RawMatCop: developing skills at the intersection between earth observation and the raw materials community

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Project Objectives

The RawMatCop program was launched in 2017 and aims to:

- Develop applications and demonstrations of Copernicus data to the raw materials sector.
- Develop skills and expertise through learning activities and short-courses.
- Focus on three “Research & Application Areas” of the raw materials sector (prospecting and exploration, mining activities, secondary resources).

Raw materials have become increasingly important to the European Union's economy, growth, and competitiveness. In this context, the EU aims to facilitate the exchange of best practices among its member states to improve the sustainable and safe supply of raw materials to the EU economy and society. Thus, monitoring of mining activities and environmental impact of waste and residue management are key issues of that strategy. With state-of-the-art spaceborne imagery, Copernicus has a strong potential in contributing to EU’s requirements and expectations.

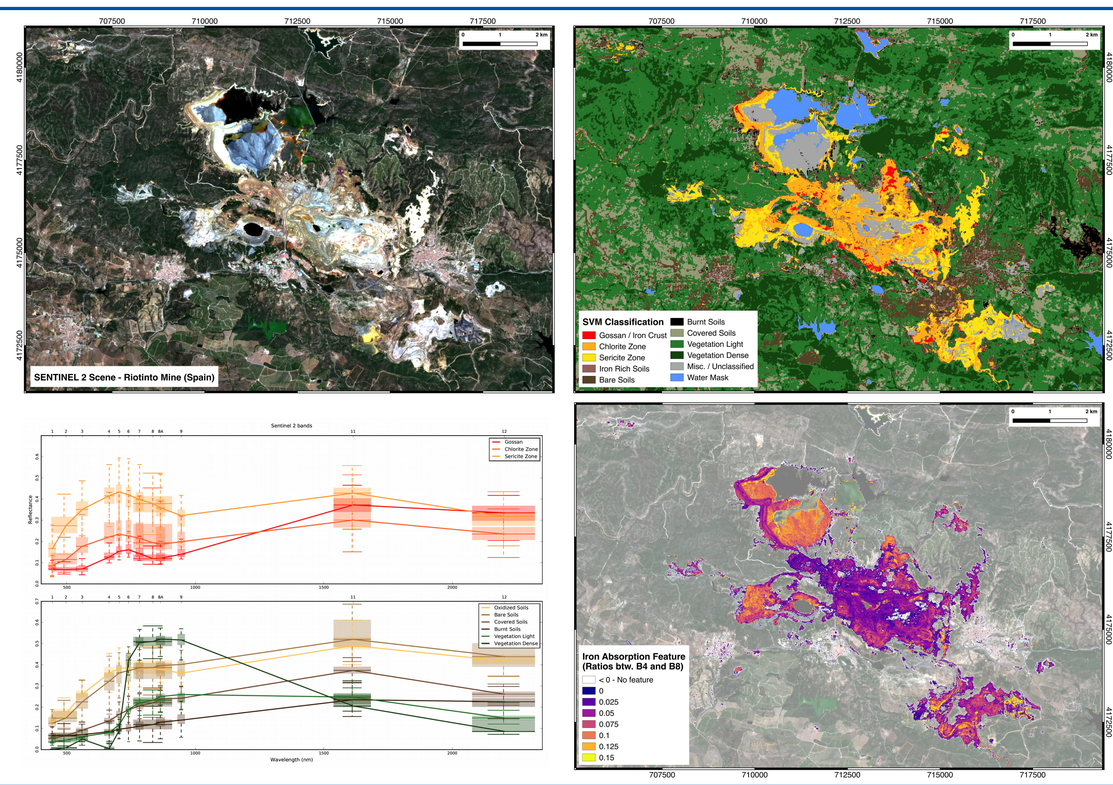
Current Research and Applications

1. Multi-scale and multi-source exploration

We propose to **integrate satellite data from Copernicus into a downscaling scheme for mineral exploration** which takes advantage of the high spatial coverage of satellite based sensors and the high spectral resolution of drone-borne/ terrestrial sensors.

