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WONDERCOINS PROJECT: AN ONLINE PLATFORM FOR THE INVESTIGATION OF ANCIENT MONETARY FINDS FROM THE IBERIAN PENINSULA AND NORTH AFRICA

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WONDERCOINS Project: An Online Platform for the Investigation of Ancient Monetary Finds from the Iberian Peninsula and North Africa

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Abstract: The WONDERCOINS project (TED2021-131704A-I00 / PY20_01295) arises for the launch of a platform for research and dissemination of ancient monetary finds recovered in the south of the Iberian Peninsula and north of Morocco. With a chronological orientation between the fourth centuries BC and sixth AD, the platform aims to fill a gap in current numismatic research in Portugal, Morocco, and Spain, where there is no such tool. In order to do this, the Dédalo digital database manager is used, an application installed by multiple numismatists throughout Europe. Our approach will be oriented mainly to conserving and disseminating the archaeological contexts of the monetary finds, whether individual or as a whole. In addition, it will offer the possibility of making online maps to analyse monetary circulation and has statistical tools for the analytical dissemination of the data.

Keywords: Antiquity, Hispania, Mauretania, Digitalisation, Coin finds, Database.



The name WONDERCOINS stands for Wide Online Numismatic Data Environment and Recognition of Coins (**Fig. 1**). These are several¹ projects generously financed by European funds

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that were born with the vocation of solving a series of perceptible problems in the research, conservation, and protection of archaeological heritage, especially numismatics (<https://www.wondercoins.es/>)



Fig. 1. Visual identity of the WONDERCOINS projects. ©Elena Moreno Pulido. [www.wondercoins.es].

To begin with, the management of the huge quantity of numismatic information is complicated to handle if it is not through specific databases that allow ordering, analysing, and fluently inventorying said material.

In addition, the volume of numismatic information results in a second serious problem: not all coins can be published in a traditional way on paper, so much of the heritage and archaeological information is unpublished and unattainable, impossible to be shared for the open advancement of knowledge. This is due to the disconnection of information from Spanish, Portuguese, and Moroccan numismatic findings with digital initiatives, which do allow for the massive publication of data openly and online.

Additionally, it is necessary to establish a standardised methodology of digital management of contextual archaeological information of numismatic findings.

State of the art. Coin finds digitization in Spain

There are many already existing or developing digital tools on the current international scene regarding the research and protection of numismatic and archaeological heritage, designed to facilitate its analysis, management, preservation, and dissemination through database projects and showing their contents on the Internet (Arévalo, Moreno 2018).

Coins are particularly suitable for their standardised inclusion in databases since they are mass-produced items which possess a relatively standard set of descriptive data. They have been the subject of interest and systematisation since the time of the first antiquarians in the 16th century. As a result, this field has experienced significant progress, and numismatic projects are seen as flagships regarding the application of this computer software in the humanities, even

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more so when it allows to connect contents to other systems through Linked Open Data.

For example, the Staatliche Museen in Berlin have only a reduced number of online numismatic records (3000–4000), but its catalogue is user-friendly, the records are excellent, and the coins are optimally photographed. Other institutions such as the Hermitage, the Smithsonian, the Fitzwilliam in Cambridge, the Yale University Art Museum, or the Bibliothèque Nationale de France (BNF via *Gallica*) are making their own online catalogues, which are now available to Internet users. Also noteworthy is the work done by the Europeana Digital Service Infrastructures (DSI) from the European Commission, linking more than 50 million cultural heritage elements from the main European museums and galleries, ranging from books and paintings to 3D objects and audio-visual material and joining more than 3500 cultural institutions throughout Europe. All of this is clear proof of the possibilities and applicability of these databases for research and shows this huge social impact in the digital culture era.

At present, the DARIAH (Digital Research Infrastructure for the Arts and Humanities) network integrates research and digital arts and humanities activities all over Europe, enabling transnational and interdisciplinary approaches. It has the support of 18 member countries and some cooperating partners. However, Spain does not belong to either of these two groups yet.

In the Spanish scene, the *Guía Digital del Patrimonio Cultural de Andalucía* (“Digital Guide of Andalusian Cultural Heritage”) from IAPH (*Instituto Andaluz del Patrimonio Histórico* – “Andalusian Historical Heritage Institute”) is an initiative promoted by the Andalusian regional government which supports the promotion of movable and immovable heritage and its added value through the ARQUEOS visualiser. However, it only displays thirteen search results for *moneda* (coin), with solely one of them entirely devoted to Antiquity.

