Stick-slip of the Drill-string in Well-Drilling processes- Causes, Effects, and Mitigation. A case study for Rumaila Field, Southern Iraq

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Abstract

This study was accomplished in order to study the effects, causes, and mitigations of stick-slip phenomena in the Rumaila field, southern Iraq using the data obtained from two wells in addition to the field monitoring.

The wells R-XX3 and R-XX8 were drilled in the Rumaila field with polycrystalline diamond compacts (PDC) bits on PD900. The bit type (QD506FX) was used in order to drill most of these intervals while the rest was drilled by MSi616 bit after which the Bottom hole Assembly (BHA) was changed to a Tungsten Carbide Inserts (TCI) bit on Positive-Displacement Motors (PDM) BHA. Stick-slip levels were high throughout the 2 PDC runs and varying formations, formation strengths, drilling parameters, or bit cuttings structures showed no considerable difference in stick-slip levels. Stick-Slip levels were high (~2xCRPM) during both PDC runs. There is no noticeable change in stick-slip levels with varying formations, formation strengths, drilling parameters, or bit-cutting structures. The collar RPM fluctuations are within a wider range in the UER formation. The range slims down in the subsequent formations but there is no change to Stick-Slip levels. ROPs dropped considerably in Shiranish and Hartha Formations (2-6 m/hr). The IDEAS sensitivity analysis on the MSi616LPX shows that there are no severe vibration levels seen at the bit with the given drilling parameters and rock types. The dull condition does not indicate the bit being subject to severe stick-slip levels as seen in the Drilling Mechanics Logs.

Keywords: Stick-slip; Rumaila field; ROP; WOB; Sensitivity analysis

1. Introduction

Stick-slip is defined as an alternate slowing and acceleration of the Bottom Hole Assembly (BHA) rotation. Stick-slip occurring while drilling with a tri-cone bit is usually due to drill string or wellbore contact (Abdollahi and Skalle, 2003). In other words, Non-uniform rotation in which the bit or BHA may stop rotating momentarily at regular intervals may cause the string to periodically torque up and then spin free and accelerate to high speeds (Greenwood, 2016; Kessai et al. 2020; Al-Dujaili et al. 2025).

The drill-string system of the well drilling process is practically utilized in order to move torque from the rotary table to the drill bit in the borehole (Lin et al. 2020). This lengthy and skinny structure constructs a drilling technique exposed to the stick-slip problem, a self-excited torsional vibration (Liu et al. 2017) Stick-slip shakings lower drilling efficiency, reduce borehole quality, induce early drill-bit wear, and yield drill-string collapses (Richard et al. 2007). These vibrations exist in 50% of the drilling time provoking the drill-bit to switch and rotate at a high rate, which may guide to extreme bit shaking and spin movement at the (BHA) Figure 1 (a). The term bit shaking directs to axial vibrations of the drill bit leading to loss of connection between the bit and the drilled formation. At the same time, whirl movement is due to drill pipe abnormality creating lateral vibrations.

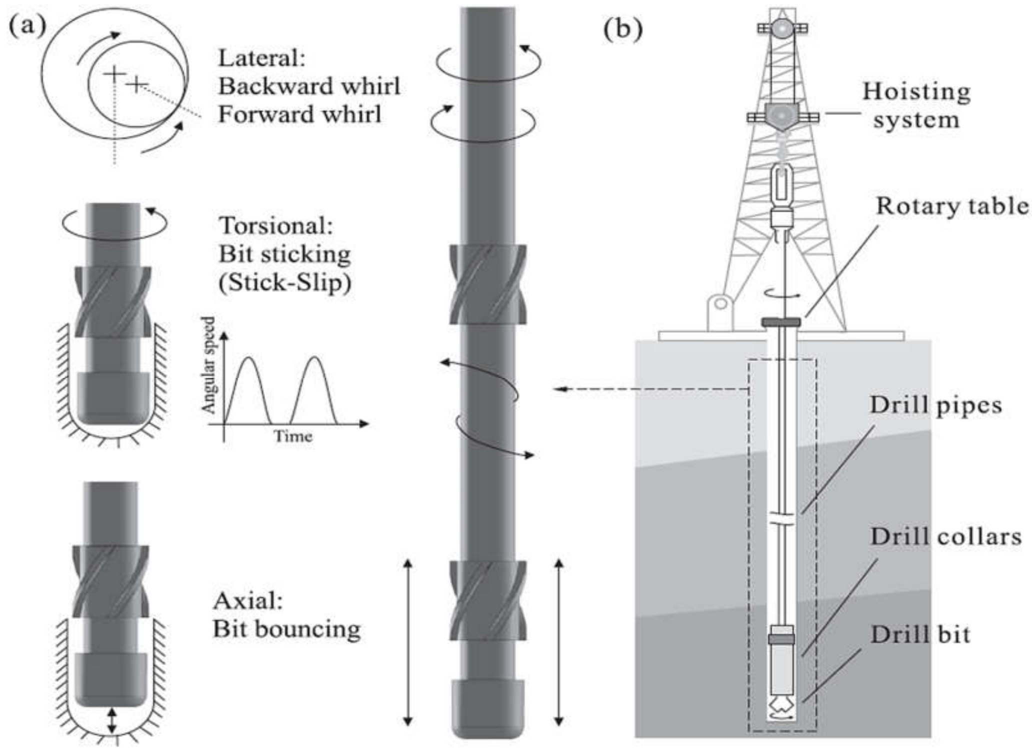

Figure 1: (a) Lateral, torsional and axial vibrations encountered in drill strings during operation, and schematics of (b) an oil well drilling rig (Liu et al. 2019).

Stick-slip is classified according to its severity status into low, medium, high, and extreme (Table 1). (Akinniranye et al. 2007 and Gupta et al. 2019).

Table 1. Classification of stick-slip percentage risk (after Akinniranye et al. 2007)

	Stick-Slip Percentage	Risk
1	50%	Low risk
2	50-100%	Medium risk
3	100-150%	High risk
4	> 150%	Extreme risk

Numerical modeling techniques (finite element or finite difference) were utilized to study the dynamic behavior of the drill string (Ghasemloonia et al. 2015). Vibration problems are typically managed via bit, borehole assembly, or drill string redesign, which are regularly expensive.

Using active control systems (Kyllingstad and Halsey, 1987) has enhanced the stick-slip vibrations modeling using surface data and a transfer matrices procedure (Ertas et al. 2014). The affordable technique (widespread) is to merge drilling input parameters (rotary RPM and decreasing WOB) to “break out” of the harmonic vibrations or stick-slip (Macpherson et al. 1993) or to reduce the WOB (Arjun and Teodoriu 2013). The use of real-time drilling parameter control for the reduction of stick-slip with active monitoring has been successful (Shuttleworth et al. 1998).

1.1 Torsional Shocks (Causes of Stick-Slip)

1. bit or BHA/wellbore friction
   Cull et al. 1999 revealed that the main reason for the stick-slip phenomenon in the downhole drill string system is the reciprocal friction between the drill bit and the bottom of the well. (Cull and Tucker, 1999, Liu et al. 2014, and Tian et al. 2020).
2. Alternate slowing down and speeding up of (BHA) rotation
   The slowing down or speeding up of the Bottom Hole Assembly (BHA) appears when the power generated by the rotary technique on a drilling rig (in the form of a surface swirl) fails to run the drill bit (Sheth et al. 2022).
3. Drill-string will periodically torque up and then spin free.
   – BHA can overextend itself and undergo backward rotation.
   – Bit accelerate to high speeds (Sadeghi et al. 2022) (Figure 2).

