A preliminary report on newly discovered fluvial vessels from Kostolac, Serbia

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Abstract: The paper presents the results of a preliminary study of a group of four fluvial vessels recently discovered in the vicinity of Kostolac (NE Serbia), dated between the Late Iron Age and the Late Medieval Period. The remains of four vessels were discovered in March 2020 during regular mining activity at the "Drmno" strip coal mine, at four kilometers' distance from the contemporary course of the Danube. Four different vessels were identified among the wooden remains, well preserved under six meters of clay-like sediment: two dugouts, a single plank belonging to a flat-bottomed vessel, and a well-preserved flat-bottomed planked barge. While focusing on the architectural characteristics and nautical capabilities of the discovered vessels, this paper will also present preliminary conclusions on the context of their discovery concerning the archaeological topography of the region.

Keywords: Kostolac, Danube, Mlava River, fluvial vessels, Serbia

1. Geographical and historical context

The municipality of Kostolac is located in northeast Serbia, approximately 90 km east of the capital city of Belgrade (Fig. 1). It is situated in the northern Stig micro-region, which represents a vast and fertile plain, bordered by the Danube River on the north. Besides the Danube, the Mlava River is the main watercourse in the area (Filipović, Mladenović 2019: 12).

First traces of human presence in the region date back to the late Neolithic period, ca. 5000 BCE. The continuity of inhabitation is attested in the later Copper, Bronze, and Iron ages (Đokić, Jacanović 1992: 68). During the 1st millennium BCE, the area was settled by the Thracian tribe of Triballi, replaced by the Celtic population, which was dominant in the area prior to the Roman invasion (Spasić-Đurić 2015: 17–22; Jovanović 2018, 11–12). Romans built a legionary camp and a civil settlement of Viminacium at the confluence of Mlava and Danube, which gradually gained on importance and became an administrative center of the province of Upper Moesia (Spasić-Đurić 2015; Korać 2019).

From the 4th century CE, the border of the Empire on the Danube is under constant threat from 'barbarian' peoples, culminating with the Hunnic invasion and the destruction of Viminacium. The aftermath of this event saw the activities of various Germanic tribes in the area. The Byzantines claimed this area towards the end of the 5th century, and, due to the war efforts in the other parts of the Empire, Germanic populations were hired to defend the border. At the beginning of the 7th century, the Byzantine rule was crushed by Avar and Slavic attacks. The latter sought to settle in the areas south of the Danube (Stojić 2022: 430–437). During the times of the Middle Ages, the northern Stig area was under the dominion of Bulgarian, Byzantine, and Hungarian states, ultimately becoming part of Serbia at the end of the 13th century, which established its northern border on the Danube River (Stojić 2022: 437–442). Serbian medieval state was crushed under Ottoman attacks during the middle of the 15th century and remained part of their Empire until liberation in the 19th century.

2. Discovery

The recent discovery of fluvial vessels near Kostolac took place during salvage excavations of the site called Rit, endangered by the expansion of the "Drmno" strip coal mine.[1] The site itself is located around 5 km northeast of Kostolac.

[1] The archaeological excavations were conducted by the Institute of Archaeology in Belgrade under the supervision of M. Korać, Ph.D. Members of the crew that undertook the works were Bebina Milovanović, Ilija Danković, Goran Stojić, Mladen Jovičić, Ljubomir Jevtović, Snežana Nikolić, Nemanja Mrđić, Ivan Bogdanović and Igor Milošević.

It encompasses a broad area between the old riverbed of the Mlava River and the drained bed of Dunavac, the latter being one of the Danube's branches (Fig. 1). Rit, meaning *swamp* in Serbian, owes its name to the circumstance that until the middle of the 20th century this area was covered by marshes (Đokić, Jacanović 1992: 73). Earlier excavations led to a conclusion that, after various phases of inhabitation of this territory in earlier periods, swamps were formed during the 4th century CE (Danković, Petaković 2014: 60–63).

Fig. 1 Location of discovered vessels (map: Documentation Center Viminacium)

The first archaeological digs in Rit were carried out in 2004 (Mikić *et al.* 2006: 21–26), and from 2012 onwards large-scale salvage excavations are being conducted, which helped in reconstructing human activities ranging from metal ages (Bulatović *et al.* 2019b: 26, 30; Bulatović *et al.* 2019a: 58) until medieval times (Milovanović *et al.* 2018: 50-51). Needless to say, remains dated back to the Roman period are the most numerous, and they include four villas, a textile workshop, several cemeteries, clay and sand pits, water wells, and drainage ditches (Redžić, Jovičić, Danković 2014: 66–69; Danković, Petaković 2014: 60–63; Redžić *et al.* 2017: 77–86; Milovanović *et al.* 2017: 71–76; Milovanović *et al.* 2018: 43–53; Milovanović *et al.* 2019: 97–108; Milovanović *et al.* 2021: 101–114).

