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Archaeobotanical and isotopic evidence of Early Bronze Age farming activities and diet in the mountainous environment of the South Caucasus: A pilot study of Chobareti site (Samtskhe-Javakheti region)

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Abstract

Recent excavation at the site of Chobareti (1615 m a.s.l., South Caucasus Mountains) reveals an important Kura-Araxes settlement and eleven burials so far, for which a first multi-proxies approach was conducted to understand both exploitation of plants and human dietary practices in this mountainous area. Thanks to the excavation of several pits, in 2011, a well-reasoned sampling for archaeobotanical analysis, including phytoliths, pollen and non-pollen palynomorphs, charcoal, seeds and other plant macroremains was undertaken. In parallel, human, animal bones and wheat seeds were recovered in order to perform stable isotope analysis ($\delta^{13}C$, $\delta^{15}N$). Results show the strong presence of cereals (especially naked wheat, as a hexaploid form, and emmer), highlighting the role played by cereal growing in the Kura-Araxes farming activities. Plant macroremains, but also phytoliths recovered in pits, reflect processing activities on the site. While animal dung seems to have been used to enhance

cereal yields, different herding practices can be suggested by $\delta^{15}N$ values. Whereas $\delta^{13}C$ values and archaeobotanical data agree for a consumption of C_3 plants, with no significant input in wheat for both animals and humans, a homogeneous mixed diet, with a great contribution of animal protein source (meat, secondary products) has been observed.

Highlights:

- Chobareti site is an Early Bronze Age settlement (3300-2900 cal. B.C.) located at 1615 m a.s.l. in the South Caucasus
- Archaeobotanical and stable isotope analysis have been performed on several pits and burials
- Phytoliths, pollen and macroremains highlight the importance of cereals cultivation in these highlands
- Isotope data suggest the use of manuring, differential herding practices, as well as C_3 plants consumption for both animals and humans
- Human dietary practices express a unique pattern with a preferential input of meat and dairy products

1. Introduction

Around 3500/3400 cal. B.C., the southern Caucasus played a pivotal role in the development of one of the most widely known archaeological cultures in the ancient Near East. Variously termed Kura-Araxes or Early Trans-Caucasian, the tradition represents the remains of village communities of stock-breeders and farmers (Sagona, 1993; Connor and Sagona, 2007). Many Kura-Araxes (K-A) sites have been discovered in the South Caucasus Mountains. While the hypothesis of their farming activities is often proposed based on archaeobotanical and archaeozoological data, it remains difficult to decipher their farming strategies in the high mountains. Despite the considerable archaeological research conducted in the Caucasus during the Soviet period, few archaeobotanical investigations have been carried out on K-A sites, except in Armenia where recent studies have been undertaken (Hovsepyan, 2009, 2010, 2011). These previous investigations provide some information about the cereal choices, but the diet strategies of K-A populations living in high mountain environment is still little known. In Chobareti (Javakheti, Georgia), despite the lack of archaeozoological data, the issue is to evaluate how significant crops were in the diet, alongside other resources. In order to tackle this issue, the combination of a multi-archaeobotanical analysis (phytoliths, pollen, non-pollen palynomorphs, plant macroremains) with stable isotope analysis ($\delta^{13}C$, $\delta^{15}N$) have

been conducted to assess crop choices, diets, as well as subsistence strategies of K-A populations, in such a mountain environment.

2. The site of Chobareti

The site of Chobareti (1615 m a.s.l., 41°35' N, 43'07 E) was discovered in 2008 during the construction of the 32 km Aspindza-Akhaltsikhe gas pipeline. Situated in the Samtskhe-Javakheti region of Georgia (Fig. 1), an area that has received little archaeological attention, excavations have so far revealed a K-A settlement and several burials, an Iron Age and Medieval stronghold, and a kurgan of a date as yet unknown. It is significant for the late prehistory of the Southern Caucasus for several reasons, but primarily because it is revealing a detailed picture of life in high altitudes at the elusive interface between the K-A tradition and its antecedents. Thirteen radiocarbon (AMS) dates (including two new dates on human bones), each falling comfortably within 3300–2900 cal. B.C. (Table 1), but clustering within the 3300–3100 bracket, enable us to better understand the nuances of cultural change and economic subsistence patterns during the earliest phase of the K-A (Kakhiani et al., 2013).

Chobareti was established on the slope of a mountain (Fig. 2). That it is a terrace site is unusual enough, but its topography is also distinctive, a saddle bookended by two rocky knolls. In choosing the site, the ancient community no doubt had considered its strategic position, overlooking the Kura River valley not far from where it meets the Uraveli River. Excavations have exposed an unusually large, curvilinear building (Structure 4), a substantial number of pits, and a growing number of burials. A distinctive feature of Chobareti is the presence of fifteen pits probably used for storage purposes and later for the disposal of waste (Kakhiani et al., 2013). One may consider that some pits have been also used for ritual purposes indicated by their structured deposition. That is, objects of value deposited in an intentional and meaningful manner (Chapman 2000).

3. Characterization of Chobareti population

Amongst the nine of the burials excavated, seven correspond to rectangular structures delimited by small basalt stones walls. One burial (Burial 5) is a circular pit and corresponds to a reuse of the pit 12 while the last one is a jar burial of a child (Burial 9). Removing the two burials (3 and 6) for which no bones allowed an anthropological study, biological analysis enabled the identification of 12 individuals of which three were subadults. The absence or bad preservation of coxal bone, which wears the most reliable indicator for sex and age at death assignation, restricts the evaluation of demographic parameters of Chobareti

population (Bruzek and Murail, 2006). Nevertheless, based on skull morphology, sex assessment yielded three males, four females and one indeterminate, while age assessment yielded five young adults below 40 years old and three adults above 40 years old.

The archaeothanatology study reveals strict anatomical connections for most of the skeletons with two types of body deposit: primary burials and reductions or secondary deposits (see Supplementary Material SD1). All individuals in primary burial were deposited in a crouched position on one side, however a difference in side was observed between adults and subadults. The deposit of the infant body in a jar (Burial 9) is surprising in a K-A context and could evoke a link with Chalcolithic tradition (Poulmarc'h, 2014).

3. Materials and methods

3.1. Phytoliths

For phytolith analysis, five samples from the lower part of pit 17 and five samples from the lower part of the pit 18 (Fig. 4) were collected at regular intervals of 10 cm along the deposits to investigate the evolution of the phytolith assemblages in each pit. Phytoliths were extracted from sediment samples using HCl and H_2O_2 baths, sieving, clay removal and densimetric separation (Lentfer and Boyd, 1998). After cleaning, the residue was suspended in glycerine, mounted on slides and observed under a Microscope at 600x magnification. Each phytolith was classified according to its morphology, following several systems (Twiss et al., 1969; Fredlund and Tieszen, 1994; Mulholland, 1989) and the International Code for Phytolith Nomenclature (ICPN Working Group et al., 2005). Based on the previous literature, the observed phytoliths were classified into 13 different categories (Table 2, see Messager et al., 2010). Silica skeletons, corresponding to fragments of silicified Poaceae epidermis, were also identified and counted, but not included in the phytolith sum.

3.2. Pollen and non-pollen palynomorphs (NPP)

For pollen analysis, five samples from the lower part of pit 17 and six samples from the lower part of pit 18 located in the trench 1 (Fig. 3) were collected. The samples were taken at regular intervals of 10 cm in each pit section to evaluate the potential evolution of the assemblages during the deposits. Pollen samples were prepared using a 10 per cent solution of potassium hydroxide (KOH), followed by heavy liquid separation and standard acetolysis (Faegri and Iversen, 1989). Pollen and non-pollen palynomorphs (NPP) identifications were made with reference to atlases (Beug, 2004; Reille, 1992, 1995, 1998; van Geel, 1998; van Geel and Aptroot, 2006) and the modern reference collection of the Institute of Palaeobiology

(Tbilisi). The criteria used for NPP identification recovered in Georgian archaeological sites have already been described in Kvavadze and Kakhiani (2010) and Chichinadze and Kvavadze (2013).

3.3. Plant macroremains

For plant macroremains analysis, including seeds, fruits and charcoal, sediment was collected from the three pits which represent a total of 48.6 litres (Fig. 3). 34.2 litres of sediment have been wet-sieved in the laboratory of the University of Geneva (Switzerland) with mesh sizes 4, 2 and 0.5 mm. Additional samples recovered from pit 18 (14.4 litres) were sieved in the field using a flotation machine (see Longford in Kakhiani et al., 2013). All residues were dried and plant remains were extracted and sorted, either with the naked eye (4 mm mesh), or with a stereoscopic microscope with magnifications x6.5–x40 (2 and 0.5 mm meshes).

Seeds, fruits and other plant macroremains were identified using the modern reference collection of plant material of the Institute for Prehistory and Archaeological Sciences (Basel University), as well as specialised literature (Cappers et al., 2006). Nomenclature follows Zohary et al. (2012). The 0.5 mm organic fraction of pit 16 was sub-sampled because of its richness in plant macrofossils. Due to its abundance, chaff was sorted in 10% of the volume of each sample; other macro-remains in 25% of the sample; remarkable elements were sorted in the whole sample. The numerical values for each group were extrapolated to the total volume of the sample applying a correction factor of x10 and x4 according to the used division.

The wood charcoal fragments were sorted from the 4 and 2 mm meshes only. Each fragment was hand-broken along the three characteristic directions (transverse, longitudinal-radial, longitudinal-tangential) in order to get fresh sections, and observed with a reflecting light microscope fitted with a bright field/dark field device (magnifications x100–x1000). The identification is done by comparing the anatomic structures with those of the modern charred wood from the laboratory's collection (UMR 7264, Nice) and with the published descriptions (Greguss, 1959; Schweingruber, 1990). Most of the time, the identification reaches the genus or group of species level, rarely the species level, and sometimes only the family level or a group of several genera. According to previous methodological investigations (Chabal, 1997, p. 27-29), the study of scattered charcoal fragments recovered from living surfaces is needed to display a reliable and complete image of the past vegetation. Thus, considering the small

size of charcoal samples from Chobareti (29 to 183 fragments) and the fact that they are coming from pits, the interpretation of the floristic list will be mainly qualitative. Nevertheless, the relative proportions of the various taxa have been figured to better visualize the results, but they must be interpreted cautiously.

