

# Interdisciplinary Research into Iron Metallurgy along the Drava River in Croatia – The TransFER Project

edited by

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# Preface

Tajana Sekelj Ivančan

Iron, as a material that our ancestors formed into objects and used in everyday life throughout many historical and archaeological periods, has always drawn attention, both from professional and scientific audiences as well as the broader public, not merely in our region, but across the entire European continent. Acquiring iron from naturally occurring iron ore is a demanding procedure that required a thorough knowledge of the entire process, from finding and collecting quality ore in nature, through construction of smelting furnaces, which could be of various types, to the process of smelting itself, whereby the half-finished product (iron bloom) was extracted at high temperatures. The procedure did not end at this phase, as there were still considerable impurities in the semi-finished product that had to be separated out in a further process of primary forging, after which the material was suitable for working and shaping by master blacksmiths. The extensive knowledge gained of all these stages was clearly transmitted from generation to generation, even though there were often secrets involved that would have been known only to experienced master smelters.

In the plains of the Drava River, threaded with meanders, some of these secrets of iron production were hidden from curious eyes. Only a few sporadic surface finds of tuyeres and pieces of smelting slag that were discovered thirty years ago at the site of Hlebine – Velike Hlebine, proved that iron ore had been processed in this area (Sekelj Ivančan 2001: 22, 101–102, Map 12, Fig. 48, 49). These initial finds led researchers to consider the origins of the raw material, in this case naturally occurring iron ore, as certain economic activities are not possible without the necessary resources, and the Drava River basin region had never been mentioned in the professional literature in the context of iron ore (Marković 2002). This was even more challenging when agricultural work was carried out at the site of Virje – Volaski breg in 2007, with heavy machinery and deep ploughing, and when large pieces of fired walls of furnaces and smelting slag appeared on the field surface, along with complete tuyeres (Sekelj Ivančan 2007), after which an intervention in the form of a rescue archaeological excavation was organized in the spring of 2008 (Sekelj Ivančan 2009). These investigations, during which paired early medieval smelting furnaces were discovered *in situ*, along with a circular pit with a fired base, and other workshop

elements, sparked further reflections on the presence of these economic activities in the Podravina region. After three years of excavations at this site, our state of knowledge expanded, having established that iron had also been produced here during the period of Late Antiquity (Sekelj Ivančan 2011; 2013). The situation was similar at nearby Sušine, where fresh surface finds resulted in new excavations in 2012. And in these three years of excavations, a large quantity of smelting waste was found from Late Antiquity, but also early medieval remains that indicated the intensive processing of iron ore and iron, over several archaeological periods, at this site – in the vicinity of Virje (Sekelj Ivančan 2013; 2014).

After that, non-invasive procedures were undertaken at selected positions, and geophysical investigations, first at Sušine and later at the site of Hlebine – Velike Hlebine, enabled the recognition of individual elements and structures beneath the ground surface (Mušič *et al.* 2013: Fig. 18; 2017: Fig. 8). For example, at Sušine places for smelting waste were identified, with all the recognizable sites of depositions of smelting waste, while at Velike Hlebine an entire smelting workshop was discovered with all its accompanying elements. This non-invasive investigation led to targeted archaeological excavations at selected sites which gave exceptional results, particularly in the case of the complete workshop at Velike Hlebine excavated in 2016 – 2017 (Sekelj Ivančan and Valent 2017; Sekelj Ivančan 2018a).

The presence of smelting furnaces at these three archaeological sites in the Drava River valley, as well as the results of all the archaeological investigations carried out until then, prompted an application for the funding of an interdisciplinary scientific research project, ‘The Production of Iron along the Drava River in Antiquity and the Middle Ages: the creation and transfer of knowledge, technology, and goods’, by the Croatian Science Foundation. The project, with the acronym TRANSFER, was carried out from 2017 – 2021 with the cooperation of several institutions and individuals: The Institute of Archaeology as the lead partner (Dr Tajana Sekelj Ivančan, Dr Tatjana Tkalčec, Dr Siniša Krznar, Dr Katarina Botić, doctoral candidate Tena Karavidović, the Koprivnica Town Museum (Dr Robert Čimin, doctoral candidate Ivan Valent), and the Zagreb City Museum (Aleksandra Bugar), and the Faculty of Mining, Geology, and Petroleum Engineering (Dr Sibila Borojević

Šoštarić, Dr Stanko Ružičić, doctoral candidate Tomislav Brenko) and the Faculty of Metallurgy of the University of Zagreb (Ladislav Lazić consultant), and also colleagues from Slovenia (Dr Branko Mušič, Dr Metka Culiberg, Ivan Marija Hrovatin), whose research results are presented in this publication. The project itself had three main goals: 1) to define the origin of the iron ore and the necessary resources (clay, water, wood); 2) to define the technology of processing the iron ore over time and the intensity of production; 3) to define the influence of the production of iron in the context of the socio-cultural environs and the interaction of people and goods.<sup>1</sup> To understand better the entire central lowland part of the Drava basin encompassed by the research, key preliminary investigations involved field survey and reambulation of the entire region – from the influx of the Mura River into the Drava to Slatina. For the recognition of those indicative archaeological sites where pre-industrial iron production took place, surface archaeological finds, gathered after agricultural work, are significant (broken slag, furnace walls, and nozzles), as was the case at the sites of Virje and Hlebine. Exceptional numbers of sites were noted during these activities having the same surface finds, indicating that this economic activity took place across the entire region under consideration. On the basis of these results and our knowledge of the large number of sites where iron ore was being smelted, the question of the origins of the raw material became even more pronounced.

The next step was soil sampling with a manual auger at hundreds of positions, with the aim of identifying the environment in which iron ore of the bog type had been formed, and which had been used as raw material in this area. The mineralogical and geochemical analyses undertaken indicated that the iron bog ore in this area can appear in three macromorphological types, which can at the same time be considered as the development stages of wetland iron ore, in the form of a) soft earthen accumulations of iron in a soil with a spongy texture; b) harden concretions and nodular forms; and c) massive stratified horizons (Brenko *et al.* 2020). All of these reflect a similar landscape: high groundwater and frequent flooding of the Drava and its tributaries and meanders, as well as the long retention of surface water, an environment that has existed over many centuries in the Podravina region. Additional consideration was given to the usage of other resources, such as the large quantities of wood required to make the charcoal needed to fire the furnaces at sufficient temperatures for the smelting process.

Several different types of furnaces were found in the archaeological excavations in Podravina. This gave rise to considerations about the varied technological

solutions utilized in the smelting of iron ore in various periods, or the different steps in processing the semi-finishing product. The technological process of smelting could have been carried out in slag-pit furnaces, or slag tapping furnaces, such as were found at the sites of Virje – Volaski breg and Sušine, as well as Hlebine – Velike Hlebine, while the further working of the acquired semi-finished product is eloquently shown by the furnaces from the site of Hlebine – Dedanovice (Sekelj Ivančan 2019a). The connection between the utilized iron ore of the bog type and the semi-finished or actual products is witnessed by the mineralogical and geochemical analyses performed.

To increase understanding of the smelting process and the primary working of iron, several partners on the TRANSFER project participated in workshops of experimental smelting and forging at Adamov in the Czech Republic and Somogyfajs in Hungary (Sekelj Ivančan 2018b; 2018c; Valent 2018; Karavidović 2020). These encouraged us to organize several of our own workshops in the framework of the Renaissance festival held in Koprivnica, the main city of the Podravina region. In addition to promoting the results of archaeological excavations in the area, and acquainting the general public with the acquisition and working of iron in these districts, the workshops also functioned as examples of experimental archaeology. The imitation of the presumed actions performed during the process of smelting and processing iron, followed by the stratigraphic excavations of the furnace remains, encouraged a better understanding and interpretation of the archaeological record.

