ARCHAEOLOGICAL INSTITUTE OF AMERICA
2011

OFFICERS
Elizabeth Bartman, President
Andrew Moore, First Vice President
Sebastian Heath, Vice President for Professional Responsibilities
John Younger, Vice President for Publications
Christopher M. Saunders, Vice President for Education and Outreach
Thomas Morton, Vice President for Societies
Brian J. Heidtke, Treasurer
Peter Herdrich, Executive Director

HONORARY PRESIDENTS
Robert H. Dyson, Jr., James R. Wiseman,
Martha Sharp Joukowsky, James Russell,
Stephen L. Dyson, Nancy C. Wilkie

GOVERNING BOARD
Susan Alcock
Michael Ambler
Carla Antonacchio
Cathleen Asch
Robert Atwater
Barbara Barletta
David R. Boochever
Eugene Borza
Laura Childs
Lawrence Coben
Mitchell Eitel
William Fitzhugh
Harrison Ford
Peter Herdrich
Lillian Joyce

William A. Lindsay
Donald W. Morrison
Robert E. Murowchick
Helen Nagy
Eleanor Powers
Lynn Quigley
Ann Santen
William Saturno
Glenn Schwartz
Ava Seave
David C. Seigle
Charles Stanish
Charles Steinmetz
Douglas A. Tilden
John J. Yarmick

TRUSTEES EMERITI
Norma Kershaw
Charles S. LaFollette

PAST PRESIDENT
C. Brian Rose

MITCHELL EITEL, SULLIVAN & CROMWELL, General Counsel

MEMBERSHIP IN THE ARCHAEOLOGICAL INSTITUTE OF AMERICA
AND SUBSCRIPTION TO THE AMERICAN JOURNAL OF ARCHAEOLOGY

The American Journal of Archaeology is published by the Archaeological Institute of America in January, April, July, and October. An annual print or electronic subscription is $80 (international, $110); the institutional rate is $280 (international, $310). A combination (print and electronic) subscription is an additional $10 (individual), $30 (institution). The AJA is also available with membership in the Institute. For more information, contact membership@ aia.bu.edu. All communication regarding membership, subscriptions, and back issues should be directed to membership@ aia.bu.edu or addressed to Membership Department, Archaeological Institute of America, located at Boston University, 656 Beacon Street, Boston, Massachusetts 02215-2006, tel. 617-353-9361, fax 617-353-6550.
FIELD REPORT

From Site to Landscape: Assessing the Value of Geoarchaeological Data in Understanding the Archaeological Record of Domuztepe, Eastern Mediterranean, Turkey

BENJAMIN R. GEAREY, A. FLETCHER, WILLIAM G. FLETCHER, STUART CAMPBELL, IAN BOOMER, DAVID KEEN, JANE REED, AND EMMA TETLOW

Abstract

This article discusses the potential value of geoarchaeological and paleoenvironmental data for the contextualization of human activity at the site of Domuztepe, southeast Turkey. The data come from cores excavated on a series of transects centered on the höyük and from samples collected for paleoenvironmental assessment and radiocarbon dating. The results indicate that the site is situated on an alluvial plain of some stratigraphic complexity. Deep (up to 9 m) sediment sequences consisting of peats, marls, silts, clays, sands, and gravels appear on all sides of the höyük. Soil and water conditions during the Holocene on the Narlı plain were quite probably different from present conditions, which are partly attributable to recent drainage and irrigation, with climatic changes also playing a significant role. The evidence suggests there were both periods of relatively wet local conditions with deep freshwater close to the site and episodes of drier, brackish conditions. Episodes of peat formation are recorded during the later Pleistocene (19,000–21,000 b.p. [calibrated]) and Early Holocene (9,500 b.p. [calibrated]). It seems unlikely that the site of Domuztepe was originally located on any topographic high point. While the extent of cultivatable land in the close vicinity of the settlement is unclear on the basis of the current data, local wetlands would have provided a range of resources, including plants, clays, and marls, evidenced in both the architecture and the cultural and environmental material from the excavations. The deposition of the alluvial silts and clays seems to have occurred during the later Holocene, with Roman pottery in these deposits providing a terminus post quem for the uppermost clays. These sediments probably mask the actual depth and extent of the archaeological remains at Domuztepe and might also obscure other early archaeological sites on the Narlı plain.*

INTRODUCTION

A range of studies carried out in the Near East have demonstrated the value of paleoenvironmental and geoarchaeological data in the understanding of the archaeological record.¹ The relationship between climatic and social change has also been the subject of debate.² The Holocene was a period of significant climatic oscillation in the Near East, and it is clear that the current landscape contexts of many sites are very different from those of the past.³ In recent years, it has been argued that geoarchaeological and paleoenvironmental data are crucial to the understanding of patterns and processes of environmental change and are also an essential element of discussions concerning the social framework of past societies.⁴

Domuztepe in southeast Turkey is a large höyük (20 ha), where deposits dating to the Halaf and preceding Ceramic Neolithic periods (ca. 6300–5400 B.C.E.) have been excavated.⁵ Evidence from this site is central to debates concerning the nature of preurban

---

* All B.C.E. dates are calibrated unless otherwise stated. The paleoenvironmental assessments were carried out as follows: Boomer, ostracods; the recently deceased Keen, mollusks; Reed, diatoms; Tetlow, plant macrofossils and coleoptera. This paper has benefited from the comments of two anonymous reviewers for the AJA. We would also like to thank Editor-in-Chief Naomi J. Norman for her assistance and advice. Gearey acknowledges the generous financial assistance of the Wainwright Fund, University of Oxford. Nigel Dodds and Stuart Campbell prepared the figures. Additional figures can be found under this article’s abstract on the AJA website (http://www.ajaonline.org).

⁵ Campbell et al. 1999; Carter et al. 2003.
societies and the immediate background to urbanism itself. The Halaf period of the Late Neolithic (broadly 6100–5400 B.C.E.) has often been associated with poorly developed social complexity that had little influence on the later rise of urban societies. Hypotheses that the key transformations toward urbanism took place in the Ubaid period (ca. 5000–4000 B.C.E.) have therefore been challenged by the discovery of large (10–20 ha) preurban settlements dating to the fifth and sixth millennia B.C.E., such as Domuztepe, Kazane, and Takyan Höyük, with estimated populations of 1,000–2,000.

