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Social Resistance in Bronze Age Iberia

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Abstract
This article contributes to current debates on interaction, expansion, and resistance in Bronze Age Europe and the Mediterranean by refining world-systems approaches through the analysis of large, uneven archaeological datasets. Focusing on Early Bronze Age Iberia (ca. 2200–1550 BCE), it examines interactions between El Argar, one of the most dynamic economic and political formations in prehistoric Western Europe, and the non-state communities occupying its northern periphery. Drawing on more than a century of archaeological research across an area in excess of 210,000 km^2, the study combines statistical and spatial analyses of the distribution of the available evidence with archaeological interpretation. Results identify macro-regional north–south economic gradients alongside localised patterns of resistance and negotiation, revealing a long-lasting interaction zone characterised by settlement atomization, enrockment, selective exchange of metals and ivory, and elevated interpersonal violence. Rather than passive margins, peripheral communities actively constructed this borderland through economic autonomy, strategic interaction, and violent resistance. These findings refine world-systems perspectives while preserving the specificity of local dynamics.

Keywords Big data · Iberian Bronze Age · Core-periphery relations · Production · Exchange · Conflict

Introduction

Current research on the Bronze Age in the Euro-Mediterranean area is confronted with two critical cornerstones in the archaeological and palaeoecological record. The first concerns the apparent contradiction between, on the one hand,

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the similarity of certain raw materials, artefacts, technologies, and social practices observed at an almost continental scale, and, on the other, the multitude of small-scale archaeological *cultures* defined by 20th-century archaeology. Much Bronze Age research (e.g., the contributions in Fokkens and Harding 2013) can be broadly divided into generalising approaches, many of which can be subsumed under the concept of "bronzization" as a driving force of the period (Vandkilde 2016), or investigations focused on the dynamics of individual sites, regions, and cultural entities or phases.

It would be misleading to frame this debate simply as an opposition between *top-down* and *bottom-up* explanations, given that both approaches rely on a wide array of methodological and archaeometric tools and draw on anthropological concepts, theoretical models, and general paradigms to explain observed patterns. Rather, the divergence stems, in our view, from differences in the scale of observation and from contrasting assumptions about the causes of historical change, local vs. global. While the archaeological record of most parts of Europe points to community-based agrarian modes of production and distribution, with limited socio-political differentiation beyond age and sex, a relatively small number of Bronze Age societies underwent profound transformations, leading to large-scale, centralised, and highly unequal economic and political formations (González et al. 1992; Kristiansen and Larsson 2005; Meller and Bertemes 2010; Primas 2008; Risch and Meller 2015; Vandkilde 2007).

These Bronze Age "disruptive societies" (Moreno Gil et al. 2023) share a marked interest in particular raw materials, artefact types, and social practices, which can be understood as outcomes of the emergence of elites or dominant classes, craft specialisation, agricultural intensification, and expanding exchange networks. Prominent examples include Minoan Crete, Mycenaean Greece, the tell societies of the Carpatho-Danubian region, the Únětice group in Central Europe, and the El Argar group in southeastern Iberia. Supra-regional similarities in new emblems of political and economic power, such as weaponry and metal ornaments (e.g., Horn 2014; Horn and Kristiansen 2018; López-Padilla et al. 2024; Lull et al. 2017a; Meller et al. 2014; Peche-Quilichini et al. 2023), together with provenance studies (e.g., Bunnefeld et al. 2023; Radivojević et al. 2018) and aDNA analyses (Haak et al. 2015; Olalde et al. 2018; Villalba-Mouco et al. 2021), increasingly suggest that elites from distant regions were interconnected. Although there is broad agreement that these Euro-Mediterranean Bronze Age societies were not states in the same sense as Mesopotamia or Egypt, substantial debate remains concerning their political organisation and the mechanisms that triggered their rapid transformations (Gilman 1991; Kienlin 2015; Lull and Risch 1995; Schoep 2010; Schoep et al. 2012; Zich 2016). What remains less explored, however, is how these rapidly expanding formations interacted with neighbouring less politically and economically asymmetrical societies over extended periods, and how such interactions materialised in frontier zones characterised simultaneously by economic exchange, political negotiation, and episodic violence (McCarthy 2008; Moreno Gil et al. 2025; Naum 2010). Archaeologically, social resistance has often been inferred indirectly or treated as a residual category, yet its material expressions—in settlement choices, production strategies, mobility

patterns, and bioarchaeological evidence of violence—remain insufficiently integrated into large-scale comparative syntheses (Driessen and Letesson 2024; Graeber and Wengrow 2021; Robb 2025).

The second cornerstone of Bronze Age research concerns the synchrony of transformations observed across distant regions. Many of these disruptive dynamics appear to have been initiated following the socio-economic changes of the late 3rd millennium BCE. Around 2200 cal BCE, a near-simultaneous collapse affected the Old Kingdom in Egypt, the Akkadian Empire in Mesopotamia, the Early Bronze II/Troy II world in the Aegean and Anatolia, Bell Beaker communities across much of central and western Europe, and monumental fortified settlements and ditched enclosures in the Iberian Peninsula (for overviews see, Kuzucuoğlu and Marro 2007; Meller et al. 2015; Risch et al. 2015; for more recent regional assessments see, e.g., Groucutt et al. 2022; Lawrence et al. 2021). The causes of these broadly contemporaneous crises appear to be multiple. Abrupt climatic change associated with the 4.2 ka event may have triggered major productive stresses with political consequences (Arz et al. 2006; Bini et al. 2019; Coussin et al. 2023; Weiss 2015), while the detection of plague and salmonella pathogens in human remains suggests additional demographic pressures (Andrades Valtueña et al. 2022; Neumann et al. 2022; Rasmussen et al. 2015). These processes likely interacted with large-scale population movements starting around 3000 BCE in Eastern Europe and which involved individuals with so-called *steppe-related ancestry* (Allentoft et al. 2015; Haak et al. 2015; Olalde et al. 2018; Papac et al. 2021; Villalba-Mouco et al. 2021). A key challenge for current archaeological, palaeoclimatic, and archaeogenetic research lies in understanding the extent to which climatic, epidemiological, and migratory processes combined and fed back into one another, shaping divergent and, at the same time, interconnected trajectories of social organisation.

The primary goal of this study is to suggest ways of moving beyond these long-standing cornerstones by combining generalising and context-specific approaches through a large-scale review of the archaeology of the southeastern quadrant of the Iberian Peninsula, an area of more than 211,000 sq km (Fig. 1). In the context of the ongoing discussions, this geographically highly diverse area offers a particularly suitable case study for four reasons:

(1) The transformations following ca. 2200 BCE, marked, among others, by the shift from the Los Millares to the El Argar archaeological complex, are especially visible in the archaeological record, involving unprecedented rates of settlement abandonment and the rapid emergence of new hilltop settlement networks (Lull et al. 2015a, 2020; Peres and Risch 2022). Indeed, 87% of the 1,517 settlements analysed in the Spanish Meseta and Levant represent new Early Bronze Age foundations, unoccupied prior to ca. 2300–2200 BCE.
(2) After this transformation, sharply contrasting settlement forms and modes of production and distribution coexisted within the same macro-region. While El Argar exhibits features consistent with a state or state-like organisation (Lull and Micó 2011), including centralized production, marked wealth asymmetries,

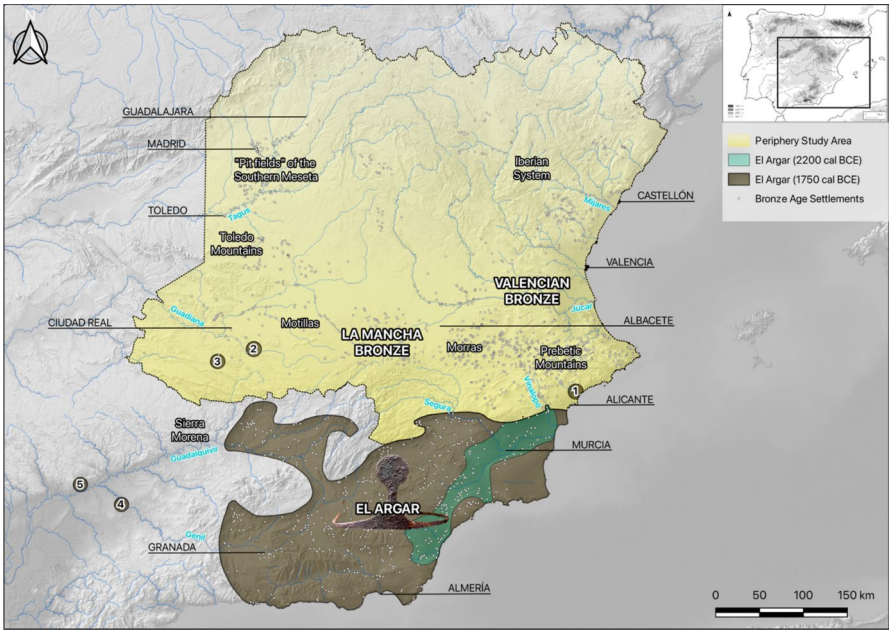


Fig. 1 The *southeastern quadrant* of the Iberian Peninsula during the Early Bronze Age (ca. 2200–1550 cal BCE). The El Argar settlement area expanded in the *Southeast* from a core region of ca. 5,500 sq km (green) to a territorial entity covering ca. 34,000 sq km (brown), with several enclaves defined by abundant settlement evidence, including intramural burials (1. Illeta dels Banyets, Campello, Alicante; 2. La Encantada, late occupation phase, Ciudad Real) or by distinctive funerary evidence (3. Cerro de San Sebastián, Puertollano, Ciudad Real; 4. El Rullero, Écija, Sevilla; 5. Setefilla, Lora del Río, Sevilla). Several archaeological groups and settlement types have been proposed north of El Argar, in the *central-eastern sector* of the Iberian Peninsula, encompassing most of the southern Meseta, the Spanish Levante, and southern Aragón. All settlement evidence of ca. 177,000 sq km has been included in the database BRONZESITES2.0 (yellow). Created by Marcello Peres (Color figure online)

and institutionalised violence, neighbouring regions to the north and west lack comparable evidence of political centralization or economic integration.

(3) The volume of settlement and artefactual data accumulated in the southeastern quadrant of the Iberian Peninsula over more than a century of excavations and surveys is exceptional in the context of the European Bronze Age. Reassessment of this record, together with focused investigation of the northern frontier of El Argar (Moreno Gil 2023; Moreno Gil et al. 2025), hints towards the emergence of a core-periphery relationship in Iberia following the disarticulation of Copper Age societies around 2300–2200 BCE (Chapman 1990, 2003).

(4) A fine-grained chronological framework, based on over 1100 radiometric dates, allow to determine the synchronicity of inter-regional dynamics between 2500–1500 cal BCE with an exceptional degree of precision.

Southeastern Iberia encapsulates within a single geographical framework the same contrasts that structure broader debates on Bronze Age social complexity

across Europe and the Mediterranean, making it an ideal laboratory for examining how expanding early complex societies interacted with non-state communities and how frontier zones were socially negotiated over time. The present study builds on this perspective by adopting an explicitly external viewpoint on El Argar, examining it through its dialectical relationship with surrounding non-state communities (for a similar approach, but in relation to ancient empires, see Düring and Stek 2018). It addresses three interrelated questions:

- Which strategies of production and distribution were developed by communities in central-eastern Iberia, and how were these spatially organised across a large and environmentally diverse territory?
- How did the emergence of a highly centralized, resource-intensive, and expansionist social formation affect the socio-political and economic dynamics of neighbouring independent communities?
- Through which defensive, social, economic, and political strategies were these communities able to resist annexation, negotiate interaction, and sustain alternative, autonomous socio-economic models?

In this sense, the present study also provides an empirical framework for assessing the explanatory potential of world-systems approaches in prehistoric archaeology (*sensu* Hall et al. 2011; Parkinson and Galaty 2010; Vondrovský et al. 2025), particularly with regard to frontier dynamics, asymmetrical interaction, and social resistance (Hanscam and Buchanan 2023; Ristvet 2018). Well-documented dynamics in both prehistoric and historical contexts include the flight of exploited populations from state systems, the demand of centralized societies for raw materials and labour, and the circulation of so called "prestige goods" among emerging local elites (Algaze 2004, pp. 17–40, pp. 75–150; Frank 1993; Kristiansen and Larsson 2005, pp. 4–30, pp. 142–249; Luxemburg 1913, pp. 316–391; Wallerstein 1974, pp. 15–38, 67–129, 2004, pp. 23–59; Scott 2009). Understanding the tension between attraction and resistance at the northern frontier of El Argar therefore requires close analysis of productive orientations, relations of production, and exchange mechanisms, with particular attention to the circulation of materials (e.g., metals), goods (e.g., grain), people, as well as the social configuration of violence. This externally oriented, frontier-based perspective constitutes the central analytical contribution of the present study.

