

# APPROACHES TO VISIBILITY AND STRATEGICAL CONTROL OF THE SIERRA HARANA SCHEMATIC ROCK ART (GRANADA, SPAIN)

Aproximaciones a la visibilidad y control estratégico del arte rupestre esquemático de Sierra Harana (Granada, España)

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**ABSTRACT** An approach about territorial control and mobility in Sierra Harana (Granada, Spain) during Late Prehistory is presented in this paper, according to rock shelters with schematic rock art distribution. Different aspects have been analysed by using tools provided by Geographic Information Systems (GIS): the relationship between rock shelters and hydrographic network and water springs, and, mainly, their visual control. The association between rock shelters with schematic rock art and burial caves use during the Neolithic period is observed in the study area. A strong link between rock shelters and traditional pathways is also attested. These facts can be read as a way to mark symbolically certain routes that could be aimed to short transhumance practice.

**Keywords:** Sierra Harana, Neolithic, Schematic Rock-Art, Geographic Information System (GIS).

**RESUMEN** En este trabajo se presenta un estudio sobre el control territorial y la movilidad en Sierra Harana (Granada, España) durante la Prehistoria Reciente, según la distribución territorial de los abrigo con arte rupestre esquemático. Se han analizado diferentes aspectos utilizando herramientas proporcionadas por los Sistemas de Información Geográfica (SIG): la relación entre los abrigo rupestres, la red hidrográfica y los manantiales de agua, y, en particular, su control visual. En el área de estudio se observa la asociación entre los abrigo con arte rupestre esquemático y el uso de cuevas funerarias durante el Neolítico en los mismos ámbitos territoriales. También se constata

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un fuerte vínculo entre los abrigos rupestres y los caminos tradicionales. Estos hechos pueden leerse como una forma de marcar simbólicamente ciertas rutas que podrían estar dirigidas a la práctica de la transterminancia o trashumancia.

**Palabras clave:** Sierra Harana, Neolítico, Arte rupestre esquemático, Sistema de Información Geográfica (SIG).

## INTRODUCTION

Sierra Harana is made up of a mountain range oriented from SW to NE, at the foot of which there are some glacis that extend towards Granada and Guadix plateaus. It is flanked by two main river basins: Cubillas River to the west and Fardes River to the east. Within this area there is a smaller hydrographic network, with small rivers such as Río Blanco or Río de Píñar, and a large number of streams, ravines and springs that pour their waters into the main basins. The maximum height of this formation is at Peñón de la Cruz (2029 m.), and its average height is 1460 m. (Pezzi, 1977; Fernández, 2009).

Since H. Obermaier (1934, 1939) discovery of the first four rock shelters with schematic paintings in Sierra Harana in 1916, several researchers have expanded the number of rock art sites known in this area over time (García Sánchez and Pellicer, 1959; Ruiz *et al.*, 1986; Riquelme and González, 1991; Soria *et al.*, 2004; Fernández, 2007, 2009, 2013; Fernández and Spanedda, 2011, 2013). Synthesis works without new data have been also numerous (Breuil, 1934; Spahni, 1957; Carrasco *et al.*, 1985; Soria and López, 1989; Martínez García, 1997; Fernández and Spanedda, 2015, 2017). After a century of research Sierra Harana rock art sites, the number of rock shelters has increased to 16, furthermore of 13 caves, 7 of them containing rock art motifs.

Sierra Harana rock art group is doubtlessly connected to the evolution of prehistoric settlement in this geographical area. Human occupation is attested at least from Middle Paleolithic as proved by Neanderthals remains and Mousterian finds from Carigüela Cave (Píñar). Upper Paleolithic and Epipaleolithic sites are also known in the area (Almagro *et al.*, 1970; García Sánchez, 1960; Lumley, 1969; Lumley and García, 1971; Obermaier, 1934; Pellicer, 1964b). Engraved figures of Middle Paleolithic Ages have been also discovered at Las Ventanas Cave (Píñar) (Cortés *et al.*, 2018).

Although human occupation in the area is attested from Middle Paleolithic, Sierra Harana rock art is related to Late Prehistory and most of the motifs can be dated in Early and Middle Neolithic Ages. However, the only published stratigraphical sequence is Carigüela Cave (Pellicer, 1964a). Excavation in this cave provide a complete Neolithic sequence that has been reinterpreted from new analysis and excavations (Navarrete and Molina, 1987; Vega *et al.*, 1997). There are also materials belonging to the Early and Middle Neolithic periods from the other caves in the area as Las Ventanas (Píñar) (Riquelme, 2002), Meye (Píñar), Pagarecio and Confites (Píñar), Agua (Iznalloz), Horá or Puntal (Navarrete, 1977; Navarrete and

Capel, 1977, 1979), but most of the items from these sites have been collected on the surface.

