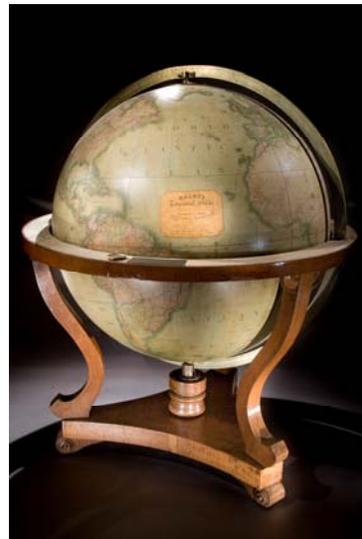




Smithsonian
Museum Conservation Institute

Project Summaries 2007



October 2006 through September 2007

Preface: MCI Overview

The Museum Conservation Institute (MCI) is a research unit of the Smithsonian Institution. Its mission is to increase and disseminate scientific knowledge that improves care and conservation of Smithsonian museum collections and related material, and contributes to their contextual interpretation. MCI staff members collaborate with museum conservators, curators, and scientists to conduct research programs in conservation, in addition to studies of collections that serve the needs of Smithsonian museums. The Institute serves as a source of technical information, advice, and assistance to the Smithsonian and other institutions. Its specialized collections and conservation research is vital to the work of the Smithsonian museums and collections, and to the greater museum community as well.

History

In 1963, the research unit that is now called MCI was established by the Smithsonian Board of Regents to respond to the need for a scientific laboratory to support collections conservation in the whole Smithsonian. A newly graduated conservator, a chemist, and a secretary with a background in the arts comprised the first staff of what was then known as the Conservation Research Laboratory (CRL). In 1965 the name was changed to Conservation Analytical Laboratory (CAL), to better reflect the needs of its constituents. With its move to the Museum Support Center in Suitland, Maryland, in 1983, the laboratory accepted a wider range of responsibilities, including a congressionally mandated national conservation training program and expanded research programs in conservation. In 1998 the Board of Regents approved another name change—to Smithsonian Center for Materials Research and Education (SCMRE)—in recognition of the expanding scope of the laboratory's work. The 2006 name change to Museum Conservation Institute, or MCI, represents a return to the original mission of CRL—collaborative research support for SI collections.

Staff

MCI's work unites the arts and humanities with physical and natural sciences, and because its work is interdisciplinary, so too is its staff. The staff of 20 includes specialists in the conservation of paintings, furniture, textiles, and objects; inorganic and organic chemistry; biology and biodeterioration; metallurgy; engineering; microscopy; information technology; training; and administration. During FY-07, MCI had 33 fellows, interns or volunteers training and assisting in the many projects and programs of the institute.

Facilities

The MCI laboratories, located in the Smithsonian's Museum Support Center in Suitland, Maryland, are equipped with advanced instrumentation, enabling staff to carry out a wide range of analytical techniques, including laser ablation inductively-coupled mass spectrometry, Fourier transform infrared and Fourier transform Raman spectroscopy, dispersive Raman spectroscopy, gas chromatography, pyrolysis-gas chromatography-mass spectrometry, optical microscopy, scanning electron microscopy with energy dispersive and X-ray spectroscopy, xeroradiography, X-ray diffraction, X-ray fluorescence, X-ray radiography, and ultraviolet-visible light spectrophotometry. MCI has acquired portable instrumentation to complement bench-top instruments; these include X-ray fluorescence, Raman, 3-D structured color scanning and

equipment for the simulation of environmental and light-induced aging of materials, and for mechanical properties testing. Our newest instrument, a dual isotope ratio mass spectroscopy system will be installed at the beginning of the next calendar year.

Activities

In fiscal year 2007, MCI collaborated with most of the Smithsonian's museums and offices and with some non-Smithsonian organizations as well. All of these projects are summarized in this document. Over the past year, 111 projects were initiated, continued, or completed. Sixty-eight percent of them were submitted by the museums and offices of the Smithsonian's Under Secretary for Science; the others originated with the museums and offices of the Under Secretary for Art (8 percent) or the Deputy Secretary and Chief Operating Officer's museums and offices (24 percent). In addition to these projects, MCI initiated or continued a series of programs to investigate specific Smithsonian museums collections-based issues, such as: modern materials program that examines degradation behavior and mitigation methodologies for plastics, adhesives, varnishes and coatings; environmental studies that examine behavior of materials to temperature and humidity, and includes recommendations and effects of cumulative exposure to light on museum objects; quantification of heavy metal pesticides on collections and mitigation methodologies; introduction of environmentally safe anoxic treatment and UVC procedures to control insect and microbial infestations within collections—already employed to save the 1000+ objects from the Black Fashion Museum; and development of color-based 3-D scanning of objects for exhibition, research and field conservation studies. MCI continued its educational activities with our lecture series on topics in museum conservation, and by hosting a mitigation of pesticides symposium, by completion of an opus on American zinc sculptures, by having many interns, fellows, or volunteers (about 33), and by responding to many professional and public conservation or conservation science inquires.

If you would like more information on any of the projects at MCI, please feel free to contact our Technical Information Specialist, Ann N'Gadi, or me directly.



Robert J. Koestler
Director

November 30, 2007

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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, 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 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, Emeritus

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, plastic, 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. He has several 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.

David W. von Endt, Senior Research Organic Chemist, Emeritus

B.A. (1960) Columbia Union College; M.S. (1966) University of Maryland; Ph.D. (1974) Howard University

Areas of interest: application of organic chemistry to problems in museum conservation and archaeology and to the study of natural organic compounds; chemical dating of archaeological bones and teeth.

Melvin J. Wachowiak, Jr., Assistant Director for Conservation/Senior Furniture 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 A. Watson, Physical Scientist

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

Areas of interest: archaeological science.

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*, NMAAHC Costume Collection
Catherine Bartels, *Summer Intern*, Objects Conservation Scanning
Christiane Bathow, *Visiting Scholar*, 3-D Scanning Project
Peter Bythrow, *Volunteer*, XRD of Paint Samples
A. Elena Charola, *Visiting Scholar*, Symposia Series
Julio Del Joyo, *Fellow*, Light Studies/Mechanics
Allison Deschler, *Volunteer*, SEM Analysis
Paul Dorn, *Summer Intern*, 3-D Scanning and Mechanics
Nato Gabelaia, *Visiting Conservator*, Book & Paper Conservation
Anne-Marei Hacke, *Post-Graduate Fellow*, Studies on Mordanted and Weighted Textiles
Mandi Haile, *Volunteer*, Archaeological Materials Analysis
Jennifer Hau, *Summer Intern*, Anoxic Testing
Tara Hornung, *Summer Intern*, Archaeological Conservation in Panama
Javier Iñáñez, *Post-Doctoral Fellow*, Technical Characterizations of 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
Michelle Lee, *Summer Intern*, Public Relations
Danielle Leikach, *VIARC Researcher*, Testing of Metals Exposed to Fire-Retardant Materials
Laura Fuster Lopez, *Visiting Scholar*, Mechanics
Odile Madden, *Arsenic Project Contractor*, Arsenic and Heavy Metal Pesticides Project
Anthony Maiorana, *Intern*, Developing a Non-invasive Instrumental Analysis Protocol of Smithsonian's Plastic Collections
Candace McMillen, *Summer Intern*, XRD of Archaeological Ceramics
Silvia Ottolini, *Volunteer*, Mechanics
Christie Pohl, *Kress Post-Graduate Conservation Fellow*, Investigation of Cyclododecane's Effect on the ¹⁴C Dating of Archaeological Materials
Christine Regan, *Summer Intern*, NMAAHC Costume Collection
Dawn Rogala, *Research Fellow*, Abstract painting structures at HMSG
J. Corey Smith, *Kress Fellow in Objects Conservation*, Organic Coatings on Silver, House of Representatives Mace, Glass Bead Disease, and Environmental Monitoring of Exhibition Cases
Stephanie Spence, *Summer Intern*, NMAAHC Costume Collection
Manisha Turner, *Summer Intern*, Mechanics
Leslie G. Weber, *Conservation Fellow*, Archaeological Conservation

Center for Folklife and Cultural Heritage

MCI 6122 Conservation of San Lorenzo 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

Cooper-Hewitt, National Design 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. The preliminary tests at the Cooper-Hewitt suggested that it was not the alkaline, insoluble lime (CaO) that is 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.



Freer Gallery of Art and Arthur M. Sackler Gallery

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

MCI Staff: Lynn B. Brostoff

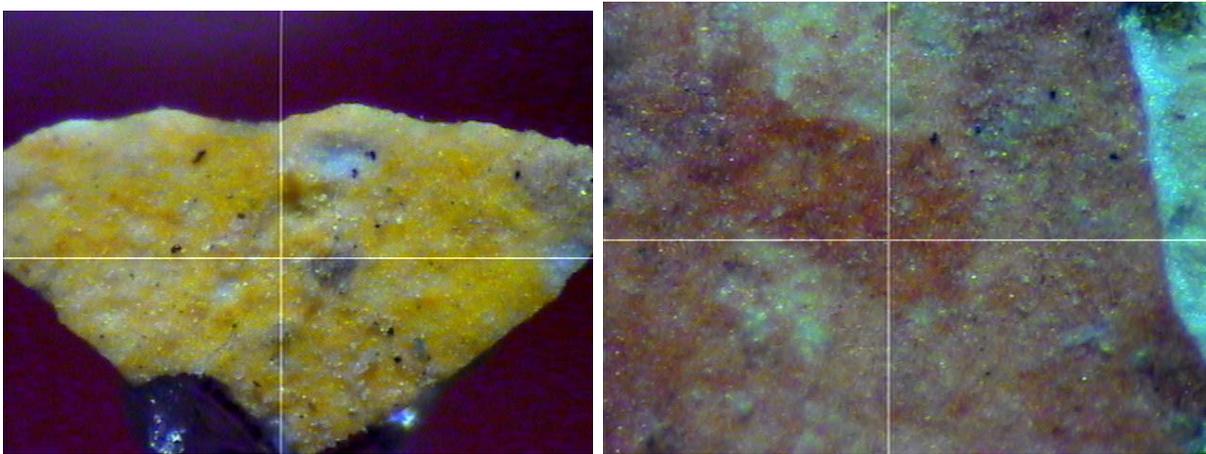
Twenty-one fragments of gold foil attributed to the late Eastern Zhou period in China have been under investigation as part of a larger study of ancient Chinese gold. Compositional analysis of the gold performed using energy-dispersive X-ray fluorescence spectrometry on the surface of the fragments showed that the pieces had the same gross alloy composition: 92-94% gold, 6-7% silver, and less than 1% copper. Trace element analysis using laser ablation inductively coupled plasma-mass spectrometry indicated two, or perhaps three, groupings of the gold according to the ratios between their platinum and palladium contents.



MCI 5998 XRD of Egyptian wall painting samples

MCI staff: Lynn B. Brostoff

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.

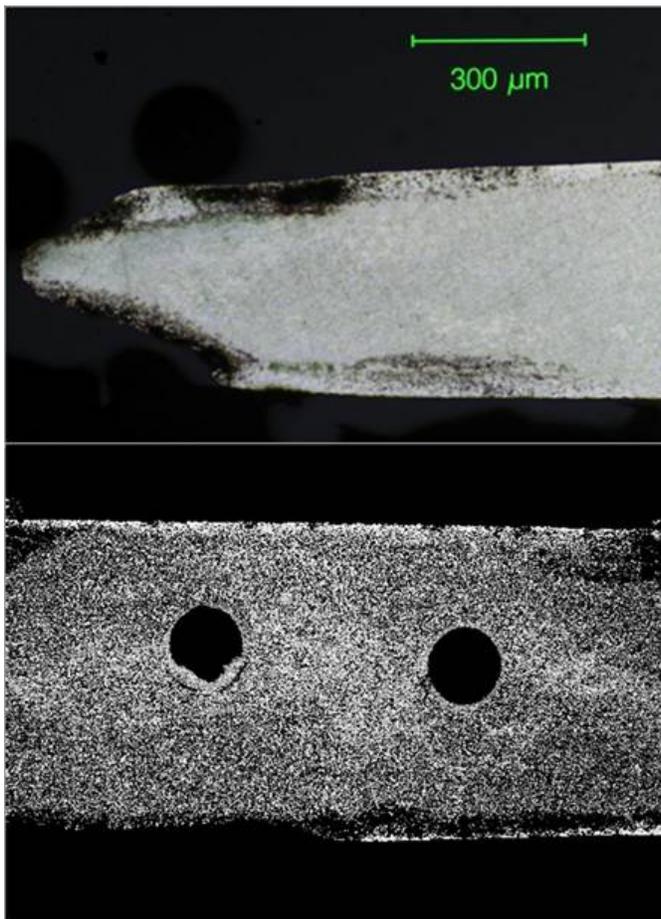


Yellow and red paint flakes mounted for XRD analysis.

