ANALYSIS OF METALLIC MATERIALS FROM MONEY FORGING SHOP / 15TH CENTURY A.D./ IN CAVE DRY HOLE, SPIŠSKÁ TEPLICA

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ANALÝZA KOVOVÝCH MATERIÁLOV Z PEŇAZOKAZECKEJ DIELNE /15.ST./ V JASKYNI SUCHÁ DIERA, SPIŠSKÁ TEPLICA

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Abstrakt

Článok prezentuje výsledky analýzy kovových nálezov z peňazokazeckej dielne, objavenej pri archeologických vykopávkach v jaskyni Suchá diera blízko dediny Spišská Teplica. Dielňa bola datovaná do 15. storočia. V nálezoch boli zistené falošné mince Mateja Korvína, vyrobené z medi a ďalšie kovové zbytky, slúžiace na ich prípravu: 5 medených polotovarov vo forme diskov, dva malé zliatky olova, jeden malý zliatok striebra, 8 železných fragmentov a 50 medených plieškov a kúskov rôznych tvarov. Mimo striebra všetky tieto kovy boli potvrdené pomocou energiovo disperznej elektrónovej mikroanalýzy. Meď a olovo sa používali priamo na výrobu mincí. Metalografická analýza železných fragmentov zistila železné materiály s rozdielnymi štruktúrami a vlastnosťami. Bolo zistené nenauhlíčené železo, mierne nauhlíčené železo, hlboko nauhlíčené železo, železo po kalení a popustení. Tieto fragmenty pochádzali z rôznych nástrojov v peňazokazeckej dielni, napr. Kladiva, sekáča, raznice.

Abstract

The paper presents results of analysis of metallic finds from money forging shop, discovered in archaeologic excavations of Dry Hole cave near Spišská Teplica village. The shop was dated to the 15th century. Energy dispersive electron microanalysis found fragments of copper sheets, lead castings and iron fragments. Metallographic analysis of the iron fragments recognised iron materials with different structures and properties. They were remnants of different tools in money forging shop – hammer, cutter, punch.

Key words: money forging shop; metallic objects; metallography.

Introduction

Village Spišská Teplica is situated on the south side of the Poprad valley in Spiš region, north – east Slovakia. The cave Dry Hole is situated about 4 km on south – west from the village. The cave has length 19.2 m, height 1.2 m and width 2.6 m. Archaeologic research found settlement of the cave by protohistoric paleolitic man, based on finds of stone tools and animal bones.

Next, medieval settlement of the cave is connected with a money forging shop. Its identification was the biggest surprise of the archaeologic research. This fact is evidenced besides a few pottery fragments by small amount of false coins of Matthias Corvin /1458 – 1490/ made of copper. Also materials from a whole production process were found: preparation of copper sheets, cutting them into bands and squares, preparation of copper discs, punching the coins with subsequent silver – plating. All false coins, found in the cave, were of poor quality, not suitable to insert them into currency. The remnants of fireplaces were also found in the cave. More detailed information on Dry Hole cave research is in the papers of M.Soják [1,2].

Besides the coins, a whole metallic inventory, found in the cave, consisted of 5 copper discs, two small lead castings, one small silver casting, 8 iron fragments and 50 copper sheets and pieces of different forms.

The aim of the work was to confirm the production of false coins in the shop.

Samples, submitted for analysis

Five satchets that contained fragments and castings of iron and non-ferrous metals were submitted for analysis. All samples represented finds from the excavations in 2000. Archaeologic description of the samples submitted for analysis:

Satchet 22: iron fragment /2.093 g/
Satchet 36: lead casting /5.294 g/
Satchet 60: lead or silver casting /0.55g/
Satchet 61/62: 4 iron fragments /4.526 g; 1.644 g; 0.637 g; 0.9649 g/
Satchet 71: copper cuttings /0.118 g; 0.264 g/

As follows from the weight of all samples, they were in form of very small pieces. It was the reason why for determination of their composition electron energy dispersive microanalysis was used instead of classical wet chemical analysis. Metallographic analysis of five iron fragments was also performed.

Chemical composition of samples

Electron energy dispersive microanalyser, connected to electron microscope Tesla BS 340, was used for analysis. It should be taken into consideration that the method is microanalysis, characterising only one small point with a diameter of a few microns. Prior to the analysis, inserting the sample into the electron microscope chamber, analysed surface was cleaned by fine grained metallographic grinding paper to remove contaminations and oxides from the surface.

Analysis of the sample from satchet 22 is in Fig.1. As can be seen from the Figure, the sample consisted of iron, no other major elements in the sample were found. Small contents of aluminium, silicon and calcium were brought into metal probably by small inclusions that interfered with the analysed spot.

