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Deterioration of the ornamental stones from Apulia (SE Italy) caused by thermal stresses

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Mesozoic carbonate rocks cropping out in Apulia, SE Italy, represent today, as in the past, a fundamental artistic and communicative mean for the local culture. For their physico-mechanical and aesthetic properties, these sedimentary rocks have always found a large application both as ornamental stones and as simple construction materials, particurarly in military architecture and worship buildings during the Middle Ages.
The Apulian "marbles" are characterised by high strength and durability, nevertheless outdoors exposure often involves significant changes in their technical properties and state of conservation caused by weathering. The effects of thermal stresses on the material performances, due to diurnal and seasonal temperature fluctuations, constitute a topic of particular interest in the assessment of durability problems associated to long-term exposure.
In this work, a study about changes in technical properties of the Apulian ornamental limestones and dolostones induced by thermal stresses is presented. Direct and indirect evaluations concerning index properties, mechanical strength, deformability, textural characteristics and chromatic features, on samples subjected to thermal cycles, were used for providing a comprehensive perspective about deterioration, from the mesoscopic scale to the microscopic one. In a muffle fornace, the samples were subjected to thermal cycles ranging from 100 to 700°C. At the end of each cycle, mass and volume determinations, mercury porosimetry measurements, sclerometric tests, ultrasonic tests, thin section observations and chromatic evaluations through image analysis and Munsell charts were performed.
The proposed methodology took into account only non-destructive or semi-destructive tests, in order to highlight the qualitative and quantitative characteristics of decay related to thermal stresses exclusively. In this way a constant comparison among the results of different experimental tests was carried out.