Sustainable Sand Management Control and Solutions - Balancing Performance, Costs, and Environment

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New Developments in Downhole Sand Detection Logging for Better Informed Sand Management Strategies and Improved Well Performance

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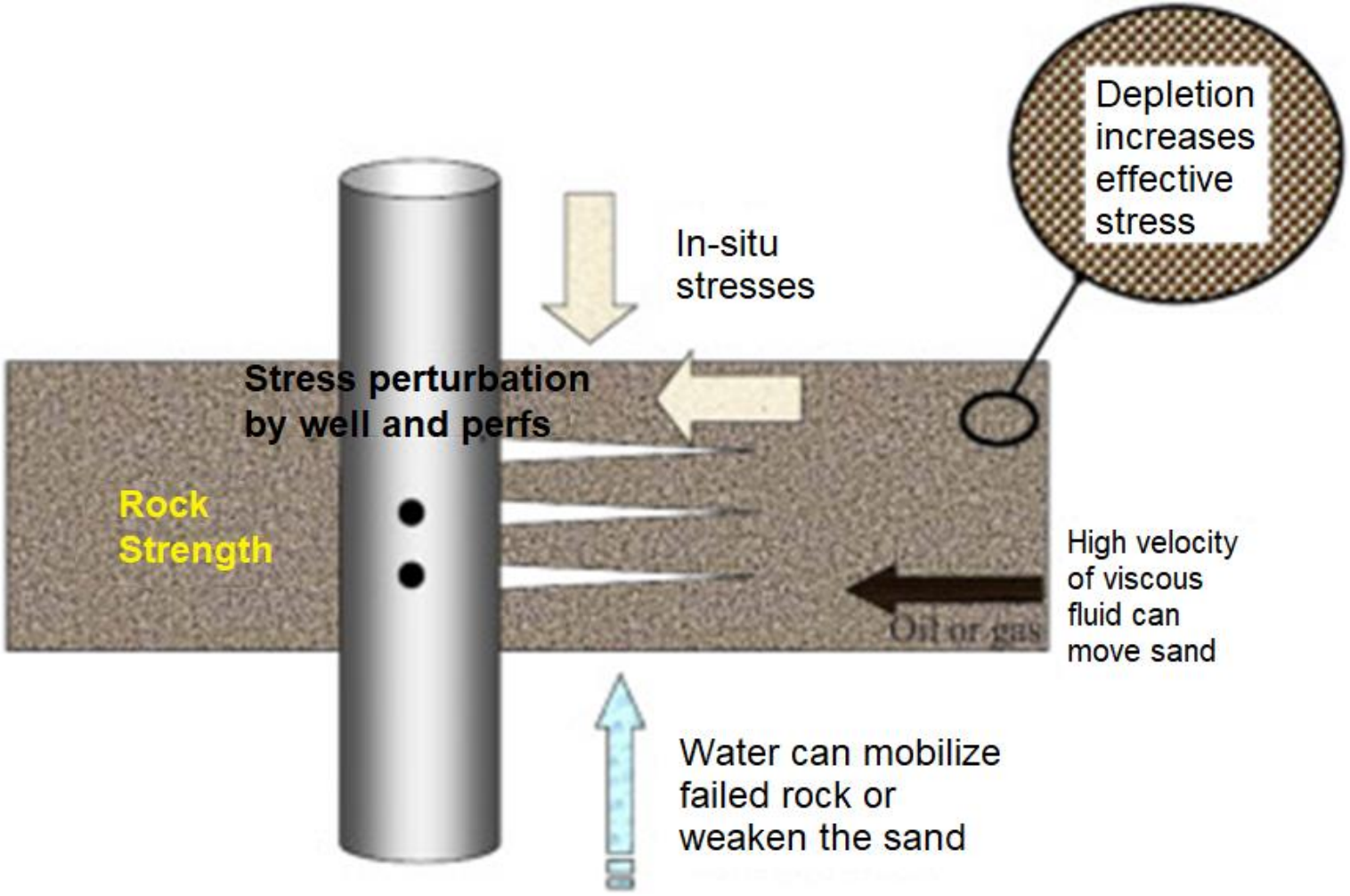
Sand Failure