The interrelationship between site and environment is arguably a key factor in understanding cultural and economic adaptations that influence settlement growth. As settlement size increases, so does the potential for social and economic stresses, which may be resolved by the population splitting into smaller settlements. Such fissioning has been identified as a significant limitation on settlement size in early village societies. For larger settlements to develop, their inhabitants require mechanisms to overcome social and economic tensions. Economic stress, for example, can be reduced by exploiting wild resources, intensifying local agriculture, or importing food from other areas.

Changes in the availability and exploitation of resources necessitate an understanding of the environment on a range of spatial scales. Landscape context is also a crucial component of discussions regarding how social stress may have been negated. There is little evidence to suggest that strongly developed social hierarchies existed in the Late Neolithic; therefore, other social factors that discouraged settlement fission must be sought. Significant investment in nonportable capital and the ritualization of daily social practice, for example, may embed normal, everyday behavior within a cosmological or ritual framework, creating new types of attachments to places and giving them enhanced meaning. Long-term investment is thereby made in social relationships and the setting in which they are defined, something that may be related as much to the environs of a settlement as to the site itself.

While detailed palynological work has been undertaken in the vicinity of Domuztepe, this was largely concerned with regional patterns of vegetation change, and little information was available concerning the landscape context of the höyük that might permit an assessment of such issues. This article describes geoarchaeological survey and paleoenvironmental assessment at this site by the Domuztepe Environments Project and discusses the potential of such data for investigating processes and patterns of landscape change and for contributing to an integrated understanding of the location, growth, and development of the site. Compared with other parts of the country, little geoarchaeological or paleoenvironmental research has been carried out in the southeast of Turkey, and the potential for such work remains unknown. This article assesses the evidence for the character of the past local environment of Domuztepe and describes how geoarchaeological data can enrich and expand interpretation of the on-site archaeological record. It demonstrates the potential importance of such research for an integrated approach to understanding human activity and cultural change.

THE STUDY AREA

Domuztepe is located close to the northwestern edge of the Narh alluvial plain in south-central Turkey (fig. 1), about 45 km from the town of Kahramanmaras. With an area of 20 ha, the site is one of the largest known Late Neolithic settlements in the Middle East (fig. 2). The höyük rises to a height of 14 m above the surrounding floodplain, now a network of irrigated fields. The prehistoric phases of the site have been under investigation since 1995. There is evidence for prehistoric occupation from the Ceramic Neolithic to the Late Halaf, with subsequent occupation during the Late Roman and post-Roman periods. The main excavated areas (see fig. 2) date from the Halaf period (ca. 6100–5400 B.C.E.). The site is located on the western edge of a plain some 10 x 10 km, which is indicated on Atak’s geological reconnaissance map of Turkey (scale 1:100,000) as consisting of “old alluvium” and

---

5. Although the likelihood that these large höyüks represent contemporaneous large-scale occupation has been challenged (Akkermans and Schwartz 2003, 60), at Domuztepe statistical analyses of surface collections indicate that, in its final stages at least, the site does comprise one large settlement rather than a smaller settlement shifting periodically around the same location (Campbell et al. 1999, 398–400).

---

15. Woldring and Kleine (forthcoming).
“alluvium,” while to the north, south, and west, the land rises to form a series of hills that are mapped as dolomitic limestone. An unnamed watercourse, now canalized, flows immediately to the west of the höyük, draining into the Aksu River some 2 km to the north. The extensive spreads of gravels, which are being extracted for aggregates, indicate that prior to the current water abstraction, irrigation, and management regime, the river was a much larger and more active fluvial system. The presence of open water or boggy ground adjacent to the settlement in the later Holocene is also suggested by the construction, possibly during the first millennium C.E., of a bridge and causeway that head from the southwestern edge of the höyük (fig. 3) westward toward the adjacent uplands.

AIMS AND METHODOLOGY

The geoarchaeological survey was carried out by the Domuztepe Environments Project during two seasons in 2004 and 2005 and focused on recording and characterizing the depositional sequences around Domuztepe with the following aims:

1. To build a working model of the geomorphic evolution of the Narlı plain around Domuztepe.

2. To determine the potential of the deposits to provide multiproxy paleoenvironmental data.

3. To explore the potential of such data to contribute to an understanding of environmental change during the Late Pleistocene and Holocene (ca. the last 20,000 years).

4. To examine the utility of these data to provide insights into the archaeological record and human activity, such as the exploitation of natural resources.

5. To assess the possibilities for further, more detailed paleoenvironmental investigations and analyses.

A total of 43 boreholes were excavated (2004–2005) using a hand-operated gouge auger along six transects centered on and near the höyük (see figs. 3, 4). Borehole lithology was logged in the field, and samples of sediment were collected for subsequent analyses. Subsamples from the cores were examined for diatoms, ostracods, and mollusks (table 1). In addition, one bulk sample of sediment was assessed for coleoptera (beetles) and plant macrofossil content using standard methods. While the relatively small size of the samples precludes detailed interpretation, they are sufficient

---

19 Atak 1967: alluvium refers to deposits such as silts and clays laid down by fluvial activity; the chronological distinction on the map between old alluvium and alluvium is unclear.

20 See Kenward et al. (1980) for beetle and plant extraction methodology and Plater et al. (2000) for diatom preparation.
to provide contextual information and to assess the potential of the deposits for more detailed study. In addition, four samples of organic sediment/peat were submitted to Beta Analytic in Miami, Florida, for radiocarbon dating using the AMS method (see table 1).

RESULTS

The results of the auger survey are presented as stratigraphic transects (online figs. 1–5 on the AJA website). These data demonstrate that a suite of deposits including silts, clays, sands, peat, and organic sediments are present in sequences up to 7 m deep around the höyük. The paleoenvironmental assessments of selected samples of sediment demonstrate variable preservation and concentration of subfossil diatoms, ostracods, and mollusks (see table 1); poor preservation in certain samples is possibly related to fluctuating hydrological conditions during sediment deposition. Plant macrofossils and coleoptera were well preserved in the single sample assessed.

