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When archaeological context is lacking. Lithology and spatial analysis, new interpretations of the "verracos" Iron Age sculptures in Western Iberian Peninsula

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A B S T R A C T
The most distinctive productions from Iron Age archaeology in the western part of the Central Iberian Peninsula are large ramparts, and big animal sculptures, both of which were usually made in granite. The latter, known as 'verracos', are representations of male boars and bulls. A characteristic of these 'verracos' is their lack of original context, thus leading to mere speculation regarding their dates and functions. The aim of this paper is to find an answer to this dilemma using archaeometric methods. This document proposes an approach through geochemical and petrological analyses, as well as statistical analyses using variables. Our target tries to recognize any differences in the making of these sculptures that might help explain functional and symbolic changes to help in understanding their unknown original contexts. For this purpose we arranged 84 sculptures by sizes, technical features and anatomical detail using a Correspondence multivariate analysis and, with the results by series, observed their spatial relationship with 34 quarries too, through kernel density applications. In order to know the origins of the stones of each sculpture, we have made geochemical characterization by mineral and chemical analyses of mayor and minor elements. Therefore, we looked for quarries around the finding place of the verracos. When the possible places were found by lithological affinities, we took samples from those, mostly granite rocks. These geochemical and petrological analyses of the sculptures have contributed towards identifying the potential locations of the quarries of origin, which coincide with the analyses of 'verracos' found far away from those quarries and that are completely decontextualized. Therefore, we could obtain least-cost paths distances between quarries and matched sculptures by GIS software (over a digital elevation map) and, then, calculate averages distances per series and quarries. Sizes, shapes and spatial relationships with quarries and nearby oppida, big fortified settlements of Iron Age, allow us to identify oldest verracos as symbols of the emergence of ethnical and communal values, as a result of the impact of the first Mediterranean people arriving to the Spanish plateau, such as the Punic and Roman armies. In this way, big verracos were transported 'till 20 and 30 km away from the quarries. However, with the Roman rule over this region, verracos became smaller and simpler, and displacements were outstandingly smaller. This is related with a change of functions, from protection symbols of the communities to funerary stelae of individual graves.

1. Introduction. 'Verracos', unique pre-roman sculptures

Regarding dimensions and volume, stone productions were the most significant technical work beared by the communities of the Iron Age in the North and West of Spain. The most characteristic productions by the 'Vettones', the inhabitants of the western plateau during the Iron Age according to classical Greek-Latin writers, were the large masonry walls that protected the villages and the large animal sculptures in granite rock (Álvarez-Sanchís, 2010; Rodríguez-Hernández, 2012). These animal sculptures are known as 'verracos', an old Spanish word derived from the Latin verres (wild boar, non-castrated pig, from Proto-Indo-European *wer̥s-*-wrs- "male": WordSense.eu/Dictionary) because they were identified as representations of non-castrated male pigs and bulls (López-Monteagudo, 1989). These animals are always represented in static, seemingly peaceful postures, although this is largely due to the technical limitations of the stone material and of the tools used by the craftsmen who carved them. More than 450 sculptures of 'verracos' have been found scattered throughout the west of the Spanish Plateau and in neighbouring Portugal (Fig. 1), and it is generally accepted that most of them were carved between the fourth century BCE and the first century CE, although only two samples were found in their original contexts of use. Similarly, it is believed that these figures were linked to the sacred protection of livestock, and there are clear indications that these sculptures were used to indicate the best pastures in the valley as well as nearby water sources (Álvarez-Sanchís, 1999, 281–294).

Between the late Iron Age and the first centuries of Roman rule in Spanish Meseta, some of these sculptures were reused as funerary monuments, as Latin inscriptions prove. The 'verracos' were also made in very different sizes and weights, ranging from big Bulls like the ones from Villanueva del Campillo or El Tiemblo, in Ávila, which are over 2 m long and weigh several tons, to small sculptures found in Muelas del Pan (Zamora), that are just over 30 cm long and only weigh a few kilograms.

Indeed, the 'verracos' were an essential part of the Vettones' landscape. They were used as a way to organize the territory in regions where there was a high population density and, at the same time, the sculptures may have symbolized both a community rich in resources, as well as the social value of some of its members in the first Roman settlements (Álvarez-Sanchís, 2003, 92–97). These different contexts and shapes help us to identify propose technical traditions, and the different artisans that made them.

Among the Iron Age Hispano-celtic population, stone sculptures are rare and date from a later period (most of them contemporary to the Roman era), and hardly any documentary evidence exists of animal figures (Schattner, 2003; Arnold and Alberro, 2005-2006). The 'verracos' are therefore a unique manifestation and so have been interpreted as a technical and conceptual technique learned from the Iberian people, who inhabited the Spanish Mediterranean coast from the late sixth century BCE (Álvarez-Sanchís, 1999, 262–263). Because the original contexts regarding the use of these boar and bull sculptures are usually unknown, it is very difficult to establish a definite chronology and functions.

Furthermore, a quick historical and ethnographic approach confirms that many of them were removed in medieval and modern times, although others were never moved from the place where they were carved, simply because they are still part of the area's stone outcrop substrate. We are therefore working in a scenario of the most likely guess.

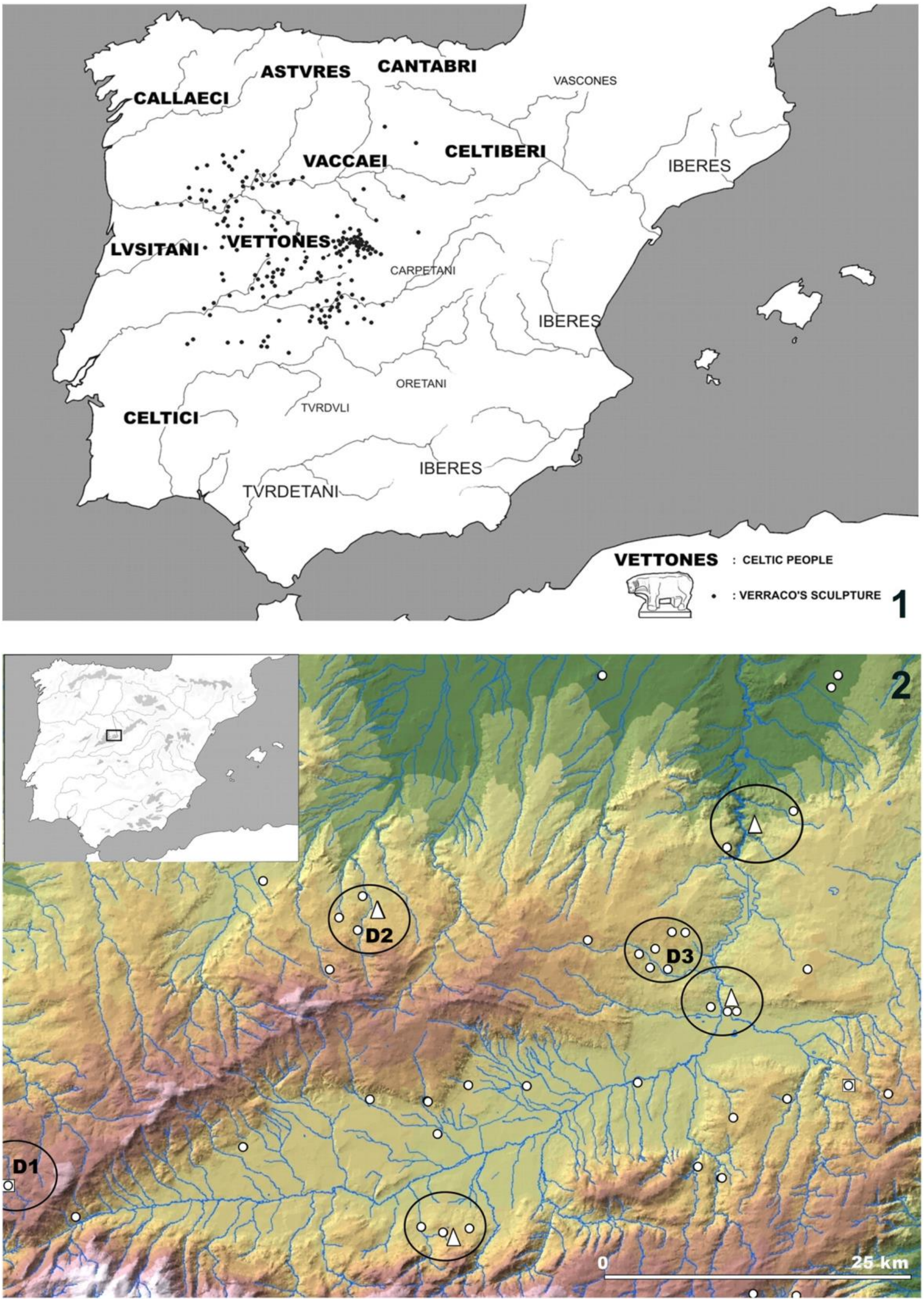


Fig. 1. 1. Pre-roman peoples and verracos in the Iberian Peninsula; 2. Region of "Valle Amblés" at the province of Avila, Castile, Spain: circles, verracos sculptures; triangles, main oppida from Iron Age; ellipses: general archaeological contexts.

Therefore, this article proposes using geochemical techniques to identify the quarries used to carve the 'verracos'. Following this line of research, a new path of knowledge can be determined to understand their original contexts of use, and accept or reject the alleged meanings of these, so far, mysterious sculptures. Our hypothesis proposes a combination of geochemical analyses, microwear observations, Correspondence analysis and Kernel density ordinations and a detailed spatial analysis to enable pattern matching in the production of these sculptures. Results are used to support the argument that there were different spread patterns according to itinerant craftsmen, authors of the sculptures made in blocks from nearby quarries or on the stone outcrop itself, but also patterns according to the existence of truly specialized workshops that were like factories, where the sculptures were carved using standardized processes. In both cases the sculptures were produced in different shapes and sizes and with different geochemical characteristics. These would be related to a shift from the communal values of the first 'verracos' to the individual funeral uses of the latter monuments of the Roman Empire (Ruiz-Zapatero and Álvarez-Sanchís, 2008).

