THE LATE THIRD MILLENNIUM IN THE ANCIENT NEAR EAST

THE LATE THIRD MILLENNIUM IN THE ANCIENT NEAR EAST

CHRONOLOGY, C14, AND CLIMATE CHANGE

edited by

Felix Höflmayer

with contributions by

Matthew J. Adams, Aaron A. Burke, Michael W. Dee,
Aron Dornauer, Donald Easton, Hermann Genz, Raphael Greenberg,
Roman Gundacker, Felix Höflmayer, Sturt W. Manning, Peter Pfälzner,
Simone Riehl, J. David Schloen, Thomas Schneider, Glenn M. Schwartz,
Harvey Weiss, and Bernhard Weninger

Papers from the Oriental Institute Seminar

The Early/Middle Bronze Age Transition in the Ancient Near East:
Chronology, C14, and Climate Change

Held at the Oriental Institute of the University of Chicago

7–8 March 2014

THE ORIENTAL INSTITUTE OF THE UNIVERSITY OF CHICAGO
ORIENTAL INSTITUTE SEMINARS • NUMBER 11
CHICAGO, ILLINOIS

Library of Congress Control Number: 2017930883
ISBN-13: 9781614910367
ISSN: 1559-2944

Published 2017. Printed in the United States of America.

The Oriental Institute, Chicago

THE UNIVERSITY OF CHICAGO
ORIENTAL INSTITUTE SEMINARS • NUMBER 11

Series Editors

Leslie Schramer

and

Thomas G. Urban

with the assistance of

Rebecca Cain and Alexandra Cornacchia

Publication of this volume was made possible through generous funding from the Arthur and Lee Herbst Research and Education Fund

Cover Illustration

Vienna Environmental Research Accelerator (VERA) at the University of Vienna

Printed by King Printing Co., Inc., Lowell, Massachusetts USA

The paper used in this publication meets the minimum requirements of American National Standard for Information Services — Permanence of Paper for Printed Library Materials, ANSI Z39.48-1984.

∞

Table of Contents

6

“Seventeen Kings Who Lived in Tents”

Harvey Weiss, Yale University

“The formula of the Naturalistic narrative is simple; it is one-way traffic: the description determines the action.” (Ibisch 1982, p. 102)

The 4.2–3.9 ka B.P. Abrupt Climate Change Event

Annual precipitation in the Mediterranean and west Asia is guided by the North Atlantic Oscillation (Kushnir and Stein 2010; Cullen et al. 2002) and delivered by the Mediterranean westerlies that pass through the Mediterranean trough to west Asia (Lionello, Malanotte-Rizzoli, and Boscolo 2013). Century-scale megadrought interruptions of the westerlies, at unexplained millennial periodicities — 8.2, 5.2, 4.2, 3.2 ka B.P. —reduced cultivable dry-farming areas in the eastern Mediterranean and west Asia and forced adaptive social responses among varied polities, economies, and agricultural regimes. During the 4.2–3.9 ka B.P. (ca. 2200–1900 B.C.) megadrought, which reduced precipitation in west Asia 30–50 percent, these adaptations — political collapse and regional desertion, habitat tracking, nomadization — are evident archaeologically and epigraphically (Weiss 2014; Weiss 2015). Many social-process details within these transitions, however, remain obscured by absent or low-resolution archaeological and epigraphic data, the targets for a new generation of researchers.

The frame of the 4.2 ka B.P. event’s North Atlantic chronology and magnitude is now available within the records of Icelandic lakes (Geirsdóttir et al. 2013) and the sequence of North Atlantic Oscillation anomalies (Olsen, Anderson, and Knudsen 2012). The high-resolution chronological boundaries of these records are reflected in the synchronous Mediterranean westerlies paleoclimate proxies that are distributed across seven regions:

Coastal Spain, France, and North Africa

Doñana National Park (Jiménez-Moreno et al. 2015), Sierra de Gador (Carrión et al. 2003), Cova da Arcola (Railsback et al. 2011), Borreguiles de la Virgen (Jiménez-Moreno and Anderson 2012), Lake Montcortès (Scussolini et al. 2011), Puerto de Mazzarón (Navarro-Hervás et al. 2014), Cueva de Asiul (Smith et al. 2016), Lake Estanya (Morellón et al. 2009), Ojo Guraena Karst Complex (Cruz et al. 2015), Lac Petit (Brisset et al. 2013), Lake Sidi Ali (Zielhofer 2017), Gueldaman Cave (Ruan et al. 2015).

Central Mediterranean Italian Lakes

Lago di Pergusa (Sadori et al. 2013; Peyron et al. 2013), Bucca della Renella (Drysdale et al. 2006; Zanchetta et al. 2016). Lago Alimini Piccolo (Di Rita and Magri 2009), Maar lakes (Magri and Parra 2002; Magri and Sadori 1999), Lake Accessa (Magny et al. 2007; Peyron et al. 2013; Magny et al. 2013), Lago Preolo (Magny et al. 2011), Corchia Cave (Regattieri et al. 2014; Zanchetta et al. 2016).

Greece and Albania

Lake Lerna (Jahns 1993), Osmananga Lagoon, Pylos (Zangger et al. 1997), Lake Vrana (Schmidt et al. 2000), Lake Prespa (Leng et al. 2010), Lake Shkodra (Zanchetta et al. 2012; Mazzini et al. 2015; Sadori et al. 2014), Lake Ohrid (Wagner et al. 2009), Lake Dojran (Francke et al. 2013), Lake Vrana (Schmidt et al. 2000), Aegean Sea (Ehrmann et al. 2007; Kuhnt et al. 2008; Triantaphyllou et al. 2014), Kotychi Lagoon (Haenssler et al. 2014), Alepotrypa Cave (Boyd 2015).

Levant and Red Sea

Acre (Kaniewski et al. 2014), Tweini (Kaniewski et al. 2008), Dead Sea (Migowski et al. 2006), Zeelim, Dead Sea (Langgut et al. 2014), Sedom, Dead Sea (Frumkin 2009), Soreq Cave (Bar-Matthews and Ayalon 2011), Shaban Deep (Arz, Lamy, and Pätzold 2006), central Red Sea (Edelman-Furstenberg, Almogi-Labin, and Hemleben 2009), Lake Hula (Baruch and Bottema 1999), Lake Tiberias (Finkelstein and Langgut 2014), Jeita Cave (Cheng et al. 2015; Verheyden et al. 2008), Tell Sukas (Sorrel and Mathis 2016).

Anatolia

Konya lakes (Roberts et al. 1999; Leng et al. 1999; Reed, Roberts, and Leng 1999), Göl Hissar Gölü (Eastwood et al. 1999; Eastwood et al. 2007; Leng et al. 2010), Eski Açigöl (Roberts et al. 2001), Koçain Cave (Göktürk 2011), Abant Gölü (Bottema 1997), Yeniçağa Gölü (Bottema 1997), Söğütlü Marsh (Bottema 1997), Lake Iznik (Ülgen et al. 2012), Yenişehir (Bottema, Woldring, and Kayan 2001), Arslan Tepe (Masi et al. 2013), Göbekli (Pustovoytov, Schmidt, and Taubald 2007), Lake Van (Lemcke and Sturm 1997; Wick, Lemcke, and Sturm 2003), Lake Tecer (Kuzucuoğlu et al. 2011), Nar Lake (Dean et al. 2015), Sofular (Göktürk et al. 2011; Fleitmann et al. 2009; Jones, Fleitmann, and Black 2016).

Persian Gulf

Gulf of Oman (Cullen et al. 2000), Awafi (Parker et al. 2006; Parker and Goudie 2008), Qunf Cave (Fleitmann et al. 2003).

Black Sea, Caspian Sea, Iranian Plateau

Lake Zeribar (Stevens, Wright, and Ito 2001), Lake Mirabad (Stevens et al. 2006; Schmidt et al. 2011), Lake Maharlu (Djamali et al. 2009), Black Sea (Cordova and Lehman 2005), Caspian Sea (Leroy et al. 2007; Leroy et al. 2014), Iranian plateau (Carolin et al. 2016).

Significant as well are the synchronous African and Indus proxy records that measure Nile flow and Indus precipitation, functions of the Indian summer monsoon as it passes across the Arabian Sea between the subcontinent and the Horn of Africa. The 4.2 ka B.P. event not only disrupted the Indian summer monsoon (Berkelhammer et al. 2012; Dixit, Hoddell, and Petrie 2014), northeast African precipitation (Marshall et al. 2011; Revel et al. 2014), and consequent Nile flow (Hassan and Tassie 2006), but also Saharan precipitation, as at Lakes Yoa (Kröpelin et al. 2008; Lamb et al. 2000) and Jikariya (Wang et al. 2008), where the aridification and dust event created the likely sources of African dust in Tuscany (Magri and Parra 2002). From Lakes Yoa and Jikariya, the westernmost proxy evidence for the event in central Africa is the Gulf of Guinea (Weldeab et al. 2005). In southern Africa the event is documented to the 30° latitude (Chase et al. 2010; Schefuss et al. 2011).

Some proxy data suffer from lengthy sampling intervals that preclude observation of century-scale events or source events — for example, Jeita Cave (Verheyden et al. 2008; Cheng et al. 2016) and Tell Sukas (Sorrel and Mathis 2016) with poor dating, confusion of wild and domesticated Olea, and misassignment of Olea, a component of dry-shrub steppe. So, too, some proxies are situated in regions where the Intertropical Convergence Zone or Black Sea orography may obscure signal clarity (Fleitmann et al. 2003; Jones, Fleitmann, and Black 2016), and some anomalies, such as Lake Bosumtwi, occur without obvious explanation but are surrounded by other robust proxies. The cumulative evidence now, however, revises prior uncertainties (Finné et al. 2011), including those from low-resolution Anatolian lake dating (e.g., Roberts et al. 2011), and indicates the event's synchronicity across the Mediterranean (fig. 6.1) (Zanchetta et al. 2012; Zanchetta et al. 2016; Carozza et al. 2015).

The range of temporal resolution of the proxy excursions at 4.2–3.9 ka B.P. is provided by linear interpolation across uranium/thorium- (U/Th) or radiocarbon- (^{14}C) dated points for measured quantities of stable isotopes, arboreal and other

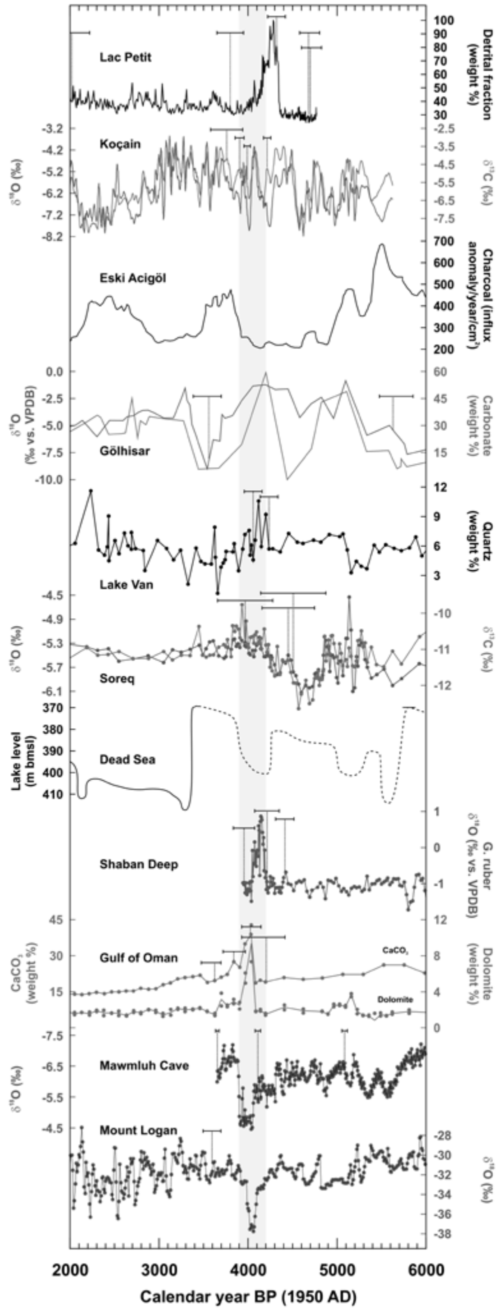


Figure 6.1. Multi-proxy stack, Mediterranean westerlies, illustrating varied temporal resolution for 4.23.9 ka B.P. abrupt climate change event (Weiss et al. 2012; Walker et al. 2012). The Mount Logan, Yukon, glacial core and the Mawmluh Cave, India, speleothem are high-resolution examples of the global distribution of synchronous paleoclimate proxies that document the megadrought (Harvey Weiss and Mark Besonen)

pollen, diatoms, carbonates, lake levels, magnetic susceptibility, or other climate proxies. The Mediterranean westerlies multi-proxy stack (Weiss et al. 2012; Weiss 2015) illustrates the ranges of chronological resolution with two-standard deviations around 4.2–3.9 ka B.P. and, as well, the coincident 4.2 ka B.P. event high-resolution chronologies at Mawmluh Cave, India (Berkelhammer et al. 2012), and Mount Logan, Yukon (Fisher 2011), which illustrate global synchronicity already suggested (Walker et al. 2012) and increasingly well documented (Weiss 2015; Weiss 2016).

At Lac Petit, France, an abrupt detrital pulse triggered by more intense or more frequent rainfall in Alpine regions (Magny et al. 2013) marks a major shift in diatom assemblages framed around 4300–4100 B.C. by radiocarbon dates (Brisset et al. 2013). The Koçain Cave, Turkey, speleothem (Göktürk 2011) provides high-resolution U/Th dates that constrain abrupt decreases and increases of $\delta^{18}O$. The Eski Açigöl, Turkey, lake core (Roberts et al. 2001) has no radiocarbon dates during a decline in lake-core charcoal interpreted as anthropogenic deforestation (Turner, Roberts, and Jones 2008), while the Göl Hissar, Turkey, lake core (Eastwood et al. 2007) carbonate spike and rise in $\delta^{18}O$ are framed by radiocarbon dates 2,000 years apart. The Lake Van, Turkey, core (Lemcke and Sturm 1997) displays a quartz spike understood as a dust proxy dated by varve counts with slight errors (see Kuzucuoğlu et al. 2011). The dense sampling intervals for the Soreq Cave, Israel, speleothem $\delta^{18}O$ and $\delta^{13}C$ values are linked to U/Th dates (Bar-Matthews and Ayalon 2011), but with large standard deviations that provide a labile chronology. The Dead Sea (Migowski et al. 2006; Kagan et al. 2015) lake levels are estimated to have dropped 45 meters (see Frumkin 2009) during this period. At the Red Sea Shaban deep core (Arz, Lamy, and Pätzold 2006) fifteen-year diatom sampling intervals are constrained by high-resolution radiocarbon dates with a marine reservoir correction (see Edelman-Furstenberg, Almogi-Leben, and Hemleben 2009).

