International Conference
Orbis Mediaevalis,
3rd edition

Exploring Dwellings and Manufacturing Spaces in Medieval Context (7 th – 14 th Centuries)

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Tracing the steps of the smelters: workspace organisation of a bloomery iron production workshop

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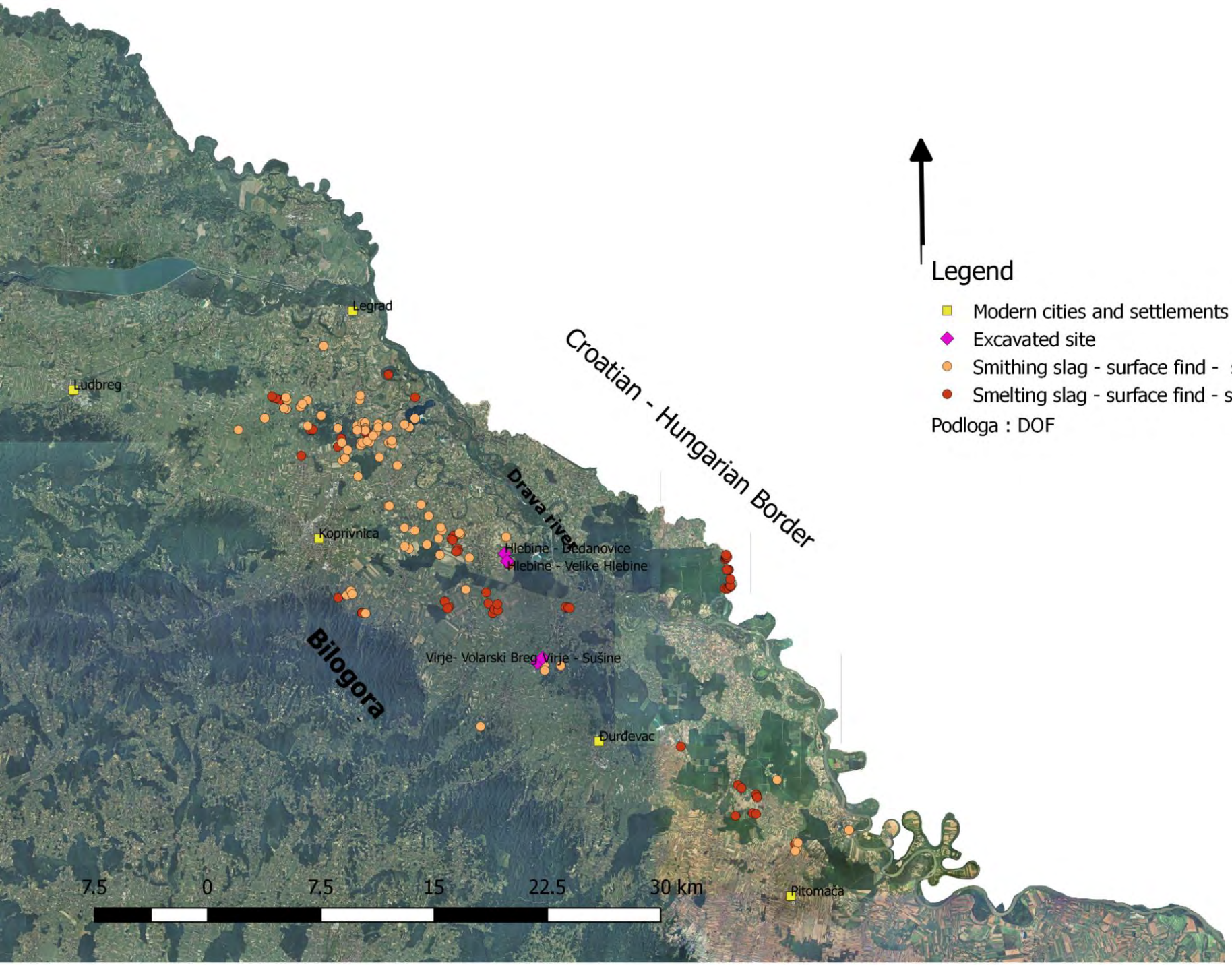