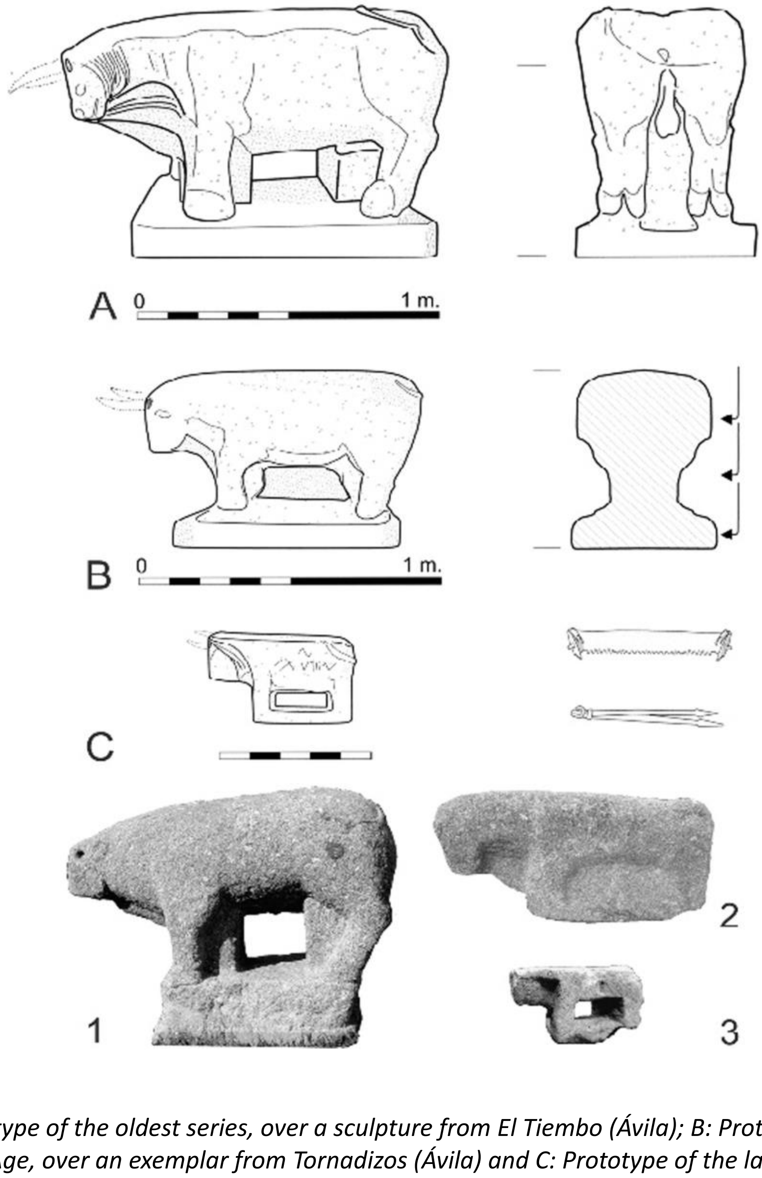


Fig. 2. A: Prototype of the oldest series, over a sculpture from El Tiembo (Ávila); B: Prototype of the series fromLate Iron Age, over an exemplar from Tornadizos (Ávila) and C: Prototype of the latest verracos, over an exemplar from Muelas del Pan (Zamora); 1. Bull from Castillo de Bayuela (Toledo); 2. Bull from Santa María del Arroyo (Ávila); 3. Bull from Villalcampo (Zamora), all of them at similar scale.

2. Preliminary discussion: what really was a 'verraco'?

Landscape archaeology allows for different interpretations of the functions of these sculptures. By studying certain regions, of special interest due to the large number of samples located in them, as well as archaeology from Iron Age and Roman settlements, it was possible to propose these functions over several centuries of use: thus, in Valle Amblés, a natural region north of the high mountains of Gredos, more than a hundred 'verracos' and four well-known oppida, the biggest Iron Age fortified settlements, have provided a good case study (Álvarez-Sanchís, 2003, 45–46). There, three different types of distribution of the 'verracos' have been identified (in Fig. 1.2): first, isolated figures ("D1") placed in surroundings with significant resources, mainly rich meadows, water sources and waypoints or crossways. It is important to highlight that these 'verracos' closely match those with more realistic features, which are also the largest and are considered to be the oldest.

LEGEND. Dichotomous values and quantitative/qualitative equivalents.

Measures values and ranks in cm.	Body cutting	Head cutting	Head detail	Back cutting	Anatomical Details	Posture	Pedestal	Species
00000000000001 = >280 <300	00001 = Complex	0001 = Complex	0001 = >2 elem.	0001 =Complex	00001 = > 4 elem.	001=Complex	00001= L.pill.	01 = Boar
00000000000010 = >260 <280	00010 =.Pyromorph	0010 = Triangular	0010 = 2 elem.	0010 =In angle	00010 = 4 element.	010= Attack	00010= C.pill	10 = Bull
00000000000100 = >240 <260	00100 = Cylindrical	0100 = Rectangular	0100 = 1 elem.	0100 =Plain	00100 = 3 element.	100= Static	00100= Solid	
00000000001000 = >220 <240	01000 = Subprism.				01000 = 2 element.		01000= Simple	
00000000010000 = >200 <220	10000 = Prismatic.				10000 = 1 element.		10000= Absence	
00000000100000 = >180 <200								
00000001000000 = >160 <180								
00000010000000 = >140 <160								
00000100000000 = >120 <140								
00001000000000 = >100 <120								
00010000000000 = >080 <100								
00100000000000 = >060 <080								
01000000000000 = >040 <060								
010000000000000 = >020 <040								

VALUES' FREQUENCY per VARIABLES for SERIES "A": 16 cases

n_v Dichotomous values	Lenght	Widht	Height	BodyCutting	Head Cutting	Head Detail	Back Cutting	Anatomical Detail	Posture	Pedestal	Species
	f_x	f_x	f_x	f_x	f_x	f_x	f_x	f_x	f_x	f_x	f_x
1 = 000000000000001				**14**	**15**	**15**	**16**	**08**	01	**07**	03
2 = 000000000000010	01			01				**07**	01	04	**13**
3 = 000000000000100	**04**		01					01	**14**		
4 = 000000000001000	**02**			01						01	
5 = 000000000010000	**04**										
6 = 000000000100000	01										
7 = 000000001000000	04		02								
8 = 000000010000000		01									
9 = 000000100000000			**04**								
10=000001000000000			**04**								
11=000010000000000			**03**								
12=000100000000000		**12**	01								
13=001000000000000		03									
Total cases	16	16	15	16	15	15	16	16	16	12	16

VALUES' FREQUENCY per VARIABLES for SERIES "B": 68 cases

n_v Dichotomous values	Lenght	Widht	Height	BodyCutting	Head Cutting	Head Detail	Back Cutting	Anatomical Detail	Posture	Pedestal	Species
	fx	fx	fx	fx	Fx	fx	fx	fx	fx	fx	fx
1 = 000000000000001				**30**	**51**	**31**	**35**	15		**26**	**30**
2 = 000000000000010	04			19	08	**27**	**29**	**33**	16		**38**
3 = 000000000000100				06	03	02	04	18	**52**	02	
4 = 000000000001000				13				02		10	
5 = 000000000010000	04									03	
6 = 000000000100000	05										
7 = 000000001000000	**17**		01								
8 = 000000010000000	**16**		04								
9 = 000000100000000	**13**		02								
10=000001000000000	04	01	**13**								
11=000010000000000	02	03	**25**								
12=000100000000000	02	09	09								
13=001000000000000	01	**47**	06								
14=010000000000000		07									
Total cases	68	67	60	68	62	60	68	68	68	41	68

VALUES' FREQUENCY per VARIABLES for SERIES "C": 66 cases

n_v Dichotomous values	Lenght	Widht	Height	BodyCutting	Head Cutting	Head Detail	Back Cutting	Anatomical Detail	Posture	Pedestal	Species
	fx	Fx	fx	fx	fx	fx	fx	fx	fx	fx	fx
1 = 000000000000001						01				03	06
2 = 000000000000010					18	**27**	07	03	03		**60**
3 = 000000000000100					**31**	**21**	**59**	**22**	**63**	**23**	
4 = 000000000001000				23				**39**		12	
5 = 000000000010000				**43**				02		02	
6 = 000000000100000											
7 = 000000001000000	02										
8 = 000000010000000	02										
9 = 000000100000000	**14**										
10=000001000000000	**24**										
11=000010000000000	09		09								
12=000100000000000	06		**25**								
13=001000000000000	08	**34**	**21**								
14=010000000000000	01	**25**	09								
15=100000000000000		07									
Total cases	66	66	66	66	49	49	66	66	66	40	66

VALUES' AVERAGES per SERIES

Series	Lenght	Widht	Height	Body cutting	Head cutting	Head detail	Back cutting	Anat. detail	Posture	Pedestal	Species
A	> 200 < 220	> 60 < 80	>100 < 120	Complex	Complex	> 2 elem.	Complex	>4 elements.	Static	Lat. pillars	Bulls
B	> 140 < 160	> 40 < 60	> 80 < 100	Complex	Complex	>2=2 element	Complex/in angle	4 elements.	Static	Lat. pillars	Bulls&Boars
C	> 80 < 100	> 20 < 40	> 40 < 60	Prismatic	Rectangular	>1=1 element	Plain	2 elements.	Static	Solid	Bulls

$$\frac{\Sigma(n_v \cdot f_x)}{n_x} = \frac{(1\cdot2)+(4\cdot3)+(2\cdot4)+(4\cdot5)+(1\cdot6)+(4\cdot7)}{16} = \frac{76}{16} = 4.75 = 5^{th} \text{ position } (00000000010000) = > 200 < 220 \text{ cm.}$$

Table 1

Datamatrix of values' frequencies per variables for series A, B and C, with the equivalences in centimetres ranks and qualitative categories. On upper part, values references for centimetres measurements ranks and quantitative categories. On inner part, the averages of values per series (according to Manglano, 2013).

