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Warfare in Late Neolithic/Early Chalcolithic Pisidia, southwestern Turkey. Climate induced social unrest in the late 7th millennium calBC

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ABSTRACT – *This paper proposes an association between climate forcing connected with the 8200 calBP 'climate event' and a postulated phase of internecine warfare and population collapse at Late Neolithic/Early Chalcolithic sites in Pisidia, southwestern Turkey. A summary of this evidence is provided and a hypothetical scenario considered in the context of contemporaneous developments in neighbouring regions.*

IZVLEČEK – *V članku predlagamo povezavo med klimatskimi anomalijami – 8200 calBP 'klimatskim dogodkom' in postulirano fazo morilskih spopadov in populacijskega kolapsa v pozno neolitskih/ zgodnje halkolitskih najdiščih v Pisidiji, v jugozahodni Turčiji. Predstavljeni so dokazi ter razmislek o hipotetičnem scenariju dogajanja v kontekstu sočasnega razvoja v sosednjih regijah.*

KEY WORDS – *8200 calBP 'climate event'; Anatolia; warfare; GIS-analysis; Neolithisation*

Introduction

The past few years have seen the publication of a number of papers in which human reactions to climate forcing at the time of the 8200 calBP 'climate event' have been discussed. These have focused not only on potential implications for contemporaneous Neolithic communities in the Eastern Mediterranean, and its possible outcome on Neolithisation processes (*Weninger et al. 2005; 2006*), but have also considered temporal correlations with developments in Late Neolithic Cilicia and the Balikh valley (*Clare et al. in press*), as well as Mesolithic and/or transitional Neolithic cultures in western, north-western, central and south-eastern parts of Europe (*Weninger et al. this volume; Weninger et al. 2007; Budja 2007*). In the following, emphasis is on the geographical region of south-western Anatolia (ancient Pisidia), which in the late seventh millennium calBC was a centre of emerging 'western' painted pottery (Hacılar) traditions[1]. Excavations at four contemporaneous sites in Pisidia (Hacılar, Kuruçay Höyük, Höyücek Höyük, Bademağacı Höyük) have produced evidence for the erection of fortifications, episodes of destruction through burning, and large scale conflagrations, all of which coincide with the 8200 calBP 'climate event'. In this paper it is argued that these may be connected with episodes of warfare triggered by the effects of altered climatic conditions in the late seventh millennium calBC.

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[1] At roughly the same time, the 'eastern' painted ware tradition, or Halaf culture, was developing under the influence of Hassuna and Samarra in the Middle Euphrates region (*cf. Cruells & Nieuwenhuyse 2004*).

Although a causal relationship between prehistoric warfare and climate change is certainly nothing new, and has been discussed for a number of years by researchers with a focus on the American Southwest (*e.g. Haas 1990; Haas and Creamer 1993; LeBlanc 1999*), as far as we are aware, this is the first time that such a hypothesis has been proposed for the Late Neolithic/Early Chalcolithic period in the Anatolian landscape of Pisidia.

Climate change around 8200 calBP

The period around 8200 calBP is marked by distinct climate change on large, Northern Hemispheric or even global, scales (for reviews, see *Alley et al. 1997; Mayewski et al. 2004; Rohling and Pälike 2005; Alley and Ágústsdóttir 2005*). In Greenland ice-core stable oxygen isotope data of the ice itself, there is a sharp 'event' that stands out from a largely 'stable' Holocene time-series, and it was first considered as a widespread abrupt climate change event in Alley et al. (*1997*). Based on the recently updated layer-counted timescale for Greenland ice cores, the apex of this event is dated at 8190 calBP, with a counting uncertainty of 47 yr (*Rasmussen et al. 2006*). Thomas et al. (*2007*) investigated the event in the ice cores in great detail, and concluded that it began at 8247 calBP and ended at 8086 calBP, with a central peak event between 8212 and 8141 calBP. At the Greenland summit, the observed oxygen isotope anomaly may imply about 6 ± 2 °C cooling (*Alley et al. 1997*).

The North Atlantic record

The 8200 calBP climate event has been ascribed to catastrophic flooding from glacial lakes Agassiz and Ojibway into the North Atlantic during the terminal demise of the Laurentide ice sheet, dated at 8470 ± 300 calBP (likely due to ice-dam collapse) (*Barber et al. 1999*). It was suggested that the freshwater release into the North Atlantic temporarily reduced, or even shut down, the formation of North Atlantic Deep Water (NADW), resulting in reduced oceanic northward heat transport and consequent cooling around the North Atlantic (*DeVernal et al. 1997; Alley et al. 1997*). Increasingly sophisticated modelling studies show good apparent agreement between the impacts of freshwater-related reduction of NADW formation and the changes inferred from observations on hemispheric to global scales, and also that the climate impacts would develop within a few decades after the freshwater flooding event (*Renssen et al. 2002; 2007; Bauer et al. 2004; Alley and Ágústsdóttir 2005; Wiersma and Renssen 2006; LeGrande et al. 2006*).

Studying a marine sediment core from Gardar Drift, where they can constrain the Iceland-Scotland Overflow Water (ISOW) component of NADW, Ellison et al. (*2006*) infer from stable oxygen isotope data a main freshening pulse in the North Atlantic close to the 8470 calBP timing of the Agassiz/Ojibway flood. They compare this with ISOW flow rates based on sortable silt data that are co-registered with their oxygen isotope data in the same sample archive. The sortable silt values indicate an onset of ISOW weakening around 8450 calBP, with a gradual decline leading to the weakest ISOW interval at about 8260–8050 calBP. These results are rather puzzling, since all models suggest that the NADW (including ISOW) response would have occurred within a few decades of the flood. In the models, the NADW slowdown then results in a sharp cool event around the North Atlantic. However, in the dataset of Ellison et al. (*2006*), there is a first cool spike centred on about 8490 calBP (spanning roughly 8550–8450 calBP), followed by a more distinct cool event that spans the interval 8380–8260 calBP. The latter immediately pre-dates (without overlap) a rapid reduction to lowest ISOW flow intensity, which spans the interval 8260–8050 calBP (see Figure 3 of *Ellison et al. 2006*). The data of Ellison et al. (*2006*) therefore pose some challenging questions: (1) Why did it take some two centuries after the main flooding event before ISOW flow was minimised, when models suggest there should be an almost instantaneous response? (2) Why does their main cold event appear to predate the ISOW flow minimum, instead of the expected reversed or virtually synchronous relationship? These questions cannot be brushed aside on the basis of dating uncertainties, since all the records of Ellison et al. (*2006*) are co-registered in a single sample archive, so that relative phase relationships are fixed.

Kleiven et al. (*2007*) emphasise that ISOW is just one component of NADW, and that the complete NADW signature should be considered when comparing data with models for the 8200 calBP climate event. They endeavour to do so by studying a marine sediment core from Eirik Drift, at the southern tip of Greenland, which records information from the total combined Nordic Seas overflow. Kleiven et al. (*2007*) find a single event of NADW weakening, which they date between 8380 and 8270 calBP, in close agreement with the main cooling event that Ellison et al. (*2006*) correlate to the actual 8200 calBP event. It is also within dating errors of both the 8247–8086 calBP age of the cold event in Greenland ice cores (*Thomas et al. 2007*) and the 8470 ± 300 calBP age of the Agassiz/Ojibway flood (*Barber et al. 1999*).

Kleiven et al. (*2007*) assert that their results confirm the scenario of flooding leading to NADW weakening and consequent climatic cooling (with only minor delays in between these stages), as seen in modelling experiments (*e.g. Renssen et al. 2002; 2007; Bauer et al. 2004; Alley and Ágústsdóttir 2005; Wiersma and Renssen 2006; LeGrande et al. 2006*). Note that this would imply that the onset of the gradual ISOW flow reduction at about 8500 calBP (*Ellison et al. 2006*) predated by more than a century the sharp flood-related '8200 calBP' cool event (8380–8260 calBP in *Ellison et al. 2006*). The first microfossil evidence of surface cooling in fact starts even earlier, around 8550 cal BP, in the records of Ellison et al. (*2006*) (their Figure 3). Even more intriguing, the ISOW flow minimum postdates the main 8380–8260 calBP cold event that Ellison et al. (*2006*) correlate to the actual 8200 calBP event, and hence the period of minimum total composite NADW influence over Eirik Drift noted by Kleiven et al. (*2007*). Clearly, relationships are by no means simple between the flooding, ISOW intensity at Gardar Drift, composite NADW intensity at Eirik Drift, and the (potentially complex) climate responses. While the short and sharp composite NADW reduction at Eirik Drift would seem to be related to the flooding event in a manner expected from modelling experiments (*Kleiven et al. 2007*), the Gardar Drift records of ISOW seem to be telling us about more subtle underlying changes, which span some 5 centuries from about 8500 calBP until the recovery of ISOW flow intensity at around 8000 calBP (*Ellison et al. 2006*). The state of knowledge should not be seen as 'muddled' or 'confused', but instead as a developing richness of information that will eventually lead towards a comprehensive understanding of climate change in the times around 8200 calBP.

Reviewing high-quality palaeoclimate records (drawing on the wider Holocene overview of *Mayewski et al. 2004*), and focusing on co-registered relationships between statistically significant anomalies, Rohling and Pälike (*2005*) established for the first time that the actual short, sharp 8200 calBP event occurred 'embedded' within a broader underlying climate anomaly. The broad anomaly was found to span 5 to 6 centuries, between about 8600/8500 and 8000 calBP, an interval similar to that of the entire ISOW anomaly of Ellison et al. (*2006*), as noted by those authors. The broad underlying anomaly forms part of a distinct repeating pattern of anomalies during the Holocene, marked by glacier expansions on a global scale; the well-known Little Ice Age of AD 1400–1900 forms the most recent example (*Mayewski et al. 2004*). Given that there clearly are two mechanisms at play, one causing the repeating pattern of anomalies during the Holocene, and the other a 'climatic accident' (the Agassiz/Ojibway flood), attribution of any record to the actual 8200 cal BP climate event has to be performed with the utmost caution (*Rohling and Pälike 2005*). A sound way forward is to carefully document patterns of change through an extended interval from about 9000 to 7000 calBP, to distinguish longer-term changes between about 8600/8500 and 8000 calBP from the sharp, short actual 8200 calBP event that has a Greenland ice-core age of about 8250–8080 cal BP (*Thomas et al. 2007*).

The Aegean record

The present paper is specifically concerned with the Aegean/Levantine region, and the regional expressions of climate change around 8200 calBP are here discussed within the context of a key record for identifying Holocene climate anomalies (Rapid Climate Change events, or RCCs, after *Mayewski et al. 2004*) in the eastern Mediterranean region, based on microfossil assemblages in marine sediment core LC21 (*Rohling et al. 2002a*). LC21 was recovered from the SE Aegean Sea, on the boundary between the north-south extended Aegean Sea and the west-east extended Levantine Sea, which is a sensitive location for the recording of expansions and contractions of the cooler Aegean signature relative to the warmer Levantine signature.

Changes in the assemblages of marine unicellular zooplankton microfossils (planktonic foraminifera) in sediment core LC21 were used to determine a Holocene history of relative surface-water temperature fluctuations (*Rohling et al. 2002a*). Mapping of the distribution of the same assemblages in core tops from the Aegean Sea allowed rough calibration of the relative changes into more quantitative estimates of sea surface temperature change. This work revealed a pattern of three main Holocene RCCs that were associated with temperature drops of the order of 2–3 °C in the SE Aegean region, notably in winter (*Rohling et al. 2002a*). Rohling et al. (*in press*) corroborate this initial estimate by similar values from statistically more robust calibrations of the faunal changes using an Artificial Neural Network approach (for method, see *Hayes et al. 2005*) (Fig.

1). Further to the north in the Aegean Sea, cooling may have been a little bit more intense (*Rohling et al. in press*). Contemporaneous cooling events of similar magnitude are known from the western Mediterranean, where they were quantified with organic geochemical techniques (*Cacho et al. 2001*).

Rohling et al. (*2002a*), Mayewski et al. (*2004*), and Rohling and Pälike (*2005*) have placed the Aegean record of RCCs within a wider framework of climate variability, and strong agreement was found between the Aegean RCCs and the more intense Holocene events found both throughout the North Atlantic region, and further afield. Besides global glacier advances, the Holocene RCCs are also marked by distinct increases in the concentration of K^+ ions (*i.e.* [K^+]) in the GISP2 ice core from Greenland (*O'Brien et al. 1995; Mayewski et al. 1997; 2004*) (Fig. 1). Potassium transport to the Greenland ice sheet is strongly related to the late winter-spring intensity of the atmospheric high-pressure conditions over Siberia (*Meeker and Mayewski 2002*), so that enhanced [K^+] within the RCCs suggests an intensification of Eurasian winter conditions. The Holocene RCCs are also characterised by peaks in the sea-salt [Na^+] series from the GISP2 ice core (Fig. 1). These sea-salt [Na^+] variations reflect the intensity of the Icelandic Low (*Meeker and Mayewski 2002*). An intensified Icelandic Low causes intensification of onshore winds to Greenland, so that sea ice stays longer each season, and persists more from season to season. The inferred increase of North Atlantic sea-ice extent and duration during the Holocene RCCs is supported by concomitant increases in the Holocene, most likely sea-ice transported, ice-rafted debris concentrations in North Atlantic sediments during the RCCs (*Bond et al. 2001*). Mangini et al. (*2007*) presented a detailed composite speleothem record from Spannagel Cave, central Alps, which displays a temporal structure similar to that of records of North Atlantic hydrographic/sea-ice variations, as obtained from ice-rafted debris counts in marine sediment cores (*Bond et al. 2001*) and supported by the GISP2 ice-core [Na^+] series (Fig. 1). The main RCCs in this speleothem record may be associated with winter cooling of roughly 3 °C, although Mangini et al. (*2007*) argue that their oxygen isotope data are better considered as a function of precipitation origin rather than temperature. The combined information demonstrates a significant correlation between terrestrial and marine palaeoclimate records at the time of Holocene RCCs, with an emphasis on winter-time perturbations.

