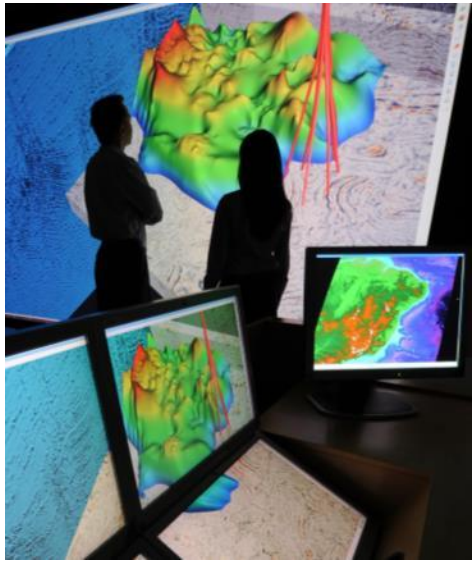

DEEP WATER

MATURE FIELDS

UNCONVENTIONALS

Pulsed Neutron Water Flow Detection

David Lavery

Formation & Reservoir Solutions

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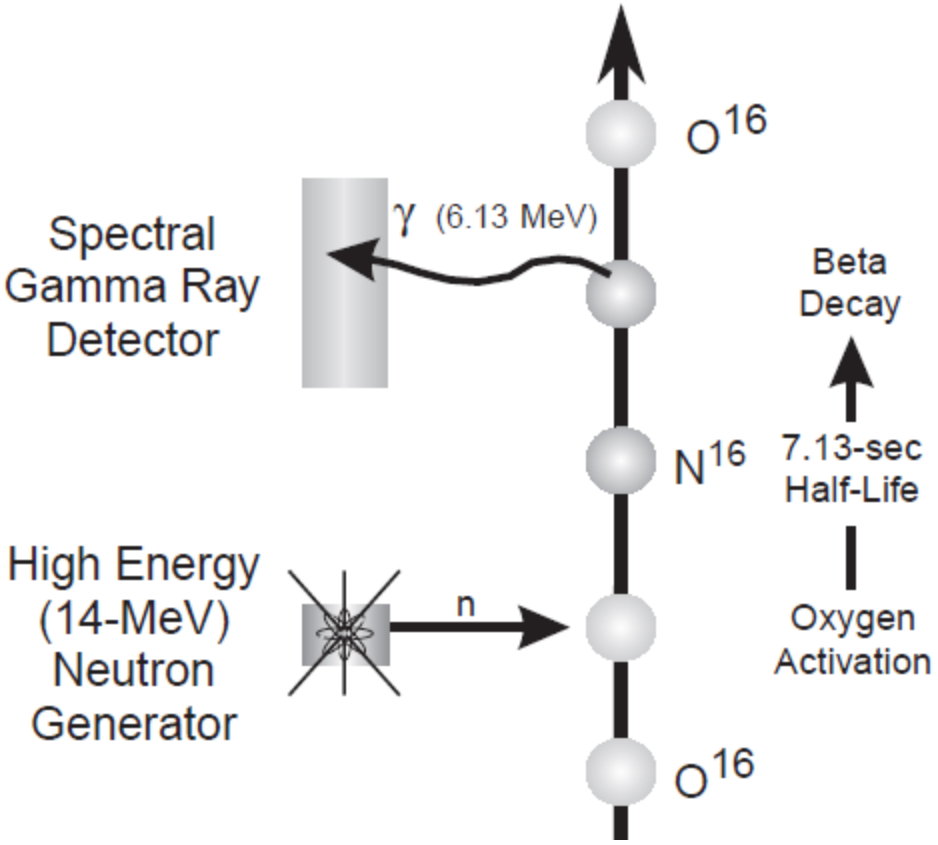
Oxygen Activation Theory



