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Foreword:

The third issue of the newsletter inaugurates two new sections: "A life in stone" and "Ideas not set in stone". In the first one we will be interviewing those "more experienced young researchers" who have left already a landmark in the field of stone decay. We hope this is inspirational for those who are entering now into this research field. In the second new section, we want to open the opportunity to debate issues related to stone decay and conservation. We begin this new section with a decay pattern of "contentious" origin.

Continuing on from the previous issues, this latest edition contains information on young researchers' projects, as well as a more broad look at the historic use of stone in an article on the importance of stone and symbolism in traditional Chinese gardens. We seek ways to control weathering of building stones, yet in traditional Chinese gardens the weathered stones are often the most coveted.

We would like to thank to all of those who have contributed so far sending material: the one you see and the one which is still in the pipeline. We would like also to follow encouraging you to send material for future issues of the newsletter, as well as suggestions as to how its contents could be improved.

Happy Holidays to all and we hope to see you in the new year's first issue.

MGH, BJS & KRD



Prof. Clifford Price having a close look to "Cleopatra's Needle" on the Thames embankment, London

My life in stone:

Professor Clifford Price is one of the leading figures on stone conservation, especially known for his efforts in bridging the gap between fundamental research and application in stone conservation.

During a very full career he has worked both with some of the most prestigious conservation bodies and research institutions in the UK. His book "Stone Conservation: an Overview of Current Research 1996" is one of the seminal texts on stone conservation and a necessary reference text for all those working in this field.

Anticipating his retirement from his post in UCL we asked him to share some of the experiences of his life in stone...

How did you first get interested in stone decay issues?

Quite by accident. After finishing my PhD in radiochemistry at Cambridge, I applied for a lot of research jobs, and the only one I was offered was at the Building Research Establishment, to work on rising damp. Even rising damp is better than starvation, so I accepted the post - only to be told on my first day that I was going to be working instead on stone decay and conservation. I fell on my feet, and have been involved in that area of work (amongst a good many others) ever since.

Which has been the most challenging project during your career?

I'm going to side-step that one a bit, and tell you which project made the biggest impact on my career. That undoubtedly was the 10-year conservation programme on the West Front of Wells Cathedral, from the mid 70s to the mid 80s. I learnt more about conservation during that project than through any other source. I was still very wet behind the ears when I started, and it was enormously formative to discover that there was more to conservation than materials science - finding a consensus amongst the widely differing views of the Dean and Chapter, the Friends of the Cathedral, the amenity societies like the SPAB, the museum world, the scientists, the art historians, etc, was enormously challenging.

Who has been the biggest influence in your career?

This is quite a hard one to answer. There have been many people to whom I owe a great debt, including John Ashurst, Alban Caroe, David Harris, Peter Ucko and my many day-to-day colleagues. But I think the accolade goes to David Honeyborne at the Building Research Establishment. We spent a lot of time together looking at stone problems, and it was he who really gave me the 'stone bug'. He had worked with Schaffer, and I like to think that I picked up the mantle of BRE research that had come down from Schaffer via David.

Which are the main changes you have observed in the approach of built heritage conservation during these years?

I've already alluded to one - the increasing awareness that conservation entails many more issues than the physical well-being of building materials. These are sometimes summed up as "the spirit of the place", but can be more positively characterised by the many different values that we attribute to it. Another change is the increasing awareness of the need for proper documentation, and that such documentation must be accessible and must remain accessible into the distant future.

What do you think are the big questions in the future for stone conservation?

Can we afford it?

Tell us one anecdote.

I'll tell you two - both incidents that still make me come in out a cold sweat when I recall them. The first was at the Tower of London where, with the necessary scheduled monument consent, I was drilling deep into the masonry to get samples for salt analysis. The hole was meant to be small and inconspicuous, but when the drill was about half a metre in, it got stuck. The only way to get it out was to drill a circle of further holes all around it, so that the small inconspicuous hole became an embarrassingly conspicuous rosette of holes...

The other incident was at a church, "somewhere in the Midlands", where I had been invited to test a silane consolidant on a Romanesque tympanum - the semi-circular panel above the main entrance door. I would never wish now to experiment on stonework of such importance, but that's another story. The stone was in very poor condition, with a palm-sized blister in a very precarious state. We decided to secure the blister by injecting a thixotropic epoxy behind it, using a hypodermic syringe that a farm vet would have been proud of. The work went really well, and we stood back at the end of the afternoon to admire our efforts. Just at that moment, the weight of the epoxy, as yet uncured, proved too much for the blister, and it slowly flopped down in a sticky mass of fragments, leaving a great patch of epoxy resin on the middle of the tympanum. It was getting dark, we were miles from anywhere without a car, and we knew all too well that epoxies are insoluble once cured. That's why I'm not telling you the location.

An advice for the young researchers in the field

Get out of the lab as much as you can, and go and look at stone problems in situ. That way, you'll be answering real questions - and you'll enjoy yourself more, too.

Symbolism of stone use in traditional Chinese gardens

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Abstract

Stones form an integral part of the traditional Chinese garden. Beginning in the 1st century BC, the gardens served as oases fostering serene contemplation and scholarly studies, and the symbolism of form, shape, and arrangement of stones sought to enhance these pursuits. Stones symbolise the mystical Immortals and the five sacred mountains floating at sea, as well as the five real mountains on the mainland so important to Tao cosmology. They represent the *yang* of the sky, the *yin* of the earth, and the blowing breath force of *Qi*. Different weathering agents produce markedly different yet equally coveted Taihu and Lingbi rocks, either appreciated singly for the imagery evoked or combined to create specific rock groupings and shapes signifying progression through the seasons of life and nature. Quarried from across the country, the reverence for and obsession with these rocks literally changed the course of Chinese history. Perhaps familiarity with and understanding of the stone symbolically placed in traditional Chinese gardens would improve our appreciation for the natural beauty of stone and our environment.

