A C T A M V S E I A P V L E N S I S

APULUM LI
series ***ARCHAEOLOGICA ET ANTHROPOLOGICA***

CARPATHIAN HEARTLANDS
Studies on the prehistory and history of Transsylvania in European contexts, dedicated to Horia Ciugudean on his 60th birthday

NUCLEUL CARPATIC
Studii privind preistoria şi istoria Transilvaniei în context european, dedicate lui Horia Ciugudean la aniversarea a 60 de ani

Edited by /
Volum îngrijit de:

Nikolaus Boroffka
Gabriel Tiberiu Rustoiu
Radu Ota

A C T A M V S E I A P V L E N S I S

APVLVM

LI

series *ARCHAEOLOGICA ET ANTHROPOLOGICA*

ALBA IULIA

MMXIV

Adresa de corespondenţă:
MUZEUL NAŢIONAL AL UNIRII
510010 ALBA IULIA
Str. Mihai Viteazul, 12-14
Tel. 0258/813300

Correspondence address:
MUZEUL NAŢIONAL AL UNIRII
RO – 510010 ALBA IULIA
Mihai Viteazul St., 12-14
Tel. (+40) (258) 813300

revista.apulum@yahoo.com
www.mnuai.ro; www.muzeuluniriialba.ro; www.anuarulapulum.ro

ISSN – 1013-428X
ISSN – 2247 – 8701
ISSN-L – 2247 – 8701

CARPATHIAN HEARTLANDS
Studies on the prehistory and history of Transsylvania in European contexts, dedicated to Horia Ciugudean on his 60th birthday

NUCLEUL CARPATIC
Studii privind preistoria şi istoria Transilvaniei în context european, dedicate lui Horia Ciugudean la aniversarea a 60 de ani

Edited by /
Volum îngrijit de:

Nikolaus Boroffka
Gabriel Tiberiu Rustoiu
Radu Ota

ALBA IULIA 2014

Tehnoredactare: RADU OTA
Traducerea şi verificarea textelor în limba engleză: ADINA GOŞA, NIKOLAUS BOROFFKA, BRÎNDUŞA CIUGUDEAN

Horia Ciugudean

S U M A R

CONTENTS – SOMMAIRE – INHALT

TABULA GRATULATORIA XV
COLEGIUL EDITORIAL, Prefaţă (Preface) XIX
NIKOLAUS BOROFFKA, Memories with Horia XXIII
Amintiri cu Horia XXVII
BIBLIOGRAFIE HORIA CIUGUDEAN XXXI

STUDII – *STUDIES*

SABIN ADRIAN LUCA, FLORENTINA MARŢIŞ, ANAMARIA TUDORIE, ADRIAN LUCA, „Consacrarea ritualică" a primei colonizări neolitice din România. Partea II. Locuirea
"Ritual Consecration" of the first Neolithic Settlements in Romania. Second part. Habitation..... 1
GHEORGHE LAZAROVICI, CORNELIA-MAGDA LAZAROVICI, SORIN COLESNIUC, SOTE ANGELESKI, Muntele Teasc. Despre sanctuare în natură (I)
The Teasc Mountain. On Sanctuaries in the Landscape (I)…….....… 25
ZSOLT SZÉKELY, Mormântul în cistă de piatră de la Şincai (jud. Mureş)
The Stone Grave from Şincai (Mureş County)…….. 81
RADU BĂJENARU, Despre datarea şi contextul unui topor faţetat din Oltenia
On the Dating and Context of a facetted Axe from Oltenia…….. 89
TÜNDE HORVÁTH, Mobility: Transhumants or Immigrants?
Mobilitate:transhumanţi sau imigranţi?..... 99
DALIA ANNA POKUTTA, Food and Cooking in the Únětice Culture
Hrană şi gătit în cultura Únětice …… 135
CLAES UHNÉR, A critical View on the Use of Salt in the political Economy of Únětice Societies in the Circumharz Region in eastern Germany

O viziune critică asupra folosirii sării în economia politică a societăţilor Únětice în regiunea Circumharz din estul Germaniei …….. 161

PETER THOMAS, Copper and Gold – Bronze Age Ore Mining in Transylvania

Cupru şi aur – exploatarea minereurilor din Transilvania in epoca bronzului ……. 177

SASCHA MAUEL, A close Association of some Tens of Loom Weights from Aiud – Evidence for the Presence of the Warp – Weighted Loom in Bronze Age Transylvania, Romania

Un ansamblu de câteva zeci de greutăţi pentru războiul de ţesut de la Aiud – Dovezi ale prezenţei greutăţilor pentru urzeală în epoca bronzului din Transilvania, România…… 195

GABRIEL BĂLAN, RALUCA BURLACU-TIMOFTE, MARIUS RÂZA, TEODOR MUNTEAN, Situri descoperite recent aparţinând culturii Wietenberg

New Sites belonging to the Wietenberg Culture…….. 215

CORNELIU BELDIMAN, DAN-LUCIAN BUZEA, DIANA-MARIA SZTANCS, BJÖRN BRIEWIG, Microscopy of Praehistoric symbolic Artefacts. Wietenberg Zoomorphic Antler Plate discovered at Şoimeni, Harghita County

Microscopia unor artefacte preistorice simbolice. Placa zoomorfă din corn de cerb aparţinând culturii Wietenberg descoperită la Şoimeni, judeţul Harghita … 241

MARCIN S. PRZYBYŁA, Cladistics, Typology and the Bronze Age Pottery from Cârna

Cladistica, tipologia şi ceramica epocii bronzului de la Cârna …… 287

ÁGNES KIRÁLY, JUDIT KOÓS, JÁNOS GÁBOR TARBAY, Representations of Jewellery and Clothing on Late Bronze Age anthropomorphic clay Figurines from north-eastern Hungary

Reprezentări ale podoabelor şi îmbrăcămintei pe figurinele antropomorfe din lut din epoca bronzului în nod-estul Ungariei ……. 307

CRISTIAN SCHUSTER, Faza Tei V, Aspectul cultural Vlădeşti II– Fundenii Doamnei, grupul Govora–Fundeni sau grupul cultural Fundenii Doamnei?

The Phase Tei V, cultural Aspect Vlădeşti II – Fundenii Doamnei, the Group Govora-Fundeni or the cultural Group Fundenii Doamnei?..... *341*

TIBERIUS BADER, Lanzenspitzen vom Typ Dremajlovka
The Dremajlovka type of lance-heads …… *369*

BOGDAN PETRU NICULICĂ, VASILE BUDUI, The Evaluation and spatial Distribution of Bronze Deposits in Bucovina
Evaluarea şi distribuţia spaţială a depozitelor de bronzuri din Bucovina …….. *387*

BIANKA NESSEL, Bronze Age Portioning of raw Metal–Concepts, Patterns and Meaning of casting Cakes
Porţionarea metalului brut în epoca bronzului- concepte, modele şi semnificaţia turtelor de turnare *401*

ANCA-DIANA POPESCU, O formă de turnare din a doua jumătate a mileniului al II-lea a.Chr. descoperită la Căscioarele
A casting Mold dated to the second Half of the 2nd Millennium BC discovered at Căscioarele……. *427*

BIBA TERŽAN, Bemerkungen zu einem bimetallenen Vollgriffschwert aus der Hallstattzeitlichen Dolenjsko-Gruppe (SO Slowenien)
Consideraţii privind o sabie bimetalică cu mânerul plin aparţinând grupului hallstattian Dalj (SE Slovenia) *445*

BEATRICE CIUTĂ, Consideraţii arheobotanice prilejuite de descoperirea unor resturi de *vitis vinifera* în interiorul unui vas de argint (sec. IV B.C.)
Archaeobotanical Considerations occasioned by the Discovery of vitis vinifera Remains within a silver Vessel (4th Century BC)…….. *457*

MARIUS-MIHAI CIUTĂ, Istoria pierdută – istoria recuperată. Cazul *Hercules 2013*
Lost History – Recovered History. The Hercules 2013 Case…… *471*

RADU CIOBANU, Statueta lui Hercule ”Farnese” recent descoperită la Apulum – elemente de mitologie comparată, iconografie, tipologie şi stil ale unei piese excepţionale de artă romană
*La Statuette d'Hercule Farn*ès*e récemment découverte à Apulum – éléments de mythologie comparée, iconographie, typologie et style d'une pièce excéptionnelle d'art romain*…….. *491*

