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Emplazamiento, infraestructuras y organización de los puertos romanos

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Antonio Pizzo
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SEEKING THE HARBOUR OF *BAELO CLAUDIA*: NEW GEOARCHAEOLOGICAL RESEARCH

En busca del puerto de *Baelo Claudia*: nuevas investigaciones geoarqueológicas[*]

Dario Bernal-Casasola[**], Ferréol Salomon[***], José Ángel Expósito[**], José Juan Díaz[*], Nicolas Carayon[****], Kristian Strutt[***]

This work is dedicated to Simon Keay, from whom we learned for years and with whom we shared many seasons of fieldwork, including in *Baelo Claudia*

Resumen

Baelo Claudia fue una de las principales ciudades comerciales y portuarias del *Fretum gaditanum*, utilizada asimismo como puerto de viajeros para las conexiones norteafricanas, como confirma Estrabón. Con motivo del proyecto europeo *Portuslimen* se ha podido analizar su problemática portuaria a través de una estrategia combinada (arqueológica, geofísica y geoarqueológica), materializada en tres campañas de campo: prospección geofísica, 23 sondeos geoarqueológicos manuales y revisión de la documentación arqueológica en 2016; 3 sondeos rotativos mecánicos en 2017 y 9 sondeos arqueológicos de verificación en 2018. Todo ello ha permitido, con nuevos datos, realizar una síntesis de nuestro conocimiento del puerto de la ciudad romana y de los embarcaderos secundarios (estos últimos especialmente importantes para interconectar las canteras con la ciudad).

En relación al puerto urbano, se ha verificado la existencia de una gran fachada marítima coincidente con la muralla sur de la ciudad, además del hallazgo de dos piedras de amarre con perforaciones pasantes. El estudio geoarqueológico y paleoambiental ha verificado la existencia en la interfaz marítimo-terrestre de depósitos prerromanos con sedimentos oscuros, pero no de época posterior, sugiriendo que la columna de agua en esta zona cercana a la ciudad no era suficiente como para permitir el varado de grandes embarcaciones. Además, los sondeos arqueológicos confirman la existencia de construcciones romanas bajo la playa actual, muy desmanteladas, descartando la existencia de un antiguo lagoon en la zona, y planteando que la conexión entre la ciudad y la ensenada de Bolonia se habría realizado con pantalanes de madera perpendiculares a la costa para alcanzar aguas profundas, asistidos de embarcaciones menores para alcanzar la playa.

Palabras clave: investigación interdisciplinar, Estrecho de Gibraltar, Piedras de amarre, sondeos, sistema portuario.

Abstract

Baelo Claudia was one of the main commercial and port cities of the *Fretum gaditanum*, also used as a passenger port for North African connections, as confirmed by Strabo. On the occasion of the European *Portuslimen* project, it has been possible to analyse this topic through a combined strategy (archaeological, geophysical and geoarchaeological), materialised in three field campaigns: geophysical prospection, 23 manual geoarchaeological soundings and review of the archaeological documentation in 2016; 3 mechanical rotary soundings in 2017 and 9 archaeological verification soundings in 2018. All this has allowed, with new data, a synthesis of our knowledge of the port of the Roman city and the secondary wharves (the latter being particularly important for interconnecting the quarries with the city).

In relation to the urban port, the existence of a large maritime façade coinciding with the southern wall of the city has been verified, in addition to the discovery of two mooring stones with through perforations. The geoarchaeological and palaeoenvironmental study has verified the existence in the maritime-terrestrial interface of pre-Roman deposits with dark sediments, but not from a later period, suggesting that the water column in this area close to the city was not sufficient to allow the beaching of large vessels. Furthermore, archaeological surveys confirm the existence of Roman constructions under the present beach, which have been largely dismantled, ruling out the existence of an ancient lagoon in the area, and suggesting that the connection between the city and the inlet of Bolonia would have been made with wooden jetties perpendicular to the coast to reach deep water, assisted by smaller boats to reach the beach.

Keywords: interdisciplinary research, Strait of Gibraltar, mooring stones, soundings, port system.

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Location and state-of-the-art[1]

The Hispano-Roman city of *Baelo Claudia* was a significant port and should have had first-rate harbour facilities to serve the three-fold economic orientation of this important *municipium* in the *Fretum Gaditanum*. First, the harbour would have been used to unload fishing ships and, more importantly, to host an *almadrabas* as suggested by archaeological evidence (Bernal-Casasola, Expósito and Díaz, 2018). Second, important commercial activities were conducted in the port at the convergence of the Atlantic and Mediterranean routes, as shown by the abundant imports of all kinds found in the city. These are testified by the *testae* -bricks- from Tingitana used in the *hipocausis* of the urban baths, as well as pottery from all over the Mediterranean and by the Parian marble used in the Doryphoros statue (AA.VV. 2017). Third, passengers were stopping in this port-city according to Strabo, who writes that voyages to *Mauretania* – especially Tangier – began on these shores: "the city of Belon. From here the trips for Tingis in Maurusia depart. And it is a commercial harbour and has fish-salting facilities" (*Geography*, III, 1, 8). This third issue is the least known archaeologically.

The *PortusLimen* research project, funded by the ERC (Advanced Grants), allowed us to re-examine what we knew about the harbour in 2016 and 2018. It consisted of a review of the available documentation, geophysical surveys, geoarchaeological coring and archaeological excavations in the sea-land interface (Keay *et al.,* 2017; Bernal-Casasola *et al.,* 2017). This work synthetises the results of this project, presenting a precise and up-to-date perspective of our understanding of the harbour facilities as one of the most important Roman cities in the Strait of Gibraltar (part of the *Conventus Gaditanus*) (Fig. 1A).

