



Smithsonian
Museum Conservation Institute

Project Summaries 2008



October 2007 through September 2008

Preface: MCI Overview for 2008

MCI's success in building partnerships for research and technical studies within the Smithsonian, as well as outside of it, is shown by the large number of projects on which we collaborate. Over the past year, 156 projects were initiated, continued, or completed in collaboration with most of the Smithsonian's museums and offices, and other U.S. government offices, including the Library of Congress, the National Park Service, the U.S. Senate and House of Representatives, and the Office of The Architect of The Capitol. The number of projects represents more than a 40-percent increase from the previous year.

Enhancing Science Capability

MCI's greatest challenge in advancing our research programs is to hire enough new scientists to strengthen our research capacity and increase our output of significant publications. During 2008, with existing funding, we hired two new conservation scientists: Ms. Jennifer Giaccai, formerly Conservation Scientist at the Walters Art Gallery, who brings us some much needed organic expertise; and Dr. Christine France, recent graduate of the University of Maryland with a specialization in stable isotope mass spectroscopy.

MCI has opened three new research science positions in the specializations of organic analysis, applied spectroscopy, and degradation of modern materials and polymers. We received 166 applications for the two entry-level research scientist positions, with many superb candidates from which to choose. The third position will be filled by a research leader with demonstrated experience in scientific analysis of museum collections. It is clear that MCI's reputation as a desirable place to work is growing.

Increasing Publication Quality and Productivity

MCI staff published 58 papers in 2008, a significant increase over the 35 papers published in 2007. Of the 2008 publications; 30 were peer-reviewed, as compared to 11 in the previous year.

Senior Objects conservator, Carol Grissom completed her opus on American zinc sculptures; it is now in press at the University of Delaware. Also, we successfully proposed a new serial, *Smithsonian Contributions to Museum Conservation*, in our Smithsonian Institution Scholarly Press series. The title was approved and the first volume will be issued in 2009.

Maximizing Instrumentation

I am particularly pleased to report that MCI's new stable isotope laboratory became fully functional this year. This resulted from a \$530,000 investment by the Under Secretary for Science's office to bring a totally new instrument capability to science at the Smithsonian. In addition, we are conducting exploratory research at York University,

U.K., on the use of MALDI-TOF, assessing the capability of this new instrumental technique to aid in identification of proteins in art and archaeological material. So far it has proven superior to DNA analysis to identify the animal hair used to make a Salish “dog” blanket (found to be goat in at least one instance).

Furthering Dissemination: Lectures, Exhibits, Symposia, Training

MCI continued its educational activities with 24 lectures in our “Topics in Museum Conservation” series and by hosting a symposium on corrosion and preservation of historic artifacts. In early 2009 we will host a symposium on control of biological organisms on stone, with a planned proceedings volume, to summarize the current status of the field.

In the past year, MCI hosted and trained 41 interns, fellows, post-docs, and visiting scientists, in addition to responding to numerous professional and public inquiries pertaining to conservation and conservation science (the previous year we had 26).

MCI staff supported 15 exhibits, including exhibits at Cooper-Hewitt; Freer Gallery of Art; International Gallery; National Air & Space Museum; National Museum of the American Indian; National Museum of Natural History; Smithsonian Affiliations/Lakeview Museum of Arts and Sciences, Peoria; Smithsonian Affiliations/Anchorage Museum; Smithsonian American Art Museum; Smithsonian Latino Center; Old Executive Office Building/US White House; and US Capitol Building/US Senate. MCI supported an exhibit of the treasures of Georgia at the Freer/Sackler Galleries, and provided information two evaluations: An Evaluation of “Conserving Georgia’s National Treasures,” for a Trust for Mutual Understanding Grant; and “Intoxicated by Georgia – A Study of Visitors to Wine, Worship and Sacrifice: The Golden Graves of Ancient Vani” – that recorded a 57% excellent rating for the exhibit. MCI worked with Smithsonian Affiliates to arrange the successful exhibit of Within the Emperor’s Garden: The Ten Thousand Springs Pavilion” at the Lakeview Museum of Arts and Sciences, Peoria, IL, April 5, 2008 – June 1, 2009.

MCI’s six conservators and their interns and fellows made 47 professional presentations, seminars, lectures and workshops on conservation technical studies and collections care, an average of over 7 presentations by each of the six conservators. This is a 30% increase from 36 professional presentations in FY2007, and 28 presentation and workshops in FY2006.

MCI’s research scientists and their staff, students, fellows, interns, and volunteers made 22 professional presentations, seminars, lectures and workshops on conservation science and technical studies. This is a 20% increase from 18 presentations and workshops in FY2007 and 15 in FY2006, and reflects the greater emphasis on dissemination for the scientific staff.

Reaching Out

MCI established collaborative research projects with the Metropolitan Museum of Art, the Getty Conservation Institute, the University of Ljubljana, The Restoration Center of the Republic of Slovenia, the Republic of Georgia's Parliamentary Library and their national museums, Johns Hopkins Library, Harvard University, and the University of Arizona, among other institutions. MCI staff participated in the Conservation Science Research Agenda workshop at Johns Hopkins, funded by the Andrew W. Mellon Foundation, and the Summit of Research Scientists in Preservation at the Library of Congress, funded by the Samuel H. Kress Foundation and the American Institute for the Conservation of Historic and Artistic Works, as well as other organizations.

MCI established research collaborations with international partners. As the only non-European on the scientific committee for the 8th European Commission on Sustaining Europe's Cultural Heritage, I was afforded an opportunity to influence future European Framework programs and develop potential collaborations with the IPANEMA/SOLEIL synchrotron outside Paris, the Franz Josef Institute (the top nuclear chemistry institute in the former Yugoslavia) in Ljubljana, Slovenia, and the EU engineering center for excellence in Maribor, Slovenia.

MCI received more than \$600,000 in grants and fellowships during the year, significantly enhancing our budget (20% increase over our federal budget).

Establishing Research Directions

In addition to the 156 projects outlined herein, MCI initiated or continued a series of research programs to investigate Smithsonian museums' collections-based issues. Specifically:

The Modern Materials Program characterizes and examines degradation behavior and mitigation methodologies for plastics, adhesives, varnishes, and coatings.

The Museum Environment Program examines behavior and aging of museum materials under realistic light, temperature, and humidity conditions, and includes recommendations for museum exhibits and storage.

The Collections Hazards Program focuses on the detection, quantification, and mitigation of heavy metal pesticides on collections, including the production of a multi-authored volume, *Pesticide Mitigation in Museum Collections*, as the first number in the Smithsonian Institution Scholarly Press series *Smithsonian Contributions to Museum Conservation*.

The Biodeterioration Program uses environmentally safe anoxic treatment and UVC procedures to control insect and microbial infestations within collections. The procedures have already been employed to treat the 1000+ objects from the former

Black Fashion Museum, in Washington, DC, the first major acquisition by the new Smithsonian museum, the National Museum of African American History and Culture.

The Imaging and Documentation Program has developed color-based 3-D scanning of objects for exhibition, research, and field conservation studies.

Overall, MCI has made great strides in building its capabilities and reputation in science. I am sure we will continue to build an even stronger presence in the coming year.

If you would like more information on any of the projects or programs at MCI, please feel free to contact our Technical Information Specialist, Ann N'Gadi (Ngadia@si.edu), or me (Koestlerr@si.edu) directly.

A handwritten signature in black ink, appearing to read "Rob Koestler". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

Dr. Robert J. Koestler
Director

December 2008

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Staff

Mary W. Ballard, Senior Textile Conservator

B.A. (1971) Wellesley College; M.A. and Diploma in Conservation (1979) Institute of Fine Arts, New York University

Areas of interest: textile preservation, storage, and treatment.

Harriet (Rae) F. Beaubien, Head of Conservation/Senior Objects Conservator

B.A. (1972) Beloit College; M.A. (1976) University of Chicago; Diploma in Conservation (1986) Institute of Fine Arts, New York University

Areas of interest: archaeological objects, on-site conservation; decorative arts.

Lynn B. Brostoff, Analytical Chemist

B.A. (1980) Vassar College; M.A. (1986) Art History, Institute of Fine Arts, New York University; Certificate in Conservation (1987) Institute of Fine Arts, New York University; M.S. (1994) Polymer Materials Science, University of Cincinnati; Ph.D. (2003)

Chemistry/Conservation Science, University of Amsterdam, Netherlands

Areas of interest: ICP-MS and chemistry of museum objects.

Roland H. Cunningham, Senior Paintings Conservator

B.A. (1962) New York University

Additional studies: Institute of Fine Arts, Conservation Center, New York University

Areas of interest: inorganic characterization of paints, pigments, and archaeological materials; technical studies of artists' materials and techniques on canvas, panel paintings, and polychromed wood sculpture.

Paula T. DePriest, Deputy Director

B.A. (1978) Union University; M.S. (1983) University of Tennessee; Ph.D. (1992) Duke University

Areas of interest: systematics, chemotaxonomy and molecular evolution of lichens, especially *Cladoniaceae* and *Parmeliaceae*.

Melanie E. Feather, Assistant Director for Operations

B.A. (1984) Franklin and Marshall College; M.S. (1986) University of Michigan

Areas of interest: application of electron and X-ray techniques to the study of art objects, archaeological material, and other museum specimens.

Martha Goodway, Metallurgist, Emerita

S.B. (1958) Massachusetts Institute of Technology

Areas of interest: archaeometallurgy; the study of the traditional technologies of mining, smelting, refining, and forming of metals and their by-products in Europe, Egypt, and Southwest Asia; the metals of music.

Carol A. Grissom, Senior Objects Conservator

B.A. (1970) Wellesley College; M.A. (1974) Oberlin College

Areas of interest: sculptures in bronze, stone, zinc, plaster, and wood.

Walter R. Hopwood, Organic Chemist

B.S. (1966) University of Pittsburgh

Areas of interest: synthetic polymers and effects of commercial products on conservation treatments, museum display and storage, carbohydrate gums.

Robert J. Koestler, Director

B.S. (1972) SUNY Stony Brook; M.A. (1977) CUNY Hunter College; M.Ph. (1983),

Ph.D. (1985) CUNY City College

Areas of interest: conservation science and collections preservation.

Francine T. Lewis, Management Support Assistant

Certificate (1980) University of the District of Columbia; Certificate (1984) Prince George's Community College

Responsibilities: management/administration support, travel coordinator, internship/fellows/visiting scientist liaison, timekeeper.

Nicole C. Little, Physical Scientist

B.A. (2001) University of Missouri – Columbia; M.A. (2005) Anthropology, University of Missouri – Columbia

Areas of interest: chemical characterization of archaeological materials utilizing inductively coupled plasma-mass spectrometry, x-ray fluorescence, and neutron activation analysis; prehistory of Mesoamerica and the American Southwest; historic archaeology of the Mid-Atlantic.

Marion F. Mecklenburg, Senior Research Scientist

B.S.C.E. (1970), M.S. (1972), Ph.D. (1984) University of Maryland

Areas of interest: mechanical properties of solid materials and the effects of environmental factors such as temperature and moisture; computer modeling of structures under static and dynamic loadings.

Ann B. N'Gadi, Technical Information Specialist/Webmaster

B.A. (1987) Anthropology, University of Oregon; M.L.S. (1992) Library Science, University of Maryland

Additional studies: Westminster College (History); University of Pittsburgh (Archaeology); Anne Arundel Community College

Areas of interest: anthropology and archaeology; computer applications for information science and retrieval; Internet applications; public relations; publications and editing.

Beverly M. Smith, Assistant to the Director

Certificate in Nursing (1971) American University; A.A. (1984) Center for Independent Studies

Responsibilities: EEO officer; budget forecasting and administration; office manager; liaison for human resources, fellowships and grants, sponsored projects, plant services, design and construction.

Robert J. (Jeff) Speakman, Head of Technical Studies

B.A. (1996) Northern Arizona University; M.A. (2002) University of Missouri; Ph.D. candidate, University of Missouri

Areas of interest: archaeology and museum studies of cultural heritage, development of instrumentation for technical studies of cultural objects, and heavy metals in the environment. Ongoing projects in Alaska, the American Southwest, the Northern Plains, the Andes, and Northeast Asia.

Jia-sun Tsang, Senior Paintings Conservator

M.S. (1974) Chemistry, Bowling Green State University; M.S. (1985) Paintings Conservation, Winterthur Museum, Art Conservation Program, University of Delaware

Areas of interest: collections care and preservation standards in museum exhibits; artists' materials and techniques; characterization and surface cleaning of varnishes on paintings; modern painting media and varnishes.

Melvin J. Wachowiak, Jr., Senior Conservator

B.S. (1981) Springfield College; M.S. (1989) Winterthur Museum, Art Conservation Program, University of Delaware

Areas of interest: history, characterization, and surface cleaning of coatings; wood technology and anatomy; microscopy; training.

Judy Watson, Physical Scientist

B.Sc. (2006) Archaeological Science, University of Bradford (UK)

Areas of interest: minimally destructive analysis and imaging using SEM-EDS.

Donald C. Williams, Senior Furniture Conservator

B.A. (1985) University of Delaware

Areas of interest: furniture finishes and colorants.

Vernetta M. Williams, Administrative Officer

B.S. (1954) Howard University

Responsibilities: financial transactions, procurement, and property accounting.

Fellows, Interns, Visiting Researchers and Volunteers

Renee Anderson, *Researcher*, Black Fashion Museum Costume Collection
Robert Baltrusch, *Visiting Scientist*, 3-D Scanning
Ray Barnett, *Intern*, Saturn V
Irakli Bokeria, *Visiting Conservator*, Anoxic Treatments and Testing
Elyse Canosa, *Intern*, Calibration Curves for XRF
A. Elena Charola, *Visiting Scholar*, Symposia Series
Annalisa Colombo, *Visiting Scholar*, Paint Consolidation
Ashley Coutu, *Intern*, Bone Isotopes
Julio Del Hoyo, *Fellow*, Light Studies/Mechanics
Paul Dorn, *Intern*, 3-D Scanning and Mechanics
Yyonette Fogg, *Intern*, Black Fashion Museum Costume Collection
Nato Gabelaia, *Visiting Conservator*, Book & Paper Conservation
Claire Gervais, *Visiting Scientist*, Treatment of Stone
Rebecca Giesecking, *Intern*, Modern Art Conservation
Greg Henkes, *Contractor*, IRMS
Javier Iñáñez, *Post-Doctoral Fellow*, Spanish Colonial Pottery
Nino Kalandadze, *Visiting Conservator*, Objects Conservation
B. Vicky Karas, *Objects Conservator/3-D Scanning Contractor*, 3-D Scanning Project
Tea Kintsurashvili, *Visiting Conservator*, Objects Conservation
Dan Koestler, *Volunteer*, Anoxic Testing
Joe Koles, *Volunteer*, Mechanics
Odile Madden, *Fellow*, Arsenic and Heavy Metal Pesticides Project
Anthony Maiorana, *Intern*, Anoxic Treatment
Maria Meléndez Bernués, *Kress Fellow*, Analysis of Paintings
Debora Minotti, *Visiting Scholar*, Paint Consolidation
Irma Molina, *Intern*, Archaeological Bone
Magdalena Moskal, *Visiting Scholar*, Archaeological Wood and Charcoal
Michele Pagan, *Volunteer*, Non-Invasive Upholstery
Ximena Pezoa, *Visiting Scholar*, Collections Management
Colby Phillips, *Post-Doctoral Fellow*, Obsidian
Christie Pohl, *Kress Post-Graduate Conservation Fellow*, Metals
Fabien Pottier, *Intern*, XRD Instrumentation
Christine Regan, *Intern*, Black Fashion Museum Costume Collection
Dawn Rogala, *Post-Graduate Fellow*, Modern painting materials and ground layers
Cristina Ruiz Recasens, *Intern*, Paint
Cristiana Sburlino, *Visiting Scholar*, Paint Consolidation
Alaina Schmisser, *Intern*, 3-D Scanning
Michal Lynn Shumate, *Intern*, Black Fashion Museum Costume Collection
Elizabeth Shuster, *Intern*, Black Fashion Museum Costume Collection
Natasha Slobodina, *Intern*, Alaskan Obsidian
Colleen Snyder, *Intern*, Mayan Pigments
Caroline Solazzo, *Visiting Scientist*, Prometics and animal fiber identification
Cathleen Zaret, *Intern*, Black Fashion Museum Costume Collection

Topics in Museum Conservation Lecture Series

October 18, 2007

Cyclododecane, Carbon Dating and Other Conservation Curiosities...

Christy M. Pohl, MCI Kress Conservation Fellow

This presentation was an overview of research and work completed during a one-year postgraduate fellowship in archaeological conservation, funded by the Kress Foundation. The primary focus was a material science research project investigating cyclododecane, a temporary fixative used in conservation, and its effect on the ^{14}C dating of organic archaeological materials. The research also explored the presence of impurities in various cyclododecane batches using Raman spectroscopy, x-ray fluorescence and gas chromatography-mass spectrometry. Additional fellowship activities were also discussed, including the continued excavation and study of a Mongolian burial assemblage and fieldwork involving Pre-Columbian gold working in Panama.

October 23, 2007

Second Symposium on Corrosion & Preservation of Historic Artifacts (NACE)

C-3PO: Preservation of a Protocol Droid

Mary Coughlin, National Museum of American History

In 1984, Lucas Films Ltd. donated to the Smithsonian Institution's National Museum of American History (NMAH) a C-3PO and R2-D2 that were used in the film *Return of the Jedi*. During a recent condition assessment, it was discovered that sections of the C-3PO costume were aging differently and that the surface was no longer a uniform golden color. While attempting to determine why the costume was aging unevenly, Lucas Films and Industrial Light and Magic were contacted. They informed the NMAH conservation department that a thin layer of aluminum was applied to the C-3PO costume in a vacuum metallizing chamber and then made golden with a tinted lacquer. Over time, areas on the back of the head and the arms became dark orange instead of gold. The dark orange discoloration was visually distracting and an effort was made to reduce its appearance in order to more uniformly integrate these areas with the rest of the costume.

The Status of Conservation of the Saturn V at the Johnson Space Flight Center and a Condition Assessment of the Neighboring Little Joe II Rocket

Ed McManus, Chief Conservator, National Air and Space Museum

This presentation discussed the current status of the preservation of the Saturn V rocket at the Johnson Space Flight Center and the need for conservation of the neighboring Little Joe II. The Little Joe II launch vehicle was used for Apollo spacecraft transonic and high-altitude abort testing from 1964-1966. The Little Joe has experienced an advanced degree of corrosion which could lead to serious structural failure.

Corrosion Mitigation of Large Artifacts Recovered from the USS Monitor (1862)

Eric Nordgren, Senior Conservator, The Mariners' Museum, **Sean Brossia**, CC Technologies, **Mark Yunovich**, CC Technologies

The recovery of the gun turret, engine, condenser, and other large metal artifacts from the wreck of the USS *Monitor* (1862) presented a major challenge to the team working to conserve this material at The Mariners' Museum in partnership with the National Oceanic and Atmospheric Administration (NOAA). The metal components raised from the *Monitor* will require long periods of wet storage during study and conservation, during which they will be vulnerable to corrosion. A Corrosion Assessment was carried out by CC Technologies and Mariners' Museum conservators. As a result of the assessment, corrosion monitoring and mitigation measures including impressed current cathodic protection were put in place on the turret and gun carriages, and a reduction in corrosion rates on these artifacts was noted. Solution chemistry and corrosion potentials of the engine, condenser, and Dahlgren guns were also recorded and their conservation treatments closely monitored. This paper described the corrosion mitigation and conservation efforts as well as research conducted by CC Technologies into appropriate corrosion inhibitors for the *Monitor's* engine and other large composite artifacts.

The Stabilization, Conservation Treatment and Exhibition Mounting of Two Saturn V Command Modules

Joseph Sembrat, Conservation Solutions, Inc., **Patty Miller**, Conservation Solutions, Inc., **Mark Rabinowitz**, Conservation Solutions, Inc.

The presentation reviewed the treatment of two similar capsules from the Saturn V rockets at NASA Johnson Space Center, Houston, TX and US Space and Rocket Center, Huntsville, AL. Each artifact, one a flight ready capsule and the other a test version for flight and recovery, was treated by Conservation Solutions, Inc. during our work on the two rockets. In both cases, the artifacts had been on display outdoors for decades and had deteriorated considerably prior to their treatment. The conditions discovered on each was reviewed, the treatments that were devised and implemented, and the engineering challenges that were encountered in displaying the artifacts.

Conserving the Cutty Sark Clipper Ship: Electrolysis and Associated Treatments for the Last Surviving Tea Clipper

Gina Crevello, Architectural Conservator, Electro Tech CP, **Paul Noyce**, Electro Tech CP

The Cutty Sark Clipper Ship, 1869, is undergoing major conservation works as part of an expansion of the museum into a conference and event centre. She is the last remaining extreme tea clipper that survives from the Tea Trade and is also only one of three composite frame ships in existence. Additionally, the Cutty Sark is a Grade I listed ship, the only ship given this designation by English Heritage. Today, she is dry docked in Greenwich, London, is a museum and the gateway to the UNESCO Maritime Greenwich World Heritage Site.

The problems affecting the Cutty Sark's iron frame are chloride induced corrosion. The rock elm and teak planks are saturated in chlorides, which eventually migrated to the iron frame. The iron frame is suffering from severe corrosion resulting in loss of material, pitting of the frame, pack rust, and scaling.

Prior to the major works, a series of trials on both the wrought iron frame and wood planks were carried out. These trials were meant to guide the Cutty Sark Trust in choosing the most appropriate treatments and help secure funding from the Heritage Lottery Fund. Trials carried out by Electro Tech CP focused entirely on the iron frame. Lead paint abatement, electrolysis, chemical chloride removal systems, and coating systems were trialed. The majority of the work was carried out in situ, while other tests were performed at the in vitro.

Since the initial idea of electrolyzing the entire ship was abandoned, construction of cassettes or tanks around the frame had to be designed. This allowed for the use of various anodes to be utilized for trial. Additionally, different electrolytes were trialed. The results of electrolysis were incredibly positive. Test results will be discussed as well as risk identification.

Since this time, a fire has broken out on the ship. The conservation time frame was considerably shortened and new specifications and trials had to be carried out. Electro Tech CP devised the new trials at a higher current density, though they are being carried out on iron elements not subjected to the intense heat of the fire. There are now many new considerations and risks to the conservation work.

January 10, 2008

Aging of Oil Paintings: Pigment/Binder Interactions and the Formation of Metal Soaps

Dr. Margaret G. MacDonald, Andrew W. Mellon Fellow, The Metropolitan Museum of Art, Department of Scientific Research

Although metal soap inclusions in traditional oil paintings have been the subject of many studies, the precise mechanism of formation is still not fully understood. It is unclear how factors such as paint layer composition, presence of driers, varnishes, other layers and environmental fluctuations affect the process and why certain pigments go on to form soaps more readily than others. Moreover, the clustering of individual

soap molecules into aggregates that eventually form protrusions and how quickly all this occurs, remains unknown. A better understanding of all these processes is therefore crucial in order to approach the preventive conservation of oil paintings at risk.

In order to address and investigate this problem using the NMR-MOUSE spectrometer, a new non-invasive technique now available to conservation studies, a series of CPMG experiments to measure the $T_{2\text{eff}}$ have been performed on samples composed of linseed, poppy and walnut oils with and without lead white, zinc white and titanium white. Through this technique, we have begun to develop a qualitative picture of the affect of age on oil mediums with and without pigments present through which we can gain insight into the initial mechanism of saponification.

January 28, 2008

Two Isotopic Approaches to Archaeological Questions: Examples from Anglo-Saxon Diet and Turkish Carpet Provenance

Bradley D. Hull, University of Oxford, Research Lab for Archaeology and the History of Art

Anglo-Saxon Diet: In order to assess dietary variability across a population/culture group, 801 bone collagen samples from 17 inhumation cemeteries and 4 settlements were analysed for $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$. In this paper we questioned the universality of human diet in a single cultural group, in the same time period at a variety of sites. Stable isotope results from Anglo-Saxon inhumations were compared with six different types of burial evidence: sex, age, height, body position, grave orientation and grave goods. A mosaic of dietary patterns was present at the sites sampled in Hampshire, Norfolk and Suffolk. Sites appear to have had dissimilar social controls over consumption of food (stable isotopes) and social expressions represented in the grave. An accurate interpretation of human isotopic data can not be made without a sufficiently large amount of equivalent animal data. Isotopic differences between the human data from Hampshire and East Anglia ($p < 0.01$) would have been identified as a different dietary/cultural pattern without the inclusion of 358 animal bone collagen samples. The $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ shift may be due to climatological, geological, and ecological factors.

Turkish Carpet Provenance: Previous research into establishing the provenance of ancient textiles using stable isotopes presented a surprising amount of variation in modern biological samples. Geographical isotopic differences were present in C, N and S as incorporated into modern sheep wool (Hedges et al 2005). In order to establish isotopic patterns, two series of sites were sampled across Turkey for modern sheep wool. Nearly 500 wool samples (2003-2005 winter growth) were collected from 30 sites from different regions across Anatolia. In this paper, we reported the C, N and S results from modern wool sampling. Five sites produced enriched $\delta^{15}\text{N}$ values ($>9.5\text{‰}$) representing a meaningful/unusual shift in nitrogen content of the diet. The implications of this pattern are very significant, especially within archaeological research into ancient diet, and will be discussed.

Geographical variation in stable isotope values across Turkey is also present. Taken together, C, N and S present a general indicator of isotopic provenance of source material, but not an exact marker. To refine/strengthen our ability to identify the source

for wool samples, $\delta^2\text{H}$ and $87\text{Sr}/86\text{Sr}$ were also analysed from wool collected in the 2003/2004 series. The hydrogen and strontium results present a further isotopic pattern, which, when used in accordance with carbon, nitrogen and sulphur, may allow for the geographical placement of ancient textiles.

February 12, 2008

An Evaluation of Supercritical Drying and PEG/Freeze-drying of Waterlogged Archaeological Wood

Eric Schindelholz, Senior Objects Conservator, National Park Service, Harpers Ferry Center

Supercritical carbon dioxide has replaced many liquid organic solvents in industry due to its tunable solvent properties, environmental friendliness, and easily achievable critical parameters. The unique properties of supercritical fluids in general, such as gas-like diffusivity and zero surface tension, make them particularly applicable to the field of conservation. This presentation reported on the results of a study undertaken to evaluate the physical effects of drying waterlogged archaeological wood using supercritical carbon dioxide as compared to air-drying and the popular polyethylene glycol (PEG)/ freeze-drying method. Samples on the order of a few cubic centimeters were prepared from two archaeological waterlogged wood sources and grouped into three treatment sets: one for air-drying, one for PEG/freeze-drying, and the other for supercritical drying. Treatment-induced dimensional changes were tracked using 3D laser scanning and pins inset in the samples. Instrumental analysis was carried out to determine the state of preservation of the wood and the microscopic effects of the imposed treatments. Results of this study were in favor of freeze drying for all samples, and supercritical drying for certain types of wood.