MCI 6019 Chinese Silver Archaeological Samples

MCI Staff: Lynn B. Brostoff

Twenty –two fragments of silver objects dating to the Tang dynasty, Warring States Period or Western Han Dynasty from various archaeological sites in the area of Xi'an, Shaanxi Province, China, were sampled in a technical study. Using X-ray fluorescence spectroscopy and laser ablation inductively coupled plasma-mass spectroscopy the alloys were determined to be generally high in their silver content, greater than 90%, and almost half of the samples had silver contents of 97% or more. Some of the samples had mercury gilding. In addition, test samples of silver alloys were cast, worked and studied to better understand the metallographic structures seen in the ancient samples.



Scanning electron micrographs of silver sample LRN 6360, after cross-sectioning and polishing; bottom image shows two laser ablation craters.

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..

Hirshhorn Museum and Sculpture Garden

MCI 6074 Rodin Sculpture: Monument to Balzac

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

The existing patina and surface coating of the Rodin sculpture was examined and analyzed to determine an appropriate replacement patina and surface coating for this outdoor sculpture.



Museum Conservation Institute

MCI 5808 Embedded Wire

MCI staff: Martha Goodway

Wire partially embedded inside the bronze bust of Bindo Altoviti dated ca.1550, attributed to Benvenuto Cellini, and was sampled at the Isabella Stewart Gardner Museum for examination at MCI. Technical examination of the wire and core were consistent with 15th century manufacture.

MCI 5959 Effectiveness of Organic Coatings on Silver Exposed to Hydrogen Sulfide

MCI Staff: Carol A. Grissom, Nichole Grabow, J. Corey Smith, Lynn B. Brostoff

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.



MCI 6039 Painted Organic Objects Recovery from the Site of El Perú-*Waka'*,
Petén, Guatemala
MCI Staff: Harriet (Rae) F. Beaubien, Leslie G. Weber

In 2005, excavations at the site of El Perú-*Waka'* – located in the epicentral region of the ancient Maya world – uncovered an elite burial in Early Classic levels of a pyramid/temple complex (250-600 AD) with burial offerings of ceramics vessels and three painted organic objects, the latter surviving only as collapsed deposits of paint flakes. The MCI conservators stabilized the paint flakes *in situ* with a relatively new conservation material – cyclododecane - and then lifted the deposits, so that they could be transported safely to the project's laboratory in Guatemala City.



Beaubien being lowered into the burial chamber



Burial floor, with one paint deposit (untreated) at the far end, and another (after plaster jacketing) in the foreground



Weber jacketing a paint deposit, following stabilization with cyclododecane



Three paint deposits in the field lab, fully protected for transport, storage and further study

MCI 6075 Inter-Instrument Comparison of Portable XRF Equipment

MCI Staff: Lynn B. Brostoff

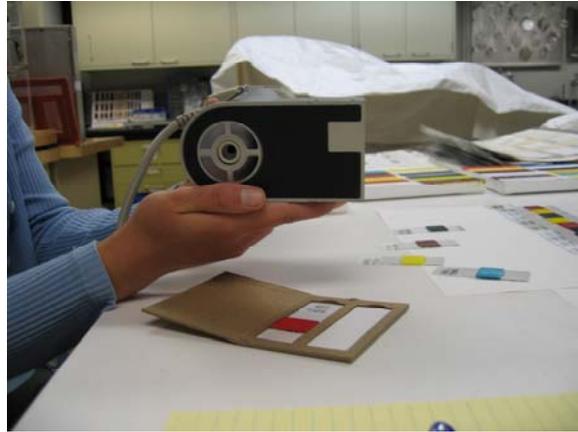
MCI is leading an inter-unit instrument comparison of portable X-ray fluorescence spectrometers at MCI, the National Museum of Natural History - Department of Repatriation, National Museum of the American Indian, Freer Gallery of Art and Arthur M. Sackler Gallery, and the Office of Safety, Health and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



MCI 6076 Characterization of Ageing of Synthetic Organic Pigments

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

Eighty pure synthetic organic pigments, plus 154 commercial paint samples on canvas and 56 commercial paint samples on glass tiles, aged and un-aged, were analyzed by X-Ray diffraction to help characterize potential changes after aging, as part of a larger study, entitled “Research on Modern Art Materials.”



MCI 6078 Hunley Silk Bandana Samples

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

Three samples from a silk bandana recovered from the H.L. Hunley submarine in the Charleston, SC harbor were analyzed for iron content and stability to determine whether the textile could be stabilized by any of the commonly used conservation treatments. Each sample had been treated in a different manner. Analysis at MCI determined the most effective treatment.

MCI 6099 10,000 Springs Pavilion Exhibition

MCI Staff: Paula T. DePriest, Jia-sun Tsang, Marion F. Mecklenburg, Mel J. Wachowiak, Don C. Williams, Ann B. N’Gadi, and 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.



MCI 6110.1 Red-slipped Maya Pottery Characterization

MCI Staff: R. Jeff Speakman, Lynn B. Brostoff, Ron H. Cunningham

Six modern low-fired, red-slipped ceramic sherd disks were analyzed by scanning electron microscopy-energy dispersive spectroscopy and X-ray dispersive spectroscopy for elemental and mineralogical composition, respectively, of the tiles to determine which of the modern slips was a best match with red Maya slips from Mesoamerica.

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

MCI Staff: Christie M. Pohl, Harriet (Rae) F. Beaubien, 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 cyclic hydrocarbon, it can contribute carbon isotopes that may confound dating of archaeological materials.

MCI 6115 Alaska Projectile Points

MCI Staff: R. Jeff Speakman, Walter R. Hopwood, Odile Madden

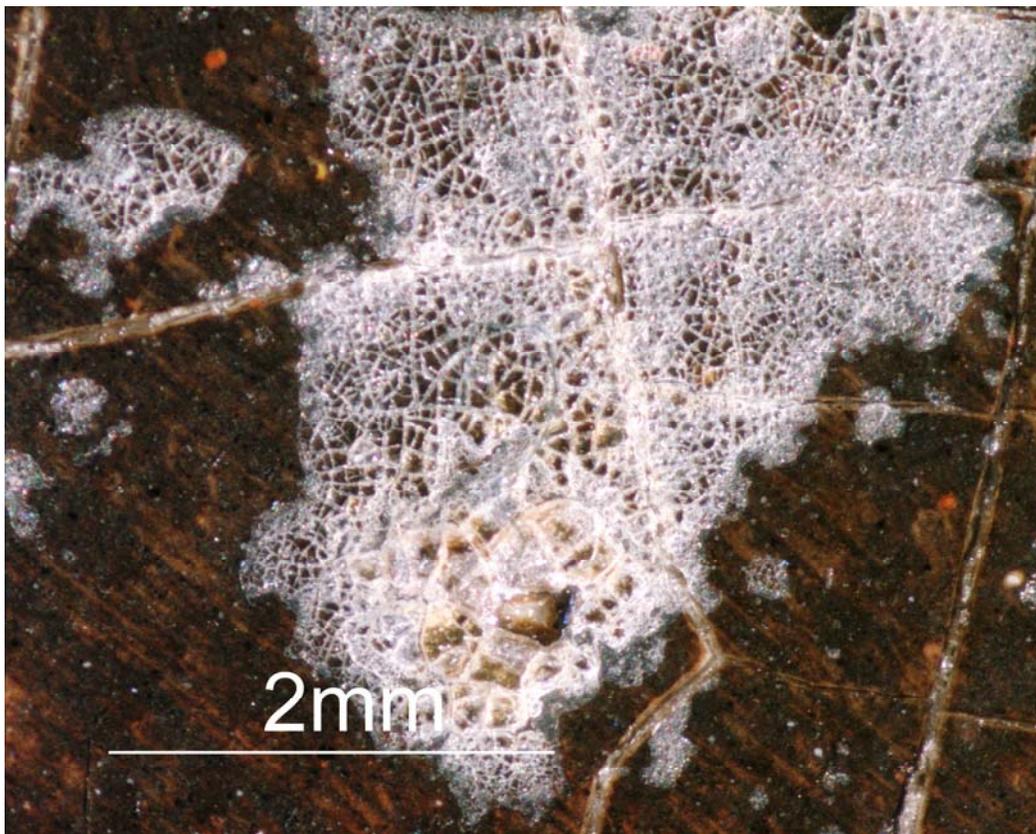
Three prehistoric chert projectile points from Alaska were analyzed with Fourier transform infrared spectroscopy and Raman spectroscopy to identify the residues that were used for hafting the projectile points by the prehistoric peoples of Alaska.



MCI 6121 Identification of 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 6123 Pesticide Mitigation Workshop

MCI Staff: Paula T. DePriest, Beverly M. Smith, Francine T. Lewis

MCI hosted a symposium on “Mitigation of Pesticides on Museum Collections” on Monday and Tuesday, April 23 and 24, 2007. The workshop was attended by approximately 60 international, national, and local participants and featured ongoing research relating to mitigation of pesticides and other contaminants on museum collections. On the basis of information presented in the symposium, MCI will develop mitigation research projects tailored to Smithsonian collections issues.

MCI 6131 Tortoiseshell and Tortoiseshell Substitutes

MCI Staff: Donald C. Williams, Odile Madden, Nicole C. Little, Judy Watson

Tortoiseshell and its plastic imitations were prepared for analysis by Raman spectroscopy and Fourier transform infrared spectroscopy. The goal of the project was to distinguish authentic tortoiseshell from artificial, with the ultimate goal of publishing an atlas of tortoiseshell and tortoiseshell substitutes.



MCI 6133 Naturally Aging Conservation Polymers

MCI Staff: R. Jeff Speakman, 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 Fourier transform infrared spectroscopy to build a reference database. The purpose of the database will be to observe, document, record, and track natural aging on conservation materials.

MCI 6134 Argon Registration: Application and Documentation

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

Documentation was compiled and collated to substantiate the claim of argon as a suffocant. The documentation was prepared according to the guidelines developed by the US Environmental Protection Agency for the registration of argon as a Registered Use pesticide, namely as an anoxic fumigant. To date Argon has only been registered as an inert ingredient.



MCI 6135 Argon Treatment Manual for Use in Structural Bubble

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

In preparation for suffocation treatment of a large costume collection acquired by the National Museum of African American History and Culture, MCI staff adapted an operation manual for carbon dioxide treatment in “Bubble” containers, 11.5 X 11.5 X 8 feet, for argon gas suffocation. The argon operation manual was reviewed and approved by the Director of the Museum Support Center, and the Deputy Director of the Office of Safety, Health, and Environmental Management, as well as by the Director of MCI, who has published extensively on his research work using argon treatments to control insect and fungal infestations in fine art objects.



MCI 6140 Testing of Metals Exposed to Fire-Retardant Materials

MCI Staff: Lynn B. Brostoff, Danielle Leikach, Anthony Maiorana

The 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 Oddy tests

electrochemical testing methodology



MCI 6141 Dissipation Characteristics of ZnO (Zinc Oxide) in Lime Water

MCI Staff: Nicole C. Little, R. Jeff Speakmen, Carol A. Grissom

Lime water [$\text{Ca}(\text{OH})_2$] spiked with known quantities of powdered zinc oxide (ZnO) was analyzed by inductively coupled plasma-mass spectroscopy to quantify the solubility of zinc oxide in lime water through time. Data from this study will facilitate a better understanding of zinc behavior in calcium carbonate environments, especially when zinc is used as an antimicrobial additive in consolidants used in the conservation of stone monuments and buildings.

MCI 6147 Lumarith: A Century Later - Developing A Protocol: Non-invasive Instrumental Analysis of Smithsonian's Plastic Collections

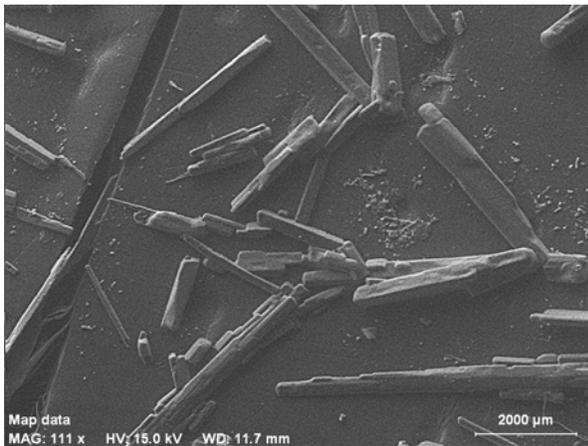
MCI Staff: Jia-sun Tsang, R. Jeff Speakman, Odile Madden, Anthony Maiorana, Walter R. Hopwood, Judy Watson

Forty-nine Lumarith (cellulose acetate) color samples from the collection of the National Museum of American History were analyzed by Raman spectroscopy, Fourier transform Raman and Fourier transform infrared spectroscopy, X-ray fluorescence spectroscopy, and scanning electron microscopy-energy dispersive X-ray spectroscopy to identify their binders and pigments and correlate this to their degree of deterioration.





