PETROGRAPHIC INVESTIGATION OF CERAMIC ARTIFACTS FROM THE THRACIAN SANCTUARIES IN THE EASTERN RHODOPES

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ABSTRACT. The paper presents the petrographic investigation of ceramic artifacts found in two archaeological sites – the Thracian sanctuaries "Gluhite kamani" and "Ada tepe" in the Eastern Rhodopes. The studied ceramic fragments from Early Iron Age (EIA) are characterized by the methods of optical analysis. The results of this study give information related to the ceramic production techniques and also help us presume the raw material sources and the probable place of production sites. The results of the petrographic investigation of the representative ceramic artifacts from the two archaeological sanctuary sites show that most of the investigated EIA pottery has different temper composition (mineral and rock).The results give us information about the local raw material used for producing the pottery and a small amount of artifacts were probably imported.

Keywords: geoarcheology, ceramic artifacts, petrography, Eastern Rhodopes

ПЕТРОГРАФСКО ИЗСЛЕДВАНЕ НА КЕРАМИЧНИ АРТЕФАКТИ ОТ ТРАКИЙСКИ СВЕТИЛИЩА В ИЗТОЧНИТЕ РОДОПИ

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РЕЗЮМЕ. В тази работа се прилагат петрографски изследвания на керамични археологически артефакти от археологически обекти – тракийски светилища „Глухите камъни"и „Ада тепе" в Източните Родопи. Изследваните керамични фрагменти от Ранно желязната епоха(РЖЕ)са характеризирани с методи на оптичния анализ. Проучването предоставя информация, свързана с техниките за производство на керамика, насоки за местоположението на източниците на суровина и вероятните места за производство.Резултатите от петрографското изследване на представителни керамични артефакти от двете светилища показват, че по-голямата част от изследваната керамика от РЖЕ има различен състав на кластичната компонента (минерален и скален). Получените резултати ни дават информация за местен източник на суровина, използвана за направа на керамичните и малка част артефакти, които вероятно са внесени.

Ключови думи: геоархеология, керамични артефакти, петрография, Източни Родопи

Introduction

The interdisciplinary study of archaeological sites has been taking place for many years, and their results complete the information about them to a great extent. Geoarchaeology is defined as the application of methods and concepts of Earth science for the needs of archaeological studies (Rapp, 2002). The petrographic study of ceramic artifacts has crucial importance in determining the way of manufacturing, the materials used to make the ceramics, the identification of fragment of igneous, sedimentary and metamorphic rocks in the ceramic form, allows to identify the source of clay, used for manufacturing the investigated ceramic (Кулев, 2012).

The aim of this study is to investigate artifacts (ceramic fragments), which refer to the Early Iron Age (EIA) in Thrace from the two archaeological sanctuary sites "Gluhite kamani" and "Ada tepe" located in the Eastern Rhodopes using a petrographic method. The obtained results will help us characterize the temper (mineral and rock composition) of the artifacts, to presume the raw material's sources and the probable place of production sites and give information related to the ceramic production techniques.

The archeological site "Gluhite kamani" is located 4.9 km south-west from the village of Malko Gradishte and 3.5 km northeast of the village of Efrem. It is situated on a hill slope at an altitude of 500 m. The site represents a rock cult complex from the Early Iron Age, Late Iron Age and the Middle ages. (Fig. 1). The research of the site is made by G. Neghrizov, J. Cvetkova and others during the period 2008-2017 (Нехризов и др., 2017). Gluhite Kamani (meaning "Deaf Stones") probably owes its name to the fact that there is practically no echo in the area. Its fame is due to the prominent rock formation on the top of the ridge. This rock formation is presented by Paleogene tuffs and rhyolites, dispersed in several groups from northwest to southeast (Aleksiev et al., 2000; Желев и др., 2010). "Gluhite kamani" consists of rhyolites forming the region of summit Sveta Marina volcanic sub-complex. (Йорданов и др., 2008). Besides the acid volcanic rocks in the region, metamorphites from the Sakar metamorphic terrain, Paleogene breccia-conglomerates, sandstones, limestone siltstones, marls, tuffites, sandy and clastic limestones also crop out (Podrumchenska Formation, carbonate-terrigenous-tuff formation, Kurdzhali terrigenous group and Vulchepolska Formation), as well as Neogene sediments (Йорданов и др., 2008).