Archaeological Setting

Hard evidence for abrupt climatic change during the second half of the 3rd millennium BCE remains elusive or inconclusive in the southeastern quadrant of the Iberian Peninsula (Dorado Valiño et al. 2002; López-Blanco et al. 2024; Manzano et al. 2019; Wolf and Faust 2015). Even if local environmental stress existed, it does not adequately explain the widespread and broadly synchronous abandonment of Chalcolithic settlements, many of which were located closer to fertile

land than the Early Bronze Age (henceforth EBA) hilltop sites that replaced them, nor the systematic search for naturally protected or fortified positions. Similarly, although epidemic pathogens have been identified elsewhere in Eurasia during this period, no such evidence has yet been detected in the bioarchaeological record of southeastern Iberia.

What is securely documented is that between 2450–2200 cal BCE, groups bearing a steppe-related genetic component appeared in the southern half of the Iberian Peninsula, likely arriving from north or northeastern Iberia (Olalde et al. 2018; Villalba-Mouco et al. 2021). Their arrival coincided with substantial changes in funerary practices—both in burial forms and grave goods—and with the introduction of metallurgical innovations with eastern European affinities, including stone anvils, forging hammers, and casting moulds (Lull et al. 2011, pp. 385–386; Risch 2002, pp. 106–110). Recent palaeogenetic studies further demonstrate that Argaric society emerged through the integration of local populations with individuals of, so called, *steppe ancestry* as well as people connected to the Mediterranean sphere (Villalba-Mouco et al. 2021). However important these long-distance connections may have been, they do not by themselves account for the pronounced divergence in settlement patterns, economic trajectories, and political organisation that developed between El Argar and the communities to its north and west.

El Argar is the most intensively studied and best-defined archaeological entity of this region. Developing between ca. 2200 and 1550 cal BCE in the arid Southeast, it takes its name from the eponymous site of El Argar (Almería), excavated at the end of the nineteenth century by Louis and Henry Siret (Siret and Siret 1887). Although debate continues regarding the extent to which El Argar may be characterised as a state (Aranda Jiménez 2023; Gilman 2023), there is broad agreement that it represents the most politically and economically centralized society of Bronze Age Iberia. This assessment is based on a combination of archaeological evidence, including a hierarchical settlement system dominated by large, permanently occupied centres, marked social differentiation expressed in standardised intramural burials with highly unequal grave assemblages, specialised craft production, large-scale storage and processing of cereals, extensive metallurgical production, monumental defensive architecture, and a distinctive repertoire of specialised weapons such as halberds and swords (Chapman 1990, 2008; Lull 1983; Lull et al. 2005, 2010, 2013, 2017a, 2018, 2021; Risch 2002). Together, these features strongly align with what political theory defines as a state-formation trajectory (Lull and Risch 1995; Lull et al. 2011). This trajectory was accompanied by sustained territorial expansion between 2200 and 1750 BCE, during which El Argar grew from a core region of ca. 5,500 sq km into a territorial entity covering ca. 34,000 sq km (Fig. 1), together with the systematic overexploitation of local environmental resources driven by cereal monoculture, which led to progressive environmental degradation (Carrión et al. 2001; Carrión 2002) and, ultimately, to the desertification of areas such as the Vera Basin by ca. 1500 BCE (Castro et al. 1999).

The Argaric landscape was dominated by large hilltop settlements, reflecting a pattern of population nuclearization (Moreno Gil et al. 2023, pp. 108–11),

generally between 1 and 4 ha in size and in some cases exceeding 10 ha (Lorca, Murcia). These centres mobilised large workforces to centralize and process substantial cereal surpluses and to construct monumental architectural features, including massive defensive walls (La Bastida, Murcia), tower-like storage or processing structures (Fuente Álamo, Almería), large rainwater cisterns (Fuente Álamo, La Bastida), and building complexes with clear political functions (La Almoloya, Murcia) (Ache 2019; Eguíluz Valentini and Risch 2024; Lull et al. 2014a, 2015b, 2021; Risch 2002). All excavated central settlements in the *core area* (Fig. 1, green) show uninterrupted occupation spanning more than six centuries, an exceptional degree of demographic continuity in the Bronze Age outside the Aegean world. Even in the Carpathian Basin, where most tell sites were occupied between 1950 and 1500 BCE, long-term settlement continuity of this kind is exceptional (Staniuk 2021). Although stratigraphic sequences occasionally include destruction layers, recent archaeogenetic research at La Almoloya confirms biological relatedness among individuals buried across successive architectural phases, demonstrating continuity of lineages with access to intramural burial practices (Villalba-Mouco et al. 2022).

In stark contrast, the northern periphery of El Argar (Fig. 1, yellow) is characterised by extreme population *atomization* and occupational instability. Early Bronze Age remains in this broad area have traditionally been classified into a series of regional "cultures", including *campos de hoyos* (pit fields) in the centre of the peninsula (Díaz-del-Río 2001), *poblados de altura* (hilltop villages) in the Toledo Mountains (Ruiz Taboada 1998), *Las Motillas* or *Bronce Manchego* culture in the La Mancha plain (Nájera 1984), *morras y castellones* in the eastern La Mancha (Fernández-Posse et al. 2008), and *Bronce Valenciano* culture in the coastal Levante (Fernández Vega 1985; Jover Maestre 1999; Jover Maestre et al. 2018). The *motillas* represent a distinctive type of fortified lowland settlement, characterized by the substantial labour investment required to construct massive concentric defensive walls, as well as specialized infrastructures for storage and water procurement, like masonry silos (López Sáez et al. 2014, lam. 2) and deep wells designed to access groundwater in dry riverbeds (Benítez de Lugo and Mejías Moreno 2016). The term *morras* refers to fortified hilltop sites in La Mancha, generally smaller than unfortified hilltop settlements and enclosed by concentric defensive walls. Beyond culturalist and regionalist perspectives, the adoption or combination of natural defenses and architectural barriers has been recognized as a pattern that clearly transcends regional boundaries (Fig. 2) and requires a more comprehensive and wide-ranging analysis.

Quantitatively, more than 83% of the known settlements in the *central-eastern sector* of the Iberian Peninsula measure less than 2000 m^2, nearly half are smaller than 500 m^2, and only 1.5% exceed 1 ha in size. This phenomenon, rather unusual in the European Bronze Age, has been defined as *atomization* (Peres and Risch 2022). On the other hand, over three quarters of these settlements are either fortified with stone barriers (e.g., Motilla del Azuer, Ciudad Real; Motilla del Acequión, Albacete), located in naturally protected perched positions (e.g., Pic dels Corbs, Castellón; Cabezo Navarro, Valencia), or combine altitude with architectural defences (e.g., Mola Alta de Serelles, Alicante; Cerro del Cuchillo, Albacete). This hybrid

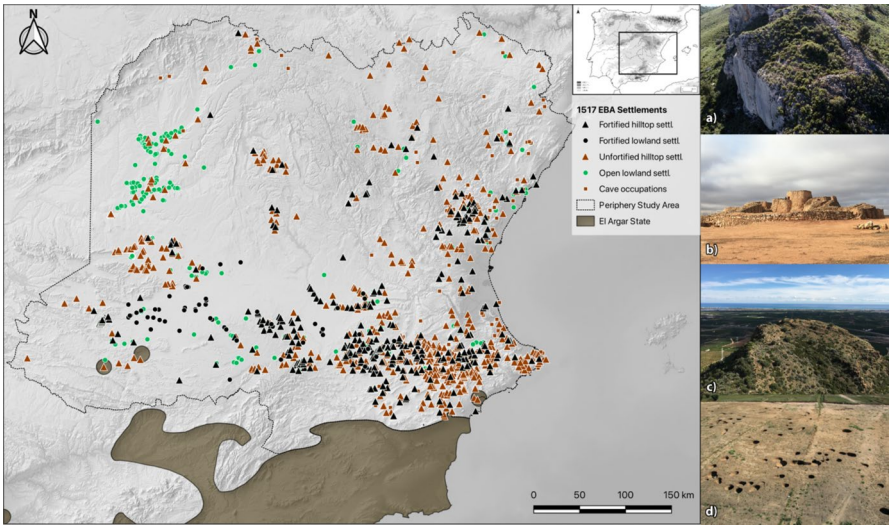


Fig. 2 Settlement evidence known to date in the *central-eastern sector* of the Iberian Peninsula. Five settlement forms can be distinguished: **a** Hilltop settlements with enclosure structures (Fortified hilltop settl.) (photo of Mola Alta de Serelles, Alicante: Jover Maestre and García Atienzar 2025, Fig. 9.25); **b** Settlements in plain with enclosure structures (Fortified lowland settl.) (photo of Motilla del Azuer, Ciudad Real: Marcello Peres); **c** Hilltop settlements without enclosure structures (Unfortified hilltop settl.) (photo of Pic dels Corbs, Valencia: Marcello Peres); **d** Settlements in plain without enclosure structures (Unfortified lowland settl.) (photo of Humanejos, Madrid: Garrido Pena et al. 2019, Fig. 3); **e** Cave occupations. Created by Marcello Peres

strategy—combining topography, elevation, and architecture—has been conceptualised as *enrockment* (Moreno Gil et al. 2023). The Spanish term *enrocamiento* (Peres and Risch 2022) encompasses three meanings: a defensive and protective movement in chess (known in English as *castling*), protecting something with large rocks (mostly in the realm of engineering works, such as dams), and getting jammed or blocked on a rocky place (mostly underwater). The English term *enrockment* is sufficiently broad and neutral to describe the protection and defence of communities through both the occupation of elevated rocky positions and the construction of stone walls, without implying specific socioeconomic dynamics. Moreover, it is particularly useful in the rough topographies that characterise large parts of the Mediterranean region. By contrast, the Italian term *incastellamento* (castling) is unsuitable in the EBA context, as it specifically refers to the construction of fortified strongholds and is closely associated with early medieval archaeological and historical frameworks. The sustained intensity with which this strategy of *enrockment* was applied over several centuries is unparalleled in most regions of Bronze Age Europe (Fig. 2).

Funerary remains in these peripheral settlements are rare or absent, and grave goods were not used as a means of overt social distinction. Occupational instability is indicated by radiometric dating, which suggests relatively short occupational spans averaging 125–170 years (Peres and Risch 2022), often ending in destruction layers and followed by abandonment or relocation to nearby hilltops. Only a few

strongly fortified *motillas* of La Mancha, such as El Azuer and El Acequión, display settlement continuity comparable to that of major Argaric centres.

Taken together, these indicators—settlement *atomization*, *enrockment*, and occupational instability—suggest that survival and prosperity in the periphery of El Argar depended heavily on defensive capacity, in a context of persistent social tension and intermittent violence. The spatial concentration of highly enrocked settlements immediately north of El Argar, where atomization levels are also highest, directly implicates the Argaric core as a major stress factor shaping regional settlement dynamics (Fig. 2). This pattern would also provide an explanation why El Argar achieved only limited territorial expansion to the north, when compared to its territorial gains toward the west and northwest (Fig. 1).

Materials and Methods

Recent research has therefore shifted away from treating the archaeological "cultures" of the southeastern quadrant as isolated entities and instead approaches them as mutually interacting and interdependent socio-political formations (Moreno Gil et al. 2023; Peres and Risch 2022, 2023a). Our analysis focuses on settlements of the central-eastern Iberian Peninsula between 2200–1550 BCE. Settlements, understood as places characterized by the recurrence of social practices involving some kind of material transformation for the production and reproduction of social life (Menasanch de Tobaruela 2003, p. 135), provide us with direct information not only on the social spaces but also on the means of production of the communities that frequented them. In the historical materialist sense, the means of production comprise the material conditions required for production, including land, natural resources, raw materials, tools, buildings, and other productive infrastructure; here, we focus on raw materials and tools as their principal archaeological proxies.

The groundwork for this macro-regional study is based on the doctoral research of one of us (Peres 2021), which led to the development of a 'big data' settlement database. This has been improved and expanded in subsequent studies (Peres and Risch 2022, 2023a), and still more settlements and artefactual data have been included for the present study (e.g., Basso Rial et al. 2023; Cabezas Romero R. 2023; Martín Morales and Benítez de Lugo 2023; Muñoz López-Astilleros 1998; Pastor Quiles et al. 2022). At the present moment, the database "BRONZESITES_IBERIA 2.0" includes 1,517 settlements distributed across an area of approximately 177,000 sq km (Fig. 2), with 125,278 collected data entries and an average of 83 information fields for each site. With this system, we opt for a change of perspective from a "cultural" filtering of the material remains towards a borderless view: a holistic perspective, beyond preconceptions or cultural barriers, where all material elements can be related at different levels (spatial, economic, political).

The data on settlement included in the database have been organised into two sections:

1. Topographical and architectural variables: height above mean sea level, relative altitude, topographical location, natural environment, settlements size and perimeter structures.
2. Artefactual variables: underground storage pits, masonry storage structures, storage vessels, sickle elements, grinding stones, pottery sieves, spindle whorls, loom weights, grooved hammers, flint arrowheads, flint cutting tools, stone axes/adzes, copper arrowheads, copper knives/daggers, copper axes/adzes, bone arrowheads, copper mineral/slag, crucibles, moulds, forging hammers, and ivory (SM1, Table 1 and Fig. 1). These 21 artefactual variables represent a wide range of productive activities, such as harvesting, storage, milling, dairy processing, spinning, weaving, construction, logging, carpentry, hunting, cutting of various materials, animal processing and metallurgy, as well as the circulation of ivory and the exercise of violence (SM1, Table 1).

