



The 3 “T” Vision of PETRONAS GR&T Geomechanics Centre of Excellence

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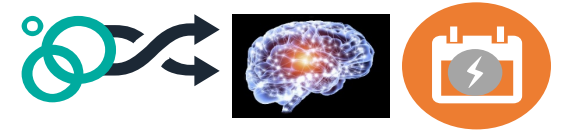
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Presentation Outline

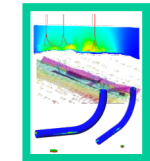
- Goal and Plan of PETRONAS Group Research & Technology (GR&T) Geomechanics Centre of Excellence (CoE)



- Six Pillars for PETRONAS GR&T Geomechanics CoE

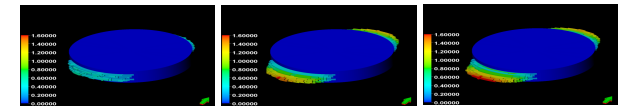


- Identification of PETRONAS Geomechanics Technology Gaps



- Technology Roadmap for PETRONAS GR&T Geomechanics

- Collaborative R&D Projects with Schlumberger Geomechanics CoE



Goal and Plan of PETRONAS GR&T Geomechanics Centre of Excellence

- PETRONAS GR&T embarking on establishment of Geomechanics Centre of Excellence
- Plan to achieve goal via 3 “T” vision



- TECHNOLOGY Development



- TALENT Enrichment



- TRANSFORMATION in Roles

- Enablers for leading edge technologies, competencies and processes development
 - Innovative solutions
 - Distinctive expertise
 - Leading practices

Six Pillars for PETRONAS GR&T Geomechanics Centre of Excellence

- Collaboration with other PETRONAS CoEs, technology clusters, custodians & technical authorities
- External collaboration with research centres, universities & Geomechanics CoEs
- Rules of engagement & governance
- Job Competency Profile & assessment guidelines
- Creation of PETRONAS standards / guidelines for geomechanics applications

- Vision, framework & roadmap
- Organisation, operation model & collaboration
- KPI definition

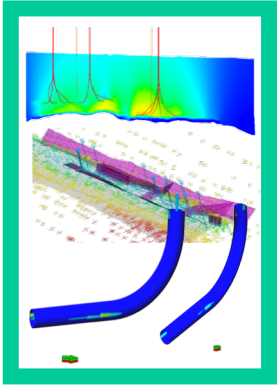


- Creation of maximizing field value & risk reduction solutions
- Technology cluster support through R&D and support projects
- Mastery & competency development
- Institutionalized in-house training within PETRONAS
- Structured & intensive competency development
- Post-graduate study
- Journal & conference publications
- High profile conference & technical workshop presentations / participation
- Accredited rock mechanics laboratory
- Required geomechanics software & adequate computing hardware

- Technology development / adaptation / improvement / implementation
- IPs, patents & trade secrets
- Technology Readiness Level for deployment

Identification of PETRONAS Geomechanics Technology Gaps

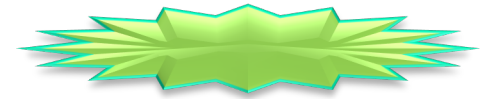
- Geomechanics R&D Masterplan Development Workshop



