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GSEU to strengthen mineral exploration in Europe

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www.geologicalservice.eu



Funded by
the European Union





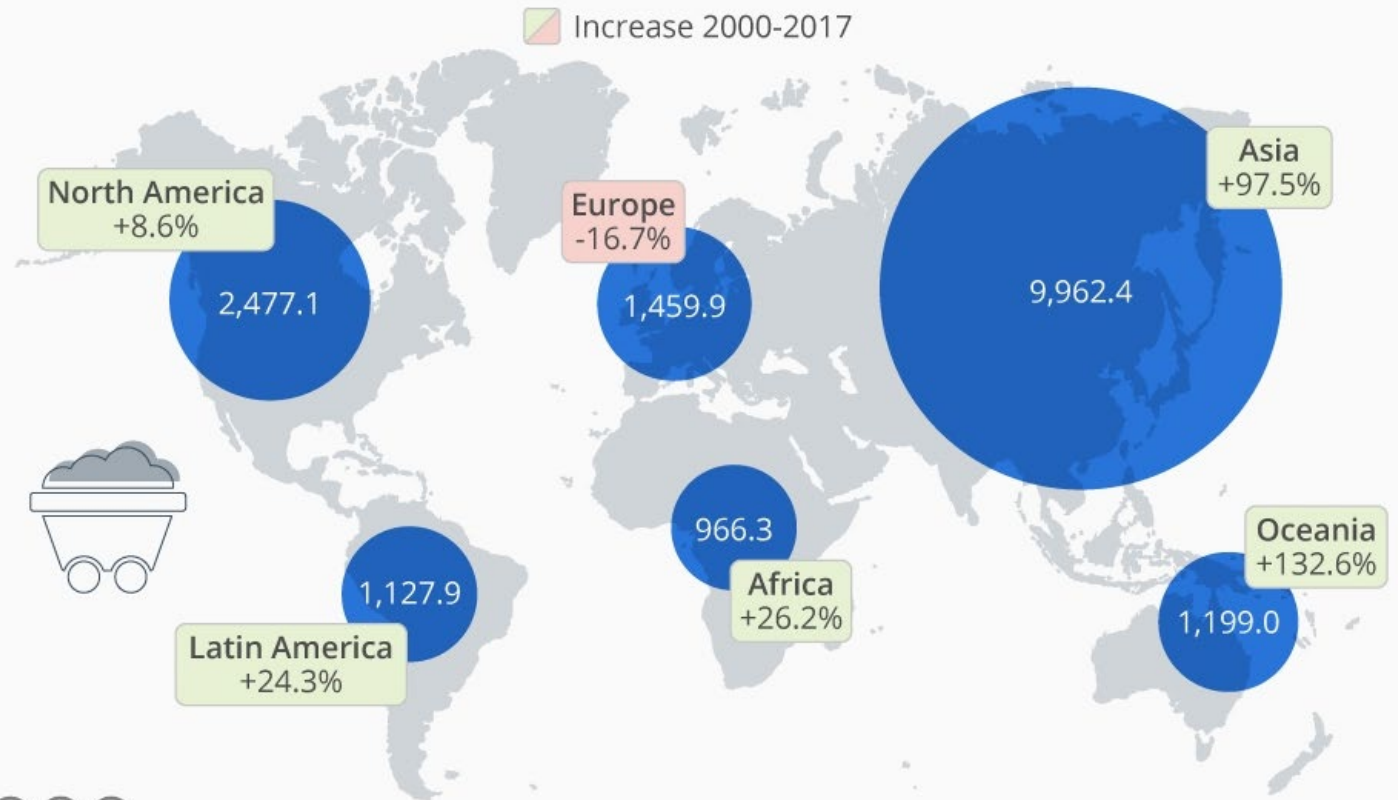
Introduction – the context

- The demand for CRMs is surging (combined effects of energy and digital transitions, world population increase and economic growth);
- Extractive/refining activities in Europe have been transferred to lower-cost countries;
- Europe is highly dependent on importations → increased vulnerability of its value chains;
- Recycling is necessary but not sufficient (increasing demand, time of residency, limitations in waste collection and separation, etc.);

We need CRM mines in Europe !

Where Mining is Thriving

Extraction of mining products in 2017 (in million metric tons) and increase, by continent



Source: World Mining Data 2019 by the International Organizing Committee for the World Mining Congresses

