

Edited by
Boris GASPARYAN
Makoto ARIMURA

STONE AGE OF ARMENIA



Kanazawa University

2014

Institute of Archaeology and Ethnography of
the National Academy of Sciences of
the Republic of Armenia

Gfoeller Fund of America Corporation, Armenian Branch

Center for Cultural Resource Studies, Kanazawa University

STONE AGE OF ARMENIA

*A Guide-book to the Stone Age Archaeology in
the Republic of Armenia*

Edited by

Boris GASPARYAN

Makoto ARIMURA

Scientific advisory board:

Pavel AVETISYAN, Sumio FUJII

Monograph of the JSPS-Bilateral Joint Research Project

Center for Cultural Resource Studies,
Kanazawa University

2014

Stone Age of Armenia. A Guide-book to the Stone Age Archaeology in the Republic of Armenia.

Monograph of the JSPS-Bilateral Joint Research Project.

Edited by Boris Gasparyan, Makoto Arimura

Published by Center for Cultural Resource Studies, Kanazawa University, Kanazawa, Japan. 2014.

ISBN 978-4-9908070-0-9

Scientific advisory board:

Pavel Avetisyan (Institute of Archaeology and Ethnography of NAS RA)

Sumio Fujii (Center for Cultural Resource Studies, Kanazawa University)

© 2014 Center for Cultural Resource Studies, Kanazawa University

© 2014 Institute of Archaeology and Ethnography of NAS RA

© 2014 Gfoeller Fund of America Corporation, Armenian Branch

All rights reserved.

Printed in Japan.

ACKNOWLEDGEMENTS

This monograph is the fruit of international cooperations by who have passion to understand the Stone Age in Armenia. We deeply express our thanks to the following people.

We want to acknowledge Charles P. Egeland, Andrew W. Kandel and Dan S. Adler for their incredible help to review and correct the English texts. Also Diana Zardaryan provided English translations for some of the texts written in Russian and Armenian. Arsen Bobokhyan and Kristine Martirosyan-Olshansky contribute to corrections of numerous texts. We thank Benik Yeritsyan for providing the photographs and lithic materials from the Soviet period excavations. The photography of the archaeological materials, map and schematic images are made by Dmitri Arakelyan. Also Andrew W. Kandel, Cyril Montoya, Vram Hakobyan, Kristine Martirosyan-Olshansky, Armine Hayrapetyan, Alexia Smith, Lyssa Stapleton, Diana Zardaryan, Arthur Petrosyan, Aleksandr Yesayan, Anna Khechoyan, Firdus Muradyan contributed to the figures and photography of the archaeological materials. Topographic and architectural plans are drawn by Smbat Davtyan, Hasmik Sargsyan, Hovhannes Sanamyan, Andrew W. Kandel, Armine Hayrapetyan and Tigran Badishyan. Geological drawing for the stratigraphic sections of archaeological sites are provided by Samvel Nahapetyan. Drawings of the artifacts are done by Garik Prveyan, Gauthier Devilder, Elham Ghasidian, Hasmik Sargsyan, Armine Harutyunyan, Narine Mkhitarian, Phil Glauberman, Yanik Henk and Diana Zardaryan. Restoration and cleaning of the textiles, basketry and metal artifacts is done by Yelena Atoyants. Special thanks to Anahit Galstyan for her kind help with the design of the figures. We acknowledge all those mentioned here without of whose contribution the book will come up just as a poor collection of texts.

We should also to acknowledge members of our team not appearing as authors, but have a big organizational input bringing this event to life, who are Suren Kesejyan, Hovhannes Partevyan and Robert Ghukasyan.

And finally, but most importantly, we extend our profound thanks to all the colleagues spending their energies, times and efforts to make this publication a reality.

CONTENTS

7 Introduction

Pavel Avetisyan and Sumio Fujii

13 Study of the Stone Age in the Republic of Armenia. Achievements and Perspectives

Boris Gasparyan and Makoto Arimura

PALEOLITHIC

37 Recently Discovered Lower Paleolithic Sites of Armenia

Boris Gasparyan, Daniel S. Adler, Charles P. Egeland and Karen Azatyan

65 The Middle Paleolithic Occupation of Armenia: Summarizing Old and New Data

*Boris Gasparyan, Charles P. Egeland, Daniel S. Adler, Ron Pinhasi,
Phil Glauberman and Hayk Haydosyan*

107 Living the High Life: The Upper Paleolithic Settlement of the Armenian Highlands

Boris Gasparyan, Andrew W. Kandel and Cyril Montoya

EARLY HOLOCENE / NEOLITHIC

135 Early Holocene Sites of the Republic of Armenia: Questions of Cultural Distribution and Chronology

Arthur Petorsyan, Makoto Arimura, Boris Gasparian and Christine Chataigner

161 Aknashen – the Late Neolithic Settlement of the Ararat Valley: Main Results and Prospects for the Research

Ruben Badalyan and Armine Harutyunyan

177 Preliminary Results of 2012 Excavations at the Late Neolithic Settlement of Masis-Blur

*Armine Hayrapetyan, Kristine Martirosyan-Olshansky, Gregory E. Areshian and
Pavel Avetisyan*

191 On Neolithic Pottery from the Settlement of Aknashen in the Ararat Valley

Armine Harutyunyan

CHALCOLITHIC

- 207 About Some Types of Decorations on the Chalcolithic Pottery of the Southern Caucasus**
Diana Zardaryan
- 219 Weaving the Ancient Past: Chalcolithic Basket and Textile Technology at the Areni-1 Cave, Armenia**
Lyssa Stapleton, Lusine Margaryan, Gregory E. Areshyan, Ron Pinhahi and Boris Gasparyan
- 233 Late Chalcolithic and Medieval Archaeobotanical Remains from Areni-1 (Birds' Cave), Armenia**
Alexia Smith, Tamara Bagoyan, Ivan Gabrielyan, Ron Pinhasi and Boris Gasparyan
- 261 Forest Exploitation during the Holocene in the Aghstev Valley, Northeast Armenia**
Makoto Arimura, Boris Gasparyan, Samvel Nahapetyan and Ron Pinhasi
- 283 Transition to Extractive Metallurgy and Social Transformation in Armenia at the End of the Stone Age**
Arsen Bobokhyan, Khachatur Meliksetian, Boris Gasparyan, Pavel Avetisyan, Christine Chataigner and Ernst Pernicka
- 315 Rock-Painting Phenomenon in the Republic of Armenia**
Anna Khechoyan and Boris Gasparyan
- 339 Discovery of the First Chalcolithic Burial Mounds in the Republic of Armenia**
Firdus Muradyan
(with contributions by Diana Zardaryan, Boris Gasparyan and Levon Aghikyan)
- 365 List of Authors**

INTRODUCTION

Our initial reason for producing this volume was to publish the proceedings of the workshop titled “Stone Age in Armenia”. This workshop was organized by staff at the Institute of Archaeology and Ethnography of the National Academy of Sciences of the Republic of Armenia, and Kanazawa University, Japan, with the support of the Armenian Branch of the Gfoeller fund of America Corporation. The main aim of the workshop was to share and exchange a growing body of knowledge emerging from archaeological investigations by researchers in Armenia. Additionally, organizers – who included the authors of this paper – invited young researchers and graduate students to make presentations at the workshop, since it was thought their involvement would be indispensable to the future development of the field of archaeology. The workshop was held in the library at the Institute of Archaeology and Ethnography, Republic of Armenia, on 5 March 2013 (Figure 1). Fifteen talks were given, introducing the latest results from field studies and scientific analyses dating from the Paleolithic, Neolithic, and Chalcolithic periods. Although the workshop was quite long and tiring, participants filled the room with a palpable sense of excitement (Figures 2-8).

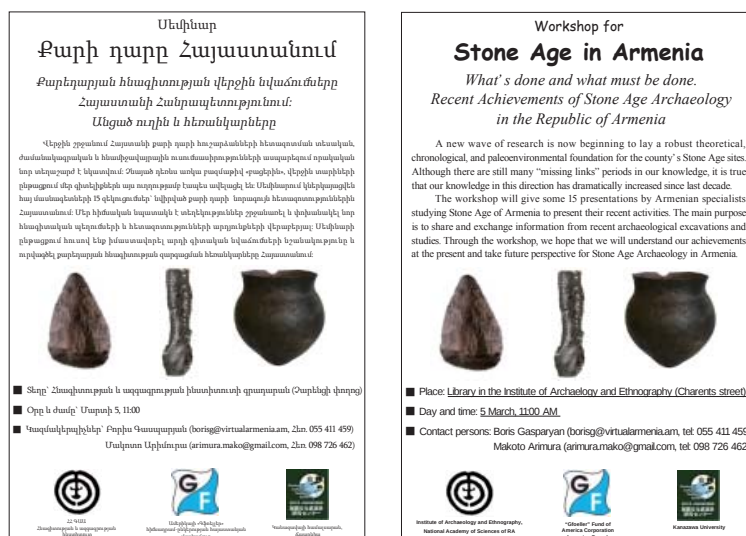


Figure 1
Announcement posters for the workshop in Armenian and English.

Since some authors prepared their papers after the workshop's conclusion, and others not in attendance expressed interest in contributing to the series of papers, we decided to prepare a monograph presenting recent findings of archaeological research conducted on the Stone Age sites in the Republic of Armenia.

By means of this publication, we hope that readers will become aware of our achievements to date, and come to understand the future prospects for Stone Age archaeology in Armenia. In addition, this workshop marks the beginning of cooperative efforts between Armenian and Japanese archaeologists - after all, both countries have unique and long-standing historical-cultural traditions in this field.

Pavel Avetisyan

Director of the Institute of Archaeology and Ethnography, the National Academy of Sciences of the Republic of Armenia

Sumio Fujii

Director of the Center for Cultural Resource Studies, Kanazawa University, Japan



Figure 2
Participants and audience in the workshop.

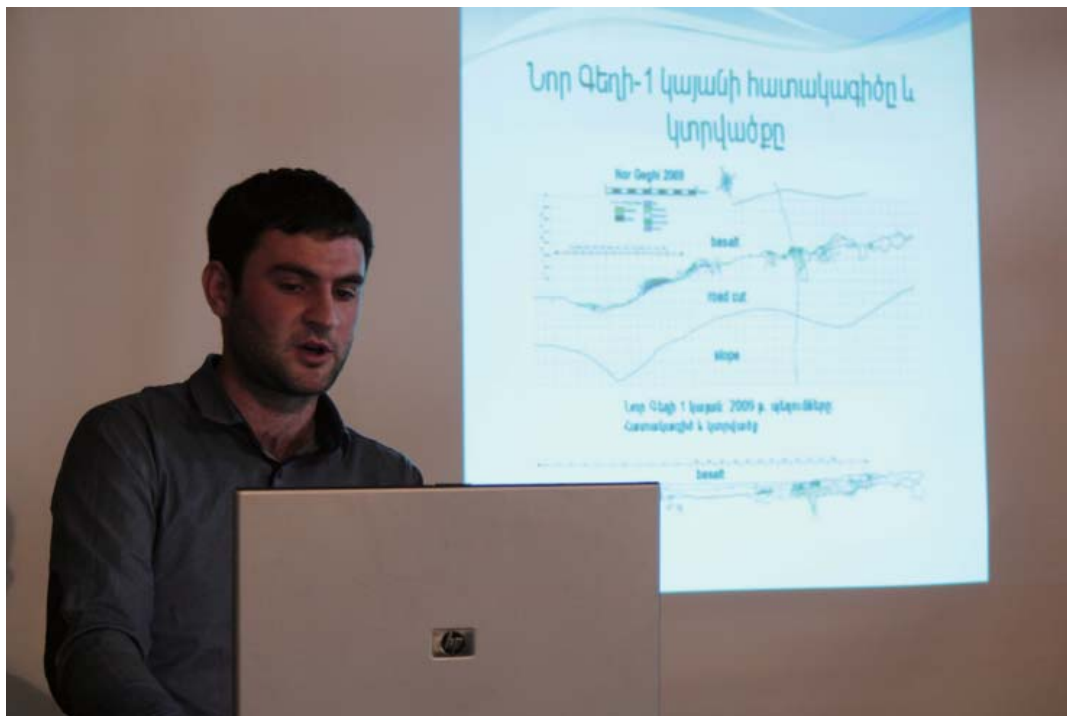


Figure 3
Presentation by Karen Azatyan.

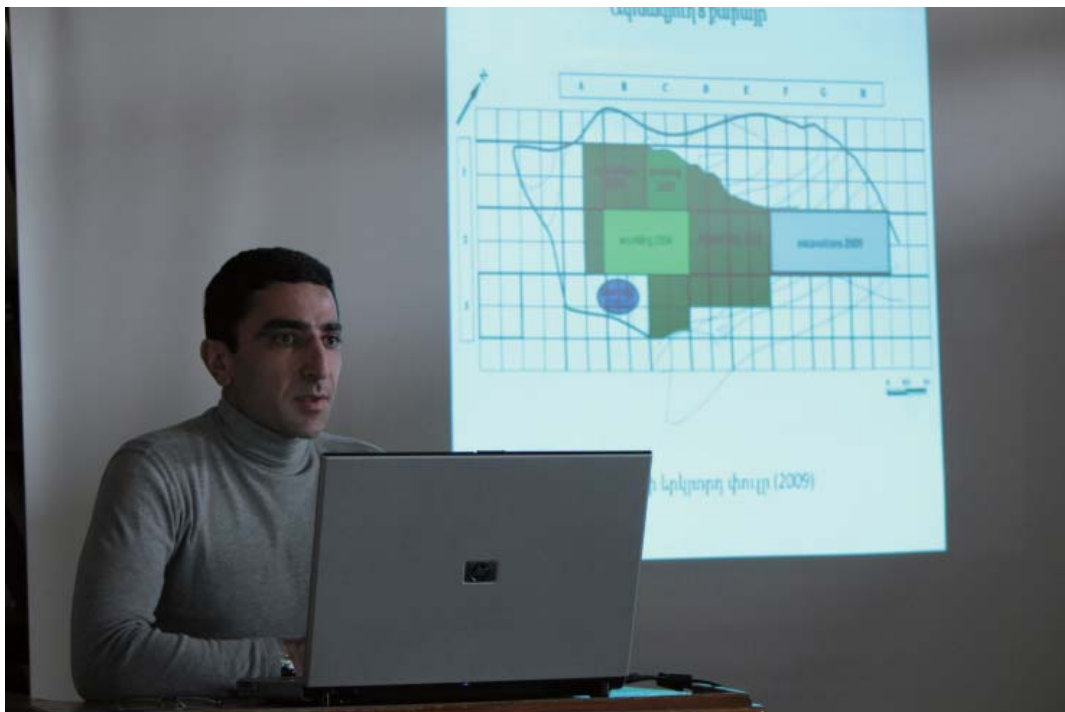


Figure 4
Presentation by Arthur Petrosyan.