February 14, 2008

Let the Envelope Speak... It Is What You Don't Know About the Envelope That Makes a Difference!

Maynard Benjamin, President and CEO, Envelope Manufacturers Association

Maynard H. Benjamin, CAE, is a life-long collector of envelopes and a member of the Director's Council of the National Postal Museum. Mr. Benjamin is the author of *History of Envelopes 1840 to 1900* and is working on the second book in this series to document the history of envelope manufacturing in America. He is the President and CEO of the Envelope Manufacturers Association and frequently works with law enforcement authorities on documenting the source and origin of envelopes.

February 21, 2008

Assessment and Monitoring Lighting Conditions in Museums

Dr. Hannelore Roemich, Associate Professor of Conservation Science, New York University, Institute of Fine Arts, Conservation Center

Works of art cannot be appreciated without light, but light is also one of the most powerful parameters in altering color and so causing irreversible damage. Before limiting the time of exposure for each object, it is advisable to monitor the lighting conditions on site with data loggers or with light dosimeters, such as the well-known Blue Wool Standard or the newly developed LightCheck. LightCheck dosimeters were tailored to detect low to medium values of light doses. Their response to light can be evaluated visually with a calibration card.

The presentation introduced general lighting concerns in museums, featuring monitoring with dosimeters. A case study in the Cloisters will demonstrate possibilities and limits of the systems. The compromise between visitor's requirements and object's safety were discussed.

March 20, 2008

An Assessment of the Use of Flame Retardant Plastics for Museum Applications

Danielle C. Leikach, The Protection Engineering Group, Inc.

Halogenated flame retardant plastic sheeting may help to reduce the spread of flame in museums; however, the treated plastics contain chemicals that may be harmful to museum objects in situ, particularly metals. This study assessed historical and contemporary problems and benefits associated with flame retardant plastics with respect to museum applications. This issue was addressed by pairing statistical data on museum fires with standard and novel electrochemical testing methods for assessing corrosivity, while also creating a format for future assessments of fire safety related practices as they are applied in museum settings. Flame retardant plastics were found to cause corrosion in copper, approximately 1.2 milli-inches per year (mpy), compared to pure polyethylene which corrodes at approximately 0.83 mpy. Conventional testing methods show that flame retardant plastics can be considered safe for limited museum use and that they delay ignition from small heat sources, but they must be assessed for each individual scenario.

April 18, 2008

Hygric Swelling of Stone

Dr. George Scherer, Professor of Civil and Environmental Engineering, Princeton University, Department of Chemical Engineering and Princeton Institute for the Science and Technology of Materials

Many sedimentary stones contain clays that cause swelling when they get wet. The expansion can be large enough to cause buckling during wetting and (in some cases) cracking during drying. Portland brownstone contains chlorite, which is not usually a swelling clay, but which becomes capable of swelling as a result of weathering. The deterioration of brownstone buildings appears to result largely from dilatation during wetting/drying cycles. In this talk, we investigated the mechanics of swelling and cracking, and explore the effectiveness of treatment with diaminoalkanes. Wendler and Snethlage showed that these molecules would reduce hygric swelling, which we have confirmed in our lab. The mechanism by which they work, and the durability of their effect, were discussed.

April 29, 2008

From Reality to Virtual Reality, and Back Again

Mel Wachowiak, MCI Senior Conservator, **Vicky Karas**, MCI Objects Conservator/3-D Imaging Specialist

This presentation provided an overview of recent 3D scanning projects undertaken by the Museum Conservation Institute. Emphasis was placed on several collaborative efforts with other Smithsonian units. Most recently, MCI worked with staff of the Museum of Natural History's Department of Anthropology and the Office of Exhibit Central to produce replicas of skeletal remains. Other project highlights included integration of other analytical information with 3D scanning, and modification of 3D data to produce new understanding of cultural iconography.

May 1, 2008

Good Governance in the Art Collections

Ximena Pezoa, MCI Visiting Scholar and Contemporary Art Collection Manager,
Ministry of Culture and Arts, Chile

Ximena received training in the Smithsonian's methodologies for organization and administration of art exhibitions. This includes analysis of issues and participation of exhibition production related to curatorship, conservation, management, education and culture. She also participated in the development of the exhibit "Teaching the *Jíbaro*: Art, Politics, and Education in Puerto Rico" set to open in September 2008. This exhibition is a collaboration between NMAH, OEC, SLC, and MCI. Ximena discussed her training and talked about her working experiences with the NMAI, OEC, and her interviews with scholars, curators, and conservators in the Smithsonian and local private museums, and her visits to exhibition and conservation departments in area museums from NGA, LC, SAAM, NPG, NMAH, NMNH and the Art Museum of the Americas.

Ximena's two months' fellowship was sponsored by Partners of the Americas and her Smithsonian sponsors are Jia-sun Tsang, Senior Paintings Conservator at MCI, and Randal Woodaman, Exhibitions and Public Programs Director, SLC. In addition, Ximena received extensive training under the direction of David Liston, Training Coordinator at OEC.

May 8, 2008

Sculpture and Painting Projects from the Straus Center for Conservation

Dr. Narayan Khandekar, Senior Conservation Scientist/Senior Lecturer on History of Art and Architecture, Harvard University Art Museums, Straus Centre for Conservation

Dr. Khandekar discussed two large projects that have involved the Analytical Laboratory of the Straus Center for Conservation, Harvard University Art Museums. The first is the re-restoration of a Donald Judd sculpture from 1965. In an earlier restoration, original cellulose nitrate paint was replaced with an acrylic paint, a replacement not approved by the artist. The original and replacement paints were compared, allowing an informed re-restoration of the Whitney work. The second is a technical examination of three works attributed to Jackson Pollock (1912–1956). The paintings were analyzed using Fourier transform infrared spectroscopy (FTIR), pyrolysis gas chromatography mass spectrometry (Py-GC-MS), Raman spectroscopy, scanning electron microscopy energy dispersive x-ray spectroscopy (SEM/EDX) and laser desorption ionization time of flight mass spectrometry (LDI-MS-TOF) to determine the age and composition of the binding media and pigments that make up the paintings. All three were found to contain some materials unavailable prior to 1956. Also included will be a brief round up of analyses carried out by the Museum of Fine Arts and Orion Analytical of other paintings from the group of thirty-two recently discovered works thought to be by Jackson Pollock.

May 15, 2008

Environmental Standards: From Rigidity to Responsibility

Jean Tétreault, Senior Conservation Scientist, Canadian Conservation Institute

Where do the standard levels of relative humidity, temperature, light and pollutants established by many heritage institutions around the world come from? Who were the pioneers setting those levels and what were their rationales? What were the obscure forces requiring tighter controls!

This presentation was a personal overview of the evolution of standards for the museum environment from rigid numbers to guidelines offering flexibility, while obliging the collection keepers to make wise decisions.

May 16, 2008

Thirty Millennia of Tibetan Prehistory

Dr. **Mark Aldenderfer**, Professor, University of Arizona

Unknown to most of the world, the prehistory of the Tibetan plateau stretches deep into the past. In this presentation, an overview of this prehistory was provided, and such topics as the peopling of the plateau, the independent domestication of plants and animals by its later inhabitants, and the origins of complexity that resulted in the emergence of the Tibetan empire that once dominated much of Central Asia was examined. Some remarks on the challenges facing the development of Tibetan archaeology as it moves into the 21st Century concluded the presentation.

May 20, 2008

Plastics Lifetimes are Short and Preserving Plastics for the Future

Dr. Thea van Oosten, Senior Researcher, Instituut Collectie Nederland/Netherlands Institute for Cultural Heritage, Research Department, **Dr. Yvonne Shashoua**, Senior Researcher, The National Museum of Denmark, Conservation Department

Plastics and rubbers are found in a variety of collections: historic, ethnographic, scientific, design, as well as modern and contemporary art. Most museums have these materials in their collections and the amount will continue to increase. This presentation included overviews of the current state of knowledge regarding identification of plastics, physical and chemical qualities, causes and appearance of deterioration, preventive and active conservation measures, health and safety, and issues such as handling and marking. There was a brief discussion on practical preventive conservation of plastics and rubbers as well as the challenges of active conservation.

Museum objects are rarely collected for their material type but for their origin, function, design, rarity, cultural or historical significance. Degradation of plastics cannot be prevented, reversed, or stopped, but only inhibited or slowed. The purpose of this presentation was to discuss the status of preservation of plastics in museum collections. Of the ca. 50 basic plastics types available today, four have been identified as being more vulnerable to degradation than others in museum collections; cellulose nitrate,

cellulose acetate plasticized PVC and rubbers. The most frequently seen forms of degradation in museums and the possibilities for slowing breakdown will be illustrated.

Recent research by the speaker into the effectiveness of inhibitive conservation and forthcoming research into interventive conservation of plastics was presented.

August 28, 2008

Historic Wood and the Microbes that Attack It: Case Studies to Better Understand the Diverse Microorganisms that Affect Wood in Different Environments

Prof. Robert A. Blanchette, Professor, University of Minnesota, Department of Plant Pathology

This seminar provided information from recent investigations of deterioration and decay in historic structures found in Polar Regions (from expeditions huts built by Robert Scott and Ernest Shackleton in Antarctica and Peary in the Arctic) and desert environments (King Midas Tomb in Turkey and Chaco Canyon in New Mexico) as well as in wood from various shipwrecks (USS Monitor and others). Information on the microbial diversity found at these national and international heritage sites and the effects of these microorganisms on wood was presented. Conservation plans to preserve these important historic sites and ships were also discussed.

September 25, 2008

Using Microstructure to Understanding Casting Technology, a Case Study from Godin Tepe, Iran

Lesley D. Frame, PhD Candidate, University of Arizona

Excavations at Godin Tepe – a Bronze Age site in Kangavar Valley of the west-central region of Iran – yielded a metal assemblage of 202 artifacts of which 91 are curated at the Royal Ontario Museum, Toronto, Canada. The assemblage consists of decorative objects (figurines, vessels, bracelets, rings, needles, pins) as well as weapons and tools (chisels, blades, daggers, and projectile points). Metallographic sections revealed that nine of these artifacts were produced by various casting methods. Secondary dendrite arm spacing was measured on polished and etched metallographic sections, and cooling rates were calculated based on these measurements along with the average composition of the metal. Comparison to reference data shows that these cooling rates group into ranges typical of quenched and furnace cooled environments. Composition and microstructure information was obtained for these artifacts with the use of scanning electron microscopy and electron beam microprobe.

Center for Folklife and Cultural Heritage

MCI 6122 Conservation of San Lorenzo *Santo* by Charles Aguilar

MCI Staff: Jia-sun Tsang, Walter R. Hopwood

A 16-inch carved and painted wooden *santo* figure of San Lorenzo, a possible object for the *Mexico at the Smithsonian* Exhibition at the Ripley Center in September 2007, was sent to MCI for binder and varnish analysis and to reattach three broken fingers and a broken handle on the grill. Fourier transform infrared spectroscopic analysis of the binder and varnish helped the conservator to select the appropriate inpainting and consolidation materials.



Before



After

MCI 6188 “Lacquer” Recording Discs: Material Characterization and Display Guidelines

MCI Staff: Jia-sun Tsang, Mel J. Wachowiak, Maria M, Lynn B. Brostoff, Judy Watson

The research of “Lacquer Records” - shellac records - was initiated to explain how to safely display the renowned Woody Guthrie 1943 record “This Land is your Land” in an exhibition case. It was important to have the materials information, e.g., response to temperature and humidity, in order to design an appropriate microclimate-controlled case to meet the conservation needs of the object.

The first shellac disc dates from the early 1900s. The 78-rpm disc was the principle commercial recording media of the 1930s and 1940s. It was estimated that the worldwide stock of this format amounted to 10 million discs. Typical shellac discs consist of fillers such as limestone, powdered slate, colorants such as carbon black, resins such as vinsol (rosin resin), Congo gum, and mold releasing agents such as zinc stearate.

FTIR and GC-MS were used to confirm the presence of the components of shellac by analyzing a similar shellac disc produced in 1944 by the same manufacturer. In addition to visual examination via light microscope and higher magnification examination of the morphology of disc cross-sections by scanning electron microscopy (SEM), SEM-EDS was used to profile the inorganic elements. Existing research and literature on the aging and deterioration behavior of shellac were the basis of drafting the display guidelines.



Lacquer Recording Disc, 1943

Cooper Hewitt Museum

MCI 6148 Small Beaded Textile Covered Container from Sumba, Indonesia
MCI Staff: Mary W. Ballard, R. Jeff Speakman, Walter R. Hopwood, Carol A. Grissom, Odile Madden, Candace McMillen, Judy Watson

The small beaded container from Sumba, Indonesia had a white powder that was thought to be associated with betel nuts on the interior of the container. A sample of the powder was analyzed to help ascertain the probable use of the container. Preliminary tests at the Cooper-Hewitt suggested that it was not the alkaline, insoluble lime (CaO) that was associated with betel nut consumption. MCI identified the white powder as hexahydrate ($\text{MgSO}_4 \cdot 6\text{H}_2\text{O}$), a drier form of Epsom salts.



MCI 6190 Ivory-Inlaid and Ebony Cabinet on Stand

MCI Staff: Donald C. Williams, Mel J. Wachowiak, Ron H. Cunningham, Lynn B. Brostoff, Judy Watson, Odile Madden

The ivory-inlaid and ebony cabinet on a stand was analyzed for materials and techniques of construction, including woods, inlays, adhesives, coatings and structure; the warped and cracked ivory inlays were stabilized, and cracked ebony; and, some loose pieces from the cabinet were re-attached.

With the stabilization of this finely inlaid chest, which has cracks and lifting pieces in the ivory inlay on wood, it was made more exhibitable. A better understanding of the chest was obtained by an analysis of the specific woods, and methods and materials of construction. This permitted a more precise location and date of creation for the object, assisted in selection of appropriate conservation treatment and helped to establish whether the stand was original to the object.



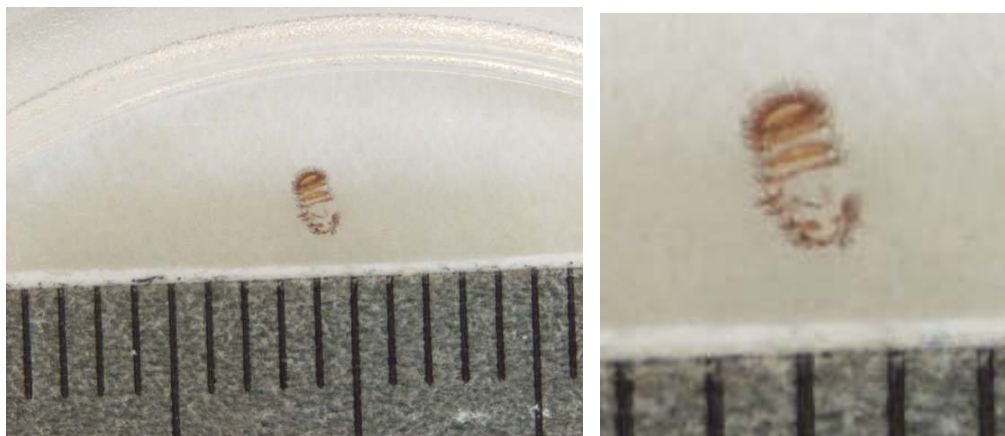
MCI 6203 Pre-Columbian Textile

MCI Staff: Mary W. Ballard, Robert J. Koestler, Ron H. Cunningham

Accessioned Nazca textiles were found to have small portions of loss apparently caused by insects. The larvae found with the textile matched the odd beetle, *Thylophorus contactus* (Mots), which is not known as a wool-eating insect. It seems likely that the larvae discovered fed on the cast skins of larvae from a different species, who did feed on the actual Nazca textile.

There are then two long-term concerns for the textiles: the monitoring and control of the *Thylophorus* and the monitoring and control of its keratin-eating predecessor. Housekeeping, rigorous inspections, and white tissue papers (for contrast) under all specimens are recommended anywhere an active infestation is suspected. Argon anoxic treatment (4 weeks at 500ppm O₂) is recommended for any active infestation.

Finally, ancient textile collections as represented by this Nazca textile may be divided into two types from the standpoint of safety concerns: those that have been treated with long lasting pesticides and those that have not. Whether the keratin eating insects in this instance succumbed to poison placed on the textile or not is unknown. It is curious that the keratin eating insects stopped eating when there was still plenty of food left for them to consume. Elemental analysis of their frass might provide an indication if they had ingested pesticides, if the assay showed elevated levels for chlorine, arsenic, or mercury--components of known early mothproofing agents—as, of course, would fibers from the Nazca textile itself.



Freer Gallery of Art/Arthur M. Sackler Gallery of Art

MCI 5912 Laser-Ablation ICP-MS Methodology for the Analysis of Ancient Chinese Decorative Gold Foil

MCI Staff: Lynn B. Brostoff

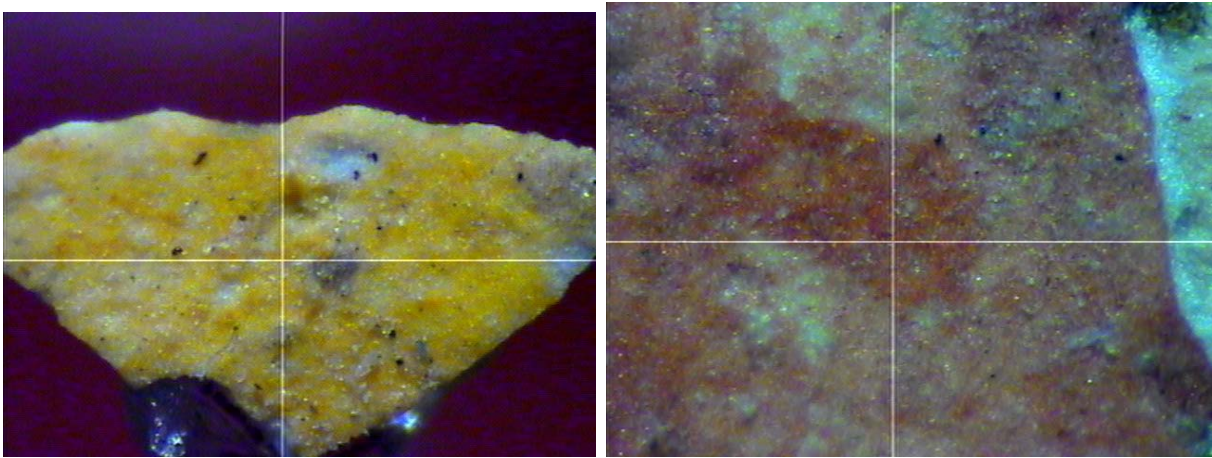
Laser ablation-inductively coupled mass spectrometry (LA-ICP-MS) was utilized to probe trace and minor element concentrations in a remarkable group of ancient Chinese gold objects in the Freer Gallery of Art and Arthur M. Sackler Gallery. The collaborative study included investigation of these objects at the Smithsonian's Museum Conservation Institute, Washington, DC, using a 266 nm Nd:YAG nanosecond laser, and at the Lawrence Berkeley National Laboratory, Berkeley, CA, using a 266 nm Ti:sapphire femtosecond laser. Our results validated use of LA-ICP-MS for revealing "fingerprints" in minute gold samples based on quantitative elemental composition. Comparison of results allowed us to establish patterns based on the association of silver, palladium and platinum that support historical, technical and stylistic relationships, and shed new light on mysteries surrounding these ancient objects. LA-ICP-MS was also shown to be valid for detecting forgeries.



MCI 5998 XRD of 18th Dynasty Egyptian Wall Paintings

MCI Staff: Lynn B. Brostoff, Ron H. Cunningham, Odile Madden

Pigments were analyzed to identify several samples from yellow and red areas of wall paintings from the 18th Dynasty Egypt, Thebes. In particular, XRD analysis was used to determine if arsenic found to be present by EDS could be confirmed to be present as orpiment, realgar, or one of their deterioration products. XRD analysis did not detect the presence of either orpiment, realgar, or other arsenical compounds that are normally associated with either yellow or red pigments. Analysis identified the ground components of huntite, anhydrite and thenardite.



Yellow and red paint flakes mounted for XRD analysis.

MCI 6130 Ceramic Remains from Tepe Hissar, Iran

MCI Staff: Ron H. Cunningham

About 120 ceramic sherds from Tepe Hissar, Iran, were analyzed by xeroradiography. The analyses were part of a doctoral dissertation on the technical analysis of ceramic and metallurgical remains from Tepe Hissar. This analysis is part of an effort to gain more information on accurately proveniencing ancient Iranian ceramics to provide comparative materials for the analysis of the collection of Iranian ceramics in the Arthur M. Sackler Gallery, many of which have undergone xeroradiography.

MCI 6167.1 SI Exhibit: *Wine, Worship & Sacrifice: The Golden Graves of Ancient Vani*

MCI Staff: Carol A. Grissom, Harriet (Rae) F. Beaubien, R. Jeff Speakman, Nino Kalandadze, Tea Kintsurashvili

Five silver and two bronze objects (one in 11 parts) were treated by MCI objects conservators prior to display in the exhibition *Wine, Worship and Sacrifice: The Golden Graves of Ancient Vani* held from December 1, 2007, to February 24, 2008, at the Smithsonian's Sackler Gallery. The objects had been excavated at the ancient Colchian ceremonial site of Vani, now in the modern republic of Georgia. Treatment of the silver objects consisted mainly of corrosion removal and improvement of old repairs. Treatment of the bronze objects consisted of visual improvement of electrochemically cleaned bronzes and amelioration of wax-filled cracks.



MCI 6167.5 Silver Objects in Vani Exhibit

MCI Staff: R. Jeff Speakman, Nino Kalandadze, Tea Kintsurashvili, Carol A. Grissom, Harriet (Rae) F. Beaubien, Nicole C. Little

Thirty six silver objects and one bronze head of Pan on loan from the National Museum of Georgia for the exhibition *Wine, Worship and Sacrifice: The Golden Graves of Ancient Vani* at the Sackler Gallery were analyzed by X-ray fluorescence (XRF) spectrometry. Analyses were carried out to quantify the alloy content as well as the presence/absence of repaired sections on objects in the collection. Results indicated that most of the objects had similar overall compositions, with ca. 96–99 % silver and no other appreciable major constituents except copper. In the case of one cauldron, the composition of one of the handles had a significantly higher concentration of zinc, indicating that the handle may not be original to the object. The analyses of ten seemingly similar coins demonstrated a high variability in copper and chromium content.



MCI 6185 Chinese Jade Geological Specimens

MCI Staff: Nicole C. Little, Judy Watson

One serpentine and twenty-two nephrite samples were selected from collections belonging to the Smithsonian Freer & Sackler Museums or Susanna Lam for elemental characterization by laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS). This was an exploratory project to determine the applicability of LA-ICP-MS for provenance studies of Chinese jade. This project was also used to determine whether surface damage from analysis was acceptable for an expanded study of accessioned art objects in museum collections. Scanning electron microscopy with energy dispersive spectrometry (SEM-EDS) was used on a subset of the geological samples to determine whether this technique would be useful in the chemical characterization of Chinese jade. Preliminary results have shown LA-ICP-MS to be the preferred method for jade characterization studies, although the heterogeneity within single jade samples, as well as the flaky ablation characteristics, suggested that this approach is not straightforward.

MCI 6194 Ceramics from Thailand

MCI Staff: Ron H. Cunningham

Xeroradiography of 32 ceramic vessels that are thought to be from Ban Chaing and related cultures in Thailand as part of a fellowship project on the technical analysis and conservation of ceramics in the Sackler. In addition, it is part of a larger ongoing examination of the Southeast Asian ceramics in the collection.

Hirshhorn Museum & Sculpture Garden

MCI 6074 Rodin Sculpture: *Monument to Balzac*

MCI Staff: Carol A. Grissom, Lynn B. Brostoff, Walter R. Hopwood

In response to a request to assist with the determination of “an appropriate replacement patina and surface coating” for the Hirshhorn’s *Balzac*, by Auguste Rodin, the statue was examined, photographed, and sampled for analysis. Composition of the bronze metal determined by XRF analysis was 94% copper, 4-4.5% tin, and about 1% zinc; consistent with published data for Georges Rudier casts of the statue. Surface compounds detected by X-ray diffraction consisted mainly of copper nitrate hydroxides and cuprite. The copper nitrate hydroxides almost certainly were derived from chemicals applied by *patineurs*. The most common atmospheric corrosion products found on outdoor bronzes, copper sulfates, were detected only in low amounts. FTIR analysis confirmed the presence of wax on the surface, known to have been applied as a protective coating since the Hirshhorn’s sculpture garden opened in 1974. FTIR also determined that remnants of coatings found below the wax in four sampled areas were acrylic. The acrylic was most likely applied just before the statue arrived at the museum in Washington in 1974, since a protective coating appeared to have been absent when the statue was displayed at Joseph Hirshhorn’s estate; there are no records of application of any other coating than wax at the museum.

Because the non-original paint and wax coatings left the surface of the *Balzac* black and opaque, they were removed as much as possible. The black paint proved difficult to remove from crevices, however, and some was left on the statue. Nevertheless, removal of these coatings revealed considerable original green patina, complete with original drips. Lengthy discussions by the team of Smithsonian conservators, scientists, curators, and contractors led to the decision to retain as much of the original patina as possible. Where the surface had been rubbed to bright metal, small areas were touched-in by applying green-producing chemicals; the statue was subsequently coated with wax. The statue is considerably lighter in appearance now than before treatment.



MCI 6176 Equipment Grant Research Proposal

MCI Staff: Marion F. Mecklenburg

The objective of this study was to measure natural and artificial light levels in exhibition spaces throughout the Reynolds Center museums (SAAM and NPG) where collection items are displayed. This was done because during the building's renovation, many previously closed windows and skylights were opened and the light levels required re-measuring. The light level information was compared with standard lighting guidelines and used to make recommendations for environmental adjustment, if needed.

Temperature and relative humidity were also monitored during this study.

