).

3.3 Bead Characterization

Efforts to characterize the beads used in this piece have been more conclusive. Two types of metal beads and eight different colors of glass beads were used. The glass beads are very small, irregular in shape, and some are translucent—all characteristics consistent with European-manufactured trade beads from the 1870s onward (Lyford 1940; Conn 1986). X-ray fluorescence (XRF)⁴ was used to investigate bead composition. Table 3 lists the major elements present in each bead type examined. Through there are minor differences, all the glass beads were highly leaded. The only bead type for which a colorant could be identified was the opaque blue bead, which had a strong copper peak. The two types of metal beads were identified as brass and iron.

⁴ All XRF data collected using a Bruker Tracer III handheld X-ray fluorescence spectrometer.







	Bead	Major Elements Detected	Interpretation
	Yellow, Translucent	Pb, As, Sb, Fe, Ca, Mn	Leaded Glass
	White, Opaque	Pb, As, Fe, Ca, Mn	Leaded Glass
	Magenta and White, Semi-Translucent	Pb, As, Sb, Fe, Ca, Mn	Leaded Glass
	Blue, Opaque	Pb, Cu, Sb, Fe, Ca, Mn	Leaded Glass, Copper Colorant
	Yellow Metal	Cu, Zn	Brass
	White Metal	Fe	Iron

Table 3: Results of XRF analysis on beads.

3.4 Hide Alteration

The primary cause of this object's instability is the large area of severe hide alteration that has resulted in fragmentation and loss of significant hide portions. It appears that this has resulted from contact with an unknown liquid, based on the tide lines that sharply divide the deteriorated and undeteriorated hide portions. The alteration of the hide is most apparent and severe on the back side of the hide, where the hide surface is dramatically darker and more compacted in the area of liquid damage. This alteration has also caused embrittlement, breakage, and loss of sinew threads and fringes, as well as localized bead corrosion.

The appearance of the altered hide takes more than one form. There are relatively light brown areas that show signs of cracking but remain largely intact (Figure 8a), while other areas are fragmenting and delaminating (Figure 8b). Adjacent to the large losses in the center of the hide, there are highly brittle, shiny areas that may have been produced by contact with a smooth surface when wet (Figure 8c). Other portions of the hide take on a slightly shiny, but more reddish appearance (Figure 8d).