Sample CA #9b Color Coupon exhibited degradation in the form of cracking, warping, shrinking and efflorescence.



Sample CA #9b. Scanning electron microscope image showing fully formed crystals and a crack. The crystals were identified as triphenyl phosphate, plasticizer, confirmed by XRD and FT-Raman and FT-IR. The leached plasticizer is one of the indicators of cellulose acetate degradation.



Scanning electron microscope elemental mapping of Sample CA #9b. Elemental mapping showing oxygen (orange), carbon (green) and phosphorus (purple). The crystals are enriched in phosphorus in comparison to the surrounding area. The crystals were identified as triphenyl phosphate, a plasticizer for the cellulose acetate.

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

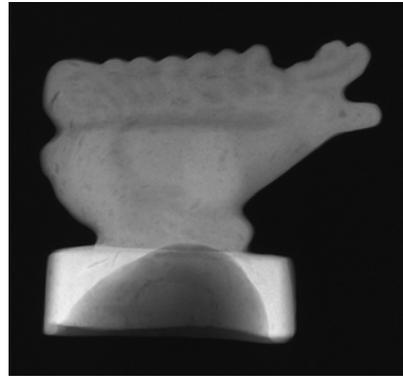
MCI Staff: R. Jeff Speakman, Mary W. Ballard, Dan Koestler, Jennifer Hau, Robert J. Koestler

Prussian blue and indigo painted and dyed onto various commercially-available materials, such as Watman'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.

MCI 6156 Small Reindeer Figure from Mongolia

MCI Staff: Nino Kalandadze, Tea Kintsurashvili, Carol Grissom, Ron Cunningham, Walter Hopwood, Judy Watson, Lynn Brostoff

A small reindeer figure from Mongolia was analyzed to determine the method of manufacture, materials made from, and the surface coatings. The technical study will contribute information on the nature of ritual objects in Mongolian culture and their shared iconography.



National Air and Space Museum

MCI 6073 World War I Balloon Basket

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

The US Marine Corps World War I balloon basket made of wicker and hemp was sent to MCI for a condition examination and recommendation for treatment to prepare the basket for an upcoming exhibit. The wicker basket was deformed and needed to be reshaped and supported.

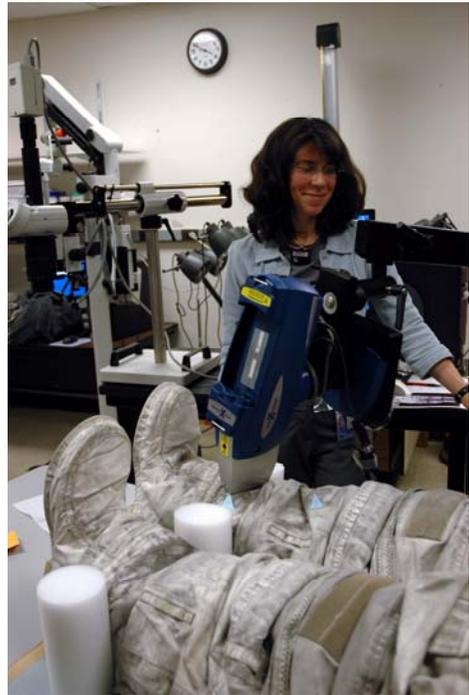


MCI 6079 Apollo Spacesuit Dust Research

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

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 World War II Aircraft Wing

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

A painted aluminum Heinkel He219A German World War II aircraft wing was examined under UV and IR light for better visualization of its partially obscured markings. In addition, on-site X-ray fluorescence spectroscopic analysis and cross-section sampling of the painted wing was undertaken to answer questions of fading and restoration. These analyses will determine if two seemingly different color regions are different paints representing the original WWII aircraft paint and its subsequent repair. The information gathered may be used to confirm/refute popular literature concerning pigments and colorants used to paint German WWII aircraft.

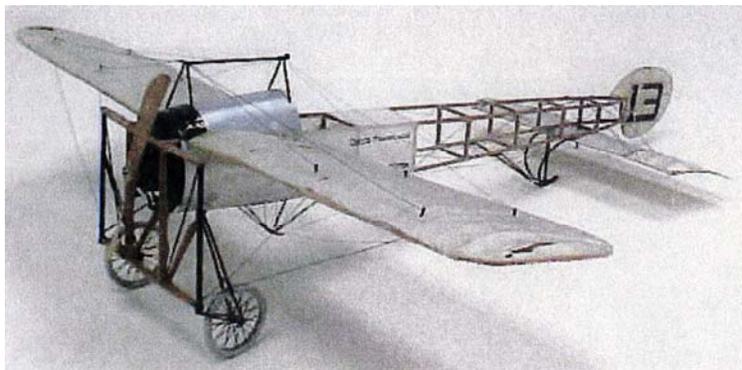


Jia-sun Tsang, Senior Paintings conservator assisted by Dave Wilson, Museum Specialist at NASM, carried out paint analysis with portable X-ray fluorescence spectroscopy on painted wing from a Heinkel He-210 German WWII aircraft.

MCI 6102 Queen Monoplane Model

MCI Staff: Mary W. Ballard

A model of the Queen Monopland, used by Earle Ovington for the first US air mail flight in September 1911, was examined to determine if the condition of its fabric cover was suitable to allow its exhibition in the upcoming "America by Air" exhibit. The fabric on the lower wing and fuselage was in good condition, perhaps due to prior replacement. The more yellowed fabric covering the upper wings was splitting where the wood frame contacted the undyed silk taffeta (plain weave). Two options were presented: exhibiting the plane from below so as to avoid any treatment or replacing the upper wing and the horizontal stabilizer while leaving intact the fuselage and underside of the wings.



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 X-ray fluorescence spectroscopy to characterize the possible original plating, and to identify secondary metals. The analysis will aid the current restoration efforts on the aircraft by providing information critical to determining whether the steel hub should be replated to mimic the original appearance, or left as-is.

MCI 6116 Herschel Telescope Tube

MCI Staff: Mel J. Wachowiak

The Herschel telescope tube was visually examined and monitored for changes in a crack in the wooden tube, visually and with physical measurement, over several months, to ensure the preservation of the artifact by monitoring for changes that may be due to exhibit conditions.

MCI 6119 Liberty 12 Model A Engine

MCI Staff: Lynn B. Brostoff

The Liberty 12 Model A engine was analyzed by XRF to determine the alloy composition of the aluminum crank case to characterize the piece and to inform restoration decisions.



MCI 6125 Cabinet Felt

MCI Staff: Odile Madden

Felt from a collection storage cabinet was analyzed by X-ray fluorescence spectroscopy to determine if the cabinet was contaminated by heavy metal pesticide residues.

MCI 6137 Grumman XF8F-1 Model Interior Weights

MCI Staff: Mary W. Ballard, Carol A. Grissom, Nora Lockshin, 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 6138 Glider Fabric

MCI Staff: Walter R. Hopwood

Fabric on a Lilienthal glider in the NASM collection, built in 1894 with minor refurbishing in 1906 and 1928, and complete restoration in 1967, was analyzed with FTIR to characterize the construction of the glider. Lilienthal was the most significant pre-Wright brothers aeronautical experimenter and the NASM Lilienthal glider is one of six remaining in the world. FTIR analysis of the fabric shows the presence of shellac in the spotty coating on the woven cellulose cloth. This information will aid in decisions regarding further conservation of this important museum object.



MCI 6139 Civil Aeronautics Board Flag

MCI Staff: Mary W. Ballard

A nylon Civil Aeronautics Board flag was evaluated in regards to display and possible treatment. The flag is to be displayed in an exhibit to open in the fall of 2007, and would be displayed horizontally within a case. Advice was provided on how to mount the flag in this position.

MCI 6144 Fokker D-7 Aircraft Fabric

MCI Staff: Mary W. Ballard, Walter R. Hopwood

The Fokker D-7 aircraft fabric was analyzed to determine the type of clear coating that was present on the fabric, identify the dyes used on the fabric, and characterize the fabric as to material and weave.

MCI 6149 1854 Trippe Globe

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

This terrestrial globe on a floor stand was treated by a team of conservators from MCI and NASM. The globe is a *papier mache* sphere nearly three feet in diameter and over four feet tall resting on an oak stand. A brass meridian ring allows the globe to rotate on its axis and longitudinally, therefore, all parts of the globe can be viewed. MCI conservators contributed their expertise in the final varnishing step in the restoration of the globe and stand. The packing case was reconfigured to suspend the globe so that no padding touched the surface. MCI scientists conducted X-ray fluorescence analysis of the metal hardware supporting the globe and Fourier transform infrared spectroscopic analysis to characterize some samples of coatings.



National Museum of African American History and Culture

MCI 6069 Painting: Walking by Charles Alston, 1958

MCI Staff: Jia-sun Tsang

A conservation condition assessment was performed for this painting. It has aged well and is in excellent condition with no evidence of past treatment or restoration. The painting needs only a stable housing and handling guidelines. The challenge is to create a suitable yet innovative framing system that includes protective glazing and security locks and to streamline and accommodate the dual function of display and storage.



MCI 6070 Costume Collection

MCI Staff: Carol A. Grissom, Mary W. Ballard, Robert J. Koestler

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 packed in 268 boxes that occupied a total volume of approximately 2000 square feet and transported to MCI for, disinfestation, cataloguing, and rehousing.



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

A technical study of skin-covered African masks was undertaken to determine if use of specific materials could assist with provenancing. While there are some contemporary accounts of materials used to make these unusual sculptures, there had, to date, been no analysis of artifacts from older collections. The sculptures consist of carved wood, which is covered with skin and decorated with hair, bone, metal, plant fiber, pigment, and/or dye. X-ray fluorescence spectroscopic analysis confirmed the use of bone to represent teeth, lead for most of the eyes, and, in most cases, iron-based pigmentation on the skin. Wooden substrates showed high amounts of strontium and associated elements, which are most likely related to the region of origin. Scanning electron microscopy images aided in identification of hair and fibers while Fourier transform infrared spectroscopy aided in the identified of organic substances and pigments from the masks.



National Museum of American History

MCI 6007.2 Columbia High-Wheel Bicycle

MCI Staff: Jia-sun Tsang, Anthony Maiorana, Candace McMillen, Jeff Speakman

Bakelite (phenol formaldehyde) handles are believed to be the only original element left on the Columbia high-wheel bicycle. A whitish bloom had developed on the handles for a second time after the bicycle was put on display in the Commons at the Castle. Raman and X-ray diffraction spectroscopies aided in suggesting an explanation for the deterioration and in devising a course of action to arrest it.



MCI 6051 NMAH Renovation Vibration Study

MCI Staff: Marion F. Mecklenburg

With the ongoing renovation in the NMAH building, there were questions regarding vibrations and their effects on the building and collection artifacts stored within: What are the effects of jack-hammers on the building? How far will the vibrations travel? At what distance could the vibrations be considered negligible? Structural engineering theory and principles were used to answer these questions.



MCI 6101.1 Ship Models

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

Samples provided by NMAH taken from several ship models were analyzed using Fourier transform infrared spectroscopy to attempt to identify substances that had been applied to them. Questions included: (1) substances, such as tea or coffee, which might originally have been applied to the sails or creosote to the wood; and (2) substances accumulated through open display. Unfortunately, the sample size was insufficient to yield results.

MCI 6101.2 HMS Caesar Ship Model

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

Samples provided by NMNH from several ship models were analyzed using Fourier transform infrared spectroscopy to attempt to identify substances that had been applied to them. Questions included: (1) substances, such as tea or coffee, which might originally have been applied to the sails or creosote to the wood; and (2) substances accumulated through open display. Unfortunately, the sample size was insufficient to yield results.



