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Magnetometry of neolithic sites in the Mil Plain of Azerbaijan

Jörg Faßbinder, Julia Koch, Roland Linck and Florian Becker

Introduction

Within the framework of the cooperation between the Eurasian Department of the German Archaeological Institute Berlin (Germany), the Department of Earth and Environmental Sciences of the Ludwig-Maximilians-University in Munich (Germany) and the National Academy of Sciences in Baku (Azerbaijan) we accomplished a geophysical prospection of archaeological sites in the Mil Plain.

Magnetic prospection – for the first time applied in 1956[47] – has become one of the most important archaeological methods for the detection and mapping of large archaeological sites.[48] The magnetic methods are extremely sensitive with respect to the characterization and detection of iron oxides and much more sensitive than any other chemical analysis.[49] Therefore, it should be emphasized here that sometimes many details of the soil layers and archaeological structures in soils can be discovered and visualized only by the "magnetic eye" and by the full understanding of their magnetic properties.[50] However, we also have case histories, in which the magnetic properties of archaeological features resemble very much those of the adjacent soils and sediments, and, thus, it is impossible to visualize these structures by magnetometer prospecting and the resulting magnetograms.[51] It is self-evident that the entire archaeological interpretation also needs every available archaeological background information as well as surface findings. Many further crucial details can be derived from a well elaborated soil magnetic analysis of the data. As a result, many new archaeological questions arise with the geophysical prospecting findings.

While for a long time it was a firm conviction of archaeologists that geophysical prospecting results on their own would be only of limited use to resolve archaeological problems,[52] today it has become common sense that the start and the initiation of a modern archaeological excavation without previous geophysical prospecting is utterly impossible.

Magnetometer prospection

Magnetometry, among other geophysical methods, is a successful and cost-effective tool for the detailed mapping of large areas within a reasonable amount of time. For our purposes in the Azerbaijan Mil Steppe, where it was necessary to reach the highest possible sensitivity combined with a maximum speed of prospection, the so-called "duo-sensor" configuration was chosen.[53] In this magnetometer configuration the probes are mounted on a wooden frame and carried in a zigzag-mode 30 cm above the ground. The profiles are oriented approximately east-west in order to minimize technical disturbance of the magnetometer probes. During the period 2010–2011 solar activity and the diurnal variation, induced by solar wind, were very low.[54] This situation allowed us to reduce the diurnal variations to the mean value of all data of each 40 × 40 m grid.[55]

The sampling frequency of the magnetometer (10 readings per second) provided the measurement of a 40-m profile of the grid in less than 30 seconds, maintaining the spatial resolution of approximately 10–15 cm at normal to fast walking speed. Every 5 m, a manual switch sets a marker additionally to the magnetic data, which is required for the correct interpolation of data during the subsequent laboratory processing work.

The linear changes in the daily variation of the geomagnetic field can be reduced to the mean value of the 40 m sampling profile or alternatively to the mean value of all data of a 40 m grid. Here it is assumed that the variation of the Earth's magnetic field during one profile length of 40 m follows a linear increase or a linear decrease in intensity. If so, it is possible to eliminate this variation for each traverse line by a reduction to the mean line value. This filters apparent linear structures parallel to the profile. Alternatively in magnetically quiet areas it is also useful to calculate the mean value of the whole 40 × 40 m square and use this value as it is described above. To create discrete field values a re-sampling program setting the data to 25 × 25 cm was used.

In addition, by using this procedure, the difference between the measurement of both magnetometer probes and the theoretically calculated mean value of the Earth's magnetic field was obtained. This intensity difference gave the apparent magnetic anomaly, which was caused by the magnetic properties of the archaeological structure, the

47 Aitken 1958; Belshe 1957.
48 Aitken 1974; Benech 2005; Clark 1996; David *et al.* 2008; Gaffney *et al.* 2000; Neubauer *et al.* 1999; Scollar *et al.* 1990.
49 Dunlop/Özdemir 1997; Faßbinder *et al.* 1990; Faßbinder 1994.
50 Faßbinder/Stanjek 1993; Fröhlich *et al.* 2003; Schleifer *et al.* 2003; Schleifer 2004.
51 Faßbinder 2009.
52 Aspinall *et al.* 2008; Schmidt 2001.
53 Becker 1999.
54 http://www.geophysik.uni-muenchen.de/observatory/geomagnetism.
55 Faßbinder/Gorka 2009.

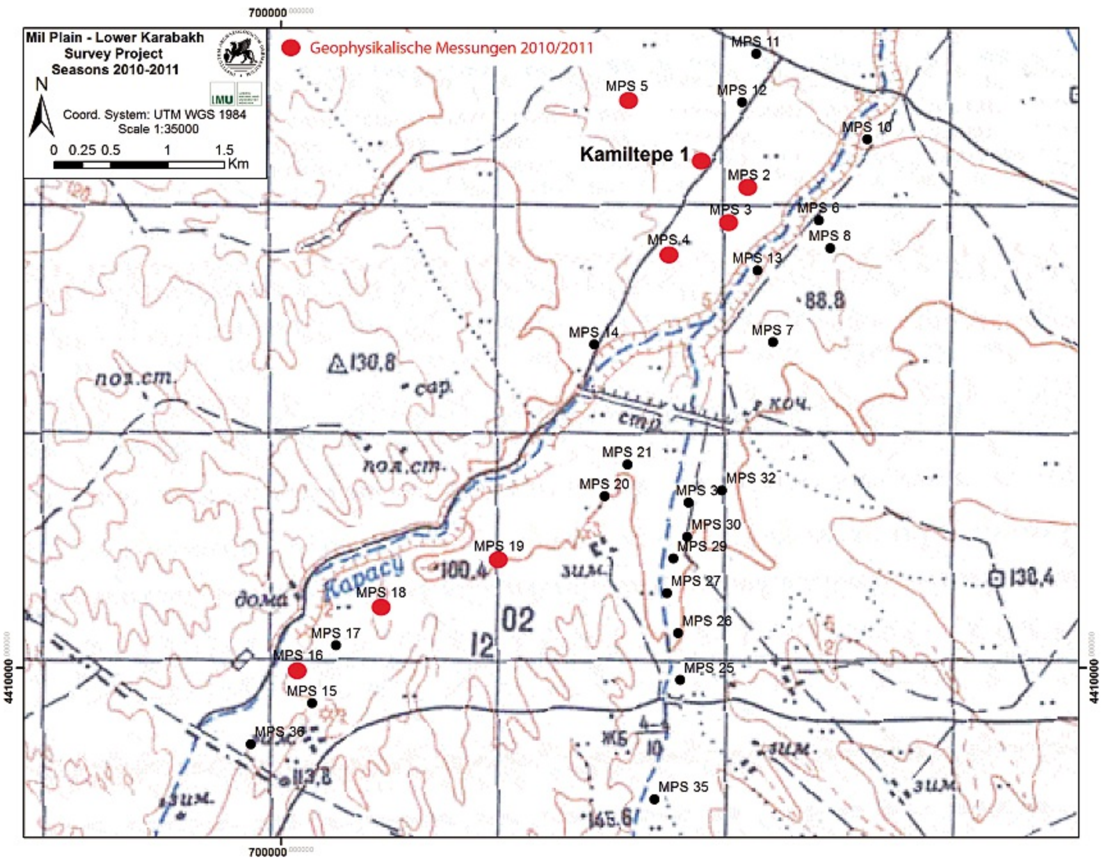

Fig. 26
Mil Plain, Lower Qarabağ region (sketch by A. Ricci). Topographical map of the survey area. The locations with settlements and tells are marked and numbered by black dots; the eight test sites for magnetic prospection are marked in red

soil magnetism and the geology. To cancel the natural micro-pulsations of the Earth's magnetic field, a band-pass filter in the hardware of the magnetometer processor was used. Usually more than 90% of the magnetometer data in a 40 m grid on archaeological sites varies in the range of ± 10 Nanotesla (nT) from the corrected mean value of the geomagnetic field. The stronger anomalies can be ascribed to burned structures or pieces of iron containing slag or iron rubbish. *In situ* burning, pieces of iron and the traces of fire are easily distinguishable by their different direction of magnetic dipole anomalies, but also by their high intensities ($> \pm 50$ nT).

Magnetic volume susceptibility measurements

The measurement of the magnetic susceptibility was done using a commercial magnetic susceptibility meter or kappa-meter (SM 30 ZH-Instruments, Czech Republic). The exploring coil has a diameter of 50 mm, the measuring frequency is 8 kHz, the sensitivity $+/-1 \times 10^{-7}$ SI Units, and the measuring time including a drift correction requires 8–10 seconds. The metered value is the alternating field susceptibility χ, which is the proportion of the induced magnetization versus the intensity of the magnetizing field. If we consider it simplified, this value compares to the concentration of ferrimagnetic minerals in the sample and gives a measure of the enhancement of magnetic minerals by the settlement activity and the use of fire.[56]

Results of the prospections

In general, all sites are situated on loamy and clayey soils and sediments. The enrichment of magnetic minerals is a widespread and typical property of almost all soils worldwide and a crucial attribute for the successful magnetometer prospection in archaeology. However, such a type of magnetic enhancement was rarely observed in the soils of the Mil Plain (see contribution and results of the angering-hole magnetic susceptibility measurements by Ainhoa Lincot or else by our measurements on excavation profiles).

56 Thompson/Oldfield 1986.

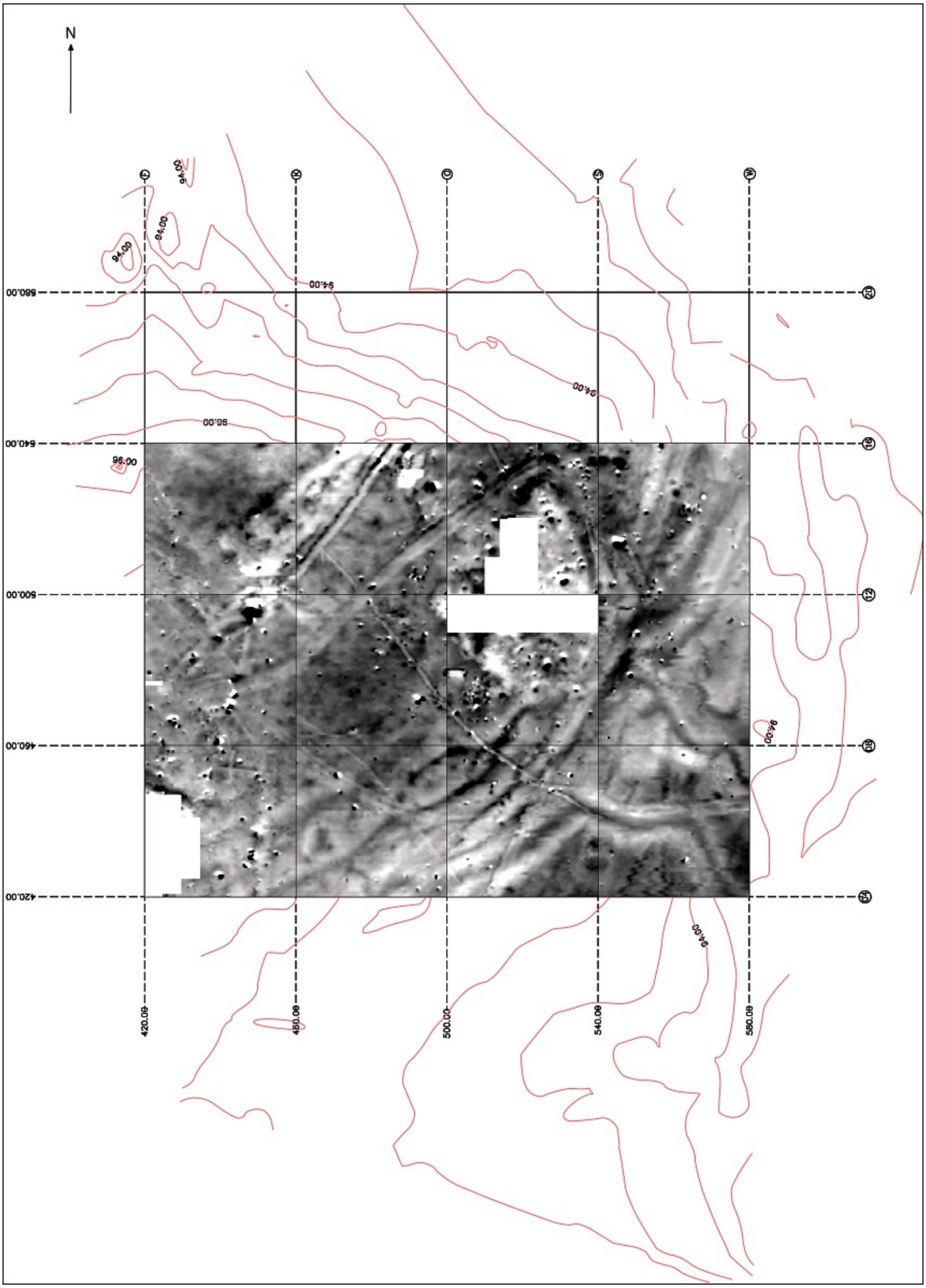

Fig. 27
Kamiltepe. Magnetogram of the site and the vicinity of the excavation trench in the centre. Smartmag SM4G special in duo-sensor configuration, total Earth magnetic field ca. 49 230 Nanotesla (7/2010), dynamics +/−25 Nanotesla in 256 gray values from black to white, grid size 40 × 40 meter, sampling density interpolated to 25 × 25 cm, reduction to the mean value of the square of the grid