"...and under that pine there shall be a rock and the rock shall be strange." - 17th Century Chinese philosopher on garden design

Traditional Chinese gardens are world-renown for their intrinsic beauty. Dating back to the first millennium BC, the role of the Chinese garden was to provide a spiritual place for serene contemplation and scholarly studies. Rocks were a common feature in these gardens, but as the art form grew the importance of the stones' symbolism grew as well. The spiritual symbolism found in traditional Chinese gardens became the driving force behind stone selection and arrangement.

The placement of stone in the garden was intended to evoke a sense, a reverence of the mystical Immortals and their mountains in microcosm. In Chinese mythology, the Immortals who governed the Earth resided on five magical mountains in the sea. Wreathed in obscuring mist, these islands floated about the sea, hidden from all but the most worthy of humans; to catch sight of one was to be truly blessed. There are also five sacred mountains on the mainland, corresponding to the five regions of the world in Taoist cosmology: Mount T'ai to the east, Mount Heng in the north, Mount Hua to the west, and another Mount Heng in the south, with Mount Sung as the central peak. Conquerors and scholars, monks and artists paid homage to these more tangible sacred mountains. Of particular importance was the central mountain that was the point from which the Emperor traveled between the realms of Heavenly Immortals

and mere mortals. This central mountain became embodied in traditional Chinese garden rock design as Axis-of-the-World stones, central peaks taller than the others, typically in compositions of three, five, or nine stones, which supported the *yang* of the sky with the *yin* of the earth. Additionally, in ancient Chinese cosmology it was believed the earth resided in a cave, and the mountains formed from rocks falling off the ceiling and plummeting into the planet. As the rocks fell, they were quickened by the winds, blowing *Qi*, the breath force, into the lifeless stone. In order to capture the essence of these mystical stone mountains within a garden, the designer sought to represent the grand macrocosm with a rocky microcosm. Fantastically shaped stones were grouped together, piled high into rockeries signifying the sacred mountains in miniature, in hopes of enticing the revered presence of the immortals to grace those who wandered the garden with a transcendent moment.

The placement of the rockeries was important as well. Certain locations within a garden were preferred, based upon their association with the changing seasons. Each season also had other items associated with it, such as elements, colours, and flowers. Spring, in the east, contained the element of wood, colour of blue-green, and flower of the peach blossom. The fleeting flamboyance of Spring turns burgeoning mounds of colorful flowers into faded lumps of former glory, leaving behind the memory of delicate colour and brightness. The stones chosen to represent this season are therefore "clear and slight to the verge of fragility", positioned to catch the first rays of the rising sun (Rambach, 1987). A specific

shape of stone, known as bamboo-shoot or Old Man stones, are particularly popular in Spring arrangements. Bamboo-shoot stones are tall, slender, tapering fragile rocks, greenish-grey in colour and with an extensively pitted surface, that rise from the ground like young bamboo shoots piercing the soil (Fig. 1). From Spring follows Summer, the season associated with the south, fire, sun-flame red, and the white lotus.



Figure 1: Bamboo-shoot stones, also known as Old Man stones, behind a crouching stone against a white wall, symbolic of Winter turning into Spring (Lan Su Yuan traditional Chinese garden, Portland, Oregon, US).

Summer arrangements of rockeries are perhaps the most important in a garden, for they typically consist of large, mountainous piles of stone penetrated by caves. The hot, humid weather of summer drives humans to seek shelter from the sun in cool, breezy places like caves, mimicking the sheltering of the Earth within the great cosmological cave from which the mountains formed (Fig. 2). Characteristically, Summer compositions are initially separated from the viewer by a body of water, one that increases the rockery's height by mirroring it on the watery surface while enticing one to journey mentally into the sacred mountain, either through the cave or up hidden



Figure 2: A tall mountain rockery reflected in the small lake, typical of Summer stone arrangements (Lan Su Yuan traditional Chinese garden).

pathways. this distance also provides a view during Winter, when the body will be cold but the mind will be warmed by the imagery of Summer.

Before Summer becomes Winter, garden wanderers pass through Autumn. The Autumn arrangements of rockeries in the garden are associated with the west, metal, the white “after sunset void”, and chrysanthemums (Rambach, 1987). Autumn compositions are designed to catch the last warming rays of the setting sun before Winter sets in. The rockeries contain hidden pathways winding through to the top, a leveled-off surface for basking in the last remaining light from the West. The stones are often massive, blocky and solid, without the whorls and pits of slender Spring stones, and with hints of yellow, orange and red. The very chunkiness of the forms evoke images of climbing towards the heavens.

After Autumn comes the bleakness of Winter. These compositions are smaller than previous seasons, shying away from the harsh wintry light. The forms are small and huddled, like a person hunched up in warm robes to evade the chill air, and are usually placed against a wall. The juxtaposition of austere white wall behind withdrawn shivering stone exemplifies the cold Winter season, creating a sense of chilled dormancy within the viewer. Yet, in some instances bamboo-shoot stones are included near the far edge of the composition. This signifies the impending return of Spring while epitomizing the *yin-yang* relationship between death and renewal, cold and warmth, darkness and light.

By traversing the seasonal arrangement of stones, representing both the changing seasons of the planet and those within a person, the all-important breath

force *Qi* was breathed into the person. This was believed to increase longevity, and in order to live a long, healthy life “it was necessary to maintain within oneself, as long as possible, in the best working condition, this life principle, this Breath Force.”(Rambach, 1987). It is a common belief that *Qi* manifests and diffuses preferentially through certain stones of strange shape, a belief that guided designers of traditional Chinese gardens in selecting specific stones for their garden arrangements.

