

# Comparison of laminite fracture features at different scales

S G Zihms<sup>\*1,2</sup> T Miranda<sup>3</sup> H Lewis<sup>1,2</sup> S Hall<sup>4</sup>

<sup>1</sup> Institute of Petroleum Engineering, Heriot-Watt University, Edinburgh, UK (s.zihms@hw.ac.uk) @geomechsteph

<sup>2</sup> International Centre for Carbonate Reservoirs, UK (www.iccr.org.uk)

<sup>3</sup> Departamento de Geologia, Centro de Tecnologia em Geociências, Unisversidade Federal de Pernambuco, Recife, Brazil

<sup>4</sup> Division of Solid Mechanics, Lund University, Lund, Sweden

## INTRODUCTION

Laminites (NE Brazil) are well laminated carbonates that provide insight into the geo-mechanical behaviour of layered systems, especially when comparing deformation characteristics observed in the laboratory with outcrop / field scale deformations.

This is useful in order to

- validate where laboratory experiments can reproduce field scale deformation types
- understand which feature characteristics can or cannot be scaled

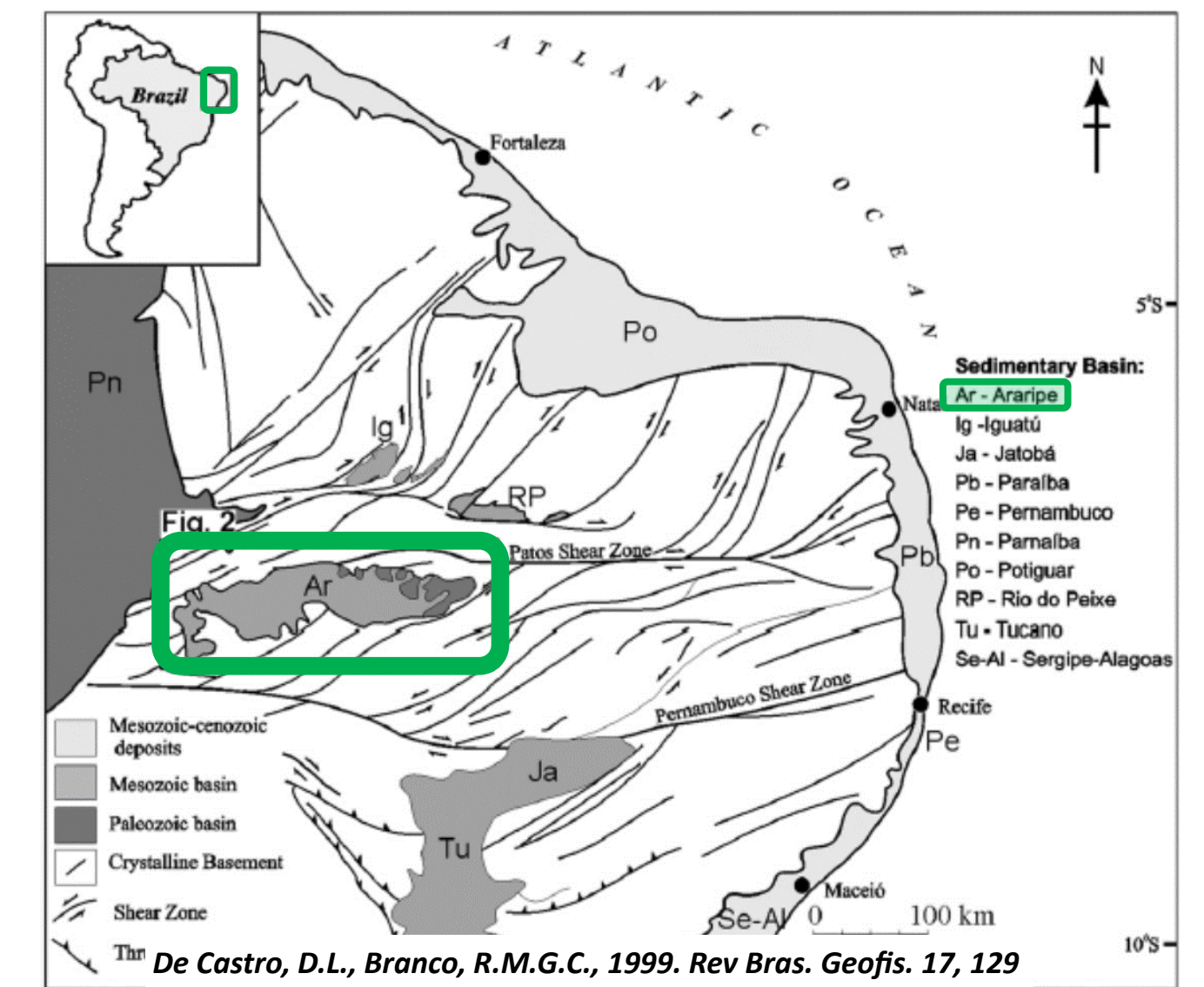


Fig 1: Map of NE Brazil showing the Araripe

## LABORATORY DEFORMATION EXPERIMENTS

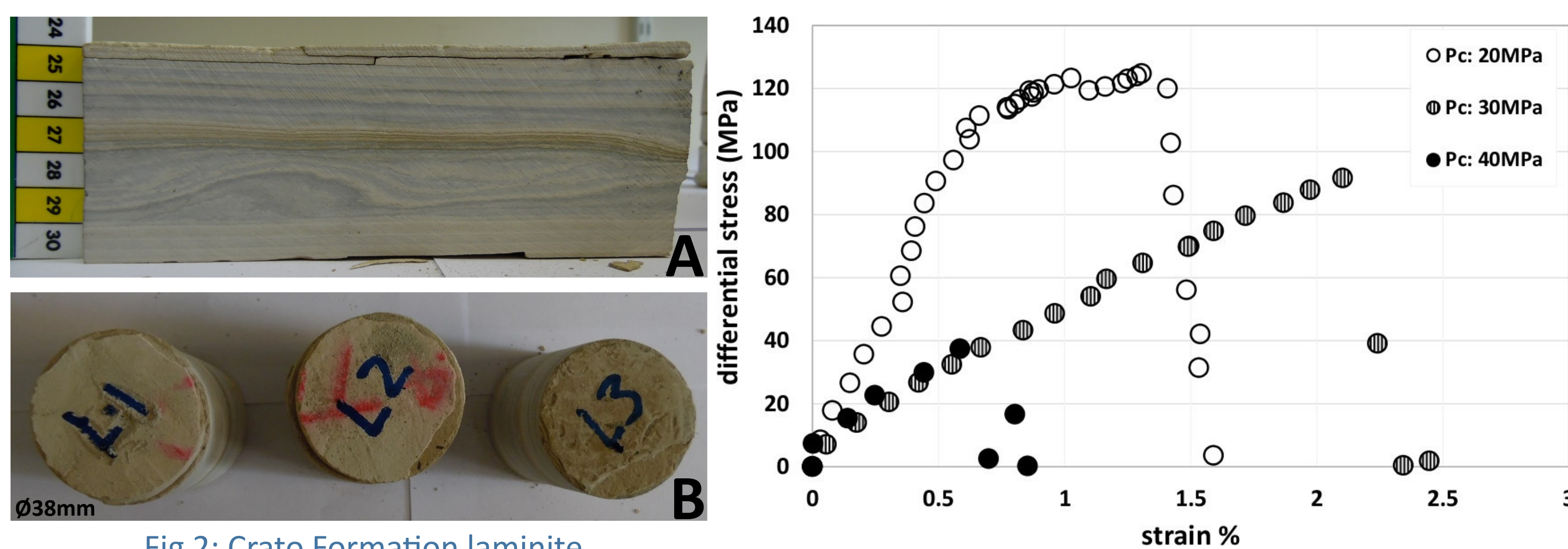


Fig 2: Crato Formation laminite (crystal size  $\sim 10\mu\text{m}$ , horizontal  $\sim \text{mm}$  laminae)  
A: Sample from Araripe Basin NE Brazil  
B: Sampled core plugs for triaxial deformation

Fig 3: Stress-strain curve for laminite triaxial deformation experiments

Triaxial deformation under dry conditions & three different confining pressures - simulating reservoir conditions