Not all of these cavities were occupied during Late Prehistory in a permanent way, as shown by the limited material provided by some of them, which leads us to think of sporadic occupations and even suggest their use as sheepfold caves. Other caves as “CV-3 and CV-10” (Cogollos-Vega, Granada) (Navarrete *et al.*, 1983; Navarrete *et al.*, 1987-1988) and Cortijo del Canal (Albolote, Granada) (Navarrete *et al.*, 1999-2000), geographically located in the foothills of Sierra Harana, mark the spread of Neolithic settlement along the mountain ridges surrounding Vega de Granada. The same befalls at the site of Las Majolicas (Alfacar, Granada), where archaeological remains are scattered in several staggered plateaus and in a large hole that could correspond to the passage of a cave on which collapsed part of the ceiling (Molina, 1970; Navarrete, 1976: 309-313; Navas *et al.*, 2008).

Neolithic sites also include some open air sites with scattered items (especially flint), for example Loma del Rubio, Venta de las Navas, Haza de la Cabaña, Cerrillo de Orea and Fuente de la Zarza (Obermaier, 1934), but it's difficult to prove the existence of Neolithic settlements without excavations. Human occupation in Sierra Harana during Late Prehistory continues without interruption until the Bronze Age.

Schematic rock art inception can be linked to Early and Middle Neolithic occupation, attending to certain parallels between painted motifs and figures found in decorated pottery, although we lack good or recent excavations and absolute dates for fixing an accurate chronology (Fernández, 2009:296-297, 2013:109-110). Besides, absence of some types of motifs, as eye-idols, could exclude a Final Neolithic/Calcolithic date for the studied sites.

Many of the decorated ceramics come from the caves that have been recently interpreted as burial sites (Navarrete *et al.*, 1999-2000; Carrasco *et al.*, 2010). This fact could help us to propose the construction of a strictly symbolic landscape in Sierra Harana in Late Prehistory. However, domestic findings in sites as Carigüela (Molina *et al.*, 2012) make difficult to accept all the caves as exclusively ritual sites during all their occupation period.

## OBJECTIVES AND METHODS

With this background, in this paper we aim to analyze the visibility pattern through a Geographical Information System model, which has allowed us to apply methodologies devoted to a discuss the causes of site location. We focused on how visibility is the key factor on shaping the Late Prehistoric Sierra Harana landscape. To achieve that goal, we will pay special attention to the Viewshed Analysis performed on rock shelters with schematic rock art along the southeast side of Sierra Harana (fig. 1:6,9,10,11,12,13,14,15,20) and also on those clustered around Peñón de la Giganta (fig. 1:16,17,18,19). Nevertheless, some sites have been left out of this study because of being scattered in a more irregular and isolated form whose available published information doesn't allow us to obtain appropriate data for their

