The First Farming Village in Northeast Iran and Turan:

Tappeh Sang-e Chakhmaq and Beyond

February 10 - 11, 2014

Program and Abstracts

RESEARCH CENTER FOR WEST ASIAN CIVILIZATION

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February 10th (Monday): (Advanced Research Building A, 107)

13:00-13:10 Opening address
Akira Tsuneki (University of Tsukuba)

13:10-13:30 Geologic setting of Tappeh Sang-e Chakhmaq
Ken-ichiro Hisada (University of Tsukuba)

13:30-13:50 The site of Tappeh Sang-e Chakhmaq
Akira Tsuneki (University of Tsukuba)

13:50-14:10 Radiocarbon dating of charcoal remains excavated from Tappeh Sang-e Chakhmaq
Toshio Nakamura (Nagoya University)

14:10-14:40 Coffee break

14:40-15:00 Pottery and other objects from Tappeh Sang-e Chakhmaq
Akira Tsuneki (University of Tsukuba)

15:00-15:20 Mineralogical study of pottery from Tappeh Sang-e Chakhmaq
Masanori Kurosawa (University of Tsukuba)

15:20-15:40 Figurines of Tappeh Sang-e Chakhmaq
Setsuo Furusato (Matsudo City Board)

15:40-16:10 Coffee break

16:10-16:30 Neolithisation of Eastern Iran : New insights through the study of the faunal remains of Tappeh Sang-e Chakhmaq
Marjan Mashkour (Central National de la Recherche Scientifique)

16:30-16:50 Charred remains from Tappeh Sang-e Chakhmaq, and a consideration of early wheat diversity on the eastern margins of the Fertile Crescent
Dorian Fuller (University College London)

18:00-20:00 Welcome party

February 11th (Tuesday): (Advanced Research Building B, 108)

10:00-10:20 Vegetation of the Chakhmaq site based on charcoal identification
Ken-ichi Tanno (Yamaguchi University)

10:20-10:40 Human remains from Tappeh Sang-e Chakhmaq
Akira Tagaya (Nagano College of Nursing)

10:40-11:00 Children at Tappeh Sang-e Chakhmaq
Yuko Miyauchi (University of Tsukuba)

11:00-12:30 Laboratory visit

12:00-14:00 Lunch

14:00-14:20 Stratigraphic Soundings at Sang-e Chakhmaq Tappehs, Shahroud, Iran; April- June 2009
Kourosh Roustaei (Iranian Center for Archaeological Research)

14:20-14:40 First archaeobotanical results from the 2009 soundings at Sang-e Chakhmaq East and West mounds
Margareta Tengberg (National Museum of Natural History)

14:40-15:10 Coffee break

15:10-17:00 Discussion

Geologic setting of Tappeh Sang-e Chakhmaq

Ken-ichiro Hisada (University of Tsukuba)

Tappeh Sang-e Chakhmaq is located on the terrace deposits that developed on the southeastern side of the Alborz Mountains, north Iran (Fig.1). It is well known that the life of ancient people was greatly influenced by various natural conditions, such as climate, topography, and geology. In particular, geology is not only important as a source of raw material for stone tools and residence construction material, but also as a provider of groundwater and mineral resources. Furthermore, soil is generated from weathered bedrocks, and soil is a key influence on vegetation. Thus, when ancient people considered the natural conditions for first settlement locations, geology would have been a crucial factor in these conditions. This paper offers a preliminary examination of the geology around Tappeh Sang-e Chakhmaq.

Tappeh Sang-e Chakhmaq is situated close to the southern edge of the “Bastam basin”. This basin is surrounded by higher mountains to the north and west (Fig. 2), whereas there are no conspicuous ridges on its eastern and southern sides. The low relief continues to the Great Kavir Basin in the Central Iran zone, making a topographic division of Iran. All the rivers in the

Fig.1. Tappeh Sang-e Chakhmaq and the Alborz Mountains.

"Bastam basin" join into two rivers near Bastam town and flow southward. The topography just south of Bastam town is hilly, but the rivers detour this hilly topography and continues to flow southward. The "Bastam basin" is built on folded strata and is filled with recent terrace deposits of gravel, sand, and mud. Thus, places near the southern edge of the "Bastam basin" may be expected to bear springs.

The geology around Tappeh Sang-e Chakhmaq is different to the northwest, the southwest, and the south: Areas A, B, and C, respectively (Fig.2). According to the quadrangle geologic map series published by the Geological Survey of Iran, the stratigraphy of these areas is as follows. The stratigraphy of Area A ranges from Ordovician to Triassic, with the main rock types being carbonate rocks except for some Silurian and Devonian effusive rocks, whereas Area B is composed mainly of Jurassic Cretaceous and Paleogene carbonate deposits in association with Lower Eocene quartzmicrodiorite Meanwhile, Jurassic carbonate rocks and Miocene and Pliocene terrigenous rocks occur in Area C.

It is already known that the Alborz Mountains is generally rich in metal mineral resources such as iron, manganese, copper, and lead-zinc in the current era, as shown in Metallogenic Map of the Middle East published by GSI in 2011. These are mainly hydrothermal in origin. However, there may be less metal production around "Bastam basin" than other parts of the Alborz Mountains, except for zinc deposits. This is also suggested by the rare exposure of acidic plutons as above-mentioned.It is inferred that ancient people who lived in Tappeh Sang-e Chakhmaq could get water easily from nearby rivers and/or springs. However, it seems that metal raw materials were only obtained through long transportation. The siliceous nodule, which is a good raw material for stone tools, usually occurs as a limestone-inclusion. Thus, siliceous nodules might be found as river pebbles shed from the mountainous area to the

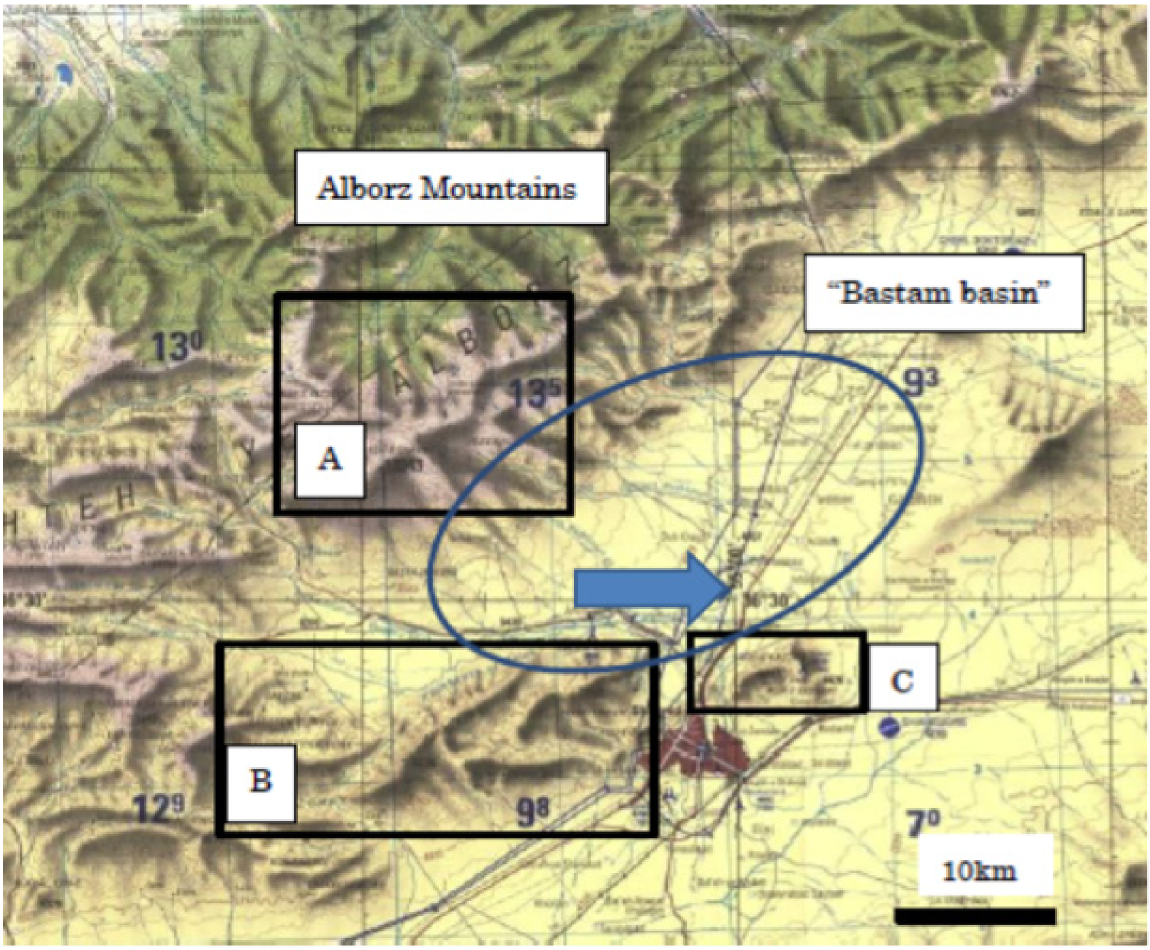

Fig. 2. "Bastam basin" in the Iran NJ40-13 map (1/250,000). Arrow indicates Tappeh Sang-e Chakhmaq.

north, west, and south of Bastam.

Appendix Stratigraphy of Areas A,B and C

1. Area A (from Aliabad (1/100,000))

Quaternary(Qt2) young alluvial terraces
Quaternary(Qtl); old alluvial terraces
Quaternary(Qplc); gray unconsolidated congloerate
Eocence(Ek); Karaj formation in general

Triassic(TRe2); yellow to pale red thick bedded dolomite to dolomitic limestone
Triassic(TRe1); thin-bedded vermiculate limestone, sandstone and sandy marl
Permian(Pd1); thick-bedded to massive oncolitic limestone and sandy limestone
Permian(Pd); white to gray quartzitic sandstone, red sandstone and silty shale
Carboniferous(Cmsh,1); black shale and yellow limestone
Devonian(Dkh4)); association of limestone, dolomitic limestone, marl, dolomite and tuff
Devonian(Dkh3); red sandstone, calcareous sandstone and limestone
Devonian(Dkh2); marly limestone, dolomitic limestone, marl, dolomite and gypsum
Devonian(Dkh1); red to brown sandstone, conglomerate, sandy limestone and volcanic rocks(basalt to andesite)
Devonian(Ds); white, red to brown sandstone shale, calcareous sandstone and cherty dolomite
Silurian(Sv); spillite, basalt, andesite and tuff
Ordovician(Osh,s); alternation of olive green and gray shale and sandstone

2. Area B (from Shahrud 1/100,000)

Quaternary(Qt2); young terraces and alluvial deposits
Quaternary(Qt1); old terraces and gravel marl
Middle Eocene(Ek); alternations of light green tuff, tuffaceous sandstone, limestone and tuffaceous shale
Lower Eocene(Ev); quartzmicrodiorite
Lower Eocene(Ez); alternations of buff to gray, medium bedded Nummulitic limestone and Nummulitic sandy limestone

Upper Cretaceous(Ku1); alternation of light gray limestone and green marl at the base and gray thick bedded to massive cliff forming limestone
Upper Cretaceous (Kum); light green marl
Upper Jurassic(Jl); light gray, thick bedded to massive limestone and cherty limestone, ammonite bearing
Middle Jurassic(Jd); middle Jurassic gray, massive dolomite
Lower Jurassic(Js3); alternation of purple, thin to thick bedded sandstone and coaly shale

3. Area C (from Bastam, 1/100,000)

Quaternary(Q2); young terraces
Quaternary(Qtl); old terraces
Pliocene(PlOc); light brown to gray polygenetic, conglomerate, coarse grain sandsone,
Pliocene(Ngm,s); light greenish yellow gypsiferous marl and fine grain sandstone

Miocene(Mgm); red to light brown, rarely light greenish yellow gypsiferous marl with intercalation of fine grain sandstone

Jurassic(J1); light gray, thick bedded to massive limestone, dolomitic limestone, with nodulesof chert
Jurassic(Jd); light greenish gray, well bedded, marly limestone, with intercalation of marly shale, ammonite bearing

The Site of Tappeh Sang-e Chakhmaq

Akira Tsuneki (University of Tsukuba)

Location

When the late Professor Sei-ichi Masuda surveyed northeastern Iran in 1969, he discovered several ancient mounds on the northern edge of the village of Bastam, which is located between Shahrud and Gurgan, beyond the Alborz Mountain range (Fig. 1). The site is found 1 km north of the village, and it consists of several mounds on both sides of small dry streams. The local people call the site Tappeh Sang-e Chakhmaq (Mound of Flintstone in Persian), since many silicious nodule fragments were scattered on the mound surfaces. Painted pottery sherds were also collected from the surface, and Professor Masuda understood that the site might involve early Neolithic cultural layers.

The site's location was also fascinating. It is situated near the edge of an alluvial fan at the southeastern foot of the Alborz Mountain range, approximately 1400m above sea level. This location is ideal because of the presence of numerous water springs that emerge from the edge of the alluvial fan. These springs must have been a valuable resource for early farmers. On a broader scale, the site is located at an important traffic position: Bastam village is situated 8 km north of Shahrud, which sits on the important main highway that runs between Tehran and Mashed along the southern foot of the Alborz Mountain range. Bastam is also positioned on the main highway that goes to the Caspian Sea lowlands, through the Alborz Mountain range.

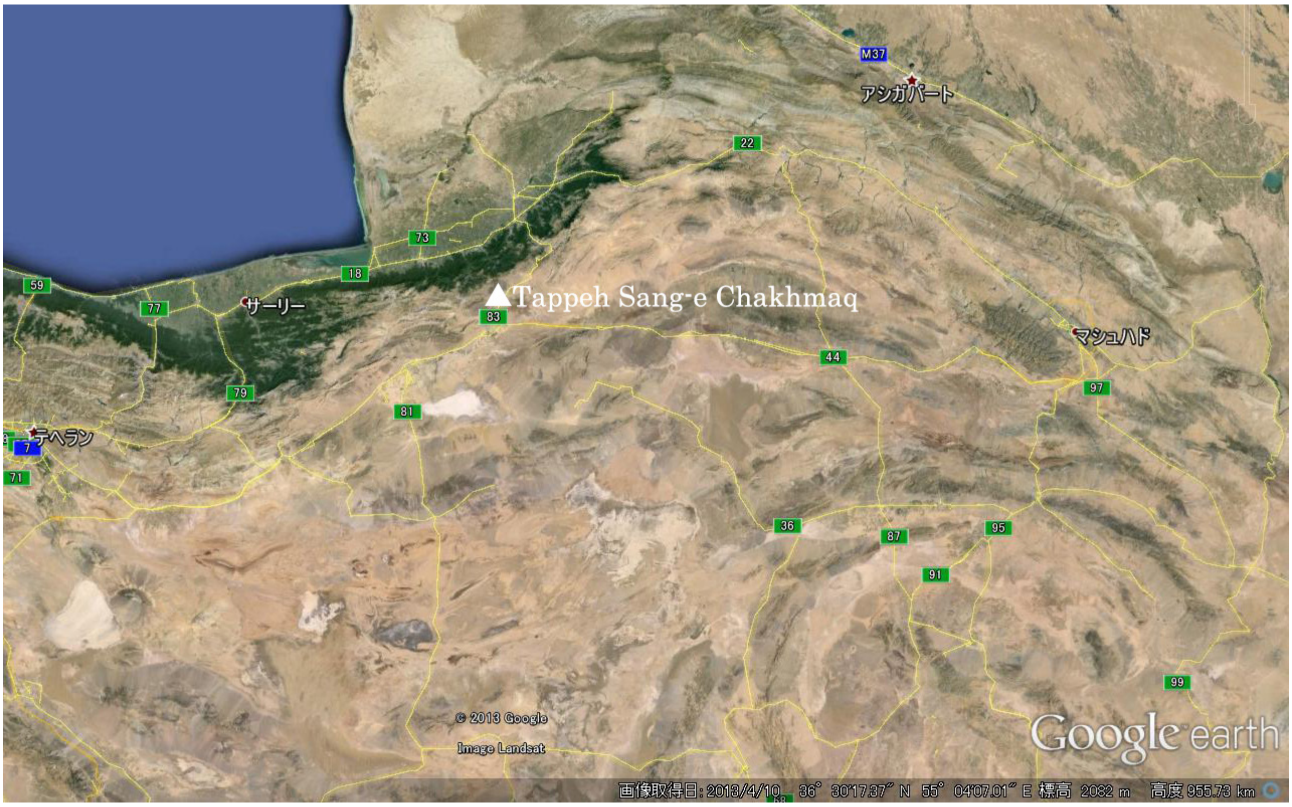

Fig. 1. Location of Tappeh Sang-e Chakhmaq in the northeastern Iran.

Fig. 2. Chakhmaq East and West Tappehs.

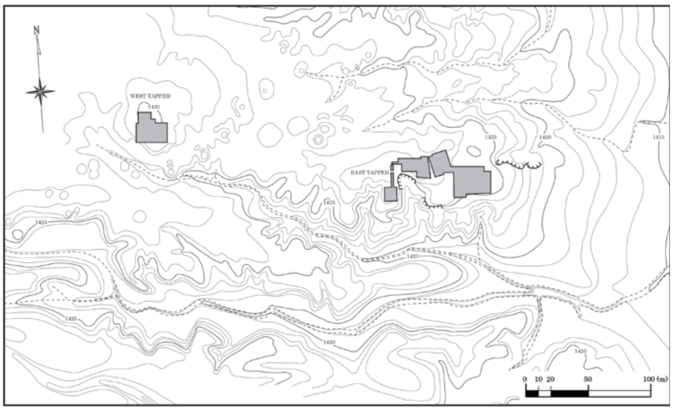

Fig. 3. Sang-e Chakhmaq and the location of trenches.


Fig. 4. Building structures, West Tappeh.


Fig. 5. Building structures, West Tappeh.

Site and excavations

The site consists of several mounds along small dry streams 1 km north of Bastam village. However, the two main prehistoric mounds are located in the middle of this cluster of mounds, situated several tens meters from one another (Figs. 2, 3). The West Tappeh is c. 80 m in diameter and rises c. 3 m above the surrounding plain. The much larger East Tappeh has an irregular plan; it measures c. 150 m east and west and c. 100 m north and south and has a height of c. 6 m.

Both East and West Tappehs were excavated in 1971, 1973, 1975, and 1977 by a team from the Tokyo University of Education (predecessor to the present University of Tsukuba), under the direction of the late Prof. Sei-ichi Masuda. Five construction layers in the West Tappeh and six in the East Tappeh were exposed, all of which belong to the Neolithic period. Based on our finds, it is quite certain that the uppermost layer I of the West Tappeh is older than the lowest layer VI of the East Tappeh. According to the results of ^{14}C dating (Nakamura's paper, this volume), the West Tappeh began at the end of 8th millennium BC, and the occupation continued into the early 7th millennium BC. The East Tappeh began in the late 7th millennium and ended in the late 6th millennium BC. Therefore, there was a hiatus, at least 300 years long, between the two tappehs.

