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# Analytical infrastructure of HERCULES Laboratory: geomaterials and prospecting (with visit)

José Mirão

*MostMeg*

Evora, June 7th

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UNIVERSIDADE  
DE ÉVORA



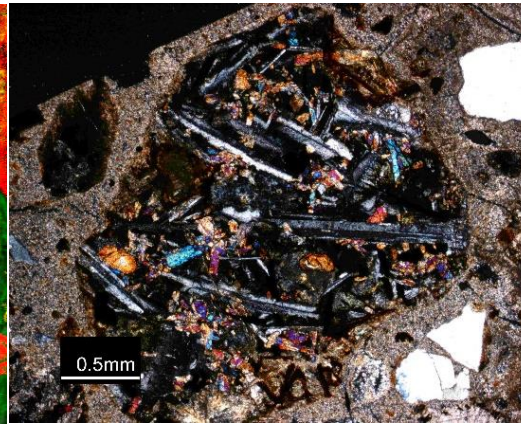
# 1. Why

## main goal

**research infrastructure** dedicated to the material study and **valorization of cultural heritage**

## Keywords

*Materials, Conservation, Restoration, Interdisciplinary, Sustainability, Life and Physical sciences, History.*



## 2. How (research team)

**40**

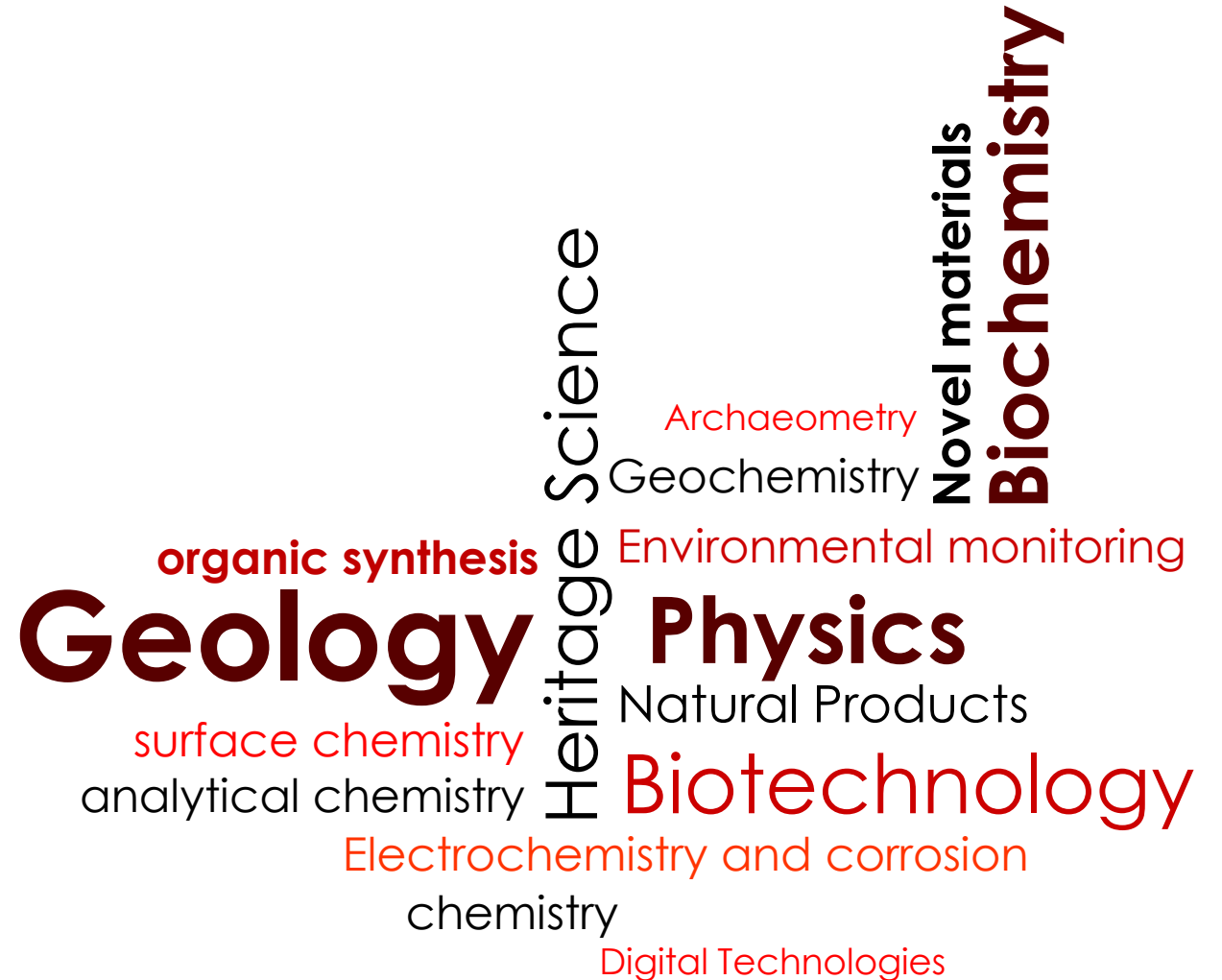
Researchers

**>35**

PhD Students

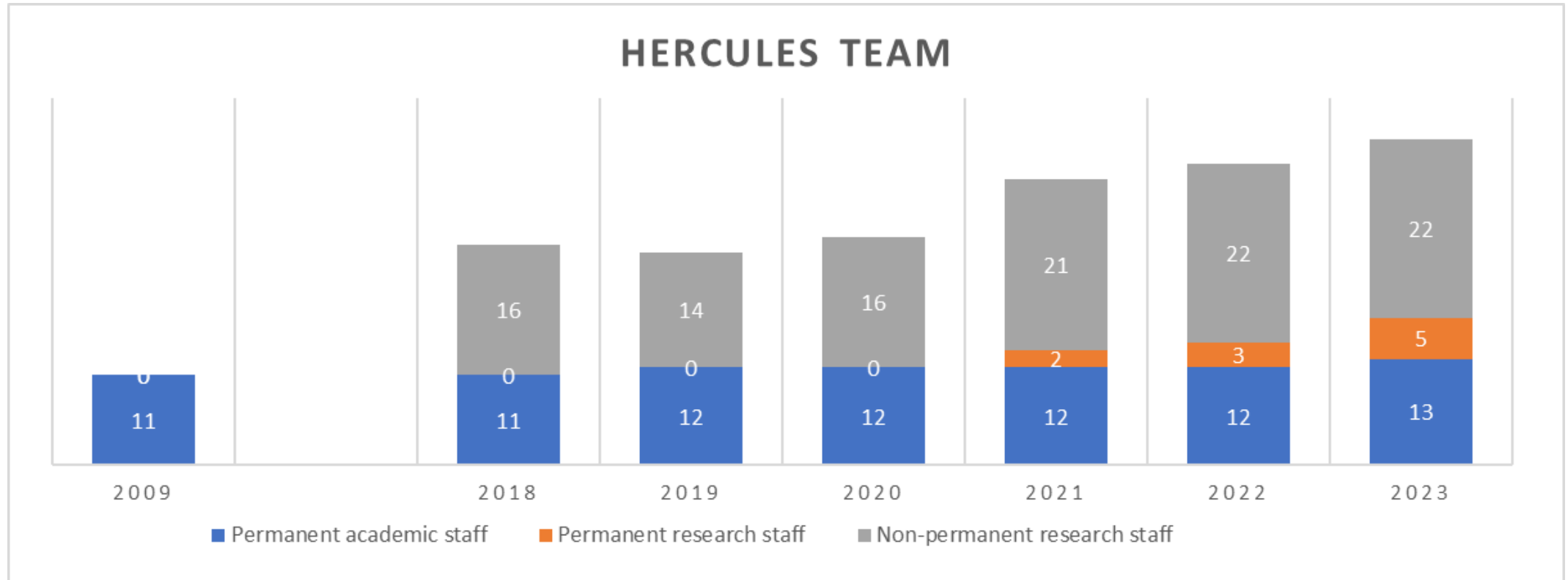
