Winterthur/University of Delaware Program in Art Conservation

Conservation Examination Report and Treatment Proposal

Owner: Winterthur/University of Delaware Program in Art Conservation (WUDPAC) Study Collection
Accession #: GACP 1754C
Object: Siapo (Barkcloth)

Provenance: American Samoa/Samoa, Tonga, Fiji, est.

Object Date: Mid-20th Century, est.

Materials: U'a (paper mulberry bark); o'a, lama, ago (black, brown, yellow dyes), est.

Dimensions: Siapo A: 67 5/16 x 28 3/8 in (171 x 72 cm)
Siapo B: 17 x 29 in (43.2 x 73.7 cm)

Reason for Treatment: Treatment project for second-year object majors

Examined By: Luca Denegre, Daisy Diamond, Leah Palmer, and Caitlyn Fong (Graduate Fellows, WUDPAC Class of 2026)

Consulted: Lara Kaplan, Objects Conservator, Winterthur Museum, Affiliated Assistant Professor, WUDPAC
Crystal Maitland, Senior Conservator of Paper, Winterthur Museum, Affiliated Assistant Professor, WUDPAC
Reggie Meredith Fitiao, Retired Faculty in the Fine Arts Department, American Samoa Community College

Proposal Date: March 10, 2025

Description

There are two *siapo* (barkcloth) included in this object. The larger siapo (Siapo A) is rectangular and made of two layers of beaten paper mulberry inner bark fiber (figs. 1-2). It has three linear edges and one serrated edge, and it has geometric patterns on both sides. The smaller piece (Siapo B) is rectangular, evenly reddish brown, and unpatterned (fig. 3-4).[1]

Siapo A

Figure 1. Siapo A, recto, normal light.

Figure 2. Siapo A, verso, normal light.

Substrate and colorants

The front of the siapo is designated in this report as the side with a repeating geometric pattern in a grid, described further below. The back is the side with parallel lines, triangles, and dots, fainter in color than the front. The serrated edge is considered the bottom.

Two layers of beaten plant fibers adhered together with a starch-based adhesive make up the siapo substrate. The grain of the top layer front runs vertically; that of the lower layer runs horizontally. There are thin areas and holes in both layers likely the result of manufacture. The back has also been patched with additional pieces of beaten plant fiber in places.

There are four colors on this siapo: dark brown, reddish brown, tan applied on off-white substrate. The dark-brown colorant is matte, while the reddish-brown colorant has a slight sheen. The tan color is difficult to distinguish from the off-white as it has faded considerably. It absorbs slightly under longwave ultraviolet light[2] and is well saturated into the fibers of the substrate. The off-white is the uncolored plant fiber substrate.

The designs on the siapo appear to have been applied by hand with a round brush, likely the *paogo* (dried pandanus fruit), which is traditionally used[3]. There are brush marks visible at the beginning of the strokes, which would be consistent with the use of a paogo. The colorant looks to have been applied in multiple washes in most areas to create a stronger tone.

Pattern

In this section, the pattern will be described as geometric shapes but the design elements represent rich symbolic imagery within Samoan and Tongan cultures.[4] As noted above, the front of the siapo features a repeating pattern of shapes laid out in a grid. The top horizontal row is made of 22 reddish-brown diamond shapes with a tan center, each set in a box. The middle three rows are composed of an alternating pattern of ten squares. Each square is divided diagonally into four quadrants with a reddish brown line. Two opposing quadrants are lined with two semicircles. The negative space is colored with the reddish brown colorant. In the middle row, these shapes are colored with the tan colorant. The other two opposing quadrants each have two triangle shapes with an oval shape in the middle, each colored dark brown on the off-white background. The squares across the siapo are arranged so that the semicircle and triangle-oval shapes alternate at each edge. The column on the edge of the proper left (PL) side is a series of triangles with reddish brown and tan parallel lines against an off-white background. The triangles at the outermost PL edge are fully colored in reddish brown.

[1] See: “Appendix I: Before Treatment Photodocumentation” for images and “Appendix V: Glossary” for a summary of terminology.
[2] See: “Analysis” for further interpretation on UV images.
[3] See: “Materials and Manufacture” for more information on *poago.*
[4] See: “Significance and Cultural Context” for the interpretation of these symbols.

The bottom row is a series of eleven triangles. Two alternating patterns have been applied. In the first set of triangles, the background is reddish brown and there is a diamond in off-white with a starburst pattern of four lines applied in tan. The other set of triangles has a reddish brown background with a semicircle in off-white with parallel lines of reddish brown across it, and three oval teardrop shapes of off-white. The triangle at the PL edge is smaller and plain reddish brown. The edge of the substrate has been cut to border the triangles, with a smaller triangle in between. The edge is colored in tan.

On the reverse is a pattern of horizontal parallel lines in reddish brown that fills the background. This reddish brown appears lighter than that on the front. Three vertical lines in a darker brown divide the piece into four quarters. In the lower half of each quarter, there is a shape made of two obtuse triangles that meet at the vertex. A darker-brown round dot is present in the first and third quarters from the proper left. There are chalky white particulates on the proper left section.

Siapo B

Figure 3. Siapo B, recto, normal light.

Figure 4. Siapo B, verso, normal light.

This piece is made of two layers of beaten inner bark. The grain of both runs diagonally and perpendicular to each other. Compared to piece A, the substrate of piece B is thicker and more robust. The edges of the material are jaggedly cut. The strong reddish brown of the siapo appears to be from an applied colorant.

Significance and Cultural Context

Siapo serve a variety of functions within Samoan traditional culture. The cultural traditions, materials use, and visual language of siapo have been passed down and continued by generations of Samoan women. The following cultural context of the siapo is largely informed by a consultation with siapo maker and educator Regina (Reggie) Meridith Fitiao from Leone, American Samoa on 2/25/2025.[5]

Provenance

This siapo was donated to the Winterthur Organic Materials Study Collection after it was deaccessioned from the Baltimore Museum of Art (BMA) on 4/23/2019. The smaller reddish brown siapo was folded into the larger piece when it arrived at Winterthur. The siapo was originally a gift of H. Richard McCord, Jr. to the BMA. Curators at the BMA were contacted for contextual information around the accession but no further information was available as of 3/7/2025.

Use

The serrated bottom edge, overall length, and folds along the top edge[6] suggest that this siapo would have been worn for a dance. Reggie suggested that this could be a *kaloa*, which would have been worn by a *tsao po* (village maiden) during an

[5] See: "Appendix IV: Consultation with Regina Meridith Fitiao" for a full summary of the meeting.
[6] See: "Condition" for a further description of the folded edge.

'ava ceremony for the bestowal of a chief's title. A similar Samoan siapo with a serrated bottom edge from the Rhode Island School of Design's collection is designated as a *lavalava* (skirt) (fig. 5).

Figure 5. Unknown Maker, Samoan, Long wrap skirt (lavalava). Image courtesy RISD Museum (46.489).

Interpretation of Samoan symbols, front

The symbols on the front of the siapo are consistent with Samoan tradition (fig. 6). During the consultation, Reggie identified five symbols: *Fa'atuli* (*Tuli* bird), *fa'a i'tuli* (Tuli bird footprint), *fa'a 'ali'ao* (Trochus shell), *fa'a aviao* (starfish), and *tusili'i* (coconut frond).

Figure 6. Front, annotated.

The semicircle-shaped fa'atuli represents the Tuli bird, and the three shapes of the fa'a i'tuli represent the bird's footprints. Tuli likely refers to the migrational Pacific Golden Plover, which journeys annually from Alaska to American Samoa and other neighboring Polynesian countries (McCormack 2021). The triangle shapes of the fa'a 'ali'ao represent Trochus shells. These are collected by women from the shoreline, and are a delicacy and integral part of Samoan diet. The faded, eight-sided starburst fa'a aviao represents starfish. Parallel lines are used as a visual filler and also represent tusili'i, which are the midribs of coconut fronds. Coconut fronds are used as brooms and combs for hair.

Interpretation of Tongan symbols, back

According to Reggie, the reverse appears to be a reused section of a larger *ngatu*, which is a Tongan barkcloth (fig. 7). There remains a lot of cultural exchange between Tonga and Samoan cultures, so it is likely that a large older ngatu would have been reused to make this siapo. Cutting up and reusing barkcloth was a common practice in Samoan and other cultures the region.