The lithology of the sediments and the paleoenvironmental assessments provide information regarding the range of depositional environments represented at the site. Most of these were evidently wetland environments that included still and flowing water, open freshwater, and brackish water, as well as semiterrestrial (i.e., peat-forming) habitats. The radiocarbon dates indicate sediment accumulation from the Upper Pleistocene to the Holocene. The main stratigraphic units identified and the results of the radiocarbon dating, paleoenvironmental assessments, and inferred depositional environments are summarized in table 2. It should be stressed that a significant degree of variation is observed in both the apparent age and

---

Fig. 2. Domuztepe site plan, showing locations of excavated areas (operations I–VIII) (drawing by S. Campbell).
depositional origin of these sediments. Hence, the sediment units described in the table do not all necessarily reflect distinct facies.

**Dense Clays**

The uppermost deposits across much of the study area other than the western edge are dense, gray, orange-mottled clays and clay silts. The lithology of these sediments probably demonstrates seasonal episodes of soil wetting and drying with vegetative remains destroyed through oxidation. This suggests deposition under seasonally waterlogged conditions such as a floodplain backswamp, a hypothesis that is supported by the presence of the mollusk *Lymnaea cf. palustris* (marsh snail) from one sample of this deposit. This species is typical of swamp or still water environments with abundant vegetational debris.

Backswamps occur on floodplains and are areas where floodwater may be confined between river levees and higher ground. They are typically lower than any neighboring alluvial fans and are locations where there is a slow accumulation of silts and clays. When
artificially drained, as on the Narlı plain, backswamp areas yield fine-grained soils, often rich in organic matter, which are good for agriculture. The stratigraphic position of this unit suggests a Late Holocene date, which is confirmed by the recovery of Roman pottery at depths of 1.0–2.5 m from test pits excavated through the clays to the southeast of the höyük. The presence of this pottery provides a terminus post quem for the overlying clays in this area, although it is unclear if the archaeological material was deposited in situ and subsequently sealed beneath the alluvial deposits or was redeposited through the fluvial processes that laid down the alluvium.

Distinctive red-brown, dense clay with abundant angular and subangular gravels was recorded to a maximum depth of 2.50 m in core 9, transect 6 (see online fig. 4) and cores 11–13, transect 7 (see online fig. 5). This unit was only identified in the cores closest to the western edge of the study area and is likely to be of colluvial/alluvial origin, derived in part from slope wash of the terra rossa soils of the surrounding hills, perhaps as a result of anthropogenic vegetation clearance and agriculture within the adjacent upland areas.

There is palynological evidence for human disturbance to the vegetation from the Middle Holocene onward (ca. 4500 B.C.E.) in a sequence from the nearby Sağlık Ovası. The clearance of vegetation and the effects of different agricultural regimes can destabilize soils, leading to erosion and redeposition producing a variety of valley fills, although climate change can also play a role in such processes. For example, a drier climate can produce increased moisture stress on vegetation, resulting in thinning plant cover, increased soil erosion, and hence minerogenic sediment accumulation in valley bottoms.

The sequences to the east of the höyük (transect 2 and the eastern ends of transects 6 and 7) (see online figs. 4, 5) show little variation, consisting of gray clay and clay-silt deposits up to 2.0–3.0 m thick. They become coarser and gravel rich at about 3.5 m deep. However, to the south, west, and north of the site, the clays were thinner (up to 1.0 m), and coring to greater

---

23 Campbell et al. 1999, 398.
24 Woldring and Kleine (forthcoming).
Table 1. Samples Assessed for Paleoenvironmental Proxies and Radiocarbon Dating.

<table>
<thead>
<tr>
<th>Transect/Core Depth (m)</th>
<th>Proxy</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C4, 2.72</td>
<td>radiocarbon date</td>
<td>charcoal: 11,310±60 b.p. (uncalibrated) (Beta-210648)</td>
</tr>
<tr>
<td>C4, 2.70</td>
<td>diatoms</td>
<td><em>Ellerbeckia arenaria, Cocconeis placentula, Cyclotella meneghiniana, Gomphonema spp.</em> (poor preservation)</td>
</tr>
<tr>
<td>C4, 2.90</td>
<td>diatoms</td>
<td><em>Cocconeis placentula, Cymbella spp., Fragilaria ulna, Gomphonema spp., Navicula spp.</em> (good preservation)</td>
</tr>
<tr>
<td>C4, 3.10</td>
<td>diatoms</td>
<td><em>Ellerbeckia arenaria, Cocconeis placentula, Epithemia spp., Cymbella spp.</em> (poor preservation)</td>
</tr>
<tr>
<td>T4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C3, 4.27</td>
<td>radiocarbon date</td>
<td>sediment: 17,450±140 b.p. (uncalibrated) (Beta-214662)</td>
</tr>
<tr>
<td>C3, 4.27</td>
<td>diatoms</td>
<td><em>Cocconeis placentula, Cymbella spp., Fragilaria ulna, Amphora spp.</em> (poor preservation)</td>
</tr>
<tr>
<td>T5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C4, 4.00</td>
<td>diatoms</td>
<td><em>Fragilaria ulna, Aulacoseira cf. granulata, Pinnularia spp., Melosira spp., Epithemia spp.</em> (good preservation)</td>
</tr>
<tr>
<td>T6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C2, 3.10</td>
<td>ostracods</td>
<td><em>Candonia sp.</em> 1 (poor preservation)</td>
</tr>
<tr>
<td>C5, 2.9</td>
<td>ostracods</td>
<td>abundant <em>Candonia sp.</em></td>
</tr>
<tr>
<td></td>
<td>mollusks</td>
<td><em>Hydrobia ventrosa, Planorbis cf. planorbis, Valvata spp., Hippeutis complanatum, Valvata naticina</em> (good preservation)</td>
</tr>
<tr>
<td>C7, 2.95</td>
<td>radiocarbon date</td>
<td>sediment: 8,490±60 b.p. (uncalibrated) (Beta-214665)</td>
</tr>
<tr>
<td>C7, 2.9–3.5</td>
<td>plant macrofossils, coleoptera</td>
<td><em>coleoptera: Cercyon spp., Plateumaris sp., Geotrupes spp.; macrofossils: Carex sp., Ranunculus sp., Rubus spp., Sambucus nigra</em></td>
</tr>
<tr>
<td>T7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C3, 1.90</td>
<td>ostracods</td>
<td>highly degraded/barren sample</td>
</tr>
<tr>
<td>C5, 3.0</td>
<td>ostracods</td>
<td><em>Candonia sp.</em> 1 and sp. 2 cf. <em>Cypridopsis vidua</em></td>
</tr>
<tr>
<td>C6, 4.20</td>
<td>radiocarbon date</td>
<td>15,670±130 b.p. (uncalibrated) (Beta-214664)</td>
</tr>
</tbody>
</table>
the candonid species recorded are not common members of the northwest European fauna. Candona sp. 1 is related to the Candida group of Candona (after Meisch 2000). Candona sp. 2 may belong to the genus Fabaeformiscandona. Without soft parts for these and the other species recovered, it is not possible to be more certain of their taxonomic affinities.

depths was feasible. Beneath the clays in these areas, a black, mollusk-rich silt unit is recorded.