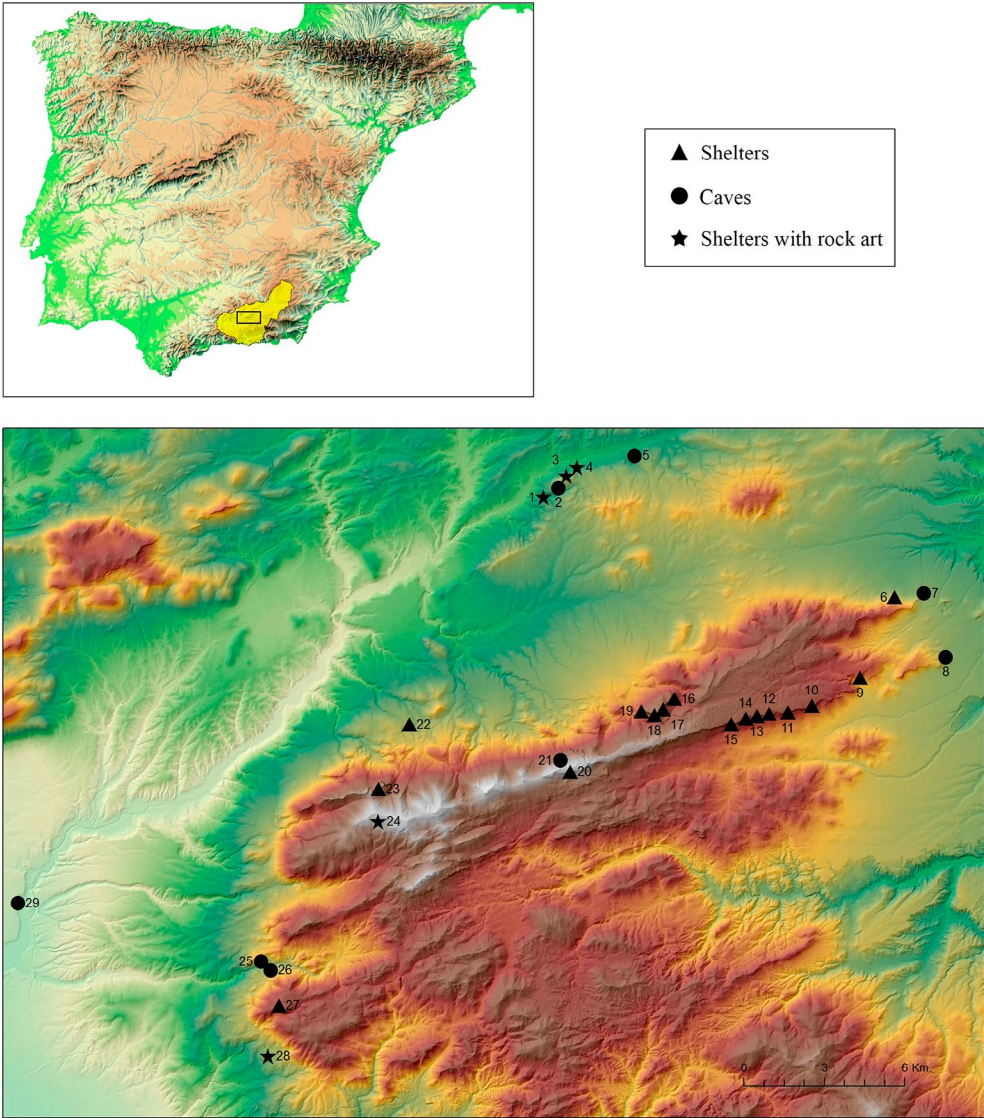


Fig. 1.—Location of shelters with schematic rock art and Neolithic sites of Sierra Harana. 1, Pagarrecio Cave (Piñar); 2, Carigüela Cave (Piñar); 3, Las Ventanas Cave (Piñar); 4, Meye Cave (Piñar); 5, Los Confites Cave (Piñar); 6, Tajos del Águila Shelter (Huélago); 7, El Puntal Cave (Darro); 8, Horá Cave (Darro); 9, Tajos de Panoria Shelter (Darro); 10, Vereda de la Cruz Shelter (Diezma); 11, Tajos de la Campana Shelter (Diezma); 12, Vereda de los Marranos Shelter (Diezma); 13, Torres Bermejas o Sillar Baja Shelter (Diezma); 14, El Tablazo I Shelter (Diezma); 15, El Tablazo II Shelter (Diezma); 16, Las Angustias Shelter (Iznalloz); 17, Giganta o IZ-18 Shelter (Iznalloz); 18, Montserrat Martínez Shelter (Iznalloz); 19, Julio Martínez Shelter (Iznalloz); 20, Tajos del Jinestral Shelter (Iznalloz); 21, Agua de Prado Negro Cave (Iznalloz); 22, Portillo del Toril (Iznalloz); 23, Peñón del Asno (Iznalloz); 24, Agua Cave (Deifontes); 25, CV-3 Cave (Cogollos-Vega); 26, CV-10 Cave (Cogollos-Vega); 27, Cerro de las Higuerrillas Shelter (Nívar); 28, Las Majolicas Cave (Alfacar); 29, Cortijo del Canal Cave (Albolote). Figure in colour in the electronic version.

inclusion in this analysis. In order to determinate the territorial control exerted from these sites, we have begun the study from the minimal exploration unity, i.e.: the panel, and then to continue with the size and location of these rock shelters. We have tried to determinate, by using GIS, if was established a standardized territorial control system during Late Prehistory, creating a visual ideological landscape defined by the spatial distribution of these painted sites. At last, the study aims to inquiry if there is any kind of relationship among these painted rock-shelters, possible optimal wander routes, hydrographic basins and water sources or other types of sites belonging to Late Prehistory.

Because of the many problems referred above, as scarcity of chronological data and absence of recent excavations, burial or residential caves haven't been included in our Viewshed Analysis, but they must be taken into account for future studies. Anyway, these caves are in all cases located in the outer foothills of the study area, except Cueva del Agua de Prado Negro, which is situated in the central part of Sierra Harana main axis. There are other two caves (El Puntal and Horá) which are directly related to the location of the painted rock shelters. They are strategically placed at the east of the formation, but they apparently were only occupied occasionally and no Neolithic remains have been found inside them (fig. 1:7,8).

## **SIERRA HARANA SCHEMATIC ROCK ART IN RELATION TO LANDSCAPE CONSTRUCTION**

### **Panels' configuration**

In order to analyse inner organization of every panel, we've followed the Julián Martínez García's proposal for Southern Iberia (Martínez, 2004). All the studied cases to date are fossilized panels, with few and simple painted motifs which are recurrently found and which are related to the themes proposed for the so called Ancient model of Schematic Rock Art: simple anthropomorphs, sun shapes, branches shapes, zoomorphic figures, etc. Compositions present no axis or an incipient horizontality, so we can categorize them as ambiguous and horizontal panels. They could be dated to Early and Middle Neolithic (fig. 2), and it can be related to the known data about occupation in different caves, and probably open air sites, in these early dates of the Late Prehistory.