Bloomery // Iron production workshops

- **Virje – Volarski breg & Sušine**

2/2 8. – 9th century

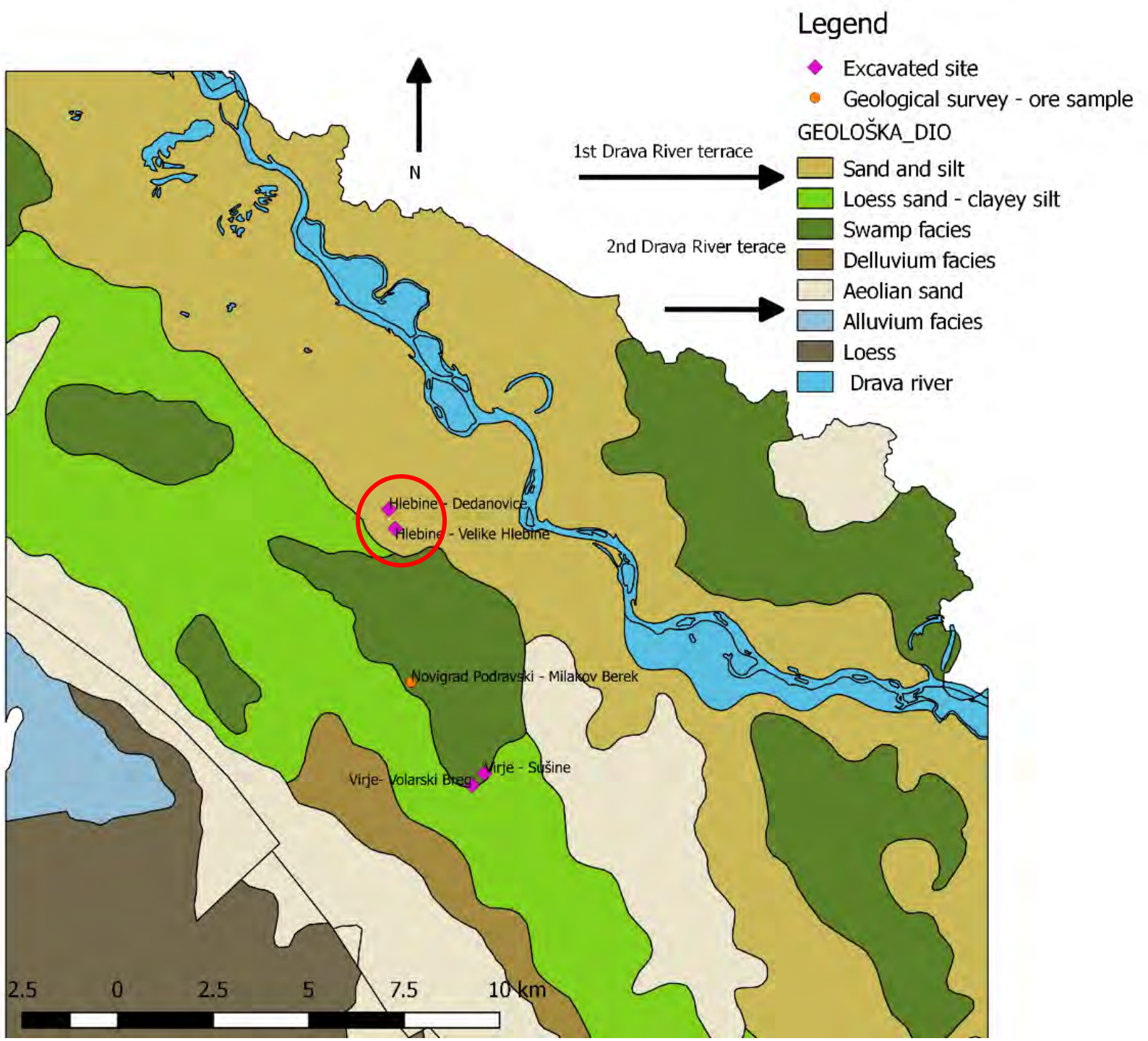
5th century

- **Hlebine – Velike Hlebine**

½ 7.th century

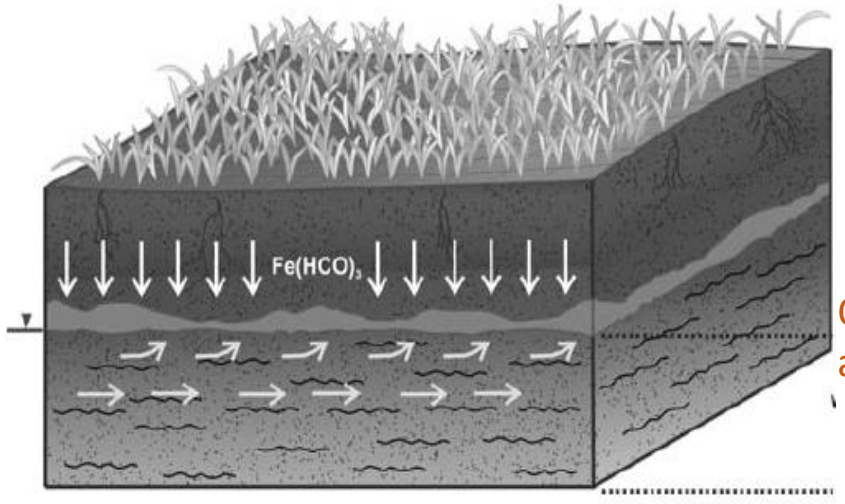
Smithy ? // primary and/or secondary smithing furnaces

- **Hlebine – Dedanovice** ½ 7th century



- edge of the Drava river flooding plain
- 2nd Drava river terrace – elevation change
- Boggy - marshy areas in vicinity – ore exploatation area?

Resources: bog iron ore



Ore forming area // accumulation area

Groundwater saturated with Fe

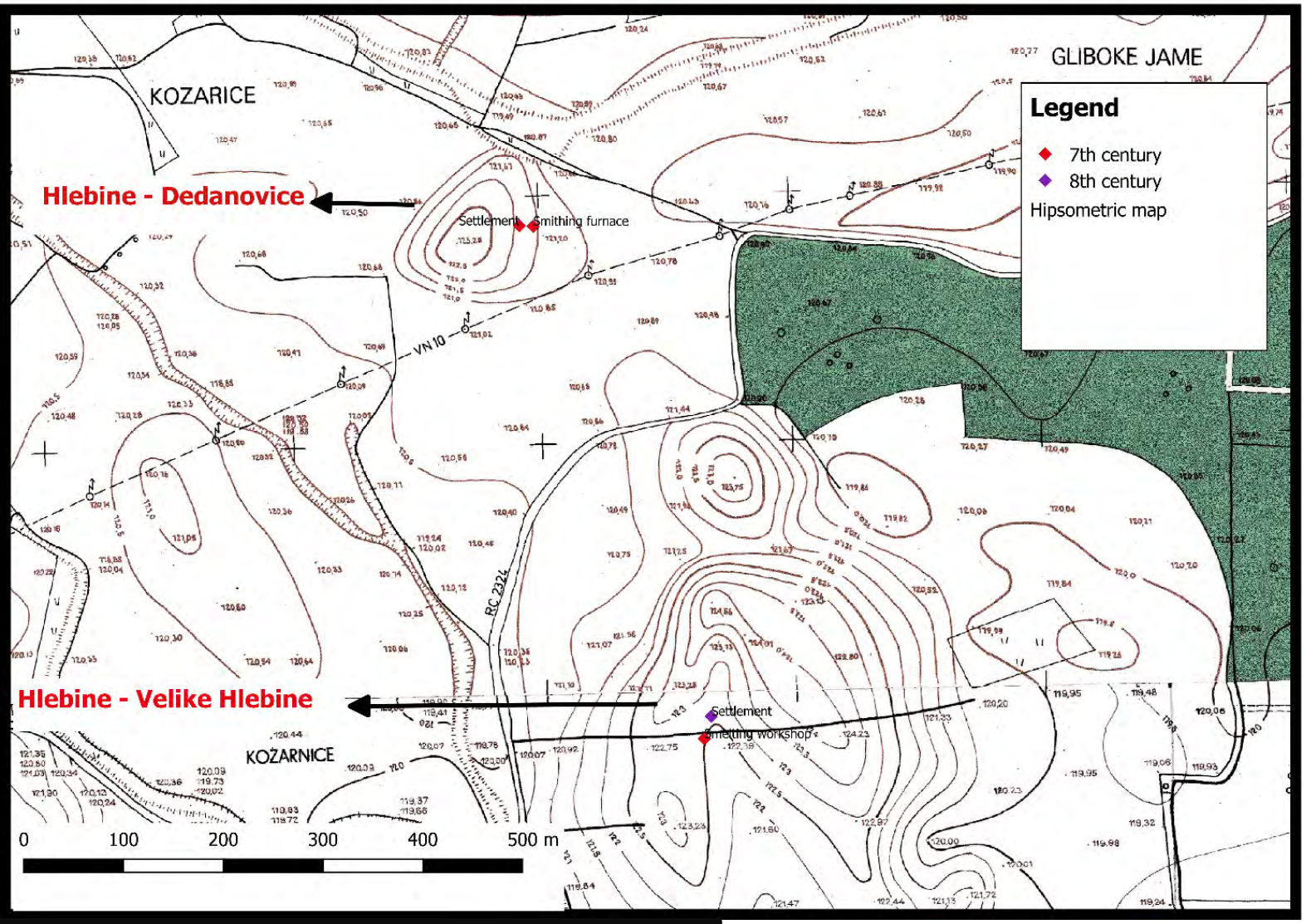
Forming mechanism for bog iron ore (after : Werovnska 2009)

Sample of the bog iron ore, Hlebine - Velike Hlebine site (SU 119)