Typology of harbour facilities and associated features

Harbour-related evidence in *Baelo Claudia* was examined for the first time by an interdisciplinary team (Universidad de Cádiz and Junta de Andalucía) two decades ago (Alonso *et al.*, 2007). This work revealed the difficulties posed by the study of the sea-land interface, which has been severely altered by coastal dynamics particularly active in the area. These have eroded part of the archaeological sequence, as shown by the unbuilt area between the city and the modern beach, which is separated by a two metre high artificial terrace (visible in section in Fig. 6C). The following section summarises what is known about the harbour to date.

An active mooring space in the Bay of Bolonia: shipwrecks and anchors

Underwater archaeology is still underused in the Bay of Bolonia since research undertaken in the 1980s demonstrated the frequent use of the bay as a mooring area (Martín Bueno, 1988). At least two shipwrecks have been identified in Punta Camarinal (one dating to the early imperial period and the other one to the Byzantine period), alongside the remains of a third one opposite the city, near the modern beach (references in Bernal-Casasola *et al.,* 2017, 319-320, Fig. 5, no. 1-3). In addition, the numerous fragments of anchors (lead clamps and a tie bar) clearly date from the Roman period but were found in unclear locations within the Bay, revealing the mooring of small boats – clamp, 59 cm long and 13.52 kg in weight (Bernal-Casasola *et al.,* 2017, 120, Fig. 6 B) – medium-sized vessels – clamp, 1 m long (Ponsich, 1976) – and large ships – several clamps, *c*. 2 m long (Martin Bueno, 2015; Bernal-Casasola *et al.,* 2017, 321-325). Owing to the sporadic nature of underwater finds, it is difficult

[1] This work has been the outcome of, and has been funded by five projects: PortusLimen project; GARVM III (PID2019-108948RB-I00/AEI / 10.13039/501100011033) Gobierno de España/Feder; Programa Operativo FEDER 2014-2020 and Consejería de Transformación Económica, Industria, Conocimiento y Universidades, Junta de Andalucía (ARQUEOSTRA, FEDER-UCA18-104415); ARQUEOFISH (P18-FR-1483) Programa de Ayudas a la I+D+i del Plan Andaluz de Investigación, Desarrollo e Innovación (PAIDI 2020); and GARVMTRANSFER (PDC2021-121356-I00), Convocatoria de Prueba de Concepto 2021, Ministerio de Ciencia e Innovación.

to establish a precise chronological range for these mooring activities, which are roughly dated (based largely on amphorae) between the republican period and the 5th century AD. It is thus likely that ships moored in the bay for as long as the city remained commercially active, between the mid-2nd century BC and the 6th-7th centuries AD. The presence of imports confirms indirectly maritime traffic. The lower end of this chronological bracket could be moved back further if the finds in the pre-Roman *oppidum* of Silla del Papa are taken into account (Moret *et al.,* 2017; for an up-to-date chronological synthesis see Bernal-Casasola, 2021).