MCI 6113 Civil War Confederate Uniform

MCI Staff: Mary W. Ballard, Walter R. Hopwood

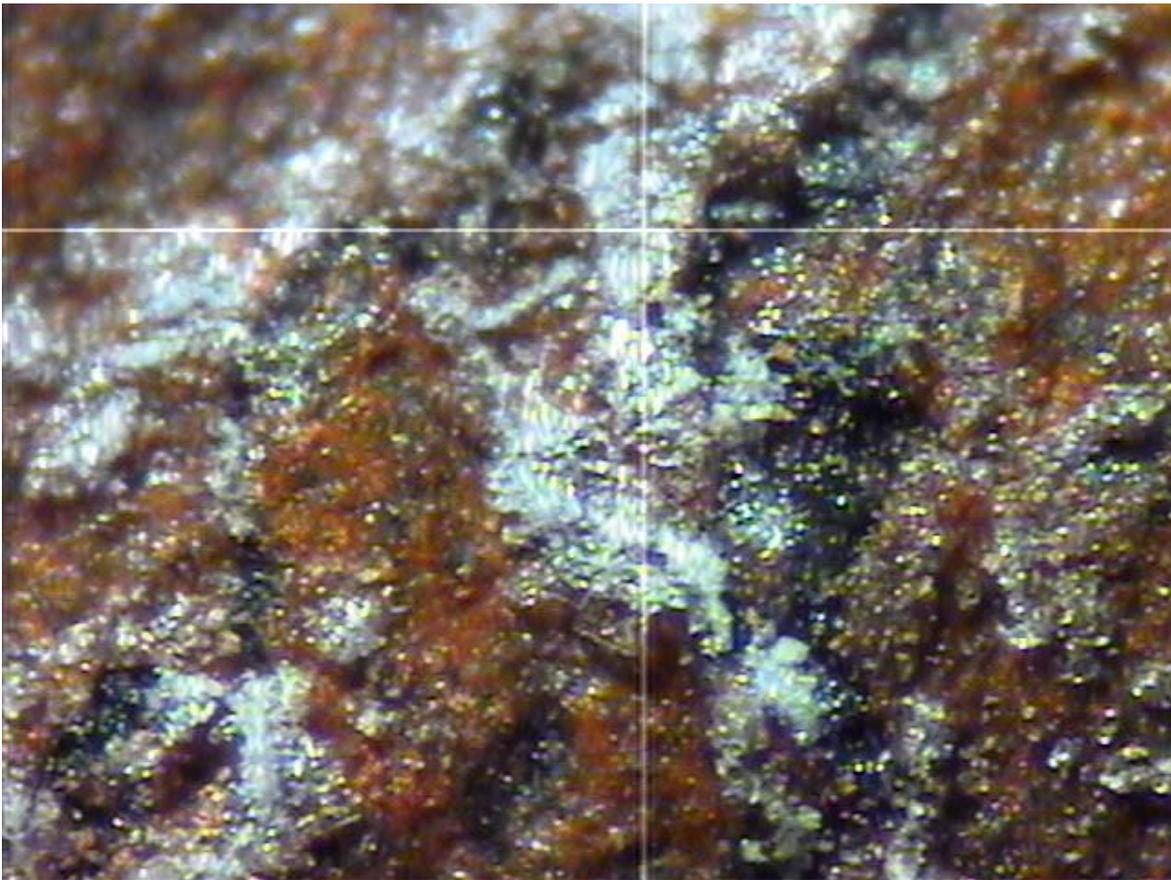
A stain transferred from a rare type of Civil War Confederate uniform to its muslin cotton storage shroud was analyzed using Fourier transform infrared spectroscopy and gas chromatography-mass spectroscopy to determine if it was historic or modern and to aid in selection of appropriate conservation treatment methods. A passive absorption monitoring device was used to collect a larger, more specific sample of volatile compounds potentially responsible for the stain's mild oily smell.

National Museum of the American Indian

MCI 5972 Research Project on Salts in Ceramics

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

Ceramic sherd samples and their associated burial soils were examined with X-ray diffraction (XRD) to identify soluble salts that could potentially cause salt efflorescence problems in excavated ceramics. The XRD examination of selected samples of soil and sherds—as whole pieces, powdered samples, and of the dried, wash water residues—showed the prevalence of calcite (calcium carbonate) and halite (sodium chloride) in most of the soil and sherd samples. A much larger array of salts representing potential efflorescence products—other carbonates that incorporate calcium, sodium, magnesium and/or potassium; potassium chloride; potassium sodium chloride; potassium nitrate; potassium hydroxide; calcium sulfate hydrate; and potassium sodium sulfate—were detected and identified in the filtered wash water residue from the soil and/or powdered sherds themselves.



Efflorescence on sherd #14 induced in the laboratory and analyzed by μ XRD.

MCI 6015 Glass Beads from a Cree Plains Prairie Woman's Dress: A case study of glass bead disease exhibited on the woman's side-fold

MCI Staff: Carol A. Grissom, Ron H. Cunningham, Lynn B. Brostoff, J. Corey Smith

An important and rare 19th century Plains woman's side-fold dress in the collection of the National Museum of the American Indian was noted to have potential glass bead disease while it was being prepared for the exhibit *Identity by Design*. The beads were tested for surface pH and examined by scanning electron microscopy-energy dispersive X-ray spectroscopy and X-ray diffraction spectroscopy. The analytical results show that sodium had leached out of the glass matrix to the surface of the beads and had reacted with the beads' local environment to form thenardite (sodium sulfate) and halite (sodium chloride). Sodium carbonate was not found in the accretions, but dolomite (calcium magnesium carbonate), huntite (magnesium carbonate) and potassium carbonate were identified within the surface accretions.



NMAI side-fold dress, front

MCI 6065 Stone Sculpture: Conquering Warrior

MCI Staff: Carol A. Grissom, J. Corey Smith, Ron H. Cunningham

A Cahokia-style stone sculpture, Conquering Warrior, was analyzed by radiography to determine the extent of the original stone material versus plaster restorations.

MCI 6092 Environmental Monitoring of Exhibition Cases in the Exhibit: “Windows on Collections”

MCI Staff: J. Corey Smith, Carol A. Grissom

The Windows on Collections exhibition at the National Museum of the American Indian was monitored for light levels with seven HOBO U12 data loggers from the time of their installation on June 29, 2006, through May 1, 2007. The five cases on the third and fourth floors of the museum are subject to daily and seasonal changes in the level of light due to their proximity to external windows and the Potomac Atrium with its large ocular window. The ten-month study showed that light levels for two monitors frequently exceeded 10 lum/ft² or about 100 lux. Most other monitors regularly measured in the 5 lum/ft² range or about 50 lux. Fifty lux is generally considered the maximum light level to prevent damage to sensitive materials over time.



MCI 6093 Ceramic Sherd

MCI Staff: Lynn B. Brostoff, Walter R. Hopwood

White crystalline material, possibly hydrophilic salts, reported to have developed quickly on a ceramic sherd shortly after excavation from the Gila River Basin was identified by X-ray diffraction spectroscopic (XRD) analysis as mainly thenardite (anhydrous sodium sulfate). Fourier transform infrared spectroscopy confirmed the presence of sulfates. A secondary phase of halite (sodium chloride) was also identified by XRD. In contrast, a related study MCI #5972 of a small group of sherds and associated burial salts from the Gila River excavation site found several types of sulfate minerals or compounds, including apthitalite (potassium sodium sulfate) and sodium sulfate, but only as trace or minor phases in the XRD patterns from wash water residues of some soil samples.

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 3D 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 6107 ShapeLock Moldable Plastic

MCI Staff: Odile Madden, Walter R. Hopwood

ShapeLock, a moldable plastic considered for use in conservation, is described by the manufacturer/distributor as an “Ultra-High Molecular Weight Low Temperature Thermoplastic,” was determined after analysis and review of the manufacturer’s technical specifications to be a polycaprolactone polymer that breaks down by hydrolysis in a short time period – in some applications in the order of months. Since the material is chemically unstable, has poor aging characteristics, and may react with other materials with which it comes in contact, it was advised that ShapeLock is not suitable for general use in conservation.

MCI 6108 Northern Great Plains Painted Hides

MCI Staff: Lynn B. Brostoff

Painted hides from the Northern Great Plains collection were examined to determine the pigments used on them. The initial study focused on the yellow-green and the red pigments on a Crow buffalo hide. Pigments were analyzed by X-ray diffraction spectroscopy and portable X-ray fluorescence spectroscopy; results were compared to materials and techniques described in the historical and ethnographic records and to a published study of similar pigments.

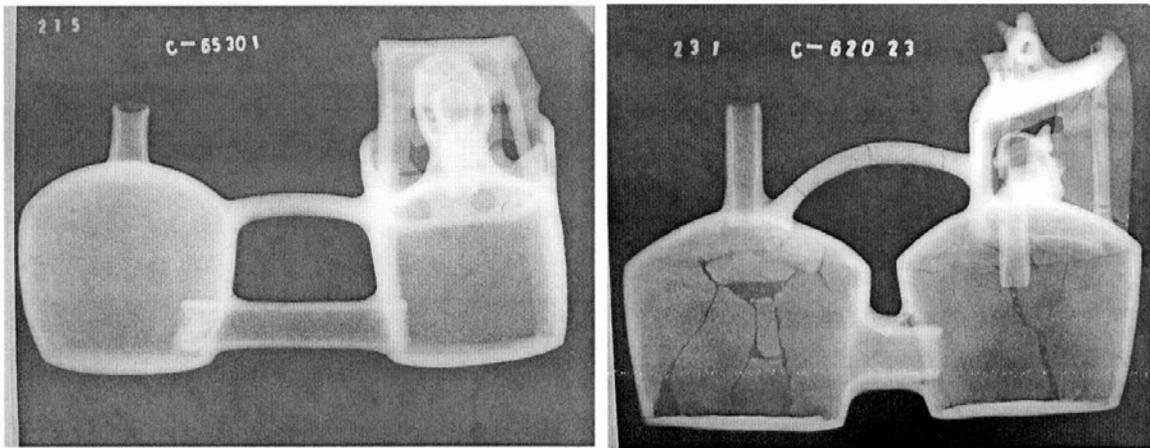


XRF analysis of the Crow Hide Robe at NMAI.

MCI 6143 Early Intermediate Period (IEP) North Coastal Peruvian Ceramic Whistling and Architectural Vessels

MCI Staff: Ron H. Cunningham

Twelve Peruvian Early Intermediate Period ceramic whistling and architectural ceramics were analyzed by X-radiography. The X-radiographs provided visual data about the technical construction of Vicús, Virú, Salinar, and Moche single- and double-chambered architectural whistling vessels. The goal was to determine whether the vessels, even those without stylistic similarities, share construction techniques and represent a technological continuum not previously documented.



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

MCI 6109 Alaska Exhibition Project

MCI Staff: Marion F. Mecklenburg

Selected collection items from 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 building addition and exhibition cases to house these items (about 600 items). The cases are purpose-built to allow display as well as handling of the objects by Native American community members. MCI was asked to review the structural designs of the cases and mounting supports for resistance to earthquakes.

National Museum of Natural History

MCI 6005 Disk Discovered in Burial # 21, Gol Mod 2 Cemetery Arkhangai aimag, Mongolia

MCI Staff: Harriet (Rae) F. Beaubien, Christie M. Pohl

Technical analysis and conservation treatment was undertaken on side A of the disk.



MCI 6022 Rosebud Winter Count (Lakota Sioux)

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

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 6047 2006 Field Season Documentation of Mongolia's Deer Stones
MCI Staff: Harriet (Rae) F. Beaubien, B. Vicky Karas, Leslie G. Weber

A Breuckmann TriTos (3-D) structured-light scanner was used to produce high-resolution 3-D digital records of "deer stones," Bronze Age monuments on the Mongolian steppe. The scanning documented 14 deer stones (including #14, which had been molded and cast by Smithsonian model-makers in 2002) at Ushkiin Uver. Also scanned this year was Ulaan Tolgoi deer stone #2, the tallest known at nearly four meters, near Lake Erkhel (both sites in Hovsgol aimag). Other deer stone documentation activities were carried out at the Hovsgol Museum in Muren, as well as at the sites of Burdnii Ekh, Khushuutii am, and Khanuy Valley KYR119 (Arkhangai aimag).



MCI 6048 Archaeological Field Conservation in Mongolia for the 2006 Field Season

MCI Staff: Harriet (Rae) F. Beaubien

The Khanuy Valley Project on Early Nomadic Pastoralism has begun to incorporate conservation in both field and lab operations. Artifacts from Gol Mod 2, an important Xiongnu period cemetery dating between approximately 300 BC and 200 AD, were recovered. A segment of a wooden coffin wall decorated with iron strap work was the focus of this field season. Although the wood was badly degraded, the iron pieces had been maintained in their original positions by the plaster jacket. The objects were excavated, reassembled and a protective storage box was fabricated that allowed the pieces and their arrangement to be accessible for further study. In addition, a protective storage housing was made for an unusual bronze disk wrapped in textile which has been excavated from burials at Gol Mod 2.

