

FOOD, ECONOMY AND SOCIAL COMPLEXITY IN THE BRONZE AGE WORLD: A CROSS-CULTURAL STUDY

Dalia A. Pokutta¹

¹*Archaeological Research Laboratory University of Stockholm, Wallenberglaboratoriet, Lilla Frescativägen 7, 114 18 Stockholm, Sweden, dalia.pokutta@arklab.su.se*

Abstract: Despite the fact that greater part of ingredients, such as dairy products or alcoholic drinks, were known already in the Neolithic, food technology of the Bronze Age changed significantly. This paper aims to investigate prehistoric dietary habits and comment on the stable isotope values ($^{13}\text{C}/^{15}\text{N}$) of human/faunal remains from several large Bronze Age cemeteries in Europe and beyond. The human skeletal material derives from Early Bronze Age Iberia (2300–2000 BC), mainland Greece (Late Helladic Period III), Bronze Age Transcaucasia (the Kura-Araxes culture 3400–2000 BC), steppes of Kazakhstan (1800 BC), and Early Bronze Age China in Shang period (1523–1046 BC). The aim of this study is to determine distinctive features of food practice in the Bronze Age with an overview of economy and consumer behaviour in relation to religion and state formation processes.

Keywords: Bronze Age, prehistoric diet, isotopic analyses, Spain, Greece, Caucasus, Kazakhstan, China.

Abstrakt: Jedlo, hospodárstvo a spoločenská komplexita v svete doby bronzovej. Napriek skutočnosti, že väčšia časť potravín, ako napríklad mliečne výrobky či alkoholické nápoje, bola známa už v závere neolitu, potravinová technológia doby bronzovej sa výrazne zmenila. Táto štúdia skúma praveké stravovacie návyky a vyjadruje sa k hodnotám stabilných izotopov ($^{13}\text{C}/^{15}\text{N}$) v ľudských/zvieracích pozostatkoch z niekoľkých veľkých pohrebísk z doby bronzovej v Európe aj mimo nej. Ľudský osteologický materiál pochádza z Ibérie staršej doby bronzovej (2300–2000 BC), pevninského Grécka (neskoroheladské obdobie III), Zakaukazska doby bronzovej (kuro-araxská kultúra 3400–2000 BC), stepí Kazachstanu (1800 BC), a staršej doby bronzovej v Číne z dynastie Šang (1523–1046 BC). Štúdia predstavuje prehľad hospodárskeho a spotrebiteľského správania vo vzťahu k stravovacím návykom, náboženstvu a štátotvorným procesom.

Kľúčové slová: doba bronzová, praveká strava, izotopové analýzy, Španielsko, Grécko, Kaukaz, Kazachstan, Čína

1. Introduction

Information pertaining to prehistoric diets can be gathered from several sources, such as depictions of plants and animals in caves, tombs and monuments. Direct evidence of consumption can be gathered from waste pits and middens, from coprolites and the stomach contents of bog bodies as well as from written sources. Additional sources of data can be found in ethnographic studies of the habits of modern aboriginal populations. For decades, the chemical analyses of food remains have been used to further archaeological research. Bog butter, first reported in 1824, was analysed chemically in 1881 by J. Plant, and later by W. MacAdam (*MacAdam 1882; Cronin et al. 2007*). Since the discovery of the dynamics underlying ^{13}C distribution in plants, however, stable isotopes have been used for several decades to explore prehistoric diets. Today, both carbon and nitrogen isotopic ratios of collagen are widely used to provide insights into different dietary transitions through time and variation through space (*Fig. 1*). Studies of prehistoric diet and nutrition are inevitably linked to health status and palaeodemography as changes in food acquisition and subsistence have a strong impact upon mortality rates and life expectancies in humans. When used in conjunction with archaeological

data, isotopic analyses have the potential to shed light onto the social developments and dynamics of past societies, such as social differentiation (Redfern *et al.* 2010; Richards *et al.* 1998), cultural changes (Müldner - Richards 2007; Newsome *et al.* 2004; Sealy 2001), networks (Barrett *et al.* 2008), as well as mobility and migrations (Katzenberg 2008).

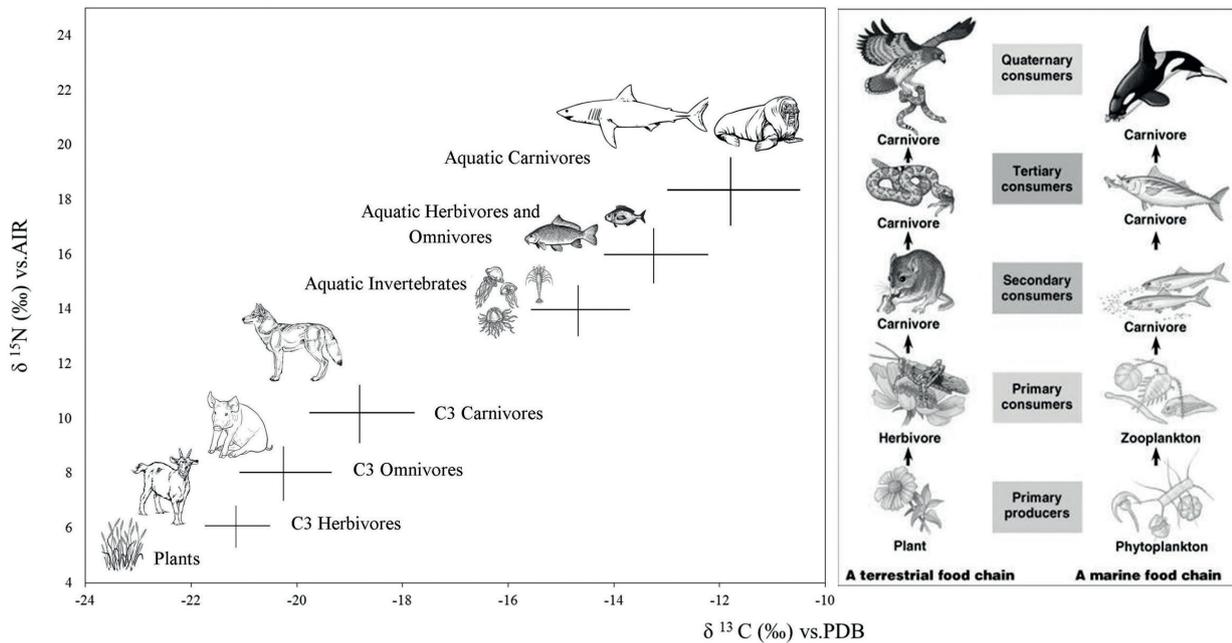


Fig. 1. Simplified overview of stable carbon and nitrogen values for terrestrial and marine ecosystems; after *Schulting 1998* with modifications.

Obr. 1. Zjednodušený prehľad stabilných uhlíkových a dusíkových hodnôt pre suchozemské a morské ekosystémy; upravené podľa *Schulting 1998*.

The novel foods (dairy products, cereals, refined cereals, refined sugars, refined vegetable oils, fatty meats, salt, and combinations of these foods) introduced during the Neolithic fundamentally altered several key nutritional characteristics of Palaeolithic diet and ultimately had far-reaching effects on health and demography in prehistoric populations. As these foods gradually displaced the minimally processed wild plant and animal foods of hunter-gatherer diets, they adversely affected certain dietary indicators, such as glycaemic load, fatty acid composition, macronutrient composition, micronutrient density, acid-base balance, sodium-potassium ratio, and fibre content. In the Bronze Age metal became a major means of control for human over the natural environment, and diversification of dietary patterns deepened. The flow of new technology affected the nature of the food supply chain, thereby altering the quantity, type, cost, and desirability of foods available for consumption.

2. The Bronze Age consumerism: technology, culinary novelties and beyond

Domestic food technology of the Bronze Age changed significantly due to three great innovations in cooking. Firstly, increased use of salt resulted in development of more sophisticated food preservation techniques available to broader group of customers. Salt appeared already in the Neolithic, however salt consumption in Bronze Age Europe played a very important role not only due to palatability (*Harding 2013a*). The use of salt expanded from food preservation, leather tanning to cloth dyeing, medicine and religion. The number of confirmed salt production sites in Western Europe increased from 1800 BC onwards. In Germany, large quantities of Early Bronze Age briquetage have been recorded in the Saale region and in districts of the Erdeborn, Hitzacker and Brehm (*Harding 2013b*, 501–507). Food processing included various types of cooking, such as smoking, steaming, fermenting, sun drying and preserving with salt.

During the Bronze Age technology influenced dietary practices on many levels. The spread of metal making technology resulted in the improvement of thermal processing of food. Roasting, frying and boiling was a lot easier due to controlled,

more efficient use of fuel in high-temperature ovens. The first use of cooking facilities (ovens) dates back to Palaeolithic (*Zvelebil 1994*), however, metal making required advanced knowledge regarding control of temperatures, the use of appropriate fuels and timing. These new technical innovations have been creatively adapted also in cooking in later times.

The third major culinary change associated with the Bronze Age was regards alcohol. Alcoholic beverages such as mead, beer, and ciders were introduced during Neolithic period, or perhaps even earlier. It was the Bronze Age society, however, that institutionalized consumption of alcohols, extended range products associated with drinking (e.g. vessel type vs. capacity) in association with gradual development of social norms and rituals. For the first time, drinking for fun appeared as socially accepted form of integration and entertainment. Nonetheless, it seems important to highlight the link between increasing consumption of salt in the Bronze Age and the rising variety of drinking vessels. Salty foods have a strong impact upon human thirst mechanism. The more salt you eat, the thirstier you are - this simple behavioural mechanism might have been responsible for global changes in attitude to consumption in that time period.