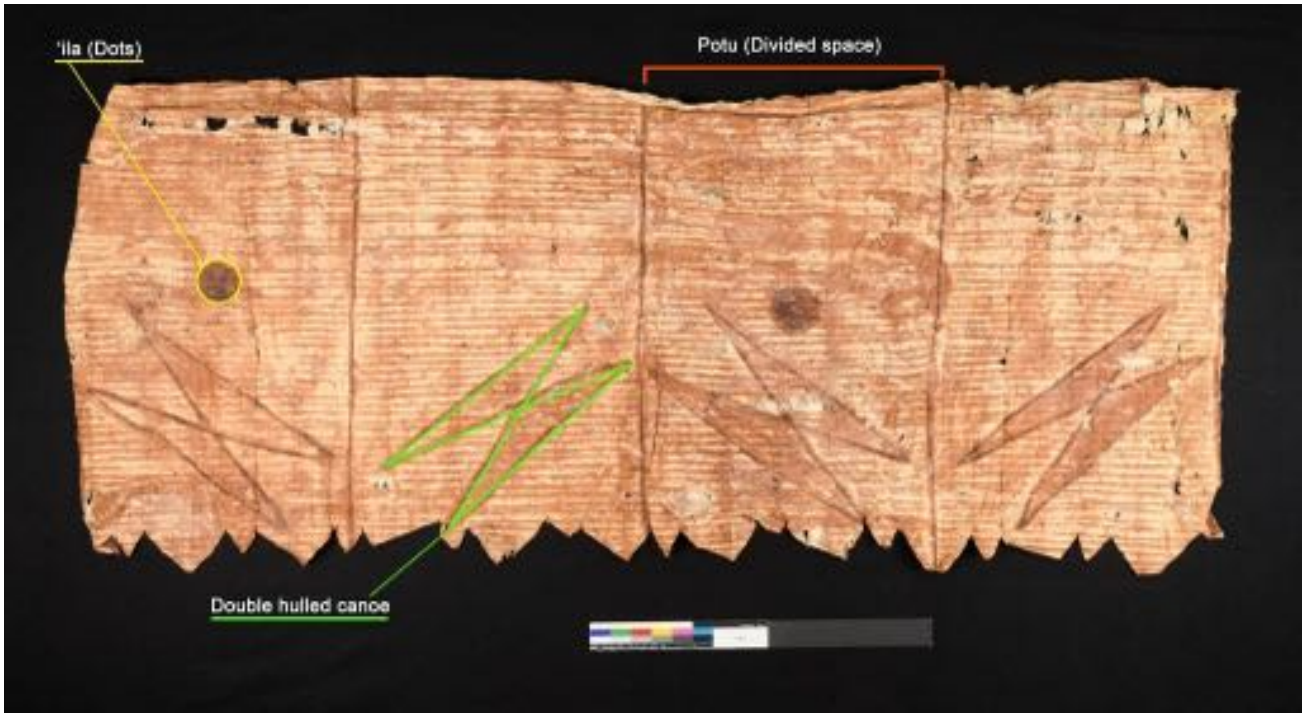

Figure 7. Back, annotated.

Ngatu is often divided into sections called *potu*, which sometimes have numbers. The two dots are *'ila*, which represent beauty marks or a mark on a person's character. The triangles represent double hulled canoes.

Materials and Manufacture

U'a

U'a is the blank, natural canvas of siapo. It is a hand-beaten bast fiber from the inner bark of the paper mulberry plant (*Broussonetia papyrifera*). This plant, a deciduous tree, is grown specifically for siapo and offshoot branches are pruned for bark uniformity. The thickness of the stem when harvest corresponds to the width of the u'a after beating.

The following steps are completed to isolate and spread the inner bast fibers. First, a combination of sharp implements–such as a knife or the siapo maker's teeth–are used to make a vertical cut along the length of the branch. The bark and inner bast fiber are removed in one piece by pulling down and away from the wooden core (Fitiao 2020). The inner bast fiber can then be isolated by mechanically separating the two layers and pulling them in opposite directions. Next, the bast fibers are cleaned and softened by soaking in water. After soaking, the strips are spread upright on a wooden board and scraped with the serrated edge of a shell. This removes any remaining outer bark and begins to spread the fibers apart.

The strips are then beaten against a *tutua,* or a wooden anvil. *I'e*, wooden beaters, have rectangular smooth or grooved faces, sometimes both on the same *i'e*. The grooved face is used first to create width. The smooth face is used second to soften and smooth the u'a. The cloth is then stretched and flattened to dry with rocks at the edges as weights. Gaps within the barkcloth correspond to natural gaps within the fibers (Fitiao 2020).

The pattern on the back appears cut off to create the serrated bottom edge, suggesting that it is a reused piece. This is not uncommon for u'a to be reused.

Joining
The u'a is then ready for joining. By joining multiple u'a, the width and height of the siapo can be increased and customized. Often, siapo are two-ply with perpendicular layers joined with an adhesive for increased strength. This starch-based adhesive comes from the tuber of an arrowroot plant, which is peeled, boiled, and rubbed directly on the surface.

Decorating
Once joined, the u'a is decorated with a combination of natural dyes: *o'a*, *ago*, *lama*, and *loa*. O'a is a natural brown dye, extracted from the bark of the *Bishofia javanica* tree, known as the "blood tree." The bark is scraped, and shavings are collected and compressed to extract the o'a. This colorant darkens quickly and can have a glossy finish when applied thickly. Ago is a yellow from grated turmeric; lama is a black colorant made by adding the soot from roasted candlenuts to the o'a dye; and loa is a red made from the pods of a "lipstick tree" (Fitiao and Fitiao, 2020).

These dyes can be applied with two techniques: *mamanu*, by hand, or *'elei*/*tasima*, with a rubbing method. The mamanu technique is done with a brush called a paogo made from dried pandanus fruits. The tip of the dried pandanus fruit is trimmed to achieve the desired delivery and thickness. 'Elei or tasima is performed with a patterned board called the *'upeti*. Earlier 'upeti were made from plant fibers and leaves. Coconut midribs and bamboo strips were often sewn onto pandanus leaves. Later 'upeti, particularly after the 1920s, were made from carved wooden boards. These are much less time consuming to create and more durable. When an 'upeti is used, the u'a is laid onto the board and a red clay, *ele*, is used to transfer the design. Once transferred, mamanu may be used to accentuate the design (Neich and Pendergrast 1997, 16; Fitiao 2020; siapo.com). The pattern on this siapo was likely created mostly freehand in the siapo mamanu style, without an 'upeti. A colorant can also be applied overall, such as the dark red-orange color of siapo B.

Condition

Overall, Siapo A is in fair aesthetic condition. It is largely structurally stable, with moderate losses, folds, and creases. The design is still clearly legible, though with significant fading and minor cracking and flaking (figs. 8-9). Siapo B is in good, stable condition.

Barkcloth
The cloth of Siapo A is still fairly flexible, but with moderate planar deformation throughout. There are roughly five major creases running vertically from top to bottom, likely due to folding in storage. Significant folds, up to three inches wide, are present along the PL edge, the top edge, and at most points of the bottom serrated edge. The top fold may be the result of use, or storage or display. There are moderate losses and tears, up to 2-3 inches across, especially along the top corners, the bottom serrated edge, and from the proper right (PR) edge to the rightmost vertical crease. Minor areas of delamination can be found between the two layers throughout, especially along the edges of the cloth, and associated with creases and losses.

On the verso, there are 1-inch or smaller patches of shiny accretions–possibly adhesive residue–at the top PL corner and the bottom PR corner, both close to a loss, and squares marked in pencil. A small (¼ inch) white powdery accretion at the top PL corner. Patches of white haze, also possibly an adhesive residue, occur across the verso. This is most visible in a rectangular patch (4-5 inch wide) at the bottom PL corner.

There is a minor accumulation of surface grime overall.

Siapo B is structurally stable, with slight planar deformation including folds and creases throughout.

Surface Decoration
The surface decoration of Siapo A is in fair-to-good condition. The design is still clearly legible. However, the lightest colorant, likely done with turmeric, has faded from what may have been once a vibrant yellow to a very pale tan. The dyes seem well adhered to the surface overall, but exhibit a moderate amount of cracking throughout, especially in areas of more thickly applied color. There are also abraded areas at high points and along folds.

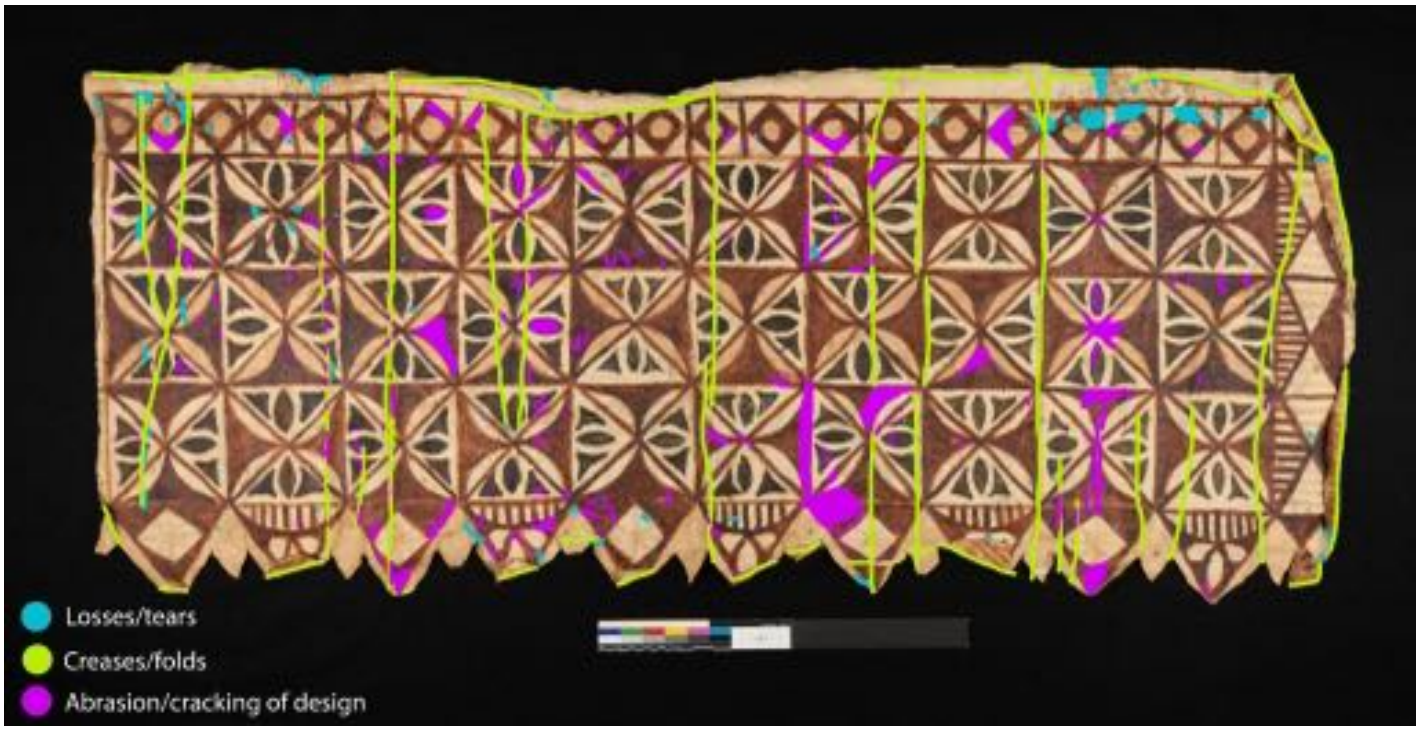

Figure 8. Condition diagram, recto.

