THE STUDY OF ARCHAEOLOGICALLY INTERESTING GLASSY AND METAL ARTEFACTS IN HAS-ATOMKI

Alíz Simon, Imre Uzonyi, Gábor Tomka[1], Zoltán Szoboszlai, Zsófia Kertész, Árpád Zoltán Kiss

Institute of Nuclear Research of the Hungarian Academy of Sciences (HAS-ATOMKI), P.O. Box 51, H-4001 Debrecen, Hungary
[1]Hungarian National Museum, 14-16 Múzeum krt., H-1088 Budapest, Hungary

IBA SETUP AND ANALYSIS

- **PIXE: UTW Si(Li) & Be windowed detectors. Simultaneous quantitative elemental analysis between C-U.**
- **RBS: Substrate composition, depth profiling**
- **ERDA: Hydrogen content determination**
- **NRA: C, O, elemental depth profiling**
- **PIGE; DIGE: Light element (Li, B, F, C, N, O) analysis**

ATOMKI Scanning Nuclear Microprobe [1,2]

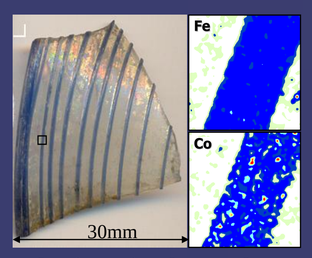
Broad beam and microbeam irradiations

- **1-3.5 MeV H^+, D^+,He^+**
- **min. beam, size: 1x1 μm² , max. scan: 2500x2500 μm²**
- **Full and area selective spectra and elemental maps**
- **Listmode, tomographic images, true elemental maps**

Venetian pottery piece from the 15th Century (Visegrád Palace, Hungary)

Data acquisition & evaluation

- **Oxford-type and Canberra-type DAQ**
- **PIXEKLM and PKLM TPI program packages [3,4]**
- **RBX and WINDF codes [5,6]**



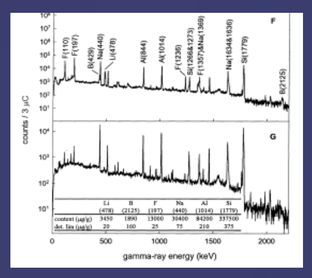
Area selective microbeam elemental mapping (1500x1500μm² scan area).

OBSIDIAN SOURCES OF THE TOKAJ MOUNTAINS, HUNGARY

The aim of the work: to find sub-groups among the classified obsidian sources of the Cenozoic volcanic Tokaj Mountains (NE Hungary-E Slovakia).

On the basis of the PIGE measurements alone, the clusterisation of samples of Tokaj Mountains from other specimens could be achieved.

As a result of the analyses a database was provided for the LITHOTECA of the Hungarian National Museum.



Compton suppressed spectrum measured on a standard macusanite obsidian glass (F) and on an obsidian sample (G). E_{proton}=3.3 MeV, Q=3.3 μC, I=1 nA [7]

MEDIVAL GLASS BOTTLE

• The "goiter necked" glass bottles were spread in Southern and Central Europe.

• The find from Győr can be dated with great probability to the 2nd half or to the end of the 13th century.

Questions to be answered: • Origin of the glass • Production technology

Archaeological excavation was carried out In Győr (West-Hungary) in 2004-2005. Remnants from the Roman Period (1st –2nd c.) and from various periods of the Middle Ages (10th –15th c.) were found .
From a storage pit (Nr. 259.) pieces of a glass bottle were saved. The 18 cm tall bottle was restored, its well preserved material has a greenish tint.

Analytical characterization by PIXE and PIGE

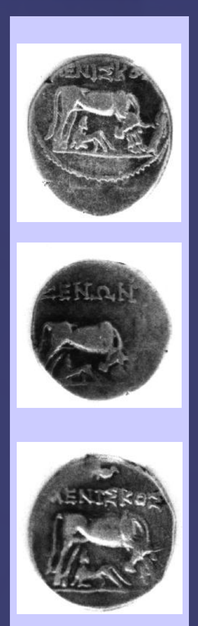
Concentrations and their Standard Deviations are in wt.%. For comparison, chemical composition of Venetian glasses (V1: 11-14th c. [8]; V2:16th c. [9]; V3:15-16th c. [10]) were used.