RADU OTA, O nouă atestare a zeului Pan şi câteva consideraţii privind imaginile iconografice ale divinităţii la Apulum
A new Atestation of the God Pan and some Considerations regarding the Iconographic Images of the Divinity at Apulum…….. *527*
CSABA SZABÓ, Notes on a new *Salariarius* from Apulum
Note asupra unui nou salariarius *de la Apulum* …… *533*
NICOLAE GUDEA, Inscriptiones Tegularum Legionis XIII Geminae 1. Tipologia ştampilelor pe ţigle şi cărămizi descoperite în castru
Inscriptiones Tegularum Legionis XIII Geminae 1. Tiles and Brick Stamps discovered in the Camp – a Typology. *545*
MONICA URSU, CLAUDIU TĂNĂSELIA, SERGIU CADAR, MIRCEA CHINTOANU, NICOLAE HAR, DAN ANGHEL, ANCA TIMOFAN, GEORGE BOUNEGRU, Studiu cu privire la compoziţia şi provenienţa mortarelor cu lianţi minerali utilizaţi la construcţia edificiilor antice de la Apulum
Study on the Composition and Provenience of Mortars with mineral Cement used in the Construction of antique Buildings at Apulum…….. *561*
CĂLIN COSMA, Consideraţii privind un nou tip de zăbală din secolele VII-VIII descoperit pe teritoriul Transilvaniei şi Slovaciei
Betrachtungen zu einem neuen Trensentyp aus dem 7.-8. JH., der auf dem Gebiet Siebenbürgens und der Slowakei Entdeckt Wurde…….. *593*
DAN BĂCUEŢ-CRIŞAN, O locuinţă medievală timpurie descoperită în anul 1995 la Alba Iulia ”Dealul Furcilor”. Câteva consideraţii privind locuirile medievale timpurii de pe teritoriul oraşului Alba Iulia
Early Medieval Dwelling found at Alba Iulia "Dealul Furcilor" in 1995. Some Considerations about Early Medieval Settlements on the Territory of Alba Iulia……. *615*
AUREL DRAGOTĂ, Tipologia pandantivelor în formă de semilună
Typology of Crescent Shaped Pendants…….. *645*

RECENZII ŞI NOTE DE LECTURĂ

REVIEWS AND READER'S NOTES

RADU CIOBANU, Alix Barbet, *Peintures romaines de Tunisie*, ed. Picard, Paris, 2013, 336 pag., 466 fig. alb-negru şi color……..... 669

RADU CIOBANU, *Jupiter on Your Side – Gods and Humans in Antiquity in the Lower Danube Area* (Accompanying publication for the thematic exhibitions in Bucharest, Alba Iulia and Constanţa: may – september 2013; editor Cristina Georgeta Alexandrescu) Bucharest, 2013, 295 pag., 163 ilustraţii alb-negru - text, 149 ilustraţii color – catalog……..... 675

Lista autorilor……. 681

Indice de autori (2004-2013)……. 685

TABVLA GRATVLATORIA

SOTE ANGELESKI – Cluj-Napoca
DAN ANGHEL - Alba Iulia
OLE CHRISTIAN ASLAKSEN - Gothenburg
TIBERIUS BADER - Hemmingen
JOZEF BÁTORA - Bratislava
DAN BĂCUEŢ-CRIŞAN - Zalău
RADU BĂJENARU - Bucureşti
GABRIEL BĂLAN - Alba Iulia
IOAN BEJINARIU - Zalău
CORNELIU BELDIMAN - Bucureşti
SÁNDOR BERECKI - Târgu Mureş
KATALIN T. BIRÓ - Budapest
WOJCIECH BLAJER - Krakow
NECULAI BOLOHAN - Iaşi
NIKOLAUS BOROFFKA - Berlin
RODICA BOROFFKA - Berlin
GEORGE BOUNEGRU - Alba Iulia
BJÖRN BRIEWIG - Berlin
VASILE BUDUI - Suceava
RALUCA BURLACU-TIMOFTE - Cluj-Napoca
DAN-LUCIAN BUZEA - Sfântu Gheorghe
SERGIU CADAR - Cluj-Napoca
MIRCEA CHINTOANU - Cluj-Napoca
DANIELA CIUGUDEAN – Alba Iulia
BEATRICE CIUTĂ - Alba Iulia
MARIUS CIUTĂ - Alba Iulia
SORIN COLESNIUC - Mangalia
CĂLIN COSMA - Cluj-Napoca
GABRIEL CRĂCIUNESCU - Drobeta Turnu-Severin
JANOS DÁNI - Debrecen
WOLFGANG DAVID - München

MIREILLE DAVID-ELBIALI - Geneva
VALENTIN DELEANU - Alba Iulia
LAURA DIETRICH - Berlin
AUREL DRAGOTĂ - Sibiu
FLORIN DRAŞOVEAN - Timişoara
CORNELIU GAIU - Bistriţa
ERWIN GÁLL - Bucureşti
CLAUDIA GERLING - Berlin
ROBERT GINDELE - Satu Mare
ADRIAN GLIGOR - Bucureşti
BLAGOJE GOVEDARICA - Berlin
HASKEL GREENFIELD - Winnipeg
NICOLAE GUDEA - Cluj-Napoca
SVEND HANSEN - Berlin
NICOLAE HAR - Cluj-Napoca
VOLKER HEYD - Bristol
TÜNDE HORVÁTH - Budapest
CONSTANTIN INEL - Alba Iulia
CAROL KÁCSO - Baia Mare
ELKE KAISER - Berlin
TOBIAS L. KIENLIN - Köln
VALERIU KAVRUK - Sfântu Gheorghe
ÁGNES KIRÁLY - Miskolc
JUDIT KOÓS - Miskolc
GABRIELLA KULCSÁR - Budapest
ILIE LASCU - Alba Iulia
ATTILA LÁSZLÓ - Iaşi
GHEORGHE LAZAROVICI – Cluj-Napoca
CORNELIA-MAGDA LAZAROVICI - Iaşi
ADRIAN LUCA - Sibiu
SABIN ADRIAN LUCA - Sibiu
JOSEPH MARAN - Heidelberg
FLORENTINA MARŢIŞ - Timişoara
SASCHA MAUEL - Thessaloniki
FLORIN MĂRGINEAN - Arad

ZSOLT MOLNÁR-KOVÁCS - Cluj-Napoca
LIVIU MARTA - Satu Mare
TEODOR MUNTEAN - Iaşi
JÓSZEF GÁBOR-NAGY - Cluj-Napoca
RITA NÉMETH - Târgu Mureş
BIANKA NESSEL - Heidelberg
BOGDAN PETRU NICULICĂ - Suceava
ANCA NIŢOI - Sibiu
JOHN O'SHEA - Michigan
RADU OTA - Alba Iulia
NONA PALINCAŞ - Bucureşti
CHRISTOPHER PARE - Mainz
JAROSLAV PEŠKA - Olomouc
RICHARD PETROVSZKY - Speyer
ZENO KARL PINTER - Sibiu
IOAN PISO - Cluj-Napoca
DALIA ANNA POKUTTA - Gothenburg
CRISTIAN I. POPA - Alba Iulia
ANCA-DIANA POPESCU - Bucureşti
MARCIN S. PRZYBYŁA - Cracow
COLIN P. QUINN - Michigan
SORIN RADU - Sibiu
LORENZ RAHMSTORF - Mainz
MARIUS RÂZA - Alba Iulia
AGATHE REINGRUBER - Berlin
BOTOND REZI - Târgu Mureş
CĂTĂLIN RIŞCUŢA - Deva
GABRIEL TIBERIU RUSTOIU - Alba Iulia
CRISTIAN SCHUSTER - Bucureşti
VALERIU SÎRBU - Brăila
TUDOR SOROCEANU - Berlin
THOMAS STÖLLNER - Bochum
COSMIN I. SUCIU - Timişoara
CSABA SZABÓ - Pécs
ILDIKÓ SZATHMÁRI - Budapest

ZSOLT SZÉKELY - Sfântu Gheorghe
ALEXANDRU SZENTMIKLOSI - Timişoara
DIANA-MARIA SZTANCS - Bucureşti
JÁNOS GÁBOR TARBAY - Budapest
CLAUDIU TĂNĂSELIA - Cluj-Napoca
BIBA TERŽAN - Ljubljana
PETER THOMAS - Bochum
ANCA TIMOFAN - Alba Iulia
SORIN TINCU – Hunedoara
GEORGE TOMEGEA - Sibiu
ANAMARIA TUDORIE - Sibiu
JAN TUREK - Pilsen
IOAN - MARIAN ŢIPLIC - Sibiu
CLAES UHNÉR - Gothenburg
MONICA URSU - Cluj-Napoca
HELLE VANDKILDE - Aarhus
MAGDOLNA VICZE - Százhalombatta
STEFAN WIRTH - Dijon
MIHAI WITTENBERGER - Cluj-Napoca
VOLKER WOLLMANN - Obrigheim
PETAR ZIDAROV - Sofia

COPPER AND GOLD – BRONZE AGE ORE MINING IN TRANSYLVANIA

Peter THOMAS
Deutsches Bergbau-Museum Bochum
Forschungsbereich Montanarchäologie

Key words: Bronze Age, ore mining, metal production, Transylvania, Eastern Alps
Cuvinte cheie: Epoca Bronzului, exploatarea minereurilor, producţia de metal, Transilvania, Alpii Estici

Introduction.