The archaeological site "Ada Tepe" is located 2.8 km from the City Hall of the village of Ovchari at the top of the ridge at an altitude of 492.4 m (Fig. 2). The research of the site consists of rescue excavations made by G. Nekhrisov during the period 2001 – 2006 (Нехризов и др., 2002; Nekhrizov et al., 2012). The site represents a cult place from the Late Bronze Age, Early Iron Age, and Late Iron Age.

Fig. 1. Archeological site"Gluhite kamani"

From the geological point of view, the area falls within the East Rhodope metamorphic terrain in the range of Krumovitsa lithotectonic unit built up by marbles, migmatized biotitie gneisses, ultrabasites, amphibolites and Kesebir lithotectonic unit represented by metagranites. The Paleogene in the area is presented by breccias, breccia-conglomerates conglomerates, sandstones, limestone argillites, marls, organogenic and clayey limestone (Shavarska and Padarska Formations) and Quaternary sediments along the Krumovitsa River. (Саров и др. 2008).

Fig. 2.Archeological site"Ada Tepe"

Methodology

The object of the study were 58 representative ceramic fragments (pottery samples) from the archeological sites "Gluhite Kamani" and "Ada tepe". The microscopic investigation was made through ceramic thin-sections using microscope Meiji7390 and digital camera Olympus 5050 in transmitted light.

The petrographic thin-sections were used to characterize the various fabrics of artifacts by their typical texture and to obtain some information about the mineralogy and rock composition of their inclusions (temper). The information obtained by the petrographic research was statistically processed according to Sauer, 1995 (Bezeczky et al., 2013). Detailed semi-quantitative analysis was performed only with thin sections of appropriate sample size and quality. For characterization of the temper and to enable graphical presentation of the results the method showed on Table 1 was applied.

Table 1.
Grain proportion

Occurrences within one (representative) field of view		
	number of grains	index
Dominant	more than 20 grains	a (80)
Very frequent	10-19 grains	b (50)
Frequent	5-9 grains	c (30)
Subordinate	2-4 grains	d (15)
Occurrences within five fields of view		
Moderate	5-9 grains	e (10)
Rare	2-4 grains	f (5)
The very rare constituents were classified as follows		
Very rare	more than one occurrence per thin section	g (3)
Traces	one occurrence	h (1)

All samples were analyzed with the same magnification.

The X-ray diffraction method was used to determine the various minerals involved in the clay composition and to determine the probable ceramic firing temperature. Powder diagrams were photographed with a powder X-ray diffractometer TuR-M62 with goniometer HZG3, modified for step scanning and electronic pulse dialing. The diffractograms were shot in the range of 4-8° 2Θ, with duration of exposure of 1.5s.

Results

The principal objective of this study was to assess the mineralogical and petrographic composition of the ceramic artifacts.

Site "Gluhite Kamani"

The ceramic artifacts from the "Gluhite Kamani" are divided into eight groups on the basis of the rock fragment inclusions. The mineral composition in all the groups is similar with exception of one group - 8G (Fig. 4 A, B).

Group 1 (1G) - the ratio between matrix and temper is from 60 to 40 %. The rock fragments are represented by acid volcanic rocks, quarzites, volcanic rocks (rhyolites) with spherulitic texture, granitoids and schists (Fig 3 a, b). The mineral fragments are presented by quartz, plagioclase, K-feldspar, micas, ore minerals, small amounts of epidote and amphibole. The main feature of the group is the presence of a large amount of volcanic rocks (acid), and volcanic rocks with spherulitic texture(Fig. 3b).

Group 2 (2G) - the ratio between matrix and temper is from 60 to 40 %. The rock fragments are represented by acid volcanic rocks, quarzites and granitoids (Fig. 3c). Quartz,

plagioclase, K-feldspar, micas, ore minerals, small amounts of epidote and amphibole are distinguished in the composition of the mineral fragments. The presence of a large amount of small-size quartz grains and rock fragments mainly of acid volcanic and a small percentage of granitoid rocks are distinguishing for the group.