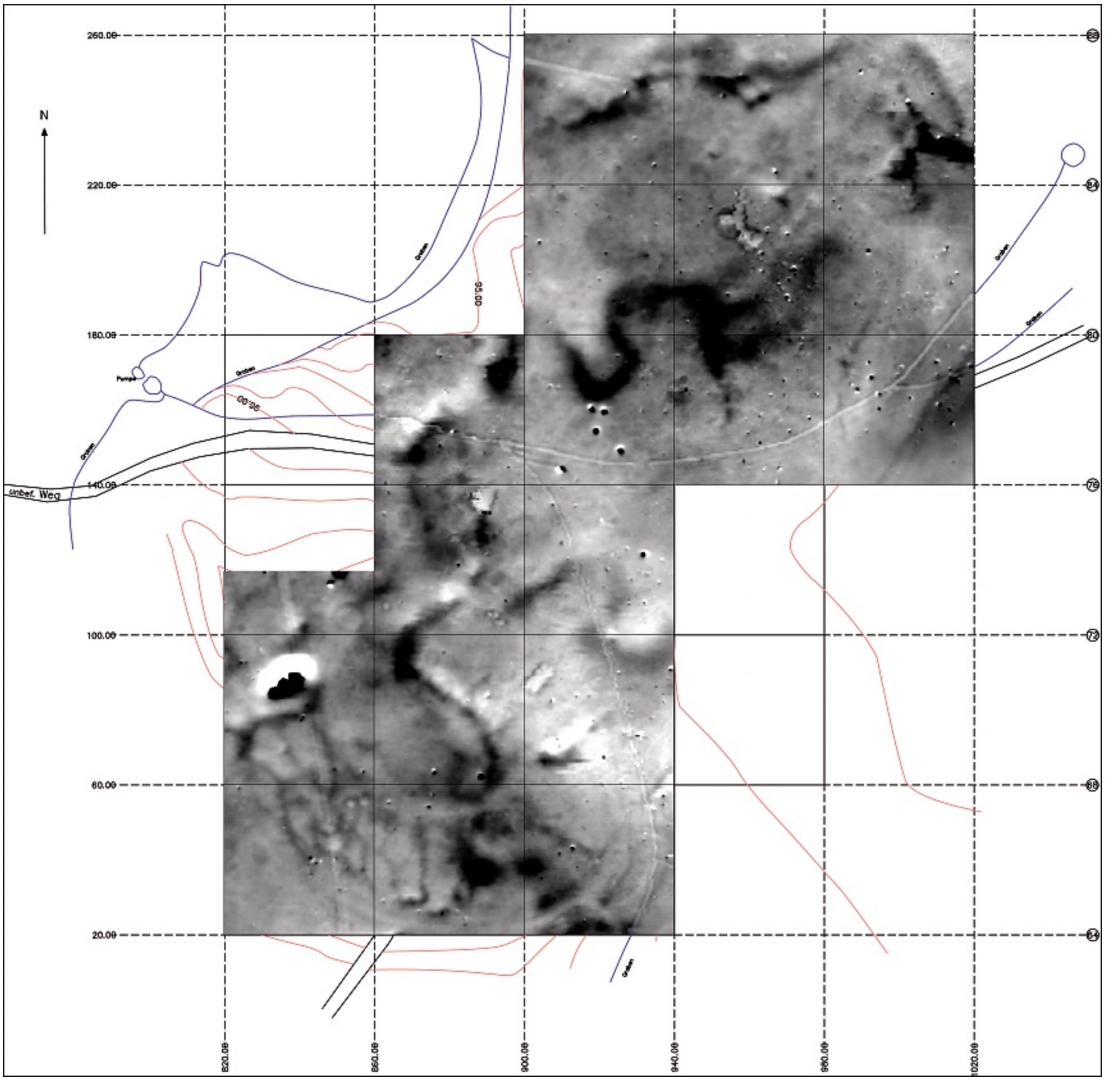

Fig. 28
Sites MPS 2-3. Magnetogram of two tells and their environment. One is centred on the upper right, the other lower left (north on top). Smartmag SM4G special in duo-sensor configuration, total Earth magnetic field ca. 49 250 Nanotesla (7/2010), dynamics +/−40 Nanotesla in 256 gray values from black to white, grid size 40 × 40 meter, sampling density interpolated to 25 × 25 cm, reduction to the mean value of the square of the grid

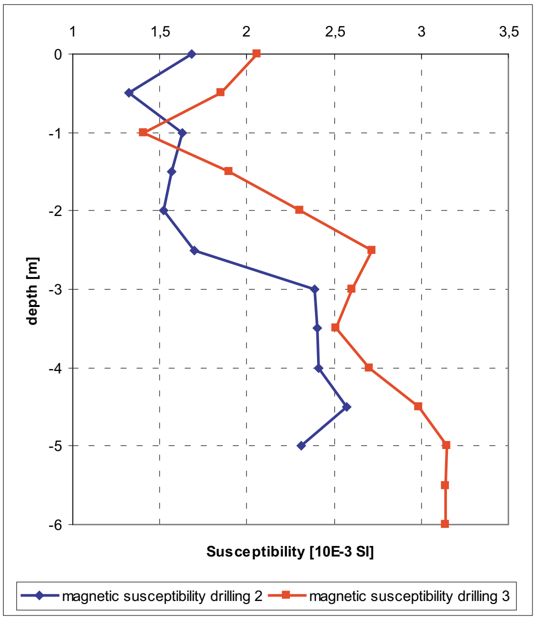

Fig. 29
Sites MPS 2–3. Magnetic susceptibility ($\times 10^{-3}$ SI units) versus profile depth drilled into an anomaly of an ancient river bed beneath the northern tell site

Nevertheless, our kappa measurements show comparatively quite high values of ca. $2–3 \times 10^{-3}$ SI units. Such values compare to a relatively high concentration of 0.01–0.02 Vol% of ferrimagnetic minerals in these soils.[57]

A noteworthy soil formation combined with the enrichment of magnetic minerals in the topsoil does not occur. This may explain the difficulty to trace small and slender archaeological structures such as mudbrick walls or traces of single posts and palisades. Even big ditches such like the ring ditch of MPS 4 **(Fig. 30)** with a depth of ca. 2 m and a width of 4–5 m became only slightly visible in the magnetogram.

The magnetograms of the Mil Plain are generally dominated by the ancient and fossil traces of meandering rivers as well as by big pits and ditches that are filled with midden deposits and burnt material. The ancient riverbeds show up by the enriched and concentrated deposits of heavy minerals in the fluvial sediments, which produce magnetic anomalies of up to +/−50 Nanotesla.

The landscape survey and surface findings of the geo-archaeological team of Andrea Ricci[58] discovered a range of potential archaeological sites in the Mil Plain area **(Fig. 26)**. The focus of our geophysical prospection team was, therefore, at first to verify and clarify a range of these settlements.

Here we present our processed high resolution magnetograms of eight test sites (red dots, **Fig. 26)** with a preliminary interpretation. The final archaeological interpretation maps, which will include all other archaeological knowledge, will be shown in a final publication.

Kamiltepe (Site MPS 1)

Kamiltepe was the aim of our first test site for magnetometer prospection in Azerbaijan. It was directed towards the environment of the already partly excavated and partly destroyed tell site of Kamiltepe **(Fig. 27)**. At the first sight, the resulting magnetogram is dominated by topographic irregularities of the surface, such as the compaction of the sediments by the modern road, the traces of modern pit digging as well as from modern irrigation systems and field boundaries. These structures show up by their clear and sharp negative (white) anomalies. Many "spike-like" anomalies (sharp black and white peaks) can also easily be identified by the erratic orientation of their dipoles in the relation to the Earth's magnetic field. The excavation trench in the centre (white area) was excluded from our survey. The southern and western part (left and upper part in our magnetogram) is dominated by the ancient meandering riverbeds and canals in the deep sediment. All of the archaeological features adjacent to the excavation trench show up only as very faint and diffuse structures and do not correspond to the excavated findings. Neither traces of the adobe architecture, which were already found by the excavation, nor other clearly interpretable features are visible at the first view of the magnetogram. Only the concentration of vague and shapeless anomalies indicate intensive settlement activity combined with the use of fire in the near environment of this tell.

Sites MPS 2/3

This test site covers an area of ca. 3 ha and reveals a settlement including two tells, elevated about 1–2 m above the plain. The magnetogram is dominated by the strong and broad magnetic anomalies of the meandering old riverbeds, which show up by the enrichment of magnetic minerals **(Fig. 28)**. Measurement of the magnetic susceptibility on augeninghole samples revealed values of ca. $2.5–3.5 \times 10^{-3}$ SI units on these river sediments. Compared to the average kappa values of the archaeological sediments and mudbricks (ca. $1.5–2.2 \times 10^{-3}$ SI), this value stands for the enrichment of magnetic minerals by the factor two **(Fig. 29)**. Interestingly, these riverbeds do not follow today's topography, but they seem to enclose the old settlement. It be-

[57] Thompson/Oldfield 1986.
[58] Ricci, in this article.

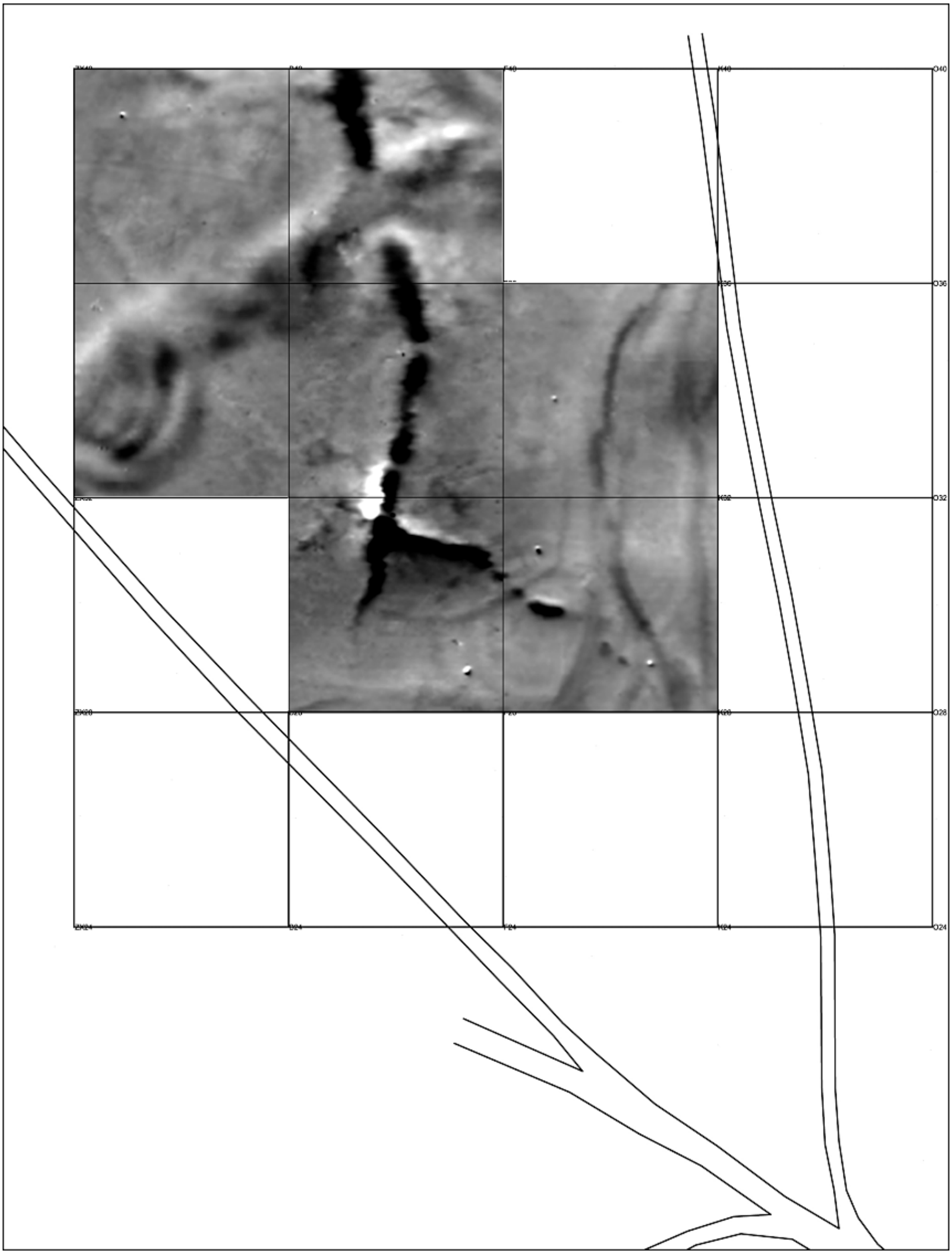

Fig. 30
Site MPS 4. Magnetogram of a settlement site with the traces of a ring ditch in the central south and other highly magnetic pit alignments (north on top). Smartmag SM4G special in duo-sensor configuration, total Earth magnetic field ca. 49 300 Nanotesla (7/2010), dynamics +/−40 Nanotesla in 256 gray values from black to white, grid size 40 × 40 meter, sampling density interpolated to 25 × 25 cm, reduction to the mean value of the square of the grid

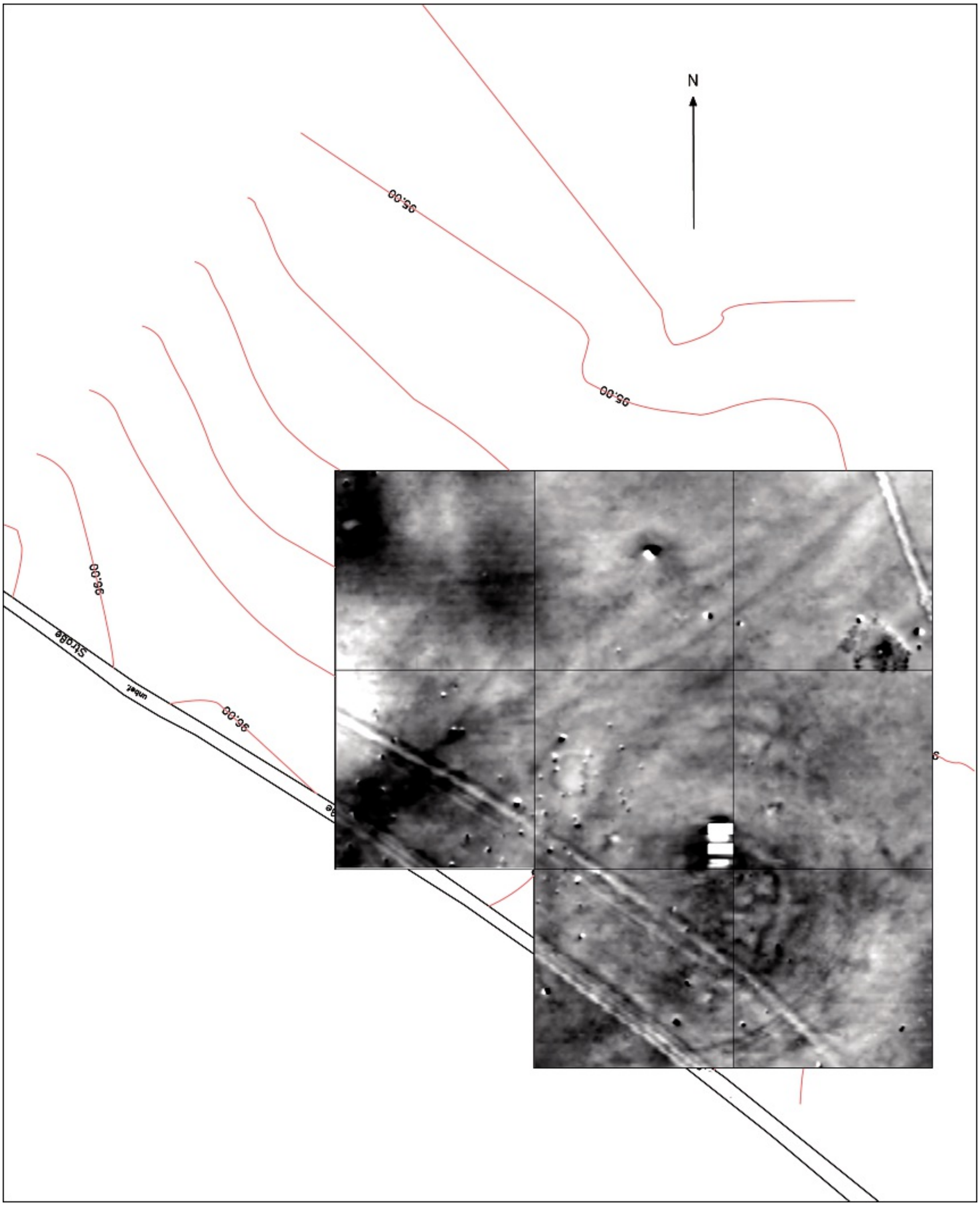

Fig. 31
Site MPS 5. Magnetogram of the tell site and its environment. Smartmag SM4G special in duo-sensor configuration, total Earth magnetic field ca. 49 300 Nanotesla (8/2011), dynamics +/−40 Nanotesla in 256 gray values from black to white, grid size 40×40 meter, sampling density interpolated to 25×25 cm, reduction to the mean value of the square of the grid

came obvious that the first settlement was situated on a peninsula in the shore of and/or between the meandering riverbeds. Both tells show up as a rotunda as well as areas of human activity inherently linked with the use of fire. While the northern one shows only some diffuse and small features, the southern one reveals some ditches and linear structures as well as some large rectangular pits, indicating heavily burned objects that are arranged around the top of the tell.

