



FRAME

FORECASTING AND ASSESSING EUROPE'S
STRATEGIC RAW MATERIALS NEEDS

FRAME

(Forecasting and Assessing Europe's Strategic Raw Material Needs)

Knowledge Increments in Mineral Intelligence

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+ the FRAME Consortium

Brussels, January 2022



This project has received funding from the European Union's Horizon 2020
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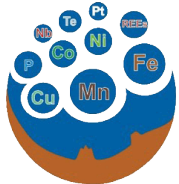




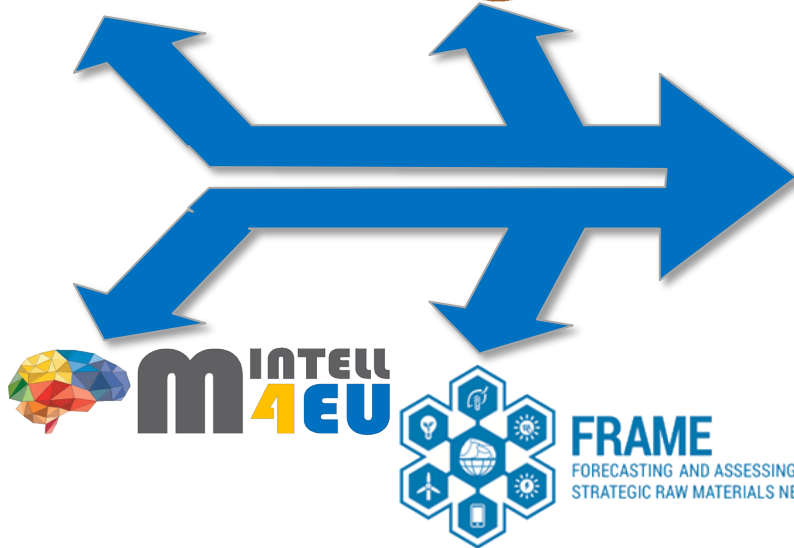
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GeoERA RM



MINDeSEA
Seabed Mineral Deposits in European Seas:
Metallogeny and Geological Potential for
Strategic and Critical Raw Materials



What is

GeoERA
RAW MATERIALS



- Works on mutual understanding
- Vocabularies, test and show cases, incl. UNFC...
- Delivers harmonised information
- Cartographies and thematic maps ...
- Accumulates expertise of regional knowledge & information to a quality controlled / cohered resource database
- Repositories, Minerals Inventory, e-Minerals Yearbook...
- Assists in identifying high potential areas for responsible sourcing and supply within Europe.

<https://geoera.eu/themes/raw-materials/>



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GeoERA RM

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<https://geoera.eu/themes/raw-materials/>

GeoERA RAW Materials Products - first of their kind -

- 1st combined database (MIN4EU) with data on mineral occurrences and mines, production, trade, resources and reserves (MINTELL4EU);
- 1st set of national atlases on ornamental stones (EUROLITHOS);
- 1st compilation (aggregated form) of the mineral occurrences, geology and potential for REE, lithium, cobalt and graphite and for the first time it was possible to make clusters of deposits and metallogenic (FRAME)
- 1st pan-European maps on marine deposits (MINDeSEA);
- 1st pan-European predictivity maps on marine and landlocked CRM (FRAME and MINDeSEA)



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MINDeSEA

Seabed Mineral Deposits in European Seas:
Metallogeny and Geological Potential for
Strategic and Critical Raw Materials



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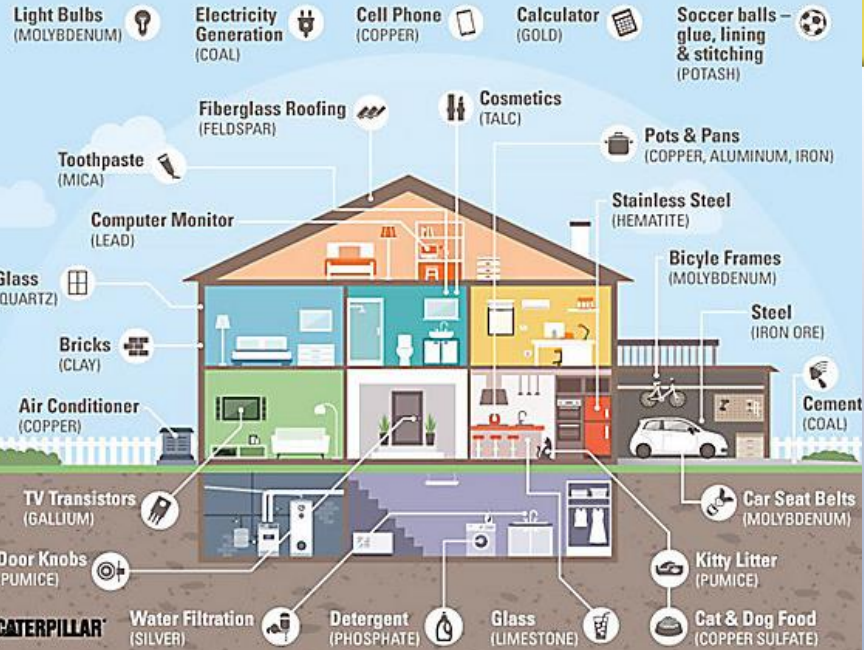
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FOUNDATIONS

MINED MINERALS MAKE OUR DAY

★ THE IMPACT OF MINING ON OUR LIVES ★



1	3	14	19	20	29	31	32	33	47	49	50	73	74	76
Li	Si	K	C	Ga	Ge	As	Ag	In	Sn	Ta	W	Pr		
lithium	silicon	potassium	carbon	gallium	germanium	arsenic	silver	indium	tin	tantalum	tungsten	praseodymium		
6.94	28.09	39.10	12.01	69.72	72.64	74.92	107.87	114.82	118.71	180.95	183.84	140.91		

A World of Minerals in Your Mobile Device

Mobile phones and other high-technology communications devices could not exist without mineral commodities. More than one-half of all components in a mobile device—including its electronics, display, battery, speakers, and more—are made from mined and semi-processed materials (mineral commodities). Some mineral commodities can be recovered as byproducts during the production and processing of other commodities. As an example, bauxite is mined for its aluminum content, but gallium is recovered during the aluminum production process. The images below show the **ore minerals** (sources) of some mineral commodities that are used to make components of a mobile device. On the reverse side, the map and table depict the major source countries producing some of these mineral commodities along with how these commodities are used in mobile devices. For more information on minerals, visit <http://minerals.usgs.gov>.

