Journal of the American Institute for Conservation

ISSN: 0197-1360 (Print) 1945-2330 (Online) Journal homepage: https://www.tandfonline.com/loi/yjac20

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To cite this article: Kathryn Etre, Renée Stein, Erin Dunn & Julia Commander (2014) SHORT COMMUNICATION: RARE ATTRACTION: EVALUATING MAGNETIC PRIMERS FOR MOUNTING TEXTILES ON RIGID BACKBOARDS WITH RARE EARTH MAGNETS, Journal of the American Institute for Conservation, 53:4, 211-218, DOI: 10.1179/1945233014Y.0000000027

To link to this article: https://doi.org/10.1179/1945233014Y.0000000027

Published online: 14 Nov 2014.

SHORT COMMUNICATION: RARE ATTRACTION: EVALUATING MAGNETIC PRIMERS FOR MOUNTING TEXTILES ON RIGID BACKBOARDS WITH RARE EARTH MAGNETS

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The goal of this experiment was to evaluate the utility of magnetic primers for mounting textiles on rigid backboards. Magnetic paints and primers consist of iron particles suspended in a binder. When applied to a rigid board, these coatings create a magnetically attractive surface. Three different brands of magnetic primers were tested for three months: Magnetic Primer by Rust-oleum, Active Wall by MagnaMagic, and Magically Magnetic Paint Additive by David B. Lytle Products Inc. Magically Magnetic Paint Additive by David B. Lytle Products Inc. provided the best results. Magically Magnetic Paint Additive was mixed 25% by volume with a commercial latex primer. Three coats of this primer were applied to a mock backboard and then covered with two coats of a latex topcoat. Small textile swatches were then mounted to this prepared board using neodymium rare earth magnets. Weight was successively added to the lower edge of each textile swatch. This system held 75 g (2.65 oz.) for three months without observable movement. Following this successful experimental performance, the backboards of three exhibit cases in the Michael C. Carlos Museum were prepared with this magnetic primer. Textile objects were installed with neodymium rare earth magnets. This case study demonstrates the potential and versatility of magnetic primer for mounting a variety of objects.

KEYWORDS: *Magnetic paint, Mounting system, Magnets, Textiles*

1. INTRODUCTION

Rare earth—typically neodymium—magnets have been used for the last few years to display various objects within museums (Spicer 2010; Hovey 2012). Magnets can be especially useful in the display of textiles, allowing hanging without stitching or inserting pins, which could damage fragile weave structures. Strips of self-adhesive metal tape or metal sheet can be applied to a backboard to enable mounting, but strips will limit textile placement and metal sheet can add considerable weight and expense to case construction. Magnetic paint produces a surface that can accept magnets, while contributing flexibility for installation, negligible added weight, and low cost.

Iron additives in paint have been in use for a number of years with diverse applications, such as radiator and car paint, metal repair, high capacity recording systems, and to reduce microwave reflection (Deetz 1997; Daniel et al. 1982). Since 1970, these additives have been mixed with paints and used to provide a magnetically attractive surface. Iron additives can be added to any type of binder, e.g. epoxy, acrylic, latex, and oil, to create so-termed "magnetic paints." These iron additives can be mixed into either the topcoat or the primer. The resulting mixture is not magnetic. Instead, the iron particles make the paint attractive to magnets. Thus, the mixture might more accurately be termed "ferrous paint." These paints and additives are commercially available as "magnetic paints." Patent literature and publications describing their use also reference "magnetic paints." In this study, the paints are used as primers. To be consistent with existing references and to clarify their use in this discussion, the nomenclature "magnetic primers" is used in this article.

The strength and texture of these magnetic primers are largely dependent on the size and amount of the iron particles. The particles can range from 0.1 μ to about 74 μ in diameter. Smoother surfaces can be achieved with finer particles (less than 10 μ), but better attraction is achieved with larger particle sizes (>44 μ) (Deetz 1997). Concentration of iron particles within magnetic primers ranges from 0.5 to 85% w/v (iron particles/binder) (Fitch 1970, 1; Denk and Sabad 1973, 1; Daniel et al. 1982, 1). Higher concentration will yield greater attraction. Magnetic primers with

DOI: 10.1179/1945233014Y.0000000027

larger particle sizes and higher concentrations will produce a more attractive surface, but this surface will also be more textured than one produced from a primer with smaller particle size and less concentration. These variables of particle size and concentration can be adjusted to impact the texture and attraction of the resulting painted surface. The differences in strength and texture obtained with various magnetic primers are demonstrated in the experiment below.

