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ON THE QUESTION OF THE PROVENANCE OF THE BOAT SHAPED FIBULAE OF ŠMARJETA TYPE IN MORAVIA AND SLOVAKIA

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Abstract: The boat shaped fibulae of Šmarjeta type are in Northeast Alpine region considered, thanks to the frequent occurrence in the cemeteries of Dolenjska group in Slovenia, as an import from the Southeast Alpine area. However, the gradually increasing number of finds of these fibulae in Northeast Alpine region (Moravia, Slovakia, Austria) indicates the hypothetic question of their local manufacture and distribution. The research of the authors aims to verify this hypothesis focusing on the technical features of individual fibulae (21 pieces from Moravia and 17 pieces from Slovakia) as well as by the XRF measurement of the composition of the alloy, they are made of. The present paper brings the preliminary results of this research.

Keywords: Early Iron Age, fibulae of Šmarjeta type, XRF analysis, Moravia, Molpír

INTRODUCTION

The gradual increase of the fibulae finds of Šmarjeta type are recently registered due to finds made by the metal detector seekers in Moravia or Slovakia. Thus, such increase stimulates a question, if their high density in certain parts of Northeast Alpine region may be caused by their hypothetical local production and distribution. To answer this question, the working team organized a small research project focused on the studying of the design details of individual pieces, including the detection of the element composition of the bronze used for manufacture of the researched fibulae. The results of such research of 21 Moravian (Fig. 4: 1, 3–5, 7–12, 14–16, 18, 20–25) and 17 Slovak Šmarjeta type fibulae (Fig. 5: 2–18)¹ may indicate specific variances and indicate the groups of the fibulae with hypothetically different origin (Table 2).

BOAT SHAPED FIBULAE OF ŠMARJETA TYPE

The boat shaped fibulae represent one of the most characteristic parts of the clothing in many European regions during the Early Iron Age. One of the most spread is Šmarjeta type, named after the eponymous site in Slovenia, which bow is characteristic by one until five longitudinal ribs, are decorated by fine transverse incisions. This type is second most common variant found at the necropolis of Dolenjska

group (Šmarjeta, Stična, Most na Soči, Magdalenska gora, etc.), where it occurs in the phase Stična, especially in Stična 2 (Dular 2003, 118; Tecco-Hvala 2012, 217), corresponding to Ha C2 and beginning of Ha D1 (Parzinger 1995, 19). However, it is known also in a combination with the later variants of the serpentine fibulae (Glunz 1997, 100; Grahek 2004, 144; Tecco-Hvala 2012, 240). Thus, its earliest occurrence in Northeast Alpine region may be paralleled with Ha C2, until Ha D1, according to some authors even until Ha D2a (Golec, Fojtík 2020, 106).

Unfortunately, Moravian finding contexts with Šmarjeta fibula cannot precise its chronology, since the major part of the finds of this fibula is represented by the stray finds made by metal detector seekers. Although, the finds from hillfort Smolenice “Molpír” in Slovakia come from excavation with documented context, their dating is based exclusively on typology without any absolute chronometrical data.

The beginning of the Šmarjeta fibulae in Ha C2 in Northeast Alpine region corresponds with the fact, that only the smaller variant is known here, which is characteristic for the phase Stična 2, while greater variant occurs in Slovenia already during the phase Stična 1 (Dular 2003, 118, 130). However, this greater variant is in Northeast Alpine region up to now unknown.

According to the typology of the boat fibulae by B. Jerin (2001) based on the technology of their casting, the type Šmarjeta falls into a group 2. It may be, according to the type of its decoration, classified as belonging to subgroups 2b, 2c and 2d. One of the most spread subgroups is 2b with typical bow decorated with three longitudinal ribs, with fine transverse incisions and round mouldings at the pin to foot transition, while

¹ Except 17 Šmarjeta type fibulae from “Molpír” two boat shaped fibulae with a reticular decoration on its bow (Fig. 5:20–21), two bow shaped fibulae (Fig. 5:1, 22), one fragment of serpentine fibula (Fig. 5:19) and two semi-products of fibulae from “Molpír” were also measured.

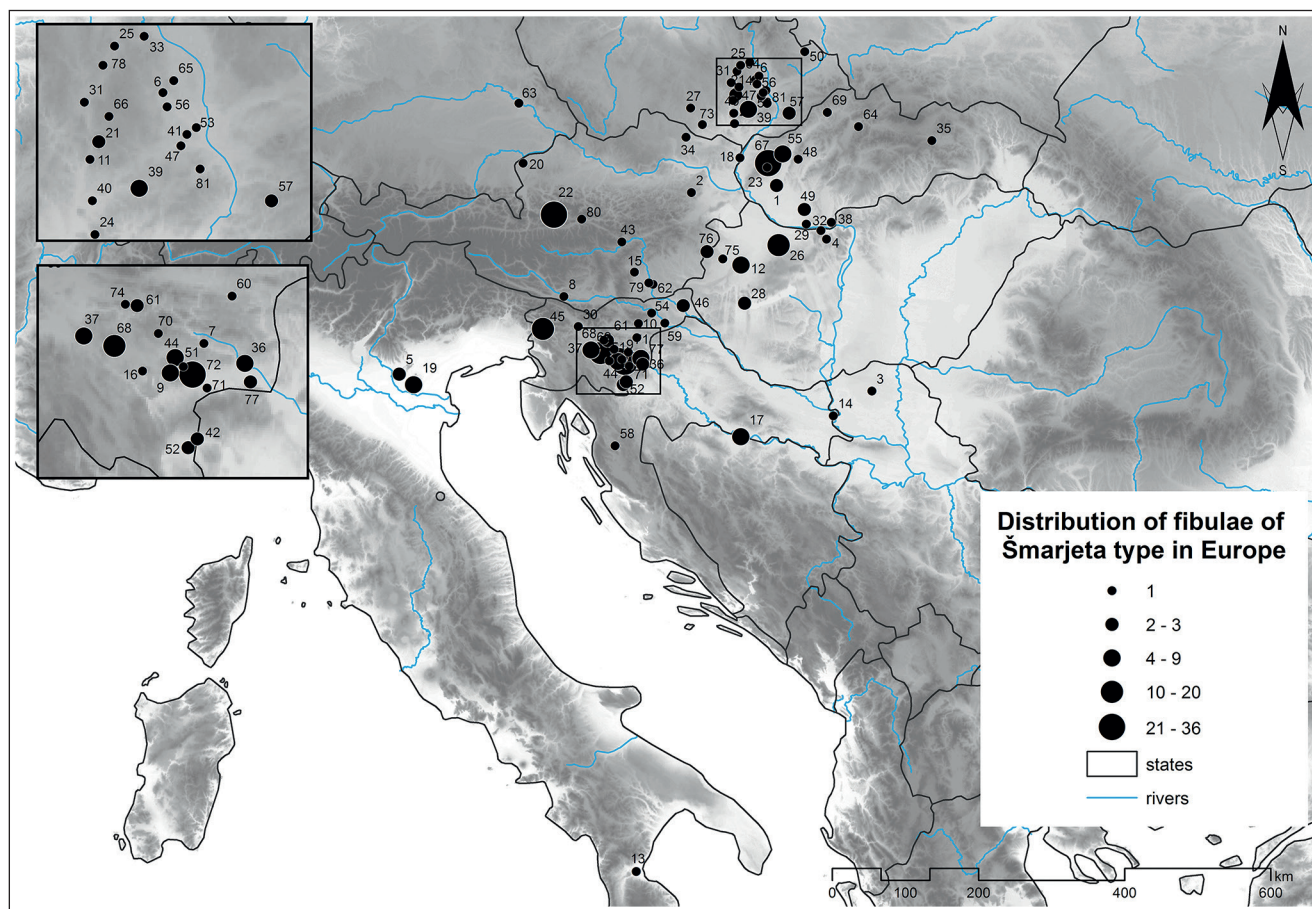


Fig. 1. Distribution of fibulae of Šmarjeta type in Europe. Complemented with new finds after Teržan 1990, Kar. 16; Glunz 1997, Kar. 24; Jerin 2001, Kar. 2; Stöllner 2002, Abb. 20; Grahek 2004, Fig. 33, 34; Felcan 2018, Fig. 8; Felcan, Stegmann-Rajtár, Tírpák 2019, obr. 6; Glunz 2019, Abb. 3. The numbers refer to Table 1

the foot terminates in a small knob. The circulating bundle of incisions, except of the mouldings, also frequently occurs in this transition. This subgroup represents 80% of known finds. Rare examples of this subgroup are represented by the fibula from Brno-Obřany, site “Široká”. The parts of the bow between three typical ribs are decorated by the longitudinal grooves and the lateral sides of the bow are decorated by the incisions (Podborský 1973/1974; Fig. 4:2). Less represented examples are the fibulae from the subgroup 2c, with bow being decorated by five longitudinal ribs, spread mainly in Italy and Slovenia, and the fibulae of the subgroup 2d with central rib on the bow and incised decoration on the sides, sometimes also with incised lateral sides. A unique type is the fibula from an unknown Italian site, with four longitudinal ribs on the bow (von Eles Masi 1986, Tav. 102:1186).

The group of the fibulae of Šmarjeta type consists of 269 pieces from 84 sites in 10 states of Southern and Central Europe (Fig. 1). They are known in the broad zone from Northern Italy (with sporadic occurrence in Calabria) and Slovenia up to Northern Moravia and Southeastern Bavaria, with principal accumulation in Southeastern Alps and Slovenia (108 pieces; Table 1).

As for the number of the sites, second significant area of their concentration is Moravia (21 sites; Fig. 2), representing also the most northerly area of their occurrence (site Opava-Kylešovice, Fig. 1). On the contrary, the most southerly

find is known from Calabrian site of Cozzo Michelichchio (Pace 2001, Fig. 3:6). The cave Čertova díra (Devil’s hole) near Letanovce in Northern Slovakia is the most easterly site of the occurrence of this fibula. The most westerly site is Schampach in Bavaria. The fibulae of Šmarjeta type are up to now unknown in Western Europe as well as in Bohemia. So, except of several fibulae from Upper Austria and one from Bavaria, we may completely consider this fibula as characteristic part of the costume of the East Hallstatt cultural zone (Fig. 1).