statista



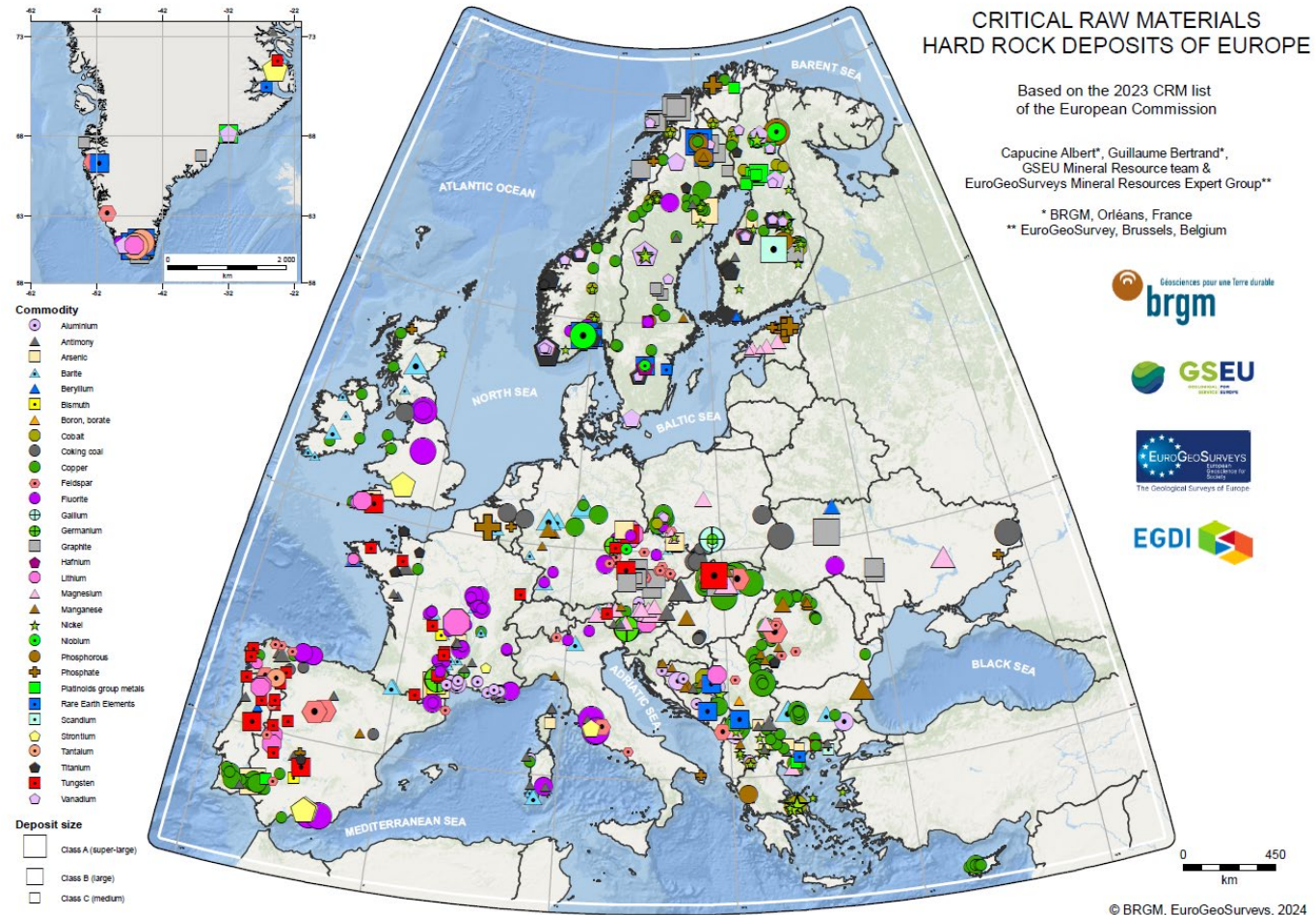
Introduction – the challenge

Despite being an “old mining continent”, Europe still has a significant potential:

- Many CRM were not explored and extracted decades ago (e.g. Li);
- Deep/undercover potential is poorly known;
- Despite large amounts of data, much is missing;

Relocating production of CRMs requires:

- large investments (long and hazardous returns);
- A pan-European approach (geology does not care for political boundaries!)
- Production of large amount of (non-competitive) data (GSOs);
- An incentive legal framework (CRM Act);



GSEU at the crossroad of Green Deal Policy & Earth Systems

GSEU is a 5 years Eu-funded project coordinated by EuroGeoSurveys. It provides pan-European geoscientific data and expertise to support European Policy and Society at large.



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For Raw Materials:

- Compilation and harmonization of CRM data at European scale;
- Assessment of primary and secondary, onshore and offshore CRM potential;
- UNFC for mineral resources and promotion of UNRMS;
- ICE-SRM for promotion and capacity building on UNFC;

... to support the CRM Act.

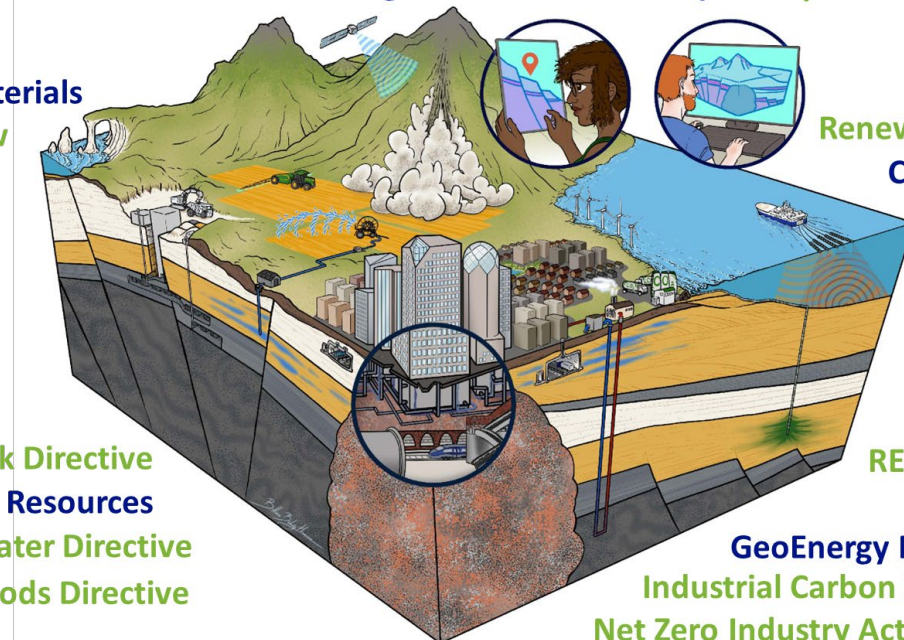
INSPIRE Directive Geological Framework Setup European Data Strategy

