Links between Megalithism and Hypogeism in Western Mediterranean Europe

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VISIBILITY AND MONUMENTALITY IN LATE PREHISTORY GRAVES OF WESTERN GRANADA. A GIS ANALYSIS

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Abstract

Although different types of late prehistoric tombs are found in the western part of the province of Granada (Andalusia, Spain), they all have certain hypogean features. Even in the famous megalithic necropolis Las Peñas de los Gitanos (Montefrío), semi-hypogean characteristics are apparent in its deep foundations. In other cases, such as those of Zujaira (Pinos Puente) and Sierra Martilla (Loja), the hypogean character is more obvious. Additionally, visibility to and from tombs did not play an important role in tomb's location, except in the case of Sierra Martilla, while hidden graves can be found in all of the necropolises, as visibility analysis using GIS indicates. A discussion of the true functions and monumentality of graves thus becomes necessary. We suggest that placement of most tombs is not based on territorial control, even if they are located in cultivation areas. The main function of funerary ritual may be related to avoiding the risks that visible differences in wealth and resource mobilization in funerals could potentially have in a rapidly changing society. Thus, funerary ritual emphasizes secrecy and masking of social differences.

Key words: Late Prehistory, Western Granada, Megalithism, Hypogeism, visibility, concealment, monumentality.

Resumen

Aunque se han localizado diferentes clases de tumbas de la Prehistoria Reciente en el oeste de la provincia de Granada (Andalucía, España), todas ellas tienen ciertos rasgos hipogeicos. Incluso en la famosa necrópolis megalítica de Las Peñas de los Gitanos (Montefrío), las características semihipogeicas quedan patentes en sus profundas cimentaciones. En otros casos como los de Zujaira (Pinos Puente) y Sierra Martilla (Loja), el carácter hipogeico es más evidente. Además, con la excepción de Sierra Martilla, la visibilidad entre y desde las tumbas no fue buscada y sepulturas especialmente ocultas pueden encontrarse en todas las necrópolis como queda demostrado en relación con el ambiente circundante y las otras tumbas a través del uso de un análisis de visibilidad usando programas basados en técnicas SIG. Se ha considerado así necesario establecer una discusión sobre la monumentalidad y las verdaderas funciones de las tumbas. Sugerimos que el emplazamiento de la mayoría de las sepulturas no tiene que ver con el control territorial, incluso cuando se sitúan en áreas de cultivo, sino que el ritual funerario estaría destinado fundamentalmente a evitar los potenciales riesgos de transformación social que provocaban las diferencias en riqueza visibles en la movilización de recursos en el funeral. Así, el ritual funerario enfatiza el secreto y el enmascaramiento de las diferencias sociales.

Palabras clave: Prehistoria Reciente, oeste de Granada, megalitismo, hipogeismo, visibilidad, ocultación, monumentalidad.

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1. Introduction

Artificial caves are regarded as the Late Neolithic and Chalcolithic Guadalquivir Valley's most characteristic type of sepulcher (Berdichewski, 1964), although interment also has been known to occur in natural caves and dolmens in the immediate mountainous zones. General catalogues of dolmens (Leisner and Leisner, 1943) and artificial caves (Rivero Galán, 1986; Berdichewski, 1964) would seem to confirm this impression. However, it has been pointed out that the main characteristics of artificial cave necropolises are concealment and the fact that they are concentrated near the main villages, which emphasizes such villages' capital status (Cámara Serrano, 2001). So perhaps there is no true morpho-functional contrast between the two types of sepulchers (Aguado Molina, 2007) nor does a cultural opposition exist, as has been claimed (Hernando Gonzalo, 1994).

Regarding specifically the zonal distribution we should point out that the megalithic sepulchers at the northern limits of the valley clearly tend to mark communication routes (through their alignment) and specific points of the cultivation territory (through their visual preeminence). These aspects have been better studied in the westernmost part of Andalusia (Piñón Varela, 1987, 2004; Nocete Calvo, 2004; Nocete Calvo *et al.*, 1997, 2001; García, 1999b, 2006; Romero, 1999; Lacalle, 2000) than in the eastern area (Cepillo, 1997; Gavilán Ceballos *et al.*, 1991; Marfil, 1997; Martín de la Cruz *et al.,* 2002), while information regarding the eastern edge is extremely limited (Castilla Segura and Ruiz Sánchez, 1990; Cámara Serrano *et al.*, 2007).

The valley's southern section has a lower density of megalithic monuments, especially on the western side, although they do extend from one end of the region to the other (Ferrer Palma, 1987; Ferrer Palma *et al.*, 1988; Carmona Ávila and Moreno, 1992; Arribas Palau and Ferrer Palma, 1997; Ramos Muñoz *et al.*, 1997; Ferrer Palma *et al.*, 2004; Zafra de la Torre, 2007) and there are certain areas of concentration (Mergelina y Luna, 1941-42), such as the River of Gor (García Sánchez and Spanhi, 1959; Castellano Gámez *et al.*, 2001; Afonso Marrero *et al.*, 2006, 2008).

As is widely known, they also can be found outside the Guadalquivir in the river valleys flowing into the Mediterranean (Martín Córdoba and Recio Ruiz, 1999-2000; Marquez Romero, 2000), with particular density in the southeast, comparable to the northern part (Ayala Juan, *et al.,* 2000; Leisner and Leisner, 1943; Lomba Maurandi, 1999; Maldonado Cabrera *et al.*, 1997; Román Díaz *et al.*, 2000, 2005; Cámara Serrano, 2001; Cámara Serrano and Molina González, 2004; San Nicolás del Toro, 1994).

The data on artificial caves is scarcer, largely because of their limited perceptibility, although it also has been suggested that their density cannot be expected to be very high, as they appear to be associated only with the most important villages and grouped in necropolises rather than scattered over extended territories (Cámara Serrano, 2001). Toward the southwest, around the Guadalquivir valley, in addition to the abundance of truly hypogean structures (Berdichewski, 1964; Castañeda Fernández *et al.,* 1999; Cruz-Auñón Briones, 1991; Mata Almonte, 1993; Posac Mon, 1975; Ramos Muñoz *et al., 1998*), the semi-hypogean character of numerous sepulchers of the central necropolises needs to be highlighted, along the lines of what is covered in this article. This is particularly evident in the second level sepulchers of Valencina de la Concepción (Arteaga Matute and Cruz-Auñón Briones, 1999b), although they possibly also can encompass large sepulchers on either riverbank (Hurtado Pérez and Amores Carredano, 1984; Ruiz Moreno and Martín Espinosa, 1993; Vargas Jiménez and Sagrera Pérez 2007). The artificial cave necropolises of the Upper Guadalquivir (Carriazo Arroquia, 1925; Espantaleón Jubes, 1957, 1960; Lucas Pellicer, 1968; Lizcano Prestel *et al.*, 2005; Zafra de la Torre, 2007) and, in general, of Upper Andalusia (Pellicer Catalán, 1957-58; Molina González, 1983; Marqués Merelo *et al.*, 1992; Carrasco Rus *et al.*, 1993; Navarrete Enciso, 2003; Spanhi, 1958) are more evident.

This study focuses on Granada province's northwestern zone, in relation to a part of the Guadalquivir river basin and, therefore, to the rivers that eventually flow into the Atlantic Ocean. It is an area characterized by the coexistence of artificial caves and megaliths and, on the other hand, by megalithic sepulchers built up by orthostatic slabs with an important hypogean component (Las Peñas de los Gitanos, Montefrío) (Cámara Serrano, 2001; Cámara Serrano *et al.*, forthcoming) and vice versa (Sierra Martilla, Loja) (Carrasco Rus e*t al.*, 1993; Navarrete Enciso, 2003).

2. Objectives and Hypotheses

This study has two main objectives. Firstly, it seeks to determine the function of the tombs in relation to territorial control and social differentiation (their concealment or exhibition). Furthermore, it focuses in determining the concrete forms in which these functions take place (the aspects implicated in their attainment) in order to read them within the context of the society that used them. In this sense, what we are concerned with here is discovering the causes and implications of the differences between artificial caves and megaliths.

To do so, we contrast two different hypotheses:

1. Tombs that emphasize visibility (from and/or towards them) have to do with territorial control.
2. Hidden tombs have to do with the concealment of social differences.