Measurements were taken every hour, 24 hours a day for a full year which helped track lighting level changes due to different sun angles

MCI 6191 A Closer Look at the Characteristics and Compatibility of Materials Used in Modern Paintings

MCI Staff: Dawn Rogala, Marion F. Mecklenburg, Lynn B. Brostoff, Mel J. Wachowiak, Judy Watson, Ron H. Cunningham, Odile Madden

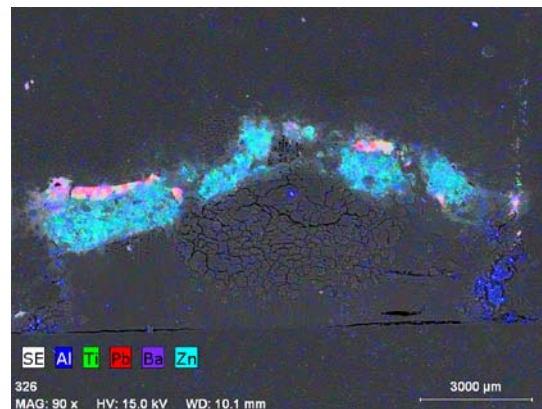
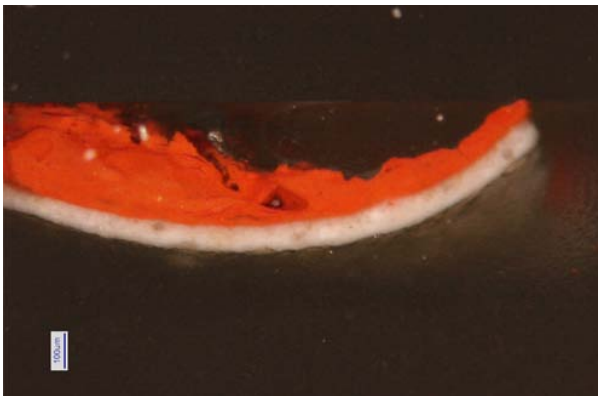
Although some research has been done on the properties of individual modern painting materials, those studies have not considered the materials in their interactive function as part of a composite painting structure. The goal of this project was to begin to address this vital part of modern materials research.

Mid-20th century artists were well-known for their use of experimental painting materials; it is perhaps significant that works from this period are unusually prone to structural- and adhesion-related condition problems. The purpose of this research was to examine works from this time period with similar condition issues, to determine the material characteristics of these paintings, and to test the responses of representative painting structures to various mechanical and environmental stresses.

In drawing attention to potentially incompatible materials and their specific vulnerabilities, this study sought to aid the future care and treatment of these (and similar) works of art.

The objective of this study was to discover potentially incompatible painting materials and to investigate the stress responses of painting structures that include combinations of these materials.

This research began with a group of modern paintings from HMSG with similar condition issues. The structure of these paintings was determined through analysis, and representative models were prepared and subjected to a series of mechanics tests. In this manner, real world examples were used as the introduction to this new area of study.



Museum Conservation Institute

MCI 4670 Conservation of Zinc Sculptures Book

MCI Staff: Carol A. Grissom

The *Conservation of Zinc Sculpture* book was laid out, edited, copy edited and sent to the printer.



MCI 4834 'Ain Ghazal Statuary Cache

MCI Staff: Carol A. Grissom, Harriet (Rae) F. Beaubien, Claire Gervais

Approaches to the 'Ain Ghazal fragment reconstruction was considered.



MCI 5277 King Midas's Textile Analysis

MCI Staff: Mary W. Ballard, Odile Madden

MCI was approached for assistance in the analysis of 11 textile samples from the prominent Tumulus MM at Gordion, Turkey—widely considered to be King Midas's tomb. Despite the tomb's pristine and methodical excavation, no gold was ever found inside it—there was bronze, iron, and exquisite inlaid furniture, but no gold.

At first glance, the textiles were unimpressive—either degraded clumps or small fragments in which uneven weaving and knots were hardly of regal quality. At high magnification, the fibers were found to be hollow—with no organic material left. What appeared as yarns seemed simply the artifact of a uniform coating, entirely hollow, as seen with SEM/EDS, and composed of iron.

After washing off microbial debris with solvents, an organic infrared spectrum was taken. It matched "Goethite" a gold-colored iron oxide (α -FeOOH), which in turn matched a recently published textile study. Various innovative analytical systems were employed, unsuccessfully, to prove the link between the Tumulus MM textiles and Goethite. The samples were subsequently analyzed with a TerraSpec VIS/NIR spectrometer which gave a definitive peak at 760 nm, in the near infrared, and proved the close similarity of Goethite in the Midas sample, its match to the modern polyester-coated linen, and a known reference spectrum.

Other fragments from the tomb, once thought to be green because of their proximity to the copper and bronze artifacts, have been proved to be composed of indigo and goethite—a sophisticated mixing of organic and inorganic chemistry. The Lydian king buried so long ago reigned over a kingdom filled with very capable scientists and textile technologists.



Three samples of Goethite: (1) on modern polyester (light-yellow background), (2) on modern linen to the right, resting on the modern Polyester, and (3) 800 BC Tumulus MM Goethite sitting on glassine envelope (M. Ballard).

MCI 5927.2 Salish Blanket Fiber Materials

MCI Staff: Caroline Solazzo, Mary W. Ballard, Ron H. Cunningham, Judy Watson, Greg Henkes, Mel J. Wachowiak

This research sought to resolve questions as to source of protein fiber in blended yarn used by the North West Coast Salish tribes in making blankets, a subject of active debate. The research method involved comparison of provenienced dog and mountain goat hair fibers to unknown fibers from provenienced Salish blankets, using a range of analytical techniques including proteomics (MALDI-TOF, peptide sequence comparison). The results will be of interest to North-American archaeologists and ethnologists first as the use or not of dog hair will change or confirm theories about the Coast Salish and shed new light on Native American weaving and archaeology in general. The second interest is for archaeological sciences: proteomics is a recent discipline, being applied to archaeology for the past three years. Its potential is just now beginning to be understood and textile identification can be a huge application for archaeology and conservation. At the same time, it will enlarge the database of provenienced animal fiber sources sequenced by the proteomics methodology. The animal hair used to make a Salish “dog” blanket was found to be goat in at least one instance.



MCI 5959 Research Project on Coatings for Silver

MCI Staff: Carol A. Grissom, Claire Gervais

Sterling silver coupons and glass slides were coated with eight commonly used coating materials and subjected to a high-sulfide environment until the coupons were severely tarnished. Of the coatings tested, Agateen® Air Dry Lacquer #27, Acrysol® WS-24, and PVAc AYAT performed the best, and Renaissance Wax was least effective. The other coatings, including HMG Heat and Waterproof Adhesive, Acryloid® B-72, Acryloid® B-48N, and polyvinyl butyral resins, retarded tarnish to varying degrees. Thickness of the coating was a significant variable in performance. More data was gathered.



MCI 6005 Technical Study of Objects from Tomb 1 Burial in Mongolia
MCI Staff: Harriet (Rae) F. Beaubien, Lynn B. Brostoff, Alaina Schmisser

Previous technical analyses and conservation treatments were carried out by MCI post-graduate conservation fellows during previous years. The excavation of Side B had been completed, Side A was exposed and excavation had been completed on the upper layers, including sampling. Side A was the uppermost surface originally exposed during the excavation of Burial #21 (formerly Burial #23). This project followed the continued excavation strategy of Side A, including documentation, technical analysis using digital X-radiography, and excavation.

MCI 6039.2 Technical Study of the Remains of Painted Organic Objects from the site of El Perú-*Waka'*, Petén, Guatemala

MCI Staff: Harriet (Rae) F. Beaubien, Judy Watson, Lynn B. Brostoff, Mel J. Wachowiak, Fabien Pottier

While objects made of painted wood, gourd and other organic materials were assumed to have been produced and used in ancient Mesoamerica, information about them has largely relied on much later ethnohistorical records dating from the time of European contact and beyond. Archaeologically, these types of objects are rather rare, with find spots almost exclusively in burials where the deposits have been relatively undisturbed. The substrate materials are presumed to have been organic materials because of the totality of their degradation, a condition not surprising in a subtropical environment. When found, these objects survive only as concentrations of paint flakes.

MCI conservation assistance from a burial at the ancient Maya site of El Perú-*Waka'* (Petén, Guatemala) led to a technical study at MCI of selected paint flakes from these objects, along with three others from a second burial. Optical microscopy, SEM-EDS and XRD analyses were carried out on small whole flakes, small samples mounted in cross-section, and scrapings of color to investigate the composition of the various paints, the paint application process, and texture on the back sides that might provide evidence of the disintegrated organic substrate.

Analyses showed that the use of stucco (lime plaster composed of calcium carbonate) as the basis for the preparation layer and pigmented paints. Colors included cinnabar (mercuric sulfide) and to a much lesser extent hematite (iron oxide) for reds, malachite (basic copper carbonate) for green, goethite (iron oxy-hydroxide) for yellow and Maya blue (a lake pigment composed of indigo and palygorskite clay); bone black or charcoal was used for black outlines. A variety of ground or preparation layer types were identified, including white, cream and orange-ish and brown, in both smooth and coarse textures. Some of the ground layer variation may reflect qualities suitable for particular organic substrates, as well as differences in texture found in a single type of substrate, such as the inner and outer surfaces of a gourd.



MCI 6075 Inter-Instrument comparison of Portable XRF Equipment

MCI Staff: Lynn B. Brostoff

MCI led an inter-unit instrument comparison of portable X-ray fluorescence spectrometers at MCI, the National Museum of Natural History - Department of Repatriation, the National Museum of the American Indian, the Freer Gallery of Art and Arthur M. Sackler Gallery, and the Office of Safety, Health and Environmental Management. The comparison explored the limitations of individual instruments and established standard methodologies for their use.

This project comprised a continuing comparison of the application and capability of various XRF instruments. For this analysis, 11 samples of paint on canvas, and 2 canvas samples, were sent to volunteer participants, including MCI, for an XRF workshop on the analysis of pigment organized by the Getty Museum, Los Angeles, CA. The samples provided by GCI were only supplied with numbers, and the results from the various participants were compiled and discussed at the workshop, which took place at the Denver X-ray Conference in August 2008. For this purpose, both the Bruker Tracer III-V handheld XRF and the Innov-X handheld XRF were used and compared.

Both instruments had comparable data in terms of the raw spectra taken at 35 kV and 13-15 μ A, with various filters, for the general identification of paint pigments. The Innov-X appeared to have somewhat better resolution, but the vacuum capability of the Bruker allowed far superior analysis of light elements, taken with settings between 12-15 kV and 12-22 μ A, using different filter combinations. Quantitative values reported by the Innov-X software, using the Soil and LEAP modes, produced inaccurate results, due in part to erroneous normalization to the Compton scattering, as well as matrix effects of heavy metals in the paint films.



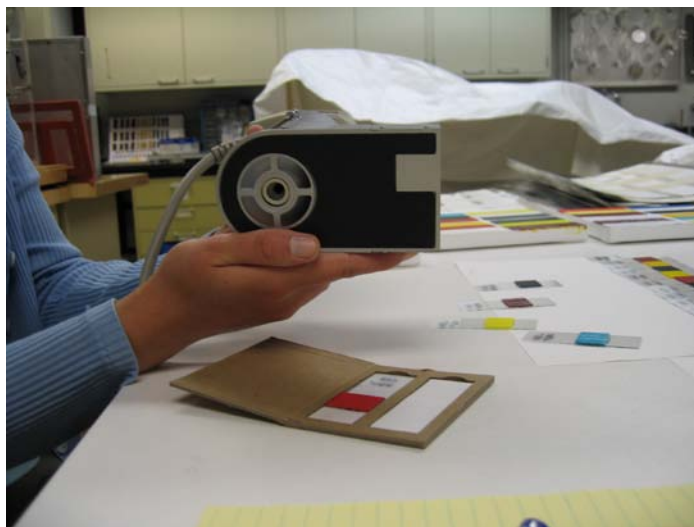
MCI 6076 Research on Modern Art Materials: Paint Samples

MCI Staff: Lynn B. Brostoff, Marion F. Mecklenburg, Ron H. Cunningham, Polonca Ropret, Peter Bythrow

This research was undertaken as part of an international collaborative study into modern art materials aimed at the characterization of selected synthetic organic pigments and paint formulations by XRD with and without aging. The overall aim of the research included: the development of a database of pure synthetic organic pigments, including both X-ray diffraction (XRD) and Raman data; identification of synthetic organic pigments and binder systems in modern works of art; and investigation into the aging effects on some synthetic organic pigments, selected modern binders and modern binder-pigment combinations. MCI had the task of determining the identification of synthetic organic pigments and commercial paint systems by micro-X-ray diffraction (μ XRD), and investigation of possible changes in crystallinity in connection with environmental influences, including temperature, relative humidity and light exposure.

Although it is generally difficult to examine organic materials by XRD, this study indicated that XRD was in many cases an excellent method for the identification of modern synthetic organic pigments in paint formulations. This was due to the tendency for the pigments to crystallize and the specificity of the analytical technique. However, the results were not always straightforward to interpret.

Pigment properties and performance depend primarily on chemical structure, surface properties, crystallinity, and particle size and distribution. It was therefore possible to use XRD not just to identify pigments, but to characterize crystallinity in the pigments, principally in terms of percent crystallinity and through diffraction features such as peak shapes and shifts in peak positions. However, this endeavor calls for improved methodology to eliminate systematic errors that may interfere with interpretation of these features.



MCI 6078 Hunley Silk Bandana Samples

MCI Staff: Mary W. Ballard, Anne-Marei Hacke, Ron H. Cunningham, Odile Madden

Samples of silk from the bandanna found in the H.L. Hunley were evaluated for three potential cleaning techniques: deionized water, citric acid, and oxalic acid. The requestor wanted to know which treatments removed iron from the textile and whether they affected the textile's stability. The treated samples were not differentiated by spot tests, i.e. bathophenanthroline iron test strips. Further analysis by Energy Dispersive Spectroscopy (EDS) provided a clear delineation of the effect of the treatments. The samples were also analyzed by FTIR, Raman spectroscopy, and XRF. The data suggested that the textile remained chemically consistent with modern silk, and that its chemical structure was not altered by any of the three treatments. Cleaning with oxalic acid and citric acid did appear to reduce the presence of some contaminants, which included the elements iron, lead, zinc, copper, and molybdenum. Though the effects of the two acid treatments were very similar, the oxalic acid treatment removed significantly more iron and lead. While the chemistry of the fibers is unchanged, the density of the fibers did appear altered, as seen in both photography and scanning electron microscopy.

As a result of the discussion and analysis the silk bandanna was successfully cleaned in the Warren Lasch Conservation Laboratory. Its treatment process was the subject of a presentation at the Annual Meeting of the American Institute for Conservation Denver Colorado, April 2008.



MCI 6099 10,000 Springs Pavilion Exhibition

MCI Staff: Paula T. DePriest, Jia-sun Tsang, Marion F. Mecklenburg, Mel J. Wachowiak, Donald C. Williams, Ann B. N’Gadi, other staff as needed

An exhibit was produced to showcase the red sandalwood replica of the 10,000 Springs Pavilion. The carved sandalwood architecture model, a 1:5 scale, was a gift from Dr. Chan Laiwa, founder and curator of the China Red Sandalwood Museum. The 10,000 Springs Pavilion was made ready for Lakeview Museum exhibit in Peoria, IL. The exhibit opened in April 2008.



MCI 6112 Investigation of Cyclododecane's Effect on ^{14}C Dating of Archaeological Materials

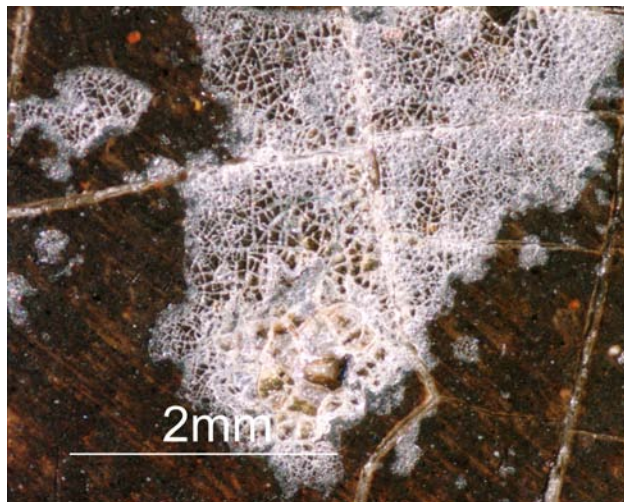
MCI Staff: Harriet (Rae) F. Beaubien, Christie M. Pohl, R. Jeff Speakman, Odile Madden, Lynn B. Brostoff, Walter R. Hopwood, Greg Hodgins (University of Arizona's Accelerated Mass Spectrometry (AMS) Facility)

Cyclododecane (CDD) is used as a temporary consolidant to stabilize fragile objects for transport, excavation, or handling and as a sealant for surfaces during various working processes. Different batches of CDD were chemically examined for compositional variation and for any effect on organic archaeological materials, beginning with its impact on ^{14}C dating. Because CDD's a hydrocarbon, it can contribute carbon isotopes that may confound dating of archaeological materials. Results indicated that CDD temporarily reduced the ratio of ^{14}C to ^{12}C , but as the CDD sublimated off, this effect lessened and eventually the ^{14}C ratio of treated material was not detectably different from untreated (modern) material.

MCI 6121 Modern Picture Varnishes (Isobutyl Methacrylate and N-Butyl Methacrylate)

MCI Staff: Jia-sun Tsang, Walter R. Hopwood

Twentieth-century picture varnish (Synvar, M-varnish, 27-H, B-67, B-72, Lucite 2046, Lucite 2044, F-10, Soluvar matte, Soluvar glossy, B-44) samples were analyzed. These aged methacrylate coatings have been known to cross-link which would make them difficult to remove with solvents or even render them completely insoluble. One of the syndromes of this increasing insolubility is a white bloom. This study focused on building data on fresh and aged samples through solubility studies and Fourier transform infrared spectroscopic analyses.



Under microscope examination, these white bubbles are caused by the lifting of

isobutyl methacrylate coating from the surface of a painting. It gives the appearance of blooming that can be confused with an unwanted biological growth.

MCI 6133 Naturally Aging Conservation Polymers Spectral Reference Collection

MCI Staff: R. Jeff Speakman, Odile Madden, Technical Studies Group

Reference samples of naturally aged conservation polymers which were cast at various times by MCI staff from 1969 to the present were analyzed by Raman spectroscopy and FTIR to build a reference database. The purpose of the database was to observe, document, record, and track natural aging on conservation materials.

MCI 6135 Argon Treatment Using the Anoxic Chambers

MCI Staff: Robert J. Koestler, Mary W. Ballard, Judy Watson, Jennifer Hau, Dan Koestler

A recently acquired collection of costumes for the NMAAHC was anoxically treated with argon gas to eradicate mold and insects. This is a well established procedure, developed by MCI's director, while at the Metropolitan Museum of Art and is used in many museums and collections world-wide.

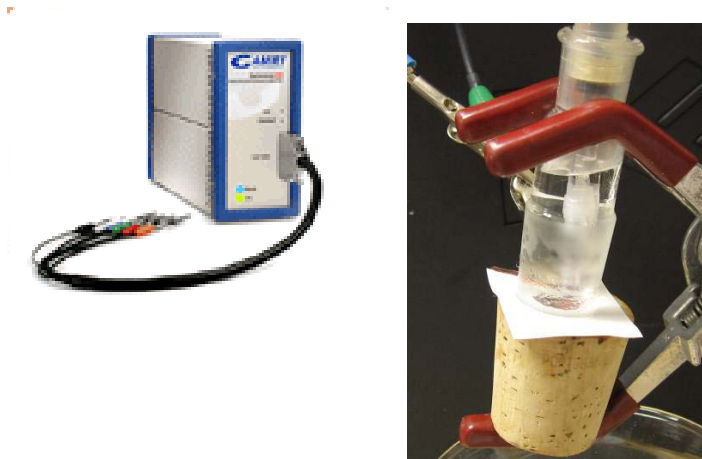


MCI 6140 Testing of Metals Exposed to Fire-Retardant Materials

MCI Staff: Lynn B. Brostoff, Danielle Leikach, Walter R. Hopwood, Odile Madden

This project assessed and further developed new methodology for the testing and evaluation of various fire-retardant materials, which may be used in museums and archival collections. This methodology, using electrochemical exposure and testing to characterize the corrosion of metal coupons (Cu, Ag, Pb) after treatment with the fire-retardant material, has the potential to replace the current conservation procedure, called the Oddy test.

electrochemical testing methodology



MCI 6147 Lumarith (Cellulose Acetate) Color Samples

MCI Staff: Jia-sun Tsang, R. Jeff Speakman, Odile Madden, Tony Maiorana, Walter R. Hopwood, Judy Watson

Objects manufactured from cellulose acetate are one of the most problematic classes of plastics that occur in collections. A 'salesman's kit' of injection molded cellulose acetate coupons, representing a wide range of colors, manufactured by the Celluloid Corporation in the 1920's under the brand name "Lumarith" provided a unique opportunity to study the degradation of three-dimensional cellulose acetate. This particular collection was selected for study because all 49 samples experienced a similar history of use, were manufactured at the same time using the same manufacturing methods, were chained together for almost a century, and were expected to be made of the same polymer and possibly plasticizers with dissimilar colorants and concentrations of plasticizers. The 49 coupons exhibited a range of condition, from seemingly intact to extremely cracked and distorted. The impact of plasticizers on the condition of the coupons turned out to be pivotal. Documentation and analysis of the coupons lent insight to the chemical stability of cellulose acetate objects in general. This understanding may ultimately evolve into methods for early detection and ideally a predictive model to identify objects at high risk of degradation.

As a result of a year-long survey of plastic objects at NMAH, it was determined that the most common plastics in the collections are cellulose nitrate, cellulose acetate, polyvinyl chloride, polyurethane, rubber, and phenol formaldehyde (i.e., Bakelite). These plastics, with the exception of phenol formaldehyde, generally are considered to be "malignant" plastics, given that their deterioration products can adversely affect other materials (e.g., plastics, paper, metal) stored in the immediate vicinity. Clearly, it is of the utmost importance to systematically identify the causes of deterioration for each class of problematic plastic and to identify the best conservation practices for plastic collections as a whole. There is no 'one size fits all' approach to dealing with these materials, as within each major class of plastics the production recipe can vary significantly.



MCI 6153 Oxygen Deprivation via Argon & Its Visible Effects on Prussian Blue & Indigo

MCI Staff: R. Jeff Speakman, Mary W. Ballard, Dan Koestler, Jennifer Hau, Robert J. Koestler, Cathleen Zaret, Tony Maiorana

Prussian blue and indigo painted and dyed onto various commercially-available materials, such as Whatman's #1 filter paper, silk, cotton, and wool were analyzed to determine if treatment of these materials and pigments in an anoxic environment would result in a detectable change in sample color and/or appearance. This project has expanded to include analytical measurements using a microfadeometer system.



MCI 6156 Small Reindeer Figure from Mongolia

MCI Staff: Nino Kalandadze, Tea Kintsurashvili, Carol A. Grissom, Ron H. Cunningham, Walter R. Hopwood, Judy Watson, Lynn B. Brostoff, Odile Madden

A small Mongolian reindeer figurine was examined by visiting Georgian conservators. The reindeer appears to have been molded rather than carved from stone. Dislevels along a line on the top and side surfaces are indicative of the use of a two-part mold. The molded substance is yellowish white in color, coated with a purple "paint" that appears to have been rubbed off most raised surfaces. SEM EDS analysis showed the presence of magnesium, silica, calcium, and sulfur on both purple-coated and unpainted surfaces. FTIR analysis showed spectra with peaks for silica and a carbonate; these are consistent respectively with talc, $Mg_3(Si_4O_{10})(OH)_2$, and calcium carbonate. A carbonyl peak suggested the presence of a natural ester oil, natural ester resin, or natural ester wax. Raman spectroscopy also showed a spectrum similar to talc, as well as a styrene. Together these results suggest that the figurine was molded from a mixture of talc with a smaller component of calcium carbonate mixed with a resin containing styrene. FTIR spectra for a sample of gauzy white water-soluble material from the surface appeared to consist of proteinaceous material with a spectrum similar to gelatin. The purple coating was not identified. The object was almost certainly made in the latter half of the twentieth century because of the styrene component.



MCI 6164 Organic Synthetic Pigments: Phase II

MCI Staff: Lynn B. Brostoff, Polonca Ropret

Synthetic organic pigments and commercial paint samples on glass and canvas were investigated by XRD for identification and characterization of potential changes after aging, as part of the larger study, entitled "Research on Modern Art Materials."

MCI 6167.2 Vani Bronze Torso

MCI Staff: R. Jeff Speakman, Nino Kalandadze, Mel J. Wachowiak, B. Vicky Karas, Harriet (Rae) F. Beaubien, Carol A. Grissom

A cast bronze torso from the archaeological site of Vani, Republic of Georgia, was scanned by MCI conservators and 3-D imaging specialists in the collections storeroom of the Smithsonian's Freer/Sackler Galleries. The sculpture was on loan from the Republic of Georgia to the Smithsonian's Sackler Gallery of Art for the exhibition *Wine, Worship and Sacrifice: The Golden Graves of Ancient Vani* (December 2007-March 2008). 3-D digitization of the sculpture was carried out to provide high quality and metrologically precise archival documentation of the artifact.



MCI 6167.3 Vani Glass Cup

MCI Staff: R. Jeff Speakman, Tea Kintsurashvili, Judy Watson, Nicole C. Little

Fragments from five core-formed glass amphorae in the Vani collection were analyzed by laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) and scanning electron microscopy coupled to an energy dispersive spectrometer (SEM-EDS). Samples were obtained from objects on loan from the Republic of Georgia for the exhibition *Wine, Worship and Sacrifice: The Golden Graves of Ancient Vani* at the Sackler Gallery. LA-ICP-MS and SEM-EDS were used for this study to determine both the surface characteristics as well as the major colorants used in the manufacture of the glass vessels. In addition to determining the major colorants used, generated data suggest that three of the objects are consistent with previously analyzed Hellenistic glass. The remaining two objects appear unique in composition, especially on the basis of rare earth elements, suggesting a secondary production locale.



MCI 6167.4 Vani Gold Buckles

MCI Staff: R. Jeff Speakman, Nino Kalandadze, Ron H. Cunningham, Judy Watson, Nicole C. Little

Two gold buckles and three fragments from the archaeological site of Vani in the Republic of Georgia were analyzed and imaged using XRF and SEM-EDS. The buckles were part of a loan from the National Museum of Georgia for the exhibition *Wine, Worship and Sacrifice: The Golden Graves of Ancient Vani* at the Sackler Gallery. The examinations were done in conjunction with additional analyses performed at the Freer's conservation laboratory. Both buckles are chemically distinct; the three fragments are chemically consistent with the composition of the second buckle.



MCI 6172 Spanish Colonial Glazed Pottery

MCI Staff: Javier Iñáñez, R. Jeff Speakman, Nicole C. Little, Judy Watson, Lynn B. Brostoff, Odile Madden

This research project focused on the technological characterization of colonial pottery dating from the 16th to 17th centuries, such as majolica ware and glazed utilitarian pottery, produced in Latin America, and the impact of those technologies on the Native American pottery.

Majolica and glazed pottery exports were very important European trade items during the colonial period. It is historically and archaeologically known that other kinds of glazed pottery played an important role, not only as part of the cargoes in the ships, but also in the way of life of these societies. A deep knowledge of these two kinds of pottery is vital for a better understanding of trade and especially colonization including acculturation processes of the autochthonous societies under the colonial impact. The identification of differences between autochthonous and colonial ceramics helped to determine social and cultural features of the acculturation process.

