

## **Stříbrná Jihlava conference 2016, preliminary program**

**Thursday, October 6**

### **Sweden**

#### **Silver and lead or Silver or lead – early mining of galena in Sweden**

Lena Berg Nilsson

The subject of this presentation consists of some question on silver and lead mining that do not fit in my on-going thesis in archaeology (Stockholm university, Sweden). In my presentation I will give an overview of early Swedish silver and lead mining and three examples showing the diversity of the mining sites and their organisation - Sala silver mine and the lead mine of Hade in the centre of Sweden, and the mine of Nasafjäll in the northernmost part of Sweden.

#### **How a 17-century scam inspired Mozart to an opera and created an industrial copper process in Sweden**

Dag Noréus

By arranging the famous international meeting in Brno 1786, Ignaz von Born sought confirmation for his chloridizing roasting process using common salt, initially intended for silver ore. In Sweden it came to be used in copper production. Born was inspired by alchemy but salt was not one of its original principles. Possibly the idea came from an alleged medieval alchemical manuscript that later was attributed to Johann Thölde owner in the salt-works at Frankenhausen. Who in his turn was inspired by Paracelsus. My talk will present the chemistry and how the process came to Sweden.

### **Bohemian-Moravian Highlands, Czech**

#### **New prospections of medieval ore mining and preparation in the Bohemian-Moravian Highlands**

Jaroslav Havlíček, Petr Hrubý, Karel Malý

The paper will introduce the results of small-scale surveys of a placer deposit near Česká Bělá, relics of an ore preparation plant near Koječín in the Havlíčkův Brod region and finally the mouth of an old shaft with timber cribbing near Opatov at the eastern edge of the Pelhřimov mining district. At these sites wooden construction elements were preserved, which yielded valuable dendrochronological dates. The origins of these mining areas are dated to the 13th century and this chronology fits well into the general historical context of medieval mining of gold and subsequently also polymetallic ores in the heart of the Přemyslid domain.

#### **New prospections of medieval metallurgical areas in the Bohemian-Moravian Highlands**

Petr Hrubý, Jaroslav Kapusta, Karel Malý

The paper is dealing with new surveys of medieval metallurgical localities, which in the “period prior to Kutná Hora” processed polymetallic ores in the Bohemian-Moravian Highlands and produced precious and non-ferrous metals. It is a combination of geomagnetic measuring, soil sampling and geochemical analyses of samples, and analysis of the most frequent metallurgical waste – slags. The paper tries to evaluate the data in topographic and regional context and set up a more or less probable model of infrastructure of this type of defunct metallurgical facilities.

#### **Chemistry and phase composition of slags from smelting of silver ores in the Havlíčkův Brod region**

Kateřina Janíčková, Zdeněk Dolníček, Karel Malý

At four localities in the neighbourhood of Havlíčkův Brod (Stříbrné Hory 1 and 2, Utín and Hesov) particularly the phase composition and chemistry of medieval slags from metallurgy of silver ores were studied. The main phase of slags was identified to be glass, which is followed by olivine and sporadically wüstite. Sulphide inclusions contained pyrrhotite, rudashevskyite, covellite and unidentified non-stoichiometric phases. The knowledge obtained by the study of slag substances enabled to draw some conclusions on the provenance of the raw material mined or the metallurgical technology, such as effectiveness of metal extraction, melt viscosity and smelting temperature.

#### **Slags from historical smelting of polymetallic ores from selected localities in the town of Jihlava**

Jaroslav Kapusta, Zdeněk Dolníček, Karel Malý

The paper is focused on a detailed characteristic of the chemistry and phase composition of slags from smelting of polymetallic ores from selected localities in the neighbourhood of Jihlava (the finds are linked with the course of the Staré Hory dislocation zone). Also presented will be smeltings in a muffle kiln, which were conducted to find out the liquidus temperature of slags. The paper also comprises interpretation of the data obtained, with regard to ore preparation and metallurgy.

#### **New prospections of medieval mining settlements in the Bohemian-Moravian Highlands**

Petr Hrubý, Peter Milo

The paper will introduce recent archaeological excavations and non-destructive surveys of deserted mining settlements in the Bohemian-Moravian Highlands. It will lead us to the Staré Hory dislocation in Jihlava, show the surprisingly extensive mining settlement near Vyskytná in the Pelhřimov region and a varied structure of the mining centre Buchberg in the Havlíčkův Brod region. It will address the material culture, social structure of these settlements and the reflection of the then mining rights in their arrangement and infrastructure.