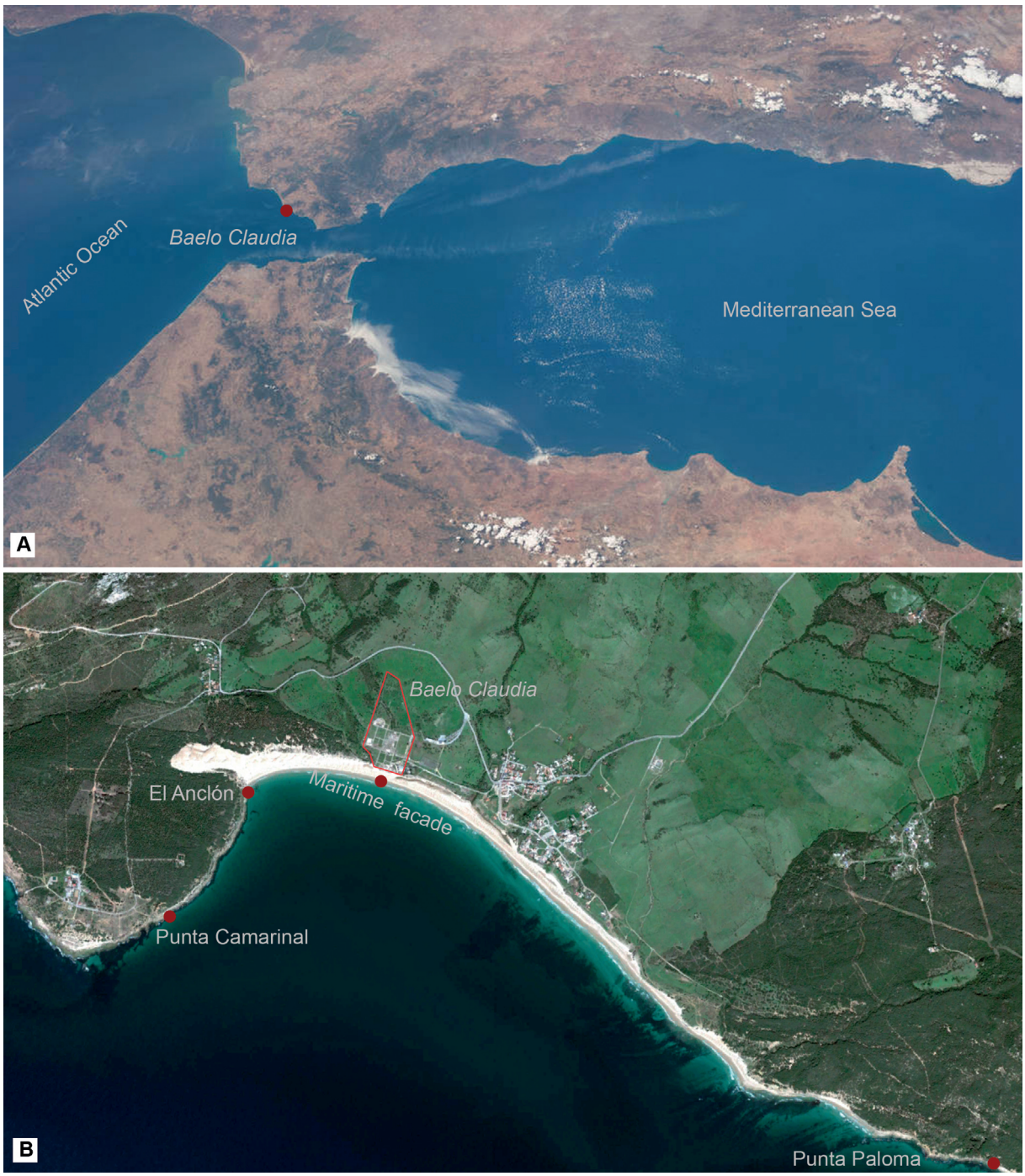

Fig. 1. Location of *Baelo Claudia* in the Strait of Gibraltar (A), and aerial view of the city and its hinterland, with indication of the sea-land interface, the secondary harbours – El Anclón, Punta Camarinal and Punta Paloma – and the geoarchaeological works undertaken in the seaward façade (B) – using satellite Nasa images, 2017, and Google Earth, 2016, respectively.

Secondary harbours

Research has identified at least three pre-Islamic enclaves that must have had secondary harbours (Bernal-Casasola *et al.,* 2017, 320, Fig. 5). First, the fish-preserving factory of Punta Camarinal/El Anclón was founded during the Republican period (2nd-1st century BC) and was situated in the inner area of the bay, just over the sea-land interface (Fig. 1 B). Remains of partially-tilted Roman salting vats built on the underlying bedrock can be seen there under the current water level. The mooring facilities that must have existed close by have been washed off by the sea (Álvarez, Arévalo and Bernal-Casasola, 2006). Second, quarries were found in two different areas of the bay: one on the south-eastern face of Cape Camarinal, and another spread over the Loma de San Bartolomé/Punta Palma (Fig. 1 B). It is certain that these quarries were active during the Roman period: the rock type coincides with some of the stones used for construction in the city, and there are extraction bays and building material whose dimensions match with the Roman construction material (Domínguez Bella, 2016, Fig. 11). These areas demand an in-depth archaeological study, among other things to determine the loading and shipping facilities used to bring construction material to the city (presumably by barge). Artificial ramps to slide the material down can be guessed in Cape Camarinal.

The shore: possible breakwaters and mooring stones

Three sets of features related to harbour activities were recorded by the Spanish-British-French team in 2016 and 2018. First, a number of square-shaped structures abutting the southern wall of the city and the façade of the so-called Southern Building XIII (Fig. 2), which may have been foundations for timber structures projecting perpendicularly from the wall[2].

Second, a preliminary excavation was undertaken in a building situated in the modern beach (so-called Southern Building XIII[3]). The building is somewhat separated from the city in the active intertidal area, which has led to the formation of an isolated "tell". Based on architectural features, the building may predate the Augustan reorganisation of the city (Bernal-Casasola *et al.,* 2017, 314, 327-330). Its location, in the sea-land interface, as well as a perpendicular feature running into the sea (N-S), strongly indicates its relation to harbour activities, perhaps it was a warehouse, as suggested by the construction technique, based on square formwork. Especially significant was the identification of a large prismatic mooring stone before the southern façade (into which it might have been fitted) and facing the sea (Fig. 2). A second similar mooring stone was found in 2018 in Trench 38 near the southern city wall, in a context will many ashlars coming from the dismantling of the defensive system[4]. The harbour connection of these finds seems straightforward. Typological parallels can be found in many Mediterranean harbours including Pompeii (Descœudres, 1998) and Rome where many examples have been found. The hole is intended to house a rope that is attached to the ship's anchor, and the substantial erosion of its inner lower face is the result of the constant friction. This is a relevant find since not many of such mooring stones have been found in *Hispania* (only in *Sexi* and, recently, in Boca do Rio, Algarve).

[2] The existence of these features was known since 2011, when the Conjunto Arqueológico de Baelo Claudia archaeological team undertook an excavation in the southern sector of the city.

[3] So called "Edificio Meridional" or "E.M." XIII in spanish literature.

[4] Carved in local biocalcarenite, the first one is a reused architectural block. Its dimensions (which match Roman metrology) are 4 x 2 feet (120 x 60 cm); it presents an oval hole, *c*. 18 cm in diameter, with clear use-related wear; the second ashlar is a big smaller (100 x 50 cm), also will a hole in oblique arrangement (diameter: 10 to 18 cm).