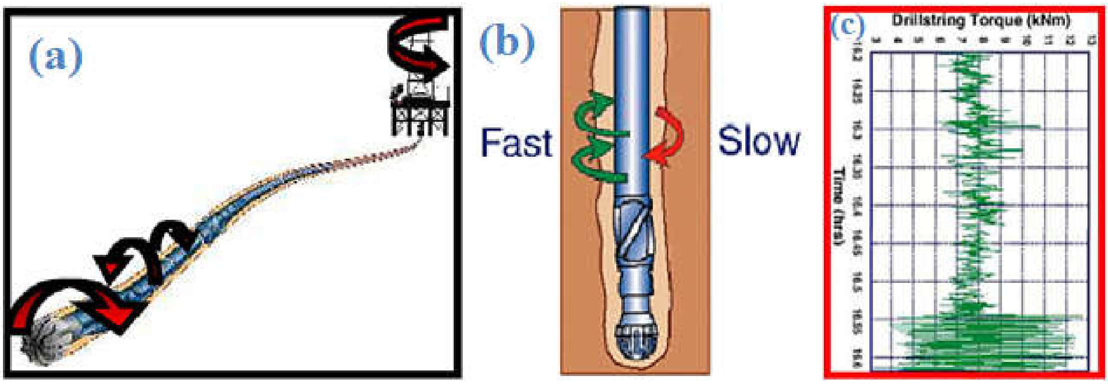

Figure 2: (a) Types of shocks and vibrations, (b) Torsional shock and vibration (stick-slip), and (c) the increasing of drilling torques while the time of drilling

Axial, lateral, and torsional shocks are the three types of drill string shock and vibration. As in Figure 2, Torsional shock and vibration (i.e. stick-slip) cause irregular downhole rotation, which can be seen while drilling in a severe form of torsional oscillation in which a bit or drill string becomes stationary for a period.

1.2 Effects of Stick-slip on the drilling process

Extreme torsional drill string shakings can affect drill pipe and PDC bit life detrimentally. These shakings are linked with accelerated PDC bit wear. It is possible that this accelerated wear results from torsional vibrations, mainly because it is possible for the bit even to spin rearward at some point during a cycle. These vibrations reduce the Rate of Penetration (ROP) and can appear in more than 50 % of the total time of a rig step (Challamel et al. 2000). The high-frequency stick-slip vibrations may lead to drill-string fatigues and even premature rupture (Riane et al. 2022).
The stick-slip will cause washouts and Twist offs tool joint damage (Xue, 2020).
Premature bit failure (PDC cutters chip off due to backward rotation) may also happen due to a stick-slip problem (Xiaofeng et al. 2022). Severe stick-slip can lead also to BHA failure; stabilizers wear, and over-torqued connections (AlGaiar et al. 2022).

1.3 Drilling environment that enhances stick-slip problem

According to (Sarker et al. 2017), many factors can make a good environment in order to create the stick-slip phenomenon and impact the efficiency of the drilling process such as:

1. High friction for wellbore and BHA due to high friction drilling mud.
2. Using aggressive PDC.
3. BHA stabilization and Stiffness, Hole to String size ratio.
4. Formation Lithology: such as Sticky formations (most sandstones and limestones), hard and or abrasive sands, and interbedded formations.
5. Selection of angle and tortuosity (- 0-15° worst, 35-60° bad, and 15-35°, +60° good).
6. Water-based mud system with low lubricity.
7. AC top drives can exacerbate stick-slip by allowing drill-string resonance to continue.
8. Poor Drilling Parameters and practices.
9. Side forces, which Increase the BHA/hole contact.

2. Geological Setting

North Rumaila Field is one of the supergiant fields (AlMalikee et al. 2018), which is located 50 km west of Basra city and 30 Km west of Zubair Field (Al-Mudhafar et al. 2010) in southern Iraq, which was discovered in 1953 and currently contributes to 33% of Iraq's oil production (Salih et al. 2016). Multiple Clastic and Carbonate represent the main oil reservoirs (Mishrif, Nahr Umr, and Zubair) (Almalikee et al. 2018). Rumaila field enfolds an area of 1600 km2 with an 80-km-long, north-south anticline (Al-Dujaili et al. 2021a), which extends with sloping from about 70 m above the sea level at the Iraqi-Kuwait border to near sea level at the West Qurna Field into the north (Al-Dujaili et al. 2021b; Al-Dujaili, 2023). This field geologically consists of two domes (northern and southern) (Shamkhi and Aljawad 2021, Al-Dujaili, 2024).
that represent gentle sloping longitudinal anticline stretching about 83 km long and 12 km wide (Handhal et al. 2022) (Figure 3).

