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Final Thesis

A microarchaeology approach to the study of the Kura-Araxes culture in Khashuri Natsargora, Georgia

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Preface

This work is centred upon the analysis of sediment samples from the archaeological site of Natsargora in Georgia, Southern Caucasus. The samples were collected by prof. Elisabetta Boaretto of the Weizmann Institute of Science in Rehovot, Israel, in the framework of her collaboration with the 'Georgian-Italian Shida Kartli Archeological Project' of Ca' Foscari University of Venice in collaboration with the Georgian National Museum, co-directed by prof. Elena Rova, during the 2011-2012 excavation seasons with the aim of characterising the context of the 14C samples collected at the site and, more in general, to highlight the micro-stratigraphical sequence of the site.

Since then, the samples had been stored at the Weizmann Institute of Science in Rehovot, Israel, where I could analyse them in the course of a study period financed through an Erasmus + ICM exchange agreement.

This work summarises the results of this study.

Chapter 1

INTRODUCTION

As most of the samples collected at Natsargora belong to the Kura-Araxes levels of the site, after briefly introducing the site, this chapter will present the main features of the Kura-Araxes culture.

1.1 THE SITE OF NATSARGORA

Georgia is a South Caucasian country located between Eastern Europe and Western Asia. It is bounded by the Black Sea to the west, by Russia to the north and northeast, by Turkey to the southwest, by Armenia to the south, and by Azerbaijan to the southeast. The country covers an area of 69700 square kilometers, with Tbilisi as capital.[1]

The site of Khashuri Natsargora (Fig. 1) is located at the western limit of the Shida Kartli province in Georgia, ca 7 km to the north of the Kura river valley. The area consists of a small mound surrounded by a flat settled area, which may have extended over about 2 hectares, and a nearby cemetery.[2] The first archeological excavations took place between 1984 and 1992 by a team of the Khashuri Archaeological Expedition headed by Al. Ramishvili. They focused on the Late Bronze and Classical Period remains and reached the Early Bronze Age layers only in some soundings in the settlement area. According to the

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[1] Lang, D. Marshall , Suny, . Ronald Grigor , Djibladze, . Mikhail Leonidovich and Howe, . G. Melvyn. "Georgia." Encyclopedia Britannica, July 8, 2023. https://www.britannica.com/place/Georgia.

[2] Rova 2014, p. 51.

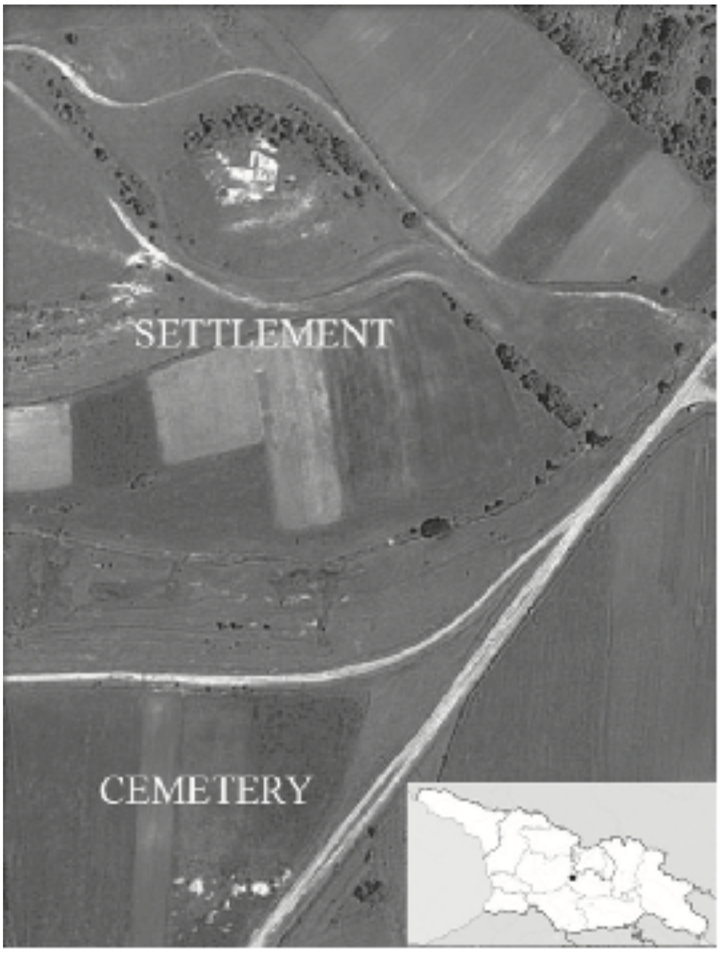

Fig. 1. Satellite view of the Khashuri Natsargora site
(from Rova, Makharadze, Puturidze 2017: fig. 1).

high quality ceramic materials discovered, it was concluded that the site belonged to the latest phase of the Kura-Araxes culture and the transition to the Bedeni culture.[3]

In 2009 and 2010, the 'Georgian-Italian Shida Kartli Archeological Project' started to study the material recovered by the previous Georgian excavations at both the cemetery and settlement. Regarding the cemetery, pottery from the graves was attributed to the Kura-Araxes tradition. It exclusively consisted of Red-Black Burnished ware from the early stage of the period (KA II). As for the settlement, Kura-Araxes pottery was very similar to that

[3] Rova, Makharadze, Puturidze 2017, p. 154-155.

Fig.2. Natsargora 2011-2012 excavations: view of the Western section of Sounding no. 1, with occupational levels (from Rova, Makharadze, Puturidze 2017: fig. 16).

from the cemetery, with the main difference that the pottery from the settlement was characterised by shapes connected with everyday life; Bedeni pottery belonged to two different functional classes: common/coarse ware for food preparation and storage, and fine/ decorated ware for serving and consuming.[4]

New excavations were carried out by the joint Georgian-Italian expedition in 2011-2012, in order to verify the reconstructed stratigraphic sequence of the site and to collect new samples for radiometric dating. The main aims were to understand the settlement's function and internal organisation and to trace possible changes in the style of life of its population. Also, combined archeological and geomorphological analyses led to establish that the area occupied by the settlement extended over about 2 ha and that the top of the mound had been leveled by local villagers after the Georgian excavation, in order to create a flattish surface.

The stratigraphic sequence of the site can be reconstructed with the top level (2.50 m thick) belonging to Late Bronze/Early Iron Age period, which had been mostly removed by the Georgian excavations. The middle level (ca 50 cm thick) didn't show clear traces of floors, walls or installations and was cut by several LB/EIA pits. The discovery of both Kura-Araxes and Bedeni sherds led to interpret this level as resulting from the long period between the abandonment of the Early Bronze Age settlement and the re-occupation of the mound at the beginning of the Late Bronze Age. The bottom level (50 cm thick) was attributed to the Kura-Araxes occupation, which had been disturbed by Early Kurgan and Late Bronze/Early Iron Age intrusions. (Fig. 2).[5]

In the Southern part of the excavation (Fig. 3) the area was disturbed by a large number of pits of the Late Bronze/Early Iron Age, so that the underlying sediments were destroyed over large areas. However, well stratified material was very homogenous and exclusively of Kura-Araxes date, suggesting that the 50 cm sequence of surfaces

[4] Rova, Makharadze, Puturidze 2017, p. 156-160.

[5] Rova, Makharadze, Puturidze 2017, p. 160-163.

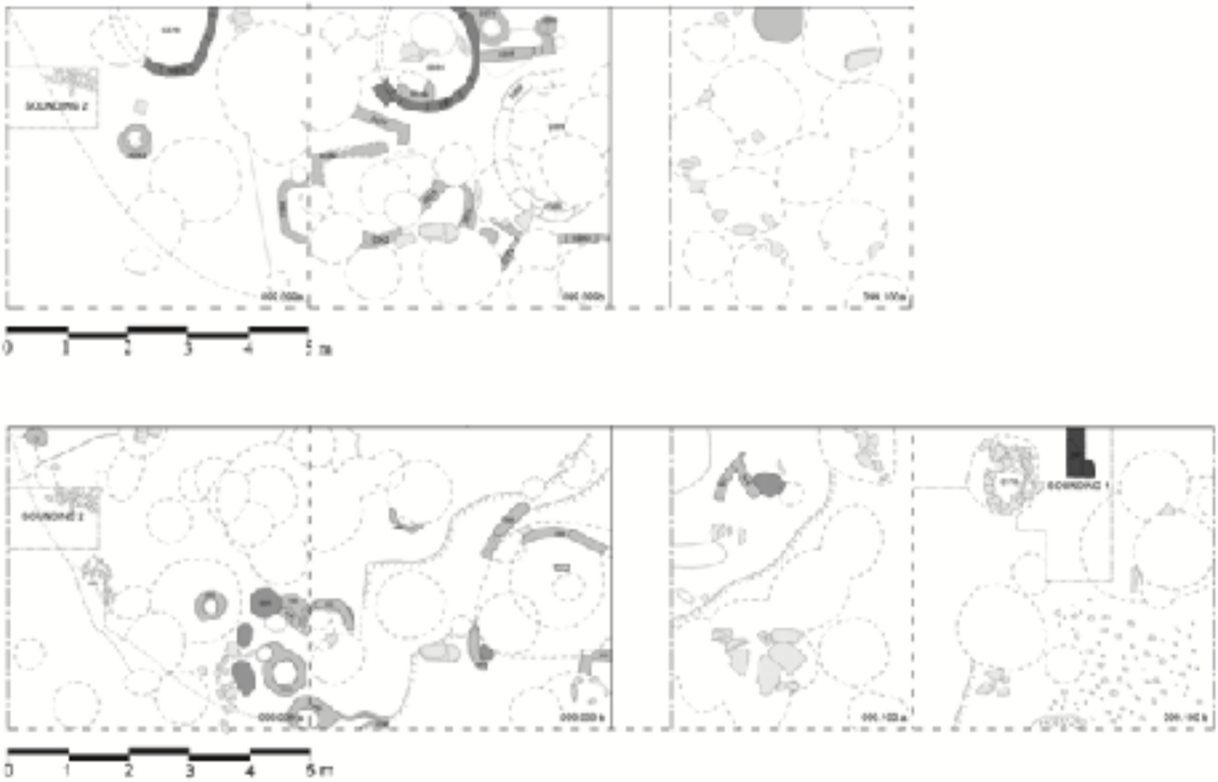

Fig. 3. Natsargora 2011-2012 excavations: composite plan of Kura-Araxes occupation, later stage (above) and earlier stage (below) (from Rova, Makharadze, Puturidze 2017: fig. 15).

accumulated over a short period of time, probably about 100 years. The sequence consists of a combination of 1 to 4 cm thick layers of compacted yellowish sandy silt, overlain by thicker greyish-brownish layers that include large quantities of charcoal, cereal seeds and some wood fragments. Soil micromorphological analyses were taken to better understand the function of the prepared floors: they show cyclical phases of preparation and use of the pavements, probably used in the processing of cereals. Few traces of animal presence suggest that domestic animals were kept in dedicated areas outside of the settlement. After the use of each floor, the vegetal residues lying upon it were burned and covered by a new layer of silt.[6]

In Natsargora, architectural features were heavily affected by both later disturbances and previous excavations and concentrated in the northern part of the site. Their walls had

[6] Rova, Makharadze, Puturidze 2017, p. 165.

been leveled at a height of ca 10 cm and covered by the floor of the next occupational layer, suggesting that the buildings had been periodically abandoned and re-occupied. These walls were mainly made of mud-bricks of rather irregular shapes or cob blocks; the wattle-and-daub technique was also in use at the site, as suggested by the presence of daub with impressions of vegetal material. Some structures were circular, and one of them was originally equipped with a typical Kura-Araxes hearth and an open-air installation. Another poorly preserved structure showed a rectangular shape with rounded corners, rather common for Kura-Araxes buildings in the Shida Kartli region, but also attested in the Bedeni period at Berikldeebi.[7]

Different types of installations, mostly connected with fire, were found in the excavated area. Typical Kura-Araxes hearths are characterised by a concave clay bottom recessed into the ground and with top projections alternated with rounded or horse-shaped features. The projections were used to hold the pottery over the fire, which was lit inside the concave bottom. These kind of hearths are also attested in Syro-Palestine and Western Iran, areas that witnessed the expansion of the Kura-Araxes culture, as will be discussed later.[8]

It's important to note that only at Natsargora part of the site is occupied by an open area recognised as a place for cereal processing activities, opposite to other Kura-Araxes sites where is hardly evidence for specialised areas devoted to economical activities. Storage facilities, consisting of pits, were attached to individual houses. The settlement was unfortified due to the naturally protected location, a steep-sided mound that served as natural defense.[9]

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[7] Rova, Makharadze, Puturidze 2017, p. 165-166.

[8] Aquilano, Gavagnin, Gervasi 2019, p. 58-59.

[9] Rova 2014, p. 57.

1.2 THE KURA-ARAXES CULTURE

The Kura-Araxes culture developed between the mid-4th and the mid-3rd millennia BC (Fig. 4) in the geographical area known as the Southern Caucasus (hence the name of "Early Transcaucasian Culture" with which it is also known).[10] Altogether it included the modern-day territories of Armenia, Azerbaijan and Eastern Georgia and parts of North-Western Iran, the North-Eastern Caucasus and Eastern Turkey.[11] The name of the culture derives from the Kura and Araxes river valleys.[12]

The origins of the Kura-Araxes culture are linked to the nature of the Chalcolithic cultures present in the Southern Caucasus. Berikldeebi, in Georgia, is one of the sites with the earliest evidence of Kura-Araxes pottery in the region, dating to the end of the first half of the 4th millennium. This phase could be considered as 'Proto Kura-Araxes', a chronological stage in which a minority of Kura-Araxes ceramics with archaic features coexisted with a majority of chaff-tempered pottery linked to Chalcolithic traditions. More recent studies at Chobareti in Southern Georgia and at Sos Höyük in North-Eastern Turkey confirm that materials associated with Kura-Araxes culture were in use in this area since 3400-3300 BC.[13]

According to the recent synthesis by Palumbi and Chataigner, in the course of the second half of the 4th millennium the new Kura-Araxes ceramic tradition establishes itself in this core area, where it becomes the main material expression of the local communities. The Kura-Araxes communities shared a set of material elements, which form a sort of

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[10] Edens 1995, p. 53.

[11] Kushnareva 1997, p. 44.

[12] Kushnareva 1997, p. 44.

[13] Palumbi, Chataigner 2014, p. 247.

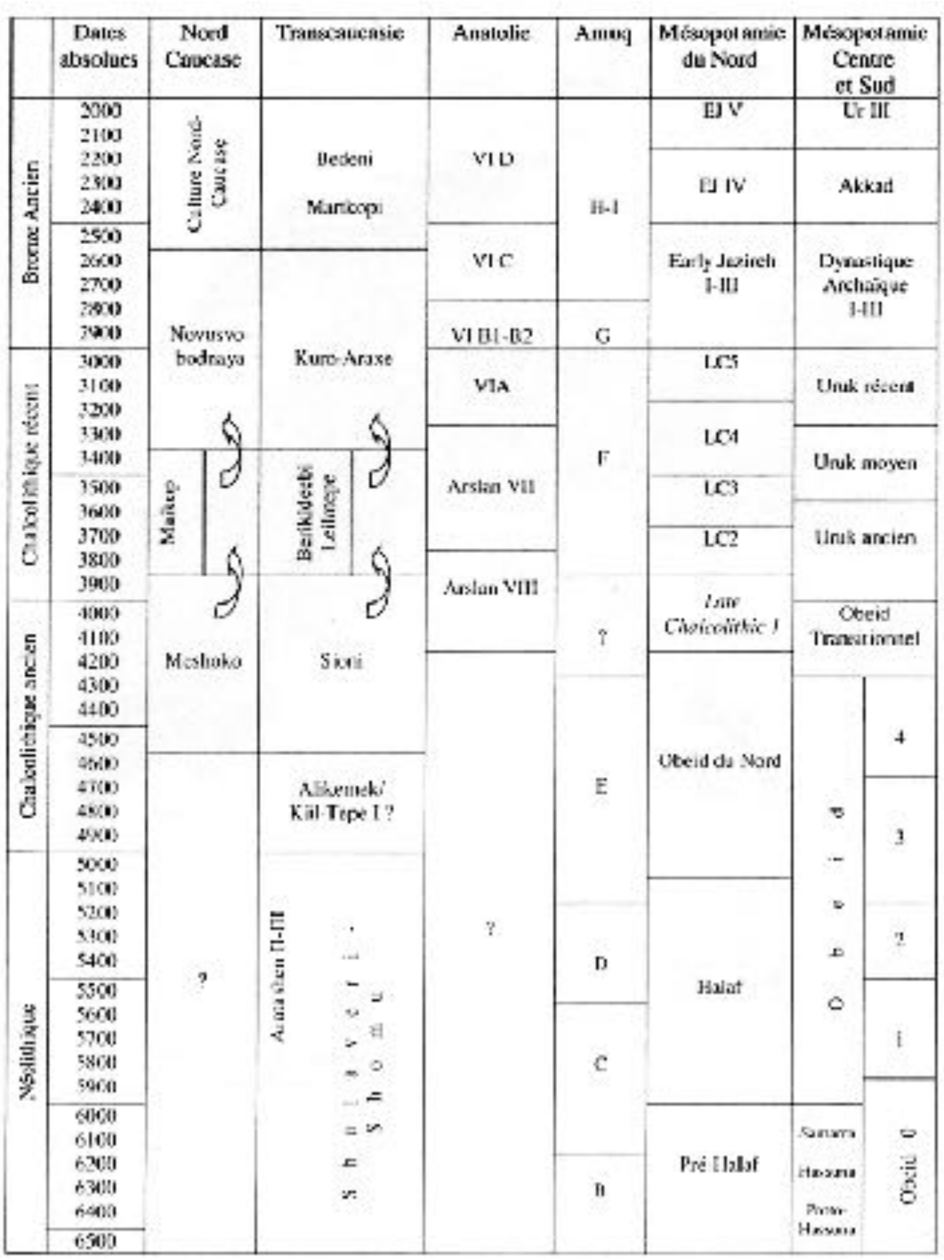

Fig.4. Chronological table of the Middle-East cultures, from Neolithic to Early Bronze Age (from Lyonnet B., 2007.).

"cultural package"; pottery, often characterised by a fixed red-black pattern (black exterior and red interior surfaces) that became a common feature by the late 4th millennium, was part of this set.[14] Palumbi and Chataigner also state that: «the consistent presence of handles

[14] Palumbi, Chataigner 2014, p. 248-249.

on both jars and bowls is one of the most distinctive elements of the Kura-Araxes vessels. New shapes were developed also, including flat, circular lids that may suggest the systematic introduction of new food processing practices (boiling) and, presumably a new culinary tradition (stews)».[15]

Not only the pottery tradition characterised the emergence of the new Kura-Araxes culture, but also the way domestic space was organised. Palumbi and Chataigner observe that the mono- or bi-cellular free-standing houses of Kura-Araxes settlements represent a break with the previous period, characterised by the multi-cellular rectangular architecture commonly seen in Late Chalcolithic settlements.[16]

Kura-Araxes settlements were generally about 1-2 ha large and the internal architectural differentiation seems to have been absent in them. This lead scholars to suggest a poorly developed socio-political hierarchy within the culture. Some, but not all, settlements were surrounded by stone walls. Kura-Araxes people built mud-brick or wattle-and-daub houses, originally round, but later developing into sub-rectangular units with just one or two rooms, multiple rooms centred around an open space, or rectilinear plans.[17]

The culture's settlements and burial grounds expanded out of lowland river valleys into highland areas. This could be thought of as an evidence for a switch from agricultural to pastoral activities, but due to the fact that the settlements in the lowlands remained more or less stable, it might merely suggest that the bearers of the Kura-Araxes culture were diversifying their economy to encompass crop and livestock agriculture.[18]

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[15] Palumbi, Chataigner 2014, p. 249.

[16] Palumbi, Chataigner 2014, p. 249.

[17] Edens 1995, p. 54.

[18] Edens 1995, p. 55.

