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# On Salt, Copper and Gold. The story behind shepherds, metallurgists and miners in the first mining enterprises of the Caucasus

Catherine Marro, Thomas Stöllner

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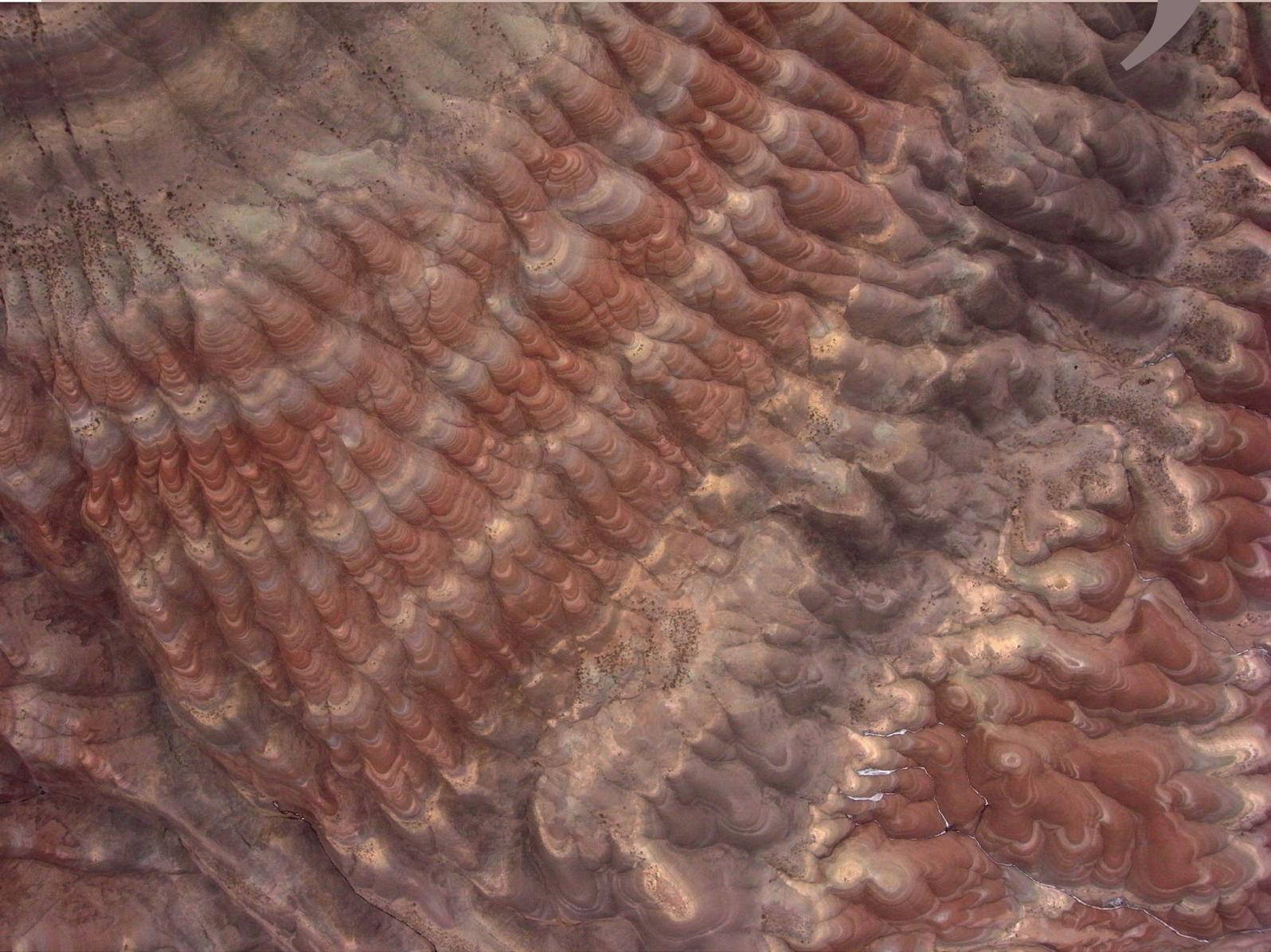
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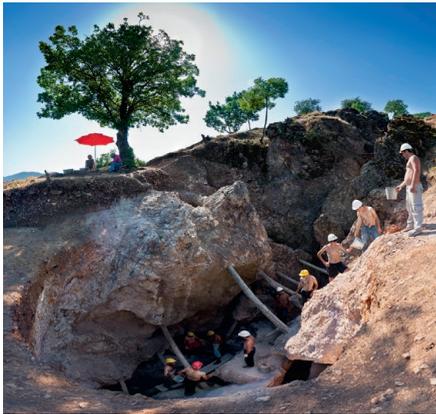


**ON SALT, COPPER AND GOLD**  
**THE ORIGINS OF EARLY MINING**  
**AND METALLURGY IN THE CAUCASUS**

*edited by Catherine Marro and Thomas Stöllner*

## ON SALT, COPPER AND GOLD: THE ORIGINS OF EARLY MINING AND METALLURGY IN THE CAUCASUS

ARCHÉOLOGIE(S) // 5



An international conference focused on the beginnings of mining and metallurgy in the Caucasus was organised in Tbilisi in June 16th-19th 2016 under the auspices of the National Museum of Georgia. This conference, which was funded by the Agence nationale de la recherche (France) and the Deutsche Forschungsgemeinschaft (Germany), aimed at discussing the intricate relationships between the emergence of mining and metallurgy, and the shaping of late prehistoric societies in south-western Asia.

The Caucasus is renowned in Near Eastern archaeology for its wealth in natural resources, in particular in metal ores: for decades, scholars have surmised a specific causal relationships between the rise of complex, hierarchical societies in the Near-East and the development of extractive metallurgy. Metallurgy, however, is only the most visible part of the story that accounts for the dramatic changes perceptible in south-western Asia in the course of the 5th millennium BCE. Early mining, which is

not restricted to metal-ore mining, certainly also had an impact in terms of economic networks, social dynamics, settlement patterns and regional integration, not only across the Caucasus, but also in the ancient Near and Middle East.

Drawing on these fundamental questions, this book explores the socio-economic, technological and environmental background that favoured the rise of systematic mining and extractive metallurgy in the Caucasus at the end of the Chalcolithic. How far was early mining linked to the spread of specific subsistence strategies such as pastoral herding? Were mined resources mainly intended for local consumption or distributed throughout the Near East, towards Anatolia, Iran or Mesopotamia? Here are some of the issues that are discussed in the present volume, which contains 21 articles written by some of the most eminent specialists in Caucasian archaeology.

*Un colloque international axé sur les origines de l'extraction minière et de la métallurgie dans le Caucase s'est déroulé à Tbilisi du 16 au 19 juin 2016, sous les auspices du Musée national de Géorgie. Ce colloque, financé par l'Agence nationale de la recherche (France) et la Deutsche Forschungsgemeinschaft (Allemagne), avait pour objectif d'aborder les relations entre la naissance des mines et de la métallurgie, et l'évolution des sociétés protohistoriques en Asie du Sud-Ouest.*

*Le Caucase est connu en archéologie orientale pour sa richesse en matières premières, en particulier pour ses ressources métallifères ; pendant des décennies, les chercheurs ont présupposé l'existence d'un lien de causalité particulier entre l'émergence de sociétés complexes hiérarchisées au Proche et Moyen-Orient et le développement de la métallurgie extractive. Pourtant, la métallurgie n'est que la partie émergée d'une histoire marquée par des changements spectaculaires tout au long du V<sup>e</sup> millénaire avant notre ère. L'extraction minière, par exemple, qui ne se réduit d'ailleurs pas à l'exploitation des minerais métallifères, a certainement eu aussi un impact sur les dynamiques sociales, les structures de peuplement, l'organisation des réseaux économiques et les processus d'intégration régionale, en Orient comme dans le Caucase.*

*Partant de ces questions fondamentales, cet ouvrage explore le contexte socioéconomique, technologique et environnemental dans lequel se sont développées la métallurgie et l'extraction minière à la fin du Chalcolithique dans le Caucase. Ainsi, dans quelle mesure les premières exploitations minières sont-elles liées à des stratégies de subsistance spécifiques, tel le pastoralisme ? Les ressources exploitées étaient-elles destinées à la seule consommation locale ? Ou bien étaient-elles aussi distribuées à travers le Proche-Orient, l'Anatolie, l'Iran ou la Mésopotamie ? Tels sont les thèmes abordés dans ce volume, qui contient 21 articles rédigés par quelques-uns des plus éminents spécialistes de l'archéologie du Caucase.*



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# **ON SALT, COPPER AND GOLD**

## **THE ORIGINS OF EARLY MINING AND METALLURGY IN THE CAUCASUS**

Proceedings of the conference held in Tbilisi (Georgia), June 16th-19th 2016

*edited by Catherine Marro and Thomas Stöllner*

*This volume is dedicated to the memory of our dear colleague  
Antonio Sagona † (1956-2017).*



Tony Sagona in the field, region of Sveli, Georgia (courtesy of C. Sagona).