3.4. Stable isotope analysis

In order to reconstitute the nature of the consumed proteins, carbon and nitrogen stable isotopes were measured on bone collagen (Katzenberg and Saunders, 2008). Since carbon stable isotope ratios ($\delta^{13}C$) are in relation with the photosynthetic pathway of plants, they can discriminate plants from temperate environment using the C_3 photosynthesis and those using C_4 photosynthesis, like millet (Smith and Epstein, 1971). Nitrogen stable isotope ratios ($\delta^{15}N$) permit to assess the trophic level of an individual within its food web because the more animal proteins are consumed the higher the isotopic values are (DeNiro and Epstein, 1981). In terrestrial ecosystems, there is a small step-wise in $\delta^{13}C$ values of about 0-2‰ while the step-wise is higher in $\delta^{15}N$ values of 3-5‰ between trophic levels (Bocherens and Drucker, 2003). Isotopic measurements on bone collagen authorize a food behaviour restitution corresponding to the consumption of proteins of the 10-15 last years of life (Hedges *et al*., 2007). The interpretation of human isotope values is dependant of those of the consumed potential food items which make indispensable the characterisation of the local environment of Chobareti population. It is well admitted that animal bones need to be considered to avoid any misinterpretation of human data (Herrscher and Le Bras-Goude, 2010). Recently, studies have also shown that anthropic factors, like manuring can significantly raise nitrogen stable isotope values in cereal grains and chaffs, affecting the isotope values in consumer tissues. It demonstrates the interest of considering the isotope values of archaeological plant remains, for reconstructing human past diets (Bogaard et al., 2007). Only two individuals, among the twelve identified, weren't sampled because of a bad macroscopic preservation and a low skeletal representation (see Supplementary Material SD1). Thus, the subsample of Chobareti population is composed of eight adults and two sub-adults (Table 3). Animal sample includes 21 herbivores attributed to nine specimens of *Bos* sp., one *Bison* sp. specimen and 11 specimens of *Ovis*/*Capra* (Table 4). In addition, analyses were also carried out on six charred seeds of *Triticum* sp., sampled from the pit 16 (Table 4).

Bone collagen extraction was based on Longin's method (1971), modified by Bocherens and collaborators (Bocherens et al., 1991) and charred seeds were prepared following the ABA method (Brock *et al*., 2010) at Aix Marseille University (UMR 7269). Samples were analyzed by elemental analysis-isotope ratio mass spectrometry (EA-IRMS) using an elemental analyzer (Europa Scientific) coupled to a continuous-flow isotope ratio mass spectrometer (Europa Scientific 20-20). International standards are V-PDB for carbon and AIR for nitrogen. Precision of isotope measurements, calculated on internal standard replicates (IA-R042, IA-R045, IA-R046 and IA-R05, IA-R06), is inferior to 0.2‰ for nitrogen and inferior to 0.1‰ for carbon. To ensure the good quality of collagens, four criteria: yield of extraction (above 10 mg/g), percentages in carbon and nitrogen (respectively above 30 per cent and 11 per cent), carbon to nitrogen atomic ratios (between 2.9 and 3.6) were checked (DeNiro, 1985; Ambrose, 1990; van Klinken, 1999).

4. Results

4.1. Phytoliths

Chobareti sediments yielded large amount of phytoliths (200 000 – 500 000 phytoliths per gram of sediment). The sediments sampled in both pits (17 and 18) have relatively homogenous phytolith assemblages (Fig. 4). Grasses (Poaceae family) are the dominant taxon in all phytolith samples (Fig. 4). In this group, long cells such as elongate and acicular morphotypes are preponderant while short acicular forms and bulliform cells are rare (Fig. 4). Rondels and sinuate short cells are well represented. They correspond to Pooideae sub-family (Twiss et al., 1969; Fredlund and Tieszen, 1994), the main group of Poaceae in temperate areas. In Chobareti archaeological deposits, bilobate phytoliths are recorded, attesting of the occurrence of the Panicoideae subfamily in the past grasses (Fredlund and Tieszen, 1994; Lu and Liu, 2003; Messager et al., 2010).

Owing to the significant values in "elongate dendritic" phytolith class, the assemblages are rather different from natural phytolith assemblages. This class of phytolith is produced in chaff (glumes, lemma, palea) of Poaceae (Ball et al., 2001). Since domesticated cereals Poaceae are selected for their abundant grains (and chaff as a consequence), they produce many dendritic phytoliths. Moreover, they also correspond to the nutritive part of the plant which is the most subject to harvesting and storage. These are the reasons why this class of phytolith is especially abundant in archaeological sites in which cereals have been processed (Berlin et al., 2003; Portillo and Albert, 2011). The other main feature of these assemblages is the frequent occurrence of silica skeletons (Fig. 4) corresponding to fragments of epidermis

(linked phytoliths) (Rosen, 1992). They represent the remains of fragmented pieces of stems, leaves and chaff of Poaceae.

4.2. Pollen and non-pollen palynomorphs

The pollen grains and non-pollen palynomorphs (NPP) were well preserved in the four lowest samples coming from pit 18 (Fig. 5). In the top of pit 18 as well as in every sample from pit 17, pollen grains were not found in sufficient quantities (<100) to be sure of the reliability of pollen spectra (Kakhiani et al., 2013). In the pit 18 spectra, pollen grains of Cerealia type are predominant (Fig. 5). Crop weeds were also identified (*Polygonum, Convolvulus, Carduus, Centaurea, Dipsacus*). The group of arboreal pollen is essentially represented by coniferous trees such as *Pinus* (pine), *Picea* (spruce) and *Abies* (fir). Pine is predominant, although there are also large quantities of fir (*Abies nordmanniana*) in the lower part of the pit 18 (Fig. 5). In the group of NPP, spores of *Glomus*, a fungus which settles only either on tilled or erosion soils (van Geel, 1998; van Geel and Aptroot, 2006) are well represented in the Chobareti spectra. Spores of dung fungi, such as *Sordaria* or *Arnium* are well-recorded. Another interesting feature of the NPP spectrum is that in all samples, remains of mites and other insects were found.

4.3. Seeds and fruits

The preservation of plant macroremains is exclusively due to carbonisation. Almost 50 litres of sediment provided more than 11,000 plant remains (Fig. 6, Table 5). It represents an average of 231.6 items/litre but concentration varies from 6.2 item/litre in pit 18 to almost 2000 items/litre in pit 16. We attested 43 different taxa, of which 16 identified as species.

The assemblage is composed of cereal grains and chaff and of wild plants seeds (Table 5). Domestic plants are represented only by wheat and barley. This group includes einkorn (*Triticum monococcum*), emmer (*Triticum turgidum* ssp. *dicoccon* often referred to as the short term *Triticum dicoccum*), naked wheat (*Triticum aestivum/durum/turgidum*) and barley (*Hordeum vulgare*) sometimes hulled; the presence of connected rachis fragments, with typical curved sides and striations, and no thickenings under the glumes (Jacomet et al., 2006, p.36-37) allows us identifying naked wheat as a hexaploid form, belonging to the *aestivum* type (see Supplementary Material SD2). Cereals are badly preserved: more than 70% are identified as Cerealia type or *Triticum* sp. and as groups of species i.e. *Triticum monococcum/dicoccum*. Representing more than 90% of the assemblage, cereals grains and chaff are dominating in the three pits. More than 85% of cereals remains are chaff – glume

base, spikelet fork and rachis fragment – and could not be assigned to a species. Few seeds attested trees and shrubs: *Rosa* sp. (one seed), *Rubus* sp. (one seed) and yew, *Taxus baccata* (several fragments of seeds). Ruderal and arable-weeds are dominated by various *Chenopodium* (*C. album* and *C. hybridum*), *Fallopia convolvulus* and *Galium* (*G. aparine* and/or *spurium*); we also determined *Avena* sp., *Buglossoides arvensis*, *Euphorbia* sp. and *Euphorbia helioscopa*, *Hyosyamus niger*, *Papaver* sp., *Polygonum* sp., *Polygonum aviculare*, *Rumex* sp. and *Urtica dioica*. Finally, various taxa mostly only assigned to a plant family are grouped in the "Miscellaneous" section which includes *Bromus* sp., Brassicaceae, *Carex* sp., Caryophyllaceae, Fabaceae type *Trifolium* and *Vicia*, Lamiaceae, Paniceae, *Poa* sp., Poaceae, Polygonaceae, Rosaceae type *Potentilla*, *Teucrium* sp. and maybe *Teucrium botrys*.

4.4 Charcoal

Charcoal from the three pits was analysed (Fig. 7, Table 6). Nine different taxa were identified, among 295 identifiable fragments. The pit 16 yielded an assemblage composed of only two taxa: *Acer* t. *campestre* (maple) and *Quercus* (deciduous oak). They could be made of a few original fragments, broken into smaller pieces, as it is sometimes the case when dealing with localized, concentrated charcoal sample (Chabal, 1997). Pits 17 and 18 show more diverse spectra, even if *Acer* and *Quercus* are still present but in low amounts. *Pinus* sp. (Pine) is dominating the assemblages from the pits, but broadleaved trees are also present: *Carpinus* sp. (hornbeam), *Fraxinus* sp. (ash), *Corylus avellana* (hazel) and Ulmaceae (wood anatomy does not allow discriminating between *Ulmus* sp., *Celtis* sp. and *Zelkova* sp.) and *Ilex aquifolium* (holly). All these broadleaved taxa refer to mixed forests in contexts of high edaphic humidity (humid mixed forests or riparian formations), some of the deciduous ones being light-demanding species (in particular hazel and ash) while the evergreen one (holly) is more shadow-loving. Charcoal assemblages show that wood was in part collected in humid mixed forest areas and on their edges, but also in dryer places, as evidenced by the important amount of pine.