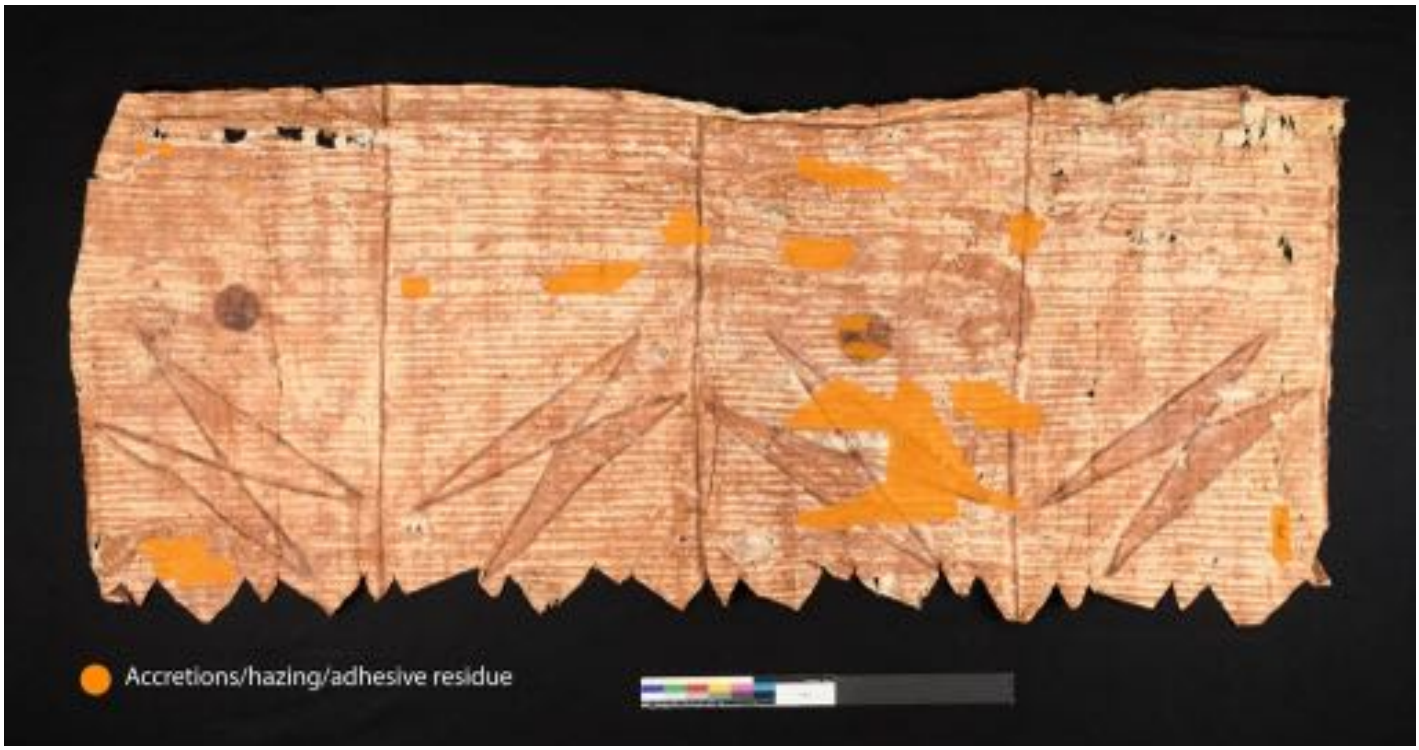

Figure 9. Condition diagram, verso.

Examination and Analysis

Ultraviolet (UV) Examination[7]

The siapo was examined under longwave UV light.[8] The dyes used to create the design on both the front and back surfaces are UV absorbing. The bare u'a fluoresces white, consistent with cellulosic material. The difference between unpainted areas and areas decorated with the faded dye is more apparent in the UV photographs than in visible light. A slight difference in fluorescence can also be seen where the faded dye overlaps with the darker, more absorbing dyes.

On the verso, there are scattered areas of white fluorescence. Some are associated with areas of white haze seen in visible light, especially the rectangular patch at the bottom PL corner. This fluorescence may be due to possible adhesive residues or the abraded surface of the u'a, or a combination of the two.

Portable X- Ray Fluorescence (p-XRF) Spectroscopy[9]

Portable XRF (p-XRF) analysis was conducted in fifteen locations on Siapo A and in three locations on Siapo B with the assistance of Dr. Rosie Grayburn, Scientist and Lab Head for Scientific Research and Analysis, to search for any elements associated with inorganic pesticides or colorants.[10] Regarding pesticides, all spectra indicated trace peaks for bromine and lead, which may be attributed to pesticide history (i.e. methyl bromide fumigants) or leaded gasoline volatile organic compounds (VOCs). Fourier transform infrared spectroscopy (FTIR) may be applicable for further investigating inorganic pesticide history, such as inorganic salts formed by methyl bromide fumigants. Strontium, calcium, copper, iron, zinc, and potassium were also detected in trace amounts. These are likely the inorganic components of manufacturing or surface soiling. Siapo B has a similar elemental composition to Siapo A. Neither siapo contained strong iron signals, indicating that neither iron-based pigments nor iron gall ink was used as a colorant.

pH Testing (agarose and electrode surface pH probe)

The surface pH of the dyed and undyed areas of the cloth was tested to help identify possible causes for degradation and inform treatment. Six locations were tested with 5% (w/v) agarose gel plugs and a digital pH meter[11] that was calibrated using a two-point calibration with Fisher Scientific 4.00 and 7.00 pH buffers (fig. 10).[12]

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[7] Everbeam 365nm 50W UV LED Black Light - High Performance LED Bulbs, IP66 Waterproof - Ultraviolet Flood Lighting

[8] See: "Appendix II: UV Photodocumentation" for images.

[9] Non-destructive, qualitative ED-XRF (energy-dispersive x-ray fluorescence) spectroscopy was performed to determine the sample area's elemental composition. Analysis was performed with the handheld Bruker Tracer III-SD XRF spectrometer using a rhodium tube (40kV high voltage, 9.6μA anode current, 25μm Ti/305μm Al filter) for 60 seconds of live time irradiation. The spot size is oblong in shape, approximately 1 × 0.5 cm. Spectra were interpreted using the PXRF1 software.

[10] See: "Appendix III: p-XRF Results" for additional information.

[11] Horiba LAQUAtwin compact pH-22 meter that reads to two decimal places.

[12] Because of the low ionic strength expected with our surface pH extraction method, several grains of non-iodized table salt (sodium chloride) were added to assist the pH meter in achieving a stabilized reading (Thermo Fisher Scientific Inc. 2022, 3).

Figure 10. pH testing spots. Verso testing spots were selected from folded edges.

Recto:	Verso:
Spot 1: pH 4.9	Spot 4: pH 5.0
Spot 2: pH 4.7	Spot 5: pH 4.8
Spot 3: pH 5.1	Spot 6: pH 4.9

The moderately low pH noted on all tested areas indicates the occurrence of acid-catalyzed hydrolysis, which is of concern for more highly-processed paper products as it breaks down the cellulose fibers, leading to embrittlement. This is not a strong concern for the long-fibred u'a, which can undergo considerable hydrolysis before losing enough flexibility to pose a handling risk. The fairly low pH does prompt the need for the maintenance of a consistently low relative humidity, as water catalyzes the process of acid hydrolysis.

Further Analysis

In the future, high performance liquid chromatography (HPLC) could aid in dye analysis. Fourier transform infrared spectroscopy (FTIR) could confirm the use of arrowroot starch paste and further investigate potential pesticide history. A spot test for starches could also be used to evaluate the use of arrowroot starch paste. During our consultation, Reggie strongly encouraged these analyses. She noted that materials analysis would be useful to her as a siapo maker, as it would inform her about the materials used in siapo-making over time. She is interested to know if she is using the same materials as historical makers used, and if makers of the past utilized a material that she isn't currently using. Uncovering this information would prompt Reggie to seek out that lost historical material and bring it back into her practice.

Purpose of Treatment

The goal of this treatment is to stabilize Siapo A and B using minimally interventive methods. Relaxing creases throughout, stabilizing the delaminating areas, and performing loss compensation would ensure the siapo's stability while highlighting its artistic beauty and skillful craftsmanship.

Treatment Proposal

Asterisk (*) indicates treatment steps which also apply to Siapo B.