Modern and recent disturbances are due to the traces of irrigation canals, a huge modern waste pit and other dugouts (sharp rectangular features). In this example the modern farm track is only slightly visible and has no influence on our measurement.

Site MPS 4

The area of potential concern, MPS 4, was discovered only by the occurrence and finding of pottery on the surface. In the topography there is no elevation or clearly visible indication of a settlement. A first test measurement was already performed in the year 2010; in 2011 we enlarged the survey area. The data revealed a large alignment of oval pits with extremely high magnetic intensity of the magnetic anomaly of ca. $+/-80$ Nanotesla. Only one of these pits shows (by his adjacent negative, white shadow) a thermo-remanent magnetization, which indicates fire damage. All of the other long and oval-shaped pits are filled and enriched by highly magnetic, but erratically oriented midden deposits.[59] The pits are aligned from north to south, and some others perpendicular to it point from east to west and dominate the magnetogram by their high magnetic anomalies. Beneath these features, however, we discovered further ditches and earthworks. The magnetic intensity of these structures is very weak ($+/-3$ Nanotesla, see **Fig. 30 bottom**). A more detailed analysis of the data revealed a ring-shaped ditch feature of up to 50 m in diameter, as it is also known from Neolithic sites in Europe (see bottom of the magnetogram **Fig. 30**). Another ring ditch is visible in the western part of the magnetogram, and a further semi-circular ditch encloses the large and highly magnetic pits.

The archaeological excavations of 2011 verified not only the finding of the ditch, but, moreover, revealed the occurrence of adobe wall structures inside the ditch. They were orientated perpendicular to the ditch and subdivide the ditch into segments.

All these small-sized features were not detectable by our magnetometer measurements. This can be explained by the measurements of the magnetic susceptibility on the profile of the excavation. On adobe bricks as well as on the undisturbed adjacent sediments, the kappa data revealed no discriminating differences in the values (ca. $1.92-2.05 \times 10^{-3}$ SI units). Only the magnetic filling of the ditch has kappa values of ca. 2.40×10^{-3} SI units and, hence, show some slight enhancement of magnetic minerals. These magnetic data indicate that the ditch and the whole archaeological feature was backfilled by one quick event, rather than by a slow sedimentation.

Site MPS 5

The area of MPS 5 showed up in the topography as a tell site of ca. 80 m diameter with a slight increase and elevation of ca. 2 meters above the Mil Plain **(Fig. 31)**. To obtain a better idea of the environment, we enlarged our magnetometer survey to the north and to the west of the tell site. Two traces of cart tracks affect the site in the southwest, while in the north we see again traces of older riverbeds or canals. The white spot in the centre marks the excavation trench, the deposits of the excavated soil and another cart track are visible in the top right square of the magnetogram. Furthermore, some black and white spots and spikes disturb our magnetogram; they are generated by pieces of iron on the top of the surface.

The tell itself becomes quite clearly visible, and the magnetogram reveals further details and the archaeological structures of a rotunda.

To understand the influence of the induced magnetization on the magnetometer data, we performed a magnetic susceptibility survey on a surface layer of the excavation trench **(Fig. 32)**. Herewith the resulting kappagram revealed and traced only the already excavated archaeological features; the results, however, confirmed that the archaeological material has comparatively low magnetic contrast, and, therefore, only little potential to trace also the small-sized and tiny archaeological structures.

Site MPS 16

Further magnetometer prospection on Neolithic places was undertaken in the southwest and the upper section of the Kura River. A natural elevation in the valley was used as shelter and heavily affected by a dugout. Moreover and very recently the area was ploughed very deeply by farmers. The resulting magnetogram is, hence, extremely affected by this activity **(Fig. 33)**. Stripes of the ploughing and farm tracks dominate the magnetogram. Never-

[59] Le Borgne 1955; Le Borgne 1960.

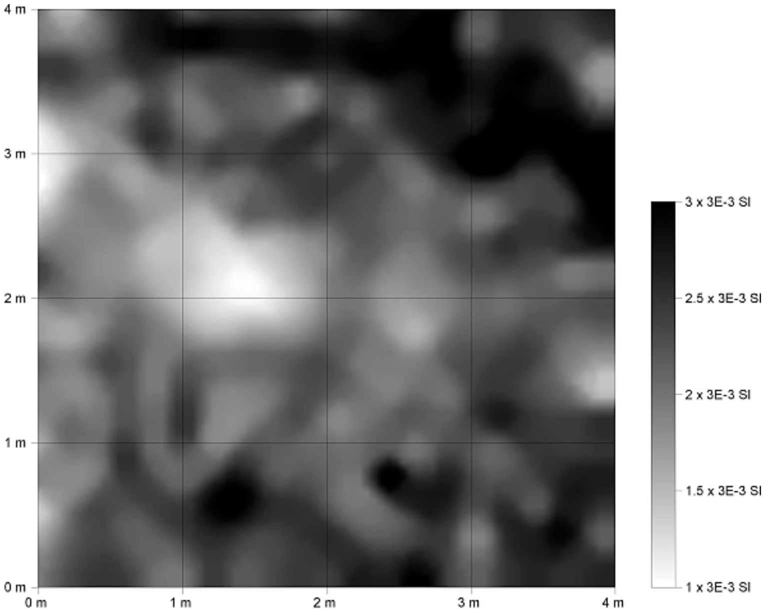

Fig. 32
Site MPS 5. Kappagram of the surface of an excavation layer (ca. 70 cm depth). Kappa meter (SM 30 ZH-Instruments, Czech Republic). The exploring coil has a diameter of 50 mm; the measuring frequency is 8 kHz; the sensitivity $+/-1 \times 10^{-7}$ SI; dynamics $1-3 \times 10^{-3}$ SI units in 256 gray values from black to white; grid size 4×4 meter; sampling density 20×20 cm

theless, some huge pits ca. 8–15 m in diameter become visible and detectable beneath the ground and indicate the occurrence of a settlement and the intensive use of fire.

Site MPS 18

The MPS 18 site is a natural elevation and forms (similar to MPS 16) a landmark in the valley. Like site MPS 16, it is heavily affected by a series of pits and dugouts. Meanwhile, the site is used as a farmland; however, it was not as deeply ploughed as the MPS 16 site. Due to the topographical situation we tilted our survey grid from the optimal and best orientation (east-west) in order to cover the area in a more appropriate manner **(Fig. 34)**.

The site is covered by many surface finds like obsidian and pottery; moreover, in the profiles of the excavated pits archaeological layers seemed visible. The magnetometer results, however, show mainly only very vanishing and fading traces of the archaeological structures. Only on the very northwestern edge of the magnetogram and on the topographically most exposed top of the site, some massive rectangular features, ca. 50×20 m in size are visible. In the total field magnetometer measurements, these features appear as a single anomaly with intensities of more than +/–70 Nanotesla, indicating an ideal thermo-remanent magnetization (TRM) anomaly. This finding can be ascribed most probably to extensive fire damage of the archaeological feature. The application of a high-pass filter to these data reveals the archaeological structures in more detail **(Fig. 35,1–2)**.

Site MPS 19

Site MPS 19 is a hill site on the slope of the hilly land on the southern border of the Qaraçay valley **(Fig. 26)**. The topography of the site compares somewhat to a settlement mound; our magnetometer results, however, revealed a single phase settlement, situated on an exposed topography rather than a multi-period tell site **(Fig. 36)**. The northern part of the magnetogram is affected by the traces of the modern car tracks; the other slight lineaments are traces of the plough. A pit alignment is arranged in a semicircle around the top of the hill; the pits follow the contour line and seem to enclose some further structures. (Note: The three black and white spots in the centre are the anomalies of modern iron pieces). In the southern part of the hill we discovered a huge semi-circular pit, ca. 35×12 m in size, indicating a highly burnt archaeological structure. The application of the high-pass filter to the magnetic data enables us to trace further structures inside this pit in more detail **(Fig. 37)**. Here these archaeological structures resemble very much a huge Neolithic house foundation, which we discovered at Asağı Pınar, Turkey.[60]

Conclusions

In the Mil Plain a total of 8 sites and areas ranging from 1–3 hectares in size, were measured by a caesium magnetometer in the total field variometer duo-sensor-configuration. This sensor configuration enabled us to trace and to detect large archaeological features to a depth of up to three meters as well as near-surface archaeological structures by a high spatial resolution of 25×25 cm, combined with a high instrumental sensitivity of +/–10 Picotesla. For comparison only: The intensity of the total Earth's magnetic field in the Mil Plain of Azerbaijan in the years 2010 and 2011 was in the range of 49200 +/–200 Nanotesla.

However, all of the magnetically extremely weak anomalies of the small-sized archaeological structures can be traced only if the area is almost flat and undisturbed by modern distortion, such as deep ploughing, car tracks or pieces of iron on the surface. That was the reason why at the first sight, the most prominent features that we detected were mainly the ancient and hidden meandering riverbeds. Borehole probing revealed that these riverbeds occur in a depth of up to 2–3 m. Namely, the Kamiltepe site was already extremely destroyed by car tracks, by a bulldozer cut, and by the ongoing

60 Faßbinder/Becker 2003.

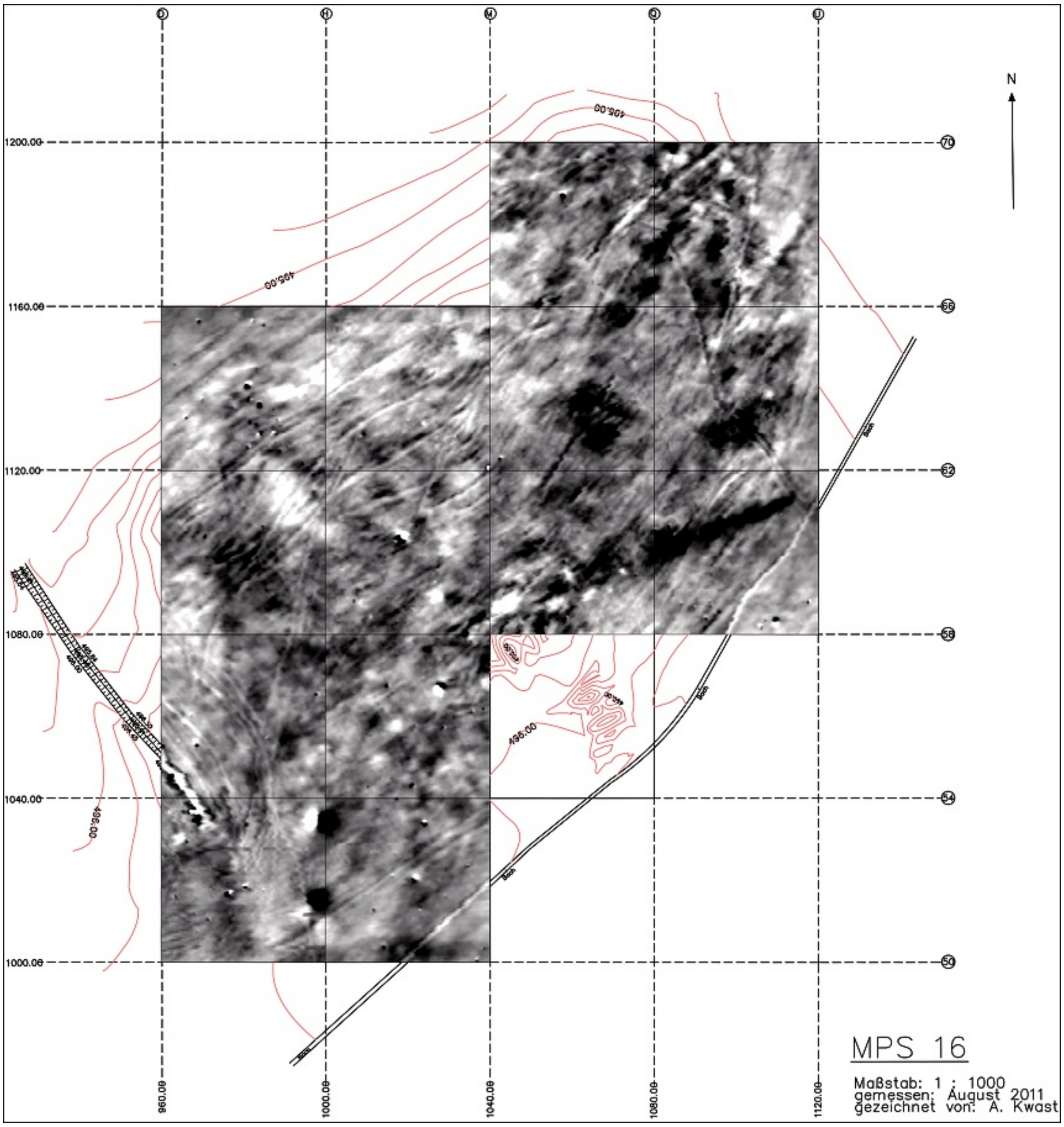

Fig. 33
Site MPS 16. The magnetogram of the settlement site with traces of pits is strongly affected and destroyed by deep ploughing and car tracks. Smartmag SM4G special in duo-sensor configuration, total Earth magnetic field ca. 49 080 Nanotesla (8/2011), dynamics +/−40 Nanotesla in 256 gray values from black to white, grid size 40 × 40 meter, sampling density interpolated to 25 × 25 cm, reduction to the mean value of the square of the grid

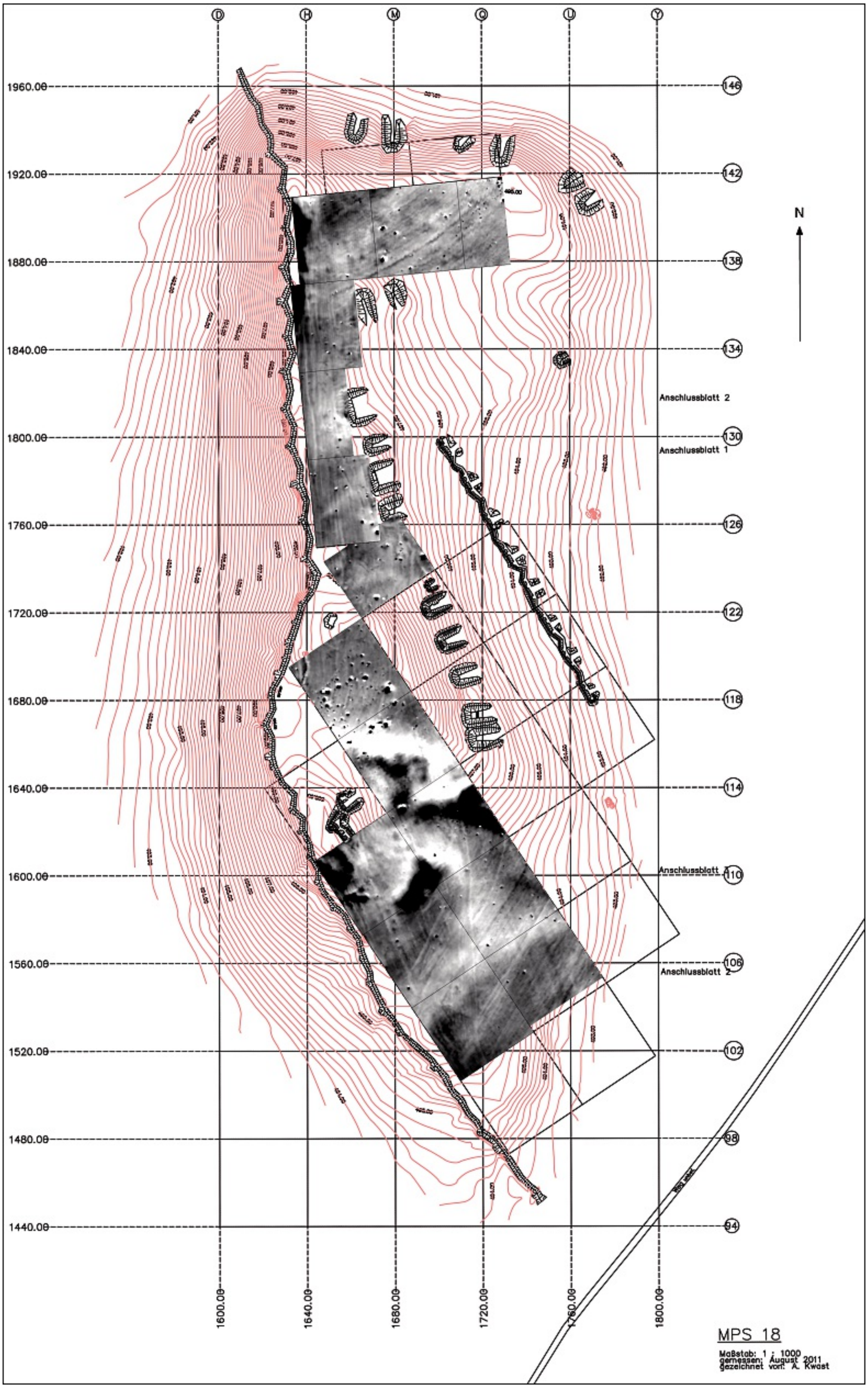

Fig. 34
Site MPS 18. Magnetogram of the settlement site and its environment. Smartmag SM4G special in duo-sensor configuration, total Earth magnetic field ca. 49 150 Nanotesla (9/2011), dynamics +/−40 Nanotesla in 256 gray values from black to white, grid size 40 × 40 meter, sampling density interpolated to 25 × 5 cm, reduction to the mean value of the square of the grid

