# AN EARLY MEDIEVAL BUCKLE WITH CLOISONNÉ DECORATION

## THE LOCALIZATION OF WORKSHOP AREA BY ARCHAEOMETRICAL INVESTIGATION

# EGY KORA KÖZÉPKORI CLOISONNÉ DÍSZES ÖVCSAT

## A MŰHELYKÖRZET LOKALIZÁLÁSA ARCHEOMETRIAI MÓDSZEREKKEL

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## Abstract

*The cloisonné buckle found as a stray find at Rákóczifalva-Kastélydomb close to Szolnok adds to the so-called "Mediterranean buckles" dated to the end of 5th century, beginning of 6th century. Finds of this type were designated in the literature by its supposed origin deduced from its main spread area and from decorating tradition. However, by expanding the archaeological material this interpretation became obviously too general, determination of origin needs refinement because of the cultural diversity in the Mediterranean region. Moreover, it became likewise clear that besides real Mediterranean products, artifacts with Mediterranean character but different origin may also be supposed. Thus, the primary question apart from the further clarification of the Mediterranean origin is concerning how the products made by ancient goldsmith tradition influenced the material culture of barbarian peoples living at the periphery of the Mediterranean region. It means among others the decision about how the particular exemplars are to be considered, which process led to their appearance: are those "import" of a foreign, non local product; local "imitation" of that, or "integration" of the artefact type or the style in the local culture? Besides stylistic studies reliable differentiation is based on technological observations and especially on analysis of material composition.*

*Due to its good condition and accessibility, general analysis of the buckle is expected to explain several disputed issues and clarify subsequent unknown details. The purpose of the archaeometrical investigation performed on the object is to contribute to the fundamental problem of workshop localization, i.e. to identify workshop tradition and to localize the workshop area. In this study we are making an attempt to reconstruct circumstances and conditions of the production of the find by examining the used raw materials and technological details as thorough as possible. The results cover the identification of the base alloy and soldering material as well as of the inlay and filling material (so-called tenax) of the mounts. This information makes the archaeological interpretation of the discussed find more convincing.*

## Kivonat

*A Szolnok közelében fekvő Rákóczifalva-Kastélydombon előkerült cloisonné díszes övcsat az ún. mediterrán csatok eddig számba vett körét gyarapítja. Az 5. század végére, 6. század elejére keltezhető tárgytípus mediterrán megnevezése a fő elterjedési terület, illetve a díszítésbeli és viseleti hagyományok alapján feltételezett eredet miatt jelent meg és állandósult a szakirodalomban. A leletanyag gyarapodásával azonban egyre nyilvánvalóbbá válik, hogy ez az értelmezés túlzottan általános – az eredet meghatározása pontosításra szorul a Mediterráneum térségének kulturális sokszínűsége miatt. Emellett az is világossá vált, hogy a ténylegesen mediterrán készítésű darabokon kívül mediterrán jellegű, de eltérő eredetű tárgyakkal is számolhatunk. A mediterrán eredet pontosítása mellett tehát a legfőbb feladat megvizsgálni, hogy az antik hagyományú műhelyek termékei hogyan hatottak a periférián élő barbárok leletanyagára. Ez többek között annak eldöntését is jelenti, hogy az egyes darabok miként, milyen folyamat részeként azonosíthatók: nem helyi eredetű, idegen tárgy behozatala: „import", annak helyben készült utánzata: „imitáció", vagy a stílus illetve a* *tárgytípus meghonosodása a helybeli anyagi kultúrában: „integráció”. A megbízható elkülönítéshez az összehasonlító stilisztikai elemzések mellett a technológiai és különösen az anyagvizsgálati megfigyelések szolgálnak alapvető támpontul.*

*Jó megtartásának és hozzáférhetőségének ismeretében sejteni lehetett, hogy a rákóczifalvai csat átfogó elemzése számos vitatott kérdésre ad majd magyarázatot, esetleg újabb ismeretlen részletekre derít fényt. A lelet archeometriai elemzésével az alapproblémaként felmerülő műhelykérdés árnyalásához járulunk hozzá. Jelen tanulmányban a nyersanyagok valamint a technológiai részletek minél alaposabb megismerése alapján kísérletet teszünk a készítés körülményeinek és feltételeinek rekonstruálására, vagyis a műhelyhagyomány valamint a műhelykörzet meghatározására. Az eredmények között tartható számon a csat alapanyagának, forrasztóanyagának, a foglalatokat kitöltő, szilárdító anyagnak, az ún. kittmasszának (tenax), illetve a berakás fajtájának azonosítása. Mindezek segítségével lehetővé válik a tárgy megbízhatóbb régészeti értékelése.*

KEYWORDS: EARLY MIDDLE AGE, CLOISONNÉ JEWELLERY, MEDITERRANEAN BUCKLES, NON-DESTRUCTIVE ANALYTICAL INVESTIGATION, LOCALIZATION OF WORKSHOP AREA

KULCSSZAVAK: KORA KÖZÉPKOR, CLOISONNÉ DÍSZES ÖTVÖSTÁRGYAK, MEDITERRÁN CSATOK, RONCSOLÁSMENTES ANALITIKAI VIZSGÁLATOK, MŰHELYKÖRZET-LOKALIZÁLÁS

