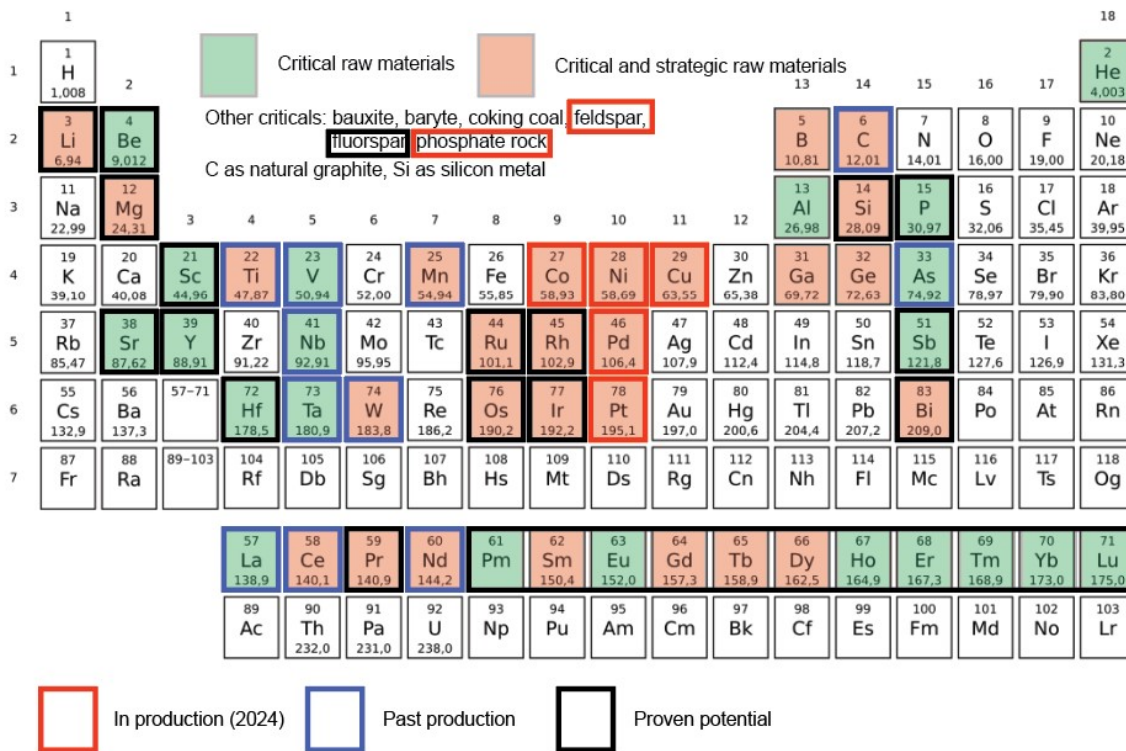


GTK's scientific projects supporting CRM exploration in Finland

Tero Niiranen
Research Professor, Ore Geology
Geological Survey of Finland
Rovaniemi

CRM Potential of Finland



EGT TWINN TALLINN 7.-8.10.2024

CRITICAL RAW MATERIALS FOR THE EUROPEAN UNION

Primary commodity

- Antimony (Sb)
- Beryllium (Be)
- Phosphate (PO₄)
- Graphite (C)
- Cobalt (Co)
- Copper (Cu)
- Lithium (Li)
- Feldspar
- Nickel (Ni)
- Niobium (Nb)
- Platinum, palladium (Pt, Pd)
- Rare Earth Element, REE
- Scandium (Sc)
- Titanium (Ti)
- Vanadium (V)
- Tungsten (W)