A wide variety of rocks were available to the ancient Chinese for use in their gardens, yet ones from specific locales were preferred for aesthetic and symbolic reasons. The desirable qualities of stones appeared rather nebulous to Westerners, but the Chinese developed a very refined taste for particular types and shapes of stone. Qualities considered important were the ability of a rock to be visually stimulating from four distinct directions; the capability of a rock to evoke memories of certain shapes like lions or dragons; the textural effect of multiple convolutions of whorls and pits; and the resonance of a stone when struck.

Stone was quarried from several places across China to fulfill the requirements of discerning garden designers. Of the most well known rocks were those from Lake Tai, known as Taihu rocks. Taihu rocks were bits of hard, glossy limestone dredged up from the bottom of Lake Tai, just southwest of Shanghai. The action of the lake currents against the stone surface formed delicately undulating whorls and cavernous pits, sometimes piercing through the entire chunk of rock (Fig. 3). A “net of raised patterns all over” (Ji, 1988), probably the result of in-filled fractures, greatly enhanced the strangeness of the stones' appearance. The resulting texture evoked the flow of careening water currents, representing a manifestation of the *yin-yang* relationship between soft malleable water and hard rigid stone. While this variety of stone was found under water, other desirable forms were found deep in the soils of mainland China.

Stones quarried from the soils included the sought-after Lingbi rocks and stone bamboo shoots. Lingbi rocks were generally smaller in size than Taihu rocks, but had a hard, clear sound when tapped and a much more craggy appearance. The acids naturally found in soils were most likely the cause of such a wrinkled surface on the stones. The bamboo-shoot stones were dug up in Huang Shan, Shangzhou, and Yizhou. They formed in a horizontal position from similar processes as those acting on the Lingbi stones, but the



Figure 3: Dragon-shaped Taihu stone at the entry to Lan Su Yuan, the Garden of Awakening Orchids.

Shapes of the stone were the characteristic long, slender bamboo shoot style. These particular stones, as well as others too numerous to mention here, were selected by garden designers and rock connoisseurs for the rock's interesting surface textures, the ability to resemble shapes found in nature, and as representations of the telluric forces flowing through the earth, the forces of *Qi*. The search for strange and fantastic stones became such an obsession of the Emperor Huizong of the Song dynasty (1101-1125 AD) that emissaries were sent to fetch exotic rocks from the far corners of China, with the associated exorbitant expense of the so-called Patterned Rock Convoy eventually leading to the fall of the Song dynasty.

While rockeries were the main symbolic use for stone found in traditional Chinese gardens, one cannot overlook the intricate paving patterns of the walkways leading visitors through the garden. Small stones, mainly pebbles, were a major component of the pavings, their colors and shapes imparting movement and texture to the pattern. Although the pebbles may impart some symbolism, the pattern itself was the dominant symbol. The begonia flower pattern alluded to the immortals living on the mystical island mountains, since begonias were

known as the Angel of Flowers or the Immortal Among Flowers beginning in the eighth century AD (Fig. 4). On the other hand, the cracked ice pattern, also known as crazy paving, was employed to signify a chaotic, natural environment and was particularly suited to pavings through artificial mountains and near terraces or pavilions (Fig. 5). These stone pavings were important, guiding a visitor through the garden, yet the symbolism of their forms was not as prominent as those of the rockeries.



Figure 4: Paving at Lan Su Yuan in a begonia flower pattern.

The symbolic uses of stone and their placement in rockeries was a vitally important aspect of the traditional Chinese garden. Rockeries were integral to facilitate longevity through the renewing *Qi* energies emanated by certain stones, the evocation of mystical heavens, and the creation of an atmosphere for scholarly contemplation. The reverence in which these stone sculptures were held and the obsession for acquiring these important stones literally changed

the history of China. Perhaps a renewed understanding and appreciation of traditional Chinese garden symbolism and theory could assist modern day China in recapturing the importance of respecting and caring for the natural environment.



Figure 5: Cracked-ice paving pattern viewed from porch of the Scholar's Study, looking southwest towards the Moon Gate at Lan Su Yuan.

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The impact of complex stress histories on the decay of historic sandstone

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The concept of 'inheritance' in stone decay studies is well established. Historic stone may 'inherit' the effects of background environmental factors (including salt weathering, temperature and moisture cycling, chemical alteration) and more extreme, 'exceptional', events (including lime rendering / removal, fire, Little Ice Age frost events, inappropriate intervention), which determine its decay pathway. Developing the notion of 'inheritance', the term 'complex stress history' describes the cumulative impact of past stresses on stone. It reflects an understanding that the response of stone to any applied stress is invariably cumulative, so that the immediate response of stone to a stress event will depend on previous stresses experienced, and will in turn help to determine response to any subsequent stresses.

