



**TÉCNICO**  
LISBOA

# **Modelling and characterization of salivary calculi**

**Pedro Nolasco**

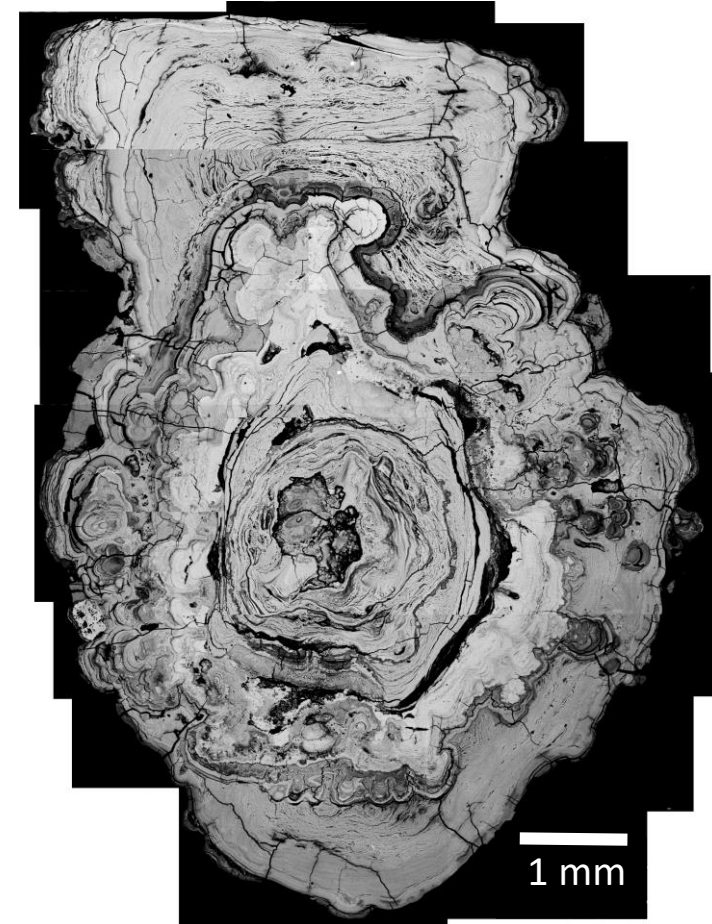
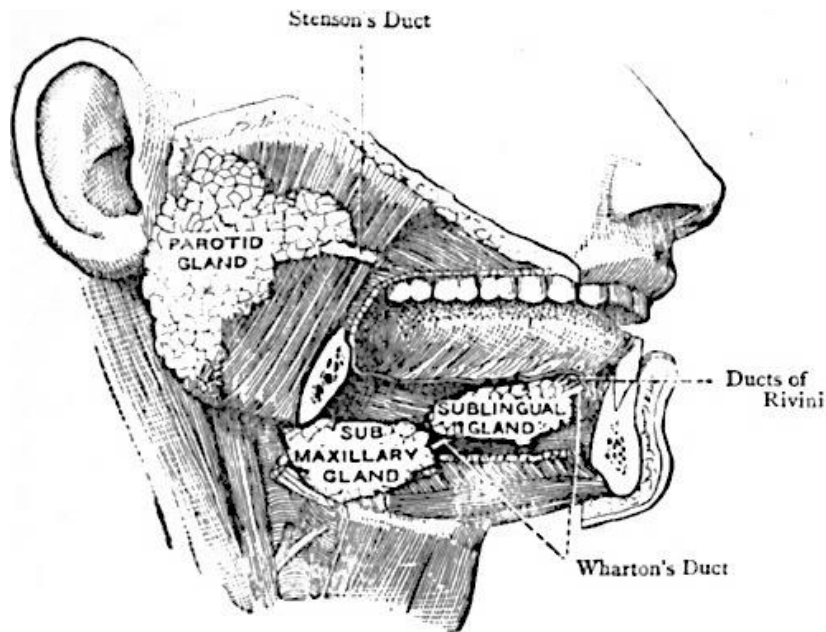
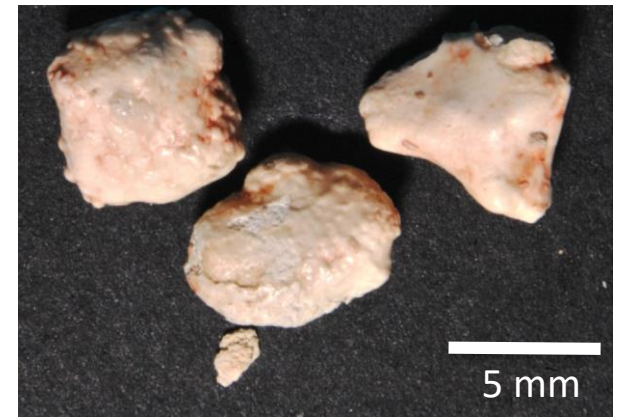
**Supervisor: Professor Patrícia Carvalho**

