

EARTH OBSERVATION CONTRIBUTION AS A COMPONENT FOR MINERAL RESOURCES SYSTEMS



L. Quental, D. de Oliveira, A. Filipe, C. Lopes, C. Fortes

lidia.quental@lneg.pt , daniel.oliveira@lneg.pt, augusto.filipe@lneg.pt,
catarina.lopes@lneg.pt, carla.fortes@lneg.pt

OUTLINE

INTRODUCTION GEORESOURCES, GEOPORTALS, EARTH OBSERVATION

MINERAL RESOURCES SYSTEMS

NATIONAL PORTUGUESE SIORMINP GEODATABASE, OTHER EUROPEAN MINERAL RESOURCE PLATFORMS/GEODATABASES

EARTH OBSERVATION

EXTRACTION OF INFORMATION RELATED TO MINING ENVIRONMENTS
EUROPEAN SPACE PROGRAM **COPERNICUS**

FINAL NOTES

GEORESOURCES

Thematic Spatial information

feeding several legal
framework at European and
national level

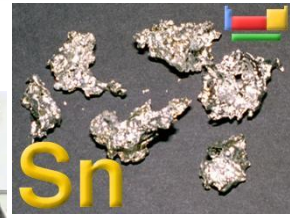
scientific point of
view

throughout all
mine life cycle

exploration
exploitation
mine closure



Sc	Y	La	Ce
Pr	Nd	Sm	Eu
Gd	Tb	Dy	Ho
Er	Tm	Yb	Lu



6.941
B3 bcc
180.5°
1342°
0.534
0.98

3
1

Li

[He]2s¹
Lithium





geoPortal

Services infrastructure to support integrated management and spatial data visualization, which aims to provide, in a web environment, geo-referenced information related to the various activities of the Laboratory for Energy and Geology of Portugal.



Metadata Search





Online Databases

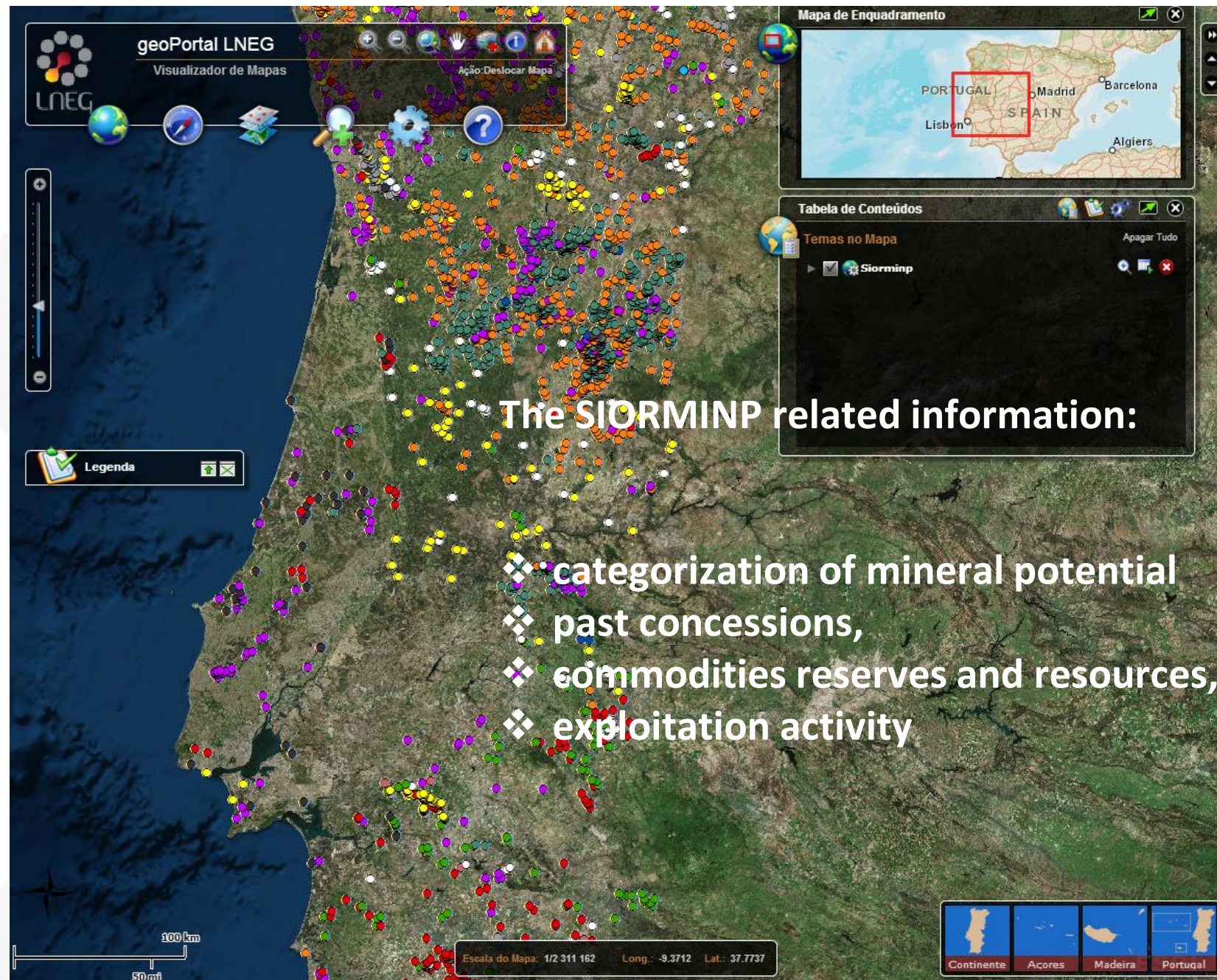


Map Viewer



Destaques:  Energia  Geologia





geoPortal LNEG
Visualizador de Mapas

Ação: Deslocar Mapa

Mapa de Enquadramento

LNEG
Laboratório Nacional de Energia e Geologia, I. P.

geoPortal do LNEG
A Cartografia ao Serviço do Conhecimento do Território

[Página Inicial](#)

[Bases de Dados Online](#)

[Pesquisa de Metadados](#)

[Visualizador de Mapas](#)

SIORMINP - Sistema de Informação de Ocorrências e Recursos Minerais Portugueses

Pesquisa:

Substância: - Todas as Substâncias/Metais -

Localização: - Todos os Distritos -

Dimensão: - Todas as Dimensões -

Busca Livre:

O Sistema de Informação de Ocorrências e Recursos Minerais Portugueses, sigla **SIORMINP**, foi concebido e criado para: aprofundar o conhecimento geocientífico, técnico e económico sobre as ocorrências, recursos minerais e reservas minerais; promover o desenvolvimento mineiro do território nacional ao seleccionar e divulgar junto do sector empresarial áreas com potencial mineiro; contribuir para o ordenamento do território; fornecer informação sobre recursos para cartas geológicas e estudos de impacte ambiental.