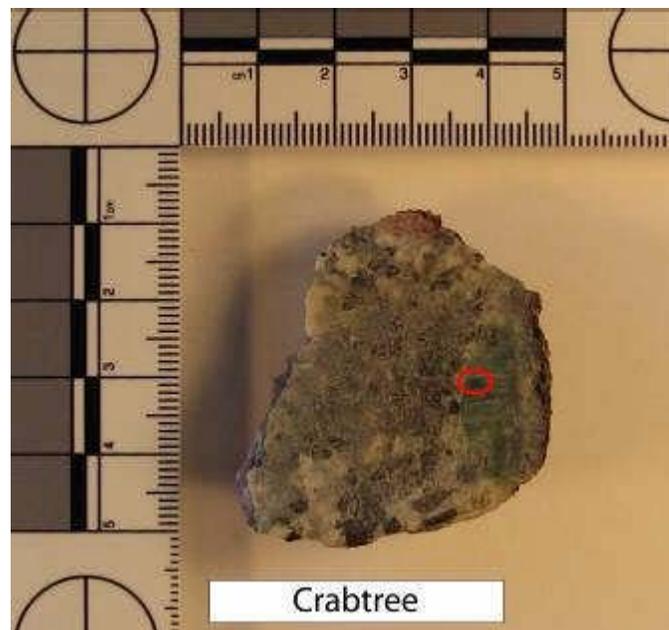
This season, the Khanuy Valley team and the French-Mongolian team excavating Gol Mod (1), another Xiongnu cemetery, had an opportunity to collaborate with the MCI team. The Cultural Heritage Center and the Institutes of History and Archaeology were collaborators in this field season also.



MCI 6077 Beryl Minerals

MCI Staff: Nicole C. Little

An investigation of the lithium content of beryl minerals was undertaken at the NMNH Mineral Sciences department. MCI initiated a pilot study to determine the feasibility of utilizing laser ablation-inductively coupled plasma-mass spectroscopy to quantitatively analyze lithium in beryl minerals. Five mineral samples from Crabtree, New Mexico, Hiddenite (dark- and light-tinted), Montana and one glass standard (Brill Glass A, Corning Museum of Glass), included for quality control were analyzed. The results indicated that individual beryl mineral sources are internally homogeneous and that lithium varied by as much as two orders of magnitude among the five sources included in this study.



MCI 6083 Efflorescent Salts on Archaeological Sherds from Mummy Lake Ruins, Mesa Verde National Park, Colorado

MCI Staff: Harriet (Rae) F. Beaubien, Christie M. Pohl, Walter R. Hopwood, Ron H. Cunningham, Lynn B. Brostoff

A dense white whiskery salt efflorescence was discovered on two Ancient Puebloan period ceramic sherds from Far View House, in the Mummy Lake Ruins at Mesa Verde National Park, Colorado, now in the collection of NMNH. Samples of the salts were analyzed at MCI using Fourier transform infrared spectroscopy, scanning electron microscopy-energy dispersive X-ray spectroscopy and X-ray diffraction spectroscopy, and were identified as a calcium chloride acetate nitrate hydrate, probably thecotrichite. This salt is somewhat unusual in that it can crystallize at RH levels considered appropriate for the museum storage environment. Test strips were placed in the cabinet to examine whether the subsequent efflorescence could have been triggered by exposure to a source of volatile acetic acid within their current metal storage unit.



Two neck-rim sherds with efflorescent salts, seen on the right (2 April 2007)



Picture of crystalline material mounted for XRD analysis.

MCI 6084 Deer Stones, Ushkiin Uver, Mongolia

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

The documentation of Mongolia's deer stones is an outgrowth of MCI-NMNH collaboration in the Joint Mongolian-Smithsonian Deer Stone Project. The deer stones at the site of Ushkiin Uver (Hovsgol aimag), Mongolia were scanned using 3-D imaging. The post-processing phase at MCI included aligning and cleaning-up the digital scan data to produce a high quality 3-D archival record for each deer stone that can also be used for web viewing, 3-D graphic analysis and study, and computer numerical controlled milling or rapid prototyping as needed.



MCI 6085 Deer Stones, Ulaan Tolgoi, Mongolia

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

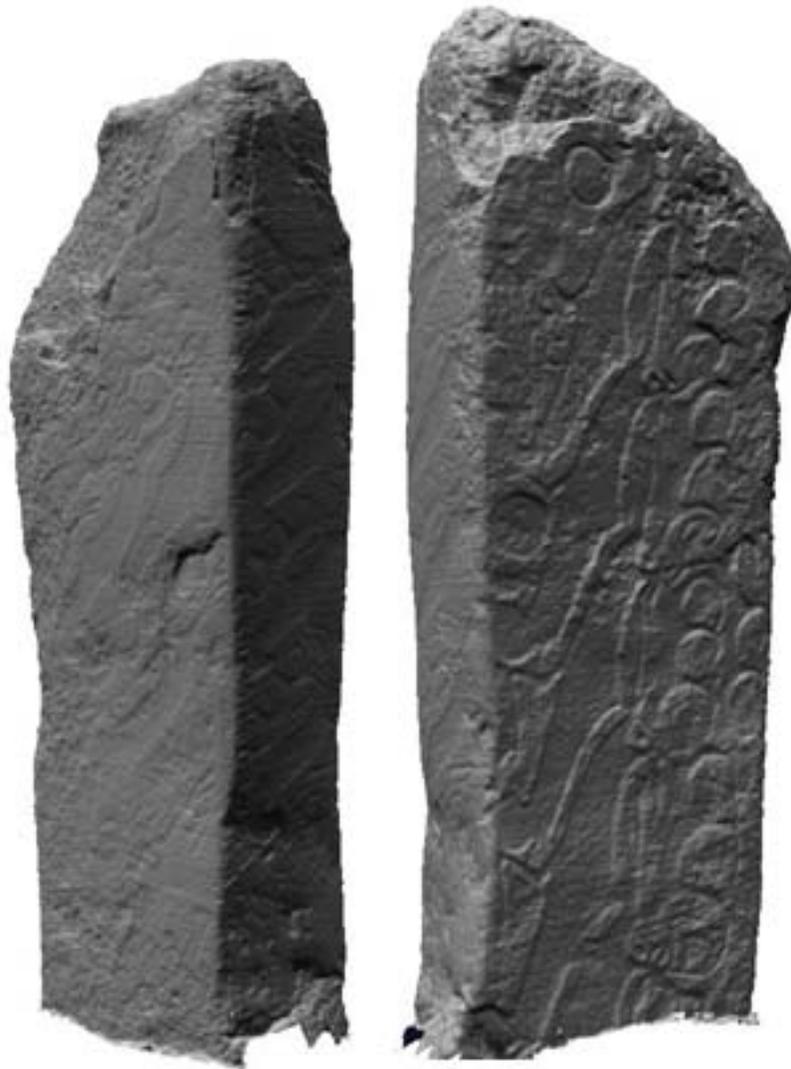
Post-processing was carried out on 3-D digital data generated from scanning the five deer stones, EL.01 – EL.05, from the site of Ulaan Tolgoi, west of Erkhel Lake (Hovsgol aimag) in northern Mongolia. These stones had been scanned in situ in the summer of 2005 by an MCI team using a FastSCAN Cobra™ handheld laser scanner (Polhemus™), and in 2006 EL.02 was re-scanned using a triTos™ structured light scanner (Breuckmann GmbH). The resulting digital data sets for EL.01, 03, 04 and 05 were post-processed into stereo tessellation language (stl) formats using Polhemus™ system software and Rapid Form™ (XOS) graphic software at MCI. The raw data set from the structured light scanning in 2006 was post-processed into stereo tessellation language (stl) formats using the triTos™ system software (Optocat) and Rapid Form™ (XOS) 3-D graphic software. The final processed data can be used for virtual metrological and iconographic study of the object as the viewer is able to manipulate the 3-D image on a computer screen. Processed data can also be used with computer numerical controlled milling machines and 3-D printers for rapid prototyping. Both technologies can utilize processed 3-D data to make replicas of the original object in the positive or negative and in a variety of materials and sizes.



MCI 6086 Deer Stones, Erkhel East 1, Mongolia

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

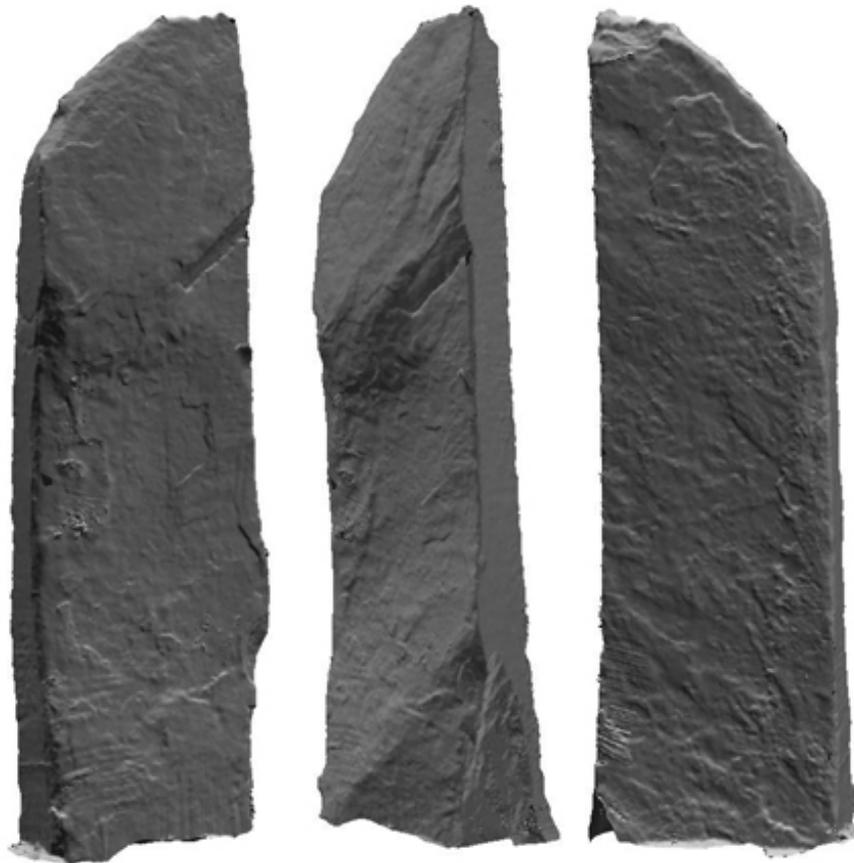
Post-processing was carried out on 3-D digital data generated from laser scanning deer stones EE.1-01 and EE.1-02 in northern Mongolia. These stones had been scanned in the summer of 2005 in situ by MCI conservators using a FastSCAN Cobra™ handheld laser scanner made by Polhemus™. At MCI, the resulting digital data set was post-processed into stereo tessellation language (stl) formats using Polhemus™ system software and Rapid Form™ (XOS) graphic software. The final processed data can be used for virtual metrological and iconographic study of the object as the viewer is able to manipulate the 3-D image on a computer screen. Processed data can also be used with computer numerical controlled milling machines and 3-D printers for rapid prototyping. Both technologies can utilize processed 3-D data to make replicas of the original object in the positive or negative and in a variety of materials and sizes.