The Gulf of Oman marine core (Cullen et al. 2000) has dolomite and calcium carbonate (dust) spikes framed by radiocarbon dates and is tephra-linked to Tell Leilan chronostratigraphy (Weiss et al. 1993). The Mawmluh Cave, India, speleothem (Berkelhammer et al. 2012) provides six-year $\delta^{18}O$ sampling intervals constrained with U/Th dates and links the Nile flow reductions (see Hassan and Tassie 2006), east African lake level reductions (see Gasse 2000), and the Indian summer monsoon deflection (see Dixit, Hodell, and Petrie 2014). The Mount Logan, Yukon, glacial core (Fisher 2011) is cross-dated with the NorthGRIP-core and exemplifies the event's North American expression (e.g., annual resolution Great Basin tree rings; Salzer et al. 2014), second in magnitude to the 8.2 ka B.P. event. These dates correspond to other recent Mediterranean core dates, such as at Lake Shkodra (Zanchetta et al. 2012; Mazzini et al. 2015; Sadori et al. 2013; Sadori et al. 2014), Lake Accessa (Magny et al. 2009; Zanchetta et al. 2012), and Acre (Kaniewski et al. 2014), that is, about 4.2–3.9 ka B.P. (Zanchetta et al. 2016).

Akkadian Imperialization

The adaptive abandonment of dry-farming plains across west Asia and habitat tracking to sustainable riparian, plaudal, and karstic refugia were synchronous social responses at the 4.2 ka B.P. onset, alongside the likely, if problematic, nomadization of formerly sedentary populations (Alizadeh 2009). At this moment, the most intensively studied locus for the social effects of the 4.2–3.9 ka B.P. megadrought in west Asia is the Khabur plains of northeastern

Syria that were then under about 100 years of Akkadian imperialization, as determined from the Tell Leilan Acropolis radiocarbon-dated occupational sequence (Weiss et al. 2012).

Imperial Akkadian production and distribution in both southern and northern Mesopotamia were controlled by local palaces and the imperial *šabra* officials, acting as the bridges between imperial Akkad and its imperialized domains (Brumfield 2013). The documentation for the extraction of provincial surplus production, reprised often by modern epigraphers, included animals, oils, finished products, and grain, the latter usually measured in Akkadian imperial *gur* (Powell 1987–1990; Glassner 1986). In central Mesopotamia, these Akkadian extractions are documented at Ešnunna, Awal, Gasur, and Aššur (Brumfield 2013; Visicato 1999) (fig. 6.2).

To the limits of efficient transport, apparently, the extractive success was unconstrained. The extortion of land and estates from local southern rulers; the murder of thousands of insurgents (e.g., the Rimush incident); the conquest and rebuild of distant cities like Mari, Leilan/Shekhna, Brak/Nagar, Nurrugum, and Ninua; crushing military defeat of "The Great Rebellion" and the deification of Naram-Sin suggest large Akkadian military forces and effective intimidation and terror.

The Akkadian extractions are certain, but their conveyance remains unclear. For example, how were imperial revenues collected and then delivered from Gasur/Yorgan Tepe to Akkad? Were the revenues collected at Aššur disposed there or removed to Akkad? Large grain shipments from NAGAR^{ki}, likely Tell Brak (Na-gàr^{ki}, Ebla; Na-ga-ar^{ki}, elsewhere; Gelb 1961, p. 191), were removed from the Khabur plains and collected at imperial Sippar (CT 1: 1b, 2,7; 1c, 12). By which waterborne route were these tons of cereal harvest dispatched to

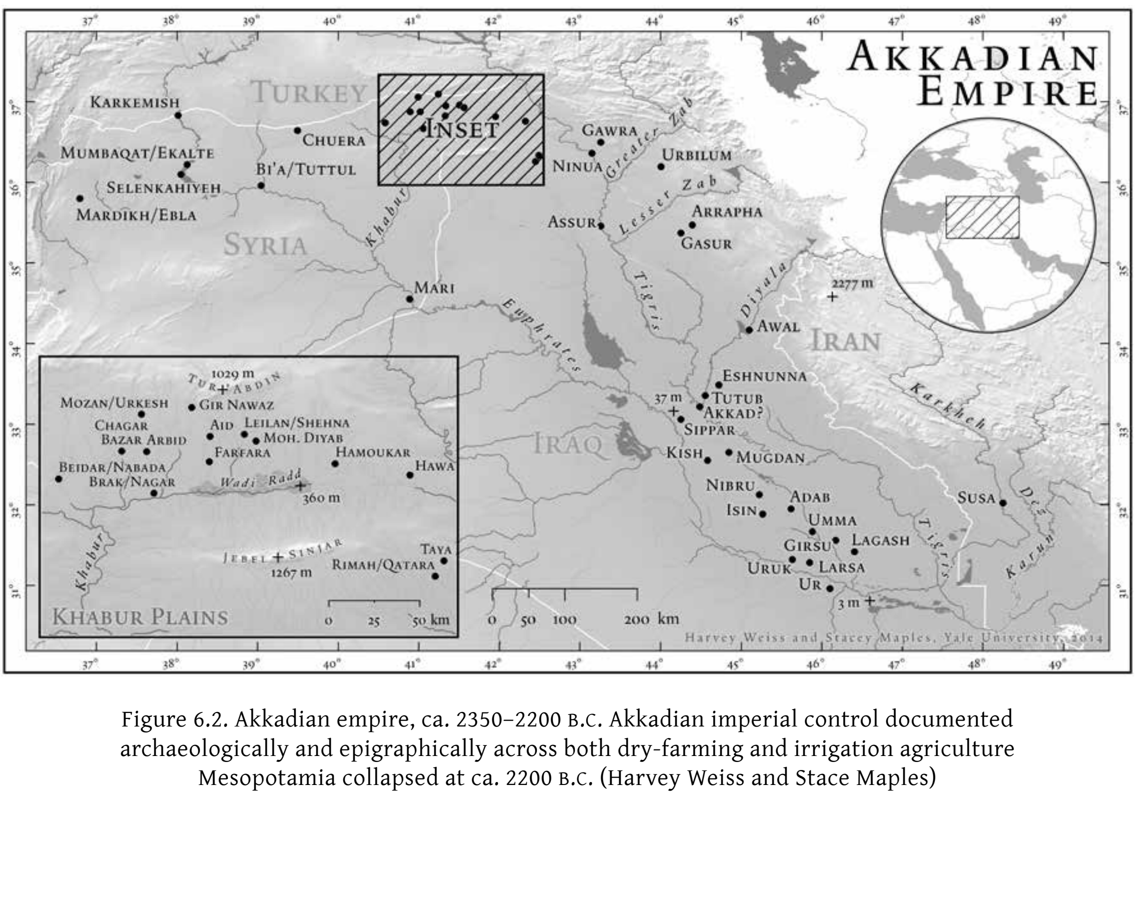


Figure 6.2. Akkadian empire, ca. 2350–2200 B.C. Akkadian imperial control documented archaeologically and epigraphically across both dry-farming and irrigation agriculture Mesopotamia collapsed at ca. 2200 B.C. (Harvey Weiss and Stace Maples)

Sippar, and who controlled their measurement (Sommerfeld, Archi, and Weiss 2004)? Also on the Khabur plains, the 379 tons of river-transported emmer probably received at the 5-hectare small town at Chagar Bazar (Chagar Bazar A.391; CDLI P212515) were destined for which storehouses? The divide between state and private interests in such imperial extractions was likely porous, as in empires to this day.

Abandonment and Collapse

Abrupt termination of Akkadian imperial control and abrupt regional abandonment by the foreign and indigenous population have been exposed at the Khabur plains' equidistant urban centers Brak, Leilan, and Mozan, and across the villages and towns of the surrounding countryside (figs. 6.3–6.4). Ritual closure of Akkadian public buildings sealed Tell Brak in dramatic fashion while the city's Naram-Sin fortress walls and floors were left unfinished (Weiss 2012). The Akkadian Administrative Building at Tell Leilan was vacated during preparation of its terminal cuneiform records, while "The Unfinished Building" (TUB), across the Leilan Acropolis

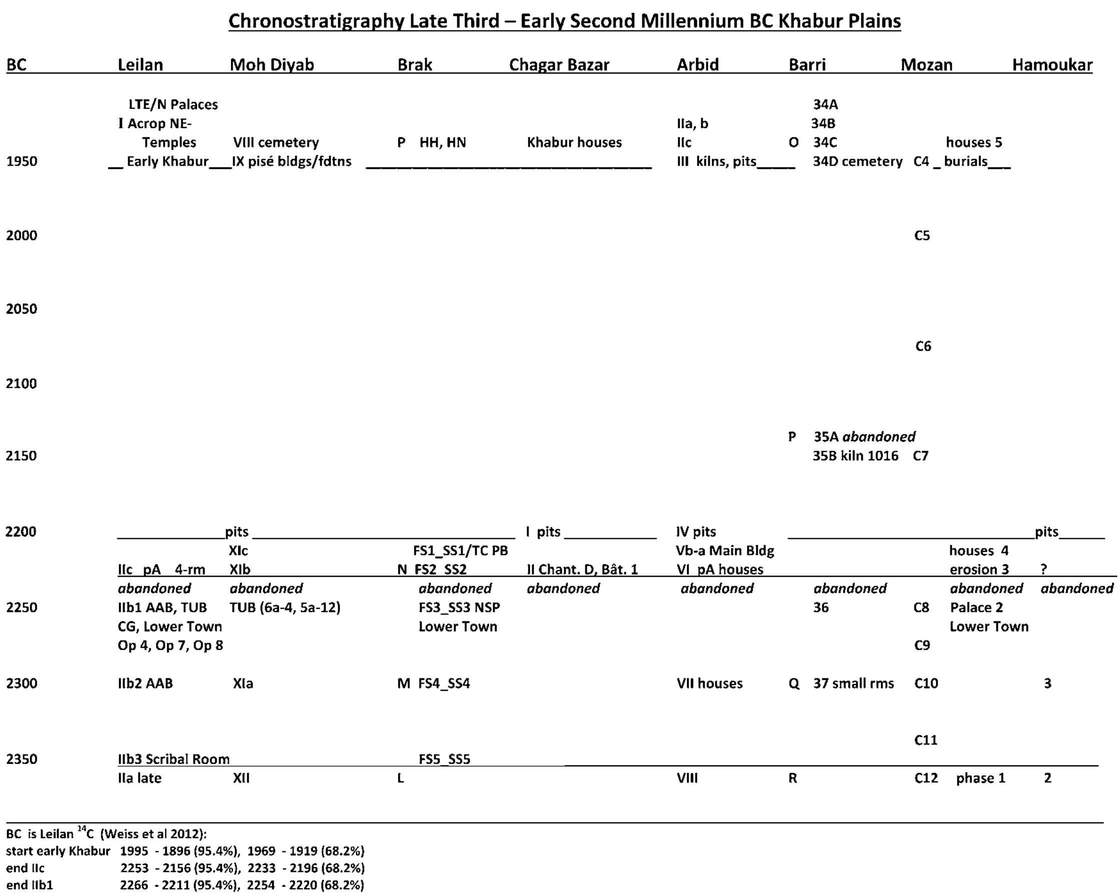


Figure 6.3. Chronostratigraphy late third–early second-millennium B.C. Khabur plains reveals a 250-year occupational hiatus, ca. 2200–1950 B.C., coincident with the ca. 4.2–3.9 ka B.P. megadrought (Weiss 2012)

Street, was deserted alongside a semicircle of basalt blocks that were being dressed for wall placement. Brick walls set upon mudpack sherds were left uncompleted, although sub-floor drains had been installed under unfinished working floors (Weiss et al. 2012). "Hayabum, šabra," an early Amorite (Gelb 1980; Bauer 1926, p. 18), walked out on the TUB construction, but left his finger- and rope-impressed sealing on its floor (McCarthy 2012). Minor pieces of two similar and aborted Akkadian TUB constructions were observed at adjacent Tell Mohammed Diyab (Nicolle 2012), while at Tell Mozan the similar basalt block-base palace was abandoned, and upon its collapse and erosion surfaces irregular private houses were eventually constructed (Buccellati and Buccellati 2000). At Tell Taya, adjacent to Tell Afar, another high-yield cereal production center, the same curious Akkadian construction technique was deployed, perhaps for structures of similar function (Reade 1968).

Famously, the Lower Towns of Brak, Mozan, Leilan, the residences of the imperialized agricultural workers, were deserted alongside their central acropolises. At Tell Mozan/Urkesh, the "continuous occupation" of a post-Akkadian–Ur III-period wealthy city was, in fact, the 80-percent-abandoned Akkadian city, with a fraction of the former acropolis inhabited after desertion of the possibly 90-hectare lower town (Pfälzner 2012). Similarly, the purported high precipitation and dry-farming at Tell Mozan during this period (Riehl 2010)