### **Distribution and visibility of the rock-shelters**

Distribution of the sites with schematic rock-art in Sierra Harana shows two well-defined clusters which can be considered as a strategy to mark natural monuments (fig. 3). In this paper, we have set the focus on these groups. First of these concentrations is located toward the southeast of the central axis. It comprises eight rock-shelters aligned along the rocky outcrop and having a strategic position to

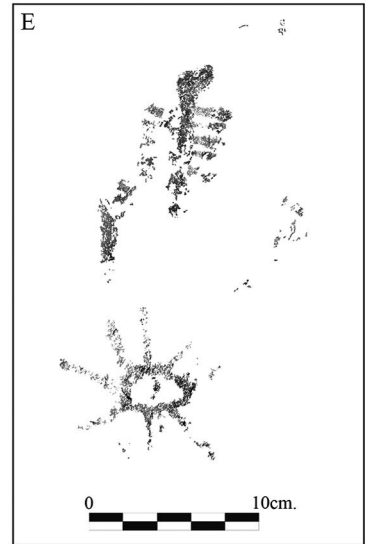
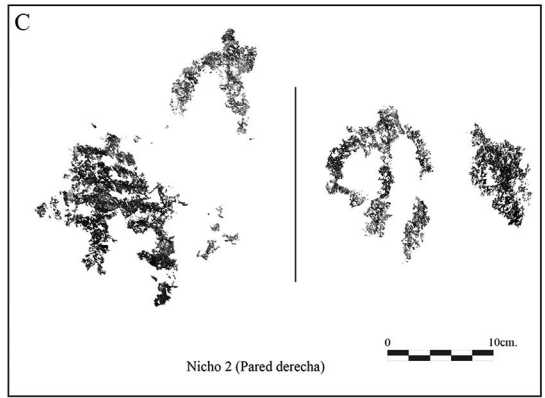
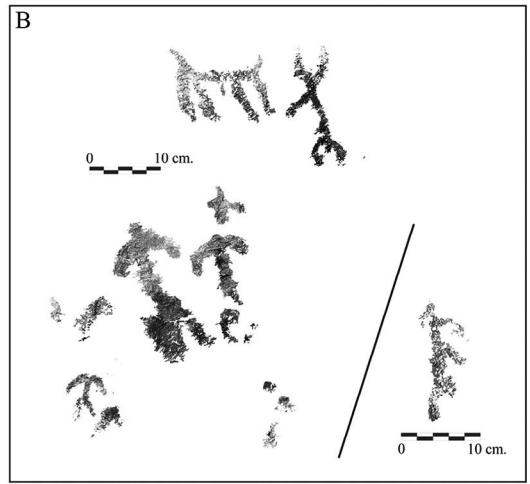


Fig. 2.—Representation of the most significant rock art panels of Sierra Harana. A) Cerro de las Higuerrillas Shelter (Nívar); B) Julio Martínez Shelter (Iznalloz); C) Tajos del Águila Shelter (Huélago); D) Vereda de la Cruz Shelter (Diezma); E) El Tablazo II Shelter (Diezma).



A



B



C



D

Fig. 3.—Overview of the cliffs where are located the shelters with schematic rock art. A) Panoramic view of the southern side of Sierra Harana; B) El Tablazo II Shelter (Diezma); C) Tajos del Jinestral (Iznalloz); D) Peñón de la Giganta. Figure in colour in the electronic version.

control the entry exit from Rambla Seca. It is a creek V-shape valley which connects the Hoya de Guadix with Vega de Granada, two plateaus. The two rock shelters that mainly exert this control are Tajos de Panoria (Darro) (fig. 4A) in the east and El Tablazo II (Diezma) (fig. 4B) in the west. Although El Tablazo II is not the last site in this alignment, it can work as control place because of its position near a hill summit, being the last but one in this alignment. On the other hand, we should note that the rest of the painted sites in this group are facing south. They are rock shelters with a wide visibility due to their position in high altitude points along the mountain axis. For this reason, we can denominate them as rock shelters of “vision and completion”, according to previous proposals (Martínez García, 1998, 2009). They don’t show a visibility that privileges a direction but a wide area.

Finally, Los Tajos del Águila site has been considered part of this group because it controls the same route (fig. 1:6), although it isn’t on the same alignment axis. The painted panels of this site are distributed throughout a group of small cavities placed on the northeast slope of Sierra Harana. Furthermore, Los Tajos del Águila site is visible from the plain and has a wide visibility over the route (fig. 5). The other concentration of painted sites is located at Peñón de la Giganta, a conical geographical feature, situated towards the north of Sierra Harana central axis. They are four shelters that constitute a cluster in the southern part of such geographical landmark. They face south and southwest (fig. 1:16,17,18,19). Regarding their placement pattern, we can associate them to a hill or isolated mountain (Martínez García, 1998), but their visibility is restricted to the northern Sierra Harana rocky outcrop so that we can categorize them as ‘route rock-shelters’.

The rock-shelters chosen to be painted are small and medium size, discarding larger ones and which show better internal geological conditions for decorative purposes. This is one of the questions to be solved, because we must think that this is not a casual selection but it would depend on symbolic attributes. We have stated that most of the painted rock-shelters have a wide visibility, but they are not so visible from the rest of the territory. Only few of them can be perceived from possible routes and most of them are only visible from their immediacy. It is a feature that difference them from the previously analysed ones. Anyway, some sites are located in strategic places and a wide territory can be seen from them. Control over movement would be associated to hidden locations.