**2**

techs



## 2. How (research team)

### Researchers



## 2. How (research team)

### Research Lines

1. Archaeometric approaches to past cultures

coordinator - José Mirão

2. Science for the Arts

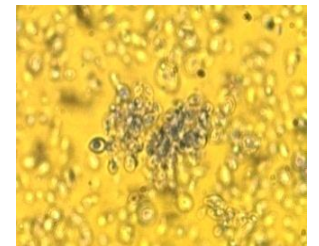
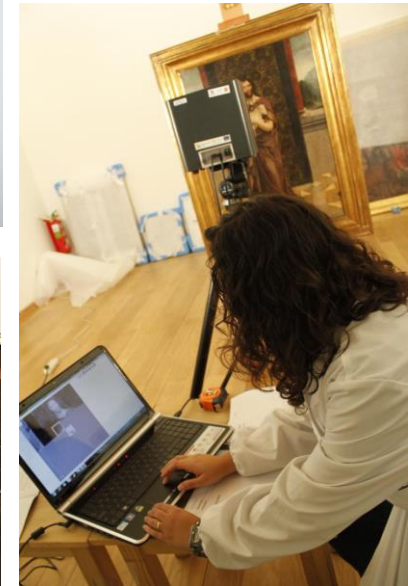
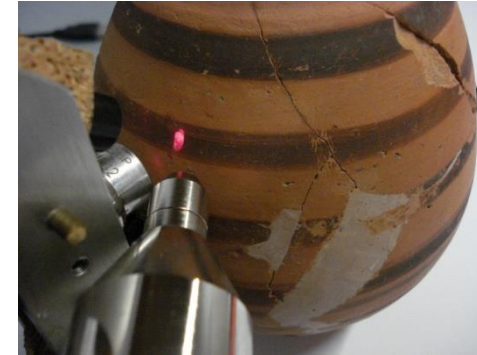
coordinator - Cristina Dias