The cooling events in the Aegean Sea have been ascribed to intensification and frequency increase of wintertime northerly outbreaks of cold polar and continental air over the basin, relative to the present (*Rohling et al. 2002a*). Such outbreaks still occur today, and for a summary and data of such an event in December 2001, we refer to Casford et al. (*2003*; and below). The northerly outbreaks are a conse-

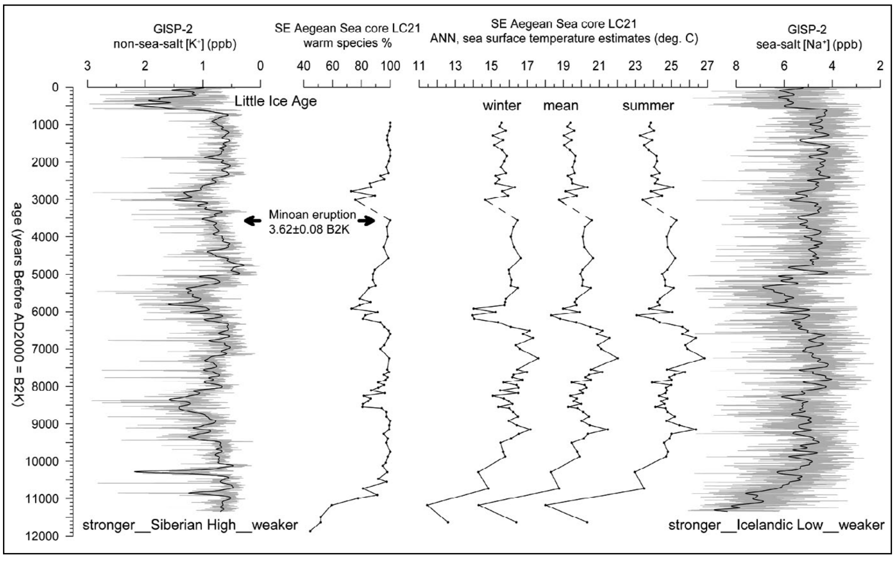

Fig. 1. After Rohling et al. (*in press*). Compilation of the Holocene non-sea-salt [K^+] and sea-salt [Na^+] series for the GISP2 ice core from Greenland (*O'Brien et al. 1995; Mayewski et al. 1997*), with 200-year bandpass filters, along with the sea surface reconstructions for the SE Aegean Sea from planktonic foraminiferal abundance data for sediment core LC21. The qualitative warm species percentage record is the same as that shown in Rohling et al. (*2002a*). An artificial neural network (ANN) technique is used to transform the faunal abundance data into records of winter, summer, and annual mean sea surface temperature. The technique and its core-top calibration set are fully explained in Hayes et al. (*2005*). Note that the records are presented on the left-hand side versus age in years Before 2000 CE (= yr B2K), which is the conventionally used ice-core reference datum, as well as (right-hand side) versus age in years CE/BCE (as used throughout this volume). The age of the Minoan eruption is indicated after Friedrich et al. (*2006*).

quence of the Mediterranean's latitudinal position and its mountainous northerly margin, which exert an important control on circulation and water-mass transformations in the Mediterranean Sea, and contemporaneous cooling events have been found in the Adriatic Sea and in the western Mediterranean (*Rohling et al. 1997; 2002b; Casford et al. 2001; Cacho et al. 1999; 2000; 2001; Frigola et al. 2007*). To understand the relationship between the frequency and intensity of wintertime northerly outbreaks over the Mediterranean and the climatic patterns inferred from proxy records from the wider northern hemisphere (particularly the Greenland ice sheet), we first consider the main drivers behind the general climatic conditions over the region.

During summer, climate over the eastern sector of the eastern Mediterranean is dominated by northward displacement of North African subtropical high-pressure conditions, causing widespread drought. The Aegean Sea then comes under the influence of northerly winds ('Etesians'), due to the extension of the deep monsoon Low of NW India over the Iranian highlands and Anatolia. Although this semi-permanent extension of the monsoon low causes local depression formation around Cyprus and the Middle East, dry summer conditions prevail due to descent in the upper troposphere that is related to the intense Asian summer monsoon (*Rodwell and Hoskins 1996; Trigo et al. 1999*).

During winter, the subtropical conditions are displaced southward, and polar/continental conditions expand southward from the North. Low surface-pressure conditions over the central to eastern Mediterranean develop as a consequence of the high sea-surface temperatures relative to the surrounding land masses, fuelled by the high thermal capacity of the basin's water masses (*Lolis et al. 2002*). Interactions between this Mediterranean Low and northeastward extension of the Azores High (over Iberia, France, and southern Britain), or westward ridging of the Siberian High towards NW Europe and southern Scandinavia (*Maheras et al. 1999; Lolis et al. 2002*), drive intense northerly flows of cold and dry air masses towards the Mediterranean basin, which are channelled through valleys in the mountainous topography of the northern Mediterranean margin. Channelling of polar and continental airflows through the lower Rhone Valley towards the Gulf of Lyons gives rise to the 'Mistral', while similar flows towards the Adriatic and Aegean Seas cause the 'Bora' and 'Vardar' (Fig. 2). These wintertime outbursts of polar and continental air cause intense evaporation and associated cooling of the sea surface (*e.g. Leaman and Schott 1991; Saaroni et al. 1996; Poulos et al. 1997; Maheras et al. 1999; Casford et al. 2003; and references therein*).

The enhanced potassium accumulation in the Greenland ice sheet during Holocene RCCs (Fig. 1) suggests an intensified late winter-early spring Siberian High (*Meeker and Mayewski 2002*). Given that expansion and westward ridging of the Siberian High are important processes controlling northerly outbreaks over the Mediterranean (*Maheras et al. 1999; Lolis et al. 2002*), we infer that the enhanced Siberian High intensity during RCCs led to an increase in the frequency and intensity of northerly air outbursts over the Mediterranean (notably the Aegean). This would offer a realistic mechanism to explain the observed episodes of about 2–3 °C winter sea surface cooling. Here, it should be emphasised that mean winter sea-surface cooling by such an amount implies significant atmospheric forcing, because the well-mixed surface ocean has very high thermal inertia. Over land, therefore, the impacts should be expected to have been much sharper and

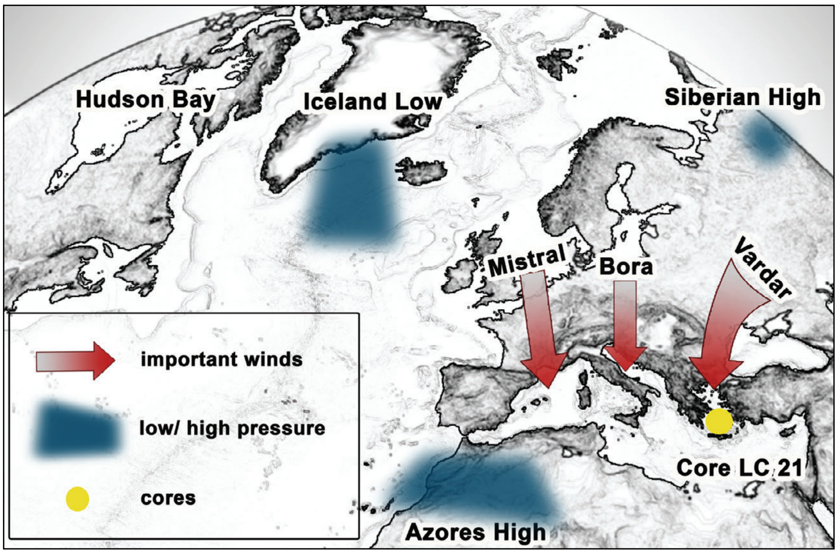

Fig. 2. Schematised map showing a) the location of Hudson Bay; b) Iceland Low, Azores High, and Siberian High pressure zones; c) the position of core LC 21; and d) intense cold northerly airflow over Western, Central and Eastern Europe in the winter months.

more pronounced, especially at altitude and further inland, away from the moderating influence of open sea (*i.e.* away from 'maritime' and into more 'continental' climate conditions). Also, the climatic effects over land may have consisted of highly variable conditions with considerable extremes, which become 'smoothed out' by long time-integration in the sea.

The main RCCs recognised in the Aegean Sea record of core LC21 are found at about 8600–8000 calBP, 6300–5500 calBP, and 3300–2600 calBP (Fig. 1). The duration of the first of these is well established at 5 to 6 centuries (*Mercone et al. 2000; Casford et al. 2007*), and it evidently forms part of a repeating RCC pattern during the Holocene. The GISP2 data (Fig. 1) clearly indicate that the Little Ice Age (LIA) is part of this repeating pattern, but the giant sediment corer used to recover core LC21 proved too crude a tool to recover this very recent (waterlogged, 'fluffy') sediment. As yet, no sharp culmination of the 8600–8000 calBP cool anomaly associated with the actual 8200 calBP event has been found in the records, which might be (unlikely) because of insufficient temporal resolution, or because further study of other indicators with different sensitivities is needed to record it. To understand the regional impact of enhanced frequency/intensity of northerly air outbreaks over the Aegean Sea, it is worth considering weather and impact reports for recent events, and historical reports for the LIA.

Modern meteorological analogies

In December 2001, several weeks of intermittent northerly winter outbreaks caused serious disruptions around the Black Sea-Aegean Sea region. The severe winter weather included sustained periods of sub-zero temperatures, snow-storms and blizzards, heavy rains, and strong winds (*e.g. CNN weather, 19 December 2001*). Aboard the German Research Vessel *Meteor*, air temperatures down to –1 or –2 °C were recorded in very strong (force 8, gusting 9) NE winds (*Casford et al. 2003*). Athens and Istanbul received about 30 cm of snow, and city governor Erol Cakir declared that conditions in Istanbul amounted to a 'national disaster' (Telegraph). In Larissa, Greece, night temperatures plummeted to a minimum of –20.2 °C, and more than 300 villages in northern and central Greece were snowed in, while airports and schools were closed in the North. In Bulgaria, heavy snowfall cut power lines in Bulgaria, while frosts cut off water supplies (World Weather News). The picture that emerges for the December 2001–January 2002 event portrays intermittently very heavy precipitation (both rain and snow), severe storms, and severe frosts (certainly for this region).

Our combined data suggest that such events were much more intense/frequent during the Holocene RCCs than they are today. This notion is further supported by a review of historical evidence for the periods 1675–1715 (Late Maunder Minimum) and 1780–1830 (Early Instrumental Period), key parts of the Little Ice Age during which Europe experienced significant cooling (*Xoplaki et al. 2001*). The majority of the documentary sources for these periods was found to refer to winter, which is the critical season for the eastern Mediterranean because it is normally wet and represents the early growing season. Relative to the present, these periods show significantly more cold/severe winters and springs, significant increases in precipitation during winter, and significantly more occurrences of winter drought (*Xoplaki et al. 2001*). Although the latter two may sound paradoxical, they simply reflect inter-annual variability within a context of significantly increased winter extremes. The study highlights the year 1700, when it is documented that snow cover remained present on the Cretan mountains throughout the year. Xoplaki et al. (*2001*) also report a rather common association between the extreme conditions and flooding, crop failure, famine, and deaths of animals and people. The main synoptic (= weather) situations responsible for cold and snowfall over the region were generally characterised by north-northwesterly or north-easterly airflow, with high pressure over northern Europe, and lower pressure over the central or eastern Mediterranean (*Xoplaki et al. 2001*).

The framework of the interval 8600–8000 calBP

Based on the above, we can build a speculative framework regarding the climatic impacts expected around the Aegean region in the period 8600–8000 calBP. Winter conditions would have been characterised by much more pronounced extremes than today, and the LIA examples suggest that very extensive rainfalls and snowfalls should be expected, which would have given rise to problems with crops and grazing, as well as larger issues such as flooding and the attendant potential destabilisation of hillsides and of mud-brick dwellings. These aspects would have been exacerbated by frequent, sustained, and very significant frosts. During other winters, conditions may have remained very dry, again with considerably detrimental effects on crops and grazing. Severe winds/gales are also expected more frequently than today. This spectrum of extreme conditions would have been considerably amplified at a distance from the coasts (away from the climate moderating effects of open sea), and especially at altitude. Overall, this analysis would suggest a considerable amount of pressure on resources, and general environmental stress during the RCC of 8600–8000 calBP, with a (not yet regionally documented) potential culmination between about 8250 and 8080 calBP.