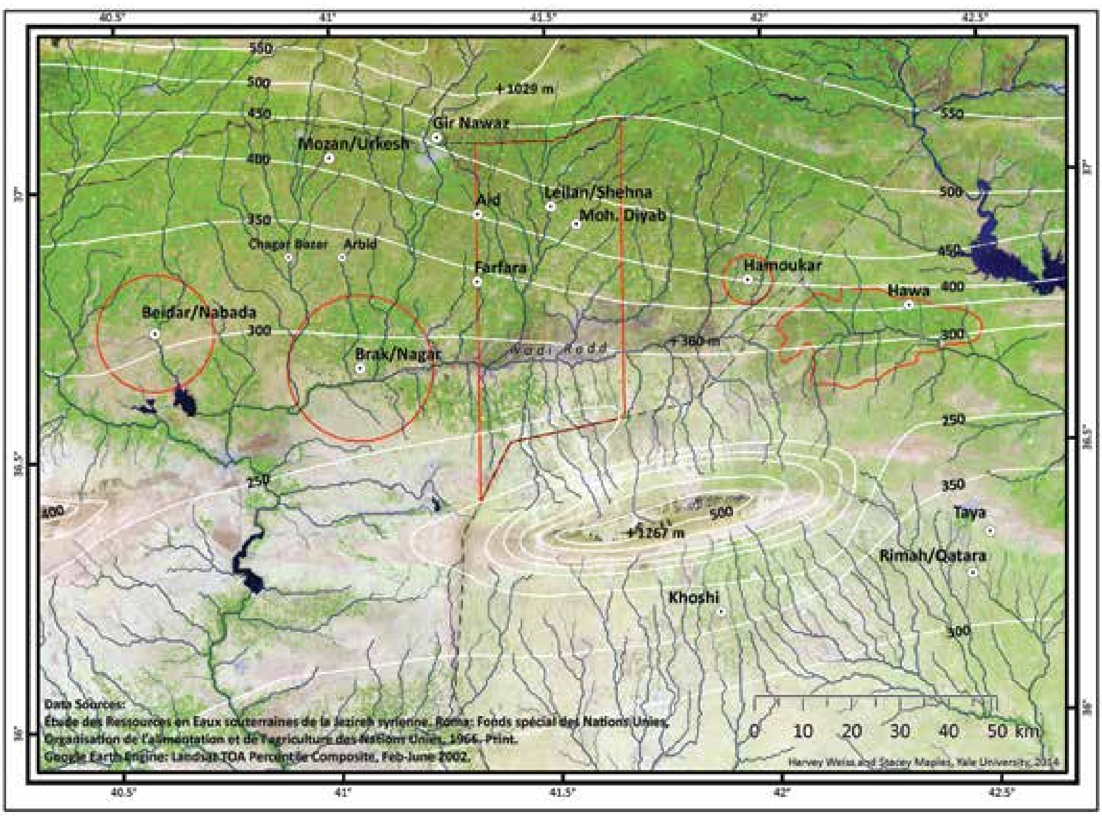
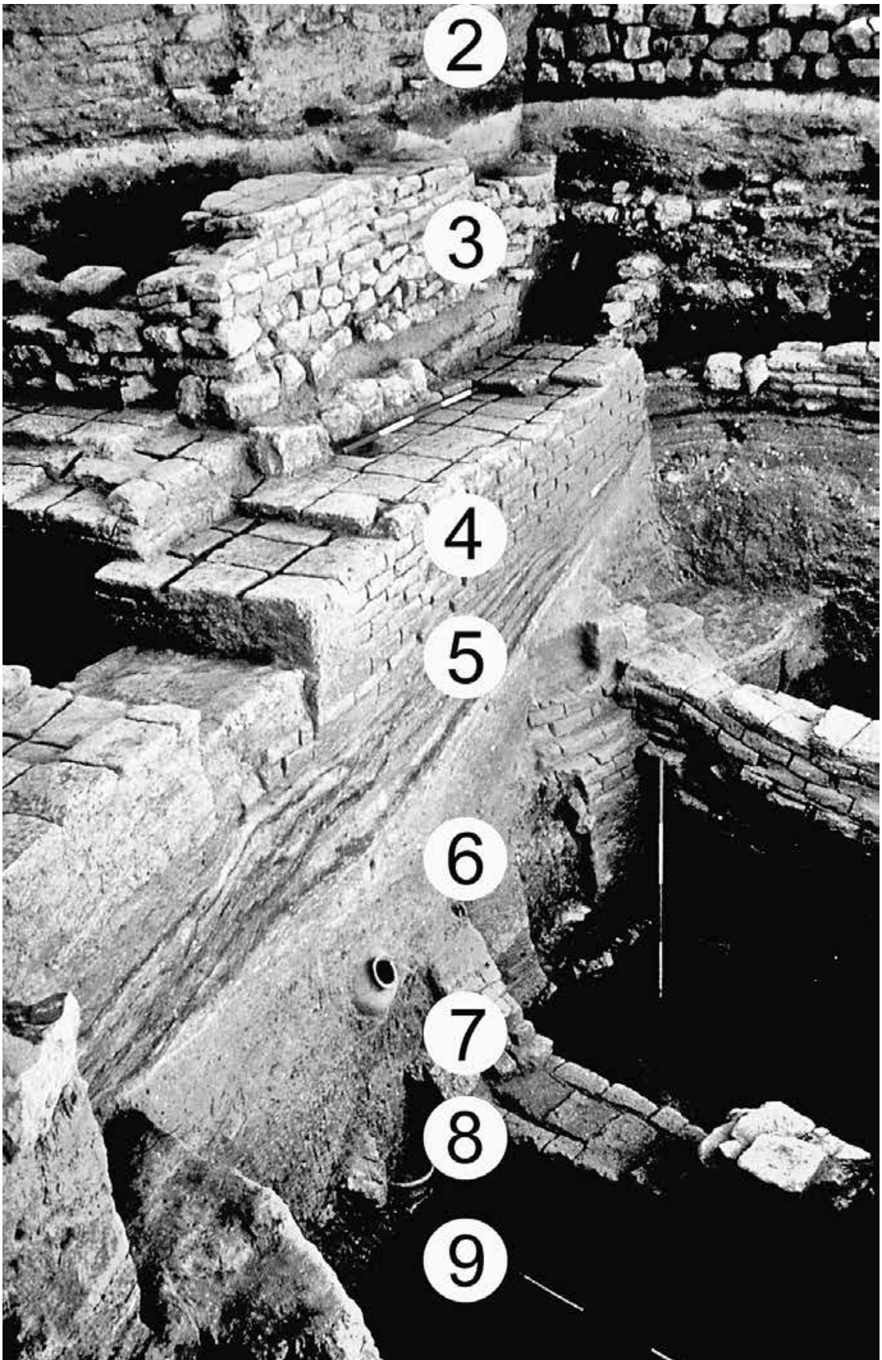


Figure 6.4. Khabur plains archaeological surveys. Beidar 450 sq. km (Ur and Wilkinson 2008), Brak 1,256 sq. km (Colantoni 2012), Leilan 1,650 sq. km (Arrivabeni 2012; Ristvet 2012), Hamoukar 78 sq. km (Ur 2010), Hawa 455 sq. km (Wilkinson and Tucker 1995). Beidar, Hamoukar, and Hawa survey analyses lumped pre-Akkadian and Akkadian settlement; Hawa survey did not distinguish post-Akkadian settlement; Brak survey is mostly unpublished (Harvey Weiss and Stace Maples)



Phase 4: Ḫabur

Phase 5: "… a single streaked layer represents all that is left of level V … chiefly black and grey, consisting respectively of carbonized sheep-dung and friable gypsous flooring … the whole deposit was clearly produced by a pastoralist population"

Phase 6: "Ur III", "… did not last much more than half a century. The population either died in the destruction, though no skeletons were found, or deserted the site."

Phase 7: "post-Akkadian"

Phase 8: Akkadian (ca. 2300–2200 B.C.)

(descriptions from Reade 1968)

Figure 6.5. Tell Taya, Sinjar plains, northwestern Iraq, Acropolis stratigraphic section, excavated by Julian Reade, British School of Archaeology in Iraq, 1967–1973 (photograph by Julian Reade)

have evaporated with notice of overlooked and unique *Phalaris* (canary grass) components of botanical samples that indicate stream-side cultivation only 8 kilometers from the Tur Abdin debouchement (Weiss 2012). Nawar, Urkesh's remnant urban complement, the "large Hurrian city" importunely sought for decades at Tell Brak, was probably located similarly along the edge of the Tur Abdin, even perhaps at homonymous Gir Nawaz. By the time of the ca. 1950 B.C. resettlement, Mozan was a small village rest stop on the famous road west from Tell Leilan/Shubat Enlil.

Elsewhere on the Khabur plains, the same process was operative. Hamoukar, about 100 hectares at the eastern edge of the Khabur plains, was possibly occupied briefly in the post-Akkadian period, but was certainly abandoned before that period ended as the low-density site is capped by "early post-Akkadian pits" (Gibson 2001) that cannot extend beyond 2200 B.C. (fig. 6.3). Adjacent Tell al-Hawa, 66 hectares, was littered with Akkadian *sila*-bowls (Senior and Weiss 1992), but had no occupation thereafter until the Khabur ware resettlement (Wilkinson and Tucker 1995). Farther southeast, at Tell Afar, the Tell Taya acropolis excavation has illustrated the abandonment with its famously transparent stratigraphic section (Reade 1968) (fig. 6.5).

Region-wide, not only large cities but also their surrounding countrysides were deserted. In the Leilan Region Survey (1,650 sq. km; figs. 6.6a–d, 6.7), some 87 percent of dependent villages and towns were abandoned at the end of Leilan IIb1, 2254–2220 B.C. (68.2%), with the remainder disappearing completely less than 50 years later at the end of Leilan IIc, 2233–2196 B.C. (68.2%). That is, Bayesian-modeled short-lived radiocarbon dates provide a chronology that defines small village or household occupations for three to five decades after the major urban collapse (Emberling et al. 2012; Koliński 2012; Weiss et al. 2012). Significantly, these short-lived post-Akkadian remnants were five times more numerous (n=18, 0.01/km^2) in the high-precipitation Leilan Region Survey (Arrivabeni 2012) than in the marginal-precipitation Brak survey area (Colantoni 2012) (table 6.1).

Table 6.1. Site size (ha) reductions, late third–early second millennium B.C. Khabur plains (Weiss 2012)

Site	*Akkadian Period (ca. 2350–2250 B.C.)*	*post-Akkadian/EJZ 4c (ca. 2250–2200 B.C.)*		*post-pA/EJZ 5 (ca. 2200–1950 B.C.)*	*Khabur (ca. 1950–1700 B.C.)*
Leilan	90	0.002	(-99%)	0	90
Mozan	120	20	(-83%)	<20	<20
Brak	70	<35	(-50%)	0	10
Moh Diyab	50	14	(-72%)	0	35
Chagar Bazar	10	1	(-90%)	0	9
Hamoukar	100	0*	(-100%)	0	0
Arbid	4	3.2	(-20%)	0	1.75
Barri	<6	0	(-100%)	0**	6
Leilan Region Survey	397	69	(-87%)	0	767

* Chronology uncertain; unlikely but possible partial occupation this period.
** Isolated stratum 35 kiln within this period.

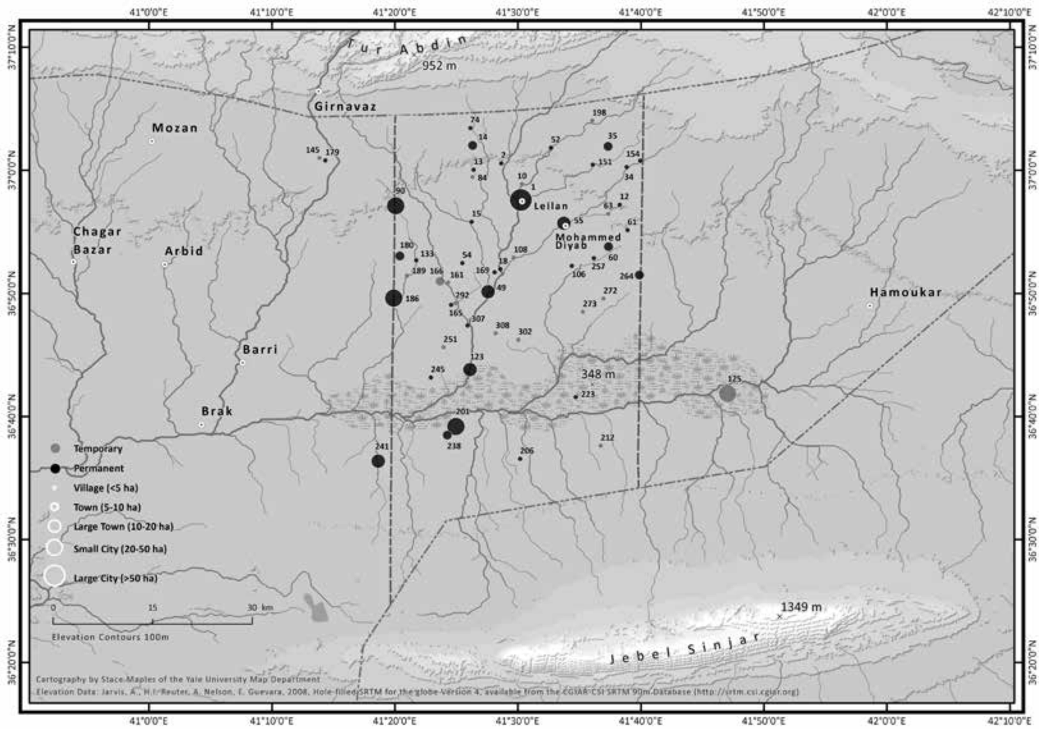


Figure 6.6a. Leilan Region Survey, Leilan IIb settlement, ca. 2350–2250 B.C. (Ristvet 2012)

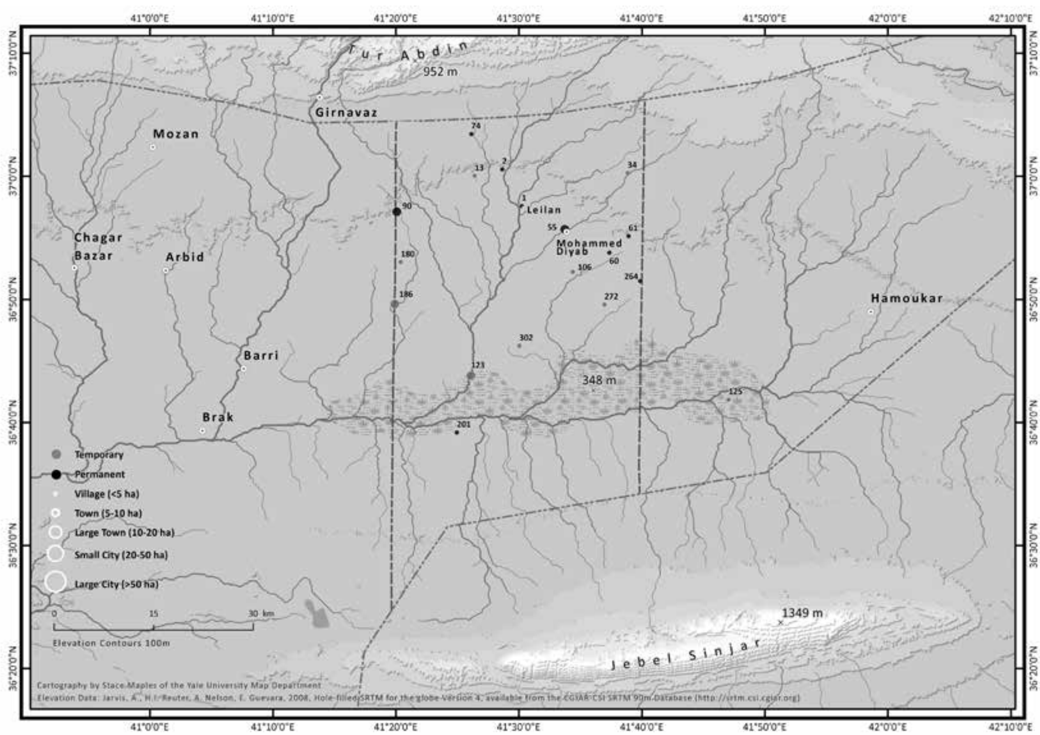


Figure 6.6b. Leilan Region Survey, Leilan IIc settlement, ca. 2250–2200 B.C. (Arrivabeni 2012)

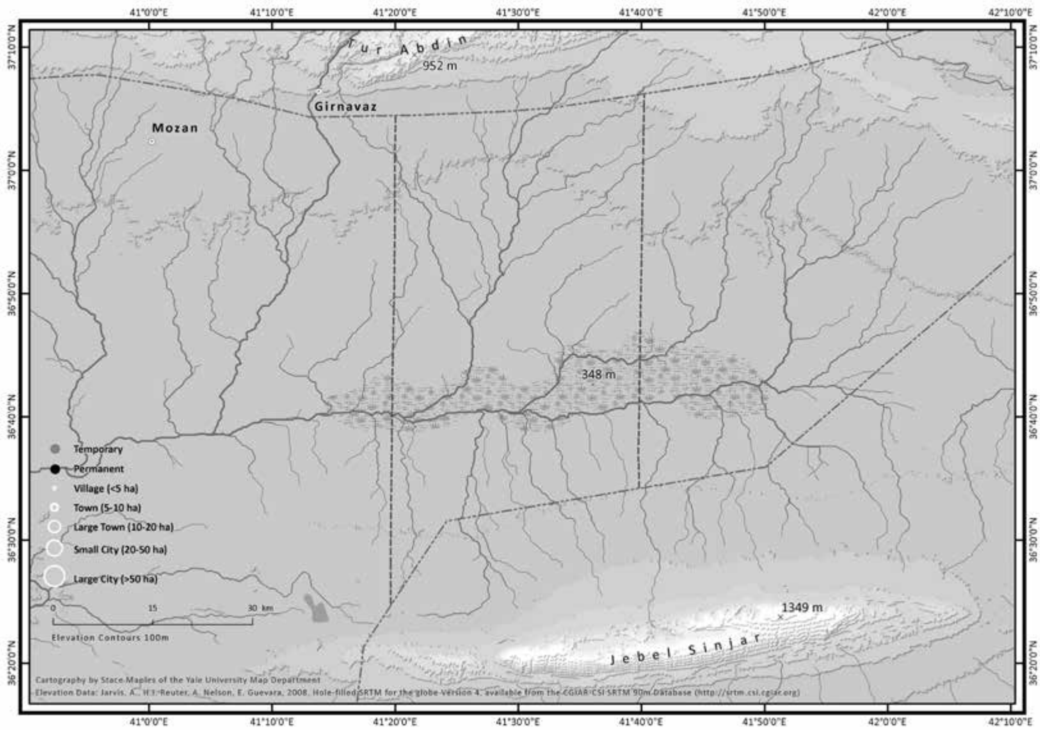


Figure 6.6c. Leilan Region Survey, Leilan IId settlement, ca. 2200–1950 B.C. (Weiss 2012)