3. Science for Heritage Conservation

coordinator - António Candeias

4. Novel materials and tools for Cultural Heritage

coordinator - Ana Teresa Caldeira



## 2. How (Geolists)



1. Anne-France Maurer
2. Fabio Sitzia
3. José Mirão
4. Mafalda Costa
5. Nicola Schiavon
6. Patrícia Moita

## 2. How (Geologists)

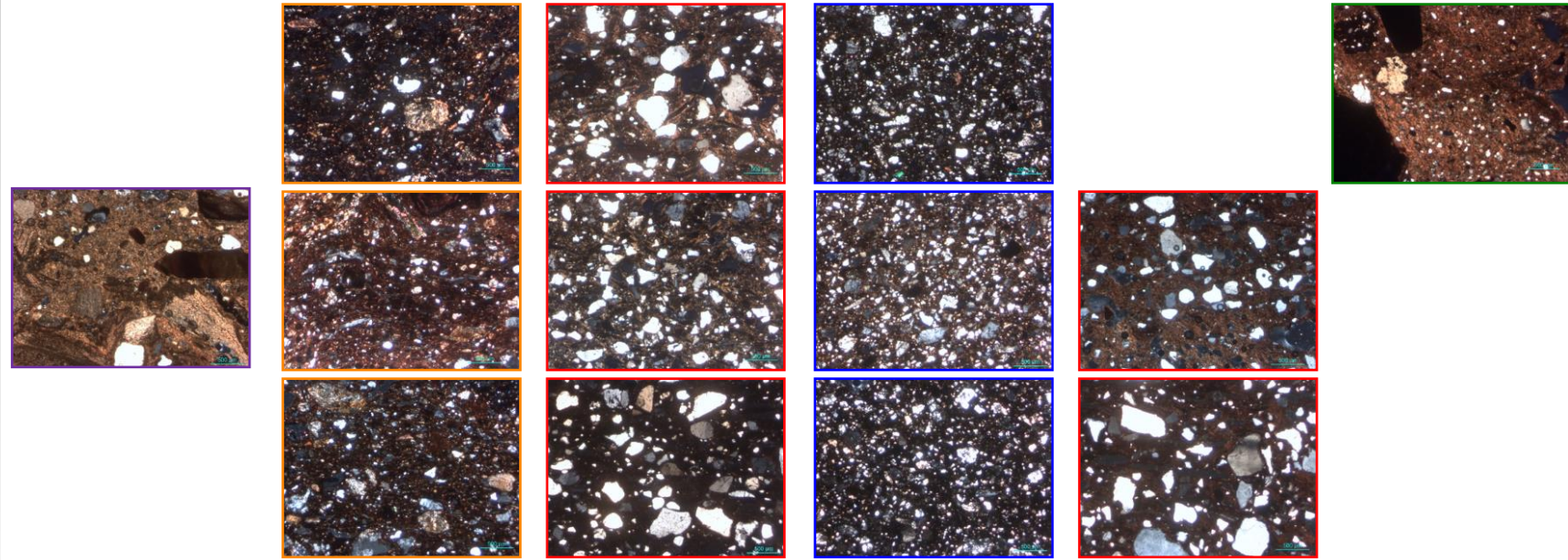
### *Petrographic analysis*

- ✓ Identification of
- ✓ six petrographic groups

Mbanza  
Kongo

Kindoki

Ngongo  
Mbata



Kindoki Group



Kongo Group  
Type A



Kongo Group  
Type C



Kongo Group  
Type D

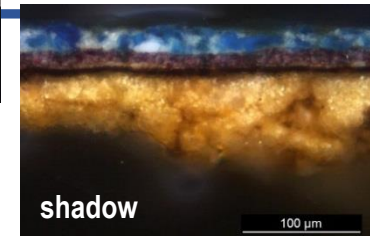


Kongo Group  
Type B

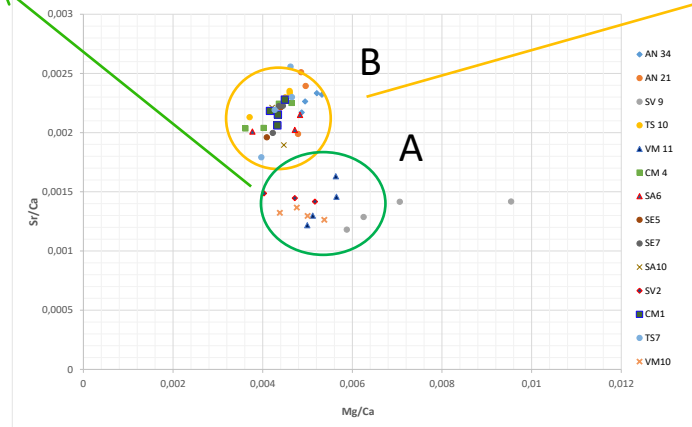


Kongo Group  
Type E

## 2. How (Geologists)



Frei Carlos? Por Sara Valadas...