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## **On salt, copper and gold**

# **The story behind shepherds, metallurgists and miners in the first mining enterprises of the Caucasus**

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## **Introduction**

The Caucasus is renowned in near-eastern archaeology for its wealth in natural resources, in particular in metal ores (*fig. 1*): scholars, for decades, have surmised causal relationships between the rise of complex, hierarchical societies in the Near East and the development of extractive metallurgy (e.g. Childe 1930; Childe 1944; Wailes 1996; Frangipane 2017). Metallurgy, however, is only the most visible part of the story that accounts for the dramatic changes that shaped south-western Asia in the course of the 5th-3rd millennia BC: the Chalcolithic period and the Early Bronze Age are indeed rich in technological innovations that had durable consequences on the local, but also interregional scale.

Together with metallurgy, early mining, which is not restricted to metal-ore mining, had certainly also an impact in terms of economic networks, social dynamics, settlement patterns and regional integration; not only across the Caucasus, but also in the ancient Near and Middle East, which includes the Levant, Anatolia, Iran and Mesopotamia. However, many of the dynamics that led to the development of mining and its impact in the Caucasus and beyond are far from being understood. What kind of socioeconomic, technological and environmental background favoured the rise of systematic mining in the Caucasus? When should the first steps of mining practices be dated? Did the Kura-Araxes communities play a specific part in the development of early Caucasian mining practices and the diffusion of metallurgical knowledge? These were some of the questions we had in mind when we launched the MINES joint-project in 2013, under the auspices of the University of Bochum, the Deutsches Bergbau-Museum (Bochum, Germany) and the Centre national de la recherche scientifique (France). This project addressed the issues of early mining and extractive metallurgy in the South Caucasus with a view to analysing the broad social and economic system in which these innovations had developed.

Our goals were manifold: in Nakhchivan<sup>1</sup>, work first aimed at documenting the methods involved in early salt exploitation at Duzdağı, while analysing the context in which salt and copper mining had appeared through the investigation of a Kura-Araxes miners' valley settlement, Kültepe I.

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1. Work in Nakhchivan was carried out in the framework of a French-Azerbaijani joint-project led by Veli Bakhshaliyev (AMEA) and Catherine Marro (CNRS).

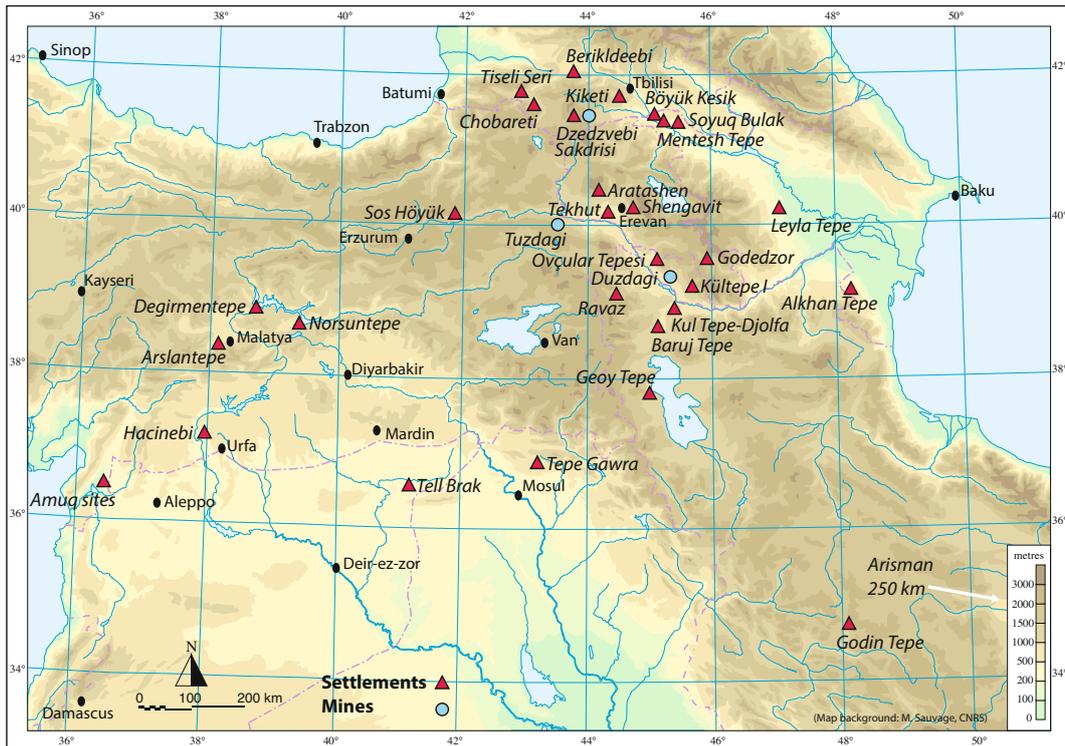


Fig. 1 – Caucasian prehistoric mining works in their regional context (map background: M. Sauvage, CNRS).

One of the underlying aims of our work at Duzdağı was to discover why the exploitation of salt had not begun until the second half of the 5th millennium: since this question is possibly linked to increasing pastoral activities resulting from zotechnological innovations (wool production and dairy products), an in-depth study of subsistence strategies was also carried out, which included the analysis of pastoral systems and pastoral routes. Several mobile camps located in the mountains opposite the salt mine, such as Zirinçlik and Uçan Ağıl, were thus investigated.

The integrated work programme that was carried out in Nakhchivan comprised excavations on valley settlements (Ovcular Tepesi, Kültepe I), mountain campsites (Şorsu, Uçan Ağıl, Zirinçlik), and the salt mine of Duzdağı, as well as an experimental programme on the use of salt-mining tools, the sampling of geological copper ores, paleo-metallurgical analyses, paleo-environmental studies, and the study of early pastoral practices through isotopic analyses. Only a fraction of the data produced during the 2013-2016 period will be presented here, since work is still in progress; but the available data certainly provides an unprecedented wealth of information on the dynamics linking the lowlands with the highlands, pastoral nomads with valley communities, metallurgists with shepherds, during the Caucasian Chalcolithic and Early Bronze Ages.