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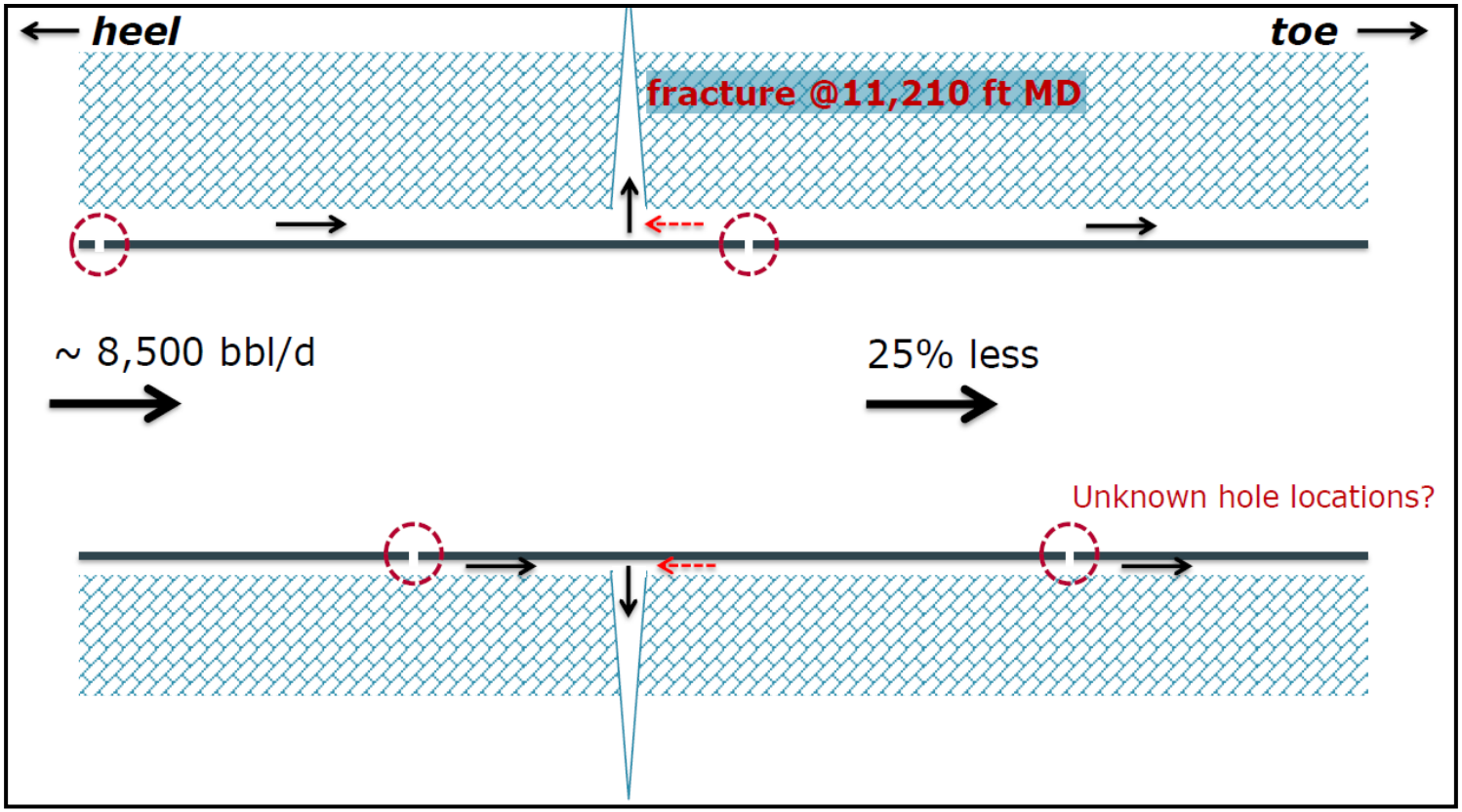
Oxygen Activation Theory

The magnitude of the oxygen activation response is a function of:

- The distance of the flowing oxygen from the tool
- The flow velocity relative to the tool
- The volume of water flowing past the tool