The archaeology of warfare

Discussions on the origins of human warfare can be traced back to the 17th and 18th centuries, to Thomas Hobbes and Jean Jacques Rousseau, respectively. Whereas in '*Leviathan*' (1651) Hobbes proposes that the natural human condition was synonymous with a violent primitive plight, characterised by endemic war, murderous feuds, and the struggle for the preservation of personal gain, liberty, reputation, and safety, Rousseau proclaims in his '*Discourse of the Origins and Foundation of Inequality among Mankind*' (1755) a totally opposite myth. Instead, he argues that warfare only emerged following the inception of agriculture, which in turn led to demographic growth, more complex forms of social organisation, the concept of private property, and ultimately, state coercion (see *Keeley 1996.5–8; Gat 2006.5–6*). Meanwhile, it is generally accepted that archaeological evidence for warfare first becomes overtly apparent from the Neolithic (*e.g. Roper 1975; Fry 2006; Hamblin 2006*), although Rousseau's myth of the non-bellicose hunter-gatherer can certainly no longer be upheld (*cf. Keeley 1996*).

Signatures for warfare in the archaeological record are manifold, and include the construction of fortified settlements by means of walls and palisades, the erection of sites in strategic defensive locations, line-of-sight connections between contemporaneous sites, and the occurrence of settlement clusters separated by buffer zones ('*no-man's-land*'). Further, the occurrence of weapons and military paraphernalia, burial information (mass graves, warrior graves), skeletal indicators ('parry' fractures, frontal head fractures, scalping marks), burned communities, and artistic depictions are all considered characteristic attributes (*Haas 1990; LeBlanc 1999*).

Case study – Pisidia

Ancient Pisidia, also known as the Lake District, lies within the central part of the western Taurus range in modern day Turkey (*Erol 1983.92–94; Yakar 1991.139–141*). Its landscape is characterised by natural depressions and basins, many of which hold lakes, the three largest being the lakes Burdur, Eğirdir, and Beyşehir, surrounded by mountain ranges and plateaus. It is bordered to the north by the terraced plateau-landscape of central-western Anatolia, to the west by the eastern foothills of the Menderes massif, to the east by the Konya-Ereğli basin, and to the south by the western Taurus range. Although the karst nature of the Pisidian landscape (primarily in its eastern parts) has resulted in a distinct lack of larger rivers in the area compared to more central parts of Anatolia, *e.g.* the Konya Plain and Cappadocia, the region is characterised by an increased water budget, availability, alimentation and routes. Compared to both the moister lower-lying coastal areas to the south (700–1200 mm/annum) and the aforementioned arid parts of the central Anatolian plateau further east (250–370 mm/annum), Pisidia receives moderate amounts of rainfall (400–800 mm), mainly in winter and spring (*Erol 1983.93, Fig. 6; Akman and Ketenoğlu 1986; Türkeş 2003. 184, Fig. 1*). Vegetation is described as heterogenous and transitional in character, connecting the milder and moister coastal zone with the arid central Anatolian plateau, the former characterised by its sub-Mediterranean and continental sub-Mediterranean vegetation, and the latter by xerophilous grassland, shrubs and patches of temperate coniferous forest. This situation is expressed by arid, steppe-like vegetation in depressions and basins, and tropical and subtropical dry forest with Scots Pine, European Black Pine, and Downy Oak in higher lying areas (see also *Hütteroth 1982.143, Fig. 50*).

Current knowledge of the Late Neolithic and Early Chalcolithic in Pisidia comes from excavations conducted at four sites: Hacılar, Kuruçay Höyük, Höyücek Höyük, and Bademağacı Höyük (Fig. 3). Whereas Hacılar was excavated in the late 1950s by James Mellaart, investigations at the latter sites, of which those at Bademağacı are still in progress, have been realised in the framework of three decades of investigations in the Burdur region by Refik Duru and the Burdur region research team.

HACILAR (37.57°N, 30.08°W): This site is located in an intramontane valley, *c.* 940m above sea level and 26km southwest of Burdur (*Mellaart 1970*). The mound, which at the time of its excavation measured 140m in diameter and approximately 5m high, lies only a small distance from Bozçay river, one of a number of tributaries draining into nearby Burdur lake. The settlement deposits excavated at Hacılar were assigned by Mellaart to a total of ten levels. These comprise five Early Chalcolithic phases (Hacılar V–I), four Late Neolithic occupations (IX–VI), and one underlying 'aceramic Neolithic' deposit thought to comprise seven different construction levels. However, more recent sondages at the site in 1985 and 1986 (*Duru 1989*) could not confirm the presence of an 'aceramic Neolithic' settlement phase, and with the continued absence of such early deposits at other sites in the region, this is now no longer seriously considered.

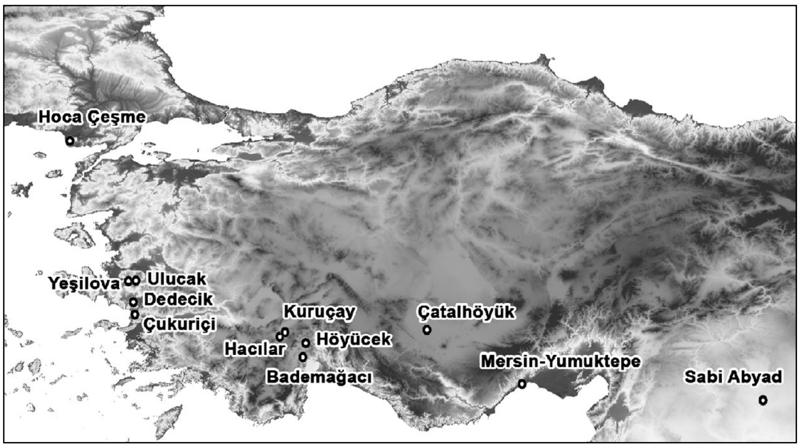

Fig. 3. Map of Anatolia and adjacent regions with archaeological sites mentioned in the text, dated to the 8600–8000 calBP RCC interval.

KURUÇAY HÖYÜK (37.63°N, 30.16°W): Kuruçay (*Duru 1983; 1994a; 2001a*) is located 15km southwest of Burdur and 10km northeast of Hacılar. The small mound, with a height of some 8m and a diameter of approximately 100m, is situated upon a natural prominence 960m above sea level, just 4km southeast of Lake Burdur. The investigation of deposits, mostly down to the underlying virgin soil, led to the identification of an archaeological sequence spanning a period from the Neolithic to the Bronze Age. Neolithic levels comprise the lowermost layers (13, 12 'lower', and 12 'upper') assigned by the excavator to the 'Early Neolithic', as well as 11 'lower' and 11 'upper' that make up the 'Late Neolithic' occupation at the site. Overlying layers 10–7 are assigned to the 'Early Chalcolithic'.

HÖYÜCEK HÖYÜK (37.45°N, 30.55°W): The small mound at Höyücek (*Duru 1994b; 1995; 2001b; Duru and Umurtak 2005*) lies in the Bucak plain, 35km south of Burdur and 30km southeast of Hacılar. The mound measures approximately 120m in diameter with a current height of some 4m. The archaeological sequence at Höyücek stretches from the Neolithic to the Chalcolithic, and features a total of four cultural layers. The earliest occupation at the site comprises the 'Early Settlements Phase' (ESP) and the 'Shrine Phase' (ShP); Late Neolithic levels are referred to as the 'Sanctuaries Phase' (SP); and finds from the Early Chalcolithic and later periods were recovered from the overlying 'Mixed Accumulations' (MA). The terminology chosen to refer to the elements of the sequence is at the same time an interpretation of the site's functions in each of its respective phases. Thus, in the Shrine Phase and the subsequent Sanctuaries Phase a dominant religious component is implied (*Duru and Umurtak 2005.230–231*).

BADEMAĞACI HÖYÜK (37.22°N, 30.49°W): This oval mound measures 200m long, some 110m wide, and 7m high (most recently *Duru 2005; Duru and Umurtak 2007; Yildirim and Gates 2007.287*). It lies on a small plain surrounded by low hills, adjacent to the northern flank of the western Taurus, approximately 50km north of Antalya. Investigations of the archaeological sequence have been underway since 1993 and have so far yielded remains from the Neolithic, Bronze Age and Christian era. Due to extreme difficulties encountered in establishing the correct stratigraphic sequence, slight revisions of previously proposed chronologies became necessary following the 2002 and 2003 seasons (*Duru 2005.541–547*). This involved the reassignment of structures previously thought to date to the Early Bronze Age, to a newly defined Late Neolithic (LN) period. Accordingly, the site of Bademağacı has yielded a Neolithic sequence (after *Duru 2005*) comprising the phases 'Early Neolithic' (ENI 9–5; ENII 4B, 4A, 4, 3A, 3, 2, 1) and 'Late Neolithic' (LN 2–1), with evidence for a Chalcolithic occupation at the site still only slight and amounting to small numbers of painted pottery sherds possibly indicative of a period of temporary settlement during this period.

From the four excavated LN/ECh sites there exists a total of 41 radiocarbon dates (Tables 1–9); 34 stem from Neolithic and Early Chalcolithic contexts, with seven Late Chalcolithic dates from the Kuruçay Höyük site. A total of 26 of these 34 dates are considered reliable, *i.e.* are neither evident outliers, nor characterised by high standard deviations in excess of ±100 ^{14}C-years. Whereas the most ancient date from the Bademağacı site (Hd-22340: 7949±31 ^{14}C-BP) may attest to the earliest reliably dated occurrence of Neolithic settlement in Pisidia so far – previously considered unlikely to predate the mid-seventh millennium calBC – others confirm contemporaneous occupation phases at all four sites with the 8600–8000 calBP RCC interval (Fig. 10, Tabs. 1–4).

On the basis of radiocarbon dates, and in due consideration of pottery assemblages from these sites, Ulf-Dietrich Schoop (*2002; 2005*) recently undertook a re-evaluation of the Neolithic and Chalcolithic sequence in the Lake District (Fig. 4). One important conclusion from this study is that the abrupt change in material culture observed in the Hacılar sequence between levels II and I, and originally interpreted by Mellaart (*1970.75*) as resulting from the immediate occupation of the site by a vanquishing 'foreign' force, was in fact due to a temporal hiatus in the occupation sequence. This gap is now filled by assemblages of a type discovered at Kuruçay 12–7. This hiatus in the Hacılar sequence is also mirrored at the nearby sites of Höyücek and Kuruçay, albeit that at these sites lacunae occurred slightly earlier. We return to the implications of such breaks (or phases of reorganisation) in settlement sequences, which can also be observed at contemporaneous sites to the east, further below.

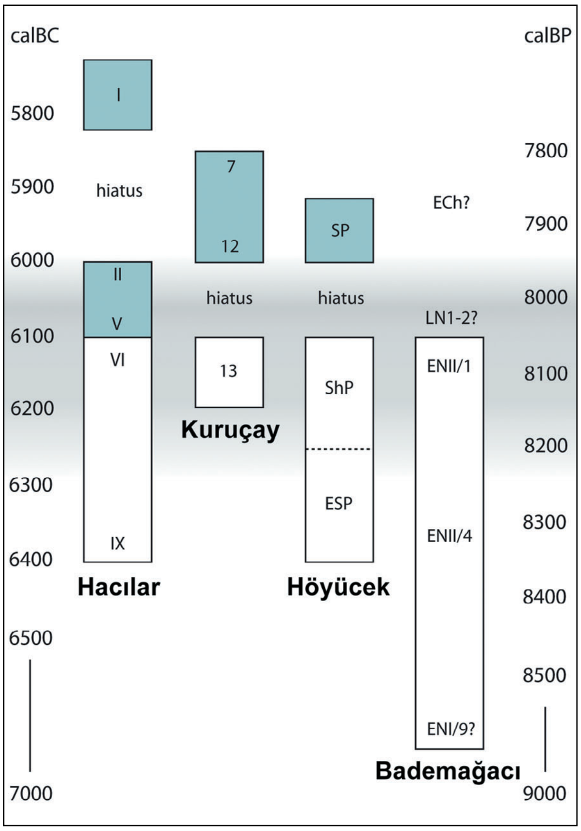

Fig. 4. Hacılar, Kuruçay Höyük, Höyücek Höyük, and Bademağacı Höyük. Synchronisation of settlement sequences after Schoop (*2005.Fig.4.9*), with most recent observations from Bademağacı after Duru (*2005*). Dark grey shading indicates Early Chalcolithic (painted pottery) levels; highlighted in light grey is the temporal extension of the 8200 calBP 'climate event'.

The main line of evidence for the occurrence of LN/ECh warfare in Pisidia is twofold. On the one hand, it comprises the occurrence of major conflagrations, and on the other it involves the construction of fortificatory walls around settlements (Fig. 5).