### **Kutná Hora**

#### **The 1999-2016 archaeological excavations of medieval mines in Kutná Hora**

Filip Velímský

The paper is conceived as a summarising review. Its main aim is to provide an up-to-date summary of crucial mining archaeological research activities which have since 1999 been carried out in the district of Kutná Hora by the local branch of the Institute of Archaeology, Czech Academy of Sciences in Prague. Another aim is to present the usual form of recorded mining contexts, the applied method of archaeological field research and documentation, processing of data and presentation of results, inclusive of limitations and obstacles in realisation of these activities which proceed from valid legal norms. The presentation will be supplemented with a set of unified posters dealing in more detail with individual excavations in 2013-2016, which have recorded and explored evidence of high medieval mining activities.

#### **Estimated silver content in ores extracted from the main ore zones of the silver-bearing polymetallic deposit in Kutná Hora from the 13th to the 20th century**

Milan Holub

According to estimations by J. Kořan (1950) and J. Bílek (1985), the several hundreds of mines of Kutná Hora mining district yielded from the Middle Ages until the industrial revolution ca. 2000 – 3000 tons of silver. These estimations are unfortunately mainly based on documents from the time of a mining revival under George of Poděbrady and from the Early Modern Times. For the pre-Hussite Period they are quite speculative. In the course of the 20th century, ore mining in the deposit was revived and extensive ore deposit survey and historical research were carried out. The results of these activities were used by the author to estimate the silver content in ores extracted from the main ore zones by calculating the mineral raw material supplies.

## Methods of historical mining research

### Mining landscape in relief: possibilities of survey and archaeological verification of mining relics

Ondřej Malina, Markéta Augustýnová, Pavlína Schneiderwinklová, David Černý

The paper deals with the analysis and verification of the ALS data. Chronology and topography of historical mining is the key question of mining-historical survey. The absence of written reports makes us concentrate on the terrain relief. Archaeological potential of mining relics is quite variable and the finding of re-presentative places demands gradual combination of methods with a very different range of activities.

### Unified terminology – foundations of a successful interdisciplinary cooperation

Josef Večeřa

In the research and survey, such as mining research, it is inevitable to give identical objects the same names. This should be secured by a unified terminology, whose concept will be the topic of this paper.

### Mapping the values: starting points and possible methods of building-historical survey of mines

Ondřej Malina, Petr Olišar

Mapping of valuable spaces, surfaces and mines is targeted at minimisation of negative impacts on the conservational and historical value of a mine which was made accessible to public. An overview of construction details, contexts and evidence of working activities, on the other hand, enables to understand better the technology and chronology of mining. The documentation is based on a GIS maps and the set of thematic marks. Both of them enable fast fieldwork even in extensive features, and various types of maps.

## Mining towns forever

### Trading in medieval mining towns – import and export of articles of daily use and luxury goods in selected Bohemian and Saxon-Meissen mining towns in comparison

Ivonne Burghardt, Jitka Hříčková

Medieval mining settlements and towns were always specific. Interesting are not only their significant constitutional-legal developments but above all the economy. The vast majority of miners, mining technicians and craftsmen, due to their time-consuming involvement in mining business, were dependent on supply with articles of daily use. Moreover, the mining entrepreneurs who got rich on mining activities craved for luxury goods. This paper will exemplify with the help of significant Saxon-Meissen as well as Czech mining towns how these mining centres were involved in long-distance trade. It will also illustrate on specific historical events, how particular political or economical developments affected the trading activities in these mining towns, and formulate questions for further research in this regard.

### Mining towns in the Ore Mountains and the origins of Jáchymov

Martin Volf

The paper presents the results of interdisciplinary research into the origins of the mining town Jáchymov. The 16th century Jáchymov represents a dynamic mining and settlement organism, in which a structural change is taking place in limited space and time and anticipates an early modern alteration of the Ore Mountains. The basic cognitive method used is field research, both building-historical and archaeological. Geological and mineralogical knowledge also are accentuated.