**Co-supervisor: Professor Raul Martins**

December 2018

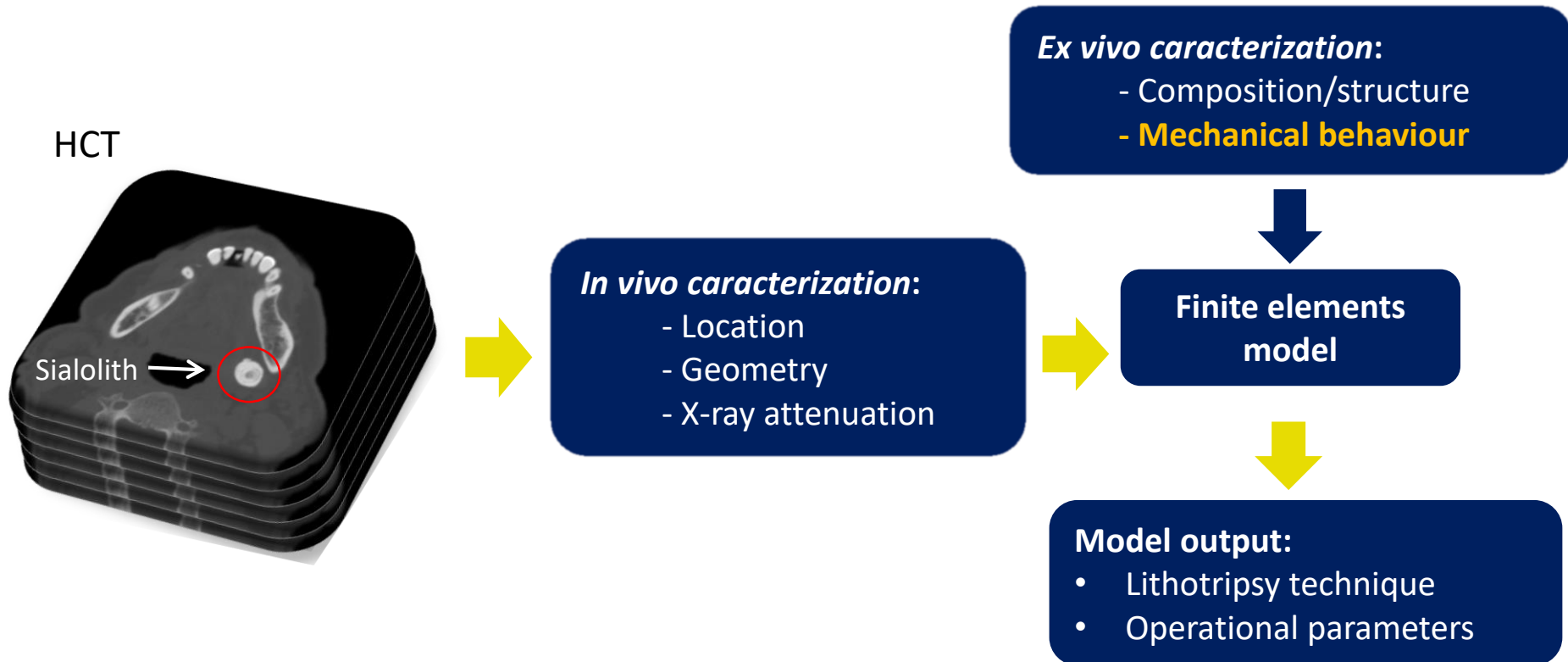
# Motivation Sialoliths?

