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The harbourscape of Gades: An archaeological and geoarchaeological state-of-the-art

Dario Bernal-Casasola, Ferréol Salomon, José Juan Díaz, Macarena Lara, Gilles Rixhon

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ENTRE MARES

Emplazamiento, infraestructuras y organización de los puertos romanos

Mertxe Urteaga
Antonio Pizzo
(Eds.)



Volumen II



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organización de los puertos romanos*

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THE HARBOURSCAPE OF *GADES*: AN ARCHAEOLOGICAL AND GEOARCHAEOLOGICAL STATE-OF-THE-ART

El paisaje portuario de *Gades*: un estado del arte arqueológico y geoarqueológico*

Dario Bernal-Casasola**, Ferréol Salomon***, José Juan Díaz**, Macarena Lara**, Gilles Rixhon****

Resumen

Gadir/Gades, fue, sin dudas, la ciudad portuaria más importante del Mediterráneo Occidental en diacronía, desde momentos fenicios arcaicos hasta al menos época antonina o primo-severiana. Estudios de los últimos años han permitido la actualización de nuestro conocimiento sobre su sistema portuario, cuya síntesis, con nuevos datos, se presenta en estas páginas. En primer lugar, se analizan los embarcaderos romanos conocidos en la bahía, que son dos actualmente (“Los Cargaderos”, de época flavia, una plataforma en el saco interior de la bahía realizada con ánforas reutilizadas; y el “Depósito de Tormentas”, una zona de interconexión de la costa norte de la isla *Antipolis* - actual San Fernando- con el litoral entre época tardopúnica y el Alto Imperio). Y en segundo término, analizando y discutiendo las evidencias del puerto principal de Cádiz, tan importante en el comercio de redistribución atlántico-mediterráneo. Por un lado, los datos aportados por las fuentes clásicas (Estrabón básicamente), que aluden al famoso *Portus Gaditanus* construido por Cornelio Balbo el menor en la zona continental, y a un dique existente en el puerto urbano, desde el cual Posidonio estudió las mareas. En segundo término, las evidencias arqueológicas conocidas, antiguas y recientes, que permiten aproximarnos a la antigua fisonomía del puerto y de sus infraestructuras terrestres asociadas: desde el importante faro (o faros) de Cádiz, conocido por grafitos de época tardorromana (s. V d.C.) y citado recurrentemente por fuentes medievales cristianas e islámicas (ss. VIII-XIV); pasando por algunas excavaciones preventivas que han permitido verificar la existencia de orillas monumentalizadas entre las islas (resultado de la llamada *cura riparum*); al hallazgo reciente del llamado Testaccio haliéutico de Gades, un vertedero periurbano gestionado por el *municipium*, muy vinculado a los menesteres portuarios. Especialmente relevantes son las investigaciones geoarqueológicas de los últimos años bajo el Edificio Valcárcel, frente a la playa de La Caleta, que han permitido renovar el conocimiento de la paleotopografía del archipiélago, manteniéndose actualmente el carácter insular de la ciudad a lo largo de toda la Antigüedad, con las estructuras portuarias a ambos lados del estrecho interinsular que separaba la isla mayor (*Cotinusa*) de la menor (*Eritia*); y habiendo descubierto la existencia de un importante archivo sedimentario muy profundo (entre 25 y 50 m de profundidad bajo la rasante actual) plagado de evidencias arqueológicas y ecofactos, en fase de estudio actualmente.

Palabras clave: sistema portuario, *portus gaditanus*, faro, embarcaderos, testaccio haliéutico, sondeos geoarqueológicos.

Abstract

Excavated at the beginning of the 20th century, the port of Delos has recently been the subject of new studies (archaeological soundings, geophysical and electromagnetic survey, sedimentological coring and architectural studies) which have questioned the restitutions initially proposed. The sea level has risen by 2.50 m since antiquity and the main basin of the “sacred port” had no moles or quays. Although the port infrastructure of the main eastern Mediterranean emporion in the 2nd-1st century BC appears to have been very modest, it had many commercial buildings built around a courtyard with one storey: they were intended for the storage of goods in transit, for sales, for administration and perhaps for temporary accommodation. *Gadir/Gades* was undoubtedly the most important port city in the Western Mediterranean in diachrony, from the Phoenician Archaic period to at least the Antonine or early Severan times. Studies in recent years have made it possible to update our knowledge of its port system, a synthesis of which, with new data, is presented in these pages. Firstly, we analyse the Roman wharfs known in the bay, of which there are currently two (“Los Cargaderos”, from the Flavian period, a platform in the inner area of the bay made from reused amphorae; and the “Depósito de Tormentas”, an area of interconnection of the north coast of the island of *Antipolis* - now San Fernando - with the bay between the Late Punic period and the High Empire). And secondly, by analysing and discussing the evidence of the main port of Cadiz, so important in the Atlantic-Mediterranean redistribution trade. On the one hand, the data provided by classical sources (basically Strabo), which allude to the famous *Portus Gaditanus* built by Cornelius Balbus the younger on the mainland, and to an existing dyke in the urban port, from which Posidonius studied the tides. Secondly, the known archaeological evidence, ancient and recent, which allows us to approach the ancient physiognomy of the port and its associated land infrastructures: from the important lighthouse (or lighthouses) of Cadiz, known by graffiti from the late Roman period (5th century A.D.) and recurrently cited by medieval Christian and Islamic sources (8th-14th century A.D.); through some rescue excavations that have allowed us to verify the existence of monumentalised shores between the islands (the result of the so-called *cura riparum*); to the recent discovery of the so-called *Haliéutico Testaccio* of Gades, a periurban rubbish dump managed by the *municipium*, closely linked to port activities. Particularly relevant are the geoarchaeological investigations carried out in recent years under the Valcárcel Building, opposite the beach of La Caleta, which have renewed our knowledge of the palaeotopography of the archipelago. The insular nature of the city throughout antiquity has been maintained, with the port structures on both sides of the inter-island strait that separated the larger island (*Cotinusa*) from the smaller one.

