EARLY MEDIEVAL IRON PRODUCTION IN PODRAVINA - NW CROATIA

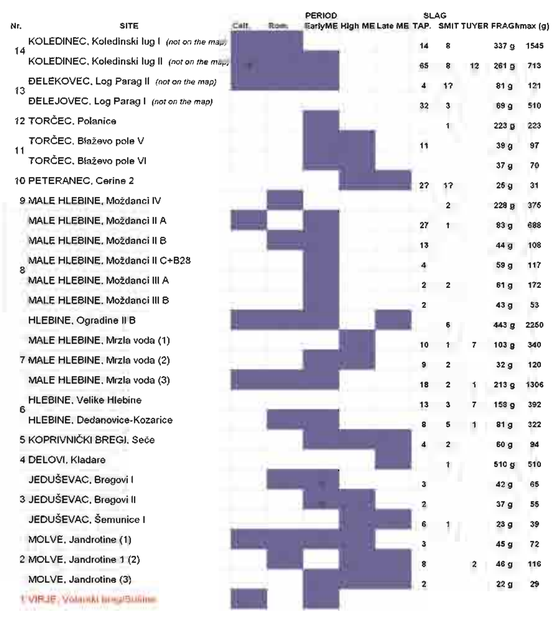
Ivan M. Hrovatin
indipendent researcher **ivanhrovatin@yahoo.it** **Trieste, via Ricreatorio 3, ITALY**

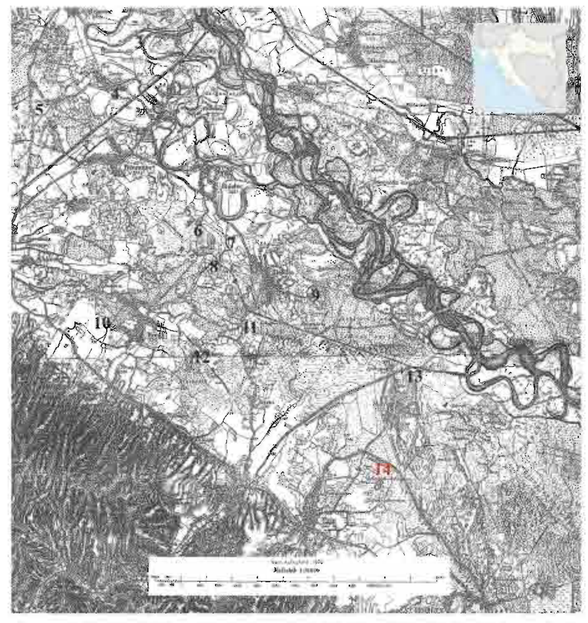
The unsystematic but intense superficial survey of the area (ca. 300 km2) around the city Koprivnica (NW Croatia), was made by local amateur archaeologist (Ivan Zvijerac, Torčec). Aside other excavation made by archaeologists from different local and national institutions based on his data, in the year 2008 was excavated the first iron production workshop (Virje Volarski breg 2008 = Sonda 1) under the leadership of the archaeologist from the national institution (dr. Tajana Sekelj Ivančan, Archaeological Institute Zagreb). In the next years further sites with iron production traces was explored by the same team. In the 2010 start the cooperation with archaeologist starting a specialisation in the topic of iron in archaeology (I. M. H.). The no budget or low budget nature of the research (very common in south-southeastern Europe) and the absence of experienced scholars in the former Yugoslavia countries pushed the development of research methods in the macroscopic analysis, based on methodology developed in Franco-Swiss archaeo-metallurgica milieu (eg. Eschenlohr, Serneels 1991, Eschenlohr et al 2007) and into no laboratory research. The almost regular continuity of excavation give the opportunity to develop documenting methods on the field survey, excavation and post excavation work.

One of the most important methodological improvement was the introduction of the total collection of the slag on excavation (even if is more than tone of such material) instead of traditional "sampling" on site with "big amount" of slag. In Podravina in 2010 started the total collection of "metallic" slag and after 2012 the whole dump. The sites with partial collection are marked by star (*).

ESCHENLOHR L., V. SERNEELS 1991, Les bas fourneaux mérovingiens de Boécourt, les Boulies (JU/SUISSE). – *Cahier d'archeologie Jurassienne 3*.

ESCHENLOHR ET AL. 2007, Metallurgie du fere t mobilier métallique. – Develier-Courtelle un habitat rural merovingien. - *Cahier d'archeologie Jurassienne 14*.

