Roman, Visigothic and Islamic evidence of earthquakes recorded in the archaeological site of “El Tolmo de Minateda” (Prebetic Zone, southeast of Spain)

Evidencias de terremotos Romanos, Visigóticos e Islámicos en el yacimiento arqueológico de “El Tolomo de Minateda” (Zona Prebética, sureste de España)

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Resumen:

El yacimiento arqueológico de El Tolmo de Minateda está localizado en la provincia de Albacete (SE de España) y muestra un registro continuo de ocupación desde hace 3500 años. A pesar de esto, el yacimiento presenta tres intervalos temporales sin registro arqueológico, todos ellos relacionados con súbitos e injustificados abandonos de la ciudad (s. I, s. VII y s. IX-X AD). Los efectos arqueológicos de terremotos (EAEs) observados sustentan la hipótesis de que se hayan podido producir terremotos de intensidad moderada a fuerte que provocaron los distintos abandonos del yacimiento: caídas orientadas de columnas, muros y arcos colapsados, abandono de los sistemas de irrigación e instalaciones de abastecimiento de agua, cerámica aplastada y en posición de caída, etc. A pesar de la falta de sismicidad histórica e instrumental en la zona,
1. Introduction

“El Tolmo de Minateda” is one of the best representative archaeological sites within the Albacete province (SE Spain), with a well-preserved record for the last c.a. 3500 years BP. During this epoch, various cultures and ancients civilizations were settled in this site, in parallelism with the historical periods of the Iberian Peninsula: Iberians, Romans, Byzantines, Muslims and Christians. The “El Tolmo de Minateda” represents a strategically geographical point between the Iberian Meseta and the Mediterranean zone, and this explains the ongoing and well-preserved archaeological record. During this period of almost 3500 yrs, “El Tolmo” shows three abandonments and destructions in three different ages: Roman (Century 1st-5th AD), Visigoth (Century 7th AD) and Islamic (Century 9th AD).

The seismic activity of the active faults in this zone could have affected the archaeological site and produce the lack of record in these three historic periods.

2. Geographical and Geological setting

“El Tolmo de Minateda” is located between the villages of Cordovilla and Agramon, at the southernmost area of the Albacete province (SE of Spain) (Figure 1A). This archaeological site appears close to the Betic Cordillera and is related with two major strike-slip faults, Pozohondo and Lietor (Figure 1B). Both structures are active faults trending NW-SE, affecting Quaternary alluvial and colluviums deposits and with a trace longitude about 90 km approximately (Rodríguez-Pascua et al., 2003).
3. Earthquake Archaeological Effects (EAEs)

The archaeological record of this ancient city supports evidence for earthquake damage linked to three periods of city abandonment and destruction, including oriented collapse of walls, watchtowers and columns, oriented cracking of walls and column drums, as well as “in situ” broken pottery, abrupt abandonment of kilns, and anomalous sedimentary infilling of canals and water supply facilities (Abad-Casal, 1998). Additionally, large scale rock landslides containing Visigothic carved tombs are also apparently associated with some of these episodes, constituting one of the few geo-archaeological earthquake ground effects reported in this zone. Using this information, we had compiled a set of Earthquake Archaeological Effects (EAEs) according to the classification of Rodríguez-Pascua et al. (2011).

3.1. EAEs during the Roman Period (Century 1st-5th AD)

In the High Roman Empire this zone was moderately occupied by people, however some evidence supports the idea that the principal city of Ilunum was deserted (Roman name of the “El Tolmo”). Evidences of this abandonment include the partial detritical infilling of the fresh-water supply and irrigation canals in the Zama town (close to Ilunum), as well as the increasing population dispersion outwards from the site (Abad-Casal, 1998). As potential coseismic effects, both the solid defensive wall and the watchtowers in the en-
entrance of the city collapsed (Figure 2), and it is possible to identify penetrative fractures across the in-situ remained stone blocks.

3.2. EAEs during the Visigothic Period (Century 7th AD)

During the middle Visigothic Period (Century 7th AD), there is a lack of archaeological record associated with an unexplained abandonment of El Tolmo, (named as Elo during this period) (Abad-Casal et al. (1998)). Associated to this abandonment and as potential coseismic effects, the defensive wall at the “El Reguerón”, as well as part of the City Wall collapsed. The watchtowers in the entrance of the city collapsed again (Figure 2), and there are penetrative fractures across the in situ remained stone blocks. Furthermore, this collapse was dipping not towards the main dip slope direction. This wall was founded on the solid Miocene sandstone, being the main way through the city gate and which displays a continuous deep wheel-tracks, carved on the sandstone substratum.