The Problem



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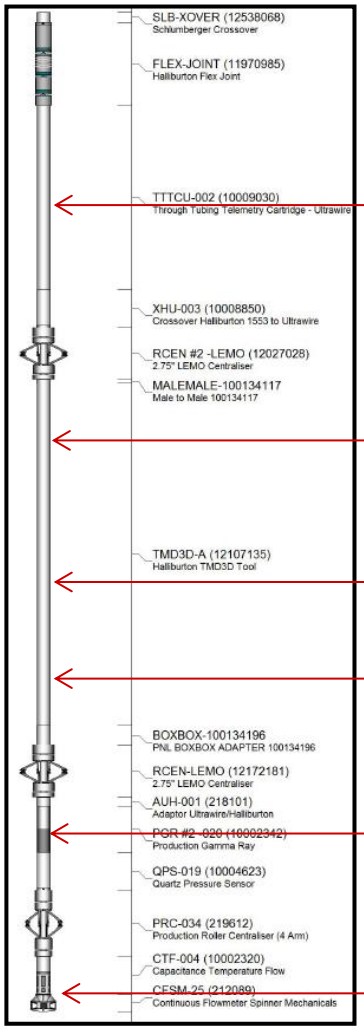
Pulsed Neutron Tool String– Run One (Inverted)



Gamma Ray (upper)

Upward flow measurement

TMD3D Neutron generator

TMD3D Far Detector

TMD3D Long Detector

Downward flow measurement

Gamma Ray (lower)

Spinner

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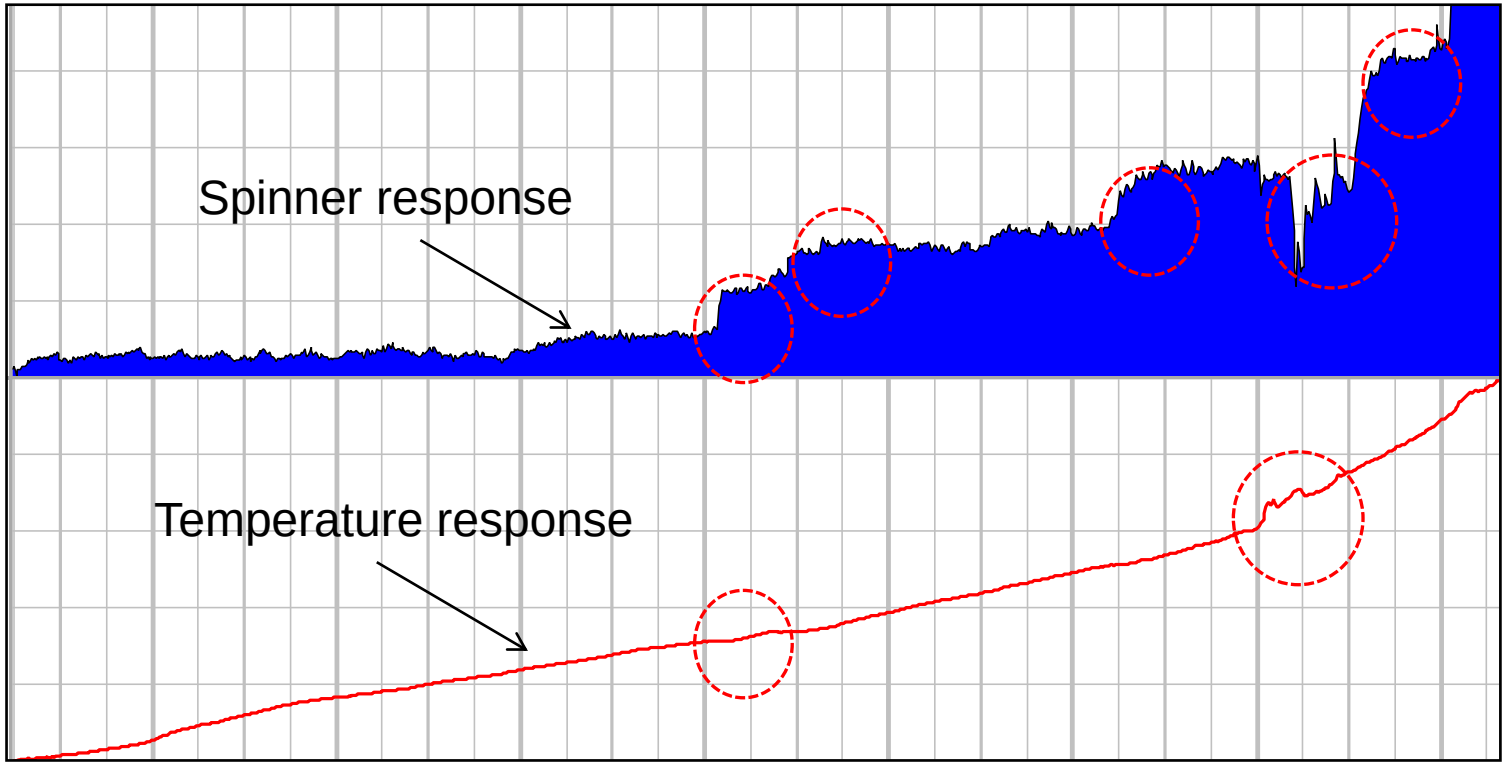
Oxygen Activation Stationary Stops



