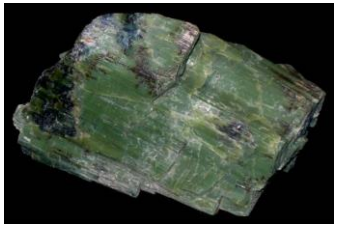
Successfully Drilled 1,300 m Serpentine with STIFF DRILL D

Serpentine, which is a volcanic rock, caused drilling difficulties. Wellbore cavities and pack-off are generally observed problems which causes high torques, pressure build up at SPP and even loss of the well. To minimize well stability problems, modified stress-cage system; STIFF DRILL D was improved and achieved in the serpentine section. The serpentine formation is the deepest and longest one in that area as well as in Turkey.



Situation:

Well stability problems during 1,300 m drilling in serpentine formation in Kütahya Gediz graben

Well Information:

Interval drilled:	12 ¼ in hole for 1,132 m
	8 3/8 in hole for 813 m
Total Well Depth :	2,545 m
Serpentine Drilled:	434 m with12 ¼ in bit
	726 m with 8 3/8 in bit

Challenges and Problems:

- Wellbore Stability and Hydrostatic Pressure Control due to Serpentine
- Formation Losses
- Increase in Rheology
- Due to geothermal gradient, the drilling fluid, which was left in the hole, was exposed to high temperature for a long time

Solutions:

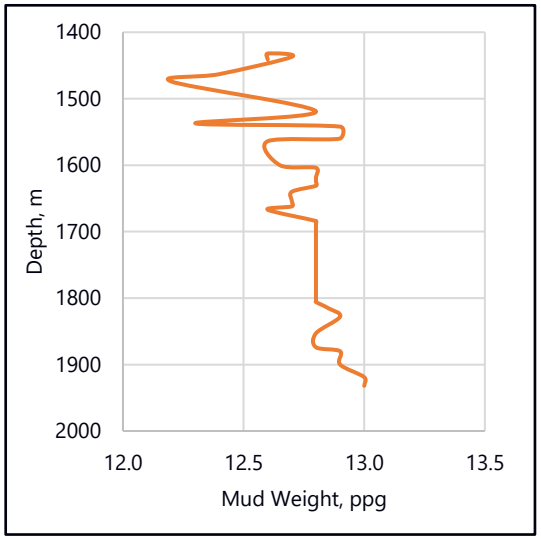
STIFF DRILL D is a high performance water-based drilling fluid that adds value to stabilize the serpentine formation with special wellbore strengthening chemicals involved in it. Fluid loss of the system, mud cake quality and encapsulating inhibition were controlled by special polymers and so minimized swelling, dispersing, pack-off potential of the formation. Solid and liquid lubricants were used in this application to minimize the friction between the drill string and casing / formation. Also, special polymers were used to control the rheology to keep the cutting carrying capacity in optimum levels and encapsulate the cuttings to carry to the surface undamaged.

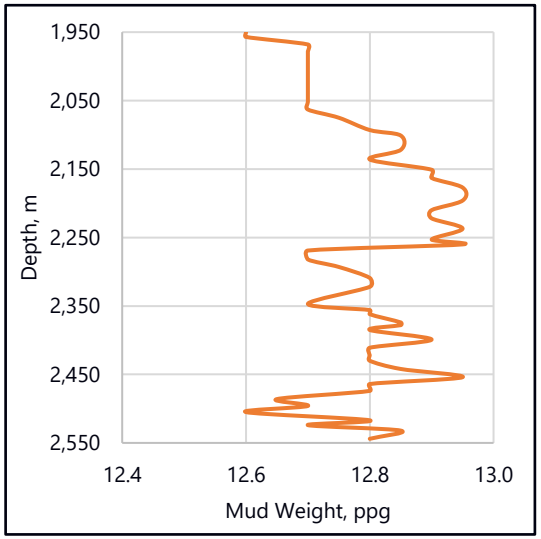
To stabilize serpentine, it is required to minimize pressure and stress release on borehole. Moreover, reduced torque was indispensable for high penetration rates. For those purposes, additives were used in general composition of the drilling fluids.