000. Quarry	Matched sculpture and finding site	UTM ED50 Coord	Series	Km.
006. Botija (El Guijo site)		**29/753120.4360693**		
Botija (CC)	089.Botija 01 (Villasviejas del Tamuja hillfort)	29/751079.4361605	B	3.97
Botija (CC)	092.Botija 04 (Tamuja River, Pasadera de Bueyes)	29/750656.4360924	B	3.77
Botija (CC)	179.Madrigalejo (Casa del Hito)	30/275988.4339467	B	58.74
Average				***22.16***
007 Cardeñosa (Las Cogotas hill-fort)		**30/356478.4510253**		
Cardeñosa (A)	019.Arévalo 03 (re-used in a village's house)	30/355762.4546600	C	54.07
Cardeñosa (A)	097.Cabizuela (re-used in a village's house)	30/348338.4529506	C	39.35
Cardeñosa (A)	109.Cardeñosa 01 (Las Cogotas hillfort)	30/356478.4510253	B	*1.0
Cardeñosa (A)	110.Cardeñosa 02 (Las Cogotas hillfort)	30/356478.4510253	A	*1.0
Cardeñosa (A)	199.Mirueña de los Infanzones (re-used in village)	30/323552.4511761	C	74.34
Cardeñosa (A)	240.Papatrigo 01 (beside San Pedro road)	30/345026.4523658	C	36.44
Average				***51.05***
008. Chamartín (La Mesa de Miranda)		**30/335633.4509898**		
Chamartin	121.Chamartin 01 (El Palomar, beside river Riondo)	30/336267.4509460	A	1.79
Chamartin	122.Chamartin 02 (in a bridge over river Riondo)	30/336020.4506967	B	5.40
Chamartin	123.Chamartin 03 (Mesa de Miranda hillfort)	30/335633.4509898	B	*1.0
Chamartin	124.Chamartín 04 (Miraflor way, beside hillfort)	30/335184.4509150	B	2.26
Chamartin	160.La Torre 01 (El Soto)	30/333923.4495554	C	30.39
Chamartin	161.La Torre 02 (El Soto)	30/333923.4495554	B	30.39
Chamartin	286.Solosancho (Fuente del Oso, Ulaca hillfort)	30/339628.4487814	A	42.52
Average				***18.79***
010. Muelas del Pan (stelae from the reservoir)		**30/251825.4602903**		
Muelas (ZA)	016.Almaraz de Duero (San Pelayo church)	30/259188.4595109	C	15.35
Muelas (ZA)	209.Muelas 06 (S. Esteban I.A. & Roman hillfort)	30/251751.4602690	C	*1.0
Muelas (ZA)	349.Villalcampo (Santiago I.A. & Roman hillfort)	29/743060.4597643	C	16.70
Muelas (ZA)	364.Villardiegüa (S. Mamede hillfort- Peñaredonda)	29/732334.4600587	B	30.72
Average				***20.90***
012. Fuentes Oñoro (Valdemuchachos)		**29/689144.4495755**		
Fuentes Oñoro (SA)	126.Ciudad Rodrigo (Agueda riverside)	29/707705.4497220	B	25.50
Fuentes Oñoro (SA)	151.Gállegos de Argañán (near the village)	29/694415.4500712	B	10.53
Average				***18.01***
019. Mingorría (Cerro de la Virgen)		**30/358966.4512293**		
Mingorría (A)	137.El Oso (beside El Oso's church)	30/350805.4523013	B	21.70
Mingorría (A)	229.Muñico (re-used in village)	30/328765.4508436	B?	51.25
Average				***36.47***
020. Montánchez (La Cuarentena water tank)		**29/744582.4345982**		
Montánchez (CC)	093.Botija 05 (Tamuja River, Pasadera de Bueyes)	29/750656.4360924	B	19.61
Montánchez (CC)	095.Botija 07 (Tamuja River, at Benquerencia way)	29/751916.4358501	B	17.61
Montánchez (CC)	098.Cáceres (re-used in Cáceres's old market)	29/725324.4372536	B	38.39
Average				***25.20***
025. Riofrío (Gemigel farm)		**30/354185.4492079**		
Riofrío (A)	136.El Fresno (village's outskirt)	30/351426.4497672	C	9.82
Riofrío (A)	259.Riofrío 09 (Gemiguel cortijo)	30/354185.4492079	C	*1.0
Average				***9.82***
029. Tornadizos (Alameda Alta wood)		**30/363084.4496056**		
Tornadizos (A)	314.Tornadizos 10 (La Alameda Alta wood)	30/363084.4496056	C	*1.0
Tornadizos (A)	316.Tornadizos 12 (La Alameda Alta wood)	30/363084.4496056	C	*1.0
Tornadizos (A)	317.Tornadizos 13 (La Alameda Alta wood)	30/363084.4496056	C	*1.0
Tornadizos (A)	318.Tornadizos 14 (La Alameda Alta wood)	30/363084.4496056	C	*1.0
Average				
030. Ventas con Peñaguilera (Venta con Peñaguilera)		**30/394964.4386035**		
Ventas Peñaguilera (TO)	157. Puebla Montalbán (Vega los Caballeros)	30/378892.4411733	B	40.75
Average				***40.75***
033. Villar del Pedroso (La Lobera site)		**30/313368.4399054**		
Villar Pedroso (CC)	114.Carrascalejo de la Jara (El Toconal wood)	30/313657.4387903	B	13.26
Villar Pedroso (CC)	355.Villar Pedroso 01 (La Oliva del Pizarroso)	30/307419.4397729	B	8.22
Villar Pedroso (CC)	358.Villar del Pedroso 04 (Caganchas river)	30/310554.4394537	C	6.10
Villar Pedroso (CC)	360.Villar del Pedroso 06 (re-used at village)	30/311916.4397643	B?	2.56
Villar Pedroso (CC)	361.Villar del Pedroso 07 (La Laguna)	30/310122.4395670	B	5.20
Average				***7.06***

Table 2

Granite's quarries with positive results. Quarries Granite type U.T.M. ED50

Different interpretations have considered them as sacred figures that protected the surrounding community's richer pastures and strategic sources of water, the most important resources for the old Vettones (Álvarez-Sanchís, 2003, 60–63). In addition, it is easy to notice in the dispersion map of this region that there is evidence of one, two or three points where 'verracos' have been found near the quoted oppida (Fig. 1.2: "D2"). The latter have led to other interpretations of the 'verracos', for example their role as protectors of the greatest villages, which appears to be confirmed by the only two found in their original position, each on either side of the early Roman Republican gate of San Vicente, which dates back to 50 BCE (Martínez Lillo and Murillo, 2003, 282). Finally, on the map of Valle Amblés, we can see isolated groups of six, seven and more 'verracos' marked with "D3" (Fig. 1.2), also strikingly distant from the Iron Age oppida and the main sources of water. Several Roman inscriptions found on the backs of these sculptures reveal that theywere funerary monuments, and of this there is little doubt, though none have been found in this original function.

Moreover, many of these findings appear to be much older examples, as if they had been reused during the Roman period for funeral purposes.

On this basis, a research was carried out by us on a new interpretation by observing the roles of the craftsmen, and the different ways of carving the 'verracos' (Fig. 2). We defended this interpretation in the meeting "Craft and People. Agents of the skilled labour in the Archaeological Record", held in the British Museum at November 2012 (Berrocal-Rangel et al., in press). According to our hypothesis, it is possible to define three type of sculptures from the referred technical approach: older 'verracos', the ones referred to as group "A", are the largest overall. They present the most complex and realistic details, as can be seen in the Castillo de Bayuela bull (Toledo) (Fig. 2.A & 1). It is known that most of the sculptures represent bulls and judging by their size and weight (ranging between 4 and 20 t), it is reasonable to presume that they were carved in situ, remaining where they are now, and were possibly carved in ronde-bosse, around the sculpture. A second type of 'verracos' corresponds to medium size figures, about 1 m long, with simple shapes and basic anatomical details (Fig. 2.B & 2).

They are representations of bulls, but also of pigs, usually in an attacking position. In a short number of cases, contemporary quarry workers have suggested that some of these verracos came from quarries, which were far away (Martín Valls, 1974, 81). This is the case of the 'verraco' from Toro (Zamora, NW Spain) and its alleged quarry located in Cardeñosa (Ávila, Central Spain), 114 km away. But these are visual perceptions, and the distances may have been the result of them being moved more recently, probably in the early Middle Ages. The technical characteristics, possible traces of micro-wear and the location of some of these examples that were found unfinished in the carving sites, suggest the existence of indigenous workshops where these 'verracos' from the late Iron Age were commissioned by the various communities of oppida in times of war and social instability, during the conquest of this area by Rome. In this regard, some of the "B" series 'verracos', made with granite from Cardeñosa (Ávila) and found around the oppidum of Las Cogotas could have been made in local workshops, sculpted for community demands and therefore moved in ancient times from the original quarries and workshops to their final locations.

A third group, the "C series", is the easiest to identify because of their obvious differences in size and schematic designs (Fig. 2.C & 3). It is true that many of the pieces included in this series are the smallest. They all have similar, well-carved geometric shapes that range from prismatic to cylindrical forms, both of which are basic. The use of saws, with water, to cut the stone can be easily noticed in the carving process, leaving a flat, even surface, following the needs of these geometric shapes, made with the use of templates.

One can also sense that fine chisels, gouges and compasses were used in the few anatomical details shown, and this is further proof of them having been worked on in series during Roman times, as there are plenty of Latin inscriptions.
Therefore, these late 'verracos' were made through "industrial" productions for individual funerary uses that could be transported over long distances, as suggested by the small size of most of them.
Consequently, our initial hypothesis defends that the 'verracos' must reflect different dispersion patterns according to different functions: from the oldest and biggest exemplars, which were carved as singular sculptures at the final site of exhibition, or nearby; to the latest and smallest, which were made through "industrial" productions and could be transported over long distances. Between them, verracos from 3rd to 1st centuries BCE were made in oppida workshops with communal values and they could appear around these fortified big settlements.