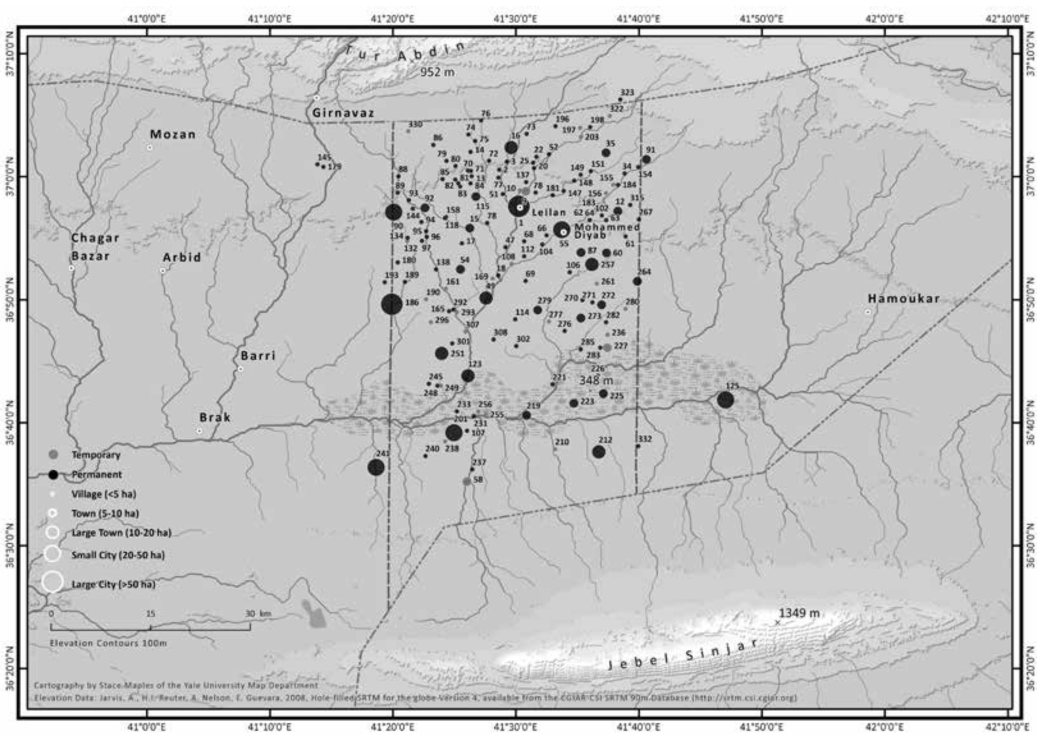


Figure 6.6d. Leilan Region Survey, Leilan I settlement, ca. 1950–1750 B.C. (Ristvet and Weiss 2013)

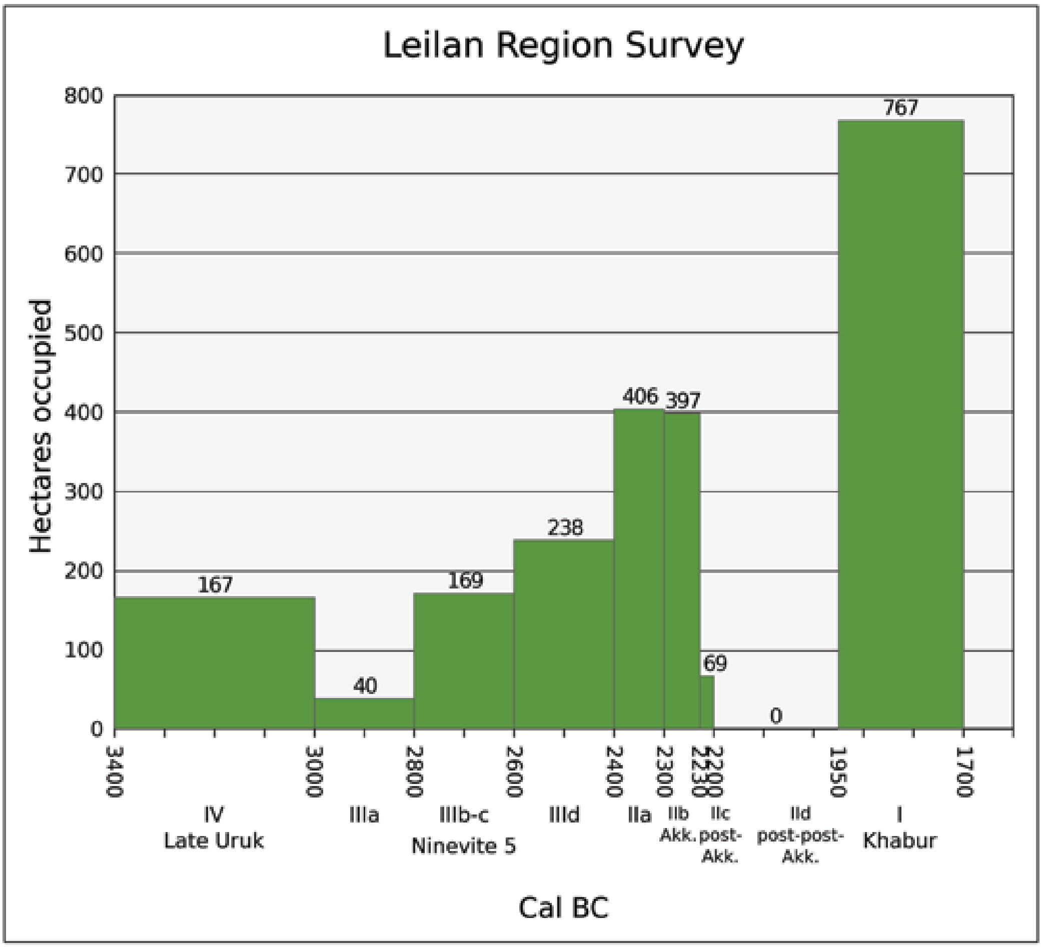


Figure 6.7. Leilan Region Survey (1,650 sq. km) histogram of total hectares occupied / radiocarbon-dated occupation periods (Weiss 2012)

At Tell Leilan, the collapsed mudbrick walls of the pre-Akkadian palace and its rebuilt Akkadian Administrative Building were used as bases for the construction of a Leilan IIc period post-Akkadian four-room house and courtyard, the only post-Akkadian structure yet uncovered there (fig. 6.8; Weiss et al. 2012). The voluminous Tell Leilan radiocarbon-dating program defines as well the synchronous short-lived and ramshackle post-Akkadian–period structures at Tell Brak (Emberling 2012), the "communal" house at Chagar Bazar (Tunça, McMahon, and Baghdo 2007), and domestic structures at Tell Arbid (Koliński 2012).

The chronological definition of Leilan IIc is also useful, where comparable radiocarbon dating is available, for understanding the coincident inter-regional effects of the 4.2–3.9 ka B.P. event. The First Intermediate Period in Egypt began synchronously with Leilan IIc (Bronk Ramsey et al. 2010) and underscores the region-specific habitat-tracking variability and systemic similarities among and between societal megadrought responses (see Macklin et al. 2013; Weninger and Easton, this volume).

Figure 6.8. Tell Leilan 2002, Acropolis Northwest, Leilan IIc, 2233–2196 B.C. (68.2%), four-room house and courtyard, the only post-Akkadian-period occupation retrieved at Tell Leilan (Weiss et al. 2012)

Megadrought and Leilan IId

Following the brief post-Akkadian interval, sedentary settlement within the Leilan Survey Region, and most of the Khabur plains, abandoned the region for about 250 years, the Leilan IId period, until the sudden return of pre-megadrought precipitation levels and Khabur-period resettlement at around 1950 B.C., earlier than a presumed Middle Chronology vanguard sedentarization led by Šamši-Adad (Weiss et al. 2012; Manning et al. 2016). The northern Mesopotamian post-megadrought soil landscape, perhaps altered analogously as that analyzed in post-megadrought south Alpine France (Brisset et al. 2013), may reveal some of the forces behind Khabur-period resettlement, possibly similar to the convenient social and climatic convergences at the termination of the Little Ice Age four thousand years later (Kaniewski, Van Campo, and Weiss 2012).

This same pattern of regional abandonment occurred across dry-farming western Syria (Weiss 2012; Weiss 2014), the Levant (Harrison 2012), Anatolia (Boyer, Roberts, and Baird 2006; Massa and Şahoğlu 2015), the Aegean (Weiss 2000; Weiberg and Finné 2013; Davis 2013), and in the western Mediterranean with the abandonment of the Late Neolithic and Bell Beaker settlements in the Languedoc and Rhône valleys (Carozza et al. 2015). However, low-resolution ceramic periodizations, survey intensity, and quantification still obscure some significant details and hinder comparative studies, as in western Syria (D'Andrea 2016). The extensive data for EB IV Ebla and its environs (Matthiae and Marchetti, eds. 2013) do not yet permit discrimination of demographic changes during this period. Re-dating the end of the Early Bronze III period in the southern Levant, for example, has encouraged re-dating of the succeeding Early Bronze IV abandonments and collapse (Regev et al. 2012). Lowering the beginning of the southern Levant Early Bronze IV period, however, alters neither the radiocarbon-dated Early Bronze IV settlements here, some number of the around 2,000 central Negev Early Bronze IV pastoral sites (Haiman 1996; Adams 2000; Regev et al. 2012), nor the famous Hauran pastoralist settlements (Braemer, Échallier, and Taraqji 2004), nor the synchronous abandonments and collapses in western Syria (e.g., Rawda: Barge, Castel, and Brochier 2014; Brochier in press; Umm el-Marra: Schwartz et al. 2012) and across northern Mesopotamia (Weiss 2014). The limited and low-resolution chronology and simple quantification of Early Bronze III and Early Bronze IV settlement in small highland areas of Israel (Langgut et al. 2014; 2016) do not allow observation of abandonments, but emphasize the need for radiometric and relative chronology Early Bronze IV subdivisions (table 6.2) and, of course, quantified regional surveys (D'Andrea 2012; 2016).

Table 6.2. Late third-millennium abrupt climate change chronology (after Weiss 2000, fig. 29) with Early Bronze IVx

Date B.C.	*Aegean*	*Egypt*	*Syria/Palestine*	*N. Mesopotamia*	*S. Mesopotamia*	*Indus*
1700						
	Middle					
1800	Helladic	Middle	Middle	Leilan I	Old Babylonian	Harappa 4
	II	Kingdom	Bronze I			
1900						
	Middle					
2000	Helladic I	First	Early	**"17 kings who lived in tents"**	Isin-Larsa	
2100	Early	Intermediate	Bronze IVx	Leilan IId	Third Dynasty of Ur	Harappa 3C
	Helladic III					
2200		Period		Leilan IIc		
2300	Late					
			Early	Leilan IIb	Akkadian	Harappa 3B
2400	Early	Old	Bronze IVa			
	Helladic	Kingdom		Leilan IIa	Early Dynastic III	
2500	II		Early			
			Bronze III			
2600	Early			Leilan IIId	Early Dynastic II/III	Harappa 3A

Habitat Tracking

The regional populations that left the Khabur and adjacent dry-farming plains beginning at the end of Leilan IIb1 and during Leilan IIc (ca. 2250–2200 B.C.) were forced by their megadrought-altered landscapes to move abruptly to alternate sustainable habitats. The down-cut channels of the Euphrates and Tigris precluded innovative irrigation agriculture in northern Mesopotamia as, of course, did the topography and hydrography of the Levant. The habitat tracking (Coope 1979) that ensued was to sustainable riparian, paludal, and karstic refugia in adjacent regions. These refugia included the close-to-sea-level irrigation agriculture of Tigris-Euphrates regions of southern Mesopotamia, soon filled with hypertrophic Ur III cities; the central Euphrates valley dotted with irrigation agriculture cities at Mari, Tuttul and Terqa, the Madekh, Ghab, Amuq, and Radd swamps; the cities of the karst-fed Orontes River; the riverside towns of coastal Syria and Lebanon; and the karst-spring towns of the southern Levant (Weiss 2014). Similar movements to sustainable agricultural regions are observed synchronously in the megadrought-afflicted western Mediterranean (Carozza et al. 2015). Coincident abandonments likely occurred across desiccated dry-farming northern and northeastern Iraq, surrounded by the plateaus' megadrought proxies (e.g., Sea of Marmara: Felikci et al. 2016; Göbekli: Pustovoytov, Schmidt, and Taubald 2007; Lake Tecer: Kuzucuoğlu et al. 2011; Lake Van: Lemcke and Sturm 1997; Black Sea: Cordova and Lehman 2005; Caspian Sea: Leroy et al. 2014; Iranian plateau: Carolin et al. 2015).

The estimated scale of this region-wide population transfer awaits refinement with regional surveys of sufficient chronological resolution to observe decadal and century-scale alterations. An early conservative estimate assumed that approximately five times the population of the Khabur plains abandoned the plains from western Syria to northeastern Iraq during the interval between about 2200 and 1950 B.C. (Weiss et al. 1993). A trickle of persons per year could accommodate this figure, but larger groups likely left periodically at junctures that remain to be identified (see Burke, this volume).

Opportunistic Resettlement and Sedentarization

The Amorite intrusions, wars, and eventual presence in riverine central and southern Mesopotamia during the Ur III, Isin-Larsa, and early Old Babylonian periods (Edzard 1957; Garfinkle 2014) — that is, during the 4.2–3.9 ka B.P. megadrought — remain to be understood within this paleoclimate and demographic frame. In particular, the normative conceptualization of Ur III dynasty southern Mesopotamia awaits reconsideration. By the early nineteenth century B.C., two confederations of Hanaean pastoralist transhumant tribes, Yaminites and Simʾalites, already ranged between northern Mesopotamia, western Syria, and the central Euphrates (Rowton 1974; Heimpel 2003), where some controlled Mari, settling opportunistically the abandoned tracts within tribe-legitimized states and territories previously ignored and unidentified epigraphically, but now called Ida-Maraṣ, Apum, and Subartu (Heimpel 2003; Ristvet 2008). This resettlement across dry-farming west Asia now seems a major archaeological research frontier.

The return of precipitation is evidenced by the abrupt 3.9 ka B.P. spikes within the paleoclimate proxies from Iceland to Iran, from the Mediterranean Sea to Mount Kilimanjaro, and from Lake Tilo to Mawmluh Cave. Geographic variability of drought stress was claimed for minor alterations of $\delta^{13}C$ values of Middle Bronze Age (1900–1600 B.C.) barley grains from

Tell Mozan (Riehl et al. 2014), but the isotope analysis has been discredited (Maxwell, Silva, and Horwath 2014). Additionally, grain stable isotopes do not reflect climate but cultivation, including possible manuring (Styring et al. in press). Hence, robust transfer functions for the megadrought's paleoclimate proxies, in addition to the 30–50-percent precipitation reductions already measured by Frumkin (2009), Bar-Matthews et al. (1997), and Kaniewski et al. (2012), remain a desideratum for observation and calculation of megadrought spatial variability across the Mediterranean and west Asia, and globally. Within current levels of resolution, however, the abrupt alterations of climate and settlement in the east Mediterranean/west Asia and the west Mediterranean at 4.2 and 3.9 ka B.P. are synchronous and extend to Central Asia, South Asia, East Asia, Australia, East Pacific, North America, South America, and the Antarctic as well (Weiss 2016).