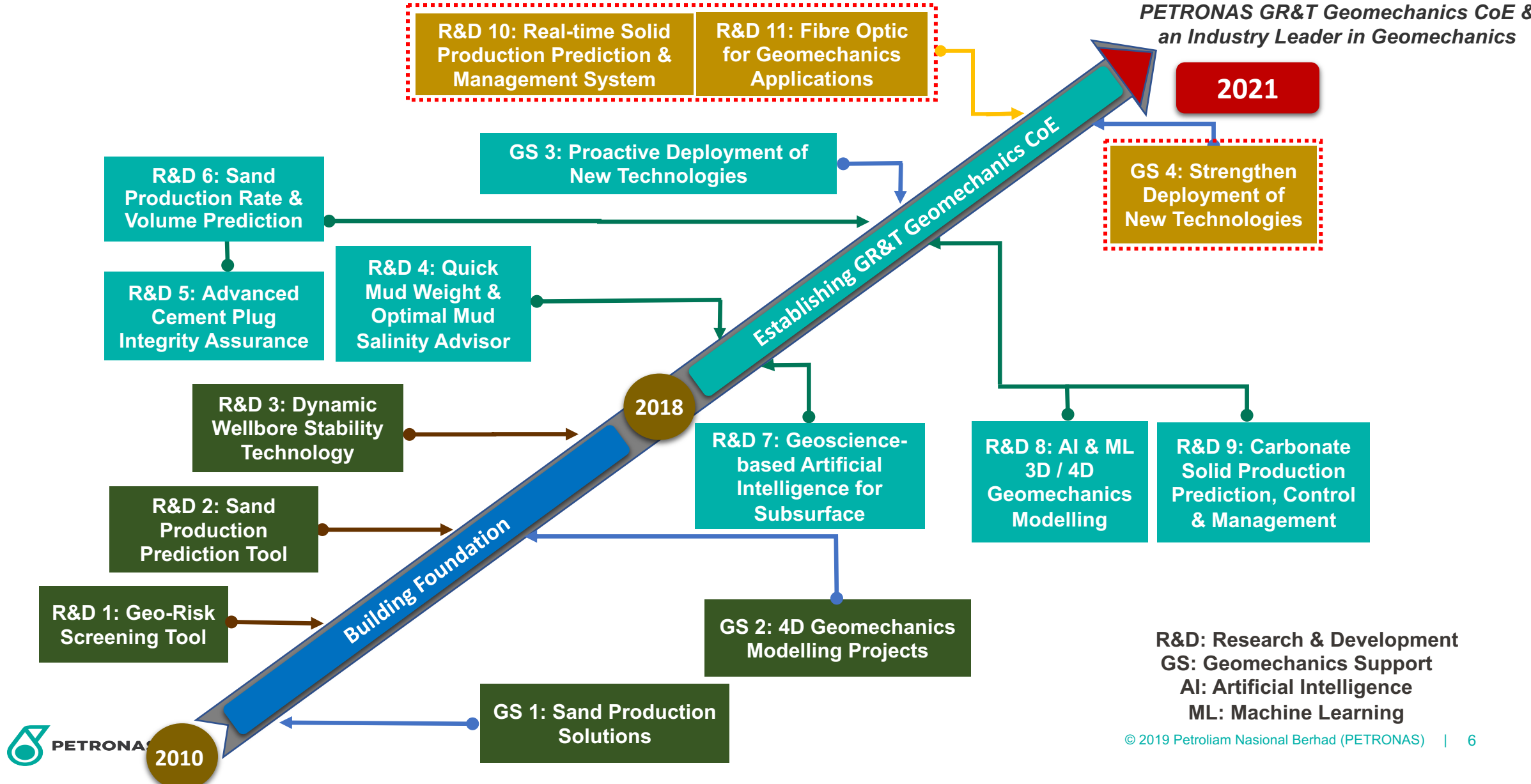
- What are the current gaps in PETRONAS geomechanics?
- What will be the future of PETRONAS geomechanics for the next 5 years?
- How best can we do it in time?
- Benefits and advantages PETRONAS can receive from geomechanics research?

- Breakout groups
 - Exploration
 - Drilling & Completion
 - Development & Production