One of the main differences between the Neolithic and the Bronze Age way of living was regarding the attitude towards consumption. Without a doubt, the attitude towards food production and utilisation of goods evolved and changed many times during prehistoric times. Consumerism, the consumption of goods and services in excess of one's basic needs, was not a new phenomenon, and early examples of consumerism can be traced back to the metal ages. Consumerism gives a choice; sense of tribal identification, self-importance and individuality. Rapid economic growth involving metal making in the Late Bronze Age formed a new socio-economic arrangement: the entire society was organised around ever-increasing rates of personal consumption bordering on profligacy. By the end of the Bronze Age, and in the Early Iron Age, for the first-time archaeology encounters uncontrolled development of prehistoric consumerist society, which resulted in reduction of non-renewable resources (woodland, ores etc.) and problems with environmental sustainability (e.g. Late Bronze Age Biskupin in Central Poland).

3. Centre and periphery: Bronze Age Spain

The Bronze Age period in Spain spans from 2200 to 900 BC. The periodization varies regionally due to ecological diversity and variety of landscapes of Iberian Peninsula, but can be divided into three major zones: the El Argar culture of eastern Andalusia and Murcia, the Bronze Valenciano of the Spanish Levant and southern Aragon, and the La Mancha Bronze Age in the southern Meseta. As pointed out by many scholars, the Iberian Bronze Age starts with a period of societal unrest and warfare, associated with crisis of Bell Beaker traditions and Chalcolithic societies (*Lull et al. 2013*). The end of the Bronze Age around 900 BC marks the beginning of Phoenician colonisation in the western Mediterranean.

In the Early Bronze Age (2200–1550 BC), El Argar is the best-documented archaeological culture, chronologically matching classic societies of the European Bronze Age such as Wessex or Unětice. In between 2300–2200 BC the evidence of interpersonal violence is evident at many sites (*Aranda-Jimenez et al. 2009*). According to some authors, significant increases in cranial injuries in the Argaric communities of southern Spain may suggest a rise of a new hierarchical social structure and warfare-orientated populations (*Jimenez-Brobeil et al. 2009*). In the classic phase the Argaric communities occupied one of the driest regions of modern Europe, stretching from the coastal plains of Murcia and Almería, south of Alicante to the high ground of Granada. However, Argaric agriculture began to develop in more favourable ecological conditions than today; archaeological evidence also reveals an overexploitation of natural resources. The clearing of forests, expansion of agriculture and creation of pastures and intensive gathering of fuel for metal making resulted in short-term economic gains, however, in the long term this contributed to the crisis that spelt the end of Argaric society. The expansionist dynamic led to systematic terracing of the slopes surrounding hilltop settlements and intensive development of mud brick/stone architecture. This in turn brought about an increase in sedentism and new models of land management and territoriality. Moreover, the gradual introduction of new crops during this period had a profound impact on the way of life of Bronze Age populations. The so-called spring or summer-grown crops, such as millets, with short lifecycles and crucial nutritional value (*James et al. 2011; Rachie 1975*) represented a clear advantage in regions where harsh winters frequently ruined crops which required longer growing seasons. Spring/summer cultivation may also have enabled to free up large areas of arable land for winter grazing, bestowing further benefits (*Sherratt 1980*). Nevertheless, and despite the importance of these new crops, there are still few data on when and how they were introduced (*Tafuri et al. 2009*).

The El Argar culture was remarkable not only because of their rapid establishment of a new model of habitat and burial customs that broke with the Copper Age tradition, but also because of a combination of easily recognizable social practices and material features that were present for almost seven centuries. Typical for this culture food acquisition strategy was based on staple grains such as wheat and barley, supplemented by legumes, peas, broad beans, and lentils. Archaeological evidence indicates cultivation of olives. Animal species included sheep and goats, cattle, pigs, and horses.

Millet was introduced in the Middle Bronze Age (approx. 1550 BC) and increased in importance through the Late Bronze Age until they became staple crops in the Iron Age. Due to scarcity of archaeological evidence, however, there is an ongoing debate as to what extent millets were already established as a regular part of the diet in the Bronze Age. To address this question, several paleobotanical investigations have been conducted (Bettencourt 2001; Tereso et al. 2013).

Uneven and zonal distribution of carbon isotopes in the biosphere is associated with the two major photosynthetic pathways used by plants for carbon assimilation and fixation. Most plants photosynthesize in the Calvin-Benson or C3 pathway, where they form an organic compound comprising of three atoms of carbon, 3-phosphoglycerate (3-PGA). Most of the plants, trees and shrubs, fruits and vegetables typical for Europe and Northern America are C3 plants. All major crops from the Near East are C3, such as wheat, barley, oats and rye. In Asia, rice also belongs to C3 group. However in an adaptive response to hot, tropical conditions, some plants use another pathway to increase glucose production. The C4 pathway is typical for domesticated tropical grasses like maize (sweet corn), sugarcane, sorghum and millet, and during the Hatch-Slack cycle these plants produce C4-dicarboxylic acid and oxaloacetate (4-carbon compounds). The results of these two different pathways are seen as different $\delta^{13}\text{C}$ values (Farquhar et al 1989).

As millets were the only C4 plants available for human consumption in prehistoric inland Spain, isotope data are particularly suited to determine their contribution to the diet. Regular consumption of millet will increase the $\delta^{13}\text{C}$ ratio of the consumer's bone collagen, while the $\delta^{15}\text{N}$ ratio should remain unaffected, allowing to distinguish C4 plants from the consumption of aquatic resources which are generally also enriched in ^{15}N (DeNiro – Schoeninger 1983).

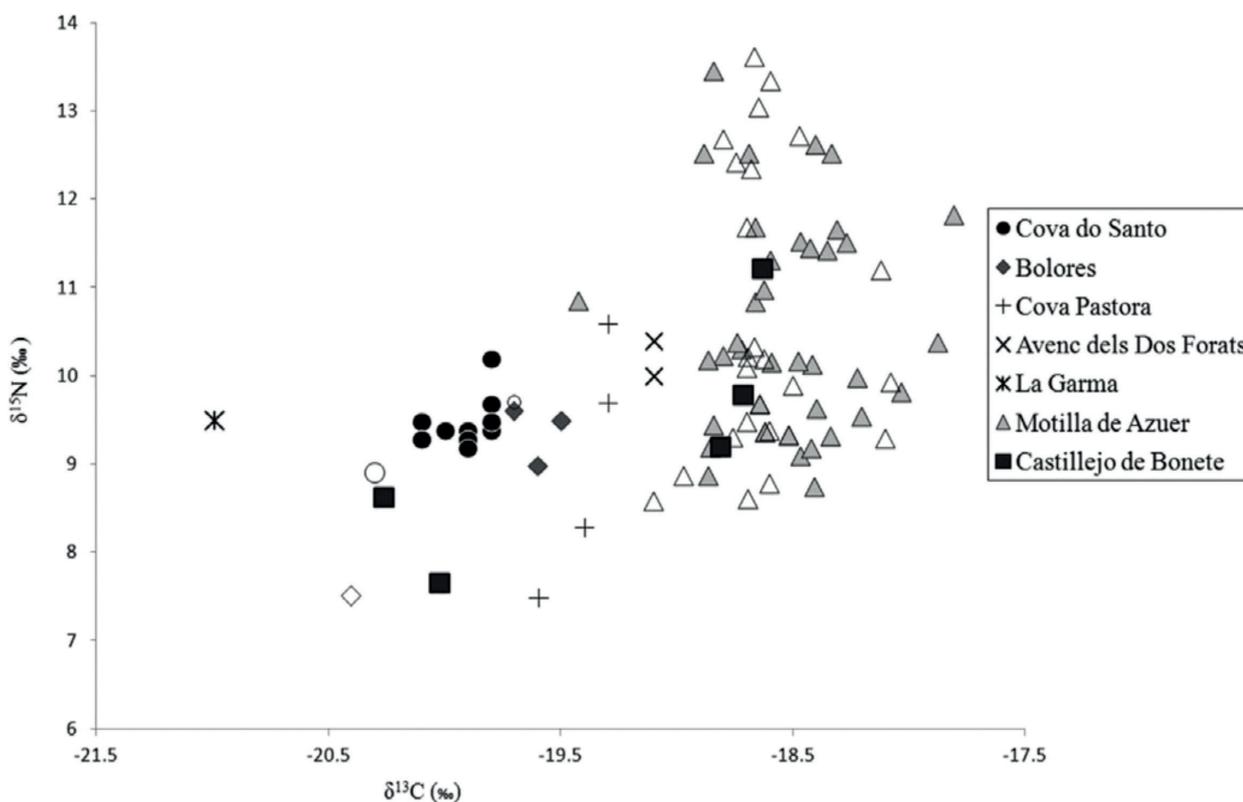


Fig. 2. Scatter plot of human $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ data from Spanish Chalcolithic and Bronze Age sites; after Lopez-Costas et al. 2015.

Obr. 2. Korelačný diagram ľudských dát $\delta^{13}\text{C}$ a $\delta^{15}\text{N}$ zo španielskych lokalít z eneolitu a doby bronzovej; podľa Lopez-Costas et al. 2015.

Today stable isotope data are available for both Chalcolithic and Bronze Age populations of the Iberian Peninsula (*Fig. 2*). New studies provide $\delta^{13}\text{C}$ data for local communities dated to Chalcolithic ($-20.8 \pm 0.9\text{‰}$, $n = 10$) and Bronze Age ($-21.0 \pm 0.6\text{‰}$, $n = 11$) from caves located on the Atlantic coast of Northern Spain (*Arias Cabal 2005*). Two cemeteries from South Central Iberia, Motilla de Azuer (Bronze Age 2200–1350 cal BC) and Castillejo de Bonete (Early Bronze Age 2340–1920 cal BC), show the highest $\delta^{13}\text{C}$ ratios. The data from Motilla de Azuer are characterized by relatively similar $\delta^{13}\text{C}$ signals ($-18.6 \pm 0.3\text{‰}$; -19.4‰ to 17.8‰ ; $n = 59$) but that corresponds with variation in $\delta^{15}\text{N}$ values ($10.6 \pm 1.4\text{‰}$; 8.6‰ to 13.6‰ ; *Najera Colino et al. 2010*). The stable isotope data from Cova do Santo correspond with those obtained from other Early Bronze Age cave burials on the Atlantic coast of Spain. The results point towards a terrestrial diet that relied exclusively on C3 plant-based protein, with a limited or irregular consumption of fish or C4 plants. In central and southern Iberia, however, elevated isotopic values of $\delta^{13}\text{C}$ indicate potential consumption of millet or other C4 plants (e.g. sorghum).