This project provided an important step in understanding colonial pottery in the Americas. Moreover, it represented one of the first attempts to assess acculturation processes in North American autochthonous societies through the study of ceramic materials using archaeometric techniques. In addition, this work represented an important achievement on the knowledge of ancient technology pottery of this historical period. Finally, this project represented a combination of analytical techniques and anthropological studies to deepen the understanding of the colonial impact and acculturation processes.

MCI 6187 Salts in Ceramics: Developing a Standard to Serve as a Tell-Tale in Storage Units

MCI Staff: Carol A. Grissom, R. Jeff Speakman, A.E. Charola, Walter R. Hopwood, Marion F. Mecklenburg

This project resulted in the development of a tell-tale standard that would show a visible signal when relative humidity falls below a given threshold. It was envisioned that new ceramic bodies impregnated with highly deliquescent salts could be placed in small containers on shelves alongside ceramic sherds in storage units. Crystallization of salts or evidence of their deliquescence (moisture, rings) would give an early warning or testimony of low humidity.

The present experiment was meant as a test run to determine which salt might be best employed for further testing. Advantageous qualities selected for were rapid crystallization, high visibility, and ease of analysis of the salt. More extensive testing using the optimal salt in cycling chambers was anticipated afterward.

MCI 6197 Characterization of Iron-Oxide Pigments

MCI Staff: Lynn B. Brostoff, Fabien Pottier, Judy Watson

The goal of this project was to obtain a better general understanding of the composition and structure of iron oxide-based pigments, as typically encountered in works of art and historic artifacts, and to optimize the analytical processes for their characterization, especially by XRD. The first step was to analyze pure commercial pigments and other references, via different techniques, and compare the results to literature and other published databases. This gave information about the amount of iron oxides, their crystallinity level, and their nature. It also permitted characterization of the whole matrices in which iron oxide pigments are typically found. Once the best conditions and instrumental parameters were determined, and the pigments were well characterized, the next step was to use these methods to analyze more complex samples such as rocks, hand-made artist pigments, as well as paint flakes and pottery sherds and to apply these analyses to conservations issues.

Iron oxides are a widely used family of pigments since ancient times, partly due to their availability in geological formations everywhere in the world. They can also be prepared simply by grinding, without complex processes. Therefore, they are very common in artists' materials. Identification of pigments and other artists' materials allow us to better understand artists' practices, as well as to understand the history of art technologies.

XRD is a useful method to analyze solid, crystalline samples, since the technique yields information about the specific identity of the materials. However, iron oxides are not always very well crystallized, and therefore can be difficult to analyze by XRD. In addition, this method is subject to interferences, since common compounds such as quartz, calcite and gypsum, which are often present in natural and synthetic pigments, are very good X - ray scatterers and may overwhelm the patterns and/or overlap with peaks from the material of interest. Therefore it is important to fully understand the composition of the whole potential matrices, as well as to determine the capabilities of this method.

MCI 6201 Distinguishing Reindeer Antler from Bone Using Raman Spectroscopy

MCI Staff: Judy Watson

This project was designed to determine whether it is possible to distinguish between modern antler and bone using FT-Raman spectroscopy. The ultimate goal of this project was to develop this method to provide a non-destructive way to confidently discriminate between antler and bone in archaeological objects. This technique would have applications within the Smithsonian's collections as well as anywhere this very common material is curated or conserved.

Distinguishing between reindeer antler and bone can often be challenging as they are essentially the same material, with antler being morphologically similar to rapidly formed bone. Determination can be aided by observation of function, macrostructure, texture, color, shape, and size of an object. Adding to the challenge is the fact that archaeological objects have often been modified, either in the manufacture of the object, or in the burial environment, or both. Accurate determination is important to archaeologists, anthropologists, ethnographers, and others because it provides information about a wide range of areas including resource management, material preferences, economy, exchange and ritual behavior.

Raman spectroscopy is a non-destructive analytical technique that has been demonstrated to be of value in distinguishing between keratinaceous material from different species (as well as identifying imitation materials). Recent research has shown that it is possible to distinguish between human finger- and toe-nails using Raman spectroscopy, most probably as a result of the fact that fingernails grow more quickly. If collagens behave similarly (i.e. if the more rapid formation of antler as compared to bone results in a difference that is reflected in Raman spectra), this would offer archaeologists a non-destructive method of accurately classifying this important material regardless of the size or nature of the artifact. The results of a study testing the applicability of this approach on collagens, using vouchered samples of modern reindeer (*Rangifer tarandus tarandus*) antler and bone were presented.



Human figurine carved in reindeer antler or bone. From Advik, Finnmark, Northern Norway (2200-1800 BC). Photo: A. Icgic, Tromsø University Museum.

MCI 6202 Non-Destructive and Minimally Invasive Analytical Approaches Applied to Modern and Contemporary Paintings Conservation

MCI Staff: Jia-sun Tsang, Maria Melendez, R. Jeff Speakman, Mel J. Wachowiak, Odile Madden

The objectives of the research project were to provide non-destructive instrumental analysis to characterize the mixed media in modern and contemporary art.

Systematic study included: literature review of non-destructive and minimally invasive analytical approaches used in conservation science; training and orientation with non-destructive and minimally invasive analytical methods and instrumental available at MCI; analyses of conservation and artists painting materials; and, analysis on contemporary paintings in Smithsonian collections.

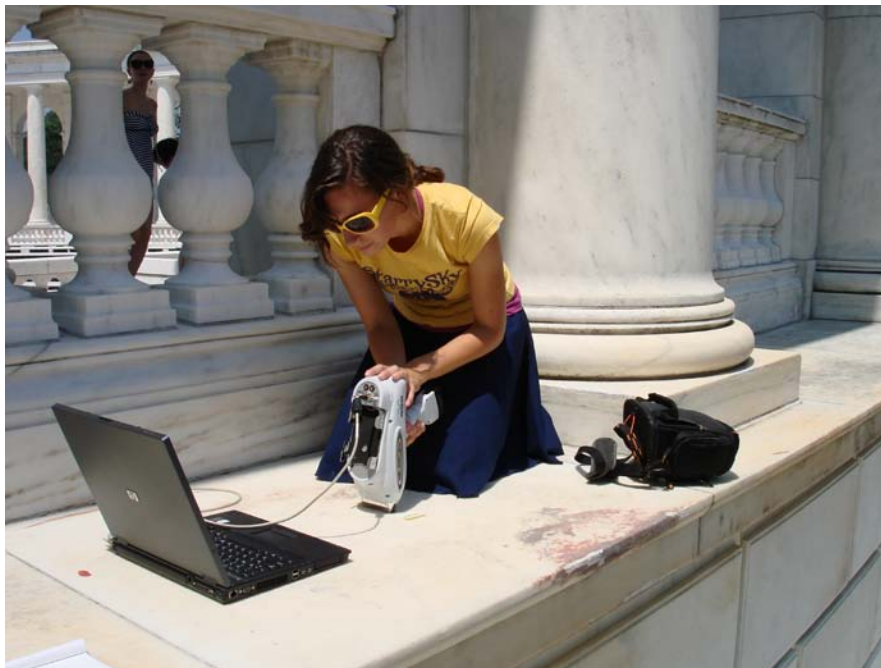
Paint samples were prepared in a single component, a mixture, and layers to test the limits and sensitivity of the instruments. Documentation of the drying properties of each preparation for one component, mounted on glass slides and prepared canvas by visual observation, digital imaging, gloss measurement, thickness (shrinkage).



MCI 6205 Arlington Cemetery's Memorial Amphitheater

MCI Staff: Carol A. Grissom, Claire Gervais, Paula T. DePriest, Robert J. Koestler, Fabien Pottier, Judy Watson, R. Jeff Speakman, Elyse Canosa, Colby Phillips, Odile Madden

Red "staining" on the marble of the Arlington Cemetery's Memorial Amphitheater was analyzed to determine possible remedies for the removal of the "staining."



MCI 6206 Morphological Comparison of Alcohol and Formalin Preparation to 3M Novec Fluids

MCI Staff: Mel J. Wachowiak, Paula T. DePriest

The purpose of the analysis was to determine if the Novec fluids provided tissue preservation that was at least as good as the traditional formalin or alcohol methods. Earthworm tissues stored in various fluids: formalin, alcohol, and 3M Novec were prepared by microtomy, stained for light microscopical examination, and documented. Formalin fixed tissue subsequently stored in Novec was at least as good as alcohol preserved tissue after one year of storage in each solution.

MCI 6207 Cleaning of Marble with Ammonium Citrate

MCI Staff: Claire Gervais, Carol A. Grissom, Nicole C. Little, Ron H. Cunningham, Mel J. Wachowiak

This study focused on cleaning marble with ammonium citrate, a product often used with success by conservators, but for which almost no critical evaluation can be found in the literature. A systematically investigate was conducted to better understand its action on the surface and establish –if possible- the optimal conditions of utilization of this cleaning agent. In particular, the solubility of calcite (the main component of marble) as well as its kinetics of dissolution in solutions of ammonium citrate at different pH and different concentrations were established. The impact on marble surface was monitored by characterizing the surface of polished marble tiles before and after application, by means of several techniques (e.g., gloss measurements, micro-drop experiments, scanning electron microscopy, and 3-D scanning), In a final step, the optimized solution (formulation and mode of application determined by previous analyses) was applied on weathered/dirty marble statues or fragments.



MCI 6210 Saturn V Rockets

MCI Staff: Ray Barnett, Carol A. Grissom, Odile Madden

The three remaining Saturn V rockets were treated for display in recent years. This investigation relied on reports generated by those who treated the rockets, curatorial files at NASM, and MCI files. Information about these treatments and their history were collated, and the methods and techniques used in the stabilization, restoration, and preservation were analyzed and compared. In particular, the investigation focused on corrosion of the exotic aluminum and other metal alloys; removal of flora and fauna infestations; preservation of rubber, plastic, Mylar, and other organic materials used in the rockets' construction; and retention of original paint and decal schemes. The information collated was the basis for treatment evaluation.



MCI 6211 Studying the Effects of Light on Sensitive Museum Objects and Materials and the Application of Research Results in Setting Lighting Levels in Museums

MCI Staff: Julio del Hoyo, Marion F. Mecklenburg, Mel J. Wachowiak

This research studied the environmental conditions in which collections are stored or exhibited. Environmental conditions normally include ambient temperature, relative humidity, air quality and filtration, and illumination levels. This study specifically addressed measurement and calibration of illumination levels in the newly renovated Old Patent Office Building (POB), now called the Donald W. Reynolds Center for American Art and Portraiture (DWRC), which is the repository for the collections of the Smithsonian American Art Museum (SAAM) and the National Portrait Gallery (NPG). With the recently completed renovation, numerous windows and skylights were re-opened raising light levels in the DWRC. This study is evaluating the new light levels to ensure the safety of the collections. Coincident with measuring light levels, research is being conducted to determine the fading rates of sensitive objects and materials in the collections. The combination of data will help set the most appropriate light levels for display objects.



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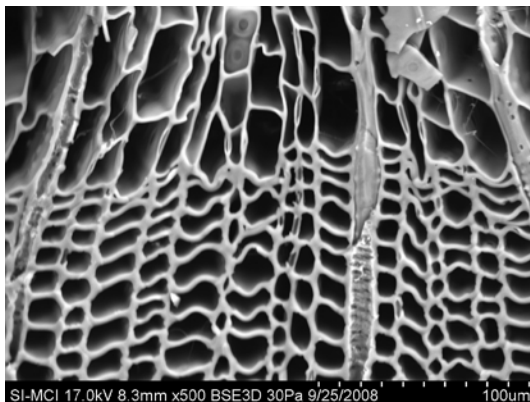
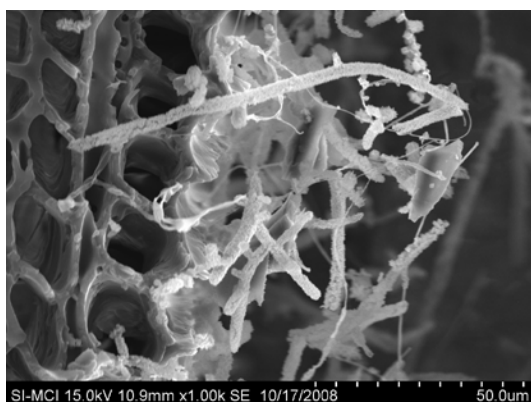
MCI 6212 Investigation of Microorganisms and Composition of Archaeological Wood Charcoal

MCI Staff: Magdalena Moskal, Robert J. Koestler, Mel J. Wachowiak, Judy Watson

Anthracology is an archaeobotanical discipline that investigates the remains of wood charcoal coming from archaeological excavations with the purpose of gaining palaeoenvironmental and palaeoethnographical information. Fungi, bacteria, and other organisms are responsible for degradation processes of living and dead organic matter in almost all environments, and their action can cause the loss of cultural heritage. Charcoal coming from archaeological excavations show evidence of microbial/insect attack at different times and places: a) in natural environments before being used by humans; b) in the archaeological site—from the formation of the site to its excavation; or c) in the archaeological museum or other storage place. The initial moment when the contamination and attack took place is difficult to establish. This project sought to identify the organisms on or within the botanical specimens, which may be fungi, bacteria, Acari, Nematoda, xylophagous insects, etc. The identification of these organisms can help to determine the initial moment of their attack and whether that attack was before or after burning. This in turn may help test the hypothesis that dead-wood was used as fuel-wood.

Anthracology investigates the remains of wood charcoal that comes from different archaeological contexts. The charcoal conserves the anatomical structure of the wood and may permit its botanical identification. The rank of identification (species, genera, family, etc.) depends on the size, anatomical characteristics of the wood and the state of preservation of the charcoal. Charcoal fragments are examined microscopically in the laboratory for botanical determination.

The study of the microorganisms found in wood charcoal could demonstrate the possible gathering mode for dead wood used as fuel-wood. Once identified, it may be possible to know when the wood became infected because the taxa found in the charcoal might be specifically associated with pre- or post-burning time-of-attack.



MCI 6220 Archaeological Obsidian from the Kuril Islands, Russian Far East
MCI Staff: S. Colby Phillips, R. Jeff Speakman, Nicole C. Little

The directions and distances associated with the exchange of lithic raw materials can provide insight into the social organization of widely dispersed hunter-gatherer groups. In order to infer network patterns of transport and trade from the archaeological distribution of obsidian across a region, it is necessary to determine the geographic and geologic source of the obsidian material. X-ray fluorescence (XRF) and laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) are two chemistry-based analytical approaches for matching obsidian artifacts to their geologic sources that are available at the Smithsonian Institution's Museum Conservation Institute.

New data from the Kuril Biocomplexity Project (KBP), specifically the recovery of nonlocal obsidian, can be used to test these conclusions as well as develop new hypotheses about the procurement, consumption, and roles of non-local raw material in the Kuril Islands. During the 2006 and 2007 KBP field season, more than 950 obsidian artifacts were recovered from 16 sites on 8 islands across the Kuril archipelago from contexts spanning at least 2,500 years, suggesting a wide-ranging distribution of obsidian throughout the island chain. While the Kurillithic assemblage includes a number of different raw materials, the presence of obsidian is important in regards to research on Kurillithic technology. Obsidian can be flaked predictably and to create extremely sharp edges, though the edges dull quickly with use and need frequent re-sharpening or replacement. Currently no sources of obsidian native to the Kuril Islands are known to have been used prehistorically.

Because obsidian can be matched to its geologic source with a high degree of reliability based on elemental analysis, chemistry-based approaches can be utilized to address issues such as raw material procurement, transport and exchange, networking, and social identity.

These analyses are crucial for understanding the geographic and geologic sources of obsidian that were utilized in the Kuril Islands, and provide a foundation for inferring social affiliation networks based on the transport and/or trade of obsidian throughout the island chain over a period of several thousand years.

Additionally, compared with Hokkaido to the south and Kamchatka to the north, relatively little archaeological research has been conducted in the Kuril Islands. Recent archaeological work in the Kuril Islands as part of the Kuril Biocomplexity Project (KBP) in 2006 and 2007 provides the means to synthesize the archaeology of the entire island chain into a coherent regional framework for the first time. Obsidian exchange networks have been identified in Japan, Sakhalin Island, Kamchatka, and mainland areas of the Russian Far East, and while non-local obsidian has been recovered from the Kuril Islands, there is currently an overall lack of obsidian source reference data for this region. The research proposed will create a significant database of source characterizations for the Kurils, and would complement the ongoing research that the Smithsonian Institution is conducting in this region of the world.

MCI 6221 African Ivory: Bioarchaeological Study: Tracing the Links Between Elephants, Humans, and Land Use During the 19th Century East African Caravan Trade

MCI Staff: Ashley N. Coutu, R. Jeff Speakman, Greg Henkes

This research project aims to determine the geographical origins (i.e., source) of ivory traded along 19th century caravan routes in East Africa. Isotopic analysis of historical ivory coupled with the analysis of historical records will be the main tools used to solve this problem. In order to carry out isotopic analysis, it is necessary to sample and analyze historic ivory with a known provenance, which will include material in the Natural History Museum collection.

The project aims to examine impacts of the East African ivory trade, which reached its peak in the mid 19th century, through the use of stable isotope analysis of historic elephants (bone, teeth, tusk). Isotope analysis of elephant remains will provide a historic proxy of what the elephant was eating (carbon isotopes), what type of climate it lived in (oxygen/nitrogen isotopes), and where it lived (strontium isotopes) in order to build up a database of where elephants were exploited. Samples from East African (Kenya, Tanzania, Uganda) elephants from the 19th and 20th century from NMNH are extremely important for this project, as this material has dates and provenance, and thus will provide a baseline for the samples in my project, namely unprovenanced antique worked ivory that was traded in the commercial market (cutlery material from Sheffield, UK, for example). In order to understand and trace this commercial trade, historic baseline data must be known before sampling of unknown ivory specimens can begin, and the Smithsonian has one of the only collections worldwide of this historic material. In order to further understand the carbon isotopes and the browser and grazer dynamic in elephants, animals from East Africa known to be browsers or grazers will need to be sampled in order to provide a standard for the carbon isotope values found for the historic elephant populations. Therefore, stable isotope analysis of the remains of hippopotamus, giraffe, zebra, and wildebeest specimens will provide the necessary data in order to understand the browse/graze dynamic in historic elephant populations, in comparison with known browsers and grazers living in the same area at the same time period.

This project, whilst providing further information about specimens in the NMNH collection, will also add to the current knowledge of elephant diet and migration patterns in recent history. Specifically, isotope ratios of elephants in the NMNH collection will be used as a baseline to source unprovenanced worked ivory from East Africa involved in the larger research on the 19th century ivory trade.

MCI 6226 Evaluation of the Effects Caused by the Use of PVAc in Lined Modern Posters

MCI Staff: Cristina Ruiz Recasens, Marion F. Mecklenburg, Dawn Rogala, Odile Madden, Tony Maiorana, Judy Watson

This project sought to determine the effects and consequences caused by the use of poly(vinyl acetate) (PVAc) in lining modern posters. The study focused on a widespread lining method developed in Spain from 1960 to 1980 which used PVAc emulsions as adhesive and cotton fabric as a secondary support. The research project evaluated the actual state of conservation of original works that have been lined with PVAc and proposed the prediction of future effects of these previous treatments in order to consider palliative treatments that guarantee conservation conditions.

The research project developed at MCI intends to provide knowledge in PVAc emulsion adhesives, in the interactions between these adhesives and paper supports and the effects of these interactions in the original lined paper works. Therefore, the work of this project has been done in three major areas:

- *Basic characteristics of 3 PVAc emulsions.* Three PVAc emulsions were selected among the most used in Spain (in different times and circumstances) for conservation purposes. The main issues of these areas of study have been (1) composition, (2) structure, (3) volatile emissions, (4) mechanical properties, and (5) aging behavior of the 3 selected adhesives.
- *Effects of the PVAc emulsions on paper support.* The effects of the 3 selected PVAc emulsions in two different kinds of paper supports were tested. These paper supports were also studied without PVAc in order to be able to attribute differences caused by the presence of the adhesives. The aim of this area of the study was to understand the interaction of the PVAc with paper. The project studied (1) changes in paper characteristics caused by the adhesive, and (2) aging of both PVAc and paper when being together in contact,
- *Effects on original paper works.* The work of this part of the study was developed by comparing paired samples from identical posters, one of them lined and the other one with no previous conservation treatment. This goal was to understand (1) changes in the original works characteristics and (2) effects on their state of conservation caused by linings with PVAc emulsion as adhesive and cotton fabric as secondary support.

National Air & Space Museum

MCI 6073 WWI Balloon Basket

MCI Staff: Mel J. Wachowiak, Marion F. Mecklenburg, Alaina Schmisser

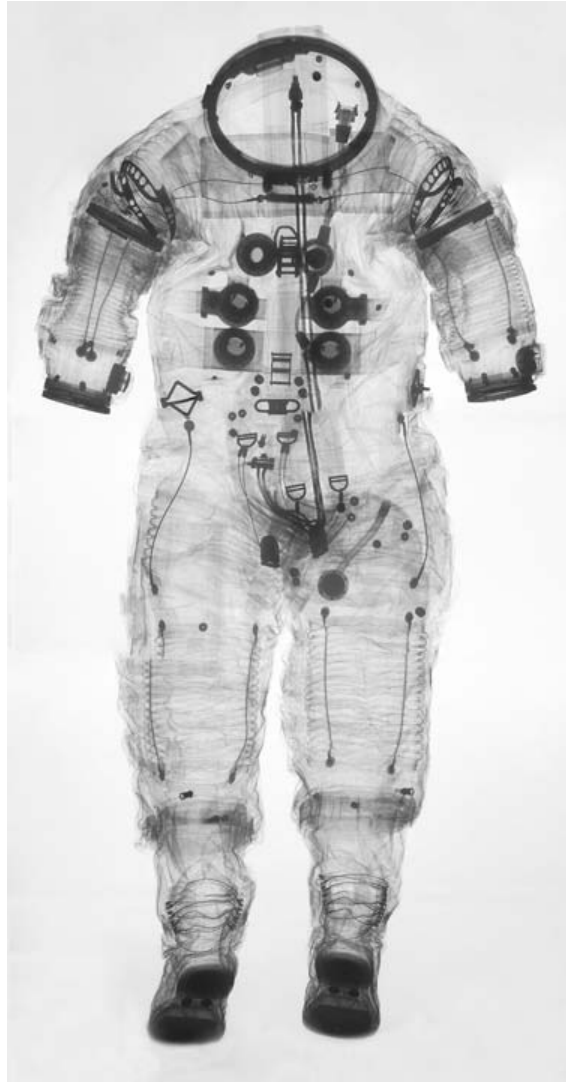
The U.S. Marine Corps World War I balloon basket made of wicker and hemp was examined and recommendations for treatment to prepare the basket for an upcoming exhibit were given. The wicker basket was deformed and needed to be reshaped and supported.



MCI 6079 Apollo Spacesuit Dust Research

MCI Staff: Mary W. Ballard, Mel J. Wachowiak, Lynn B. Brostoff, Ron H. Cunningham

Apollo spacesuits of Teflon and Teflon-coated fiberglass textiles from the late 1960s and early 1970s were examined close-up with scanning electron microscopy for imagery of the textiles and the associated embedded dust from the lunar surface. NASA is researching the effects of the lunar soil on the textiles of the spacesuits, especially the level of abrading and damage to the textiles as a result of this close association. Research will be applied to the design and construction of future spacesuits.



MCI 6082 Heinkel He219 A German WWII Aircraft Wing

MCI Staff: Jia-sun Tsang, Lynn B. Brostoff, Walter R. Hopwood, Julio del Hoyo, Marion F. Mecklenburg, Mel J. Wachowiak, Judy Watson, Tony Maiorana, Rebecca Giesecking

The purpose of the analysis was to determine if original German WWII aircraft paint remains, as well as its identity.

ATR-FT-IR spectra obtained from different surfaces of the paint samples, as well as the acetone extract residue, indicate that the paint medium is a cellulose-nitrate based formulation that most likely contains other unresolved additives. Pigments were not identified by IR.

The Heinkel He219A aircraft is part of NASM's collection. Outdoor storage of this aircraft has resulted in prolonged exposure to sunlight. As a result, alterations to the original paint colors have occurred. There is an area on one of the flaps that was protected from solar radiation and has been used as an approximated reference of the original paint. This assumption was based on both the color of the paint relative to other areas which have been exposed to light and also on the way the flap was assembled indicating that the edge was protected from sunlight. The surface has several layers of paint but the interest was to test the pale blue paint in order to understand its discoloration process.



MCI 6111 Metal Plating on Steel Hub

MCI Staff: Lynn B. Brostoff

The die-cut carbon steel hub for a Curtiss Junior aircraft propeller was analyzed by XRF for possible original plating, plus identification of secondary metals present. The analysis aided the decision process in the current restoration of the aircraft, specifically with regard to replating of the hub.

Results showed that the steel alloy making up the hub is a carbon steel, approximately 99.5% Fe, with minor amounts of Mn, as well as trace amounts of Cu. The abraded or slightly rusty-looking side of the hub produced similar results, with the exception of detection of trace amounts of Cr and Zn. These results were confirmed by visual inspection of the XRF spectra. Comparison of spectra taken in different modes from the hole edge, both at an angle and flush, do not show any convincing evidence for the presence of any additional metals, including Cd, which would indicate that the hub had previously been plated.

MCI 6116 Herschel Telescope Tube

MCI Staff: Mel J. Wachowiak

The 20 foot long wooden telescope tube was examined to determine if the condition had changed due to fluctuation in the ambient relative humidity. NASM conservators noted that the crack monitoring “telltale” gage indicated that the pre-existing crack had opened several millimeters. Examination of the hygrothermograph records showed that the relative humidity fluctuated below recommended levels. However, the wood of the tube is quite thick. So while the conditions were too dry, the wood surface would be affected more than the core. In fact, the paint would be the most affected component. No recent loss of paint was noted at the juncture of metal bands and fasteners, the most susceptible areas. The conclusion was that the gage had slipped and so the reading was erroneous.



MCI 6137 Grumman XF8F-1 Model Interior Weights

MCI Staff: Mary W. Ballard, Carol A. Grissom, Walter R. Hopwood

Bags of weights inside a model plane scheduled for display at the Udvar Hazy Center were examined for discoloration and incipient corrosion on their fabric covers. The fabric, corrosion and discoloration were analyzed using Fourier transform infrared spectroscopy. MCI and SIA conservators provided advice regarding the long-term storage options and provided treatment materials for prophylactic storage in place.



