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Women, residential patterns and early social complexity. From theory to practice in Copper Age Iberia

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ABSTRACT

The relationship between residence, gender and mobility is central to the study of early social complexity. And yet, until recently, it was deemed as archaeologically intractable. The recent combination of strontium data and genomics with other methods has opened up entirely new possibilities for the archaeological study of human mobility, but these advances are not without problems. Theoretical framing, empirical accuracy and data interpretation remain controversial. In this paper we address the relationship between residence patterns, gender and mobility among early complex societies, combining both ethnographic and archaeological evidence. Our approach focuses on Chalcolithic Iberia, a period in which the stage for emerging social complexity was set. The possible existence of male-centered residential patterns and their possible connection with conflict, social complexity and gender inequalities is examined. The available data on strontium isotopes suggest women were more frequently buried in places different from those where they grew up, which can be linked to bilocality biased to patrilocality, especially in the so called 'mega-sites'. While preliminary, this body of evidence opens up fresh lines of enquiry for the study of early complex societies, highlights the benefits of combining different kinds of evidence, and underlines the centrality of gender in the social analysis.

1. Introduction

The role played by gender inequalities at the onset of early social complexity is a recurrent theme both in Social Anthropology and Archaeology, especially after the rise of feminist studies (Moore, 1999; Cruz Berrocal, 2009; Sorensen, 2000; Moncó, 2011; Alberti and Back Danielsson, 2014; Dommasnes, 2014; Montón Subías, 2014). Several theories have been proposed from both disciplines (Divale and Harris, 1976; Ortner, 1979; Rosaldo, 1979; Sacks, 1979; Leacock, 1983; Meillassoux, 1985; Estévez et al., 1998; Lerner, 1990; Hernando Gonzalo, 2012; etc.), focusing on factors such as the rise of surplus accumulation, private property, or violence, among others.

There seems to be widespread agreement that social complexity and gender dissymetries correlate positively: the more complex and hierarchical societies became, the more pronounced inequalities between males and females were to be (Martin and Voorhies, 1975; Lerner, 1990). This principle is based on the following line of reasoning. With the domestication of plants and animals, human societies were able to accumulate surplus, which opened up new possibilities for economic, social and political development. Accumulated wealth became subject to property and inheritance rights, which made the control of lineage lines important. In such a context, the control of women's sexuality may have appeared as an obvious way for males to achieve a more assertive control of inheritance lines. With increasing social complexity, women also became relevant for the establishment of alliances through marriage, which further objectified them. At this point, residential patterns may have played a relevant role, patrilocality causing women to be alienated from their kinsfolk, which rendered them more vulnerable to male domination. Thus, mobility may have played an important part in the development of gender inequality.

Although residence (and kinship) studies no longer seem to occupy a central place in Social Anthropology (Peletz, 1995: 344-346), the issue was addressed in numerous ethnographical studies undertaken throughout the second half of the 20th century, including their possible causes and their relationship with certain factors, such as gender. While recognizing that those case-studies were historically situated and profoundly shaped by colonialism, they do, nonetheless, provide some useful insights into the factors shaping residence patterns among early

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complex societies. In spite of the mutual interest and significant epistemological potential, not much progress has been made in using archaeological and anthropological evidence in a combined way. Albeit ethnographic evidence is frequently mentioned in archaeological discussions, its usage in approaches to gender and early social complexity is seldom systematic (but see Hrnčíř et al., 2020a and b), focusing mainly on the description of specific examples (contexts and/or communities) (*cf.* González Ruibal et al., 2011; Mansur and Piqué Huerta, 2012; Varna and Menon, 2017). Whenever cross-societal data are gathered, they are largely used as a 'list of case-studies' to support a given hypothesis. Both ethnographic analogy and cross-cultural analysis are powerful tools for archaeologists, but while the former uses specific cases in a non-systematic – and, often, non-representative – way, the latter test hypothesis employing large datasets to quantitatively evaluate generalizations. Paradoxically, in none of these two situations archaeological research takes full advantage of the potential of ethnography and cross-cultural studies as tools to explain early social complexity (*cf.* Ember, 1973; Ember and Ember, 1995; Peregrine, 1996).

Unlike Social Anthropology, however, recent archaeological research has shown a great deal of interest on residential patterns, a subject regarded as almost intractable not so long ago. This is reflected in a suite of papers which, focusing on prehistoric Europe, use strontium isotope analysis to provide direct evidence of mobility between the time of a person's (or animal's) biological maturation and their death (Bentley et al., 2002; Bentley, 2006; 2007; Bickle and Hofmann, 2007; Price et al., 2006; Knipper, 2009; Reiter et al., 2019; Slovak and Paytan, 2012; Scaffidi and Knudson, 2020). Specifically, isotopic data have been coupled with bioarchaeological evidence to explore sex-based differences in residential patterns, leading to suggestions of patrilocality among Neolithic and Copper Age communities in central Europe (Bentley, 2007; Knipper et al., 2017; Bentley et al., 2012; Masclans Latorre et al., 2020; Sjögren et al., 2020), although a recent review is critical of these interpretations (Ensor, 2021).

This flurry of papers has set the stage for a completely new understanding of the role played by residential rules and gender inequality among early complex societies. This is the theme of this paper. Specifically, we address three questions: i) what kind of residential patterns are more likely connected with early social complexity? ii) is there a relationship between the residential patterns and the social status of women among early complex societies? iii) what can the available archaeological evidence tell us about the relationship between early social complexity, gender status and residential patterns?

Our approach combines both ethnology and bioarchaeology. While the former provides the basis for a theoretical foundation, the empirical record of Copper Age Iberia offers a rare opportunity to examine gender status through the lens of a set of early complex societies. Starting *c.* 3200 BCE and spanning roughly 900 years, the Iberian Copper Age represents a period of true flourishing for early farming societies (the Neolithic in Iberia started *c.* 5600 BCE), characterized by the appearance of the first permanent settlements - including some very large ones (in the dozens or even hundreds of hectares) that have been termed 'mega-sites' -, agricultural intensification, surplus accumulation, craft specialization, social aggregation, large-scale monument-building, and a high degree of connectivity and mobility. A range of contributing factors has been proposed to explain the Iberian Copper Age social landscape, including economic intensification, political leadership, centralization, monumentality, competition, and inter-regional interaction (Díaz-del-Río et al., 2006; Chapman, 2008; García Sanjuán and Murillo Barroso, 2013; Cruz Berrocal et al., 2013; García Sanjuán et al., 2018; Lillios, 2019). Beyond underlying common trends, however, it is worth noting that Copper Age Iberia was also characterized by a strong element of variability in settlement dynamics, funerary practices or subsistence strategies, undoubtedly partly in connection with the region's geographic and ecological diversity. The differences are especially clear between the north and the south - the latter supplying larger and more heavily monumentalised sites.

The increase in mobility and connectivity is reflected in various cultural indicators, including higher frequencies of non-local (and even extra-Iberian) raw materials and people, herding practices (transhumance) and, possibly, shifting residence patterns. Indeed, there has been a recent surge of research specifically devoted to human and animal mobility in Copper Age Iberia, largely on the basis of isotope analysis (Díaz-Zorita Bonilla, 2017; Díaz-Zorita Bonilla et al., 2014; 2017; Waterman et al., 2014; Díaz-del-Río et al., 2017; Sarasketa-Gartzia et al., 2018; Zalaité et al., 2018; Wright et al., 2019; Jones et al., 2019; Carvalho et al., 2019; Fernández-Crespo et al., 2020). However, one element conspicuously absent in these recent approaches is gender (Cintas-Peña, 2020). This is clearly a significant problem, as gender[2], like age or kinship, is closely embedded in the fabric of social organization (Sorensen, 2000; Sofaer, 2011) and therefore cannot be left out if a successful analysis of social complexity is to be attained.

2. Methodology

Two different types of ethnographic data have been compiled for this study: i) cross-cultural analyses aimed at explaining the causes and consequences of residential patterns, including the variables that can help to establish the status of women; ii) aggregated data from the open access D-Place database [Database of Places, Language, Culture, and Environment] (Kirby et al., 2016), including variables linked to residential patterns, subsistence economy and inheritance: 'Marital residence with kin: prevailing pattern [Note, identical to EA012] [SCCS215]', 'Subsistence Economy: Dominant Mode [SCCS833]' and 'Inheritance of Property of Some Economic Value [SCCS590]'. These sources of information have been used to produce contingency tables and to apply statistical significance testing (χ^2 and Fisher's Exact Test) on which the theoretical and hypothetical framework for this study has been built. All the data considered for contingency tables were selected from the Standard Cross-Cultural Sample [SCCS] (Murdock and White, 1969) of the D-Place database. The Standard Cross-Cultural Sample encompasses 186 societies designed to correctly represent cultural diversity, minimize the effects of autocorrelation and the famous 'Galton's Problem' – which questions the validity of cross-cultural findings on the basis that the cases included in the sample can be historically related (*cf.* Ember and Ember, 2009: 107-110) -, and ensure the validity of the conclusions.

In terms of archaeological data, all results for strontium isotope analyses for Copper Age Iberia published at the moment of writing these lines have been collected. The only criterion for the selection was chronological adscription to the relevant period. The resulting database contains information for 473 individuals (or 476, depending on the counting criteria) from 26 different sites (Fig. 1). This dataset is available as an Excel document in the "Supporting Information Bioarchaeology" file.

The application of strontium isotope analysis to the study of past human mobility is not straightforward and presents significant challenges. Strontium is incorporated through the food chain and accumulates in teeth and bone during their formation. Thus, isotopic values reflect the water and dietary intake of an individual in a specific environment. While bone is constantly being remodeled, dental enamel does not change after its formation, which implies that isotopic signatures provide varying information depending on whether bone or teeth are analyzed. In the former, isotopic signature reflects approximately the last ten years of life of an individual (Manolagas, 2000: 116). In the latter the situation is more complex, since each tooth has a specific time of formation. The enamel of the three permanent molars (M1, M2 and

[2] [2] The term 'sex' will be employed to refer biological differences among males and females, while 'gender' will be used to allude to the socio-cultural elements ascribed to men and women, commonly – but not necessarily always – in a binary system and established on the basis of sex.