Critical Raw Materials
The Critical Raw Materials Act

Renewable Energy Directive
Coastal vulnerability &
Windfarm siting
Marine Strategy

Water Framework Directive
Groundwater Resources
Groundwater Directive
Floods Directive

REPower EU
GeoEnergy Resources
Industrial Carbon Management Strategy
Net Zero Industry Act

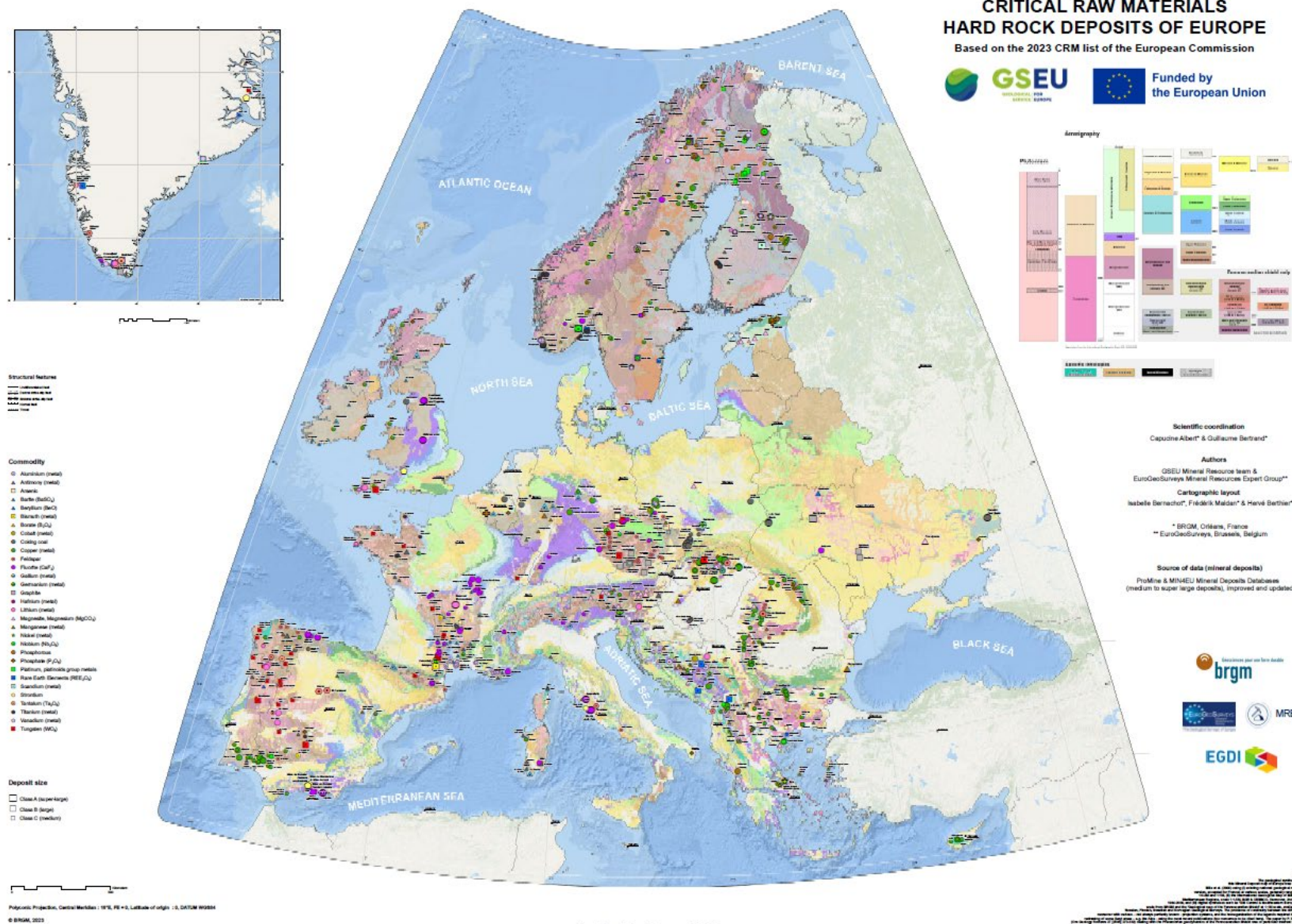




Onshore CRM potential assessment

Pan-European map of CRM deposits:

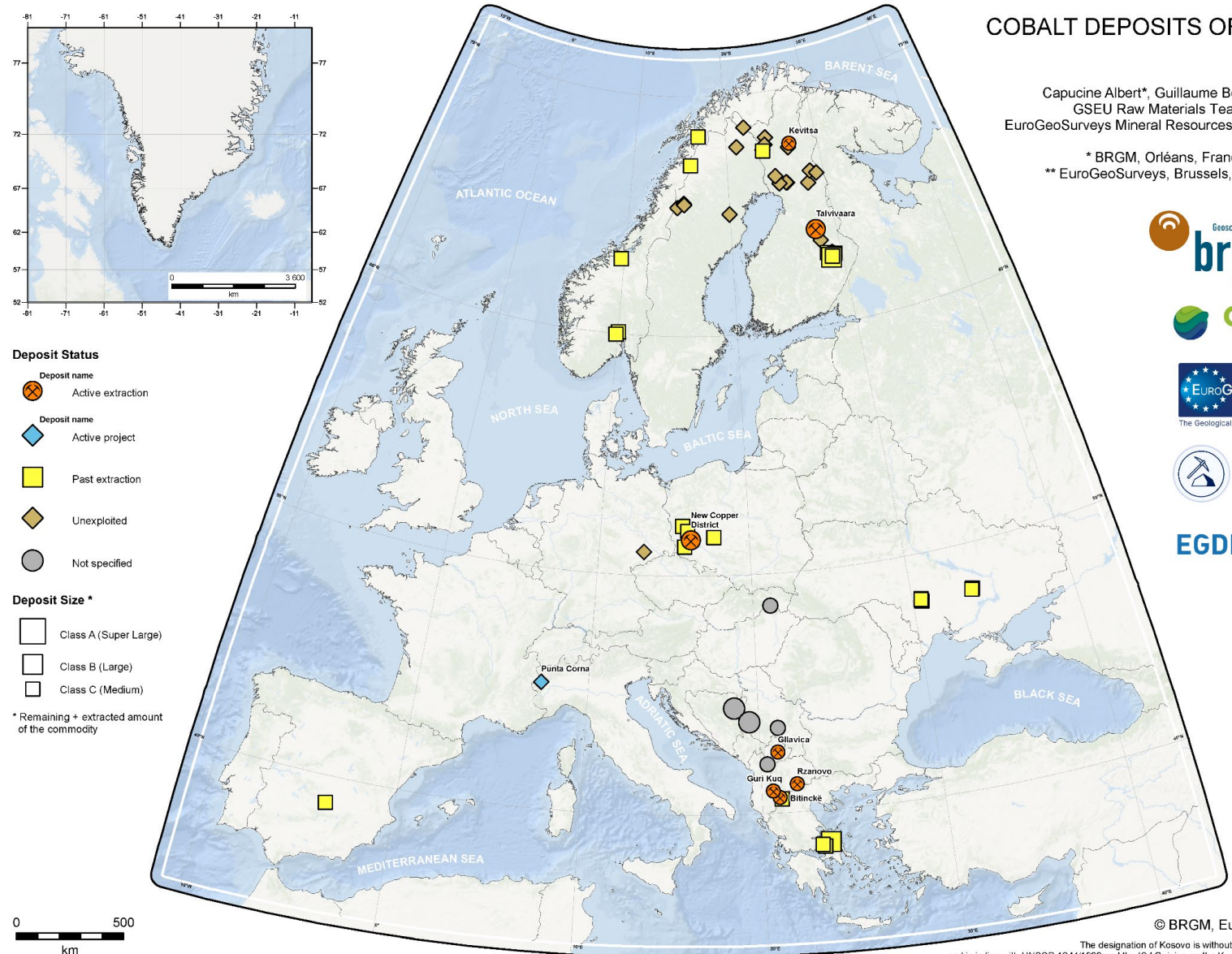
- Based on the 2023 CRM list;
- Covers geographic Europe;
- All known medium to world-class deposits;
- 30 commodities (all except helium and silicon);
- Complete check and update by all data providers;



Onshore CRM potential assessment

Pan-European commodity maps:

- Derived from the Pan-European map of CRM deposits;
- 30 maps for 30 commodities;
- Display all medium to world-class deposits;
- Symbology based on size and status of deposit;





Onshore CRM potential assessment

Pan-European commodity assessments:

- Resource assessment for 30 commodities;
- Resources aggregated at country level and classified on their level of confidence;

Name	Country	Class	Deposit status	Commodities currently mined	Confidential	Resources (t)	Reserves (t)	Extracted (t)	Total endowment (t)
Jadar	Serbia	A	Under development		no	2697003			2697003
Zinnwald	Germany	A	Feasibility		no	1078443			1078443
Beauvoir (Echassières)	France	A	Under development		no	1053000			1053000
Cínovec	Czechia	A			yes				1000000 ^m
Dobra	Ukraine	A	Not operating		yes				1000000 ^m
San Jose	Spain	B	Under development		no	678930	234360*		913290
St Austell Granite	UK	B			no	869613			869613
Las Navas	Spain	B	Under development		no	811370			811370
Kvanefjeld/Kuannersuit	Greenland	B	Not exploited		no	505885			505885
Sepeda (Romano)	Portugal	B	Under development		no	300000			300000
Barroso	Portugal	B	Under development		no	293400			293400
Weinebene	Austria	B	Not exploited		no	128500			128500
Sadisdorf	Germany	B	Closed		no	127284			127284
Trelavour	UK	B			no	124080			124080
Shevchenkivske	Ukraine	B	Not operating		yes				100000 ^m
Polokhivske	Ukraine	B	Operating	Li	yes				100000 ^m
Rapasaaret	Finland	C	Not exploited		no	94877			94877
Alberta I	Spain	C			no	90340			90340
Altenberg	Germany	C	Closed		no	71039			71039
Tréguenec-Prat-ar-Hastel	France	C	Not exploited		no	68680			68680
^m minimum estimate									
* reserves not included in resources									