Black, Mollusk-Rich Silts
Black, mollusk-rich silts underlie the upper alluvial clays and clay silts on transects 1, 3, 4, and 5 and the western ends of transects 6 and 7. These silts are laminated in places and sometimes intercalated with thin, well-humified peat bands, coarse sand, or detrital clay layers and fragmentary mollusks. One sample of these mollusks (see table 1) from transect 6, core 5 (see online fig. 4) contained species such as Planorbis planorbis that suggest slow or standing freshwater habitats, although other species, including Hydrobia ventrosa, can tolerate increased salinity. Diatoms tend not to be well preserved in this sediment, but a sample from near the base of this deposit on transect 5, core 4 (see online fig. 3) was dominated by Fragilaria ulna and Aulacoseira cf. granulata, which indicate a deep freshwater habitat dominated by plankton, with little plant cover. The most abundant ostracods in samples of the silt (see table 1) were identified as candonid species (Candona sp. 1 and sp. 2), which are typical of freshwater permanent or semipermanent bodies of water.27

27The candonid species recorded are not common members of the northwest European fauna. Candona sp. 1 is related to the candida group of Candona (after Meisch 2000). Candona sp. 2 may belong to the genus Fabaeformiscandona. Without soft parts for these and the other species recovered, it is not possible to be more certain of their taxonomic affinities.

Table 2. Summary of Sediment Units Identified During the Auger Survey, Results of Paleoecological Assessments and Interpretation.

<table>
<thead>
<tr>
<th>Stratigraphic Unit</th>
<th>Dating Evidence/Comments</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dense gray clay/silty clay; often orange mottled with fine rootlets, sometimes weakly laminated</td>
<td>uppermost unit across most of study area; Halaf and Roman pottery</td>
<td>Late Holocene backswamp</td>
</tr>
<tr>
<td>Dense red-brown clay with rounded pebbles</td>
<td>uppermost deposit adjacent to dry land on western edge of study area</td>
<td>Late Holocene colluvial/alluvial deposit</td>
</tr>
<tr>
<td>Black mollusk-rich silts; sometimes laminated and intercalated with humic clay/organic units of varying thicknesses</td>
<td>absent from boreholes in eastern half of study area</td>
<td>Middle–Late Holocene slow or standing water, brackish in places; freshwater, semipermanent/permanent bodies of water; possibly reworked; deep, plankton-dominated freshwater; preservation of proxies patchy</td>
</tr>
<tr>
<td>Calciteous silts/clays/marl</td>
<td>various contexts/depths</td>
<td>shallow water; various ages likely</td>
</tr>
<tr>
<td>Organic limus</td>
<td>charcoal: 11,310±60 b.p. (uncalibrated) (Beta-210648)</td>
<td>Late Glacial shallow freshwater, plant-dominated subbasin</td>
</tr>
<tr>
<td>Highly humified peats/silty peats; monocot sometimes evident</td>
<td>sediment: 17,450±140 b.p. (uncalibrated) (Beta-214682)</td>
<td>floodplain vegetation, reed swamp; Early Holocene and Late Pleistocene contexts; evidence for disturbed habitats/large herbivores</td>
</tr>
<tr>
<td></td>
<td>sediment: 15,670±130 b.p. (uncalibrated) (Beta-214684)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>sediment: 8,490±60 b.p. (uncalibrated) (Beta-214663)</td>
<td></td>
</tr>
<tr>
<td>Dense blue-gray clay</td>
<td>basal deposit in many cores</td>
<td>Late Pleistocene lake</td>
</tr>
<tr>
<td>Sands, silty sands, gravels</td>
<td>various contexts; basal deposit to east of site</td>
<td>high-energy fluvial environments; various ages</td>
</tr>
</tbody>
</table>
However, the subfossils do not appear to be in situ, a potential indication that these samples represent a slack water environment, downstream of the actual original ostracod habitat.28

These deposits therefore seem to have accumulated in a fresh, still, or slowly flowing open water environment, but there is also evidence in the lithostratigraphy for episodes of enhanced fluvial influence in the form of lenses of sand and bands of fragmented mollusks. The thin peat units suggest phases of so-called shallowing up resulting in semiterrestrial conditions, with the remains of monocotyledonous plants indicating colonization by wetland grasses or sedges. No extensive channel fill deposits, such as coarser silts and sands, which might represent higher-energy paleochannel deposits, are recorded in the cores excavated to the west of the höyük. The apparently well-sorted nature of the silt deposits and the paleoenvironmental evidence described above suggest that deposition was in a relatively low-energy fluvial environment with occasional episodes of inwash and reworking.

The spatial distribution of the black silts appears to correspond to the line of the now-canalized watercourse to the west of the site. Aerial photographs taken before the cutting of drainage channels in the 1970s indicate that prior to its canalization, the watercourse was laterally active with a number of oxbow lakes apparent. This could suggest that the previous flow regime was one of gently sustained, perennial, or semiperennial flow rather than the more laterally active regime of the later Holocene. Establishing the precise temporal range for the deposition of the black silts is problematic, but a terminus post quem of 8,490+60 b.p. (uncalibrated) (7602–7384 B.C.E.) is provided by the radiocarbon date from the peat unit (Beta-214663) at transect 6, core 7 (see online fig. 4), since this unit is overlaid by black, mollusk-rich silts. While further analyses of these deposits supported by radiocarbon dating are required, it can be hypothesized that these silts represent Early–Middle Holocene deposition, probably within a low-energy channel.