Keywords: port system, *portus gaditanus*, lighthouse, wharfs, haliéutico testaccio, geoarchaeological surveys.

* Traducción realizada por los editores.

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Location and state-of-the-art¹

Cádiz's archaeological context is exceptional as it was one of the most important harbours between Mediterranean and Atlantic shipping routes during the Roman period (Reddé and Golvin, 2008, 88-89) and also, for centuries before, since the Phoenician-Punic period (Botto, 2014). It was the capital of the *conventus Gaditanus*, one of the four administrative units into which the *provincia Baetica* was divided in the Augustan period, and this emphasised its administrative, legal, and naval importance for the territories of Modern Andalusia, whose governance revolved around the city during Antiquity. Its strategic location, at the gates of the Atlantic, in one end of a wide gulf (Fig. 1), made for an ideal harbour that became a central piece in ancient narratives of the conquest of the Ocean and naval exploration outside the *Mare Nostrum* (Millán, 1998). Its position as main hub for the redistribution of commercial goods is also reflected in multiple archaeological indicators.

Like in any historical city in which harbour activities have remained intense until nowadays, archaeological layers from Antiquity are buried under more recent sediments and features. Therefore, one of the few ways to increase our understanding of the operation of the ancient harbour is through geoarchaeological analyses, which began here decades ago (Arteaga *et al.*, 2001; Arteaga and Roos, 2002). The insular nature of Cádiz, however, makes paleo-topographical and geoarchaeological analysis extremely difficult; of all the islands of the archipelago, the three largest ones (Cotinusa, Eritía and Antipolis) were the most intensely occupied (Fig. 2). The topography and urban layout of ancient *Gadir/Gades* are still poorly understood accordingly, in spite of more than one century of archaeological research and recent substantial progress (Lara, 2019; Lara and Bernal-Casasola, 2022). A few notable buildings are the exception, such as the famous *Theatrum Balbi* and the spectacular early imperial necropolis (Bernal-Casasola and Lara, 2012).

Reconstructing *Gadir/Gades*'s harbourscape: evidence and typology of harbour structures

In the following study we shall briefly review the available pieces of evidence related to port and/or harbour structures. More details can be found in Bernal-Casasola (2012 and especially 2022). Each evidence is presented deductively, from the general to the particular, moving from the Bay of Cádiz as a whole, which is the broader geographical framework that defines *Gadir/Gades*'s harbour system, to the evidence available for urban harbour structures (Fig. 3).

Network of secondary mooring points in the bay

As pointed out many years ago (Pemán, 1959), the numerous production sites found in the Bay of Cádiz (e.g., *villae*, *campi salinarum*, amphorae-producing *figlinae*, farming areas...) needed the redistribution hub of *Gades* as an outlet for their respective products. For this reason, most of them must have had their own mooring facilities. Two sites pertaining to this model are known so far but many similar sites should have probably existed. First, there is the "Los Cargaderos" site, whose toponym clearly refers to loading and offloading practices in the of Sancti Petri channel connecting the Atlantic Ocean to the Bay. The excavation of the site identified mooring features dated to the Flavian period, i.e., reused amphorae, arranged and fitted to one another in horizontal rows, and reinforced with timber, to form a draining platform (Bernal-Casasola *et al.*, 2006). Second, the so-called