We tested the ability of Sentinel 2 to deliver information relevant to mineral exploration by mapping alteration zones associated to Volcanic Hosted Massive Sulfides (VHMS) within the Iberian Pyrite Belt (Southern Spain). Two main types of alterations (chlorite and sericite) can be observed in Riotinto mine and were locally mapped using field work and ground-based or drone-borne hyperspectral cameras. Sentinel 2 spectra show that both alteration zones have absorption features likely related to an enrichment in iron (835.1 to 945.0 nm). We tested several classification methods in order to map these alteration zones. We work on a Python-based implementation which takes advantage of existing open source libraries (e.g. GDAL for handling raster data and scikit-learn for machine learning classification). Our aim is to achieve a completely free workflow.

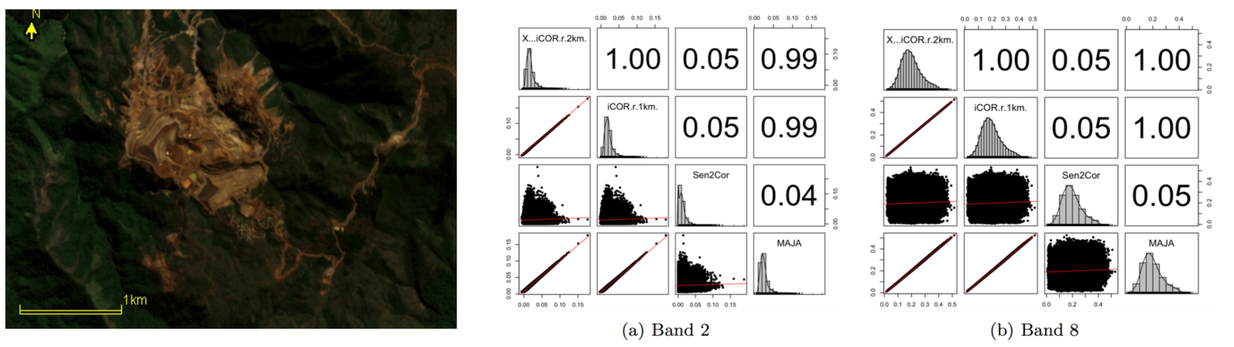
These results show a clear potential of Sentinel 2 data for regional scale mapping of alteration zones. Future work will focus on the integration of other datasets (SAR from Sentinel 1, geomorphic features).



2. Spatiotemporal mapping of dust dispersion around mining sites

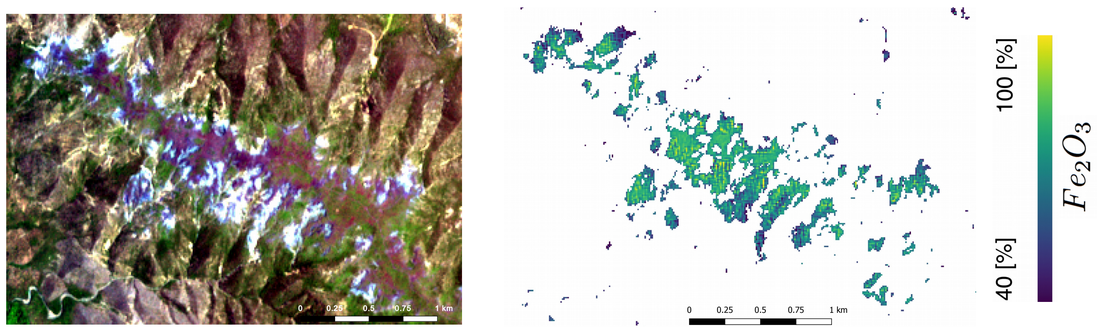
minEOdust aims at exploring the potential of Copernicus data in mine-site monitoring and especially in mapping iron-oxide bearing dust dispersion patterns around active sites.