The fibulae in individual zones are characteristic by the varying finding contexts (Fig. 3). Slovenian fibulae are mostly found in the female inhumations. This feature may reflect a local tradition of their use in costumes as well as of their probable origin. More to the north, the fibulae are gradually missing in the graves and are typical in the settlements and occasionally in hoards. This fact suggests the possibility that the Šmarjeta fibulae represented here particular innovation, whose wearing was a phenomenon of the fashion, but did not become a part of the traditional grave inventory. This supposition, however, is not in contradiction with the assumed local provenance and manufacture of this type in some areas (see below). High popularity of this type is attested by the fact, that it represents one of the small number of the fibulae of the Southeast Alpine area, which frequently diffused other regions of Central Europe.

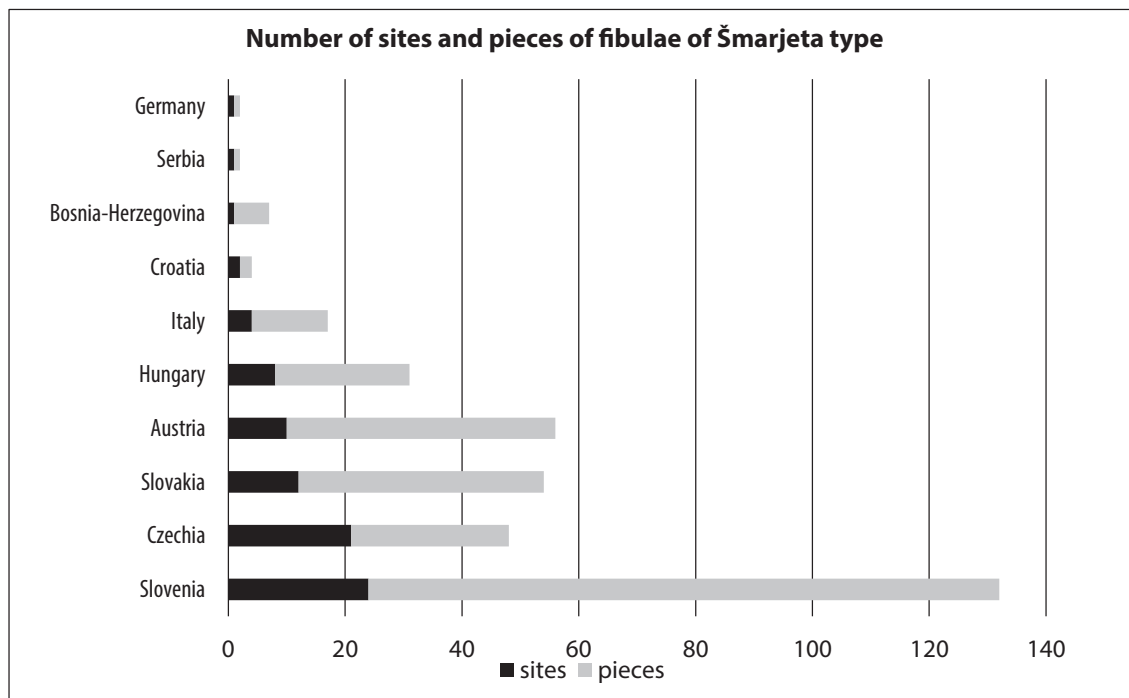


Fig. 2. Number of sites and pieces of fibulae of Šmarjeta type

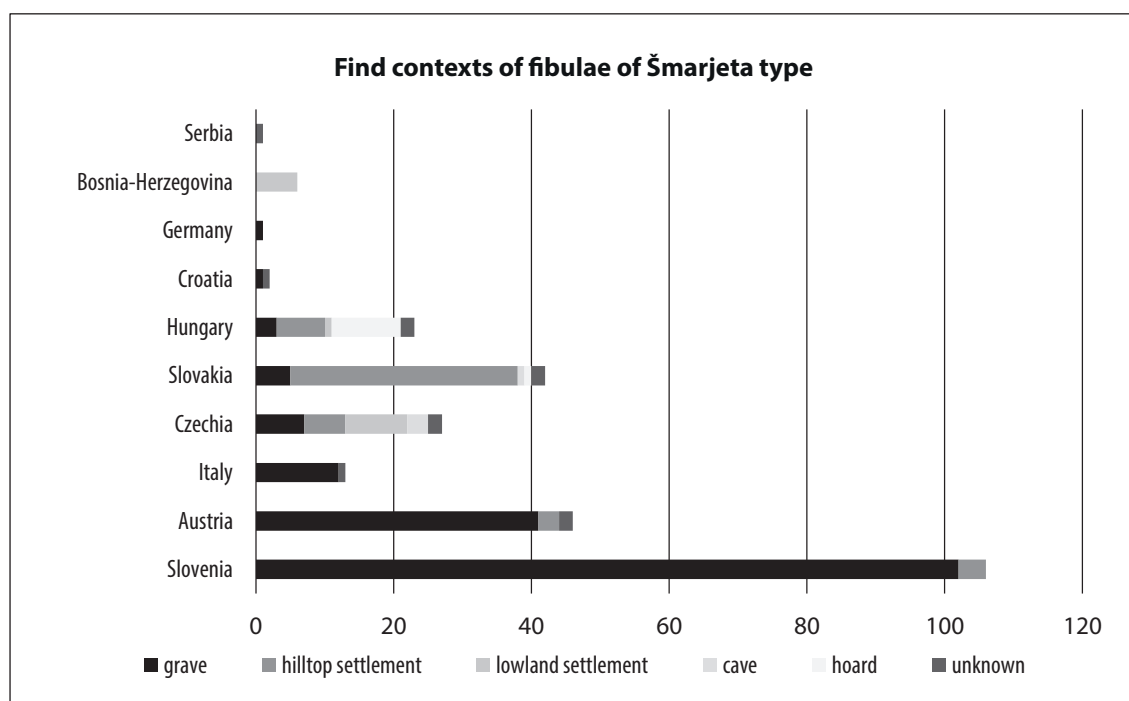


Fig. 3. Find contexts of fibulae of Šmarjeta type

The area of the distribution of Šmarjeta fibulae features three sites, which are absolutely untypical by the number of the evidenced fibulae: Hallstatt (36 pieces), eponymous site Šmarjeta (30 pieces) and the hillfort Smolenice “Molpír” (26 pieces) in Southwestern Slovakia. Only the site of Smolenice “Molpír” represents a settlement site. Fibulae of Šmarjeta

type have been discovered here within the 3rd yard (so called acropolis). Furthermore, it is possible to locate some unfinished fibulae (not of Šmarjeta type) in this yard, particularly close to the excavated gates no. 3 and 4 as well as in the area known as the cult place (Felcan, Stegmann-Rajtár, Tirpák 2019, Fig. 5).

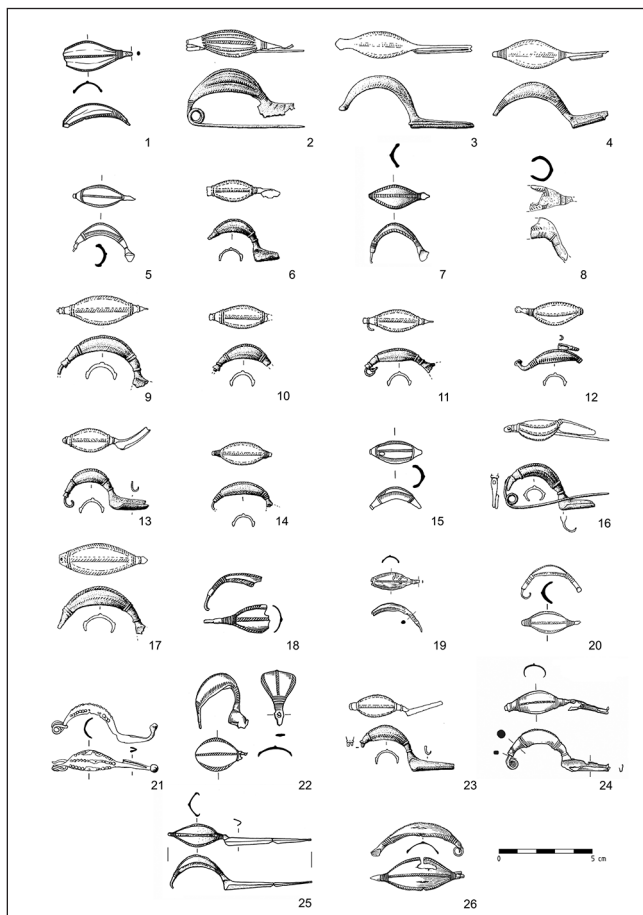


Fig. 4. The boat shaped fibulae of Šmarjeta type in Moravia. 1. Bílovice-Lutotín “Zadní Hony” (6); 2. Brno-Obřany “Široké” (11); 3., 4. Habrůvka “Býčí skála” (21); 5. Hustopeče “Lány” (24); 6. Jaroměřice n. R. “Hradisko” (27); 7. Křhov “Malý Chlum” (31); 8. Lechovice u Pavlova “Obersko” (33); 9.–13. Marefy “Člupy” (39); 14. Měnín (40); 15. Měrovice nad Hanou “Babiny” (41); 16. Nezamyslice (47); 17. Opava-Kylešovice (50); 18. Polkovic “Ostrov” (53); 19. Prostějov-Domamyslice “Vinohrádky” (56); 20, 21. Provodov-Ludkovice “Rysov” (57); 22. Slatinice “Na stráži” (65); 23. Sloup “Kůlna” (66); 24. Těšetice “Sutny” – obj. 264 (73); 25. Velké Opatovice “Hradisko” (78); 26. Zdounky-Něččice “U trati” (81). The numbers in parentheses refer to Table 1