## POST-DEFORMATION OBSERVATIONS

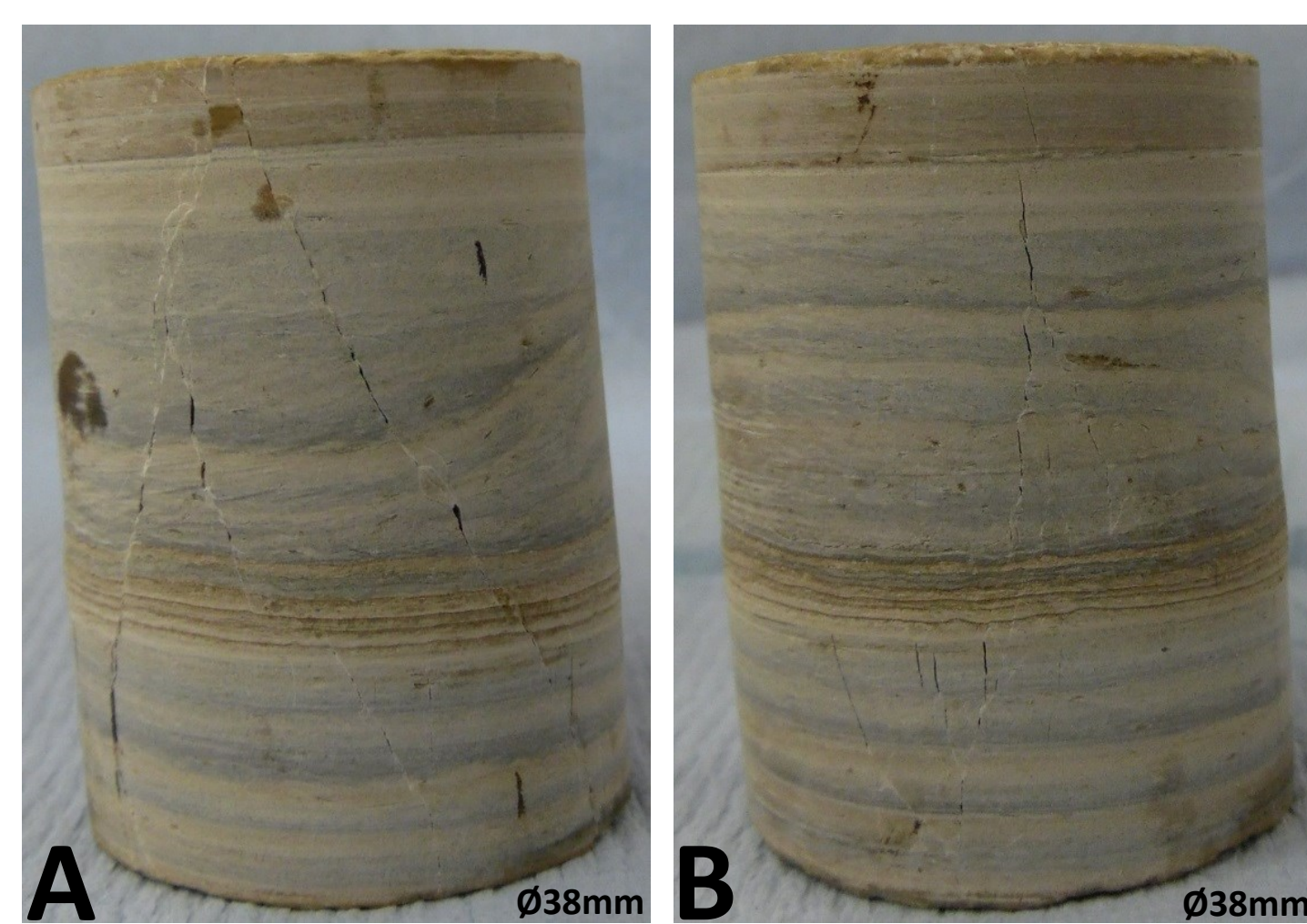


Fig 4: Post-deformation core plugs deformed at Pc: 20MPa (A) and Pc:30MPa (B)