To verify these observations regarding differences in visibility among sites, we have carried out a viewshed analysis through a GIS application (Wheatley, 1995; Fairén, 2002-2003). So, we have been able to distinguish those areas visible from each of the rock-shelters. To achieve this purpose, we have used different parameters such as height and orientation in order to modify the default values which have been obtained by considering only an area around every site. *Offseta* (or height of the observer), have been used with a value 0, in order to harmonize possible differences deriving from rock shelter entrances and possible modifications in them. *Azimuth* (or the angle visible from a given point to the observer), has been established in our study as 180°, by considering rock shelters are opened in a rocky wall which hides behind it a large portion of the territory. Anyway rock



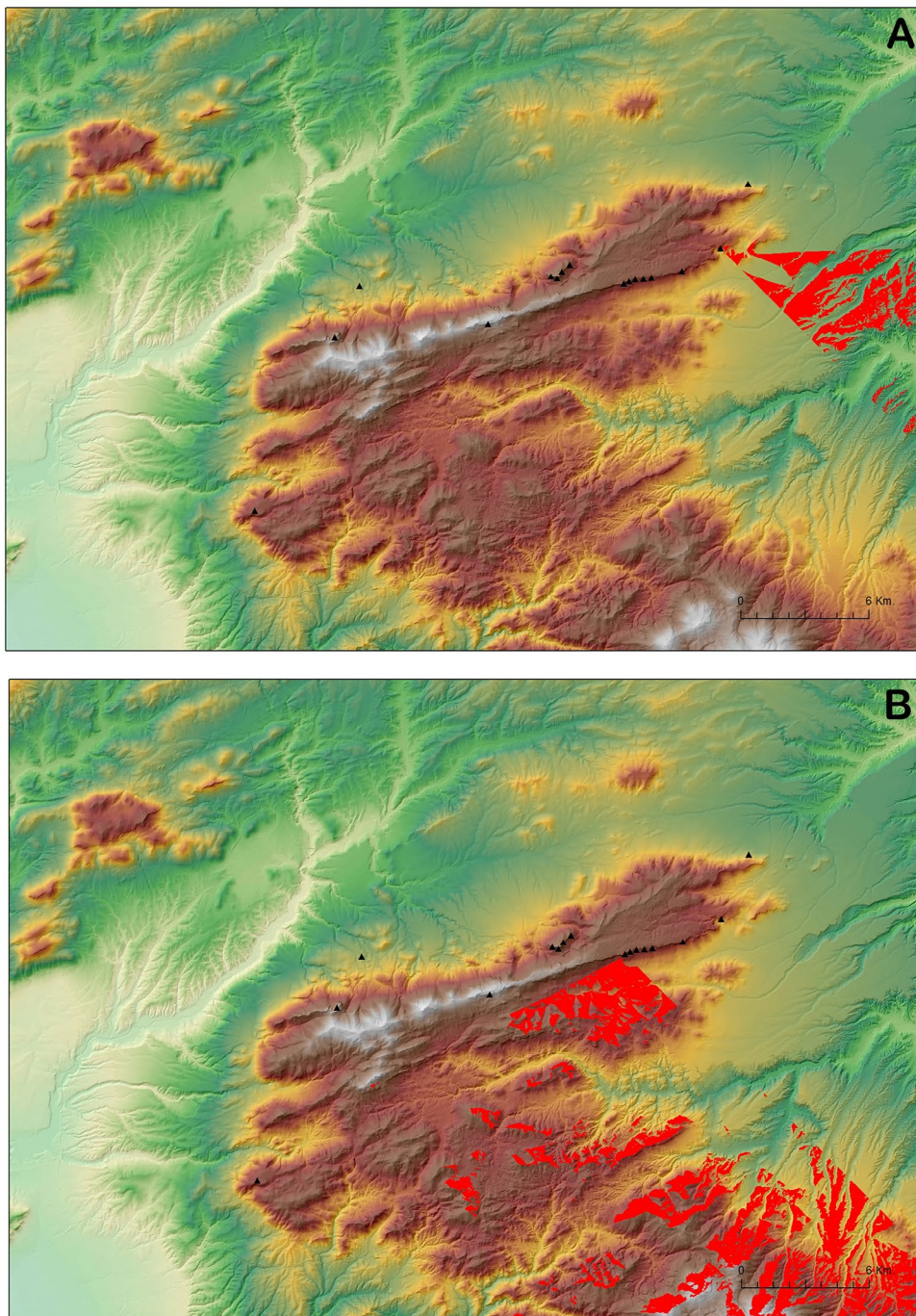


Fig. 4.—Simple Viewshed of those rock shelters that exercise a territorial control of the entrance and exit of Rambla Seca stream. A) Tajos de Panoria Shelter (Darro); B) El Tablazo II Shelter. Figure in colour in the electronic version.