A full appreciation and explanation of the societal forces released or propelled at about 3.9 ka B.P. awaits additional quantification of the return of pre-megadrought precipitation. In the Mesopotamian domains of the Mediterranean westerlies, this juncture is marked by the sedentarization of Amorite pastoralists and resettlement of previously desiccated and abandoned dry-farming territories. However, pre-Akkadian Amorite precursors of the nineteenth- and eighteenth-century B.C. Euphrates-Khabur pastoralist transhumants are not observed in the personal names of the Beydar archives (Talon 1996), while the MAR.DÚ of the Ebla archives are not described as pastoralist transhumants (Archi 1985) and do not extend in time to the pre–Lim dynasty period at Mari (Butterlin 2007). Hence the megadrought "enforced sedentism" of Khabur pastoralist transhumants, along and down the Euphrates (Weiss et al. 1993), beginning at Leilan IIc and extending through Leilan IId, a potential correlate of "enclosed nomadism" (Rowton 1974; Klengel 1972), remains elusive but for records from the ethnographic present (de Boucheman 1934). This period, however, is likely that designated in the Assyrian King List as the reigns of the "seventeen kings who lived in tents" (Finkelstein 1966). Subsequent sedentarization, resettlement, and state formation across northern Mesopotamia and western Syria, idealized in Shamshi-Adad's Amorite genealogy in the Assyrian King List, nevertheless remain enigmatically unexplained. Assyriological documentation assumes, however, that "there will always be some further more concrete description that the causing consists in" (Cartwright 1999, p. 120). Within central Asian Mongol history, a similar process of sedentary state formation at the return of pre-drought precipitation has been documented recently (Pederson et al. 2014). Here too, beyond the sudden availability of rain-fed domains, the forces for pastoralists' opportunistic sedentarization and state formation await exploration.

Acknowledgments

The Directorate-General of Antiquities and Museums, Syrian Arab Republic, provided the essential administrative support for the Yale University Tell Leilan Project research that is reviewed here. Research funding was provided by the National Science Foundation, National Endowment for the Humanities, Yale University, Malcolm Wiener, Roger and Barbara Brown, Raymond and Beverly Sackler Foundation, and the late Leon Levy. I also thank Mark Besonen (Texas A&M University, Corpus Christi) and Stace Maples (Stanford University) for their essential technical assistance and cartography.

Portions of this paper appeared in Harvey Weiss, "Megadrought, Collapse and Resilience in Late 3rd Millennium BC Mesopotamia," in *2200 B.C. — A Climatic Breakdown as a Cause for the*

Collapse of the Old World?, edited by Harald Meller, Helge Wolfgang Arz, Reinhard Jung, and Roberto Risch, pp. 35–52 (Halle: Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt, Landesmuseum für Vorgeschichte, 2015).

Abbreviations

CT	Cuneiform Texts from Babylonian Tablets in the British Museum
CDLI	Cuneiform Digital Library Initiative. cdli.ucla.edu

Bibliography

Adams, Russell B.

2000 “The Early Bronze Age III–IV Transition in Southern Jordan: Evidence from Khirbet Hamra Ifdan.” In *Ceramics and Change in the Early Bronze Age of the Southern Levant*, edited by Graham Philip and Douglas Baird, pp. 379–401. Levantine Archaeology 2. Sheffield: Sheffield University Press.

Alizadeh, Abbas

2009 “Prehistoric Mobile Pastoralists in South-central and Southwestern Iran.” In *Nomads, Tribes, and the State in the Ancient Near East: Cross-Disciplinary Perspectives,* edited by Jeffrey Szuchman, pp. 129–46. Oriental Institute Seminars 5. Chicago: The Oriental Institute.

Almamori, Haider Oraibi

2014 “Gissa (Umm al-Aqarib), Umma (Jokha), and Lagas in the Early Dynastic III Period.” *Al-Rāfidān* 35: 1–38.

Archi, Alfonso

1985 “Mardu in the Ebla Texts.” *Orientalia* 54: 7–13.

Arrivabeni, Monica

2012 “Post-Akkadian Settlement Distribution in the Leilan Region Survey.” In *Seven Generations Since the Fall of Akkad*, edited by Harvey Weiss, pp. 261–78. Studia Chaburiensia 3. Wiesbaden: Harrassowitz.

Arz, Helga W.; Frank Lamy; and Jürgen Pätzold

2006 “A Pronounced Dry Event Recorded around 4.2 ka in Brine Sediments from the Northern Red Sea.” *Quaternary Research* 66/3: 432–41.

Bar-Matthews, Miryam, and Avner Ayalon

2011 “Mid-Holocene Climate Variations Revealed by High-resolution Speleothem Records from Soreq Cave, Israel and Their Correlation with Cultural Changes.” *The Holocene* 21/1: 163–71.

Bar-Matthews, Miryam; Avner Ayalon; and Aaron Kaufman

1997 “Late Quaternary Paleoclimate in the Eastern Mediterranean Region from Stable Isotope Analysis of Speleothems at Soreq Cave, Israel.” *Quaternary Research* 47/2: 155–68.

Barge, Olivier; Corinne Castel; and Jacques Élie Brochier

2014 “Human Impact on the Landscape around al-Rawda (Syria) during the Early Bronze IV: Evidence for Exploitation, Occupation and Appropriation of the Land.” In *Settlement Dy-*

namics and Human–Landscape Interaction in the Dry Steppes of Syria, edited by Daniele Morandi Bonacossi, pp. 173–85. Studia Chaburensia 4. Wiesbaden: Harrassowitz.

Baruch, U., and Sytze Bottema

1999 "A New Pollen Diagram from Lake Hula: Vegetational, Climatic and Anthropogenic Implications." In *Ancient Lakes: Their Cultural and Biological Diversity*, edited by Hiroya Kanawabe, George W. Coulter, and Anna C. Roosevelt, pp. 75–86. Ghent: Kenobi Productions.

Bauer, Theodor

1926 *Die Ostkanaanäer*: *Eine philologisch-historische Untersuchung über die Wanderschicht der sogenannten "Amoriter" in Babylonien*. Leipzig: Asia Major.

Berkelhammer, Max; Ashish Sinha; Lowell Stott; H. Cheng; F. S. R. Pausata; and K. Yoshimura

2012 "An Abrupt Shift in the Indian Monsoon 4000 Years Ago." In *Climates, Landscapes, and Civilizations*, edited by Liviu Giosan, Dorian Q. Fuller, Kathleen Nicoll, Rowan K. Flad and Peter D. Clift, pp. 75–87. Geophysical Monograph 198. Washington D.C.: GeoPress/American Geophysical Union.

Bottema, Sytze

1997 "Third Millennium Climate in the Near East Based upon Pollen Evidence." In *Third Millennium B.C. Climate Change and Old World Collapse*, edited by H. Nüzhet Dalfes, George Kukla, and Harvey Weiss, pp. 489-515. NATO ASI Series I: Global Environmental Change 49. Berlin: Springer.

Bottema, Sytze; H. Woldring; and I. Kayan

2001 "The Late Quaternary Vegetation History of Western Turkey." In *The Ilıpınar Excavations* II, edited by J. J. Roodenberg and Laurents C. Thissen, pp. 327–54. Uitgaven van het Nederlands historisch-archaeologisch Instituut te Istanbul 93. Leiden: Nederlands Instituut voor het Nabije Oosten.

Boyd, Meighan

2015 *Speleothems from Warm Climates: Holocene Records from the Caribbean and Mediterranean Regions.* Stockholm: Department of Physical Geography, Stockholm University.

Boyer, Peter; Neil Roberts; and Douglas Baird

2006 "Holocene Environment and Settlement on the Çarşamba Alluvial Fan, South-central Turkey: Integrating Geoarchaeology and Archaeological Field Survey." *Geoarchaeology* 21/7: 675–98.

Braemer, Frank; Jean-Claude Échallier; and Ahmad Taraqji

2004 *Khirbet al Umbashi: Villages et campements de pasteurs dans le 'désert noir' (Syrie) à l'âge du Bronze. Travaux de la mission conjointe franco-syrienne 1991 - 1996.* Bibliothèque Archéologique et Historique 171. Beirut: Institut français du Proche-Orient.

Brisset, Elodie; Cécile Miramont; Frédéric Guiter; Edward J. Anthony; Kazuyo Tachikawa; Jérôme Poulenard; Fabien Arnaud; Claire Delhon; Jean-Dominique Meunier; Edouard Bard; and Franck Suméra

2013 "Non-reversible Geosystem Destabilisation at 4200 cal. B.P.: Sedimentological, Geochemical and Botanical Markers of Soil Erosion Recorded in a Mediterranean Alpine Lake." *The Holocene* 23/12: 1863–74.

Brochier, J. E.

In press A Cataclysm in the Steppe? Environmental History of al-Rawda, an Ephemeral Town in the Arid Syrian Margins at the End of the Third Millennium." *Subartu.*

Bronk Ramsey, Christopher; Michael W. Dee; Joanne M. Rowland; Thomas F. G. Higham; Stephen A. Harris; Fiona Brock; Anita Quiles; Eva M. Wild; Ezra S. Marcus; and Andrew J. Shortland

2010 "Radiocarbon-Based Chronology for Dynastic Egypt." *Science* 328/5985: 1554–57.

Brumfield, Sara

2013 Imperial Methods: Using Text Mining and Social Network Analysis to Detect Regional Strategies in the Akkadian Empire. Ph.D. dissertation, University of California Los Angeles.

Buccellati, Giorgio, and Marilyn Kelly-Buccellati

2000 "The Royal Palace of Urkesh. Report on the 12th Season at Tell Mozan/Urkesh: Excavations in Area AA, June–October 1999." *Mitteilungen der Deutschen Orient-Gesellschaft zu Berlin* 132: 133–83.

Butterlin, Pascal

2007 "Mari, les Šakkanakku et la crise de la fin du Troisième Millénaire." In *Sociétés humaines et changement climatique à la fin du troisième millénaire: une crise a-t-elle eu lieu en Haute Mésopotamie? Actes du Colloque de Lyon, 5–8 décembre 2005,* edited by Catherine Kuzucuoğlu and Catherine Marro, pp. 227–45. Varia Anatolica 19. Paris: De Boccard.

Carolin, Stacy; Jacob Morgan; Emily Peckover; Richard Walker; Gideon Henderson; Peter Rowe; Julian Andrews; Vasile Ersek; Alastair Sloan; Morteza Talebian; Morteza Fattahi; and Javad Nezamdoust

2016 "Iranian Speleothems: Investigating Quaternary Climate Variability in Semi-arid Western Asia." *Geophysical Research Abstracts* 18, EGU2016-923, 2016. European Geosciences Union 2016.

Carozza, Laurent; Jean-Francois Berger; Cyril Marcigny; and Albane Burens

2015 "Society and Environment in Southern France from the 3rd Millennium B.C. to the Beginning of the 2nd Millennium B.C.: 2200 B.C. as a Tipping Point?" In *2200 B.C.: Ein Klimasturz als Ursache für den Zerfall den Alten Welt?* edited by Harald Meller, Helge Wolfgang Arz, Reinhard Jung, and Roberto Risch, pp. 335–64. Tagungen des Landesmuseums für Vorgeschichte Halle 12. Halle (Saale): Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt, Landesmuseum für Vorgeschichte.

Carrión, José S.; Pedro Sánchez-Gómez; Juan F. Mota; Riker Yll; and Celia Chaín

2003 "Holocene Vegetation Dynamics, Fire and Grazing in the Sierra de Gádor, Southern Spain." *The Holocene* 13/6: 839–49.

Cartwright, Nancy

1999 *The Dappled World: A Study of the Boundaries of Science.* Cambridge: Cambridge University Press.

Chase, Brian M.; Michael E. Meadows; Andrew S. Carr; and Paula J. Reimer

2010 "Evidence for Progressive Holocene Aridification in Southern Africa Recorded in Namibian Hyrax Middens: Implications for African Monsoon Dynamics and the 'African Humid Period.'" *Quaternary Research* 74/1: 36–45.

Cheng, H.; A. Sinha; S. Verheyden; F. H. Nader; X. L. Li; P. Z. Zhang; J. J. Yin; L. Yi; Y. B. Peng; Z. G. Rao; Y. F. Ning; and R. L. Edwards

2016 "The Climate Variability in Northern Levant over the Past 20,000 Years." *Geophysical Research Letters* 42: 8641–50. DOI: 10.1002/2015GL065397.

Colantoni, Carlo

2012 "Touching the Void: The Post-Akkadian Period Viewed from Tell Brak." In *Seven Generations Since the Fall of Akkad*, edited by Harvey Weiss, pp. 45–64. Studia Chaburiensia 3. Wiesbaden: Harrassowitz.

Coope, Geoffrey R.

1979 "Late Cenozoic Fossil Coleoptera: Evolution, Biogeography, and Ecology." *Annual Review of Ecology and Systematics* 10: 247–67.

Cordova, Carlos E., and Paul H. Lehman

2005 “Holocene Environmental Change in Southwestern Crimea (Ukraine) in Pollen and Soil Records.” *The Holocene* 15/2: 263–77.

Cruz, J. A.; M. J. Turrero; J. O. Cáceres; A. Marín-Roldán; A. I. Ortega; A. Garralón; L. Sánchez; P. Gómez; M. B. Muñoz-García; R. L. Edwards; and J. Martín-Chivelet

2016 “Long-term Hydrological Changes in Northern Iberia (4.9–0.9 ky B.P.) from Speleothem Mg/Ca Ratios and Cave Monitoring (Ojo Guareña Karst Complex, Spain).” *Environmental and Earth Sciences* 74: 7741–7753. DOI: 10.1007/s12665-015-4687-x.

Cullen, Heidi M.; Peter B. deMenocal; Sidney R. Hemming; Gary Hemming; F. H. Brown; Tom Guilderson; and Frank Sirocko

2000 “Climate Change and the Collapse of the Akkadian Empire: Evidence from the Deep Sea.” *Geology* 28/4: 379–82.

Cullen, Heidi M.; Alexey Kaplan; Phillip A. Arkin; and Peter B. deMenocal

2002 “Impact of the North Atlantic Oscillation on Middle Eastern Climate and Streamflow.” *Climatic Change* 55: 315–38.

D’Andrea, Marta

2012 “The Early Bronze IV Period in South-Central Transjordan: Reconsidering Chronology Through Ceramic Technology.” *Levant* 44/1: 17–50.

2016 Review of ARCANE, Vol. IV: Middle Euphrates, edited by Uwe Finkbeiner, Mirko Novák, Ferhan Sakal, and Paola Sconzo. *Studia Eblaitica* 2: 213–23.

Davis, Jack L.

2013 “‘Minding the Gap’: A Problem in Eastern Mediterranean Chronology, Then and Now.” *American Journal of Archaeology* 117/4: 527–33.