The size of the iron particles and the amount of these particles in magnetic primers vary from brand to brand. The size and amount of iron particle is not reported by manufacturers, but can be inferred by the texture of the primer (Fitch 1970; Daniel et al. 1982; Solc 1983; Deetz 1997). Most of the commercially prepared products are black or gray. The drying time varies depending upon the type of binder. Safety concerns arise from the potential inhalation of iron particles, if not pre-mixed, and from the toxicity of solvents in the primers.

2. Properties of selected magnetic primers

Based on online reviews, three magnetic primers were selected for testing: *Magnetic Primer* by Rust-oleum, *Active Wall* by MagnaMagic, and *Magically Magnetic Paint Additive* by David B. Lytle Products Inc. All of these products are similar in that they consist of minute particles of iron, although their sizes and amounts appear to differ. *Active Wall* is mixed in a low-VOC acrylic binder and *Magnetic Primer* is in a latex binder. *Magically Magnetic Paint Additive* is a gray powder additive to be mixed by the user with either oil- or latex-based primers. All three products are marketed as primers and therefore are intended to receive a topcoat to achieve the desired surface color. These products are also marketed to hang photographs and children's art projects. See comparisons of the three products in table 1.

Active Wall is dark gray and *Magnetic Primer* is black, so neither may be used under light paint colors. *Magically Magnetic Paint Additive* mixed at the recommended 25% w/v concentration will only slightly alter the color of the primer; so can be used under almost any paint color. More than one layer of topcoat may be needed to cover the darker magnetic primers. However, numerous layers of topcoat will also diminish the attraction by increasing the distance between the magnetic primer and the neodymium magnet. All of these primers contribute texture to the finished surface. This effect is reduced by thorough mixing and uniform application, as well as by the addition of topcoats. As previously noted, the texture of these primers is based on both the size and amount of iron particle. *Magically Magnetic Paint Additive* at 25%w/v seems to have the lowest concentration of iron particles but the most texture, suggesting that the iron particles are larger than those in the other two brands. Mixing the *Magically Magnetic Paint Additive* at higher concentrations than directed imparts even more texture. This higher-concentration mixture is difficult to spread, and the resulting layer is quite lumpy.

The instructions for all three products recommend vigorous stirring and the application of two or three coats. Mechanical mixing can be used, but the iron particles may deposit on the walls of the can. The primers must be stirred before use and between coats, scraping the sides of the can. As Fitch notes in his 1970 patent, "Iron powder is, of course, very heavy and tends to settle out of liquid carriers to a dense immobile layer" (Fitch 1970, 1). A lack of magnetic attraction may be due to poor mixing. The magnetic primer should be applied with a brush. The roller retains some of the iron particles and repeated passes with the roller remove some of the iron particles already applied. Thus, roller application significantly reduces the amount of iron particles deposited and hence, the magnetic attraction of the primer.

3. Practical experiment

The goal of this experiment was to determine whether a magnetic primer would provide enough attraction to vertically display textiles held to painted backboards by neodymium magnets. Three brands of magnetic primer were tested. A test board prepared with the selected primers was placed upright, and swatches of fabric were hung with a single neodymium magnet. Weights were attached with small binder clips to the bottom edge of the fabric swatches. Weight was gradually added every two weeks, until the magnet slid from its starting position. Sliding of the magnet and/or fabric swatch demonstrated failure in the system, representing the weight limit of the attraction.

The experimental set-up is pictured in figure 1. A mock display case backboard measuring 12″ l × 24″ w (30.3 cm l × 60.7 cm w) was cut from a sheet of ¼″-thick Masonite. This board was divided into four sections, and each section was labeled A, B, C, or D. Section A was painted with *Active Wall* magnetic paint. Section B was painted with *Magnetic Primer*. Section C was painted with 25% w/v *Magically Magnetic Paint Additive* and latex primer, mixed as directed. Section D was painted with 50% w/v *Magically Magnetic Paint Additive* and primer, doubling the recommended proportion of additive to primer. Three coats of the magnetic primers were applied to each section and allowed to dry. These magnetic primers were not Oddy tested; however, the topcoat can provide a sealing layer.