Ocorrência Mineral	Substâncias e/ou Metais	Distrito	Concelho	Categoria
A da Prelinha e Barrocais	Urânio (U)	UISEU	SERNANCELHE	Mineral não-económica
A Mina e Sítio do Pinheiro	Lignito (C)	COIMBRA	SOURE	Recurso mineral medido
A Quinta (1)	Tungsténio (W)	UISEU	UISEU	Mineral
A Quinta (2)	Estanho (Sn)	GUARDA	GOUVEIA	Mineral
A Seara do Soito	Volfrâmio (W), Antracite (C), Estanho (Sn)	UISEU	UISEU	Mineral
Abelhas	Urânio (U)	GUARDA	AGUIAR DA BEIRA	Recurso mineral medido
Abelheira 2	Urânio (U)	CASTELO BRANCO	BELMONTE	Mineral
Abelheira e Medas	Antimónio (Sb),	PORTO	PAREDES	Mineral
Abelheiras	Estanho (Sn), Nióbio (Nb), Tântalo (Ta)	BRAGA	VILA VERDE	Mineral
Abogaria e Ferrarias	Tripoli (SiO2)	SETÚBAL	SESIMBRA	Recurso mineral medido
Açafal	Ouro (Au)	CASTELO BRANCO	VILA VELHA DE RÔDÃO	Mineral
Achada	Manganês (Mn)	BEJA	CASTRO VERDE	Mineral
Acorroadoiro e S. Domingos	Urânio (U)	GUARDA	AGUIAR DA BEIRA	Mineral

Legenda

Escala do Mapa: 1/2 311 162 Long.: -9.3712 Lat.: 37.7737

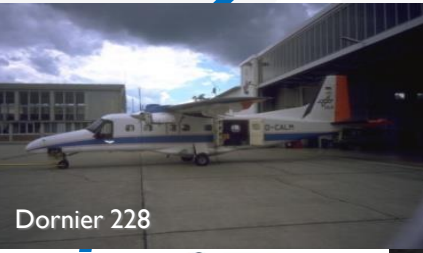
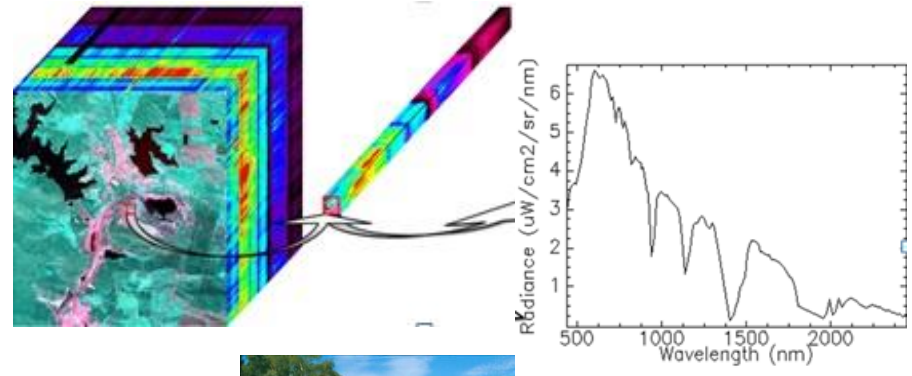
100 km / 50 mi

Continente Açores Madeira Portugal

EARTH OBSERVATION

Synoptic overview
Multitemporal acquisition

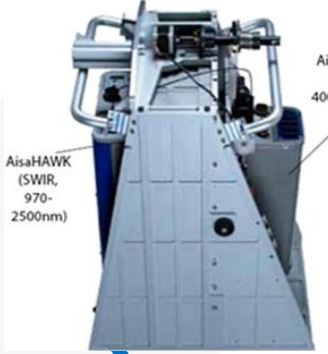
platforms



Dornier 228



sensors



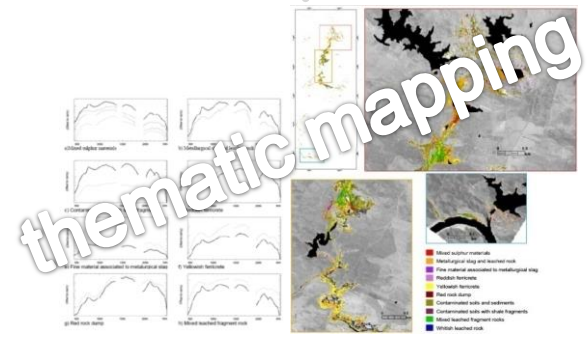
AisaHAWK (SWIR, 970-2500nm)