Fires

Why were the blazes at Hacılar, Höyücek, and Bademağacı not accidental? A number of points suggest that these events are warfare-related. To this end, we must turn to an earlier study of prehistoric warfare in the American Southwest by LeBlanc (*1999*), who discusses the characteristics of accidental fires on the one hand, and warfare-related fires on the other. Here it is noted that the most telling difference between the two concerns scale. Whereas accidental burning is more likely to be characterised by small and random fires, perhaps limited to just a single room, and occurring only rarely, warfare related conflagrations will affect the entire settlement, or large sections thereof, and result from a single event. Potential motives for burning entire settlements can be, for example, the displacement of its inhabitants by the enemy (by killing them or forcing them to migrate); to strike a blow sufficient to render defenders incapable of retaliation; or alternatively, if initiated by the defenders themselves, to deny the site to the enemy. A further indicator for warfare-related fires is noted already by Roper (*1975.301*), and more recently by Fry (*2006.136–137*), who state that a good signature is when burning is followed by either abandonment or a hiatus in the occupation sequence. Unburied bodies of victims and the discovery of 'in-situ' finds in burnt houses also suggest that blazes may have resulted from conflict situations (*Roper 1975.301*). Whereas the former are considered by LeBlanc (*1999.85*) as a good signature of warfare, in-situ finds might also indicate a potential element of surprise, which of course could also suggest the occurrence of an accidental fire.

Site	Signature	Source
Hacılar	**level IB**: large scale destruction of settlement through fire; burned bodies in rooms	*Mellaart 1970.76*
	level IA-B: Hacılar I *'fortress'*	*Mellaart 1970.75–76, Figs. 33–35*
	level IIB: large scale destruction of settlement through fire	*Mellaart 1970.37, 75*
	level IIA: large scale destruction of settlement through fire; body in burnt room	*Mellaart 1970.36–37*
	level IIA-B: fortified enclosure	*Mellaart 1970.25, Figs. 19–22, 25–27*
	level IV: *'bad fire'*	*Mellaart 1970.16*
	level VI: large scale destruction of settlement through fire	*Mellaart 1970.16*
Kuruçay	**level 11**: fortified enclosure	*Duru 1994.99*
Höyücek	**ShP (end)**: large scale destruction of remaining buildings 3, 4, and 5 through fire; large number of sling projectiles found on floor of building 3 **ShP**: destruction of buildings 1 and 2 through fire; large number of sling projectiles found on floor of building 1	*Duru 1995.486–487, plate 57.1;* *Duru & Umurtak 2005.230*
Bademağacı	**ENII/2**: burned structures (?)	*Duru & Umurtak 2006.12*
	ENII/3: bodies in burned house	*Duru 2005.548*
	ENII/4-3: remains of fortificatory structure	*Duru 2002.582, 591, plate 11/1,2; 2004.16f.; 2005.548, plates 5, 8/1; Umurtak 2007.141; Yildirim & Gates 2007.287*

Fig. 5. Hacılar, Kuruçay Höyük, Höyücek Höyük, and Bademağacı Höyük. Archaeological signatures for warfare.

Large scale destruction through fire at Pisidian sites can be especially observed at Hacılar at the end of levels VI, IIA, IIB, and IB, whereby Mellaart himself only considers the conflagrations at the end of phases IIB and IB as resulting from attack by hostile groups (*Mellaart 1970.75, 87*). A further '*bad fire*' is also noted in level IV (*Mellaart 1970.16*). Following the destruction of level IIB, Mellaart suggests that the attacker took possession of the site, importing their own material culture and erecting the Hacılar I 'fortress'. Meanwhile, the profound change in material culture observed between these two levels is instead thought to stem from a hiatus in the occupation sequence (*Schoop 2002; 2005; see above*). Thus, this newly recognised gap, which is directly subsequent to the destruction of the IIB settlement, serves to substantiate Mellaart's original assumption that this settlement fell victim to a violent act at this time. Similarly, the '*fire and massacre*' at the end of level IB is termed by Mellaart as the "*death blow to the once flourishing settlement*", culminating in its permanent abandonment at the end of level ID (*Mellaart 1970.87*). Here, although abandonment was delayed, it would appear to have followed within a short period of the conflagration, and therefore was presumably related to this catastrophe. It should be noted, however, that the much earlier conflagration at the end of Hacılar VI, although not followed by a temporal hiatus, is characterised by a development in ceramic traditions, it marking the generally acknowledged transition from the predominantly monochrome Late Neolithic to the Early Chalcolithic, during which the ratio of painted decoration in the ceramic assemblage rapidly increased.

Whereas at Höyücek all five structures belonging to this 'religious' complex were destroyed by two separate outbreaks of fire (*Duru and Umurtak 2005.230*), at Bademağacı the evidence for destruction by fire is more limited in scale, with burned houses so far noted for levels ENII/3 and ENII/2 (*Duru 2005.548; Duru and Umurtak 2006.12*). At Höyücek, the destruction at the end of the 'Shrine Phase' is followed by a temporal hiatus in the occupation sequence of approximately 100 years until reoccupation in the so called 'Sanctuaries Phase'.

Unburied victims of fires have been reported from both Hacılar and Bademağacı. At Hacılar, unburied victims were excavated from the ruins of both the IIB and IB settlements. From the former, one victim was recovered – the crouching skeleton of a person of advanced age was found upon the floor next to the western hearth of the northeast shrine (*Mellaart 1970.36*) – and in the remains of Hacılar IB an unspecified number of bodies, especially children, has been reported (*Mellaart 1970.76*). A further occurrence of unburied victims stems from the burnt remains of house 8 in level ENII/3 at Bademağacı Höyük. Upon excavation, this structure revealed the remains of nine burnt skeletons (two adults and seven children) "*in disorderly positions in different parts of the house*" (*Duru 2005.548*). Further, the discovery of large numbers of complete pottery vessels, stone tools, a terracotta seal, bone items, and thousands of beads suggests that this building may have been destroyed by a sudden fire.

Fortifications

The erection of fortifications around settlements has often been regarded as one of the most reliable indicators for the occurrence of warfare in prehistoric societies, although more recently, alternative proposals have been considered; for example, a wall can divert flood waters away from houses, it can block winds that produce sandstorms, and it can keep animals and children in and wild animals out (*Otterbein 2004*). In the case of the first of these proposals, this calls to mind Bar-Yosef's reappraisal of the function of the walls at Jericho (*Bar-Yosef 1986*). Be this as it may, Otterbein has also compiled ethnographical data which leads him to the conclusion that there is indeed a correlation between the frequency of internal war and village 'fortifications'. Accordingly, whereas village fortifications could be shown to predict continual or frequent warfare (15 out of 18 societies), war does not predict village fortifications (15 out of 25 societies) (*Otterbein 2004.192*). Thus, whereas this evidence confirms that walls are a reliable marker for the occurrence of war, it also demonstrates that they are not a compulsory feature. Additionally, following Keeley (*1996.55*), "*the variant sufficient condition for the construction of defences is the relative intensity of the perceived threat*", *i.e.* only if the danger of attack is sufficiently acute and constant, and the community meets the necessary preconditions for construction (social systems, adequate labour input etc.), will fortifications be erected.

Fortifications at Hacılar are known from the settlements Hacılar IIA, IIB, and I. However, it remains unknown whether the earlier Hacılar VI settlement, which was destroyed in a major conflagration (see above), was also fortified, as the edge of the settlement was never reached during excavations. Nevertheless, according to Mellaart, if not enclosed by a wall, it is extremely likely that it would have been provided with "*some sort of defence, probably as at Çatalhöyük, in the form of blank doorless outer walls in the houses on the periphery of the site*" (*Mellaart 1970.10*). For all remaining periods at Hacılar, fortifications are unknown; in the case of Hacılar V, this corresponds to a general loss of evidence associated with large-scale levelling and reshaping of the mound prior to the erection of the Hacılar I 'fortress' (*Mellaart 1970.23*).

Essentially, Hacılar IIA is a rectangular, fortified enclosure, measuring 36 x 57m and comprising a mud brick wall 1.5m to 3m thick (Fig. 6). Although lacking stone foundations itself, the wall was equipped with small and irregularly placed towers which did feature such substructures (*Mellaart 1970.25, plates XXVIIIa, XXVIIIb*). The exact number of gateways to the settlement remains ambiguous – either three or four (to the northwest, southwest, northeast, and possibly southeast). The main entrance to the settlement, a narrow doorway flanked by two towers, was located on the (north)western side of the settlement and led into the 'West Court'. The shape of the enclosure was changed slightly following the fire at the end of phase IIA. In Hacılar IIB the walls were extended several metres eastwards, whereby the eastern quarter of the settlement that had been destroyed at the end of level IIA was not rebuilt, but left void of structures; this part of the settlement is now referred to as the 'Eastern Court' (*Mellaart 1970.31, Fig. 25*). Following the destruction of Hacılar IIB and the ensuing hiatus in the Ha-

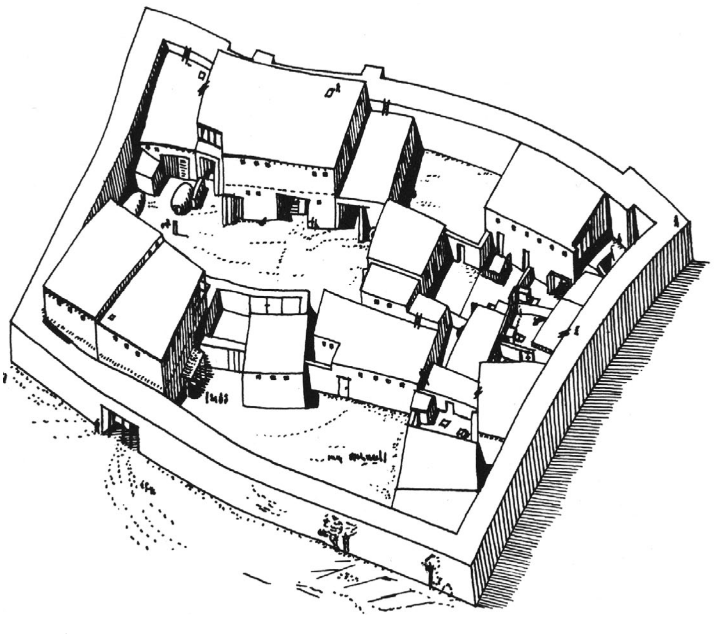

Fig. 6. Hacılar IIA. Reconstruction of the fortified settlement (from* Mellaart 1970.Fig. 22*).

cılar sequence, a new 'fortress' (Hacılar I) was erected. This comprised an extremely massive, on average 2m (and up to 4m) thick, solid mud brick wall that had been erected upon a single course of limestone rubble on the prepared level ground (*Mellaart 1970.75, 77*). The fortifications of the Hacılar I 'fortress' surrounded the entire *höyük* (approximately 100m in diameter) and encompassed a central court void of further structures; rooms were located against the inner side of the wall, groups of which were separated by small courtyards.

Of particular note is the continued presence of a deep, stone-lined well in the Hacılar settlement, in levels VI, IIA and IIB (*Mellaart 1970.19, 35, Figs. 7, 20, 25*). In each case, the numerous postholes discovered in its proximity might have belonged to some water-drawing appliance (*Mellaart 1970.35*). Here, a remark made by LeBlanc (*1999.69*) is of some relevance: "*Ethnographic accounts of warfare point to the very significant danger of ambush. Having a source where domestic water could be procured without fear of ambush would have been very valuable – and considerable effort was made to provide this security in some cases*".

Turning now to Kuruçay Höyük, the fortificatory wall discovered at this site is reported to have enclosed the level 11 settlement (*Duru 1994.99*) (Fig. 7). In spite of its poor state of preservation (only the stone foundations of the southern wall are well preserved), the fortification is thought to have been of rectangular plan, with a series of externally situated circular towers, three of which (one complete and two partially preserved) were discovered during excavations (*Duru 1999.plate 15*). The entrance to the enclosure was located at its south-eastern corner. Within the enclosure, excavations revealed very little architectural evidence. It is proposed that this is due to the northern part of the settlement having been swept away following a heavy downpour (flooding) which may have occurred during a late stage of the level 11 settlement phase (*Duru 1994a.99*).

At Bademağacı Höyük, levels ENII/4 and ENII/3 have also provided some potential evidence of fortificatory architecture (*Duru 2002.582, 591, plate 11/1,2; 2004.16–17; 2005.548, plates 5 and 8/1; Umurtak 2007.141; Yildirim & Gates 2007.287*). This feature, which is located at the edge of the tell and "*in keeping with the outer boundary of the höyük*" (*Duru 2005.548*), comprises five northwest-southeast oriented, parallel rows of foundations constructed of medium sized stones (20–35cm in diameter) placed approximately 40–50cm apart. Beneath this structure was discovered an older and more substantial (1m thick), L-shaped wall foundation. Both the younger 'grid plan foundations' as well as the earlier L-shaped wall section are thought to date to levels ENII/3 and ENII/4, respectively. Indeed, if the proposed function of this feature is confirmed, this would mean that Bademağacı presides over the earliest fortification so far discovered at a Neolithic settlement in Anatolia (*c.* 64th–63rd century calBC). On the other hand, the excavations at both Hacilar (level I) and Kuruçay (level 11) suggest that fortifications were still a common feature of Early Chalcolithic settlement into the sixth millennium calBC.