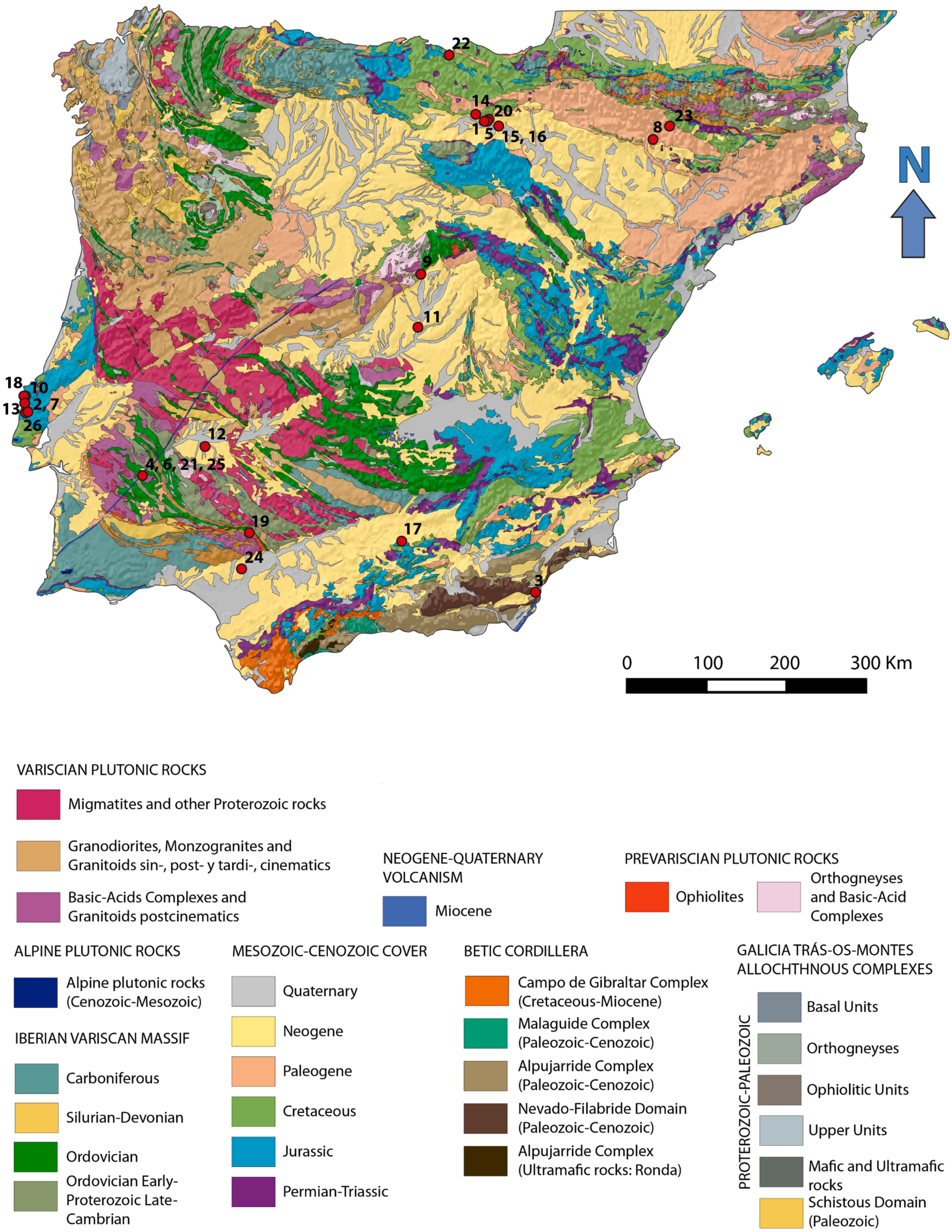

Fig. 1. and Fig. 1 **(key).** Geology of the Iberian Peninsula and distribution of sites mentioned in the text. Based on the "Mapa geológico de España con la inclusión de Portugal continental y Pirineos franceses. Escala 1:2.000.000″, published in Vera, J. A. (ed.) (2004) Geología de España. Sociedad Geológica de España & Instituto Geológico y Minero de España. ISBN 84–7840-546–1, and PePeEfe, CC BY-SA 4.0 <https://creativecommons.org/licenses/by-sa/4.0>, via Wikimedia Commons, (and references therein). The colors of the legend have been overlaid on a digital terrain model available from Centro de Descargas (Centro Nacional de Información Geográfica. Gobierno de España: http://centrodedescargas.cnig.es/CentroDescargas/catalogo.do?Serie=MPPIF#). The red circles correspond to the different archaeological sites studied in this paper. 1: Alto de la Huesera. 2: Bolores. 3: Camino del Molino. 4: Cebolinhos 1. 5: Chabola de la Hechicera. 6: Comenda 1. 7: Cova da Moura. 8: Cueva de los Cristales. 9: El Rebollosillo. 10: Feteira II. 11: Gozquez 047. 12: La Pijotilla. 13: Lapa da Rainha 2. 14: Las Yurdinas. 15: Longar. 16: Los Husos. 17: Marroquíes Bajos. 18: Paimogo I. 19: Palacio III 20: Peña Larga. 21: Perdigões. 22: Pico Ramos. 23: San Juan. 24: Valencina. 25: Vidigueiras 2. 26: Zambujal. Authors: J. A. Lozano Rodríguez and J. Cárdenas. (For interpretation of the references to color in this figure legend, readers are referred to the web version of this article.)

M3), the dental pieces more frequently used in strontium studies, form in the first three years of life, between the 3rd-7th year, or between the 7th to 14th/16th year, respectively (AlQahtani et al., 2010). If the M1 of an individual has a local signature different than the one of the region where their remains were discovered it means that this person lived their first three years of life in another geological setting. However, if it is the M3, the signature will refer to their juvenile stage.

Because of the reasons mentioned above, the direct interpretation of values that fall outside the local baseline in terms of non-locality can be problematic. In geologically homogeneous regions, strontium ratios are more clearly defined than in areas where geology is highly heterogeneous. In the case of Iberia, we deal mostly with the second scenario (Fig. 1), which often causes the distinction between local and non-local values to be difficult. Since this research is based entirely on previously published data, judgements made in the bibliography are, in principle, not challenged: characterization of individuals as local and non-local are accepted as published.

However, it is important to bear in mind that even within geologically homogeneous regions the establishment of a clear local baseline is not entirely straightforward. Usually, this is achieved through strontium ratios of archaeological faunal remains, since domestic animals are assumed to have lived and fed close to human settlements. Nevertheless, recent research suggests caution must be applied as some data may inform not on local baselines but on different patterns of land use (Knipper et al., 2018: 745). To avoid such problems, vegetable remains, soil and/or water must be used in combination with faunal remains to set up the local range, combining $^{87}Sr/^{86}Sr$ and $\delta^{18}O$ (Bentley and Knipper, 2005: 632). Optimal approaches should include small animal samples (Price et al., 2002), modern snail shells and river water (Stephan et al., 2012), considering the analysis of different teeth – ideally both deciduous pieces and permanent molars - from the same individual (Knipper et al., 2018). Developing 'isoscapes', as suggested by Scaffidi and Knudson (2020), and mapping systematically the biologically available strontium ratios of wide regions, as made in south Germany (Bentley and Knipper, 2005), would be also important to identify potential migrants in a more detailed and robust way. In Iberia, in spite of the very relevant progress made in the last few years (Valenzuela-Lamas et al., 2018; James et al., 2022), this work is still to be fully done.

The identification of migrants and non-migrants informs us about mobility, but not about types of mobility. Different models have been proposed (*cf.* Reiter and Frei, 2019), especially in relation to post-marital residence patterns as an explaining factor. Hrnčíř et al. (2020a: 4) suggested 7 different possibilities, based on the percentage of non-local males and females, and applied them to the analysis of the LBK cemeteries of Vedrovice and Nitra (Czech Republic), questioning earlier views on patrilocality for both sites. In a more ambitious and general work, Ensor (2021: 29-34) develops 4 models based on strontium isotope results: i) male homogeneity and female heterogeneity, with some female non-local ratios; ii) both male and female homogeneity and local ratios; iii) female homogeneity and male heterogeneity, with some male non-local ratios; and iv) female and male variability in ratios. In each case one or some kinship practices are considered. We will go back to this issue in the discussion section.

In Archaeology, any attempt to cross-analyze mobility and gender in order to infer post-marital residence patterns has to deal with an additional challenge: sex determinations. Although gender is not always expressed in binary terms and it does not necessary rely on sex, in a great number of societies there is a close connection between both. In addition, despite the fact that research has experienced a huge leap in the last decades, largely thanks to the application of osteological analysis, the available knowledge on Iberian prehistoric demography remains fragmented and shallow. Furthermore, a recent review has showed that conventional bioarchaeological methods may lead to an over-representation of males (Cintas-Peña and Herrero-Corral, 2020). Promising new techniques for sex identification through peptides from dental enamel may help solve this problem (Stewart et al., 2017; Rebay-Salisbury et al., 2020). All this suggests that caution must also be taken when selecting the human populations to be examined.

In this paper, strontium isotope data were addressed in two ways: firstly, a pan-Iberian approach was assumed, considering all the available data; secondly, data from the so-called 'mega-sites' – remarkably large settlements, several dozen hectares in size and boasting major monuments, such as ditched enclosures and megaliths (see description in García Sanjuán et al., 2017; Gaydarska, 2017; Gaydarska et al, 2020) - were examined. In both cases there are some methodological and interpretative issues that must be taken into account, as will be discussed below.

The methodological and theoretical background described above sets the basis for the interpretation of the relationship between sex, early social complexity and residential patterns in Copper Age Iberia. Two different sections on 'sex estimation' and 'local baseline ranges' are included in the "Supporting Information Bioarchaeology" file.