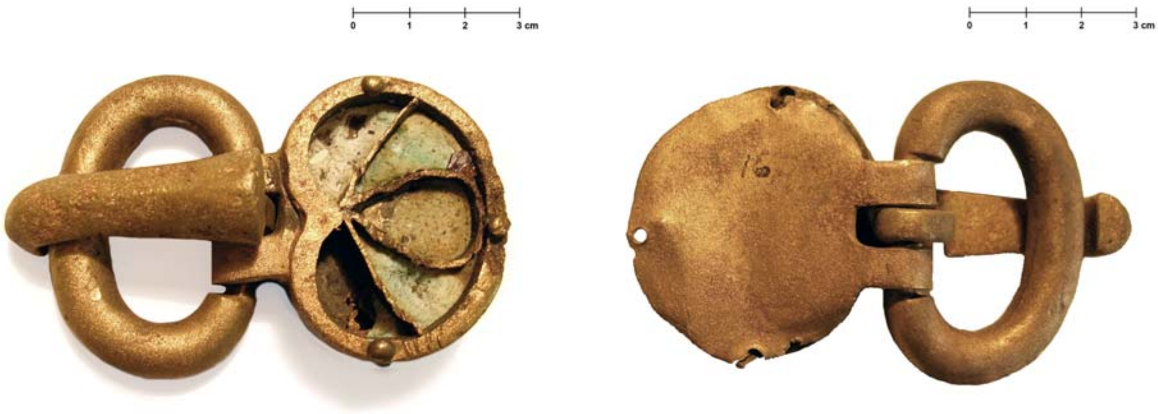

**Fig. 1.:** The buckle from Rákóczifalva-Kastélydomb

**1. ábra:** A Rákóczifalva-kastélydombi csat

## *Introduction*

*Rákóczifalva* (Jász-Nagykun-Szolnok county) and other sites surrounding Szolnok adds to archaeological material of the Carpathian Basin and especially the early medieval material for almost fifty years. The inlay decorated, kidney shaped belt buckle discussed in this study was found as a stray find during sand mining activities in the 1960's, west from the present-day town, at the so called *Kastélydomb* (**Fig. 1**). The contextless find, considering the nearby excavated fragment of a contemporary cemetery could be interpreted as part of the grave goods of a Gepidic man (Cseh 1985, 4-5.). By its typological and stylistic characteristics, it belongs to the so called *Mediterranean buckles* dated to the end of the 5$^{th}$ century, beginning of the 6$^{th}$ century. Most of the buckles within this group are precious metal or copper alloy castings, mainly characterized by their *cloisonné* decoration. (In the so called cloisonné work, thin strips of metal are soldered onto a metal plate to produce cells, “cloisons” into which inlays are set.) Apart from their stylistic similarities, significant differences are to be noticed regarding both the used materials and the applied goldsmith technique. Diversity is supposedly due to different traditions of the goldsmith craft and the accessible raw material of the particular workshop areas. Beyond the Mediterranean coast, examples of this group appeared widespread also north of the Alps (Böhme 1994, Abb. 23.). According to the grave goods excavated in this region, mainly warriors were the owners wearing them as a part of their equipment and even if they were members of distinct Germanic peoples, they had direct connections to the Mediterranean world, the generally supposed origin of the buckles. During the last fifteen years several archaeological studies focused on the interpretation of origin and spread of these objects; even though the distinction between workshops relating particular areas was not solved sufficiently (Kazanski 1994; Böhme 1994; Quast 1999).

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**Table 1:** Exact parameters of the analytical investigations

**1. táblázat:** Az analitikai vizsgálatok paraméterei

| **X-ray Fluorescent Spectroscope (XRF)** | **X-ray Diffractometer (XRD)** |
| --- | --- |
| Institute of Materials and Environmental Chemistry | Institute of Geochemical Research |
| Hungarian Academy of Sciences | Hungarian Academy of Sciences |
| type: Thermo Scientific Niton XL3t 900 | type: Phillips PW 1730 |
| He flow, portable | data processing software: PC-APD |
| spectrometer: Thermo Niton XRF Analyser | radiation: Cu Kα |
| detector: energy dispersive (EDS) | current intensity: 35mA |
| voltage: 50kV | voltage: 45kV |
| anode: silver | monochromator: graphite |
| sample preparation: none | sample preparation: grinding |
| | |
| **Scanning Electron Microscope (SEM)** | **Electron Probe micro-analyser (EPMA)** |
| Archaeological Research Laboratory | Institute of Geochemical Research |
| Stockholm University | Hungarian Academy of Sciences |
| type: LEO 1455VP | type: JEOL Superprobe 733 |
| spectrometer: Oxford Instruments INCAEnergy | spectrometer: Oxford Instruments INCAEnergy 200 |
| Analyser Navigator, detector: energy dispersive (EDS) | detector: energy dispersive (EDS) |
| cathode: wolfram | cathode: wolfram |
| voltage: 20kV | voltage: 20kV |
| sample preparation: none, without evaporation | sample preparation: none, without evaporation |
| | |
| **Dispersive Raman Spectrophotometer (Raman)** | |
| Institute for Forensic Sciences | |
| type: HORIBA Jobin Yvon, LabRAM ARAMIS | |
| frequencies of laser light: 532 nm | |
| objective: 50x | |
| grating: 300 line/mm | |
| sample preparation: none | |

The primary questions are addressing circumstances of production. The purpose of the archaeometrical investigation performed on the buckle from Rákóczifalva is to contribute to the fundamental problem of workshop localization that requires further clarification – our goal was to identify workshop tradition and to localize the workshop area as close as possible. Importance of the find is mainly due to the ideal conditions it offers for an archaeological, art historical and scientific analysis, i.e. accessibility, availability, proper method of conservation and good condition of the object; furthermore the lack of the inlays in the cloisonné work. The latter is to be emphasized, since in the case of immaculate, entire finds characteristics of raw materials and steps of the production process are more difficult to identify; thus, the one-time damage helps in fact to "see into" the object.

## *Methods*

Composite construction and diverse components of the buckle indicated the combination of various investigations.

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**Fig. 2.:** Single remained fragment of the inlay decoration

**2. ábra:** A rekeszdísz egyetlen, töredékesen megmaradt berakása

Non-destructivity was fundamental regarding the different analytical methods. Following the first observation carried out on optical microscope our investigation included several microanalytical techniques in order to determine the chemical as well as phase composition (exact parameters of analysis in **Table 1**).

## Elements made of metal

Besides identification of the main alloy, the analysis was expected to determine composition of all elements made of metal such as the fastening rivets, the partly preserved solder and the fragmentary underlay of plain foil. The quantitative chemical analysis was carried out on a portable X-ray fluorescence spectrometer (XRF) in a surprisingly uncomplicated and quick way. The mobile instrument proved to be appropriate especially for analysing well accessible and plain details (e.g. in the case of the back-plate of the object). Moreover, it provided a significant amount of valuable data even about the tiny details of inner, deeper areas. As this method was not applied until the recent times in our country for analysing this kind of archaeological artifacts, control-measurements were also carried out on electron probe micro-analyser (EPMA) in order to avoid the possible faults. The accordance of results verifies measurements and makes the interpretation apparent.

## The inlay

Only a small fragment of red inlay remained in the incomplete cloisonné work indicating the character of one-time decoration (**Fig. 2**).

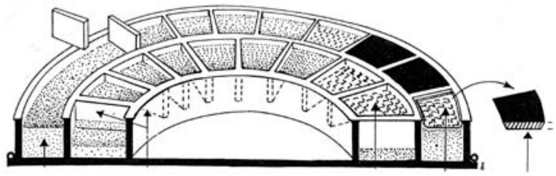

**Fig. 3.:** Construction of cloisonné decoration (Arrhenius 1985, Fig. 1.)

**3. ábra:** A *cloisonné* foglalás szerkezeti rajza (Arrhenius 1985, Fig. 1.)

Identification of the inlay material was problematic due to several reasons, e.g. its small size, mounted position and the lacquer coat on its surface left by conservation treatment. There was no chance to observe in the half millimetre thick piece either characteristic inclusions of minerals or gas-bubbles typical for glasses. The position of cell walls did not allow the use of refractometer either. The problem finally could have been solved by another method more rarely applied for this purpose. In the course of dispersive Raman spectrophotometric analysis laser light penetrated through the lacquer coat, and the confocal Raman microscope permitted us to interpret information provided by laser light backscattering from underneath. This method typically does not determinate chemical or phase composition but the otherwise inaccessible molecular composition that is specific for different materials.

## Tenax (filling material)

Due to the regular low thickness of inlays typical for cloisonné goldsmith works, use of the so called *tenax* for filling cells was a generally adopted practice in the discussed period (**Fig. 3**).

The usually 3-5 mm thick layer of this filling and firming substance was made of pulverized minerals and organic binder.