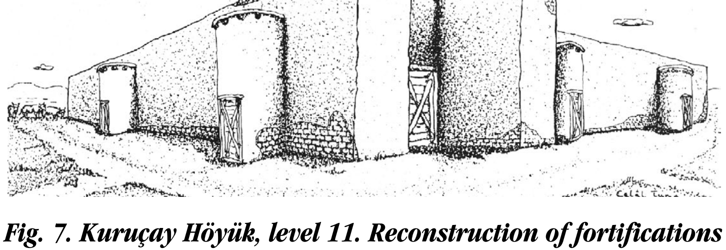

*Fig. 7. **Kuruçay Höyük, level 11. Reconstruction of fortifications (from** **Duru 1994.Fig I–11**), with kind permission of the author.*

Slings and sling missiles

Although there is no direct evidence that slings were used as weapons during the Late Neolithic and Early Chalcolithic periods in Anatolia, it is interesting to note the widespread use of the sling at this time (as testified by the frequent occurrence of biconical clay sling missiles) and the contemporaneous decline in the use of the bow (as evidenced by the absence of arrowheads among these same communities) (*Korfmann 1972; Özdoğan 2002*). This is a phenomenon which can be observed over a large region, from the eastern fringes of the Near East to the Aegean in the west. Indeed, by the close of the seventh millennium calBC, the sling would have been the most readily available long-distance weapon of communities living in these geographical regions, and therefore in Pisidia also.

Nevertheless, to interpret all clay sling missiles as weapons, without considering other functions, would be wrong, and similarly, it would be false to assume that all locations where clay sling missiles occur were war zones. Indeed, Perlès (*2001.229–231*) has criticised the over-emphasis on the sling's status as a weapon, which in her opinion is more likely a '*shepherd's implement*' used to bring back stray animals to a herd in the absence of sheep dogs. Although such an interpretation is acceptable, the potential destructive power of the sling should not be played down in any way. Indeed, its capabilities as a hunting weapon are related from the Halaf culture in northern Syria (*Akkermans and Wittmann 1993. 159*), and it is but a small step from its usage in the hunt to its being brandished as a weapon (*cf. Otterbein 2004.85–86*); Chapman (*2004.108*) refers to the sling as a so-called '*Tool-Weapon*', whereby the hoarding of such items, in this case sling projectiles, has been noted as a significant marker for the preparation of a community for war, particularly in the case of fortified settlements (*Redmond 1994; Chapman 2004.102–103*).

For the Neolithic, the use of slings and sling missiles in a conflict situation has been proposed by Vutriropulos (*1991.129, plate V*) for a discovery made at the Bulgarian site of Stara Zagora. Here, the excavation of a burnt (Karanovo II period) settlement – followed incidentally by a gap in the occupation sequence – revealed the remains of two adjacent structures, both of which yielded a large number of clay missiles dispersed throughout. This scene is commented on by Vutriropulos as a prime example of prehistoric warfare in the archaeological record. However, although a tempting interpretation, it is essential that we proceed with a little more caution, it being equally conceivable that these objects fell from an upper storey in the course of the (accidental) fire (*pers. comm. H. Todorova*). Be this as it may, the factor of warfare should not simply be passed by, as recent discoveries at the fourth millennium calBC settlement of Hamoukar in northern Syria have demonstrated. At this site, an excavation team "*found extensive destruction with collapsed walls, which had undergone heavy bombardment by sling bullets and eventually collapsed in an ensuing fire*" (*University of Chicago News Office*).

At the Late Neolithic/Early Chalcolithic sites in Pisidia, (clay) sling missiles are a very common occurrence. At Hacılar VI, a depot was discovered in a recess behind the oven in house Q.5 (*Mellaart 1970. 18, plate XIVb*), and in Hacılar V, IV, and III further deposits of '*slingstones*' were revealed (*Mellaart 1970.24, plate XXVIa, Fig.16*). At Höyücek (Shrine Phase), sling projectiles were also discovered in large numbers. Duru refers to "*hundreds of clay sling pellets found on the floors of the* [burnt] *Structures 3 and 1*" (*Duru 1995.486–487, plate 57.1*); in the first of these buildings they were found together with a collection of large stone hand axes (*Duru and Umurtak 2005.165*). At Kuruçay Höyük, sling projectiles are not mentioned in the comprehensive English summary of the final publication (*Duru 1994a*), although their occurrence at this fortified site must be assumed; and at Bademağacı they occur from level ENII/3 onwards, following absence from earlier levels (*Çilingiroğlu 2005.7*). On the basis of this evidence, it may be assumed that slings and clay sling missiles were introduced to the Lake District from around 6300 calBC. Only further east are earlier finds of clay projectiles known, *e.g.* at Çatalhöyük East in Central Anatolia, where they appear from level VI (*c.* 6500/6400 calBC), and at Tell Sabi Abyad in the Balikh valley, northern Syria, where – although particularly common in phases Balikh IIC and IIIA (*c.* 6200–5900 calBC) – they have also been found in relatively large numbers in recent excavations of older deposits that date back to the mid-seventh millennium calBC (*Akkermans et al. 2006.141, 144, 149*). Ultimately, this spatial and temporal pattern might be suggestive of a rapid dispersal of sling and clay projectiles from the east towards the west, arriving in Pisidia and western Anatolia in the late seventh millennium calBC. Indeed, in more westerly parts, for example in the Aegean region and the south-eastern periphery of Europe, they may even have arrived as part of the larger 'Neolithic Package', as may have been the case at Hoca Çeşme and Ulucak Höyük (*Çilingiroğlu 2005. Tab. 2*).

Who was the enemy?

Naturally, the Late Neolithic and Early Chalcolithic settlement of Pisidia comprised more than just the four excavated settlements at Hacılar, Kuruçay, Höyücek, and Bademağacı. On the basis of past and recent survey work, it must be assumed that both in the Lake District and in adjacent regions there was a dense network of contemporaneous and semi-contemporaneous sites during these periods, and therefore also in the centuries 6200–6000 calBC. So who was the enemy?

Here we must return to an aforementioned archaeological study from the American Southwest (see above) in which similar lines of enquiry have previously featured. In his investigation, LeBlanc (*1999*) reports of typical situations in which clusters of three or more sites are separated from each other by about 20 miles, with the spaces between clusters – '*no* *man's land*' – increasing over time. Whereas such a settlement pattern is presumed characteristic for group internal conflict, more densely packed conglomerations of site clusters, or the appearance of long linear arrangements of settlements, are thought likely to denote an 'outside' threat (*LeBlanc 1999. 53–54*). In order to gain a picture of these aspects in the Late Neolithic and Early Chalcolithic settlement pattern, a GIS-analysis of available settlement distribution data for south-western Anatolia and adjacent parts was undertaken.

Using GIS-applications, the spatial distribution of prehistoric sites can form the basis for a 'reconstruction' of past settlement areas and, in some cases, permits calculations of population densities (*e.g. Zimmermann 2003; Zimmermann et al. 2004; Vogelsang & Wendt 2007; Hilpert et al. 2007*). LN/ECh settlement groups have been identified using spatial data from south-western and central Anatolia using a method known as KDE ('*Kernel Density Estimates*'), first applied to an archaeological dataset by Beardah and Baxter (*1996*). It has been noted more recently (*Herzog 2007a; 2007b, Hilpert et al. in press*) as a promising alternative to the counterpart method based on the LEC ('*Largest Empty Circle*'). Common to both methods is their ability to transform point data into area data. While LEC calculations involve the application of Thiessen polygons (voronoi tessellation) for territory allocation, and the geostatistical kriging interpolation to produce isolines, the KDE method instead uses the find spots themselves. This latter method has the advantage of being less dependent on interpolation, and hence more robust in large areas with relatively low density sites, as given here.

Data was accessed from the online TAY Project Database. It includes both excavated sites with deposits radiocarbon dated to the 8200 calBP 'climate event' (N = 6; Hacılar, Kuruçay Höyük, Höyücek Höyük, Bademağacı Höyük, Erbaba, Çatalhöyük), as well as unexcavated sites (N = 81) from the Lake District and adjacent regions with surface collections assigned to either the Late Neolithic and/or Early Chalcolithic (*c.* 6500–5300 calBC) and therefore 'straddling' this same time period. Naturally, in the case of the latter sites, which by far outnumber the former, temporal resolution is far from sufficient to identify those settlements occupied during the 8200 calBP 'climate event'. Nevertheless, this database provides the best evidence for potential settlement groups in south-western Anatolia and adjacent parts at the end of the seventh millennium calBC.

The GIS-analysis of the Anatolian data confirms the existence of four distinguishable settlement groups situated within clearly defined physical borders (Fig. 8). Each group is characterised by clusters of settlements located on small plains or within natural depressions and basins, and each separated from its neighbour(s) either by bodies of water or by extensions of the western Taurus range. At the same time, the two larger groups (Burdur and Beyşehir groups) are characterised by an internal structure comprising smaller agglomerations of sites. Here it is striking that the arrangements of settlements within these same two groups show analogies with the spatial criteria stipulated by LeBlanc (*1999*) as characteristic of an 'outside' threat; particularly notable is the high frequency of sites arranged in a linear, ribbon-like manner, especially in the Beyşehir group, but also to a very visible extent in the Burdur group. Further, the GIS-analysis is particularly effective in highlighting clusters of settlements. Whereas in the Burdur group one might differentiate between three, possibly four, different concentrations, in the Beyşehir group a total five clusters are clearly distinguishable. The distance between these clusters exceeds in some cases – especially in the Beyşehir group of settlements – some tens of kilometres. Therefore, if all the analysed sites were contemporaneous, on the one hand, one might interpret their distribution as spatial evidence of an external threat, particularly the long linear arrangement of sites providing inhabitants with mutual support from neighbouring communities in times of danger; while on the other hand, visible clusters of settlements separated by considerable distances might also suggest internal conflicts. A more satisfactory conclusion from GIS-analyses would require a higher temporal resolution of the featured data, which is only possible through sondages or excavations at the featured Late Neolithic/ Early Chalcolithic sites.

Contemporaneous developments in adjacent regions

As is evident from the chronology table (Fig. 9) and the available radiocarbon dates (Figs. 10 and 11, Tabs. 1–10), there appears to be a temporal association of the 8200 calBP 'climate event' with gaps and/ or phases of reorganisation at Pisidian sites, as well as similar events at settlements in other parts of Anatolia and beyond. In the following, reference is made to Çatalhöyük in the Konya plain, Mersin-Yumuktepe in Cilicia, and Tell Sabi Abyad in the Balikh valley, northern Syria. At all three sites there is evidence that there occurred a change in settlement

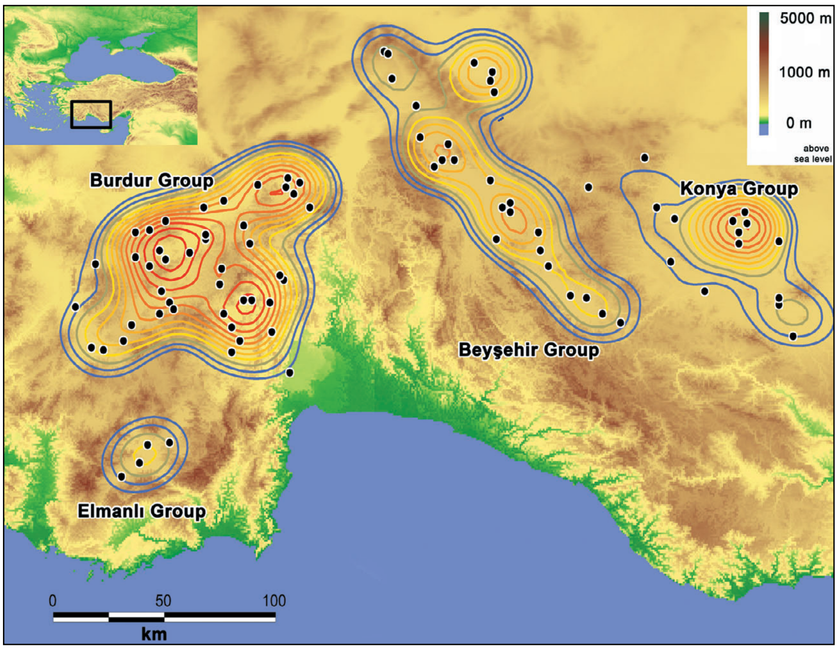

Fig. 8. Southwest Anatolia. Distribution of Late Neolithic/Early Chalcolithic sites with discernible settlement groups based on GIS-analysis (data accessed from TAY Project Database).

structures which correlate temporally with the 8200 calBP 'climate event'.

