GREENSTONE BEADS IN THE EARLY NEOLITHIC OF TRANSYLVANIA? AN INTERDISCIPLINARY APPROACH TO STUDY A SMALL PREHISTORIC ADORNMENT DISCOVERED IN LUNCA TÂRNAVEI, ROMANIA

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Cuvinte cheie: Transilvania, cercetare de teren, preistorie, mărgică din piatră, analize interdisciplinare

Introduction

On the outskirts of Lunca Târnavei, Romania, over a decade ago, a greenish stone bead was discovered in a place called *Ierdaş*. The artefact was identified in the vicinity of an Early Neolithic feature, characteristic of the Starčevo-Criş cultural complex. At first glance, the appearance of the ornament is similar to the beads that came out of the Neolithic sites of the northern Balkans within the Near East, more than a few of the artefacts being merely several millimetres in diameter and having a greenish colour of the rock from which they had been made.

The ornament was subjected to X-ray diffraction and Raman spectrometry investigations in order to establish the composition of its raw material, and was studied with electron microscopes (SEM) with energy dispersive spectroscopy (EDS) detectors for high resolution imaging and qualitative chemical composition. The data gathered support the hypothesis that it is carved from a metamorphic rock, probably a greenschist or chlorite schist.

The typological correspondence of the stone bead and of a small batch of

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archaeological materials in its vicinity, all discovered on the surface of the Lunca Târnavei-*Ierdaş* site, offer us a new perspective on the cultural links from the beginning of the 6th millennium BC between the Starčevo-Criş communities in Transylvania and the ones located in the Lower Danube area.

Physical-geographical marks

The Lunca Târnavei village (formerly named Spini, until 1964[1]), of the Șona commune, Alba County, is located in the hilly Depression of Transylvania (Pl. I/1a–1b), in the western part of the Târnavelor Plateau[2], 6 km east of the town of Blaj and 27 km west of the town of Târnăveni, traversed by the county road DJ 107. The same rural settlement is bordered in the north by the lower reaches of the Târnava Mică river[3].

South of the village, there is a place that the villagers of Lunca Târnavei call *Ierdaş*[4] or *Coasta lui Vastian*[5] (Pl. I/2) where, 10 years ago, a small ornament in the form of a stone bead was accidentally found (Pl. II/1a–1c).

Ierdaş[6] is located south of the village cemetery and the Orthodox church dedicated to the Holy Archangels Michael and Gabriel, on the bridge of the second Târnava Mică terrace[7], on the left side of the aforementioned river. To the south, the relief on which the site is located is bordered by the 3rd terrace[8], and the same relief form is delimited to the east and west by two streams, Valea Viilor and Valea Șonii. We need also add that the eastern part of the *Ierdaş* archaeological site was affected by a quarry for the exploitation of sands and gravels, which, apparently, functioned until the second half of the 20th century[9].

The "archaeological" context

The *Ierdaş* site entered the archaeological literature not so long ago; at this point, as well as over the entire area of the Lunca Târnavei village and the

1 Buza, Stroia 1985, 79; Horșia *et alii* 2006, 46, 105.

2 Josan 1979, 9–15, fig. 1; Mac, Josan 1987, 566–567, fig. 190; Sorocovschi 1996, 7–11, fig. 1; Pop 2012, 219–220, 229, 231–236, fig. 12.

3 Josan 1979, 14–15, 18, 46–48; Mac, Josan 1987, 568–570; Sorocovschi 1996, 50–52; Pop 2012, 233–236.

4 Horșia *et alii* 2006, 86, 89, 121.

5 Horșia *et alii* 2006, 86, 89, 121.

6 A name by which the archaeological site came to be known in the historiography, used in the present paper as well (see: Bărbat 2005, 17–18, 28, pl. VIII/10–18; Bărbat 2007–2008, 49, 55–56, fig. 1/1–2, 2/1; Bărbat 2008, 13–14, 17, 21–23, pl. I/2–4, V/3–6, VI/1–7, VII/1–2; Bărbat 2011, 19, 21, 28–29, fig. 2/12).

7 Josan 1979, 54; Horșia *et alii* 2006, 107.

8 Josan 1979, 54; Horșia *et alii* 2006, 107.

9 Horșia *et alii* 2006, 86, 89, 121.

neighbouring areas (towards the Șona and Sâncel villages), field surveys were conducted between 1995 and 2009. Particularly for the Lunca Târnavei-*Ierdaş* we must mention that, north-east of the archaeological site, prehistoric materials were found, as well as artefacts from later chronological eras, most of the prehistoric ceramics belonging to the Early Neolithic and the Late Bronze Age[10].

The stone bead (Pl. II/1a–1c) was found in the eastern side of the *Ierdaş* site (Pl. I/2), on the surface of ploughed land, in a place in which the natural terrace gently descends towards the same cardinal landmark. Approximately 5 m west of where the ornament was discovered, an Early Neolithic feature was identified (Cx. 1), possibly a dwelling, affected by the agricultural works undertaken on the terrace[11]. The aforementioned feature, rich in ceramic materials that are characteristic of the older phases of the Starčevo-Criş cultural complex (Pl. V/1–7, VI/1–8), occupied a remarkable area (approx. 7 × 3 m); the presence of two "contemporary" features with the same material culture characteristics is also possible. The mark of at least one archaeological feature is also proven by the appearance of other categories of objects, such as osteological items, hearth fragments and knapped stones (Pl. IV/1), as well as rock fragments that bear traces of secondary burning.

Description of the stone bead and the manufacturing methods

The greenish stone bead is discoidal in shape and it bears a fairly good polish (Pl. II/1a–1c). On the surface of the item, there are several residues of iron oxides, which appeared as a result of the preservation conditions in the archaeological sediment. Regarding the dimensions of the bead, we must mention that the exterior diameter is 3.632 mm, the diameter of the orifice is up to 1.431 mm, the length or height is 1.840 mm and its uneven thickness is up to a maximum of 1.130 mm. The item weighs 0.0375 g.

Concerning the manufacturing methods, we admit that they can be deduced only to a limited extent, due to the very small dimensions of the ornament, but also for other reasons, such as the finished appearance of the artefact, the fairly good polish on the surface and the iron oxi-hydroxide residues[12]. However, based on the morphology of the bead and the observations made using SEM-EDS, certain stages in the manufacturing of the stone bead from Lunca Târnavei-*Ierdaş* can be outlined.

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10 Bărbat 2005, 17–18, 28, pl. VIII/10–18; Bărbat 2007–2008, 49, 55–56, fig. 1/1–2, 2/1; Bărbat 2008, 13–14, 17, 21–23, pl. I/2–4, V/3–6, VI/1–7, VII/1–2; Bărbat 2011, 19, 21, 28–29, fig. 2/12.

11 GPS coordinates (Garmin Montana 650t): Cx. 1 (West side) 46°12'59.2"N, 23°59'07.1"E; Cx. 1 (East side) 46°12'59.3"N, 23°59'07.4"E; Elevation 286.79 m.

12 The surfaces of the bead were not cleaned of the iron oxides residues (which are also visible in the microscopic images), so that the ornament's patina was preserved.

What is truly striking from the very beginning with respect to the disc-shaped bead are certainly the dimensions (see above) which show a "millimetric" precision of the craftsman who made the item. Despite the very few millimetres of the ornament, we cannot overlook the uneven appearance of both sides and the oblique profile, viewed from the section. The aforementioned details could explain part of the bead making process, in which case we could consider two probable scenarios, without disregarding other working versions:

1. The first assumption is that the bead had been obtained from a small stone cylinder, processed beforehand by the artisan of the ornament; the diameter of the cylinder must have been close to that of the bead from Lunca Târnavei. By carefully sectioning and portioning the stone cylinder, several beads could have been obtained. Such examples have been noted in the scholarly literature, both in the case of stone beads[13], like the ones from Çayönü[14], and in the case of bone ones, obtained using the "groove-and-snap technique"[15].

2. The second hypothesis regards the individual method of obtaining a bead[16], a very well documented technique for the Near East area. Here, the production of such ornaments implied at least five major stages according to some authors, each having several sub-stages, the production chain thus reaching 9 sequences to process the disc-shaped beads, from the moment of obtaining the primary blank[17], in which the appearance of the item is connected to one of the initial stages of the rough preparation of the rock (by sawing)[18], before the perforation, or the uniformisation of the two faces of the bead through polishing[19].

After obtaining the roundel (the pre-form of the future bead) through at least one of the two methods described above, it is almost certain that the following stage in manufacturing the future ornament consisted in the perforation of the item, which seems to have been bilateral, if we are to consider the conical appearance of the perforations (Pl. II/1a, 1c). The scanning electron microscope images show that the act of perforating the bead imprinted several concentric parallel striations in the gripping hole (Pl. II/2b–2d). The grooves within the bead were the result of a perforation with a flint tip (with a diameter less than <1.5 mm), probably driven by a mechanical drill (a bow drill or a pump drill)[20].

