

# Preface

From 2014 to 2018 the trinational research project “Prehistoric copper production in the Eastern and Central Alps – technical, social and economic dynamics in space and time” was carried out by project partners of the University of Innsbruck, department of Archaeologies (A), the German Mining Museum Bochum/University of Bochum, department of Archaeological Sciences (D), the Curt-Engelhorn-Zentrum Archäometrie in Mannheim (D), the University of Zürich, department of Archaeology (CH) and the Archäologischer Dienst Graubünden (CH). The joint project (D-A-CH-project) was financed by the Austrian Science Fund FWF, the Deutsche Forschungsgemeinschaft DFG and the Swiss National Science Foundation SNF in the framework of a Lead Agency procedure.

The essential aims of the project were to investigate and/or to provide:

- a reconstruction of workflows associated with copper production (“chaîne opératoire”)
- procurement strategies with regard to different raw materials (fahlore, chalcopryrite)
- a mineralogical and geochemical characterisation of raw materials
- the transfer of knowledge by exporting or applying established technologies
- the dating of mining activities (beginning – duration – end)
- an econometric assessment of metal output in small, medium and large production units (single mines/smelting sites – mining districts – supra-regional networks)
- the positioning of Alpine copper on the Central European metal market during Bronze Age and Early Iron Age (provenance studies on metal artefacts)

The Eastern and Central Alpine copper economy played a major role in the metal supply of Central Europe during the Bronze Age and Early Iron Age. In that period, the Alpine economy changed considerably as mining and metal production transformed large parts of the landscape from remote even uncolonized areas into early industrialized regions. Three of the most important copper producers were selected for this joint research project: (1) the Schwaz/Brixlegg district in North Tyrol, Austria, (2) the Mitterberg district in Salzburg, Austria and (3) the Oberhalbstein district in Grisons, Switzerland. In all of these mining districts Bronze Age to Early Iron Age relics of copper ore mining and/or metallurgy are widespread and the archaeological investigation of a considerable number of sites is highly advanced. The state of research represents an excellent base for a supra-regional study deal-

ing with the dynamics of prehistoric large-scale metal production in the three key-areas and beyond.

The fahlore mining district of Schwaz/Brixlegg played an important role during the Later Copper Age “Neolithic” and the Early Bronze Age, when “fahlore-copper” became an essential raw material for the Central European copper respectively bronze market. From the late Early Bronze Age on and especially during the Middle Bronze Age, the Mitterberg district dominated the copper supply. An estimated 20,000 tons of copper were produced in this region, mainly from chalcopryrite ore (“Eastern Alpine copper”). The Mitterberg area can be considered as a starting point for technological and economical innovations in copper production (“Mitterberg-process”) and the associated occupation of the Eastern and Central Alps by specialized communities. Fahlore mining and metallurgy in the Schwaz/Brixlegg district reached a second prime during the Late Bronze Age and Early Iron Age. In the Oberhalbstein and in the Trentino chalcopryrite ores were exploited from the earlier Late Bronze Age to the Early Iron Age. Due to a different geological genesis, a geochemically distinguishable type of copper is to be expected compared with the “Eastern Alpine copper” and the “fahlore-copper”.

Based on specialized (mining-)archaeological investigations, highly precise chronological data using dendrochronology, geochemical analyses and econometric evaluations, the joint project aimed to carry out a comparative and diachronic study of these three important prehistoric copper mining districts. The aim was to reconstruct and to better understand the development and significance of the districts, their economic dynamics and the manifold interrelations within the network of alpine metal producers. First results of this fruitful cooperation are published in this volume, together with contributions from other international authors working in the field of “prehistoric alpine copper”.

This volume therefore marks a next step of reconsidering the state of research. A last similar step was made already 25 years ago. In 1995 the University of Innsbruck (Gert Goldenberg) together with the German Mining Museum in Bochum (Gerd Weisgerber) and the Ufficio Beni Archeologici in Trento (Gianni Ciurletti) organized the first international workshop „Alpenkupfer – Rame delle Alpi”. This meeting was focused on prehistoric copper production in the Eastern and Southern Alps. The proceedings were published in 2004 in „Der Anschnitt, Beiheft 17“ (mainly in german language). In the meantime the knowledge in this field of research had considerably increased and numerous research groups had achieved new and partly spectacular results from different regions in the Alps.