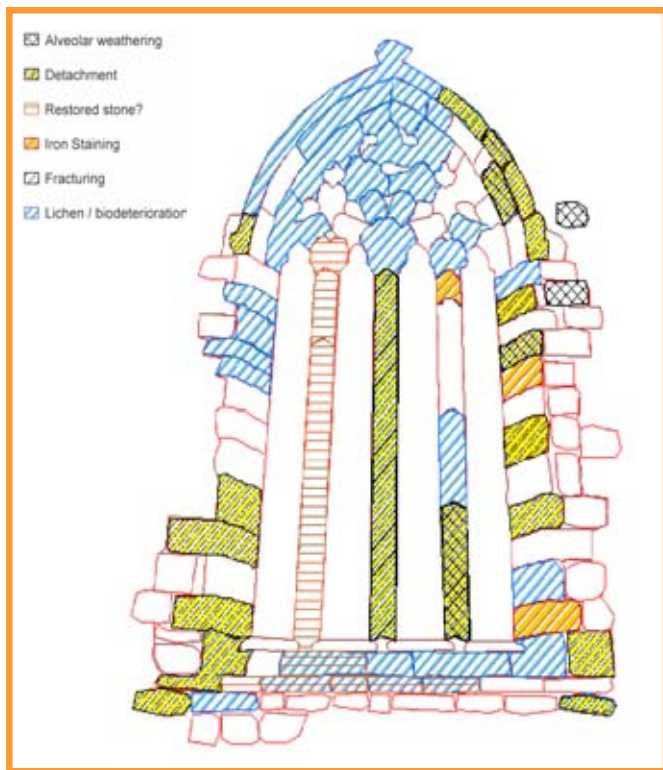


Figure 1: Decay mapping of Iona Abbey east window (Iona, western Scotland)

Building on this conceptual framework, this PhD research (completed in February 2007) drew on three main themes to assess the impact of complex stress histories on the decay of historic sandstone:

1) Fieldwork (Northern Ireland and western Scotland) was used to map the decay on of selected façades (for example, Iona Abbey east window, Figure 1), using connectivity analysis (Turkington & Smith 2004) and the Unit Area Spread (UAS) Staging System (Warke et al. 2003) to give a meaningful rating of façade condition and to provide an understanding of factors controlling decay in the field;

2) Historical research was essential for building a clear picture of the stresses historic sandstone structures have experienced since their construction; or historical facts.

3) Laboratory simulation, informed by fieldwork and historical research, explored the effects of lime rendering, furnace heating, fire, frost events, and salt weathering cycles on representative sandstones (Peakmoor and Dunhouse) blocks, both in isolation and in combination. Special emphasis was given to the study of 'process combinations', where each sample was given a carefully designed stress history before moving on to the next stage in simulation. Thus, different groups of stone blocks with different stress histories were created. Each stress history group experienced salt weathering cycles and the response of each group to salt weathering was monitored by weight loss at the start of each cycle, blocks were immersed into a 10% salt solution (equal parts NaCl and MgSO₄) for approximately 10 seconds, and the debris released during this immersion was collected, dried and weighed.

Results highlight the non-linear nature of the stone decay system, with different stress histories producing divergent response of sandstone over time. Over the period of the experimental run (75 cycles, 150 days), the effects of lime rendering tended to suppress debris release (although this does not preclude rapid future decay as surface sealing effects from the render appeared to encourage salts to concentrate at depth), while other stress histories (fire and frost) increased breakdown in response to salt weathering. The impact of fire on subsequent performance is especially complex, with soot cover potentially hindering soluble salt ingress, and fracturing from the complex stresses created in the fire leading to spalling events during salt weathering

cycles (see Figure 2, showing the importance of fire in causing accelerated weight loss in Peakmoor Sandstone by spalling events).

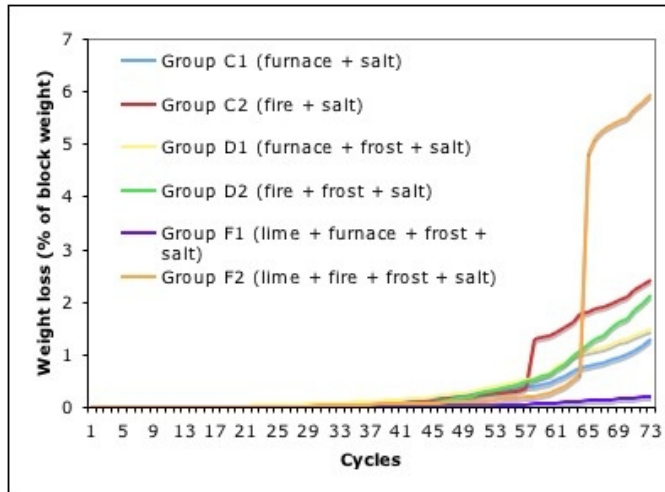


Figure 2: Cumulative weight loss graph for blocks of Peakmoor Sandstone with different stress histories, highlighting the importance of fire in causing accelerated weight loss

Variable response of stress history groups to salt weathering emphasises the importance of stress history in understanding the performance of historic sandstone if breakdown could be attributed to salt weathering alone, then all stress history groups would have yielded similar response patterns. In future, conservation practitioners should approach the management of historic sandstone with a knowledge of the pathology of structures (potential inherited and concealed stresses) in mind.

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McCabe, S., Smith, B. J. & Warke, P. A. 2006. Calcium loading of building sandstones by lime rendering: implications for decay. In: Fort, R., Alvarez de Buergo, M., Gomez-Heras, M. & Vazquez-Calvo, C. (eds.), *Heritage, Weathering and Conservation*. Taylor & Francis Group, London, 177-182.

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The influence of weathering on the mechanical properties of anisotropic carbonate rocks (dolostones, limestones and marbles).

J. Martinez-Martinez

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The aim of this thesis is to study the decrease in rock strength during the weathering of rocks with low porosity when two processes occur simultaneously: thermal shock and salt crystallization. This research is based on the fact that an extremely high anisotropic thermal expansion occurs along the c-axis of calcite. This causes an important new internal stress system to appear in the rock fabric, and thus a greater number of cracks and increased porosity. Meanwhile, salt crystallization damage depends on the porous system of the rock and consequently, limestones and marbles are not as susceptible to salt crystallization in their original states as they are after thermal weathering. The outcome of all these processes is the weakening of the materials' mechanical behaviour when both porosity and the number of discontinuities are increased.

