ÖAW AUSTRIAN ACADEMY OF SCIENCES

23RD – 24TH MAY 2019
OREA
AUSTRIAN ACADEMY OF SCIENCES
HOLLANDSTRASSE 11–13
1ST FLOOR
1020 VIENNA

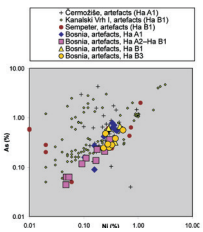
INTERNATIONAL WORKSHOP

UK-Gespräche
"Bronze Age Metallurgy production – consumption – exchange"
and
20th Anniversary Archaeometallurgical Laboratory VIAS, University Vienna

23rd – 24th May 2019

OREA - Austrian Academy of Sciences
Vienna Institute for Archaeological Science, University Vienna



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ÖAW AUSTRIAN ACADEMY OF SCIENCES OREA VIAS universität wien

PROGRAM

THURSDAY, 23RD MAY

1. Panel – Mining and smelting

9:00 *Welcome:* **B. Horejs** *(Director, OREA, ÖAW)*
Introduction: **M. Gavranović, M. Mehofer**

9:30 **G. Goldenberg**
The process of extractive copper metallurgy in the Bronze Age - theory and practise

10:00 **M. Staudt**
Late Bronze Age copper smelting in the fahlore mining district Schwaz-Brixlegg

10:30 **P. Trebsche, A. Flores-Orozco, I. Schlögel, G. Weixelberger**
Geophysical prospection and radiocarbon dating of the Bronze Age copper mine at Prigglitz in Lower Austria

11:00 – 11:30 COFFEE BREAK

11:30 **T. Koch Waldner**
Discovery of a mining area in the Ortler region, South Tyrol - Prehistoric settlements and traces of mining at the traffic junction of the Central Alps

12:00 **L. Reitmaier-Neaf**
From Ore to Metal: Late Bronze and Early Iron Age Copper production in the Oberhalbstein, Valley (CH)

12:30 **M. Mehofer, A. Kapuran, M. Gavranović, I. Jovanović**
New insights into Bronze Age metal production in Eastern Serbia - the copper smelting sites of Trnjane und Ružana

13:00 – 14:30 LUNCH BREAK

2. Panel – Exchange of raw metals and distribution networks

14:30 **E. Pernicka**
The problem of mixing and recycling in the study of Bronze Age metallurgy

15:00 **B. Nessel**
How do you recognize the quality of an ingot? Some thoughts about raw metal distribution in Bronze Age Europe

15:30 **C. Grutsch, J. Lutz, G. Goldenberg**
The use of different copper types in the Middle and Late Bronze Age in Western Austria

16:00 – 16:30 COFFEE BREAK

17:15 **Keynote lecture**

17:15 - 17:30 *Welcome:* **S. Schütze** *(Dean, Faculty of Historical and Cultural Studies, University of Vienna)*

17:30 **Th. Stöllner**
Der Mitterberg und die alpinen Kupfererzreviere. Technische Innovationen und Verwobenheit in alpinen Wirtschaftsräumen der Bronzezeit.

19:30 *Conference Dinner at Stiegl Ambulanz – Gasthaus im Alten AKH*
Alser Straße 4
1090 Wien
Am Campus des Alten AKH

FRIDAY, 24TH MAY

2. Panel – Exchange of raw metals and distribution networks

9:30 **C. Bruyère, S. Daly, D. Jovanović, B. Molloy**
Metal Mobility and Social Interaction in the Later Bronze Age of Northern Balkans

10:00 **M. Gavranović, M. Mehofer**
Metal consumption and exchange networks during the Bronze Age in the Western Balkans

10:30 **A. Bankhoff, W. Powell, A. Bulatović, V. Filipović**
Sn isotopic evidence for Late Bronze Age exploitation of multiple tin sources across the Central Balkan

11:00 – 11:30 COFFEE BREAK

3. Panel – Metallurgical activities and finished products

11:30 **S. Karavanić, A. Kudelić**
The evidence of bronze-casting at the Kalnik-Igrišče Site (NW Croatia)