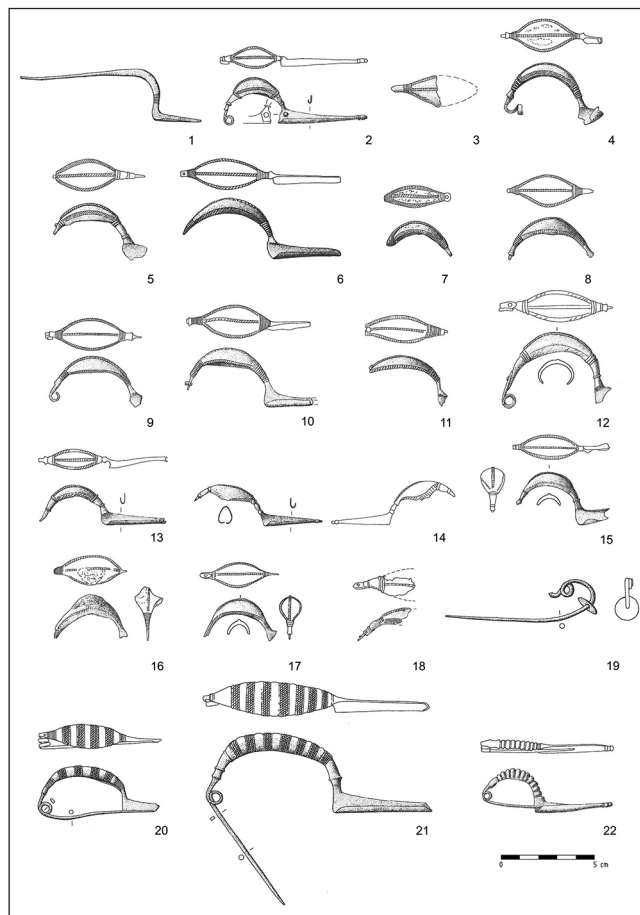


Fig. 5. The analyzed fibulae from Smolenice “Molpír”. 1. House 23; 2. 8 without context; 3. House 62; 4–5. House 61; 6. House 37; 7. House 2; 9. House 45; 10–12. House 46; 13. House 8; 14–15. House 15; 16, 19. House 16; 17. House 21; 18. Gate III; 20. Cult place; 21. House 37; 22. Gate IV (after Novotná 2001, Taf. 17: 154; 18: 170–175, 177, 182–183; 19: 186–188, 191–195; 21: 233–234; 22: 253; 23: 279)

THE PURPOSE OF THE MEASUREMENT AND THE METHOD

The purpose of the XRF measurement² of the selected examples of the Šmarjeta fibulae and several pieces of relative boat shaped fibulae from Slovakia and Moravia was an attempt to find out the hypothetic relationships between various finds of these fibulae from the point of the view of their composition of the bronze or their manufacturing technologies. Measured data from fragments and especially from semi-products of fibulae of another type should serve to validate the hypothesis of a possible local origin of the Šmarjeta fibulae from Smolenice. The Šmarjeta fibulae were long time regarded as

² The instrument used for XRF measuring of individual fibulae was Olympus Vanta VMR ED-XRF handheld spectrometer including rhodium (Rh) anode, 50 kV X-ray tube and large-area silicon drift detector (SDD). Since the alloy is not homogenous, we realized more measurements in each case, because the results of only one measurement provides values which in reality do not fully represent the characteristic of a bronze material. All measuring were realized by M. Cihla.

a uniform group of the products with supposed origin in the Southeast Alpine area. As it has been already mentioned, the observations of M. Felcan, M. Tirpák and S. Stegmann-Rajtár (2019) indicated the possibility of the independent manufacture in Smolenice “Molpír”. Thus, our research was realized as an initiative stimulated by the activity of three above mentioned researchers with the purpose to verify this very interesting idea of independent evolution of Šmarjeta fibulae in more manufacturing centers.

The suitability of the XRF for the analysis of the composition of various alloys has been discussed since the long time. The negative opinion about this method has expressed for instance E. Pernicka (Pernicka 2014, 245). On the contrary a particular suitability of this method, under some conditions, was stressed by some other scholars (cf e.g. Radivojević *et al.* 2018). The problem of the method resides in the fact that it provides an information only from the surface of the investigated item, not from its core. It is obvious that many invasive methods provide

more complex information on the composition of the metal alloy. The degradation of copper alloys typically results in the formation of a corrosion layer enriched by the alloying metals, when compared with the intact metal core. Different soil types may also influence the corrosion. However, it seems that the suitable setting of our measuring device is able to filter out the disturbing elements of the corruptions, also when its layer is in all measured cases only microscopically thin. Nevertheless, we must point out, that we are fully aware of the fact that our data are only semi-quantitative, thus causing certain relativity of our results. However, it must be stressed, taking into considerations the non-homogeneity of the bronze, that also the destructive analyses provide only the limited information on the composition of the alloy in the place of the sample. In this regard, the XRF measurement, providing the unlimited possibility of measurements, yield perhaps more complex information on the alloy composition, than one or two samples analyzed by the destructive methods. Furthermore, the repeatedly made sampling of the researched item by the destructive method is impossible, since it may cause practical damage to the object.

Also the brand new and frequently used method of the analysis of the isotopes of the lead is also invasive. Moreover, this method provides information on the origin of individual ores, not products. This may be also somewhat problematic, since it is never granted that the site of the manufacture of the bronze and site of the manufacture of particular item is the same. For this reason the described method would not be perhaps fully suitable for our research.

Nevertheless, a decisive factor in method's choice is represented by the approach of the museum's curators, which make a decision on that if the invasive method will be permitted or not. In situations, when the invasive method was not permitted, the only remaining approaches are the non-invasive ones.

In our case, it was not possible to remove patina or make any destructive sample preparation because of restrictions from artefacts owners.

The advantage of using XRF method for studying alloy composition is also the fact that it gives us absolute values applicable to statistical and multi-variation tools. PCA and correspondence analysis were applied to the XRF spectra to highlight the compositional similarities between the analyzed fibulae (Fig. 6–8). The plots show that the variance in the data depends mainly on copper, tin, iron and silver. The XRF technique, in combination with typological and multivariate methodology, proved to be a powerful and efficient tool to obtain valuable information from a large set.

Thus, we aim our research to provide an information about the character of the fibulae alloys, with certain potential to create particular groups of items with similar composition or to trace the fibulae with anomalies, etc. The groups defined in this way may be then considered together with typology of the fibulae, with certain technical features identified on them or with other manufacturing specifics. The results should then provide an information needed for sketching the relationships between individual pieces or groups from the point of the view of their spatial distribution.

RESULTS

As for the composition of the metal alloy, two different groups emerged from the series of measurements. The group 1 is characteristic by the proportional amount of the copper and tin, up to the ratio of 1/1 and does not contain in most cases the admixture of silver. The fibulae which belong to this group are the pieces Smolenice 10961, Smolenice 11354, Smolenice 11353,