4.5. Stable isotopes

Isotope values of *Triticum* sp. charred seeds range from -22.3 to -20.5‰ and from 3.9 to 11.1‰, respectively for carbon and nitrogen (Table 4). The typical $\delta^{13}C$ values of modern C_3 plants present a modal value of -27‰ (O'Leary, 1988), while archaeological crop species can range between -26.7 to -21.1‰ (Riehl et al., 2008). A variety of environmental factors can affect their ratios and explain the more positive $\delta^{13}C$ values measured on Chobareti seeds

(Tieszen, 1991). Compared to modern values, one could be the depletion of atmospheric CO_2 in modern time due to anthropogenic addition of CO_2 (Tieszen and Fagre, 1993), as well as the fact that seed proteins isotope values are enriched relative to leaf tissue because of their low cellulose content (Tieszen, 1991; Heaton, 1999). Among the factors which could affect $\delta^{13}C$ values, the altitude could be a reliable one to explain the high *Triticum* sp. $\delta^{13}C$ values. As altitude increases the partial pressure of CO_2, an increase of 1‰ per 1000m of $\delta^{13}C$ values can be expected in plant (Heaton, 1999). Similarly, a water stress as well as a high nutrient level in soil can be correlated with an enrichment in ^{13}C of plant tissues (Tieszen, 1991). In addition, concerning the wide dispersion of $\delta^{13}C$ values, the inter-individual seed variability could be related to the short-term seasonal/annual indicating the presence of seeds from different harvests (Heaton, 1999). $\delta^{15}N$ values of modern C_3 and C_4 plants of a wide variety of environments range from -1 to 6‰ (Heaton, 1987). Among factors which could increase the nitrogen isotope ratios, the modification of the environment by human might be one of the more relevant (Bogaard et al., 2007; Fraser et al., 2011).

Human and animal bones present yields of collagen extraction above 15.6mg/g (m=94.3±47.0mg/g, n=31). The percentages of carbon and nitrogen are above the required limits (%C: 39.4±1.8%: %N: 14.4±0.7%) and the C/N ratios have a mean of 3.2 indicating a well preservation for all collagen samples (Table 4). For herbivores (Fig. 8), $\delta^{13}C$ values range from -20.5 to -18.4‰ (-19.5±0.5‰, n=21) and from 3.3 to 8.1‰ (5.7±1.3‰, n=21) for $\delta^{15}N$ values (Fig 8). A sole wild animal, the bison, is included in the isotope variability of *Bos* sp. indicating a similar environment occupancy. Its carbon and nitrogen isotope values are amongst the highest (-18.5‰; 7.1‰) within *Bos* sp. group. Bovid group express significant higher nitrogen isotope values in comparison to *Ovis/Capra* group ($p(\delta^{15}N)=0.02$, Mann Whitney test), for which no biological explanation, as the age at death, can be evoked. On the other hand, both groups exhibit no difference for $\delta^{13}C$ values, indicating a similar environment occupancy constituted mainly by C_3 plants.

Human $\delta^{13}C$ and $\delta^{15}N$ values range respectively from -19.3 to -18.1 ‰ and from 9.8 to 13.9‰ (Table 3, Fig 8). The wide dispersion of $\delta^{15}N$ values (4.1‰) can be explained by the value of a young child (under one year-old), who was probably breastfed at his/her death (Katzenberg et al., 1996). Removing this specific individual, the dispersion of $\delta^{13}C$ and $\delta^{15}N$ values becomes very low (respectively about 0.3‰ and 1.4‰), highlighting a homogeneous dietary practice within the group (O'Connell and Hedges 1999; O'Connell et al., 2001). In addition, despite an apparent diversified funeral practices identified, any significant relation has been

observed between isotopic values, funerary and biological criteria, confirming the strong homogeneity of dietary practices at Chobareti.

5. Discussion

5.1. Surrounding vegetation

Despite the clear anthropogenic origin of botanical remains accumulations in the pits, they can provide some information about the surrounding vegetation. In the pollen and charcoal spectra from Chobareti site, coniferous, as well as deciduous broadleaved trees, are attested (Fig. 5). Pine is predominant according to both proxies. In pollen assemblages, fir (*Abies*) is better represented than spruce (*Picea*), which is a trend also recorded for the same period (4500-4000 cal BP) in continuous pollen sequences from lakes such as Aligol or Paravani (Connor, 2011; Messager et al., 2013). The presence of *Pinus* in the form of charcoal indicates its occurrence in the Chobareti vicinity. Deciduous trees such as oak, maple or hornbeam have been identified in charcoals assemblages (Table 6), whereas they are slightly recorded in pollen spectra. Charcoal reflects local environment, which is the one exploited for fuel gathering according the "principle of least effort" defined by Shackleton and Prins (1992). The occurrence of few fragments of yew seeds (*Taxus baccata*), and holly (*Ilex aquifolium*) charcoal confirms the local presence of dense forests, as both taxa are shade-loving species. All archaeobotanical data deliver a partial picture of the vegetation due to the anthropogenic origin of the assemblages but the palaeoenvironmental information they provide fits well with pollen records from regional natural sequences (Margalitadze, 1995; Connor, 2011; Messager et al., 2013). It's important to note that the landscape depicted by palaeoenvironmental records on the Javakheti Plateau is completely different from the present-day landscape, mainly dominated by steppic grassland (Nakhutsrishvili, 1999; Matcharashvili et al., 2004).

5.2. Agricultural practices

5.2.1. Cultivated cereals

In Chobareti, phytoliths and pollen as well as plant macroremains show a predominance of cereals in the studied pits. Pollen assemblages are not so well-preserved than in the lakes, but deliver information concerning human practices, which are badly recorded in pollen sequences from lakes (Messager et al., 2013; Joannin et al., 2014). According to seed analysis, *Triticum* (wheat) is the most important cereal in Chobareti, while *Hordeum* (barley) is found in very low quantity. Within *Triticum*, it seems that naked wheat, and probably the

hexaploid form (*T. aestivum*), is the most cultivated cereal, even if *T. dicoccum* (emmer) predominates in pits 17 and 18. Indeed, cereals in pit 16 are much more abundant than in pits 17 and 18 (Table 5). In the latter, few grains and chaff of emmer (n=136) were identified whereas naked wheat widely predominates in pit 16 with more than 2,000 pieces of chaff (Fig. 6).

The studied pits only draw a partial picture of the relative proportions of cultivated cereals. The archaeobotanical analysis of other sectors of the site is currently under process (C. Longford, University of Sheffield) and will give further information. Nevertheless, these first data at Chobareti confirm that, as previously observed on other K-A sites in the region, *Triticum aestivum* is one of the most important cultivated cereals, with *Hordeum*. For instance, in Armenia, on the sites of Tsaghkasar and Arapan III, located between 1860 and 2080m a.s.l, *T. aestivum* and *Hordeum*, mainly hulled, predominate while *T. dicoccum* is very discrete (Hovsepyan, 2010; 2011). In Gegharot, around 2000m a.s.l, hulled barley represents 96.1% of the assemblage, together with few bread wheat grains and weeds (Hovsepyan, 2009). In northeast Turkey, at Sos Höyük, bread wheat and hulled barley also predominate (Longford et al., 2009). In Azerbaijan, the site of Ovçular Tepesi (912m a.s.l) also delivered naked hexaploid wheat, and barley, including hulled form (Decaix, 2011).

In Chobareti, the presence of *T. dicoccum* is interesting, considering that hulled wheats (*Triticum monococcum*, *T. dicoccum*, *T. spelta*) are rare, or even missing, on other K-A sites. At the contrary, we found very few grains of *Hordeum* (n = 18, including six hulled forms), whereas this cereal is predominant elsewhere. In this way, further analyses on the site should precise the status of emmer and barley. The abundance of cereal remains in Chobareti, as well as in other sites we have mentioned above, shows that K-A populations successfully managed mountainous environments for cereals cultivation. Indeed, Chobareti is located on the western part of the Javakheti Plateau (1500-2000m a.s.l), which is still today, a fertile land where barley and wheat are widely cultivated.

5.2.2. Seed isotopic values: evidence of manuring?

Chobareti charred seeds display more positive $\delta^{15}N$ values than excepted variability for plants (Heaton, 1987). The aridity is usually evoked to explain this kind of shift (Ambrose, 1991). But, in this region, the different palaeoecological records do not reveal a drought phase at that time (Connor 2011; Messager et al., 2013). Recently, agricultural long-term and short-term experiments have been done to understand the impact of animal manure application on the $\delta^{15}N$ values of a broad range of crops and pulses (Bogaard et al., 2007; Fraser et al., 2011). It

has been demonstrated a gradual increase of $\delta^{15}N$ values in modern wheat and barley samples related to low, medium and high manuring rates, with the respective ranges: inferior to 3‰, from 3 to 6‰ and up to 6‰ (Bogaard et al., 2013). The wide variability of Chobareti wheat $\delta^{15}N$ values (from 3.9 to 11.1‰; Fig. 8) could be explained by different strategies of manuring. Wheat may have not grown in the same location, and/or in the meantime, indicating specific practices of using animal dung, to restore nutrients and enhance crop yields. Even if, only wheat seeds have been considered here, their specific isotopic pattern constitute a great constraint to interpret animal and human isotope values and assess the potential contribution of domesticated cereals in their diets.

5.2.3. Animal husbandry practices

The animal $\delta^{13}C$ values display a range from -20.5 to -18.4‰, in agreement with a consumption of C_3 plants which fits well with the archaeobotanical assemblages. Considering wheat seed $\delta^{13}C$ values, whatever animal species, the diet-tissue spacing ($\Delta^{13}C_{seed\text{-}bos}$= 1.7‰; $\Delta^{13}C_{seed\text{-}ovis/capra}$= 1.9‰) is significantly less important than the average of +5‰ observed between $\delta^{13}C_{collagen}$ and $\delta^{13}C_{diet}$ in numerous experimental animal studies (Froehle et al., 2010). Our data can't be explained by a regular consumption of wheat, whatever seeds, or chaff, even if these last have lower $\delta^{13}C$ and $\delta^{15}N$ values than seeds (Tieszen, 1991; Bogaard et al., 2007). The high $\delta^{15}N$ values of *Bos* sp. in comparison with those of *Ovis/Capra* sp. suggest various strategies to feed those animals. In addition, our results could indicate herding practices based on the use of animal dung for agriculture and the probable use of different pastures rather than a feeding strategy based on wheat chaff.

