# EXPLORING LUMINESCENCE BEHAVIOUR OF CALCITIC ARCHAEOLOGICAL FILL MATERIALS IN THE CONTEXT OF CHEMICAL AND MINERALOGICAL COMPOSITION

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# **Objective**

Investigate luminescence and dosimetric behaviour of quartz grains in calcitic archaeological ditch-fills,

and its relationship with chemical and mineralogical composition

# Context

TÉCNICO LISBOA

Three negative archaeological structures, initially excavated in distinct poorlyconsolidated carbonate geological contexts of the Ossa Morena Zone

Ditches with stratified accumulation of materials (weathered materials from the surrounding geological contexts) and

□ Monte Carrascal (CII) - 4 samples

collected through the fill materials

artefacts (after human abandonment)

# Calcite rich contexts

May contribute with mineral grains to **residual luminescence signals** 

and/or change dose rates by precipitation/dissolution, alteration of water



#### **Methods**

- **Chemical composition:** trace, minor and major elements content obtained by INAA (irradiation made on Portuguese research reactor) and XRF
- Mineralogical characterization: obtained by XRD on non-oriented aggregates of sample powder
- Absorbed Dose: SAR-OSL analysis of 160-250µm quartz grains - absorbed dose determination
- **Dose rate:** K, Rb, Th and U contents determinated by field gamma spectrometry and INAA, cosmic radiation and water content

retention properties and ability of alkali cation exchange

#### **Geological Substrates**

- □ Monte Carrascal (CII) Miocene caliche (precipitates) deposits (small area)
  - surrounded by Gabbros of Beja formation
- **Horta dos Quarteirões (HQ)** Miocene calcitic alluvia of Moura Basin
  - (calcretes and calcoshist) surrounded by chlorite-sericite schists with
  - hydrothermal quartz and metavolcanic acid rocks.
- **Cortes (COR) -** Miocene calcitic alluvia of Moura Basin (calcretes) surrounded by chlorite-sericite schists
- with hydrothermal quartz and small granitic outcrops



# **Results and Discussion**

# Quartz Sensitivity and Geochemistry

A positive relation between and **Zr** content of whole sample was observed, though Zircon was not identified by XRD analyses (often associated with transport and weathering processes),

□ Horta dos Quarteirões (HQ) - 2 samples collected from less calcitic layers below schist rock





Expected

Age

Chalcolithic

Late

Neolithic

Neolithic -

Chalcolithic

12

10

**Cortes** (COR) - 2 samples from two distinct archaeological structures (probably related with each other)



### Quartz enriched fraction luminescence signals:

- Low IRSL signals (evidence of "clean" quartz fraction)
- OSL signals are dominate by fast component
- High TSL peaks around 90 °C and 300 °C

Quartz Sensitivity and **Dispersion of the estimated Absorbed Dose** 



Greater dispersion for CII than HQ and COR: indicates residual gabbro bedrock - sensitivity related to source rock?

and also with **Ba** (Ba<sup>2+</sup> may be replacing  $Ca^{2+}$  in calcite).

Lack of a relationship with **Br** and **Sb** indicated little anthropogenic

influence on quartz OSL sensitivity.



**Quartz Sensitivity and Physical Weathering** 

• Quartz grains most rounded at CII:

indicates greater transport and hence environmental exposure - sensitivity related to weathering?

> 'ity 35 , Sensiti (<sup>w</sup>) ×10<sup>3</sup> 52





# **Final Remarks**

CII - ages higher than expected but in stratigraphic order - dispersion of absorbed dose but very high sensitivity (good candidate for single grain analyses) - quartz from caliche or locally weathered gabbro

U HQ - lowest calcite content but similar bedrock to COR - ages similar to expected - quartz from calcrete or directly from schists / metavolcanic rocks

- COR highest calcite content but similar bedrock to HQ and similar dose rate slightly higher than expected ages quartz from calcrete
- The estimated ages for samples with the lowest calcite content were closest to archaeological expectations
- In these calcitic contexts, the Quartz OSL sensitivity is in all cases high responses appear activated in nature suggesting geochemical effects of a high calcium environment
- U However, variations in sensitivity between samples and sites do not seem to show relationships with calcite content, but instead with the geological units from which the quartz is thought to originate or severity of physical weathering.

To resolve these questions: luminescence behaviour evaluation of parent rocks, and other archaeological sites of the region with different geomorphologic characteristics

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