Frei Carlos



datado de  
1523



**Limestones**

Sr/Ca

Mg/Ca





## 2. How (Geologists)

### Alcobaça Monastery

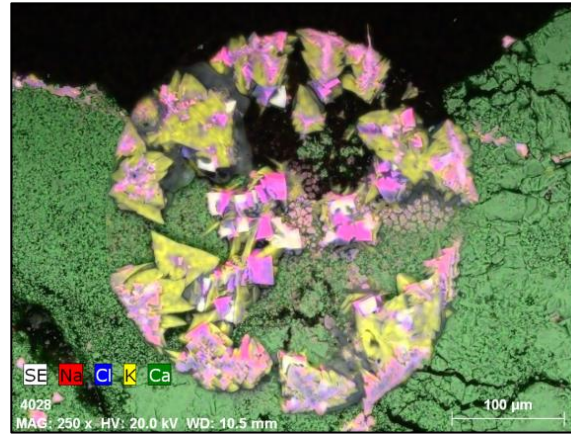
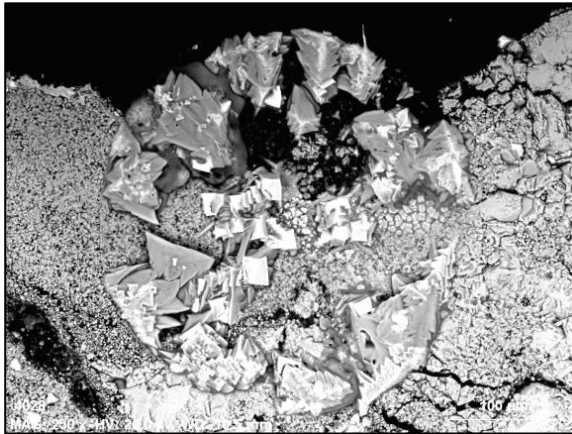
The Alcobaça Monastery, listed as **World Heritage by UNESCO** since 1989, is one of the finest examples of Gothic **Cistercian** religious architecture, with some contributions of Baroque style present in the main facade.



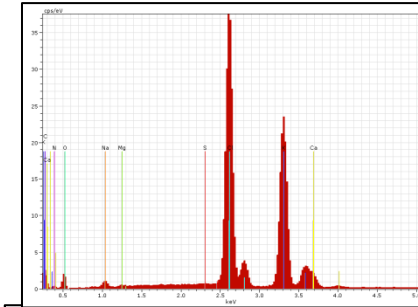
## 2. How (Geologists)

Alcobaça Monastery: SEM-EDS  
stone deterioration

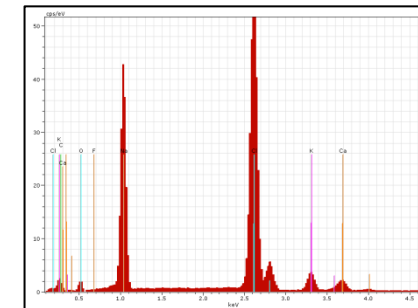
Outside from the building sylvite (KCl) was  
detected