5.3. Function of the pits

In the pits, among cereals remains, chaff is very abundant, especially in pit 16, where only 6.8% of wheat remains are grains. The assemblage is composed of rachis and awn (not counted) fragments, spikelet forks and glume basis, probably waste products of threshing. This hypothesis is strengthened by the presence of common arable weeds in the macroremains assemblages (e.g. *Fallopia convolvulus*, *Euphorbia helioscopa*, *Polygonum aviculare*) as well as in the pollen assemblage (*Polygonum* sp., *Convolvulus* sp.). The phytolith spectra from pits 17 and 18, displaying a lot of dendritic phytolith and fragmented silicified epidermis, support the interpretation of cereals threshing.

All these botanical remains evidence cereals processing, however their presence in these pits

can have several origins. Threshing by-products can be stored and used for fuel or forage. It is also plausible that the pits were silos re-used as rubbish dumps. It is difficult to determine whether there was *in situ* burning in the pits or if the material has been deposited after being charred elsewhere. Plant remains could also come from burnt dung. It has been demonstrated that the burning of dung cakes is a plausible pathway for the presence of charred cereals remains, especially threshing by-products like chaff, which was used as fodder (Miller, 1984). In Chobareti, this interpretation could be supported by the record of spores of coprophilous fungi (e.g. *Sordaria*), but no spherulites have been observed in the sediment. In this case, it is challenging to assign a function to those pits.

5.4. Human dietary breadth

Animal and human $\delta^{13}C$ values (average respectively -19.5‰ and -18.8‰), as well as $\Delta^{13}C$ offset between the Chobareti domesticated animals and human isotopic values of 0.7‰, suggest a dietary pattern focusing on either the direct consumption of C_3 plants and cereals, as recorded by archaeobotanical data, or the exploitation of livestock products (meat, secondary products) of animals fed on C_3 plants. In the same vein, the $\Delta^{15}N$ of 4.9‰ between local animals and adult humans indicate a significant contribution of animal proteins in human diet. It highlights an exploitation of livestock products as much as, or more than plant products. Alternatively, based on the theoretical enrichment in heavy isotopes between two consecutive trophic levels (on average +0.8 ‰ in ^{13}C and +4‰ in ^{15}N; Bocherens and Drucker, 2003), the expected mean isotopic values of the consumed food items by the adult group would be around -19.7±0.2‰ and 6.6±0.5‰, for respectively carbon and nitrogen. These isotope values would refer to a preferential consumption of bovid meat, since these animals present significantly higher $\delta^{15}N$ values in comparison with those of *Ovis/Capra* group.

Furthermore, recent isotopic data on modern freshwater fishes from the Northern Caucasus can be used as proxy to question their consumption by humans (Higham et al., 2010, Svyatko et al., 2013). Even if freshwater fish did contribute to the diet, it was not significant enough to be recorded in the isotopic composition of Chobareti human tissues (Fig. 8). In addition, as previously mentioned, concerning management practices of arable land, the consumption of animal proteins could be overestimated instead of the consumption of vegetal ones (Bogaard et al., 2013). Indeed, wheat seeds of Chobareti show $\delta^{15}N$ values, similar to those of herbivores, making difficult the estimation of proportion of animal *versus* vegetal proteins in human diet (Fig. 8). Another limit comes from the magnitude of $\Delta^{13}C_{diet\text{-}collagen}$ that can greatly

vary depending on the $\delta^{13}C$ values of dietary macronutrients (Froehle et al. 2010). While archaeological seeds were analysed to evaluate the crop contribution to human and/or herbivore diet, their isotopic values reveal a problem of equifinality for past dietary reconstruction. To gain insight about the real contribution of C_3 cereals to Chobareti diet, carbon isotope analyses of human bone apatite could be undertaken, as prescribed elsewhere (Kellner and Schoeninger, 2007).

In any case, our results support the view of a mixed diet for the Chobareti group involving a direct consumption of cereals as well as a consumption of meat or dairy products from the livestock. While funerary practices are diversified, the low dispersion of carbon and nitrogen isotope values supports the hypothesis of a community life, without any social, age or sex distinction in the food item choices. Such a pattern could be in relation with either the stability of the environment through time (Connor, 2011; Messager et al., 2013), a homogenous range of food items at this altitude, or the equality of the Kura-Araxes people, as already proposed, based on socio-cultural features (Sagona, 1994).

6. Conclusion

This pilot study, involving archaeobotanical and isotopic investigations, performed at Chobareti site, has started to draw a picture of the subsistence activities in mountainous environment of the South Caucasus during the Kura-Araxes culture.

All botanical data indicate that inhabitant of Chobareti cultivated cereals. Cultivated crops were essentially naked wheat, including *Triticum aestivum* and *Triticum dicoccum* (emmer). The threshing process is attested by phytoliths as well as macroremains assemblages, both dominated by cereal chaff remains. Chobareti community appears to be an efficient farming group, able to grow wheat and barley up to 1600m a.s.l.. High $\delta^{15}N$ values of wheat seeds suggest that animal dung were used to restore nutrients and enhance crop yields. Animal nitrogen stable isotope data indicate different herding practices based on differential occupancy of environments. In the meantime, both animal and human carbon stable isotope data support C_3 plants and cereals consumption. Whereas biological and funerary records support diversified cultural traits, a mixed diet, with a great contribution of animal protein source (meat, secondary products) seems homogenous within the entire Chobareti population.

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760 **Captions**

761 Figure 1. Map showing the location of Chobareti.

762 Figure 2. Bottom: location of the pipeline corridor and the Kura-Araxes site of Chobareti,
763 Top: Chobareti structures. A. Burials, B. Structure 4.

764 Figure 3. Chobareti: trench 1 (2011) in which archaeobotanical sampling was undertaken.

765 Figure 4. Phytolith assemblages (%) of pits 17 and 18 from Chobareti.

766 Figure 5. Pollen and non-pollen palynomorphs (NPP) assemblages (%) of pit 18 from
767 Chobareti.

768 Figure 6. Different proportions of cereals identified in pits 16, 17 and 18 from Chobareti,
769 according to the number of caryopsis and chaff. For chaff, we took into account only spikelet
770 fork and glume basis, estimating that one spikelet fork = two glume basis, and only rachis
771 segments for naked wheat.

772 Figure 7. Charcoal assemblages from pits 16, 17 and 18. N=number of identified charcoals for
773 each pit of Chobareti.

774 Figure 8. Carbon and nitrogen isotope ratios for animals, seeds and humans from Chobareti.
775 (Freshwater fish data from Higham et al., 2010 and Svyatko et al., 2013)

776

777 Table 1. List of AMS ^{14}C dates from Chobareti. All data are from Kakhiani et al., 2013,
778 except samples Poz-56370 (Burial 5) and Poz-56370 (Burial 9). 14C ages were calibrated
779 using INTCAL09 (Stuiver and Reimer, 1993, Reimer et al., 2009).

780 Table 2. Phytolith morphotypes (following ICPN Working Group et al., 2005) identified in
781 Chobareti with their taxonomic attributions and the corresponding literature.

782 Table 3. Archaeological, funerary, biological data and isotope values for humans from
783 Chobareti

784 Table 4. Archaeological data and isotope values for animals and seeds from Chobareti

785 Table 5. Plant macroremains identified in pits 16, 17 and 18 from Chobareti.

786 Table 6. Results of charcoal analysis from pits 16, 17 and 18 from Chobareti.

787 Supplementary data SD1. Archaeothanatological study

788 Supplementary data SD2. Archaeobotanical material from pits 16, 17 and 18

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Lab. Code	material	Radiocarbon Age BP			Age cal BC
Wk-34451	charcoal	4490	±	33	3349-3089
Wk-34452	charcoal	4470	±	36	3341-3024
Wk-34453	charcoal	4528	±	33	3244-3101
Wk-34454	charcoal	4517	±	35	3359-3262
Wk-34455	charcoal	4501	±	39	3356-3090
Wk-34456	charcoal	4501	±	33	3351-3094
Wk-34457	charred grain	4451	±	34	3338-3208
Wk-34458	charred grain	4451	±	34	3195-3007
Wk-34459	charred grain	4434	±	35	3125-2926
SacA 27471	charcoal	4500	±	30	3348-3096
SacA 27472	charcoal	4535	±	30	3241-3104
Poz-56370	human bone	4460	±	40	3346-2944
Poz-56371	human bone	4380	±	40	3264-2902

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Samples	median depth	Age BP			Age cal BP	remarks
PAR09-P1-0-2	1	0	±	0	0	
PAR09-P1-12-13	12.5	525	±	30	509-628	
PAR09-P3-25-27	26	490	±	45	474-632	rejected
PAR09-P1-35.5-36.5	36	2430	±	40	2351-2702	
PAR09-P1-45.5-46.5	46	5345	±	35	6000-6269	rejected
PAR09-P6-54-56	55	5355	±	40	6001-6275	
PAR09-P1-61.5.5-62.5	62	6325	±	30	7171-7313	
PAR09-P8-68-70	69	7400	±	50	8050-8355	
PAR09-P1-81.5.5-82.5	82	10740	±	40	12563-12739	rejected
PAR09-P10-94-96	95	10690	±	50	12548-12710	

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		top depth	base depth	median depth	Age BP			Age cal BP	remarks
PAR09-P1-0-2	PAR09-P1	0	2	1	0	±	0	0	
PAR09-P1-12-1	PAR09-P2	12	13	12.5	525	±	30	509-628	
PAR09-P3-25-2	PAR09-P3	25	27	26	490	±	45	474-632	rejected
R09-P1-35.5-3	PAR09-P4	35.5	36.5	36	2430	±	40	2351-2702	
R09-P1-45.5-4	PAR09-P5	45.5	46.5	46	5345	±	35	6000-6269	rejected
PAR09-P6-54-5	PAR09-P6	54	56	55	5355	±	40	6001-6275	
R09-P1-61.5.5-6	PAR09-P7	61.5	62.5	62	6325	±	30	7171-7313	
PAR09-P8-68-7	PAR09-P8	68	70	69	7400	±	50	8050-8355	
R09-P1-81.5.5-8	PAR09-P9	81.5	82.5	82	10740	±	40	12563-12739	rejected
AR09-P10-94-9	PAR09-P10	94	96	95	10690	±	50	12548-12710	