target



in situ spectral measurements

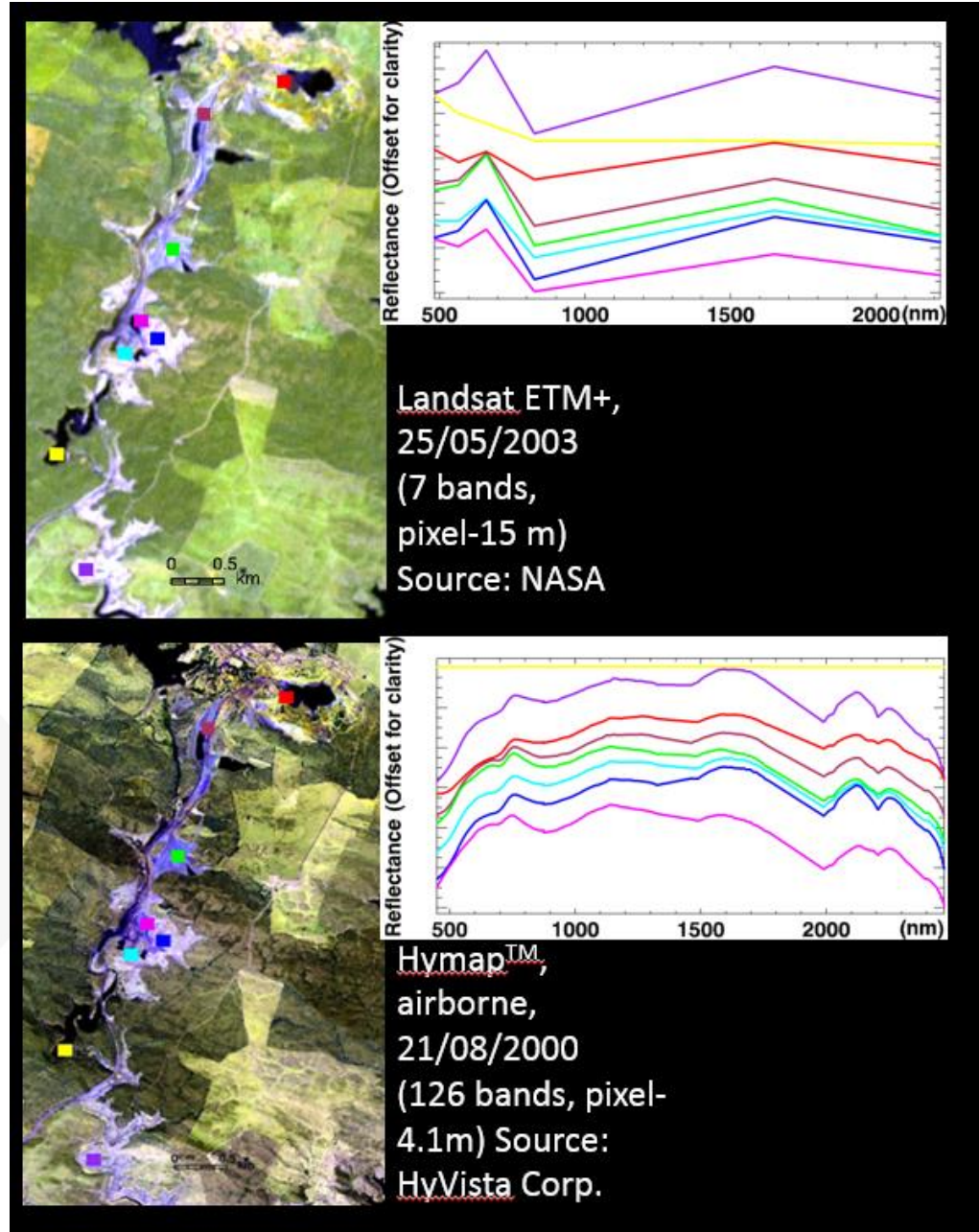


thematic mapping

Different type of information concerning different sensors -spatial, spectral resolution, wavelength range

adequate tool for all mine life cycle, particularly suitable for environmental monitoring depending on the spectral characteristics of the sensor

Adapt. Quental L, Sousa AJ, Marsh S, Brito G, Abreu MM (2012). REMOTE SENSING FOR WASTE CHARACTERISATION. In FIELD TRIP GUIDEBOOK Multidisciplinary contribution for environmental characterization and improvement at the S. Domingos mining site. MJ Batista, Matos JX, Oliveira D, Abreu MM, Figueiredo MO, Quental L, Africano F, Branquinho C, Pena T, Santana H, Pereira Z, Silva TP, Santana H, Matielli N.





ACHADA DO GAMO



Slags, tailings and heap dumps are estimated at several hundred thousand tons



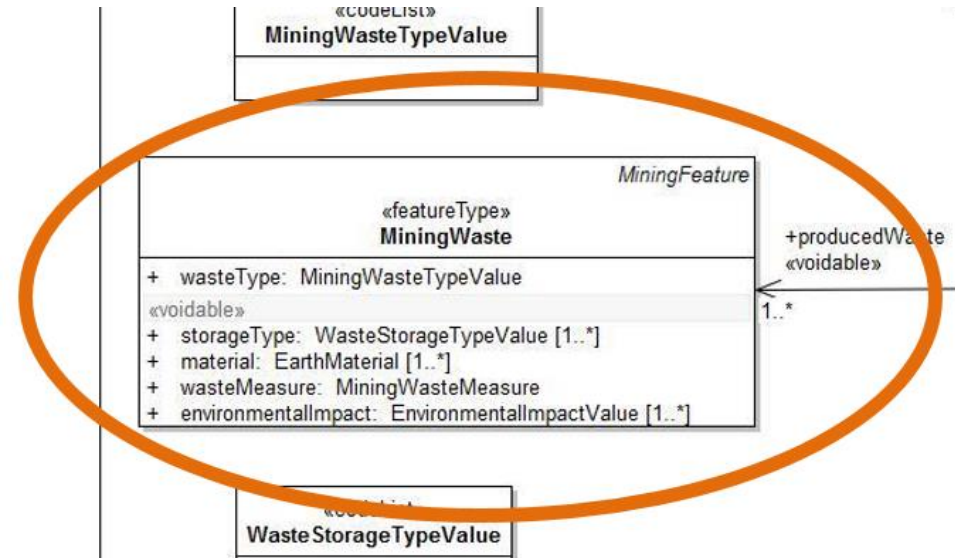
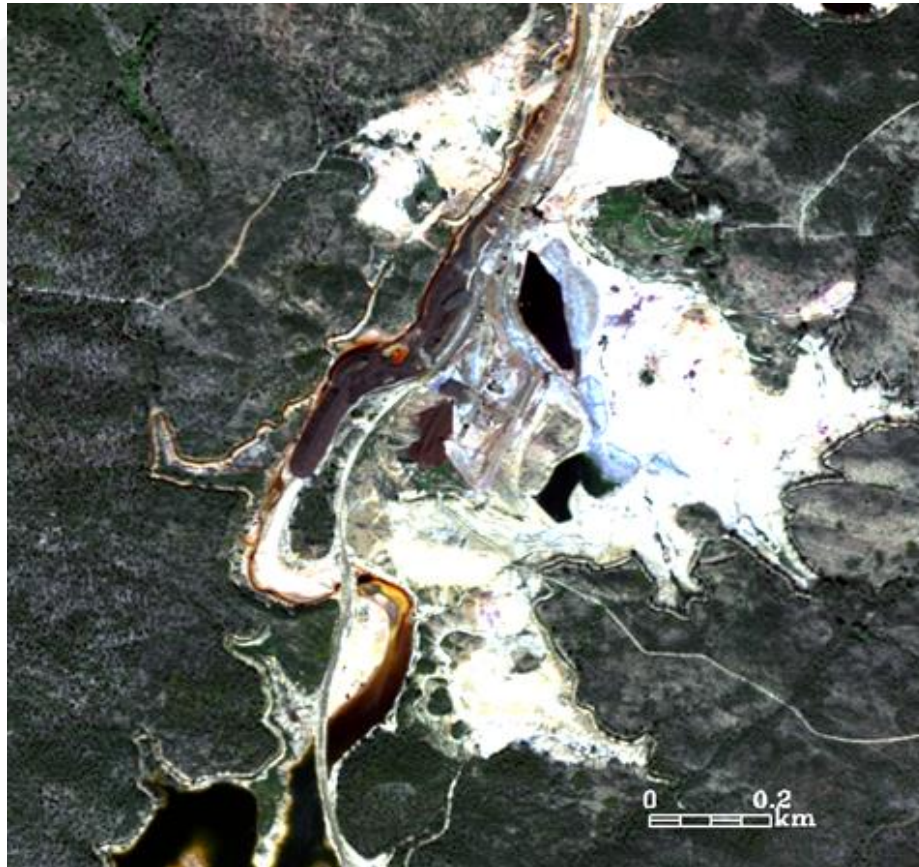
Distinct acid generating potential for waste mining materials

