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COMPARING GEOPHYSICAL PROSPECTION DATA WITH ARCHAEOLOGICAL EXCAVATION AT THE LATER CITY WALL OF ROMAN ITALICA (SANTIPONCE, SEVILLA)

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ABSTRACT

Italica's late city wall, first identified by geophysical methods in the 1990s, has been recorded within a Hispano-German cooperation project more accurately thanks to technically improved measurement equipment and new methodology. In addition, its course in the area of the *Traianeum* could be further narrowed down. Based on the geophysical surveys conducted between 2015 and 2018, the structure, stratigraphy and chronology of one of the corner towers and parts of the course of the wall were examined archaeologically. The expected clarity and state of preservation of the features, as suggested by the geophysical measurements, was not met by the excavation results. By means of an objectified approach in interpreting the geophysical data, an attempt is made to correlate the survey images with the excavation findings. Also problems which arise by comparing radiocarbon dates from bone samples of the necropolis with traditional ceramic chronology are discussed.

KEYWORDS: Nova Urbs, defensive architecture, Late Antiquity, necropolis, geophysical, survey

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1. INTRODUCTION

The Roman city of Italica is located in the current municipality of Santiponce, 10 km from the city of Seville. In origin, the city was located on the shore of the Guadalquivir River, an exceptional route of communication and export of agricultural and mining products of the province. With the passage of time, the riverbed moved away from the city, which caused its crisis and decline.

Appian (Iber. 6, 7, 38) gives the only (surviving) testimony of the historical moment and circumstances of the birth of the Roman settlement and connects it to the victory of Public Cornelio Scipio Africanus over the Punics in the Battle of Ilipa. After battle, a permanent settlement called after their home was hence founded for the sick and wounded men of his army. It is believed to have been no more than a vicus, which become a municipium in Augustan time (Caballos Rufino, 2010). During the reign of Hadrian the city itself requested to become a colony, which was granted by the emperor. Italica hence was known as Colonia Aelia Augusta Italicensium (Caballos Rufino et al. 1999).

We hardly have any archaeological evidence from the city of the republican era though. It is well known today that it was not an ex novo foundation and relied on an earlier indigenous settlement. Few, largely decontextualized, elements, provide us with a glimpse of what could have been the Republican city of Italica (vid. Ramallo, 1999, 171-176, Ahrens, 2001, 28-35). Only from the end of the republic and especially since Augustus' time onwards, the urban image of Italica can be clearly made out. To this period the theatre of the city should be assigned, as various inscriptions testify.

The great urban transformation of Italica occurs in the Hadrian era, when the city is enlarged with the incorporation of a new urban sector, which makes the city increase its extension considerably. It was A. García Bellido who coined the term Nova Urbs for the extension, as opposed to Vetus Urbs for the pre-existing city (García y Bellido, 1960). Although, to understand the new city of Italica, it should be borne in mind that the Hadrian's program did not mean the mere juxtaposition of a new "neighbourhood" to the pre-existing city, but a thorough removal of the Vetus Urbs' space. The Nova Urbs enclosure was to be understood as a single urban complex (Hidalgo, 2003, 104-105). This transformation of the Vetus Urbs, not only affected public buildings, such as the theatre or the forum, which would also be subject to of improvements at this time, but also to the urban fabric, which had to be adapted to the access routes of the new city.

Hadrian's new city was based on the hippodamic-system and equipped with an important set of new public buildings: the Traianeum, an imperial cult temple consecrated by Hadrian to his adoptive father Trajan, that from an urban point of view acquires the role of the forum in this zone. With it, a new public bath (Major Baths), which add at least to the other thermal complex installed in the vetus urbs (Minor Baths). All this was surrounded by a new city wall.

In addition, the city is now endowed with a aqueduct to supply the new area and, next to it, an amphitheatre is built, which had a spectator capacity much higher number than that of the estimated inhabitants for the roman Italica (Jiménez Hernández, 2018, 4; Jiménez Hernández and Carrasco Gómez, 2020, 352). The physiognomy of the city is completed with a series of partially known urban domus, of which its architectural and decorative features evidence the high aristocratic level of their corresponsive owners. These houses are of special importance for the image we have of Roman domus in Hispania in the second century.

The clear link between this new city project and Hadrian the Emperor meant that, once the emperor died, the project would enter into a progressive crisis, largely coinciding with what happened in the emperor's megalomaniac project in his villa in Tibur (MacDonald and Pinto, 2002, 229). As a result, and thanks to what has been proven in the geophysical survey carried out in Italica in the early 90s of the last century (Rodríguez Hidalgo, 1997; Rodríguez Hidalgo and Keay, 1995; Rodríguez Hidalgo et al., 1999), good part of the insulae that conformed the Hadrian's extension of the city never got to be constructed, being unfinished the project of the new city (fig. 1).

Figure 1. Location of Italica (Seville, Spain).

But, non-invasive prospection identified a large, previously unknown wall. It was reinforced by towers at a regular distance of about 28-30 m, which overlapped this original layout of the Hadrian extension (Fig. 3), and the walled area of the city. This new enclosure started from the southwest section of the Hadrianic wall, after a break reinforced by a tower at the corner, which is our point of attention, connected with the northern facade of the Traianeum, reusing part of its structure for defensive purposes. From there, the wall would have continued until it connected with the opposite section of the walled enclosure.

As a result of the dispersion of materials located on the surface, especially with respect to the presence of ARSW, this second fortification of the Nova Urbs was seen as a late-antique wall, dating between the end of the 3rd century and the beginning of the 4th century. The construction of this new enclosure was - according to a hypothesis that since its detection has been maintained by other researchers - related to the incursions of the Mauri from North Africa (Trillmich, 1993; Verdugo, 2003, 377; Rodríguez Gutiérrez, 2004, 23). Adding the information transmitted by literary sources (J. Bicl. Chron. a 584.1), it has been proposed that the construction of the wall was carried out in a more advanced moment, relating it with the impulse that the city could have received after the presence of the Visigoth king Leovigild surrounding his son Hermenegild, who was in nearby Seville (Hidalgo, 2003, 122; Hidalgo, 2016).

The results presented here are one aspect of a broader archaeological research program realised in the last years in the Nova Urbs of Italica (Santiponce, Seville). The project started in June 2017 and has since been carried out by the Archaeology Seminar of the Pablo de Olavide University in Seville, in cooperation with the Department of Prehistory (Vorgeschichtliches Seminar) of the University of Marburg and researchers associated with other institutions.

Our Hispano-German project had a first phase of execution between 2017 and 2019, the preliminary results of the first campaign in 2017 have already been published (Hidalgo et al., 2018). It focuses on two specific sectors of Italica located in the southern section of the Nova Urbs, the large expansion of the city carried out during Hadrian's reign. The specific locations on which the project has concentrated its attention on are on the one hand on private architecture, namely the Casa de la Cañada Honda, and on the other hand the public architecture, specifically the later city wall in the southwest of the urban territories' corner (fig. 2). A supplementary geoarchaeological case study focussing on the geohazards the buildings had to face, was realised in the Casa de la Exedra (Brühlmann et al. 2022).

Until the beginning of this project, the late-antique wall was only known through geophysical surveys. However, until recently, these results had never been verified by archaeological test trenches or excavations. The specific section of the wall chosen to be studied in this project, the southwest corner within

the Hadrianic expansion, presents two points of interest (Fig. 2).

