Scientific methods and applications to archaeological provenance studies of pottery from Podgoria, site of the Early Neolithic period in Albania

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Introduction

- In this paper, we will summarize the results obtained from the examinations carried out on the ceramic dough from the Podgoria settlement, an Early Neolithic site in the Albanian territory, and we will try to point out the similarities and differences between them.

- The study of the composition of the materials these clay products were made of as part of human activity will help us understand more about the technological abilities of the communities, their behavior, social organization and on the other hand the testing of different hypotheses regarding the origin of the objects and their dating in historical periods.

- In the ceramics of the entire area of the south-east of Albania, what is to be distinguished is the high quality of the ceramic work and the predominance of ceramics with fine and medium textures against those with coarse textures.

- In this study, by applying some archaeometric methods such as Energy Dispersive X-ray Fluorescence (EDXRF), micro-X-ray Fluorescence, X-Ray diffraction and Optical Microscopy (OM), we will aim to characterize the elemental composition and structure of ceramic samples selected from the site of Podgoria.

Introduction

- The site of Podgoria, as well as the other sites identified in the Albanian territory of the Neolithic period, have developed with significant regional changes influenced by the factors of internal economic and cultural development, but at the same time from the different geographical factors of the territory's positioning in the corridor of intersection of different cultures of the Neolithic development of the Balkans.

- In terms of geological development, the settlement of Podgorie is located in the quaternary formations of the Korca depression, which are filled with alluvial, proluvial and swamp sediments which are usually placed on top of the old Pliocene formations.

Typological data

- Tables 1 summarize the results of the typological examination of thick-walled and thin-walled ceramics from the early Neolithic settlement of Podgoria studied in this article.

	Samples analyzed from thick-walled vessels	**Samples analyzed from thin-walled vessels**
Selection of clay	Coarse sand particles	Fine sand + limestone particles
Color	Red, rarely with a gray tint	Monochrome red
Surface	Smooth	Carefully polished, shiny
Firing	High quality but not complete	High quality, but not complete
Decoration	With printing, with nail biting, with stripes, rarely with ink, with spraying	With painting
Ornamental instrument	Matte paint	White ink on red background
Decorative motifs	Lines, triangles with different orientations	Matte and glossy paint

The study of elemental composition

- The clay sample was collected by archaeologists and represents soil from an excavation layer.
- The data of the content of major elements show a group of samples with similar composition

    - The content of K_2O varies between 1.5 - 2.8%,
    - CaO between 2 - 5.4%,
    - TiO_2 between 0.6 - 1%
    - Fe_2O_3 between 5.2 - 9.1%.

- The clay sample appears to have a content of major elements similar to that of ceramics.

The content of light elements in the analyzed samples varies as follows:

MgO 0.75 – 5.7%,

Al_2O_3 13 – 16%

SiO_2 50.3 – 55.9%.

The study of elemental composition

- Comparing the composition of thin-walled and thick-walled ceramics indicate similar raw materials used for each group.
- Thus, both the average values of the groups and the variation of the values do not show any significant difference .

- Even for the Podgoria samples we can say that the clays used are of the low calcium (non-calcareous) type, as the CaO content in the ceramic samples is generally lower than 5% with the exception of one sample with CaO – 5.1 %.