Dean, Jonathan R.; Matthew D. Jones; Melanie J. Leng; Stephen R. Noble; Sarah E. Metcalfe; Hilary J. Sloane; Diana Sahy; Warren J. Eastwood; and C. Neil Roberts

2015 “Eastern Mediterranean Hydroclimate over the Late Glacial and Holocene, Reconstructed from the Sediments of Nar Lake, Central Turkey, Using Stable Isotopes and Carbonate Mineralogy.” *Quaternary Science Reviews* 124: 162–74.

de Boucheman, Albert

1934 “La sédentarisation des nomades du désert de Syrie.” *L’Asie française* 320: 140–43.

Di Rita, Frederico, and Donatella Magri

2009 “Holocene Drought, Deforestation and Evergreen Vegetation Development in the Central Mediterranean: A 5500-Year Record from Lago Alimini Piccolo, Apulia, Southeast Italy.” *The Holocene* 19/2: 295–306.

Dixit, Yama; David A. Hodell; and Cameron A. Petrie

2014 “Abrupt Weakening of the Summer Monsoon in Northwest India ~4100 Yr Ago.” *Geology* 42/4: 339–42.

Djamali, Morteza; Jacques-Louis De Beaulieu; Naomi F. Miller; Valérie Andrieu-Ponel; Philippe Ponel; Razieh Lak; Nasser Sadeddin; Hossein Akhani; and Hassan Fazeli

2009 “Vegetation History of the SE Section of the Zagros Mountains during the Last Five Millennia: A Pollen Record from the Maharlou Lake, Fars Province, Iran.” *Vegetation History and Archaeobotany* 18/2: 123–36.

Drysdale, Russell; Giovanni Zanchetta; John Hellstrom; Roland Maas; Anthony Fallick; Matthew Pickett; Ian Cartwright; and Leonardo Piccini

2006 “Late Holocene Drought Responsible for the Collapse of Old World Civilizations Is Recorded in an Italian Cave Flowstone.” *Geology* 34/2: 101–04.

Eastwood, Warren J.; Melanie J. Leng; Neil Roberts; and Basil Davis

2007 "Holocene Climate Change in the Eastern Mediterranean Region: A Comparison of Stable Isotope and Pollen Data from Lake Gölhisar, Southwest Turkey." *Journal of Quaternary Science* 22/4: 327–41.

Eastwood, Warren J.; Neil Roberts; H. F. Lamb; and J. C. Tibby

1999 "Holocene Environmental Change in Southwest Turkey: A Palaeoecological Record of Lake and Catchment-related Changes." *Quaternary Science Reviews* 18/4–5: 671–95.

Edelman-Furstenberg, Yael; Ahuva Almogi-Labin; and Christoph Hemleben

2009 "Palaeoceanographic evolution of the central Red Sea during the late Holocene." *The Holocene* 19/1: 117–27.

Edzard, Dietz Otto

1957 *Die "Zweite Zwischenzeit" Babyloniens*. Wiesbaden: Harrassowitz.

Ehrmann, Werner; Gerhard Schmiedl; Yvonne Hamann; Tanja Kuhnt; Christoph Hemleben; and Wolfgang Siebel

2007 "Clay Minerals in Late Glacial and Holocene Sediments of the Northern and Southern Aegean Sea." *Palaeogeography, Palaeoclimatology, Palaeoecology* 249/1–2: 36–57.

Emberling, Geoff; Helen McDonald; Jill A. Weber; and Henry Wright

2012 "After Collapse: The Post-Akkadian Occupation in the Pisé Building, Tell Brak." In *Seven Generations Since the Fall of Akkad*, edited by Harvey Weiss, pp. 65–87. Studia Chaburiensia 3. Wiesbaden: Harrassowitz.

Felikci, Betül; K. Kadir Eris; M. Namık Çağatay; Luca Gasperini; Asen Sabuncu; Dursun Acar; and Burak Yalamaz

2016 "Late Pleistocene to Holocene Paleoceanographic and Paleo-climatic Changes in Gulf of Gemlik, Sea of Marmara, Turkey." *Geophysical Research Abstracts* 18, EGU2016-625-1, European Geosciences Union General Assembly 2016.

Finkelstein, Israel, and Dafna Langgut

2014 "Dry Climate in the Middle Bronze I and Its Impact on Settlement Patterns in the Levant and Beyond: New Pollen Evidence." *Journal of Near Eastern Studies* 73/2: 219–34.

Finkelstein, Jacob J.

1966 "The Genealogy of the Hammurapi Dynasty." *Journal of Cuneiform Studies* 20/3–4: 95–118.

Finné, Martin; Karin Holmgren; Hanna S. Sundqvist; Erika Weiberg; and Michael Lindblom

2011 "Climate in the Eastern Mediterranean, and Adjacent Regions, during the Past 6000 Years — A Review." *Journal of Archaeological Science* 38/12: 3153–73.

Fisher, David A.

2011 "Connecting the Atlantic-sector and the North Pacific (Mt. Logan) Ice Core Stable Isotope Records during the Holocene: The Role of El Niño." *The Holocene* 21/7: 1117–24.

Fleitmann, Dominik; Stephen J. Burns; Manfred Mudelsee; Ulrich Neff; Jan Kramers; Augusto Mangini; and Albert Matter

2003 "Holocene Forcing of the Indian Monsoon Recorded in a Stalagmite from Southern Oman." *Science* 300/5626: 1737–39.

Francke, Alexander; Bernd Wagner; Melanie J. Leng; and J. Rethemeyer

2013 "A Late Glacial to Holocene Record of Environmental Change from Lake Dojran (Macedonia, Greece)." *Climate of the Past* 9: 481–98.

Frumkin, Amos

2009 "Stable Isotopes of a Subfossil *Tamarix* Tree from the Dead Sea Region, Israel, and Their Implications for the Intermediate Bronze Age Environmental Crisis." *Quaternary Research* 71/3: 319–28.

Garfinkle, Steven J.

2014 “The Economy of Warfare in Southern Iraq at the End of the Third Millennium B.C.” In *Krieg und Frieden im Alten Vorderasien. 52e Rencontre Assyriologique Internationale. International Congress of Assyriology and Near Eastern Archaeology. Münster, 17.–21. Juli 2006*, edited by Hans Neumann, Reinhard Dittmann, Susanne Paulus, Georg Neumann, and Anais Schuster-Brandis, pp. 353–62. Alter Orient und Altes Testament 401. Münster: Ugarit-Verlag.

Gasse, Françoise

2000 “Hydrological Changes in the African Tropics since the Last Glacial Maximum.” *Quaternary Science Reviews* 19/1–5: 189–211.

Geirsdóttir, Áslaug; Gifford H. Miller; Darren J. Larsen; and Sædís Ólafsdóttir

2013 “Abrupt Holocene Climate Transitions in the Northern North Atlantic Region Recorded by Synchronized Lacustrine Records in Iceland.” *Quaternary Science Reviews* 70: 48–62.

Gelb, Ignace J.

1961 *Old Akkadian Writing and Grammar*. 2nd edition. Materials for the Assyrian Dictionary 2. Chicago: University of Chicago Press.

1980 *Computer-aided Analysis of Amorite*. Assyriological Studies 21. Chicago: Oriental Institute.

Gibson, McGuire

2001 “Hamoukar.” In *Oriental Institute 2000–2001 Annual Report,* edited by Gene Gragg, pp. 77–83. Chicago: The Oriental Institute.

Glassner, Jean-Jacques

1986 *La chute d’Akkadé: l’événement et sa mémoire.* Berliner Beiträge zum Vorderen Orient 5. Berlin: Dietrich Reimer.

Göktürk, Ozan M.

2011 Climate in the Eastern Mediterranean through the Holocene Inferred from Turkish Stalagmites. Ph.D. dissertation, Universität Bern.

Göktürk, Ozan M.; D. Fleitmann; S. Badertscher; H. Cheng; R. L. Edwards; M. Leuenberger; A. Fankhauser; O. Tüysüz; and J. Kramers

2011 “Climate on the Southern Black Sea Coast during the Holocene: Implications from the Sofular Cave Record.” *Quaternary Science Reviews* 30: 2433–45.

Haenssler, Elke; Ingmar Unkel; Walter Dörfler; and Marie-Josée Nadeau

2014 “Driving Mechanisms of Holocene Lagoon Development and Barrier Accretion in Northern Elis, Peloponnese, Inferred from the Sedimentary Record of the Kotychi Lagoon.” *Quaternary Science Journal* 63: 60–77.

Haiman, Mordechai

1996 “Early Bronze Age IV Settlement Pattern of the Negev and Sinai Deserts: View from Small Marginal Temporary Sites.” *Bulletin of the American Schools of Oriental Research* 303: 1–32.

Harrison, Timothy P.

2012 “The Southern Levant.” In *A Companion to the Archaeology of the Ancient Near East*, volume I, edited by Daniel T. Potts, pp. 629–46. Malden: Wiley-Blackwell.

Hassan, Fekri, and Geoff Tassie

2006 “Modelling Environmental and Settlement Change in the Fayum.” *Egyptian Archaeology* 29: 37–40.

Heimpel, Wolfgang

2003 *Letters to the Kings of Mari. A New Translation, with Historical Introduction, Notes, and Commentary*. Mesopotamian Civilizations 12. Winona Lake: Eisenbrauns.

Ibisch, Elrud

1982 "Historical Changes of the Function of Spatial Description in Literary Texts." *Poetics Today* 3/4: 97–113.

Jahns, Susanne

1993 "On the Holocene Vegetation History of the Argive Plain (Peloponnese, Southern Greece)." *Vegetation History and Archaeobotany* 2/4: 187–203.

Jiménez-Moreno, Gonzalo, and R. Scott Anderson

2012 "Holocene Vegetation and Climate Change Recorded in Alpine Bog Sediments from the Borreguiles de la Virgen, Sierra Nevada, Southern Spain." *Quaternary Research* 77/1: 44–53.

Jiménez-Moreno, Gonzalo; Antonio Rodríguez-Ramírez; José N. Pérez-Asensio; José S. Carrión; José Antonio López-Sáez; Juan J. R. Villarías-Robles; Sebastián Celestino-Pérez; Enrique Cerrillo-Cuenca; Ángel León; and Carmen Contreras

2015 "Impact of Late-Holocene Aridification Trend, Climate Variability and Geodynamic Control on the Environment from a Coastal Area in SW Spain." *The Holocene* 25/4: 607–17.

Jones, Sarah; Dominik Fleitmann; and Stuart Black

2016 "A Critical Evaluation of the 4.2 ka B.P. Event Using New High-resolution Evidence from Stalagmites in the Middle East." *Geophysical Research Abstracts* 18, EGU2016-582, European Geosciences Union General Assembly 2016.

Kagan, Elisa J.; Dafna Langgut; Elisabetta Boaretto; Frank H. Neumann; and Mordechai Stein

2015 "Dead Sea Levels during the Bronze and Iron Ages." *Radiocarbon* 57/2: 237–52.

Kaniewski, David, Etienne Paulissen; Elise Van Campo; Michel al-Maqdissi; Joachim Bretschneider; and Karel Van Lerberghe

2008 "Middle East Coastal Ecosystem Response to Middle-to-late Holocene Abrupt Climate Changes." *Proceedings of the National Academy of Sciences* 105/37: 13941–46.

Kaniewski, David E.; Elise Van Campo; Christophe Morhange; Joël Guiot; Dov Zviely; Idan Shaked; Thierry Otto; and Michal Artzy

2013 "Early Urban Impact on Mediterranean Coastal Environments." *Scientific Reports* 3: 35–40.

Kaniewski, David E.; Elise Van Campo; and Harvey Weiss

2012 "Drought is a Recurring Challenge in the Middle East." *Proceedings of the National Academy of Sciences* 109/10: 3862–67.

Klengel, Horst

1972 *Zwischen Zelt und Palast: Die Begegnung von Nomaden und Seßhaften im alten Vorderasien.* Wien: Schroll.

Koliński, Rafał

2012 "Generation Count at Tell Arbid, Sector P." In *Seven Generations Since the Fall of Akkad*, edited by Harvey Weiss, pp. 109–28. Studia Chaburiensia 3. Wiesbaden: Harrassowitz.

Kröpelin, Stefan; Dirk Verschuren; Anne-Marie Lézine; Hilde Eggermont; Christine Cocquyt; Pierre Francus; J.-P. Cazet; Maureen Fagot; Bob Rumes; J. M. Russell; F. Darius; D. J. Conley; M. Schuster; H. von Suchodoletz; and D. R. Engstrom

2008 "Climate-Driven Ecosystem Succession in the Sahara: The Past 6000 Years." *Science* 320/5877: 765–68.

Kuhnt, Tanja; Gerhard Schmiedl; Werner Ehrmann; Yvonne Hamann; and Nils Andersen

2008 "Stable Isotopic Composition of Holocene Benthic Foraminifers from the Eastern Mediterranean Sea: Past Changes in Productivity and Deep Water Oxygenation." *Palaeogeography, Palaeoclimatology, Palaeoecology* 268/1–2: 106–15.

Kushnir, Yochanan, and Mordechai Stein

2010 “North Atlantic Influence on 19th–20th Century Rainfall in the Dead Sea Watershed, Teleconnections with the Sahel, and Implication for Holocene Climate Fluctuations.” *Quaternary Science Reviews* 29/27–28: 3843–60.

Kuzucuoğlu, Catherine; Walter Dörfler; Stéphane Kunesch; and Franck Goupille

2011 “Mid- to Late-Holocene Climate Change in Central Turkey: The Tecer Lake Record.” *The Holocene* 21/1: 173–88.

Lamb, Angela L.; Melanie J. Leng; Henry F. Lamb; and Mohammed

2000 “A 9000-year Oxygen and Carbon Isotope Record of Hydrological Change in a Small Ethiopian Crater Lake.” *The Holocene* 10/2: 167–77.

Langgut, Dafna; Frank H. Neumann; Mordechai Stein; Allon Wagner; Elisa J. Kagan; Elisabetta Boaretto; and Israel Finkelstein

2014 “Dead Sea Pollen Record and History of Human Activity in the Judean Highlands (Israel) from the Intermediate Bronze into the Iron Ages (~2500–500 B.C.E.).” *Palynology* 38/2: 280–302.

Langgut, Dafna; Matthew J. Adams; and Israel Finkelstein

2016 “Climate, Settlement Patterns and Olive Horticulture in the Southern Levant during the Early Bronze and Intermediate Bronze Ages (c. 3600–1950 B.C.).” *Levant* 48: 117–34.

Lemcke, Gerry, and Michael Sturm

1997 “$\delta^{18}O$ and Trace Element Measurements as Proxy for the Reconstruction of Climate Changes at Lake Van (Turkey): Preliminary Results.” In *Third Millennium B.C. Climate Change and Old World Collapse*, edited by H. Nüzhet Dalfes, George Kukla, and Harvey Weiss, pp. 653-78. NATO ASI Series I: Global Environmental Change 49. Berlin: Springer.

Leng, Melanie J.; Ilaria Baneschi; Giovanni Zanchetta; Catherine N. Jex; Bernd Wagner; and Hendrik Vogel

2010 “Late Quaternary Palaeoenvironmental Reconstruction from Lakes Ohrid and Prespa (Macedonia/Albania Border) Using Stable Isotopes.” *Biogeosciences* 7/10: 3109–22.