Figure 5
Presentation by Diana Zardaryan.



Figure 6
Participants and audience in the workshop.



Figure 7
Young participants.



Figure 8
Participants and audience in the workshop.

TRANSITION TO EXTRACTIVE METALLURGY AND SOCIAL TRANSFORMATION IN ARMENIA AT THE END OF THE STONE AGE

Arsen Bobokhyan, Khachatur Meliksetian, Boris Gasparyan, Pavel Avetisyan, Christine Chataigner and Ernst Pernicka

1. Introduction

Recent archaeological work in the South Caucasian region in general and in Armenia in particular, accompanied by a great quantity of new C14 data, have fundamentally changed our reconstructions of the development of the Neolithic and Chalcolithic in the region. In particular, we now know that the southern Caucasus was part of a greater Near Eastern network linked by common technological practices and structural transformations. One of the most important of these transformations was the first use of metal, the appearance of which at the end of the Stone Age had a great impact on various spheres of human society and resulted in an increase in productivity, the accumulation and redistribution of wealth, the growth of social stratification, status, and power, the functional differentiation of society, and the development of long distance trade. It is widely accepted that the earliest evidence of copper smelting, frequently defined as the “first technological revolution” (around 5,000 BC), is limited to regions of the Near East, southeastern Europe, the Iranian Plateau, and the southern Caucasus. The early appearance of metallurgy in the southern Caucasus and the abundance of copper and polymetallic ores make this region particularly important for archaeometallurgical studies. In spite of this, our knowledge about the earliest metallurgy in the region remains limited, and any new discovery such as metal artifacts and metalworking attributes provide an opportunity to study not only the earliest stages of metal production but to understand technology and artifact provenance. During last decade, important evidence of early metalworking has been recovered in Armenia at number of Chalcolithic sites such as Areni-1 cave and the settlements of Nerkin Godedzor and Mushakan-4. This paper provides an introduction to recent

archaeological and archaeometallurgical investigations and attempts to summarise the earliest evidence of copper based metal production in Armenia.

2. Armenia at the End of the Stone Age

According to new data based on recent stratigraphic observations and C14 chronology, we can reconstruct the following sequence of archaeological traditions in Armenia at the end of the Stone Age:

The Early Holocene (Mesolithic/Proto-Neolithic, ca. 10,000–7,500 Cal BC) is represented by sites of Apnagyugh/Kmlo tradition like Apnagyugh-8/Kmlo-2 cave, Kuchak-1 rock-shelter, and the open-air site of Gegharot-1, among others. This period is characterized by a society at the gateway of a food-producing life style, yet continues to live much like the hunters and gatherers of the preceding Pleistocene. Early Neolithic sites (ca. 7,500–6,000 Cal BC) that evidence the beginnings of a food-producing economy have not yet been recorded in Armenia nor in the southern Caucasus as a whole.

The Late Neolithic (ca. 6,000–5,200 Cal BC) is represented by sites of the “Aratashen-Shulaveri-Shomutepe” tradition like Aratashen (Horizons I-II), Aknashen/Khatunarkh (Horizons II-V), and Masis Blur. The Armenian sites had links to the Syro-Mesopotamian world (e.g. Samarra and Halaf). Society is characterized by a sedentary economy, the full establishment of a food-producing life style, a more-or-less uniform cultural complex, the beginning of pottery production, and first use of native copper.

The Early/Middle Chalcolithic (ca. 5,200–4,300 Cal BC) is known by the “Adablur” and “Sioni” traditions, with sites such as Aratashen (Horizon 0), Aknashen (Horizon I), Artashat, Adablur, and Mushakan-4. Armenian late Middle Chalcolithic settlements have close connections with sites like Sioni, which developed in the Kura Basin after the disappearance of the “Aratashen-Shulaveri-Shomutepe” tradition. The present data suggest a change in the economy towards more mobility with the shifts towards early extractive copper metallurgy. Society is characterized by its relationship to the Syro-Mesopotamian world (Early Ubaid).

The Late Chalcolithic (ca. 4,300–3,500 Cal BC) is represented by the “Areni” and “Godedzor” traditions, with such sites as Areni-1 cave and the settlements of Teghut and Nerkin Godedzor. Society is characterized by a diversity of cultural complexes, growing complexity, relations to the Syro-Mesopotamian (Late Ubaid, Uruk) and North Caucasian (Early Maikop) worlds, as well as extractive copper metallurgy¹.

1. Cf. Badalyan *et al.* 2004; 2007; 2010; Avetisyan *et al.* 2006; Chataigner *et al.* 2007; Arimura *et al.* 2010; Areshian *et*

3. Early South-Caucasian Metallurgy and the Armenian Evidence

The first metal objects, made from native copper, appear during the Neolithic of Anatolia and Iran in the 8th–6th millennia BC. The 5th millennium is characterized by significant changes in a number of regions of the Old World that ultimately led to copper smelting (Pernicka 1990; Meliksetian *et al.* 2011; Pigott *et al.* 1999). The earliest reliable evidence for copper smelting is dated to the 5th millennium BC and is found at sites related to the late Ubaid period in Mesopotamia (Zwicker 1977; Hauptmann 1982; Seeliger *et al.* 1985) and Late Neolithic and Chalcolithic sites in Iran (Pigott 1999). Contemporary copper based metallurgy is also evident in the Balkan region in southeastern Europe (Radivojević *et al.* 2010; 2013).

In the southern Caucasus, early use of metals dates to the 6th millennium BC and is characterized by the extraction of native metal and cold-working-cum-annealing (Khramis Didi-Gora, Arukhlo and Gargalar Tepesi, represented mainly by beads). Copper smelting appears at late 5th millennium BC (Mentesh Tepe, with a mould find). The evidence of metallurgical activities in the region increases in the early 4th millennium BC and is represented by previously known finds from Kültepe I in Nakhijevan, Alikemektepesi (knife, bead like ornaments, made of pure copper, some with low arsenic) and new finds, particularly in the Middle Kura region, such as pit furnaces, slags (Leylatepe), casting molds (Böyük Kesik, Qarakepektepe), heavy tools like axes or knife/daggers (Ovçular Tepesi, Soyugh Bulagh) with use of arsenical copper (Berikdeebi, Böyük Kesik, Leylatepe), and gold and electrum beads (Soyugh Bulagh)².

What, then, is the situation in Armenia? Recent excavations in the Ararat valley and southern Armenia revealed new data on early metallurgy from Late Neolithic horizons as well as early (First Stage) and late (Second Stage) Chalcolithic horizons.

First Stage. Copper beads and their fragments as well as some pieces of copper ore minerals from Ararat valley sites represent the earliest known appearance of copper in the southern Caucasus. The finds of azurite and malachite from Aratashen Horizon IId (5,905–5,711 Cal BC)

al. 2012; Zardaryan and Gasparyan 2012; Avetisyan and Bobokhyan 2012. For historiography of the question and the southern Caucasian context, cf. Munchayev 1975; 1982; Kiguradze 1976; Korobkova 1987; Chataigner 1995; Areshian and Ghafadaryan 1996; Kushnareva 1997. For correlation of cultural and metallurgical developments, cf. Gevorkyan 1980; Meliksetian *et al.* 2011; Courcier 2014 (with further literature). In all these publications we can trace a wide range of diverse terminologies concerning Neolithic-Chalcolithic “cultures/groups/assemblages/complexes/communities/sites” of the region. We use here the neutral term “tradition” to bridge the former culture-historical approaches to modern ones.

2. For detailed history of research and list of materials, cf. Courcier 2014, as well as Courcier *et al.* 2008; 2012; Lyonnet *et al.* 2007; 2012, p. 109; Marro *et al.* 2011, pp. 69–72; Helwing 2012, pp. 212–213.

and Horizon I (probably mid 6th millennium BC), as well as from the nearby site of Aknashen/Khatunarkh (first half of the 6th millennium BC)³ have parallels in the 8th–6th millennia sites of Anatolia and Iran (Hallan Çemi, Çayönü, Aşıklı, Hassuna, Yarim Tepe I and II).

In Aratashen IIb (5,878–5,775 Cal BC) a bracelet about 6 cm in diameter made of 57 partly oxidized copper beads and their fragments made of a foil rolled up around a stem was unearthed *in situ*. They were made of native copper (Meliksetian *et al.* 2011), but the technique and shapes are known from the 8th–6th millennia BC at sites in North Mesopotamia (Yarim Tepe I and II, Chagar Bazar) and others of “Aratashen-Shulaveri-Shomutepe” tradition (Gargalar Tepesi, Chalaghantepe).

A ring, a bracelet fragment with secondary use, a hook, a holed disk (bead?), an awl/retoucher, and a small piece of copper derive from the Chalcolithic settlement Mushakan-4, which probably dates to the third quarter of the 5th millennium BC (Figure 1). Although all of the metal finds from Mushakan-4 are from the disturbed components of Horizon I and only the holed disk (bead?) was found *in situ* from the Chalcolithic context (Figure 1: 1), there is no doubt about their belonging to the same layer since the site has an exceptionally well-preserved Chalcolithic occupation (excavations of B. Gasparyan).

Especially important for reconstructions of metallurgical procedures are a basalt pestle-hammer/grinding stone with traces of crashed oxide copper ore and two ceramic crucibles (Figure 6: 7-8) from the Chalcolithic Horizon of Aknashen/Khatunarkh (more probably dating by mid 5th millennium BC).

Second Stage. The transition to extractive metallurgy between the 5th and 4th millennia BC is also evident in the territory of Armenia. The metal objects from the Chalcolithic settlement of Teghut (4,000–3,700 BC), analyzed in the 1970s, turned out to be made of arsenical copper (3–4.6 % As), among which the knife is particularly noteworthy (Figure 7: 2, after new restoration). A similar knife, though with only 0.69% As, was recently found by an Armenian-German joint expedition during excavations at the settlement of Sotk 2 (Horizon IIa, 3,700–3,400 Cal BC) (Figure 7: 3). Four small awls and a ring (Figure 8: 5-9) originate from the Late Chalcolithic settlement of Nerkin Godedzor (3,700–3,400 Cal BC) excavated by an Armenian-French joint expedition (co-directors P. Avetisyan and C. Chataigner): the composition of the pins is similar to the objects from Teghut, showing an arsenical copper with an arsenic content ranging from 4 to 5%⁴.

3. Excavation at Aratashen and Aknashen/Khatunarkh are conducted by Armenian-French joint expedition, co-directors R. Badalyan and C. Chataigner. For detailed history of research and the published materials, cf. Badalyan *et al.* 2004; 2007; 2010.

4. Meliksetian *et al.* 2007, pp. 1-4; 2011, p. 201. For Teghut finds, cf. Torosyan 1976, pp. 60-65; Tedesco 2006, p. 104; for Aratashen, cf. Badalyan *et al.* 2007, pp. 52-53; for Godedzor, cf. Chataigner *et al.* 2010, p. 399; for Sotk, cf. Kunze *et al.*

4. New Data from Areni-1

Excavations of the Areni-1 cave in the Arpa River valley (southern Armenia) open a new stage in our understanding of Chalcolithic societies of the southern Caucasus. Owing to cave's dry conditions, the perishable organic materials have been wonderfully preserved. As a result, stratigraphic observations and a set of secure radiocarbon dates allow the reconstruction of the Late Chalcolithic sequence of Armenia (and the entire Caucasus and Near East) between 4,300–3,400 Cal BC with unparalleled precision. It appears that from the end of the 5th millennium BC onwards, people used the cave for different purposes – as a habitation, for keeping animals and storing plant foods, for the production of wine, as well as for ritual purposes. The data from the cave demonstrated evidence for early social complexity, and connections to contemporary Near Eastern and North Caucasian societies⁵.

The excavations of Areni-1 also revealed a very significant group of finds that reflect metallurgical processes, most of which derive from the Chalcolithic Horizons I and II and the garbage layer in front of the cave, the latter of which is contemporary with the Horizons II and III⁶.

Horizon I is represented by reinforced and repeatedly rebuilt paved and plastered floors with household pits and jar burials that date to the final phase of the Late Chalcolithic (3,700–3,400 Cal BC). It is spread only within the limits of Trench 3 outside the entrance to the first gallery and the slope at the entrance of the cave complex. Metallurgical data from the context of Trench 3 include crucibles of basalt and clay with traces of fire (Figure 4: 1, Figure 5: 1) and a casting mould (Figure 6: 10).

Horizon II occupies a more extensive area. It begins in Trench 3 (here it underlies Horizon I but is separated from it by a layer of zoogenic humus or dung) and extends into the cave, to the rear part of the first gallery across to the limits of Trenches 1 and 2. The Horizon II of the Trench 3 is also characterized by reinforced and repeatedly finished floors and includes wooden constructions or buildings and large, unfired bins. Trench 1 contains artifacts and features that are clearly related

2013, p. 63; for Aknashen/Khatunarkh, cf. basalt pestle-hammer (Gevorkyan 1980, p. 38; 1981, p. 13), crucibles (excavations of R. Torosyan, Vagharshapat Museum), copper ore (excavations of R. Badalyan, cf. Courcier 2014, p. 592). Materials from Mushakan are published here for the first time. The authors are thankful to Vagharshapat Museum for the permission to publish the materials from Aknashen/Khatunarkh and Teghut.

5. The site was excavated by Armenian-Irish-American joint expedition, director B. Gasparyan (Institute of Archaeology and Ethnography), co-directors R. Pinhasi (University College Cork) and G.E. Areshian (Cotsen Institute of Archaeology, University of California). For preliminary results of Areni excavations, cf. Pinhasi *et al.* 2011; Areshian 2012; Areshian *et al.* 2012; Wilkinson *et al.* 2012; Zardaryan and Gasparyan 2012; Gasparyan 2013.

