

## Archaeoseismological Evidence for a Possible Destructive Earthquake in the 7th Century AD at the Ancient Sites of Bulla Regia and Chemtou (NW Tunisia): Seismotectonic and Structural Implications

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**Abstract :** The historic sites of Bulla Regia and Chemtou are among the most important archaeological monuments in northwestern Tunisia, which flourished as large, wealthy settlements during the Roman and Byzantine periods (2nd to 7th centuries AD). An archaeoseismological study provides the first indications about the impact of a possible ancient strong earthquake in the destruction of these cities. Based on previous archaeological excavation results, including numismatic evidence, pottery, economic meltdown and urban transformation, the abrupt ruin and destruction of the cities of Bulla Regia and Chemtou can be bracketed between 613 and 647 AD. In this study, we carried out the first attempt to use the analysis of earthquake archaeological effects (EAEs) that were observed during our field investigations in these two historic cities. The damage includes different types of EAEs: folds on regular pavements, displaced and deformed vaults, folded walls, tilted walls, collapsed keystones in arches, dipping broken corners, displaced-fallen columns, block extrusions in walls, penetrative fractures in brick-made walls and open fractures on regular pavements. These deformations are spread over 10 different sectors or buildings and include 56 measured EAEs. The structural analysis of the identified EAEs can indicate an ancient destructive earthquake that probably destroyed the Bulla Regia and Chemtou archaeological sites. We then analyzed these measurements using structural geological analysis to obtain the maximum horizontal strain of the ground (e.g.,  $S_{hmax}$ ) on each building-oriented damage. After the collection and analysis of these strain datasets, we proceed to plot the orientation of  $S_{hmax}$  trajectories on the map of the archaeological site (Bulla Regia). We concluded that the obtained  $S_{hmax}$  trajectories within this site could then be related to the mean direction of ground motion (oscillatory movement of the ground) triggered by a seismic event, as documented for some historical earthquakes across the world. These  $S_{hmax}$  orientations closely match the current active stress field, as highlighted by some instrumental events in northern Tunisia. In terms of the seismic source, we strongly suggest that the reactivation of a neotectonic strike-slip fault trending N50E must be responsible for this probable historic earthquake and the recent instrumental seismicity in this area. This fault segment, affecting the folded quaternary deposits south of Jebel Rebia, passes through the monument of Bulla Regia. Stress inversion of the observed and measured data along this fault shows an N150 - 160 trend of  $S_{hmax}$  under a transpressional tectonic regime, which is quite consistent with the GPS data and the state of the current stress field in this region.

**Keywords :** NW Tunisia, archaeoseismology, earthquake archaeological effect, bulla regia - Chemtou, seismotectonic, neotectonic fault

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