Firstly, this section of the city wall is located on an (designated?) insula of the Nova Urbs. It seems however, according to the results of previous (works by Rodríguez Hidalgo and Keay) and our own non-invasive geophysical surveys (Hermann et al., 2016), that this part of the city was never completely urbanised.

On the other hand, the section of the wall in question, could provide, besides possible information about the tower itself, the possibility of understanding its layout as part of the whole west side: its continuation in a northeast direction to connect with the Traianeum, the temple of the Imperial cult located in the centre of the Hadrianic expansion, and its traces in a southeast direction to connect with the old walled-in enclosure of the Vetus Urbs that existed before the mentioned expansion.

In May 2015, a more detailed non-invasive survey was carried out in Nova Urbs, as part of an international workshop (financed by the German Academic Exchange Service DAAD), which constituted the precedent and first steps of this new project (Hermann et al., 2016; Hidalgo et al., 2018), which have been completed with the new data presented here. Earlier works combining geophysical prospection and archaeological excavation is well documented. Holistic methodological approaches are deemed necessary for example see Levy et al., 2018 for Kastrouli southern Phokis, Greece; in a medieval castle in Zelechow (Mazovia, Poland) (Bis et al. 2021) or in the archaeological site of Europos (Greece) (Tsokas et al. 1994). The study of the ceramic material has also been performed by the team, combining the chronological information with the C14 analysis.

2. THE GEOPHYSICAL SURVEYS OF 2015 AND 2018

2.1. *Equipment and Methodology*

In *Italica*, in 2015 our Hispano-German team recorded a total area of 1.34 ha by geomagnetic prospections. The passive method is well-known and particularly suitable to measure deviations in the field strength or gradient of the natural magnetic field of the earth (Bevan and Smekalova, 2013; Brito-Schimmel and Monfort, 2005, 2010; Teichner and Hermann 2022). This induced magnetisation is measured in the unit nano tesla (nT), the values determined are compiled into prospective images. We used a MAGNETO-ARCH 5-channel system (Sensys Sensor & System GmbH in Bad Saarow Germany) which works with five FGM-650 / 3B Förster sensors. Those are attached on a frame with two wheels, which has to be moved by walking. With a set distance sensor distance of 50 cm, and a data point recorded every 10 cm a resolution of 20 data points per square-metre (or 0.05 m) is reached.

All data had to be transferred as well as corrected and filtered using *Magneto*, a software developed by *Sensys*. After exporting the corrected data as a vector point cloud, these were georeferenced in QGIS 3.16. The interpolation in QGIS was carried out by means of natural-neighbour interpolation which creates a grid containing the original nano tesla data values. For further interpretation of the data also a reduction-to-the-pole transformation was undertaken by the help of MagPick-Software 3.25 (Geometrics). This step helps to relocate distorted magnetic anomalies to their true origin (Baranov/Naudy 1964).

In a second step, in the year 2015 also an earth resistivity measurement was carried out on a 200 m² area (20 m x 10 m), in which due to the previous geomagnetic investigations, a corner tower of an ancient city wall was suspected. The geoelectric method is based on the determination of the electrical resistivity of the substrate. A four-electrode twin configuration with a 4point light10W (*Lippmann Geophysikalische Messgeräte, LGM*) was used for the near-surface electrical mapping of the resistivity. This was undertaken under very dry soil-conditions in the early summer of 2015. An exploration depth of about 0.5-0.6 m can be assumed at the present distance of the mobile electrodes and mostly dry soil conditions, as has been elaborated in the comparison of geophysical and archaeological data (Osten, 2003). The measurement resolution as well as the distance between the movable electrodes was 0.5 m x 0.5 m. In 2018, an advanced method for resistivity-measurements, a self-elaborated "four-twin-Kiesow" arrangement was used on a larger area (cf. Teichner/Hermann 2022, fig. 4). It operates with a 4Point light mC (*LGM*) device and offers a resolution of 0.25 x 0.25 m. It is an enhancement of the standard-Twin array in which two separate frames with four pairs of electrodes each are led through the field and allows the measurement progress to be accelerated considerably. All resistivity data processing (georeferencing, interpolation) was performed by QGIS 3.16 following the indications given for the geomagnetic data above.

GPR-Data was only collected in the area of the termas mayores.

2.2. *Interpretation of the geophysical Data*

The generated image of the geomagnetic measurements reveals –-as expected– a variety of anomalies, that means potential archaeological traces (fig. 2). Looking at the prospecting results in detail, it quickly becomes clear that the individual detected anomalies

can be assembled into two groups due to their different orientations in the study area. The larger group of structures seem to have been aligned on the Imperial, SO-NW-oriented urban grid of the *Nova Urbs*, while other anomalies differ significantly in their orientation.

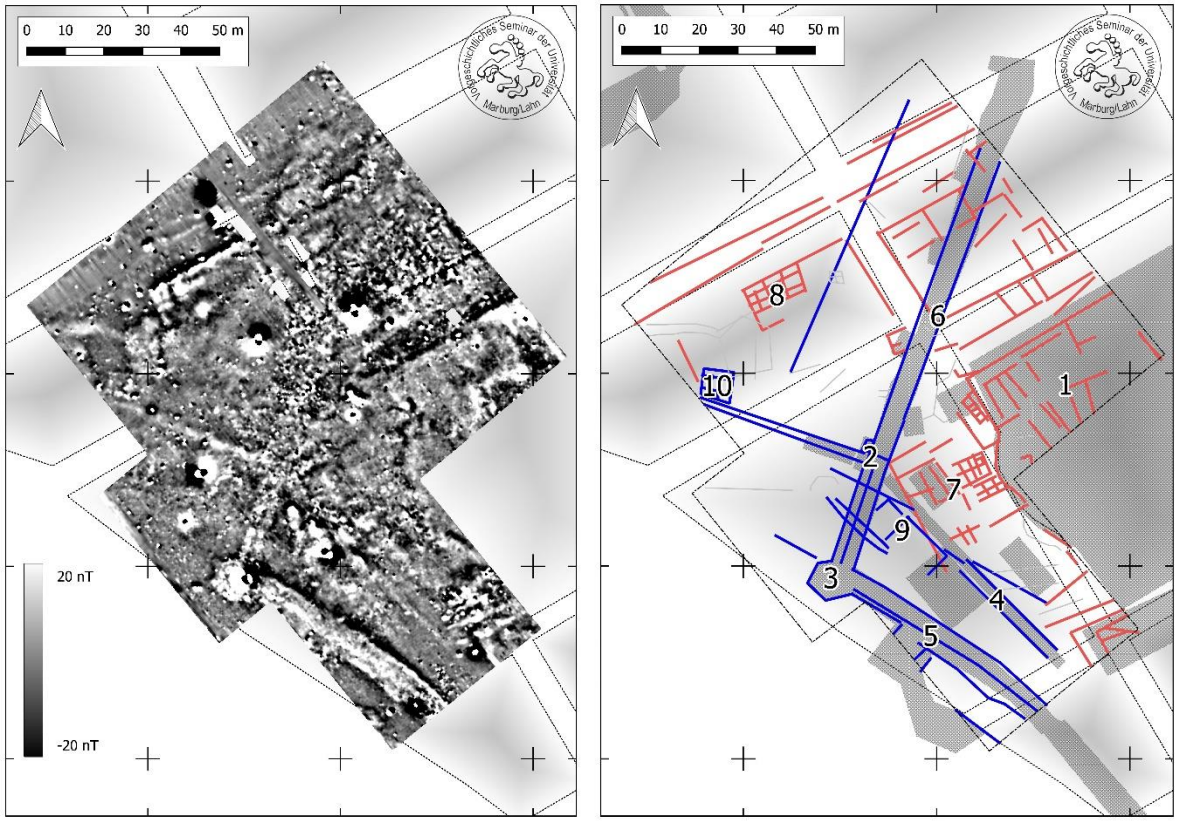

Figure 2. Results of magnetometry measurements in 2015 (left) and their interpretation (right). Clearly erosion of the city wall (6) becomes visible in its northern section.