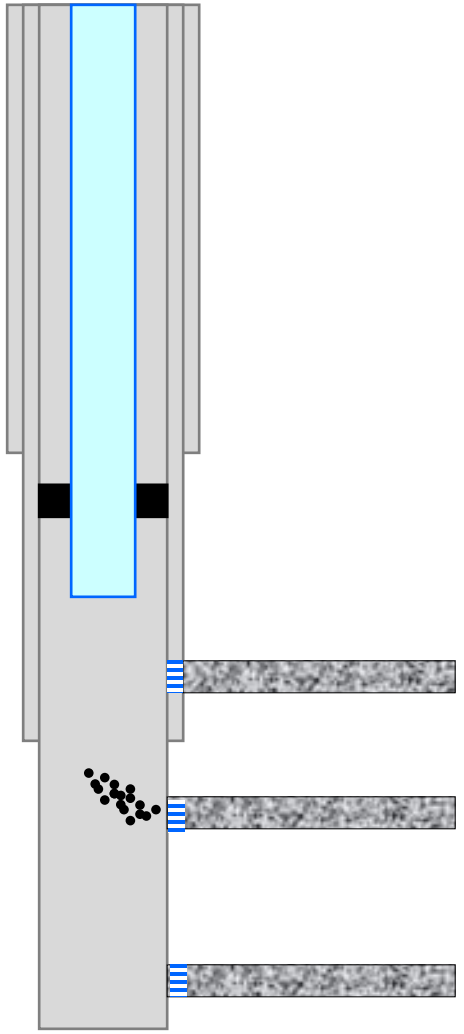
Occurs when stress exceeds strength



- Gas Production depletion = higher flow velocity. Higher chance to get sand production
- Water conning in oil well can mobilize sand
- In situ stress can weakened the rock strength

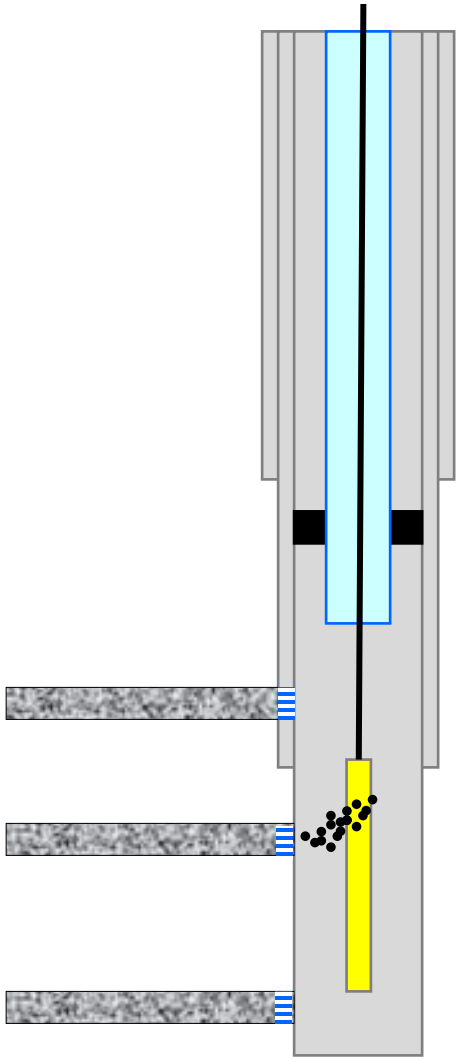
Challenges

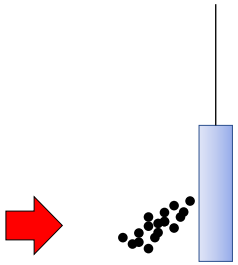
- Sand particle is varying in size
- Sand could be from any open perforation in multiple zone production
- Sand is flowing along with other mix fluid (gas, oil, or water)
- Sand particle movement velocity will be dependent to fluid velocity