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Morphotypes	Main taxonomic attribution	Bibliography
Elongate	Poaceae	Twiss et al., 1969 (elongate)
Elongate dendritic	Poaceae	Ball et al., 1996 (dendriform)
Acicular	Poaceae	Twiss et al., 1969 (point-shaped)
Short acicular	Poaceae	Kaplan et al., 1992 (short point)
Bulliform (cuneiform & parallepipedal)	Poaceae	Twiss et al., 1969 (fan-shaped)
Papillae	Poaceae	Rosen, 1992 (papillae)
Rondel & trapeziform short cells	Poaceae, Pooideae	Fredlund et Tieszen, 1994 (keeled, conical, pyramidal)
Sinuate trapeziform	Poaceae, Pooideae	Mulholland, 1989 (sinuate)
Bilobate	Poaceae, Panicoideae/Arundinoideae	Brown, 1984 (bilobate)
Cylindric sulcate	cf. Dicotyledonous	Strömberg, 2002 (tracheid)
Globular	cf. Dicotyledonous	Runge, 1999 (spherical)
Jigsaw	cf. Dicotyledonous	Bozarth, 1992 (jigsaw)
Point-hair	No taxonomic value	Pearsall, 2000 (hair cell)

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Burial	#Catalog	Individual	Funerary practices	Decomposition	Stage	Skull[1]		Coxal		Skeletal Element	Yield (mg/g)	%C	%N	C/N	$\delta^{13}C_{V\text{-}PDB}$	$\delta^{15}N_{Air}$
						Age	Sex	Age[2]	Sex[3]							
Burial 1	2838		Primary burial	Filled space	adult	30-35	M	25-30[a]		Phalanx	104.3	42.1	15.7	3.1	-19.0	9.8
Burial 2	2846	1	Several inhumation	?	adult	40-45	F			Skull	58.7	38.9	14.1	3.2	-18.7	10.8
Burial 2	2840	3	Several inhumation	?	adult	50-55	M			Skull	30.6	35.2	12.7	3.2	-18.8	11.2
Burial 2	2839	4	Several inhumation	?	adult	20-25	F	20-29[b]	F[b]	Skull	106.9	37.9	13.8	3.2	-19.3	10.5
Burial 4	-		Primary burial	Filled space	adult	25-30	F			Skull	78.4	41.0	15.1	3.2	-18.9	10.8
Burial 5	2845		Primary burial	Filled space	adult	30-35	M	25-30[a]		Phalanx	57.3	40.1	14.8	3.1	-18.8	11.0
Burial 7	2842		Primary burial	Filled space	subadult	5y		2y-3y6m[c]		Skull	114.9	41.3	15.0	3.2	-18.9	9.9
Burial 8	2843	1	Primary burial	Filled space	adult	40-45	F	>40[2]	F	Phalanx	33.6	40.9	14.9	3.2	-18.7	10.1
Burial 8	-	2	?	?	adult	25-30				Skull	40.8	37.9	13.7	3.2	-19.0	11.0
Burial 9	2944		Primary burial	Filled space	subadult	1y		1y[d]		Skull	46.6	38.6	14.1	3.2	-18.1	13.9
										Mean	*67.2*	*39.4*	*14.4*	*3.2*	*-18.8*	*10.9*
										N	*10*	*10*	*10*	*10*	*10*	*10*
										SD	*31.8*	*2.1*	*0.9*	*0.03*	*0.3*	*1.2*
										minimum	*30.6*	*35.2*	*12.7*	*3.1*	*-19.3*	*9.8*
										maximum	*114.9*	*42.1*	*15.7*	*3.2*	*-18.1*	*13.9*

Several inhumation: no possibility to reconstruct the chronology/reorganization of the skeleton deposits and to cut off between reductions and secondary deposits

[1]Buikstra and Ubelaker 1994; [2]Schmitt 2005; [3]Bruzek 2002; Murail et al. 2005

[a]based on fusion of sternal extremity of clavicula; [b]coxal bone could be associated with this skull but nothing is sure; [c]dental age expressed in years/months after Moorrees et al. 1963a, 1963b; [d]Age expressed in years based on long bone measurements after Scheuer and Black 2000

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#Lab	Excavation	Archaeological Information	Species	Skeletal Element	Yield (mg/g)	%C	%N	C/N	$\delta^{13}C_{V\text{-}PDB}$	$\delta^{15}N_{Air}$
CHOF01	2011	Trench I	*Bos* sp.	Femur	44.0	40.1	14.6	3.2	-19.9	6.0
CHOF02	2011	Trench I	*Bos* sp.	Radius	67.4	41.0	14.8	3.2	-18.9	5.5
CHOF04	2011	Trench I	*Bos* sp.	Talus	58.2	39.4	14.3	3.2	-20.2	8.1
CHOF05	2011	Trench I	*Bos* sp.	Calcaneum	75.6	39.9	14.4	3.2	-20.0	6.1
CHOF06	2011	Trench I	*Bos* sp.	Phalanx	15.6	39.4	14.1	3.2	-19.2	5.1
CHOF09	2009	Building 4	*Bos* sp.	Talus	81.5	40.4	14.6	3.2	-19.2	7.9
CHOF10	2009	Building 4	*Bos* sp.	Radius	40.2	37.4	13.7	3.2	-19.6	4.6
CHOF11	2009	Building 4	*Ovis* sp.	Humerus	73.6	39.8	14.6	3.2	-18.4	3.3
CHOF12	2009	Building 4	*Bos* sp.	Radius	101.7	42.6	15.3	3.2	-20.5	5.3
CHOF30	2009	Pit 4	*Bison* sp.	Calcaneum	149.9	38.6	14.4	3.1	-18.5	7.1
CHOF31	2009	Pit 4	*Bos taurus*	Mandibula	128.3	35.8	13.1	3.2	-19.4	7.9
CHOF32	2009	Pit 4	*Ovis/Capra*	Femur	156.9	41.6	15.3	3.2	-19.6	5.0
CHOF33	2009	Pit 4	*Ovis/Capra*	Mandibula	130.1	38.0	13.9	3.2	-19.4	4.9
CHOF34	2009	Pit 4	*Ovis/Capra*	Radius	164.7	39.9	14.7	3.1	-19.0	4.5
CHOF35	2009	Pit 4	*Ovis/Capra*	Humerus	120.3	40.4	14.7	3.2	-19.5	5.9
CHOF36	2009	Pit 4	*Ovis/Capra*	Femur	116.4	41.4	15.1	3.2	-19.5	4.3
CHOF37	2009	Pit 5	*Ovis/Capra*	Metapode	94.4	36.1	13.2	3.2	-19.9	6.3
CHOF38	2009	Pit 4	*Ovis/Capra*[a]	Mandibula	126.3	38.7	14.1	3.2	-19.1	5.7
CHOF39	2009	Pit 4	*Ovis/Capra*	Tibia	155.6	38.9	14.2	3.2	-19.5	4.1
CHOF40	2009	Pit 6	*Ovis/Capra*	Rib	146.5	39.0	14.2	3.2	-19.3	5.2
CHOF41	2009	Pit 13	*Ovis aries*	Phalanx	204.4	38.4	14.1	3.2	-20.0	5.9
CHO.BL01	2012	Pit 16	*Triticum a/d/t*	Charred seed		66.1	4.8	-	-21.4	6.0
CHO.BL02	2012	Pit 16	*Triticum a/d/t*	Charred seed		61.6	4.2	-	-20.5	6.6
CHO.BL04	2012	Pit 16	*Triticum a/d/t*	Charred seed		58.6	5.0	-	-20.8	6.0
CHO.BL05	2012	Pit 16	*Triticum a/d/t*	Charred seed		61.3	4.5	-	-21.2	3.9
CHO.BL06	2012	Pit 16	*Triticum a/d/t*.	Charred seed		59.1	3.8	-	-21.7	11.1
CHO.BL07	2012	Pit 16	*Triticum a/d/t*	Charred seed		59.5	3.5	-	-22.3	4.8

[a]No age information ; (*Triticum a/d/t = Triticum aestivum/durum/turgidum*)

