Geophysical Research Abstracts
Vol. 14, EGU2012-1752, 2012
EGU General Assembly 2012

Computed Tomography and Nuclear Magnetic Resonance to study the internal structure and measure weathering

A. Zornoza-Indart, P. Lopez-Arce, M. Alvarez de Buergo, and R. Fort
Instituto de Geociencias (CSIC-UCM), Madrid, Spain (ainarazornoza@pdi.ucm.es)

Outdoor stone heritage is prone to decay due to its direct exposure to weathering agents such us thermal shock caused by isolation processes, salt crystallization phenomena, atmospheric pollutants effects on stone surfaces, freezing and thawing cycles or biodeterioration o decay provoked by biogenic activity. These damages use to affect the surface of the objects or elements causing de-cohesions (flaking, spallings, grain disintegration), material loss or color changes, but also use to affect the internal structure of the objects, although they are not visible, causing internal pressures, fissures and fractures, mineral transformations or inner biodeterioration compromising objects conservation. For this reason, the study of the internal structure of the objects is necessary to establish its weathering and conservation state, to determine its restoration needs and achieve its conservation. Moreover, in cultural heritage where the originality of the objects and their historical or artistic values are so important the use of non-destructive techniques result necessary for their study without causing any damage by sampling.

In this work X ray Computed Tomography (CT) and Nuclear Magnetic Resonance (NMR) are used to analyze rock samples (dolostones used in historical buildings from Central Spain and Madrid both in the city and in the province) subjected to different artificial accelerated ageing tests (thermal shock, salt crystallization, freezing and thawing cycles and marine aerosol) to simulate the most common outdoor heritage deterioration scenarios. The changes in the internal structure and pore system modifications are studied with these non-destructive techniques. Nuclear Magnetic Resonance (both imaging and relaxometry) experiments were performed in stone specimens to observe and to quantify the location and distribution of water inside the objects, been able to analyze pore size and location. X ray Computed Tomography was used for visualizing and locating internal damage allowing to measure non visible structural weathering and also to analyze surface damage due to 3D reconstructions of the samples. MRI results show higher T1 and T2 values in samples subjected to salt crystallization and freezing and thawing cycles than in samples subjected to thermal shock and marine aerosol ageing test meaning the presence of larger pores in these specimens. This results correlate with the results obtained by X ray Computed Tomography analysis where a dramatic internal damage is observed in samples subjected to salt crystallization and freezing and thawing cycles while in the other samples the damage concentrates in the surface. Nuclear Magnetic Resonance and X ray Computed Tomography proved to be powerful non-destructive techniques for study the internal structure and measure weathering.