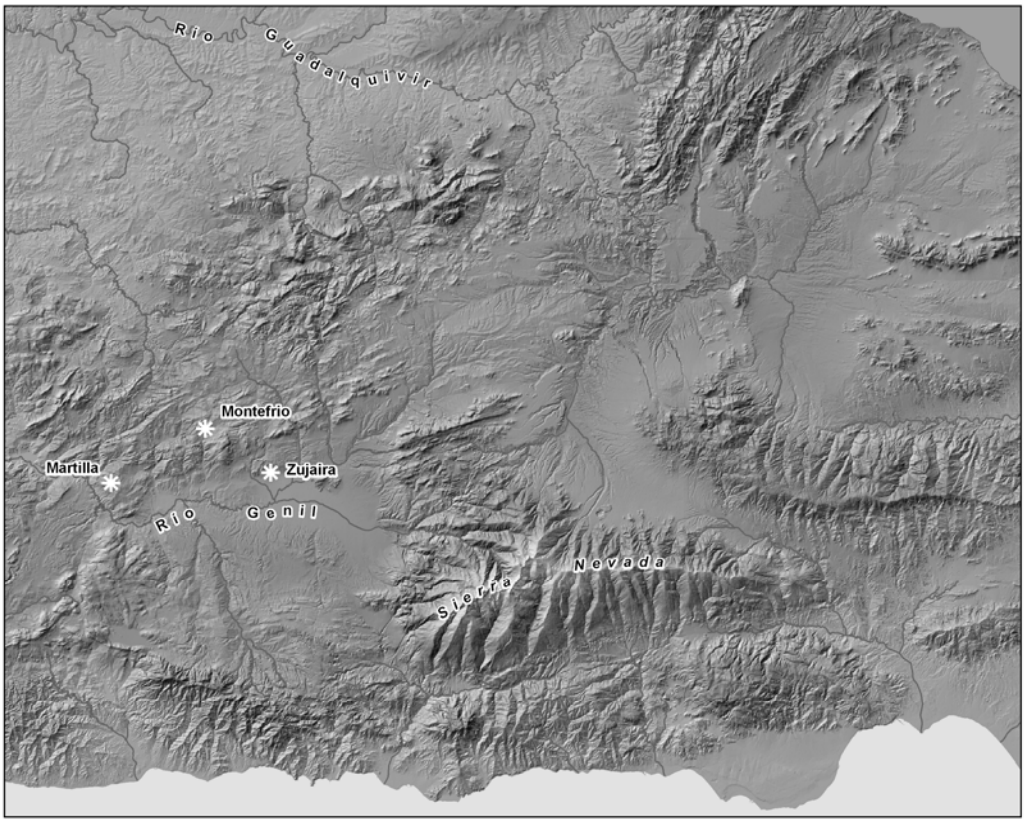

Figure 1: Regional map with location of necropolis

Subsequently two possible consequences must be tested:

- Both kind of tombs can perform the same function, especially when concealment and monumentality features can be found within the same sepulchers, whether in a part of the tomb (the separation of areas, longitudinal development, the combination of techniques, etc.) or in the cluster as a whole (underground foundations, barrow development, placement in depressed or striking areas).
- Function (and, consequently, those features suggesting concealment) does not have to do with the predominantly hypogean or megalithic character of the sepulcher but rather their topographical site and the development (or not) of certain secondary features.

3. Study Sample and Preliminary Considerations

Introduction

Among Late Neolithic and Chalcolithic sepulchers known in the western zone of Granada (Figure 1), we decided to begin our study with the Las Peñas de los Gitanos (Montefrío) (Mergelina y Luna, 1941-42), Sierra Martilla (Loja) (Carrasco Rus *et al.*, 1993) and Zujaira (Pinos Puente) (Molina González, 1983) necropolises. Other sites were excluded (Ferrer Palma, 1980, 1981; Jabaloy Sánchez *et al.*, 1982; Arribas Palma and Ferrer Palma, 1997) because of the sepulchers' dispersion, disappearance, and even relocation, as in the case of the Pantano de los Bermejales (Arenas del Rey).

Las Peñas de los Gitanos (Montefrío)

Las Peñas de los Gitanos is the best known of the necropolises included in this study. The first references to the different groups of tombs in which we can divide the necropolis (El Rodeo, La Camarilla and Figure 1: Regional map with location of necropolis Los Guirretes Castellón-Hoyón of the Virgin) are already in the work of M. Gongora y Martinez (1868:82-85), although the first analysis is due to M. Gomez-Moreno Martinez (1905:123) As early as 1907 he made reference to decreasing size of the graves, always of modest dimensions, to the west, from the group of El Rodeo to La Camarilla (Gomez-Moreno, 1907:352). The site first tomb typology was established by G. and V. Leisner (1943).

These early works contain references to cairns (Gómez-Moreno Martínez, 1907:352; Mergelina y Luna, 1941-42:67), which had practically disappeared by the time the University of Granada's Department of Prehistory and Archaeology made their interventions in 1971 and 1974 (Arribas Palau and Molina González, 1977; Molina Gonzalez, 1983). All of the clusters have in common sepulcher placement in depressed passages situated between various karst outcrops that create a terraced setting facing the valley. The location of the passages at a

lower height with respect to the surrounding terraces, whether to the north or south, creates a limitation in visibility, even for those sepulchers near the highest parts.

The sepulchers are constructed by digging a trench to partially fit the stone slabs. The tombs consist of a trapezoidal chamber preceded by a short, generally trapezoidal, passage that sometimes is segmented and has a sort of vestibule (Molina González, 1983:62) (Figure 2). In some cases, the passage has large tombstones that alternate with stretches of masonry (Molina González, 1983) or small braces that are constructed using the same technique (Gómez-Moreno Martínez, 1907:353). The chamber and passageways are comprised of doors obtained by perforating a large stone slab or by making opposing notches in two slabs to act as jambs (Mergelina y Luna, 1941-42:85, 104) (Figure 3). Some of the Montefrío dolmens have ornamentation in relief (horns) (Gómez-Moreno Martínez, 1907:353; Mergelina y Luna, 1941-42:99) or engravings (zoomorphic, geometric) (Mergelina y Luna, 1941-42:67-68) (Figure 4) within their chambers.

Despite the age of the excavations, which became relatively systematic only in the 1920s (Mergelina y Luna, 1941-42), certain findings such as bracelets made on *pectunculum* shells (Mergelina y Luna, 1941-42:77, 94) suggest that the sepulchers were initially used in Neolithic times (fourth millennium B.C.).

Three scales of concealment that are complementary and articulated can be distinguished in the Las Peñas de los Gitanos megaliths: the concealment of funerary space (chambers and passages as containers), the concealment of the overall structure of the dolmen and the concealment of the entire constructed structure.

Firstly, the chamber is always situated beyond a narrow passage; both can be accessed by means of narrow openings defined by very close stone jambs or by doors perforated in one or two of the slabs (Mergelina y Luna, 1941-42). This system is common among the *tholoi* and certain tombs of the Southeast (Almagro Gorbea and Arribas Palau, 1963; Molina González and Cámara Serrano, 2005) and is also present in other monuments no related to burials (Edmonds, 1993; Barnatt, 1998; Hartwell, 1998, 2002). In our case, this limited access is accentuated by the trapezoidal form of the passage and chamber, with the widest part toward the rear. Undoubtedly, the present image is partially distorted by the collapse of upright stones resulting from the surrounding sediments' pressure and the absence of interior filling, especially following clandestine removals and archaeological interventions. This has been related to secrecy and restriction in the access to funerary rituals (Camara Serrano, 2001)

Figure 2. Peñas de los Gitanos dolmen 9

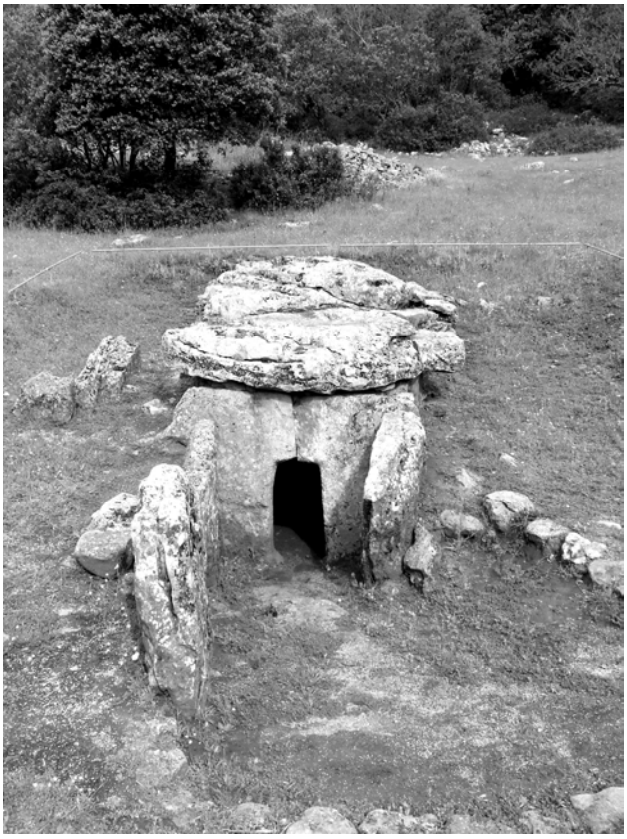

Figure 3. Peñas de los Gitanos dolmen 23 with a bored gate

Figure 4. Engraved geometric motifs. Las Peñas de Los Gitanos dolmen 23

In the second place, the sepulchers' aforementioned semi-hypogean character accentuates the difficulties of access that must be surmounted through placement of a ramp between the various spaces or stretches and a vestibule situated at the height of the exterior surface.

In some cases, concealment is achieved not by digging a pit to build up the chamber and passage but rather by placing them over the rocky outcrops of a hillside. In this way the semi-hypogean character is maintained, as can be seen not only in the excavation of the orthostats' foundation (which is also necessary for the building's stability given the barrows' characteristics) but also in the chamber placement which, once again, is deeper than the passage (Figure 5).

Similarly, the entire funerary structure is covered by very low barrows that, instead of highlighting the monument (nevertheless, something partially achieved by a perimetric ring of bioclastic limestone), actually conceal it, given the placement of most of the megalithic tombs on the hillsides.