Last, but not least, it should be pointed out that at all of the archaeological sites excavated until now, the remains have been found of dwelling structures and other settlement elements that accompanied and supported these production activities. The typological and chronological analyses of the discovered settlement finds, immovable and movable, often contemporary with elements related to the processing of iron ore and iron, and supported by radiocarbon dating, served to give a more precise chronological classification of the excavated parts of the settlements and workshops. According to our current knowledge it is possible therefore to trace the continuity of this economic activity in the Podravina region from the 4th/5th centuries (Virje – Sušine), through the 5th/6th centuries (Virje – Volarski breg), into the first half of the 7th century (Hlebine – Velike Hlebine; Hlebine – Dedanovice), and as far as the 8th and 9th centuries (Virje – Volarski breg; Virje -Sušine) (Sekelj Ivančan 2017a; 2017b; 2019b; Sekelj Ivančan and Tkalčec 2018). Zooarchaeological and archaeobotanical analyses were also performed on samples collected from the excavated structures and elements by external experts

<sup>1</sup> <http://transfer.iarh.hr>.

from the Veterinary Faculty (Dr Snježana Kužir) and the Faculty of Science, Department of Botany (Dr Renata Šoštarić) of the University of Zagreb, whose results of the investigations and interpretations supplemented both the settlement and workshop contexts of the sites.

It is our hope that the interdisciplinary research conducted within the framework of the TRANSFER project has illustrated all the stages involved in the processing of iron in the Podravina region across several archaeological and historical periods, and as well as significantly adding to our present knowledge has also revealed new insights hidden, perhaps, behind the iron objects that were used daily in this area in the pre-industrial periods.

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# Methodological Approach to Detecting Archaeological Sites with Metallurgical Activities on the Territory of the River Drava Basin and the Possibilities of Analysing the Collected Information

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**Abstract:** The first part of this chapter presents the results of field surveys conducted along the Drava River basin during the *TransFER* project, and the database of those archaeological sites with metallurgical activities created. The second part offers an analysis of the information collected – type and intensity of activities (smelting, smithing, etc.) throughout historical periods.

**Keywords:** Field survey, Drava River basin, database, smelting, smithing, Hallstatt, La Tène, Antiquity, Middle Ages

## Introduction

During the first year of the project one of the main objectives was to establish a database of archaeological sites containing finds connected to metallurgical activities (slag, furnace walls, tuyeres). The task consisted of analysing all currently known information and finds collected during previously conducted explorations, as well as the implementation of new surveys employing different methodological approaches.

The importance of establishing a database lies in three key factors. Firstly, recognizing the overall number of sites and connecting them with the specific types of metallurgical activity carried out at each of them. Data collected on the topography of the sites associated with smelting consequently enable one to understand the use of the primary resources involving this activity, which in turn assists in the fulfilment of the primary objective of the project (Sekelj Ivančan and Marković 2017; Karavidović 2020: 11–12). Secondly, the information contained in the database referring to the individual dating of the site, obtained by the preliminary attribution of any accompanying pieces of pottery, goes towards partially fulfilling the second goal of the project – definition of the historical periods in which metallurgical activities took place. On the other hand, the number of metallurgical finds at each site can be indicative of the intensity of the production, while their types determine the technology and/or category of activity, i.e. smelting, primary/secondary smithing. Finally, the construction of the database allows one to determine which sites will be additionally examined using non-invasive geophysical methods (Sekelj Ivančan and Mušič 2014; Mušič *et al.* 2017; 2019; 2020), the results of which, in the end, lead to the selection of sites to be excavated (Sekelj Ivančan and Karavidović, in this volume).

## Methodology

To construct a database, all the previously collected information on the topic has to be taken into

consideration. The next step refers to the analysis of the collected information and their arrangement in a way that suits the needs for which the database is formed; the database can then be expanded by the introduction of new data. The following paragraphs describe the different methods of approach used to establish and implement the database on archaeological sites during the course of the project (Table 1).

## Reconnaissance

As an introduction to the construction of the database of archaeological sites containing evidence of metallurgical activities within the territory of the Drava basin, Podravina, all the previously collected material from field surveys, and/or any systematic, preventive, pilot archaeological excavations has been examined, i.e. all the material now stored within the Koprivnica Town Museum archaeological collection, the Zvijerac family archaeological collection in Torčec (AZoZ), and the Josip Cugovčan archaeological collection in Podravske Sesvete. The aim of this task was to single out all the sites containing finds connected to metallurgy (slag, tuyeres, furnace walls). All the published data for these sites were also examined.

The collected information served as a starting point for surveys of the selected sites, which were undertaken during the early spring of 2017. At the same time, based on the analysis of the information collected during reviews, new field surveys were undertaken on positions whose topography resembled the topography of the sites at which traces of smelting activities were previously recognized. The results of the surveys were presented within an extensive report which contained basic information on each site: position, topography, type of finds, dating, bibliography, additional information, images of site and collected material (Valent 2018a). Parts of the report were additionally published as separate articles (Valent 2018b; Valent *et al.* 2017; 2018). New surveys were undertaken in 2018 (Valent 2019a; Valent *et al.* 2019: 16–24) and over the next





Figure 1. Aerial image of the Kalinovac–Vuglenice I site: A) Elevated position with surface finds of ceramic sherds from Prehistory to the Modern period, and smelting/smithy slag; B) Surface finds of Roman pottery; C) Elevated position with surface finds of crushed stone; D, E) Elevated positions – potential archaeological sites (made by: Tatjana Tkalc̃ec; Google Earth image, <http://earth.google.com>, accessed June 2021).

two years of the project.<sup>1</sup> These two types of approach present the first method which was implemented during the conducted surveys.

### Field surveys based on aerial photography

The second method applied was the remote interpretation of aerial photography (Tkalc̃ec 2017). The aim here was to determine whether, and if so, to what extent the preindustrial processing of iron, preserved only within an archaeological context, can be positively manifested on aerial images. Furthermore, the idea was to establish whether there are some recognisable markers in aerial photography which might point to the existence of smelting activities on a certain position and be differentiated from general markers of habitation (Valent *et al.* 2019: 6). To test this theory, the surroundings of the excavated site Hlebine–Velike Hlebine (Sekelj Ivančan and Valent 2017; Sekelj Ivančan 2018) was taken as a model (Tkalc̃ec 2017: 4, Fig. 1). Through the examination of available sources,<sup>2</sup> nine positions in the vicinity of the villages of Delovi, Jeduševac, Vlaislav, Srdinac, and Plavštinac were singled out, based on similar indicative manifestations of the below-surface appearances, previously recognised on the site model. Seven of these locations were then thoroughly examined in the Autumn of 2017 to test

the given hypothesis (Valent *et al.* 2018: 146; 2019: 6). Unfortunately, the method proved to be inefficient. Even though new archaeological sites were discovered on newly examined areas, no archaeological sites containing indicative surface finds connected to smelting activities have so far been discovered (Valent *et al.* 2018: 146; 2019: 23).