Transylvania and the encircling mountains of the Carpathians are among the most important mining regions in Europe. Large deposits of gold, silver, copper and tin ores, as well as rock salt and brine springs, have consistently attracted humanity´s attention[1]. Consequently, an abundance of mining monuments testify to their extensive and long-lasting exploitation[2].

Our knowledge about the history of mining, however, is not equally good throughout the ages. While some periods are well known and documented by various sources, others are not. This becomes especially apparent when tracing back mining activities to the period of Roman Dacia and beyond.

The time of Roman occupation is one of the best-researched periods in Transylvania and its surroundings. Archaeological finds, architectural remains, and written sources help to reconstruct an unusually clear image of this time, including also the mining. Time and again, modern exploitation work has revealed the remains of Roman mines. Both their extent and the artefacts found yield an impression of the vast scope of the mining activities, as well as their structure and organisation[3].

The frequency of the findings thereby led to a scientific perception already in early modern times[4]. It was intensified later in the 19th century, when important research was performed by scholars like Gábor Téglás or František

[1] In summary: Boroffka 2009, p. 191-121, fig. 1.
[2] Wollmann 2010/2011.
[3] In summary: Ciugudean 2012, p. 222-223.
[4] Köleséri de Keres-Eér 1780.

Pošepný[5]. And today, Roman mining is again the focus of mining archaeological research, as the monuments in the gold district of Roşia Montană are immediately endangered by modern exploitation, requiring large-scale rescue excavations[6].

Regarding the pre-Roman periods, the situation is completely different. Only prehistoric salt mining is evinced beyond doubt, by several well-dated mining sites[7]. Yet the exploitation of metal ores is indicated only indirectly by several tools and stray finds, and with one possible exception[8], no prehistoric ore mines have so far been identified with certainty.

History of Research.

The existence of prehistoric mining for metal ores has been assumed frequently. Already Téglás concluded that the exploitation of the gold and silver deposits of Transylvania in particular predated the Romans. He could not believe that the extent of Roman mining could have been achieved only during the short timespan of the province Dacia. Therefore he assumed already exiting mines had been reorganised and continued by the Romans[9]. Remarkably, this assumption is now supported by new research carried out in the Roman gold mines of Transylvania[10].

Ore mining and metal production in the Carpathians is likewise assumed to have taken place during the Copper Age and the Bronze Age. Frequently used arguments for this assumption are abundant ore sources and large amounts of metal objects found in the Carpathian Basin, dated to different periods of prehistory[11].

Support for this hypothesis was gleaned from several artefacts interpreted as mining tools, such as bronze picks, grooved stone implements, and some types of heavy copper tools, though only few pieces were actually found in a context directly connected to mining[12]. The aforementioned heavy copper tools, moreover, affected the interpretation of several stone steles as further

[5] For example: Pošepný 1868; Téglás 1883; 1894. Further references: Wollmann 2002, p. 125-126; 2010, p. 36-37, annot. 1.
[6] Cauuet *et alii* 2003; Cauuet 2011.
[7] Szathmáry 1867; Preisig 1877; Harding, Kavruk 2010; Cavruc, Harding 2012.
[8] Zimmermann 1993, p. 53, fig. 45.
[9] Téglás 1888, p. 463; 1889.
[10] Cauuet *et alii* 2003, p. 474; Cauuet 2005, p. 41; Wollmann, Ciugudean 2005, p. 102-108; Baron *et alii* 2011, p. 1093-1094.
[11] For example: Rusu 1963; 1981; Mozsolics 1984, p. 22-23.
[12] See below.

indications for old mining activities[13]. This is due to the fact that metal axes of similar appearance are depicted on these and were, in analogy to the copper artefacts, interpreted as mining tools, thus interpreting the steles as representations of prehistoric miners[14].

This state of research, reached in the early 20th century, remained widely unchanged for a long time and was extended only infrequently by chance finds[15]. Only recently has research on prehistoric mining and metal production intensified again.

In this context the work of Horia Ciugudean has to be pointed out. In his studies he did not merely summarize, reconsider, or reinterpret known artefacts and data, as done frequently before. With his fieldwork and analysis of archive materials he gathered new information and further indications to find assured evidence for prehistoric ore mining and metal production[16].

Indications for prehistoric ore mining.

The emphasis in the argumentation for prehistoric ore mining has hitherto been on archaeological artefacts. This remains mostly true even today, since the analyses of the composition as well as the isotopy of ores and metal objects from Transylvania and its surroundings are still in their initial stage[17]. However, the relevance of some of these artefacts in the argumentation is regarded with retention or is even rejected so far.

Heavy copper axe-adzes and hammer-axes are now interpreted predominantly as weapons or symbols of power and status, and not as tools[18]. In fact, only in one case were implements like these actually found in a mining context,[19] and it is questionable whether this isolated instance is sufficient to broaden the common interpretation of these artefacts. This of course, negatively affects the interpretation of the stone steles as representations of prehistoric miners too[20].

[13] Compilation: Ciugudean 2011, p. 33, Appendix 2.
[14] Téglás 1885; 1887; Makkay 1996, p. 44; Wollmann 1996, p. 24, annot. 52, p. 336, p. 360; Rotea 2002/2003, p. 7; Andriţoiu 2007, p. 58, annot. 31.
[15] Boroffka 2009, p. 121, annot. 2.
[16] Ciugudean 2002, 2012; Wollmann, Ciugudean 2005.
[17] In summary: Boroffka 2009, p. 124; Lazarovici *et alii* 2012, p. 7. In detail with bibliography: Constantinescu *et alii* 2009; 2010; Baron *et alii* 2011; Pop *et alii* 2011.
[18] With history of research: Vulpe 1970.
[19] Černych 1978, p. 212-213, pl. 20, 1-2.
[20] Already: Hoernes 1925, p. 620. Also: Ciugudean 2011, p. 27; Wollmann, Ciugudean 2005, p. 95.

The abundance of grooved stone implements[21] could be more convincing in this respect, since tools like these, and in particular grooved hammer stones, are typical indications of prehistoric mining[22]. However, their distribution pattern in the Carpathians only marginally covers the locations of the large ore deposits[23]. In some cases, it rather seems to match the areas with rock salt deposits or brine springs, suggesting their preferred use in salt mining[24]. This also seems likely based upon the results of the excavations in the salt mining district of Băile Figa, where several hammer stones have been found[25].

In addition to mining activities, also other reasons for their distribution are to be taken into consideration. Typological differences, suggesting a range of different tools represented in this material, whose function does not need to be restricted to mining alone, could also be a possible explanation[26].

Thus an evaluation of the entire range of grooved stone implements in terms of their relevance to prehistoric ore mining can be performed only after a detailed analysis of these artefacts, and is so far only possible in some exceptional cases. Among these is a grooved hammer stone from the gold mining district of Căraciu. It was discovered in the 19th century already, when modern exploitation cut old workings[27]. Due to its shape, this artefact was immediately interpreted as a prehistoric mining tool. And although the old workings in Căraciu are attributed to the Roman era[28] and no further prehistoric traces are known, it is one of the best indications for prehistoric exploitation of gold ores in Transylvania[29].

