A Perspective on Geotechnical Related Drilling Issues

By
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Topics

- Shallow water flow
- Near surface faults
- Basin modeling
- Sand production
- Jetted conductors
- Conductor/riser fatigue
Geotechnics for wells, top-hole section and conductor

Jeanjean, P., Zakeri, A., Al-Khafaji, Z., Hampson, K., Clukey, E., and Liedtke, E.,
2015 ISFOG keynote paper
Shallow Water Flow SWF

- SWF sands occur in water depths of more than 400m.
- They are found at depths of 250-1000m below the mud-line.
- Overpressures are usually caused by rapid sedimentation.
- Flow typically increases with time.
- Sediments pile up at well head.
- Estimated costs of the SWF problem.
SWF – Root cause
Solution
Sedimentation model

- Sedimentation rate faster than pore pressure dissipation
- Increasing drainage path
- Gibson, R. E., 1958 ‘Consolidation in a clay increasing in thickness with time, Geotechnique
- More advanced techniques now available

Diagram:
- Pressure or Stress vs Depth
- Overburden stress ($\sigma_v$)
- Pore Pressure ($u$)
- Hydrostatic Pressure ($u_h$)
- Overpressure ($u^*$)
- Top of Overpressure

accretion
Salt tectonics
Another example-
Cross hole geophysics
Normal application
Shallow faults
A really good paper!

Slip Instability and State Variable Friction Laws

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Fig. 4. Spring and slider model. A slider of negligible mass slides a distance $\delta$. A load point moves a distance $u$ stretching the spring with stiffness $k$ (dimensions: (stress/distance)) and causing the driving stress $\tau$. 
Results

Ring shear test!

Fig. 5. Friction stress $\tau$ versus load point displacement $u$ in the spring and slider model of Figure 4. The load point speed is suddenly increased from steady sliding at $0.7V_0$ to $V_0$. Subsequent motion for various $k$ are shown, as calculated with equation (18), the simplified Dieterich Friction Law.
Ring shear testing

Figure 5.2 Set up HPRS apparatus

Figure 5.3 Sample pieces prepared for mounting in HPRS apparatus.

Figure 5.4 Ring filled up with sample pieces prior to mounting top piston.
Basin Modeling

- Liquefaction
- Low relative density sands
- G Castro dissertation

sand
Clay/shale
1 – 2 km
Borehole/perforation stability

...affecting sand production...
Jetted conductors

Controlled soil removal

Set-up
Centrifuge verification – Bass Straits Retrofit
Example 3 - Suction caissons
the beginning

Snorre TLP Foundations

1-g model tests (~12 to 1 scaling)
Centrifuge simulation of Snorre 1-g model tests