13 Wright, Critchley, Garrard 2008, 142; Baysal 2016, 19–20.

14 Altınbilek *et alii* 2001, 137; Baysal 2017, 11.

15 Bains *et alii* 2013, 361–362, fig. 19.29; Baysal 2013, 6–9, fig. 7, 13; Yelözer, Sönmez 2018, 185–186, fig. 15/2–3; Yelözer, Christidou 2020, 202–203, 205, fig. 2/a–c, 3.

16 Wright, Critchley, Garrard 2008, 142; Bains 2012, 44, 247–248; Bains *et alii* 2013, 343, 345–346, fig. 19.5/1–2; Baysal 2014a, 63, 68, 79, fig. 6; Baysal 2016, 19, 21; Baysal 2017, 11.

17 Wright, Critchley, Garrard 2008, 140, 145, fig. 8.

18 Wright, Critchley, Garrard 2008, 142; Bains 2012, 46.

19 Wright, Critchley, Garrard 2008, 140, 145, fig. 8/2; Bains 2012, 45.

20 Altınbilek *et alii* 2001, 140, 142, fig. 2e; Coşkunsu 2008, 33–34; Bains 2012, 42, 49, 53,

The activation of the flint drill through successive, alternative rotations, possibly in the presence of fine sand and water, led to the appearance, inside the orifice of the bead, of several extremely fine, parallel striations[21] (Pl. II/2d). Other arguments that support the hypothesis that a complex perforation process was used in the case of the bead from Lunca Târnavei-*Ierdaş* are given by the dimensions of the item and the hardness of the rock (between 4 and 5 on the Mohs scale), as well as the data obtained from several experimental studies that have been conducted recently. Attempts at perforating certain beads during their manufacturing, or even of certain raw materials used in prehistory for stone ornaments, showed that the perforation of rocks with an average to low Mohs hardness would not have required a great effort if a mechanical drill (bow drill or pump drill) were employed[22].

We also notice that after the rough ornament was drilled out, the walls of the bead hole were left unsmoothed (Pl. II/1a, 1c, II/2a–2d).

For the last stage in manufacturing the item, namely the polishing stage, the images barely showed the marks of this finishing process on the bead's length, faces and margins, which proves an almost complete smoothening[23] (Pl. II/2a, X). The ornament was polished by rubbing the bead on a hard surface, possibly a stone slab, and using fine sand and water for an increased efficiency in the last technological process[24]. Moreover, another method proposed in the archaeological literature implies that small beads, as is the item from Lunca Târnavei-*Ierdaş*, were "strung on a stick or on twisted fibres" and then abraded at once[25]. This way of working ensured, at least in theory, both the efficiency and very good results in the polishing of the items.

Analytic methods and mineral composition of the bead

X-ray diffraction, Raman spectrometry, scanning electron microscope and EDS analyses were employed to determine the mineral composition of the bead. X-ray diffraction entails irradiating a sample with an incident X ray beam and recording the scattering angles and intensities of secondary beams exiting it. The recorded diffractogram (or pattern) is a result of the crystalline structure

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142–143, 146, 163, 247; Bains *et alii* 2013, 341–342, 345; Groman-Yaroslavski, Bar-Yosef Mayer 2015, 80, 86, Baysal 2016, 19; Baysal 2017, 11.

21 Bains 2012, 150–153, fig. 3.3.7/B, 3.3.14/B.

22 Bains 2012, 42, 44, table 2.3.2; Gurova *et alii* 2013, 206, 210, 213, 217, 219, table 1; Gurova, Bonsall 2017, 162–163, 166, table 12.1.

23 Bains 2012, 154–159, fig. 3.3.11/C.

24 Wright, Critchley, Garrard 2008, 148–152, fig. 14/c, 15/a, c.

25 Wright, Critchley, Garrard 2008, 148; Bains 2012, 47–48, 99, 159, 163, 248, 250, fig. 4.35/5; Bains *et alii* 2013, 343, 345–346, fig. 19.5/5; Baysal 2014a, 60; Baysal 2016, 20.

of the minerals in the sample. The analyses were performed with a Bruker D8 Advance diffractometer, with a Cu tube ($K\alpha_1$ with a wavelength of 0.15418 nm), Ni filter and a LynxEye detector[26], between 5° and 64°, at 0.02° steps, with a timing of 1s/step. Diffractions were performed on the various bead surfaces after it was fixed with silicone gel on a standard PMMA (Poly methyl methacrylate) sample holder, with the primary beam carefully aligned to the surface of the bead. Although this method yielded patterns with reduced intensity, the characteristic reflections of the crystallised components could be identified. For pattern identification we used the Diffrac.Eva software from Bruker AXS, and the PDF2 database from the ICDD (International Center for Diffraction Data).

The Raman spectroscopy analyses, based on the inelastic scattering of laser beams on the sample, were performed using a Renishaw InVia Reflex confocal Raman spectrometer, equipped with a Leica microscope with lenses of 5x, 20x and 100x magnification. The samples were excited with two laser beams with wavelengths of 532 nm and 785 nm respectively, for 1s exposure time, and 200 mW laser power. The spectral resolution was: 0.5 cm^{-1} for the 532 nm laser beam and 1 cm^{-1} for the NIR (near-infrared, 785 nm) beam. For high resolution imaging and qualitative chemical composition, we used a ThermoFisher Phenom ProX scanning electron microscope operated at 15 kV, equipped with an EDS detector. Additional EDS analyses were obtained using a Hitachi SU–8230 SEM operated at 30 kV.

The X-ray diffraction patterns obtained from the bead surface are consistent with muscovite, nominally $KAl_2(Si_3Al)O_{10}(OH)_2$, a common phyllosilicate, with the broad reflections centred at the 2θ angles of 6° and 12° possibly indicating a mineral from the chlorite group (Pl. VIII). The intensities of the reflections differ from the database pattern, most likely due to the fact that the analysis was done on the bead surface, and not on the usual powdered sample. However, except for the two broad reflections tentatively assigned to chlorite, all the d-spacings obtained are consistent with the muscovite pattern.

The mineral composition of the bead surface as identified using micro-Raman spectroscopy with two distinct laser excitation beams, at 785 and 532 nm respectively, indicated the dominant presence of muscovite as the main silicate mineral (Pl. IX). Multiple points analysis confirmed the muscovite Raman signal but additional chlorite (clinochlore $(Mg,Fe^{2+})_5Al(Si_3Al)O_{10}(OH)_8$, also a common phyllosilicate) and rare signals of calcite and amorphous carbon were randomly detected on the sample surface. The band assignment and mineral identification were achieved using the Raman spectral features of phyllosilicates[27] and the RRUFF database[28] for clinochlore (RRUFF ID: R150146)

[26] Pușcaș *et alii* 2019, 59.
[27] Wang, Freeman, Jolliff 2015, 838, 842; Singha, Singh 2016, 119.
[28] https://rruff.info/ (Accessed: 18.06.2021).

and muscovite (RRUFF ID: R040104). Other minor constituents are the iron oxi-hydroxides determined by SEM-EDS, to which we could partially ascribe the amounts of Fe (0.7–2.8) determined in the EDS analyses (Pl. XI). The indicatives for the type of rock used as a raw material for the bead are the mineral association (muscovite + chlorite (clinochlore), calcite and iron oxi-hydroxides) and a hardness established based on the Mohs' scale (between 4–5), which would point to a metamorphic rock, probably a greenschist or chlorite schist.

Discussions

Even though the item emerged from an archaeological site, on the surface of arable land, we are perfectly aware of the risk entailed by such an approach, namely the introduction into the archaeological literature of a small ornament that was discovered accidentally, with no clear context. However, several more or less direct arguments we wish to propose in the following could favour the artefact's belonging to the prehistorical periods.

The relative chronology and the analogies of the stone bead. The first reason for attributing the stone bead to an early period, possibly from prehistory, is supported by the presence of iron oxide residues on its surface, which shows that the artefact had remained in the sediment of the archaeological site of Lunca Târnavei-*Ierdaş* for a very long time[29]. The presence of the iron oxides and the way in which they were deposited on the rock from which the item was made is undoubtedly an indication of age.

We should also add other considerations regarding the paleo-technology of the item, since the stone bead was made in accordance with a similar, perhaps even identical process to beads from Neolithic sites located between south-eastern Europe and the Near East. Without returning to all of the previous clarifications regarding the manufacturing methods, we mention that the current shape of the item and the means of its perforation, completed by the observations made by SEM, ensure the inclusion of the bead from Lunca Târnavei-*Ierdaş* among prehistoric items, most likely from the Early Neolithic period[30].

The third argument that supports the previous discussion is given by the appearance of the stone bead. From a typological viewpoint, the bead from Lunca Târnavei-*Ierdaş* could be included in a very simple category of small

[29] As a characteristic of the area, we mention that the pedology of the clays that can be found under the plough level present a considerable amount of iron oxides and chalk; these minerals are often found in the paste of Neolithic ceramics.