A further argument for prehistoric gold mining is a stone tool found by Horia Ciugudean in the vicinity of large ore dressing sites in the Vâlcoi-Corabia massif close to Bucium[30]. Two shallow depressions on its upper side led to the interpretation as a mortar for crushing ore. The lower side, on the other hand, is slightly convexly abraded, a feature typical for grinders of alternating mills. This, together with a groove running around the circumference of the tool,

[21] Compilation: Schuster 1998. Additional: Boroffka 2009, p. 127; Hegyi 2012.
[22] Craddock 1995, p. 37-39.
[23] Boroffka 2009, p. 125, fig. 4, p. 127-128.
[24] Schuster *et alii* 2012, p. 202, p. 209-210, fig. 10.
[25] Harding, Kavruk 2010, p. 149-150, fig. 30; Cavruc, Harding 2012, p. 189, fig. 9, p. 192, p. 194.
[26] Schuster 1998, p. 116-117; Wollmann, Ciugudean 2005, p. 96. Compare with: Ciugudean 1998, p. 31-33, fig. 1; Kašuba, Kaiser 2009.
[27] Téglás 1888, p. 464; 1889, p. 263, p. 333; Papp 1906, p. 309-311.
[28] Wollmann 1999, p. 28.
[29] Popescu 1951, p. 27-28; 1956, p. 197; Mareş 2002, p. 59-60; Rotea 2002/2003, p. 7. Similar: Wollmann, Ciugudean 2005, p. 96.
[30] Ciugudean 2012, p. 225, p. 232, pl. 11.

shows a great similarity to grinders of Bronze Age stone mills as used in the Eastern and Southern Alps, to grind the ore for subsequent wet beneficiation[31]. Given the gold bearing loads of the Vâlcoi-Corabia massif, this tool was likely used in prehistoric gold mining and production.

Several bronze tools are of similar significance. Winged bronze picks deserve mention here, originating from the large hoards of Uioara de Sus and Guşteriţa II[32]. Their interpretation as mining tools has been expressed quite early and has never been seriously in doubt[33]. Close analogies from the salt mining district of Hallstatt are supporting this interpretation[34].

Due to their certain Bronze Age dating, these tools represent conclusive evidence for prehistoric mining in Transylvania. Although it still has to be discussed which kind of raw material has been mined with them. This is because both the Alpine analogues and the Transylvanian sites are associated with salt mining[35]. Yet although salt exploitation in Bronze Age Transylvania is known[36], this possibility seems unlikely. Though large amounts of artefacts have recently been recovered from the salt mining district of Băile Figa, no handles for winged tools are reported so far[37]. Note that pick handles are among the most abundant finds in mines where their use is proven[38].

On the other hand, the use of these tools in ore mining has been discussed also[39]. An argument for this could be the fracture patterns of the Transylvanian pieces which differ from those found in the Alps. A heavy bronze hammer that was found together with the picks in the hoard of Uioara de Sus supports this interpretation[40], because this hammer has its closest analogues in the copper mining areas of the Eastern and Southern Alps[41].

Besides salt and gold, copper ores are another mineral resource, the exploitation of which is likely to date back to prehistoric times. This assumption is supported by numerous plane-convex casting cakes found in the large hoards

[31] Klose 1918, p. 23-24, fig. 33, 7; Preuschen, Pittioni 1937, p. 56-57, p. 94; 1954, p. 48-49, fig. 28, 1-2, p. 80; Šebesta 1992, p. 38-40, fig. 71; Stöllner *et alii* 2010, p. 21-22, fig. 14, 7074.
[32] Vulpe 1975, p. 79-80, pl. 45, no. 457-459, pl. 46, no. 460-464.
[33] Roska 1942, p. 91-93, fig. 117; Vulpe 1975, 80.
[34] Mayer 1977, 228, pl. 92, no. 1357; Windholz-Konrad 2003, p. 41-42, p. 154, pl. 25, no. 352; 2012, p. 120-122, fig. 4-5.
[35] Rusu 1981, p. 381, p. 388; Wollmann 1996, p. 408.
[36] Harding, Kavruk 2010; Cavruc, Harding 2012.
[37] Harding, Kavruk 2010.
[38] For example: Barth 1998, p. 123-124.
[39] Barth 1970, p. 48, annot. 11.
[40] Mayer 1977, p. 230-233; Höglinger 1996, p. 43-44. In summary: Thomas 2012, p. 455-457.
[41] Mayer 1977, p. 223, pl. 89, no. 1328; Teržan 1989, p. 246-247, fig. 7, 6.

of the Transylvanian Basin and the Maramureş. In the eight large *"workshop and foundry hoards,"* for example, almost 7,000 pieces and fragments thereof were discovered, with a total weight of nearly four tons. Sizes range from small examples of up to 15 cm diameter to large ones with a diameter of 30 cm weighing up to 10 kg[42].

In this context, the larger pieces are of special interest. Whereas the small examples are thought to be the result of melting and recycling of metal in the crucibles of foundries[43], the larger ones are thought to be products of smelting ore to metal[44]. Consequently, their abundance in large numbers is an enormous accumulation of raw copper, originating directly from the furnaces and being thereby the direct product of primary production of metal.

In summary, the existence of prehistoric mining of metal ores in Transylvania and its surroundings has to be considered very likely. In particular, the exploitation of gold and copper ores is indicated by the aforementioned artefacts. For gold, the stone hammer from Căraciu and the grinder from the Vâlcoi-Corabia massif have to be mentioned. For copper ore mining and copper production it is the sheer number of plane-convex casting cakes from Transylvania and the Maramureş. The use of winged bronze picks as well as of heavy bronze hammers has to be considered for both cases and cannot be narrowed down due to the lack of further information.

Dating.

Concerning the chronological framework, the bronze picks are of special interest. Both Transylvanian hoards containing tools of this type belong to the horizon of Cincu-Suseni and therefore to the Ha A1 period, or approximately to the 12th century BC[45]. In the case of Uioara de Sus, material from the preceding horizon of Uriu-Dragomireşti is also found in the hoard, making a dating of the picks to the Bz D period or the 13th century BC another possibility[46]. The same is applicable for the bronze hammer and the plane-convex casting cakes from this hoard.

This chronological frame is supported by the Alpine pieces. The best analogies for the picks are, as mentioned earlier, from the salt mining district of Hallstatt and the hoard of Sipbachzell, where three additional pieces were

[42] Rusu 1981, p. 378-379, tab. 1; Popa, Totoianu 2010, p. 326-327, annot. 1741.
[43] Rusu 1981, p. 382-383; Mozsolics 1981; 1984, p. 35-37.
[44] Drescher 1958, p. 19, annot. 1; Bachmann *et alii* 2002/2003, p. 81-89.
[45] Rusu 1963, p. 184-189.
[46] Vulpe1975, p. 72.

found[47]. Their main characteristics are a massive spike and large wings with parallel sides, separated from the spike by a clear shoulder. In general they date to the Urnfield Period[48]. The composition of the hoard of Sipbachzell, however, could indicate an earlier date. This is because in addition to the predominant artefacts from the Early and Older Urnfield Period it also contains some Middle Bronze Age ones[49]. A dating for these picks from the Middle Bronze Age to the Urnfield Period is supported by finds of corresponding wooden handles. These were recovered in several parts of the prehistoric salt mine of Hallstatt, dating roughly between 1400 BC and 1000 BC[50].

For the heavy bronze hammer, the closest analogy originates from the Bronze Age copper mines of the Mühlbach-Bischofshofen mining district, the so-called Mitterberg Area. Since the piece was discovered already in the 19th century it is not possible to date it precisely, though a date between the late 13th century BC and the 11th century BC is likely[51]. A similar dating range was suggested for a comparable piece from the Hudinja valley in Slovenia[52].

For the stone grinder from the Vâlcoi-Corabia massif a dating is difficult to obtain, since it is a stray find and the only datable artefacts from the surrounding area belong to the Roman period[53]. A Roman date for this piece, however, seems very unlikely. The aforementioned analogies from the Eastern and Southern Alps in fact would suggest a Bronze Age date. The earliest examples originate in the Mitterberg area and date back at least to the early 14th century BC[54]. Other pieces are known from ore dressing sites of the 13th century BC[55] and even the Late Bronze Age[56]. Thus a date within this time span seems likely also for the piece from Transylvania.

Finally, the stone hammer from Căraciu is not suitable for narrowing down the date of possible prehistoric mining activities. The shape of these tools is far too common and does not show any development of chronological significance. It, therefore, can only be referred to as being of general prehistoric origin.

The indications for prehistoric ore mining, as far as described here, thus focus on the Late Bronze Age. Especially the 13th and 12th century BC appears

[47] Höglinger 1996, p. 41-42, p. 129, pl. 20, no. 349-354.
[48] Mayer 1977, p. 230.
[49] Höglinger 1996, p. 78.
[50] Barth 1993/1994, p. 29-31, tab. 1; 1998, p. 124, p. 126; Stadler 1999.
[51] Mayer 1977, p. 223, pl. 89, no. 1328. In summary: Thomas 2012, p. 244-247, p. 451.
[52] Teržan 1989, p. 246-247.
[53] Ciugudean 2012, p. 225.
[54] Stöllner *et alii* 2010, p. 19-22.
[55] Preuschen, Pittioni 1937, p. 56-57, p. 94; 1954, p. 48-49, fig. 28, 1-2, p. 80; Pichler *et alii* 2009.
[56] Šebesta 1992, p. 38-40.

as a time of large-scale exploitation, when in particular the copper ore mining and copper production is clearly noticeable in the archaeological record. Gold mining is also indicated, though it is not possible to accurately assess its extent, as the number of related pieces is too small.