Kura-Araxes burial customs are very diverse: kurgans (burial mounds) are scarce, clustering in the area of Azerbaijan, with collective burials rather than individual ones; while tombs in the rest of the area are very differentiated (i.e. cist, shaft, horse-shoe shaped) but all of them have poor and undifferentiated burial goods. These elements lead to the hypothesis of a tradition based on group membership, horizontal relations and an egalitarian funerary ideology.[19] Palumbi and Chataigner suggest that, although «large burial mounds [, the kurgans,] were probably the only element of cultural continuity shared by both the Chalcolithic and Kura-Araxes funerary traditions in Azerbaijan, […] changes are detectable in the burial customs and in funerary representations. While the Chalcolithic kurgans— with single burials containing prestige and luxury goods hint at the existence of forms of social differentiation and point to the existence of community leaders, the burials in the Kura-Araxes kurgans held collective burials with a very homogenous repertoire of grave goods», supporting the hypothesis of a lack of social differentiation and hierarchical leadership within the Kura-Araxes society.[20]

Practices related to craftwork (pottery and metals), culinary traditions and tastes, body ornaments (like metal spiral pins), the organization of domestic space, cultic and religious practices (funerary structures and burial customs) formed a common Kura-Araxes material and cultural package, which the Kura-Araxes groups replicated in the wide area of their expansion. Accordingly, in the whole area that covered the Southern Caucasus, North-Western Iran, Eastern Anatolia and the Levant, the Kura-Araxes culture can be identified by this cultural package shared by communities living in different geographies, ecologies and with different historical backgrounds.[21]

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[19] Rova 2019, p. 17.

[20] Palumbi, Chataigner 2014, p. 249.

[21] Palumbi, Chataigner 2014, p. 253.

Pottery of the Kura-Araxes culture is very distinctive. Its surface is typically black and red, sometimes decorated with geometric designs. According to Palumbi, this color scheme actually originated in Eastern Anatolia, and then moved on to the Southern Caucasus. In later phases, however, these cultural influences came back to Anatolia mixed in with other cultural elements of Caucasian origin.[22] The pottery shows how much the culture spread on the territory; in fact, some Kura-Araxes groups may have spread, as will be discussed later, from their original homes into North-Western Iran, Eastern Anatolia and Syro-Palestine. Most certainly, in any case, they had extensive trade contacts.[23]

According to the ceramic features, the Kura-Araxes culture in Shida Kartli has been divided into three main phases: the pottery from the first phase (KA I) is now usually mineral-tempered (rather than Chaff-Faced Ware as was previously the case), surfaces are burnished and the morphological repertoire features handled vessels and flat lids, pottery is often poorly fired, mostly monochrome an undecorated; the following KA II phase develops a 'Shida Kartli' variant, characterised by a variety of single and double-handed vessels of different dimensions, with large mouths, out-turned rims and flat bases and are typically undecorated; KA III pottery shows a large presence of Black Burnished Ware, although there is a morphological continuity with phase II. Another distinctive feature of this later phase is the presence of incised and grooved decorations consisting in groups of zigzag or cross-pattern lines around the wider point of the vessel's surface.[24]

Especially in its later phases, the Kura–Araxes culture exhibits precocious metallurgical developments which strongly influenced the surrounding regions. Bronze tools included axes, awls, sickles and knives; the characteristic metal weapon was the

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[22] Palumbi 2008, p. 677.

[23] Edens 1995, p. 54.

[24] Rova 2014, p. 53.

dagger and large bronze spearheads are also known.[25] Other than bronze, Kura-Araxes people worked copper, arsenic, silver, gold and tin, as proven by the ornaments (pins, hair-rings, bracelets, beads etc.) found in burial chambers.[26]

It is also remarkable that all these communities went through comparable processes of change and development during an extraordinarily long span of time of approximately 1000 years, despite of the presence of regional and local peculiarities.[27] Palumbi and Chataigner explain that «regional factors and local dynamics must certainly have played a role in these changes and processes of diversification. Scholars also think that the involvement of the South Caucasian communities in the dynamics which were developing in adjacent regions could have played a determining role in the transmission, adaptation and transformation of the Kura-Araxes traditions».[28]

By the beginning of the 3rd millennium BC, the Kura-Araxes culture is found in areas outside its regions of development: the Iranian plateau and the Anatolian highlands as well as, in a slightly later phase, in the Levantine region (Fig. 5). This expansion has been interpreted by some scholars as the result of different migratory waves that occurred in this period. However, the Kura-Araxes culture could also have spread in these regions due to unidirectional shifts, cyclic seasonal movements or even mere 'movements of ideas', that didn't involve the physical shifting of a large Kura-Araxes population.[29] In Iran, the Kura-Araxes culture was introduced at the end of the 4th millennium BC, but, as suggested by studies in Kültepe, some North-Iranian communities already included Kura-Araxes

[25] Mallory 1997, p. 342.

[26] Edens 1995, p. 55.

[27] Palumbi, Chataigner 2014, p. 254.

[28] Palumbi, Chataigner 2014, p. 254.

[29] Palumbi, Chataigner 2014, p. 254.

Fig. 5. Distribution area of the Kura-Araxes culture (Elaboration by Toby Wilkinson on satellite image base, courtesy of the author)

characteristics since 3340 BC. However, it's worth saying that Iranian Kura-Araxes communities didn't simply copy the Caucasian Kura-Araxes package, for instance in the pottery repertoire. This suggests that «the Kura-Araxes traditions went through processes of adaptation, change and re-elaboration according to local tastes and technologies».[30]

Scholars have also suggested a relation between the Kura-Araxes expansion and the Uruk 'collapse', offering a new view of the Kura-Araxes in Iran and elsewhere. The site of Godin Tepe (ca 3000 BC), for instance, shows a sequence of Uruk levels, covered by Kura-Araxes levels where remains of dwellings, interpreted as huts made of wattle-and-daub, and ceramics with Kura-Araxes characteristics have been found.

[30] Palumbi, Chataigner 2014, p. 255.

Palumbi and Chataigner, however, portray the process as more complex rather than as the mere process of filling a void left by the demise of the Uruk phenomenon by intrusive Kura-Araxes populations.[31]

It is indeed possible that some Kura-Araxes groups may have moved during the earlier 3rd millennium, concurring in the expansion of the culture. This can be proved by a selected package of Kura-Araxes traits that, starting from ca 2800 BC, is found in geographic and ecological regions different from the original Kura-Araxes mountain and highland areas. One example of this can be the so-called Khirbet Kerak phenomenon: the Levantine tradition that included red-black ceramics and anthropomorphic portable andirons, specific markers of the Kura-Araxes culture. Scholars identify these markers as «material signs of the diffusion of traditions related to the household sphere, implying specific forms of rituality, consumption and, as a consequence, culinary practices that were directly linked to those practiced in the Anatolian and Caucasian highlands».[32]

The end of the Kura-Araxes culture can be set in the mid-3rd millennium BC, when new cultural models and changes in the social order started to emerge. Late or post-Kura-Araxes sites often featured kurgans of greatly varying sizes, with larger and richer kurgans surrounded by smaller ones containing less goods. Bigger kurgans contained a wide assortment of metalworks, including gold and silver. The adoption of new funerary traditions in the Southern Caucasus marks the development of the Martqopi and Bedeni cultures (also called Early Kurgans cultures), where the emphasis on elites and new forms of leadership is proved by the display of luxury and exotic artifacts as part of the burial goods. Together with the construction of monumental burial mounds, this may suggest the

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[31] Palumbi, Chataigner 2014, p. 255.

[32] Palumbi, Chataigner 2014, p. 256.

emergence of social differentiation.[33] Scholars are still debating whether these new funerary traditions were introduced in Southern Caucasus by external communities, possibly from the Northern Caucasus, and whether Kura-Araxes, Martqopi and Bedeni communities coexisted in the same area, as shown by some technical elements of continuity, for instance on pottery production, in particular between Kura-Araxes and Martqopi.[34]

In North-Eastern Anatolia some elements of the Kura-Araxes culture persist until the early 2nd millennium, with Kura-Araxes ceramic evidence that may confirm the coexistence between Kura-Araxes and Early Kurgans cultures. In North-Western Iran, on the contrary, the majority of the ceramic traditions show clear signs of change. In other regions that witnessed the presence of the Kura-Araxes cultural package, a process of elaboration or abandonment of the culture can be perceived. The Upper Euphrates Valley undergoes a renewed period of construction of large regional centres with large-scale architecture; the only elements left from the Kura-Araxes culture here are Red-Black Burnished Ware and andirons, which are still found in both domestic and ritual buildings, that are incorporated into new systems of production and different socio-cultural models. At Khirbet Kerak in Palestine, red-black ceramics and andirons can still be found in Phase I, the mid-3rd millennium but later, during the following period (Phase J), they disappeared completely, giving way to standardised wheel-made goblets that attest new pottery manufacturing processes and new drinking practices.[35]

To sum up, around the end of the first half of the 3rd millennium, the development of new city states in Syria may have broken the networks of movement and communication between the Syrian lowlands and the Anatolian highlands, thus isolating the communities

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33 Edens 1995, p. 54.

34 Palumbi, Chataigner 2014, p. 257.

35 Palumbi, Chataigner 2014, p. 258.

living in the former regions from the Southern Caucasus. This phenomenon may explain the absorption and assimilation of the Kura-Araxes traditions into local Levantine societies of the mid-3rd millennium.[36]

[36] Palumbi, Chataigner 2014, p. 258.

Chapter 2

MATERIALS AND METHODS

2.1 MATERIALS

My research consisted in analysing the samples collected in Natsargora, Georgia by prof. Elisabetta Boaretto, during the 2011-2012 'Georgian-Italian Shida Kartli Archeological Project'. Since then, the samples were stored in the Kimmel Center for Archaeological Science at the Weizmann Institute of Science in Rehovot, Israel. The amount of analysed samples was 36. Most of them were sediments collected in plastic bags or aluminium foils, but charcoals and bones were also present.

Along with the samples, I had the possibility to examine the logbook where all the information concerning the samples were noted day by day by prof. Boaretto. This gave me the opportunity to trace the precise point where each sample had been collected, in terms of its position in the excavation grid and, more specifically, of its provenance locus. The logbook contained also a brief description of each sample, together with the date of the sampling. In the case of charred remains, in-field wet or dry sieving was also noted.

Also, the whole archaeological documentation by the 'Georgian-Italian Shida Kartli Archeological Project' was available to me. It consisted of "loci database" records, daily graphic journals, excavation photos, list of finds, plans, preliminary reports, matrixes etc. Thanks to this information, I tried to contextualise the samples in a more precise way. I traced the stratigraphic position and the planimetric origin of each sample, organised a relative chronology and conceptualised their cultural affiliation.

In order to analyse the samples I had the opportunity to use the equipment available at the Kimmel Center laboratory (Fig. 1). The machinery which I used most frequently was

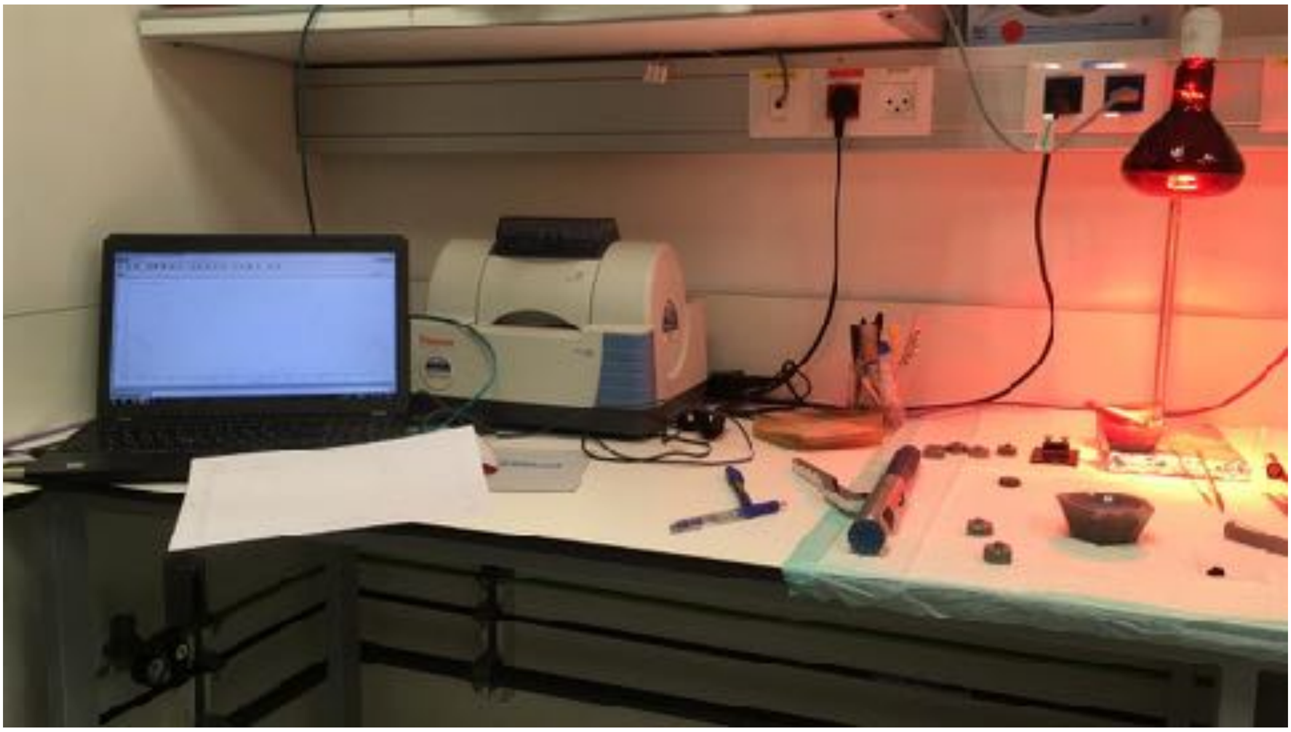

Fig. 1. The Kimmel Center FTIR station. (photo of the author)

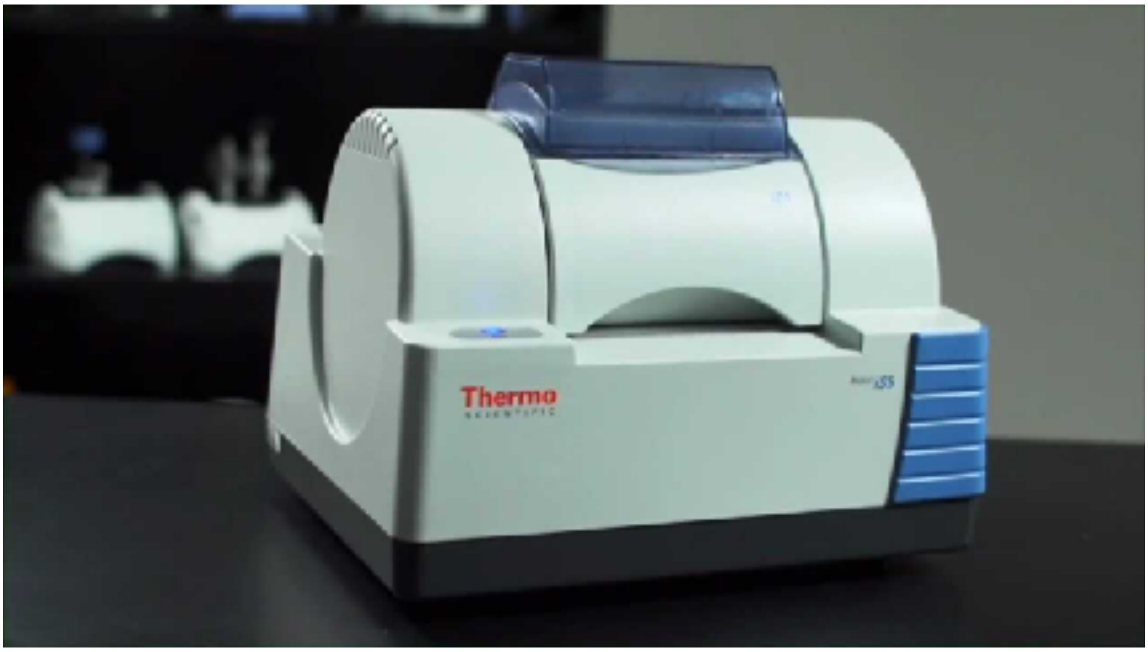

Fig. 2. Thermo Scientific Nicolet™ iS5 FTIR Spectrometer. (from Thermo Scientific product specifications booklet)

the Thermo Scientific Nicolet™ iS5 FTIR Spectrometer (Fig. 2), by which I could identify the samples by means of infrared spectroscopy. Along with the FTIR spectrometer, the equipment used to prepare the sample included a mortar and pestle, a metal dye, a manual or hydraulic press and a 400-watt heat lamp. Other equipment used was optical and polarising microscopes, electronic scales and laboratory centrifuges.

2.2 METHODS

The primary method used to analyse the samples is the Fourier Transform Infrared Spectroscopy (FTIR). This is a technique used to acquire an infrared spectrum of absorption or emission of a solid, liquid or gas, hence mostly applied in geology, chemistry, materials, botany and biology research fields. A spectrometer collects high-resolution spectral data over a wide spectral range that measures intensity over a narrow range of wavelengths at a time.[37]

The development of FTIR would have been impossible without the use of the Michelson interferometer, an optical device invented in 1880 by the Nobel Prize in Physics scientist Albert Abraham Michelson. His interferometer was not originally designed to perform infrared spectroscopy, instead it was meant to test the existence of a "luminiferous aether", a medium through which waves were thought to propagate. Michelson was aware of the potential use of the interferometer to obtain spectra and manually measured many interferograms. Unfortunately, the time-consuming calculations required to convert an interferogram into a spectrum made using an interferometer to obtain spectra impractical.

The invention of computers made calculating Fourier transforms faster, and an algorithm made by J.W. Cooley and J. W. Tukey, known as the Fast Fourier Transform (FFT), is still the basis for the transformation routines in nowadays FTIRs. The first

[37] Griffiths, de Haseth 2007, p. 75.

commercially infrared spectrometers were available since the late 1960s, manufactured by the Digilab subsidiary of Block Engineering in Cambridge, Massachusetts. These instruments incorporated many features we now take for granted, as an air bearing driven Michelson interferometer, a He-Ne reference laser used to track mirror position and act as a wavelength standard and a minicomputer running the FFT algorithm. These instruments made possible the acquisition of quality, high resolution data in a short period of time.[38]

FTIR spectroscopy is based on the idea that the interference of radiation between the two beams yields an interferogram. The latter is a signal produced as a function of the path length change between the two beams reflected from two mirrors (resides in the interferometer block). The two domains of distance and frequency are interconvertible by the mathematical method of Fourier transformation (hence the name Fourier transform infrared spectroscopy). The Michelson interferometer is the core of FTIR spectrometers and is used to split one beam of light into two, creating the different paths of the two beams. Then it recombines the two beams and conducts them into the detector, where the differences in the intensity of these two beams are measured as a function of the difference in the paths.[39]

Infrared spectroscopy is based on the manner in which radiation interacts with material in the infrared range (4,000 to 250 centimeter^{-1} [cm^{-1}; wavenumbers, or the inverse of wavelength]). Some of this radiation is absorbed by the sample because it causes the chemical bonds of the sample to vibrate. The result is that less radiation reaches the detector at specific wavenumbers, and this is recorded as a series of peaks in the infrared absorbance spectrum. The wavenumber at which the peak maximum is located is characteristic of a chemical bond, or a network of chemical bonds. Furthermore, variations in the shape of a peak, or shifts in the location of the peak maximum, may be indicative of disorder in the

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38 Smith 2011, p. 5.

