Assessment of by-product potential in Europe – contribution to the Raw Materials Information System

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ION4RAW

Ionometallurgy of primary sources for an enhanced raw materials recovery

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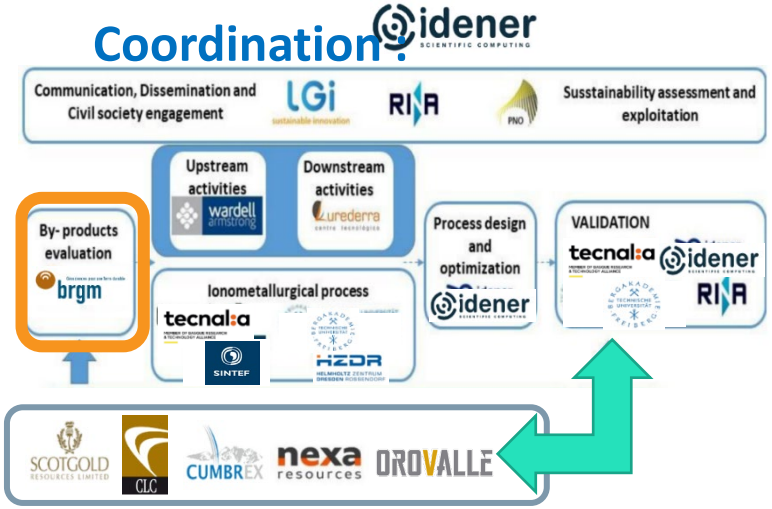
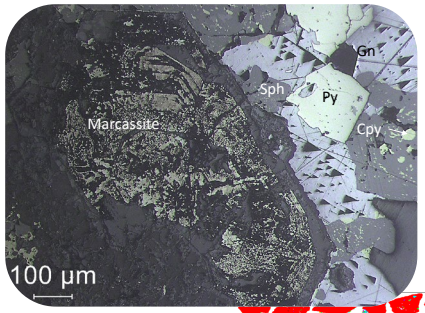
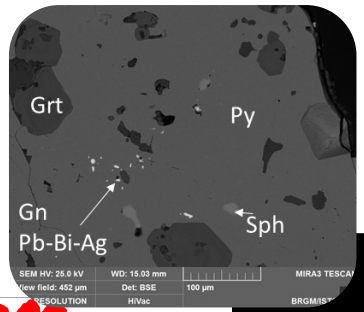
WP2 : By-products potential evaluation

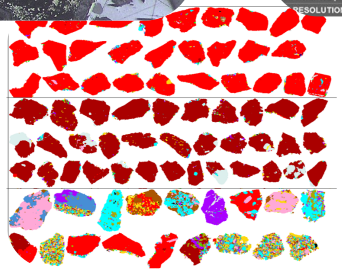
To encourage and support by-product recovery by conducting a comprehensive by-product potential identification and assessment

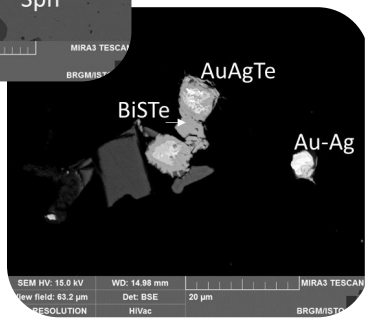
- ❑ **Produce an assessment and inventory of target by-product distribution in existing and currently unexploited resources from Europe**
- ❑ Sample and extensively characterize target by-products in 5 ores
  - from Cononish Gold Mine (Scotland); Cobre Las Cruces and El Valle Boinas (Spain); El Porvenir and Cerro Lindo (Peru)
  - Original and innovative analytical approach based on multi scale analyses (ICP-MS, XRD, µXRF, SEM, EPMA and laser ablation-ICP MS, QEMSCAN, TIMA-X).