Images from SPECIM EAGLE-HAWK sensor
Funding: EUFAR /NERC HyPMINGEO project



EARTH OBSERVATION

Extraction of information on waste materials, deposit geometry and environmental impact



Data Specification on Mineral Resources
 Mine Extension (Mining Waste, Product and Mined material)

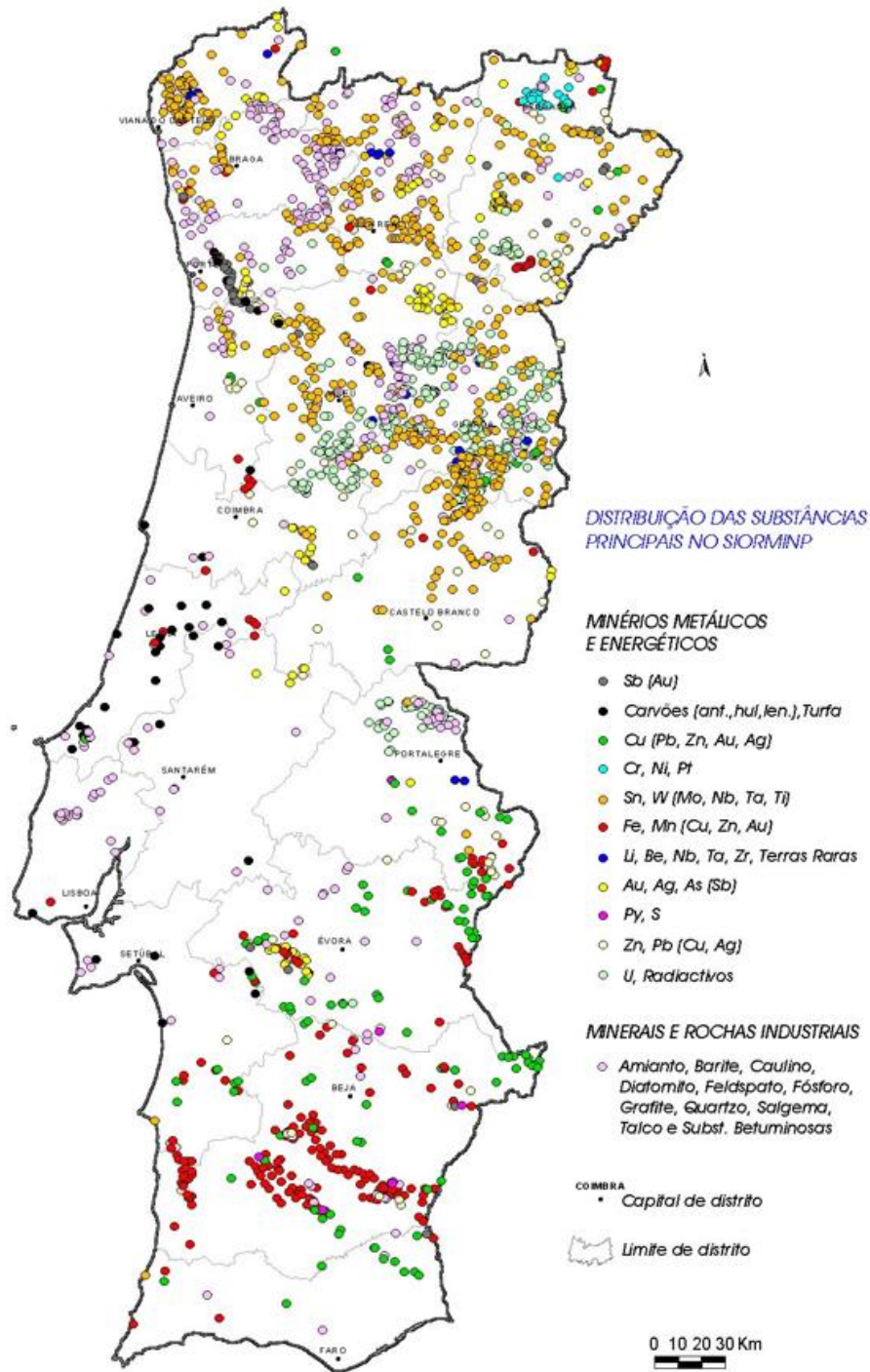
D2.8.III.21 INSPIRE Data Specification on *Mineral Resources* –Technical Guidelines

MINERAL RESOURCE SYSTEMS

SCOPE OF MINERAL RESOURCES FOR INSPIRE

1. two legal texts providing requirements for the data specification:
 - EU Raw Materials Initiative;
 - Management of waste from extractive industries;
2. the standard data model EarthResourceML for Mineral resources;
3. the work currently done in raw materials related to European projects.