39 Berna 2016, p. 285.

material or a small change in its composition. Infrared spectrometers are relatively robust instruments that can be operated under field conditions.[40]

In order to analyse the samples in the FTIR spectrometer, they must be prepared in potassium bromide (KBr) pellets, as KBr does not absorb the infrared spectrum. KBr pellets are prepared using tens of micrograms of a sample, that are lightly ground in a mortar and pestle. Only after this grinding about 50 milligrams of KBr can be mixed with the sample. The mixture is then put into a metal dye and placed under pressure using a press. After a few minutes, a transparent disk is formed and placed in the instrument beam.[41] To prevent cross-contamination, the sample preparation equipment is washed in hydrochloric acid (HCl), denied water, and then acetone for rapid drying.[42] As the sample should be as dry as possible, the sample preparation equipment and the KBr are heated under a 400-watt heat lamp for a few minutes prior to sample preparation.[43]

In archaeology, infrared spectroscopy is used as a sensitive method for obtaining information on the molecular structures and crystalline and amorphous/disordered materials as well as organic materials. It can be used both to identify materials and to characterise their states of atomic order and disorder.[44]

Other than FTIR, different analytical techniques that can provide information about compositions and structures of sedimentary mineral components are: energy-dispersive x-ray fluorescence spectrometry (EDXRF) coupled with scanning electron microscopy (SEM), x-ray diffractometry (XRD) and polarized light microscopy. Unfortunately, all these techniques need a time-consuming sample preparation that are incompatible with the time

40 Weiner 2010, p. 275-276.

41 Weiner 2010, p. 276.

42 Weiner, Goldberg 1990, p. 40.

43 Weiner 2010, p. 277.

44 Weiner 2010, p. 275.

frame of the excavation. FTIR sample preparation is simple, inexpensive, and takes only a few minutes. Infrared spectroscopy is thus a very convenient and informative analytical tool to operate on-site at an excavation, as well as in the laboratory.[45]

One of the first on-site application of infrared spectrometry in an archeological excavation was the analyses of bones and sediments from Kebara Cave, located on Mount Carmel, Israel, in 1989.[46] The aim of these analyses was to understand the history of bone preservation at the site and the mineralogical assemblages in the cave, in order to understand the behavior patterns of the cave occupants; but also to prove the benefits from the operation of an on-site FTIR spectrometer. In fact, a small, lightweight and portable FTIR spectrometer was chosen to be used directly on-site, and not necessarily in a laboratory environment. The device, a Midac Corporation spectrometer, was designed to operate at a few degrees above ambient temperature to minimize damage due to humidity, also operating without the need for realignment. The instrument, connected to a computer, was electrically powered by a gasoline generator, placed in a tent to reduce dust contamination and moved from the cave to the lodgings each day. The opportunity to operate the FTIR spectrometer right at the archaeological site allowed the team to solve problems during the excavation and to contribute to decisions concerning the overall excavation strategy, like choosing the next sampling based on the mineralogical assemblage analyses from the previous.[47]

The main aim of my research was to distinguish the materials that were present in the sediment samples. By looking at the spectra generated by the infrared spectrometer I could distinguish between charcoal, calcitic materials and clay minerals. For charcoal individuation I compared my spectra with the ones of Motza charcoal from the field and

[45] White 1982, p. 90.

[46] Weiner, Goldberg 1990, p. 38.

[47] Weiner, Golberg 1990, p. 38.

during pretreatment for radiocarbon dating.[48] For calcitic materials I was able to distinguish different forms of calcite in an archaeological site.[49] I was also able to hypothesize the temperature that clay minerals were exposed.[50]

All these methods gave me a series of information that will be detailed in the following chapter. I will discuss thoroughly the analyses of each sample and the results I obtained. This will be contextualised within the Kura-Araxes levels of Natsargora, in order to better understand the activities performed at the site.

48 Yizhaq et al. 2005, p. 200.

49 Regev et al. 2012, p. 3022.

50 Berna et al. 2007, p. 364-365.

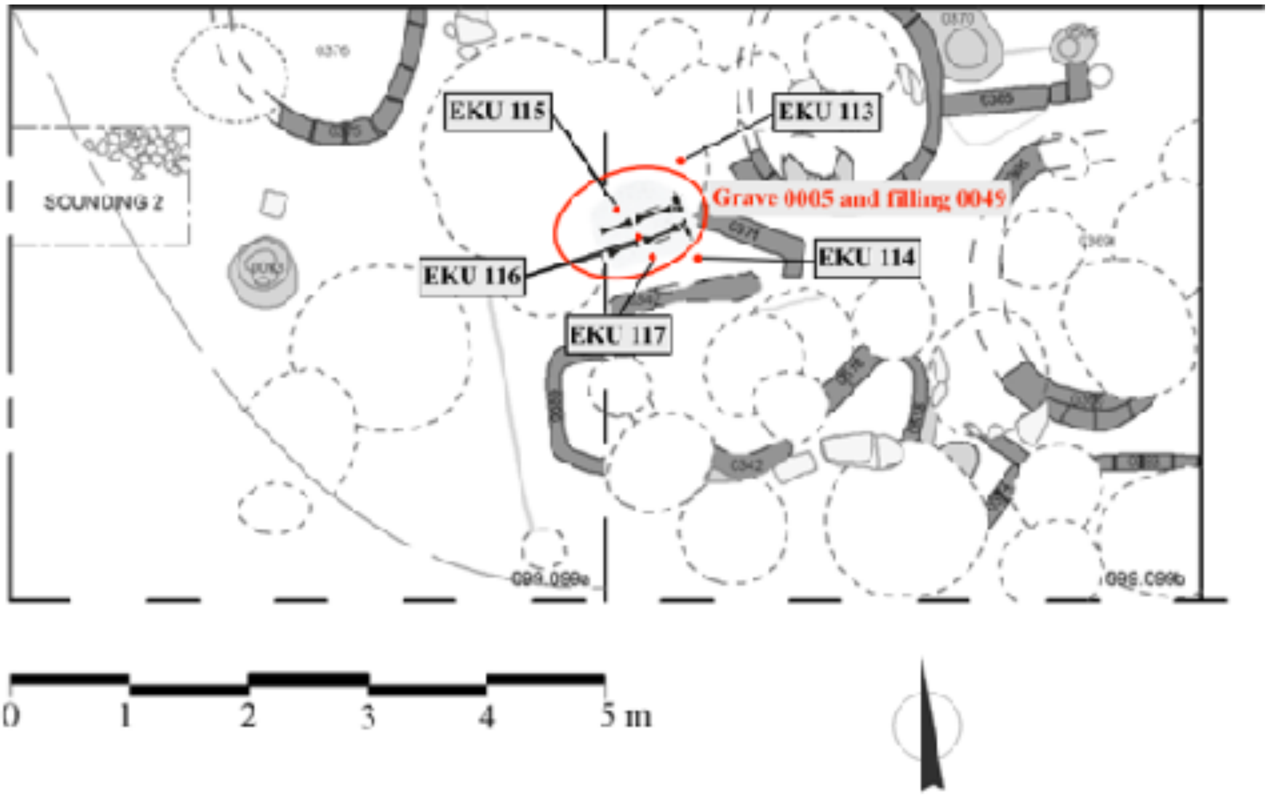
Chapter 3

RESULTS

This chapter reports the analyses of the samples from the Natsargora site. Infrared spectrometry analyses are complemented with information derived from the 'loci database' and photos and illustrations from the original excavation documentation. In order to create a thorough contextualisation, the chapter is organised by groups of samples: they are described and their locus of origin is visualised in the excavation plan; the different loci are outlined and contextualised in relation to each other; then FTIR results are reported by the reading of the spectra and, finally, an interpretation of all the data is given at the end of each paragraph. This procedure helps to merge the data with the aim to put together the results of different analyses and to reconstruct the activities performed by the Kura-Araxes inhabitants of Natsargora.

3.1 EKU 113-117

The first samples analysed are EKU 113, belonging to locus 0005, and EKU 114, 115, 116 and 117, belonging to locus 0049 (Map 1). The logbook reports the sampling date as 03/09/2011 and describes EKU 113 as single seeds within the sediments; EKU 114 is a single fragment of charcoal, sampled very close to the border of the locus; EKU 115 is a single fragment of charcoal taken close to top left border; EKU 116 is a single fragment of charcoal; EKU 117 is a single fragment of charcoal sampled near the left border. These samples were taken in order to understand if "grave" 0005 is contemporary with the KA layer surrounding it, or if is a later intrusion, and if the fragments of charcoal had been burnt in situ or transported there.



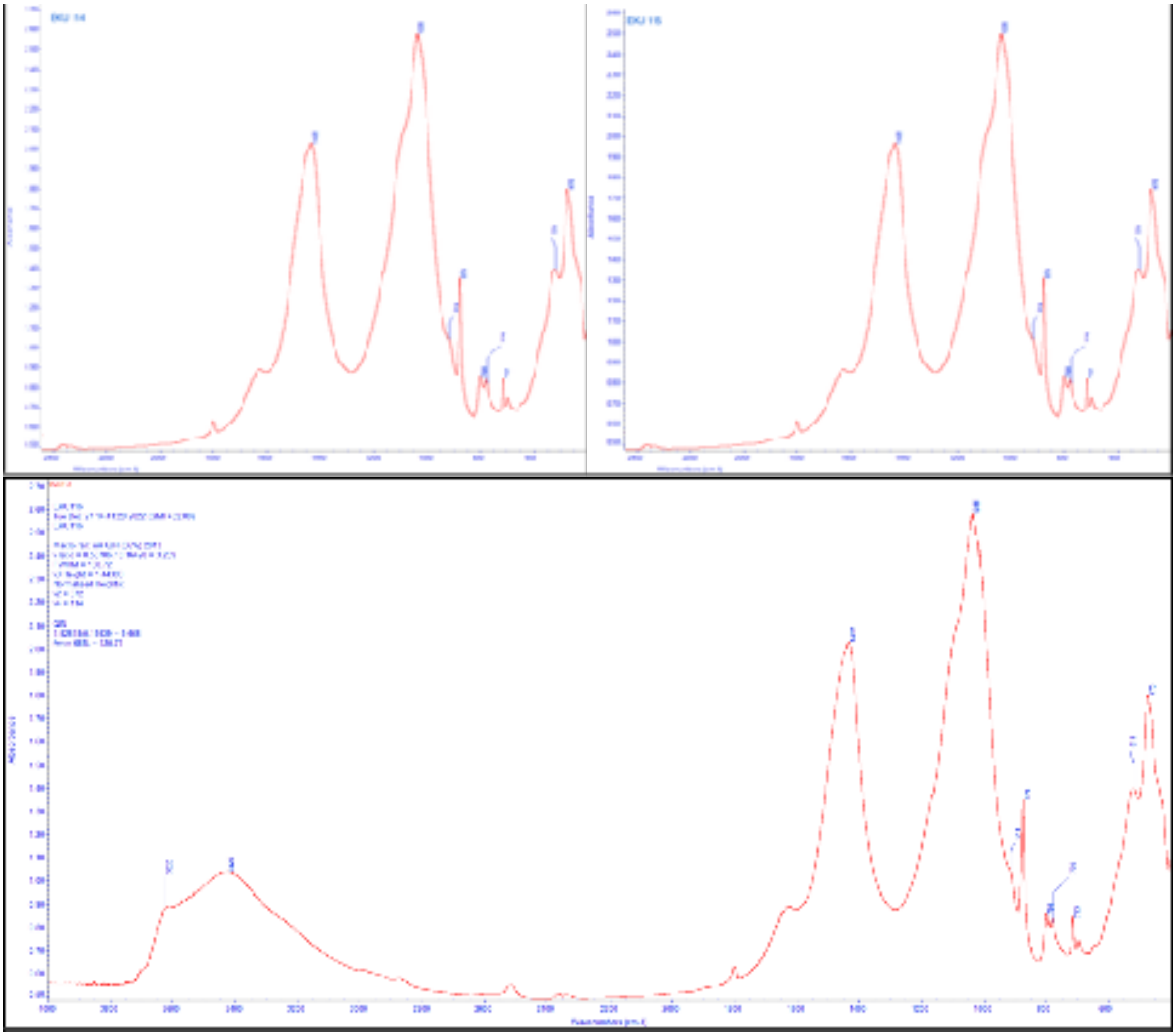
Map 1 showing the position of EKU 113, 114, 115, 116 and 117 in loci 005 and 0049.

Locus 0005 (Fig. 1) is a grave located at the W limit of quadrant 099.099b, ca 2 m South of the NW corner of the quadrant. It extends over an area of ca 150 x 120 cm, the limits of which are somehow arbitrary (as no limit could be found to the grave, except for a line of small stones on its southern side). Two abruptly cut femurs and the feet of an adult are oriented in slightly SW-NE direction, as if the dead was lying on the back, with some pottery sherds, mainly KA (but probably not belonging to the burial goods) lying in-between, delimited to the S by a line of small stones. The filling of the grave (L. 0049) lays under surface soil 0001, near the W limit of quadrant 099.099b, ca in its centre (the grave must have originally continued in quadrant 099.099a, but it had completely disappeared there). The stones surrounding it stop at the same height as the bones. There is no clear surface under them, but the body lies at approximately the same height as locus 0048 (KA

Fig. 1. Photos of L. 0005 and 0049.

level with patches of burnt sediments), over dark layer 0082 (see 3.2). Locus 0048 is the layer surrounding “grave” 0005 and is cut by numerous pits. According to what can be seen in section, the layer was slightly sloping from east to west, i.e. contrary to the general slope of the area.

FTIR analyses (Spectr. 1) shows exclusively charcoals, while surrounding sediments were not burnt. All the samples show that clay is present in a larger amount than calcite, as shown by characteristic absorbance bands (peaks) around 1033, 915, 530-525 and 470 cm^{-1}. Calcite is organised as ash for EKU 114 and as limestone for EKU 115 and 116. Clay is not altered in all of the samples, as peaks around 3965 and 3620 cm^{-1} are still visible, indicative



Spectra 1. EKU 114, 115 and 116.

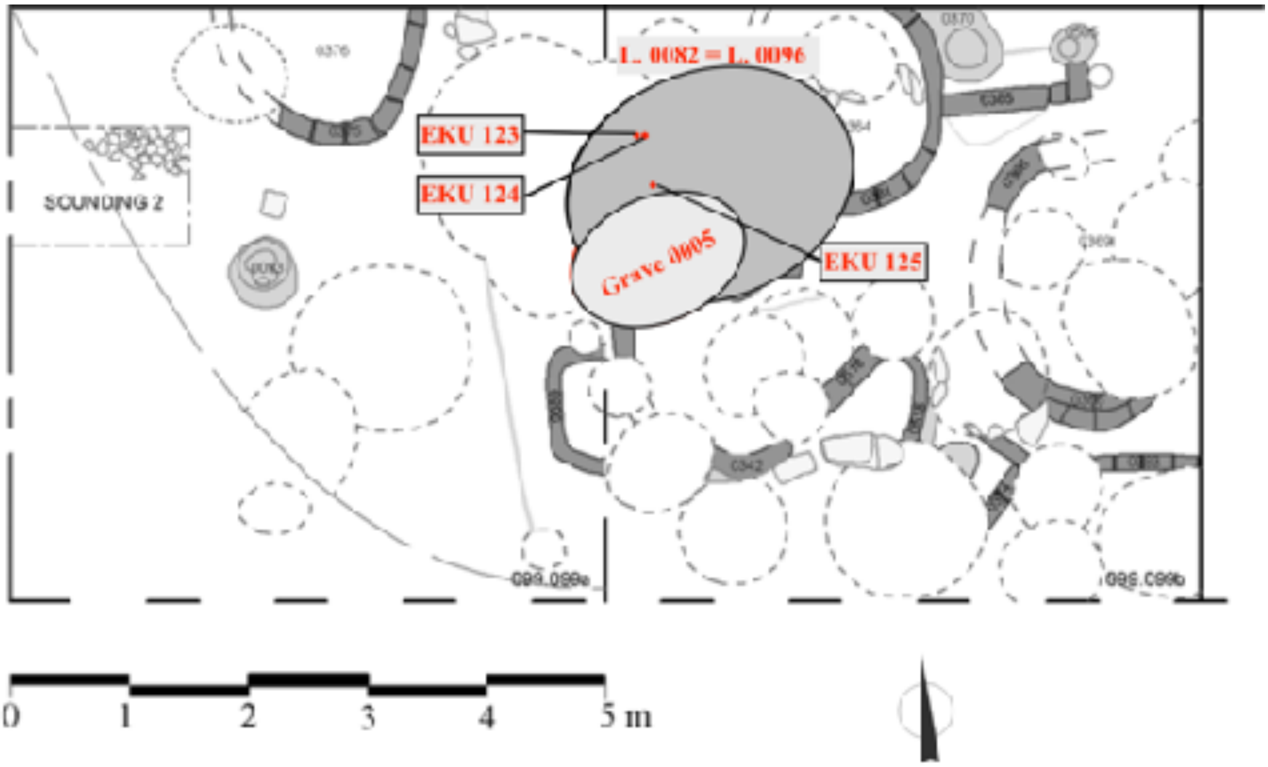
of clay structural water. This means that charcoals had not been burnt in situ, but rather burnt elsewhere and then transported to the analysed locus.

All this information may bring to the conclusion that the grave is a later feature, disturbing the KA levels. This is suggested by the fact that calcite of EKU 115 and 116, coming from an area very close to the legs, has a different order from calcite of EKU 114, coming from outside the filling of the grave. The calcite of EKU 115 and 116 is ordered as limestone, and it is probably part of the filling which is contemporary to later levels; opposite to the calcite of EKU 114, which is ordered as ash and relatable to KA level. Regarding the not altered clay and the presence of charcoals, this may be indicative of the fact that those charcoals were burnt in a different area, most likely from one of the numerous fireplaces located in the nearby area. After their burning, they were taken away from their original position (possibly, a fireplace emptied and cleaned for new use) and then spread and compacted on surrounding area in order to create a walkable surface. This kind of activity seems very common in the Kura-Araxes occupation of the area and will be discussed later (see 3.2 and 3.3).

3.2 EKU 123-125

The next group is composed of samples EKU 123, 124 and 125, collected from locus 0082 on 07/09/2011 (Map 2). The logbook notes EKU 123 as a sample rich in charred seeds; EKU 124 similar to EKU 123, collected close to it, but it seemed reacher in charcoal, whereas EKU 125 consists of crumble yellow sediments with seeds.

Locus 0082 (Fig. 2) is an ovoid-shaped area of dark brown soil (about 10 cm thick) oriented in NE-SW direction, in quadrant 099.099b. This area lies to the north of, around and under grave 0005 and its filling 0049. It consists of black soil in patches, where two smaller ovoid-shaped areas, measuring 120 x 90-100 cm, are distinguishable. It’s rich in



Map 2 showing the position of EKU 123, 124 and 125 in locus 0082 and its relation with locus

burnt seeds, with some fragments of daub incorporated inside it. The borders of the area are irregular, and measure ca 240 x 140 cm. The bottom of the layer is slightly concave and covers surface 0096.

Finds from the area appear to consist exclusively of Kura-Araxes pottery, thus dating the locus to this period; but little contamination from LB pits, which surround the area, is not excluded. Locus 0096 is an irregular area measuring ca 300 x 150 cm, cut by several pits. The colour is yellowish with some burnt patches in the areas where the overlying black layer is thicker. Also from here comes only KA pottery.