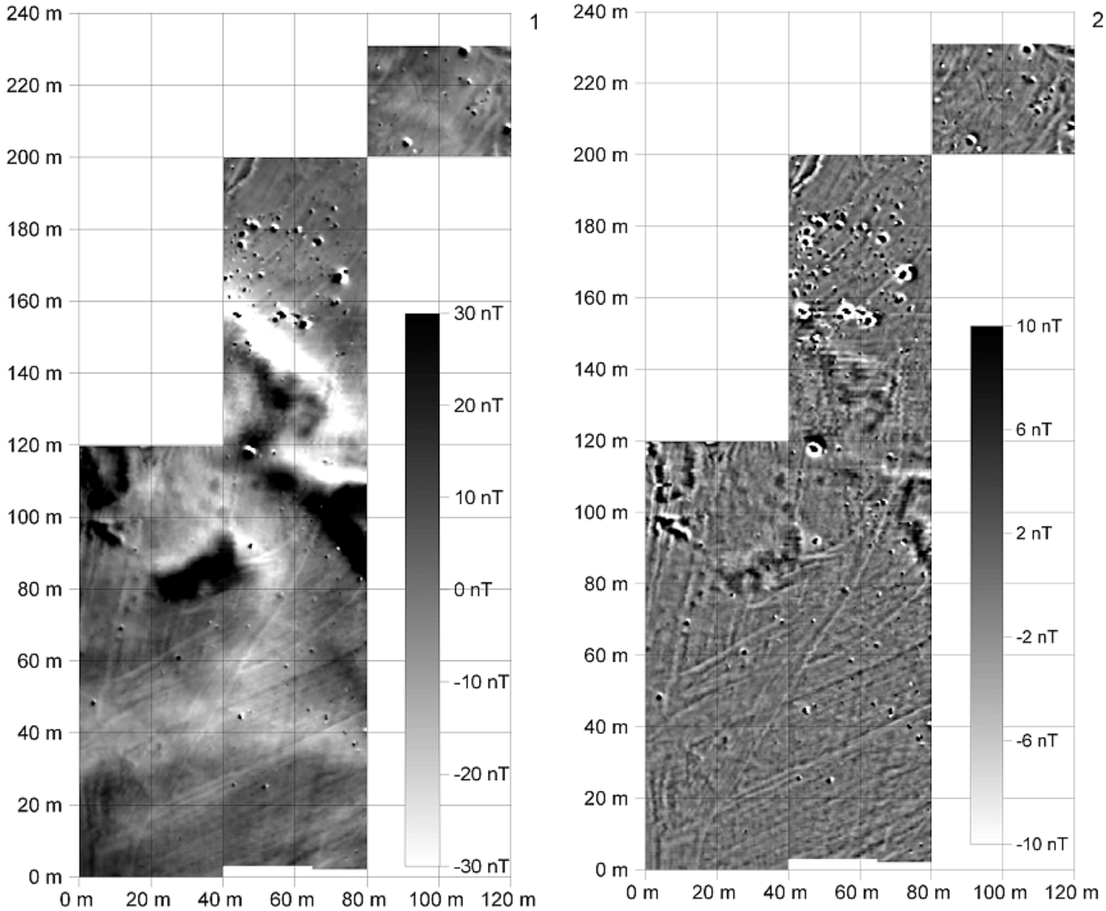

Fig. 35
Site MPS 18 south. Magnetogram (1) left side, in the total field mode. Smartmag SM4G special in duo-sensor configuration, total Earth magnetic field ca. 49 150 Nanotesla (9/2011), dynamics +/−40 Nanotesla in 256 gray values from black to white; (2) the same data but treated with a high-pass filter, dynamics +/−40 Nanotesla in 256 gray values from black to white, grid size 40 × 40 meter, sampling density interpolated to 25 × 25 cm, reduction to the mean value of the square of the grid

archaeological excavation. This may explain why it was utterly impossible to detect the weak magnetic structures of the adobe bricks inside the tell.

At the other archaeological test sites MPS 2–MPS 5, the conditions for the magnetometer prospection were much better **(Fig. 36)**. The tell sites appear with some very typical features of rotundas, but the adobe features remain almost unsearchable. The test sites in the southwest of the survey area, MPS 16–MPS 19, were quite different from the former ones. They mainly showed up by their huge and strong magnetic pit anomalies, which by further processing turned out to be large objects with some more detailed structures inside. All in all, the results of the magnetometer prospection not only trace archaeological structures, but help decisively to detect, to trace and to discriminate different types of settlements. Moreover, the geophysical results originate new insights and aspects that can be essential for the success of any modern scientific archaeological excavation.

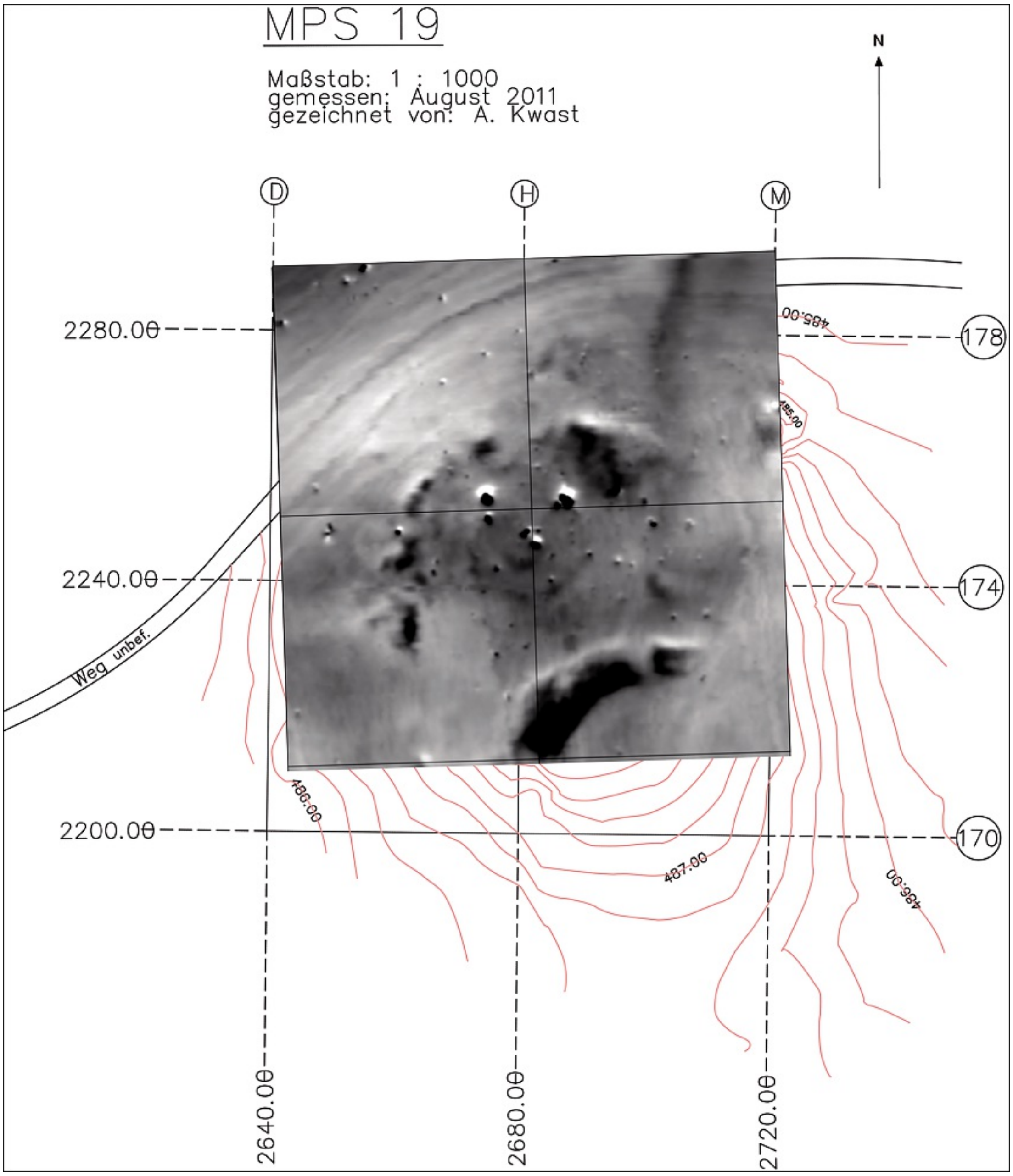

Fig. 36
Site MPS 19. Magnetogram of the hill, revealing pits and traces of a settlement site. Smartmag SM4G special in duo-sensor configuration, total Earth magnetic field ca. 49 370 Nanotesla (8/2011), dynamics +/−40 Nanotesla in 256 gray values from black to white, grid size 40 × 40 meter, sampling density interpolated to 25 × 25 cm, reduction to the mean value of the square of the grid

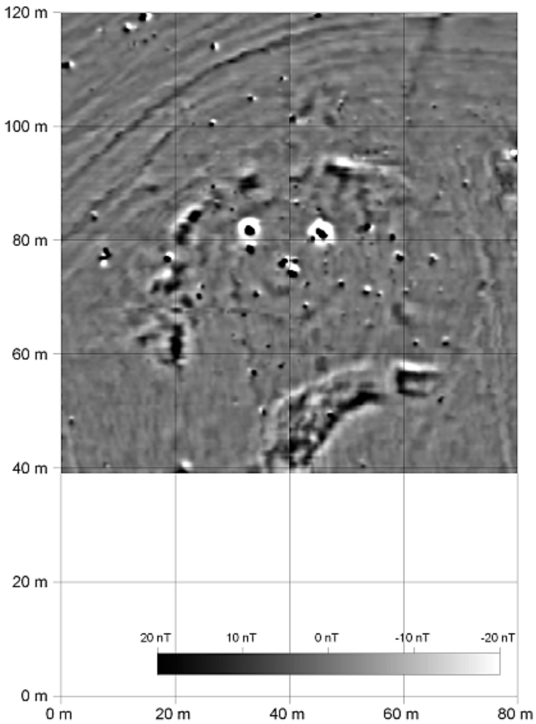

Fig. 37
Site MPS 19. Magnetogram of the hill, processed with a high-pass filter revealing the structures inside the huge pit in the south in more detail. Smartmag SM4G special in duo-sensor configuration, total Earth magnetic field ca. 49 370 Nanotesla (8/2011), high-pass filter 10 × 10 (Gaussian), dynamics +/−15 Nanotesla in 256 gray values from black to white, grid size 40 × 40 meter, sampling density interpolated to 25 × 25 cm

Preliminary microstratigraphic observations of ash deposits and architectural materials at Kamiltepe, Azerbaijan

Lisa-Marie Shillito

Introduction

Our understanding of prehistoric urban societies in the Near East has traditionally been based on the analysis of architecture and artifacts. More recently, it has been recognised that the study of sediments and micro-residues at such sites can be highly informative about the lives of the inhabitants, and the activities that were occurring on site.[61]

Micromorphology is the study of archaeological deposits *in situ*, in their precise depositional context. It is highly valuable in understanding the formation processes of complex deposits, or those which are too fine to observe by eye in the field. In addition, it enables the observation of different components of deposits simultaneously, which can aid significantly in the interpretation of deposits.[62] Microstratigraphic analysis combines thin section micromorphology with other high resolution analytical techniques, and has become well established as a method for investigating activities within archaeological sites and settlements at a high spatial and temporal resolution.[63] The term 'microarchaeology' has been used to describe this combination of high resolution techniques. This can be thought of in the same way as excavation, but under the microscope, with successive layers being observed and analysed to understand how the deposits formed and which were the activities represented.[64]

For sites that lack structural remains, this approach has allowed, for instance, the identification of livestock enclosures[65] or, on the basis of ash residues, hearth areas.[66] In early urban sites this approach has enabled the understanding of sequences of activities within buildings, for example, at Çatalhöyük, Turkey,[67] and of formation processes and, thus, activities within complex midden deposits[68] and, in Šeiḫ-e Ābād in the Central Zagros region, the investigation of evidence for early animal management.[69]

The 2009 excavations at Kamiltepe revealed complex deposits in a range of contexts, particularly several large 'ashy' deposits along the edge of a platform structure, and multiple floor layers within buildings,[70] hypothesised during excavation as being fill/feasting debris. The microstratigraphic approach was selected to investigate the formation processes of these deposits, to better understand activities occurring within buildings and open areas. Analysis of the large 'ashy' deposits in open areas will test the hypothesis that these are the remains of 'feasting'. Floor layers in the round building (MPS 4 square E29 op. 5) were selected to investigate the nature of activities occurring in this area and to assess the contribution of microstratigraphic analysis to understanding the use of space and activities within the settlement.

This report presents the preliminary results from the analysis of seven micromorphology sam-

61 W. Matthews 2005; W. Matthews 2010; Shillito *et al.* 2011 a.

62 W. Matthews *et al.* 1997.
63 W. Matthews *et al.* 1996; W. Matthews 2005; Shillito *et al.* 2011 a; Shillito *et al.* 2011 b.
64 Weiner 2010.
65 Shahack-Gross *et al.* 2003.
66 Weiner *et al.* 2002.
67 W. Matthews *et al.* 1996; W. Matthews 2005.
68 W. Matthews 2005; Shillito *et al.* 2011 a.
69 W. Matthews 2010; W. Matthews *et al.* 2010.
70 Aliyev/Helwing 2009.

National Museum in Tblissi. In the Ancient Kura project, three previously independent research projects based on excavations in Aruchlo (German-Georgian excavations since 2005), Mentesh Tepe (French – Azerbaijan excavations since 2007) and Kamiltepe (German – Azerbaijan excavations since 2009) since 2010 have joined their forces by combining their individual perspectives on natural resources and environmental factors behind the cultural development in the Southern Caucasus since early sedentism. Previous and additional financial support for these investigations was provided to the Mentesh Tepe excavations by CNRS (LIA *AzAr2*) and the French Ministry of Foreign and European Affairs, to Aruchlo by DFG and DAI, and to Kamiltepe by DAI. We gratefully acknowledge the support of all these institutions.