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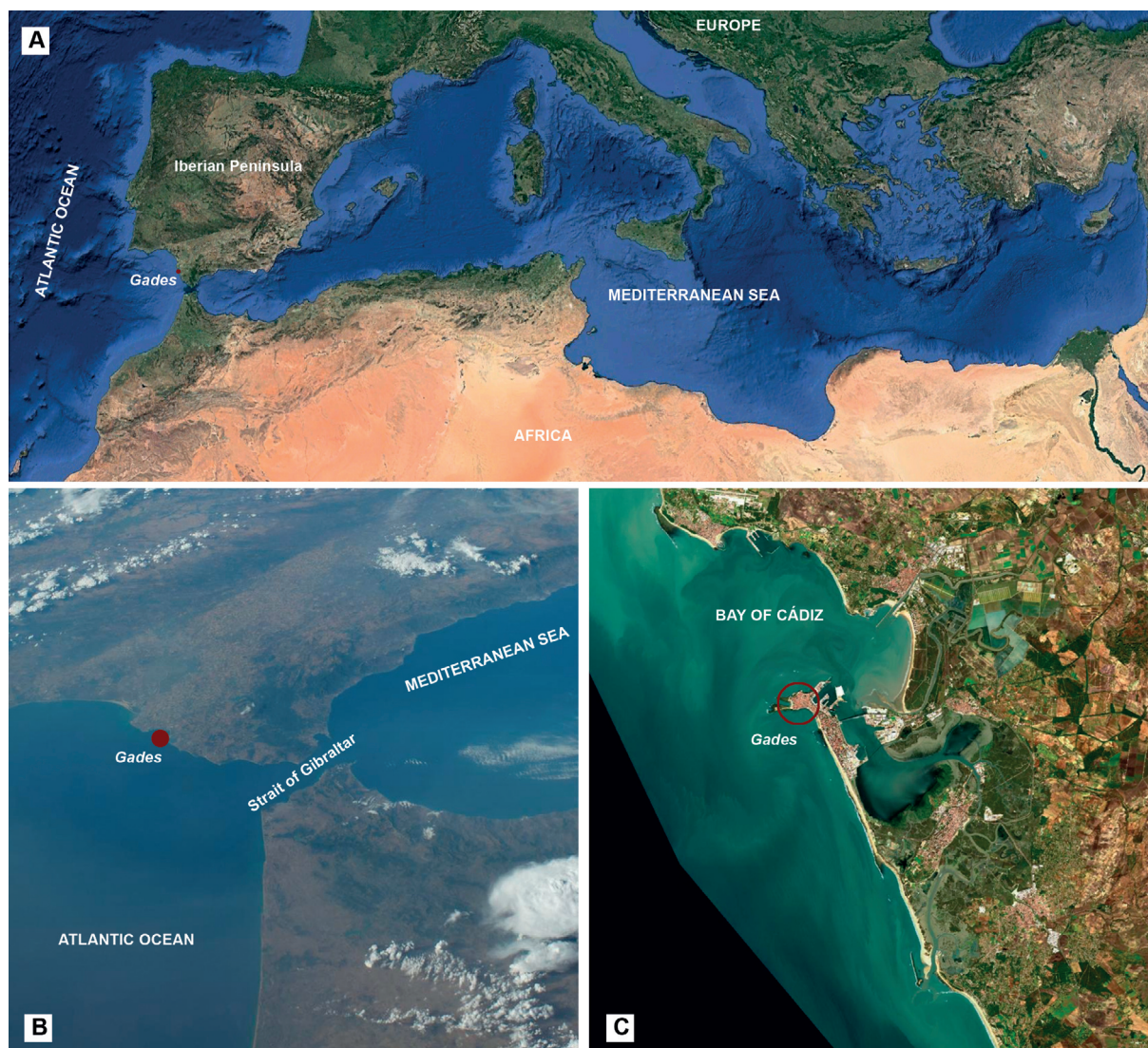


Fig. 1. Location of Cádiz in the confluence between the Mediterranean and the Atlantic (A) and within the Strait of Gibraltar (B), and detail of the location of the city within the Bay of Cádiz (C; remake of satelital images from Google Earth, Nasa & IGN).

“Depósito de Tormentas” (San Fernando) was identified during a rescue excavation inside the Bay (Lorenzo, 2016) as a loading and offloading area ranging from the 2nd century BC to the 2nd century AD. This area channelled cargoes from the northern shore of *Antipolis*, and its excavation yielded numerous barnacle-covered ceramic remains and a lead sounding line, which confirms the nautical activity in the area (Bernal-Casasola *et al.*, i.p.). Many other locations, such as Coto de la Isleta and Puente Melchor, may have had similar features.

The *Portus Gaditanus* according to the written sources

The enigmatic *Portus Gaditanus* was built by the Cádiz-born Lucius Cornelius Balbus the younger within the framework of the urban reorganisation of *Gades* in the Augustan period, as expressed by Strabo: “Originally, the city in which they lived (Cádiz residents) was extremely small, but Balbus the Gaditanian, who received the honours of the triumph, added another to it which they call the New Town. These two form the city of Didyme (...). However, few in comparison inhabit either this or the sea-port which Balbus constructed for them in the opposite continent” (Strabo, Geography, 3, 5, 3). In the wake of this statement, which suggests that the so-called *Portus Gaditanus* was not built on an

island but on the continental shore. Many scholars have located at what is today the historical district of the city of El Puerto de Santa María, where Roman archaeological remains abound (Chic, 1983; López and Pérez, 2013), although other alternatives have been sought (Rimbaud, 1996), but always on the continent.