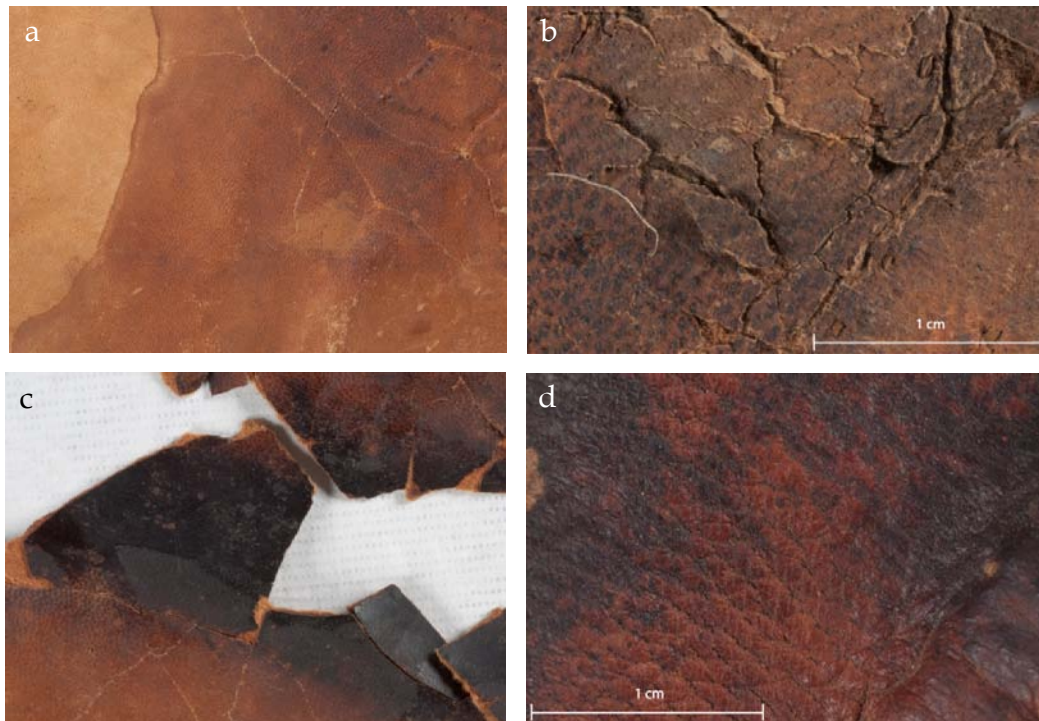


Figure 8: Appearance of hide alteration in liquid-damaged areas.

Fourier transform infrared spectroscopy (FTIR)⁵ and XRF were used to investigate chemical differences between the altered and unaltered hide in order to gather clues about the nature and possible sources of the alteration. No clear differences emerged using FTIR, but XRF produced more informative data. As shown in Figure 9, acquired using the vacuum attachment and no filter to enhance the signal of low-Z elements, the altered and unaltered hide differ in potassium and calcium content, with the altered hide showing stronger peaks for these elements. This suggests that the liquid causing the alteration introduced additional quantities of these elements to the hide. XRF performed using different filters and setting also detected elements that may have been involved in mineral tanning processes, such as titanium and zirconium (Covington 2005). Iron was also detected, and could potentially derive from an iron oxide-based colorant. It should also be noted that chromium was not detected, indicating that the hide was unlikely chrome tanned.

⁵ All FTIR data collected using a Perkin-Elmer Spectrum One instrument, equipped with a solid state attenuated total reflectance (ATR) sample stage.