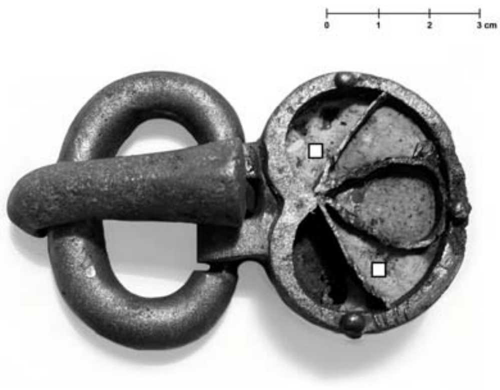

**Fig. 4.:** Spots of the tenax-sampling

**4. ábra:** A mintavételezés helyei a kitöltőanyagon (kittmassza, tenax)

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**Fig. 5.:** Golden lustre on the surface of the tongue

**5. ábra:** A csattüske felületének aranyló fénye

Different components could be compounded by a recipe adapted to the accessible raw materials of the particular region. Composition analysis of various types of tenax leads to valuable contribution regarding the problem of production site localization (Arrhenius 1985, 84-187.; Horváth in press), since its results are independent from typological aspects. These give the intention and background for the investigation of tenax samples from the damaged, easily accessible cells of the discussed buckle. The samples from the hardened tenax (amount of a just a few $mm^2$) could be removed by a scalpel (**Fig. 4**). The preliminary optical microscopic observation was followed by scanning electron microscope (SEM) and X-ray diffraction (XRD) analysis – sample preparation required solely by the latter. The electron microscope analysis was carried out in low vacuum mode, focusing both on single mineral grains and on longer lines covering larger areas as well. Repeated measurements were performed on the chosen grains with both instruments in order to avoid false identification.

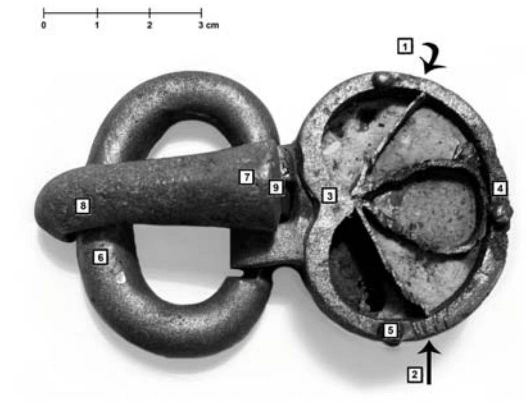


**Fig. 6.:** Measuring points of the metal analysis

**6. ábra:** A fémvizsgálat során felvett mérési pontok

### *Results*

## Results of metal analysis

In spite of the first documentation of the buckle describing it as a massive bronze casting, its golden shine and yellowish colour showed up already by our first survey, especially in those areas where traces left by wearing appeared strongly (**Fig. 5**). Based on the observed properties earlier identification of the main material became questionable. The detailed analysis led to convincing results and supported not only our preliminary assumption but also the choice and efficiency of applied techniques. It directed our attention to the possibility that the designation "bronze" at other artifacts could also be used as an impression without the necessary conviction, also missing later revision. The data measured at nine different points on the surface clarified that the discussed object is actually a brass casting (**Fig. 6-7**).

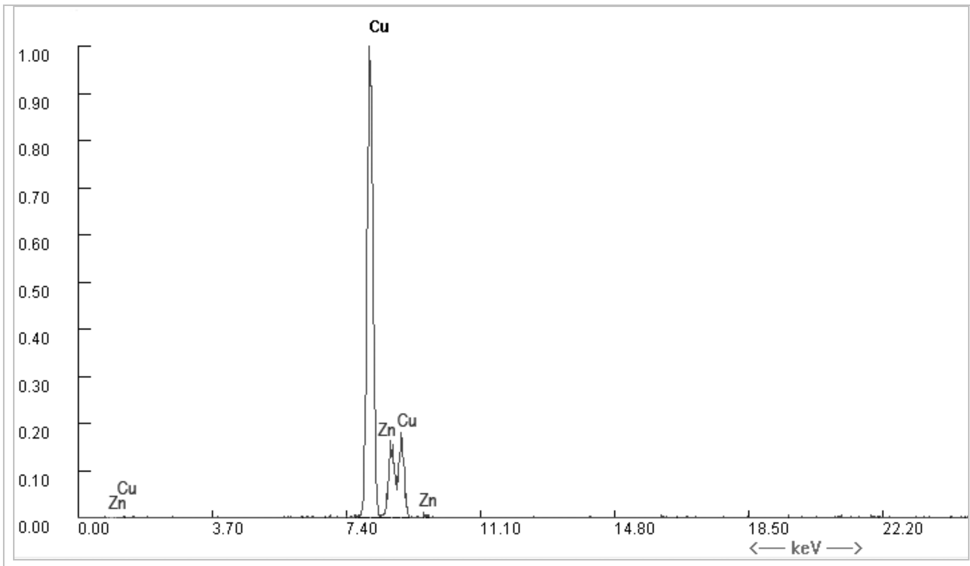


**Fig. 7.:** XRF spectrum of the base alloy

**7. ábra:** Az alapötvözet XRF-spektruma

**Table 2:** XRF results of metal analysis

**2. táblázat:** Az XRF elemanalízis eredményei

| Measurement points | Elementary composition (atom%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Zn** | **Cu** | **Ni** | **Sn** | **Pb** | **Fe** | **Au** | **TOTAL** |
| **Plaque of buckle** | | | | | | | | |
| 1. back-plate | 10.53 | 88.45 | 0.08 | < LOD | < LOD | < LOD | < LOD | **99,06** |
| 2. side | 10.33 | 87.02 | 0.09 | 0.11 | < LOD | < LOD | < LOD | **97,55** |
| 3. frame/1 | 10.65 | 88.14 | 0.10 | < LOD | < LOD | < LOD | < LOD | **98,89** |
| 4. frame/2 | 10.44 | 88.14 | 0.10 | < LOD | < LOD | < LOD | < LOD | **98,68** |
| 5. rivet | 10.41 | 87.11 | 0.10 | < LOD | < LOD | < LOD | 0.70 | **98,32** |
| **Loop of buckle** | | | | | | | | |
| 6. loop | 10.34 | 86.8 | 0.14 | 0.39 | 0.17 | 0.10 | < LOD | **97,94** |
| **Tongue of buckle** | | | | | | | | |
| 7. tongue/1 | 15.85 | 81.36 | 0.10 | 0.35 | 0.03 | 0.13 | < LOD | **97,82** |
| 8. tongue/2 | 14.84 | 82.69 | 0.08 | 0.43 | 0.08 | 0.12 | < LOD | **98,24** |
| 9. base of tongue | 15.42 | 82.98 | 0.07 | 0.33 | 0.05 | 0.10 | < LOD | **98,95** |
| **Maximum** | 15.85 | 88.45 | 0.07 | 0.43 | 0.17 | 0.14 | 0.70 | |
| **Minimum** | 10.33 | 81.36 | 0.14 | 0.11 | 0.03 | 0.10 | 0.70 | |