The temporal correlation of climate forcing and the abandonment of the eastern mound at Çatalhöyük has already featured in earlier papers (*Weninger et al. 2005.98; 2006.410*). There it was proposed that, following the abandonment of Çatalhöyük East, there ensued a hiatus of some 200 years prior to the founding of Çatalhöyük West in the Early Chalcolithic. Remarkably, a new series of radiocarbon dates from the western mound (Fig. 11, Tab. 5) has recently been put forward as "*strong evidence supporting the hypothesis that the sequence at Çatalhöyük West overlaps with that of its Neolithic predecessor Çatalhöyük East*" (*comment C. Cessford in Higham et al. 2007*). Notwithstanding, even in light of this new evidence, we feel obliged to hold fast to our earlier claim, *i.e.* that the available radiocarbon dates are still suggestive of a temporal break in the Çatalhöyük sequence at the end of the seventh millennium calBC, as shown in Figure 11. However, caution should be exercised, at least until it is clear that the basal deposits of the Çatalhöyük West mound are covered by the available dates. The results from continuing investigations should bring clarity in this matter. Ultimately, irrelevant to whether the abandonment of Çatalhöyük East predated, coincided with, or even post-dated, the establishment of the nearby western '*höyük*', this same period is still marked by a major reorganisation of the settlement structure in the Çatalhöyük area. This involved not only the abandonment of the eastern mound after some 1000 years of uninterrupted settlement activity, but also the founding of a new settlement on the opposite side of the Çarşamba river, *c.* 200m to the west. Further, this development is also concurrent with a major change in material culture that is characterised by the abrupt increase of painted decoration in the 'Early Chalcolithic' ceramic assemblage found at Çatalhöyük West.

A very similar development can be observed not only at the Cilician settlement of Mersin-Yumuktepe, but also at the northern Syrian site of Tell Sabi Abyad (*Akkermans et al. 2006; Clare et al. in press*). At the former, the final two centuries of the seventh millennium calBC coincide with those occupation levels (Yumuktepe XXVII–XXVI) recently assigned to an independent 'Middle Neolithic' settlement phase (*Caneva 2004a*). Whereas this period is noted for the earliest evidence at this site of rectilinear stone foundations of structures interpreted as a combination of living quarters and storage facilities (*Garstang 1953.27, Fig. 12; Caneva 2004a.37, Figs. 8 and 9; Balossi Restelli 2006.14, Pl. 2.1*), it is also a period during which its ceramic repertoire began to diverge from the contemporaneous (DFBW) assemblages found in adjacent regions to the east, *i.e.* in the Amuq plain, at Ras Shamra, and in the Rouj basin (*Balossi 2004. Tab. 1*). This 'Middle Neolithic' occupation, with its characteristic 'cell-buildings', appears to have climaxed, at least in the excavated area of the mound, with a major conflagration and the likelihood of a subsequent hiatus, albeit of short duration (*Caneva 2004b.45; Clare et al. in press*). Following this break, a marked change is suggested in both the settlement structure and function of this same part of the settlement. This sees a broad shift from the 'domestic' to the 'agricultural', with the same part of the settlement now accommodating large rectilinear stone-based structures that have been interpreted as animal pens, followed in levels XXV ('Late Neolithic') and XXIV ('Final Neolithic') by the introduction of (communal?) storage facilities in the form of cobble-paved silos (*Caneva 2004b.49–50; Balossi Restelli 2006.14*).

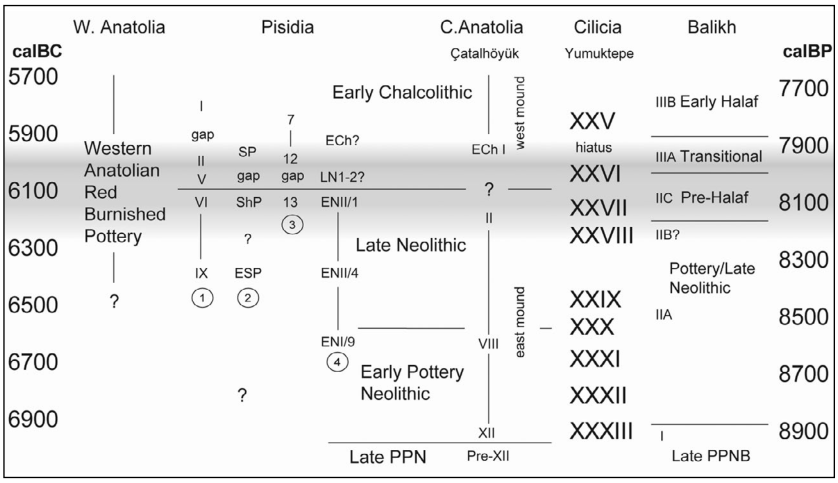

Fig. 9. Late Neolithic/Early Chalcolithic chronology. Western Anatolia after Lichter (2006); Pisidia after Schoop (2005), with recent observations from Bademağacı after Duru (2005); Mersin-Yumuktepe after Balossi Restelli (2006); Balikh valley after Akkermans et al. (2006). 1. Hacılar, 2. Kuruçay, 3. Höyücek, 4. Bademağacı. Grey shading marks the temporal extension of the 8200 calBP 'climate event'.

Moving eastwards, the northern Syrian settlement of Tell Sabi Abyad in the Balikh valley has also provided evidence of a significant reorganisation of its structure in the transition from the Early Pottery Neolithic (Balikh IIA/B) to the Pre-Halaf period (Balikh IIC), *i.e.* at around 6300/6200 calBC (*Akkermans et al. 2006*). This was connected with a substantial decline in the size of the settlement, during which "*the formerly densely occupied area on the western side of Tell Sabi Abyad was abandoned*" (*Akkermans et al. 2006.150*). In the wake of this reorganisation, settlement appears to have continued at two separate occupations on the eastern side of the mound. The subsequent 'Transitional' period (Balikh IIIA; *c.* 6050–5900 calBC) is associated with a number of major developments marking the run-up to the emergence of the Halaf culture in the early sixth millennium calBC. Particularly significant for the 'Transitional' period at Tell Sabi Abyad is the so called 'Burnt Village' (level 6) which, as its name implies, was destroyed by a major fire. New evidence suggests that not only the south-eastern part of the site was destroyed in this event, but that the same blaze may also have ravaged north-eastern parts of the settlement (*Akkermans et al. 2006.129–130*). The current hypothesis concerning the background of this conflagration lies in a ritual context, possibly an intentional (cleansing) act, perhaps in association with the death of (a) prominent individual(s), although accidental or warfare related causes cannot be ruled out entirely[2]. The end of the Transitional period sees the beginning of the Halaf sequence proper (from *c.* 5900 calBC), characterised by large numbers of small (0.1–1 ha) and short-lived (seasonal?) sites, widespread mobility, and a relatively low population density (*Akkermans and Schwartz 2003.119–120*). Pottery frequently displays a mainly black or brown painted decoration, also with highly standardised motifs (*Le Mière and Nieuwenhuyse 1996*).

To the west of Pisidia, research into contemporaneous settlement is still at a relatively early stage (*Lichter 2005; 2006*), with excavations and sondages so far conducted at only a small number of Western Anatolian sites, which include Ulucak Höyük (*Çilingiroğlu et al. 2004; Çilingiroğlu and Çilingiroğlu 2007*), Dedecik-Heybelitepe (*Lichter and Meriç 2007; cf. Yilderim and Gates 2007.287*), Yeşilova Höyük (*Derin 2007*), as well as Çukuriçi Höyük (*Horejs 2008*), although many more are known by surface finds, indicating that the region was densely populated at this time (*cf. Erdoğu 2003.12–14; Lichter 2005.62–63*). In addition to the archaeological evidence, absolute radiocarbon dates from the area are still limited to just a handful of measurements from Ulucak and Yeşilova. These suggest the first occurrence of Neolithic lifeways in this region not prior to the final centuries of the seventh millennium calBC, with the oldest date so far from Yeşilova (KN–5811: 7505 ± 30 ^{14}C-BP). Traces of earlier Neolithic settlement activity is still lacking, although deeper deposits at Ulucak, for example, still remain unexcavated. Exceptional are the slightly older dates from the lowermost level at Hoca Çeşme in Turkish Thrace, which may testify to the sporadic occurrence of earlier (fortified) Neolithic 'colonies' (*cf. Özdoğan 1998*) in the Turkish Aegean region from the mid-seventh millennium calBC. The absence of painted pottery is striking, and in stark contradiction to the ceramic assemblages recovered from contemporaneous sites in the Lake District. Recently referred to

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[2] http://www.sabi-abyad.nl/tellsabiabyad/projecten/index/0/8/?sub=9&language=en

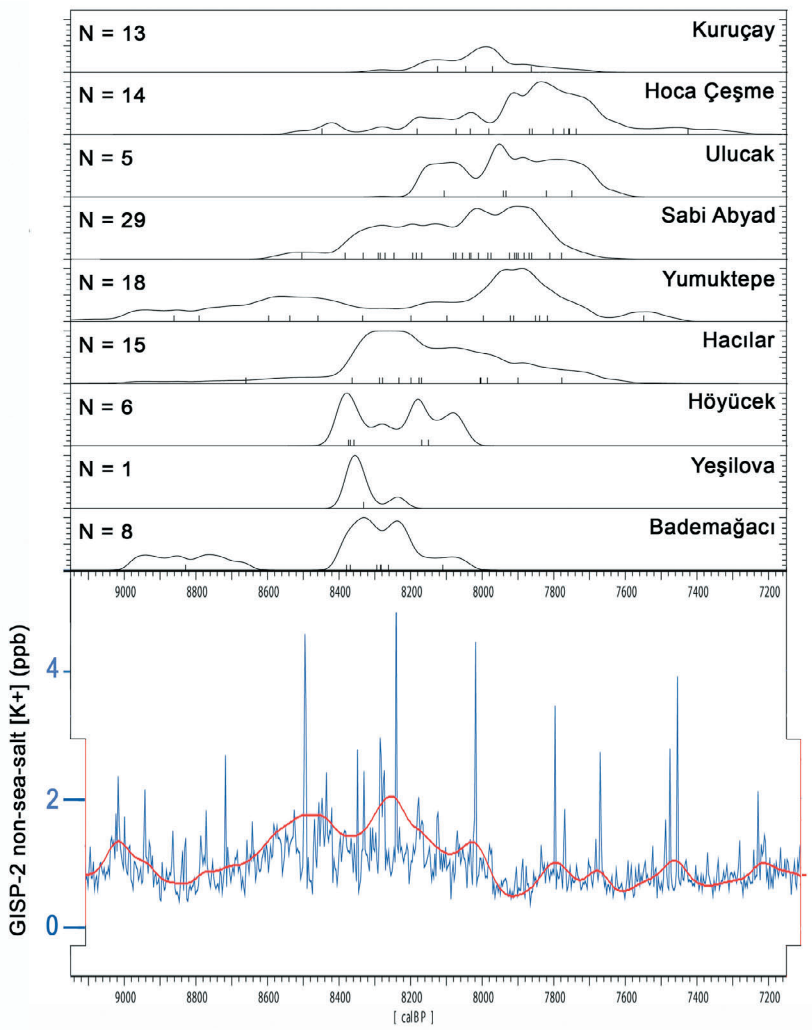

Fig. 10. Cumulative calibrated dating probability of radiocarbon data from nine archaeological sites in Turkey (Kuruçay Höyük/Table. 2, Hoca Çeşme/Table 9, Ulucak Höyük/Table 7, Mersin-Yumuktepe/Table 6, Hacılar/Table 1, Höyücek Höyük/Table 3, Yeşilova Höyük/Table 8, Bademağacı Höyük/Table 4) and Northern Syria (Tell Sabi Abyad/Table 10) in relation to the Holocene non-sea-salt [K+] series for the GISP2 ice core from Greenland (**O'Brien et al. 1995; Mayewski et al. 1997*****) (bottom).***

by Lichter (*2006*) as 'West Anatolian Red Burnished Pottery' ('*Westanatolische Rot Polierte Keramik*' or WARP), vessels from these assemblages are red to reddish brown, slightly burnished, and sometimes slipped; most frequent forms are hole-mouth and S-shaped pots, with flat bases or sometimes with low pedestals (*Lichter 2005.63; 2006.34*).

Discussion

Summarising the evidence presented in this paper, it appears that the 8200 calBP 'climate event' coincides not only with clear breaks (and possible lacunae) in sequences at major settlements in the Balikh valley, Cilicia, and the Konya plain, but also with potential evidence for warfare in Pisidia, as well as with an intensification of Neolithic dispersal into western Anatolia, the Aegean, and south-eastern Europe. In this context, it is of particular interest to note some remarks made recently by M. Özdoğan (*2005*) who, in reference to the spread of Neolithic lifeways and traditions westwards from their 'formative zone', writes: "*The fact that the expansion continued on [beyond western Anatolia and the Marmara region], rather quickly reaching the farthest extents of Europe, implies that some sort of social turbulence must have been the main reason, giving way to what can be described as the motivation to migrate*" (*Özdoğan 2005.20–21*).

Might then this 'social turbulence' be partly explained, at least for the Lake District, by the outbreak of warfare in the late seventh and early sixth millennium calBC? If so, how might this conflict relate to the roughly contemporaneous interludes of settlement reorganisation at the sites of Çatalhöyük, Yumuktepe and Tell Sabi Abyad? Although Özdoğan makes no suggestions himself as to the possible 'motivation' behind migration, the apparent coincidence of the 8.2 ka calBP 'climate event' with this period of intensive Neolithic dispersal may be critical. In the semi-arid interior of the Anatolian peninsular and in northern Syria, communities may have been struck by particularly cold/severe winters and springs, combined with either drought conditions or the effects of more extensive rainfalls and snowfalls. These would have placed an increased strain on resources, leading ultimately to food shortages and famine situations; substantiation for such a scenario is certainly found in historical accounts from central parts of the Anatolian peninsular (*Christiansen-Weniger 1964*).