To sum up, samples EKU 123, 124 and 125 were taken from locus 0082, an ovoid shaped area, over layer 0048 and under and around grave 0005 and its filling 0049. The

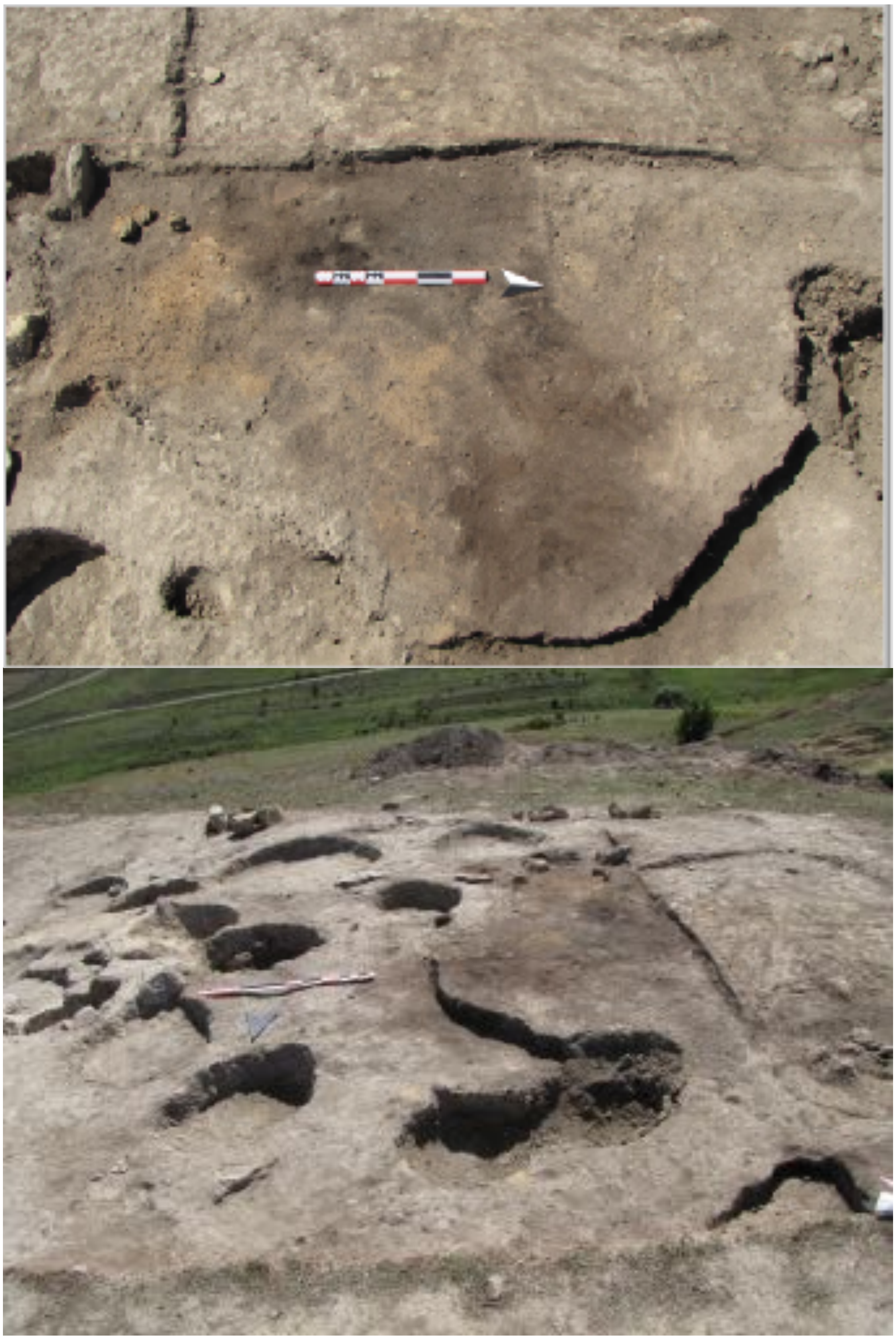
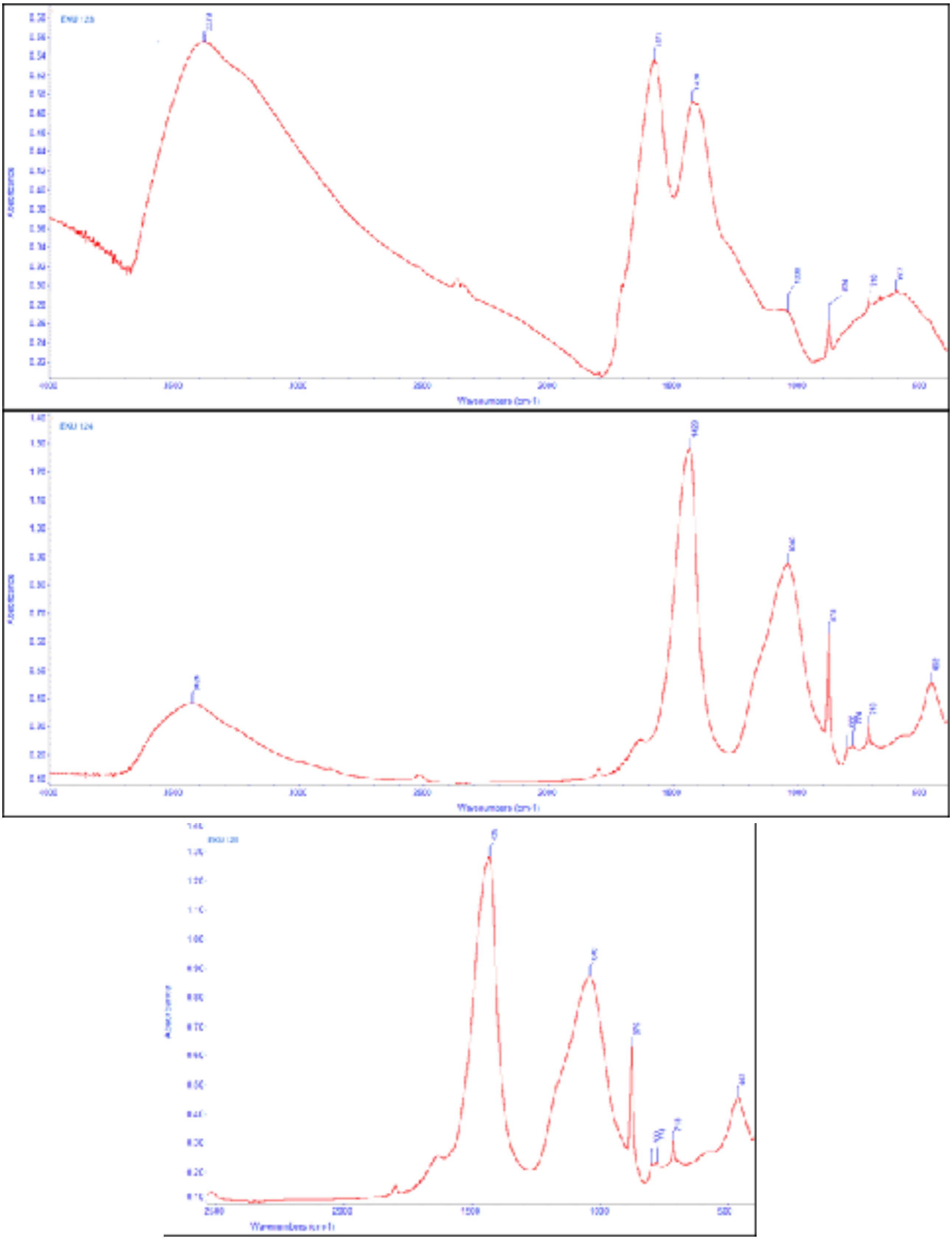


Fig. 2. Photos of L. 0082.

burnt layer measures about 10 cm in diameter, with many seeds and fragments of daub. It could be an area surrounding a hearth, like locus 0092 in quadrant 099.099a.



Spectra 2. EKU 123, 124 and 125.

FTIR analyses (Spectr. 2) show that EKU 123 can be interpreted as charcoal, shown by peaks at 1571 and 1420 cm^{-1}. EKU 124 is richer in calcite (noticeable are peaks around 1425, 875 and 715 cm^{-1}), however clay seems altered to 350°C, as peaks indicative of clay structural water (at 3695 and 3620 cm^{-1}) are not present. The spectrum of EKU 125 shows that calcite is more abundant than clay (see peaks 1429, 875 and 713 cm^{-1}); calcite has the same order of limestone and clay is altered to 400-500°C, as clay peak has shifted to 1040 cm^{-1}.

Regarding this area it can be confirmed that L. 0082 and L. 0096 belong to a series of external KA floors, as they are spread for a quite large area. These prepared floors were a very common feature at Natsargora site. A similar case is found in L. 0305, where previous studies have concluded that it testify the cyclical phases of preparation and use of external surfaces, probably used in the processing of cereals.[51] L. 0082 and L. 0096 may have had the same function: the vegetal residues on the earlier surface (L. 0096) were burnt and covered by the next one (L. 0082). In this case EKU 123 represents the burnt seeds that were covered by the new floor. Furthermore, the surface could be connected with one of the many firing installations located in the neighbourhood, as the presence of altered clay in the sediments (EKU 125) may suggest that these included fragments from the structure of a clay hearth, as the clay reached a temperature of at least 400-500°C. Further proof of this general interpretation is EKU 124 showing abundant presence of charcoal, recognised as burnt waste from an hearth. However, the relation of the floors with the grave and its filling remains unclear. Since the grave is later, the most likely hypothesis is that the KA floors were simply disturbed by it, and there isn't any actual connection between the two features.

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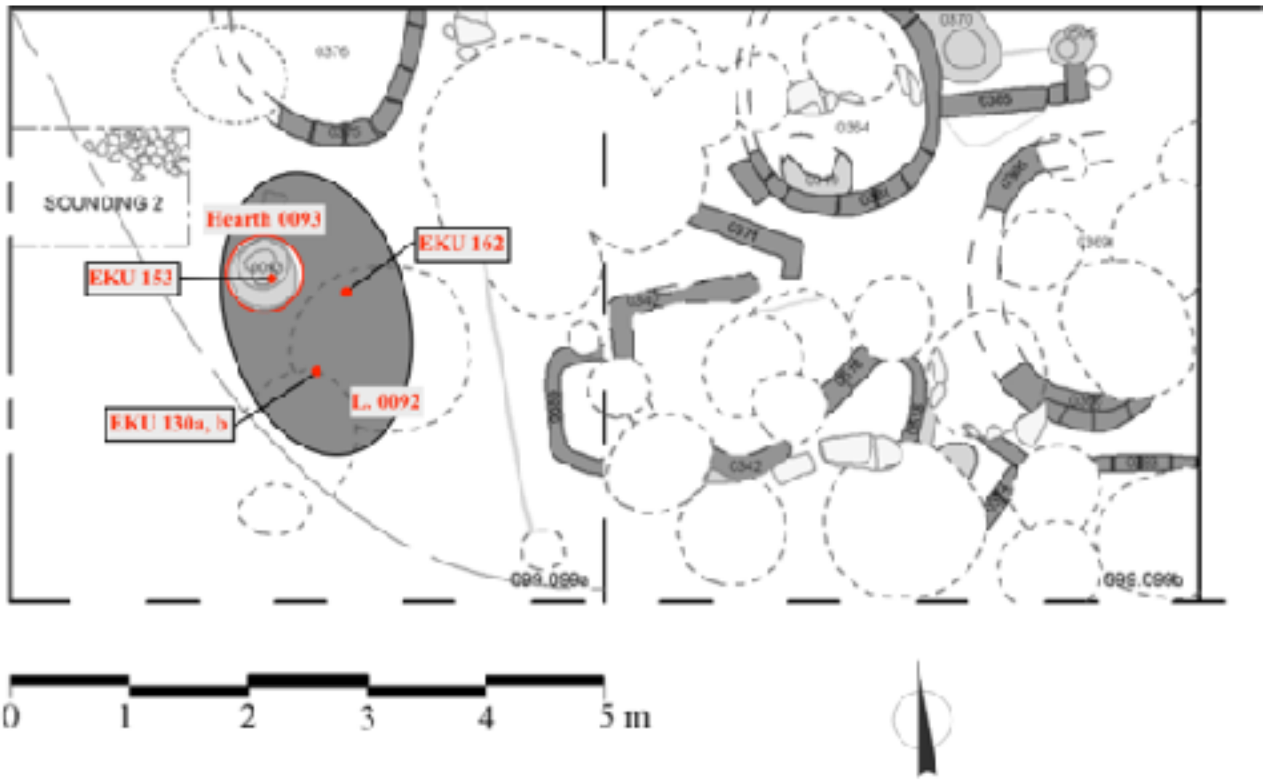
51 Boschian, Rova 2014, p. 388.

3.3 EKU 153, 162, 130a, 130b

The next group of samples is composed of EKU 153, 162, 130a and 130b, sampled on 10/09/2011 in loci 0093 and 0092, in quadrant 099.099a (see Map 3).

The logbook describes EKU 153 as sediments coming from the interior of the hearth (L. 0093); EKU 162 was sampled from the black burnt layer around the hearth (L. 0092) and radiocarbon dated to KA phase[52]; EKU 130a and 130b are two bags of black sediments collected for flotation again from the layer around the hearth (L. 0092).



Map 3 showing the position of EKU 153, 162, 130a and 130b in loci 0093 and 0092.

[52] Sample RTK 6587: 4340 ±55 BP (68.2% probability: 3020-2900 cal BC).

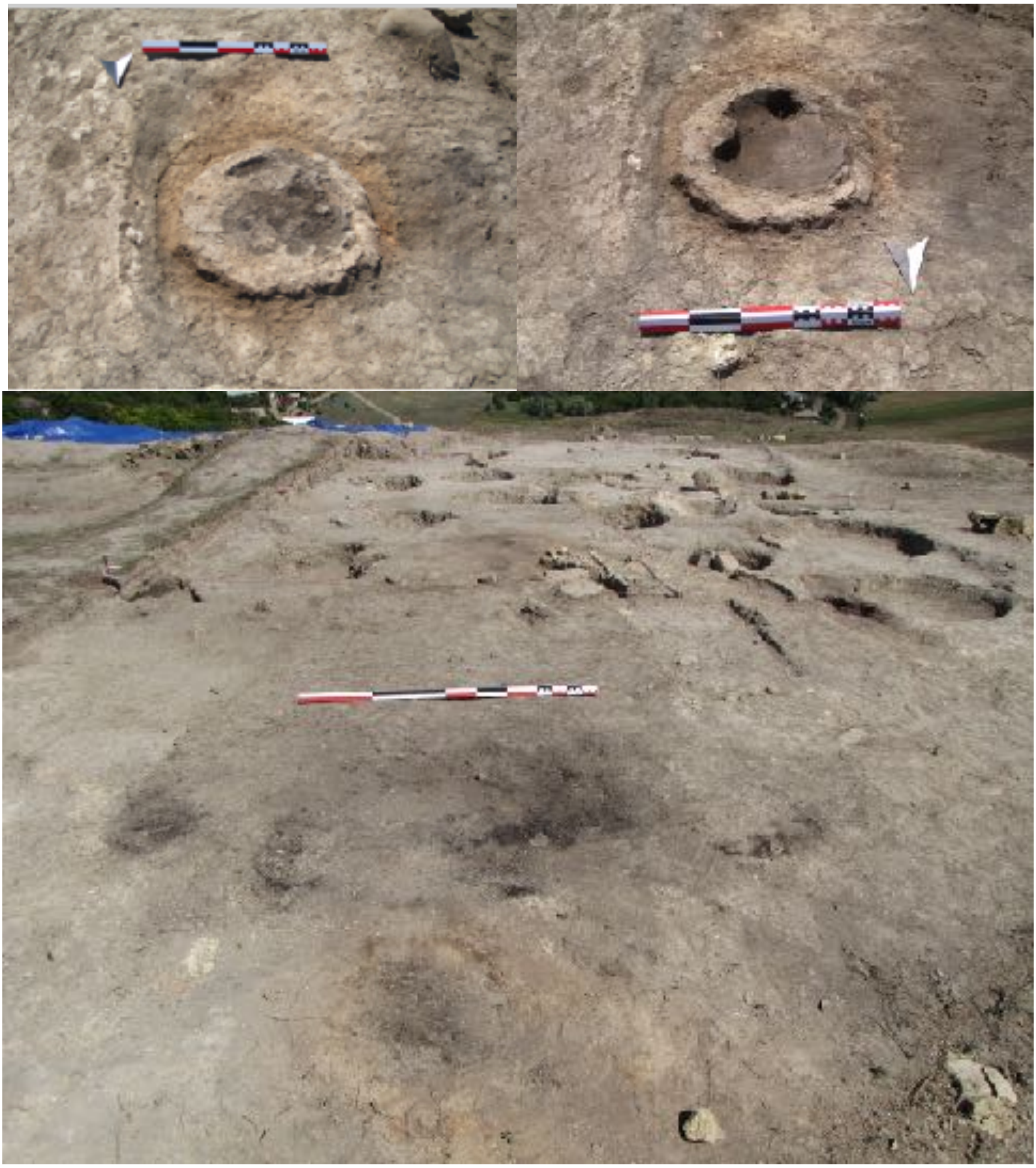


Fig. 3. Photos showing hearth 0093 (above, left and right) and its relative black burnt layer (L. 0092, below).

According to the 'Loci database' locus 0093 (Fig. 3) is a small fireplace consisting of a raised ring of clay (diameter 43 x 43 cm), the top of which is damaged, with one (maybe originally two) inner projections, with an internal "bowl" (diameter 31 cm) the surface of which is carefully smoothed and fired. It was filled with ashes and burnt soil. On its bottom, there was a hemispherical cavity of 7 cm of diameter, 4 cm deep (a feature which is paralleled in other KA fireplaces). Under the bottom, there was a 3 cm thick layer of coarse orange clay. The hearth was surrounded by and deepened into a ring of reddish clay of squared shape with rounded corners (measuring 50 x 60 cm), slightly shifted to the SW. This represents the remains of an earlier installation (locus 0332) presumably of similar function. 0093 belongs together with surface 0081, from which it was built over the previous installation, and black layer 0092 leans to it. The area was excavated from 07/09/2011 to 16/09/2011 and sampled for soil micromorphology as well.

Locus 0092 is the layer surrounding hearth 0093. It extends over an irregular area, measuring ca 200 x 90 cm, oriented NS, to the east of the hearth, and is contemporary with it. As noted above, similar burnt layers and installations (respectively 0096 and 0082) have been found also in adjacent quadrant 099.099b. Regarding locus 0081, the layer under the fireplace, it appears as a yellowish surface in the northern and eastern parts of quadrant 099.099a, extending over a length of 295 cm in EW direction and about is 408 cm in NS direction.

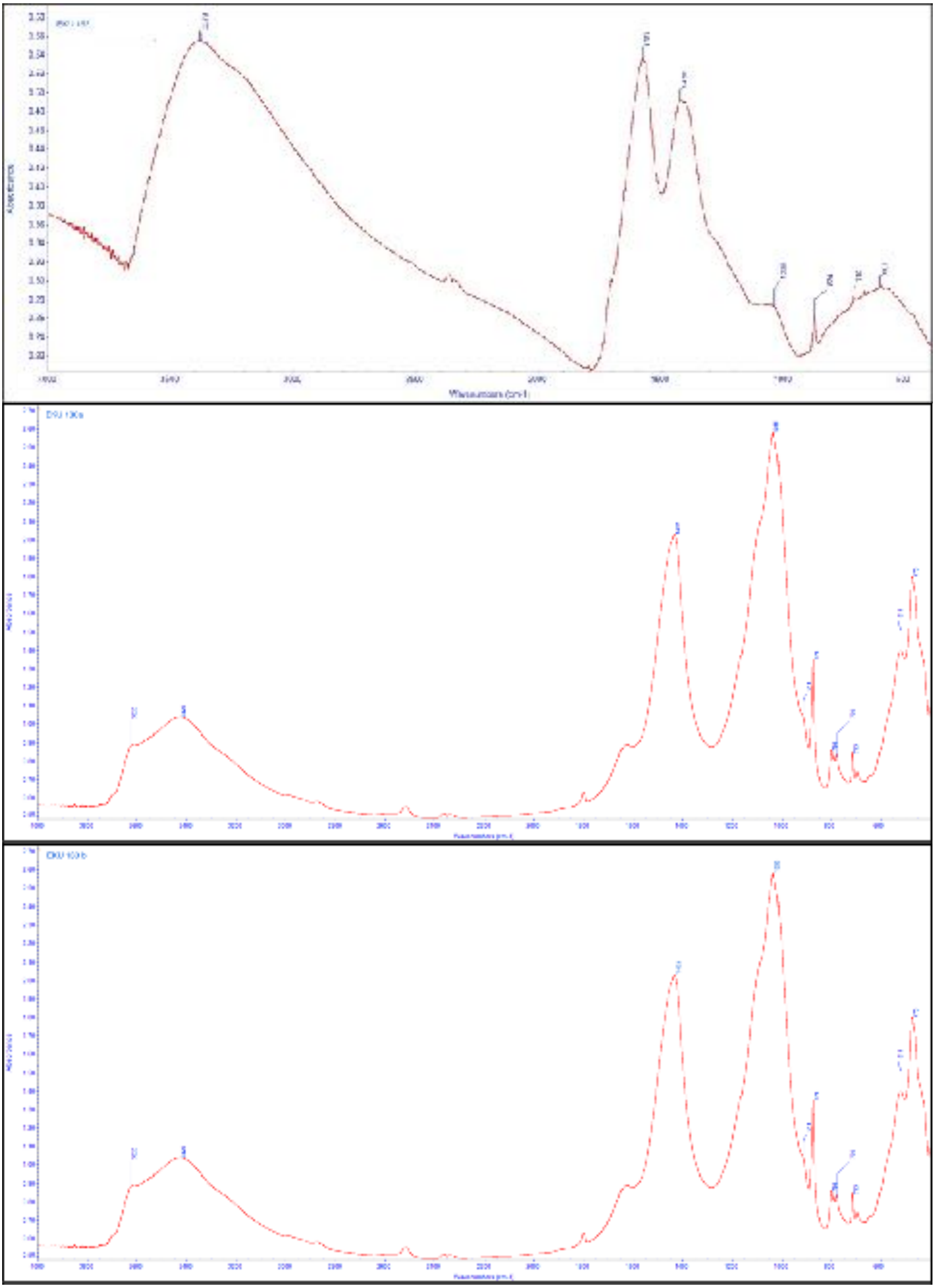
It is also worth taking a look at locus 0332. This installation is located under fireplace 0093, slightly shifted to the SW in comparison with it. It had probably the same function, and had probably been leveled in order to be used as a base for 0093. It consists of a rounded area (diameter 30 cm) filled with reddish soil, surrounded by a sub-rectangular area, oriented NS, of light yellowish compact clay (55 x 42 cm).