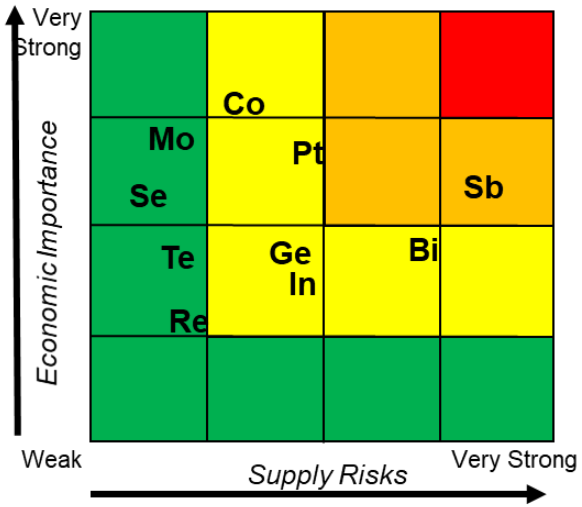






Targeted by-products of the ION4RAW prroject

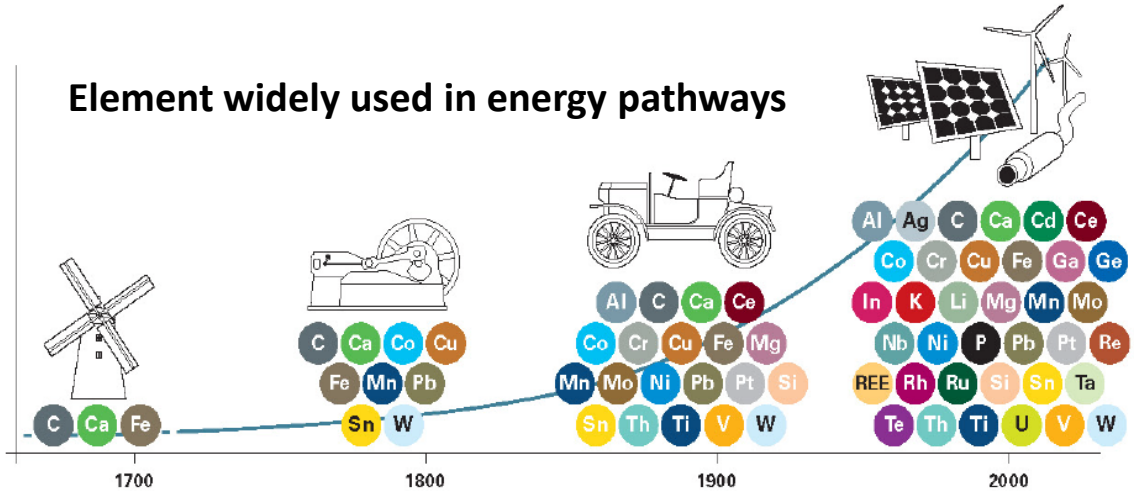
10 targeted by-products : Te, Bi, Co, Re, Mo, Pt, Sb, Ge, Se, In



	Energy Generation & Storage	Transport	Electronics & Telecoms	Industry 4.0	Defence
Antimony		X	X	X	X
Bismuth			X	X	X
Germanium	X		X		X
Indium	X		X	X	X
Cobalt	X	X	X	X	X
Tellurium	X			X	X
Selenium	X	X		X	X
Molybdenum	X	X		X	X
Rhenium		X			X
Platinum	X	X	X	X	X
Copper	X	X	X	X	X
Gold	X	X	X	X	X
Silver	X	X	X	X	X

Market analysis (D7.2 Dkhissi et al. 2021)

Element widely used in energy pathways



Achzet B., Reller A., Zepf V., (2011) – Materials critical to the energy industry. An introduction

