Geophysical Research Abstracts
Vol. 16, EGU2014-12800, 2014
EGU General Assembly 2014

Integrated ultrasonic and petrographical characterization of carbonate building materials

Paola Ligas, Silvana Fais, and Francesco Cuccuru

Department of Civil and Environmental Engineering and Architecture (DICAAR), University of Cagliari, Cagliari, Italy (pligas@unica.it; sfais@unica.it, cuccuruf@unica.it)

This paper presents the application of non-destructive ultrasonic techniques in evaluating the conservation state and quality of monumental carbonate building materials. Ultrasonic methods are very effective in detecting the elastic characteristics of the materials and thus their mechanical behaviour. They are non-destructive and effective both for site and laboratory tests, though it should be pointed out that ultrasonic data interpretation is extremely complex, since elastic wave velocity heavily depends on moisture, heterogeneity, porosity and other physical properties of the materials. In our study, considering both the nature of the building materials and the constructive types of the investigated monuments, the ultrasonic investigation was carried out in low frequency ultrasonic range (24 kHz – 54 kHz) with the aim of detecting damages and degradation zones and assessing the alterability of the investigated stones by studying the propagation of the longitudinal ultrasonic pulses. In fact alterations in the materials generally cause a decrease in longitudinal pulse velocity values. Therefore starting from longitudinal velocity values the elasto-mechanical behaviour of the stone materials can be deduced. To this aim empirical and effective relations between longitudinal velocity and mechanical properties of the rocks can be used, by transferring the fundamental concepts of the studies of reservoir rocks in the framework of hydrocarbon research to the diagnostic process on stone materials.
The ultrasonic measurements were performed both in laboratory and in situ using the Portable Ultrasonic Non-Destructive Digital Indicating Tester (PUNDIT) by C.N.S. Electronics LTD. A number of experimental sessions were carried out choosing different modalities of data acquisition.
On the basis of the results of the laboratory measurements, an in situ ultrasonic survey on significant monuments, have been carried out.
The ultrasonic measurements were integrated by a petrographical and petrophysical study of the investigated stone materials to correlate their petrographical-petrophysical features with the elastic ones. From this integrated study results that the modifications in the elasto-mechanical and petrographical-petrophysical features of the investigated carbonate materials are the main causes which reduce their quality as building materials.
The use of the ultrasonic method integrated with information on petrography and petrophysics of the rocks has been successful to assess the rock quality and better understanding their alteration process.

Acknowledgments: This work was financially supported by Sardinian Local Administration (RAS – LR 7 August 2007, n.7, Promotion of Scientific Research and Innovation in Sardinia - Italy, Responsible Scientist: S. Fais).