



**Doctoral Thesis Title:** A new approach to the integration of non-destructive techniques for the knowledge of the epicarst of surface caves with rock art.

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**Abstract:** The proposal of this Doctoral Thesis is based on the development of a procedure for the integration of non-destructive techniques that spatially analyses the interrelation of abiotic factors and the internal epicarstic structure of surface caves with rock art. The results of this thesis would contribute to the advancement of research, management, conservation, monitoring and dissemination of such a valuable and fragile heritage.

Shallow caves are those which, due to their small size, are more affected by external conditions and undergo a process of deterioration associated with the geological evolution of the cave and the hydrogeochemistry of the water at a faster rate than deep caves. They are generally subject to different physical-chemical alteration factors such as infiltration and condensation flow, water composition, relief of the support and relationship with the fracture network, which greatly influence the conservation of their rock art.

Ground penetrating radar (GPR) is an indirect non-destructive technique that allows obtaining detailed information of the rock structure or massif which, when processed in 3D using precise georeferencing, could be integrated with other direct mapping techniques such as 3D ground laser scanning, UAV photogrammetry or hyperspectral remote sensing.

The aim of this thesis proposal is to integrate the 3D georeferenced information obtained by georadar with models obtained by direct techniques in order to derive new detailed maps using Geographic Information Systems, such as the thickness of overlying layers, dolines, fractures, joints and landslides. It would also allow to advance in the knowledge of the interior-exterior interconnection of the cave and the gaseous exchange and water filtrations, therefore, the state of senescence of the karst that contains a cave with rock art.

**Available Means:**

Equipment:

- GPR:
  - GSSI central unit: SIR 3000 and SIR 4000 models.
  - Antennas: 100 MHz bistatic and monostatic, 400 MHz, 900 MHz and Dual 300-800 MHz.
- Topcon GPT 7503 Survey Station.
- GNSS Topcon Hiper VR.
- FARO X130 and X330 Laser Scanner.
- Intel Falcon 8+ Drone with Sony A7R Camera.

Associated Project: None.

Collaboration: None.

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