[30] We cannot exclude another chronology for the bead, especially since, on the surface of the *Ierdaş* site, chronologically subsequent artefacts had also been found. Sporadically, materials from the Late Eneolithic, La Tène, Roman period and from the time of the migrations have also been noted, more consistent being the dwelling from the Late Bronze Age.

disc-shaped beads[31], often found in archaeological contexts that belong to the Neolithic period from north of the Balkans to the Near East, at the level of the 12th/11th–6th millenniums BC. The morphology or the hue of the item is closer (Pl. II/1a–1c), if not identical to beads discovered in Neolithic sites from: Serbia – Lepenski Vir[32], Vlasac[33], Divostin[34]; Bulgaria – Gradets[35], Gălăbnik[36]; North Macedonia – Anza[37]; Greece – Mavropigi[38]; Turkey – Barcın Höyük[39], Pınarbaşı[40], Boncuklu Höyük[41], Aşıklı Höyük[42], Mersin-Yumuktepe[43], Çatal Hüyük[44], Körtik Tepe[45], Sumaki Höyük[46]; etc. In more than a few cases, the diameter of the disc-shaped beads whose occurrence was documented in the aforementioned sites was of approximately 3–5 mm, and the perforation was of approximately 1–2 mm, similar to the item from Lunca Târnavei-*Ierdaş*. Such a detail could be "translated" by the existence of a "template" in the manufacturing of these artefacts in the Neolithic period, from western Asia to south-eastern Europe.

The relative chronology of the ceramics. The second issue on which we need to focus is that of the chronology of the archaeological materials discovered in the proximity of the Neolithic bead, practically „inside" the Neolithic feature (Cx. 1).

From ceramic fragments published some time ago, we are inclined to support a later classification of the Starčevo-Criş dwelling of Lunca Târnavei-*Ierdaş*, in phase IVA in Gheorghe Lazarovici, which means that they belong to the period immediately after the mid–6th millennium BC[47]. Based on a recent examination of the ceramic material published and unillustrated[48], we

31 Beck 1928, 4, 7, pl. II/A; Wright, Garrard 2003, 272, 274, fig. 3/1a; Bains 2012, 74–75, fig. 3.1.5/(top left); Bar-Yosef Mayer 2013, 134, fig. 2; Baysal 2016, 28, fig. 6/1, 7/1; Özdoğan 2016, 138, fig. 3/1–5; Bains *et alii* 2013, 337, 340, fig. 19.1; Boroneanţ, Mărgărit, Bonsall 2019, 52.

32 Borić 2016, 240–242, fig. 4.62–4.63.

33 Borić *et alii* 2014, 24, 26, fig. 14/11; Borić 2016, 324.

34 McPherron, Rasson, Galdikas 1988, 329, 336, table 11.9, fig. 11.5/e.

35 Ganetsovski 2015, 8–9, fig. 11/6.

36 Gurova *et alii* 2013, 203–204, fig. 2; Gurova, Bonsall 2017, 159–160, fig. 12.2.

37 Gimbutas 1974, 59–60, fig. 35/4.

38 Karamitrou-Mentessidi *et alii* 2015, 62, 65, fig. 40.

39 Baysal 2014b, 2–3, 9, fig. 2/2, 4.

40 Baysal 2013, 5–6, fig. 6.

41 Baysal 2013, 7–8, fig. 8.

42 Özbaşaran 2012, 142, 157, fig. 21.

43 Caneva 2012, 8, 25, fig. 26.

44 Mellaart 1967, 156, 214, pl. XV, 103–104.

45 Özkaya, Coşkun 2011, 94, 99–100, 116, 127, fig. 13–14, 38.

46 Erim-Özdoğan 2011, 32, 57, fig. 35/C/m.

47 Bărbat 2005, 17; Bărbat 2008, 13–14; Bărbat 2011, 19.

48 Bărbat 2008, 13–14, 17, 21–23, pl. I/2–4, V/3–6, VI/1–7, VII/1–2. For objective reasons,

are certain that the dwelling dates to several centuries earlier than our initial estimations, towards the beginning of the 6th millennium BC.

These statements are supported by those ceramic shapes with partially or almost completely "fallen/exfoliated" slips[49], sometimes with traces of polishing, discovered in the Neolithic feature Cx. 1 (Pl. V/1–7, VI/1–8) and outside it (VII/1a–1c), , which we shall selectively present as follows: 1. Tronconic bowls, the versions with thin walls (Pl. V/1–3), no ornaments, or the versions with thick walls and rare grooves on the lip (Pl. V/4–5); 2. Globular or spherical pots, with almost straight lips (Pl. VI/1), or more or less pulled out (Pl. VI/2–3, 5, 7–8), often decorated with grooves on the body of the vessel (Pl. VI/5–6), sometimes leaving the impression of "pinches" with the "fingernail/fingers"; other times, the same ceramics bear plastic applications, such as semi-circular or vertical alveolar girdles (Pl. VI/4, 6); 3. Ceramics that have small support legs on their bottoms (Pl. V/6–7), sometimes with a more well-preserved and polished slip (Pl. V/6); 4. "Special" types of bowls, such as those with alveolar lobes (Pl. VII/1a–1c).

Without aiming for a detailed approach to the ceramic materials discovered in the proximity of the bead, which we shall do upon another occasion, we must mention that all of the ceramics presented above have correspondences in the settlements from the end of the early Starčevo-Criş horizon of south-eastern Europe. For instance, if we were to focus solely on the case of Romania, there are tens of sites with such materials and we could enumerate the Neolithic locations of Livada-*Ferma Zootehnică*[50], Gura Baciului[51], Ocna Sibiului-*Triguri*[52], Șoimuş-*Teleghi*[53], Haţeg-*Câmpul Mare*[54], Iaz-*Dâmb*[55], Pojejena-*Nucet*[56], Gornea-*Locurile Lungi*[57], Basarabi[58], Târgşoru Vechi[59], etc.

To be more concise in our statements, we draw attention to the fact that the

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in the last publication of the Starčevo-Criș discoveries from the Lunca Târnavei area, not all of the archaeological materials could be published, one cause being the limited number of pages granted to the authors for illustrations, which is why, through the present article, we aim to readdress these discoveries.

49 The weak adherence of the slip on the surfaces of the fragments is due to the technology of producing the ceramics, since the soils of the Lunca Târnavei area lack acidity.

50 Lazarovici, Maxim, Pintea 1989–1993, 321–322.

51 Lazarovici, Maxim 1995, 87–93.

52 Paul 1989, 4–5, 7, 10–11; Paul 1995, 30, 35, 38–39.

53 Bărbat 2013, 314–315.

54 Roman, Diaconescu 2002, 8–9.

55 Lazarovici 1992, 8.

56 Luca 1995, 6–9.

57 Lazarovici 1977, 44.

58 Nica 1971, 549–556.

59 Teodorescu 1963, 254–256, 261.

last ceramic fragment, the one with the alveolar lobe (Pl. VII/1a–1c), represents a good chronological indicator for a part of the Early Neolithic dwelling of the *Ierdaş* site, bearing similarities with items from the Lower Danube area. The closest analogy is in northern Serbia, in the site of Padina, where, in dwelling 18, a vessel with four slightly alveolar lobes was discovered[60] (Pl. VII/2). The radiocarbon dating of an antler from dwelling 18, a sample taken from the floor of the feature, provided a result between 5990 and 5720 cal BC (at 95 per cent probability; 2 sigma)[61], and the ^{14}C age could thus easily be seen to correspond with the end of the early Starčevo-Criş horizon, namely with the Starčevo-Criş II phase in Gheorghe Lazarovici[62]. In the same temporal sequence, Starčevo-Criş IIA (late)–IIB, we could also include the Early Neolithic dwelling of Gyálarét-Szilágyi-major, in south-eastern Hungary, where there was a lip with a lobe and a protome (Pl. VII/3a–3b), whose profile is similar to the ceramic item under scrutiny from Lunca Târnavei-*Ierdaş*[63].

Moreover, we shall also add that on the surface of the site of Lunca Târnavei-*Ierdaş* there were no late Starčevo-Criş ceramics with hollow tall stems ("cups") or bitronconic pots (dishes, bowls); there were also no ornaments made with organised barbotine and black paint (in garlandoid or spiraloid type motifs) on the ceramics. As such, we have all the grounds to include the Early Neolithic dwelling of Lunca Târnavei-*Ierdaş* in the first centuries of the 6th millennium BC.

Several archaeological interpretations. If we accept the Neolithic age of the stone bead from Lunca Târnavei-*Ierdaş*, even in the form of a working hypothesis, the following question arises: *How can we interpret or catalogue the appearance of such ornaments in the Early Neolithic settlements of Transylvania?*

To the extent of our knowledge, such disc-shaped stone beads have not yet been discovered in the Starčevo-Criş sites of Transylvania, which could be justified by the stage of the research, the digging methods or the absence of concrete archaeological proof (characteristic flint drills – microdrills, beads in the process of their manufacturing, technological waste, raw materials etc.), as well as the possibility that such an ornament may have been produced by other Early Neolithic communities, from a completely different area. The last assertion is supported by the more recent information from Schela Cladovei, in south-western Romania, where manufacturing with malachite and greenschist was

60 Jovanović 1969, 31, pl. XVI/2; Jovanović 1971, 5, 9, T. VI/1; Jovanović 1987, 11, Abb. 11.

61 Borić, Miracle 2004, 347, 352, table 4/lab ID OxA–9052.

62 Lazarovici 1977, 36–37; Lazarovici 1979, 43–46; Lazarovici 1983, 19–20; Lazarovici 1984, 60–64; Lazarovici, Maxim 1995, 79–94; Maxim 1999, 40–41, 43–45; Ciută 2005, 16–17, 119–120; Angeleski 2012, 157–158, 160–161; Tudorie 2013, 27–28, 59–60.