Technology Roadmap for PETRONAS GR&T Geomechanics

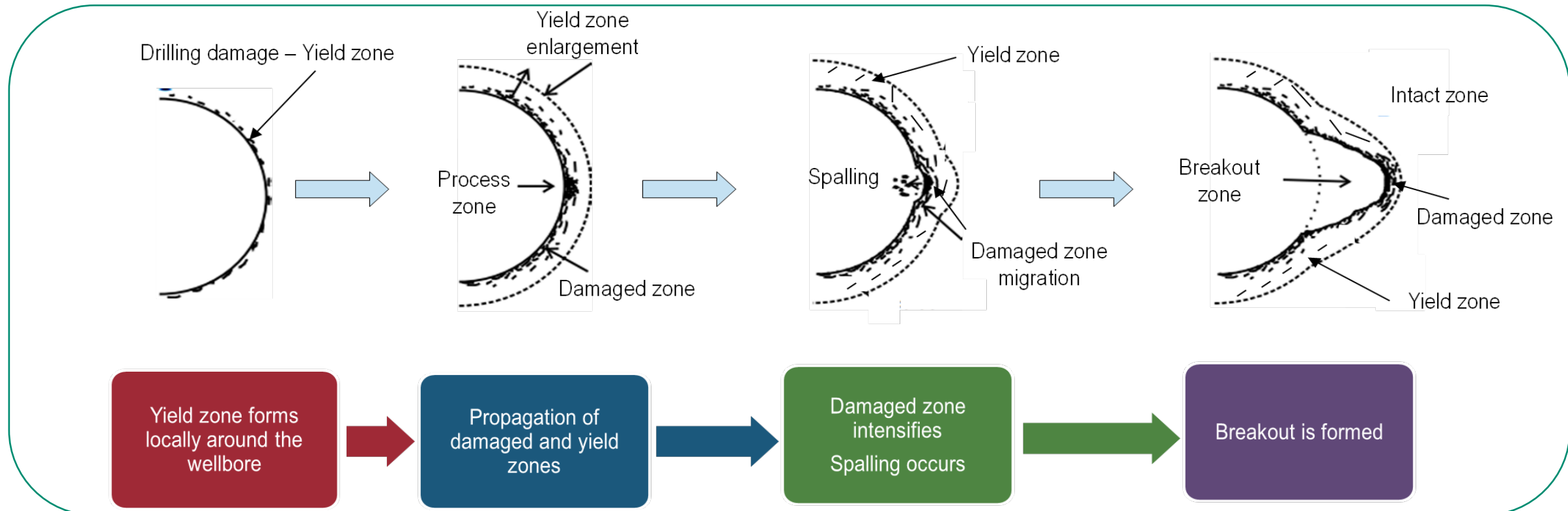


PETRONAS GR&T Geomechanics CoE & an Industry Leader in Geomechanics



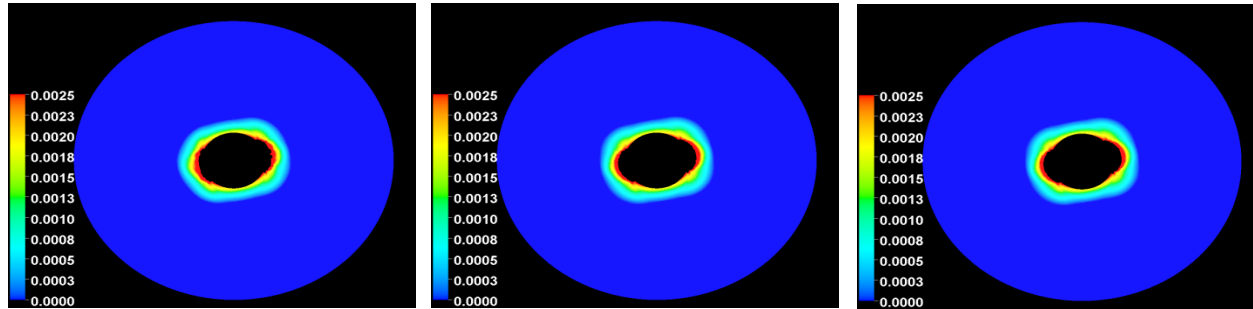
Collaborative R&D Project with Schlumberger Geomechanics CoE – Failure Geometry Stabilization Project

- Objectives
 - Development and validation of failure geometry stabilization mechanism / criteria in shales
 - Development of failure geometry stabilization software