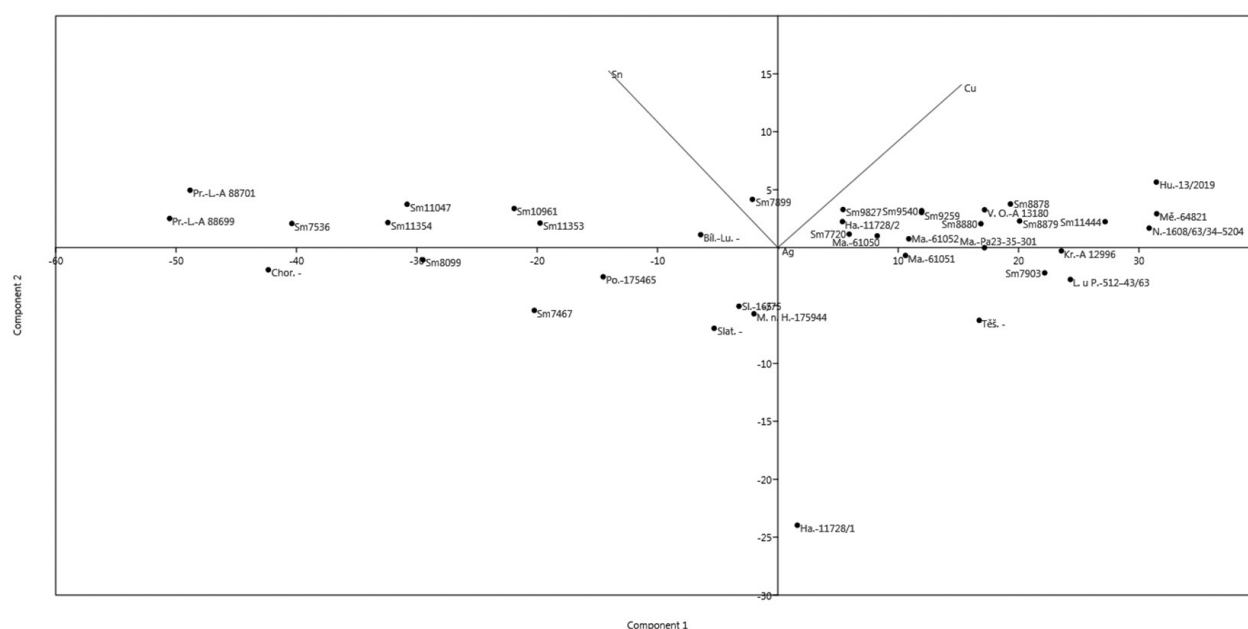


Fig. 6. PCA plot for selected elements (copper, tin, silver) in XRF spectra

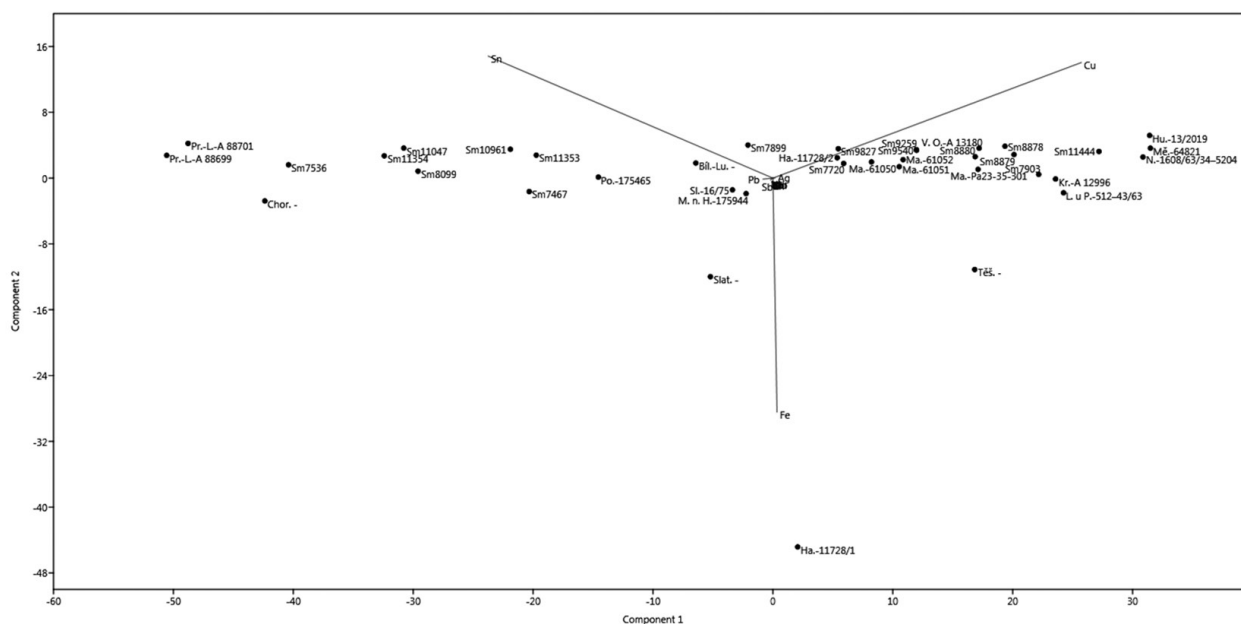


Fig. 7. PCA plot for all measured elements by XRF method

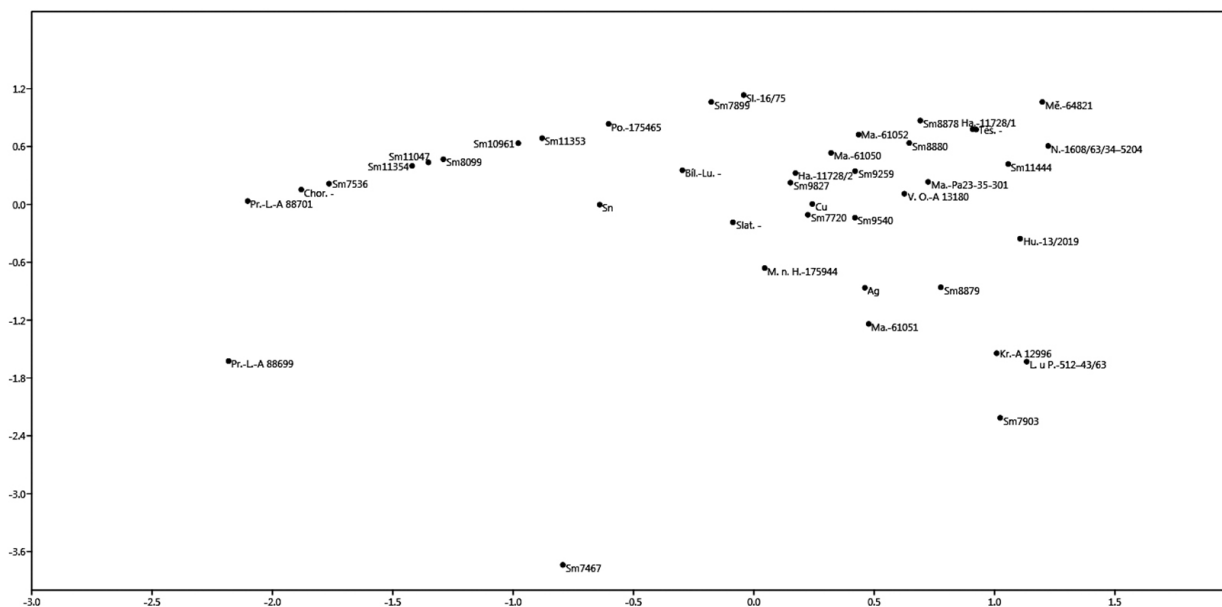


Fig. 8. Results of correspondence analysis for selected elements (copper, tin, silver)

Smolenice 11047, Smolenice 8099, Smolenice 7536, Smolenice 7467, Smolenice 11140, Smolenice 7709, Provodov-Ludkovice 1 A 88699, Sloup 16/75, Polkovice 175465, Provodov-Ludkovice 2 A 88701, Bílovice-Lutotín, Slatinice or Chornice.

The group 2 is on the contrary characteristic by a disproportion in the representation of these two elements, whereas the amount of the copper significantly exceeds the amount of the tin. This group is in many cases also characteristic by the presence of the silver. The fibulae falling into this group are Smolenice 9235, Smolenice 11444, Smolenice 9827, Smolenice 9540, Smolenice 9259, Smolenice 8880, Smolenice 8879, Smolenice

8878, Smolenice 7903, Smolenice 7899, Smolenice 7720, Smolenice 9074/A, Smolenice 9744/A, Smolenice 10100/A, Těšetice, Habrůvka 1 11728/1, Měnin 64821, Marefy 1 Pa 23-35-301, Marefy 4 61052, Habrůvka 2 11728/2, Marefy 3 61051, Měrovce n. Hanou 175944, Hustopeče 13/2019, Marefy 2 61050, Krhov A 12996, Velké Opatovice A 13180, Lechovice u Pavlova 512-43/63 and Nezamyslice 1608/63/34-5204.

As for the contain of lead, some Moravian fibulae, particularly finds from Měrovce nad Hanou and Sloup, show significantly higher amount. This can be explained by the necessity of having a more malleable alloy.

An interesting composition shows the fibula Smolenice 11147. It belongs also to the group where the copper and the tin are not equally represented, however in the reverse relationship, when the amount of the tin exceeds the amount of the copper. The same feature may be observed also in case of the fibula Provodov-Ludkovice 2 A 88701. Here the differences are emphasized by the fact that this fibula represents also typologically different variant. It may be characterized as a conglomerate of the boat shaped fibula and *Fußzierfibel* type which is characteristic for the Late Hallstatt period. This fibula could be also understood as an evidence of the influence of the Šmarjeta fibulae on the later Hallstatt fibulae.

The fibula Smolenice 9235, although not Šmarjeta type but a bow fibula, represents a prefabricate or semi-finished product, which confirms the supposition of the manufacture of the fibulae in this hillfort. This fibula falls into one of the two above mentioned group, namely to that showing the disproportional amount of the copper and tin, where the amount of the copper significantly exceeds the amount of the tin (group 2). Considering this, we could perhaps suppose that the exemplars of the group 2, with similar composition as in the case of the fibula Smolenice 9235, represent local products. However this preliminary supposition must be verified by the future research.

Some fibulae of the Šmarjeta type are also characteristic by the use of the iron parts. These bimetallic fibulae are typical for Moravia and occur also in Southeast Alpine area. On the contrary Smolenice finds are manufactured exclusively from bronze. This phenomenon represents again an interesting feature, which makes the Smolenice production specific and may confirm to the supposition of the production of the Šmarjeta fibulae here.

Dealing with the use of the iron in the design of Šmarjeta fibulae, it may be of course explained by the reparations of the fibulae, etc. Nevertheless, we should not neglect also other possible interpretation concerning the technological or decorative reasons. As well known, the iron is more resistant than bronze. The frequent crooking of the bronze needle of the fibula, caused by its use, may be solved by the use of the iron needle, which could prevent a frequent warping. Moreover, it must be pointed out that our imagination of the corroded ugly iron is very distant from the original look of this metal characteristic with the silver-like gloss. Thus, the use of the iron elements could have been also caused by the specific decorative role of this metal. The use of the iron for the decorative purposes together with bronze is in the Early Iron Age milieu known also in case of some other jewellery, such as bimetallic needles, etc. (cf. Reiter *et al.* 1994, 75–84; Vokolek 1999, tab. 48:3; Reinhard 2004, 40–41; Půlpán 2008, obr. 6:15; Půlpán 2012, 56, tab. 18: 41; Trefný, Cihla, Polišínský 2020).

Some Moravian examples (Těšetice; Habrůvka 1) showed (by XRF measuring and also visually) the abnormal presence of the iron in the spring of the fibulae and in its vicinity. This fact seems to be surprising. If these fibulae would be the *Fußzierfibeln*, then the presence of the iron could be explained as a result of the corrosion of the iron axis in the spring. But Šmarjeta fibulae are usually produced as one piece fibulae with unilateral spring, not with bilateral which has an axis. The presence of the iron in the spring is also not explicable

by the reparations etc. We must admit that we are not able in the moment to explain this phenomenon. Perhaps it cannot be ruled out that it may be somehow connected with hypothetical later interventions.

Results of XRF measurements also precised our observations relating to construction and reparations of the fibulae. Several exemplars were repaired by using a rivet, which is usually placed on the transition from the head to the spring as it is point that is most subjected to cracking. Therefore, it can be assumed that the rivet served as an element of reparation. Other fibula of Šmarjeta type from “Molpír” has rivet situated between the bow and the pin catch. Based on XRF measurements, composition of the both parts were homogenous in the terms of main and trace elements. Thus, we can suppose that the rivet is used in this case as a reparation tool of the broken place of the fibula. Nevertheless, it is necessary to point out, that such conclusions may be related to researched “Molpír” fibulae. However, it cannot be generally excluded, that some other fibulae with parts connected together by a riveting found out of Smolenice “Molpír”, may feature this technical element as a normal part of their construction, not reparation.

CONCLUSION

The XRF research of the fibulae of the Šmarjeta type from the significant central place Smolenice “Molpír” in the Southwestern Slovakia and from several Moravian sites has revealed one substantial finding, namely the material non-homogeneity of this type of the fibulae. This finding seems to confirm the earlier conclusions of the Slovak colleagues in that sense, that the hillfort Smolenice “Molpír” was with high probability the place of the independent manufacture of Šmarjeta fibulae (Felcan *et al.* 2019). Some results of the research of the Moravian pieces indicate, that also some of the Moravian pieces need not be necessarily the product of the Southeastern Alpine area as considered up to now. Unfortunately, we are lacking similar data for verification from the Southeast Alpine region. Finally the XRF research together with the typological classification of one Moravian find (Provodov-Ludkovice 2) supported an idea of the surviving of particular typological features of the Šmarjeta fibulae also in the Late Hallstatt period.