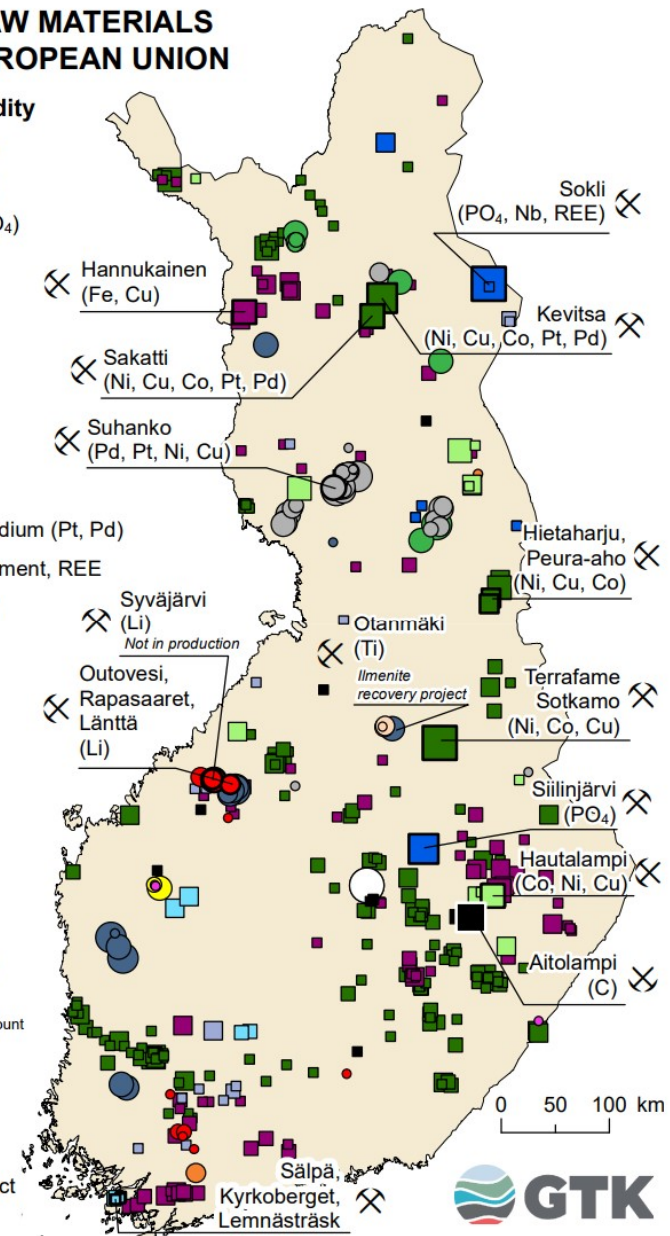
Size*

- Very large
- Large
- Medium
- Small
- Very small
- Unknown

*Remaining + extracted amount of the commodity

- ⊗ Mine
- ⊗ Mine project
- ⊗ Advanced exploration project

6.3.2024



CRM Act Article 19 – National Exploration Programs

They shall include, as appropriate, the following measures:

- (a) *mineral mapping* at a suitable scale;
- (b) *geochemical campaigns*, including to establish the chemical compositions of soils, sediments or rocks;
- (c) *geoscientific surveys*, such as geophysical surveys;
- (d) *processing of the data* gathered through general exploration, including through the development of *predictive maps*;
- (e) *reprocessing of existing geoscientific survey data* to check for unidentified mineral occurrences containing critical raw materials and carrier minerals of critical raw materials.



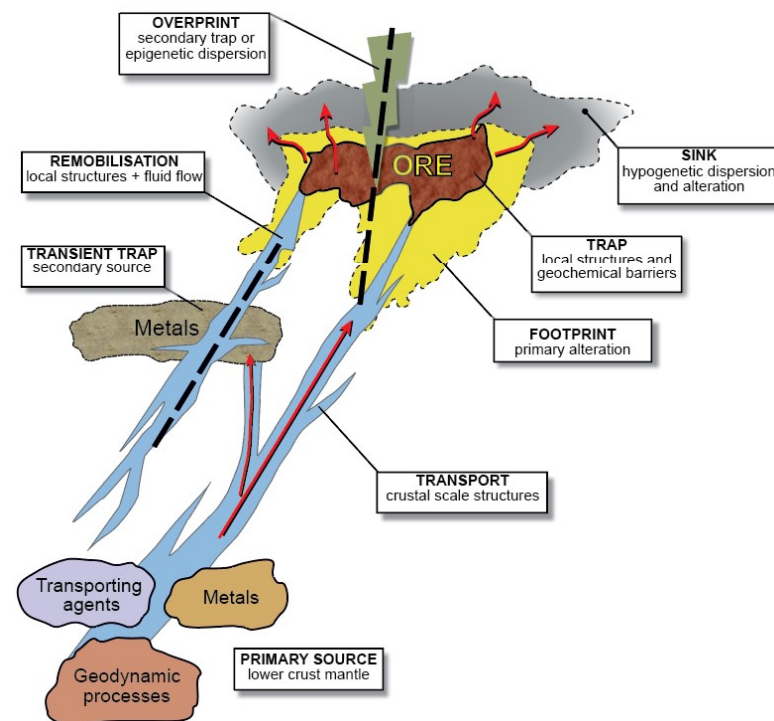
A Masterplan is needed...