Failure Geometry Stabilization Modelling of Study Wells

Equivalent plastic shear strain

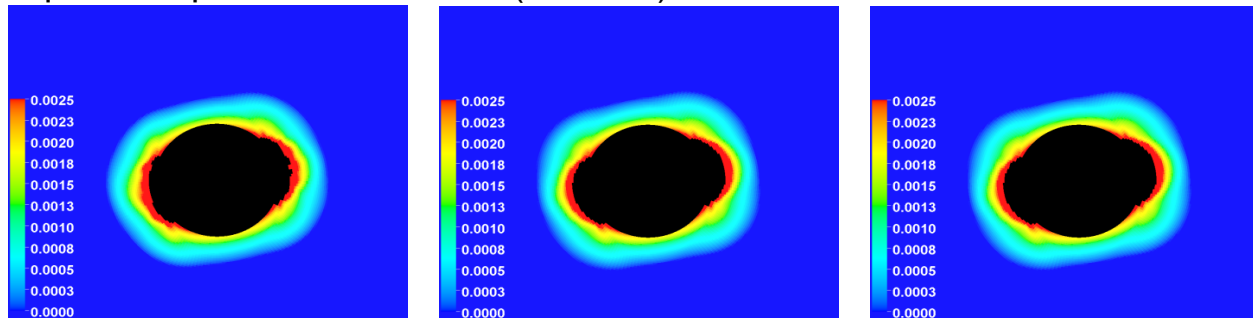


Step 6

Step 11

Step 17

Equivalent plastic shear strain (zoom-in)

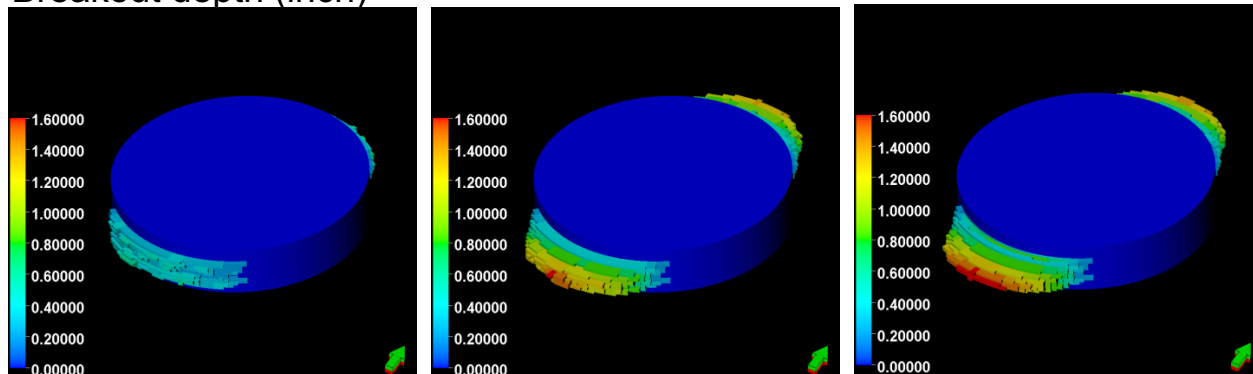


Step 6

Step 11

Step 17

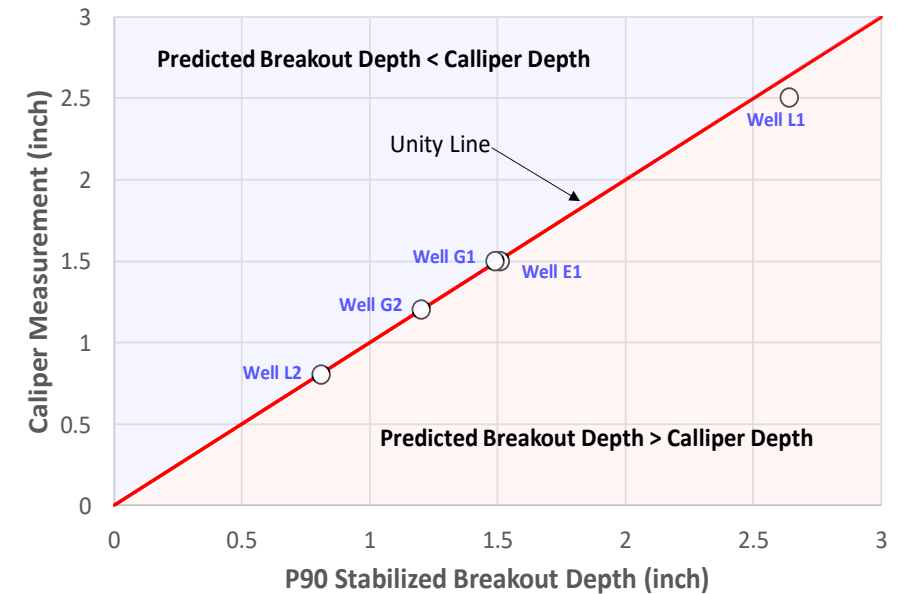
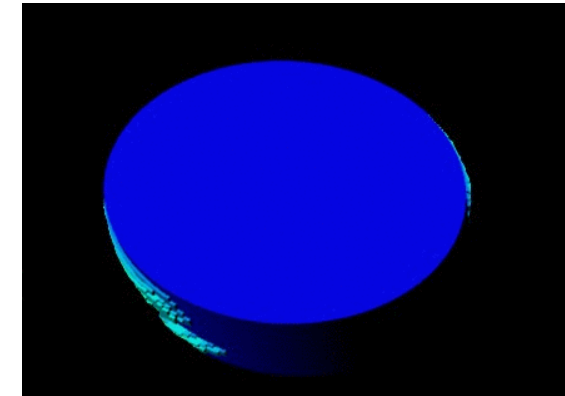
Breakout depth (inch)