3. Methodology 1: lithology, a new perspective to study of the verracos
To test these hypotheses, we developed a method for identifying the origin of the stone used for carving 'verracos', thus moving beyond our limited knowledge about the original contexts (Yonekura et al., 2008; García Talegón et al., 1999…).
The method is based on a combination of three techniques (two mineralogical ones: petrographic analysis and mineralogical analysis through X-ray diffraction; and a chemical analysis: Antonelli et al., 2010; García Giménez et al., 2013; Vigil et al., 2000: Yonekura et al., 2008). We collected small samples of 105 boars and from about 50 potential quarries (easily recognized due to their archaeological remains, their contemporary use or just the proximity to the sculptures), of which 34 gave positive results (Table 1). By using small chisels (cloth wrapped), jewellery hammers and a CTS F1 vibrating cutter, in some cases, we obtained small rock aliquots (about 1 to 2 g) from fragmented or poorly maintained sculptures, mostly from the back or the base. It is
important to remember that these sculptures are scheduled monuments with the highest law protection (SMRs). Therefore, required authorities' permissions allowed to get samples from the "hidden" sides of the sculptures. Fortunately, they are very homogenous in geology composition.
However, in order to avoid weathering, as gelifraction process which could transform mica and feldspar into clay, we chose not surfaces samples or samples from zones without signs of physical/chemical weathering. And, in this way, always that it would be possible we tried to collect several samples from different locations of the same sculpture.
Easier was the analysis of quarries, chosen between the traditional ones with masonry workers' help, because there it was easy to get samples from new fractures, without weathering. From each quarry we got a sampling with a rate of 2 samples/1 m3 of rock.
First, these samples were identified by contrasting colours using a Munsell colour chart. Later they were ground for a mineralogical analysis, followed by a chemical analysis with the same mineral fraction.
Petrography was developed by think lames for defining geological characteristics from quarries. Unfortunately this method is difficult to carry out over the verracos, because the size of the needed samples, but petrography analyses have been very useful in the identification of all the rock patterns from quarries and lithic substratum.
Mineralogical composition was studied by X-ray diffraction (XRD), using the random powder method for the bulk sample, and the oriented slides method for the b2 μm

fraction. A Siemens D-5000 X-ray diffractometer equipped with a Cu anode, operated at 30mA and 40 kV with divergence and reception slits of 2 and 0.6 mm, respectively, was used. The XRD profiles were measured in 0.04 2θ goniometer steps for 3 s.

Samples were dissolved as follows: a minimum amount of sample was treated with hydrofluoric acid in an open vessel, heating it on a hot plate until dry. This treatment was followed by the addition of aqua regia, followed once again by heating until dry. The residue was dissolved with 1 ml of concentrated hydro-chloric acid and diluted with water to the mark in Teflon volumetric flasks. Care was taken to keep any possible contamination to a minimum. Ultrapure water was used at all times and all reagents were of analytical grade. Chemical analyses of major and minor elements were performed by Inductively Coupled Plasma–Mass Spectrometry (ICP–MS) in a Scie x Elan 6000 Perkin-Elmer spectrometer equipped with an AS91 autosampler. A total of 45 elements were determined: Al2O3, CaO, K2O, Fe2O3, Na2O, MgO, MnO2, and TiO2 as major elements (measured as wt % oxide); Ag, B, Ba, Be, Ce, Co, Cr, Cs, Cu, Dy, Er, Eu, Ga, Gd, Ho, La, Li, Mo, Nd, Ni, Pb, Pr, Rb, Sb, Sc, Sm, Sn, Sr, Tb, Th, U, V, W, Y, Zn and Zr as minor and trace elements (in ppm). SiO2 content was estimated by difference.

Blank samples and standard samples were simultaneously taken for quality control purposes. Finally, transversal thin sections (20–25 mm) were cut off the samples, in order to observe several components in a Petrographic Polarisation Orto Plan Pol Leitz Microscope.

When suitably thin sections of the samples were not easily available, these were consolidated with resin and the sections were cut off, following drying, as previously described. By comparing the results of these three techniques, it was possible to recognize the existence of small groups of 'verracos' made from the same type of granite rock and to try to identify the quarries from which these rocks could have been obtained (Table 2).

Fig. 3. 1. First verraco from Lumbrales, at La Barrera Square; 2. Second verraco from Lumbrales, at the old site of Mercado Square; 3.Base, beside the main wall gate of the oppidum Las Merchanas, as it was placed in first instance, spring of 2012; 4. Second verraco from Lumbrales after its original restitution shape and place (from Bescos and Macarro, 2010).

The effectiveness of the method was tested in 2012 in a unique case, when a broken 'verraco' basewas found during cleaning of recent excavations near the main gate of the Iron Age and early Roman time oppidum of LasMerchanas, near the medieval village of Lumbrales (Salamanca). Before this find, two 'verracos' had been exhibited in several local squares of this villages, for several decades, if not centuries (Fig. 3.1–2). The new base, which had part of a 'verraco's' claws, was found during the restoration work on the rampart in 2009 and was subsequently placed on a new monumental podium next to the door of the oppidum, at the start of the musealized circuit (Fig. 3.3). At that point, someone remembered that the second 'verraco' in the medieval village had a modern base, possibly made in the mid-twentieth century (Fig. 3.2). This then opened up the possibility of the new find being the original base of that 'verraco', which led the local authorities to propose analysing both pieces, each of which weighed several tons, before moving or undoing anything (Bescos and Macarro, 2010).
The four samples were then analysed (Fig. 3): firstly, the bedrock under the gate of the oppidum's rampart, which was used as a sample of the potential quarry; secondly, the 'verraco' that was fully preserved, in the Plaza de la Barrera of Lumbrales; thirdly, the incomplete 'verraco' located in theMarket Square; and finally, the base found in recent years.
All samples reflected the same Munsell 10 R8/1white colour, and the Xray diffraction spectrometry showed the same mineral composition: Biotite (8.77–9.99 2Θ); Chlorite (17.76–4.98 2θ); Quartz (20.88–4.25 2θ); Potassium feldspar microcline (27.48–3.24 2θ) and Plagioclase oligoclase (27.91–3.19 2θ) (Fig. 4). All of them were monzogranites, although there were small variations in the intensity of the peaks due to the relative proportions of the area's geochemical bedrock, as can be seen in the diffractogram of Fig. 4.B.
The wet chemical analysis of the four samples to identify major and minor elements yielded clearly similar results. Therefore, the results were conclusive and both pieces were joined back together with the maximum guarantees for success, resulting in a perfect assembly (Fig. 3.4).

4. Methodology 2: statistics, an old approach for a new focusing

After this analysis, samples were taken from over one hundred original sculptures and from about fifty potential quarries, with only 84 'verracos' matching 34 quarries (Tables 2 and 3; Figs. 5 and 6). The initial hypothesis was based on 376 samples from within Spain. According to our hypothesis, the 'verracos' may have been dispersed in different patterns, based on different functionalities: type 'A' sculptures were the oldest and biggest, and therefore less easy to move; type 'B' 'verracos', from the late Iron Age, were medium size and probably produced at local workshops with 'ethnical' values, thus making it possible to find them quite far away from the place where they were produced; and finally type 'C' 'verracos', small and prismatic in shape, satisfied individual needs and could well be found both near and far away from the workshops, depending on their owner's financial circumstances.
A Correspondence analysis was applied to objectively classify the 'verracos' according to these three types, which had up to then been defined in theory as prototypes. This analysis is a known multivariate method that was successfully tested on a previous selection of 'verracos' by Álvarez-Sanchís (1999, 223).He worked over 100 bulls' and 72 boars' sculptures, separately, and defined 5 types of bulls and 4 types of boars according

to measures (long, high, width) and presence/absence of 17 anatomical features (plinth, faces, front, jaw, ears, horns or defences, eyes, dewlap…). From this base, and with general data attachments, he defined the two formal taxonomies, one for each animal species. Our later hypothesis proposed a similar approach but with a different focusing, which was explained before (Section 2; Fig. 2). Our approach interprets verracos' shapes according to different ways of carving and to the ways of different tools too. Therefore, we do not have reasons for separating bulls from boars (our interest was the way of making sculptures not the carved motives) and, also, there were new findings along the last fifteen years, for our repertoire of examples analysed was much higher (over 400 cases). Therefore, the formal series of five were simplified to three technical series, according to measures; geometric shapes and technical details of representing heads; backs and legs; and also to attitudes (passive or attacking positions) and types of plinths Table 1). All this data was converted into dichotomous values in 20 cm ranges in the three main dimensions (from b20 to over 300) and in scales from 0 to 3, or 5, for qualitative elements, according to the technical and anatomical features registered. Only 155 sculptures still retained enough features to apply the full test (Fig. 5; Tables 1–3).
Three contingency tables,with rows representing nominal variables of taxa and columns containing frequencies of taxa in dichotomous ranks of values, show total results for each series (Table 1). For working easier with these ranks, it was very useful to give equivalent numbers to the dichotomous values ("v"), from 1 to 15, and so for all the variables. Therefore, it was easy to reach averages according to:

$$\frac{\sum (nv \cdot fx)}{nx}$$

where "nv" defines as the addition of dichotomous values equivalent numbers; "fx" as the frequency of cases per variables; and "nx" as the total number of cases per series (Table 1). By this way we could define the average types of each series and to re-order the ambiguous cases according to the inclusion of these into the three clouds of dots (Fig. 5). "CA attempts to place samples in similar positions in the ordination plot. The measure of distance between samples is proportional to the chi-squared statistics ", calculated using the PAST 3.2 open source-program to analyse scientific data (Hammer et al., 2001). This was all then plotted in a scatter graph, in Fig. 5, with a horseshoe type result, a prototypical shape for chronological series (Fernández-Martínez, 2015, 162ff; Orton, 2000, 44; Fig 3.2; Shennan, 1988, 281). There are different clouds of dots, according to the three series (A: blue squares; B: green diamonds; C: red crosses) and their averages are marked with capital letters A, B, and C (Figs. 5, 2 and Table 1). These averages replace initial theoretical models built with proposed criteria as the biggest sizes are between the "A" series samples, and they allows us to recognize the success of the CA. In this way, CA axis 1 (Eigenvalue 21%) can be reflecting the sizes of the sculptures (p.e. the cloud of points of "series A" is clearly located at the right of the plot, with some of the biggest examples in the extreme right, as number 353, which is the huge bull of Villanueva del Campillo 01). But there are other big verracos, as numbers 142–145, which lie in the wrong order considering their measures. Because, bulls nos. 142 to 145 belongs to the well-known examples from El Tiemblo, sculptures with 2.64 to 2.78 m long which are between the biggest ones of the whole sample. Anyway they are located in the "B" series, at the central bottom of the plot (when we considered as theoretical prototype of series "A" before the analyses). On the contrary, the magnificent bull of Castillo de Bayuela 01, no. 115 of the sample, is a smaller sculpture (1.70 m long).