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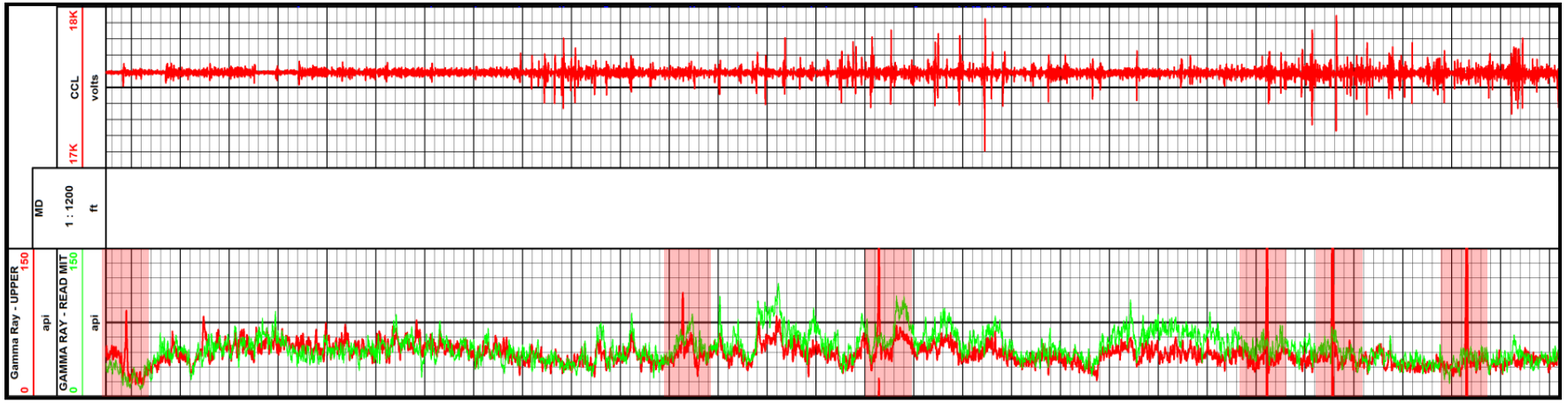
Oxygen Activation Stationary Stops



