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Editorial

Editorial on the Special Issue "Application of Petrography, Geochemistry, and Geomechanics to Architectural Heritage"

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In historical architecture, which includes many types of monuments and ancient buildings, natural stone was used as the main building material because of its natural beauty, availability and durability. However, geomaterials do not last forever. As natural outcrops or exposed to the natural environment in a building or monument, they are subject to destructive physical, chemical, biological, and anthropogenic weathering. Their decay processes cannot be considered independently, as complex interactions occur between them and with the rock itself. The compositional, physical and mechanical characterization of different types of materials is essential to obtain information on their current conditions, environmental influences, and mechanisms of weathering through natural aging, including biodeterioration, and human-induced decay processes. Architectural heritage represents the historical and cultural memory of our cities; its conservation and restoration are global issues. Natural stone is not only an important ancient component of cultural works, but also an important modern building material. The uses of stone have increased over time and, unlike in the past, the use of natural stones and their derivative artificial materials today must meet the requirements for the intended purpose.

This Special Issue focuses on the important role played by petrography, geochemistry and geomechanics in the study of building material, revealing the close relationships between the various parameters that characterize each stone.

Within the topic covered by this Special Issue, the paper entitled "A Multidisciplinary Methodology for Technological Knowledge, Characterization and Diagnostics: Sandstone Façades in Florentine Architectural Heritage" by Centauro et al. [1] proposes an all-around diagnostic protocol encompassing some of the most advanced methods in a multidisciplinary approach. The aim of the paper is to provide a complete characterization of stone materials and their state of conservation, enabling the management of multi-scale surveys through the use of a specific investigation protocol. In particular, the proposed multidisciplinary methodology for the acquisition of technological knowledge, characterization, and diagnostics of built cultural heritage was applied to historical Florentine buildings characterized by stone façades. The diagnostic project first involved a historical analysis and an architectural survey; then a complete characterization of the rough-hewn rusticated blocks was carried out through decay and optometric surveys, and mechanical, physical, mineralogical, and petrographic analyses.

The use of combined techniques is also suggested [2] to investigate the Bargello masonry, an important building located in the historical center of Florence (Italy); in the paper entitled "Technical Analysis of the Masonry of the Bargello' Palace, Florence (Italy)", different techniques, including georadar, ultrasounds, a thermal survey, microperforations (DAC-test), and endoscopy, were employed; the results of this investigation were determined using a full HBIM 3D model which is a valuable tool for creating an active database that allows one to simultaneously read all the information relating to an element in order to identify critical issues and provide conservation strategies through multidisciplinary knowledge.

The decay of stones of different compositions and origins was investigated in three studies [3–5] published in this Special Issue to contribute to the conservation of architectural

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heritage. In the first paper entitled "The Alteration of Giglio Island Granite: Relevance to the Conservation of Monumental Architecture", the alteration phenomena of an Italian granite, a rock that was quarried by the Romans since the third century, used for building columns on the Italian Peninsula and later reused in many Christian religious buildings, were studied [3]. The investigation was carried out by Fratini et al. using petrographic observations, X-ray diffraction, and X-ray fluorescence spectrometry. Physical parameters such as open porosity, imbibition coefficient and saturation index were also obtained. Starting from an unweathered rock, materials with different alteration states were investigated. The results show that the degradation of this type of rock is accompanied by a progressive increase in porosity and a subsequent loss of cohesion, which underlines the need for continuous monitoring of the state of conservation of such material in the architectural heritage.

In the second paper entitled "Decay Process of Serpentinite: The Case of the San Giovanni Baptistery (Florence, Italy) Pavement", the authors (Santo et al.) focus on the numerous forms of serpentinite decay which include fractures, loss of material, erosion, discoloration and efflorescence [4]. X-ray diffractometer analyses of efflorescence revealed the presence of numerous salts whose formation could be imputed to multiple, possibly concomitant, causes such as high relative humidity, variation of the inside temperature, the presence of concrete and/or cementitious mortars in the subsoil, atmospheric pollution and the burial ground located close to the baptistery.

The paper entitled "The San Giovanni Baptistery in Florence (Italy): Assessment of the State of Conservation of Surfaces and Characterization of Stone Materials" by Calandra et al. [5] describes the state of conservation of external surfaces of marble, brick and mortar of the San Giovanni Baptistery (Florence, Italy). The proposed multi-analytical approach revealed the presence of black crusts, red staining, sulphation products, and organic patinas. A geochemical and minero-petrographic approach was used in order to classify and assess the provenance of marbles, and to define the raw materials and technologies for the production of bricks and mortars.

The last two contributions [6,7] of this Special Issue provide two detailed case studies performed on artificial materials such as *terracotta* and plaster. In the paper entitled "Insights into Della Robbia's Terracotta Monument to Cardinal Federighi: Raw Materials and Technologies", Magrini et al. [6] examine the glazed tiles from Benozzo Federighi's tomb made by Luca della Robbia and apply a multi-analytical strategy based on the combination of several non-destructive and micro-invasive methods. The results of this investigations deepen our knowledge of the execution technique of this artwork and of the raw materials used by Luca della Robbia. The paper entitled "The Preparatory Layers in the Etruscan Paintings of the Tomba dei Demoni Alati in the Sovana Necropolis (Southern Tuscany, Italy)" presents an investigation of the Tomba dei Demoni Alati, located in the Etruscan necropolis of Sovana (Grosseto, Southern Tuscany, Italy) [7]. The aim of this work is to investigate the materials and manufacturing techniques of the preparatory layers applied to the rock surface through minero-petrographic, chemical, and micro-chemical characterization. The results show that different methods were used to prepare the tomb surfaces to be painted. In particular, two preparatory layers were found in the niche of the tomb: a Ca-based plaster was applied to cover the rock and a thin white Ca lime layer was applied on top. For the sculptures inside the niche, colours were applied on two finishing white Ca lime layers of similar composition, while for the decorations of the sculptures on the outside, the colour layers were applied onto a thin white silica layer. The data obtained demonstrate, for the first time, the use of plaster in Tuscany, and enable the discovery of the presence of a preparation layer not previously found in any other local archaeological context.

The results reported in the papers published in this Special Issue highlight the importance of a multidisciplinary approach to the study of stones in order to obtain information on composition, and physical and mechanical properties. We believe that this Special Issue represents a small but significant step in this direction and that it will encourage researchers interested in this area of research to pursue this type of approach.

Conflicts of Interest: The author declares no conflict of interest.

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