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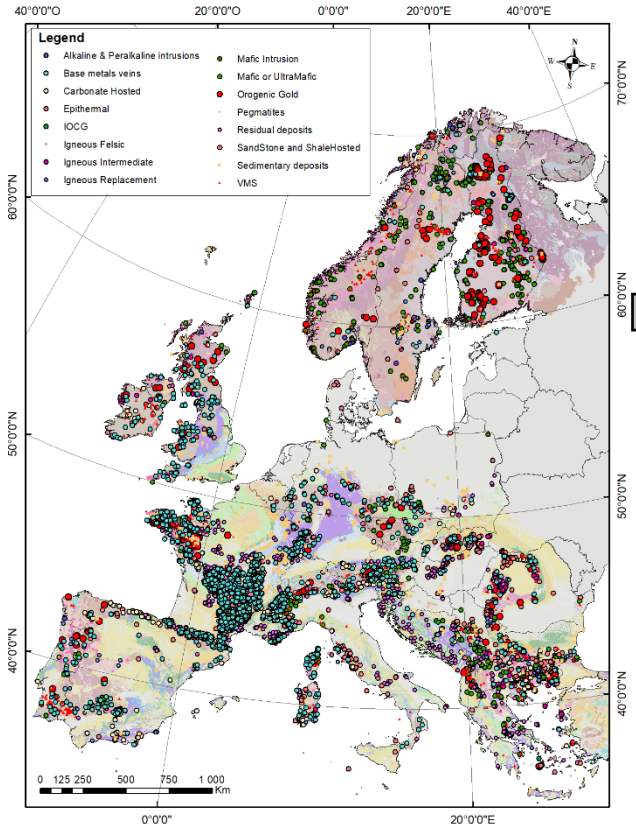
Compilation of Geoscientific Data

Production of a geographically-based compilation of the by-products occurrences and potential in EU

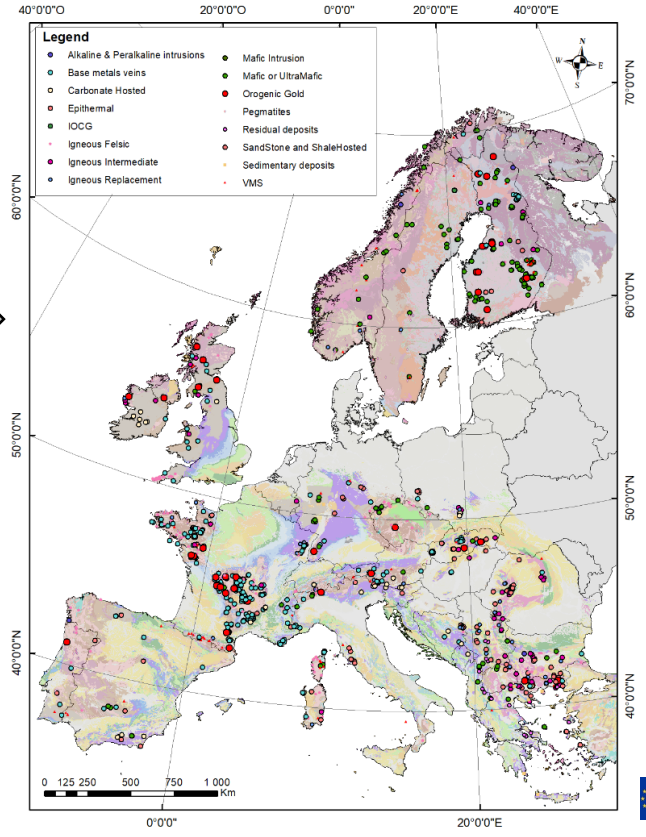
- ProMine database
- 17 metallogenic families

TOTAL of 8364 identified occurrences



ION4RAW target by-products where rarely identified, assessed and/or calculated

⇒ **'ONLY' 1400 identified occurrences for Cu, Au, Ag and Pb-Zn**



perform a **predictive assessment** of the by-product elements as they are **not usually or automatically identified through the EU database**

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DBQ method – favourability mapping

- **DBQ method** was developed to perform predictive assessment on datasets to identify the potential presence of target by-product elements **where they have not been searched or described**.
- Step 1: An ER (enrichment ratio)

$$\text{ER} = \frac{frequency\ of\ occurrence\ of\ [e] in\ a\ given\ metallogenic\ family}{frequency\ of\ occurrence\ of\ [e] in\ the\ whole\ dataset}$$

ER > 1 : the metallogenic family is enriched with the element
ER < 1 : the metallogenic family is depleted with the element