Display

A mobile device's glass screen is very durable because glassmakers combine its main ingredient, **silica** (silicon dioxide or quartz) **sand**, with ceramic materials and then add potassium.

Layers of indium-tin-oxide are used to create transparent circuits in the display. Tin is also the ingredient in circuit board solder, and **cassiterite** is a primary source of tin.

Gallium provides light emitting diode (LED) backlighting. **Bauxite** is the primary source of this commodity.

Sphalerite is the source of indium (used in the screen's conductive coating) and germanium (used in displays and LEDs).

Electronics and Circuitry

The content of copper in a mobile device far exceeds the amount of any other metal. Copper conducts electricity and heat and comes from the source mineral **chalcopyrite**.

Tetrahedrite is a primary source of silver. Silver-based inks on composite boards create electrical pathways through a device.

Silicon, very abundant in the Earth's crust, is produced from the source mineral quartz and is the basis of integrated circuits.

Arsenopyrite is a source of arsenic, which is used in radio frequency and power amplifiers.

Tantalum, from the source mineral **tantalite**, is added to capacitors to regulate voltage and improve the audio quality of a device.

Wolframite is a source of tungsten, which acts as a heat sink and provides the mass for mobile phone vibration.

Battery

Spodumene and subsurface brines are the sources of lithium used in cathodes of lithium-ion batteries.

Graphite is used for the anodes of lithium-ion batteries because of its electrical and thermal conductivity.

Speakers and Vibration

Bastnaesite is a source of rare-earth elements used to produce magnets in speakers, microphones, and vibration motors.

<https://notyourgrandfathersmining.ca/minerals-in-your-life>



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Barrier image courtesy of
"redactor-artistic.com"

U.S. Department of the Interior
U.S. Geological Survey

General Information Product 167
September 2016

GeoERA
RAW MATERIALS



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FOUNDATIONS

Circular Economy



Battery Initiative



Critical Raw Materials List



Conflict Minerals Regulation **2021**



The EU Raw Materials Initiative
- Critical Raw Materials for the EU -



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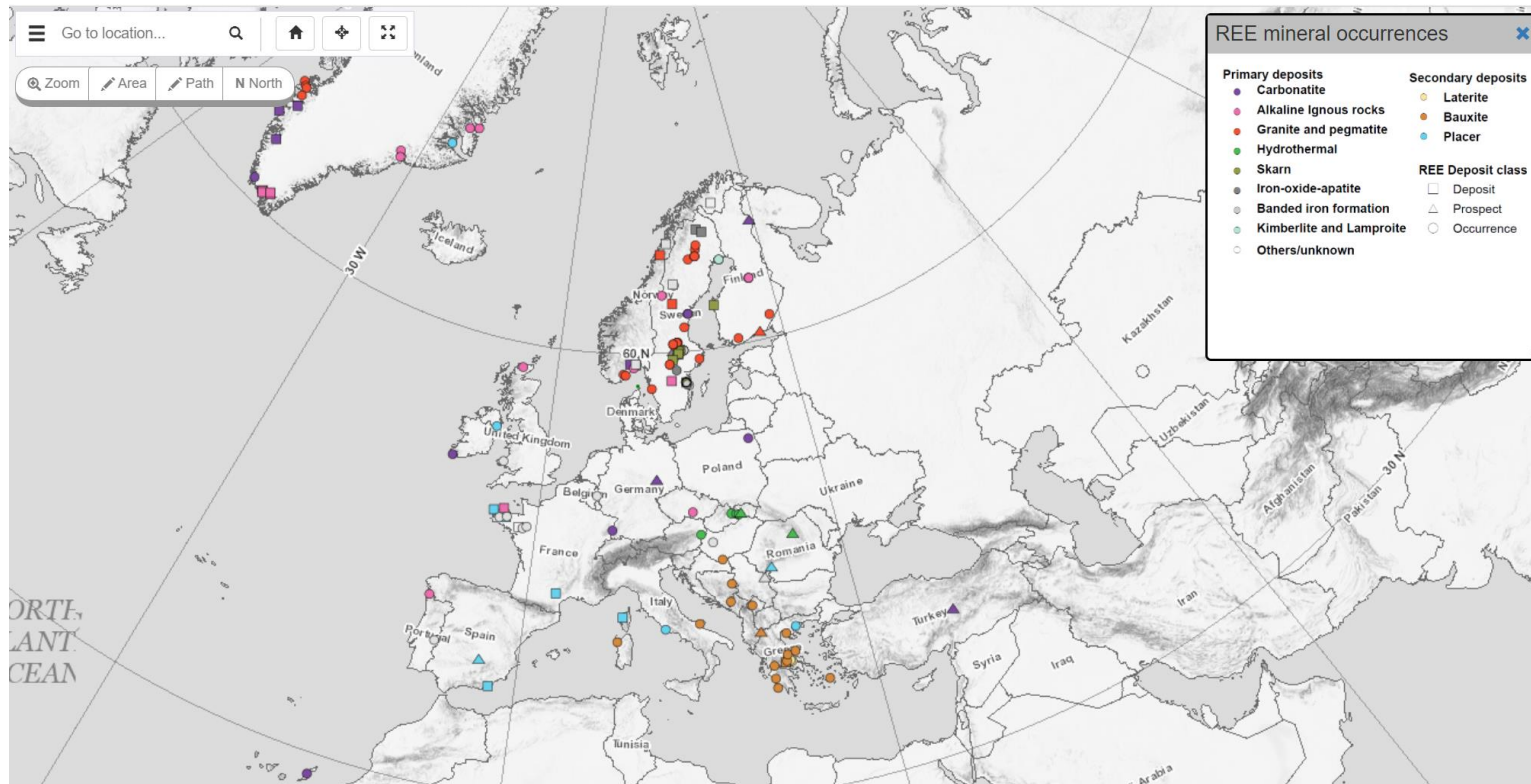




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IMPACTS Min. Int.



FRAME updated and completed, ProMine, Minerals4EU (M4EU), EURARE and European Geological Data Infrastructure (EGDI) datasets on rare earth elements, graphite, cobalt, lithium, phosphor, niobium and tantalum



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IMPACTS Min. Int.