The results of isotopic dietary analyses show cultural and economic divisions between El Argar communities and peripheral populations in Iberian Peninsula. El Argar culture achieved a dominant position over certain resources and communication routes. Their agriculture and economy reached a level of economic development that was far superior to the rest of the Iberian Peninsula and had a direct influence on their neighbours (e.g. the Bronze Valenciano and the La Mancha Bronze Age) as a social and productive model. In Argaric territory there is evidence indicating millet consumption and production.

Outside of this area, however, other archaeological groups have been defined based on geographical criteria and certain material elements, but their limits in area and time are often vague or non-existent. It is also possible to recognize some characteristic features of El Argar beyond its territory, though generally in a distorted or impoverished manner. In these peripheral territories the development of Bronze Age expansive agriculture encountered obstacles, therefore isotope data provides no evidence of millet consumption by human on the Spanish Atlantic coast (*Fig. 2*). Small farms and settlements in this area testify to the fragmentation of economic collectivism. Such an economic model is linked to seasonal exploitation of certain resources rather than to the centralized accumulation of products.

4. Dietary taboos and food avoidance: Bronze Age Greece

Many dietary taboos stem from a social disgust at the consumption of certain foods (*Rozin – Fallon 1987*). Disgust is governed by culture and it has been proposed that disgust processes underlie the transmission of social and moral values (*Rozin – Zellner 1985*). Food selection in prehistory was primarily motivated by availability and taste. Eating choices were typically made according to what was obtainable, what was acceptable and what was preferred. Local ecological conditions, such as climate, weather, soil or native animal population, shaped the food supply at the fundamental level, but seasonal variations were probably also a factor along with climatic events such as drought or floods occasionally disrupting food supplies. The dietary domain for prehistoric population was generally limited to several food categories: a) inedible foods, b) edible by animals but not by humans, c) edible by humans but not by us/our tribe, d) edible by humans but not by me, and finally, e) edible by me. Foods defined as inedible vary culturally (*Rozin et al. 1999*). This group comprises actually poisonous products as well as harmless food items not eaten because of an unpalatable appearance strong beliefs or taboos against consuming the food. It may include, for example, animals dangerous to catch or animals that have died due to unknown reasons or disease, animals that consume garbage or excrements and so on. The second group is also highly variable, and consists of foodstuff thought to be inappropriate for humans, e.g. the consumption of rats in a modern western example. The third category encapsulates the sense of tribal identity because it comprises foods that were recognized as acceptable in some societies, but not in one's own culture.

Archaeological and isotopic evidence available today, indicate that in the Bronze Age Europe food taboos included primarily consumption of cats, dog meat and fish. The bones of cats are rarely found on Bronze Age sites. It seems feasible that cats were regarded as pets kept to control vermin, not as a food animal; however, the archaeological record of cat remains in Europe is very incomplete (*L. Bartosiewicz pers. comm.*).

Currently there is not enough archaeological evidence to specify how often or on what occasion was dog meat eaten in Bronze Age Europe. It is easier, however, to pinpoint territories where the consumption of dog meat was more common. According to early Chinese written records, dogs served not only as hunting companions and guard-

ians, but were also used in rituals and sacrifices, and were even a source of meat. It has been pointed out, for instance, that during the Shang Dynasty, dog sacrifices marked the conclusion of the construction of every palace, tomb, or royal building. Additionally, dogs were once killed and buried in front of homes, or before the city gates in order to ward off evil or bad luck. Over time, however, as the practice of sacrificing dogs became less popular, straw dogs were used instead (Fiskej  2001, 48-192).

Although the dog has been honoured, and was a useful animal in prehistoric Chinese society, this animal did have some negative connotations attached to it as well. For example, according to a myth explaining the occurrence of eclipses, there is a creature known as the Tiangou (literally meaning ‘Heavenly Dog’), who occasionally gets hungry, and devours the moon/sun (Mair 1998). Interestingly, it was rare for wolves to be hunted for food, though historically, people have resorted to consuming wolf flesh in times of scarcity, or for medicinal reasons. Most Native American tribes, especially the Naskapis, viewed wolf flesh as edible but inadequate nutrition, but some region of prehistoric Japan wolf meat was considered poisonous (Walker 2005, 331).

Between the Palaeolithic and Iron Age fish remains identified in northern Europe include pike, bream, pollack, perch, tench, cod, dogfish, flounder, eel, haddock, mackerel, coalfish, whiting, wrasse and tunny (Brothwell 1969, 58). That list can be extended; e.g. on many sites associated with the EBA Unetice culture in Silesia (Oder river) fish remains of catfish, zander, salmon and sturgeon have been found (Pokutta 2013, 95). Despite the abundance of fish and seafood, however, those particular products were not considered attractive in some parts of the world especially in Egypt, and in Greece.

The Late Bronze Age in the Aegean Basin (1700–1100 BC) witnessed the rise of two interdependent civilizations, the Minoan on Crete and the Mycenaean culture in Central and Southern Greece (Dickinson 1977; Harding 1984; Cherry 1984, 18-48). Currently our knowledge regarding dietary practices in BA Greece is based on archaeozoological and archaeobotanical evidence and written sources (Linear B tablets; Chadwick 1976, 126–133; Ruizperez-Melena 1996, 149–180). Various species of grains were cultivated, among which at least six cereal species. Species which have for a long time been widely recognized to have been cultivated include: emmer (*Triticum dicoccum*), wheat (*Triticum monococcum*, *Triticum spelta*), peas (*Lathyrus sativus*, *L. ariculatus*), tare (*Vicia sativa*), chick-peas (*Vicia ervila*, *Icer arretinum*), millet (*Panicum miliaceum*), lentil (*Lens esularis*), and barley (*Hordeum vulgare*) (Halstead 1995). The majority of the above species have been found at various sites dated to the Bronze Age, in Southern mainland Greece (Mycenae), in Crete (Knossos), and in Central mainland Greece (Thebes), apart from wheat and millet, which have been found also in the Late Bronze Age sites of Assiros and Kastanas in Northern Greece (Halstead 1995; Jones 2002).

The terrain of the Greek peninsula creates several micro-ecosystems with variable floral composition, and consequently differences in consumed plant species between Northern, Central and Southern Greece. For example, Triantaphyllou (2001) reported the consumption of C4 plants in Northern Greece while in Southern Greece it seems that C4 plants are consumed only in the Early Bronze Age Perachora near Ancient Corinth (Petroutsas et al. 2009).



Fig. 3. ‘The Fisherman’; fresco from Akrotiri on Santorini, Greece, 17th century BC.

Obr. 3. ‘Ryb r’; freska z Akrotiri na Santorini, Gr cko, 17. storo ie BC.

The importance of marine foods (fish and seafood) in the diet of the LBA people is still discussed, but many studies have failed to identify marine protein intake in diet at all. The only evidence comes from the MBA Mycenae (*Hedges – Richards 1999, 227–228*), where it seems that nobility of this era consumed seafood. The Greek peninsula is surrounded by sea and we now know from much earlier archaeological findings (fishing-tackles and bony fish remains from e.g. Cave of Cyclops in Youra Island, and Franchthi Cave) that the ancient inhabitants were familiar with fishing (*Farrand 2003; cf. Fig. 3*). However, at Greek coastal sites such as Perachora and Lerna (*Triantaphyllou et al. 2009*), isotopic dietary studies surprisingly did not reveal any consumption of marine/seafood. That may indicate that food avoidance was already present in Bronze Age Europe and it is quite likely that fish, so abundant in the Aegean Sea, might have been considered too cheap. The trend towards a terrestrial diet in LBA Greece, despite its potential inconvenience and economic maladaptiveness, seems to be stable over long period of time.

5. Vineyards in the high mountains: Bronze Age Caucasus

Remote territories of the Caucasus played an important role on the map of Bronze Age Europe. The North marks the geographical transition from Europe to Asia. South Caucasia comprises of the Black Sea, the Caspian Sea and the southern slopes of the Greater Caucasus. This area, however, is at the same time also linked to eastern Anatolia. Two major rivers of this region, the Kura and the Araxes, create broad flood plains on their way to the Caspian Sea (*Fig. 4*). The arrival of the Leyla-Tepe culture (4400–4000 BC) in Central Caucasia marked the appearance of the first local metallurgy. The development of local metal making was linked in that period to expansion of the Uruk cultural traditions from adjacent Mesopotamia. Caucasia has been serving as a connecting link of the old ancient cultures for millennia, leading to unprecedented economic and social changes. The beginnings of the Bronze Age in this region, were linked to the Kura-Araxes culture (3500–2000 BC). At that time, the exploitation of rich local cassiterite tin deposits had started. Due to strategic location, Caucasia maintained long distance connections with Mesopotamia and the Near Eastern world (e.g. the Khirbet Kerak culture in western Syria; *Akbundov 2004*), and very soon this region became an important centre of metalworking (*Nathaniel et al. 2015*). Currently debates regarding the origins of the Kura-Araxes culture are ongoing. Some scholars suggest that rapid development of the Kura-Araxes bronze making was linked to rising mobility of local populations. According to that scenario, local sedentary population had moved from the south to the north Transcaucasia in the 4th millennium BC and this dislocation triggered the process of further development.



Fig. 4. The view from archaeological site of Chobareti (1610 a.s.l), southwest Georgia; photo by A. C. Sagona
Obr. 4. Pohľad z archeologickej lokality Chobareti (1610 m n. m.), juhozápadné Gruzínsko; autor fotografie: A. C. Sagona.