Organic Muds
A suite of sediments recorded to the west of the höyük on transect 1 (see online fig. 1) were not observed elsewhere in the study area. The deepest sediments in cores 3 and 4 consisted of silty, calcareous sands with occasional rounded pebbles and fragmented mollusks. These sands were overlaid in cores 3 and 4 by drab olive and brown organic muds, or gyttja, with intercalated layers of well-humified peat. This evidence suggests an initial episode of fluvial influence during which the basal silty sands were deposited, followed by a transition to standing open water under conditions of higher biological productivity. As described above, the peat bands indicate phases of shallowing up and colonization by vegetation, predominantly sedges/grasses judging from the remains of monocotyledonous plants apparent in the organic units; these phases were interspersed with periods when a raised water table meant shallow standing water was present.

The diatom samples (see table 1) from these organic deposits in transect 1, core 4 (see online fig. 1) suggest deposition in a fresh, plant-dominated body of water with the aerophilous species *Ellerbeckia arenaria* abundant in the sample from close to the top of the unit. This suggests shallow water conditions and an eventual infilling of the feature. A charcoal fragment (Beta-210648) recovered from the top of this deposit was dated to 11,310+60 b.p. (uncalibrated) (11,346–11,141 B.C.E.), indicating this shallow body of water had infilled by the Late Glacial period. The organic muds are overlaid by the black silts (described above) in cores 3 and 4.

Humified and Silty Peats
Other organic deposits in the form of humified peats and humic clays and silts were observed in the cores to the west, south, and north of the study area. These sediments; the peats in particular, are important because they provide opportunities to establish an outline of a chronological framework for the data set. The distinctive sediments and the corresponding radiocarbon date from transect 1, core 4 have been described above. Three other samples provided material for radiocarbon dating. A well-humified silty peat (Beta-214622) in transect 4, core 3 (depth 4.25–4.35 m) (see online fig. 2) produced the oldest date of 17,450+140 b.p. (uncalibrated) (19,122–18,295 B.C.E.). The thickest peat unit (Beta-214664) recorded on transect 7, core 6 (depth 4.23–4.50 m) (see online fig. 5) produced a date of 15,670+130 b.p. (uncalibrated) (17,207–16,766 B.C.E.). The corresponding diatom sample was poorly preserved but contained the species *Cocconeis placentula*, *Cymbella* spp., *Fragilaria ulna*, and *Amphora* spp., which imply a shallow, freshwa-

---

28 The autochthonism of a subfossil ostracod assemblage can often be inferred by analysis of the population age structure. Ostracods grow by a series of seven to eight successive molts, each slightly larger than the previous, until they reach adulthood. If adult and juvenile valves are found together in a sample, then little if any transport may be inferred; if only juveniles are recovered, this may indicate postmortem transportation suggesting that the species did not necessarily live in this environment. See Boomer et al. (2003) for further discussion of ostracod taphonomy.
ter, plant-dominated environment. The stratigraphic context of these samples and the poor preservation of diatoms, quite possibly a result of accumulation under relatively dry conditions, suggest a phase or phases of peat formation dating to the Late Pleistocene.

A sample of highly humified peat (Beta-214663) from transect 6, core 9 (depth 2.9 m) (see online fig. 4), close to the wetland-dryland interface (see fig. 3), yielded the youngest radiocarbon date of 8,490±60 b.p. (uncalibrated) (7602–7384 B.C.E.), indicating an Early Holocene phase of peat formation. Beetle and plant macrofossil remains from this organic deposit were also assessed. Abundant sedge fruits (Carex spp.) and buttercup (Ranunculus spp.) seeds along with bramble (Rubus spp.) and elder (Sambucus nigra) pips were recovered in numbers large enough to suggest the presence of these herbs and shrubs. Fragmentary remains of the Chrysomelidae Plateumaris spp.—a beetle closely associated with sedges and Phragmites (reeds)—were recorded. Species of coleoptera indicating damp rotting material and possibly dung included the aquatic Cercyon spp. (a member of the Hydrophilidae family) and a fragment of the Scarabaeidae Geotrupes spp. (dung beetles), the latter taxon suggesting that large herbivores may have been grazing near the sampling site. No distinct aquatic coleopteron or plant taxa were recovered, and hence it seems unlikely the sampling site was permanently waterlogged. Elder and bramble are found on waste ground; elder commonly grows on well-manured, disturbed ground. It is possible that the paleoenvironmental record indicates such disturbed habitats at the wetland-dryland interface.

**Dense Blue-Gray Clays**

The two previous radiocarbon samples derive from peats recorded toward the base of the black silts described above, overlying the lowermost deposit observed across much of the study area. This is blue-gray, fine-grained, slightly silty clay, typically compact and stoneless with no organic remains. The mineralogy of this deposit and its stratigraphic relationships to the radiocarbon dates suggest that this deposit represents a shallow, open body of water dating to the Late Pleistocene.

**Calcareous Silts, Clays, and Marls**

Other deposits recorded included silty sands and gravels, but such coarse-grained deposits tended to be relatively rare; this may be a function in part of the difficulty of penetrating or recovering such sediments with a hand auger. Other than the basal deposit of coarse sands and gravels in the eastern quarter of the study area (see above), discrete sand lenses were also evident in other cores in a range of stratigraphic contexts. These presumably represent episodes of fluvial activity at different times and of different intensities and durations. The clays and silts were noted as calcareous, and marl deposits were also recorded, reflecting either increased sediment supply from the limestone uplands or carbonate accumulation during drier periods when groundwaters became chemically concentrated and saline.

**DISCUSSION**

**The Geomorphic Evolution of the Narlı Plain**

The auger survey at Domuztepe has demonstrated that the Narlı plain consists of deep (up to 9 m) sediment sequences comprising peats, marls, silts, clays, and gravels. The variation in stratigraphy observed between individual cores and transects may be the result of a number of factors including changes in channel positions and floodplain stability as well as the effects of climate change and human activity on the sediment archive. The sequences imply a complex depositional history stretching back through the Holocene and into the Upper Pleistocene. Such so-called stacked alluviations, often with numerous hiatuses, have been observed in other studies of valley fills in both eastern Turkey and Syria, where, as Wilkinson notes, “sedimentary environments appear to have shifted abruptly from one state to another during the Holocene.”