The primed sections were divided in half vertically, and one half of each section was painted with two

Table 1. Properties of Tested Magnetic Primers

Name	Binder	Amount of Iron Particles	Color	Texture (1 Smoothest: 4 Roughest)	Cost per Quart	Coverage	Section on Experimental Board
Active Wall MagnaMagic	Acrylic	Unknown, contains 79% total solids	Dark gray	1	\$30	25 ft²	A
Magnetic Primer Rust-oleum®	Latex	45%	Black	2	\$20	16 ft²	B
Magically Magnetic David B. Lytle Products Inc.	Latex or oil, selected by user	25%	Gray powder[a]	3	\$20 + cost of primer	25 ft²	C
Magically Magnetic David B. Lytle Products Inc.	Latex or oil, selected by user	50%	Gray powder[a]	4	\$32 + cost of primer	25 ft²	D

[a]The paint color depends upon user's primer. The authors chose a light gray latex primer for this experiment.

coats of the *Glidden* latex paint in the chosen gallery color "Chocolate Kiss." Two horizontal parallel lines were then drawn on the board in graphite to mark the starting point for initial placement of the neodymium magnets. These horizontal lines are indicated by red lines in figure 1.

Sixteen rectangular swatches measuring 2½″ l × 1½″ w (6.35 cm l × 3.81 cm w) were cut from the cotton damask weave fabric. Tabs of polyester *Stabiltex* of the same width were hand-stitched to eight of the cotton swatches, using a running stitch along the top edge. These test swatches were chosen to simulate objects in the Art of the Americas collection at the Michael C. Carlos Museum of Emory University. The collection includes ancient and modern textiles from Central and South America. Many of these objects

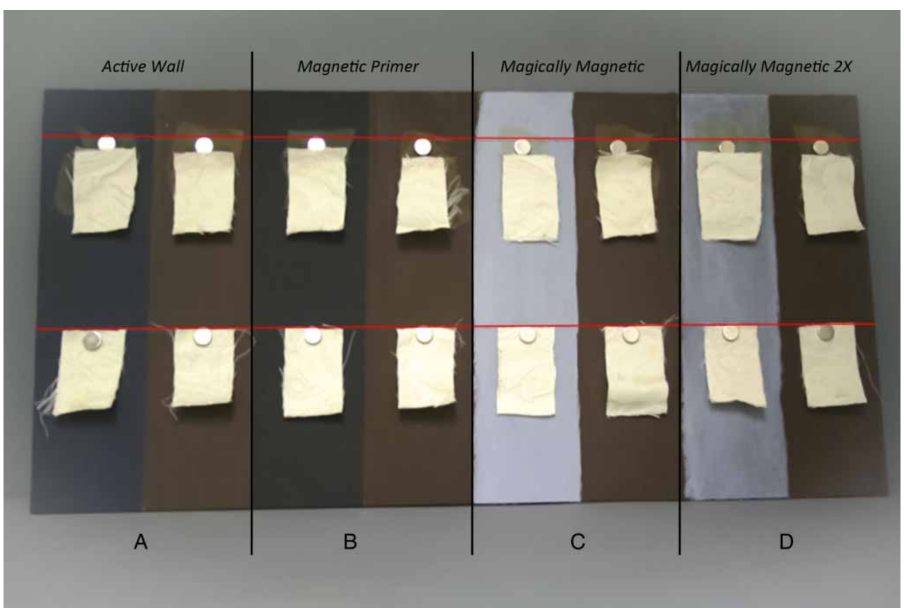

Fig. 1. Initial experimental set-up: each of the four magnetic primers tested with a swatch of fabric, with (top) and without (bottom) a *Stabiltex* tab, using a N48 magnet (1/2″ in diameter). The left side of each sample area is only primer and the right is primer and topcoat. The magnets are placed on a line (in red) to track any movement of the magnet.

have complex weave structures and/or significant thickness, represented by the cotton damask weave fabric. Some of the ancient fragments are backed with a *Stabiltex* lining where a magnet could be safely placed for mounting and is therefore represented by the *Stabiltex* tab.

The test swatches with *Stabiltex* tabs were positioned along the upper line on the prepared test board. A neodymium magnet was placed on the *Stabiltex*, with the top edge of magnet at the line. The other eight swatches were positioned at the lower line, with a neodymium magnet placed directly on the cotton fabric. All magnets were grade N48, measuring ½-inch (12 mm) in diameter and ⅛-inch (3 mm) in thickness. The board was stood vertically.

Grade N48 magnets were chosen to balance the strength, brittleness, and cost of the magnets. The greater the grade, the stronger the magnet. Brittleness and cost will both increase at higher grades. Evaluating magnets of different grades was not the goal of this experiment. See Resources for further information on the selection of magnet grade (Amazing Magnets 2002; Magcraft 2007; Spicer 2013).