1. **Carry out pre-treatment examination and photo documentation** (5 hours, completed).
2. **Carry out pH testing** (2 hours, completed).
3. **Conduct additional analysis, as necessary** (est. 5 hours).*
    a. Polarized light microscopy (PLM) to identify siapo fibers; using Graff C staining to evaluate lignin and alpha-cellulose content and potassium iodide staining for starch.
    b. Solubility testing (water, ethanol, and isopropanol) for colorants, binder, and substrate.
4. **Surface clean** (est. 4 hours).*
    a. Test vacuuming with a variable speed HEPA filter and soft brush, vacuuming through a screen, and vacuuming through Vellux (nylon and polyurethane foam screening material). Select one or a combination of methods that prove to be the safest and most effective.
    b. Gently dry clean with cosmetic sponges (polyurethane) and/or soot sponges (latex natural rubber) as needed.
5. **Consolidate flaking colorants and fibers at risk of detachment** (est. 5 hours).
    a. Following solubility testing, select a compatible conservation grade adhesive (i.e. methylcellulose) for consolidation.
6. **Humidify and relax creases** (est. 8-12 hours; 48-72 passive hours).*
    a. Perform humidification on creased areas until flexible. Create a localized humidification packet using Reemay (polyester spunbonded fabric) and Sympatex (polyether/polyester semipermeable membrane) (fig. 10). Use a thin, slightly damp blotter as the source of humidification. Thin plastic sheeting can be used overall to contain the water vapor.
    b. Realign and reduce creased areas under felts and between sheets of a non-woven polyester material such as Hollytex (spun-bonded nonwoven polyester fibers). Plexiglas and weights can be added on top of the felt for increased pressure if necessary. Care will be taken not to over-flatten the siapo.
7. **Reduce adhesive residues, as necessary** (est. 4 hours).
    a. Mechanically with a stiff brush, microspatula, scalpel, or other tool.
    b. If needed, soften or remove residue with an appropriate solvent, as determined by solubility testing.
8. **Stabilize areas of delamination** (est. 5 hours).
    a. Apply an appropriate adhesive, such as wheat starch paste or methyl cellulose, between the delaminating layers with a brush.
    b. Let dry under a non-woven polyester material and weights as needed.

9. **Perform loss compensation** (est. 12 hours).

    a. Upon further testing, select an appropriate adhesive for fills. Adhesives such as wheat starch paste, methylcellulose, or a mix of the two could be used.

    b. Adhere a pre-toned, untoned, or dyed appropriately weighted Asian paper to the verso of the siapo in areas of loss as noted in the condition diagram in Figure 4. If deemed desirable, tone the paper fills in-situ with QOR watercolors, Golden Fluid Acrylics, or another medium to further aesthetically integrate the fill. Areas of design loss will not be replicated.

10. **Design and create an appropriate storage housing** (est. 10 hours).

    a. The housing should be composed of acid free and lignin free materials.

    b. The object should ideally be stored flat but can be folded (with the folds padded) or rolled (with folds supported using custom Tyvek cushions).

11. **Carry out post-treatment documentation and photography** (est. 3 hrs).

Total Estimated Treatment Time: 64 active hours, 96 passive hours

Luca Denegre **Date:** 3/31/25

Daisy Diamond **Date:** 3/31/25

Caitlyn Fong **Date:** 3/31/25

Leah Palmer **Date:** 3/31/25

Lara Kaplan **Date:** 3/31/25

Crystal Maitland **Date:** 3/31/25

Treatment Report

1. **Carried out pre-treatment examination and photo documentation** (5 hours).
2. **Carried out pH testing** (2 hours).
3. **Conducted solubility testing Siapo A and B** (1.5 hours).
    a. Brush applied the solvent on the surface of the siapo (see figs 11-13 for testing locations). Absorbed solvent with filter paper, followed by 5-10 seconds of light finger pressure. Solvent test areas were dried under pressure with a blotter and small weight.

Table 1. Solvent testing on Siapo A (recto).

Solvent	Undyed	Yellow	Brown	Dark brown
Water	Higher contact angle, no noticeable change	Higher contact angle, no noticeable change	Higher contact angle, minimal change	Higher contact angle, minimal change
Ethanol	Wet up quickly, no noticeable change	Wet up quickly, soluble, turned bright yellow	Wet up quickly, no noticeable change	Wet up quickly, no noticeable change
Isopropanol	Wet up quickly, no noticeable change	Wet up immediately, soluble, turned bright yellow	Wet up quickly, no noticeable change	Wet up immediately, no noticeable change

Table 2. Solvent testing on Siapo A (verso).

Solvent	Adhesive residue	White haze	Undyed	Brown
Water	Higher contact angle, no noticeable change or tack	Higher contact angle, no noticeable change	Higher contact angle, no noticeable change	Higher contact angle, minimal change, observed changes might be surface dirt
Ethanol	Wet up quickly, no visual change and light tackiness	Wet up quickly, no noticeable change	Wet up quickly, no noticeable change	Wet up quickly, no noticeable change
Isopropanol	Wet up immediately, no visual change and light tackiness	Wet up quickly, no noticeable change	Wet up immediately, no noticeable change	Wet up immediately, no noticeable change

Table 3. Solvent testing on Siapo B (recto and verso).

Solvent	Recto	Verso
Water	Slightly high contact angle, minor visible color on filter paper	Slightly high contact angle, minor visible color on filter paper

Ethanol	Wet up immediately, no visible change	Wet up immediately, no visible change
Isopropanol	Wet up immediately, no visible change	Wet up immediately, no visible change

Figure 11. Solubility testing sites for Siapo A, front

Figure 12. Solubility testing sites for Siapo A, back

Figure 13. Solubility testing sites for Siapo B

4. **Conducted PLM of Siapo A and B** (3 hours).

   a. Two samples were taken from the PR lower quadrant of siapo A, one of the recto and one of the verso (figs.14-15). One sample was taken from siapo B (figs. 16-17). All three samples stained with Graff C stain and examined under magnification to characterize the fiber content of each.

Figure 14. Siapo A, sample location.

Figure 15. Siapo A recto (top) and verso (bottom) sample locations, detail.

Figure 16. Siapo B sample location.

Figure 17. Siapo B sample location, detail.

   b. **Siapo A Recto (fig. 18)**: With Graff's "C" stain, the fibers appeared red to grayish pink. For Japanese fibers, this is consistent with Kozo fibers, which are derived from the inner bark of the paper mulberry tree. The width of the fibers ranges from 0.15-0.025 mm. Nodules are visible, which is consistent with bast fibers.

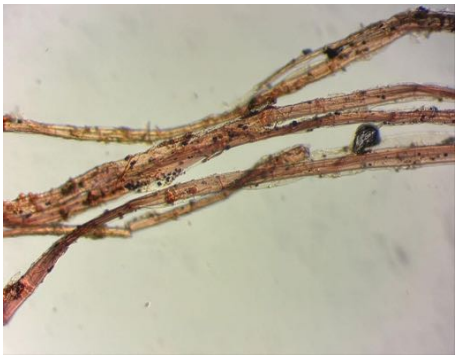

Figure 18. Nodules of Siapo A, recto, 200x.

c. **Siapo A Verso (fig. 19)**: With Graff's "C" stain, the fibers appeared red to grayish pink. For Japanese fibers, this is consistent with Kozo fibers, which are derived from the inner bark of the paper mulberry tree. The width of the fibers ranges from 0.02-0.025 mm. Nodules are visible, which is consistent with bast fibers.

Figure 19. Nodules of Siapo A, verso, 200x.

d. **Siapo B (fig. 20):** With Graff's "C" stain, the fibers appeared dark pink/purple. The width of the fibers ranges from 0.025-0.05 mm.

Figure 20. Siapo B, 200x.

5. **Surface cleaned Siapo A and B, following testing** (3 hours).

   a. Siapo A

      i. Completed surface cleaning tests. As there was only slight soiling, vacuuming was not effective and risked removing friable fibers and colorants.

ii. Completed surface cleaning with a cosmetic sponge in a dabbing motion (fig. 21).[13] There was significantly less soiling on the verso.

Figure 21. Surface cleaning. Image courtesy Evan Krape.

b. Siapo B

i. Completed surface cleaning tests. Fibers were notably more friable, lifting with both cosmetic sponge, vacuum, and brush cleaning tests.

ii. Overall surface cleaning was not deemed necessary, given the extent of friability. Localized cleaning was performed: non-original bright white particles, potential from former housing enclosures, were removed with tweezers on the recto and verso.

6. Upon further investigation, consolidation of flaking colorants and fibers at risk of detachment was not determined to be necessary before humidification, and was thus not conducted prior to this treatment step as previously proposed. This was decided due to time limitations, and will be performed at a later date.

7. **Humidified and relaxed creases** (12 hours; 24 passive hours).*

a. Creased areas were humidified through layers of Hollytex and Sympatex, with blotter dampened with DI water, and plastic sheeting to contain the water vapor. The plastic sheeting was weighed down around the edges. The area was humidified in 5-10 minute intervals. The humidified areas were left to acclimate to ambient humidity overnight with Hollytex, stiff blotter, plastic sheeting loosely placed on top, and weights (figs 22,23).

[13] Leah Palmer and Caitlyn Fong cleaned the recto. Daisy Diamond and Lu Denegre cleaned the verso.

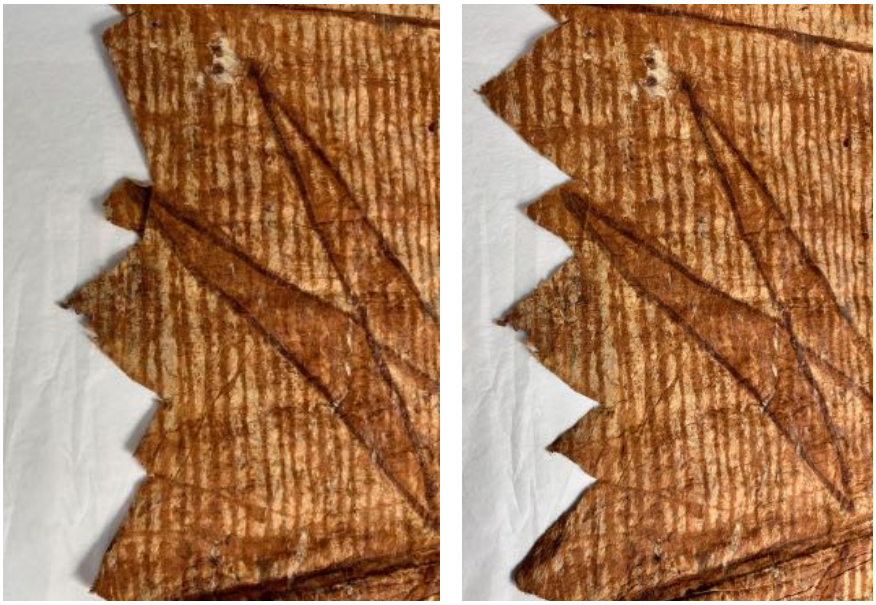

Figure 22. Before (left) and after (right) humidification.