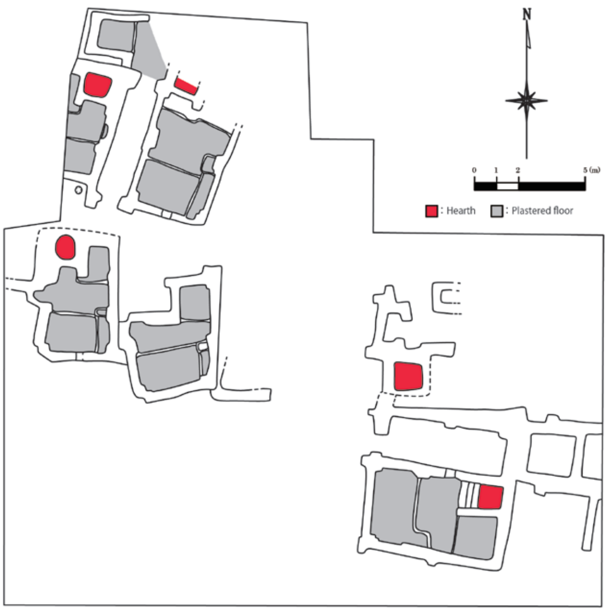

Fig. 6. Building structures in Layer III lower, West Tappeh.

Fig. 7. Building structures of Layer V, East Tappeh.

Fig. 8. Building structures of Layer IV, East Tappeh.

Structures

The building structures discovered from the West Tappeh have clearly defined forms. These consist of one-room, rectangular houses, measuring 6 x 3-4 m. The interiors of each building, especially the floors, were carefully treated with gypsum plaster. In addition, each building was divided into several different leveled parts, including a square-shaped hearth on the northern side (Figs. 4-6). A small square area with a hearth and a southern rectangular part appear to have had floors one step higher in elevation. These one-roomed houses usually stood alone; however, in some cases they were joined with another one-room house or a courtyard.

Fig. 9 Structures of layer IV, East Tappeh.

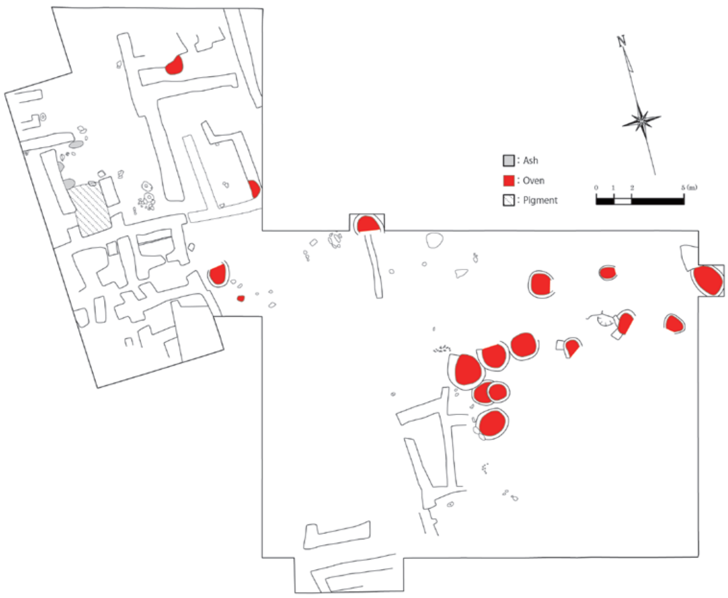

Fig. 10. Structures of Layer III, East Tappeh.

The building structures from the East Tappeh have various forms. In Layers V to III, we found multiple-roomed rectangular houses with a range of sizes. The most basic house was rectangular and had multiple rooms, which measure c. 5 x 8 m, with an annex room or a courtyard equipped with kilns (Figs. 7-10). Unlike the West Tappeh, meticulous gypsum plastering was not observed on the walls and floors of these houses. Distinctive cigar-shaped mud bricks were used as building materials (Fig. 11). A large number of kilns were discovered in the open space of Layer III (Fig. 12). In the uppermost Layers II and I , different types of buildings were found, characterized by square-shaped rooms with hearths on their northern sides. Although

Fig. 11. Ciger-shaped bricks in lower layers, East Tappeh.

Fig. 12. Round kilns in Layer III of East Tappeh.

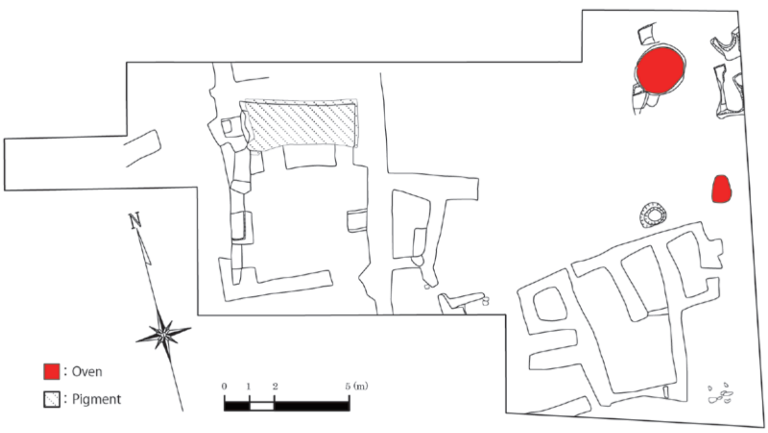

Fig. 13. Structures of Layer II, East Tappeh.

the primary rooms were not divided into minor rooms, small rectangular rooms were attached to them (Fig. 13).

Some remarks

In northeastern Iran, only a small number of Neolithic sites have been investigated thus far. For example, during excavations in the 1950s-1960s, Neolithic materials were excavated from the basal layers of tappeh sites in the Gorgan Plain (e.g., Yarim Tepe and Tureng Tepe) and from the uppermost layers of cave sites along the Caspian coast (e.g., Belt Cave). More recently, Iranian archaeologists have discovered Neolithic materials at the sites of Tugh Tepe in the Behshahr region, Aq Tappeh in the Gorgan Plain, and Armadlu Tepe in Golestan National Park. In the Shahrud region, new Neolithic sites were reported and exploratory excavations were carried out by Mr. Rezvani and Mr. Roustaei at Deh Keir Tepe, Kalate Khan, and Tape Sang-e Chakhmaq itself. In the Khorasan region to the east, Dr. Garazhian has investigated the Neolithic sites of Qaleh Khan and Borj Tepe. However, these Neolithic settlements have not been as comprehensively excavated as Tappeh Sang-e Chakhmaq was by Prof. Masuda. Therefore, the results of the 1970s excavations at Tappeh Sang-e Chakhmaq still represent the most comprehensive data for studying the process of Neolithisation in northeastern Iran.

Radiocarbon dating of charcoal remains excavated from Tappeh Sang-e Chakhmaq

Toshio Nakamura (Nagoya University)

Introduction

As absolute-age determination of the Tappeh Sang-e Chakhmaq, radiocarbon (^{14}C) dating was performed by a conventional beta-counting technique for only three samples in 1970s just after the excavation studies, and more systematic dating works have been required. Recently 40 sets of charcoal samples collected at the excavations in 1970s have been offered to the Center for Chronological Research, Nagoya University, for ^{14}C dating with accelerator mass spectrometry (AMS). The results of AMS ^{14}C dating on the samples excavated from the Tappeh Sang-e Chakhmaq archeological site in Iran are described here.

Sample description

Totally forty charcoal samples collected during the excavations in 1970s from East and West Tappehs were selected for ^{14}C analysis with AMS. Thirty-seven samples out of forty were grouped into 11 layers of East Tappeh I to West Tappeh V, from the uppermost to the lowermost layers, as listed in Table 1. Samples Nos. 23, 35 and 36 are not in Table 1, because these three samples showed quite old ^{14}C ages over the age limit measurable with our AMS machine, and were not able to be classified to the 11 layers above.

Experimental procedure

Removal of carbonaceous contaminants by acid-alkali-acid treatments and CO_2 extraction from charcoal remains, production of graphite from the CO_2 , and AMS ^{14}C

Table 1. Grouping into 11 horizons of charcoal samples, from uppermost down to lowermost layers.

East or West Tappeh	Horizon belongs	Samples belonging
East	I - layer	ET-21
East	II - layer	ET-24, ET-22, ET-25
East	III - layer	ET-31
East	IV - layer	ET-37, ET-32, ET-34, ET-33
East	V - layer	ET-38, ET-40, WT-2, ET-39, WT-1
East	VI - layer	none
West	I - layer	none
West	II - layer	WT-17, WT-18, ET-28, ET-26, WT-19, ET-30, ET-29
West	III - layer	WT-10, WT-12, ET-27, WT-15, WT-11, WT-14, WT WT-8, WT-13, WT-16
West	IV - layer	WT-7, WT-20, WT-6, WT-5
West	V - layer	WT-3, WT-4

measurements, were performed at the Center for Chronological Research, Nagoya University (Nakamura et al. 2000; 2004). In brief, the charcoal remains were treated twice with 1.2 M HCl for 2 hrs at 90°C, to remove any possible contaminants like carbonate. Next, the samples were treated with 1.2 M NaOH solution for 2 hrs at 80°C, 3 to 5 times depending on the condition of the samples, to eliminate organic substances adsorbed while the charcoal samples were buried at the archeological sites. The samples were treated again to get rid of NaOH fractions with 1.2 M HCl for 2 hrs at 90°C, and rinsed with distilled water to remove completely any residual HCl.

The charcoal remains were dried in an electric oven at 90°C. About 6 mg of the samples were placed in Quarz tubes of 9-mm outside diameter, with ca. 500 mg of granular CuO, and then the tubes were connected to a vacuum line, evacuated completely and sealed to a tube length of ca. 300 mm. The Quarz tubes were heated to 900°C for 3 hrs to convert the sample to CO_2 completely. The CO_2 produced of ca. 3-4 mg in carbon was purified cryogenically in a vacuum line, and an aliquot of the CO_2, ca. 1.5mg in carbon, was reduced to graphite on ca. 3mg of Fe powder by hydrogen at 620°C for 6 hrs (Kitagawa et al. 1993). The graphite materials thus produced were pressed into aluminum target holders for AMS ^{14}C measurements. We used the HOx-II standard (NIST oxalic acid, SRM-4990C) as a reference for carbon isotope ratios and commercial oxalic acid containing no ^{14}C (oxalic acid dihydrates produced from Wako Pure Chemical Industries Ltd, Japan; Product No. 57952) for ^{14}C blank subtraction. The sample $\delta^{13}C$ values were measured by the AMS system with errors less than ±1‰, including the effects from both machine instability and graphite production (Nakamura et al. 2004), and were used for a mass-fractionation correction in calculating sample ^{14}C concentrations (Mook and van der Plicht 1999). Finally, the conventional ^{14}C ages were calculated using the half-life of 5568 yrs, as summarized on the left side of Figure 1. The errors of ^{14}C age cited here include statistical uncertainties based on ^{14}C counting of sample, standard and ^{14}C-background targets, machine errors evaluated by the ^{14}C reproducibility of repeated measurements on standard targets, and errors in ^{14}C background removal calculations. The obtained ^{14}C age was calibrated to calendar age by using a calibration program OxCal v.4.1.7 (Bronk Ramsey 2009) and IntCal09 calibration data set (Reimer et al. 2009), as given in Figure 1.

Results and discussion

As shown in Figure 1, ^{14}C ages were consistent with the classification of layer levels for West and East Tappehs. Calibrated ages for West Tappeh samples ranged from ca. 7200 cal BC to 6600 cal BC. Several hundred years after the termination of residence at West Tappeh, activities at East Tappeh that is located just east of West Tappeh started at around 6300 cal BC. Residence at East Tappeh was stable from 6200 to 5700 cal BC, but it may have continued until around 5200 cal BC, though the estimation is based on ^{14}C age resulting from only one sample and it is requested to analyze more samples belonging to the level of East Tappeh Layer I to be confirmed.

Three samples, ET-23, ET-35 and ET-36, among forty submitted for ^{14}C analysis, were dated to be very old, showing ^{14}C ages of >48,980 BP, >55,470 BP, >54,940 BP, respectively. At the moment, we consider that these charcoal samples should have contaminated from lower and older horizons. A careful investigation on the origin of these charcoal samples is required.

Table 2 Chronology of the Tappeh Sang-e Chakhmaq site based on ^{14}C dating on charcoal samples.

Locality	^{14}C age chronology	Remarks
West Tappeh	7200 cal BC – 6600 cal BC	
East Tappeh	6300 cal BC – 5200 cal BC	Main age range: 6200 – 5700 cal BC

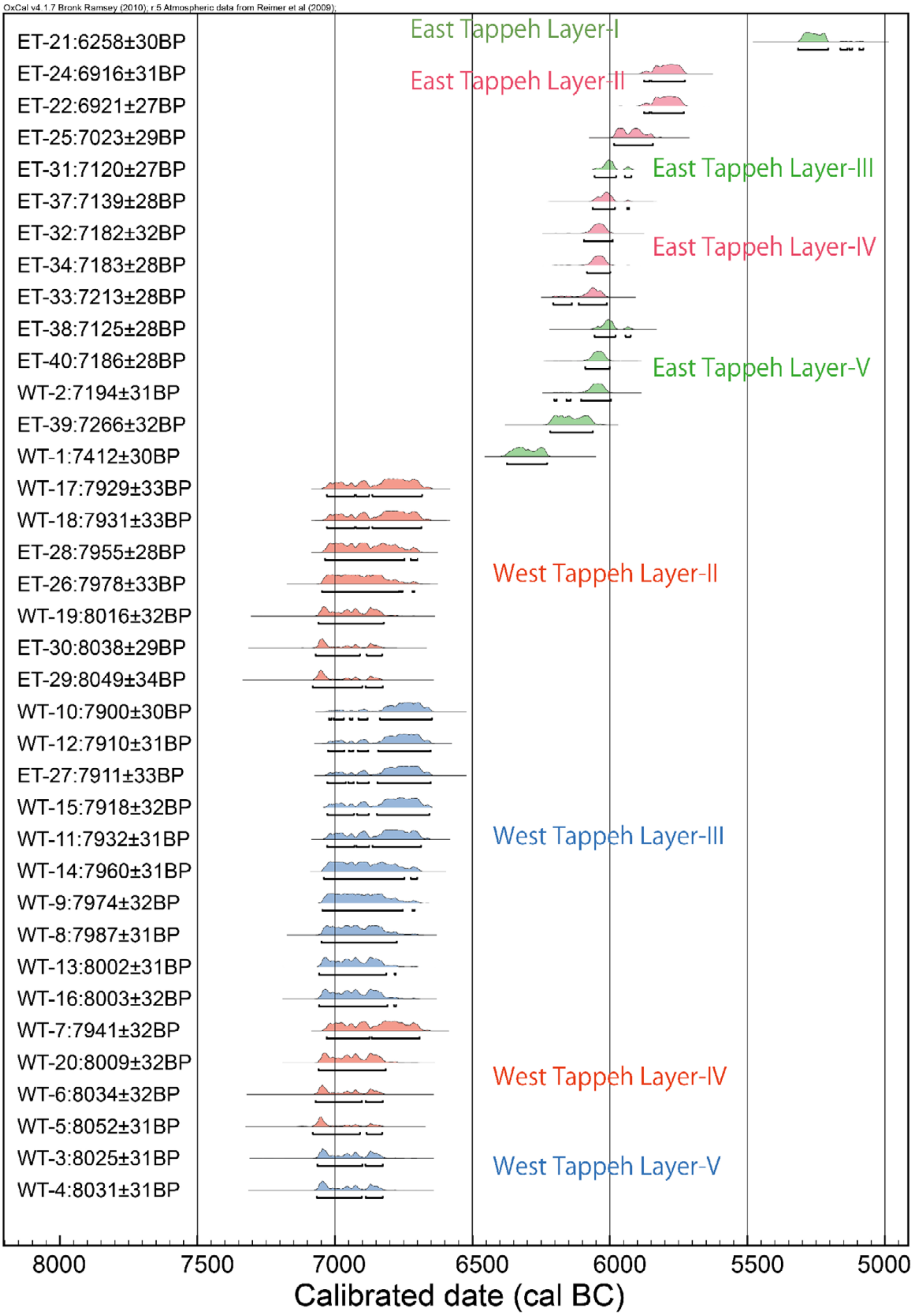

Fig. 1. Calibrated ages for charcoal samples from West and East Tappehs at Tappeh Sang-e Chakhmaq site. Probability density against calendar year is illustrated for each sample, from the down to the top classified based on excavation layers from the deepest to the uppermost.

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Pottery and Other Objects from Tappeh Sang-e Chakhmaq

Akira Tsuneki (University of Tsukuba)

Pottery

A few small potsherds were discovered in Layer III of West Tappeh, all of which share common characteristics (Fig. 1). These include a reddish-brown colored chaff-tempered paste, with highly burnished and red-washed surfaces. It is debatable whether the West Tappeh pottery represents settlements dating to the Pre-Pottery Neolithic, or the Pottery Neolithic. I would argue that the pottery was not used for practical purposes in the Neolithic settlement of West Tappeh.

Group 1 consists of the red-on-buff painted pottery found in all layers of East Tappeh (Fig. 2). It is characterized by its heavy chaff-tempered paste and reddish-brown color. Dark

Fig. 1 Potsherds from West Tappeh.

Fig. 2. Group 1 Painted Pottery.

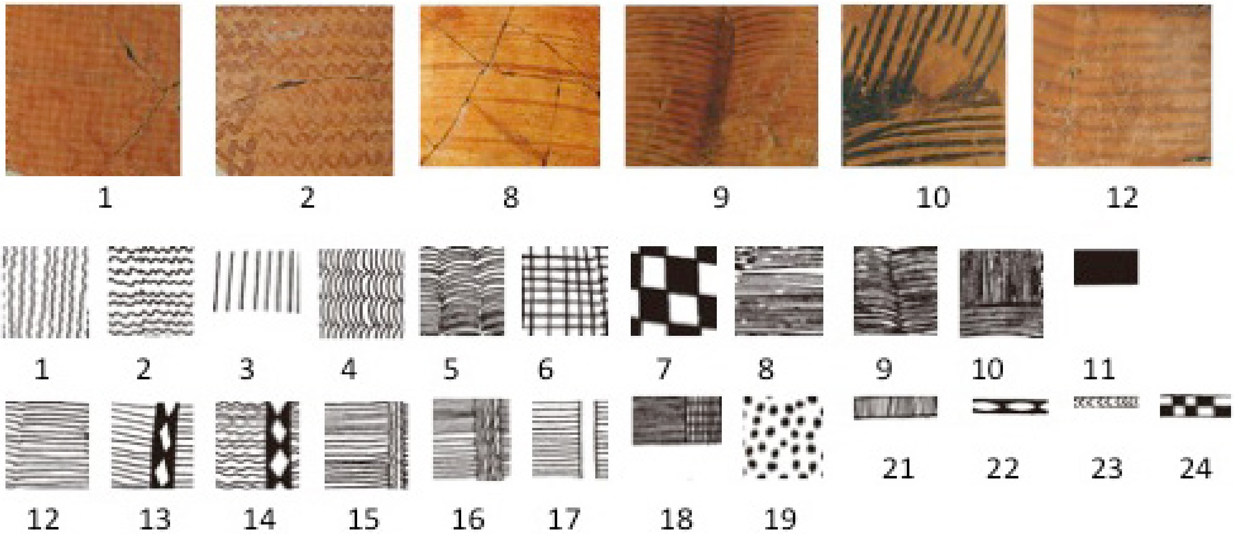


Fig. 3. Main painted patterns of Group 1 Painted Pottery.

cores are often visible in the thin section. The surface of the pottery was often decorated with a buff-colored slip, and geometric patterns were often painted in a reddish color. The exterior surfaces were normally well-burnished. The main forms are Type A bowls, Type B carinated bowls, Type D hole-mouthed jars, Type G cups, and Type H stands (Fig. 6). The designs most frequently painted on the exterior of the pot can be seen in nos. 1-19 in Fig. 3, whilst the designs most frequently seen on the interior rims can be seen in nos. 21-24 in Fig. 3.