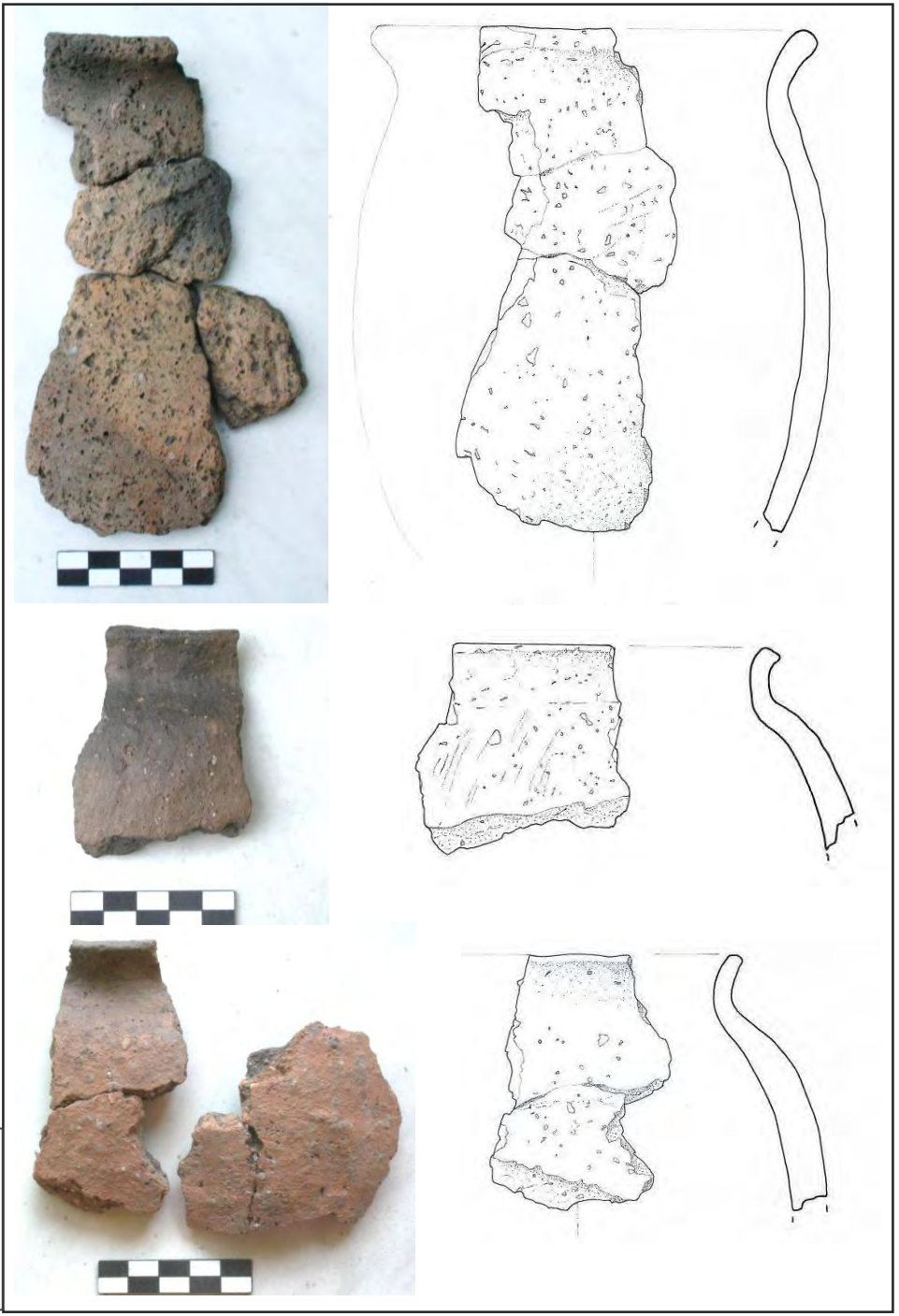
Arh. Sample	Site	Period	Type	Quartz	Goethit	Hematit	Magnetit	Rutile	Other min.
SJ 83 (N 242)	Hlebine - Velike Hlebine		Iron ore	++	+++	-	+	-	Pl
SJ 27 (U 71)	Hlebine - Dedanovice		Roasted iron ore	+	-	+++	-	-	/
SJ 10 (U 26)	Hlebine - Dedanovice	**7th century**	Roasted iron ore	+	-	+++	-	-	Mgh
SJ 16 (U 45)	Hlebine - Dedanovice		Roasted iron ore	+	-	+++	-	-	/
SJ 8 (U 11)	Hlebine - Dedanovice		Roasted iron ore	+	-	+++	+	-	/
SJ 102/90 (N 223)	Hlebine - Velike Hlebine		Roasted iron ore?	+	++		+++	-	/

Mineralogical composition of the ore samples (XRD),

Faculty of Geology and Mining, Zagreb, Croatia (Tomislav Brenko)