Group 3 (3G) - the ratio between matrix and temper is from 65 to 35 %. The rock fragments are represented by acid volcanic rocks, quarzites and schists. The mineral fragments are quartz, plagioclase, muscovite and biotite, ore minerals, epididote and amphibole. The amount of the muscovite in this group is more than in the previous ones. The group is distinguished by a large percentage of schists (Fig. 3d) in the temper component. The mineral fragments have a similar level and differ only by their quantity.

Group 4 (4G) - the ratio between matrix and temper is from 60 to 40 %.The rock fragments are varied: acid volcanic rocks, quarzites, schists, granitoids, intermediate volcanic rocks and volcanic rocks with spherulitic texture. The mineral fragments are represented by quartz, plagioclase, K-feldspar, mica, ore minerals and small amounts epidote and amphibole. The higher percentage of rock fragments with varied composition and appearance of medium-sized volcanoes is characteristic of this group.

Group 5 (5G) - the ratio between matrix and temper is from 65 to 35 %. The rock fragments are from acid volcanic rocks, volcanic rocks with spherulitic texture, schists, gneisses. The mineral fragments are represented mainly by quartz, plagioclase, K-feldspar, muscovite (with increased percentage), biotite, ore minerals and small amounts of epidote and amphibole. The presence of large amounts of gneisses and schists in the temper is distinguishing for this group (Fig. 3e).

Group 6 (6G) - the ratio between matrix and temper is from 60 to 40 %. The rock fragments are presented by quartzites, granitoids and schists. The mineral fragments are mainly of quartz, plagioclase (with an increased percentage), K-feldspar, muscovite, biotite, ore minerals, small amounts of epidode and amphibole. The presence of granitoids and schists in the composition of the rock fragment is determinative, here.

Group 7 (7G) - the ratio between matrix and temper is from 70 to 30 %. The rock fragments are represented with almost the same percentage as the mineral fragments. The rock fragments are presented mainly by intermediate volcanic rocks (Fig. 3g) and fewer quartzites, granitoids and volcanic rocks with spherulitic texture. Typical for this pottery is the larger percent of matrix as compared to temper and the presence of rock fragments from intermediate volcanic rocks.

Group 8 (8G)- the ratio between matrix and temper is from 65 to 35 %. The rock fragments are of small amount, represented mainly by granitoids, amphibolite and single enriched by epidote rocks. The mineral fragments here are represented by quartz, plagioclase, amphibole, epidote, ore minerals and small amounts of K-feldspar, micas and pyroxene. The high quantity of amphibole (Fig. 3f) and the epidote grains in the composition of the mineral temper are specific for this group.

The matrix in all the groups is optically active and represented by micaceous groundmass and clay minerals (illite–montmorillonite).

Site "Ada Tape"

The ceramic fragments from the archaeological site "Ada Tape" are divided into 4 groups according to their petrographic and mineralogical features (Fig. 4A,C). Only two pottery fragments are without analogue (Adt-15-14 and Adt-52-12) and they are not included in any of them. For all groups, the amount of included rock fragments is smaller than that of the mineral fragments. The variation rock fragments and their limited quantity do not allow their use for grouping.

Group 1 (1A) - the ratio between matrix and temper is from 55 to 45 %. The individual rock fragments are represented by quartzites, schists, granitoids, gneisses, acid volcanic rocks, intermediate and basic volcanic rocks and amphibolites. The mineral fragments are represented by quartz, plagioclase, K-feldspar, muscovite, biotite, ore mineral, amphibole and epidote. The main factor for the pottery of this group is a greater presence of quartz, feldspars and micas with sporadic grains of amphibole and epidote (Fig. 3i).

Group 2 (2A) - the ratio between matrix and temper is from 60 to 40 %. The rock temper is represented by quartzites, altered volcanic rocks (Fig. 3j), tuffs, granitoids, schists and amphibole with low quantity compated to the mineral temper. The mineral fragments are represented by quartz, plagioclase, K-feldspar, muscovite, biotite, ore mineral, amphibole and epidote. In this group, the percentage of the quantity of amphibole and epidote increase at the expense of K-feldspar and quartz.