Country	Remaining resources – lithium contained (tons of Li ₂ O)	Category
Austria	128500	2 – mineral resources
Finland	94877	2 – mineral resources
France	1121680	4 – historical or non-compliant
Germany	1078443	2 – mineral resources
	198323	4 – historical or non-compliant
Greenland	505885	2 – mineral resources
Portugal	593400	2 – mineral resources
Serbia	2697003	2 – mineral resources
Spain	234360	1 – mineral reserves
	1580640	2 – mineral resources
UK	993693	2 – mineral resources

GSEU assessment of Li potential in Europe; above: list of known European deposits; left: potential per country and level of confidence.



Onshore CRM potential assessment

Pan-European mineral prospectivity maps:

- Display the spatial distribution of geological favourability;
- Use the latest data and methodology (DBA+RF);
- 11 CRM processed so far: Co, Cu, Li, Mg, Mn, Nb, Ni, Sb, Ta, V, W;
- More to come ...

FAVOURABILITY MAP FOR ANTIMONY MINERALIZATION IN EUROPE

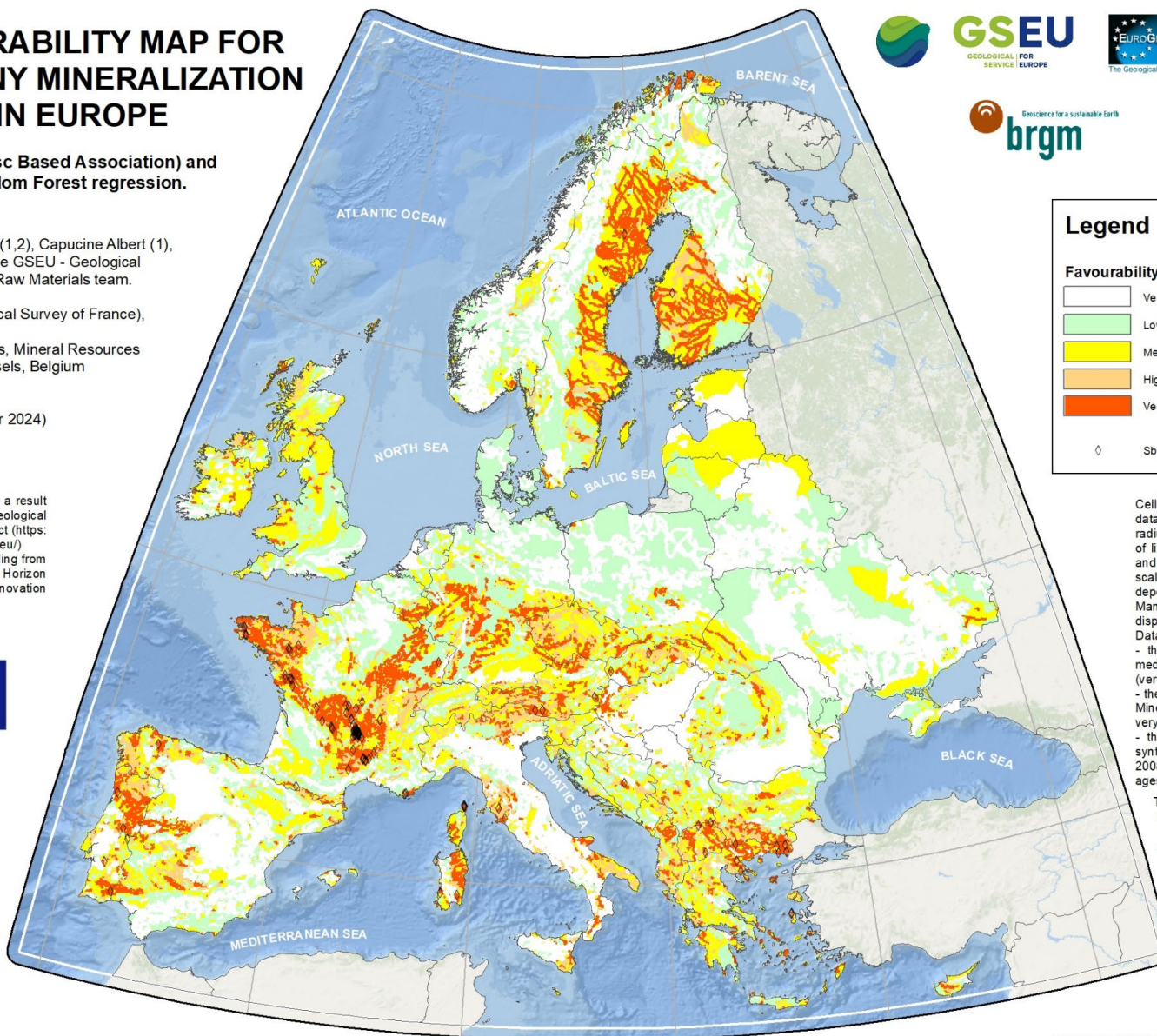
DBA (Disc Based Association) and Random Forest regression.