At the same time, anthropological data attest to homogeneity and local roots of the old ancient Caucasian population. The Early Bronze Age represented by the Kura-Araxes culture was a new stage of civilizational development in the Caucasus and adjacent regions. Distinctive pottery making traditions together with agriculture and animal husbandry constituted the main activities of the local economic life. The Bronze Age brought around new forms of land management and irrigation. The land was cultivated intensively and harvests occurred twice in a year (spring-autumn). Archaeological evidence of grape vine cultivation and winemaking has been found on the Kura-Araxes settlements. While the hypothesis of their farming activities is often based on archaeobotanical and archaeozoological data, it remains difficult to understand the farming strategies in the high mountains (Sagona 1984).

The inhabitants of Chobareti, a large settlement dating to 3500/3400 BC cultivated cereals (Messenger *et al.* 2015). Cultivated crops were essentially naked wheats, including *T. aestivum* and *T. dicoccum* (emmer). The threshing process was attested by phytoliths and macroremains assemblages, both dominated by cereal chaff remains. Chobareti community appears to be an efficient farming group, able to grow wheat and barley in high mountains up to 1600 m a.s.l. (Fig. 4). According to data collected by the authors, high $\delta^{15}\text{N}$ values of wheat seeds suggest that animal dung was used to restore nutrients and enhance crop yields (Fig. 5). Animal nitrogen stable isotope data indicate different herding practices based on differential occupancy of biomes. Both animal and human carbon stable isotope data point towards most common C3 plants and cereals consumption. Whereas biological and funerary records support diversified cultural traits, a mixed diet with a great contribution of animal protein sources (meat, secondary products), seems homogenous within the entire Chobareti population.

6. In the ocean of grass: Bronze Age Kazakhstan

The Bronze Age in Kazakhstan has been associated with a significant transformation in the societies of the region, notably a transition from fishing and hunting to pastoralism (Outram *et al.* 2012; Frachetti – Benecke 2009). It is important to point out that vegetation across Kazakhstan generally represents a mosaic landscape with varying densities of C4 plants, particularly suitable for ranching economy (Fig. 6ab).

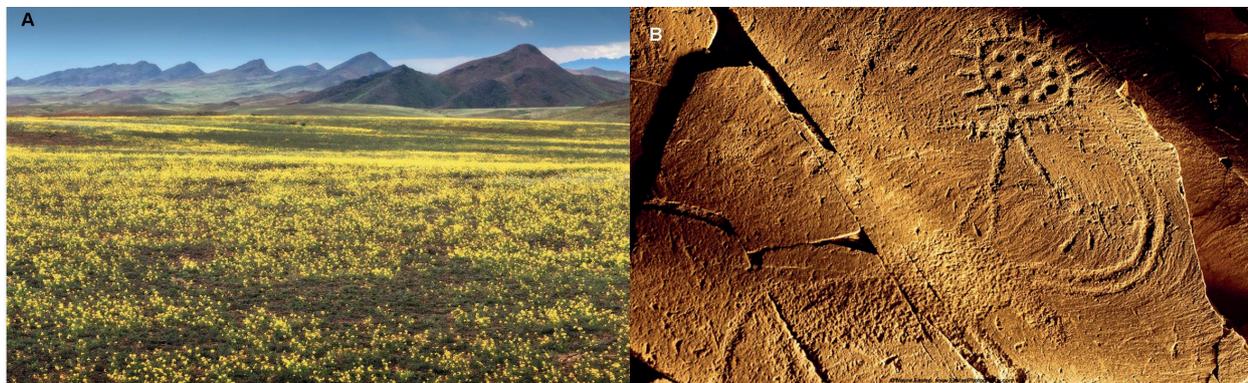


Fig. 6. A: The Toraigyr steppe mountains in spring, Almaty region, Kazakhstan; B: Bronze Age Sun god of fertility riding a bull; a petroglyph located 120 km north of Almaty; Tamgaly, Kazakhstan; photo by W. Eastep.

Obr. 6. A – Toraigyrské stepné hory na jar, Almatinská oblasť, Kazachstan; B – slnečný boh plodnosti z doby bronzovej jazdiaci na býkovi; a petroglyf nachádzajúci sa 120 km severne od mesta Almaty; Tamgaly, Kazachstan; autor fotografie: W. Eastep.

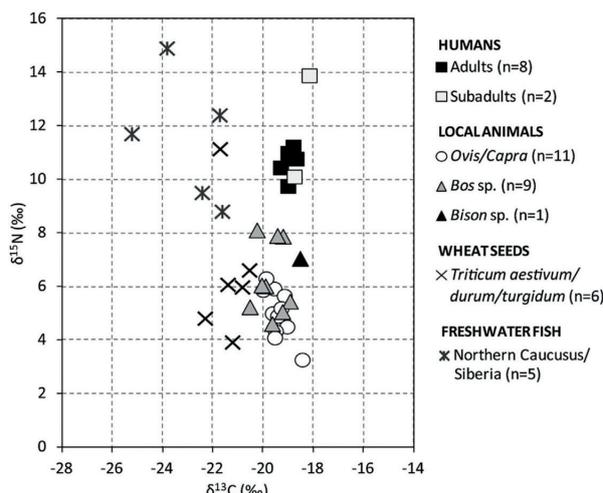


Fig. 5. Scatter plot of human and animal $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ data from Chobareti; after Messenger *et al.* 2015.

Obr. 5. Korelačný diagram ľudských a zvieracích dát $\delta^{13}\text{C}$ a $\delta^{15}\text{N}$ z Chobareti; podľa Messenger *et al.* 2015.

Pastoral nomadism as a food-producing economy based on specialized animal husbandry was considered the only form of human subsistence strategy in the grassland during the Bronze Age (Kbaxanov 1994) until recent research on past steppe societies has shown the use of a much wider range of food sources than just animal products (e.g. Leonard – Cranford 2002, 1–63; Lightfoot et al. 2014). The archaeobotanical records from southern Kazakhstan show that this territory constitutes a crossroads for the movement of crops that were traded and shared by mobile pastoral societies (Frachetti 2012; Frachetti et al. 2010).

Southwestern Asian crops, such as wheat and barley (*Triticum turgidum/aestivum* and *Hordeum vulgare/nudum*), were spreading eastwards to China, while the Chinese crops, such as broomcorn and foxtail millets (*Panicum miliaceum* and *Setaria italica*), arrived in Europe by the Bronze Age period (Jones et al. 2011).

Archaeobotanical studies have repeatedly provided evidence for the availability and probable consumption, of domestic cereals among pastoralists living in the southern Central Asia (e.g. Rouse – Cerasetti 2014). Despite the suggestion, however, that during the Final Bronze Age (1300-900 BC) agriculture in the region of Kazakhstan and Turkmenistan was well-established with a wide range of cereals being grown (Spengler et al. 2013; Honeychurch 2015, 161), archaeobotanical data alone cannot provide information on the extent of cereal consumption.

While the dominant narrative in the literature is that the Bronze Age inhabitants of Kazakhstan were pastoralists consuming mainly animal products (Kbaxanov 1994; Kuzmina 2008), in recent years the evidence for plant cultivation and consumption has grown (e.g. Chang et al. 2003; Spengler et al. 2013). Sickles and grinding stones have been discovered at prehistoric sites all across Central Asia (Volkov – Dryabina 2001), indicating human involvement in harvesting and processing plants. Millet (*P. miliaceum*) in particular has played a very important role among the populations of Central Asia. This crop was, and still is, highly suitable for cultivation by semi nomadic societies in Central Asia, as it completes its life cycle in a very short period (40–90 days) and has the lowest water requirements among the major crops (Nesbitt – Summers 1988). Several stable isotope studies in Kazakhstan have focused on Chalcolithic or Bronze Age sites in the northern and central territories. In combination with published zooarchaeological data (e.g. Kalieva – Logvin 2011; Outram et al. 2012), they indicate a Bronze Age diet based on cattle and ovicaprid meat and milk as well as freshwater fish (Privat et al. 2006; Ventresca Miller et al. 2014; O’Connell et al. 2003). Some dietary contribution of C4 plants is detectable, with a few human outliers from the Lisakovsk and Bestamak sites in the northern regions with higher $\delta^{13}\text{C}$ values near -18‰ (Ventresca Miller et al. 2014). The stable isotope analysis recently conducted from the central regions of Kazakhstan report the possible consumption of C4 plants among a small part of population during the Late Bronze Age (from ca. end of the 2nd to the beginning of the 1st millennium BC; Lightfoot et al. 2014).

A study by G. Motuzaitė-Matuzevičiute revealed that C4 plants became established food sources in southern Kazakhstan from the Middle-Late Bronze Age onwards (1800 BC), and were likely eaten directly by humans (Motuzaitė – Matuzevičiute et al. 2013). Given the archaeobotanical evidence, it is reasonable to attribute the C4 signal to the consumption of millet. These results constitute the earliest-to-date directly dated isotopic signals of millet consumption outside of China. The isotopic data suggests that millet was a significant dietary component for a number of individuals, such that it is detectable in stable isotope analysis of human bone collagen.