As noted by J. Yakar (*2000.229*), the only sensible way to alleviate such problems "*is for farming communities to temporarily minimize the pressure on*

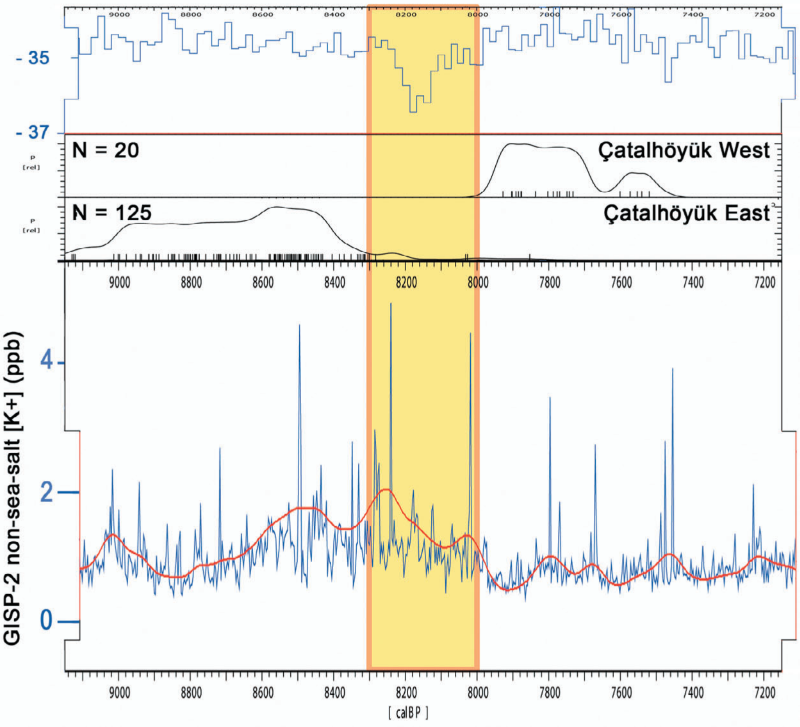

***Fig. 11. Cumulative calibrated dating probability of radiocarbon data from Çatalhöyük East (*Weninger et al. 2005.Tab.4*) and Çatalhöyük West (Tab. 5) in relation to GISP2 $\delta^{16}O/^{18}O$ (*Grootes et al. 1993*) (top) and the Holocene non-sea-salt [K$^+$] series for the GISP2 ice core from Greenland (*O'Brien et al. 1995; Mayewski et al. 1997*) (bottom). In contrast to published GISP2 ages (*Grootes er al. 1993*), GISP2 $^{16}O/^{18}O$ records (top) and GISP2 [K$^+$] records (bottom) are shifted 40 yrs to the younger, as proposed by Weninger et al. (*2006*) and Vinther et al. (*2006*).**

the carrying capacity of the land. The best solution is to relocate much of the livestock and part of the community to less affected habitats". He stresses, however, that any translocation of even small groups of pastoralists and/or farmers to areas beyond the crisis zone can lead "*to territorial disputes, and large-scale intrusions may well have sparked serious conflicts and anarchy*". This same basic assumption, *i.e.* that climate change affects societies by altering agricultural productivity and consequently social stability, is encountered in most studies to have focused on the effects of climate deterioration on human society. Could this then also be a likely scenario for the late seventh and early sixth millennium calBC in Anatolia? Had the climate in central and eastern parts of the peninsular become too unpredictable? Did parts of the population from these regions seek alternative territories in adjacent, less afflicted areas? Indeed, this may have led not only to a reorganisation of their own communities, for example, as at Çatalhöyük, Mersin-Yumuktepe and Sabi Abyad, but also to the destruction and periodical abandonment of settlements encountered in the latter, *e.g.* in Pisidia. As noted by Keeley (*1996.139*), "*Droughts figure frequently in examples of disaster-driven warfare*".

Finally, and perhaps most controversially, are we witnessing a climate induced ***intensification*** of Neolithisation processes from the semi-arid 'formative zone' of Neolithic genesis westwards into both the Aegean region and into centres of south-eastern European 'Early Neolithic' development, *e.g.* in Thessaly, in the Strumon valley, and beyond? Certainly, the aforementioned predominance of the sling over the bow at this time has been linked with the migration of specialised craftsmen from core areas of obsidian tool manufacture, located primarily in Central Anatolia (*Özdoğan 2002.443*).

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Appendix

Date List: ^{14}C-Data from archaeological sites referenced in the text

The radiocarbon dates are cited according to the original publication (*reference*). There are cases when the archaeological sample description is only available from secondary and higher order data descriptions, and notably from the following on-line databases:

Reingruber and Thissen 2004: www.canew.org/download.html
Gérard 2001: www.canew.org/download.html
Thisssen 2007: www.canew.org/download.html
Böhner 2006: www.context-database.uni-koeln.de.

Conventional ^{14}C-ages [BP ± 1 σ] are defined as dimensionless logarithmic ^{14}C count rates of dated samples relative to the standard NBS Oxalic Acid (*Mook and van der Plicht 1999*). Calibrated ages [calBC ± 1 σ] are calculated with the CalPal program (www.calpal.de) using methods of Weninger (*1986*) as the base of the INTCAL04 ^{14}C-age tree-ring calibration database (*Reimer et al. 2004*). Numeric calibrated ages are given as median values, with errors (p = 68.2% interval derived from the calibrated age distribution) rounded to the nearest decade.

Lab code	^{14}C age (BP)	$\delta^{13}C$	Material	Species	Period	Site Locus	Cal age (calBP)	Reference
P–315	6926 ± 95	n.d.	charcoal	(poutre)	level IA	Room 5, Roof Beam	7780 ± 90	*Ralph and Stuckenrath 1962*
P–315A	7047 ± 221	n.d.	charcoal		level IA	Room 5, Roof Beam	7900 ± 210	*Ralph and Stuckenrath 1962*
P–313	7150 ± 98	n.d.	charcoal		level VI	Area E, ash from fireplace	7990 ± 110	*Ralph and Stuckenrath 1962*
P–326A	7169 ± 131	n.d.	n.d.				8000 ± 140	*Bienert 2000*
P–316	7170 ± 134	n.d.	charcoal		level IIA	Area N, Room 4, Roof Beam	8000 ± 140	*Ralph and Stuckenrath 1962*
P–316A	7172 ± 127	n.d.	charcoal		level IIA	Area N, Room 4, Roof Beam	8010 ± 130	*Ralph and Stuckenrath 1962*
P–314	7340 ± 94	n.d.	charcoal		level IX	Area E, ash from fireplace	8170 ± 110	*Ralph and Stuckenrath 1962*
P–313A	7350 ± 85	n.d.	charcoal		level VI	Area E, ash from fireplace	8180 ± 110	*Ralph and Stuckenrath 1962*
P–326	7386 ± 131	n.d.	charcoal				8200 ± 130	*Bienert 2000*
AA–41604	7398 ± 63	n.d.	charcoal	juniper	level VI	Area P, Burnt Post, id BM–48	8230 ± 80	*Thissen 2006*
AA–41603	7452 ± 51	n.d.	charcoal	juniper	level VI	Area P, Burnt Post, id BM–48	8280 ± 60	*Thissen 2006*
AA–41602	7468 ± 51	n.d.	charcoal	juniper	level VI	Area P, Burnt Post, id BM–48	8290 ± 60	*Thissen 2006*
BM–48	7550 ± 180	n.d.	charcoal		level VI	Area P, Burnt Post	8360 ± 180	*Barker and Mackey 1960*
BM–125	7770 ± 180	n.d.	charcoal		level VII	Area P, Corner Beam from room	8660 ± 230	*Barker and Mackey 1963*
BM–127	8700 ± 180	n.d.	charcoal		level V "aceramic"	Area Q, ash from fireplace	9810 ± 240	*Barker and Mackey 1963*

Tab. 1. Hacılar (37.57°N, 30.08°W). Database references: **Gérard 2001; Thisssen 2006; Böhner 2006.**

Lab code	^{14}C age (BP)	$\delta^{13}C$	Material	Species	Period	Cal age (calBP)	Reference
Hd–9988/10341	4620 ± 60	n.d.	charcoal	n.d.	L–CH	5310 ± 140	*Duru 1994*
Hd–9992/10363	4650 ± 55	n.d.	charcoal	n.d.	L–CH	5400 ± 70	*Duru 1994*
Hd–9990/10361	4690 ± 60	n.d.	charcoal	n.d.	L–CH	5440 ± 100	*Duru 1994*
Hd–9991/10362	4720 ± 60	n.d.	charcoal	n.d.	L–CH	5450 ± 100	*Duru 1994*
Hd–9989/10360	4740 ± 50	n.d.	charcoal	n.d.	L–CH	5460 ± 100	*Duru 1994*
–	4795 ± 82	n.d.		n.d.	L–CH	5490 ± 110	*Duru 1994*
–	5170 ± 70	n.d.	charcoal	n.d.	PN	5910 ± 110	*Duru 1983*
–	5450 ± 52	n.d.		n.d.	L–CH	6240 ± 50	*Duru 1994*
HD–12917/12830	7045 ± 95	n.d.	bone	n.d.	PN	7850 ± 90	*Duru 1994*
HD–12916/12674	7140 ± 35	n.d.	bone	n.d.	PN	7940 ± 50	*Duru 1994*
–	7214 ± 38	n.d.	charcoal	n.d.	PN	8040 ± 60	*Duru 1983*
HD–12915/12673	7310 ± 70	n.d.	bone	n.d.	PN	8100 ± 70	*Duru 1994*

Tab. 2. Kuruçay Höyük (37.63°N, 30.16°W)

Lab code	^{14}C age (BP)	$\delta^{13}C$	Material	Species	Period	Site Locus	Cal age (calBP)	Reference
HD–14217/13822	7349 ± 38	n.d.	charcoal	n.d.	Shrine Phase	post	8150 ± 70	*Duru 1995*
–	7350 ± 50	n.d.	charcoal	n.d.	Shrine Phase	post	8170 ± 90	*Duru 1994b*
–	7350 ± 50	n.d.	charcoal	n.d.	Shrine Phase	post	8170 ± 90	*Duru 1994b*
–	7540 ± 45	n.d.	charcoal	n.d.	Shrine Phase	post	8360 ± 40	*Duru 1994b*
HD–14218/14002	7551 ± 46	n.d.	charcoal	n.d.	Shrine Phase	post	8370 ± 40	*Duru 1995*
HD–14219/14007	7556 ± 45	n.d.	charcoal	n.d.	Shrine Phase	post	8370 ± 30	*Duru 1995*

Tab. 3. Höyücek (37.45°N, 30.55°W)

Lab code	^{14}C age (BP)	$\delta^{13}C$	Material	Species	Period	Cal age (calBP)	Reference
Hd–21046	7307 ± 41	n.d.	n.d.	n.d.	EN II/1	8110 ± 50	*Thissen 2006*
Hd–21016	7424 ± 37	n.d.	n.d.	n.d.	EN II/4	8260 ± 50	*Thissen 2006*
Hd–21058	7459 ± 51	n.d.	n.d.	n.d.	ENII/3	8280 ± 60	*Thissen 2006*
Hd–22279	7465 ± 27	n.d.	charcoal	n.d.	EN II/4A	8280 ± 60	*Duru 2004*
Hd–21015	7481 ± 40	n.d.	n.d.	n.d.	EN II/4	8290 ± 60	*Thissen 2006*
Hd–20910	7546 ± 41	n.d.	n.d.	n.d.	EN II/3	8370 ± 30	*Duru 2002*
Hd–22339	7553 ± 31	n.d.	charcoal	n.d.	EN II/4–3A	8380 ± 30	*Duru 2004*
Hd–22340	7949 ± 31	n.d.	charcoal	n.d.	EN I/8	8830 ±110	*Duru 2004*

Tab. 4. Bademağacı (37.22°N, 30.49°W)