SM14



KCl - sylvite



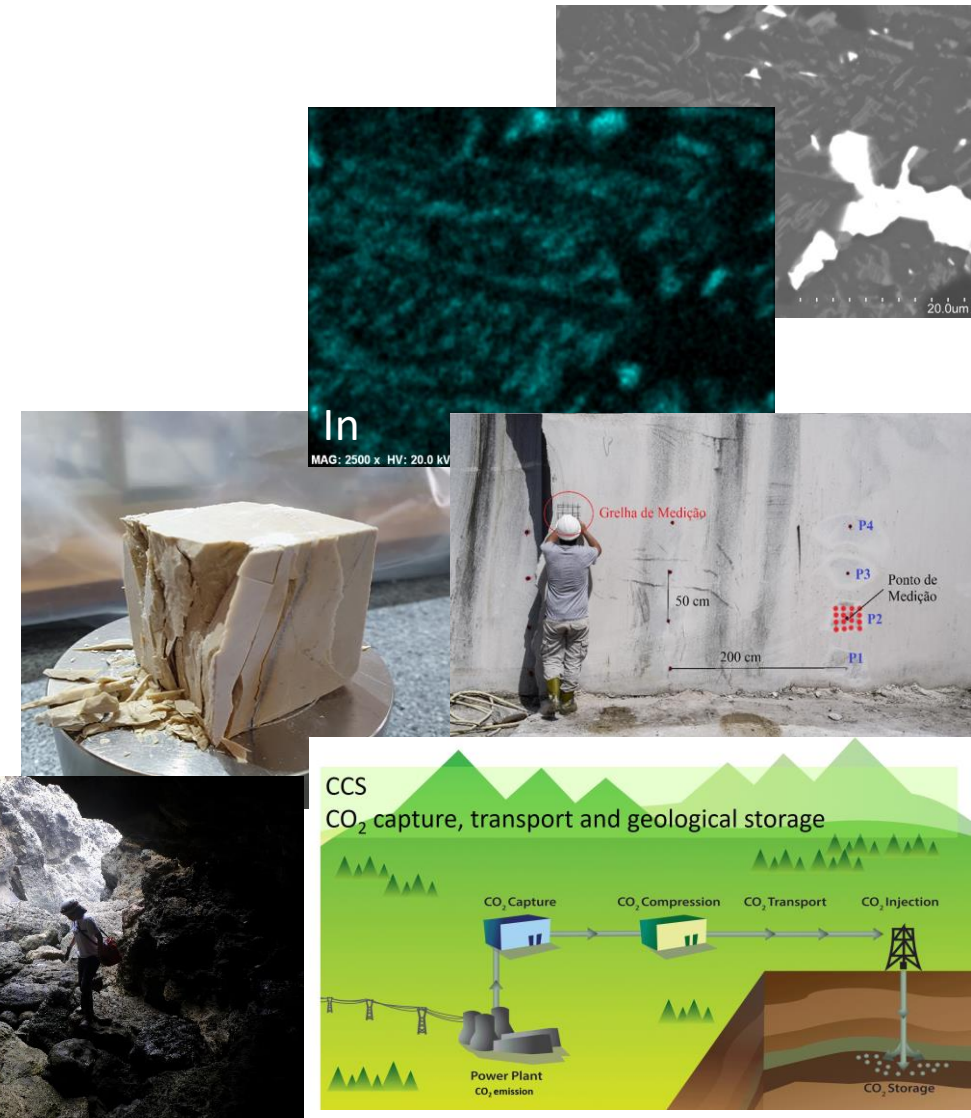
NaCl - halite

## 2. How (research team)

### Other Research activities

The Hercules Laboratory team carries out **other research activities**. These are important because they allow for **additional funding** and essential because they enable us to maintain **links** with other teams in the fields of physical and life sciences. E.g.,

- Agro-industry
- Carbon capture and storage (CCS)
- Geomicrobiology
- Natural Stone Industry
- Ore deposits



## 3. How (resources)

### Microscopy and Microanalysis Lab

- VP-SEM-EDS HITACHI 3700N with EDX BRUKER Xflash 5010SDD
- TESCAN CLARA FEG-SEM-EDS
- VP-SEM-EDS PHENOM ProX with EDX BRUKER
- Raman microspectrometer HORIBA Xplora
- Imaging micro-FTIR BRUKER Hyperion
- Optical microscope LEICA DM2500M
- Optical microscope LEICA DM2500P
- Inverted optical microscope MOTIC
- 2x epifluorescence microscope MOTIC BA-410
- Stereozoom microscope LEICA M205C
- HIROX 3D digital microscope

### Chromatography Lab

- LC-DAD-MS THERMO LCQ Fleet
- GC-MS SHIMADZU GCMS-QP2010 Plus
- Py-GC-MS SHIMADZU GCMS-QP2010Plus

### Mass spectrometry Lab

- LA-ICP-MS Agilent 8800 TriQuad
- IR-MS Thermo Delta V Advantage
- GC-IR-MS Thermo

### Materials characterization Lab

- TG-DTA NETZSCH STA 449F3 Jupiter
- X-ray Microdiffractometer BRUKER Discover
- EDXRF BRUKER S2PUMA

### Biotechnology and Biodegradation

- New generation DNA sequencer Illumina MySeq
- DNA PCR Biorad
- Eletroforesis system Biorad
- Image acquisition DNA Biorad
- Cell analyzer Millipore Muse

### Accelerated ageing chambers

- COFOMEGRA Solarbox
- QUV - Q-Lab
- ARALAB 'REACH-IN' (Ice, CO<sub>2</sub>, Humidity)