Analysis of the sample from satchet 36 is in Fig.2. From the analysis follows the fragment was made of lead. Minor elements represent surface contaminations. The same facts resulted from analysis of the sample from satchet 60, analysed metal was lead. Analysis of four samples from satchet 61/62 found only iron in analysed metal.

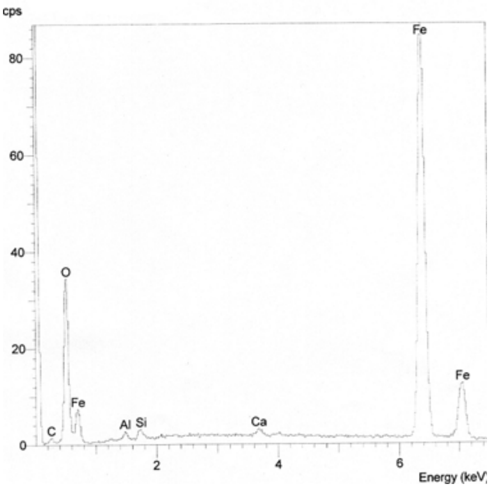

Fig.1 Analysis of sample from satchet 22: iron

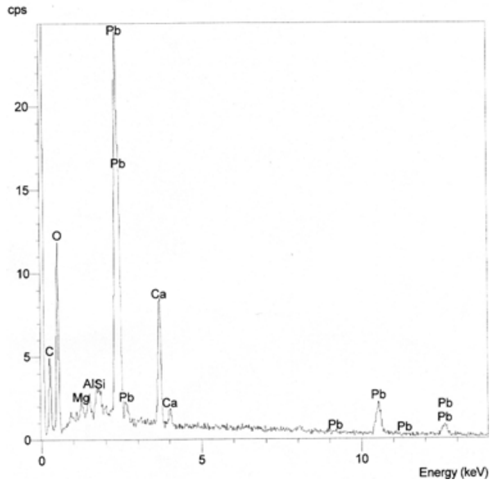

Fig.2 Analysis of sample from satchet 36: lead

Analysis of one of the samples from satchet 71 is in Fig.3. As can be seen from the Figure, analysed sheet cutting was made of copper. Analysis of the other cutting revealed also only copper.

It is important that all analyses fully matched the evaluations of the archaeologist.

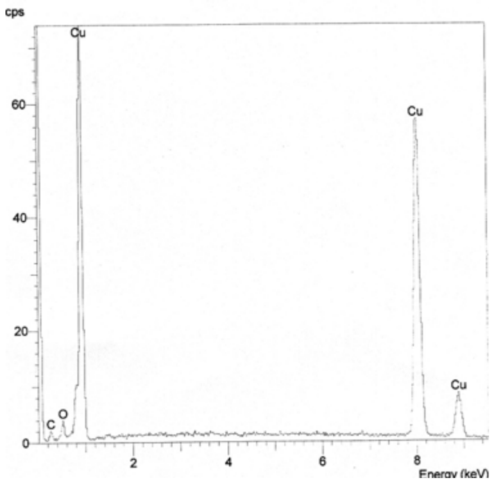

Fig.3 Analysis of sample from satchet 71: copper.

Metallographic analysis of iron samples

All five iron samples /satchets 22 and 61/62/ were submitted to metallographic analysis. All five samples were in form of little pieces damaged by corrosion. Preparation of high quality metallographic surfaces was difficult. After preparation of metallographic samples all metallographic surfaces were studied under metallographic light microscope Neophot 32. Inclusions, cracks and other discontinuities were observed and recorded by photography. Next the metallographic surfaces were etched by etching solution nital, the microstrucures, visualised by etching, were also studied with the help of microscope and documented by photography.

Sample 61a

The sample 61a was in highly corroded state. It contained metallic core surrounded by rust. Prior to etching many corrosion products, smithy inclusions particles and partly reacted scales were observed on the metallographic surface. Presence of smithy inclusions and partly reacted scales relates to smithy methods used from antiquity till to 18^{th} – 19^{th} centuries A.D. From it followed that analysed iron object was not a modern object. Etching visualised ferritic structures with deformed grains on the whole area of the metallographic surface, Fig.4. The object, represented by the analysed fragment, was made from non-carburised iron. Many kinds of objects of economic character were produced from non-carburised iron, mostly these that didn´t need to increase the mechanic properties by carburisation and thermal treatment methods.

Sample 61b

The sample 61b was also highly corroded, solid iron was found only in centre of the sample. Prior to etching, a small quantity of smithy inclusions was found on the metallographic surface. Etching by nital visualised structure of tempered martensite, as a result of tempering of martensite , on the whole surface, Fig.5. It meant the object, represented by the analysed fragment, was intensively carburised,and, after reheating, quenched. Next, it was subjected to tempering to remove strains in the quenched structure. From the metallographic analysis follows the object was assigned to demanding use.