The respective roles of human impact and climate change in the eastern Mediterranean as a whole have been much debated since initial concerted investigations of such valley fills were first carried out. Separating the impact of climatic deterioration from that of human factors such as vegetation clearance and cultivation is problematic because both may lead to destabilized soils and hence increased erosion and redeposition of alluvial/colluvial material. There are a range of methodological issues associated with investigating these processes, such as establishing robust chronologies for sediment sequences and reliably determining the long-term pattern of climatic variation. This is further complicated by the fact that

---

30Menzie and Cox 1996.
32Stacked alluviations are sequences of vertical accumulations of alluvial and colluvial deposits, often with hiatuses between different units.
34Vita-Finzi 1969.
there is likely to be a complex nonlinear relationship between environmental changes and human activity, perception, and response to such changes and the formation of the geoarchaeological record. To this end, it would seem appropriate to consider the geoarchaeological record of each site on its own merit and in particular to recognize the limitations of establishing cause and effect with respect to the recursive nature of anthropogenic and so-called natural processes of landscape change.

The radiocarbon dates suggest three periods of peat formation: the Upper Pleistocene (ca. 20,800 b.p. [calibrated] and ca. 18,700 b.p. [calibrated]), the Late Glacial (ca. 13,000 b.p. [calibrated]), and the Early Holocene (ca. 9,500 b.p. [calibrated]). Although it is difficult to draw anything more than broad conclusions from a small number of dates across a relatively wide study area, some general observations can be made. The presence of thin, humified peat deposits overlying fine-grained clays may point to drier conditions on the Narlı plain during the Upper Pleistocene, which led to the drying out of a body of open water and the development of a peaty marsh. Dry, cold conditions during this period are also evident elsewhere in Turkey and led to the abrupt drying out of lakes on the Konya plain on the Anatolian plateau and on the Amuq plain. Similarly, the infilling of an apparently discrete body of water on the western edge of the study area may also reflect the effect of dry conditions during the Younger Dryas (ca. 11,000–10,000 b.p. [calibrated]). Elsewhere in Turkey, this period is characterized by a near absence of deposits, suggesting either a lack of deposition or reworking of sediments through wind action.

Peat formation during the earlier Holocene may be a result of the more humid conditions that seem to be recorded during this period in Turkey. Palynological analyses of a sediment core from the nearby Sağlık Ovası on the western side of the Kahramanmaraş Valley indicate that increasingly humid conditions were coincident with the expansion of pine- and oak-dominated vegetation during the Early Holocene. The period between 9,000 and 8,000 b.p. (calibrated) at Çatalhöyük and on the Konya plain was also characterized by the spread of marshy backswamps. Peat accumulation during the earlier Holocene seems to have been followed by the deposition of alluvium across the Narlı plain. On transect 4, core 4 and transect 6, core 6, the black, mollusk-rich silts displayed an unconformable contact with the basal blue-gray clays, which probably indicates a phase of fluvial incision (erosion) prior to floodplain aggradation, but the precise timing and nature of Holocene environmental change require further, more detailed investigation.

### Assessing the Relationship Between Environment and Settlement Location

Despite the current lack of a robust chronological framework for the geomorphic development of the Narlı plain, it is clear that deep alluvial deposits are recorded on all sides of Domuztepe. This has two main implications for the archaeological record. The first concerns the location of the original settlement, since there is no evidence for any topographic anomaly that might have formed an obvious drier island within these wetlands. If such a location exists, then it must be at some depth below the current plain surface or below the central area of the höyük. The second implication concerns the identification of the full extent of Domuztepe and the potential masking effect of the upper alluvial deposits, which appear to date to the Roman period and later, on the visibility of other archaeological sites. With few exceptions, cores proximal to the mound (i.e., within 10 m of the break of slope) could not be excavated to any great depth (e.g., more than 1 m) because of the presence of subsurface obstructions. It may be inferred that these are archaeological, given that such obstructions were not encountered elsewhere across the study area. Hence, the current boundaries of the site are not a true representation of its past extent, while other archaeological sites have almost certainly been obscured by the overburden of the alluvium.

The geoarchaeological survey allows hypotheses to be constructed regarding the relationship between site to oak-pine woodland during the Middle Holocene. Pollen analyses of the organic deposits at Domuztepe could be correlated with these data to compare and contrast patterns of local and regional vegetation change.

42 Further information on regional vegetation change is provided by Woldring and Kleine (forthcoming). These pollen analyses are yet to be published in detail but suggest a transition from steppe vegetation during the Late Glacial period

---

56 Butzer 2005.
57 Fontugne et al. 1999.
59 Fontugne et al. 1999.
40 Woldring and Kleine (forthcoming).
41 Roberts et al. 1999, Jones et al. (2007) have estimated that during the Early Holocene, precipitation in central Anatolia may have been 25% higher than the present day.
42 This tentative hypothesis is based on the presence of Roman pottery in the upper alluvial clays to the east of the höyük (see above under “Dense Clays”). This of course only provides a terminus post quem for the clays in this area. It is quite probable that there is a degree of spatial and temporal variation in the deposition of the alluvium across the study area, but additional work is required to investigate this further.
location, availability of agricultural land, and seasonal flow of watercourses. Domuztepe is on the distal edge of the floodplain of the Aksu River (see fig. 3), a location that may have reduced the risk of seasonal flooding. Additionally, on large floodplains, subtle differences in topography may equate to significant differences in hydrology. For example, levees, formed of coarser, more permeable sediments, remain drier than surrounding areas for much of the year. The slight elevation of levee slopes and their improved drainage in comparison with backswamp areas may also provide opportunities to intensify agricultural production.

The current data would seem to indicate that there has been little lateral channel migration on the Narlı plain, as no paleochannel deposits have been located by the survey. It can be hypothesized, therefore, that the earliest settlement at Domuztepe occupied a levee formed by the now canalized watercourse just to the west of the site. This location would have been both well supplied with water and sufficiently elevated to reduce the risks presented by floods and erosion. The potential for cultivation adjacent to the settlement is unclear, but agricultural land and other resources such as timber were probably available in the hills immediately to the west of the site.

Use and Significance of Natural Resources

Settlement on floodplains may clearly have been problematic for a number of reasons, including risks of flooding, erosion, and the limited availability of land for agriculture. For such reasons, these environments are viewed in some cultures as liminal, dangerous, and of low utility. However, a rich diversity of wild plant and animal resources are often available in wetlands, which, from a subsistence point of view, may help promote year-round economic stability. The availability of water in an otherwise relatively dry environmental setting should also not be underestimated in supporting elevated population numbers.