Finally, the geographical distribution of the funerary structures over the landscape of Las Peñas de los Gitanos and their specific location generate a relative concealment that, as GIS analysis indicates, can be defined first by their aforementioned setting against rocky outcrops on the hillside. The concealment is also achieved by the graves placement on terraces that gently slope toward the inner part, near the remains of the small quarries from which the construction material was extracted, such that they too became fully concealed. The conjuction of graves scatter in small clusters and low barrows generates a relatively continuous hilly terrain that also contributes to the megaliths' concealment.

Figure 5. Las Peñas de Los Gitanos dolmens 7 and 8

Considering these three concealment systems, we need to ask ourselves about the specific form of "monumentality" present in the megalithic tombs of the Las Peñas de los Gitanos, and whether monumentality does exist, since, in addition, the sepulchers' dimensions are not very large.

Certainly, the distinction of these structures from their surroundings is minimized and, undoubtedly, their concealment, materials and construction method allow guarantee their permanence. Additionally, they give rise to a new space through their association with the local geographical traits, a landscape in the sense of a perceivable element and a territory as a constructed space designed for a social function: masking by concealment (Cámara Serrano, 2001; Rojo Guerra et al., 2006) but also appropriation by placement (Criado Boado, F., 1998; Cooney, G., 1999; Kolb, M.J., 2005).

Zujaira (Pinos Puente)

The Zujaira necropolis (Figure 6) was not an object of archaeological investigation but, rather, had been continually pillaged by poachers and partially destroyed because of development in the neighboring quarries.

The concealment strategies at Zujaira, located in a narrow and relatively deep gully, are different and yet similar to those established in Montefrío. In fact, the entire funerary space concealment is more accentuated in this case by its underground character, which and, once again, the chamber is made remote by the building of antechambers/passages, nowadays very ruined. Furthermore, visibility to and from the tombs is clearly

limited by their location halfway up the hillside and distribution along the gully. Nonetheless, certain features link these structures to the megalithic world (beyond similarities in the distribution of internal space). Firstly, emphasis is on the entryway, which lies horizontally at the entrance of a passage rather than beginning from a pit like in the silos of archaic artificial burial-caves, and is visible as long as it is not closed-camouflaged. Secondly, genuine façades were developed in certain cases that were destined for exposure (Figure 7). Finally, and this is profoundly different from the megalithic tombs of Montefrío, preparation of the rocky surroundings to create a demarcated funerary area (or the imitation of a much eroded barrow). This implies a demarcation that contrasts with concealment and only today appears to be hardly noticeable as a result of erosion and the growth of vegetation. In this sense and, in contrast to the relative concealment of a particular tomb and its incapacity for territorial control or perceptibility from a distance, the whole necropolis becomes fully visible to those who are sufficiently close.

Figure 6. Zujaira rock cut tomb

Sierra Martilla (Loja)

The Sierra Martilla tombs, which also have suffered looting since ancient times, have been systematically studied (Carrasco Rus *et al.*, 1993). These last researches have led to the interpretation that some tombs were possibly constructed during later periods of the fifth millennium B.C., and some were reused in the Iron Age and even readapted to industrial use in more recent times (Carrasco Rus et al., 1993; Navarrete Enciso, 2003).

Regarding their design, attention should be paid not only to the striking differences in form and dimensions between sepulchers but also to specific characteristics, which are recurrent above all in the tombs of greater size. These features are, first, the frequent use of orthostatic elements to form passages and, in some cases, antechambers (Figure 8), second, the restricted access, whether through perforated doors (in the case of truly hypogean areas wherein the rock wall is perforated) or due to the proximity of the orthostats that lie perpendicular to the tomb axis, creating a threshold at the two jambs. Moreover, a reduction in the rock sometimes can be appreciated where the slab used to close the door should have been set, a feature that can also be observed opposite the excavated doors. More frequently, chamber (and passage) covers were made from a large cut slab while, in contrast, modification of the tombs' surroundings, especially of the most elaborate ones, created a false barrow (Figure 9) that, as we suggested in the Zujaira case, doubtless conferred greater visibility to the tombs.

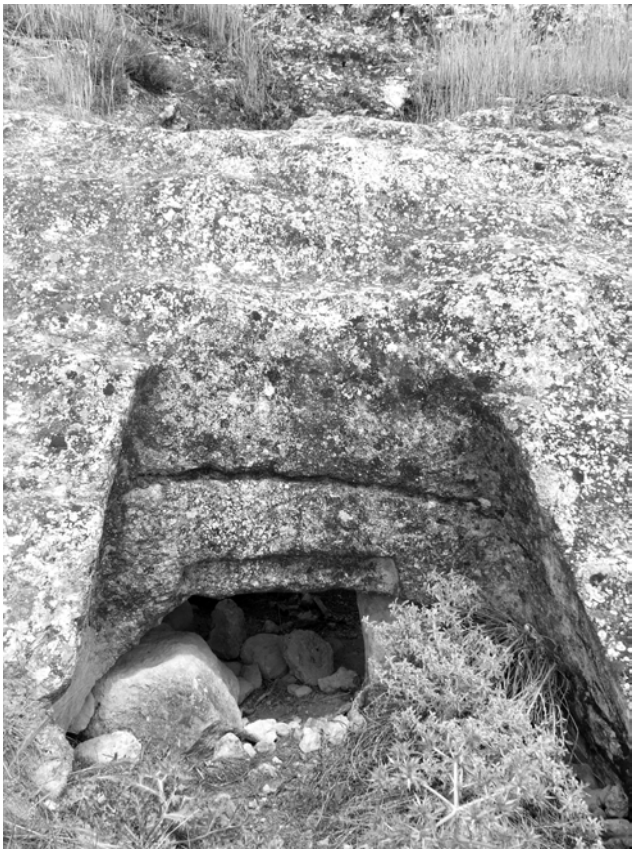

Figure 7. Zujaira rock-cut tomb façade

In this respect also, the Sierra Martilla necropolis is different because, although some tombs are oriented parallel to the slope, others offer access from it, which in turn, in a site of great visibility, allowed for the localization of the access from far away, assuming it was not camouflaged by being closed. This, together with the surrounding modifications, facilitated identification of the necropolis zone where access into the interior of the sepulchers nevertheless was made difficult by the hindrances and closure. If one can speak of monumentality, then this is certainly the most spectacular case of those studied and, despite even its underground character, the terraced chambers and passages covered by slabs (and perhaps by a real earthen barrow in addition to the imitation one) facilitated the visibility of certain structures (Figure 10). In any case, the tombs' visual control is different and even when visible from the rest,

and with the development of the aforementioned demarcation strategies, the tombs situated at lower heights do not exercise control over the surroundings.

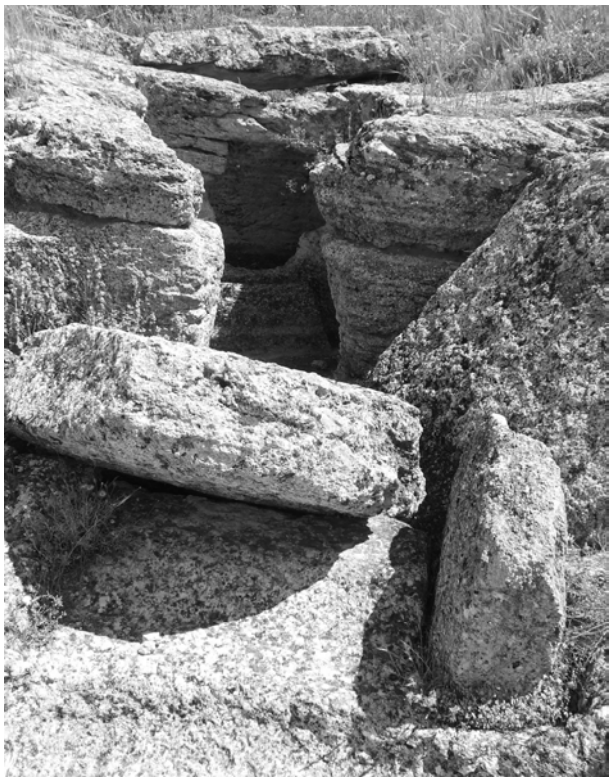

Figure 8. Sierra Martilla tomb 3

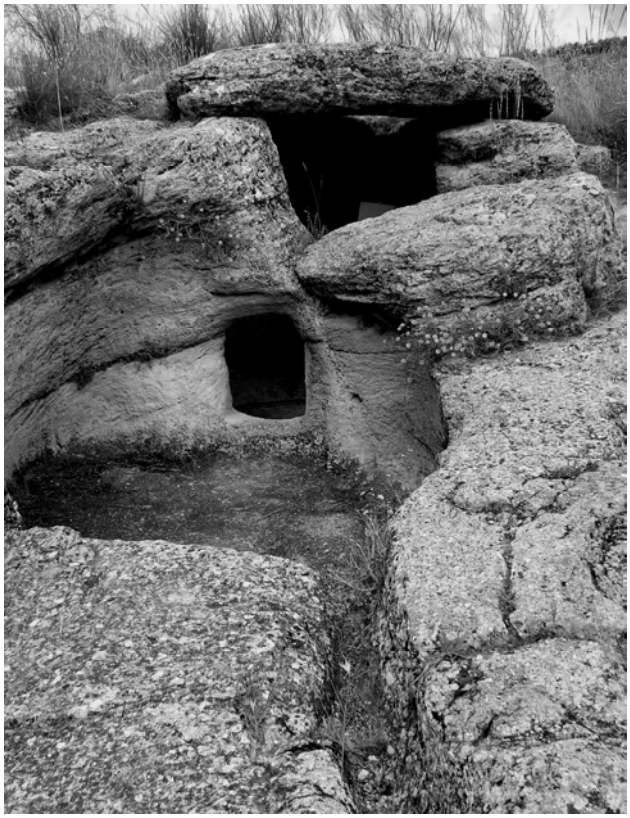

Figure 9. Sierra Martilla tomb 7

4. GIS Analysis of Visibility Variables

Methodological Considerations

The analysis of visibility as indicator of territorial occupation by past societies has been simplified by the availability of computing tools that allow the rapid and automatic calculation of the visual relationship between different sites in a given territory. Since the 1990s, research that uses GIS to study areas of visual dominion to or from archaeological sites has become widespread, with the so-called Cumulative Viewshed Analysis (CVA) gaining particular relevance.