12:00 **E. Borgna**
Of hoards, individuals and communities in Late Bronze Age Italy

12:30 **R. Jung**
Zur Metallurgie in den Regionen des südlichen Tyrrhenischen Meeres

13:00 – 14:00 LUNCH BREAK

14:00 **G. Tarbay, Z. Kis, B. Maróti**
Archaeometallurgical characterization of Late Bronze Age metal artefacts from Hungary by the "Neutron Methods"

14:30 **M. Črešnar, R. Urankar**
Late Bronze Age metallurgy in Slovenia. Current state of research

15:00 – 15:30 COFFEE BREAK

15:30 **K. Nowak, B. Miazga, Z. Stos-Gale**
Die aktuellen Forschungsergebnisse zur bronzezeitlichen Metallurgie in Südwest-Polen

16:00 **J. Sobieraj, Z. Stos-Gale and R. Anczkiewicz**
Remote from mining and smelting: second millennium BC bronze finds from north-east Poland.

16:30 – 17:00 *Final Discussion*

ABSTRACTS

The process of extractive copper metallurgy in the Bronze Age - theory and practice

G. Goldenberg (RC HiMAT, Institute of Archaeologies, University of Innsbruck)

At least in theory extractive copper metallurgy seems to be well understood by metallurgists when reading the manifold metallurgical information reported and published in the 19th and 20th centuries. This is especially the case for the processing of "simple" copper ore minerals like chalcopyrite. The reconstruction of prehistoric extractive copper metallurgy generally refers to such sources of information when established models of chemical reactions and physical smelting conditions (temperature, gas atmosphere, fuel, fluxes …) are presented and discussed. In experimental archaeometallurgy modern tools like electric blowers as well as sophisticated measuring instruments to determine all kind of smelting parameters are often used. The raw material, the intermediate and final products of the smelting process are analysed in detail using mineralogical and/or geochemical methods. Some experiments are even conducted under controlled laboratory conditions. In spite of all this knowledge, the experience and the archaeological evidence, the result of field experiments is in practice often somewhat disappointing, when it comes to the evaluation of the product where a satisfying mass of good quality copper is expected. Even when including ethnographic knowledge from the observation of successfully operated traditional copper smelting in remote world regions, the experimental results are still not convincing. The inability of experimental archaeometallurgists to adequately reproduce the process is on the one hand due to the very heterogeneous system of each field experiment, depending on a multiplicity of parameters difficult to control and to measure in detail. On the other hand, the lack of "tacit knowledge" appears to be a substantial factor of failure. This paper moves between theory and practice referring to some of the author's experiences with chalcopyrite smelting.

Late Bronze Age copper smelting in the fahlore mining district Schwaz-Brixlegg

M. Staudt (RC HiMAT, Institute of Archaeologies, University of Innsbruck)

Since the 1990s several international research projects on prehistoric copper production in the Eastern and Central Alps, located at the University of Innsbruck (Research Centre HiMAT), have investigated and documented several prehistoric mines, pit fields and ore beneficiation sites, as well as two smelting sites in the fahlore district of Schwaz-Brixlegg.

Dendrochronological investigations as well as radiocarbon analyses from the mining district prove continuous mining activities from the 12th to the 8th century BC. The documented structures and recovered artefacts provide detailed information on the complex production chain in prehistoric copper extraction as well as on the way of life of the miners and smelters. Two Late Bronze Age smelting sites, one in the Maukental (Gem. Radfeld) and one near Rotholz (Gem. Buch i. T.) have been investigated extensively. During the excavations, multi-phase roasting beds and various installations, which had been constructed for wet-mechanical processing of slag(sand), came to light in addition to the so-called furnace batteries. These structures showed up in shape of multi-phase wash troughs and shallow pits, deepened in the ground. Most of the slag on the two smelting sites is now only present in the form of sand and indicates a systematic recycling of the slag which was produced in the smelting furnaces.

