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

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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

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

- 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

- Create & Shape
- Distinctive Expertise
- Leadining Practices & Innovative Solutions
- Robust System, Process, Tools
- Develop Technical Capabilities
- Exploit Technical Knowledge
- Stewardship on Standards & Governance
- Innovate Solutions & Practices
- Deliver Solutions

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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
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

![Diagram of drilling damage and yield zone stabilization](image-url)
Failure Geometry Stabilization Modelling of Study Wells

Equivalent plastic shear strain

Equivalent plastic shear strain (zoom-in)

Breakout depth (inch)

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 (Shmin) 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!