The effects of thermal shock and salt crystallization weathering on carbonate rocks have been evaluated individually and jointly from three different angles:

- Petrographic study of the evolution of textural rock properties: several polished samples at different stages of weathering have been observed using a scanning electron microscope (Figure 1).

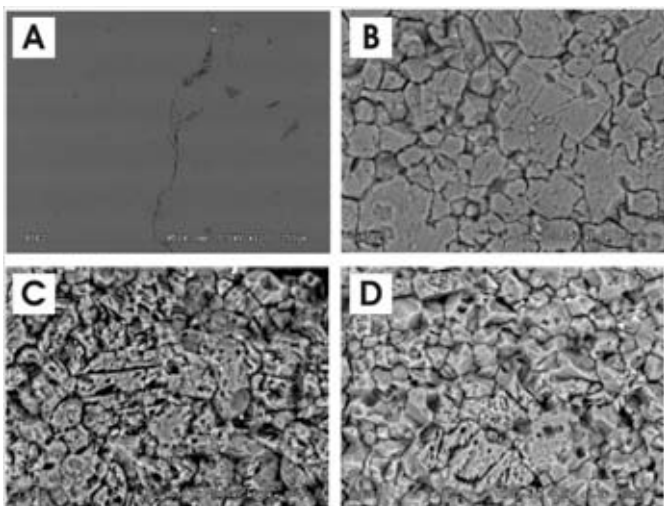


Figure 1: Example of rock sample at different stages of weathering (SEM-BSE image).

-- Mechanical characterization of the weathering process by means of a non-destructive technique (ultrasounds) (Figure 2): this study allows two important correlations to be obtained: a) a precise relationship between ultrasonic wave propagation and porosity, due to the fact that the porosity of the sample increases whilst the other petrographic variables remain constant (crystal size, mineralogy, etc) during the decay process; b) a calibration of ultrasounds in order to obtain a highly effective non-destructive technique to quantify the degree of decay in carbonate rocks.

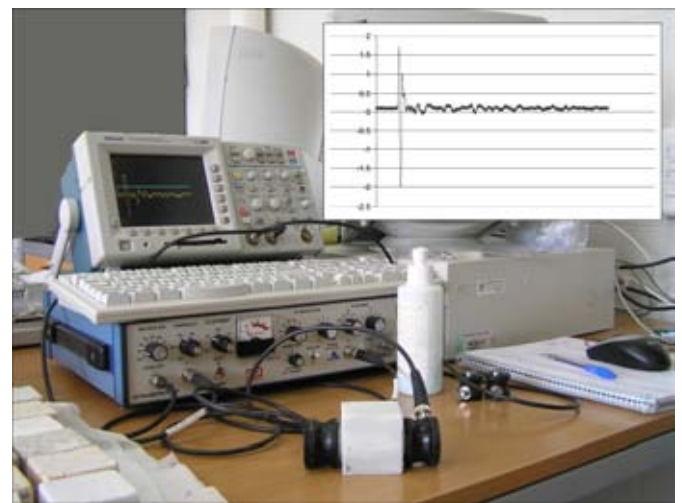


Figure 2: Ultrasounds velocity (non-destructive test) and an example of an ultrasonic signal).

Study of the stress-strain behaviour during the weathering process by means of uniaxial compression test and strain gauges (destructive tests) (Figure 3): stress-strain curves from both unaltered and decayed samples were obtained in order to analyse the effect of the textural evolution on mechanical behaviour. Moreover, ultrasonic measurements were carried out on the same samples that were subsequently tested in the uniaxial press. Thus a useful correlation was obtained between destructive and non-destructive techniques, static and dynamic elastic constants, etc.

Nine different rocks were selected for this research (Figure 4). All of these were Spanish building rocks

that are currently worked and marketed. The selection criteria were carefully established for studying rocks with different crystal size, mineralogy, presence of discontinuities, etc. Consequently, the selected rocks show:

- Wide ranging crystal size: from Crema Valencia or Rojo Cehegín (mean crystal size < 10 m) to Gris Macael or Blanco Tranco (mean crystal size > 1 mm).
- Rocks with a marked preferred crystal orientation (Amarillo Triana, Gris Macael or Blanco Tranco), and rocks with a random crystal orientation (Blanco Alconera, Crema Valencia or Ambarino).
- A dolomite/calcite nature: dolostones, dolomite marbles, limestones and calcite marbles were selected in order to quantify the degree of anisotropic thermal expansion in calcite compared with dolomite.

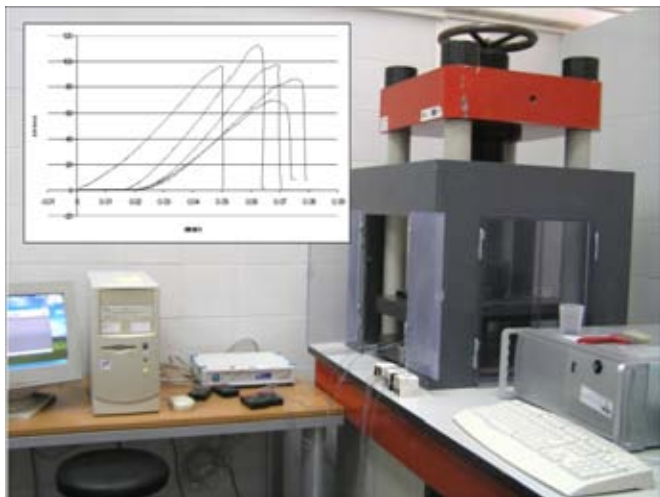


Figure 3: Uniaxial compression test and an example of stress-strain curves.