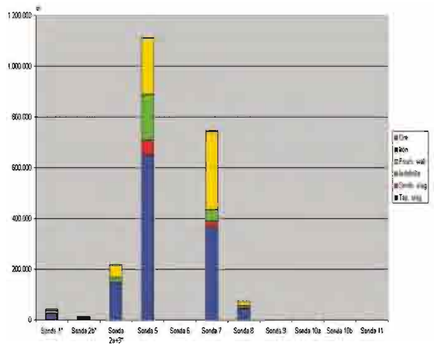


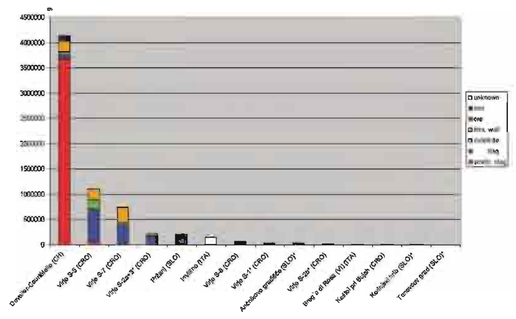


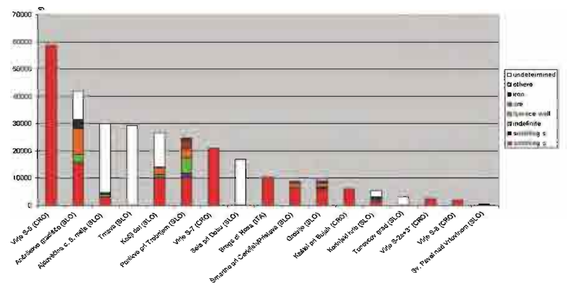
THE SITES

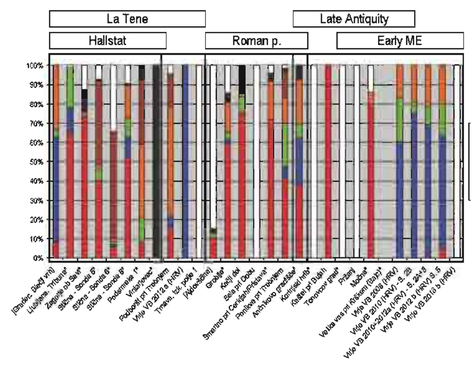
The part of Podravina region where the iron was produced is a flatland of former river meanders frequently flooded by the river Drava. The sites with ironworking debris are mostly on the lower edge of these dunas or little hills. From the data of field survey is very probable the production was carried out from the pre-roman/celtic period through the roman and early medieval (EMA) and maybe high medieval period. The excavation was pointed to discover the early medieval and late antique sites but discovered also some probably pre roman furnaces debris.

SITE	Sonda 1*		Sonda 2b*		Sonda 2a+3*		Sonda 5*		Sonda 6		Sonda 7		Sonda 8		Sonda 9		Sonda 10		Sonda 10b		Sonda 11		Total	
	weight (kg)	pcs.	weight (kg)	pcs.	weight (kg)	pcs.	weight (kg)	pcs.	weight (kg)	pcs.	weight (kg)	pcs.	weight (kg)	pcs.	weight (kg)	pcs.	weight (kg)	pcs.	weight (kg)	pcs.	weight (kg)	pcs.	weight (kg)	pcs.
tap. slag	25,652	247	10,235	145	143,090	1146	648,860	2734	0,143	10	366,739	5418	45,581	1109	0,437	12	0,203	7	0,459	7	0,543	15	1241,942	10851
smith. slag	?	?			2,565	5	58,676	157			21,020	133	2,006	32					0,315	2			84,582	329
undef.	9,619	63	0,803	13	21,221	182	180,456	729			45,876	1006	9,616	214	0,112	6	0,091	1	0,575	4	0,102	3	268,471	2221
four. wall	7,251	74	4,121	181	48,109	958	222,587	1751	0,011	2	307,402	8721	16,066	660	0,256	16	0,285	13	0,963	15	0,037	4	607,088	12395
iron					0,781	7	2,582	21			4,063	139	0,656	15	0,037	2			0,014	1			8,133	185
ore			0,190	9	4,096	99					0,302	21	0,132	7	0,020	2			0,331	17	0,003	1	5,074	156
total	42,648	438	15,349	349	219,922	2406	1112,535	5389	0,154	11	745,422	15438	79,855	2144	0,862	38	0,579	21	2,657	46	0,685	23	2220,668	26303
surface	230,0		307,5		1013,5		201,7		26,3		226,0		74,0		144,2		208,7		290,7		127,7		2850,3	
average (kg/m2)	0,112		0,033		0,141		5,516		0,005		1,622		0,616		0,003		0,001		0,002		0,004		0,779	









HOW MUCH SLAG IS A LOT OF SLAG?

Even if you have not a remarkable remain of furnaces or smithy oven is the slag and other waste one of the ways to get the possibility to compare the different iron workshops.

The simplified documenting protocol is consisted of: 1. collect all material divided per stratigraphic unit; 2. wash all material with water ((tooth)brush can be used); 3. dry it; 4. divide material per major categories (smelting slag, smithing sl., indefined sl., furnace wall, iron, ore, other); 5. weight it (every piece and write in a paper notebook so you can draw the most interesting pieces); 6. take pictures of all material (together but divided per categories); 7. pick up the material for the catalogue (=>singular description, measurement, picture, analysis); 8. put the unselected material back in the bag or box.

At the beginning is always hard to distinguish the different categories (and also later is not always easy) but there is always very useful category: a undefined category. Don't forget, the first half tone is always the hardest.

PICTURES AND TABLES

1. The first group (until 2015) of sites with slag in Podravina and their position on the map before the regulation of the Drava river.
2. The cumulative weight of macroscopic/morphologic analysis divided per trench (numbers).
3. The position of the trenches on the site.
4. The cumulative weight of macroscopic/morphologic analysis divided per trench (graph).
5. Virje slag dumps (cumulative) compared with other early medieval sites.
6. Virje smithy dumps compared with antique and early medieval smithy dumps in Slovenia and Croatia.
7. Map of analysed dumps in Slovenia and Croatia (full dot) and other sites mentioned (empty dot).
8. Reconstruction of the workshop organization on the Virje - Site 1.
9. Construction of the furnace wall. (Virje – Site 5)
10. Ideal reconstruction of the smelting process – max number of taping slag. (Virje – Site 5)
11. Smallest and biggest complete taped slag. (Virje – Site 5)