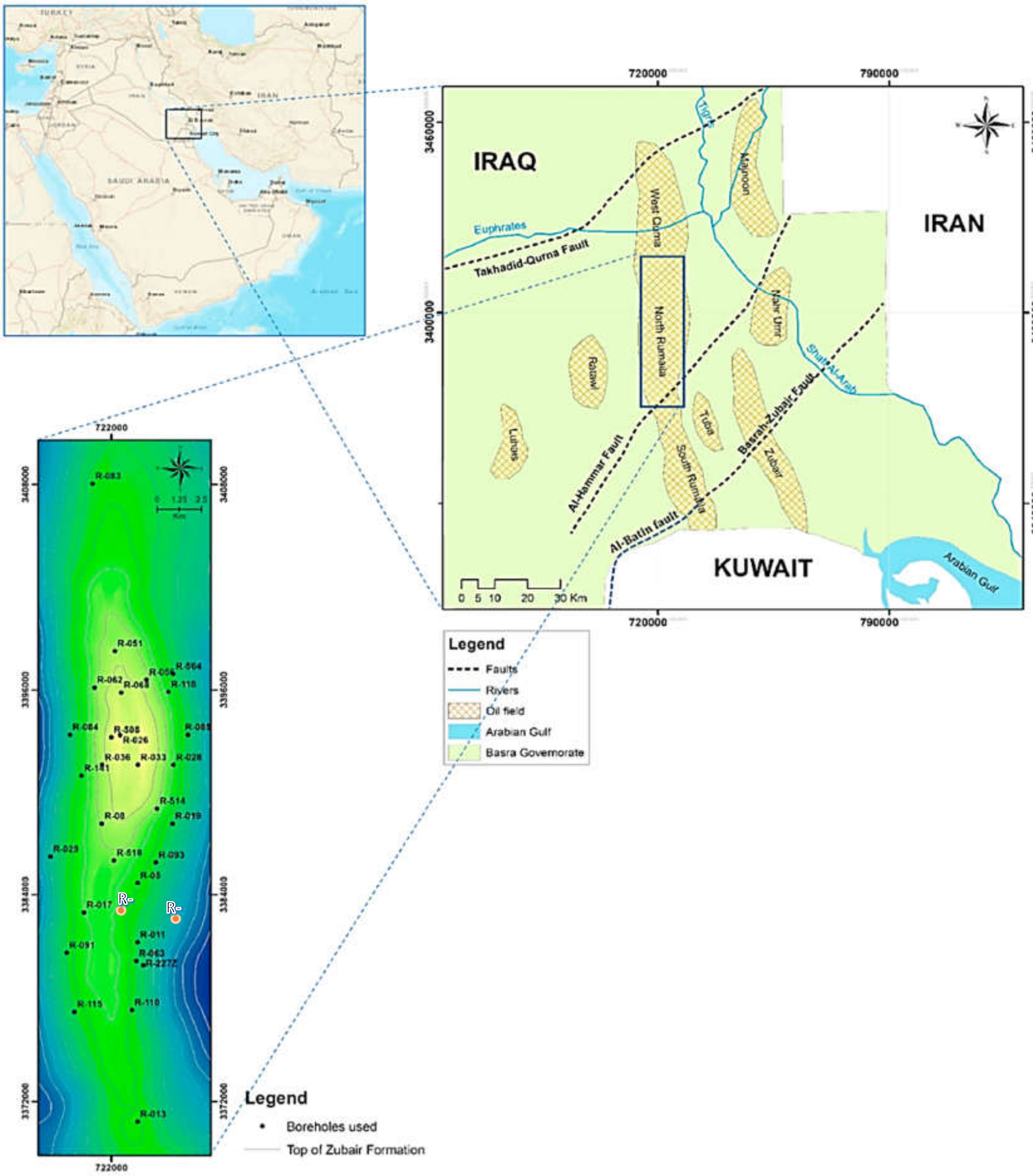

Figure 3: Rumaila field relative to other fields and transverse fault zones in the Zubair subzone of the Mesopotamian foredeep basin (Handhal et al. 2022)

The Stratigraphic column of the North Rumaila field shown in Figure 4.

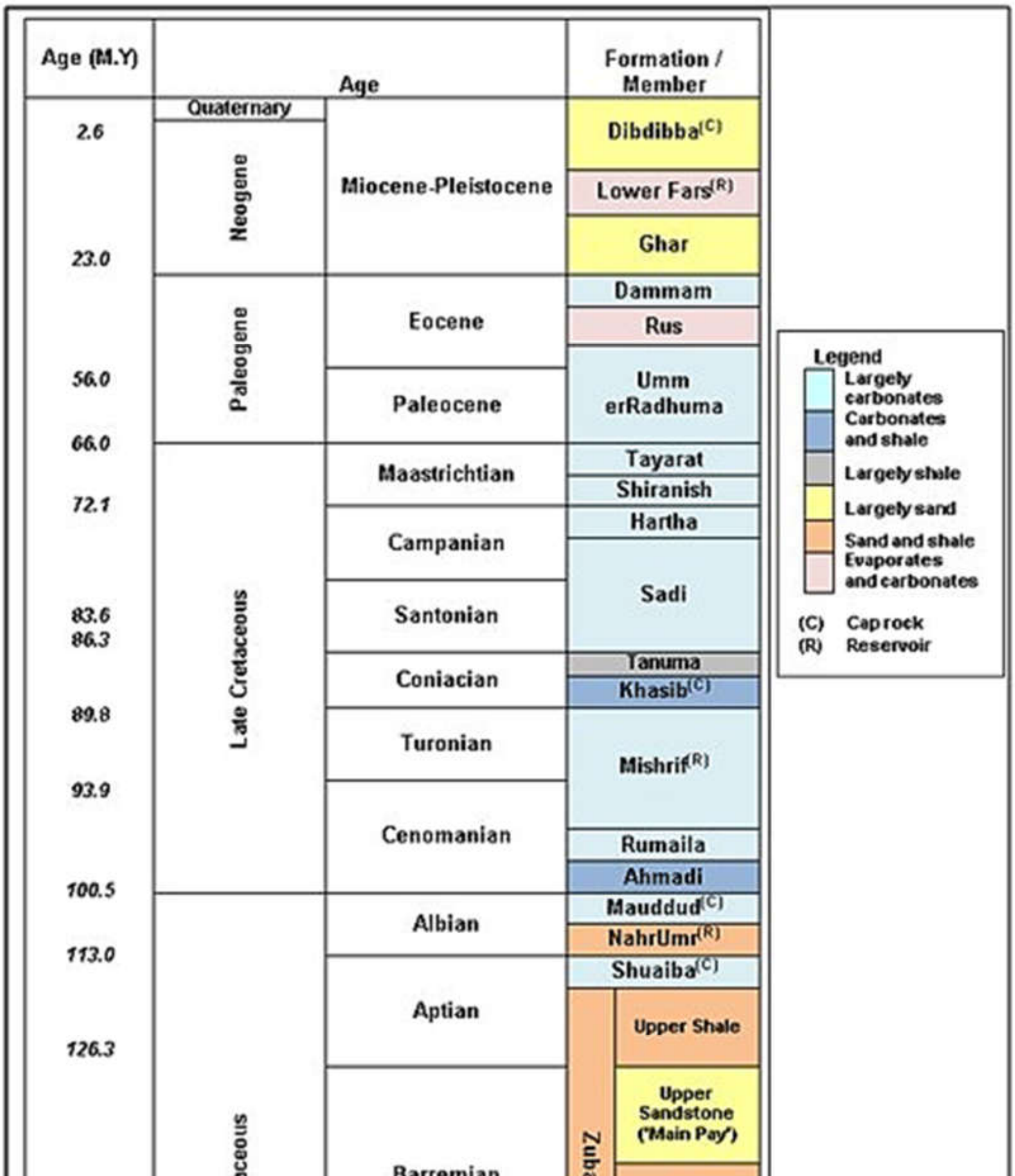

Figure 4: Stratigraphic column of North Rumaila field (Owen and Nasr 1958)

3. Materials and Methods

Mishrif S-shape well (Well R-XX3) was drilled to 2501m MD by Bit Release Tool (BRT) in the North Rumaila field targeting the Mishrif reservoir to be an oil producer well. While S-shape well (well R-XX8) was drilled to be a Mishrif observing Well, with a true depth (TD) of 2438m targeting the Rumaila Formation with 50m below the top of the Rumaila Formation.

The wells R-XX3 and R-XX8 were drilled with four sections, a 26” hole (20” casing) preset at 47m and 35m offline respectively. Then a 17 ½” hole section (13 3/8” casing) drilled to 607m and 613m (MD) with BRT and extended gel mud while the third section was a 12 ¼” hole (9 5/8” casing) drilled to 2051m and 2503m (MD) with BRT and gel-polymer mud. The final section was an 8 ½” hole (7” casing) drilled to 2501m (MD) for R-XX3 and 2477.5m for R-XX8 with BRT and KCL-polymer mud. (Figure 5).