According to the excavation matrix, installation 0093 belongs to the KA layer, which is over 0081 and surrounded by layer 0092. Under locus 0093 there is a similar fireplace, locus 0332. In fact in the graphic journals locus 0093 is substituted by locus 0332.

Soil micromorphology analyses have been carried out by G. Boschian on installation 0093. The installation consists of at least four concave-upward layers with different composition that dip towards its centre. Layer 1 is the top level, it was laid upon two other layers, which represented the body of the fireplace (layer 2), made of mixed components such as daub, pottery fragments, sandy silt and few lime lumps. Hearth 0093 lay upon a yellowish surface (L. 0081), covered by a layer of black burnt soil (layer 3). These analyses confirm that the installation was deepened into what appears to be the remains of an earlier installation of similar function (installation 0332), which had been leveled to be used as a base for installation 0093. Layer 4 seems compact and probably prepared with a sort of mortar. As aforementioned, only the bottom of this earlier fireplace is preserved, consisting in a rounded, 30 cm wide area, filled with reddish soil and surrounded by a yellowish compact clay area. Soil micro morphology analyses also confirm the fact that hearth 0093 was not positioned exactly over the earlier hearth (L. 0332), but it's shifted in a NE direction. According to Boschian, the whole layer underwent strong heating, his FTIR analysis results indicate a temperature not over 400°C as an average of the bulk of the sequence of microlayers, whereas at least 600°C are likely for the uppermost 5 mm of the sequence.[53]

To sum up, installation 0093 is a round-shaped fireplace in the western part of the Natsargora excavation area, more precisely in quadrant 099.099a. The topmost part is damaged by later LB activities, but its body, provided with internal projection, which is a common feature in the Shida Kartli region during the KA period, clearly dates it to the KA phase. The fireplace is constituted of a raised rind made of clay, measuring 43 cm in diameter, and of a 31 cm deep concavity filled with ash and burnt wood. According to the soil micromorphology analyses, installation 0093 is composed by at least 4 layers lowering to the centre, which are made of different components. The surface is rather compact and made of clay mixed with quartz, daub, pottery fragments and some fine sediments, possibly calcite. Also, the surface had been carefully smoothed and some burnt vegetal components

[53] Boschian, Rova 2014, p. 386.



Spectra 3. EKU 153, 130a and 130b.

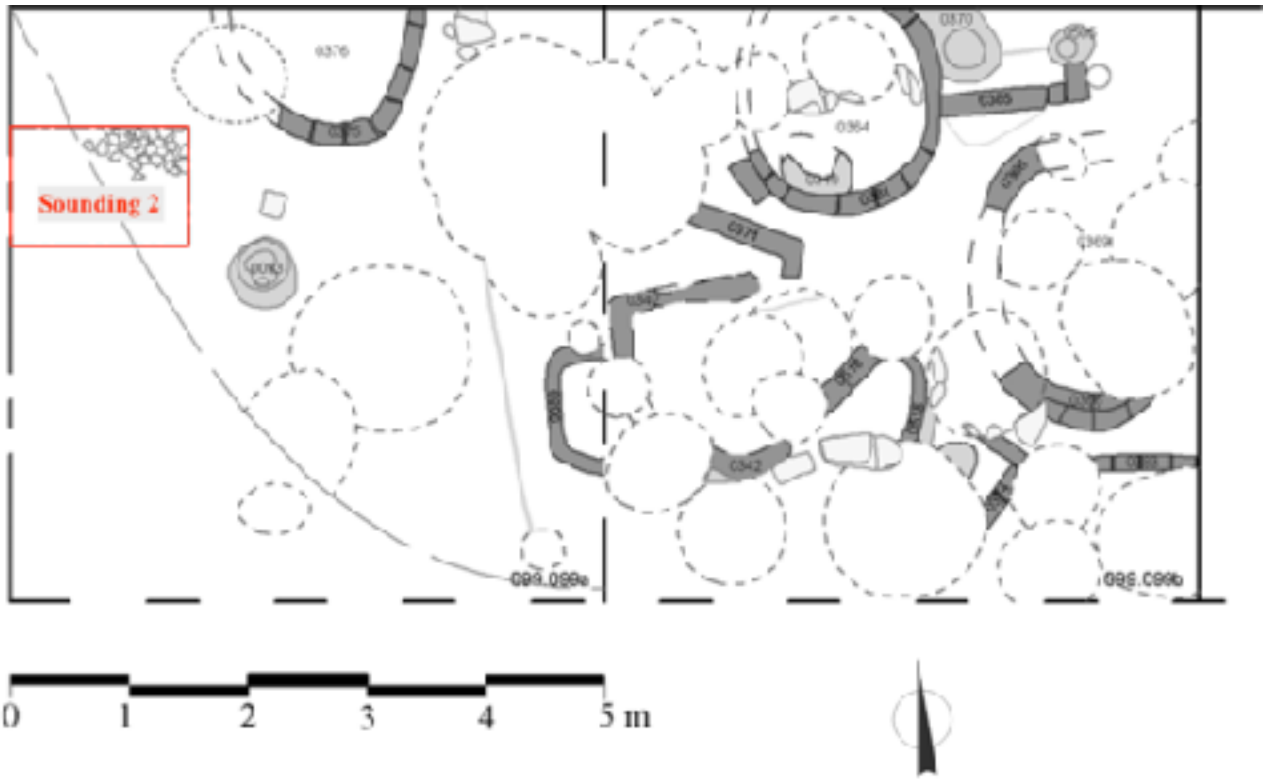
(straw and herbivore dung) are noticeable in it. They wee probably added in order to strengthen its structure.

My FTIR analyses (Spectr. 3) shows that EKU 153, coming from the inner surface of hearth 0093, is a fragment of charcoal (peaks at 1571 and 1420 cm^{-1}). Both EKU 130a and EKU 130b, from the area surrounding the fireplace (L. 0092), show non-altered clay (visible from the higher characteristic absorbance bands around 1033, 915, 530-525 and 470 cm^{-1}) more present than calcite. However, calcite has the same order as the limestone in EKU 130a and as the ash in EKU 130b. Thus, basically my FTIR analyses confirm the results of the soil micromorphology analysis. It agrees with the interpretation of this area as a fireplace – or rather a superimposition of two fireplaces – surrounded by a black burnt area, a common KA feature also found in L. 0082 and 0096 (see 3.2).

EKU 153 is a fragment of charcoal, confirming a burning activity performed on the inner surface of installation 0093; EKU 130a and 130b, from the surrounding area 0092, are sediments made mostly of clay that could be interpreted as the remains of parts of the fireplace structure that had been spread in the area. However, the spectra show that clay structural water is still present, meaning that the samples have not seen an alteration in temperature. This observation leads to the hypothesis that these samples were part of the deepest hearth structure, that probably wasn’t reached by the heat of the fire.

3.4 EKU 118-122, 126, 127, 129

The next samples are EKU 118-122, 126, 127, 129, taken from 06/09/2011 to 08/09/2011. They come from a sounding of 1 x 1.5 m (Sounding 2) excavated by G. Boschian in quadrant 099.099a, at the western edge of the excavation area (Map 4). The Lithological Units of the sounding correspond to the loci where the samples were taken



Map 4 showing the position of Sounding 2 in quadrant 099.099a.

from (Fig.4). In order to have a better perspective, here’s the loci paired with the corresponding Lithological Units:

- L. 0077 —> LU 2+3;
- L. 0078 —> LU 4+5;
- L. 0091 —> LU 6;
- L. 0097 —> LU 7.

Here is the description of the FTIR samples from the excavation logbook: EKU 118 appears as two aluminum foil bags of charred remains from L. 0077, corresponding to Lithological Unit 3; EKU 119 consists of white material near the black EKU 118, also coming from L. 0077-LU 3. EKU 120 are sediments with seeds from L. 0078-LU 4; the seeds are abundant in the sediments and they seem to continue lower in the white layer. This

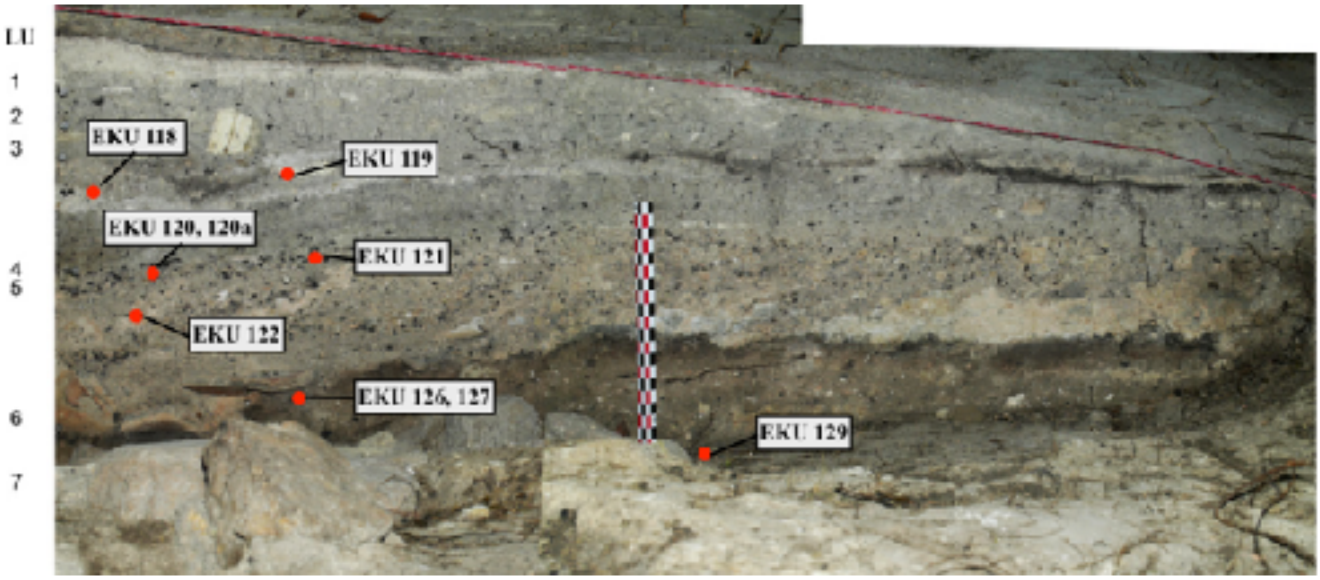


Fig. 4. EKU 118, 119, 120, 120a, 121, 122, 126, 127 and 129 with their relative Lithological Unit from Sounding 2.

sample has been 14C radiocarbon dated to KA phase.[54] EKU 121 is a cluster of seeds from L.0078-LU 4; EKU 122 are sediments mixed with ash from L. 0078-LU 5 below EKU 120 (of LU 4), is very similar to EKU 121, but is not in a cluster formation; EKU 126, from L. 0091-LU 6, appears as coarse sand, light brown in colour; EKU 127 is from L. 0091-LU 6.1 which is the same unit as 6, but with less matrix; EKU 129 is a bag of black sediments from L.0097-LU 7, below cluster EKU 121, and above LU 8.

Starting from locus 0077 (Fig. 5), 'loci database' describes it as a rather irregular layer (0-15 cm thick), greyish brown in colour, cut by several pits of LB date and also by a number presumably of KA features. Corresponding to LU 2+3, soil micromorphology analyses present these top units as levels separated by thin brownish-greyish layers that include moderate amounts of charcoal. The stratigraphy of the area is very complex due to the sequence of tightly packed surfaces and thin fillings between them (evidence of pavement preparation), disturbed by numerous pits. In this locus a large number of KA pottery was found, but also lithics, a fragment of a basalt pestle, stone artifacts, charcoals and animal bones, one in an awl shape. Locus 0078 underlies L. 0077 and corresponds to

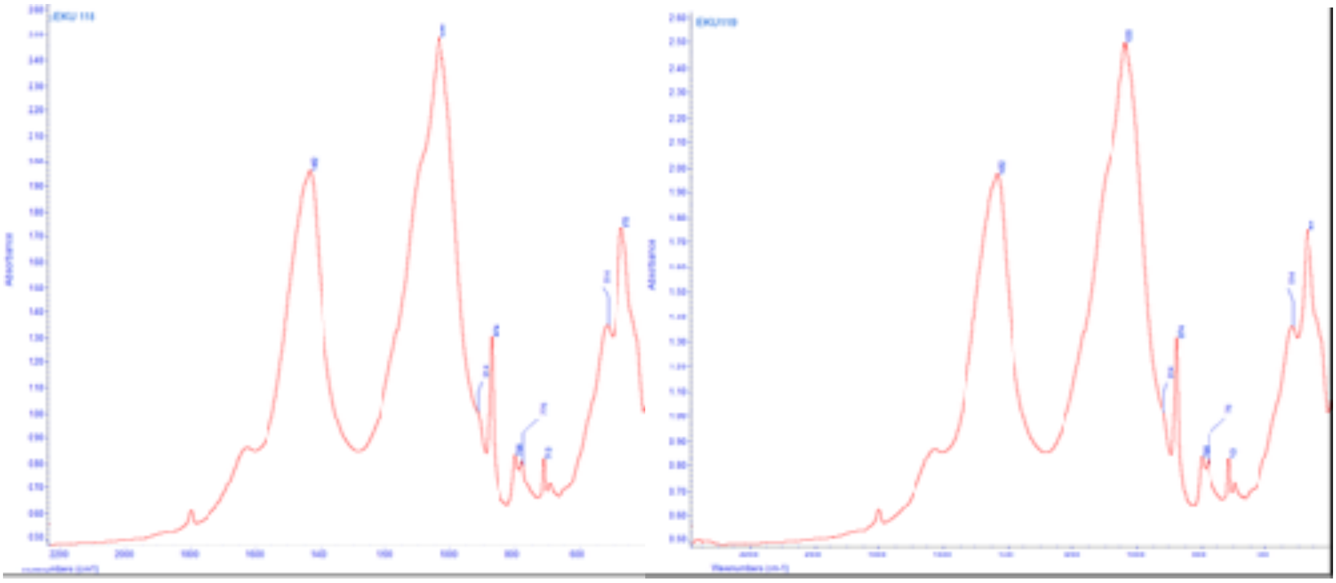
[54] Sample RTK-6586: 4325 ±60 BP (68.2% probability: 3020-2895 cal BC).

Fig. 5. Photo of L. 0077.

LU 4+5. It is described as a dark grey black layer and is present only on a small area of max. 2 x 2 m in the NW corner of the quadrant, W of construction 0376, over surface 0091. It actually consists of two layers, a grey one and a thin black one. Opposite to the layers above, they do not show clear evidence of pavement preparation, but apparently consist of a sequence of ash layers alternating with clay loam sediments rich in charcoal. Locus 0091, a yellowish layer with KA ceramic fragments on its bottom, was found below it. It corresponds to Lithological Unit 6, described as a sequence of yellowish layers (surfaces) alternating with dark ash and black layers. It overlies L. 0097, corresponding to LU 7, a dark grey layer covered by a thin layer of black burnt soil over stones 0098.

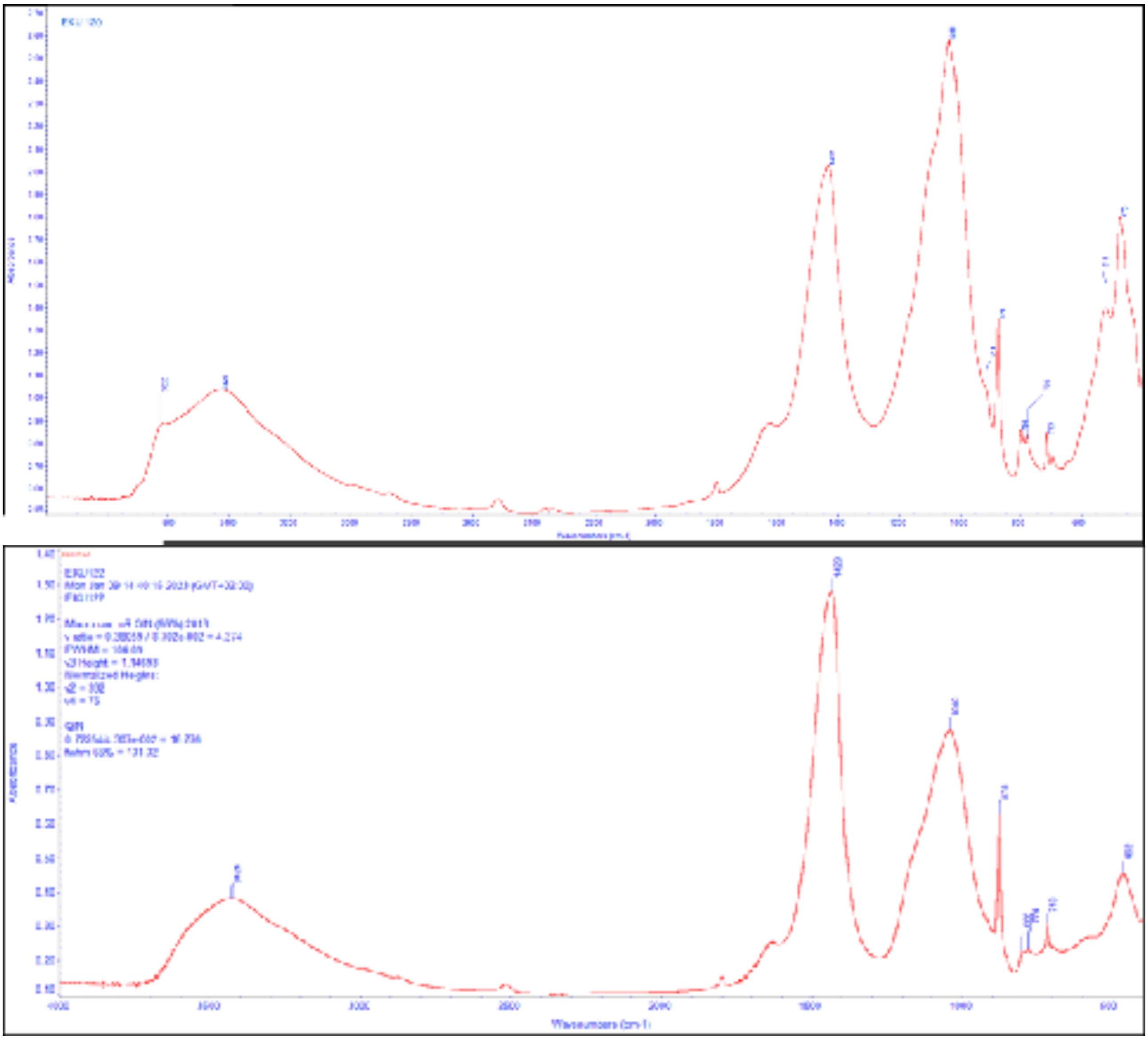
Looking at the FTIR analyses, together with soil micromorphology analyses, it can be confirmed that this is a sequence of KA finely compacted floors. L. 0077 is the topmost KA level, corresponding to LU 2+3, brown-grayish in colour and cut by several LB pits.

From this locus, two samples (EKU 118, 119, see Spectr. 4) were analysed by infrared-spectrometry. Both spectra are very similar, as they present non altered clay (peaks around 1033, 915, 530-525 and 470 cm^{-1}, also present is clay structural water) more than calcite, ordered as limestone.



Spectra 4. EKU 118 and 119 from locus 0077.

