

## PRELIMINARY CONSIDERATIONS ON GUMELNITA STATUETTES OF TEIU, ARGEȘ DISTRICT, BASED ON MICROSCOPY AND XRF ANALYSIS

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**Abstract:** The analytical study was carried out on 13 Eneolithic statuettes displaying incisions made in the wet clay, prior to firing. The XRF (X-ray fluorescence) analysis was performed with InnovX Alpha Series handheld instrument, based on 30 kV mini W-target X-ray tube, working at 40  $\mu$ A intensity, using 60s acquisition time. There are two distinct categories of ceramic paste – with feldspars and without feldspars. In the graphs representing calcium vs. titan concentration three groups of items distinctly separates.

**Keywords:** gumelnița, statuettes, microscopy, xrf analysis.

The analytical study was carried out on 13 Eneolithic statuettes displaying incisions made in the wet clay, prior to firing.

The microscopy was performed on Nikon SMZ1000 stereomicroscope, at magnifications from 40x to 80x and photographs were taken with the microscope camera.

The XRF (X-ray fluorescence) analysis was performed with InnovX Alpha Series handheld instrument, based on 30 kV mini W-target X-ray tube, working at 40  $\mu$ A intensity, equipped with electrically cooled Si-PIN detector, using 60s acquisition time. The measurements were performed using *Soil* acquisition mode, presenting the concentration values in ppm (parts per million), in two stages – for heavy and for light elements. The measuring errors lie between 1-5%. The determined values are presented in Table 1.

As a result of microscopic study we reached the following conclusions:

The statuette N.I. 1548 shows two kinds of incisions: a first type, wider, nearly 1 mm width, and a second one, finer, of 0.3mm width, filled with a white paste, probably calcite (Photo 1). The amount of sample was not sufficient enough for compositional analysis.

The statuette N.I. 2069, unlike the other similar items, was realized by another artisan, using sharper incision tools. The density of the material (gravimetrically determined) is higher (Photo 2).

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At the statuette N.I. 2079, even if the incisions seem to have been filled with a paste, in fact it is sand deposited from the environment.

At the statuette N.I. 2078 the incisions have been filled with a white paste, possible calcite, poorly preserved, probably as a result of binder quality. The amount of sample did not allow the material identification.

The statuette N.I. 1532 shows superficial firing. Even if the firing was performed at relatively high temperature, in oxidant conditions, the firing time was insufficient to transform the whole clay quantity in ceramics; the transformations reaching a deepness of 1.5 mm beneath the surface.

At the statuette N.I. 1562 incisions are barely visible and no white deposits exist in the incisions or on the artefact's surface.

The statuette N.I. 2067 shows some sand deposits in incisions, which seems to be done with another type of tool.

The statuette N.I. 1556 shows sand deposits in incisions (Photo 3).

The items N.I. 2067 and 1556 were, presumably, buried in the same environment, considering the nature of sand deposits within the incisions.

The statuette N.I. 610 shows silicates deposits from surrounding soil. It is also possible that this statuette have been buried in other conditions than the other studied items (Photo 4, 5).

**Table 1 Concentration of constituent elements in the ceramic paste of the statuettes (XRF determinations)**

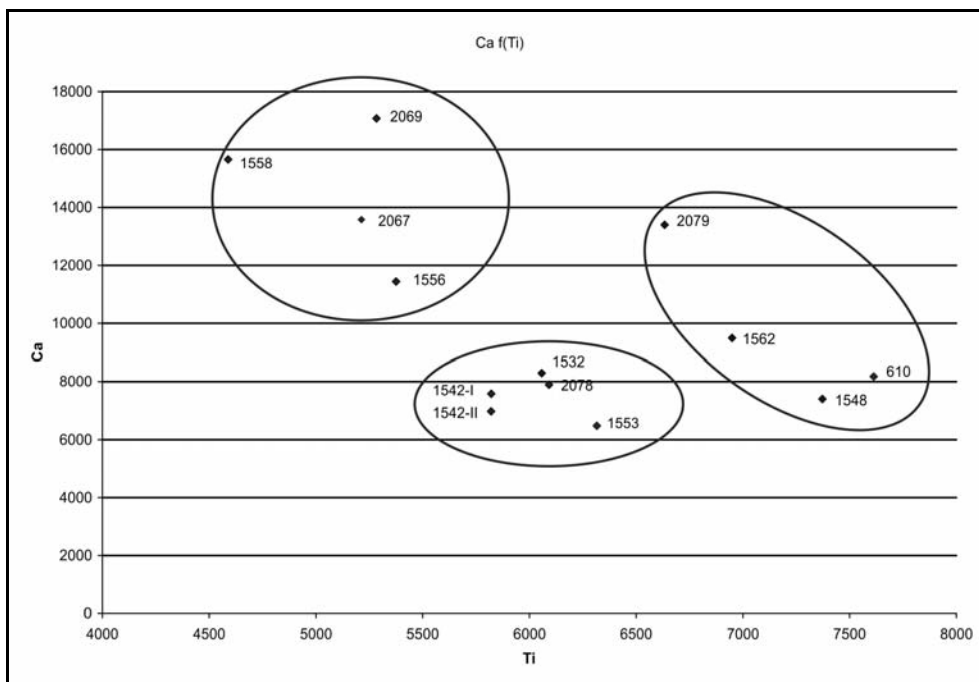
Nr.inv.	Ti	Ba	Mn	Fe	Cu	Zn	Pb	Rb	Sr	Zr	K	Ca
2067	5213	829	355	28822	74	157	180	93	309	230.5	0	13578.5
2079	6633.5	1159	410.5	36989.5	67	180.5	28.5	93.5	313	236	8368	13399.5
1556	5375.5	844	469	21052.5	62.5	104	34.5	95.5	268	225.5	8484	11439.5
1532	6057.5	857.5	427.5	38751	52	124	20.5	98	180	236.5	2675.5	8296
1562	6949	959	614	47639	72.5	119.5	37.5	83.5	333	271	0	9494.5
1542-II	5820.5	934.5	246	39136	30	96.5	34.5	81.5	218.5	239.5	6375.5	6978
2069	5283.5	752.5	188.5	21811	52	86.5	28	76.5	246.5	288.5	15576.5	17074.5
2078	6092	1105	308.5	32071.5	40.5	154	30.5	91.5	258.5	264.5	3164.5	7895
1558	4589	848.5	319.5	27017	52	91.5	26.5	85	235.5	244.5	3925	15655
1548	7372.5	992.5	270.5	36013	66	91	38.5	71.5	256.5	289.5	0	7406
1542-I	5821	879	464	39298.5	47.5	131	35	90.5	214.5	239.5	2781.5	7583
1553	6316	1004.5	940.5	45507.5	66	146.5	32.5	110.5	165	205	0	6483
610	7612.5	1245	281.5	41625.5	62	122	57	81.5	216	328	0	8181

The values included in table are the average of two distinct measurements performed on the same statue.

Some conclusions can be drawn from the above table:

1. There are two distinct categories of ceramic paste – with feldspars and without feldspars (with K and without K).

2. In the graphs representing calcium vs. titan concentration (Fig. 1.) three groups of items distinctly separates. It had to be underlined that this grouping agrees well with archaeological observations concerning the nature and the decoration technique.



**Fig. 1.** Calcium/titan concentration graphical representation.

In order to go deeper into the study of this type of Eneolithic ceramics a greater range of archaeologically excavated items had to be analyzed concerning their composition and decoration materials.