

Extensive multi-channel GPR mapping over the site of the ancient Archiepiscopal Palace of Alcalá de Henares (Spain)

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KEY-WORDS: GPR, multi-channel, archaeology, Archiepiscopal Palace, Alcalá de Henares

INTRODUCTION

A case history concerning an extensive multi-channel GPR survey (IDS Stream-X 200 MHz, 16 channels) carried out over the site of the ancient Archiepiscopal Palace of Alcalá de Henares (16th century AD) (Madrid, Spain) is presented in this paper. The palace was built over a *mudéjar* hillfort (13th century AD), in 1858 it became the Historical Central Archive of the Spanish Kingdom and in 1939 was largely destroyed by an accidental fire (Sánchez España 2012).

The objectives of the work include identification of the remains of the palace and the investigation of undocumented underground structures, like old tunnels and rooms, where, according to oral tradition, documents and precious materials were buried after the fire.

DATA ACQUISITION AND POST-PROCESSING

The survey investigated about 25,000 m² (Fig. 1) with 3195 radargrams organised into 213 swaths. Each swath is composed of 15 radargrams acquired simultaneously at fixed spacing (cross-line resolution) of 12 cm (Novo *et al.* 2011). The data positioning was performed by an RTK GNSS system (Topcon GR5) including base and rover, working with GPS and Glonass constellations. The GPR and GPS equipment were synchronized with the UTC clock pulse by ppsync link.

GPR data post-processing was carried out using GRED HD (IDS spa) and GPR-Slice (Geophysical Archeometry Laboratory, California, USA). Radagram filtering included static correction (first pulse realigning and synchronizing), gaining curve, spectral whitening, spectral deconvolution, background filtering and Hilbert transform. The estimation of the velocity was performed by the hyperbola fitting method, giving values ranging between 0.09 and 0.075 m/ns. Due to the high variability of the parameter, data were not migrated.

RESULTS

A set of GPR time slices, each one representing a soil thickness of about 10 cm, was processed for the four areas covered by the survey, employing and comparing both techniques based on volume pulsing and classical slicing/gridding method (Goodman *et al.* 1995).

High quality GPR results were obtained despite the electrically conductive lithological context, mostly in the sector occupied, in ancient times, by the “Patio de Fonseca” and “de la Fuente”, around

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Fig. 1. Area covered by the GPR survey (marked with straight lines)

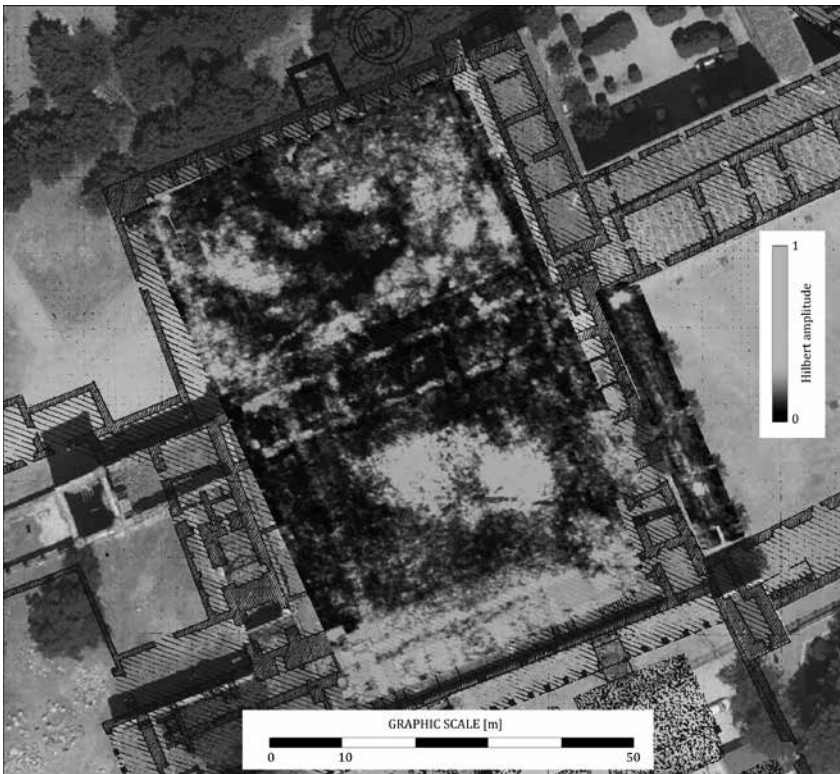


Fig. 2. GPR time-slice at about 0.7 m depth, overlapping documentation from AD 1862. The northern area (north is up) corresponds to the ancient “Patio de la Fuente”, the southern to the “Patio de Fonseca”. White corresponds to strong GPR reflections, dark to weak reflections

which most of the buildings were erected. The GPR imagery clearly showed the layout of the ancient building, matching almost perfectly the historical records from the beginning of the 19th century.

Moreover, several undocumented structures were discovered lying below the “Patio de la Fuente”. They could represent the remains of a partly preserved underground tunnel, documenting an important stratigraphic discontinuity in the “Patio de la Fuente” and providing interesting archaeological information about the origin of the Palace. An example of the GPR results from the above sectors is shown in Figure 2 (time slice at 0.7 m depth). The results of an archaeological verification of a selection of GPR anomalies, carried out in the spring of 2015, will also be presented.

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