3. A theoretical framework

Since the beginning of the discipline, social anthropologists have produced a vast amount of research on residential patterns and kinship. Especially in the 1970s and 1980s (*cf.* Goody, 1973; Goody and Goody, 1983 among many others) very relevant work, aimed at understanding their role in the shaping of social organization among early complex societies, was published. Various kinds of residential patterns have been described in the anthropological literature. If, after marriage, the new couple establishes their residence with (or next to) the husband's parents and kinfolk, we would speak of patrilocality, whereas if it refers to the 'residence with the husband's brothers' (Ensor et al., 2017: 53) we would speak of virilocality. Conversely, when the newly-wed couple is received by the wife's parents, we would speak of matrilocality, whereas if the residence also involves the wife's extended kinsfolks, the term applied is uxorilocality. Patrilocality and virilocality, on the one hand, and matrilocality and uxorilocality, on the other, are usually explained jointly. However, these residential patterns are not the only ones and other alternatives have been described: avunculocality (residence next to a maternal uncle or some other maternal relative); bilocality (residence with either wife's or husband's residential group, or with a different residential group where neither previously lived); neolocality (new residence, not associated to either parent); separate residence (husband and wife do not share residence); mixed systems (some of the categories mentioned above are combined).

As Marvin Harris famously claimed, "the overwhelming majority of known societies show residential and affiliation patterns centered on the male" (Harris, 2007: 231). Data extracted from the *Ethnographic Atlas* (Murdock et al., 1999), reflecting 1291 societies distributed across the world, and available in the D-Place open-access database (Kirby et al., 2016), support that claim. This source reveals that among the 1267 societies classified according to their postmarital residence pattern (coded as: Marital residence with kin: prevailing pattern [EA012]), up to 797 (62.9%) are 'patrilocal' (n = 638, 50,36%), or 'virilocal' (n = 159, 12.55%), patrilocality being the most frequent result (Table 1). By contrast, 103 societies (8.1%) are classed as matrilocal (n = 58, 4.58%) or uxorilocal (n = 45, 3.55%). Noticeably, by itself matrilocality only represents 4.58% of that population, as opposed to 50.36% being patrilocal. Despite the fact that the *Ethnographic Atlas* presents some relevant problems of method and representativeness, including the famous and already mentioned Galton problem and other errors noted by Murdock himself (Murdock, 1967: 111-113), this evidence strongly suggests a cross-cultural prevalence of male-centered residential patterns.

This finds further corroboration in the Standard Cross-Cultural Sample (Murdock and White, 1969). According to the data compiled in D-Place (which includes 185 of 186 societies) (Table 2) [Code: "Marital residence with kin: prevailing pattern" [SCCS215] [identical to EA012]], 94 (50.81%) of societies show either patrilocal (n = 69, 25%)

Table 1
Marital residence with kin: prevailing pattern according to the Ethnographic Atlas by Murdock et al., 1999, available in D-Place database (https://d-place.org/parameters/EA012#1/30/152), based on the "Marital residence with kin: prevailing pattern" [EA012] variable.

Type	N	%
Avunculocal	54	4.26
Ambilocal	83	6.55
Avuncu-uxorilocal	5	0.39
Avuncu-virilocal	11	0.87
Matrilocal	58	4.58
Neolocal	62	4.89
Separate	8	0.63
Patrilocal	638	50.36
Uxorilocal	45	3.55
Virilocal	159	12.55
Ambi-uxo	37	2.92
Ambi-viri	107	8.45
TOTAL	1267	100.00

Table 2
Marital residence with kin: prevailing pattern according to the Standard Cross-Cultural Sample by Murdock and White available in D-Place database (https://d-place.org/parameters/SCCS215#2/14.3/150.3), based on the "Marital residence with kin: prevailing pattern" variable, [SCCS215] [identical to EA012].

Type	N	%
Avunculocal	8	4.32
Ambilocal	12	6.49
Avuncu-uxorilocal	1	0.54
Avuncu-virilocal	1	0.54
Matrilocal	16	8.65
Neolocal	15	8.11
Separate	1	0.54
Patrilocal	69	37.30
Uxorilocal	6	3.24
Virilocal	25	13.51
Ambi-uxo	8	4.32
Ambi-viri	23	12.43
TOTAL	185	100.00

or virilocal (n = 25, 13.51%) residential rules, as opposed to 22 (11.9%) with either matrilocal (n = 16, 8.65%) or uxorilocal (n = 6, 3.24%) ones. Again, patrilocality is the most frequent of all possible options, quadrupling the frequency of matrilocality. Moreover, the combination of ethnographic information and linguistic data has demonstrated that 'there is a tendency for patrilocality to be the most common and persistent state" (Moravec et al., 2018: 598).

Why is patrilocality the prevailing residential pattern? After assessing a number of variables Ember and Ember provided a potential explanation: while patrilocality is favored by internal conflict, matrilocality is connected to external conflict – but only if that conflict leads women to contribute to subsistence on a par with men (Ember and Ember, 1971: 585). The relationship between matrilocality and external conflict was also analyzed by Divale, who incorporated a trigger factor to the model: a migration to a new region already inhabited that causes a disequilibrium (Divale, 1974: 79-80). In Divale's opinion, in such scenario, "the most adaptive response would be for local communities to direct all their hostilities toward the communities of the other culture – i.e. to have a pattern of purely external warfare" (Divale, 1974: 80). Under these circumstances, matrilocality is more efficient because it breaks the bonds between men, hence diluting internal conflict and channeling all efforts to the external struggle (Divale, 1974: 100). As a consequence, matrilocal groups such as the Iroquois, the Wyandotte ('Huron') (North-America) or the Mundurucu (South-America) are more internally peaceful (Harris, 2007: 235).

To sum up, Ember and Ember (1971) suggested that what most influences the type of residence is warfare, while Divale (1974) pointed out the opposite: different forms of residence determine different patterns of warfare (Ember, 1974: 140). Although both models focus on the association between conflict and residence, they propose opposite causal chains. Divale's take was criticized by Ember (Ember, 1974), who argued that warfare is more likely to precede residence than vice versa, because it is related to societal population (Ember, 1974: 140). In fact, using Divale's own data, Ember demonstrated that the larger the population, the more likely internal conflict was to exist. Although some small-scale societies also have internal warfare, "almost all of the societies over 21.000 in total population have some internal warfare" (Ember, 1974: 143).

The residence pattern has also its effect in relation to house size and settlement organization. Cross-cultural data show that living floor areas are significantly larger in matrilocal societies than in patrilocal ones (Ember, 1973; Divale, 1977; Brown 1987; Porčić, 2010; Hrnčíř, 2020b). Concerning spatial organization, the distribution of houses in a settlement would also be different depending on residence and descent (Ensor, 2013; 2021: 132-133). Both results may act as proxies for the analysis of archaeological record. However, the current knowledge on both dwelling size and settlement organization in Copper Age Iberia is very limited or even non-existent, which prevents us from integrating this type of evidence in our analysis.

To what extent do residence patterns affect the social status of women? According to Whyte (2015), who carried out an ambitious cross-cultural research on *the status of women in preindustrial societies* in which 93 different cultures from a SCCS sample were analyzed, "matrilineal descent and matrilocal residence are associated with modest benefits for women in certain areas (particularly in property rights)" (Whyte, 2015: 171). Indeed, out of 10 variables (property control, kin power, value of life, value of labor, domestic authority, ritualized female solidarity, control of sex, ritualized fear, joint participation and informal influence) only one - property control - was statistically more likely to happen in matrilocal and/or matrilineal communities (Whyte, 2015: 133). Ethnographers argue that the existence of *modest* and not *high* effects on women's status based on residence patterns must be explained by the fact that men are decision-makers in their kin groups even if their community is organized through matrilineal descent (Ember et al., 2019: 15). Another relevant conclusion was addressed by Fink (2004), who also used SCCS data to prove that male-based inheritance rights and patrilineal descent predict significant restriction or even exclusion of women from religious rituals.

If the focus is placed not on residential patterns but on social complexity, there are some conclusions worth mentioning. As shown by Whyte (2015: 172), in more complex societies, women tend to have i) less domestic authority, ii) less independent solidarity with other women, iii) more sex-based restrictions, iv) more ritualized fear from men, and v) fewer property rights than men. Also, in more complex societies women tend to have i) more informal influence and ii) perhaps somewhat more joint participation with males. In Whyte's opinion, these differences could be partly explained by two factors: intensive farming and social differentiation (or emerging class structure), on the one hand, and the existence of "many specialized roles outside the family and complex political hierarchies legitimated by ascriptive ideologies", on the other. Although there are major differences among the sample of 93 societies analyzed by Whyte, the author concluded that women would seem to be somewhat better off in simpler societies than in more complex ones (2015: 172–173). But what do 'simple' and 'complex' societies mean in such context? In Whyte's study, less complex (or more 'simple') societies are those in which there are few recognized social differences in terms of stratification, individual positions depending more on personal skills than in inherited status; economically and technologically, a 'simple' society bases its subsistence in hunting and gathering, not being able to accumulate inheritable property and lacking tools to exploit nature intensively; finally, concerning settlement patterns, people live in small groups and are nomadic or seminomadic (Whyte, 2015: 155). On the contrary, complex societies are those where: i) there is a social stratification dividing people in classes or castes whose members have varying degrees of control over resources and property; ii) economically and technologically, they rely on intensive agriculture and use advanced tools and techniques; iii) both men and women inhabit large and stable settlements (Whyte, 2015: 156). Notions of 'simplicity' and 'complexity' applied to whole social systems can be problematic (Barrientos and García Sanjuán, 2020). While there are forms of complexity in all societies, there are non-stratified (i.e. non-class-based) societies which display the basic traits associated to complexity by Whyte. The bottom line, however, is that there is an observed correlation between increased social inequality and increased gender inequalities.

In light of the above, it seems rather uncontroversial to assume that women enjoy higher social positions with regards to men in matrilocal, matrilineal and more egalitarian societies than in patrilocal, patrilineal and more inegalitarian ones. That does not mean that patrilocal or patrilineal societies are necessarily unequal (Stone and King, 2019; Bickle and Hofmann, forthcoming), but that they are more likely to be unequal than matrilocal and matrilineal ones. But are residence patterns, inheritance rights and societal complexity related, as mentioned at the beginning of this paper? To answer this question, two D-Place pairs of codes were combined: on the one hand "Subsistence Economy: Dominant Mode [SCCS833]" and "Marital residence with kin: prevailing pattern [Note, identical to EA012] [SCCS215]", and on the other "Inheritance of Property of Some Economic Value [SCCS590]" and "Marital residence with kin: prevailing pattern [Note, identical to EA012] [SCCS215]", the three of them are based on Standard Cross-Cultural Sample. The two combinations return some interesting results.