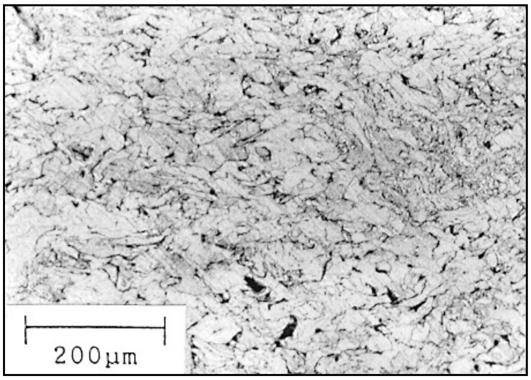

Fig.4 Ferritic structure in sample 61a

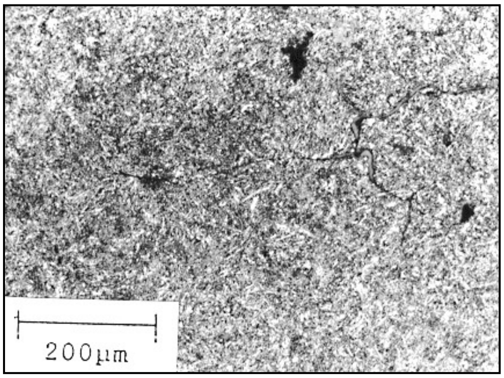

Fig.5 Structure of tempered martensite in sample 61b.

Sample 61c

The sample was not damaged by corrosion. No inclusions of both smithy and furnace slag were found on the metallographic surface prior to etching. Etching by nital visualised on most of the surface area ferritic – pearlitic fine grained structure, representing mildly carburised iron material. In one part of the surface area structure of tempered martensite was observed, Fig.6, indicating iron material with increased carbon content /about 0.4%/. There was no sharp boundary between the structures, but continuous change. It meant distribution of structures resulted from carburisation of the object, not from welding of two iron semiproducts with different contents of carbon during production of the object. The analysed fragment represented iron object, that was not very deeply carburised. The carburisation was not even.

Sample 61d

The sample was in highly corroded state, solid iron was found only in centre of the piece. No inclusions were found on the metallographic surface area prior to etching, iron material was very clean. Etching revealed ferritic – pearlitic structure with low content of pearlite, Fig.7, nearly on the whole area of the surface. It indicated mildly carburised iron material with about 0.2% C. Only in one place by the surface side the structure with somewhat higher portion of pearlite was observed, Fig.8, indicating deeper carburisation of iron. Character of structure of this sample was very similar to structure of the sample 61c.

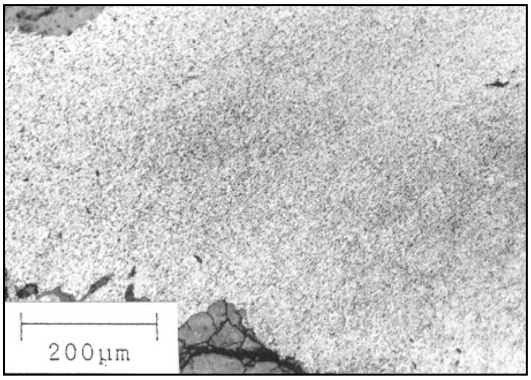

Fig.6 Two structures with different carbon contents in sample 61c

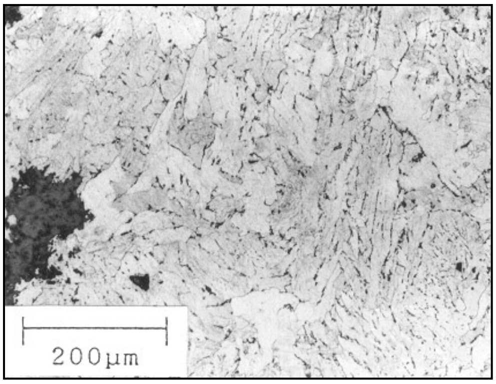

Fig.7 Ferritic – pearlitic structure with low content of pearlite in sample 61d

Sample 22

The sample was in form of iron sheet fragment. Prior to etching thin bands of smithy inclusions were found on metallographic surface of the sample, Fig.9. The bands resulted from heavy mechanical forming. After etching pearlitic structure of intensively carburised iron material with fine network of secondary cementite, Fig.10, was observed on nearly whole area of the metallographic surface. Only on one end of the surface two different structures were found: pearlitic, that continued from the other part of the surface, and ferritic or ferritic – pearlitic structure of non-carburised or mildly carburised iron, Fig.11. Sharp boundary between the structures was observed, as can be seen from the Figure, suggesting welding of non-carburised iron semiproduct into the carburised one. Such technology in production of thin iron sheet is not clear. The use of the iron sheet and the aim of its deep carburisation are not explained.

