

Case study: Indonesia

PERFLEX high-performance WBM system successfully drills through problematic paleosol zone in geothermal well

A major geothermal operator in North Sumatra, Indonesia required a well-strengthening solution while drilling through a paleosol formation.

In geothermal fields, paleosol is classified as a reactive formation layer and can potentially cause significant hole problems. While drilling previous wells in the formation, the operator experienced five consecutive stuck pipe events and two lost-in-hole (LIH) bottomhole assembly (BHA) incidents that increased drilling time and costs to target depth (TD).

The operator asked Baker Hughes to develop a drilling fluid solution that would help safely drill the geothermal well to TD without stuck pipe incidents. The resulting high-quality wellbore would also facilitate efficient running and setting of the production liner to bottom.

Collaborating on an optimal fluid solution

Because Baker Hughes was already providing geothermal well construction services to the operator, the service provider quickly began work on developing the right fluid strategy. Through close collaboration with the operator's subsurface and drilling teams, the Baker Hughes team reviewed all downhole data related to the problematic paleosol zone.

The team performed a thorough series of shale studies to customize the fluid design for the formation. These studies included conducting erosion, accretion, and linear swell meter (LSM) tests on paleosol cutting samples from the most recent stuck pipe event.

X-ray diffraction studies were also performed on core samples.

Based on the results of the shale study, the team proposed drilling through the paleosol formation with a standard potassium chloride (KCl) polymer customized to the PERFLEX™ high-performance, water-based drilling fluid system.

The PERFLEX formulation for this particular formation included the MAX-GUARD™ shale control additive, a polyamine that suppresses clay hydration, swelling, and plasticity to lower the risks of bit balling. The formulation also included the PENETREX™ rate-of-penetration (ROP) enhancer, which preferentially wets the surfaces of tubulars, the drill bit, and formation to reduce torque and drag while increasing ROP.



This microscope image shows red paleosol in the cuttings sample.

Challenges

- Drilling through paleosol formation raises risk of wellbore instability
- Borehole degradation during drilling creates higher rate of stuck pipe incidents
- An unstable wellbore prevents efficient running of the production liner to bottom

Results

- Improved wellbore stability with customized fluid design
- Successfully drilled through paleosol formation and reached TD
- Reduced drag on liner during tripping
- Reduced the formation of highly dispersive and accretive cuttings to minimize bit balling
- Allowed the operator to save approximately \$1 million USD by preventing LIH incidents

Reaching TD with high efficiency

The operator drilled the next geothermal well on the same pad with the customized PERFLEX formulation.

This drilling job marked the first time a polyamine additive was used in a geothermal well.

The PERFLEX system minimized borehole degradation and sloughing while drilling through the paleosol formation. This reduced the risk of bit balling while allowing the bit to pass through the formation to TD, with no

stuck pipe events and with higher average ROP than previous wells.

This allowed the operator to save approximately \$1 million USD from preventing LIH incidents.

The fluid system helped produce a stable wellbore that reduced drag during liner tripping. As a result, the production liner was successfully run and set at bottom, allowing the operator to deliver the geothermal well to plan—in less time and at lower overall operating costs.