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Samples	Pit 16	Pit 17	Pit 18	Total (MNI)
Samples volumes (litres)	4,9	20,7	23	**48,6**
Domesticated plants				
cf. Cerealia, grain	41	26	20	**87**
Cerealia, grain	296	189	66	**551**
Triticum sp., grain	14	31	12	**57**
Triticum sp., spikelet fork	136	-	-	**136**
Triticum sp., glume base	5519	281	100	**5900**
Triticum sp., rachis fragment	218	44	14	**276**
Triticum monococcum , grain	1	-	-	**1**
Triticum monococcum , spikelet fork	8	-	-	**8**
Triticum monococcum/dicoccum , spikelet fork	40	5	6	**51**
Triticum monococcum/dicoccum , rachis fragment	112	-	-	**112**
Triticum cf. *dicoccum,* grain	13	-	-	**13**
Triticum cf. *dicoccum* , glume base	25	-	-	**25**
Triticum dicoccum, grain	36	10	9	**55**
Triticum dicoccum , spikelet fork	50	1	1	**52**
Triticum dicoccum , glume base	89	94	21	**204**
Triticum cf. *æstivum/turgidum* , grain	18	-	-	**18**
Triticum æstivum/turgidum , grain	80	13	12	**105**
Triticum æstivum/turgidum , rachis fragment	2059	18	12	**2089**
Triticum æstivum, rachis fragment	423	12	3	**438**
cf. *Hordeum vulgare* , grain	8	1	2	**11**
Hordeum vulgare , grain	-	-	1	**1**
Hordeum vulgare hulled, grain	6	-	-	**6**
TOTAL CEREALS	**9192**	**725**	**279**	**10,196**
Trees and schrubs				
Rosa sp., seed	-	1	-	**1**
Rubus sp., seed	-	1	-	**1**
Taxus baccata , seed	-	2	1	**3**
Ruderal and arable-weeds				
cf. *Avena* sp., grain	**-**	1	1	**2**
Avena sp., grain	**-**	-	2	**2**
Buglossoides arvensis , seed	-	1	-	**1**
Chenopodium sp., seed	20	28	10	**58**
Chenopodium album , seed	6	17	8	**31**
Chenopodium hybridum , seed	-	5	4	**9**
Euphorbia sp., seed	-	1	1	**2**
Euphorbia helioscopia , seed	-	2	-	**2**
Fallopia convolvulus , seed	10	17	5	**32**
Galium sp., seed	49	62	15	**126**
Galium aparine , seed	-	-	3	**3**
Galium aparine/spurium , seed	-	161	35	**196**
Hyoscyamus niger , seed	-	2	-	**2**
Papaver sp., seed	4	-	-	**4**
Polygonum sp., seed	-	16	2	**18**
Polygonum aviculare , seed	-	1	-	**1**
Rumex sp., seed	25	-	-	**25**
cf. *Urtica dioica* , seed	-	1	-	**1**
Urtica dioica , seed	-	3	-	**3**
Miscellaneous				
cf. *Bromus* sp., grain	135	1	-	**136**
Bromus sp., grain	161	25	8	**194**
Brassicaceae, seed	3	-	-	**3**
Carex sp., seed	1	-	-	**1**
Caryophyllaceae, seed	-	1	-	**1**
Fabaceae type *Trifolium* , seed	15	29	10	**54**
Fabaceae type *Vicia* , seed	-	1	-	**1**
Lamiaceae, seed	-	3	-	**3**
Paniceae, grain	-	3	-	**3**
Poa sp., grain	4	-	-	**4**
Poaceae, grain	45	21	26	**92**
Poaceae type *Poa* , grain	-	8	3	**11**
Polygonaceae, seed	11	7	3	**21**
Rosaceae type *Potentilla* , seed	-	4	-	**4**
Teucrium sp., seed	-	1	-	**1**
Teucrium cf. *botrys* , seed	-	3	-	**3**
Foliar scar	-	3	-	**3**
Total	**9681**	**1157**	**416**	**11,254**
Concentration/litres	1975,7	55,9	18,1	231,6

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	Pit 16	Pit 17	Pit 18
Acer campestre type	33	8	-
Carpinus sp.	-	11	-
cf. *Carpinus* sp.	-	1	-
Corylus avellana	-	1	1
Fraxinus sp.	-	8	6
Maloideae	-	1	-
Ilex aquifoliuum	-	-	2
Pinus sylvestris type	-	126	18
Quercus deciduous	50	26	1
cf. *Quercus* sp.	-	1	-
Ulmu/Zelkova sp.	-	-	1
TOTAL (identified)	83	183	29
Unidentified	-	5	2
TOTAL	83	188	31

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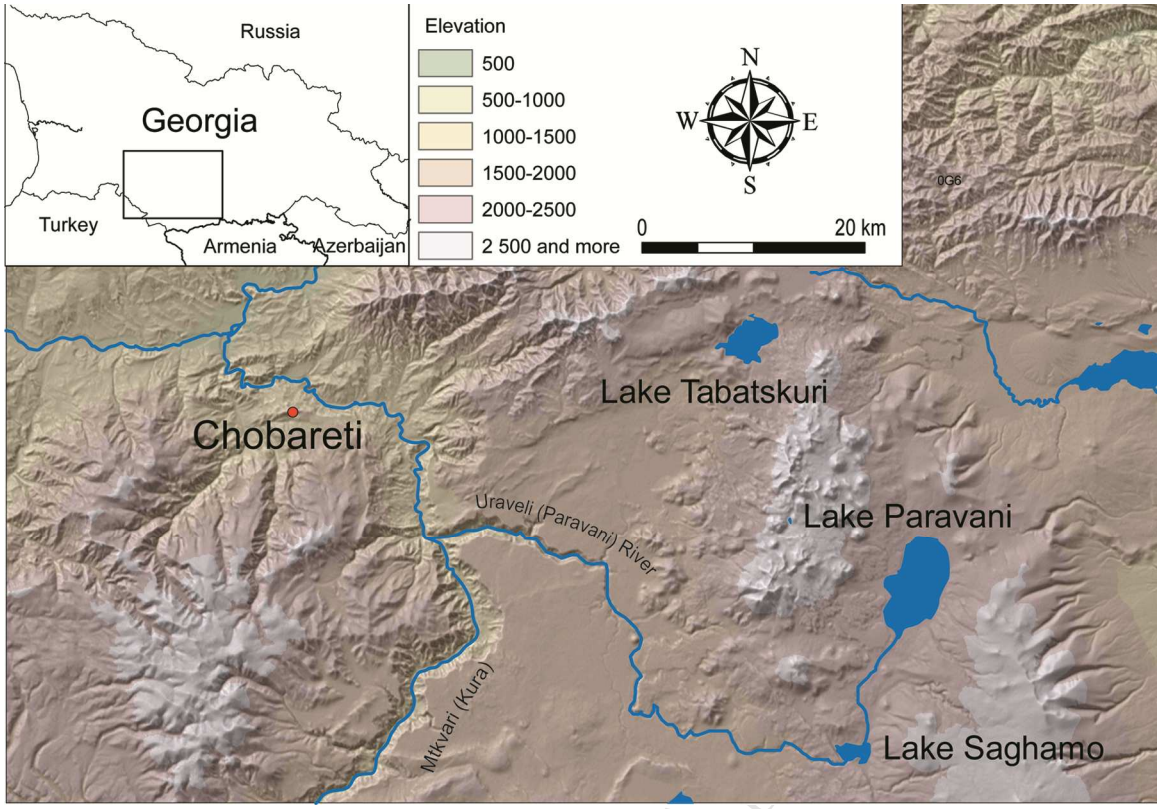
	Treligorebi I Square C4 building 4 locus 15 floor level 4	Treligorebi I Square E3 building 4 locus 3 (-4,00)	Treligorebi I Square E3 locus 12 2	
Fagus sp. *Quercus* caducifolié	1	1	24	
TOTAL	1	1	24	26

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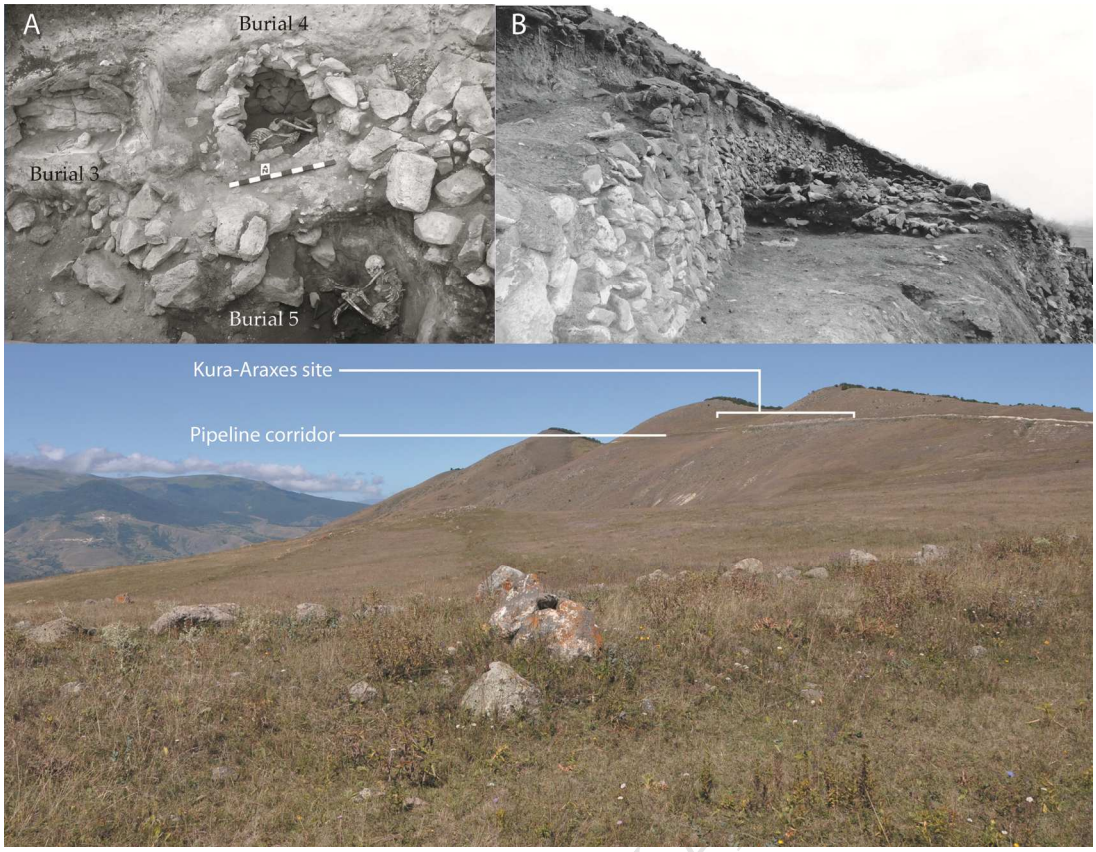
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	Godachrili Gora 2012 CB 13 US 123	Godachrili Gora 2012 CB9 US 142 Ashy layer	Godachrili Gora 2012 Fosse 148
Fraxinus sp.			5
Populus sp./*Salix* sp.			7
Angioperme dicotylédone	1		
	Rhamnacée?? Racine probable…	très petits et nbx cernes	monospé: 1 seul fgmt P. Nigra possible