Fig. 4. Group 2 Painted Pottery.

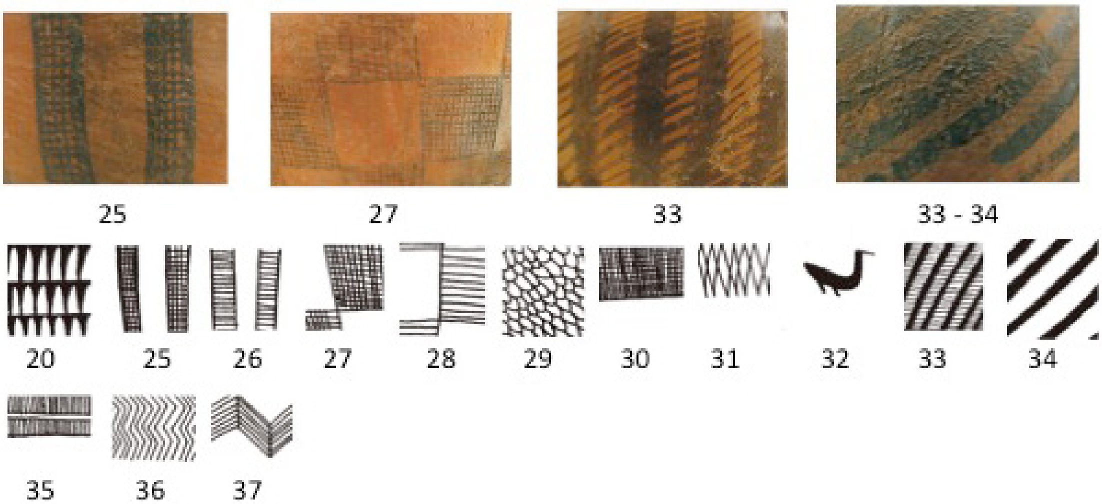


Fig. 5. Main painted patterns of Group 2 Painted Pottery.

Group 2 pottery appeared in Layer III of East Tappeh (Fig. 4), and became dominant in Layers II and I, replacing Group 1 painted pottery. Both the surface and paste of Group 2 pottery are reddish brown in color. The paste contains less chaff, and in some cases is well levigated without any chaff tempering. Dark cores were less, or not observable in the thin section. The reddish-brown exterior surface was decorated with black painted patterns on a red-slipped surface. These designs include both geometric and naturalistic patterns. The main pottery forms include Type A bowls, and Type C shallow bowls (Fig. 6), whilst the most

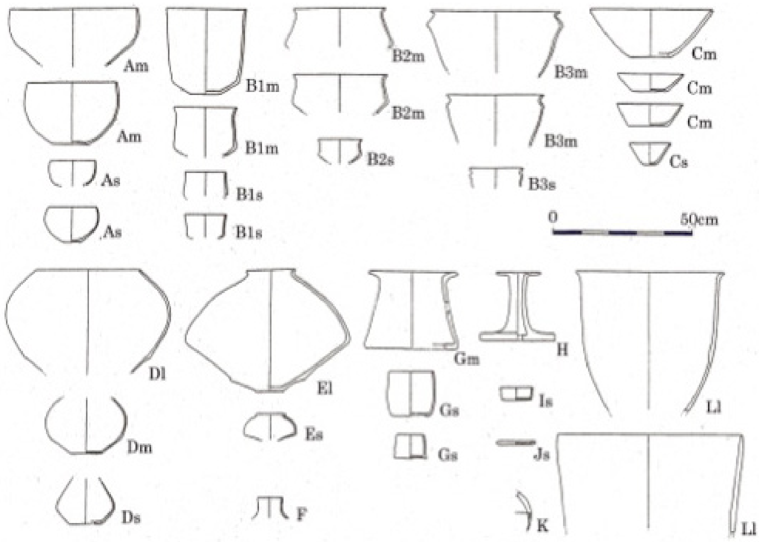


Fig. 6. Main pettery forms at Tappeh Sang-e Chakhmaq East Tappeh.

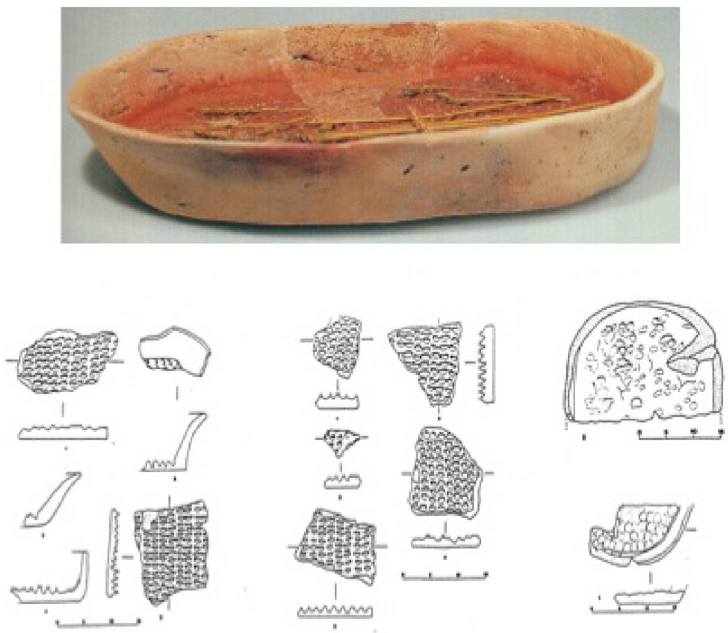


Fig. 7. Husking trays from Layers I-III of East Tappeh.

commonly painted designs are the pattern nos. 20 and 25-37 seen in Fig. 5.

The plain pottery type consists of large jars and other characteristic forms, such as husking trays and small, shallow cups. Husking trays were only discovered in Layers III-I of East Tappeh (Fig. 7). The number of thin black burnished pottery specimens was limited to five pieces, recovered in various layers of East Tappeh.

Lithics

The materials used for making chipped stone tools consist mainly of siliceous nodule varieties, though a small number of obsidian tools were represented in the lithic assemblages (6-7% in West Tappeh and c. 1% in East Tappeh). Most of the tools were made on blades, which were detached from single-platform cores. The stone tools in both East and West Tappeh were classified into four main types: sickle elements, trapezes, drills, and scrapers (Fig. 8). Drills became more numerous and stylized in East Tappeh, and the scrapers made on flakes were more common in East Tappeh, too.

Bone tools

A large number of bone and antler tools were discovered in both East and West Tappeh. Awls and spatulas make up approximately 70% of the bone tool assemblage. The typological details of these bone tools differ slightly between East and West Tappeh; for example, pins and sickle hafts were common in East Tappeh, with some sickle hafts beautifully decorated with carvings of animals (Fig. 9).

Other objects

In addition to ceramic, lithic, and bone artifacts, the excavations yielded other classes of cultural objects, including: ground stone artifacts, such as stone axes or mortars and pestles; stone vessels; figurines; and assorted ornaments.

Discussion

It is clear that there were strong similarities in the painted pottery between East

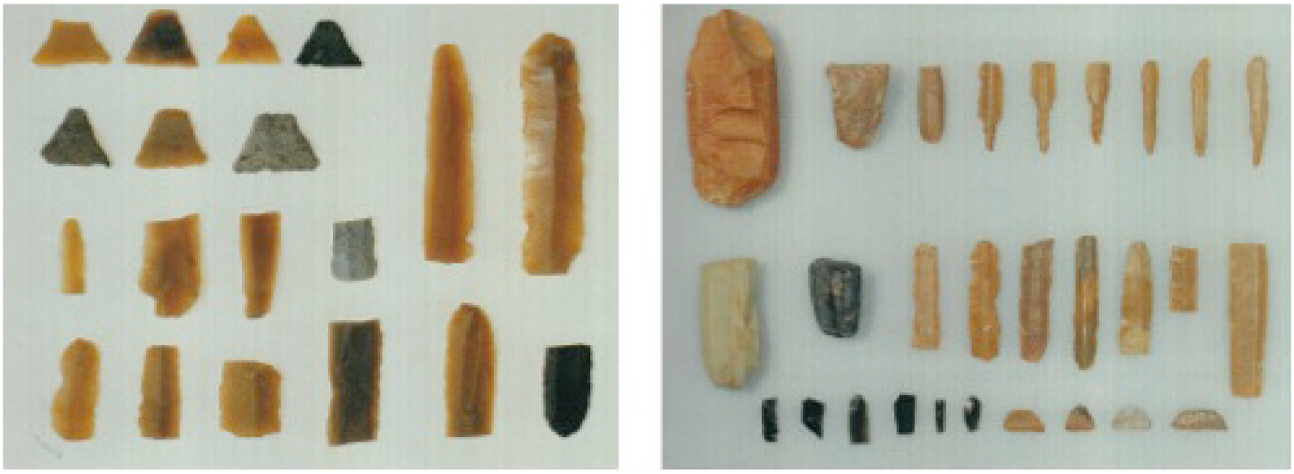


Fig. 8. Lithics from Tappeh Sang-e Chakhmaq.

Fig. 9. Bone tools from Tappeh Sang-e Chakhmaq.

Tappeh of Sang-e Chakhmaq and Jeitun cultural sites in southern Turkmenistan. Berdiev divides the Jeitun culture into the Early, Middle, and Late Jeitun periods. Overall, the attributes of Jeitun culture are represented at Tappeh Sang-e Chakhmaq by the building materials, such as cigar-type mud bricks of East Tappeh; and other artifacts, such as the lithics, bone tools, figurines, and spindle whorls.

The clearest similarity, however, is between the Group 1 painted pottery of Layers VI and V of East Tappeh Sang-e Chakhmaq, and the Early Jeitun painted pottery. Attributes such as paste, surface treatment, painted designs, and form varieties are remarkably similar. Although each painted design evolved concurrently in both regions (Fig. 10), the prototype pattern for all painted designs (no. 8 in Fig. 10) was observed only at Tappeh Sang-e Chakhmaq (especially from Layer VI of East Tappeh). This motif probably developed into various painted designs. Therefore, we suggest that Tappeh Sang-e Chakhmaq represents the progenitor of the Jeitun culture.

In regard to pottery from the Middle Jeitun, we observed some similarities from this

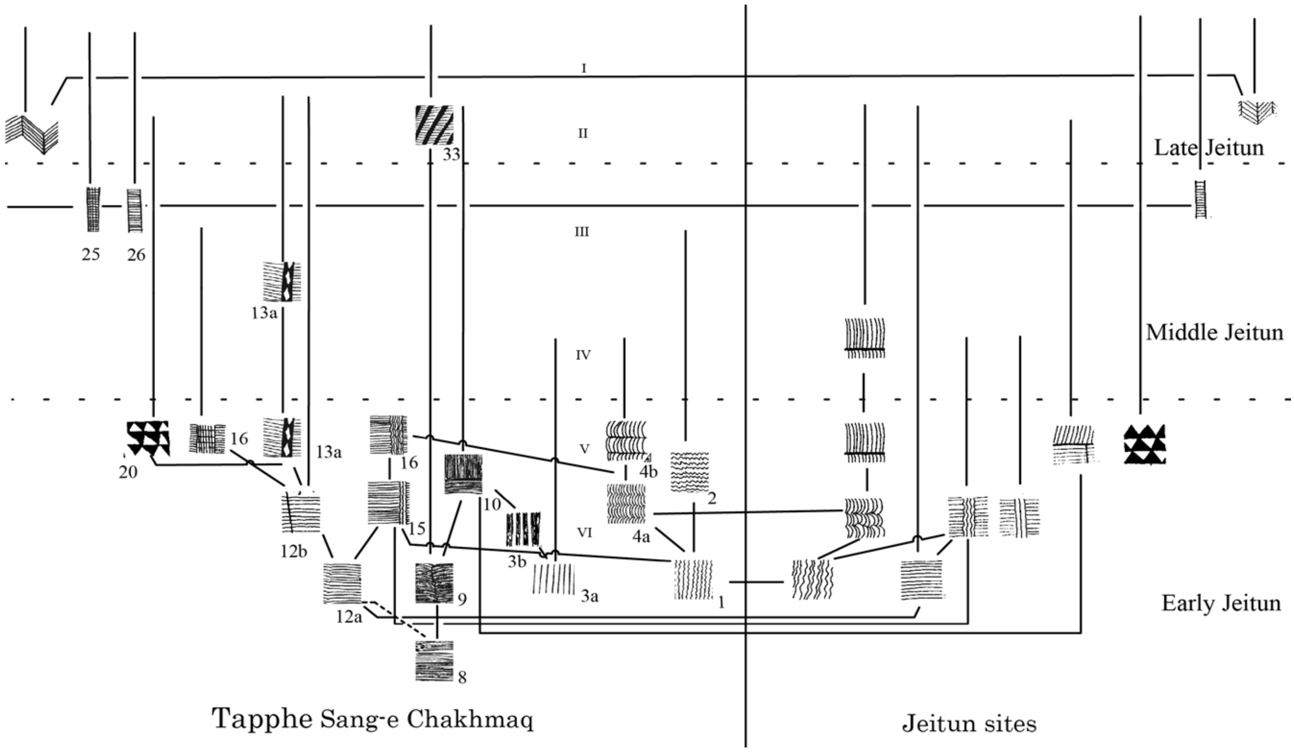


Fig. 10. Painted pottery design comparison between Tappeh Sang-e Chakhmaq and Jeitun sites

period to the Group 1 painted pottery from Layers IV and III of East Tappeh Sang-e Chakhmaq. However, unlike the Early Jeitun, not all attributes of the Middle Jeitun pottery were the same; e.g., it appears that the painted designs developed independently in each region (Fig. 10). From this evidence, we conclude that Neolithic settlements in each region might have developed independently in the Middle Jeitun era.

In Layers II and I of East Tappeh Sang-e Chakhmaq, we observed few similarities between Group 1 painted pottery and Late Jeitun pottery. Instead, Group 2 painted pottery appeared in Layer III and then became the primary pottery type in Layers II and I. The attributes of Group 2 painted pottery – such as paste, color, firing technique, and certain painted designs and vessel forms – have some similarities with those of 6th millennium painted pottery, especially Sialk II/Cheshmeh Ali type pottery, in central Iran. Until now, it has been unclear whether this newly established Group 2 painted pottery developed independently from the local Group 1 painted pottery, or if it was the result of a fusion between local Group 1 painted pottery and pottery of an external origin. The Sialk II period in central Iran started c. 5200 BC (Fazeli et al. 2009), but our Group 2 painted pottery appeared much earlier, in the early 6th millennium BC. Therefore, it is difficult for us to say that the attributes of Sialk II/Cheshmeh Ali pottery were fused into the old Group 1 pottery tradition to establish the new Group 2 painted pottery type at Tappeh Sang-e Chakhmaq. Nonetheless, the people of Tappeh Sang-e Chakhmaq probably had a more intensive relationship with central Iran than with southern Turkmenistan in the last stage of their occupation.

In summary, the dynamics we have observed among the pottery industries at Tappeh Sang-e Chakhmaq shed light on the movements of people throughout this region, and the broader issue of Neolithisation in northeastern Iran and southern Turkmenistan.

Mineralogical study of pottery from Tappeh Sang-e Chakhmaq

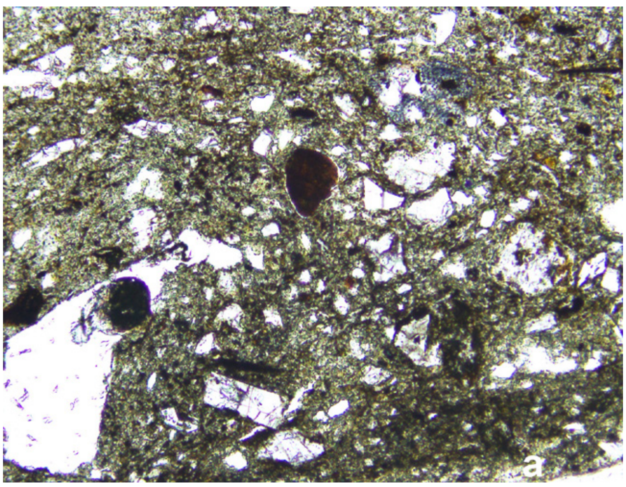
Masanori Kurosawa (University of Tsukuba)

Introduction

A series of prehistoric pottery samples from Tappeh Sang-e Chakhmaq were investigated using a polarized microscope and a scanning electron microscope equipped with an energy-dispersive X-ray spectrometer (SEM–EDS) to characterize their mineralogical compositions, micro-textures, and firing temperature. Microscopic observation and SEM–EDS analysis can be used to identify mineral species, matrix textures, and distinct additive and firing minerals in potteries. These features are important to estimate firing temperatures but are difficult to observe through more traditional bulk analysis techniques such as X-ray powder diffraction and X-ray fluorescence.