This analytical method allows the examination of the relationships of visibility between different archaeological sites and their territories by means of individual maps obtained of the viewsheds of each of the sites. They are then combined to obtain a final map that indicates in each cell the number of sites from which is visible. Since Ruggle's initial work (Ruggles *et al.*, 1993) and, fundamentally, David Wheatley's research (1995, 1996, Gillings and Wheatley 2001), this type of analysis has been applied to the study of megalithic sepulchers' settlement and distribution patterns, towers and other sites of territorial control. In the Andalusian case, these analyses have been used to understand prehistoric settlement patterns of the Cordovan landscape (Martín de la Cruz *et al.* 2004) from the Turdetani and Roman Era of the Lower Guadalquivir (Keay et al., 2001; Zamora Merchán, 2002) and the distribution of megalithic monuments in Western Sierra Morena (García Sanjuán *et al.,* 2006, 2009).

Cumulative Viewshed Analysis (CVA) allows the establishment of intervisibility relationships between archaeological sites and their comparison to the general intervisibility characteristics of the territory in order to identify the existence of patterns of site selection based on their visibility or lack of it from other archaeological sites. In the case of the study of necropolises located in small-scale landforms, such as these analyzed in this paper, CVA also allows the exploration of complementarity among the sepulchers' individual viewsheds.

Nevertheless, CVA has practical limitations in assessing visibility from a given number of locations, since archaeological knowledge of the territory analyzed then becomes a critical factor and the entire study is founded on the correct identification of the locations from which visibility is computed. On the other hand, by centering the analysis on viewshed calculation from specific points, the global valorization of the sites' visual relevance becomes greatly limited since it does not base itself on the entire territory analyzed in its globality but rather upon those calculation points taken into consideration.

Figure 10. Sierra Martilla tomb 2

The so-called Total Viewshed or Inherent Viewshed is a variant of visibility analysis that can avoid the aforementioned limitations (Llobera, 2003, Llobera *et al*., 2004). In this case, the viewshed is calculated by taking each cell of the Digital Elevations Model (DEM) and combining them to obtain a map that represents "*a first description of the visual structure for an entire terrain*" (Llobera, 2003:34).

Archaeologists have rarely used this analytical modality up today mainly due to "the very high computational intensity required to calculate them" (Llobera et al., 2004). The pioneering work by Llobera et al. (2004) establishes an effective methodology for this type of analysis, as exemplified by the study of Avebury's prehistoric funerary monuments. The combined application of this technique and traditional cumulative analysis led to the finding that certain sepulchers were located in areas of poor visual global relevance, areas that nonetheless became very relevant when visibility was regarded solely from the funerary monuments.

In this paper, we make use of both techniques in order to, on the one hand, assess the global visual relevance of the necropolis sites under consideration and, on the other hand, analyze the relationships established between the necropolises' megaliths, thereby identifying the possible complementarity of the sepulchers' individual viewsheds to obtain the global visual control over the territory. Likewise, the size and orientation of the sepulchers' individual viewsheds can be assessed by comparing them to those obtained from a set of random points.

The digital elevations models used in this analysis were obtained from the Digital Elevations Model (DEM) produced by Andalusia's Cartography Institute with a 20 m. resolution. The study area for each necropolises was established, using as limit a 5 km buffer from each of the farthest sepulchers of each necropolis. The location of the graves was established through fieldwork, including data collection using a Leica GX1230 GPS with differential correction. In Montefrío's necropolis case, another task undertaken was to correlate the located sepulchers with those identified and numbered in the bibliography about the site.

The following variables were used in this analysis:

- The visual prominence for each necropolis' location.
- The individual viewshed of each grave.
- The cumulative viewshed for each necropolis

Visual Prominence of the Necropolis' Location

The first variable to be analyzed is the visual prominence of each necropolis' location. To fulfill this task a calculation was made of the total viewshed of the whole landscape where the necropolis is located, using a 5 km buffer as the limit for the study area. This results on extensive study areas to be analyzed.

Then a systematic cumulative visual analysis of the entire territory was undertaken by calculating the individual viewsheds from each of the DEM points to obtain a final layer in which the value of each pixel indicates the number of points from which it is visible. This analytical methodology requires a very long calculation time, since it generates numerous individual viewsheds that then must be processed. For instance, in the case of Las Peñas de los Gitanos more than 25.000 viewsheds were calculated.

Once the final map is obtained, the values' distribution can be analyzed and a classification of visual relevance can be established to identify areas of visual prominence. Although it is possible to indicate an altitude offset representing the approximate height of a monument or an observer, we preferred not to introduce this variable. Despite the existence of diverse forms of classifying quantitative variable ranges, we choose the use of standard deviation as it allows the assessment of those sites that in relative terms assume a visual prominence greater or less than average within the study area.. The visibility maps obtained were classified into nine classes and were represented using a two-colored ramp that emphasizes values above (shown in green) and below (shown in red) the mean.

The Zujaira necropolis' territory (Figure 11) is characterized by low relief orography, with southern-facing longitudinal valleys that converge in the depression of Granada's low-lying land, the Vega de Granada. The general intervisibility of this area is limited, and there are no remarkable landmarks that claim particular visual dominion. The necropolis is located in a site of very limited visual prominence in the territory. After the total viewshed analysis, the values obtained range between 223 and 1258, meaning that the necropolis site is visible from a maximum of 1258 points, which is 7,6% of the territory under consideration. The minimum value obtained in the analysis corresponds to Tomb 1, which is only visible from 223 points (1,34% of the area analyzed). To better assess the results obtained at the tombs within a general context of the territory's visual relevance, we can indicate that the sites of greatest visual prominence in this area, unoccupied bytombs, are visible from 55% of the territory, with absolute values greater than 9200.

The territory of the Sierra Martilla necropolis is defined by the presence of the sierra itself (Figure 12) because it is a visual referent that dominates a gully zone with various fluvial valleys facing northeast and southeast and whose territory drains into the valley of the Genil and Pesquera Rivers. The tombs represent a case opposite to that of Zujaira as they were erected in a zone of great visual prominence, dominating 26% of the territory under consideration. The number of points from which the necropolis site can be seen ranges between 4139 and 4605, which represents 26% of the total points analyzed. This value takes on a greater dimension when considering that the most visible point of the entire zone studied, where no evidence of tombs has been located, only reaches a value of 6191, or 36% of the total calculated points. The visual prominence of the necropolis is therefore evident and clearly opposite to the characterization of the Zujaira necropolis.

At Las Peñas de Los Gitanos (Figure 13) an intermediate situation is documented since the tombs are found in sites with visual relevance values between those of Zujaira and Sierra Martilla. In this case, the characterization of the territory analyzed is of a relatively low intervisibility wherein the Sierra of Parapanda, located to the southeast of the study zone, stands out as one of the landscape's referents and visually dominates this territory, which offers considerable intervisibility to the southeastern sector.

In contrast, the characterization of the northwestern zone is of an uneven landscape with crossing valleys and poor intervisibility because of its orographic configuration.