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Bibliography

Akhundov 2007
T. Akhundov, Sites des migrants venus du Proche-Orient en Transcaucasie. In: B. Lyonnet (ed.), Les cultures du Caucase (VI^{e}–III^{e} millénaires avant notre ère). Leurs relations avec le Proche Orient (Paris 2007) 95–122.

Adamia *et al.* 1981
S. A. Adamia/T. Chkhotua/M. Kekelia/M. Lordkipanidze/I. Shavishvili/G. Zakariadze, Tectonics of the Caucasus and adjoining regions: implications for the evolution of the Tethys ocean. Journal of Structural Geology 3, 1981, No. 4, 437–447.

Aitken 1958
M. J. Aitken, Magnetic prospecting I. Archaeometry Archaeometry 1, 1958, No. 1, 24–29.

Aitken 1974
M. J. Aitken, Physics and archaeology (Oxford 1974).

Akhalkatsi 2009
M. Akhalkatsi (ed.), Conservation and sustainable use of crop wild relatives in Samtskhe-Javakheti (Tbilisi 2009).

Akkermans 1988
P. M. M. G. Akkermans, The Period IV Pottery. In: M. N. van Loon (ed.), Hammam et-Turkman I. Report on the University of Amsterdam's 1981–1984 Excavations in Syria I. Publications de l'Institut historique-archéologique neerlandais de Stamboul (Leiden 1988) 181–285.

Akkermans/Schwartz 2003
P. M. M. G. Akkermans/G. M. Schwartz, The archaeology of Syria (Cambridge 2003).

Aliyev/Helwing 2009
T. Aliyev/B. Helwing, Kamiltepe in der Milebene. Archäologische Untersuchungen 2009. Archäologische Mitteilungen aus Iran und Turan 41, 2009, 23–45.

Apakidze 1999
J. Apakidze, Lapislazuli-Funde des 3. und 2. Jahrtausends v. Chr. in der Kaukasusregion – ein Beitrag zur Herkunft des Lapislazuli in Troia. Studia Troica 9, 1999, 511–525.

Apakidze 2009
J. Apakidze, Die Spätbronze- und Früheisenzeit in West- und Zentralkaukasien: chronologische Studien zur Kolchis-Kultur 1600–700 v. Chr (Rahden/Westf. 2009).

Arazova 2008
R. Arazova, Sickles of early farmers of Azerbaijan. In: L. Longo/N. Skakun/M. Saracino/M. Dalla Riva (eds.), Prehistoric technology 40 years later: functional studies and the Russian legacy. Proceedings of the International Congress, Verona (Italy) 2005. British Archaeological Report International Series 1783 (Oxford 2008) 435–438.

Areshian *et al.* 2012
G. E. Areshian/B. Gasparyan/P. S. Avetisyan/R. Pinhasi/K. Wilkinson/A. Smith/R. Hovsepyan/D. Zardaryan, The Chalcolithic of the Near East and South-Eastern Europe: discoveries and new perspectives from the cave complex Areni-1, Armenia. Anitiquity 86, 2012, No. 331, 115–130.

Asgari/Zare 2010
B. Asgari/R. Zare, Two new species of Preussia from Iran. Nova Hedwigia 90, 2010, No. 3/4, 533–348.

Arimura *et al.* 2012
M. Arimura/B. Gasparyan/C. Chataigner, Prehistoric sites in Northwest Armenia: Kmlo 2 and Tsaghkahovit. In: R. Matthews/J. Curtis (eds.), Proceedings of the 7th ICAANE, London 2010 (Wiesbaden 2012) 135–150.

Aspinall *et al.* 2008
A. Aspinall/C. F. Gaffney/A. Schmidt, Magnetometry for archaeologists. Geophysical methods for archaeology 2 (Lanham 2008).

Badaljan *et al.* 1993
R. S. Badaljan/C. Edens/R. Gorney/P. L. Kohl/D. Stronach/A. V. Tonikijan/S. Hamayakjan/S. Mandrikjan/M. Zardarjan, Preliminary report on the 1992 excavations at Horom, Armenia. Iran 31, 1993, 1–24.

Badalyan *et al.* 2007
R. Badalyan/P. Lombard/P. Avetisyan/C. Chataigner/J. Chabot/E. Vila/R. Hovsepyan/G. Willcox/H. Pessin, New data on the Late Prehistory of the Southern Caucasus. The excavations at Aratashen (Armenia): preliminary report. In: B. Lyonnet (ed.), Les cultures du Caucase (VIe–IIIe millénaires avant notre èra. Leurs relations avec le Poche-Orient (Paris 2007) 37–61.

Badalyan/Avetsiyan 2007
R. S. Badalyan/P. S. Avetsiyan, Bronze and early Iron Age archaeological sites in Armenia 1. Mt. Aragats and its surrounding region. British Archaeological Report International Series 1697 (Oxford 2007).

Badalyan *et al.* 2010
R. S. Badalyan/A. A. Harutyunyan/C. Chataigner/F. Le Mort/J.-E. Brochier/A. Balasecu/V. Radu/R. Hovsepyan, The settlement of Aknashen-Khatunarkh, a neolithic site in the Ararat Plain (Armenia): Excavation results 2004–2009. TÜBA-AR. Turkish Academy of Sciences Journal of Archaeology 13, 2010, 185–218.

Balossi Restelli 2006
F. Balossi Restelli, The development of "cultural regions" in the Neolithic of the Near East. British Archaeological Report International Series 1482 (Oxford 2006).

Becker 1999
H. Becker, Duo and quadro-sensor configuration for high speed/high resolution magnetic prospecting with caesium magnetometer. In: J. W. E. Fassbinder/W. E. Irlinger (eds.), Archaeological prospection. Proceedings of the 3rd International Conference on Archaeological Prospection, vol. 108. Arbeitshefte des Bayerischen Landesamtes für Denkmal pflege (München 1999).

Belfer-Cohen 1988
A. Belfer-Cohen, The Natufian settlement at Hayonim Cave (Jerusalem 1988).

Belshe 1957
J. C. Belshe, Recent magnetic investigations at Cambridge University. Advances in Physics 6, 1957, No. 22, 192–193.

Benech 2005
C. Benech, Etude des plans d'urbanisme. Dossiers de l'archéologie 308, 2005, 12–19.

Beug 2004
H.-J. Beug, Leitfaden der Pollenbestimmung für Mitteleuropa und angrenzende Gebiete; mit 13 Tabellen (München 2004).

Blum 2010
M. D. Blum, Sediment supply to the shelf margin and beyond: alluvial valley responses to sea-level change. In: H. R. Roberts/N. C. Rosen/R. F. Fillon/J. B. Anderson (eds.), Shelf margin deltas and linked down slope petroleum systems. 23rd Annual GCSSEPM Foundation Bob F. Perkins Research Conference, December 7–10, 2003, Houston, Texas, USA (Red Hook 2010) 70–95.

Boardman/Jones 1990
S. Boardman/G. Jones, Experiments on the effects of charring on cereal plant components. Journal of Archaeological Science 17, 1990, No. 1, 1–11.

Bockheim/Tarnocai 1998
Bockheim J. G./Tarnocai C., Recognition of cryoturbation for classifying permafrost-affected soils. Geoderma 81, 1998, No. 3–4, 281–293.

Bull *et al.* 1999
I. D. Bull/I. A. Simpson/P. F. van Bergen/R. P. Evershed, Muck "n" molecules: organic geochemical methods for detecting ancient manuring (1999).

Bull *et al.* 2005
I. D. Bull/M. M. Elhmmali/P. Perret/W. Matthews/D. J. Roberts/R. P. Evershed, Biomarker evidence of faecal deposition in archaeological sediments at Çatalhöyük, Turkey. In: I. Hodder (ed.), Inhabiting Çatalhöyük. Reports from the 1995–1999 seasons. Çatalhöyük Project 4. Monograph of the British Institute of Archaeology at Ankara 38 (Cambridge 2005) 415–420.

Bullock *et al.* 1985
P. Bullock/N. Federoff/A. Jongerius/G. Stoops/T. Tursina, Handbook for soil thin section description (Wolverhampton 1985).

Campana 1989
D. V. Campana, Natufian and protoneolithic bone tools. British Archaeological Report International Series 494 (Oxford 1989).

Campbell *et al.* 2003
S. Campbell/E. Carter/S. Gauld, Elusive complexity: new data from late Halaf Domuztepe in South Central Turkey. Paléorient 29, 2003, No. 2, 117–133.

Canti 1998
M. G. Canti, The micromorphological identification of faecal spherulites from archaeological and modern materials. Journal of Archaeological Science 25, 1998, No. 5, 435–444.

Cassard *et al.* 2010
D. Cassard/A. Courcier/M. Billa/C. Gateau/A. Lafitte/B. Lyonnet/F. Maldan/J.-F. Mallon, NavigaSIG©: Les cultures du Caucase et la métallurgie, 6e–3e millénaires

(Sud Russie, Républiques du Nord Caucase, Géorgie, Arménie, Azerbaïdjan, Iran du NO, Turquie orientale) (Unpublished report, 2010).

Chataigner 1995
C. Chataigner, La Transcaucasie au Néolithique et au Chalcolithique. British Archaeological Report International Series 624 (Oxford 1995).

Chelidze/Gogelia 2004
L. Chelidze/D. Gogelia, Arukhlo I: An early-farming site. Journal of Georgian Archaeology 1, 2004, 46–92.

Chelidze/Chikovani 2008
L. Chelidze/G. Chikovani, Pottery of the early farmers from Eastern Georgia. In: A. G. Sagona/M. Abramishvili (eds.), Archaeology in Southern Caucasus: perspectives from Georgia. Ancient Near Eastern Studies, supplement 19 (Leuven 2008) 27–36.

Chernykh 1992
E. N. Chernykh, Ancient metallurgy in the USSR (Cambridge 1992).

Chikovani *et al.* 2010
G. Chikovani/Z. Shatberashvili/G. Gogochuri/G. Gamkrelidze, A new site of the Eneolithic-Bronze Age from Tetritsqaro. In: G. Gamkrelidze (ed.), Rescue archaeology in Georgia: the Baku-Tbilissi-Ceyhan and South Caucasian pipelines (Tbilisi 2010) 95–109.

Clark 1996
A. Clark, Seeing beneath the soil – prospecting methods in archaeology (London 1996).

Connor *et al.* 2004
S. E. Connor/I. Thomas/E. V. Kvavadze/G. J. Arabuli/G. S. Avakov/A. Sagona, A survey of modern pollen and vegetation along an altitudinal transect in southern Georgia, Caucasus region. Review of Paleobotany and Palynology 129, 2004, No. 4, 229–250.

Cotkin *et al.* 1999
S. J. Cotkin/C. Carr/M. L. Cotkin/A. E. Dittert/D. T. Kremser, Analysis of slips and other inorganic surface materials on Woodland and Early Fort ancient ceramics, South-Central Ohio. American Antiquity 64, 1999, No. 2, 316–342.

Courcier 2007
A. Courcier, La métallurgie dans les pays du Caucase au Chalcolithique et au début de l'âge u Bronze: bilan des études et perspectives nouvelles. In: B. Lyonnet (ed.), Les cultures du Caucase (VI^{e}–III^{e} millénaires avant notre ère). Leurs relations avec le Proche Orient (Paris 2007) 199–232.

Courcier *et al.* 2012
A. Courcier/B. Lyonnet/F. Guliyev, Metallurgy during the Middle Chalcolithic Period in the Southern Caucasus: Insight through recent discoveries at Mentesh-Tepe, Azerbaijan. In: P. Jett/B. McCarthy/J. G. Douglas (eds.), Scientific Research in Ancient Asian Metallurgy. Proceedings of the 5th Forbes Symposium at the Freer Gallery of Art (London 2012) 205–224.

Courcier *et al.* in prep.
A. Courcier/A. Hauptmann/B. Jalilov/S. Merkel/M. Prange/M. Ragimowa, Archaeometallurgical research on chalcolithic artifacts from Mentesh-Tepe (5th mill. BCE): preliminary results., in prep.

Courty *et al.* 1989
M. A. Courty/P. Goldberg/R. Macphail, Soils and micromorphology in archaeology (Cambridge 1989).

David *et al.* 2008
A. David/N. Linford/P. Linford/L. Martin/A. Payne, Geophysical survey in archaeological field evaluation (Swindon 2008).

Deschamps *et al.* 2012
P. Deschamps/N. Durand/E. Bard/B. Hamelin/G. Camoin/A. L. Thomas/G. M. Henderson/J. Okuno/Y. Yokoyama, Ice-sheet collapse and sea-level rise at the Bolling warming 14,600 years ago. Nature 483, 2012, No. 7391, 559–564.

Djamali *et al.* 2009
M. Djamali/J.-L. de Beaulieu/P. Campagne/V. Andrieu-Ponel/P. Ponel/S. A. G Leroy/H. Akhani, Modern pollen rain-vegetation relationships along a forest-steppe transect in the Golestan National Park, NE Iran. Review of Palaeobotany and Palynology 153, 2009, No. 3–4, 272–281.

Le Dosseur 2008
G. Le Dosseur, La place de l'industrie osseuse dans la néolithisation au Levant Sud. Paléorient 34, 2008, No. 1, 59–89.

Dschaparidze 2011
I. Dschaparidze, Kupfer und Bronzeartefakte aus der Bronzezeit Georgiens. Unpublished PhD thesis, Ruhr University Bochum (Bochum 2011).

Dunlop/Özdemir 1997
D. J. Dunlop/Ö. Özdemir, Rock magnetism: fundamentals and frontiers (Cambridge 1997).

Ellis/Ellis 1988
M. B. Ellis/J. P. Ellis, Microfungi on miscellaneous substrates: an identification handbook (1988).

Ellis/Ellis 1997
M. B. Ellis/J. P. Ellis, Microfungi on land plants: an identification handbook (1997).

FAO Rome 2001
FAO Rome, FAOCLIM 2. World-wide agroclimatic database. Food and Agriculture Organisation of the United Nations (2001).

Farr *et al.* 2007
T. G. Farr/P. A. Rosen/E. Caro/R. Crippen/R. Duren/S. Hensley/M. Kobrick/M. Paller/E. Rodriguez/L. Roth/D. Seal/S. Shaffer/J. Shimada/J. Umland/M. Werner/M. Oskin/D. Burbank/D. Alsdorf, The Shuttle Radar Topography Mission. Reviews of Geophysics 45, 2007, doi:10.1029/2005RG000183.

Faßbinder 1994
J. W. E. Faßbinder, Die magnetischen Eigenschaften und die Genese ferrimagnetischer Minerale in Böden im Hinblick auf die magnetische Prospektion archäologischer Bodendenkmäler (Buch am Erlbach 1994).

Faßbinder 2009
J. W. E. Faßbinder, Geophysikalische Prospektionsmethoden – Chancen für das archäologische Erbe. In: E. Emmerling (ed.), Toccare – Non Toccare. ICOMOS – Hefte des Deutschen Nationalkomitees 47 (München 2009) 10–32.

Faßbinder *et al.* 1990
J. W. E. Faßbinder/H. Stanjek/H. Vali, Occurrence of magnetic bacteria in soil. Nature 343, 1990, 161–163.

Faßbinder/Stanjek 1993
J. W. E. Faßbinder/H. Stanjek, Occurrence of magnetic bacteria in archaeological soil. Archaeologia Polona 31, 1993, 117–128.