MCI 6149 1854 Trippe Globe

MCI Staff: Mel J. Wachowiak, Jia-sun Tsang, R. Jeff Speakman

This terrestrial globe on a floor stand was treated and restored by a team of conservators from MCI and NASM, and materials analyzed by MCI chemists. The globe date is 1844 or 1854; the date is obscured but can be deduced by national boundaries. The globe is nearly three feet in diameter and is over four feet tall on the oak stand. The hand-colored paper map sections, called gores, are adhered to a *papier mache* sphere. A brass meridian ring allows the globe to rotate on its axis and longitudinally; therefore, all parts of the globe can be seen.

MCI conducted XRF analysis of the metal hardware supporting the globe. The analysis demonstrated that all hardware is essentially the same composition, except for the base bearing post, which may be a replacement. The meridian ring, screws, and the base bearing post for the meridian were zinc-bronze. The base bearing post is iron with apparent traces of plating or gilding. FTIR characterized some samples of coatings. Shellac was the principle component of both the dark upper layer as well as the lower layer.

The globe is featured in the exhibit *America by Air*, as well as the online exhibit, which opened November 17, 2007 at the National Air and Space Museum. According to exhibit text, Pan American president Juan T. Trippe used this globe to plan his airline's expansion around the world.



MCI 6157 Structural Load Spreader

MCI Staff: Marion F. Mecklenburg, Paul Dorn

A safe load carrying capacity for a steel beam was determined. Bridle cables should be used and attached to each end of the support beam. This system will be able to handle a larger load than if a cable was attached at the center of the support beam. There are limiting factors using the bridle cable system and the load may increase if the angle between the bridle and the beam is varied. The type of wire cable used in this system is extremely important. It is important that the strength and dimensions of the cables be known so that they will not fail under these recommendations.

MCI 6168 Satellite Deterioration Products: Satellite S-46 and Vanguard I

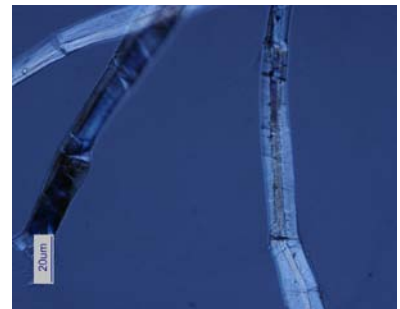
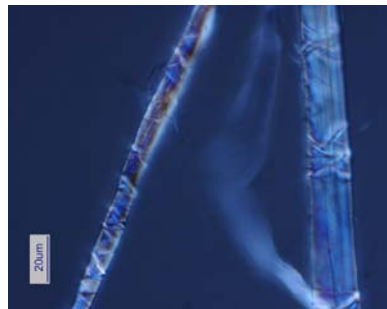
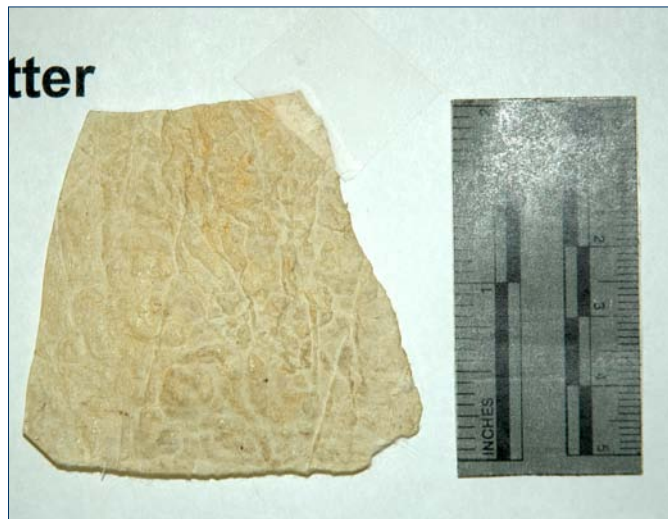
MCI Staff: R. Jeff Speakman, Walter R. Hopwood, Judy Watson, Lynn B. Brostoff, Carol A. Grissom

Samples of the deterioration products on the synthetic/composite materials of the satellites were identified to establish and better understand the nature of the material's composition to guide a treatment protocol. The corrosion is severe, and treatment should be undertaken as soon as possible to prevent further damage; there is a possibility that some residues may be toxic.

MCI 6184 Possible WWII Fu-Go Balloon Bomb Fragment

MCI Staff: Mary W. Ballard, Mel J. Wachowiak, Lynn B. Brostoff, R. Jeff Speakman, Judy Watson, Ann B. N'Gadi

NASM working in conjunction with the television show "The History Detectives" sought the expertise of MCI in identifying a small piece of laminated paper said to have been taken from a "Fu-Go Incendiary War Balloon" launched from Japan towards the U.S. mainland in 1944-1945. In the MCI files was a sample from NASM of such a balloon. This sample was compared to that provided by the History Detectives. The paper, its quality, characteristics, and laminar nature of the new sample were consistent with the sample belonging to the NASM balloon. On February 15, 2008 Jeff Speakman acted as spokesman for MCI in delivering the report to the History Detectives.



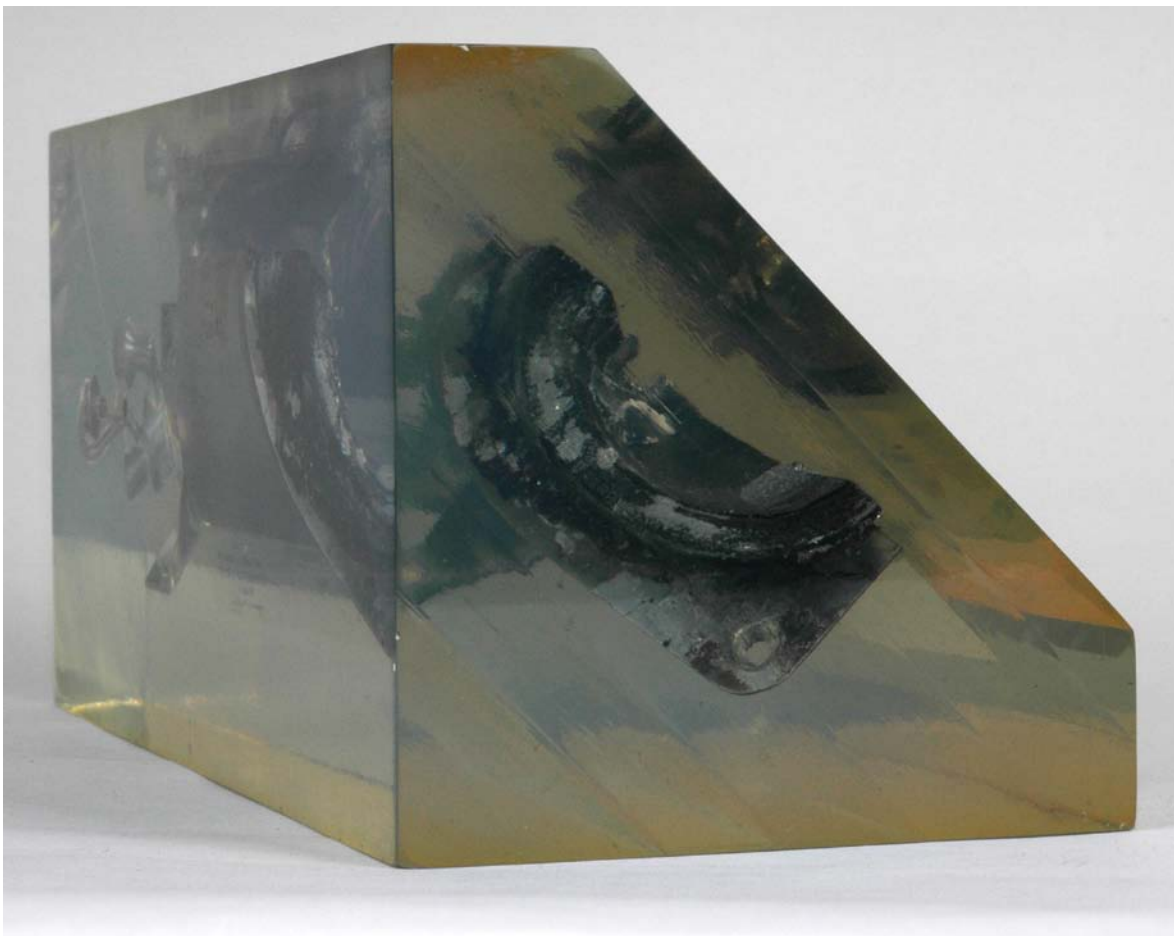
On the left are fibers from the Smithsonian's sample from NASM, on the right, fibers from the sample procured by the "History Detectives."

MCI 6219 Gemini 8 Thruster Resin

MCI Staff: Jia-sun Tsang, Judy Watson, R. Jeff Speakman

The cast resin was analyzed to determine if it contained sulfur compounds or other compounds harmful to the artifact materials. The results were used to evaluate whether the cast resin should be removed from the artifact.

The artifact, a nozzle section from Gemini 8, is considered a piece of space history. In the 1970s, it was mounted in a Lucite-like resin as a paperweight. Silver items set in similar Lucite-like resins were found to be darkening. While Lucite is not reported to contain sulfur, information from manufacturers indicates that some may contain sulfur. Removal of the object from the resin may be desirable if the resin is found to contain destabilizing ingredients.



MCI 6228 Marine Flare

MCI Staff: Ron H. Cunningham, Donald C. Williams

The object is a flare that has been selected for display in the *Interwar Military Exhibit*. No NASM records have yet been located that would indicate whether the flare is inert and/or deactivated. Additionally, there is no tag on the object or in the box that indicates the status of the flare. The flare is a marine floatlight that was designed for use in water. The flare has a wooden body that would likely be filled with some flammable material. It is weighted on one end to keep the flare side out of the water. The end that would have stayed out of the water is sealed with wax. Given that the wax visually appears to be old, it could be original. There are two cracks that appear to have been glued. It is not possible to tell if the flare had been opened. Radiography was used to determine if the flare side of the canister is empty and safe for display without opening the object. The flare was found to be empty and safe.



National Museum of African Art

MCI 6146 Skin Covered Masks from the Cross River Region of Nigeria and Cameroon

MCI Staff: Carol A. Grissom, Harriet (Rae) F. Beaubien, Judy Watson, Lynn B. Brostoff, Walter R. Hopwood, R. Jeff Speakman, Ron H. Cunningham

Analyses were done for a technical study of skin-covered African masks in the collection. The masks consist of carved wood covered with skin (probably from an antelope) and decorated with hair, bone, metal, plant fiber, pigment, and/or dye. Some contemporary accounts describe materials used to make these unusual sculptures, but to date no analyses had been done of artifacts from older collections. One of the goals of the project was to determine if the maker's use of specific materials could assist with provenancing.

XRF and XRD analyses proved successful in identifying some materials. They confirmed use of mainly bone and teeth to represent teeth. Mostly lead but also iron, lead & iron (possibly from an attachment nail), and tinned iron were used for the eyes. Iron-based pigments were mainly identified in red, brown, and black decoration; zinc together with barium (lithipone?), white lead, and probably chalk in white decoration; hematite in red paint on one mask; and possibly yellow chromate in yellow decoration on another. Black pigments probably consist of carbon black, but this was not confirmed. One mask was notable for the probable use of two modern pigments. Skin, hair, and exposed wood also showed minor and trace amounts of lead, bromine, and arsenic, elements associated with pesticide treatment. High amounts of strontium and associated elements were found in the wooden substrates, most likely related to the region of origin.

Plant fibers and hair were imaged at high magnification using a SEM. It is anticipated that these images will be used by botanists and other specialists to assist with identification. Using energy dispersive X-ray analysis, it was determined that a white powder found on the eye of one mask contained substantial amounts of barium, lead, and zinc, which are common components of white paint.

Nearly all FTIR samples exhibited proteinaceous spectra, which tended to overwhelm spectra of other components. Nonetheless, spectra similar to natural ester resins were suggested in nearly half of the samples, probably from pigment binders. More than half of the spectra showed peaks typical for silica and silicates; some of these spectra also had peaks typical of clay minerals like kaolinite.



Efe Mask, NMAfA 2005-006.019

MCI 6180 Benin Ivory Tusk
MCI Staff: Lynn B. Brostoff

FTIR analysis of surface dirt was performed to determine if there was a significant organic component and, if possible, to identify any detectable organics.

Non-indigenous surface dirt on the object appears to be effectively removed with ethanol, leaving a slight stickiness, whereas cleaning with distilled water/ethanol is usually most effective. This led to the inquiry as to the nature of the surface dirt deposits. Examination of the tusk under UV light did not indicate a residual indigenous coating or Western applied surface coating, though the literature suggests that either, on similar objects, is possible. Confirmation of an organic component of the dirt, with possible identification of any substances present, will facilitate cleaning/removal of non-indigenous dirt and grime, in preparation for NMAfA *TREASURES 2* Exhibition (15 April-5 Sept. 2008).

Overall, results of this analysis confirmed the conservator's suspicions that the dirt and grime, which were concentrated on the inside curve of the tusk, were Western in origin, and related to the addition of a resinous coating. The slight blanching produced by acetone during the conservator's cleaning tests were also consistent with the presence of an additional wax layer, although evidence for a wax component was inconclusive.

National Museum of African-American History and Culture

MCI 6070.1 Black Fashion Museum Costume Collection

MCI Staff: Mary W. Ballard, Carol A. Grissom, Renee Anderson, Catherine Bartels, Jennifer Hau, Manesha Turner, Stephanie Spence, Christine Regan, Cathleen Zaret

The MCI staff advised the National Museum of African American History and Culture (NMAAHC) on conservation aspects of acquisition of a collection of costumes and related materials from the Black Fashion Museum located in Washington, DC. The collection was surveyed and packed for safe transport in 268 boxes that occupied a total volume of approximately 2000 square feet and transported to MCI for, disinfestation, cataloguing, and rehousing.



MCI 6070.2 Black Fashion Museum Costume Collection Phase II Rehousing

MCI Staff: Mary W. Ballard, Jennifer Hau, Stephanie Spence, Christine Regan, Renee S. Anderson, Cathleen Zaret , Elizabeth Shuster, Yyonette Fogg

The Black Fashion Museum costume collection was prepared for off-site storage, which included examination and documentation of the condition of the collection, packed in retrievable (accessible) storage format, and accessioning of the collection.



MCI 6070.3 Black Fashion Museum McGee Collection Anoxic Treatment
MCI Staff: Mary W. Ballard, Nicole C. Little, Renee Anderson, Cathleen Zaret

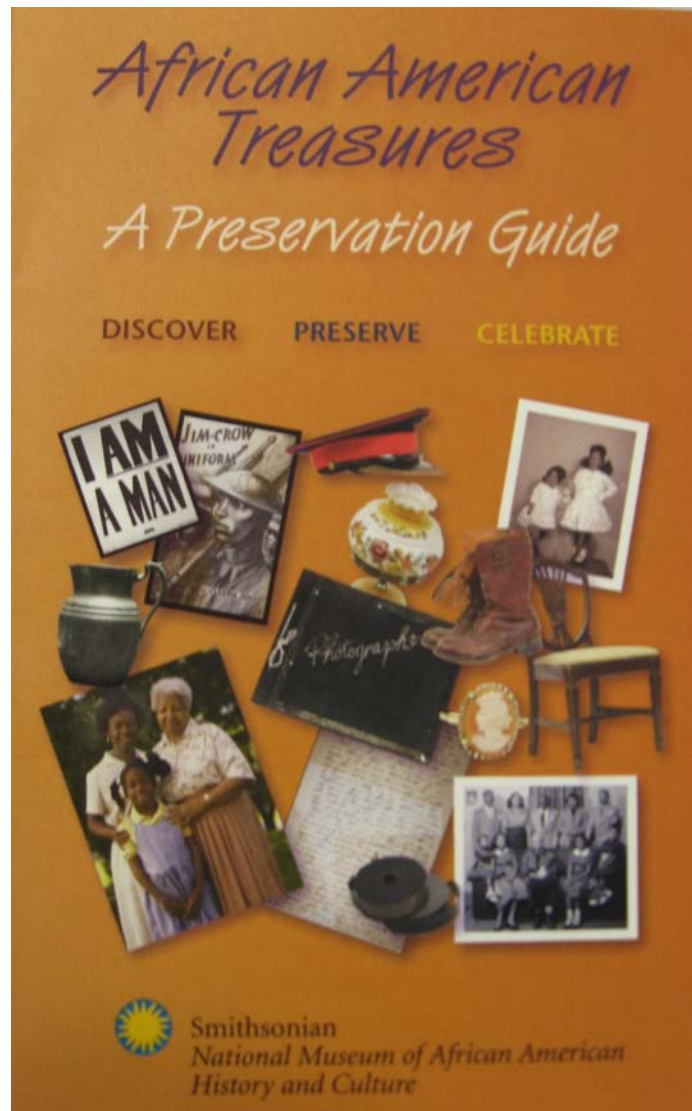
Argon anoxic treatment of selected items from the Arthur McGee collection, newly accessioned in 2008 to the Black Fashion Museum collection at NMAAHC, was completed. The collection was disinfested, vacuumed, photographed, and packed for storage and eventual transfer to NMAAHC.

MCI 6165 Wooden Kitchen Table
MCI Staff: Donald C. Williams

A wooden, hand-joined mid-19th century kitchen table was examined and photographed in situ to provide counsel to NMAAHC regarding the nature of the object and its potential accession.

MCI 6166 African American Treasures: A Preservation Guide Booklet
MCI Staff: Donald C. Williams, Carol A. Grissom, Mary W. Ballard

Significant historical items of the 20th century and many from the 19th century are in the basements and attics of private homes all over the country. NMAAHC has launched a program to help identify these objects and encourage people to protect and preserve them. The Treasures initiative features this guide, Web-based instruction, and hands-on workshops in key cities around the country. The Treasures initiative will stimulate preservation activity nation-wide, help people identify and preserve objects of historical and cultural significance, and help identify potential collaborations among other cultural institutions and communities around the country. MCI provided content and content oversight for a booklet created by NMAAHC as a foundation for their outreach programming.



MCI 6204 Charleston Slave Badge

MCI Staff: Carol A. Grissom, R. Jeff Speakman

A mechanic's slave badge made of copper sheet and stamped "1850" was examined for possible acquisition by the National Museum of African American History and Culture. Its fabrication, patina, and condition were found to be consistent with a date of 1850 as well as other badges made by William Rouse, who was contracted to make badges in 1850 and many other years. In particular, dies used to stamp "CHARLESTON," "MECHANIC," and "1850" are consistent with those of another badge made by the Rouse in 1850 and other Rouse badges before and after 1850.



Detail of "CHARLESTON," Norwood badge, showing the backward lean of the "R" and "S."

MCI 6217 Danny Drain Collection of Slave Artifacts

MCI Staff: Carol A. Grissom, Mary W. Ballard, R. Jeff Speakman, Ron H. Cunningham, Judy Watson

Nine slave-related items from the Danny Drain Collection proposed for acquisition by the National Museum of African American History and Culture were examined at Museum Conservation Institute to determine if they were consistent with pre-Civil War dates. In addition to physical examination and X-radiography, most iron objects were analyzed using X-ray fluorescence spectroscopy.

All iron shackles were made primarily of wrought iron, based on physical examination and X-radiography; this is consistent with pre-1863 technology. X-ray fluorescence analyses showed constituent elements typical for iron; these constituents cannot be used to distinguish time or place of origin. The pair of “middle passage shackles” is of a type found on the *Henrietta Marie* (sunk in 1700) and a pair published in an anti-slave tract in 1836. The “plantation shackle” and “ankle irons with intricate carvings” are consistent with pre-1863 technology. Nonetheless, the first appears to be an assemblage made from unrelated horse fetters, and the “ankle irons with intricate African carvings” have been identified as North African (probably Moroccan) camel fetters. The shackles of the “iron coffle chain” are also consistent with pre-1863 technology, but they too appear to consist of horse fetters, and the six shackles are assembled on a twentieth-century chain.

A wrought-iron slave collar identified as from Charleston (ca. 1790) with African blacksmith markings appears to be old but bears no physical evidence of date or origin. A wrought-iron “runaway slave collar” has been identified as an Iku, a dance rattle worn around the ankle by Yoruba.

“Kissi iron” or Kissi Guinze is also made of wrought iron. It is a type of currency used in West Africa, mainly associated with bride exchange.

The “Chief’s bag” has been identified as used by an important member of a mask group of the Nuna (Gurunsi) in present-day Burkina Faso.



Kissi iron.



Chief's bag.

Photos by Don Hurlbert.

MCI 6229 Leather Bound Magazines

MCI Staff: Mary W. Ballard, Nicole C. Little

A newly acquired collection of leather bound magazines were stabilized and protected appropriately for safe transfer to storage destination. The collection was argon anoxically treated to stabilize, deodorize, and manually disinfest. The housing and storage needs of the collection were determined.

National Museum of American History

MCI 6020 Planispheric Astrolabes

MCI Staff: Aaron Shugar, Brian Newbury

X-ray fluorescence (XRF) was used to investigate the potential authenticity of planispheric astrolabes and their components. Components of astrolabes can include the following: rete, plates, rules, horse, alidades, mater, pin and shackle (depending on whether the astrolabe is sheet-formed or cast). XRF analyses of random spots on the astrolabes were able to successfully differentiate original pieces from reproductions, according to the purity of alloys used.

The astrolabe was one of the most important tools of pre-telescopic astronomy. Many historians consider the astrolabe to be the first modern scientific instrument. It was designed to model the heavens with a stereographic projection representing the three-dimensional celestial sphere on a flat plane while maintaining spatial relationships. Originally developed by the Greeks, astrolabes were continually improved and used throughout the European and Islamic world for over 1000 years as a tool to tell time, predict and study astronomical events, and for surveying. Indeed, the astrolabe was such a recognized tool that painters would include them in works to signify an astronomer or as a symbol of astronomy or the sciences. In Islamic society, the astrolabe maintained an important religious role in the prediction of prayer time and direction to Mecca, securing its use in religious context long after it had become technologically irrelevant.



MCI 6032 Painting: *American Clipper Ship Coeur de Lion in Hong Kong Harbor* by Chong Qua

MCI Staff: Jia-sun Tsang, Maria Melendez

Coeur de Lion was an outstanding example of the golden age of the American clipper ship, a medium clipper, measuring 198 feet in length (overall) and 1098 tons. She was built at Portsmouth, NH for a local captain and a Bostonian and the figured head portrayed British King Richard the Lionhearted. The ship was launched January 3, 1854 and was lost in a collision in the Baltic Sea in 1915. The clipper ship *Coeur de Lion* was painted in oil on canvas during her maiden voyage in 1854 by the Chinese artist Chong Qua. Chong Qua's classic portrait of *Coeur de Lion* is his only known example of the genre. The ship is depicted in a standard pose of a classic ship portrait entering the Hong Kong seaport with house, signal, and American flags flying from all three masts and the spanker gaff.

The painting is glue-lined on a heavier weight canvas and the stretcher is not original. The natural resin varnish has yellowed over time and has shifted the tonal quality of the entire painting. The oil based retouching has darkened significantly, and it is noticeable even to the casual observer. This disfiguring and blotchy retouching covers almost 50% of the entire sky. Technical study including FTIR analysis of the medium of retouching was carried out and a special safe and sound cleaning technique was developed to remove the stubborn oil retouching.



After treatment

MCI 6161 Dried Grains, Beans, and Seeds

MCI Staff: R. Jeff Speakman

Tinned iron containers and paper wrappings, containing beans, rice, and seeds, are currently in storage at NMAH. Some of the papers wrappings have broken and the contents, which appear to be in remarkably good condition, are spilling out. All of these items are being re-housed. Results of on-site XRF analyses to determine if arsenic, lead, or mercury pesticides are present will help determine whether or not they can be safely handled or what precautions need to be taken. XRF analyses results were negative for heavy metals.

MCI 6162 Paintings: *Packet Ship Issac Webb*, *S.S. City of Tokio*, *Capturing a Sperm Whale*, and a Painting by Edith Wilson

MCI Staff: Jia-sun Tsang, Maria Melendez, Walter R. Hopwood, Judy Watson

Photo-documentation, visual examination, and condition survey information were provided to the museum conservators to assist them in their conservation treatments of these objects for the exhibition *On the Water* and *First Ladies* associated with the re-opening of the museum.



Packet Ship Issac Webb



S.S. City of Tokio



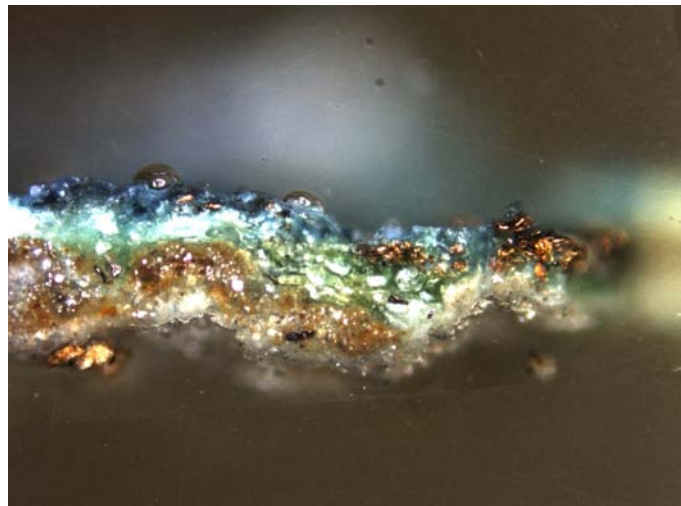
Capturing a Sperm Whale



Painting by Edith Wilson

MCI 6169 American Committee Model of the Statue of Liberty
MCI Staff: Carol A. Grissom, Ron H. Cunningham, Judy Watson

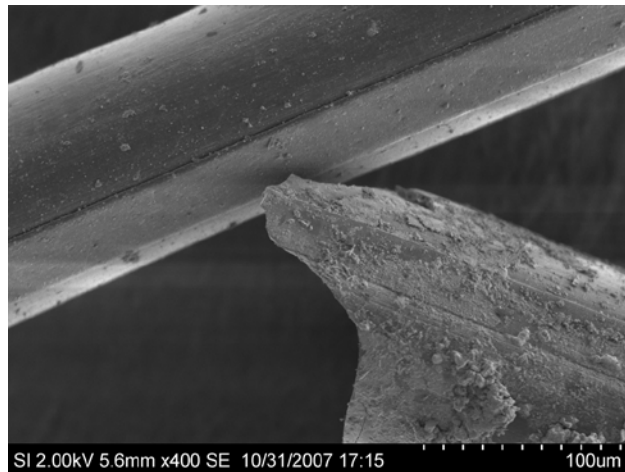
The American Committee Model of the Statue of Liberty's broken crown was repaired in preparation for display in the exhibition *Communities in a Changing Nation*. It was also an opportunity for technical study of paint coatings on the statue as part of a project in zinc sculpture.



