# Geo3bcn
# Spectroscopy Lab

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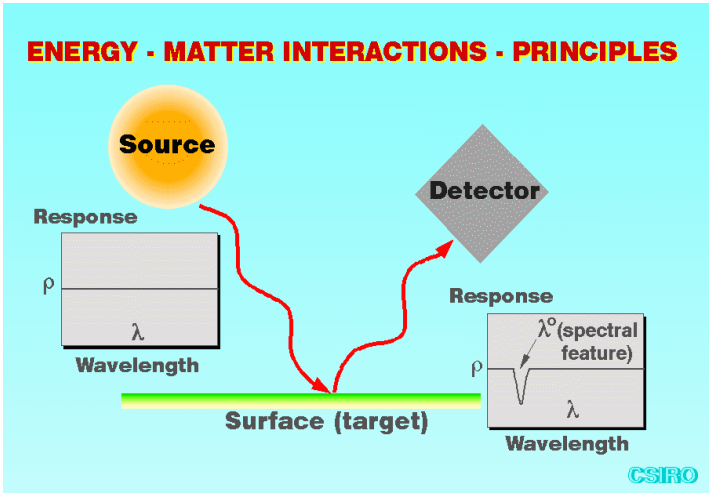
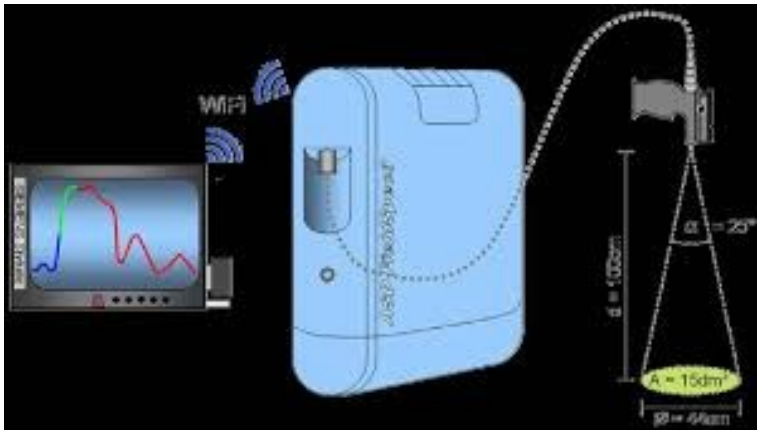
*Background*

# Reflectance Spectroscopy



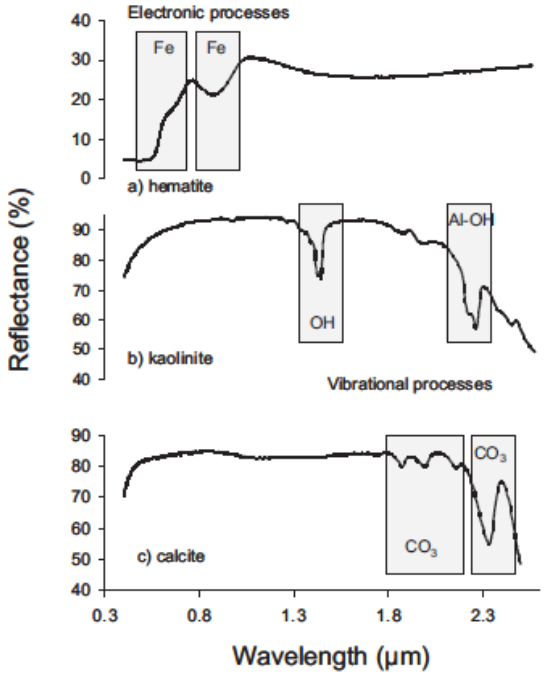

Reflectance spectroscopy is the study of the light reflected by a target along wavelength, normally to retrieve information on the target (typical range 400 – 2600 nm)