During the Visigoth period, a Basilica was built at the top of the town (Abad Casal et al., 2000). The Basilica was also damaged, coeval with the wall collapse, showing fallen columns with an approximate N-S trending, and fallen north. The arches of the main nave of the basilica and the principal vault was also collapsed (Figure 3). Moreover, the key stone of the arch appeared in a vertical position and there are cracks dipping 45° and affecting the Basilica pillars. These types of cracks have been cited as possible coseismic effects by other works (e.g. Silva et al., 2009).
In this period, a part of the city was reconstructed on the Visigothic ruins and by the Moslem and was called as Madinat Iyih (Gutiérrez-Lloret, 2000). The eventual abandonment of the city was inferred from the lack of any archaeological record between the 9th and 10th centuries AD. Moreover, multiple pottery artifacts were destroyed by walls collapses in the interior of the buildings (Figure 4). In fact, the whole of the ceramic district collapsed during this period.

Historical documents suggest possible seismic geological effects affecting to the ground water level. Carmona González (1998) cited these documents and told that the springs of the “El Tolmo” were dried by the Christians and appeared 50 km southward from this site. This effect is common during an earthquake, amply documented and registered in the ESI-07 scale (Michetti et al. 2007; Silva et al. 2008).

Other geological effects of this possible earthquake are the large landslides affecting anthropomorphic tombs carved by the Visigoths (Figure 5). This large landslide corresponds to the south part of the butte, and is more recent than those preserved in the northern slope connected with the Visigothic episode of destruction. The wasted sandstone blocks appear weakly weathered and uncovered by colluviums. Scars on the cliff are fresh scarps, with nearly vertical free-faces displaying a very poor lichen evolution. Individual mobilized blocks can reach dimensions of about 4000 m³, and the total mobilized material at the northern slope comprises 500 m³.

In order to illustrate the landsliding susceptibility of the butte cliffs, it can be said that some historical reports seem to indicate that landslide scars were presumably reactivated as far-field effects from the well-known Lisbon earthquake (1755 AD). An historic chronicle from the close village of Agramon (Figure 1B for location) literally reported: “de una montaña se desprendió mucha parte” (a large part of a mountain collapsed; Martínez-Solares, 2001), and there are many more historic reports for the 1755 event mentioning similar gravitational processes in this zone.
4. Paleoseismic evidences

Several palaeoseismological studies close to “El Tolmo” (within the 15 km of radius) revealed active seismic sources in the surroundings (Rodríguez-Pascua et al., 2008, 2009 y 2010; Pérez-López et al., 2009). The closest seismic source corresponds to the Pozohondo Fault, a NW-SE trending strike-slip and ca 90 km long (see Figure 1 for location). In detail, this fault exhibits an active segment, the Tobarra-Cordovilla segment (15 km length), which shows a complex graben basin affecting Quaternary lacustrine deposits and displaying well-preserved coseismic fault scarps with large cracks of metric scale affecting recent soils.

Furthermore, the present landscape along this fault segment is controlled by active faulting, with the occurrence of a dammed lake caused by the obstruction of the drainage by Late Pleistocene to Holocene surface ruptures. Rodríguez-Pascua et al. (2008) obtained a relative dating of the youngest fault scarp using the scarp diffusion equation, calibrated for the semi-arid climate of SE Spain (Pérez-López et al., 2007), ranging between the ages 3 BC and 920 AD, and with the highest likelihood about 500-700 AD. Recent trench digging in this fault shows the last important earthquake aged by radiocarbon in between the Century 1st – 4th AD (Rodríguez-Pascua et al., 2012).

5. Conclusions

The Figure 6 resumes the tentative proposal of the historic evolution of “EL Tolmo de
Minateda” from archaeoseismic studies. Three possible earthquakes affected this archaeological site (Figure 6). The first earthquake occurred in the High Roman Empire (Centuries 1st-2nd AD). The city collapsed and it was abandoned. Paleoseismological studies in the Pozohondo Fault (10 km northward) indicate one earthquake of $6 < M < 7$, dated in the Century 1st AD by radiocarbon measurements. We propose this ancient earthquake as a possible cause for the massive desertion of Ilunum. The second one occurred during the Visigothic period (Century 7th AD), the city of Elo was destroyed and showing documented damage: oriented fallen columns, collapsed arches, cracks dipping 45° in the masonry blocks, etc. The last earthquake probably occurred during the Islamic period (Centuries 9th). In this case the archaeoseismological evidences are based on the collapse of the city of Madinat lyih (pottery destroyed in situ, etc.) and secondary earthquake ground effects as large landslide affecting anthropomorphic tombs of Visigoth era (post-quem). The assumed damage of the “El Tolmo” from the last two earthquakes, suggests that the epicentre could be located close to the ancient city but, until now, there is not paleoseismological evidence for the seismic source.

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References


Figure 6. Chronological archaeoseismic scheme proposed for the ancient city of “Tolmo de Minateda”. *Figura 6. Tabla cronológica arqueosísmica propuesta para el yacimiento arqueológico de El Tolmo de Minateda.*