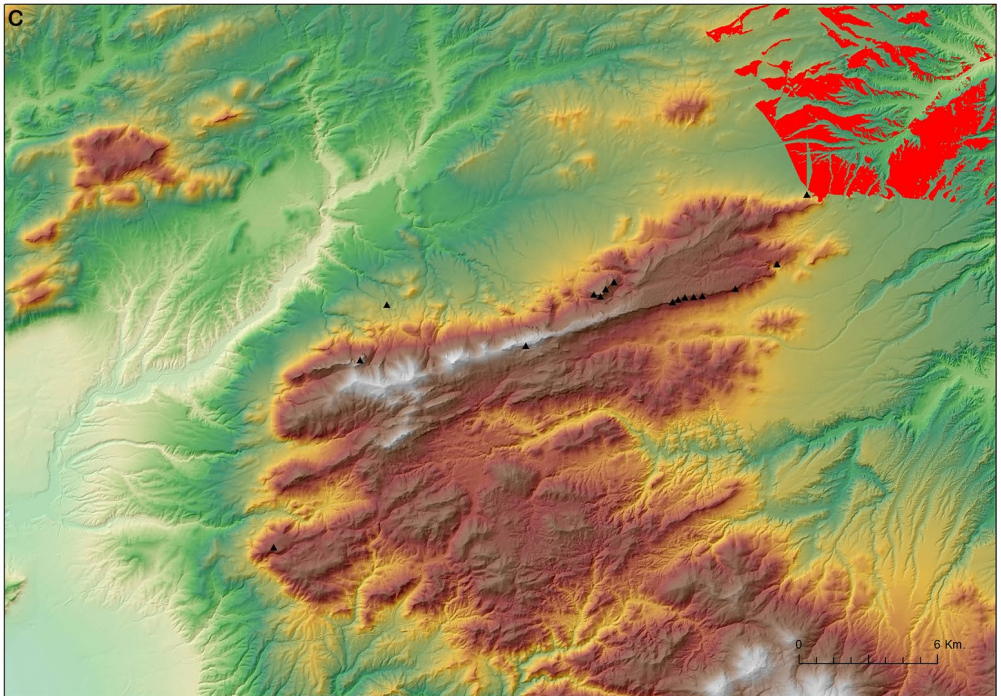


Fig. 5.—Tajos del Águila rock shelter (Huélago): A) overview of the rock shelter; B) visibility from the rock shelter to the northeast; C) simple viewshed of the rock shelter. Fig. in colour in the electronic version.

shelter orientation taking into account its known entrance must be also considered. We have also taken into account changes in bearing position produced by each season. The points representing the rock-shelters on the base map are exported to the database in order to establish themselves as individual elements so that the Viewshed operation can be applied differentially to each one. As a result, we obtain an influence area on the map for every site (or point). Results show the visible area from each point within the study area regarding its orientation. If we add the areas visible to all points through an arithmetic sum we get *Cumulative Viewshed*. This solution allows us to determine those areas of the map visible from all the rock-shelters. It should be noted that the location of some sites close to the borders of the study area or the wide visibility of others results in a limitation on the representativeness of the entire visible area.

*Viewshed Analysis* have allowed us to infer that all the stream of Rambla Seca is visually controlled. This creek runs below the rocky outcrop where rock-shelters are located, coinciding with the layout of a livestock road that crosses the area from east to west. This road is still one of the traditional routes passing through this sector of Sierra Harana. Overall, *Viewshed* analysis of this area defines a set of rock-art sites with a high degree of visual integration. Rock-shelters located further to the East dominate visually the entrance to the valley while the others control the route through it until Tajos del Jinestral site. This last one controls the valley exit and the source of Fardes River (fig. 6). Viewshed data of Peñón de la Giganta show different pattern. In this case, any visual preponderance over the territory has been not observed (except for the rock-shelters of Julio Martínez which shows a wide visibility to the west). However, another interesting trait is the wide visual control on Barranco del Contadero from these sites. This fact may denote the existence of a transit route by the interior of the mountains, although this interpretation needs future research and could be tested with the discovery of new painted sites in this northern slopes of Sierra Harana.

### **Territorial analysis by calculating Optimal Routes**

Along this mountain area movement of people, animals, products or information would occur through fixed routes more or less depending on natural features (corridors) (García Atiénzar, 2011). In fact, movement out of these corridors is difficult, with steep areas and zones with dense vegetation (even nowadays). Another question is the role that rock-art shelters might have as landmarks associated with pathways, strategic crossing places, such as fords, mountain passes, road crossings, etc. (Martínez García, 1998). These pathways could be especially linked to grazing (Fairén *et al.*, 2006; García Atiénzar, 2006), considering that the Arroyo de Rambla Seca acted as a transit channel for movements related to the transterminance of the herds between Hoya de Guadix and Vega de Granada lowlands and Sierra Harana highlands. These pathways are validated by GIS optimal routes analysis and, as in other areas, will remain in later periods (Villaverde *et al.*, 2016). In fact, a function