Several levels of anisotropy associated with the content of discontinuities: the presence of discontinuities in the rock is an important factor as these may have a double effect on rocks subjected to salt crystallization. These discontinuities allow solutions to enter the rock more easily; and they constitute a weakness plane where salt crystallization

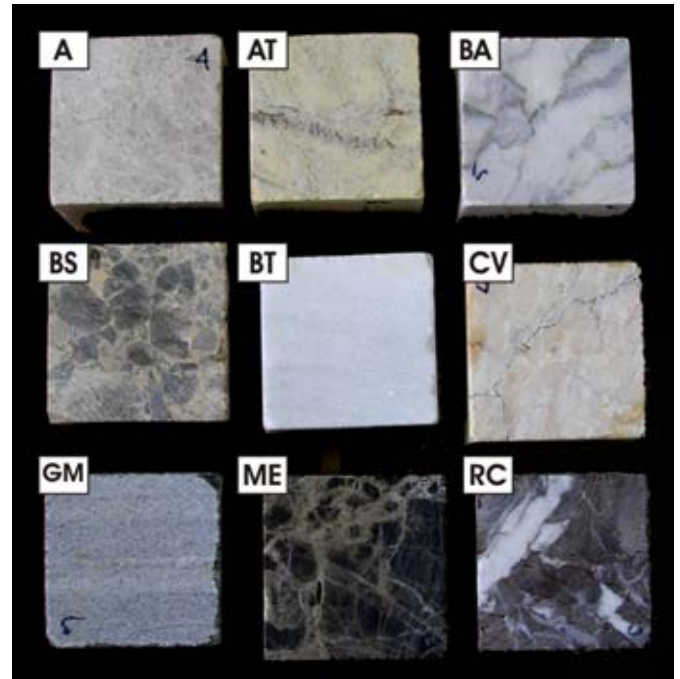


Figure 4: Selected materials (A: Ambarino; AT: Amarillo Triana; BA: Blanco Alconera; BS: Beige Serpiente; BT: Blanco Tranco; CV: Crema Valencia; GM: Gris Macael; ME: Marrón Emperador; RC: Rojo Cehegín).

stress may be concentrated, consequently causing breakage.

In conclusion, this research offers an in depth study of the weathering process of different carbonate rocks (limestones, dolostones and marbles) when subjected to thermal shock and salt decay conditions, as well as the evolution of their mechanical behaviour during these processes. The characterization of this decay has been carried out by: a) a petrographic study using scanning electron microscopy; b) a mechanical evaluation with a non-destructive technique (ultrasounds); and c) with a destructive technique (uniaxial compression and strain gauges). Moreover, this study has allowed us to define the ultrasonic test as an effective technique to assess both the mechanical resistance of these materials as well as the degree of weathering.

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Recording weathering and decay:



Incompatibility of materials. Porous red sandstone column on a less porous compact limestone base in an Oxford building. The mismatch on the water transport properties enhance the decay in the base of the sandstone column.

(Picture: M. Gomez-Heras)



Heavy pollution soiling and surface loss of Binny Sandstone on Scott Memorial, Edinburgh

(Picture: C. Adamson)

Granite boulder in a peat accumulation on the Mourne Mountains (Northern Ireland). As a consequence of the extremely acid conditions, the stone appears completely bleached.

(Picture:M. Gomez-Heras)



Multiple tafoni in volcanic tuff, Posillipo Headland, Campi de Flegri

(Picture: B. J. Smith)

Ideas not set in stone:

Red sandstone pillar.
Belfast, UK.

(Picture: M. Gomez-Heras)

This decay feature provides an opportunity for debate and we would like to ask the readers for their opinions. In discussion of its origin two possible mechanisms are proposed: the first one, result from a lithological control, which would make of this feature an example of the control of the stratification on weathering where depositional ripples would be revealed after the weathering of the surface. The second one, is that it is the result of water flow over the surface. In this case, the wavy surface would be the result of a progressive dissolution of cement to reflect “roll waves” produced as the result of non-uniform flow of a very fine water film over the stone surface.

Suggestions to appear in the next issue (sorry, no prizes!)

NEWLY FUNDED PROJECTS:

A new way of dissemination of cultural and natural heritage: the geomonumental routes in the regions of Madrid (Spain) and Salento (Italy)

Both the Instituto de Geología Económica of CSIC and Istituto per i Beni Archeologici e Monumentali of CNR, are experiencing a new way of disseminating cultural and natural heritage within a project financed in the framework of CNR-CSIC agreement 2007-08 biennial programme.

The project is aimed at the set up of geomonumental routes, based on the study of the cultural aspects linked to the use and working of geological materials for the building of historical monuments.

The methodology is based on a multiscale and integrated approach, which take into account both social and scientific perspectives, in order to provide a new model for the knowledge, transfer and preservation of architectural legacy.

The geomonumental routes considered are two, each of which is related to a different geological material. One is located in Madrid region: it is the bridges' route over the Guadarrama river built with granitic material coming from the nearby Guadarrama mountain range.

The second route is located in the South of Italy: it is the route of the coastal towers built in the 16th century with calcarenitic stones that outcrop along the Salento coast. Calcarenite has been used since ancient times, even before the Romans, till present, along the Adriatic coast.

The procedure that has been followed for the confection of both routes is focused on the determination of:

- the historic, architectural and building aspects of the monuments;
- the mineralogical and petrographic characteristics of materials;
- the quarries of provenance of the building stones;
- the conservation or restoration interventions that have been carried in the structures;

- the conservation/decay condition in relation to the building materials and to the surrounding environment;
- the relation of monuments considered with historical roads, geographical and geomorphological surrounding and landscape.