In addition, numerous stone tools (hammerstones, anvil- and grinding stones) as well as tuyères came to light. Also some food remains in the form of animal bones and some ceramic fragments (coarse and fine ceramics) have been preserved. The majority of the pottery found is tempered with slag and thus speaks for local production. Radiocarbon analyses of charcoal and animal bones as well as a dendrochronological investigation date the sites to the 12th/11th century BC. The two smelting sites, with their numerous, partly well-preserved structures, provide new insights into smeltingtechnologies in the Late Bronze Age.

The different phases of the roasting beds, the furnace batteries, the findings on the processing of the slag sand and the extensive find material speak for a production site with an "early industrial character" which was operated by experts. The features and findings from the Schwaz-Brixlegg mining district show a relatively uniform picture of East Alpine copper technology and indicate a transfer of knowledge from East to West.

Above all, the systematic use of slag sand as temper material in ceramics (tuyères, household and burial ceramics), but also tools such as miner´s tools (socketed picks) and big grinding stones with horizontal shafting for processing, prove close contacts with the major Bronze Age copper producers in the Kitzbühel and Salzburg mining districts.

Geophysical prospection and radiocarbon dating of the Bronze Age copper mine at Prigglitz in Lower Austria

P. Trebsche (Institute of Archaeologies, University of Innsbruck)

A. Flores-Orozco (Geophysics Research Division, Department of Geodesy and Geoinformation, TU Wien)

I. Schlögel (Central Institute for Meteorology and Geodynamics, Applied Geophysics)

G. Weixelberger (Geologie Weixelberger GmbH)

Locating a prehistoric mine is difficult if there are no visible features in the surface morphology (e.g. sunken shafts) or if there are no historic records. We faced this problem when investigating the Late Bronze Age mining settlement of Prigglitz-Gasteil, which is located at the easternmost fringe of the Alps in Lower Austria. The site was occupied during the late Urnfield Period (ca 1050 to 900 BC). It reached a maximum extent of about 3 hectares, making it the largest known prehistoric mining settlement in Lower Austria. The site has yielded only indirect evidenced of copper ore extraction, in the form of huge piles of mining debris and some miners' tools (antler picks and hammers) recovered during systematic excavations from 2010 to 2014.

Application of several prospection techniques, including terrain walking, aerial photography, LiDAR terrain modeling, geomagnetic surveys, and percussion drillings, has failed to delineate traces of copper mines. Therefore, in a current project funded by the Austrian Science Fund (FWF), a combination of different geophysical, geoarchaeological and geochemical techniques were applied in 2017 and 2018 to investigate the stratigraphy of the mining dumps and locate the underground works and the copper vein.

Geophysical methods employed included Induced Polarization (IP) imaging and ground penetrating radar (GPR). The IP method is an extension of electrical resistivity tomography (ERT), and provides information of the electrical conductivity and capacitive properties of the subsurface. Electrical resistivity imaging enabled us to delineate the extension of the main geological units, as well as the position and geometry of the dump materials. Additionally, imaging of the polarization effect revealed significant anomalies related to subsurface areas with high volumetric content of metallic minerals. The seismic refraction and tomography results allowed us to distinguish the overburden (dump material) from the bedrock and aided in the interpretation of the IP imaging results.

After preliminary analyses of the geophysical results, we conducted two core drillings, which reached the underlying bedrock at 32 m and 37 m depth. The archaeological and geological interpretation of the two cores provided the key to the interpretation of the geophysical measurements. A series of radiocarbon dates from the drilling cores allows for a precise dating of the mines and the mining dumps in the frame of the late Urnfield Period.

Discovery of a mining area in the Ortler region, South Tyrol - Prehistoric settlements and traces of mining at the traffic junction of the Central Alps

T. Koch Waldner (Deutsches Bergbaumuseum Bochum)

From the Middle Bronze Age onwards, two settlements developed at the foot of the Ortler at the Stilfs copper deposit in Vinschgau. It was the beginning of a long settlement history that lasted at least until the end of the late Iron Age. The location of the settlement sites „Kaschlin" and „Weiberbödele" at a chalcopyrite deposit gave reason to believe that the prehistoric settlement traces like the historic village of Stilfs were related to mining. With the discovery of prehistoric copper slags at Prader Berg, there are now clear indications of Bronze Age mining in the Ortler region. The slag heap can be dated to the 13th/12th century BC on the basis

of ceramic finds of the Laugen-Melaun A phase. The montanarchaeological discovery led to the first research project regarding prehistoric copper mining in South Tyrol.