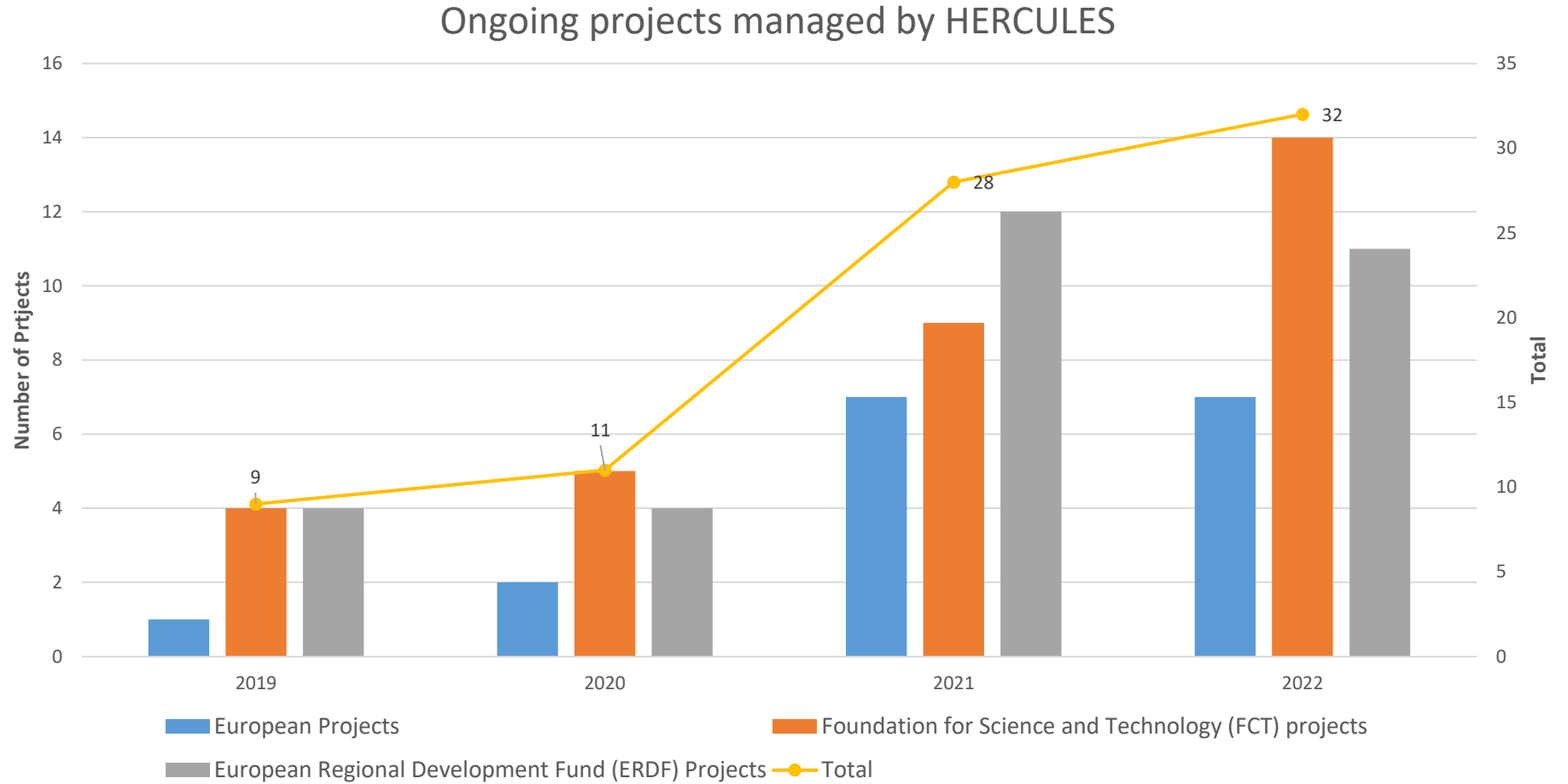
## 3. How (resources)