LOD: Limit of detection


**Fig. 8.:** Cloisonné work of the buckle, the drop shaped cell

**8. ábra:** A csatot díszítő rekeszmű részlete – a csepp alakú rekesz

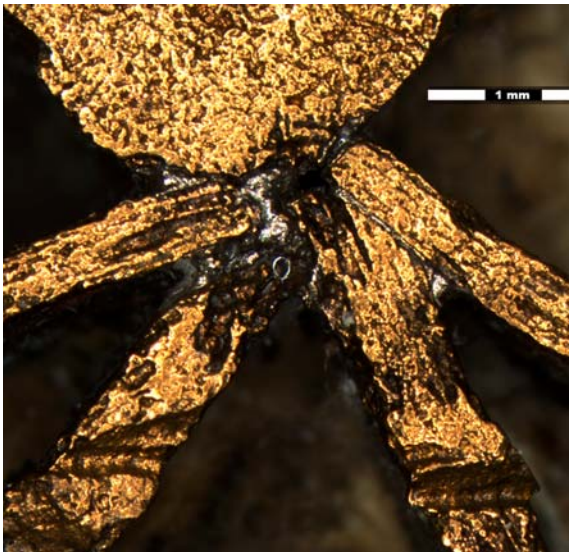


**Fig. 9.:** Soldering material at the joining point of cell walls

**9. ábra:** Forrasztóanyag a rekeszfalak találkozásánál

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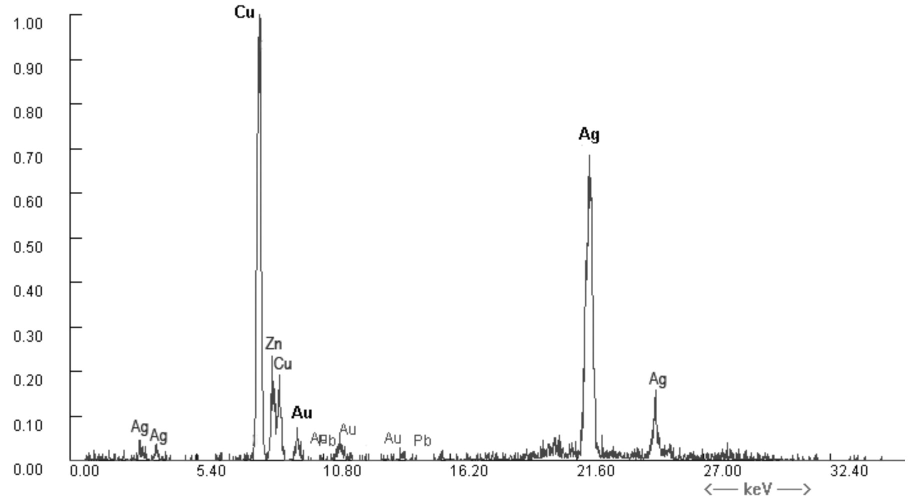


**Fig. 10.:**

XRF spectrum of the silver-copper solder

**10. ábra:**

Az ezüst-réz forrasz XRF-spektruma

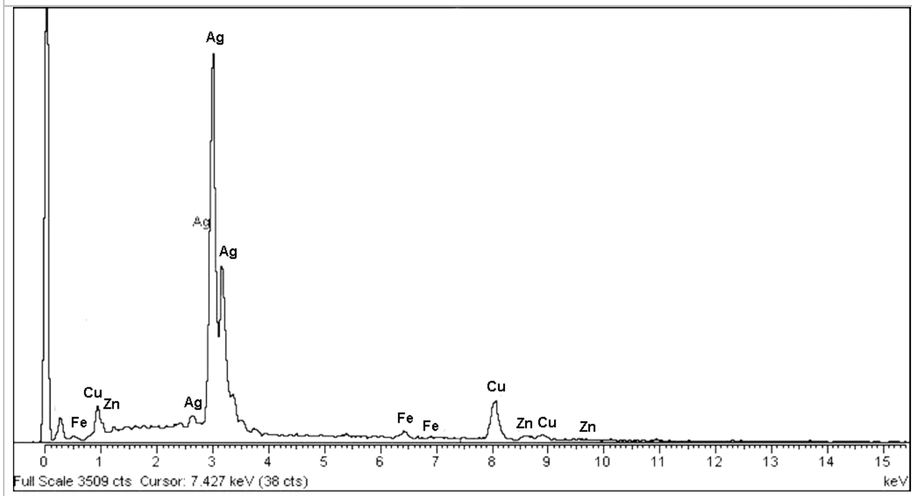


**Fig. 11.:**

EPMA spectrum of the silver-copper solder

**11. ábra:**

Az ezüst-réz forrasz EPMA-spektruma

The cloisonné decorated plate, the loop and the fastening rivets have almost identical composition, in case of the tongue ratio of the Zn is slightly increased against Cu (**Table 2**). As a second benefit analysis identified soldering material as well. The thin cell walls dividing cloisonné work in five parts run into a single joining point, in this area by proper magnification a metallic gray solder was noticeable (**Fig. 8-9**). The preliminary XRF measurements have shown here a higher silver-content, while the spectrum of microprobe analysis carried out under better conditions pointed out silver and copper (**Fig. 10-11**). By the joint of the kidney shaped frame and back-plate the same metallic gray material was observed. Although this area was not analysed, most likely a similar Ag-Cu solder was used here as well. This type of solder led to a so called *hard soldering* that provided a stronger, refractory joint due to the higher melting-point of its components (Toll 1968, 318, 320.; Brepohl 1994, 321.).

The third separate element, i.e. the underlay of thin, plain foil remained fragmentally in the central, drop shape cell – it was intended to enhance luminosity of the one-time inlay by reflecting the light (**Fig. 8**).