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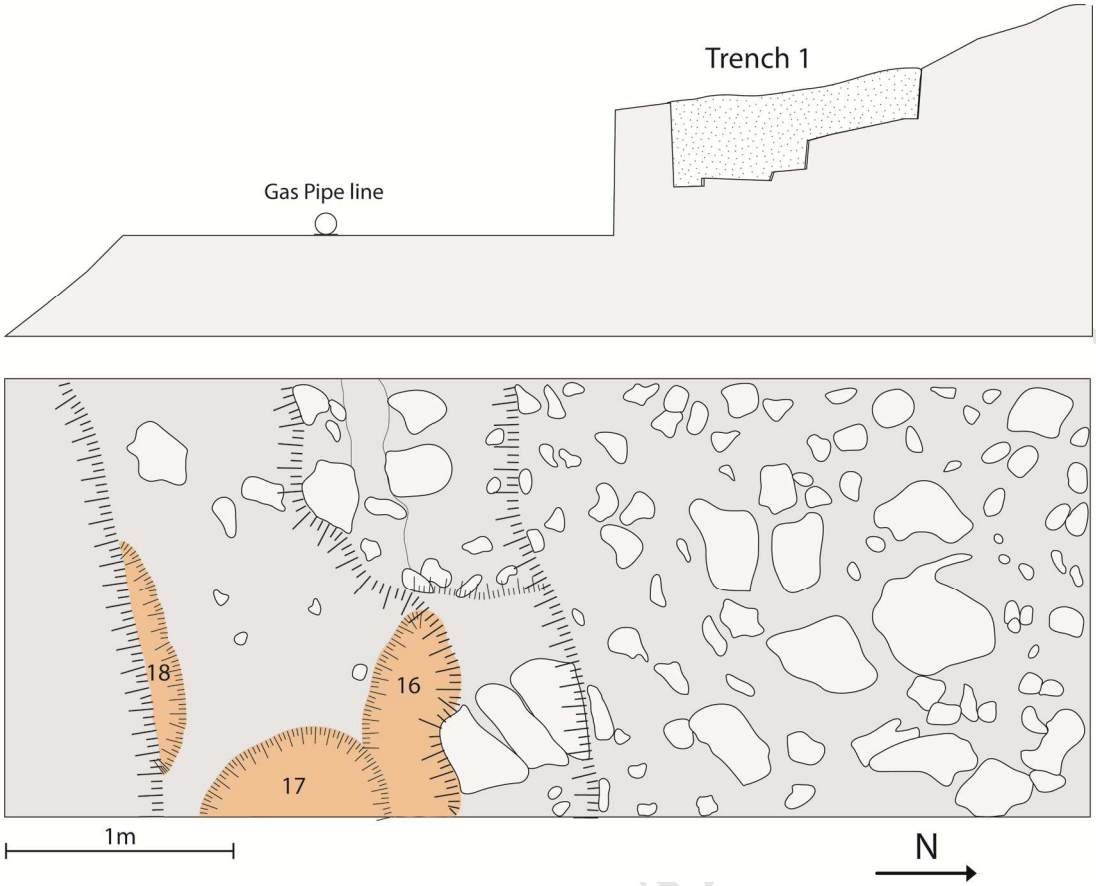


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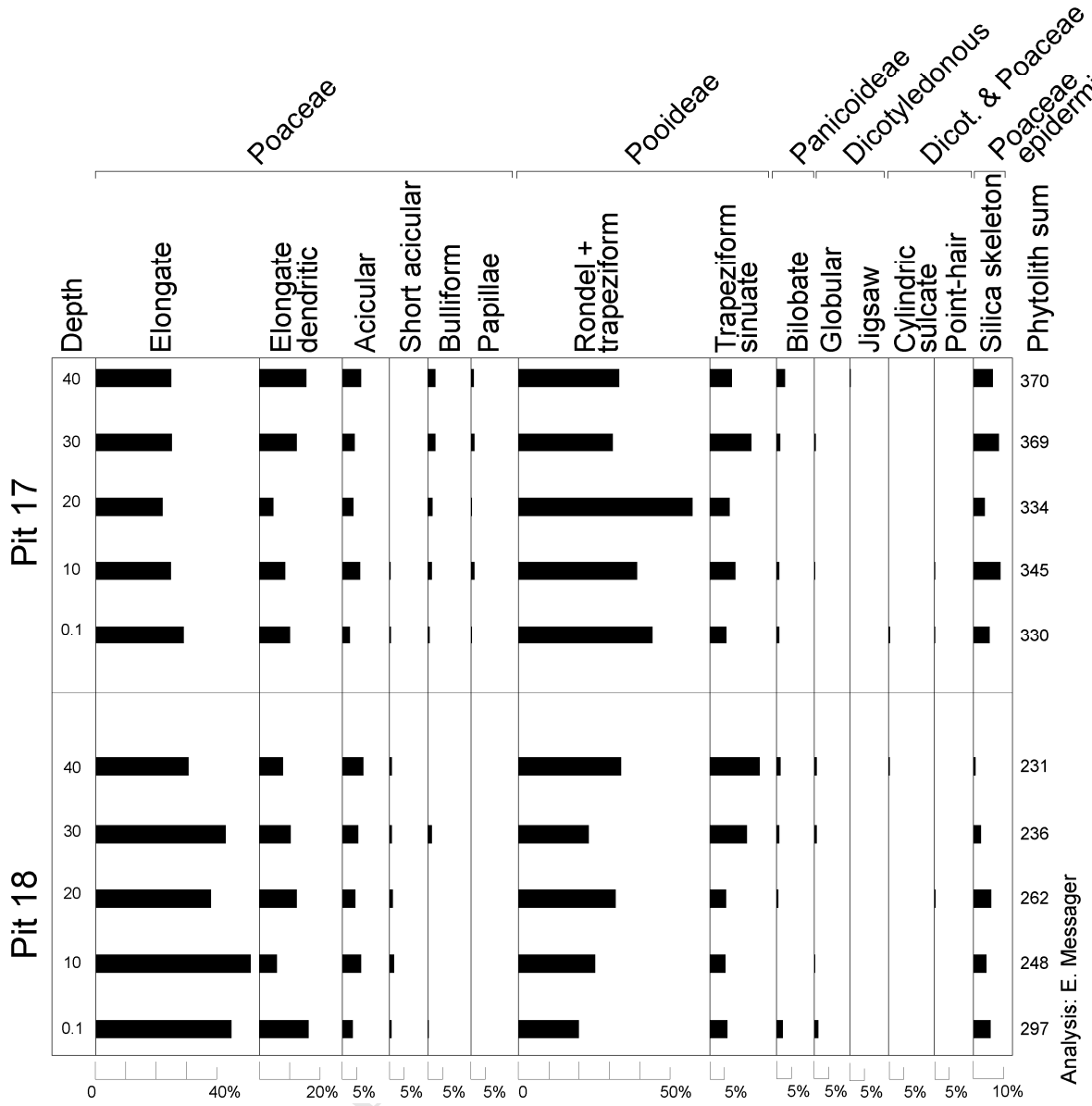
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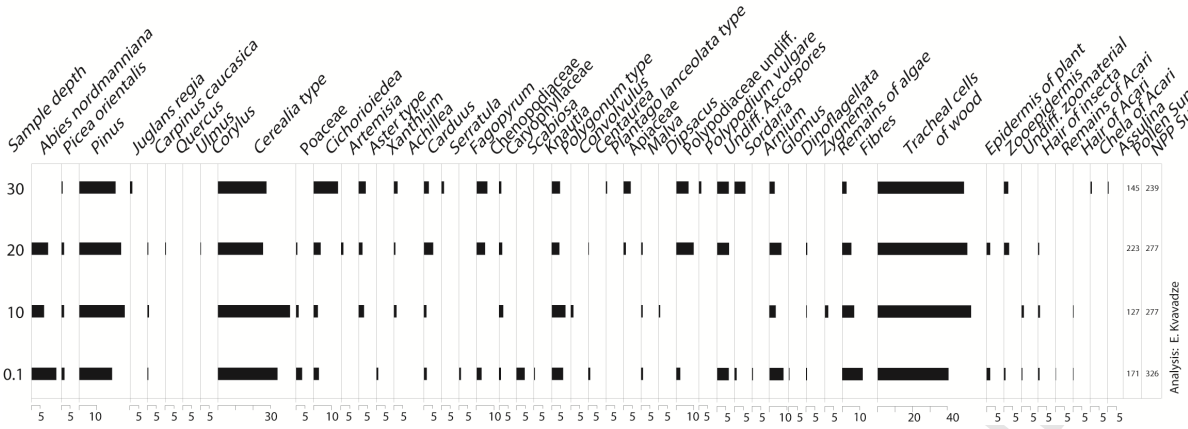


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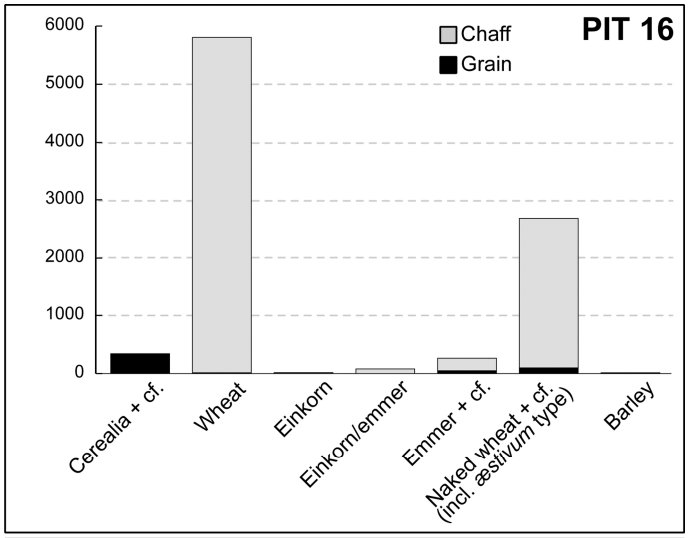
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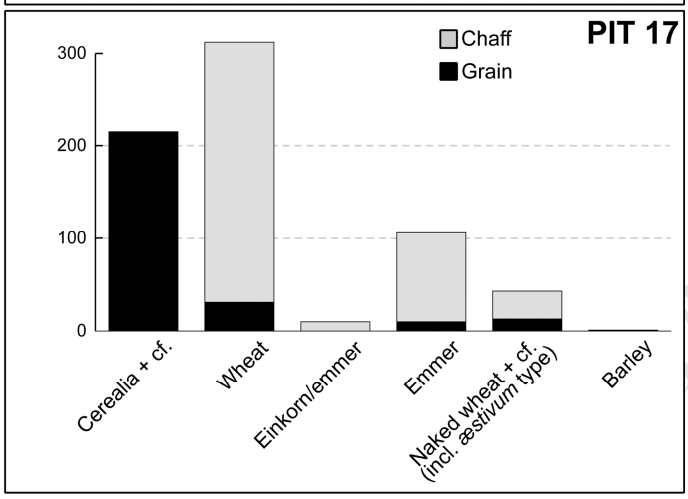


