

COALITION

CSIC Thematic Network on Cultural Heritage. Electronic Newsletter

**Newsletter No. 13
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Special issue: Conservation of Rock Art. Part IV

Previous issues at <http://www.rtphc.csic.es>

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CONSERVATION OF ROCK ART: A BRIEF OVERVIEW

Miguel A. Rogerio-Candelera

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COALITION editor*

The last four issues of COALITION were devoted to Rock Art. We would like to thank the contributors who made possible their publication.

As we can see through this and previous issues of COALITION, Rock Art is a particularly threatened part of Cultural Heritage. This is due to different factors, such as the fragile techniques involved in its creation, climate, natural disasters or the type of environment (open-air, shelter or subterranean). Anthropogenic impact might be one of the most important threats among a myriad of risks surrounding Rock Art.

Twelve papers have been published on this subject focusing on different aspects of Rock Art conservation. Thus, two papers have been published on a global perspective (Bednarik 2006, Seglie 2006), four papers presented an overview of world Rock Art and their specific problems of conservation: Fortea (2005), Watchman (2005), Strecker and Podestá (2006), and Gutierrez (2006) on Iberian, Australian, South American and Baja California respectively. On issues related to biodeterioration four papers have been published (Saiz-Jimenez 2005, Gonzalez and Saiz-Jimenez 2005, Dandridge and Meen 2007, Jurado et al. 2007). A paper on non-invasive documentation (Mark and Billo 2006) and another one on the management of a World Heritage site, Altamira Cave (Lasheras and de las Heras 2006), complete this special issue.

From these papers a variety of conclusions could be extracted. Among them it was clear a need for a strong public promotion of the principle that all Rock Art is part of the common heritage of mankind (Bednarik 2006), a proactive research, conservation and planning in order to preserve Rock Art (Watchman 2005), the premise that the best strategy on prehistoric painting conservation

could be maintaining their original conditions (Gonzalez and Saiz-Jimenez 2005, Lasheras and de las Heras 2006). A highlight on the fragility of Rock Art and the importance of human aggressions (Fortea 2005), such as vandalism or uncontrolled tourism (Strecker and Podestá 2006), sometimes consequence of a lack of knowledge (Seglie 2006), invasive methods of recording (Strecker and Podestá 2006), and by changes of the environmental conditions that may provoke unpredicted effects (Saiz-Jimenez 2005).

We hope that this series of papers devoted to Rock Art conservation were useful for both the scientific community and those involved in the conservation and management of Cultural Heritage. We conclude the series with this issue, although papers on this subject will be welcome, as well as those related to scientific research and conservation of Cultural Assets.

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ROCK ART, LICHENS, AND GEOCHEMISTRY

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Managers of rock art sites often are confronted with the dilemma of encroaching lichen colonies on ancient rock art.

Considerable literature has been published on attempts to eliminate these enigmatic microorganisms of which there are thousands of known species. Lichens can and will colonize nearly any surface including rocks of any type from sandstone to marble. However, all lichens do not affect all rock surfaces in the same manner; though lichens ability to degrade rock surfaces both mechanically and chemically has been well established by Seaward (1997), Jones (1988), and Syers and Iskandar (1973) as well as others. The extent of the mechanical and chemical changes is dependent upon the substrate, the lichen species present, and environmental conditions including atmospheric and ground pollution.

Questions that rock art managers frequently want to answer are whether or not all lichens affect all rock surfaces and if so to what extent. The extent to which a rock surface is affected by the presence of lichens is dependent on several factors. These factors include the density of the rock substrate, the type of lichens present (such as crustose, squamulose, foliose, endolithic, etc.) and the presence of an aqueous environment. The type of lichens present along with the type of substrate can be an indicator of the depth to which surface degradation is occurring. For example, a squamulose type lichen which "anchors" itself to a surface by rhizines or hyphae and is colonizing a sandstone surface, may have a affect from the surface into the rock interior by as much as five mm or more depending on how deep into the rock the rhizines may have penetrated. Alternatively, on a more dense substrate such as granite or marble, degradation attributable to similar type lichens may only be one to two mm in depth from the surface. The difference is due to the microscopic pore spaces of the former substrate is generally greater than that of the latter. Thus, it is obviously easier for rhizines and hyphae to penetrate in between the microscopic pore spaces of the sandstone substrate. Also, the greater the porosity of the substrate, the easier it is for moisture to move through the substrate.