7. Chopsticks and state formation processes: Bronze Age China

The Bronze Age in China is linked to the period between about 2000 till 771 BC, however it is very often narrowed down to the Xia (2070–1600 BC) and Shang Dynasties (1600–1046 BC). Many legends, histories and folk tales is associated with the first rulers of dynastic China. Archaeological investigation has confirmed much of the legendary history of the dynasty following the Xia, the Shang, but the existence of Xia itself is still debated (Bagley 1999, 123–231). Today, Chinese scholars generally identify Xia with the Erlitou culture (1900–1500 BC), but debate continues on whether Erlitou represents an early stage of the Shang dynasty, or whether it is entirely unique (Guo et al. 2000; Thorp 2005, 21–61). The Erlitou culture is now recognized at more than 100 sites spread across Henan, Hebei, Shanxi, and Shaanxi. The Western Henan type has been identified at more than sixty sites. We encounter first archaeological evidence of walled palaces (walled internal cities), that served as political centre and later became well-recognizable feature of Chinese city planning and architecture (Ma 2009, 65–71). The range of metal items is relatively limited and specific. We encounter small knives, bells (*ling*), plaques with turquoise inlay,

weapon and bronze vessels. Studies of the alloys used at Erlitou suggest that tin and lead were mixed with copper in ways suited to the function of the objects (Thorpe 2005, 40). Thus, a weapon might have a high tin content for hardness. Some specimens are pure copper, while others are zinc-copper or tin-copper alloy. The ternary alloy (copper with tin and lead) that characterized much Shang bronze casting appears only in period IV at Erlitou site. Several dagger blades (*ge*) were also found. While the bronze *ge* dagger-axe became the mainstay of Bronze Age warriors in China, these examples may have been carried instead as regalia (Bao et al. 2016). Archaeological evidence regarding the Shang Dynasty comes mainly from excavations at Zhengzhou and Anyang, both in Henan province. Zhengzhou assigned to the period 1500–1300 BC and Anyang (ancient Yinxu) to the period of roughly 1200 to 1050 BC (Fig. 7a).



Fig. 7. A: The Shang Dynasty in China (1523–1028 BC); B: Wine Vessel *Lei* (亞父方罍), Late Shang Dynasty (1600–1046 BC), Shanghai Museum; photo by Qianse.

Obz. 7. A – Dynastia Šang v Číne (1523–1028 BC); B – nádoba na víno *Lei* (亞父方罍), neskorá dynastia Šang (1600–1046 BC), Shanghai Museum; autor fotografie: Qianse.

The first evidence of chopsticks dates back to the Shang period. The Bronze Age defined the fundamental aspects of Chinese art of food preparation. This is particularly true when it comes to structure of traditional Chinese food, food customs for festivals and celebrations, seasoning, dining etiquette, traditional cooking methods, and medicinal diets (Chang 1977, 1–22). In Chinese folk tradition and legends, the Bronze Age rulers of Shang Dynasty were commonly associated with excessive drinking and religious piousness bordering on superstition. Divination and fortune telling was performed on turtle shells, that were later burnt by the shamans. Over the last century more than 200 000 oracle-bone fragments and pieces have been collected around city of Anyang. These oracles serve as very important archaeological evidence, as they help us to track the historical development of Chinese writing system. The topics addressed in divination charges were extremely wide-ranging in the Bronze Age. Diviners inquired about rainfall, the king's health and dreams, sacrifices (both regular and *ad hoc*), childbearing of royal consorts, warfare, harvests, settlement building, celestial events, the outlook for the night or the next ten-day week, and the like (Thorpe 2005, 172–213). Like divination, sacrifice was a defining feature of Shang rituals.

We encounter a specialized vocabulary of ritual procedures, many interpreted as various forms of butchering (cleaving, splitting, decapitating). There are enumerations of quantities of cult: the numbers of cattle, sheep, or humans, for example (Yuan-Flad 2005). Archaeological evidence shows an array of specific rites, such as burning, drowning rites and so on. The most common treatment of human victims was decapitation with the corpse face down. During royal funeral, servants or concubines interred in their own coffins are quite different from humans slaughtered and buried like animals on a large scale in mass graves. The context for these offerings, feeding the ancestral spirits, is explicitly detailed by oracle-bone inscriptions.

Bronze vessels (*ding*) were used during the Shang period in ancestral rituals. Ancestors, it was believed, could intercede on behalf of the living, provided they were honoured and respected. The bronze vessels were kept in ancestral halls and used during a variety of feasts and banquets. Most bronze vessels were used to heat or cool a millet-based wine. Early bronze vessels, including the jue, gu, and ding, were based on Neolithic pottery prototypes (Bao-Ping *et al.* 2008). But as bronze technology improved, vessels took on shapes and decorative schemes that were unique to the medium. A common Shang decorative motif was the taotie (Fig. 7b). Other zoomorphic designs consisted of various animal parts flowing into one another. In the following period, this imagery had begun to turn into purely abstract patterns.

Looking from political perspective China in the Bronze Age was divided into many kingdoms. The Shang kings were most concerned about their own lands (*wang ji*) and the bordering territories (*si tu*). Reports of hostile incursions on these flanks and inquiries about their harvests are common among oracle-bone inscriptions. A variety of persons are named: various archer lords (*hou*) and marshals (*yu*), allies of the kings, and various chiefs or lords (*bo*) of (often hostile) statelets (*fang*) (Thorp 2005, 215).

Traditional histories speak of the Zhou conquering the Shang and proclaiming a Mandate of Heaven. The concept of the so-called Mandate of Heaven, still functioning in Chinese culture rule, that divine approval is essential and gods will bless the authority of only a righteous individual, date back to these times. The Zhou justified their conquest by citing the moral depravity and excesses of the last Shang king. They set up a network of kin relationships (*zongfai*) in various regions, which formed the basis of a new unified state. But in fact, the main legacy of the Late Bronze Age in China is the concept of ethnic uniformity and identity, the 'Chineseness'. The Zhou Dynasty wished to set new standards of ritual practice as a way of exercising control over a changing political landscape. Having a core state surrounded by alliances may have contributed to a feeling that the outside world was filled with barbarians. Fear of barbarians with different customs became even more entrenched after 771 BC (e.g. in poetry), when the Zhou court fled to their eastern capital, under pressure from enemies to the west.

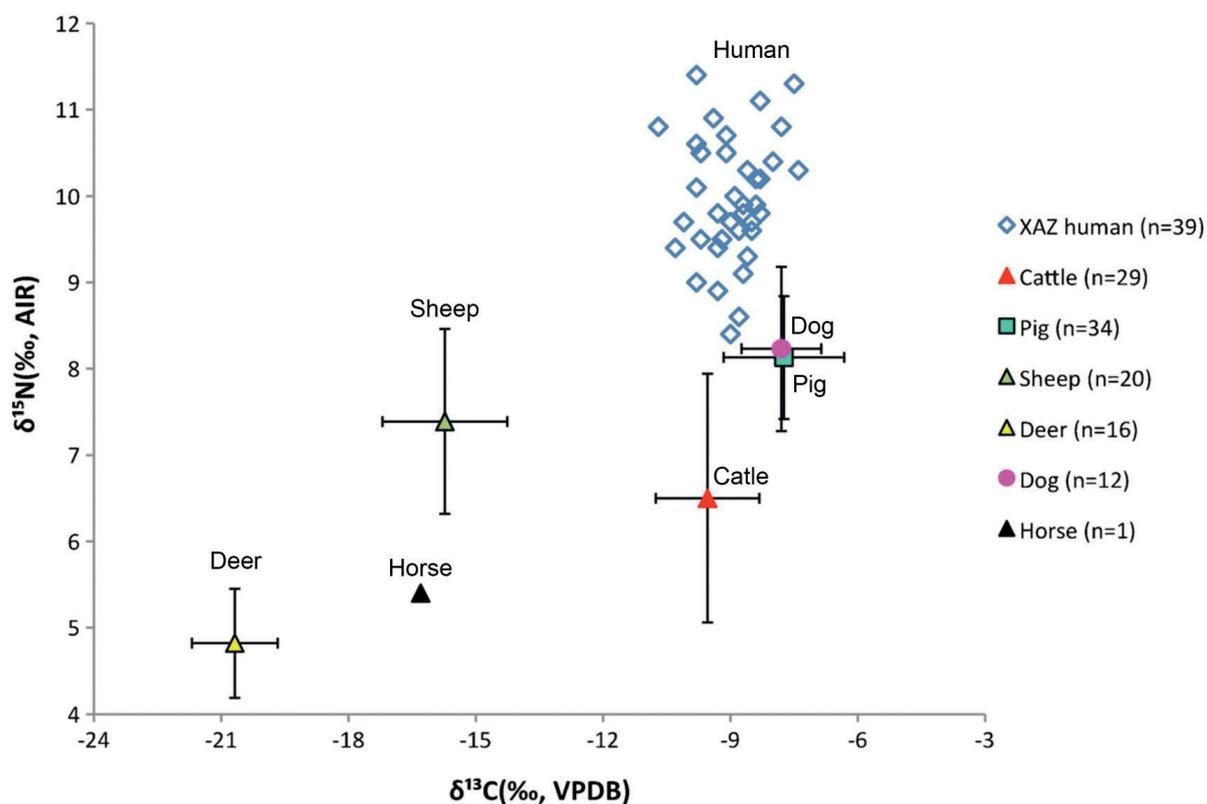


Fig. 8. Bone collagen $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values of all Yinxu (Anyang) residents plotted with local fauna data; after Cheung *et al.* 2015.

Obr. 8. Hodnoty $\delta^{13}\text{C}$ a $\delta^{15}\text{N}$ kostného kolagénu všetkých obyvateľov Jin-sü (An-jiang) na diagrame s dátami miestnej fauny; podľa Cheung *et al.* 2015.

Recent isotopic studies show the extent of social diversification in Yinxu (present-day Anyang), capital of China's first historical dynasty in Shang period (Cheung *et al.* 2015). According to the authors, the climate in the Anyang region during Early Bronze Age was wetter and warmer than current conditions, thus able to support a much wider range of flora and fauna. Broad range of wild animals supplemented Shang diet, e.g. water deer (*Hydropotes inermis*), sika deer (*Cervus nippon*), field rat (*Myospalax psilurus*), hare (*Lepus sp.*), black bear (*Ursus thibetanus japonicus*), tapir (*Tapirus indicus*), and various aquatic resources. Cheung *et al.* analysed in total 59 individuals interred in simple graves of commoners. The $\delta^{13}\text{C}$ values of all individuals ranged from -10.7 to -7.4‰, and $\delta^{15}\text{N}$ values ranged from +8.6 to +11.4‰ (Fig. 8). All individuals displayed stable carbon and nitrogen values typical of a population subsisting heavily on a C4-based terrestrial diet. The range of $\delta^{13}\text{C}$ values from both humans and domesticated animals from Yinxu indicated that millet was not only a staple crop for humans, but secondary products of millet were likely also fed to domesticated animals as fodder. Rice (*Oryza sativa*) was not consumed in Bronze Age China.