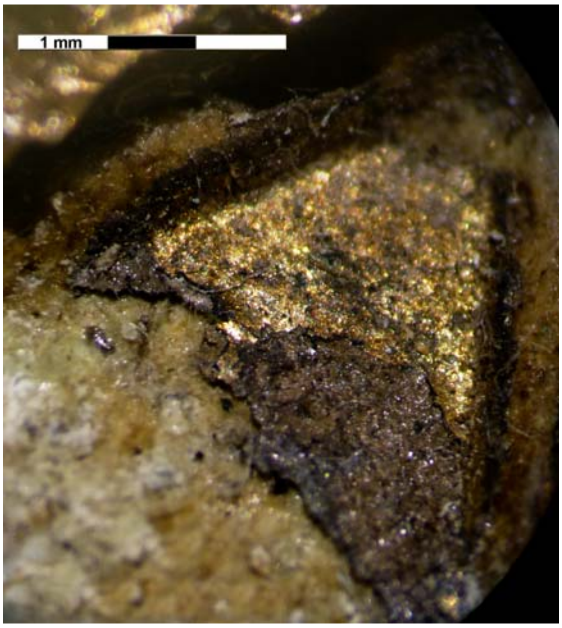


**Fig. 12.:** Single remained fragment of the underlay foils

**12. ábra:** Az egyetlen, töredékesen megmaradt alátétlemez fénymikroszkópos felvétele

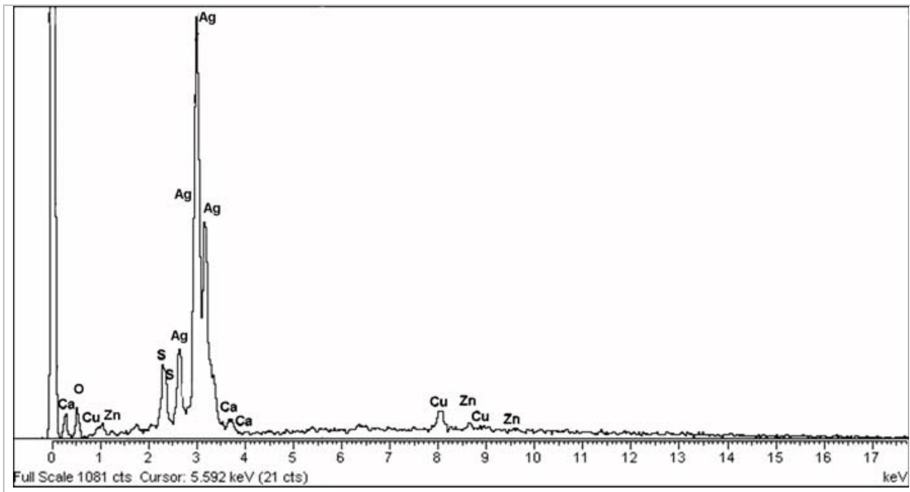


**Fig. 13.:**

EPMA spectrum of the underlay foil

**13. ábra:**

Az alátétlemez EPMA-spektruma

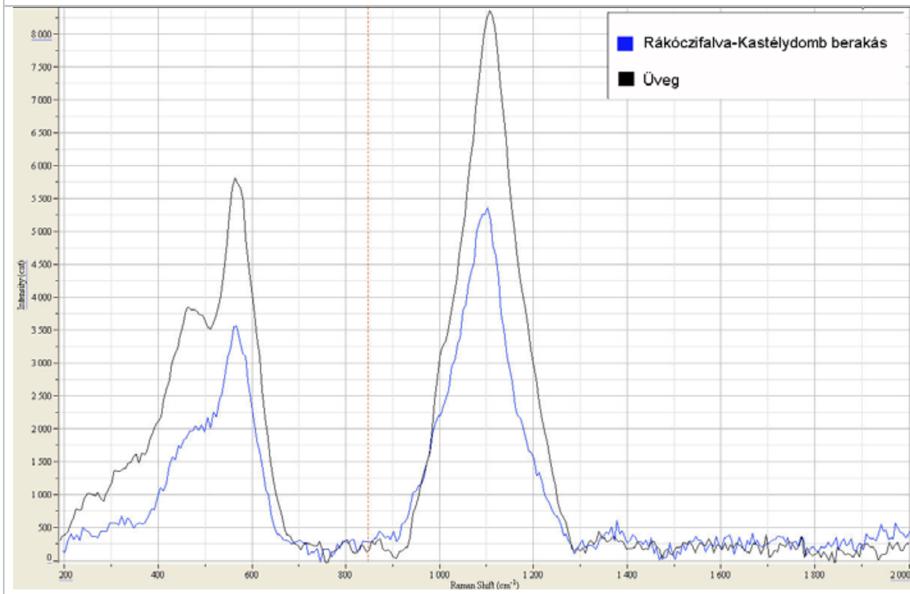


**Fig. 14.:**

Raman spectra of the glass inlay and the reference material

**14. ábra:**

Az üvegberakás és a referencia anyag Raman-spektruma

Observation trough microscope have shown the largest part of the surface having the same shine and colour as the main alloy; but underneath in a smaller part a dark, matt oxide layer was apparent (**Fig. 12**). Based on the measurements, the underlay consists of two strongly compressed metal foils made of silver and brass (**Fig. 13**), in fact the latter increased shine and colour of the mounted precious stone or glass plate.

## Results of inlay analysis

As a result of the Raman spectrophotometric analysis, the fragmentary remained inlay could be identified as glass. The resulting spectrum has displayed characteristic frequencies for Raman-active chemical bindings typical for components of glass (**Fig. 14**). However, under the given conditions, determination of the type of glass, i.e. analysis of chemical composition and raw material could not be conducted in a non-destructive way.

## Results of tenax analysis

The image analysis performed by optical and scanning electron microscope has clearly shown the microstructure of tenax. The optical microscopic survey has shown some darker grain mixed in the brighter mass, and a blue, tiny chip was noticeable as well (**Fig. 19**). The electron microscopic investigation supported the differentiation between the main component and contamination both morphologically and by chemical composition. The analysis has proven that the specimens consist of finely grinded mineral grains, and by higher magnification their lamellar crystal structure was also observable (**Fig. 15-18**).

Inhomogeneity and irregular surface of the samples did not allow quantitative analysis of chemical composition, making the results qualitative. The resulting spectra with S-Ca-O dominance, considering the approximate proportions led to a preliminary identification as *gypsum* ($CaSO_4$ * $H_2O$) (**Fig. 20**).

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**Fig. 15.:** Micrograph of accessible tenax in situ in the cells

**15. ábra:** A rekeszekben in situ módon hozzáférhető tenax fénymikroszkópos felvétele

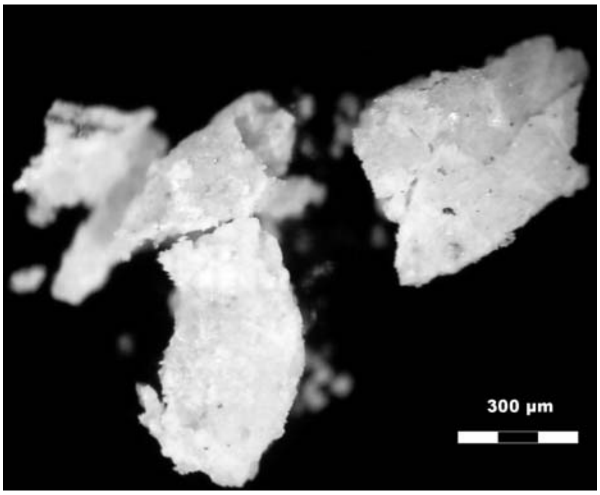


**Fig. 16:** Micrograph of grains of the tenax samples

**16. ábra:** A tenax-minták szemcséi fénymikroszkópos nagyítás mellett

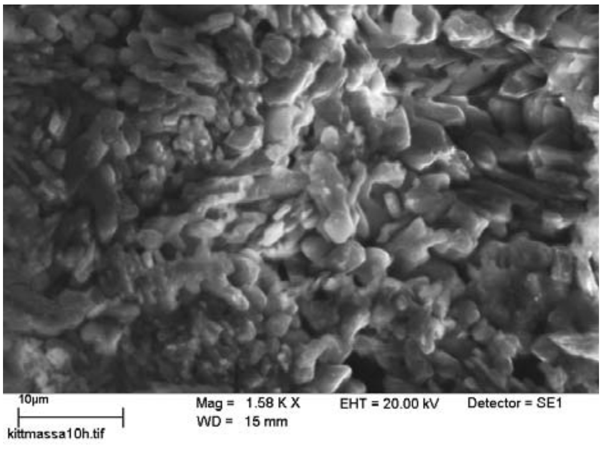


**Fig. 17:** Lamellar crystal structure of the grains (SEM)

**17. ábra:** A szemcsék lemezes kristályszerkezete (SEM)

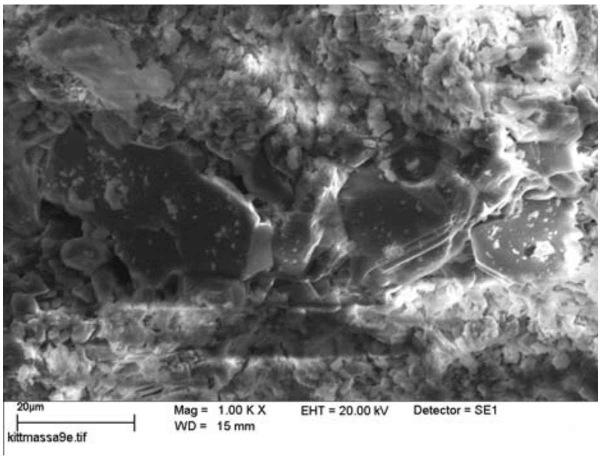


**Fig. 18:** Lamellar crystal structure of the grains (SEM)

**18. ábra:** A szemcsék lemezes kristályszerkezete (SEM)

Regarding chemical composition of the morphologically differentiable tiny grains mixed in the mass, higher amount of Si and O has shown up, assuming the existence of *quartz* (quartz sand, $SiO_2$). Low amount of these grains is supported by their sparse existence and by the fact that X-ray diffraction was unable to detect them as a significant component. These altogether imply contamination during use or rather after it in the soil, but not intended addition, during production. The spectrum has shown the blue chip being glass – besides O and Si (quartz sand) it contains significant amount of Mg and Al as well as trace of Na and K (**Fig. 21-22**). Incompleteness of cloisonné work makes colour of only one inlay known.