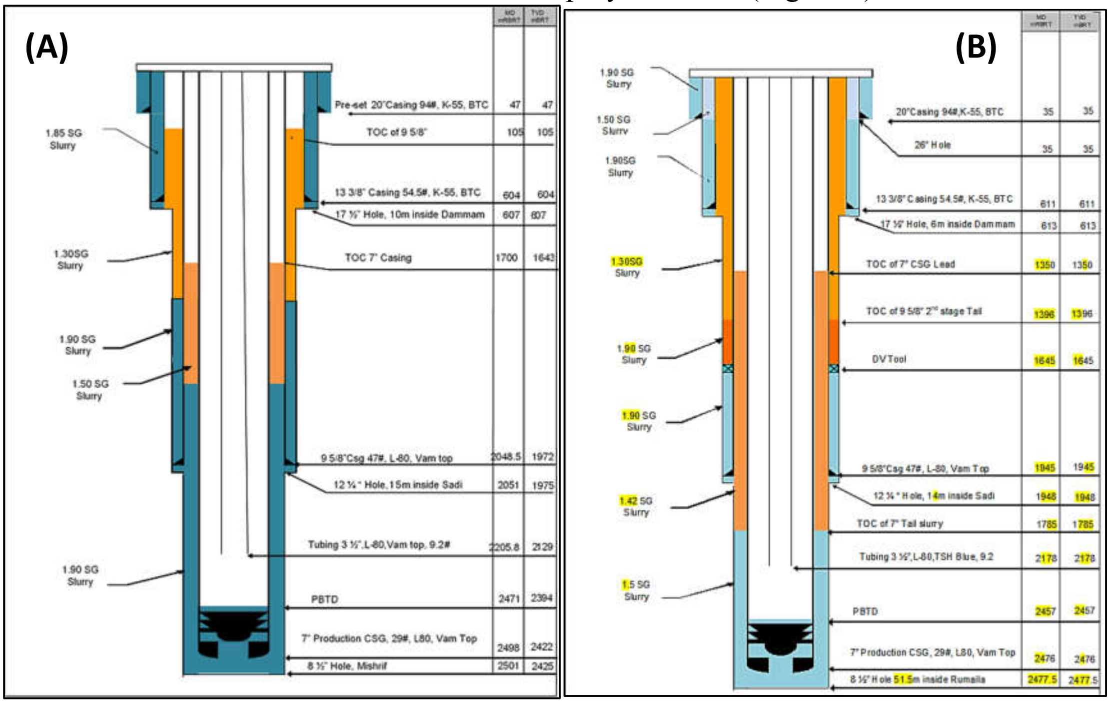

Figure 5: Schematic diagram of wellbore barrier (A) for the Well R-XX3, (B) for the Well R-XX8

3.1 The Root Cause of Stick-Slip in Rumaila field

The factors that affect stick-slip in the wells R-XX3 and R-XX8 based on the field observations can be summarized as follow:

1. Polycrystalline Diamond Composite (PDC), Stabilized Precision Drilling (PD), Measurement-While-Drilling (MWD), two Drill Collar (DC), and Heavy Weight Drill Pipe (HWDP).
2. Heavy BHA in the S-Shape well results in high side force and BHA/ Hole contact force.
3. Heavy BHA in S-Shape well increases the stick-slip.

3.2 Stick-Slip Mitigation Measures Plan

The mitigation plan depends on the factors affecting stick-slip, which mainly are borehole assembly, formation friction, and slide forces, type of bit, mud system, and top drive system (Table 2).

Table 2: Stick-slip Mitigation plan for Rumaila field

Factor Measures	Mitigation
BHA/ Formation friction and side force	BHA is Optimized in order to decrease the side force:- 1-Light BHA In Hole, the number of the HWDP with the PDC BHA must be reduced (currently 18, Planned 9). 2-Stac stabilizers 1/8" under gauge must be added. 3- Roller Reamer to reduce the Stick-slip.
Bit	Less aggressive bits:- Rack Back angles, Depth of cut limiter, cutter size and number, blade number, bit profile, tapered gauge,.. etc (Smith Inputs are required after vibration data analysis...)
Mud System	Enough lubricant (8-10%)to the water-based mud (WBM) in one well must be added when severe Stick-slip is experienced and the mud system difference before and after would be recorded, In order to reduce friction, Lost circulation Material (LCM) could be used within tools limits and proper instructions (ROO inputs are required).
Top Drive System	Switching to higher top drive gear, (BH and DQ inputs required…)
Well Profile (Planned & Actual)	1- The planned well profile must be optimized in order to finish the EOD 100m before the 9 5/8" casing shoe, 2- the last 100m of the section showed very poor steering tendency with all BHA's (PD/ Motor) 3- Full Control of the actual trajectory, 4- Kick-off in the right direction, 5- The change in azimuth along the profile has to be noticed, and the correction has to be smooth.

Ideally, these WOB and RPM changes would be applied while on the bottom in order to avoid any Non-productive time (NPT). However, greater shock conditions will happen when the rotation speed changes while the drilling process.

Increasing drilling parameters is not an assurance of attaining higher ROP. A driller should have the option to incorporate parameters to be within the zone of stable drilling (Figure 6) (Amorim et al. 2019). Some combinations of WOB vs RPM may cause complex and detrimental effects on drilling performance, such as bit whirl, stick-slip, bit bounce, linear coupling, parametric coupling between axial and bending vibrations, and chaotic whirl. The most destructive drilling mode is the chaotic whirl, a harmful vibration form aggravated by the excessive power in a drilling technique under resonance (Christian, 2017).

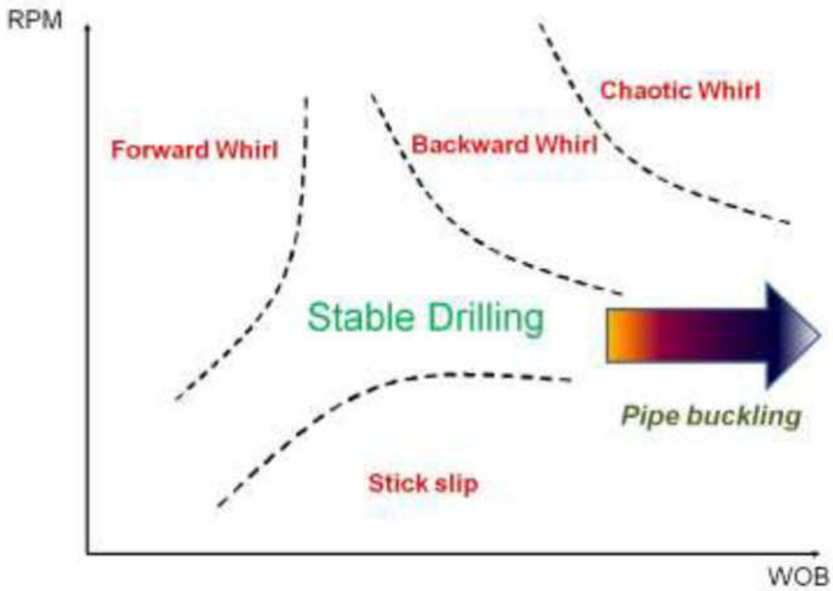

Figure 6: Stable drilling process according to RPM and WOB relationship (Amorim et al. 2019)

4. Results

12.25" Bit plus rotary steerable system (RSS) Picked up BHA and successfully function tested for depths 1042m to 1746m. Severe stick-slip was observed while drilling the whole section, which has affected the directional control from power drive and kicked-off around 285 to 290deg direction. Then, controlled in the required direction to 262deg. Umm-Er-Radhuma Formation has been shown to give high dog legs. The wiper trip was made without any issues. The hole (POOH) was Pulled out due to a poor penetration rate was decided. POOH was smooth without pumping or reaming (Figure 7).