However, some sites with metallurgical activities were identified from the aerial images, but only after reconnaissance. After the existence of surface finds has been established, prominent elevations in the lowland area have been identified at certain locations which were used for settlement and sometimes for metallurgical activities as well. For example, at the Kalinovac–Vuglenice I site, surface finds of fragments of pottery from the Neolithic, Late Bronze Age, Early and High Middle Ages and Modern periods, and, indicatively, fragments of smelting and smithing slag, were collected at slightly elevated position (Figure 1: A). Several fragments of Roman pottery were also found, c. 140 m to the southeast (Figure 1: B). At the elevated position 250 m to the northeast, a larger amount of crushed stone was also recorded, which is not present in the surrounding terrain (Figure 1: C). Traces of mortar/plaster are visible on some pieces (Krznar 2017: 10–11, Fig. 13). The other more remote elevated positions (Figure 1: D, E), which show on the aerial images as lighter spots, as well as the positions A and C, have unfortunately not been available for field

<sup>1</sup> The results of the 2019 and 2020 surveys have not yet been published. They are presented here in the Table 1.

<sup>2</sup> Geoportal, ARKOD, Google Earth, Military survey conducted prior to 15 February 1968.



survey but they represent potential archaeological sites as well.

Unfortunately, a review of the infrared images also gave us relatively poor results. Near InfraRed (NIR) images of the State Geodetic Administration from 2011 and 2015 were procured for the entire observed area of the Drava basin. Although the use of infrared images of the surface has an increasingly important role in the remote sensing of archaeological sites, in this case an attempt to identify sites with metallurgical activities on the images available to us produced only one positive result, at the site of Kalinovac–Hrastova greda 1. Even then, the site was recognized retroactively, only after reconnaissance. Surface finds of pottery fragments from the Early and High Middle Ages, as well as fragments of smelting slag, found on a sandy tump (Valent *et al.* 2017: 17–18) (Figure 2), were confirmed by geophysical research (Mušič *et al.* 2019) as well as recent archaeological excavation (Sekelj Ivančan 2020).

### Field surveys based on indicative toponyms

Conducting field surveys based on indicative cartographic toponyms is a well-established method for detecting archaeological sites. Based on current experience within the territory of the Drava basin, this is most applicable for the High and Late Medieval periods in terms of recognising positions of settlements and cemeteries. In some cases, it is quite easy to recognise the position of the site, as the toponym in question directly describes the type of site (castle/motte/fortification = *grad/gradište/gradina*; rural settlement = *selište*; cemetery = *groblje*). Some are hidden behind local names associated with the site type (*cirkvišće* = position of a ruined church; *gradišće* = position of ruined fortification), while some, on the other hand, are hidden behind ‘foreign’ names of the site type (*klisa* = *tur. Kilise* = church). To test whether the same method can be applied to recognising sites associated with metallurgical activities, it was first necessary to examine all the available cartographic sources<sup>3</sup> and compile a list of toponyms that might be associated with different metallurgical processes (smelting, smithing), or resources used during such processes in the Drava basin (bog iron ore, wood/charcoal) (Krznar 2018). The preliminary examination of toponyms, which was conducted in three counties within the region,<sup>4</sup> uncovered 29 toponyms associated with metallurgical activities. Only seven positions, situated in the lowland area, were selected for detailed survey, as most are positioned in the Mtn. Bilogora highlands, which lacks the natural preconditions for the formation of the

basic raw material required in the smelting process – bog iron ore. The selected toponyms were related to the exploitation (of ore), digging, mining (Kopčice, Rudina Jokna), production of charcoal (Vuglenice), smithing, and/or the production and repair of iron objects (Kovačice, Zakovačnice) (Valent *et al.* 2018: 145; 2019: 11). The final result, as with the previous method, did not yield overall positive results. Out of the seven selected toponyms, fragments of ceramic pots dated to Prehistory and the Medieval and Modern periods have been discovered at five archaeological sites, some of which were spread on several positions. The area of two toponyms contained no surface archaeological material. As far as surface finds connected to metallurgy are concerned, pieces of smelting slag were collected at three sites with toponyms, i.e. Đurđevac–Kopčice I, Đurđevac–Kopčice III, and Kalinovac–Vuglenice I (Valent *et al.* 2018: 145–146; 2019: 11–16, 23).

Even though the results are slim, the method of approach proved to be partially efficient. In analysing the applicability of the method, in our specific case, but also in general terms, one must take into account two external factors: (1) the fact that certain areas of the inspected and presented toponyms currently have a very low visibility as they are not agriculturally cultivated (under forests and/or meadows); and (2), and even more problematically in terms of this approach, that the toponyms, due to human error, are often relocated by up to several hundred meters, given new names, removed from registers/maps, or exist now only in local oral transmission.<sup>5</sup>

### Analysis and interpretation

As mentioned above in the introduction, the collection of data, coupled with a list of positions with metallurgical activities, enables various possibilities of analysis and interpretation of the collected data. Even though the earlier version contained much more (technical) data,<sup>6</sup> the information presented in Table 1 sums up all the necessary basic information on each site. The table is divided into six groups of information.<sup>7</sup> The first refers to the name of the site;<sup>8</sup> the second to the

<sup>3</sup> Google Earth Pro, www.mapire.eu; www.arcod.hr; https://geoportal.dgu.hr.

<sup>4</sup> Koprivnica-Križevci County, Virovitica-Podravina County, Bjelovar-Bilogora County.

<sup>5</sup> As an example of the last remark, we cite the toponym Jaklanova Greda in the village of Podravske Sesvete. *Jaklo* (variation of *jeklo*) stands for iron in the colloquial language, but the toponym, referring to a small tump in the village, only exists among the villagers. Unfortunately, it cannot be excavated as modern houses are built on it.

<sup>6</sup> Position of finds; person(s) discovering the site; position of storage of finds; information whether the site and the collected material is photographed; existence of a topographic map and Google reference; county; GPS data; information whether the site is registered/protected by the Ministry of Culture and Media; the researched area of the site, year, institution, information concerning the existence of bog iron ore, ingots, charcoal pits, dumping ground (if the site was excavated).

<sup>7</sup> Almost each group of information has several subgroups, depending on the type/number of parameters.

