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Procedia Earth and Planetary Science 16 (2016) 52 – 60

Procedia
Earth and Planetary Science

The Fourth Italian Workshop on Landslides

Advances in sustainable conservation practices in rupestrian settlements inscribed in the UNESCO's World Heritage List.

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Abstract

Rupestrian settlements were among the first man-made works in the history of humanity. The most relevant masterpieces of such human history have been included in the UNESCO World Heritage List. These sites and remains are not always in equilibrium with the environment. They are continuously impacted and weathered by several internal and external factors, both natural and human-induced, with rapid and/or slow onset. These include major sudden natural hazards, such as earthquakes or extreme meteorological events, but also slow, cumulative processes such the erosion of rocks, compounded by the effect of climate change, without disregarding the role of humans, especially in conflict situations. Many rupestrian sites have been carved into soft rock, generally with UCS<25 MPa (ISRM, 1981), in vertical cliffs, and show major conservation issues in the domain of rock slope stability and rock weathering. The present paper reports the experience of rock fall mitigation in rupestrian sites, mainly from the UNESCO World Heritage List (Bamiyan in Afghanistan; Lalibela in Ethiopia; Petra in Jordan and Vardzia in Georgia). The general approach, implemented in the reported activities, include field conservation works enhancing traditional knowledge and sustainable practices, primarily based on local conservation techniques.

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Peer-review under responsibility of the organizing committee of IWL 2015

Keywords: Rupestrian site, rock mechanic, geotechnical threats, investigations, conservation policies

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Peer-review under responsibility of the organizing committee of IWL 2015
doi:10.1016/j.proeps.2016.10.006

1. Introduction

Rupestrian settlements were among the first man-made works in the history of humanity. During almost 3 million years, human kind has survival relied on two basic activities: hunting (or fishing) and gathering edible items of all kinds (from fruit to insects). A radical change came roughly 10,000 years ago, after the last glacial age, when people first learned to cultivate crops and to domesticate animals, in what can certainly be considered one of the most significant development in human history. This process took place during the Stone Age, when tools were still made of stone rather than metal[1].

A subsequent significant change concerned the process of planning, designing and building structures for human settlements. Architectural works, in the material form of buildings and/or rupestrian settlements, are often perceived as cultural symbols and as works of art and historical civilizations are often identified with their architectural achievements. However, architectural works are not merely physical construction. They represent the synthesis of a complex system that, in all ages, is guided by human genius, and it depends on the availability and types of construction materials (natural geological resources). Their form is determined by social and economic conditions, by local morphological situations (e.g. defensive settlements on top of cliff), and it is influenced by local meteo-climatic conditions. The most relevant masterpieces of such human history, have been included in the UNESCO World Heritage List.

Following is a brief description of some advanced sustainable conservation practices, employed by the authors in selected case histories.

2. Conservation policies and management

Conservation of rupestrian sites is a complex endeavour, requiring expertise from the sciences of conservation, geotechnical engineering and earth science. On the other hand there is a high need for innovation, addressing the central and exclusive role of conservators in the past and looking toward a truly holistic and interdisciplinary approach. As a matter of fact, measures to be adopted need to be as much as possible:

- effective
- non-invasive
- feasible for the employment of local materials and manpower.

The first requirement is obviously aimed at solving the problem; the second to emphasize the maximum preservation of the original aspect of the site, while the third is meant to maximize the reproducibility, both in time and space, of the adopted techniques in case of further interventions. The latter also includes the involvement of local community in protection and development of the site. This is not a minor point, since local expertise and traditional knowledge may enrich the sustainability of the conservation policies, ensuring local management and the long term maintenance.

Clearly, since any site is showing a different problem, no standard procedures can be established. The following figure is trying to synthesize the potential interconnections among landslide science and science for cultural heritage conservation[2].

Following are some example of rupestrian sites where the above approach was pursued. Clearly, any case is unique, showing peculiar natural processes and social elements. As a consequence any site must be investigated with high attention and avoiding the imposition of techniques and solutions that are not balanced in the specific cultural, natural and human “environment, then balancing mitigation strategies with local expertise and traditional knowledge.

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