This applies in particular to the two sections of the late city wall located in the west of the study area, which join together at an obtuse angle to form a corner. The sections of the city wall that continue to the south (Fig. 2.5) and northeast can be clearly seen (Fig. 2.6), as the prospection of the years 1991-93 had already suggested (Rodríguez Hidalgo 1993). Within the new geomagnetic image, however, a division into three parallel segments (Fig. 2.5) now appears to be visible in the western wall section. We wall's northern perimeters also seem to be less well preserved, as is indicated by its hardly discernible perimeters. In the southern part however, the position of a corner tower (Fig. 2.3) and a possible entrance situation (fig. 2.2) are clearly recognizable. The latter appears to be related to a structure orthogonal to the city wall, identified during an earlier prospection from 2004, then interpreted as a "wall and / or aqueduct." The linear continuation inside the city (Fig. 2.4), especially in comparison with the resistivity data given below, seems to support the latter interpretation (Fig.3.a). There, a clearly rectangular building of about 6 x 4 m is connected to the linear structure. Given the interpretation as water pipe this could be a connected water installation (water tank?). Other buildings inside the fortified area seem also to be aligned on this axis (Fig. 2.4). An elongated building (Fig. 2.9) can be recognized right next to the possible entrance situation (Fig. 2.2), both in the older geoelectric (Fig. 3) and in the newly acquired magnetic data. These observations indicate an abandonment of the axis system of the Imperial city and a restructuring of the inner area in the late phase. But even outside the defensive walls a rectangular stone building is clearly recognizable (Fig. 2.10). That construction is orientated again on the assumed path axis and can be contemporary with the wall. Therefore, the building is also suspected to have been constructed together with or after the wall in a later settlement period.

The – as expected – lower lying remnants of Hadrianic city fit in the descripted manner in the axis system of *Nova Urbs* planned according to hippodamic scheme. A large, presumably public building with an apse in the west (Fig. 2.1), maybe another publics baths (Hidalgo, 2003, 110-113), is already known from the electrical measurements of 1991-93 in the eastern

part of the researched area and was again clearly recorded during the Hispano-German investigations. Further small structures can be observed in the western parcels (Fig. 2.7-8). These are likely to be elements of residential buildings whose small-scale room layout is clearly visible in the generated Magnetometry images. Striking is the extensive development in the area west of the apse of the major construction (Fig. 2.1). This seems to cut at least parts of the *cardo minor* running here, which would point towards a more recent dating of these buildings (cf. see on this occupation of public space the examples of Emerita Augusta, Cartago Nova or Astigi (Noguera and Madrid, 2016; Alba, 2016). During that time older structures were overbuilt. Even the exedral end of the major construction seems to reach out in the street.

In 2015 a supplementary 20 m x 10 m large area covering exactly the tower-reinforced corner of the late antique defensive wall was surveyed via resistivity (Fig. 3.a). Due to the stone walls and the associated foundations corresponding high resistive disturbances were to be expected. In fact, the measurement image shows a square-looking anomaly of almost 10 m by 10 m continuing from the northeast into the researched area. Its edge areas have significantly higher and more homogeneous resistivity than the inhomogeneous interior. Another elongated structure is connected with it to the east. Apart from a weak transitional area at the western edge of these two objects, the surrounding areas are to be described as homogeneous without further notable anomalies. This strong contrast was surely favoured by the drought or low water content in the soil during the 2015 field campaign. The interpretation of this massive structure as the foundations of a corner tower with adjoining defensive wall fits into the overall picture; in addition to the 'legacy measurements' from 1991/1993 the picture allowed for more detail.

These positive results with resistivity, encouraged us to prospect larger areas of the urban area, focusing on so far missing parts of the continuation of the late roman city wall (Fig. 3).

The city wall has been well visible in the earlier measurements from the 1990s as well as the section covered in 2015. However, some sections southwest and north west of the so called *Traianeum* as well as north-east of the current cemetery were yet uncovered and no indication of the city wall was available. We hence covered all available, not yet excavated areas in the section. It shows, that, starting at the excavated corner tower (fig. 3.a), the linear structure continues straight towards the north-east, and aims precisely at the western corner of the so called *Traianeum* (Fig. 3.b). The section between the *Traianeum* and the current cemetery could not be surveyed, as due to excavation trenches and current (reconstructed roman) streets no free, undisturbed, space and unsealed surface was available. The course of the wall cannot be identified clearly northwest of the *Traianeum* but maybe some high resistivity values in the geophysical image near to the modern fence of the museums ground, can be interpreted as just another corner or corner tower, which appear to be more or less evenly spaced at about 28 – 30. Given that range, it would be a suitable position for another tower (Fig. 3.c). The structure then seems to have encircled the important public building the *Traianeum* resembled (a fact that seem to be logical from a strategical and logistical point of view). The next secured point is about 230 m towards the north-east, were two linear high-resistivity anomalies meet in an obstruse angle, which might indicate the connection point of the wall (Fig 3.d). By connecting these two known locations (Fig. 3.c+d) a hypothetical guidance line which resembles exactly the orientation of the current cemetery can be drawn.

This way it becomes clear, that we have to expect the northern limit of the late roman enclosure along the southern border of the current cemetery, most probably excluding the famous *domus* like the Casa de los Pajaros, but including most parts of the *Traianeum* (and its north front) and the neighbouring private buildings like the Casa de la Cañada Honda. As a consequence, the connection between the former city wall of the 2nd century (with its large extension of the famous housing area in the northern half of the *Nova Urbs*) and the late roman one (protecting just the southern part of the *Nova Urbs*) has to be expected in the area just north of the mentioned joint (Fig. 3.d) just east of where nowadays the statue of Emperor Trajan is exhibited. The other part of the wall continued south-east, largely parallel to the older wall, situated downhill.

