

THE BEHAVIOUR OF THE “CALCARE A LUMACHELLA” STONE TO WEATHERING: AN EXPERIMENTAL STUDY

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This work focuses on the study of the “*calcare a lumachella*”, a carbonate rock widely used in monuments of historical-artistic interest of the eastern Sicilian architecture. It is a limestone almost entirely consisting of fossil shells (from which it derives the name), belonging (along with the “*calcare oolitico*”) to the Monte Carrubba Formation (Messinian) [1]. In the past, this lithotype was extracted from underground quarries, known as “*latomie*”, in the Syracuse area. Despite the many extractive difficulties, it was extensively used as construction and decorative material in edifices and monuments of the Val di Noto (south-eastern Sicily). Among all types of limestone outcropping in this area and used in the historical-architectural heritage, the *calcare a lumachella* is the one showing the best physical and mechanical features as well as the higher resistance to weathering. Nevertheless, only few papers in the existing literature deal with the characterization of this lithotype [2], while many studies refer to other types of limestone from the same area [3-6]. In such a context, the main purpose of the present study is to provide a complete characterization of the *calcare a lumachella*, in order to correlate its mineralogical, physical and mechanical features with the excellent response to weathering.

The studied specimens were sampled from a historic underground quarry “*latomia*” (Fig. 1a), in the Maddalena peninsula (Syracuse). The mineralogical-petrographic features were determined through polarized optical microscope and X-ray diffraction. As regards the physical properties, porosimetric analyses, hydric tests (capillary water absorption, water absorption at atmospheric pressure), ultrasound speed determinations and salt crystallization tests (Fig. 1b), were carried out. For what concerns the mechanical characterisation, the specimens underwent tests aimed to determine the uniaxial compressive strength, the flexural strength and the elastic modulus to uniaxial compressive strength. Both physical and mechanical analyses were carried out on cubic specimens on the three orthogonal directions to highlight the possible differences caused by the typical orientation of the rock due to the accumulation of shells.

All obtained data, also compared with those from literature relative to other types of limestone employed in the same area, point out that the intrinsic characteristics of the

“*calcare a lumachella*”, namely its textural and mineralogical features, are responsible for the excellent properties and resistance to decay of such a lithotype.



Fig. 1. a) Historic underground quarry “latomia” of the “*calcare a lumachella*” (Maddalena peninsula - Syracuse); b) specimens of “*calcare a lumachella*” before and after the salt crystallization tests.

References

- [1] Pedley, M., Grasso, M., Maniscalco, R., Esu, D., 2007. The Monte Carrubba Formation (Messinian, Sicily) and its correlatives: New light on basin-wide processes controlling sediment and biota distributions during the Paleomediterranean – Mediterranean transition. *Paleogeography, Paleoclimatology, Paleocology*, 253: 363-384.
- [2] Punturo, R., Russo, L. G., Lo Giudice, A., Mazzoleni, P., Pezzino, A., 2006. Building stone employed in the historical monuments of Eastern Sicily (Italy). An example: the ancient city centre of Catania. *Environ. Geol.*, 50: 156-169.
- [3] Anania, L., Badalà, A., Barone, G., Belfiore, C. M., Calabrò, C., La Russa, M. F., Mazzoleni, P., Pezzino, A., 2012. The stones in monumental masonry buildings of the “Val di Noto” area: New data on the relationships between petrographic characters and physical-mechanical properties. *Constr Build Mater*, 33: 122-132.
- [4] La Russa, M. F., Barone, G., Belfiore, C. M., Mazzoleni, P., Pezzino, A., 2011. Application of protective products to “Noto” calcarenite (south-eastern Sicily): a case study for the conservation of stone materials. *Environ. Earth Sci.*, 62: 1263-1272.
- [5] Belfiore, M. C., Fichera, G. V., La Russa, M. F., Pezzino, A., Ruffolo, S. A., 2012. The Baroque architecture of Scicli (south-eastern Sicily): characterization of degradation materials and testing of protective products. *Periodico di Mineralogia*, 81, 1: 19-33.
- [6] Belfiore, M. C., La Russa, M., Pezzino, A., Campani, E., Casoli, A., 2010. The Baroque monuments of Modica (Eastern Sicily): assessment of causes of chromatic alteration of stone building materials. *Appl. Phys. A*, 100: 835-844.