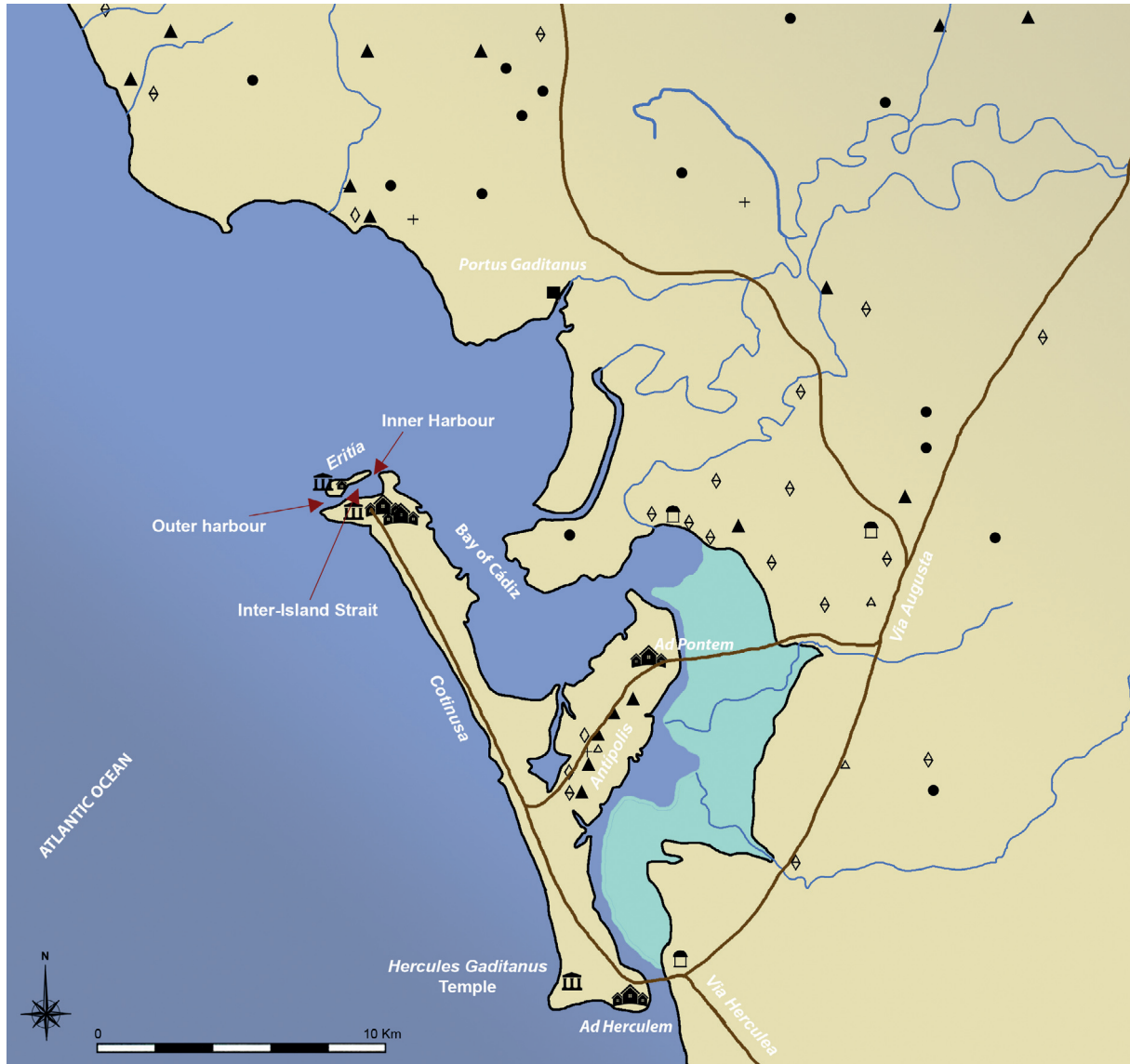


Fig. 2. Schematic plan of the Bay of Cádiz, with the three islands separated by the “canal bahía-Caleta” or inter-island strait (B).



Fig. 3. General view of the Bay of Cádiz, with the main features in *Gades's* harbourscape (remake of satellite images from Google Earth).

About the double urban harbour: “Inner” and “Outer” separated by the “Interisland strait”

Gades’s paleo-topography sprawls over two islands: the northern end of Cotinusa, the largest of the two, and the whole area of Eritía, the smallest. They are separated by a strait, traditionally called “canal Bahía-Caleta” or “Canal de Ponce”, leading to the existence of two harbour areas. The so-called “outer” harbour is located between the two promontories on which the castles of San Sebastián and Santa Catalina were later built. It faced the ships arriving from the *Mare Nostrum*, although today’s coastline profile has much changed because of wave dynamics (Fig. 4A). The “inner” harbour, facing the Bay and much more sheltered from winds, currents, and tides, is the location of the modern port of Cádiz (Fig. 4B). During the Antiquity, both harbours were connected by the so-called “interisland strait”, as recently confirmed by geo-archaeological survey in the Edificio Valcárcel. This study has demonstrated that this channel, between 100 and 400 m wide, was subject to intense naval traffic in the Phoenician, Punic and Roman periods: the bottom of the channel is formed by a 25 m-thick layer of rich archaeological deposits (Bernal-Casasola *et al.*, 2020; 2021 a and b; Salomon *et al.*, 2020).

About the *cura riparum*: monumental access to the channel from the shore

Understanding the sea-land interface in Cádiz is not easy because the whole historical district of the city is surrounded by early modern defensive walls (Calderón, 1976). This problem can be partially solved by studying historical maps, which indicate that the coast was made up of alternating cliffs and small coves or palaeo-beaches. Some of the latter have been archaeologically identified in c/ San Rafael 49-51 – dated to around the turn of the era (Pajuelo *et al.*, 2012) – and in the nearby El Olivillo – dated to the late republican period (Gracia, 2019). Like in many marine or riverine areas, including Rome itself, the banks were monumentally built up. Two of these structures have been clearly identified in Cádiz: in Mercado Central and especially 96-98, Sagasta street, where a monumental porticoed breakwater gave direct access to the between-islands strait (Bernal, 2012). The question whether *Gades* had specific magistrates to manage the *cura riparum* -or similar-, as it was the case in the Guadalquivir River (González, 2017), or if this function was undertaken by local urban magistrates, remains open.

The *Gades*’s harbour’s dike

Strabo, again, informs us that the Roman harbour of Cádiz had a built dike: “Posidonius tells us that ... he himself passed many days in the temple of Hercules at Gades... but could not see anything of these annual irregularities. However ... the basement of the temple in the enclosure dedicated to Hercules, and the top of the mole protecting the harbour of Gades, were not covered higher than 10 cubits...” (Strabo, Geography, 3.5.9). Due to fragmentary archaeological evidence, its emplacement hitherto remains unknown although a location in the “inner” harbour (Bernal-Casasola, 2012, 230, Fig. 11.3), perhaps in the shores of Cotinusa, where the early modern port was constructed, is hypothesized (Bernal-Casasola, 2022).