Building techniques, materials, historical data, architectural values, quarries and ancient roads are related each other within a GIS and geo database, with threefold scope:

- 1) to improve the knowledge of cultural aspects to the use of materials in the regions of Madrid and Salento;
- 2) to set up a GIS-based platform dedicated to the design of an atlas of geomonumental routes for educational purposes and for their protection;
- 3) to promote geomonumental routes within the cultural tourism and sustainable development.

This bilateral cooperation project between thw CSIC-CNR (2006IT0021) is funded by both the Ministries of Education from Spain and Italy.

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NEWS

Job opportunities:

1 short-term (6 months) research and training stages. CSIC, Spain.

Assessment of the durability of building stones by means of non-destructive techniques (10 months). Instituto de Geología Económica (IGE), Madrid, Spain.

Eligibility:

This action supports the initial training of researchers, typically during the first four year of their research careers, starting at the date of obtaining the degree which would formally entitle them to embark on a doctorate. We are looking for young and highly motivated individuals with a M Sc in Geology. Other related specializations will be also considered. The candidates should have a strong background and currently undertaking studies in a subject area similar to that of the training site. A high level of English skill is required.

The applications should include experience in the field of research, aptitude of the candidate to carry out an individual training/mobility project, capability for integration in a research team, potential for excellence, impact and the benefit of the proposed training to the individual fellow's research career and their origin country, academic degree obtained and date, list of scientific publications and participation in congresses, willingness to carry out an intense research training programme, and potential interest in a multidisciplinary research based on Cultural Heritage.

The positions are not available to Spanish or EU citizens with residence in Spain, but to EU citizens.

Contact:

Candidates are invited to send an application letter Dr. R. Fort, Instituto de Geología Económica (CSIC-UCM). Email: rafort@geo.ucm.es

Forthcoming events:

International Symposium on Stone Consolidation in Cultural Heritage



Lisbon, 6-7 May 2008

Consolidation is one of the most complex and controversial actions in stone conservation. Different lithologies and distinct void/ microstructural relationships show different behaviours towards consolidation. The frequent presence of soluble salts also induces variability and complexity in the consolidation process.

Effectiveness is not within reach for all stone types and harmful effects are too often found. Research is currently being carried out around the world and new products and new knowledge are being produced for the benefit of conservation practice. This Symposium will focus on the present state of the art and state of the practice as regards consolidation mechanisms, degradation of consolidated stones, novel products for consolidation and long term monitoring of consolidation interventions on monuments aiming at discussing both research and practical issues.

Key dates

Deadline for submission of abstracts: 31 January 2008

Deadline submission of full papers: 15 March 2008

Workshop: 6-7 May 2008

Further information:

<http://eu-artech.lnec.pt/>

International Workshop In Situ Monitoring of Monumental Surfaces



Florence, 27-29 October 2008

The conservation and preservation of monumental cultural heritage has become one of the main concerns within Europe today. In particular, the introduction of the concept of planned maintenance has highlighted the need to adopt suitable procedures to monitor the state of conservation of Cultural Heritage assets. Monitoring is here taken to mean systematic and periodical surveillance and is based on the assumption of cause and effect; the results will help in damage assessment, and will aid in the identification of potential threats and development trends in order to define possible risks and to facilitate maintenance management decisions. The typologies of artefacts involved in this workshop are focused on: monumental buildings, painted facades and archaeological remains, whilst the materials to monitor are: stones, mortars, plasters, bricks, ceramics, tesserae, wooden structures and metals.

The main objective of this workshop is to illustrate the ultimate state of the art of portable diagnostic technologies for monitoring cultural heritage and their general and specific uses. Furthermore, during two round tables there will be the opportunity to debate their possible future technological developments and to discuss the need of establishing common "on site monitoring" recommended protocols (parameters, devices, time steps etc.) and proposing the creation of data treatment infrastructures in order to link historic surfaces data to geographical positioning and climatic conditions of the monitored structure

Key dates

Deadline for submission of abstracts: 15 February 2008

Workshop: 27-29 October 2008

Further information:

[Http://www.surfacemonitor.eu/](http://www.surfacemonitor.eu/)

Education:

International School in Archaeology and Cultural Heritage



The International Summer School in Archaeology is a well-established interdisciplinary event. These events represent an important occasion to establish contacts between experts in archaeology, cultural heritage, art history and experts from remote sensing, photogrammetry, CAD, spatial information science, computer graphics, virtual reality, etc. The School emphasizes international composition of the audience, extended discussions between participants and direct relationships between lecturers and students, which ultimately could lead to joint projects. The organizing institutions have longstanding experiences in the preparation of international scientific events. The Summer Schools organized in the last decades dealt with themes which have created important initiatives and international debate aimed at advancing archaeological work in Europe and beyond. In general the Schools emphasize an interdisciplinary concept, involving the use of techniques from natural, geo- and engineering sciences in archaeology and natural/cultural heritage.

Furthermore, our School will give the chance to participants to enter in a very short time the kernel of the scientific discussion on 3D technologies' surveying methods, documentation, data management and data interpretation - in archaeological research and practice. The general objectives of the Summer School are:

- To encourage the integration of theoretical, methodological and analytical aspects of archaeological research
- To develop interdisciplinary research and practice, by bringing together researchers and users in the natural, geo- and engineering sciences, using advanced information acquisition and processing techniques, supported by work in the laboratory
- To promote a dialog between workers in different fields, particularly between those concerned with research and those more concerned with matters of conservation

The School will be held in the congress centre Centro Stefano Franscini, Monte Verità, Ascona, Switzerland. The centre is an ETH-affiliated seminar complex located in a superb botanical park on the historic and cultural Monte Verità area, which will also be the residence of the participants with its integrated hotel and restaurant. Monte Verità is overlooking the picturesque village of Ascona and Maggiore lake and it offers many possibilities for catching a glimpse of the Swiss Canton Ticino, famous for its scenery and lively beauty.

