



SECURE AND SUSTAINABLE SUPPLY OF RAW MATERIALS FOR EU INDUSTRY

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S34I PROJECT OVERVIEW

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S34I WILL BE BASED ON SATELLITE DATA, AIRBORNE, UNMANNED AERIAL VEHICLE (UAV), GROUND BASED AND CONVENTIONAL IN-SITU TECHNIQUES/METHODS AND FIELD WORKS.

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SECURE AND SUSTAINABLE SUPPLY OF RAW MATERIALS FOR EU INDUSTRY

From the sky to the soil

S34I will research and innovate new data-driven methods to analyse Earth Observation (EO) data, supporting systematic mineral exploration and continuous monitoring of extraction, closure and post closure activities with the aim to increase European autonomy regarding raw materials (RM) resources.

S34I PROJECT OVERVIEW



WHAT

Explore and prototype new methods to analyse EO.

Demonstrate its value to stakeholders (geology surveys, mining industry, local communities and policy makers) under ethics and EU values preservation.



WHY

Many datasets are still under-exploited from different European space based missions (e.g. COSMO-SkyMed, EnMAP, PRIMSA, TerraSAR-X), EO based services are very promising from environmental and mining sustainability views.

EO based services are an independent tool to build trust on local communities and to improve policy and related legislations.



ADDED VALUE

Mining digital transformation towards its sustainability, security, and EU Raw Materials sovereignty.

Mining green transformation towards circular economy adoption and local communities better acceptance.

Promotion of open databases for future research.

New mine owner and operator independent tool for public awareness.

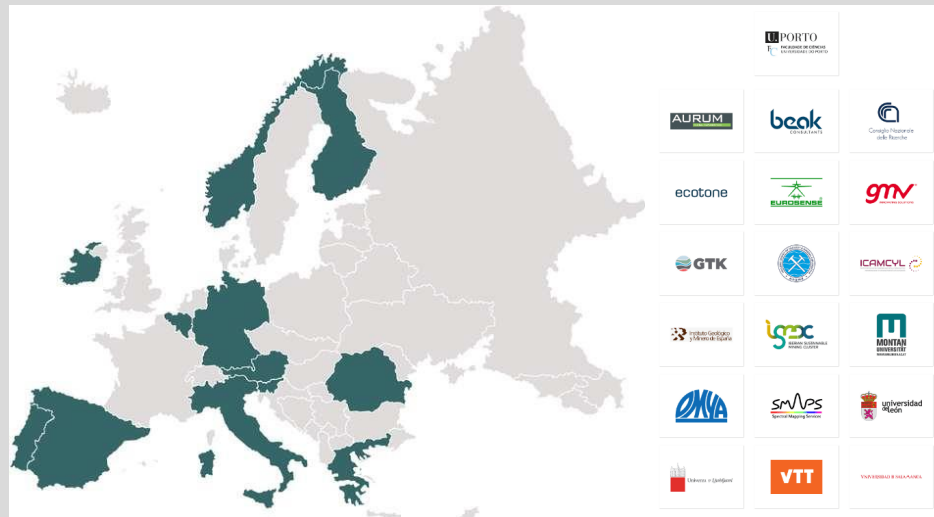
S34I PROJECT CONSORTIUM



WHO

EU wide interdisciplinary and complementary team from important EU mining countries embracing 12 important countries for mining sector from EU- Austria, Belgium, Germany, Spain, Finland, Greece, Ireland, Italy, Norway, Portugal, Romania, Slovenia.

The S34I Consortium is formed by 19 partners.



S34i PROJECT PILOTS



@Provided by AURUM

Land exploration in Spain

Aramo mine

The Aramo Plateau pilot study area lies within the central part of Principado de Asturias in Northern Spain and at the western closure of the Cantabrian Orocline Fold and Thrust Belt. The historic Texeo or Aramo mine lies on the eastern side of the plateau and is classed as an epithermal carbonate hosted copper – cobalt – nickel deposit. The study area is focused on the identification of broader zones of alteration of the host rocks and by association the exploration potential for further mineralization both proximal to the historical mine as well as for new target areas across the plateau.