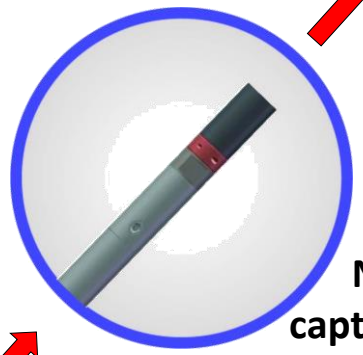
Sand Detection Tool

a particles hit count noise tool

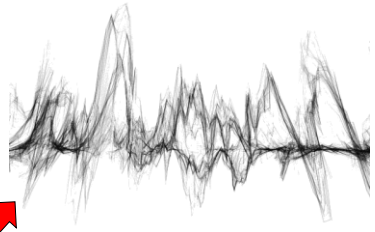




Noise generated by particle hit to tool body

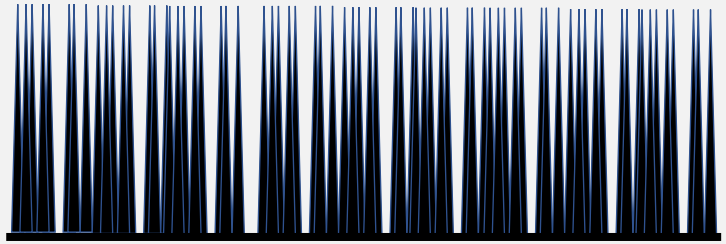


Noise signal captured by sensor



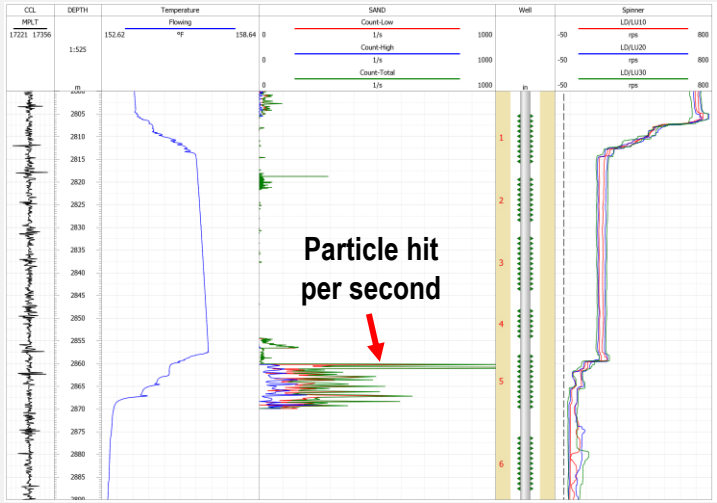
Filtered @ 500 – 700 kHz

Reconstructed Signal

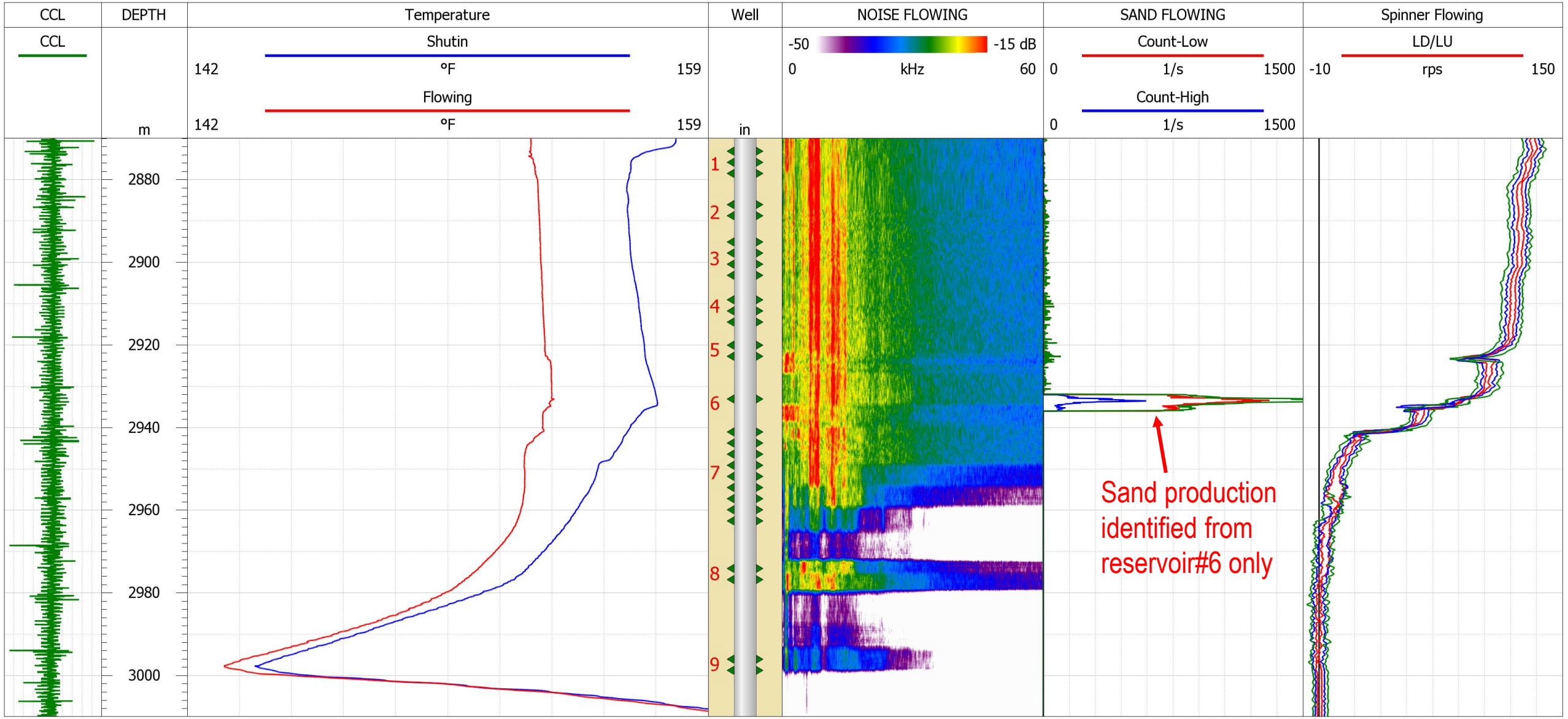


Pulse Counter

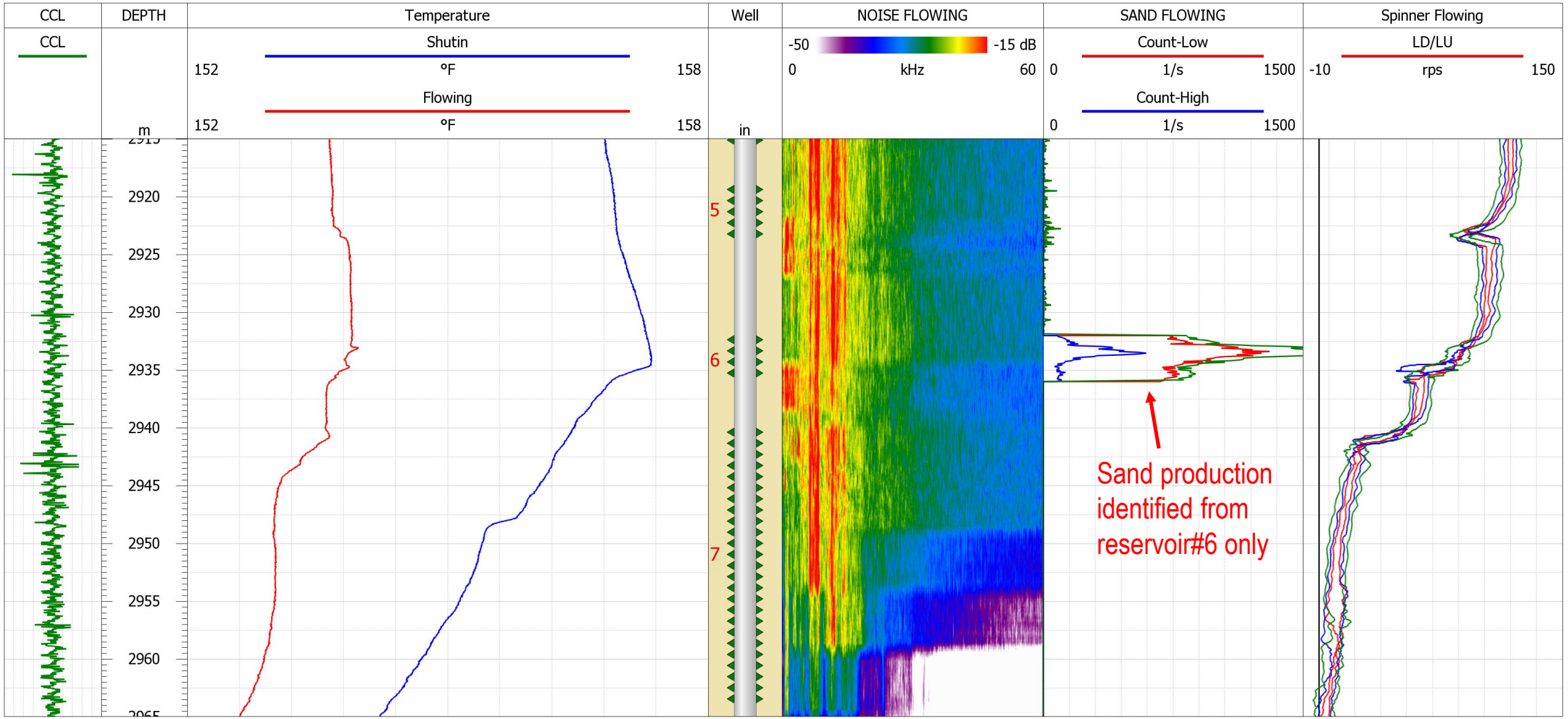
1 pulse = 1 sand hit



Case Example



Case Example (zoomed)



Q & A

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Downhole sand production often results in reduced well productivity, significant operational challenges, costly equipment blockages or damage, and additional operating costs to separate and dispose of the produced solids. Detecting sand influx at an early stage in the well life cycle is crucial to sand management, to prevent production interruptions and maintain well integrity. It is essential to investigate the sanding problem for effective planning of sand control techniques to optimize production, to extend the well life, and to increase economic returns. However, the traditional methods of sand detection, such as surface monitoring, downhole pressure and temperature measurements, and production logging tools, have limitations in terms of accuracy, sensitivity, and real-time monitoring capabilities. As a result, there has been a growing interest in developing new technologies to improve downhole sand detection and quantification in the industry.

