

## International Symposium CONSOLIDATION 2021

Stone Consolidation in Cultural Heritage

A NOVA CONSERVAÇÃO participa no Simpósio Internacional “Consolidation 2021” sobre a consolidação dos materiais pétreos no património cultural, que decorre de 23 a 25 de março de 2022 no LNEC - Laboratório Nacional de Engenharia Civil.

No dia 24 a Maria João Revez vai apresentar “Onsite assessment of subtle consolidation actions: can Shore durometers help?” e no dia 25 o João Aguiar e o Professor Delgado Rodrigues apresentarão “Marble biomineralisation: pilot application results at the Arch of Septimius Severus”.

Teremos, ainda, dois posters sobre as várias aplicações de biomineralização segundo o método de Granada, realizadas em Portugal, Espanha e Itália.

Para mais informações:

- sobre a metodologia da biomineralização aplicada pela Nova Conservação;
- sobre o programa do simpósio.

**Biomineralisation with the Granada method: field results**

For the past decade, Novo Conservação, S.A. is performing over 1000 consolidations by means of the Granada method following the Granada method. The used biomineralization solution (Mycoseal® M3P) is a natural organic-based cementitious medium that promotes the regeneration of dolomitic limestone and calciferous stones by activating carbonate-generating bacteria naturally occurring in stone materials. The metabolic activity of these bacteria converts the stones from within without any morphological or chromatic modifications to the surface, and its compatibility and efficacy has been amply demonstrated in the consolidation of several heritage sites in Portugal, Spain and Italy.

**Septimius Severus Arch**  
(Case study disseminated with the kind permission of Parco Arqueológico del Colosseo)  
Roman Forum, 203 C.E.  
Richly-decorated Pentelic marble cladding

Sculpted surfaces showed advanced decay with active degradation processes – widespread sugaring, particularly on the protruding parts of the carved sculptures; scaling and thin chipping fractures – causing the loss of considerable portions of stone material.

**Results**

clear improvements on surface stability after 1 month  
no surface discolouration  
chemically and physically compatible treatment  
no resistance contexts created

Notable reduction of water absorption, showing that calcite deposition is large enough to have an impact in absorption features. Significant cohesion increase, with mass losses 5–10 times lower than those before treatment.

**MARBLE**

**Court of the Lions**  
(Case study disseminated with the kind permission of Tresor)  
Alhambra, 1362–1391 C.E.  
Colonnade in Macael marble

The columns exhibited several degradation patterns including deformation, loss of texture, loss of cohesion, mainly due to this particular marble's sensitivity to thermal variations.

**Results**

the treatment was effective and made the marble less vulnerable to atmospheric agents  
the application method does not seem to influence the efficacy of biomineralisation

Precipitation of calcium carbonate as nanoparticles enclosed in organic substances – generation of a compact matrix covering most of the calcite crystals.

**LIMESTONE**

**Gate of the Pomegranates**  
(Case study disseminated with the kind permission of the Patronato de la Alhambra y del Generalife)  
Alhambra, 1326 C.E.  
Arch in limestone

Several areas showed active degradation patterns including sanding and disaggregation. A total of 100 m<sup>2</sup> was treated via nebulization.

**Results**

the treatment period was doubled to make up for the lack of radiation and T/R control (heating)

the treatment was effective, proving that under relatively mild atmospheric conditions, the treatment of large areas is possible without sheltering

Microbially-generated calcite and selenite crystals were clearly observed in the treated areas with the aid of a digital magnifier.

**Biomineralisation with the Granada method: field results**

Carmo Convent  
Lisbon, 14th–15th centuries  
Portal in Lusitano limestone

Capitals showed active granular disintegration and scaling phenomena in progress under the black coats.

**Results**

these very high-value capitals, still bearing traces of polychromy, required a very careful and fully compatible consolidation solution. stone disintegration phenomena were severe and very localized, making biomineralisation an adequate stabilization solution. treatment was repeated so as to ensure its effectiveness in this aggressive urban environment.

**Church of St. Clemente**  
Loudi, late 13th century  
Portal in limestone

The stone blocks containing clays were severely affected by intense scaling and chipping, as well as cracking networks.

**Results**

soft decayed limestones present the greatest challenges to stone conservators due to the risk of consolidate creating strongly contrasting textures. the negative effects of biomineralisation pose no such risk.

biominerilization cannot bridge wide scales or distracting chips – but it can stabilise the stone and allow the safe repairing of wider discontinuities.

**LIMESTONE**

**Church of Our Lady of Mercy**  
Loudi, late 13th–early 14th century  
Portal and Calvary in limestone

With a stone similar to that of St. Clemente, the clay content of this local (Aragonian) limestone induced severe scaling and chipping, as well as wide-spread cracking networks.

**Results**

absorb testing (sponge test and peeling test) proved consolidation effect was indisputable, and enough to have an impact on the water absorption behaviour of the stone. Some of the measured points revealed that consolidation was still ongoing after 2.5 months.

biominerilization was instrumental in stabilising the stone and complemented the consolidation via repairing of discontinuities.