
EVALUATION OF MARINE BIOCALCIFYING BACTERIA FOR THE CONSOLIDATION OF BUILT HERITAGE

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Résumé

To ensure the longevity of cultural heritage, consolidation methods are essential to prevent ongoing decay. Recent advancements have utilized calcifying bacteria that penetrate stone pores and produce calcite, binding weakened particles and strengthening the material. Traditional biocalcification techniques rely on terrestrial bacteria, which, through urease metabolism, promote calcium carbonate precipitation but also produce toxic by-products such as ammonia, which can damage both the environment and materials. This study explores for the first time the potential of marine bacteria, with non-urease-based metabolism, for biomineralization and consolidation of limestone, offering a more sustainable and environmentally friendly approach. Marine biocalcifying bacteria, naturally adapted to saline environments, are particularly promising for restoring coastal monuments exposed to sea spray, with potential applications in various other environments.

The study compares the effectiveness of marine bacteria with terrestrial strains by applying them to two types of limestone used in monument restoration: sparitic limestone from the La Rochelle coastal area and oolitic limestone from eastern France. Prior to bacterial treatment, the stones underwent petrographical and petrophysical analysis, and the selected

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bacteria were characterized for their ability to biomineralize. Next, the bacterial treatments will be assessed using techniques such as SEM, Raman spectroscopy, roughness, color, microhardness measurements, and NMR to observe and quantify precipitated crystals, and measure changes in porosity and strength.

The results will enhance our understanding of marine bacteria bioconsolidation in different substrates, helping to identify the most effective marine strains for built heritage consolidation, and providing eco-friendly solutions by combining biotechnology, microbiology, and geomaterials characterization.

Mots-Clés: Biomineralization, marine bacteria, consolidation, stone durability, innovative techniques, built heritage