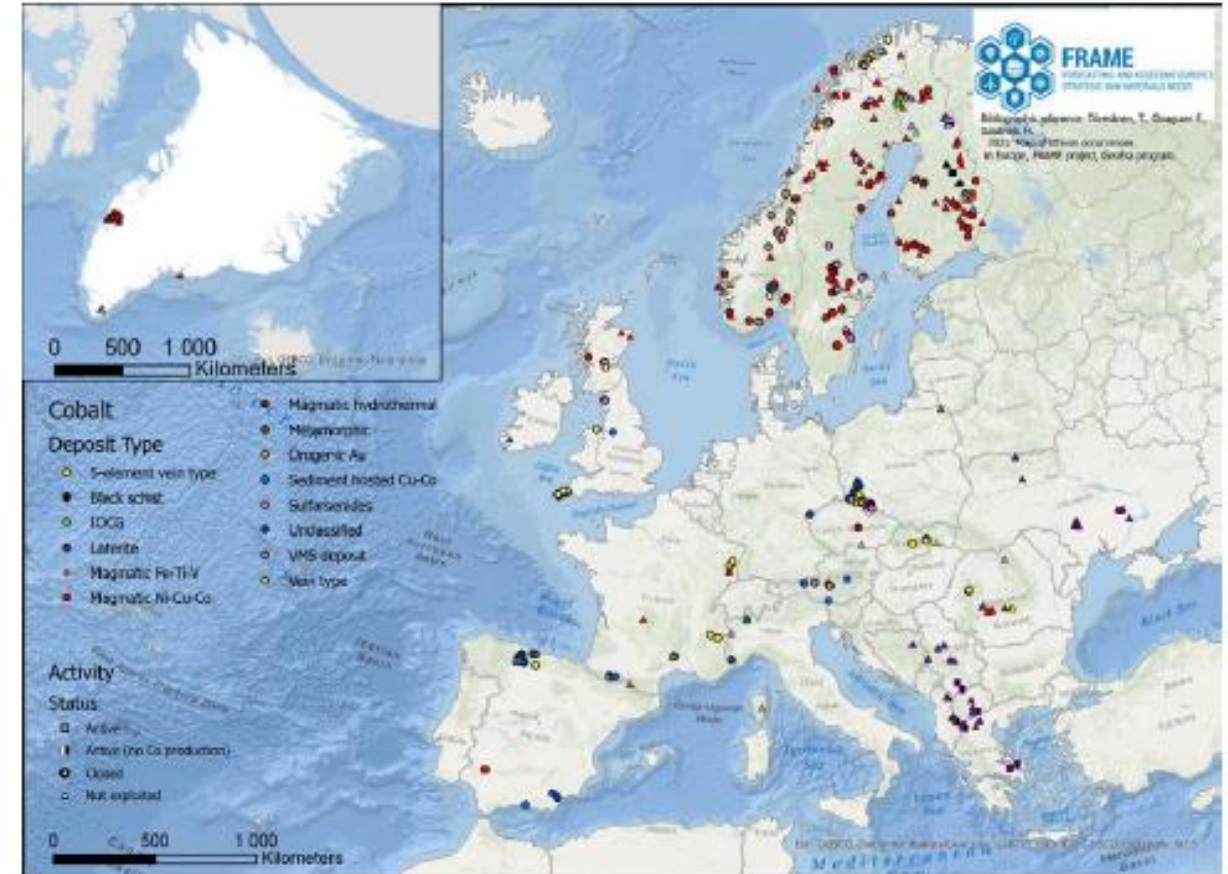
Close cooperation with
non-consortium members
in the Mineral Resources
Expert Group of
EuroGeoSurveys to supply
extra data

> 60%



MREG

MINERAL RESOURCES
EXPERT GROUP
EuroGeoSurveys



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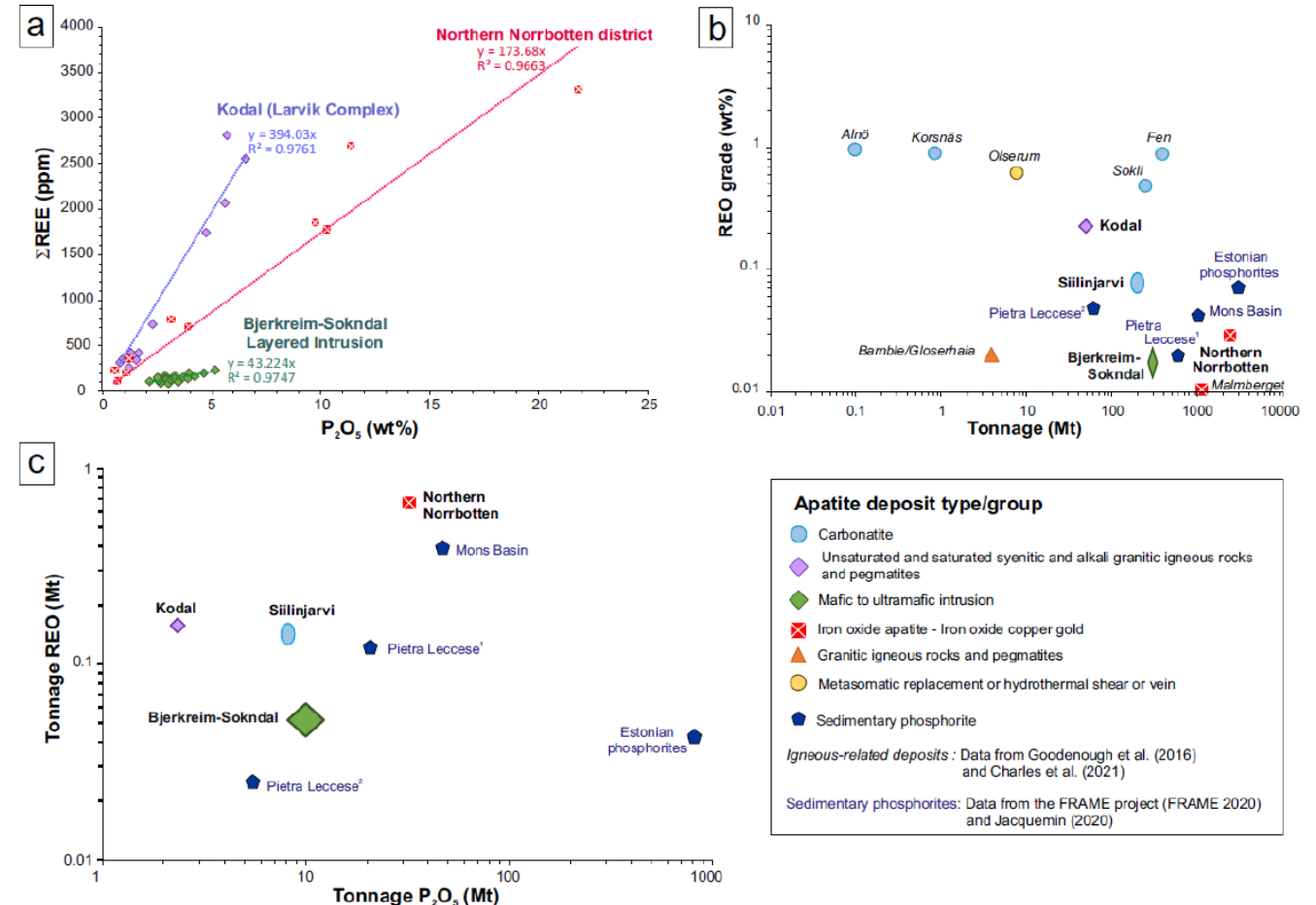


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IMPACTS Min. Int.