6. Metallurgical materials from Areni-1 are published here for the first time. For a brief reflection, cf. Areshian *et al.* 2012, p. 127.

to funerary rituals including human remains and a wine producing complex. Trench 2 is adjacent to Trench 1 and has produced pots containing cremations, as well as isolated human remains recovered from loci between the pots. A set of carbon dates from Horizon II produces a time range of 4,000–3,800 Cal BC, which places it in the middle phase of the Late Chalcolithic. It is this horizon that reveals a majority of data on complex metallurgical processes, which is attested in five contexts: the partially excavated workshop at the south-eastern side of Trench 3, the stratified plastered floor (also in Trench 3), in the context of the wine producing complex, inside and nearby the ritual features in Trench 1, and, finally, the garbage layer on the slope at the entrance of the cave complex (Trench 4).

Copper ores (Figure 2: 1-2), basalt pestle-hammer and grinding stones with metal working/crushing traces (Figure 3: 1), ceramic crucibles with traces of fire (Figures 4: 2 and 5: 2), a spouted vessel (Figure 6: 6), a pourer with metal traces (Figure 6: 1), and casting molds (Figure 6: 9-10), the last of which were very probably used for the smelting of such objects as ingots (Figure 8: 4), have been found within the limits of the workshop.

Additional stratified metal finds appeared on the paved and plastered floors around the workshop in Trench 3, including copper ores (Figure 1: 3), a small ceramic crucible (Figure 6: 5), a knife and corresponding fragment (Figure 7: 4 and 6), and an awl (Figure 8: 2).

One of the most interesting finds, a copper ingot originating from the Chalcolithic garbage layer partly opened in Trench 4 on the steep northern slope in front of the cave complex (Figure 7: 1), most probably belongs to Horizon II.

The other archaeometallurgical finds from Horizon I appear in connection with the wine producing complex and the accompanying funerary pots and features (clay constructions) in Trenches 1 and 2. These finds include a pourer (Figure 6: 2), a ventilation pipe with traces of fire (Figure 6: 11), a small knife (Figure 7: 5), an ingot (Figure 8: 3), an adze (Figure 7: 7), a bowl fragment (Figure 7: 8), a bracelet fragment (Figure 8: 10), and a massive pike head (Figure 8: 1).

The majority of the present finds from Horizon II of Areni-1, almost all of which are *in situ* with some light Middle Age disturbances, reconstruct a *chaîne opératoire* with most stages of the metallurgical process (ore working, smelting, and recycling). The workshop, wine producing complex, and the funerary features or “burials” represent a common ritual and production oriented complex, where a syncretic landscape of human behavior is attested connected mainly with creating and sacrificing procedures. In such a context metal activity is not only a practical but also a sacred/cult/ritualistic action. In this respect some of the metal finds such as the knives and especially the pike head, as their context suggests, can be considered as weapons used during the ritual.

Preliminary investigation of the metal objects from Areni-1 demonstrates that we are dealing with an open mould and additional hammering techniques. Archaeometallurgical analyses of the metal objects from Areni-1 are in process (cf. Table 1)⁷.

The materials concerning metallurgical activities from Areni-1 find parallels at Early and Late Chalcolithic sites of the Armenian Highlands as well as in the North Caucasus and Iran. First of all, connections are discernable at previously Armenian sites (cf. azurite of Aratashen and Aknashen/Khatunarkh, basalt pestle-hammer from Aknashen/Khatunarkh, awls from Godedzor, knives of Teghut and Sotk). The awl and the knife from Kültepe I can also be mentioned in this context. Similarities in finds and context are also visible in the settlements of the Middle Kura and Karabakh such as Mentesh Tepe (crushed azurite, crucibles, moulds, awls, rings – Courcier *et al.* 2012, pp. 211-214, fig. 6: 9; Lyonnet *et al.* 2012, pp. 112-114, fig. 155-156); for awls in contemporary Sioni horizon sites of Georgia – Alazani III, Tsiteli Gorebi, Kviriatskhali (cf. Courcier 2014, p. 210), Leylatepe (ingots, a fired clay fragments plashed with pieces of oxidized metal, awls, an adze, knife fragments – Narimanov *et al.* 2007, pp. 62-64; Museyibli 2007a, pp. 142-143; Akhundov and Makhmudova 2008, p. 65), Böyük Kesik (knives, awls, molds – Museyibli 2007, pp. 138-140, 174, Tab. 16: 6-8, XL; Akhundov and Makhmudova 2008, p. 160, Photo 14), and Hantepe near Fizuli (a clay crucible – Museyibli 2007a, p. 142). Worth mentioning also are metal finds from the kurgans of Soyugh Bulagh and Telmankend (flat axe-adzes, awls, knives – Akhundov and Makhmudova 2008, pp. 62-63, 145, 170, Tab. 28: 5, Tab. 30: 3-6, Photo 32).

The knives/daggers, pourers, and ingot molds find parallels at the Maikop sites as well (Chernykh 1992, pp. 75, 82-83, fig. 24: 14, fig. 27: 5-6, fig. 28: 8; Korenevskiy 2004, p. 42, knife subtypes 1-2). Especially noteworthy is a metal vessel fragment from Areni-1; such vessels are also known in the Maikop sites (Chernykh 1992, p. 76, fig. 25; Hansen 2013, p. 154, fig. 25) and the contacts to which can be postulated through finds of Maikop ceramics at Areni-1 (Zardaryan and Gasparyan 2012, p. 48; Areshian *et al.* 2012, p. 128).

Finds similar to the Areni-1 ores, chisels, awls, and crucibles are reported at Arslantepe VII (3,800–3,400 BC) (Di Nocera 2010, pp. 255-256, fig. XIII. 3: 15).

Similiar crucibles, ingot moulds, and knives/daggers are visible also in Chalcolithic Iran, particularly in such sites as Tal i-Iblis, Cheshmeh Ali, Tepe Ghabristan, Qaleh Gusheh, and Arisman (Azarnoush and Helwing 2005, p. 209, fig. 30; Thornton 2009, pp. 310-313, fig. 2-5; Ivanova 2012, p. 11, Abb. 7: 6-8). A chisel/adze like that at Areni-1 is reported from Mersin in the period after ca. 5,000 BC (Hansen 2013, p. 139, fig. 1).

7. Analyses are made in Curt-Engelhorn-Zentrum Archäometrie, GmbH, Mannheim.

Resemblances are also discernable in metal compositions: like at Areni-1, Teghut, Nerkin Godedzor (see above), Mentesh Tepe (Courcier 2014, p. 221, Tab. 3), Leylatepe, Kültepe I, Poylu II (Museyibli 2007a, p. 142; Akhundov and Makhmudova 2008, p. 66) and Arslantepe VII (Di Nocera 2010, p. 255), the main objects are copper based, some of which contain ca. 1 to 4% and, rarely, up to 5%, arsenic.

5. Chemical compositions of Chalcolithic metal finds in the territory of Armenia

As mentioned above, the first evidence of smelted copper in Armenia appear as several Chalcolithic metal objects from the settlement of Teghut (Torosyan 1976), the OES analysis of which revealed the use of arsenical copper (3-4.6% of As) (Gevorkyan 1980). Obviously, these objects were smelted from ores, pointing to a transition from the use of rare native copper to extractive metallurgy. Some of previously mentioned copper based artifacts from Areni-1 cave and Nerkin Godedzor were recently analyzed for chemical composition (XRF) and Pb isotopes (ICP-MS) by Curt-Engelhorn-Zentrum Archäometrie GmbH, Mannheim, Germany. Detailed study of these artifacts is still in progress and here we present some discussion based on preliminary results.

By means of chemical composition, four of the objects from Nerkin Godedzor, two fragments and two pins (MA-082106, MA-070019, MA-071550, MA-071551 respectively) turned out to consist of copper-arsenic alloys with about 5% of As (Table 1). Enrichment of copper with arsenic is a feature typical for Chalcolithic and Early Bronze Age metal production in the region (Gevorkyan 1980; Meliksetian *et al.* 2003; Meliksetian and Pernicka 2010). The chemical composition of the fifth object, another pin (MA-082105), turned out to be quite surprising: it consists of copper (84%) with an admixture of nickel 3,6%, arsenic (6%), and silver (6%). It seems reasonable to assume that such a composition is not an intentional alloying, but is a characteristic of the polymetallic ores that were utilized.

Another interesting geochemical feature of all the objects from Nerkin Godedzor is the extremely low concentration of lead. XRF analysis shows that lead content is below the detection limit of the method (<100 ppm), but attempts to measure lead concentration with more sensitive method such as ICP-MS shows that the lead content is extremely low, around 10 ppb (0.01 ppm). The concentration of lead in these objects is so low, in fact, that it was not possible to perform lead isotope analysis for these artifacts. While this makes provenancing these objects quite complicated, the very low content of lead could also be an important geochemical feature of the ore deposit

Table 1
Chemical composition of metal objects from Areni-1 cave and Nerkin Godedzor settlement. Concentrations of copper are given in weight percents, all other values are in ppm.

	Sample #	Original sample #	Site	Description	Dating	Cu %	Fe	Co	Ni	Zn	Pb	Bi	Sn	As	Sb	Se	Te	Au	Ag
1.	MA-082105	Gd-07-34	Nerkin Godedzor settlement	Pin (Figure 8/5)	Late Chalcolithic	84.0	<200	<100	36000	<2000	<100	<100	<50	61000	250	<50	<50	540	60000
2.	MA-082106	Gd-07-28		Ring-fragment (?). (Figure 8/9)	Late Chalcolithic	95.0	<200	<100	140	<2000	<100	<100	90	52000	<50	<50	<50	<100	230
3.	MA-070019	GD-05-2		fragment	Late Chalcolithic	94.7	200	100	<100	2000	<100	<100	58	51516	15	50	92	100	76
4.	MA-071550	GD-05-03		Pin (Figure 8/6)	Late Chalcolithic	95.1	1248	100	<100	2000	<100	<100	86	45874	381	50	50	200	347
5.	MA-071551	GD-05-04		Pin (Figure 8/7)	Late Chalcolithic	94.8	200	100	111	2000	<100	<100	50	51064	50	50	50	115	143
6.	MA-082097	Areni-1	Areni-1 cave	Pike head (Figure 8/1)	Late Chalcolithic	99.0	<200	<100	<100	<2000	<100	<100	<50	12800	<50	<50	<50	<100	300
7.	MA-082098	Areni-2		knife (Figure 7/5)	Late Chalcolithic	97.0	470	<100	230	<2000	<100	<100	<50	28100	<50	<50	<50	<100	310
8.	MA-082100	Areni-4		knife (Figure 7/4)	Late Chalcolithic	97.0	850	<100	870	<2000	<100	<100	<50	30000	60	<50	<50	<100	160
9.	MA-124777	T3-SP7		Copper ingots (Figure 8/3-4)	Late Chalcolithic	96.0	<200	<100	950	<1000	144	<100	<50	42280	103	<100	<50	<100	397
10.	MA-124778	T2A-SP20			Late Chalcolithic	97.0	<200	<100	2610	<1000	2205	<100	<50	28025	79	<100	<50	<100	366

and thus may be used for locating the origin of these objects. It should be noted that all studied Armenian copper ores and all studied Bronze Age artifacts contain a noticeable amount of lead (Meliksetian and Pernicka 2010). According to Dr. Nima Nezafati⁸, some ores with very low lead content are known in the Tarom-Hashtjin region (western Alborz, North-West Iran) but more work and comparison to chemical composition of ores in North-West Iran is necessary. Therefore, our current state of knowledge does not allow the determination of a matching ore source for these objects, but presumably it is outside the southern Caucasus region, perhaps in northwest Iran.

The compositions of the Areni-1 objects are less surprising (Table 1), being made of copper with an admixture of arsenic ranging from 1.3 to 4.2%; comparable arsenic content is typical for tools and weapons of Early Bronze Age Armenia, while for decorative objects the content is usually much higher (Meliksetian and Pernicka 2010; Meliksetian *et al.* 2011). Also noteworthy is the elevated content of Ni in three of Areni-1 samples (870-2600 ppm) and an admixture of lead (about 0.2% in one of the ingots; MA-124778). Figure 9 shows a comparison of Ni and Ag content in the analyzed Chalcolithic artifacts compared with available data from Early Bronze Age artifacts (Meliksetian and Pernicka 2010). With the exception of Cu + (Ni-Ag-As) alloy (MA-082105), most of the artifacts from Areni-1 and Nerkin Godedzor are within the range of Armenian ores and Early Bronze Age artifacts.

For two samples, MA-124777 and MA-124778, lead isotope values are also available (Table 2). Figure 10 shows a comparison of $^{207}\text{Pb}/^{206}\text{Pb}$ vs. $^{208}\text{Pb}/^{206}\text{Pb}$ of analyzed Chalcolithic artifacts with the lead isotope compositions of Armenian and regional ores. Interestingly, the artifacts from Areni-1, at least according to their lead isotope signature, lie at the intersection of the Armenian “old” lead compositional field with those of Anatolia and the ores of Oman. So, it is unclear whether their source ores are within the region or from distant sources. More detailed lead isotope

Table 2.

Lead isotope ratio abundance values of metal ingots from Areni-1 cave.

Sample #	MA-124777	MA-124778
Original sample #	T3-Sp7	T2A-Sp20
Site, Description	Areni-1 cave	
Description	Copper ingots	
$^{208}\text{Pb}/^{206}\text{Pb}$	2.0848	2.0860
2σ	± 0.0001	± 0.0001
$^{207}\text{Pb}/^{206}\text{Pb}$	0.84746	0.84816
2σ	± 0.00005	± 0.00003
$^{208}\text{Pb}/^{204}\text{Pb}$	38.546	38.528
2σ	± 0.002	± 0.003
$^{207}\text{Pb}/^{204}\text{Pb}$	15.669	15.666
2σ	± 0.001	± 0.001
$^{206}\text{Pb}/^{204}\text{Pb}$	18.489	18.470
2σ	± 0.001	± 0.001

8. We gratefully acknowledge Dr. Nima Nezafati (Islamic Azad University of Tehran, Iran) for information about copper sources in Iran with low lead content.

investigations of ore sources around Areni-1, which is in progress, may provide further information about their provenance.