Unfortunately most rock art conservation literature primarily deals with the effects that lichen colonies have on the surface of rock substrates such as research conducted by Chiari and Cossio (2004), Laver and Wainwright (1995), and Piterans et al. (1997). It is, however, a well established fact in lichen

literature such as Ahmadjian and Hale (1973) and Aghamiri and Schwartzman (2002) that lichens affect rock surfaces mechanically and chemically, both surface and subsurface. Other recent research (e.g., Dandridge 2006, Dandridge and Meen 2003, and Bjelland and Thorseth 2002) has demonstrated that lichens do indeed adversely affect rock substrates from the surface to the interior of the rock. In a study conducted on two types of sandstone rock types in Wyoming by Dandridge and Meen (2003) it was found that lichen by-products, principally organic acids, can result in the reduction of mineral cements that are responsible for the consolidation of microscopic grains of the sandstone constituents. While the acids were obviously not strong enough –as documented by Chiari and Cossio (2004)–, to produce etching of quartzite grains, they were sufficiently strong to cause the loss and/or reduction of the sparse amount of mineral cements (Figure 1).

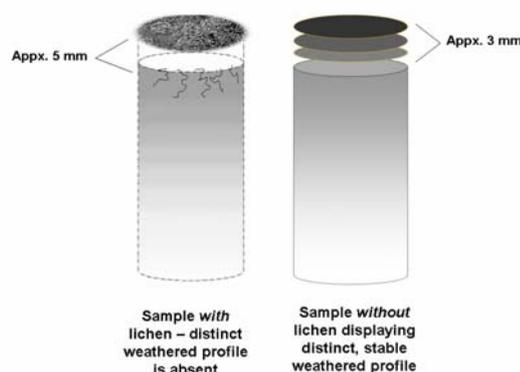


Figure 1. Illustration of rock core samples with and without lichens.

An abbreviated explanation of the very complex naturally occurring mechanisms initiated by the presence of lichens is important background information for rock art managers. Basically, in the presence of an aqueous environment, lichenic acids (when present) will be transported from the surface to the interior of the rock via microscopic pore spaces. The lichen hyphae, when present, provide an accessible transport route. Once the acids come in contact with susceptible geochemical compounds, such as highly insoluble lepidocrocite FeO(OH) or calcite cements, the cements are effectively chelated and complexed into compounds that are more easily erodable than the original matrix.

Dandridge and Meen's research has demonstrated that this general process is viable for rock substrates including sandstone, granitic, and volcanic types.

What does this mean for rock art managers and conservators? In general, lichen hyphae or other anchoring organic components of a lichen biome, penetrate the rock surface thus causing a mechanical disaggregation of the rock substrate. When lichenic acids are present any susceptible geochemical compounds will be changed into more easily erodable minerals complexes than found in the unaltered (i.e., no lichen present) weathered surface. Both actions effectively result in a surface that is unstable and susceptible to accelerated loss. Careful thought must therefore be exercised prior to removing lichens which may be obscuring, or encroaching on, rock art imagery. If lichens are removed managers must ensure that detailed recordation and documentation of rock art imagery ensues immediately. They must also assume that the newly exposed surface is going to erode at a rate faster than the surrounding rock matrix. Unfortunately, at this time there are no viable and accepted means to consolidate natural rock surfaces successfully. If visitor viewing is the objective actions, such as protective railings or viewing platforms, must be constructed so that visitors do not touch the newly exposed rock surface as that will also cause additional loss of an already weakened surface.

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CAVE RESEARCH: UNDERSTANDING BIODIVERSITY THROUGH CONSERVATION STUDIES

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Human activities generate new environments, either by the introduction of new substrata or by the generation of particular microclimates or by both processes simultaneously, and these new environments are susceptible to colonization by organisms.

Caves, monuments and Cultural Heritage sites are colonized by different classes of organisms due to their great adaptability (Saiz-Jimenez 2001). Organisms establish themselves and develop pioneer communities which are generally formed of almost monospecific populations. Pioneer communities open the way to the colonization of secondary populations, thus establishing a succession. Therefore, caves harbour a significant number of organisms adapted to that environments.