Color-coded weight bags were prepared from lead shot in nitrile glove fingertips, tied with cotton twine. Blue bags weighed 20 g (0.71 oz.); purple bags weighed 10 g (0.35 oz.), and green bags weighed 5 g (0.18 oz.). These values include the weight of a small binder clip. Every two weeks, a blue 20 g weight bag was clipped to the bottom of the test swatch. If the swatch slipped, the 20 g bag was replaced with a 10 g bag, and the swatch was moved back to the starting line. If the swatch slipped, the 10 g bag was replaced with a 5 g bag, and again the swatch was moved back to the starting line. Weight was added every two weeks until the maximum weight tolerance (within 5 g) was reached or until 100 g (3.53 oz.) had been added. After the maximum weights were achieved for all swatches, the board was left standing for three months in order to observe if slipping would occur over time.

4. Experimental results and discussion

The experimental results are pictured in figure 2 and table 2. The maximum weight achieved without slipping is recorded for each test swatch.

The weight added to each test swatch effectively represented the amount of weight a single magnet could hold in each test scenario. *Active Wall* holds the least weight, and the *Magically Magnetic Paint Additive* at double the recommended concentration holds the most weight, at least 100 g (3.53 oz.). The *Magically Magnetic Paint Additive* mixed at the recommended ratio also holds significantly more weight than the other two primers. This is likely due to the size of the iron particles in the primer, as mentioned previously.

As presented in table 2, the topcoat of latex paint does reduce the attraction of the underlying magnetic primer. This effect is seen with both *Active Wall* (Section A) and *Magnetic Primer* (Section B). It is probable that this same reduction in attraction would be demonstrated with the *Magically Magnetic Paint Additive* had the addition of weight continued beyond 100 g (3.53 oz.). This effect is not evident in Section C for swatches without *Stabiltex,* where those placed on the

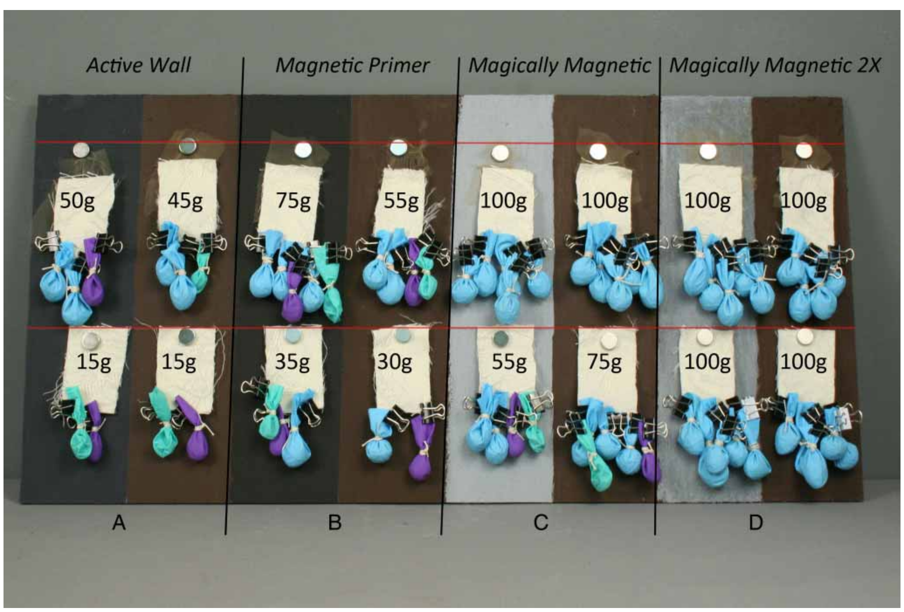

Fig. 2. Results: the maximum amount of weight held by a N48 magnet (1/2-inch in diameter) without movement from the starting line (in red) for each mounting system.

Table 2. Results

Brand	*Stabiltex*/Damask	Damask	*Stabiltex*/Damask w/topcoat	Damask w/topcoat
Active Wall	50 g	15 g	45 g	15 g
Magnetic Primer	75 g	35 g	55 g	30 g
Magically Magnetic	≥100 g	≥100 g	55 g	75 g
Magically Magnetic 2X	≥100 g	≥100 g	≥100 g	≥100 g

topcoat hold 20 g (0.71 oz.) more weight. This exception is likely due to the uneven application of the magnetic primer. Because multiple topcoats reduce the magnetic attraction, it may be necessary to reapply the magnetic primer to maintain the level of attraction when gallery colors are changed.