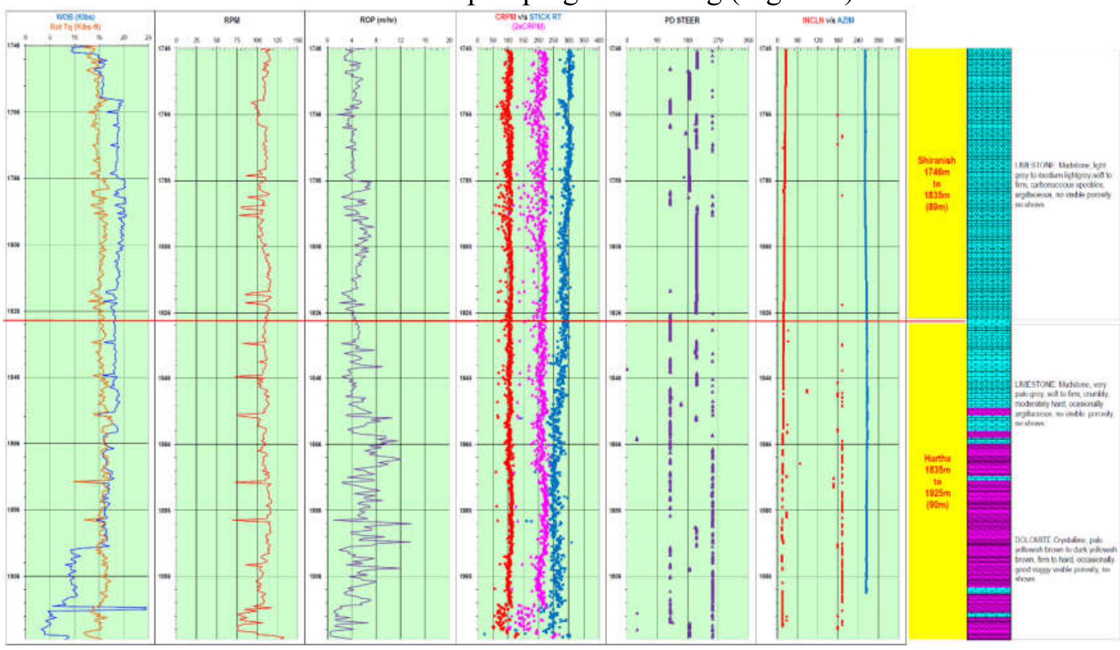

Figure 7: Drilling Parameter & Mechanics Plots for section12.25 with PDC, interval on PD900 for well R-XX3

Continue Run in Hole (RIH) after successful Shallow Hole Test (SHT) with new Bit, PD, and Measurement-While-Drilling (MWD) tool. Drilled the section (1746m to 1925m) successfully with decent directional objectives, at a depth of 1900m, it was observed that the tool face was fluctuating between the low and high side due to a severe stick-slip effect, which resulted in an interest in the inclination instead of dropping and increasing mud lubricate to 2% during the changing of the drilling parameters but without any success, so POOH changed to the BHA and POOH was very smooth with good hole condition (Figure 8).

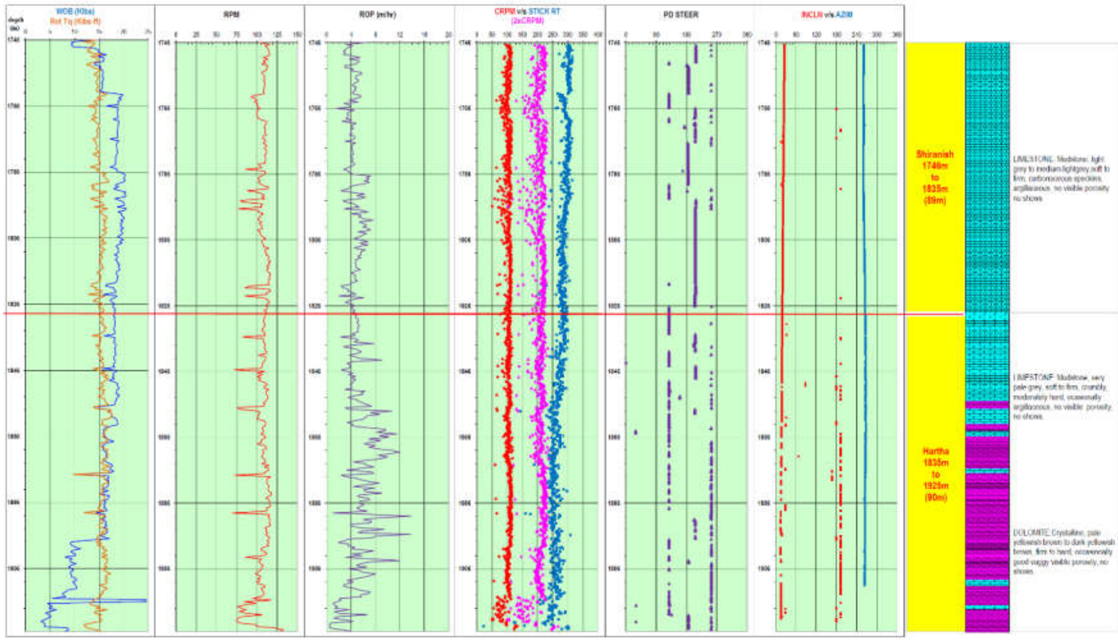

Figure 8: Drilling Parameter Plots for well R-XX3- section 12.25, and depth 1746-1925m

A new (BHA) with a tri-cone bit and mud motor for depths 1925m to 2051m was used, then run in the hole, and drilling continued by sliding and rotary mode. The rest of the section was drilled successfully till the casing point at 2051m, it was observed that BHA was not dropping as per the expectation in Hartha formation, and high stick-slip was noticed even with 2.5% lubrication in the mud system.

4.1 Offset Runs in Rumaila Field with MSi616L cutting structure:

22 bits of the MSi616L design have been used in 24 wells on different drive types in the Rumaila Field prior to the run in R-XX3. PDC Bits, such as MSi616L, will drill formations by shearing the rock. Rocks typically fracture more easily with shear loading (less energy, WOB). The most efficient cutting action than other bits. This type of bit was used more in the previous drilling operations in the Rumaila Field and was well-proven.

A summary of the performance shown in Figure 9. The bit records of the 12 ¼” MSi616L design in the offset wells indicate a median of 1000m per bit (Figure 9 -Left part) and a median ROP/ run of 13 m/hr (Figure 9- Middle part). The number of broken cutting structures of the inner and outer rows of the bit was two (Figure 9- right part).

Figure 10 shows simulation of wellbore stability (stress regimes, rock properties, and well design) for well R-XX8. The pressure/depth summary was examined and indicated that there are no significant pressure ramps or regions of overpressure within the horizons likely to be encountered except an implied minor pressure ramp in the Shiranish Formation.

