



Fracture networks in carbonate laminites

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Introduction

The second second

- Laminite pre-salt analogue
- Applications of Brazilian pre-salt carbonates
- Understand impact of deformed geometry and composition + interplay with the pore network
- Understand changes to permeability across scales

www.petrobras.com.br/en/our-activities/performance-areas/oil-and-gas-exploration-andproduction/pre-salt/



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Geomechanics testing & analysis

- Cylindrical rock samples Ø 38mm
 - Permanent deformation
 - Control conditions
- Pre- and post-deformation analysis
 - Image analysis
 - X-ray tomography + 3D visualisation (post deformation only)









Laminite





Thanks to Profs Leonardo Borghi (UFRJ) & Leonardo Guimaraes (UFPE)















Laminite – triaxial testing







Laminite – triaxial testing





Compaction bands are hard to identify



Laminite – image analysis



ImageJ analysis of fractures on the plug surface

20MPa



30MPa



Laminite – x-ray tomography 2D fracture analysis





Laminite – x-ray tomography 2D fracture analysis



Laminite – x-ray tomography 2D fracture analysis





Laminite – x-ray tomography Image processing work flow for 3D analysis



Steve Hall: 4D imaging lab at Lund University using Zeiss XRadia XRM 520







L-20MPa 401-500



5.5mm





L-30MPa 401-500





6.6mm

6.6mm

38mm







- Visualise fracture network in 2D using circular scanline on XRT images
- Visualise fracture network in 3D (XRT reconstruction)
 - Use 2D & 3D visualisations as a map for deformation fabrics & features – comparison with thin section & outcrop observations
- Measure fracture networks & deformation features
- Understand evolution & relationships
- Impact of lamination & link to mineralogy



What's next



Laboratory testing

- □ Further laboratory testing on laminite & other pre-salt analogues (Nov, Dec)
- Detailed SEM & SEM-EDX analysis on thin sections
- Detailed comparison of fracture patterns with outcrop observations (NE Brazil)

Image analysis & 3D visualisation

- Exploring software to improve 3D visualisation & fracture analysis capabilities e.g. permeability calculations
- □ Planning pre- and post-deformation scans of all future plugs
- Digital Image correlation





EGU 2017

23-28 April



EMRP/GI3.13 **Rock deformation imaging techniques - from micro scale to field applications (co-organized)**

Convener: Stephanie Zihms Co-Conveners: Luca De Siena, Elma Charalampidou, Edward Andò

Dates: 20 October: Abstract submission open 01 December: Deadline if applying for travel support (Early career researchers) 11 January: Abstract submission closes



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