The halieutic Testaccio: an unexpected finding

Renovation works undertaken by the University of Cádiz in the Edificio de Transferencia Empresarial of El Olivillo led to the identification, nearby the southern shore of Eritía, of a large artificial mound used for the selective recycling of waste from the harbour and the nearby fish-salting factories. This large suburban garbage dump was still represented in urban plans as late as the 18th century, before the construction of the urban district of Balón. While six metres of the original stratigraphy are still preserved, its original height may have reached 25 to 30 m over a surficial area exceeding a half or around an hectare (Bernal-Casasola and Vargas, 2019). The chronology of the site spans the period from Corneli Balbi (75-50/40 BC) to Nero’s reign. The top part was wiped out by early modern and

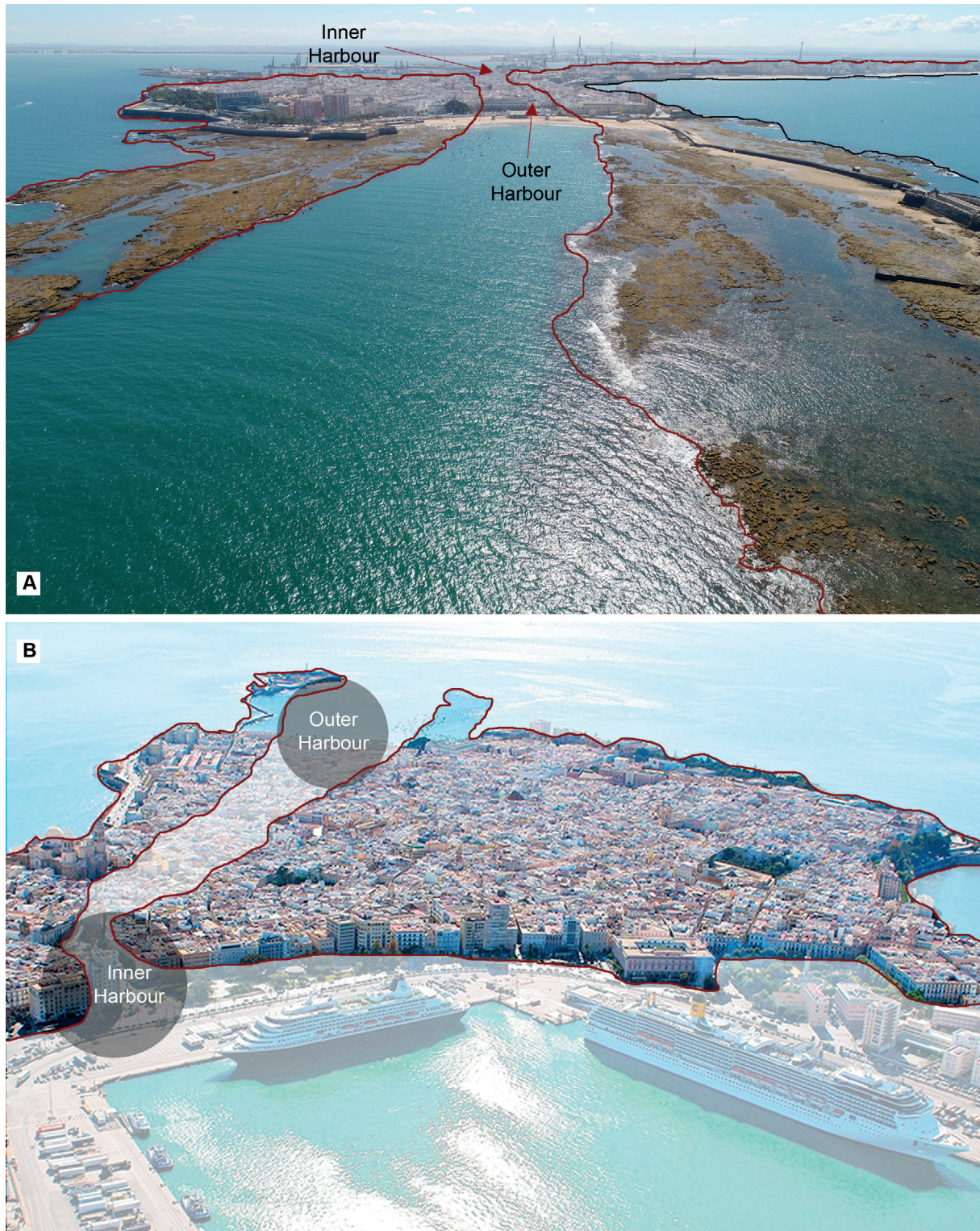


Fig. 4. Aerial views of Cádiz from the outer sea (A) and from the inner part of the Cádiz Bay (B) with the location of the “outer harbour” near the modern beach of La Caleta, and the “inner harbour”, which coincides with the location of the modern one.

modern constructions. The similarities with *Mons Testaccio* at Rome, after which it was named, are obvious, including the retaining walls built with amphora sherds, which also form most of the fill (Bernal-Casasola and Vargas, 2022). From a harbour perspective, its size must have had an effect on navigation (used as a signal for navigational purposes?), as it must have been visible from afar, especially considering the numerous intentional fires attested by the excavations. They are interpreted as a strategy to burn organic waste from the fish-salting factories to prevent sanitary problems (Fig. 5A).