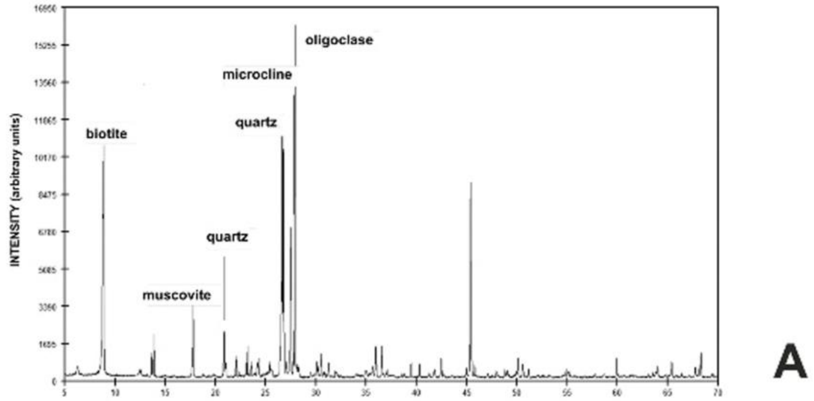
000. Quarry	Matched sculpture and finding site	UTM ED50 Coord	Series	Km.
006. Botija (El Guijo site)		**29/753120.4360693**		
Botija (CC)	089.Botija 01 (Villasviejas del Tamuja hillfort)	29/751079.4361605	B	3.97
Botija (CC)	092.Botija 04 (Tamuja River, Pasadera de Bueyes)	29/750656.4360924	B	3.77
Botija (CC)	179.Madrigalejo (Casa del Hito)	30/275988.4339467	B	58.74
Average				***22.16***
007 Cardeñosa (Las Cogotas hill-fort)		**30/356478.4510253**		
Cardeñosa (A)	019.Arévalo 03 (re-used in a village's house)	30/355762.4546600	C	54.07
Cardeñosa (A)	097.Cabizuela (re-used in a village's house)	30/348338.4529506	C	39.35
Cardeñosa (A)	109.Cardeñosa 01 (Las Cogotas hillfort)	30/356478.4510253	B	*1.0
Cardeñosa (A)	110.Cardeñosa 02 (Las Cogotas hillfort)	30/356478.4510253	A	*1.0
Cardeñosa (A)	199.Mirueña de los Infanzones (re-used in village)	30/323552.4511761	C	74.34
Cardeñosa (A)	240.Papatrigo 01 (beside San Pedro road)	30/345026.4523658	C	36.44
Average				***51.05***
008. Chamartín (La Mesa de Miranda)		**30/335633.4509898**		
Chamartin	121.Chamartin 01 (El Palomar, beside river Riondo)	30/336267.4509460	A	1.79
Chamartin	122.Chamartin 02 (in a bridge over river Riondo)	30/336020.4506967	B	5.40
Chamartin	123.Chamartin 03 (Mesa de Miranda hillfort)	30/335633.4509898	B	*1.0
Chamartin	124.Chamartín 04 (Miraflor way, beside hillfort)	30/335184.4509150	B	2.26
Chamartin	160.La Torre 01 (El Soto)	30/333923.4495554	C	30.39
Chamartin	161.La Torre 02 (El Soto)	30/333923.4495554	B	30.39
Chamartin	286.Solosancho (Fuente del Oso, Ulaca hillfort)	30/339628.4487814	A	42.52
Average				***18.79***
010. Muelas del Pan (stelae from the reservoir)		**30/251825.4602903**		
Muelas (ZA)	016.Almaraz de Duero (San Pelayo church)	30/259188.4595109	C	15.35
Muelas (ZA)	209.Muelas 06 (S. Esteban I.A. & Roman hillfort)	30/251751.4602690	C	*1.0
Muelas (ZA)	349.Villalcampo (Santiago I.A. & Roman hillfort)	29/743060.4597643	C	16.70
Muelas (ZA)	364.Villardiegüa (S. Mamede hillfort- Peñaredonda)	29/732334.4600587	B	30.72
Average				***20.90***
012. Fuentes Oñoro (Valdemuchachos)		**29/689144.4495755**		
Fuentes Oñoro (SA)	126.Ciudad Rodrigo (Agueda riverside)	29/707705.4497220	B	25.50
Fuentes Oñoro (SA)	151.Gállegos de Argañán (near the village)	29/694415.4500712	B	10.53
Average				***18.01***
019. Mingorría (Cerro de la Virgen)		**30/358966.4512293**		
Mingorría (A)	137.El Oso (beside El Oso's church)	30/350805.4523013	B	21.70
Mingorría (A)	229.Muñico (re-used in village)	30/328765.4508436	B?	51.25
Average				***36.47***
020. Montánchez (La Cuarentena water tank)		**29/744582.4345982**		
Montánchez (CC)	093.Botija 05 (Tamuja River, Pasadera de Bueyes)	29/750656.4360924	B	19.61
Montánchez (CC)	095.Botija 07 (Tamuja River, at Benquerencia way)	29/751916.4358501	B	17.61
Montánchez (CC)	098.Cáceres (re-used in Cáceres's old market)	29/725324.4372536	B	38.39
Average				***25.20***
025. Riofrío (Gemigel farm)		**30/354185.4492079**		
Riofrío (A)	136.El Fresno (village's outskirt)	30/351426.4497672	C	9.82
Riofrío (A)	259.Riofrío 09 (Gemiguel cortijo)	30/354185.4492079	C	*1.0
Average				***9.82***
029. Tornadizos (Alameda Alta wood)		**30/363084.4496056**		
Tornadizos (A)	314.Tornadizos 10 (La Alameda Alta wood)	30/363084.4496056	C	*1.0
Tornadizos (A)	316.Tornadizos 12 (La Alameda Alta wood)	30/363084.4496056	C	*1.0
Tornadizos (A)	317.Tornadizos 13 (La Alameda Alta wood)	30/363084.4496056	C	*1.0
Tornadizos (A)	318.Tornadizos 14 (La Alameda Alta wood)	30/363084.4496056	C	*1.0
Average				
030. Ventas con Peñaguilera (Venta con Peñaguilera)		**30/394964.4386035**		
Ventas Peñaguilera (TO)	157. Puebla Montalbán (Vega los Caballeros)	30/378892.4411733	B	40.75
Average				***40.75***
033. Villar del Pedroso (La Lobera site)		**30/313368.4399054**		
Villar Pedroso (CC)	114.Carrascalejo de la Jara (El Toconal wood)	30/313657.4387903	B	13.26
Villar Pedroso (CC)	355.Villar Pedroso 01 (La Oliva del Pizarroso)	30/307419.4397729	B	8.22
Villar Pedroso (CC)	358.Villar del Pedroso 04 (Caganchas river)	30/310554.4394537	C	6.10
Villar Pedroso (CC)	360.Villar del Pedroso 06 (re-used at village)	30/311916.4397643	B?	2.56
Villar Pedroso (CC)	361.Villar del Pedroso 07 (La Laguna)	30/310122.4395670	B	5.20
Average				***7.06***

Table 3 Relation of quarries and verracos: tested and match ed sculptures samples with UTMED50 coordinates and least-cost paths distances between them. Verracos' identification numbers from Manglano data base (2013).

Mineral (%)	Sample 1	Sample 2	Sample 3	Sample 4
Biotite	12	18	27	13
Muscovite	3	6	8	4
Quartz	7	11	8	17
Orthoclase	n.d.	n.d.	n.d.	n.d.
Oligoclase	55	35	40	49
Microcline	23	30	17	17
Albite	n.d.	n.d.	n.d.	n.d.
Sanidine	n.d.	n.d.	n.d.	n.d.
Anorthite	n.d.	n.d.	n.d.	n.d.
Observations	possible presence of chlorite	possible presence of chlorite	possible presence of chlorite	possible presence of chlorite
Petrological clasification	Monzogranite	Monzogranite	Monzogranite	Monzogranite

Oxides (%)	Sample 1	Sample 2	Sample 3	Sample 4
Na_2O	2,73	2,45	1,65	1,78
Al_2O_3	10,86	11,03	11,64	5,71
MgO	0,31	1,7	0,34	0,12
K_2O	3,41	3,11	4,39	2,94
MnO	0,02	0,02	0,03	0,01
TiO_2	0,1	0,13	0,27	0,08
CaO	0,62	1,15	0,43	0,25
Fe_2O_3	1,01	0,9	1,79	0,66
SiO_2	80,86	79,51	79,46	88,45

Elements (ppm)	Sample 1	Sample 2	Sample 3	Sample 4
Li	160	57	186	89
Be	8	4	7	3
B	281	5461	n.d.	n.d.
P	412	422	378	217
Sc	1	n.d.	n.d.	4
Co	1	1	2	1
Ni	5	n.d.	n.d.	3
Cu	5	2	2	1
Ga	14	14	24	11
Rb	241	226	306	161
Sr	47	87	43	26
Y	6	10	8	5
Zr	59	58	78	38
Nb	6	5	12	5
Sn	8	3	7	5
Cs	11	12	10	4
Ba	157	272	202	133
La	9	14	15	10
Ce	21	30	35	24
Pr	2	4	4	3
Nd	9	15	17	12
Sm	3	4	4	3
Gd	3	3	3	2
Dy	2	2	2	1
Hf	2	2	3	1
Ta	1	1	2	1
W	1	1	3	1
Pt	n.d.	n.d.	n.d.	n.d.
Au	n.d.	n.d.	n.d.	n.d.
Hg	n.d.	n.d.	n.d.	n.d.
Tl	1	2	2	1
Pb	26	28	22	12
Bi	n.d.	n.d.	n.d.	n.d.
Th	4	8	11	7
U	16	7	17	2