The faunal and macrofossil records indicate that during the Late Halaf period, the subsistence economy of Domuztepe comprised mixed farming along with the exploitation of wild plants and animals from a wide range of ecosystems that included scrub, steppe and park woodland, oak, and coniferous forest. However, plant remains, including Cyperaceae (sedges), Juncus sp. (rushes), Schoenus nigricans (black bog rush), and Eleocharis sp. (spike rush), which are typical of wetland environments, are ubiquitous in samples from the excavated layers at the site. The faunal record includes pig (21%), cattle (25%), and fish, which may have made up as much as 5% of the assemblage, while the presence of duck and beaver further points to the exploitation of wetland areas.

While the precise character of soil and water resources during the Halaf period requires further study, deep alluvial sediments are present on all sides of the höyük. The landscape context of Domuztepe during the Halaf period was therefore probably very different from that of the present day. Although the timing and nature of environmental change remains tentative, it can be hypothesized on the basis of the on-site environmental analyses and the geoarchaeological survey that Domuztepe was established within a wetland context between at least two depositional systems, represented by the clay-rich floodplain deposits to the east and the black silts to the west (see fig. 4). While alluvial sediments may be rich in nutrients that are seasonally renewed, they tend to be very difficult to cultivate and prone to flooding. It thus seems likely that the arable crops recovered during the excavations were not grown immediately adjacent to the site.

The local environment may have offered an alternative benefit: risk reduction and flexibility in resources. Rushes (Juncus sp.) were used in woven basketry, as shown by plastered examples (fig. 5), and as fodder during the Halaf period. Motifs on pottery from the site include plants such as rushes and reeds (Phragmites), as well as birds that appear to be representations of the Ciconiidae family (storks); these arguably imply the significance of wetland environments in the social life of the inhabitants (fig. 6). The geoarchaeological survey has identified the local presence of clay deposits that may well have been exploited in a variety of ways. Preliminary thin-section analysis of pottery has identified a pronounced use of calcareous clays or intractable when wet (French 2003, 237).

Site catchment analyses have suggested that the land within a 5 km radius of the site would have been insufficient to support the subsistence requirements of the settlement (Eisenstat 2004); this estimation is based on the current, drained landscape of the present day and hence takes no account of the presence or extent of wetlands in the past.

© 2011 Archaeological Institute of America
and has also discerned a significantly wider range of pottery fabric types than the 12 previously recorded.\textsuperscript{55} Future research should be able to link these pottery fabrics more closely to the clay sources identified by the geoarchaeological survey and hence facilitate investigation of spatial patterns of resource exploitation during the Halaf.

Marl deposits to the east of the höyük might have been used to make the plaster that has been recovered from walls, floors, and vessels. The use of wood in construction has been identified in the remains of a burnt structure, and archaeobotanical analyses have suggested wood was preferred to dung as a fuel source.\textsuperscript{56} The deep alluvial sediments make it unlikely that extensive woodland was able to flourish close to the site, and hence timber may have come from hills to the west. The burnt structure has also provided evidence for the use of rushes in roofing and lightweight walls or screens, something apparently confirmed by the images of houses painted on pottery (see fig. 6).

Exploitation of the natural environment for practical purposes was coupled with more symbolic forms of resource use during the Halaf period. It appears that Domuztepe’s surroundings were important in ways beyond simple economic exploitation. As discussed in the introduction, investment in nonportable capital may help create long-term attachments to places and imbue them with meaning.\textsuperscript{57} A feature known as the Red Terrace, a linear earthwork 20 m wide aligned east–west, has recently been excavated and may be an example of such an investment: a physical landmark linking the environs of Domuztepe to the settlement itself.

The Red Terrace was subject to multiple acts of construction over a period of perhaps 500 years, using red clay. On-site auger survey revealed that the terrace was at least 75 m in length. It was bisected by a series of segmented scoops and pits formed by repeated cutting and recutting, following the same alignment as the terrace for about 25 m.\textsuperscript{58} The pit deposits were rich in artifacts, whereas the terrace was largely devoid of the material culture remains found elsewhere on the site. Discontinuous spreads of thin plaster wash and lines of retaining stones may have been related to attempts to clean and stabilize the surface. The distinctive red clay and the almost complete lack of artifactual debris within the terrace’s structure suggest it was constructed from sediment that had been deliberately brought into the settlement.

\textsuperscript{55}Irving 2001, 112–17. There is no archaeological evidence for imported ceramics at the site.
\textsuperscript{56}Kansa et al. 2009, 908.
\textsuperscript{57}Bourdieu 1977; Hodder and Cessford 2004; During

Fig. 5. Base of plaster-coated basket excavated from the northern section of the so-called death pit (S. Campbell).

The most likely source for red-clay deposits identified by the survey (see above) was located at the wetland-dryland interface some 500 m to the west of the site (see fig. 4). The deliberate transport of such material to the site can be regarded as significant in two main ways. First, this clay is markedly different in color to any of the other brownish-gray pisé derived deposits present on the site, and even though the solid color was broken up by thin spreads of white plaster, the structure would have made a bold visual statement. Unlike other common sediments on the sites, the Red Terrace remains distinctive even after prolonged exposure.

It is likely that the color and perhaps texture\textsuperscript{59} of the clay made its off-site source readily identifiable, and therefore its use may have referenced external landscape features within the settlement itself. It may have also imbued the terrace with a degree of neutrality within its on-site context because it was derived from an external source rather than being a recycled tell soil that might have preexisting associations with a particular family or social grouping within the wider settlement population. Second, the clay was clean, practically devoid of any material remains, and appears

\textsuperscript{59}Carter et al. 2003, 118–19, fig. 6; Campbell 2004, 2005. See Evans (2003) for a discussion of the potential significance of “texture” in the landscape.
to have been maintained in that state, in contrast to soils and surfaces elsewhere on-site, which were rich in artifactual fragments. The Red Terrace was therefore a visually arresting structure deliberately kept clear of domestic occupation and debris.