Application of a Mineral Systems Approach:

- *Generate relevant CRM related mineral systems models*
- *Define and outline mappable critical MSM components*
- *Geological mapping, geochemical campaigns & geophysical surveys where needed to detect the components*
- *Model the components in 2-3-4D space (where applicable)*
- *Generate predictive maps using mapped critical MSM components & GIS based prospectivity modeling*

+ Method development along all the workflow



REPower-CEST 1/2024 - 6/2026

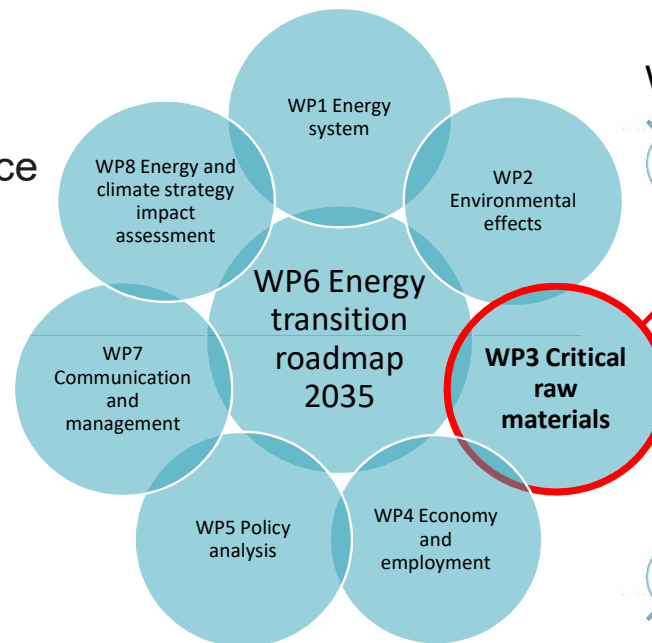
Consortium: Finnish Environmental Institute (SYKE), Technical Research Centre of Finland (VTT), and GTK

Funding: EU recovery and resilience plan for Finland (Next Generation EU)

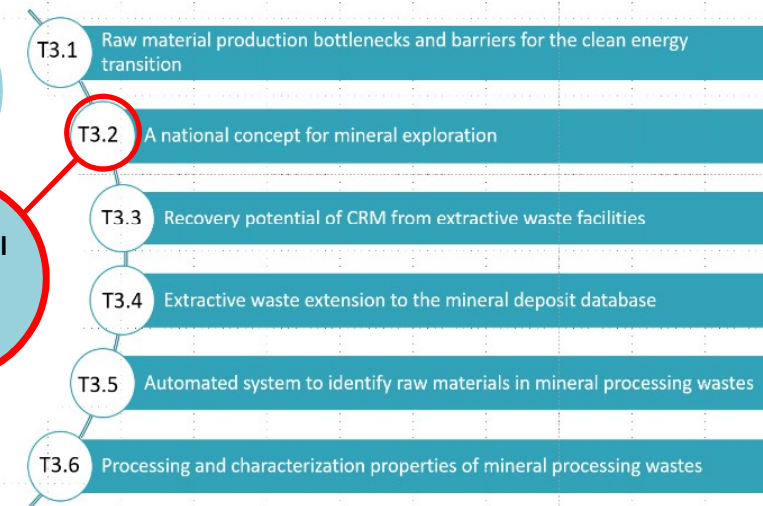
Budgeted: 14 M€, (GTK 4.1 M€)

THE FOCUS:

ENERGY TRANSITION AND THE EFFICIENT USE OF NATURAL RESOURCES TO INCREASE THE RESILIENCE, SECURITY, AND SUSTAINABILITY OF FINLAND'S ENERGY SYSTEM.