MCI 6087 Deer Stones, Erkhel North 1, Mongolia

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

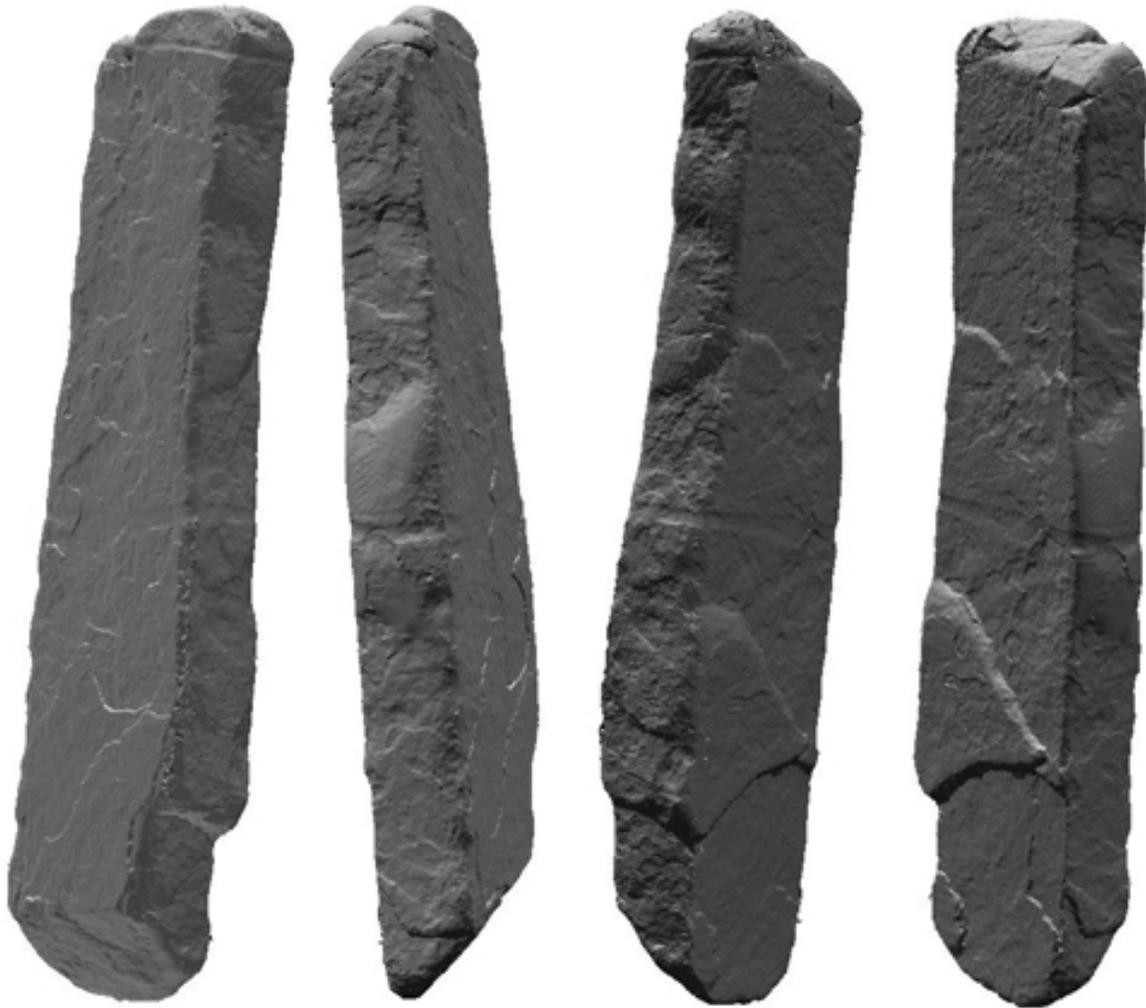
Post-processing was carried out on 3-D digital data generated from laser scanning deer stones EN.1-01 and EN.1-02 in northern Mongolia. These stones had been scanned in the summer of 2005 *in situ* by MCI conservators using a FastSCAN Cobra™ handheld laser scanner made by Polhemus™. At MCI, the resulting digital data set was post processed into stereo tessellation language (stl) formats using Polhemus™ system software and Rapid Form™ (XOS) graphic software. The final processed data can be used for virtual metrological and iconographic study of the object as the viewer is able to manipulate the 3-D image on a computer screen. Processed data can also be used with computer numerical controlled milling machines and 3-D printers for rapid prototyping. Both technologies can utilize processed 3-D data to make replicas of the original object in the positive or negative and in a variety of materials and sizes.



MCI 6088 Deer Stones, Efd Valley, Mongolia

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

Post-processing was carried out on 3-D digital data generated from laser scanning deer stone Efd-01 at Efd Valley in northern Mongolia. This stone had been scanned in the summer of 2005 in situ by MCI conservators using a FastSCAN Cobra™ handheld laser scanner made by Polhemus™. At MCI, the resulting digital data set was post-processed into stereo tessellation language (stl) formats using Polhemus™ system software and Rapid Form™ (XOS) graphic software. The final processed data can be used for virtual metrological and iconographic study of the object as the viewer is able to manipulate the 3-D image on a computer screen. Processed data can also be used with computer numerical controlled milling machines and 3-D printers for rapid prototyping. Both technologies can utilize processed 3-D data to make replicas of the original object in the positive or negative and in a variety of materials and sizes.



MCI 6089 Deer Stone #14, Ushkiin Uver, Mongolia
MCI Staff: Mel J. Wachowiak, B. Vicky Karas, Harriet (Rae) F. Beaubien

Deer stone #14 is one of the most well-known deer stones in Mongolia because of the rare incorporation of a human face, in addition to the stylized deer with exaggerated antlers, that typify the iconography of these Bronze Age carved stone monuments. In June 2006, deer stone #14 at the site of Ushkiin Uver was 3-D scanned by conservators from MCI, as part of an ongoing deer stone documentation program under the auspices of the Joint Mongolian-Smithsonian Deer Stone Project. The scan data provided a complement to traditional methods of documentation as it records precise and high resolution metrological and topographic information of a three dimensional object. The resulting processed data can be used in a variety of formats to support the project's research, preservation and outreach goals, including virtual display, and production of 3-D models and accessible 2-D graphic products. The data file was created in the field using a Breuckmann triTos™ structured light scanning system. At MCI, the data was processed using commercial software *Optocat* and *Rapidform 2006*.



MCI 6094 Lepidoptera Genitalia Slides

MCI Staff: Walter R. Hopwood, Mel J. Wachowiak

Lepidoptera genitalia mounted were on glass slides thirty years ago in a medium that subsequently crystallized and obscured the specimens. MCI specialists analyzed the medium in an attempt to recover the pieces and remount them. The medium was soluble in xylene, but the pieces were too far gone to be saved and remounted. Recommendations on how to best treat the slides for recovery were provided.

MCI 6095 Chilkat Blanket and Related Textiles

MCI Staff: Mary W. Ballard, Anne-Marei Hacke, Lynn B. Brostoff, R. Jeff Speakman

X-ray fluorescence spectroscopic analysis (XRF) was performed with a portable, handheld spectrometer by Innov-X Systems, Inc. on four Chilkat textiles. At least one XRF spectrum of each color in the design was obtained from each textile. The colors were white, yellow, blue and two areas of black (design area and side panel). The Chilkat textiles showed similar distributions of elements indicating that the same types of dyes were used throughout. Contaminants, possibly arising from pesticide treatment, comprised high levels of mercury on all textiles and comparatively lower levels of lead and arsenic.



MCI 6098 Ancient Maya Figurines

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

3-D scanning of three Mayan figurines was completed to assess the quality of the 3-D digital data and feasibility of using them for supplemental publications.



MCI 6098: 3D Scan Data (Solid Views of Individual Figurines)

MCI 6110.2 Mesoamerican Clays

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

Clays, possibly used in the manufacture of Maya pottery, were analyzed by X-ray diffraction spectroscopy to compare their mineralogical characteristics with chemical profiles of known clays used by Maya pottery producers.

MCI 6114 New MSC Pod 5 Fluid Storage Tanks Design

MCI Staff: Marion F. Mecklenburg

MCI assisted in the design of the new fluid storage tanks for Pod 5 at the Museum Support Center, which will be used for large specimen storage. These tanks are essential containers for these collections, and require engineering appropriate for the size requirements, as well as a design that promotes long-term preservation of fluid-stored collections in a purpose-built facility.

MCI 6117 Documentation of Mongolia's Deer Stones – 2007 Field Season
MCI Staff: Harriet (Rae) F. Beaubien, B. Vicky Karas, Christiane Bathow

Hundreds of carved stone monuments called “deer stones,” produced about 3000 years ago, are distributed across the vast northern steppe of Mongolia. High-precision documentation of the stones’ surfaces was continued in the 2007 field season. This season the team used a Breuckmann triTos structured-light scanner to produce complete high-resolution 3-D digital records of 14 deer stones (several in two pieces) at five sites and the Hovsgol Museum, all in the northernmost province of Hovsgol aimag. These were among 30 partial or complete deer stones also documented with photographs and condition records over a three-week period. The 3-D scan files, together with these other documents, have important applications for research (such as detailed iconographic and technical study), museum display (including high-resolution models created from the digital files), and preservation (including base-line condition monitoring records).



Two deer stone groups at Khyadag



Night scanning a deer stone at Khushuugiin Devseg

MCI 6118.1 Colonial American Skeletal Material

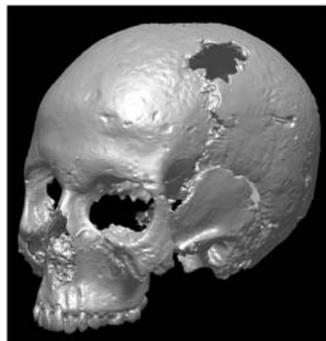
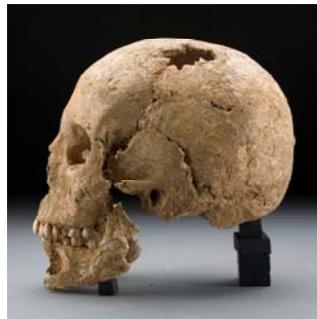
MCI Staff: Nicole C. Little, R. Jeff Speakman

Approximately 50 samples of 17th century colonial human skeletal material were analyzed by inductively coupled plasma-mass spectroscopy to quantify lead and other heavy metal concentrations. Data from this project was integrated into a NMNH exhibit entitled *Life and Death in the Colonial Chesapeake*. Lead concentration will be used to infer health and social status in early colonial populations.

MCI 6118.2 Colonial American Skeletal Material

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

Three 17th century colonial skulls were 3-D scanned, photographed, and re-housed. A 3-D hardcopy of one of the skulls was manufactured by the Smithsonian's Office of Exhibits Central, using 3-D data generated by MCI, for facial reconstruction and exhibit.



MCI 6118.2: 3D Scan Data (Solid Views)



MCI 6124 Ethnographic Objects: Baskets and Plastic Hair Ornament
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 in NMNH's ethnology collection, 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.



NMNH ET8589 Pair of hairpins

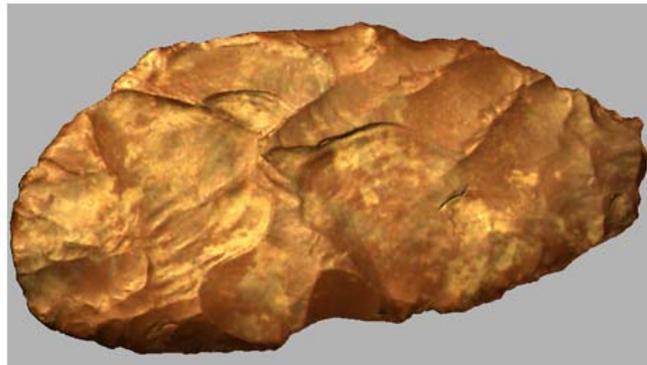
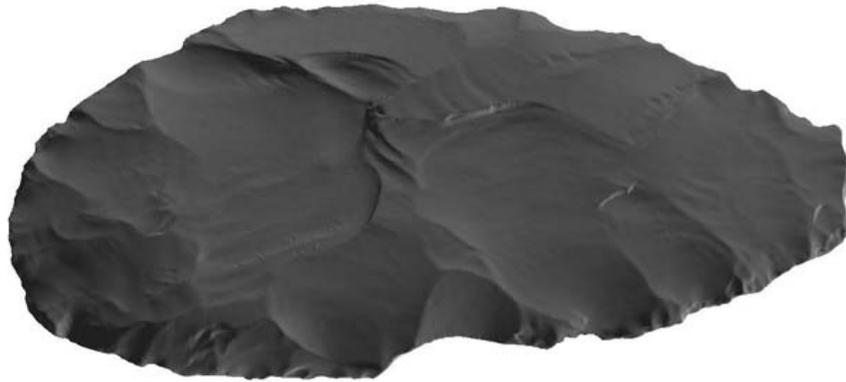


NMNH E203286 Pomo seed bin basket

MCI 6126 Clovis Obsidian Biface from Idaho

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

3-D 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 6127 Animal Hides

MCI Staff: Harriet (Rae) F. Beaubien, R. Jeff Speakman, Lynn B. Brostoff, Walter R. Hopwood, Marion F. Mecklenburg, Judy Watson, Robert J. Koestler, Paula T. DePriest

A collection survey and analysis of the white efflorescence on animal hides in the Mammals Division of NMNH determined the extent of the problem. The results of the survey and the analyses were used to make recommendations regarding the preservation measures and appropriate storage conditions for the hides.

MCI 6129 Meteoritic Bead

MCI Staff: Nicole C. Little

A study of the applicability of laser ablation inductively coupled-mass spectroscopy (LA-ICP-MS) to compositional analysis of meteoritic ore was performed on two meteoritic ore samples: one from a well-characterized meteorite from northern Chile, and the second submitted as an unknown source. The goal was to verify the analytical accuracy of LA-ICP-MS for analyses of the meteorites and to identify the origin of meteoritic ore used in the manufacture of a Native American bead uncovered in Illinois dating from the Mississippian period (800–1500 AD).

MCI 6132 Olorgesailie Rock

MCI Staff: Judy Watson, Odile Madden

A rock with possible anthropogenic modification, recovered during excavation at Olorgesailie, Kenya from a stratum dating between 200,000 and 400,000 years old, was analyzed using scanning electron microscopy-energy dispersive X-ray spectroscopy (SEM-EDS) to determine whether the red areas on this rock were ochre. Data generated by the SEM-EDS analysis indicated that the red areas on this rock were indeed ochre. If these results are confirmed, this might be the earliest positive evidence for the use of pigments by hominines.