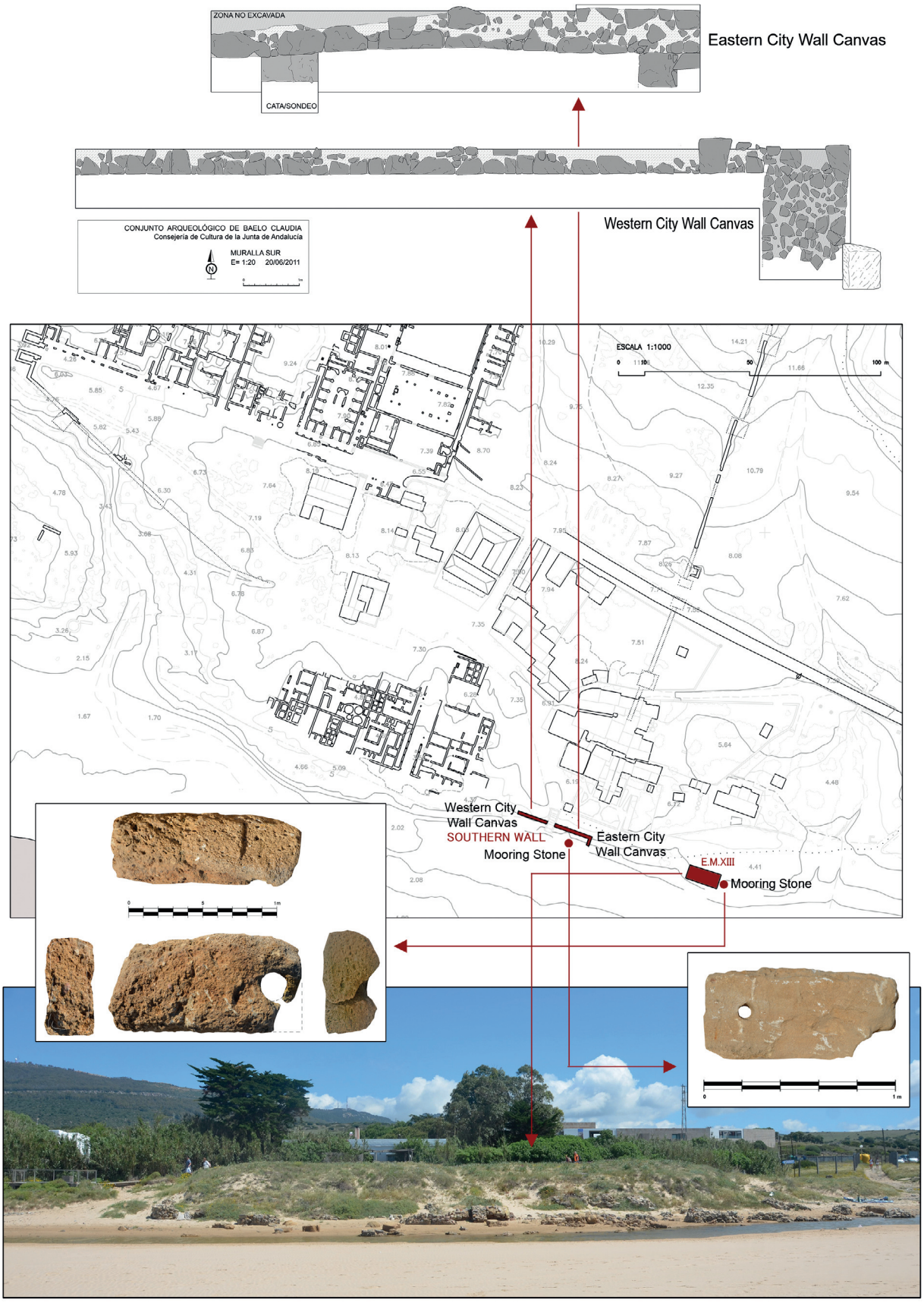

Fig. 2. Plan of the city, with the location of the foundation of three possible timber breakwaters edges in the southern wall (opposite the Cetaria XII, the south-eastern corner of the city, and Southern Building XIII), and location spots for the two mooring stones found near the maritime façade.

In addition, geophysical survey in the seaward front of the site, between the southern district and the western necropolis, contributed to a better understanding of the area connecting the site and the beach – the so-called western *suburbium*, location of the Maritime Baths – although no clear harbour facilities could be identified.

About the possible lighthouse and *thynnoskopeia*

It seems likely that this harbour city had a lighthouse, but no archaeological evidence for this has been found to date. Some years ago, it was argued that the lighthouse could be located in the western *suburbium*, and this was the chosen location for it in historical reconstructions (Alonso *et al.,* 2007, 537, Fig. 16). Later, it was suggested that an exempt square feature with thick perimeter walls on the top of a knoll to the northwest of Arroyo de las Villas could be the lighthouse (Bernal-Casasola, 2009, 103-104, Fig. 11). This hypothesis was ruled out after the excavations demonstrated that the feature is in fact a cistern (Room H-1) of the Maritime Baths, which explains the thickness of the walls (Bernal-Casasola, Díaz and Expósito, 2017, 138, Fig. 1A and 3A). It must be recalled that the city's economy was based on fishing and fish-preserving activities, so the possibility must be kept in mind that the lighthouse also served as watchtower for the arrival of tuna to the *almadrabas* (the so-called *thynnoskopeia*). Currently, it is believed that the *lanterna/pharus* could be in one of three locations: somewhere in the western *suburbium*, between the Maritime Baths and the western necropolis; at the tip of Cape Camarinal; and in one of the towers in southern walls of the city, acting as lighthouse/*thynnoskopeion*.

Geoarchaeological survey in Baelo Claudia: new data

In the context of the already mentioned ERC funded RoMP-*PortusLimen Project* (Keay, 2015), a geoarchaeological survey was conducted at Baelo Claudia alongside the geophysical surveys. The main aim of this study was to combine geophysical and palaeoenvironmental data in order to identify the location of a potential enclosed harbour at Baelo Claudia during the Roman period. Previous works already attempted to solve this issue in using similar techniques. At the end of the 1970's / beginning of the 1980's, Loïc Ménanteau and his team performed electric resistivity survey along the coast and dug some trenches in the sands (Ménanteau *et al.,* 1983). They identified several features below the coastal sand using geophysics but they were not able to dig all the way to the potential structures below the loose sands. At the end of the 1990's / beginning of the 2000's, Carlos Alonso, Javier Gracia and their team performed geophysical surveys (electric resistivity) together with sedimentary drilling with the same objectives (Alonso Villalobos *et al.,* 2007). Based on geophysical results with higher resolution, they also observed features possibly associated with structures below the beach in front of Baelo Claudia. Importantly, they identified dark silty clays below the beach sand dated before the 2nd millennium BC and fine deposits at the at the bottom of a ramp at the limit between the Lower City of Baelo Claudia and the current beach sands. They suggested that the 2nd millennium lagoonal environment lasted at least until the Roman period and could have been used as a harbour (Alonso Villalobos *et al.,* 2007). However, more data were needed to clarify the chronology of the fine deposits, to determine the depth of the water column available in front of Baelo Claudia during the Roman period, and to delineate the extent of the potential harbour area.