In 1996, Ariño and Saiz-Jimenez stated that an increasing in biological diversity was noticed in building stones that differed from the surrounding natural substrata and that monuments constituted a true niche for a few species when the natural habitat is threatened. This observation can be extended to caves. However, the authors suggested that biological diversity, when it does not represent a threat for the Cultural Heritage, should be considered worthy of preservation. The situation in caves with heavy microbial

colonisation is different, as the rock art paintings are threatened.

In the last years, several microbiological studies were carried out on caves (Altamira in Santillana del Mar, Murcielagos in Zuheros and Doña Trinidad in Ardales, Spain; Grotta dei Cervi in Porto Badisco, Italy) and some catacombs (Saint Callixtus and Domitilla, Rome, Italy) in the framework of European and Spanish projects. The aim of these projects was to know the effect of microbial colonization on the rocks and paintings. Due to the high number of strains isolated from these environments that could be ascribed to the actinobacterial genus *Agromyces*, a taxonomical study on the previously described *Agromyces* species and a comparison with the new isolates was performed. The research allowed us to describe 6 novel species within this genus (Figures 1 and 2), and, at the same time, an old species was reclassified (Ortiz-Martinez 2004, Jurado et al. 2005a-c). Three out of the six were isolated from caves, two from Grotta dei Cervi in Porto Badisco, Italy and one from Cueva de los Murcielagos, Zuheros, Spain. Over 1/3 of the described species within the genus *Agromyces* have been erected by these studies (Figure 3),

which enlarges considerably the diversity of the genus *Agromyces*.



Figure 1. Domitilla Catacombs: Little Apostle Cubicle where *Agromyces italicus* and *Agromyces humatus* were isolated



Figure 2. Domitilla Catacombs: First arcosolium after the entrance where *Agromyces lapideus* was isolated

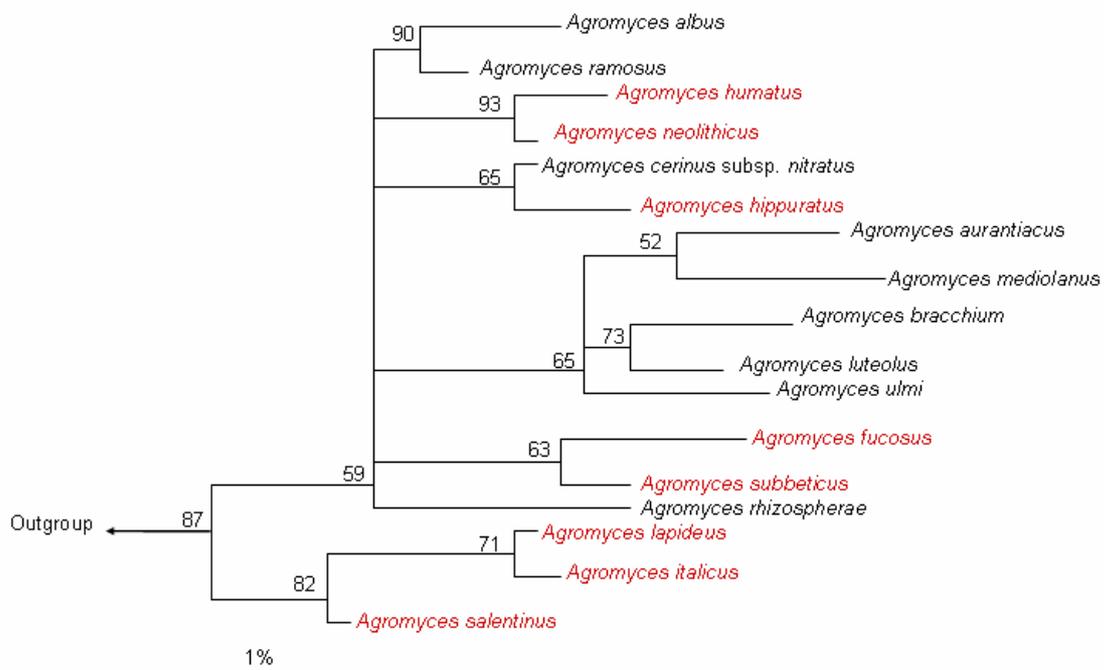


Figure 3. Phylogenetic relationships among the current species belonging to the genus *Agromyces*. Reliability values are given at branching points as percentages from 1,000 trials