### „Gold rush” or considered investment? Origins of mining towns in medieval Central Europe

Paweł Cembrzyński

There are two basic medieval mining towns' development models: (i) dynamic transition of rapidly growing mining settlement, strictly tied to ore extraction zone, into a town; (ii) emergence due to planned colonization as a multifunctional town in a settlement network. I will try to show that the latter model prevailed in Central Europe through analysis of towns' localization factors, their spatial structure and chronology of changes.

## Evening in the Town Hall

### Old Jihlava mining in visual arts: Gustav Krum, Josef Kos and Zdeněk Mězl

Zdeněk Laštovička

In the Jihlava conference 2004, a paper was presented on three art painters who devoted their works, among others, to the topic of mining in Jihlava. Their names were Gustav Krum, Josef Kos and Zdeněk Mězl. All of them were still alive at that time. Master Krum even celebrated a jubilee. This year dealt us a heavy blow because after the earlier deceased Gustav Krum (23 May 1924 – 21 March 2011) both of the remaining two artists passed away in May (Josef Kos 26 July 1932 – 1 May 2016; Zdeněk Mězl 31 October 1934 – 23 May 2016). Let this paper be a memory of the three artists, maybe the only ones who were so deeply interested in the history of mining. The paper will commemorate their selected works of art and interesting biographies.

## Friday, October 7

### Špania Dolina – Piesky. A 15th-16th century coin hoard. Analysis of the assemblage and its historical background.

Martin Kvietok, Ján Hunka

The paper presents a unique hoard of coins from the late 15th and early 16th centuries. The hoard was discovered in 2009 on the ridge Glezúr dividing the mining settlements Špania Dolina and Piesky. The hoard contained coins of the Sicilian-Aragonese King John II and two Popes, Sixtus IV and Leo X, as well as Emperor Charles V. The treasure may have been hidden before 1520. The coins may have reached Špania Dolina as a result of mining activities of the Thurzó and Fugger families. Hoarding of the coins may have been induced by a period of unrests in the 1520s-1530s (an uprising of miners, fear from the Ottomans).

## Prehistoric ore mining and metallurgy

### Metallurgy in the foothills of the Ore Mountains – evidence of Bronze Age bronze production

Markéta Augustýnová

Northwest Bohemia and especially Ore Mountains, represent with regard to Bronze Age bronze metallurgy an area with the highest number of localities showing evidence of this activity in Bohemia. There also are numerous deposits of copper and tin in the Ore Mountains, which are supposed to have been exploited in prehistoric times already. This territory is also interesting due to abundant information about the appearance of the settlement and the role of the Elbe and Ohře Rivers in communication. The paper is focused on how the production of bronze artefacts has been organised in comparison with the other Bohemian regions.

### On prehistoric or early medieval activities in the area of copper mines Měděnka u Mutěšina (Domažlice Dist.)

Dana Chmelíková

The paper will introduce the ongoing survey at Měděnka site in 2014–2016. The survey was based on test trenching, soil geochemistry, archaeobotany and measuring with the help of a portable XRF device. It is for the first time in Bohemia that stratified prehistoric pottery was found on a deposit of copper ores. The subsequent 14C measurement of macroremains from relevant layers, however, did not yield early medieval dates. The survey thus, on the one hand, yielded new information which can enhance the knowledge of copper production in prehistoric and early medieval Bohemia. But, on the other hand, instead of a desirable evidence of Bronze Age ore mining it rather brought many other questions into the study of this topic.

## European cross-border projects of mining history and mining archaeology

### „Regio Mineralia“: a european project for science and tourism about the origin of industrial mining culture in The Oberrhein Region

Joseph Gauthier, Pierre Fluck, Guntram Gassmann, Sebastian Brather, Carole Begeot, Laure Giamberini, Jean-Jacques Schwein

On the west side of Vosges, Schwarzwald and Pfalz have shared a long and complex history concerning metal production. *Regio Mineralia* is a new project which aims to study the apparition of a common industrial mining culture in the Oberrhein region during the Middle Ages, considering archaeology, history and environment. 18 organizations will work together from 2016 to 2019 to connect data from each sides of the Rhine and to produce new evidences about medieval mining activities. All the results will be showed in a new network of tourist mines.