<sup>8</sup> The first colon refers to the name of the contemporary village and

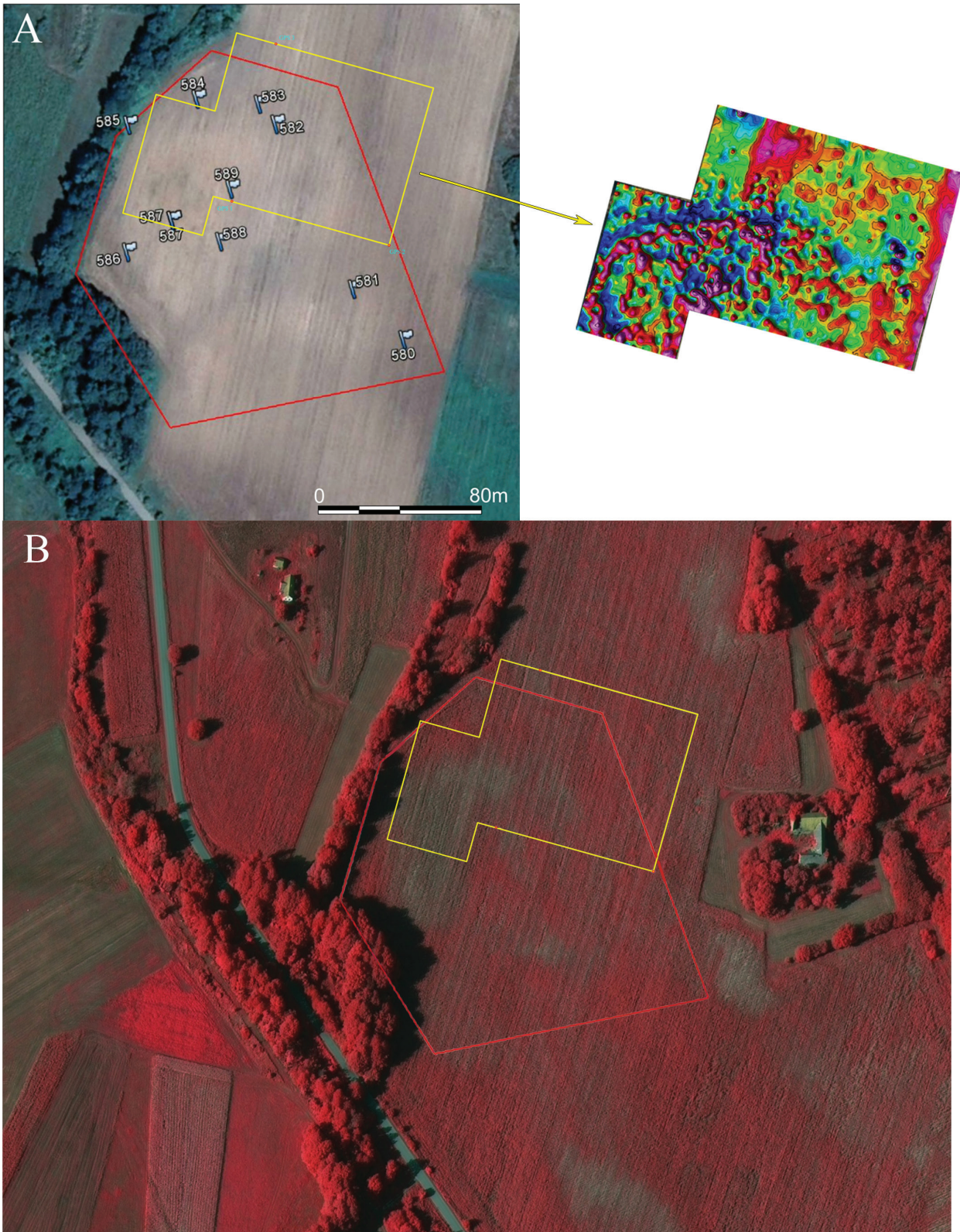
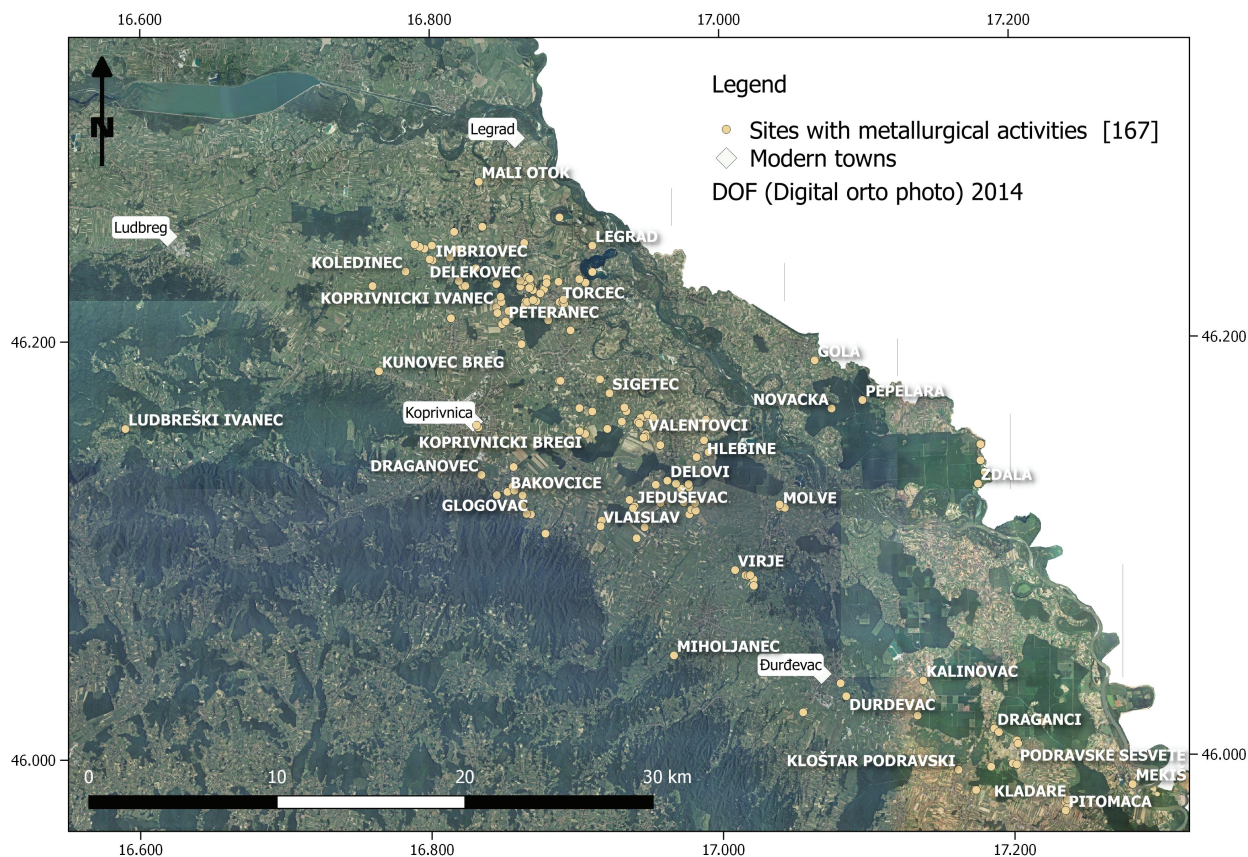


Figure 2. Kalinovac - Hrastova greda 1: A) red mark - an area where an intensive field inspection was conducted with marked positions of higher concentration of smelting slag; yellow mark - the area where geophysical surveys were conducted, with details of the results of these surveys (after: Mušić *et al.* 2019: 118-119, Figs. 1A and 2B); B) Near InfraRed image of Kalinovac-Hrastova greda 1 site (State Geodetic Administration, Republic of Croatia, digital cyclic recording 2011, nr. 9225 CIR).





Map 1. Sites with archaeological finds connected to bloomery iron production (details given in Table 1) (made by: Tena Karavidović; base map: DOF (Digital orthophoto), 2014, <https://geoportal.dgu.hr>).

circumstances in which the finds were found/collected (field surveys, excavation); the third one describes different presumed context of finds (settlement, cemetery, workshop).<sup>9</sup> The following four colons refer to the type of finds collected within the given context (smelting/smithing slag, tuyeres,<sup>10</sup> furnace walls).<sup>11</sup> The fifth group refers to the dating of each site, based on the accompanying pieces of pottery discovered in the

same context as the metallurgical finds.<sup>12</sup> The last colon refers to references.<sup>13</sup>

The overall number of positions listed is 167 (Table 1, Map 1).<sup>14</sup> The material known from the sites is derived from field surveys and/or excavations. Some of the listed sites (21) were excavated during pilot, systematic or preventive archaeological research, but only six excavations were conducted with the aim of investigating iron production (Sekelj Ivančan and

the second to the toponym.