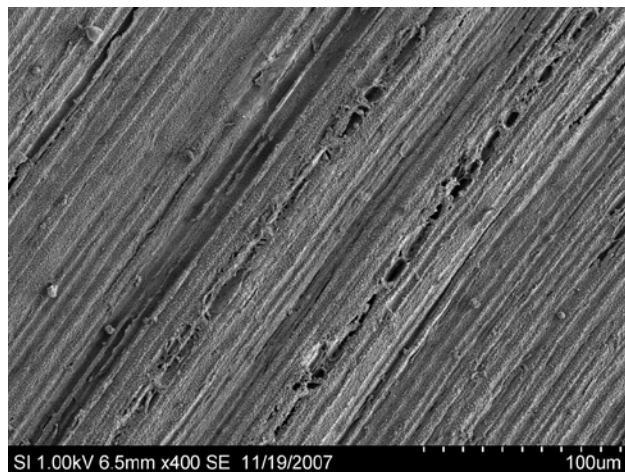
MCI 6175 Edison's Light Bulb

MCI Staff: R. Jeff Speakman, Judy Watson, Lynn B. Brostoff

Questions arose regarding the method of manufacture and composition of Edison's earliest light bulb filaments. Specifically, what were the filaments made of and how did the technology change (through the addition of different additives to the filaments) during the early years of light bulb manufacture. It was hypothesized that Edison would not have had to add anything to Bristol board and Madake bamboo filaments because the former contains kaolin and the latter has lots of silica; both of which would contribute to the formation of a conductive ceramic if heated properly in the absence of oxygen and the presence of fluxes (such as any salts in the organic material). However, it was uncertain if this is the case, or if Edison did indeed use additives. Nine filaments made of cellulose, cardboard, or bamboo were examined using FTIR, XRF, and SEM-EDS. The results were ambiguous; possible follow-up testing may occur.



Two filaments viewed with MCI's SEM



SEM image of processed & used bamboo

MCI 6215 Plastics Survey in the Division of Medicine and Science MCI Staff: Jia-sun Tsang, Rebecca Giesecking

The goal of the survey was to re-house the plastics collection at American History to minimize degradation of the plastics. To accomplish this, the plastics must be sorted by type. For many objects in the collection, the type of plastic was known, but many others were unidentified.

In an effort to identify these unknown plastics, small samples were taken for analysis by ATR-FTIR. The sample size was typically around the size of the head of a pin, and samples could usually be taken from the underside or inside of an object or a place where the object was already damaged so that the small sample would not be noticeable. Most of these samples could be easily identified by matching the spectrum or a sample to a spectrum of a known standard of a type of plastic.

Samples were taken not only of unidentified plastics but also of objects that did not have the typical appearance of the plastic they were identified as. In some cases the analysis confirmed the prior identification, but in other cases the original identification was incorrect and the object could be identified as a different type of plastic. For example, several white objects and translucent objects catalogued as Bakelite were correctly identified as either thiourea formaldehyde or Glyptal. The data gathered from survey guided the drafting a comprehensive re-housing plan.



Auto Dashboard, NMAH, 1981.0976.70
Gift of Union Carbide; molded Bakelite with
cellulose acetate dials and cellulose acetate
covers for speedometer and odometer

National Museum of the American Indian

MCI 5985 Trace Element Composition of Archaeological Copper Bells from Honduras

MCI Staff: Lynn B. Brostoff, Ron H. Cunningham

The purpose of the analysis was to investigate the chemical composition of a group of archeological copper bells, specifically in terms of trace element composition; by laser ablation inductively coupled mass spectrometry (LA-ICP-MS). This request was an addendum to a prior request, for which 14 copper objects, including “lamanai metals,” were analyzed. For the second part of the analysis, 28 copper bells from Honduras were submitted for analysis. The bells are shown to be at least 99.9% copper with various levels of trace elements, including sometimes significant amounts of arsenic and silver, as well as tin, antimony, or iron. Very low trace levels of lead, nickel, zinc, manganese, and cobalt were generally detected.



MCI 6068.2 XRF Training for Heavy Metal Pesticide Identification

MCI Staff: R. Jeff Speakman, Odile Madden

MCI provided assistance with upgrading and standardizing the use of NMAI's new NITON portable XRF analyzer for the identification of heavy metal pesticide contamination of NMAI's collections to help ensure health and safety of NMAI staff and constituents and to further the standardization and quantification of portable XRF analysis of heavy metal contamination.

MCI 6103 Southeastern North American Archaeological Copper Artifacts

MCI Staff: Mel J. Wachowiak, B. Vicky Karas, Ron H. Cunningham

Six southeastern North American archaeological copper artifacts were documented by X-radiography and 3-D imaging using structured light scanning. The images captured using non-contact 3-D scanning will provide a way to virtually examine and document the fragile worked surfaces and construction aspects of the copper artifacts. The digital files of the artifacts will also provide an accurate and high resolution metrological archival record of each object. These data files can be used in the future for interactive web exhibits or virtual study and physical replicas can be made in the positive or negative in any material and at any scale.



MCI 6103: 3D Scan Data
(Solid View Front & Back of Copper Sheet)

MCI 6105 Surface Area Calculation of Artifacts Using 3-D Imaging

MCI Staff: Mel J. Wachowiak, B. Vicky Karas, Odile Madden

Four ethnographic artifacts were scanned with a Breuckmann TriTos (3-D) structured-light scanner as a means to provide an accurate measurement of their 3-D surface areas. The measured surface areas will be used to determine the potential error in estimates produced by typical museum workers modeling the artifact as a collection of simple geometric shapes. These surface area measurements and estimates will be used to calculate “total potential dose” of heavy metal pesticide residues on the artifacts.



MCI 6105: 3D Scan Data (Solid Views with Measurement Calculations)

MCI 6174.5 Anchorage Project: Wooden Doll
MCI Staff: Ron H. Cunningham

Radiography of the doll's wooden armature to acquire information regarding the fabrication of the armature was completed.

MCI 6178 Mechanical Behavior of Animal Skins and Hides at Low
Temperatures
MCI Staff: Marion F. Mecklenburg, Daniel Cull

This study examined the mechanical (and structural) behavior of hides and skins subjected to low, even sub zero temperatures for the purpose of evaluating sub zero storage. New and naturally aged samples were tested to determine the strength and modulus of these materials, according to experimental protocols developed by Marion Mecklenburg. Results were used to develop protocols for storage of hide drums at NMAI.

The most revealing component of the research was the thermal coefficients of expansion. They were measured at relatively constant levels of relative humidity and were found to be extremely low. Further where the hides and skins tested were found to be considerably stiffer at low temperature their strength increases remarkably without becoming brittle.

This project provided some useful answers. Low temperature treatment ("freezing") of constrained rawhide is not likely to cause damage. Unless extremely fragile, the age of the hide makes little difference to the effects of low temperature. Large moisture changes in the hides put the objects at a far greater risk than sub zero temperatures.

MCI 6192.1 Painting: *Super Pueblo* by Fritz Scholder, 1968 for NMAI exhibition: *Fritz Scholder: Indian/Not Indian*

MCI Staff: Jia-sun Tsang, Lynn B. Brostoff, Maria Melendez, Mel J. Wachowiak

This daringly geometric depiction of the Pueblo landscape with its intense lighting and rich colors has been defined as a “landmark painting” of Fritz Scholder’s career who greatly influenced the New American Indian Art movement.

The artist made the spontaneity and immediacy of the brush marks visible through the uniformly thinly painted surface. Closer examination of the hills and buildings revealed the artist’s emerging signature style of retaining drips and splashes of paint, exposing under paint, breaking away the space with voids, and shifting the perspective with lines. The creative process, materials, and subject matter of these paintings marked a turning point in Fritz Scholder’s fusion of abstract expressionism, surrealism, and pop art.

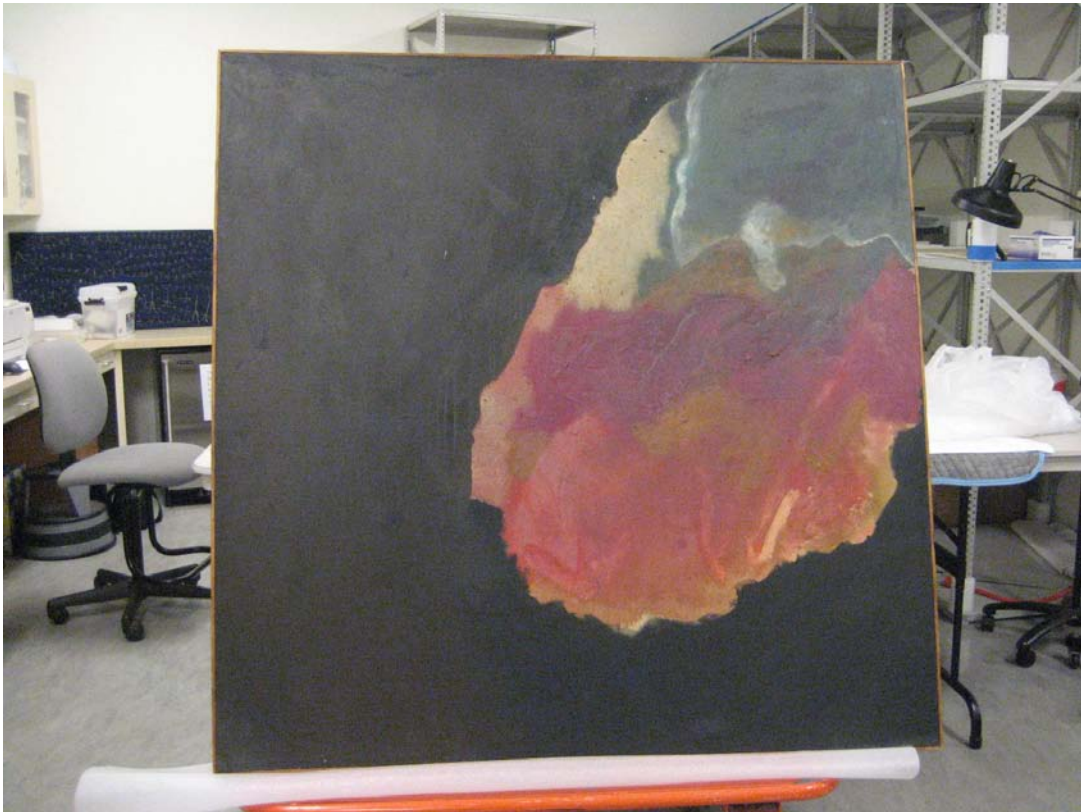
The most visible setback of the painting was the airborne dust and grime that had accumulated over time. The dirt cast a grayish veil over the intense blue sky, and the grayish veil had altered the color balance and the artist’s original intent. Since acrylic paint is sensitive to solvent or water, a custom cleaning tool was designed to remove the dirt effectively and to preserve the chemical and aesthetical integrity of the painting.



MCI 6192.2 Painting: *End of Season* by Fritz Scholder
MCI Staff: Jia-sun Tsang, R. Jeff Speakman

Information from paint media analysis helped identify the reason for the paint deterioration, determine whether or not further deterioration was likely to occur while the piece is under the responsibility of NMAI, and provided information to the Curators of the exhibit about the working habits of the artist.

Aesthetic integration of two small losses using a passive method improved the painting's appearance, so that they are not obvious during the course of the exhibit.



MCI 6195 Moundville Bowl

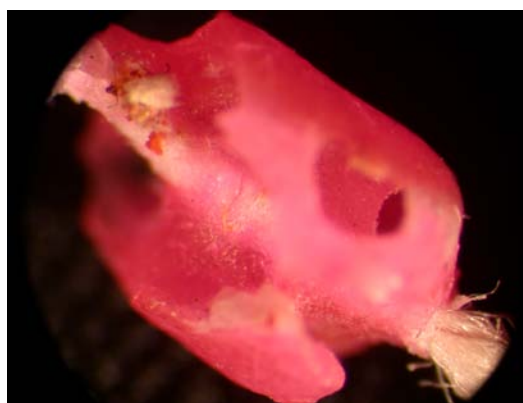
MCI Staff: Mel J. Wachowiak, B. Vicky Karas

The bowl was submitted for 3-D scanning to make a reproduction that can go on long term loan to the Moundville State Park, an exhibit venue close to modern descendants of the original creators of the object. The original is one of the iconic objects of NMAI and is regularly used for NMAI exhibits and other loans. However, NMAI wishes to make a copy of the object available for permanent exhibit at the park.

MCI 6196 Organic Pink Beads on Doll

MCI Staff: Odile Madden

A doll in the NMAI collection wears unique pink beads made of an unknown organic material that appears to have been damaged by insects. The doll was brought to MCI to identify the bead composition using non-invasive FT-Raman spectroscopy. This analytical technique elucidates molecular structure of organic and inorganic materials by measuring inelastically scattered energy from a material that has been excited with monochromatic infrared radiation. This is one of the first times that an accessioned artifact in the Smithsonian collections has been analyzed in situ using MCI's new FT-Raman instrument and is a useful contribution to MCI's ongoing research into polymer identification and analysis. The beads were identified by FT-Raman as starch, and the identification was confirmed at NMAI using a microchemical potassium iodide/iodine test for starch. The identification was made relatively quickly and without difficulty, which underscores the great potential of Raman spectroscopy for rapid, in situ, polymer analysis.



(Photographs by Ashley Jehle provided by NMAI)

MCI 6200 Three Dolls

MCI Staff: Ron H. Cunningham

X-radiography was performed to better understand the interior construction and damage observed on the dolls to inform the treatment and mounting decisions. These items will be included in *Window on Collections* exhibition rotation.

MCI 6216 Maya Polychrome Stucco Head

MCI Staff: Nicole C. Little, Judy Watson, R. Jeff Speakman

The Maya polychrome stucco head was submitted for characterization of the stucco to determine and distinguish original material. The characterization of restoration material was used to inform the treatment (removal) procedure in areas where the disfiguring restoration material covers the original surface.

MCI 6224 Horse Mask

MCI Staff: R. Jeff Speakman

A horse mask was submitted to identify, by XRF mapping, the extent and location of mercury contamination across the object to potentially gain a better understanding of whether mercury is a result of pesticide treatment with mercuric chloride or of mercuric sulfide in the red wool textile. The horse mask was analyzed by micro-XRF. Preliminary results indicate that the mercury identified on the object occurs as a consequence of a “pesticide treatment”.



MCI 6225 Andean Pottery

MCI Staff: R. Jeff Speakman, Odile Madden

Micro-XRF mapping of selected pigmented areas for identification was conducted. Results were compared to pigment identification data collected with other types of instrumental analysis from similar collection items and incorporated into on-going research. Data was compiled for publication of a study of materials and manufacture techniques used for two groups of objects from the Andean region: polychromed wooden vessels (*qeros*) and Paracas ceramics decorated with post-fire paint.



National Museum of the American Indian/National Museum of Natural History

MCI 6109 Alaska Exhibition Project

MCI Staff: Marion F. Mecklenburg

Over 700 Native American objects from the collections NMAI and NMNH are being transferred to the Alaska Museum in Anchorage (AMA) for a multi-year loan (up to 15 years). The AMA is constructing a new wing for the museum and new exhibition cases to house these items. The cases are purpose-built to allow display as well as handling of the objects by Native American community members. Because Anchorage is in a seismic zone MCI reviewed the structural designs of the cases and mounting supports for resistance to earthquakes. Fairly detail dynamic analyses showed that the original vertical rod supports proposed for the cases were too flexible and that larger diameter rods would be necessary to reduce lateral vibrations and increase damping in vibrations. The larger diameter rods were chosen for the case supports.

National Museum of Natural History

MCI 6022 Lakota Sioux Rosebud Winter Count

MCI Staff: Lynn B. Brostoff, Harriet (Rae) F. Beaubien, Odile Madden

The Rosebud Winter Count, a Lakota 137-year old pictorial calendar, was examined with X-ray fluorescence spectroscopy (XRF) to determine the elemental composition of inorganic pigments found on the painted textile. Identification of the pigments may permit the object to be dated and may reveal information of different hands being involved in its decoration. The in-situ elemental analysis suggested the use of chrome yellow in the yellow areas, vermilion in the red areas, and chromium in the brown areas. Results are inconclusive for the grey and black pencils/inks and for the blue colors with XRF; additional subsequent analyses with other techniques identified Prussian blue or synthetic ultramarine for the blue pigments. A few motifs were found to have distinctive elemental signatures. The results are consistent with manufacture dates of the winter count around the end of the 19th century.



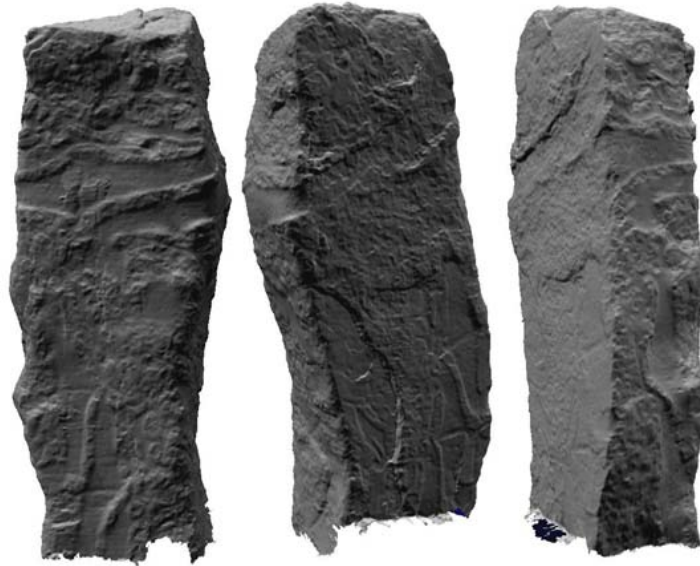
MCI 6084.2 Deer Stone #15 from Ushkiin Uver, Hovsgol, Mongolia
MCI Staff: Mel J. Wachowiak, B. Vicky Karas, Harriet (Rae) F. Beaubien

3-D imaging and post-processing of two fragments of deer stone #15 from the site of Ushkiin Uver, Mongolia, were carried out. Scanning took place on location in northern Mongolia at the Hovsgol Museum, Muren (Hovsgol aimag, Muren sum). Post-processing of some of the scan data was begun in Mongolia and completed at MCI. A Breuckmann GmbH, triTos™ scanner, purpose built for heritage scanning, was used to digitize the stone fragments. Post processing the raw 3-D digital data was done using Rapid Form™ graphic software on a desk top computer.



MCI 6086.2 Deer Stones from Khushuugiin Devseg, Mongolia
MCI Staff: Mel J. Wachowiak, B. Vicky Karas, Harriet (Rae) F. Beaubien, Christiane Bathow

Post-processing of the digital 3-D scan data, acquired by the MCI scanning team during the Deer Stone Project's 2007 field season in Mongolia was completed to align and clean-up the digital scan data to produce a high quality 3-D archival record for each of the deer stones, which can also be used for web viewing. 3-D graphic analysis and study, and CNC milling or rapid prototyping as needed.



MCI 6094.2 Degradation of Embedding Medium on Prepared Microscope Slides

MCI Staff: Mel J. Wachowiak, Jia-sun Tsang, Tony Maiorana, Rebecca Giesecking, Marion F. Mecklenburg

Eight slides of transparent and translucent resin under cover glass were submitted to determine the type (natural or synthetic) or brand of resin, if there were any additives detectable, if the resin was homogeneous, if there were alternatives to these resins, and if the procedure used to remount samples in Paleobotany was practical for large numbers (thousands) of slides. If the medium of older samples of cleared leaf specimens can be dissolved and transferred to a new slide, it would be ideal; if it can be done more efficiently, and they will not degrade, it is preferred. Predicting when, and which samples might degrade, would be useful.



MCI 6098 Ancient Maya Figurines

MCI Staff: B. Vicky Karas, Mel J. Wachowiak

3-D imaging and post-processing of three Mayan ceramic figurines belonging to the Anthropology department of the National Museum of Natural History (NMNH) were carried out at MCI. A Breuckmann GmbH, triTos™ scanner, purpose built for heritage scanning, was used to digitize the three artifacts. Post processing the 3-D digital data was carried out using Rapid Form™ graphic software on a desk top computer.



MCI 6110.2 Mesoamerican Clays

MCI Staff: R. Jeff Speakman, Candace McMillan, Lynn B. Brostoff

The Mesoamerican Clays project identified the mineral components of raw clays obtained from various locations along the Usumacinta River Valley, Mexico (and Guatemala) for purposes of comparison with archaeological ceramics found at prominent archaeological sites in the region. Based on the mineral components of the clays and fired sherds identified by XRD, inferences were drawn to determine whether the clay used for production at the surrounding sites was selected based on relative proximity to the site via the river valley or preferred characteristics of specific clays regardless of distance. The possibility of long distance trade was also examined based on the mineral structures of sampled clays. The combination of XRD data and neutron activation data facilitated a better understanding of regional variation in the mineralogical and chemical components of these and other regional clays.

Results from the analyzed clays demonstrated that mica is a definitive component in the clays of the Usumacinta region with the exception of two samples that were predominantly calcite. Although it was not possible to minimize the quartz signal in the light fraction of prepared clays, it was determined that in addition to mica, smectites, calcites, kaolinites, chlorites and feldspars occur as minor phases in the clays throughout the region. Twenty five clays and three fired sherds were analyzed under raw, glycolated, and fired conditions.

MCI 6114 New MSC Pod 5 Fluid Storage Tank Design

MCI Staff: Marion F. Mecklenburg

MCI completed the engineering design calculations for the new large fluid storage tanks for Pod 5 at the Museum Support Center, which will be used for large specimen storage. The fundamental requirements were to develop a design using light weight gage stainless steel where the sides of the tanks did not deform under the weight of the storage fluid and provided pressure relief in the case of fire. These tanks are essential containers for these collections for the long-term preservation of fluid-stored collections in a purpose-built facility.

MCI 6117 Mongolia's Deer Stones & Related Archaeological Conservation Activities, 2007 Field Season of the Joint Mongolian-Smithsonian Deer Stone Project (DSP)

MCI Staff: Harriet (Rae) F. Beaubien, B. Vicky Karas, Christiane Bathow

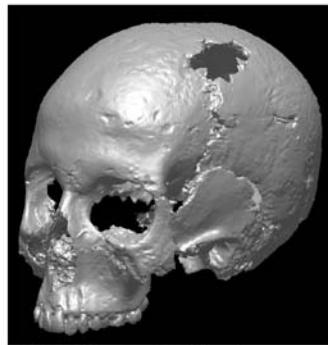
The 2007 field season was the third year of conservators' involvement in the field activities of the Joint Mongolian-Smithsonian Deer Stone Project [DSP]. Our primary objectives during the 2007 field season were (1) to document deer stones at sites that the DSP would be surveying and excavating in Hovsgol aimag, especially the northern Darkhad Valley region; and (2) to complete the documentation of deer stones from the site of Ushkiin Uver, by scanning the two fragments belonging to deer stone #15, currently in the Hovsgol Museum collection. (The deer stones *in situ* were scanned in 2006.) Over a three-week period, complete high-resolution 3D digital records were produced for 14 deer stones from 6 locations including the Hovsgol Museum; these were among 30 partial or complete deer stones documented systematically with photographs and condition records. MCI's participation was supported by funds from the Smithsonian's Under Secretary for Science Endowment and the Samuel H. Kress Foundation.



MCI 6118.2 Colonial American Skeletal Material

MCI Staff: Mel J. Wachowiak, B. Vicky Karas, Ron H. Cunningham, R. Jeff Speakman

Three 17th century colonial skulls were 3D scanned, photographed, and re-housed. A 3D hardcopy of one of the skulls was manufactured by the Smithsonian's Office of Exhibits Central, using 3D data generated by MCI, for facial reconstruction and integration into a NMNH exhibit entitled *Life and Death in the Colonial Chesapeake*.



MCI 6118.2: 3D Scan Data (Solid Views)



MCI 6118.3 Colonial Skeletal Material from Leavy Neck, Maryland

MCI Staff: Mel J. Wachowiak, B. Vicky Karas

3D imaging and post-processing of skeletal material and an associated artifact from Leavy Neck, MD, belonging to the Anthropology Department of NMNH, was carried out at MCI. The burial of a male individual as he was unearthed *in situ* was recreated in the MCI scanning lab using the excavated human remains. The recreation was 3D imaged using a Breuckmann GmbH, triTos™ scanner, purpose built for heritage scanning. Post processing the 3D digital data was done using Rapid Form™ graphic software on a desk top computer. The digital files were transferred to the Smithsonian's Office of Exhibits Central (OEC) for physical reproduction by computer numerical controlled (CNC) milling. The physical replica created by OEC will be used by NMNH as a display integrated into the exhibit entitled *Life and Death in the Colonial Chesapeake* which is scheduled to open in 2009.



MCI 6118.4 Historic Human Bone

MCI Staff: Nicole C. Little, Irma Molina, R. Jeff Speakman

This preliminary study determined whether external contaminants (i.e., adhered dirt) affect lead concentrations as measured by X-ray fluorescence (XRF), in comparison with measurements obtained by ICP-MS. Lead standards will be manufactured and analyzed by digestion ICP-MS for cross-calibration. Successful calibration of XRF for analysis of lead in bone will potentially be used as a non-destructive determination of health and social status in early colonial populations.

MCI 6124 Ethnographic Objects – Hair Ornament and Basketry

MCI Staff: Harriet (Rae) F. Beaubien, Walter R. Hopwood, Lynn B. Brostoff

Crystalline materials, appearing on the surfaces of a plastic hair ornament from China and three Pomo basketry items were sampled and analyzed. Such efflorescences are often related to some combination of past treatment, sealed storage and environmental conditions, and their identification would assist in determining an appropriate conservation course of action. The deposit on one of the hair ornaments was identified by XRD as sodium acetate hydrate (a sodium salt of acetic acid). This compound could be a degradation product of the substrate material, possibly a plastic, potentially exacerbated by conditions in the storage cabinet.

Treatment records proved to be helpful in interpreting the analytical results for samples taken from the Pomo baskets. Methods listed for several of the baskets during the 1960s and 1970s included cleaning using abrasive powders delivered with an air-driven tool, and coating with wax-like materials, such as British Museum Dressing. This is a lubricant dressing composed primarily of anhydrous lanolin (the grease derived from sheep fleece), and no longer favored as a treatment for such collection materials. Fatty acids, suggestive of lanolin residues, were detected by FTIR in a sample of the slightly sticky, white deposit on a basket, as was dolomite, identified by XRD. FTIR analysis of a sample of the white deposit on another basket suggested the presence of an organic alcohol, also potentially from the previous treatment. A sample from the deposit on a basket was found to be largely inorganic, identified by XRD as dolomite and silicon dioxide, both relatively inert from a conservation standpoint. When examined under magnification, the sample appeared to be made up of tiny spheres, suggesting remnants from some kind of glass bead or other abrasive cleaning procedure.