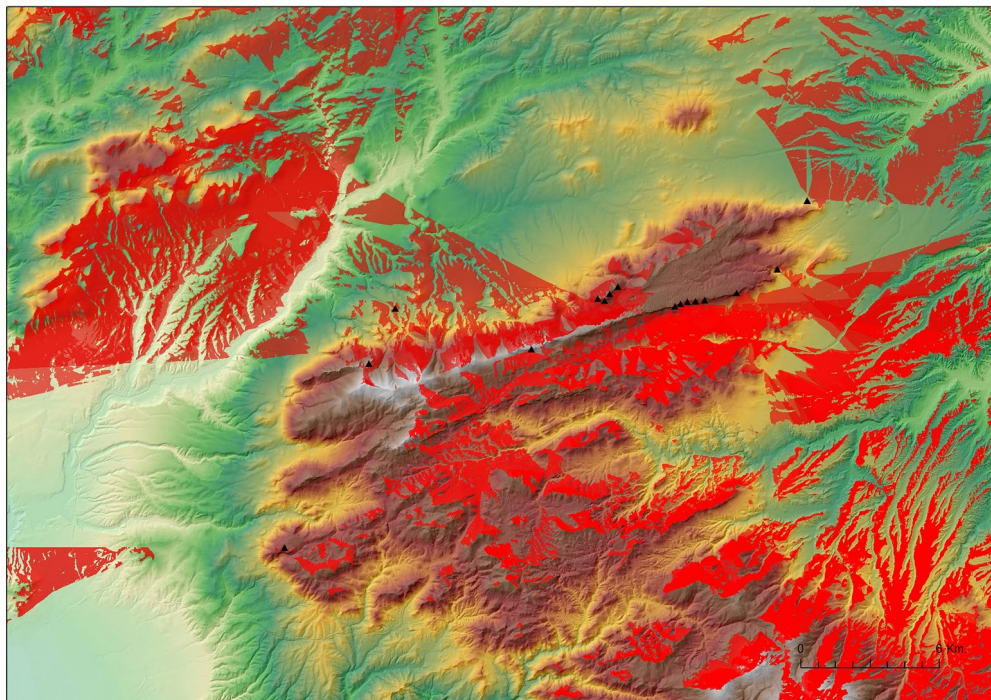


Fig. 6.—Cumulative Viewshed Analysis of the rock shelters with schematic rock art placed on Sierra Harana. Figure in colour in the electronic version.

of milestones or markers on the territory has been proposed for rock shelters with schematic rock-art according their association to roads and their scattering. It has also been suggested that painted rock-shelters could serve as symbolic places aimed to mark ownership of a territory, allowing free transit in certain circumstances (Fábrega-Álvarez, 2006; White and Surface-Evans, 2012).

With the operation of Optimal Routes, we can calculate the connection between two given points taking into account all the environment characteristics (including distance gradient, etc.). In this case, the program calculates the cumulative cost value for each cell of our Digital Elevation Model (DEM), having applied in our case an DEM with a pixel resolution of 25 meters.

The results of the Optimal Route are highly variable depending on the number of applied factors: naturals, waterways, vegetation or cultural dynamic (Fairén, 2004). Anyway, topographic features are the most significant factors in route calculation and they have been the key variable for this study. Thus, both the slope of each cell of the raster and the general slope constitute fundamental variables, along with the distance, in order to obtain the different optimal routes. First, it has been introduced a slope map that has been subsequently reclassified in order to implement cost levels for each gradient group. Secondly, we have created a cost distance between a given point and the other points of the map. Under certain conditions, distance

and cost distance will be similar but not in other cases, as orography can supply many obstacles to displacement. Once created the cost distance raster, we've added destination points to calculate the optimal route.

This analysis has shown that there is a tangible correspondence between the layout of large cattle trails (*cañadas reales*) and optimal paths deducted, showing that optimizing energy investment due to the topography was a substantial factor when performing these routes. There are several historical cattle trails as Cañada de Rambla Seca, Cañada del Rey and Cañada Real from Víznar to Sillar Baja, among others. This coincidence of between obtained optimal routes obtained ancient “*cañadas reales*” (royal roads), either totally or partially, is a factor common to other Iberian Peninsula territories (Martínez i Rubio and Martorell, 2012), and confirms that these traditional routes have existed at least since the beginnings of Late Prehistory.

The most important result is the link of rock-shelters with the layout of the optimal paths on the south side of Sierra Harana, demonstrating the intention to control this passageway by the stream of Rambla Seca. In fact, this road is still in use for the transit of cattle (although it begins to fall into disuse by the less weight of transhumance). The coincidence of the Viewshed with this path (fig. 7) reinforces the important territorial control exerted by the rock shelters sites in this area since the Early Neolithic Age.