In early 2020, the giant bucket-wheel excavator came across remains of wooden vessels on several occasions, at depths greater than 6 m. A total of four vessels were discovered, denominated as Viminacium 1 to 4, each of them dated to a different period spanning from the 2nd century BCE to the 17th century CE. These include two dugouts, well-preserved remains of a flat-bottomed planked boat, and three planks associated with another boat. Each of the vessels will be discussed in chronological order, from the most ancient to the most recent.

2.1. Viminacium 3

The oldest of the four vessels was discovered during the inspection of the profile of the coal mine during excavations of the Viminacium 2 ship. It was positioned 10 m beneath the ground level, on a layer of sand and fine gravel. The vessel was damaged by the bucket-wheel excavator that broke off one extremity and moved it several meters from the rest of the boat.

Fig. 2 Remains of Viminacium 3 vessel (photo: Documentation Center Viminacium)

Viminacium 3 is a dugout boat dated between the 2nd century BCE and 1st century CE.[2] It is an elongated and straight dugout with parallel sides (Fig. 2), just under 8 m long, 70 cm wide, and 40 cm deep. It has no bulkheads, while its extremity has been pierced with a horizontal rectangular orifice (Fig. 3). The dating of this vessel is most puzzling, and further research is needed to understand whether it belongs to pre-Roman communities or the earliest phase of Roman presence in the area. In the vicinity of the vessel, several shards of Roman pottery vessels, as well as one intact pot, were discovered.

Fig. 3 Piercing on the extremity of Viminacium 3 vessel (photo: Documentation Center Viminacium)

[2] The AMS analysis was conducted by the Isotoptech Laboratory in Debrecen, and the lab-code of the sample is DeA- 27284 (BP 2047±23; cal. BCE 150–cal. CE 24).

2.2. Viminacium 1

The first of the vessels to be discovered is another dugout, damaged and dislocated by the excavator, which resulted in the preservation of two pieces (Fig. 4). According to the employee that was operating the excavator at the moment of the discovery, these remains were located at a depth of approximately 9 m, in the layer of light gray clay mixed with fine yellow sand and thick stratum of gravel under the vessel. Such circumstances point to the conclusion that the boat was resting on the bottom of a riverbed.

Fig. 4 Remains of Viminacium 1 vessel (photo: Documentation Center Viminacium)

Viminacium 1 is dated between the 7th and the 9th centuries CE.[3] Two preserved pieces measure to a total of 7.20 m in length. The width of the vessel is 50 cm and the height is 70 cm. The internal depth is 35 cm.

Two conserved bulkheads were documented within the hull, as well as some interesting elements towards the preserved extremity of the boat. One of these is a semi-circular carved recess that might have served as a bench, while some 40 cm from the extremity, a rectangular recess has been carved into the upper face along the full width, decorated with three carved radial notches. This recess might have held an outrigger for additional stability, or a steering oar.

2.3. Viminacium 4

Viminacium 4 refers to a group of five planks that most likely made up a part of a planked boat (Fig. 5), dated between the 8th and the 10th centuries CE.[4] Once again, remains were discovered resting on a layer of sand and fine gravel.

Several rectangular metal clamps are associated with one of the planks, driven into its edge. Morphologically, these clamps can be brought into connection with those used for attaching the planks of four Roman-era boats discovered within the Danube hydrographical basin,[5] although being chronologically apart from them by several centuries. Whether this speaks in favor of the continuation of this attachment technique into the Middle Ages is not yet possible to determine, based on such a small sample.

[3] The AMS analysis was conducted by the Isotoptech Laboratory in Debrecen, and the lab-code of the sample is DeA- 28923 (BP 1249±18; cal. CE 678–871).

[4] The AMS analysis was conducted by the Isotoptech Laboratory in Debrecen, and the lab-code of the sample is DeA- 28924 (BP 1143±17; cal. CE 775–977).

[5] Sinja Gorica from the Ljubljanic River, Slovenia (Erič *et al.* 2014); Kamensko from Kupa River, Croatia (Boetto *et al.* 2021); Sisak from Kupa River, Croatia (Gaspari *et al.* 2006); Kušjak from the Danube, Serbia (Bockius 2003).