The content of major elements (%) in the ceramics and clay of Podgoria

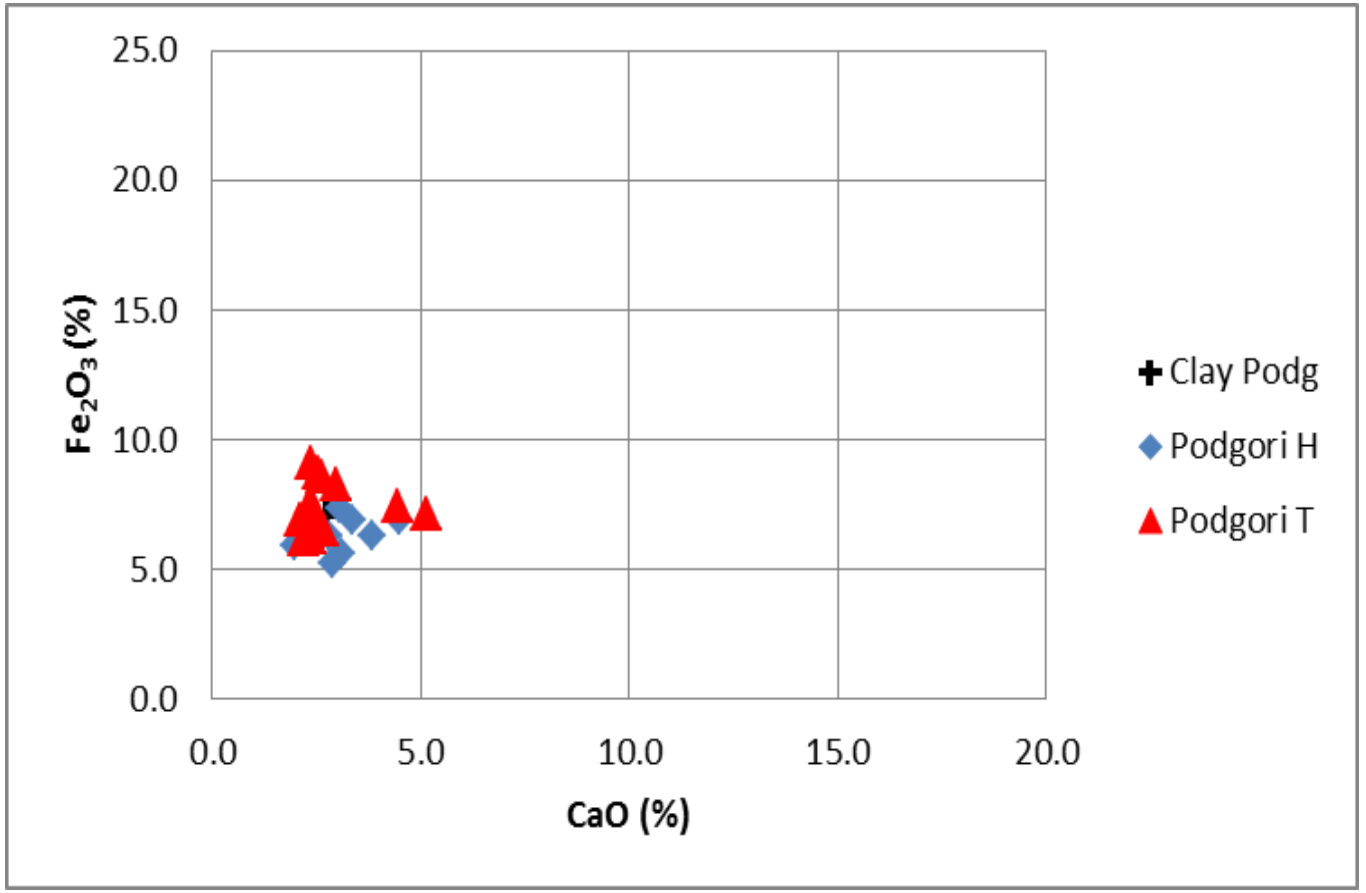
Sample Code	Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	Fe_2O_3
KPh 1243					2.54	3.35	0.94	6.89
KPh 1137					1.82	3.08	0.75	5.59
KPh 1127					2.82	3.06	0.91	7.39
KPh 1212					1.68	1.95	0.78	5.93
KPh 1230					2.06	2.81	0.79	6.30
KPh 2	0.09	1.39	15.15	50.35	2.54	4.49	0.88	6.90
KPh 717	0.85	1,15	13.57	54.31	1.50	3.82	0.81	6.27
KPh 7	0.48	0.75	14.59	54.43	1.84	2.86	0.73	5.20

KP-Ceramic sample from Podgoria, h- thin-walled, the number represents the inventory code in the fund of the Institute of Archaeology, Academy of Albanological Studies, Tirana.