63 Trogmayer 2004, 18, fig. 5/1.

archaeologically documented in situ[64]. A second production centre is assumed to have been in Măgura-*Buduiasca*[65], in southern Romania. Moreover, the functioning of other workshops specialised in the production of such ornaments is almost certain in the Early Neolithic sites located nearby, such as those south of the Danube, in the Balkans. The proof is represented by malachite items which were either finished or in the process of manufacturing, discovered in Divostin[66], in Serbia, and the enormous quantity of stone beads from Gălăbnik[67] (Pl. III/1–2), in Bulgaria.

In this context, the manufacturing of such an item is thus not impossible in a workshop that can be located somewhere in the area between the Lower Danube and the southern Balkan peninsula. If our working hypothesis were plausible, then there are high chances that the greenish stone bead entered the intra-Carpathian space through trade, or in the context of the transportation of the products of the material culture by the Neolithic population groups.

However, we must also add that the Starčevo-Criş settlement of *Ierdaş* also contains other elements that are "foreign" to the local Neolithic environment, if we could consider the stone bead as such, which include the knapped stones and certain ceramics.

Regarding the "flint" implements gathered from the surface of the *Ierdaş* site, mostly represented by blades (Pl. IV/1–5) and scrapers (Pl. IV/6–8), as well as other products of knapping, like flakes (Pl. IV/9), we could note that the Early Neolithic population here used raw materials that, at least on a macroscopic level, share certain similarities with the cherts of the Lower Danube area[68], known in the archaeological literature as "Balkan flint"[69] (Pl. III/3–12). We need to underline that nowhere in the vicinity of the Lunca Târnavei village are there chert deposits with such characteristics (usually translucid; with yellow, orange, sometimes light brown shades, less often reddish, the chromatic range being completed by white or yellowish spots), which implies the introduction of such a raw material within the settlement, perhaps even in the form of finite items, from an external source, as northern parts of the Balkans.

Concerning the types of vessels established to have originated from the

[64] Boroneanţ, Mărgărit, Bonsall 2019, 54, 57, 69, fig. 4/4; Mărgărit, Boroneanţ, Bonsall 2021, 791–792, fig. 7/n–p.

[65] Boroneanţ, Mărgărit, Bonsall 2019, 57.

[66] Glumac 1988, 457–461, fig. 19.1/m, q, table 19.1/22–23, 28–29, 31–32; Boroneanţ, Mărgărit, Bonsall 2019, 57.

[67] Gurova *et alii* 2013, 203–204, fig. 2; Gurova, Bonsall 2017, 159–160, fig. 12.2.

[68] Ciornei 2013, 9–30; Ciornei, Mariș, Soare 2014, 138.

[69] We cite selectively several recent works on the issue of the so-called "Balkan flint": Biagi, Starnini 2011, 69–78; Gurova 2012, 15–43; Biagi, Starnini 2013, 47–57; Gurova, Bonsall 2014, 108–127; Gurova *et alii* 2016, 422–440; Moreau *et alii* 2019, 522–523, 526, 532, 534.

vicinity of the location in which the bead was discovered, we mentioned the appearance of a fragmented lobe (Pl. VII/1a–1c). The occurrence of such a form in the Early Neolithic pottery in Transylvania[70], although it had been manufactured locally (based on the inclusions of iron oxides, similar to the other ceramic shards), is highly interesting, especially due to the fact that such vessels are mostly encountered in the area around the Danube Iron Gates and in the neighbouring region. Thus, the morphology of the lobe from Lunca Târnavei-*Ierdaş* has good correspondences in northern Serbia, in Padina, where we know of a quadrilobed ceramic vessel[71] (Pl. VII/2). The same ceramic lobe is very similar, especially with respect to its profile, to a ceramic fragment from the Starčevo-Criş settlement of Gyálarét-Szilágyi-major (Pl. VII/3a–3b), in south-eastern Hungary[72].

On the other hand, the appearance of certain southern "type" cultural products within certain Starčevo-Criş settlements of Transylvania, such as the archaeological items invoked above, in the Lunca Târnavei-*Ierdaş* site, could be discussed from the viewpoint of the richness of the saliferous resources of the western area of the Târnavelor Plateau. In the archaeological literature, there are more than a few occurrences of arguments in support of interpreting the process of Neolithisation from the perspective of the salt deposits located inside and outside the Hilly Depression of Transylvania[73]; a series of early Starčevo-Criş settlements are located near salt sources (under 6 km), as is the case of the following sites[74]: Săndulești-*La Stână*, Uioara de Sus-*Cimitirul Ortodox*, Șoimuş-*Teleghi*, Șeușa-*La Cărarea Morii*, Miercurea Sibiului-*Petriş*, Ocna Sibiului-*Triguri* etc. within this "phenomenon", we could also include the Starčevo-Criş settlement of Lunca Târnavei-*Ierdaş*, especially since only a few kilometres away from the site there are saltwater streams or springs and salt massifs, as indicated by the neighbouring villages: Pănade[75], Biia[76], Iclod[77], Petrisat[78], Cetatea de

70 In Ocna Sibiului-*Triguri*, there was another early Starčevo-Criş ceramic lobe from level II of the Neolithic settlement, but it had a different morphology (see Ciută 2005, 111).

71 Jovanović 1969, 31, pl. XVI/2; Jovanović 1971, 5, 9, T. VI/1; Jovanović 1987, 11, Abb. 11.

72 Trogmayer 2004, 18, fig. 5/1.

73 Lazarovici, Lazarovici 2017, 291–294; Lazarovici, Lazarovici 2018, 149–163; Lazarovici, Lazarovici 2019, 78–83.

74 Lazarovici, Lazarovici 2017, 291–292, 294; Lazarovici, Lazarovici 2018, 155–160; Lazarovici, Lazarovici 2019, 82.

75 Laţiu 2015, 114.

76 Chintăuan, Lehaci, Marquier 2019, 25.

77 Roșu 1943, 6; Laţiu 2015, 112; Moscal 2018, 4, 11, fig. A; Chintăuan, Lehaci, Marquier 2019, 26–27.

78 Laţiu 2006, 44, 46; Moscal 2018, 6, 11, fig. A; Chintăuan, Lehaci, Marquier 2019, 28.

Baltă[79], Ocnişoara[80] etc. Moreover, it would appear that the largest bronze hoard in Transylvania is located exactly in the aforementioned area with the saline deposits, some of which contain thousands of items, such as those of Şpălnaca-*La Dudău* and Uioara de Sus-*Tăul Mare*, each deposit having an estimated weight of over one ton[81]. This is why some researchers believe that the salt sources of the Hilly Depression of Transylvania are "responsible" for the formation of the great hoards of bronze items from the end of the Late Bronze Age[82].

Conclusions

The analytic methods employed in this study have given an insight into the mineral composition of the raw material utilised to carve the bead: the muscovite – chlorite ± calcite – iron oxi-hydroxides association clearly indicates that the bead was made from a low-grade metamorphic rock, most likely a greenschist or chlorite schist. The morphology of the stone bead from Lunca Târnavei-*Ierdaş* as revealed by means of electron microscopy imaging, together with the appearance of the knapped stones (tools and debris) and the presence of certain special ceramics, the latter originating in the area of the Danube Gorge, cannot be considered to be simple coincidences, despite the fact that all the archaeological materials came from a surface survey. The discussed items belong to the Starčevo-Criş community of the aforementioned site, and, through their characteristics, they show a southern cultural "penetration" within a Neolithic settlement of Transylvania.

The discovery of the stone bead, the flint implements and the presence of the special ceramics, such as the lobed vessels, are surely merely a part of the artefacts that prove certain "connections" between the Starčevo-Criş settlement of Lunca Târnavei-*Ierdaş* and the Early Neolithic world of the northern Balkans. Moreover, the same elements of the material culture also outline an "anthropological" portrait of the Early Neolithic community of Lunca Târnavei-*Ierdaş*, probably with roots within the Starčevo-Criş settlements from the proximity of the Danube Gorge and downstream.

In conclusion, surely the answer to the question raised in the title of the article – *Greenstone Beads in the Early Neolithic of Transylvania?* – must be

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79 Roşu 1943, 6; Moscal 2018, 5, 11, fig. A; Chintăuan, Lehaci, Marquier 2019, 26.

80 Ciupagea, Paucă, Ichim 1970, 191; Laţiu 2006, 46–47; Moscal 2018, 5, 11, fig. A; Chintăuan, Lehaci, Marquier 2019, 28.