A crucial aspect of the analysis is to what extent the data adequately represents past economic activities. Over a century of surveys and excavations has produced a vast, albeit uneven, archaeological record. The main question concerns the difference between excavated sites (134) and those that were only surveyed (1382). The regression analysis (i.e., the modelling of relationships between variables) indicates that, as expected, surveys have recorded a lower quantity and diversity of means of production than excavations. However, the relative proportions in which the different artefact categories are identified are comparable (Fig. 3). In fact, the correlation indices (i.e., the strength of association between variables) are exceptionally high, confirming that the survey evidence represents a significative sample of what would have been found had all sites been excavated.

Once the representativeness of the data had been verified, all settlement and economic information were introduced in a geographic information system (GIS) by using the open-source software QGIS to generate multilayer heatmaps of artefacts and productions (Figs. 4, 5, 6, 7, 8, 9).

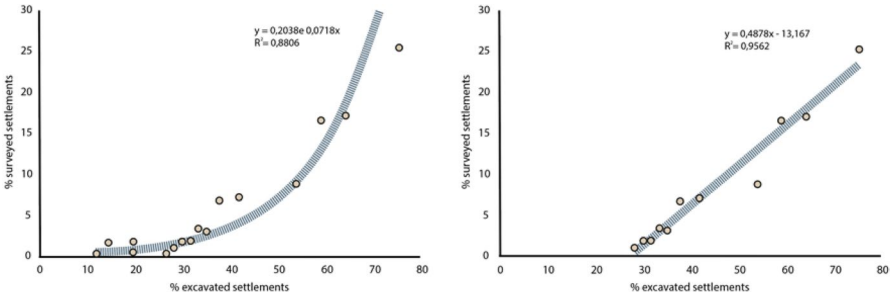


Fig. 3 Representativeness of artefact categories in surveyed and excavated sites (modified from Peres and Risch 2022, fig. 4). Left: including textile production (spindle whorls, loom weights), bevelled stone and copper artefacts (axes, adzes and chisels), flint, bone and metal arrowheads, grinding stones, sickle elements, flint cutting tools and copper knives/daggers, metallurgy (copper mineral/slag, crucibles, moulds), storage vessels, storage pits, pottery sieves, grooved and forging hammers, and ivory; Right: including only the 11 most frequent means of production (excluding storage pits, grooved and forging hammers, bone arrowheads, bevelled copper artefacts, and ivory). Created by Marcello Peres

A next step was the statistical analysis of the different means of production and of artefacts potentially capable of inflicting violence (axes, arrow heads, knifes, etc.). The correlation analysis (i.e., the assessment of relationships between variables) of 389 settlements (26% of the total) with evidence of two or more productive activities allowed to summarize the initial 21 artefactual categories (SM1: Table 1) into 14 principal means of production and violence (SM 1: Table 2). Through t-tests (i.e., tests of differences between group means), Chi-square tests (i.e., tests of association between categorical variables), and Pearson correlation coefficients (i.e., measures of linear association), the significance levels and degrees of association between the 14 main means of production and violence were analysed (SM1: Table 2). We also analysed the significant relationships of the means of production and violence, jointly considering settlement topography, relative altitude, size and defensive architectures, in order to determine the socio-economic orientation of the five main settlement types (Table 1; SM1: Table 3). Finally, a principal component analysis (i.e., a multivariate statistical technique for reducing data dimensionality and identifying major patterns of variation) was carried out to decipher the socio-productive macro-trends of the study area north of El Argar. The weights assigned by the principal components (PC) to each settlement were projected in the GIS to observe them in relation to the geographical space. The multi-variable framework of topographic, architectural, and artefactual variables allowed us to analyse the social relations of production of different settlement types and of different regions. This revealed the possible role of economic and/or conflictual relations with political actors outside the study area.

Finally, the spatial distribution of raw materials (ivory, silver), technologies (silver-riveted bladed weapons), and specialised weapons (halberds and swords), closely associated with the El Argar economy and its dominant social strata, was analysed in order to trace the interaction dynamics, including exchange, control, and conflict, across the southeastern quadrant of the Iberian Peninsula. The role of violence in these interactions was further assessed through a review of the available bioanthropological evidence.

Production Strategies

Out of the 21 recorded artefact categories, the most recurrent ones are related to the cultivation, storage and processing of cereals, the most prominent being sickle elements, grinding tools and storage vessels (Fig. 4). Flint cutting tools and bevelled stone artefacts, with potential association to various activities such as woodworking, hunting and animal processing, as well as potential use as weapons, are of notable relevance, as are flint and copper arrowheads. Textile production (represented by loom weights and spindle whorls) and dairy production (pottery sieves) have a moderate frequency, as do copper artefacts and metallurgical activities. In contrast, the scarcity of materials such as ivory, silos, grooved hammers, forging hammers and bone arrowheads is possibly a consequence of their limited visibility during surface surveys.

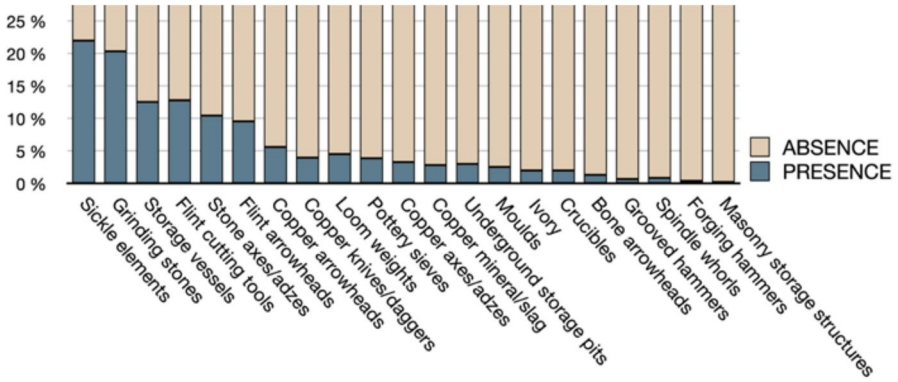


Fig. 4 Graph showing the presence of the 21 artefactual variables in the 1517 sites inventoried. Created by Marcello Peres

For the reasons mentioned above, we applied the Pearson correlation analysis (SM1: Table 2) to the 14 most representative means of production and violence across 389 settlements (26% of the total), each with two or more economic indicators. The Pearson correlation indices, their degrees of significance, and the relation of artefactual evidence to specific production processes allowed us to distinguish five principal realms of production and circulation:

1. Based on the available functional and morpho-technical studies, four economic indicators can be associated to storage and processing of cereals, and agriculture in general terms: sickle elements, grinding stones, large storage vessels, and silos. While sickle elements and grinding stones are significantly and mutually associated tools, large storage vessels are not (SM1: Table 2). This could suggest that settlements devoted to crop production and processing might not necessarily specialize in storing cereals, and vice versa.
2. Flint arrowheads are positively correlated with various flint cutting tools and stone axes. (SM1: Table 2). The economic relationship of these stone tools is already observed in certain Chalcolithic communities, and they seem to be linked to hunting activities and animal processing (Eguíluz Valentini et al. 2023). Edge ground tools can, of course, also be used for wood working. Another tool related to livestock farming would be the pottery sieves which, however, show a different economic behaviour (SM1: Table 2).
3. Textiles (spindle whorls and loom weights) represent the most cross-cutting form of production, given their significant link with almost all other production activities.
4. Metallurgy and all its products (copper knives/daggers, axes/adzes, and arrowheads) form—together with ivory—a highly correlated and clearly differentiated economic pattern (SM1: Table 2).
5. The behavior of ivory is particularly revealing, as its presence seems to denote settlements with a higher technological level and storage capacity (SM1: Table 2),

something which can be expected from a material with an exchange value function.

Once it was confirmed that the different economic indicators were not randomly distributed in the archaeological contexts and that different settlements followed different economic strategies, the question rose if these strategies were organized according to the topographic location of the settlements, the presence of fortifications, or if regional differences existed (Table 1).

Agriculture

In the Iberian Peninsula, no Bronze Age plow remains have yet been found, such as those from Lavagnone in Italy, but micromorphological analyses carried out in the surroundings of the Argaric site of Gatas have revealed plow-marks in paleosoils dated to the Bronze Age (Courty and Fedoroff 1999). Despite its invisibility in the archaeological records, it is generally believed that the use of the plow in the Iberian Peninsula became widespread in the late third millennium. This technological innovation may have favored the fragmentation of settlements and the productive independence of smaller family units (Díaz-del-Río 2023; Sherratt 1981), something clearly compatible with the atomization of settlements observed in the central-eastern quadrant of the Iberian Peninsula (Peres and Risch 2022).

Tangible artefacts related to agricultural production, such as sickle elements, grinding stones, storage vessels, underground storage pits, and masonry storage structures, have been recorded in 37.3% of the inventoried settlements (566/1517), with a uniform spatial distribution throughout the analyzed territory (Fig. 5). The only outstanding difference between the settlements has to do with the forms of storage: while large storage vessels are present throughout the territory, the Chalcolithic tradition of underground storage pits continues predominantly in the interior (Fig. 5). The presence of masonry storage structures with exceptional storage capacity is limited to three of the most outstanding settlements in the La Mancha plain (Motilla del Azuer, Motilla de los Palacios and Los Dornajos).

In terms of the topographic distribution of the means of agricultural production, a T-Test analysis carried out on 323 settlements with information on relative altitude and with a minimum of two productive indicators confirmed that the only materials and structures with notable altimetric differences among all 14 economic indicators -apart from the pottery sieves that will be discussed later- are the sickle elements, grinding stones and underground storage pits. While grinding stones and sickle elements stand out for being prevalent in high positions (with a mean relative altitude of 70 m and 69 m, respectively, and a maximum relative altitude of up to 340 m and 250 m), silos turn out to be characteristic in low-altitude settlements (mean 36 m / max. 68 m). More specifically, it can be observed how the cultivation and processing of cereals are associated with the unfortified hilltop settlements, while the storage in underground storage pits reaches high levels of significance with the unfortified lowland settlements (Table 1). Storage vessels reveal a different socio-economic dynamic, being significantly linked to fortified settlements, both in lowland and

Table 1 Relation between settlement forms and means of production and violence

Economic patterns	Unfortified lowland settlements (n=76; 37% excavated)	Fortified lowland settlements (n=13; 54% excavated)	Unfortified hilltop settlements (n=147; 19% excavated)	Fortified hilltop settlements (n=109; 31% excavated)	Caves (n=44; 32% excavated)
Positive relationship	Silos (<0,0001) Flint arrowheads (0,0017) Flint cutting tools (<0,0001)	Storage vessels (<0,0001) Silos (<0,0001) Textile (0,0007) Copper axes/adzes (0,0183) Copper knives/daggers (0,0119) Stone axes/adzes (0,0433) Ivory (0,0006) *Pottery sieves (0,067)* *Copper arrowheads (0,064)*	Sickle elements (0,0013) Grinding stones (0,029)	Storage vessels (0,0002) Textile (0,038) Metallurgy (<0,0001) Copper knives/daggers (0,019)	Flint cutting tools (0,009)
Negative relationship	Copper axes/adzes (0,003) Copper arrowheads (0,0174) Metallurgy (0,0354) *Copper knives/daggers (0,0719)*		Storage vessels (0,0237) Stone axes/adzes (0,005) Flint arrowheads (0,004) Flint cutting tools (0,018) *Pottery sieves (0,066)*	Flint cutting tools (0,004) Silos (0,0092)	Sickle elements (<0,0001) Silos (0,0187) Grinding stones (0,0008) Textile (0,037) Metallurgy (0,009)

Only statistically significant results (according to Chi^2 test $p < 0.5$) are mentioned (SM1: Table 2), as well as results which are slightly below the threshold of significance (in *italics*). Only 389 settlements with two or more productive indicators were considered

high-altitude contexts (Table 1), and presenting a positive correlation with metals, metallurgy and ivory (SM1: Table 2).