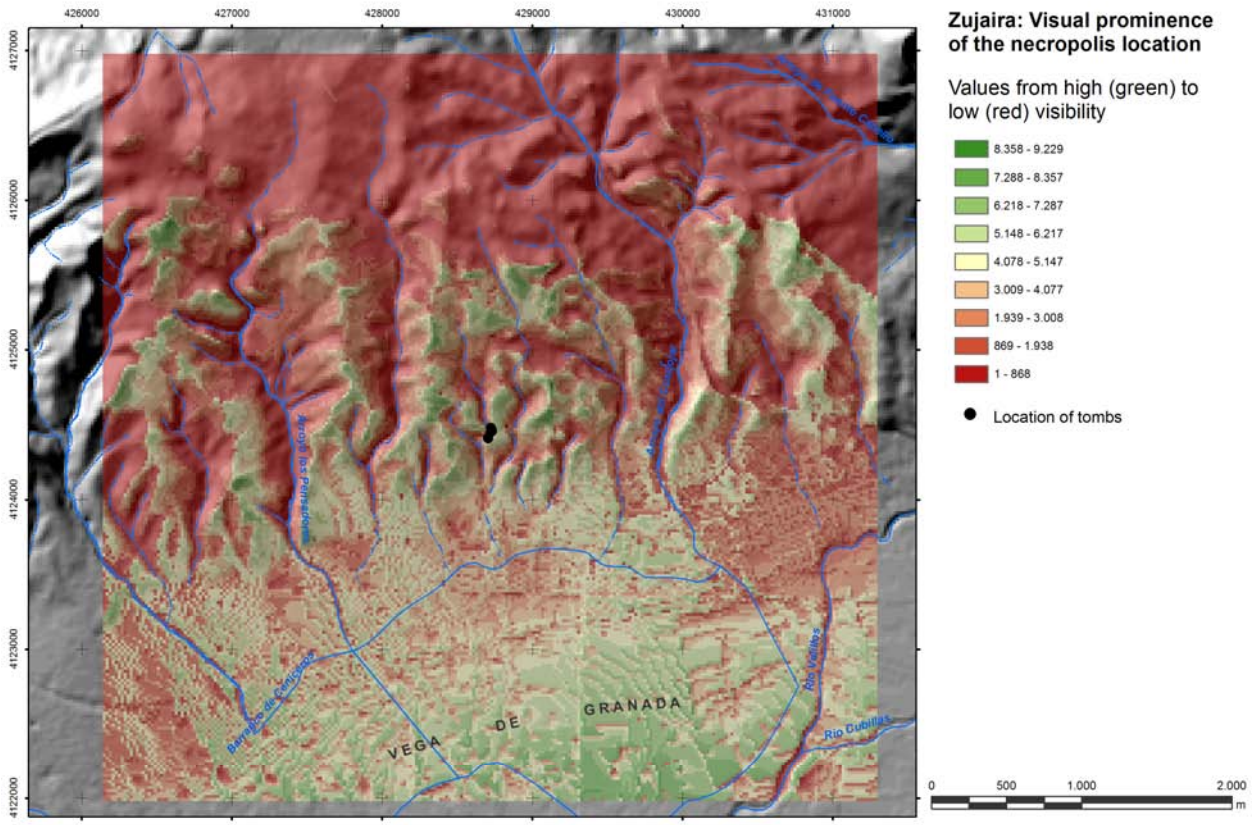

Figure 11. Zujaira: Visual prominence of the necropolis location

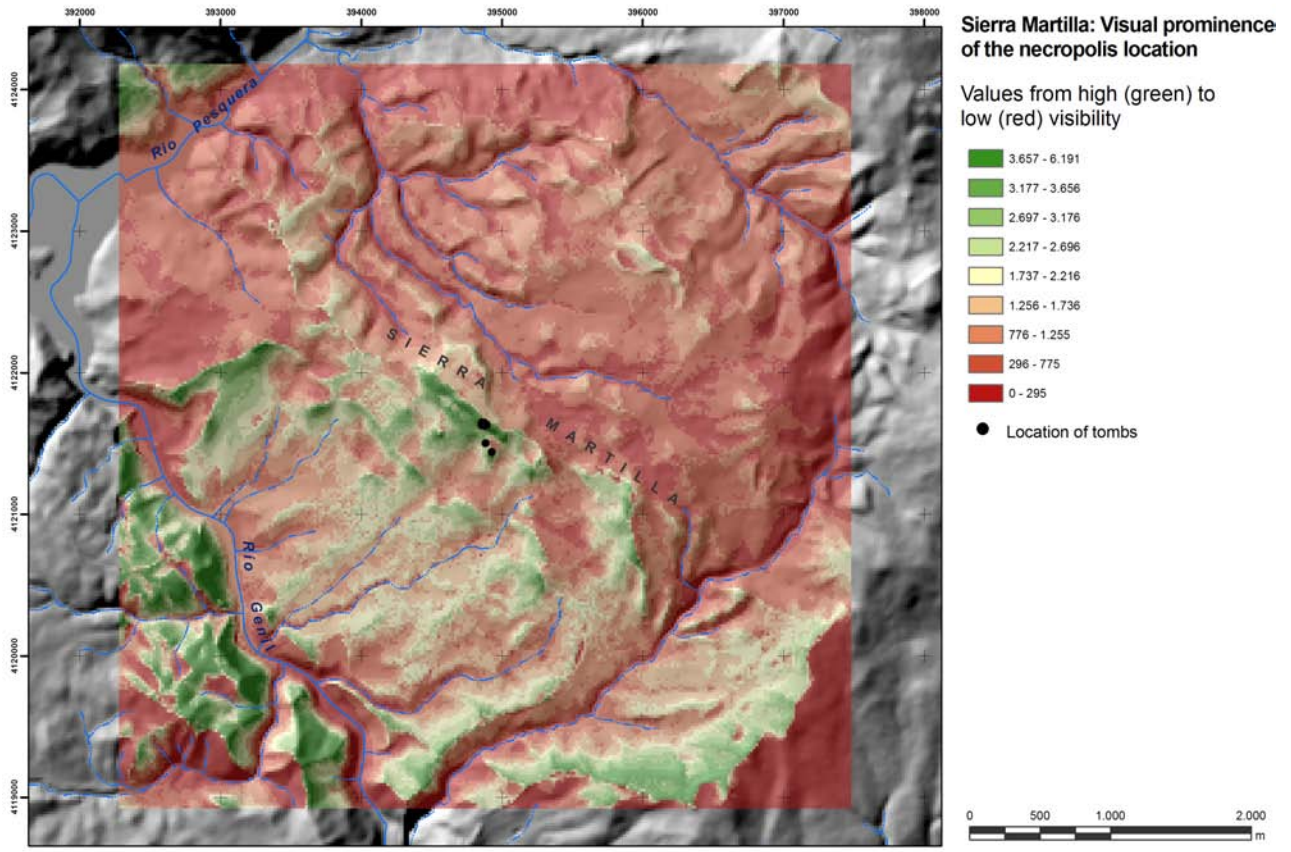

Figure 12. Sierra Martilla: Visual prominence of the necropolis location

The tombs are mostly located near the chalky escarpment of Las Peñas de los Gitanos, which forms a significant visual referent within this territory. Nonetheless, the riverbeds where the tombs are distributed have intervisibility much inferior to that of the rocky outcrops dominating the landscape. This characteristic of poor visibility repeats itself with the sepulchers located to the west, in the area of Hoyón de la Virgen.

Having accounted for the number of tombs and their organization within four recognizable necropolises, we decided to assess the average values of visual relevance of each one. So the Los Guirretes and Hoyón de la Virgen necropolises clearly stood out with very low indexes of visual relevance wherein the tomb sites were only visible from 7,76% and 5,34%, respectively, of the computed points. In contrast to the Camarilla and Los Guirretes tombs, which were visible from 14,68% and 15,88%, respectively, of the territory. In order to assess these quantitative indexes, we need only to highlight that the most visible enclave of the territory analyzed has a visual relevance index of 54,26%, which clearly demonstrates the selection of a site of limited visual dominion.

Individual Viewsheds from graves

Once the visual relevance of the necropolis location in the nearby territories is analyzed, the visibility from individual graves must be assessed by identifying the total surface visible from the tomb and placing it in relation to the theoretical viewshed. Although certain variations exist in the bibliography concerning the maximum limit of visual perception, a limit of 3 km radius from a given point is used in this paper, as it has already been used in other analyses of megalithism in western Andalusia (García Sanjuán *et. al.,* 2006). The maximum potential viewshed (PV) can thus be established at 28 km^2.

To determine the significance of the archaeological sites' viewsheds, the values obtained are contrasted with the viewsheds obtained from random points. Both samples undergo statistical analysis, generally the Mann-Whitney test, which checks for the existence of significant differences between the values corresponding to the archaeological sites and the random control points.

Unlike in other cases in the archaeological literature, we decided to establish sampling points in the same landform where the necropolis is situated, an aspect that *a priori* could possibly favor the attainment of a negative result since the visual dominion from points within a restricted geographic area *a priori* could be homogeneous. However, as argued below, in each case the results were positive, thereby demonstrating.