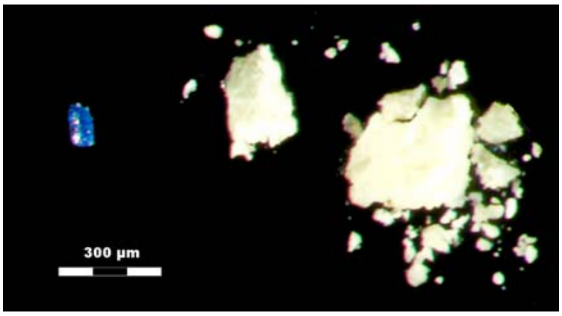


**Fig. 19:** Blue colour of chip mixed into the bright mass

**19. ábra:** A világos színű masszába keveredett apró kék színű törmelék

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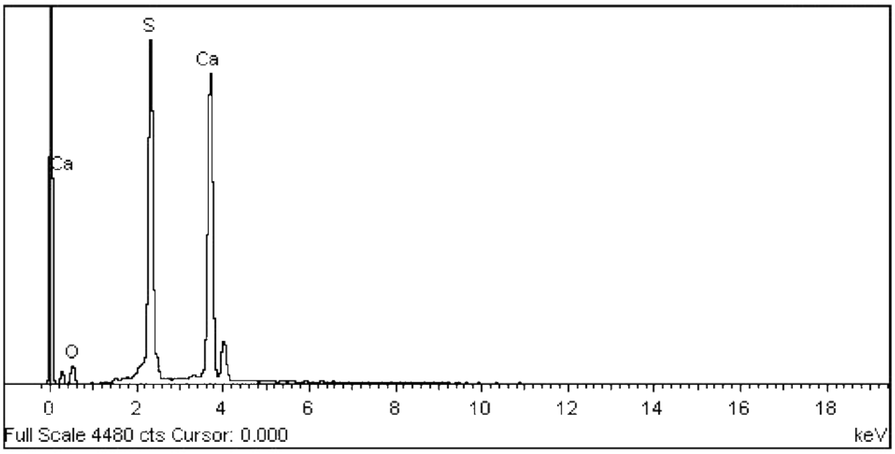


**Fig. 20:**

SEM spectrum of the tenax (gypsum)

**20. ábra:**

A tenax SEM-spektruma (gipsz)

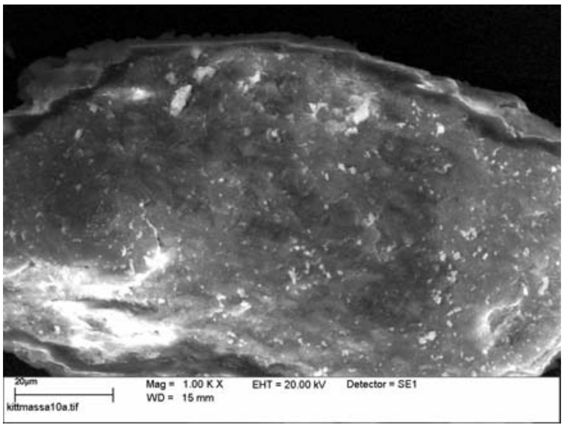

**Fig. 21:** Micrograph of the chip of glass (SEM)

**21. ábra:** A kék színű üvegdarabról készült mikroszkópos felvétel (SEM)

However, due to its size and position, this tiny chip could not be a remainder of the lost inlays, it was more likely mixed into the mass during the preparation process, accidentally as workshop debris.

Previous assumptions regarding the main mineral composition were verified by the X-ray diffraction analysis. The analysis has differentiated only one dominant mineral in the samples: the gypsum, as well as its anhydrous variant, the *anhydrite* (**Fig. 23**). Results presented by these two different analytical methods clearly prove that the tenax was made of gypsum, which as an ideal binder was perfect for firming cells of the cloisonné work. Organic binders could not be detected by the applied instruments, even though their one-time use cannot be excluded. The compact, conglomerate, solid state could be achieved by pulverizing then heating the mineral and finally adding water to it. During consolidation, the ductile, soft paste becomes massive, cement-like material. Its extreme hardness could be noticed even at the sampling.

## *Discussion – archaeological interpretation*

### Elements made of metal

Archaeometrical investigation of the discussed find apparently demonstrated that on the one hand the buckle is a brass casting of good quality, and on the other hand elements of its cloisonné work are joined by hard soldering. In contrast to the bronze, ductility of brass alloys is excellent due to their inherent capacity for plastic deformation. This mechanical property was especially important regarding the joining-works of the buckle; the double strap attachment starting at the upper border of the kidney shape plate, including loop and tongue folds back on the backside as a thinned plate (**Fig. 24**). However, alloying process of brass was much more complicated as of bronze (Craddock & Eckstein 2003). It was commonly known already in the antiquity and the process is also documented in several historical sources among others in the "goldsmith handbook" *De diversis artibus* written by *Theophilus Presbyter* (~1070-1125). According to the description, smithsonite ($ZnCO_3$, formerly known as calamine) was used for preparing brass; furthermore alloying zinc and copper took much more time than tin and copper in case of bronze (Brephol 1987, 198-199.). The same source is relevant while interpreting composition results of soldering material – according to the recipe-like description in order to produce the desirable material, two parts of pure silver and one part of copper were to be mixed with borax. On the whole it can be stated that although the buckle was not made of precious metal, due to the advantageous properties of its alloy as well as the time-consuming workmanship it could convey the impression of being a valuable apparel element.