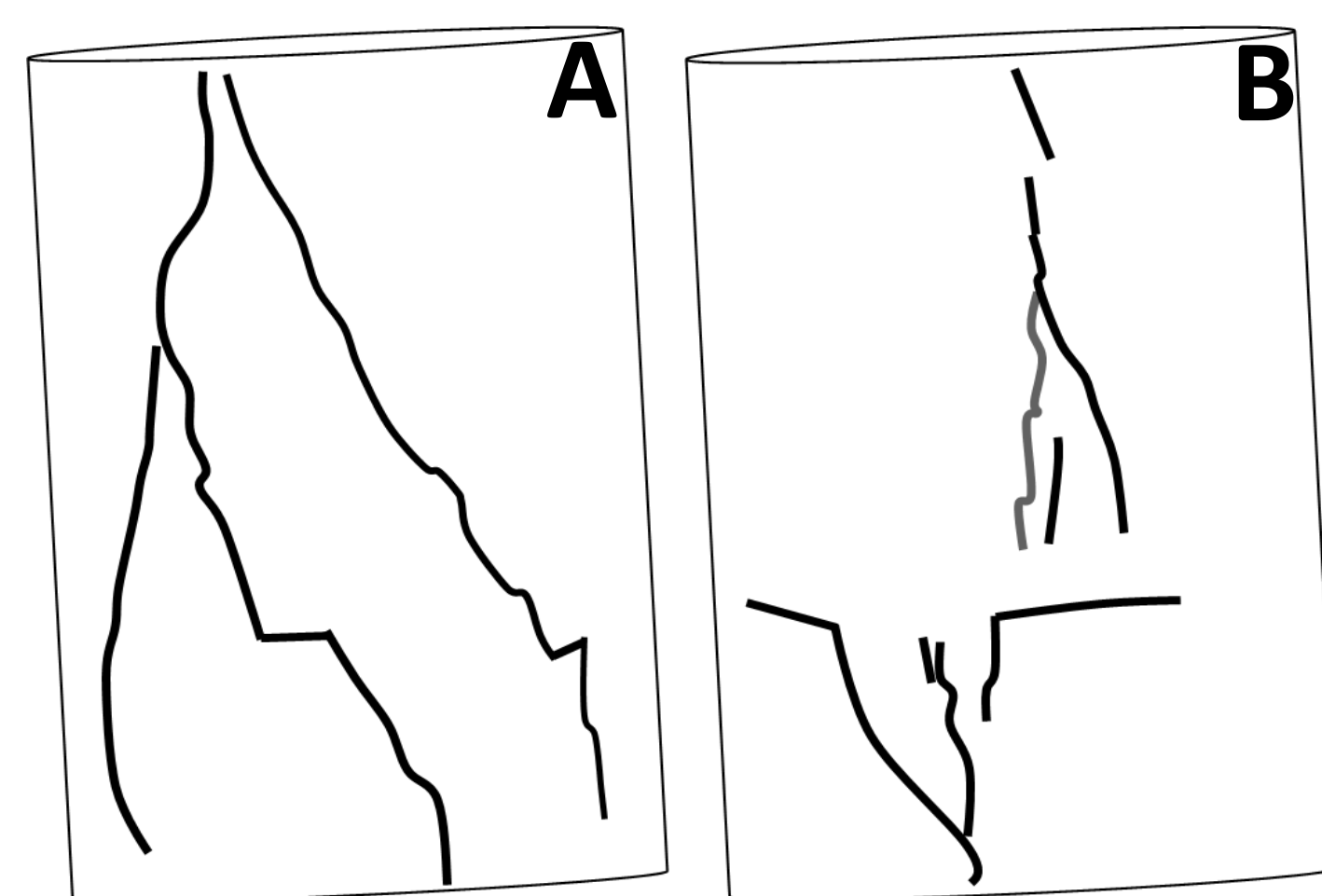


Fig 5: Schematic surface core plug deformation for core plugs A and B Fig 4. (Plugs  $\varnothing 38\text{mm}$ )