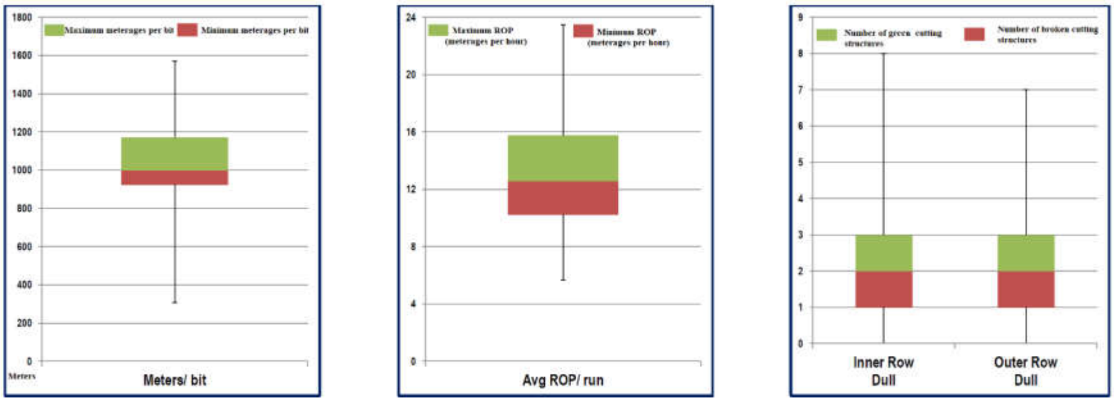

Figure 9: MSi616L bit performance of 22 wells prior to the run in the well R-XX3

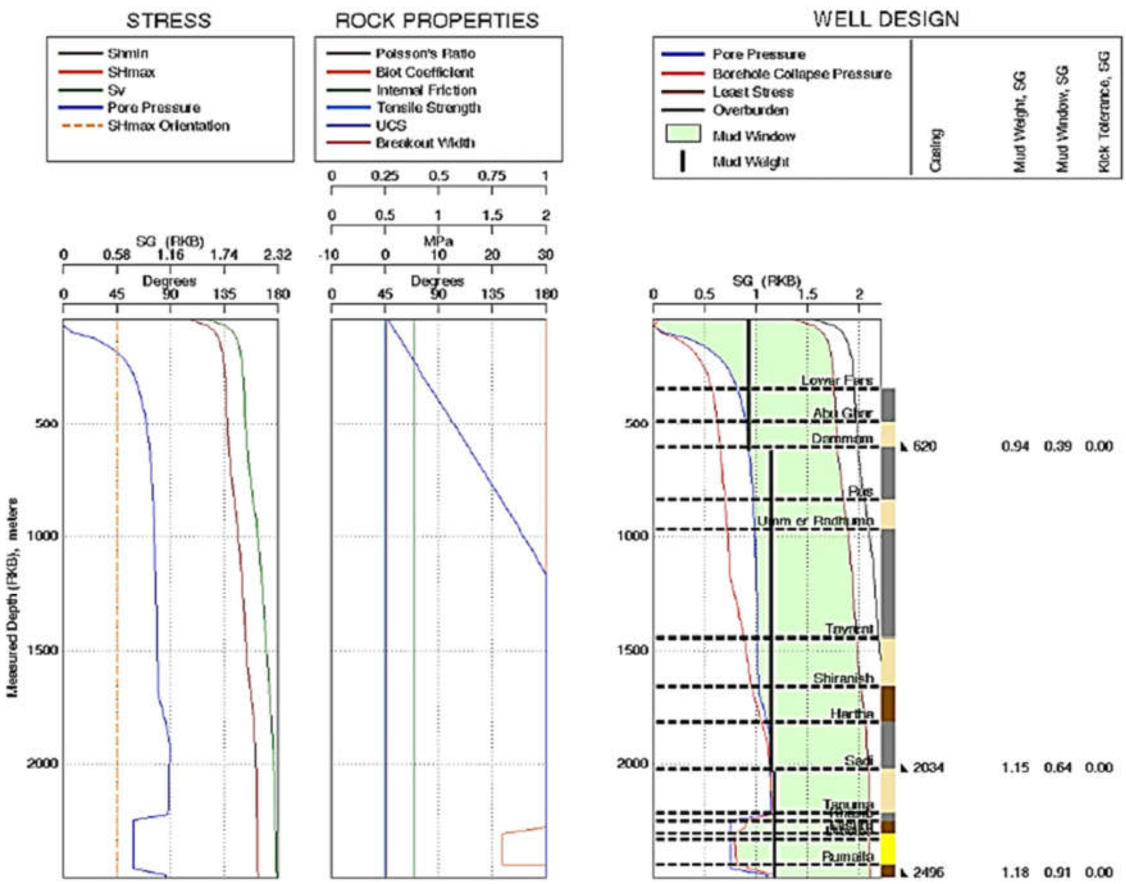

Figure 10: Simulation of wellbore stability on Rumaila Field (Strike-Slip regime) R-XX8

4.2 IDEAS Analysis for 12 ¼" section with MSi616LPX bit in the well R-XX3

An IDEAS sensitivity analysis is a high-fidelity dynamic simulation tool that provides capabilities throughout the entire drilling process was performed to identify the stability matrix of a 12 ¼" section with MSi616LPX bit type under different drilling parameters and rock types (Table 3). The simulation parameters were as follows:

Rock Types:
• Limestone (~7 Kpsi)
• Dolomite (~15 Kpsi)
Drilling Parameters:
• WOB: 10, 15, 20, 30 Klbs
• RPM: 80, 100, 120, 150

Table 3: Stability Matrix of 12 ¼" section with MSi616LPX bit type under different drilling parameters and rock types

BIT TORQUE				
Axial(g)	Delta (klb-ft)	Lateral (g)		
0.2	0.85	5		Excellent
0.4	1.5	10		Good
0.6	2.15	15		Safe
0.8	2.8	20		Moderately Safe
1	3.5	25		Unsafe

The Sensitivity analysis plots for axial, torsional, and lateral torques was plotted between RPM and WOB for each limestone and dolomite formations (Figure 11).