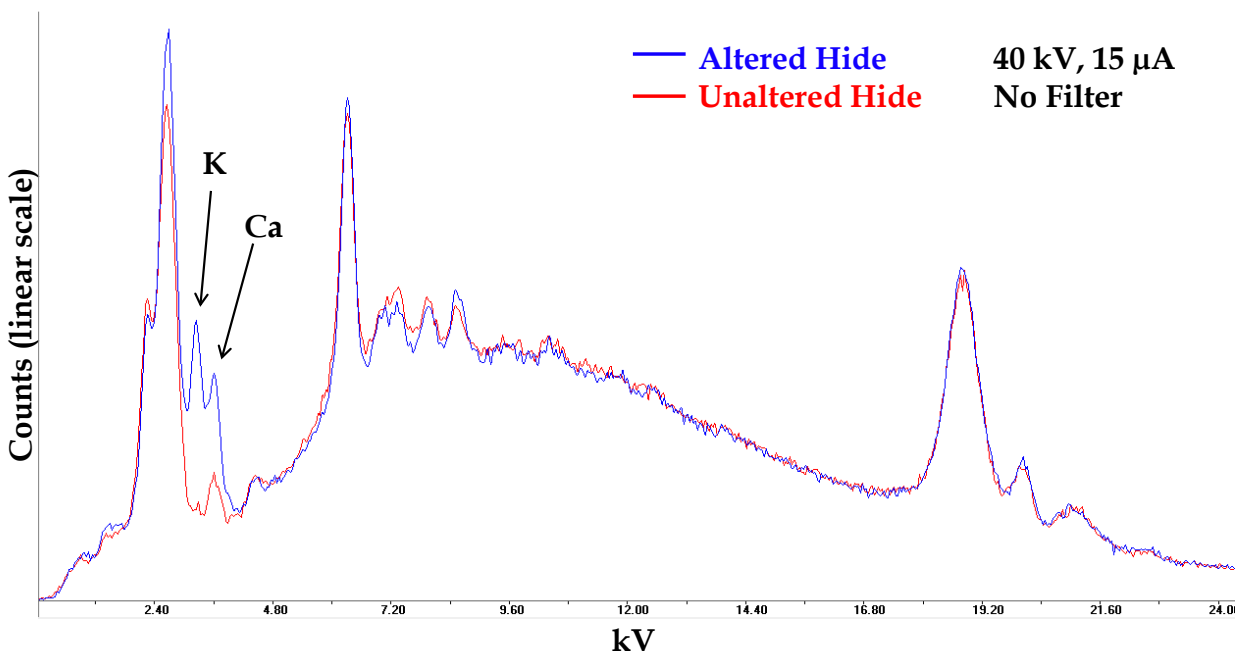


Figure 9: Comparison of XRF spectra obtained for altered and unaltered hide areas.

3.5 Bead Corrosion

The poor interaction between the hide and metal beads was also investigated. Localized areas of the hide covered, or once covered, with iron beads have become severely darkened and weakened, especially in the liquid-damaged areas (Figure 10). The iron beads have also corroded where in contact with the altered hide, but appear to be unaffected over the unaltered hide. On the brass beads, a dark green corrosion has formed on the bead faces in contact with the hide, regardless of its alteration. Green corrosion residue remains on the hide surface in some areas where the brass beads have detached.



Figure 10: Severe darkening where iron beads have contacted the hide.

FTIR analysis was performed on a sample of the green corrosion in an attempt to identify it. The resulting spectrum closely matched spectra for various metal soaps, such as copper stearate, copper oleate, and copper palmitate (see Figure 11). X-ray diffraction (XRD)⁶ was performed as a follow-up, producing a spectrum with peaks matching many of the various copper and zinc soaps, suggesting that the corrosion is likely a mixture of carboxylate corrosion products (Robinet and Corbeil 2003). Perhaps the most interesting finding was the result of XRD performed on the red-orange iron bead corrosion. The corrosion was identified as akaganéite, a corrosion product produced in the presence chlorides (Selwyn, Sirois, and Argyropoulos 1999), indicating that chlorides are either present in the hide or were introduced by the liquid that damaged it.