The supposition of the individual manufacture of Šmarjeta fibulae in two, but most likely in more sites, should affect also the perception of the role of the Šmarjeta fibulae in the long distance contacts. We considered up to now these fibulae to be the particular indicator of the movement of individuals along the eastern fringes of the Alps on so called Amber route. Taking into account that these fibulae might be produced in more centers, it is necessary also to rethink the imagination of their spatial distribution. Although there is no doubt, that these fibulae keep further the function of the marker of the courses of the long distance routes, their occurrence in a particular zone or site need not be further interpreted only as a result of the contact with the Southeast Alpine zone, but possibly with other sites or significant zones, where their production may be supposed.

Table 1. Complete list of the boat shaped fibulae of Šmarjeta type in Europe

Id	Site	pcs	Typology by B. Jerin 2001				Country	Context	References
			2b	2c	2d	?			
1	Abrahám	2			2		Slovakia	grave	Novotná 2001, Taf. 19: 196, 199
2	Alland "Buchberg"	1	1				Austria	hillfort	Glunz 1997, 185
3	Bačka	1	1				Serbia	unknown	Vasić 1999, 88, Taf. 43: 658
4	Bajna "Órhegy-alja"	1	1				Hungary	unknown	Grahek 2004, Fig. 33
5	Baldaria	2		2			Italy	grave	Eles Masi 1986, 128, Tav. 101: 1181, 1182
6	Bilovice-Lutotín "Zadní hony"	1	1				Czechia	settlement	Golec, Fojtík 2020, obr. 35: 1
7	Bostajn "Mali Lukovec"	1	1				Slovenia	grave	Glunz 1997, 185
8	Breg-Frög	2	2				Austria	grave	Grahek 2004, Fig. 33
9	Brezje pri Trebelnem	4	3	1			Slovenia	grave	Jerin 2001, Kar. 2
10	Brinjeva gora	1	1				Slovenia	hillfort	Teržan 1990, 220
11	Brno-Obrány "Široké"	1	1				Czechia	grave	Říhovský 1993, Taf. 14: 136
12	Cellödömlök "Sághegy"	4	4				Hungary	hillfort	Teržan 1990, 220
13	Corigliano Calabro "Cozzo Michelichio"	1		1			Italy	grave	Pace 2001, Fig. 3: 6
14	Dalj	1	1				Croatia	grave	Teržan 1990, 220
15	Dietenberg	1	1				Austria	unknown	Teržan 1990, 220
16	Dobrava pri Dobrniču	1	1				Slovenia	grave	Glunz 1997, 185
17	Donja Dolina	6	4	1	1		Bosnia a Herzegovina	settlement	Teržan 1990, 220; Jerin 2001
18	Drössing	1	1				Austria	unknown	Glunz 1997, 185
19	Este	9	1	8			Italy	grave	Eles Masi 1986, 128, Tav. 101: 1175–1180; 102: 1183–1185
20	Gilgenberg	1	1				Austria	grave	Stöllner 2002, 452
21	Habrůvka "Býčí skála"	2	2				Czechia	cave	Říhovský 1993, Taf. 14: 142, 143
22	Hallstatt	36	30	1	5		Austria	grave	Glunz 1997, 184; Jerin 2001, Kar. 2
23	Horné Orešany "Slepý vrch"	1	1				Slovakia	hillfort	Pieta 2007, Fig. 3: 4
24	Hustopeče "Lány"	1	1				Czechia	settlement	unpublished (Thanks F. Trampota for the information)
25	Chornice 2c	1	1				Czechia	settlement	unpublished (Thanks D. Vích for the information)
26	Chotín	1	1				Slovakia	unknown	Novotná 2001, Taf. 18: 176
27	Jaroměřice n. R. "Hradisko"	1	1				Czechia	hillfort	Říhovský 1993, Taf. 14: 144
28	Kesthely "Árpád u"	2			2		Hungary	grave	Teržan 1990, 220
29	Kisravazd-Ravazd	10	10				Hungary	hoard	Teržan 1990, 220
30	Kranj	1	1		1		Slovenia	grave	Glunz 1997, 185; Jerin 2001, Kar. 2
31	Krhov "Malý Chlum"	1	1				Czechia	hillfort	Novák 2015, tab. 34: 9
32	Lábatlan "Eisenbahn"	1	1				Hungary	unknown	Teržan 1990, 220
33	Lechovice u Pavlova "Obersko"	1	1				Czechia	hillfort	Novák 2020, Tab. 1: 9
34	Leodagger "Sonnenwendberg"	1	1				Austria	hillfort	Puschnik 2013, Abb. 34, 35
35	Letanovce "Čertova diera"	1			1		Slovakia	cave	Novotná 2001, Taf. 19: 198
36	Libna	4	3		1		Slovenia	grave	Jerin 2001, Kar. 2; Grahek 2004, Fig. 33; 34
37	Magdalenska gora "Voselca"	9	8		1		Slovenia	grave	Jerin 2001, Kar. 2; Grahek 2004, Fig. 33; 34
38	Malá nad Hronom	1	1				Slovakia	grave	Novotná 2001, Taf. 19: 197
39	Marefy "Člupy"	5	5				Czechia	grave	Říhovský 1993, Taf. 14: 145–149
40	Měnín	1	1				Czechia	unknown	Říhovský 1993, Taf. 14: 150
41	Měrovice nad Hanou "Babiny"	1	1				Czechia	settlement	Golec, Fojtík 2020, obr. 35: 15
42	Metlika Hrib	2	1		1		Slovenia	grave	Grahek 2004, Fig. 33; 34

Id	Site	pcs	Typology by B. Jerin 2001				Country	Context	References
			2b	2c	2d	?			
43	Mezőörs-Alsótág	1	1				Hungary	grave	Grahek 2004, Fig. 33
44	Mokronog "Preloge"	7	7				Slovenia	grave	Jerin 2001, Kar. 2
45	Most na Soči-Sveta Lucia II	14	14				Slovenia	grave	Glunz 1997, 184
46	Murska Sobota	2	2				Slovenia	grave	Grahek 2004, Fig. 33
47	Nezamyslice	1	1				Czechia	grave	Říhový 1993, Taf. 14: 137
48	Nitrianska Blatnica "Marhát"	1	1				Slovakia	hillfort	Jakubčinová 2008, Fig. 1: 14
49	Nové Zámky	2	2				Slovakia	grave	Stegmann-Rajtár 2009, tab. VII: 2; XIX: 1
50	Opava-Kylešovice	1	1				Czechia	unknown	Říhový 1993, Taf. 14: 151
51	Osredek pri Čužnji vasi	1	1				Slovenia	grave	Dular 2003, Taf. 19: 12
52	Podzemelj	2	2				Slovenia	grave	Grahek 2004, Fig. 33
53	Polkovice "Ostrov"	1	1				Czechia	settlement	Čížmář, Čížmářová, Kejzlar 2011, obr. 4: 6
54	Poštela pri Razvanju	1	1				Slovenia	hillfort	Teržan 1990, Fig. 45: 4
55	Prašník "Tlštá hora"	4				4	Slovakia	hillfort	unpublished (Thanks R. Čambal for the information)
56	Prostějov-Domamyslice "Vinohrádky"	1	1				Czechia	settlement	Golec, Fojtík 2020, obr. 35: 26
57	Provodov-Ludkovice "Rysov"	2	1			1	Czechia	hillfort	Novák 2017, tab. 1: 3, 5
58	Prozor	1	1				Croatia	unknown	Teržan 1990, 220
59	Ptuj "Rabeljčja vas"	1			1		Slovenia	hillfort	Teržan 1990, Fig. 7: 2
60	Rifnik	1				1	Slovenia	hillfort	Teržan 1990, 220
61	Rovišče pri Studencu	2	1	1			Slovenia	grave	Jerin 2001, Kar. 2; Grahek 2004, Fig. 33
62	Sankt Georgen an der Stiefing	1			1		Austria	grave	Teržan 1990, Fig. 33: 4
63	Schambach, Lkr. Straubing-Bogen	1	1				Germany	grave	Glunz 2019, Abb. 1: 6
64	Sklabinský Podzámok "Katova skala"	1	1				Slovakia	hoard	Pieta, Veliačik 2014, Fig. 7: 9
65	Slatinice "Na stráž"	1	1				Czechia	settlement	Golec, Fojtík 2020, obr. 35: 27
66	Sloup "Kůlna"	1	1				Czechia	cave	Říhový 1993, Taf. 14: 152
67	Smolenice "Molpír"	26	25		1		Slovakia	hillfort	Novotná 2001, Taf. 18: 168–175, 177–182; 19: 183–188, 191–195, 200
68	Stična ("Gríže", "Vir", "Žvajdrga")	18	18				Slovenia	grave	Jerin 2001, Kar. 2
69	Stupné "Žeravica"	1	1				Slovakia	hillfort	Fröhlich 2016, Fig. 12
70	Suhadole	1			1		Slovenia	grave	Dular 2003, Taf. 91: 5
71	Šentjernej	1		1			Slovenia	unknown	Jerin 2001, Kar. 2
72	Šmarjeta ("Družinska vas", "gomile pri Mladih vinih", "Ivanec pri Družinski vasi", "Straža nad Osrečjem", "Vinji Vrh")	30	24	6			Slovenia	grave	Jerin 2001, Kar. 2
73	Těšetice "Sutny"	1			1		Czechia	settlement	Golec 2003, 359, obj. 264: 10, a new drawing by Jitka Molčíková
74	Vače	1			1		Slovenia	grave	Grahek 2004, Fig. 34
75	Vát "Bodon-tábla"	1	1				Hungary	settlement	Molnár, Farkas 2010, Abb. 18: 1
76	Velem "Szentvid"	3	3				Hungary	hillfort	Grahek 2004, Fig. 33
77	Velike Malence	2	2				Slovenia	grave	Grahek 2004, Fig. 33
78	Velké Opatovice "Hradisko"	1	1				Czechia	hillfort	Novák 2015, tab. 34: 8
79	Wildon	1				1	Austria	grave	Teržan 1990, 220
80	Wohrschach "Wolkenstein"	1	1				Austria	hillfort	Glunz 1997, 185
81	Zdounky-Nětčice "U trati"	1	1				Czechia	settlement	Golec, Fojtík 2020, obr. 35: 39
82	not located	1				1	Italy	unknown	Eles Masi 1986, 128, Tav. 102: 1186
83	not located	1	1				Slovakia	unknown	Novotná 2001, 75, Taf. 19: 190
84	not located	1	1				Slovenia	unknown	Jerin 2001, Kar. 2

Table 2. Complete list of analyzed fibulae from Moravia and Slovakia with measured composition using XRF technique. Grey color in the row indicates group 1, white indicates group 2. Grey color in the N. column indicates fibulae from Moravia, white indicates pieces from Slovakia.