WP3: GTK lead



REPower-CEST Task 3.2. National Exploration program concept

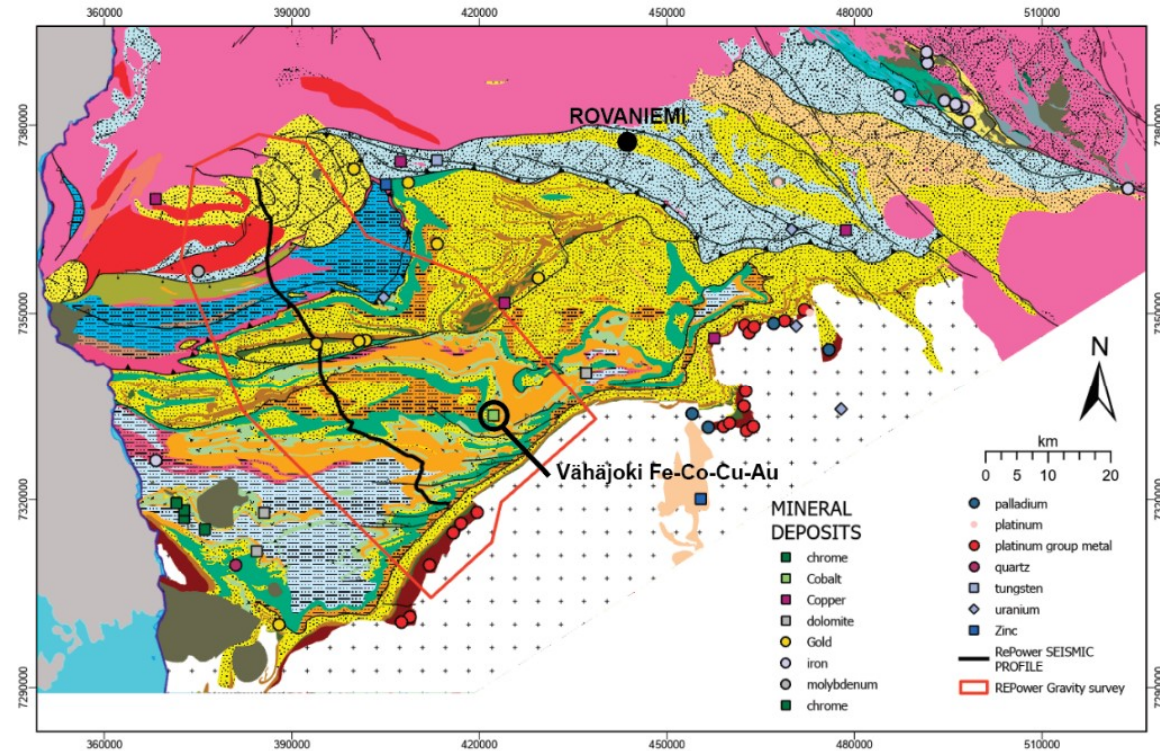
- Task 3.2 lays the foundation for the national mineral exploration concept and tests the concept as it pertains to the research institution with the following exceptions:
 - *The development of an integrated database solution for the storage of national programs too large an EU level goal to be included in the current project*
 - *Direct mineral exploration is within the purview of companies -> not included*
- The concept is tested in Peräpohja Schist belt, including the following sub-areas of CRMA article 19:
 - *Data collection, geophysical measurements (c)*
 - *Identification of mineral system fingerprints in the target area (d)*
 - *Data processing and interpretation, modeling of mineral systems (d)*
 - *Prospectivity modeling (d)*
 - *Re-processing of existing data from the target area (e)*

Test site: Peräpohja Schist Belt

- High potential for a number of CRM
- Focus in epigenetic Au-Co and FeOx-Cu-Co-Au mineral systems

Main aims:

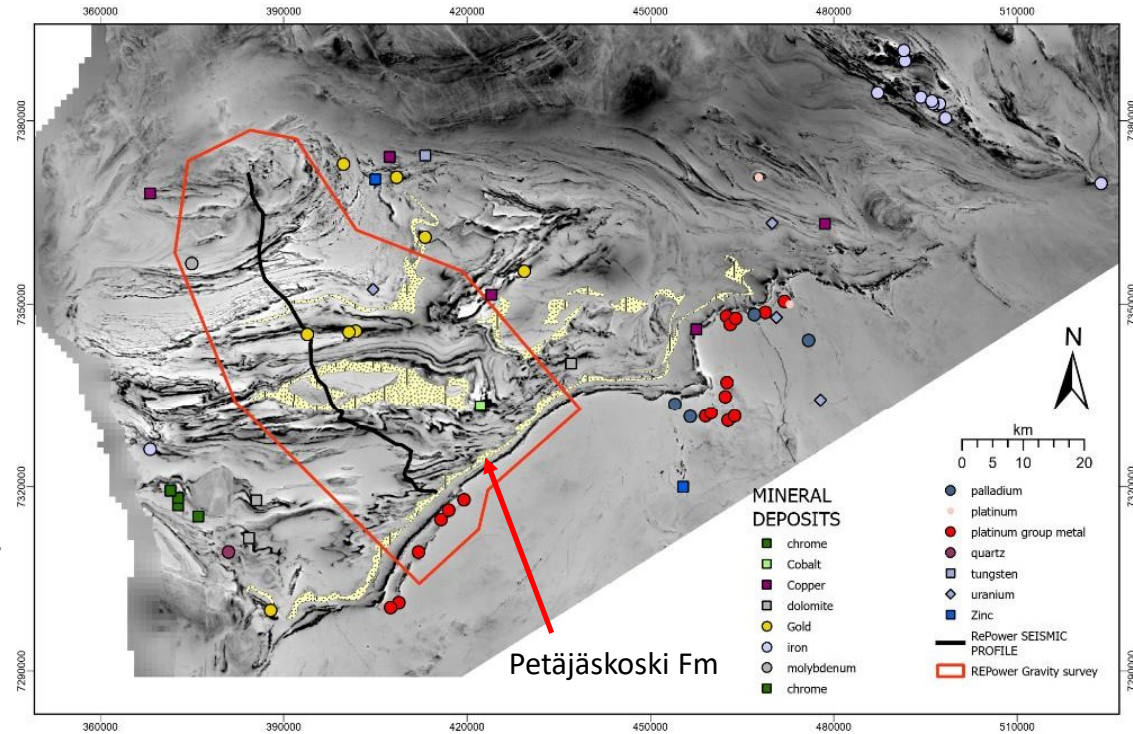
- Regional scale work:
 - 65 km reflection seismic profile (done)
 - 2500 km² gravity survey (ongoing)
- Fingerprinting Vähäjoki FeOx-Cu-Co-Au deposit



Test site: Peräpohja Schist Belt

Modelling of mineral systems components:

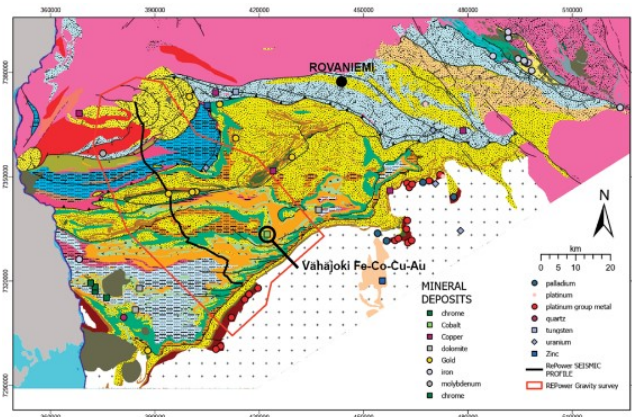
- **Structural Framework (3D)**
 - Fluid & metal pathway (and potential trap in local scale) for ALL epigenetic deposits
- **3D modeling of the paleo-evaporite bearing Petäjäsoski FM**
 - Potential source for a) chlorine in metamorphic and magmatic metamorphic fluids b) source for sulfur in magmatic Ni-Cu systems
- Timing of mineralization and alteration events (reg. Na-alteration, link to evaporites, potential source for metals)



Test site: Peräpohja Schist Belt

Characterization of Vähäjoki Fe-Co-Cu-Au deposit

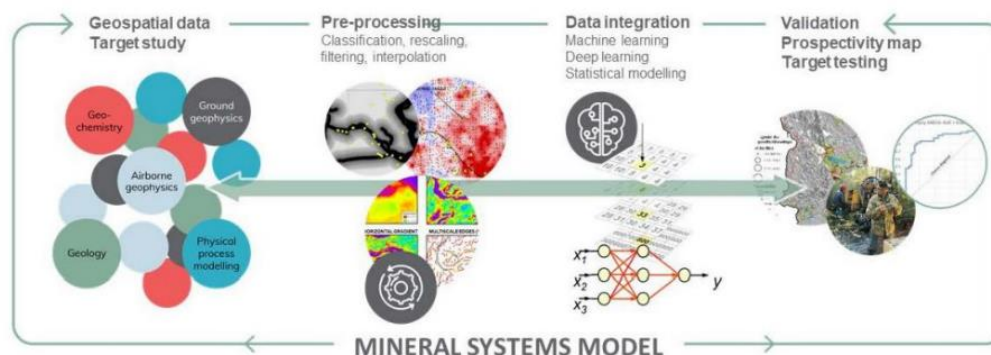
- *Delineation of different alteration stages*
- *Geochemical characterization*
- *Trace element composition of ore minerals*
- *Age determination of different mineralization stages*
- *Genetic interpretation*