Indirect evidence of the lighthouse (¿or lighthouses?)

Lighthouses are an essential feature for all major harbours, and *Gades* must not have been an exception. No archaeological remains of such a building have been found to date, but some indirect, yet substantial, evidence points in this direction. First, there are two pencil drawings, dated to the late 5th century AD, found on the walls of an abandoned cistern in a *cetaria* in the southern shore of Eritía (former location of Teatro Andalucía), in the central area of the strait (Cobos, Muñoz and Perdignes, 1997; Cobos, Mata and Muñoz, 2017). Currently on display in the city museum, these drawings clearly depict two terraced buildings (Fig. 5B). Whereas the first one exhibits twelve storeys and the top structure, accessed through a flight of steps from near the shoreline (i.e., very close location to a small boat on the sea), projects a beam of light, the other has three reticulated storeys. This led Bernal-Casasola (2009) to suggest that there were not one but two lighthouses in Cádiz. Numerous Christian and Islamic medieval texts dated to between the 8th and 14th centuries – which have attracted a good deal of scholarly attention (Fear, 1993; Ordóñez, 1993) – are in line with this as they mention the city’s “tower” or “idol”, in clear reference to the old Roman lighthouse, dismantled in Late medieval period.

Deep geoarchaeological drillings in the strait (Edificio Valcárcel): an exceptional sedimentary sequence

Recent geoarchaeological survey at Edificio Valcárcel (i.e., the results are still being processed), has led to the reassessment of the paleo-topography of the islands: 50-m deep soundings have revealed the existence of hitherto unknown harbour sediments between 25 m and 50 m below the current urban surface. These sediments bear witness to the intense maritime traffic in the area from the Protohistory to well into the Imperial period. These studies have also ruled out a long-held idea, by demonstrating that the strait remained open and active, allowing for the passage of ships between Cotinusa and Eritía throughout the antiquity. This has entirely changed our view of the cultural-maritime landscape of *Gadir/Gades*, forcing the re-examination of important aspects, such as urban physiognomy and maritime traffic in the bay.

Of the six cores drilled in the area, ongoing studies on VAL-Core 2 show very interesting results in terms of chrono-stratigraphy and associated age-depth model.

Six stratigraphic units have been identified (Fig. 6). Radiocarbon dates were re-calibrated with IntCal20 (Reimer *et al.*, 2020) comparing to previous publications (Bernal-Casasola *et al.*, 2020 a; 2021; Salomon *et al.*, 2020). Unit A (41.20 to 32.20 m b.s.l.) corresponds mainly to dark grey silty sand intercalated with layers with finer (sandy silt) or coarser material (pebbles). Some ceramics were discovered in this lower unit. This lower unit was dated to the Phoenician-Punic period based on radiocarbon dates (2450 ± 30 calibrated to 754-412 BC and 2400 ± 30 BP calibrated to 733-397 BC) and a thermoluminescence date (2868 ± 191 before 2018). Unit B (32.20 to 20.20 m b.s.l.) is composed of grey sandy silts to coarse sands. Many artefacts dated at least from the 4th BC and the 2nd c. AD were discovered in this unit. The upper part of this unit was dated to the Imperial Roman period (1890 ± 30 BP calibrated to 76-231 AD). A sharp change occurs at 20.20 m b.s.l. Above this limit, Unit C (20.20 to 6.05 m b.s.l.) offer no evidence of ceramics but only well sorted grey sands with thin yellow