6. Discussion

Metallurgical developments in Armenia and the southern Caucasus region were directly connected with important social transformations. As we noted above, during the Late Neolithic (6,000–5,200 Cal BC) Armenia was involved in the “Shulaveri-Shomutepe” tradition, which by the Early/Middle Chalcolithic (5,200–4,300 Cal BC) was followed by the “Adablur” and, eventually, the “Sioni” traditions. These were, on the whole, uniform societies that relied on native copper and some relations to the South (Samarra, Halaf-Ubaid). Beginning with Late Chalcolithic (4,300–3,500 Cal BC) we see unprecedented complexity, intensive inter-regional contacts, and use of extractive metallurgy.

The Late Chalcolithic traditions in Armenia (Areni-1, Teghut, Nerkin Godedzor), Azerbaijan (Ovçular Tepesi, Mentesh Tepe, Leylatepe) and Georgia (Berikldeebi) share common characteristics and regional contacts to Maikop⁹ and Ubaid-Uruk¹⁰. These societies are on the way towards growing complexity, a process reflected in the appearance of developed copper based metallurgy (molds, slags, ingots, kilns, pure and arsenic copper), new metal weapons/tools (knife/daggers, spearheads, flat axes), ceramics (potter’s wheel, pottery signs), exotic and prestigious objects of gold, silver, and lapis-lazuli, stamp seals and status symbols (scepters), kurgans and jar burials, and rudiments of monumental architecture (cf. the “temple” of Berikldeebi). This is all accompanied by the blossoming of long distance trade, essential transfer of knowledge, and the development of centralized hierarchies¹¹.

Recent investigations demonstrate that although these developments were typical for the Near Eastern region¹², the highland zone between the Caucasus and Taurus, that is, territories

9. Maikop relations are reflected in ceramics (cf. Areshian *et al.* 2012, pp. 128-129) and kurgans (Üç Tepe, Telmankend, Kudurlu, Kavtiskhevi, cf. Makharadze 2007; Akhundov and Makhmudova 2008, pp. 3, 80).

10. In the literature Caucasian specialists speak mainly about the Ubeid-Uruk (Akhundov and Makhmudova 2008), Ubaid (Museibli 2007a) or Uruk (Munchayev 2007, pp. 8-9; Areshian *et al.* 2012, pp. 128-129) influences.

11. For the mentioned Late Chalcolithic developments, cf. Torosyan 1976; Narimanov 1987; Korobkova, 1987; Kiguradze and Sagona 2003; Narimanov *et al.* 2007; Museyibli 2007a; 2007b; Akhundov and Makhmudova 2008; Zardaryan and Gasparyan 2012; Helwing 2012; Areshian *et al.* 2012; Lyonnet 2000; Marro 2005; 2007; Makharadze 2007; Wilkinson *et al.* 2012; Courcier 2014.

12. So the Ubaid chaff-tempered ware alongside the Ubaid-related painted black-on-buff ware spreads not only in the southern Caucasus but also in the regions from Mediterranean coast to North Zagros (Helwing 2012, pp. 204-210; cf. Ivanova 2012, pp. 19-23).

from the Upper Euphrates to the regions around lakes Van, Urmia, and Sevan, also shared common trends of development¹³. This is a landscape of mountainous communities which were clearly distinguished by their mode of life from the Maikop people in the North (inhabitants of river valleys in the environment of steppe landscapes) and that of the Syro-Mesopotamian peoples in the South (inhabitants of the lowland).

These transformations have been often related to the establishment of Ubaid or Uruk related communities. Various ideas based on migration or early imperialism theories have been suggested as possible interpretations of those developments. However, recent approaches suggest new models that acknowledge more locally rooted paths towards complexity in the highlands (cf. Marro 2007; Thornton 2009; Helwing 2012). The material similarities are thereby understood to indicate shared practices/knowledge of production and consumption.

Metal seems to be a very essential factor in these regional connections, and it can also explain the interests of Mesopotamians in the southern Caucasus, being a kind of “*moteur des relations*” (Lyonnet 2007, p. 15; cf. Munchayev 2007, p. 9; Courcier 2014, p. 643)¹⁴. Other factors such as obsidian (cf. Chataigner *et al.* 2010, pp. 401-402) and wine¹⁵ may also have played an essential role in those contacts, realized either by trade (cf. Palumbi 2007, p. 75) or through nomadic pastoralists (cf. Marro 2005, p. 32; 2007, p. 93; Chataigner *et al.* 2010, pp. 401-405).

Two routes from the Near East to the South Caucasus have been identified as contact zones, one passing through the Urmia basin (cf. Museyibli 2007a, p. 89; Ivanova 2012, p. 23) and the other through the Upper Euphrates region (cf. Marro *et al.* 2011), both of which have the nearest analogies to southern Caucasian materials and practices (cf. also Munchayev 1975, pp. 122-123, 130). In the same time, the southern Caucasian route over Dagestan to the North-West Caucasus could be essential for the transmission of Near Eastern influences to the North and vice

13. Cf. Torosyan 1976; Areshian and Ghafadaryan 1996; Lyonnet 2000; Marro 2005; 2007; 2008. For B. Helwing the Late Chalcolithic landscape of modern eastern Turkey, North-West Iran, and the southern Caucasus “falls into a series of parallel, largely comparable yet individual clusters of sites that develop in lockstep and share a general lifestyle, visible from a closely related material record” (Helwing 2012, pp. 201-203, 214).

14. In this regards noteworthy is the statistical point of L. Avilova, according to which, the Mesopotamian Ubaid period sites lack metal in sharp contrast to Iran, which implies that the technological skills elaborated in Mesopotamia during the Ubaid period apparently originated in Iran (Avilova 2009, pp. 52, 56). Perhaps the relations of the southern Caucasus to Mesopotamia were really conditioned by the growing interest of Syrian-Mesopotamian societies in metal.

15. The mentioned grape pressing context with preserved remains (seeds, stems, skins) of crushed or pressed grapes from Areni-1 (Horizon II, 4,223–3,790 Cal BC) is thus far the oldest known wine production complex (Barnard *et al.* 2011; cf. Areshian *et al.* 2012, pp. 128-129), which attests that the wine could be South Caucasian “brand” in the ancient Near East.

versa¹⁶. Chemical and isotope characteristics of Chalcolithic metal artifacts from Nerkin Godedzor also suggest that a North-West Iranian ore source may have been utilized to produce copper. This datum underlines the importance of the North-West Iranian route and is in accordance with other assemblages from this site, again hinting at a North-West Iranian direction of contacts, among which especially painted pottery (from South to North) and obsidian (from North to South) should be mentioned (Chataigner *et al.* 2010, pp. 399-401).

The transformational processes in the southern Caucasus described above did not develop further in the second half of the 6th millennium BC. Similar to highly developed Chalcolithic Carpato-Balkan metallurgical centers, which collapsed at the beginning of the Bronze Age in the wake of invasions from steppe nomads (Chernykh 1992, p. 55), the southern Caucasus's "Near Eastern way" stalled with the emergence of the Kura-Araxes complex. Although Late Chalcolithic diversity was changed by Early Bronze Age uniformity¹⁷, in contrast to the Carpato-Balkan Early Bronze Age invaders, the Kura-Araxes people, who were indigenous to the region, possessed highly developed metallurgy and ceramic making traditions.

One of the most difficult questions is the relationship between the Late Chalcolithic and Kura-Araxes traditions. Various sites in modern Armenia, Georgia, Azerbaijan, and eastern Turkey show clear coexistence of the ceramic and metal (first use of arsenic, molds and heavy tools) traditions of these two stages going back to the end of the 5th and first half of the 4th millennia BC¹⁸. Essential differences between those traditions are reflected in other practices such as their

16. Some influences such as introduction of potters' wheel and Ubaid-Uruk similar ceramics appear also in Dagestan (Ginchi, Velikent) demonstrating some affinities to South Caucasian Chalcolithic centers (Magomedov 2007, p. 53; Munchayev 1982, p. 124; 2007, p. 8) as well as in Maikop (Ivanova 2007, p. 17). More Iranian-Central Asian than Mesopotamian direction of contacts for Maikop have been recently postulated on the ground of metal and precious stone finds (Ivanova 2012).

17. Kura-Araxes communities clearly secluded the Highlands from the Mesopotamian world (cf. Marro 2007, p. 92). Such a transformation was especially crucial for the sites which were deeply involved in Syrian-Mesopotamian developments, among which Arslantepe VIA, the large public building of which gave way to the settlement of wattle-and-daub architecture and Late Chalcolithic pottery diversity was narrowed to red-black burnished Kura-Araxes pottery (cf. Kiguradze and Sagona 2003, p. 92).

18. For Armenia, cf. Torosyan 1976; Avetisyan *et al.* 2006; Zardaryan 2011; Wilkinson *et al.* 2012; Zardaryan and Gasparyan 2012; for Georgia, cf. Kiguradze 1976; 2000; Kiguradze and Sagona 2003; for eastern Turkey, cf. Marro 2005; 2008, for Nakhijevan, cf. Marro 2011; for Karabakh, cf. Museyibli 2007a, pp. 60, 73, 87, 92, 142-143 (also as regards metallurgy, especially molds, cf. also Courcier 2014, p. 213) contra Narimanov *et al.* 2007, p. 74; Akhundov and Makhmudova 2008, p. 77. Based on materials from eastern Turkey C. Marro develops a possible point of view that in Late Chalcolithic (4,000–3,500 Cal BC) at least four pottery trends developed in the Highland zone where later Kura-Araxes culture came to existence: Late Sioni, Proto-Kura-Araxes, Tilki-Tepe and chaff-faced wares. If the chaff-faced ware was connected to Mesopotamia and Syria, than Late Sioni and Proto-Kura-Araxes were local. Tilki Tepe had both local and influenced traits. These four assemblages could develop more or less at the same time (Marro 2008).

use of painted pottery, potters' wheel, seals, gold and silver, lapis lazuli, flint, rather than obsidian, tools, and jar burials and kurgans, traits that are strange to the Kura-Araxes and typical more for the Upper Mesopotamian and Maikop traditions. Regardless, it is clear that the social context that accompanied Bronze Age developments in the region goes back to the Chalcolithic period (cf. Avetisyan 2012, p. 9). There is, moreover, one systematic feature common to both – the landscape: the Kura-Araxes tradition evolved in the same environment as the Late Chalcolithic communities, i.e. in the area from the Upper Euphrates to Mt. Ararat and around lakes Van, Urmia, and Sevan. This condition creates an essential background to consider both phenomena in the same developmental contexts.

7. Conclusion

According to new data, metallurgy in the southern Caucasus and Armenia in particular, appears with the extraction of native copper and cold-working-cum-annealing at the beginning of the 6th millennium BC. Copper smelting is practiced by the late 5th millennium BC. Metallurgical activities essentially increased in the early 4th millennium BC with evidence of *chaîne opératoire*, attested most spectacularly at Areni-1, which makes this site one of the most important in the whole Near Eastern landscape, and not only as regards the perfectly preserved organic materials. These all allow us to challenge the earlier understanding of the Caucasian Copper Age as a “fairly modest cultural focus” (Chernykh 1992, p. 54; cf. also Munchayev 1982, p. 136).

Due to its rich ores and important geographic location, the southern Caucasus turns out to be a kind of bridge between two metallurgical centers – Anatolia and Near East, where metallurgy commenced at the 8th–6th millennia BC, and South-East Europe, where during the 5th–4th millennia BC we have highly developed metallurgical centers. The southern Caucasus had definite Near Eastern (North Syrian-Mesopotamian and North Iranian) direction of contacts, which is reflected both in material assemblage and in metal industry.

However the Near Eastern relations of the southern Caucasus, which undoubtedly accelerated the process of the appearance of early complex societies in the region, should not be interpreted in terms of significant migrations, expansions, or colonizations from core to periphery being linked to forms of territorial control, as used to be the case, but more as a reflection of shared knowledge and widening of mental horizons born as the result of active interactions in which the “highland zone” turned out to be not only an imitator of Near Eastern values but possessed its own independent identities and even privileges: and this is especially visible in developments of metallurgy.

References

- Akhundov, T.I. and Makhmudova, V.A.G. (2008) *Yuzhniy Kavkaz v kavkazsko-peredneaziatskikh etnokul'turnykh protsessakh IV tis. do n.e.* (The South Caucasus in Caucasian-Near Eastern Ethno-Cultural Processes, 4th millennium BC). Baku (in Russian).
- Areshian, G.E. (2012) Neolithic and Chalcolithic (Eneolithic) Periods in Armenia, In: Simonyan, H. (ed.), *Archaeological Heritage of Armenia*. Yerevan: Ministry of Culture of the Republic Armenia, Historical-Cultural Heritage Scientific Research Centre, pp. 8–12.
- Areshian, G.E., Gasparyan, B., Avetisyan, P.S., Pinhasi, R., Wilkinson, K., Smith, A., Hovsepyan, R. and Zadrardyan, D. (2012) The Chalcolithic of the Near East and South-Eastern Europe: Discoveries and New Perspectives from the Cave Complex Areni-1, Armenia. *Antiquity* 86, pp. 115–130.
- Areshian, G.E. and Ghafadaryan, K.K. (1996) Haykakan lernashkharhi chartarapetutiuny nakhnadaryan hamaynakan hasarakargi ev petakan arajin kazmavorumneri zhamanakashrjanum (The Architecture of the Armenian Highland during Prehistoric Times and in the Period of First State Formations). In: Tiratsyan, G.A. (ed.), *Hay Chartarapetutyun patmutyun* (History of Armenian Architecture). Yerevan: National Academy of Sciences of the Republic of Armenia “Gitutyun” Publishing House, pp. 13–86 (in Armenian).
- Arimura, M., Badalyan, R., Gasparyan, B. and Chataigner, C. (2010) Current Neolithic Research in Armenia. *Neolithics* 1/10, pp. 77–85.
- Avetisyan, P. (2012) Haykakan lernashkharhi hnamshakutayin mijavayri dsevakokhumneri himnakan mitumneri vagh bronzi darum (The Main Tendencies of Transformation of the Ancient Cultural Environment of the Armenian Highland during the Early Bronze Age), *Patma-banasirakan handes* (Historical-Philological Journal) 2 (190), pp. 3–19 (in Armenian).
- Avetisyan, P. and Bobokhyan, A. (2012) Archaeology of Armenia in Regional Context: Achievements and Perspectives. In: Avetisyan, P. and Bobokhyan, A. (eds.), *Archaeology of Armenia in Regional Context, Proceedings of the International Conference dedicated to the 50th Anniversary of the Institute of Archaeology and Ethnography Held on September 15-17, 2009 in Yerevan*. Yerevan: National Academy of Sciences of the Republic of Armenia “Gitutyun” Publishing House, pp. 7–20.
- Avetisyan, P., Chataigner, C. and Palumbi, G. (2006) The Results of the Excavations of Nerkin Godedzor (2005–2006). Preliminary Report. *Aramazd* I, pp. 6–18.
- Avilova, L.I. (2009) Models of Metal Production in the Near East (Chalcolithic - Middle Bronze Age). *Archaeology Ethnology and Anthropology of Eurasia* 37/3, pp. 50–58.
- Azarnoush, M. and Helwing, B. (2005) Recent Archaeological Research in Iran – Prehistory to Iron Ages. *Archäologische Mitteilungen aus Iran und Turan* 37, pp. 189–246.
- Badalyan, R., Lombard, P., Chataigner, C. and Avetisyan, P. (2004) The Neolithic and Chalcolithic Phases in the Ararat Plain (Armenia): The View from Aratashen. In: Sagona, A. (ed.), *A View from the Highlands – Archaeological Studies in Honour of Charles Burney*. Ancient Near Eastern Studies, Supplement 12. Leuven, pp. 399–420.