Two geoarchaeological fieldworks were organised. The first campaign was conducted between the 9th and the 22th of May 2016 in order to study the fluvial-coastal context of Baelo Claudia (Keay *et al.,* 2017). The aim was to constrain the location of a possible Roman harbour along the coast, but also in the lower course of the Arroyo de las Villas. A mechanical percussion drilling type Cobra TT was use to extract 23 cores. A second fieldwork was organised a year later, the 10th and 11th of July 2017, to complement the investigation with three mechanical rotative drillings. Three cores were drilled using this device from a contracted company along the shore. This powerful coring device drilled through the coarse sediments or stiff mud.

Chronostratigraphy and harbour potential of the Arroyo de las Villas

In this short article we present some results from the lower part of the Arroyo de las Villas. This small torrent offers a watershed of 3.3 km^2 (Fig. 3) and an intermittent discharge throughout the year. Its lower reach is entering in the urban area of Baelo Claudia at the south west between the Lower City of Baelo Claudia and the Roman Maritime baths (Bernal-Casasola, Díaz and Expósito, 2017; Fig. 5). It was hypothesized that the part of the river within the city could have been channelized and used as a harbour. We drilled three cores across the river from the right side (Maritime Baths - *Thermae maritimae*) to the left side (Lower City of Baelo Claudia), respectively Cores BAC-3, BAC-1, and BAC 7 (Fig. 4). The cores were extracted with a percussion corer. We did reach the Cretaceous grey marls in Cores BAC-1 and 3 but not in BAC-7 (Fig. 5). We could not penetrate blocks and pebbles below 3 m below the topographic surface.

Core BAC-3 was drilled next to the Maritime Baths and revealed a strong human influence in the stratigraphy expressed by the presence of ceramics and many sharp edge gravels in sands, silty sands and sandy silts. It is difficult to determine the processes linked to the deposits in this core since the human impact was very high (reworked aeolian and fluvial material? colluvial deposits? archaeological layers?). In contrast, Core BAC-1 is easier to interpret. It presents a succession of brown silty sands to sandy silts deposits with rounded pebbles and gravels interpreted as fluvial deposits. We drilled this core next to the active Arroyo de las Villas. Two radiocarbon dates were

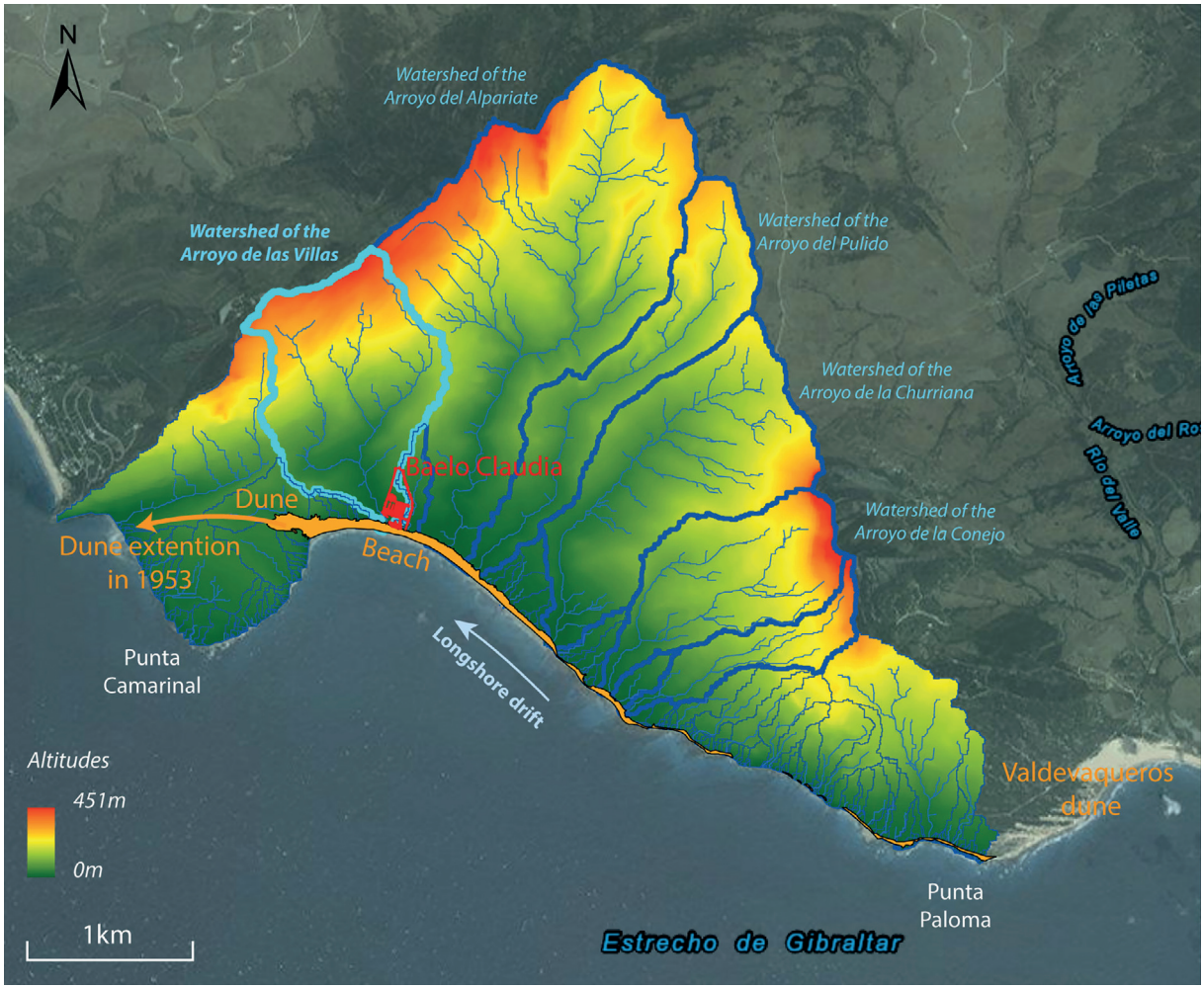

Fig. 3. Map of river courses in Ensenada de Bolonia and modern sea-land interface.