Fig. 5 Remains of Viminacium 4 vessel (photo: Documentation Center Viminacium)

2.4. Viminacium 2

The last of the four discoveries is represented by well-preserved remains of a flat-bottomed fluvial vessel (Fig. 6), dated between the 14th and the 17th centuries CE.[6] The bucket-wheel excavator obliterated a large portion of what seems to have been an entirely preserved ship, located 6 m beneath the surface level. The bottom of the ship was situated in a layer of sand and fine gravel, in which shells of river shells and snails were present. Apparently, it is the bottom of the same body of water in which the other Viminacium vessels had sunk. The ship itself was surrounded by a layer of clay, intersected with thin layers of organic matter (peat?), which indicates that at some point the river ceased to flow, i.e., the ground became swampy.

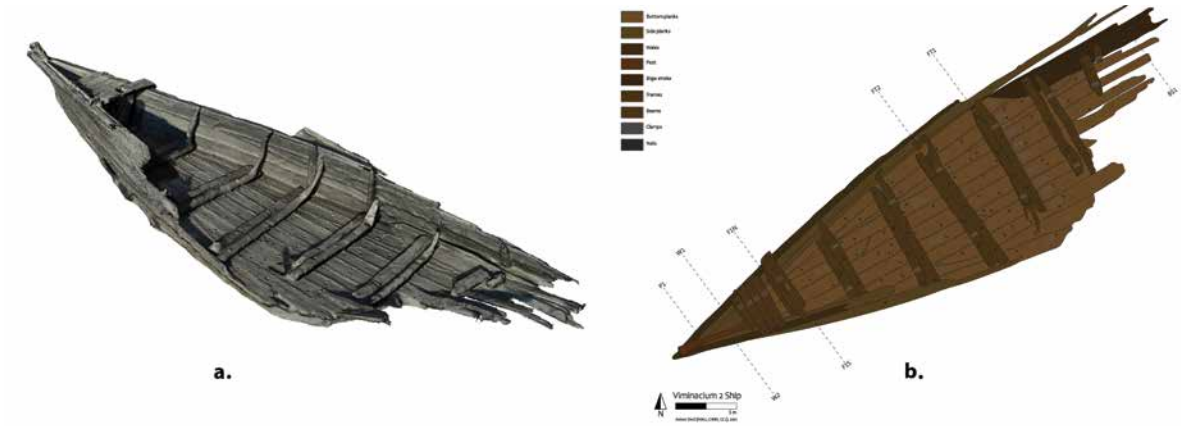

Fig. 6 a) Photogrammetric model of Viminacium 2 vessel (model: Documentation Center Viminacium), b) Plan of the Viminacium 2 vessel (drawing: A. Divić)

[6] The AMS analysis was conducted by the Isotoptech Laboratory in Debrecen, and the lab-codes of the samples are: 1. DeA- 27281 (BP 349**±23; cal.** CE 1471–1635); 2. DeA- 27282 (BP 603**±**22; cal. CE 1303–1403); 3. DeA- 27283 (BP 565±23; cal. CE 1321–1422).

Viminacium 2 is broken approximately amidships, with one longitudinal half of the entire vessel remaining preserved, although it is difficult to determine whether it is the aft or forward one. The discovered remains are 10 m long and 2.80 m wide, while the preserved depth of 0.82 m corresponds to the ship's original maximum draft, as it remained conserved up to the sheer strake.

Wooden architectural elements of the vessel can be divided into longitudinal and transversal ones, held together by the assembly elements. Longitudinal elements include bottom planks, side planks, wales, bilge strake, and a post. Transversal elements are frames, deck planks, and a beam, while the attachment has been achieved with iron nails.

A total of 15 planks that make up the flat bottom of the barge remain conserved. They are up to 20 cm wide and up to 5 cm thick. In three instances two planks have been joined into a single strake by an oblique scarf, while several stealers running towards the extremity can be observed as well. These planks were edge-fastened together by iron nails horizontally driven from the inside of the hull every 37 to 52 cm through triangular notches carved in the upper surface of the planks.

The steep, vertical sides were made up of side planks. The northern flank of the shipwreck, which remained far better preserved than its southern counterpart (the first one being 10 m long, and the latter 5.1 m long), is made up of eight side planks that constitute four strakes. They are of similar dimensions as the bottom planks, up to 23 cm wide and 5 cm thick. They were also attached by iron nails, although driven downwards from the outside of the hull.