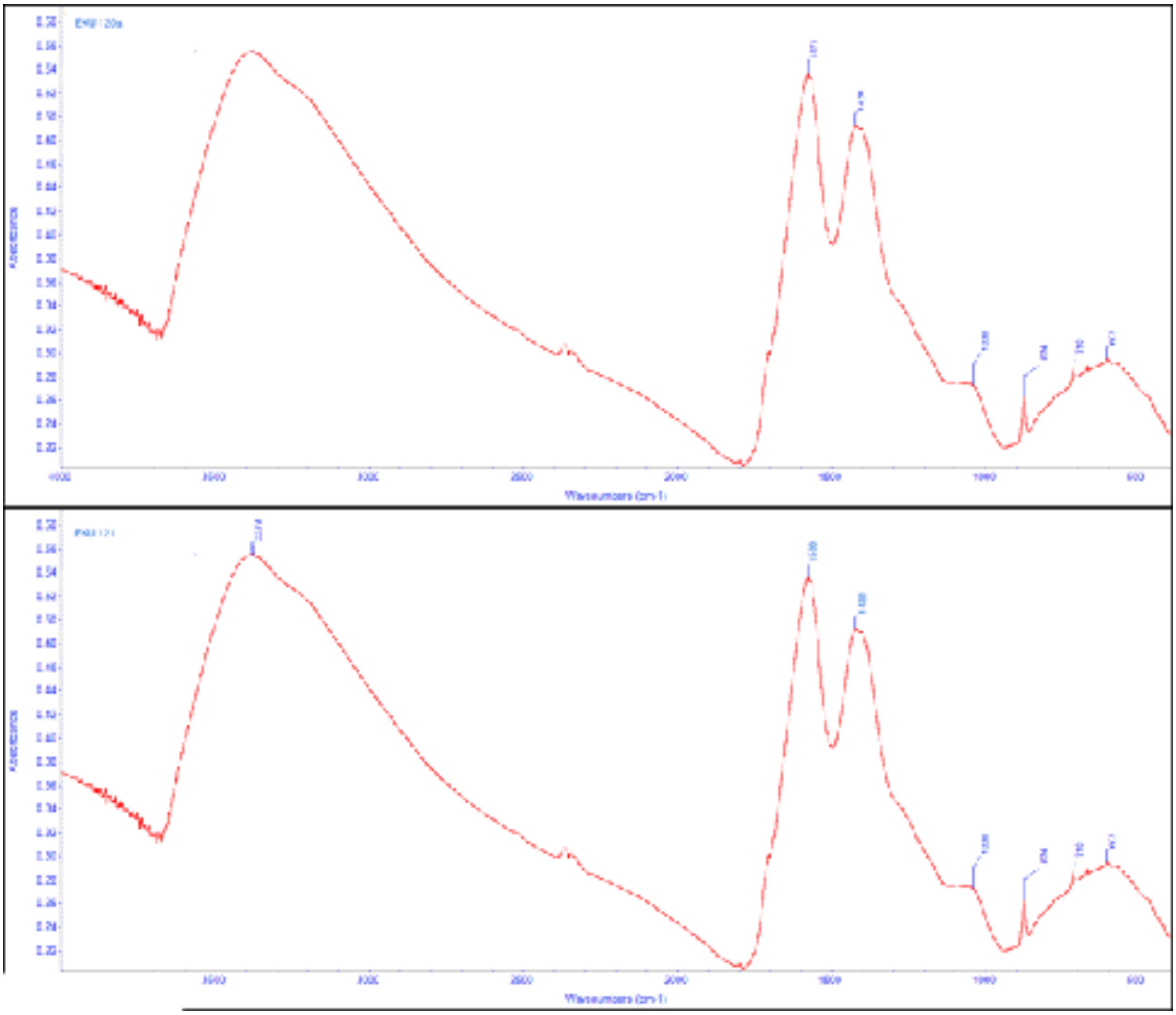
Next locus is L. 0078, corresponding to LU 4+5. Its colour appears dark gray. Four samples belong to this locus: two sediments (EKU 120, 122, see Spectr. 5) and two seeds (EKU 120a, 121, see Spectr. 6). EKU 120 has more clay (higher peaks around 1033, 915, 530-525 and 470 cm^{-1}), non altered (clay structural water as shown by peaks around 3695 and 3620 cm^{-1}), than calcite, ordered as limestone. The spectrum of EKU 122 shows the characteristic peaks (1429, 874 and 713 cm^{-1}) of the presence of calcite greater than clay. Calcite has the same order of ash, while clay seems to have reached a temperature around 600-700°C, as structural water has evaporated (no absorption bands at 3695, 3620, 915 and 713 cm^{-1}), and 1032 cm^{-1} has shifted to 1040 cm^{-1}. EKU 120a and EKU 121 are charcoals, as shown by peaks about 1580 and 1420 cm^{-1}. The next samples from the sounding came from L. 0091, which is associated to LU 6. This Lithological Unit is yellowish in colour,



Spectra 5. EKU 120 and 122 from locus 0078.

with pottery fragments on its bottom. From this locus are EKU 126 and 127 (Spectr. 7). Both of the samples are very similar in composition, as they have a higher presence of calcite (peaks at 1431, 874 and 713 cm^{-1}) with the same order of limestone, rather than clay, which was heated up to 600°C (no clay structural water peaks and shifting to 1039 cm^{-1}).

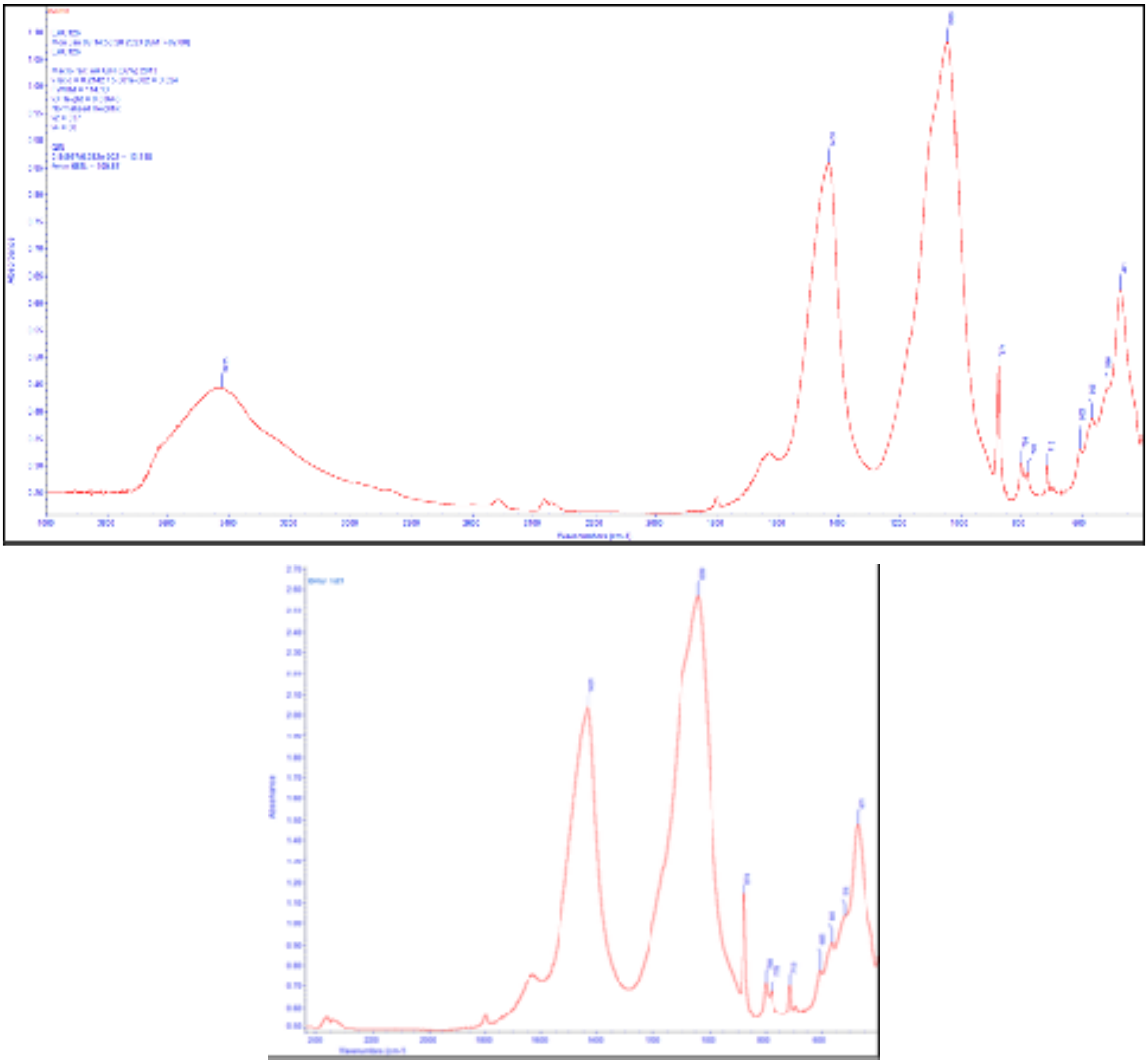
At the very bottom of the sequence there is locus 0097, corresponding to LU 7. The Unit is dark gray in colour, covered by a thin burnt layer. In fact the sample from this locus



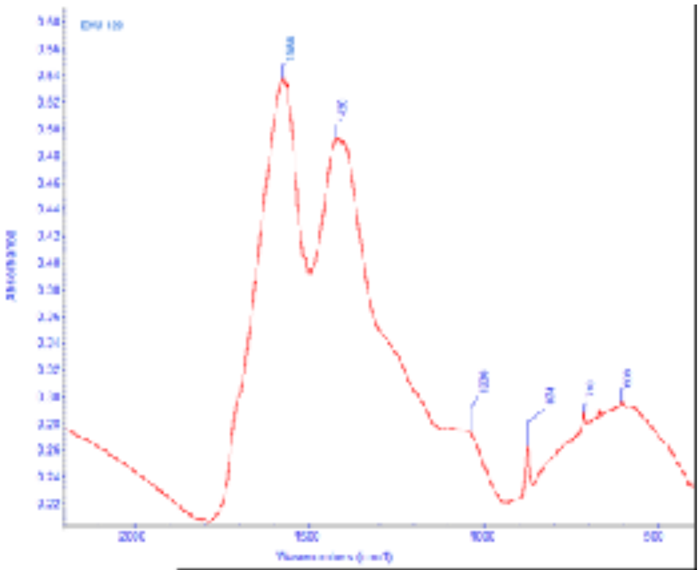
Spectra 6. EKU 120a and 121 from locus 0087.

(EKU 129, see Spectr. 8) turned out to be composed of charcoal, visible from characteristic absorption bands at 1588 and 1420 cm^{-1}.

The FTIR analyses confirm the results of soil micromorphology. In fact, they prove that Sounding 2 is a sequence of prepared floors, belonging to KA culture (as also confirmed by the 14C-dated sample). As observed in other cases (see 3.2 and 3.3), the preparation of external surfaces was a common feature in this site. The Kura-Araxes inhabitants used to compact the floors that are connected with agricultural and farming activities, like the processing of cereals (indeed, many of them were found in burnt clusters)



Spectra 7. EKU 126 and 127 from locus 0091.



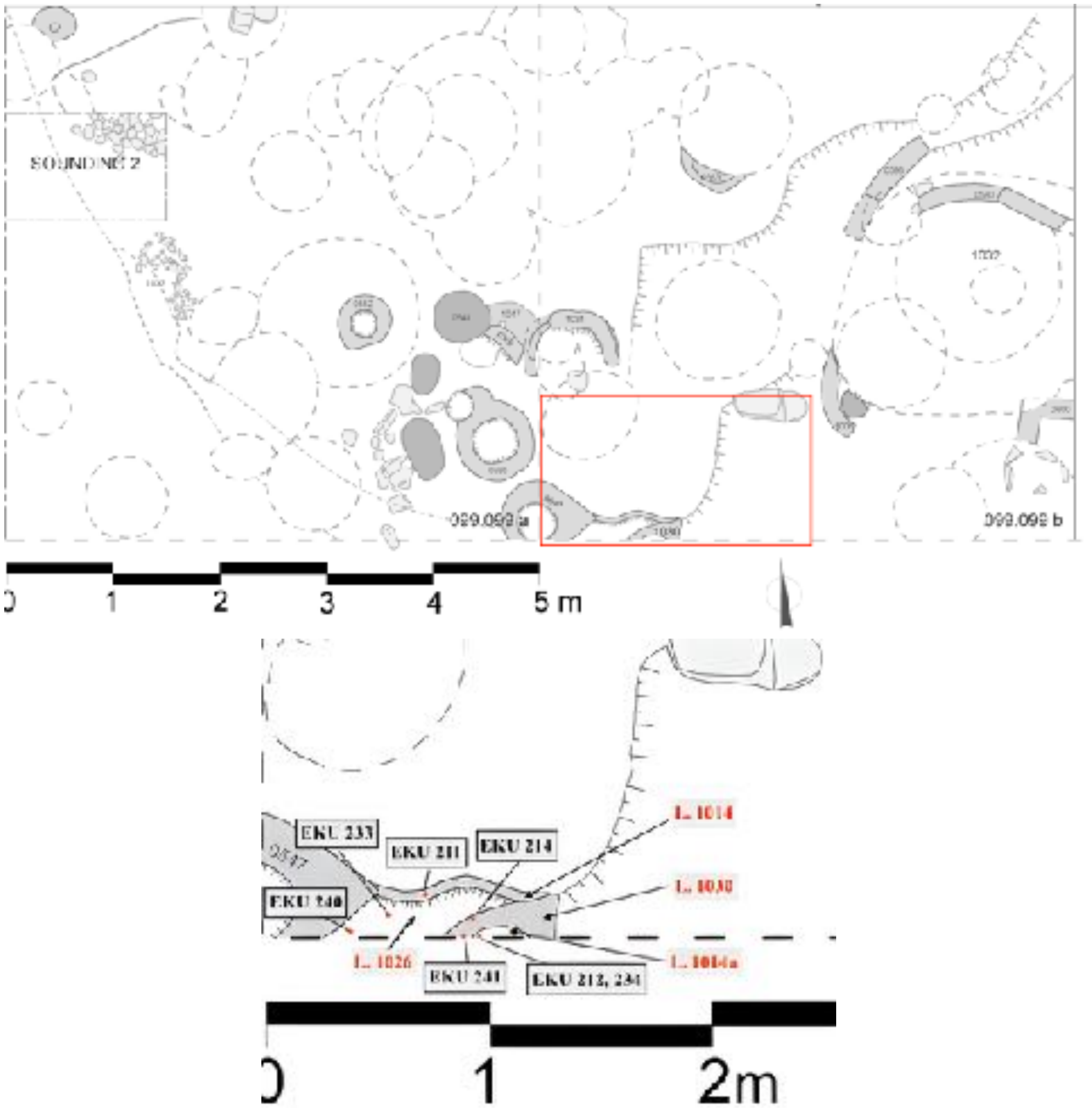
Spectrum 8. EKU 129 from locus 0097.

or animal parking. The activity of processing cereals is confirmed by FTIR results, which show that all of the Lithological Units (except for L.0077-LU 2+3), witnessed a burning activity: as noted above, the clay of samples L. 0078-LU 4+5 and L.0091-LU 6 reached a temperature around 600-700°C and the sample from L. 0097-LU 7 is charcoal, clearly a burnt residue. The fact that the topmost layer (L. 0077-LU 2+3) doesn't show evidence of burning activity may signify that this layer was prepared for the same aim as the layers below it, however this kind of activity didn't take place due to unknown reasons.

3.5 EKU 211, 212, 214, 233, 234, 240, 241

The final group of samples comes from L. 1014, where EKU 211, 212, 214, 233, 234, 240, 241 were sampled (Map 5). The logbook notes that EKU 211, a bag of sediments with 2 little seeds; EKU 212, sediments with a single piece of charcoal, and EKU 214, also sediments with a single piece of charcoal, were taken on 09/07/2012. EKU 233, sediments with white slots; EKU 234, sediments with a large single charcoal, similar to EKU 212 and EKU 240 and EKU 241, sediments with a single piece of charcoal, were collected later, on 12/07/2012.

'Loci database' indicates that locus 1014 (Fig. 6) has been excavated from 09/07/2012 to 18/07/2012 in the SW part of quadrant 099.099b. The locus is described as a sequence of yellowish surfaces, at least three of them, divided by thin layers of black burnt soil. The upmost of them leans to fireplace 0547. It was exposed over an irregular area, measuring approximately 220 x 60-80 cm, between the step created by surfaces 0564 and a second step, leading to surface 1034, which is also contemporary. The surfaces rise to the large stone which represented, together with other stones, the S limit of the step till the time of later surface 1032. To the S of it, in the W part there is a complex installation (1030)



Map 5. Above the location of locus 1014 in quadrant 099.099b.
Below an enlargement of the area showing the position of EKU 211, 212, 214, 233, 240 and 241.

consisting of two concave areas, the fillings of which are layer 1026 and respectively 1014a, linked to installation 0547.

A peculiar feature is locus 0547: a clay hearth in the SE corner of quadrant 099.099a and in the SW corner of 099.099b. It measures 70 x 70 cm and consists of a horseshoe-shaped feature of clay, 12-20 cm thick, oriented NW-SE, closed on the East side by a

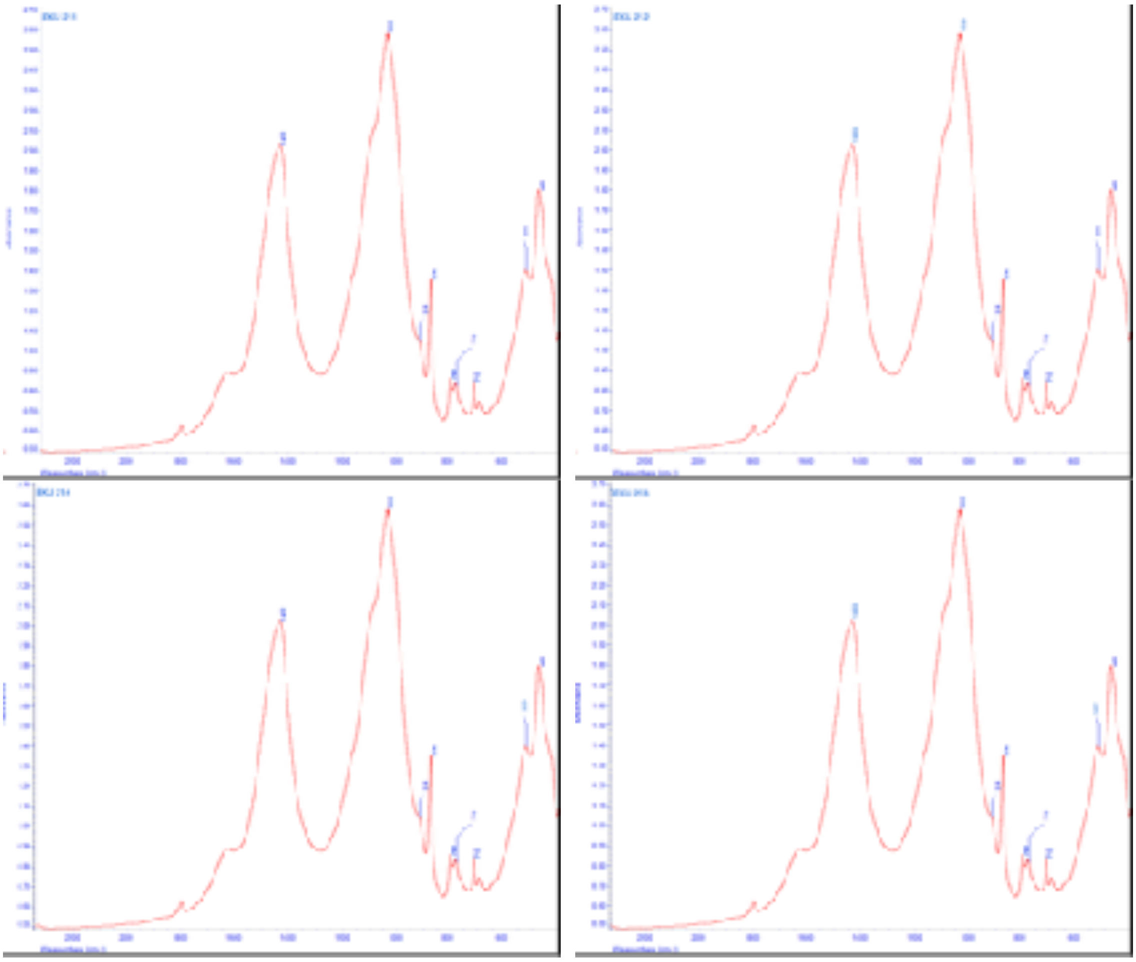
Fig. 6. Photos showing L. 1014, together with the clay wall (L. 1030), its two fillings (L. 1026 and 1014a) and the round firing installation (L. 0547).

straight line, which divides it from installation 1030, which is contemporary and linked with it. In the center, slightly shifted to the southwest, there is a circular area (diameter 35-40 cm, 9 cm deep), filled with black burnt soil rich in seeds and containing some charcoal. Its surface is burnt, the rest is made of brown-yellowish mud.