<sup>9</sup> The context of finds refers both to the type of site and its interpretation. The situation with cemeteries is clear - the metallurgical finds arrived there indirectly, but the workshop/settlement context can be misleading. The reason for this is that slag may not only be connected to a workshop site, but can, and in most cases is, to be found in waste pits within the settlement (Valent 2020). Therefore, in determining a site as a position of a workshop within this database the following parameters were set as guidelines: 1) The site was proven to be a workshop by excavation and/or electromagnetic survey; 2) Evidence of large amounts of slag, furnace walls and/or tuyeres, which point to a possible landfill; 3) Metallurgical finds without ceramics, i.e. with no settlement indicators. For this reason, only a few sites within the database are marked as positions of workshops.

<sup>10</sup> Numbers of tuyeres refer to field survey finds.

<sup>11</sup> The number of finds for each site is different. Some positions have only one find, while others have dozens. The amount/type of finds collected, and their interpretations, is presented within the columns referring to the context of the site/workshop/settlement.

<sup>12</sup> Multi-layer sites from which only surface finds (of pottery) are known, i.e. from which it is not possible to determine in which period the metallurgical activity took place, have all the potential periods listed. Furthermore, given that this chapter deals only with metallurgical aspects of the presented sites, information on the dating of the excavated sites refers only to the metallurgical activity, not on the remaining periods from which parts of settlements were discovered during excavations.

<sup>13</sup> The references are only to publications in which the site is mentioned in relation to metallurgical processes/finds. Some sites have not yet been published, therefore no bibliography for them exists. As for the excavated sites, and for which numerous papers have been published, only one bibliographical entry referring to a text in this present publication, containing all the published articles, is listed.

<sup>14</sup> The term position is used because certain large sites are divided into several smaller positions, which were mutually separated based on the different ceramic finds collected during the surveys.

Karavidović, in this volume).<sup>15, 16</sup> Furthermore, the archaeological finds from ten sites, known only from the field surveys conducted prior, or after, the discussed research, revealed no finds connected to metallurgy of iron.

Based on the collected material, a total of 25 sites are proven, or presumed, to be bloomery iron production workshops.<sup>17</sup> Only two sites were recognised as smithies,<sup>18</sup> Hlebine–Dedanovice was recognised as a reheating/smithing workshop (Sekelj Ivančan and Karavidović, in this volume), while others are determined as smelting workshops. Iron metallurgy artifacts were also found at four (excavated) cemeteries,<sup>19</sup> while the majority of sites have a settlement context.<sup>20</sup>

<sup>15</sup> Five sites were excavated during the TRANSFER project: Virje–Volarski breg, Virje–Sušine, Hlebine–Velike Hlebine, Hlebine–Dedanovice, Kalinovac–Hrastova greda 1. The site at Draganovec was excavated in March 2021 for the purposes of a PhD thesis of one of the authors of the article, and the analysis of the material is currently in progress. As Table 1 presents only the dates of the metallurgical aspects of these sites, we find it important to mention the era of the remaining occupation phases of the sites: Virje–Volarski breg (IV) was also occupied during the Late Iron Age, as well as the neighbouring site of Sušine (Dizdar and Ložnjak Dizdar, in this volume), which also has High Medieval and Early Modern occupation (Botić, in this volume). Hlebine–Velike Hlebine was, as well as the Early Medieval period, occupied during Antiquity and the High Middle Ages (Botić, in this volume), while the Dedanovice site also presents a Late Antiquity occupation (Sekelj Ivančan, in this volume; Sekelj Ivančan and Karavidović, in this volume).

<sup>16</sup> The aim of research into the remaining 14 sites was the excavation of the settlements. Finds connected with metallurgy from these campaigns gave additional information on the economy of the settlement.

<sup>17</sup> The methodology of determining a site as a workshop is described above in note 9.

<sup>18</sup> The sites are Peteranec–Petrovci and Koprivnica–Stari Magistrat. The smithy workshop on the site Koprivnica–Stari Magistrat was discovered during a preventive excavation campaign which began during the course of the preparation of this article and is currently active. The presumed workshop on the Peteranec–Petrovci site was located c. 200 m from the settlement during a pipeline survey conducted in 2016 (Valent 2016: 131). The assumption of a workshop there is based on the discovery of large amounts of slag, furnace walls (Valent 2019a: 179), and hammer-scale (not mentioned in any report so far, documented during the survey by a photograph).

<sup>19</sup> Antiquity period: Kunovec Breg–Kod poklonca, Gola–Vlaško polje, and Novačka–Gradina; High/Late Middle Ages: Đurđevac–Sošice.

<sup>20</sup> The settlement context can be presumed for each site, whether it is a smelting or smithy workshop. It can be argued that each site containing finds of smithy slag is a settlement, based on the continuing need to repair metal objects. This might be applicable in the context of a smithy within the settlement, as well as for a travelling blacksmith. A similar approach can be applied in the interpretation of smelting finds/workshops. The establishment of a smelting workshop requires organisation in the context of acquiring and preparing primary resources, which takes some time, during which the smelter(s) most likely reside in dwellings next to the workshop itself. Therefore, whether the smelting process is conducted within a more permanent or seasonal settlement, some sort of accommodation is always present. The distance of housing from the workshop remains an open and insufficiently researched issue. Taking all this into consideration, we can only state that surface finds of pottery were not found during the conducted surveys at the following six positions we know are connected with smelting activities: Delovi–Banovice IIIA, Delovi–Poljane 6, Delovi–Poljane 7, Đurđevac–Kopčice III, Molve–Jandrotine IIA, Sigetec–Moždanci IIIB; which, on the other hand, are located in close proximity of other positions/sites, also connected to smelting, which have settlement indicators.

The number of sites associated with smelting is 75, while finds of smithy slag were found at 105 sites.<sup>21, 22</sup>

When it comes to discussing the segment of dating of the sites presented, one is faced with certain difficulties, two in particular. Although the dating of the excavated sites can be (and in the case of the TRANSFER project was) determined by radiocarbon analysis (Botić, in this volume), dating a site associated with metallurgy merely on accompanying finds of pottery collected during field surveys presents certain obstacles. The first major problem that arose during the analysis were that the pottery might not be from the same period as the finds connected to metallurgy of iron, and that most of the sites were settled during several different periods in which this economic activity was conducted. However, taking into account that some pottery is better than none, it is possible to conclude that the metallurgical processes conducted within a single-layer site occurred during the same period indicated by the surface ceramic finds.<sup>23</sup> Based on this presumption, it is possible to extract the following information from the database. Iron smelting in the Early Iron Age along the Drava basin can securely be associated with one site, while finds of smithing slag were found at three more. Metallurgy in the Late Iron Age is currently associated only with smithing, traces of which were discovered at four positions within three different sites. The number of sites with traces of iron metallurgy from Antiquity is 15; three are cemeteries with finds of smithy slag, which was found at eight further sites. The number of sites associated with smelting in Antiquity is three. Three more sites are dated to Late Antiquity, and two to the transition from Late Antiquity to the Early Middle Ages.<sup>24</sup> One Late Antiquity site has smithy slag.<sup>25</sup> The

The settlement context is also recognised around two cemeteries: Đurđevac–Sošice and Kunovec Breg–Kod poklonca. Smelting slags at Sošice were found during excavations around the High and Late Medieval church of St George, and as surface finds within the settlement area. Finds of smithy slag on the Kod poklonca site, dated within the 1st/2nd century, came only from trenches within the graveyard part of the site, but not within the settlement. Positions of settlement for the Gola Vlaško–polje and Novačka Gradina Antiquity cemeteries have not yet been recognised.