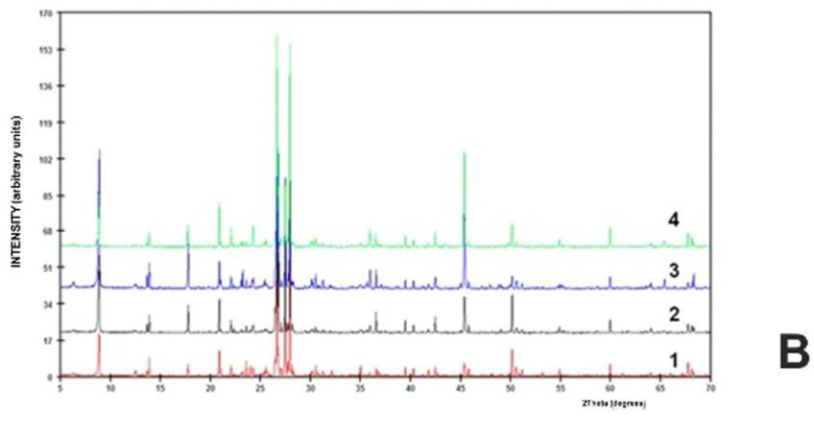


Fig. 4. 1. Semi-quantitative table with minerals from the samples; 2. Chemical analysis with major elements; 3. Chemical analysis of minor elements; A. Powder diffractogram by X-ray with mineral identification of the picks; B. Diffractograms from the four samples from Lumbrales.

But this verraco was carved splendidly (Fig. 2.1), therefore is correct the CA place, closed to the average "A" series, meanwhile the El Tiemblo four exemplars show sub-prismatic bodies, very stout and simple although with many anatomical detail. This allows us to recognize CA axis2 (Eigenvalue 9.6%) as an indication of some factors correlating with structural complexity of the sculptures.

Fig. 6 shows the spread of the analysed sculptures, some of which (black dots) match the quarries samples (black circles with numbers). The failed cases are also shown, as are a large number of 'verracos' with positive results but not valid for this study (both of which appear as white circles). These last cannot be included to obtain good results because they were found in locations where they were clearly being reused, as can be seen in the numerous examples from the medieval ramparts of the city of Ávila. 1A third group, mapped with smaller circles, includes 'verracos' found near their identified quarries, but samples of them could not be obtained for legal reasons. We considered these findings with a view to better identifying potential workshops.

The analysis of the spread of verracos in relation to quarries shows a big concentration around the Roman and medieval town of Avila, with several quarries, and dispersed smaller cores which are located between the Douro and Tajo basins, mainly with one or two quarries per group. Looking for illuminating differences between each series, we applied an analysis of kernel density distributions in 2D, with results in Fig. 7.2–3, according to the UTM coordinates of verracos "B" and "C" series, and their quarries. Verracos from series "A" are limited to three exemplars from Cardeñosa, one, and Chamartín, two. Therefore, they are few cases for obtaining conclusions. From the kernel density plot it is easy to prove as "B" series verracos has a wider and biggest spread, with several cores (Fig. 7.2). "C" series cases show only one big group, the quoted around the city of Avila, which was the biggest yet before, but not so clearly. These clear differences reflect two types of quarries, according to the number of sculptures found in the surrounding area (Fig. 7.1):

1. Quarries like Muelas del Pan (010), Riofrío (025) or Tornadizos (029), around which dozens of sculptures have been found, most of them identified as examples of the "C" series. These 'verracos' share similar formal characteristics and can be identified as productions of workshops located near their quarries.
2. In quarries such as Cardeñosa (007) and Chamartín (008), both into the big core of Avila, a different dispersion pattern is observed: there are fewer sculptures, but they include 'verracos' from the "A", "B" and "C" series. These sculptures have been found in or near large protohistoric villages like Las Cogotas (Cardeñosa), La Mesa de Miranda (Chamartín) or Ulaca (Solosancho) that were inhabited during the Late Bronze and Iron Age, and abandoned during the first decades of Roman rule in this territory.

But for getting an idea of the capability of the quarries according to spread sculptures, less or more finished, we need to calculate distances between them. Fig. 8 and Table 3 contain the identified matching sculptures and quarries, and the least-cost path distances from these ones to the places where the sculptures were discovered.

Those distances were calculated with ArcMap 10.3, from ArcGis, over an ED 1950 UTM30 N Zone map projection, which correspond to the National Topographic Map of Spain2.

These calculations were important because the rugged topography of the Spanish plateau, which obviate any straight-line paths. Least cost distances have been calculated by tools as Cost Distance and Cost Back Link, which generate the least-cost path (by a cost backlink raster) for each sculpture's site and matched quarry. We have done that for

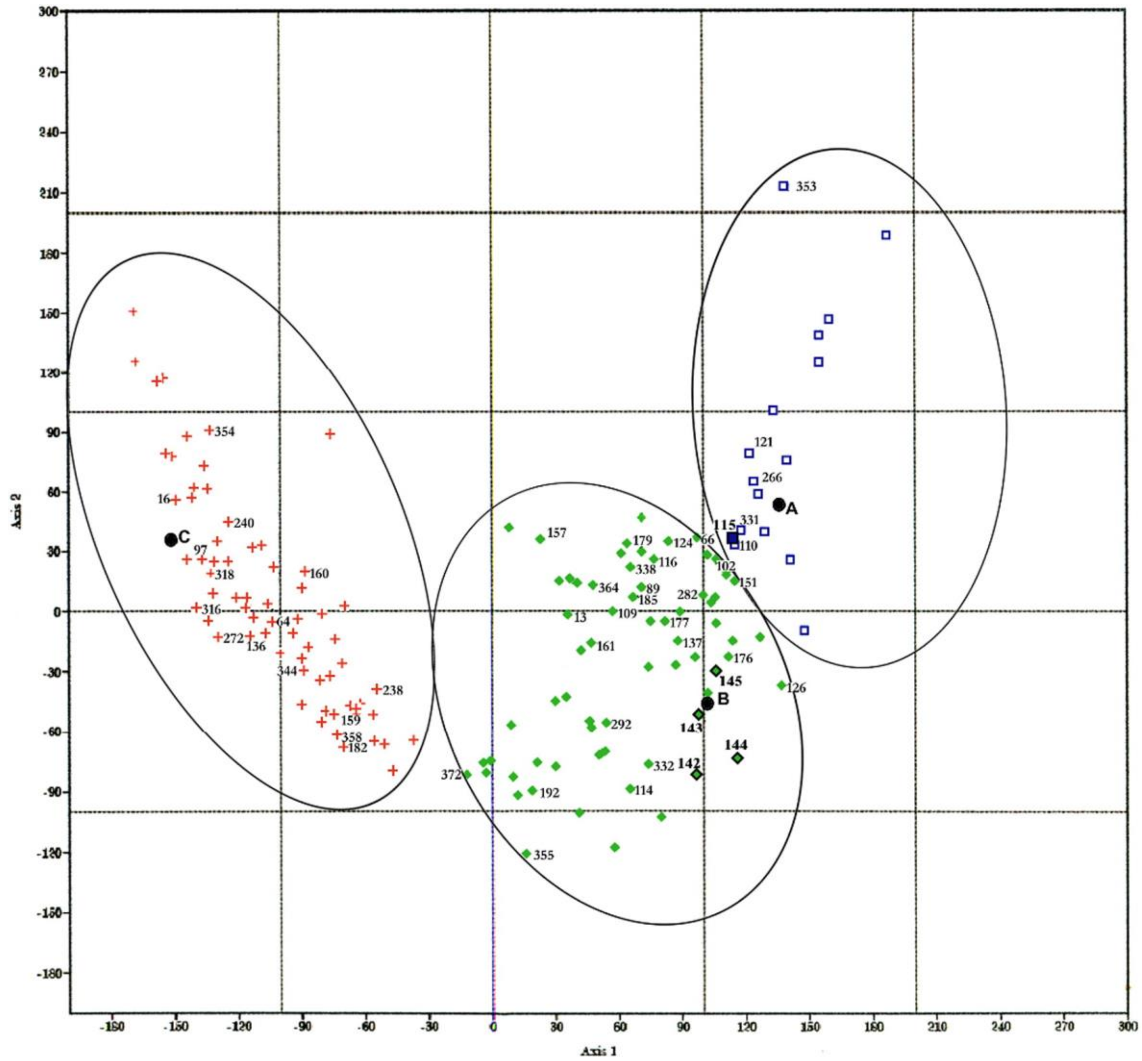


Fig. 5. Correspondence Analysis (CA) between 155 well-preserved sculptures and series of verracos. Numbers correspond to the sculptures with known quarries. Squares: series A sculptures with unknown quarries; Diamonds: series B sculptures with unknown quarries; Crosses: series C sculptures with unknown quarries.

But this picture will change a lot if we take out two quarries from the sample: Chamartín and Cardeñosa. Then it is easy to note as “C” average becomes 8.74 km from the first 19.23; “A” average disappears, because the only two cases were from Chamartín; and only “B” average keep a similar result: 20.71 km.

5. Results: beyond numbers…workshops and community identities? Movements, weight and distances from communal values to individual values

The geochemical analysis of a hundred sculptures of ‘verracos’ and of fifty possible quarries resulted in 84 cases of ‘verracos’ that match 34 quarries. These cases were studied taking into consideration the morphological and technical characteristics of the sculptures (size, geometric features, anatomical details, etc.) and the distances of possible movements between the places where the ‘verracos’ were found and their quarries.