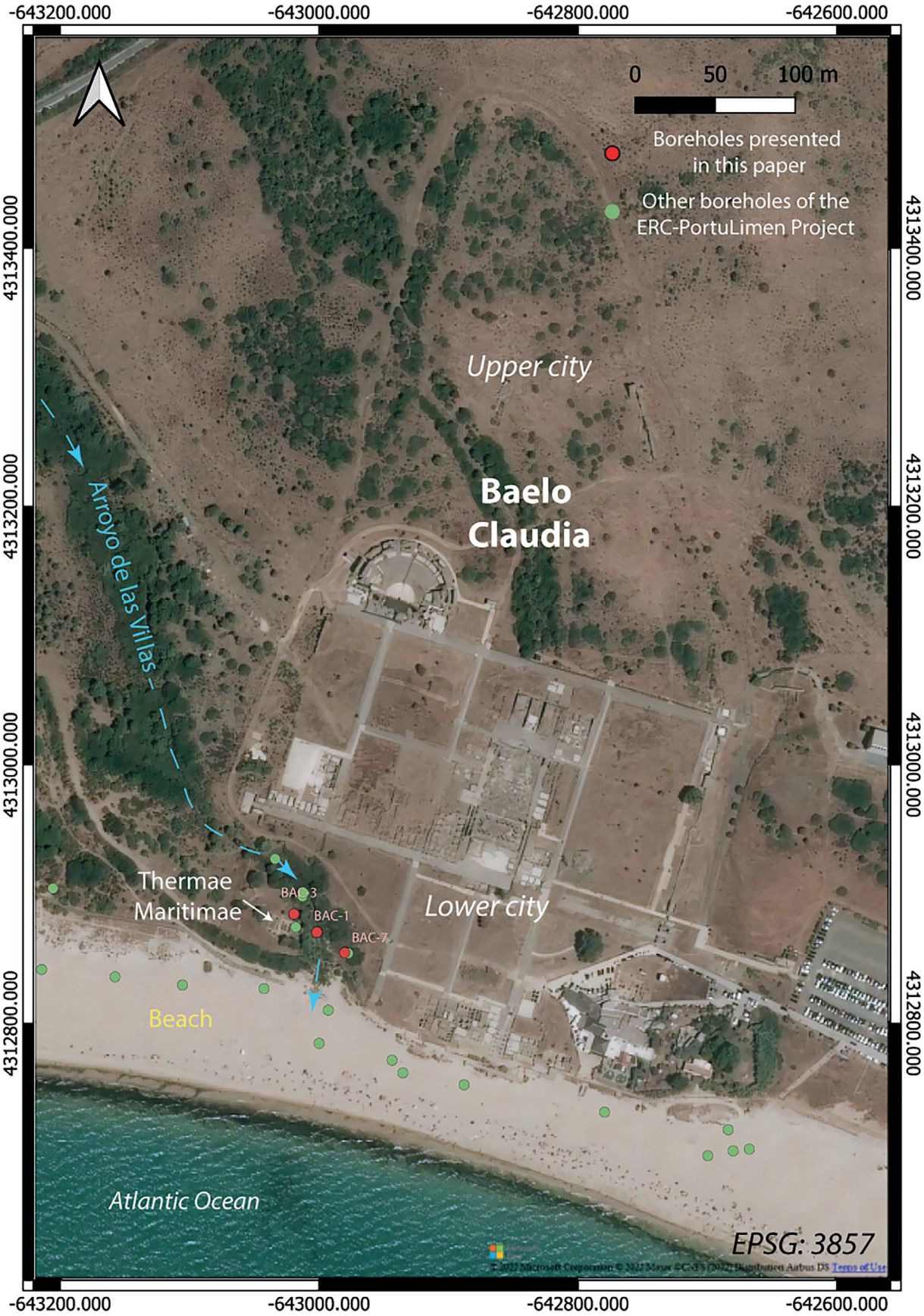

Fig. 4. Aerial view of *Baelo Claudia*, with the geoarchaeological soundings undertaken near Arroyo de las Villas.