Sample and method

The pottery samples were selected from five occupation layers (Layers I, II, III, IV and VI) at the East Tappeh of Sang-e Chakhmaq, and were collected by Prof. Masuda in the 1970s. Layers I and VI are the uppermost and lowermost layers, respectively. Potteries from the East Tappeh were decorated by a yellow to reddish-colored slip and paintings and have been classified into two main groups based on differences in their features and decoration: Group 1 and Group 2. The Group 1 potteries, obtained from Layer VI up to Layer III, were thickly make and included relatively large amounts of chaff (straw) as an additive material. The style of the paintings on these examples was thought to be similar to ceramics from the Jeitun culture (Kamuro, 1977). The Group 2 potteries, obtained mainly from Layer II up to Layer I, were thinly made with relatively small amounts of chaff and paintings related to ceramics from Late Neolithic layers at Tepe Sialk (Period I) (Kamuro, 1977). The sherd bodies were



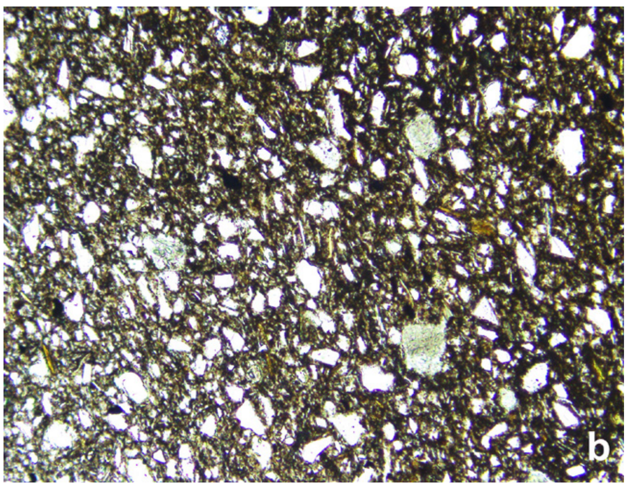


Fig. 1. Photomicrographs of mineral textures in sherd from Layer VI (a) and Layer I(b) (plane polarized). The horizontal length is 0.7 mm. (a) Large fragments are large quartz alkali and rectangular feldspar (lower left). Irregular forms with small pores are alkali feldspar melted. White platy or prismatic crystals are mainly muscovite. (b) Pale-green grains with small pores are alkali feldspar melted. Greenish brown elongated crystals are chloritized biotite, and transparent prismatic crystals are muscovite and alkali feldspar of firing mineral. Prismatic minerals arrange parallel to the sherd wall (vertical direction).

typically reddish brown in color with black in the central parts of the bodies, although several Group 2 samples lacked the black cores. Doubly polished thin sections of fifteen sherds were prepared: three samples from Layer I, two samples from Layer II, two samples from Layer III–IV, three samples from Layer IV, and five samples from Layer VI. To ensure clear microscopic observations, the thickness of the thin sections was set to 10–20 μm. Then, micro-textures and major chemical compositions of minerals in the sherds were analyzed using the SEM–EDS. Analytical conditions were as follows: acceleration voltage of 20 kV, beam current of several nA, and beam diameter of ~1 μm. Analytical data were corrected according to the ZAF method.

Results

All of the sherds included large amounts of quartz, alkali feldspar, muscovite, and chloritized biotite, with subordinate potassium feldspar, albite, twinned plagioclase, augite; trace amounts of heavy minerals, enstatite, diopside, rutile, ilmenite, titanite, apatite, and zircon were also found. Alkali feldspar had exsolved into albite and potassium feldspar, and polycrystalline quartz with wavy extinction was also included as rock fragments. Rarely, calcite and chromian spinel were also observed. These minerals were fractured and exhibited cleavage or subrounded shapes, suggesting that they were probably natural inclusions deposited in the clay as raw materials or were man-made additives introduced into the ceramic bodies during production. The mineral species present, approximate volume ratios of heavy minerals, and chemical compositions of each mineral were very similar for all sherds. This indicates that the potteries from the five occupation layers were made from the same source materials. In the specimens from Layer VI, the grain sizes of quartz and alkali feldspar were relatively variable and larger grains were observed often (Fig. 1a). Conversely, the grain sizes of these minerals in the Group 2 samples were relatively fine and nearly constant and the volume fraction of quartz was larger in the Group 2 specimens relative to the Group 1 sherds (Fig. 1b). The slip and body mineral tempers were almost identical for all sections. This similarity indicates the close association of the source materials used for the sherd body and the slip.

In addition to the mineral tempers, the firing minerals and decomposition or melting textures of mineral tempers were also observed. The most abundant burning mineral was a transparent prismatic crystal, several to tens of micrometers in length (Fig. 2a). This crystal was estimated to be alkali feldspar based on consideration of its chemical compositions and

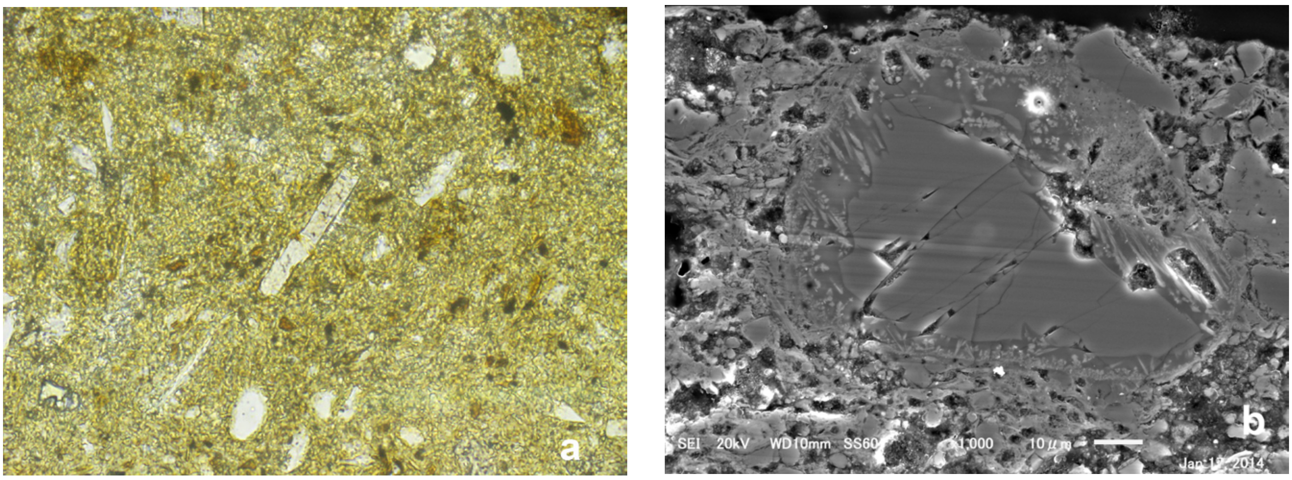


Fig. 2. (a) Photomicrograph of alkali feldspar (white prismatic) as a firing mineral in a sherd from Layer VI (plane polarized). The horizontal length is a 100 micrometer. (b) SEM image of melting texture of plagioclase in a sherd from Layer III–IV. A relict plagioclase (center grey part) is surrounded by melt (relatively dark grey) and minute prismatic precipitates of plagioclase (light grey). Scale bar is 10 micrometer.

optical properties. The alkali feldspar was distributed widely throughout the sherd body and slip of all samples and tended to be elongated parallel to the sherd wall. This tendency was particularly intense in the Group 2 samples (Fig. 1b). The length and thickness of alkali feldspar crystals were also greater in the Group 2 samples relative to the Group 1 samples, implying differences in the degree of firing. Moreover, the chemical composition of these crystals was relatively constant between samples, although minor substitution of K, Na, and Ca and Si and Al were observed. Mullite, spinel, gehlenite, diopside, and wollastonite (all of which are considered firing minerals) were not discovered during SEM–EDS observations in the present study. The absence of visible mullite and spinel can be attributed to their very small grain sizes (<1 μm). Conversely, the lack of gehlenite, diopside, and wollastonite is thought to have arisen from the low CaO contents of the raw material (illite-Group clay) of the sherds.

Decomposition or melting textures in the original mineral temper were also observed for some alkali feldspar, plagioclase, calcite, and augite. The melting of alkali feldspar was observed frequently in all samples: the melted alkali feldspar exhibited a relatively rounded shape, appearing as polycrystalline assemblages under the polarizing microscope, and included tiny pores (Fig. 1b). The majority of the fused alkali feldspar consisted of a melt or a relict of the alkali feldspar. The melt had a composition similar to that of alkali feldspar or silica and was often accompanied by prismatic precipitates of a silica mineral and alkali feldspar. Based on the crystal shape and the abundances of Al and Na impurities, the silica mineral was likely a tridymite. Within each section, the melted alkali feldspar crystals were typically less abundant than unmelted crystals. However, the number of melted feldspar crystals present tended to be greater in the Group 2 sherds than in the Group 1 samples. Melted plagioclase was also sometimes observed (Fig. 2b), and the resulting melt typically included prismatic precipitates of plagioclase. Decomposition of calcite was observed in the samples form Layer VI up to Layer II, where the decomposed calcite exhibited an ellipsoidal shape and polycrystalline assemblages, in contrast to thermally unaltered grains of calcite, which typically exhibit a shape of the cleavaged fragments. The product of calcite decomposition was assumed to be a lime crystal (CaO) owing to its extremely high Ca content. Calcite in the sherds from Layer II was almost decomposed, although a small number of unaltered calcite crystals was also observed in sherds from Layer VI. In addition, decomposition of augite was observed in the samples collected form Layers VI, III–IV, and II, where the decomposed augite formed rounded polycrystalline assemblages and consisted of a melt with pyroxene composition and prismatic precipitates of pyroxene, alkali feldspar, and (rarely) rutile.

Discussion

The formation temperature of alkali feldspar as a firing mineral in an illite matrix has been estimated to be 900–1000°C (Bersani et al., 2010). The melting of alkali feldspar as a temper mineral may have been occurred by eutectic melting of alkali feldspar coexisting with quartz. In this case, the melting occurs at only crystals of alkali feldspar contact directory with quartz. The eutectic melting temperature of alkali feldspar coexisting with quartz has shown to be approximately 980°C at 1 atm and under dry conditions (Johannes and Holtz, 1996). Thus, the melted alkali feldspar crystals likely melted near 1000°C. Since illite decomposes at temperatures greater than 850°C to produce free SiO_2 (Rice, 1987), this free SiO_2 may also be important for the eutectic melting. Moreover, calcite decomposes at 850–900°C (Rice, 1987) and the melting temperature of augite is about 1050°C at 1 atm and under dry conditions (Deer et al, 1978). Although a few unaltered calcite crystals were observed in one sample from Layer VI, these may simply be relics due to a short firing time. Thus, it is estimated that almost all of the potteries from each layer were fired at about 900–1000°C. Such high-temperature firing suggests the use of a kiln for ceramic making. Thus, pyrotechnology may have been advanced in the Tappeh Sang-e Chakhmaq culture, even during the earliest stage of development at this site.

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Figurines of Tappeh Sang-e Chakhmaq

Setsuo Furusato (Matsudo City Board)

Tappeh Sang-e Chakhmaq has yielded many figurines that represent both animals and human beings. More than fifty figurines have been found in the West Tappeh, about half of which are human figurines. At the East Tappeh, over one hundred, mostly animal figurines have been uncovered.

I describe these figurines by comparing them to those of Jarmo, whose occupation was almost contemporary to that of Tappeh Sang-e Chakhmaq and which has yielded a great number of figurines that have been typologically well classified (Morales 1983).

Animal figurines

Most of animal figurines from Tappeh Sang-e Chakhmaq are made of clay and only a few of stone. One well-made marble figurine represents a sheep (Fig.1-1). At Jarmo, no stone figurines, either of animals or human beings, have yet been found; however, many decorative, non-utilitarian stone objects, such as beads, pendants, and even spoons, have been uncovered there. Discussing these finds, Vivian Morales writes, “If they had wished to make permanent figurines, it appears certain that they could have done so. That they did not, therefore, supports the idea that permanence was not necessary.” How about the people of Tappeh Sang-e Chakhmaq?

Most of the clay animal figurines of Tappeh Sang-e Chakhmaq are fragmentary. Thus, it is difficult to identify what animals they depict. The modeling is usually crude and lightly fired or baked. Backs are round and smooth, and no accentuated spines, of which Jarmo offers many examples, are portrayed. Their colors are grey or pinkish beige, except for one figurine that is painted red (Fig. 1-2). One specimen has a double-wing base, which is comparable with type N of Jarmo (Fig. 1-4).

Carved bone or horn sickle hafts are another interesting category of animal representation. These display very realistic figures, especially those of the lizard and fox (Figs 1-5, 6).

Human figurines

As mentioned above, there are not many human clay figurines from Tappeh Sang-e Chakhmaq. Those of the East Tappeh are realistic, and those of the West Tappeh are abstract. Their colors are grey or pinkish beige, and they are lightly fired or baked, just like the animal figurines.

Relying on style and shape, I divided these human figurines into three types. Those of type I have a realistic form, and all come from the East Tappeh (Figs. 2-1~3). Because only heads have been found, the sex of these figurines cannot be determined. Noses are pinched out, and eyes and mouths are punched into the clay with a straw or small stick.

Types II and III are abstract forms and found only at the West Tappeh. The shape of type II is cylindrical (Figs 2-4~6). Two of them are perforated at the throat, and one is incised with two vertical lines at the neck. Because of their shapes, the figurines of type III (Fig. 2-6, 8) are termed “double-wing-based” figurines (Bradwood 1960) or “T-shaped” figurines (Hole

1974). They have been found in many Neolithic sites in the Near East. Tepe Tūlā'i has yielded 111 figurines of this type. Another example with specific features has been found at the West Tappeh (Fig. 2-9). This figurine resembles the torso type of Jarmo. Three parallel and horizontal lines, looking like a belt, and a diagonal line around the body are incised.

The stone figurines that depict animals are very realistic and carefully made, while those of clay are crude and carelessly modeled. This difference seems to suggest that the meanings and uses of the stone and clay objects differed. With regard to human figurines, it is notable that the abstract examples are earlier than the realistic ones and that figurines of type III have been found at Tappeh Sang-e Chakhmaq.

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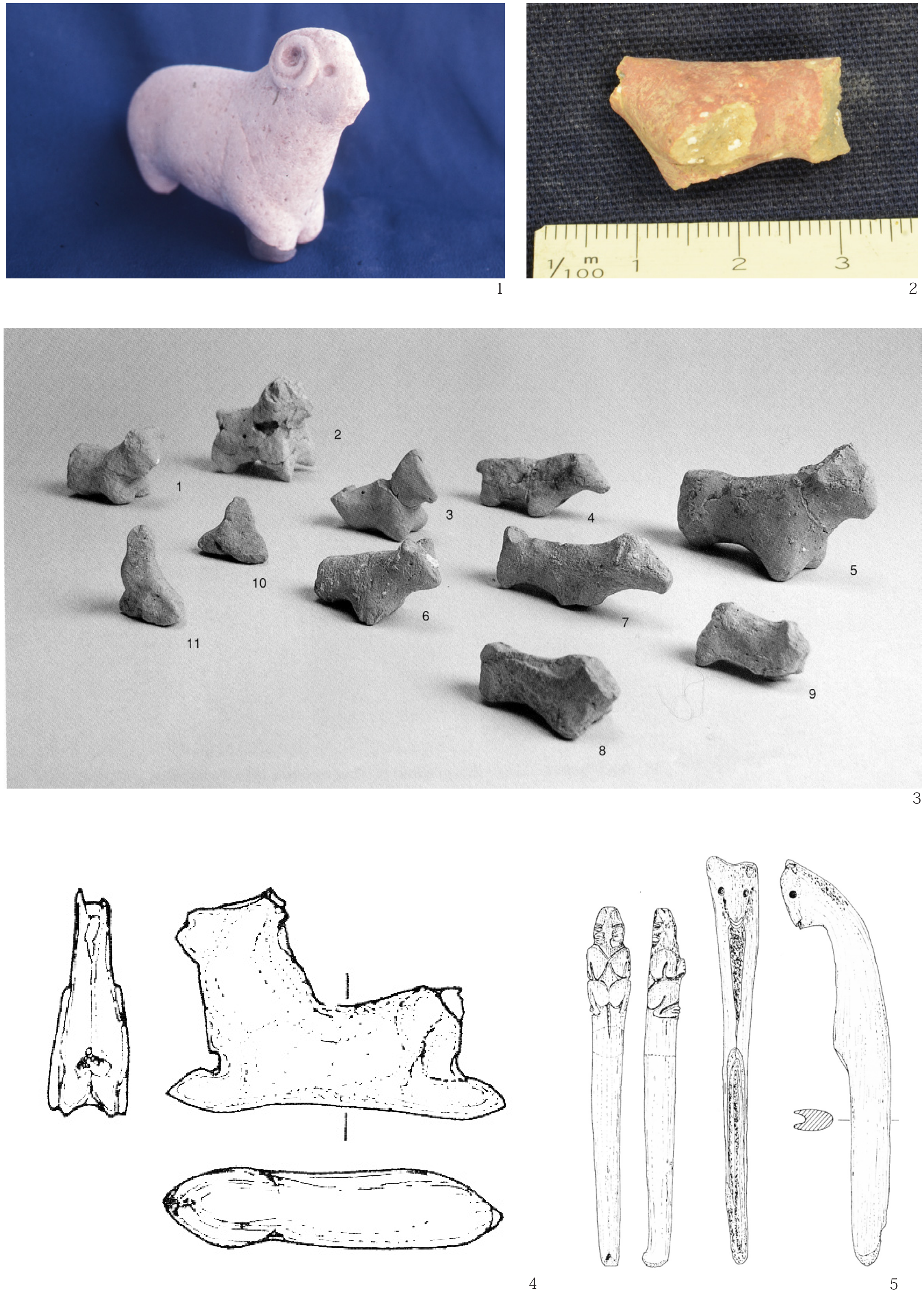

Fig. 1. Animal figurines and sickle haft of Tappeh Sang-e Chakhmaq.

Fig. 2. Human figurines of Tappeh Sang-e Chakhmaq.

Neolithisation of Eastern Iran : New insights through the study of the faunal remains of Tappeh Sang-e Chakhmaq

Marjan Mashkour (Central National de la Recherche Scientifique), Jean-Denis Vigne (CNRS), Azadeh Mohaseb (CNRS), Stéphanie Bréhard (CNRS), Céline Bémili (CNRS, Institut National de Recherche Archéologique Préventive), William Reynolds (Darthmouth Colledge), Julie Daujat (CNRS), Karyne Debue (CNRS), Akira Tsuneki (University of Tsukuba)

Tappeh Sang-e Chakhmaq[1] (TSC) is a unique Neolithic site in the North East of Iran for documenting the subsistence economies although two other major sites, Yarim Tepe (Crawford 1963, Stronach 1972) and Tureng Tepe (Wulsin 1932, Deshayes 1963), despite the lack of a secure chronology and proper bioarchaeological data, provide the evidence of early agricultural settlements in the 6th mil BC in this part of Iran.

The site of Tappeh Sang-e Chakhmaq was first excavated by a Japanese team during the early 1970s under the supervision of Sei-ichi Masuda. The uniqueness of Tappeh Sang-e Chakhmaq is due to the fact that it was investigated in a very large scale and has delivered a considerable amount of various archaeological data. Additionally, new recent investigations allow refining our understanding of the site and the process of the Neolithisation of this part of the Iranian Plateau. Outside the present frontiers of Iran, and on the same scale, the site of Jeitun[2] in Turkmenistan, excavated first by Russian (Shevchenko, 1960) and then English scholars (Legge, 1992), is the immediate pendant of Tappeh Sang-e Chakhmaq, which in turn has been the reference of the south central Asian Neolithic for long.

The presentation here, prepared for the Tsukuba workshop organised by Professor Akira Tsuneki, will be focussing on the archaeozoological results obtained on the Japanese faunal assemblage, collected during the four excavation seasons from 1971 to 1977.

Backgroud of archaeozoological studies

In the framework of several funded projects by France and Japan[3] we investigate the origin of domestication on the Iranian Plateau by examining several thousand faunal remains of the Marvdasht Plain and Tappeh Sang-e Chakhmaq. Here we will focus on the results obtained on the latter.