81 Petrescu-Dîmboviţa 1977, 108, 115.

82 For the latest discussion on this subject in the archaeological literature, in the context of the discovery of the bronze hoard from Pănade near a saltwater stream (located approximately 2 km north of the Lunca Târnavei-*Ierdaş* site!), see especially: Wollmann, Ciugudean 2005, 98; Ciugudean, Ciută, Kádár 2006, 102; Ciugudean, Luca, Georgescu 2006, 51–52; Popa, Totoianu 2010, 338–339; Ciugudean, Boroffka 2015, 34.

sought through subsequent endeavours on the surface of the site of Lunca Târnavei-*Ierdaş*, perhaps even in the form of systematic archaeological surveys; otherwise, all will remain a simple working hypothesis.

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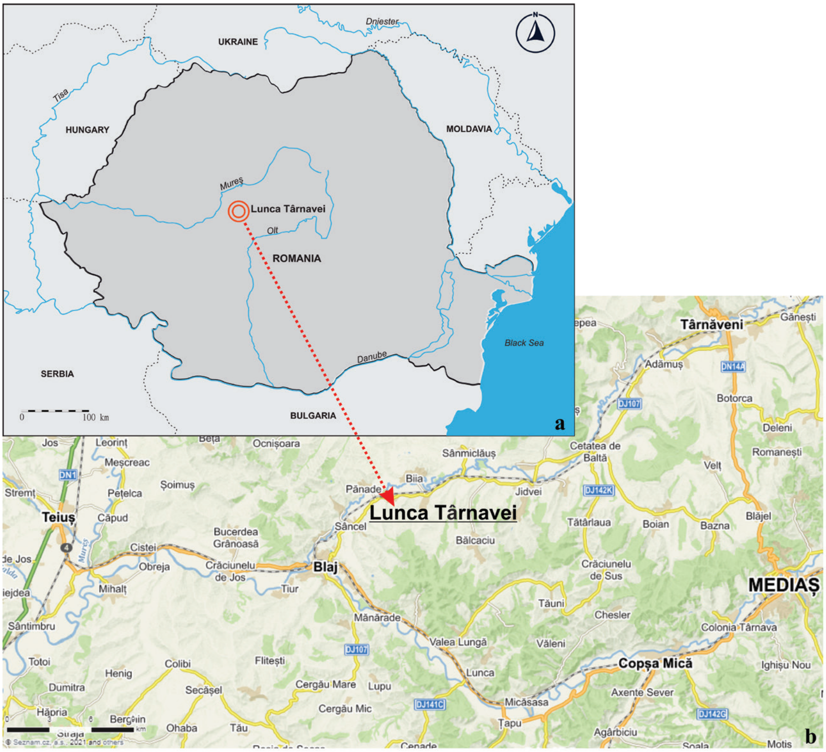
MĂRGELE DIN PIATRĂ VERZUIE ÎN NEOLITICUL TIMPURIU DIN TRANSILVANIA? O ABORDARE INTERDISCIPLINARĂ A UNEI MICI PODOABE PREISTORICE DESCOPERITE LA LUNCA TÂRNAVEI, ROMÂNIA

Rezumat

La marginea localităţii Lunca Târnavei (com. Şona, jud. Alba), acum peste un deceniu, a fost descoperită întâmplător o mărgică din piatră de culoare verzuie în locul numit *Ierdaş*. Artefactul a fost identificat în vecinătatea unui complex neolitic timpuriu, specific complexului cultural Starčevo-Criş. La o primă vedere, aspectul obiectului de podoabă este asemănător cu mărgelele apărute în siturile neolitice din Balcani şi Orientul Apropiat, nu puţine dintre artefactele respective având doar câţiva milimetri în diametru şi o cromatică verzuie a rocii din care au fost confecţionate.

Piesa de podoabă a fost supusă unor investigaţii interdisciplinare non-distructive, în vederea determinării materiei prime, de tipul difracţiei de raze X şi spectrometriei Raman, şi observată la microscopul electronic (SEM) cu detector pentru microanaliză de raze X (EDS) pentru detalii foto şi determinarea compoziţiei chimice calitative. Toate datele obţinute ne confirmă că mărgica a fost obţinută dintr-o rocă metamorfică, probabil de tipul unui şist verde sau a unui şist cloritos.

Corespondenţele tipologice ale mărgelei din piatră şi a unui mic lot de materiale arheologice din vecinătatea acesteia, toate descoperite la suprafaţa sitului Lunca Târnavei-*Ierdaş*, ne oferă o nouă perspectivă asupra legăturilor culturale, la începutul mileniului VI BC, între comunităţile Starčevo-Criş din Transilvania şi cele aflate în zona Dunării Inferioare.



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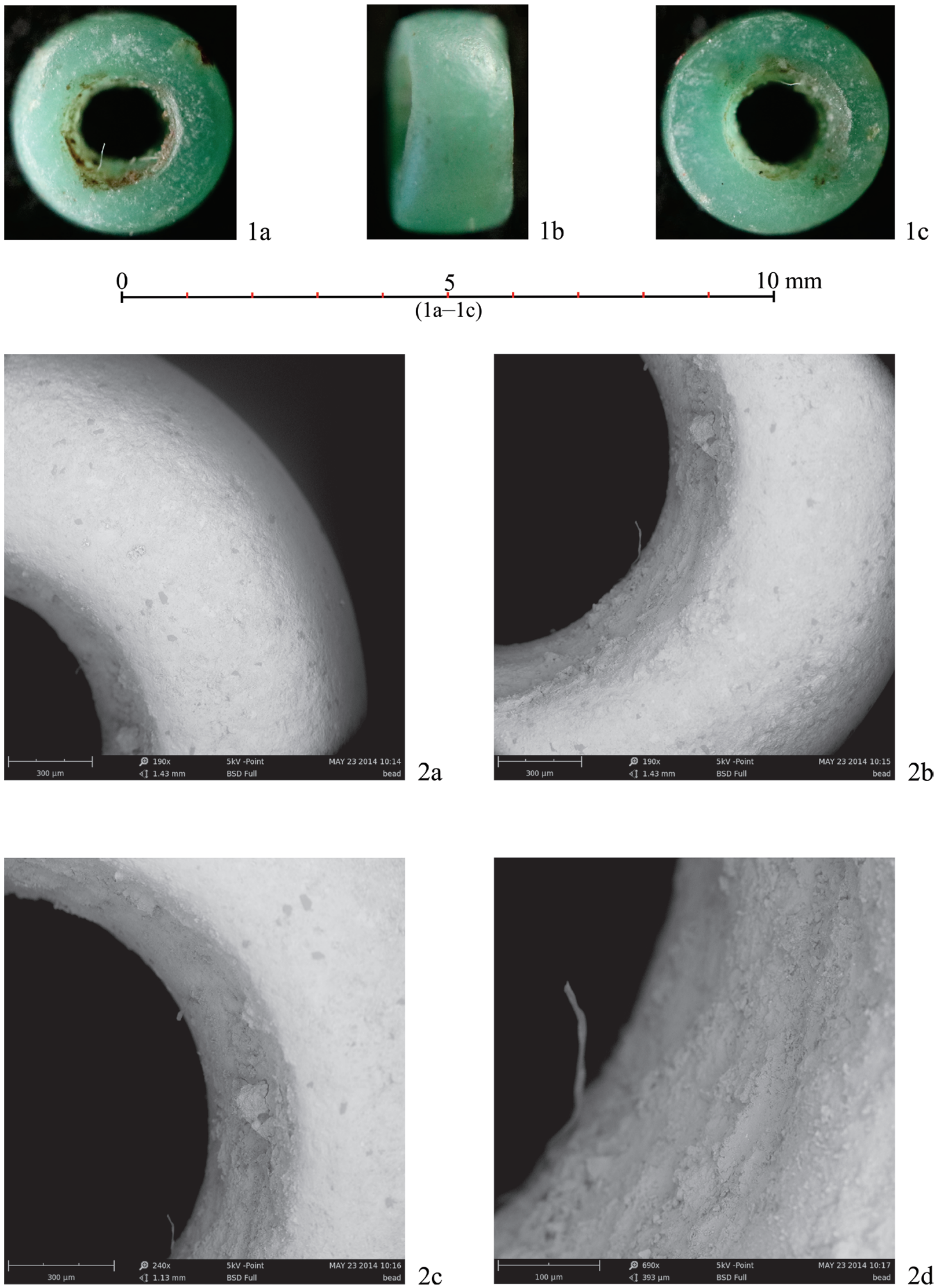
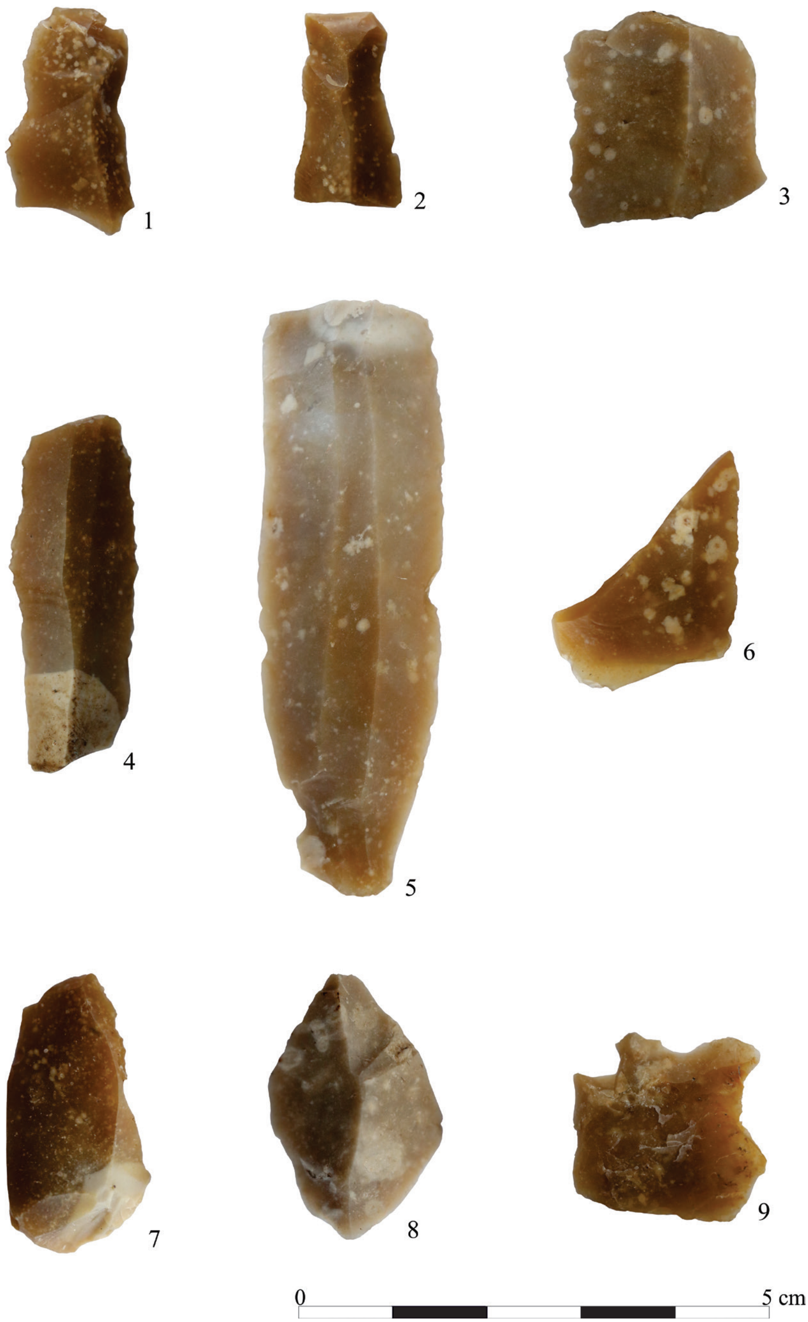
Pl. I. 1a–1b. The location of Lunca Târnavei village on the map of Romania and on a regional map (1b – processed from en.mapy.cz at 27.05.2021); 2. Drone photography with the *Ierdaş* site in the foreground; the locality of Lunca Târnavei is in the background. / 1a–1b. Localizarea satului Lunca Târnavei pe harta României si pe o hartă regională (1b – prelucrat din en.mapy.cz la 27.05.2021); 2. Fotografie cu drona a sitului *Ierdaş* în primul plan; în al doilea plan este localitatea Lunca Târnavei.