Group 3 (3A) - the ratio between matrix and temper is from 60 to 40%. The rock fragments are represented by quartzites, amphibolites, schists, gneisses and altered volcanic rocks. The mineral fragments are represented by quartz, plagioclase, K-feldspar, muscovite, biotite, ore minerals, amphibole, epidote and pyroxene. Typical for this group is the presence of a high percentage of amphibole and epidote in the temper component (Fig. 3i).

Group 4 (4G) - the ratio between matrix and temper is from 70 to 30 % (Fig. 3h). The rock fragments are represented by altered intermediate, acid and basic volcanic rocks, volcanic glass and schists. The mineral fragments are represented by quartz, plagioclase, K-feldspar, muscovite, biotite, ore minerals. The presence of plagioclase among the mineral fragments and high amount in the matrix is typical for this group.

Ceramic artifact Adt-15-14 – the ratio between matrix and temper is 60/40%. It is characterized by a large amount of muscovite and biotite among mineral temper (Fig. 3k). Quartz, K-feldspar, plagioclase and ore minerals are also included in the temper. The rock fragments are limited, represented by single quartzites, schists and tuffs.

Fragment Adt-52-17 is made of matrix and temper in ratio from 65 to 35 %. The mineral fragments are represented mainly by quartz and in a small amount by K-feldspar, plagioclase, ore minerals and single epidote grains. The rock temper is presented by single granitoids and schists, fragments of chamotte (older ceramics) and carbonate. The last one fills all gaps and pores in the ceramic.