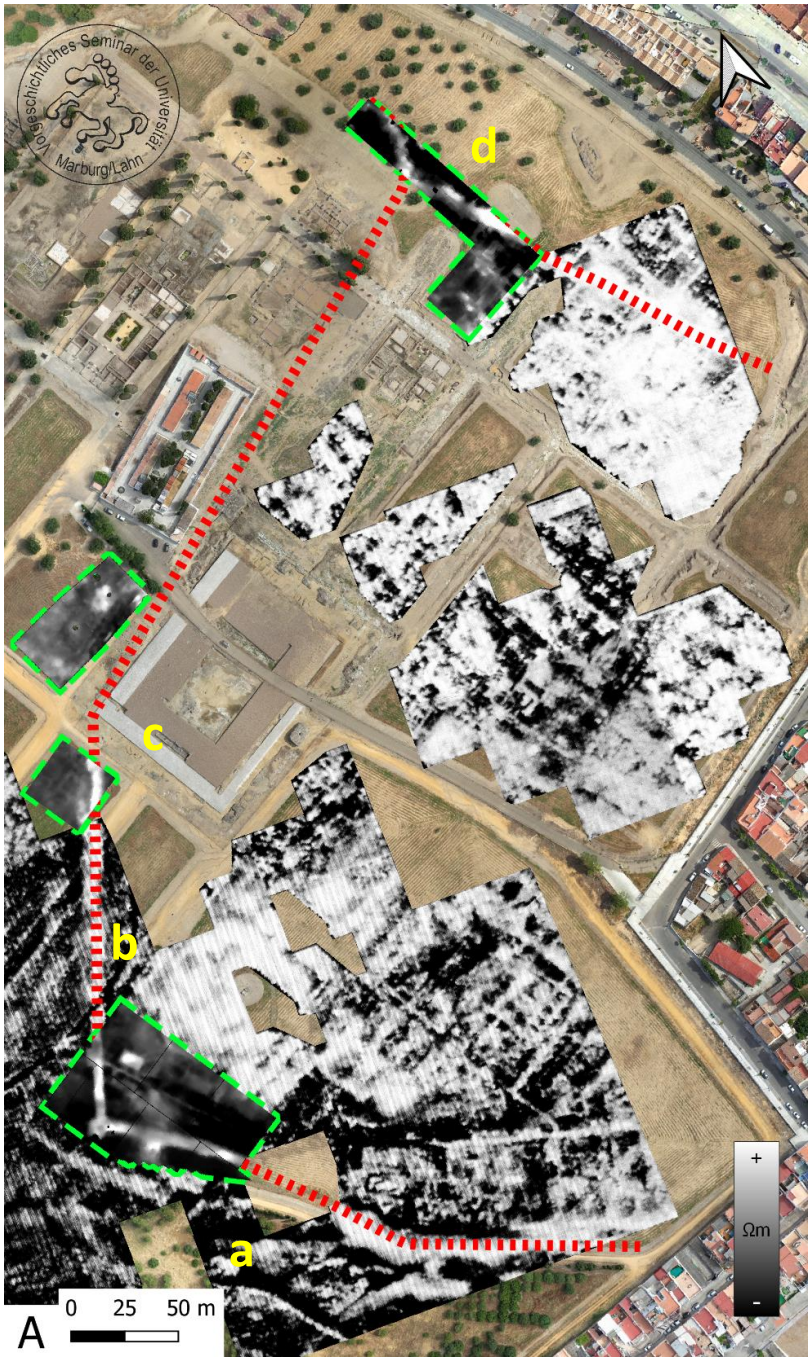

Figure 3. Results of the 2018 Resistivity results (in green) in comparison to the results from 1991/1993. The results from 2015 are incorporated into the image from 2018 (around the a). A prospected course for the city wall is given (dotted red line). Small letters refer to the text.

3. THE ARCHAEOLOGICAL EXCAVATION

3.1. *Approach and Primary Results*

Based on these results of the recent geophysical prospection, our Hispano-German team proceeded to propose a series of trenches on the ground, located in those areas where the anomalies detected by the geophysical prospection would allow us to define and characterize the structures. Trenches were arranged in relation to the elements identified in the geophysics: the corner tower and the adjoining sections of the city wall southeast and northeast of the tower (table 1). These trenches have allowed us to verify the geophysical data and to document the stratigraphic sequence of the sector in which they were located. Surprisingly also, a necropolis close to the walls was identified, additionally we could document the heavy looting processes to which both the edges of the wall and the documented tower were subject.

Table 1. Overview on the individual trenches, the archaeological interpretation of the main features in respect to the wall/tower-section (fig 2.a) and lateral dimensions of the trench, dimension is given in NW-SE/SW-NE-direction (Hermann).

Trench	Expected structure of tower/wall based on geophysical interpretation	Brief interpretation of identified archaeological structures	Dimension [m]
1	SW-edge of the tower	SW-edge of the tower, building pit	8.5 x 5.0
2	SW-edge and filling of the city wall	SW-edge of the city wall, rest of filling, stone looting, densely placed burials	3.0 x 5.0
3	SW and NE-edge and filling of the city wall	Filling of the city wall, stone looting, pits, densely placed burials	3.0 x 9.0
4	NE-edge of tower, transition to adjoining city wall	Fill & foundation of the city wall, brick-pavement unrelated to wall	2.0 x 5.0
5	NW-corner of tower	Rest of tower's fill, stone looting	2.0 x 5.2
6	NW-edge of tower	NW-edge of tower, stone looting, burial	1.6 x 4.9
7	NE-edge of tower, transition to adjoining city wall	Rest of fill & foundation of the city wall	2.0 x 2.0
8	Fill of the tower	Wall inside tower with façade (internal structure)	2.0 x 2.0
9	SE-edge of tower, transition to adjoining city wall	Rest of fill & foundation of the city wall, stone looting	2.5 x 3.0
10	SE-edge of tower	Rest of edge of tower, stone looting	2.5 x 4.2

3.2. The stratigraphic sequence.

For a correct understanding of the stratigraphic situation documented/identified in the 10 trenches realised in the area (table 1), the stratification units were individualized and classified in an order determined by the stratigraphic relations with the surrounding units. The units are also organised into stratigraphic groups established according to the characteristics of the units and their position in the general stratigraphic sequence. At the same time, stratigraphic groups are attached to the successive phases that we extract from the archaeological analysis and are dated at a chronological moment and a specific historical period. The 180 stratigraphic units defined in the 10 trenches have been unified for this preliminary report into the following 12 stratigraphic groups that represent 5 main/principal settlement phases:

Table 2. Phases of evolution of the area around the corner tower and absolute chronology.

Settlement Phase	Stratigraphic Group	UE nr. in stratigraphic group	Identification	Type of structure	Description	chronological period
I	12		Strata linked to activities of the area	Amortisation	Strata of rubbish of pre-wall-activities; ditch-filling	LATE ANTIQUITY
II a	11		Preliminary levelling of the area	Construction	Levelling work on the sector	LATE ANTIQUITY
II a	10		Foundation trenches	Construction	Opening of the foundation trenches that hold the defensive structures	LATE ANTIQUITY
II a	9		Southwestern edge of wall	Construction	Placement of interior and exterior ashlar masonry blocks on the SW edge of the wall	LATE ANTIQUITY
II a	8	10.7	Tower	Construction	Placement of ashlar masonry blocks on the eastern front of the tower	LATE ANTIQUITY
II a	7	1.5	Tower	Construction	Construction of the reinforcement at the base of the tower	LATE ANTIQUITY
II a	6	2.11, 4.7, 5.5, 6.8, 7.5, 8.4, 9.4	Constructive filling of the wall and the tower	Construction	Internal filling of the tower and the sections of the wall with constructive debris and transport material	LATE ANTIQUITY
II b	5	4.6	Pavement inside the wall	Construction	Construction of a brick pavement inside the sections of the wall and the tower	LATE ANTIQUITY