In the first pair - "Subsistence Economy: Dominant Mode [SCCS833]" and "Marital residence with kin: prevailing pattern [Note, identical to EA012] [SCCS215]" -, among the dozen potential combinations of residence patterns and types of subsistence (Supporting Information Cross-Cultural Analysis S1 and S2), the only option that shows a very clear differential distribution is patrilocality, which is more likely to occur in societies with an economy based on advanced agriculture than in any other ($\chi^2 = 34.731$, $p = 1.26E\text{-}05$). If data on patrilocality and virilocality are cross-examined against matrilocality and uxorilocality, the former option also yields a statistically significant result ($\chi^2 = 23.514$, $p = 0.0013864$), while the latter does not. In the second pair - "Inheritance of Property of Some Economic Value [SCCS590]" and "Marital residence with kin: prevailing pattern [Note, identical to EA012] [SCCS215]" -, three of the twelve possible combinations show a statistical difference between inheritance and residence: in matrilocal societies there is a more likely 'roughly equal' or 'female preference' in the inheritance ($\chi^2 = 27.87$, $p = 3.97E\text{-}06$), while in patrilocal ones the most frequent is the inheritance 'only by men' or 'by both, but with male preference' ($\chi^2 = 14.981$, $p = 0{,}0018334$). In neolocality, a statistically significant difference is found in terms of inheritance between men and women ['roughly equal ($\chi^2 = 8{,}8525$, $p = 0{,}031318$)]. The combination of patrilocality and virilocality ($\chi^2 = 21.641$, $p = 7.75E\text{-}05$), and matrilocality and uxorilocality give similar results ($\chi^2 = 24.854$, $p = 1.66E\text{-}05$). In conclusion, patrilocality is more frequent in societies whose economy is based on advanced agriculture and in patrilocal societies male inheritance is more likely to occur, whereas in matrilocal communities, inheritance is roughly equal or biased to a female preference.

To sum up, a number of points can be derived from the ethnographic record in order to build a theoretical framework to analyze the connection between early social complexity, residential patterns and gender. Patrilocality i) is the most frequent residential pattern in the ethnographic record, ii) it is more likely to occur in societies engulfed in internal conflict - internal conflict being more frequent in societies bigger than 21.000 people -, iii) is more likely to occur in societies economically relying on advanced agriculture, iv) is predicted by multilocal political integration, v) may be linked to a lower status of women with regards to control over property, and vi) is more likely related to male-based inheritance rights. In turn, in matrilineal and matrilocal societies, women i) have more control over property, and ii) and are more likely to inherit a property of some economic value. In societies with male-centered inheritance rights and patrilineal descent, women are more likely to be excluded from religious rituals, and in more complex societies they tend to have less domestic authority, less independent solidarity with other women, more unequal sexual restrictions and receive more ritualized fear from men. As a result, it seems fair to conclude that, according to a substantial body of ethnographic evidence, women's status in relation to men, male-centered residence patterns and social complexity are clearly inter-connected (Fig. 2).

Of course, extrapolating this to prehistory is by no means straightforward. Cross cultural studies show certain trends and an enormous diversity in relation to kinship systems and residence patterns (Stone and King, 2019; Hrnčíř et al., 2020a; Brück, 2021). Neither the general guidelines nor particular examples allow us to independently address the entirety of human behavior. However, both contribute to a better understanding of the functioning of societies over time.

For now, suffice it to say that early complex Copper Age Iberian societies show incipient, but not widespread, internal or external conflict, an economy based on agropastoral intensification but largely lacking in technological sophistication (for example irrigation) and multilocal forms of political integration in which ritual monumentality at central places (of the 'mega-site' type) played an important role. We will return to these issues in the discussion section.

4. The Iberian Copper Age

4.1. Iberia

As mentioned above, data on strontium isotopes from samples of human bone and teeth are currently available for 473 or 476 individuals from 26 different Copper Age sites of the Iberian Peninsula - it is unclear whether the samples from two of the sites (Cebolinhos 1 and Vidigueiras) correspond to 1 or 2 and to 2 or 4 individuals, respectively. This count does not result from a sampling strategy, but represents the totality of strontium isotope information available for Copper Age Iberia at the time of writing. The sites included here are: Alto de la Huesera, Bolores, Camino del Molino, Cebolinhos 1, Chabola de la Hechicera, Comenda 1, Cova da Moura, Cueva de los Cristales, El Rebollosillo, Feteira II, Gózquez 047, La Pijotilla, Lapa da Rainha 2, Las Yurdinas, Longar, Los Husos I, Marroquíes Bajos, Paimogo I, Palacio III, Peña Larga, Perdigões, Pico Ramos, San Juan, Valencina, Vidigueiras 2 and Zambujal (Table 3 and Fig. 3) (full data in Supporting Information Bioarchaeology S3 file).

Geographically, 15 of these sites are located in southern Iberia, especially in the southwest, while 9 are located in the north and 2 in central Spain. This somewhat irregular distribution can be partly explained because of the larger size of some of the southern sites, such as Perdigões, La Pijotilla, Marroquíes Bajos or Valencina, which have been recently termed 'mega-sites' (García Sanjuán et al., 2017). Nevertheless, differences in research intensity, as well as availability of human remains and preservation conditions (i.e., high soil acidity across the west and the north-west) also have to be born in mind as relevant factors to explain the geographical distribution of the sample.

A first approach to all data (Table 3) shows that the highest percentages of non-local individuals appear in Perdigões (75%), Valencina (33%) and La Pijotilla (29.4%), all of them southern 'mega-sites', and in Chabola de la Hechicera (50%), Cebolinhos 1 (33 or 50%), Cova da Moura (30.8%), and Alto de la Huesera (28.6%), which are megalithic constructions (dolmens) and a natural cave. It is important to note that among the 15 sites with non-local individuals there are major differences in sample size: the number of individuals analyzed in Chabola de la Hechicera (n = 2) or Cebolinhos 1 (2 or 3) is very low compared to that of Perdigões (n = 72) or Valencina (n = 33). The list of sites with under 20% non-locals includes San Juan (19%), Las Yurdinas (18.2%),

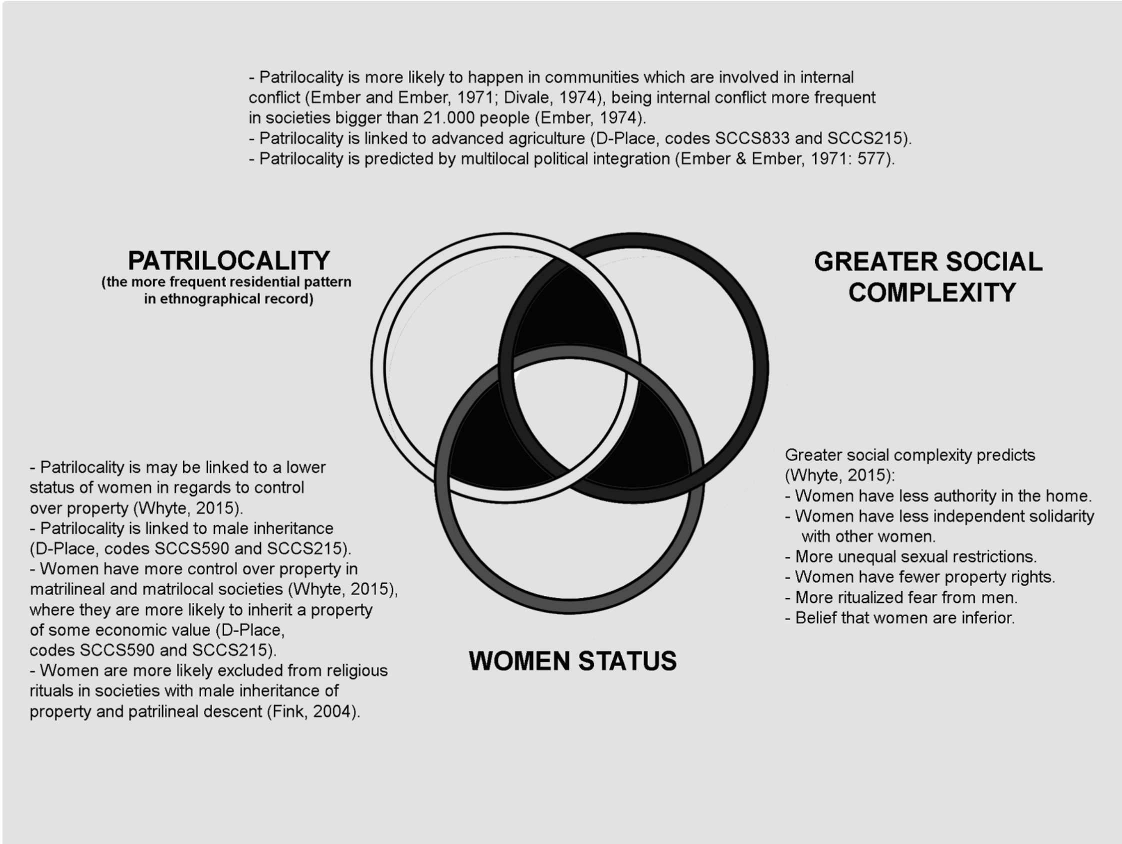

Fig. 2. Borromean ring showing the connection among women's status, greater social complexity and male-centered residential patterns.

Pico Ramos (16.7%), Camino del Molino (12.9%) and Marroquíes Bajos (6%). In the remaining 13 sites there are no individuals with values that fall outside the local baseline. In sum, 107/108 of 473/476 individuals show values outside their respective local baselines (Supporting Information Bioarchaeology S3: yellow cells).

Therefore, in principle, an average of up to 22.6% of individuals were inhumed in places different from those where they grew up, which suggests a substantial degree of mobility for Copper Age people.

In addition, there seems to be a wide spectrum of burial types that housed relatively high percentages of non-locals, including hypogea (Camino del Molino, 12.9%), caves (Las Yurdinas, 18.2% or Pico Ramos, 16,7%) and megaliths (Alto de la Huesera, 28.6%), which could suggest they were used by people who originally grew up over a wide area.