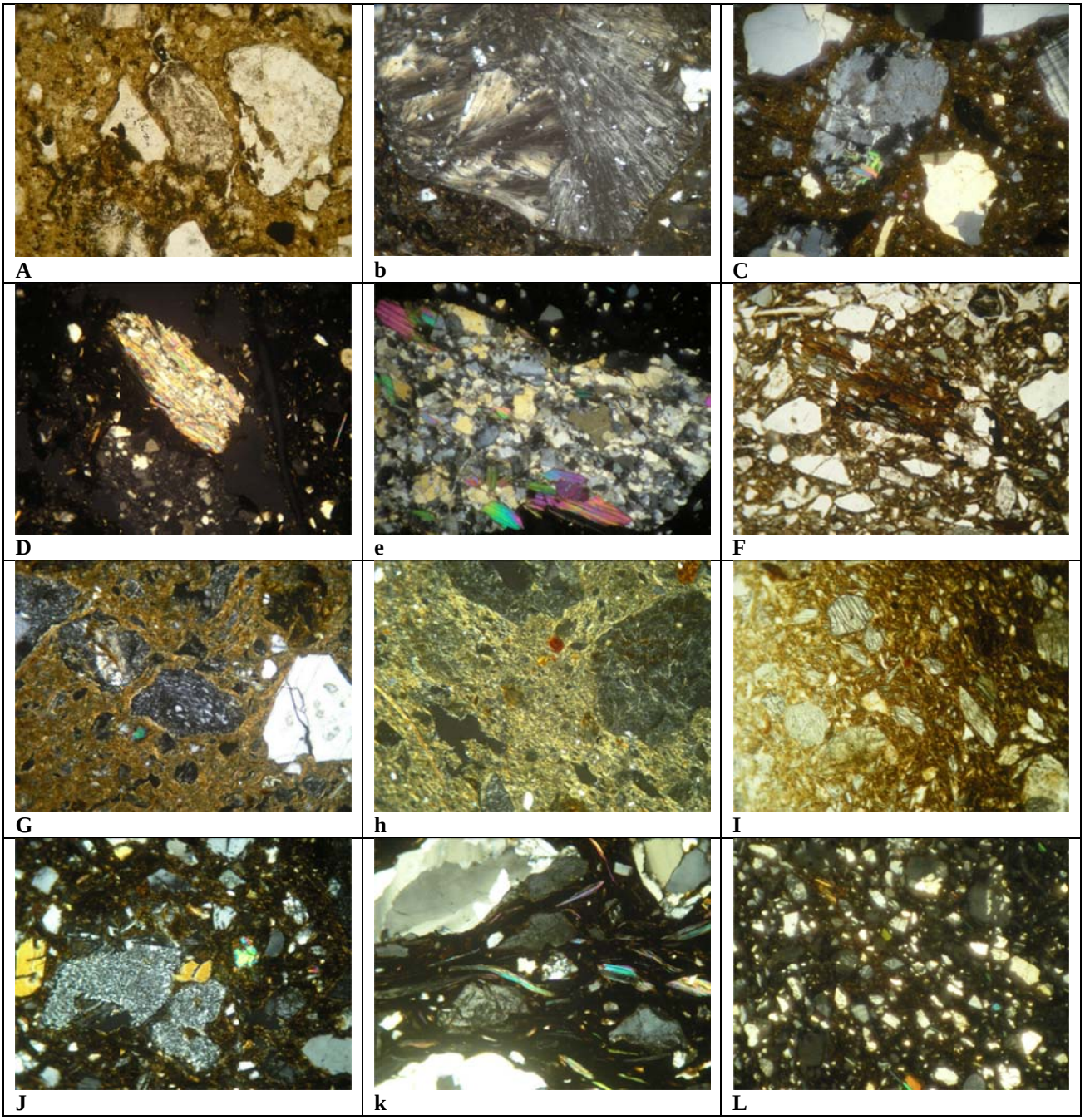

Fig. 3. Microphotos of ceramic artifacts: a –Rock fragment of the acid volcanic rock (centre) and quartzitesamong micaceous matrix.,PPLII, Observation field wide (Ob.F. W.) = 1900 μm; b –Rock fragment of volcanic rock with spherulitic texture.,CPL, Ob.F. W.= 1900 μm; c – rock fragment of granitoid (centre), CPL, Ob.F. W. = 3900 μm; d – Rock fragment of schist (centre). CPL, Ob.F. W. = 1900 μm; e – Rock fragment of gneiss. CPL, Ob.F. W.= 1900 μm; f – Enriched of amphibole ceramic artifact. PPL, Ob.F. W. = 1900 μm; g –intermediate volcanic clast among micaceous matrix. CPL, Ob.F. W. = 1900 μm; h – Fragments of acid volcanic rock among fine crystalline matrix. CPL, Ob.F. W = 1900 μm.; i –Enriched of amphibole pottery. PPL, Ob.F. W. = 1900 μm; j – Fragment of altered volcanic rock (centre) and epidote.CPL, Ob.F. W. = 1900 μm; k –Enriched of micas (biotite and muscovite) and quartzites pottery. CPL, Ob.F. W.= 1900 μm; l–Ceramic artifact enriched of minerals– quartz, micas and ores. CPL, Ob.F. W.= 3900 μm.