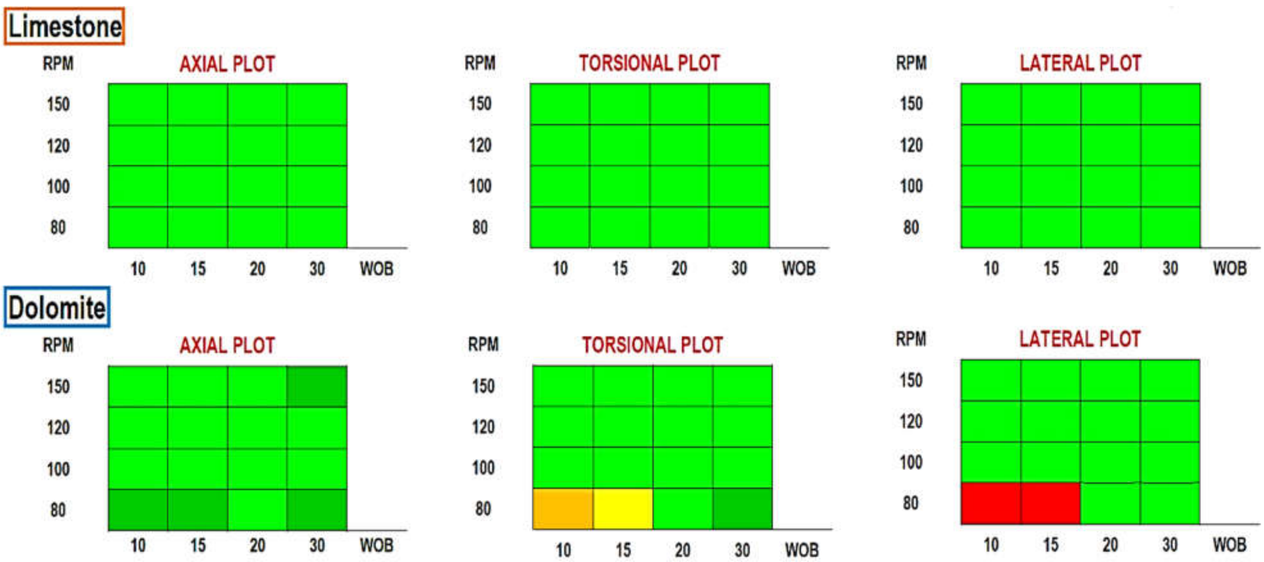

Figure 11: Sensitivity axial, torsional, and lateral torques (RPM Vs WOB) for limestone and dolomite formations

As seen in Figure 11- middle part, The IDEAS sensitivity analysis on the MSi616LPX shows that no severe vibration levels, which are related to the stick-slip seen at the bit with the given drilling parameters and rock types despite WOB and RPM behavior moderate safe condition at low parameters.

5. Discussion

S-Shape wells always have high side forces, so as inclination decreases around 15 deg. strike – slip increases and tortuosity increase with well profile poor control and result in more Side forces (Figure12-A). Side forces increase as drilling deeper and drop inclination (Figure12-B).

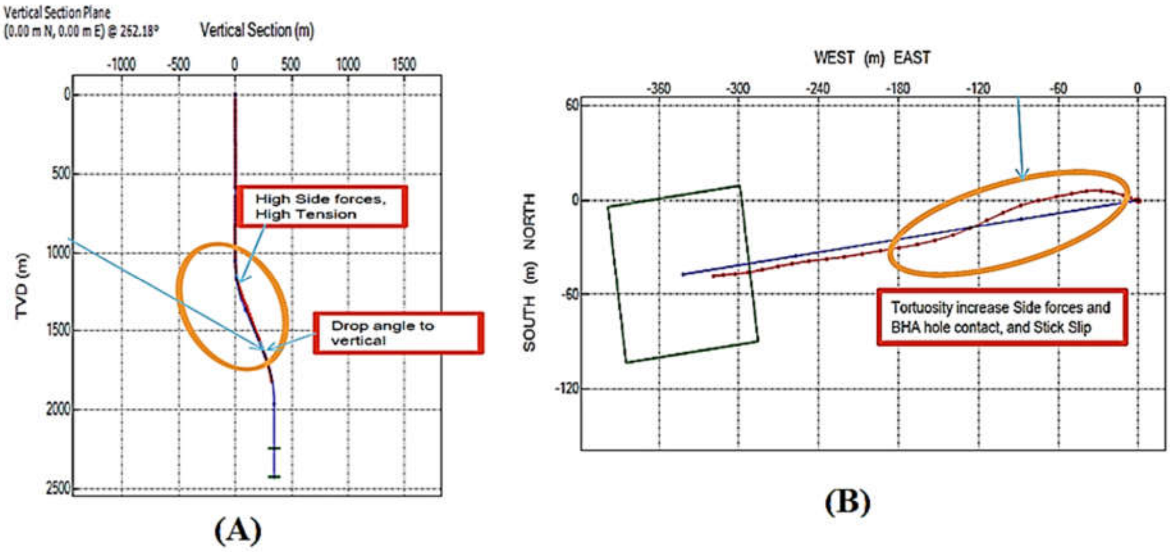

Figure 12: A- Tortuosity, B- Side forces of the well R-XX3

Severe stick-slip was encountered during the entire section 12 ¼” in addition to medium shocks. The torque was very high and unstable all the time. Mitigations should be taken by adding mud lubricant and looking at bit selection.

The MSi616 bit was pulled out with just two broken cutters and the remaining cutting structure was green. The dull condition does not indicate that the bit is subject to severe stick-slip levels as seen in the Drilling Mechanics Logs (Figs.13, 14, and 15).

Figure 13 shows that torque will reduce at low WOB, while Figure 14 indicates that even with less torque value, RPM recorded a high value with low value of WOB. The Stick-Slip still shows a high value.

Figure 15 (depth Vs RPM, CRPM, Stick, ROP, WOB, and Torque) explains that the Stick-Slip is lightly increases with the decreasing of WOB.

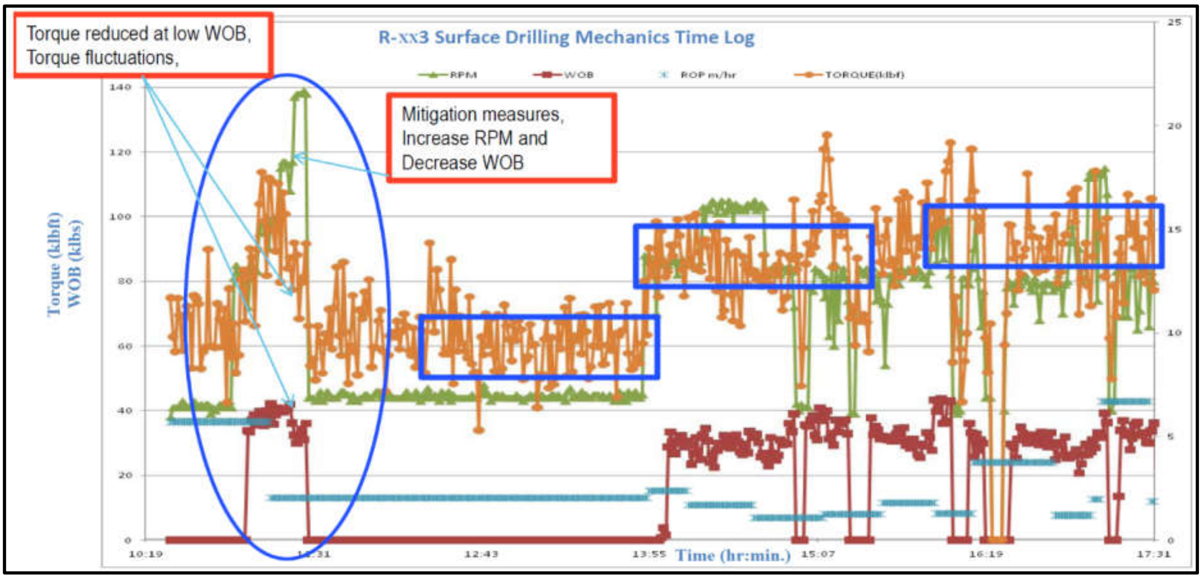

Figure 13: Drilling Mechanics log for Well R-XX3 (at the Surface)