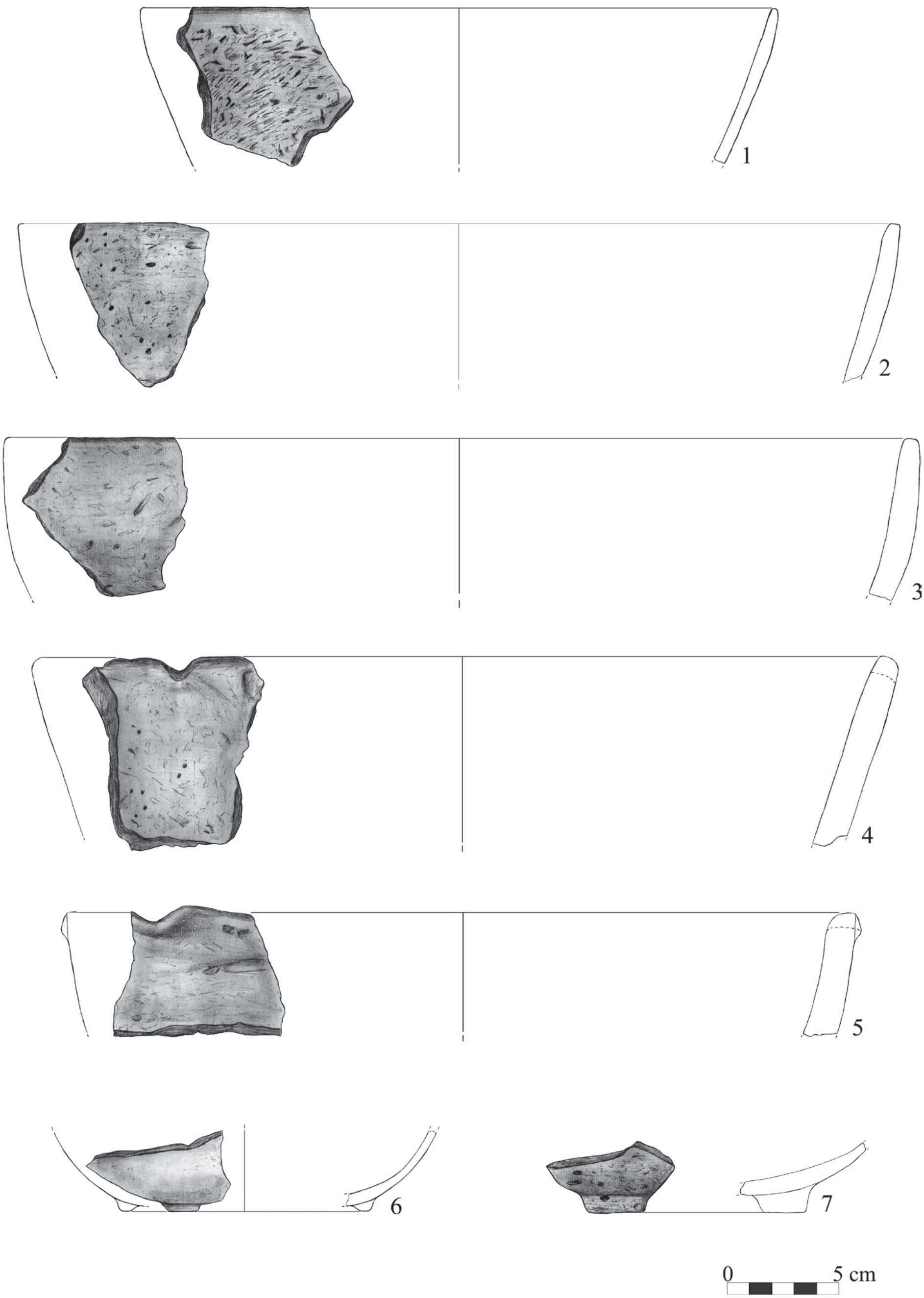


Pl. II. 1a–1c. Photos of the greenstone bead discovered at the Lunca Târnavei-*Ierdaş* site; 2a–2d. Details of the discoidal bead under the scanning electron microscope. / 1a–1c. Fotografii cu mărgica din piatră verzuie descoperită în situl Lunca Târnavei-*Ierdaş*; 2a–2d. Detalii cu mărgica discoidală la microscopul electronic cu baleiaj.