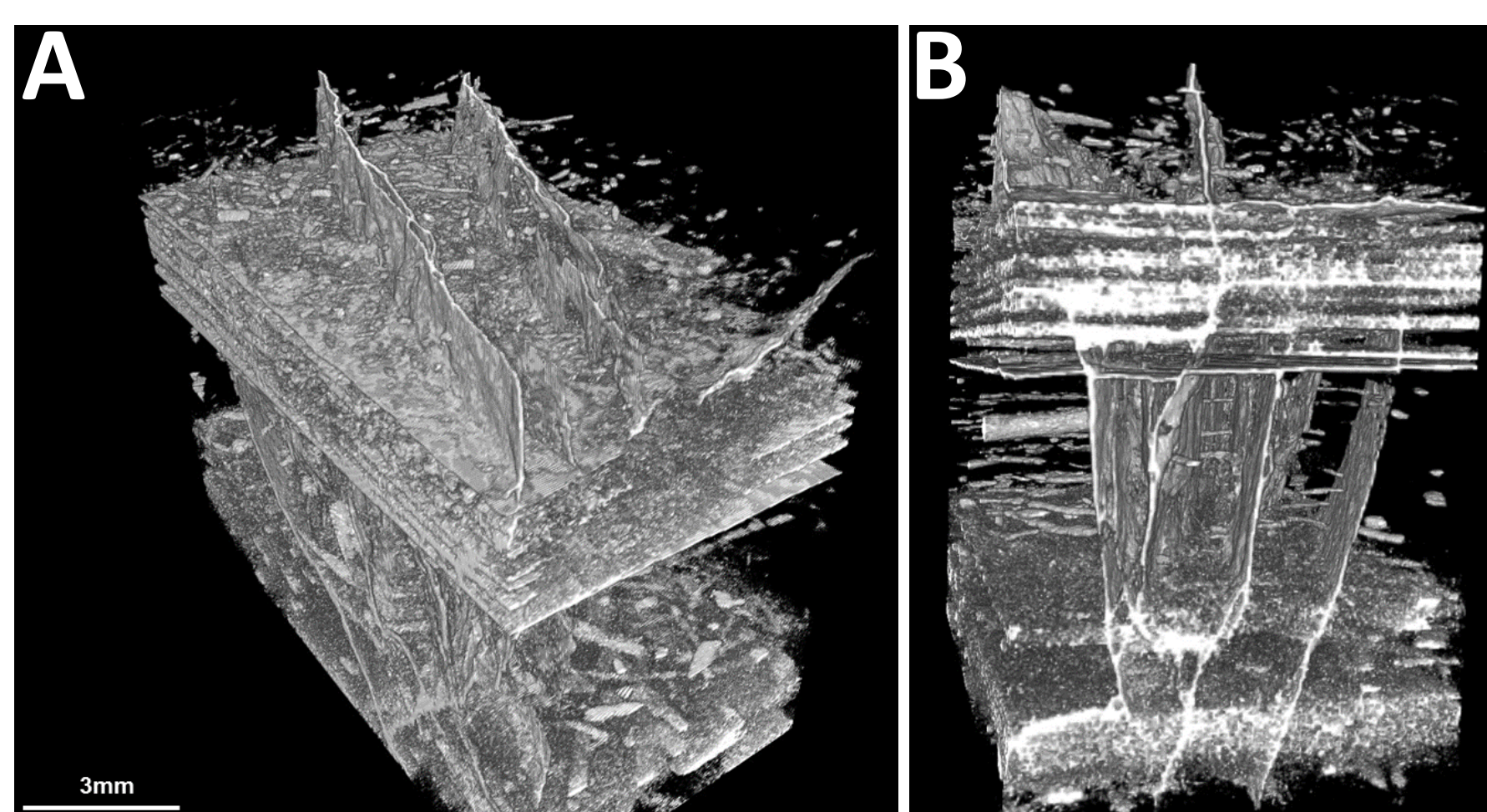


Fig 6 A & B: 3D reconstruction of post-deformation core plug (Pc:30MPa) using X-ray tomographs

**Observe a combination of**

- ⇒ **Now-open fractures**
- ⇒ **Shear fractures**
- ⇒ **Across lamination**
- ⇒ **Parallel to lamination**

## OUCROP OBSERVATIONS



Fig 7: Laminite quarry, Nova Olinda (NE Brazil)