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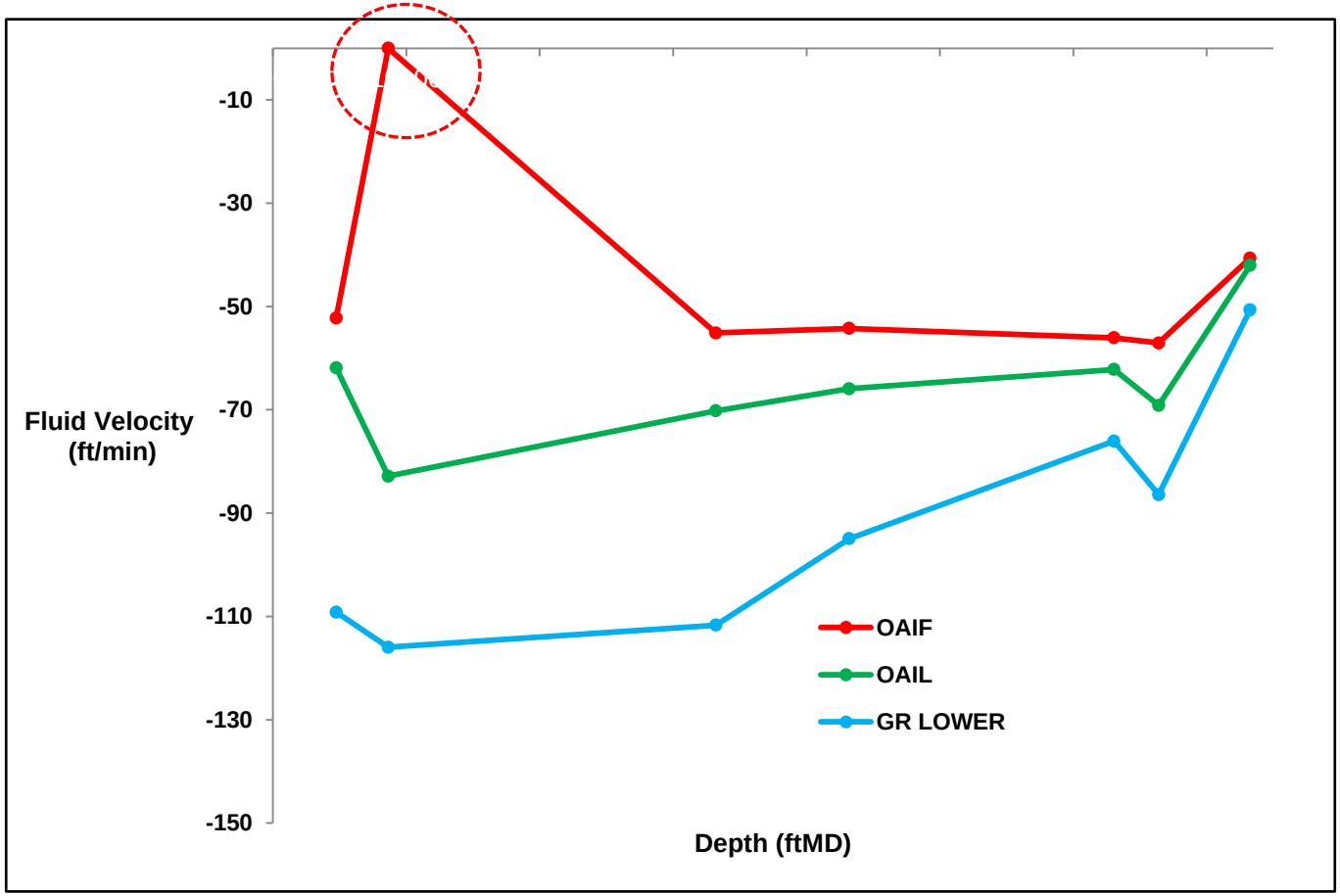
Oxygen Activation Results – Run One (Inverted)