- Step 2: Identification of the multi-element signatures
- Step 3 – Ranking

$$\text{Rank} = \sum_{commodity\ \#1}^{commodity\ \#n} \left(\frac{commodity\ frequency\ x\ binary\ presence\ value}{100} \right)$$

	Sb	Bi	Te	Pt	Co	Mo	Ge	Se	Re	In	TOTAL
Epithermal	3,37	1,03	8,68				1,39	5,21		1,82	6,00
Igneous Intermediate			2,73			22,35		16,37	50,92	2,46	5,00
Igneous Replacement		2,67	1			1,85		4,01		2,71	5,00
Orogenic Gold	2,9	3,42	3,61		1,84			1,44			5,00
Mafic or UltraMafic		1,69	2,86	12,16	8,1						4,00
SandStone and ShaleHosted				1,44		1,01		2,2	5,86		4,00
Igneous Felsic		2,97				3,47				4,14	3,00
VMS					1,89		2,02			1,13	3,00
Residual deposits					1,2			1,35			2,00
Base metals veins	2,34						1,36				2,00
Mafic Intrusion				3,57							1,00
Carbonate Hosted							4,41				1,00
Placers				5,09							1,00
Alkaline & Peralkaline intrusions											0,00
IOCG											0,00
Pegmatites											0,00
Sedimentary deposits											0,00

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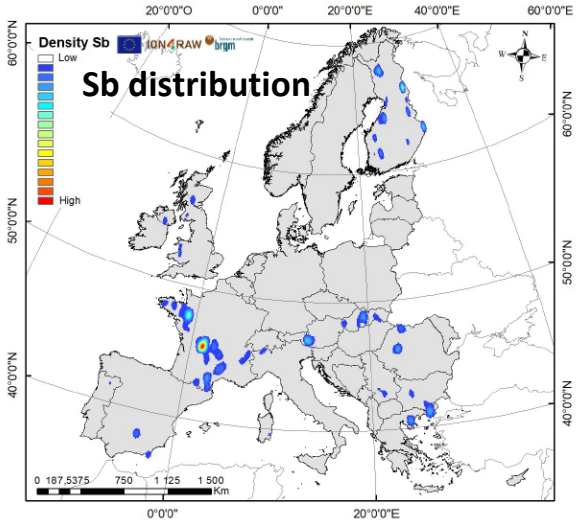
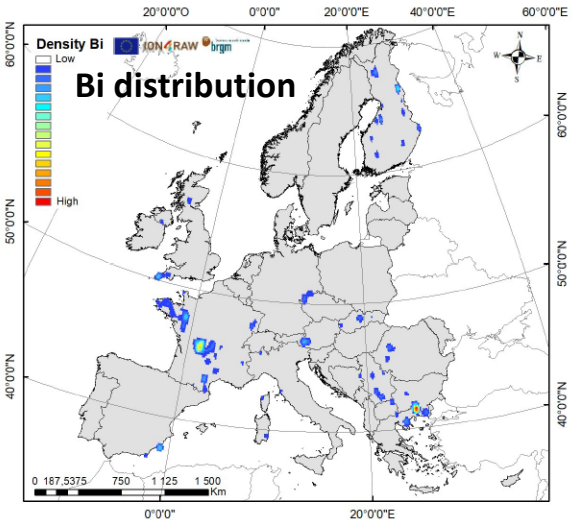
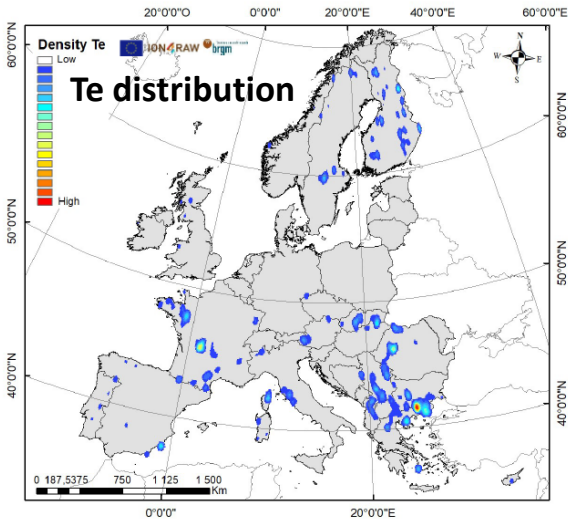
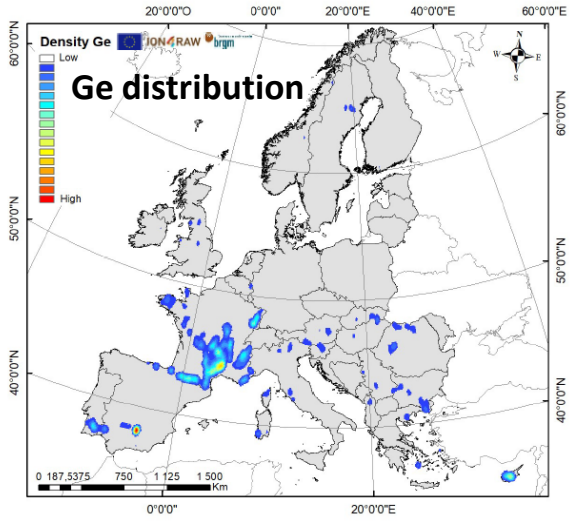
Metallogenic families signatures