- Acquisition of new mineralogical and geochemical data on selected phosphate deposits and occurrences;
- Chemistry of apatite + igneous P deposits;
- + procedure to prepare samples and analyze phosphate deposits to provide internally consistent geochemical data at a European level



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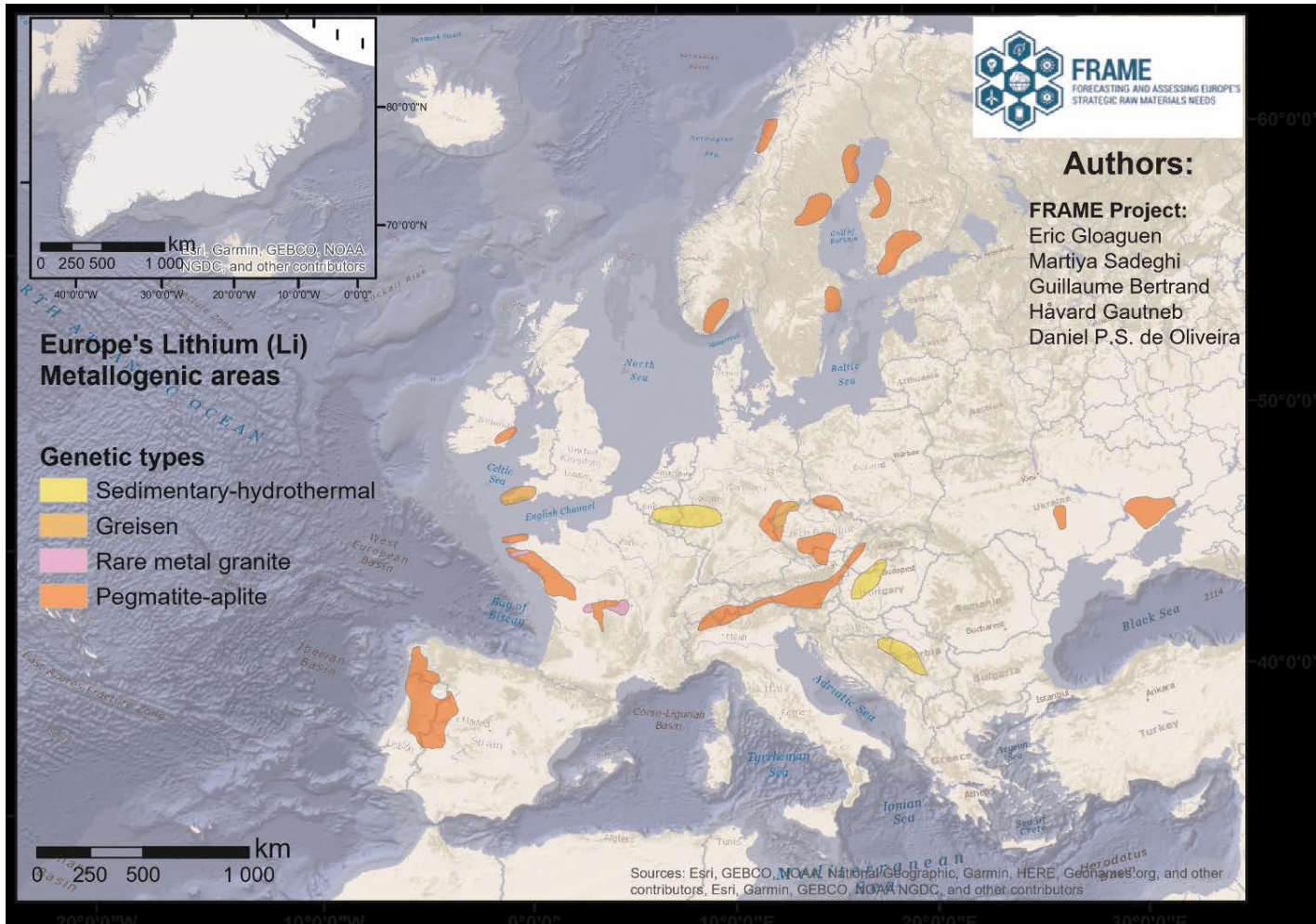




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IMPACTS Min. Sc.