The work programme in Georgia<sup>2</sup> was set up on the basis of earlier preliminary results, which had cast some light onto the early gold-mining processes of the so-called Sakdrisi-Dzedzvebi complex and had been investigated in detail. By 3000 BCE, mining and metallurgical processes had developed so as to reach a high and sophisticated level (Stöllner et al. 2014). It became clear that the communities from Dzedzvebi, an extended settlement scattered with workshops, graves and living quarters, had lived on that site on at least a semi-permanent basis to exploit the mineral resources of the surrounding Bolnisi-Madneuli ore district, where not only gold, but also copper and other semi-precious minerals

2. Work in Georgia was carried out by Irina Gambashidze (National Museum of Georgia), and Thomas Stöllner (University of Bochum and German Mining Museum).

were being processed (Gambashidze, Stöllner 2016). Their activities not only covered different aspects of gold production but also underlay larger societal and economic processes. The simple fact that the production of gold had developed in a period when it had no decisive role in societal and ritual display made it clear that the cultural appropriation of metals was already confronted with norms and a social narrative (e.g. Stöllner 2016). These norms must have developed during the Late Chalcolithic and were likely at work when the Transcaucasian Kura-Araxes groups settled around the middle of the 4th millennium. Thus, beyond the analysis of early mining and metallurgy in south-eastern Georgia and the Dzedzvebi plateau, our task was to discover how early mining groups had approached the region from the late 5th millennium onwards. This also raised questions concerning the routes leading to the lower mountain ranges, where rich natural resources are concentrated; these areas were most probably accessed from the Kura river and its tributaries. The quest for natural resources and pastures, as well as raw materials located in the mountains, probably transformed the perception Transcaucasian societies had of mountain territories and impacted their collaborative habits with groups who had a different subsistence basis (such as pastoralists, farmers, miners, etc.). Therefore, it seemed necessary to investigate not only the Dzedzvebi plateau and its related mines (such as Sakdrisi), but also the Kura-valley socioeconomic system of Georgia and western Azerbaijan.

After four years of combined research on early mining and metallurgy in Nakhchivan and south-eastern Georgia, it was high time to compare our data with those from colleagues working on related issues in the wider region. This is how we came to organize an international conference in Tbilisi in June 2016, with the valuable support of the National Georgian Museum. This conference, which included colleagues working in the three Caucasian republics (Armenia, Azerbaijan and Georgia), as well as in Iran and eastern Anatolia, was a welcome opportunity to reflect on early mining and metallurgy in their broader socioeconomic, but also regional, contexts.

One of the major tasks was of course to analyse how and when extractive metallurgy had developed in the Caucasus – until fairly recently, the principal steps leading to extractive metallurgy had first been attributed to the Kura-Araxes phenomenon (Chernykh 1966; Chernykh 1992, pp. 59-67; recently Courcier 2014, pp. 601-623), and later to the Majkop culture (Munchaev 1975, pp. 322-335; for a discussion, see Courcier 2014, pp. 622-623). Both hypotheses have now been disproved, respectively by the reassessment of the Majkop culture, and its subsequent re-dating to the first half of the 4th millennium (Trifonov 1996; Lyonnet 2000); and by the discovery at Ovçular Tepesi of three copper axes (among which a shaft-hole axe-hammer) in a tomb dated to the end of the 5th millennium BCE (Marro, Bakhshaliyev, Ashurov 2011; Gailhard et al. 2017). The early production of shaft-hole axes in the South Caucasus itself has been further evidenced by the recent find of an ad-hoc mould at Dzedzvebi, in a Late Chalcolithic pit dated to the late 5th millennium BC (Gambashidze, Stöllner 2016, pp. 108-109). Moreover, the geochemical analyses carried out on the axes and the copper-ore fragments retrieved from Nakhchivani archaeological sites and geological copper deposits have confirmed the local provenance of the copper used by Late Chalcolithic communities in the production of large artefacts.

Thus, it is now beyond doubt that an advanced stage of extractive metallurgy had been reached in the South Caucasus as early as the last quarter of the 5th millennium BCE and possibly earlier, which means that this innovation developed in the South Caucasus when the region was integrated into the “CFW *oikumenè*”<sup>3</sup>: this is a specific period in Caucasian history when the Caucasus became part of a large interaction

---

3. The Chaff-Faced Ware (CFW) *oikumenè* developed in the second half of the 5th millennium in several parts of the South Caucasus, eastern Anatolia, western Iran, the northern Levant and Mesopotamia. In western Iran, the northern Levant and Mesopotamia, the CFW *oikumenè* progressively followed up the so-called “Ubaidian interaction sphere” (Stein 2010), hence the terms “Post-Ubaid”, “Terminal Ubaid” or “Late Ubaid” frequently used in Near Eastern archaeology when referring to the 4500-4000 BC period. From a Caucasian point of view, however, the CFW *oikumenè* clearly evolved from earlier Chalcolithic cultures that bear no relationship with the Ubaidian world whatsoever (Marro 2010).

sphere that included Anatolia, the Levant and the Middle East during the Late Chalcolithic (Marro 2010; Marro 2012; Marro, Yilmaz 2018). The integration of the Caucasus into these dynamics must certainly be taken into account when assessing the wider significance of the innovations under study.

## The organisation of early mining and metal production

Among the main questions that were discussed during the Tbilisi conference, one relates to the organisation of early mining and metal production. This issue is particularly important since organisational matters are closely linked to the finality and the scale, as well as the significance of mining and extractive metallurgy in the social and economic sphere. The processes involved in the production of salt, copper and gold in the Caucasus and beyond were thus examined with careful attention with a view to evaluating the investment of Late Prehistoric Caucasian societies in mining and metal-producing activities.

Central to this question was the status of the individuals involved in these activities: early metallurgical practices were thus studied in order to make clear which part of the community was involved in mining and metallurgy, whether these required the expertise of specialists or were performed at the household level. No straightforward answer could be given to these questions since the data proved to be ambivalent at best: pretty much as in the Balkans, where so far the earliest remains of copper metallurgy have been brought to light (Radivojević, Rehren 2016), the emerging picture at Ovçular Tepesi is that of specialist work carried on all over the settlement within the domestic sphere (Gailhard et al. 2017). Whether all the metallurgical work, including large and sophisticated objects, was performed by the Ovçular residents or by itinerant coppersmiths, is however still an open question (Gailhard et al., this volume). If we focus on the circulation of metallurgical knowledge as suggested by the distribution of shaft-holed casting moulds or large copper smelting crucibles, it is clear that the mobility of specialized individuals must have contributed to the spread of techniques between south-eastern Europe, the Iranian plateau, Transcaucasia and eastern Anatolia during the late 5th and 4th millennium BCE (Stöllner, this volume). It is important to stress here the fact that metallurgical technical concepts were elaborated in the highlands, possibly in south-eastern Europe, but not in the Mesopotamian lowlands (Gailhard et al., this volume).

Similar issues have been discussed in the well-documented synthesis on Iranian metallurgy presented by B. Helwing (this volume). Most interestingly, Helwing shows how the lowland urban communities of Khuzestan and the highland villages of the Zagros or the Central Plateau were integrated into a supra-regional economic network during the Late Chalcolithic: the copper objects used by lowland urban centres were seemingly produced by highland metallurgists. Judging by the mutually exclusive distribution of metallurgical tools and metal objects respectively in the lowlands and the highlands, it seems that Khuzestan, pretty much like Mesopotamia, was still dependent on highland metalsmiths for the crafting of metal goods by the end of the 4th millennium. This suggests that the circulation of metallurgical practices in the Middle East was somehow restricted to highland areas, but also that metallurgical knowledge was in the hands of highland specialists during most of the 4th millennium BCE.

Together with questions regarding the interregional circulation of metal goods and knowledge, the organisation of mining and metallurgy at the local level was also examined, in particular as regards the rhythm and intensity of labour: were these seasonal or permanent activities? The mining infrastructures at Duzdağı – individual cells – indicate that salt exploitation during the Kura-Araxes period was probably carried out by small groups of miners (Gonon et al., this volume), whereas the great diversity in the temper used in ceramic crafting suggests that these groups came from different places (Marro, this volume). Study is in progress to determine whether these miners' groups worked more or less together within the same time span or scattered over a long period of time. But the available data is altogether not sufficient for us to say if these small groups worked at Duzdağı seasonally at specific intervals (Berthon et al., this volume) or throughout the year.