The content of major elements (%) in the ceramics and clay of Podgoria

Emertimi i kampionit	**Na_2O**	**MgO**	**Al_2O_3**	**SiO_2**	**K_2O**	**CaO**	**TiO_2**	**Fe_2O_3**
KPt 777					2.26	2.12	0.80	6.89
KPt 1130					2.24	2.95	0.83	8.26
KPt 270					1.69	2.35	0.78	6.23
KPt 602					2.33	2.67	0.80	6.54
KPt 606c					1.88	2.32	0.75	6.47
KPt 700					2.37	2.53	0.86	8.72
KPt 700a					2.43	2.35	0.91	9.13
KPt 1011					1.63	5.14	1.05	7.14
KPt 1089					1.82	2.38	0.78	7.56
KPt 1193					2.07	2.20	0.83	6.12
KPt 2695	0.05	2.10	15.87	55.93	2.74	2.60	0.86	8.57
KPt 813	0.05	5.73	13.03	52.12	2.07	4.44	0.65	7.43
KPt 583	0.04	0.86	15.98	55.90	1.97	2.38	0.76	6.90
Clay from Podgoria					2.74	2.74	0.92	7.07

KP-Ceramic sample from Podgoria, t-thick-walled vessel, the number represents the inventory code in the fund of the Institute of Archaeology, Academy of Albanological Studies, Tirana.



CaO-Fe2O3 graph for Podgoria clay and ceramics.

Mineralogical characterization

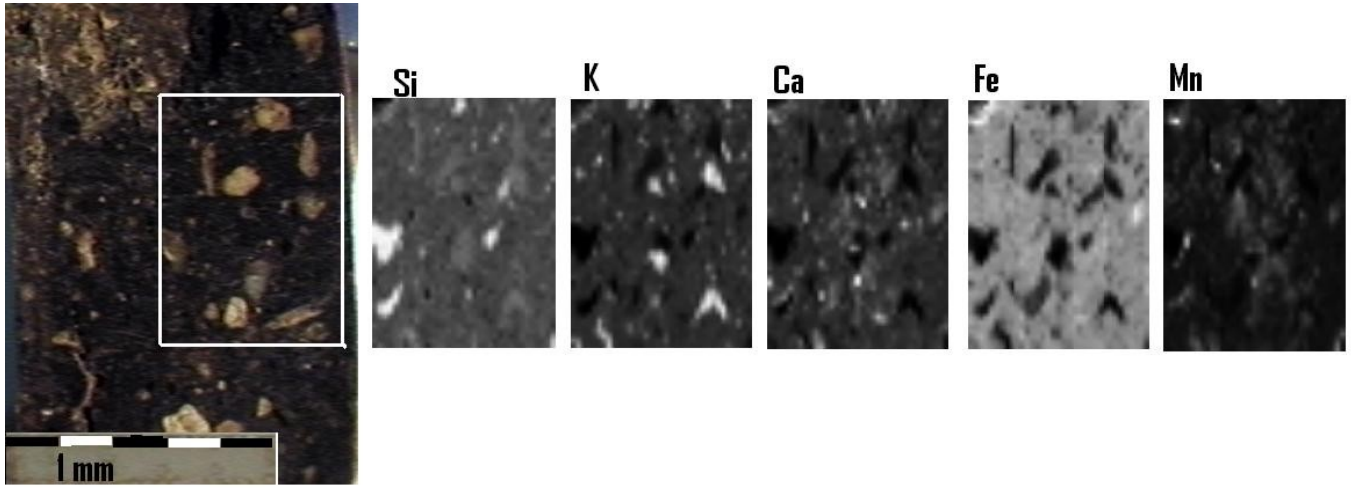
- Figures shows some analyzed samples from the Podgoria site and for each of them, the distribution of the major elements in the visible inclusions is given in the form of a map.

- From the analysis, we notice that among the detected inclusions, those with a high Silicon (Si) content predominate, which are most likely quartz particles. The inclusions rich in potassium (K), calcium (Ca) and iron (Fe) are observed in smaller quantities.