Guillaume Bertrand (1,2), Capucine Albert (1), Alex Vella (1) and the GSEU - Geological Service for Europe Raw Materials team.

- 1 – BRGM (Geological Survey of France), Orléans, France
- 2 – EuroGeoSurveys, Mineral Resources Expert Group, Brussels, Belgium

Version 1.0 (October 2024)

This favourability map is a result from the GSEU - Geological Service for Europe project (<https://www.geologicalservice.eu/>). GSEU has received funding from the European Union's Horizon Europe research and innovation programme.



Legend

Favourability scores for antimony

White	Very low (0 to 0.4)
Light Green	Low (>0.4 to 0.6)
Yellow	Medium (>0.6 to 0.75)
Orange	High (>0.75 to 0.85)
Red	Very high (over 0.85)

◊ Sb deposits (107 deposits)

Cell size of 5 km x 5 km. DBA data aggregation with search radius of 7.5 km (associations of lithologies) and 5 km (faults and known deposits). Log4 scale weighting based on deposit class. Manual classification for the display of favourability scores. Data sources are:

- the GSEU Wp2 dataset of medium to super large deposits (version August 2024);
- the EGD I (MIN4EU) and Pro-Mine databases for small and very small deposits;
- the 1/1 500 000 geological synthesis of Europe (Billa et al., 2008); lithologies of Quaternary ages have been excluded.

The use of this map remains the sole responsibility of the users. The authors assume no responsibility for the use of this map and the consequences that may result.



Offshore CRM potential

Global map of CRM occurrences in European and neighbouring seas:

- Based on the compilation and harmonization of 595 mineral occurrences and 1961 samples from 13 marine regions;
- Display areas of high potential for future research and exploration;