For the first purpose, the sculptures were arranged into three series (A, B and C) according to quoted technical and morphological features, which also generally coincide with different dates and proposed functions. Thus, the sculptures belonging to the “A” series are the largest, the most complex with regards the carving technique used and are possibly the oldest, dating back to the fourth and third centuries BCE. The samples from the "B" series are somewhat smaller and simpler, but more numerous, and in some exceptional cases, their original locations are known to have been found on both sides of the main doors of the oppida. These "B" 'verracos' were probably produced in indigenous workshops, located on the outskirts of the villages, and it is believed that they symbolized a community's power, as well as acting as a kind of sacred figure that protected them. The largest number of known 'verracos' belongs to the "C" series, often carved in geometric shapes using templates and tools like saw blades. Roman funerary inscriptions and some sculptures in necropolis belonging to this period, but not found in modern excavations, indicate that they date back to the early centuries of Roman presence on the Spanish plateau, and that they had individual functions related to the protection and prestige of souls. The 84 sculptures of 'verracos' with- matching quarries were classified according to the ABC series, applying statistical Correspondence analysis on 75 variables per sample in dichotomous values.

For the second target, the results of the CA ordination were spatially associated with the quarries by using orthophotomap and a GIS software, with which the least-cost distances between them can be accurately calculated. First of all, we rejected all the reused samples in big historical buildings as construction material and those in urban places, where they have been moved post-culturally. Also we did not take into account from exemplars found less of 1 km away from the quarries, because they will distorted the average distances of the sculptures which were carved at the quarries. Therefore, our final sample for this spatial analysis was of 35 sculptures and 12 matched quarries.

Despite the reduced samples, results threw similar average distances: 21.5 km for "A" series; 19.23 km for "C" verracos and 23.26 km for "B" cases. For us, this similarity shows that weights and size were not problem for transporting these sculptures along the time of they were carved, from 4th century BCE to 1st century CE. But the results change outstandingly if we do not use the data from the main quarries, according to the number of matched verracos and distances: Cardeñosa and Chamartín. Then, verracos of series "A" were usually closer to the quarries; sculptures from the "B" series could be displaced until 20 km and more; but "C" series examples were moved just only 8.74 km as average distance. These results are at variance with our initial hypothesis, which suggested the smallest 'verracos', generally from the "C" series, as those that could be transported across longer distances. However the biggest average obtained in the "B" series is quite logical, because the archaeological contexts for the "B" verracos' are clearly the richest in this territory's diachronic settlement. They are usually located near large Iron Age oppida and their neighbouring quarries, as in the case of Chamartín and Cardeñosa (Ávila). Samples like the unfinished 'verraco' on the bedrock near the rampart of the oppidum of Las Cogotas, in Cardeñosa, confirm that at the time workshops were located on the outskirts of largest settlements and that their products were moved across significant distances. We explain this fact as a consequence of the quality of the granite of these quarries. Cardeñosa is the best traditional one of the region, so it is not a surprise the largest distances for carved verracos with granites from here: 50.53 km, in series "C" and 54.07 km in series "B", with an exemplar at Mirueña, 74.33 km away, by the least-cost path. Similar conclusions comes from Chamartín, where the big bull of Solosancho is located to 49.52 km away. This is only explained by the best quality of the granite from Chamartín, because there are granite around Ulaca, the Solosancho oppidum Iron Age site.

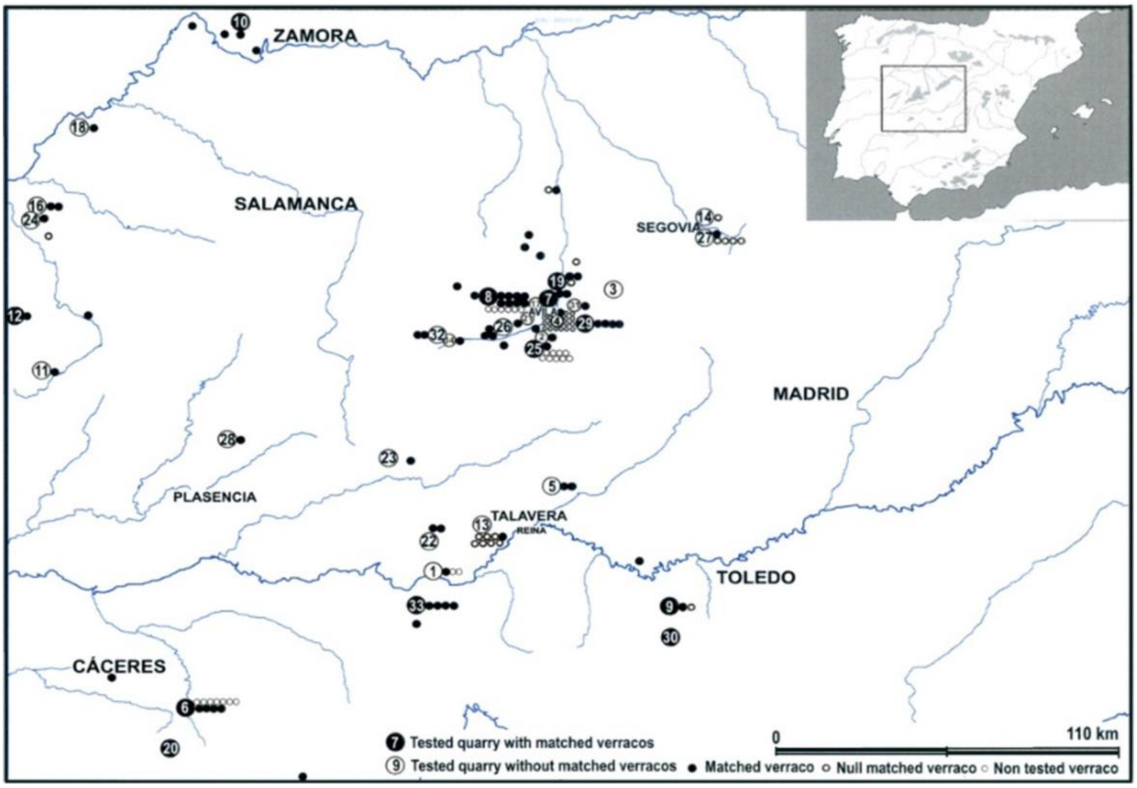


Fig. 6. Map of verracos' spread with location of quarries and sculptures. Numbers are quarries according to Table 2: Black circles, most significant quarries in this study case.

While the "C" series quarries served to produce large amounts of sculptures, often with twenty or thirty identified examples (as Tornadizos or Riofrío), the B series quarries provided fewer boars and, with them, were some of the "C" and "A" series' exemplars. As is known, the oppida were abandoned during the first century BCE, and it is assumed that their quarries continued to remain in use. Therefore, the rock had to be transported to the new Roman workshops. In thus, the initial hypothesis regarding series "C" as products with Roman chronologies because there are no Iron Age villages in the vicinity but there are Roman rural settlements. In quarries such as Muelas del Pan, some large and small samples were found N15 km away (as Almaraz and Villalcampo).

In conclusion, big bulls of the "A" series were usually carved in their final exhibition place, as was assumed due to the sheer size of some of them. Most of them have been located beside the quarry although some exemplars from the biggest quarries were displaced to large distances, as the 40.52 km of the huge Solosancho bull. Therefore, we make sure that the oldest workshops, that can be dated back to the second Iron Age, were already more than capable of moving their products, finished or not, as far as the latter ones would do. Moreover, sculptures of the "B" series, dated along the 2nd century BCE to the end of 1st century BCE, throw the average largest displacement distances, with 23.26 km. This defends the theory of the importance of the community values that these sculptures represented along a conflict period, during the Roman conquest of the region, and related to ethnic and protective functions. In this way, we have the examples of the two bulls of Avila's San Vicente gate, both in the "B" series, and dated at 50 BCE (Martínez Lillo and Murillo, 2003, 282). But, also, the experiment over the second 'verraco' of Lumbrales, which has been explained in Section 3, offer us an exceptional

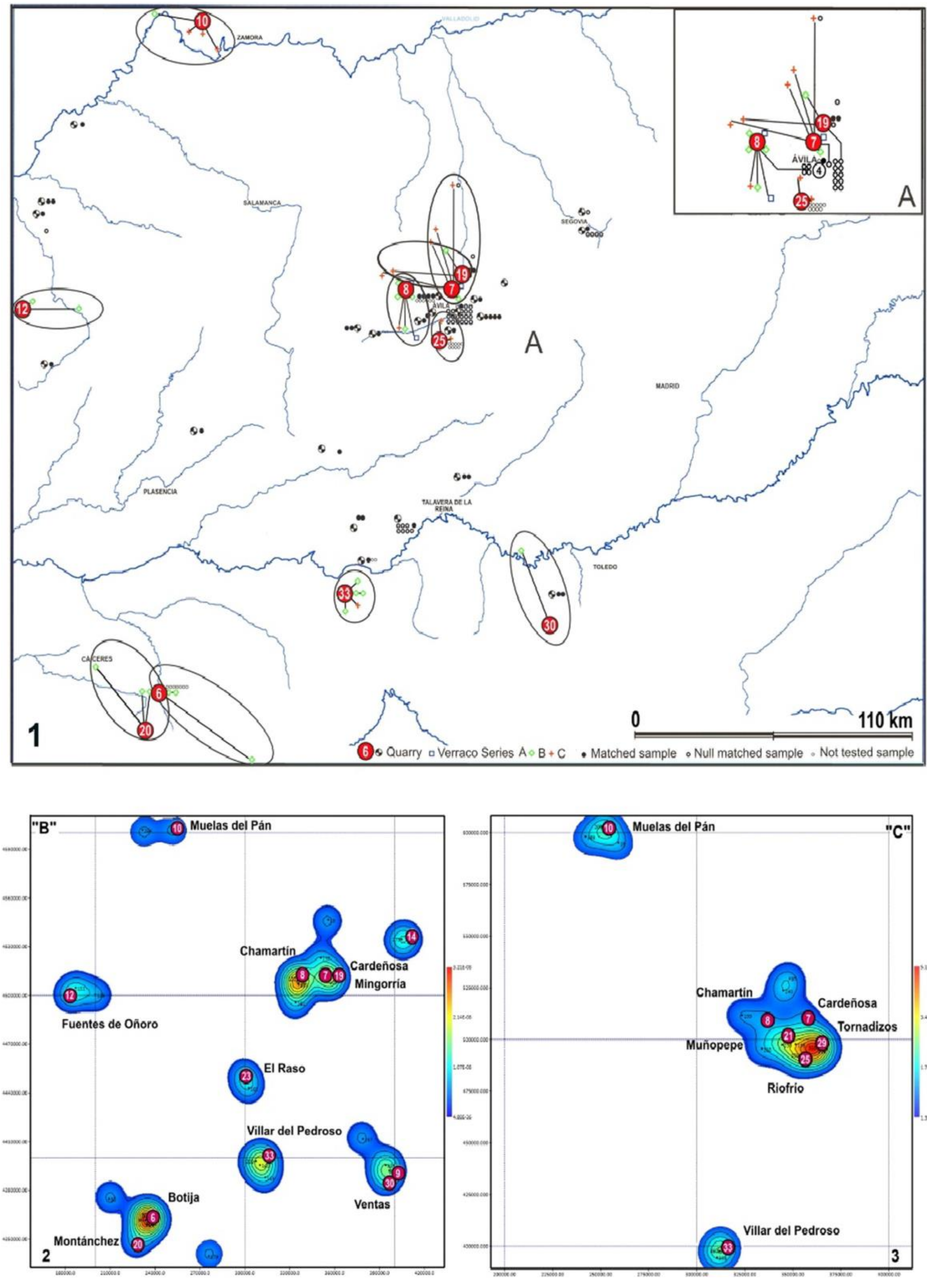


Fig. 7. 1.Map of verracos' spread with location ofmatched quarries and sculptures. Straight lines showproved origin relations. 2. Kernel density plot of series "B" verracos and quarries; 3. Kernel density plot of series "C" verracos and quarries, using PAST 3.06.

