# Borehole quality insights using Hook Load and Wavelets

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GeoS
ENERGI SIMULATION
CENTRE FOR GEOTHERMAL SYSTEMS RESEARCH

# A Novel Data Science Approach to Borehole Dysfunction Analysis

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# GeoS Research Areas from Exploration to Sustainability

## Exploration Geology and Geophysics

Improving the understanding of the base geology and geochemistry of potential geothermal targets and the effects on seismicity

## Thermal and Fluid Flows in Reservoirs

For open- and closed-loop geothermal systems, an understanding of conductive and convective heat flows, at pore and reservoir scale, is critical for optimal system operations and system design

**Proposed Project:** Energy Harvesting Processes with *multiple partners*

## Drilling and Well Designs

Design and drilling of new wells and re-use of existing infrastructure to access geothermal reservoirs economically and effectively

**Active Project:** Hard-rock Drilling with *Eavor Technologies*

## Thermodynamics and Energy Conversions

Thermal energy may be used and harvested from a variety of temperature ranges, and efficient systems rely on a combination of technologies

**Proposed Project:** Energy Harvesting Processes with *multiple partners*

## Sustainability, Social License and Indigenous Perspectives

Widespread acceptance and adoption of geothermal technologies relies not only on an effective engineering solution but also on integration of societal acceptance and needs

## Geothermal Policy and Law

Extraction of thermal energy from the subsurface requires updated policy and regulation, both to reduce risk to developers, operators and the government and to increase benefit to society