@Provided by ISME

Coastal exploration at the Iberian Peninsula Atlantic coast

Ria de Vigo

Ria de Vigo, is part of a system of several funnel-shaped estuarine inlets, Rias Baixas at the northwestern coast of Spain, formed by tectonic action and subsequent erosion. It exhibits suitable geological conditions (primary mineral source, weathering environment, means of transportation) for the occurrence of important CRM mineralizations including Ti, Sn, Li, REEs and Au placers, pegmatite, and hydrothermal deposits. The purpose of the study at Ria de Vigo is to investigate improved seabed mineral mapping, using novel EO-based methods, also by exploring the connection between seashore and coastal areas.

The **S34i** project is supporting the technical experiments and validation at different phases of the mining life-cycle:

- **Onshore exploration** to gain knowledge on cobalt (Co) deposits.
- **Shallow water exploration** to update the knowledge on coastal metallic placers.



@Source S34I GA

Extraction phase in Austria

Gummern

The Gummern quarry produces roughly 1 Mio. t of high-quality marble, both in open-pit and underground extraction sites. The mining procedure is accompanied by a range of technical challenges, mainly including proper quality control, sequencing / scheduling accompanied by geotechnical considerations on the stability of the slopes, as well as following the piling up of the waste dumps.



@Source National Land Survey of Finland

Aijala

Finland

The underground mine is located in SW Finland, closed in 1961 and has been filled with water. The tailing area and the deposits rich in Au, Ag, Cu, Pb, Zn have been recently studied and are of interest for future development. In the project are addressed stability issues because there has been a collapse of the tunnel on February 7-8 2017.

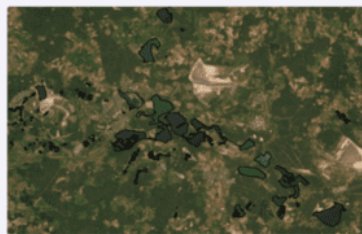


@Source National Land Survey of Finland

Outokumpu

Finland

Three multimetal (Cu-Co-Ni-Zn also Au, Ag, pyrite concentrate) underground mines in Outokumpu, Finland. The study focuses on the water network including Outolampi pond on the mine site, that stands on the tailings, has pH around 2 and is not under a monitoring program and the lake Sismäjärvi, Natura 2000 area, that is well monitored and that is affected by the industrial activities of the region.



@Provided by BEA

Lausitz

Germany

The mining and post-mining landscapes of the Lausitz area cover approx. 7000km². There are a high number of former and active pits, remaining lakes, and channels used to release pumped water to surface water bodies with significant patterns of AMD.

S34I PROJECT PILOTS

The **S34I** project is supporting the technical experiments and validation at different phases of the mining life-cycle:

- **Extraction** for soil instability monitoring for securing safety within the operation, and efficient volumetric estimation.
- **Closure/post-closure** tackles environmental and health impact challenges.

Exploration phase

Onshore (Áramo, Spain)