Discussion of the results

Analysis of metallic fragments, made by energy dispersive electron microanalysis, confirmed an assumption of the archaeologist about their compositions. Copper sheets and lead castings were used directly in production of coins. Iron fragments were remnants of tools used in money forging shop. The fragments had different structures and properties. They detected non-carburised iron, mildly carburised iron, deeply carburised iron, carburised, quenched and tempered iron. Deeply carburised and quenched pieces could be remnants of hammer, cutter, punch.

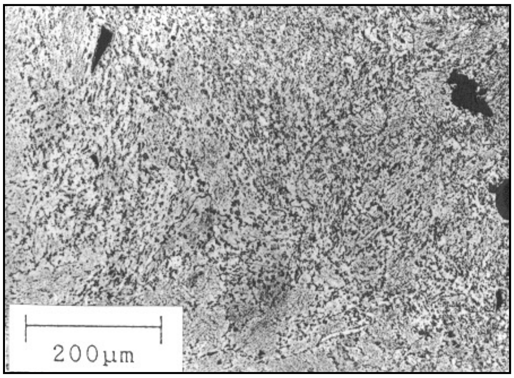

Fig.8 Ferritic – pearlitic structure with higher content of pearlite in sample 61d

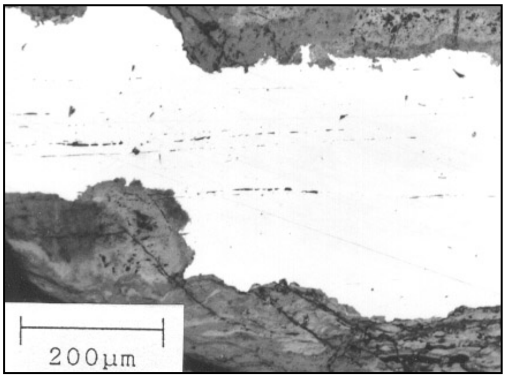

Fig.9 Bands of smithy inclusions in sample 22

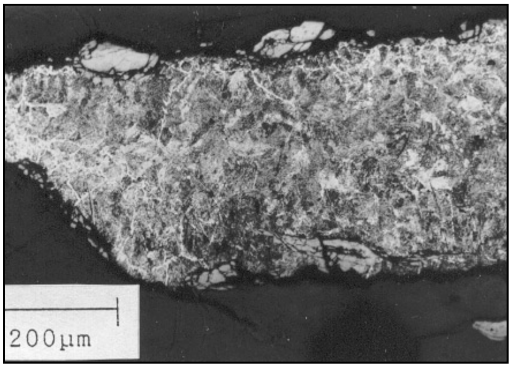

Fig.10 Pearlitic structure in sample 22.

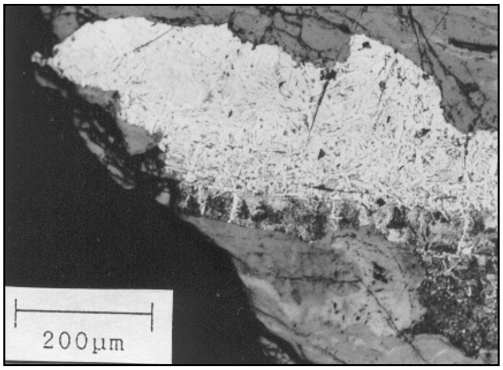

Fig.11 Two structures with different contents of carbon in sample 22.

Conclusions

The paper presents analysis of metallic finds, resulting from archaeologic excavations of money forging shop in Dry Hole cave, dated to the 15^{th} century. Both analysis of chemical composition and metallographic analysis of the finds were performed. The most important results are as follows:

1. Iron fragments, fragments of copper sheets and fragments of lead castings were recognised by analysis. Both copper and lead were used for production of false coins.
2. Iron fragments had different structures and properties. Structures of non-carburised, mildy carburised, deeply carburised, carburised, quenched and tempered iron were recognised by metallographic analysis.
3. Iron sheet, made of two iron semiproducts with different carbon contents, was recognised by metallography. Its production method and use were unclear.

4. This analysis is the first analysis of money forging shop finds in Slovakia, there exists no base for comparison.Unfortunately, analysed finds were in form of corroded fragments, not the whole objects. The results do not allow to make the conclusions related to variety of tools, used in the shop.

Literature

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