Leng, Melanie J.; Neil Roberts; Jane M. Reed; and Hilary J. Sloane

1999 “Late Quaternary Palaeohydrology of the Konya Basin, Turkey, Based on Isotope Studies of Modern Hydrology and Lacustrine Carbonates.” *Journal of Paleolimnology* 22/2: 187–204.

Leroy, Suzanne A. G.; Lourdes López-Merino; Alina Tudryn; Françoise Chalié; and Françoise Gasse

2014 “Late Pleistocene and Holocene Palaeoenvironments in and around the Middle Caspian Basin as Reconstructed from a Deep-sea Core.” *Quaternary Science Reviews* 101/1: 91–110.

Leroy, Suzanne A. G.; Fabienne Marret; E. Gibert; Françoise Chalié; Jean L. Reyss; and Klaus Arpe

2007 “River Inflow and Salinity Changes in the Caspian Sea during the Last 5500 Years.” *Quaternary Science Reviews* 26/25–28: 3359–83.

Lionello, P.; Paola Malanotte-Rizzoli; and R. Boscolo, editors

2013 *Mediterranean Climate Variability*. Developments in Earth and Environmental Sciences 4. Amsterdam: Elsevier.

Macklin, Mark, G.; Jamie C. Woodward; Derek A. Welsby; Geoff A. T. Duller; Frances M. Williams; and Martin A. J. Williams

2013 “Reach-scale River Dynamics Moderate the Impact of Rapid Holocene Climate Change on Floodwater Farming in the Desert Nile.” *Geology* 41/6: 695–98.

Magny, Michel; Jacques-Louis de Beaulieu; Ruth Drescher-Schneider; Boris Vannière; Anne-Véronique Walter-Simonnet; Yannick Miras; Laurent Millet; Gilles Bossuet; Odile Peyron; Elisabetta Brugiapaglia; and Aurélie Leroux

2007 "Holocene Climate Changes in the Central Mediterranean as Recorded by Lake-level Fluctuations at Lake Accesa (Tuscany, Italy)." *Quaternary Science Reviews* 26/13–14: 1736–58.

Magny, Michel; Nathalie Combourieu-Nebout; Jacques–Louis de Beaulieu; Viviane Bout-Roumazeilles; Daniele Colombaroli; Stéphanie Desprat; Alexander Francke; Sébastien Joannin; Elena Ortu; Odile Peyron; Marie Revel; Laura Sadori; Giuseppe Siani; Marie A. Sicre; Stéphanie Samartin; Anaëlle Simonneau; Willy Tinner; Boris Vannière; Bernd Wagner; Giovanni Zanchetta; Flavio Anselmetti; Elisabetta Brugiapaglia; Emmanuel Chapron; Maxime Debret; Marc Desmet; Julien Didier; Latifa Essalami; Didier Galop; Adrian Gilli; Jean N. Haas; Néjib Kallel; Laurent Millet; Agnès Stock; Jean L. Turon; and Stefanie Wirth

2013 "North-south Palaeohydrological Contrasts in the Central Mediterranean during the Holocene: Tentative Synthesis and Working Hypotheses." *Climate of the Past* 9/5: 2043–71.

Magny, Michel; Boris Vannière; Camilla Calo; Laurent Millet; Aurélie Leroux; Odile Peyron; Giovanni Zanchetta; Tommaso La Mantia; and Willy Tinner

2011 "Holocene Hydrological Changes in South-western Mediterranean as Recorded by Lake-level Fluctuations at Lago Preola, a Coastal Lake in Southern Sicily, Italy." *Quaternary Science Reviews* 30/19–20: 2459–75.

Magny, Michel; Boris Vannière; Giovanni Zanchetta; Eric Fouache; Gilles Touchais; Lera Petrika; Céline Coussot; Anne-Véronique Walter-Simonnet; and Fabien Arnaud

2009 "Possible Complexity of the Climatic Event around 4300–3800 cal. BP in the Central and Western Mediterranean." *The Holocene* 19/6: 823–33.

Magri, Donatella, and I. Parra

2002 "Late Quaternary Western Mediterranean Pollen Records and African Winds." *Earth and Planetary Science Letters* 200/3–4: 401–08.

Manning, Sturt W.; Carol B. Griggs; Brita Lorentzen; Gojko Barjamovic; Christopher Bronk Ramsey; Bernd Kromer; and Eva Maria Wild

2016 "Integrated Tree-ring-radiocarbon High-resolution Timeframe to Resolve Earlier Second Millennium B.C.E. Mesopotamian Chronology." *PLOS ONE.* DOI: 10.1371/journal.pone.0157144.

Marshall, Michael H.; Henry F. Lamb; Dei Huws; Sarah J. Davies; Richard Bates; Jan Bloemendal; John Boyle; Melanie J. Leng; Mohammed Umer; and Charlotte Bryant

2011 "Late Pleistocene and Holocene Drought Events at Lake Tana, the Source of the Blue Nile." *Global and Planetary Change* 78/3–4: 147–61.

Masi, Alessia; Laura Sadori; Giovanni Zanchetta; Ilaria Baneschi; and Marco Giardini

2013 "Climatic Interpretation of Carbon Isotope Content of Mid-Holocene Archaeological Charcoals from Eastern Anatolia." *Quaternary International* 303: 64–72.

Massa, Michele, and Vasif Şahoğlu

2015 "The 4.2 ka B.P. Climatic Event in West and Central Anatolia: Combining Palaeo-climatic Proxies and Archaeological Data." In *2200 B.C.: A Climatic Breakdown as a Cause for the Collapse of the Old World?* edited by Harald Meller, Helge Wolfgang Arz, Reinhard Jung, Roberto Risch, pp. 61–78. Halle: Landesmuseum für Vorgeschichte.

Matthiae, Paolo, and Nicolo Marchetti, eds.

2013 *Ebla and Its Landscape: Early State Formation in the Ancient Near East.* Walnut Creek: Left Coast Press.

Maxwell, Toby M.; Lucas C. R. Silva; and William R. Horwath
2014 “Using Multielement Isotopic Analysis to Decipher Drought Impacts and Adaptive Management in Ancient Agricultural Systems.” *Proceedings of the National Academy of Sciences* 111/45: E4807–E4808.

Mazzini, Ilaria; Elsa Gliozzi; Rexhep Koci; Ingeborg Soulie-Märsche; Giovanni Zanchetta; Ilaria Baneschi; Laura Sadori; Marco Giardini; Aurelien VanWelden; and Salvatore Bushati
2015 “Historical Evolution and Middle to Late Holocene Environmental Changes in Lake Shkodra (Albania): New Evidences from Micropaleontological Analysis.” *Paleogeogreaphy, Paleoclimatology, Paleoecology* 419: 47–59.

McCarthy, Andrew
2012 “The End of Empire: Akkadian and Post-Akkadian Glyptic in the Jezirah, the Evidence from Tell Leilan in Context.” In *Seven Generations Since the Fall of Akkad*, edited by Harvey Weiss, pp. 217–24. Studia Chaburiensia 3. Wiesbaden: Harrassowitz.

Migowski, Claudia; Mordechai Stein; Sushma Prasad; Jörg F. W. Negendank; and Amotz Agnon
2006 “Holocene Climate Variability and Cultural Evolution in the Near East from the Dead Sea Sedimentary Record.” *Quaternary Research* 66/3: 421–31.

Morellón, Mario; Blas Valero-Garcés; Teresa Vegas-Vilarrúbia; Penélope González-Sampériz; Óscar Romero; Antonio Delgado-Huertas; Pilar Mata; Ana Moreno; Mayte Rico; and Juan Pablo Corella
2009 “Lateglacial and Holocene Palaeohydrology in the Western Mediterranean Region: The Lake Estanya Record (NE Spain).” *Quaternary Science Reviews* 28: 2582–99.

Navarro-Hervás, Francisca; María-Milagros Ros-Salas; Tomás Rodríguez-Estrella; Elena Fierro-Enrique; José-Sebastián Carrión; Javier García-Veigas; José-Abel Flores; María Ángeles Bárcena; and Ma Soledad García
2014 “Evaporite Evidence of a mid-Holocene (c. 4550–4400 cal. yr BP) Aridity Crisis in Southwestern Europe and Palaeoenvironmental Consequences.” *The Holocene* 24/4: 489–502.

Nicolle, Christophe
2012 “Pre-Khabur Occupations at Tell Mohammed Diyab (Syrian Jezirah).” In *Seven Generations Since the Fall of Akkad*, edited by Harvey Weiss, pp. 129–44. Studia Chaburiensia 3. Wiesbaden: Harrassowitz.

Olsen, Jesper; N. John Anderson; and Mads F. Knudsen
2012 “Variability of the North Atlantic Oscillation over the Past 5,200 Years.” *Nature Geoscience* 5: 808–12.

Orsi, Valentina
2012 “Tell Barri Before Kahat.” In *Seven Generations Since the Fall of Akkad*, edited by Harvey Weiss, pp. 89–108. Studia Chaburiensia 3. Wiesbaden: Harrassowitz.

Parker, Adrian G., and Andrew S. Goudie
2008 “Geomorphological and Palaeoenvironmental Investigations in the Southeastern Arabian Gulf Region and the Implication for the Archaeology of the Region.” *Geomorphology* 101/3: 458–70.

Parker, Adrian G.; Andrew S. Goudie; Stephen Stokes; Kevin White; Martin J. Hodson; Michelle Manning; and Derek Kennet
2006 “A Record of Holocene Climate Change from Lake Geochemical Analyses in Southeastern Arabia.” *Quaternary Research* 66/3: 465–76.

Pederson, Neil; Amy E. Hessl; Nachin Baatarbileg; Kevin J. Anchukaitis; and Nicola Di Cosmo
2014 “Pluvials, Droughts, the Mongol Empire, and Modern Mongolia.” *Proceedings of the National Academy of Sciences* 111/12: 4375–79.

Peyron, Odile; Michel Magny; S. Goring; S. Joannin; J.-L. de Beaulieu; E. Brugiapaglia; L. Sadori; G. Garfi; K. Kouli; C. Ioakim; and N. Combourieu-Nebout

2013 "Contrasting Patterns of Climatic Changes during the Holocene across the Italian Peninsula Reconstructed from Pollen Data." *Climate of the Past* 9: 1233–52.

Pfälzner, Peter

2012 "Household Dynamics in Late Third Millennium Northern Mesopotamia." In *Seven Generations Since the Fall of Akkad*, edited by Harvey Weiss, pp. 145–62. Studia Chaburiensia 3. Wiesbaden: Harrassowitz.

Powell, Marvin A.

1987–1990 "Maße und Gewichte." *Reallexikon der Assyriologie* 7: 457–517.

Pustovoytov, Konstantin; Klaus Schmidt; and Heinrich Taubald

2007 "Evidence for Holocene Environmental Changes in the Northern Fertile Crescent Provided by Pedogenic Carbonate Coatings." *Quaternary Research* 67/3: 315–27.

Railsback, L. Bruce; Fuyuan Liang; Juan Ramón Vidal Romaní; Aurora Grandal-d'Anglade; Marcos Vaqueiro Rodríguez; Luisa Santos Fidalgo; Daniel Fernández Mosquera; Hai Cheng; and R. Lawrence Edwards

2011 "Petrographic and Isotopic Evidence for Holocene Long-term Climate Change and Shorter-term Environmental Shifts from a Stalagmite from the Serra do Courel of Northwestern Spain, and Implications for Climatic History across Europe and the Mediterranean." *Palaeogeography, Palaeoclimatology, Palaeoecology* 305/14: 172–84.

Reed, Jane M.; Neil Roberts; and Melanie J. Leng

1999 "An Evaluation of the Diatom Response to Late Quaternary Environmental Change in Two Lakes in the Konya Basin, Turkey, by Comparison with Stable Isotope Data." *Quaternary Science Reviews* 18/4–5: 631–46.

Reade, Julian E.

1968 "Tell Taya (1967): Summary Report." *Iraq* 30/2: 234–64.

Regattieri, Eleonora; Giovanni Zanchetta; Russell Drysdale; Ilaria Isola; John C. Hellstrom; and Luigi Dallai

2014 "Lateglacial to Holocene Trace Element Record (Ba, Mg, Sr) from Corchia Cave (Apuan Alps, Central Italy): Paleoenvironmental Implications." *Journal of Quaternary Science* 29/4: 381–92.

Regev, Johanna; Pierre de Miroschedji; Raphael Greenberg; Eliot Braun; Zvi Greenhut; and Elisabetta Boaretto

2012 "Chronology of the Early Bronze Age in the Southern Levant: New Analysis for a High Chronology." *Radiocarbon* 54/3–4: 525–66.

Revel, Marie; Christophe Colin; Stefano Bernasconi; Nathalie Combourieu-Nebout; Emmanuelle Ducassou; Francis E. Grousset; Yann Rolland; Sebastien Migeon; Delphine Bosch; Pierre Brunet; Yulong Zhao; and Jean Mascle

2014 "21,000 Years of Ethiopian African Monsoon Variability Recorded in Sediments of the Western Nile Deep-sea Fan." *Regional Environmental Change* 14/5: 1685–96.

Riehl, Simone

2010 "Plant Production in a Changing Environment: The Archeobotanical Remains from Tell Mozan." In *Development of the Environment, Subsistence and Settlement of the City of Urkes and Its Region*, edited by Katleen Deckers, Monika Doll, Peter Pfälzner, and Simone Riehl, pp. 131–158. Studien zur Urbanisierung Nordmesopotamiens Serie A 3. Wiesbaden: Harrassowitz.

Riehl, Simone; Konstantin E. Pustovoytov; Heike Weippert; Stefan Klett; and Frank Hole

2014 "Drought Stress Variability in Ancient Near Eastern Agricultural Systems Evidenced by $\delta^{13}C$ in Barley Grain." *Proceedings of the National Academy of Sciences* 111/34: 12348–53.

Ristvet, Lauren

2008 "Legal and Archaeological Territories of the Second Millennium B.C. in Northern Mesopotamia." *Antiquity* 82: 585–99.

2012 "Resettling Apum: Tribalism and Tribal States in the Tell Leilan Region, Syria." In *Looking North: The Socioeconomic Dynamics of Northern Mesopotamian and Anatolian Regions during the Late Third and Early Second Millennium B.C.*, edited by Nicola Laneri, Peter Pfälzner, and Stefano Valentini, pp. 37–50. Studien zur Urbanisierung Nordmesopotamiens, Serie D, Supplementa 1. Wiesbaden: Harrassowitz.

Ristvet, Lauren, and Harvey Weiss

2013 "The Ḫābūr Region in the Old Babylonian Period." In *Archéologie et Histoire de la Syrie*, Volume I: *La Syrie de l'époque néolithique à l'âge du fer,* edited by Winfried Orthmann, Michel al-Maqdissi, and Paolo Matthiae, pp. 257–72. Schriften zur vorderasiatischen Archäologie 1/1. Wiesbaden: Harrassowitz.

Roberts, Neil; David J. Brayshaw; Catherine Kuzucuoğlu; Rosa Perez; and Laura Sadori

2011 "The Mid-Holocene Climatic Transition in the Mediterranean: Causes and consequences." *The Holocene* 21/1: 3–13.

Roberts, Neil; Stuart Black; Peter Boyer; Warren J. Eastwood; Huw I. Griffiths; Henry F. Lamb; Melaine J. Leng; Romoia Parish; Jane M. Reed; D. Twigg; and Hakan Yiğitbaşioğlu

1999 "Chronology and Stratigraphy of Late Quaternary Sediments in the Konya Basin, Turkey: Results from the KOPAL Project." *Quaternary Science Reviews* 18/4–5: 611–30.