CRITICAL RAW MATERIALS OFFSHORE OCCURRENCES OF EUROPE

Based on the 2023 CRM list of the European Commission



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Bathymetry

0 m -8000 m

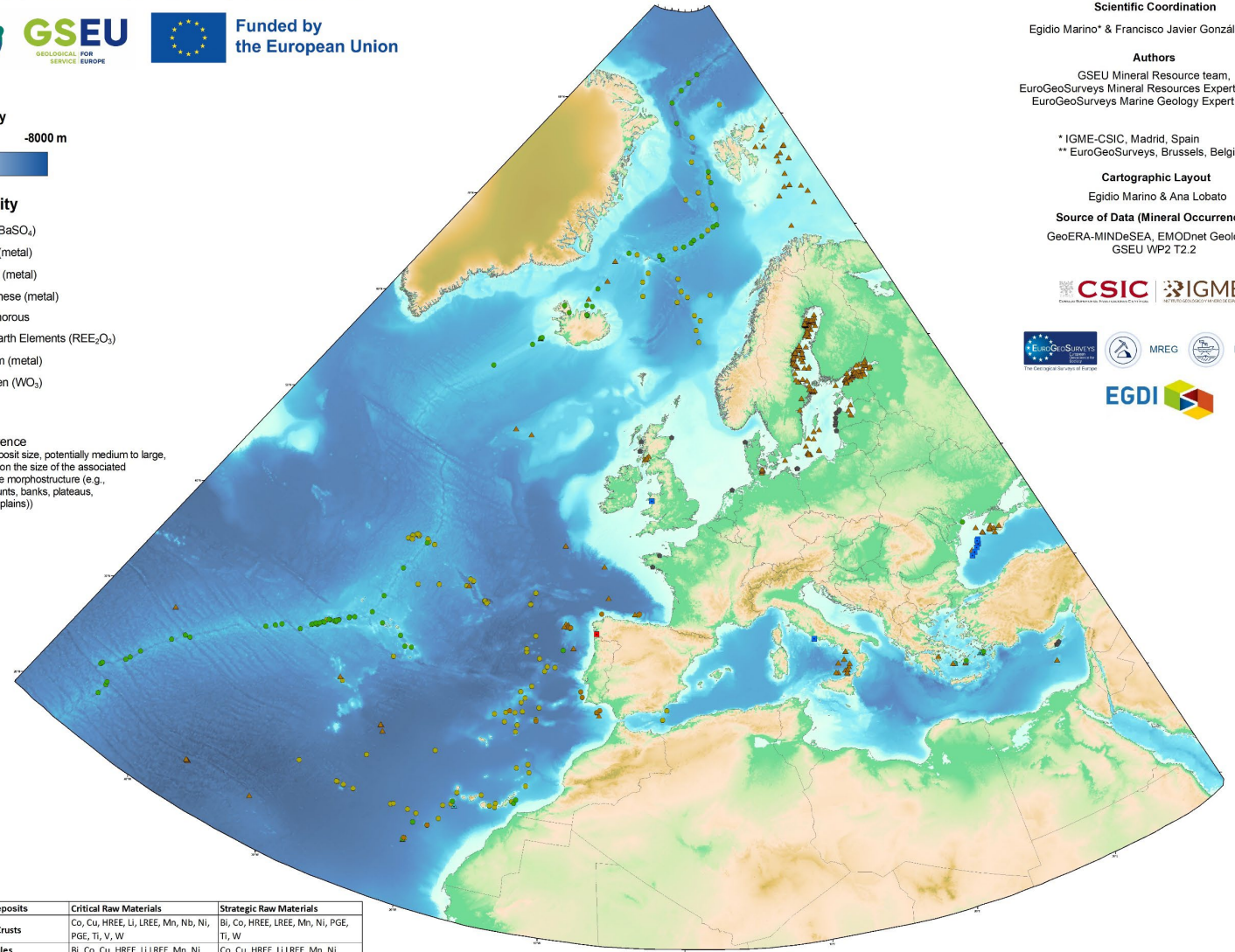


Commodity

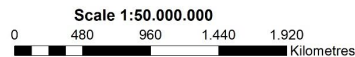
- ▲ Barite (BaSO₄)
- Cobalt (metal)
- Copper (metal)
- ▲ Manganese (metal)
- Phosphorous
- Rare Earth Elements (REE₂O₃)
- Titanium (metal)
- Tungsten (WO₃)

Size

- Occurrence
(The deposit size, potentially medium to large, depend on the size of the associated favorable morphostructure (e.g., seamounts, banks, plateaus, abyssal plains))



Marine Mineral Deposits	Critical Raw Materials	Strategic Raw Materials
Ferromanganese Crusts	Co, Cu, HREE, Li, LREE, Mn, Nb, Ni, PGE, Ti, V, W	Bi, Co, HREE, LREE, Mn, Ni, PGE, Ti, W
Polymetallic Nodules	Bi, Co, Cu, HREE, Li, LREE, Mn, Ni	Co, Cu, HREE, Li, LREE, Mn, Ni
Polymetallic Sulphides	As, Bi, Cu, Ga, Ge, Sb	Bi, Cu, Ga, Ge
Phosphorites	F, HREE, LREE, P	HREE, LREE
Placers	HREE, LREE, PGE, Ta, Ti, W	HREE, LREE, PGE, Ti, W



Polyconic Projection, Centra l Meridia n : 16° E, FE = 0, L a titude of Origin : 0, DAT U M WGS84

Scientific Coordination
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** EuroGeoSurveys, Brussels, Belgium

Cartographic Layout
Egidio Marino & Ana Lobato

Source of Data (Mineral Occurrences)
GeoERA-MINDeSEA, EMODnet Geology &
GSEU WP2 T2.2



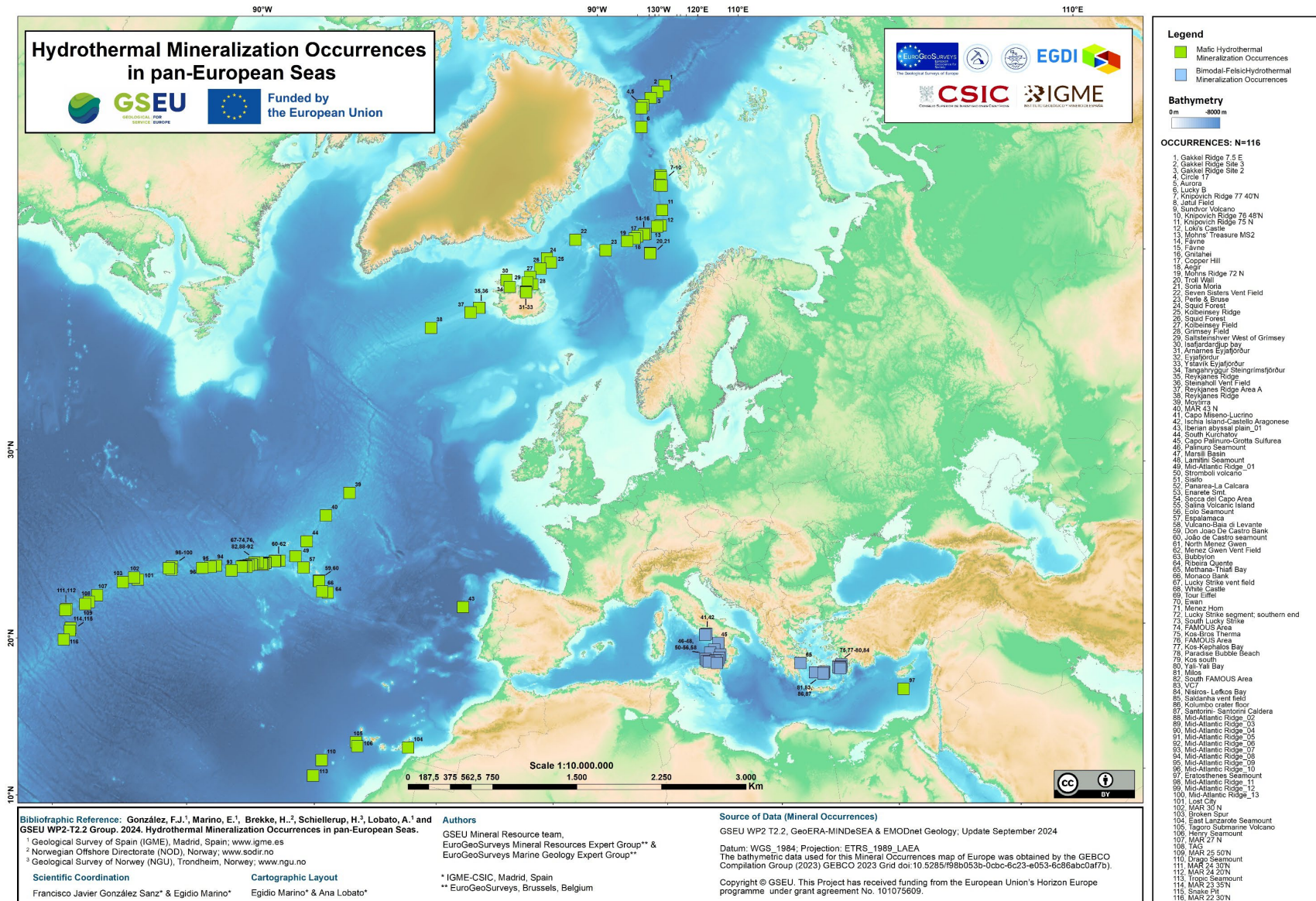
WARNING:
The bathymetric data used for this Mineral Occurrences map of Europe was obtained by the GEBCO Compilation Group (2023) GEBCO 2023 Grid doi: 10.5285/98b053b-0cbc-6c23-e053-6c86abc0af7b). Given the polymetallic nature of marine minerals deposits only is represented in the map the main commodity, having the potential to contain various Strategic and Critical Raw Materials.