Husbandry, Hunting and Animal Processing

Unlike agriculture, husbandry involves few specialised artifacts (Elías Pastor 2003), with most implements being multifunctional and used across a range of other productive activities as well as in contexts of conflict. The importance of arrow heads as weapons in violent confrontations is attested in the rock art of the Spanish Levant, probably dating to the Neolithic and Copper Age periods (for a summary, see Fernández López de Pablo 2006; López-Montalvo 2018). However, of all the scenes involving the use of archery, only 8% depict confrontations between individuals or groups of individuals (Risch and Meller 2017). The rest refers to hunting, which probably was also the main function of arrow heads. On the other hand, axes can generically be related to wood working. However, in the rather open landscape which seems to have dominated the central-east quadrant of Iberia, stone and metal axes might have been more relevant in the butchering and processing of animals, which has been confirmed through use-wear analysis on Neolithic tools (Masclans et al. 2017). This result is supported by the significant association observed between number of arrow heads and stone axes in the Copper Age settlements (Eguíluz Valentini et al. 2023), an association we continue to detect in the EBA (SM1: Table 2). One category of artefact that may be considered specialised in the processing of animal-derived products is pottery sieves. Several analyses of comparable pottery sieves have identified residues of animal fats from Neolithic contexts in northern Europe and Dalmatia (McClure et al. 2018; Salque et al. 2013), and from Bronze Age contexts in Spain (El Portalón de Cueva Mayor [Francés-Negro et al. 2021]; the Argaric site of Peñalosa [García García 2021]), suggesting an association between this vessel type and milk processing. In this regard, pottery sieves may be interpreted as cheese strainers used to separate curds from whey, while simultaneously functioning as cheese moulds. More generally, they may be defined as perforated cheese-making vessels.

Artifacts related to husbandry, hunting and animal processing have been found in 23.1% of the sites inventoried (351/1517), making this productive sphere the second most important in the study area (Fig. 4). This confirms, once again, the primarily subsistence-orientated nature of the communities of the central-eastern quadrant of the Iberian Peninsula.

Flint arrowheads, which disappeared abruptly in El Argar around 2200 cal BCE, continued to be used in the central-eastern quadrant since the Palaeolithic without interruption and with a relatively high frequency, being an accessible, widespread and multi-purpose tool. In the La Mancha plain there is a lower concentration of flint cutting tools, possibly due to the greater importance of agriculture and husbandry than hunting. In contrast, the diffusion of bone arrowheads seems to be a phenomenon more characteristic of the Spanish Levante, especially in the area of Castellón and northern Valencia (Fig. 6; Peres 2021, pp. 176-180). Dairy processing by means of pottery sieves (Peres 2021, pp. 223-230),

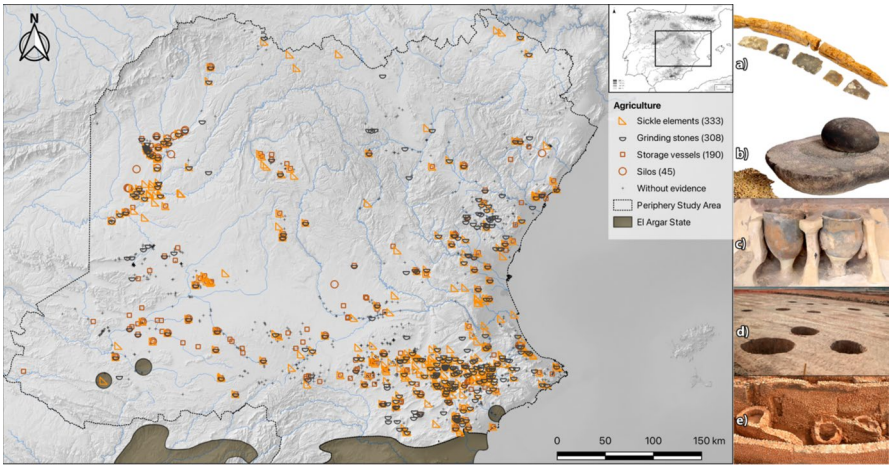


Fig. 5 Distribution of means of agricultural production in the central-eastern quadrant of the Iberian Peninsula. On the right side: **a** sickle complete with wooden handle and flint sickle elements from Mas de Menente (Alcoi, Alicante) (Museu de Prehistòria de València); **b** Grinding slab and handstone from Lloma de Betxí (Paterna, Valencia) (de Pedro Michó and Soler Mayor 2015, p. 6); **c** large storage vessels from Cabezo Redondo (Villena, Alicante) (photo: R. Risch); **d** underground storage pits from La Villeta (Ciudad Real) (Benítez de Lugo 2015, fig. 5.6); **e** masonry storage structures from Motilla del Azuer (Daimiel, Ciudad Real) (López Sáez et al. 2014, lam. 2). Created by Marcello Peres

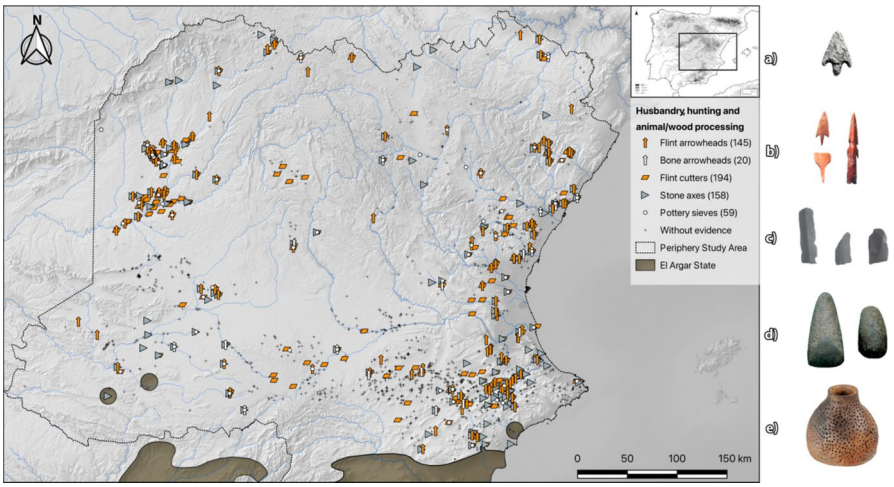


Fig. 6 Distribution of artefacts related to husbandry, hunting and animal processing in the central-east quadrant of the Iberian Peninsula. On the right side: **a** flint arrowhead from Muntanya Assolada (Alzira, Valencia) (Museu de Prehistòria de València); **b** bone arrowheads from Cabezo Redondo (Villena, Alicante) (Hernández Pérez et al. 2016b, p. 98); **c** flint cutting tools from Cabeçó de Serrelles (Alfafara, Alicante) (Hernández Pérez et al. 2016a, p. 89); **d** stone bevels from Terlinques (Villena, Alicante) (photo: R.E. Basso Rial); **e** pottery sieve from Castillo de Frías (Frías de Albarracín, Teruel) (Museo de Teruel). Created by Marcello Peres

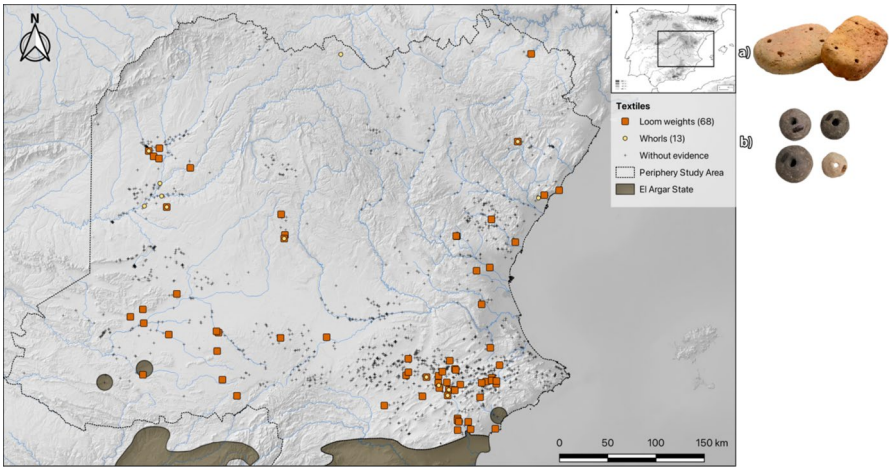


Fig. 7 Distribution of artefacts related to textile production in the central-east quadrant of the Iberian Peninsula. On the right side: **a** loom weights from Lloma de Betxí (Paterna, Valencia) (de Pedro Michó and Soler Mayor 2015, p. 74); **b** spindle whorls from Cabezo Redondo (Villena, Alicante) (photo: R.E. Basso Rial). Created by Marcello Peres

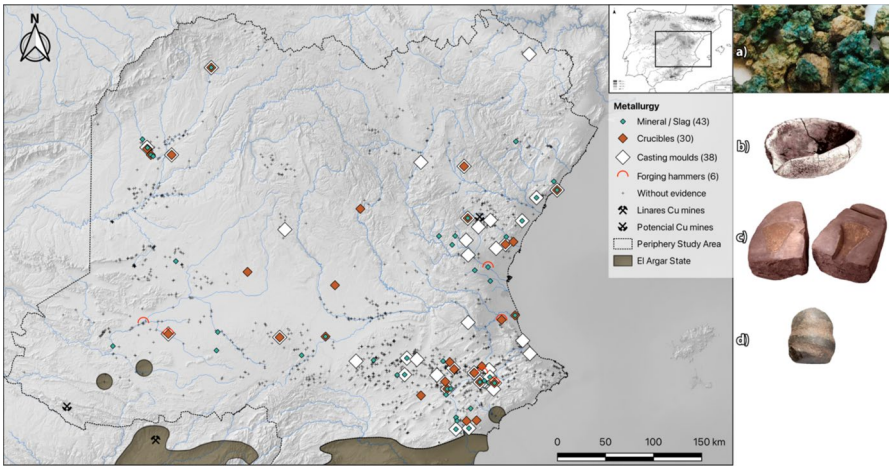


Fig. 8 Distribution of artefacts related to the melting, casting and forging of metals in the central-east quadrant of the Iberian Peninsula. Al lado derecho: **a** copper mineral/slag (Consuegra and Díaz-del-Río 2013, p. 25); **b** crucible from Orpesa la Vella (Orpesa, Castellón) (Gusi and Olària 2014, fig. 64); **c** foundry mould and lid from Mola Alta de Serelles (Alcoi, Alicante) (Museu de Prehistòria de València); **d** forging hammer from Cabeço de Serelles (Alfafara, Alicante) (Hernández Pérez et al. 2016a, fig. 12). Created by Marcello Peres

practically unknown in the Argaric *core area*, is one of the most characteristic productions of the central-eastern quadrant of Iberia. Moreover, it has a relatively homogeneous spatial distribution, as do the flint cutting tools and bevelled stone artefacts associated with butchery (Fig. 6). In this sense, it is possible to suggest

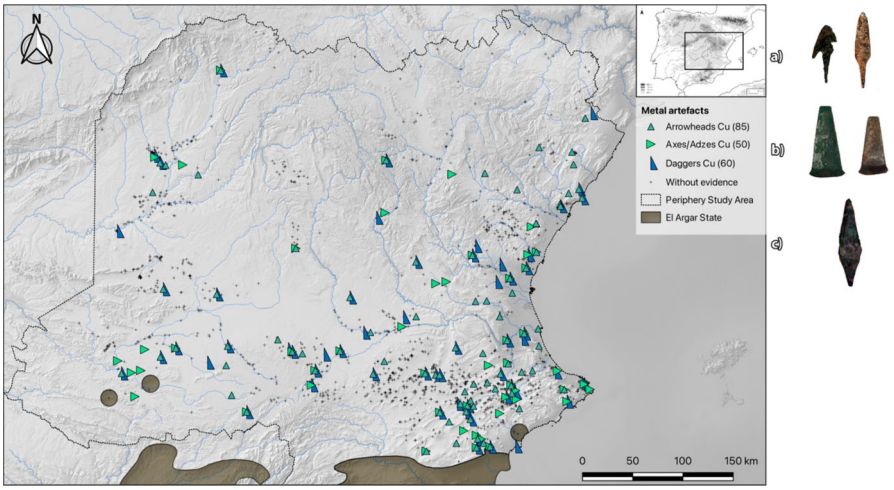


Fig. 9 Distribution of metal artefacts analysed in the central-east quadrant of the Iberian Peninsula. On the right side: **a** copper arrowheads from Muntanya Assolada (Alzira, Valencia) and from Lloma de Betxí (Paterna, Valencia) (Museu de Prehistòria de València); **b** copper dagger from Castillejo de Bonete (Terrinches, Ciudad Real) (Benítez de Lugo et al. 2020, Fig. 3); **c** copper axes from Lloma de Betxí (Paterna, Valencia) (Museu de Prehistòria de València). Created by Marcello Peres

that all three artefacts had a similar distribution, basically due to their link with animal processing. Moreover, the persistence of flint arrowheads and the presence of an intense dairy production are autochthonous and characteristic economic features that clearly differentiate the productive forces of the *periphery* with respect to El Argar.

The T-Test on relative altitude and productive variables shows a statistically significant pattern, with dairy sieves located in low-altitude settlements (mean relative altitude: 38 m; maximum: 153 m). Sieves, stone bevelled, arrowheads and flint knives also show a significant concentration in lowland settlements (Table 1). On the other hand, cave occupations are only distinguished economically by the presence of flint cutting tools (Table 1), which is consistent with their use (especially in the Levante) during seasonal activities linked to livestock transhumance.