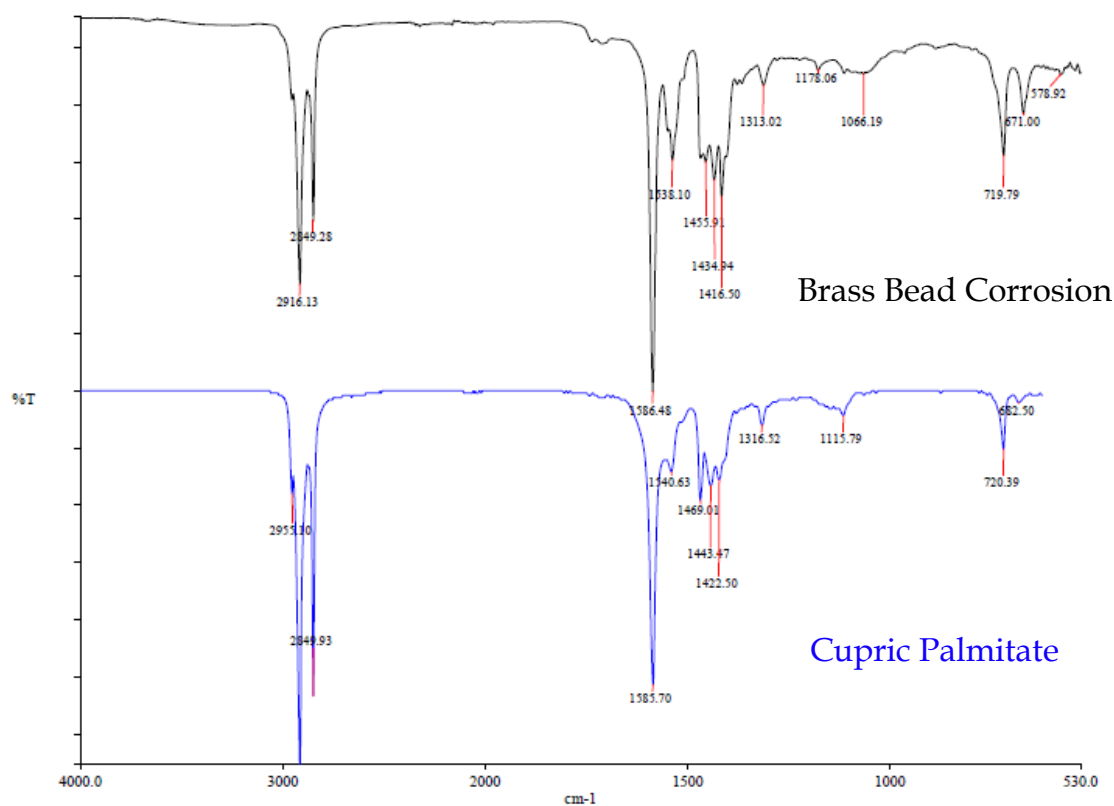


Figure 11: Comparison of brass bead corrosion and cupric palmitate FTIR spectra.

⁶ All XRD data collected using a Rigaku R-Axis Spider X-ray diffraction instrument.

4. Other Condition Issues

Another interesting condition issue affecting the hide is splitting and delamination. Some fringes appear to be splitting sharply between the grain and corium layers, and in the liquid-damaged areas, delamination also seems to be occurring along this plane. One possibility is that the hide was produced by laminating two separate hide layers, but no traces of adhesive were detected through UV examination under the microscope. It could also be what is referred to in the leather industry as “double hiding,” in which over-acidity of vegetable tanning liquors causes splitting (Tancous 1986). Another possibility is that the hide is sheepskin, which has been known to split in a similar manner.

The fringes are somewhat stiff and many are bent and twisted. Most of the fringes on the damaged edges of the hide have been lost, and a great deal have spots of darkening that were likely caused by drops of liquid. There is a green-colored stain in the middle of the three-flower motif in the unaltered portion of the hide which is also visible on the back surface. There is also a black stain in the shape of a “7” that is adjacent to the green stain and only visible on the back.

Much of the beadwork attached to the altered areas of the hide is unstable due to the structural deterioration of the hide and sinew. Figure 12 shows how the fragmentation of the damaged hide has unraveled beadwork and placed additional strains on the sinew. As a result, many of the sinew threads are broken and significant sections of beadwork have been lost. The beadwork attached to the more stable areas of the hide has also suffered similar damage, but to a lesser extent.



Figure 12: Strains on beadwork resulting from hide alteration and fragmentation.

5. Treatment

Based on all of the technical and contextual information collected, a treatment has been proposed for the stabilization and reintegration of the beaded hide. Some steps were completed in preparation for flipping the object, so that the back could be examined. Additional treatment measures (currently underway) aim to prevent further fracturing and delamination of the hide, to provide structural support to the highly fragmented areas, to reestablish the object's overall form, and to stabilize the remaining beadwork.

5.1 Preliminary Stabilization of the Beadwork

Preliminary stabilization of the beadwork was undertaken in preparation for flipping the object so that the back could be examined. First, loose beads and small fragments of hide debris scattered on the surface of the object were collected. Then, a method was devised for stabilizing the beadwork in areas where loose beads were in danger of slipping off of broken sinew strands. The small size of the beads presented a challenge, because there is no room to run an additional thread through the bead alongside the sinew. Therefore, the beads were stabilized using an approach published by Richardson (2002), in which small balls of Paraloid B-72 (an ethyl methacrylate copolymer) are applied to the sinew, just large enough to prevent the loose beads from slipping off. It was found that applying a 20% solution using a small syringe to produce the balls worked well, and the treatment proved to be quite successful (see Figure 13). This preparation stabilized the object sufficiently to allow it to be flipped using a padded support board.



Figure 13: Preliminary stabilization of beadwork. Red arrows point to balls of Paraloid B-72.