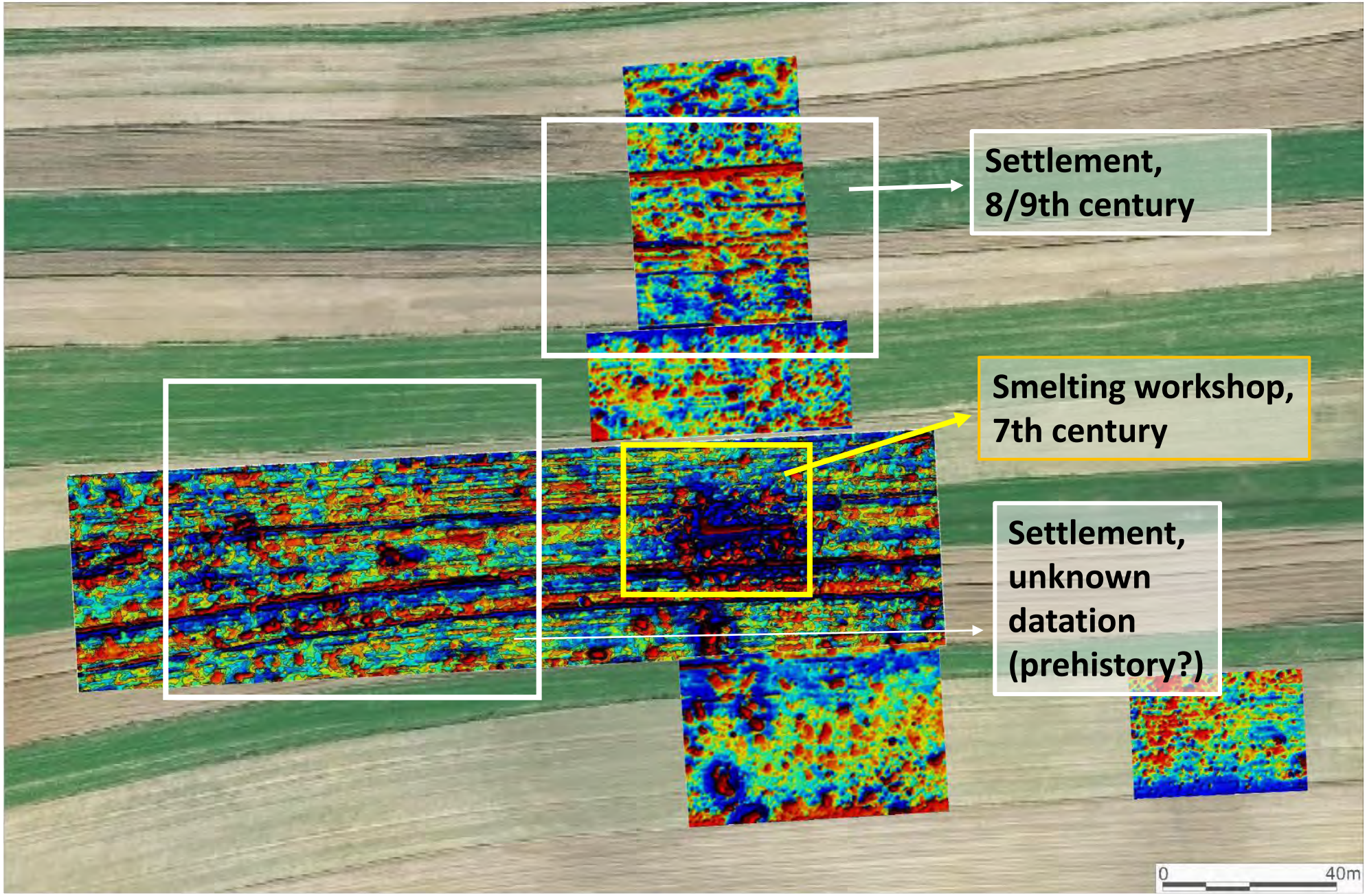


Spatial relation betwen locations of contemporary sites; iron production workshop (Velike Hlebine) and the setllement (Dedanovice)



Ceramic material, ½ 7th century, Hlebine – Dedanovice site

Hlebine – Velike Hlebine site

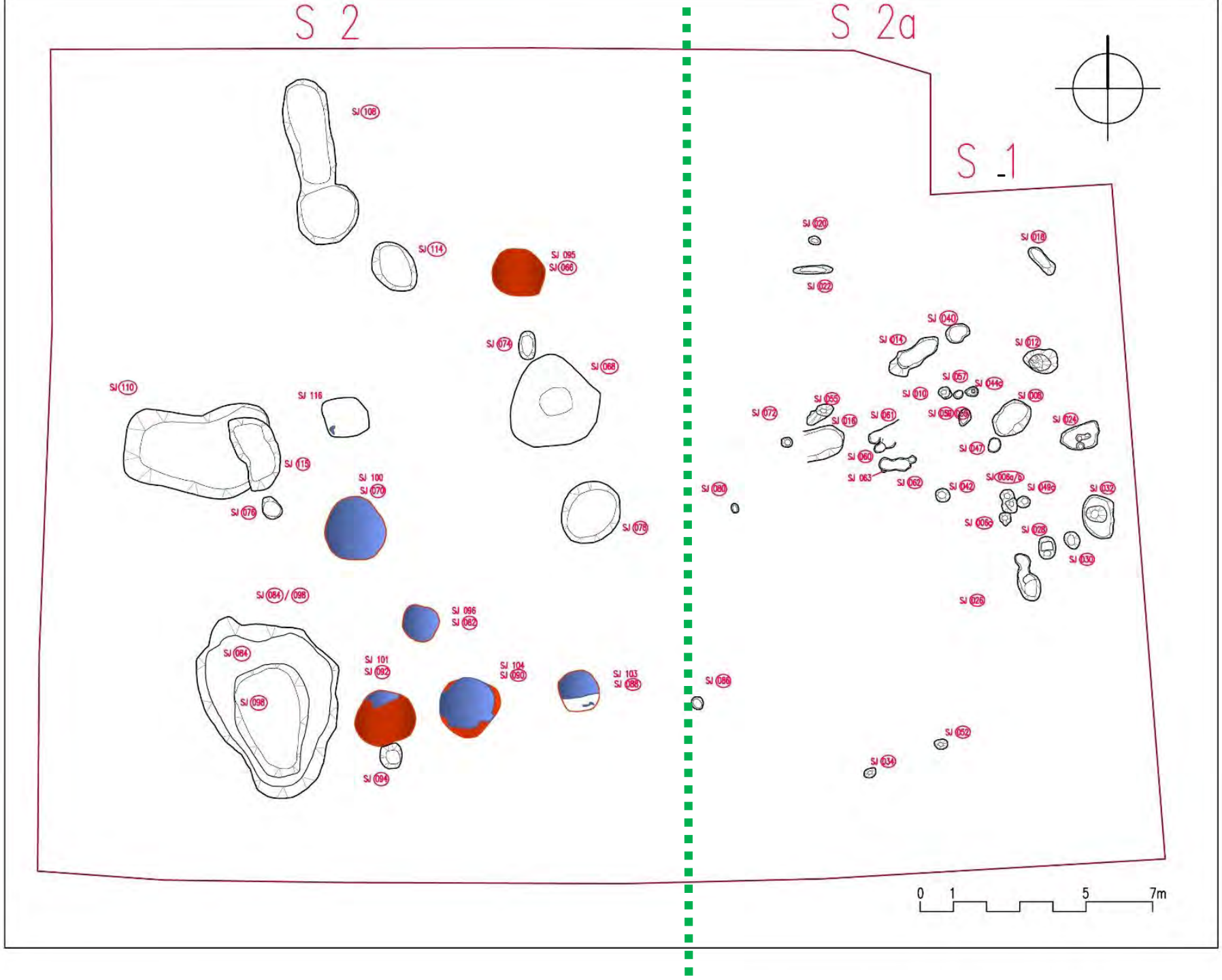


Results of magnetometry (Geometrics G-858), background : aerial photography (DOF).