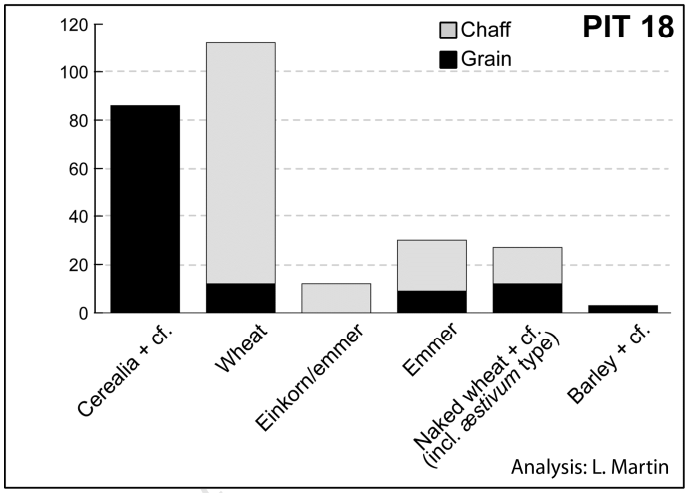
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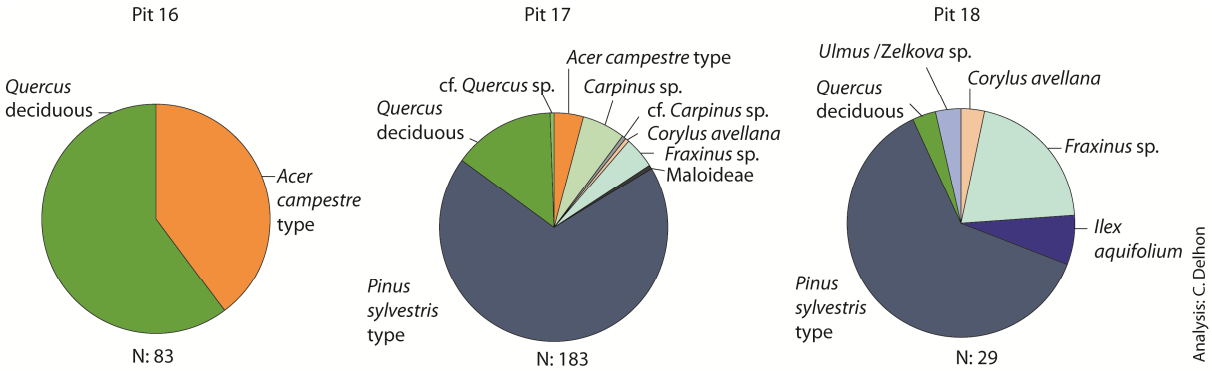
ACCEPTED MANUSCRIPT


PIT 16
Chaff
Grain
6000
5000
4000
3000
2000
1000
0
Cerealia + cf.
Wheat
Einkorn
Einkorn/emmer
Emmer + cf.
Naked wheat + cf. (incl. æstivum type)
Barley

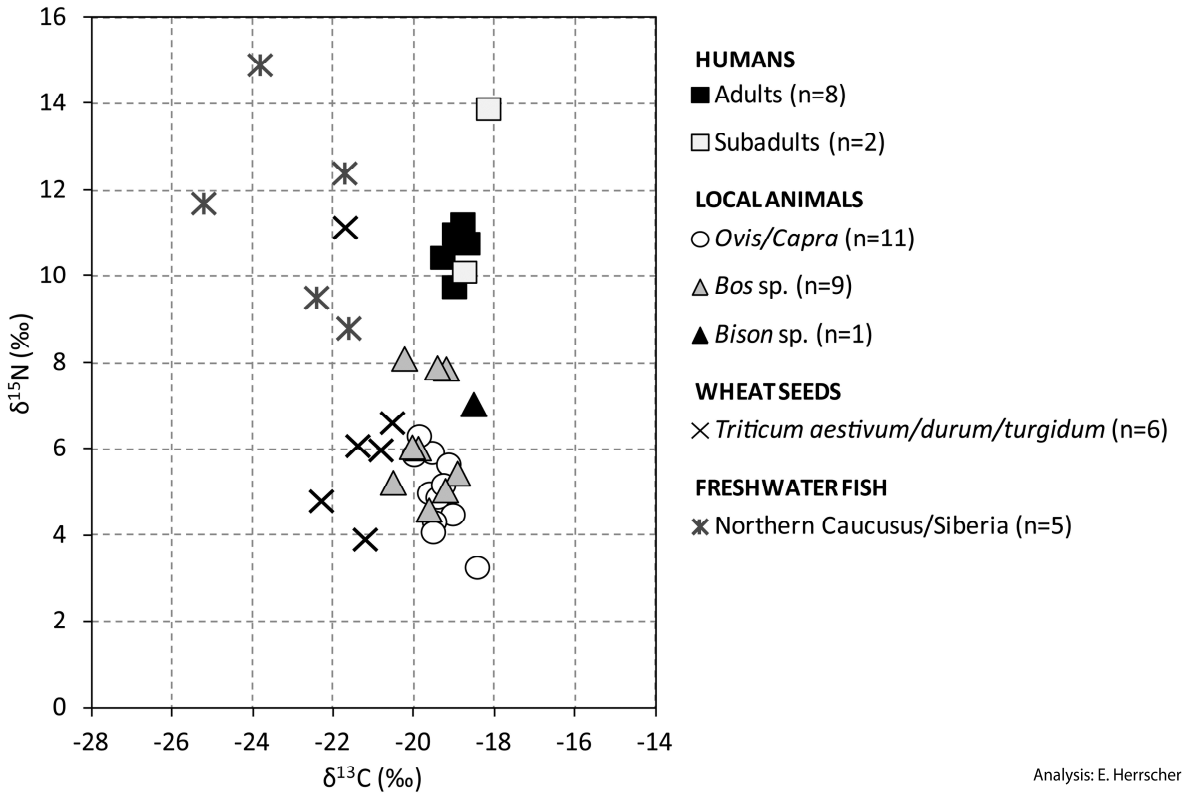

PIT 17
Chaff
Grain
300
200
100
0
Cerealia + cf.
Wheat
Einkorn/emmer
Emmer
Naked wheat + cf. (incl. æstivum type)
Barley


PIT 18
Chaff
Grain
120
100
80
60
40
20
0
Cerealia + cf.
Wheat
Einkorn/emmer
Emmer
Naked wheat + cf. (incl. æstivum type)
Barley + cf.
Analysis: L. Martin

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Analysis: E. Herrscher

ACCEPTED MA

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Highlights:

- Chobareti site is an Early Bronze Age settlement (3300-2900 cal. B.C.) located at 1615 m a.s.l. in the South Caucasus
- Archaeobotanical and stable isotope analysis have been performed on several pits and burials
- Phytoliths, pollen and macroremains highlight the importance of cereals cultivation in these highlands
- Isotope data suggest the use of manuring, differential herding practices, as well as C_3 plants consumption for both animals and humans
- Human dietary practices express a unique pattern with a preferential input of meat and dairy products

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Archaeobotanical material from pits 16, 17 and 18 of Chobareti (Georgia)



1: Spikelet fork of *Triticum monococcum/dicoccum*; 2-3: Spikelet fork of *Triticum monococcum*
4: Glume base of *Triticum monococcum*; 5: Grains of *Triticum aestivum/durum/turgidum*;
6: Rachis segment in connexion of *Triticum aestivum*;
7-8-9: rachis fragments of *Triticum aestivum/durum/turgidum*.
Photos: L. Martin.

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Sd1 **Archaeothanatological study (M Poulmarc'h)**

This archaeothanatological analysis is a part of a larger research, focusing on the funerary practices in Southern Caucasus from the 6th to the 3rd millennium B.C. (Poulmarc'h, 2014). In the case of Chobareti, the study revealed strict anatomical connections for most of the skeletons (burials 1, 4, 5, 7, 8 individual 1, and burial 9) indicating body decomposition in a filled space which corresponds to a gradually replacement of soft tissues by soil (Duday, 2009). Concerning the modalities of body deposit, two types were observed: primary burials (burials 1, 4, 5, 7, 8 individual 1, and burial 9) and possible reductions or secondary deposits (burials 2 and 8), both in rectangular structures in shape with stone walls. All individuals in primary burial were deposited in a crouched position on one side, however a difference was observed according to age groups. Adult bodies are right-crouched (burials 1, 4, 5 and 8) while subadults are left-crouched (burials 7 and 9). Reductions are characterized by additional treatments of bones after body decomposition, which could have been motivated by the grave digger to clear the necessary space for depositing a new individual (Duday, 2009). Secondary deposits correspond to the transfer of part of skeleton in a different location, from where the body was decomposed. For instance, in burial 8, one notes a primary burial of a female and bones of two occupants (one adult and one subadult), located to the west wall of the tomb, for which it is not possible to cut off between reductions and secondary deposits. In burial 2, at the northwest corner, commingled bones evoke the displacements (reductions or secondary deposits), at least, of three individuals and a primary deposit of one of them suggested by the presence of anatomical connections of lower limbs and ribs (Poulmarc'h, 2014). In addition, in this burial, a fourth individual is attested by a skull located at the northeast corner of the tomb. Although the infant skeleton (burial 9), aged around one year, was buried in a filled space, the deposit of its body in a jar could evoke a different funerary practice in relation with the container and the age at death of the deceased. This specific practice, unknown during the Kura-Araxes culture, could evoke a link with Chalcolithic tradition.