Just a few Spanish museum collections are available through the CER.es website, the *Red Digital de Colecciones de Museos de España* (“Digital Network of Spanish Museum Collections”), which records contents generated from DOMUS (an integrated system for museum documentation and management). Developed by the Ministry of Culture and Sports, it is currently used by 195 museums and integrated into Europeana. Unfortunately, this resource does not use Linked Open Data, and its database, interface, and information search methods do not meet the current standards and regulations applied by far-reaching international initiatives.

As we have already seen, the proposals to digitise numismatic heritage have been improved over the years and have reached an apogee of great activity. However, it must be said that they were mainly developed within their own museum and collection contexts, excluding archaeological context-related aspects of the numismatic findings. Adding to this, these data have not been properly treated yet – not even standardised nor linked to other databases of archaeological materials.

The University of Barcelona is the sole Spanish contributor which provided the project with its database of epigraphic documents, so this European infrastructure cannot be used to visualise other geolocated archaeological objects in our country. Regarding CSIC’s IDEArq (Archaeological Research Spatial Data Infrastructure) for the online publication of repertoires of georeferenced archaeological information, it offers access to data from about 1900 archaeological sites in the Iberian Peninsula through Web Map Services and this online platform. Nevertheless, the data from numismatic findings cannot be visualised since they have not been compiled yet.

In this sense, coin findings from the Hispanic territory must be digitally included, a need already detected years ago (Volk 1984; Mora and Arévalo 2009; Ripollés, Gozalbes 2016; Arévalo, Moreno 2018), which would enable Spain to meet the current international standards in research and promotion of numismatic heritage.

WONDERCOINS Objectives

To try to solve these problems we have managed to establish a powerful interdisciplinary team from several Spanish and Portuguese universities and enterprises. The funding of these projects has been obtained through the research plan of the *Junta de Andalucía*, the Campus of International Excellence of the Sea, the *Casa de Velázquez*, the call for the Digital and Ecological

Transition and the call for Research Consolidation – the latter two of the Ministry of Science and Innovation of Spain and in the lines marked by the Recovery and Resilience funds of Europe.

Therefore, the main mission of these projects is to improve conservation and research on coinage in Antiquity. To this end, the design and implementation of a digital platform with services and features that would allow the consultation and dissemination of numismatic material was proposed, in addition to being strongly prepared for research work.

This platform would serve to register in the database unpublished or published numismatic findings that had not yet been inventoried, digitised, georeferenced, and disseminated online.

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Methodology. Collaborating through Dédalo software for coin finds registration

WONDERCOINS projects could not be carried out without a powerful, versatile, and constantly evolving database management software system.

In order to free archaeological researchers specialised in numismatics from the problem of dealing with the underlying technological complexity related to computing applied to this domain of heritage, our projects are supported and deployed by the free and open-source software named *Dédalo* that is developed by the Spanish company RENDER S.L., located in Valencia.

As can be read on the Dédalo website, the idea behind its creation is to face a historical problem in the management of cultural and memory archives. For various economic, political, and logistical reasons, no company or organisation is thinking of a global free and open solution for creating and sharing cultural archives. Each institution is creating its own tailor-made solutions, which are usually not re-usable in other institutions and are only in very few cases free to use, so modest institutions or researchers do not have access to them.

The Dédalo developers think that the importance of our past and our cultural legacy and memory is so great that it should not be left only in the hands of private companies with exclusively economic interests. It is everyone's job to preserve and spread it, both for current and future generations.

There is much more information about this initiative on their website (<https://dedalo.dev>).

It is important to emphasise the philosophy followed by the WONDERCOINS projects, which from the very first moment wanted to integrate into the current standards set by Nomisma for numismatic content websites. Moreover, Dédalo is configured to output the contents registered on its platform in the RDF format that Nomisma needs to view its contents on its websites.

Dédalo can even automatically import the RDF corresponding to Nomisma's typological catalogues, so that we have a typological database to easily catalogue our coins through Nomisma's standards.