- Badalyan, R., Lombard, P., Avestisyan, P., Chataigner, C., Chabot, J., Vila, E., Hovsepyan, R., Willcox, G. and Pessin, H. (2007) New Data on the Late Prehistory of the Southern Caucasus. The Excavations at Aratashen (Armenia): Preliminary Report. In: Lyonnet, B. (ed.), *Les cultures de Caucase (VIe-IIIe millénaires avant notre ère). Leurs relations avec le Proche-Orient*. Paris, pp. 37–61.
- Badalyan, R., Harutyunyan, A.A., Chataigner, C., Le Mort, F., Chabot, J., Brochier, J.-E., Balasescu, A., Radu, V. and Hovsepyan, R. (2010) The Settlement of Aknashen-Khatunarkh, a Neolithic Site in the Ararat Plain (Armenia): Excavation Results 2004–2009. *TÜBA-AR* 13, pp. 185–218.
- Barnard, H., Dooley, A.N., Areshian, G.E., Gasparyan, B. and Faull, K.F. (2011) Chemical Evidence for Wine Production around 4000 BCE in the Late Chalcolithic Near Eastern highlands. *Journal of Archaeological Science* 38, pp. 977–984.
- Chataigner, C. (1995) *La Transcaucasie au Néolithique et au Chalcolithique*. BAR International Series 634. Oxford.
- Chataigner, C., Arimura, M. and Gasparyan, B. (2007). La néolithisation de l'Arménie. *Les dossiers d'archéologie* 321, pp. 30–35.
- Chataigner, C., Avetisyan, P., Palumbi, G. and Uerpmann, H.-P. (2010) Godedzor, a Late Ubaid-related settlement in the Southern Caucasus. In: Carter, R.A. and Graham, P. (eds.), *Beyond the Ubaid. Transformation and Integration in the Late Prehistoric Societies of the Middle East*. Studies in Ancient Oriental Civilization 63. Chicago, pp. 391–409.
- Chernykh, E.N. (1992) *Ancient Metallurgy in the USSR*. Cambridge.
- Chernykh, E.N. and Orlovskaya, L.B. (2007) Radiouglerodnaya khronologiya Maykopskoy arkheologicheskoy obshchnosti (Radiocarbon Chronology of Maikop Archaeological Unity). In: Gadzhiev, M.S. (ed.), *Arkheologiya, Etnologiya i Fol'koristika Kavkaza. Materiali Mezhdunarodnoy nauchnoy konferentsii "Noveyshiye arkheologicheskiye i etnograficheskie issledovaniya na Kavkaze"* (Archaeology, Ethnology and Folkloristic of the Caucasus. Materials of International Conference, "Newest Archaeological and Ethnographic Investigatios in the Caucasus"). Makhachkala: Institute of History, Archaeology and Ethnography of the Russian Academy of Sciences. Dagestan Scientific Center, pp. 10–28 (in Russian).
- Courcier, A. (2014) Ancient Metallurgy in the Caucasus from the Sixth to the Third Millennium BCE. In: Roberts, B.W. and Thornton, C.P. (eds.), *Archaeometallurgy in Global Perspective*. New York, pp. 579–664.
- Courcier, A., Kuparadze, D. and Pataridze, D. (2008) Archaeometallurgical Researches on the Early Beginnings of Metallurgy (VI–III Millennia BC) in the Caucasus: An Example of Interdisciplinary Studies. *Metalla* 15, pp. 35–50.
- Courcier, A., Guliyev, F. and Lyonnet, B. (2012) Metallurgy during the Middle Chalcolithic Period (Last Third of the 5th Millennium B.C.) in Southern Caucasus: An Insight Through Recent Discoveries at Mentesh-Tepe (Azerbaijan). In: Jett, P., McCarthy, B. and Douglas, J.G. (eds.), *Scientific Research on Ancient Asian Metallurgy: Proceedings of the Fifth Forbes Symposium at the Freer Gallery of Art*. London, pp. 205–224.

- Di Nocera, G.M. (2010) Metals and Metallurgy. Their Place in the Arslantepe Society between the End of the 4th and Beginning of the 3rd Millennium BC. In: Frangipane, M. (ed.), *Economic Centralization in Formative States. The Archaeological Reconstruction of the Economic System in 4th Millennium Arslantepe*. Studi di Preistoria Orientale 3. Rome, pp. 255–274.
- Gasparyan, B. (2013) Areni-1 karayri usumnasirutyany himnakan ardyunknery (Main Results of Investigation of Areni-1 Cave). In: Suvaryan, Y. (ed.), *Hayagitutiumy ev ardi zhamanakashrjani martahravernery. Hayagitakan mijazgayin erkrord hamazhoghov* (Armenien Studies and Challenges of Modern Times: Second International Congress on Armenian Studies). Yerevan: National Academy of Sciences of the Republic of Armenia “Gitutyun” Publishing House, pp. 77–78 (in Armenian).
- Gevorkyan, A.Ts. (1980) *Iz istorii drevneyshey metallurgii Armyanskogo Nagor'ya* (From the History of Ancient Metallurgy of the Armenian Highland). Yerevan: Armenian SSR Academy of Sciences Press (in Russian).
- Gevorkyan, A.Ts. (1981) *Hayastani hin metaghagortsutyany zargatsman himnakan pulery* (The Main Stages of Developments of Ancient Metallurgy in Armenia). In: Arakelyan, B.N. (ed.), *Haykakan SSH-um 1979-1980 tt. dashtayin hnagitakan ashkhatankneri ardyunknerin nvirvats gitakan nstashrjan, Zekutsumneri tezisner* (Abstracts of Reports of the Conference devoted to the Archaeological Fieldwork Results in 1979-1980 in the Armenian SSR). Yerevan: Armenian SSR Academy of Sciences Press, pp. 13–14 (in Armenian).
- Hansen, S. (2013) Innovative Metals: Copper, Gold and Silver in the Black Sea Region and the Carpathian Basin during the 5th and 4th Millennium BC. In: Burmeister, S., Hansen, S., Kunst, M. and Müller-Scheeßel, N. (eds.), *Metal Matters: Innovative Technologies and Social Change in Prehistory*. Rahden/Westf. Deutsches Archäologisches Institut, Verlag Marie Leidorf (VML), pp. 137–167.
- Hauptmann, H. (1982) *Die Grabungen auf dem Norşuntepe, 1974, Keban Project 1974-1975 Activities*. Ankara, pp. 41–70.
- Helwing, B. (2012) Late Chalcolithic Craft Traditions at the North-Eastern “Periphery” of Mesopotamia: Potters vs. Smiths in the Southern Caucasus. *Origini* XXXIV, pp. 201–220.
- Ivanova, M. (2007) The Chronology of the “Maikop Culture” in the North Caucasus: Changing Perspectives. *Aramazd* II, pp. 7–39.
- Ivanova, M. (2012) Kaukasus und Orient: Die Entstehung des “Maikop-Phänomens” im 4. Jahrtausend v. Chr. *Praehistorische Zeitschrift* 87/1, pp. 1–28.
- Kiguradze, T.V. (1976) *Periodizatsia rannezemledel'cheskoy kul'turi Vostochnogo Zakavkaz'ya* (Periodization of Early Farming Culture of Eastern Transcaucasus). Tbilisi: “Metsniereba” Publishing House (in Georgian, with Russian Resume).
- Kiguradze, T.V. (2000) The Chalcolithic-Early Bronze Age Transition in the Eastern Caucasus. In: Marro, C. and Hauptmann, A. (eds.), *Chronologie des pays du Caucase et de l'Euphrate au IVe–IIIe millénaires*. Varia Anatolica 11. Paris, pp. 321–328.

- Kiguradze, T. and Sagona, A. (2003) On the Origins of the Kura-Araxes Cultural Complex. In: Smith, A. and Robinson, K. (eds.), *Archaeology in the Borderlands: Investigations in Caucasia and Beyond*. Cotsen Institute of Archaeology Monograph 47. Los Angeles, pp 38–94.
- Korenevskiy, S.N. (2004) *Drevneyshie zemledel'tsi i skotovodi Predkavkaz'ya: Maykopsko-novosvobodnenskaya obshchnost', problemi vnutrenney tipologii i simboliki pogrebal'noy praktiki* (The Ancient Farmers and Cattle-Breeders of the Anterior Caucasus: Maykop-Novosvobodnenskaya Unity, the Problems of Inner Typology and Symbolism of Burial Practices). Avtoreferat dissertatsii na soiskanie uchenoy stepeni doktora istoricheskikh nauk (Synopsis of Doctoral Dissertation). Moscow: Institute of Archaeology of Russian Academy of Sciences (in Russian).
- Korobkova, G.F. (1987) *Khozyaystvenniye kompleksi rannix zemledel'chesko-skotovodcheskix obshchestv yuga SSSR* (Economic complexes of the early farming-cattle-breeding societies of the South of the USSR). Leningrad: "Nauka" Publishing House, Leningrad Branch (in Russian).
- Kunze, R., Bobokhyan, A., Pernicka, E. and Meliksetian, Kh. (2013) Project Ushkiani. Investigations of the cultural landscape around the Sotk prehistoric gold-working region. In: Meller, H. and Avetisyan, P. (eds.), *Archäologie in Armenien II*. Halle: Veröffentlichungen des Landesamtes für Denkmalpflege und Archäologie Sachsen-Anhalt – Landesmuseum für Vorgeschichte, pp. 49–88.
- Kushnareva, K.Kh. (1997) *The Southern Caucasus in Prehistory, Stages of Cultural and Socioeconomic Development From the Eight to the Second Millennium B.C.* University Museum Monograph 99. Philadelphia: the University Museum, University of Pennsylvania.
- Lyonnet, B. (2000) La Mésopotamie et le Caucase du Nord au IV^e et au début du III^e millénaires av. n.e.: Leurs rapports et les problèmes chronologiques de la Culture de Majkop. Etat de la question et nouvelles propositions. In: Marro, C. and Hauptmann, H. (eds.), *Chronologies des Pays du Caucase et de L'Euphrate aux IV^e-III^e Millénaires*. Varia Anatolica 11. Paris, pp. 299–320.
- Lyonnet, B. (2007) Introduction. In: Lyonnet, B. (ed.), *Les cultures de Caucase (VI^e-III^e millénaires avant notre ère). Leurs relation avec le Proche-Orient*. Paris: CNRS Éditions, pp. 11–19.
- Lyonnet, B., Guliyev, F., Helwing, B., Aliyev, T., Hansen, S. and Mirtskhulava, G. (2012) Ancient Kura 2010–2011: The First Two Seasons of Joint Field Work in the Southern Caucasus. *Archäologische Mitteilungen aus Iran und Turan* 44, pp. 1–190.
- Magomedov, R.G. (2007) Eneolit i rannyya bronza na severno-vostochnom Kavkaze (Eneolithics and Early Bronze Age of the North-East Caucasus). In: Gadzhiev, M.S. (ed.), *Arkheologiya, Etnologiya i Fol'koristika Kavkaza. Materiali Mezhdunarodnoy nauchnoy konferentsii "Noveyshiye arkheologicheskiye i etnograficheskiye issledovaniya na Kavkaze"* (Archaeology, Ethnology and Folkloristic of the Caucasus. Materials of International Conference, "Newest Archaeological and Ethnographic Investigations in the Caucasus"). Makhachkala: Institute of History, Archaeology and Ethnography of the Russian Academy of Sciences. Dagestan Scientific Center, pp. 47–55 (in Russian).