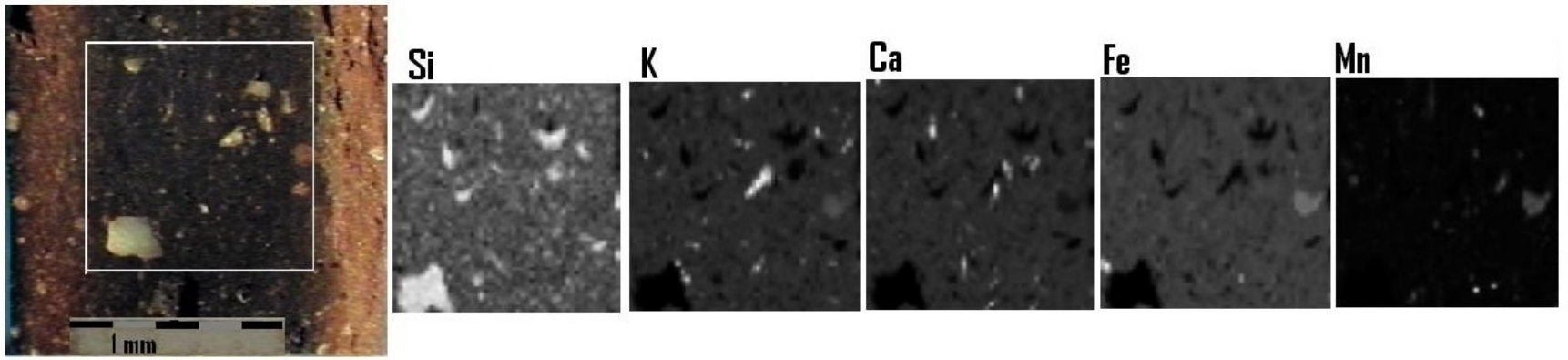
- The expected result of low amounts of calcium oxide (CaO) from the analysis of the elemental composition is also confirmed in these analyses, where it is again observed that the number of particles rich in Ca is relatively low, although we also have cases of exception in a number of limited samples where these particles have a larger surface area.

- In the samples taken in the study, we noticed that the inclusions which can be interpreted as recycled ceramics are fewer in number and smaller in size. Under these conditions, we assume that particles with larger dimensions may have been added to the clay dough in the form of tempera.

µ-XRF results in the analysis of ceramic dough inclusions in some samples analyzed from the Podgoria site.