In addition to its importance for metal extraction, the entrance to the Suldental at Prad and Stilfs represents an important point in terms of traffic geography. In this area, the path to the Stilfser Joch (Lombardy) and to the Ofenpass (Switzerland) branches off from the ancient transalpine route over the Reschenpass (Danube-Adriatic Sea). The prehistoric finds in the upper Vinschgau region testify to the far-reaching links via these traffic routes. Mediterranean casting moulds and Eastern European spiral pendants from Ganglegg as well as the Etruscan warrior statuette from the Suldenbach near Prad are particularly worth mentioning.

From Ore to Metal: Late Bronze and Early Iron Age Copper Production in the Oberhalbstein Valley (CH)

L. Reitmaier-Neaf (University of Zurich, Institute of Archaeology, Dep. of Prehistory)

In recent decades the precise mode of operation of Bronze Age copper smelting process in the Alps has been subject to ongoing scientific debate, dominated mainly by natural scientists. A new, transdisciplinary study in the Oberhalbstein Valley aims to shed a new light on these old questions from a new perspective: besides the common mineralogical and geochemical investigations, also a detailed typological and morphological examination of the main information carrier, the smelting slag, has been carried out. A joint interpretation of the results of these natural scientific and archaeological approaches lead to a less one-sided reconstruction of the smelting process. The proposed model shows parallels as well as significant differences compared to the east alpine "Mitterberg-process". According to geochemical analyses, Oberhalbstein copper can also be distinguished relatively clearly from other alpine copper.

Furthermore, intensive field survey resulted in a good knowledge of the mining area and its organisational structure with a total of approximately 100 sites, consisting of a couple of (pre)historic mines, dozens of smelting sites and a few prehistoric settlements connected to copper production by the finds of smelting slags and beneficiation tools. Furthermore, a significant improvement of the previously limited dating of these sites clearly shows the peripheral location of the copper production area under investigation – both from a geographical and a chronological point of view. While most of the (south)eastern and western Alpine mining districts flourished during different periods of the Bronze Age, the Oberhalbstein Valley in the central Alps did not reach its production peak until the Early Iron Age.

New insights into Bronze Age metal production in Eastern Serbia - the copper smelting sites of Trnjane und Ružana

M. Mehofer (Vienna Institute for Archaeological Science, University of Vienna)

A. Kapuran (Institute of Archaeology Belgrade)

M. Gavranović (Institute for Oriental and European Archaeology OREA, Austrian Academy of Sciences)

I. Jovanović (Museum of Mining and Metallurgy Bor)

Within an ongoing interdisciplinary research project, it was for the first time possible to investigate two copper smelting sites near Bor (Eastern Serbia), which can be dated to the Middle Bronze Age. The systematic excavations at the sites Trnjane und Ružana brought to light various remains of copper smelting activities. In Ružana a slag pit and the fragments of a furnace were detected, in Trnjane numerous slags were found within the settlement and the graveyard. Beside LiDAR scans of the region, 14^{C} samples were taken from the excavated charcoals and slags which revealed unexpected and very interesting dates that point to metallurgical activities already on the onset of the MBA. The excavated slags can be dived into several groups. One group is formed by slags with a dark grey colour and an irregular shape (Schlackenkuchen), the second is characterized by hooked edge at the bottom side, meanwhile the third group includes plate slags (Plattenschlacke) with variable thickness. The morphology as well as the cross sections of these slags showed that they can be assigned to a copper smelting processes which comprises several steps. With the help of SEM-EDS analyses, it was also possible to assign the detected Cu/Fe-sulfides (Matte) in the slags to sulfidic copper ores, which were also found in the archaeological record. The planned lead isotope analyses of the smelting remains will not only be set in

relation to already published data from the nearby copper mining district of Bor but also to the available data of adjoined regions.