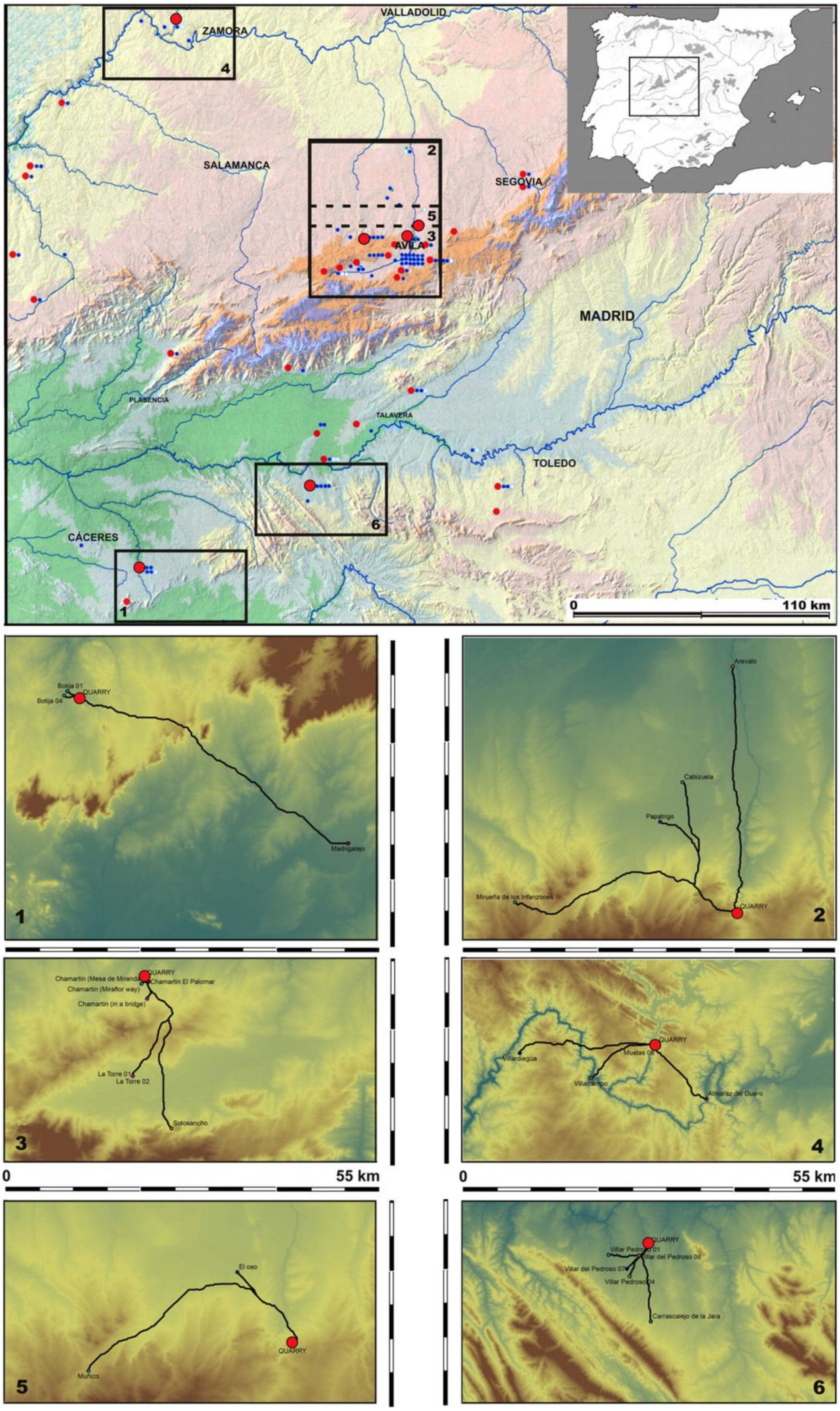


Fig. 8. Least-cost paths between matched quarries and verracos: 1. Botija; 2. Cardeñosa; 3. Chamartín; 4.Muelas del Pan; 5.Mingorría; 6. Villar del Pedroso, calculated with ArcMap 10.3 (ArcGis).

	Botija	Cardeñosa	Chamartin	Cuerva	Muelas	Fuentes Oñoro	Gamonal	La Lastrilla	Mingorría	Montánchez	Muñopepe	El Raso	Riofrio	Ventas	VillarPedroso
Series A	0	0	21.15	0	0	0	0	0	0	0	0	0	0	0	0
Series B	22.16	54.07	17.89	4.7	30.72	18.01	6.1	5.6	21.68	25.2	0	28.15	0	40.74	8.8
Series C	0	50.03	30.39	0	16.02	0	0	0	0	0	4.82	0	9.82	0	4.3

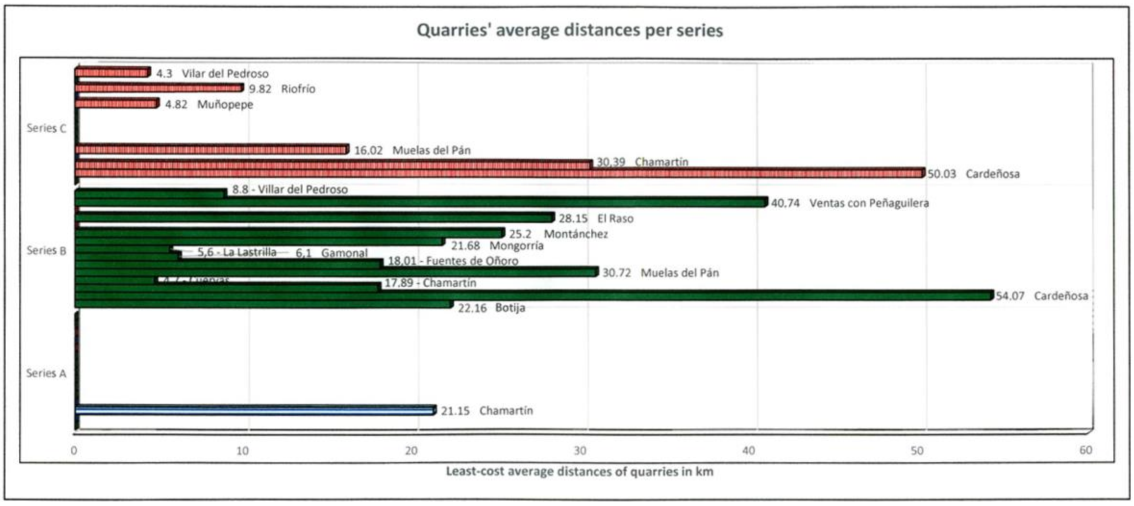


Fig. 9. Averages least-cost distances between quarries and series of sculptures with positive results.

and unexpected achievement, as we now realize that the resulting new figure was a twin 'verraco' of the complete sample exhibited in the Plaza de la Barrera. Both figures represent boars in an attacking posture and could have originally been placed on each side of the oppidum's rampart's gate, as the, up until now, only arrangement of 'verracos' found in their original position: the previously mentioned exemplars in the San Vicente gate of Avila.

At a later stage, workshops became established by producing many more sculptures, smaller and simpler, from series "C", dating back to the end of first century BCE and continued throughout the Roman period. It is possible the workshops were moved away from the quarries but the raw material could have been transported in blocks from the quarries to the new workshops, now located near the Roman cities.

Anyway, out of the main old quarry, the new products were displaced a shorter distances, 8.74 km average, despite they use to be smaller. But, then, they played a funerary roll, as protective symbols of the Roman deaths, a change to the individual sphere of a rural society which need smaller and cheaper products. Anyway, in a way for strengthening these conclusions, we are increasing the database of matched verracos and quarries samples, and we believe that the extension of the model to ramparts and buildings of Iron Age settlement of this region would illuminate the contexts of making and use of the "verracos".

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Footnotes

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1. In fact, all sculptures which are found as masonry of big historical buildings as Medieval churches and walls (in Ávila or Arévalo, per example), or reused in Roman constructions were rejected for the study because it is clear that they could be transported in historical times. This includes also examples which are in “urban” sites as historical ornaments of bridges, squares, etc. But we assume as valid cases for spatial analysis all sculptures found isolated and without reused signs. We also consider good some number of verracos, which were re-used as a wall-stones, benches, etc. in small houses, shacks or livestock buildings. They could not be located in their original places but these have to be closer to the re-used site because weights and values not allows to believe a carriage along medium or big distances.
2. We use three layers: sculptures and quarries represented by dots over a resolution digital elevation model with a grid of 25m, official Digital Spanish Map (MDT25), obtainable from the Instituto Geográfico Nacional (http://centrodedescargas.cnig.es/CentroDescargas/index.jsp).