CONVERGENCE OF NATIONAL GEODATABASE IN THE CONTEXT OF INSPIRE DIRECTIVE



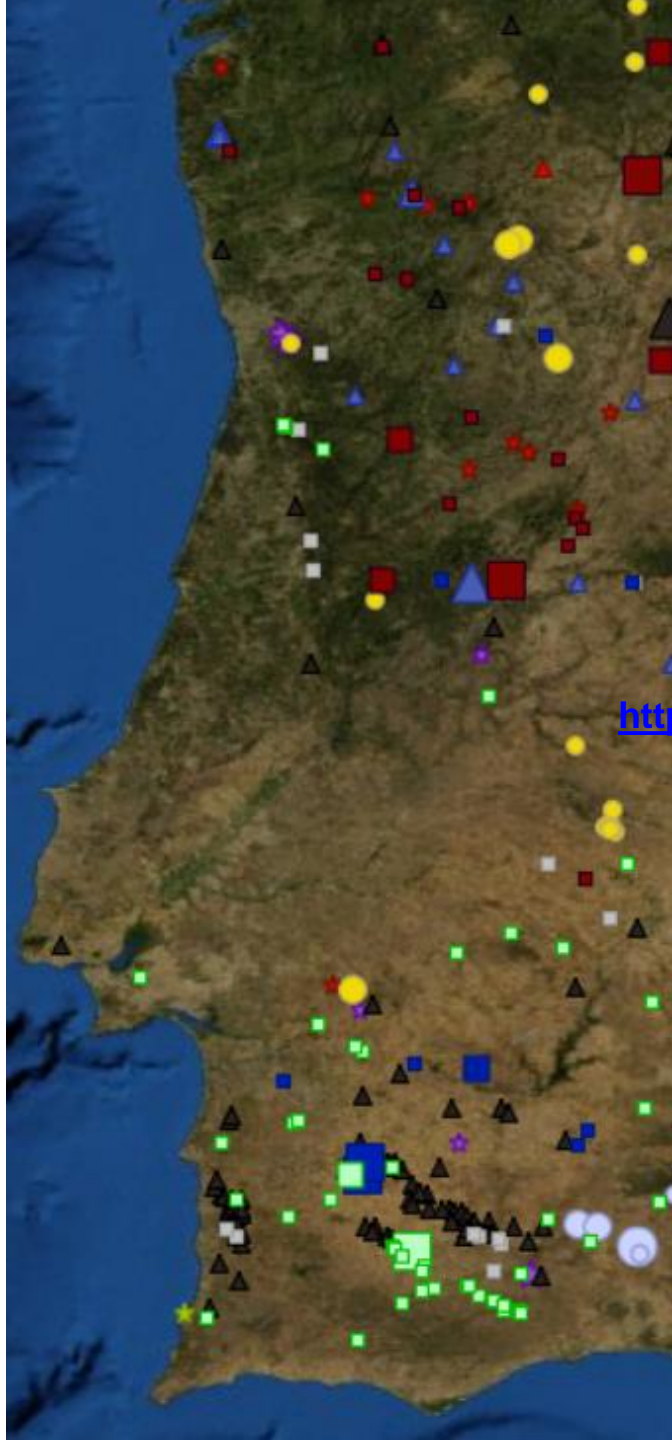
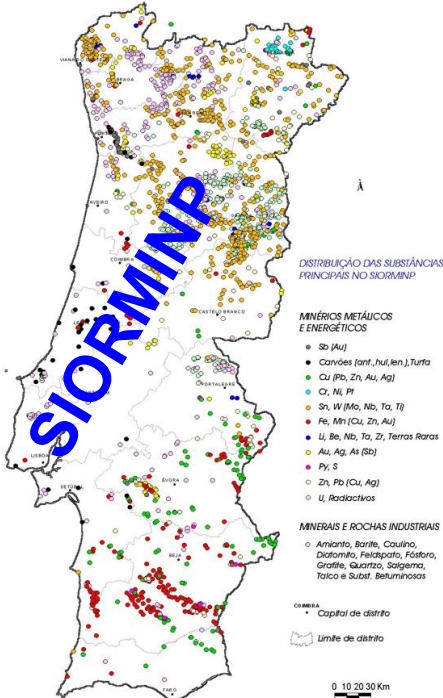
SIORMIN

CONVERGENCE OF NATIONAL GEODATABASE IN THE CONTEXT OF INSPIRE DIRECTIVE

PROMINE

<http://ptrarc.gtk.fi/ProMine/default.aspx>

325 NATIONAL MINERAL DEPOSITS
92 ANTHROPOGENIC CONCENTRATION

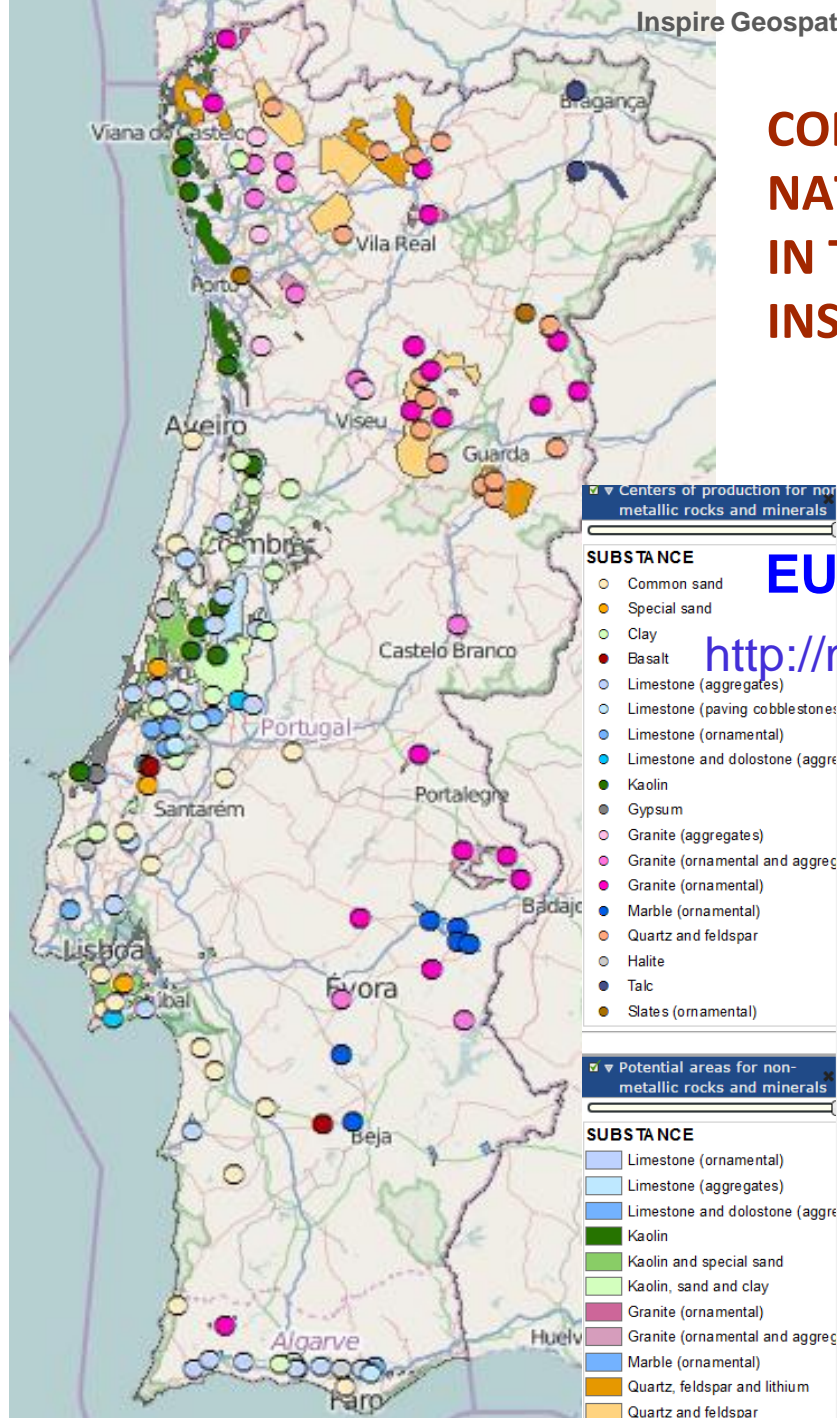
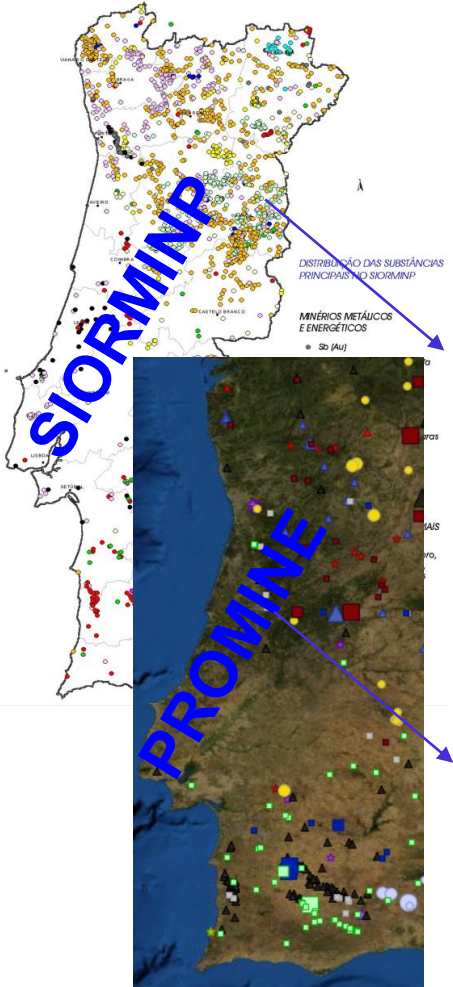