- Medical condition: Sialolithiasis
- **Lithotripsy with low success rate**



# Motivation

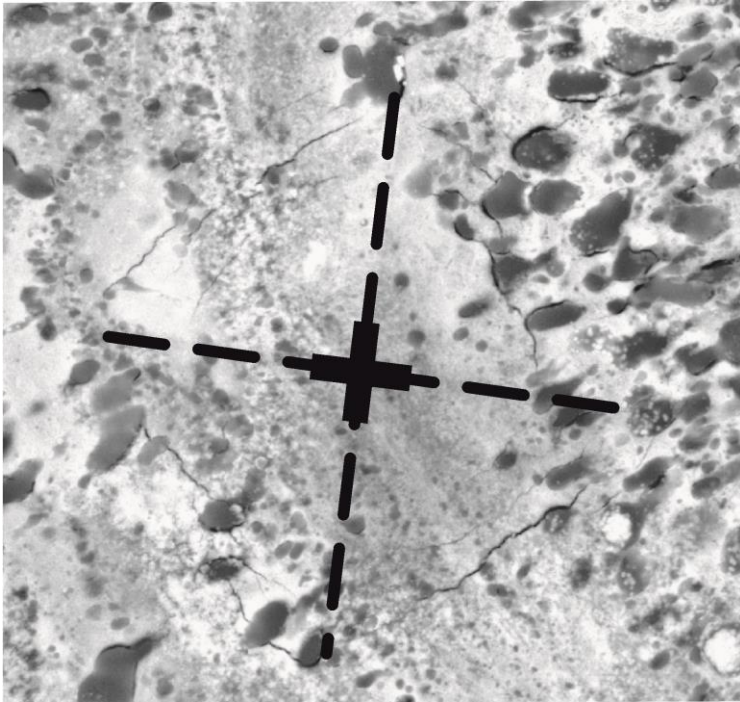
Personalized medicine: Sialoliths mechanical modelling