Establishment of metallogenic areas
for several critical elements in Europe



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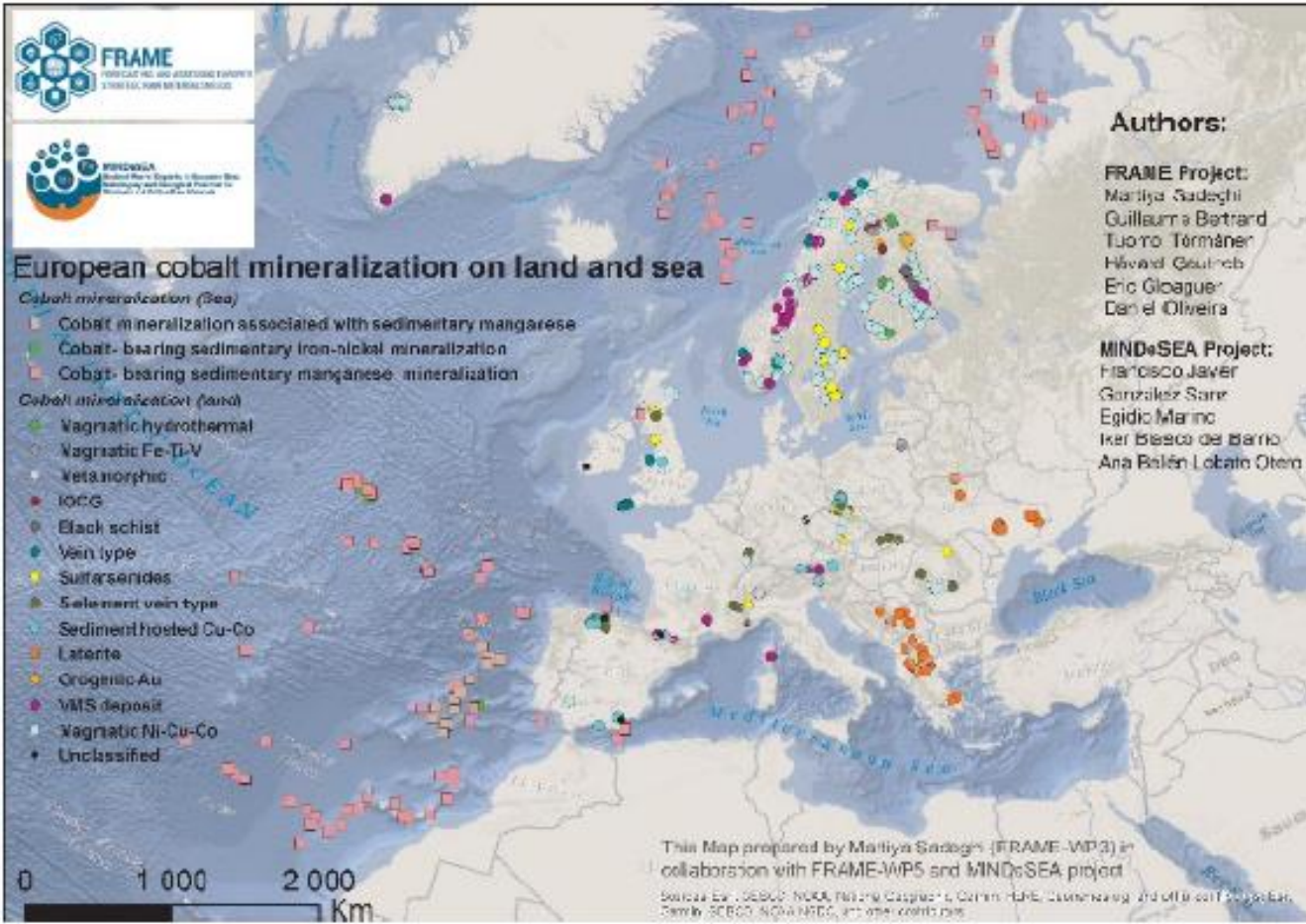




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IMPACTS Min. Int.



- Bilateral collaboration between FRAME and MINDeSEA projects - land and sea
- + Production of land-Sea maps containing phosphate, cobalt



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IMPACTS Min. Int.

FAVOURABILITY MAP FOR LITHIUM MINERALIZATION IN EUROPE

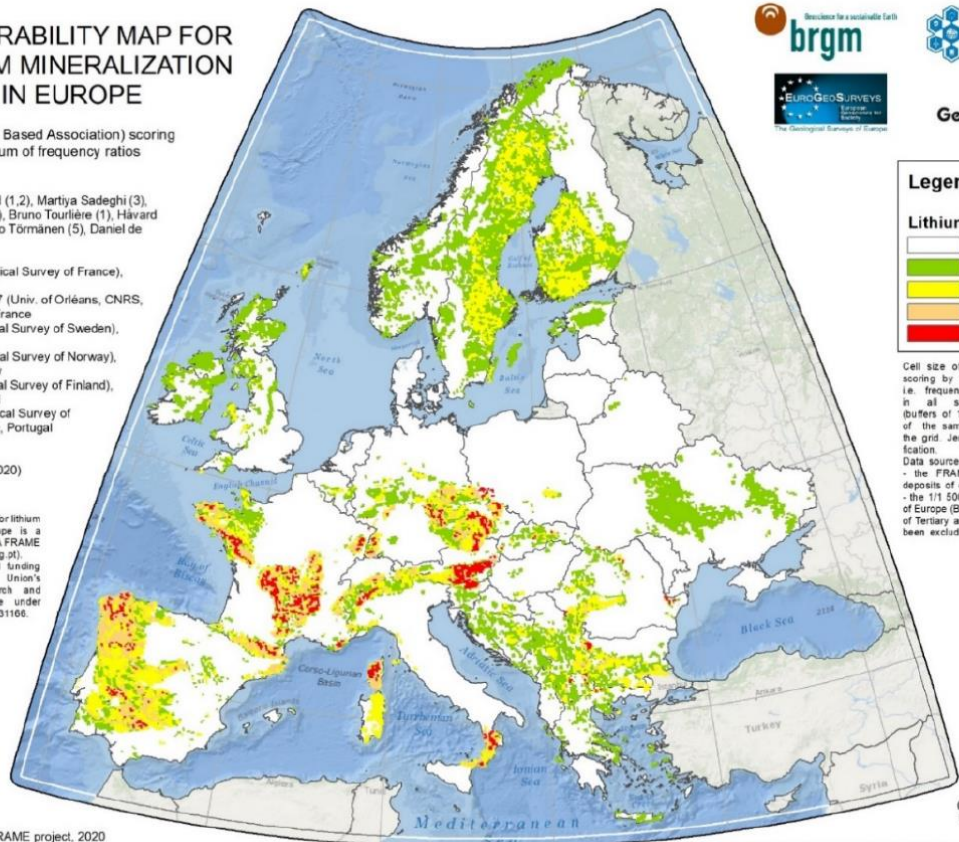
CBA (Cell Based Association) scoring
by sum of frequency ratios

Guillaume Bertrand (1,2), Martiya Sadeghi (3),
Eric Gloaguen (1,2), Bruno Tourlière (1), Håvard
Gautneb (4), Tuomo Törmänen (5), Daniel de
Oliveira (6)

- 1 – BRGM (Geological Survey of France),
Orléans, France
- 2 – ISTO UMR7327 (Univ. of Orléans, CNRS,
BRGM), Orléans, France
- 3 – SGU (Geological Survey of Sweden),
Uppsala, Sweden
- 4 – NGU (Geological Survey of Norway),
Trondheim, Norway
- 5 – GTK (Geological Survey of Finland),
Rovaniemi, Finland
- 6 – LNEG (Geological Survey of
Portugal), Alfragide, Portugal

Version 1.2 (July 2020)

This favourability map for lithium
mineralization in Europe is a
result from the GeoERA FRAME
project (www.frame.integ.pt).
GeoERA has received funding
from the European Union's
Horizon 2020 research and
innovation programme under
grant agreement No. 731166.