Faßbinder/Becker 2003
J. Faßbinder/H. Becker, Die Magnetometerprospektion in Aşağı Pınar. In: N. Karul/Z. Eres/M. Özdogan/H. Parzinger (eds.), Aşağı Pınar: Einführung, Forschungsgeschichte, Stratigraphie und Architektur. Studien im Thrakien-Marmara-Raum 1, Archäologie in Eurasien 15 (Mainz 2003) 39–41.
Faßbinder/Gorka 2009
J. W. E. Faßbinder/T. H. Gorka, Beneath the soil – archaeological prospecting with a caesium magnetometer. In: M. Reindel/G. A. Wagner (eds.), New technologies for archaeology: multidisciplinary investigations in Palpa and Nasca, Peru (Berlin 2009) 49–69.
Fazeli *et al.* 2005
H. Fazeli/E. H. Wong/D. T. Potts, The Qazvin Plain revisited: A reappraisal of the chronology of northwestern Central Plateau, Iran, in the 6th to 4th mill. BC. Ancient Near Eastern Studies 42, 2005, 3–82.
Fröhlich *et al.* 2003
N. Fröhlich/M. Posselt/G. A. Wagner, Excavations in a "blinde mode". Magnetometer survey, excavations and magnetic susceptibility measurements of a multiperiod cite at Bad Homburg, Germany. Archaeologia Polona 41, 2003, 167–169.
Furholt/Müller 2011
M. Furholt/J. Müller, The earliest monuments in Europe – architecture and social structures (5000–3000 cal BC). In: M. Furholt/F. Lüth/J. Müller (eds.), Megaliths and identities: early monuments and neolithic societies from the Atlantic to the Baltic. 3rd European Megalithic Studies Group Meeting, 13th–15th of May 2010 at Kiel University. Institut für Ur- und Frühgeschichte der CAU Kiel and Römisch-Germanische Kommission Frankfurt a.M. Frühe Monumentalität und soziale Differenzierung 1 (Bonn 2011) 15–32.
Gabrielian/Fragman-Sapir 2008
E. Gabrielian/O. Fragman-Sapir, Flowers of the Transcaucasus and adjacent areas. Including Armenia, Eastern Turkey, Southern Georgia, Azerbaijan and Northern Iran (Ruggell 2008).
Gabrielian/Zohary 2004
E. Gabrielian/D. Zohary, Wild relatives of food crops native to Armenia and Nakhichevan. Flora Mediterranea 14, 2004, 5–80.
Gaffney *et al.* 2000
C. Gaffney/J. A. Gater/P. Linford/V. Gaffney/R. White, Large-scale systematic fluxgate gradiometry at the Roman city of Wroxeter. Archaeological prospection 7, 2000, 81–100.
Galiatsatos *et al.* 2009
N. Galiatsatos/T. J. Wilkinson/D. N. M. Donoghue/G. Philip, The Fragile Crescent Project (FCP): Analysis of settlement landscapes using satellite imagery. In: Proceedings of CAA 2009: Making history interactive (Williamsburg 2009) 1–15.
Gallis 1996
K. Gallis, Ausgrabungen der neolithischen Siedlungen und Friedhöfe von Platia Magoula Zarkou, Souphli-Magula und Makrychori 2 in Thessalien. In: E. Alram-Stern (ed.), Die Ägäische Frühzeit, 2. Serie, Forschungsbericht 1975–1993. Das Neolithikum in Griechenland mit Ausnahme von Kreta und Zypern (Wien 1996) 521–562.
Gambaschidze *et al.* 2001
I. Gambaschidze/A. Hauptmann/R. Slotta/Ü. Yalçın, Georgien. Schätze aus dem Land des Goldenen Vlies. Katalog der Ausstellung des Deutschen Bergbau-Museums Bochum in Verbindung mit dem Zentrum für Archäologische Forschungen der Georgischen Akademie der Wissenschaften Tbilissi vom 28. Oktober 2001 bis 19. Mai 2002. Veröffentlichungen aus dem Deutschen Bergbaumuseum (Bochum 2001).
Gamkrelidze 1982
I. P. Gamkrelidze, Nappe structures of the Caucasus. In: M. Mahel' (ed.), Alpine structural elements: Carpathian-Balkan-Caucasus-Pamir orogene zone (Bratislava 1982) 95–114.
Gasanov 1996
T. A. Gasanov, Geodynamics of ophiolithes in the structure of the Lesser Caucasus and Iran (Baku 1996).
Gaude 2005
A. Gaude, Socio-economic situation and land use conflicts in the Ag-Göl National Park region, Azerbaijan (Greifswald 2005).
Geel *et al.* 2003
B. van Geel/J. Buurman/O. Brinkkemper/J. Schelvis/A. Aptroot/G. B. A. van Reenen/T. Hakbijl, Environmental reconstruction of a Roman Period settlement site in Uitgeest (The Netherlands), with special reference to coprophilous fungi. Journal of Archaeological Science 30, 2003, 873–883.
Geel/Aptroot 2006
B. van Geel/A. Aptroot, Fossil ascomycetes in Quaternary deposits. Nova Hedwigia 82, 2006, No. 3–4, 313–329.
Geörg 2011
C. Geörg, Paläopopulationsgenetik von Schwein und Schaf in Südosteuropa und Transkaukasien. Unpubl. PhD dissertation, University of Mainz (Mainz 2011).
Glonti *et al.* 2008
L. Glonti/M. Ketshoveli/G. Palumbi, The cemetery at Kvatshelebi. In: A. G. Sagona/M. Abramishvili (eds.), Archaeology in Southern Caucasus: perspectives from Georgia. Ancient Near Eastern Studies, supplement 19 (Leuven 2008) 153–184.
Gratuze 1999
B. Gratuze, Obsidian characterization by laser ablation ICP-MS and its application to prehistoric trade in the Mediterranean and the Near East: sources and distribution of obsidian within the Aegean and Anatolia. Journal of Archaeological Science 26, 1999, 869–881.
Greaves 2007
A. Greaves, Trans-Anatolia: Examining Turkey as a bridge between East and West. Anatolian Studies 57. Transanatolia. Proceedings of the conference held at the British Museum, 31 march to 1 april 2006, 2007, 1–16.
Guliev *et al.* 2009
F. Guliev/F. Guseynov/H. Almamedov, Excavations of a Neolithic settlement at Goytepe (Azerbaijan). In: Eurasien-Abteilung des Deutschen Archäologischen Instituts (ed.), Azerbaijan – Land between East and West. Transfer of knowledge and technology during the "First Globalization" of the VII.–IV. mill. BC. International Symposium Baku, April 1–3, 2009 (Berlin 2009) 26–30.
Guliyev/Nishiaki 2012
F. Guliyev/Y. Nishiaki, Ecavations at the Neolithic settlement of Göytepe, the Middle Kura Valley, Azerbaijan,

2008–2009. In: R. Matthews/J. Curtis (eds.), Proceedings of the 7th ICAANE, London 2010 (Wiesbaden 2012) 71–84.

Hamlin 1975
C. Hamlin, Dalma Tepe. Iran 13, 1975, 111–128.

Hamon 2007
C. Hamon, Modes de subsistance et activités dans le Chalcolithique du Caucase Nord: étude fonctionelle des outils en pierre de la culture de Maikop. In: B. Lyonnet (ed.), Les cultures du Caucase (VIe–IIIe millénaires avant notre ère). Leurs relations avec le Proche Orient (Paris 2007) 189–198.

Hamon 2008a
C. Hamon, From Neolithic to Chalcolithic in the Southern Caucasus: economy and macrolithic implements from Shulaveri-Shomu sites of Kwemo-Kartli (Georgia). Paléorient 34, 2008, No. 2, 85–135.

Hamon 2008b
C. Hamon, Functional analysis of stone grinding and polishing tools from the earliest Neolithic of north-western Europe, Journal of Archaeological Science 35, 1502–1520.

Hamon 2009
C. Hamon, Macrolithic tools of Georgian sites of the Shulaveri-Shomu culture (VIIIth–Vth mill. B.C.), Paléorient 34, 2008, No. 2, 85–135.

Hansen 2011
S. Hansen, Innovation Metall. Kupfer, Gold und Silber in Südosteuropa während des fünften und vierten Jahrtausends v. Chr. Das Altertum 56, 2011, 275–314.

Hansen *et al.* 2006
S. Hansen/G. Mirtskhulava/K. Bastert-Lamprichs/N. Benecke/I. Gatsov/P. Nedelcheva, Aruchlo 2005–2006. Bericht über die Ausgrabungen in einem neolithischen Siedlungshügel. Archäologische Mitteilungen aus Iran und Turan 38, 2006, 1–34.

Hansen *et al.* 2007
S. Hansen/G. Mirtskhulava/K. Bastert-Lamprichs/J. Görsdorf/D. Neumann/M. Ullrich/I. Gatsov/P. Nedelcheva, Aruchlo 2007. Bericht über die Ausgrabungen im neolithischen Siedlungshügel. Archäologische Mitteilungen aus Iran und Turan 39, 2007, 1–30.

Hansen *et al.* in press
S. Hansen/G. Mirtskhulava/K. Bastert-Lamprichs, Neolithic settlements of the 6th mill. BC in the southern Caucasus. In: O. Niewenhuyse/A. Russel/R. Bernbeck/P. M. M. G. Akkermans (eds.), Interpreting Late Neolithic in Upper Mesopotamia (in press).

Helwing 2009
B. Helwing, Azerbaijan in the Chalcolithic: A view from the Southwest. In: Eurasien-Abteilung des Deutschen Archäologischen Instituts (ed.), Azerbaijan – Land between East and West. Transfer of knowledge and technology during the "First Globalization" of the VII.–IV. mill. BC. International Symposium Baku, April 1–3, 2009 (Berlin 2009) 62–66.

Helwing *et al.* 2012
B. Helwing/T. Aliyev/A. Ricci, Mounds and Settlements in the Lower Qarabakh – Mil Plain, Azerbaijan. In: R. Hofmann/F.-K. Moetz/J. Müller (eds.), Tells: Social and Environmental Space. Proceedings of the International Workshop "Socio-Environmental Dynamics over the Last 12,000 Years: The Creation of Landscapes II (14th–18th March 2011)" in Kiel. Universitätsforschungen zur prähistorischen Archäologie 207 (Bonn 2012) 67–77.

Henrickson/McDonald 1983
E. F. Henrickson/M. McDonald, Ceramic form and function: an ethnographic search and an archaeological application. American Anthropologist 85, 1983, 630–643.

Hjulström 1935
F. Hjulström, Studies of the morphological activity of rivers as illustrated by the River Fyris. Inaugural dissertation (Uppsala 1935).

Hoogendoorn *et al.* 2005
R. M. Hoogendoorn/J. F. Boels/S. B. Kroonenberg/M. D. Simmons/E. Aliyeva/A. D. Babazadeh/D. Huseynov, Development of the Kura delta, Azerbaijan. A record of Holocene Caspian sea-level changes. Marine Geology 222, 2005, 359–380.

Hovsepyan/Willcox 2008
R. Hovsepyan/G. Willcox, The earliest finds of cultivated plants in Armenia: evidence from charred remains and crop processing residues in pisé from the Neolithic settlements of Aratashen and Aknashen. Vegetation History and Archaeobotany 17, 2008, 63–71.

Jeunesse 2011
C. Jeunesse, Enceintes à fossé discontinu et enceintes à pseudo-fossé dans le Néolithique d'Europe centrale et occidentale. In: A. Denaire/C. Jeunesse/P. Lefranc (eds.), Nécropoles et enceintes danubiennes du Ve millénaire dans le Nord-Est de la France et le Sud-Ouest de l'Allemagne (Strasbourg 2011) 31–72.

Kazancı *et al.* 2004
N. Kazancı/T. Gulbabazadeh/S. A. G. Leroy/O. Ileri, Sedimentary and environmental characteristics of the Gilan-Mazanderan Plain, northern Iran: Influence of long- and short-term Caspian water level fluctuations on geomorphology. Journal of Marine Systems 46, 2004, No. 1–4, 145–168.

Kennedy 1998
D. Kennedy, Declassified satellite photographs and archaeology in the Middle East: case studies from Turkey. Antiquity 72, 1998, 553–561.

Kiguradze 1986
T. Kiguradze, Neolithische Siedlungen von Kvemo-Kartli, Georgien (München 1986).

Kiguradze 2000
T. Kiguradze, The Chalcolithic – Early Bronze Age transition in the Eastern Caucasus. In: C. Marro/H. Hauptmann (eds.), Chronologies des Pays du Caucase et de L'Euphrate aux IVe–IIIe Millénaires. Varia Anatolica 11 (Paris 2000) 321–328.

Kiguradze/Sagona 2003
T. Kiguradze/A. Sagona, On the origins of the Kura-Araxes cultural complex. In: A. T. Smith/K. S. Rubinson (eds.), Archaeology in the borderlands: investigations in Caucasia and beyond. The Cotsen Institute of Archaeology, University of California, Los Angeles Monograph 47 (Los Angeles 2003) 38–94.

Kottek *et al.* 2006
M. Kottek/J. Grieser/C. Beck/B. Rudolf/F. Rubel, World Map of the Köppen-Geiger climate classification updated. Meteorologische Zeitschrift 15, 2006, No. 3, 259–263.

Kroonenberg *et al.* 1997
S. B. Kroonenberg/G. V. Rusakov/A. A. Svitoch, The wandering of the Volga delta: a response to rapid Caspian sea-level change. Sedimentary Geology 107, 1997, nos. 3–4, 189–209.