The thickness of the fabric also affects the strength of the system. In all cases, placing the neodymium magnets on the *Stabiltex* instead of on the thicker cotton damask allows for approximately 60% more weight. Thick textile objects and/or added interleaving layers will further reduce the system's attraction.

Although the neodymium magnets did not slip with the *Stabiltex* except at higher weights, the *Stabiltex* often stretched or tore around the magnet. Placing more magnets throughout the object will reduce localized stress, indicated by the tearing around the magnet. Neodymium magnets can also be placed inside Ethafoam, foamcore, or corrugated board forms, distributing the magnets' force and contact areas, thereby reducing localized stress. Backboards can also be angled to reduce the downward pull on the textiles and magnets.

Neodymium magnets are manufactured in numerous shapes, sizes, and grades. In practice, the number, shape, size, grade, and distribution of magnets used in a particular application will likely be determined by trial and placement, depending upon the dimensions, weight, fragility, thickness, etc. of the object. This experiment demonstrates the weight tolerance of specific primer, object, and magnet systems and thus illustrates the strength of the systems in measurable terms that could be compared. It is probably impractical to use these measurements to calculate the number of magnets needed to mount an object.

5. Application within a gallery installation

In 2013, the Carlos Museum reinstalled the Art of the Americas galleries. Five wall cases were designated for the rotating display of textiles, including ancient objects and fragments as well as modern examples. The first six-month rotation included modern textiles hung with the magnetic primer system in three of the cases. Based on the results of this experiment, birch plywood backboards were prepared with three coats of *Magically Magnetic Paint Additive* mixed at the recommended volume ratio of 25% w/v in *Sherwin Williams PrepRite ProBlock* latex primer. Two coats of latex wall paint in the chosen colors (*Glidden Chocolate Kiss* and *Country Brown* latex paint) were applied over the primer. The boards were allowed to cure for one month. Wood display cases are routinely prepared with three priming layers and two topcoats at the Carlos Museum. Preparing these cases for use with magnets required only the additional working time necessary to stir-in the *Magically Magnetic Paint Additive*. A layer of thin spun-bonded polyester was placed behind each textile to isolate it from direct contact with the painted surface.

Panamanian molas, two panels and a shirt, were displayed in two of the cases (fig. 3). Molas are constructed from several layers of colored cotton cloth, using a reverse appliqué technique. Intricate patterns are created by cutting, folding, and stitching sections of each layer to reveal the underlying textiles. Embroidery is often added. Approximately 8–12 small rectangular or circular neodymium (N48) magnets were inserted between the stitched layers of the mola panels, placing magnets around the perimeter of the objects (fig. 4). A child-sized blouse was hung with three large rectangular neodymium magnets placed inside the bodice. In

Fig. 3. Molas in pedestal case (Courtesy of Stacey Gannon-Wright). The panel on the bottom of the case is pictured in figure 4.

FIG. 4. Round Neodynium magnets, indicated by red arrows, placed between layers of a Mola. Note the spun-bonded polyester interleaving between the object and the painted backboard. Also note the texture of the painted backboard.

FIG. 6. Ethafoam blocks backed with magnets inside the shoulder folds of a heavily brocaded Huipil.

order to distribute the contact area, these rectangular magnets (1″ × 2″) were set into pieces of archival corrugated board (3″ × 4″). Voids were cut in the corrugated boards to fit the magnets, and the edges of the boards were rounded. The magnets were secured in the voids with linen tape.

Two huipils (women's shirts) from Guatemala were installed in a third case (fig. 5). The huipils are constructed from three vertical panels of woven cotton cloth and elaborately embroidered with wool thread at the neck and shoulders. Rectangular blocks of carved ethafoam (approximately 2″ × 10″) wrapped with needle-punch polyester were placed inside the shoulder seams of each huipil (fig. 6). Four 1″-diameter circular neodymium magnets were attached to one side of each ethafoam block using hot-melt glue. The ethafoam blocks padded the shoulder seams, and the magnets secured the textile to the backboard. Pieces of acid-free corrugated board with in-set rectangular magnets (described above) were placed inside the huipils as needed to provide additional support and distribute the weight of these objects. The two huipils were installed in a single wall case, measuring approximately 7′ × 4′. The painted wood backboard of this case is angled approximately 12° from the top.