The use of red clay rather than alluvial deposits closer to the site may have been both aesthetically and socially driven. The Red Terrace might have acted as a neutral marker, barrier, or space between different subgroups within Domuztepe’s population, which could use but not take possession of it. Stylistic analyses comparing exterior pottery motifs and vessel shapes have suggested that such groups may have existed as suprahousehold affinities within the settlement. Alternatively, the feature may have been a so-called enframed expression relating to the agricultural land and grazing located on the drier terra rossa of the hills to the west. As such, its maintenance and cleanliness may have served to indicate the importance of these drier lands within the mosaic of environments that the continuing existence of the site relied on. The materials used in its construction may have provided visual linkages between the settlement and its landscape.

CONCLUSIONS

It seems likely that the Narlı plain has been a highly dynamic environment for much of the Holocene; the depositional sequences identified by the survey are characterized by the complexity that is typical of other such deposits in this region and farther afield, reflecting the interplay of natural and anthropogenic factors in landscape evolution. While further work is required to determine fully the chronology and character of environmental change, Domuztepe seems to have been established in a wetland landscape. The range of local wetland resources reflected in the on-site archaeological record, in the use of clays for pottery, rushes for matting, and marl for plaster, were probably all sourced locally. It can be hypothesized that the site location permitted exploitation of a range of diverse resources, including wetland plants and animals. Local intensification of agriculture may have been possible on raised levees or, perhaps more likely, on the nearby drier upland soils. This landscape context might have been capable of supporting elevated population numbers that in turn could have reduced the likelihood of settlement fission, but further work is needed to

---

62 Neely et al. 1994; Bandy 2004.
establish the relationship between the status of local soils, hydrology, and resource exploitation during the Halaf period.65

Economic factors appear to have been accompanied by symbolic forms of resource usage. The survey has indicated that a major feature of the Late Halaf site architecture, the Red Terrace, was constructed using distinctive red clay probably sourced from deposits located at the wetland-dryland interface to the west. It appears that the terrace was deliberately kept clear of association with a particular household or group and can be regarded as a visually arresting expression of ideologies relating both to Domuztepe’s community and its surrounding landscape. The local environment thus both provided economic stability and maintained a social resonance that was enhanced through activity and symbolism apparent in the material culture and architecture of the site.66 It can also be observed that Çatalhöyük, large-scale settlement appears to have continued despite the presence of economic deprivation as indicated by skeletal evidence of malnutrition, suggesting social practices and environmental factors may have been critical in promoting settlement growth.67

The study has contributed to a longue durée assessment of the factors that might have influenced the growth of Domuztepe. While chronological control for the depositional sequences described remains tentative, it seems likely that wetlands have been a key feature of the local environment of the site for much of the Holocene. Such a landscape context is reminiscent of other sites in the Near East. The significance of the location of Çatalhöyük with respect to access to clay and marl deposits has been highlighted,68 while the site of Abu Hureyra, a spur at the edge of the floodplain, has been described by Moore et al. as “the closest to the river the inhabitants could live while still being above the flood level.”69 Another possible parallel in terms of landscape context is Tell Brak, in northeastern Syria, which occupies a position between two wadi systems described by French as “marginal.”70

The survey also has implications with respect to future archaeological prospection and survey, as the depth of alluviation recorded raises questions of archaeological site visibility within the Narlı plain. The deposits of later Holocene alluvium suggest that earlier sites may be obscured or even completely buried and hence preserved,69 although the precise spatial and temporal patterning of this alluviation require further investigation.70 Much has been achieved through traditional archaeological survey in this area;71 now attention must be directed toward the identification of sites within deeply alluviated areas such as the Narlı plain. A “toolkit” including remote-sensing techniques such as LIDAR (Light Detection and Ranging) could be employed in the future to investigate such landscapes.72

This work has demonstrated that there is considerable potential for wider paleoenvironmental and geoarchaeological research using proxies such as diatoms, ostracods, coleoptera, and macrofossils. Future study should use the potential of the deposits identified to develop robust chronological frameworks for records of landscape change linked to on-site archaeological chronologies.73 Geoarchaeological data can be a critical component in understanding the interrelationship between people and landscapes.74 Past societies existed within social, spiritual, and physical landscapes, the interconnected nature of which can only be fully appreciated through consideration of both off- and on-site artifactual, ecofactual, and environmental data. There is clear potential for further work to determine the extent to which nature might have aided Domuztepe’s development and to build this into models that incorporate the societal factors that may also have nurtured its development.

BENJAMIN R. GEAREY
BIRMINGHAM ARCHAEO-ENVIRONMENTAL
UNIVERSITY OF BIRMINGHAM
EDGBASTON, BIRMINGHAM B15 2TT
UNITED KINGDOM
B.R.GEAREY@BHAM.AC.UK

65 See Roberts and Rosen (2009) for a recent discussion of such issues for the Neolithic of Çatalhöyük, which concludes that the bulk of cereal agriculture was taking place at least 13 km from the settlement.
68 Balter 2001; Rosen and Roberts 2005; Roberts and Rosen 2009.
69 Moore et al. 2000, 112.
70 French 2003, 237.
71 The implications of alluvial processes for archaeological visibility have long been recognized for Çatalhöyük (Roberts 1982).
72 Boyer et al. 2006; Beach and Luzzadder-Beach 2008.
73 Campbell et al. 1999.
74 See Carey et al. (2006) for an example of this methodology.
75 See Gearey et al. (2009) for a worked example of linking archaeological and paleoenvironmental chronologies using a Bayesian approach.
A. Fletcher
Department of the Middle East
The British Museum
Great Russell Street
London WC1B 3DG
United Kingdom

William G. Fletcher
English Heritage
24 Brooklands Avenue
Cambridge CB2 2BG
United Kingdom

Stuart Campbell
School of Arts, Histories and Cultures
University of Manchester
Oxford Road
Manchester M13 9PL
United Kingdom

Ian Boomer
School of Geography, Earth and Environmental Sciences
University of Birmingham, Edgbaston
Birmingham B15 2TT
United Kingdom

David Keen
Institute of Archaeology and Antiquity
University of Birmingham, Edgbaston
Birmingham B15 2TT
United Kingdom

Jane Reed
Department of Geography
University of Hull
Hull HU6 7RX
United Kingdom

Emma Tetlow
Headland Archaeology
13 Jane Street
Edinburgh EH6 5HE
United Kingdom

Works Cited


© 2011 Archaeological Institute of America


Spataro, M., and A. Fletcher. Forthcoming. “Centralisation or Regional Identity? Halaf Culture Fine Painted Ware Production.” *Paléorient*.