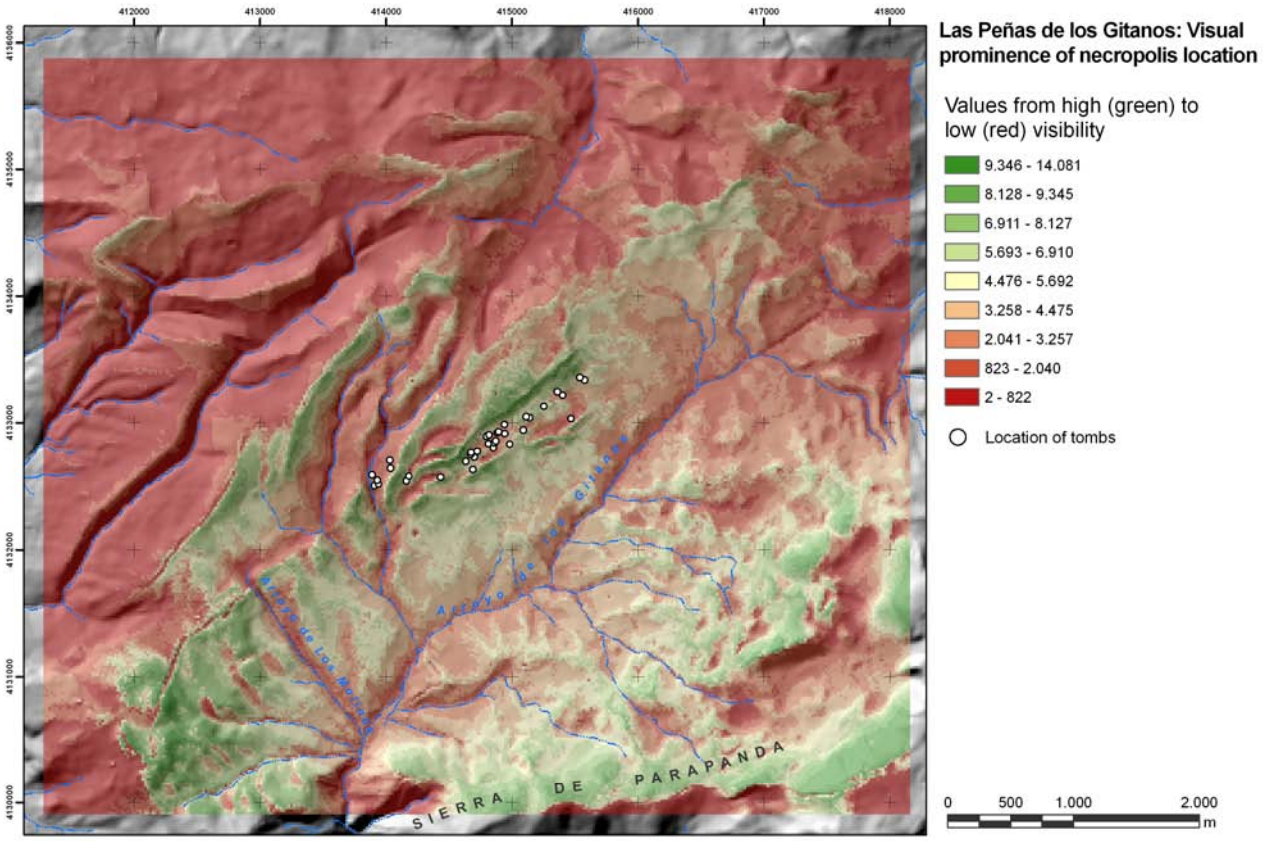

Figure 13. Las Peñas de los Gitanos: Visual prominence of the necropolis location

the existence of significant differences in the sizes of graves' viewsheds and those of the control points located in the corresponding landforms.

The size of the Zujaira tombs' viewsheds is very limited. Tomb 1 stands out with a theoretical viewshed of 0,72 km^2, barely 2,5% of the potential viewshed and, consequently, an extremely low value (figure 14). The average size of the viewsheds in this necropolis' tombs is 2,44 km^2, 8,62% of the PV, which is clearly inferior to other published data such as that of the Almadén de la Plata (15,46%) or Aracena (11,88%) dolmens, although this last case is affected by the presence of a reservoir which prevents an effective calculation of the viewsheds' shadows (García Sanjuan *et al*., 2006).

The viewsheds calculated from control points have considerably greater dimensions, with an average surface of 4,5 km^2 (15,79% of the PV), which is almost double the necropolises' average. Overall, these are relatively small viewsheds, which is unsurprising since the previous analysis shows the selection of a landform characterized by scarce visual relevance for the necropolis location (figure 14).

The Mann-Whitney test resulted in a p-value of 0.009, which is below the significance threshold situated at 0,05, and has a 95 per cent significance interval, which lends credence to the alternative hypothesis (H1).

Tomb	**Potential Viewshed (km^2)**	**Actual Viewshed (km^2)**	**% Theoretical Viewshed**
1	28,24	0,72	2,55
2	28,24	2,36	8,37
2b	28,24	2,61	9,26
3	28,24	2,53	8,95
4	28,24	2,64	9,34
5	28,24	3,75	13,26
Average		**2,44**	**8,62**
Sample 1	*28,24*	*7,59*	*26,86*
Sample 2	*28,24*	*3,20*	*11.33*
Sample 3	*28,24*	*3,51*	*12,43*
Sample 4	*28,24*	*4,17*	*14,76*
Sample 5	*28,24*	*4,01*	*14,21*
Average Sampling		***4,29***	***15,17***

Figure 14. Zujaira tombs data

The tombs of Sierra Martilla represent the opposite phenomenon. They are located in an area of significant visual dominion over the territory, with an average viewshed of six km^2, which is 21,28. The size of individual viewsheds is very homogeneous, and only

Tomb 7 appears to be clearly different, with values that are 50% lower than those of the rest of the tombs, as is shown in the following table (figure 15).

Tomb	**Potential Viewshed (km^2)**	**Actual Viewshed (km^2)**	**% Theoretical Viewshed**
1	28,24	6,56	23,22
2	28,24	6,98	24,73
3	28,24	6,83	24,17
4	28,24	6,51	23,06
5	28,24	6,22	22,03
6	28,24	6,19	21,92
7	28,24	3,31	11,72
8	28,24	5,48	19,40
Tomb Average		**6,01**	**21,28**
Sample 1	*28,24*	*0,88*	*3,13*
Sample 2	*28,24*	*6,61*	*23,42*
Sample 3	*28,24*	*1,02*	*3,61*
Sample 4	*28,24*	*4,82*	*17,07*
Sample 5	*28,24*	*2,26*	*8,00*
Sample 6	*28,24*	*1,28*	*4,53*
Sample 7	*28,24*	*5,64*	*19,98*
Average Sampling		***3,22***	***11,b 39***

Figure 15. Sierra Martilla tombs data

The size of viewsheds from control points show a considerably greater variability, ranging from viewsheds of less than 0,9 km^2 (3,25% of the PV) to others of dimensions comparable to those of the sepulchers. The average size of control viewsheds is of 3,22 km^2 (11,39% of the PV). As in the previous case, the statistical analysis indicates the existence of significant differences between the distributions of the two villages, with a p-value of 0,029, which is below the significance threshold situated at 0,05.

In the case of the Las Peñas de Los Gitanos necropolises (Figure 16), and considering their complexity given the number of sepulchers and diversity of geographic sites that can lead to significant differences in viewshed size, we decided to present the average values obtained in each of the recognizable necropolises, as is shown in the following table (figure 17).

The analysis undertaken shows the low visibility from graves in the Hoyón de la Virgen group, which barely exerts visual dominion in the direction of the valley drained by the Molinos and Las Peñas de Los Gitanos streams. Nor is there visibility towards the Sierra of Parapanda, a dominant element in this territory on the southeastern slope, facing Granada's low-lying lands, the Vega de Granada, as well as to the northeast, facing the Montes region. The average size of the viewsheds of this necropolis' tombs is 2,43 km^2, hardly 8,6% of the PV's surface.

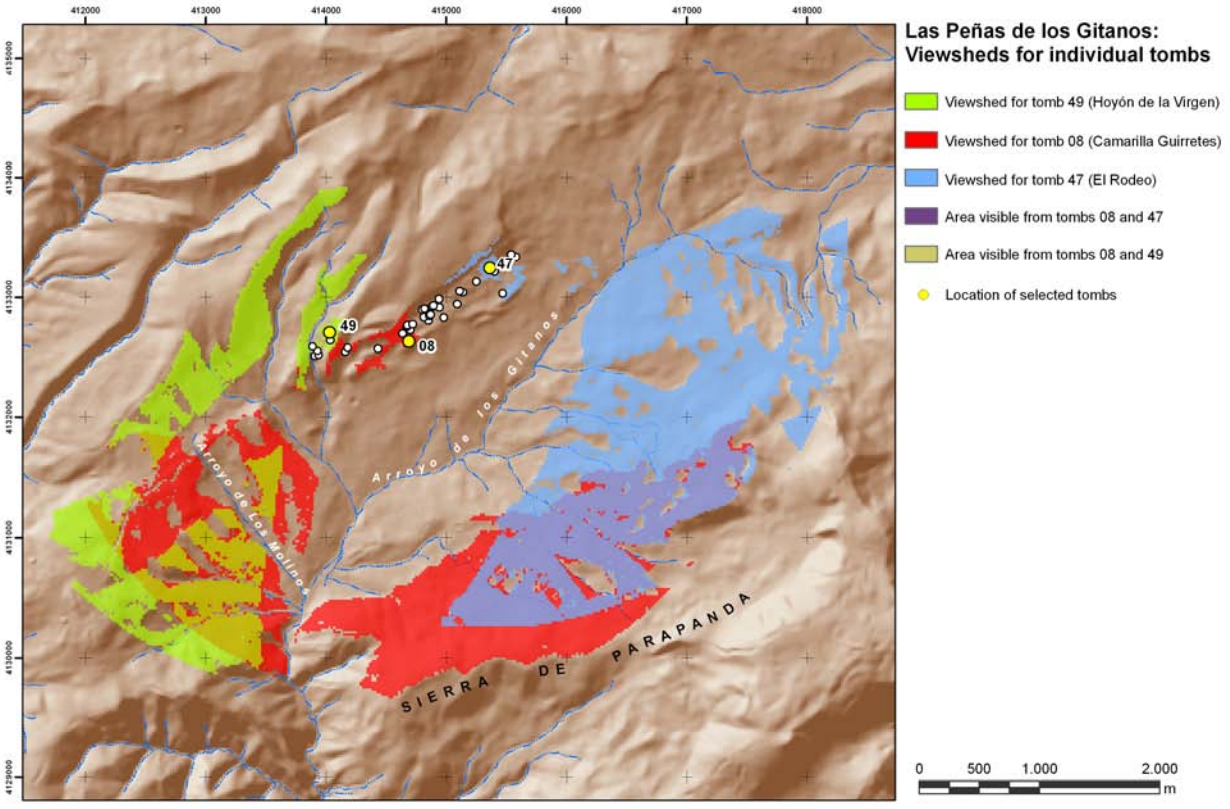

Figure 16: Las Peñas de los Gitanos: Individual viewsheds

Group	Potential Viewshed (km^2)	Actual Viewshed (km^2)	% Theoretical Viewshed
El Rodeo	28,24	4,68	16,58
El Hoyón	28,24	2,43	8,61
Camarilla	28,24	4,76	16,86
Guirretes	28,24	4,09	14,50
Sample test	28,24	7,18	25,43