Fig.	N.	ID	castr/registration No.	Ti	V	Cr	Mn	Fe	Co	Ni
5:1	1	9	Smolenice semi-finished bowfibula 9235	0	0	0	0		0	0,34500432
		10		0	0	0	0		0	0,377388507
		11		0,074210808	0	0	0		0,023796823	0,480244577
		12		0,160710394	0	0	0		0	0,273931712
5:2	2	13	Smolenice 11444	0,095690154	0	0	0		0	0,370572001
		14		0	0	0	0		0	0
		15		0,070274815	0	0	0		0,008565247	0,309359074
		16		0,091333911	0	1	0		0,009241836	0,324481636
5:3	3	17	Smolenice 10961	0	0	0	0		0	1,38491786
		18		0	0	0	0		0	0,999726772
		19		0	0	0	0		0	1,19991732
5:4	4	20	Smolenice 11354	0,315526187	0	0	0		0,151694193	0,736046374
		21		0,387053788	0	0	0,059861787		0,102313869	0,629286587
		22		0,173310339	0	0	0		0,07873971	0,394492328
		23		0,971037626	0	0	0		0,122600295	0,58718282
5:5	5	24	Smolenice 11353	0,503362715	0	0	0,055676747		0	0,28820914
		25		0,594406962	0,030076796	0	0,051691197		0	0,31260246
		26		0,589278102	0	0	0,032172166		0	0,311324
		27		0	0	0	0,031498056		0	0,473378181
5:6	6	28	Smolenice 11047	0,248313695	0	0	0		0,04523344	0,704544187
		29		0	0	0	0		0	0
		30		0	0,277607888	0	0		0	0,560151994
5:7	7	31	Smolenice 9827	0,188597366	0	0	0		0,048406933	0,674785435
		32		0,088812672	0	0	0	0,146712705	0,020226404	0,332846671
		33		0,517063379	0	0	0	0,241911575	0	0,177224264
5:8	8	35	Smolenice 9540	0,167524472	0	0	0	0,371058404	0	0,318706602
		36		0	0	0	0	0,298284352	0	0
		37		0,12588799	0	0	0,019172017	0,381476283	0	0,012476028
5:9	9	38	Smolenice 9259	0,187232077	0	0	0	0,097849608	0,024301495	0,873387635
		39		0	0	0	0		0	0,187083632
		40		0,437938094	0	0	0	0,28277269	0	0,086612776
		41		0	0	0	0	0,17463024	0	0,243098781
5:10	10	42	Smolenice 8880	0	0	0	0	0,34736985	0	0,093064047
		43		0	0	0	0	0,275624782	0	0,10323213
		44		0,816499829	0	0	0,022573113	0,928210258	0	0,132368892
		45		0	0	0	0	0,196512505	0	0,270357072
		46		0	0	0	0	0,962329388	0	0,095502235
5:11	11	47	Smolenice 8879	0	0	0	0	0,207374275	0	0,073122099
		48		0	0	0	0	0,443353921	0	0,136283532
		49		1,04378831	0	0	0,017749161	0,676378071	0	0,178649157
5:12	12	50	Smolenice 8878	0	0	0	0	0,247188359	0	0,040936325
		51		0	0	0	0	0,240075648	0	0,034620985
		52		0	0	0	0	0,264668167	0,016210849	0,13434808
		53		0	0	0	0	0,208605111	0	0,136664316
5:13	13	54	Smolenice 8099	0,356553614	0	0	0,328148365	0	0	0,523726106
		55		0	0	0	0	0	0	0

Cu	Zn	Zr	Nb	Mo	Ag	Cd	Sn	Sb	Pb	Bi
77,8803329	0,296552688	0	0	0	0	0	19,4429932	0	1,18430948	0,061960276
73,9712448	0,222018763	0	0	0	0	0	21,5542698	0	1,07796919	0,061532326
80,2209549	0,174066827	0	0	0	0,123374067	0	16,7655544	0	1,3916198	0,050433993
81,5096283	0,211401269	0	0	0	0,532144904	0	14,5611286	0,737912536	0,949260354	0,031987786
85,059288	0,128526419	0	0	0	0,799928248	0	11,4845505	0,903781772	1,05308855	0,02256345
95,5254135	0,506223261	0	0	0	0	0	0	0	3,6873343	0
85,3549728	0,135569781	0	0	0	0	0	12,0802584	0,853180349	1,05710149	0,037278533
85,8843765	0,120800868	0	0	0	0,518260121	0	10,8766518	0,433473259	1,64692831	0,045219433
50,071476	0,636165023	0	0	0	0	0	44,0179367	0	2,11538434	0,269273609
42,1637039	0,176974922	0	0	0	0	0	54,1973724	0	2,09511447	0
65,6509933	0,431980342	0	0	0	0	0	29,9918385	0	2,05000281	0
35,9804993	0,156985149	0	0	0	0	0	56,8148918	0,554508328	3,87582803	0,234507576
34,1006508	0,123738714	0,00861167	0	0	0	0	56,8256454	0,578730226	3,70527244	0,217148244
68,7324295	0,32735917	0	0	0	0	0	26,9363174	0	2,87909698	0,143216193
37,5700569	0,17982699	0	0	0	0	0	55,2375488	0,616670012	2,98091292	0,17840524
55,5676231	0,115900517	0,00768653	0	0	0	0	37,4852524	0,914033592	1,64311981	0,040785041
58,3164215	0,18790096	0,00677182	0	0	0	0	34,711689	0,919335485	1,23271894	0,04609381
58,8786888	0,231269941	0	0	0	0	0	34,7135735	0,913751721	1,84227026	0,036987748
40,6751709	0,149919391	0	0	0	0	0	54,5018883	1,28164721	1,85092795	0,022193467
49,6307487	0,550510108	0	0	0,003439798	0	0	46,0734711	0,992751718	1,40013242	0,047107067
44,0310478	1,19908404	0	0	0	0	0	50,4549904	0	3,09277439	0
45,3530083	0,540052772	0	0	0	0	0	50,5761528	0,993281305	1,2732501	0,069608182
67,6118763	1,04151809	0	0	0	0	0	28,5132923	0,886205733	0,870947361	0,057059761
71,9404526	0,395061225	0	0	0	0,424351841	0	25,3216057	0,734564066	0,580784142	0,014534572
78,4279022	0,446053922	0	0	0	0,346822709	0	18,6054668	0,619763494	0,590964854	0,026825957
69,3193665	1,14152038	0	0	0	0,485790163	0	25,7700882	0,902724564	1,50002551	0,023198303
78,475769	0	0	0	0,01641598	0,36526233	0	19,4762669	0,685940504	0,682064414	0
84,3876801	0,151778504	0	0	0	0,308918744	0	13,6916075	0,542668641	0,378335834	0
67,4155807	0,156797379	0	0	0	0	0	27,4106159	1,04315758	2,76433945	0,026742013
79,5902405	0,075716995	0	0	0	0,421250284	0	17,7212658	0,724187672	0,935394049	0
81,3566895	0,073170498	0	0	0	0,396354169	0	16,0153351	0,692140341	0,658990443	0
80,7704086	0,093882456	0	0	0	0,236164182	0	16,9956474	0,431893975	1,03013301	0,024140708
82,9472656	0,156107679	0	0	0	0,33665204	0	13,6932735	0,763784945	1,66247988	0
80,8947678	0,117728978	0	0	0	0	0	15,3998051	0,696588933	2,48609662	0,026154708
82,4463806	0,09867537	0,011517658	0	0	0,364198744	0	12,4040661	0,698489606	2,07702398	0
72,0219498	0,262515217	0	0	0	0	0	23,0708256	0	4,17784214	0
32,9233551	0,163602799	0	0	0	0,384263754	0	12,8267403	0,814077318	1,8301307	0
84,4439545	0,118328296	0	0	0	0,540214479	0	12,5583115	1,03279436	1,02589798	0
79,0843201	0	0	0	0	0,741282761	0	17,0643616	1,31242681	1,21796799	0
84,7777023	0,100249052	0	0	0,003163513	0,567387462	0	10,8085947	0,876049042	0,950291574	0
84,4602661	0,087506995	0	0	0	0,134368509	0	14,3025255	0,190629587	0,521661878	0,014916183
84,1256256	0,102469273	0	0	0	0,145454764	0	14,6529284	0,200665116	0,48432219	0,013835844
79,745163	0,206602335	0	0	0	0,159564897	0	18,4012375	0,234692931	0,819699168	0,017815759
84,496109	0,131087109	0	0	0	0,238147542	0	12,9262753	0,441989273	1,42112327	0
50,3453102	0,600605786	0	0	0	0	0	37,9035912	1,73770773	6,10761452	0,086884528
37,7622871	0,446556777	0	0	0	0	0	51,3315811	0	8,28239346	0