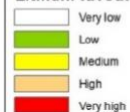
© BRGM, GeoERA FRAME project, 2020

Sources: Eri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors



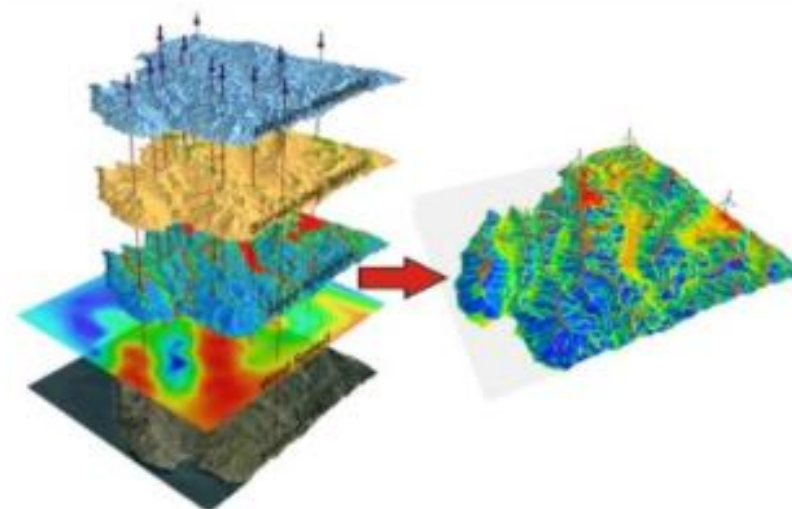
Legend

Lithium favourability



Cell size of 10 km x 10 km. CBA
scoring by sum of frequency ratios,
i.e. frequency of a given lithology
in all standards neighbourhood
(buffers of 100 sq km) vs. frequency
of the same lithology in all cells of
the grid. Jenks natural breaks classifica-
tion.
Data sources are:
- the FRAME project database on
deposits of energy critical elements;
- the 1:1 500 000 geological synthesis
of Europe (Billa et al., 2008); lithologies
of Tertiary and Quaternary ages have
been excluded.

Predictability mapping using both
Cell Based Association and Fuzzy
Weight of Evidence methods



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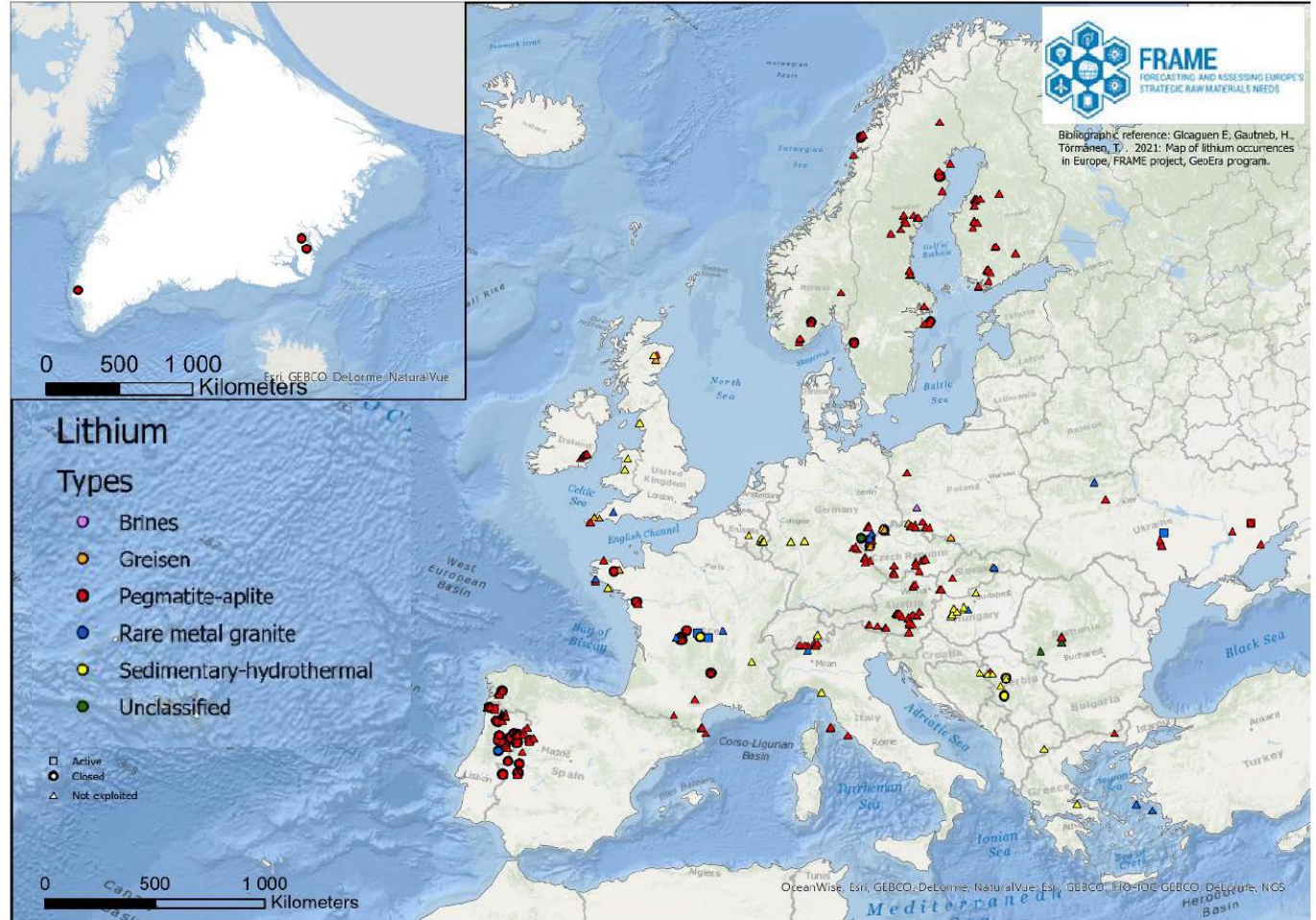


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IMPACTS Min. int.