In 2015 a repetition of the 1995 workshop was projected in order to rediscuss the aspects of Bronze Age and Early Iron Age copper production in the Alps. A welcome occasion was offered by the trinational D-A-CH-project mentioned above.

The international workshop “Alpine Copper II” was held from 21<sup>st</sup> to 25<sup>th</sup> September 2016 in Innsbruck and was organized by a multinational committee of experienced investigators in order to include and to motivate researchers from all over the Alps (Gert Goldenberg, Austria/Thomas Stöllner, Germany/Rouven Turck, Switzerland/Elena Silvestri, Italy and Vanessa Py-Saragaglia, France). The organization on site was taken over by the team of the Research Center HiMAT (History of Mining Activities in the Tyrol and adjacent areas – Impact on environment and human societies). The aim of the 2016 workshop was to present and to discuss the updated state of the art concerning the prehistoric copper production in the Alps and to stimulate further fruitful synergies by developing and intensifying the international collaborations. During the workshop a thematic focus had been placed on the topics of the above mentioned D-A-CH-project.

During three days participants from seven countries (Austria, Germany, Switzerland, Italy, France, Norway and England) presented and discussed 30 papers and 8 posters dealing with the main topics Mining Archaeology, Archaeometallurgy, Ethnoarchaeology, Experimental Archaeology, GIS and Data Management. The discussion about new discoveries and findings completed the indoor part of the workshop. Two days of field excursions to Bronze Age and Early Iron Age mining and smelting sites in North Tyrol concluded the event.

The volume comprises 23 contributions issued from Alpine research environments between Lower Austria to the East, and the departments of Isère and Savoy to the West. There is a focus on the Eastern and Central Alps: Most papers emanate from the international “Alpine Copper” D-A-CH project, partly with data from the foregoing project of the SFB HiMAT (“The History of Mining Activities in the Tyrol and adjacent areas”).

A wide methodological range is addressed in the papers: After a keynote by Thomas Stöllner highlighting essential elements of mining-archaeological research in the resource-scapes of the Eastern Alps, Thomas Koch Waldner and Susanne Klemm offer new assessments and updated information for two important mining districts of the Austrian Alps, i.e. famous Kitzbühel region in North Tyrol and the Lower Austria region respectively. Fundamental orientations on data setup and management in mining archaeological projects are given by Gerald Hiebel et al.

Mines and ores of various regions are the topics of the following section. Bernard Moulin et al. discuss the fascinating Early Bronze Age mining evidence in the Grandes Rousses massif in the French Alps, one of the few western districts with ongoing research. The Montafon in West Austria has been a focus of historical and

prehistoric mining research for many years, as Rudolf Klopfer et al. discuss in their paper. Their research provide first sound indication for later Iron Age mining in the Montafon, while Bronze Age mining activity is still absent. New results of mining archaeological surveys in North Tyrol are introduced by Caroline Grutsch et al. This research made a new field of rather small scale prehistoric copper mining accessible. Evidence of fahlore mining in the Lower Inn Valley during Late Bronze Age and Early Iron Age is presented by Markus Staudt et al., while the mineralogical and chemical analysis of copper ore deposits of the Eastern Alps by Peter Tropper et al. provides a general overview of economically used ores during prehistory.

Ore beneficiation processes form an important part of the metallurgical “chaîne opératoire”. Spectacular are Thomas Stöllner’s excavation results from the “Sulzbach-Moos”-bog in the well-known Mitterberg mining district, along with Simon Timberlake’s experimental approaches to the treatment of chalcopyrite ores as evidenced at the Troiboden site of the Mitterberg.

The next step in the ore treatment is smelting that for long decades was one of the focusses of archaeological and archaeometallurgical research. Recent excavation work in the Oberhalbstein district yielded a broad variety of archaeometallurgical structures, relating to various steps of the copper producing sequence, as shown by Rouven Turck in an overview article. The massive slag finds of the reduction process offer ground for a new typological and morphological approach to slags, as Leandra Reitmaier-Naef shows in her contribution. Monika Oberhänsli et al. present comprehensive dendrochronological data for the newly investigated mining district of the Oberhalbstein in Switzerland, framing ore exploitation and processing there to the Late Bronze Age and Early Iron Age.