Although this data help to explain the dynamic nature of Copper Age society, not all the available strontium isotope results can be correlated with sexual estimations, which is clearly a prerequisite to undertake any postmarital residence pattern analysis. Sexual identification is only available for 131 of those 473 individuals, including 60 females and 71 males (Table 4 and Fig. 4). Sexed individuals are found in the following sites: Alto de la Huesera (n = 7), Camino del Molino (n = 45), Chabola de la Hechicera (n = 2), El Rebollosillo (n = 3), Las Yurdinas (n = 11), Longar (n = 6), Los Husos (n = 3), Marroquíes Bajos (n = 36), Peña Larga (n = 1) and Valencina (n = 17). Remarkably, Perdigões, one of the most intensively researched Copper Age sites, is not in this list on account of the high degree of fragmentation of its human bone assemblages, which prevents a precise sexual identification (see discussion in Shaw Evangelista, 2018).

Out of 60 females, 46 present strontium values compatible with the area in which they were buried (76.7%), which would make them 'local', while 14 (23.3%) exceed the local ratios, and in principle could be regarded as 'non-local' (Supporting Information Bioarchaeology S3: yellow cells and S7). As for the 71 males, 64 are 'local' (90.1%), while only 7 are 'non-local' (9.9%). The percentage of female individuals with ranges not compatible with those of the locality or region where they were buried is well over twice that of males. The result of a χ^2 test (4.386, p = 0.036234) allows the rejection of the null hypothesis, pointing to a possible difference in the residential mobility of females and males, while the result of Fisher's exact test (p = 0.05444) is in the limit of significance.

Nevertheless, as we mentioned in the methods section, strontium signatures obtained through dental analysis provide information regarding the moment in which the tooth was formed, while bone analysis tells us about the last ten years of an individual's life. In order to be more precise, we have examined how many of the sexed individuals previously mentioned are non-adults or have had their bones analyzed, instead of their teeth (Supporting Information Bioarchaeology S8). The application of this criteria imply the exclusion of only 4 individuals: 3 female adolescents from Camino del Molino and 1 likely female adolescent from Los Husos. All the samples of the sexed individuals are from teeth. In any case, these exclusion leads, on the one hand, to 42 local (75%) and 14 (25%) non-local females, on the other, of 64 local (90.1%) and 7 (9.9%) non-local males. Again, both the results of a χ^2 test (5.2003, p = 0.022583) and a Fisher's exact test (p = 0.030152) point to significant differences, suggesting a higher female mobility.

If the available evidence is assessed on a site-by-site basis, a more complex and nuanced picture emerges. For example, at Valencina, the χ^2 test also allows for the rejection of the null hypothesis, given the high proportion of non-local women. However, at four other sites (Alto de la Huesera and Las Yurdinas in the north, and Marroquíes Bajos and Camino del Molino in the south), the χ^2 test does not support the rejection of the null hypothesis, although in all cases the number of non-local women is either equal to or higher than that of men.

These results are consistent with observations already made for some specific sites, such as Los Berrocales (Díaz-del-Río et al., 2017),

Table 3
Summary of contextual data for the sampled sites. SWA: stone-walled architecture. D: ditches. Radiocarbon chronologies have been obtained from IDEARQ database (www.idearqueologia.org), considering the earliest and the most recent dates for the period of analysis and prioritizing human bone samples. Dates have been calibrated using OxCal 4.4 (IntCal 20). The laboratory reference of each date can be consulted in Supporting Information Biarchaeology (S2), as well as the criteria followed to select them.

Site	Type	Location	Size	Chronology (cal BCE)	SWA	D	N samples	N individuals analyzed	N non-locals	% non-locals
Alto de la Huesera	Megalith	Álava	<1 ha	3360–3101 to 3011–2876	–	–	7	7	2	28.6%
Bolores	Cave	Lisbon	<1 ha	2880–2584 to 2008–1744	–	–	6	6	0	0%
Camino del Molino	Hipogeum	Murcia	<1 ha	3010–2696 to 2456–2172	–	–	103	93	12	12,9%
Cebolinhos 1	Megalith	Évora	<1 ha	Late Neolithic / Chalcolithic	–	–	3	2/3	1 / 2	33% / 50%
Chabola de la Hechicera	Megalith	Álava	<1 ha	3911–3652 to 3307–2899	–	–	2	2	1	50%
Comenda 1	Megalith	Évora	<1 ha	Late Neolithic	–	–	1	1	0	0%
Cova da Moura	Cave	Lisbon	<1 ha	3763–3639 to 2622–2209	–	–	13	13	4	30,8%
Cueva de los Cristales	Cave	Huesca	<1 ha	3091–2906 to 2835–2039	–	–	5	4	0	0%
El Rebollosillo	Cave	Madrid	<1 ha	2865–2533 to 2293–2049	–	–	19	16	0	0%
Feteira II	Cave	Lisbon	<1 ha	3697–3367 to 2879–2494	–	–	10	10	0	0%
Gózquez 047	Pit	Madrid	<1 ha	2878–2476 to 2469–2211	–	–	3	3	0	0%
La Pijotilla	Settlement: megalith	Badajoz	*c.* 80 ha	3313–2886 to 2563–2136	X	X	17	17	5	29,4%
Lapa da Rainha	Cave	Lisbon	<1 ha	2849–2496	–	–	2	2	0	0%
Las Yurdinas	Cave	Álava	<1 ha	3338–2891 to 3022–2778	–	–	11	11	2	18,2%
Longar	Megalith	Álava	<1 ha	3623–3019 to 3342–2923	–	–	7	7	1	14,3%
Los Husos	Cave	Álava	<1 ha	Late Neolithic / Early Chalcolithic	–	–	3	3	0	0%
Marroquíes Bajos	Settlement: different contexts	Jaén	*c.* 113 ha	2898–2671 to 2471–2287	X	X	99	99	6	6.1%
Paimogo I	Megalith	Lisbon	<1 ha	3261–2504 to 2622–2471	–	–	9	12	0	0%
Palacio III	Megalith	Seville	<1 ha	Chalcolithic	–	–	12	8	0	0%
Peña Larga	Cave	Álava	<1 ha	3486–3099	–	–	2	2	0	0%
Perdigões	Settlement: different contexts	Évora	*c.* 16 ha	3259–2898 to 2455–2201	–	X	113	72	54	75%
Pico Ramos	Cave	Vizcaya	<1 ha	3913–3345 to 2912–2346	–	–	24	24	4	16.7%*
San Juan	Cave	Huesca	<1 ha	3514–3348 to 2845–2470	–	–	32	21	4	19%
Valencina	Settlement: different contexts	Seville	*c.* 400 ha	3011–2879 to 2474–2236	–	X	33	33	11	33%
Vidigueiras 2	Megalith	Évora	>1 ha	Late Neolithic	–	–	4	2/4	0	0%
Zambujal	Settlement	Lisbon	*c.* 1 ha	3333–2934 to 2198–1775	X	–	3	3	0	0%
TOTAL							543	473/476	107/108	22.6%

Marroquíes Bajos (Beck, 2016: 314; Díaz-Zorita Bonilla et al., 2018: 1002–1003) or Alto de la Huesera, Chabola de la Hechicera and Longar (Fernández-Crespo et al., 2020: 7 and fig S7). At those sites, the lower variability of strontium isotope values among the male population was interprreted as consistent with a patrilocal residential pattern. In more general terms, these data would be coherent with both the “point-to-point” (“single, unidirectional movement of the individual(s) concerned”) and “repeated mobility” (“movements between two or more locations followed by short stays”) models proposed by Reiter and Frei (2019), although only the first one, interpreted as a consequence of exogamy, could explain the differences regarding sex. However, it is important to note that mobile individuals were not the norm among these sites: in the sample of 131 sexed individuals for whom strontium isotopes values are available, 76.7% of the females and 90.1% of the males were local. If there was a higher female mobility linked to patrilocality, it was either a non-compulsory norm or an incipient practice. Here, we should bear in mind that we are treating the Copper Age (*c.* 900 years) as a single temporal block.

In terms of the seven models proposed by Hrnčíř et al. (2020a: 4) depending on the percentage non-local or local male and females the data presented here would not fit within the ‘extreme’ options (#1 and #7, predominantly patrilocal an predominantly matrilocal, respectively) but, if anything, with the other models in between. Indeed, patrilocality and matrilocality are not the only residence patterns to consider. In this vein, a recent publication by Ensor (2021) proposes 4 models to interpret strontium ratios. The Copper Age data presented in this paper, which show a higher number of female (23.3%) than males (9.9%) outsiders and a majority of locals of both sexes (76.7% F/F? and 90.1 % M/M?), fit with two of the four models (#1 and #4) proposed by Ensor (2021: 29-34). According to this author, in model #1 the male homogeneity and the female heterogeneity caused by some nonlocal female ratios may be the result of three different kinship practices: i) bilateral descent in combination with patrilocality; ii) patrilineal descent with transfer women’s membership, which is indicative of extreme gender inequality; and iii) matrilineality combined with avunculocality, also an indicator of extreme gender inequality. In model #4, the majority of both sexes have local ratios, but some of them present non-local values. This author indicates that ‘because of the tendency among bilateral societies for a patrilocal bias, more of those with nonlocal ratios may be females’ (Ensor, 2021: 34). The higher number of non-local women in comparison to men, and the majority of local individuals of both sexes shown by Iberian Copper Age strontium isotope data would fit better with Ensor’s model #4, although model #1 cannot be ruled out, especially considering that only a 47.8% of individuals for which we have strontium data have been sexed. If we accept this, strontium isotopes data would be showing a Copper Age social organization based on bilaterality and bilocality, but with a tendency to patrilocality or a patrilocal bias.