If we compare the distribution of tools linked to subsistence production, we observe a dichotomy between the settlements at high altitude, which are distinguished by the frequency of sickle elements, grinding stones and storage vessels, and the settlements on the plain, which have a significant concentration of silos, pottery sieves, bevelled stone artefacts, arrowheads and flint blades/knives. In other words, within subsistence production, the means of production of husbandry, hunting and animal processing are located in more accessible settlements and closer to water supplies than those related to the harvesting, storage and processing of cereals.

Textiles

Spindle whorls and loom weights are good proxies for textile production. According to the available evidence, linen seems to have been by far the most important raw material for textiles (Basso Rial 2022). Most of the linen remains identified in the Iberian Peninsula have been found in Argaric burial contexts. The vast majority were found adhered to 64 bronze knives/daggers from El Argar, El Oficio, La Almoloya, La Bastida and San Antón, among other sites, but also associated to halberds, axes, bracelets, earrings, beads, awls, and the silver diadem from Tomb 398 at El Argar (Basso Rial 2023). Nevertheless, in the central-eastern quadrant we have the exceptional linen fabric from the infant inhumation at Monte Bolón, Alicante (Basso Rial 2023, fig. 15), and three fragments found in a habitat context at Cabezo Redondo, one of them found attached to carbonised wood remains (Soler García 1987, plate 78.1), and the other two adhered to copper knives/daggers (Basso Rial et al. 2023, fig. 10). The only physical remains of wool, at the moment, have only been detected in the tomb 121 of the Argaric site of Castellón Alto, chronologically dated to ca. 1800–1600 cal BC (Molina et al. 2003). However, the progressive changes in loomweight typology and in the quantity and diversity of spindle whorls between 1800 and 1600 cal BC appear to indicate the gradual introduction of wool as a textile fiber around the middle of the second millennium BC (Basso Rial et al. 2023).

In the studied area, the textile tool set is not the most frequent artefact category (only 4.8%, 73/1517) yet it is the most evenly distributed (Fig. 7). The use of clay loom weights of different shapes and sizes (Basso Rial et al. 2023; Peres 2021), is attested and widespread throughout the analysed territory. In some cases, associations of more than 30 pieces have even been found, indicating the presence of complete vertical warp-weighted looms, as in Lloma del Betxí (Paterna, Valencia) and Cabezo Redondo (Villena, Alicante). The scarcity of spindle whorls and their uneven distribution, being practically absent in the La Mancha plain, is probably related to the raw materials used: besides the ceramic artefacts in the central-eastern quadrant, spindle whorls can be made of deer antler, as in some El Argar sites, or of wood, as preserved in contemporary settlements in northern Italy (e.g., Fiavé palafittes) and in Egypt (e.g., Gurob).

Textile production took place mainly in settlements perched at relatively high relative altitudes (mean: 65 m; maximum: 200 m) but below the average height of agricultural indicators. Correlation analysis suggests a clear association between textile production and settlements with architectural defences, as well as storage vessels and copper daggers/knives (Table 1). At the same time, textile production had to be highly transversal, given its significant correlation with all means of production, except flint cutting tools (SM1: Table 2).

Metallurgy and Metal Artefacts

It is possible to trace Bronze Age metallurgy in two different economic spheres: through the presence of workshops and tools related to the smelting, melting and

forging; or through the finished artifacts and their distribution. In the central-eastern quadrant of the Iberian Peninsula, 14% of the settlements have at least one metal artefact or an indicator of metallurgical activity. Specifically, metallurgical workshops and metal artefacts are known from 84 and 174 settlements, respectively. This highlights the relative scarcity of metallurgical activities (5.5%) and metal artefacts (11.4%) compared with subsistence production tools.

In the archaeological record of the Iberian Peninsula, we identify four main indicators of metallurgical activity: copper mineral/slag (including extracted mineral, crushed mineral, slag, and copper droplets), crucibles, casting moulds, and forging hammers (Fig. 8). Only six of the 84 metallurgical workshops have yielded evidence of the simultaneous occurrence of the first three copper-processing elements (Peres 2021, p. 275), and only at Ull del Moro (Alcoy, Alicante) was there also a forging hammer. This might suggest that smelting and forging were carried out in different places. Nevertheless, it should be noted that the identification of forging hammers in the macrolithic record of the Iberian Peninsula is still at an early stage, as their typological definition and recognition are relatively recent (Delgado-Raack et al. 2016; Delgado-Raack and Risch 2017). Locating specific metal working spaces is even more complicated: only in Orpesa la Vella (Orpesa, Castellón) a furnace and some terracotta tuyeres were excavated (Gusi and Olària 2014), while in Mola Alta de Serelles (Alcoy, Alicante) the presence of six moulds in a single department suggests the presence of a specialised workshop (Simón García 1998).

The ensemble of metallurgical materials and tools and, therefore, the knowledge of metal extraction and casting techniques, seem to be common to the whole study area, although the La Mancha plain stands out for its low number of production-related remains. The scarcity of stone moulds in this area could indicate the continued use of sand moulds that leave no trace in the archaeological record (Peres et al. 2024) or clay moulds, frequently underrepresented due to their fragmentation and poor preservation (Rose et al. 2023). The finished metal artefacts show an even distribution, both in terms of types and technologies, with a relatively low frequency of finds compared to other strategic production areas. Copper arrowheads have been found in 5.6% of the inventoried settlements, copper bevelled tools (axes and adzes) in 3.3%, and copper knives/daggers in 4%. All three categories of metal artefacts can also be used as weapons in violent conflicts, as can their stone equivalents. As with all productions, there is a higher density of metal artefacts/weapons in the southeast, a direct consequence of the higher density of settlement attested around the Font de la Figuera crossroads (Peres and Risch 2022, fig. 7), but in this case the Villena corridor that connects the periphery with the Argaric territory is clearly the area with the highest density of metal artefacts. This distribution, also in potential weapons, cannot be considered random, because along the corridor the settlement density decreases progressively in the direction of El Argar (Jover Maestre et al. 2018, p. 101; Peres 2021, p. 67), while the density of metal artefacts/weapons increases (Fig. 9).

Although the indicators of metallurgical activities, weapons and copper tools show a generalised distribution, their relationship with topography and settlement types reveals some exceptional patterns. The T-Test between relative altitude and means of production shows that metallurgy tends to be located in perched positions

(mean and maximum relative heights are 73 m and 200 m, respectively), similar to the means of harvesting and grinding. Furthermore, the evidence for metallurgical production is the only evidence that is significantly, positively and exclusively associated with fortified high-altitude settlements, most of which are located in the south-east of the studied region. In this sense, metallurgy must have been the most deeply *enrocked* productive activity. Copper daggers, as well as textile production and storage in large vessels, are particularly concentrated in fortified settlements, both on the hilltop and on the plain. The *motillas* are more closely associated with metal weapons, such as arrowheads and copper daggers, than with metallurgy (Table 1). This confirms, once again, an altimetric and regional dichotomy between production and products.

Ivory

In recent decades, the number of ivory artefacts recovered in prehistoric sites has increased notably due to the greater attention paid to this material in excavations and ancient museum collections. Recent analyses of a slice of ivory found at the Cabezo Navarro settlement (Ontinyent, Valencia) revealed that the raw material belonged to an African steppe elephant, probably from Libya, Egypt or Sudan (López Padilla 2011, p. 327). Although no whole tusks have been found at any Iberian Bronze Age settlements, blanks in different stages of transformation are known, such as slices cut transversally and/or longitudinally (which we will consider here as imported raw material), pre-cut prismatic sticks (preforms) and finished objects in the form of buttons (final products).

The exceptionality of this material does not lie in its physical or functional characteristics, but in its rarity and exogeny. In the central-eastern quadrant of the Iberian Peninsula we have ivory remains in only 2% of the inventoried settlements. Finished ivory products have only been found in 30 settlements, and among these only five also have partially sawn preforms for the manufacture of buttons, and five have raw material and/or carving remains (Fig. 10).

The distribution of ivory is clearly biased towards the southeast and gradually decreases until it disappears completely in a northerly and north-westerly direction. The only four ivory workshops are located close to the Argaric territory. Among these, the most abundant eburnean assemblage has been found in the Middle Bronze Age levels of the Mola de Agres (Agres, Alicante), a fortified hilltop settlement which also stands out as one of the most important metallurgical workshops in the central-eastern quadrant. Here 48 pieces of ivory have been found: raw material (Fig. 10a), carving remains, lang and short prisms (Fig. 10b), pendants, perforated plaques, buttons, bracelets and a handle (Pascual 2012). The decision to gather and guard ivory pieces in specific locations of the settlements is well exemplified at Lloma del Betxí (Paterna, Valencia), where more than half of the 46 ivory objects (mostly buttons and pendants) were stored in a single ceramic vessel in Room I (Fig. 10c). The concentration of ivory in specific rooms, and even more so in ceramic vessels, indicates a similarity with the Argaric world in terms of the

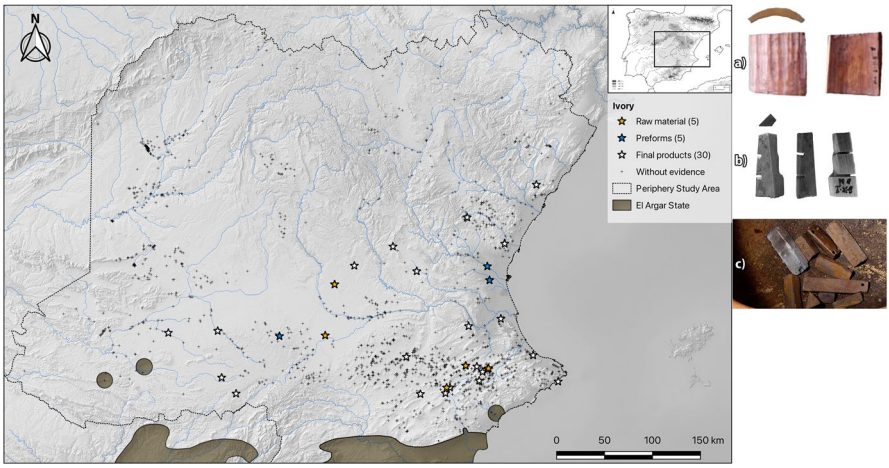


Fig. 10 Distribution of ivory production in the central-east quadrant of the Iberian Peninsula. On the right side: **a** Raw material, curved carved portion of a tusk from Mola d'Agres (Agres, Alicante) (Pascual 2012, Fig. 4); **b** Preform, partially serrated triangular prism from Mola d'Agres (Agres, Alicante) (Pascual 2012, fig. 7); **c** Final product, long and short prismatic buttons from Lloma del Betxí (Paterna, Valencia) (de Pedro Michó and Soler Mayor 2015, p. 94). Created by Marcello Peres

control and centralization of an exogenous material of great symbolic value (Liesau and Cabrera 2024).

The T-Tests carried out do not show any significant relationship between the presence of ivory and the size or topography (relative altitude, lowland or hilltop) of the settlements, but the Chi^2 reveals a clearly positive relationship (0.0006) with fortified settlements (Table 1).

The significant Pearson's correlation of ivory with metallurgy and all its products (knives/daggers, axes/adzes and arrowheads) forms a clearly differentiated economic pattern associated with fortified or high-altitude settlements (Table 1; SM1: Table 2). The significant correlation of a material such as ivory, which we suspect had an exchange value, with *enrocked* settlements, which are characterised by a higher technological level and storage capacity than other sites, is a result whose political and social implications deserve to be explored further.

Discussion

The spatial distribution of the means of production in the central-east quadrant of the Iberian Peninsula is widespread (Figs 5, 6, 7, 8, 9, 10). Not one of the 21 artefact types is restricted to any region, area, nor to the cultural entities defined by traditional archaeology. While the artefactual evidence suggests a shared productive and technological environment, the density and management of the means of production is not even neither in space nor in relation to settlement types. These differences require to be understood in more detail, both in terms of the internal socio-economic relations, as with regards to El Argar.

Internal Asymmetries North of El Argar

The previously identified realms of production and circulation associated with the different settlement types allow for the interpretation of broader socio-productive macro-trends, while also raising the crucial question of social asymmetries in access to the means of production. To explore this issue, we have opted for a change of analytical perspective, carrying out a principal components analysis on the sample of 389 settlements with relevant economic indicators (SM2). This analysis has revealed three structuring axes, which confirm the positive and negative correlations already observed:

1. The first component (PC1) is highly correlated (R^2= 0.91) with the number of artefact categories identified in a settlement. It is therefore an indicator of the amount of archaeological information available, rather than of productive distances.
2. The second component (PC2) contrasts settlements with stone tools related to hunting and animal processing (arrowheads and flint cutting tools, bevelled stone artefacts), with settlements characterised by tools for harvesting and cereal processing (sickle elements and grinding stones). These two assemblages are associated, respectively, with open settlements in lowland and with hilltop settlements (SM1: Fig. 2).
3. The third component (PC3) shows a dissymmetry between settlements with a primary agricultural orientation and their derivatives (grinding stones, underground storage pits, sickles, pottery sieves, and textiles) and those with clear access to metal tools and weapons (daggers, axes, and arrowheads), as well as ivory. These elements confirm a certain opposition between use values (food subsistence) and exchange values (copper and ivory), with the latter possibly denoting greater economic power. This differentiation transcends topography and forms of settlement (SM1: Fig. 2).