The case with gold mining and gold processing is different: the amount of work needed to produce gold is considerable and would probably require the work of many individuals throughout the year, as shown by the Paravani calculation (Stöllner et al., this volume). But the settlement fabric at Dzedzvebi is rather sparse, while metal-related installations prevail over domestic buildings, as if the *raison d'être* of this settlement had been just the production of gold. The site may have been permanently occupied by a small group of people and may have grown into a larger population only when mining was carried out at Sakdrisi (Stöllner et al., this volume). The possibility that certain groups came to Dzedzvebi on a seasonal basis is still debated: the zooarchaeological data (the age at slaughtering) suggests that the sheep and goat herds were not present in the vicinity of Dzedzvebi during the spring and summer seasons. It is therefore possible that certain groups came to the miners' settlement only on a seasonal basis, that is during the cold season.

No *comparanda* to the miners' settlement of Dzedzvebi so far exist for the production of salt, since most of the Kura-Araxes occupation levels of Kültepe I, a valley-site probably partly occupied by the miners of Duzdağı, were dug away by the Soviet excavations. Unfortunately, these excavations left limited written archives<sup>4</sup>, while the occupation levels excavated by the French-Azerbaijani project did not produce evidence related to salt mining or processing. About twelve grooved hammers, very similar to the Duzdağı examples, were retrieved from the Kura-Araxes levels by the Soviet team (Hamon et al., this volume), but we have no information as concerns the context of these finds and, for this reason, can only speculate about the actual function of salt at Kültepe I during the Early Bronze Age.

This is all the more regrettable as interesting issues arise relating to the modalities of salt processing – and thus salt function – after extraction, especially since several querns and pestles have been found on the site of Duzdağı itself, next to a large number of grooved hammers. According to Harding (this volume), who draws on ethnographic data from south-eastern Europe, rock salt is unlikely to be ground up to fine grains when used for human consumption: in Transylvania, he claims, salt is usually dissolved in fresh water and turned into brine when used for preserving food. However, different food types may require alternative methods of preservation, such as the Tarex fish from Lake Van, which used to be a prized commodity in the Middle Ages and was preserved in salt (Manandian 1965, p. 150). Hamon herself believes that the grinding tools collected at Duzdağı, rather limited in number, were used for the ad-hoc consumption of food by Kura-Araxe miners on the salt mine (Hamon et al., this volume).

To sum up, since the clues related to salt mining or salt processing brought to light at Kültepe I are very limited, interpretations of the actual function of salt on that site or the general significance of salt for Kura-Araxes communities remain for the time being tentative.<sup>5</sup>

## The role of pastoral nomads in mining and early metallurgy

Considerations on the function of salt and the seasonality of mining raise the question of the role of pastoral nomads in these matters, since salt is essential to herding, while metal ores concentrate in mountainous areas: did nomad pastoralists play a specific role in salt or copper-ore exploitation or even metallurgical activities? This question is all the more relevant since some evidence relating to extractive metallurgy has been found both at Zirinçlik and Uçan Ağıl, two campsites with Chalcolithic

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4. The study of the Soviet archives of Kültepe I has been undertaken by a project funded by the Shelby-White foundation, led by R. Berthon (Muséum national d'histoire naturelle, Paris, France).

5. Relevant information may be obtained from a new excavation programme on the site of Kültepe II in the future. This site, which is located between Kültepe I and Duzdağı at the confluence between the Çehri Çay and the Naçivan Çay, has also yielded grooved stone hammers typical of the Duzdağı macro-lithic assemblage during the Soviet excavations carried out in the 1980s.

and Kura-Araxes occupation levels that are located over the mountain slopes of the Sirab basin (Gailhard et al., this volume). One wonders in particular whether the practice of metallurgy in mountainous areas may be correlated with the development of vertical pastoralism, which in the South Caucasus is attested since at least the middle of the 5th millennium BCE: the mountain slopes of the Sirab basin in Nakhchivan, but also the Syunik area in Armenia, were home to pastoral groups that came from the Urmiah region in Iran, probably on their way to the Upper Karabagh pasturelands (Bakhshaliyev, this volume; Palumbi et al., this volume).

As far as the exploitation of South Caucasian copper ores is concerned, very little information is available on the circulation system of the ores, since no traces of mining activities could be recorded in the vicinity of Nakhchivani copper deposits during the survey carried out by the French-Azerbaijani team in 2016 (Marro, this volume). Interesting clues are nonetheless given by the combination of the geochemical analyses of the copper ores and the isotopic analyses of the domestic animal remains from Ovçular Tepesi, which suggest that an early route along an east-west pastoral axis existed between the region of Şarur and the Sirab basin: according to the  $^{87}\text{Sr}/^{86}\text{Sr}$ ,  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  ratios in the caprine tooth enamel, at least some of the flocks, and thus part of the Ovçular community, would leave this valley settlement to reach the uplands, possibly in late spring (Berthon et al., this volume). The presence of petroglyphs across the pastureland of Gemikaya, which depict caprines that strongly resemble the animals illustrated on the jars of Ovçular Tepesi (Gailhard et al., this volume, fig. 17), suggest that at least one of these routes may have led to the pastures of Gemikaya, which border the region of Ughtasar in Armenia where similar petroglyphs are also attested (Walkling, Danielyan, Khechoyan forthcoming). Since the copper-ore fragments found at Ovçular Tepesi, with their molybdenum content, match the geochemical composition of the copper deposits of Eastern Nakhchivan, it seems possible that the pastoral movements of the Ovçular shepherds also included the seasonal exploitation of the copper deposits located near the eastern pasturelands (Gailhard et al., this volume).

To sum up, metallurgical activities were certainly carried on by pastoral groups as well as by valley dwellers, but the evidence is still lacking for us to conclude as to whether the pastoral nomads had a specific role in the procurement of metal ores to the valley sites, or whether each community provided for its own needs.

The complexity of the economic system set up by Late Chalcolithic and Bronze Age communities in the highlands is further illustrated by the article by Palumbi et al. (this volume), which shows that some form of agriculture was probably carried out in the uplands by nomadic pastoral groups in the second half of the 4th millennium. This is suggested by the evidence from Godedzor, a campsite located at 1,800 m asl, about 50 km (as the crow flies) from the petroglyph landscape of Gemikaya and Ughtasar. No traces of metallurgy have so far been found at Godedzor, but the available evidence points to the practice of weaving, possibly wool-weaving, as suggested by the predominance of caprines in the faunal assemblage, the discovery of a long-toothed comb, as well as numerous bone and fired-clay spindle whorls. These important finds should be related to the emergence of woollen textiles in the North Caucasus sometime in the first half of the 4th millennium, where the remains of woollen fabrics have been found in a grave, Kurgan 2, at Novosvobodnaya (Shishlina, Orfinskaya, Golikov 2003, p. 333, fig. 2).

One wonders whether the importance given by Kura-Araxes communities to salt exploitation may have a connection with the development of wool exploitation during the 4th millennium BC: if the production of wool started sometime during the 4th millennium in the South Caucasus, as seems to be the case in the north, then it probably gave rise to increased herding, which in turn may have increased the need for salt. The connections between salt exploitation and mobile pastoralism are illustrated by the discovery of two stone artefacts<sup>6</sup> similar to the tools from Duzdağı on the pastoral campsite of Uçan Ağıl, where, incidentally, a piece of pure copper was found in Locus 2045 (Gailhard et al., this volume).

6. One of these tools is a grooved hammer, the other one is a stone ball very similar to those illustrated in Tamazashvili, this volume, fig. 8, probably some kind of pestle.

Metallurgy was certainly carried on by Kura-Araxes groups, possibly in mobile camps as well as in valley settlements, as suggested by the copper chunk from Uçan Ağıl. But the evidence for the mobility of these communities seems to vary from site to site or from region to region, as suggested by the papers by Longford and Sagona (this volume) on the evidence of Sos Höyük in eastern Anatolia, or that of Herrscher and al. (this volume) on the sites of Kiketi and Tseli Gora in South Georgia: according to these authors, the mobile component of these Kura-Araxes populations was fairly limited. Drawing on archaeobotanical studies, Longford even identifies Sos Höyük as “a sedentary mixed-farming village”.