- Makharadze, Z. (2007) Nouvelles données sur le Chalcolithique en Géorgie orientale. In: Lyonnet, B. (ed.), *Les cultures de Caucase (VIe-IIIe millénaires avant notre ère). Leurs relation avec le Proche-Orient*. Paris: CNRS Éditions, pp. 123–132.
- Marro, C. (2005) Cultural Duality in Eastern Anatolia and Transcaucasia in Late Prehistory (ca. 4200–2800 BC). *Archäologische Mitteilungen aus Iran und Turan* 37, pp. 27–34.
- Marro, C. (2007) Upper Mesopotamia and Transcaucasia in the Late Chalcolithic Period (4000–3500 BC). In: Lyonnet, B. (ed.), *Les cultures de Caucase (VIe-IIIe millénaires avant notre ère). Leurs relation avec le Proche-Orient*. Paris: CNRS Éditions, pp. 77–94.
- Marro, C. (2008) Late Chalcolithic Ceramic Cultures in the Highlands (4000–3500 BC). In: Robinson, K.S. and Sagona, A. (eds.), *Ceramics in Transition: Chalcolithic through Iron Age in the Highlands*. Ancient Near Eastern Studies 27. Louvain, pp. 9–37.
- Marro, C., Bakhshaliyev, V. and Ashurov, S. (2011) Excavations at Ovçular Tepesi (Nakhichevan, Azerbaijan). Second Preliminary Report: The 2009–2010 Seasons. *Anatolia Antiqua* XIX, pp. 53–100.
- Meliksetian, Kh., Pernicka, E., Badalyan, R. and Avetisyan, P. (2003) Geochemical Characterisation of Armenian Early Bronze Age Metal Artifacts and their Relation to Copper Ores. In: Proceedings vol. 1 at the International Conference Archaeometallurgy in Europe, 24–26 September 2003, Milan, Italy, pp. 597–606.
- Meliksetian, Kh., Pernicka, E. and Badalyan, R. (2007) Compositions and Some Considerations on the Provenance of Armenian Early Bronze Age Copper Artefacts, In: Proceedings of the 2nd International Conference “Archaeometallurgy in Europe”, Aquileia, Italy, 17–21 June 2007, organized by Associazione Italiana di Metallurgia, Milano, pp. 1–13.
- Meliksetian, Kh. and Pernicka, E. (2010) Geochemical Characterization of Armenian Early Bronze Age Metal Artifacts and Their Relation to Copper Ores. In: Hansen, S., Hauptmann, A., Motzenbäcker, I. and Pernicka, E. (eds.), *Von Majkop bis Trialeti. Gewinnung und Verbreitung von Metallen und Obsidian in Kaukasien im 4. - 2. Jt. v. Chr.* Beiträge des Internationalen Symposiums in Berlin vom 1.-3. Juni 2006. Bonn, pp. 41–58.
- Meliksetian, Kh., Kraus, S., Pernicka, E., Avetisyan, P., Devejian, S. and Petrosyan, L. (2011) Metallurgy of Prehistoric Armenia. In: Yalçın, Ü. (ed.), *Anatolian Metal V*. Bochum, pp. 201–210.
- Munchayev, R.M. (1975) *Kavkaz na zare bronzovogo veka. Neolit, eneolit, rannyya bronza* (The Caucasus on the Threshold of the Bronze Age. Neolithic, Eneolithic, Early Bronze Age). Moscow: “Nauka” Publishing House (in Russian).
- Munchayev, R.M. (1982) Eneolit Kavkaza (Eneolithic of Caucasus). In: Masson, V.M. and Merpert, N.Ya. (eds.), *Eneolit SSSR* (Eneolithic of USSR). Arkheologiya SSSR (Archaeology of USSR). Moscow: “Nauka” Publishing House, pp. 100–164 (in Russian).
- Munchayev, R.M. (2007) Urukskaya kul'tura (Mesopotamiya) i Kavkaz (Uruk Culture [Mesopotamia] and the Caucasus). In: Gadzhiev, M.S. (ed.), *Arkheologiya, Etnologiya i Fol'koristika Kavkaza. Materiali Mezhdunarodnoy nauchnoy konferentsii “Noveyskiye arkheologicheskiye i etnograficheskiye issledovaniya na Kavkaze”* (Archaeology, Ethnology and Folkloristic of the Caucasus. Materials of International Conference,

- “Newest Archaeological and Ethnographic Investigations in the Caucasus”). Makhachkala: Institute of History, Archaeology and Ethnography of the Russian Academy of Sciences. Dagestan Scientific Center, pp. 8–9 (in Russian).
- Museyibli, N.A. (2007a) *Böyük Kesik. Eneolit Dövrü Yaşayış Məskəni* (Chalcolithic settlement Beyuk Kesik). Baku: “Nafta Press” Publishing House (in Azeri, Russian and English).
- Museyibli, N. (2007b) K voprosu o khronologii leylatepinskoy kul’turi (Towards the Question of Chronology of Leylatepe Culture). In: Gadzhiev, M.S. (ed.), *Arkheologiya, Etnologiya i Fol’koristika Kavkaza. Materiali Mezhdunarodnoy nauchnoy konferentsii “Noveyshiye arkheologicheskiye i etnograficheskiye issledovaniya na Kavkaze”* (Archaeology, Ethnology and Folkloristic of the Caucasus. Materials of International Conference, “Newest Archaeological and Ethnographic Investigations in the Caucasus”). Makhachkala: Institute of History, Archaeology and Ethnography of the Russian Academy of Sciences. Dagestan Scientific Center, pp. 155–158 (in Russian).
- Narimanov, I. (1987) *Kul’tura drevneishego zemledel’chesko-skotovodcheskogo naseleniya Azerbaidzhan (Eneolit. VI–IV tis. do n.e.)* (The Culture of the Ancient Farming Population of Azerbaijan [the Chalcolithic Period. VI–IV millennia BC]). Baku: “Elm” Publishing House (in Russian).
- Narimanov, I.G., Akhundov, T.I. and Aliyev, N.G. (2007) *Leylatepe*. Baku: “Elm” Publishing House (in Russian).
- Palumbi, G. (2007) A Preliminary Analysis on the Prehistoric Pottery from Aratashen (Armenia). In: Lyonnet, B. (ed.), *Les cultures de Caucase (VIe-IIIe millénaires avant notre ère). Leurs relation avec le Proche-Orient*. Paris: CNRS Éditions, pp. 63–76.
- Pernicka, E. (1990) Gewinnung und Verbreitung der Metalle in prähistorischer Zeit. *Jahrbuch des Römisch-Germanischen Zentralmuseums* 37, pp. 21–129.
- Pigott, V.C. (1999) The Development of Metal Production on the Iranian Plateau: An Archaeometallurgical Perspective. In: Pigott, V.C. (ed.), *The Archaeometallurgy of the Asian Old World*. University Museum Monograph 89. Philadelphia: University of Pennsylvania, pp. 73–106.
- Pinhasi, R., Gasparian, B., Areshyan, G.E., Zardaryan, D., Smith, A., Bar-Oz, G. and Higham, T. (2010) First direct evidence of Chalcolithic footwear from the Near Eastern Highlands. *PLOS ONE* 5 (6) (<http://www.plosone.org/article/info:doi/10.1371/journal.pone.0010984>).
- Radivojević, M., Rehren, T., Pernicka, E., Dušan, Š., Brauns, M. and Dušan, B. (2010) On the Origins of Extractive Metallurgy: New Evidence from Europe. *Journal of Archaeological Science* 37, pp. 2775–2787.
- Radivojević, M., Rehren, T., Kuzmanović-Cvetković, J., Jovanović, M. and Peter Northover, J. (2013) Tainted Ores and the Rise of Tin Bronzes in Eurasia, c. 6500 Years Ago. *Antiquity* 87, pp. 1030–1045.
- Seeliger, T.C., Pernicka, E., Wagner, G.A., Begemann, F., Schmitt-Strecker, S., Eibner, C., Özuntali, Ö. and Baranyi, I. (1985) Archäometallurgische Untersuchungen in Nord- und Ostanatolien. *Jahrbuch des Römisch-Germanischen Zentralmuseums* 32, pp. 597–659.
- Tedesco, L.A. (2006) *Redefining Technology in Bronze Age Transcaucasia: Copper-Alloy Metallurgy in Armenia in the 3rd-mid 2nd millennium BC*. Ph.D Dissertation, Department of Anthropology, New York University.

- Thornton, C.P. (2009) The Emergence of Complex Metallurgy on the Iranian Plateau: Escaping the Levantine Paradigm. *Journal of World Prehistory* 22, pp. 301–327.
- Torosyan, R.M. (1976) *Teghuti vagh erkragortsakan bnakavairy (m.t.a. IV hazaramyak)* (The Early Farming Settlement of Teghut [IV Millennium BC]). Hnagitakan peghumner Hayastanum (Archaeological excavations in Armenia) N14. Yerevan: Armenian SSR Academy of Sciences Press (in Armenian with Russian Resume).
- Wilkinson, K.N., Gasparian, B., Pinhasi, R., Avetisyan, P., Hovsepyan, R., Zardaryan, D., Areshian, G.E., Bar-Oz, G. and Smith, A. (2012) Areni-1 Cave, Armenia: A Chalcolithic-Early Bronze Age Settlement and Ritual Site in the Southern Caucasus. *Journal of Field Archaeology* 37/1, pp. 20–33.
- Zardaryan, D.E. (2011) O rannikh proyavleniyakh elementov kuro-arakskoy kul'tury v pozdneeneoliticheskoy keramike Areni-1 (Towards Early Reflections of Elements of Kura-Araxes Culture in the Late Eneolithic Ceramics of Areni-1). In: Skakov A.Yu. (ed.), *Problemi Arkheologii Kavkaza: k 70-letiyu Yu.N. Voronova. Sbornik materialov Mezhdunarodnoy nauchnoy konferentsii posvyashchennoy 70-i letiyu Yu.N. Voronova (10-11 maya, 2011 g., g. Sukhumi)* (Problems of Archaeology of the Caucasus: to the 70th anniversary of Yu.N. Voronov, Collection of Materials of the International Conference dedicated to the 70th anniversary of Yu.A. Voronov, 10-11th of May 2011, Sukhum). Sukhum: AbIGI Press, pp. 53–57 (in Russian).
- Zardaryan, D. and Gasparyan, B. (2012) Kul'turnye vzaimosvyazi pozdneeneoliticheskikh obitateley peshcheri Areni-1: na osnove sravneniya keramicheskikh materialov (Cultural Contacts of Late Eneolithic Inhabitants of Areni-1: According to Comparisons of Ceramic Materials). In: Gadzhiev M.S. (ed.), *Noveyshie otkrytiya v arkheologii severnogo Kavkaza: issledovaniya i interpretatsii, XXVII Krupnovskie Chteniya. Materiali Mezhdunarodnoy nauchnoy konferentsii, Makhachkala, 23-28 aprelya 2012 g.* (The Newest Discoveries in Archaeology of the North Caucasus: Investigations and Interpretations, XXVII Krupnov Readings. Materials of the International Conference, Makhachkala, 23-28 April 2012). Makhachkala: "Mavraev" Publishing House, pp. 46–49 (in Russian).
- Zwicker, U. (1977) Investigations on the Extractive Metallurgy of Cu/Sb/As Ore and Excavated Smelting Products from Norşun-Tepe (Keban) on the Upper Euphrates (3500–2800 B.C.). In: Oddy, W.A. (ed.), *Aspects of Early Metallurgy*. London: Historical Metallurgy Society, pp. 13–26.

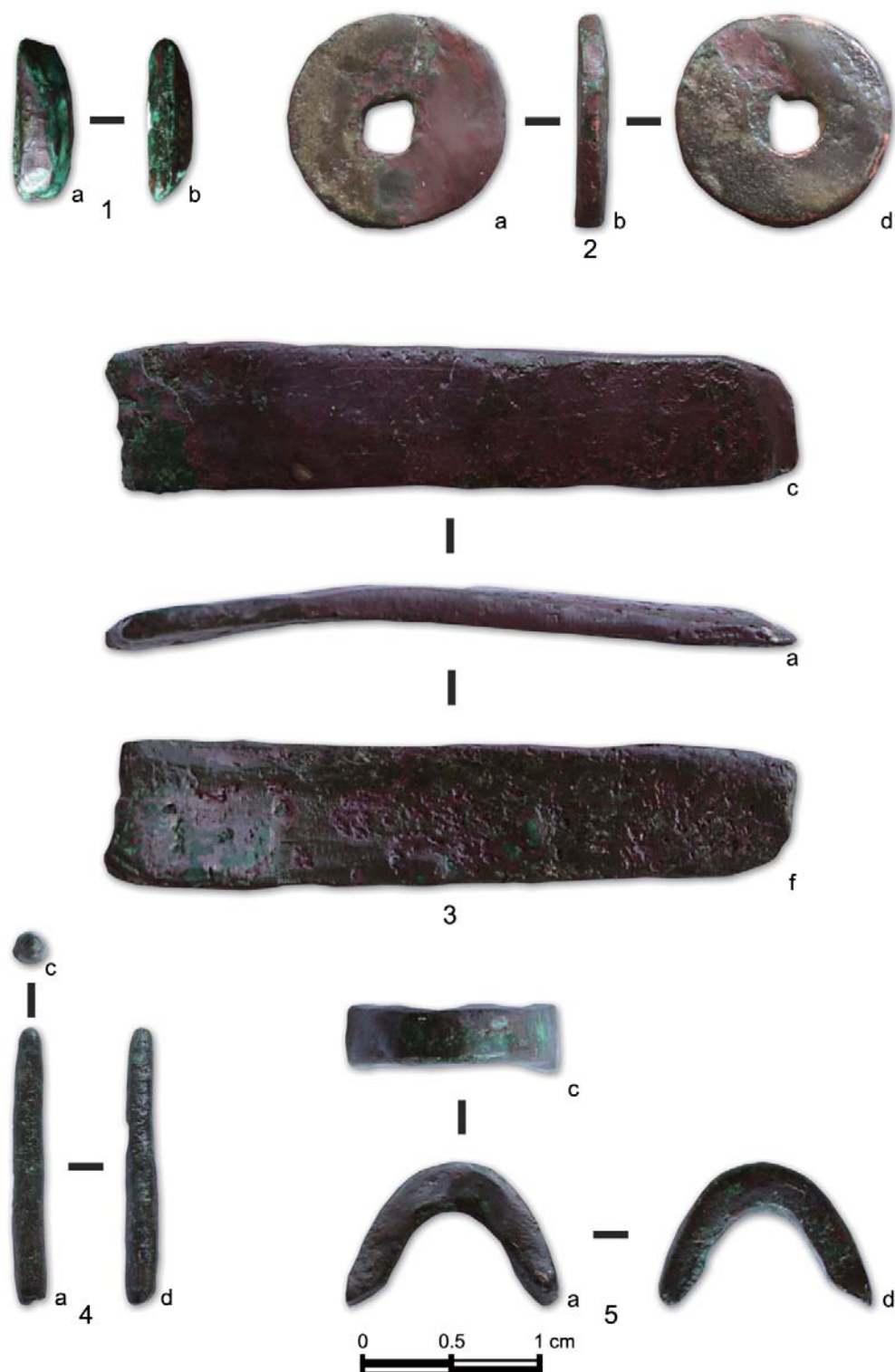


Figure 1

Mushakan-4. Metal artifacts from the Chalcolithic Horizon I (third quarter of the 5th millennium BC).

