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Application of integrated acoustic and mineralogical techniques for the characterization of building stones in monumental structures.

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Integrated acoustic (ultrasonic and seismic) and mineralogical techniques were applied to acquire information on the preservation state of building materials. Analyses and tests were performed on a main façade of a monumental building in the historical city centre of Cagliari (Italy). The analysed materials are mainly limestones with different chemical-mineralogical composition and different mechanical conditions. The acoustic techniques, involving the propagation of elastic waves, are based on the principle that the characteristics of the acoustic signal are related to the mechanical status of a material. Therefore the acoustic velocity can be used efficiently to characterize both in laboratory and "in situ" the building stones. In this study, to objectively evaluate the conservation state of the building materials, an experimental integrated application of low frequency ultrasonic (24 kHz) and seismic techniques was carried out. The data acquisition modalities were very similar to those used for the ground geophysical prospecting. The above mentioned techniques allowed to define the thickness of altered zones and detect mechanical discontinuities throw the study of acoustic velocity anomalies (low velocity zones). The acoustic techniques were integrated by mineralogical analyses, carried out by X-Ray Diffraction (XRD) and optical techniques on microsamples from the shallow part of the walls (mortar) and from some representative sectors inside the walls (by microcores), in order to assess the nature, type and intensity of alteration of the materials, on which to carry out geophysical laboratory tests. The interpretation of the results obtained by the integrated use of acoustic techniques and mineralogical analyses revealed very effective in the characterization of the materials and in defining its preservation state, both in the mortars and masonry wall faces and inside the masonry structure.