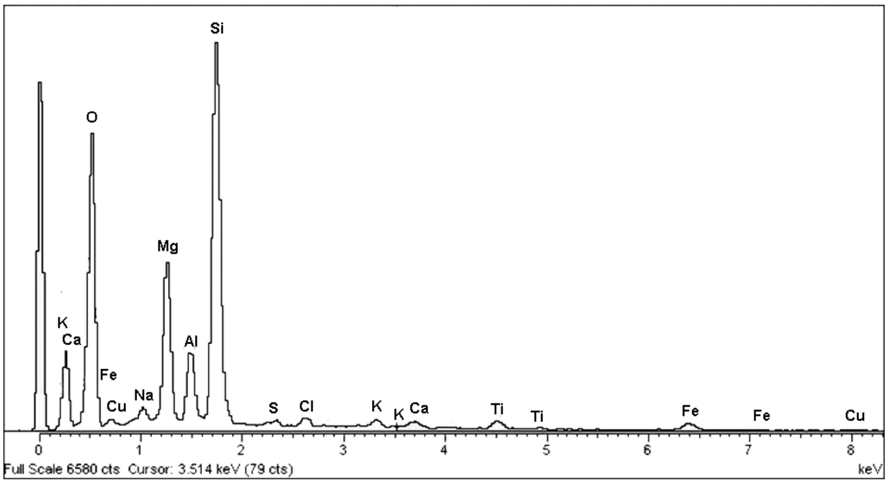


**Fig. 22:** SEM spectrum of the chip of glass

**22. ábra:** A kék üvegdarab SEM-spektruma

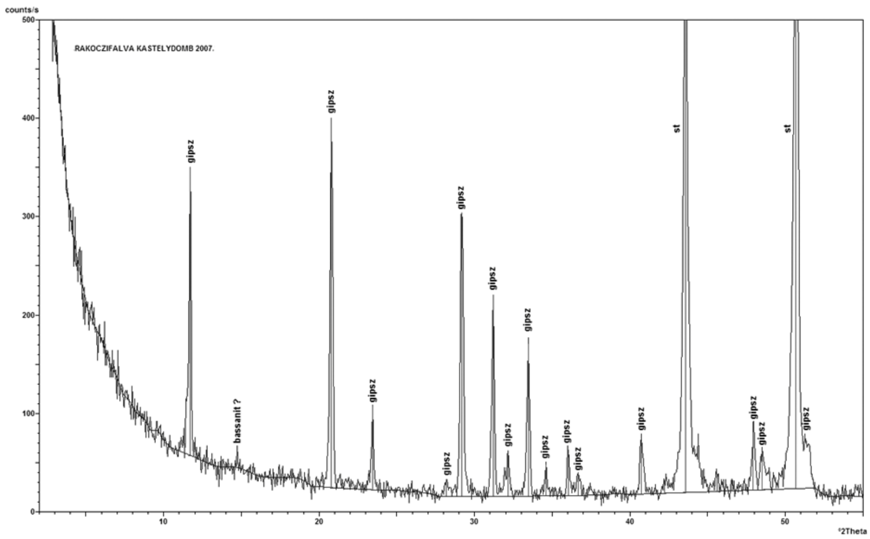


**Fig. 23:** X-ray diffractogram of the tenax (gypsum)

**23. ábra:** A tenax röntgen-diffraktogrammja (gipsz)

Thus, it is especially significant that the post casting polishing process could make its surface having a shine similar to gold. Regarding the discussed period and region, archaeological importance of identification of this copper alloy seems to be gold or gilded cannot be emphasized enough. In this case the choice of a more economic but delusive solution is obvious.

Unfortunately, the amount of already published results is not sufficient for a comparative analysis of our compositional observations.


**Fig. 24:** Profile of the buckle

**24. ábra:** A csat oldalnézeti képe

Concerning the Gepidic material, metal analysis was performed only in case of two buckles but the results are not relevant at the moment because of compositional and chronological differences (Tóth et al. 2005). Among the Mediterranean buckles, the find from *Kerč* (Crimean region), located at the British Museum is the only available reference – by its XRF analysis it is likewise a brass casting (Andrási et al. 2008, 59, 105, 156.). Regarding the late Avar period, the situation is better; results of the archaeometrical research play an increasingly important role in archaeological interpretation (Daim 2000, 86-88.; Schreiner et al. 2000; Vida & Kasztovszky 2000). A number of belt mounts from the 8$^{th}$ century investigated by scientific methods was proven to be brass, e.g. the main alloy under the gilding layer of the representative belt garniture from Hohenberg (Steiermark), falsely documented as bronze for a long time. This fact, along with special technological details raised questions regarding the former theory about local production of the garniture, and suggested the Byzantine origin (Daim 2000, 151-152.).

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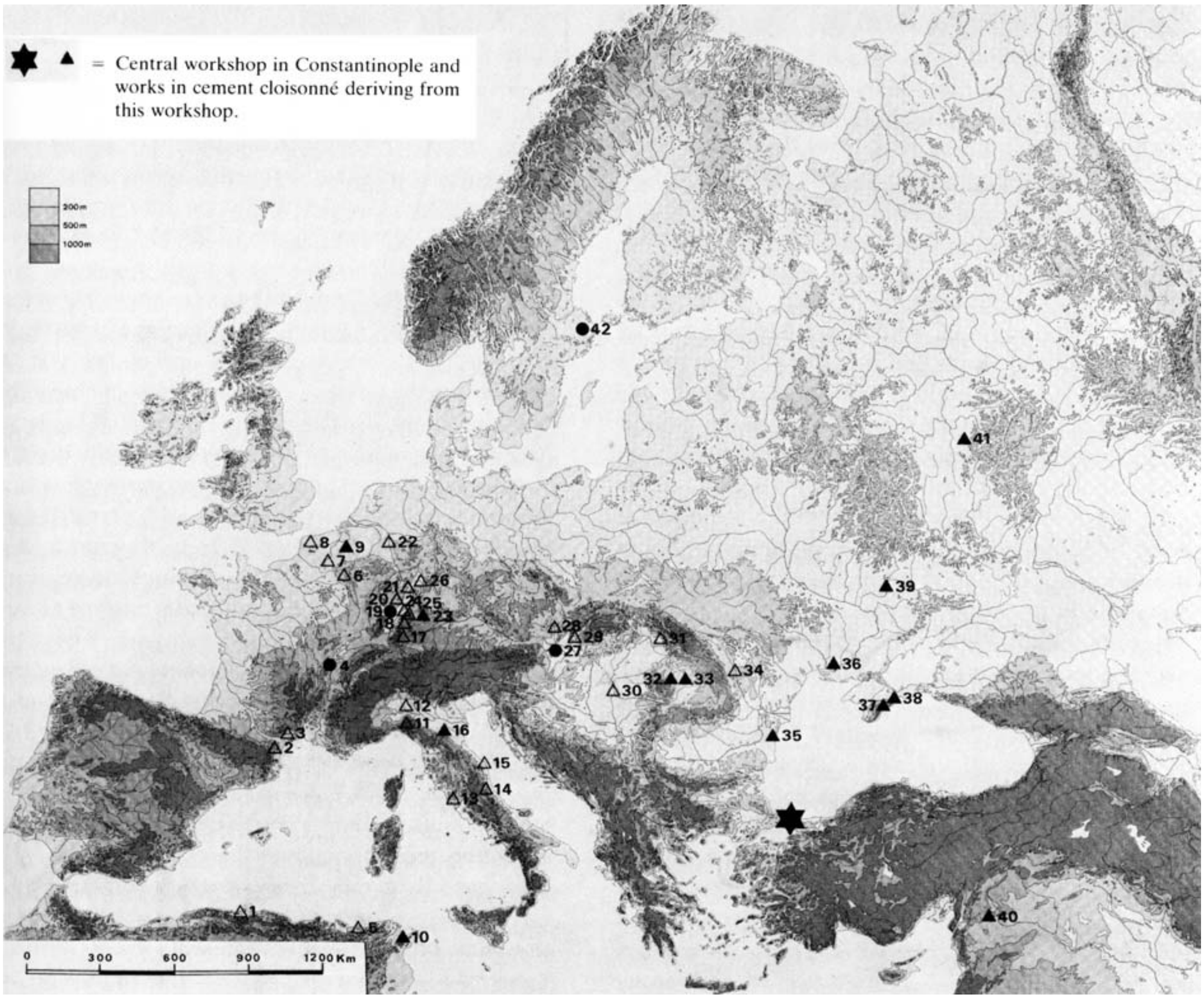


**Fig. 25:** Hypothetical centre of Eastern-Mediterranean workshop area and works deriving from this area (Arrhenius 1985, 119. Distribution map I.)