In some graves in Yinxu dead were buried with their hand and legs cut off in refuse pits. These inhumations are linked to burials of non-local labourers, criminals, or those with little importance in society. The study revealed that individuals buried in refuse pits likely had a significantly smaller amount of animal protein in their diet. On the other hand, the correlation between dietary patterns and the types of grave goods showed that individuals, who were buried with rich or exotic burial goods, and the presence of animal sacrifices, generally consumed more animal protein as is evident by their higher $\delta^{15}\text{N}$ values. It seems that in the late Shang society, the consumption of large quantities of animal protein was associated with greater economic power and higher social rank. Moreover, the results also suggested that males consumed more animal protein than females. The social position of females in prehistoric Chinese society is debated, because it is believed that even though the Shang was a patrilineal society, women could still hold high offices and even military posts, which in later historical periods were positions held only by men. Therefore, it is not clear whether the difference detected by Cheung *et al.* (2015) in $\delta^{15}\text{N}$ values is related to burial positions, sex, or perhaps both.

Closing remarks: Bronze Age food regimes

In this paper we tackled the relationship between regional and international food regimes in the Bronze Age, of 'local' and 'global' models of consumption. My understanding of prehistoric food regimes combines two strands of macro-sociological theory: regulationism and world-system theory. According to the regulationist perspective, the majority of Bronze Age societies has evolved through several stages of wealth accumulation, each with its own underlying logic and conditions of stability (Aghietta 1979). At each stage, food supply and agricultural production were linked with stabilizing social and political institutions. This concept can be extended to the world-historical scale by combining it with a world-system interpretation of social change (Wallerstein 1974). The rise, fall, and transformation of successive forms of agriculture, consumption and food systems occurred in the broad framework of an evolving economy of bronze and metal making, subject to changing social, technological, and ecological bases of organization.

In the ultimate sense civilizational success of bronze making technology was grounded on numerous and multi-layered choices that were made by individuals, communities and states in the process of deciding what to eat.

In that global sense, the major difference between Neolithic era and the Bronze Age was regarding new agriculture, livestock management strategies and reorganized food supply chains. On community level, the vast majority of isotopic studies of the Bronze Age populations indicate clearly that agricultural productivity in that time depended on attitudes of the farmers towards work and their aspirations for better standard of living.

The process of Neolithization in Europe and beyond can generally be seen as the emergence of very stable cultural adaptations; pottery making and sedentary agriculture with stock breeding. Looking from dietary perspective however, the same process resulted also in strong unification of dietary practices over millennia in whole Europe. The Neolithic diet was, in some sense *frozen in time*, and did not evolve in any spectacular manner for centuries. Technically speaking, the pottery making traditions may have varied in distant regions of the continent, but the content of the dish was very similar. Therefore very complementary $\delta^{15}\text{N}/\delta^{13}\text{C}$ isotopic values can be found in Neolithic bone materials across whole Europe, from Britain to Greece and from Portugal to western Russia.

The situation did change rapidly in the Early Bronze Age due to huge shifts in agriculture, through transmission of diverse organizational models, technologies, and socio-political traditions (*Kristiansen 2017*). When compared to the Neolithic, Bronze Age consumption enabled meeting human needs and wants, introducing selectiveness, excessiveness and food taboos. This new model of consumption encompassed a big spectrum of need fulfilment activities and purposes including status acquisition, identity formation, social class identification. More efficient use of fire combined with the development of kitchen procedures not only improved the taste of foods but also enhanced safety, hygiene, and health. The growth of metal-using consumer society was accompanied by agricultural productivity, promoting technical progress and the optimum utilisation of labour. The isotopic data from the Bronze Age shows therefore higher variability and multidirectional regimes (cf. *Britton et al. 2008; Tafuri et al. 2003; Sandias et al. 2015; Thompson et al. 2008*)

Rise and expansion of militaristic societies in the Late Bronze Age brings also in mind questions regarding survival strategies, especially the ability to cope with crops failure and famine. In some regions, e.g. in Spain but also in Kazakhstan and China new types of drought-tolerant plants were introduced (C4 group, esp. millets), probably in respond to changing climatic conditions and natural disasters. It should be highlighted isotopically proven case of introduction of millet in Italy after Santorini/Thera eruption in respond to climatic changes. After Santorini eruption, the so-called ‘volcanic winter’ lasted few centuries (*Tafuri et al. 2009*). Millet was also used as versatile animal fodder supporting transportation security in society and accelerating human mobility.

Like spoken language, the Bronze Age ‘*food system*’ contained and conveyed the culture of its practitioners; it was the repository of traditions and of collective identity. It is therefore an extraordinary vehicle of self-representation and of cultural change.

Bibliography

- Aglietta, M. 1979*: A Theory of Capitalist Regulation, New Left Books, London.
- Akhundov, T. 2004*: South Caucasus in the Neolithic to Early Bronze Age: The Question of Epochs and Periods, In: Sagona, A. (ed.): A View from the Highlands: Archaeological Studies in Honour of Charles Burney, Louvain, 421–436.
- Aranda-Jimenez, G. – Monton-Subías, S. – Jimenez-Brobeil, S. A. 2009*: Conflicting evidence? Weapons and skeletons in the Bronze Age of South-East Iberia. *Antiquity* 83, 1038–1051.
- Arias Cabal, P. 2005*: Determinaciones de isotopos estables en restos humanos de la region Cantabrica. Aportacion al estudio de la dieta de las poblaciones del Mesolitico y el Neolitico. *Munibe. Antropologia Arkeologia* 57, 359–374.
- Bagley, R. 1999*: Shang archaeology. In: Loewe, M. – Shaughnessy, E. (eds.): The Cambridge history of ancient China: from the origins of civilization to 221 B.C. Cambridge University Press, Cambridge.
- Bao, Z. – Yuan, W. – Yuan, H. – Liu, X. – Chen, K. – Zong, C. 2016*: Non-matrix-matched determination of lead isotope ratios in ancient bronze artefacts by femtosecond laser ablation multi-collector inductively coupled plasma mass spectrometry. *International Journal of Mass Spectrometry* 402, 12–19.
- Bao-Ping, L. – Liu, L. – Zhao, J. – Chen, X. – Feng, Y. – Han, G. – Zhu, J. 2008*: Chemical fingerprinting of whitewares from Nanwa site of the Chinese Erlitou state. *Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms* 266, 2614–2622.
- Barrett, J. – Johnstone, C. – Harland, J. – Van Neer, W. – Ervynck, A. – Makowiecki, D. – Heinrich, D. – Hufthammer, A.K. – Enghoff, I. B. – Amundsen, C. – Christiansen, J. S. – Jones, A.K.G. – Locker, A. – Hamilton-Dyer, S. – Jonsson, L. – Lougas, L. – Roberts, C. – Richards, M. 2008*: Detecting the medieval cod trade: a new method and first results. *Journal of Archaeological Science* 35, 850–861.

- Bettencourt, A. M. S. 2001*: O povoado da Santinha, Amares, Norte de Portugal, nos finais da Idade do Bronze Braga. Col. Cadernos de Arqueología. Monografías 12, Braga.
- Britton, K. – Müldner, G. – Bell, M. 2008*: Stable isotope evidence for salt-marsh grazing in the Bronze Age Severn Estuary, UK: implications for palaeodietary analysis at coastal sites. *Journal of Archaeological Science* 35, 2111–2118.
- Brothwell, D. – Brothwell, P. 1969*: *Food in Antiquity: A Survey of the Diet of Early Peoples*. Thames & Hudson Ltd, New York.
- Chadwick, J. 1976*: *The Mycenaean World*. Cambridge University Press, Cambridge.
- Chang, C. – Benecke, N. – Grigoriev, F. – Rosen, A. – Tourtellotte, P. 2003*: Iron Age society and chronology in South-East Kazakhstan. *Antiquity* 77, 298–312.
- Chang, K. 1977*: Introduction. In: *Food in Chinese culture: anthropological and historical perspectives*. Yale University Press, New Haven.
- Cherry, J. F. 1984*: The Emergence of the State in the Prehistoric Aegean. *Proceedings of the Cambridge Philological Society* 30, Cambridge, 18–48.
- Cheung, C. – Jing, Z. – Tang, J. – Yue, Z. – Richards, M. P. 2015*: Examining social and cultural differentiation in early Bronze Age China using stable isotope analysis and mortuary patterning of human remains at Xin'an-zhuang, Yin-xu. *Archaeological and Anthropological Sciences*. doi:10.1007/s12520-015-0302-z
- Cronin, T. – Downey, L. – Synnott, C. – McSweeney, P. – Kelly, E.P. – Cabill, M. – Rossa, R.P. – Stanton, C. 2007*: Composition of ancient Irish bog butter. *International Dairy Journal* 17, 1011–1020.
- DeNiro, M. J. – Schoeninger, M. 1983*: Stable carbon and nitrogen isotope ratios of bone collagen: variations within individuals, between sexes, and within populations raised on monotonous diets. *Journal of Archaeological Science* 10, 199–203.
- Dickinson, O. T. P. K. 1977*: *The Origins of Mycenaean Civilisation*. SIMA 49. Paul Åströms Förlag, Göteborg.
- Farrand, W. R. 2003*: Depositional environments and site formation during Mesolithic occupations of Franchthi Cave, Peloponnesos, Greece. In: Galanidou, N. – Perles, C. (eds): *The Greek Mesolithic: Problems and Perspectives*. British School at Athens, *Studies* 10, 69–78.
- Farquhar, G. D. – Ehleringer, J. R. – Hubick, K.T. 1989*: Carbon isotope discrimination and photosynthesis. *Annual Review of Plant Physiology and Plant Molecular Biology* 40, 503–537.
- Fiskesjö, M., 2001*: Rising from blood-stained fields: royal hunting and state formation in Shang China. *Bulletin of the Museum of Far Eastern Antiquities* 73, 48–192.
- Frachetti, M. – Benecke, N. 2009*: From sheep to (some) horses: 4500 years of herd structure at the pastoralist settlement of Begash (south-eastern Kazakhstan). *Antiquity* 83, 1023–1037.
- Frachetti, M. D. 2012*: Multiregional emergence of mobile pastoralism and nonuniform institutional complexity across Eurasia. *Current Anthropology* 53, 2–38.
- Frachetti, M. D. – Spengler, R. N. – Fritz, G. J. – Maryashev, A. N. 2010*: Earliest direct evidence for broomcorn millet and wheat in the central Eurasian steppe region. *Antiquity* 84, 993–1010.