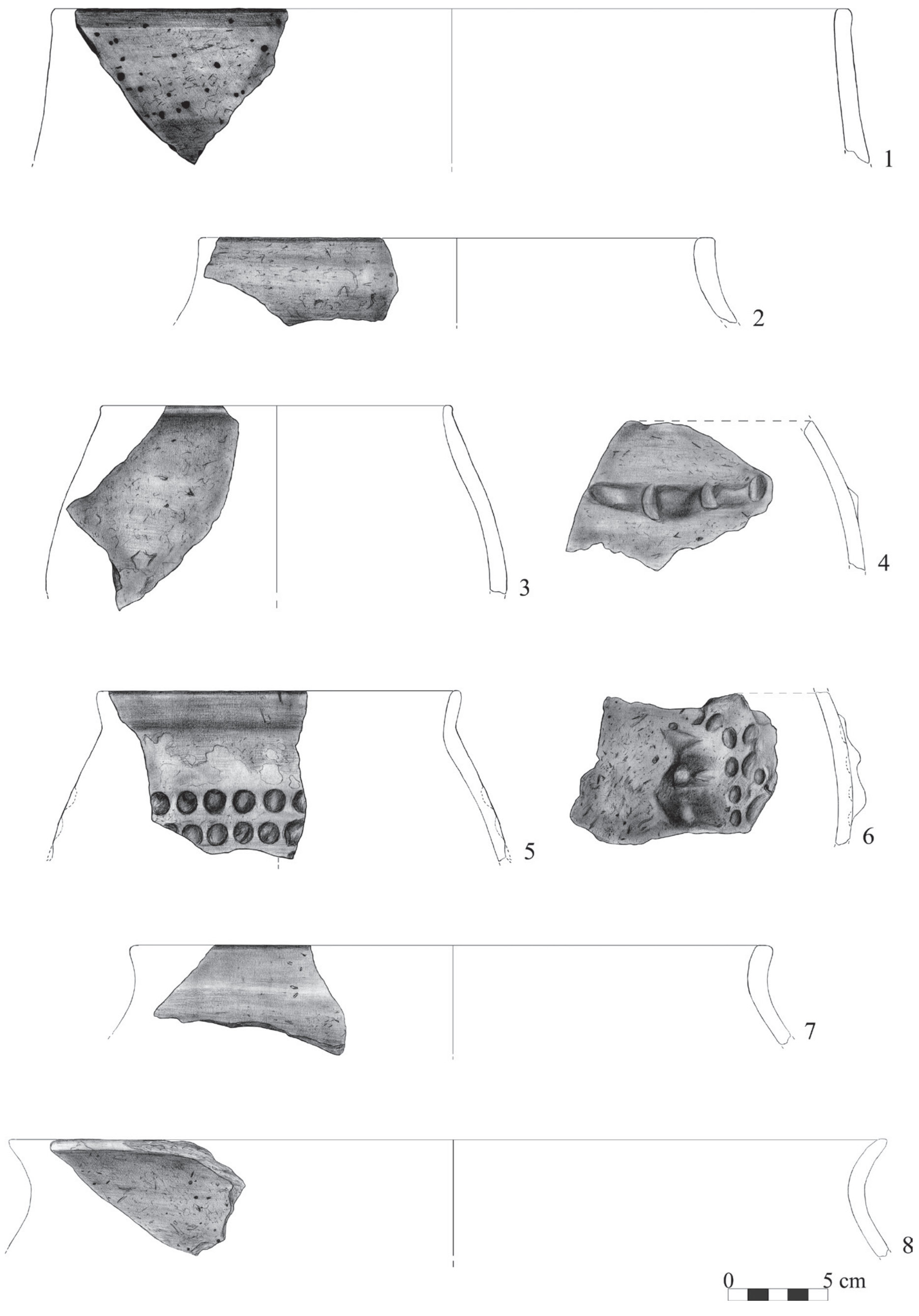
Pl. III. 1–2. Details with discoidal stone beads from Early Neolithic settlement of Gălăbnik, Bulgaria (processed from Gurova *et alii* 2013, 203, fig. 2); 3–12. Chert ("Balkan flint") knapped implements discovered in Early Neolithic sites from south-eastern Europe (processed from Gurova 2012, 34, fig. 11). / 1–2. Detalii cu mărgele discoidale din piatră din aşezarea neolitică timpurie de la Gălăbnik, Bulgaria (prelucrat din Gurova *et alii* 2013, 203, fig. 2); 3–12. Unelte cioplite din silicolit („silex Balcanic") descoperite în situri neolitice timpurii din sud-estul Europei (prelucrat din Gurova 2012, 34, fig. 11).



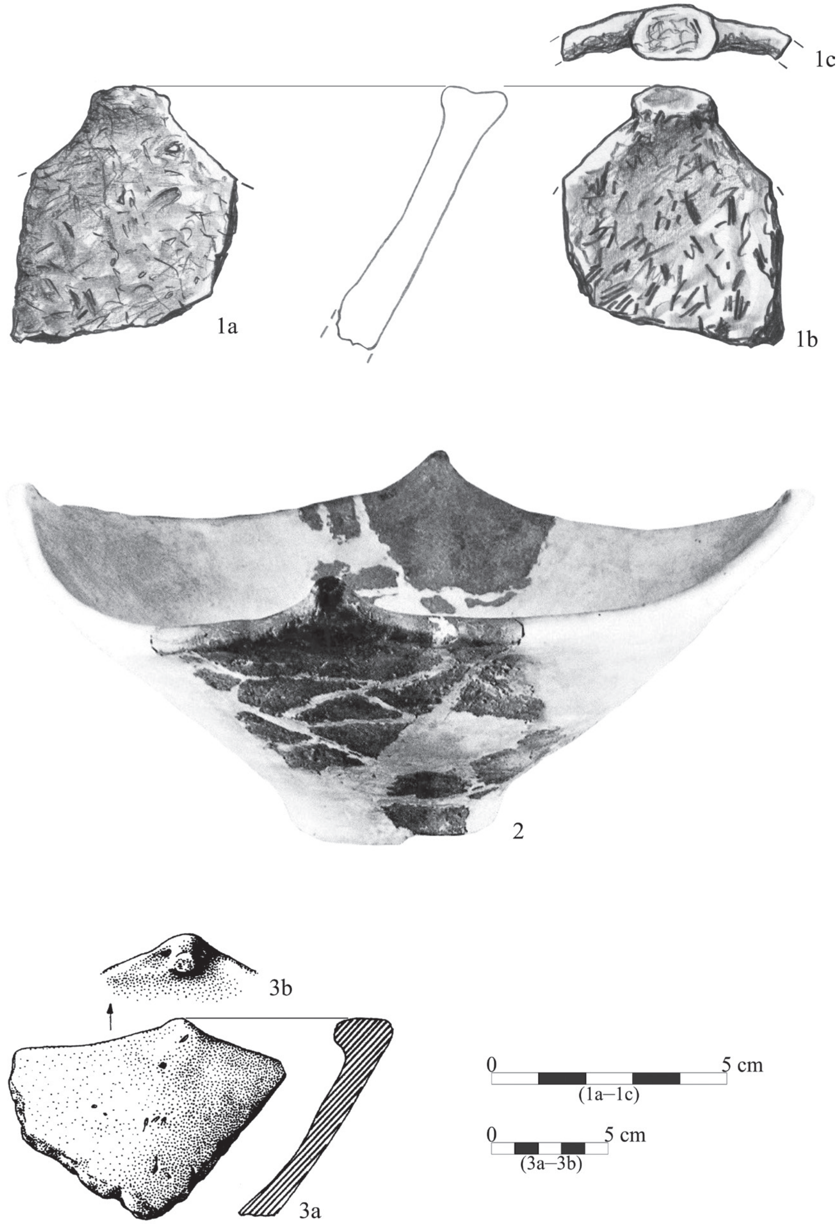
Pl. IV. 1–9. Chert ("Balkan flint") tools and flakes identified from the Lunca Târnavei-*Ierdaş* site. / 1–9. Unelte şi aşchii din silicolit („silex Balcanic") identificate în situl Lunca Târnavei-*Ierdaş*.



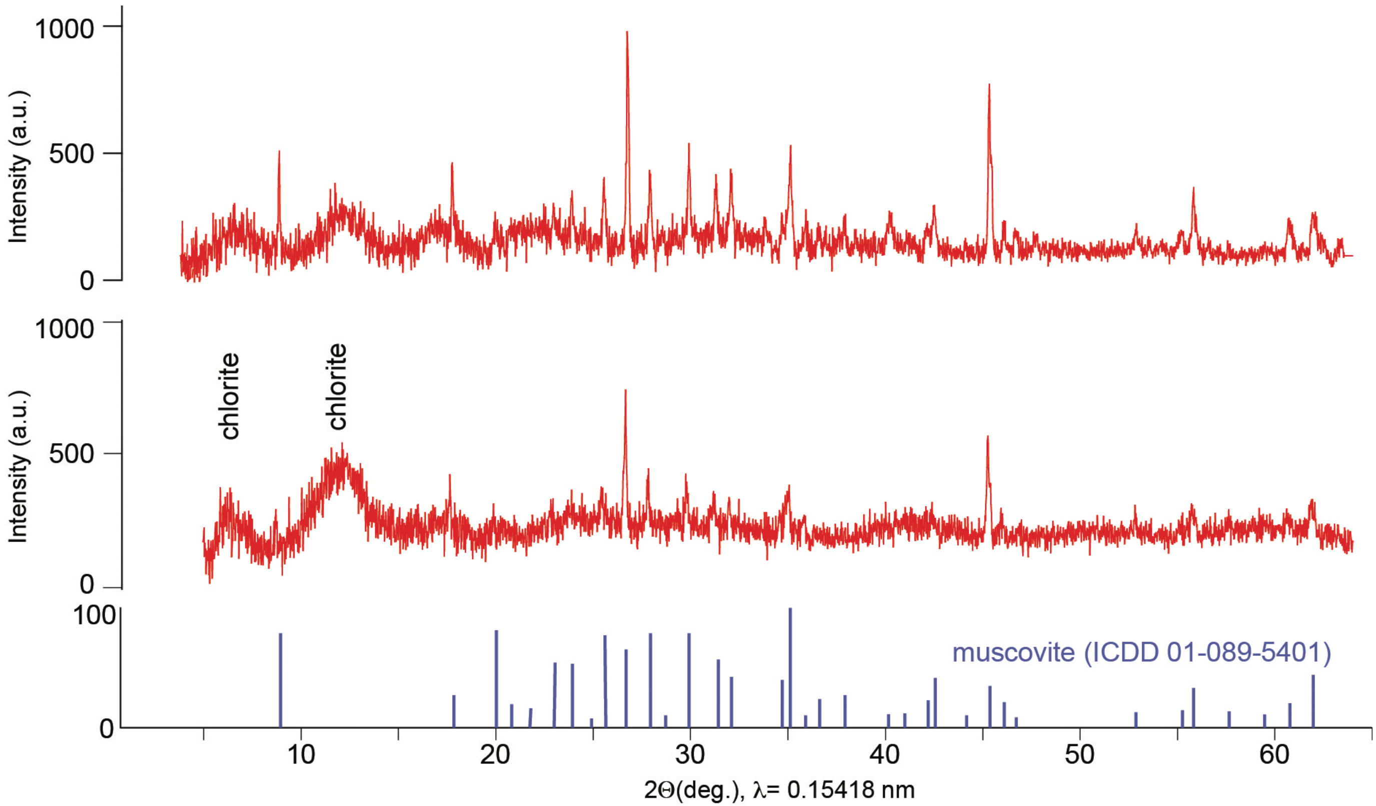
Pl. V. 1–7. Pottery fragments discovered at Lunca Târnavei-*Ierdaş* in feature Cx. 1. / 1–7. Fragmente ceramice descoperite la Lunca Târnavei-*Ierdaş* în complexul Cx. 1.