The problem of mixing and recycling in the study of Bronze Age metallurgy

E. Pernicka (Curt-Engelhorn-Centre for Archaeometry gGmbH, University Heidelberg)

How do you recognize the quality of an ingot? Some thoughts about raw metal distribution in Bronze Age Europe

B. Nessel (Vor- und Frühgeschichtliche Archäologie, Universität Mainz)

Ingots appear in different shapes during certain periods in the Bronze Age. Some types are widely distributed in Europe; others can only have circulated in regional networks. In addition, some of them were distributed intact, while others were portioned in different ways. Especially the portion shapes vary more than usually recognized. This is not only true for their optical appearance, but also for the raw material they are made of. It is striking that changes in the exploitation of ore sources are not necessarily affecting the shape of certain ingot types. Regarding this, it seems reasonable to assume, that certain ingot types might have been preferred in different regions or by particular consumer groups. This paper concerns cognitive patterns of ingot distributions and the reasons behind these patterns based on an approach that combines provenance analysis and archaeological material studies, with the aim to add to the understanding of Bronze Age exchange networks and communication zones.

The use of different copper types in the Middle and Late Bronze Age in Western Austria

Caroline Grutsch (RC HiMAT, Institute of Archaeologies, University of Innsbruck)

Joachim Lutz (Curt-Engelhorn-Centre for Archaeometry gGmbH, University Heidelberg)

Gert Goldenberg (RC HiMAT, Institute of Archaeologies, University of Innsbruck)

First evaluations of analytical data from East Alpine prehistoric metal artefacts have shown that a use of different types of copper can be expected varying in time and space (Sperber 2004, Möslein 2008). These studies mainly emphasise a change from the use of fahlore based copper in the Early Bronze Age to the major use of chalcopyrite based copper in the Middle Bronze Age, with a shift in the Hallstatt A2 period, when both materials were used to produce bronze (Lutz/Pernicka 2013, Pernicka/Lutz 2015, Lutz 2016).

In the following these general observations are specified for copper and bronze axes from Western Austria (Vorarlberg, Tyrol, Salzburg, Upper Austria). The analyses of 175 Early Bronze Age to Early Iron Age axes show a differentiated and sequential use of copper ores and tin in correlation to each other. According to the technical development of metallurgy the earliest phase of the Bronze Age (BA A1) is of course characterized by the use of fahlore copper complemented by arsenical copper. From BA B2 on chalcopyrite copper clearly dominates the metal market for more than 300 years. Fahlore copper has its comeback only in Ha A1 when it is first recognized within diluted fahlore copper, from Ha B2 on also as pure fahlore copper. Anyway the axes do not show a replacement of chalcopyrite copper by fahlore copper. This is particularly notable as a big Late Bronze Age/Early Iron Age fahlore copper production center – Schwaz/Brixlegg – lies in the heart of the examined area. The amount of the available chalcopyrite copper is still remarkable. As the Mitterberg and Kitzbühel districts do not seem to produce anymore at that time, other chalcopyrite dominated mining districts, like in the Trentino, must be taken into consideration as potential copper suppliers.

Regarding alloying practice a notable observation can be made for the Late Bronze Age. From Ha A1 to Ha B3 the average tin content in the axes drops significantly when correlated with fahlore copper. This is also remarkable in comparison to the next period, as in Ha C a comparable amount of fahlore copper is in use but tin contents rise to a level similar to the one in the Middle Bronze Age.

In summary a major shift in the use of different copper types and alloying techniques can be observed at the transition from Bronze Age D to Ha A1. On the one hand fahlore copper comes in use again – remarkably mainly in mixed copper objects, not in pure fahlore copper objects – on the other hand selective alloying in the sense of saving tin when using fahlore copper is observable.

Der Mitterberg und die alpinen Kupfererzreviere. Technische Innovationen und Verwobenheit in alpinen Wirtschaftsräumen der Bronzezeit.