5.2 Testing Consolidants and Adhesives

Attempts were made to reproduce the liquid damage on leather facsimiles so that consolidants and adhesives could be tested and evaluated on artificially deteriorated hide with similar properties to the original piece. Since the tanning method used to produce the hide has not been conclusively identified, artificial deterioration was attempted using modern oil tanned chamois leather and aged vegetable tanned bookbinding leather, derived from a late 19th century book that had been rebound by UCLA Library conservation staff (Figure 14a). Hot tap water was poured onto the center of the leather pieces (Figure 14b). Once the liquid was absorbed by the leather, the wet leather pieces were pressured under a weighted glass Petrie dish and allowed to dry (Figure 14c). The oil tanned chamois only stiffened slightly, even after repeated wetting and accelerated drying using infrared lamps. However, the aged bookbinding leather responded to just one wetting and drying cycle by substantially darkening and stiffening in a way that is nearly identical to the damaged area of the beaded hide (Figure 14d). In addition, the compression produced an altered surface that is similar to the smooth, shiny areas on the original piece. This result provides further evidence that the beaded hide was commercially tanned with vegetable tannins.

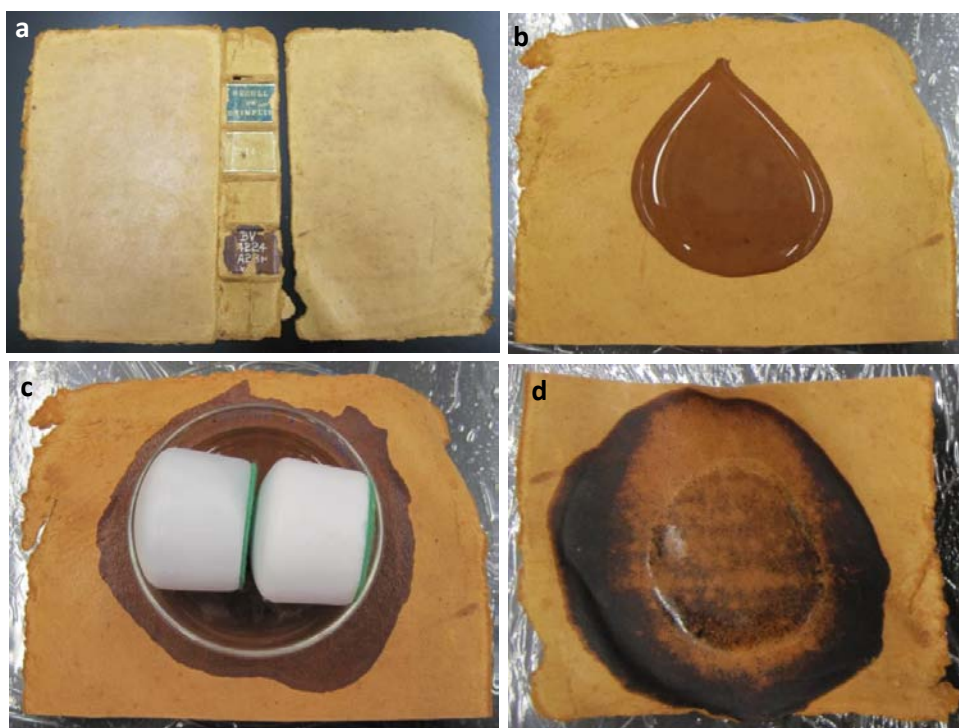


Figure 14: Preparation of artificially deteriorated bookbinding leather.

The similarity of the artificially altered bookbinding leather to the liquid-damaged areas of the beaded hide made it an ideal material for testing consolidants and adhesives as treatment materials. A consolidant is required to stabilize areas on the back surface of the hide that are splitting and lifting. Klucel G (a hydroxypropyl cellulose compound) was chosen for testing in various concentrations because it produces minimal darkening and has a relatively high viscosity, which limits its penetration into the hide (Feller and Wilt 1990). 5% Klucel G in ethanol (w/v) was found to have good working properties and sufficient strength to consolidate most areas. However, various mixtures of Klucel G and low concentrations of PVA AYAF (a polyvinyl acetate resin) in ethanol were also tested in order to find a consolidant with slightly higher strength and tack for the lifted areas that proved more difficult to adhere. Unfortunately, the addition of the low viscosity PVA AYAF solution to the Klucel G reduced the overall viscosity of the mixture, so this combination found only limited uses.