# Drilling optimization is crucial for several industries


**Water**

**Lithium**
**Helium**
**Natural Gas**
**Oil**

**C02 Storage**

**Nuclear Waste Storage**

**Geothermal**

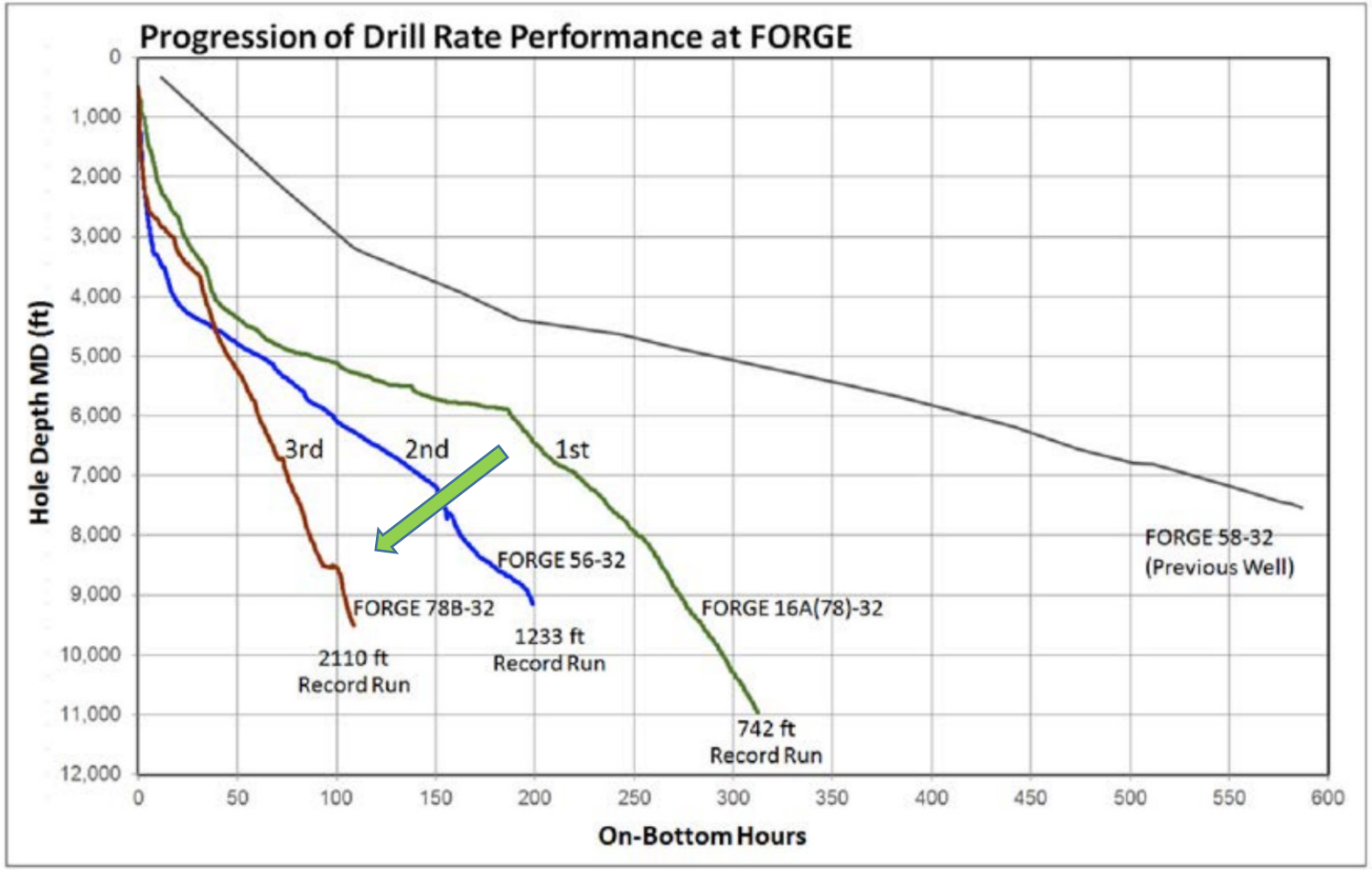
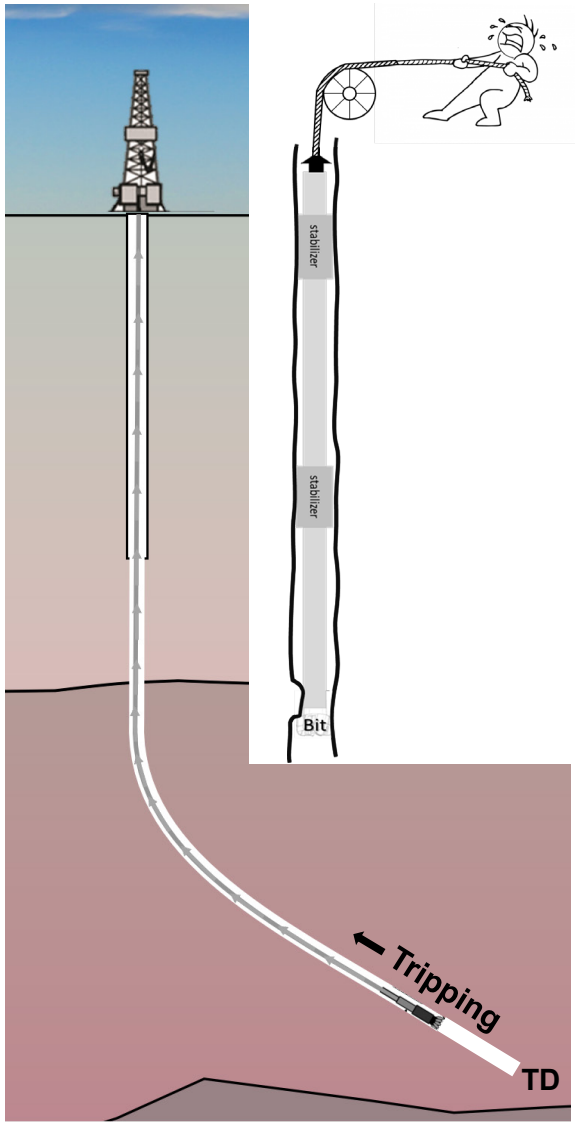
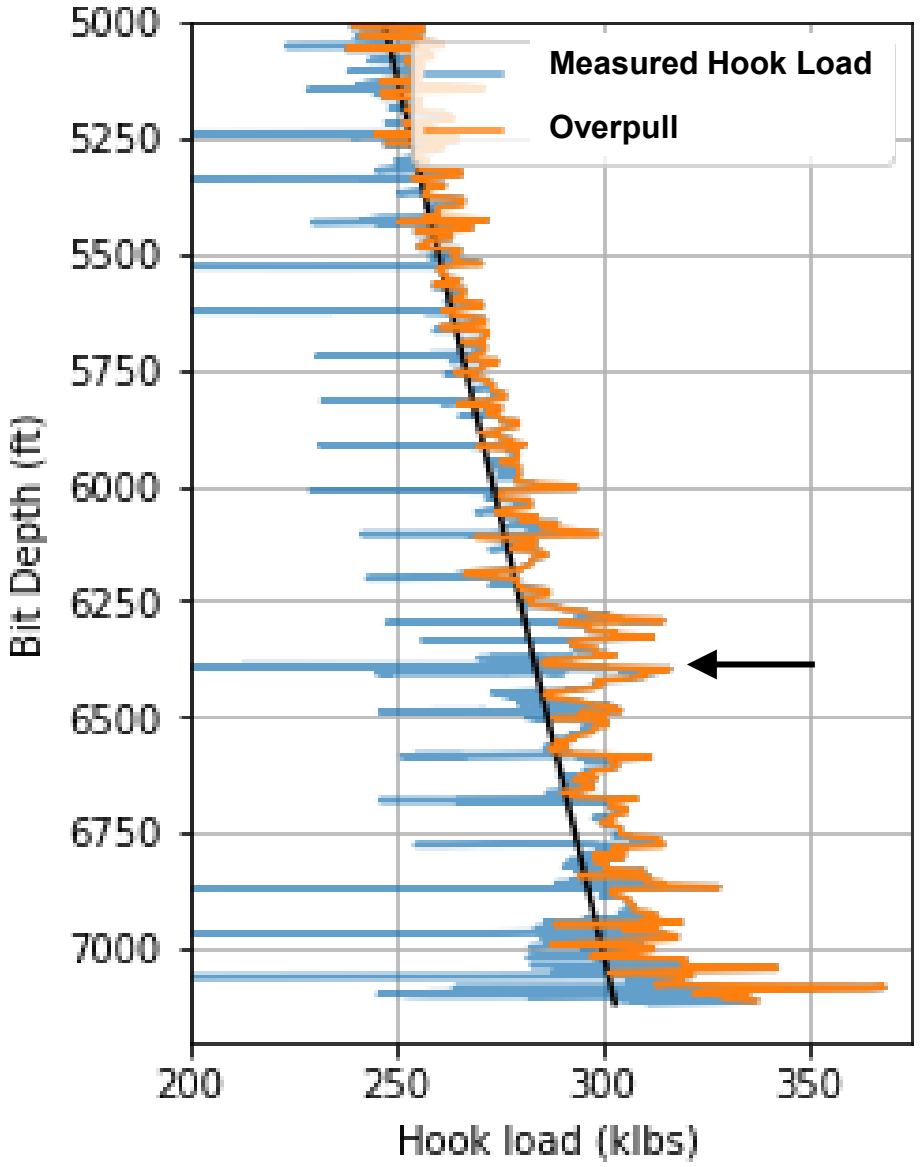