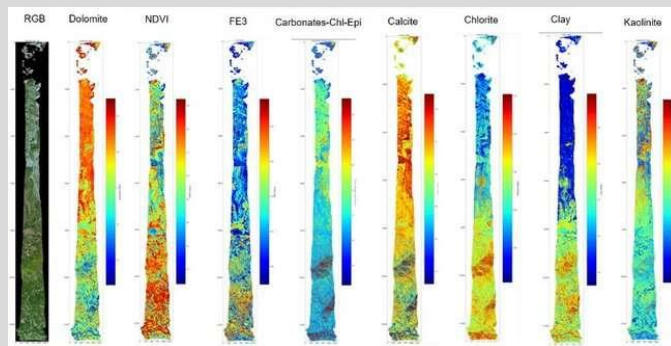
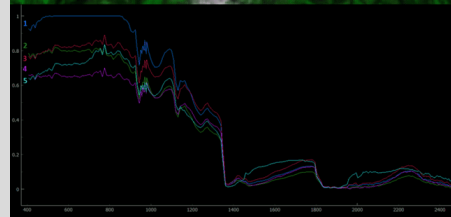
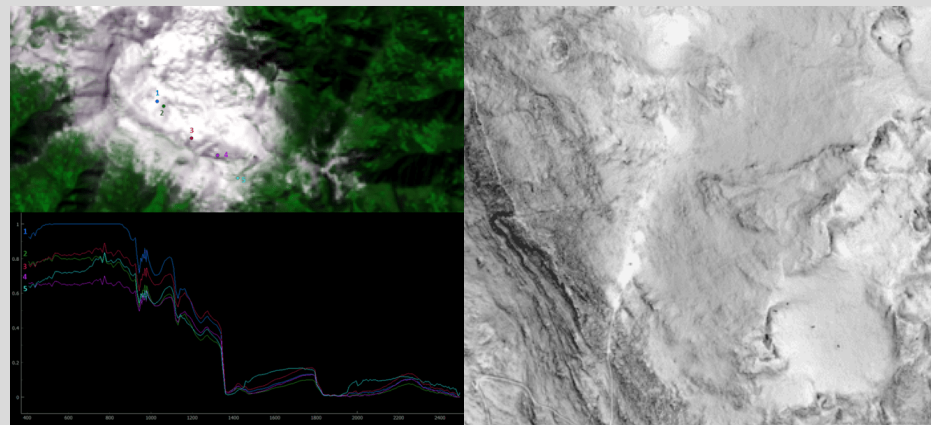
Data

- Sentinel-1
- Sentinel-2
- Landsat-9
- PRISMA
- ALOS PALSAR-2
- COSMO-SkyMed
- Airborne LiDAR
- Airborne hyperspectral data
- Ground spectral libraries



Methods

- RGB combinations
- Band ratios
- Principal Component Analysis (PCA)
- K-means
- Endmember extraction
- Minimum wavelength mapping
- Spectral Angle Mapper (SAM)
- Self-Organizing Map (SOM)
- Artificial Neural Networks (ANNs)
- New ensemble method



Exploration phase

Shallow waters (Ria de Vigo Spain)



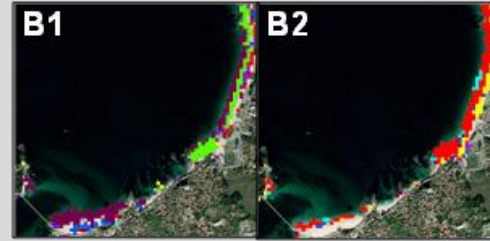
Data

- Sentinel-1
- Sentinel-2
- Landsat-9
- WorldView-2/-3
- EnMap
- Underwater Hyperspectral Image (UHI)
- Complementary spectral libraries
- Pre-existing/new geological data



Methods

- RGB combinations
- Band ratios
- Principal Component Analysis (PCA)
- K-means
- Endmember extraction
- Spectral unmixing
- Object-Based Image Analysis (OBIA)



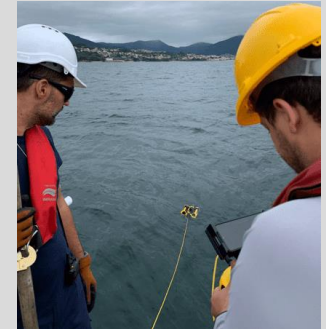
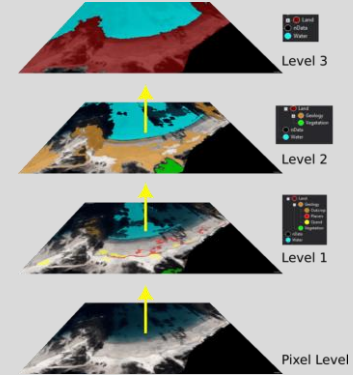
LEGEND

First classification

- Almandine
- Goethite
- Grossular
- Ilmenite
- Monazite
- Rutile
- Sillimanite
- Spessartine
- Zircon
- Tourmaline