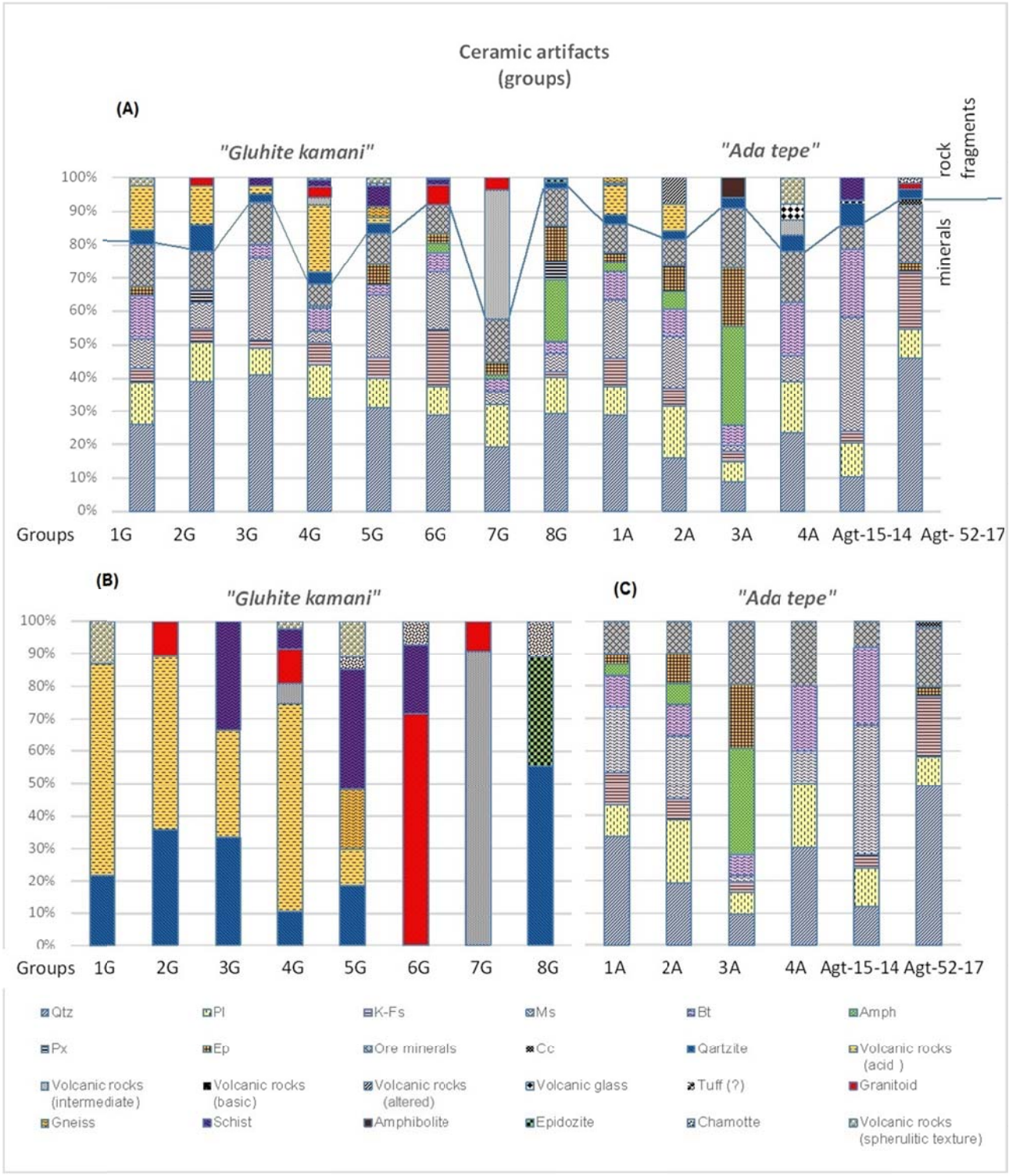

Fig. 4.The distinguished groups of the ceramic artifacts from the sites "Gluhite kamani" and "Ada tepe" according to their temper

The matrix in all the groups is optically active and represented by micaceous groundmass. The XRD analyses supplement the information for ceramic artifacts from the „Gluhite Kamani" (Янкова и др., 2013) and give the new data about those from the site "Ada tepe". The results confirm the optically specified mineral composition and register the presence of illite, montmorillonite-illite and montmorillonite. The supposed temperature of the firing of the studied ceramics is within the limit from 500-550°C to 800° (850°) according to the determined mineral phases. The upper limit of this temperature range is indicated by the presence of illite in some fragments (Fig. 5). The lower limit of this range is not very clear, due to the presence of montmorillonite and montmorillonite-illite, which indicate temperatures from 500° to 550°C.