The low weight of metalworking in the definition of PC 2 and 3 reflects a homogeneous distribution of these means of production in the territory analysed. In this sense, metallurgical production itself does not seem to have been a determining economic element, whereas access to metal products appears to have been.

On the other hand, principal component analysis warns that a simple distinction between highland and lowland settlements, or between unfortified and fortified, does not fully explain the relations of production in the central-eastern quadrant of the Iberian Peninsula. The economic reality between ca. 2200–1550 BCE must have been diverse and changing, within a shared material background. Only metal and ivory clearly distinguish certain hilltop and/or fortified settlements as one moves nearer to the border with El Argar.

At the spatial level, GIS-based projections of PC 2 and 3 reveal a general north-south economic gradient, without sharp boundaries (Fig. 11). According to PC 2, more hunting and husbandry-oriented economies appear mostly in the

north versus more cereal-oriented economies corresponds to settlements in the southeast (Fig. 11, top). PC 3 indicates a greater importance of the cereal, textile and dairy economies in the north, and greater access to metals and ivory in the south and southeast (Fig. 11, bottom). We may conclude that despite of relative fluidity in the access to the means of production, a gradual, but clear economic differentiation developed from south to north. Particularly, the increase of the frequency of certain raw materials, such as ivory and copper, indicates an unequal circulation and a possible influence of factors external to the territory analysed.

It is equally important to note that these two principal components, although statistically significant, together explain only 19% of the inter-regional variability in the archaeological record. A further 59% of the variance remains unexplained once PC1—largely driven by sample size effects– is excluded, and likely reflects local or small-scale dynamics. In this way, the analysis allows us to differentiate between processes operating at broader spatial scales and those shaped by local conditions, an issue that lies at the core of debates concerning the explanatory capacity of World-Systems analysis in archaeology (Hall et al. 2011).

Interactions with El ARGAR

Any approach to the El Argar entity must take into account its expansive dynamic, particularly during the twentieth and nineteenth centuries BCE (Fig. 1). Originating from a *core territory* of approximately 5,000 sq. km at the end of the third millennium BCE, encompassing the fertile coastal plains between Almería and Alicante (Hernández Pérez et al. 2021), a recognizable settlement pattern, architectural repertoire, artefact assemblage, and suite of funerary practices became established across much of southeast Iberia (Lull et al. 2011; Moreno Gil et al. 2023). The marked distinctiveness of El Argar material culture has made it possible to identify borderlands and zones of interaction, which appear to have been especially pronounced to the north of the original core area (Jover Maestre and López Padilla 2004; Martínez Monleón 2014; Moreno Gil et al. 2025). This territorial expansion–conceptualised as a process of "argarisation" (Moreno Gil et al. 2023)—was particularly successful towards Granada in the west and the upper Guadalquivir valley in the northwest. The motivations underlying this expansion appear to have included access to the fertile valleys of the more humid southeastern hinterland, north and west of the Sierra Nevada, as well as to the rich metalliferous deposits of the Linares mining district in the eastern sector of Sierra Morena (Fig. 1). Extensive excavations and systematic surveys carried out by the University of Granada at the metalworking settlement of Peñalosa and in the Rumblar valley have documented a process of colonisation, fortification, and hierarchisation of a previously uninhabited territory, together with the onset of large-scale, intensive mining activities in the resource-rich Linares–La Carolina mining district (Arboledas Martínez et al. 2017; Contreras Cortés et al. 2000; Delgado-Raack et al. 2026; Moreno Onorato and Contreras Cortés 2010). These sites might be interpreted as a network of functionally specialised outposts dedicated to resource extraction, the production of metal surpluses, and territorial control within the mining district.

Beyond this largely "continuous" expansion, increasing evidence suggests that the El Argar network also operated through geographically discontinuous presences. In several cases, the archaeological record points to the establishment of enclaves, that is, resident communities reproducing recognisably El Argar domestic and funerary practices within regions otherwise dominated by different Bronze Age traditions. The clearest example is Illeta dels Banyets, El Campello (Fig. 1), an El Argar settlement dated to ca. 2100/2000–1550 BCE, located on a small island within a region otherwise dominated by sites attributed to the Valencian Bronze Age (Soler Díaz 2006). The nearest known El Argar settlement (possibly Tabaià) would have been situated ca. 40 km to the southwest.

Evidence for enclave-like situations is also present in inland regions. At the hilltop settlement of La Encantada (La Mancha), intramural burials and associated materials characteristic of El Argar—particularly metal objects and pottery—have been identified in a late Early Bronze Age context dated to ca. 1750–1550 BCE (Sanz del Cerro and Sánchez Meseguer 1988). In this case, the closest El Argar sites are located approximately 70 km to the south. Intramural burials displaying diagnostic El Argar features have also been recorded at other sites in La Mancha (e.g., Cerro de San Sebastián [Siret 1913, p. 383]) and in the middle Guadalquivir valley (e.g., Setefilla [Aubet Semmler and Serna González 1981] and El Rullero, Écija). Although the corresponding settlement contexts are badly known, these materials and burials suggest a more sporadic presence of El Argar outposts.

These latter cases are more difficult to interpret unambiguously. They may reflect short-lived or demographically limited enclaves, the episodic presence of El Argar groups, or the selective adoption of El Argar funerary practices by local communities. Such variability suggests that El Argar expansion did not operate through a single, homogeneous mechanism, but rather through a range of interactional forms, from extractive and strategic outposts to socially reproductive enclaves, as well as hybrid or transitional situations shaped by local conditions.

The recognition of these different modes of interaction has important implications for how El Argar territoriality is conceptualised. Rather than a uniformly bounded territory, the El Argar world appears as a differentiated landscape composed of areas with dense settlement, zones of interaction, and isolated presences embedded within otherwise "foreign" material environments. This perspective requires a modification of earlier representations of El Argar territorial extent (Delgado-Raack and Risch 2016, Fig. 1; Lull et al. 2011, Fig. 3) and foregrounds the role of negotiation, selective incorporation, coercive dynamics, and potential resistance in shaping the archaeological expressions of El Argar expansion (Figs. 1, 12).

The existence of exchange relations and permeable contact, direct or indirect, between El Argar and the communities living in its periphery is also confirmed by the distribution of certain Argaric objects beyond its territorial limits (Fig. 12). This is the case, among others, of the Argaric halberds found in Motilla del Retamar, Ciudad Real (Benítez de Lugo et al. 2022), in Tossal de l'Abeller, Castellón (Oliver Foix 2010), and in Atalayuela, Valencia (Simón García 1998), or the Argaric sword found in Guadalajara (Dani 2024). On the other hand, our recent study on peninsular metal axes has revealed that the two most representative taxa of Argaric axes were also produced beyond the El Argar territory, along the Mediterranean, up to

Catalunya, providing further evidence of the far-reaching relations between El Argar and other communities of the Iberian Peninsula (Peres et al. 2024).

Characterisation studies are increasingly providing evidence for interaction between geographically distant communities. To date, approximately 200 copper and bronze artefacts from the southeastern quadrant of the Iberian Peninsula have been subjected to lead isotope analysis (LIA), although the majority derive from sites within the El Argar territory (Escanilla et al. 2025; Murillo-Barroso et al. 2025, 2015; Stos-Gale et al. 1999). The available results indicate that metals circulated widely, both within the El Argar area and between this region and its periphery.

It is important to note that more than 50% of El Argar metal objects cannot yet be securely provenanced (Murillo-Barroso et al. 2025, p. 24), probably due to the lack of systematic isotopic characterisation of the abundant ore deposits of the Iberian Peninsula. Nevertheless, between 17% and 24% of analysed El Argar metals appear to derive from the above-mentioned Linares-La Carolina mining district, in the eastern sector of Sierra Morena. This proportion is remarkably consistent across the El Argar territory, from the western regions of the present-day province of Granada—closer to the mining areas—to Alicante in the east (Brandherm et al. 2022; Escanilla et al. 2025; Lull et al. 2017a, b, c; Murillo-Barroso et al. 2025).

Comparable, or slightly lower, proportions of metal appear to have originated in outcrops located in the Inner Betic mountain ranges, in Granada. In addition, around 17% of the analysed El Argar metals seem to have circulated from deposits in La Alcudia and Los Pedroches, situated further west within Sierra Morena (Fig. 1). The scale of metal—and possibly ore—circulation has recently been underscored by evidence from the large El Argar hilltop settlement of Laderas del Castillo, Alicante, where LIA indicates that a smelting prill likely derived from the Los Pedroches district, at a distance of more than 350 km (Escanilla et al. 2025). Some El Argar metal objects may even have originated from mining areas in southern Catalonia.

At the same time, growing evidence indicates that metals mined within the El Argar territory, particularly in the Linares district, circulated widely across the central and eastern Iberian Peninsula, reaching as far as the Tagus basin in central Spain and the river Millars in the northern Levant (Galindo San José et al. 2018; Montero Ruiz et al. 2014, 2017).

Together, the available chemical and isotopic data suggest that the exploitation and circulation of metals between El Argar and surrounding regions was both intensive and complex. A model based on small-scale, settlement-level production exploiting nearby copper outcrops would predict a much stronger reliance on local sources; however, this is clearly not supported by the evidence, even in settlements located directly above copper mineralizations, such as Cabezo de la Mina, Santomera, Murcia (Brandherm et al. 2022). Instead, the Linares-La Carolina deposits, under the control of the El Argar outposts such as Peñalosa, emerge as a major metallurgical region, supplying not only the core El Argar territory but also much of eastern Iberia.

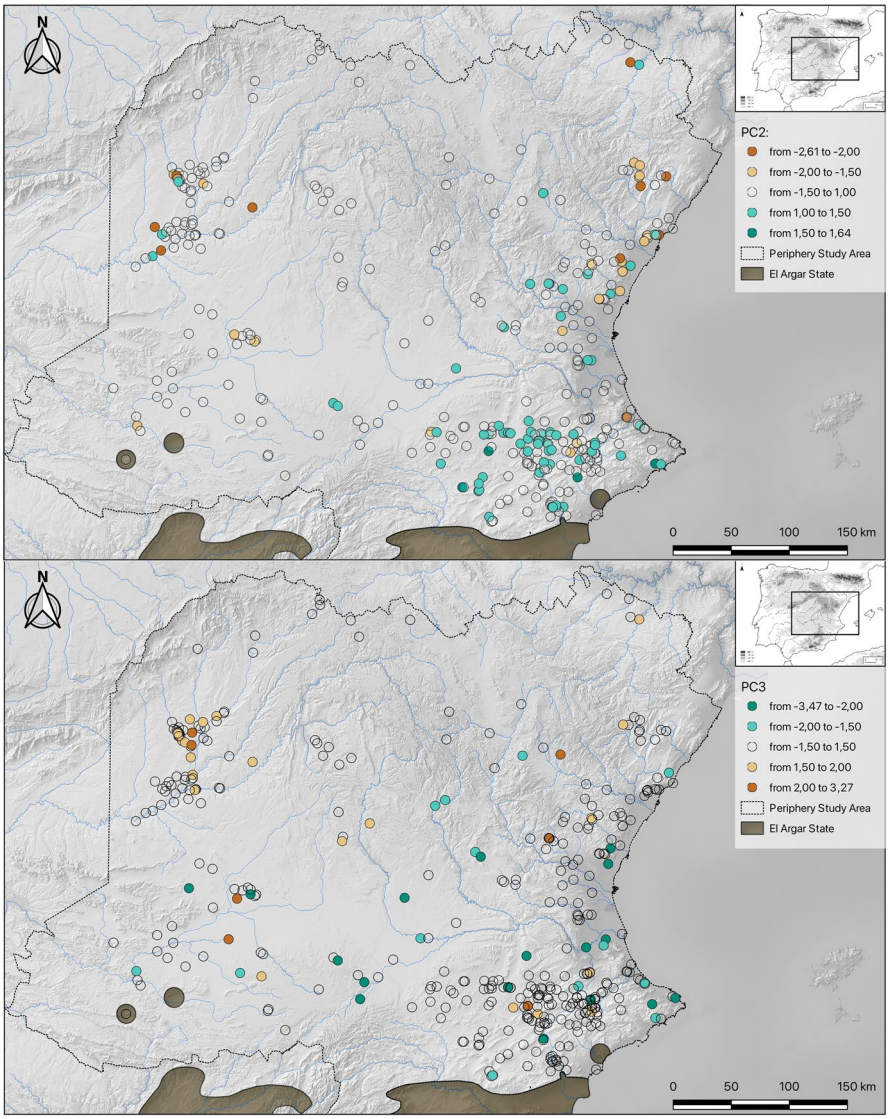


Fig. 11 Spatial projection of principal component scores. Top: PC2 shows the importance of hunting and livestock farming (brown) compared to cereal-based economies (green). Bottom: PC3 shows primary and secondary subsistence economies (brown) versus settlements that stand out for their access to metal tools/weapons and, occasionally, ivory (green). Created by Marcello Peres (Color figure online)

Metal weapons—such as daggers, halberds, and swords—equipped with silver ornaments or rivets constitute particularly effective technological and artefactual tracers of El Argar production. Although lead isotope analyses have not yet been conducted on these silver rivets, several lines of evidence allow this metalworking technology to be confidently associated with El Argar. These include the exceptional

abundance of silver ornaments within El Argar contexts, especially when compared to the rest of the Iberian Peninsula (Lull et al. 2014b; Murillo-Barroso 2013), as well as the identification of a specialised silver-working workshop at the fortified settlement of Tira del Lienzo (Murcia) (Delgado-Raack et al. 2016). This technological tradition, which has close parallels in the Aegean, Egypt, and the Near East, appears to have been deliberately adopted and developed within the El Argar sphere (Fig. 12b).