Interpretation.

In the preceding sections, the known indications for prehistoric ore mining were considered in terms of the raw material mined and their dating. In doing so it became apparent that most of the considered artefacts have close analogies in the Eastern and Southern Alps. This poses the question whether these analogies are merely coincidental, to be explained by the functional requirements of specific implements, or rather, as expressions of contacts and interactions between different prehistoric mining regions.

The former hypothesis, still possible for simple forms such as the heavy hammers, is unlikely to hold for pieces like the winged picks, which are comparable even in detail. The hexagonal spike, for example, which is found on all pieces except one can be explained as providing stability, but is not at all an indispensable feature. Thus a common source as origin of the formal similarities appears likely.

A different aspect that, moreover, yields deeper insight into the nature of these contacts is provided by engraved markings. These are found on picks from both Transylvania and the Alps[57]. Although their full meaning is not yet understood, they are variously interpreted as markings for control, signs of production, or even ownership[58]. In these cases not only the purpose-specific design of a tool would have been transported and adopted, but also significant contextual meanings as part of the social infrastructure. It is an interesting question whether such associated meanings would have been transported by distant contacts and exchange of objects or rather, through the mobility of the people themselves.

The latter notion is supported by the similarity between the ore grinders from the different regions. In this context it is necessary to stress that the grinding of ore is only one step in a complex process including several steps of repeated breaking and subsequent sorting of ore[59]. Technically speaking, the grinding should thus not be seen as isolated from the other steps of ore dressing. The similarity of the grinders, whose significance is furthermore underlined by

[57] Mayer 1976; 1977, p. 230-233.
[58] In summary with bibliography: Mayer 1976; Thomas 2012, p. 190-192.
[59] Stöllner *et alii* 2010.

their limited distribution, may therefore be assumed to be representative of the similarity of the entire process. If so, the final step of sorting, using water, the so-called shaking or tying is of particular interest. For example, in the Eastern Alps a special type of trough is documented, whose use certainly required special skills and training[60]. The spreading and transfer of these techniques are most easily explained through the mobility of skilled craftsmen.

Interactions between the mining regions of the Alps and the Carpathians have been considered before, as was the mobility of people as medium for the transfer of techniques[61]. The direction of influence, however, is to be discussed. Hitherto, it was mostly assumed that the relevant impulses came from the Eastern Mediterranean, finding their way through the Carpathian Basin to the Eastern Alps. Arguments for this reconstruction were based upon analogies between both the tools (such as the picks) and the engraved markings, as well as dating attempts, which at that time suggested a chronological succession along the delineated route.

With new dating, especially from the Alps, the situation has changed. The Alpine picks actually predate their analogies in Transylvania by at least one century. The same is true for the engraved markings which already appear between the 15th and the 13th century BC on socketed bronze picks from the Mitterberg copper mines[62]. Further examples appear on wooden objects. In addition to two possible pieces from the Mitterberg Area, dating back to the 14th century BC, they are known in greater number on artefacts found on the ore dressing site of the Kelchalm in Northern Tyrol, dating to the mid-13th century BC[63].

Besides the chronological aspect, both the distribution pattern and the quantity of markings in the regions concerned are also relevant for the reconstruction of their dispersal. In the Eastern Alps they appear on at least forty bronze tools like winged axes, winged and socketed mining picks, chisels, anvils, and plane-convex casting cakes[64]. The mentioned wooden objects are likewise relevant in this respect. In Transylvania, on the other hand, the markings are found only on the mining picks and on one plane-convex casting

[60] Pošepný 1880, p. 279-280; Klose 1918, p. 26-27. In detail: Thomas 2012, p. 369-374.
[61] Mayer 1976; 1977, p. 230-233; Barth 1993/94, p. 31; 1998, p. 124, 126.
[62] Unpublished results of the author´s research. Concerning the dating see: Thomas 2012, p. 237-244.
[63] In summary: Thomas 2012, p. 190-192.
[64] Mayer 1976, p. 371, fig. 2. In addition: Mayer 1977, p. 230-233; Höglinger 1996, p. 40-43, 129, pl. 19, no. 347-348; Windholz-Konrad 2012, p. 120-122, fig. 4-5. Also unpublished observations. A second concentration of objects with engraved markings is to be found in Upper and Middle Italy. Due to their dating they are not considered here: Mayer 1976, p. 367.

cake[65]. And whilst their practice in the Alps seems to extend to various fields of activity, as indicated by their appearance on various objects, in Transylvania they are restricted to artefacts related to ore mining and metal production. Thus it is likely that the practice of engraved markings was in common use in the Eastern Alps and was introduced to Transylvania as part of the transfer of skills and knowledge concerning mining and primary production of metals.

Conclusion.

The mining of metal ores and the primary production of metal in prehistoric Transylvania appears to be beyond doubt, although the final proof is still lacking. However, it is already clear that the development and meaning of mining activities at the start of the Late Bronze Age are to be interpreted in a wider context. The influences and relations between the Alpine and Transylvanian mining regions are apparent, but demand further investigation, especially in Transylvania, as started by Ciugudean. The geographical gap between the two regions furthermore seems to close with findings of Alpine mining tools in Northern and Southern Hungary[66]. This would indicate that interactions as outlined above took place not only in a bilateral but in a multilateral system, encircling and fusing with the Carpathian Basin, one of the richest regions of European prehistory.

Zusammenfassung

Der Metallreichtum in den Hinterlassenschaften vieler prähistorischer Kulturen des Karpatenraumes sucht in der Vorgeschichte Europas seinesgleichen. Aufgrund der reichen Erzvorkommen in den Karpaten und insbesondere in Transsylvanien wird in der Forschung meist eine eigenständige Primärproduktion als Quelle dieses Reichtums angenommen, ohne aber, dass sich eine solche direkt nachweisen ließe. Nur vereinzelte Funde lassen sich als indirekte Hinweise anführen, verdeutlichen aber, dass vor allem mit dem Beginn der Spätbronzezeit mit einem intensiven Bergbau auf Gold und Kupfererz zu rechnen ist. Parallelen zu den bronzezeitlichen Bergbaurevieren der Ostalpen lassen darüber hinaus intensive Verbindungen zwischen den verschiedenen Montanräumen erkennen und unterstreichen somit die Bedeutung, die eine Erforschung des prähistorischen Bergbaus in den Karpaten hat.

[65] Vulpe 1975, p. 79-80, pl. 45, no. 457-459; Ciugudean *et alii* 2006, p. 98-99, p. 110, fig. 9.
[66] Unpublished results of the author´s research.

Bibliography

Andriţoiu 2007 - I. Andriţoiu, "Vor- und früh-geschichtlicher und antiker Bergbau im Gebiet von Nagyág/Săcărâmb (Kreis Hunedoara)", R. Slotta, V. Wollmann, I. Dordea (Hrsg.), *Săcărâmb (Nagyág) - die Schatzkammer Rumäniens (1). Silber und Salz in Siebenbürgen* 8, Bochum, 2007, p. 51-66.

Bachmann *et alii* 2002/2003 - H.-G. Bachmann, A. Jockenhövel, U. Spichal, G. Wolf, "Zur bronzezeitlichen Metallversorgung im mittleren Westdeutschland: Von der Lagerstätte zum Endprodukt", *Bericht der Kommission für Archäologische Landesforschung in Hessen*, 7, 2002/2003, p. 67-120.

Baron *et alii* 2011 - S. Baron, C. G. Tămaş, B. Cauuet, M. Munoz, "Lead isotope analyses of gold-silver ores from Roşia Montană (Romania): a first step of a metal provenance study of Roman mining activity in Alburnus Maior (Roman Dacia)", *Journal of Archaeological Science*, 38, 2011, p. 1090-1100.

Barth 1970 - F. E. Barth, *Krieger und Salzherren. Hallstattkultur im Ostalpenraum*, Mainz, 1970.

Barth 1993/1994 - F. E. Barth, "Ein Füllort des 12. Jahrhunderts v. Chr. im Hallstätter Salzberg", *Mitteilungen der Anthropologischen Gesellschaft in Wien*, 123/124, 1993/1994, p. 27-38.

Barth 1998 - F. E. Barth, "Bronzezeitliche Salzgewinnung in Hallstatt", B. Hänsel (Hrsg.), *Mensch und Umwelt in der Bronzzeit Europas. Man and Environment in European Bronze Age*, Kiel, 1998, p. 123-128.