### „ArchaeoMontan“: results of four-year-long international interdisciplinary cooperation

Christiane Hemker

Since 2012, German and Czech scientists have been carrying out a research within the “ArchaeoMontan” project on many aspects of medieval mining in the Saxon-Bohemian Ore Mountains. The research comprises, for example, archaeological documentation of the high medieval mines in Dippoldiswalde and Niederpöbel in the eastern part of the Ore Mountains, and excavation of the medieval mining settlement Kremsiger. In the course of these activities, researchers are confronted with new finds and findings, which are analysed and evaluated in an interdisciplinary context. This paper presents important mining archaeological discoveries and shows how the knowledge obtained can be set into another thematic context, for example the landscape and settlement development or legal-organisational aspect of mining enterprises. The ArchaeoMontan project is financially supported by the European Regional Development Fund within the Operational Programme of cross-border cooperation between the Free State of Saxony and the Czech Republic.

## The Ore Mountains

### Kremsiger 2016: present state of knowledge of a medieval mining settlement in the Ore Mountains

Kryštof Derner, Petr Bohdál, Jiří Crkal, Petr Kočár, Roman Křivánek, Petr Lissek, Vladimír Šrein

The paper summarises the present knowledge of a mining settlement from the turn of the 13th/14th centuries on the so-called Kremsiger in the Ore Mountains. In the past research campaigns the written sources were retrieved, a characteristic house was explored and geophysical survey was carried out. Now the first results of the analysis of technoliths and new results of the macroremains analysis will be discussed. We will present a new survey of the site and new knowledge of the extent of settlement obtained by small-scale test trenching.

### Archaeological and archaeometallurgical research in the medieval mining towns Dippoldiswalde and Freiberg

Matthias Schubert, Karel Malý, Petr Hrubý

Archaeological research in the Saxon mining towns Dippoldiswalde and Freiberg recently unearthed remnants of non-ferrous metallurgical workshops showing evidence of metallurgical activities which have taken place in mining settlements. Interpretation of technical devices and finds is mostly only possible with the help of natural-scientific analyses and relevant analogous relics from contemporaneous mining areas.

### Mining area Smrkovec

Ondřej Bouše

Smrkovec is a defunct silver ore mining area in the southwestern part of Slavkovský Forest. It is associated with not very extensive dyke outcrops of the Ag-Bi mineralization in the Podleské Valley (cadastre Milíkov). The earliest prospecting/mining activities can be dated to the 1st half of the 16th century; possible older activities are not known. The settlement centre of the area was the originally high medieval village Smrkovec, today already deserted. Mining was carried out here with the help of underground adits and mining pits.

## Gold

### The problem of historical gold mining in the neighbourhood of Vodňany

Kateřina Mašlová

The paper, which is based on a Bachelor's thesis (University of České Budějovice) presents a historical gold mining region of Vodňany. The aim of the paper is to present the results of surveys which are targeted at documentation of mining areas, set up their list and try to enhance the knowledge about them.

### The first archaeologically documented gold mill in the catchment area of Lužnice River in South Bohemia: Černýšovice nearby Bechyně

Daniel Hlásek, Jiří Fröhlich, František Janda

Nearby Černýšovice remnants of a gold mill were discovered. Dozens of millstones were pulled out of the river. Even a gold mines were discovered nearby. The area might have something to do with the 1514 charter, by which King Vladislav II of Hungary granted the right to precious metals in the Bechyně manor.

### Sedimentary gold deposits

Maria Legut-Pintal

In 2014 we analysed ALS data as a part of *Mikroregion osadniczy we Wleniu w X-XVIII w. Ewidencja elementów krajobrazu kulturowego* project. The results allowed identifying several previously unknown sites related to exploitation of sedimentary gold deposits. The sites cover vast areas and contain large variety of preserved terrain forms. In our presentation we would like to discuss the main characteristics of such sites and problems related to excavating and studying them.

## Archaeometallurgy: theory, practice, experiment

### Ancient gold refining recipes: interpretation of their reliability through experimental archaeology, analytical characterization and thermodynamic interpretation

Angela Celauro, David Loepp, Daniela Ferro

Reproductions of ancient gold-silver separating procedures were carried out following experimental archaeology protocols and interpreted in the light of the analytical and thermodynamic characterization of the chemical reactions involved. Analysis was conducted by the authors on different kinds of ancient recipes, involving the use of different cementation components. Our experiments were conducted using two different cements: one based on a recipe of *Pedanius Dioscorides* for the production of *ios scolecos*, the second consisting of brick powder and salt, a procedure described by *Theophilus Presbyter*. A new experiments was then designed and carried out with cements containing the natural weathered mineral complex “misy”, following descriptions by *Galen*, *Dioscorides*, or *Agricola*. Other experiments reproduced the description of gold purification made by *Agatharchides of Knidos*, after his direct observations made in the Nubian mines. The aims of these studies are to enlighten and classify the technical processes, to evaluate the reliability and the parameters of the procedures (e.g. temperature, atmosphere, and duration) and the characterization of products: all this information allows to obtain insights in the study of the ancient production of gold and precious metallic artefacts.

