ENVIRONMENTAL IMPACT ON UNESCO ARCHAEOLOGICAL SITES IN PANAMA

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Abstract

In Panama two archaeological sites have been included in the World Heritage List of UNESCO in the last decade [1]. Both located near the sea, one is situated on the North Coast, exactly on the Caribbean Sea and it consists in military Spanish fortifications (XVII-XVII cent.), built in Portobelo and San Lorenzo areas, aimed at protecting the coasts and the transoceanic commerce from the pirate attacks (Fig. 1). The second one arises on the opposite littoral, just in front of the Pacific Ocean, in the downtown of Panama City (Fig. 2). Nowadays it is known as Panama Viejo and it is the first Spaniards settlement on the Pacific coast, founded in the 1519 A.D.. Archaeological excavations showed also the presence of a previous indigenous community, called Cueva, dating from 500 A.D. and representing a symbol of national identity [2-4].

At the beginning of the next year the Institute of Atmospheric Sciences and Climate, (ISAC-CNR, Bologna), in collaboration with the "Panama Viejo Patronage" and the Department of Physics and Earth Sciences of the University of Ferrara, will start a research project in Panama focused on the evaluation of the state of conservation and damage due to climate and pollution impact on the two sites described above. Specifically the selection of these two locations was done to compare a rural archaeological site with an urban one, both exposed to the same climatic conditions and located in adjacent areas of the Panama Canal.

As a first step the characterization of the construction materials, in conjunction with the evaluation of their state of degradation, will be carried out. For achieving this aim a survey campaign will be conducted, in order to examine the sites and to select the most significant sampling areas. The collected samples will be analyzed in laboratory by Optical Microscopy (OM), X-Ray Powder Diffraction (XRD), Differential Thermal Analysis and Derivative Thermogravimetric Analysis (DTA-DTG), Scanning Electron Microscopy in combination with Energy-Dispersive X-ray spectroscopy (SEM-EDX) and Mercury Intrusion Porosimetry (MIP).

In addition, Fluorescence X-Ray (XRF) investigation of the samples will be executed in order to identify the provenance of the raw materials employed in the buildings belonging to the archeological sites.

Subsequently, the evaluation of the interaction between the characterized construction materials and the surrounding environment will be carried out. As part of the planned activity, the climate parameters to be monitored will be prioritized, in particular considering air and

surface temperature, relative humidity, solar radiation, wind speed and direction, atmospheric pressure and rainfall. It is known that these parameters play a driving role in deterioration processes, such as decohesion, fracturing and detachment due to salt crystallization, thermoclastism and erosion. Moreover CO_2, NO_x, SO_x Volatile Organic Compounds (VOC) and Particular Matter (PM), from anthropogenic activity (mobile and stationary combustion sources), will be taken into account and monitored as responsible of surface recession, soiling and black crusts formation [5].
Investigations will be arranged to ensure an yearly campaign of continuous measurements of climatic parameters; in addition weekly sampling campaigns of pollutants will be performed during both the dry and the rainy seasons. The sampled particulate matter will be analyzed in order to measure the soluble, insoluble and carbon fractions by Ion Chromatography analysis (IC), SEM-EDX and by a thermal-chemical methodology developed by Ghedini et al.[6].
In conclusion this research project proposes to consider for the first time the environmental impact on the Panama Viejo, Portobelo and San Lorenzo archaeological sites, with the final aim the identification of sustainable strategies for their conservation in facing climate and pollution changes.


Fig. 1. Portobelo and San Lorenzo Fortifications (© F. Letullier, 2007)


Fig. 2. Archaeological Site of Panamá Viejo (© Our Place World, 2010)

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