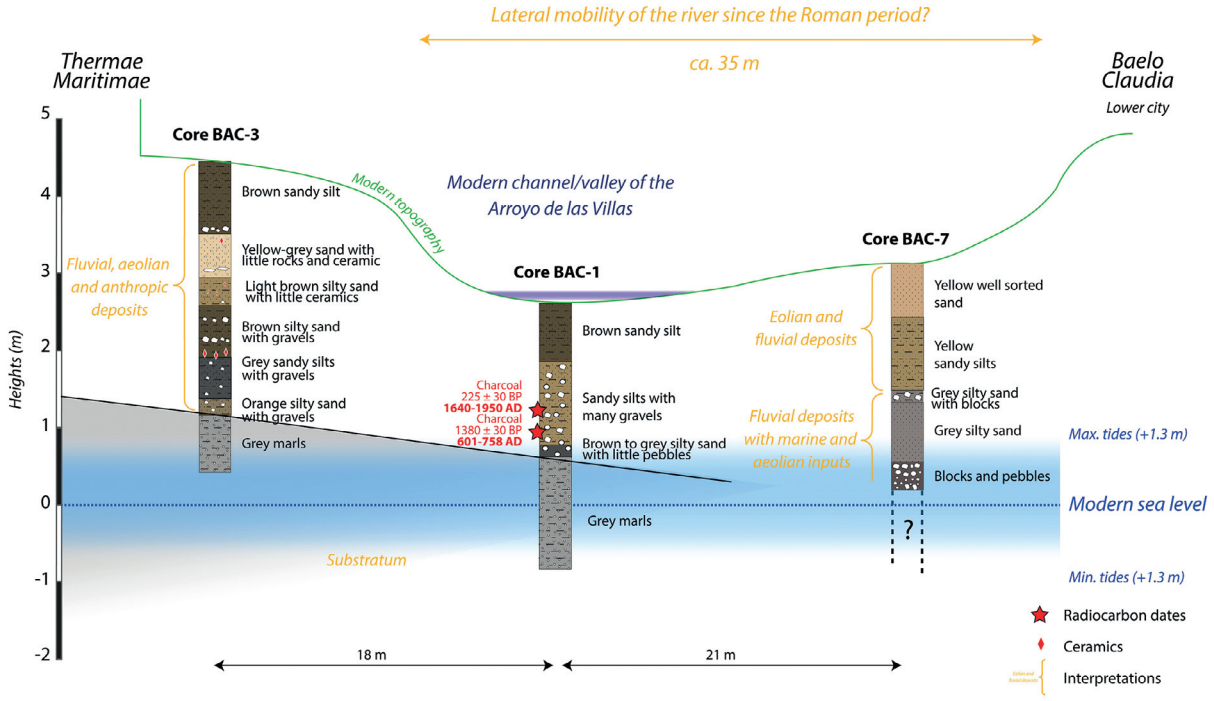

Fig. 5. W-E section of Arroyo de las Villas, with the interpretation of the geoarchaeological soundings undertaken.

performed on charcoals extracted from Unit C. The lower part of this unit is dated to 601-758 AD (1380±30 BP) and the charcoal just above is modern (225±30 BP). It reveals that the river was active in this area during the last centuries reworking previous materials. Core BAC-7 records coarse material in Unit A partly rounded suggesting fluvial influence and anthropic/colluvial inputs. Unit B is more difficult to interpret but the presence of small pebbles in a sandy matrix suggest that it is fluvial deposits with possible coastal and aeolian inputs. Unit D dominated by fine deposits would be interpreted such as fluvial deposits with possible aeolian inputs. Finally, Unit E composed of well sorted sand would have been deposited by aeolian deposits.

The three cores reveal the complexity of the deposition processes recorded at the mouth of the Arroyo de las Villas. Data from sedimentological analyses will be published soon to complete this short description. The observation of the stratigraphies demonstrates that anthropic and fluvial processes are dominating. Fine deposits and rounded pebble are indicators of the fluvial influence while the anthropic influence is related to intentionally reworked material during the periods of activity of Baelo Claudia and the taphonomic evolution of the archaeological site. Coastal and aeolian inputs are also recorded in varying proportion in the different layers.

This lower part of the Arroyo de las Villas was unlikely to be a harbour. With a very small watershed, the amount of water flowing in this river was low most of the year-round. In addition, there is no evidence of marine sediments in Cores BAC-3, BAC-1 and BAC-7. The torrential regime of the river is expressed by the massive fine sediment deposits and the coarse material and pebbles deposited. The location of a harbour in such environment would have been risky. More importantly, the substratum is very high. According to local and regional data, the sea level reconstructions of the Roman mean sea level would have been between +0.5 m to -2 m comparing to the current sea level (Gracia *et al.,* 1999; Zazo *et al.,* 1999; García-Artola *et al.,* 2018). Consequently, there would have been no water column available for a harbour from tide to tide in the lower reach of the Arroyo de las Villas.

The maritime harbour of Baelo Claudia

This methodology using sedimentary cores and palaeoenvironmental analyses was also applied along the shore (figure 3, green dots). Data will be published soon (Salomon *et al., in prep*.), but two results regarding the Roman harbour issue in Baelo Claudia are presented here. First, stratigraphies extracted under the sandy beach sediments at the foot of the Lower City of Baelo Claudia did not reveal dark fine sediments from the Roman period. These deposits would have been an indicator of a calm and protected environment that could have been related to a lagoonal or enclosed harbour environment (Goiran and Morhange, 2003; Marriner and Morhange, 2007). Second, pre-Roman deposits have been found until the current mean sea level. It corroborates results from Alonso Villalobos *et al.,* (2007). It suggests that this area was not offering a deep enough water column for ships to reach the Lower City.

These results contradict the discovery of mooring stones discovered between the Lower City of Baelo Claudia and the beach already mentioned (Bernal-Casasola *et al.,* 2017, 329-334, Fig. 12). As the mooring stone seem close to their original place, they would have been used (1) during high tides only, (2) to facilitate beaching, or (3) to attach boats actually mooring seaward through long ropes. The mooring stones could also have been transported far from their original place by natural (e.g. high energy event(s) like storms or tsunamis - Reicherter *et al.,* 2022), or anthropic factors (e.g. reuse of the stone for a later structure), though it does not seem to be the case (mooring stone finds exactly in front of the maritime façade). In could also be possible that a harbour would have to be found seaward and more geoarchaeological investigation would be necessary.

