A RARE CASE OF PRESERVED EARTHQUAKE RUPTURES IN AN ARCHAEOLOGICAL SITE: MIKRI DOXIPARA – ZONI, NE GREECE

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Abstract: This abstract describes the results of an archaeoseismological / palaeoseismological research at the site of Mikri Doxipara – Zoni (NE Greece). Faulted layers, surface ruptures, displaced structures, fissures etc. indicate that this site has undergone severe deformation during at least two large, ground rupturing earthquakes. Radiocarbon dating and detailed log analysis suggest that these two earthquakes probably happened in 1752 (Edirne earthquake) and after 960 ± 50 BC. Both earthquakes produced vertical displacement in the order of 0.9-1 m, therefore their magnitude is estimated at ca. 6.5. This site is unique in the sense that faulting is directly correlated to archaeoseismological deformation.

Key words: archaeoseismology, palaeoseismology, surface ruptures, Greece

INTRODUCTION – SETTING

Mikri Doxipara – Zoni excavation site (MDZ) is a Roman burial site located in the low seismicity Evros region (NW Greece), very close to the Greek-Bulgarian-Turkish borders (Fig. 1).

The MDZ site is located on a vantage elevated point, as it is built on a hill overlooking the Vardas river valley. The site was also near the commercial roads linking Hadrianoupolis, Plotinopolis and Trojanoupolis.

The area around MDZ site is modified by both the erosion of Ardas river system in the closer area and Evros river in the broader, as well as by a set of normal faults ranging in strike from WNW-ESE to WSW-ENE (Fig. 2). This fault system has caused the Neogene sediments (locally consisted of marl and fine to medium grained sand) to form a set of hills roughly oriented E-W, smoothed out due to erosion. Relief is not strikingly modified by faults, therefore they would normally considered to be inactive or of low activity (Pavlides et al., 2006a and b, 2007).

DISCUSSION

The site consists of a tumulus in which four members of a rich family have been cremated and buried in the beginning of 2nd century AD. The tumulus is very close to the road connecting Hadrianopolis (Edirne) and Philippoupolis (Plovdiv). Four excavation pits since 2002, revealed the cremated remains of three males and one female, along with numerous offerings to accompany them into the afterlife (Whitley, 2002-2003).

The site is located in close proximity to the well known Roman cities of Hadrianoupolis, Plotinopolis and Trojanoupolis.

Fig. 1: Location map of Mikri Doxipara – Zoni site in NE Greece. It is in close proximity to the well known Roman cities of Hadrianoupolis, Plotinopolis and Trojanoupolis.

Fig. 2: Landsat image showing the main fault systems that modify the area around Mikri Doxipara – Zoni site.

Fig. 3: Initial topography of the tumulus before the excavation. It is evident that the tumulus is deformed in an E-W direction (photo courtesy: D. Triantafyllos).
The tumulus initial morphology showed signs of grave robbing, as well as of irregular topographical anomalies aligned in an E-W direction. Photographs of the tumulus before the excavation site, as well as large scale topographic maps of the site prepared by the Archaeological Survey, confirm that these small depressions are indeed aligned in an E-W direction (Fig. 3).

Apart from the human remains and the offerings, which include horses, carriages and their equipment, two brick-built altars serving as platforms for offerings to the dead were found. One of them (site DOX 2-1) has been found to be heavily deformed by a system of normal faults, which clearly affect the ground surface of 2nd Century AD (Figs. 4 and 5).

This system is comprised by several roughly E-W trending normal faults, which form a fairly large depression at the altar site. The maximum observable throw of the main S-dipping surface is 1.9 m, but taking into account the secondary features and the total displacement of the N-dipping antithetic faults, the total net displacement is estimated at ca. 0.9 m. This displacement, which is attributed to an earthquake post-dating the date of altar, is well visible in site DOX 2-2 (Fig. 6). The fault system affects the Neogene substratum (marls and fine-grained sands) as well as the artificial deposits that formed the tumulus.

These deposits were removed during the archaeological excavation; hence no direct association to the faulting is possible at this stage.

Secondary faulting and jointing, also affecting the Roman ground surface, has been detected in several other sites in various parts of the excavation.
On another excavation site at the tumulus (DOX-1 site, there are indications of another earthquake that predates the one detected in DOX-2 site. This earthquake produced ground rupturing with significant displacement, visible at a cross-section (Fig. 7). A palaeosol, dated at 960 ± 50 BC, is displaced by a normal fault of roughly E-W strike by about 1 m. This palaeosol and the associated colluvial deposits of the hangingwall are covered by historical layers of Roman time. It seems therefore that Mikri Doxipara – Zoni tumulus has been faulted twice during historical times:

1. The last event postdates 2nd century AD and is probably associated with the large Edirne Earthquake of 1752, the only known large event in the area.

2. The penultimate event happened between 960 BC and 2nd Century AD, but most probably occurred closer to the lower limit of this time window, as suggested by microstratigraphy.

It seems therefore that the recurrence interval for large, ground rupturing earthquakes in the area is quite long, which comes in agreement with the current seismotectonic status of the area. Despite the fact that there are no clear geomorphological or geological indications for a large fault zone in the area, the order of displacement per event is large (ca. 1 m) and should be taken into account for local seismic hazard assessment.

Taking into account the behavior of normal faults in Greece during historical earthquakes, as well as in paleoseismological research, it is estimated that the earthquakes that formed this fault system were strong ones, possibly at the order of Ms 6.5.

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References