1 The name of the site has been written in various ways, probably due to the complexity of the its various components and inheriting various French or English transliteration traditions. Sei-ichi Masuda himself seemed to be undecided till the end since he wrote the name of the site in various manners: in 1973 he transliterated it as Tappe Sang-i Cagmaq, in 1974 Tappeh Sang-i Caxmaq and also Tepe Sang-i Caxamaq (1974a), in 1977 Tappeh Sang-i Chaxmaq and finally in 1994 Tappeh Sanghi- Chakhmaq. David Harris (2010) reported the site as Sang-i Čakmaq or Sang-i Chakmak. Recently a new transliteration has been proposed with the translation of the Japanese report and edited by Ch. Thornton (2013): Tappeh Sang-e Chakhmaq (also in an earlier version of the translation Tappeh Sang-i Čaxmaq) as Kourosh Roustaei. We will follow this last transliteration.

2 Also written in the literature Djeitun

3 French-Japanese cooperation research programs funded by the Japan Society for Promotion of Science (JSPS) and by the French Ministry of Culture- Cooperation project (ACR-SAKURA), the PPF “Biodiversité actuelle et fossile. Crises, stress, restaurations et panchronism : le message systématique” of the Natural History Museum of Paris. All of these institutions are particularly thanked for supporting different parts of this project.

Initial archaeozoological studies

After the excavations by the Japanese team the faunal assemblage of Tappeh Sang-e Chakhmaq was cautiously brought back to Japan and housed at the Department of Archaeology of the University of Tsukuba. Professor Masaki Nishida was the first person to examine the faunal remains and to report on them. Later on, between 2000-2002, Sachiko Yano began a Master thesis on the faunal remains at the University of Tsukuba, but she did not pursue her work.

In 2003, following our introductory visit to Japan, we made a first quick expertise on the fauna. The assemblage was in a very good preservation condition and all the bones were ink marked individually with archaeological records. This is indeed an extremely time consuming work which means that the excavators knew the importance of this unique material and made their best to save the information. Our archaeozoological project on the site began on 2005 and we went later in 2007 to continue the work.

The archaeozoological results

The first results by Masaki Nishida have been reported in Masuda 1986 p. 49 (translated in 1994 Fig 23). The author has summarised the results of his studies in a table presenting the faunal spectra based on weight of the bones for the West and East mound, the first referring to an earlier settlement.

In 2007, while following the archaeozoological studies, it was possible to compare our results with those previously observed; It seems that there is a discrepancy in the data between the two studies. This mismatching affected mainly the contribution of Cattle and Equids. This means either that some of the faunal remains had been lost or extracted from the

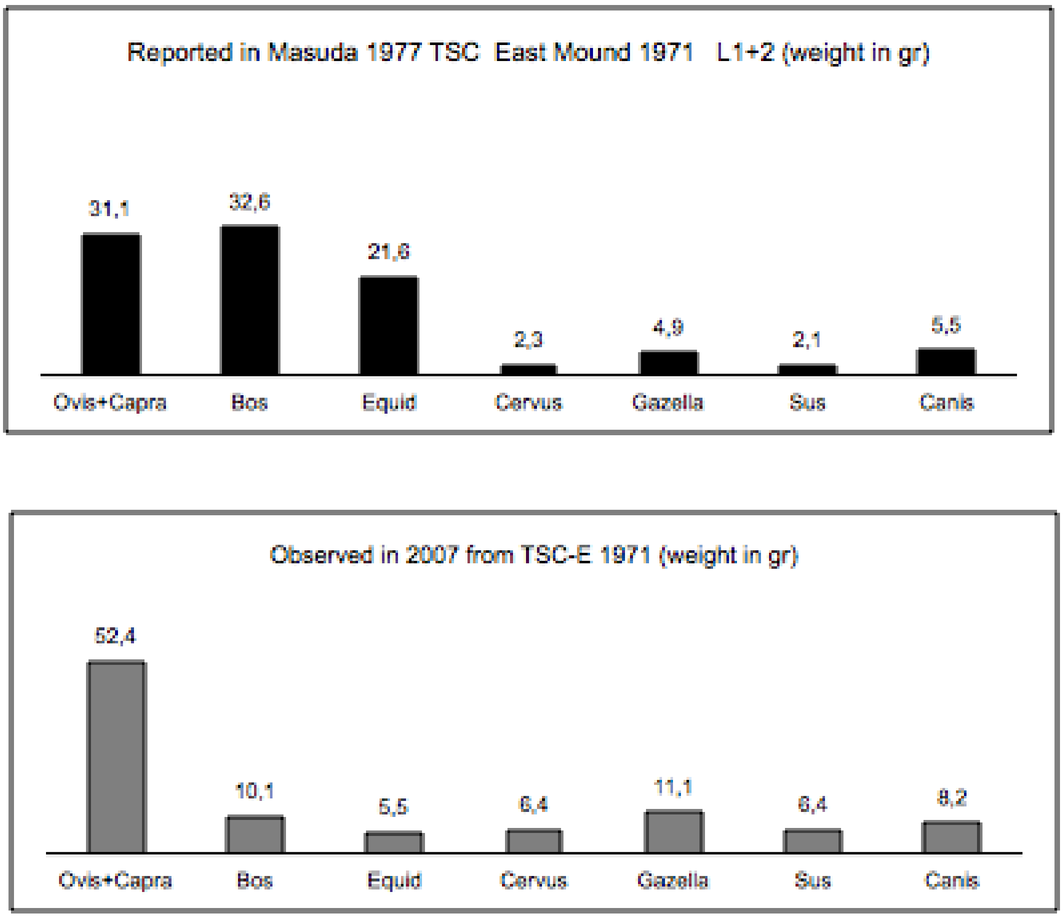

Fig. 1. The comparative faunal spectra of the previous and recent studies of Tappeh Sang-e Chakhmaq East Mound based on weight (g).

assemblage, which seems not reliable, or that there has been another methodological problem during the registration of the data. In any event the current studies provide a totally different picture.

The subsistence economy of Tappeh Sang-e Chakhmaq West and East

Interestingly the two mounds, West and East, do not show a major difference in the exploitation of the animals (Fig. 2). Both economies are based on hunting of wild sheep and goat since we have many evidences on the cranial remains (horn cores see Figure 3a and b), and Gazelle. Equids (Hemiones) are very little represented in both sites. The remains of Suids were allocated to the wild boar, because of their very low representation. The Red Deer is also present among the wild hunted species and seems to have been more hunted during the later period, in the East Mound. The contribution of carnivores (wolf, dog, fox) is also very important in Tappeh Sang-e Chakhmaq and seem to increase in the later period. Bear remains were also found in the site. One of the interesting and unexpected features at Tappeh Sang-e Chakhmaq is the diversity of the bird remains, most of which belong to wetland species. The presence of the gazelles on the other hand indicates clearly the exploitation of steppe environment in the same time.

The ecological information provided by the wild taxa reflects the presence of a wide range of ecological niches around Tappeh Sang-e Chakhmaq in various distance of the site

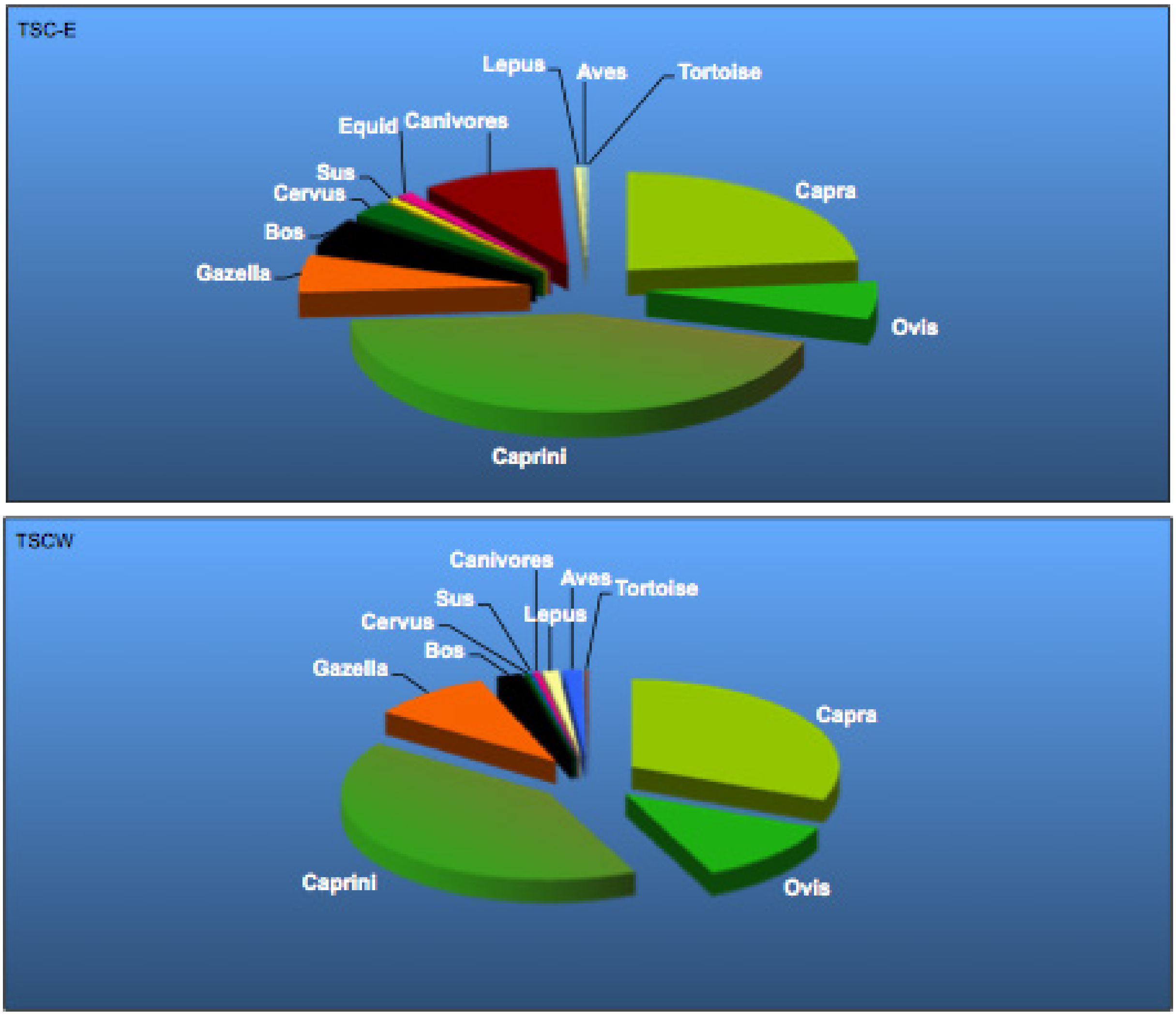

Fig. 2. The faunal spectra of Tappeh Sang-e Chakhmaq West Mound (TSCW), and East Mound (TSCE) according to the present study.

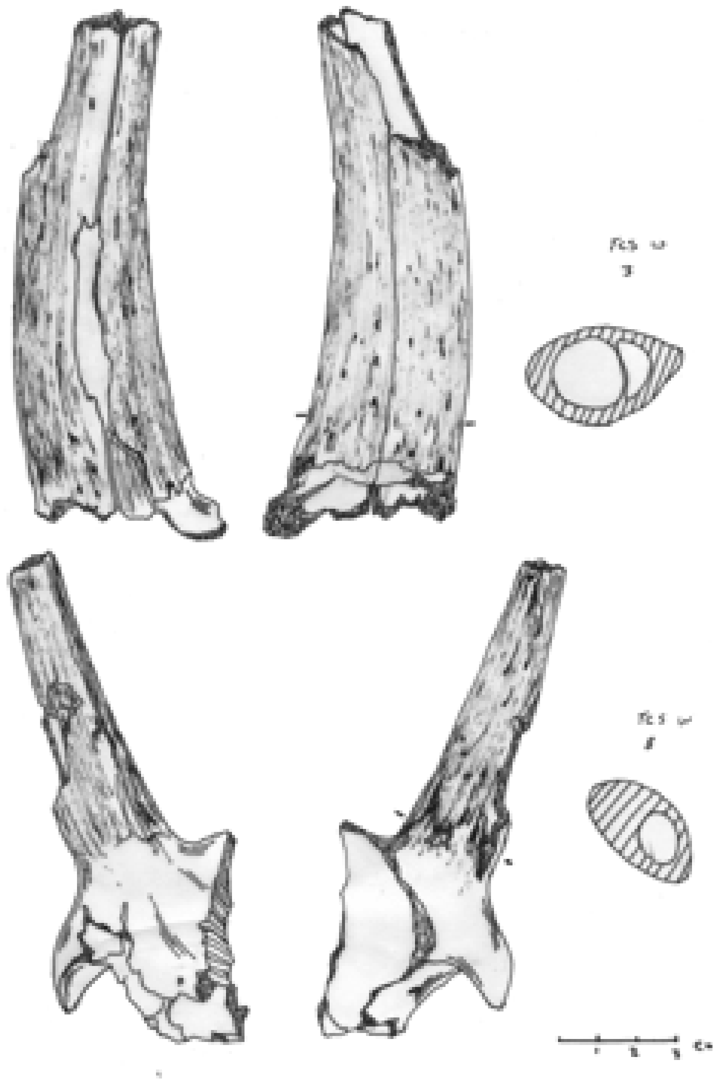

Fig. 3a. Examples of wild (up) and domestic (down) goat horn cores.

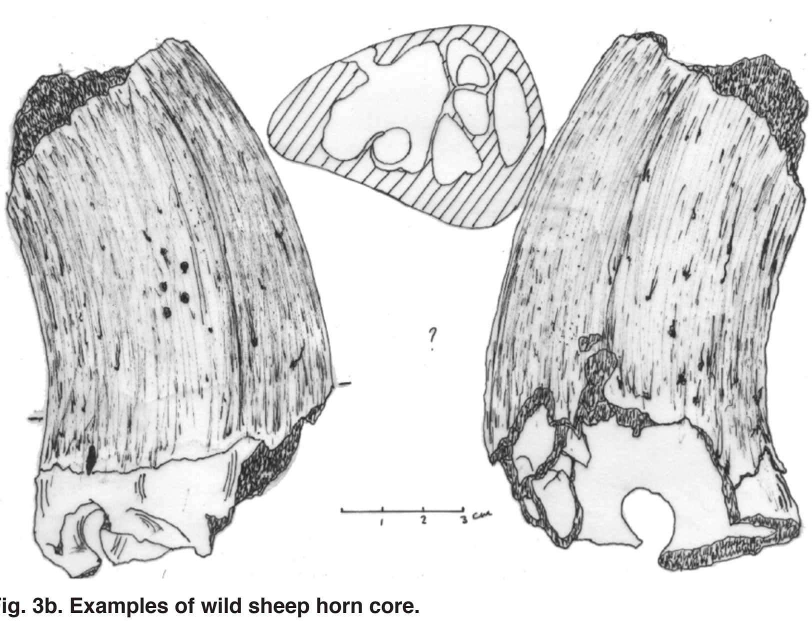

Fig. 3b. Examples of wild sheep horn core.

for some, like for the mountainous taxa, that were all exploited by the inhabitants of the site. Nowadays the site plain around the site is extremely arid and at least wetlands are totally absent from this landscape.

As for the domesticates, they are essentially goat and sheep although the sheep is much less represented. Cattle is hardly represented in the West Mound and its contribution increases in the East Mound where it clearly has a domestic morphology and also genetically tested (Bollongino et al 2012). The scarcity of the data does not allow a clear picture of the status (wild or domestic) of the animal during the earlier occupation of the site.

The archaeozoological project of Tappeh Sang-e Chakhmaq has been also the occasion to launch a radiocarbon dating of the site supported by the CNRS and the Natural history Museum of Paris (PPF program see note 3).

The animal bones excavated by the Japanese team in the 1970s have now been directly dated by the AMS radiocarbon method. Two very similar dates show that the western mound was occupied by 7997 ± 42 BP (7059–6767 cal. BC at 95% confidence), and several new dates for the East Mound range from 7182 ± 42 BP (6110–5985 cal. BC) and 6444 ± 42 BP (5497–5338 cal. BC). These results confirm that the West Mound was occupied substantially earlier than Jeitun whereas the earliest new date for the East Mound is contemporary to the occupation of Jeitun at c. 6100 cal. BCE (Harris, 2010). In 2009 Kourosh Roustaei (Iranian Center for Archaeological Research- ICHHTO) conducted a new archaeological excavation for a stratigraphic investigation at Tappeh Sang-e Chakhmaq. Here again new radiocarbon dates have been performed and confirm that Tappeh Sang-e Chakhmaq predated the occupation of Jeitun.

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Charred remains from Tappeh Sang-e Chakhmaq, and a consideration of early wheat diversity on the eastern margins of the Fertile Crescent

Dorian Fuller (University College London)

Introduction

Although the 1970s excavations at Tappeh Sang-e Chakhmaq did not include systematic sampling forarchaeobotanical remains, some concentrations of grains were recovered and offer an opportunityto assess the diversity of cereals cultivated and consumed during the site's occupation. As these isvery little evidence of this age between Iraq and the Indus valley, such data are important forformulating hypotheses about the multi-regional development and dispersal of agriculture in and from the Fertile Crescent. This is especially important as it is now evident that the domestication ofcrops and agricultural origins was a protracted process that was taking place in parallel over severalparts of the fertile crescent (e.g.Willcox 2005; Fuller & al. 2012; Asouti and Fuller 2013; Riehl et al2013). Of particular interest in the Chakhmaq assemblage are a diversity of wheat remains, whichprobably include all 4 of the early wheat species, the histories of some of which are still just starting to be unravelled.

The assemblage

The assemblage as received came in 12 boxes of variable content. Most of these come from the 1975 excavations of the east mound, and only 6 seeds were assigned to the earlierWest mound. One box, consisting of ca. 250 barley grains, lacked context details. Nevertheless the assemblage as a whole can be taken as reflecting in part the subsistence during the EastMound occupation, roughly contemporary with Djeitun in Turkmenistan, which provides an archaeobotanical assemblage for comparison (Bogaard and Charles in Harris 2010). The assemblage examined consists in total of 436 grains or grain fragments. The vast majority of these are cereals, including 81% barley and 17% wheats. Among the wheats, einkorn dominates, including both two-grained and onegrained forms, and emmer/emmeroid tetraploid glume wheats are next. Only a single grain of freethreshing wheat was found. Beyond these a single likely fragment of lentil (cf. Lens culinaris) was recovered, as well as a few wild/weedy types (Rubiaceae, Bromus sp.) and one unidentified segmented fruit. The lentil is of particular interest, as these have not been found at Djeitun nor Mehrgarh, and there is a general impression that pulses were rare or not adopted at all east of the Fertile Crescent during the Neolithic.