Further studies including the stable isotopic analysis of animal and human bones from a larger number of Kura-Araxes sites in different locations are needed before we may draw robust conclusions from these discrepancies. All we may say for the time being is that the evidence retrieved from the Sirab basin in Central Nakhchivan certainly points to the existence of small Kura-Araxes flat sites in the mountains, in particular along the Qahab river, whose location and specificities strongly recall those of seasonal campsites (Bakhshaliyev, Novruzov 2010).

Lastly, it should be noted that if the development of salt mining in the 4th millennium BC might be correlated with the appearance of woollen fabrics, the heavy focus on caprine attested during the Late Chalcolithic clearly predates the appearance of the woollen sheep, since caprine-herding specialization appears to be the norm in the Araxes basin from the Neolithic onwards, as apparent from the faunal assemblage of Kültepe I (Berthon et al., this volume): this is much before salt started to be exploited on a steady basis by Kura-Araxes communities.

All these finds put together nonetheless suggest that close relationships existed between shepherds, metallurgists and miners between the 5th and the 3rd millennium BC.

## **The place of salt and metal in the economy of Late Chalcolithic and Early Bronze Age communities**

To sum up, the reasons that prompted Nakhchivani Late Prehistoric communities to start exploiting the salt from Duzdağı regularly from the 4th millennium BC onwards are still not very clear. The correlation between the development of true salt mining, as indicated by the existence of Kura-Araxes mining cells, and the appearance of Caucasian woollen fabrics during the 4th millennium BC, suggests that wool production may well have been one of the reasons that prompted Nakhchivani Late Prehistoric communities to start exploiting the salt from Duzdağı on a steady basis. Indeed, if a few Chalcolithic ceramic potsherds are attested here and there over the slopes of the dome, suggesting some form of exploitation from the 5th millennium onwards, it should be noted that no Late Chalcolithic mining infrastructures have so far been found anywhere on the salt dome (Gonon et al., this volume): although this may be caused by the vagaries of field research, the available evidence suggests that salt had a much greater role during the 4th than during the 5th millennium BC economy – for the time being, however, it seems difficult to say anything more specific about the place of salt in Kura-Araxian economies.

The economic importance of copper and gold production during Late Prehistory in the Caucasus and beyond is also a debated issue, especially as the function of metal objects in early societies is currently being challenged: the monetary value and technological use of metal in contemporary societies should not obviate the fact that in many cases stone, obsidian, flint and bone tools continued to be used in Late Prehistoric economies alongside metal objects, including picks and axes, and this remained the case for quite a long time (Thornton, Roberts 2009, p. 183). Considerable work has been devoted to the evaluation of the importance of gold in Kura-Araxes economies, which has led Stöllner et al. (this volume) to estimate the overall production of gold at Sakdrisi as between 500 kg and one ton. The point to be emphasized here is that gold-production activities were accompanied by ritual practices

that were obviously part of the collaborative work processes, possibly with the view to integrating working groups coming from different areas in the joint venture (Stöllner 2017).

However the production capacity is estimated, its probable aim was seemingly to produce items of social value that had been in use in many Transcaucasian communities since the end of the 4th millennium BCE. Most of the early production of gold is perhaps not visible to us because of strict Kura-Araxes burial customs, which may have reduced the burial goods to a minimum during the second half of the 4th millennium (Stöllner 2016). The desire to craft special gold items such as spiral rings – possibly an important item for the display of rank within Transcaucasian communities – may have prompted some groups to join the Sakdrisi and Dzedzvebi communities. Gold consumers from the valleys may have been directly involved in the gold production, as the earrings from Hasansu – which were made with the gold of Sakdrisi – suggest (Jansen, Stöllner, Courcier, in Stöllner et al. 2014, pp. 105-108). These items – or was it their owners/producers? – did travel some 140 kilometres down the river towards western Azerbaijan, where they were found in a grave dating to the first half of the 3rd millennium BCE (Jansen et al., this volume). The intricate relationships between gold producers and consumers lasted for several hundreds of years, as far as can be gathered from the Sakdrisi mining complex and its chronology (Stöllner et al., this volume).

Attempts at estimating both the importance and the duration of salt mining at Duzdağı have not been successful so far, especially since so few mining infrastructures have been brought to light (Gonon et al., this volume). The evidence from the salt mine of Duzdağı certainly testifies to the thorough investment of Kura-Araxes groups in the mining of salt (Hamon et al., this volume), even if the large quantity of potsherds retrieved from the site should not be taken at face value. The pottery vessels found on the salt mine were most probably used to bring water for the miners; in any case they do not directly reflect the intensity of mining during the Kura-Araxes period (Marro, this volume). A similar use may be assumed for the Kura-Araxes vessels attested on the gold mine of Sakdrisi, where a complete drinking set (containers and handled goblets) is attested. Broken vessels, however, were reused for further work-purposes, as shown from the careful study of use-wear traces left over the surfaces and worn sherd edges (Otchvani et al., this volume).

One of the major difficulties in assessing the function and importance of salt in ancient economies is linked to the nature of this mineral, which is unlikely to be found very far from its production sphere: unlike metal or stone, it disappears after being used. Therefore, only proxies may be employed to trace back its distribution ambit, or its former use in Late Prehistoric societies. The tools used for extracting salt may constitute one of these proxies: interestingly enough, their circulation seemed to be restricted to the salt mine itself and the two nearby settlements of Kültepe I and II. The only exceptions are two grooved hammers, one stray find from Uçan Ağıl (see above), where Kura-Araxes occupation levels have been brought to light, and another one collected at the bottom of Oğlankale near Şarur, where Middle Bronze and Iron Age occupation levels are attested. It should be noted that the hammers used by the Kura-Araxes gold miners of Sakdrisi are markedly different from those crafted by the salt miners of Duzdağı (Tamazashvili, this volume); this is of course related to the respective technical operations engaged in salt and gold mining, but the sophisticated shapes of the Duzdağı hammers, which imply a significant work investment, have also been interpreted as a marker of social distinction by Hamon (Hamon et al., this volume).

In contrast to salt, the distribution of metal ore may be traced back thanks to the geochemical and isotopic analysis of related objects, and this was certainly one of the goals of the ambitious work carried out by Jansen (this volume) on the gold artefacts collected from several sites, notably funerary contexts, in Azerbaijan and Georgia. More specifically, Jansen tried to check whether the Martkopi-stage gold objects retrieved from a number of kurgans had been made from the gold of Sakdrisi: surprisingly enough, it turned out that these artefacts had all been crafted from placer gold; which prompted Jansen to raise this puzzling question: where has the gold from Sakdrisi gone? But intriguing as it may be, one has to remember that most of the mining in Sakdrisi had in fact been

carried out between the second half of the 4th and the beginning of the 3rd millennium BCE, whereas the gold found in the early Martkopi kurgan was produced several hundred years later. Even if the gold from Sakdrisi had been later blended with alluvial gold to craft the Martkopi objects it would be very hard to trace it back. The main problem is in fact to understand what prevented the gold of Sakdrisi from being used in depositional ritual practices.

To conclude, if the value of gold in Early Bronze Age Georgia may be deduced from the amount of work devoted to mining and gold beneficiation at Sakdrisi and Dzedzvebi, its final destination, and the circumstances in which it was actually used, are still open to query.

The circulation of other natural resources has been addressed by Astruc et al. (this volume) in an article that tries to evaluate the resource-procurement ambit of the settlement of Mentesh Tepe in the Kura valley through the study of obsidian and metal ores, as well as semi-precious stones. It turns out that these raw materials were provided by areas that are all located at a distance of only 30-300 km from the site, which suggests that the territorial purview of the Mentesh communities was deeply rooted in the Caucasus itself during the Late Chalcolithic and the Early Bronze Age.