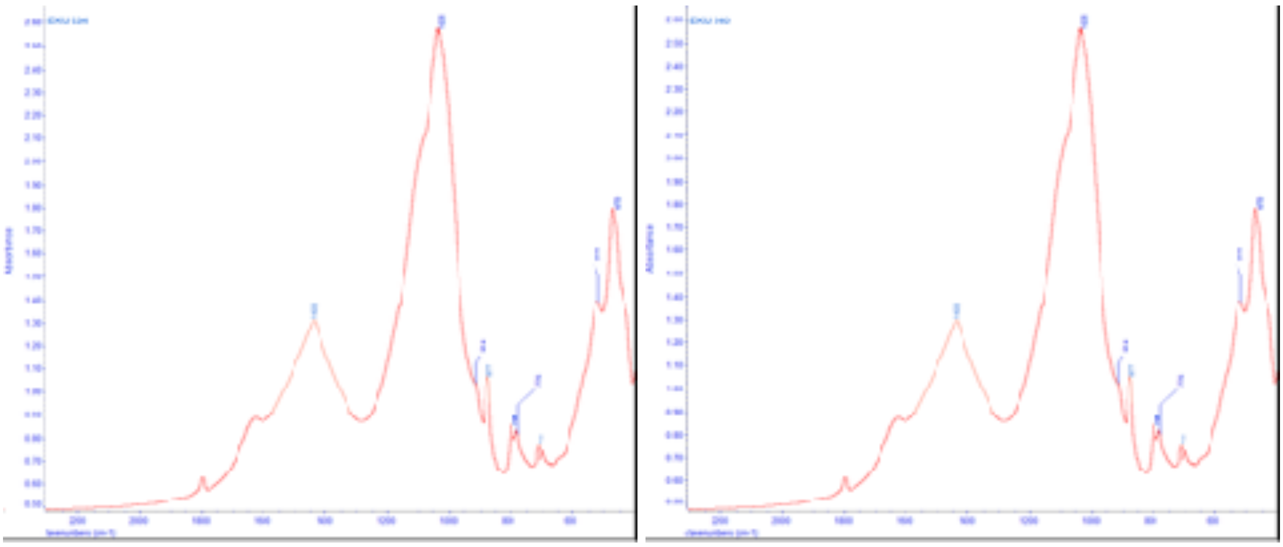
Locus 1030 is defined in the 'loci database' as a complex installation in the SW corner of quadrant 099.099b, continuing in the unexcavated area to the South. It consists of a double cavity, joining the step of 1014. All the small walls of the installation are burnt on their surfaces. The bottom of the installation is a dark brown layer, some centimeters over surface 1048. The larger cavity filling (L. 1026) measures 90 x 20 cm, leans to surfaces 1014, and to the outer wall of installation 0547. It consists of brown-grey soil on the top, but the bottom consists of black burnt soil, full of charcoals. The smaller cavity filling (L. 1014a) must have been ca 35 cm in diameter, rounded in shape, but most of it lies outside of the quadrant. It leans to L. 1014. It consists of black soil, the lowest part is full of charcoals and black soil. It leans to the clay wall of L. 1030, which in its turn leans to the step of 1014. Under it there is a grey layer, probably earlier than the installation, therefore excavation is stopped here. The bottom is concave. Under it (but not directly) is surface 1048.

The matrix positions L. 1014 in the first phase of Kura-Araxes occupation of the site. It is covered by fireplace 0547 and installation 1030, which is filled by L. 1026 and 1014a. FTIR analyses show that EKU 211, 212, 214 and 233 (Spectr. 9) have clay in larger amount than calcite, as visible by peaks around 1033, 915, 530-525 and 470 cm^{-1}. EKU 234 and 240 (Spectr. 10) have clay in much larger amount than calcite, as characteristic absorbance bands of clay are visibly higher than calcite ones. Only EKU 241 (Spectr. 11) has calcite more abundant than clay, shown by peaks at 1429, 875 and 713 cm^{-1}. In all of the samples calcite has the same order as limestone, except for EKU 212 and 241, where calcite has the same order as ash. Characteristic absorption bands indicative of clay structural water (at 3695 and 3620 cm^{-1}) are still present in all of this group of samples, except for EKU 234 where they disappear, indicating that clay seems altered to 500°C.

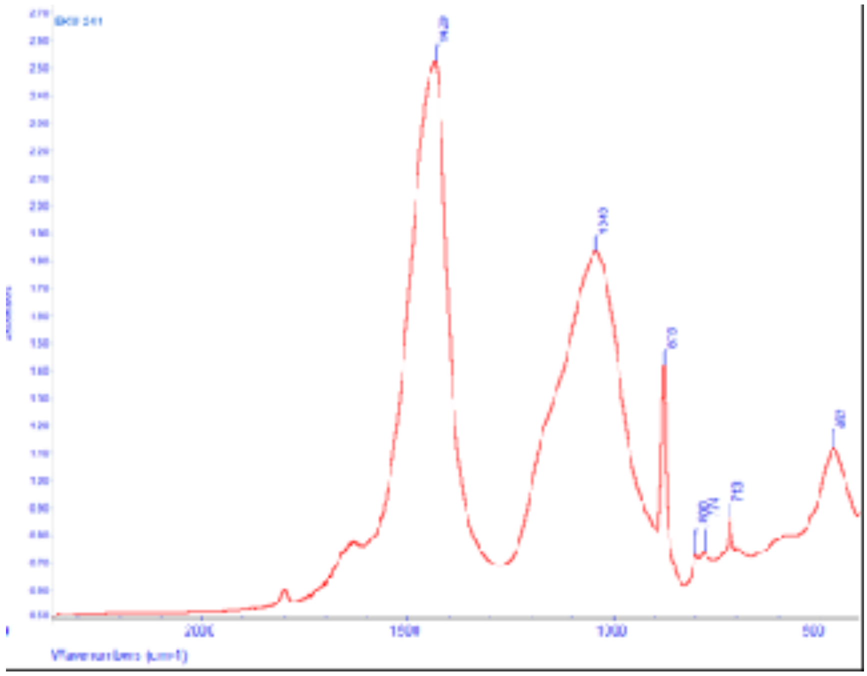
Comparing the ‘loci database’ descriptions and the FTIR results, it is possible to confirm that we are dealing with another fireplace and relative burnt surface. The locus described as complex installation (L. 1030) presents a sample (EKU 214) that is richer in clay than calcite. This could represent the clay structure of a fireplace, a common feature also seen above. Also, EKU 234, coming from the inner area of the installation, is much richer in clay and its temperature is altered up to 500°C, confirming the fact that L. 1030 could be interpreted as a clay-made structure that witnessed burning activities.



Spectra 9. EKU 211, 212, 214 and 233.



Spectra 10. EKU 234 and 240.



Spectrum 11. EKU 241.

Regarding L. 1014 and 1026, this area represents the series of compacted floors (yellowish layers divided by black burnt ones) that are found around the fireplace. It is not clear if the two fireplaces (L. 1030 and L. 0547) are directly connected with each other. However, it’s pretty sure that they belong to the same KA level, as confirmed by the matrix. Most of known Kura-Araxes hearths were featured as central installations inside domestic structures. The central position in this cases is assumed to be linked to the idea of the symbolic significance of the installation, which was not used only for cooking activities. Indeed, this kind of hearth is often associated with other elements indicating ritual activities (e.g. an arrowhead in a skeleton of a goat, red coloured benches with twelve ash-filled holes and some anthropomorphic figurines around a fireplace in the site of Kvatskhelebi)[55].

In our case, however, since that L. 1030 is very close to L. 0547, and they are both found in an outside area, they might be hypothesised as fireplace installations working in

[55] Aquilano, Gavagnin, Gervasi 209, p. 69.

tandem, and probably not connected with ritual activities. Instead, they may represent an area dedicated exclusively to economic activities, that is mainly processing of agricultural products. Even if no in situ burnt remains were found, this area may align to the aforementioned structures dedicated to the processing of cereals.

Bearing in mind all the information presented so far, the conclusions derived from FTIR analyses basically align with the previous studies of the site of Natsargora. The fact that many fireplaces and successive compacted floors were present nourishes the idea of activities related to the processing of cereals; actually, this part of the Natsargora village appears to have been occupied by an open area mainly used for this kind of activities.

Chapter 4

CONCLUSIONS

This work used a microarchaeological approach to analyse some sediment samples from the Kura-Araxes levels of the archaeological site of Natsargora in Georgia, Southern Caucasus, excavated in 2011-2012 by the ‘Georgian-Italian Shida Kartli Archeological Project’ of Ca’ Foscari University of Venice. The aim was to contextualise the samples with respect to their layer of origin, in order to better understand the activities carried out at the site by its Kura-Araxes inhabitants. Indeed, the site belongs to the core area of the Kura-Araxes culture, which flourished between the mid-4th and the mid-3rd millennia BC in the Southern Caucasus (in nowadays Georgia, Azerbaijan and Armenia) and expanded from there over Eastern Anatolia, Western Syria and Western Iran.

The study was supported by FTIR spectroscopy and was carried out by the author at the Kimmel Center for Archaeological Science of the Weizmann Institute of Science in Rehovot, Israel, thanks to a 4,5-month grant provided by an Erasmus + ICM agreement between Ca’Foscari and the Weizmann Institute.

FTIR technology was essential to analyse the samples, most of which were sediments collected in situ by prof. Boaretto on the occasion of her visits to the site. Thanks to infrared spectroscopy I have been able to identify the composition of the samples and distinguish them between charcoal, calcitic materials and clay minerals.

The results of the infrared spectroscopy analyses were complemented by the information reported in the unpublished documentation of the 2011-2012 seasons of the ‘Georgian-Italian Shida Kartli Archeological Project’, in particular in the ‘loci database’, filled by the project’s collaborators.

Five groups of samples (for a total of 25 items), that helped in reconstructing the activities and the use of peculiar areas of the site of Natsargora by its Kura-Araxes inhabitants, are discussed in this thesis.

The first group of samples, EKU 113, 114, 115 and 116, proved that the area of their origin, grave 0005 and its filling 0049, were later features disturbing the KA levels. This is due to the fact that the sediments within the grave are very different in composition in respect to the sediments coming from outside of the grave. In particular, some charcoals which had been identified near the grave did not belong to its filling and had not been burnt in situ, but had probably been burnt in one of the numerous fireplaces in the nearby area and then scattered on the Kura-Araxes outer surface later disturbed by the grave.

The area of provenance of the next group of samples, EKU 123-125 shows similar characteristics. In fact, the surfaces (L. 0082 and 0096) from which the samples come are recognisable as a series of prepared floors of compacted silt. These kind of surfaces were a very common feature in the Natsargora Kura-Araxes settlement. They were used for different kind of activities, but mainly for the processing of cereals. This hypothesis is conformed by the burnt seeds (EKU 123) from the lower layer (L. 0096), which had later been covered by a new thin layer (L. 0082) and from the charcoal (EKU 124) that indicates a burning activity, probably originated from a nearby hearth.

The same kind of activity is also attested in L. 0093 and in its surrounding area (L. 0092), where the third group of samples (EKU 153, 162, 130a and 130b) comes from. As also confirmed by soil micromorphology analyses, L. 0093 is a circular-shaped fireplace mainly composed of clay. Indeed, FTIR analyses identified burnt residues within the installation. L. 0092, the black burnt layer found around hearth 0093, was subjected to a similar use as testified for L. 0082: a prepared external surface of dedicated area where domestic activities related to agriculture were performed, where the refuse from adjacent firing installations was scattered.

The next group of samples (EKU 118-122, 126, 127 and 129), coming from Sounding 2, also attests a sequence of external prepared floors in the KA phase. The first layers are a sequence of compacted layers where the aforementioned domestic activities were probably performed (burnt residues are confirmed by FTIR analyses, leading to the hypothesis of the processing of cereals); after that, a new layer of sediments would have been laid in order to repeat the same kind of activity. The hypothesis is further supported by the fact that some levels witnessed an alteration in temperature (about 600-700°C), which confirms a burning activity happening within the area.

FTIR analyses of the last group of samples (EKU 211, 212, 214, 233, 234, 240, 241) produced information about an installation that is interpretable as a fireplace and its relative burnt surface. L. 1030 is mostly made of clay that reached a temperature up to 500°C, a composition that lead to the hypothesis of a man-made structure related to burning activities. The burnt layer around the fireplace is represented by L. 1014 and 1026, that show the common features of a prepared floor. It is worth noting that another fireplace (L. 0547) was found in the close neighbourhood of the analysed loci, in spite of the fact that the relation, if any, between the two firing installations, is not clear.

In conclusion, it can be affirmed that infrared spectrometry, complemented by soil micromorphology studies, which basically confirmed its results, proved a valid method to reconstruct the human activities performed by the inhabitants of the Natsargora settlement and to understand the geomorphological patterns of the archeological site.

Infrared spectrometry can be considered as a useful method in archeological sites. A future promising application of the method would include preliminary FTIR analyses directly on the archeological field, which was not possible in our case due to the lack of portable equipment. As a matter of fact, on-field FTIR results can be very useful by giving an on-the-spot reading of the composition of the excavated soil; archaeologists will thus gain a better perception of what they are excavating, so that they may give an instant interpretation of the human activities performed in situ.

This kind of field study might have helped, in our case, reaching more thorough results, where the researcher would have followed every single step of the study: sampling, cataloguing, description, infrared spectrometry analysis and interpretation of the results. However, the impossibility of carrying out this complete procedure of study has in our case been satisfyingly fulfilled by the a posteriori analysis of the samples collected in situ associated with the re-evaluation of the reports completed by the archaeologists during the excavation, such as the 'loci database'.

As Weiner affirms «infrared spectra are easy to obtain but can be difficult to interpret»[56], for this reason I hope that my study will help future researchers to take greater account of the microarchaeological approach; the wider diffusion of this method will make possible more and more study comparisons, thus facilitating the interpretation of the results.

[56] Weiner 2010, p. 275.

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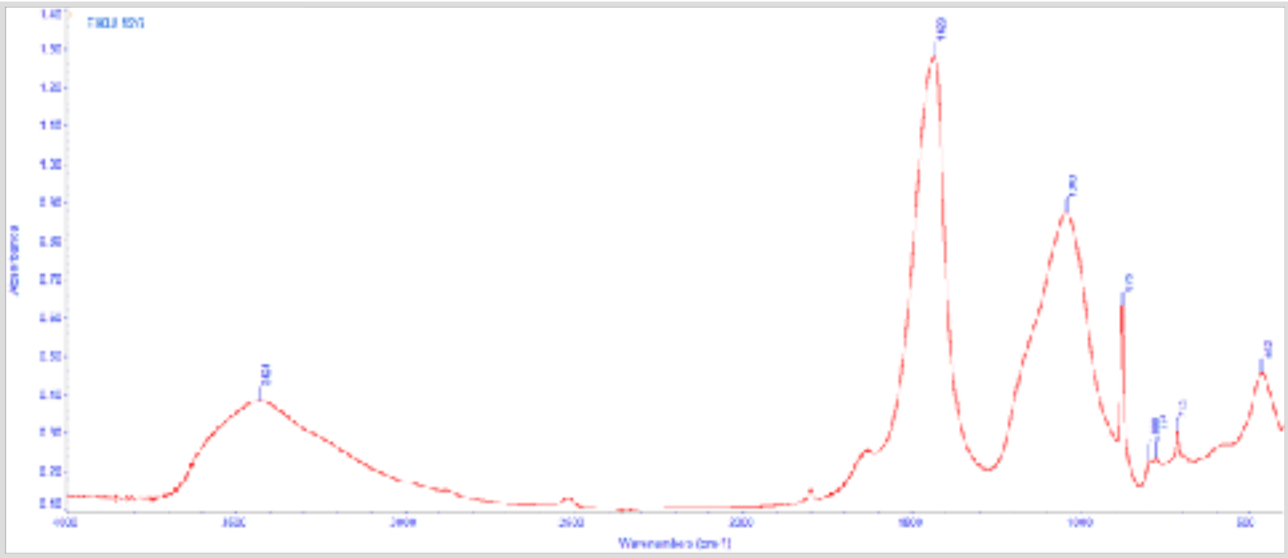
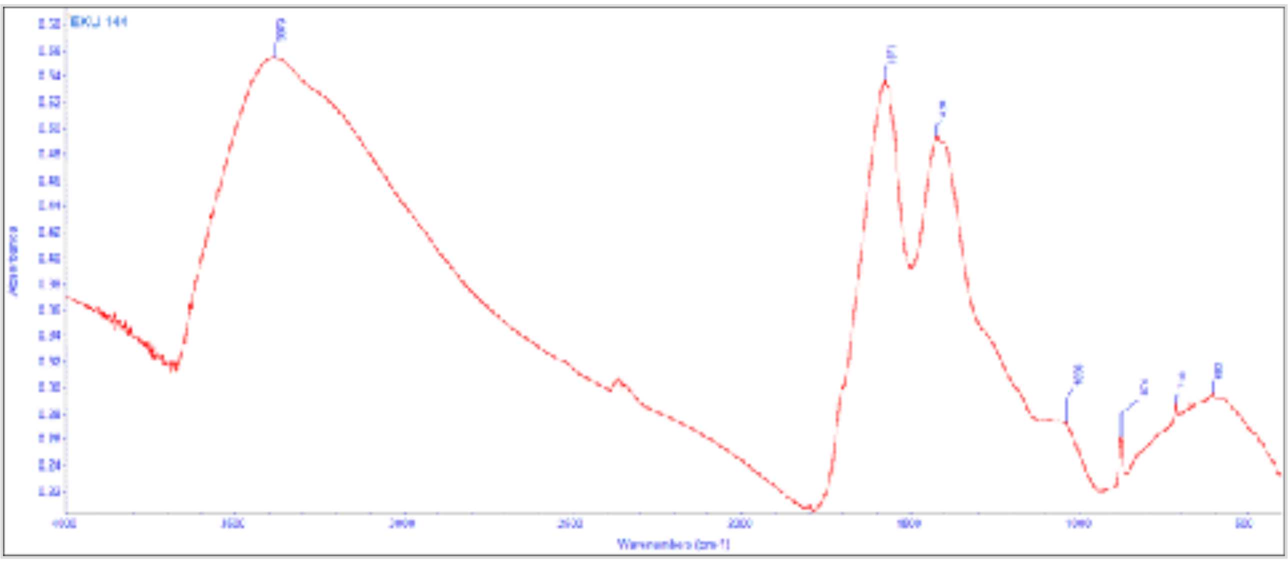
Appendix

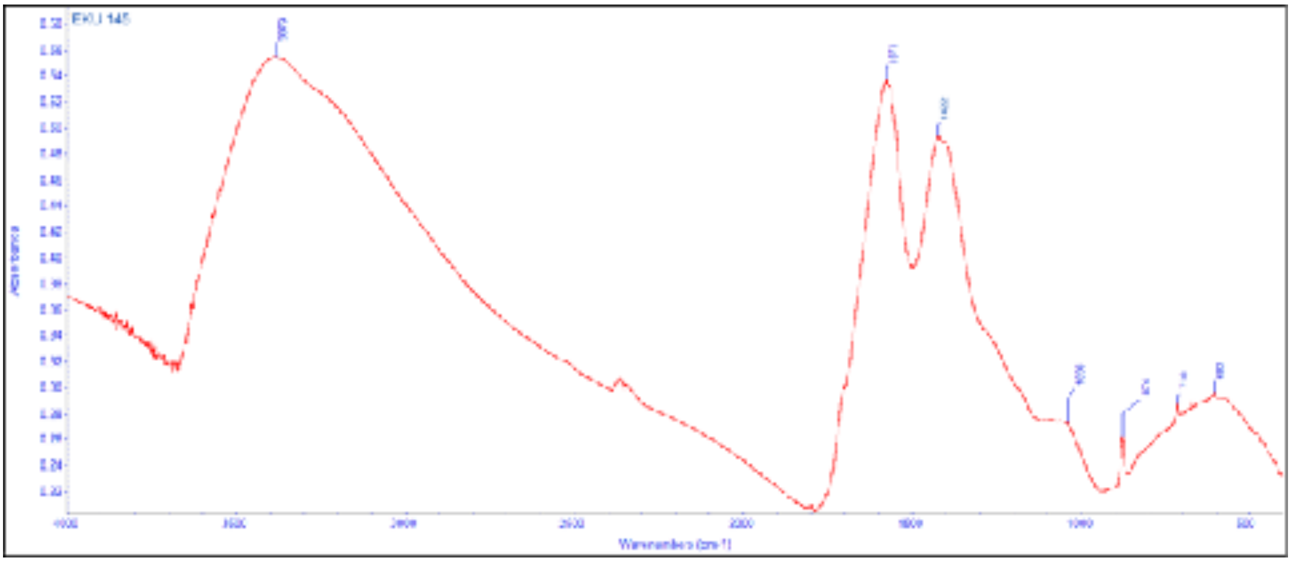
FTIR spectra of analysed samples from Natsargora 2011-2012, but not involved in this study because not belonging to the Kura-Araxes phase.