Figure 23. Humidification

Total treatment time: 27.5 hours active, 24 passive hours

Environmental and Handling Recommendations

Storage and display conditions for the siapo should remain stable and generally stay between 70 F (± 2°F) and 45-55% (± 5% RH). Lighting levels should remain below 100-200 lux, and light exposure for a year should not exceed 180,000 lux hours. The siapo should be handled without gloves, as Reggie emphasized the importance of human touch to the life of the object.

Flipping the siapo can be performed with the approach illustrated in Figure 24[14]:

[14] The following photos were taken prior to receiving the results of the XRF pesticide testing. Therefore gloves were required for safe user handling of the object at the time of this image. However, gloves no longer need to be worn.

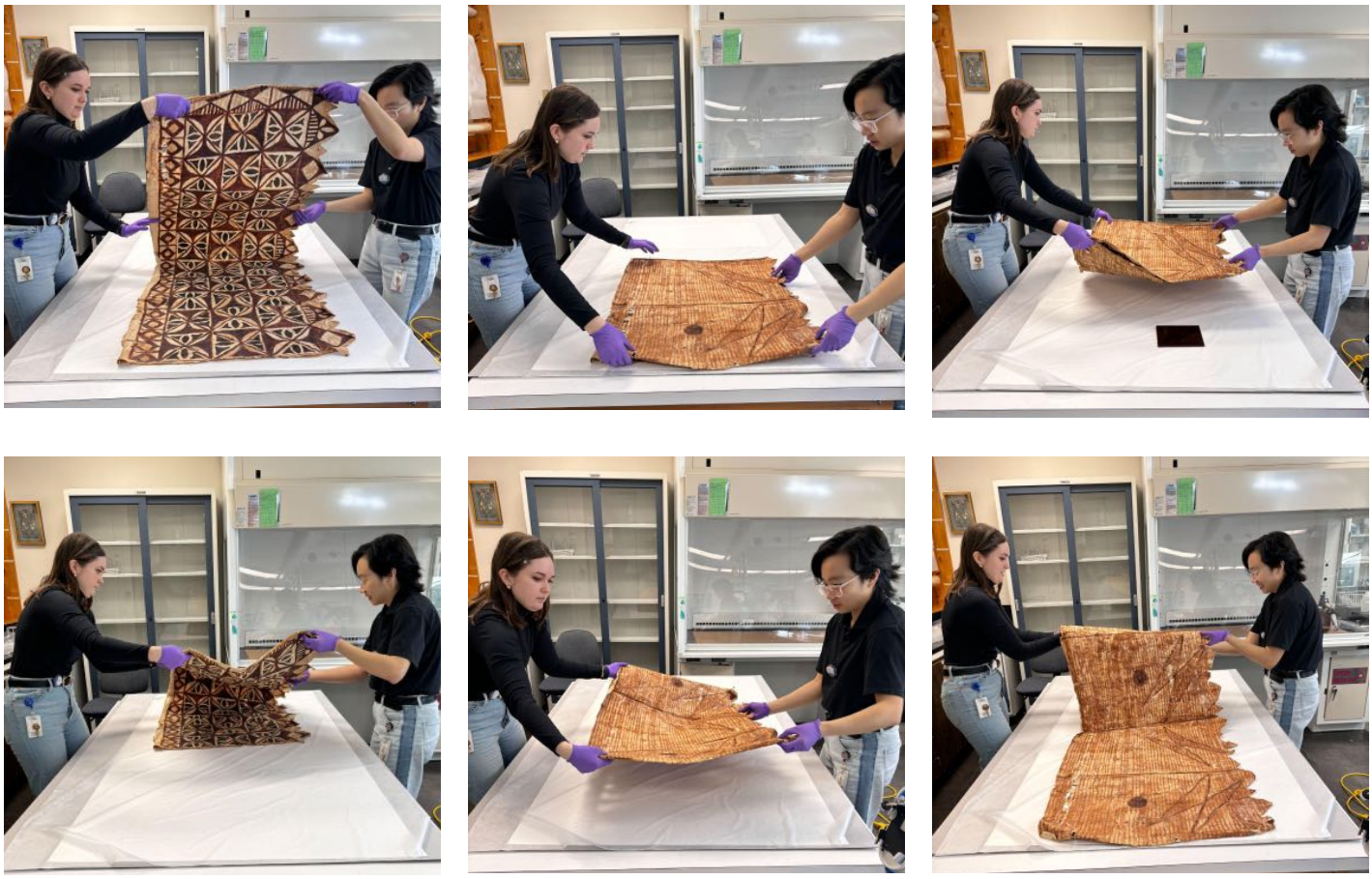

Figure 24: Photo illustration of strategy for flipping the Siapo

Future Treatment Summary

Additional analysis could include FTIR to investigate adhesives and potential inorganic pesticides. HPLC could be conducted to investigate the dye colorants used, as supported by Reggie Meredith Fitiao. The remainder of the treatment is for Siapo A. Consolidation of flaking colorants and fibers with wheat starch paste or methyl cellulose will continue to stabilize the siapo for handling. Adhesive residues can additionally be reduced further mechanically or with solvents if determined necessary and following solubility testing. Loss compensation could include pre-toned mulberry paper, with the extent of aesthetic integration determined collaboratively with stakeholders. Storage housing should be constructed for the long-term preservation and accessibility of the siapo. Post-treatment documentation and photography will conclude the treatment.

Treated By: Caitlyn Fong, Daisy Diamond, Leah Palmer, Luca Denegre

Report Date: May 20th, 2025

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Further Reading

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Appendix I: Before Treatment Photodocumentation

Figure 11. Siapo A, recto, normal light.

Figure 12. Siapo A, verso, normal light.

Figure 13. Siapo A, recto, raking light.

Figure 14. Siapo A, verso, raking light.

Figure 15. Siapo B, recto, normal light.

Figure 16. Siapo B, verso, normal light.

Figure 17. Siapo B, recto, raking light.

Figure 18. Siapo B, verso, raking light.

Appendix II: UV Photodocumentation

Figure 19. Siapo A, recto.

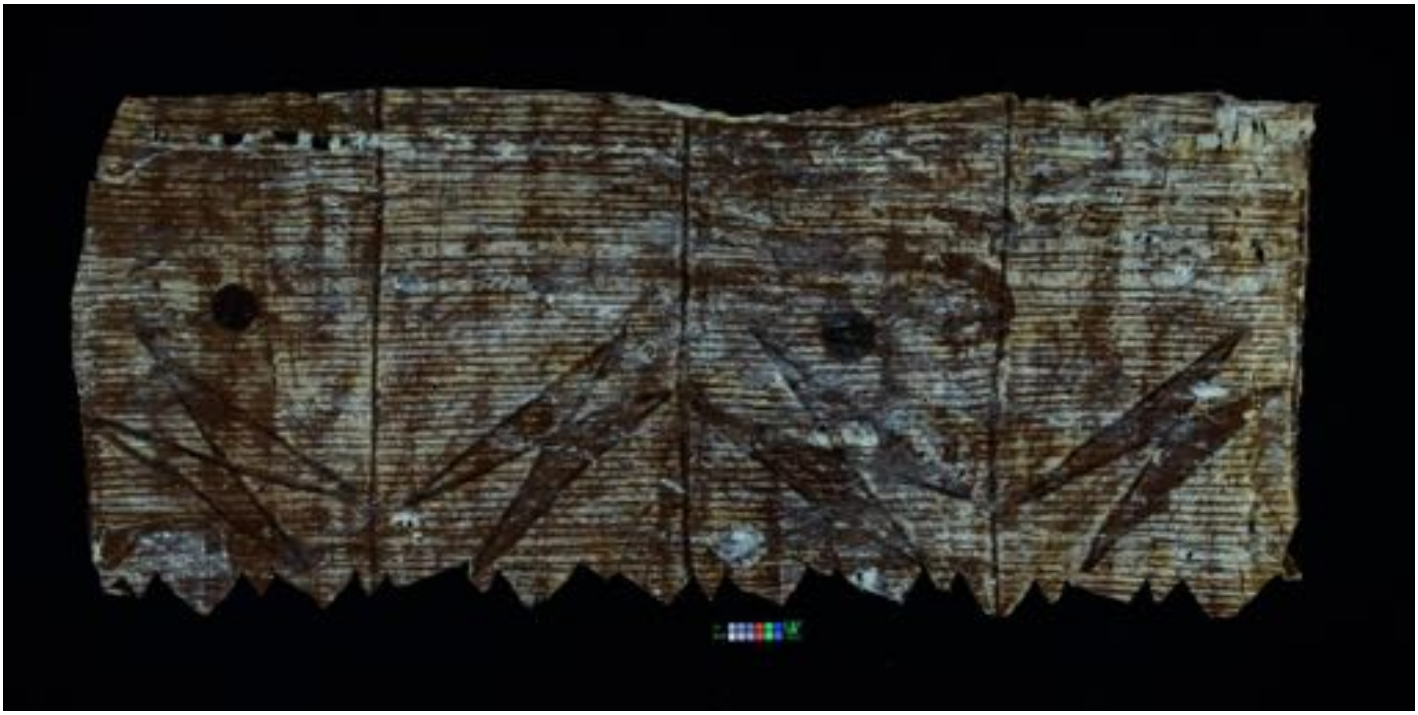

Figure 20. Siapo A, verso.