Lancelotti 2010
C. Lancelotti, Fuelling Harappan hearths: human-environment relations as revealed by fuel exploitation and use. Unpubl. PhD dissertation (Cambridge 2010).
Landmann 1996
G. Landmann, Dating Late Glacial abrupt climate changes in the 14,570 yr long continuous varve record of Lake Van, Turkey. Paleogeography, Paleoclimatology, Paleoecology 122, 1996, 107–118.
Le Borgne 1955
E. Le Borgne, Susceptibilité magnétique anormale de sol superficiel. Annals of Geophysics 11, 1955, 399–419.
Le Borgne 1960
E. Le Borgne, Influence du feu sur les propriétés magnétiques du sol et sur celles du schiste et du granite. Annals of Geophysics 16, 1960, 159–195.
Lyonnet 2007a
B. Lyonnet (ed.), Les cultures du Caucase (VI^e^–III^e^ millénaires avant notre ère). Leurs relations avec le Proche Orient (Paris 2007).
Lyonnet 2007b
B. Lyonnet, Introduction. In: B. Lyonnet (ed.), Les cultures du Caucase (VI^e^–III^e^ millénaires avant notre ère). Leurs relations avec le Proche Orient (Paris 2007) 11–20.
Lyonnet 2007c
B. Lyonnet, La culture du Maikop, la Transcaucasie, l'Anatolie orientale et le Proche-Orient: relations et chronologie. In: B. Lyonnet (ed.), Les cultures du Caucase (VI^e^–III^e^ millénaires avant notre ère). Leurs relations avec le Proche Orient (Paris 2007) 133–162.
Lyonnet 2009a
B. Lyonnet, Périphérie de la Mésopotamie à la période d'Uruk (4^e^ millénaire): le cas des régions du Caucase. In: J.-M. Durand/A. Jacquet (eds.), Centre et Périphérie: approches nouvelles des Orientalistes, Actes du colloque organisé par l'Institut du Proche-Orient Ancien du Collège de France, la Société Asiatique et la CNRS (UMR 7192) les 31 mai et 1er jiun 2006 (Paris, Collège de France). Cahiers de l'Institut du Proche-Orient Ancien du Collège de France (Paris 2009) 1–28.
Lyonnet 2009b
B. Lyonnet, Surveys and excavations in Western Azerbaijan: settlement changes and relations with surrounding areas, from the Neolithic to the Bronze Age. In: Eurasien-Abteilung des Deutschen Archäologischen Institut (ed.), Azerbaijan – Land between East and West. Transfer of knowledge and technology during the "First Globalization" of the VII.–IV. mill. BC. International Symposium Baku, April 1–3, 2009 (Berlin 2009) 41–47.
Lyonnet *et al.* 2008
B. Lyonnet/T. Akhundov/K. Almamedov/L. Bouquet/A. Courcier/B. Jellilov/F. Huseynov/S. Loute/Z. Makharadze/S. Reynard, Late Chalcolithic kurgans in Transcaucasia. The cemetery of Soyuq Bulaq (Azerbaijan). Archäologische Mitteilungen aus Iran und Turan 40, 2008, 27–44.
Lyonnet/Guliyev 2010
B. Lyonnet/F. Guliyev, Recent discoveries on the Neolithic and Chalcolithic of Western Azerbaijan. TÜBA-AR. Turkish Academy of Sciences Journal of Archaeology 13, 2010, 219–228.
Lyonnet/Guliyev 2012
B. Lyonnet/F. Guliyev, Recent research on the Chalcolithic Period in Western Azerbaijan. In: R. Matthews/J. Curtis (eds.), Proceedings of the 7^th^ ICAANE, London 2010. (Wiesbaden 2012) 85–98.
Makharadze 2007
Z. Makharadze, Nouvelles données sur le Chalcolithique en Géorgie orientale. In: B. Lyonnet (ed.), Les cultures du Caucase (VI^e^–III^e^ millénaires avant notre ère). Leurs relations avec le Proche Orient (Paris 2007) 123–132.
Mamedov 1997
A. Mamedov, The Late Pleistocene-Holocene history of the Caspian Sea. Quaternary International 41–42, 1997, 161–166.
Marro 2007
C. Marro, Upper-Mesopotamia and Transcaucasia in the Late Chalcolithic period (4000–3500 BC). In: B. Lyonnet (ed.), Les cultures du Caucase (VI^e^–III^e^ millénaires avant notre ère). Leurs relations avec le Proche Orient (Paris 2007) 77–94.
Marro 2010
C. Marro, Where did late Chalcolithic chaff-faced ware originate? Cultural dynamics in Anatolia and Transcaucasia at the dawn of urban civilization (ca 4500–3500 BC). Paléorient 36, 2010, No. 2, 35–55.
Marro *et al.* 2011
C. Marro/V. Bakhshaliyev/S. Ashurov, Excavations at Ovcular Tepesi (Nakhchivan, Azerbaijan). Second preliminary report: the 2009–2010 seasons. Anatolica Antiqua 19, 2011, 53–100.
Matsutani 1991
T. Matsutani, Tell Kashkashok. The excavations at Tell n. II Supplement to the Bulletin of the Institute of Oriental Culture (Tokio 1991).
R. Matthews 2003 a
R. Matthews, Traces of early complexity. Late fifth to early fourth-millennia investigations: the early Northern Uruk. In: R. Matthews (ed.), Excavations at Tell Brak 4: Exploring an Upper Mesopotamian regional centre, 1994–1996. McDonald Institute Monographs (Oxford 2003) 25–52.
R. Matthews 2003 b
R. Matthews, Surface investigations. In: R. Matthews (ed.), Excavations at Tell Brak. Vol. 4: Exploring an Upper Mesopotamian regional centre, 1994–1996. McDonald Institute Monographs (Oxford 2003) 7–24.
R. Matthews *et al.* 2010
R. Matthews/Y. Mohammadifar/W. Matthews/A. Motarjem, Investigating the Early Neolithic of western Iran: the Central Zagros Archaeological Project (CZAP). Antiquity 84, 2010, No. 323.
W. Matthews 2001
W. Matthews, Micromorphological analysis of occupational sequences. In: R. J. Matthews/N. Postgate (eds.), Contextual analysis of the use of space at two Near Eastern Bronze Age sites [data-set] (2001 York).
W. Matthews 2005
W. Matthews, Micromorphological and microstratigraphic traces of uses and concepts of space. In: I. Hodder (ed.), Inhabiting Çatalhöyük. Reports from the 1995–1999 seasons. Çatalhöyük Project 4. Monograph of the British Institute of Archaeology at Ankara 38 (Cambridge 2005) 355–398.
W. Matthews 2010
W. Matthews, Geoarchaeology and taphonomy of plant remains and microarchaeological residues in early urban

environments in the Ancient Near East. Quaternary International 214, 2010, No. 1–2, 98–113.

W. Matthews/Postgate 1994
W. Matthews/J. N. Postgate, The imprint of living in an early Mesopotamian city: questions and answers. In: R. Luff/P. Rowley-Conway (eds.), Whither enviromental archaeology? Papers from the Association of Environmental Archaeology Conference, Selwyn College, Cambridge, 1991. Oxbow Monograph 38 (Oxford 1994) 171–212.

W. Matthews *et al.* 1996
W. Matthews/C. French/T. Lawrence/D. Cutler, Multiple surfaces: the micromorphology. In: I. Hodder (ed.), On the Surface. Çatalhöyük 1993–1995. Monograph of the Çatalhöyük Project 1, McDonald Institute for Archaeological Research (Cambridge 1996) 301–342.

W. Matthews *et al.* 1997
W. Matthews/C. A. I. French/T. Lawrence/D. F. Cutler/M. K. Jones, Microstratigraphic traces of site formation processes and human activities. World Archaeology 29, 1997, No. 2, 281–308.

Maynard 2011
D. Maynard, The BTC Pipeline archaeological excavations in Azerbaijan. http://archaeologydataservice.ac.uk/archives/view/btcpipeline_leap_2011/

Meliksetian *et al.* 2009
K. Meliksetian/E. Pernicka/R. Badalyan, Composition and some considerations on the provenance of Armenian Early Bronze Age copper artifacts. In: Archaeometallurgy in Europe 2007: 2nd International Conference, Grado and Aquileia, 17–21 June 2007 (Milano 2009) 41–58.

Miall 1988
A. D. Miall, Reservoir heterogenities in fluvial sandstones – Lessons learned from outcrop studies. American Association of Petroleum Geologists Bulletin 72, 1988, No. 6, 682–697.

Le Mière 2000
M. Le Mière, L'occupation proto-Hassuna du Haut-Khabur occidental d'après la céramique. In: B. Lyonnet (ed.), Prospection archéologique. Haut-Khabur occidental (Syrie du N.E.) 1. Bibliothèque Archéologique et Historique 155 (Beyrouth 2000) 127–149.

Mikhailov *et al.* 2003
V. N. Mikhailov/V. I. Kravtsova/D. V. Magritskii, Hydrological and morphological processes in the Kura River Delta. Water ressources – Vodnye Resursy 30, 2003, No. 5, 495–508.

Miller 2003
M. Miller, Technical aspects of ornament production in Sitagroi. In: E. S. Elster/C. Renfrew (eds.), Prehistoric Sitagroi: Excavations in Northeast Greece, 1968–1970. Final Report 2. Monumenta Archaeologica 20 (Los Angeles 2003) 369–382.

Mills 1979
H. H. Mills, Downstream rounding of pebbles: a quantitative review. Journal of Sedimentary Research 49, 1979, No. 1, 295–302.

Mosar *et al.* 2010
J. Mosar/T. Kangarli/M. Bochud/U. Glasmacher/A. Rast/M.-F. Brunet/M. Sosson, Cenozoic-recent tectonics and uplift in the Greater Caucasus: a perspective from Azerbaijan. Geological Society special publication 2010, No. 340, 261–280.

Muhs *et al.* 2004
D. Muhs/J. McGeehin/J. Beann/E. Fisher, Holocene loess deposition and soil formation as competing processes, Matanuska Valley, southern Alaska. Quaternary Research 61, 2004, 265–276.

Nebieridze 2010
L. Nebieridze, The Tsopi chalcolithic culture. Studies of the Society of Assyriologists, Bibliologists and Caucasiologists 6 (Tbilisi 2010).

Nechitajlo 2007
A. Nechitajlo, La céramique de Ust'-Dzheguta, établissement du début de la culture de Maikop en Karachaevo-Tcherkessie. In: B. Lyonnet (ed.), Les cultures du Caucase (VI^{e}–III^{e} millénaires avant notre ère). Leurs relations avec le Proche Orient. Éditions Recherche sur les Civilisations (Paris 2007) 163–178.

Neill 1967
C. R. Neill, Mean-velocity criterion for scour of coarse uniform bed-material. 12th Proceedings of the International Association of Hydrological Research, Fort Collins (Colorado 1967) 46–54.

Neill 1968
C. R. Neill, A re-examination of the beginning of movement for coarse granular bed materials. Report of the Wallingford Hydraulics Research Station 68, 1968, 1–37.

Neubauer *et al.* 1999
W. Neubauer/A. Eder-Hinterleitner/S. S. Seren/M. Doneus/P. Milichar, Kombination archäologisch-geophysikalischer Prospektionsmethoden am Beispiel der römischen Zivilstadt Carnuntum. Archaeologica Austrica 83, 1999, 1–26.

Newson 2002
M. D. Newson, Geomorphological concepts and tools for sustainable river ecosystem management. Aquatic Conservation: Marine and Freshwater Ecosystems 12, 2002, No. 4, 365–379.

Nieuwenhuyse 2000
O. Nieuwenhuyse, Halaf settlement in the Khabur headwaters. In: B. Lyonnet (ed.), Prospection archéologique. Haut-Khabur occidental (Syrie du N. E.) 1. Bibliothèque Archéologique et Historique (Beyrouth 2000) 151–260.

Nieuwenhuyse 2008
O. P. Nieuwenhuyse, Feasting in the steppe – Late Neolithic ceramic change and the rise of the Halaf. In: J. M. Córdoba/S. Martínez Lillo/M. Molist/M. C. Pérez Díe/I. Rubio (eds.), Proceedings of the 5th International Congress on the Archaeology of the Ancient Near East (Madrid 2008) 692–708.

Nieuwenhuyse *et al.* 2010
O. P. Nieuwenhuyse/P. M. M. G. Akkermans/J. van der Plicht, Not so coarse, nor always plain – the earliest pottery of Syria. Antiquity 84, 2010, 71–85.

Ollivier *et al.* in press
V. Ollivier/M. Fontugne/B. Lyonnet, Caspian Sea mobility during the Late Quaternary: impact on the upstream hydrosystem and the Neolithic – Chalcolithic settlements of the Middle Kura Valley (Azerbaijan). Quarternary Science Review, in press.

Özdoğan 2007
M. Özdoğan, Amidst Mesopotamia-centric and Euro-centric approaches: The changing role of the Anatolian Pe-

ninsula between the East and the West. Anatolian Studies 57. Transanatolia. Proceedings of the conference held at the British Museum, 31 march to 1 april 2006, 2007, 17–24.

Palumbi 2008
G. Palumbi, The Red and the Black. Social and cultural interactions between the Upper Euphrates and Southern Caucasus communities in the fourth and third mill BC. Studi di Preistoria Orientale 2 (Roma 2008).

Pernicka/Anthony 2010
E. Pernicka/D. Anthony, The invention of copper metallurgy and the Copper age of Old Europe. In: D. Anthony/J. Y. Chi (eds.), The lost world of Old Europe. The Danube valley 5000–3500 BC (New York, Princeton, Oxford 2010) 163–177.

Perrot 1968
J. Perrot, La préhistoire palestinienne. In: Supplément au Dictionnaire de la Bible 8 (Paris 1968) 423–440.

Piperno 2006
D. R. Piperno, Phytoliths: a comprehensive guide for archaeologists and paleoecologists (Lanham, New York, Toronto, Oxford 2006).

Posamentier 2001
H. W. Posamentier, Lowstand alluvial bypass systems: Incised vs. unincised. American Association of Petrol Geologists Bulletin 85, 2001, No. 10, 1771.

Reimer P. J. *et al.* 2009
P. J. Reimer/M. G. L. Baillie/F. G. McCormac/R. W. Reimer/E. Bard/A. Bayliss/J. W. Beck/P. G. Blackwell/C. E. Buck/T. J. Heaton/C. B. Ramsey/G. S. Burr/R. L. Edwards/M. Friedrich/B. Kromer/P. M. Grootes/T. P. Guilderson/I. Hajdas/A. G. Hogg/K. A. Hughen/K. F. Kaiser/S. W. Manning/D. A. Richards/J. R. Southon/S. Talamo/C. S. M. Turney/J. van der Plicht/C. E. Weyhenmeyer, IntCal09 and Marine09 radiocarbon age calibration curves, 0–50 000 years CAL BP. Radiocarbon 51, 2009, No. 4, 1111–1150.

Reinhold 2007
S. Reinhold, Die Spätbronze- und frühe Eisenzeit im Kaukasus: materielle Kultur, Chronologie und überregionalle Beziehungen. Universitätsforschungen zur prähistorischen Archäologie 144 (Bonn 2007).

Ryan 2011
P. Ryan, Plants as material culture in the Near Eastern Neolithic: Perspectives from the silica skeleton artifactual remains at Çatalhöyük. Journal of Anthropological Archaeology 30, 2011, No. 3, 292–305.

Rychagov 1997
G. Rychagov, Holocene oscillations of the Caspian Sea, and forecasts based on palaeogeographical reconstructions. Quaternary International 41–42, 1997, 167–172.

Rye 1981
O. S. Rye, Pottery technology: principles and reconstruction. Manuals on archeology 4 (Washington 1981).

Scheu 2011
A. Scheu, Palaeogenetische Studien zur Populationsgeschichte von Rind und Ziege mit einem Schwerpunkt auf dem Neolithikum in Südosteuropa. Unpubl. PhD dissertation (Mainz 2011).

Schleifer 2004
Schleifer N., Ghost features: a proposal for appropriate management and a forum for discussion. Newsletter of the International Society of Archaeological Prospection 1, 2004, 6–9.

Schleifer *et al.* 2003
N. Schleifer/J. W. E. Fassbinder/W. E. Irlinger/H. Stanjek, Investigation of an Eneolithic Chamer-group ditch system near Riekofen (Bavaria) with archaeological, geophysical and pedological methods. In: Soils and archaeology. Papers of the 1st International Conference on Soils and Archaeology, Szazhalombatta, Hungary, 30 May–3 June 2001, vol. 1163. British Archaeological Report International Series (Archaeopress 2003) 59–64.

Schmidt 2001
A. Schmidt, Geophysical data in archaeology. A guide in good practice (York 2001).

Schumm 1977
S. A. Schumm, The fluvial system (New York 1977).

Schütt *et al.* 1997
B. Schütt/J. Berking/M. Frechen/P. Frenzel/A. Schwalb/C. Wrozyna, Late Quaternary transition from lacustrine to a fluvio-lacustrine environment in the north-western Nam Co, Tibetan Plateau, China. Quaternary International 218, 1997, No. 1–2, 104–117.

Scollar *et al.* 1990
I. Scollar/A. Tabbagh/A. Hesse/I. Herzog, Archaeological prospecting and remote sensing. Topics in remote sensing (Cambridge 1990).

Selimkhanov 1978
I. R. Selimkhanov, Ancient tin objects of the Caucasus and the results of their analysis. In: A. D. Franklin/J. S. Olin/T. A. Wertime (eds.), The search for ancient tin (Washington 1978) 53–58.

Shahack-Gross *et al.* 2003
R. Shahack-Gross/F. Marshall/S. Weiner, Geo-ethnoarchaeology of pastoral sites: The identification of livestock enclosures in abandoned Massai settlements. Journal of Archaeological Science 30, 2003, No. 4, 439–459.