Emerging technologies such as acoustic devices, fiber optic sensors, and intelligent completions offer promising solutions for detecting sand production in real-time and in providing valuable data for well management. Acoustic methods detect sand particles in the wellbore by analyzing the acoustic signals generated during production. Fiber optic sensors can provide continuous monitoring of sand production and offer insights into the flow dynamics within the wellbore. Intelligent completion systems offer the possibility to integrate sensors to detect sand influx along with control systems to optimize production and to reduce the amount of sand produced.

This work provides a comprehensive review of the current methods for downhole sand detection and introduces an innovative technology which utilizes a sensor that is sensitive to very high-frequency ultrasonic noise. This device is designed to differentiate between the acoustic signals generated by sand particles impacting the sensor and the noise produced by fluid flow. The sand particles can be categorized into several sizes by differentiating the frequency of the noise produced when the solids hit the sensor. By analyzing the frequency, amplitude, and timing of the acoustic signals, the technique detects sand entry zones and provides count rates based on particle size, to help estimate the downhole sand production.

Various case studies will also be discussed in which the technology was successfully deployed in gas wells in the Asia Pacific region. These wells were producing from multiple perforated intervals, and the gas production was being choked back to restrict the sand entry, but this was in turn limiting the well deliverability. In these examples, the new sand detection technology was used in conjunction with a spectral-type noise tool, and conventional production logging sensors.

The sand detection sensor data clearly identified the sand producing zones, while the other tools showed no such response. However, the spectral noise tool helps in diagnosing fluid flow activity behind casing, while the production logging data allows flow rate calculations for each zone, providing beneficial decision-making information for further actions to manage the sand production. Ultimately, this new technology offers a non-intrusive and efficient method for sand diagnostics, enabling operators to reduce well integrity risks, minimize equipment damage, and enhance overall well performance.

Keyword: sand production, sand detection technology, acoustic sensor, high frequency sensor, noise, optimize production