All these efforts are focused on trying to homogenise numismatic findings with an origin in the same platform through collaboration between interrelated projects.

Concretely, the WONDERCOINS projects offer any interested researcher the free use of Dédalo's software, since it is free and open source. It allows the advancement in open science research, since it is based on linked open data. It is a collaborative tool based on wiki principles and in the solid belief that science should advance thanks to multi and interdisciplinary international collaboration.

In addition, Dédalo allows for independence in the investigation of any interested party, since it has functionalities that allow the visualisation of the data to be restricted to certain profiles and users. This research independence is reaffirmed thanks to the fact that Dédalo offers recognition of authorship of the files or contents published in the database and in the chosen output web platform. Moreover, the program allows the user to publish on multiple and different websites, choosing which material will be published on each platform. These websites are also provided

with an ISBN, making them recognised publications for all purposes valid for a scientific and academic career.

If in addition to inventorying and working with the coins in the database, a researcher would like to see them online, he or she can choose to create their own website and connect it to the database. For this, we will also offer a template for free use that is customisable and facilitates the direct connection with the platform.

However, it is also possible to work collaboratively on a single website that grows thanks to the general work of all researchers interested in digitising and publishing numismatic findings online in an archaeological context.

As mentioned, the contents are managed with Dédalo, an opensource system for research and publishing based on web standards, with powerful capabilities for collaborative projects. The continuous development of this management system has allowed it to reach a high standard, making it possible to create large digital catalogues with filters that allow for dynamic and personalised queries. The best example of Dédalo's possibilities about numismatics at present day is <https://monedaiberica.org/> (Ripollès Alegre, Gozalbes Fernández de Palencia 2016).

The WONDERCOINS projects' budget made it possible to acquire the necessary server infrastructures to install this tool in the domain <https://wondercoins.uca.es>, which can currently be accessed by any researcher who is granted a username and password to start working privately, individually, or collaboratively on said platform that is physically located in the computing infrastructure installations of the University of Cádiz. The tasks of configuring these servers and software installation fell to Mr. Felipe Bergua Toledo, a signatory of this article.

While there are many advantages to using Dédalo, it should mainly be emphasised here that it is free software. Dédalo is a web application system that was born in 1998 for the management and research of cultural heritage. In 2016, another new ontology was created for the management and publication of numismatic catalogues, a data model to which the name Numisdata was given. It allows for collaborative work because it is multi-user – that is, a large number of users can be working in the same database at the same time, registering new files or modifying others without data inconsistency. On the other hand, it should be noted that it has a friendly user interface (**Fig. 2**) and is very easy to work with, which greatly facilitates the labour and the digital challenge we face.

Fig. 2. Sample of the registering of a numismatic object in Dédalo (coin conserved at the Archaeological Museum of Tetouan). [www.wondercoins.uca.es].

Data recorded by WONDERCOINS projects

Our projects for recording numismatic data have two different parts: the Dédalo management system and the public website. Like two sides of a coin, Dédalo is the application that allows one to organise, to select, and to publish the contents on the website. In our case, we have a beta platform of the website under development, whose final version will be available soon.

The ultimate goal of this initiative is, over time, to collaboratively build an online platform that shows in a unified way the numismatic findings with a more or less uncertain provenance and without temporal or geographical limits.

This is not a goal that has arisen spontaneously or without strong foundations. Prior to this initiative of homogenisation in a single webpage, Dédalo has been used monographically to record findings published in other Numisdata websites. This is the case of Numisdata Sardinia, an initiative of Pere Pau Ripollés and Manuel Gozalbes for the registration of coins found in an archaeological context on the island (<https://numisdata.org/sardinia/web/>) or the Carthaginian Coin Finds initiative of Iván Fumadó Ortega for the registration of already published numismatic finds found in Carthage (<https://carthaginiancoinfinds.numisdata.org/web/>).

We are currently in the process of homogenising these initiatives on the same Internet domain with findings from Hispania, Sardinia, Carthage, and Mauretania Tingitana. We are especially interested in recording where each coin was found in a hierarchical way. For example, one Ae3 of Constantine was found in an excavation in Tamuda (Tetouan, Morocco) in the Roman baths, in one of the canalisations of these baths, and in a specific stratigraphic unit. Following this hierarchy of findings allows us to study the coin in context. In the funerary case (**Fig. 3**), we can record its specific position in the tomb, its relationship with the body, or with the trousseau (Arévalo, Moreno 2016).