### The richness of silver ore in the Middle Ages: A comparative study of historical descriptions and the archaeological evidence

Stephen Merkel

How rich were silver ores in the past? What was the limit of economic extraction of silver? These questions have different answers depending on whether you are a mining historian, an archaeometallurgist or an ore mineralogist. The medieval and post medieval accounts like *Al-Hamdani* (10th century) and *Agricola* (16th century) paint pictures of silver production that clash with and contradict the archaeometallurgical evidence from numerous medieval sites in Europe and Asia. In this paper, the arguments from both sides will be addressed and a tentative reconciliation will be attempted.

### **Cupels a hundred times different**

Michaela Kovářová, Martin Bartoš

Cupel is a small cup-like container used in the analysis of content of precious metals in ores and alloys – the so-called cupellation. Cupels can be made from various materials. The material of a cupel can influence its properties and therewith also the whole cupellation process. Testing of cupels made from various materials is topic of this paper. The basic “recipe” for the production of cupels was obtained from the *Treatise on Ores and Assaying* by Lazarus Ercker. This “recipe” was subsequently variously modified.

### **Early medieval processing of iron ores in central part of the Moravian Karst – archaeological evidence and smelting experiments in replicas of medieval bloomery furnaces**

Ondřej Merta, Martin Barák, Dominik Talla

Central part of the Moravian Karst is rich in evidence of early medieval iron production. Iron production workshops have already been excavated from the last quarter of the 19th century but the study of metallurgical devices and understanding of the technological procedures used were only enabled by archaeological research in the second half of the 20th century which was followed by several series of smelting experiments. They recently yielded reliable results which were also achieved by the use of authentic iron ores.

## **Slovakia**

### **New mining archaeological research in the Slovak Ore Mountains**

Jennifer Garner, Diana Modarressi-Tehrani

The Slovak Ore Mountains must at least since the 5th millennium BC have been an important supplier of raw materials for metal trade. Evidence thereof is mainly provided by intensive archaeometallurgical research carried out in this region in the past years. However, the questions concerning the use of the mining area as a whole, organisation of mining activities at individual localities with ore deposits and their positive identification as raw material sources remain open so far. Similarly, the trade routes connecting the mining area with its surroundings, the involvement of large settlements in river valleys as well as the overall Eneolithic and Bronze Age settlement structure are for the most part not yet clarified, either. Since 2011, the German Mining Museum at Bochum started to solve these open questions within a joint project coordinated by the Romano-Germanic Commission. These activities comprised metallurgical and archaeological research concerning the processing of metals at the settlement site Vráble – Fidvár and in the surrounding micro-region. Focus was also laid on mining archaeological survey as well as excavation of sites with ore deposits which have probably been exploited in the Bronze Age already (Špania Dolina-Piesky, Poniky, Ľubietová). Besides field research, samples were taken from Bronze Age metal artefacts stored in various museums, which will provide a base for study of the origin of artefacts in the future.

### **Profitability of state mines and smelteries in the Habsburg Monarchy at the end of the Seven Years' War**

Miroslav Lacko

In 1763, a so-called state inventory was finished, which recorded yields and expenditures of the Habsburg Monarchy at the end of the Seven Years' War. One of the volumes of this state inventory, which is dealing with coinage and mining, represents a valuable source of information about the situation with state mines and smelteries in the lands of the Monarchy. The aim of the paper is to analyse and evaluate the data on profitability of the then state mines and smelteries.

## **Friday evening and night**

### **Roštejn Castle (common by bus): open air barbecue and castle guide**

## **Saturday, October 8**

### **Field excursion (common by bus or individually by own cars):**

**Mediaeval open cast gold mines and placers Štůle nearby Humpolec  
castle ruine Orlík nearby Humpolec**