In order to reestablish the hide's original form and prevent further fragmentation and loss, an adhesive is needed that is capable of joining the fragments of significantly altered hide. Because of the low shrinkage temperature results, adhesives requiring heat for setting were eliminated from consideration. Beva 371 (a mixture of ethylene vinyl acetate resin, polycyclohexanone, and paraffin wax) and Lascaux 360 HV and 498 HV (dispersions of butyl methacrylate copolymers thickened with acrylic butyl-ester) have found widespread use as adhesives in skin and leather conservation and can set through solvent evaporation, without the application of heat (Kite, Thomson, and Angus 2005; Kronthal et al. 2003). These adhesives were evaluated for their effectiveness at joining stiffened hide using Japanese tissue paper carriers.

5.3 Consolidation

5% Klucel G in ethanol (w/v) was used to consolidate the hide in the liquid-damaged region. It was applied by feeding the solution into the gaps between split and lifted hide layers using a small brush. Where necessary, small weights were used to hold the hide in position while the adhesive set. Special attention was given to the areas surrounding break edges to ensure that these surfaces would be sufficiently stable to support adhesive mends. A mixture of Klucel G and PVA AYAF was used in a few narrowly lifted areas where reduced viscosity was an advantage. The composition of this solution was a 2:1 mixture (by volume) of 5% Klucel G in

ethanol (w/v) and 5% PVA AYAF in 4:1 ethanol:acetone (w/v)⁷. In both cases, little to no darkening was observed on the front or back surfaces of the hide.

6. Future Work

The next phase in the treatment of the beaded hide will be to realign and join the fragmented sections. Based on the results of testing, a 1:1 mixture (by volume) of Lascaux 360 HV and 498 HV was chosen as an adhesive for this purpose. When applied using a Japanese tissue paper carrier, the Lascaux mixture conformed well to uneven surfaces. The Lascaux mixture also dried slowly relative to the Beva 371, providing more working time for positioning the material across complex joins. Although the water-based nature of the adhesive caused some initial concern, it did not show any signs of poor interaction with the artificially altered leather when used undiluted.

To join the larger hide fragments, Lascaux will be applied to small Japanese tissue paper carriers with feathered edges and placed across joins on the back surface of the hide. These small joins will be spaced apart at intervals that will depend on the length and configuration of the join. Once the fragments have been realigned and joined, a Japanese tissue paper lining will be applied to the back of the liquid-damaged section, spanning areas of loss and backing highly fragmented regions. This lining will be toned on its front surface to match the color of the hide and will serve to fill and reintegrate areas of loss visually while providing necessary additional support to the most fragile areas.

Final conservation measures will include repairing damaged fringes and additional securing and stabilization of the beadwork. Sharply bent and twisted fringes will be relaxed through very gentle humidification, if this is determined to be possible, and light cleaning using dry methods will be performed on the front surface. Finally, the possibility of compensating some of the larger areas of beadwork loss will be considered in consultation with curators and tribal members.

7. Acknowledgements

Many people have provided valuable information, perspectives, advice, and assistance throughout the course of this project. My advisor, Prof. Ellen Pearlstein, has provided invaluable

⁷ Plus a small amount of additional acetone to reduce the cloudiness of the solution.

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8. Materials List

Vanillin

Ethanol

Hydrochloric Acid

Ferric Sulfate

Distilled Water

Paraloid® B-72 (Rohm & Haas)

Acetone

Klucel® G (Aqualon Division of Hercules)

PVA AYAF (Union Carbide)

Beva® 371 (Conservator's Products)

Lascaux 360 HV (Alois K Diethelm)

Lascaux 398 HV (Alois K Diethelm)

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