The transition between the flat bottom and vertical sides was achieved in two ways. Towards the preserved extremity, side planks were posed directly on the bottom planks, to which they were attached by iron nails driven downwards from the outside of the hull. Amidships, however, adjacent to the northern flank, an element identified as a carved-out bilge strake was observed. This carved-out, monoxyle element served to achieve the transition between the bottom and the sides. It was connected to its associated strake by an oblique scarf and edge-fastened to its adjacent bottom planks by iron nails driven through the upper surface of the bottom plank into the edge of the bilge strake.

Another longitudinal component of the barge were the two wales, attached to the exterior of the sheer strakes. These two elements, 10 cm sided and moulded, provided the barge with additional longitudinal sturdiness, at the same time possibly protecting the hull from any outside damage.

The extremity of the vessel was made out of a post to which the bottom and the side planks were attached by iron nails. It is a monoxyle element, carved from a single piece of timber, flat at its base with a rectangular post rising from it at a 45° angle. Its flat base was attached to the adjacent bottom planks, while the rectangular post presents a carved rabbet in which the side planks were inserted.

Transversal stiffness of the barge was achieved by the insertion of frames, seven of which remained partially or fully conserved, their room-and-space amounting from 60 to 85 cm. They were made out of paired knees settled side by side that had been carved out of tree trunks with integrated branches. The horizontal part of each knee transverses the bottom in full width, while the integrated vertical elements are attached to the flanks in an alternating fashion. In some instances, the insertion of futtocks nailed to the flanks was documented as well. Attachment of frames to the planking was achieved by iron nails, three to six nails per knee, driven from the inside and clenched on the outside of the hull.

About 2 meters from the ship's extremity, a horizontal transversal beam was installed to the sheer strakes and the wales. This roughly rectangular element presents an unusual shape, with one of its short sides cut in an oblique angle and the opposite side irregularly carved. The oblique side of the beam was attached to the wale by three iron nails, while the opposite, carved, side does not seem to present any attachments at all. Approximately in its center, a recess, 15 cm long and 11 cm wide, has been carved through the beam.

The proximity of the beam to the extremity and the lack of mast step do not speak in favor of it serving as a support for a mast. It seems more likely it might be an element connected to the use of the ship's rudder, which might have been handled from the deck platform. Between the beam and the extremity, a small deck made out of four deck planks, 1 m wide and 60 cm long, has been installed and nailed to the wales. This interpretation would identify the preserved extremity of the ship as the stern.

Water-tightness of the ship was achieved by the insertion of organic material in the seams between the planks. It seems most likely that this was done by moss, but the ongoing analyses will give the decisive determination. A lath, made out of small branches, or possibly canes, was placed over the seams and the water-tightness material, and both were secured in place by numerous semicircular, crescent-shaped iron sintels driven across the seams every 2 to 6 cm. The function of these sintels, driven only on the inside of the hull, was to keep the water-tightness material in place.

We can conclude that Viminacium 2 was a fluvial flat-bottomed ship that was between 18 and 28 m long. It is a good example of the bottom-based shipbuilding construction concept, where the flat bottom of the ship was the first element to be conceived and constructed, subsequently determining the size and shape of the vessel (Pomey, Rieth 2005: 33). Due to the combination of planked and monoxyle elements, its structure can be considered as monoxyle – assembled (Rieth 1998: 74–76).

Underneath deck planks, a fragment of a brick was discovered, which represents the only surviving piece of cargo/inventory. Off course, there is a possibility that this fragment was deposited by currents and erosive processes. In the layers of clay, directly above the extremity of the ship, a shard of a Roman amphora was unearthed, while there were several more pieces of pottery and glass vessels on the riverbed itself.

3. Concluding remarks

Remains of the vessels discovered near Kostolac have been relocated to the Viminacium Archaeological Park (Fig. 7), where they are currently undergoing the process of conservation. Simultaneously, an outline for further research is being developed.

One of the important goals is to determine the waterway network in this part of the Danube basin and how it changed in different periods. There is no obvious logic to the spatial distribution of the finds which would confirm one of the initial theories that the riverbed gradually moved towards current position, as the wreckage found furthest to the north is not the youngest.

Another important question to answer is whether these boats were found inside of the riverbed of some of the Danube's branches or if we are dealing with older beds of the Danube River itself before it moved to the north. Several canals can be observed in this area on satellite imagery, and it is possible that the river changed its course multiple times over such a large timespan.

Fig. 7 Extraction of the Viminacium 2 vessel from the coal mine (photo: Documentation Center Viminacium)

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