

IPL Project Proposal Form 2017

(MAXIMUM: 3 PAGES IN LENGTH)

1. Project Title: (2 lines maximum)

Landslide risk analysis and mitigation in the ancient rock-cut city of Vardzia (Georgia)

2. Main Project Fields

Select the suitable topics. If no suitable one, you may add new field.

- (1) Technology Development

A. Monitoring and Early Warning, B. Hazard Mapping, Vulnerability and Risk Assessment

- (2) Targeted Landslides: Mechanisms and Impacts

B. Landslides Threatening Heritage Sites

- (3) Capacity Building

A. Enhancing Human and Institutional Capacities

- (4) Mitigation, Preparedness and Recovery

A. Preparedness, B. Mitigation

3. Name of Project leader: **Claudio Margottini** (*Scientific Coordinator*)

Affiliation: **Scientific and Technological Attaché Embassy of Italy in Egypt - UNESCO Chair at Florence University (Italy) Prevention and sustainable management of geo-hydrological hazards adj. Professor and Founder**

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Dr. Daniele Spizzichino (ISPRA project manager)

Affiliation: (office and position)

ISPRA - The Italian National Institute for Environmental Protection and Research – Researcher (Rome office)

and Contact: (postal address and email)

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Core members of the Project: Names/Affiliations: (4 individuals maximum)

- **Dr. Nikoloz Antidze (General Coordination) Director General of the National Agency for Cultural Heritage Preservation of Georgia. Tbilisi, Georgia.**
- **Dr. Mikheil Elashvili Professor (Contribution to monitoring system implementation and analysis) School of Natural Sciences and Engineering, Ilia State University Tbilisi, Georgia.**
- **Prof. Nicola Casagli – (Contribution to Engineering Geology, thermographic survey and kinematic analysis). UNESCO Chair at Florence University (Italy) Prevention and sustainable management of geo-hydrological hazards.**

- **Prof. Daniela Boldini – (Contribution to geotechnical characterization, stability model and mitigation measures design). Department of Civil, Chemical, Environmental, and Materials Engineering. University of Bologna.**

4. Objectives: (5 lines maximum; what you expect to accomplish?)

The project will:

- **Geological, geomorphological and geomechanical characterization of the entire monastery (laboratory and field survey);**
- **Identify potential unstable area in the rock cut city by means of field geotechnical techniques;**
- **Stability model implementation for the entire rock slope and suggestion for mitigation measures;**
- **Implementation of long term monitoring system (GBR, meteo station, seismic)**
- **Improve knowledge of local authorities for the identification of potential unstable areas, monitoring of the site, design and implementation of landslide mitigation works/strategies.**

5. Study Area: (2 lines maximum; where will the project be conducted/applied?)

Rock cut city of Vardzia Monastery (Georgia)

6. Project Duration: (1 line maximum)

September 2017 – September 2019 (possibility of extension for another one year)

Personnel involved: about 10 experts in the field of Rock mechanic, Engineering geology, monitoring management, ICT, management of Cultural Heritages.

Facilities: Monitoring network composed by Ground Based Radar, seismic accelerometers, meteorological sensors; ICT laboratories.

Budget: operational budget (monitoring, mitigation, etc.) is provided by the National Agency for Cultural Heritage Preservation of Georgia; personnel cost is covered by involved institutions.

7. Project Description: (30 lines maximum)

The rock-cut city of Vardzia is a cave monastery site in South-western Georgia, excavated inside the Erusheti mountain on the left bank of the Mtkhviri river. The caves stretch along the cliff for about 800 m and up to 50 m inside the rock slope. Most of the site was carved inside the volcanic and pyroclastic rock layers located at an elevation of 1300 m above the sea level. The earthquake that struck the Samtskhe region in 1283 AD destroyed about two thirds of the city cave, exposing most of the rooms to the exterior. Recently, as a part of a National Heritage Reserve, the site was submitted for a prospective inclusion into the UNESCO World Heritage List. However, the site has been affected by frequent instability phenomena along the entire volcanic cliff that, because of their rapid evolution, are deemed dangerous to the visitors that daily crowd the site to discover its beauties. In consideration of this high risk, the National Agency for Cultural Heritage Preservation of Georgia (NACHPG) promoted, with the support of Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA), based in Italy, an assessment of the landslide hazard for the entire area: this project included in situ surveys, terrestrial laser scanner acquisitions and elaborations, rock mechanics characterization, geo-structural and kinematic analysis and a real time monitoring based

on Ground Based Radar interferometry, meteo-climatic, seismic network and real time photo-camera, for the identification of deformation paths for the most hazardous areas. Vardzia is an excellent example of a cultural landscape in which human activities and natural processes are strictly connected. Often, lithology (e.g., soft rock easy to excavate), geomorphological processes (e.g. landsliding, erosion and weathering), beautiful and impressive landscapes and inaccessibility (settlement easier to defend and protect) have been the main elements in the history of humanity concerning the choice for the realization of towns, monuments, religious structures, and defence works. This is one of the main cultural heritage sites of Georgia, attracting thousands of tourists every year. It is essential to preserve the site to guarantee a safe access for the visitors

8. Work Plan/Expected Results: (20 lines maximum; work phases and milestones)

The main activities of the Vardzia project include a multidisciplinary survey and monitoring of Vardzia rock cut complex, that implies the following:

1. General coordination and cooperation with National experts;

a. State of art in the field of Geology, Rock mechanic, hydrology and hydrogeology (from other project partners)

b. State of art in the field of cliff monitoring (past and existing)

c. Analysis and elaboration of all data coming from different working groups;

2. Detail reports for practical design

a. Final elaboration on Thermal Infrared Analysis of the cliff

b. Implementation of rock laboratory tests

3. General design of mitigation works

a. General mitigation plan of the site

b. Operational design in selected unstable portion of the cliff;

4. Maintenance of the site

a. Operational plan for maintenance of the mitigation works

b. Analysis and elaboration of all data coming from different working groups;

5. General framework for safety of field-workers and field support

a. Field support to local companies in drilling and mitigation works;

6. Final report

7. Workshops with local experts

9. Deliverables/Time Frame: (10 lines maximum; what and when will you produce?)

Three report/deliverables must be produced every years in order to verify the progress of the works.

10. Project Beneficiaries: (5 lines maximum; who directly benefits from the work?)

The project is directly addressed to support the local authority and more in detail the National Agency for Cultural Heritage Preservation of Georgia. Another beneficiary will be for sure the Ilia University of Tbilisi that will be supported for the implementation and interpretation of all the data coming from the monitoring system.

11. References (Optional): (6 lines maximum; i.e. relevant publications)