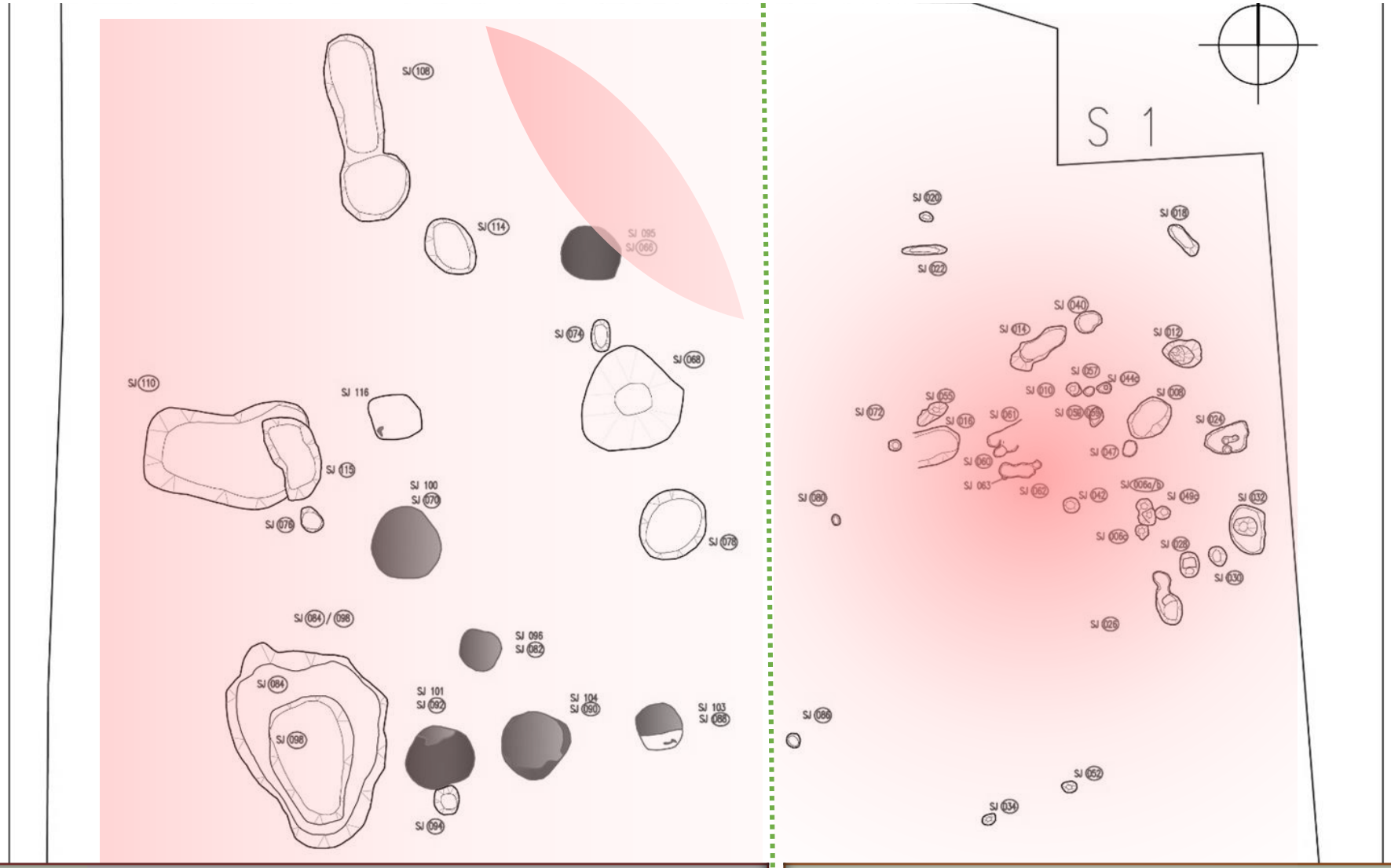
- Areas of extra high magnetic anomalies are concentrated on the place where a high concentration of surface slag was found.
- Cluster of low magnetic anomalies can be interpreted as pits without iron production debris. (Mušič, B., Medarič, I., Matijević, F., 2016 -2017.)

Ground plan, Hlebine - Velike Hlebine site, excavation 2016 – 2017

(made by: K.Turkalj)



Spatial distribution of archaeological features and density of occurence of indicative finds



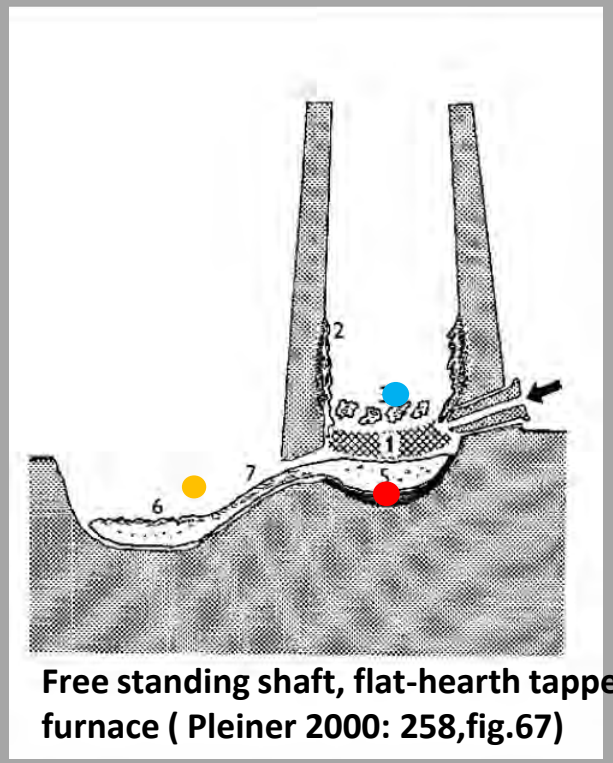
Type	Mass/ kg	Total waste %	density kg/m2
Slag/Fe/	382.98	81	0.61
Technical ceramics/furnace walls/tuyere	200.64	93	0.32

Mass/ kg	Total waste %	density kg/m2
90.90	19	0.44
15.08	7	0.07

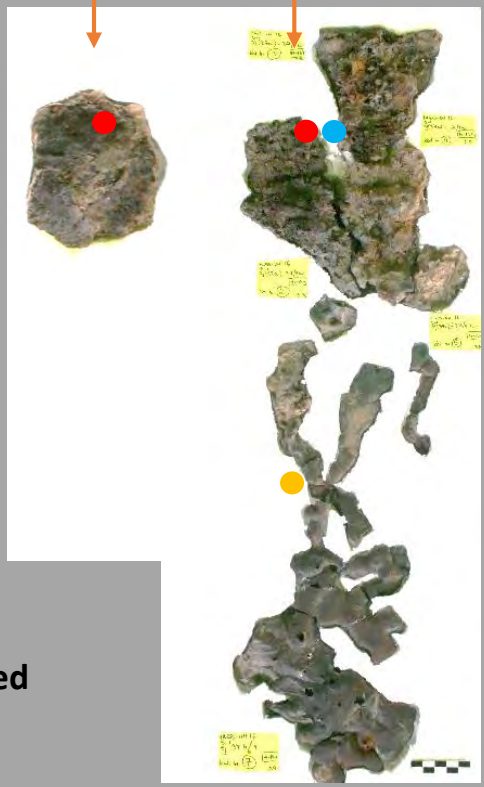
Remains of the furnaces with slag *in situ*

(SU 038/38-1

SU 037/ 37 -1)