1. Small piece of copper; 2. Holed disk (bead?); 3. Bracelet fragment; 4. Awl/retoucher; 5. Hook?



Figure 2
Areni-1 cave. Copper ores from the Chalcolithic Horizon II (4,000–3,700 Cal BC).

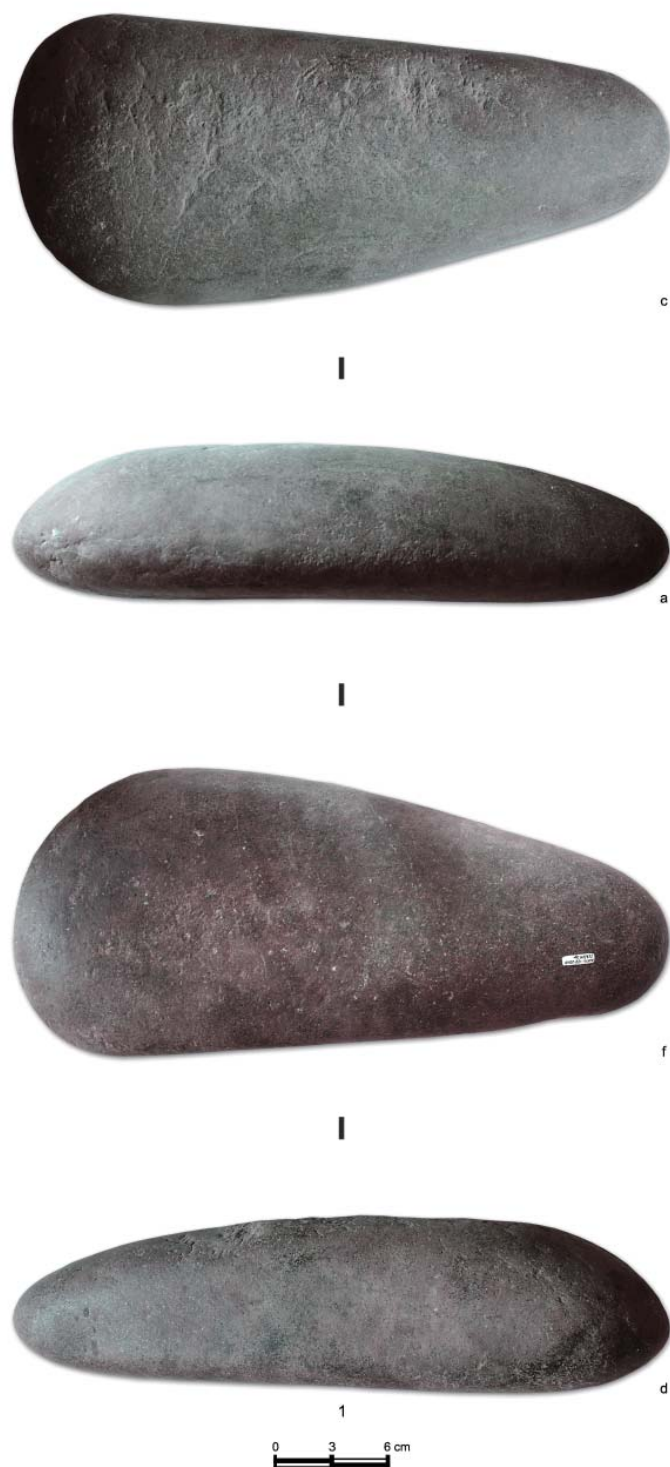


Figure 3
Areni-1 cave. Basalt pestle-hammer and grinding stone from the Chalcolithic
Horizon II (4,000–3,700 Cal BC).

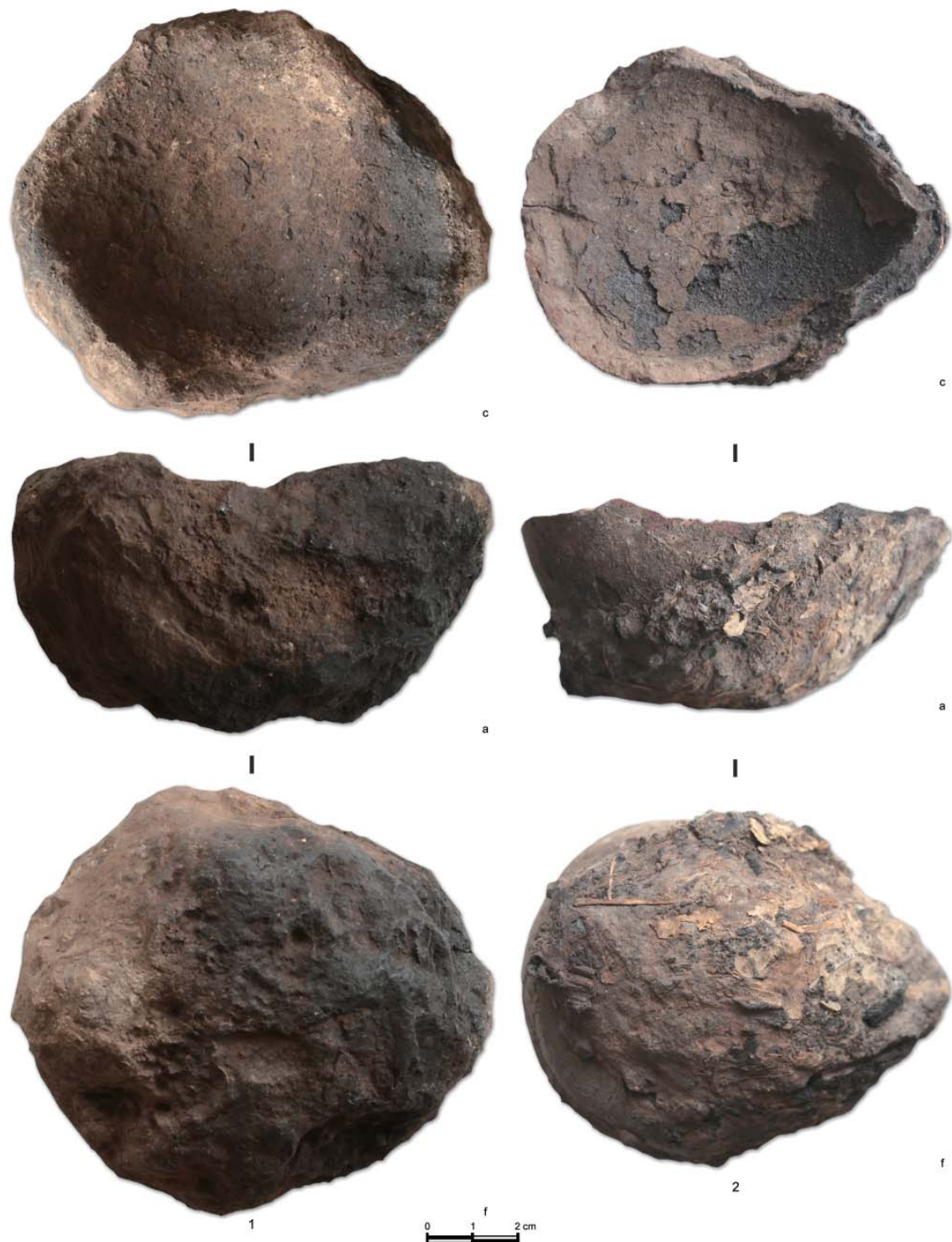


Figure 4
Areni-1cave. Basalt (1) and clay (2) crucibles from the Chalcolithic Horizons I (1) and II (2) (4,000–3,400 Cal BC).

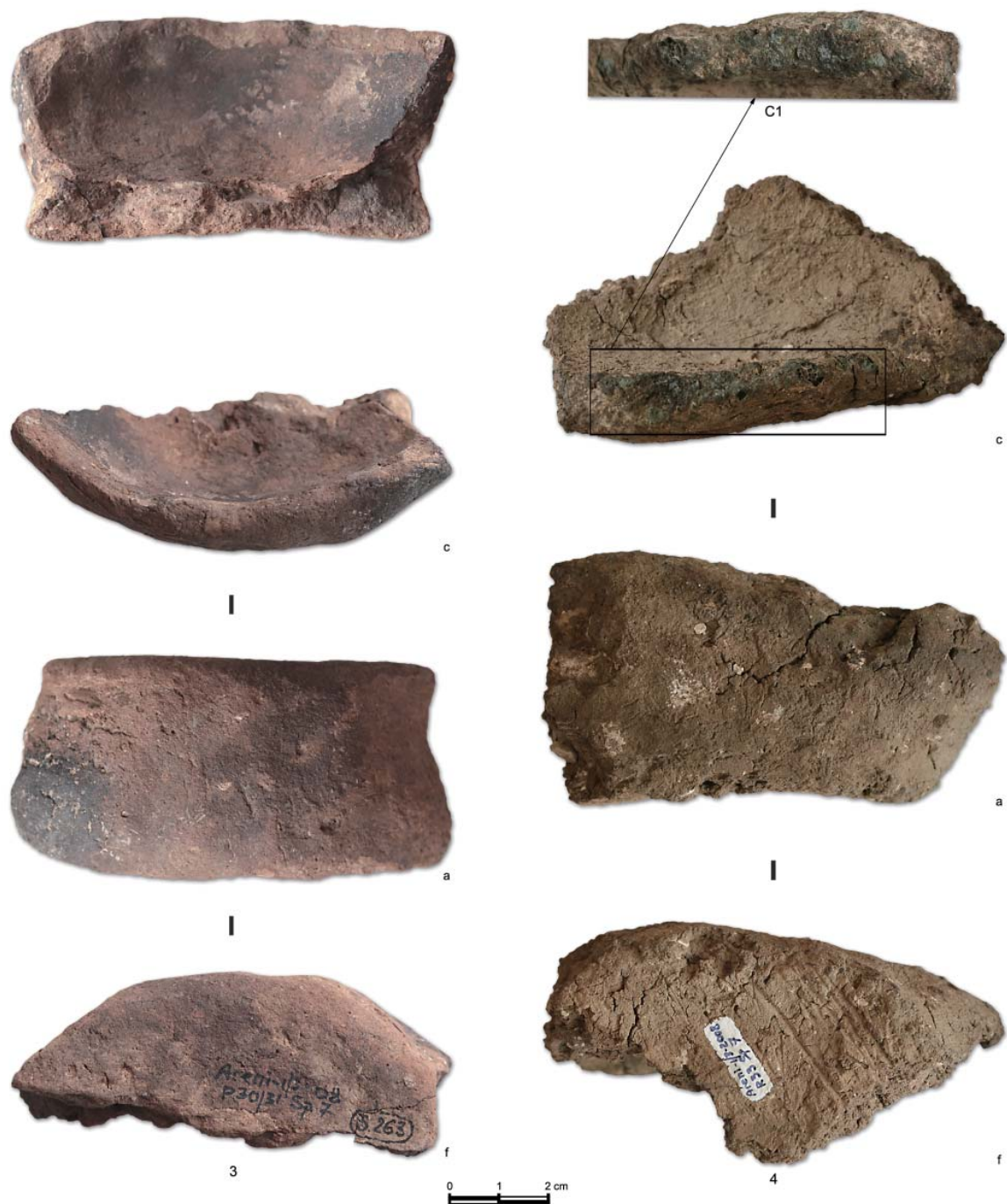


Figure 5
Areni-1 cave. Clay crucibles from the Chalcolithic Horizons I (1) and II (2) (4,000–3,400 Cal BC).



Figure 6
 1-6, 9-11: Areni-1 cave. Ceramic artifacts (1-2. Pourers; 3-5. Crucibles; 6. Spouted vessel; 9-10. Casting moulds; 11. Ventilation pipe) from the Chalcolithic Horizons I (4, 10) and II (1-3, 5-6, 9, 11) (4,000–3,400 Cal BC).
 7-8: Aknashen/Khatunarkh. Clay crucibles from Chalcolithic Horizon (mid 5th millennium BC).



Figure 7

1, 4-8: Areni-1 cave. Metal artifacts (1. Copper ingot; 4-5. Knives; 6. Knife base fragment; 7. Adze; 8. Bowl fragment) from the Chalcolithic garbage layer (1) (4,000–3,700 Cal BC) and the Chalcolithic Horizon II (4-8) (4,000–3,700 Cal BC). 2: Teghut. Knife from the Chalcolithic Layer (after new restoration, 4,000–3,700 Cal BC). 3: Sotk 2. Knife from Horizon IIa (3,700–3,400 Cal BC).



Figure 8
1-4, 10: Areni-1 cave. 1. Pike head; 2. Awl; 3-4. Ingots; 10. Bracelet fragment from the Second Chalcolithic Horizon (4,000–3,700 Cal BC). 5-9: Nerkin Godezvor. 5-8. Awls; 9. Earring from the Late Chalcolithic Layers (3,700–3,400 Cal BC).