Figure 17. La Peñas de Los Gitanos necropolises data

Visibility from the Los Guirretes, La Camarilla and El Rodeo tombs is higher, with viewsheds greater than 4 km^2 (between 14,50% and 16,86% of the PV). However, some factors affect the orientation and distribution of visibility from graves, since most of the visible areas correspond to the mountainous massif Sierra of Parapanda, located to the south of the necropolis, which is clearly visible in the distance, while the visual dominion exercised in the direction of the necropolis and its vicinity is very limited. Nor is there visibility towards the slopes descending towards the streams of Molinos and Las Peñas de los Gitanos.

The size of viewsheds calculated from the random points is clearly greater, averaging over 7 km^2, more than 25% of the PV. The tombs location indicates site selection based on low visibility, despite the presence of the Sierra of Parapanda, which constitutes a dominant visual referent within this area. This factor alters the viewsheds, increasing their size, as most of visible areas within the viewsheds correspond to Sierra de Parapanda while intervisibility of tombs and visual dominion of the necropolis area is scarce. The resulting p-value upon performing the Mann-Whitney test is <0,0001, impressively below the significance threshold situated at 0,05.

Cumulative Viewshed Analysis of the Necropolises

Cumulative Viewshed Analysis is the last element to analyze in the study of these megalithic necropolises' visual relationships. The goal of this analysis is to assess visual dominion from the necropolis as a whole rather than from the individual sepulchers in order to identify possible patterns of complementarity in the visual dominion exercised by each sepulcher. The value of each cell in the final map indicates the number of times seen from graves. Furthermore, we assess the viewsheds' form and orientation.

As previously stated, CVA has been used mostly to assess the visual relevance of megalithic monument sites over vast territories and the intervisibility relationships between them, while assuming the aforementioned limitations in terms of the validity of results obtained achieve an effective assessment of the visual relevance of sites location.

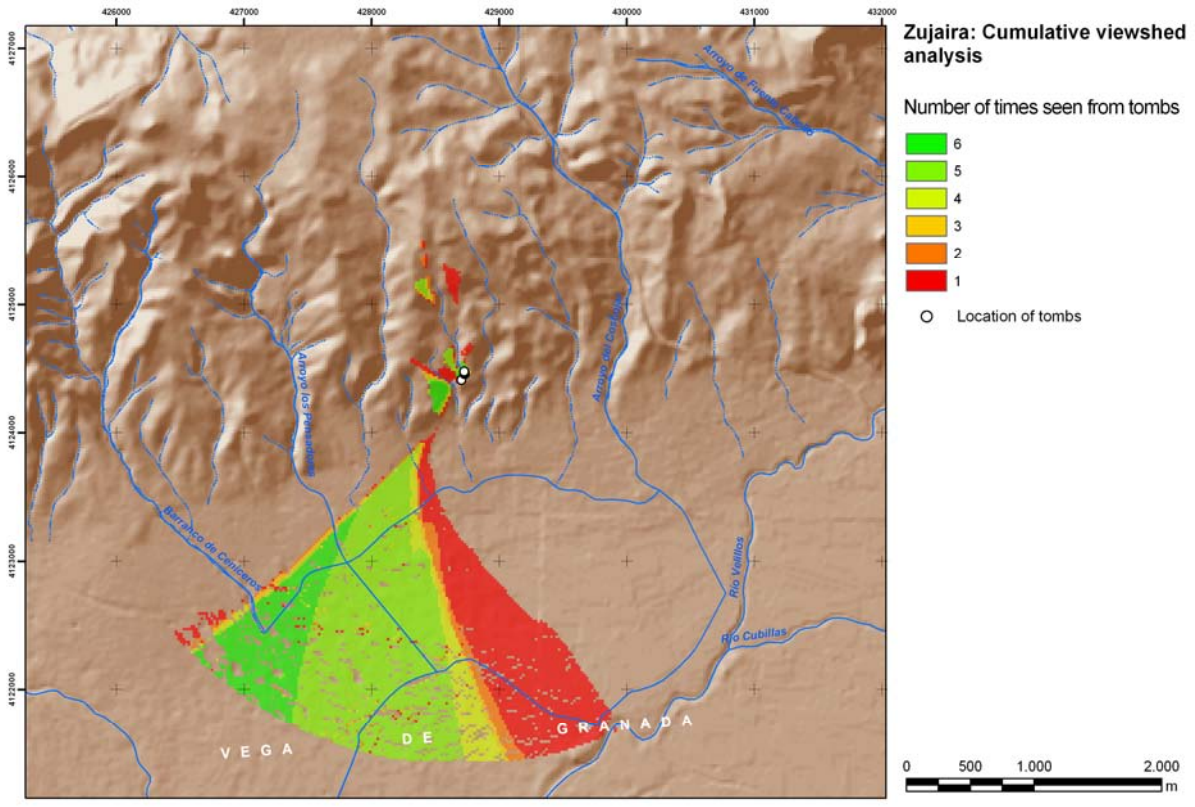

Figure 18. Zujaira: Cumulative viewshed for describing the viewsheds' predominant direction, as is reflected in the adjoining diagram.

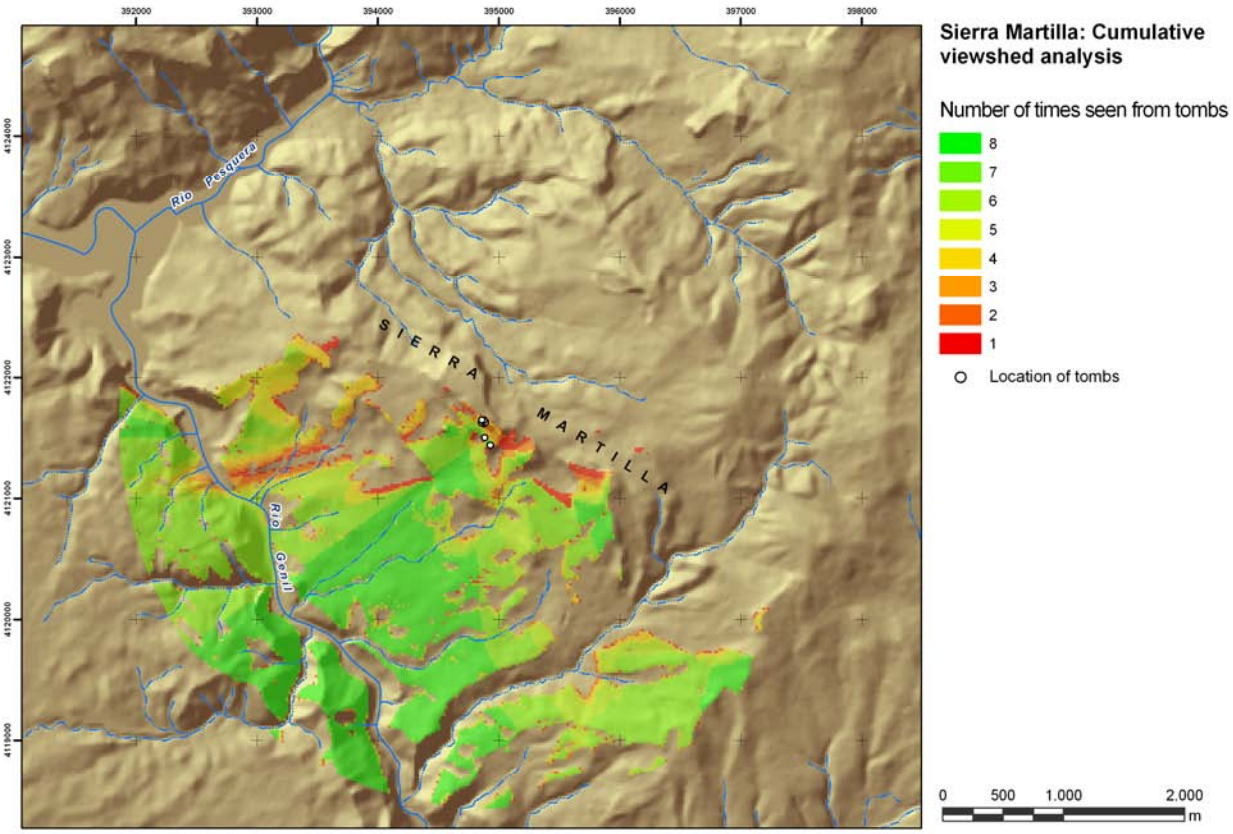

Figure 19. Sierra Martilla: Cumulative viewshed

However, it seems appropriate to underscore the suitability of this analytical method for studying necropolises located in small scale landforms interacting over extensive areas, such as those analyzed here. In such cases, the analysis allows the assessment of visibility from the entire necropolis in order to identify if the location of each sepulcher was determined by the need to obtain visual dominion over uncontrolled zones from other sepulchers within the necropolis.