# Mechanical behaviour

## Microindentation

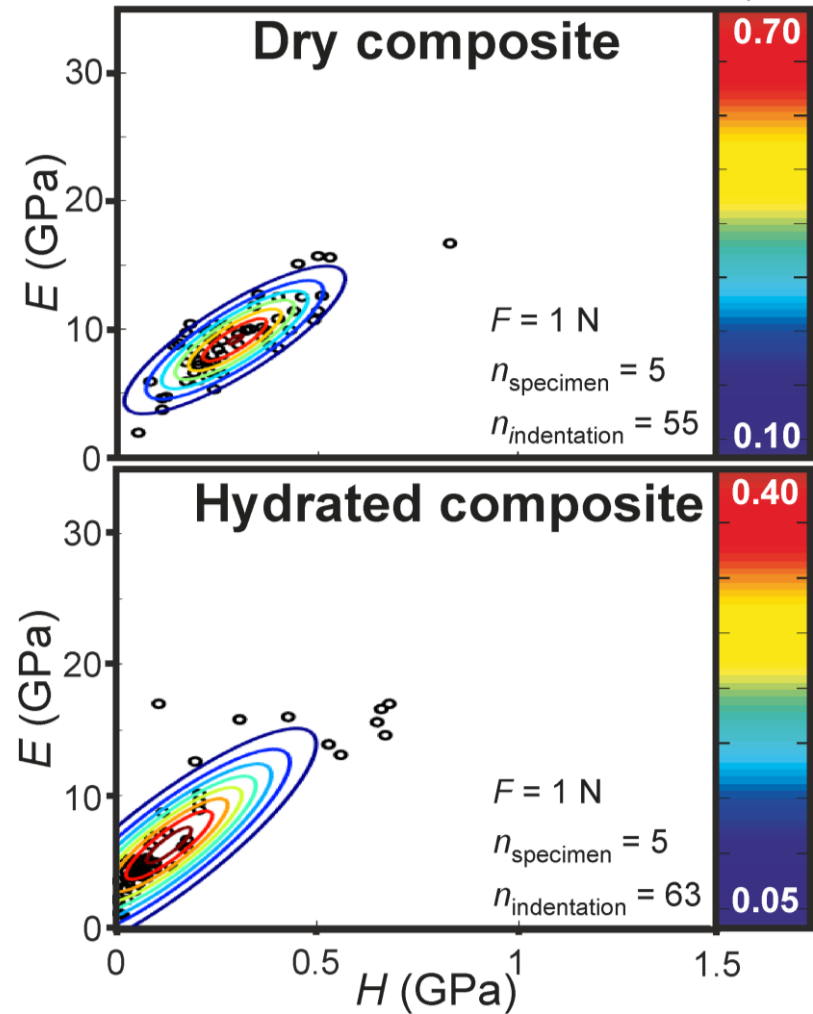


SEM-BSE

25  $\mu\text{m}$

- **Composite material**

Single mode distribution at microscale

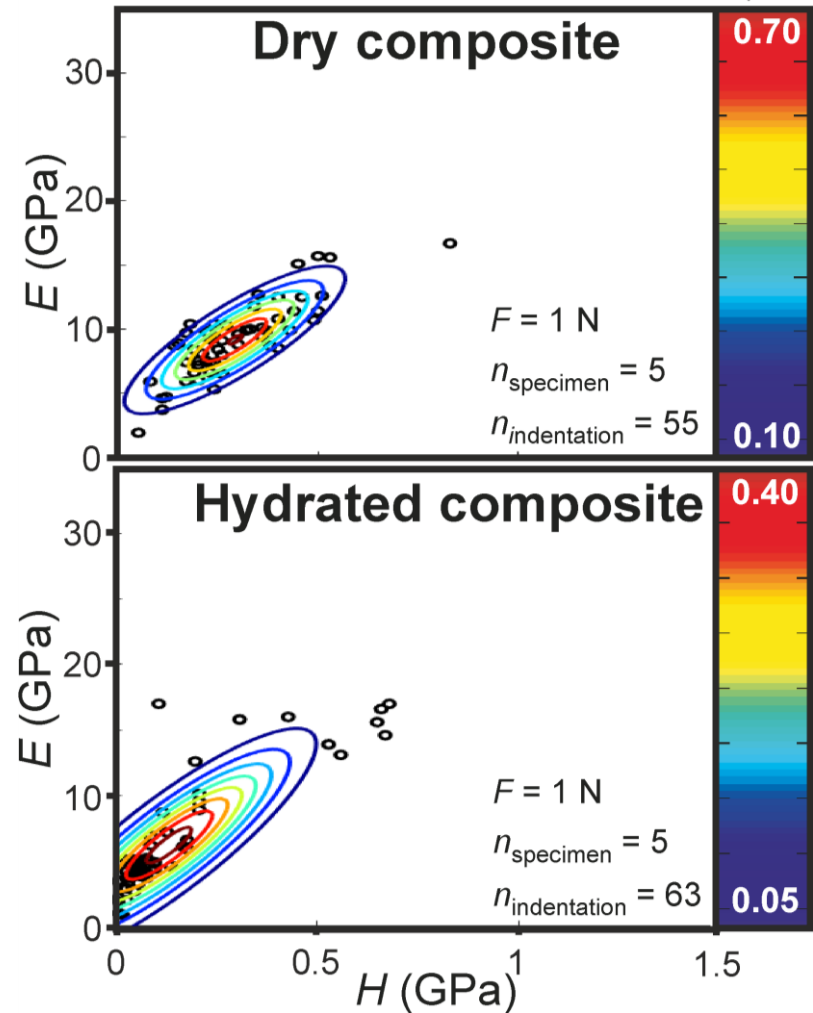