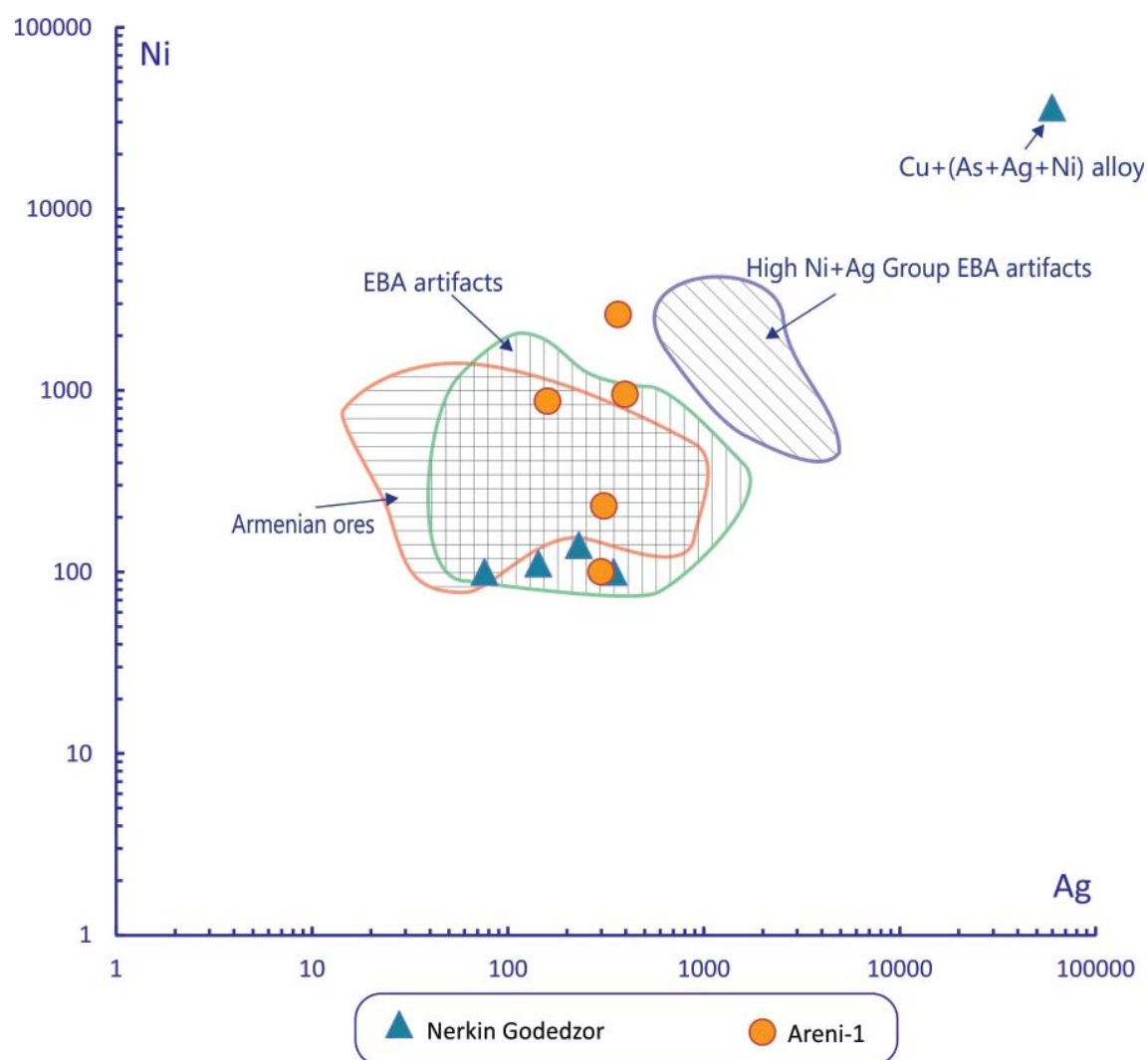


Figure 9

Ag vs. Ni diagram from comparison of Armenian ores, Early Bronze Age artifacts and analyzed Chalcolithic artifacts from Areni-1 cave and Nerkin Godedzor settlement.

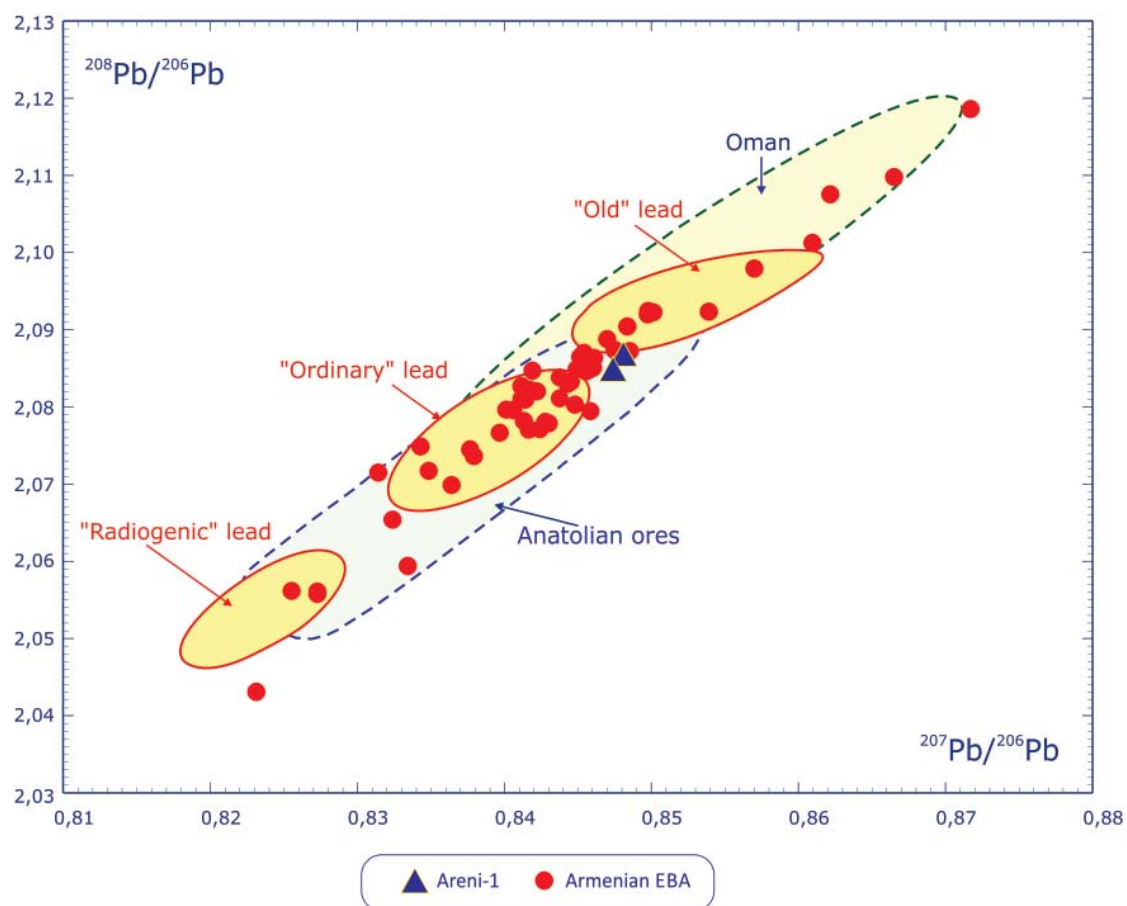


Figure 10

Diagram of the $^{207}\text{Pb}/^{206}\text{Pb}$ vs. $^{208}\text{Pb}/^{206}\text{Pb}$ in analysed artifacts from Areni-1 cave and previously analysed Early Bronze Age Armenian artifacts. Isotope compositional fields of Armenian ores are shown.

1. “Radiogenic” lead group; 2. “Ordinary” lead group; 3. “Old” lead group (Meliksetian and Pernicka 2010). Lead isotope compositional fields of ores of Anatolia and Oman are given for comparison.

LIST OF AUTHORS

Alphabetical order

Adler, Daniel S. (Mr.)

Department of Anthropology, University of Connecticut, 354 Mansfield Road, Unit 1176, Storrs, CT 06269, United States of America.

e-mail: daniel.adler@uconn.edu

Aghikyan, Levon (Mr.)

Institute of Archaeology and Ethnography, National Academy of Sciences of the Republic of Armenia, 15 Charents Street, 0025 Yerevan, Republic of Armenia.

e-mail: aghikyan@mail.ru

Areshian, Gregory E. (Mr.)

Cotsen Institute of Archaeology, University of California, Los Angeles, Box 951510, Los Angeles CA 90095-1510, United States of America.

e-mail: gareshia@ucla.edu

Arimura, Makoto (Mr.)

Center for Cultural Resource Studies, Kanazawa University, Kakuma-machi, Kanazawa-shi, Ishikawa, 920-1192, Japan.

e-mail: arimura.mako@gmail.com

Avetisyan, Pavel (Mr.)

Institute of Archaeology and Ethnography, National Academy of Sciences of the Republic of Armenia, 15 Charents Street, 0025 Yerevan, Republic of Armenia.

e-mail: pavetisyan@sci.am

Azatyan, Karen (Mr.)

Institute of Archaeology and Ethnography, National Academy of Sciences of the Republic of Armenia, 15 Charents Street, 0025 Yerevan, Republic of Armenia.

e-mail: karenvayk@gmail.com

Badalyan, Ruben (Mr.)

Institute of Archaeology and Ethnography, National Academy of Sciences of the Republic of Armenia, 15 Charents Street, 0025 Yerevan, Republic of Armenia.

e-mail: r.badalyan@yahoo.com

Bagoyan, Tamara (Ms.)

Institute of Archaeology and Ethnography, National Academy of Sciences of the Republic of Armenia, 15 Charents Street, 0025 Yerevan, Republic of Armenia.

e-mail: tbagoyan@yahoo.com

Bobokhyan, Arsen (Mr.)

Institute of Archaeology and Ethnography, National Academy of Sciences of the Republic of Armenia, 15 Charents Street, 0025 Yerevan, Republic of Armenia.

e-mail: arsenbobokhyan@yahoo.com

Chataigner, Christine (Ms.)

Archéorient, UMR 5133, CNRS/Université Lyon 2, 7 rue Raulin, 69007 Lyon, France.

e-mail: christine.chataigner@mom.fr

Egeland, Charles P. (Mr.)

Department of Anthropology, University of North Carolina at Greensboro, 426 Graham Building, Greensboro, North Carolina, 27402, United States of America.

e-mail: cpegelan@uncg.edu

Fujii, Sumio (Mr.)

Center for Cultural Resource Studies, Kanazawa University, Kakuma-machi, Kanazawa-shi, Ishikawa, 920-1192, Japan.

e-mail: fujiiikun@staff.kanazawa-u.ac.jp

Gabrielyan, Ivan (Mr.)

Institute of Botany, National Academy of Sciences of the Republic of Armenia, 1 Acharyan Street, 0063 Yerevan, Republic of Armenia.

e-mail: ivangabrielyan@yahoo.com

Gasparyan, Boris (Mr.)

Institute of Archaeology and Ethnography, National Academy of Sciences of the Republic of Armenia, 15 Charents Street, 0025 Yerevan, Republic of Armenia.

e-mail: borisg@virtualarmenia.am

Glauberger, Phil (Mr.)

Settlement Archaeology Program, Middle East Technical University, Üniversiteler Mah. Dumlupınar Blv. No.1, Mimarlık Fakültesi, Yeni Bina, No.410, 06800, Çankaya, Ankara, Turkey.

e-mail: phil.glauberger@gmail.com

Harutyunyan, Armine (Ms.)

Institute of Archaeology and Ethnography, National Academy of Sciences of the Republic of Armenia, 15 Charents Street, 0025 Yerevan, Republic of Armenia.

e-mail: arm.harutyunyan@yahoo.com

Haydosyan, Hayk (Mr.)

Institute of Archaeology and Ethnography, National Academy of Sciences of the Republic of Armenia, 15 Charents Street, 0025 Yerevan, Republic of Armenia.

e-mail: haykhay@rambler.ru

Hayrapetyan, Armine (Ms.)

Institute of Archaeology and Ethnography, National Academy of Sciences of the Republic of Armenia, 15 Charents Street, 0025 Yerevan, Republic of Armenia.

e-mail: hnaget@mail.ru

Kandel, Andrew W. (Mr.)

The Role of Culture in Early Expansions of Humans (ROCEEH), Heidelberg Academy of Sciences and Humanities at the University of Tübingen, Rümelinstr. 23, 72070 Tübingen, Germany.

e-mail: a.kandel@uni-tuebingen.de

Khechoyan, Anna (Ms.)

Institute of Archaeology and Ethnography, National Academy of Sciences of the Republic of Armenia, 15 Charents Street, 0025 Yerevan, Republic of Armenia.

e-mail: annakhechoyan@yahoo.com

Margaryan, Lusine (Ms.)

Institute of Archaeology and Ethnography, National Academy of Sciences of the Republic of Armenia, 15 Charents Street, 0025 Yerevan, Republic of Armenia.

e-mail: margaryanlusine1989@yahoo.com

Martirosyan-Olshansky, Kristine (Ms.)

Cotsen Institute of Archaeology, University of California, Los Angeles, Box 951510, Los Angeles CA 90095-1510, United States of America.

e-mail: kristineolsh@ucla.edu

Meliksetian, Khachatur (Mr.)

Institute of Geological Sciences, Armenian National Academy of Sciences, 24a Marshal Baghramian Ave.0019, Yerevan, Republic of Armenia.

e-mail: km@geology.am

Montoya, Cyril (Mr.)

Aix Marseille Université, CNRS, Ministère de la Culture et de la Communication, LAMPEA UMR 7269, 13094 Aix-en-Provence, France and DRAC Picardie, 5 rue H. Daussy, 80 000 Amiens, France.

e-mail: cyril.montoya@culture.gouv.fr

Muradyan, Firdus (Mr.)

Institute of Archaeology and Ethnography, National Academy of Sciences of the Republic of Armenia, 15 Charents Street, 0025 Yerevan, Republic of Armenia.

Nahapetyan, Samvel (Mr.)

Department of Cartography and Geomorphology, Yerevan State University, Alek Manukyan 1, 0025 Yerevan, Republic of Armenia.

e-mail: nahapetyan@ysu.am

Pernicka, Ernst (Mr.)

Curt-Engelhorn-Zentrum Archäometrie GmbH an der Universität Heidelberg D5, Museum
Weltkulturen, 68159 Mannheim, Germany.

e-mail: ernst.pernicka@cez-archaeometrie.de

Pinhasi, Ron (Mr.)

School of Archaeology, University College Dublin, Newman Building, Belfield, Dublin 4,
Ireland.

e-mail: ron.pinhasi@ucd.ie

Petrosyan, Arthur (Mr.)

Institute of Archaeology and Ethnography, National Academy of Sciences of the Republic of
Armenia, 15 Charents Street, 0025 Yerevan, Republic of Armenia.

e-mail: artur.petrosian@yahoo.com

Smith, Alexia (Ms.)

Department of Anthropology, University of Connecticut, 354 Mansfield Road Unit-1176, Storrs,
Connecticut 06269-1176, United States of America.

e-mail: alexia.smith@uconn.edu

Stapleton, Lyssa C. (Ms.)

Cotsen Institute of Archaeology, University of California, Los Angeles, Box 951510, Los
Angeles CA 90095-1510, United States of America

e-mail: lstapleton@ucla.edu

Zardaryan, Diana (Ms.)

Institute of Archaeology and Ethnography, National Academy of Sciences of the Republic of
Armenia, 15 Charents Street, 0025 Yerevan, Republic of Armenia.

e-mail: dzardaryan@ymail.com