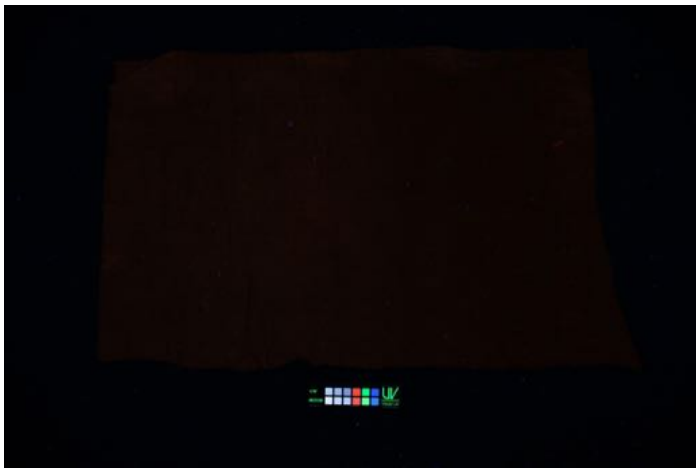

Figure 21. Siapo B, recto.

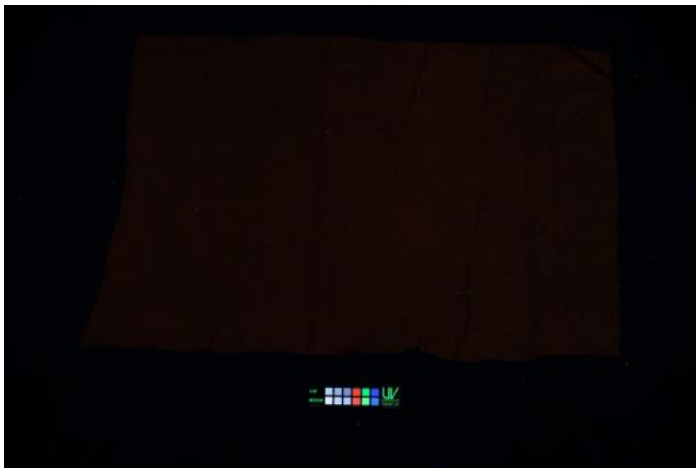

Figure 22. Siapo B, verso.

Appendix III: p-XRF Results

Analysis Locations

Eighteen p-XRF locations were selected on the front and back of Siapo A and on one side of Siapo B (figs. 23-25).

Figure 23. p-XRF locations. The colored dots correspond to the following investigation sites on the siapo: **without colorants (A1-#)**, **faded colorants (A2-#)**, **red-brown colorants (A3-#)**, and **dark brown colorants (A4-#)**. From left to right, the clusters of investigation sites correspond to spots **3**, **2**, and **1**.

Figure 24. p-XRF locations on Siapo A of areas with white friable applied material. From left to right, the clusters of investigation sites correspond to spots **A5-1**, **A5-2**, and **A5-3**.

Figure 25. p-XRF locations on Siapo B. From left to right, the clusters of investigation sites correspond to spots **B-3**, **B-2**, and **B-1**.

Spectra

For each distinct component investigated, one representative spectra was selected for inclusion in this report (figs. 26-31).

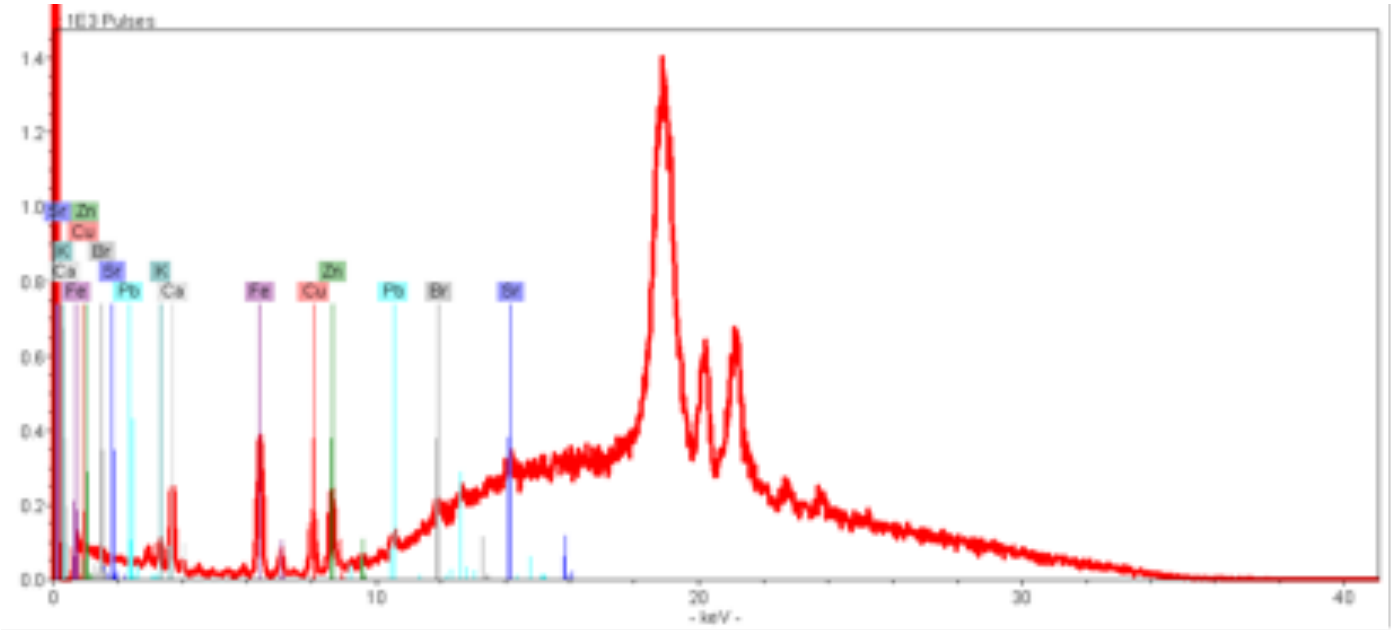

Figure 26. p-XRF spectrum of Siapo A without colorants (**A1-2**).

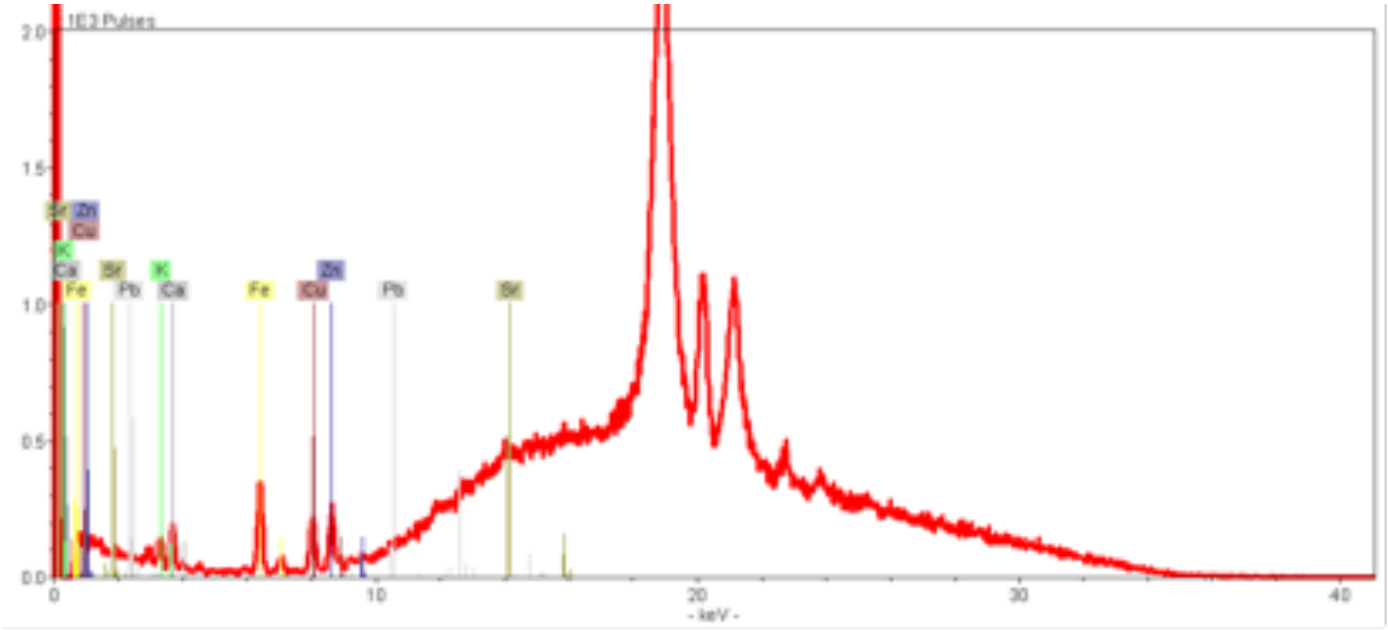

Figure 27. p-XRF spectrum of Siapo A with faded colorants (**A2-3**).