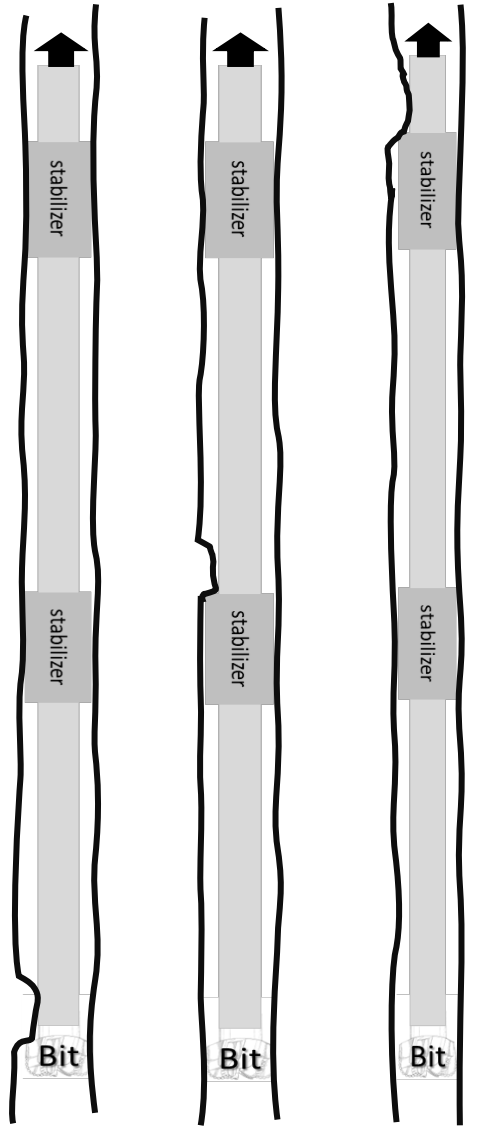

**Figure 1—Reduction in On-Bottom rotating hours in sequential wells at FORGE. At the same time ROP was increased, bit life in the hard granite was more than doubled.**

Dupriest et al. 2022 (IADC/SPE)