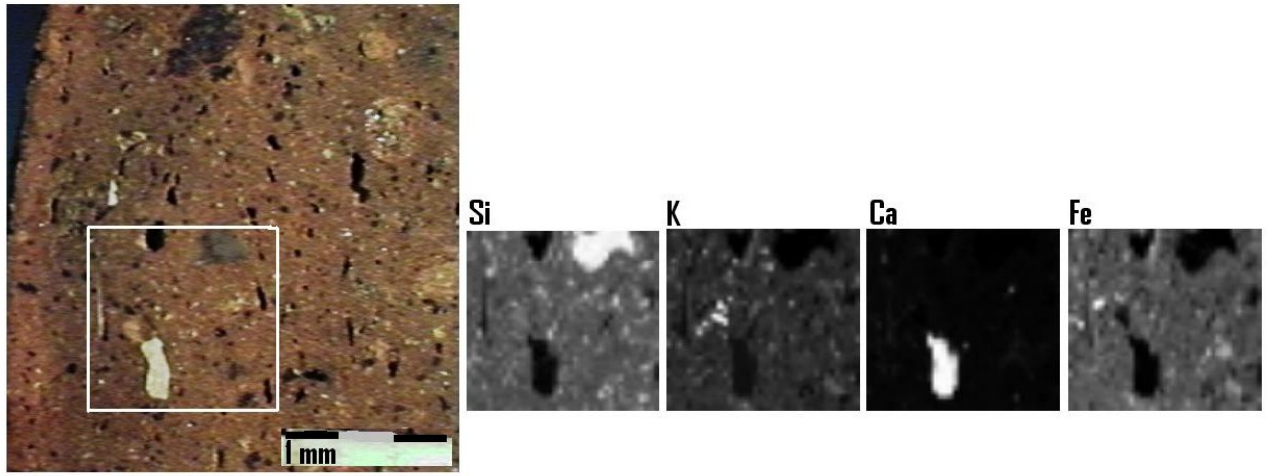


Sample from Podgoria, thin-walled vessel, No: 717

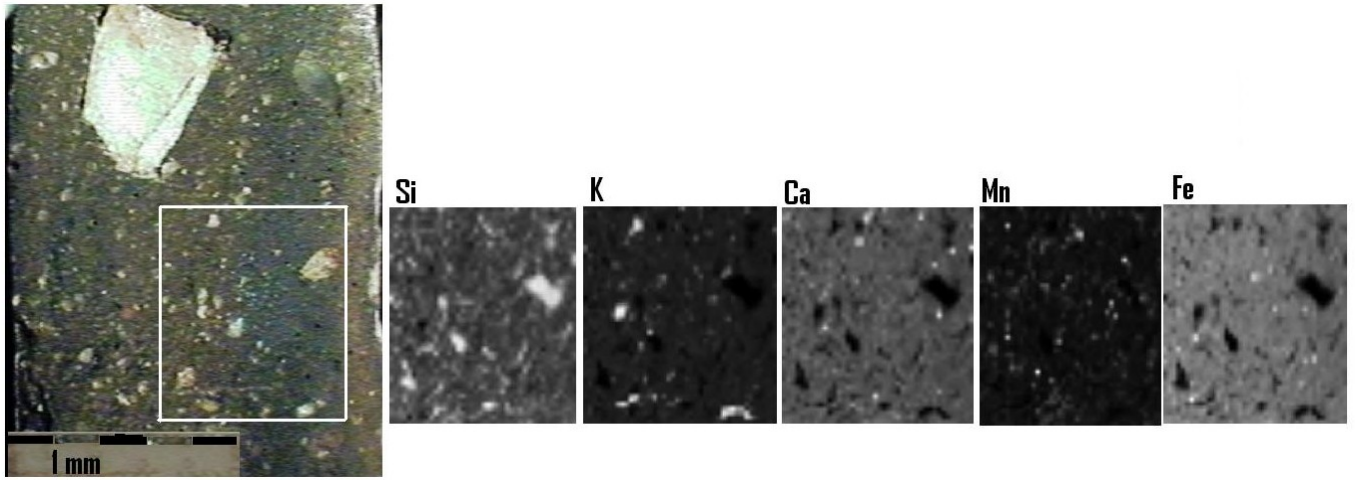


Sample from Podgoria, thick-walled vessel, No: 583

µ-XRF results in the analysis of ceramic dough inclusions in some samples analyzed from the Podgoria site.



Sample from Podgoria, thick-walled vessel, No: 1089



Sample from Podgoria, thick-walled vessel, No: 1011

Petrographic analysis

- For petrographic study, from the group of ceramics from the Podgoris site, we selected three of them.

- A sample with the inventory name KPh2 is part of the group of samples from thin-walled vessels, while the other two samples, respectively, with inventory designations KPt 813 and KPt 2695, are part of the group of samples from thick-walled vessels.

Petrographic analysis

Sample KPt 813. From the petrographic analysis of the sample, it can be seen that the matrix is homogeneous and appears with a slightly red beige color, it has a very good sorting, it is anisotropic and fine. The mineralogical composition is represented by plagioclase, quartz, white and black mica, as well as opaque minerals represented by magnetite or hematite. The material has a poor degree of vitrification. It is noticed that the voids and channels are filled with gel from the recrystallization process.

Inclusions: They are represented by recycled ceramics, bioinclusions (vegetation) and hematitic pelitic concretions.

Gaps: They are evident in elliptical, closed spherical, cavity forms.

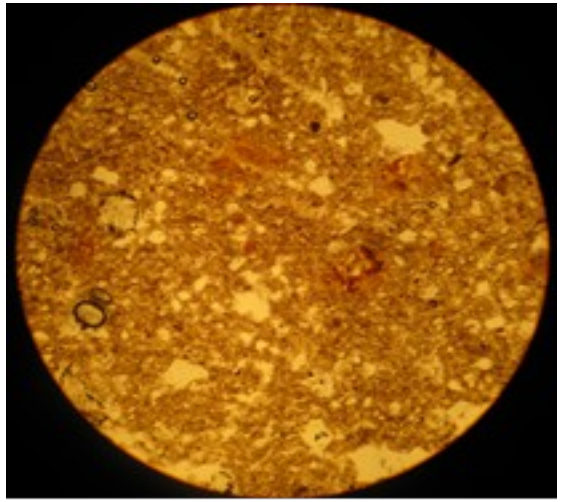
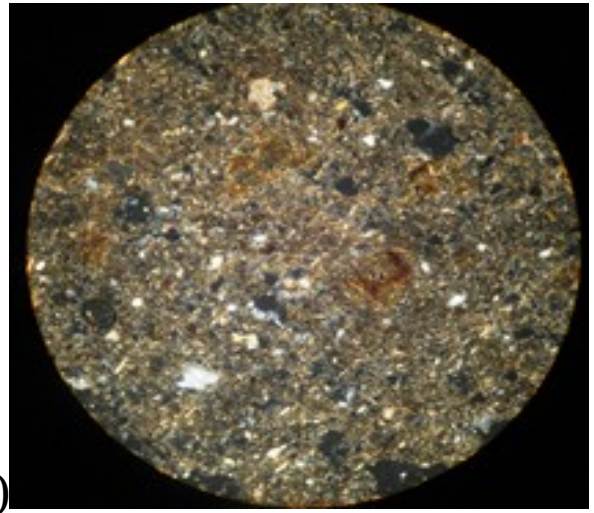
a)  b) 