It should be noted that the attraction of the neodymium magnets to each other is significantly stronger than their attraction to the painted backboards. Attraction to the primed backboard is further diminished by the textiles and additional mounting materials such as foam, interleaving, or corrugated board that increase the distance between the magnetic primer and the

FIG. 5. Huipils installed with magnets in large hanging wall case (Courtesy of Stacey Gannon-Wright).

neodymium magnet. It is important to space the magnets so that they do not spontaneously pull together and away from the backboard, potentially impacting adjacent objects or installers.

The five cases with backboards prepared with the magnetic primer have been and will be repeatedly used for the display of textiles and other objects. Given the wide range of object sizes and shapes, the ability to vary placement is necessary for both physical and esthetic reasons. Narrow strips of metal embedded in the backboards, perhaps at the top and/or center, would enable the use of magnets but would restrict installation options. Ferrous metal sheets large enough to line entire backboards would add significant weight, especially to the very large hanging wall case. Using metal sheet for the backboards would also make it more difficult to install other types of objects that may require mounts drilled or screwed into the case. The magnetic primer permits the use of magnets with greater flexibility of object placement and future case use.

6. Conclusion

Backboards prepared with magnetic primers offer a flexible, low-cost, light-weight method for mounting textiles using neodymium magnets. Of the three brands of magnetic primer tested (*Active Wall, Magnetic Primer,* and *Magically Magnetic Paint Additive*), *Magically Magnetic Paint Additive* mixed with a latex primer at the recommended 25% w/v concentration proved to be the best option. This mixture accomplished sufficient magnetic attraction with acceptable texture.

Through the use of this magnetic primer and neodymium magnets, textiles were installed with minimal intervention and safely displayed for six months. No mounting aids such as *Velcro*, fabric backings, or hanging sleeves were stitched to the objects. No pins were inserted into the weave structures. Foam or corrugated board could be added to the magnets in advance of installation to accomplish padding or larger contact areas. Magnets that would be visible could also be prepainted. With advance preparation of magnets and prior cutting of interleaving materials, installation and deinstallation were quite efficient, only requiring additional hands to hold the textile in position while magnets were placed or removed.

This experiment and case study have successfully demonstrated the use of magnetic primers for mounting textiles with neodymium magnets. This mounting system offers significant versatility and could easily be employed with other types of objects.

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Sources of Materials

MAGNETIC PRIMER
Rust-oleum
1-800-323-3584
Sold at most hardware stores and www.amazon.com

ACTIVE WALL
MagnaMagic
1 Emerson St.
Mendon, MA 01756
1-508-473-4240
www.magnamagic.com or www.amazon.com

MAGICALLY MAGNETIC PAINT ADDITIVE
David B. Lytle Products Inc.
P.O. Box 219
Saxonburg, PA 16056
1-866-683-7474
www.lyt.com

NEODYMIUM MAGNETS
Amazing Magnets LLC
3943 Irvine Blvd. #92
Irvine, CA 92602
1-888-727-3327
www.amazingmagnets.com
Neodymium magnets are sold at many specialty hardware and craft stores as well as www.amazon.com.

Author Biographies

Kathryn Etre is the Andrew W. Mellon Assistant Conservator at the Michael C. Carlos Museum of Emory University in Atlanta, Georgia. She previously held Andrew W. Mellon Fellowships at the Carlos Museum and at the Detroit Institute of Arts. She earned a Master of Science in Conservation for Archaeology and Museums and a Master of Arts in Principles of Conservation from University College London. She is a Professional Associate of the American Institute for Conservation. E-mail:ketre@emory.edu.

Renée Stein is Chief Conservator for the Michael C. Carlos Museum at Emory University where she oversees treatment and preventive care, teaches courses on conservation, as well as collaborates with students and faculty on research. She earned a Master of Science in Conservation specializing in objects from the Winterthur/University of Delaware Program in Art Conservation. She is a Professional Associate of the American Institute for Conservation.

Erin Dunn is a graduate of Emory University. While completing a major in Art History, she worked in the Parsons Conservation Laboratory of the Carlos Museum as a student assistant. She earned a Master of Arts in contemporary art history at University of Georgia, where she also served as a teaching assistant and museum intern.

Julia Commander graduated from Emory University with a major in Anthropology. She was an Andrew W. Mellon summer intern in the Parsons Conservation Laboratory and wrote an honors thesis on decorative patterning and use-wear on ancient Costa Rican metates in the Carlos Museum. Julia is a student at the Winterthur/University of Delaware Program in Art Conservation.