Study of currency in context

- Specific position of the coin in the tomb layer
- Relationship with the body
- Relationship with trousseau



Necropolis of Gadir (Cádiz Spain)
Project I+D+i
(IP: Profa. Dra. Alicia Arévalo)

Fig. 3. Registering of the coins in their archaeological context. Coins in funerary context (Arévalo and Moreno, 2016).

Hierarchy (Fig. 4) can be complicated or simplified as required, depending on the needs of the excavation or its periodisation.

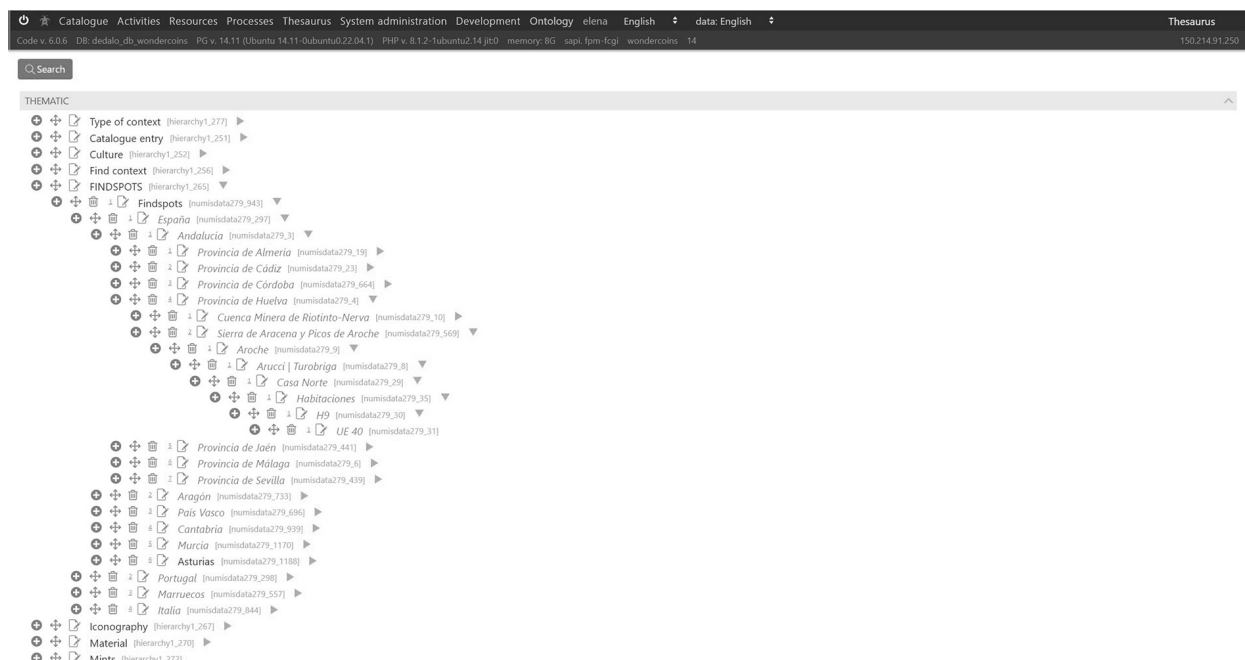


Fig. 4. Hierarchical organisation of the findspots where the coins were found in Dédalo. [www.wondercoins.uca.es].

We can thus register examples of coins in a necropolis with multiple positions, leaving all of them organised and filterable, facilitating their joint analysis.

Thanks to Dédalo, we can filter and retrieve each monetary record, whether we search for the higher hierarchical levels (parents) or lower ones (children). As an example, we have recorded more than one thousand coins in different *cetariae* contexts (**Fig. 5**).