### *HERCULES mobile*

- High resolution infrared reflectography OSIRIS with InGaAs detector
- digital radiography (pulse X-ray source SCANNA XR200 -150kV- and XRS3 -300kV- with digital scanner SCANNA CR35)
- photographic equipment (visible, UV and IR)
- 2D XRF Bruker XGLAB ELIO
- CRONOS XRF Scanner
- handheld X-ray fluorescence spectrometer Bruker tracer IIID
- portable X-ray fluorescence spectrometry Amptek ( Mini-X source and X-123SDD detector)
- handheld colorimeter/visble spectrometer Datacolor Mercury 3000
- several handheld digital microscopes
- FTIR spectrometer Bruker ALPHA (with reflection, transmission, and ATR module)
- laser scanner 3D (FARO) for architectonic structures (c/ ICT)
- Building materials characterization
- FORS

### 3. How (resources)

*Projects*

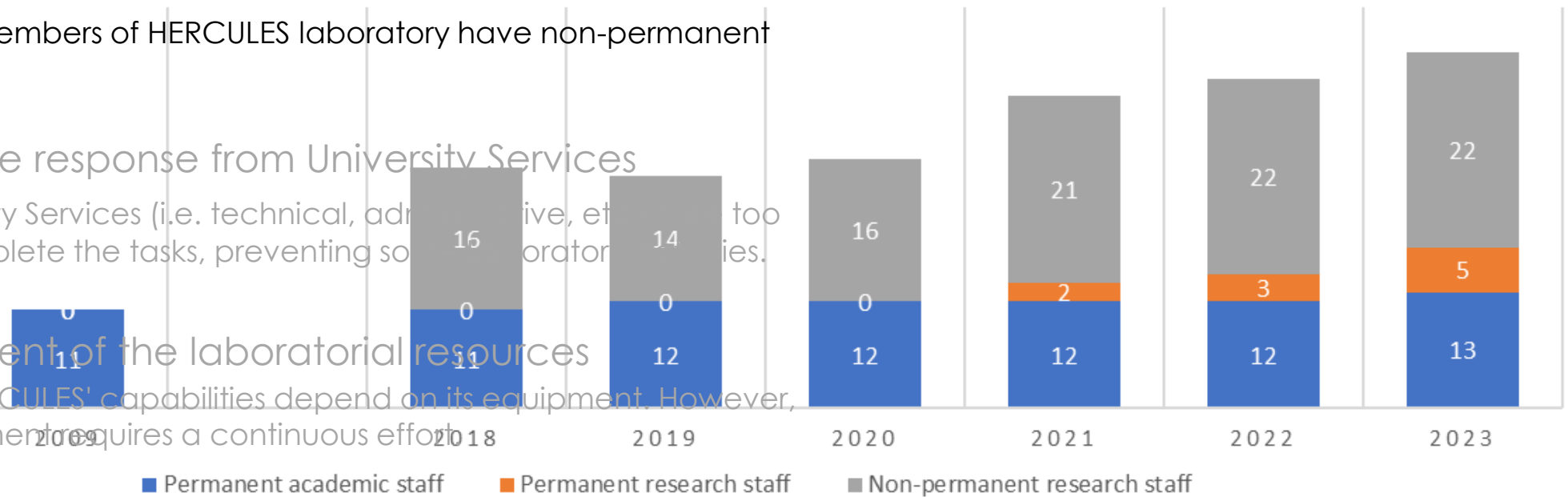


## 6. Challenges

- **Instability in the Human resources**  
 Too many members of HERCULES laboratory have non-permanent positions

- **Inadequate response from University Services**  
 The University Services (i.e. technical, administrative, etc.) are too long to complete the tasks, preventing some laboratories from operating.

- **Management of the laboratorial resources**  
 Some of HERCULES' capabilities depend on its equipment. However, its management requires a continuous effort.



- **Knowledge valorization**  
 The knowledge generated by HERCULES Laboratory must be increasingly valued. This entails greater collaboration with companies and investment in research&development activities.

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**Obrigado**



UNIVERSIDADE  
DE ÉVORA



LABORATÓRIO  
**HERCULES**  
HERANÇA CULTURAL, ESTUDOS E SALVAGUARDA