In terms of the orientation of the viewsheds, we can use traditional classification in eight quadrants.

As we saw earlier, viewsheds of limited dimension characterize the tombs of the Zujaira necropolis, with an average size of 2,4 km^2 (8,62% of the PV). However, the calculation of the cumulative viewshed indicates a clear complementarity between graves individual viewsheds (Figure 14), wherein the territory controlled from the necropolis rises to 4,2 km^2, a 14,35% of the maximum theoretical viewshed. Although this is still a low figure, it is important to highlight how the distribution of the individual viewsheds is established complementarily, as indicated in the map (Figure 18), which results in viewsheds facing south with minor changes in orientation between the southwest and southeast such that the viewshed from the necropolis attains 80º degrees of width.

Regarding the form and orientation of viewsheds, it is especially remarkable that they all face exclusively south in the direction of the Vega, a territory suitable for agricultural use, whereas there is no visibility to the north, east and west.

Viewshed complementarity is not as observable in the Sierra Martilla tombs as it is in Zujaira; the zones visible from the tombs are largely coincident and only small zones are visible from one or two tombs (Figure 19). This is demonstrated when considering that the average individual viewshed size is 6,8 km^2 (24,32% of the PV) whereas the necropolis' cumulative viewshed size is only 7,8 km^2, a 26,33% of the potential cumulative viewshed.

Once again, it is important to highlight the orientation of the viewsheds, in this case facing southeast (W-SW-S quadrants), whereas to the north-northeast (quadrants NW, N, NW and E) visual dominion is nonexistent.

Complementarity between the tombs' individual viewsheds can be observed once again in the case of the Las Peñas de los Gitanos necropolis. As the adjoining map reflects (Figure 20), there exists an obvious distant visual referent, the Sierra of Parapanda, which is perceptible from the greatest number of tombs and, therefore, for which it is not possible to establish the

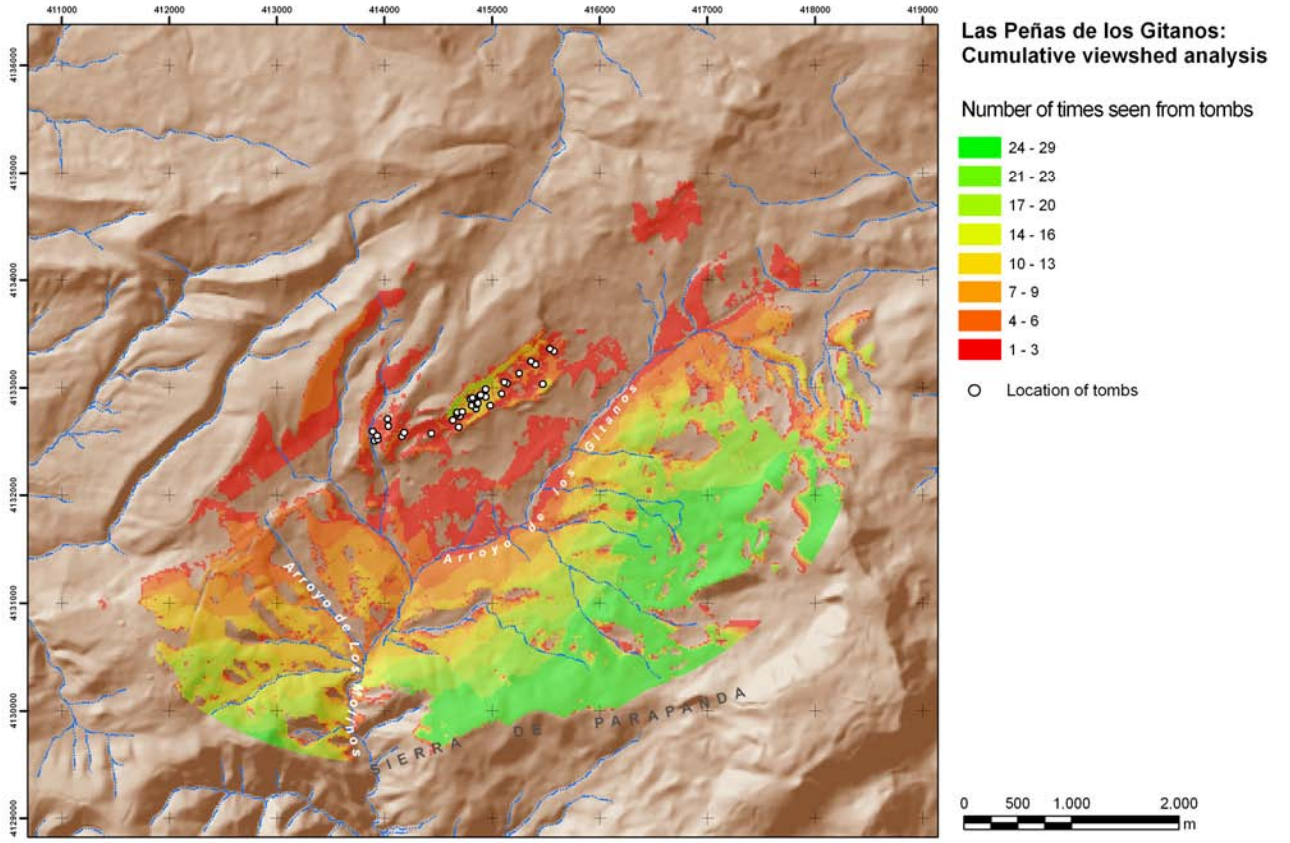

Figure 20. Las Peñas de los Gitanos: Cumulative viewshed

existence of complementarity between the tombs' visual dominion areas in the far-distance viewshed. Nonetheless, the middle-distance visual areas present a more heterogeneous distribution, with zones visible from a number of tombs and between which the establishment of such complementary relationships becomes possible. These zones, exemplified within the valleys of the Molinos and Las Peñas de los Gitanos streams, are visible from an average of 10 tombs, being depicted on the map in orangish-yellow tones. Finally, immediate visual dominion is very limited, with most areas visible only from a very small number of tombs.

As in the earlier cases, the orientation of the viewsheds is striking, although the presence of the Sierra of Parapanda, approximately 3 km southeast of the necropolis, determines the general pattern of visibility in this territory. Even so, the concentration of visual dominion areas between the northeast and southeast (NE, E, SE, S, SW) is remarkable whereas, to the west and north, visual dominion is practically nonexistent.

6. Conclusions

The main use of funerary ritual in the studied zone appears to have been related to the dissolution of differences within the collective framework with the onset of generally hidden sites (of the tomb complex that, in any case, was not used by the entire community). This coincides with the masking function attributed to the ritual of collective inhumation (García Sanjuán, 2000:174; Chambon, 2000:273; Cámara Serrano, 2001:236; Nocete Calvo, 2001:97) and, moreover, accentuates the secrecy (from the restricted area to the tomb's interior) of certain manifestations (Bradley, 1998:190; Schoep, 2007:229). Aspects such as the low visibility from sepulchers and the selection of sites with low visual relevance for the necropolises location, excepting the case of Sierra Martilla, confirm this hypothesis.

Nonetheless, other factors do not seem to have been ruled out and if, in the vicinity of Vegas del Genil (Sierra Martilla and Zujaira), visual control from the sepulchers and necropolises emphasizes dominion over low-lying areas suitable for agricultural use, then in the case of the Las Peñas de Los Gitanos necropolises, even if certain control over the valleys (Los Molinos and Las Peñas de Los Gitanos) does exist, the fundamental factor appears to be the linkage with spatial referents of broad territorial dominion (the Sierra of Parapanda), the openings of which were vital for communications (the valley of the Los Molinos stream).

Monumentality is not determined by the architectural impact of tombs on the environment (Moore, 1996:92;

Johansen, 2004:319; Bretschneider *et al.*, 2007:1; Cunningham, 2007:26; Driessen, 2007:73; Scarre, 2007:34), although in some concrete cases structural modifications exist not only in the funerary container but also in the surrounding environment, as exemplified by the preparation of the rock in Zujaira and Sierra Martilla for creating façades and false barrows. What confers monumentality to the necropolis in question (and facilitates the transmission of an ideological message of appropriation and camouflage) is the sepulchers' unity and their connection to a prominent natural space that encompasses and hides them (even megalithic tombs) to the extent that they are not even located in the most prominent spots. In this sense, the monumentality of the "natural" space containing the necropolises is remarkable even in comparison to a more prominent element, as in the case of the Las Peñas de Los Gitanos – Sierra of Parapanda opposition in Montefrío.

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