CONVERGENCE OF NATIONAL GEODATABASE IN THE CONTEXT OF INSPIRE DIRECTIVE

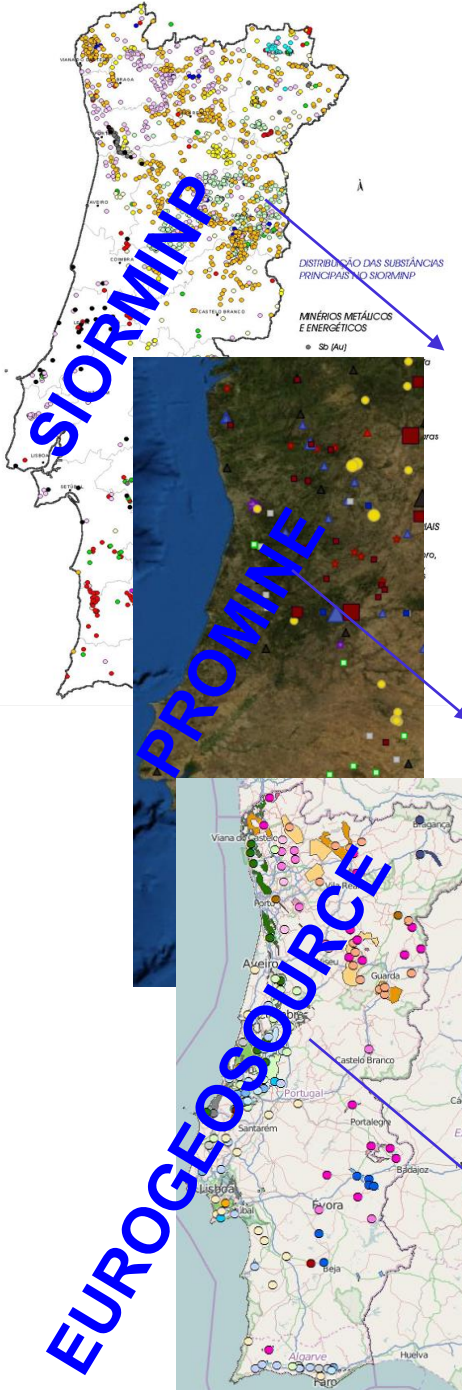
EUROGEOSOURCE

<http://maps.eurogeosource.eu/>

376 NATIONAL MINERAL DEPOSITS



CONVERGENCE OF NATIONAL GEODATABASE IN THE CONTEXT OF INSPIRE DIRECTIVE



HOME

DATA SEARCH

MAP VIEWER

YEARBOOK



ONGOING...

Minerals Intelligence Network for Europe

Simplified, user-friendly and efficient access to all available and new data related to mineral resources through the EU-MKDP (European Minerals Knowledge Data Platform)



DATA SEARCH

Search into the EU-MKDP (Mineral Resources Database and Knowledge Documents) to find the best data



MAP VIEWER

View the data inside the EU-MKDP and combine them with other data to create decision support maps



MINERALS YEARBOOK

View data for primary minerals production, trade, resources and reserves; and for secondary materials

NEWS

March 9, 2015

European Minerals Yearbook pre-version available

The pre-version of the new Electronical European Minerals Yearbook is available on the EU-MKDP