# Hook load Overpull indicates Borehole Dysfunctions

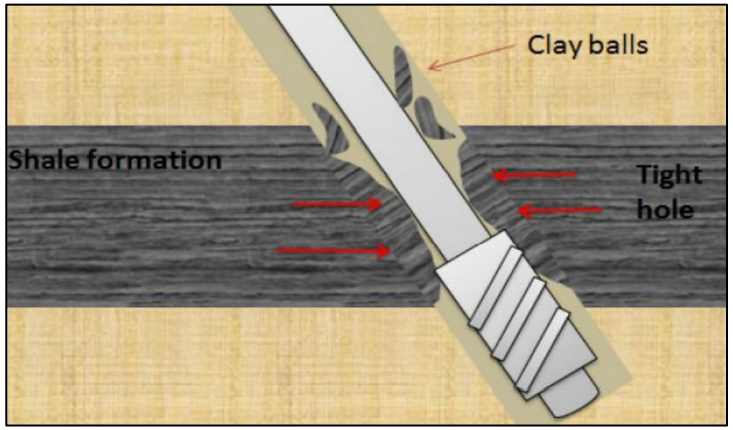


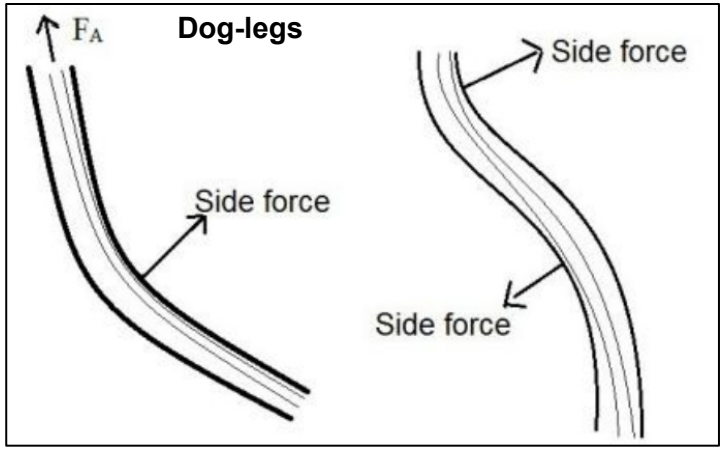



# Borehole Dysfunctions mechanism and thickness

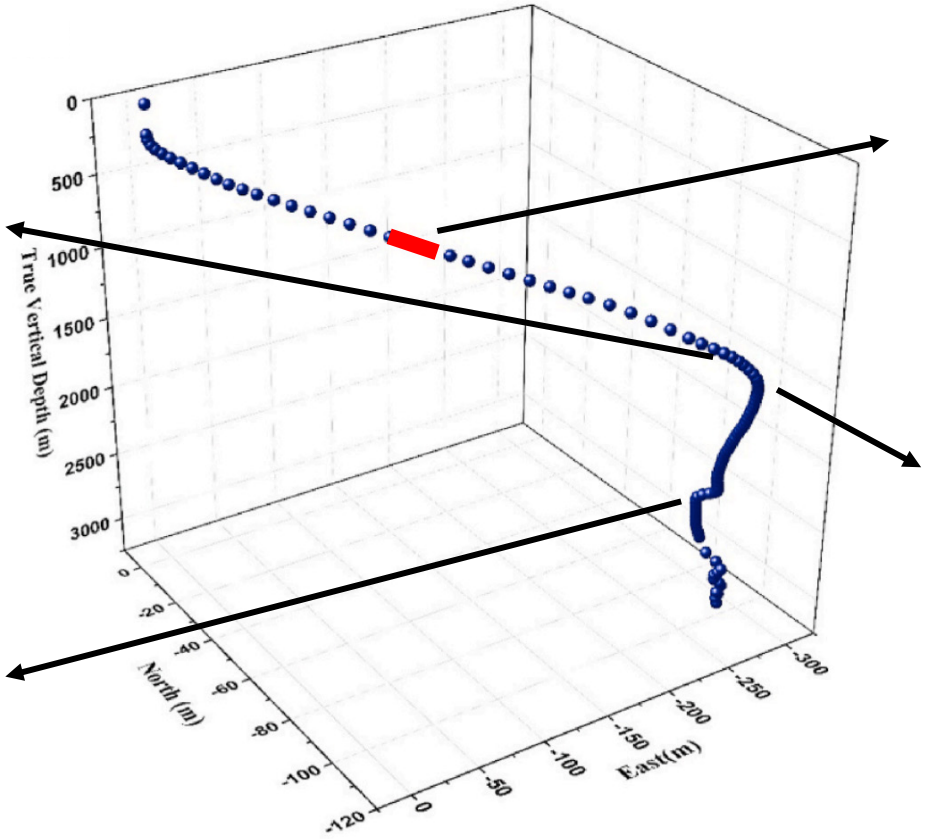
Abnormalities in the borehole that create excessive resistance to rotation or sliding of the drillstring.



