

# 2026 Drill Bit Forum and Exhibition



Highland Pines Golf Club

February 24, 2026

## Cutter grade and shape selection for geothermal applications

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Feb 24th, 2026

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# Not All Geothermal Applications Are Equal

## Fundamentally Different

### Shallow / Direct-Use / GSHP

- Environment
  - < 1,000 ft typical
  - Low temperature
  - Soft-medium formations
  - High volume drilling
- Technical Bit Focus
  - Standard PDC cutters
  - Cost-effective steel body
  - High ROP optimization
  - Simple hydraulics
  - Low thermal risk

### Sedimentary Basin / District Heating

- Environment
  - 3,000–12,000 ft
  - Up to 150°C
  - Sandstone, carbonates
  - Loss zones possible
- Technical Bit Focus
  - Abrasion-resistant cutters
  - Improved thermal stability
  - Balanced cutter density
  - Optimized hydraulics for hole cleaning
  - Enhanced gauge protection

### High-Temp Power / EGS / Volcanic

- Environment
  - 8,000–20,000 ft
  - >150°C
  - Granite, basalt, metamorphic
  - Severe vibration & losses
- Technical Bit Focus
  - Thermally stable cutter grades
  - High-impact resistance
  - Reinforced blade geometry
  - Anti-whirl stability design
  - Heavy gauge / backup cutters
  - Hard rock cutting structure

# Rotokawa, New Zealand – Volcanic 12.25” Section

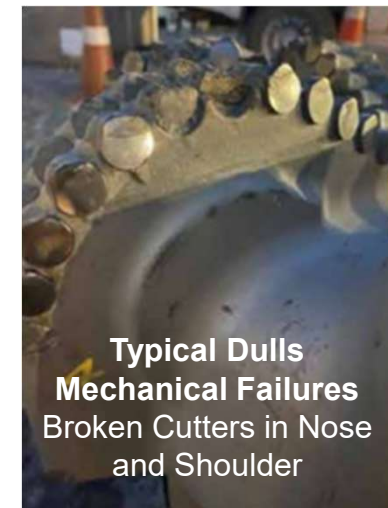
- Challenge: drill the long deviated 12 ¼” section through a very hard volcanic and sedimentary rock in a single run to TD. To date this section has required several Roller Cone drill bits to complete the section, which, apart from low ROP and high cost presents few other operational risks.
- Solution: Upgrade cutting structure use nonplanar cutter geometry
- Results:
  - Set new performance benchmarks for ROP and interval
  - Completed the section in a single run, replacing multiple
  - 15% higher ROP comparing to the best offset
  - Met all the directional targets
  - Outstanding dull : 1-1-BT-S-X-I-WT-TD (rig)



# Tauhara Field, New Zealand – Volcanic 16” Section

(SPE-210468-MS)

Drilling Challenge	Drill Bit Challenge
Waiora and Rhyolite Formation	Be durable enough to drill both formations and ideally be rerunnable after two shallow well or one deep well
Directional Objectives	Drill desired profile with good tool face control
Parameter Limitation	Achieve ROP and generate lower torque than a conventional PDC with limited parameter range
Logistic and Economical	Be flexible for all potential drilling challenges and minimize drilling cost.



**Waiora formation** includes interbedded siltstones and tuffs. PDC have higher ROP than RC & hybrid drill bits. PDC are more directionally friendly.

**Rhyolite formation** hard and dense section that causes torque spikes and low for PDC bits. Typical front face overload to shoulder cutters.

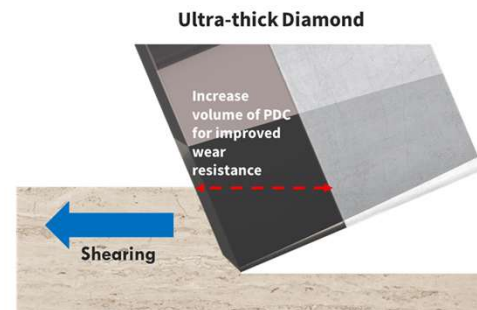
# Tauhara Field, New Zealand – Volcanic 16” Section

(SPE-210468-MS)

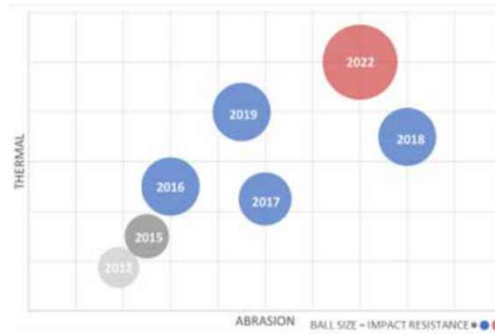
## Tauhara Field, New Zealand – 16” Volcanic Section