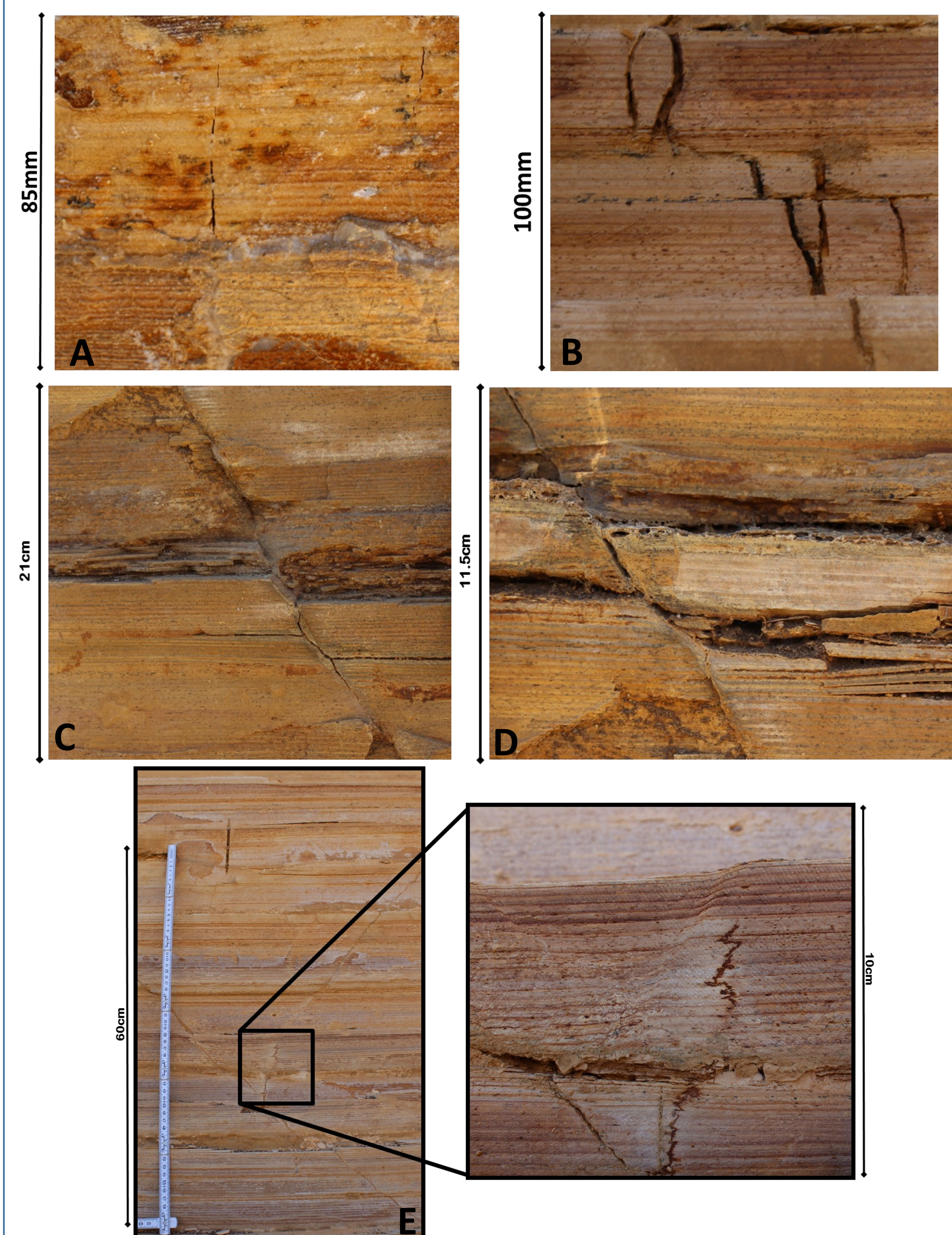


Fig 8 A-E: Deformation features observed at different laminite quarries in the Araripe Basin (NE Brazil)

## CONCLUSIONS

Comparison of laminite fracture characteristics shows similarities between lab-induced deformation features & deformations observed in outcrop. This suggests that the response to accommodate strain in these laminites is scale independent. If we consider laminites as analogues for layered systems this could mean that layered systems - independent of rock type - might have a similar scale independent response to accommodate strain.

Further investigation is required into the relationships between different fractures types and their evolution under changing strain conditions during deformation.