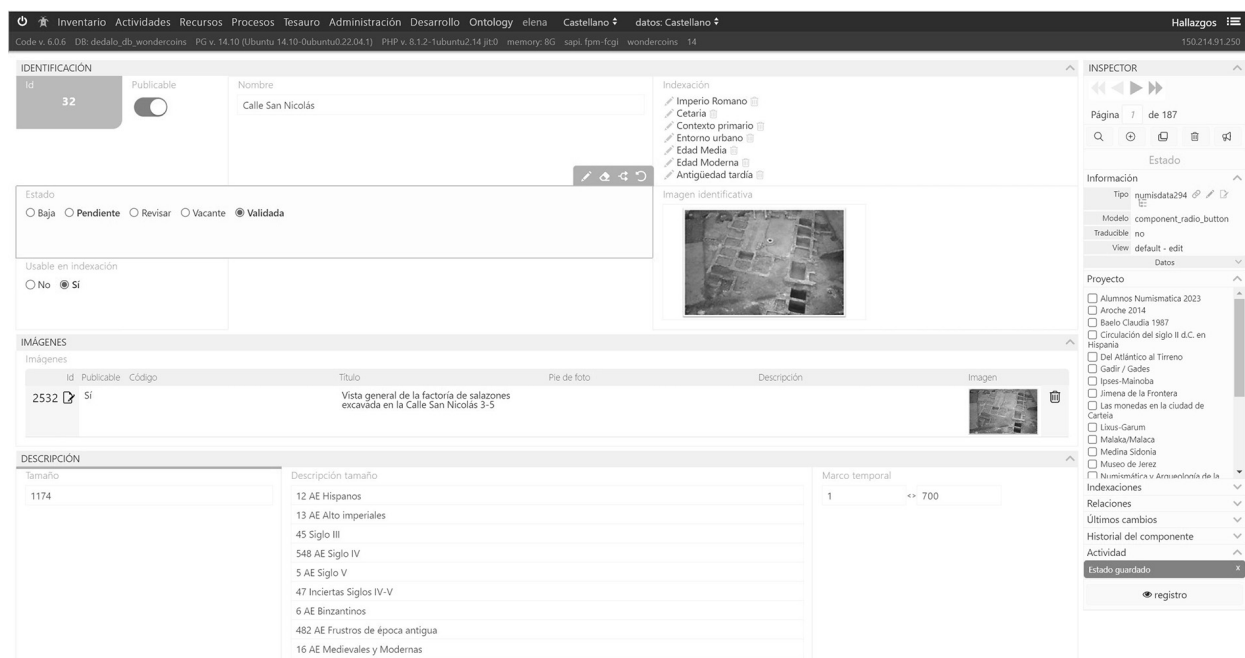


Fig. 5. Registering findspots in Dédalo. Example of *cetariae* contexts. Identification and indexation of the context. [www.wondercoins.uca.es].

Of course, it is necessary to add the bibliographic references of the studies already published, so Dédalo makes this work possible in an excellent way and also allows integration with the Zenon system (**Fig. 6**) from the DAINST (*Deutsches Archäologisches Institut*/German Archaeological Institute).