Boroffka 2009 - N. Boroffka, "Mineralische Rohstoffvorkommen und der Forschungsstand des urgeschichtlichen Bergbaues in Rumänien", M. Bartelheim, H. Stäuble (Hrsg.), *Die wirtschaftlichen Grundlagen der Bronzezeit Europas. The economic foundations of the European Bronze Age*, Rahden, 2009, p. 119-146.

Cauuet 2005 - B. Cauuet, "Mines d´or et d´argent antiques de Dacie. Le district d´Alburnus Maior (Roşia Montană, Roumanie)", *Les nouvelles de l´archéologie*, 100/2, 2005, p. 38-43.

Cauuet 2011 - B. Cauuet, "L´espace minier romain. Le cas des mines d´or et d´argent d´Alburnus Maior en Dacia Romaine (Roşia Montană, Roumanie)", J. M. Mata-Perelló, L. T. Abat, N. Fuentes Prieto (Hrsg.), *Actas del quinto Congreso Internacional sobre Minería y Metalurgia Históricas en el Suroeste Europeo (León 2008)*, Leon, 2011, p. 342-379.

Cauuet *et alii* 2003 - B. Cauuet, B. Ancel, C. Rico, C. Tamaş, ”Ancient Mining Networks. The French Archaeological Missions 1999-2001”, P. Damian (Hrsg.), *Alburnus Maior*, 1, Bucureşti, 2003, p. 467-526.

Cavruc, Harding 2012 - V. Cavruc, A. Harding, ”Prehistoric production and exchange of salt in the Carpathian-Danube Region”, V. Nikolov, K. Bacvarov (Hrsg.), *Salz und Gold: die Rolle des Salzes im prähistorischen Europa. Salt and Gold: The Role of Salt in Prehistoric Europe*, Provadia/Veliko Tarnovo, 2012, p. 173-200.

Černych 1978 - E. N. Černych, „Aibunar - a Balkan copper mine of the fourth millenium BC (Investigations of the years 1971, 1972 and 1974)”, *Proceedings of the Prehistoric Society*, 44, 1978, p. 203-217.

Ciugudean 1998 - H. Ciugudean, ”Noi descoperiri cu caracter "stepic" în eneoliticul Transilvănean”, *Apulum*, 35, 1998, p. 31-36.

Ciugudean 2002 - H. Ciugudean, ”The Copper Metallurgy in the Coţofeni Culture (Transylvania and Banat)”, *Apulum*, 39, 2002, p. 95-106.

Ciugudean 2011 - H. Ciugudean, ”Mounds and Mountains: Burial Rituals in Early Bronze age Transylvania”, S. Berecki, R. E. Németh, B. Rezi (Hrsg.), *Bronze Age Rites and Rituals in the Carpathian Basin. Proceedings of the International Colloquium from Târgu Mureş, 8-10 October 2010*, Târgu Mureş, 2011, p. 21-57.

Ciugudean 2012 - H. Ciugudean, ”Ancient gold mining in Transilvania: The Roşia Montană - Bucium area”, *Caiete Ara. Arhitectura – Restaurare – Arheologie*, 3, 2012, p. 219-212.

Ciugudean *et alii* 2006 - H. Ciugudean, M. Ciută, M. Kádár, ”Consideraţii privind câteva din depozitul de bronzuri de la Pănade (com. Sâncel, Jud. Alba)”, *Apulum*, 43/1, 2006, p. 95-110.

Constantinescu *et alii* 2009 - B. Constantinescu, A. Vasilescu, M. Radtke, U. Reinholz, ”Micro-SR-XRF studies for archaeological gold identification - the case of Carpathian gold and of Romanian museal objects”, *Proceedings of the 7th Conference on Nuclear and Particle Physics, 11-15 Nov. 2009, Sharm El-Sheikh, Egypt*, 2009, p. 627-634.

Constantinescu *et alii* 2010 - B. Constantinescu, E. Oberländer-Târnoveanu, R. Bugoi, V. Cojocaru, M. Radtke, ”The Sarmizegetuse bracelets”, *Antiquity*, 84, 2010, p. 1028-1042.

Craddock 1995 - P. T. Craddock, *Early metal mining and production*, Edinburgh, 1995.

Drescher 1958 - H. Drescher, *Der Überfangguss. Ein Beitrag zur vorgeschichtlichen Metalltechnik*, Mainz, 1958.

Harding, Kavruk 2010 - A. Harding, V. Kavruk, "A prehistoric salt production site at Băile Figa, Romania", *Eurasia Antiqua*, 16, 2010, p. 131-167.

Hegyi 2012 - A. Hegyi, "Un fragment de ciocan pentru minerit descoperit la Zădăreni, judeţul Arad", *Acta Musei Caransebesiensis*, 3, 2012, in print.

Hoernes 1925 - M. Hoernes, *Urgeschichte der bildenden Kunst in Europa. Von den Anfängen bis um 500 vor Christus*, Wien, 1925.

Höglinger 1996 - P. Höglinger, "Der spätbronzezeitliche Depotfund von Sipbachzell/OÖ", *Linzer Archäologische Forschungen*, *Sonderheft*, 16, Linz, 1996.

Kašuba, Kaiser 2009 - M. Kašuba, E. Kaiser, "Ein Rillenhammer mit geritzten Darstellungen aus Şoldăneşti, nordwestliches Schwarzmeergebiet", *Analele Banatului, SN., Arheologie – Istorie*, 17, 2009, p. 175-198.

Klose 1918 - O. Klose, "Die prähistorischen Funde vom Mitterberge bei Bischofshofen im städtischen Museum Carolino-Augusteum zu Salzburg und zwei prähistorische Schmelzöfen auf dem Mitterberge", Kunsthistorisches Institut der k. k. Zentral-Kommission für Denkmalpflege (Hrsg.), *Urgeschichte des Kronlandes Salzburg. Österreichische Kunsttopographie*, 17, Wien, 1918, Beitrag II.

Köleséri de Keres-Eér 1780 - S. Köleséri de Keres-Eér, *Auraria Romano-Dacica una cum Valachiae Cis-Alutanae subterraneae descriptione*, Bratislava/Košice, 1780.

Lazarovici *et alii* 2012 - G. Lazarovici, C.-M. Lazarovici, B. Constantinescu, "Despre analizele pieselor de aur din atelierul de bijuterii de la Cheile Turzii - Peştera Caprelor / Peştera Ungurească", *Apulum*, 49, 2012, p. 1-12.

Makkay 1996 - J. Makkay, "Copper and gold in the Copper Age of the Carpathian Basin", T. Kovács (Hrsg.), *Studien zur Metallindustrie im Karpatenbecken und den benachbarten Regionen. Festschrift für Amália Mozsolics zum 85. Geburtstag*, Budapest, 1996, p. 37-53.

Mareş 2002 - I. Mareş, *Metalurgia aramei în neo-eneoliticul României. The metallurgy of copper in the Romanian Neo-Eneolithic*, Suceava, 2002.

Mayer 1976 - E. F. Mayer, "Zur Herkunft der Marken auf urnenfelder- und hallstattzeitlichen Bronzegeräten des Ostalpenraumes", *Germania*, 54, 1976, p. 365-381.

Mayer 1977 - E. F. Mayer, *Die Äxte und Beile in Österreich. Prähistorische Bronzefunde* IX, 9, München, 1977.

Mozsolics 1981 - A. Mozsolics, ”Gußkuchen aus wieder eingeschmolzenem Altmetall”, *Beiträge zur Ur- und Frühgeschichte (1). AFD Beiheft* 16, Berlin, 1981, p. 403-417.

Mozsolics 1984 - A. Mozsolics, ”Ein Beitrag zum Metallhandwerk der ungarischen Bronzezeit”, *Bericht der Römisch-Germanischen Kommission*, 65, 1984, p. 19-72.

Papp 1906 - K. von Papp, ”Die Goldgruben von Karács-Czebe in Ungarn”, *Zeitschrift für praktische Geologie*, 14, 1906, p. 305-318.

Pichler *et alii* 2009 - T. Pichler, G. Goldenberg, M. Klaunzer, K. Nicolussi, ”Die Hölzer des bronzezeitlichen Bergbaus auf der Kelchalm bei Kitzbühel”, *Archäologisches Korrespondenzblatt*, 39, 2009, p. 59-75.

Pop *et alii* 2011 - D. Pop, C. Ionescu, F. Forray, C. G. Tămaş, M. Benea, ”"Transylvanian gold" of hydrothermal origin: en EMPA study in an archaeological provenancing perspective”, *European Journal of Mineralogy*, 23, 2011, p. 911-923.