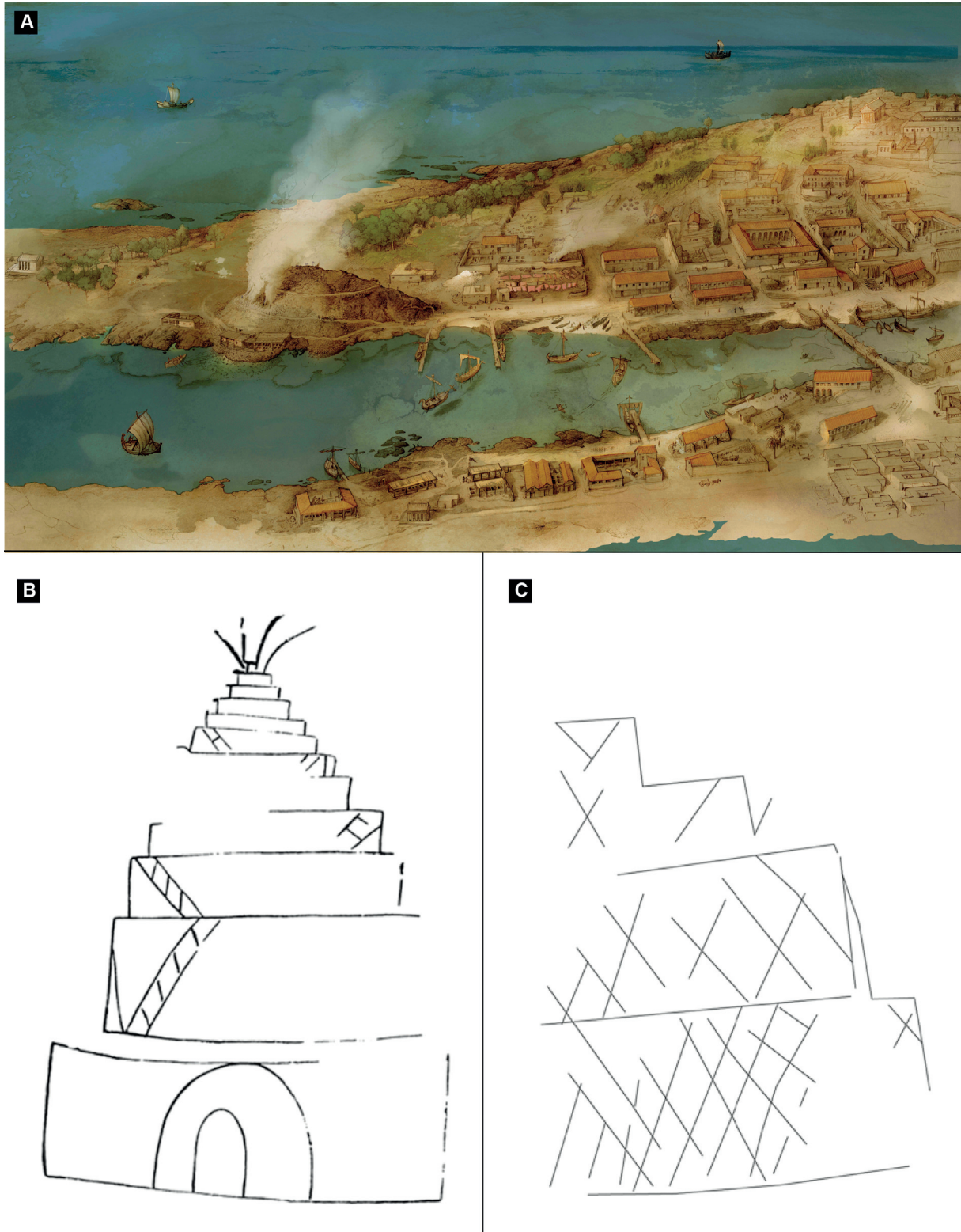


Fig. 5. Proposed reconstruction of the Halieutic Testaccio and the inter-island strait (A.- Scientific drawing by A. Álvarez Marsal, advised by Bernal-Casasola) and rubbings of late Roman pencil drawings of *Gades'* lighthouse(s) from the inner walls of a cistern in the *cetaria* of former Teatro Andalucía (B, C; Cobos, Mata and Muñoz, 2017).

sand layers in the upper part. Unit D (6.05 to 0.70 m b.s.l.) presents yellow to light grey well sorted sands corresponding to nearshore sands. The upper two units (E and F) corresponds to archaeological layers from the modern city of Cadiz (Lara *et al.*, 2020).

Based on mean values of the TL, radiocarbon and archaeological dates, we calculated sedimentation rate in mm/yr: $[(depth\ down) - (depth\ up)] / [(mean\ year\ down) - (mean\ year\ up)]$. Data are presented in Fig. 6 and 7.

Sedimentation rates are generally calculated in geoarchaeology of ancient harbours using simple equations or softwares with more complex computed age-depth models. However, no standard method is used in each studied area. We are reporting here the values proposed by the different authors in order to give a rough estimate. In the fluvial harbour of Ostia (Core PO-2; Goiran *et al.*, 2014), sedimentation rates were estimated from 8.5 to 10.5 mm/yr between the 4th BCE and the 1st CE (Salomon *et al.*, 2016). In the pool of the harbour of Portus (between the darsena, the Trajanic and the Claudian harbour basin) (Core TR-XIV - Goiran *et al.*, 2010), sedimentation rate was estimated to 26.5 mm/yr during the period 250-400 CE (Salomon *et al.*, 2016). However, these two harbours were excavated inland at a maximum of 6-7 m below the ancient sea level (Goiran *et al.*, 2010, 2014), and were probably affected by dredging to maintain a water column deep enough for ship navigation (Salomon *et al.*, 2016). In the eastern Mediterranean, the geoarchaeological study of the harbour of Ephesus revealed quick sedimentation rates of 30 mm/yr from the end of the 2nd c. BCE to the 1st c. CE and decreasing to the 1.6 mm/yr between the 1st and 6th c. CE (Core Eph 276 in Stock *et al.*, 2016). This decrease in sedimentation rate was probably linked to dredging activities as well (Kraft *et al.*, 2011; Stock *et al.*, 2016), in line with Roman inscriptions mentioning these in the harbour of Ephesus (Arnaud, 2020). Archaeological excavations in the ancient harbour basin of Naples allowed reconstructing high-resolution sedimentation rates based on archaeological dates. Along the 6 m-deep stratigraphy dated between the 2nd c. BCE and the 6th c. CE, sedimentation rates exceeded 20 mm/yr during three periods: late second c. BCE, 1st c. CE and 5th c. CE (Morhange and Marriner, 2010). Dredging activities were also suggested at least during the Late Antiquity (Delile *et al.*, 2016). In Marseille, sedimentation rate was estimated to 10-22 mm/yr (Marriner and Morhange, 2006). The site of Marseille is particularly important since three dredging boats were found in the harbour (Pomey and Rieth, 2005).