Step 6 Open

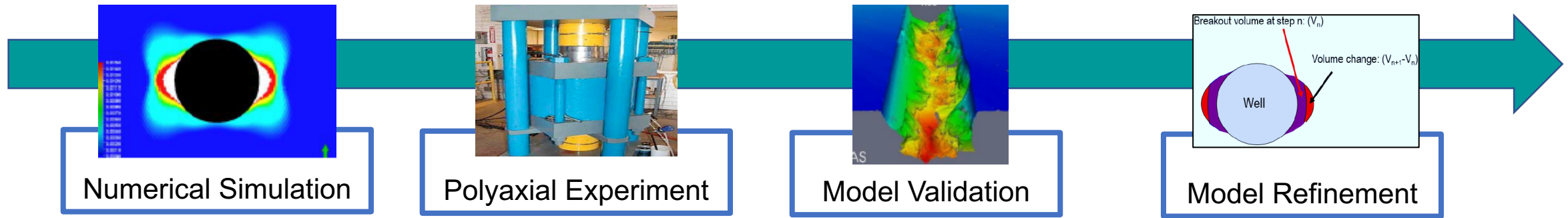
Step 11

Step 17



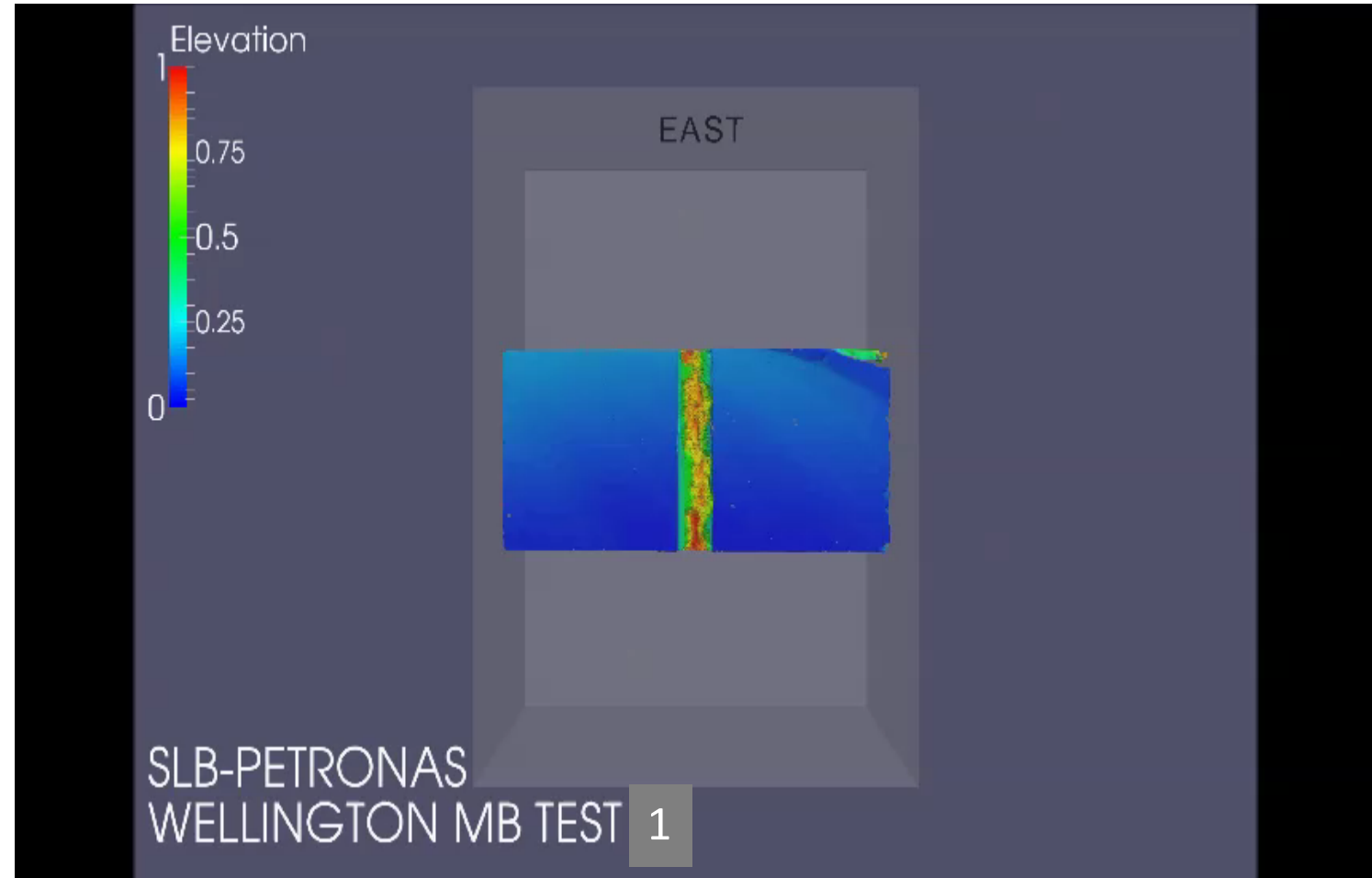