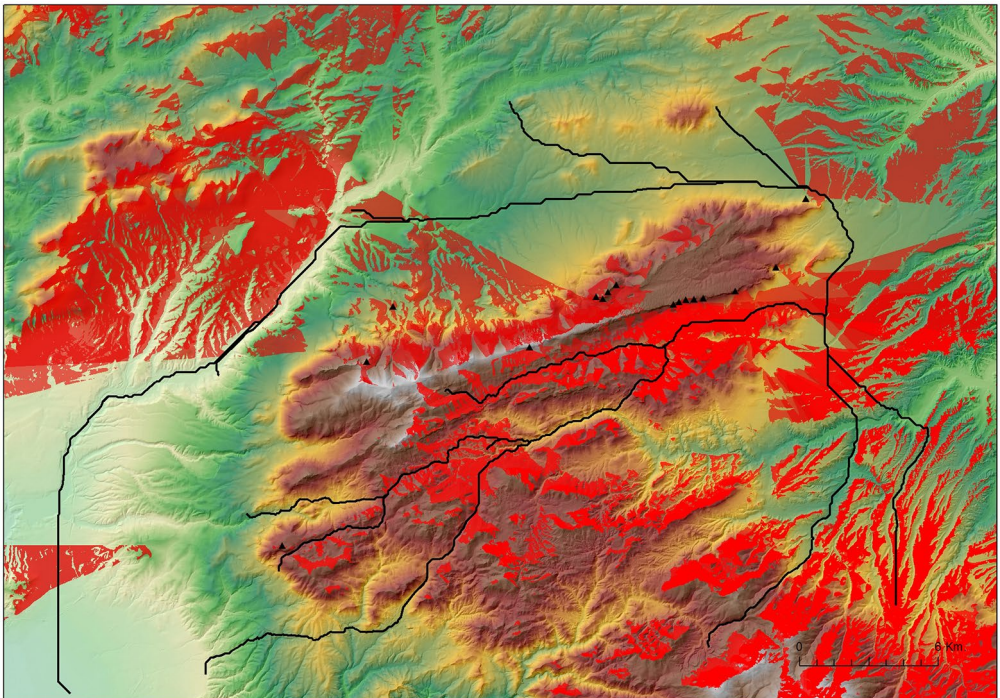


Fig. 7.—Optimal Routes Analysis associated with Accumulated Viewshed Analysis. Figure in colour in the electronic version.

For the other cluster of rock-art sites, results have been negative. Optimal Routes don't appear to correlate with the location of painted rock-shelters. It's necessary to design future research aimed to identify factors that could explain their placement choices. In any case, it should be noted that at the east and along the base of Peñón de la Giganta runs Cañada Real del Aguadero that connects with Cañada Real de Víznar to Sillar Baja, with Cañada Real de la Buitrera and Cañada del Rey. Northernmost, the results have given a route that coincides with the current highway A-340 that connects Cubillas river basin with Hoya de Guadix, where exist other several cattle routes as Cañada Real from Iznalloz to Guadix or Venta Tejada or Cañada Real de la Atalaya. Separation of the painted rock-shelters of this cluster regarding the optimal route can be related to the previously referred hidden placement of most of them, even with high visibility from these locations.

Anyway, we are confident that the addition of new data such as the location of open air settlements, caves as burial sites or sheepfold, and new findings of rock-art sites in future work will help us to understand the territorial organization to these Late Prehistoric communities, showing in any case which sites were related to the optimal routes, being linked by them or marking them.

## CONCLUSIONS

The analyses performed and their results allow us to propose the effective importance of rock shelters with schematic rock art regarding territorial control in Sierra Harana. In relation to visibility, Viewshed Analysis has showed the intentional choosing of rock art sites location, discarding rock shelters with better conditions to be painted (i.e. by their sizes), and endowing the chosen sites with a symbolic and ideological significance in order to control and/or mark traffic areas. On the south side of the mountain, we see clearly how this strategic location is closely related to the optimal routes according GIS analysis results, and viewshed results match the areas related to the circulation through the valley of Rambla Seca stream and west exit to Vega de Granada.

Concerning the relationship of schematic rock art with Late Prehistoric settlement, and especially Neolithic one, several clues can help us to propose it. On the one hand, the simplicity of the iconographic motifs represented is explained because they belong to the early stages in Holocene rock art development. Sites show fossilized panels arranged in an ambiguous distribution inside of rock shelters within small and medium size. On the other hand, the concomitance of some of the painted motifs with schematic figures on ceramics recovered in different known sites in the area suggest for the rock art sites a chronology ranging from the Early to Middle Neolithic in synchrony with the related pottery.

Neolithic settlement would be organized in small communities established in open air sites located in suitable fertile areas for farming, with nearby caves aimed to burial and ancestors worship including anthropophagy (Botella *et al.*, 2000, 2003). Remains of fires, skulls cups or opium poppy seeds can be related to these

activities. This ritual might become part of the symbolism of some paintings in these caves or near rock shelters. Anyway abundant remains in Carigüela suggest that the cavity could be used for different and continued purposes during all the Late Prehistory, including settlement (Molina *et al.*, 2012). Other caves, by the limited material found inside, could be considered sheepfolds or places occupied occasionally as Horá or El Puntal. Rock shelters with schematic rock art would be part of this general awareness in marking, also with ritual sites, all the territory, being these places a way to define identity and territoriality ownership. In fact, they constituted an important segment of the physical network aimed to control the roads, possibly related to livestock (transterminance), the hunting use or exploitation of other natural resources.

From Final Neolithic period there is a change in the Neolithic symbolic territorial control, leaving paint on rock shelters and proliferating the first megalithic necropolises associated with roads. Geographically coinciding with rock art sites or completing the routes lines, these megaliths are known in the area and especially in neighbor zones.

Rock art sites performed a conscious act of linking the territory with people through the use of past, reaffirming the presence of a community in a place and creating a specific landscape, later modified by the addition of megaliths (Cámara *et al.*, 2010; Bueno and Balbín, 2016).

This study has allowed a better understanding of the function and meaning of schematic rock art in Sierra Harana through Viewshed Analysis and Optimal Routes obtained with GIS, a furthermore, our results will serve as predictive methods for future findings and will be expanded with the addition of new factors and sites in the area.

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