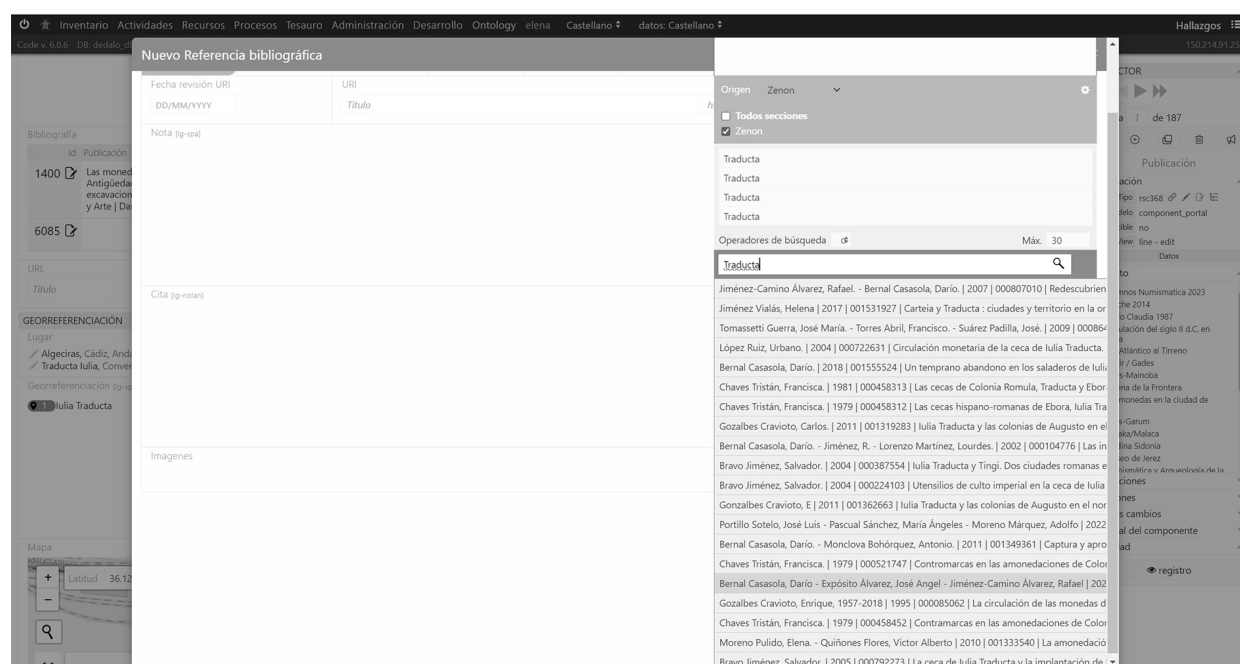


Fig. 6. Registering bibliography and public information about the context in the system. [www.wondercoins.uca.es].

In order to accomplish the named objectives, we have the collaboration of different museums and archaeological interventions of Spain, starting in Andalusia, where we are cooperating firstly by recording and cataloguing the coins. We are collaborating with the University of Cádiz professors Alicia Arévalo and Darío Bernal; assistant professors Macarena Lara and José Ángel Expósito; and Titular Professor Manuel Palomo, as well as various students also from the University of Cádiz; Professor Bartolomé Mora from the University of Málaga; Assistant Professor Ruth Pliego from the University of Seville; Titular Professor Javier Bermejo and Assistant Professor Lucía Fernández from the University of Huelva; Ph.D. Nieves Medina from the Archaeological Museum of Aroche; Ph.D. Manuel Gozalbes from the *Museo de Prehistoria de Valencia*; Associate Professor Ivan Fumadó and former Professor Père Pau Ripollès, from the University of Valencia. We are all together, the IT crew and the team of archaeologists, still working together to keep recording data in museums, archaeological sites, and bibliography references at the moment of writing of the present pages.

Among others, we can enumerate the introduction of this data in our Dédalo system:

- *Museo Provincial de Cádiz* (Cádiz), where we have recorded more than 4350 coins (Arévalo, 2006).
- *Museo Arqueológico de Jerez* (Cádiz), registering 432 coins.
- *Museo Arqueológico de Medina Sidonia* (Cádiz), recording 250 coins.
- *Museo Arqueológico de Chiclana de la Frontera* (Cádiz), recording 93 coins (Gómez García, 2020).
- *Museo Arqueológico de Riotinto* (Huelva), recording 1200 coins (Arévalo and Moreno 2021, 2024).
- *Museo Archeológico de Aroche* (Huelva), recording 378 coins (Medina, Campos, Bermejo, 2016).
- The archaeological site of Carteia, with the recording of the coins still in progress, has uncovered more than 400 coins (Arévalo and García, forthcoming).
- The archaeological site of Baelo Claudia, still recording the coins from the old excavations of the site in 20th century through the bibliographical references (Bost et alii, 1987) and the recent excavations of the University of Cádiz (Arévalo and Moreno, forthcoming).

- The archaeological site of Torre de Benagalbón (Málaga), 27 coins (Mora and Pérez, 2017).
- The archaeological intervention in C/San Nicolás (Algeciras, Cádiz), recording 1152 coins (Arévalo and Mora 2018).
- Hoard of Linares (Jaén), recording 130 coins.
- Hoard of Plaza España (Écija, Sevilla), 1305 coins (Chaves, García, López, Pliego, 2009).
- Association *Tanit, Jimena de la Frontera* (Cádiz), recording 39 coins.
- Bibliographical information of the doctoral thesis from Laura Arias, coins from the second century AD found in Hispania (Arias Ferrer, 2007), yet recording of the coins in progress, more than 497 coins already in the system.