- BORESTIFF G is a water dispersible gilsonite primarily designed to stabilize mechanically weak or fractured shales when used in water-base drilling fluids
- BORESTAB N is a sulfonated asphalt designed as shale inhibitor and high temperature fluid loss control additive.
- FIBROCEL is a fine grade cellulose fiber used to control seepage loss in water-base drilling fluids
- SLIDE G is high performance graphite, specially sized and formulated lubricant for drilling fluids.
- SLIDE L is a high quality, highly active, environmental friendly based on modified vegetable oil used as a lubricant and surfactants.

Formation Strengthening Pill, FSP, were also applied before trips and run in casing operations. FSP composition was 6 ppb BORESTIFF G, 6 ppb BORESTAB N, 10 ppb SLIDE G, 5 ppb FIBROCEL C and 2 vol% SLIDE L.

To increase physical stability and balance stress on wellbore, drilling fluid density, MW, was increased by GEOBAR. Before 7" casing operation, MW was increased to 14.1 ppg.





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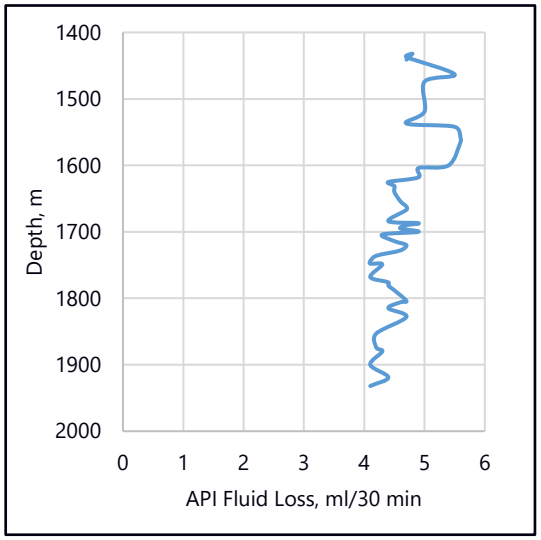
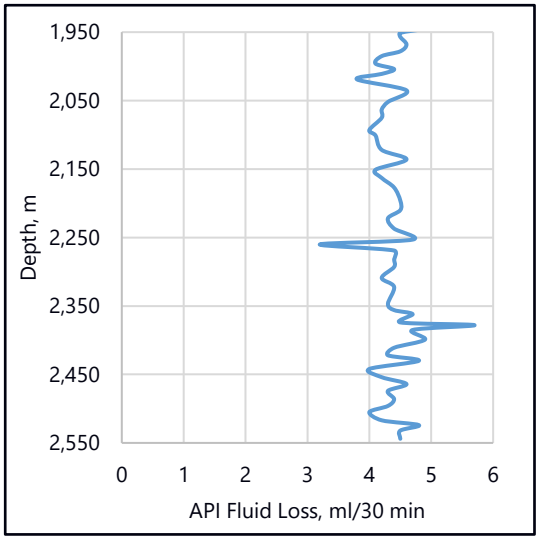
Due to high risk of swelling at clay layers, to minimize API Fluid Loss, special chemicals were used with support of REOPAC LV

- HOTTROL NP sodium polyacrylate copolymer is a medium-molecular-weight, anionic additive used to reduce fluid loss in freshwater and seawater mud.
- REOPAC LV is a premium grade low molecular weight polyanionic cellulose (PAC) used to control fluid loss in all types of water-base drilling fluids.
- LIGTROL N is synthetically formulated resinated lignite designed to control filtration and rheological stability of water-base drilling fluids over a wide range of temperatures.

Wellbore strengthening material, WSM, were used to minimize capillary generation through formation. WBSM pill (with a composition of 5 ppb FIBROCEL C, 22 ppb GEOCARB F, 22 ppb GEOCARB M, 22 ppb GEOCARB C, 6 ppb BORESEAL G, 6 ppb BORESTAB N, 10 ppb SLIDE G) were circulated.