The economic importance of copper for Kura-Araxes societies has been suggested by Badalyan through an analysis of the settlement patterns: according to Badalyan (this volume), several Kura-Araxes sites were purposefully founded along certain routes to control access to the copper-ore deposits, as indicated by the correlation between the Ayrum-Teghut cultural sub-complex and the extension of the Alaverdi-Vanadzor copper-ore region. No similar pattern may be observed for obsidian, a fact that Badalyan interprets as resulting from the ubiquity of obsidian beds throughout the South Caucasus, and the subsequent absence of need of control over these resources.

Lastly, the paper presented by Nezafati et al. (this volume) is a useful reminder of the complexity of the archaeological record, in particular when it comes to interpreting the remains of metallurgical activities using polymetallic ores: while the brown slags from Arisman had so far been interpreted as the production remains of a planned arsenical copper alloy, the authors now demonstrate that these slags probably correspond to a single smelting procedure of polymetallic ores, which may also have been used for producing silver.

This audacious claim, which will certainly fuel further discussions, is a welcome opportunity to introduce silver into the debate, since silver was probably as valued as gold in 4th millennium economies. As is the case with gold, silver is seldom found either in domestic or in funerary contexts – except perhaps for the Majkop kurgans – while the work needed to produce a few grams of metal is also very heavy (Courcier 2014, pp. 625-634). In some cases, silver is found together with gold (natural electrum) and the separation of gold from silver may entail the use of salt, but this technology has so far not been evidenced in the Caucasus and beyond before the mid 1st millennium BCE, as testified by the absence of purified gold before that date. The most likely technological process in use during earlier periods was the cupellation of silver-rich lead ores, as suggested by the finds from Alkhantepe and Soyuq Bulaq, which contain a small amount of lead (see Courcier 2014, tab. 22-24 for Soyuq Bulaq; Akhundov 2014 for Alkhantepe).

To sum up, the assessment of the function of salt, copper, and gold, as well as their economic importance, in Late Prehistoric societies meets with several difficulties: in many cases, we failed to identify the final destination of these raw materials, since their circulation network could not be traced back. The best evidence is given by copper, for which the picture of a complex system involving both pastoral nomads and valley dwellers gradually emerges. The available data so far make it possible to link Nakhchivani Late Chalcolithic metallurgy and local copper ores, and thus establish the existence of a sophisticated local craftsmanship; but the metallurgical system in use during the Early Bronze Kura-Araxes period is not totally clear yet. Another important work challenge in the near future will be to analyse how far the copper (and gold) resources of the South Caucasus travelled in the ancient world, in particular whether they reached the emerging urban elites of the lowlands, as was the case with highland Iranian copper in Khuzestan: what was the circulation ambit of the Caucasian copper and gold?

## The social impact of mining and metallurgy on Late Prehistoric societies

Another question closely linked to the importance of salt, copper and gold in Late Prehistoric economies is the social impact early mining and metallurgy may have had on Chalcolithic and Early Bronze communities. Ever since the influential texts written by Childe (1930, 1944), the rise of metallurgy has often been equated with the development of social elites and inequalities. This claim, however, has recently been challenged by different authors, who argue that the emergence of metal did not necessarily lead to social hierarchy or, conversely, that certain complex societies had no need for metal at all (Hansen 2013, p. 137).<sup>7</sup> The evidence from the Caucasus is certainly, once again, ambivalent.

A puzzling example of this ambivalence is embodied by the discovery of three copper axes in a Late Chalcolithic burial jar at Ovçular Tepesi (Locus 17002). Altogether these finds amount to one kilo of metal, which geochemical analyses have proved to be pure copper in two cases, and copper mixed with 1.95% of arsenic in the third (Gailhard et al. 2017). This extraordinary find, which has no equivalent in the Caucasian Chalcolithic so far, was placed in a ceramic vessel under the body of a newborn child. There is no doubt that the quantity of copper found in this tomb was a very valuable gift at the end of the 5th millennium, when extractive metallurgy in the Caucasus was still in its infancy, but how should we interpret this gift? Eight burial jars containing the remains of newborn children were found at Ovçular Tepesi altogether, but tomb 17002 is the only one that contained a burial gift, with the exception of tomb 17000, which contained two simple copper bracelets and four shell beads (Marro, Yılmaz 2018). The outstanding gift of tomb 17002 shows that this child probably had a special status, a status evidently linked to birth and not to function: this suggests some form of social inequality in the Late Chalcolithic Ovçular community, although some other explanations may also be put forward.<sup>8</sup> The fact that this gift was placed in a child's grave, however, certainly points to the existence of family dynasties, which may have had some link with copper metallurgy or mining, as suggested by the axe-hammer found in the tomb.<sup>9</sup>

The interpretation of this find also depends of course on its socioeconomic context, which in the case under study, appears to be a simple village, where metallurgical activities were commonly carried out in domestic buildings: no traces of inequality have so far been perceived in the architecture or artefact distribution of the Ovçular culture. It is possible that the concept of family dynasty that nonetheless seems to be at the core of this funerary deposit, is linked to structural changes in the community at large (e.g. from a community-based to a family-based social structure), which do not necessarily, or immediately, imply the development of social inequalities (Marro, Yılmaz 2018).

The evidence from Dzedzvebi is just as ambiguous, especially as there are still doubts concerning the real nature of the site where the workshop was brought to light (Dzedzvebi II): was it permanently settled? One wonders whether this site was a settlement in its own right since so little refuse relating to daily life has been found (Stöllner et al., this volume). A possibility would be that the site was a miners' or goldsmiths' camp rather than a simple village where gold mining and gold production would have been performed among other activities. Interestingly enough, activities related to gold production at Dzedzvebi seem to have been enmeshed with ritual, as shown by the skull of a juvenile placed under gold grinding plates (grave 7). A similar skull grave (grave 5) was also found in a cist attached to a gold-milling house (house 3/Dzedzvebi II.3), while ceramic deposits, probably

7. See Hansen 2013 for relevant bibliography.

8. Interpretations that consider burial gifts in babies' graves as a symbolic link between generations rather than prestige and wealth display may be envisaged for this ritual (Marro, Yılmaz 2018).

9. Since the tools were restored as soon as they were exhumed, it has not been possible to carry out metallographic analyses to determine whether they had ever been used before being buried.

linked to feasting activities at the end of the gold processing, were located under grinding plates and tools. The most important evidence comes from complex II.7-8 where a milling and gold-washing building has yielded many traces of feasting and depositional rituals at the closing of working activities. A central feasting and burial complex was situated nearby, which includes a platform with a central hearth and two male graves whose burial customs appear as outstanding for many reasons (e.g. Gambashidze, Stöllner 2016, pp. 88-99). Ritual activities are also attested in relationship with mining at Sakdrisi, where deposits of stone hammers were found at the bottom of the mine shafts, for instance (Stöllner 2017; Stöllner et al., this volume). Altogether, the production of gold by Kura-Araxes communities seems to have been ridden with religious rules, but there is no evidence suggesting that these rules laid the foundation for social inequalities or hierarchy: the Kura-Araxes people of Dzedzvebi-Sakdrisi were producing gold, but we still do not know for whom, for what and where the gold was actually being used.