- Compilation of new and more complete data - lithium, cobalt and graphite;
- Classification of the Li-type deposits into brine, hard-rock, magmatic Li, Magmatic-hydrothermal Li and sedimentary-hydrothermal Li;
- Separation of the European graphite deposits are of the so-called flake and amorphous types;
- The Frame project, for the first time, compiled in an aggregated form, the occurrences, geology and potential for Lithium Cobalt and Graphite and for the first time it was possible to make clusters of deposits and metallogenetic provinces for most of Europe



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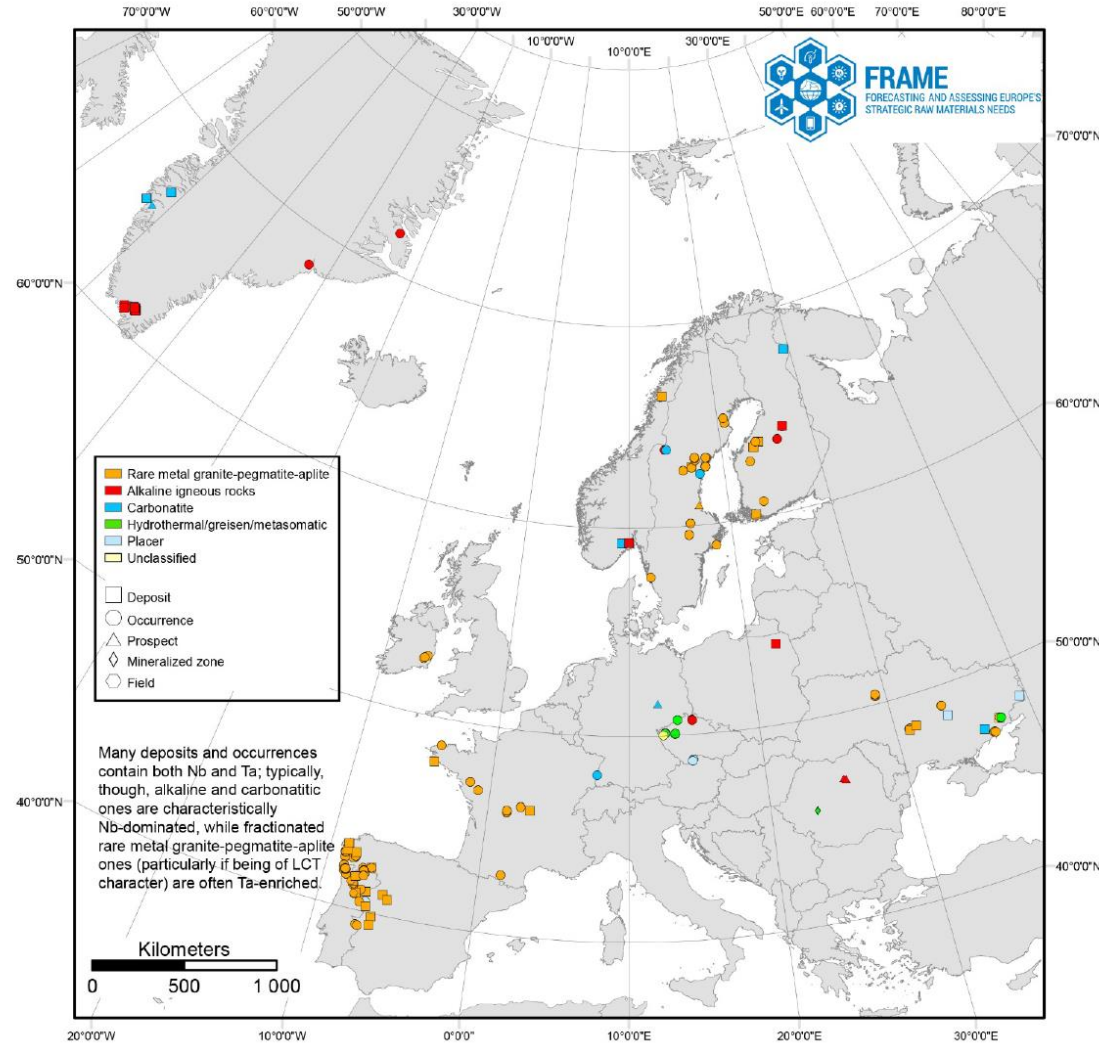




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- FRAME carried out a look at the “Conflict Minerals”, namely Nb-Ta, ahead of the EU legislation comprehensive characterization of the European and African Nb-Ta deposits;
- New petrographic and quantitative mineral chemical analyses
- - identification of different Nb-Ta minerals - Ta-enriched cassiterite, columbite-(Fe), columbite-(Mn), tantalite-(Fe), tantalite-(Mn), tapiolite (s.l.), wodginite, ixiolite, microlite minerals, Nb-bearing rutile, Ta-Nb-bearing rutile and Ta-rich rutile (“strüverite”)



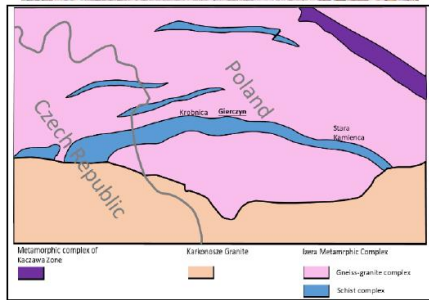


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IMPACTS Min. int.

CRM potential collected from 160 mine sites and specific case studies were undertaken in a dozen old mines; e.g., St. Leopold historical mine in Gierczyn (Poland)



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IMPACTS in EU DB

FRAME worked together with the other Raw Materials projects, - A strong network was established among the FRAME, MINDeSEA, Mintell4EU and GIP-P projects to facilitate on-going support);

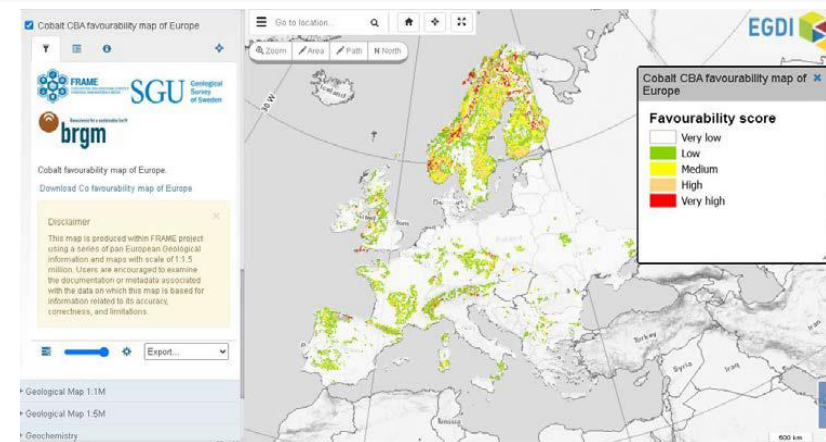
- Together with GIP-P and MINTELL4EU projects implemented important issues in a global context of the overall system of information, including:
- FRAME integrated results through the EGDI Portal (metadata, structured and unstructured data (EU-MKDB architecture)
- FRAME was instrumental in the improvement of the present harvesting system and its quality assurance