MCI 6136 Basketry

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

See MCI 6124.

MCI 6145 *Ursus* Bone

MCI Staff: Ron H. Cunningham

Twenty *Ursus* bones from NMNH collections were xeroradiographed to facilitate the measurement of cortical area dimensions. Data generated from this project will be combined with *Ursus* data from other collections and also with data generated for *Canis* species to evaluate the hypothesis that skeletal robusticity scales with body size and possibly is associated with the increasing size of prey taken.

MCI 6150 Tapa Fibers

MCI Staff: Ron H. Cunningham

The inner bark or "bast" of tropical trees was frequently used to make a cloth known as "tapa"—examples of which are housed in NMNH collections. For the native inhabitants of the Pacific, tapa had many ceremonial and ritual uses, and was made into bedding, robes, and other articles of clothing. For this project, fibers from a Hawaiian tapa believed to be manufactured from a breadfruit tree were examined by scanning electron microscopy (SEM). The SEM images aided a botanist in the identification of the plant source used to create the tapa.

MCI 6151 Two New Reference Materials: STL-1 Stewart Lepidolite and ZA-1 Zapot Amazonite

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

A study of granitic pegmatites was undertaken to provide an X-ray fluorescence calibration curve. Due to the complex geochemistry of granitic pegmatites, it is difficult to find reference standards suitable for their quantitative analyses. Samples from well-characterized pegmatites (Macusani and Zinnwaldite) were analyzed by inductively coupled plasma-mass spectroscopy in conjunction with previously uncharacterized amazonite and lepidolite samples.

MCI 6152 Mollusk Shell from North Syria

MCI Staff: Ron H. Cunningham, Nicole C. Little

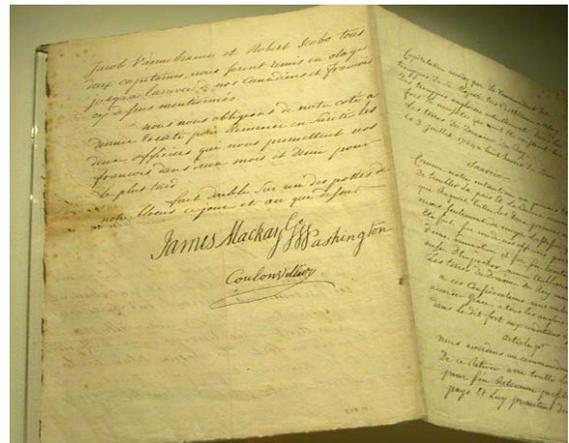
Mollusk shell samples from North Syria were embedded in epoxy and analyzed by scanning electron microscopy. The reconstruction the aquatic environments and long-distance trade patterns in North Syria during the 3rd millennium BCE, based on the study of mollusk remains from archaeological sites in the Khabur region, were aided by these analyses.

Office of Exhibits Central

MCI 6071 Exhibit: “Clash of the Empires: The British, French, and Indian War 1754-1763”

MCI Staff: Jia-sun Tsang, J. Corey Smith, Anthony Maiorana

The largest French & Indian War Exhibition to date, *Clash of the Empires*, was installed and de-installed with exhibition conservation services provided by MCI staff which included setting procedures for unpacking, mounting, condition surveying, packing, relative humidity, temperature, and lighting standards. Included in the exhibition was a multi-million dollar collection of 32 paintings, many of them masterpieces of the time. One was the “Treaty of Fort Necessity,” an original surrender document signed by 22-year-old British officer George Washington of the Virginia Regiment in 1754.



MCI 6154 SI Exhibit “Lola Alvarez Bravo” Installation

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.



Jia-sun Tsang served as exhibition conservator working with A&I and IG exhibition office in collaboration with Smithsonian Latino Center in the installation of *Lola Alvarez Bravo* at the S. Dillon Ripley Center, International Gallery

MCI 6155 SI Exhibit “Mexican Treasures in the Smithsonian Institution”
Installation
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.



Entrance of the exhibition **Mexican Treasures of Smithsonian** organized by Smithsonian Latino Center at S. Dillon Ripley Center, International Gallery, September 5-November 11, 2007

Office of Facilities Engineering and Operations

MCI 6081 Peas-and-Flowers Settee

MCI Staff: Carol A. Grissom, Walter R. Hopwood

The Peas-and-Flowers Settee was examined while it was undergoing treatment by an outside firm. Removal of most of the paint from cast-iron elements had begun prior to the repair of a broken-off back leg and repair of several decorative elements on the backrest. The lowest layer of paint was sampled to determine if the color should be copied when the bench is repainted. Fourier transform infrared spectroscopic analysis found that the paint consisted of a polyester resin; indicating that it is modern. During the examination an English copyright registration mark was spotted on the reverse of the backrest, and the date of registration has been tentatively identified as April 8, 1865.



Peas-and-Flowers Settee examined and analyzed for paint authenticity.

MCI 6128 Survey of Stone Staining in the South Mall Zone Smithsonian Buildings MCI Staff: Carol A. Grissom

A survey of the staining of Indiana limestone and Seneca red sandstone in the Smithsonian's south zone, which includes the Smithsonian Castle, Freer/Sackler, National Museum of African Art, and the gateway to the Enid Haupt Garden was conducted. A tour of the facilities revealed salt formation associated with entry of water in a number of locations on building interiors. Biological growth was observed on the exterior of the Castle, apparently where there was excess moisture from a faulty downspout or guttering. The most serious damage, however, was found on the Enid Haupt Garden gateway; salt efflorescence appears to be causing delamination of the Seneca red sandstone of which it is carved.



White salt efflorescence on Enid Haupt Garden gateway appears to be causing delamination of the sandstone.

Smithsonian American Art Museum

MCI 6066 Portable X-ray Fluorescence Spectroscopy Demonstration on Some of SAAM's Collection of Art

MCI Staff: Lynn B. Brostoff

MCI demonstrated the use of our handheld Innov-X X-ray fluorescence spectroscope (XRF) at SAAM to analyze four different types of objects in their collection to answer an array of questions concerning the material composition. The XRF 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.



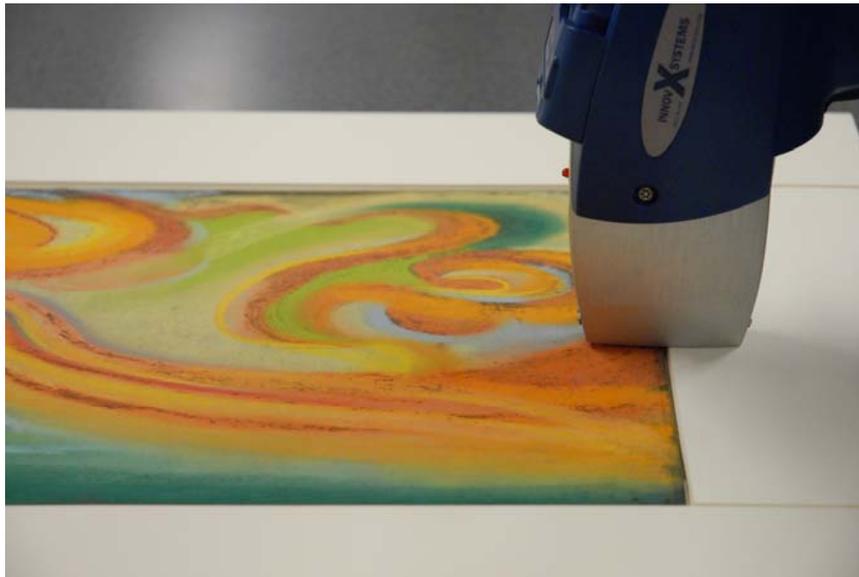
MCI scientist, Lynn Brostoff demonstrating the operation of MCI's handheld X-ray fluorescence spectrometer to the conservation staff at SAAM.



MCI 6120 Georgia O'Keefe's *Special No. 32*

MCI Staff: Lynn B. Brostoff

A pastel drawing by Georgia O'Keefe, entitled "Special No. 32" was analyzed using X-ray fluorescence spectroscopy and μ X-ray diffraction spectroscopy to identify the nature of the discoloration and to determine whether or not the pastel's current appearance is a significant departure from the artist's original intent. This analysis formed the basis for considering whether treatment was necessary and possible, and for further technical study. The analysis confirmed conservators' suspicions that dark areas in some of the red and orange pigmented parts of the drawing were composed of red lead, which has blackened from its original red color.



MCI's handheld X-ray fluorescence spectroscope used to examine discolored region of a Georgia O'Keefe pastel.

Smithsonian Institution Archives

MCI 6142 Detached Ink Silhouette Fragments from William Bache Silhouette Portrait Album

MCI Staff: Mel J. Wachowiak, Lynn B. Brostoff, Walter R. Hopwood, Judy Watson

A William Bache silhouette portrait album created with cut paper silhouettes from prepared papers and pasted in bound book with manuscript annotation has ink that is possibly iron-gallotannate with a coating resin/varnish or mixed carbon-based ink with shellac (India ink). The detached fragments were analyzed by X-ray fluorescence spectroscopy, Raman spectroscopy and energy dispersive X-ray spectroscopy to determine the pigments, dyes and binders used in the ink formulation. Random sampling throughout the bound album was done to profile the ink(s) used over time by the artist. The identification of the component/coating and ink coloring agents helped to determine a treatment plan with regard to visual compensation (retouching).

Smithsonian Institution Traveling Exhibition Service

MCI 6096 Fabric Samples

MCI Staff: Mary W. Ballard, Walter R. Hopwood

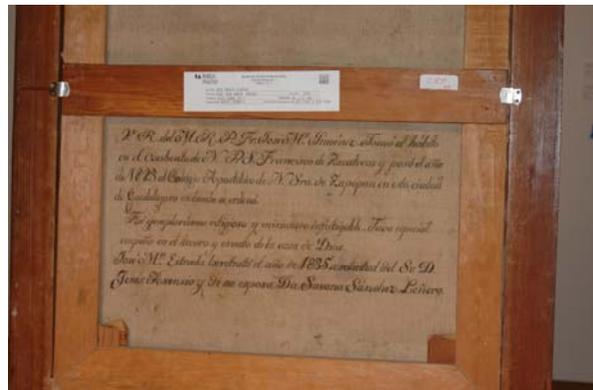
Baumann and Bellinger cotton velvet fabrics were analyzed to determine whether or not the fabrics are suitable for airtight silica micro-environment cases.

Smithsonian Latino Center

MCI 6064 Installation and De-installation of Exhibit: “Myth, Mortals and Immortality: Works from Museo Soumaya de México”

MCI Staff: Jia-sun Tsang

The *Myth, Mortals and Immortality: Works from Museo Soumaya de México* exhibition featured over 100 works by some of Mexico’s most renowned artists. For many of the pieces, which span from 16th century to the 20th century, this was the first time they had been displayed outside Mexico. Exhibition conservation services for the installation and de-installation were provided including examination and documentation the condition of 100 works of art as they were unpacked, advised contractors in safe handling of the objects, documentation and photo-documentation, provided environmental standards such as proper humidity, temperature and light level for the exhibition. Most importantly, MCI staff supervised the installation of the oversize Diego Rivera sketch “Trazo para el mural pesadilla de Guerra, sueño de paz” (32.8’ W x 13.45’ H) and suggested alternate conservation method of safe installation to the fit the curved structure walls.



Smithsonian Tropical Research Institute

MCI 6043 Series of Gold Fragments from Objects in Cerro Juan Díaz, Panama
MCI Staff: Harriet (Rae) F. Beaubien, Karla Muñoz-Alcocer, Ron H. Cunningham

This study focused on a group of 39 metal artifacts, 38 of which were excavated at the site of Cerro Juan Díaz, an important village and funerary precinct in the Azuero Peninsula. The study group included 18 gold and gilded artifacts – the largest number found at a single site in Panama. Samples from the metal objects were analyzed using scanning electron microscopy-energy dispersive X-ray spectroscopy, laser ablation-inductively coupled-mass spectroscopy and X-ray fluorescence spectroscopy to identify major and minor elements present. Quantitative information was collected on selected elements—gold, silver, copper, iron, manganese, nickel, zinc and osmium—to determine the alloy composition. Analyses of one additional sample highlighted the importance of selecting appropriate locations for sampling, and of examining not just surface composition but also the bulk.