III	4	2.ET2, 2.ET3, 2.ET4, 2.ET5, 2.ET.7, 6.ET.1	Necropolis	Funerary	Extramural area used as necropolis	LATE ANTIQUITY
III	3	2.ET6, 3.ET1, 3.ET.2	Necropolis	Funerary	Perduration of the cemetery area	LATE ANTIQUITY
IV	2		Destruction and stone looting	Looting	Looting of the constructive material of the wall and the tower	LATE ANTIQUITY-MEDIEVAL
V	1	4.3	Abandonment	Destruction	Destruction of the structures and change of use of the sector to agriculture	MODERN AND CONTEMPORARY

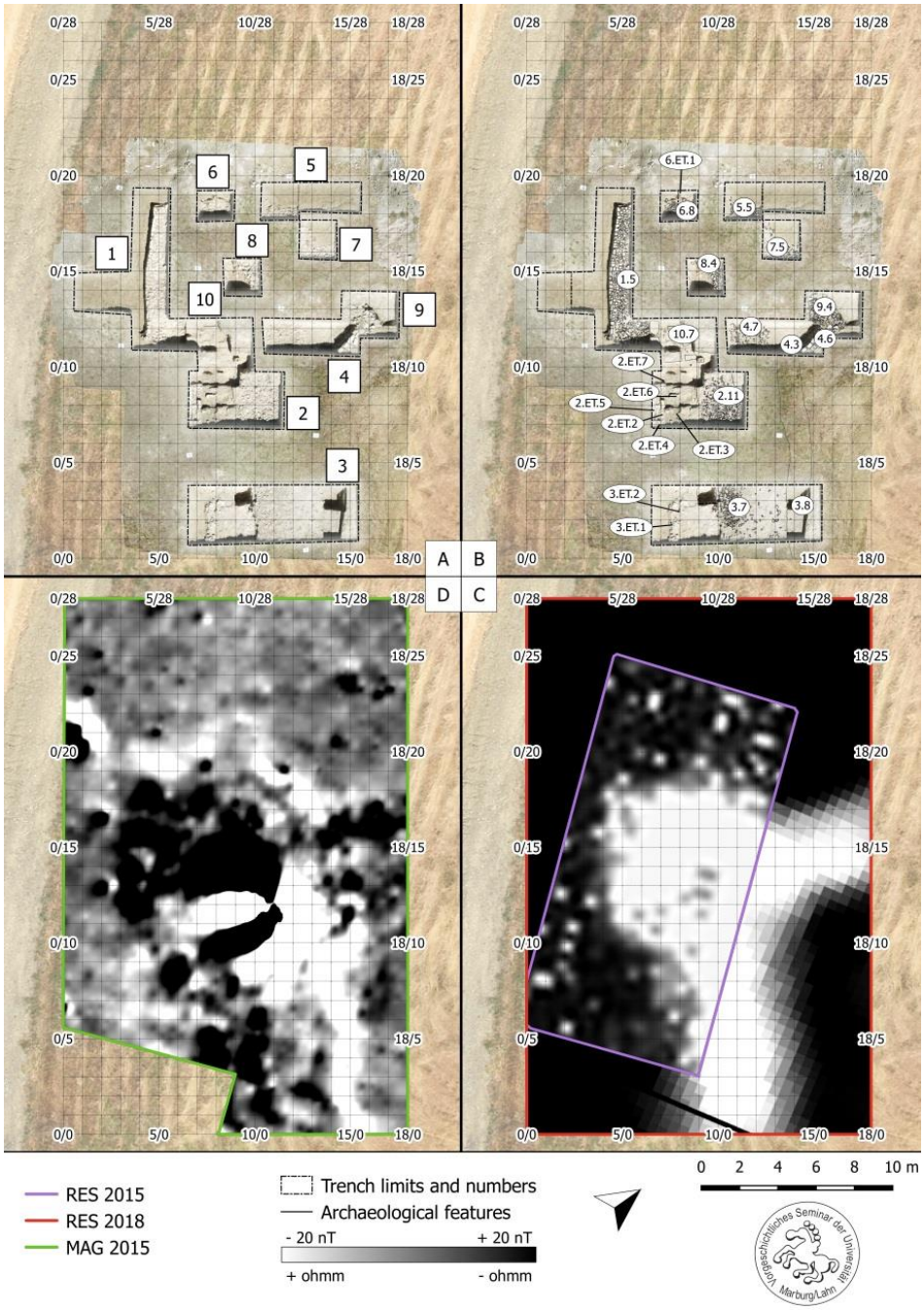

Figure 4. A: Excavation results of the city wall and corner tower with trench numbers (squares) B: main stratigraphic units (numbers), and inhumation graves (...ET...), C: Resistivity, D: Magnetometry. For better orientation, a local grid is given (F.Hermann, background orthophoto Chr. Salzmann).

Summing up, the archaeological data from the 10 trenches opened the possibility of defining five consecutive settlement phases of the area.

Phase I (Late Antiquity)

On the base of the geological substratum, blue marls "margas azules", the stratigraphic sequence documented during of the archaeological intervention starts with the recording of a series of strata of waste and ashes, deposited over the natural ground (Subsoil). These layers fill a tangentially documented ditch in the sector where the tower of the wall was later projected, being reflected in group 12 of Phase I of the stratigraphic sequence. These strata contained abundant constructive and ceramic material that is not representative for chronological purposes, which tells us about undetermined activities developed in this sector of the expansion of the city of the Hadrianic period which, as has already been said, never was fully developed.

Among the datable ceramic materials of these stratigraphic units, it is remarkable the presence of coarse wares such as pouring jars and cooking pots, *Terra Sigillata Hispanica,* Early Imperial thin-walled wares and the frequent Late Roman African Cookware casseroles -Lamboglia 9B, 10A, 10B, Hayes 14C, Ostia III fig. 267, Ostia III fig. 332, Ostia I fig. 262- and lids -Ostia I fig. 261, Ostia IV fig. 60 and Hayes 185 nº. 1 D-, as well as imitations of the African Hayes 196B. It has been also found African Red Slip Ware C^1 and, among the most modern productions, an unshaped D^1 fragment dating the units between the 4th and 5th centuries AD.

Phase II (Late Antiquity. Terminus post quem: 2nd half of the 4th century)

This phase starts with the preliminary work of levelling the area to build the structures that conform the different elements of the wall. These preliminary works were carried out by levelling the natural ground. Perhaps the difference in height existing in various sections of the natural ground may be due to an embankment projected at this time.

After this preliminary levelling, the foundation trenches are traced at the same time for the construction of the sections of the wall and the tower. These trenches have a "U" shaped section and cut the preexisting ground. In the southwestern section the foundation trench reaches a width of 6 m and a maximum documented depth of 1.70 m, while in the eastern section, which reaches the north-western corner of the *Traianeum*, it has a width of 4.30 m. As regards to the tower, this is projected by reinforcing the corner of both sections, drawing a quadrilateral of at least 4.5 m maximum side documented, which is projected 2.5 m of the southwest wall, with a documented maximum depth of 1.50 meters.

Once the ground has been levelled and the foundation trenches have been traced, the paraments of the southwestern section of the wall are built: this is a double parament built with ashlar blocks and reused constructive elements (pieces of grooved pilaster), all of them of calcarenite. Both the ashlars and the construction elements constitute materials reused from other buildings in the city that are no longer in use. The external facing has a variable thickness ranging from 1 m to 1.20 m, with the ashlars arranged on a rope, while the interior wall, which is smaller, has a width of around 0.80 m to 1 m. Like the exterior, this one would also be made of limestone ashlars, none of which were preserved in the excavated area.