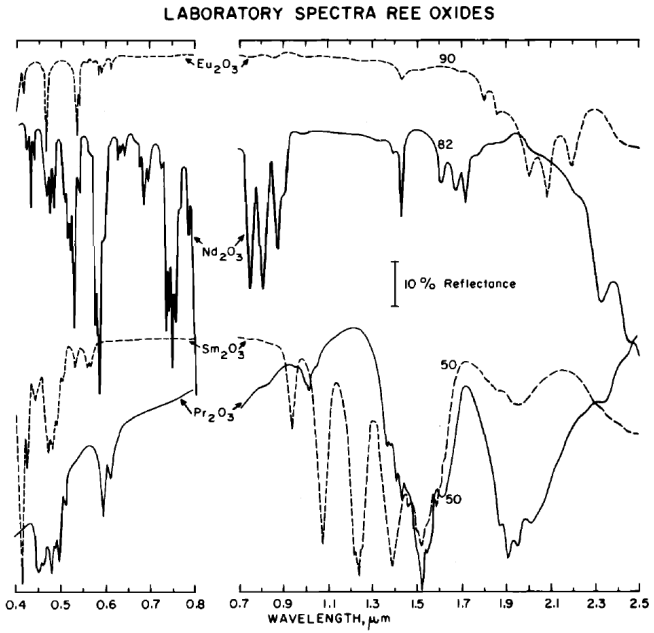
- Relatively cheap and simple
- No contact, non-destructive
- No sample preparation is required
- Essentially the same technique in laboratory, field, aerial/satellite platform (similar setting in close-range and remote sensing)

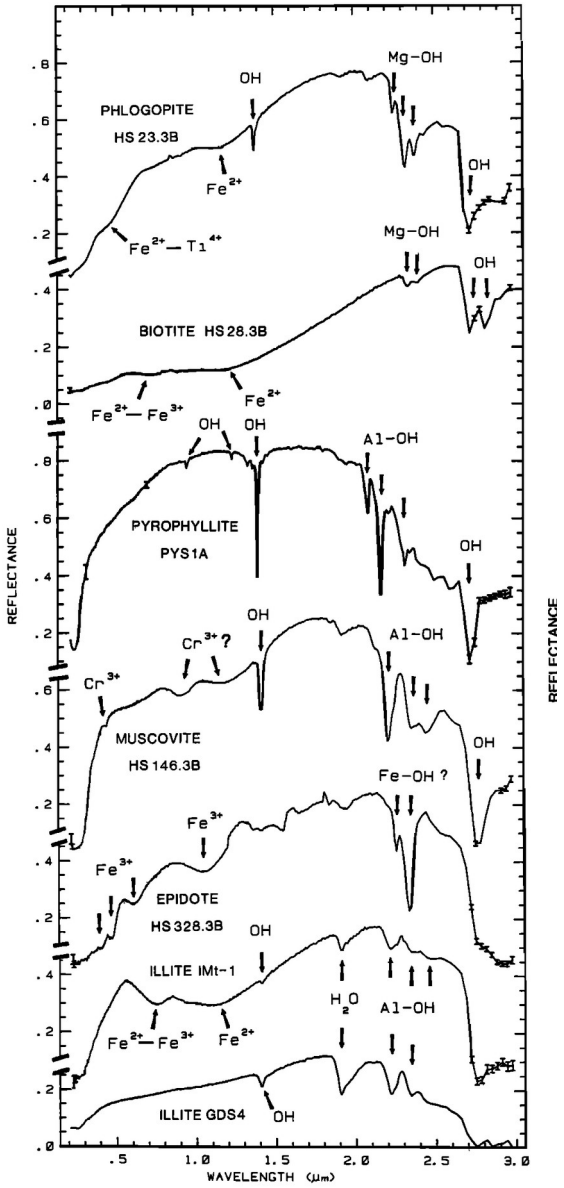
*Background*

# Reflectance Spectroscopy

Physico-chemical characteristics of the target determine the interaction. The involved physical processes are well known