Figure 5.6. Analysis of sample KPt 813 with polarized light microscope (x10)

a) (parallel polars=PPL, and b) crossed polars (=+PL).

Petrographic analysis

Sample KPt 2695. From the petrographic analysis of the sample, we notice that it is very similar to the above-mentioned sample KPt 813. The matrix is homogeneous, has a slightly reddish beige color, appears anisotropic, has a very good sorting and is very fine. The mineralogical composition is represented by plagioclase, quartz, white and black mica, as well as opaque minerals represented by magnetite or hematite. The material has a poor degree of vitrification. Recrystallization of lime is observed, filling voids and channels with recrystallization calcitic material.

Inclusions: Represented by recycled ceramics, bioinclusions (vegetation) and pelitic hematitic concretions.

Gaps: They are evident in elliptical, closed spherical, cavity forms.

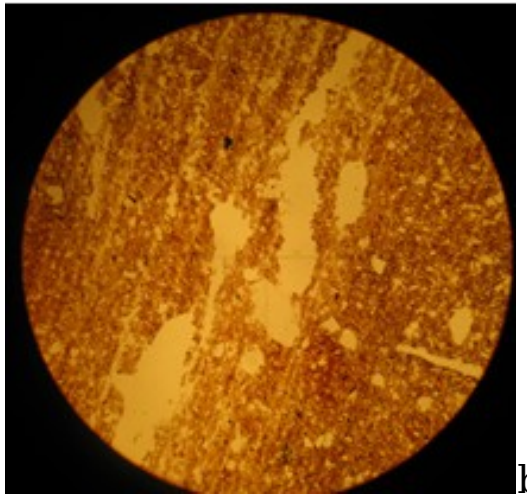
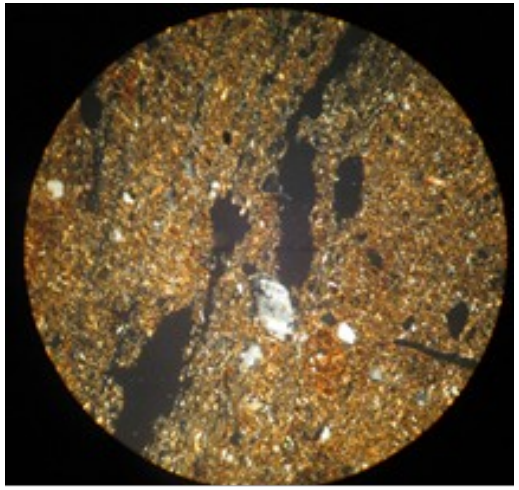
a)  b) 

Figure 5.7. Analysis of sample KPt 2695 with a polarized light microscope (x10)

a) (parallel polars=PPL, and b) crossed polars (=+PL).

X-ray Diffractometry Analyses

- Through X-ray diffraction analysis, the mineral phases in the ceramic samples analyzed have been identified. The main phases identified are quartz (SiO_2) and albite ($NaAlSi_3O_8$), while the calcite phase ($CaCO_3$) was also identified in the clay sample.

- These results also agree with the results obtained from the petrographic study as well as those with μ-XRF, which have identified minerals in which these phases are contained. The fact that some minerals with small amounts have not been identified by XRD, which were detected by petrographic analysis, we think is due to the low sensitivity of the XRD technique.