The western front of the tower was built at the same time as the wall, also using calcarenite ashlar blocks. Again, fragments of pilasters with grooves, and a column shaft, works that, together with those defined in the previous event, led to the generation of an appreciable work surface in two of the excavated trenches.

Figure 5. Reinforcement at the base of the tower. (UE nr. 1.5. in stratigraphic group).

It is in this phase when, anticipating the canvas of the tower, a reinforcement is built at the base of the tower, which serves as a support to avoid the pushes of the tower itself in a space where the ground descended. It is a structure built with fragments of bricks arranged on a herringbone on a row of masonry of calcarenite and fragments of bricks arranged on a blight, on which rises a lining made up of bricks and fragments of bricks and tegulae, which has barely five rows. For its part, the interior composed of a filling of bricks and fragments of bricks and tegulae worked with earth with some lime, which are arranged on the ground plan until they reach the base of the tower built with ashlars. It is 8.70 m long on the north-south axis (Fig. 5).

Forming part of the same phase and within stratigraphic group 6, the paraments of the wall and the

tower are filled with carrying material (bricks and fragments of bricks and tegulae, fragments of storage pottery, masonry of calcarenite, etc.) worked with earth and lime. These layers of rubble form the filling of the core of the wall. The width of this filling is between 4 m and 4.30 m. The recording of a fragment of an African lamp (Atlante VIII A) in the cleaning of the units which form the foundation of the factory of the wall shows a late chronology - at least from the second half of the 4th century - for the construction of the sections of the wall detected in the excavation.

Finally, group 5 of Phase IV consists of a pavement made of 29.5 x 22 x 4.5 cm bricks arranged in a rope in the intramural sector, reinforcing the interior connection between the tower and both canvases.

Phase III (Late Antiquity)

This phase involves the establishment of a necropolis area outside the city walls and immediately adjacent to the wall. The inhumations that make up the necropolis have been documented in two of the trenches carried out (trenches 2 and 3), with a total of 11 graves in an area of just 7 m² (fig. 6).

Figure 6. Trench 2. General view of the necropolis area.

They have a series of common characteristics: they are all burials in simple graves or in cysts built with brick fragments. They are oriented in a northwest-southeast direction following the alignment of the wall in the sector next to which they are arranged, although we also find some graves with an east-west orientation, adapting to the available space. The stratigraphical relationship between the necropolis and the wall and tower can in most excavated places not be determined, as the identified looting processes to which the wall was subjected removed most of the stratigraphical units which supposedly connected the wall with the necropolis. Only trench 2 shows the construction of tomb 2.ET7 on a remainder of natural soil and on the construction interfacial of the wall, thus resting on a natural soil that had already been lowered during the construction of the wall. They have walls built with fragments of bricks and tegulae and flat or double-gabled tegulae roofs. Some of them (2.ET3 and 2.ET4) have compartments inside to hold secondary burials, which means that the tombs may be reused in a familiar way. The bodies are placed in supine decubitus and, when the tomb is reused, the ossuary is placed at the feet of the newly buried individual. Only in one of the excavated tombs, 2.ET7, we collected the fragments of a glass balsamarium.

As proof of the continued use of the area as a cemetery, we note the presence of two children's burials

in amphorae on top of the remains of the roofs of the tombs of the previous phase, which represents a second phase of the necropolis, summarised in Stratigraphic Group 3. Both of these structures are oriented northwest-southeast, using the tegulae roofs of the previous phase as the base and fitting the sides with fragments of bricks and tegulae (Fig. 7).

Figure 7. Trench 2. Child's burial in amphora.

Phase IV (Late Antiquity-Medieval)

Subsequently as part of Phase II of the stratigraphic sequence, represented by group 2, we observe a process of destruction and looting, stone robbery of the construction material of the wall. In this process, trenches are opened following the alignments of the masonry paraments, destroying much of the stratigraphic sequences connected with the construction of the wall and tower, as well as their chronological relation to the necropolis.

Phase V (Modern-Contemporary)

Finally, Phase V indicates the demolition and destruction of both the structures that make up the defensive system and the adjacent necropolis. It is represented by Stratigraphic Group I. It contains the stratification units that show the destruction, which are the erosive and depositional processes produced from the abandonment and looting of the structures until our days. These are units formed in recent periods, especially due to agricultural work carried out until the 1980s, which eroded the remains of the ancient inhumation necropolis and city wall.

3.3. Problems in chronology and harmonising the radiocarbon dates and chronology from small finds.

The modern excavation in the area of the supposed late antique city wall offers the possibility to compare the traditional dating of ceramics with radiocarbon dates from bones of the inhumations of the *necropolis* which surrounds the tower (Table 3, Fig. 8).

On the one hand five samples from the wall-trenches have been send for radiocarbon-dating to two well established laboratories in Posen and Mannheim. In all cases the samples were bones from inhumed individuals of the newly discovered necropolis (Table 3). Because of the importance of the results, the samples from burials 1 (trench 3), 2, 7 and 8 (trench 2) were analysed in two different laboratories. Samples 2 and 3 belong to the same individual and were distributed between the two laboratories to blindly cross-check the analyses. No dietary correction has been made (this may introduce another error). Although sample 3 is not very reliable due to a too low collagen value (<1%), it roughly coincidences with the result of samples 2 and 5, which can be dated into the second half of the 2nd century AD until the first half of the 3rd century AD. Samples 1 and 4, on the other hand, are somewhat later, and date to the 3rd century AD, with a tendency towards the 4th century AD.

Moreover, the archaeological materials associated with the wall construction are scarce but can still be dated. As it has been mentioned, the African Red Slip Ware D, ascribed to the phase prior to the wall construction, suggest a late context. The discovery of African Red Slip Ware D (lamp type Atlante VIII) and

D[1] (Hayes 67) in the construction fill of the wall suggest a *terminus post quem* of - at least - the second half of the 4th century AD, even the 5th century AD. The ceramic discoveries in the necropolis outside the walls include a clearly later stratigraphic context than the wall construction due to the presence of a child burial in an Almagro 51 C/Keay 23 amphora, which is dated between the 3rd and 5th centuries AD. Consequently, the stratigraphy and the materials indicate a later date a date for the wall construction than the 14C analyses: between the second half of the 4th and the end of the 5th century AD.

Table 3. List of ^{14}C samples from the wall-excavation trenches; calibrated 14C ages are given in sub intervals (2σ); Calibration with Calib 8.2 [http://calib.org/calib/calib.html]; ID 1+2 Curt-Engelhorn-Zentrum Archäometrie Mannheim; ID 3-5 Poznan Radiocarbon Laboratory; ID 2+3 stem from the same buried individual.