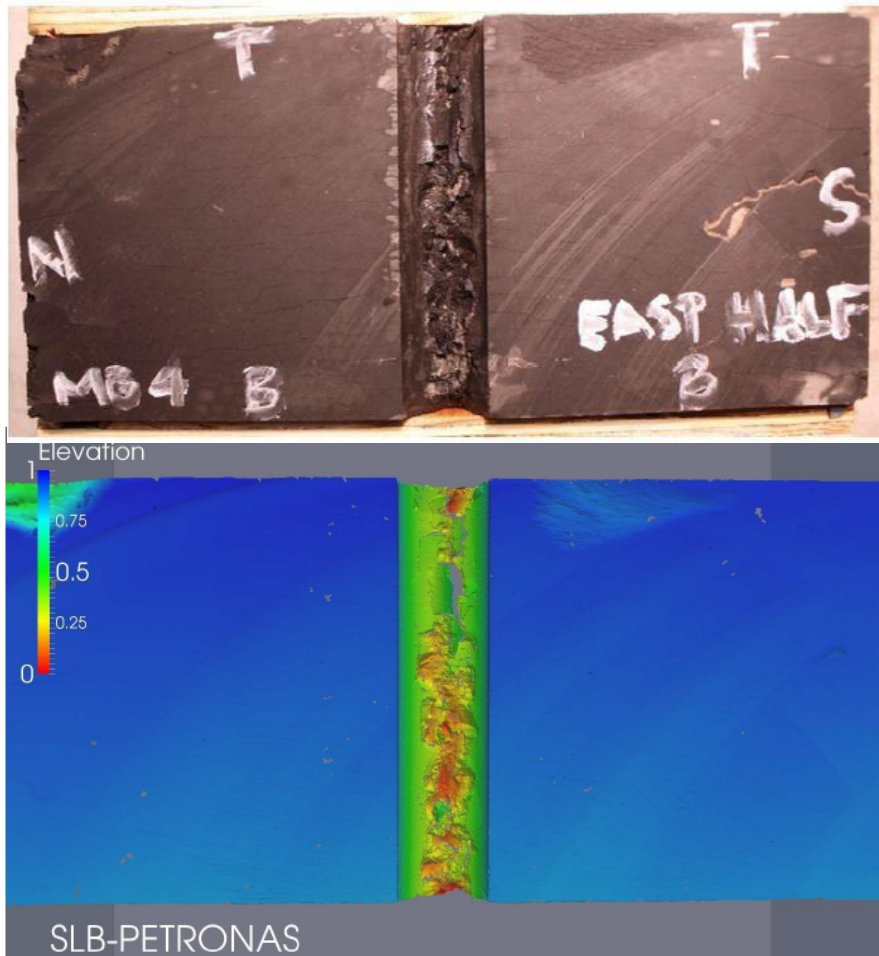
Measured caliper depth versus predicted stabilized breakout depth for all study wells