Barley

The staple grain was perhaps barley (Figures 1, 3). Not only were these the most abundant but theyare predominantly of the naked type, which is typically grow where barley is consumed as human food, as opposed to hulled barleys which are often turned into beer or used as animal fodder. Some assymetrcial grains suggest the presence of 6-row hulled barley but the high proportion of straight grains suggests that some two-row naked barley may also be present. A few grains of hulled barley are present, and might be contanimants or weedy forms. In addition a few grains of wild barley were found; these are very likely to have been weeds. Despite the presence of wild barley there is no evidence in the current material for

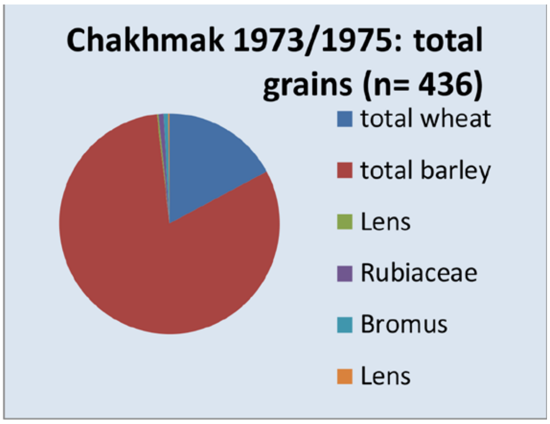

Figure 1. Percentage composition of the charred seed assemblage.

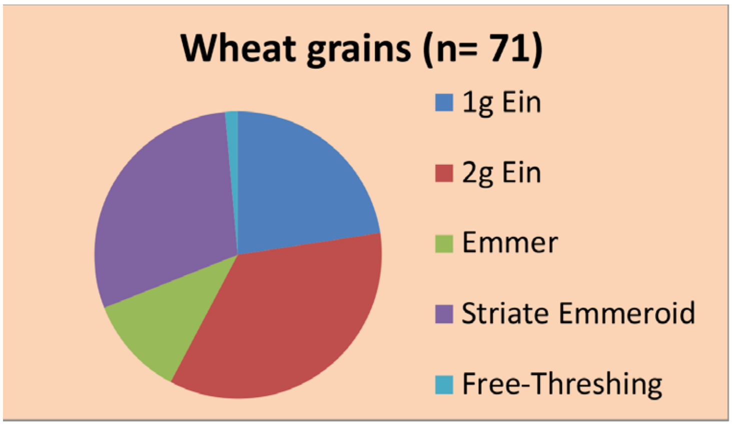

Figure 2. The relative proportion of wheat types identified in the assemblage.

local barley domestication; the grains are all well within the larger domesticated size range and are mostly of the naked type , which represents postdomestication evolution in barley.

Wheat diversity

As already indicated the wheat grains present a great deal of diversity, although all but one are glume wheats (Figure 2). Recent archaeobotanical work inWestern Asia and Europe has made it clear that in addition to the two modern relict glume wheats (diploid einkorn and tetraploid emmer) at least two more were important in prehistory and must have had separate domestication histories. These wheats, including two-grained einkorn and a striate emmeroid glume wheat (or "new type" tetraploid) are important parts of a growing number of "lost crops" that were experimented with in the Neolithic Near East, and in some cases became important and spread, for example into Europe, but which have not persisted as crops to the present day (Fuller et al 2012). Recent work in European archaeobotany especially has worked to sort out the identification criteria of these species, but this work is ongoing and the material from Chakhmaq may be able to contribute.

Figure 3. Example of barley grains from Sang-e Chakhmaq. These are typically plump and rounded in cross-section, suggesting a naked barley that would have been consumed as staple food.

The recognition of 2-grained einkorn, which can be followed from wild through domestication in Syria/SE Turkey (seeWillcox 2005; Fuller et al 2012), is reasonably well-established and focused on grain shape criteria (Kruez and Boenke 2002). Of more of a challenge, however, has been to identify the "new" emmeroid glume wheat, which has distinctively striate glume bases. Such glume bases are very common in Anatolian Neolithic sites, such as Catalhoyuk and Can Hassan

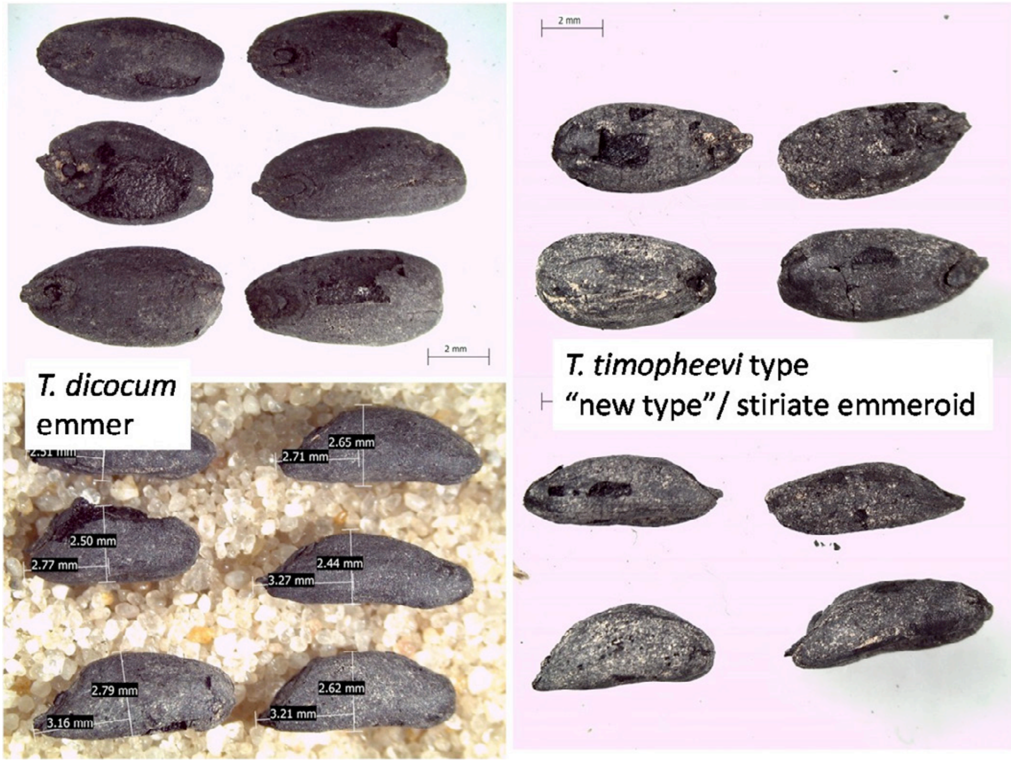

Figure 4. A comparison of tetraploid wheat grain types, including more typical emmer and a type, suggested to represent the "new" striate emmeroid grain type, which may be realted to the modern relict crop Timopheev's wheat.

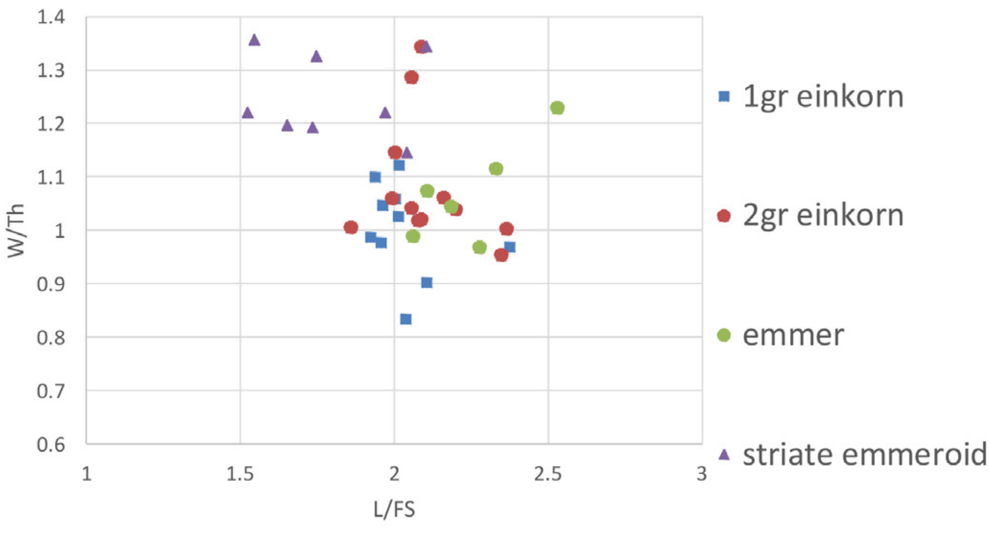

Figure 5. A scatter plot of grains from Chakhmaq showing one pair of metrical indices that are being applied to these material to help clarify the divisions between wheat grain types.

III, and were reported from Djeitun (Bogaard and Charles in Harris 2010). An assemblage of grains, in large quantity, from recent work at Catalhoyuk as well as at Stilifried in Austria (Kohler-Schneider 2003) suggest that these grains are more flattened and elongated than typical emmer, and resemble the modern relict crop Triticum timopheevi. Among the Chakhmaq material are twomodalities of emmeroid grains, suggested to include true emmer (Triticum diococum) and the striate emmeroid (Triticum cf. timopheevi type) (Figure 4).We have been making some efforts to arrive at fairly simplemetrical indices for separating these glume wheat times which some promise of success (e.g. Figure 5).

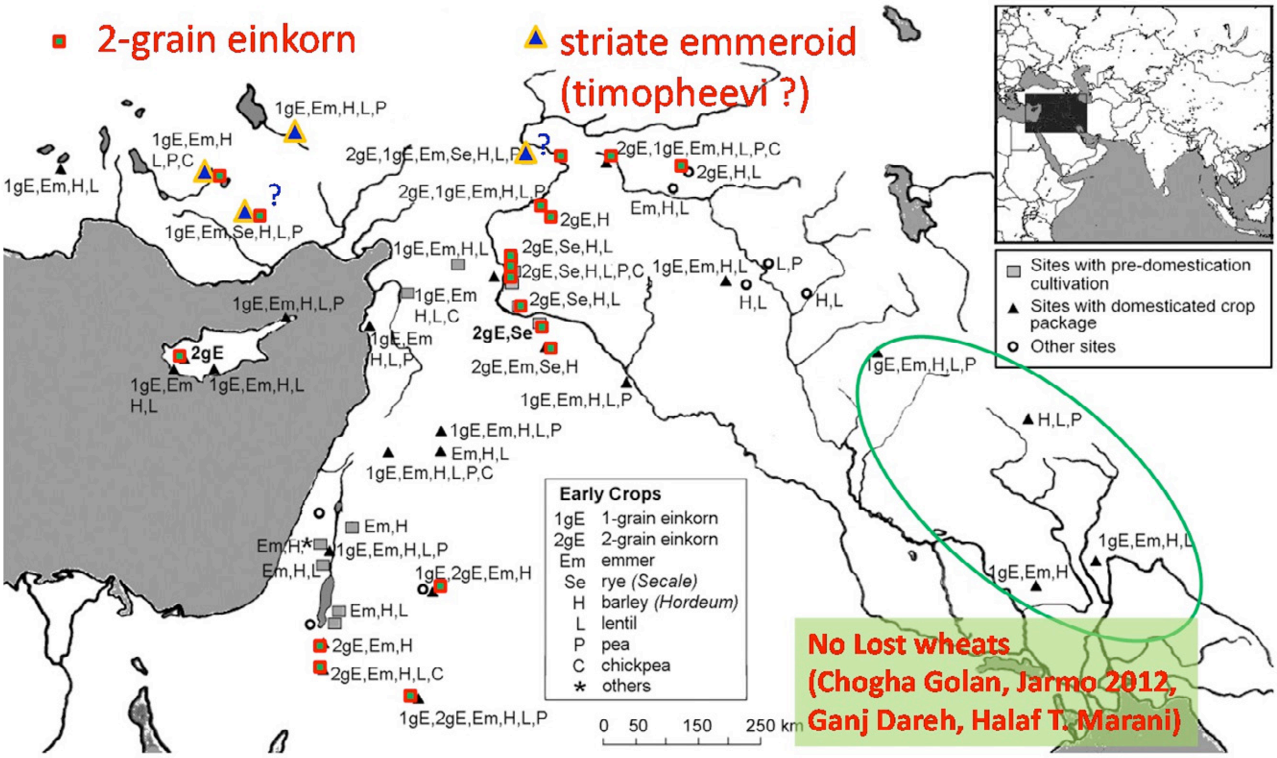

Figure 6. A map showing the known distribution on Neolithic site of the "lost" crops of two-grained einkorn and striate emmeroid wheat, both of which are suggested to have been grown at Chakhmaq. This highlights links in terms of wheat crops with Anatolia and parts of the western Fertile Crescent but not with the southeastern Fertile Crescent.

Implications for the origins and spread of crops in the greater Near East

The presence of this great cereal diversity at Chakhmaq, as at Djeitun, suggest comparisons with some more distant parts of the Near East and differences from other parts of Iran and adjacent countries, especially in terms of where these lost wheat originated (Figure 6). This raises important research questions about where these crops, like striate emmeroid, were first brought into cultivation—as this is not yet known from the classic Levantine corridor sites of early cultivation, and how these crops dispersed, whether by culture contact or migrating farmers, as two-grained einkorn and striate emmeroid are thus far absent from the eastern wing of the Fertile Crescent, including Southwest Iran, and they do not appear to have made it to the Indus valley.

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Vegetation of the Chakhmaq site based on charcoal identification

Ken-ichi Tanno (Yamaguchi University)

Wood charcoals collected at the West and East Tappehs at Sang-e Chakhmaq between 1973 and 1977 had been placed into long-term storage at the University of Tsukuba. They were sent to Yamaguchi University for identification. These samples were not collected using water-floatation treatment but were picked up by hand. This means that they are not suitable for a perfect reconstruction of the entire vegetation around the site, although they do provide an approximate impression of the environment and the use of plants at the site.

Method

Identification was performed based on three planes through a single sample: transversal, radial, and tangential sections. Microscopic observation was performed using a VHX-D510 electron microscope system (Keyence).

Results

As the study is currently ongoing, Table 1 shows only the preliminary results. Populus and/or Salix were the most common trees at least in West Tappeh. Both Populus and Salix are riparian forest elements that grow under conditions of high groundwater level. In West Tappeh, a house named No. W-9 yielded 2.9 cm and 1.5 cm charred twig in radial, whereas the floor of structure 9 yielded 3.2 cm and 3.0 cm fragments. These charcoals had homogeneous ray tissues, indicating that they were not Salix but were Populus sp. In East Tappeh, a sample from Layer V was either Juniperus or Cupressus sp., indicating the possible presence of coniferous trees at the site, although the wood might have been brought from elsewhere due to its value.

Table 1. Preliminary results of the charcoal analysis.

	grid	structure	layer	species
West tape	W–III	–	IV	4 *Populus* sp.
(TSC–W)	–	house No. W–9	–	2 *Populus* sp.
	–	No.4 lower II	–	1 *Populus/ Salix* sp., 1 indet., 1 impossible
	–	No.9, III, outside north from west wall	–	8 *Populus/ Salix* sp., 1 impossible
East tape	–	–	V	1 *Juniperus/ Cupressus* sp.
(TSC–E)				

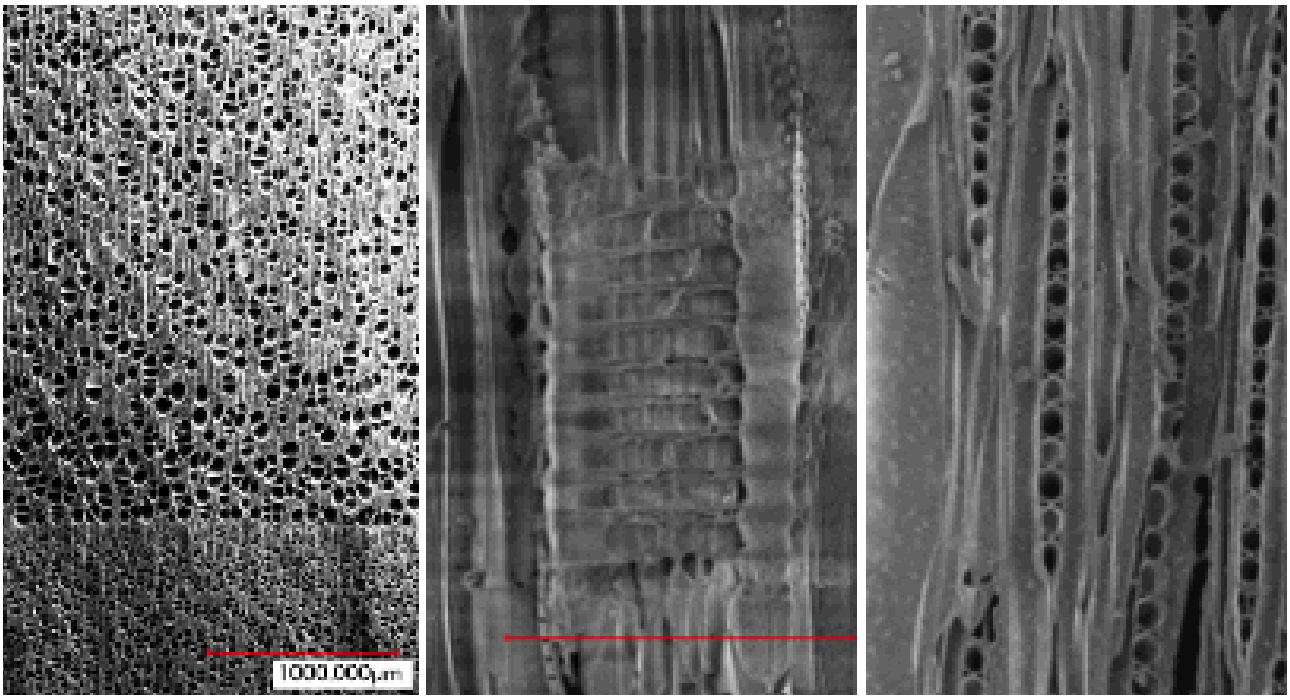


Fig. 1. Populus sp. was most frequently found. Left: transversal (x70), center:radial (x800), right: tangential (x700) sections from a sample TSC-W House No.W-9.