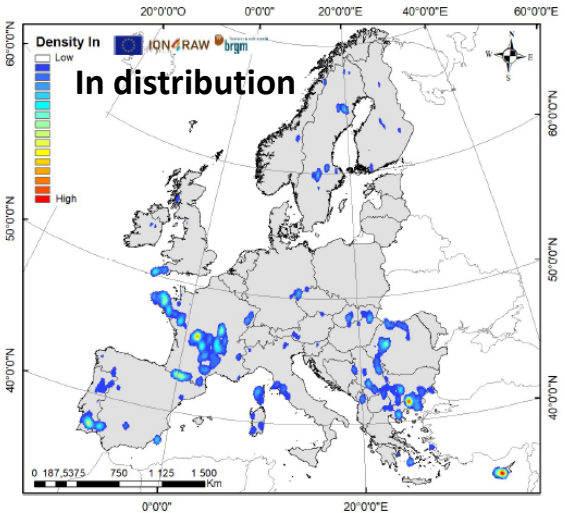
Sb, Bi, Te, Ge, In and Se define the epithermal signature

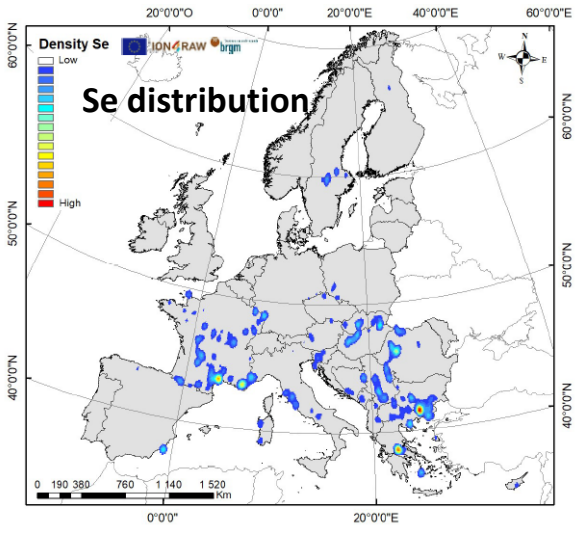












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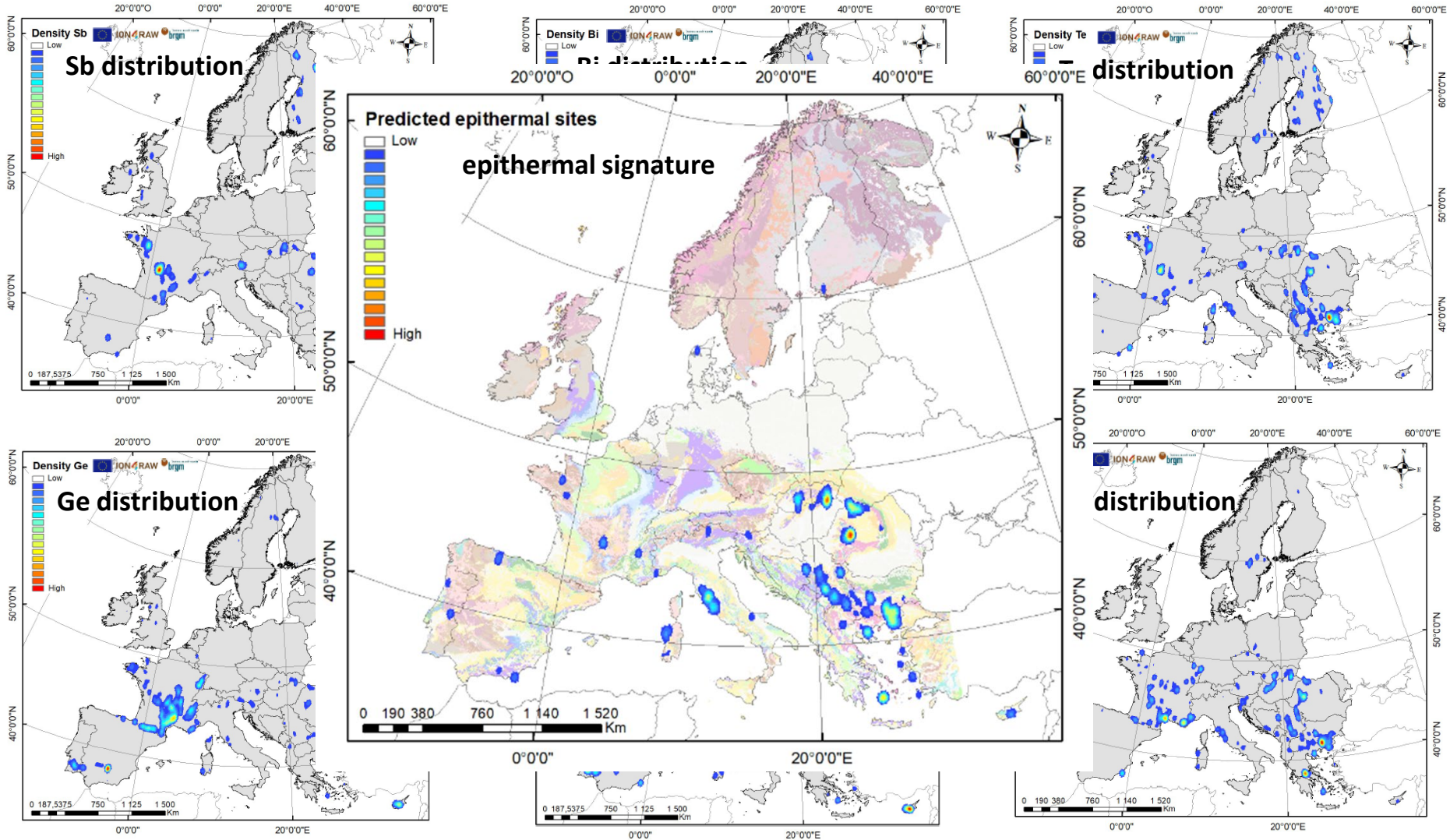

If you want more details …

- Methodology and results are extensively described in public ION4RAW deliverable D2.1 (available @ www.ion4raw.eu and RMIS)
- Scientific article : *Predictive assessment of metallogenic signature using the DataBase Querying (DBQ) method: A European application* (B. Gourcerol et al., 2022), Journal of Geochemical Exploration - https://doi.org/10.1016/j.gexplo.2022.106966
- These data served as input for the Decision Support System online available from the ION4RAW website ➞ Access Link
- Data were uploaded in the 'The European Commission's Raw Materials Information System' (RMIS). ➞ Access Link

Thank you. Get in touch for more information!

Follow the progress of the project on the ION4RAW website.

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