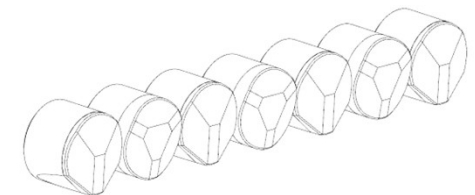
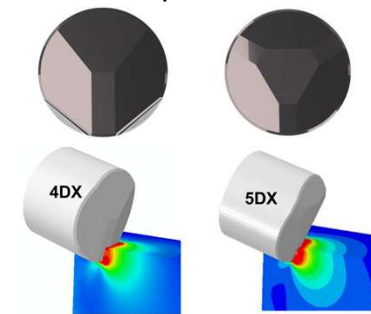
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**Choosing the Right Cutter Grade**  
Balance Abrasion, Impact & Thermal



**Shaped Cutters Designs**  
Purpose Built



**Alternating Shaped Cutters**  
Balance Efficiency & Durability



# Tauhara Field, New Zealand – Volcanic 16” Section

(SPE-210468-MS)

Tauhara Field, New Zealand – Volcanic 16” Section



**1<sup>st</sup> Run – Successfully drilled the section in one run**  
ROP of 16.09 m/hr & Excellent Dull

**2<sup>nd</sup> Run – Successfully drilled the section in one run**  
ROP of 14.36 m/hr & Excellent Dull

**3<sup>rd</sup> Run – Successful short run**

**4<sup>th</sup> Run – Pulled for erratic torque**

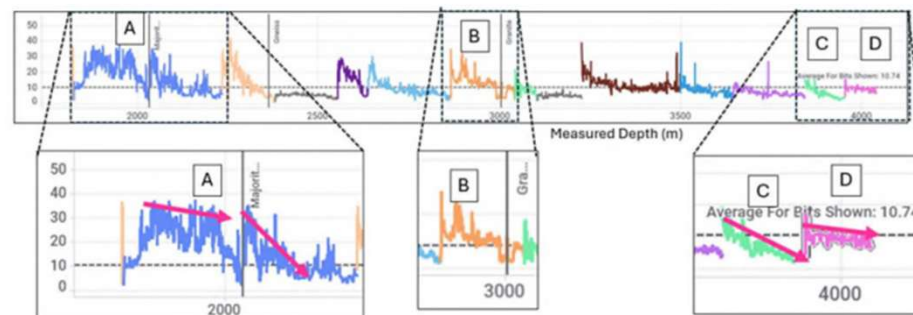


1,000m longer than any RC run, 700m longer than any Hybrid run

# Deep Geothermal Drilling, Switzerland – 12.25” Granite & Gneiss

(SPE/IADC-223784-MS)

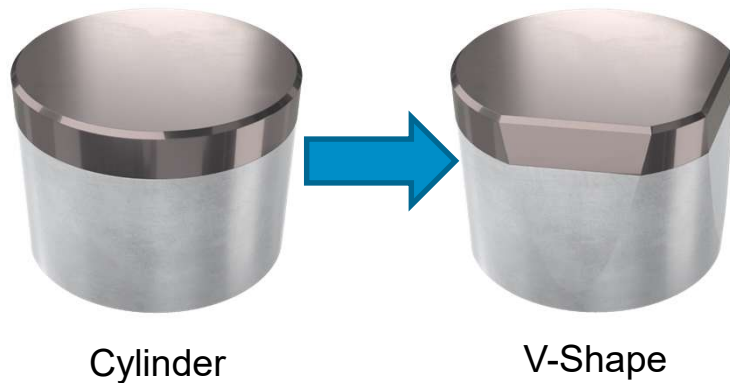
- The geothermal reservoir lies at a depth of 4 to 5 km below the surface, in lithologies formed of crystalline basement, composed mainly of granite and gneiss.
- Ultra-hard formation and abrasive to PDC Cutters leading to “early ROP decline” by 30-50%



# Deep Geothermal Drilling, Switzerland – 12.25” Granite & Gneiss

(SPE/IADC-223784-MS)

- Use V-shaped cutter technology achieves higher ROP – reducing sliding distance



- Reduced sliding distance reduces thermal and abrasive wear (SPE-208798)

