

The Huayruro Project: mapping the Calicanto Inca area buried by the A.D. 1600 Huaynaputina eruption, with geophysical imaging and remote sensing

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We present geophysical and remote sensing observations near the Quinistaquillas town (southern Peru), in the framework of the HUAYRURO Project. This Inca zone was buried during the A.D. 1600 Huaynaputina eruption, the most important volcanic phenomenon of the last 400 years. The eruption had a global impact, due to the volume of emitted ash (2-3 times the one emitted by Vesuvius in A.D. 79). This led to a 1.13°C cooling of the planet and caused a worldwide agricultural crisis.

During the eruption, the Calicanto-Chimpapampa zone was covered by ashes and pyroclastic flows, with a thickness in the range [1 - 20] m. From 2015 to 2017, remote sensing and geophysical methods were deployed to map a ~ 1 km*2 km area, up to 3-m depth.

A multi-spectral drone was first used to acquire visible and thermal infrared data 1) to obtain a high resolution photogrammetric DEM (resolution: 1.23 cm) and 2) to detect the buried walls. Then, several 3D geophysical methods were performed to get a fast and precise location of the structures:

- An EM31 electromagnetic survey (Geonics instrument) and magnetic observations (GEM systems proton magnetometer) were tested for a fast mapping of the area;
- An IDS Ground Penetrating Radar (with antennas of 200 MHz) was used to obtain the precise location of the buried walls;
- All the methods were georeferenced using a Trimble R6 differential GPS.

In this work, several examples of combination of these methods are presented. Finally, this methodology allowed us to propose a complete map of the structures at Calicanto, now used by the archeologists to excavate the town. This study shows the potentialities of the joint use of drone-based remote sensing and geophysical imaging for the promotion of archeological sites.