Pair of hairpins

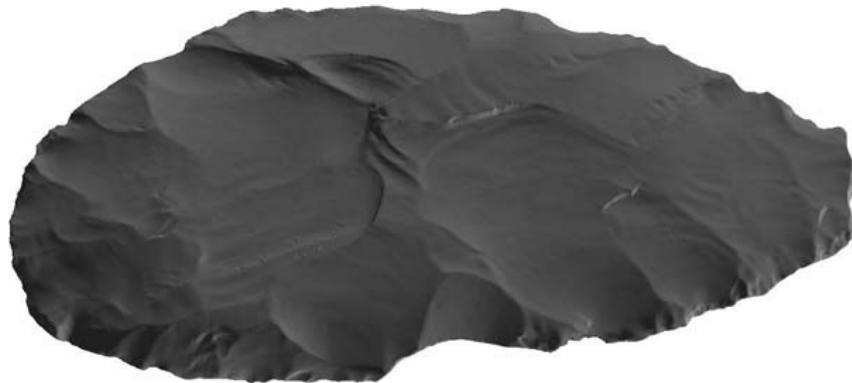


Pomo seed bin basket

MCI 6126.1 Clovis Obsidian Biface from Idaho

MCI Staff: Mel J. Wachowiak, B. Vicky Karas, Christie N. Pohl, R. Jeff Speakman

3D scanning of a Clovis obsidian biface was carried out to assess the quality of 3-D scan data and to determine the data's potential for producing precise physical replicas of this object. The Clovis biface is a stone tool over 10,000 years old, it is important to maintain the stone's intrinsic research value through replication without compromising its complex geometric angles and other diagnostic surface characteristics. Using 3-D digital data collected from non-contact 3-D scanning would significantly mitigate the possibility of damage to the object. In addition to creating a physical replica, the decision to document and archive this object by highly accurate metrological 3-D imaging will allow for high resolution virtual study and presentation to a much broader audience.



MCI 6126.2 Prehistoric Projectile Points

MCI Staff: Mel J. Wachowiak, B. Vicky Karas

3D imaging and post-processing of two (2) prehistoric projectile points from the Anthropology Department of the National Museum of Natural History (NMNH) were carried out at MCI. A Breuckmann GmbH, triTos™ scanner, purpose built for heritage scanning, was used to digitize these artifacts. Post processing 3D digital data was carried out using Rapid Form™ graphic software on a desk top computer.



3D digital screen shots showing projectile points with color information. The image on the left is the NMNH projectile point (Clovis-A), the image on the right is the Uptar projectile point (Clovis-B).

MCI 6152 Mollusk Shell from North Syria
MCI Staff: Ron H. Cunningham, Nicole C. Little

Samples were submitted to embed in epoxy and to image them on the SEM for identification for current research focusing on taxonomic, sclerochronological, and geochemical investigations of mollusk remains from archaeological sites in the Eastern Mediterranean.

The research aimed at reconstructing the aquatic environments and long-distance trade patterns in North Syria during the 3rd millennium BCE, based on the study of mollusk remains from archaeological sites in the Khabur region, currently housed in the Smithsonian. Extant archaeological and palaeoclimatic evidence attributes the development of social and political systems of the 3rd millennium BCE in Syria to humid climatic conditions. Their collapse is considered to have occurred largely as a consequence of globally-effective arid conditions. Archaeological mollusk remains in the region provided an excellent opportunity to investigate both the exchange networks of these systems and the local palaeoenvironmental conditions. The research utilized the taxonomic, morphological, sclerochronological, and biogeochemical properties of modern and archaeological freshwater clams to establish chronological variability and continuity in seasonal patterns of pluvial regimes and palaeotemperatures. It also used the taxonomy of imported marine mollusks in the archaeological assemblages to trace the direction and development of long-distance trade connections. This work allowed inferences about the temperature, seasonality, and productivity of the water sources that were essential for the subsistence and development of the third millennium BCE societies in North Syria. It also offered a direct and simple method to map the greater contact area of these complex urban cultures.

MCI 6158 Deer Stones at Khyadag, Mongolia

MCI Staff: Mel J. Wachowiak, B. Vicky Karas, Harriet (Rae) F. Beaubien

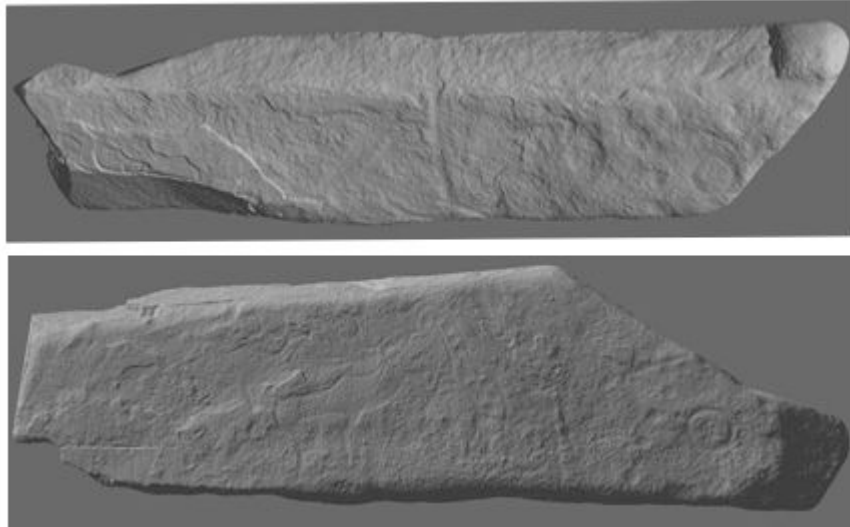
3D imaging of deer stones from the site of Khyadag, Mongolia, was carried out during the summer of 2007. Post-processing of the scan data was begun in Mongolia and completed at MCI. A Breuckmann GmbH, triTos™ scanner, purpose built for heritage scanning, was used to digitize the stones. Post processing the raw 3D digital data was done using Rapid Form™ graphic software on a desk top computer.



MCI 6159 Deer Stones at Hort Uzuur, Mongolia

MCI Staff: Mel J. Wachowiak, B. Vicky Karas, Harriet (Rae) F. Beaubien, Christiane Bathow

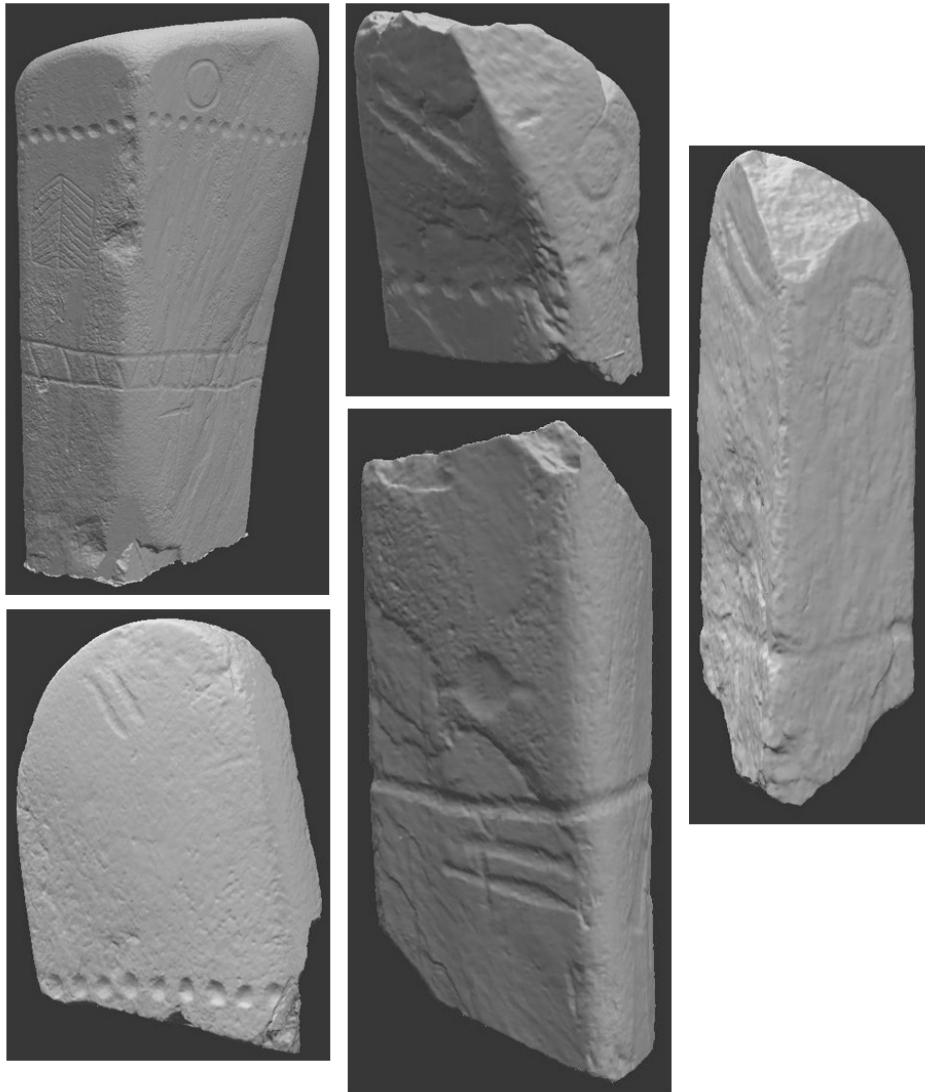
3D imaging of deer stones from the site of Hort Uzuur, Mongolia, was carried out during the summer of 2007. Post-processing of the scan data was begun in Mongolia and completed at MCI. A Breuckmann GmbH, triTos™ scanner, purpose built for heritage scanning, was used to digitize the stones. Post processing the raw 3D digital data was done using Rapid Form™ graphic software on a desk top computer.



MCI 6160 Deer Stones at Avtiin, Mongolia

MCI Staff: Mel J. Wachowiak, B. Vicky Karas, Harriet (Rae) F. Beaubien, Christiane Bathow

3D imaging of deer stones from the site of Avtiin, Mongolia, was carried out during the summer of 2007. Post-processing of the scan data was begun in Mongolia and completed at MCI. A Breuckmann GmbH, triTos™ scanner, purpose built for heritage scanning, was used to digitize the stones. Post processing the raw 3D digital data was done using Rapid Form™ graphic software on a desk top computer.



MCI 6174.1 Anchorage Loan: Yup'ik Basket/Grass Bag

MCI Staff: Lynn B. Brostoff

Ethnographic objects collected during the late 1800s were routinely treated with a wax and gasoline bath to inhibit pest activity. They also may have been treated with British Museum leather dressing as part of conservation. This grass bag may have been subjected to one or both of these types of treatments. Identifying the surface coating will assist in subsequently devising a conservation treatment strategy to humidify and reshape the bag; conservation treatment will be undertaken by ACL conservators.

FT-IR analysis indicated that the fine, buff-colored particulate matter that has appeared over most of the basket surfaces is beeswax, which may either be the product of a former wax/gasoline bath treatment, or have crystallized out from previous application of British Museum leather dressing. The material thus appeared to have formed as a result of a former conservation treatment and environmental conditions/aging.

MCI 6174.2 Anchorage Loan: Yup'ik Boots

MCI Staff: Lynn B. Brostoff

FTIR identification of the waxy substance, apparently splattered on the boots, was requested in order to determine if it is related to use of the object or to a post-collection activity. Analysis results will be used by the requestor in conjunction with contextual information in order to guide the next steps in preparing the object for long term loan. If the wax is related to a post-collection activity, it will be removed as part of the conservation treatment.

FT-IR evidence provided excellent support for conservators' suspicions that the waxy material sampled from the fur boots is likely to come from candle wax drips and/or splatters. The solubility of the sampled waxy material in mineral spirits, along with FT-IR results, suggests that the sample was primarily made of paraffin with a smaller Candelilla (or similar vegetable) wax component.

MCI 6174.3 Anchorage Loan: Yup'ik Ivory Harpoon Counterbalance and Socket Piece and Ivory Pipe

MCI Staff: Ron H. Cunningham

X-radiography was performed to further examine and document the condition of the objects, in preparation for transfer to the Alaska Museum in Anchorage for a multi-year loan (up to 15 years). Information was used to make decisions about treatment and display.

There are several deep cracks in the ivory harpoon counterbalance and socket piece and there is a desire to understand the extent and depth of these cracks and to further document them.

There are questions about the authenticity of the pipe bowl (which may be a later museum addition), and questions about the techniques used to manufacture the pipe, such as the hole drilled through the center of the pipe and the connection between the separate bowl and the pipe.

MCI 6174.4 Anchorage Loan: Wooden Figures

MCI Staff: Lynn B. Brostoff; Odile Madden

FTIR identification of the splattered white residue was requested in order to determine if it was related to the use of the object, or if it was related to a post-collection activity. Results will be used by the requestor, in conjunction with contextual information, to guide the next steps in preparing the object for long-term loan.

While IR and Raman analysis of the splattered spots on the surface of the guardian figure did not allow positive identification of the material, evidence points to this residue originating from a modern, but not contemporary, paint or lacquer coating based on cellulose nitrate. No colorant was identified in the material, however.

MCI 6174.6 Anchorage Project: Lightfastness of Boot Fabrics and Leather

MCI Staff: Marion F. Mecklenburg, Julio del Hoyo

A series of light-fastness tests were conducted on a select group of ethnographic objects scheduled for long term exhibition at the Anchorage Museum of Alaska starting in 2010. The objects come from the collections of the NMNH and NMAI. A broad range of objects containing numerous materials were selected to assess the light fastness of the objects and help the conservation staff establish exhibition recommendations taking into consideration the light levels in the building and the complexity of the materials included in the objects.

MCI 6174.7 Anchorage Project: Fur from Yup'ik Hood & Boots; Siberian Apron & Boots

MCI Staff: Ron H. Cunningham, Mary W. Ballard, Caroline Solazzo

The features of hair samples from various fur objects, for use in species identification, were examined by SEM imaging. After discussing these objects with Alaskan cultural consultants and NMNH mammalogists, there were still questions about what types of fur and hair were used for the decorative features on these objects. Attempts to characterize/identify the hair from these objects using PLM had been unsuccessful. Identification and/or characterization of this hair are important for a greater understanding of these objects; in particular which hair and/or fur might be chosen to decorate clothing.

MCI 6174.8 Anchorage Loan: Inupiaq Objects – Seal Retriever and Doll

MCI Staff: Ron H. Cunningham

X-radiography was performed on the seal retriever to determine the method and purpose of the nails embedded in the wood and to determine the stability of the wood cracks and metal corrosion. X-radiography was performed on the doll to acquire information regarding the fabrication of the armature.

MCI 6198 Mineral Microprobe Standards

MCI Staff: Judy Watson

This study explored the accuracy of MCI's Bruker EDS system under different conditions relative to published data and other EDS systems. The microprobe standards received from Mineral Sciences on the SEM-EDS, both as unpolished and uncoated samples and as embedded and polished samples were quantitatively analyzed. The Mineral Sciences microprobe standards studied were: anorthite (Gr. Sitkin island), anorthoclase (Kakanui), Dirango apatite 1, augite (chromium, Kakanui), benitoite (San Bernardino), calcite, chromite (Tiebaghi Mine), corundum (synth), dolomite, diopside (Natural Bridge diopside), fayalite (Rockport fayalite), gahnite (Brazil), garnets (Roberts Victor), glass (tektite, VG-A99, VG-2, VG-568 rhyol, basaltic-Indian Ocean), hornblende (Arenal, Kakanui), hyperstene (Johnstown), ilmenite (Ilmen Mnts.), magnetite (Minas Gerais), microcline, olivine (San Carlos, Springwater), omphacite, osumilite (Main, Labrador), plagioclase (Lake County plagioclase), pyrope (Kakanui), quartz (Hot Spring), scapolite, and siderite.

MCI 6199 Volcanic Glass Particles in Archaeological Sediment

MCI Staff: Judy Watson, Nicole C. Little

Sediment samples to extract volcanic glass were prepared; samples were analyzed using a particle analyzer for shard counts and general classification; more precise geochemical characterization was accomplished using SEM-EDS, micro-XRF, and/or LA-ICP-MS.

A novel technique for processing sediment samples looking for microtephra was developed. This will permit discovery and identification of volcanic glass shards to use in providing or constraining dates and/or chronologies.

Microtephrochronology is a stratigraphic dating method used by archaeologists and Quaternary scientists (among others) involving the location and characterization of volcanic glass particles present in soils and sediments in sizes and amounts invisible to the naked eye. Accurate determination of the presence or absence of volcanic glass shards in a soil or sediment sample precedes quantitative analysis, and is one of the most time-consuming and laborious steps in the process, with great potential for misclassification or miscounting error by traditional methods. The aim is to develop a novel method of automating and accelerating the process of identifying and counting volcanic glass particles while providing a rough geochemical characterization of all the particles present in the sample.

Many SI units in addition to Anthropology and Paleobiology might find this technique applicable to their research.

MCI 6218 Mantle Garnets

MCI Staff: Nicole C. Little

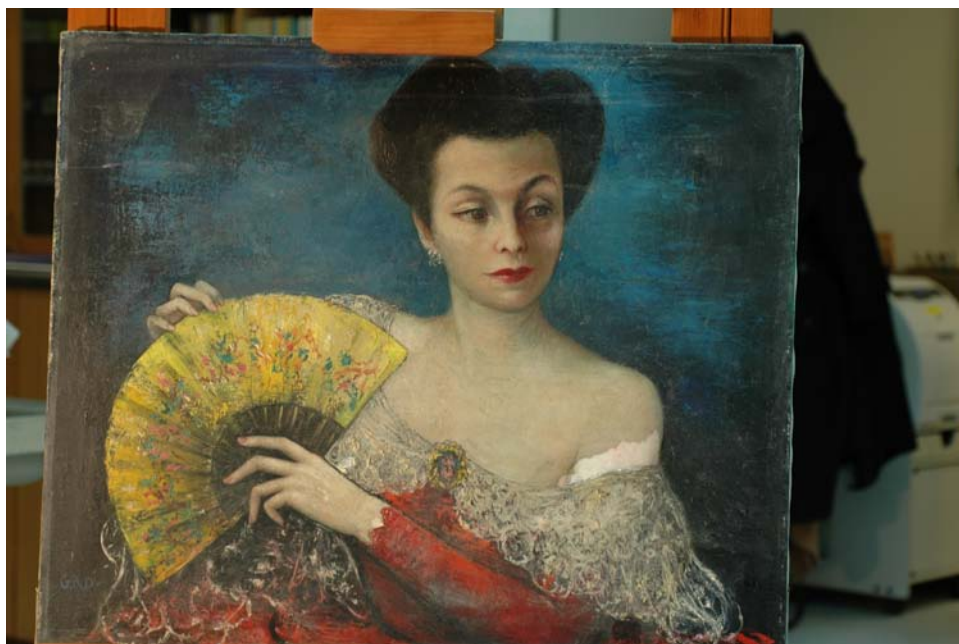
Three mantle garnets from the Smithsonian Microbeam Reference materials have been and are distributed world-wide as standards for electron microprobe analysis. These specimens were characterized for their major element contents by E. Jarosewich, but they have not been characterized for their trace element contents. The scientific community is in great need of reference materials for trace elements with matrices similar to the unknowns. Despite the extensive efforts of many scientists to develop algorithms for matrix corrections, reference materials with similar matrices to the unknowns still provide the most accurate results. Electron microprobe analyses of these three specimens indicated that they have homogenous distributions of Cr, V, and P. The purpose of this project is to develop reliable microbeam reference materials for the analysis of trace elements in garnets; of particular interest is the evaluation of rare earth element (REE) distribution.

National Portrait Gallery

MCI 6181 Painting: *Cornelia Otis Skinner* by Gladys Rockmore Davis
MCI Staff: Jia-sun Tsang, Maria Melendez, Lynn B. Brostoff, Odile Madden

The goal of this project was to identify the surface coating on this painting to assist in the conservation treatment. The dark color of the coating, either from intended tinting or natural aging, had significant visual impact on the sitter or limited the conservation treatments. The dark surface coating was soluble in mild solvent. The solubility behavior and type of solvent it dissolved in indicated that the coating had not aged extensively. The darkened coating could have been from tinting or from the native color of coating material itself.

In addition to visual examination with light microscopy and higher magnification examination of the morphology of paint cross-sections made by scanning electron microscopy (SEM), SEM-EDS was used to profile the inorganic elements in the coating. An additional paint sample that included a coating layer was subjected to 3-D microscope examination under the visible and ultra-violet light.



Cornelia Otis Skinner by Gladys Rockmore, During Treatment,
National Portrait Gallery, Smithsonian Institution

National Zoological Park

MCI 6222 *Nautilus pompilius* Shell

MCI Staff: R. Jeff Speakman, Nicole C. Little, Judy Watson, Greg Henkes

A *Nautilus pompilius* shell from a specimen that died in captivity at NZP was analyzed by XRF, XRD, SEM-EDS, ICP-MS, and other appropriate techniques to determine if there were identifiable inorganic chemical differences between the early- and late-growth shell. Organic analyses were incorporated as necessary.

Nautili are a nocturnal species that undergo a daily, vertical migration. In captivity, nautilus require cool-water, dark, and deep, in dedicated aquariums. Even in 'proper' environments, they experience buoyancy problems (they float), and they are unable to properly grow new shell in captivity. In addition, it appears that the mortality rate for captive specimens is quite high. Identifiable chemical differences between the "new" and "old" shell growth may point to/help determine the bigger picture.



Office of Exhibits Central

MCI 6154 SI Exhibit: *Lola Alvarez Bravo*

MCI Staff: Jia-sun Tsang

Exhibition conservation services were provided by MCI staff for the *Lola Alvarez Bravo* Exhibition. On-site condition surveys were conducted and guidance was provided for the care and safety of the objects during the installation and de-installation.

Lola Alvarez Bravo (1903–1993) is widely recognized as Mexico's first woman photographer and a pioneering figure in the rise of modernist photography in Mexico. The 56 vintage photographic prints on display span six decades and range in subject matter and technique, including street photographs, images documenting indigenous people and traditional culture in Mexico, portraits and Surrealist-inspired photomontages.



MCI 6155 SI Exhibit: *Mexican Treasures in the Smithsonian*
MCI Staff: Jia-sun Tsang

Exhibition conservation services were provided by MCI staff for the *Mexican Treasures in the Smithsonian* Exhibition. This exhibit showcased precious objects from Olmec statuettes and an Aztec obsidian mirror to a portrait of Emiliano Zapata by David Alfaro Siqueiros, all from Smithsonian collections.



MCI 6186 Exhibition Case Materials: Oddy Tests and AD-Strip Tests

MCI Staff: Jia-sun Tsang

Oddy tests and AD strip tests were performed to study the off-gassing behavior of the selected wood intended as construction material for exhibition cases. Tests were also carried out to select an effective vapor barrier, heavy inorganic pigments loaded paints or epoxy base clear coating to seal the off gassing. The client for this request was the fabrication division of the Office of Exhibition Central (OEC) and cases were constructed for a short-term temporary exhibition (1-2 years) for National Museum of National History.

The test samples were prepared by OEC via spray coating. The tested wood materials were Medex and Appleply. The Vapor Barriers were Ceramic Paints, sealer and flat paints, and Camger. Tests were carried out over 6 weeks and observed on May 13, May 19, June 2 and June 19.

It appeared that thicker paint i.e., multiple coatings, served as a better vapor barrier. A birch edge band with conservation grade adhesive also acted as an effective vapor barrier. Appleply was not more effective than Medex in current Oddy and AD strip tests. For temporary exhibitions (approx. 1-2 years), Medex coated with multiple coatings of ceramic paint should suffice. To evaluate the effectiveness of multiple coatings, a new set of samples and tests was recommended.



A small block of wood sample coated with sealant was inspected for off-gassing.

MCI 6189 SI Exhibit: *Classically Greek: Coins and Banknotes from Antiquity to Today*

MCI Staff: Jia-sun Tsang, Ximena Pezoa

Classically Greek: Coins and Bank Notes from Antiquity to Today was a traveling exhibit from Greece on display in the Schumer Hall of the Smithsonian Castle from April 10 to June 10, 2008. There were ancient Greek bronze coins and modern Greek bank notes in the exhibit. Since the NMAH closed its numismatic display, this exhibit was highly anticipated by the connoisseurs.

The purpose of the consultation was to interact with the conservator from Greece and to ensure that the lender's requirements in the condition reporting, handling, mounting, encapsulating, and security were met. MCI worked with the conservator from Greece who hand-carried the objects to Washington, DC on April 1, 2008. The objects were checked for condition and consultations were made jointly on techniques and methods of mounting encapsulation at the Smithsonian.



Office of Facilities Engineering and Operations - Horticulture

MCI 6182 Andrew Jackson Downing Urn

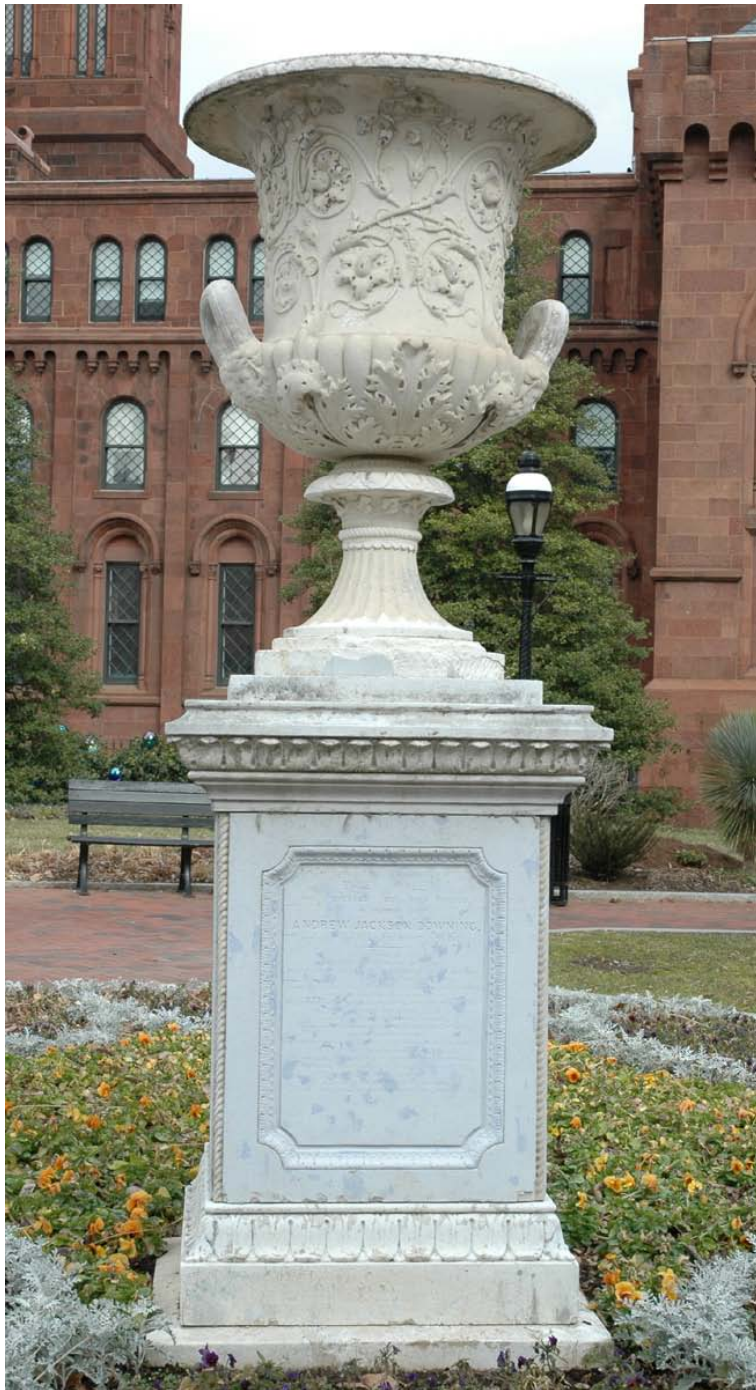
MCI Staff: Carol A. Grissom

Twenty-two years after it was examined in 1985, the Andrew Jackson Downing Urn was again examined by an MCI staff member. As was the case in 1985, concern about the poor condition of the urn led to interest in application of a consolidant or another material for the memorial's preservation. A second issue for consideration was the possible movement of the memorial indoors, with a copy placed outside.