Besides, new species from other bacterial groups are also being identified as it was the case of *Phyllobacterium catacumbae* isolated from the Roman catacombs (Jurado et al. 2005d) and *Aurantimonas altamirensis* (Jurado et al. 2006) isolated from Altamira cave (Figure 4). *Phyllobacterium catacumbae* and *Aurantimonas altamirensis* are members of the Rhizobiales (Alphaproteobacteria) which is a bacterial group commonly found in subterranean environments. Some members of the Rhizobiales are involved in nitrogen fixation usually in association with plants. Since hypogean environments do not allow the growth of plants, we hypothesized that *P. catacumbae* might be involved in a symbiotic relationships with phototrophic microorganisms, such as the Cyanobacteria. *Aurantimonas altamirensis* is related to marine species and represents the first known representative living under no-salt, freshwater-like, conditions as opposed to the other members of the *Aurantimonas/Fulvimarina* group within the Rhizobiales. These microorganisms remained unknown until discovered through microbiological studies for conservation.

Cultural Heritage microbiology represents a preliminary approach to the discovery of a large bacterial diversity waiting to be discovered, and certainly having serious implications on the conservation of the sites as well as the understanding of the role and functioning of microorganisms in our planet, both at the local and global scales.



Figure 4. Microbial colonization of Altamira Cave walls showing the white colorations of this type of communities where a sample resulting in the isolation of *Aurantimonas altamirensis* was collected.

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Forthcoming Congresses



THE PROTECTION OF CULTURAL HERITAGE FROM AIR POLLUTION:

The need for effective local policy, maintenance and conservation strategies

Paris, France, 15-16 March 2007

Joint workshop of the EU Project CULT-STRAT and ICP Materials Task Force of the Convention on Long-Range Transboundary Air Pollution

Aims

The purpose of the workshop is to bring together heritage building managers and policy makers and CULT-STRAT partners so that practitioner experiences and requirements are fully represented in the work of the project. This is an important opportunity for practitioners in the field to influence the policy review of the project and ultimately to help ensure that future policy properly reflects their needs. The project will be widely disseminated across Europe to appropriate local, national and international policy and decision-making bodies.

Conference Topics

- ✉ Presentation of the project's findings to date and the key issue facing the protection of cultural heritage.
- ✉ Methods for estimating the damage (corrosion & soiling) caused to materials following exposure to air pollution, including differences between indoor and outdoor exposures.
- ✉ A discussion and evaluation of prevention, maintenance and conservation strategies and plans.
- ✉ The impact and importance of air pollution relative to other factors including an assessment of economic and legal issues and public attitudes,
- ✉ Policy at local, national and international levels.

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CONSERVATION SCIENCE 2007

Milan, Italy, 10-11 May 2007

Aims

The Institute of Conservation Science, in collaboration with the Centre for Conservation and Promotion of Cultural Heritage of the

Politecnico di Milano and the Department of Food Science, Technology and Microbiology (DiSTAM) of the University of Milan, is organising an international conference, building on the earlier ICS conference held at the National Museums of Scotland, Edinburgh, Conservation Science 2002.

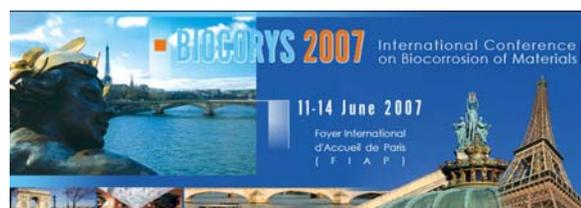
Conservation science is an international discipline which involves a great deal of international collaboration among scientists coming from all over the world. The venue has been chosen to reflect the links between the sciences and the humanities, and between architects and scientists. The hosting institutions have carried out research into the conservation of the cultural heritage for many years, and they offer good conference facilities in the university quarter of Milan.