Thanks to the spectacular depth of the harbour of Cadiz within the city, we may reconstruct more precise sedimentation rates comparing to other Roman harbours. Dredging activities did not reach the deepest parts of the Cadiz's palaeochannel, making the semi-natural harbour of Cadiz somehow unique. The second very important outcome is the possibility to compare sedimentation during the Roman period with that of earlier periods. Interestingly, sedimentation rates were already high in the palaeochannel during the Phoenician period confirming observations from the harbours of Sidon and Tyre (Marriner *et al.*, 2006; Marriner and Morhange, 2006). However, the sedimentation rates estimated in the palaeochannel and harbour of Cadiz should be coupled to the palaeogeographical context to better understand the context of sedimentation. Complementary palaeoenvironmental data are thus currently being processed.

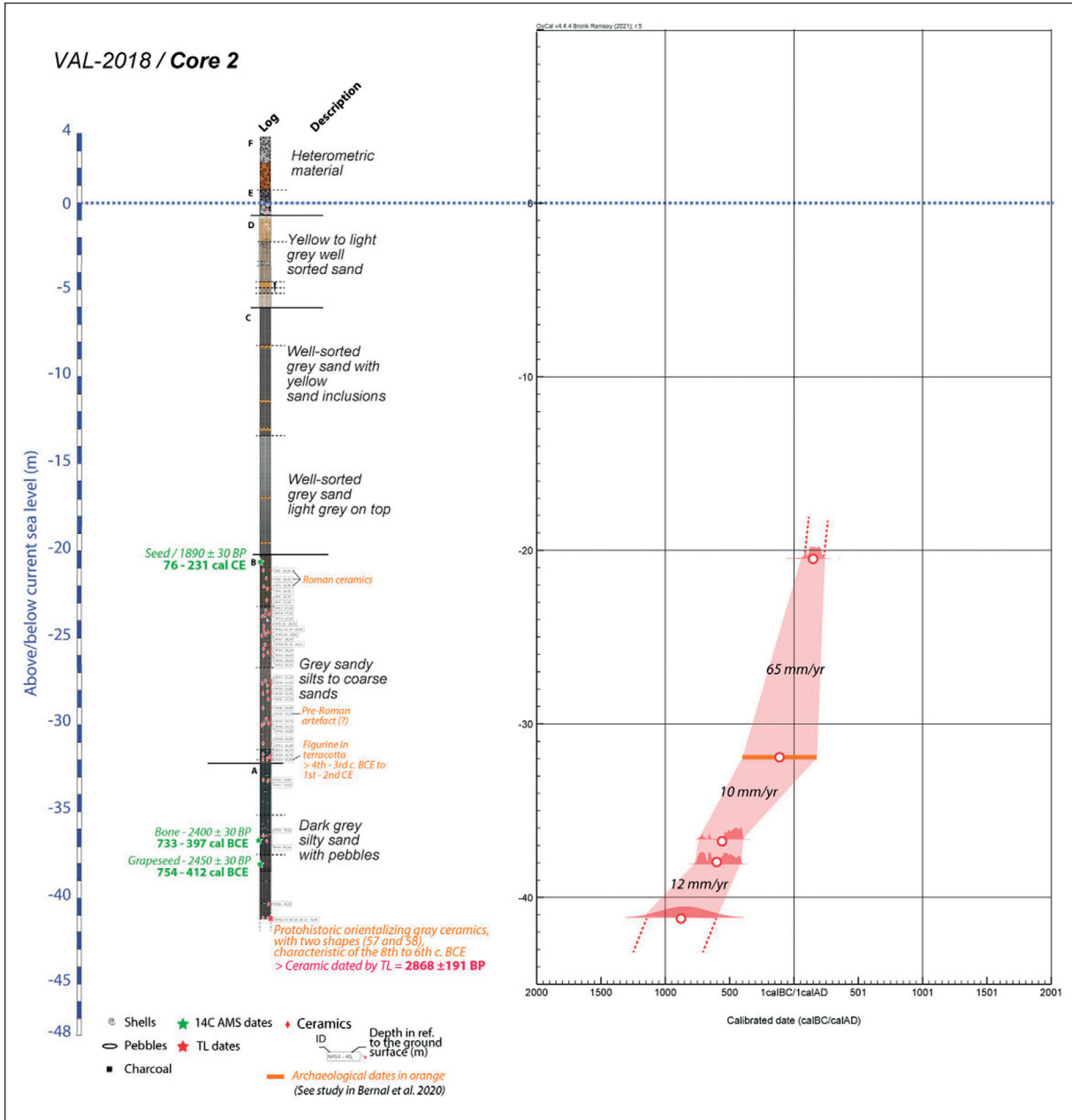


Fig. 6. Sedimentation rate inside the inter-insular strait of ancient Gades (Val – Core 2).

AGES						DEPTHS		SEDIMENTATION RATE (mm/yr)
Dating method	Date (uncalibrated)	Min. date	Max. date	Mean year	Nb. of years btw mean year <i>n</i> and mean year <i>n+1</i>	Depth (m b.s.l.)	Thickness (mm)	
Radiocarbon date	1890 ± 30 BP	-76	231	77.5	177.5	20.48	11520	65
Archaeological date	4th BCE to 2nd CE	-400	200	-100	465	32	4640	10
Radiocarbon date	2400 ± 30 BP	-733	-397	-565	18	36.64	1430	79 (not relevant)
Radiocarbon date	2450 ± 30 BP	-754	-412	-583	267	38.07	3130	12
TL date	2868 ± 191 before 2018	-1041	-659	-850		41.2		

Fig. 7. Estimated sedimentation rate in VAL2018-Core 2.

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