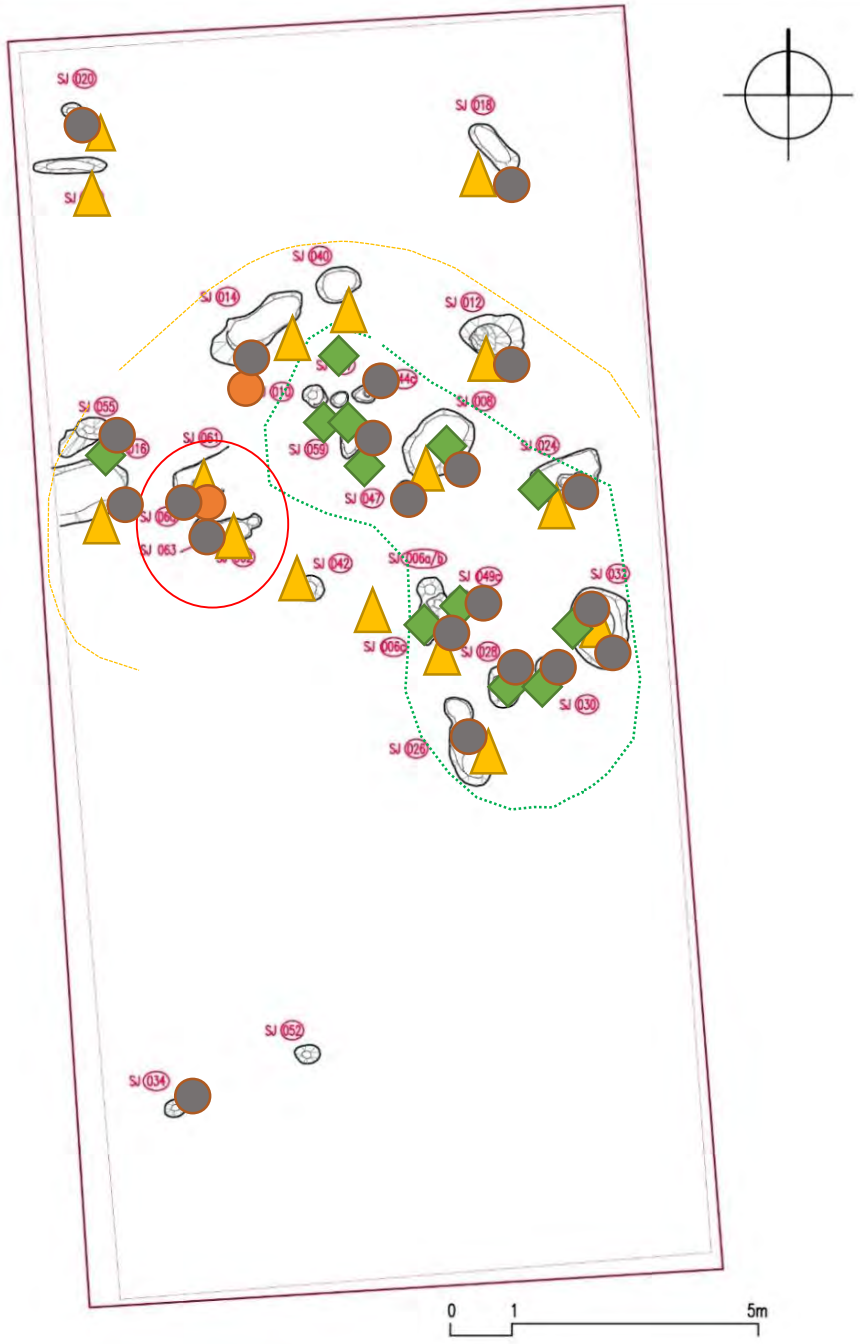
Free standing shaft, flat-hearth tapped furnace (Pleiner 2000: 258,fig.67)



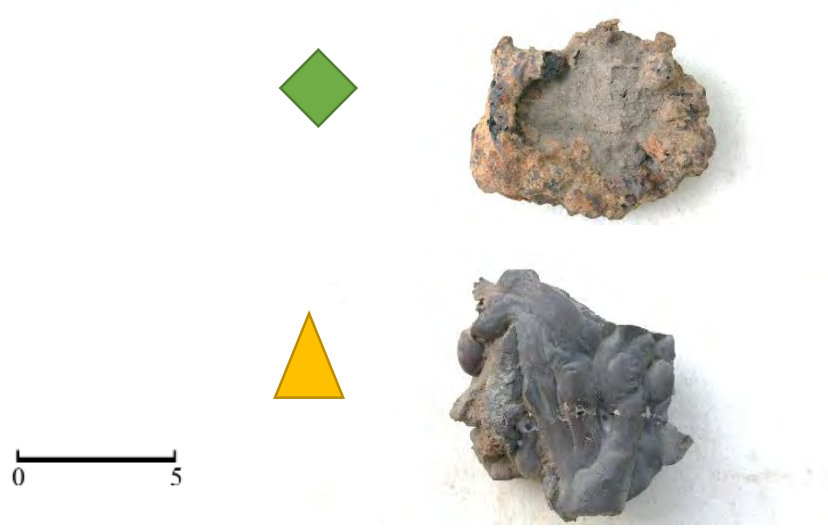
SU 5a, N, 128, U 14

Incorporated:

Hammercale
Spheres of slag



Distribution of finds – eastern part



Post reduction slag – bloom refining/smithing?