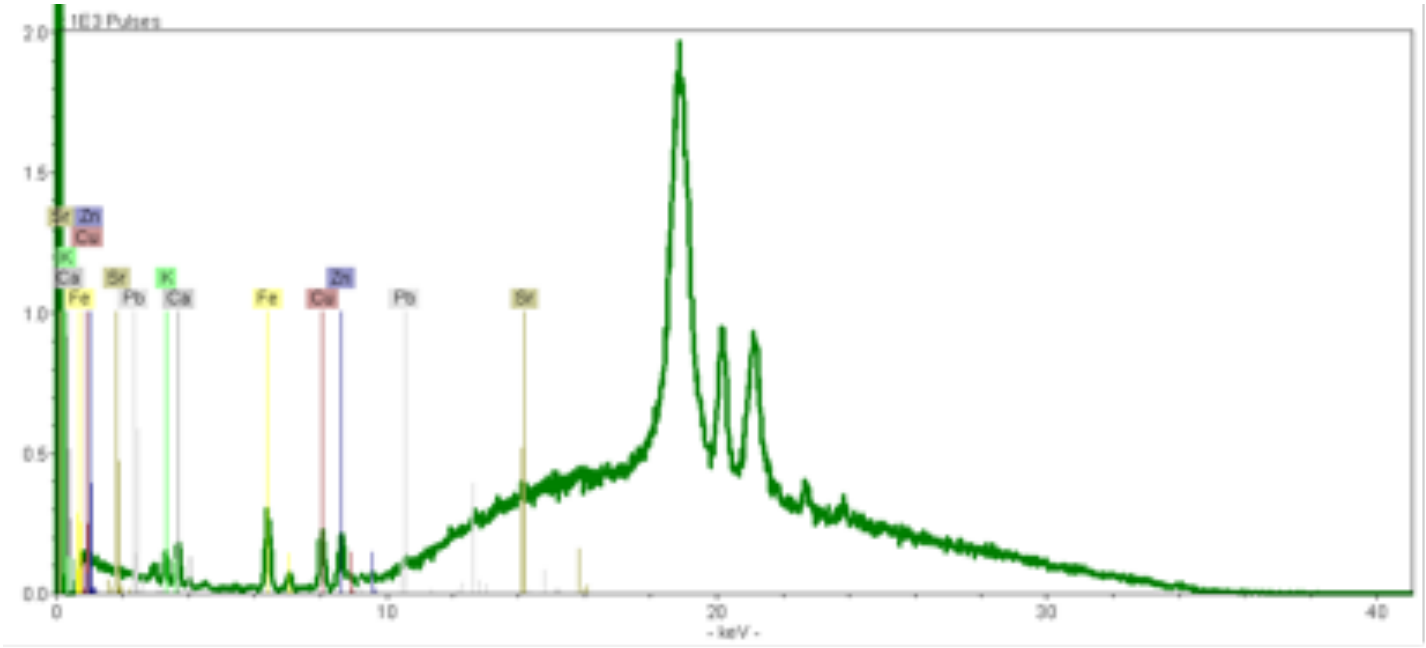

Figure 28. p-XRF spectrum of Siapo A with red-brown colorants (**A3-2**).

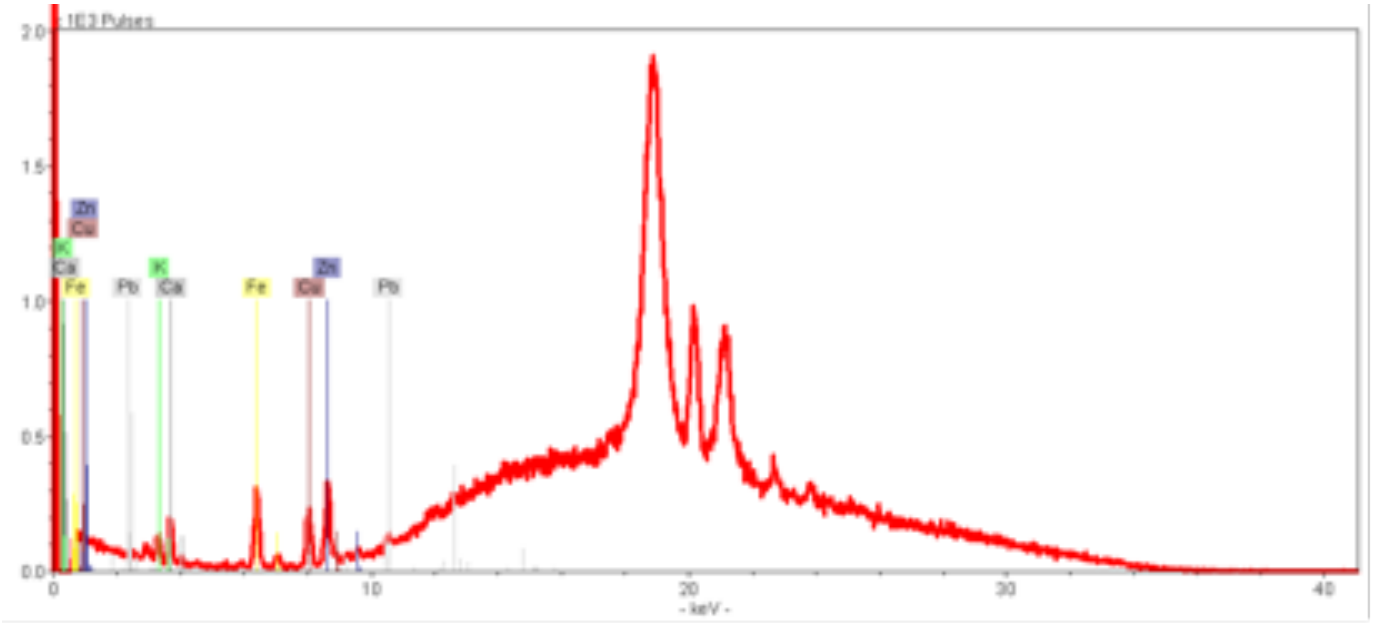

Figure 29. p-XRF spectrum of Siapo A with dark brown colorants (**A4-1**).

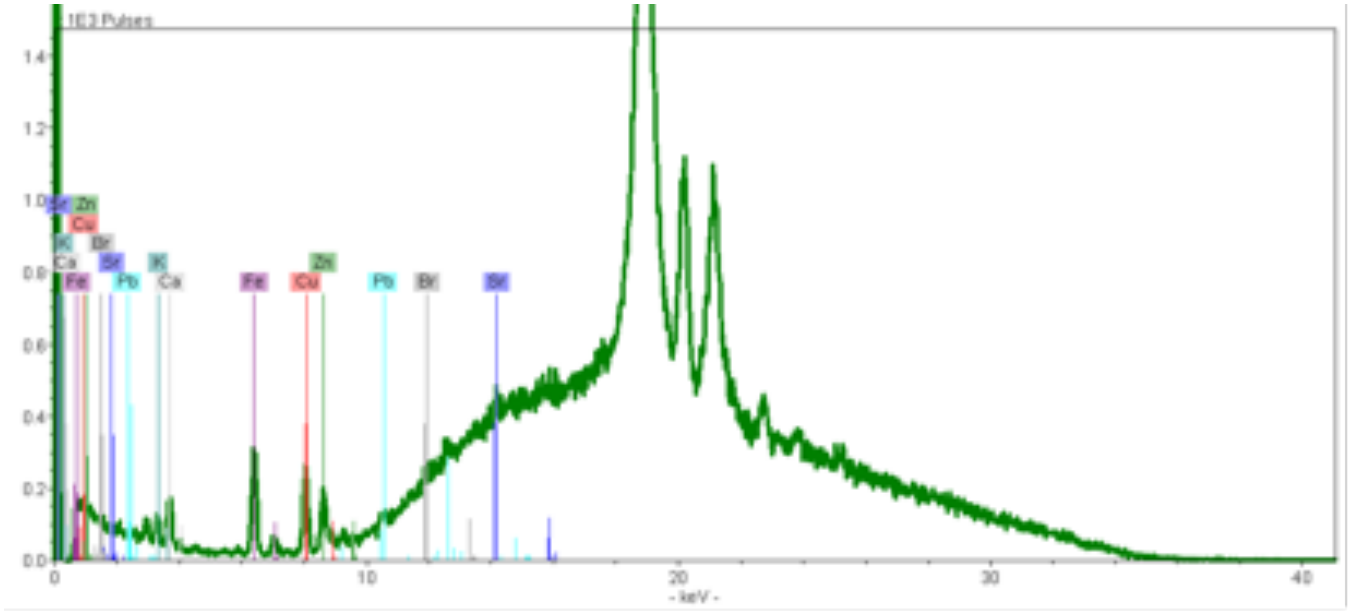

Figure 30. p-XRF spectrum of the white powder on Siapo A verso (spot **A5-2**).

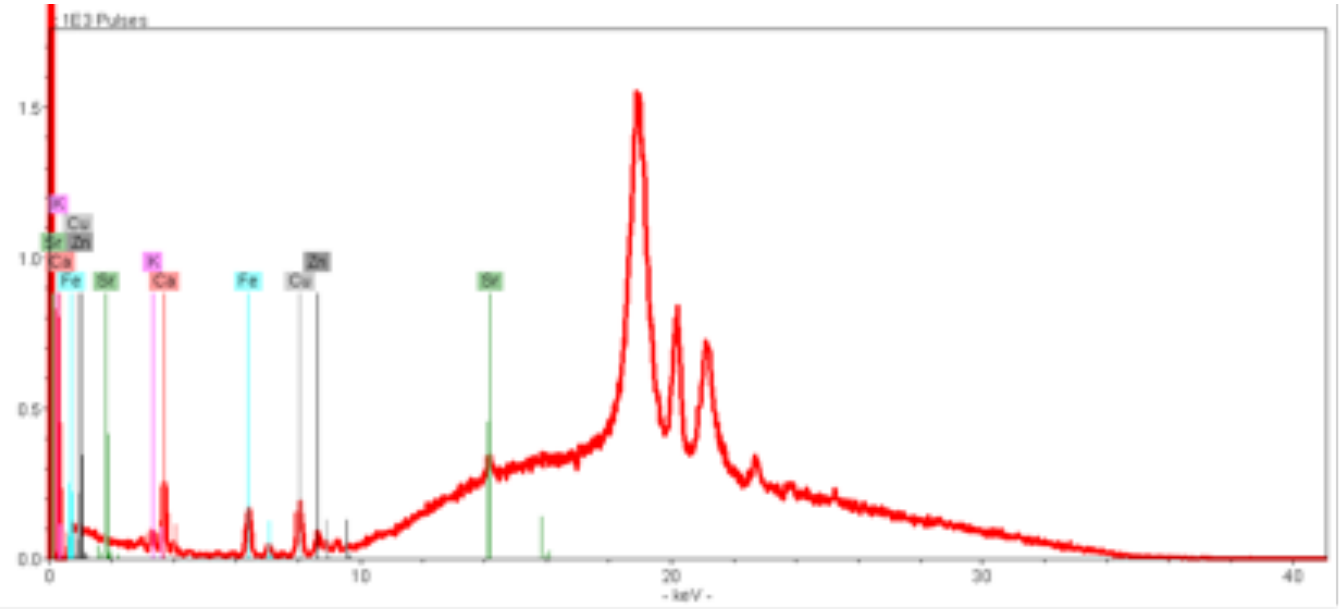

Figure 31. p-XRF spectrum of Siapo B (**B-1**).