ID	Excavation Code	Lab. Code	Context	^{14}C Years [yr BP]	Cal. ^{14}C Age AD [2 σ, 95,4%]	Remark
1	ITALICA-19-M1-C2-ET3-UE39	50900	Corte 2, ET 3	1801 ± 20	**213-256** / 283-326	7.5% N; 24.7% C; 3.5% coll.; Bone
2	ITALICA-19-M3-C2-ET8-UE60A	50901	Corte 2, ET 8	1845 ± 22	129-147 / **152-240**	10.7% N; 35.5% C; 1.5% coll; Bone
3	ITALICA-19-M3-C2-ET8-UE60B	Poz-136859	Corte 2, ET 8	1900 ± 30	**63-222**	1.1% N; 3.4% C; 0.9% coll. (!); Bone
4	ITALICA-2019-1-S3	Poz-116384	Corte 3, ET 1	1770 ± 30	220-222 / **225-364** / 370-375	1.2% N; 5.6% C; 3% coll.; Bone
5	ITALICA-2019-2-S2	Poz-115906	Corte 2, ET 7	1850 ± 30	**121-248** / 298-306	0.6% N; 4.6% C; 1.6% coll.; Bone

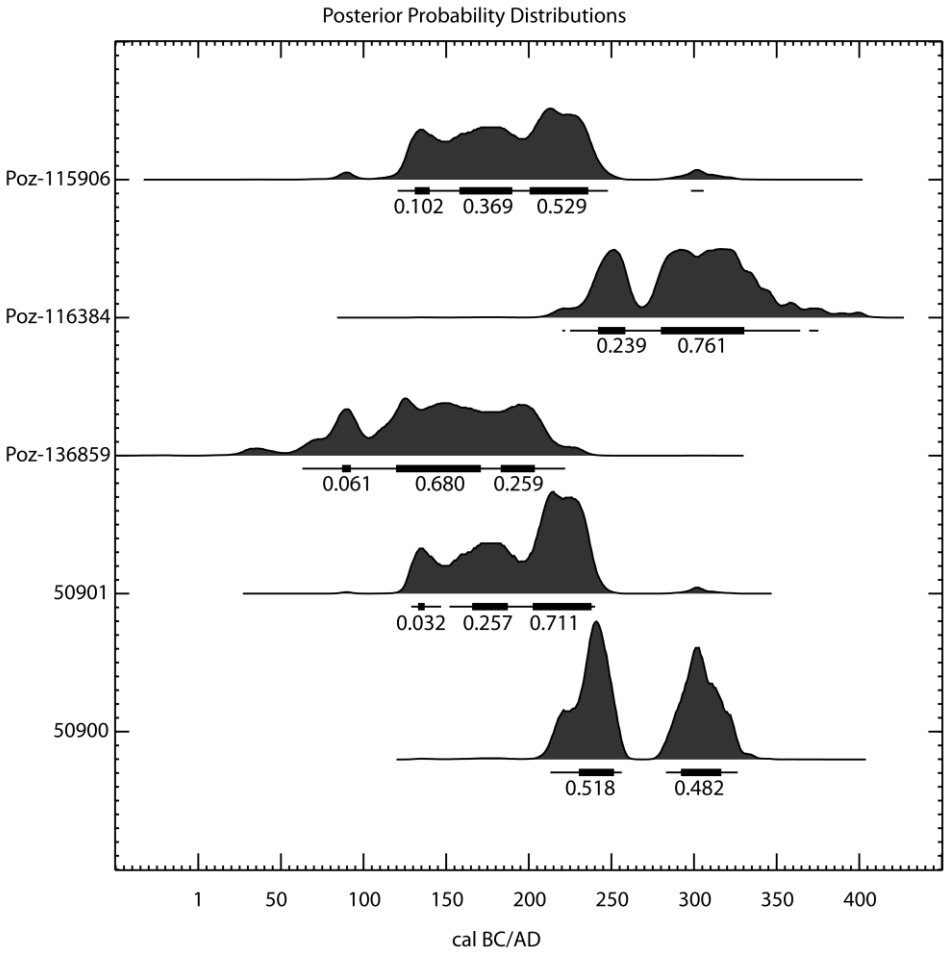

Figure 8: Probability distributions of C14 samples.

4. CONCLUSION

It has been mentioned in the previous lines that the study of Italica's Late Antique wall has been approached from a diverse perspective through the combination of different methodological strategies. The information provided by the geophysical investigations was the basis for the following field surveys carried out in the area.

In contrast to the first geophysical surveys carried out in *Italica*, in 1991/1993, it can be concluded that the recent Hispano-German investigations have provided a sharper picture of the structures located in the ground due to higher measurement resolution. Thanks to the technological advances within the 22 years since our first campaigns, workflows have also been significantly simplified and accelerated both during on-site measurement and during post-processing. A complementary use of resistivity and geomagnetic measurements has proven to be successful, especially since individual structures are apparently recognizable only with one or the other method. Interestingly, the preferences regarding the applied methods have shifted meanwhile. While significantly larger areas were prospected by means of the earth resistivity method between 1991 and 1993 and magnetics were only used in smaller areas, today the universal, cheaper and, above all, faster geomagnetic method is preferred to the active measuring method of the resistivity. The latter is used mainly additionally in the areas of already detected building structures. The descripted possibility of clarification of the older results, especially with regard to the late city wall, may be of particularly importance for the future exploration of *Italica.*

But the technological advances do not always facilitate archaeological interpretation: The absolute chronologies provided by the C-14 analyses on the necropolis samples and the chronology offered by the stratigraphic sequence and the study of ceramic materials of the wall and the necropolis outside the walls do not coincide. As it has been mentioned above, the samples taken from the skeletal remains of the buried individuals were analysed in two different laboratories, providing a chronology with a certainty of 2 σ -2nd-3rd centuries AD. Two of the samples suggest a later chronology, reaching the third quarter of the 4th century. On the other hand, the chronologies provided by the associated ceramic contexts would range from the second half of the 4th century to the end of the 5th century, as the necropolis cannot exist before the wall.

Perhaps, the requested C-14 analyses on samples of mortar will allow to refine the chronologies, being able to coordinate the data provided by these analyses with those offered by the stratigraphic sequence and the studies of ceramic material.

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REFERENCES

Alba, M., Morería, F. (2016) Einblicke in die Geschichte der Provinzhauptstadt. Augusta Emerita von ihrer Gründung bis in die westgotische Epoche. In F. Teichner (ed.), Aktuelle Forschungen zur Provinzialrömischen Archäologie in Hispanien (=Kleine Schriften aus dem Vorgeschichtlichen Seminar Marburg 61). Marburg, pp. 77-84.

Baranov, V., Naudy, H. (1964) Numerical Calculation of the Formula of Reduction of the Magnetic Pole, *Geophysics* 29, pp. 67-79.

Bevan, B. W., Smekalova, T. N. (2013) Magnetic Exploration of Archaeological Sites. In C. Corsi, B. Slapšak, F. Vermeulen (eds.) *Good Practice in Archaeological Diagnostics: Non-invasive Survey of Complex Archaeological Sites*. Cham, pp. 133-152.

Bis, W., Herbich, T., Ryndziewicz, R., Osiadacz, M., Radomski, M., Cembrzyński, P., Zbieranowski, M., Majewski, J. (2021) An integrated geophysical and archaeological approach to the study of the Late Medieval castle in Żelechów in Mazovia, Poland, *Archaeological Prospection,* 28. DOI: 10.1002/arp.1820.

Brito-Schimmel P., Carreras Monfort, C. (2005) Aplicación de métodos geofísicos en Arqueología: Una recopilación sobre el estado actual de la cuestión en España, *Scientific Heritage*, 0(1), pp. 1-20.