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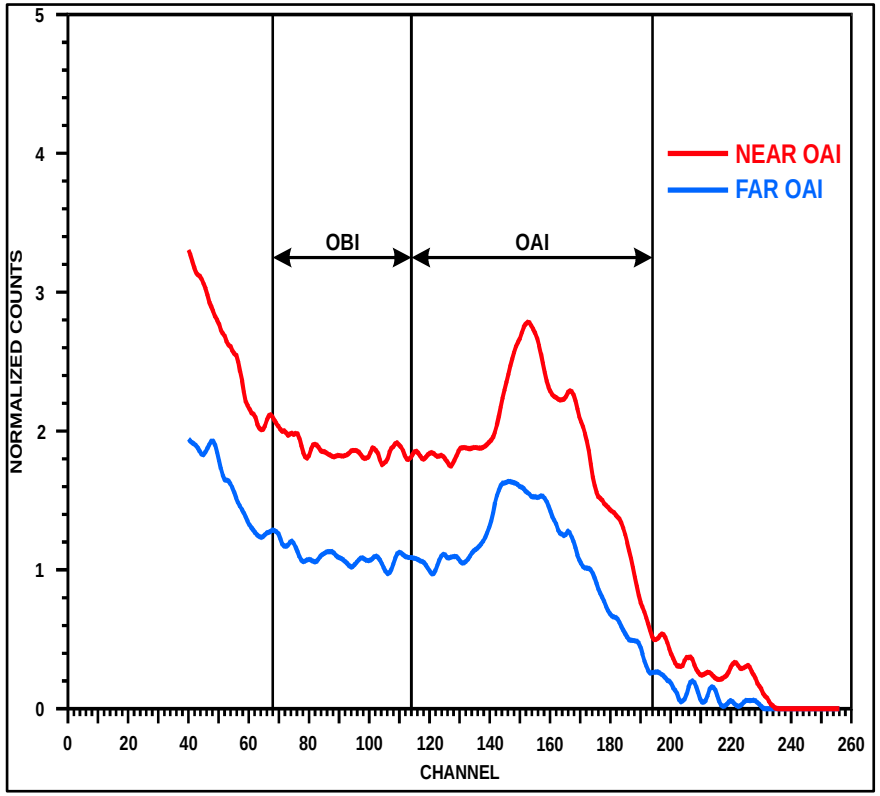
Pulsed Neutron Compton Ratio



$$Compton\ Ratio, CRAT = \frac{OAI}{OBI}$$

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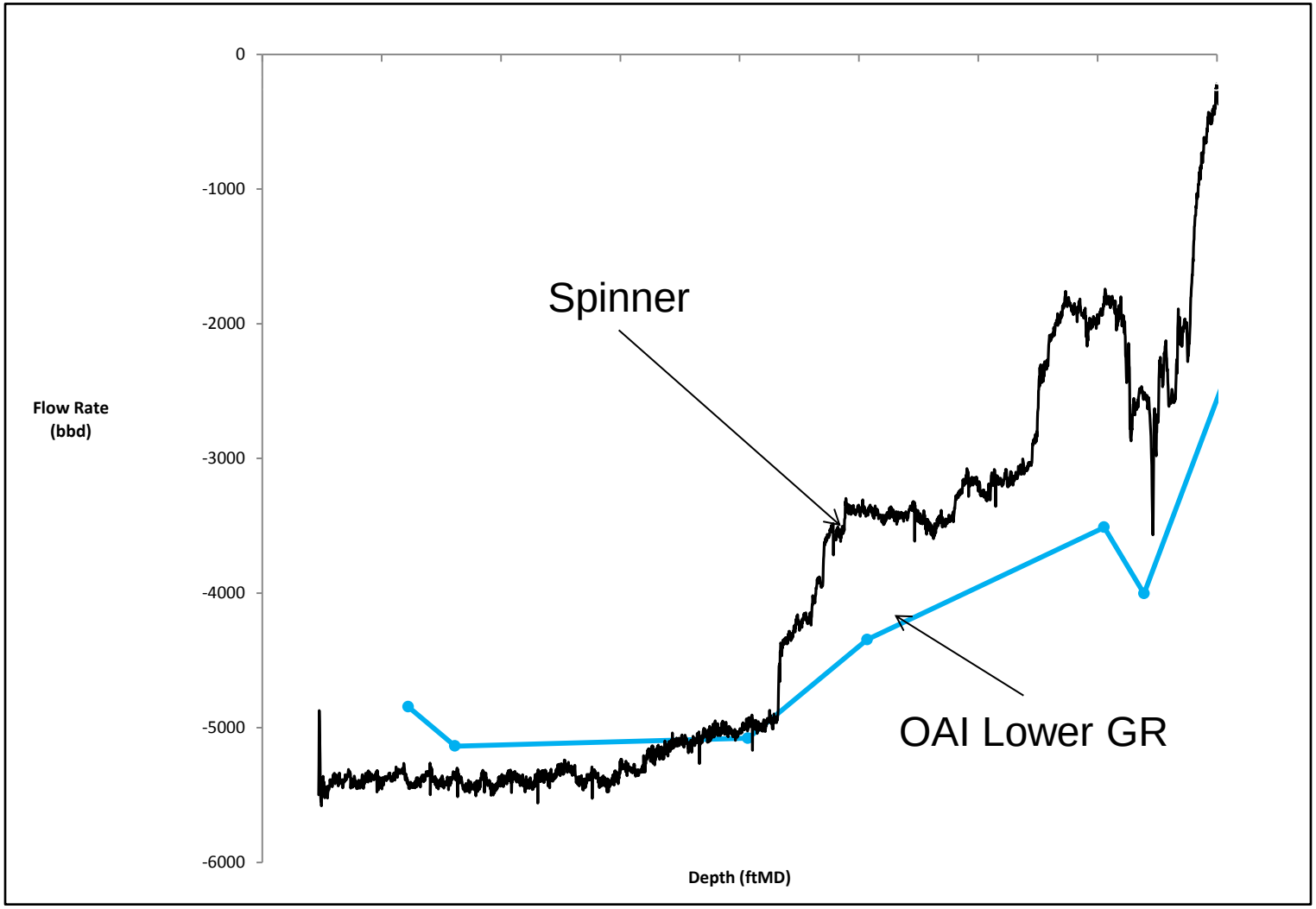
OAI vs Spinner – 5000bbd Injection