The spatial distribution of bladed weapons with metal rivets confirms their high frequency not only at the eponymous site of El Argar but also across other, less intensively investigated regions of El Argar territory (Fig. 12c, d). Beyond this core area, however, the presence of silver-riveted weapons decreases markedly with increasing distance from El Argar. Significantly, their circulation appears to have been oriented primarily towards southwestern Iberia, whereas no examples are currently known from the Levantine region. This asymmetric distribution pattern suggests that such artefacts were not merely stylistic markers but may have functioned as socially and politically charged objects, whose circulation was selectively structured within broader networks of interaction. This asymmetry cannot be attributed to depositional or recovery patterns as neither the amount of Bronze Age burials nor the intensity and number of excavations is higher in the Southwest, as compared to La Mancha and the Levante.

This picture gains further nuance when the distribution of halberds and swords is taken into account. So-called Carrapatas-type halberds are documented across the central-northern and western Iberian Peninsula from the second half of the third millennium BCE onwards, as confirmed by radiocarbon dates from burials and hoards associated with Bell Beaker contexts (Garrido-Pena et al. 2019; Valera et al. 2020). As part of the Atlantic halberd tradition, these weapons are characterised by wide blades with convexly curved cutting edges. The typical El Argar halberds, by contrast, follow a markedly different technological and morphological logic, making a far more efficient use of metal. Although several subtypes have been distinguished by different authors, they share a set of defining features: a narrow, pointed blade with concave edges and a broad hafting plate. These halberds can be dated to approximately 2000–1800/1750 cal BCE (Lull et al. 2017b), coinciding with the period of greatest territorial expansion of El Argar from its core area (Fig. 1).

Around 1800/1750 BCE, halberds were replaced in funerary contexts by swords and axes, at least within El Argar burials (Bonora Soriano 2024, 2025). On the basis of these funerary associations, both halberd- and sword-bearers have been interpreted as members of an emerging warrior group or class (Lull et al. 2017a). Consequently, the presence—or absence—of these weapons may be taken as an indicator of the presence of such individuals, particularly when they occur in burials conforming to characteristic El Argar funerary practices, as observed in the above-mentioned burials of Setefilla and, probably, Puertollano (Fig. 1).

Similar to these weapons, ivory likewise displays a radiating pattern in the circulation of raw material, preforms, and finished objects originating in the Argaric southeast; in this case, however, the principal routes of distribution were oriented towards the Levantine region and La Mancha (Fig. 11a). The radial diffusion pattern points to Illeta dels Banyets (Alicante) as a possible transit hub for ivory arriving

from North Africa (Belmonte Mas and López Padilla 2006). Another important ivory-working workshop has been identified within the Argaric hilltop settlement of Fuente Álamo (Almería) (Liesau and Cabrera 2024). The identification of small workshops containing raw ivory in sites located close to the eastern border of El Argar—such as Mola de Agres, Cabezo Redondo, Cabezo Navarro, Motilla del Acequión, and Cerro de la Encantada—further suggests the involvement of economic actors from the eastern Argaric territory as intermediaries in its circulation. A progressive decrease in the presence of ivory artifacts is observed towards the north and northwest, until they disappear entirely in settlements of the central Iberian Peninsula. In this sense, ivory appears to have moved through networks requiring negotiation, brokerage, and sustained interaction rather than direct control and might have become a "boundary object" capable of bridging social distances between asymmetric communities (Frieman 2012).

The contrast between the spatial distribution of ivory ornaments and that of bladed weapons with or without silver rivets is particularly striking, especially given their broad contemporaneity. While both categories of artefacts possessed high social value, they appear to have been embedded in markedly different social practices. This distinction is also evident in the El Argar funerary record: bladed weapons are predominantly found in burials—more specifically in socially outstanding male graves—whereas ivory objects were only rarely deposited as grave goods and do not feature among the assemblages of the wealthiest 10% of El Argar burials (Lull et al. 2005, 2011). Ivory, therefore, seems to have operated primarily within spheres of exchange, display, and alliance-building between communities, rather than as a marker of individual coercive power.

From a spatial perspective, elite weapons delineate a distribution route extending mainly from the El Argar territory towards southwestern Iberia, broadly following the Sierra Morena mountain chain, where major copper and silver ore deposits are located (Fig. 12). A second axis of circulation appears to extend northwards from the Linares-La Carolina mining district. These routes broadly coincide with areas where El Argar military expansion involved mining outposts, fortified settlements, and, plausibly, episodes of forceful occupation. In contrast, very few Argaric halberds and no silver-riveted weapons nor swords are known from the Levantine region and La Mancha—areas characterised by a marked *enrockment* and *atomization* of communities (Fig. 2). Instead, these regions are precisely those integrated into the circulation of ivory, suggesting forms of interaction that privileged mediation, selective incorporation, and negotiated access over overt coercion.

Taken together, these divergent distribution patterns indicate that El Argar expansion and interaction operated through differentiated material regimes: weapons signalling violence, control, and the presence of warrior elites circulated along extractive and strategic corridors, while ivory objects moved through networks of exchange that required cooperation with, rather than domination of, local communities. This duality provides an important material framework for understanding the coexistence of coercion, negotiation, and resistance within the broader dynamics of El Argar interaction beyond its core territory.

These new lines of evidence support the results of the recent study of the borderland between El Argar and the communities related to La Mancha, in the Middle

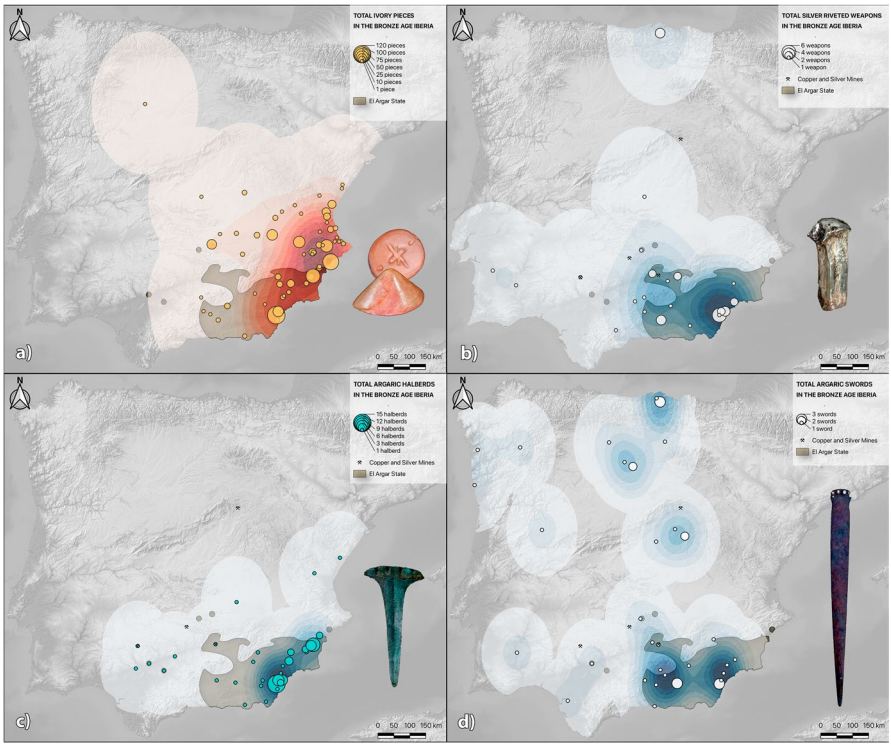


Fig. 12 Total distribution of ivory pieces (**a**), weapons with silver rivets (**b**), argaric halberds (**c**) and argaric swords (**d**) in the Iberian Peninsula between ca. 2000–1550 BCE. Full-size maps available in SM1: Figs. 3, 4, 5, 6. For the complete databases with references, see SM3. Created by Marcello Peres

and Upper Segura (Moreno Gil et al. 2025). The distribution of imported El Argar and locally produced pottery, combined with the presence—or absence—of intramural burials in the settlements revealed a heterogeneous borderland, with "porous and permeable" sectors, which allowed the movements of goods and, probably, people, while other border communities appear to have rejected contacts with the powerful south. Within this contested border context, ivory appears to have operated as an alternative means through which El Argar engaged with peripheral regions, facilitating access to essential resources such as cereals and workforce (Peres and Risch 2023a, 2023b). Under these conditions, ivory likely functioned primarily as a medium of exchange and negotiation rather than as a marker of individual distinction, which may explain its marginal role within El Argar funerary assemblages.

Traces of Violence

The evidence for economic contacts and exchange between El Argar and its periphery raises the question of the role played by violence in these interactions.

A rapidly expanding social and political entity such as El Argar necessarily relied on forms of social obedience and, therefore, on structural violence in order to reproduce itself and to expand beyond its core territory. Peripheral communities, in turn, appear to have opposed this expansion through indirect social strategies—such as atomization, enrockment, invisibility, and food self-sufficiency—and, possibly, through episodes of violent resistance. After 1800/1750 BCE, the territorial growth of El Argar seems to have been curtailed, as its influence never extended beyond the Middle Segura valley in Murcia (Moreno Gil 2023; Moreno Gil et al. 2025), nor did it reach further than the coastal plains of southern Alicante (Jover Maestre and López Padilla 2004; Martínez Monleón 2014).

Differences in weaponry between El Argar and its periphery are indicative of two contrasting political and military models. El Argar developed highly specialised weapons, such as halberds and, later, swords, which were explicitly designed and produced to inflict physical harm on human bodies. In the case of Argaric halberds—used during the phase of greatest territorial expansion between ca. 2000 and 1800/1750 cal BCE (see above)—traces of impact and repair have been identified on blades and hafting elements, providing direct evidence of use in combat (Brandherm 2011; Lull et al. 2017a). Although few comparable functional studies are available for axes and swords (Brandherm et al. 2011), recent analyses of weapon deposits from the Únětice group, where the association between halberds and axes is frequent, offer relevant comparative arguments for interpreting these weapons as part of organised military formations operating under centralised command (Meller 2019).

In contrast, within the periphery, artefacts with potential use as weapons—such as stone and copper axes, as well as flint, bone, and copper arrowheads—are documented in approximately 14% of all surveyed sites and in 59% of excavated sites. This distribution suggests a widespread availability of non-specialised means of violence in these communities, whereas halberds are rare and swords entirely absent from the central-eastern quadrant of the Iberian Peninsula (Fig. 11c, d). Conversely, flint arrowheads are notably absent from El Argar contexts. This sharp divergence between specialised weaponry within El Argar and opportunistic armament in the periphery points to the presence, on the one hand of a professionalised warrior group trained primarily for close combat, and, on the other, of communities that appear to have defended themselves using locally available tools.

Bioarchaeological evidence supports the interpretation that these contrasting military configurations occasionally resulted in direct violent encounters between El Argar and its northern neighbours. According to the comprehensive synthesis by Oliart (2021, pp. 137, 297), anthropological remains are available for 1,522 individuals from El Argar contexts, although the number of preserved crania—the skeletal element most suitable for identifying weapon-related trauma—is limited to only a few hundred. Within this sample, evidence for violent injury and death has increased significantly as new analyses have been conducted. This is particularly evident in northern Murcia, an area considered part of the El Argar border, where weapon-related trauma has been identified in up to 37.5% of the analysed skeletons (Fregeiro et al. 2023; Oliart 2021, p. 295). By contrast, comparable anthropological indicators

of interpersonal violence appear to be less frequent within the El Argar core territory, where available samples suggest lower proportions of weapon-related trauma (Kunter 1990, pp. 4–6, 2000; López-Padilla et al. 2006).