Popa, Totoianu 2010 - C. I. Popa, R. Totoianu, ”Problematica turtelor de cupru şi bronz din Bazinul Carpatic şi câteva precizări necesare cu privire la depozitul de bronzuri de la Pănade”, C. I. Popa, R. Totoianu (Hrsg.), *Aspecte ale Epocii Bronzului în Transilvania (între vechile şi noile cercetări). Bibliotheca Musei Sabesiensis*, 1, Sebeş 2010, p. 321-347.

Popescu 1951 - D. Popescu, ”Exploatarea şi prelucrarea metalelor în Transilvania până la cotropirea romană”, *Studii şi Cercetări de Istorie Veche*, 2/2, 1951, p. 27-44.

Popescu 1956 - D. Popescu, ”Prelucrarea aurului în Transilvania înainte de cucerirea Romană, *Materiale şi Cercetări Arheologice*, 2, 1956, p. 197-250.

Pošepný 1868 - F. Pošepný, ”Eine Bergmaschine aus dem zweiten Jahrhundert und einige gleichzeitig gefundene Gegenstände”, *Österreichische Zeitschrift für Berg- und Hüttenwesen*, 16/20-21, 1868, p. 153-154, p. 164-168.

Pošepný 1880 - F. Pošepný, Die Erzlagerstätten von Kitzbühel in Tirol und der angrenzenden Teile Salzburgs. *Archiv für praktische Geologie* 1, 1880, p. 257-439.

Preisig 1877 - E. Preisig, ”Geschichte des Máramaroser Bergbaues”, *Österreichische Zeitschrift für Berg- und Hüttenwesen*, 25/28-30, 1877, p. 301-303, p. 311-312, p. 321-323.

Preuschen, Pittioni 1937 - E. Preuschen, R. Pittioni, ”Untersuchungen im Bergbaugebiet Kelchalm bei Kitzbühel, Tirol. Erster Bericht über die Arbeiten 1931-1936 zur Urgeschichte des Kupferwesens in Tirol”, *Mitteilungen der Prähistorischen Kommission der Akademie der Wissenschaften*, 3, 1937, p. 3-159.

Preuschen, Pittioni 1954 - E. Preuschen, R. Pittioni, ”Untersuchungen im Bergbaugebiet Kelchalm bei Kitzbühel, Tirol. Dritter Bericht über die Arbeiten 1946-1953 zur Urgeschichte des Kupferwesens in Tirol”, *Archaeologia Austriaca*, 15, 1954, p. 5-97.

Roska 1942 - M. Roska, *Erdély Régészeti Repertoriuma. I. Öskor*, Kolozsvár, 1942.

Rotea 2002/2003 - M. Rotea, ”Non-ferrous metallurgy in Transylvania of Bronze Age”, *Acta Musei Napocensis*, 39-40/1, 2002/2003, p. 7-17.

Rusu 1963 - M. Rusu, ”Die Verbreitung der Bronzehorte in Transsilvanien vom Ende der Bronzezeit in die mittlere Hallstattzeit”, *Dacia N. F.*, 7, 1963, p. 177-210.

Rusu 1981 - M. Rusu, ”Bemerkungen zu den grossen Werkstätten- und Giessereifunden aus Siebenbürgen”, H. Lorenz (Hrsg.), *Studien zur Bronzezeit. Festschrift für Wilhelm Albert v. Brunn*, Mainz 1981, p. 375-402.

Schuster 1998 - C. Schuster, ”Despre un anumit tip de ciocan şi ciocan-topor neperforat din piatră de pe teritoriul României”, *Thraco-Dacica*, 19, 1998, p. 113-144.

Schuster *et alii* 2012 - C. Schuster, I. Tuţulescu, I. Dumitrescu, ”Zum Salz im Nordosten Olteniens (Rumänien) in der Vorgeschichte bis ins Mittelalter: Eine Einführung”, V. Nikolov, K. Bacvarov (Hrsg.), *Salz und Gold: die Rolle des Salzes im prähistorischen Europa. Salt and Gold: The Role of Salt in Prehistoric Europe*, Provadia/Veliko Tarnovo, 2012, p. 201-212.

Šebesta 1992 - G. Šebesta, *La via del rame. Supplemento a Economia Trentina* 3, Trento, 1992.

Stadler 1999 - P. Stadler, ”Aktueller Stand der Absolutdatierung der verschiedenen Gruppen des urgeschichtlichen Bergbaus und eines Blockbaus in Hallstatt aufgrund von ^{14}C-Daten”, *Annalen des Naturhistorischen Museums Wien*, 101A, 1999, p. 69-80.

Stöllner *et alii* 2010 - T. Stöllner, E. Breitenlechner, D. Fritzsch, A. Gontscharov, K. Hanke, D. Kirchner, K. Kovács, M. Moser, K. Nicolussi, K. Oeggl, T. Pichler, R. Pils, M. Prange, H. Thiemeyer, P. Thomas, ”Ein Nassaufbereitungskasten vom Troiboden. Interdisziplinäre Erforschung des bronzezeitlichen Montanwesens am Mitterberg (Land Salzburg, Österreich)”, *Jahrbuch des Römisch-Germanischen Zentralmuseums Mainz*, 57/1, 2010, p. 1-32.

Szathmáry 1867 - K. Szathmáry, ”Máramarosi régiségek”, *Vasárnapi Ujság*, 11/8, 1867, p. 91.

Téglás 1883 - G. Téglás, ”A rómaiak aranybányászata Boiczán és Rudnán Hunyad megyében”, *Archaeologiai Értesitö*, 3, 1883, p. 142-147.

Téglás 1885 - G. Téglás, ”Bányászszobrok a daciai aranyvidékröl”, *Archaeologiai Értesitö*, 5, 1885, p. 16-20.

Téglás 1887 - G. Téglás, ”Bergbau-Denkmäler im einstigen Dacien”, *Österreichische Zeitschrift für Berg- und Hüttenwesen*, 35/2, 23, 1887, p. 251-258, p. 282-283.

Téglás 1888 - G. Téglás, ”Prähistorische Gold- und Steingrubenbau-Werkzeuge aus Dacien”, *Österreichische Zeitschrift für Berg- und Hüttenwesen*, 36/35, 1888, p. 463-466.

Téglás 1889 - G. Téglás, ”Beiträge zum Goldbergbau des vorrömischen Dacien”, *Ungarische Revue*, 1889, p. 260-266, p. 323-334.

Téglás 1894 - G. Téglás, ”A rómaiak bányászati technicája az Erdélyi Érczhegység leletei szerint”, *Erdélyi Muzeum Értesítője*, 1894, p. 323-331.

Teržan 1989 - B. Teržan, ”Pohorje - Prazgodovinski rudarski revir?”, *Časopis za zgodovino in narodopisje*, 2, 1989, p. 238-260.

Thomas 2012 - P. Thomas, *Studien zu den bronzezeitlichen Bergbauhölzern im Mitterberger Gebiet. Inauguraldissertation zur Erlangung des Grades eines Doktors der Philosophie in der Fakultät für Geschichtswissenschaften der Ruhr Universität Bochum*, Bochum, 2012.

Vulpe 1970 - A. Vulpe, *Die Äxte und Beile in Rumänien I. Prähistorische Bronzefunde* IX, 2, München, 1970.

Vulpe 1975 - A. Vulpe, *Die Äxte und Beile in Rumänien II. Prähistorische Bronzefunde* IX, 5, München, 1975.

Windholz-Konrad 2003 - M. Windholz-Konrad, *Funde entlang der Traun zwischen Ödensee und Hallstätter See. Vorlage der prähistorischen bis neuzeitlichen von Karl Gaisberger und Mitarbeitern vorgenommenen Metallfunde aus den Prospektionen im Salzkammergut, mit besonderer Berücksichtigung der Altfunde. Fundberichte Österreich Materialhefte* 13, Wien, 2003.

Windholz-Konrad 2012 - M. Windholz-Konrad, ”Das Deponierungsareal bei der Rabenwand im steirischen Kainischtal in Österreich. Zum ausgeprägten Hortphänomen entlang der Traun im Alpendurchgang zwischen Zinkenkogel und hohem Sarstein”, S. Hansen, D. Neumann, T. Vachta (Hrsg.), *Hort und Raum. Aktuelle Forschungen zu bronzezeitlichen Deponierungen in Mitteleuropa*, Berlin/Boston, 2012, p. 117-149.