Smelting slag
Tap slag
Furnace bottom slag
Furnace slag

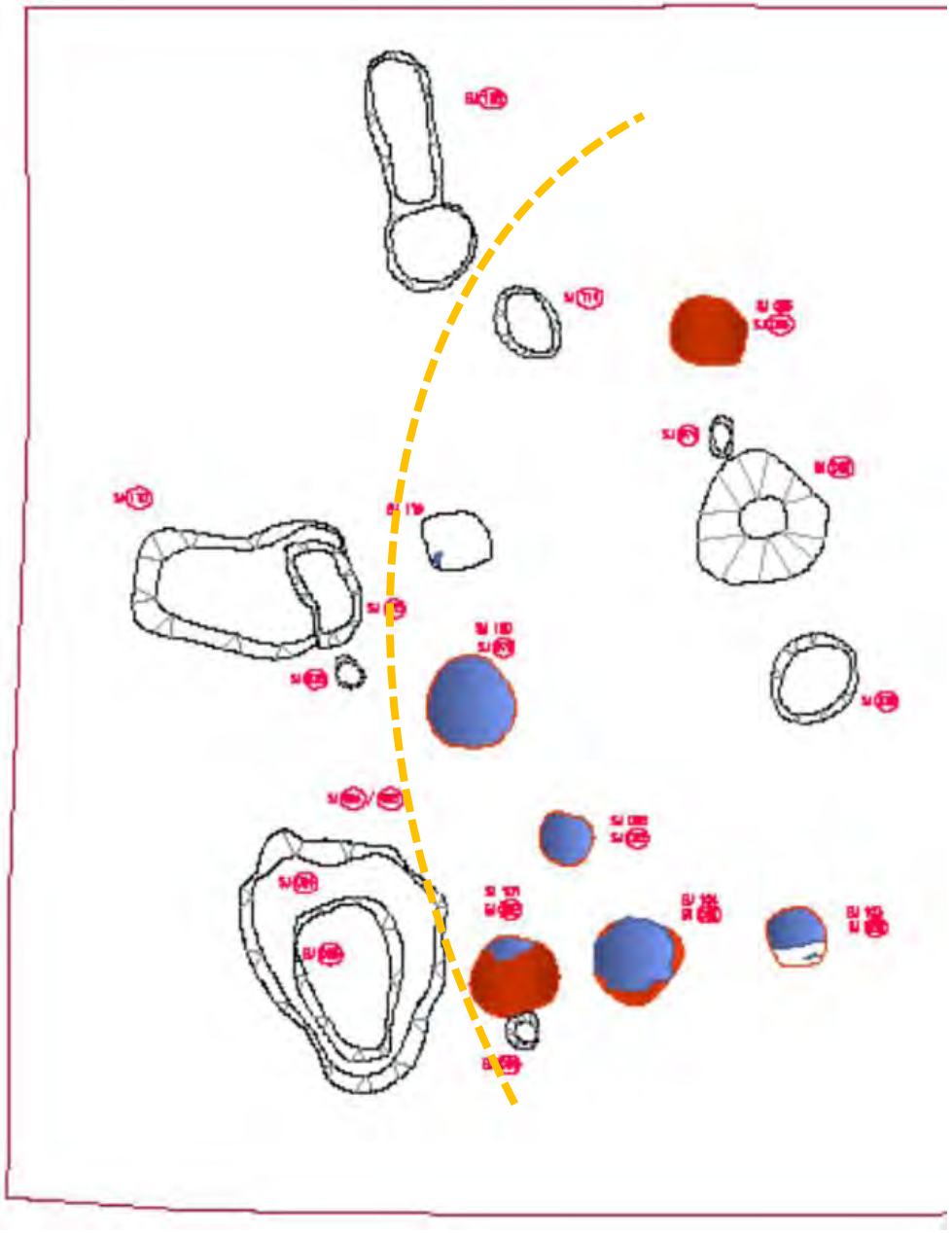
Roasted bog iron ore

Furnace walls

Distribution area – operating space

- Smelting
- Bloom refining – compacting and/or primary smithing
- Storage area (temporary) – ore & charcoal

Western part: archaeological record



Ground plan, Hlebine - Velike Hlebine site, excavation 2017 (made by: K.Turkalj)

- 811 – 812 °C

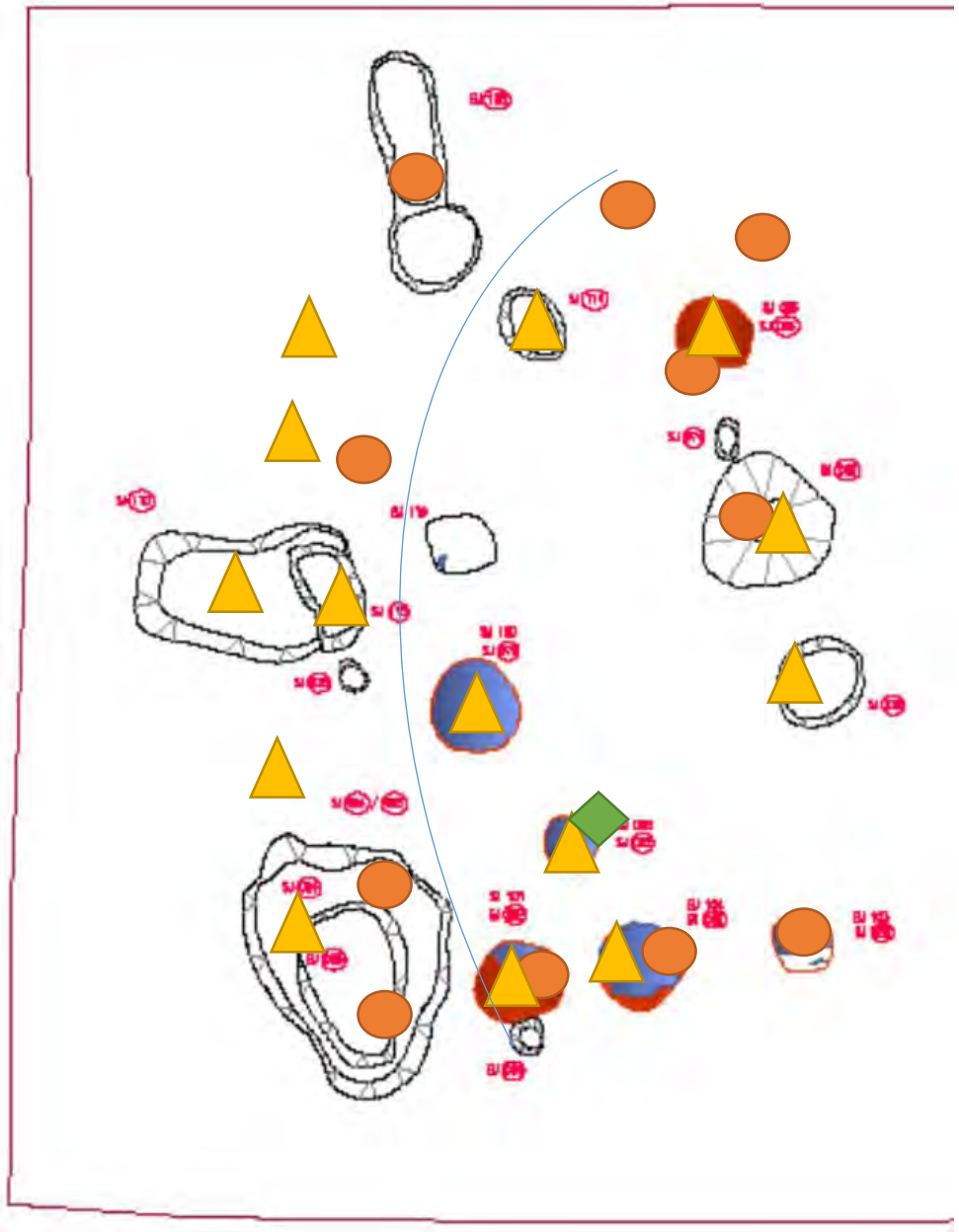
(max range 701 – 891 °C)

- 2h

Traces of experimental roasting

11th IRON SMELTING WORKSHOP 2019: FROM THE SOIL TO THE IRON PRODUCT, Somogyfajsz, Hungary 2019.

Distribution of finds – western part



Bog iron ore (unroasted and roasted)