X-ray Diffractometry Analyses

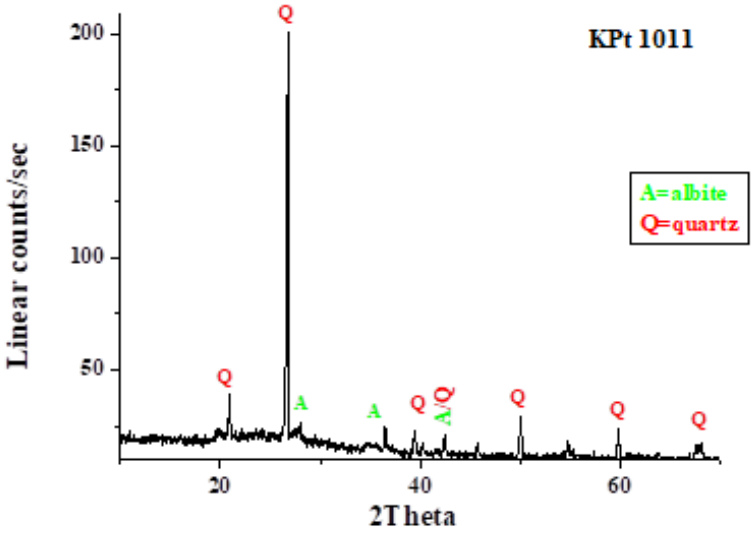


Fig. XRD spectrum of sample KPt 1011 from Podgoria

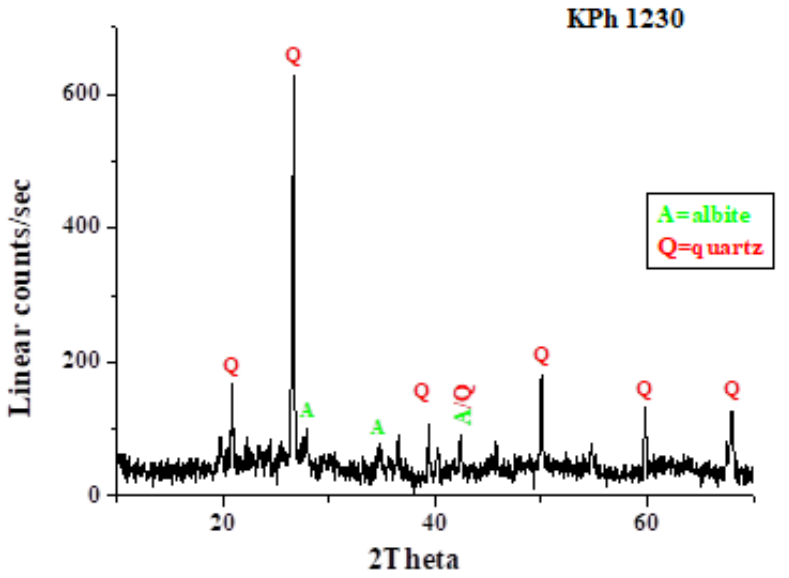


Fig. XRD spectrum of sample KPh 1230 from Podgoria

X-ray Diffractometry Analyses

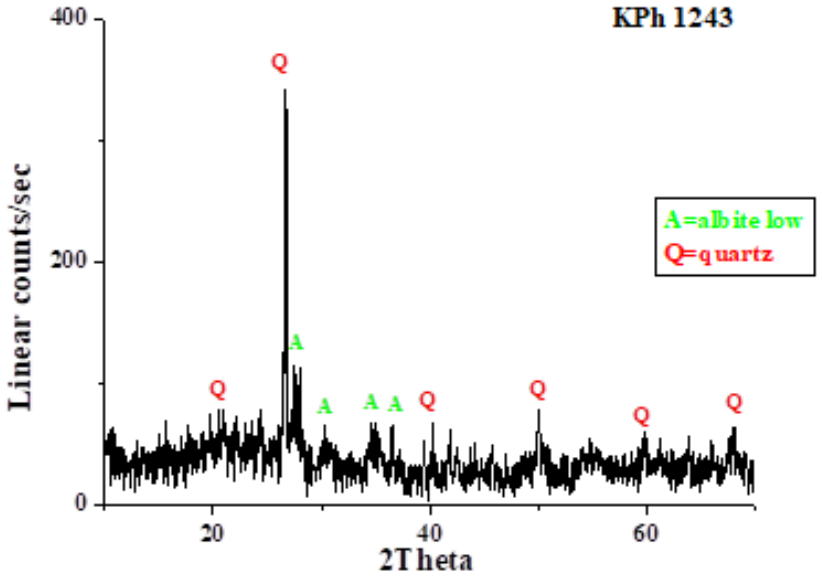


Fig. XRD spectrum of sample KPh 1243 from Podgoria

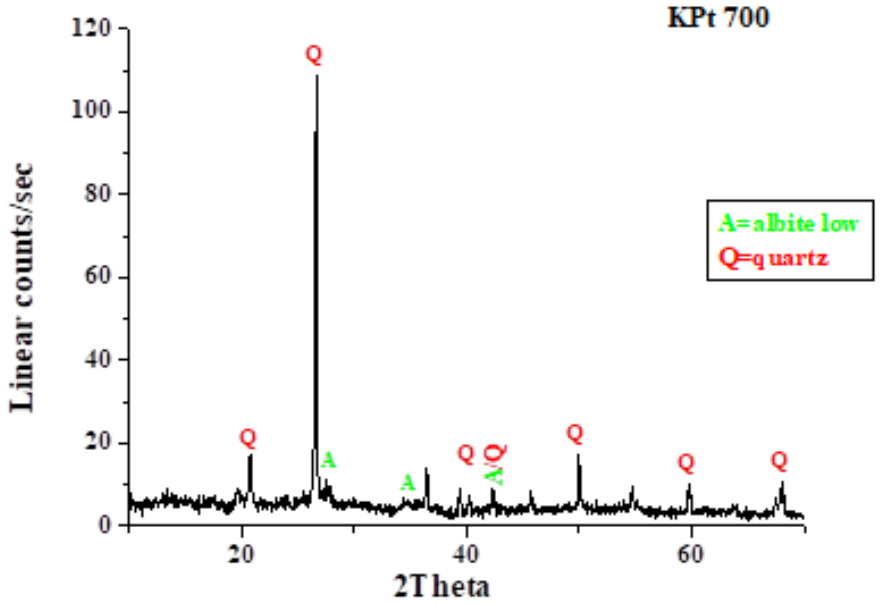


Fig. XRD spectrum of sample KPt 700 from Podgoria

Conclusions

• Evidence shows that most ceramics from Podgoria were prepared from low calcium (non-calcareous) clay.

• The data prove that the clays used for ceramics from all Early Neolithic settlements in Albania belong to the category with high SiO_2 and Al_2O_3.

• Minerals rich in Si and Ca together with recycled ceramics have been used as tempers.

Bioinclusions have been identified in some of the samples from each settlement.

• Ceramics are fired at low temperatures (700-800^{0}C), with non-prolonged firing followed by rapid cooling.

• The results support the idea of local pottery production at the Podgoria site, although they do not exclude the possibility of exchanges between them.

References

- Prendi, F., & Bunguri, A. (2013). Prehistoria e Shqipërisë, Qendra e Studimeve Albanologjike, Instituti i Arkeologjisë, Tiranë
- Lera, P., (1971). Informata mbi zbulime të reja arkeologjike në rrethin e Korçës, Buletini Arkeologjik, Tiranë.
- Prendi, F., 1972. Tipare të Neolitit të Vonë në Shqipëri në dritën e zbulimeve të reja (kultura Maliq-Kamnik)
- Prendi, F, 1976. Neoliti dhe Eneoliti në Shqipëri, Iliria VI.
- P. Van Espen, H. Nullens, F. Adams, “A computer analysis of X-ray fluorescence spectra”, Nucl. Instrum. Methods, 142, pp. 243-250, 1977 4.
- I. Orlic, J. Makjanic, J. Ross, D. Valkovic, X-ray Spectrom., 17, pp. 139-150, 1988 5.
- P. J. Potts, A. G. Tindle, P. C. Webb, Geochemical Reference Materials Compositions, Whittles Publishing, London, 199