<sup>21</sup> The number of sites at which solely smelting slag was found is 61, and smithy slag 90. Pieces of both were found at 14 sites, while slag from Dedanovice is characterised as reheating/smithing slag (Sekelj Ivančan and Karavidović, in this volume).

<sup>22</sup> The determination of activities at Koledinec–Brezovice I (and other sites) is insecure, as only one nozzle fragment was discovered.

<sup>23</sup> This presumption must be taken with a certain amount of caution, as it may not necessarily be applicable for each site!

<sup>24</sup> The smelting sites occupied during Late Antiquity are Virje–Sušine, Virje–Volarski Breg and Kalinovac–Hrastova greda 1 (Sekelj Ivančan and Karavidović, in this volume; Botić, in this volume). The two sites dated to the transition between Late Antiquity and the Early Medieval period are Hlebine–Velike Hlebine and Hlebine–Dedanovice (Sekelj Ivančan and Karavidović, in this volume; Botić, in this volume).

<sup>25</sup> The Draganovec site was excavated in March 2021. Smithy slag from within the settlement confirmed the surface finds (Valent 2021), but the date of the smelting workshop next to the settlement is still unknown. Radiocarbon dating of the furnaces still has to be done here, but pottery from within the workshop is dated to Late Antiquity and the Early Medieval period.

number of sites with smelting activities during the Early Middle Age period is 11, with smithing associated with five of them. During the High Middle Ages smelting occurred at four sites, and smithing on five. The highest number of sites is dated to the Late Medieval period, during which smelting activities were recognised at seven sites, and smithing is associated with 20 of these. Finally, four positions, at three individual sites, are associated with the Early Modern period – two are connected with smelting and two with smithing.<sup>26</sup>

The second difficulty we referred to above represent the multi-layered sites. In these cases surface finds of ceramic material from different periods pose a problem, as it is not possible to determine the exact period in which the iron metallurgy process was conducted. To find out whether indeed iron smelting and/or smithing in the Drava basin was conducted continuously, or with some periodical interruptions, from the Early Iron Age to Early Modern times, and with what intensity, future archaeological excavations will need be conducted at more sites, and across different periods.

Based on the analysis from single-layer sites alone, it is evident that the number of sites with metallurgical activities has an almost linear growth, except during the High Medieval period, in which a decline is recorded, as opposed to the periods before and after. Similarly, a decline is recorded in case of the Early Modern period sites, which are also generally underrepresented. As it is to be expected, the highest number of sites associated with metallurgical activities is present during Late Medieval times, which also precedes in the number of sites at which smithy slag was found. On the other hand, the highest number of single-layer sites associated with smelting is recognised during the Early Medieval period, which is, with Late Antiquity, also the period of dating of all the excavated and analysed sites presented in this current work (Sekelj Ivančan and Karavidović, in this volume).

Translated by: Ivan Valent

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<sup>26</sup> The two smithing sites are Koprivnica–Oružana and Koprivnica–Stari Magistrat, functioned simultaneously, i.e. they were located within the parameters of the Early Modern fortress of Koprivnica. Smithy slag within the Koprivnica–Oružana position was found within a disturbed archaeological context, while the Koprivnica–Stari Magistrat finds originate from an archaeological context. Smelting is presumed at Ludbreški Ivanec–Pod humcem, Vapnenica (Marković 1986: 8–10), while surface finds of Modern ceramics from Kalinovac–Vuglenice I (Krznar 2018) indicate that this activity might also have occurred within this period.

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Table 1. Sites with archaeological finds connected to bloomery iron production within the territory of the River Drava Basin (made by: Ivan Valent).

No.	Area	Toponym	Type of archaeological research		Context			Type of find				Datation						Bibliography
			Surface survey	Excavation	Workshop	Settlement	Cemetery	Smelting slag (T)	Smithing slag (K)	Tuyere (No.)	Furnace walls	Halstatt (Ha)	La Tene (Lt)	(Late) Antiquity (L/A)	Early Middle Ages (EMA)	High Middle Ages (HMA)	Late Middle Ages (LMA)	
1	BAKOVČICE	Nadbarice 1	*		*	*			T	K	1			EMA	HMA			Valent 2018b: 83; Valent et al. 2018: 143, Tab. 1:1; Mušič et al. 2020: 138-140, Fig. 3
2		Nadbarice 3	*		*	*				K					HMA	LMA		Valent 2018b: 84; Valent et al. 2018: 143, Tab. 1:3
3		Velike livade 1	*		*	*			T		1					LMA		Valent et al. 2017: 11; Mušič et al. 2020: 138,140, Fig. 2
4		Veliko polje	*		*	*				K	*							Valent 2018b: 84-85; Valent et al. 2018: 143, Tab. 1: 5
5	DELOVI	Banovice I	*		*	*			T						HMA	LMA		Valent et al. 2019: 16-17
6		Banovice II	*		*	*			T						HMA	LMA		Valent et al. 2019: 17-18
7		Banovice III	*		*	*			T		2	*			HMA	LMA		Valent et al. 2019: 18
8		Banovice IIIA	*		*	*			T		3	*						Valent et al. 2019: 18
9		Grede 1		*	*	*				K			Lt			LMA		Marković 1984: 302; Valent 2019b; Valent 2021
10		Poljane 1	*		*	*			T		1			EMA		LMA		Valent et al. 2017: 15-16.
11		Poljane 4	*		*	*			T				Lt	A				Valent et al. 2017: 16
12		Poljane 5	*		*	*			T						HMA			Valent et al. 2017: 16
13		Poljane 6	*		*	*			T									Valent et al. 2017: 16
14		Poljane 7	*		*	*			T									Valent et al. 2017: 16
15		Poljane 8	*		*	*			T				Lt	A				Valent et al. 2017: 16
16	DRAGANOVEC	Draganovec	*	*	*	*			T	K	*			?				Valent 2021
17	DRAGANCI	Bokčev grob 1	*		*	*			T					EMA	HMA	LMA		Valent et al. 2017: 18
18		Bokčev grob 3	*		*	*			T	K						LMA		Valent et al. 2017: 18
19	ĐELEKOVEC	Močvar I	*		*	*			T					A		EMA		Valent et al. 2017: 13
20		Močvar I A	*		*	*				K				A				Valent et al. 2018: 143, Tab. 1: 12

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			Surface survey	Excavation	Workshop	Settlement	Cemetery	Smelting slag (T)	Smelting slag (K)	Tuyere (No.)	Furnace walls	Halstatt (Ha)	La Tene (Lt)	(Late) Antiquity (L/A)	Early Middle Ages (EMA)	High Middle Ages (HMA)		Late Middle Ages (LMA)
21		Močvar II	*			*						Lt	A		LMA			Valent 2018a: 38-39
22		Šabac II A-C	*			*												Valent 2018a: 40-45
23		Vidak II A, B	*			*							A					Valent 2018a: 46-55
24	ĐURĐEVAC	Kopčice I	*			*				*		Lt	A		LMA			Valent et al. 2018: 143, 146, Tab. 1: 13; Valent et al. 2019: 15
25		Kopčice III	*			*												Valent et al. 2018: 143, 146, Tab. 1: 15; Valent et al. 2019: 16
26		Sošice	*			*		*							LMA			Valent et al. 2017: 17
27	GLOGOVAC	Groblje 2	*			*									LMA			Valent 2018b: 85; Valent et al. 2018: 143, Tab. 1: 18
28		Palfjev jarek 1	*			*									LMA			Valent et al. 2019: 19-20
29		Selište	*			*									LMA			Valent et al. 2017: 11
30		Veliko polje 3	*			*									LMA			Valent et al. 2019: 21
31		Veliko polje 4	*			*										HMA		Valent et al. 2019: 21-22
32	GOLA	Vlaško polje		*				*					A					Valent 2021
33	HLEBINE	Dedanovice	*	*		*							LA / EMA	LA / EMA				Sekej Ivančan, in this volume; Sekej Ivančan and Karavidić, in this volume
34		Domaća greda	*			*										HMA	LMA	Alečković 1996: 284; Sekej Ivančan 2016: 122; Kudelić et al. 2017: 475-476; Valent et al. 2017: 15.
35		Klepe	*			*										HMA	LMA	Kudelić et al. 2017: 476; Sekej Ivančan 2016: 122; Valent et al. 2017: 15
36		Kozarnice	*			*										HMA		Valent et al. 2017: 14
37		Velike Hlebine	*	*		*							LA / EMA	LA / EMA				Sekej Ivančan, in this volume; Sekej Ivančan and Karavidić, in this volume
38	IMBRIOVEC	Berek I	*			*						Lt	A	MA				Valent 2018a: 69-70
39		Berek II	*			*						Lt	A					Valent 2018a: 71-72
40		Čanjevci	*			*										HMA	LMA	