MCI 6097.1 Two Pre-Columbian Stone Sculptures

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

Two Pre-Columbian basalt sculptures at the Museo Antropológico Reina Torres de Arauz, Panama City, Panama were analyzed with 3-D imaging using MCI's non-contact structured light scanning system that produced accurate metrological and high quality digital files. Data was used to produce exhibition panels at El Caño Archaeological Park and to carry out a comparative study between the Gran Coclé and Gran Chiriquí sculptures. The 3-D imaging information will also be used to create replicas by rapid prototyping or computer numerical controlled milling machines.



MCI's 3-D structured light scanning system collecting data from pre-Columbian objects.

MCI 6097.2 Four Pre-Columbian Stone Sculptures

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

Four Pre-Columbian carved basalt stone sculptures from the El Caño Museum, El Caño Archaeological Park, Panama were analyzed with 3-D imaging. The 3-D imaging used non-contact structured light scanning that produced accurate metrological and high quality digital files that would be used to produce exhibition panels at El Caño Archaeological Park and to carry out a comparative study between the Gran Coclé and Gran Chiriquí sculptures. The 3-D imaging information will also be used to create replicas by rapid prototyping or computer numerical controlled milling machines.



MCI's 3-D structured light scanning system collecting data from pre-Columbian objects.

MCI 6100 Pre-Columbian Goldworking in Panama: Illuminating Its History, Preserving Its Heritage

MCI Staff: Harriet (Rae) F. Beaubien, Christie M. Pohl, Richard Cooke, Aaron Shugar, other interns

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, 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, 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 Five 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 were 3D scanned using a Breuckmann GmbH, triTos™ scanner. The 3-D digital raw data were post-processed using Rapid Form™ (2006 & XOS) graphic. The digital data will be used by researchers from STRI 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 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.

Library of Congress

MCI 6090 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.

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 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 6091 Armorial Chandelier

MCI Staff: Carol A. Grissom, Walter R. Hopwood, Ron H. Cunningham

A Cornelius & Baker *Armorial Gasolier*, probably one of three originally installed in the second-floor hallway of the U.S. Senate around 1857, was recently acquired by the Senate from Tudor Place in Georgetown. Examination and analyses of a halberd component from the gasolier revealed that a silver-colored coating on the light fixture consisted of tin-flake paint rather than plating. Analyses of the halberd's metal confirmed that it consists of nearly pure zinc and that slush-cast zinc components were joined with lead-tin solder.



Topics in Museum Conservation Lecture Series

October 12, 2006

Technical Investigation and Conservation of Two Unusual Offerings from Mongolia

Leslie G. Weber, MCI Conservation Fellow

This presentation was an overview of technical study and conservation of two unusual objects excavated in 2005 from a burial in the Xiongnu period cemetery Gol Mod 2 (Mongolia). The artifacts, a large disk and a small perforated hemisphere, included wrappings of fragile but well-preserved cloth and cordage remains. Following preliminary stabilization by conservators in the field, they were brought to the Smithsonian Museum Conservation Institute for further conservation and technical investigation. The artifacts' structure and composition were analyzed using several non-invasive techniques. The information obtained from these analyses and comparative stylistic research helped to elucidate the function of the artifacts and the possible provenance. As demonstrated by such artifacts, a link between the Xiongnu and more western nomads of Central Asia could have important implications in understanding the relationships among the Eurasian steppes peoples. In addition, the results of this study provided further insight into Xiongnu material culture both for bronze artifacts and textile production.

October 17, 2006

Preservation and Conservation of the Wooden Tomb Chamber in Tumulus MM at Gordion

Dr. Richard F. Liebhart, University of North Carolina at Chapel Hill

Tumulus MM at Gordion is the largest of the earthen burial mounds surrounding the ancient Phrygian capital of Gordion in modern Turkey. Excavations in 1957 revealed a 2,700-year-old tomb chamber built of squared pine timbers with an outer casing of roughly-trimmed juniper logs. The 53-meter-high mound had sealed the tomb and created cave-like conditions that protected the wood from normal fungal degradation. The archaeologists found a tomb chamber filled with grave goods surrounding the remains of the dead king: they also discovered the oldest standing wooden building in the world. The focus of the discussion was the history of the preservation and conservation of the tomb, including the current environmental and structural studies.

November 3, 2006

Problematic Issues in Conservation: An Example of the Jesuit-Guarani Missions in South America

Dr. A. Elena Charola, University of Pennsylvania, School of Design, Historic Preservation

The Jesuit-Guarani Missions were established in the Guayrá area near the Paraná and Uruguay rivers in the heart of the tropical forest in the early 17th century. The system devised by the Jesuits was economically independent and comprised some thirty towns. These were located at

strategic points in the region now found in Argentina (15 towns), Paraguay (8 towns) and Brazil (7 towns). After the expulsion of the Jesuits in the mid 18th century, the missions were taken over by other religious orders, but these could not follow the system and the missions fell into disrepair and abandoned during the border wars of the 19th century. Some of these sites, such as São Miguel das Missões in Brazil, La Santísima Trinidad and Jesús de Tavarangüe in Paraguay, and San Ignacio Mini, Santa Ana, Nuestra Señora de Loreto and Santa María la Mayor in Argentina, have been declared World Heritage Sites by UNESCO. The preservation of these sites is a challenge and although foreign support is forthcoming, in many cases it brings with it other problems. Some of the issues related to both material conservation and conservation management of these sites were discussed.

December 14, 2006

Deconstructing a 17th c. Panel Painting by David Teniers and Jan Brueghel Using Confocal X-Ray Fluorescence Microscopy

Jennifer Mass, Winterthur Museum and Country Estate

The North Carolina Museum of Art's Flemish panel painting, *The Armorer's Shop*, has long been attributed to David Teniers the Younger (1610-1690). The attribution is based on the presence of his signature at the bottom right as well as visual elements that are commonly associated with him and executed in his style. The oak plank has a smaller wooden panel insert with the parade armor painted upon it. This unusual construction, combined with the identification of several paintings by Jan Brueghel the Younger (1601-1678) with the same parade armor, raised questions about the attribution and chronology of construction of the painting. Conventional microanalysis did not resolve the painting's construction chronology. Confocal x-ray fluorescence microscopy at the Cornell High Energy Synchrotron Source revealed the composition and location of buried paint layers at the panel interfaces. The relationship of the layers at these interfaces provided evidence that the inserted panel with armor was painted prior to the rest of the composition.

January 8, 2007

The Utah Pottery Project: Historic Archaeology and Materials Science

Timothy Scarlett, Michigan Technological University, Department of Social Sciences

During the late 19th century, European and Euro-american immigrants established more than 45 potteries in more than 26 towns and cities throughout the Intermountain Region of North America. These potters immigrated with the Church of Jesus Christ of Latter-day Saints (LDS) and brought with them their technological expertise into this arid region. Using materials science techniques, the Utah Pottery Project seeks to unravel the complexities of economic interaction in the "Mormon Domain." A baseline study using neutron activation analysis (NAA) of pottery from several of the primary LDS production sites was conducted in 2002 and enabled the identification discrete "chemical fingerprints" for each of the potteries included in the study. More recently, the first NAA study of trade and exchange, mapping the distribution of wares through various routes of exchange was completed. The results, although preliminary, are extremely provocative and raise a number of significant questions about traditional assumptions regarding domestically manufactured earthen- and stoneware production and distribution in the American economy.

January 30, 2007

3-D Documentation in Natural History Collections

Christine Hemm, Senckenberg Research Institute, Department of Palaeoanthropology

The Senckenberg Research Institute is one of the biggest institutions for natural history in Germany, with research stations located all over Germany. It covers all areas of natural history, from geology to deep sea research. The department of Palaeoanthropology is headed by professor Friedemann Schrenk. 3-D scanning was established in 2001, and has already proven its value in several research projects. One project which was described involves scanning of early human teeth. The study of functional aspects of dental morphology has allowed gathering information about food composition, life history and the paleoenvironment of extinct species. Other work ranges from dinosaur trackways to creating large-scale replicas from models for exhibitions.

February 22, 2007

Studies on the Identification of Mordanted and Weighted Textiles

Marei Hacke, MCI Postgraduate Fellow

Historic textile collections frequently hold silks weighted with mineral salts, and mordanted and dyed fabrics containing metal ions. These textiles are generally regarded as being the most susceptible to degradation, and conservation treatments are often problematic. The identification of the metal ions present in the textile is not only of art historical interest, but may also aid the conservator in the choice of conservation treatment. This talk provided a summary of the literature on silk weighting, focusing on its history as well as the deterioration, stabilization and identification of weighted silks. In addition, results were presented from a recent research project at MCI regarding the applicability of portable XRF analysis for the in-situ identification of metallic mordanting and weighting agents.

March 29, 2007

Saving the Marks: Preserving the Early Evidence of Tools

Donald C. Williams, MCI Senior Furniture Conservator

The process of producing lumber from a tree always leaves its mark. This presentation was a brief review of the process of getting a tree from a log; then to a cabinetmaker or joiner; what they do after they get it; and the physical evidence you can “read” from these transformations. As observers and caretakers of artifacts fashioned from these materials, it is vital for us to understand those marks so that we can consciously preserve them.

May 4, 2007

Tarnish, Silver Eagles, and Buffaloes

J. Corey Smith, MCI Fellow

This end-of-fellowship presentation covered the effectiveness of organic coatings on silver exposed to hydrogen sulfide, the House of Representatives Mace of the United States, and glass beads from a Cree Plains Prairie Woman's dress: a case study of glass bead disease exhibited on the woman's side-fold.

June 27, 2007

Having a Corking Good Time Ironing Things Out: Sub- and Super-Critical Fluids in the Conservation Field

Dr. Michael J. Drews, Clemson University, School of Material Science and Engineering, Clemson Conservation Center

Sub- and super-critical fluids have been demonstrated to have many interesting and useful characteristics in a variety of applications from the decaffeination of coffee to solvent-less cleaning. The ability to tailor the properties of these fluids by adjusting the parameters of temperature and pressure make them unique among process fluids. The general properties of super- and sub-critical fluids were discussed with an emphasis on those that make them of interest to the field of conservation. The remainder of this presentation was focused on two specific applications; the utilization of sub-critical fluids for the stabilization of iron recovered from maritime and terrestrial sites and the use of supercritical CO₂ in the drying of archaeological cork. The results from over seventy experiments on Civil War era wrought and cast iron samples recovered from saline environments were summarized. Archaeological cork was selected for study in the drying experiments because it has often been reported to be very difficult to conserve with traditional methods. PEG and other consolidants generally do not readily penetrate the pore structure as they do in very degraded wood. The cork samples employed in this study were from the *Machault*, a French ship that was scuttled in 1760 in Chaleur Bay during the battle of Restigouche and excavated by Parks Canada. The supercritical CO₂ drying procedure employed was modeled after one that has previously been reported in the literature.

June 28, 2007

The Making of Matisse's Bronzes

Ann Boulton, Baltimore Museum of Art

The first exhibition in twenty years devoted to the sculpture of Henri Matisse (1869-1954) and jointly organized by the Baltimore Museum of Art, The Dallas Museum of Art and the Nasher Sculpture Center, presented a welcome opportunity for a technical study of his bronzes. The study was undertaken at the Baltimore Museum of Art by Objects Conservator, Ann Boulton, and Curator of European Painting and Sculpture, Oliver Shell. Unlike Degas, another painter who made sculpture, Matisse exhibited his sculpture early and often and cast his first bronzes in 1906 only seven years after the creation of his first sculpture. He continued to make sculpture throughout his life, modeling the last one three years before his death. In total about 80 different sculptures were created, most cast in limited bronze editions of ten. Matisse cast editions

sporadically over decades as the market or exhibition schedule demanded with the result that early casts within one edition were sometimes separated by as many as forty or more years from later casts in the same edition. Some editions were completed after his death by his family who destroyed most of the original plaster models at the completion of each edition. This talk described the results of the technical study that included the examination of more than 120 casts some of which were subjected to x-radiography, 3-D computer modeling and alloy composition analysis (performed at the Smithsonian Museum Conservation Institute (then SCMRE) by Jia-sun Tsang, Dr. Charles Tumosa and Sarah Pinchin). Mold-making techniques Matisse used to convert clay to plaster and that resulted in series of works such as *Madeleine I* and *II* and the *Backs* were described. His choice of sand casting for bronzes made prior to 1925 and lost wax casting used after that date was discussed and compared.

July 26, 2007

Determining the Acceptable Ranges of Relative Humidity and Temperature in Museums and Galleries

Dr. Marion F. Mecklenburg, MCI Senior Research Scientist

Historically there has been considerable confusion and controversy with regards to determining the correct temperature and relative humidity settings for museums and galleries. There is no single environment that works for everything in the collections. This presentation summarized the research on how the acceptable ranges of relative humidity and temperature guidelines for museums and galleries were determined. This talk looked at how the research results fit in with the actual environmental control of the buildings at the Smithsonian Institution.



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