

INTRODUCTION

The INCOME project (Instruments for Managing Areas Contaminated by Metals) proposes developing an environmental management model for mining soils contaminated by metals. This study presents preliminary results obtained using the Multispectral Imager (MSI) aboard the Sentinel-2 satellite to identify contaminated soils in the São Domingos Mine in southeastern Portugal.

The MSI instrument offers significant advantages, including high spatial resolution (10, 20, or 60 m, depending on the spectral band), open access for rapid image download, and frequent revisitation of the study area.

Contaminated soils characteristically exhibit discrepancies in optical properties, such as distinct colouration, which can also be detected in the visible region bands of the MSI instrument. The Shortwave Infrared (SWIR) bands are particularly efficacious for identifying heavy metals.

The preliminary analysis focuses on identifying areas with fully exposed soil using spectral indices, which combine spectral measurements at different wavelengths to improve classification accuracy.



Note: BSI – Bare Soil Index;

METHODOLOGY

SAVI – Soil-Adjusted Vegetation Index SCL – Pixel classification from Sen2Cor, including bare soil (class 5)

PRELIMINARY ASSESSMENT OF METAL CONTAMINATION IN MINING EGUGeneral 2025 SOILS USING SENTINEL-2 MSI: A CASE STUDY OF SÃO DOMINGOS MINE, PORTUGAL

GONÇALO RODRIGUES^{1,2,3}, PEDRO TEIXEIRA^{1,2,3}, RUI JORGE OLIVEIRA^{1,2,3}, MARIA JOÃO COSTA^{1,2,3}, MARIA JOÃO COSTA^{1,2}

¹ UNIVERSITY OF ÉVORA, CREATE – CENTER FOR SCI-TECH RESEARCH IN EARTH SYSTEM AND ENERGY, ÉVORA, PORTUGAL ² DEPARTMENT OF PHYSICS, UNIVERSITY OF ÉVORA, ÉVORA, PORTUGAL ³ EARTH REMOTE SENSING LABORATORY – EARSLAB, UNIVERSITY OF ÉVORA, ÉVORA, PORTUGAL ⁴ POLYTECHNIC INSTITUTE OF BEJA, BEJA, PORTUGAL ⁵ GEOBIOTEC, NOVA SCHOOL OF SCIENCE AND TECHNOLOGY, CAPARICA, PORTUGAL



KEY FINDINGS

- The Scene Classification Layer (SCL) initially identified a large number of pixels as bare soil (SCL = 5), many of which did not correspond to exposed mining soils. Applying additional spectral indices (BSI and SAVI) effectively reduced false positives, isolating dry and vegetation-free pixels that were more consistent with actual mining soil conditions.
- Preliminary results show that spectral indices using the instrument MSI highlight areas with exposed contaminated soils in the São Domingos Mine.
- The combination of the Iron Oxide Index, Gossan Index, and Ferrous Silicates Index allowed the effective identification of altered soils and highly oxidized zones associated with mining contamination.



Corresponding author: grodrigues@uevora.pt



False Color Composite – Healthy Vegetation (B8-B11-B2)

BARE SOIL DETECTION



True Color Composite (RGB: **B4-B3-B2**)

DETECTION OF POTENTIAL CONTAMINATED AREAS





CONCLUSION

contaminated soils in legacy mining areas.

Detecting soil metals via remote sensing remains challenging due to weak spectral responses and their adsorption to soil constituents such as organic matter and clay minerals, which limits detection using multispectral sensors.

Future work will explore predictive modelling approaches, including Multiple Linear Regression (MLR) and Partial Least Squares Regression (PLSR). Hyperspectral satellite data from the Environmental Mapping and Analysis Program (EnMAP) and PRISMA (Hyperspectral Precursor of the Application Mission) will be integrated to improve detection through enhanced spectral resolution.









CREATE



White pixels represent areas excluded by the SCL \neq 5, while black were selected pixels using spectral thresholds (BSI, SAVI). Only the intersection of these filters — shown in orange corresponds exposed bare soil primarily located within the mining zones.

High values of the Iron Oxide and Gossan indices matched consistently areas of known ferric alteration, while variations in the Ferrous Silicates highlighted Index potential zones of hydrothermal alteration, supporting more detailed discrimination of surface mineralogy.

Preliminary results highlight the potential of Sentinel-2 MSI data in identifying exposed and potentially