An alternative – or complementary - explanation for the (relatively) high number of non-local individuals at some sites is transhumance, as suggested for the Pico Ramos cave (Sarasketa-Gartzia et al., 2018: 23). The testing of this hypothesis is theoretically viable through faunal data and a comparison of the values obtained for ovicaprids with other less mobile species, such as suidae, as well as vegetables, water or soil. However, although transhumance has been widely discussed as major phenomenon in Iberian later prehistory and history (Chapman, 1979;

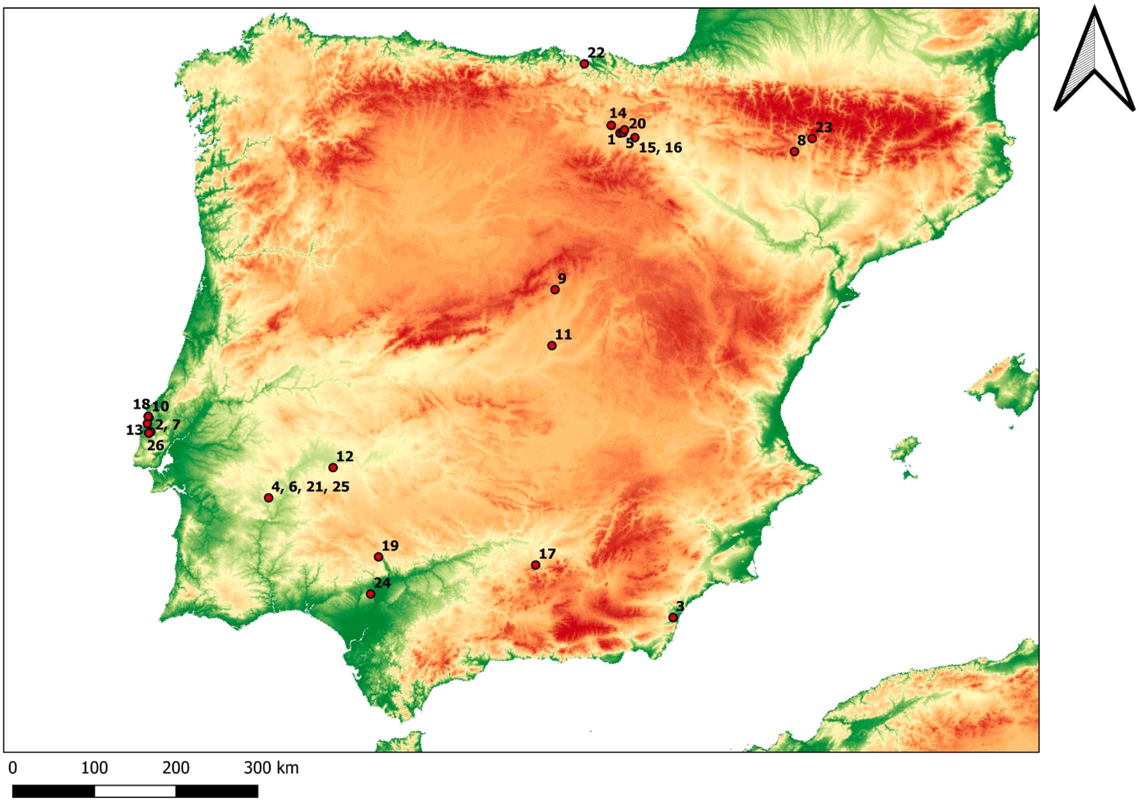

Fig. 3. Distribution of sites mentioned in the text. 1: Alto de la Huesera. 2: Bolores. 3: Camino del Molino. 4: Cebolinhos 1. 5: Chabola de la Hechicera. 6: Comenda 1. 7: Cova da Moura. 8: Cueva de los Cristales. 9: El Rebollosillo. 10: Feteira II. 11: Gozquez 047. 12: La Pijotilla. 13: Lapa da Rainha 2. 14: Las Yurdinas. 15: Longar. 16: Los Husos. 17: Marroquies Bajos. 18: Paimogo I. 19: Palacio III 20: Peña Larga. 21: Perdigões. 22: Pico Ramos. 23: San Juan. 24: Valencina. 25: Vidigueiras 2. 26: Zambujal. Author: M. E. Costa Caramé.

Table 4
Individuals with estimated sex and strontium isotope analysis from Copper Age Iberia. The percentage showed in the columns 'F/F? local', 'F/F? non-local' refers to the total of F/F?; the percentage showed in the columns 'M/M? local' and 'M/M? non-local' refers to the total of M/M?

Site	NMI total	NMI sex	F/F?	F/F? local	F/F? non-local	M/M?	M/M? local	M/M? non-local
Alto de la Huesera	7	7 (100%)	3	2 (66.6%)	1 (33.3%)	4	3 (75%)	1 (25%)
Camino del Molino	93	45 (48.4%)	19	16 (84.2%)	3 (15.8%)	26	23 (88.5%)	3 (11.5%)
Chabola de la Hechicera	2	2 (100%)	1	0 (0%)	1 (100%)	1	1 (100%)	0 (0%)
El Rebollosillo	16	3 (18.8%)	1	1 (100%)	0 (0%)	2	2 (100%)	0 (0%)
Las Yurdinas	11	11 (100%)	4	3 (75%)	1 (25%)	7	6 (85.7%)	1 (14.3%)
Longar	7	6 (85.7%)	2	2 (100%)	0 (0%)	4	4 (100%)	0 (0%)
Los Husos	3	3 (100%)	2	2 (100%)	0 (0%)	1	1 (100%)	0 (0%)
Marroquíes Bajos	100	36 (36%)	20	17 (85%)	3 (15%)	16	16 (100%)	0 (0%)
Peña Larga	2	1 (50%)	1	1 (100%)	0 (0%)	0	0 (0%)	0 (0%)
Valencina	33	17 (51.5%)	7	2 (28.6%)	5 (71.4%)	10	8 (80%)	2 (20%)
TOTAL	274	131 (47.8%)	60	46 (76.7%)	14 (23.3%)	71	64 (90.1%)	7 (9.9%)

*All individuals analysed in Pico Ramos show values that fall outside the bioavailable 87Sr/86Sr ratios, what is interpreted as linked to pastoral transhumance (Sarasketa-Gartzia et al., 2018: 25). Here, following the indication by the authors in the paper (Sarasketa-Gartzia et al., 2018: 23), we have considered as clearly non-locals only 4 individuals.

Davidson, 1980; Walker, 1983; Ruiz, and Ruiz, 1986; Cara Barrionuevo and Rodríguez López, 1987; Ruiz-Gálvez Priego and Galán Domingo, 1991; Vega Toscano et al., 1998; Fairén Jiménez et al., 2006; Murrieta Flores, 2012; Murrieta Flores et al., 2009; Rojo-Guerra et al., 2013; Carvalho et al., 2017; Colominas et al., 2019), at least in its historically-documented form in did not involve the regular re-allocation of people. Indeed, mobility may have been linked to other social and economic practices, such as the exchange of raw materials or specialized skills (manufacture) and know-how. In this case, the higher mobility of females could perhaps be explained by women being the "carriers" or "traders" of either of those; hypothetically in such a situation, specific objects associated to these women would be found in burials. Unfortunately, the collective character of Copper Age funerary practices, with heavily commingled remains, makes it very difficult to evaluate this hypothesis properly.

Of course, these observations must also be pondered against the fact that the period under consideration here lasted for *c*. 900 years, and significant variations in residential rules may have occurred across Iberia during that time. In addition, the number of individuals analyzed in some of the sites is very low - for five sites (Chabola de la Hechicera, El Rebollosillo, Longar, Los Husos and Peña Larga, all in the north) (Supporting Information Bioarchaeology S1) the data are clearly insufficient to support any interpretation -, and the nature of the contexts is quite diverse. Because of that in the next subsection four sites that share some characteristics (including more robust data) will be addressed.

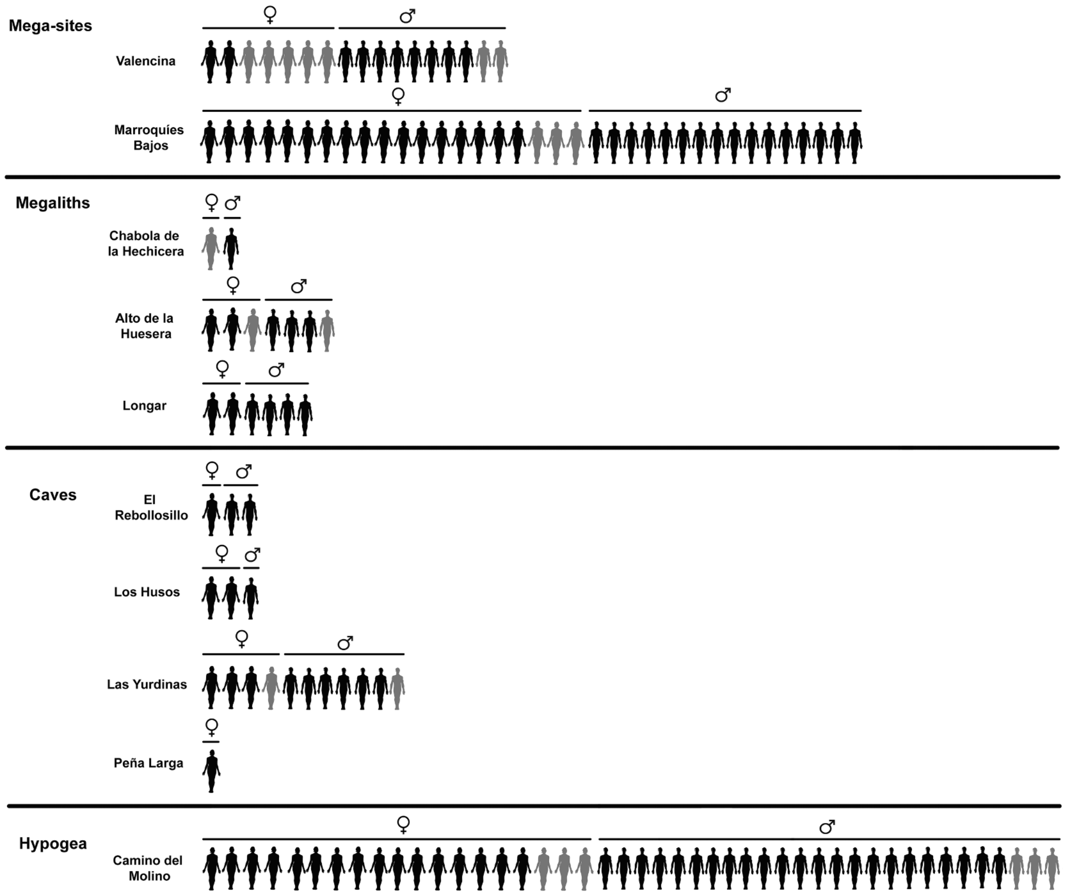

Fig. 4. Individuals with estimated sex and strontium isotope data from Copper Age Iberia. In black, locals; in grey, non-locals.