As for the coins found in Portugal, we have already worked with Celso Candeias from the archaeological site of Balsa, Vera Freitas from the Museum of Portimao, Francisco Pacheco from the Museum of Beja, María Luisa Guerreiro from the *Museu Nacional de Arqueologia*, Professor Carlos Fabiao and Professor Ana Margarida Arruda from the University of Lisboa, and Professor Rui Centeno from the University of Oporto. Thanks to these collaborations, we have already registered the coins of these museums and archaeological interventions:

- The archaeological site of Vaiamonte and its surroundings (Portugal), 285 coins (Fabiao, 1998).
- *Museu Nacional de Arqueologia*, 977 coins (Moreno and Arévalo, 2021a).
- *Museu de Portimão*, 262 coins (Sousa, 2013a, 2013b).
- *Museu Municipal de Faro*, 129 coins (Moreno and Arévalo, 2021).
- *Campo Arqueológico de Tavira*, just one interesting coin (Moreno and Arévalo, 2021a).
- *Camara Municipal de Tavira*, 105 coins from the bibliography (Viegas, 2005; Moreno and Arévalo, 2021a).
- *Museu Regional de Beja*, 685 coins (Viana, 1942; Hipolito 1962; Faria, 1992; Moreno and Arévalo, 2021a).
- *Museu de Santiago Cacem*, 87 coins (Pereira, 1993).
- *Centro Explicativo de Sao Bras de Alportel*, seven coins.
- The archaeological site of Milreu, 86 coins (Conejo, 2019).
- *Campo Arqueológico de Mértola*, 144 coins (Moreno and Arévalo, 2021a, 2021b)
- Archaeological interventions in *Horta da Misericórdia* (Faro), 50 coins (Valente, 2016; Moreno and Arévalo, 2021a).
- Private collections from Algarve, 731 coins (Arévalo and Moreno, 2017; Moreno and Arévalo, 2021a).
- Old references of coin findings in Algarve from the bibliography, 737 coins (for detailed references see Moreno and Arévalo, 2021a).

In order to record the coins found in North of Morocco, we already have the collaboration of the *Foundation Nationale des Musées de Maroc*, and we worked closely in research projects with the professors Darío Bernal Casasola from the University of Cádiz and Laurent Callegarin from the University of Pau and the Pays of the Aldour. We are nowadays working in registering data from:

- Archaeological interventions in Lixus (Morocco), recording of the coins in progress.
- Archaeological Museum of Tetouan (Morocco), recording of the coins in progress, but more than 3000 specimens (Moreno and Arévalo, forthcoming).
- Archaeological interventions in Tamuda (Morocco), recording of the coins in progress,

more than 100 specimens.

Also, our system hosts coin finds from Italy, thanks to the work of Gozalbes and Ripollès:

- Archaeological sites in Sardinia (Italy), recording 396 coins already registered in <https://numisdata.org/sardinia/web/>

Moreover, at present we have already incorporated into Dédalo's database more than ten thousand coins, more than a thousand ancient mints, almost nineteen thousand coin types, and one thousand coin find spots.

Complementary to this data loaded in our Dédalo installation, we have incorporated more than five thousand bibliographic references as well as more than three hundred publications.

The development of a new georeferencing tool for Dédalo

But what happens when we do not have precise information about the place of discovery of the coin? In many cases we have very vague information about the context, and the coin cannot be specified at an exact location point. The key is the organisation in hierarchy for the registration of the places of discovery and the use of a thesaurus of interpretation of the contexts that can index the functionality of each find in relation to each excavation. In this way, a typical finding sheet in Dédalo uses tags linked to the thesaurus to index the finding in terms of its interpretation as well as its periodisation or culture. You can register as many media files as you need, such as planimetries, photographs, orthophotos and much more. Also, a description of the site can be included in text mode.

The problem of uncertainty can be narrowed relatively easily, as geographers have spent years working with different scales that are bounded by the number of digits of the coordinates. Combining the precision of coordinate degrees is the key to reliable spatial analysis. In this way, we can combine in the same database the precise coordinates for some georeferenced findings with other findings of which we only know the toponymy.

Establishing a mathematical value of precision of the rest of the finds is made easy by dividing the known extension of the place of discovery. In this way, we can work with geographical uncertainty, establishing numerical values for known findings in nations, regions, cultural areas, etc. Logically, the smaller the extent of the area where we know the coin was found, the greater the accuracy of our spatial analysis. This analysis can be performed using automatic calculations based on data easily stored in the database. A georeferencing of the site is included in relation to its current and historical toponymy and the coordinates of the find when available. Points, polygons, or lines can be used to delimit the place of discovery.

