Environments of Early Agriculture: Where and When did Cultivation take place in Neolithic Çatalhöyük, Turkey? (Ref IAP-17-110)

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In partnership with BGS and University of Stirling, Biological & Environmental Sciences

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1. Landscape reconstruction, 2. geoarchaeology, 3. early agriculture, 4. isotopes

Overview
Çatalhöyük, in the Konya Plain of central Turkey (figure 1), is an important archaeological site for the understanding of the development of early agriculture in the period c.7,100-6,000 cal BCE (Bayliss et al., 2015). The site covers 13 ha and contains significant evidence of domesticated plant and animal species.

Figure 1 View of the Çarşamba plain from the East Mount at Çatalhöyük.

The landscape setting of the site has become a topic of intense debate. Our team has recently published a re-evaluation of the sedimentary environment before and during the time the site was occupied (Ayala et al., 2017). By carrying out coring in 29 locations and comparing the results to earlier samples, we were able to reconstruct the landscape at a higher resolution than had previously been possible. The results suggest that the sedimentology was more consistent with an anabranching system of the type described by North et al. (2007), and formed a spatially and temporally variable pattern of deposition around the site (Figure 2).

Figure 2 Reconstruction of the patterns of sedimentation and of palaeosurfaces surrounding Çatalhöyük (Ayala et al., 2017).

This interpretation contrasts sharply with earlier ones, which saw the site as being in a “backswamp” area formed in a “semi-lacustrine marsh” (de Meester 1970: 86) with repeated inundation (Roberts et al., 1999; Boyer et al., 2006). A consequence of this previous interpretation was that Roberts and Rosen (2009) suggested that there was a contradiction between the ecology of plant macrofossils and cereal phytoliths on the one hand, both of which suggest a dry environment in which cereals were grown, and the sedimentary depositional environment, which suggested wet conditions surrounding the site. Thus, Roberts and Rosen suggested that cereal cultivation and other subsistence activities had to have been carried out on limestone terraces, some 13 km or more distant from the site. Notwithstanding the impracticality of commuting such distances to cultivate, and the lack of clear ethnographic analogues, other lines of evidence have questioned this.
interpretation. Bogaard et al. (2014) used strontium-isotope analysis of sheep teeth and plant remains from the site to demonstrate that cultivation did not seem to have occurred on the limestone terraces, and most herding was carried out on the Konya plain.

The anastomosing system suggested by Ayala et al. (2017) would be consistent with presence of seasonal wetland (Roberts and Rosen, 2007; Bar-Yosef Mayer et al., 2012) and dryland characteristics (Bogaard et al., 2014) of the archaeofaunal and botanical remains on the site, and importantly would be consistent with a more local model for cultivation. There are also suggestions from Corona satellite imagery taken in the 1960s and thus predating much of the drainage and intensification of agriculture surrounding the site that this style of deposition may at least in part have continued into the 20th Century (Wainwright and Bogaard, field observations) and thus providing further support that North et al. provided a useful analogue for understanding the local environment.

In order to test this theory further, we have cored the sedimentary deposits further at 34 sites in 2015 and taken further samples on- and off-site in 2017 so that novel isotopic and geochemical methods can be used to provide more detailed environmental data, to complement more traditional sedimentological analyses, and developed into a more holistic framework for landscape reconstruction.

A key aspect of this reconstruction is the nature and dynamics of the fluvial system before and during the Neolithic occupation. We propose to bridge the gap between the sedimentary evidence and the archaeobotanical data by using modelling of the palaeo-Çarşamba.

The objectives of this PhD proposal are thus:

1. To develop more detailed spatial and temporal understanding of the depositional environment surrounding the site;
2. Use novel isotopic and geochemical methods to complement existing data, especially where traditional proxies for vegetation and wetness are lacking; and
3. Use these data to produce best estimates of whole-landscape reconstructions which correspond to the period of Neolithic settlement at Çatalhöyük.

**Methodology**

The objectives will be delivered using the following methods:

1. Sediment cores are available from 33 locations in 2015 to complement the eight cores already taken in 2013. These cores will be described in detail and standard sedimentological analyses carried out, together with further geophysical investigations.
2. Novel geochemical (e.g. biomarkers) and isotopic analyses (e.g. C, N and Sr) will be carried out to evaluate water use and vegetation types and their spatial patterns in the contemporary environments.
3. Dating of the sequences will be carried out using a combination of radiocarbon and optically stimulated luminescence, and robust dating methodologies using Bayesian models will be developed.
4. Innovative visualization techniques (Forte, 2013, 2014) will be developed to combine the 4D data produced on past environments, and used to help develop our understanding of how and where agriculture was carried out at Neolithic Çatalhöyük.

This project is part of an international collaboration with Dr Gianna Ayala (Sheffield, Archaeology) Prof. Amy Bogaard and Mike Charles (Oxford, Archaeology), Prof. Maurizio Forte (Duke) and Prof. Ian Hodder (Stanford).

**Timeline**

The project schedule is as follows:

**Year 1:**
- **Oct-Dec:** Background reading. Research Visa application. Training in Laboratory techniques. Faculty Training Programme
- **Jan-Mar:** Commence description of cores and carry out initial sedimentological analyses. Faculty Training Programme
- **Apr-May:** Visit to BGS to carry out isotopic analyses and to receive training in techniques and software.
- **June-July:** Fieldwork Preparation. Field visit to confirm sedimentation patterns, make geophysical observations and take further samples of sediments locally and regionally (for tracing work) as appropriate.
- **Aug/Sept:** Combine existing laboratory and field analyses.

**Year 2:**
- **Oct-Dec:** Analysis of field observations. Visit to Oxford or SUERC to participate in dating of samples. Complete review chapter.
- **Jan-May:** Carry out further laboratory analyses at Durham and BGS.
- **June-Sep:** Initial analyses of spatial and temporal patterns of agriculture. Visit to field site to complete in situ sampling.
Year 3:
Oct – Dec: Visit to Duke to learn and develop visualization methods.
Jan-Sep: Complete first empirical chapters of the thesis. Continue analytical work as appropriate, including visits to other laboratories.

Year 4 (6 months only):
Oct – Dec: Final analytical and visualization work for final interpretation of the data.
Jan-Mar: Writing Thesis - chapters passed for comment as and when ready.

Training & Skills

This project will develop cross-disciplinary scientific training in problem solving, data analysis and report writing. It will provide the student with high-level skills in: (a) the production, processing and interpretation of sedimentological, geochemical, geochronological and geographical information systems (GIS) data; (b) modern analytical techniques in geochemistry and geophysics as well as in Bayesian modelling of dating; (c) geomorphology and geoarchaeological approaches to understanding past environments; and (d) spatial modelling and visualization.

The student will also benefit from broad skills training provided in-house at Durham (e.g. thesis and paper writing, presentation skills etc.); the specific training available through BGS; and from a broad range of environmental science training provided within the IAPETUS Doctoral Training Partnership framework. The presence of National and International collaborators on the project will also mean that the student has an excellent opportunity to develop not only a strong network in the area of study, but also a training in a range of skills beyond those available just within the IAPETUS network.

References & Further Reading

Roberts et al. 1999 ‘Chronology and stratigraphy of Late Quaternary sediments in the Konya Basin, Turkey: results from the KOPAL project’, Quaternary Science Reviews 18, 611–630.

Further Information

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