Th. Stöllner

Metal Mobility and Social Interaction in the Later Bronze Age of Northern Balkans

C. Bruyère, S. Daly, B. Molloy (University College Dublin)

D. Jovanović (Town Museum of Vršac, Serbia)

In recent years, lead isotope and trace element analyses have frequently been used to explore metal mobility and community interaction. In this paper we will use the above methods to investigate change in patterns of interaction through time and space in the later Bronze Age of the northern Balkan area. Significant changes in landscape use, metal deposition and funerary practices during this period are visible indicators of important social change. Such changes can disrupt established systems of trade and exchange of goods like metal. We will be focusing on the cultural landscape surrounding the emergence and development of a horizon of mega-forts in the northern Balkans. Pilot data from analyses of metal from cemeteries and hoards will be presented. The dynamic mobility of metal as a resource can offer a supra-regional perspective to this unique regional network of fortified sites.

Metal consumption and exchange networks during the Bronze Age in the Western Balkans

M. Gavranović (Institute for Oriental and European Archaeology OREA, Austrian Academy of Sciences)

M. Mehofer (VIAS - Vienna Institute for Archaeological Science, University of Vienna)

Based on a larger series of trace element analyses of ingots, slags and finished metal objects, this paper will focus on a diachronic overview of metal consumption and exchange among Bronze Age societies in the area of western Balkan, between Carpathian Basin and Adriatic Sea. By combing stringent archaeological criteria in terms of typology, chronology and distribution with results of chemical analyses, it becomes apparent that during the Bronze Age several local and regional metallurgical networks exited in this area. Clearly to distinguish are also several object with a composition that do not relate to any of the clusters form western Balkan, pointing to imported objects of non-local origin. Further interesting is a comparison of analytic data with the archaeological finds pointing to a significant increase of bronze casting activities in the advanced stages of Late Bronze Age (11^{th} – 9^{th} century BCE). The strong development of regional bronze metallurgy during this period appears to be associated with a common technological background. While the results of trace element analysis do not provide a final answer regarding the possible use of local copper ore sources, the obtained data represent a first step toward better understanding of bronze metallurgy in the Western Balkans.

Sn isotopic evidence for Late Bronze Age exploitation of multiple tin sources across the Central Balkan

W. Powell, H.A. Bankoff, A. Mason, M. Mathur (Department of Earth and Environmental Sciences, Brooklyn College)

A. Bulatović, V. Filipović (Institute of Archaeology, University Belgrad)

The potential of tin isotopes to define tin provenance is complicated by the isotopic range inherent to each ore deposit, resulting in significant compositional overlaps. In addition, it is uncertain whether smelted tin inherits the isotopic composition of ores from which they were produced. Thus, the efficacy of tin has yet to be proven. A study of the 317 Late Bronze Age (BrD -HaA) bronze artifacts from Central Europe and the Balkans provide a robust test of the feasibility of isotopic approaches to tin provenance studies. The artifacts yield a

multimodal distribution of $\delta^{124/116}$Sn from -0.68 to +1.33‰ relative to NIST 3161a. δ^{124}Sn values define several distinct geographic groupings. The region north of the Danube is characterized by moderate δ^{124}Sn (0.2-0.7‰). Western Serbia is characterized by heavy (>0.7‰) and bimodal (0 to 0.2 and >0.7‰) metals. Artifacts from east of the Morava, and across the eastern Lower Danube Valley of Bulgaria, are typically light (0 to 0.2‰), whereas those of the western Lower Danube region are characterized by negative δ^{124}Sn values. This pattern suggests that as many as 5 distinct tin sources were utilized in the LBA. Most groups display a limited geographic distribution suggesting small scale exploitation of localized ore sources.

Based on isotopic composition alone, the artifact clusters cannot be definitively correlated with specific ore sources. However, based on relative probability plots from known deposits (Erzgebirge, southeast England, central Serbia), the geographic pattern of tin composition would be consistent with the use of nearby ores: an Erzgebirge source for northern artifacts; Serbian sources (Cer and Bukulja) for the artifacts of west Serbia. Artifacts from the Lower Danube Valley do not match known tin ores in the region, indicating at least two undocumented sources. There is no evidence for the use of Cornish tin. The correspondence between artifacts and ores is maximized if it is assumed that smelting induced an increase in δ^{124}Sn of ~0.2‰ increase, consistent with recently published experimental work.