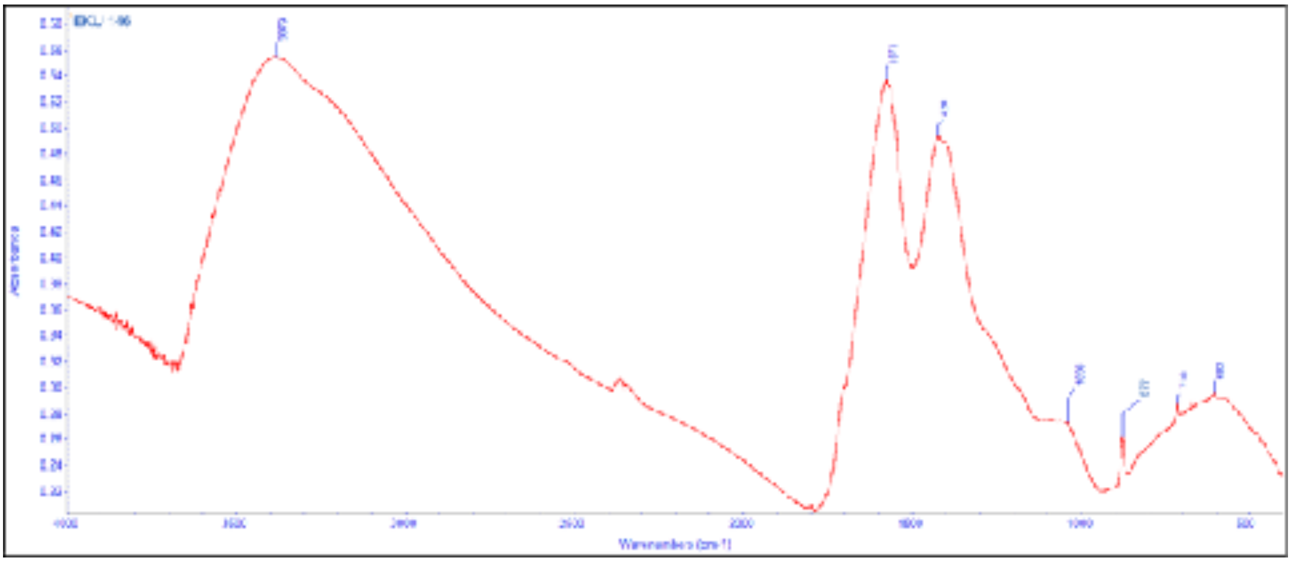
Spectrum 1. EKU 126.



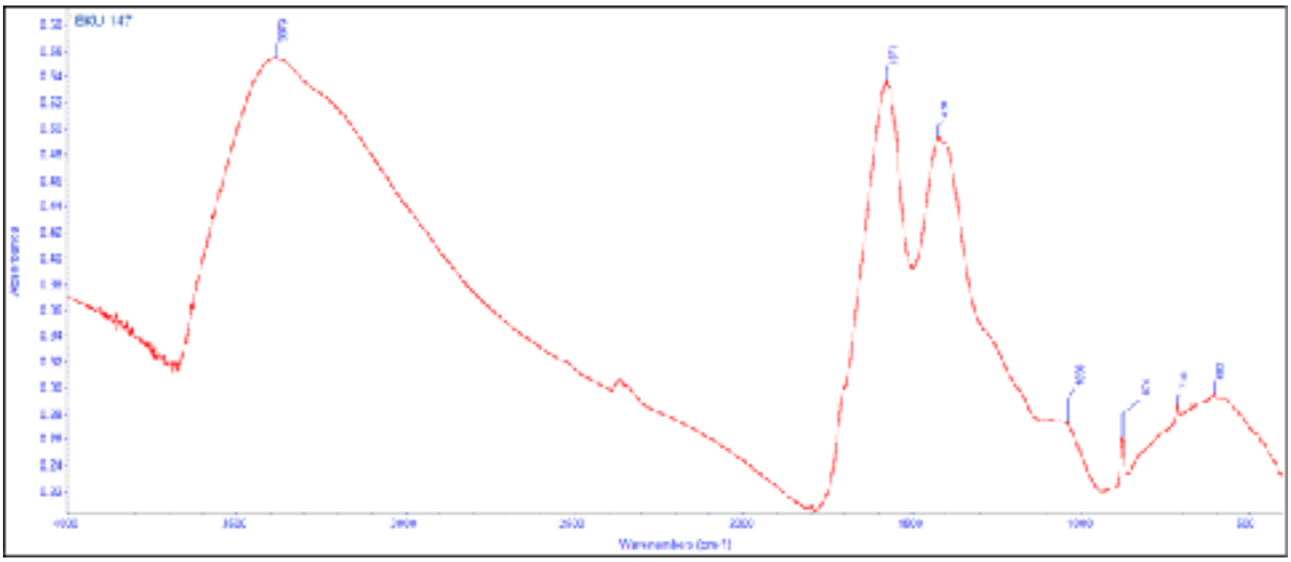
Spectrum 2. EKU 144.



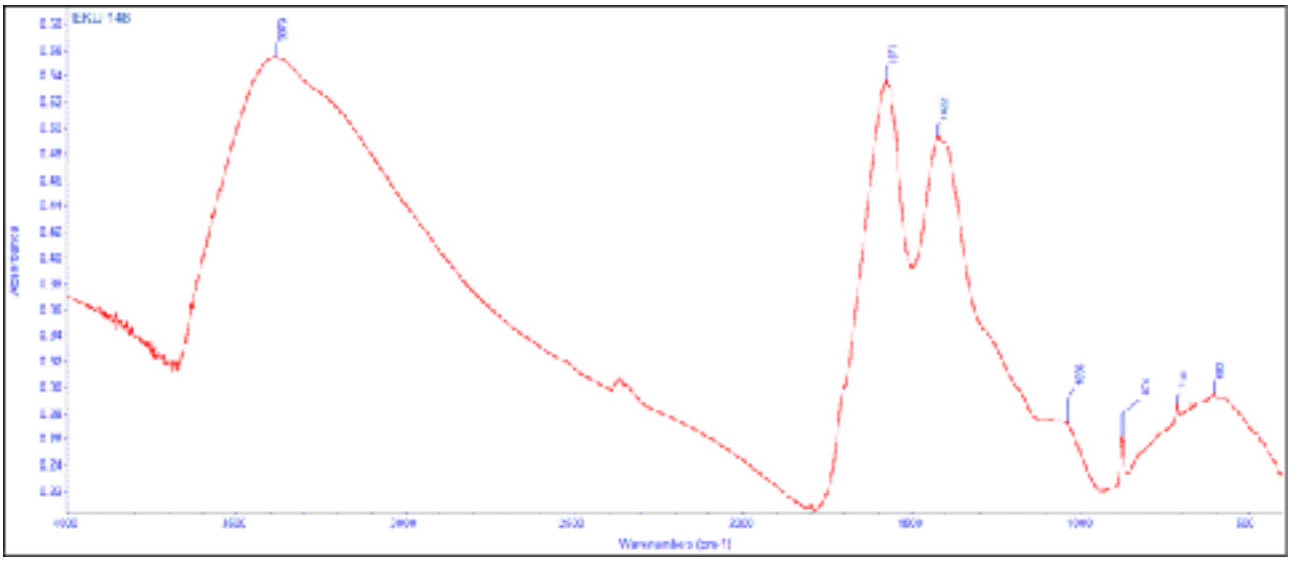
Spectrum 3. EKU 145.



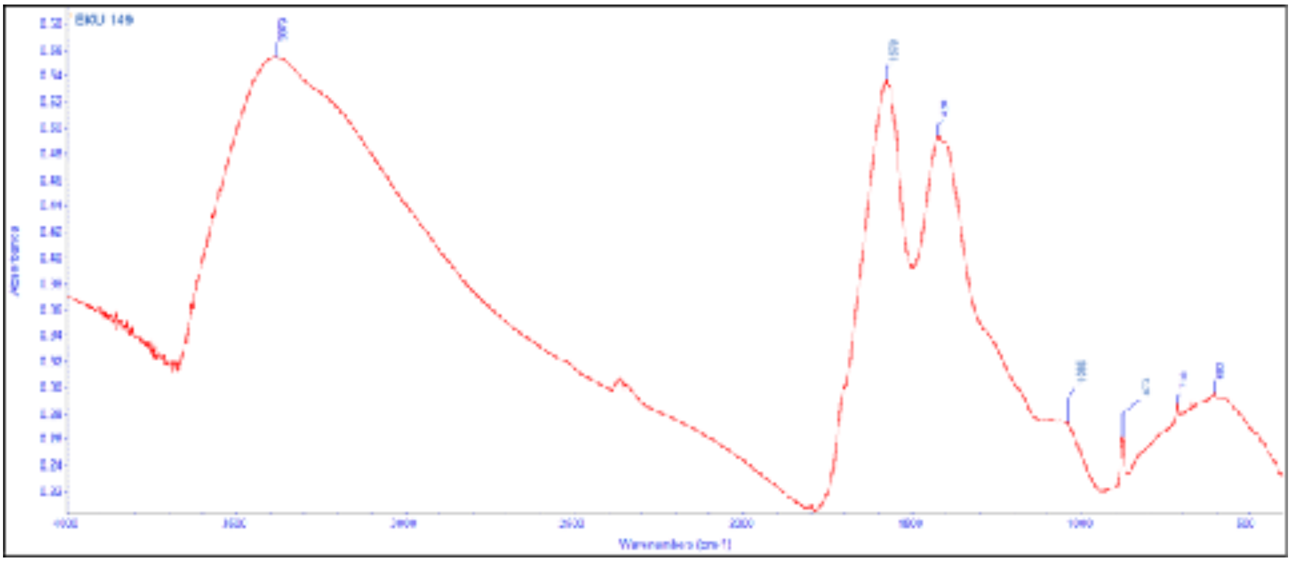
Spectrum 4. EKU 146.



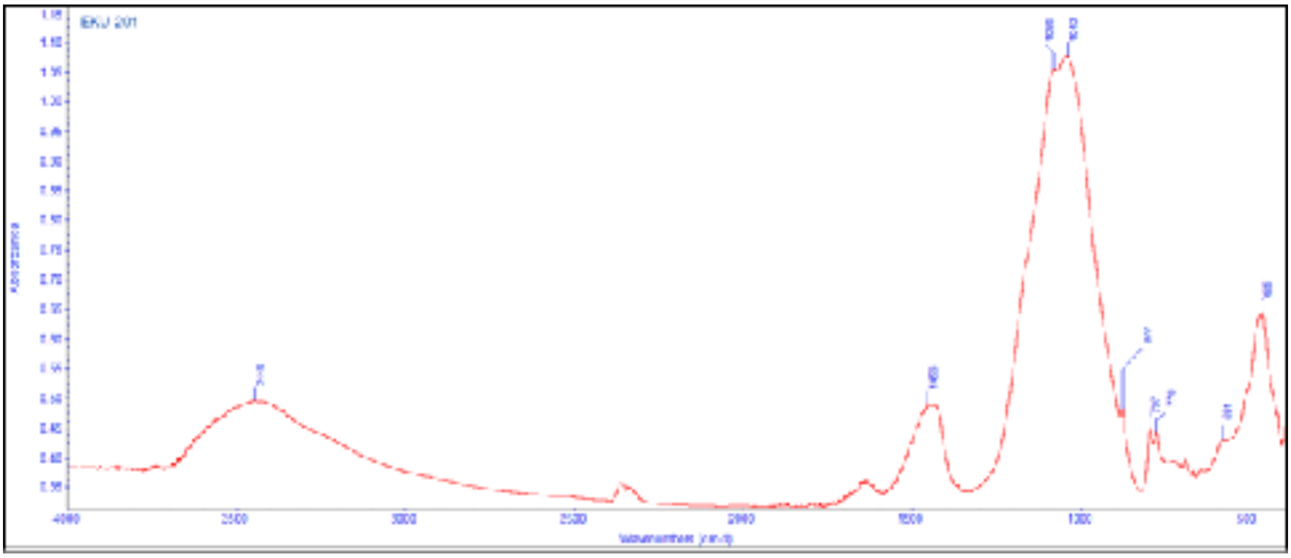
Spectrum 5. EKU 147



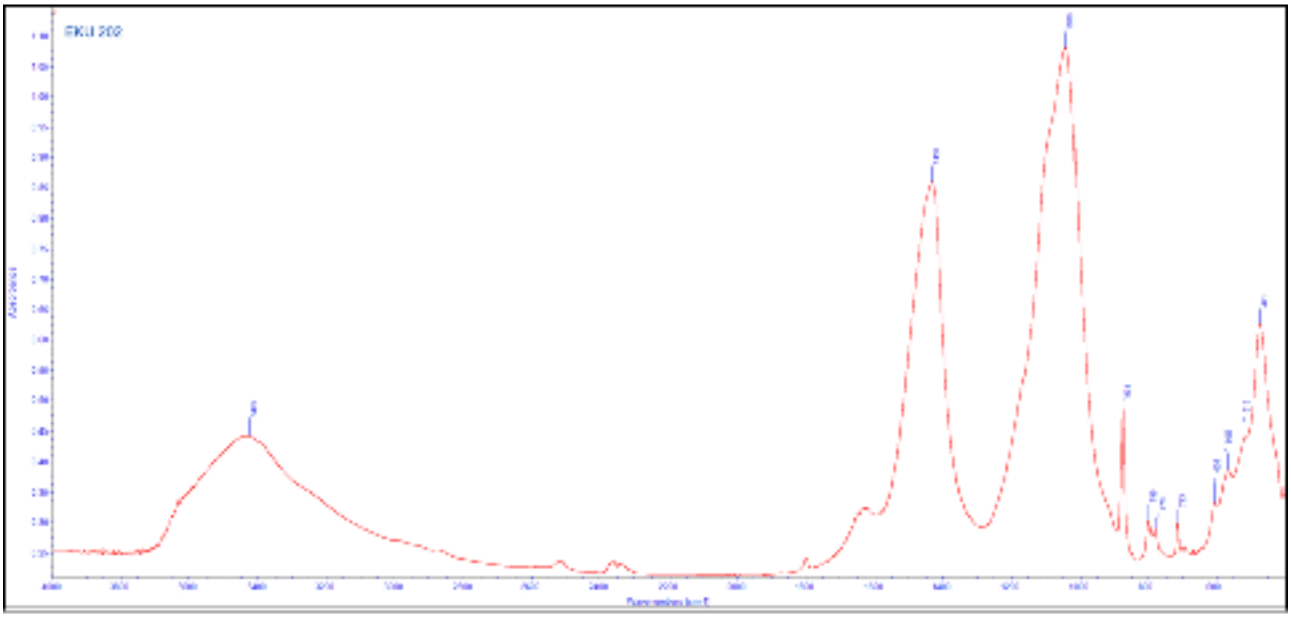
Spectrum 6. EKU 148.



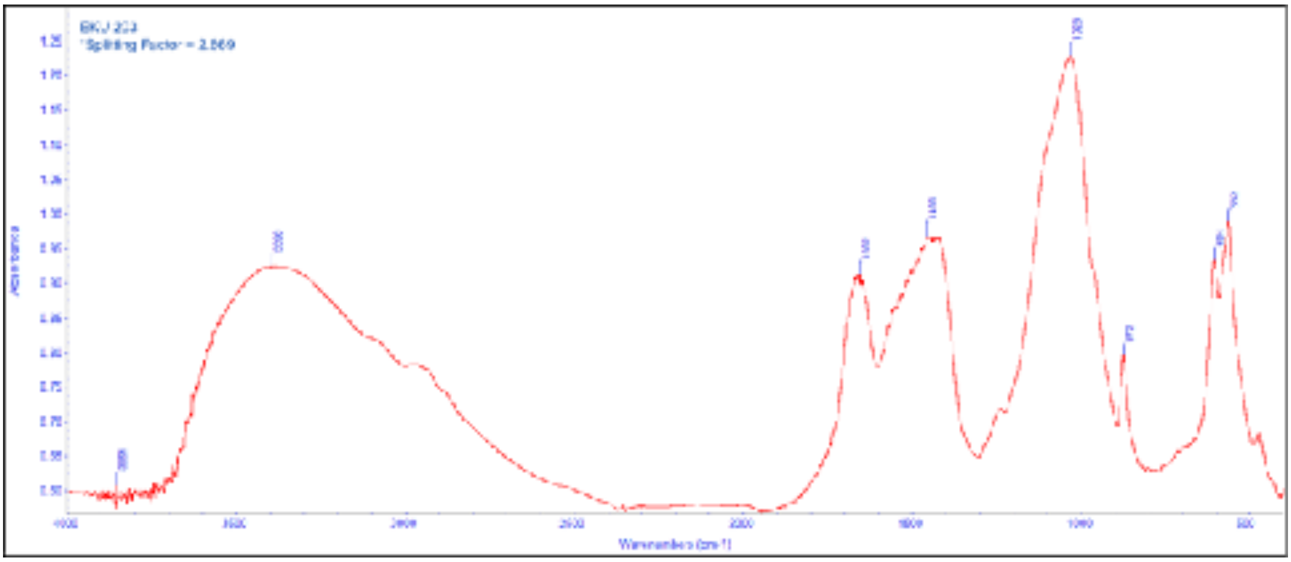
Spectrum 7. EKU 149.



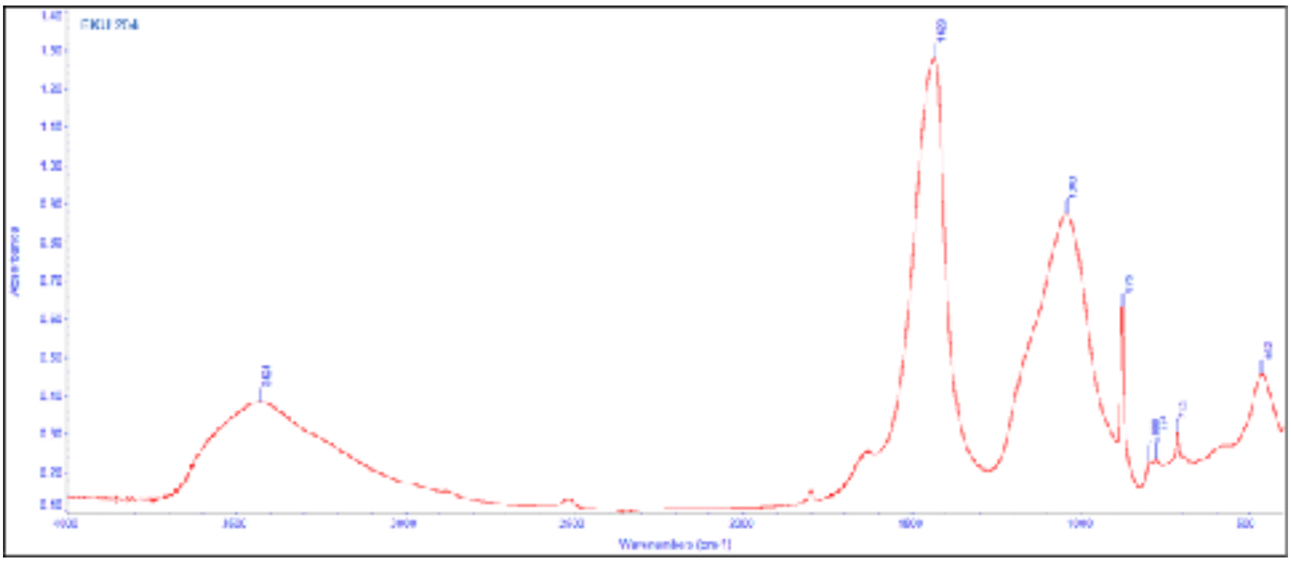
Spectrum 8. EKU 201.



Spectrum 9. EKU 202.



Spectrum 10. EKU 203.



Spectrum 11. EKU 204.