Polyaxial Block Tests for Model Validation and Refinement



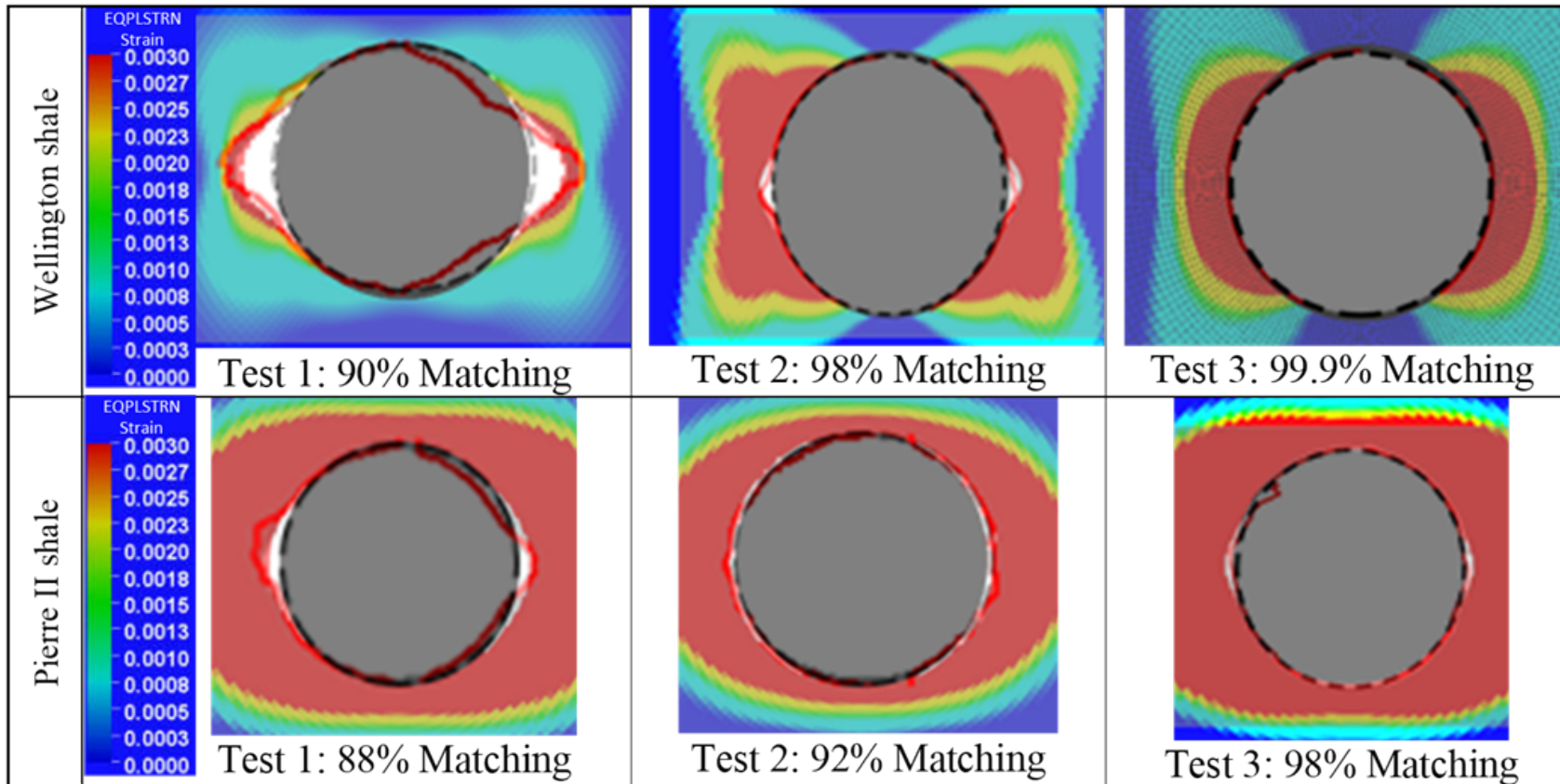
- Polyaxial block tests conducted at controlled stress condition to validate and refine failure geometry stabilization model
- Breakouts formed in minimum horizontal stress (Sh_{min}) direction along vertical length of wellbore