Fig.	N.	ID	cadastr/registration No.	Ti	V	Cr	Mn	Fe	Co	Ni
5: 14	14	56	Smolenice 7903	0,101613663	0	0,006423048	0	0,597909331	0	0,29444477
		57		0	0	0	0	0	0	0
		58		0,330812335	0	0	0	0	0	0,35326311
5: 15	15	59	Smolenice 7899	0,381582439	0	0	0	0,132754937	0,009828174	0,31983012
		60		0,273773193	0	0	0	0,141959742	0,028951235	0,364519596
5: 16	16	61	Smolenice 7720	0	0	0	0	0,787757516	0,06171095	0,188137665
		62		0,116763525	0	0	0,017710563	0,806748807	0,039392438	0,192380905
5: 17	17	63	Smolenice 7536	0,305875808	0	0	0	1,59815884	0	0,63596189
		64		0	1,96043837	0	0	0,807535112	0	0
5: 18	18	65	Smolenice 7467	0,188101321	0	0	0,074857593	0	0	0,439634353
		66		0,439990997	0	0	0,031797968	0	0	0,410960525
—	19	67	Smolenice semi-finished product 11140	0,488142371	0	0	0	00	0	0,442654043
		68		0,360055625	0	0	0	0,604482472	0	0,498698264
—	20	69	Smolenice semi-finished product 11147	19,8408184	0	0	0	0,254537344	0	0,390764445
		70		4,51162052	0	0	0,033397693	0,879734516	0,046564579	0,768011391
		71		0,157809481	0	0	0	0,25532794	0,021797184	0,645712078
5: 19	21	72	Smolenice serpentine fibula 7709	0	0	0	0	0	0	0
		73		0	0	0	0	3,52627182	0	0
		74		0	0	0,047961466	0,034199644	0,871440232	0,362152338	0,232203707
		75		0,297792882	0	0	0		0,219366595	0
5: 20	22	76	Smolenice boat fibula with a recticular decoration on its bow 9074/A	0,256046414	0	0	0	0,582623363	0	3,01388812
		77		0,243581161	0	0	0	0,473911464	0,021757124	3,10461688
5: 21	23	78	Smolenice boat fibula with a recticular decoration on its bow 9744/A	0,158509463	0	0	0	0,059063878	0	0,229298115
		79		0	0	0	0	0,050762024	0	0,049865808
		80		0	0	0	0	0,508508921	0	0
5: 22	24	81	Smolenice bow fibula 10100/A	0	0	0	0	0,747641802	0	0
		82		0	0	0	0	0	0	0,100947112
4: 20	1	83	Provodov-Ludcovice 1 A88699	0	0	0	0,120652653	0	0	0,075073205
		84		0,225026235	0	0	0,037971903	0	0	0,046473291
		85		0,546735764	0	0	0,160000578	0	0	0,269012137
4: 24	2	86	Těšetice —	0,197661653	0	0	0	0	0	0,456383616
		87		0	0	0	0	21,2875023	0	0
		88		0	0	0	0,045265064	14,6299849	0	0
		89		0	0	0	0	0	0	0
4: 3	3	90	Habrůvka 1 11728/1	0,169753209	0	0	0	0	0	0,403088063
		91		0	0	0	0	93,0947037	0	0
		92		0	0	0	0	0	0	0,246497244
		93		0,09060 7949	0	0	0	14,4133434	0	0,181298614
4: 14	4	94	Těšetice 64821	0	0	0	0	0	0	0,044298176
		95		0	0	0	0	0,0501475	0	0,012604951
		96			0	0	0	0,078166895	0	0,069024168
		97			0	0	0	0,055716056	0	0,024221344
4: 9	5	98	Marefy 1 Pa 23-35-301		0	0	0,021313723	0,492841274	0	0,025053036
		99		0,186422259	0	0	0,132419109	1,7518127	0	0,062173579
		100			0	0	038215905	0,604235947	0	0,106043965

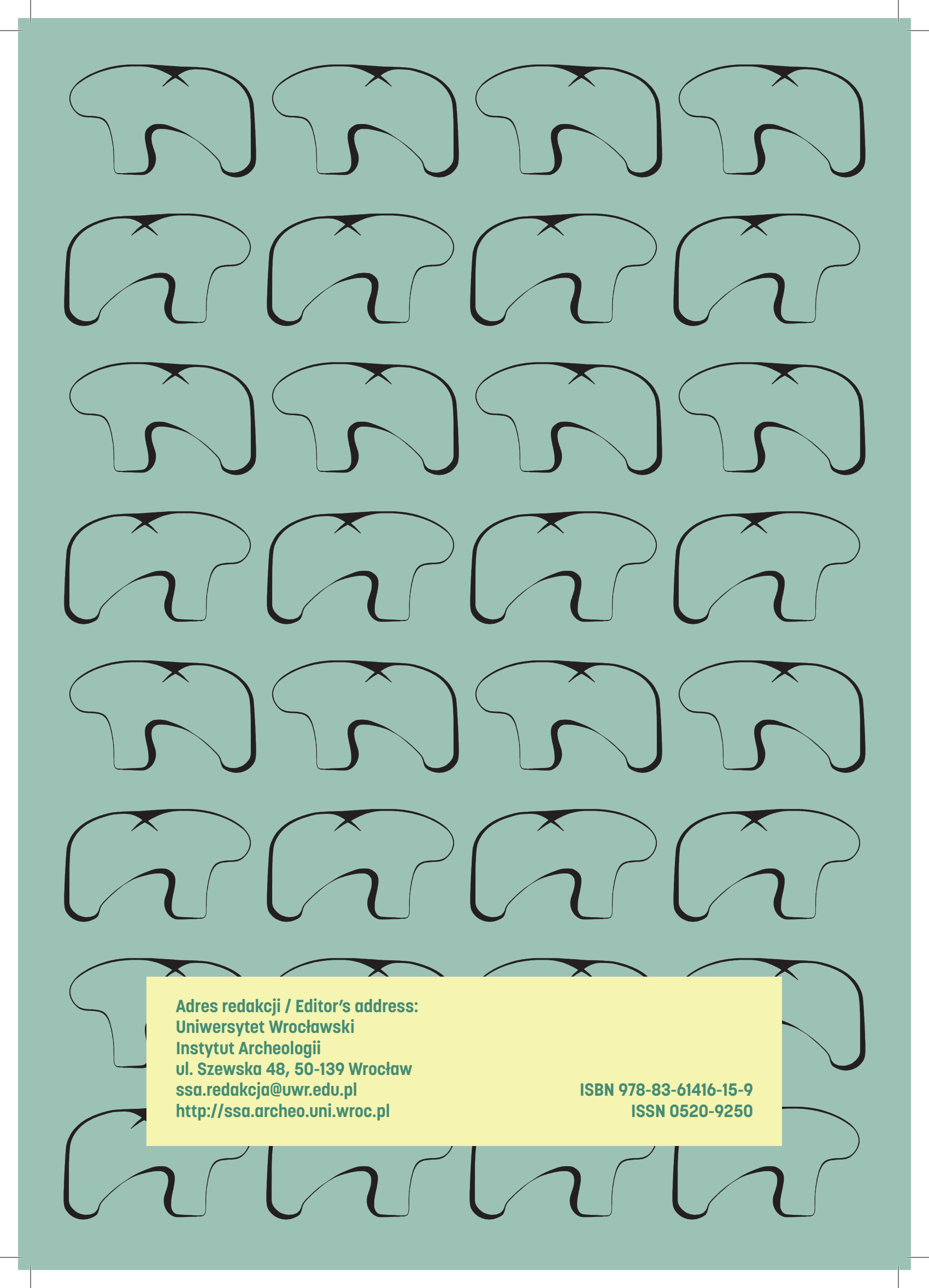
Cu	Zn	Zr	Nb	Mo	Ag	Cd	Sn	Sb	Pb	Bi
88,3177414	0,107534692	0	0		0,763372779	0	5,95596647	0,82332629	2,79156923	0,240099862
87,2447586	9,96080017	0	0		0	0	0	0	0	0
68,233284	0,269829601	0	0	0,0094202	2,03279686	0,135688171	20,3714523	2,53085351	3,80100584	0,294876039
67,6894073	0,192860708	0	0	0	0	0	29,8944778	0,355232507	0,946317494	0,077707455
67,7459259	0,17110306	0	0	0	0	0	29,9138699	0,363945603	0,922278225	0,073672511
74,7565994	0,188245073	0	0	0	0,233042464	0	19,7766914	0,407547027	3,60026765	0
68,4342422	0,336129427	0	0	0	0,449065655	0	24,7067814	1,12230134	3,7265203	0,051961768
33,6669884	0,181301981	0	0	0	0	0	57,5515862	1,31249964	4,65664244	0,090983011
42,677269	0	0	0	0	0	0	51,0560379	0	3,49872065	0
46,5811043	0,232766643	0	0	0	0	0	36,2862358	2,75327563	6,10292864	0,126567736
49,2149658	0,167537659	0	0	0	1,96593678	0	33,9986382	2,6209271	5,81823206	0,156463459
48,4168777	0,168265343	0	0	0	0	0	39,7307167	2,48185134	6,07633638	0,133544236
65,9440842	0,303218126	0	0	0	0	0	25,7842026	2,18073726	4,2346096	0,089911841
26,1507111	0,114384986	0	0	0	0	0	51,1956673	1,69475758	0,309242815	0,049114905
15,5694113	0,11735031	0	0	0	1,93840754	0	72,1572723	2,89270473	0,971992433	0,113533303
26,4477806	0,113505051	0	0	0	0	0	70,1347809	1,79496336	0,366719931	0,061603546
33,8711815	0	0	1,62982249	0	0	0	64,4990005	0	0	0
34,463913	0	0	0	0	0	0	58,8913879	0	3,11842561	0
43,046196	0,371614575	0	0	0	0	0	50,5548744	0,422284812	3,7352097	0,321862966
37,4699249	0,279202044	0	0	0	0	0	57,7117844	0	2,45388222	0,267477334
68,5802689	0,21826829	0	0	0	0,264297396	0	25,1011562	0,482927889	1,47714627	0,023377765
64,6711121	0,126107991	0	0	0	0	0	29,2280312	0,560896158	1,55603814	0,013948195
75,1759109	0,210422248	0	0	0	0,538778365	0	18,7862473	1,1076386	3,38759208	0,346540987
90,2831573	0,07330478	0	0	0	0,242698491	0	7,83850956	0,50456512	0,932370603	0,024769776
79,5442123	0	0	0	0	0,961548805	0	15,86588	0	3,11984849	0
85,1319504	0	0	0	0	1,53063762		10,1035185	1,83623922	0,650012314	0
83,4489288	0	0	0	0	0,752318501	0,285613865	11,7572031	1,09252191	2,03756022	0
22,33220236	0	0	0	0	1,17864954	0	69,1549835	0,876169801	4,52862406	0,251527607
0	0	0	0	0	0	0	75,3579712	1,55588198	3,72948122	0,239552841
0	0	0	0	0	0	0	40,0132294	1,44056249	3,47033048	0,19374077
0	0	0	0	0	0,442179501	0	24,0435562	0,723896444	2,08770847	0,021348752
0	0	0	0	0	0	0	7,32847977	0,524748921	1,66102004	0
0	0	0	0	0	0,516343892	0	8,50030422	0,606869459	1,24585533	0
0	0	0	0	0	0	0	0	0	7,71663523	0
0	0	0	0	0	338505149	0	12,3039122	0,575443804	0,941215396	0,018376458
0	0	0	0	0	0	0	0	0	0	0,242585927
0	0	0	0	0	0,318535417	0	11,7150011	0,594141066	1,19346976	0
0	0	0	0	0	0	0	9,38830853	0,482995838	0,743691027	0
91,5590363	0,072753921	0	0	0	0	0	6,72700214	0	1,4806689	0
92,1451645	0,096774265	0	0	0	0,205146059	0	5,33853149	0,487959534	1,66366911	0
89,9847641	0,180818647	0	0	0	,306738496	0	7,6487627	0,580295861	1,15142798	0
92,0165787	0,104219183	0	0	0	0,222761035	0	6,02414131	0,501019001	1,05134654	0
85,9606857	0,104930647	0	0	0	0,253289104	0	9,5571022	0,499417543	3,08536744	0
71,6863556	0,085401125	0	0	0	0,456462294	0	19,6998692	,839311957	5,09976959	0
79,5546799	0,111359492	0	0	0	0,247769624	0	12,0321522	0,727228165	6,57831287	0