# Mechanical behaviour

## Microindentation

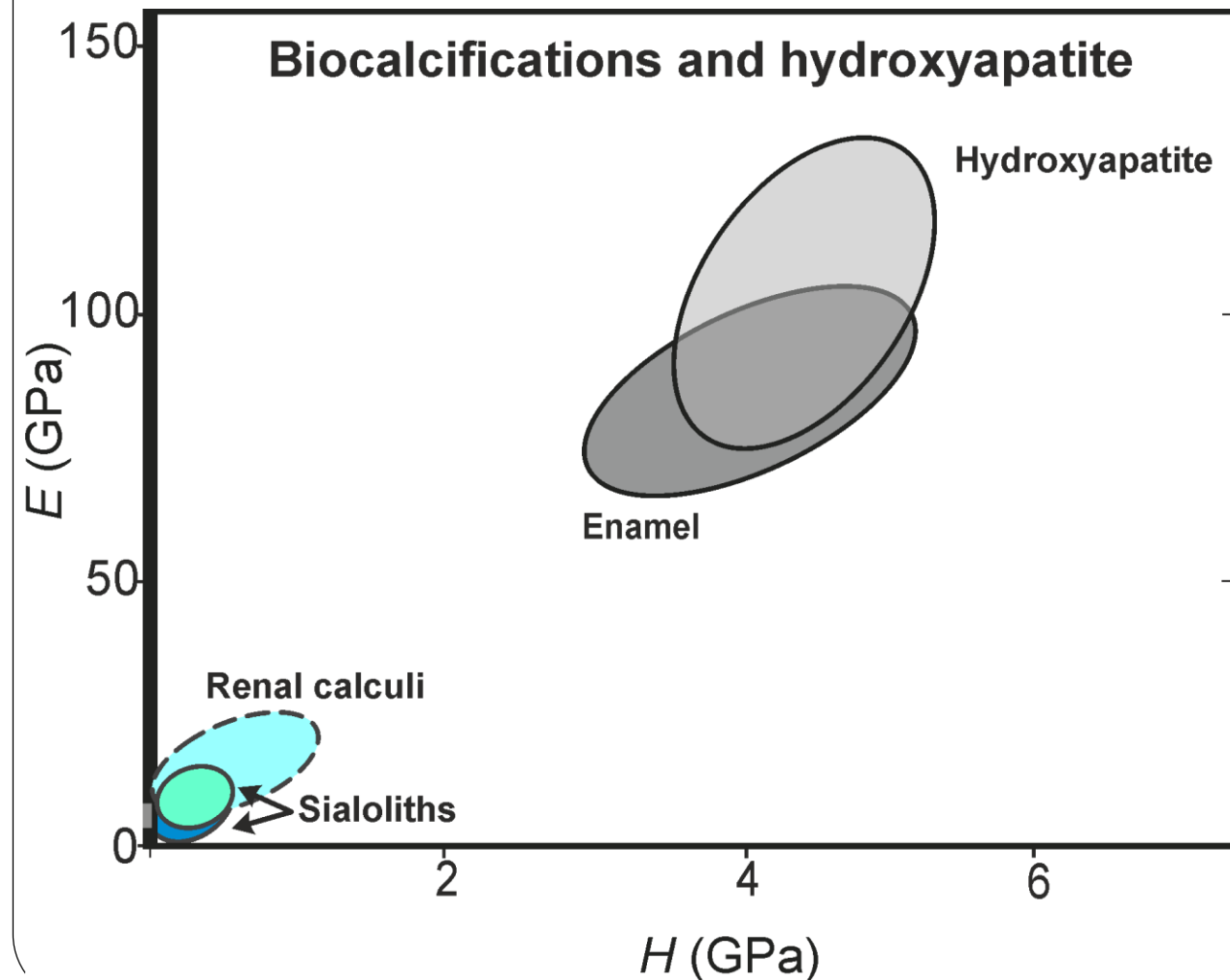
- **Hidratation state**

Drying strengthens the organic matter, without affecting the mechanical



# Mechanical behaviour

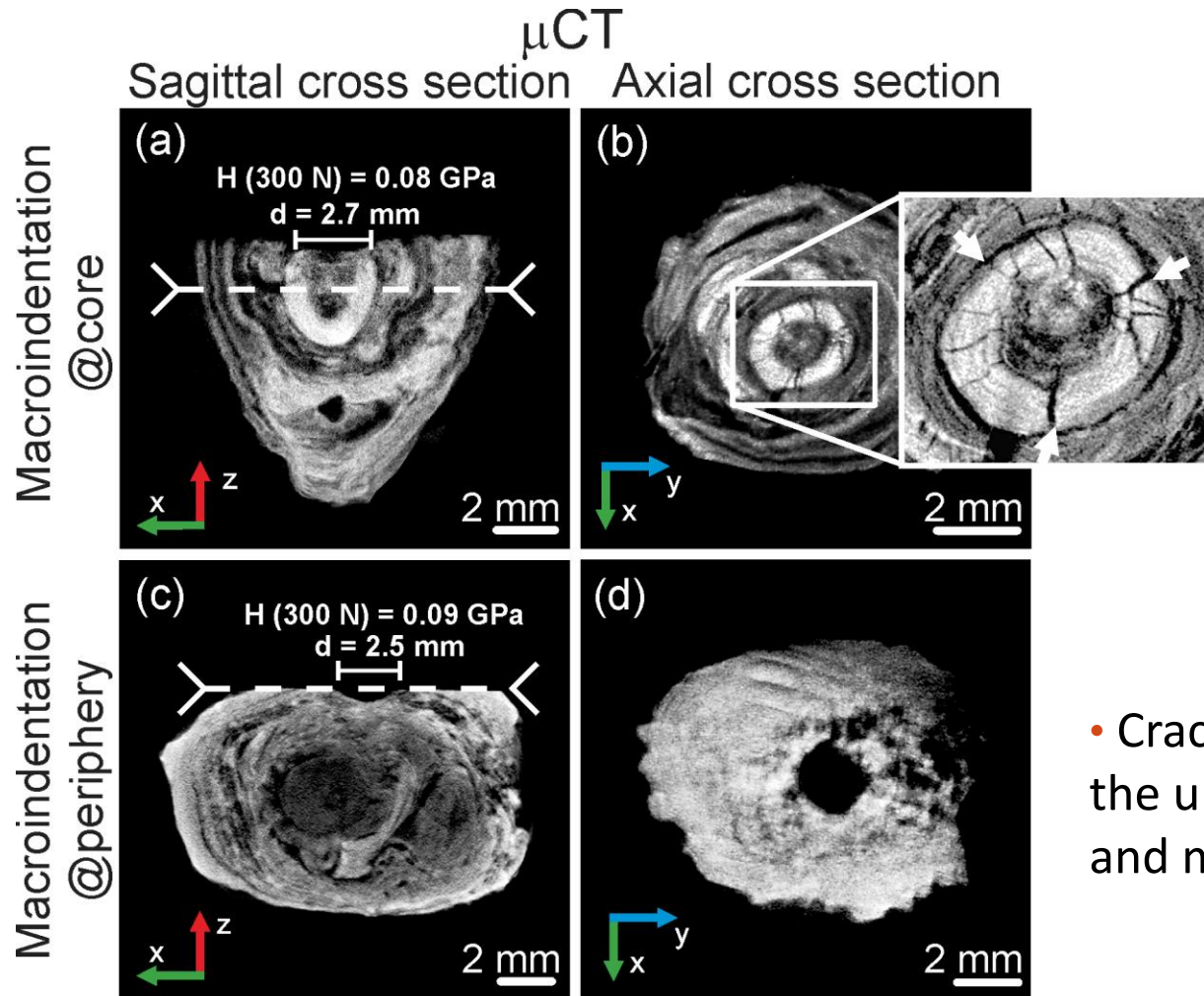
## Microindentation



- Dry sialoliths' H and E are within the mechanical properties of the most organic renal calculi
- The organic fraction enhances toughness of both renal calculi and sialoliths