The marble of this memorial has eroded from exposure outdoors, but its surfaces do not appear to have markedly changed since 1985 based on comparison to photographs taken then. About 50 percent of the monument's surface is covered with a non-original plastic material applied over intentionally scarified marble. This repair material is deteriorating, but it is so extensive that it is recommended that it be retained as long as possible.

Original surfaces of the Jackson Urn have been lost, but the memorial's appearance is age appropriate, and it is attractive in the garden context. It is an authentic part of the history of the National Mall, and it is on display in its intended context outdoors. It is unlikely that original material will deteriorate markedly in the future. At this point minor treatment of the memorial is counseled, such as cleaning, and continued display in the garden. Repair material is likely to continue to deteriorate to the point that replacement will eventually be desirable.

Should a copy be made, the original memorial should be displayed indoors. Extensive treatment would be necessary to make the memorial displayable in the closer scrutiny of a museum, and it may be difficult to find a location indoors that can bear the memorial's estimated weight of 2-3 tons. Storage off display does not seem a purposeful solution.



South face, Jackson Urn, February 2008.

Smithsonian American Art Museum

MCI 5984 Renwick Exhibit: *High Fiber* - Textile Art Works

MCI Staff: Mary W. Ballard, Christine Regan, Stephanie Spence

The exigencies of exhibition and work schedules precluded actual work on most of the treatments proposed with a checklist developed during the exhibition, *High Fiber*, at the Renwick Gallery in July, 2005. A request to discuss one of the problematic textile art works, Lenore Tawney's *In the Dark Forest*, provided the opportunity and impetus to complete this project at the Apollo Drive warehouse in Largo, Maryland with MCI summer interns in conjunction with a SAAM objects conservator and curator. Sheila Hick's six sections of *The Principal Wife Goes On* were examined and vacuumed as was Neda Alhilali's *Medusa*. The Lenore Tawney *In the Dark Forest* was examined, vacuumed, and repaired.



MCI interns examining and vacuuming Sheila Hick's *The Principal Wife Goes On*

MCI 6061 Roux Cabinet
MCI Staff: Donald C. Williams

Conservation treatment was completed: restoration of damaged veneer, finish, and bronze mounts; fabrication of new base according to the style of the cabinet.



MCI 6066 Portable XRF Demonstration on Some of SAAM's Collections

MCI Staff: Lynn B. Brostoff

This demonstration helped SAAM Conservation make a decision about the usefulness of XRF analysis for their purposes, and whether they would like to purchase a handheld XRF of their own. After advising SAAM about portable XRF units currently on the market, SAAM Conservation requested that MCI staff demonstrate the use of MCI's handheld Innov-X XRF unit at SAAM on various types of works of art in the lab setting. The day-long demonstration included a brief overview of XRF and the instrument, as well as data collection from four different objects that were chosen by SAAM Conservation staff.

XRF analysis of four different types of objects in the SAAM collection successfully demonstrated the capability of this analytical technique to answer an array of typical questions concerning the materials out of which art objects are made. In particular, the handheld XRF unit was used to differentiate a mercuric chloride/chromate type patina from the bulk bronze alloy on a Remington statue; to identify the remnants of bronze powder gilding on a frame; and to identify a red lead-based ground on a charcoal portrait drawing. In addition, the instrument was optimized for both standard elements and light elements for preliminary analysis of a 20th century painting on paperboard by William H. Johnson. In this way, analysis proved useful in proposing identification of blue, black and red pigments, including bone black, red ochre, zinc white or lithopone, plus barium sulfate extenders. Based on the XRF demonstration, the SAAM Conservation staff felt that it is appropriate and convenient to request MCI's services for future XRF analyses.



MCI 6170 Painting: *Indian Hunting Buffalo* by Edwin Willard Deming
MCI Staff: Mel J. Wachowiak, Walter R. Hopwood, Jia-sun Tsang

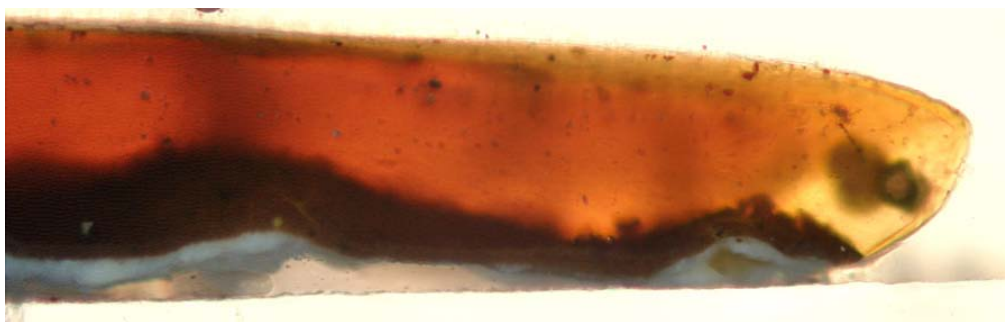
Coating samples were divided for organic chemical analysis and light microscopy. Two samples were embedded in epoxy resin and polished cross sections were made for optical microscopy. The darkened resin drips were unpigmented resin, with some ground associated. A third sample was lost in the preparation for microscopy, but initial examination indicated that the resin coating was very thin and that ground was present. The result of the Fourier transform infrared (FTIR) analysis was that the coating was probably shellac and linseed oil. The result of gas chromatography/ mass spectrometry (GCMS) analysis was that the coating was linseed oil. The whole sample was analyzed by FTIR, and an extract was analyzed using GCMS.



before treatment to remove darkened varnish
(both images A. Kerr-Allison)



varnish removed, before retouching of losses



sample removed from tacking edge is seen above in cross section (magnified 200x)

MCI 6171 Hiram Powers Hand

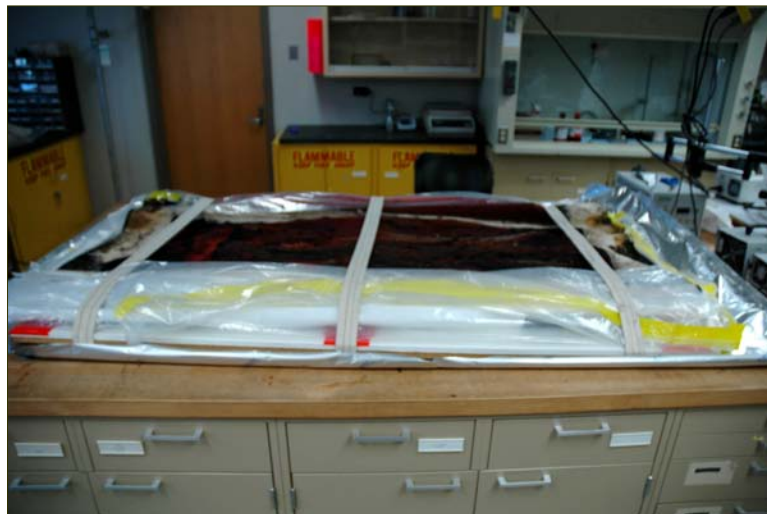
MCI Staff: Mel J. Wachowiak, B. Vicky Karas

3-D scan data for each of 6 pieces of mold of Hiram Powers Hand was created and data was prepared for milling by the Office of Exhibits Central. The hand was documented and two missing pieces from the mold were replaced for conservation. Copies of the mold and sculpture were created for use in curatorial and educational activities.



MCI 6179 *Entrada* by Stephen Thurston
MCI Staff: Mary W. Ballard, Robert J. Koestler, Nicole C. Little

Artist Stephen Thurston's *Entrada*, a tapestry woven hanging with wool, silk, rayon, cotton, and metallic thread, was found to have evidence of *Tinea pellionella*, the casemaking clothes moth. In order to maintain a constancy of temperature and humidity for the diverse elements of the hanging, MCI was asked to carry out an argon anoxic suffocation treatment to eradicate the insects without damaging the textile.



MCI 6208 Marble Columns

MCI Staff: Claire Gervais, Carol A. Grissom, Marion F. Mecklenburg

Residues of epoxy and silicone rubber remained on several marble columns after temporary walls, which were attached to them, were removed to improve the appearance of the stone. The damage was examined and a course of action for removal of pencil marks, adhesive, and staining was recommended. The affected area on each of the two columns was treated. A strategy for safe removal of the remaining walls at some point in the future, when the gallery is reorganized, was researched and documented.



MCI 6213 Painting: *Still Life #12* by Tom Wesselmann

MCI Staff: Jia-sun Tsang, Mel J. Wachowiak, Rebecca Giesecking, Judy Watson

While on display, an efflorescence, or growth, of white crystals on *Still Life # 12* by Tom Wesselmann became noticeable. The white crystals were visible on the red paint over the entire tablecloth as well as on the red paint on the apple; however, they were not visible on the rest of the painting. The investigation was focused on identifying the efflorescence to provide advice on the appropriate treatment and removal procedures.

In addition to visual examination with light microscopy and higher magnification examination of the morphology of paint cross-sections by scanning electron microscopy (SEM), SEM-EDX was used to profile the inorganic elements. The possibility of pigment-induced efflorescence by vermilion or cadmium red was eliminated. Systematic analysis of the white crystals and the paint binders of the ground and red color was first assessed by FTIR and later confirmed by GC-MS, and finally verified by XRD. The correlation of these three complementary analytical techniques was exceptional. The feather-like white crystals were extremely small and difficult to sample. The analytical schemes had to be streamlined to narrow the margin of error.

The white crystal was free palmitic acid (major), stearic acid (minor), and paraffin. The possible relationship between crystallization and fluctuations of temperature was explored. Fats, wax, and saturated oil undergo polymorphic transformations that can result in the appearance of a surface bloom. Polymorphism, described as the occurrence of several different crystals (alpha, beta prime, and beta) that form for the same compound, is also described as the process of destearinating or winterizing in the food industry and candle manufacturing. This process was established to remove traces of paraffin and waxes by a process of very slow cooling so the white crystals are large enough to be removed by centrifuge or filter.



MCI 6214 Painting: *Dream # 2* by Jacob Lawrence

MCI Staff: Jia-sun Tsang, Rebecca Giesecking, Mel J. Wachowiak, Judy Watson

While on display, the efflorescence, or growth of white crystals, on *Dream # 2* by Jacob Lawrence became noticeable. The white crystals were visible over a large portion of the proper right side of the image, extending 29 inches down from the top edge and 6 ¼ inches wide from the proper right edge. The efflorescence appeared to be associated with the dark green paint used to depict the proper right green wall to the left of the seated woman. The investigation was focused on identifying the efflorescence prior to treatment and removal.

In addition to visual examination with light microscopy and higher magnification examination of the morphology of paint cross-sections by scanning electron microscopy (SEM), SEM-EDX was used to profile the inorganic elements. Systematic analysis of the white crystal and the paint binders of the ground and green color was first assessed by FTIR and later confirmed by GC-MS, and finally verified by XRD. The correlation of these three complementary analytical techniques was exceptional. The feather-like white crystals were extremely small and difficult to sample. The analytical schemes had to be streamlined to narrow the margin of error.

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Smithsonian Institution Archives

MCI 6163 Anderson Collection Negatives

MCI Staff: Judy Watson, Ron H. Cunningham

Nineteen assorted photographic negatives and some envelopes in varying condition were brought to the attention of Nora Lockshin (paper conservator) in August, 2007 by the curators and contract registrars of the NMAAHC. They were seeking any indication of what caused the damage observed on some of the objects, or when the damage might have occurred. SEM-EDS analysis detected only elements that would be consistent with photographic chemicals, therefore it was not possible to draw any conclusion about the timing or cause of the damage to the objects based on this.

Smithsonian Latino Center

MCI 6173 SI Exhibit: *Posters from the Division of Community Education (DIVEDCO) of Puerto Rico, 1949-1989*

MCI Staff: Jia-sun Tsang

The Smithsonian Latino Center's (SLC) planned celebration of the 2008 Hispanic Heritage Month was initiated in September 2007 with an exhibition to highlight the culture and accomplishments of Puerto Rico. The planning committee was composed of an NMAH Curator, an MCI Conservator, and an SLC Exhibition/Public Programs Director. The goal of the planning committee was to develop, plan, and install the exhibition. The working title of the exhibit was *Spiritual Visions: The Religious Images of Borikén, Puerto Rico* and the plan was to include approximately 70 objects from the George Latimer Collection (acquired by NMNH in 1869) and Teodoro Vidal Collection (acquired by NMAH in 1997), to be displayed in four 4' x 3' cases. Through long discussions and reviews, a new proposal was written and successfully changed the theme to highlight the posters from NMAH Archives Center. Because of the change, the current exhibit has more objects, more space, and no need for conservation of a *Santo* as originally planned.

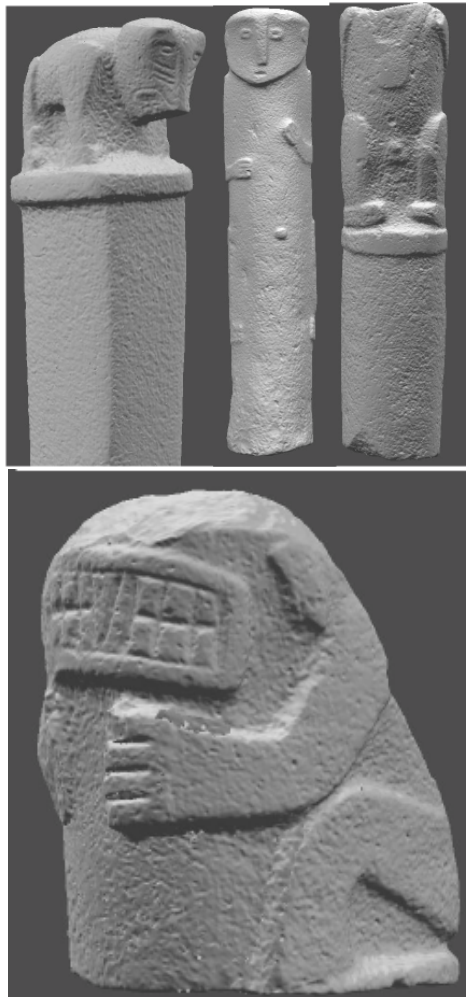


Smithsonian Tropical Research Institute

MCI 6097.1 Pre-Columbian Sculptures

MCI Staff: B. Vicky Karas, Mel J. Wachowiak

Seven Pre-Columbian stone sculptures originally from the El Cãno and Gran Coclé regions of Panama, were 3-D scanned at the Museo Antropológico Reina Torres de Araúz (MARTA) in Panama City using a Breuckmann GmbH, triTos™ scanner. The 3-D digital raw data were post processed at MCI using Rapid Form™ graphic software on a desk top computer. The digital data will be used by researchers from STRI, Panama, for replication of the sculptures, comparative study between the sculptural varieties of several of Panama's cultural regions, and for exhibition panels at El Cãno Archaeological Park and MARTA in Panama City.



MCI 6097.2 Four Pre-Columbian Sculptures

MCI Staff: B. Vicky Karas, Mel J. Wachowiak

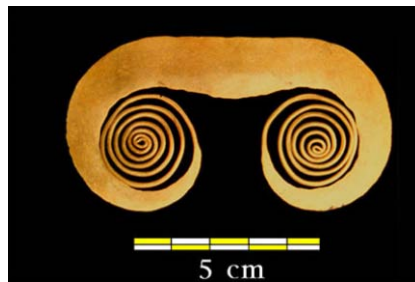
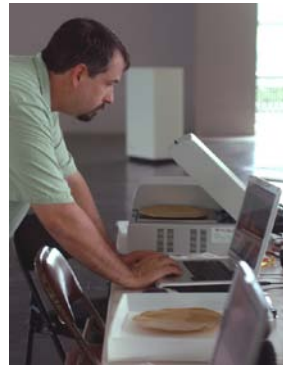
Four Pre-Columbian stone sculptures from the El Cãno and Gran Coclé regions of Panama, were 3-D scanned at the site museum in El Cãno Archaeological Park, Panama, using a Breuckmann GmbH, triTos™ scanner, during the summer of 2007. The 3-D digital raw data were post processed at MCI using Rapid Form™ graphic software on a desk top computer. The digital data will be used by researchers from the Smithsonian Tropical Research Institute (STRI), Panama, for replication of the sculptures, comparative study between the sculptural varieties of several of Panama's cultural regions, and for exhibition panels at El Cãno Archaeological Park and the Museo Antropológico Reina Torres de Araúz (MARTA) in Panama City.



MCI 6100 Pre-Columbian Goldworking in Panama

MCI Staff: Harriet (Rae) F. Beaubien

More than 600 pre-Columbian gold objects from Panama were included in this in-depth investigation, among them over 100 well-provenienced artifacts, recovered during excavations by archaeologists from STRI, as well as gold artifacts in the collection of the Museo Antropológico Reina Torres de Araúz (MARTA), in Panama City. Technical and scientific data were gathered about the objects' alloy composition and manufacturing techniques, through X-ray fluorescence spectroscopic analysis and detailed microscopical examination. The objects were fully photographed and recorded with notes on condition and contextual information. Treatment was carried out on selected items and all were protectively re-housed for accessible study and safe storage.



MCI 6104 Pre-Columbian Stone Sculptures from Gran Coclé, Panama
MCI Staff: B. Vicky Karas, Mel J. Wachowiak

Five Pre-Columbian stone sculptures from the El Cãno and Gran Coclé regions of Panama, now in the collection of the Smithsonian's National Museum of the American Indian (NMAI), were 3-D scanned at the Cultural Resources Center (CRC) using a Breuckmann GmbH, triTos™ scanner. The 3-D digital raw data were post-processed at MCI using Rapid Form™ graphic software. The digital data will be used by researchers from the Smithsonian Tropical Research Institute (STRI), Panama, for replication of the sculptures, comparative study between the sculptural varieties of several of Panama's cultural regions, and for exhibition panels at El Cãno Archaeological Park and the Museo Antropológico Reina Torres de Araúz (MARTA) in Panama City.



MCI 6106 Ceramic Sherds from Panama

MCI Staff: R. Jeff Speakman, Ron H. Cunningham

One hundred fifty low-fired, sand-tempered ceramic sherds from Panama, about 4000 years old, were analyzed by xeroradiography to assist in a study to determine the methods and sequences of manufacture.

MCI 6223 Volcanic Rocks from Panama

MCI Staff: Nicole C. Little, Agustin Cardona, R. Jeff Speakman, Javier Iñáñez

Major and trace element data was gathered to geochemically characterize volcanic rocks from Panama, tracing the tectonic evolution of the Central American Isthmus. ICP-MS analyses of approximately 200 pulverized rock samples were performed for major and trace element analysis: SiO₂, TiO₂, Al₂O₂, Fe₂O₃, MnO, MgO, CaO, Na₂O, K₂O, P₂O₅ and Sc, V, Co, Ni, Cr, Zn, Rb, Sr, y, Zr, Nb, Ta, Cd, Cs, Ba, Hf, Pb, Th, U, La, Ce, Pr, Nd, Sm, Eu, Gd, Tbm Dy, Ho, Er, Th, Yb, and Lu. Results provided insights on how the composition of the volcanic rocks of the Central American isthmus has changed during the last 70 million years, and how these changes reflect the evolving geological configuration of the margin and the final emergence of the American land bridge.

Library of Congress

MCI 6090.1 Malby Globe Stand

MCI Staff: Donald C. Williams

The 1882 Malby and Son globe stand was stabilized and the appearance of the globe stand was conserved for an exhibit in the office of the Vice President of the United States.



MCI 6090.2 Malby Globe and Stand

MCI Staff: Donald C. Williams, Mel J. Wachowiak, Jia-sun Tsang, R. Jeff Speakman, Michele Pagan

The 1882 Malby and Son globe was damaged as a result of the OEOB fire in December, 2007. The damage was assessed, the soot encrustation from the surface was removed, and the globe was returned to the appearance as before the fire. The globe was returned to the Office of the Vice President (OVP) as part of the permanent exhibit in the newly refurbished (and presumably newly re-refurbished) executive offices of the Vice President of the United States.



Phillips Collection

MCI 6193 Antoine Pevsner's Plastic Sculpture

MCI Staff: Jia-sun Tsang, Lynn B. Brostoff, Judy Watson

This project aimed to identify the plastic from the sculpture created by Antoine Pevsner in 1928 and to recommend methods and devices to monitor and regulate the off-gassing problems for safe long-term storage. The sculpture was acquired in 1953 by the Phillips Collections in Washington, DC.

In addition to visual examination with light microscopy and higher magnification examination of the morphology of plastic by scanning electron microscopy (SEM), SEM-EDS was used to profile the inorganic elements. Systematic analysis of the plastic in addition to the white bloom on the sculpture and metal frame was performed by FTIR. The plastic was confirmed to be cellulose acetate and the white bloom on the plastic was associated with cellulose acetate degradation. The acid released during the degradation progress caused corrosion in the metal frame in the form of a white bloom. A test strip was designed to monitor the off-gassing; a molecular sieve was recommended to absorb the off-gas so it will not harm any objects in the vicinity of the storage room.



National Park Service

MCI 6227 Sherman Monument Sword and Statue

MCI Staff: R. Jeff Speakman, Carol A. Grissom, Colby Phillips

A bronze sword confiscated from an auction by the FBI was being considered by the National Park Service as one having been stolen in the early 1950s from the life-size bronze statue of *Artillery* located on the northeast corner of the *General William Tecumseh Sherman Monument* in President's Park in Washington, D.C. Examination of the sword on site indicated that it is too short for the statue. In addition, the pebbly, unweathered and mostly "as cast" surface of the sword, in contrast to the weathered but highly finished surface of a similar sword on the monument's *Cavalry*, also suggests that it is not the lost sword. X-ray fluorescence analyses were conducted to determine if the alloy composition of the sword is consistent with that of *Artillery* and other elements of the monument. The composition of the confiscated sword is not consistent with the composition of the statues proper, but it is not very different from that of *Cavalry's* sword, which is believed to be original.



Office of the Architect of the Capitol

MCI 6183 Statue for Freedom Model

MCI Staff: Carol A. Grissom

MCI advised on conservation-related aspects of moving the Statue for Freedom model from the Russell Office Building to the new visitors' center to minimize damage to the statue, which has to be cut into sections for transport.

US House of Representatives

MCI 6072 Mace of the United States

MCI Staff: Donald C. Williams, Carol A. Grissom, J. Corey Smith, Lynn B. Brostoff, B. Vicky Karas, Mel J. Wachowiak, Walter R. Hopwood, Martha Goodway

Continuing a longstanding practice of more than four decades, staff at MCI examined, analyzed, and conserved The Mace of The United States House of Representatives. The Mace normally resides immediately adjacent to The Speaker's dais, and must be present for the House of Representatives to convene. MCI's examination and analysis focused on the aggressive corrosion which had suddenly beset the silver and ebony artifact and the fabrication details during the original manufacturing in 1841. Noteworthy observations included 1) the probable source of the sudden onset of tarnish, and 2) the fabrication method of the hollow silver globe. The conservation treatment dealt with removing the previously applied coating from conservation treatment in 2001, and cleaning, polishing, and re-coating the silver. The conservation of The Mace was featured on C-SPAN, the nation's premier public affairs broadcaster, when they re-broadcast their major documentary, "The Capitol."



US Senate

MCI 6177 Creation of Minimally Invasive Upholstery Prototypes

MCI Staff: Donald C. Williams, Michele Pagan

MCI created a fully functional prototype of minimally invasive upholstery systems for the Office of the Curator, U.S. Senate so that they can instruct their own craft shops in the treatment of historic upholstered pieces in their collection. This involved the treatment of three pieces, two from MCI holdings (one commissioned by us, the other acquired at a flea market) and one piece from the Senate collections.

MCI provided contextual and conceptual examples of treatment options for the decision-making strategies employed in preserving Senate collections. The projects products included: physical examples of minimally invasive upholstery for both exhibit and utilitarian applications, a detailed monograph on the processes used to create the prototypes, which will be used as an instruction manual by the Senate offices and would also be published independent of that application, and a hands-on workshop for/in the Senate craft shops on the techniques, and hopefully a workshop at MCI for professional practitioners as well.



MCI 6209 Daniel Webster Desk

MCI Staff: Donald C. Williams

Scholarly guidance was provided to the U.S. Senate Curatorial Offices and Cabinet Shop for their replication of the desk reserved for the Senior Senator from New Hampshire (the "Daniel Webster Desk"), considered the most important desk in the well of the Senate. MCI provided information, demonstrations, and education for the Curatorial Offices and the Cabinet Shop artisans in the traditional methods of veneer fabrication and application, and the use of traditional adhesives (animal hide glue) for both veneer work and joinery. MCI worked with the unfinished sample boards provided by the Senate Curator (and other samples), created a series of finish protocols and samples reflecting historical precedents of the early 19th Century U.S. cabinetmaking practices. Once the samples were done, MCI provided demonstration, instruction, and ongoing oversight to Senate cabinet shop staff for the successful completion of the project.

MCI provided visual and informational context regarding craft practices for the creation of historic furniture, especially pertaining to veneered surfaces and transparent finishes. This assisted the Cabinet Shop in making a set of newly constructed desks for the U.S. Senate compatible with existing historic artifacts (the "Daniel Webster" desk currently in the well of the Senate chamber.) The information transmitted to the Senate Cabinet Shop will in turn further their understanding of historic artifacts and their ongoing preservation, restoration, and use of them.

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