WONDERCOINS projects are also improving Dédalo software in a collaborative way. We have hired the services of Manuel Jesús Dávila González through the Spanish company IBERMAD. Mr. Dávila is an expert in georeferencing and web design development and has implemented GIS improvements in the map visualisation part of the Dédalo application (**Fig. 7**). These new enhancements are designed so that all possible end users of the software beyond the WONDERCOINS projects can take advantage of the benefits these new functionalities will bring to the community.

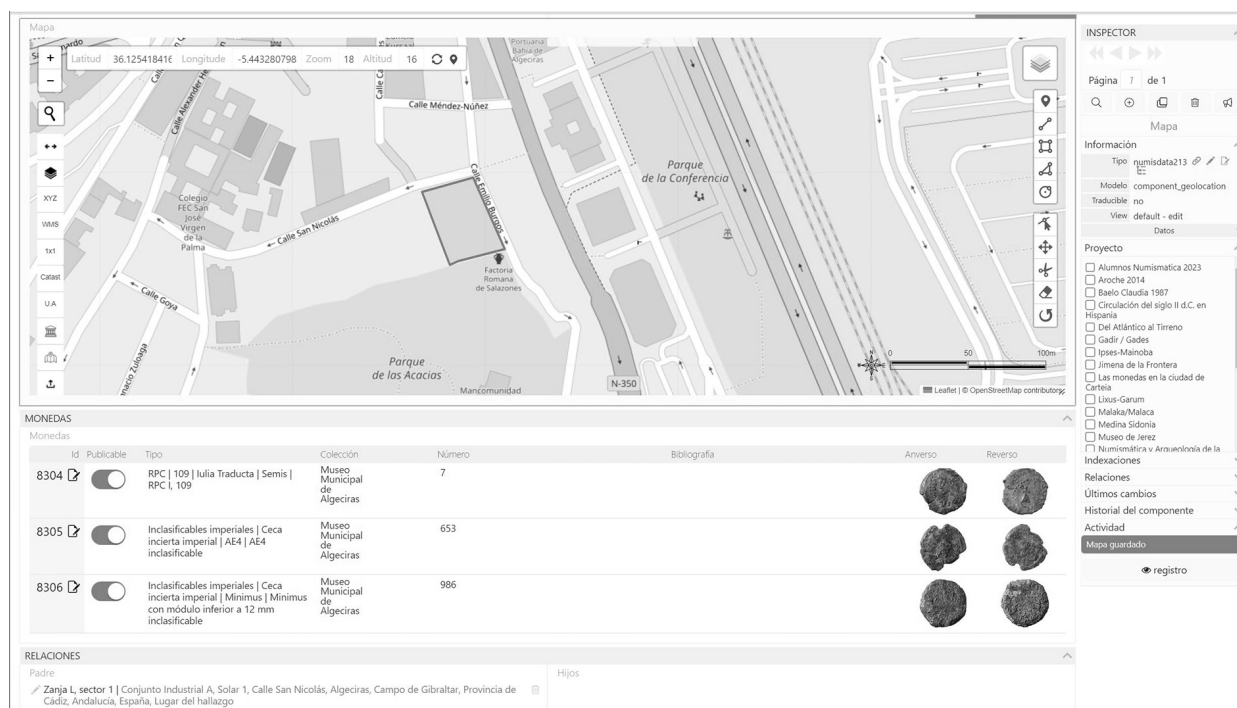


Fig. 7. Georeferentiation of the findspot and previsualisation of the several coins associated with the site. [www.wondercoins.uca.es].

Future plans and reflexions

We will quickly end by citing plans for the next two years. First, we aim to offer collaborations with other institutions, museums, universities, sites, and archaeologists interested, and we will try to prepare a solid candidacy for a coordinated international research project in this regard. Also, we freely offer collaboration in our project to whomever wants to participate; all they need to do is contact us.

In line with the successful Iberian initiative developed by Ripollés and Gozalbes <https://mone-daiberica.org/>, we announce that we are embarking on the elaboration of the typological corpus of Mauretanian coins.

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