4.2. *Mega-sites*

Located in southern Iberia, Valencina, Perdigões, La Pijotilla and Marroquíes Bajos (Fig. 3), display sizes in the several dozen hectares (even well above 100), clearly surpassing that of the rest of sites from where information on strontium isotopes is available. These sites present (demonstrated or probable) ditched enclosures, major megalithic monuments and thousands of pits, all of them yielding abundant burial deposits and large amounts of material culture. In fact, if we consider site size and a simple distinction is made between large (>1 ha) and small (≤1 ha) ones (Table 3), the percentage of non-locals varies significantly (Table 5). There appears to have been more mobility connected with larger sites.

Both χ^2 (32.816, $p = 1.0131$E-08), and Fisher's Exact test ($p = 1.18$E-04) show differential distributions. The combined sum of non-local individuals (n = 76) for the four mega-sites (La Pijotilla, Marroquíes Bajos, Perdigões and Valencina) amounts to 34.4% of the total (n = 221), whereas the combined sum of non-locals (n = 31) for all 22 small sites represents only 12.3% of the total (n = 252).

In some sites, particularly at Valencina and Perdigões, this is matched by the high frequency of exogenous raw materials, such as ivory, flint, cinnabar, ostrich eggshell, rock crystal, variscite and amber. The high (or comparatively higher) percentage of non-locals in mega-sites such as Perdigões, Valencina or La Pijotilla (Fig. 5) could be explained by their being places of aggregation, attracting both non-local people and exogenous materials (Valera et al., 2020). However, at Marroquíes Bajos, also a mega-site, only 6 out of a of 115 analyzed individuals were considered non-local (Díaz-Zorita Bonilla et al., 2018). It is interesting to note that exotic raw materials, such as ivory, so abundant in Valencina or Perdigões, are conspicuous by their absence at Marroquíes Bajos. Therefore, although caution must be applied, there appears to be a correlation between comparatively higher percentages of non-local individuals and higher frequencies of foreign raw materials at mega-sites, with some exceptions, such as Marroquíes Bajos, which clearly supports the interpretation that they acted as central places of aggregation (Díaz-del-Río, 2004; García Sanjuán et al., 2017).

While for Marroquíes Bajos and Valencina, data on sex can be cross-analyzed with strontium data, in Perdigões and La Pijotilla sex data are not available, since human remains come mainly from commingled contexts and therefore were highly fragmented (Fig. 4, Supporting Information Bioarchaeology S5 and S6). In Marroquíes Bajos, the three sexed non-local individuals (of 36) were females, but they are not statistically significant (χ^2 2.6182, p = 0.10565; Fisher p = 0.2381); in Valencina 5 out of 7 women *versus* 2 out of 10 men were non-local, which is a statistically significant difference taking the result obtained in χ^2, and very close to the level of significance in the case of Fisher' Exact test (χ^2 = 4.4963, p = 0.033968; Fisher *p:* 0.58412). Can the higher female non-locality at Valencina be taken as evidence of patrilocality or bilocality biased to patrilocality as mentioned previously according to Ensor's 4th model? Given the small number of individuals, this hypothesis will require further empirical support in the future.

Table 5
Distribution on local and non-local individuals by site size.

	Locals	Non-Locals	Total	Chi squared	p	Fisher's Exact
Large sites	145	76	221	32.816	1.0131E-08	1.18E-04
Small sites	221	31	252			
Total	366	107	473			

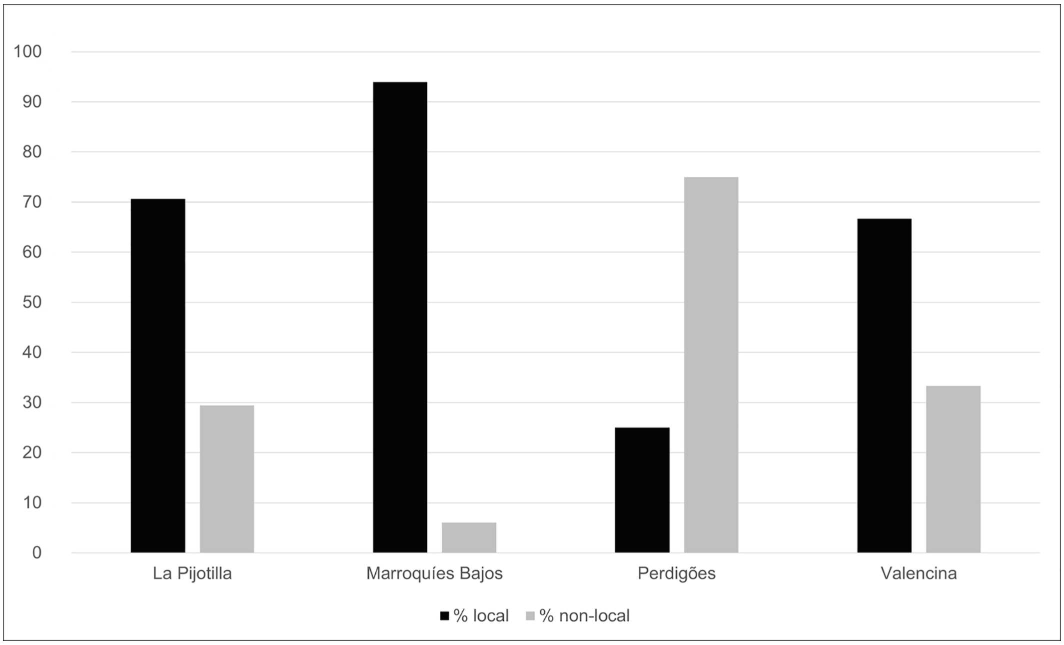

Fig. 5. Percentage of local and non-local individuals in mega-sites.

5. Discussion

How do the interpretations stemming from the ethnographic record compare with the evidence available for the Iberian Copper Age as summarized above? The ethnographic data compiled for this paper suggests, firstly, a higher frequency of residential patterns centered on the male and their possible connection with internal conflict, social complexity and a more unequal relationship between women and men. Secondly, there is a relationship between social complexity and a lower status for women. Thirdly, the available data on strontium isotopes from Copper Age Iberia shows that women were more frequently buried than men in places different from those where they grew up, which can be potentially linked to bilocality biased to patrilocality, especially in the so called 'mega-sites' and partly explained by the 'aggregational pull' exerted by such sites.

The characterization of Iberian Copper Age society is not straightforward. Since the period covers a time span of *c*. 900 years, a great diversity of situations is likely to have occurred. The communities who lived at the end of 4th millennium were very different from those living at the end of 3rd millennium. In between, a series of relevant transformations took place. Although it is difficult to establish a specific moment, it seems that the period between the 30th and 28th centuries BCE witnessed an increase in social differentiation, at least in southern Iberia, where Valencina, Perdigões, La Pijotilla and Marroquíes Bajos are located.

At some of these sites, the striking differences in burial treatment between some people suggest increased social differentiation, with some people rising above other, and setting up 'elite' groups within an increasingly non-egalitarian society. A recent review has discussed the main features characterizing the burials that can be assumed to represent Copper Age 'elite' groups. This includes the 'Ivory Merchant' and Montelirio 'religious specialists', from the Valencina 'mega-site', the woman from La Molina (also from the lower Guadalquivir valley) and a juvenile individual from Structure El-06 at Camino de las Yeseras, in central Spain (García Sanjuán et al., 2018). The emergence of individuals and groups (kinship units or factional groups) buried in grandiose megalithic tombs lavishly furnished with high-end (and sometimes, very exclusive) material culture manufactured on foreign raw materials (such as flint, rock crystal, ivory, amber or ostrich eggshell) suggests the existence of incipient (albeit unstable) forms of leadership, political centralization and social differentiation (Flores Fernández and Garrido Pena, 2014; García Sanjuán et al., 2018, etc.). The archaeological visibility of this 'elite' groups appears to be largely restricted to the domain of burial practices and funerary ideology, suggesting their position was based more on the exhibition of wealth in certain strategic rituals than on an institutionalized political power supported by control over a stapple economy. In other words, although still very limited in its scope, the available data do not appear to suggest Copper Age 'elites' were supported by institutional power based on a coercive apparatus and/or hereditary rights (García Sanjuán et al., 2017: 251; Cintas-Peña et al., 2018).

What is the evidence for gender differentiation in the Iberian Copper Age? A recent study (Cintas-Peña, 2020) revealed some statistically significant differences in how men and women perform with certain variables, such as artifact types and pathological features. Of the 76 χ^2 tests carried out as part of that study, 20 showed statistically significant differences. Here, we have added the result of Fisher's Exact test, in order to make those results more robust. Among them, some are worth noting. Males were more frequently associated with metal objects (χ^2 = 7.1699, p = 0.0074136; Fisher p = 0.014845), which in this period include mostly arrowheads, flat axes and punches, personal ornaments being absent. Men also display significantly higher associations, with 'technomic' artefacts – sensu Binford (1962) - such as punches and flint blades (χ^2 = 4.2174, p = 0.040012; Fisher p = 0.062541), and with osteological traumas caused by either violence or accidents (χ^2 = 8.5684, p = 0.0034204; Fisher p = 0.0032967). Females, on the other hand, were more frequently inhumed in association with 'socio-technomic' artefacts such as beads or pendants (χ^2 = 5.2754, p = 0.021629; Fisher p = 0.03115), and, as mentioned above, were buried more frequently than men in places other than the locality where they grew up (χ^2 = 5.625, p = 0.017706; Fisher p = 0.025167). The χ^2 test also showed some significant sex differences in terms of burial structures, with women being buried more frequently in megaliths (χ^2 = 8.0092, p = 0.0046539; Fisher p = 0.0052334) or negative structures without stone elements (χ^2 = 5.2701, p = 0.021695; Fisher p = 0.023924). Males were also more likely than females not to be buried inside a formal burial chamber (χ^2 = 20.962, p = 4.6859E-06; Fisher p = 4.64E-06) – we refer, for example, to individuals who were deposited directly on cave floors. Although not statistically significant, males and females also display some interesting quantitative differences in physical anthropology ($\chi^2 = 3.5952$, $p = 0.057948$; Fisher $p = 0.07977$), with a higher presence of stress markers in the upper extremities of women than men. A full breakdown of these results can be consulted in the Supporting Information Bioarchaeology, S9).