Roberts, Neil; Jane M. Reed; Melaine J. Leng; Catherine Kuzucuoğlu; Michel Fontugne; Jacques Bertaux; Hendrik Woldring; Sytze Bottema; Stuart Black; E. Hunt; and Mustafa Karabiyikoğlu

2001 "The Tempo of Holocene Climatic Change in the Eastern Mediterranean Region: New High-resolution Crater-lake Sediment Data from Central Turkey." *The Holocene* 11/6: 721–36.

Rosen, Steven A.

2009 "History Does Not Repeat Itself: Cyclicity and Particularism in Nomad-Sedentary Relations in the Negev in the Long Term." In *Nomads, Tribes, and the State in the Ancient Near East: Cross-Disciplinary Perspectives,* edited by Jeffrey Szuchman, pp. 57–86. Oriental Institute Seminars 5. Chicago: The Oriental Institute.

Rowton, Michael

1974 "Enclosed Nomadism." *Journal of the Economic and Social History of the Orient* 17/1: 1–30.

Ruan, J.; F. Kherbouche; D. Genty; D. Blamart; H. Cheng; F. Dewilde; S. Hachi; R. L. Edwards; E. Régnier; and J. L. Michelot

2015 "Evidence of a Prolonged Drought ca. 4200 yr BP Correlated with Prehistoric Settlement Abandonment from the Gueldaman GLD1 Cave, N-Algeria." *Climate of the Past* 11/4: 2729–62.

Sadori, Laura; Elena Ortu; Odile Peyron; Giovanni Zanchetta; Boris Vannière; Marc Desmet; and Michel Magny

2013 "The Last 7 Millennia of Vegetation and Climate Changes at Lago di Pergusa (Central Sicily, Italy)." *Climate of the Past* 9/4: 1969–84.

Sadori, Laura; Marco Giardini; Elsa Gliozzi; Ilaria Mazzini; Roberto Sulpizio; Aurelien van Welden; and Giovanni Zanchetta

2014 “Vegetation, Climate and Environmental History of the Last 4500 Years at Lake Shkodra (Albania/Montenegro).” *The Holocene*, published online December 9, 2014. http://dx.doi.org/10.1177/0959683614561891 (accessed 1/13/2017).

Salzer, Matthew W.; Andrew G. Bunn; Nicholas E. Graham; and Malcolm K. Hughes

2014 “Five Millennia of Paleotemperature from Tree-rings in the Great Basin, USA.” *Climate Dynamics* 42/5–6: 1517–26.

Schefuss, Enno; Holger Kuhlmann; Gesine Mollenhauer; Matthias Prange; and Jürgen Pätzold

2011 “Forcing of Wet Phases in Southeast Africa over the Past 17,000 Years.” *Nature* 480/7378: 509–12.

Schmidt, Roland; Jens Müller; Ruth Drescher-Schneider; Robert Krisai; Krystyna Szeroczyńska; and Ante Barić

2000 “Changes in Lake Level and Trophy at Lake Vrana, a Large Karstic Lake on the Island of Cres (Croatia), with Respect to Palaeoclimate and Anthropogenic Impacts during the Last Approx. 16,000 Years.” *Journal of Limnology* 59/2: 113–30.

Schmidt, Armin; Mark Quigley; Morteza Fattahi; Ghasem Azizi; Mehran Maghsoudi; and Hassan Fazeli

2011 “Holocene Settlement Shifts and Palaeoenvironments on the Central Iranian Plateau: Investigating Linked Systems.” *The Holocene* 21/4: 583–95.

Schwartz, Glenn M.; Hans H. Curvers; Sally S. Dunham; and Jill A. Weber

2012 “From Urban Origins to Imperial Integration in Western Syria: Umm el-Marra 2006, 2008.” *American Journal of Archaeology* 116/1: 157–93.

Scussolini, Paolo; Teresa Vegas-Vilarrúbia; Valentí Rull; Juan P. Corella; Blas Valero-Garcés; and Joan Gomà

2011 “Middle and Late Holocene Climate Change and Human Impact Inferred from Diatoms, Algae and Aquatic Macrophyte Pollen in Sediments from Lake Montcortès (NE Iberian Peninsula).” *Journal of Paleolimnology* 46/3: 369–85.

Senior, Louise, and Harvey Weiss

1992 “Tell Leilan ‘sila-bowls’ and the Akkadian Reorganization of Subarian Agricultural Production.” *OrientExpress* 1992/2: 16–23.

Smith, Andrew C.; Peter M. Wynn; Philip A. Barker; Melanie J. Leng; Stephen R. Noble; and Wlodek Tych

2016 “North Atlantic Forcing of Moisture Delivery to Europe Throughout the Holocene.” *Nature Scientific Reports* 6: 24745. DOI: 10.1038/srep24745.

Sommerfeld, Walter; Alfonso Archi; and Harvey Weiss

2004 “Why ‘Dada Measured 40,000 Liters of Barley from Nagar for Sippar’” 4ICAANE Berlin March 29April 3, 2004. Tell Leilan Project Poster Presentations. http://leilan.yale.edu/sites/default/files/publications/figure-specific/poster2.jpg

Sorrel, Philippe, and Marie Mathis

2016 “Mid- to Late Holocene Coastal Vegetation Patterns in Northern Levant (Tell Sukas, Coastal Syria): Olive Tree Cultivation History and Climatic Change.” *The Holocene* 26: 858–73.

Stevens, Lora R.; Emi Ito; Antje Schwalb; and Herbert E. Wright Jr.

2006 “Timing of Atmospheric Precipitation in the Zagros Mountains Inferred from a Multi-proxy Record from Lake Mirabad, Iran.” *Quaternary Research* 66/3: 494–500.

Stevens, Lora R.; Herbert E. Wright; and Emi Ito

2001 “Proposed Changes in Seasonality of Climate during the Lateglacial and Holocene at Lake Zeribar, Iran.” *The Holocene* 11/6: 747–55.

Styring, Amy K.; Michael Charles; Federica Fantone; Mette Marie Hald; Augusta McMahon; Richard H. Meadow; Geoff K. Nicholls; Ajita K. Patel; Mindy C. Pitre; Alexia Smith; Arkadiusz Sołtysiak; Gil Stein; Jill A. Weber; Harvey Weiss; and Amy Bogaard

In press "New Isotope Evidence for Agricultural Extensification Reveals How the World's First Cities Were Fed." *Nature Plants.*

Talon, Philippe

1996 "Personal Names." In *Administrative Documents from Tell Beydar (Seasons 1993–1995)*, edited by Farouk Ismail, Walther Sallaberger, Phillipe Talon, and Karel Van Lerberghe, pp. 75–80. Subartu 2. Turnhout: Brepols.

Triantaphyllou, M. V.; Alexandra Gogou; Ioanna Bouloubassi; Margarita Dimiza; Katerina Kouli; Grigoris Rousakis; Ulrich Kotthoff; Kay-Christian Emeis; Maria Papanikolaou; Maria Athanasiou; C. Parinos; Constantine Ioakim; and Vasilios Lykousis

2014 "Evidence for a Warm and Humid Mid-Holocene Episode in the Aegean and Northern Levantine Seas (Greece, NE Mediterranean)." *Regional Environmental Change* 14/5: 1697–1712.

Tunça, Önhan; Augusta McMahon; and Abd el-Massih Baghdo, editors

2007 *Chagar Bazar (Syrie) II: Les vestiges 'post-akkadiens' du Chantier D et études diverses.* Bibliothèque d'études classiques 52. Louvain: Peeters.

Turner, Rebecca; Neil Roberts; and Matthew D. Jones

2008 "Climatic Pacing of Mediterranean Fire Histories from Lake Sedimentary Microcharcoal." *Global and Planetary Change* 63/4: 317–24.

Ülgen, Umut B.; Sven O. Franz; Demet Biltekin; M. Namık Çagatay; Patricia A. Roeser; Lisa Doner; and Jean Thein

2012 "Climatic and Environmental Evolution of Lake Iznik (NW Turkey) over the Last ~4700 Years." *Quaternary International* 274: 88–101.

Ur, Jason A.

2010 *Urbanism and Cultural Landscapes in Northeastern Syria: The Tell Hamoukar Survey, 1999–2001.* Tell Hamoukar 1, Oriental Institute Publications 137. Chicago: The Oriental Institute.

Ur, Jason A., and Tony J. Wilkinson

2008 "Settlement and Economic Landscapes of Tell Beydar and Its Hinterland." In *Beydar Studies*, volume I, edited by Marc Lebeau and Antoine Suleiman, pp. 305–27. Subartu 21. Turnhout: Brepols.

Verheyden, Sophie; Fadi H. Nader; Hai J. Cheng; Lawrence R. Edwards; and Rudy Swennen

2008 "Paleoclimate Reconstruction in the Levant Region from the Geochemistry of a Holocene Stalagmite from the Jeita Cave, Lebanon." *Quaternary Research* 70/3: 368–81.

Visicato, Giuseppe

1999 "The Sargonic Archive at Tell el-Suleimah." *Journal of Cuneiform Studies* 51: 17–30.

Wagner, Bernd; André F. Lotter; Norbert Nowaczyk; Jane M. Reed; Antje Schwalb; Roberto Sulpizio; Verushka Valsecchi; Martin Wessels; and Giovanni Zanchetta

2009 "A 40,000-Year Record of Environmental Change from Ancient Lake Ohrid (Albania and Macedonia)." *Journal of Paleolimnology* 41/3: 407–30.

Walker, Michael J. C.; Max Berkelhammer; Svante Björck; Les C. Cwynar; David A. Fisher; Antony J. Long; John J. Lowe; Rewi M. Newnham; Sune O. Rasmussen; and Harvey Weiss

2012 "Formal Subdivision of the Holocene Series/Epoch: A Discussion Paper by a Working Group of INTIMATE (Integration of Ice-core, Marine and Terrestrial Records) and the Subcommission on Quaternary Stratigraphy (International Commission on Stratigraphy)." *Journal of Quaternary Science* 27/7: 649–59.

Wang, Hongya; Jonathan A. Holmes; F. Alayne Street-Perrott; Martyn P. Waller; and R. Alan Perrott

2008 "Holocene Environmental Change in the West African Sahel: Sedimentological and Mineral-magnetic Analyses of Lake Sediments from Jikariya Lake, Northeastern Nigeria." *Journal of Quaternary Science* 23/5: 449–60.

Weiberg, Erika, and Martin Finné

2013 "Mind or Matter? People-Environment Interactions and the Demise of Early Helladic II Society in the Northeastern Peloponnese." *American Journal of Archaeology* 117/1: 1–31.

Weiss, Harvey

2000 "Beyond the Younger Dryas: Collapse as Adaptation to Abrupt Climate Change in Ancient West Asia and the Eastern Mediterranean." In *Environmental Disaster and the Archaeology of Human Response*, edited by Garth Bawden and Richard M. Reycraft, pp. 75–98. Anthropological Papers 7. Albuquerque: Maxwell Museum of Anthropology, University of New Mexico.

2012 "Quantifying Collapse: The Late Third Millennium Khabur Plains." In *Seven Generations Since the Fall of Akkad*, edited by Harvey Weiss, pp. 1–24. Studia Chaburiensia 3. Wiesbaden: Harrassowitz.

2014 "The Northern Levant during the Intermediate Bronze Age. Altered Trajectories." In *The Oxford Handbook of the Archaeology of the Levant: c. 8000–332 B.C.E.*, edited by Margreet L. Steiner and Ann E. Killebrew, pp. 367–87. Oxford: Oxford University Press.

2015 "Megadrought, Collapse and Resilience in Late 3rd Millennium B.C. Mesopotamia." In *2200 B.C.: Ein Klimasturz als Ursache für den Zerfall den Alten Welt?* edited by Harald Meller, Helge Wolfgang Arz, Reinhard Jung, and Roberto Risch, pp. 35–52. Tagungen des Landesmuseums für Vorgeschichte Halle 12. Halle (Saale): Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt, Landesmuseum für Vorgeschichte.

2016 "Global Megadrought, Societal Collapse and Resilience 4.2–3.9 ka B.P. across the Mediterranean and West Asia." *PAGES (Past Global Changes)* 24/2: 62–63. DOI: 10.22498/pages.24.2.62.

Weiss, Harvey; Marie-Agnès Courty; Wilma Wetterstrom; François Guichard; Louise Senior; Richard Meadow; and Anne Curnow

1993 "The Genesis and Collapse of Third Millennium North Mesopotamian Civilization." *Science* 261/5124: 995–1004.

Weiss, Harvey; Sturt W. Manning; Lauren Ristvet; Lucia Mori; Mark Besonen; Andrew McCarthy; Philippe Quenet; Alexia Smith; and Zainab Bahrani

2012 "Tell Leilan Akkadian Imperialization, Collapse and Short-lived Reoccupation Defined by High-resolution Radiocarbon Dating." In *Seven Generations Since the Fall of Akkad*, edited by Harvey Weiss, pp. 163–92. Studia Chaburiensia 3. Wiesbaden: Harrassowitz.

Weldeab, Syee; Ralph R. Schneider; Martin Kölling; and Gerald Wefer

2005 "Holocene African Droughts Relate to Eastern Equatorial Atlantic Cooling." *Geology* 33/12: 981–84.

Wick, Lucia; Gerry Lemcke; and Michael Sturm

2003 "Evidence of Lateglacial and Holocene Climatic Change and Human Impact in Eastern Anatolia: High-resolution Pollen, Charcoal, Isotopic and Geochemical Records from the Laminated Sediments of Lake Van, Turkey." *The Holocene* 13/5: 665–75.

Wilkinson, Tony J., and D. J. Tucker

1995 *Settlement Development in the North Jazira, Iraq: A Study of the Archaeological Landscape*. Iraq Archaeological Reports 3. Warminster: Aris & Phillips.

Zanchetta, Giovanni; Aurelien Van Welden; Ilaria Baneschi; Russell Drysdale; Laura Sadori; Neil Roberts; Marco Giardini; Christian Beck; Vincenzo Pascucci; and Roberto Sulpizio

2012 "Multiproxy Record for the Last 4500 Years from Lake Shkodra (Albania/Montenegro)." *Journal of Quaternary Science* 27/8: 780–89.

Zanchetta, Giovanni; Eleonora Regattieri; Ilaria Isola; Russell N. Drysdale; Monica Bini; Ilaria Baneschi; and John C. Hellstrom

2016 "The So-called '4.2 Event' in the Central Mediterranean and Its Climatic Teleconnections." *Alpine and Mediterranean Quaternary* 29: 5–17.

Zangger, Eberhard; Michael E. Timpson; Sergei B. Yazvenko; Falko Kuhnke; and Jost Knauss

1997 "The Pylos Regional Archaeological Project. Part II: Landscape Evolution and Site Preservation." *Hesperia* 66/4: 549–641.

Zielhofer, Christoph; William J. Fletcher; Steffen Mischke; Marc De Batist; Jennifer F. E. Campbell; Sebastien Joannin; Rik Tjallingii; Najib El Hamouti; Annett Junginger; Andreas Stele; Jens Bussmann; Birgit Schneider; Tobias Lauerj; Katrin Spitzer; Michael Strupler; Thomas Brachert; and Abdeslam Mikdad

2017 "Atlantic Forcing of Western Mediterranean Winter Rain Minima during the Last 12,000 Years." *Quaternary Science Reviews* 157: 29–51.