Brito-Schimmel P., Carreras Monfort, C. (2010) Metodología para la prospección geofísica en arqueología: Apuntes a partir de los trabajos de Iesso, Can Tacó, Molins Nous y El Goleró, *Lucentum* 29, pp. 9-22.

Brühlmann, B., Hidalgo-Prieto R., von Schéele, A., Tello-Martín, C., Reicherter, K., Teichner, F. (2022) Geological Hazards in Archaeological Heritage. Building Damage in the Roman Domus Casa de la Exedra at Italica (Santiponce, Prov. Sevilla/E), *Korrespondenzblatt*, 52, p. 3.

Caballos Rufino, A., Marín Fatuarte, J., Rodríguez Hidalgo, J. M. (1999) *Italica arqueológica*, Sevilla.

Caballos Rufino, A., (2010) *Italica-Santiponce. Municipium y Colonia Aelia Augusta Italicensium*. *Ciudades romanas de Hispania 7*.

García y Bellido, A., (1960) *Colonia Aelia Augusta Italica*, Madrid.

Hayes, J (1972) *Late Roman pottery,* London.

Hermann, F., Mertl, P., Teichner, F., (2016) Geophysikalische Testmessung an der Westgotischen Stadtmauer von *Italica* (Santiponce). In F. Teichner (ed.), *Aktuelle Forschungen zur Provinzialrömischen Archäologie in Hispanien (=Kleine Schriften aus dem Vorgeschichtlichen Seminar Marburg 61)*. Marburg, pp. 16-21.

Hidalgo Prieto, R. (2003) En torno a la imagen urbana de Itálica, *Romula*, 2, pp. 89-126.

Hidalgo Prieto, R. (2016) Zur Veränderung der Siedlungsstruktur baetischer Städte in der Spätantike. In: F. Teichner (ed.), *Aktuelle Forschungen zur Provinzialrömischen Archäologie in Hispanien (=Kleine Schriften aus dem Vorgeschichtlichen Seminar Marburg 61)*. Marburg, pp. 85-90.

Hidalgo Prieto, R., Teichner, F., Carrasco Gómez, I., Hermann, F. (2018) El proyecto de investigación arqueológica en la Cañada Honda de Italica. Planteamientos, objetivos y primeros resultados, *Antiquitas*, 30, pp. 45-61.

Jiménez Hernández, A. (2018) Errores de replanteo en el anfiteatro de Itálica. *Arqueología de la Arquitectura*, 15, pp. 1-32

Jiménez Hernández, A., Carrasco Gómez, I. (2020) Los anfiteatros de Écija e Itálica: similitudes para la definición de un modelo en la Bética, *Mastia: Revista del Museo Arqueológico Municipal de Cartagena*, 15, pp. 37-64.

Levy, T.E., T. Sideris, M. Howland, B. Liss, G. Tsokas, A. Stambolidis, E. Fikos, G. Vargemezis, P. Tsourlos, A. Georgopoulos, G. Papatheodorou, M. Garaga, D. Christodoulou, R. Norris, I. RiveraCollazo, and I. Liritzis (2018) At-Risk World Heritage, Cyber, and Marine Archaeology: The Kastrouli–Antikyra Bay Land and Sea Project, Phokis, Greece , Springer International Publishing AG In: T.E. Levy, I.W.N. Jones (eds.), Cyber-Archaeology and Grand Narratives, One World Archaeology, 143-230 (doi-org-443.webvpn.fjmu.edu.cn/10.1007/978-3-319-65693-9_9)

MacDonald, W.L., Pinto, L.A. (2002) *Villa Adriana. La construzione e il mito da Adriano a LuisI. Kahn,* Milano.

Noguera J. M., Madrid, M. J. (2016) *Carthago Nova:* Akkulturation und Krise in einer antiken Stadt. In F. Teichner (ed.), *Aktuelle Forschungen zur Provinzialrömischen Archäologie in Hispanien (=Kleine Schriften aus dem Vorgeschichtlichen Seminar Marburg 61)*. Marburg, pp. 70-76.

Osten, H. v. D, (2003) *Geophysikalische Prospektion archäologischer Denkmale unter besonderer Berücksichtigung der kombinierten Anwendung geoelektrischer und geomagnetischer Kartierung, sowie der Verfahren der elektromagnetischen Induktion und des Bodenradars. Ber. Geowiss*, Aachen.

Ramallo, S. (1999) *Terracotas arquitectónicas de inspiración itálica en la Península Ibérica. El ladrillo y sus derivados en la época romana,* Madrid.

Reimer, P., Austin, W., Bard, E., Bayliss, A, Blackwell, P., Bronk Ramsey, C., Butzin, M., Cheng, H., Edwards, R., Friedrich, M., Grootes, P., Guilderson, T., Hajdas, I., Heaton, T., Hogg, A., Hughen, K., Kromer, B., Manning, S., Muscheler, R., Palmer, J., Pearson, C., Plicht, J. van der, Reimer, R., Richards, D., Scott, E., Southon, J., Turney, C., Wacker, L., Adolphi, F., Büntgen, U., Capano, M., Fahrni, S., Fogtmann-Schulz, A., Friedrich, R., Köhler, P., Kudsk, S., Miyake, F., Olsen, J., Reinig, F., Sakamoto, M., Sookdeo, A., Talamo, S. (2020) The IntCal20 Northern Hemisphere radiocarbon age calibration curve (0–55 cal kBP), Radiocarbon 62.

Rodríguez Gutiérrez, O. (2004) *El teatro romano de Itálica. Estudio arqueoarqueológico. Monografías de arquitectura romana*, 6.

Rodríguez Hidalgo, J.M. (1997) La nueva imagen de la Itálica de Adriano. In A. Caballos., P. León (eds.), *Itálica, MMCC,* Sevilla, pp. 87-114.

Rodríguez Hidalgo, J. M., Keay, S. J., Creighton, J., Jordán, D., Rodá, I., (1999) La Italica de Adriano. Resultados de las prospecciones arqueológicas de 1991 y 1993. *AEspA* 72, pp. 73-97.

Teichner, F., Hermann, F. (2022) Ocultos bajo las dunas. Las prospecciones geofisicas. / Hidden under the dunes. The geophysical prospections. In D. Bernal Casasola, J. J. Díaz, E. Vijande Vila, J. A. Expósito Álvarez, J. J. Cantillo Duarte (eds) *Arqueología azul en Trafalgar / Blue Archaeology in Trafalgar. De la Investigación al Turismo sostenible. From Research to Sustainable Toursim*. Trafalgar, pp. 84-95.

Tsokas, G.N., Giannopoulos, A., Tsourlos, P., Vargemezis, G., Tealby, J.M., Sarris, A., Papazachos, C.B., Savopoulou, T. (1994) A large scale geophysical survey in the archaeological site of Europos (northern Greece), *Journal of Applied Geophysics*, Volume 32, Issue 1, pp. 85-98.

Trillmich, W., Hauschild, Th., Blech, M., Niemeyer, H. G., Nünnerich-Asmus, A., Kreilinger, U., (1993) Denkmäler der Römerzeit, *The Journal of Roman Studies*, vol. 86, pp. 224-226.

Verdugo, J. (2003) El cristianismo en Italica: fuentes, tradiciones y testimonios arqueológicos, in *Santos, obispos y reliquias*. *Actas del III Encuentro Hispania en la Antigüedad Tardía*. Alcalá de Henares, pp. 353-389.