Comparable anthropological data from peripheral communities are scarce. The most informative case comes from the *motilla* of El Azuer, where 63 adult and juvenile individuals have been studied (Jiménez-Brobeil et al. 2014; Nájera et al. 2012a). In this assemblage, 48% of adult males—but only 9.1% of females—display traumatic lesions affecting the cranium, neck, or post-cranial skeleton that can plausibly be linked to violent encounters. The proportion of buried males showing evidence of participation in violent events reaches 57% in the earliest phases, particularly between 2000 and 1800 BCE, coinciding with the period of maximum El Argar territorial expansion. Burial 60 from the Motilla del Azuer, dated to 2040–1870 cal BCE, provides an example of extreme interpersonal violence (Nájera et al. 2012b). It corresponds to a 20-year-old male individual, deposited on his right side with a coherent but modest grave assemblage, parallel to the external face of Wall Y (which at that time represented the outermost defensive enclosure), and whose decomposition must have occurred in an open-air context. The anthropological study identified numerous deep perimortem wounds, including fatal injuries resulting from the penetration of three different types of weapons, including copper axes and a dagger with a blade measuring at least 15 cm in length. The forensic reconstruction of the assault suggests that the individual was attacked simultaneously by multiple assailants, attempted to resist through frontal confrontation, and sustained defensive injuries to the hands and elbows before ultimately receiving a stab wound to the back and several axe-inflicted cuts to both sides of the body. Evidence of violence dated to around 1900–1700 BCE has also been reported at Cerro del Cuchillo (Albacete), another settlement located close to the El Argar frontier. In addition to six individual burials, two adult individuals—at least one of them identified as male—were recovered from the bottom of a cistern, lacking any formal funerary structure or associated grave goods (Hernández Pérez et al. 1994, pp. 140–142). The complete lack of spatial organisation and funerary treatment points to an unstructured disposal of corpses, consistent with a context of violent death and social disruption. Moreover, a bone arrowhead was found at chest level of one of the individuals. Although no detailed anthropological analysis has yet been conducted, the context of deposition and the presence of a projectile point strongly point to a violent death and an atypical treatment of the bodies. The identification of all biologically sexed adult individuals as male, together with the absence of any funerary structures beyond the covering of the bodies with stones, also points to unusual, possibly violent, circumstances surrounding their death (de Miguel Ibáñez 2022).

Beyond the El Argar interaction zone, in the Middle Tagus valley, only 9% of a sample of 74 Bronze Age individuals—both male and female—exhibit traumatic lesions, none of which can be securely associated with interpersonal violence (Pérez Villa 2014, pp. 270–271, 348, tab. 6).

The available bioarchaeological evidence indicates a significant involvement of adult males in violent encounters on both sides of El Argar's northern border, whereas such traces decrease markedly, or even disappear, with increasing distance from this border, both towards the El Argar core region along the southeastern coast

and towards the Tagus valley, where settlement *enrockment* is less pronounced and El Argar material culture becomes rare. From this perspective, the boundary between El Argar and its immediate neighbours emerges simultaneously as a zone of economic interaction, when the circulation of raw materials such as copper and ivory is considered, and as a zone of conflict, when the distribution of protected hilltop settlement, fortifications, specialised weaponry, and the bioarchaeological signatures of violence are taken into account. Taken together, these lines of evidence suggest that along this border, economic exchange and negotiation likely coexisted with episodes of overt conflict, forming a dynamic and unstable interface in which cooperation and coercion were not mutually exclusive but structurally intertwined. The first micro-scale study of a 150 km stretch of the 1000 km border of El Argar at the time of its maximum expansion has confirmed this variety of strategies in the face of the Argaric entity. In this sense, the distribution and circulation of ceramics show how, given the formal and material uniformity of Argaric pottery production, some communities were more permeable or open to exchange, while others clearly opted for isolation (Moreno Gil et al. 2025).

Conclusions

The present study has explored new approaches to addressing the uneven yet substantial archaeological record generated by more than a century of excavations and surveys in the east-central sector of the Iberian Peninsula, despite the diversity of methods and criteria used for recovery and publication. By combining a large-scale comparative review with attention to locally specific practices, this study moves beyond traditional dichotomies between cultural-historical entities, environmental determinism, and monocausal explanations of social change.

Our study has shown that the volume of available information is sufficiently large to allow for the combined use of survey and excavation data, although certain materials—most notably ivory—are systematically underrepresented in survey-based records.

The screening of 1,517 settlements known in the east-central sector reveals an outstanding level of productive capabilities and flexibility in the management of a broad and diversified set of shared means of production. Across a geographically and ecologically diverse area of approximately 177,000 sq km, none of the 21 recorded artefact categories displays strict spatial exclusivity. Instead, throughout the ecologically varied regions north of El Argar, a generalised distribution of means of production and technological knowledge can be observed. This pattern is consistent with an economic strategy based on food self-reliance, self-sufficiency, and self-sustenance among generally small social groups with relatively small populations.

This situation contrasts sharply with El Argar, not only in terms of its distinctive funerary practices and large hilltop settlements but also with respect to the diversity and intensity of its means of production and violence. Particularly notable is the volume of metal-processing tools, copper and silver artefacts, and ivory—both as worked raw material and finished ornaments—documented in Argaric contexts. While the abundance of metal artefacts can partly be attributed to the exceptional

number of burials compared to other Iberian regions, most evidence for metalworking activities and ivory consumption derives from settlement contexts and therefore cannot be explained in terms of ritual or funerary bias. The volume of macrolithic artefacts and cereal-processing tools, in particular, is exponentially higher in El Argar than in any other archaeological entity of the western Mediterranean (Delgado-Raack and Risch 2016; Eguíluz Valentini and Risch 2024; Risch 2002).

Conversely, two archaeological materials characteristics of the communities of the central-eastern quadrant are rare or absent in El Argar settlements: dairy sieves and flint arrowheads, the latter being the most widespread projectile weapon in Iberia since the Upper Palaeolithic. While dairy sieves point to specific forms of ruminant-product processing, flint arrowheads relate both to hunting practices and to non-specialised forms of violence, their scarcity in El Argar likely reflecting the abundance of copper and the development of specialised metal weaponry in the Argaric southeast.

The economic and demographic strength of El Argar, combined with its surplus oriented production, marked social asymmetries, and long-term expansionist—and apparently aggressive—policies, stands in sharp contrast to the dynamics observed in the periphery. North of El Argar, no clearly defined "archaeological cultures" can be established on the basis of material culture alone, beyond specific settlement forms such as the 45 fortified *motillas* of La Mancha. Consequently, it has proven impossible to trace firm archaeological boundaries between cultural entities traditionally defined in 20th-century archaeology, such as *Bronce Manchego* and *Bronce Valenciano,* as has also been indicated by other authors (Hernández Perez 1996; Martínez Navarrete 1988).

Instead, the main differences in settlement forms and economic indicators across the central-eastern sector follow a pronounced north–south gradient. The degree of what we have defined as settlement enrockment and social atomization increases gradually towards the south, in proximity to El Argar. This trend towards occupying highly protected locations developed in parallel with an increase in metals, ivory, and cereal-related tools—particularly grinding stones and sickle blades—although with a significant distinction. While copper and ivory—materials obtained through exchange with El Argar—are disproportionately present in settlements with defensive architecture, cereal production appears to have been especially intensive in unfortified hilltop locations, situated on average some 70 m above the nearest cultivable land. Textile production, although the most evenly distributed economic indicator in spatial and topographic terms, was likewise particularly prominent in fortified settlements. These relative, though never absolute, differences suggest that increasing community wealth required additional defensive efforts and point to the coexistence of diverse interaction strategies, both internally and in relation to the powerful southern neighbour.

Evidence of violence in the anthropological record—especially among individuals buried close to the northern border of El Argar—together with the gradual advance of this border and the presence of distinctive Argaric weapons beyond it, provides insight into the causes of the extreme enrockment and atomization observed among northern communities. Over more than six centuries, the repeated abandonment of settlements and the establishment or re-establishment of others on

neighbouring hilltops constitutes a unique phenomenon in the Bronze Age of Western Europe and suggests a climate of persistent socio-political instability and conflict. Within this context of generalised tension, in which "everything is protected," the emerging value of grain, textiles, ivory, metals, and violence becomes particularly apparent.

The exceptional volume of grinding stones documented in the central settlements of El Argar (Ache 2019; Delgado-Raack 2008; Eguíluz Valentini and Risch 2024; Risch 2002) implies the capacity of the dominant classes to channel equally exceptional quantities of grain to hilltop sites poorly suited for agricultural production. Although less archaeologically visible due to preservation biases, textile production appears to have been an equally strategic component of the Argaric economy, as suggested by the manufacture of hundreds of loom weights in specialised work installations (Siret y Siret 1890, pp. 11–12, 154–157, Fig. XVII). The periphery of El Argar thus possessed the capacity to produce resources of prime economic importance for the Argaric system. Metals and ivory would have represented ideal exchange media for acquiring such goods when violent appropriation was not feasible, as suggested by the limited territorial advance and broad interaction zone along the northern and northeastern border of El Argar (Moreno Gil et al. 2025). The epicentric distribution of ivory from El Argar outwards, primarily in the form of standardized prismatic ivory buttons, supports its interpretation as a form of *proto-money* (Graeber 1996; Haselgrove and Krmnicek 2012; Kuijpers and Popa 2021) within peninsular exchange networks, or at least as a symbolic marker of large-scale alliances and economic agreements.

Workforce, an archaeologically invisible commodity, may represent another resource that El Argar needed to obtain from outside its core territory. The only aDNA-based study conducted so far in southeastern Iberia has identified a direct biological link between a woman buried at the Argaric settlement of La Almoloya (Murcia) and a child burial from the Levantine site of La Horna (Alicante) (Villalba-Mouco et al. 2022). Given that only 89 individuals from El Argar and 12 from Bronce Valenciano contexts have been sequenced to date, this connection is unlikely to be the result of random contact.

Beyond the clear signs of mobility and asymmetric exchange between both territories, the indicators of violence on either side of the northern Argaric border suggest that resistance to the El Argar state was both forceful and sustained. This resistance combined active strategies, such as enrockment and armed confrontation, indicated by high-altitude occupations, fortifications, weapons, and osteological evidence of violence, with passive ones, including social atomization and deliberate invisibility through settlement in perched and inaccessible locations. While armed resistance is readily understood, given the abundance of historical and even contemporary examples, the effectiveness of passive resistance can be better appreciated through less familiar ethnographic examples. One such case is described by Joseph Henrich (2022, p. 154), who illustrates the adaptive logic of highly dispersed settlement patterns among Amazonian populations: "It was by living in tiny villages or isolated nuclear-family households, disappearing at the slightest sign of approaching strangers, that the Matsigenka managed to survive and, over time, increase their numbers. The absence of larger settlements

undoubtedly reduced the potential gains for slave raiders. At the same time, exploiting people who were dispersed and concealed along remote tributaries was both difficult and costly. Even in recent decades, an anthropologist might arrive at a remote Matsigenka household only to find the fire still smouldering, but no one at home." Beyond ensuring the self-sufficiency of individual communities, the atomization and spatial protection of the means of production also enhanced the resilience of the productive system as a whole: dispersed productive units were more difficult to locate, less attractive targets for seizure, and their loss did not necessarily compromise the functioning of the wider productive system. Such strategies would have been particularly difficult to integrate into systems based on the appropriation of cereal surpluses (cf. Scott 2009, on Zomia).

At the same time, the periodic escape of people from Argaric exploitation, combined with the inflow of raw materials and objects of high social value, transformed the periphery into a particularly dynamic and contested territory. Stress was generated not only by the expansionist pressure of El Argar but also by emerging internal social asymmetries and the continual negotiation of situational alliances between family groups and external communities. From the perspective of material culture, the periphery appears to have formed a heterogenous front in response to the advance of El Argar. This front was characterized by broadly shared settlement and defensive strategies, and by a high degree of socio-economic (and possibly political) autonomy among the individual groups that comprised it, while at the same time exhibiting diverse responses to Argaric economic and cultural influence. Such internal diversity is reflected in the varying degrees of permeability—or impermeability—of its territorial boundaries to the circulation of Argaric pottery, as well as in the selective imitation of Argaric pottery types in some peripheral areas but not in others (Moreno Gil et al. 2025).

The El Argar expansion created a long-lasting frontier zone in which resistance was not expressed through isolation, but through a calibrated combination of economic autonomy, strategic exchange, and armed defence. Bronze Age Iberia thus offers a clear example of how peripheral communities, rather than acting as passive recipients of state pressure, actively shaped their borderlands as spaces of both cooperation and conflict, revealing resistance itself as a productive and organising social force.

By analysing both large-scale structural asymmetries and locally grounded practices, ranging from settlement enrockment and economic self-sufficiency to selective exchange and violence, this study highlights the need to approach cores and peripheries relationally. In this sense, the Iberian Bronze Age provides a valuable case for evaluating the explanatory potential of World-Systems approaches in prehistoric contexts, demonstrating that their analytical strength depends on integrating macro-regional dynamics with the diverse, context-specific strategies through which non-state societies negotiated, resisted, and reshaped expanding state or proto-state formations.

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Data Availability Data supporting the findings of this study are available within the paper and its Supplementary Material. The complete database of 1,517 analyzed sites is provided in Supplementary Material 2, although, due to the risks of illegal excavations, the coordinates cannot be published. The complete databases of all ivory pieces, silver rivets, and Argaric halberds and swords from the Iberian Peninsula are provided in Supplementary Material 3.

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