- Guo, Z. – Liu, K. – Lu, X. – Ma, H. – Li, K. – Yuan, S. – Wu, X. 2000:* The use of AMS radiocarbon dating for Xia-Shang-Zhou chronology. *Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms* 172, 724–731.
- Halstead, P. 1995:* Late Bronze Age grain crops and Linear B ideograms. *The Annual of the British School at Athens* 90, 229–234.
- Halstead, P. – Isaakidou, V. 2004:* Faunal evidence for feasting: burnt offering from the Palace of Nestor at Pylos. In: Halstead, P. – Barrett, J.C. (eds.): *Food, Cuisine and Society in Prehistoric Greece*. Oxbow Books, Oxford, 136–154.
- Harding, A. 1984:* *The Mycenaeans and Europe*. Academic Press, London.
- Harding, A. 2013a:* *Salt in Prehistoric Europe*. Sidestone Press, Leiden.
- Harding, A. 2013b:* Salt production in the Bronze Age. In: Harding, A. – Fokkens, H. (eds.): *The Oxford handbook of the European Bronze Age*. Oxford University Press, Oxford, 501–507.
- Hedges, R. E. M. – Richards, M. P. 1999:* Grave Circle A at Mycenae. In: Tzedakis, Y. – Martlew, H. (eds.): *Minoans and Mycenaeans: Flavours of their Times*. Greek Ministry of Culture, National Archaeological Museum, Kapon Publisher, Athens, Greece, 227–228.
- Honeychurch, W. 2015:* *Inner Asia and the Spatial Politics of Empire: Archaeology, Mobility, and Culture Contact*. New York, Heidelberg, Dordrecht, London: Springer.
- James, T. K. – Rahman, A. – McGill, C. R. – Trivedi, P. D. 2011:* Biology and survival of broom corn millet (*Panicum miliaceum*) seed. *New Zealand Plant Protection* 64, 142–148.
- Jimenez-Brobeil, S. A. – du Souich, P. – Al Ounmaoui, I. 2009:* Possible relationship of cranial traumatic injuries with violence in the south-east Iberian Peninsula from the Neolithic to the Bronze Age. *American Journal of Physical Anthropology* 140, 465–475.
- Jones, G. 2002:* Charred grain from Late Bronze Age Gla, Boiotia. *The Annual of the British School at Athens* 90, 237–238.
- Jones, M. – Hunt, H. – Lightfoot, E. – Lister, D. – Liu, X. – Motuzaitė-Matuzevičiute, G. 2011:* Food globalization in pre-history. *World Archaeology* 43, 665–675.
- Kaliova, S. – Logvin, V. 2011:* On the origins of nomadism in the Asian steppes. *Archaeology, Ethnology & Anthropology of Eurasia* 39, 85–93.
- Katzenberg, M. A. 2008:* Stable isotope analysis: a toll for studying past diet, demography and life history. In: Katzenberg, M. A. – Saunders S.R. (eds.): *Biological Anthropology of the Human Skeleton*, Wiley, doi: 10.1002/9780470245842.ch13
- Khazanov, A. M. 1994:* *Nomads and the Outside World*. University of Wisconsin Press, Madison.
- Kristiansen, K. 2017:* Interpreting Bronze Age Trade and Migration. In: Kiriatzi, E.- Knappett, C. (eds.): *Human Mobility and Technological Transfer In The Prehistoric Mediterranean*, Cambridge University Press, Cambridge, 154-180.
- Kuzmina, E. E. 2008:* *The Prehistory of the Silk Road*. University of Pennsylvania Press, Philadelphia.

- Leonard, W. R. – Crawford, M. H. 2002: The biological diversity of herding populations: an introduction. In: Leonard, W. R. – Crawford, M. H. (eds.): *The Human Biology of Pastoral Populations*. Cambridge University Press, Cambridge.
- Lightfoot, E. – Motuzaitė-Matuzevičiute, G. – O'Connell, T. – Kukushkin, I. – Loman, V. – Varfolomeev, V. – Liu, X. – Jones, M. 2014: How 'Pastoral' is pastoralism? Dietary diversity in Bronze Age communities in the Central Kazakhstan steppes. *Archaeometry* 45, 574–623.
- López-Costas, O. – Müldner, G. – Cortizas, A. M. 2015: Diet and lifestyle in Bronze Age Northwest Spain: the collective burial of Cova de Santo. *Journal of Archaeological Science* 55, 209–218.
- Lull, V. – Micó, R. – Ribuet Herrada, C. – Risch, R. 2013: Bronze Age Iberia. In: Harding, A.- Fokkens, H. (eds): *The Oxford Handbook of the European Bronze Age*. Oxford University Press, Oxford, 596–616.
- Ma, L. J. C. 2009: Chinese Urbanism. In: Kitchin, R. – Thrift, N. (eds.): *International Encyclopedia of Human Geography*, 1st Edition. Elsevier Science, Amsterdam, 65-71.
- MacAdam, W. I. 1882: On the results of a chemical investigation into the composition of 'bog butters' and of 'adipocere' and the 'mineral resins' with notice of a cask of bog butter from Glen Gill, Morvern, Argyllshire and now in the museum. *Proceedings of the Society of Antiquaries of Scotland*, 16, 204–223.
- Mair, V. H. 1998: Canine Conundrums: Eurasian Dog Ancestor Myths in Historical and Ethnic Perspective. *Sino-Platonic Papers* 87, Yale.
- Messenger, E. – Herrscher, E. – Martin, L. – Kvanadze, E. – Martkoplshvili, I. – Delbon, C. – Kakhiani, K. – Bedianashvili, G. – Sagona, A. – Bitadze, L. – Poulmarc'h, M. – Lordkipanidze, D. 2015: Archaeobotanical and isotopic evidence of Early Bronze Age farming activities in the mountainous environment of the South Caucasus: a pilot study of Chobareti site (Samtskhe-Javakheti region). *Journal of Archaeological Science* 53, 214–226.
- Motuzaitė Matuzevičiute, G. – Staff, R. A. – Hunt, H. V. – Liu, X. – Jones, M. K. 2013: The early chronology of broom-corn millet (*Panicum miliaceum*) in Europe. *Antiquity* 83, 1073–1085.
- Müldner, G. – Richards M. P. 2007: Diet and Diversity at Later Medieval Fishergate: The Isotopic Evidence. *American Journal of Physical Anthropology* 174, 162–174.
- Najera Colino, T. – Molina Gonzalez, F. – Jimenez-Brobeil, S.A. – Sanchez Romero, M. – Al Oumaoui, I. – Aranda Jimenez, G. – Delgado-Huertas, A. – Laffranchi, Z. 2010: La población infantil de la Motilla del Azuer: Un estudio bioarqueológico. *Complutum* 21, 69–102.
- Nathaniel, L. – Erb-Satullo, B. – Gilmour, J. J. – Khakbutaishvili, N. 2015: Crucible technologies in the Late Bronze–Early Iron Age South Caucasus: copper processing, tin bronze production, and the possibility of local tin ores. *Journal of Archaeological Science* 61, 260–276.
- Nesbitt, M. – Summers, G. D. 1988: Some recent discoveries of Millet (*Panicum miliaceum* L. and *Setaria italica* (L.) P. Beauv.) at excavations in Turkey and Iran. *Anatolian Studies* 38, 85–97.
- Newsome, S. D. – Phillips, D. L. – Culleton, B. J. – Guilderson, T. P. – Koch, P.L. 2004: Dietary reconstruction of an early to middle Holocene human population from the central California coast: insights from advanced stable isotope mixing models. *Journal of Archaeological Science* 31, 1101–1115.
- O'Connell, T. – Levine, M. – Hedges, R. 2003: The importance of fish in the diet of Central Eurasian peoples from the