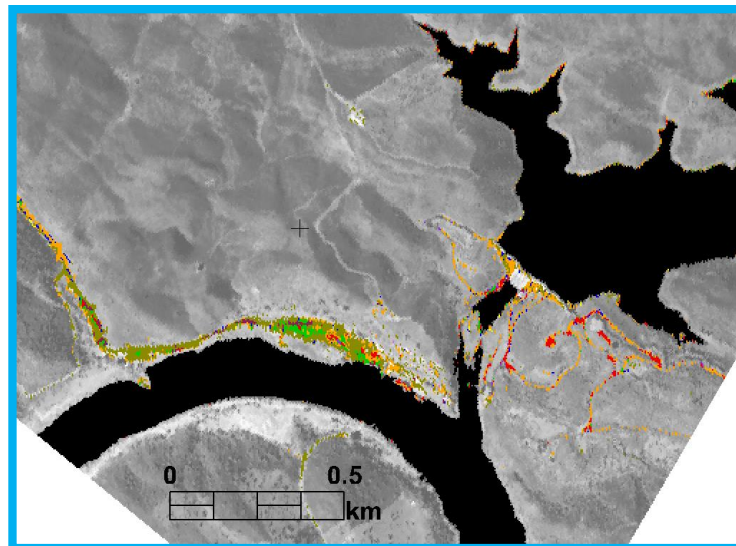
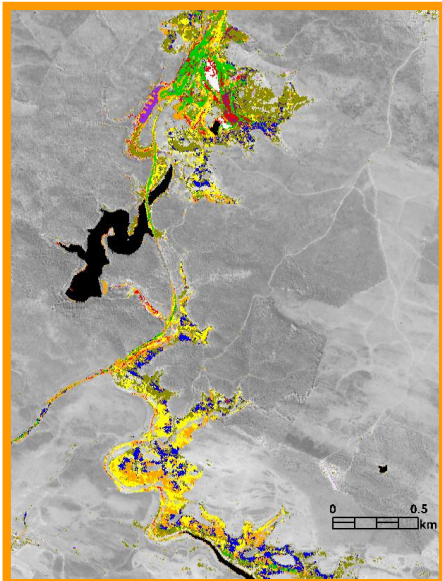
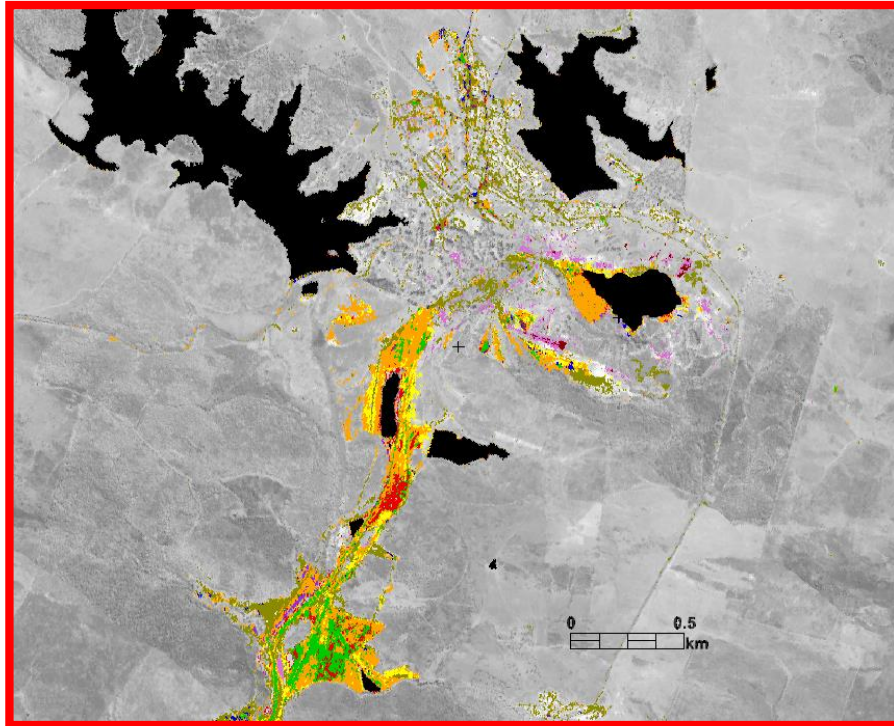
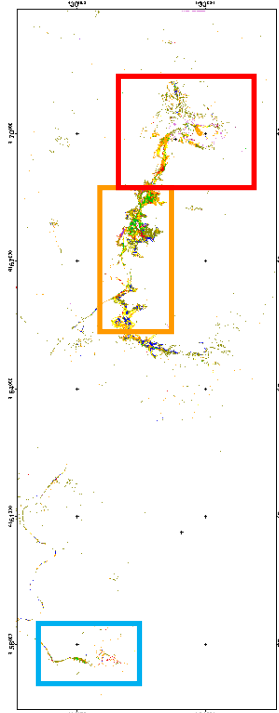
EARTH OBSERVATION

EXTRACTION OF INFORMATION RELATED TO RAW MATERIALS/ MINING ENVIRONMENTS

EARTH OBSERVATION

- Mixed sulphur materials
- Metallurgical slag and leached rock
- Fine material associated to metallurgical slag
- Reddish ferricrete
- Yellowish ferricrete
- Red rock dump
- Contaminated soils and sediments
- Contaminated soils with shale fragments
- Mixed leached fragment rocks
- Whitish leached rock

**WASTE MATERIAL
MAPPING ACCORDING
WITH DIFFERENT
CHEMICAL
CHARACTERISTICS**



In Quental, L. Sousa, A.J, Marsh, S., Brito, G. Abreu, M.M. (2011) IMAGING SPECTROSCOPY ANSWERS TO ACID MINE DRAINAGE DETECTION AT S. DOMINGOS, IBERIAN PYRITE BELT, PORTUGAL. *Comunicações Geológicas*, 98, 61-71

COURTESY of COMUNICAÇÕES GEOLÓGICAS

S.DOMINGOS - MINERALOGICAL CORRELATION MAP ≥ 0.90 (AMD)

MINERALOGICAL CORRELATION (≥ 0.9) MAP OF ACID MINE DRAINAGE

COPIAPITE-COQUIMBITE-ALUNITE pH < 3 (exclusive mineralogical signature)

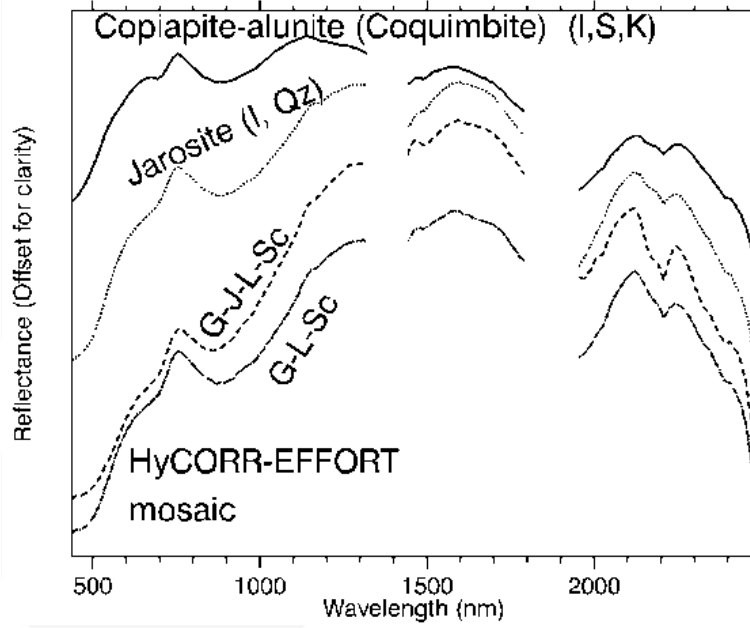
4170000
4167000
4164000
4161000
4158000

HyMAP Sensor
HyCORR-EFFORT
CORRECTION
(HVC Corp.)
FLIGHT
21 August 2000

- COPIAPITE (Cq) (A-I-K)
- JAROSITE (I,Qz)
- JARO.-GOETHI.-LEPIDOCR.-SCHWER.
- GOETH.-LEPIDOCR.-SCHWER.