The impact of metal on early societies, however, should not be considered solely in relationship with the emergence of social elites and inequalities. Scanty as it is, the evidence brought to light in Armenia in the Ayrum-Teghut region, or in Nakhchivan in the Sirab basin, suggests that settlement patterns underwent a marked change from the middle of the 5th millennium onwards, a phenomenon that could be related to some kind of “copper rush” triggered by this new, prized commodity: dozens of Chalcolithic campsites appeared within the 4500-3500 BC time span across the piedmonts of the Lesser Caucasus, in particular in the Sirab area (Bakhshaliyev, Novruzov 2010). Excavations carried out at Nakhchivan Tepe, Şorsu, Uçan Ağıl and Zirinçlik in Nakhchivan (Bakhshaliyev, this volume; Marro, Yılmaz 2018), but also at Godedzor in Armenia, have shown that mobile groups from different cultural horizons would meet and coexist during the 5th and 4th millennium BCE in the Araxes basin. Considering the wealth in metal ores of eastern Nakhchivan and southern Armenia, it seems most probable that the sudden importance of metal for lowland and highland societies alike favoured a change in regional and interregional dynamics, which eventually led to the formation of the “Chaff-Faced Ware *oikumene*”<sup>10</sup>: this trend is illustrated by CFW ceramics, which spread from the Caucasus to the Mesopotamian lowlands and the south-west from ca 4500 BC onwards (Marro 2010, 2012)<sup>10</sup>, but also by the distribution of large obsidian blades with steep retouches, which first appeared in the highlands but were later crafted in flint by Mesopotamian and Levantine communities<sup>11</sup> (Thomalsky, this volume). Since all these trends may be dated to the middle of the 5th millennium, it seems most probable that they were initiated by incipient mining and extractive metallurgy which had a structuring effect on interregional dynamics.

The evidence retrieved from late 4th and 3rd millennium Kura-Araxes sites conjures up a similar picture: the data from the Ayrum-Teghut region for instance suggests that copper exploitation had had an impact on Kura-Araxes settlement patterns by the middle of the 3rd millennium, since a number of sites seem to have been founded to gain access control over copper resources; these sites are sometimes located even high up in the hills, as is the case of Gegharot (ca 2,000 m asl).

## Conclusions

From the data recently collected in the Caucasus, we must admit that the visionary model proposed by G. Childe more than 80 years ago has proved to be partly right: the rise of metallurgy (and henceforth mining) was instrumental in bringing about the changes that affected Late Prehistoric Caucasian societies to a large extent.

10. This spread should not necessarily be equated, however, with human migrations from the Caucasus.

11. Where they are commonly called “Canaanite blades”, since they were first described in this region of the Levant.

But these innovations – and their impact – should not be considered in isolation: they must be integrated into the wider context of social change, which saw the development of many interrelated innovations, such as vertical pastoralism, the production of wool, new dairy products, but also the domestication of equids, and the appearance of the wheel (Anthony 2007, p. 59), in the course of the 5th-4th millennia BCE. These changes are only visible as an integrated package whole, and it is often difficult to unravel the dynamics that linked the different elements of this package together. Clearly, the development of copper and gold metallurgy in the South Caucasus did not give rise in itself to a complex social hierarchy. Even if richly endowed kurgans have also occasionally been found at Majkop and Staromyshastovskaja in the North Caucasus (second quarter of the 4th millennium BCE), in the “royal tomb” of Arslantepe in eastern Anatolia (late 4th millennium BCE<sup>12</sup>), or in the Martkopi-Bedeni culture (second half of the 3rd millennium BCE), the social structures that are perceptible in the fabric of Caucasian and East Anatolian settlements belong to villages or small rural towns with no institutionalized central power. It seems that these graves were related to specific social and historical circumstances within their communities and regions<sup>13</sup>: as may be gathered from the tomb of Arslantepe, these kurgans were central places where the hybrid integration of different forms of social display was necessary to maintain some kind of cohesion within the different groups involved (Palumbi 2008, 2012). “Big men”, probably with fluctuating prerogatives, were at the head of these communities.

This image might change, however, with the future excavations of urban-looking Kura-Araxes settlements, as is the case of Ravaz in north-western Iran (Summers 2013; Alizadeh, Egbal, Samei 2015): one of the characteristic features of the Kura-Araxes phenomenon is certainly its extraordinary multifaceted visage.

To conclude, social complexity in Late Chalcolithic and Early Bronze Age Transcaucasia certainly did not develop as straightforwardly as envisaged by Childe in his days. Rather, from the beginning of the 3rd millennium BCE metal objects seem to have been used by Transcaucasian highland populations partly to display social status, which may not have been the case in the previous period; at any rate, metals are extremely rare in the graves of the early Kura-Araxes communities. The procurement of a new range of raw materials, which involved new territories, economic strategies and acquisition techniques was certainly an innovative process. These innovations have prompted deep changes in highland and lowland communities, in their economic and warfare capacities and contributed to reinforce mobile ways of life. The integration of mountain areas into the agro-pastoral and the resource procurement systems was a major step that eventually accelerated population growth, and possibly prompted migrations towards neighbouring areas in the course of the 4th and 3rd millennium BC.

## Bibliography

- Akhundov 2014: T.I. Akhundov, “At the beginning of Caucasian metallurgy”, in G. Narimanishvili (dir.), *Problems of Early Metal Age archaeology of Caucasus and Anatolia. Proceedings of International Conference (November 19-23, 2014, Georgia)*, Tbilisi, 2014, pp. 11-16.
- Alizadeh, Egbal, Samei 2015: K. Alizadeh, H. Egbal, S. Samei, “Approaches to social complexity in the Kura-Araxes culture. A view from Köhne Shahar (Ravaz) in Chaldran, Iranian Azerbaijan”, *Paléorient* 41/1, 2015, pp. 37-54.
- Anthony 2007: D. Anthony, *The horse, the wheel and language: how Bronze-Age riders from the Eurasian steppes shaped the modern world*, Princeton/Oxford, Princeton University Press, 2007.

12. See Vignola et al. 2019 for the new dating of Period VIB1 at Arslantepe.

13. This refers to the interpretation of large “elite burials” as a manifestation of crisis during transition periods after the death of an important person or, alternatively, as the manifestation of self-empowerment of a separated group (Kossack 1974).