The Trentino ore processing evidence is reviewed by Elena Silvestri et al., the remarkable features and findings of recent excavations at Rotholz in North Tyrol by again Markus Staudt and colleagues. A second paper by Peter Tropper et al. focuses on slag-tempered ceramics of the same region, as a further element of the operational sequence (recycling of slag).

Production quantification, yet another aspect of copper production, is addressed by Erica Hanning using archaeological and geophysical methods on slagheaps. It is shown that the ancient slag heaps underwent massive transformation (erosion, reusage, vegetation) that considerably reduces the amount of slag represented at such sites and in our archaeological heritage. Many of these sites should have been even completely lost according to the amount of copper once produced at the Mitterberg. Roland Haubner et al. discuss various elements of the production sequence at Priggglitz-Gasteil in the Lower Austria district.

Finally, metal provenance and metal exchange are topics investigated by Caroline Grutsch et al. using finished objects and copper signatures from Early Bronze



*The participants of the “Alpine Copper II” international workshop in Innsbruck in 2016, photo: Research Center HIMAT, University of Innsbruck, M. Staudt.*

Age to Early Iron Age. New quantitative calculation of the combination of fahlore and chalcopyrite copper allows important insight to the amount of fahlore copper used in relation to chalcopyrite copper especially as deliberate alloy at the end of the Bronze Age and the beginning of the Iron Age. Chalcopyrite still was the main ore used.

Joachim Lutz et al. focus on raw material evidence, their interest lies with plano-convex ingots of the Salzburg region and spatial distribution patterns. As with the finished objects it turns out that the abundant amount was made of Mitterberg and Kitzbühel copper variations while a smaller amount resembles import of fahlore-copper likely from the Schwaz-Brixlegg mining district. It is remarkable that already the oldest ingots resemble an exclusive origin of the Mitterberg district. Bronze Age ingots from Styria and Upper Austria are classified by Daniel Modl in order to understand their production and distribution. His attempt is also to debate the phenomenon on a larger scale in order to establish a method in dealing with these find category. Last but not least, Stephan Möslein and Ernst Pernicka take up the task to re-contextualize the analytical data of the large 20<sup>th</sup> century Bronze Age metal analyses from the SSN (“Salzburg-Southern Bavaria-North Tyrol”) project. All the analytical and archaeological data of this large scale analytical project are presented for the first time with an extensive catalogue.

From the beginning it was planned to publish the workshop proceedings again in the series „Der Anschnitt, Beihefte”, as a second volume with the title “Alpine Copper II”. More than a half of the contributions in this volume is related to the D-A-CH-project and thus provide a representative overview of the research activities in the

frame of this joint project. The editorial work for the publication has been taken over in Zürich and Bochum, the layout and printing was performed in Bochum in cooperation with the printing house Marie Leidorf and Bert Wiegel. We especially thank several persons who made this volume possible. In a 1<sup>st</sup> step Rouven Turck by advice of Philippe Della Casa coordinated the reviewing process in Zurich. We are especially thankful to the numerous reviewers that took up the heavy task of bringing the papers into good scientific and formal shape and particularly for their indispensable advices and comments. This made the presented volume a real peer-reviewed one. Thomas Stöllner undertook the 2<sup>nd</sup> step of the editing process in Bochum and coordinated the proof-reading process with the authors. The layouting and pre-print-process was accompanied by Petra Eisenach, Bochum, and Angelika Wiebe-Friedrich, Straßenhaus, with whom we formed a tight cooperative atmosphere during finalization process of the volume. This is gratefully regarded and acknowledged. Elena Silvestri, Italy, and Vanessa Py-Saragaglia, France, are thankfully regarded for their contribution at the conference.

Zurich, Bochum and Innsbruck joined to bring the important economic and social aspects of Alpine copper exploitation to a new scientific synthesis. The term resource-scape now helps to culturally and socially integrate this fascinating evidence to a better understanding of those specialized Alpine communities in the Bronze Age and the Early Iron Age. We therefore hope that the current volume will find an interested and benevolent audience.

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