Appendix IV: Consultation with Regina Meridith Fitiao

Background

This consultation with siapo maker Regina (Reggie) Meredith Fitiao, a siapo maker from Leone, American Samoa, was conducted by Leah Palmer, Lara Kaplan, Crystal Maitland, Daisy Diamond, Caitlyn Fong, and Lu Denegre. The goal of this consultation was to understand more about the cultural context, materials and manufacture, condition, and treatment options for two siapo from American Samoa (GACP1754C). Below is a summary of the information received from Reggie.

Large Siapo

Use

Reggie explained that this siapo was likely used as a clothing item, likely an ‘ie (similar to a lavalava), for dance or ceremony, as evidenced by the decorative serrated edges at the bottom of the cloth. The edge would have reached the wearer’s knees. The person who wore this may have been a dancer or a performer. For example, the wearer may have been a tsao po, a village maiden performing during an ‘ava ceremony (the ceremony for the bestowal of a chief’s title). The word for the tsao po’s clothing is called kaloa, and it’s oftentimes colored yellow.

Decoration/Symbolism: Recto

Reggie noted that brown dye is used to outline the decoration. There are some irregularities in the design, but this is not a flaw. When the viewer stands back, the beauty of the work comes together. There are no mistakes when you see the siapo as a whole, she says.

- **Triangle shapes**: Fa'a 'ali'ao (Trochus shell). Samoan women love to go shelling, and they’ll often collect these shells because the mollusk is a delicacy and an integral part of the Samoan diet.
- **Lines:** tusili’i (broom, comb in hair), made from the centers of the coconut leaves. These are employed as filler shapes to make the whole siapo look more cohesive. The main foci are the fa’a ali’ao and other larger shapes, but the tusili’i are essential in filling space. .
- **Black almond shapes:** fa’a tuli’i. Tuli bird is migratory. It migrates to Alaska and comes back. They have two designs for this bird. The Fa’atuli and the fa’a i’tuli (the footprints of the bird). The almond shapes are not touching.
- **White crescent shapes:** fa’atuli, birds.
- **Faded yellow starburst:** fa’a aviao- starfish.

Decoration/Symbolism: Verso

The back is decorated with distinctly Tongan patterns. Reggie noted that American Samoa has a strong relationship with their Tongan brothers. There was and is a lot of intermarrying and cultural exchange. Tongan tapa makers would make large ngatu that would often be cut down, and the “scraps” would be repurposed. This is not destructive to the siapo in any way, but it instead makes full use of the craft work of each siapo.

- **Triangles:** the double hulled canoe/sailing vessel.
- **Dots:** known in Samoan as ‘ila. Reggie did not know the Tongan word. These dots are thought of as beauty marks or marks on one’s character.
- **Vertical lines:** Tongan siapo makers divided the siapo into potu (spaces, like a room). These potus are often numbered on the cloth itself.

Materials and Manufacture

The siapo is 2-ply, and as Reggie noted, that is typical of Samoan siapo. Samoan tapa makers usually make 2-ply cloths with the grain running in opposite directions in order to ensure strength and durability. There are always weaknesses and holes in one singular mulberry panel, so the second ply ensures strength. Reggie used the term “maso’a” (“samoan glue

stick") for the glue. It is a potato-like plant that is boiled until sticky, and it is rubbed directly onto the tapa for use as an adhesive.

Decoration

Reggie hypothesized that the siapo looks to be siapo mamanu, decorated without the aid of an upeti rubbing board. She is specifically looking at the top edge where it's clean. She does not note any rubbing evidence, in comparison to the verso. She did not rule out the concept that the recto decoration could have been made using an upeti board, but she said that the evidence of rubbing would be much more widespread. If we lift the top ply and look inside, we will be able to see if it was rubbed.

Dyes:

- **Black:** Reggie hypothesized that the maker is intending to make lama (black) by using the soot of the kukui nut (candle nut). The maker may not have had enough of the soot so she mixed it with a brown dye. This lack of soot resulted in this dark brown color. A well-made soot dye would be a very dense, jet black.
- **Yellow:** Turmeric. Reggie grows, grates, squeezes it, and applies it directly onto the siapo. It starts out VIVID yellow, but it fades over time into appearing just as "evidence" of the past color. This evidence looks faded or tan-looking.
- **Dark brown:** Medicinal. Has a built-in shine. Has been used to dye leather. Commonly cracks.
- **Light brown:** 'ele. a dye which originated from the river rock/red ochre pigment. The red ochre/river rock would be scraped with a shell and the pigments would be sprinkled onto the upeti to perform the rubbing.

Condition

The brown cracking is very normal and considered beautiful. The brown has a beautiful shine, likely due to a double application of the dye. It is visually evident to Reggie that the maker has allowed the brown dye to pool, leading to this varied thickness of color. Regarding the folding along the top, people wearing siapo would tie them any which way, even taping them together. That wear and tear is due to use. Reggie has not seen the white powdering observed on Siapo A. She has seen yellow clumps of the Samoan glue, but this does not look like that.

Small Siapo

Use

Upon visual examination, Reggie didn't notice any particular significance to the shape or size of this siapo.

Materials and Manufacture

Reggie hypothesized that this smaller piece looks on camera as though it was colored with loa, a red dye that came from the lipstick bisha or ilana tree, or it could be 'ele, a dye which originated from the river rock/red ochre pigment. Lara suggested that this barkcloth looks quite similar to Fijian barkcloth in WUDPAC's collection. Reggie agreed, and also suggested that the cloth could potentially be made NOT from u'a, but instead could be mamaki or from the banyan tree. She said this because u'a usually has small circular holes (due to the need to pinch off the leaves as the mulberry grows), porousness, and ribbing.

Treatment

Treatment Rationale

Reggie sees the treatment of the siapo as a conservation learning experience that highlights the siapo's artistic beauty. Its secondary significance is that it was an object of use. Ensuring its stability while highlighting its skillful craftsmanship is the most important goal of this treatment.

Approaches to Treatment

Reggie emphasized that siapo wants you to touch it! Barkcloth is meant to be handled with care. Reggie extends that to us: she exhorted us that handling the siapo is normal in the eyes of a siapo maker, despite their age. We must simply care for it

as we always do to objects. Don't be afraid of them! Interact with them! Obviously wash hands, don't eat near the siapo, ensure that there are no pesticides, etc.

Humidification and Flattening

Siapo have a mind of their own. They are flexible, but they have their stopping point, so listen to the siapo as you are humidifying and flattening it, and don't push it past its limit. Reggie does not feel that the fold at the top of Siapo A is significant to keep in this context, even though it likely arose due to use. Humidification and flattening would be "a beautiful presentation" of the Siapo and there is no need or desire to retain this sign of use.

Loss Compensation:

Adrienne Kaeppler, past curator at the Smithsonian National Museum of Natural History, approached loss compensation as a stabilizing effort, not a visually restorative effort. They did not dye or color the Japanese paper loss compensation. However, the previous WUDPAC students did tone the paper in loss compensation, and it was really beautiful. The extent of loss compensation is up to the conservators. The most important result is to care for the object.

White Powdering

Reggie has not seen this type of white powdering. She has seen yellow clumps of the samoan glue, but this does not look like that.

Future Analyses

The analyses suggested, HPLC for dye analysis and FTIR for adhesive analysis, were met with a resounding "yes" from Reggie. She said that these materials analyses would be useful to her as a siapo maker because it would tell her that the materials used in the past are or are not the same materials she is using now, or confirm that what she is using has continuity with past practice. She would be interested to know if makers of the past were using a material that she isn't currently using; this would prompt her to explore her forest to find that material and bring it back into her practice.

Appendix V: Glossary

Samoan	**English Translation**
Ago	Yellow colorant from turmeric
‘ava	Ceremony for bestowing a chief’s title
Ele	Red clay used to transfer the design on an ‘upeti
‘elei/tasima	Siapo decorating method utilizing an ‘upeti
Fa’a ‘ali’ao	Trochus shell
Fa’a aviao	Starfish
Fa’atuli	Tuli bird
Fa’a i’tuli	Tuli bird footprint
I’e	Wooden beaters for u’a
‘ila	Beauty mark symbol on ngatu
Kaloa	Garment worn by tsao po during the ‘ava
Lama	Black colorant from soot of roasted candlenuts
Loa	Red colorant made from the pods of a “lipstick tree”
Lavalava	Skirt
Mamanu	Freehand siapo dye application
O’a	Brown colorant from the bark of *Bishofia javanica*
Paogo	Dried pandanus fruit
Potu	Divided sections of ngatu
Siapo	Barkcloth
Tsao po	Village maiden
Tuli	Pacific Golden Plover
Tusili’i	Coconut frond
Tutua	Wooden anvil for beating u’a
U’a	Inner bark of paper mulberry tree
‘upeti	Patterned board for ‘elei/tasima
Ngatu	Barkcloth

Appendix VI: During Treatment Photodocumentation

Figure 33. Siapo A, recto, normal light.

Figure 34. Siapo A, recto, raking light.

Figure 35. Siapo A, verso, normal light.

Figure 36. Siapo A, verso, raking light.