High rheological readings were measured during the first circulations which was hold just after long tripping time. Due to geothermal gradient, the drilling fluid, which was left in the hole, was exposed to high temperature for a long time. For conventional drilling fluids, temperature is high enough to degrade Bentonite and polymers and results in an increase in viscosity. In addition to this, active clay layers reacted with water based system and boost effect of temperature on viscosity and rheology.

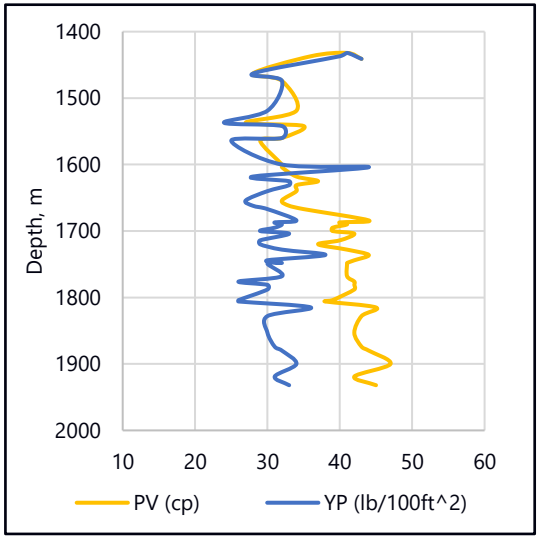


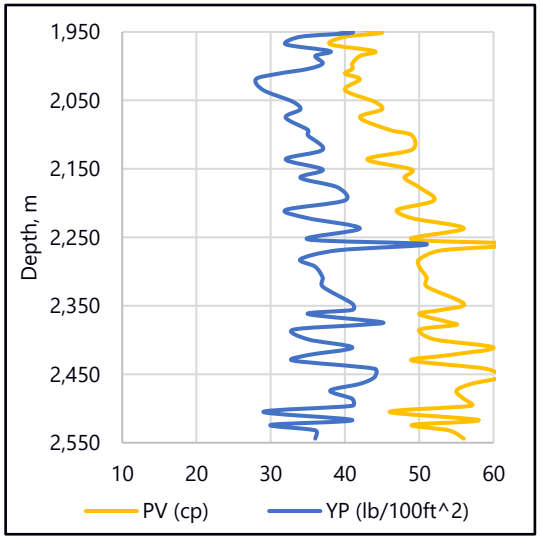


GEOTHIN HT, which is a liquid anionic acrylic copolymer, was used to control rheology. GEOTHIN HT was used in general formulation of STIFF DRILL D, see graph. Moreover, GEOTHIN HT pills, contains 2 vol% GEOTHIN HT, was left in the hole during each trip.

Results:

No NPT was reported**.** The well was drilled safely to total depth with the drilling fluid proving to be very stable for high temperature. The fluid loss and hole stability were controlled easily. Casing was set at the end of this formation successfully.





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About STIFF DRILL D:

- High performance water based drilling fluid system
- Maximized hole stability
- Active API Fluid Loss control
- High cutting caring capacity
- Enhended lubricisity

General formulization of STIFF DRILL D was used in the application is below.

Additive Name	Function	Concentration (ppb)
GEOBEN NT	Viscosifier & Fluid Loss Control	10.0 - 20.0
REOPAC LV	Fluid Loss Control	2.0 - 6.0
BORESTAB N	Shale Stabilizer	2.0 - 6.0
SLIDE G	Lubricant & Hole Stability	2.0 - 6.0
BORESTIFF G	Shale Stabilizer & LCM	2.0 - 6.0
REOZAN D	Viscosifier	0.25 - 1.0
GEOTHIN HT	High Temperature Deflocculant	0.5 - 1.5
HOTTROL NP	HT Fluid Loss & Rheology Control	0.5 - 1.5
GEOCARB M	LCM	10.0 - 20.0
GEOBAR	Weighting Material	147 - 245
CAUSTIC SODA	Alkalinity Control	0.5
SODA ASH	Calcium Remover	0.25