- Bakhshaliyev, Novruzov 2010: V. Bakhshaliyev, Z. Novruzov, *Sirabda arxeoloji arasturmalar*, Bakı, Oskar, 2010.
- Chernykh 1966: E.N. Chernykh, *Istorija drevnejshej metallurgii vostochnoj Evropy*, Materialy i isselovaniya po arkhologii SSR 132, Leningrad/Moscow, Nauka, 1966.
- Chernykh 1992: E.N. Chernykh, *Ancient metallurgy in the USSR: The Early Metal Age*, Cambridge, Cambridge University Press, 1992.
- Childe 1930: V.G. Childe, *The Bronze Age*, Cambridge, Cambridge University Press, 1930.
- Childe 1944: V.G. Childe, "Archaeological ages as technological stages", *Journal of the Royal Anthropological Institute of Great Britain and Ireland* 74, 1944, pp. 7-24.
- Courcier 2014: A. Courcier, "Ancient metallurgy in the Caucasus from the 6th to the 3rd millennium BCE", in B. Roberts, C. Thornton (dir.), *Archaeometallurgy in global perspective. Methods and syntheses*, New York/London, Springer, 2014, pp. 579-664.
- Frangipane 2017: M. Frangipane, "The role of metal procurement in the wide interregional connections of Arslantepe during the late 4th-early 3rd millennia BC", in Ç. Maner, M. Horowitz, A. Gilbert (dir.), *Overturning certainties in Near Eastern archaeology. A Festschrift in honor of K. Aslihan Yener*, Leiden/Boston, Brill, 2017, pp. 187-210.
- Gailhard et al. 2017: N. Gailhard, M. Bode, A. Hauptmann, V. Bakhshaliyev, C. Marro, "Archaeometallurgical investigations in Nakhchivan (Azerbaijan). What does the evidence from Late Chalcolithic Ovçular Tepesi tell us about the beginning of extractive metallurgy?", *Journal of Field Archaeology* 42/6, 2017, pp. 530-550.
- Gambashidze, Stöllner 2016: I. Gambashidze, T. Stöllner, *The gold from Sakdrisi. Man's first gold mining enterprise*, Rahden, Leidorf, 2016.
- Hansen 2013: S. Hansen, "Innovative metals. Copper, gold and silver in the Black Sea Region and the Carpathian Basin during the 5th and 4th millennium BC", in S. Burmeister, S. Hansen, M. Kunst, N. Müller-Scheessel (dir.), *Metal matters. Innovative technologies and social change in Prehistory and Antiquity*, Rahden, Leidorf, 2013, pp. 137-167.
- Kossack 1974: G. Kossack, "Prunkgräber. Bemerkungen zu Eigenschaften und Aussagewert", *Studien zur Vor- und Frühgeschichtlichen Archäologie. Festschrift für Joachim Werner*, Münchner Beitr. Vor- und Frühgesch. Ergänzungsband 1, Munich, 1974, pp. 3-33.
- Lyonnet 2000: B. Lyonnet, "La Mésopotamie et le Caucase du Nord au IV<sup>e</sup> et au début du III<sup>e</sup> millénaires av. n.è: leurs rapports et les problèmes chronologiques de la culture de Majkop. État de la question et nouvelles propositions", in C. Marro, H. Hauptmann (dir.), *Chronologie des pays du Caucase et de l'Euphrate aux IV<sup>e</sup>-III<sup>e</sup> millénaires*, Varia Anatolica XI, Paris, De Boccard, 2000, pp. 299-320.
- Manandian 1965: H. Manandian, *The trade and cities of Armenia in relation to ancient world trade*, Lisbon, Armenian Library of the Calouste Gulbenkian Foundation/Livraria Bertrand, 1965.
- Marro 2010: C. Marro, "Where did Late Chalcolithic Chaff-Faced Ware originate? Cultural dynamics in Anatolia and Transcaucasia at the dawn of urban civilization (4500-3500 BC)", *Paléorient* 36/2, 2010, pp. 35-55.
- Marro 2012: C. Marro, "Is there a Post-Ubaid culture? Reflections on the transition from the Ubaid to the Uruk periods along the Fertile Crescent and beyond", in C. Marro (dir.), *After the Ubaid. Interpreting change from the Caucasus to Mesopotamia at the dawn of urban civilization*, Varia Anatolica XXVII, Paris, De Boccard, 2012, pp. 13-38.
- Marro, Bakhshaliyev, Ashurov 2011: C. Marro, V. Bakhshaliyev, S. Ashurov, "Excavations at Ovçular Tepesi (Nakhchivan, Azerbaijan). Second preliminary report: the 2009-2010 seasons", *Anatolia Antiqua* XIX, 2011, pp. 53-100.
- Marro, Yılmaz 2018: C. Marro, Y. Yılmaz, "The infant jar-burials from the Late Chalcolithic village of Ovçular Tepesi (Nakhchivan, Azerbaijan). A Mesopotamian tradition?", in A. Batmaz, G. Bedianashvili, A. Michalewicz, A. Robinson (dir.), *In context and connection. Studies on the archaeology of the Ancient Near East in honour of Antonio Sagona*, Leuven, Peeters, 2018, pp. 29-47.
- Munchaev 1975: R. Munchaev, *Kavkaz na zare bronzovogo veke, Neolit, Eneolit, Rannaja Bronza*, Moscow, Nauka, 1975.

- Palumbi 2008: G. Palumbi, "From collective burials to symbols of power. The translation of role and meanings of the stone-lined cist burial tradition from southern Caucasus to the Euphrates Valley", *Scienze dell'Antichità* 14, 2008, pp. 7-44.
- Palumbi 2012: G. Palumbi, "The Arslantepe Royal tomb and the 'manipulation' of the Kurgan ideology in eastern Anatolia at the beginning of the third millennium", in E. Borgna, S. Müller Celka (dir.), *Ancestral landscapes, burial mounds in the Copper and Bronze Ages. Proceedings of the International Conference (held in Udine, May 15-18, 2008)*, Lyon, MOM Éditions, 2012, pp. 47-58.
- Radivojević, Rehren 2016: M. Radivojević, T. Rehren, "Paint it black: the rise of metallurgy in the Balkans", *Journal of Archaeological Method and Theory* 22, 2016, pp. 1-38.
- Shishlina, Orfinskaya, Golikov 2003: N. Shishlina, O. Orfinskaya, V. Golikov, "Bronze Age textiles from the North Caucasus: new evidence of fourth millennium BC fibres and fabrics", *Oxford Journal of Archaeology* 22/4, 2003, pp. 331-344.
- Stein 2010: G. Stein, "Local identities and interaction spheres: modeling regional variation in the Ubaid horizon", in R. Carter, G. Philip (dir.), *Beyond the Ubaid. Transformation and integration in the Late Prehistoric societies of the Middle East*, Oriental Institute Publications 63, Chicago, The University of Chicago Press, 2010, pp. 23-44.
- Stöllner 2016: T. Stöllner, "The beginnings of social inequality: consumer and producer perspectives from Transcaucasia in the 4th and 3rd millennia BC", in M. Bartelheim, B. Horejs, R. Krauss (dir.), *Von Baden bis Troia. Ressourcennutzung, Metallurgie und Wissenstransfer. Eine Jubiläumsschrift für Ernst Pernicka*, Rahden, Leidorf, 2016, pp. 209-234.
- Stöllner 2017: T. Stöllner, "The ritual interplay: gold mining practices in the late 4th and early 3rd millennia BC", in V. Eriksen, A. Abegg-Wigg, R. Bleile (dir.), *Interaction without borders. Exemplary archaeological research at the beginning of the 21st century. Festschrift für Claus von Carnap-Bornheim zum 60. Geburtstag*, Schleswig, Lund University Publications, 2017, pp. 119-136.
- Stöllner et al. 2014: T. Stöllner, B. Craddock, I. Gambashidze, G. Gogotchuri, A. Hauptmann, A. Hornschuch, F. Klein, I. Löffler, G. Mindiashvili, B. Murwanidze, S. Senczek, M. Schaich, G. Steffens, K. Tamasashvili, S. Timberlake (with an appendix of M. Jansen, T. Stöllner, A. Courcier), "Gold in the Caucasus: new research on gold extraction in the Kura-Araxes culture of the 4th millennium BC and early 3rd millennium BC", in H. Meller, E. Pernicka, R. Risch (dir.), *Metalle der Macht. Frühes Gold und Silber*, published in *Tagungen des Landesmuseums für Vorgeschichte Halle* 11, 2014, pp. 71-110.
- Summers 2013: G.D. Summers, "The Early Bronze Age in northwestern Iran", in D.T. Potts (dir.), *The Oxford Handbook of Ancient Iran*, Oxford, Oxford University Press, 2013, pp. 161-178.
- Thornton, Roberts 2009: C. Thornton, B. Roberts, "Introduction: the beginnings of metallurgy in global perspective", *Journal of World Prehistory* 22, 2009, pp. 181-184.
- Trifonov 1996: V.A. Trifonov, "Popravki k absolyutnoi khronologiyi kult'ur epokhi neolita bronzy severnogo Kavkaza", in Y. Piotrovskii (dir.), *Mezhdru Aziei v Evropoi: Kavkaz IV-I tys. do n.e.*, Saint Petersburg, Gosudarstvennyi Ermitazh, 1996, pp. 43-49.
- Vignola et al. 2019: C. Vignola, F. Marzaioli, F. Balossi Restelli, G.M. Di Nocera, M. Frangipane, A. Masi, I. Passariello, L. Sadori, F. Terrasi, "Changes in the Near Eastern chronology between the 5th and the 3rd mill. BC. New AMS <sup>14</sup>C dates from Arslantepe (Turkey)", *Nuclear Instruments and Methods in Physics Research. B: Beam Interactions with Materials and Atoms* 456, 2019, pp. 276-282.
- Wailes 1996: B. Wailes (dir.), *Craft specialization and social evolution. In memory of V. Gordon Childe*, University Museum Monograph 93, Philadelphia, University of Pennsylvania/Museum of Archaeology and Anthropology, 1996.
- Walkling, Danielyan, Khechoyan forthcoming: T. Walkling, A. Danielyan, A. Khechoyan, "Seeking the elusive goat: conspicuous and hidden petroglyphs in a caldera in southern Armenia", *Symbols in the landscape: rock art and its context. XIX International Rock Art Conference IFRAO 2015*, forthcoming.