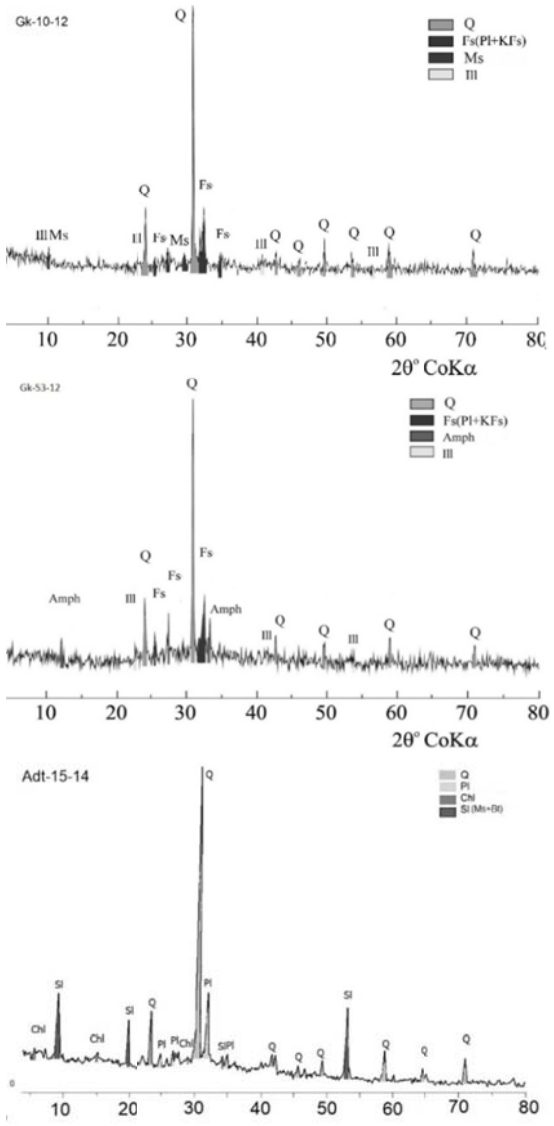

Fig. 5. XRD analyses of the ceramic artifacts from the sites "Gluhite kamani (Gk-10-13 representative for Group 2G; Gk-53-12 representative for group 8G) and "Ada tepe"(Adt-15-14).

Discussion and conclusion

The results of the petrographic investigation of the representative ceramic artifacts from the two archaeological sanctuary sites "Gluhite kamani" and "Ada tepe" with regard to the groups described above show that most of the investigated EIA pottery has different temper composition (mineral and rock). The differences could be summarized in the following way:

- The raw material used for the production of the pottery in the site "Gluhite kamani" is enriched by rock fragments compared to those from "Ada tepe" where the mineral inclusions are dominant (Fig. 4 A);
- The rock fragments included in the ceramic artifacts from the site "Gluhite kamani" are presented mainly by acid volcanic rocks, some of them with spherulitic texture;
- The pottery temper from the site "Ada tepe" consists of a large variety of rock fragments – schists, gneisses, granitoids, acid, intermediate and basic volcanic rocks, amphibolites and tuffs;
- The raw material used for the production of pottery from the site "Ada tepe" is characterized by the presence of lot of minerals like epidote, micas and amphibole (Fig. 4C);
- In the representative investigated pottery there is a small quantity of ceramic with different temper (minerals) which cannot be included into the divided groups (Adt-15-14, Adt-52-17).

All this evidence for the ceramic artifacts from these two archaeological sites gives us information about the local raw material used for producing the pottery. The site "Gluhite kamani" is situated on the Paleogene rhyolites and most of the included fragments in the pottery from this site are from these rocks. The other rock inclusions like bitotite, gneisses and schists are probably from the Thracian unit (Sacar metamorphic terrain) revealed to the north and northeast of the site.

In the "Ada tepe" site the presence of minerals like epidote and amphibole and rock inclusions of amphibolites, schists, granitoids and basic volcanic rocks are the most distinct mineral and rock temper for the divided ceramic groups (4a,c). These types of rocks crop out in the vicinity of the site (south and northwest) and suggest the presence of short transportation in the valley of the river Krumovitsa and Elbasan Dere. The possible local raw material of the EIA pottery was also investigated through the heavy mineral fraction of the site "Ada tepe" showed by the data published by Ajidanlijsky et al. (2008). A small amount of ceramic artifacts (Adt-15-14, Adt 52-17) are probably imported in the site "Ada tepe".

On the basis of the petrographic features in some of the studied artifacts (groups 8G and 3A) from the two archaeological sites was found similarity in the mineral temper especially in the content of the minerals like amphibole. There are, also, a similarity according to the type of the raw material (groups 7G and 4A) which indicates the similar way of production using more amounts of matrix and a small quantity of temper. These indicators could be presumed about the relation between these two archaeological sites during EIA and only future investigation will confirm this.

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