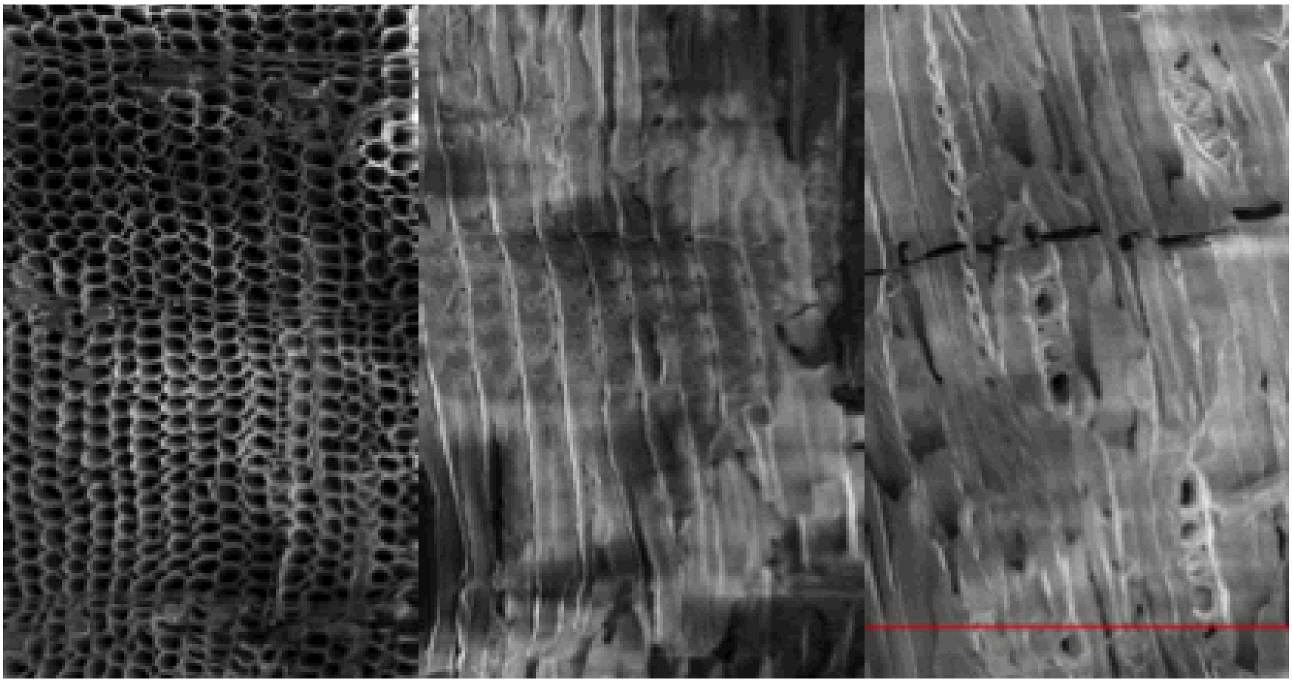


Fig. 2. A Conifer, Juniperus/ Cupressus sp. was found from Eastern Tape. Left: transversal, center:radial, right: tangential sections, a sample from TSC-E Layer V.

Human remains from Tappeh Sang-e Chakhmaq

Akira Tagaya (Nagano College of Nursing)

The human skeletal remains of 140 individuals—107 fetuses/infants, seven juveniles, two adolescent males, 12 adult males, 10 adult females, and two sex-unknown adults—have been unearthed from Tappeh Sang-e Chakhmaq. The bones of the children have been reexamined by Miyauchi in order to determine the sex and age composition of these individuals with greater precision. In this paper, we scrutinize the burial forms, pathologies, and morphologies of these materials (see Table 1).

Table 1. Skeletons examined.

	No.	Sex	Age	Burial	Year	Drawing	Cranium	Face	Extrem
East	101	F	20-40	?	1971		Y		
Tappeh	201	F	20-40	pit grave	1973	1/5			Y
	202	F	20-40	pit grave	1973	1/5			Y
	203	F	20-40	pit grave	1973	1/5	Y	Y	Y
	301	F	20-40	pit grave	1975	1/4	Y	Y	Y
	102	M	20-40	?	1971		Y	Y	Y
	105	M	40-60	?	1971		Y		
	302	M	20-40	pit grave	1975	1/4			Y
	305	M	20-40	pit grave	1975	1/4	Y	Y	Y
	209	?	Infant?	urn	1973	1/2			
	306A	?	Infant	pit grave	1975	1/2			
	204	?	7yr	pit grave	1973	1/5			
West	313	F	40-60	pit grave	1975	1/4	Y	Y	Y
Tappeh	314	M	60+	pit grave	1975	1/4	Y	Y	Y
	416	M	40-60	pit grave	1977		Y	Y	Y
	317	?	1yr	pit grave	1975	1/2			
	410	M	16-18	pit grave	1977				

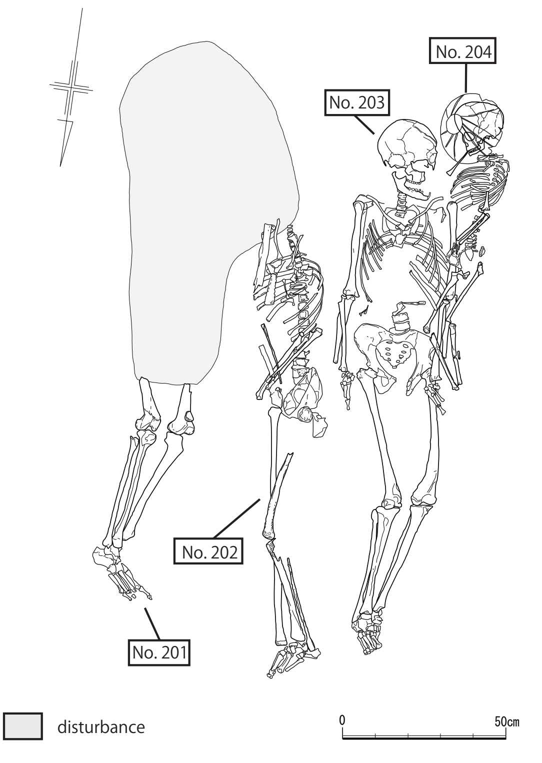


Fig. 1. Human remains No. 201-204 from East Tappeh .

Burial form

The skeletons from the West Tappeh were lying on their right sides in contracted positions. The body direction was north-south in three cases and east-west in the other three. The skeletons from the East Tappeh were lying on their sides in extended positions (three on their left and five on their right sides). The body direction was north-south in five cases and east-west in the other three. The burial form of the West Tappeh (contracted, lying on the side) is common in Iran (i.e., at Sialk, Tepe Hissar, Shah Tepe, and Shar-i Sokhta), while the extended burial position of the East Tappeh is found at Mesopotamian sites, such as the Ubaid period of Eridu, the Ur, Tepe Gawra, and Telul eth Thalathat.

Three females (Nos. 201-203) and one juvenile (No. 204) from the East Tappeh seem to have been buried at the same time (Fig. 1). Pottery was covering the skull of the juvenile, which was buried in a way as if looking each other with No. 203, a female with a late-term fetal skeleton on her sacrum. No. 201 and No. 202 were fragmentary remains containing fetal bones, suggesting that both or at least one was pregnant.

Fetuses, infants, and children

Of the 140 skeletons, 76% were

Table 2. Estimated stature.

East Tappeh				West Tappeh			
male		female		male		female	
n	mean	n	mean	n	mean	n	mean
3	164.8	4	157.5	2	169.4	1	160.0

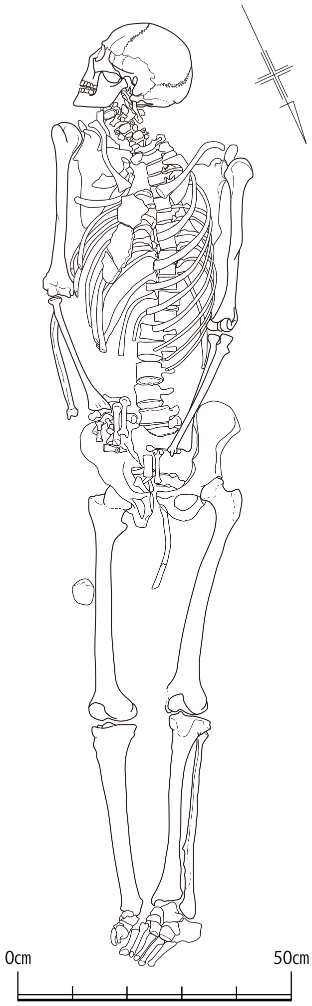


Fig. 2. Human remain No. 305 from East Tappeh.


Fig. 3. Feet of No. 305.

fetuses or infants. Most of these were buried in the walls or in floors close to walls; they were lying in contracted positions, on their right or the left sides. A minority, however, were lying on their backs, and two from the East Tappeh were in extended positions. No. 209 from the East Tappeh was in an urn in a contracted position, on its left side. Only seven skeletons were those of juveniles and two of adolescents, while 24 were of adults. This distribution seems to indicate a lower death rate for children than at Shar-i Sokhta, where 38 juveniles, two adolescents, and 45 adults were excavated.

Craniofacial morphology

The cranial and facial skeletons are highly homogeneous in morphology. The cranial vaults are generally long, narrow, and high. The faces are relatively narrow. The orbital and nasal index fall into relatively wide ranges. A narrow and elevated nasal root is a common feature. Among the nonmetric traits, the high incidence of hypoglossal canal bridging is marked, and in the males, a well-developed medial part of the superciliary arch is evident.

Postcranial morphology

The postcranial skeletons are rather homogeneous in morphology. The long bones of the leg exhibit significant muscular development. The high incidence of sacra with six vertebrae and of humeri with septal apertures are notable common features. The estimated stature of the skeletons is taller in the West Tappeh for both sexes (Table 2).

Pathology

Cribra orbitalia or osteoporitic pittings are observed for Nos. 313 and 314 from the West Tappeh and Nos. 101, 110, 203, and 317 from the East Tappeh. No. 416 exhibits severe osteoarthritic changes on both knee joints and modifications of the articular surfaces of the right shoulder joint, which seem to indicate a shoulder that was dislocated during early in life and left untreated. No. 202 shows considerable lipping and spur formation on the anterior side at both upper and lower edges of the bodies of lumbar vertebrae and at the promontory of the sacrum.

No. 305 exhibits extensive irregular bony deposits in tibiae and fibulae of both sides (Fig. 2). The left metatarsal bones are normal, but the right metatarsal bones show "penciling" or "point" formation (Fig. 3) . The phalanges of both feet are absent. These conditions suggest leprosy. Although no leprotic changes are observed in the skull and hand bones, leprosy without pathological changes at the skull or hands is not rare.

Multivariate comparison of cranial measurements

A principal component analysis (PCA) based on Penrose's shape distance was employed to compare the cranial measurements of 14 male and 16 female populations unearthed in Iran, Mesopotamia, and Caucasus. The pooled estimates of the standard deviations of Nippur and Shar-i Sokhta were used for standardization. Maximum cranial length, maximum cranial breadth, upper facial height, and bizygomatic breadth were employed.

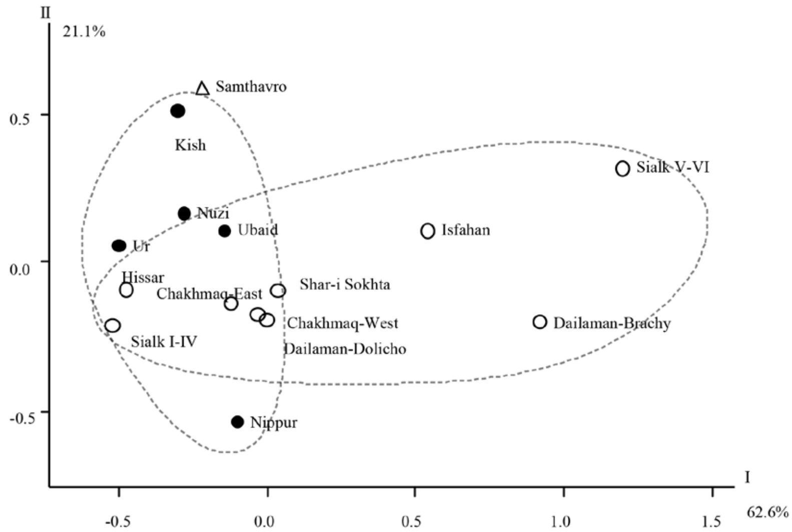


Fig. 4. PCA based on shape distance by four craniofacial measurements (male).

Figure 4 shows the results for the males. The first component separates the later Iranian group from the Mesopotamian and early Iranian groups. The Samthavro population of the Caucasus is located close to the Mesopotamian populations.

Figure 5 shows the result for the females. The overall pattern of distribution of populations is similar to that of the males. The first component separates the later Iranian group from the Mesopotamian and early Iranian groups. In this grouping, the Samthavro population of the Caucasus belongs to the Mesopotamian and early Iranian groups.

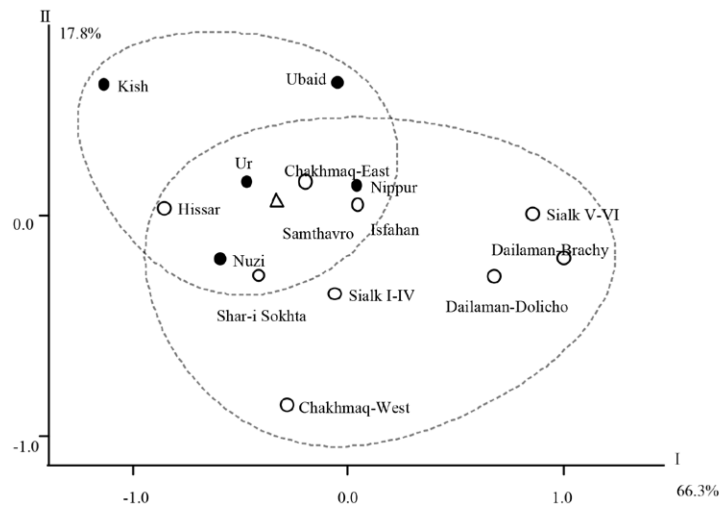


Fig. 5. PCA based on shape distance by four craniofacial measurements (female).

In both sexes, component I mainly reflects the ratio of maximum cranial breadth to maximum cranial length; the cranial vaults of Mesopotamian and early Iranian populations were narrower than those of late Iranian populations. There is little variation within the Mesopotamian group but a greater one in the Iranian group. Both sexes of the West and East

Tappeh of Tappeh Sang-e Chakhmaq fall among the early Iranian populations, close to those of Shar-i Sokhta, Sialk I-IV, Tepe Hissar, and the Dailaman dolichocranic type, and also the Mesopotamian populations.

Children at Tappeh Sang-e Chakhmaq

Yuko Miyauchi (University of Tsukuba)

Materials

The remains of 102 non-adult human beings were discovered at Tappeh Sang-e Chakhmaq during the 1971, 1973, and 1975 seasons. Most were buried in walls or in floors close to walls within settlements. Since about 90% of the human remains are non-adults, the study of non-adult human remains would greatly aid our understanding of the burial features of Tappeh Sang-e Chakhmaq. Therefore, this study examines these burial features through an examination of the ages-at-death, burial gifts, and pathologies of the non-adult remains.

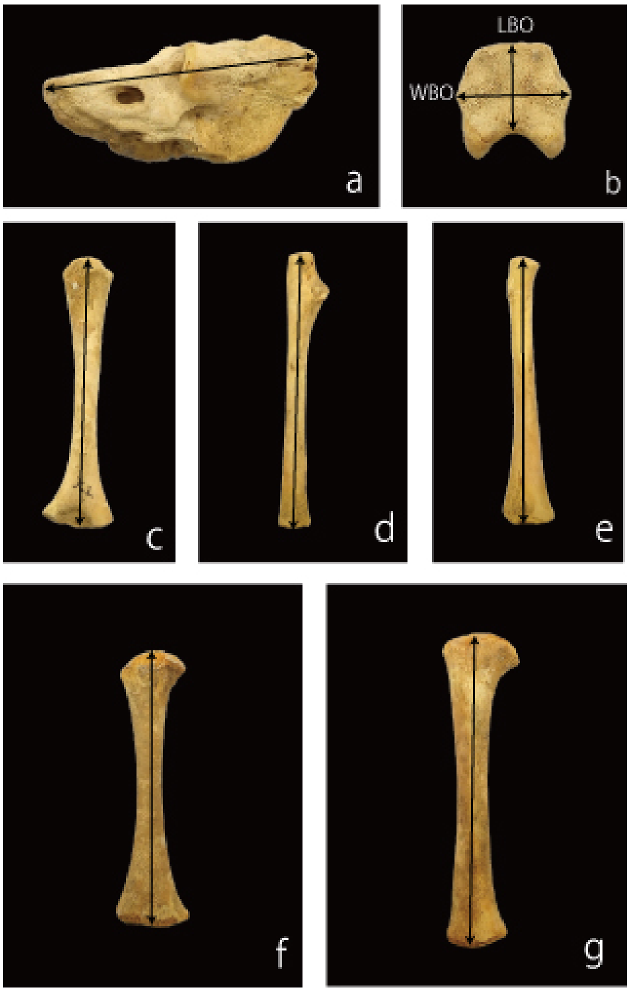


Fig. 1. Measurements of the bones.
a: Length of petrous part of temporal bone, b: Length of basilar part of occipital bone and width of basilar part of occipital bone, c: Length of humerus, d: Length of ulna, e: Length of radius, f: Length of femur, g: Length of tibia

Method

Age-at-death estimation

The age-at-death estimation was conducted through measurements of skulls, long bones, and dental development. Unfortunately, calcifying teeth are small and poorly preserved, especially in fetuses and neonates (Tocheri et al. 2005). Therefore, when an age-at-death approximation was possible for these categories, it was estimated by a regression equation for individuals that lived less than one month after birth, and by dental development for individuals that lived more than two months after birth.

Measurements

The age-at-death estimation from the regression equation with bone measurements was conducted by the methods of Scheuer et al. (1980); Nagaoka, Kawakubo, and Hirata (2012); Nagaoka, Abe, and Shimatani (2012); Nagaoka et al. (n.d.), and Scheuer et al. (1980). The measurements followed the modified definitions of Fazekas and Kósa (1978) (Fig. 1). Measurements were taken by the author with a digital caliper (Mitutoyo NTD12P-15C). Scheuer et al. (1980) has estimated the age-at-death of late fetal and perinatal individuals from limb bone lengths with a regression equation.

Fetal age (week) = 0.4585*Humerus (mm) +8.6563
Fetal age (week) = 0.5850*Radius (mm) +7.7100
Fetal age (week) = 0.5072*Ulna (mm) +7.8208
Fetal age (week) = 0.3303*Femur (mm) +13.5583
Fetal age (week) = 0.4207*Tibia (mm) +11.4727

Nagaoka, Kawakubo and Hirata (2012); Nagaoka, Abe and Shimatani (2012); and Nagaoka et al. (n.d.) have estimated fetal age-at-death from temporal bones and the basilar part of occipital bones by the regression equation.

Fetal age (month) = 0.194*Length of petrous part of temporal bone (mm) +2.833
Fetal age (month) = 0.953*Length of basilar part of occipital bone (mm) -1.693
Fetal age (month) = 0.519*Width of basilar part of occipital bone (mm) +2.323

Dentition

The ages-at-death of non-adult skeletons were also determined by dental development (Moorrees et al. 1963a, b; Ubelakar 1989).

Sex determination

Sex is normally determined in the adult skeleton through the morphological features of the skull and pelvis and the measurement of long bones. Unfortunately, the sexually dimorphic characteristics of the pelvis and skull do not become apparent until puberty; consequently, determining the sex of non-adult skeletons is problematic; therefore, it is not attempted in this study.

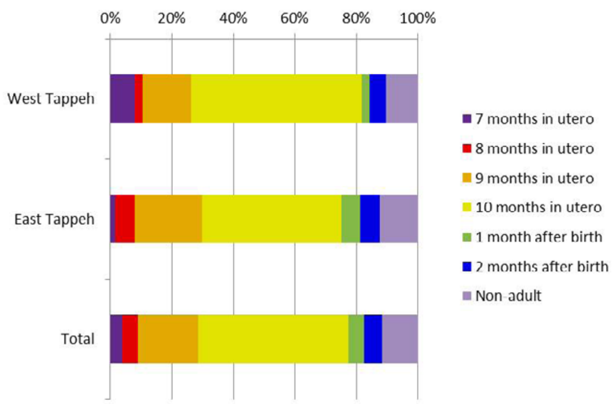


Fig. 2. Age-at-death distributions of non-adults at Sang-e Chakhmaq (Frequency).

