Case Study: BitLife

$15M USD Saved Through Bit Trip Optimization

Client

A major E&P operator in Sub-Sahara Africa utilizing a deep-water rig for an exploration campaign. Drilling was done using with synthetic oil based muds.

Challenge

The operator was faced with periods of very slow drilling and was reliant on standard surface readings to try to determine if the drill bit was still performing. Being an exploration well, it was difficult to assess if the low ROP was caused by a lithological change or if the bit was no longer functioning. Any round trip to verify or replace the drilling bit took five (5) days.

Solution

As the client was utilizing a synthetic oil based mud, if the low ROP was due to the bit being worn, then it was highly likely that "bit burn" would be evident. Deploying GEOLOG's "BitLife" service would enable the surface detection of the alkenes associated with this phenomenon and thus confirming a worn bit.

Results

The "BitLife" service was deployed and a direct correlation was observed between the presence of alkene gas contamination (ethylene and propylene) and the low rates of penetration.
The bit was removed after this correlation was seen for a period of time and the bit was found to be extremely worn and damaged. Thus, it confirmed the interpretation of the "BitLife" service. Subsequent bit runs were then performed utilizing the results from the "BitLife" service as the key indicator as to when a bit trip was necessary.

Value

The improved bit trip efficiency resulted in a client-estimated savings of $15M USD.
This was calculated based on the reduced number of bit trips required (no longer were 'verification' trips necessary) and by eliminating the time previously spent drilling with over-worn bits.

Services used

BitLife

Confirming that worn drilling bits are the reason for low ROPs

With bit trips taking approximately five days of rig time, it was essential that the operator was only making bit trips when necessary. Slow ROPs were experienced but it could not conclusively be proven that it was due to bit wear. The only method available to confirm this was a time-consuming and expensive bit trip.

GEOLOG's "BitLife" service allows for the surface monitoring of drill bit metamorphism or "bit burn" effects in near real-time

The "bit burn" effect occurs when bit wear reduces the cutting action of the drill bit and, therefore, increases the frictional effects. This then generates increased levels of heat which can cause temperatures at the bit to rise to as high as 800°C. At these elevated temperatures, alkene gases are produced due to the cracking of the hydrocarbons within the drilling fluid (OBM, SBM, or WBM with oil-based additives). The "BitLife" service monitors the presence of these gases in order to complement the traditional surface readings (such as ROP and Torque) to provide an over-all picture to the drilling team which allows for optimal decisions to be made in regards to bit trips.

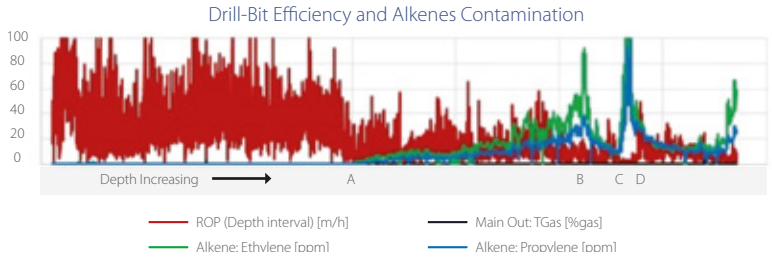

Figure 1. Drill Bit Efficiency plot highlighting ROP and detectable Alkenes. "Drill-Bit-Metamorphism" effect was observed starting at point A. Alkenes continue to increase until point B, indicating the ideal time to perform a bit trip. An additional increase in Alkenes occurs at point C, correlating to extremely low ROP before performing the bit trip. Point D marks the start of the new bit, which demonstrated extreme wear very quickly due to junk left in the hole.

Figure 2. PDC bit shown before and after drill bit metamorphism. Bit on the right, note the center has completely broken off and the bit is under gauge. Metal left down hole can result in additional NPT for fishing operations, circulation to clear debris and damage to subsequent bits.

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