Laser Scan of Breakout Geometry of Wellington Shale Test 1



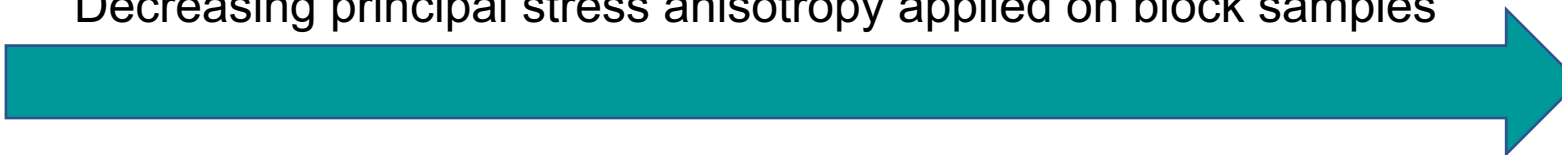
- Shale block cut in half along wellbore to reveal breakouts
- Breakout scanning performed using laser scanning system mounted on arm
- Laser scanning data compiled into 3D image with elevation map filter applied to data

Breakout Geometry Modelling Validation against Polyaxial Block Tests



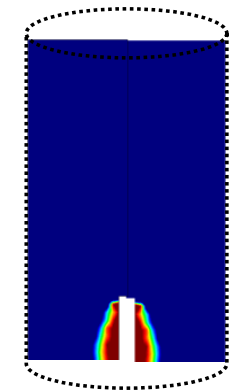
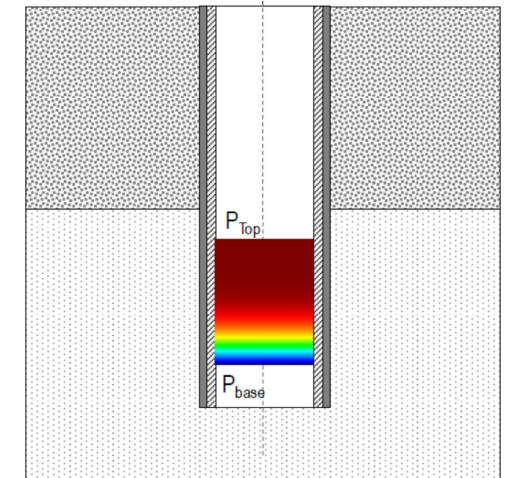
- Cross-section from laser scan transposed over equivalent plastic shear strain shown in colour contour
- Cross-section of laser scan is compared against simulated stabilized geometry
- Black dashed circle is original borehole surface
- White space is simulated borehole surface
- Red line is laser scan borehole surface

Decreasing principal stress anisotropy applied on block samples



Potential Collaborative R&D Projects with Schlumberger Geomechanics CoE

- Advanced Cement Plug Integrity Assurance Modelling and Simulation for HPHT Wells
 - Develop engineering methodology and integrated solutions / workflows for cement plug design and placement in HPHT conditions
 - Incorporate technology into PETREL-based enhanced Near Wellbore Geomechanics cement plug software for “touching the field”
- Dynamic Sand Production Rate and Volume Modeling and Simulation
 - Develop dynamic sand production and wall geometry evolution mechanisms / criteria for episodic sand production rate and volume prediction
 - Develop PETREL-based plug-in for “touching the field”



Thank you for your passion!