Mechanical and manual archaeological soundings: main results

Finally, in 2018 nine mechanical and manual archaeological soundings were opened in the modern beach[5]. The soundings followed a line, 350 m long, between the Southern Building XIII in the east to the Maritime Baths in the West (Fig. 6 A). Some soundings did not yield any finds (S. 35 and S-39) and others resulted only in the identification of Roman construction materials and pottery in secondary position (S. 34 and S. 36). In addition to this, the main results were:

- Masonry cut walls running N-S (Fig. 6 B), probably corresponding to those which project southward from Southern Building XIII (S. 41).
- Identification, as said before, of a second mooring stone in secondary position, but very close to the southern wall, where it may have been originally placed (S. 38). Is lithological and typologically similar to the other one (Fig. 2), with an oblique hole; this indicates that the other stone was not an isolated find, but that these elements must have been a common feature in *Baelo Claudia* seaward façade.
- A possibly anthropic level to fix the dune system *extra moenia* (S. 40), with a clayey matrix, south of *Cetaria* XII (Fig. 6 C), perhaps the remains of the ramp identified in previous works (Alonso *et al.,* 2007).
- Structures found *in situ* but badly preserved, south of the modern mouth of Arroyo de las Villas, which can perhaps be interpreted as a retaining wall for a platform which would mark the sea-land interface in this area (northern part of S. 37).
- Several large blocks of sandstone, partially displaced but keeping a general E-W orientation (Fig. 6 D). The lithology of some of them is clearly foreign (Fig. 6 E). They seem to be related with the foundation of a harbour structure situated *c*. 20 m from the wall, in an area exposed to flooding (S. 42).

[5] They were numbered 34 to 42, following the nomenclature used by Universidad de Cádiz in their excavations in the southern front of the city.

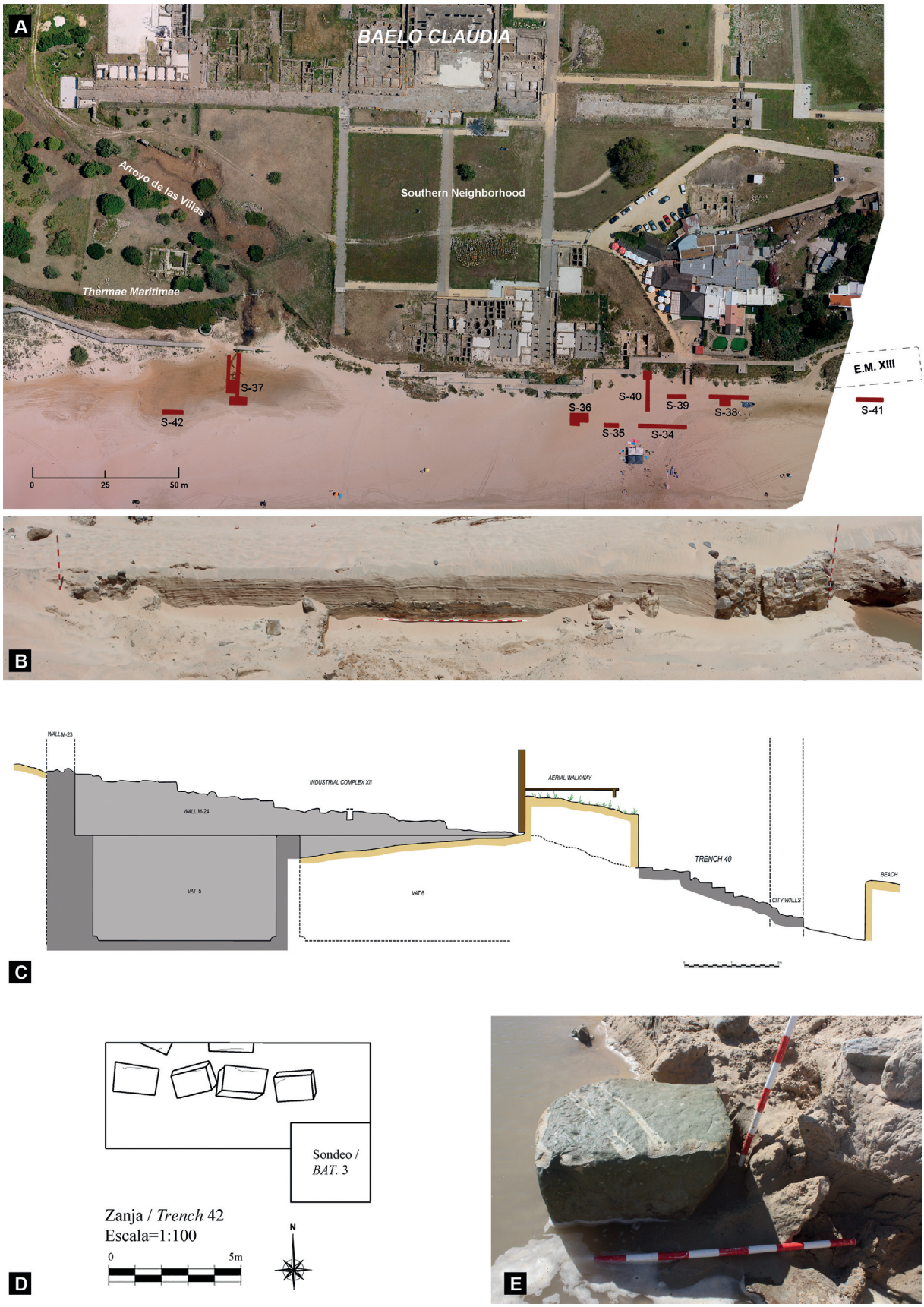

Fig. 6. Location of archaeological trenches opened in the beach of *Baelo Claudia* (A), with the finds in S. 41(B), S. 40 (C) and aligned masonry blocks in S. 42 (D and E).

These finds confirm the existence of Roman constructions under the northern area of the modern beach. They are heavily altered by the sea dynamic and recent human action.

In conclusion, our understanding of the harbour structures of *Baelo Claudia* remains very partial:

the southern wall must have played a very active role according to the mooring stones. While the configuration of the area is still unclear, we confirmed that no navigable natural lagoon existed during the Roman period. Based on the available data and considering basic needs for such an important port, we would suggest that smaller boats were pulled on the beach and that at least a strong enough wooden wharf was built perpendicular to the coast to reach deeper waters (Fig. 7).

Fig. 7. Illustration of the southern sector of *Baelo Claudia* (*Cetaria* XII and Street of the Columns), with the sea-land interface (2020, drawn A. Álvarez Marsal, with the advice of Bernal-Casasola, Díaz and Expósito).

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