FRAME augmented and updated pan-European data sets, namely

> 135 new docs added



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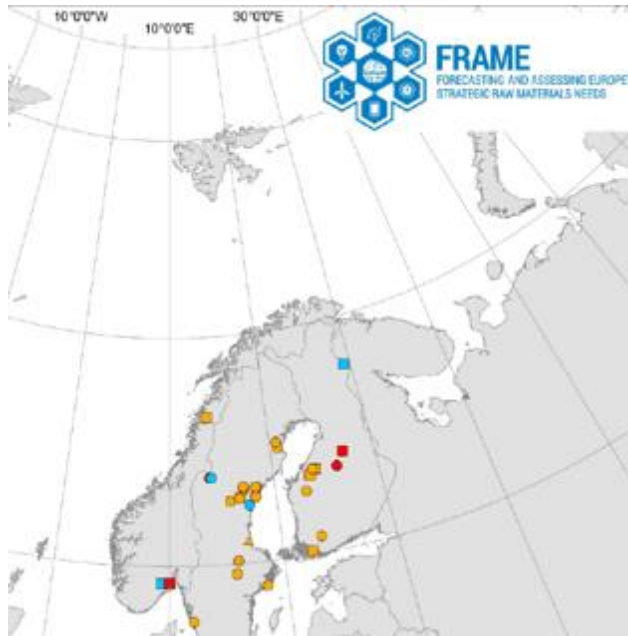


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TRANSITION

Point
Data



Area
Data



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GEN IMPACT



FRAME made a significant attempt to further unlock the mineral potential for a renewed raw materials sector in Europe as a driver for domestic raw material value chains



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Thank you for listening



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INTRODUCTION

Coordinating partner: Laboratório Nacional de Energia e Geologia, I. P. - LNEG

Federal Institute for Geosciences and Natural Resources – BGR

Bureau de Recherches Géologiques et Minières – BRGM

Czech Geological Survey – CGS

Geological Survey of Estonia – GSE

Geological Survey Sweden – SGU

Geological Survey Ireland – GSI

Geological Survey of Finland – GTK

Geological Survey of Croatia – HGI-CGS

Hellenic Survey of Geology & Mineral Exploration – HSGME

Instituto Geológico y Minero de España – IGME

Mining and Geological Survey of Hungary – MBFSZ

Geological Survey of Norway – NGU

Polish Geological Institute – PGI-NRI

Royal Belgian Institute of Natural Sciences – RBINS

State Informational Geological Fund of Ukraine – GeolInform-GIU

Institutul Geologic al Romaniei – IGR

Geološki Zavod Slovenije – GZS

Istituto Superiore per la Protezione e la Ricerca Ambientale – ISPRA

Geological Survey of Austria - GBA



SGU

Sveriges geologiska undersökning
Geological Survey of Sweden



Bundesanstalt für
Geowissenschaften
und Rohstoffe

GEOZENTRUM HANNOVER



Instituto Geológico
y Minero de España



ISPRA
Italian National Institute
for Environmental
Protection and Research



GEOLOGICAL
SURVEY OF
NORWAY
- NGU -



Geoscience for a sustainable Earth
brgm



GTK



20 Partners

The FRAME Team

19 partners @ Mid-Term Review
Meeting, 10/02/2020



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INTRODUCTION

WP 1 – Project Coordination

WP 2 – Communication, Dissemination and Exploitation

WP 3 – Critical and Strategic Raw Materials Map of Europe

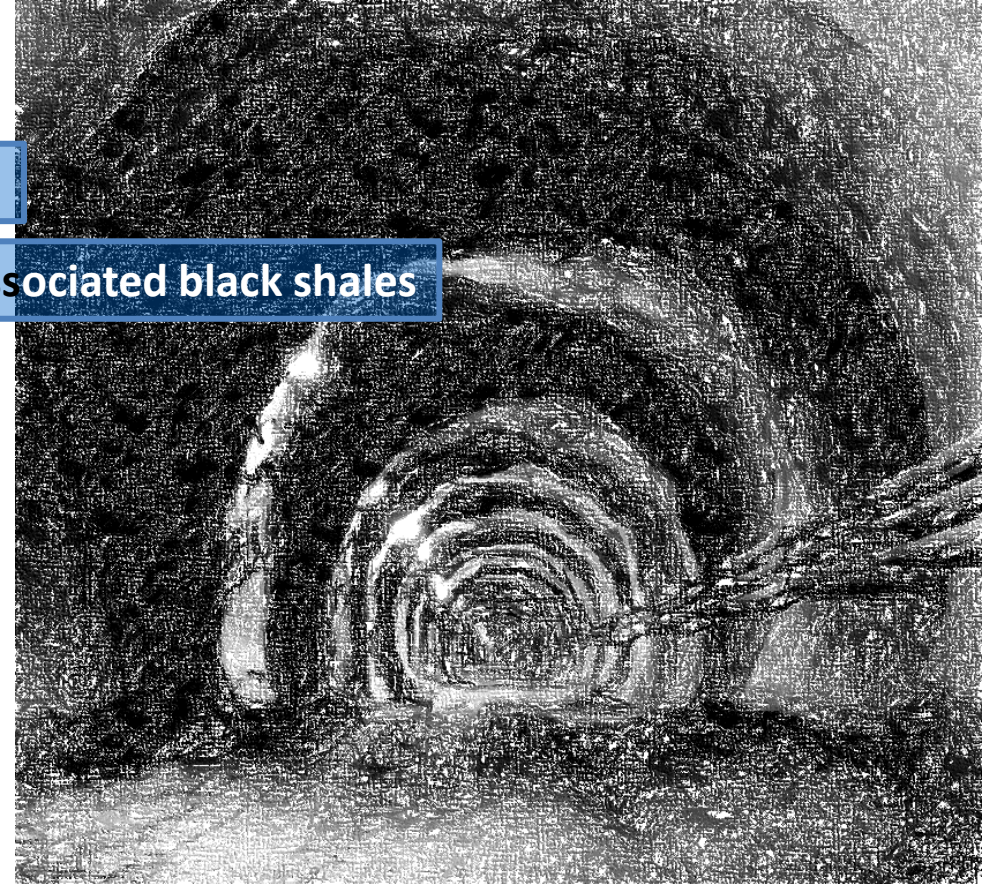
WP 4 – Critical Raw Materials in phosphate deposits, and associated black shales

WP 5 – Energy Critical Elements

WP 6 – Conflict free Nb-Ta for the EU

WP 7 – Historical mining sites revisited

WP 8 – Link to Information Platform



Work Packages



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