Offshore CRM potential assessment

Maps of offshore CRM occurrences per deposit types:

- 5 maps: marine placers, phosphorites, FeMn crusts, hydrothermal mineralization, polymetallic nodules;
- Additional focuses on selected European marine regions (regional maps);
- Include also summaries of genetic processes, lists of occurrences and potential assessments;

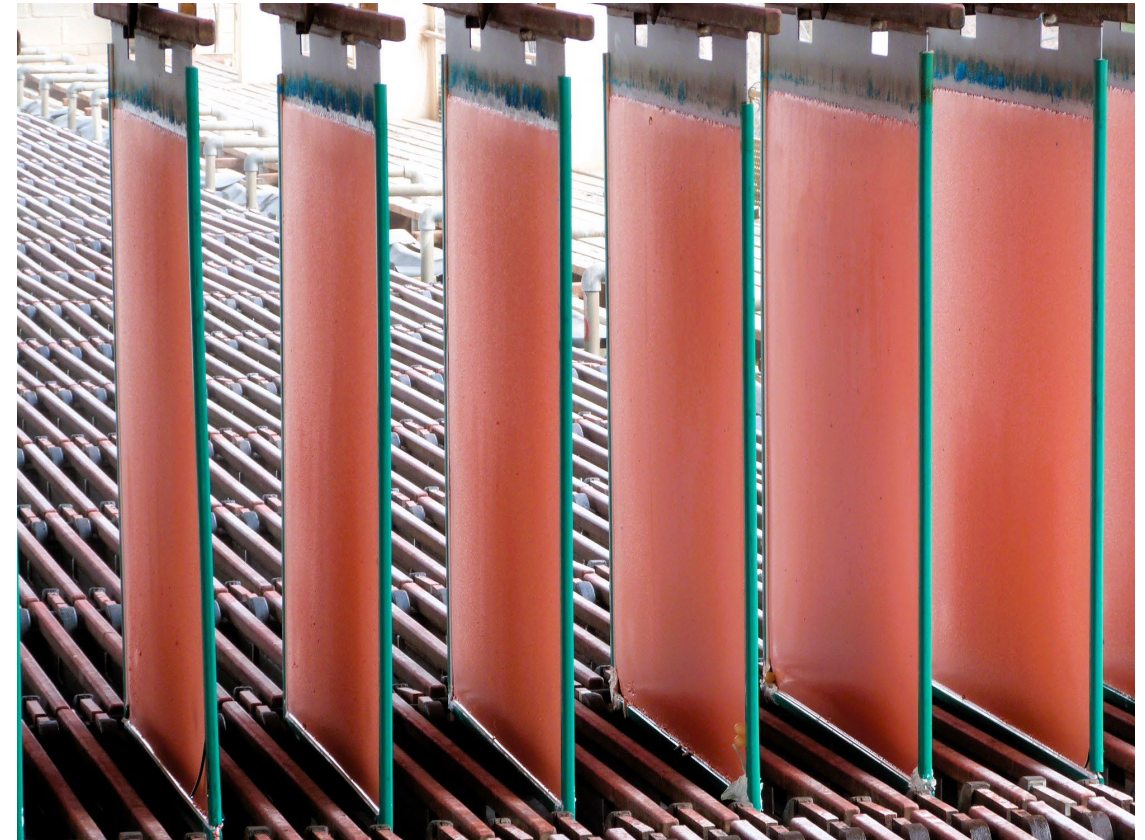




Conclusion

Takeaway points

- GSEU « Raw Materials » team is developing added-value products to assess European CRM potential, both onshore and offshore;
- These products support decision making at national to European scale, for policy-makers, exploration/mining companies, academic research, etc.;
- All maps presented here (and many more) are provided in 2 reports currently under review;
- They will be available soon on the GSEU web page: <https://www.geologicalservice.eu/>
- More products on European CRM potential are being developed: additional mineral prospectivity maps, metallogenic potential maps, secondary resource potential (in collaboration with FutuRaM), etc.



Cu-cathods production at the Skouriotissa mine, Cyprus (phot G. Bertrand, BRGM)



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Thanks for your attention !