DOC  
10 Revolutions  
Sliding Distance



2 x DOC  
5 Revolutions  
½ x Sliding Distance

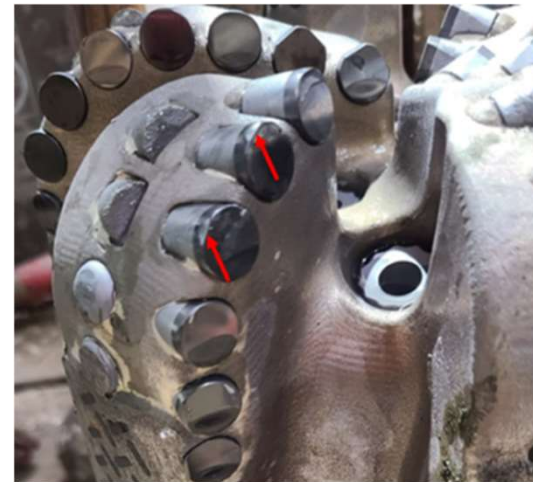
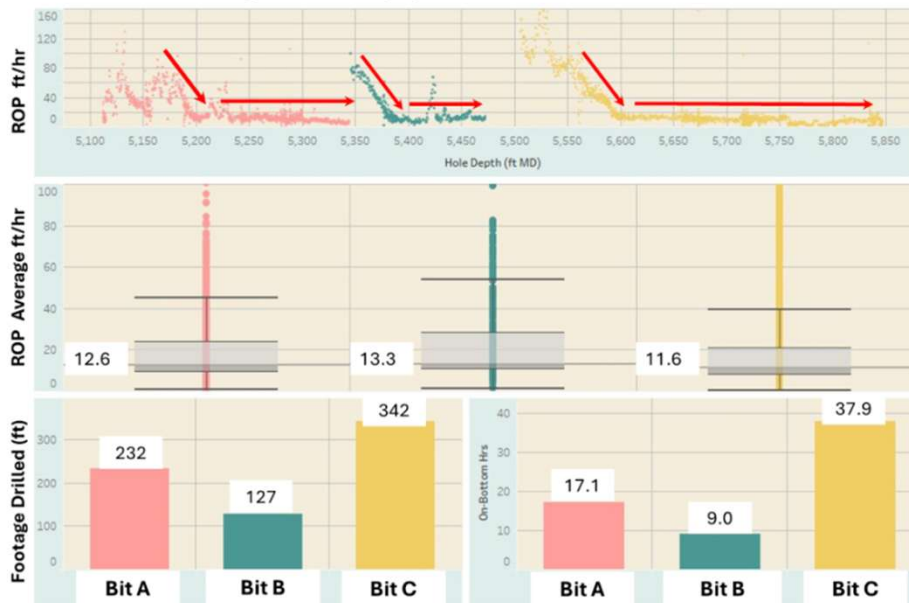


# Deep Geothermal Drilling, Switzerland – 12.25” Granite & Gneiss

(SPE/IADC-223784-MS)

- Utah Forge - use V-shaped cutter technology achieves higher ROP

FORGE – 8.75” Drilling Date – 16A (78)-32



# Deep Geothermal Drilling, Switzerland – 12.25” Granite & Gneiss

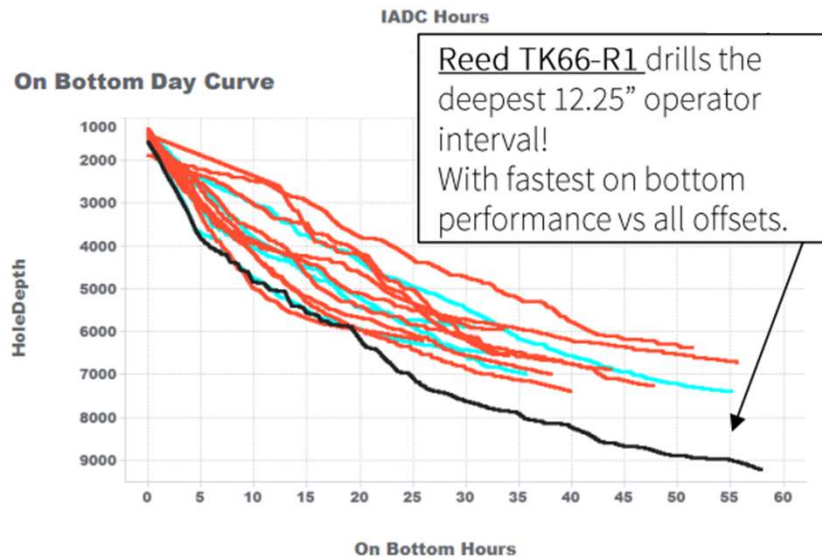
(SPE/IADC-223784-MS)

- Reached TD 26 days ahead of AFE days and reached rig release, after coring, logging, and running casing and cementing, 16 days ahead of schedule
- Dulls indicate more work to be done with cutter grade development.
- Two different designs: One bit displays thermal abrasive wear while the other shows predominately mechanical damage



# Utah – Deep Set 12.25” Drill-Out

- Drilled medium formation but eventually tagged granite top



# Utah – Deep Set 12.25” Drill-Out

- Same bit with different shaped cutters.



# Conclusions

- Shaped cutters
  - Will make or break performance in geothermal applications
  - Cutter rock interaction is lithology dependent
  - Placement on the drill bit is critical
    - Alternating patterns
    - Shoulder, cone, & nose
- Cutter Grades
  - Is the foundation of performance
  - Regardless of shape cutter grade can limit performance

# Acknowledgements

- Utah Forge Work and the Team
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- Walker Olsen, Stephen Dalton, & James May – Geothermal Team

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# Thank you

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