Wollmann 1996 - V. Wollmann, *Mineritul metalifer, extragerea sării şi carierele de piatră în Dacia romană. Der Erzbergau, die*

Salzgewinnung und die Steinbrüche im römischen Dakien, Cluj-Napoca, 1996.

Wollmann 1999 - V. Wollmann, "Bergbau im römischen Dacien", R. Slotta, V. Wollmann, I. Dordea (Hrsg.), *Einleitende Aufsätze, Gutachten, Reiseberichte und Katalog der Exponate. Silber und Salz in Siebenbürgen* 1, Bochum, 1999, p. 24-34.

Wollmann 2002 - V. Wollmann, "Zur Geschichte des Goldbergbaus in Roşia Montană in der frühen Neuzeit", R. Slotta, V. Wollmann, I. Dordea (Hrsg.), *Einleitende Aufsätze, Reiseberichte sowie geologische und mineralogische Literatur. Silber und Salz in Siebenbürgen* 4, Bochum, 2002, p. 125-162.

Wollmann 2010 - V. Wollmann, "Der Bergbau von Brad und Umgebung (in Crişcior/Kreischquell, Ruda, Valea Arsului, Zdraholţ und Musariu) von seinen Anfängen bis zur Gründung der "Mica"-Gesellschaft im Jahre 1920", R. Slotta, V. Wollmann, I. Dordea (Hrsg.), *Gold aus dem "Goldenen Viereck". Der Bergbau in Brád, Offenburg (Baia de Arieş/Offenbánya), Băiţa (Boicza/Pernseifen) und Baia de Criş (Altenburg/Körösbánya) (1). Silber und Salz in Siebenbürgen* 10, Bochum, 2010, p. 35-80.

Wollmann 2010/2011 - V. Wollmann, *Patrimoniu preindustrial şi industrial în România*, Sibiu/Hermannstadt, 2010/2011.

Wollmann, Ciugudean 2005 - V. Wollmann, H. Ciugudean, "Noi cercetări privind mineritul antic în Transilvania (I)", *Apulum*, 42, 2005, p. 95-116.

Zimmermann 1993 - U. Zimmermann, "Urgeschichtlicher Metallerzbergbau in Mitteleuropa", H. Steuer, U. Zimmermann (Hrsg.), *Alter Bergbau in Deutschland*, Stuttgart 1993, p. 48-54.

LISTA AUTORILOR

Dan Anghel - Muzeul Naţional al Unirii, Alba Iulia, dnanghel@yahoo.com

Sote Angeleski - Cluj-Napoca, s_angeleski@yahoo.com

Tiberius Bader - Hemmingen, tib.bader@web.de

Dan Băcueţ-Crişan - Muzeul Judeţean de Istorie şi Artă, Zalău, bacuet@yahoo.com

Radu Băjenaru - Institutul de Arheologie "Vasile Pârvan", Bucureşti, radu.bajenaru@gmail.com

Gabriel Bălan - Muzeul Naţional al Unirii, Alba Iulia, liviugabrielbalan@yahoo.com

Corneliu Beldiman - «Dimitrie Cantemir» Christian University, Faculty of History, Bucharest; Romanian Scientific Society for Interdisciplinary Research, Bucharest; belcor@gmail.com

George Bounegru - Muzeul Naţional al Unirii, Alba Iulia, bounegru_g_viziru@yahoo.com

Björn Briewig - German Archaeological Institute, Berlin, bjoerndebrie@yahoo.de

Vasile Budui - "Ştefan cel Mare" University, Suceava, Faculty of History and Geography, Department of Geography, vbudui@yahoo.com

Raluca Burlacu-Timofte - Universitatea "Babeş-Bolyai", Cluj-Napoca, raluburlacu@gmail.com

Dan-Lucian Buzea - National Museum of the Eastern Carpathians, Sfântu Gheorghe, buzealuci@yahoo.com

Sergiu Cadar - Institutul de Cercetări pentru Instrumentaţie Analitică Cluj-Napoca, sergiu.cadar@icia.com

Mircea Chintoanu - Institutul de Cercetări pentru Instrumentaţie Analitică Cluj-Napoca, chintoanu_m@yahoo.com

Radu Ciobanu - Muzeul Naţional al Unirii, Alba Iulia, pufu_ciobanu@yahoo.com

Beatrice Ciută - Universitatea "1 Decembrie 1918", Alba Iulia, beatriceciuta@yahoo.com

Marius Ciută - Universitatea ”Lucian Blaga”, Sibiu, mariusciuta@yahoo.com

Sorin Colesniuc - Muzeul de Arheologie Callatis, Mangalia, sorinmarcelcolesniuc@yahoo.com

Călin Cosma - Institutul de Arheologie şi Istoria Artei, Cluj-Napoca, cosma.calin@yahoo.com

Aurel Dragotă - Universitatea „Lucian Blaga”, Sibiu, reludragota@yahoo.com

Nicolae Gudea - Universitatea ”Babeş-Bolyai”, Cluj-Napoca

Nicolae Har - Universitatea ”Babeş-Bolyai”, Facultatea de Biologie şi Geologie, Departamentul de Geologie, Cluj-Napoca, nicolae.har@ubbcluj.ro

Tünde Horváth - Budapest, tundehorvath4@gmail.com

Cornelia-Magda Lazarovici - Institutul de Arheologie, Iaşi, magdamantu@yahoo.com

Gheorghe Lazarovici - Universitatea „Lucian Blaga”, Sibiu, ghlazarovici@yahoo.com

Adrian Luca - Muzeul Naţional Brukenthal, Sibiu, luca_adrian_sibiu@yahoo.com

Sabin Adrian Luca - Universitatea „Lucian Blaga”, Sibiu, sabinadrian.luca@ulbsibiu.ro; Muzeul Naţional Brukenthal, Sibiu, sabin.luca@brukenthalmuseum.ro

Florentina Marţiş - Muzeul Banatului, Timişoara, tina.martis@yahoo.com

Sascha Mauel - Aristotle University of Thessaloniki, Thessaloniki, kontakt@mauel.dk

Teodor Munteanu - Universitatea ”Alexandru Ioan Cuza”, Iaşi, teddy_muntean@yahoo.com

Bianka Nessel - ERC Project “BronzeAgeTin” Institute of Earth Sciences Ruprecht-Karls-Universität Heidelberg, Heidelberg, Bianka.Nessel@geow.uni-heidelberg.de

Bogdan Petru Niculică - Bukovina Museum, Suceava, niculicab@yahoo.com

Radu Ota - Muzeul Naţional al Unirii, Alba Iulia, eractum@yahoo.com

Dalia Anna Pokutta - Department of Archaeology, University of Gothenburg, Gothenburg, dalia.anna.pokutta@gu.se

Anca-Diana Popescu - Institutul de Arheologie "Vasile Pârvan", Bucureşti, ancadiana_popescu@yahoo.com

Marcin S. PRZYBYŁA - Institute of Archaeology, Jagiellonian University, Cracow, mszprzybyla@gmail.com

Marius Râza - Universitatea "1 Decembrie 1918", Alba Iulia, raza_marius@yahoo.com

Cristian Schuster - Institutul de Arheologie „*Vasile Pârvan*" – Centrul de Tracologie, Bucureşti, cristianschuster@yahoo.com

Csaba Szabó - University of Pécs, Pécs, szabo.csaba.pte@gmail.com

Zsolt Székely - UBB, Extensia Sf. Gheorghe, Sf. Gheorghe, szekely.zsolt@fspac.ro

Diana-Maria Sztancs - «Dimitrie Cantemir» Christian University, Faculty of History, Bucharest; Romanian Scientific Society for Interdisciplinary Research, Bucharest; beldiana22@yahoo.com

Claudiu Tănăselia - Institutul de Cercetări pentru Instrumentaţie Analitică Cluj-Napoca, claudiu@tanaselia.ro

Biba Teržan - Univerza v Ljubljani Filozofska fakulteta Oddelek za arheologijo, Ljubljana, ljubinka.terzan@ff.uni-lj.si

Peter Thomas - Deutsches Bergbau-Museum Bochum Forschungsbereich Montanarchäologie, Peter.Thomas@Bergbaumuseum.de

Anca Timofan - Muzeul Naţional al Unirii, Alba Iulia, anca.timofan@yahoo.com

Anamaria Tudorie - Muzeul Naţional Brukenthal, Sibiu, anamaria.tudorie@brukenthalmuseum.ro

Claes Uhnér - Department of historical studies, University of Gothenburg, Gothenburg, claes_uhner@hotmail.com

Monica Ursu - Institutul de Cercetări pentru Instrumentaţie Analitică, Cluj-Napoca, monaursu5@yahoo.com