**25. ábra:** A kelet-mediterrán műhelykörzet feltételezett központja és az innen származó ötvöstárgyak lelőhelyei (Arrhenius 1985, 119. Distribution map I.)

Concerning the buckle from Rákóczifalva, the Cu-Zn proportion of the brass alloy, as well as the Ag-Cu solder seems to be identical to the relevant properties of the Hohenberg finds (Schreiner et al. 2000, Abb. 6-7. Tab. 3). Since differentiation between "original Mediterranean" and "local imitation" needed clarification in both cases about the localization of production sites, this accordance cannot be neglected. The available results of metal analyses make the local (Carpathian Basin) production doubtful, and the Mediterranean origin more likely. Extending the above discussed investigations is necessary due to the lack of comparative data, especially for the less studied archaeological material from the 5$^{th}$-6$^{th}$ century. Involving the most possible factors, e.g. inlays and filling material of the cloisonné work in the analysis is highly recommended.

## The inlay

The single preserved inlay of the buckle does not reveal colour of the whole cloisonné work; analogies permit homogenous red or polychrome surface as well. The preserved fragment implies the use of a remarkable high quality glass plate, exceeding opacity typical for glass inlays of Gepidic goldsmith work. Besides the dominant purple-red garnets, glass occurs rarely in the material of the discussed period. Amount of red glass inlays identified by optical microscope is not significant; the majority is rather green, generally preserved in bad condition (Horváth 2006, 50.). Production of durably transparent, coloured glass could be problematic. Even though, the roughly 1500 years in the soil was obviously harmful for the glass inlays, quality variance is rather due to the chosen technology, raw and colouring materials used.

**Table 3:** List of goldsmith works containing gypsum as tenax (Arrhenius 1985, 203.)

**3. táblázat:** Gipsz-alapú kitöltőanyagot (tenax) tartalmazó ötvöstárgyak listája (Arrhenius 1985, 203.):

| | | | |
|---|---|---|---|
| **III:1. Gypsum with wax on the surface (in a separate layer)** | | | |
| 41. | BM 1/M | Reastan | gypsum + burnt gypsum (small quantity) + wax (small quantity) |
| 49. | BM 7/Bu | N P Continent | gypsum + wax + quartz |
| 116. | Paris 1a/Sw | Childeric | gypsum + quartz + wax + anhydrite |
| | | | |
| **III:2. Gypsum without wax** | | | |
| 42. | BM 7/Bu | N P Continent | gypsum |
| 96. | Liver 1/M | Gilton | gypsum + burnt gypsum (small quantity) |
| 115. | Paris 1d/Sw | Childeric | gypsum + quartz (+ small fragment goethite) |
| 117. | Paris 2b/Sa | Childeric | gypsum + quartz + muscovite |
| 121. | Cluj 1/M | Apahida II | gypsum (ca. 0,5 mm lentoid gypsum monocrystals) + quartz + MS |
| 122. | Cluj 2/M | Apahida II | gypsum (ca. 0,3 mm lentoid gypsum monocrystals) + quartz + MS |
| 144. | Paris 2d/Sa | Childeric | gypsum |

Preserved quality of the glass fragment supports foreign origins promoted by metallic components of the buckle. Since identification of the chemical composition was beyond our possibilities, at the moment we are unable to support our assumptions by measurement data.

## Tenax

Regarding the circumstances of production of the buckle, comprehensive analysis of samples taken from the tenax is decisive. Among results of the international research serving as a base for comparison, data measured in Stockholm and in Richmond proved to be significant in this question. The identified gypsum component has close analogies in a small group of tenax from $5^{th}$-$6^{th}$ century finds analysed in Stockholm. Among several hundred specimens representing early medieval archaeological collections from whole Europe, gypsum was detected as main component only in a few of them (**Table 3**) (Arrhenius 1985, 200-204.). It has been found in such unique or rarely occurred artifact types that cannot be interpreted as local products typical for the territory of Germanic peoples. Group of these finds was extended by another investigation performed in Richmond, where gypsum was identified as filling material in the core and mountings of two precious stone inlaid gold bracelets dated to the $3^{rd}$-$4^{th}$ century, unearthed in Syria (Gonosova & Kondoleon 1994, 67, 71, 160-161.). Hence, production of high gypsum-content tenax exceeds territories influenced by different Germanic peoples and cannot be considered as their typical practice. The group of these samples represents both the precious wearing elements of the aristocracy and mass-products made of less valuable material. The finds from the famous royal graves discovered in *Apahida* and *Tournai* (Cluj county and Wallonie) along with the mentioned bracelets from Syria belong to the former category, other Syrian finds e.g. the bronze (or another copper alloy) buckle and mounts from *Reastan/Homs* (Quast 1996, 530-533.) or the presently discussed brass buckle from Rákóczifalva belongs to the latter category. Thus, the use of gypsum-content tenax as a technology trick was independent from the social or economical status of the consigners or owners; moreover it was not limited to a shorter period but was in practice trough centuries. Undoubtedly, it was known and used in several workshops of different qualities serving different demands. The finds known so far imply that these workshops could be situated in one geographical region. This possibility was already emphasized by Arrhenius. Based on the typological, technological properties and on accessibility of raw materials she assumed one central and several satellite workshops in the Eastern-Mediterranean region as the production sites of gypsum-content cloisonné goldsmith work (**Fig. 25**) (Arrhenius 1985, 100-102, 119.).

These assumptions are in accordance with regional and political relations of the 5th-6th century known from historical sources and also confirmed archaeologically. The most important archaeological evidence for the Eastern-Mediterranean relationship with the German aristocracy are the three Gepidic royal graves from Apahida containing luxurious Byzantine goods and insignia (Horedt & Protase 1972; Kazanski et al. 2002). For the presence of various Eastern-Mediterranean and Byzantine elements in the material culture of the Gepids, the military alliance between the Gepidic Kingdom and the neighbouring Byzantine Empire could serve as an explanation. This alliance began with the disintegration of the Hun Empire and lasted until the outbreak of the Gepidic-Langobardic wars (Kiss 1991, 115-120.). Based on the recent discoveries, the buckle unearthed at Rákóczifalva-Kastélydomb could also belong to the above mentioned Eastern-Mediterranean workshop area. As part of the mass-produced military equipment available for Germanic solders, this buckle probably was not produced in an outstanding workshop belonging to the prestigious milieu; however, a more exact localization is not possible at the moment. Also the question about geological provenience of the identified gypsum is still open. Due to the general occurrence of the gypsum sediments, collecting reference data and, among others, performing isotope analysis is necessary to trace its source.

## Conclusions

Summarizing the results presented above, the casted brass cloisonné decorated belt buckle from Rákóczifalva-Kastélydomb belongs to the elements reflecting foreign influences in the early medieval Gepidic material culture. By studying the analogies and examining characteristic details of the object we can conclude that it was not a local imitation. Based on its typological, technological characteristics as well as the composition of the metal alloy, soldering material and mineral based filling material named tenax, the buckle could be considered as a product of a satellite goldsmith workshop in the Eastern-Mediterranean area. For verification of the assumption, further comparative analysis is necessary regarding archaeological material both inside and outside the Carpathian Basin.

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