1- Discrepancy assessment of open-source atmospheric correction of Sentinel 2 on tropical mining areas. With the large footprint and distinct spectra of mining sites, there is discrepancy in the retrieved surface reflectance by different atmospheric correction approaches. An example of a mining site at Kouaoua, New Caledonia shows Sen2Cor’s results are highly distinct from iCOR and MAJA. Two adjacency effect ranges were considered for iCOR (1x1 km and 2x2 km), and pairwise linear correlation is reported as R^2.



(a) Band 2 (b) Band 8

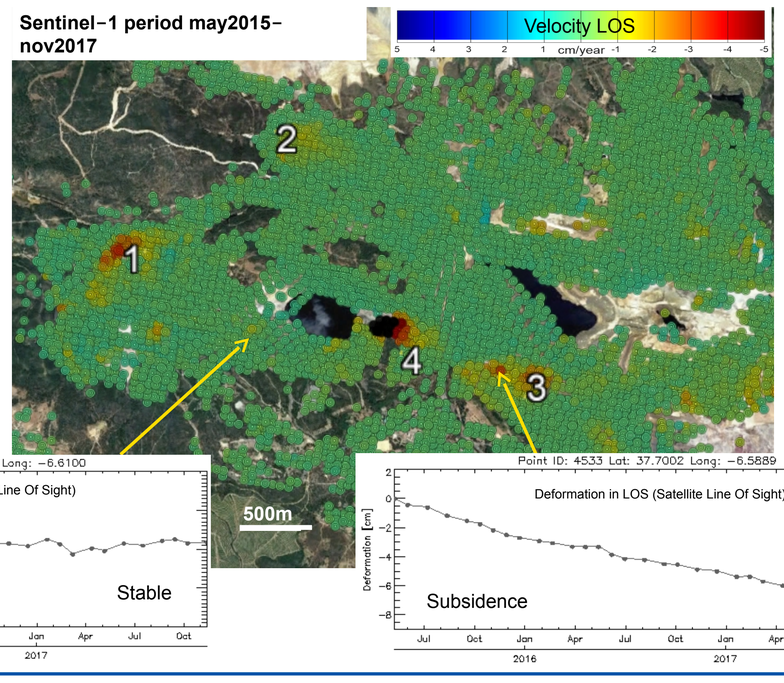
2- Fusion of various sources of data with Sentinel 2 to accomplish mapping of iron-oxide and its bearing dust. Using hyperspectral acquisitions and chemical composition of field samples, regression models can be developed to map mining sites and outcrops. The example below shows an outcrop in Thiebaghi, New Caledonia (False color Sentinel 2 image of 11th of February, 2018) and its iron-oxide content.



3. Monitoring of surface/subsurface deformation

The CSIC project focuses on a **"real-time" monitoring system** that combines **SAR and passive seismic** data in order to reduce the hazards of mining activities affecting the subsoil mechanical integrity. Our pilot site is the Riotinto mine, SW Spain.

SAR data are processed using the advanced differential interferometric SAR technique (**A−DinSar**) and the PRISAR/SUBSOFT suit (Universitat Politècnica de Catalunya) based on the Coherent Pixels Technique (CPT).



We have identified four deformation zones (left). Zone 1, 2 and 3 are tailing zones showing subsidence patterns (warm colors) due to settlement. Zone 4 is the eastern wall of an abandoned pit affected by landslides. Thus, Sentinel-1 is a good tool for monitoring soil integrity in a mine context.

A seismic network is in place (48 stations, right figure) and will be used for monitoring micro-seismicity and changes in subsoil mechanical properties using seismic noise from mining activity.

We are preparing the algorithms for a “real-time” monitoring consisting in a sequence of data acquisition, processing and alerting integrated in a stand-alone system.

Acknowledgements
Research support, Ref: 248/G/GRO/COPE/16/9077 - Lot 2, CGL2016-81964-REDE, CGL2014-56548-P, ESP2013-47780-C2-1-R

RawMatCop is co-funded by the European Commission (DG for Internal Market, Industry, Entrepreneurship and SMEs) and the EIT RawMaterials (RawMaterials Academy).

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