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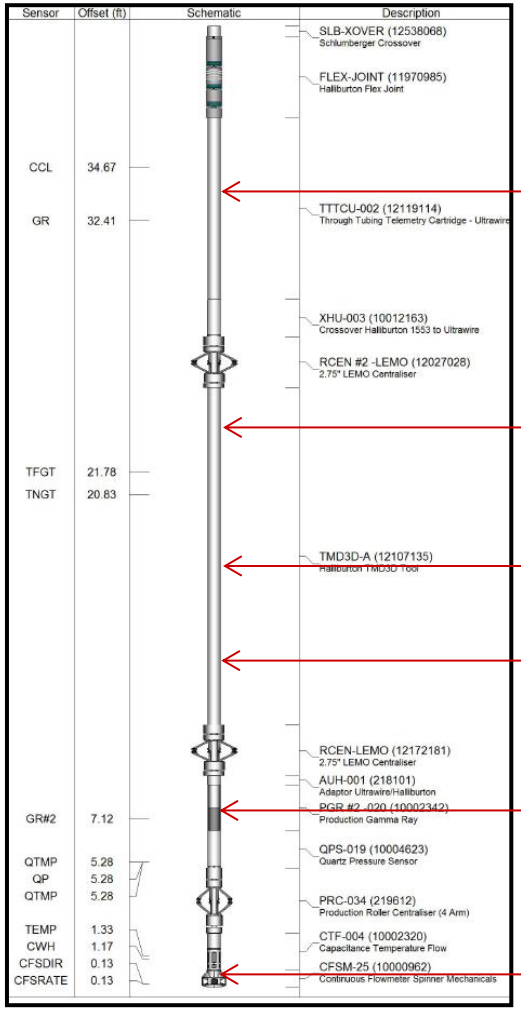
Pulsed Neutron Tool String– Run Two (Standard)



Gamma Ray (upper)

Upward flow measurement

TMD3D Long Detector

Upward flow measurement

TMD3D Far Detector

TMD3D Neutron generator

Gamma Ray (lower)