Conference topics

- ✉ Planning and monitoring conservation works
- ✉ New trends for architectural heritage: projects and case studies
- ✉ New, non-invasive techniques for analysis
- ✉ Polymers in Cultural Heritage – deterioration and preservation.

More information:

CS2007@chem.polimi.it



BIOCORYS 2007

International Conference on Biocorrosion of Materials

Paris, France, 11-14 June 2007

Aim of the Conference

This international conference on biocorrosion of materials is in continuity of the 4 previous European workshops on microbial corrosion organized in agreement with the WP "biocorrosion" of the European Federation of Corrosion (EFC) in 1988, 1992, 1995, 1999. This event takes place in the frame of a four year French interregional R&D program, "Biocorys-interrégional".

It will provide an international exchange of information on the recent advances in the understanding and control of biocorrosion.

Conference Topics

- ☞ Case histories
- ☞ Metals and alloys
- ☞ Organic materials
- ☞ Stone, concrete
- ☞ Mechanisms and modeling
- ☞ Enzymes and corrosion
- ☞ Methods and simulation (local, electrochemical, biological, testing, ...)
- ☞ Natural environments (river and sea water, soils, ...)
- ☞ Industrial environments (cooling systems, oil & gas storages, ...)
- ☞ Biofilms
- ☞ Prevention (biocides, coatings, cathodic protection)
- ☞ Assisted protection by bacteria
- ☞ Control and monitoring
- ☞ Other topics (bioleaching, side effects of microbial corrosion, ...)

More information:

<http://www.cefracor.org/biocorys2007>



7th INTERNATIONAL SYMPOSIUM ON THE CONSERVATION OF MONUMENTS IN THE MEDITERRANEAN BASIN

Water and Cultural Heritage

Orleans, France, 6-9 June 2007

Aims

This international symposium will provide a forum for scientists, technicians and experts in the area of conservation and restoration of monuments to present their work and exchange their ideas and experiences. During the Orléans 2007 Symposium, new opportunities shall be presented to deepen the existing knowledge base regarding the problems of Cultural Heritage.

The theme chosen for this session, "Water and Cultural Heritage", refers to the general problem of the interaction between water and construction materials, with a particular emphasis on monuments which are permanently in contact with water, such as quays, bridges, water mills or châteaux surrounded by moats.

Symposium Topics

- ☞ Physical and (bio)chemical processes in material deterioration
- ☞ Treatments, restoration
- ☞ Monuments and natural disasters (in particular high water levels, storms and floods)
- ☞ Attendance and conservation
- ☞ Economic and managerial aspects
- ☞ Professional training and the relationship between restorers and scientific research organizations

More Information:

<http://www.valde Loire.org/front.aspx?SectionId=135&PubliId=2363&CHANGELANG=en>



LACONA VII

Lasers in the Conservation of Artworks

Madrid, Spain, 17-21 September 2007

Aims

LACONA VII continues the tradition of previous LACONA conferences with an increased number of participants and contributors in every event of the series. The field of LACONA has gained enormously in importance in the last decades with a number of monuments of high historical and artistic value (e.g. St. Stephens Cathedral in Vienna, Notre Dame of Paris, Santa Maria dei Fiori, Florence, etc.) been cleaned or measured by laser. In the Spanish arena the list of

monuments that have been restored using lasers include Cathedral of Seville, Burgos Museum, several Mudejar style churches in Aragón (World Heritage listed), Cathedral of Jaca, Cathedral of Santiago de Compostela, etc. As a consequence of the research carried out and the practical demonstration of the advantages of laser tools, the use of lasers has been increasingly implemented worldwide in the activities related with artwork conservation and management.

Conference Topics

- ☞ Laser cleaning, innovation, case studies, evaluation
- ☞ Laser based techniques for analysis and diagnostics
- ☞ Imaging, 3D documentation and modelling
- ☞ Optoelectronic devices and sensors
- ☞ Applications of nanophotonics in Cultural Heritage
- ☞ Projects, Networks

More information:

<http://www.lacona7.es>



37th INTERNATIONAL SYMPOSIUM ON ARCHAEOMETRY

Siena, Italy, 12-16 May 2008

Aims

The aim of the Symposium is to promote the development and use of scientific techniques in order to extract archaeological and historical information from the cultural heritage and the palaeoenvironment. It involves all Natural Sciences and all types of objects and materials related with human activity.