Second classification

- UPO_1
- UPO_2
- UPO_3
- UPO_4
- UPO_5
- UPO_6
- UPO_7
- UPO_8
- UPO_9
- UPO_10



Extraction phase

Gummern (Austria)



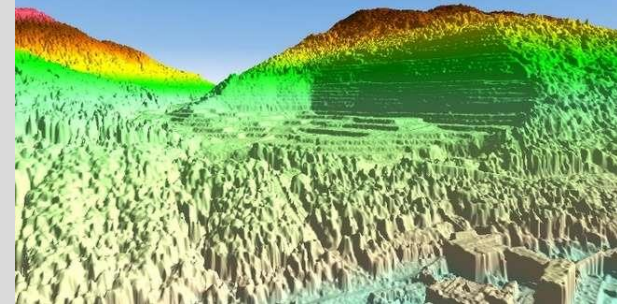
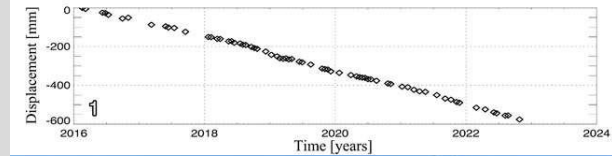
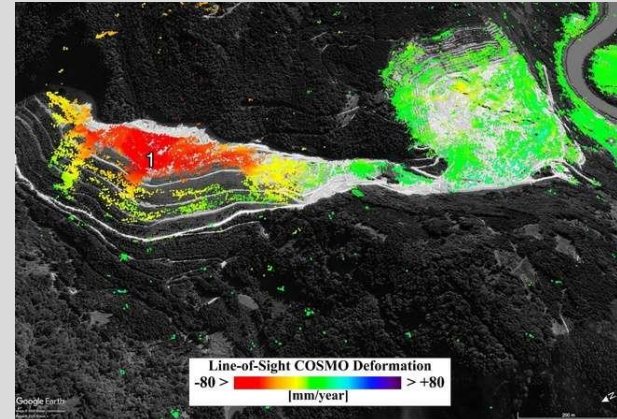
Data

Pléiades Neo tri-stereo
Sentinel-1
Sentinel-2
Landsat-9
WorldView-2
COSMO-SkyMed
UAV data
Ground GNSS stations



Methods

Digital elevation models (DEMs) production
UAV photogrammetry using Structure from Motion (SfM)
Interferometric synthetic-aperture radar (InSAR)
Change detection (Normalized Decorrelation Change Index (NDCI))
Super-resolution enhancement using Residual-in-residual Dense Block (RRDB) model
Super-Resolution U-Net (SRUN)
Optical-guided Super-Resolution Network (OGSRN)



Closure and Post-closure phase

Lausitz (Germany)



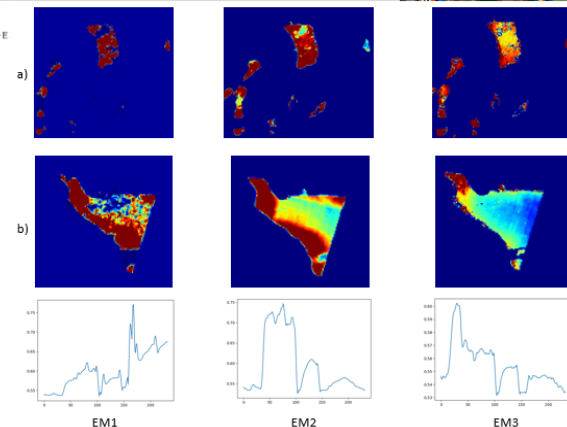
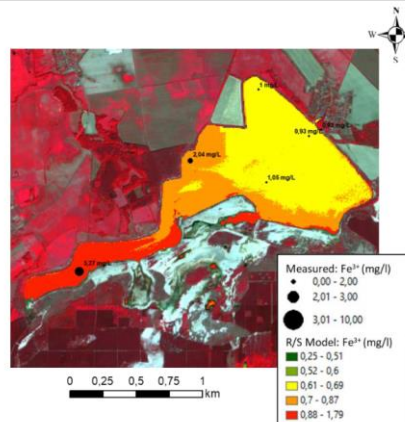
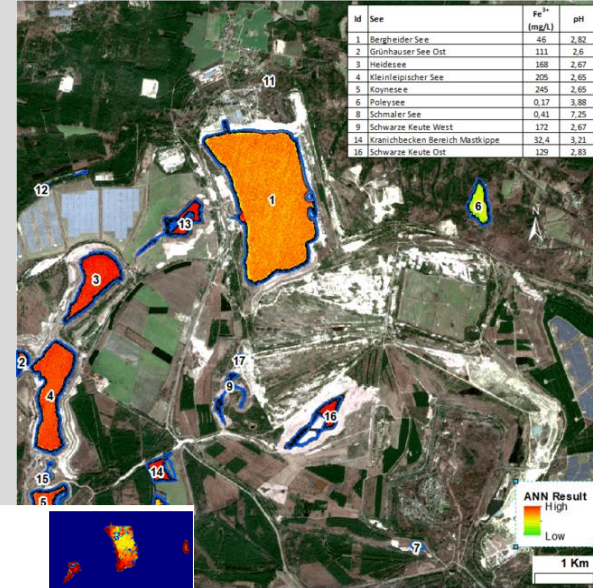
Data