Shahack-Gross *et al.* 2005
R. Shahack-Gross/R.-M. Albert/A. Gilboa/O. Nagar-Hilman/I. Sharon/S. Weiner, Geoarchaeology in an urban context: The uses of space in a Phoenician monumental building at Tel Dor (Israel). Journal of Archaeological Science 32, 2005, No. 9, 1417–1431.

Shillito 2011
L. Shillito, Simultaneous thin section and phytolith observations of finely stratified deposits from Neolithic Çatalhöyük, Turkey: implications for paleoeconomy and Early Holocene paleoenvironment. Journal of Quaternary Science 26, 2011, No. 6, 576–588.

Shillito *et al.* 2011 a
L.-M. Shillito/W. Matthews/M. J. Almond/I. D. Bull, The microstratigraphy of middens: capturing daily routine in rubbish at Neolithic Catalhoyuk, Turkey. Antiquity 85, 2011, No. 329, 1024–1038.

Shillito *et al.* 2011 b
L.-M. Shillito/I. D. Bull/W. Matthews/M. J. Almond/J. M. Williams/R. P. Evershed, Biomolecular and micromorphological analysis of suspected faecal deposits at Neolithic Çatalhöyük, Turkey. Journal of Archaeological Science 38, 2011, No. 8, 1869–1877.

Stöllner *et al.* 2010
T. Stöllner/I. Gambaschidze/A. Hauptmann/G. Mindiashvili/G. Gogocuri/G. Steffens, Goldbergbau in Südgeorgien. Neue Forschungen zum frühbronzezeitlichen Bergbau in Georgien. In: S. Hansen/A. Hauptmann/I. Motzenbäcker/

E. Pernicka (eds.), Von Majkop bis Trialeti: Gewinnung und Verbreitung von Metallen und Obsidian in Kaukasien im 4.–2. Jt. V. Chr.: Beiträge des Internationalen Symposiums in Berlin vom 1.–3. Juni 2006. Kolloquien zur Vor- und Frühgeschichte 13 (Bonn 2010) 139–160.

Stordeur 1988
D. Stordeur, Outils et armes en os du gisement natoufien de Mallaha (Eynan) Israel. Mémoires et travaux du Centre de Recherche Français de Jérusalem 6 (Paris 1988).

Stordeur 1999
D. Stordeur, Néolithisation et outillage osseux, la révolution a-t-elle eu lieu? In: M. Julien/A. Averbouh/D. Ramseyer (eds.), Préhistoire d'os. Recueil d'études sur l'industrie osseuse préhistorique offert à Henriette Camps-Fabrer (Aix-en-Provence 1999) 261–272.

von Suchodoletz *et al.* 2011
H. von Suchodoletz/D. Faust/D. Wolf, Investigations of the fluvial dynamics in Eastern Georgia as a contribution to paleoenviromental research of the region. Annals of Agrarian Science 9, 2011, No. 3, 13–17.

Taylor 1972
C. C. Taylor, The study of settlement patterns in pre-Saxon Britain. In: P. Ucko/R. Tringham/G. W. Dimbleby (eds.), Man, settlement and urbanism (London 1972) 109–113.

Tekin 2011
H. Tekin, Karavelyan kazılarından insan ve yapı betimli bir Halaf kabının tanıtımı. TÜBA-AR. Turkish Academy of Sciences Journal of Archaeology 14, 2011, 309–312.

Thompson/Oldfield 1986
R. Thompson/F. Oldfield, Environmental magnetism (London, Boston 1986).

Tobler 1950
A. J. Tobler, Excavations at Tepe Gawra II, Levels IX–XX (Philadelphia 1950).

Tucker *et al.* 2004
C. J. Tucker/D. M. Grant/J. D. Dykstra, NASA's global orthorectified Landsat data set. Photogrammetric Engineering & Remote Sensing 70, 2004, No. 3, 313–322.

Ur 2003
J. Ur, CORONA satellite photography and ancient road networks: a Northern Mesopotamian case study. Antiquity, 2003, No. 295, 102–115.

Vandiver 1987
P. B. Vandiver, Sequential slab construction: a conservative southwest Asiatic ceramic tradition, ca. 7000–3000 BC. Paléorient 13, 1987, No. 2, 9–35.

Vavilov/Dorofeev 1992
N. I. Vavilov/V. F. Dorofeev, Origin and geography of cultivated plants (Cambridge, New York 1992).

van der Veen 2007
M. van der Veen, Formation processes of desiccated and carbonized plant remains – the identification of routine practice. Journal of Archaeological Science 34, 2007, No. 6, 968–990.

Vitelli 1989
K. Vitelli, Were pots first made for food? Doubts from Franchthi. World Archaeology 21, 1989, No. 1, 17–29.

Voigt 1983
M. M. Voigt, Hajji Firuz Tepe, Iran: the Neolithic settlement, University Museum Monograph 50 (Philadelphia 1983).

Weiner *et al.* 2002
S. Weiner/P. Goldberg/O. Bar-Yosef, Three-dimensional Distribution of Minerals in the Sediments of Hayonim Cave, Israel: Diagenetic Processes and Archaeological Implications. Journal of Archaeological Science 29, 2002, No. 11, 1289–1308.

Weiner 2010
S. Weiner, Microarchaeology (Cambridge, New York 2010).

Wilkinson 2003
T. J. Wilkinson, Archaeological landscapes of the Near East (Tuscon, AR 2003).

Wilkinson *et al.* 2012
K. N. Wilkinson/B. Gasparian/R. Pinhasi/P. Avetisyan/R. Hovsepyan/D. Zardaryan/G. E. Areshian/G. Bar-Oz/A. Smith, Areni-1 Cave, Armenia: A Chalcolithic-Early Bronze Age settlement and ritual site in the southern Caucasus. Journal of Field Archaeology 37, 2012, No. 1, 20–33.

Wu *et al.* 1973
T. H. Wu/S. K. Vyas/N. Y. Chang, Probabilistic adjustment of seepage. Journal of soil mechanics and foundation division. Proceedings of the American Society of Civil Engineers 99, 1973, No. 4, 323–340.

Yang/Song 1979
C. T. Yang/C. C. S. Song, Dynamic adjustment of alluvial chanels in Rhodes D. D. In: G. P. Williams (ed.), Adjustments of the fluvial system (London 1979) 55–67.

Yener *et al.* 2000
K. A. Yener/C. Edens/T. Harrison/J. Vestraete/T. J. Wilkinson, The Amuq valley regional project, 1995–1998. American Journal of Archaeology 104, 2000, No. 2, 163–220.

Zohary/Hopf 2003
D. Zohary/M. Hopf, Domestication of plants in the Old World. The origin and spread of cultivated plants in West Asia, Europe and the Nile Valley (New York 2003).

Азизбеков *et al.* 1961
Ш. А. Азизбеков/М. А. Гашгак/А. Султанов, Геология Азербайджана, рудные полезные ископаемые (Баку).

Абибуллаев 1982
О. А. Абибуллаев, Энеолит и бронза на территории Нахичеванской АССР (Баку 1982).

Алиев/Нариманов 2001
Н. Алиев/И. Нариманов, Культура северного Азербайджана в эпоху позднего энеолита (Баку 2001).

Амирханов 1987
Х. А. Амирханов, Чохское поселение. Человек и его культура в мезолите и неолите горного Дагестана (Москва 1987).

Аразова 1986
Р. Аразова, Каменные орудия труда ранних земледельческо-скотоводческих племён западного Азербайджана (по данным экспериментально-трассологических исследований) (Баку 1986).

Баба-заде *et al.* 2005
В. М. Баба-заде/А. А. Надиров/Г. С. Багиров/С. А. Бекташи/М. М. Мамедов/В. Г. Рамазанов/Ш. Д. Мусаев/Ф. А. Ахундов, Минерально-сырьевые ресурсы Азербайджана (условия формирования, закономерности размещения, научные основы прогнозирования) (Баку 2005).

Варазашвили 1992
В. Варазашвили, Раннеземледельческая культура Иоро-Алазанского бассейна (Тбилиси 1992).

Иессен 1959

А. А. Иессен, Труды азербайджанской (Орен-Калинской) археологической экспедиции (Москва, Ленинград 1959).

Иессен 1965

А. А. Иессен, Из исторического прошлого Мильско-Карабахской степи. In: А. А. Иессен/К. Кушнарева (eds.), Труды азербайджанской археологической экспедиции II (1956–1960). Материалы и исследования по археологии СССР 125 (Москва, Ленинград 1965) 10–35.

Кореневский 1998

С. Кореневский, Поселение “Замок” у города Кисловодска (нижний слой). In: А. Белинский (ed.), Материалы по изучению историко-культурного наследия Северного Кавказа 1. Археология (Ставрополь 1998) 96–147.

Коробкова 1978

Г. Коробкова, Древнейшие жатвенные орудия и их производительность (в свете экспериментально-трасологического исследования). Советская археология 4, 1978, 36–52.

Кушнарева 1993

К. Кушнарева, Южный Кавказ в IX–II тыс. до н.э.: Этапы культурного и социально-экономического развития (С. Петербург 1993).

Кушнарева/Лисицына 1979

К. Кушнарева/Г. Лисицына, О возникновении пашенного земледелия в Закавказье: (к постановке проблемы). Советская археология vl. 2, 1979 5–18

Махмудов *et al.* 1987

А. И. Махмудов/А. С. Пириев/С. Н. Багирова/Т. Т. Исмаил-заде/И. М. Малумян/Т. А. Адилов, Новые минералы медно-порфировых руд Кадабекского района Малого Кавказа. Доклады Академии Наук Азербайджанской СССР (Баку 1987).

Мунчаев 1982

Р. Мунчаев, Энеолит Кавказа. In: В. Массон/Н. Мерперт (eds.), Археология СССР, Энеолит СССР (Москва 1982) 93–164.

Нариманов 1966

И. Нариманов, Древнейшая земледельческая культура Закавказья. In: Доклады и сообщения археологов СССР на VII Международном конгрессе доисториков и протоисториков в Праге (Москва 1966) 121–126.

Нариманов 1971

И. Нариманов, О земледелии эпохи энеолита в Азербайджане. Советская археология 3, 1971, 3–14.

Нариманов 1987

И. Нариманов, Культура древнейшего земледельческо-скотоводческого населения Азербайджана (эпоха энеолита VI–IV тыс. до н.э.) (Баку 1987).

Семёнов/Коробкова 1983

С. А. Семёнов/Г. Ф. Коробкова, Технология древнейших производств: мезолит-энеолит (Ленинград 1983).

Хансен *et al.* 2009

С. Хансен/Г. Мирцхулава/К. Бастерт-Ламприз, Арухло, поселение эпохи неолита в Грузии. In: Германский Археологический институт (ed.), Азербайджан – страна, связывающая восток и запад. Обмен знаниями и технологиями в период «первой глобализации» VII–IV тыс. до н. э (Берлин 2009) 80–82.

Черныш 1982

Е. Черныш, Энеолит Правобережной Украины и Молдавии. In: В. Массон/Н. Мерперт (eds.), Энеолит СССР. Археология СССР (Москва 1982) 166–320.

Чиковани 1999

Г. Чиковани, Поселение раннеземледельческой культуры из Чинти. In: Труды университета «Легия и компания», vol. 2. (Тбилиси 1999) 72–84.

კიღურაძე 1976

თ. კიღურაძე, აღმოსავლეთ ამიერკავკასიის ადრესამიწათმოქმედო კულტურის პერიოდიზაცია (თბილისი 1976). [T. Kiğuradze, The periodization of the Early Farming culture in Eastern Transcaucasia (Tbilisi 1976)]

მენაბდე/კიღურაძე

მ. მენაბდე/თ. კიღურაძე, სიონის არქეოლოგიური ძეგლები (თბილისი 1981). [M. Menabde/T. Kiğuradze, The archaeological sites at Sioni (Tbilisi 1981)]

ჩიქოვანი 1998

გ. ჩიქოვანი, ადრესამიწათმოქმედო კულტურის ნამოსახლარი სოფ. ჩინთიდან. „ლეგია და კომპანიის“ უნივერსიტეტი, შრომები vol. 2 (თბილისი 1998) 72–80. [G. Chikovani, An Early Farming culture by the village Chinta. In: Papers of „Legia and Co.“ University, vol. 2 (Tbilisi 1998)].

ჩიქოვანი 1999

გ. ჩიქოვანი ადრესამიწათმოქმედო კულტურის ნამოსახლარი თანდიწყარო სოფელ ხელთუბანთან. ძიებანი. საქართველოს მეცნიერებათა აკადემიის არქეოლოგიური კვლევის ცენტრის ჟურნალი 3, 1999, 19–23. [G. Chikovani, „Tandistsqaro I“. A settlement of the Early Husbandry culture near the Village of Kheltubani (Gori District). Dziebani. The Journal of the Centre for Archaeological Studies, Georgian Academy of Sciences].

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Abstract

The multidisciplinary international research project "Ancient Kura" aims at the diachronic reconstruction of human-landscape interaction in the southern Caucasus from the begin of sedentism to the Early Bronze Age. It combines research in three areas around the archaeological sites of Aruchlo in Georgia, Mentesh Tepe in western and Kamiltepe in southern Azerbaijan with comparative research concerning environment, archaeological landscapes, bio-archaeology and material culture. The article presents an interim report of the whole project, with chapters by authors on their individual, specialized studies. One of the main foci is on the Neolithic period, which is represented in all three research areas. The Neolithic shows two distinct regional traditions, known as Šulaveri-Šomutepe in the northwestern and as Mil Steppe Painted Ware in the southern area, which reflect different cultural affiliations in these neighboring regions. The Chalcolithic is investigated in great detail at Mentesh Tepe and has also been touched upon in the Kamiltepe region. The Early Bronze Age is represented through burials and pits at Mentesh Tepe. The diachronic and supra-regional comparative approach adopted by the project provides a new perspective concerning specific adaptations within variable habitats reflected in the faunal and botanical record, ranging from temperate to arid climatic zones. Individual sites show differing degrees of integration into regional raw material procurement systems that crosscut and overlie the cultural affiliations.

Резюме

Целью междисциплинарного международного научного проекта «Древняя Кура» является реконструкция на диахронной основе антропогенного влияния на ландшафт Южного Кавказа в период с начала оседлости по эпоху ранней бронзы. Проект включает в себя фундаментальные исследования по экологии, ландшафтной археологии, биоархеологии, а также и изучение материальной культуры на археологических памятниках Арухло в Грузии, Ментеш Тепе в западном и Камильтепе в восточном Азербайджане. В статье представлен предварительный отчёт о проведённой совместной работе, каждая глава написана соответствующими специалистами на основе проведённых ими исследований. В центре проекта находится эпоха неолита, представленная на каждом из упомянутых памятников и составляющая два различных в региональном плане феномена: «Шулавери-Шомутепе» на северо-западе и «расписная керамика Мильской степи» на юго-востоке. Разница между этими культурными феноменами прослеживается также и в их ориентации на сопредельные территории. Эпоха халколита детально исследована на Ментеш Тепе и только частично затронута в районе памятника Кямильтепе. Эпоха ранней бронзы представлена рядом захоронений в Ментеш Тепе. Сравнительный анализ на диахронной и над-региональной основе открывает новые перспективы для изучения форм адаптации к изменениям среды обитания от засушливого до умеренного климата, что нашло отражение в ботаническом и зоологическом материале. В то же самое время, изучение каждого памятника в отдельности даёт возможность проследить различную степень интеграции населения в региональную систему добычи и разработки сырья, что, в свою очередь, обуславливает культурную принадлежность общества.