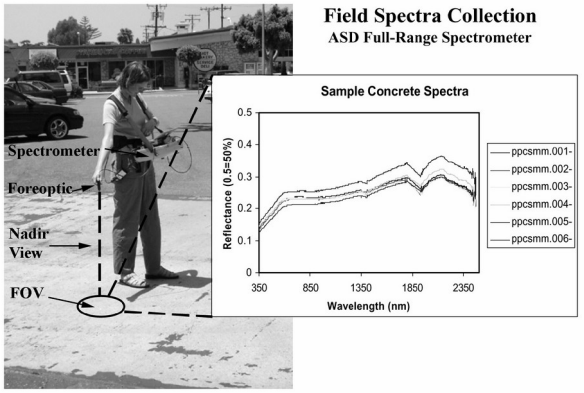



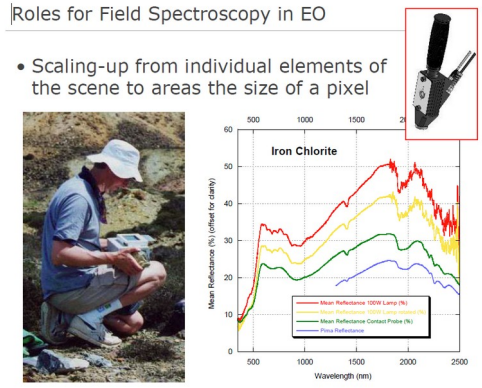




- Identification of many minerals from their reflectance spectra is possible in many cases.
- Spectral libraries (for spectral matching) exist.
- Some portable systems for automatic identification of minerals exist

*Background*

# Reflectance Spectroscopy

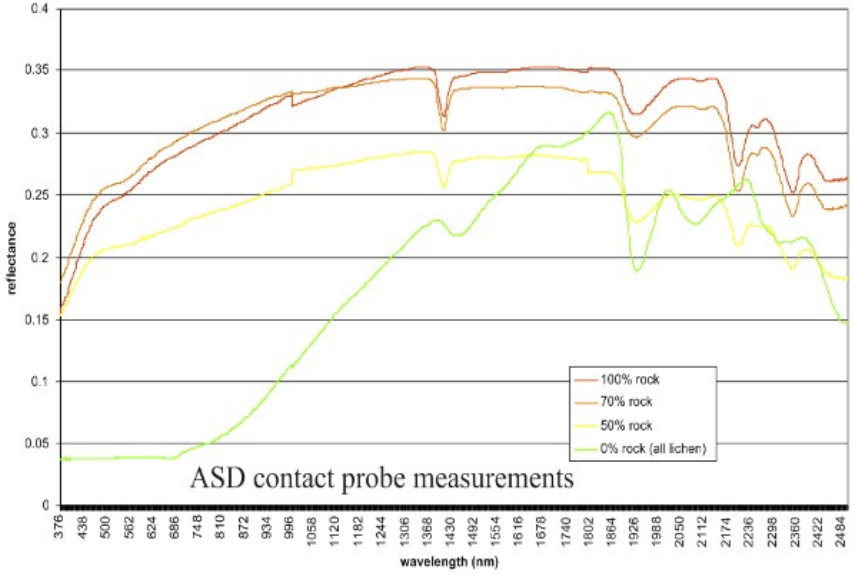



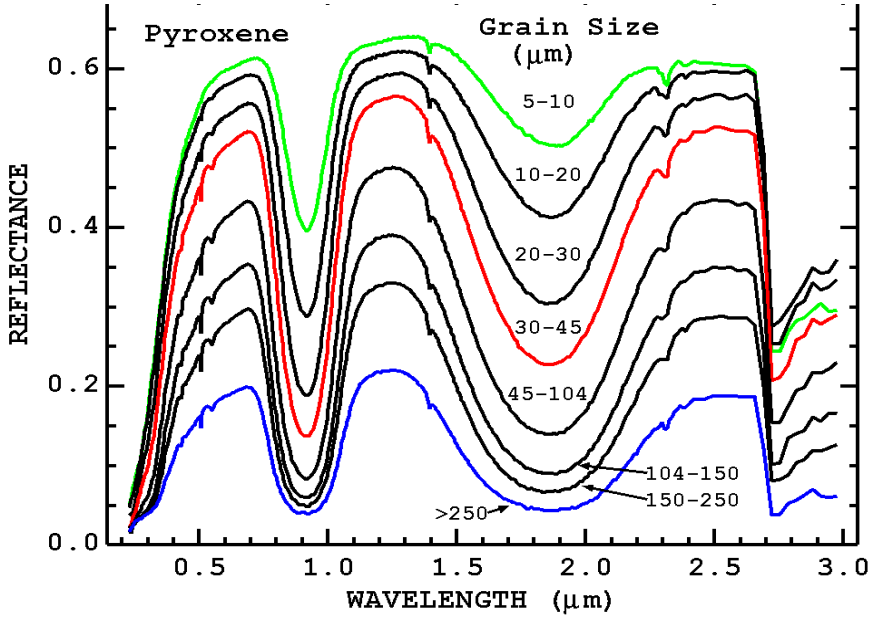




# Reflectance Spectroscopy

Disadvantage: many other factors affect the spectra and identifications can be ambiguous or erroneous:

- Illumination and observation angle
- Presence of several materials in the field-of-view (mixtures)
  (in some cases, mixtures can be analytically solved in post-processing)
- Grain size (which in some cases is actually an advantage)
- Wetness



***Background***

# Imaging Spectroscopy

Imaging spectrometers render image cubes in which each voxel is a spectrum.