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			Surface survey	Excavation	Workshop	Settlement	Cemetery	Smelting slag (T)	Smelting slag (K)	Tuyere (No.)	Furnace walls	La Tene (Lt)	(Late) Antiquity ((L)A)	Early Middle Ages (EMA)	High Middle Ages (HMA)	Late Middle Ages (LMA)	Early Modern Period (EMP)	
41		Godāšin	*			*								LMA				
42		Jablanec I, II	*			*								LMA				Valent 2018a: 73-76
43		Rasko pole	*			*				Ha	Lt			HMA				Valent et al. 2018a: 77-78
44		Vujčec 1-3	*			*								EMA				Valent et al. 2018: 143, Tab. 1: 20
45		Vujčec II	*			*					A			LMA				Valent 2018a: 81-82
46	JEDUŠEVAC	Bregovi I	*			*								EMA				Valent et al. 2017: 15
47		Bregovi II	*			*								EMA				Valent et al. 2017: 15
48		Kladare	*			*										LMA		Valent et al. 2018: 143, Tab. 1: 21
49		Stari jeduševci 1	*			*					A			LMA				Valent et al. 2018: 143, 146, Tab. 1: 23; Valent et al. 2019: 7
50		Staro selo 2	*			*					A			LMA				Valent et al. 2018: 143, 146, Tab. 1: 22; Valent et al. 2019: 8-9
51		Šemunice I	*			*								LMA				Valent et al. 2017: 15
52	KALINOVAC	Hrastova greda 1 (7 positions)	*			*					LA			EMA				Valent et al. 2017: 17-18; Sekej Ivančan 2020
53		Vuglenice I	*			*					A			EMA				Valent et al. 2018: 143, 146, Tab. 1: 26; Valent et al. 2019: 12-13
54		Vuglenice II	*			*								HMA				Valent et al. 2018: 143, Tab. 1: 27; Valent et al. 2019: 13
55	KLADARE	Lasci	*			*								HMA				Valent 2018a: 96-97
56		Orešje 1	*			*					A			HMA				Valent et al. 2017: 19
57		Orešje 2	*			*					A			HMA				Valent et al. 2018: 143, Tab. 1: 28
58		Orešje-Lasci (Meandar)	*			*					A			HMA				Valent et al. 2018: 143, Tab. 1: 29
59	KLOŠTAR PODRAVSKI	Corbonok		*		*												

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60		Limbuš 2	*			*			K					HMA	LMA					
61	KOLEDINEC	Brezovice I	*		*	*		?	?	1										Valent 2018a: 104-105
62		Koledinski lug I	*		*	*		T	K											Valent et al. 2017: 12
63		Koledinski lug II	*		*	*		T												Valent et al. 2017: 12
64		Koledinski lug II A	*		*	*		T												Valent et al. 2017: 12
65		Koledinski lug III	*		*	*		T		1										Valent et al. 2017: 12
66		Kvake	*		*	*														Valent et al. 2018: 144, Tab. 1: 41
67	KOPRIVNICA	Miholjansko polje	*		*	*														Valent et al. 2019: 22-23
68		Oružana		*		*			K											Valent 2019a: 19-20
69		Stari magistrat		*		*			K	*										Valent 2019a: 21-22
70	KOPRIVNIČKI BREGI	Gorice I	*		*	*														Valent et al. 2018: 144, Tab. 1: 42
71		Gorice II	*		*	*														Valent et al. 2018: 144, Tab. 1: 43
72		Seče	*		*	*														Valent 2018a: 119-120
73	KOPRIVNIČKI IVANEC	Cerine 6	*		*	*		T												Valent et al. 2017: 12
74		Gaj	*		*	*		T												Valent et al. 2017: 12
75		Log I	*		*	*														Valent 2018a: 125-126
76		Log-Parag I	*	*	*	*		T		1										Valent et al. 2017: 12; Valent 2020
77		Log-Parag II	*		*	*		T												Valent et al. 2017: 12

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			Excavation	Surface survey	Workshop	Settlement	Cemetery	Smelting slag (T)	Smithing slag (K)	Tuyere (No.)	Furnace walls	Halstatt (Ha)	La Tene (Lt)	(Late) Antiquity (L/A)	Early Middle Ages (EMA)	High Middle Ages (HMA)	Late Middle Ages (LMA)	
78		Log-Parag III	*			*										LMA		Valent 2018a: 131-132
79		Zovje I	*			*										LMA		Valent et al. 2018: 144, Tab. 1: 44
80	KUNOVEC BREG	Kod poklonca		*			*											Marković 1990: 129; Valent 2021
81	LEGRAD	Donja šuma	*			*										LMA		Valent et al. 2017: 13
82		Jegeniš	*			*										LMA		Valent et al. 2017: 13
83		Šoderica /'Keter'	*			*										LMA		Valent 2018a: 139-140
84	LUDBREŠKI IVANEC	Pod humcem, Vapnenice		*		*											EMP	Marković 1986: 8-10
85	MALI OTOK	Gmanje	*			*										LMA		Valent et al. 2018: 144, Tab. 1: 46
86	MEKIŠ	Crlenika	*	*		*										LMA		Valent 2018a: 144-145
87	MIHOLJANEC	Pod goricom 2	*			*										LMA		Valent et al. 2018: 144, Tab. 1: 48
88	MOLVE	Jandrotine I	*	*		*										LMA		Valent et al. 2017: 15
89		Jandrotine II	*	*		*										LMA		Valent et al. 2017: 15
90		Jandrotine II A	*	*		*												Valent et al. 2017: 15
91		Jandrotine III / Sigeček	*			*												Valent et al. 2019: 18-19
92	NOVAČKA	Gradina		*			*											Valent 2021
93	PEPELARA	Gradina	*	*		*										LMA		
94	PETERANEC	Cerine 2	*	*		*										LMA		Valent 2018a: 154-155
95		Cerine 2A	*	*		*												Valent 2018a: 156-157
96		Cerine 4	*	*		*										LMA		