	Bottle	V-1	V-2	V-3
Na_2O	15.7±1	14.0	13.0	15.4±2.4
MgO	2.3±0.2	2.30	3.30	1.1±0.3
Al_2O_3	4.5±0.5	4.00	0.90	1.7±1.2
SiO_2	65.0±2	64.7	68.0	70.3±2.0
K_2O	2.3±0.1	2.50	2.50	3.4±2.0
CaO	6.5±0.1	7.50	9.50	4.6±0.8
TiO_2	0.23±0.01	0.24	0.06	-
MnO	1.1±0.1	1.90	0.60	0.12±0.07
Fe_2O_3	2.0±0.6	1.40	0.50	0.77±0.38

Conclusions

- **The bottle was made from soda-lime glass.**
- **Comparing Na, Mg and Ca values with literature data → "similarity" with Venice glass.**
- **However, high Ti, Fe (and Al) concentrations → relatively low quality vitrifying agent. (siliceous material) was used excluding late medieval (15-16th c.) fine Venetian glass.**
- **The greenish tint attributable to the high Fe content → incomplete decolourization (by MnO) → characteristic for lower quality glass products.**

The analytical results do not falsify the hypotheses that the artefact can be a 13th century (supposedly Venice) glass.



SILVER COINS

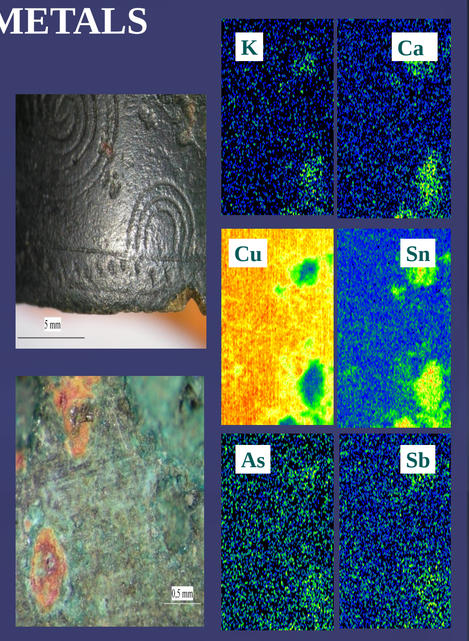
Ancient silver coins (drachms) issued by the Greek city Dyrrhachium during 68-43 years BC were analysed non-destructively by micro-PIXE method. The selected 27 drachms, including four imitations, belong to the numismatic collection of the Hungarian National Museum.

Nine elements (Fe, Cu, Zn, Br, Ag, Sn, Au, Pb and Bi) were determined quantitatively. PIXE showed uniformly low (~92%) Ag concentrations, implying debasement. The PIXE results also made it clear that ancient imitations can be identified by their high Sn content [11].

ANALYSIS OF LATE BRONZ AGE METALS

The main event of the complex cultural changes during the transition from Middle to Late Bronze Age was the appearance of Tumulus culture in the Danube-Tisza region. In this period people rose mounds (tumuli) above their graves made from stone and soil. Depots were typical of the final period of Middle Bronze Age called Koszider-phase. During the tumulus period the practice of hiding depots came to its end, bronze objects were put into graves.

The IBA analyses can provide a relation between the Koszider and Tumulus metallurgy. The main question is whether there is any noticeable change between the metallurgical craftsmanship of the consecutive eras. It is important to determine the composition of the used raw materials, their sources, as well as the applied manufacturing technologies [12].



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For scientific collaboration and TNA service please contact Dr. Aliz Simon, a.simon@atomki.hu