Earthquake Destruction at Antiochia ad Cragum and Blaudos in Western Turkey: a perspective from geoarchaeology

Introduction

The geoarchaeological investigation carried out at the Roman Imperial temple at Antiochia ad Cragum and Byzantine portico at Blaundos (Figure 1) further tests hypotheses that earthquakes aided in their destruction (see Erdogmus et al. 2011). The results contribute to the understanding of the social context of the structures in relationship to destruction events and introduces the advantages of using geoarchaeological methods in archaeoseismic excavations.

Figure 1: locations of study sites Antiochia ad Cragum and Blaundos (Image: Google Earth Pro)

Geological and Historical Background

The sites of Antiochia ad Cragum and Blaundos are located in the Mediterranean-Himalyam earthquake zone where major faults cause shallow, frequent, and large earthquakes. Since 1900 earthquakes ranging in magnitude from Ms = 4 - Ms = 7 and have resulted in death and destruction in the area of Antiochia ad Cragum. Furthermore, the sites are located within the region of the so-called 'Early Byzantine Tectonic Paroxysm' in which a series of earthquakes occurred during the fourth to sixth centuries A. D. as attested in historical and archaeological data (Stiros 2001). It is within this context that a hypothesis for the earthquake destruction of the Antiochia ad Cragum temple is further investigated.

Methods: geoarchaeology

The methods and techniques involve the subdisciplines of archaeoseismology and geoarchaeology. Geoarchaeology combines subjects of earth sciences in order to inform archaeological interpretations and/or explore geological aspects of the human past (Ghilardi and Desruelles 2008; Gilbert et al. 2017). The subfield of archaeoseismology uses archaeological data to establish a deeper time perspective on earthquake histories and seismic hazards (Ambraseys 1973; Karcz and Kafri 1978).

Methods: soil micromorphology

Rapp (1986) has made the suggestion that researchers should pay more attention to soils and sediments in archaeoseismic investigations. In particular, the geoarchaeological method of soil micromorphology can allow for more site-specific analyses and for strong chronological linkages to be made between observed destruction and earthquake events. Soil micromorphology is the study of features and structures of undisturbed soils at the microscopic level. Earthquakes have an impact on soil formation and also have the potential to leave seismically induced soft-sediment microstructures, which can be identified in thin section analyses using a petrographic microscope (Cetin 1997; Frigerio et al. 2017; Matsuda 2000; Menzies and Taylor 2003). Examples of seismically induced microstructures include fluid escape features and deformation in the form of intense folds, collapse, sag, and load structures, micro-faults, and fractures (Menzies and Taylor 2003) (Figure 2). If these types of microfeatures can be identified in the stratigraphy associated with collapsed structures at Antiochia ad Cragum and Blaundos, then an earthquake can be more securely associated with the observed archaeological evidence of architectural destruction.

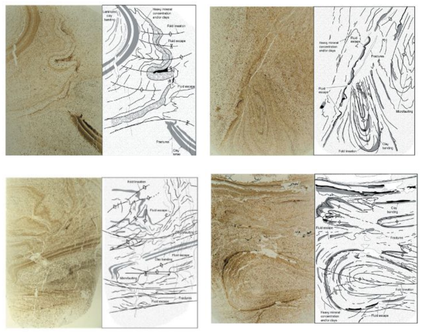

Figure 2: examples of micro-seismic soil signatures (c. 40 x 77 cm thin sections. Images: Menzies and Taylor 2003

External stratigraphic areas of the temple at Antiochia ad Cragum (Figure 3) and the portico at Blaundos (Figure 4) were selected for documentation and sampling. I sampled a continuous set of soil blocks from below, through, and above the foundational levels of the structures, which correspond to pre-occupational, occupational, and post-occupational phases of the structure. Samples were also taken at the level of building destruction.

Figure 3. Locations of study areas (northwest corner, north end, and northeast corner) of the Temple. Image: author

Figure 4. Portico and Blaundos (Image: author)

Results and Interpretation

The various accumulations of colluvium in the stratigraphic sequences at Antiochia ad Cragum are attributed to the temple's setting on a steep hillslope. Furthermore, the construction of a large terrace wall (see Figure 5) running the width of the temple reflects human efforts to minimize or stop the downslope movement of soil. The accumulation of boulders and mortar in a layer ranging from c. 20-50 cm is interpreted to be building debris from a destruction event (Figures 6, 8). The c. 40-50 cm accumulation of colluvium under the building debris in the northwestern corner (Figure 6) demonstrates that the building discontinued in function prior to its larger destruction in a later period, since colluvium accumulates gradually whereas the building debris appears to have occurred more suddenly.

Figure 5: north end of Roman Imperial tmeple, Anntiochia ad Cragum

Figure 6: northwestern corner of Roman Imperial temple, Antiochia ad Cragum

On the opposite end, the sedimentary sequence consisting of several layers of flat lying pottery sherds and animal bones (Figure 7) is the result of human dumping events. This layer coincides with the conversion of the eastern side of the temple into a drain for moving and collecting waters flowing downslope, prior to the building destruction.

Figure 7: northeastern corner of Roman Imperial temple, Antiochia ad Cragum

At Blaundos, the sedimentary sequence consists of accumulations of unconsolidated aeolian soil with only minor changes in compaction and color between the layers (Figure 8).

Figure 8: sedimentary sequence of portico, Blaundos

Soil micromorphological analyses of soil thin sections are still being carried out. This requires a petrographic microscope and Fourier Transform Infrared Spectroscopy (FTIR) to analyze microfacies, microfeatures, and elemental compositions, with particular attention to the potential structures and features induced by seismic activity. Soil micromorphological studies will provide further detailed information needed to determine associations between earthquakes, phasing of destruction and reconstruction, and cultural activities in particular phases of the identified stratigraphic levels.

Conclusions

The geoarchaeological investigation provides insight into human and geological events surrounding the structural destruction at Antiochia ad Cragum and Blaundos. Furthermore, it introduces the advantages of using sampling techniques and methods of soil micromorphology in archaeoseismic excavations. The soil micromorphological analyses of thin sections of the sampled areas will provide further detailed information in determining how earthquakes may or may not have factored into the temple's building destruction.

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Contact

Amanda Gaggioli
Stanford University
Department of Classics
gaggioli@stanford.edu