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97		Cerine 7 (sjeverno)	*			*									HMA	LMA		Valent 2018a: 158-159	
98		Cerine 10	*		*	*									HMA			Valent 2018a: 160-161	
99		Gorica	*		*	*												Valent et al 2018: 144, Tab. 1: 52	
100		Jablanje	*		*	*									HMA			Valent et al 2018: 144, Tab. 1: 53	
101		Novi krči I (Učo's parcel)	*		*	*							Lt					Valent 2018a: 166-167	
102		Novi krči I (Ignac Milić's parcel)	*		*	*							Lt	A				Valent 2018a: 168-169	
103		Novi krči I (Ivica Varga's parcel)	*		*	*								A				Valent 2018a: 170-171	
104		Novi Krči I (Josip Kolesar's parcel)	*		*	*							Lt					Valent 2018a: 172-173	
105		Novi krči III (Joja's parcel)	*		*	*							Lt					Valent 2018a: 176-177	
106		Novi krči III (Dean Šomoci's parcel)	*		*	*										LMA		Valent 2018a: 174-175	
107		Petrovci (Berek)	*		*	*										LMA		Valent 2018a: 178-179	
108		Podgorica	*		*	*										LMA		Valent 2018a: 182-183	
109		Pod Siget II	*		*	*											HMA	Valent et al. 2018: 144, Tab. 1: 56	
110		Vratnec II	*		*	*								A	EMA	HMA		Valent et al. 2018a: 184-185	

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	Area	Toponym		Excavation	Surface survey	Workshop	Settlement	Cemetery	Smelting slag (T)	Smelting slag (K)	Tuyere (No.)	Furnace walls	Halstatt (Ha)	La Tene (Lt)	(Late) Antiquity ((L)A)	Early Middle Ages (EMA)		High Middle Ages (HMA)	Late Middle Ages (LMA)
111	PITOMAČA	Pod gredom 1	*	*				K								HMA			Valent et al. 2018: 144, Tab. 1: 57
112	PODRAVSKE SESVETE	Čovašev breg	*	*			T										LMA		Valent et al. 2017: 18
113		Delci-Torbaev kut	*	*			T										LMA	EMP	Valent et al. 2017: 18
114		Popovice - položaj 1	*	*			T					Lt		A	EMA	HMA	LMA		Valent et al. 2017: 18-19
115		Popovice - položaj 2	*	*			T					Lt		A	EMA	HMA	LMA		Valent et al. 2017: 18-19
116		Popovice - položaj 3	*	*			T							A	EMA				Valent et al. 2017: 18-19
117		Ravnice	*	*			T			*				A			LMA		Valent et al. 2017: 18
118		Ruškova greda		*				K									LMA		Valent 2018a: 200-201
119	SIGETEC	Moščanci I	*	*				K						A	EMA	HMA			Valent et al. 2018: 144, Tab. 1: 65
120		Moždanci I	*	*				K						A					Valent 2018a: 204-205
121		Moždanci II A	*	*			T			*		Lt			EMA				Valent et al. 2017: 14
122		Moždanci II B	*	*			T					Lt		A		HMA			Valent et al. 2017: 14
123		Moždanci II C	*	*			T			*					EMA				Valent et al. 2017: 14
124		Moždanci III A	*	*			T		K	*					EMA				Valent et al. 2017: 14
125		Moždanci III B	*	*			T												Valent et al. 2017: 14
126		Moždanci IV	*	*				K					A						Valent 2018a: 216-217
127		Moždanci V	*	*				K					A						Valent 2018a: 218-219
128		Ogradine I	*	*				K								HMA	LMA		Valent et al. 2018: 144, Tab. 1: 66
129		Ogradine II A	*	*				K				Lt					LMA		Valent 2018a: 222-223

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			Surface survey	Excavation	Workshop	Settlement	Cemetery	Smelting slag (T)	Smelting slag (K)	Tyere (No.)	Furnace walls	Halstatt (Ha)	La Tene (Lt)	(Late) Antiquity (L/A)	Early Middle Ages (EMA)	High Middle Ages (HMA)	Late Middle Ages (LMA)	
130		Ogradine II B	*			*												Valent 2018a: 224-225
131		Ogradine II C	*			*												Valent 2018a: 226-227
132		Peski I	*			*												Valent et al. 2018: 144, Tab. 1: 68
133	TORČEC	Blaževo pole 3	*			*												Valent 2018a: 230-231
134		Blaževo pole 4	*			*												Valent 2018a: 232-233
135		Blaževo pole 5	*			*												Valent 2018a: 234-235
136		Blaževo pole 6	*	*		*												Valent 2018a: 236-237
137		Cirkvišče	*	*		*												Valent 2018a: 238-240
138		Dožine I A	*			*												Valent 2018a: 241-242
139		Dožine III B	*			*												Valent et al. 2018: 144, Tab. 1: 73
140		Ivanovo	*			*												Valent et al. 2018: 144, Tab. 1: 74
141		Međuriće II	*			*												Valent 2018a: 247-248
142		Međuriće III	*			*												Valent et al. 2017: 13
143		Međuriće IV	*			*												Valent 2018a: 251-252
144		Međuriće VI	*			*												Kovačević 2009: 63-64; Valent 2021
145		Međuriće VIII	*			*												Valent et al. 2017: 13
146		Međuriće IX	*			*												Valent et al. 2017: 13
147		'Mlad' (Klokočevje)	*			*												Valent 2018a: 259-260
148		Pod Panje II	*			*												Valent 2018: 261-262
149		Pod Vratnec - (Joja)	*			*												Valent et al. 2017: 12
150		Polanice	*			*												Valent 2018a: 265-266

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			Surface survey	Excavation	Workshop	Settlement	Cemetery	Smelting slag (T)	Smelting slag (K)	Tuyere (No.)	Furnace walls	Halstatt (Ha)	La Tene (Lt)	(Late) Antiquity (L/A)	Early Middle Ages (EMA)	High Middle Ages (HMA)	Late Middle Ages (LMA)	
151		Prečno pole 4A	*			*								EMA				Valent et al. 2018: 144, Tab. 1: 75
152		Vratno II	*			*										LMA		Valent et al. 2018: 144, Tab. 1: 76
153	VALENTOVCI	Mrzla voda 1	*		*				*					EMA	HMA			Valent et al. 2017: 14
154		Mrzla voda 2	*		*					Lt				EMA				Valent et al. 2017: 14
155		Mrzla voda 3	*		*					Lt				EMA	HMA			Valent et al. 2017: 14
156	VIRJE	Sušine	*	*	*	*			*				LA	EMA				Sekelj Ivančan, in this volume; Sekelj Ivančan and Karavidović, in this volume
157		Volarski breg (IV)	*	*	*	*			*				LA	EMA				Sekelj Ivančan, in this volume; Sekelj Ivančan and Karavidović, in this volume
158		Volarski breg I	*			*			*				A	EMA				Valent et al. 2017: 17, fus. 45
159		Volarski breg II	*		*	*			*				A	EMA	HMA	LMA		Valent et al. 2017: 16-17
160		Volarski breg III A	*			*										LMA		Valent et al. 2017: 17, fus. 45
161		Volarski breg VIII	*			*			*							LMA		Valent et al. 2017: 17, fus. 45
162	VLAISLAV	Mulji 1		*		*				Ha								Marković 1988: 186; Valent 2021
163		Mulji 2A		*		*			*	Ha								Valent 2021
164	ŽDALA	Telek 2 A-F	*		*	*										LMA		Valent et al. 2017: 19; Mušič et al. 2020: 136-140, Fig. 4,5
165		Telek 3	*		*	*			*				A					Valent et al. 2017: 19
166		Telek 4 A-C	*		*	*			*							LMA		Valent et al. 2017: 19
167		Telek 7 A-F	*		*	*			*				A			LMA		Valent et al. 2017: 19; Mušič et al. 2020: 136-140, Fig. 6