# Mechanical behaviour

## Fracture: Fracture patterns (Macroindentations)

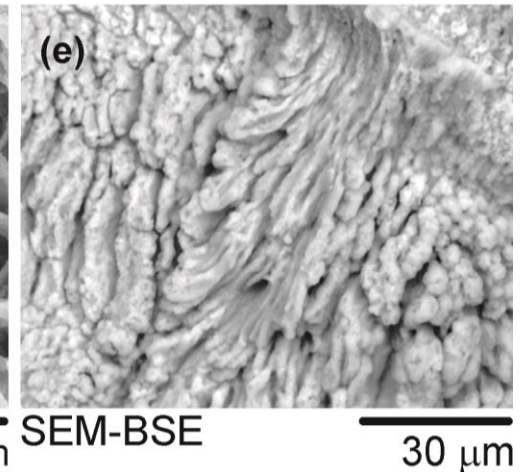
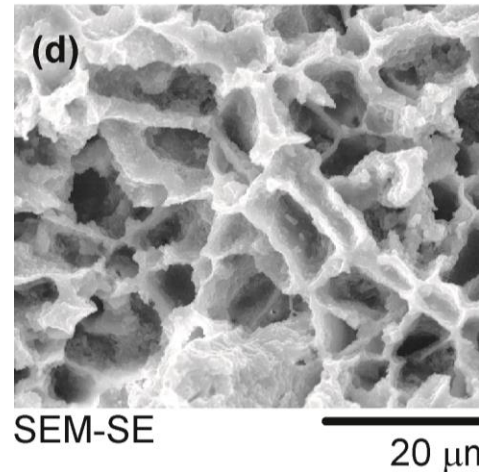
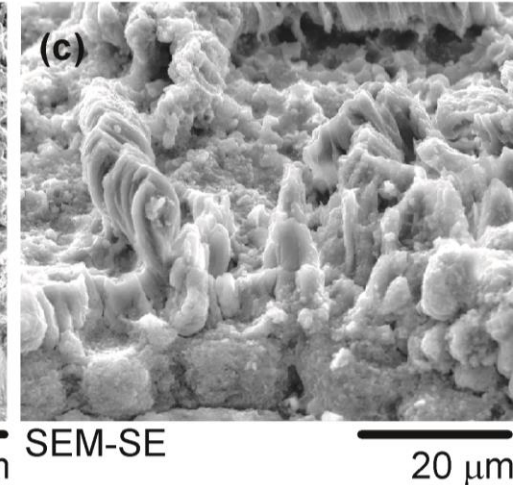
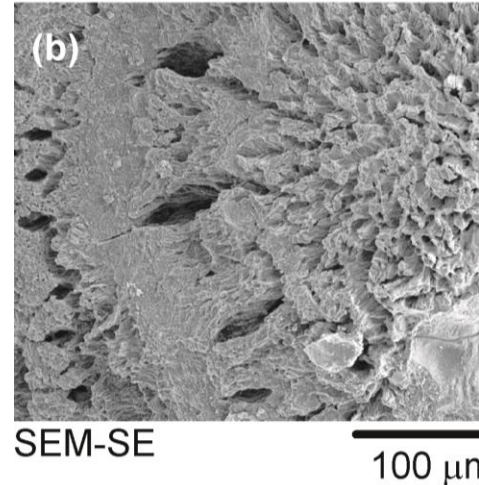
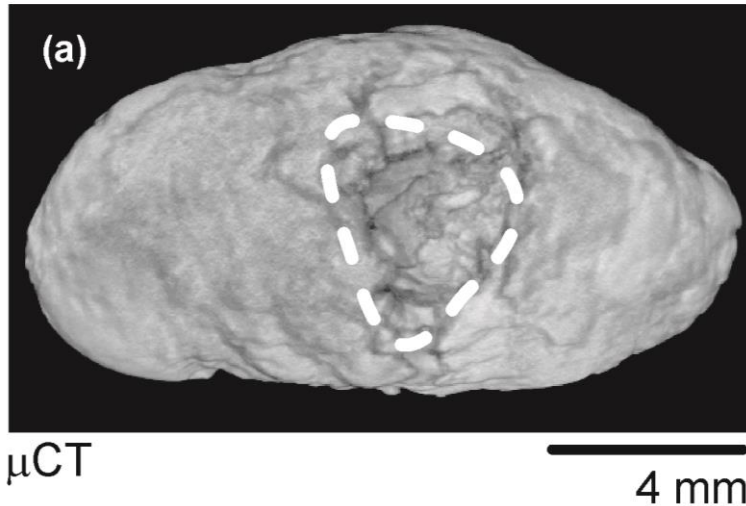




# Lithotripsy damage

## Mechanical lithotripsy

### Shock waves



- Extensive damage
- Leaching of the organic components, the mineral components were left relatively unaffected

# Final remarks

## Sialoliths mechanical characterization

- **Composite material at microscale: ductile / brittle phases**
- Hydration state of sialoliths must be considered during the mechanical characterization
- Fracture dependent on the underlying ultrastructure and mineralization degree
- **Shock waves damage: leaching of organic matrix** presumably by cavitation

Thank you for your attention