Downward flow measurement

Spinner

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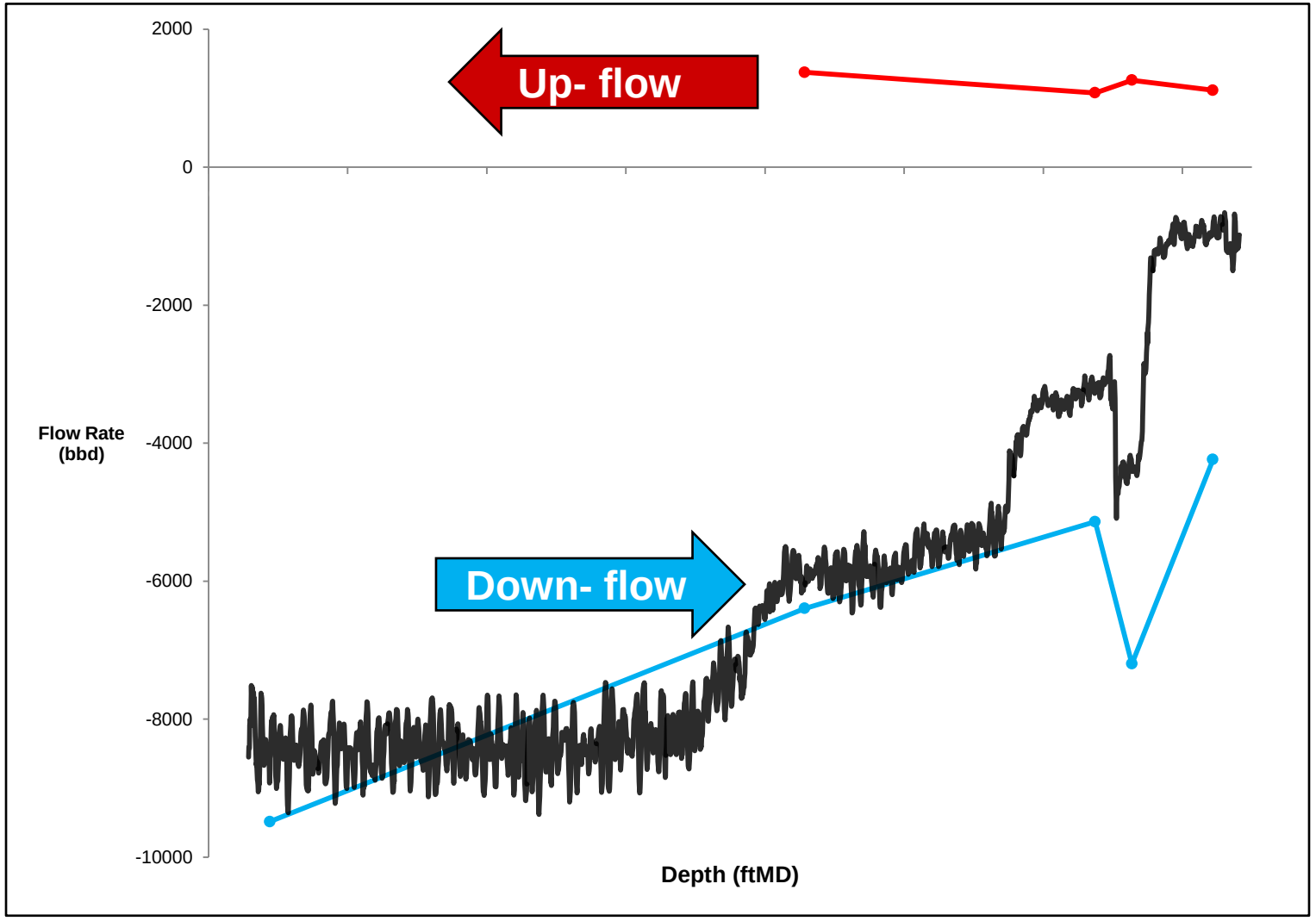
OAI vs Spinner – 9000bbd Injection



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Observations and Conclusions

- Characterisation of the pulsed neutron tool oxygen activation response allowed for a more accurate interpretation of the water flow rates.
- The flexibility of running the tool in inverted and standard mode allows for detection of water flow in both directions.
- Up flow was detected predominantly on the outside of the liner using pulsed neutron oxygen activation

THANK YOU

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