New methods of geomechanics core testing

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- Unique equipment: **Scratcher TSI System, 20ksi Triaxial Load Frame**
- Well-tested methodology of core testing and test results interpretation
- Testing experience of **different core types**
- **Technical and theoretical support** from worldwide experts: Schlumberger Moscow Research Center, Schlumberger geomechanics and core analysis communities
- Test data and interpretation of high quality, double-check of test interpretation
- **Test data repeatability** among Schlumberger laboratories around the world, standard work instructions (SWI)
Whole core mechanical properties measuring with Scratch TSI System

**TSI Scratch test system** developed and patented by TerraTek – Schlumberger company.

The only example of TSI system used for commercial projects located in Tyumen Schlumberger Rock Laboratory

**TECHNICAL CHARACTERISTICS:**

- Cutter size: 5 & 10 mm
- Core diameter – 10-130 mm, Length – up to 1 m
- Cutter load: 10-2000 N
- Key measurable parameter: **Unconfined Compressive Strength (UCS), psi**
- Test data resolution: 10000 points per 1 meter
Whole core mechanical properties studies with Scratch TSI System
Advantages and application of TSI Scratch test system profiling

- Express measurement of Unconfined Compressive Strength (UCS)
- Optimal geomechanics core sampling. For better sampling, Heterogeneous Rock Analysis (HRA) Techlog clustering module could be used
- Continuous detailed UCS profile of all available core
- Scratch-test could be done even if there is no possibility to plug the samples
- Scratch data could be used to build failure envelope (strength passport)
20ksi Triaxial Load Frame

**TECHNICAL CHARACTERISTICS:**
- Axial load: up to **226 tones** (500 000 lbf)
- Hydraulic confining: up to **137 MPa** (20 000 psi)
- Pore pressure: up to **137 MPa** (20 000 psi)
- Core size: D= **30 mm; 80 mm; 1 inch; 1.5 inch**

Sample deformations measurement while sample testing:
axial and 2 transversely spaced radials

Concurrently with sample loading, ultra wave velocities (UV’s) are measured to get dynamic characteristics

Correlation of static and dynamic elastic parameters:
Young’s modulus (E) and Poisson’s coefficient (v)
Triaxial compression test (TCS) with UV’s recording during all testing period
Triaxial compression test (TCS) with UV’s recording during all testing period

- UV’s are picked in elastic zone (when sample is deforming elastically)
  - Correct dynamic elastic parameters
- Correct correlations between dynamic and static parameters
- Correlations used to calibrate log and seismic data
Thick-Walled Cylinder (TWC) Test

The only direct way of sand production measurement
Standard and low sample strain rate control

Standard strain rate control – $10^{-5}$ inch per sample length inch per sec.

Low strain rate control – $10^{-6}$ inch per sample length inch per sec. – 10 times lower than standard control
Pore Volume Compressibility (PVC) Test to get right effective stresses

- Non-destructive testing in elastic zone of core sample deformation
- Grain Compressibility and Bulk Compressibility $\rightarrow$ Biot’s coefficient (alpha):

\[ \text{Effective Stress} = \text{Stress} - \alpha \cdot \text{Formation pressure} \]

\[ \sigma' = \sigma_v - \alpha P_p \]

- $P_p$ = formation pressure,
- $\alpha$ = Biot’s coefficient
- $\sigma_v$ = vertical stress
- $\sigma'_v$ = effective vertical stress

*Note: Biot’s calculation, vertical sample*
Multi-Stress Compression Test (MSC). Formation anisotropy (transverse isotropy) study
Thank you for your attention!
Questions?

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