The centre provides 26 double rooms and 19 single rooms located in 3 buildings, plus 3 rooms in Casa Amicizia (Monescia). Most of the bedrooms have a bathroom with shower, telephone, radio and a minibar, while for few cases one bathroom is shared between two rooms. Organisers, lecturers and participants will stay at the Centro throughout the School.

- The length of the School will be from Friday 9th to Wednesday 14th May 2008
- Lessons will be interspersed with theory, examples and demos
- Number of lecturers: about 20
- Number of participants: about 60
- The official language of the School is English
- Half-day excursion to the UNESCO castles in Bellinzona.

The School will be open to ca 60 participants at graduate level, to those carrying out doctoral or specialist research, to established research workers, to members of State Archaeology Services and to professionals specializing in the study and documentation, modeling and conservation of the archaeological heritage.

Registration fee: EURO 650, including accommodation and meals (full board) at the centre, proceedings on CD and hardcopy, coffee breaks, icebreaking party and excursion. The registration form will be available soon online. The deadline for the registration is 31st March, 2008.

There will be available also some grants offered by UNESCO and ISPSR to support students with limited budgets. More info online.

Further information:

<http://www.3darchaeology.org/>

Recently listed publications on stone decay:

Papers: (As listed in ISI-Thompson database)

Cappitelli F, Principi P, Pedrazzani R, et al. 2007. Bacterial and fungal deterioration of the Milan Cathedral marble treated with protective synthetic resins *Science of the Total Environment* 385 (1-3): 172-181

Bugani, S., Camaiti, M., Morselli, L., de Castele, E.V. and Janssens, K., 2007. Investigation on porosity changes of Lecce stone due to conservation treatments by means of x-ray nano- and improved micro-computed tomography: preliminary results. *X-Ray Spectrometry*, 36(5): 316-320.

Lazzarini, L., Borrelli, E., Bouabdelli, M. and Antonelli, F., 2007. Insight into the conservation problems of the stone building "Bab Agnaou", a XII cent. monumental gate in Marrakech (Morocco). *Journal of Cultural Heritage*, 8(3): 315-322.

Sharma, P.K., Khandelwal, M. and Singh, T.N., 2007. Variation on physico-mechanical properties of Kota stone under different watery environments. *Building and Environment*, 42(12): 4117-4123.

Afouxenidis, D. et al., 2007. TL/OSL properties of natural schist for archaeological dating and retrospective dosimetry. *Nuclear Instruments & Methods in Physics Research Section a-Accelerators Spectrometers Detectors and Associated Equipment*, 580(1): 705-709.

Almeida, A. and Begonha, A., 2007. Stone decay in two-mica granite buildings of Northern Portugal. *Geochimica Et Cosmochimica Acta*, 71(15)

Jimenez-Lopez, C. et al., 2007. Consolidation of degraded ornamental porous limestone stone by calcium carbonate precipitation induced by the microbiota inhabiting the stone. *Chemosphere*, 68(10): 1929-1936.

Arman, H., Ramazanoglu, S. and Akinci, A., 2007. Mechanical and physical properties of the Kandira stone, Kandira, Turkey. *Bulletin of Engineering Geology and the Environment*, 66(3): 331-333.

Hall, C. and Hoff, W., 2007. Rising damp: capillary rise dynamics in walls. *Proceedings of the Royal Society a-Mathematical Physical and Engineering Sciences*, 463(2084): 1871-1884.

Poli, T. et al., 2007. A portable NMR device for the evaluation of water presence in building materials. *Journal of Cultural Heritage*, 8(2): 134-140.

Rozenbaum, O., Le Trong, E., Rouet, J.L. and Bruand, A., 2007. 2-D image analysis: A complementary tool for characterizing quarry and weathered building limestone. *Journal of Cultural Heritage*, 8(2): 151-159.

Camaiti, M., Bugani, S., Bernardi, E., Morselli, L. and Matteini, M., 2007. Effects of atmospheric NOx on biocalcarenite coated with different conservation products. *Applied Geochemistry*, 22(6): 1248-1254.

Cerimele, M.M. and Cossu, R., 2007. Decay regions segmentation from color images of ancient monuments using fast marching method. *Journal of Cultural Heritage*, 8(2): 170-175.

Okol, D., 2007. Interiors - Within historic buildings, modern treasures (Moving back to cities). *Architectural Record*, 195(6): 199-199.

Hexham, I., 2007. Sermons in stone: Along the Cumbrian coast to the Bewcastle cross. *Expository Times*, 118(9): 436-439.

Books and Special Issues:

Natural Stone a material and topic not only of major interest to geologists and suppliers of natural stone products, but also to architects, construction and civil engineers, conservers of monuments and historical buildings and last but not least for everybody building and maintaining a home. Its importance to the construction industry as well as its role in our society has changed constantly over the years. Shortly after the Session „Rohstoff Naturstein“ at the DGG-Symposium Geo Berlin 2006 a large collection of papers covering the following thematic issues has been compiled in ZDGG 158/3 and 158/4:

- Support for and preservation of the national natural stone industry, data supply for the characterization of local and imported natural stones.
- Research on the preservation and the restoration of the cultural heritage built of natural stone
- Inside information for construction and civil engineers and home builders



- Making available results of more than 30 years of research on natural stones

ZDGG Special Issue *Geowissenschaften und Denkmalschutz* (156/1) provides a large variety of results from research projects on deterioration and conservation of natural stones. In ZDGG Special Issue „Marmorkonservierung“ (150/2) methods to characterize, to preserve and to restore marble are thoroughly discussed and presented.