Fig.	N.	ID	cadastr/registration No.	Ti	V	Cr	Mn	Fe	Co	Ni
4: 12	6	101	Marefy 4 61052	0,07843601	0	0	0,050848294		0	0,033901308
		102		0	0	0	0,126113668		0	0,057380516
4: 4	7	103	Habrůvka 2 11728/2	0,20155701	0	0	0,017164756	0,8905 72429	0 008941058	0,104863554
		104		0,249713346	0	0	0,051072862	0,954619944	0	0,138003707
		105		0	0		0,02051946	0,344185263	0	
4: 11	8	106	Marefy 3 61051	0,109944746	0		0,019541781		0	38332
		107		0,156463996	0		0,061722498		0	0,23748593
4: 15	9	108	Měrovice n. Hanou 175944	0	0		0	0,182843849	0	0,641005397
		109		0	0			0,322919548	0,019649014	
4: 23	10	110	Sloup 16/75	0,239677295	0		0,066208705		0	0,212494314
		111		0	0		0,192389488		0	0
		112		0	0	0	0		0	0
		113		0,21540 3274	0	0	0,02358046	0,841770828	0	0,353607833
		114		0	0	0	0		0	0
4: 5	11	115	Hustopeče 13/2019	0,080298819	0	0	0,029657031	0,131671712	0	0,241532192
		116		0,107490741	0	0	0	0,154011726	0	0,269688994
		117		0	0	0	0		0	0
4: 10	12	118	Marefy 2 61050	0,064263649	0	0	0,06690529	0,993959069	0,017826874	0,149205625
		119		0	0	0	0,080835864		0	0,181028903
4: 18	13	120	Polkovice 175465	0,49032107	0,031875514	0	0,139505446		0	0,418349952
		121		0,969965816	0	0	0,229589149		0	0,203767687
		122		1,02109563	0,028848287	0	0,188658759		0	0,237225443
4: 21	14	123	Provodov-Ludkovice 2 A 88701	0,653842092	0	0	0,129604995		0	0
		124		0	0,655731201	0	0		0	0
4: 7	15	125	Krhov A12996	0,260159373	0	0,795493245	0,043253664	3,73374939	0	0
		126		0,796067059	0	0,040812478	0,027092809	1,52177191	0	0
		127		0	0	0,089281924	0	1,56288195	0	0
4: 25	16	128	Velké Opatovice A13180	0,110347062	0	0	0	0,056115545	0,013302534	0,266364932
		129		0,068191648	0	0	0	0,321456224	0,013802053	0,304375976
		130		0,121785447	0	0	0	0,066695906	0	0,262568086
4: 1	17	131	Bilovice-Lutotín	0,265185386	0	0,013596502	0,020711789	0,551580846	0,02006058	1,77095389
		132		0,247745901	0	0	0,02253555	0,569641411	0	1,4809196
		133		0,399624795	0	0,033477694	0,017395584	0,631341875	0,035463281	1,68501568
4: 8	18	134	Lechovice u Pavlova 512-43/63	0,133905888	0	0	0,019805782	4,12214804	0	0,115096912
		135		0	0	0	0	0,971505582	0	0,015838055
4: 22	19	136	Slatinice	0,60909301	0	0	0,012499322 0	0,195628747	0 0,009496705	1,782022238
		137		0	0	0	0	1,56886959	0	0
		138		0,679920554	0	0335504	0	0,105251551	0,017277779	1,03876507
		139		0	0	0	0,110271387	35,2208061	0	0
		140		0,207029326	0	0,037109084	0	21,9047165	0	0,270335495
-	20	141	Chornice	0,478560269	0,064881727	0	0	3,94333482	0	0,329052448
		142		0,674930096	0,043589704	0,016379364	0,019741058	3,45912981	0	0,404104888
4: 16	21	143	Nezamyslice 1608/63/34-5204	0	0	0	0	1,23399889	0	0
		144		0	0	0	0	0,582260787	0	0,186669141
		145		0	0	0	0	0	0	0
		146		0	0	0	1,50203156	0	0	0
		147		0	0	0	0	0,540114462	0	0,041538451

Cu	Zn	Zr	Nb	Mo	Ag	Cd	Sn	Sb	Pb	Bi
81,2105408	0,148099795	0	0	0	0,32663101	0	13,4181271	0,33326298	2,24765229	0
68,7051773	0	0	0	0	0	0	23,7619934	0,226719111	3,6325624	0,04241712
68,5586624	0,223856881	0	0	0	0	0	25,8030243	0,373844951	3,72427654	0,093236476
69,753891	0,255297482	0	0	0,003178626	0,348320901	0	25,12887	0,409386605	2,60648394	0,101162687
77,4312744	0,131913513	0	0	0	0,344472021	0,049985867	19,3107586	0,442788899	1,76946759	037578289
69,8822327	0,141322434	0	0	0	0,722922146	0	20,4019737	1,1774323	5,96645212	,035629548
776838303	0,125037491	0	0	0	0,554116547	0	15,0290852	0,910613716	4,02098656	0
642316818	0,128344908	0	0	0	0,809924722	0,0428156	21,2527199	2,02430415	10,5859098	0,079808928
58,00493362	0,136982381	0,007314003	0	0	0	0,04940401	23,8485718	2,10983992	15,0114202	0,047385197
53,8566704	0,233344719	0,007995502	0	0	0	0	38,5359535	1,54560566	3,83913517	0,14292191
45,6250801	0,402554303	0	0	0	0	0	47,5073395	1,58123696	3,38106132	0
77,4227219	5,57493496	0	0	0	0	0	0	0	12,1160307	0
59,6940765	0,296449363	0	0	0	0	0	33,3081131	1,44428897	3,70220637	0,120502912
65,7186127	4,54279518	0	0	0	0	0	0	0	19,9306602	0
91,2129669	0,127991483	0	0	0	0,573742926	0	6,36780548	0	1,23432994	0
85,0586166	0,149710298	0	0	0	1,11264658	0,058225229	10,1141272	1,20979953	1,76568615	0
93,4001236	0	0	0	0	0	0	0	0	6,59988022	0
69,429184	0,126087755	0	0	0	0	0	22,001379	0,533360243	6,46779108	0,150036186
76,9822464	0,076609388	0	0	0	0,390736282	0	19,1026516	0,725985706	1,24482381	0
45,3704262	0,300872386	0	0	0	0	0	41,8106155	1,71392846	4,9332881	0,116045825
58,1633301	0	0	0	0	0	0	30,2810631	0	4,18240023	0
58,6806412	0,352732092	0,059100289	0	0	0	0	28,069828	1,24923086	3,53348732	0,047386546
37,4883232	0,140310705	0	0	0	0	0	58,6321602	0	0,860977113	0,060204208
30,3224182	0	0	0	0	0	0	65,6611557	0	0,620363176	0,125282779
76,3027725	0,300895482	0,024276756	0	0	0,642872155	0	13,5362244	1,26415217	3,09614849	0
87,5064163	0	0	0	0,017325452	0,483723253	0	7,19815588	1,08916712	1,3194679	0
86,9185715	0	0	0	0	1,25242937	0,406531423	6,96027136	1,10377777	1,7062577	0
82,0222626	0,058226496	0	0	0	0,356371701	0	15,4338474	0,5374856	1,12153292	0,024146585
79,4657745	0,106231727	0	0	0	0,364490986	0	17,5602303	0,55601573	1,21129024	0,028139135
82,3744583	0,095468238	0	0	0	0,339226723	0	15,4887857	0,464947134	0,7567963	0,029270032
60,2978668	0,226780623	0	0	0	0	0	32,5708008	0,938938737	3,21335316	0,110170238
68,0262451	0,213493407	0	0	0	0,470108658	0	25,686161	0,838069737	2,37845516	0,06662453
59,1417809	0,206322685	0	0	0	0	0	33,4469795	0,938369751	3,34250903	0,121719904
75,1109772	0	0	0	0	0	0,025109403	9,91165161	2,15596318	7,12520552	0
89,7868805	0	0	0	0	0	0	0	1,3394686	3,54200101	
49,9770584	0,197102189	0,022482872	0	0	0,403444678	0	41,1519089	1,89076698	5,09830856	0,088614173
76,8410416	0	0	0	0	1,39017475	0,653099656	12,9945421	2,71428919	3,83798361	0
46,0067825	0,199087605	0	0	0	0	0	44,6848984	2,16913795	4,93411636	0,131210849
54,7229538	0	0	0	0	0	0	7,46173382	0,398710966	2,08552456	0
61,6229706	0,11306563	0,019840915	0	0	0	0	708199	0,843288302	1,88807654	0,022748048
31,256237	0,174082845	8009128	0	0	0	0	55,5377007	2,9283011	5,14498615	0,134854034
36,7977676	0,140792534	0,00671619	0	0	0	0	49,8493576	2,751791	5,67600393	0,159696192
87,4183121	0,233135521	0	0	0	0,442218989	0	7,82038069	0,848437607	2,00351524	0
84,0322113	0,108031735	0	0	0	0,686188817	0	11,4867153	1,11660361	1,80131757	0
96,0397186	0	0	3,96028209	0	0	0	0	0	0	0
98,4979706	0	0	0	0	0	0	0	0	0	0
85,3524628	0	0	0	0	0,385795742	0	9,31300545	0,83906132	3,52802086	0

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