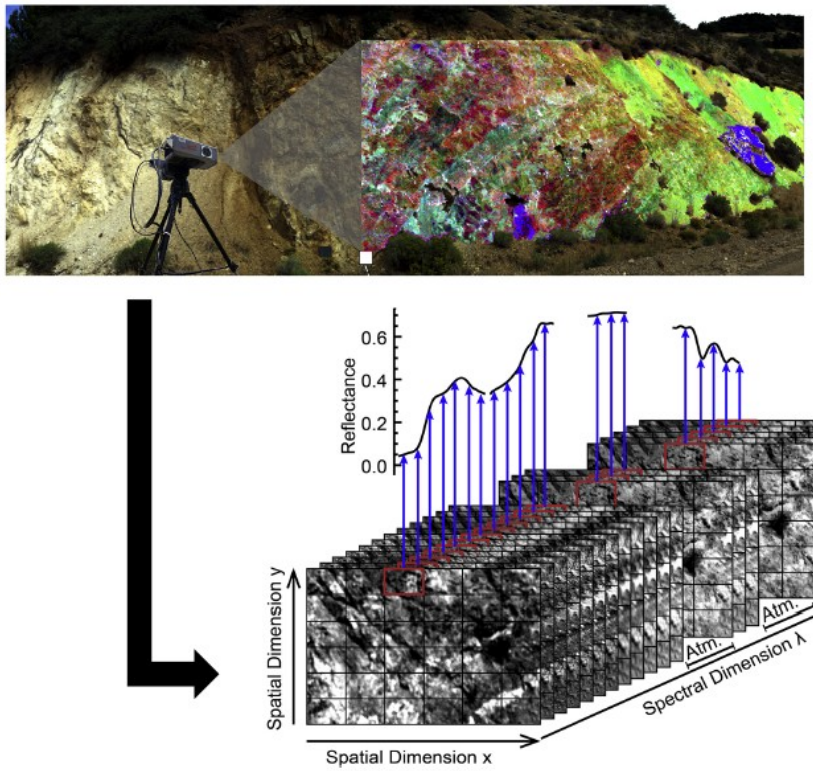
Image processing + spectrometry

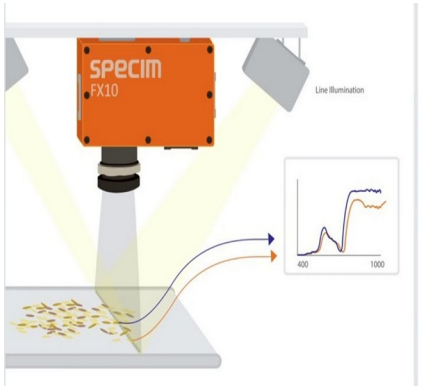
Advantages:

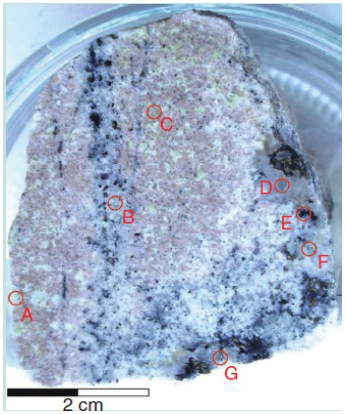
- Results include the spatial distribution and structures of the targets
- In case of ambiguous identifications, delimit area and sample for other analysis (e.g. XRD)

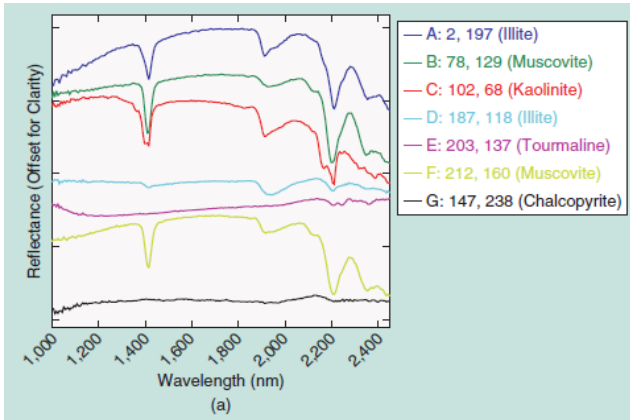
Disadvantages:

- More expensive
- Complex processing
- Huge amount of disk space



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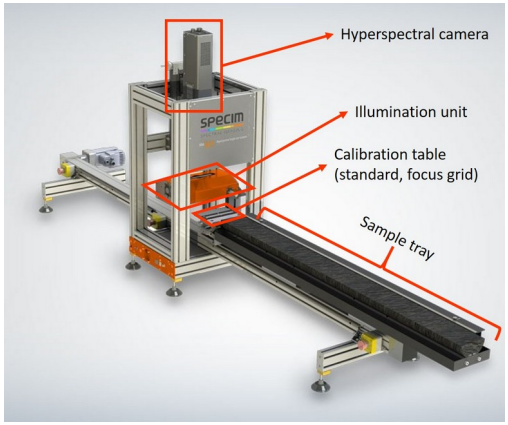
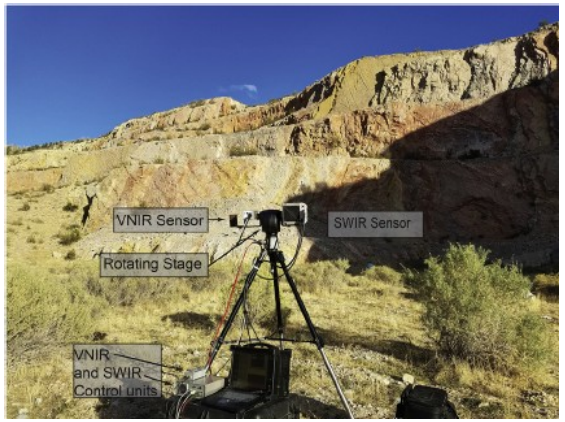
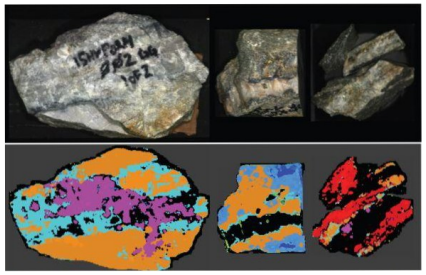
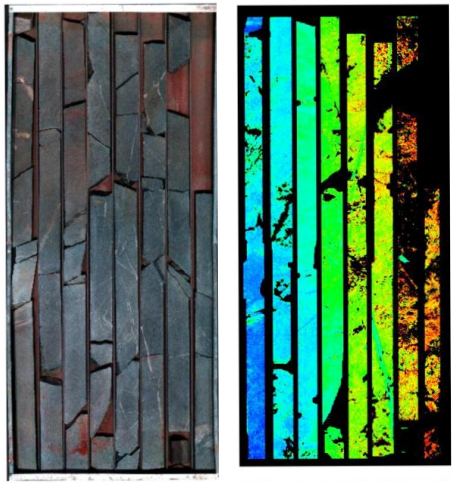
# Imaging Spectroscopy