Smelting waste

- Tehnical ceramics
- Smelting slag

Bloom refining /primary smithing slag

Distribution – structured workspace

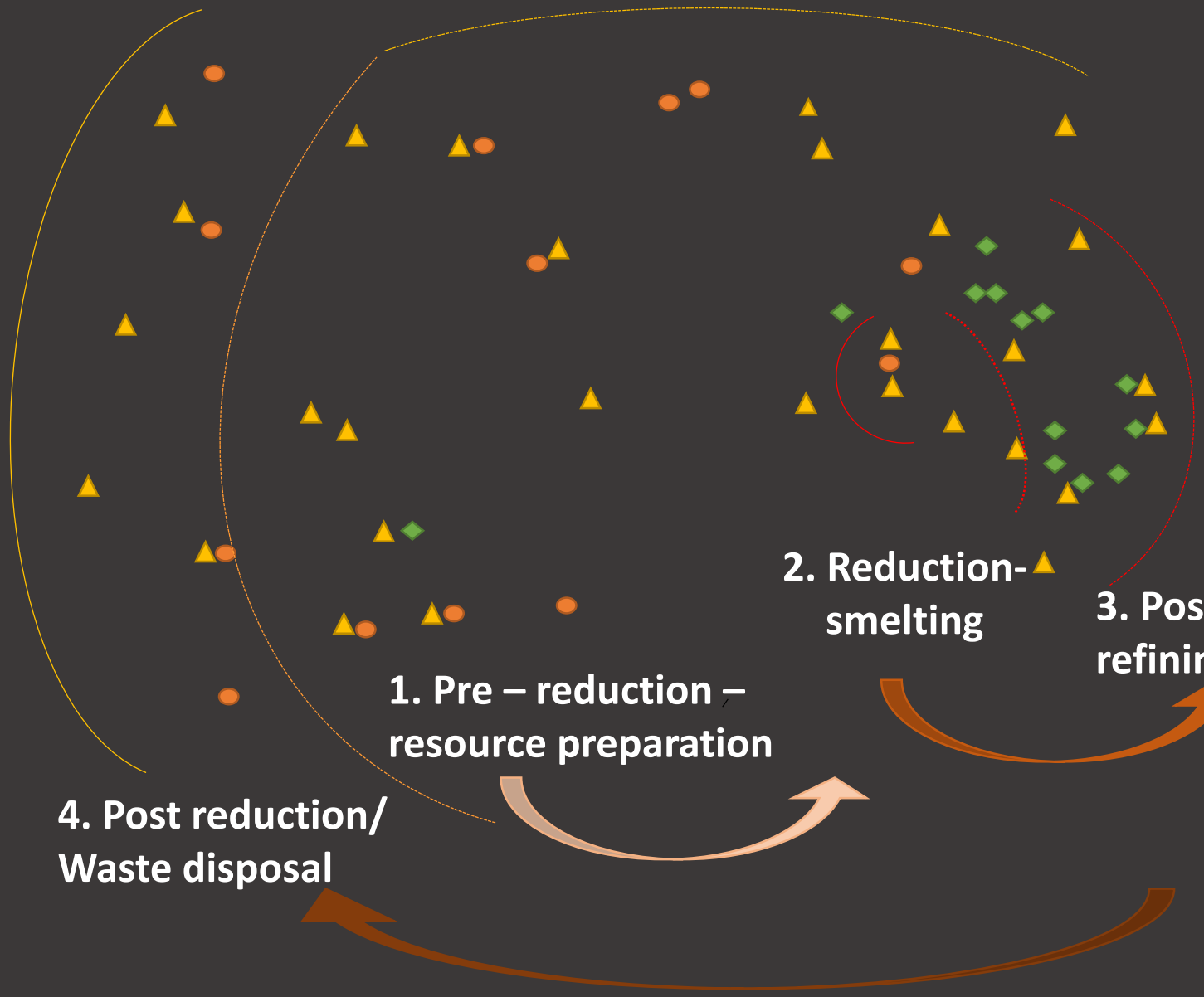
- Pre-reduction : Roasting of iron ore
- Post-reduction: Waste discarding area (382 kg)

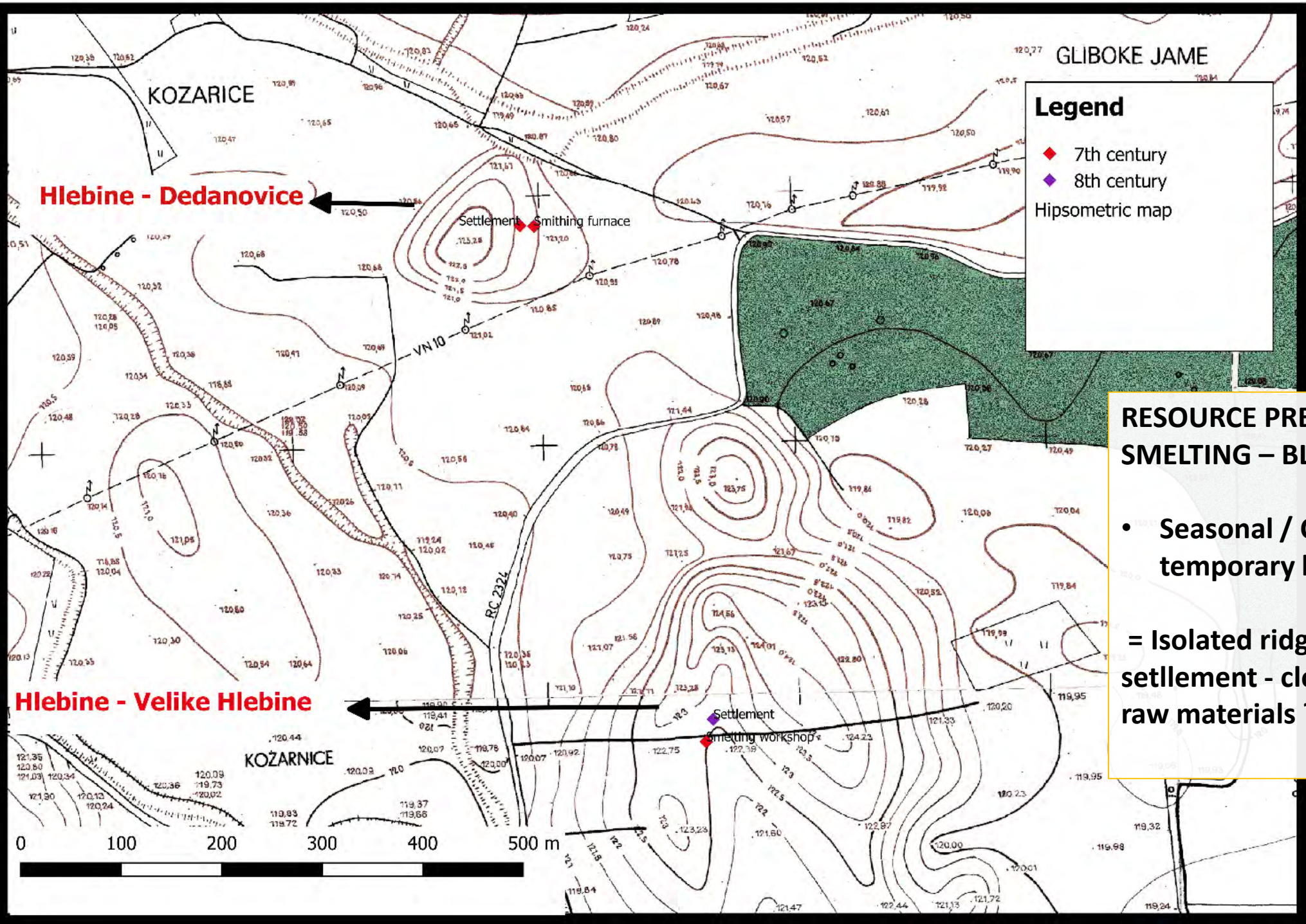
Spatially divided concentrations of waste – seasonal/campaign use of the workspace

Spatial organisation of the workshop

In situ slag= 1 smelt

Total smelting waste =
117 smelts/time span?





RESOURCE PREPARATION – SMELTING – BLOOM REFINING

- **Seasonal / Campaign activities – temporary location**

= Isolated ridge away from the setllement - close to the source of raw materials ?

Structured organisation of activities and the workspace

Workspace location selection is influenced by :

- type of activity (resource exploatation and preparation, smelting, primary smithing)
- dynamics of activities (seasonal)
- natural landscape prerequisites (floods, wet-dry season, source of raw materials, bog iron ore deposits)

a high level of iron production management in the ½ 7th century

Thank you for the attention !

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