- Mesolithic to the Early Iron Age. In: Levine, M. – Renfrew, C., Boyle, K. (eds.): Prehistoric Steppe Adaptation and the Horse. McDonald Institute for Archaeological Research, Cambridge, 253–268.
- Outram, A. K. – Kasparov, A. – Stear, N. A. – Varfolomeev, V. – Usmanova, E. – Evershed, R. P. 2012:* Patterns of pastoralism in later Bronze Age Kazakhstan: new evidence from faunal and lipid residue analyses. *Journal of Archaeological Science* 39, 2424–2435.
- Petroutsas, E. I. – Richards, M. P. – Kolonas, L. – Manolis, S. K. 2009:* Isotope palaeodietary analysis of humans and fauna from the Late Bronze Age site of Voudeni, Greece. In: Schepartz, L. – Fox, S., Bourbou, C. (eds.): *New Directions in the Skeletal Biology of Greece*. *Hesperia Suppl.* 43, 237–244. The American School of Classical Studies at Athens, Princeton.
- Pokutta, D. 2013:* Population Dynamics, Diet and Migrations of the Unetice Culture in Poland, GOTARC Series B, Gothenburg archaeological theses 60. Gothenburg.
- Privat, K. – Schneeweiß, J. – Benecke, N. – Vasil'ev, S. K. – O'Connell, T. – Hedges, R. – Craig, O. 2006:* Economy and diet at the Late Bronze Age-Iron Age site of Tita: artefactual, archaeozoological and biochemical analyses. *Eurasia antiqua: Zeitschrift für Archäologie Eurasiens* 11, 419–448.
- Rachie, K. O. 1975:* The Millets: Importance, Utilisation and Outlook. International Crops Research Institute for the Semi-Arid Tropics, Hyderabad.
- Redfern, R. C. – Hamlin, C. – Beavan Athfield, N. 2010:* Temporal changes in diet: a stable isotope analysis of late Iron Age and Roman Dorset, Britain. *Journal of Archaeological Science* 37, 1149–1160.
- Richards, M. P. – Hedges, R. E. M. – Molleson, T. I. – Vogel, J. C. 1998:* Stable Isotope Analysis Reveals Variations in Human Diet at the Poundbury Camp Cemetery Site. *Journal of Archaeological Science* 25, 1247–1252.
- Rouse, L.M. – Cerasetti, B. 2014:* Ojakly: a Late Bronze Age mobile pastoralist site in the Murghab Region, Turkmenistan. *Journal of Field Archaeology* 39, 32–50.
- Rožin, P. 1999:* Food is fundamental, fun, frightening, and far-reaching. *Social Research* 66, 9–30.
- Rožin, P. – Fallon, A. E. 1987:* A perspective on disgust. *Psychological Review* 94, 23–41.
- Rožin, P. – Zellner, D. A. 1985:* The role of Pavlovian conditioning in the acquisition of food likes and dislikes. *Annals of the New York Academy of Sciences* 443, 189–202.
- Ruipérez, M. – Melena, J. 1996:* The Mycenaean Greeks. Kardamitsas Publ. Co., Athens.
- Sagona, A. 1984:* The Caucasian Region in the Early Bronze Age. BAR International Series 214, British Archaeological Reports, Oxford.
- Sandias, M. – Müldner, G. 2015:* Diet and herding strategies in a changing environment: stable isotope analysis of Bronze Age and Late Antique skeletal remains from Ya'amun, Jordan. *Journal of Archaeological Science* 63, 24–32.
- Sealy, J. C. 2001:* Body tissue chemistry and palaeodiet, In: Brothwell, D. R. – Pollard, A.M. (eds.): *Handbook of Archaeological Sciences*. Wiley, 269–279.
- Sherratt, A. 1980:* Water, soil and seasonality in early cereal cultivation. *World Archaeology* 11, 313–330.

- Spengler, R. N. – Chang, C. – Tourtellotte, P. A. 2013:* Agricultural production in the Central Asian mountains: Tuzusai, Kazakhstan (410–150 BC). *Journal of Field Archaeology* 38, 68–85.
- Spengler, R. N. – Frachetti, M.D. – Domani, P.N. 2014:* Late Bronze Age agriculture at Tasbas in the Dzhungar Mountains of eastern Kazakhstan. *Quaternary International* 348, 145–157.
- Tafuri, M. – Mastroroberto, M. – Manzi, G. 2003:* Human skeletal remains from the Middle Bronze Age cemetery of Sant'Abbondio (Pompeii, Italy). *Rivista di Antropologia*, 81, 79–106.
- Tafuri, M.A. – Craig, O.E. – Canci, A. 2009:* Stable isotope evidence for the consumption of millet and other plants in Bronze Age Italy. *American Journal of Physical Anthropology* 139, 146–153.
- Tereso, J.P. – Ramil-Rego, P. – Alvarez Gonzalez, Y. – Lopez Gonzalez, L. – Almeida-da-Silva, R. 2013:* Massive storage in As Lajas/O Castelo (Ourense, NW Spain) from the Late Bronze Age/Iron Age transition to the Roman period: a palaeoethnobotanical approach. *Journal of Archaeological Science* 40, 3865–3877.
- Thompson, A. H. – Chaix, L. – Richards, M. P. 2008:* Stable isotopes and diet at Ancient Kerma, Upper Nubia (Sudan). *Journal of Archaeological Science* 35, 376–387.
- Thorp, R. L. 2005:* China in the Early Bronze Age: Shang Civilization. University of Pennsylvania Press, Philadelphia.
- Triantaphyllou, S. 2001:* A Bioarchaeological Approach to Prehistoric Cemetery Populations from Central and Western Greek Macedonia. BAR International Series 976. Archaeopress, Oxford.
- Triantaphyllou, S. – Richards, M.P. – Zerner, C. – Voutsaki, S. 2009:* Isotopic dietary reconstruction of humans from Middle Bronze Age Lerna, Argolid, Greece. *Journal of Archaeological Science* 35, 3028–3034.
- Wallerstein, I. 1974:* The Modern World system, vol. 1. Academic Press, New York.
- Walker, B. L. 2005:* The Lost Wolves of Japan. University of Washington Press, Washington.
- Ventresca Miller, A. – Usmanova, E. – Logvin, V. – Kalieva, S. – Shevnina, I. – Logvin, A. – Kolbina, A. – Suslov, A. – Privat, K. – Haas, K. 2014:* Subsistence and social change in Central Eurasia: stable isotope analysis of populations spanning the Bronze Age transition. *Journal of Archaeological Science* 42, 525–538.
- Volkov, E. N. – Dryabina, L. A. 2001:* Kulturno-Khronologicheskie Kompleksy Pamyatnika ostrov-2 v ingalskoi doline. In: Zakh, V. A. (ed.): Problemy izucheniya neolita zapadnoi sibirii. IPOS SO RAN, Tyumen, 26–37.
- Yuan, J. – Flad, R. 2005:* New zooarchaeological evidence for changes in Shang Dynasty animal sacrifice. *Journal of Anthropological Archaeology* 24, 252–270.
- Zvelebil, M. 1994:* Plant use in the Mesolithic and the implications for the transition to farming. *Proceedings of the Prehistoric Society* 60, 35–74.

Résumé

Táto štúdia ukazuje praveké stravovacie návyky a vyjadruje sa k hodnotám stabilných izotopov ($^{13}\text{C}/^{15}\text{N}$) v ľudských/zvieracích pozostatkoch z niekoľkých veľkých pohrebísk z doby bronzovej v Európe a Ázii. Ľudský osteologický materiál pochádza z Ibérie staršej doby bronzovej (2300–2000 BC), pevninského Grécka (neskoroheladské obdobie III), Zakaukazska doby bronzovej (kuro-araxská kultúra 3400–2000 BC), stepí Kazachstanu (1800 BC), a staršej doby bronzovej v Číne z dynastie Šang (1523–1046 BC). Rozšírenie kovopracujúcich technológií malo za následok zlepšenie tepelnej úpravy jedla, zvýšenú produkciu soli a alkoholu. Po prvý raz bolo opekanie, praženie a varenie oveľa ľahšie vďaka kontrolovanému, efektívnejšiemu využitiu paliva vo vysokoteplotných peciach. V určitom smere bola celá spoločnosť doby bronzovej sústredená okolo stále sa zvyšujúcim množstvom osobnej konzumácie hraničiacej so zhýralosťou. Koncom doby bronzovej a v dobe železnej sa archeológia prvý raz stretáva s nekontrolovaným rozvojom pravekej konzumnej spoločnosti, ktorý vyústil do úbytku neobnoviteľných zdrojov (lesy, nerastné suroviny, atď.) a problémov s environmentálnou udržateľnosťou. Tento proces je vidno v staršej dobe bronzovej v Španielsku, kde výrub lesov, rozvoj poľnohospodárstva a tvorba pastvín spolu s intenzívnou ťažbou paliva pre metalurgiu mali za následok krátkodobé ekonomické zisky, ale z dlhodobého hľadiska prispeli ku kríze, ktorá znamenala koniec argarskej spoločnosti. Kultúra El Argar sa spoliehala na jarný/letný kultivačný cyklus a plodiny ako proso, s krátkym životným cyklom, ktoré predstavovali jasnú výhodu v oblastiach, kde kruté zimy zničili plodiny s dlhšou vegetačnou dobou. V nasledovnej časti sú ukázané izotopové dáta týkajúce sa pravekých kulinárskych tabu, odporu a vyhýbania sa jedlám, konkrétne vyhýbanie sa rybám v Grécku a ostatných častiach sveta doby bronzovej. Ďalšie podkapitoly sú zamerané na rôzne formy špecializovaného poľnohospodárstva v horských častiach Kaukazu a na stepiach Kazachstanu. Podľa nových izotopových dát zozbieraných pre kuro-araxskú kultúru na Kaukaze, vysoké hodnoty $\delta^{15}\text{N}$ pšeničných zŕn naznačujú, že zvierací trus bol používaný na dodanie živín plodinám a zlepšenie výnosov. Okrem toho doba bronzová na Kaukaze priniesla nové formy spravovania pôdy a zavlažovania. Pôda bola intenzívne obrábaná a zber úrody bol dvakrát do roka (jar-jeseň). Archeologické doklady pestovania viniča a vinárstva boli nájdené na sídliskách kuro-araxskej kultúry. Doba bronzová v Kazachstane bola spájaná s výraznou transformáciou spoločenstiev v oblasti, najmä prechodom od rybolovu a lovu k pastierstvu. Kočovníctvo ako spôsob obživy založený na špecializovanom chove zvierat bolo považované za jedinú formu obživy na lúkach počas doby bronzovej, kým nedávny výskum minulých stepných spoločností neukázal využívanie oveľa širšej škály zdrojov potravy než sú len živočíšne produkty. Kosáky a znotierky boli nájdené na pravekých lokalitách po celej Strednej Ázii, čo svedčí o zbere a spracovávaní rastlín. Zvlášť proso zohrávalo veľmi dôležitú úlohu u populácií Strednej Ázie. Posledná podkapitola skúma stravu a stravovacie návyky v Číne. Nedávne izotopové štúdie ukazujú rozsah spoločenskej diverzifikácie v Jin-sü (An-jang), hlavnom meste prvej historickej čínskej dynastie Šang.