In general, papers should deal with the development and/or application of scientific techniques for extracting information related

to human activities of the past, including the biological nature of man himself and the environment in which he lived.

Symposium Topics

- ☞ Field Archaeology (Remote sensing and Geophysical prospecting, sampling and fieldwalking strategies, in situ observations of preservations, site monitoring, etc.)
- ☞ Archaeo-chronometry (New developments in dating techniques, novel applications, methods of combining dating strategies, new interpretation strategies, synchronization of cultures, cultural phase analysis, etc.)
- ☞ Recent developments in Radiocarbon Dating (special sub-session)
- ☞ Human – Environment interactions (Geoarchaeology, Palaeoclimate studies, Landscape Archaeology, Environmental reconstructions, etc.)
- ☞ Bioarchaeology (DNA, Human diet, health, mobility, demography, residues, zooarchaeology, archaeobotany, etc.)
- ☞ Food preparation and consumption in Antiquity (special sub-session)
- ☞ Stone, Plaster and Pigments (technology and provenance)
- ☞ Ceramics, glazes, glass and vitreous materials (technology and provenance)
- ☞ Integrated site studies (they should combine: excavation procedure, scientific studies of materials and environment, and archaeological interpretation)
- ☞ Special Theme Session for Siena: Micro/nano diagnostic and ancient technology

More information:

<http://www.unisi.it/eventi/isa2008/>



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Workshop Report

JORNADAS DE REFLEXIÓN SOBRE LA CONSERVACIÓN DE LA PINTURA RUPESTRE EN ANDALUCÍA

WORKSHOP ON CONSERVATION OF ROCK PAINTINGS IN ANDALUCÍA



During January 18-20, 2007 a workshop on Conservation of rock paintings in Andalucía was held in Antequera (Málaga, Spain), organized by the Consejería de Cultura, Junta de Andalucía.

This workshop focused on two major topics: First, introducing to the scientific community the research results carried out by the Consejo Superior de Investigaciones Científicas on conservation of rock paintings which was funded by the Junta de Andalucía and, second, to progress onto a multidisciplinary research by implementing a management model for the conservation of caves and shelters with rock painting representations.

Workshop participants were mainly archaeologists and other professionals working on rock art from Andalucía, and representatives of other autonomous Spanish governments as Aragón or Cantabria.

The workshop was structured into two main axes: i) the description of the current state of the art, provided by specialists in the fields of research and conservation of rock art, and ii) an open discussion through two round tables entitled "Rock paintings conservation in Andalucía" and "Assessment of the impact of mass tourism on the conservation of rock paintings".

The scientific programme was as follows:

January 18, 2007

10.00-10.30 Conference opening
10.30-11.00 *Consejería de Cultura activities on rock paintings*, E. Pinilla

11.00-12.00 Coffee break
12.00-12.45 *Studies on rock paintings in Andalucía. I*, S. Sanchez-Moral
12.45-13.30 *Studies on rock paintings in Andalucía. II*, C. Saiz-Jimenez
13.30-14.30 *Current state of Spanish rock paintings*, J. Fortea
16.30-18.30 Round Table: *Rock paintings conservation in Andalucía: current state of the art*. Chairperson: J. Cuaresma. Participants: E. Pinilla, J. Sanchidrian, S. Sanchez-Moral, C. Saiz-Jimenez.

January 19, 2007

10.00-11.00 *Musealization and dissemination: the example of Altamira*, C. de las Heras
11.00-12.00 Coffee break
12.00-13.00 *Rock art conservation in France*, N. Aujoulat
13.00-14.00 *Rock art conservation in Italy*, D. Seglie
16.30-18.30 Round Table: *Assessment of mass tourism impact on rock paintings conservation*. Chairperson: C. Sanchez. Participants: C. de las Heras, F. Criado, D. Seglie, J. Fortea.
18.30 Closing remarks.



Book Announcement



Dossier Grottes ornées Decorated caves Dossier

Monumental 2006,
2nd Semester

Monum, Éditions du
Patrimoine, Paris, 2006

Orders to: ANRP. 46, avenue
Galiéni. 93250 Villemomble,
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