- Sentinel-2
- WorldView-3
- PRISMA
- UAV data
- Geochemistry water data



Methods

- Endmember extraction
- Artificial Neural Networks (ANNs)



Closure and Post-closure phase

Outukumpu (Finland)



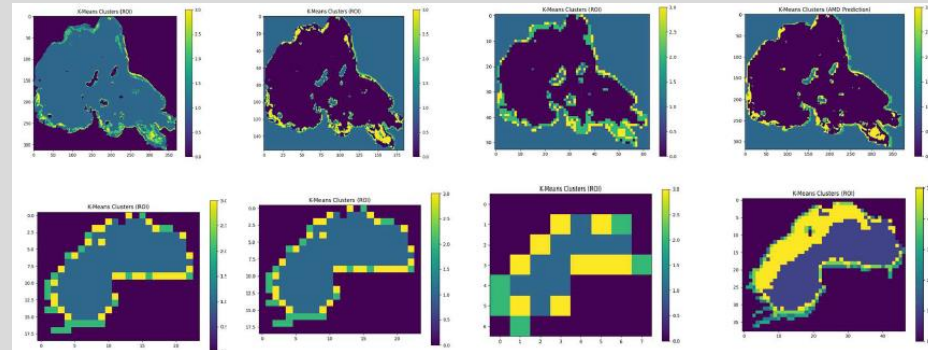
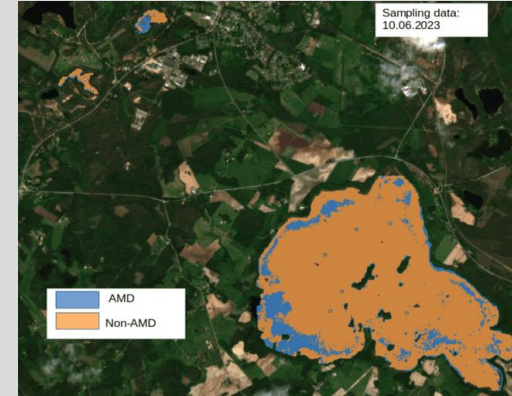
Data

Sentinel-2
UAV data
Geochemistry water data



Methods

K-means
Self-Organizing Map (SOM)
Artificial Neural Networks (ANNs)
Logistic regression
Random forest
K-nearest neighbour (K-NN)



Closure and Post-closure phase

Aijala (Finland)



Data

Sentinel-1
Sentinel-2
COSMO-SkyMed



Methods

Change detection (Normalized Decorrelation Change Index (NDCI))
Super-resolution enhancement using Residual-in-residual Dense Block (RRDB) model
Super-Resolution U-Net (SRUN)
Optical-guided Super-Resolution Network (OGSRN)





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THANKS!



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