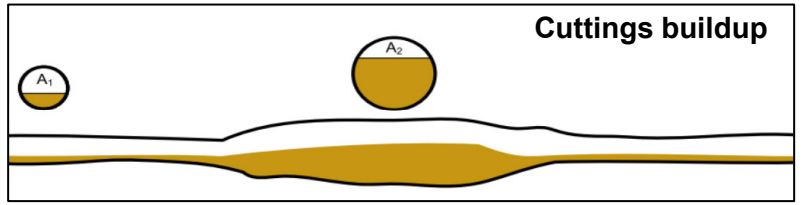

2013 Agasøster, NTNU



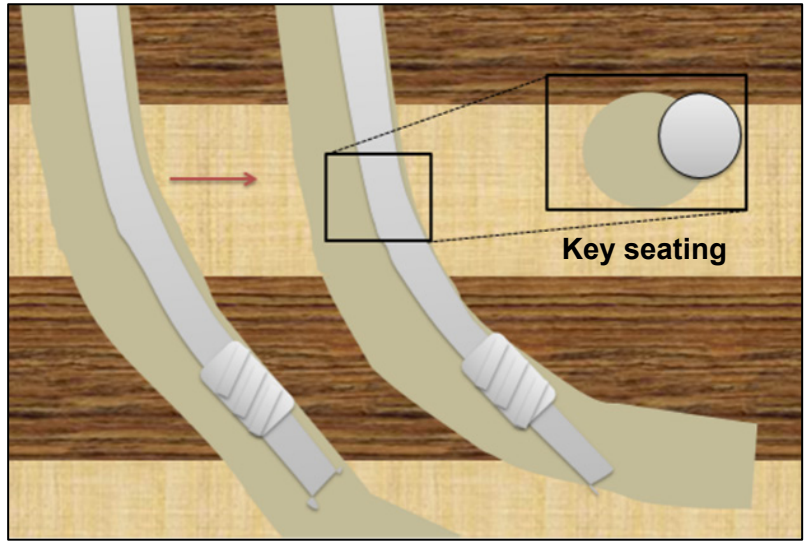

2013 Kristensen, NTNU




2020 Ramba et al, JPSE




2014 Skalle, DFE

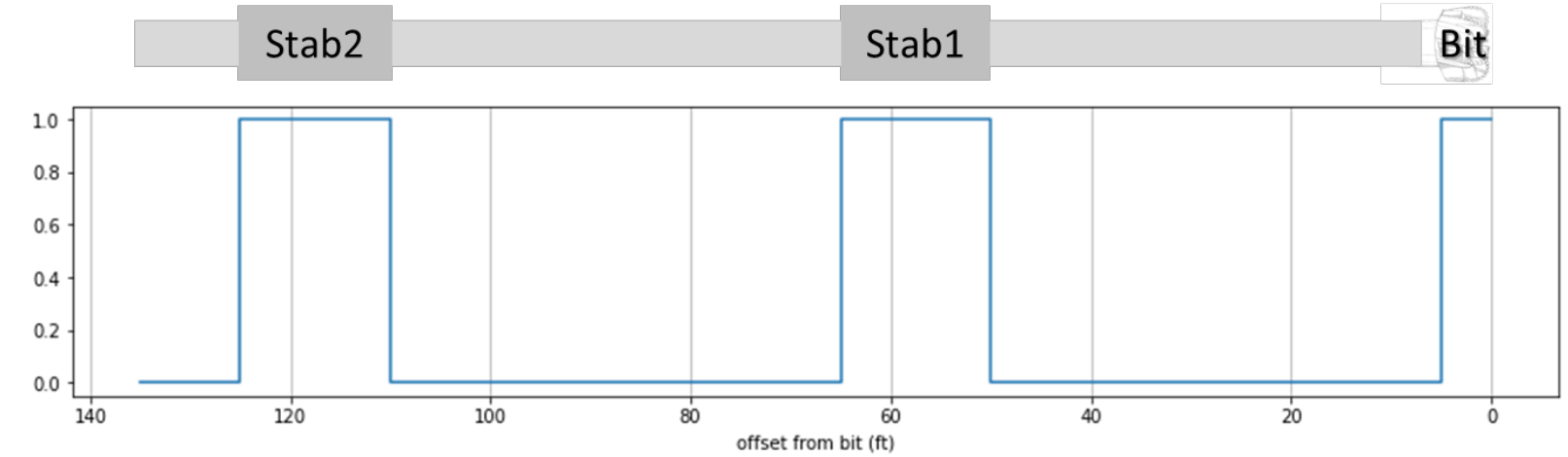



2013 Agasøster, NTNU

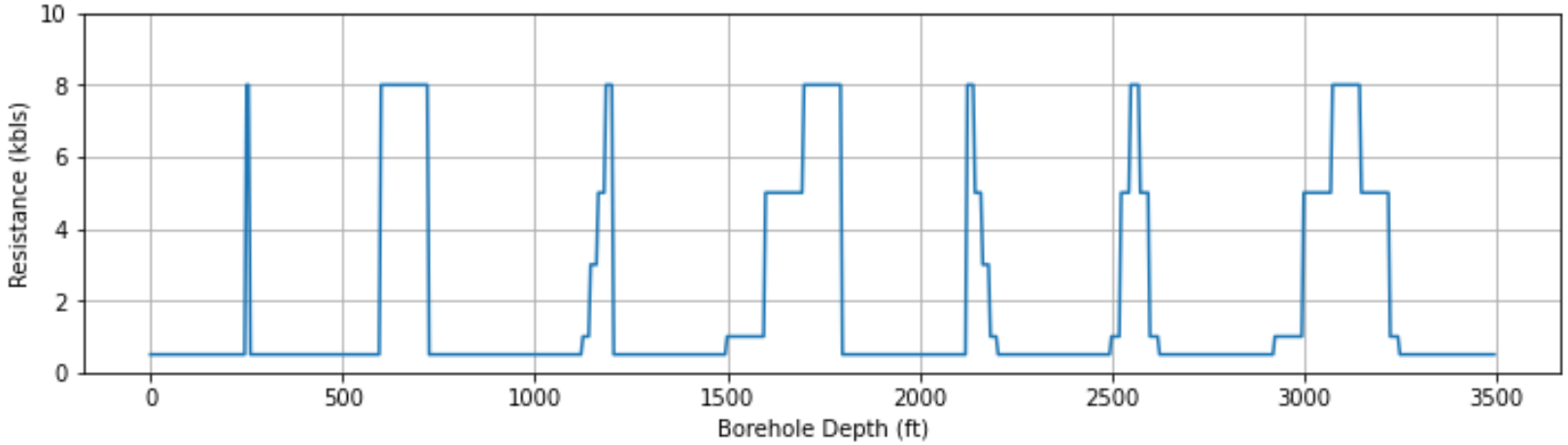
# Forward model Inputs

$$OP(z) = S(z) * R(z)$$

$S(z)$

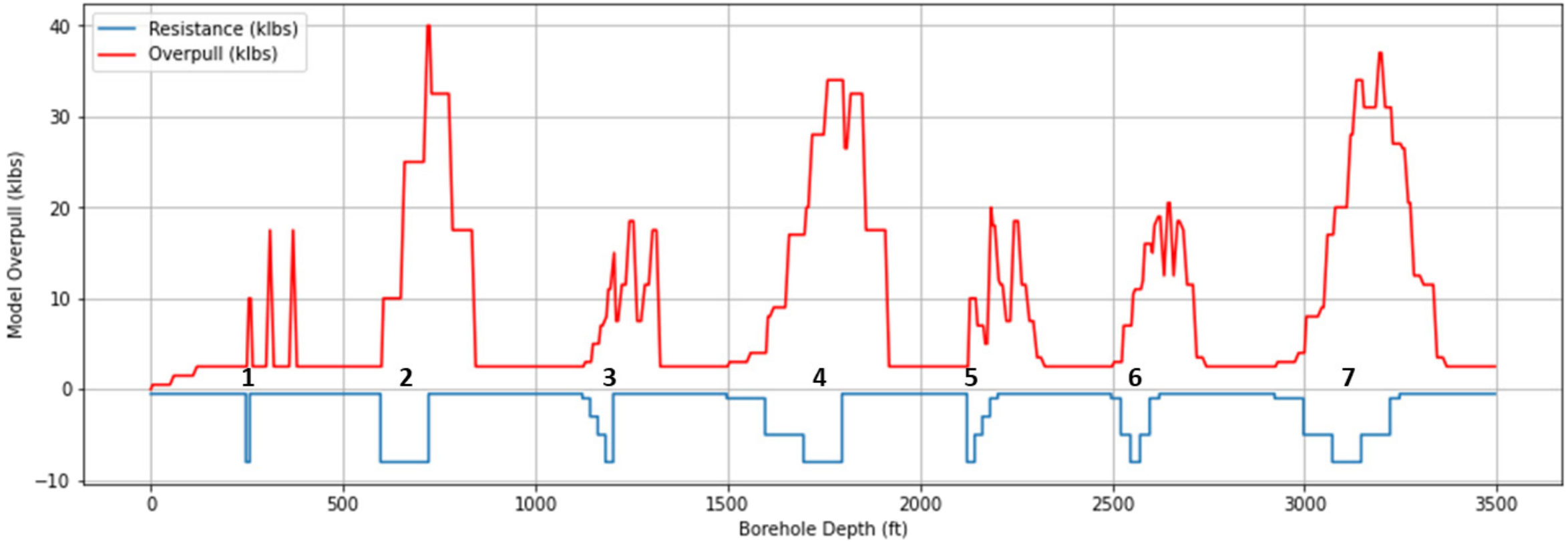



$R(z)$

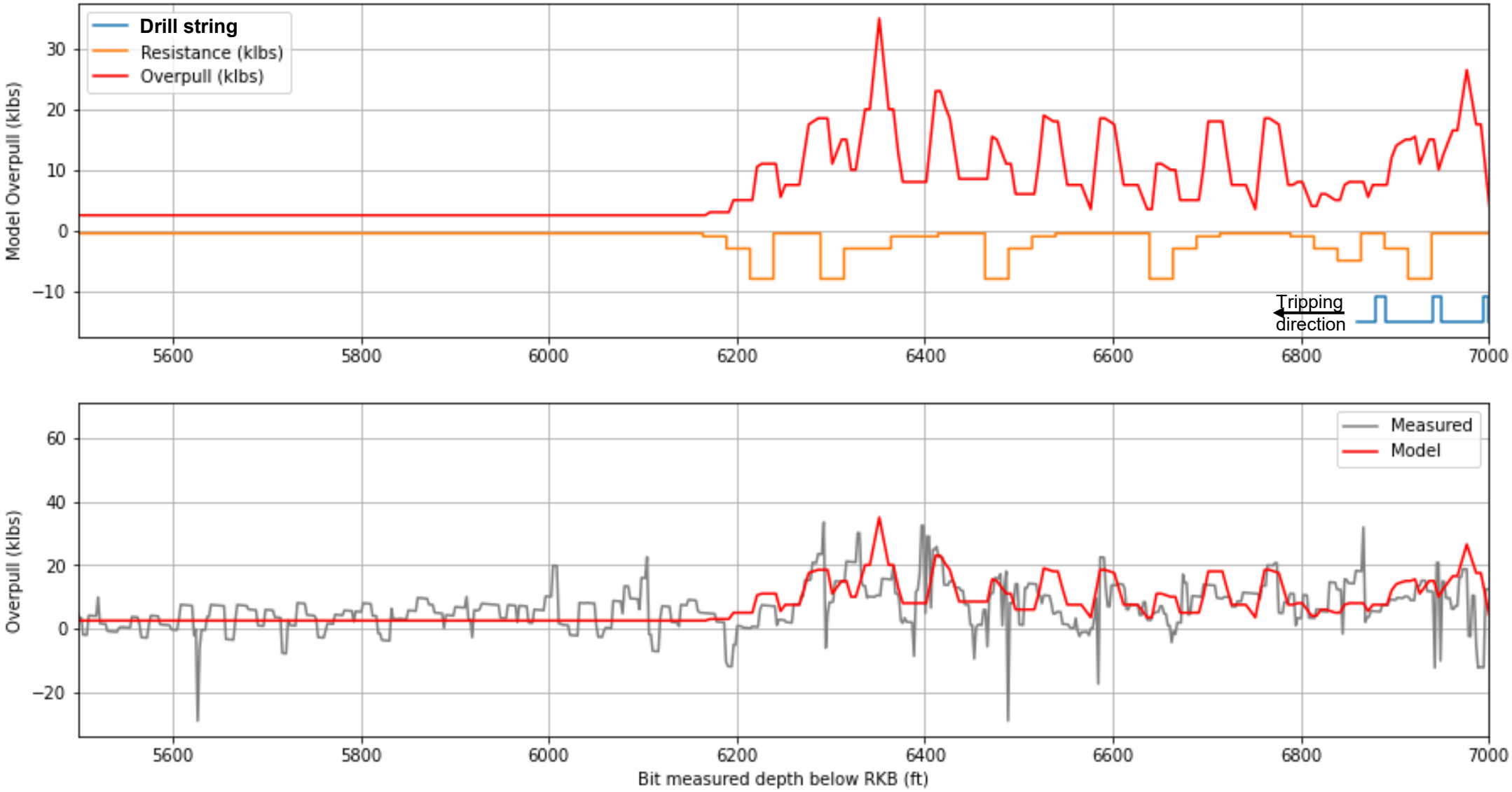


# Modelled Overpull

$$OP(z) = S(z) * R(z)$$



# Comparison to Measured Overpull



# Next steps

**The forward model looks promising**

- Test other options for BHA source signal
- Comparing of other real data examples to the forward modelled data

**Deconvolution of the overpull should provide a resistance depth profile**

- Deconvolution testing of synthetic overpull data
- Application of the deconvolution method on the real data sets

**Can the resistance signatures indicate types of dysfunction?**

- Comparison to drilling reports, drilling data, and wireline data to confirm borehole dysfunctions and investigate correlation of resistance profiles with types of borehole dysfunctions.

# Acknowledgments

## Thanks for listening!

CREWES

ALBERTA INNOVATES

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