In addition to this, results published by Fernández-Crespo et al. (2018) are worth mentioning. As part of the research of the megalithic monument of Alto de la Huesera, whose strontium data are included in this paper, they analyzed $d^{13}C$ and $d^{15}N$ stable isotope from 17 juveniles and 7 adults, focusing on breastfeeding. The data obtained show that "female infants appear to have been exclusively breastfed for longer (1.4 ± 0.2 years) than males (1.0 ± 0.2)". Since beyond 6 months of age, a diet based exclusively on breastmilk does not provide the whole energy a child needs, they interpret the shorter exclusive breastfeeding in females but not in males as "a parental investment strategy in which boys preferentially receive complementary foods earlier in a context of possible food scarcity" (2018: 548). According to the authors, this different parental investment could be linked to the higher value given to males in societies in conflict.

Altogether, these results suggest an interesting pattern of emerging gender differentiation in Copper Age Iberia. The social and cultural background is not necessarily one of 'patriarchy', but does include elements that make sense in the context of emerging patrilocality, maybe in the frame of a bilocal residence pattern biased to patrilocality, as suggested above. Needless to say, given the limited numbers of individuals analyzed up to now, these are tentative postulates.

We are aware of the fact that there are issues concerning how to interpret human mobility. Reiter and Frei (2019) proposed 4 general models, which they called 'non-migratory', 'point-to-point migratory', 'back-and-forth' and 'repeated mobility', the last one being subdivided in cyclical and non-cyclical. These are the itineraries, but what are the reasons for people to move? Answering this question is key if mobility patterns are to be understood, because the causes of mobility may be social, and therefore linked to categories of identity such as gender, age or status. As Lillios points out (2007: 225), "gender and social status structured who would have been able to go on different kinds of journeys". In addition to that, Frieman et al. (2019) noted that interpretations of mobility are often gender-biased: female mobility is explained as a consequence of women being passive as opposed to male mobility resulting from freedom and agency. In this vein, the three adult males from the famous burial at Boscombe Down (British Isles) could have moved "for some social or age – or work – related reason" (Evans et al., 2006: 316), whereas the Egtved girl (Denmark) "was a Southern German girl who was given in marriage to a man in Jutland so as to forge an alliance between two powerful families" (Frieman et al., 2019: 161). Interpretations of female mobility caused by patrilocality are very common (Sjögren et al., 2020; Mittnik et al., 2019), but matrilocality rarely appears as an explanation in spite of the existence of cases of higher male mobility, which is more often seen as a reflection of greater access to resources or food (Scaffidi and Knudson, 2020: 149). Gender cannot be ignored as a relevant variable to study human mobility, but it is important to note that both men and women, and not just women, are gendered individuals. Assumptions not articulated within theoretical frameworks may influence interpretations of mobility.

In fact, the range of human mobility is very broad. Without ambitioning to provide a comprehensive list, several major causes can be mentioned: i) shepherding, ii) war, iii) fostering, iv) kidnapping, v) pilgrimage, vi) nomadism, vii) trade, viii) gathering/feasting, ix) mating and marrying and x) migration (subdivided into a) expansionism and b) escape). Prehistoric research has largely focused on mating and marrying, gathering/feasting, war and migration. Thus, and to name just a few recent examples, Stonehenge and Durrington Walls have been interpreted as the focus for big supra-regional gatherings held during the solstices (Wright et al., 2014); female mobility within the Linearbandkeramic culture has been explained as consequence of exogamic practices and patrilocality (Bentley et al., 2012; Masclans Latorre et al., 2020), while Yamnaya pastoralists have been noted to have spread from Eurasian Steppe into Europe at the beginning of the 3rd millennium BCE (Naransimhan et al., 2019).

In this context, sex-based differences in mobility in Copper Age Iberia emerge as a powerful indicator in terms of social organization, specially at a time when the incipient social differences and rise of 'would-be' leaders must have caused internal friction within communities. The marked differences in the scale of burial construction and quality of grave goods reveal the tensions caused by the emergence of an 'elite' that stressed the traditional collective fabric of society (Gilman, 2013: 15). As noted above, the Iberian Copper Age record shows a statistically significant difference in traumas between men and women, affecting the former more than the later. The ethnographic record suggests a correlation between internal conflict and patrilocality, but at this time, it is difficult to say whether the violence existing in 3rd millennium Iberia was predominantly 'internal', 'external', or both, and how widespread it was. In principle, while present (see Monks, 1997; Kunst, 2000; Cámara Serrano and Molina González, 2015), inter-group conflict does not appear to have been a pervasive phenomenon.

Did bilocality biased to patrilocality play a significant role in favoring gender inequalities and consolidating the power of 'would-be' leaders in Copper Age Iberia? If insufficient, the available evidence suggests that the accumulation and exhibition of wealth by wannabe leaders within the context of factional competition (Díaz-del-Río, 2004) and the emergence of an 'elite' in the first centuries of the 3rd millennium BCE in the southern regions of Iberia, could have taken place in parallel to the emergence of male centered residential patterns. This does not imply that women, like swords, were passively carried around by "apparently socially unencumbered men" (Frieman, 2019: 156). Instead, the interplay of gender differentiation, a bilocality biased to patrilocality and the emergence of forms of social complexity within which the control of inheritance rights rendered biological reproduction socially strategic, may have laid the foundations for a new social system which, in later on, little by little, displaced women to a secondary position.

In addition to that, and following the logic of the ethnographic evidence, matrilocal residential rules would have been favored by external conflict. But while there appears to exist some degree of inter-group conflict during the Copper Age (Monks, 1997; Kunst, 2000; Cámara Serrano and Molina González, 2015), suggested by evidence such as fortifications, the absence of a well-defined 'warrior' ethos in the burial record, at least until an 'advanced' stage of the Bell-beaker complex, at the end of the 3rd millennium BCE, suggests that such conflicts were not widespread, or structural. This is in sharp contrasts with the available archaeological record for the Early Bronze Age [EBA], especially for Argaric societies, where the widespread presence of fortified settlements, the use of halberds and swords as grave goods, and the association of individual male burials with some specific artefacts and pathologies (Lull et al., 2017), act as powerful indicators of such 'warrior ethos' and pervasive conflict. It has been claimed that, on the basis of the burial record, matrilocality and matrilineality may have been prevalent within Argaric societies of the EBA (Lull et al., 2016: 38-43). According to ethnography, this would be inconsistent with the more pronounced social differentiation of EBA societies in comparison to Copper Age ones. But the increased social hierarchisation and institutionalization of the elites, the subsistence strategies (extensive agriculture), as well as the consolidation of a 'warrior' ethos, all of which occurred in the Iberian south-east during the EBA, are more likely related to male centered residential patterns. In fact, a recent genomic analysis reveals that at the Argaric site of La Almoloya males had more close relatives than females, although not to the point of statistical significance (Villalba-Mouco et al., 2021). In principle, a closer kinship connection of males would be more consistent with patrilocality than with matrilocality, although other alternative residence patterns cannot be discarded. The availability of more date will clarify this in the future.

6. Corollary

Residential patterns are highly relevant to understand the processes leading to gender differentiation and inequality within early complex societies. In principle, male centered residence fosters an increased control of women by men: women leave their kinship group and social background, which deprives them of the support of their social network, making them more vulnerable to manipulation and control by their husbands (and their kin groups) (for an example see Hernando Gonzalo, 2020). Nevertheless, the position of women in patrilocal – and patrilineal - societies can be highly variable, and each case must be analyzed separately (*cf.* Bickle and Hofmann, forthcoming). In general terms and from a masculine point of view, patrilocality and patrilineality affords further assurance concerning biological offspring, a factor that may have acquired strategic importance, both socially and economically, among early complex societies, among which the increased availability of surplus and accumulation of wealth rendered inheritance rights crucial. Kinship, in any case, is not necessarily determined by biology (Brück, 2021: 228-231) so the key point is if there was such a sex/gender system that valued males and females differently, benefiting the former over the latter.

The results presented and discussed in this paper suggest that incipient social differences, visible at the start of the 3rd millennium BCE in Iberia, also included increased gender differentiation that could have been supported by residence patterns more centered in the males than in the females. The data on strontium isotopes available for the Iberian Copper Age is compatible with bilocality biased to patrilocality, especially at larger sites (including 'mega-sites'). A higher female mobility has also been suggested in the Neolithic period in other European regions, such as southwestern Germany (Bentley, 2007; Knipper et al., 2017; Bentley et al., 2012; Masclans Latorre et al., 2020), being in most cases interpreted as a consequence of patrilocality, although recent re-analysis of such data offer alternative interpretations (Ensor, 2021). This is consistent with other types of archaeological evidence revealing productive intensification, increased surplus accumulation, as well as more acute forms of social hierarchisation and social differentiation. It is also consistent with solid ethnographic data showing a prevalence of patrilocality among agricultural societies of emerging complexity – such as those of southern Iberia in the Copper Age. While preliminary, this body of evidence opens up fresh lines of enquiry regarding social organization in the 3rd millennium, a time of increased social complexity and, possibly, increased gender differentiation.

At the same time, however, the strontium data presented must be interpreted with caution as the evidence presents significant problems. It is unclear at this point to what extent local geological variability distorts our perception of 'locality' vs 'non-locality', a problem that demands much more attention before further progress is made in the analysis of human mobility based on isotopes. The current availability of isotopic data for 3rd millennium Iberia, itself not necessarily small or trivial, is still biased towards certain sites (particularly some 'mega-sites'), while for some other sites the evidence is still too thin. In addition, most data come from collective burial structures, where remains are heavily commingled and difficult to individualize, with the additional difficulty of diagnosing sex. Finally, for very significant regions of Iberia, preservation problems (particularly soil acidity) make anthropological analysis, and subsequently isotope analysis, quite difficult, if not impossible.

The methodological problems and apparent discrepancies or contradictions of the available results highlight the need to treat the issue of residential rules, and associated implications in terms of gender inequality, through robust multi-method approaches based on broad samples, avoiding simplification. Whatever our interpretation may be, biases must be detected and accounted for and simple narratives must be avoided. As Frieman and Hofmann argue (2019), we are responsible for the co-created pasts we present to the world, which is nowhere truer than in the case of gender inequality, a topic of the utmost relevance in today's society.

CRediT authorship contribution statement

Marta Cintas-Peña: Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Writing – original draft, Writing – review & editing, Visualization. **Leonardo García Sanjuán:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing, Visualization, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary material

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