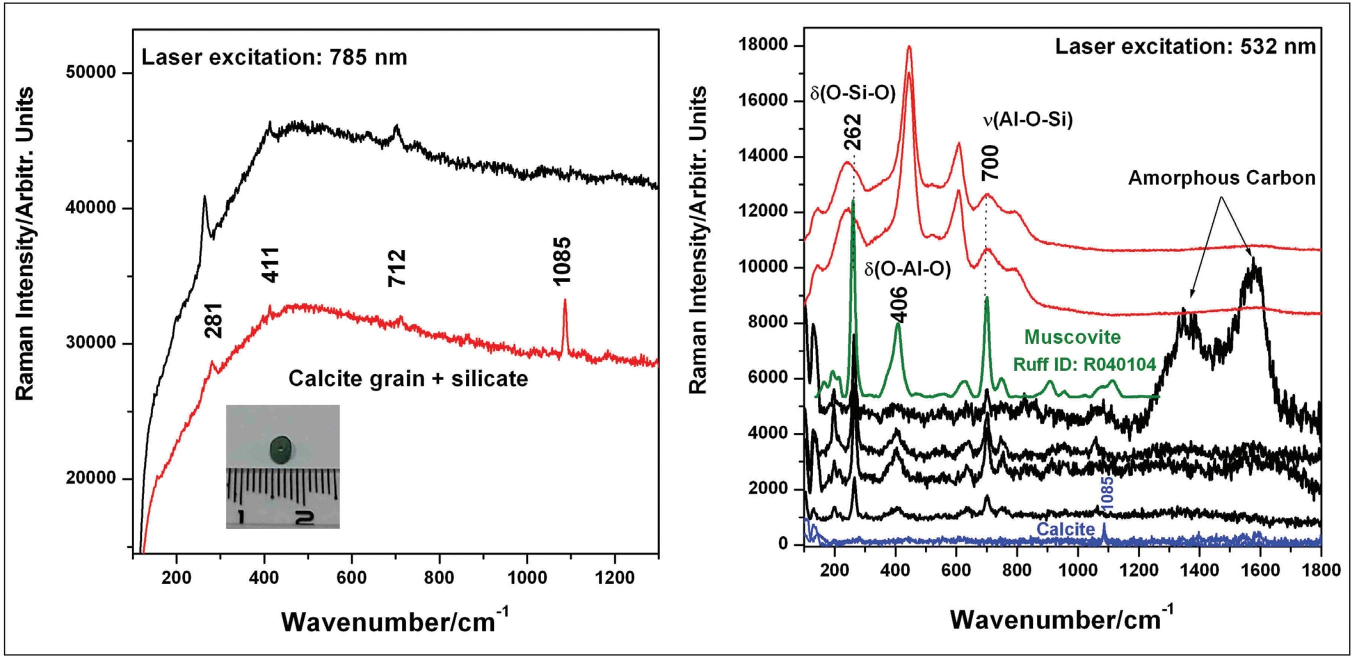
Pl. VI. 1–8. Pottery fragments discovered at Lunca Târnavei-*Ierdaş* in feature Cx. 1. /
1–8. Fragmente ceramice descoperite la Lunca Târnavei-*Ierdaş* în complexul Cx. 1.



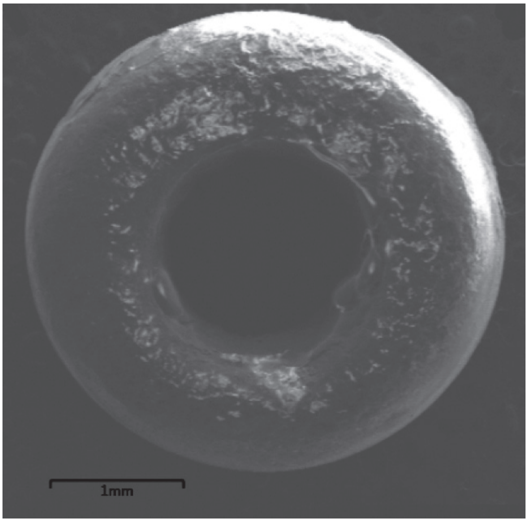
Pl. VII. 1–3. Lobed ceramic vessels and bowl from Early Neolithic sites of Lunca Târnavei-*Ierdaş* (1a–1c), Padina (2 – processed from Jovanović 1987, 11, Abb. 11; without scale) and Gyálarét-Szilágyi-major (3a–3b – processed from Trogmayer 2004, 18, fig. 5/1). / 1–3. Vase ceramice cu lobi din siturile neolitice timpurii de la Lunca Târnavei-*Ierdaş* (1a–1c), Padina (2 – prelucrare din Jovanović 1987, 11, Abb. 11; fără scară) and Gyálarét-Szilágyi-major (3a–3b – prelucrare din Trogmayer 2004, 18, fig. 5/1).



Pl. VIII. X-ray diffraction patterns acquired from the two round surfaces of the bead compared with the main reflections of a muscovite pattern (ICDD 01-089–5401). The two broad reflections at ~ 6° and 12° 2θ were tentatively ascribed to chlorite (clinochlore). / Difractograme de raze X obţinute pe cele două suprafeţe rotunjite ale mărgelei, comparate cu reflexiile principale ale muscovitului (ICDD 01-089–5401). Cele două reflexii largi de la ~ 6° şi 12° 2θ au fost atribuite cloritului (clinoclor).



Pl. IX. Micro-Raman spectra recorded from various bead points using two laser beams for excitation, 785 nm (left) and 532 nm (right). The left panel shows typical Raman bands of calcite (1085, 712, 281 cm^{-1}) and silica (411 cm^{-1}) on a substantial fluorescence background; the right panel shows the characteristic Raman signal of muscovite (black spectra), clinochlore (red spectra) and traces of calcite (blue). The RRUFF reference spectrum of muscovite (RRUFF ID: R040108) is given for comparison. The characteristic O-Si-O and Al-O-Si bonds from the mineral composition are plotted. / Spectre micro-Raman obţinute în diferite puncte ale mărgelei folosind două linii laser pentru excitare: 785 nm (stânga) şi 532 nm (dreapta). Stânga: benzile tipice pentru calcit (1085, 712, 281 cm^{-1}) şi silice (411 cm^{-1}) pe zgomot de fond cu fluorescenţă ridicată; dreapta: semnalul Raman caracteristic pentru muscovit (negru), clinoclor (roşu) şi urme de calcit (albastru), comparate cu spectrul de referinţă al muscovitului (RRUFF ID: R040108). Sunt indicate legăturile caracteristice O-Si-O şi Al-O-Si.



Pl. X. SEM image (Hitachi SU–8230) of the bead. /
Imagine SEM (Hitachi SU–8230) a mărgelei.

element/ sample	1	2	3	4	5	6
Si	25.47	25.29	28.32	24.49	25.38	19.1
Al	18	18.36	14.23	19.15	16.82	13.5
O	47.67	47.59	48.26	47.24	46.99	57.3
K	7.22	6.97	6.97	7.8	7.3	2.7
Fe	0.7	0.7	1	0.49	1.6	2.8
Na	0.52	0.67	0.74	0.59	0.59	1.4
Mg	0.42	0.42	0.48	0.24	1.32	2.2

Pl. XI. Chemical composition (%) determined by energy dispersive spectroscopy (EDS) on various spots on the bead surface. / Compoziția chimică determinată prin microanaliză de raze X în diferite puncte de la suprafața mărgelei.