The Evidence of Bronze-Casting at the Kalnik-Igrišče Site (NW Croatia)

Snježana Karavanić, Andreja Kudelić (Institute of Archaeology, Zagreb)

The multi-layered site Kalnik-Igrišče is located in south-western part of Carpathian Basin, on the territory of North-western Croatia. The Late Bronze Age settlement lies on the southern slopes of Kalnik hill, at 500 m above sea level.

The results of excavations at Kalnik-Igrišče site show evidence for bronze casting activities that started in early Urnfield Culture and continued in the period of Ha B (late Urnfield Culture). The archaeological excavations carried out in the 80s revealed the finds of 7 hearths, surrounded by pieces of slag, fragmented bronze items (mostly pins) and several fragments of bronze casting moulds and so called channelled stone. Because of the highly valued site and low state of research of the period in question, in 2006 a new campaign of systematic excavation has begun. Under the layers of later periods a well preserved Late Bronze Age house has been found. The house was probably destroyed in a fire. After that event and after a certain time this space was used for metal processing. Strong indicators of this kind of activity were discovered: remains of a furnace; remains of the hearth located next to the furnace. Near the furnace we have found one bronze or copper ingot and tuyere or below nozzle. In the area in front of the furnace the large stone slab has been found as well as fragments of bronze-casting moulds and pieces of slag together with small bronze items.

Of hoards, individuals and communities in Late Bronze Age Italy

E. Borgna
(Department of History and Preservation of the Cultural Heritage, Department of University of Udine)

The contribution takes into consideration the social organization of Late Bronze Age Italian communities by reviewing patterns of bronze deposition within a diachronic perspective and with a special concern for the Adriatic regions. The much debated question regarding the interpretation of metal hoards is reappraised by exploring some major discontinuities in both the association of materials and the metal composition of objects in some LBA hoards from NE Italy, which, on one hand, can help understand the role of the Adriatic communities in the metallurgical koine at a Mediterranean scale, and, on the other hand, can illuminate modes and nature of the special relationships linking Italy to the Urnfield areas - or transalpine and western Balkan regions – in the Final Bronze Age or Late Bronze Age/Early Iron age transition. Then, some major changes in the patterns of both metal supply and bronze consumption might be related to substantial social transformations pointing to the emergence of political economies at a regional level.

Zur Metallurgie in den Regionen des südlichen Tyrrhenischen Meeres

R. Jung (OREA - Austrian Academy of Sciences)

Die Region des südlichen Tyrrhenischen Meeres nördlich der Straße von Messina, zwischen den Küsten Siziliens und Kalabriens, war von strategischer Bedeutung für die Seefahrer, die die Routen zwischen der östlichen und der westlichen Hälfte des Mittelmeers befuhren – vor allem in einer Zeit, als Seefahrt vor allem Küstenschifffahrt bedeutete. Diese Scharnierfunktion schlägt sich auch im archäologischen Fundspektrum des 2. Jahrtausends v.u.Z. nieder: Typologische Analysen wie auch Herkunftsbestimmungen auf der Basis chemischer und massenspektrometrischer Daten demonstrieren eindrücklich, dass hier Produkte der nördlichen Adria, Siziliens und der Ägäis zusammenkamen bzw. diese Region passierten. Erst zu Beginn des 1. Jahrtausends v.u.Z. änderte sich diese Situation grundlegend – allerdings nur kurzzeitig.

Archaeometallurgical Characterization of Late Bronze Age Metal Artefacts from Hungary by the 'Neutron Methods'

J. Gábor Tarbay (Hungarian National Museum, Department of Archaeology, Budapest)
Z. Kis, B. Maróti (Centre for Energy Research, Hungarian Academy of Sciences, Nuclear Analysis and Radiography Department, Budapest).