Lab code	^{14}C age (BP)	$\delta^{13}C$	Material	Species	Period	Cal age (calBP)	Reference
PL– 980524A	6940 ± 80	n.d.	charcoal	n.d.	Early Chalcolithic	5840 ± 80	*Göktürk et al. 2002*
AA–27981	7040 ± 40	n.d.	charcoal	n.d.	Early Chalcolithic	5940 ± 50	*Göktürk et al. 2002*
OxA–11763	6626 ± 36	–22,20	seeds	cereal	Early Chalcolithic	7520 ± 40	*Higham et al. 2007*
OxA–11762	6662 ± 38	–21,80	seeds	hackberry	Early Chalcolithic	7540 ± 40	*Higham et al. 2007*
OxA–12105	6682 ± 34	–19,60	seeds	cereal	Early Chalcolithic	7550 ± 40	*Higham et al. 2007*
OxA–11764	6707 ± 38	–22,10	seeds	cereal	Early Chalcolithic	7570 ± 40	*Higham et al. 2007*
OxA–11764	6730 ± 40	–22,00	seeds	hackberry	Early Chalcolithic	7600 ± 40	*Higham et al. 2007*
OxA–12106	6894 ± 34	–10,10	seeds	cereal	Early Chalcolithic	7730 ± 40	*Higham et al. 2007*
OxA–11760	6904 ± 39	–22,40	seeds	cereal	Early Chalcolithic	7740 ± 50	*Higham et al. 2007*
OxA–11773	6915 ± 34	–23,90	seeds	cereal	Early Chalcolithic	7750 ± 40	*Higham et al. 2007*
OxA–11756	6937 ± 38	–20,80	seeds	cereal	Early Chalcolithic	7770 ± 50	*Higham et al. 2007*
OxA–11754	6945 ± 39	–21,90	seeds	cereal	Early Chalcolithic	7780 ± 50	*Higham et al. 2007*
OxA–11774	6969 ± 36	–22,70	seeds	cereal	Early Chalcolithic	7800 ± 50	*Higham et al. 2007*
OxA–12089	6990 ± 40	–22,20	seeds	cereal	Early Chalcolithic	7840 ± 60	*Higham et al. 2007*
OxA–11758	7028 ± 37	–23,10	seeds	cereal	Early Chalcolithic	7880 ± 50	*Higham et al. 2007*
OxA–11759	7028 ±39	–23,60	seeds	cereal	Early Chalcolithic	7880 ± 50	*Higham et al. 2007*
OxA–11755	7049 ±39	–23,40	seeds	cereal	Early Chalcolithic	7890 ± 40	*Higham et al. 2007*
OxA–11750	7065 ± 40	–21,50	seeds	cereal	Early Chalcolithic	7900 ± 40	*Higham et al. 2007*
OxA–11751	7070 ± 45	–23,50	seeds	cereal	Early Chalcolithic	7900 ± 50	*Higham et al. 2007*
OxA–11757	7103± 39	–23,60	seeds	cereal	Early Chalcolithic	7930 ± 50	*Higham et al. 2007*

Tab. 5. ÇatalhöyükWest (37.66°N, 32.82°W). Database references: Thissen 2007 (CaNEW, March 2007).

Lab code	^{14}C age (BP)	δ^{13}C	Material	Species	Phase	Cal age (calBP)	Reference
R–805	5360 ± 80	n.d.	seeds	Triticum	XIIB	6140 ±110	*Caneva 1999*
R–602	5940 ± 70	n.d.	charcoal	n.d.	XIIB	6780 ± 90	*Caneva 1999*
R–1010	6675 ± 70	n.d.	charcoal	n.d.	XVI	7550 ± 60	*Caneva 1999*
R–809	6980 ± 80	n.d.	charcoal	n.d.	XXV	7820 ± 90	*Caneva 1999*
R–1345	7010 ± 75	n.d.	charcoal	n.d.	XXV	7840 ± 80	*Caneva 1999*
R–806	7030 ± 90	n.d.	charcoal	n.d.	XXV	7850 ± 90	*Thissen 2007*
R–7090	7090 ± 70	n.d.	charcoal	n.d.	XXV	7910 ± 70	*Caneva 1999*
R–956	7090 ± 70	n.d.	charcoal	n.d.	XXVI	7910 ± 70	*Caneva 1999*
R–957	7100 ± 70	n.d.	charcoal	n.d.	n.d.	7920 ± 70	*Caneva 1999*
R–807	7160 ± 80	n.d.	charcoal	n.d.	XXVI	8000 ± 90	*Caneva 1999*
R–1226	7280 ± 70	n.d.	charcoal	n.d.	XXVI	8100 ± 70	*Caneva 1999*
R–808	7380 ± 80	n.d.	charcoal	n.d.	XXVI	8200 ±110	*Thissen 2006*
R–1011	7545 ± 75	n.d.	charcoal	n.d.	XXVI	8330 ± 80	*Caneva 1999*
R–1343	7640 ± 80	n.d.	charcoal	n.d.	XXX–XXXIII	8460 ± 70	*Caneva 1999*
R–1344	7750 ± 80	n.d.	charcoal	n.d.	XXX–XXXIII	8540 ± 80	*Thissen 2007*
R–734	7790 ± 80	n.d.	charcoal	n.d.	XXX–XXXIII	8600 ±110	*Thissen 2007*
R–467	7920 ± 90	n.d.	charcoal	n.d.	XXX–XXXIII	8790 ±140	*Caneva 1999*
W–617	7950 ± 250	n.d.	charcoal	n.d.	XXXIII	8860 ±310	*Caneva 1999*

Tab. 6. Mersin-Yumuktepe (36.80°N, 34.60°W)

Lab code	^{14}C age (BP)	δ^{13}C	Material	Species	Period	Cal age (calBP)	Reference
Beta–178748	6900 ± 70	n.d.	charcoal	n.d.	Phase IVb2	7750 ± 70	*Derin et al. 2004*
Beta–178747	6980 ± 60	n.d.	charcoal	n.d.	Phase IVb2	7820 ± 80	*Derin et al. 2004*
Beta–188371	7110 ± 40	n.d.	charcoal	n.d.	Phase V	7930 ± 50	*Derin et al. 2004*
Beta–188370	7120 ± 50	n.d.	charcoal	n.d.	Phase V	7940 ± 50	*Derin et al. 2004*
Beta–188372	7300 ± 40	n.d.	charcoal	n.d.	Phase V	8110 ± 50	*Derin et al. 2004*

Tab. 7. Ulucak (38.46°N, 27.35°W)

Lab code	^{14}C age (BP)	δ^{13}C	Material	Species	Period	Site Locus	Cal age (calBP)	Reference
KN–5811	7505 ± 30	–26.40	charcoal	n.d.	Early Chalcolithic	Phase III.8, AGZ–L1b, 15.25–14.80 m	8330 ± 50	*Derin 2007*

Tab. 8. Yeşilova (38.45°N, 27.22°W)

Lab code	^{14}C age (BP)	δ^{13}C	Material	Species	Period	Site Locus	Cal age (calBP)	Reference
GrN–19356	6520 ±110	n.d.	charcoal	n.d.	Early Chalcolithic	phase II	7420 ±100	*Özdoğan 1997*
GrN–19782	6890 ± 60	n.d.	charcoal	n.d.	Early Chalcolithic	phase II	7740 ± 60	*Özdoğan 1997*
GrN–19310	6890 ±280	n.d.	charcoal	n.d.	Early Chalcolithic	phase II	7760 ±250	*Özdoğan 1997*
GrN–19781	6900 ±110	n.d.	charcoal	n.d.	Early Chalcolithic	phase II	7760 ±110	*Özdoğan 1997*
GrN–19780	6920 ± 90	n.d.	charcoal	n.d.	Early Chalcolithic	phase II	7770 ± 90	*Özdoğan 1997*
GrN–19311	6960 ± 65	n.d.	charcoal	n.d.	Early Chalcolithic	phase II	7800 ± 80	*Özdoğan 1997*
Hd–16726/17084	7005 ± 33	n.d.	n.d.	n.d.	Pottery Neolithic	phase III	7860 ± 50	*Karul 2000*
Hd–16727/17038	7028 ± 50	n.d.	n.d.	n.d.	Pottery Neolithic	phase III	7870 ± 60	*Karul 2000*
GrN–19357	7135 ±270	n.d.	charcoal	n.d.	Pottery Neolithic	phase III	7980 ±260	*Özdoğan 1997*
GrN–19355	7200 ±180	n.d.	charcoal	n.d.	Pottery Neolithic	phase IV	8030 ±180	*Özdoğan 1997*
Hd–16724/17186	7239 ± 29	n.d.	n.d.	n.d.	Pottery Neolithic	phase III	8070 ± 60	*Özdoğan 1997*
GrN–19779	7360 ± 35	n.d.	charcoal	n.d.	Pottery Neolithic	phase IV	8180 ± 80	*Karul 2000*
Hd–16725/119145	7496 ± 69	n.d.	n.d.	n.d.	Pottery Neolithic	phase IV	8300 ± 70	*Karul 2000*
Bln–4609	7637 ± 43	n.d.	n.d.	n.d.	Pottery Neolithic	phase IV	8450 ± 50	*Karul 2000*

Tab. 9. Hoca Çeşme (40.70°N, 26.13°W)

^{14}C age (BP)	δ^{13}C	Material	Period	Operation/Phase	Cal age (calBP)	Reference
6670 ±100	n.d.	charcoal	Halaf	Op.I, NE–Mound	7550 ± 80	*Akkermans 1997*
6930 ± 45	n.d.	seeds	Transitional Balikh IIIA	Op. II, level 2, on floor of oven	7770 ± 50	*Akkermans et al. 2006*
6930 ± 80	n.d.	charcoal	Transitional Balikh IIIA	Op. I, level 4	7780 ± 80	*Akkermans 1993*
6975 ± 30	n.d.	seeds	Early Halaf	Op. I, level 1	7810 ± 50	*Akkermans 1993*
7005 ± 30	n.d.	charcoal	Early Halaf	Op. I, level 2	7860 ± 50	*Akkermans 1993*
7025 ± 25	n.d.	seeds	Transitional Balikh IIIA	Op. I, level 6, floor of building	7880 ± 40	*Akkermans & Verhoeven 1995*
7025 ± 45	n.d.	seeds	Transitional Balikh IIIA	Op. II, level 2, in fill of hearth	7870 ± 60	*Akkermans et al. 2006*
7065 ± 30	n.d.	seeds	Early Halaf	Op. I, level 3	7900 ± 40	*Akkermans 1992*
7075 ± 30	n.d.	seeds	Transitional Balikh IIIA	Op. I, level 4	7910 ± 40	*Akkermans 1993*
7080 ± 80	n.d.	seeds	Pre-Halaf	Op.I, Level 8	7900 ± 80	*Akkermans 1993*
7100 ± 60	n.d.	charcoal	Transitional Balikh IIIA	Op. I, level 6, SE area room 7, floor	7920 ± 60	*Akkermans & Verhoeven 1995*
7145 ± 30	n.d.	charcoal	Pre-Halaf	Op. I, level 8–10	7980 ± 30	*Akkermans 1993*
7150 ± 90	n.d.	charcoal	Pre-Halaf	Op.I, NE-mound	7980 ±100	*Akkermans 1993*
7170 ± 90	n.d.	charcoal	Pre-Halaf	Op.I, NE-mound	8010 ±100	*Akkermans 1993*
7190 ± 55	n.d.	seeds	Pre-Halaf	Op. I, level 7, in fill of pit	8030 ± 60	*Akkermans et al. 2006*
7190 ± 60	n.d.	seeds	Transitional Balikh IIIA	Op. I, level 5, in fill of oven	8040 ± 70	*Akkermans et al. 2006*
7225 ± 30	n.d.	charcoal	Pre-Halaf	Op.I, NE-mound	8050 ± 60	*Akkermans 1993*
7240 ± 50	n.d.	charcoal	Pre-Halaf	Op. I, level 7, on floor of circular building	8070 ± 70	*Akkermans et al. 2006*
7240 ± 50	n.d.	charcoal	Pre-Halaf	Op. V, level 2, in fill of oven	8070 ± 70	*Akkermans et al. 2006*
7250 ± 50	n.d.	charcoal	Pre-Halaf	Op. V, level 2, in fill of oven	8080 ± 60	*Akkermans et al. 2006*
7250 ± 50	n.d.	charcoal	Pre-Halaf	Op. V, level 2, in fill of oven	8080 ± 60	*Akkermans et al. 2006*
7350 ± 50	n.d.	charcoal	Pre-Halaf	Op. V, level 2, in fill of oven	8170 ± 90	*Akkermans et al. 2006*
7360 ± 25	n.d.	seeds	Early Ceramic Neolithic	Op. III, level 2, slightly above floor in building II	8180 ± 40	*Akkermans et al. 2006*
7370 ± 55	n.d.	charcoal	Pre-Halaf	Op. V, level 2, in fill of building III	8190 ±100	*Akkermans et al. 2006*
7400 ± 25	n.d.	seeds	Early Ceramic Neolithic	Op. III, level 2, slightly above floor in building II	8250 ± 50	*Akkermans et al. 2006*
7440 ± 50	n.d.	charcoal	Early Ceramic Neolithic	Op. IV, level 1, on floor in room of building I	8270 ± 60	*Akkermans et al. 2006*
7465 ± 35	n.d.	seeds	Early Halaf	Op. I, level 1–3	8280 ± 60	*Akkermans 1993*
7475 ± 45	n.d.	charcoal	Early Ceramic Neolithic	Op. III, level 3, floor in room	8290 ± 60	*Akkermans et al. 2006*
7525 ± 45	n.d.	charcoal	Early Ceramic Neolithic	Op. III, level 3, slightly above floor in room	8330 ± 60	*Akkermans et al. 2006*
7570 ± 50	n.d.	charcoal	Early Ceramic Neolithic	Op. III, level 2, in fill of building IV	8380 ± 40	*Akkermans et al. 2006*
7720 ± 50	n.d.	charcoal	Early Ceramic Neolithic	Op. III, level 2, on floor in oven	8500 ± 50	*Akkermans et al. 2006*

Tab. 10. Sabi Abyad (36.52°N, 39.10°W)