Projection - UTM, Zone 29 N
Pixel - 4.1 Meters
Datum - WGS-84
0.5 km

630000 633000

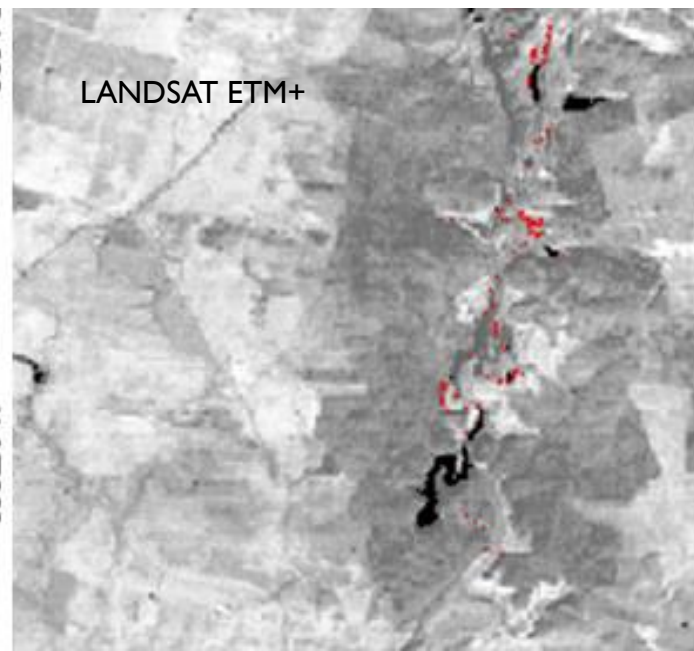
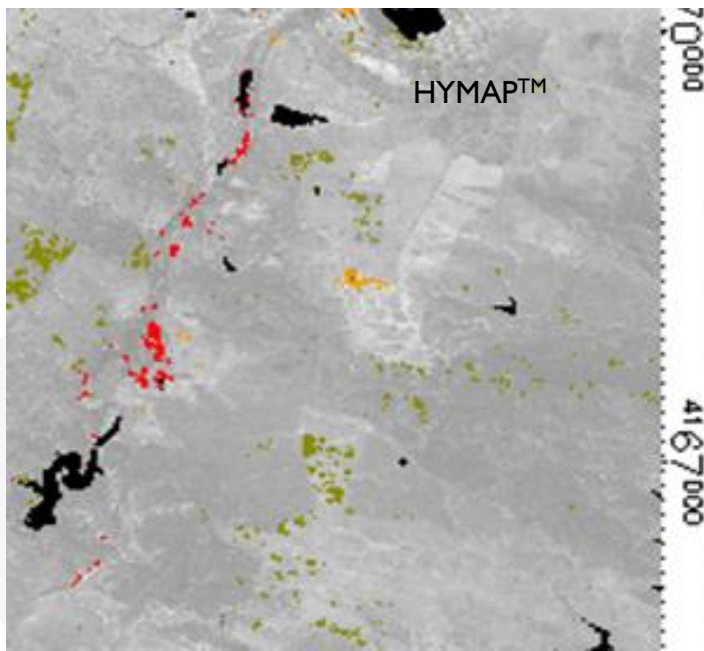


Average spectral values of the classes obtained

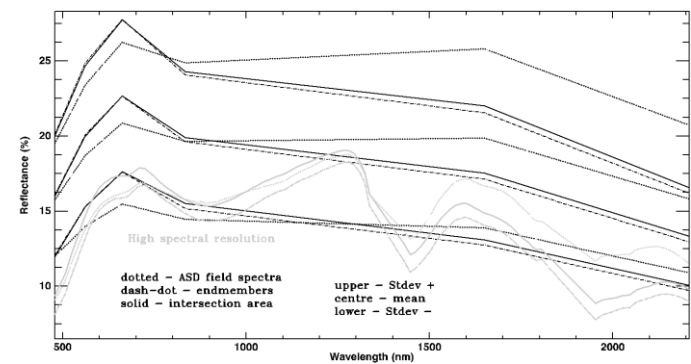
In Quental, L. Sousa, A.J, Marsh, S., Brito, G. Abreu, M.M. (2011) IMAGING SPECTROSCOPY ANSWERS TO ACID MINE DRAINAGE DETECTION AT S. DOMINGOS, IBERIAN PYRITE BELT, PORTUGAL. Comunicações Geológicas, 98, 61-71

COURTESY of COMUNICAÇÕES GEOLÓGICAS





MOVING FROM HYPERSPPECTRAL TO MULTISPECTRAL WITH IMPROVED METHODOLOGY...



European Earth Observation Programme

SENTINEL 1A
Radar

SENTINEL 2A
To be launched in June
2015

▸ **Medium Res Multispectral optical satellite for observation of land, vegetation and water**

- 13 spectral bands with 10, 20 or 60 m resolution and 290 km swath width
- Global coverage of the Earth's land surface every 5 days

http://www.space-airbusds.com/media/image/copernicus-poster-840x297_eng_1_1.jpg



[http://www.esa.int/Our Activities/Observing the Earth/Copernicus/Overview4](http://www.esa.int/Our_Activities/Observing_the_Earth/Copernicus/Overview4)

Sentinel family

SPACE COMPONENT

SENTINELS

SENTINEL 2A

SENTINEL-2 BRINGS LAND INTO FOCUS

http://www.esa.int/Our_Activities/Observing_the_Earth/Copernicus/A_wing_for_Sentinel-2A/%28print%29



REMARKS

EARTH OBSERVATION can provide useful components to mineral resources systems, following INSPIRE requirements, seen here under the environmental point of view

can also be applied to characterise waste materials for secondary exploitation

Importance of multitemporal data acquisition for monitoring purposes

more complex indicators derived from advanced Earth Observation have been demonstrated to be also achieved by simpler sensors giving an opportunity to use COPENICUS to characterise and monitor mining environments

THANK YOU FOR YOUR ATTENTION!



www.lneg.pt



MINISTÉRIO DO AMBIENTE,
ORDENAMENTO DO TERRITÓRIO E ENERGIA