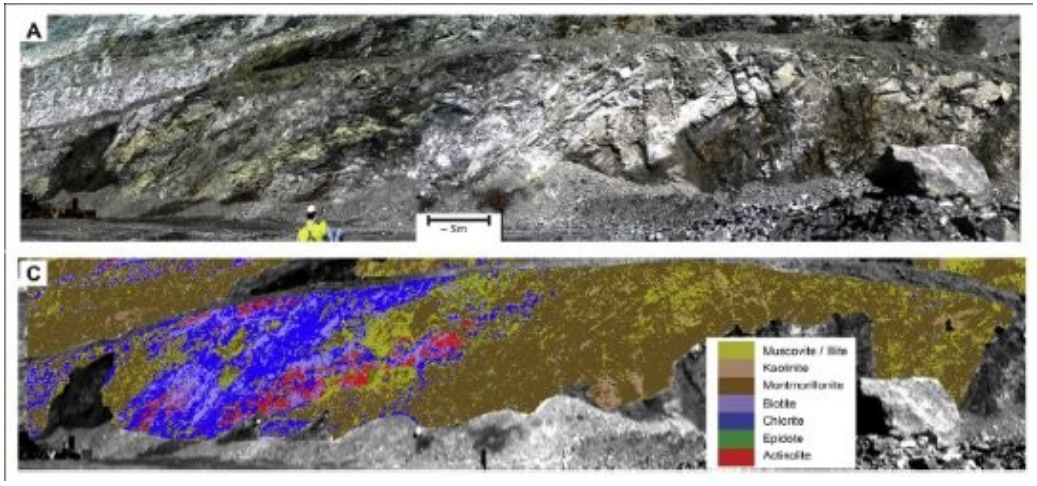









Mg-Chlorite Fe-Chlorite



# Reference Laboratories

## Laboratory of Spectroscopy
## ITC – Faculty of Geoinformation and Remote Sensing (University of Twente)

https://www.itc.nl/research/research-facilities/labs-resources/geoscience-laboratory/spectroscopy-laboratory/

- FTIR spectrophotometer reflectance and emissivity in 2.5 to 16 um
- ASD Spectrometers (reflectance 450 – 2600 nm)
- Hyperspectral cameras: VISNIR (350 – 1000 nm) and SWIR (1000 – 2500 nm)
- IR radiometric camera (Thermal camera)
- Terrestrial Laser Scanner
- MIDAC FTIR thermal infrared (MWIR and LWIR) spectrometer
- FLIR X6570sc thermal imaging camera

## Laboratory of Spectroscopy
## GFZ-Postdam

https://www.gfz-potsdam.de/en/section/remote-sensing-and-geoinformatics/infrastructure/spectroscopy-laboratory/

- Spectroradiometers ASD FieldSpec Pro, Spectral Evolution PSR+ (VNIR and SWIR) and GER instrument in the VNIR region
- Hyperspectral cameras HySpex and HyperCam
- Agilent 4300 Handheld FTIR
- UAV sensors: multispectral (Tetracam Mini MCA, MicaSense RedEdge M) and hyperspectral cameras (HySpex Mjolnir SWIR-620, Cubert VNIR)
- Airborne sensors: vis/NIR and thermal hyperspectral cameras (HySpex VNIR and SWIR, HyperCam LW)

## USGS Spectroscopy Lab

https://www.usgs.gov/labs/spec-lab

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# Goals

- Support of spectroscopy methods for research projects in which we participate
- Provide hyperspectral imagery to other projects/companies if of scientific interest

# Equipment

- SpectroPi
  In-house made system based on 2 Ocean Optics spectrometers integrated with a Raspberry Pi computer and controlled with an Android phone/tablet. Software in python (400 – 2500 nm).
- Hyperspectral camera in VIS (450-950 nm): Cubert Firefleye S185 SE
- Hyperspectral camera in NIR (900-1700 nm): Specim FX17
- Accessories:
  - Contact probe
  - Illuminations systems
  - White reference targets
  - Standard reference target
  - Laboratory Stands
  - Field rotary stand (for panoramic hyper-spectral imaging)


# Personnel

- Agustín Lobo (part time), Jordi Ibáñez (part time)
- Anna Giralt (student, part time 2018-2019)

# Funding

- PostVoldec (PI Adelina Geyer)
- XRD service
- Infraestructuras y Equipamiento Científico-Técnico 2016

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# Work Done (2018-2020)

- Lab setting up
- SpectroPi construction and testing
- Software for our hyperspectral cameras:
  - Processing from radiance to reflectance
  - Scripts for extracting spectra and concatenating VISNIR to SWIR
  - Integration of FX10 (400-1000) and FX17 (900-1700) (geometric co-registration and radiometric consistency)
- Hyper-spectral images and spectra of all Deception Is. samples (+ specific studies on lapilli grain size and comparison to XRD results).
  - 1 TFG
  - 2 conference presentations.
  - 2 research articles in progress.
  - 1 Data base to be published.
- Hyper-spectral images of arqueological pigmented pottery samples (external)
- Hyper-spectral images of antique pigments
- Hyper-spectral images of hand samples of a Sn – W mine (laboratory and field-simulation setting) (external, funding income)
  - 1 TFM
  - 1 article close to be submitted

Machine-learning for mineral identification and ore estimation in Sn – W deposits from close-range conventional and proximal hyper-spectral imagery