In the discourse, some results of three case studies will be presented, which were carried out by a scientific cooperation between the Hungarian National Museum, Department of Archaeology (Budapest) and the Centre for Energy Research, Hungarian Academy of Sciences, Nuclear Analysis and Radiography Department (Budapest).

The three projects focus on different archaeological questions, related to the Late Bronze Age metal technology that can be answered in depth by the aid of non-destructive imaging techniques such as Neutron tomography. 1.) The *Spear Project* aims to characterize bronze spearheads between the Ha A and Ha B1 periods from the Carpathian Basin and its adjacent areas that contains wooden and additional organic residues in the shaft. By the assistance of advanced imaging techniques, valuable information were gained about the inner structure and casting quality of the metal parts, as well as detailed images were provided of the wooden shaft and additional organic residues within some specimens. 2.) From the *Warrior Equipment Project* a case study will be presented about the complex technological analysis of Late Bronze Age elite assemblages that contain bronze vessels, defensive- and offensive weapons by macro-and microscopic observations, non-destructive elemental composition analysis (PGAA) and imaging techniques. 3.) Finally, the results of the recently started *Axe Project* will be discussed, which is a scientific cooperation that seek to interpret the phenomena of the Late Bronze Age defected casts that have appeared in large numbers during the Ha A and Ha B1 in the Carpathian material. It was examined by combining experimental archaeology with non-destructive and destructive analytical techniques. This last case study will focus on the formation of porosity in Late Bronze Age and their precise documentation, analysis and interpretation through imaging techniques.

Late Bronze Age metallurgy in Slovenia. Current state of research

M. Črešnar, R. Urankar (University of Ljubljana, Slovenia)

Die aktuellen Forschungsergebnisse zur bronzezeitlichen Metallurgie in Südwest-Polen

K. Nowak, B. Miazga (Institute of Archaeology, University of Wroclaw)
Z. Stos-Gale (Ifold, UK)

Im Rahmen der Präsentation werden die aktuellen Forschungsergebnisse zum Thema Organisation der metallurgischen Produktion in der Spätbronzezeit im Südwesten Polens diskutiert. Die Ergebnisse der räumlichen Analyse bezüglich des Vorkommens metallurgischer Objekte (die Gussformen, Düsen, Tiegel usw.) werden mit den benachbarten Gebieten verglichen.

Darüber hinaus werden in einer kurzen Übersicht aktuelle Forschungsprojekte zur Buntmetallurgie in diesem Gebiet vorgestellt. Besondere Aufmerksamkeit wird der Prüfung von Indikatoren der Metallurgie in den Gräberfeldern (den sogenannten Metallurgengräbern) und auch den Möglichkeiten der Gewinnung von Kupferlagerstätten in Niederschlesien gewidmet. Die Ergebnisse der neuesten Forschung anhand der experimentellen, physikochemischen und trasologischen Methoden werden vorgestellt.

Remote from mining and smelting: second millennium BC bronze finds from north-east Poland

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At the end of first half of the second millennium BC, after the collapse of the Únětice cultural circle, central and eastern part of Poland was occupied by the societies that developed local Trzciniec culture. Further north-east, in the region known as Warmia, east of the Vistula river and a short distance from the Baltic coast, groups of inhabitants seem to have different, until now unknown, cultural characteristics. Current excavations and finds indicate that these societies were well acquainted with metalwork, using quantities of tin-bronze tools and weapons. In their graves there are also gold, faience and glass ornaments.

The north-east Poland is geologically completely void of metal ores. In fact, the nearest copper deposits that were exploited in the Bronze Age are in the Carpathian Mountains, about 1000 km away from Warmia. Therefore, all these metal finds indicate lively contacts with the European trading networks.

A group of 30 tin-bronzes from graves and stray finds in Warmia, dated mostly to the middle of the second millennium BC, was analysed qualitatively by non-destructive ED-XRF and for their lead isotope compositions by MC-ICP-MS. Our paper will examine the style of these artefacts and their lead isotope characteristics in comparison with other groups of contemporary bronzes from central, southern and northern Europe. We will also attempt to propose preliminary hypotheses about trading contacts of the Middle Bronze Age Warmians.

Info

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