	West Tappeh	East Tappeh	Total
7 months in utero	3	1	4
8 months in utero	1	4	5
9 months in utero	6	14	20
10 months in utero	21	29	50
1 month after birth	1	4	5
6 months after birth	1	-	1
6-9months after birth	-	1	1
2 years old	-	1	1
3-4 years old	1	-	1
4 years old	-	1	1
6 years old	-	1	1
Non-adult	4	8	12
Total	38	64	102

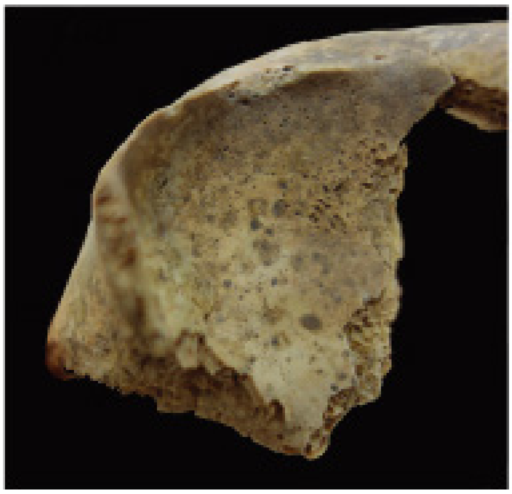
Table 1. Age-at-death distributions of non-adults at Sang-e Chakhmaq (Number of individuals).

Results

Age-at-death distributions

According to the measurements of skulls and long bones, the average age-at-death distributions are as follows (Table 1, Fig. 2): The smallest group is composed of 4 in-utero fetuses aged 7 months. There are only 5 in-utero fetuses aged 8 months but 20 in-utero fetuses aged 9 months. There are 50 in-utero fetuses aged 10 months, which is about 60% of the non-adult individuals. The number of individuals decreases to 5 at 1 month after birth.

There were only 6 individuals that are older than 2 months. These ages of individuals were estimated by their teeth. According to the age-at-death, there is 1 individual of 6 months (No. 202), 1 individual of about 6~9 months (No. 213), 1 individual of 2 years (No. 110), 1 individual of 3~4 years (No. 317), 1 individual of 4 years (No. 306A), and 1 individual of 6 years (No. 204).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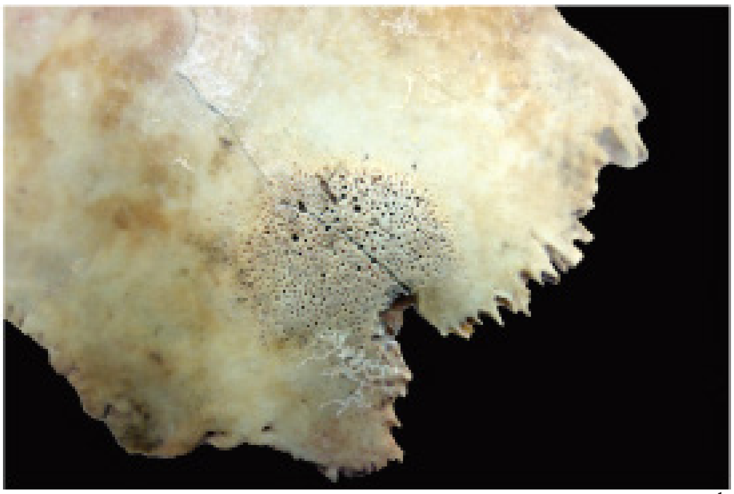
b

Fig. 3. Pathological features in No. 110, a: Criba Orbitalia, b: Cribra Cranii

No individual is 7 or more years old; however, ages-at-death of 12 non-adult individuals could not be estimated by either measurements or dentition. The age-at-death distribution did not noticeably differ between the East Tappeh and West Tappeh.

Burial Gifts

Burial gifts were associated to 5 individuals. From the West Tappeh, a 10 month fetus was buried with 183 shell beads and 90 clay beads (No. 319). From the East Tappeh, a 8 month fetus was buried with a clay ball (No. 320) and a 9 month fetus with a bone needle (No. 206), and individuals 1 month after birth (No. 306C) and 4 years old (No. 306A) were buried with beads around their necks.

Red ochre is observed in 5 individuals from the East Tappeh. They are 8 month (No. 215) and 9 month fetuses (No. 306B), and children 1 month old (No. 307), 4 years old (No. 306A), and of unknown age (No. 306D).

Pathology

Cribra Orbitalia are observed in individuals that were 2 years old (No. 110) (Fig. 3a) and 6 years old (No. 204) and in 2 individuals whose ages-at-death could not be estimated (No. 311?, No. 317). Cribra Cranii are observed in a 2-year-old (No. 110) (Fig. 3b), a 6 year old (No. 204), and an individual of unknown age (No. 311?). Enamel Hypoplasia was observed in a 6 year old individual (No. 204).

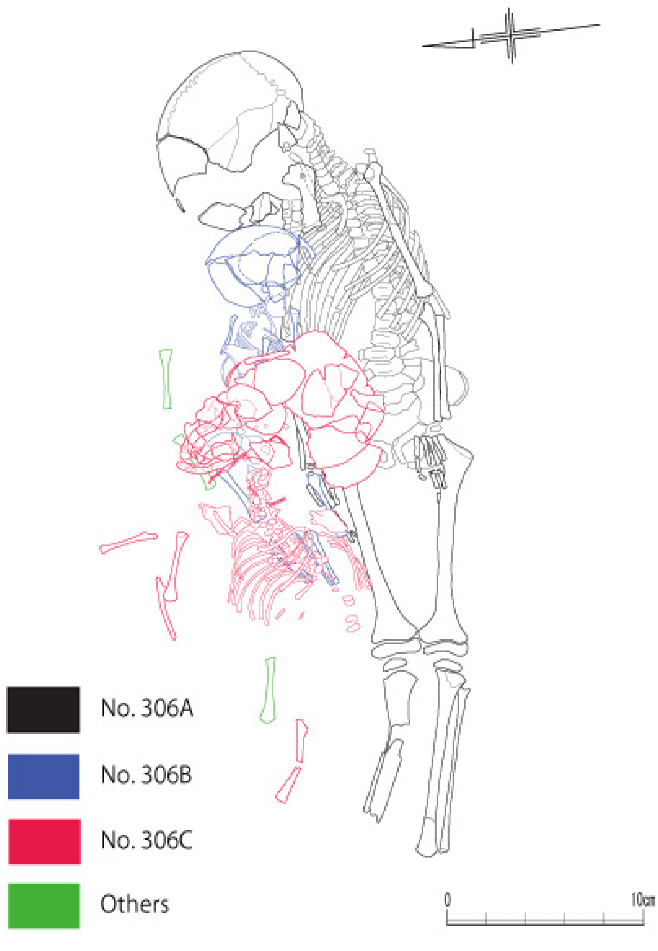

Fig. 4. Multiple burials No. 306 from East Tappeh.

The burial features of children at Sang-e Chakhmaq

Based on the re-estimation, about 60% of the non-adult remains are fetuses, 10 months in utero. As 10 months in utero is full term pregnancy, we can imagine that many children died related to birth. Moreover, the strikingly high rate of non-adults to adults indicates that the former were specifically buried close to or inside the settlement and the latter in different places. This finding corresponds to those of other Pottery Neolithic sites in the Near East.

Burying a child with a gift is very rare at Sang-e Chakhmaq. Only 5 individuals have burial gifts, but no tendency between gifts and ages-at-death is evident. The 5 individuals from the East Tappeh have red ochre on some parts of their bodies. The multiple burials No. 306A-D (Fig. 4) have red ochre on 3 individuals and burial gifts for 2 individuals. This finding may indicate a special burial ritual practiced at Tappeh Sang-e Chakhmaq.

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Stratigraphic soundings at Sang-e Chakhmaq Tappehs, Shahroud, Iran; April- June 2009

Kourosh Roustaei (Iranian Center for Archaeological Research)

Fig.1. East Mound- a mud-brick wall.

Fig.2. East Mound-Stratigraphic cut.

The twin mounds of Sang-e Chakhmaq lie some 8 km north of Shahroud city in northeastern Iranian Plateau. These mounds were excavated by a Japanese team directed by Seiichi Masuda in 1970s. In spite of prime importance of the site, the results of excavations remained largely unpublished. Starting his prehistoric researches in the Shahroud area in 2004, the present writer came to a conclusion that a survey of cultural development of the area would not be possible unless having some basic information on the early phases of the settled life. Because of the special aspects of the twin mound of Tappeh Sang-e Chakhmaq, the site would be one of the best among the known Neolithic sites of the area to answer our questions on the cultural developments of early settled life.

In April of 2009 a team from Iranian Center for Archaeological Research, directed by the author started a small scale sounding at both mounds to get the basic data to apprehend in some details the Neolithization process in the area. The fieldwork lasted for 70 days and stratigraphic soundings at both mounds reached virgin soil at the end of the season.

We made our main stratigraphic trench (Trench 1; c. 2.5x1.5m) at East Mound on the northern edge of the main Japanese trench. After about 4.5 m vertical digging we reached the virgin soil at the trench. As the uppermost layers in this trench were some 2.5 m lower than the uppermost parts of the mound, we made a small (1.5x1.5 m; Trench 2)


Fig. 3. East Mound-Stone beads.

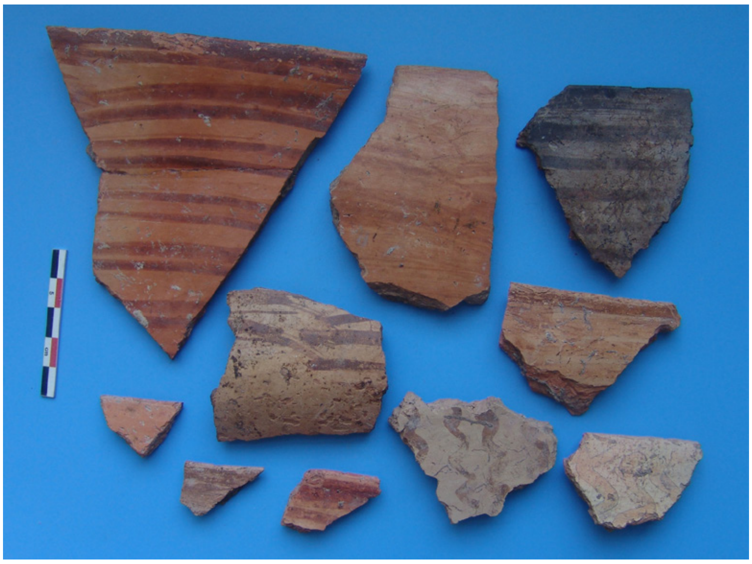
Fig. 4. East Mound-A sample of the Neolithic pottery.


Fig. 5. West Mound-stone drills.

trench on the highest part of the site to get some samples from these layers that had not been encountered in the Trench 1. Excavation in this trench was halted after exposing a mud-brick wall in the depth of 1 m below the surface.

In general, in Trench 1 the sequential deposits were composed of some architectural layers and some trash deposits. While uppermost and lowermost layers were trash/pit deposits with lots of small finds and potsherds, especially the lowermost layers, the middle part of the sequence was characterized by some repeated architectural layers of which just patches were remained. The mud bricks used in these partial architectures were hand-made, oval in section and with length of about 50-60 cm. The most interesting architecture we found was a horseshoe-shaped clay oven/hearth partially exposed in the excavated area. This type of hearth is very common in the Jeitun culture of the Kopet Dagh piedmont, some 100-200 km further north.

The pottery collection of the Trench 1 numbered more than 2900 pieces. Generally speaking, pottery assemblage of the East Tappeh is rather conservative in many aspects. Most physical attributes of the ware remains rather the same with some developments in decorative motifs. Overwhelming majority of the potteries have been baked under proper temperature, therefore the paste shows various degrees of blackness, from faint gray to black and from a thin line in the middle of the sherd section to whole thickness of the sherds. Vegetal material was the sole temper used; it seems that the size of vegetal agent was in direct relationship with sherd thickness.

Fig. 6. West Mound-An incised clay figurine.

Fig. 7. West Mound-Stratigraphic cut.

Some sherds show occasional white inclusions in their paste, maybe as a later product of some impurities in the clay. Shiny tiny dots on the surface of sherds probably indicate the presence of minor amount of mica in the original clays.

Altogether, more than 1000 small finds were recovered from Trench 1 at East Tappeh; Trench 2 provided no small find. The materials used to make different items were more varied than those were used in the West Tappeh. In terms of stone, turquoise, marble and shale are now used to make some items, while fine siliceous rocks were used to make chipped stone.

We made a small trench, 2.5x1m, on one of the northern walls of the polygonal trench of the Japanese at the West Tappeh. The trench reached to the virgin soil after 2.45 m of vertical digging. Altogether, we discerned 48 loci in the whole excavated sequence, which consequently divided into 4 phases. The excavated sequence is characterized essentially by repeated layers of pit deposits and architectural remains, the latter in badly state of preservation.

People of the West ound used a restricted spectrum of materials to make different items, mostly for daily use. In fact, vast majority of recovered small finds were made either from different types of stone or clay, the latter in both baked and unbaked forms. There were few items of other materials including bone and shell as well.

There is an apparent temporal gap between West and East mounds of Tappeh Sang-e Chakhmaq; while the occupation in the former ends around early 7th millennium BC, the earliest deposits of the latter dated to the late of the millennium. Therefore, there is a 500-600 year hiatus between the end of occupation at West Tappeh and the beginning of occupation at the East Tappeh.

First archaeobotanical results from the 2009 soundings at Sang-e Chakhmaq East and West Mounds

Margareta Tengberg (National Museum of Natural History)

In his book "Origins of Agriculture in Western Central Asia", published in 2010, the late David Harris summarises the available data on the earliest Neolithic communities known in southern Turkmenistan and surrounding regions, with a focus on the multidisciplinary excavations conducted by British archaeologists, in collaboration with Russian and Turkmen colleagues, at early 6th millennium BC Jeitun. Analysis of the archaeobotanical remains shows a reliance on cereal cultivation that, combined with hunting and caprine herding, constituted the basis of the village's subsistence economy. Interestingly, in addition to the two predominant cereal species - barley (Hordeum vulgare) and einkorn (Triticum monococcum, one and two-grained forms) - a previously unnoticed hulled wheat type is cited in the more recent publications (cf Charles & Bogaard 2010). This is the so-called "new glume wheat", first described from Neolithic and Bronze Age contexts in Greece, Turkey and eastern to central Europe (Jones et al. 2000, Köhler-Schneider 2003). With morphological traits close to Timopheev's wheat (T. timophevii), still cultivated on a reduced scale in southern Caucasus, the presence of this "new" wheat species at Jeitun opens up interesting perspectives on the spread of agriculture across the Iranian plateau.

Fig. 1. Grain (caryopse) of one-grained einkorn (Triticum monococcum), locus 129, Sang-e Chakhmaq West (dorsal, lateral and ventral views).

Fig. 2. Grain of emmer (Triticum dicoccum), locus 129, Sang-e Chakhmaq West mound (dorsal, lateral and ventral views).

On the basis of the results obtained at Jeitun and other Neolithic sites in the Kopet Dagh piedmont zone, Harris speculates on the possible origins of the domesticated plants that characterise early production economies in this part of Asia. While he does not exclude a local domestication of barley (also supported by genetic evidence) he considers an origin of the cultivated wheat species to the east of the Caspian Sea as unlikely, mainly due to the more western distribution pattern of their wild ancestors. Still, he stresses the necessity to complete the Jeitun record by studies of more and earlier (Mesolithic and Neolithic) sites in southern Central Asia and in northeastern Iran.

Tappeh Sang-e Chakhmaq is one of these sites offering us the possibility to fill in the gaps and answer some of the important questions addressed by David Harris. The site's exceptionally long occupational sequence allows us to study crop spectra

Fig. 3. Spikelet bases of "new glume wheat", locus 129, Sang-e Chakhmaq West mound.

and plant uses in the Sharoud plain during a period that starts almost a thousand years before the settlement of Jeitun and lasts until the mid-6th millennium BC. The present paper deals with the first results of the analysis of plant remains recovered during the stratigraphic soundings of the West and East mounds, undertaken in 2009 by a team from the Iranian Centre for Archaeological Research under the direction of Kourosh Roustaei. These samples, most of which are rich in plant remains, are at present being sorted and analysed in the archaeobotanical laboratory at the Natural History Museum in Paris. The results presented here have been obtained by the study of a yet limited number of samples (c. 15% of the total flotation samples) and are to be considered as preliminary. As the study goes on these results will be completed and extended in order to allow us to assess more in detail the patterns of exploitation and use of wild and domesticated plant resources at Neolithic Tappeh Sang-e Chakhmaq.

One of the objectives of the 2009 soundings was to systematically sample faunal and floral remains from the succession of archaeological layers excavated. Thus the team collected18 flotation and 20 manual samples from the Pre-Pottery Neolithic West mound and 41 flotation and 45 manual samples from the Pottery Neolithic East mound. In terms of volume, the flotation samples correspond to 1980 litres of soil from the West mound and 3232 litres from the East mound. The manual samples consist mainly of larger charcoal fragments that will be included in the wood charcoal analysis. Carbonised plant remains, charcoal and seeds/fruits, were extracted from the archaeological sediment by bucket flotation.

The first results based on the identification of almost 1400 plant items from 7 different contexts excavated at the West mound shows a predominance of seeds/fruits from wild species compared to that of crop remains. The latter are composed of almost equal quantities of cereal grain and chaff. The crop spectra is similar to that identified at Jeitun with the presence of barley, one and two-grained einkorn (Fig. 1) as well as the "new" glume wheat type. Emmer (Triticum dicoccum) is identified from a reduced number of spikelets and certain grains also present an emmer-like morphology (Fig. 2). However, among the chaff remains the "new" glume wheat is predominant (Fig. 3). The samples from the East mound are still to be studied but a preliminary analysis shows the presence of free-threshing wheat (Triticum cf aestivum), suggesting a change in the crop assemblage through time.

So far, no cultivated pulses have been noted in the samples from Tappeh Sang-e Chakhmaq and on this point the first results resemble those of Jeitun where pulses seem to be absent too.

On the contrary, wild pulses (cf Astragalus) are identified in most samples where they are associated with the seeds and fruits of other wild plants, mainly numerous grasses, such as Aegilops, Eremopyron and Bromus, and nutlets from plants belonging to the sedges (Cyperaceae) and the goosefoot (Chenopodiaceae) family. It is too early to draw any functional or ecological conclusions on the basis of the wild plant assemblages but the identified taxa may correspond to either weeds cleaned out from cereal crops or plants that were browsed by livestock and accidentally carbonised when dung was used as a fuel.

Fragments of charred wood, plentiful in the samples, will be the subject of a separate anthracological analysis. Preliminary observations show the presence of both riparian taxa (poplar/willow, tamarisk) and juniper, with the latter probably being collected on the nearby slopes of the eastern Alborz Mountains.

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University of Tsukuba

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