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Exploration Information Systems (EIS) 2023-2025

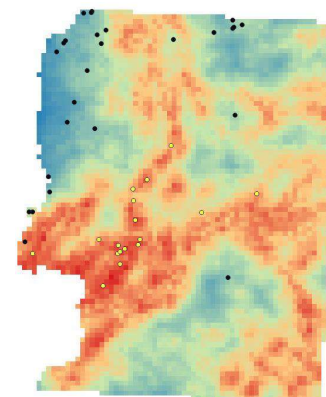


- **FUNDING:** Horizon Europe RIA, 7.5 M€ (GTK 1.4 M€)
- Pan-European consortium, which consists of **17 partners** from research institutes, academia, service providers and industry.
- **AIM:** EIS will develop *new mineral systems models* and novel, fast and cost-effective *spatial data analysis tools* for mineral exploration.
- **IMPACT:** EIS will bring *CRMs for EU* by new innovative exploration concepts and data analysis tools.
- The project is *raising the awareness* and trust among the general public *of the importance of raw materials* for a successful transition to a climate-neutral and digitized economy and society

Exploration Information Systems (EIS) 2023-2025



- Mineral systems modelled:
 - *Co-bearing VMS*
 - *Li-Sn-Ta pegmatite (Central Finland one of the sites)*
 - *REE-Co-bearing Iron oxide-Cu-Au*
- New prospectivity modeling tools for open-source platform (QGIS)
- New predictive maps using generated mineral systems models and new EIS tools
 - *Finland: IOCG & LCT-pegmatites*



Tag	Data
1 AEMquad_Lin_0-1	AEMquad_Lin_0-1
2 Ktil_Lin_0-1	Ktil_Lin_0-1
3 Magn_Lin_0-1	Magn_Lin_0-1
4 MetamFacLin_0-1	MetamFacLin_0-1
5 PSpgrWrms_Lin_0-1	PSpgrWrms_Lin_0-1
6 RadK_Lin_0-1	RadK_Lin_0-1
7 RadTh_Lin_0-1	RadTh_Lin_0-1
8 RadU_Lin_0-1	RadU_Lin_0-1
9 Struct_Lin_0-1	Struct_Lin_0-1

Proxy	Category	Process
Magnetic highs	geophysics	Process
Distance to high-magnetic field anomalies	geophysics	Process
Presence of carbonate horizons in metavolcanic rocks	geology	Process
Ca-Fe metasomatism, Distance high Ca-Fe molar proportions relative to Na, K, and Mg	geochemistry	Process
Distance to rock units displaying -sodic alteration signature -potassic and/or calcic alteration signature	geology	Process
Distance to (Sub) economic Cu-Au concentrations	geochemistry	Process
Distance to (Sub) economic Cu-Au concentrations 2	geochemistry	Process
Distance to altered rocks	geology	Process
K-anomalies in till	geochemistry	Process
Elevated V in till	geochemistry	Process
Elevated Au, Ba, Co, Cu, La, P in till	geochemistry	Process
Radiometric U and/or Th anomalies	geophysics	Process
Distance to high concentrations of REE, Fe	geochemistry	Process
Massive magnetite	geology	Process
Low Ti signature in Fe-oxides	geology	Process
Elevated Ba, Co, Cu, P, Au in till	geochemistry	Process
Massive magnetite and vansetite	geology	Process

Other major CRM related projects in pipeline

UNDERCOVER (2025-2028)

- **FUNDING:** Horizon Europe RIA, 5 M€ (GTK 1 M€)
 - *Consortium in Grant agreement phase*

DeepBEAT (2024-2027)

(Deep exploration BoostEd by Advanced exploration Technologies)

- **FUNDING:** Horizon Europe RIA, 4.89 M€ (GTK 1.2 M€)
 - *Project started October 2034*

THANK YOU!

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gtk.fi



GTK