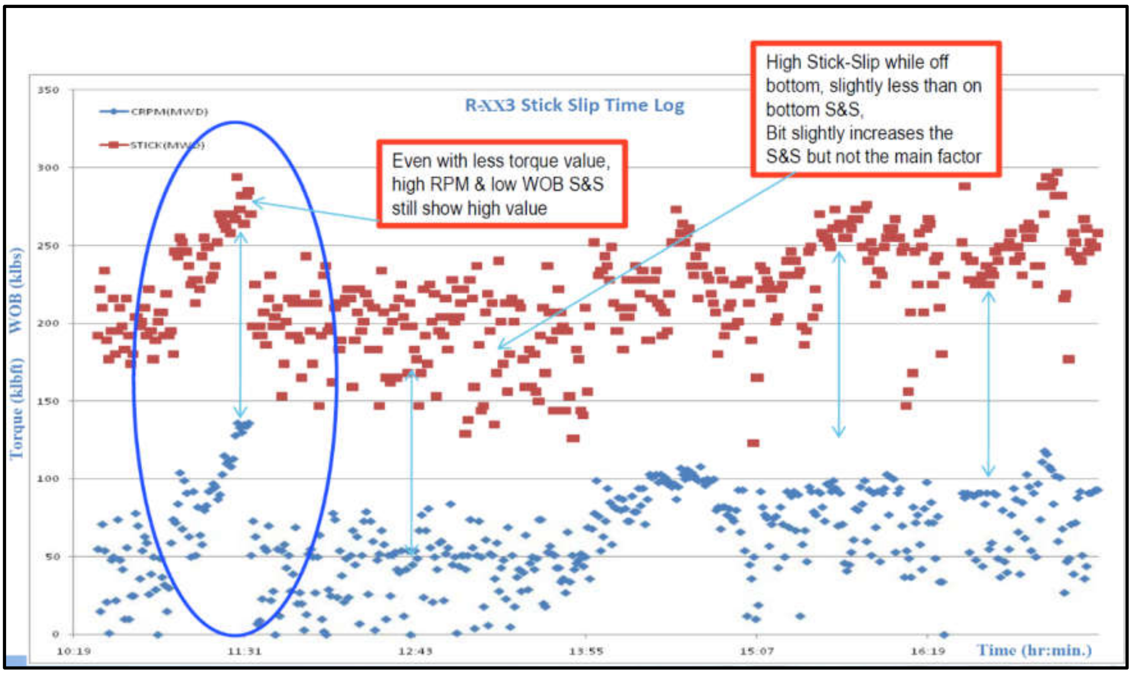

Figure 14: Drilling Mechanics log for downhole R-XX3

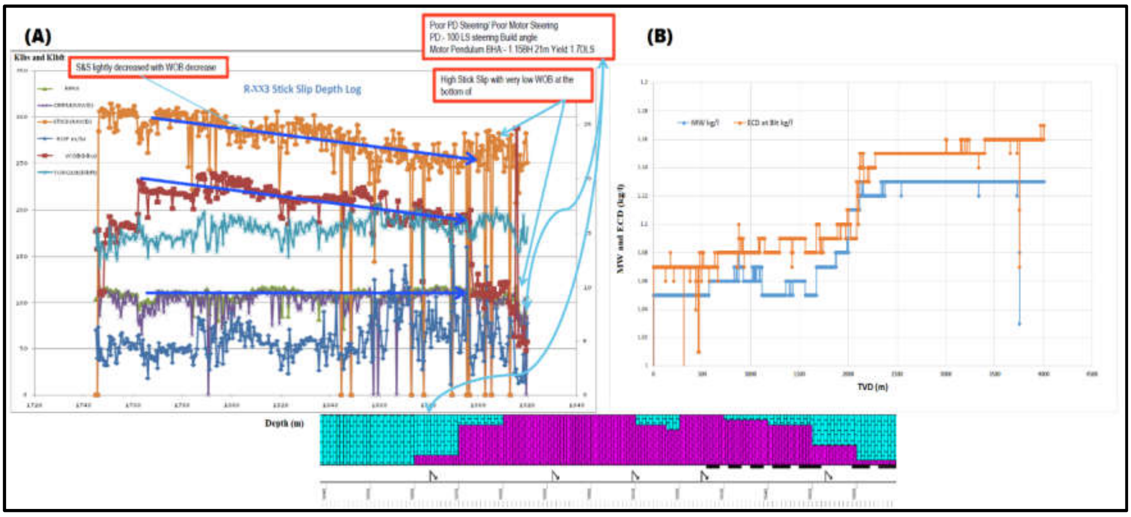

Figure 15: (A) Drilling Mechanics log (depth Vs RPM, CRPM, Stick, ROP, WOB, and Torque) shows The Stick-Slip indicators, (B) Depth Vs mud weight and ECD

Drilling operation ahead to a depth of 1925m, Rate of Penetration is low and stick-slip is severe. At 1900m, BHA failed to drop the angle due to tool face fluctuation. BHA was changed out (Figure 15).

ROPs dropped considerably in the Shiranish (MD of 1680m, TVD of 1622m) and Hartha (MD of 1832m, TVD of 1768m) Formations (2-6 m/hr). There was no noticeable variation in ROP even after changing to the new MSi616LPX while drilling through the Shiranish Formation.

The rotary torque plot after ~1600m does not show much variation corresponding to changes in drilling parameters on bit type. WOB was reduced considerably, first to 10 Klbs and then to 5 klbs in the final about 30m of the MSi616 run but the torque plot does not show any corresponding reduction in values. This is an indication that the torque at the surface after ~1600m was not dependent on the engagement of the cutting structure with the formation.

The azimuth plot of the well's section (Figure 12) indicates a tortuous profile with a ~9°/30m turn rate over a 200m interval. This would increase the drag of the BHA and drill string along the wellbore resulting in inadequate weight transfer on the bit and poor ROP. The rotary torque signature further confirms this after around 1600m as discussed above.

The ROP was the highest in the UER formation in the region of 10-20 m/hr for the most part of the run. This section involved the kick-off and builds.

The rotary torque trend matched the WOB trend until around 1600m after which the variation was minimal and Wireline Riser Tensioner (WRT), which provides stability to the riser while controlling its stresses, displacements, and angles changed in WOB.

The ROP was the highest in the UER formation in the region of 10-20 m/hr for the most part of the run. This section involved the kick-off and builds. The ROP dropped to 5-10 m/hr in the Tayarat Formation and further in the softer Shiranish Limestone Formation to around 2-5 m/hr. The ROP picked up slightly in the Hartha to about 5-10 m/hr but dropped back to the 2-5 m/hr range before the MSi616 was POOH.

The rotary torque trend matched the WOB trend until around 1600m after which the variation was minimal w.r.t changes in WOB.

The azimuth plot for the PD900 run (Figure 12) shows the well R-XX3 kicked off in the ~300° direction up to around 1140m (MD). The well was then steered to the left by ~60° to ~240° azimuth in the next 200m (~9°/30m turn rate) and then corrected back right by another ~25° to hold a final azimuth of ~265° until the end of the Well run.

The azimuth of well R-XX8 was constant (202.57 deg.) while the dip was 0.00 at the depths 0-860 m then rising from 2.7° at the depth 870 m to 24.01° at 1110 m, continuing stable to the depth 1650 m then started decreasing till been 0.00° at depth 1950-2500 m.

The selection of angle and tortuosity of the wells under study (as shown in Figure 16-A) will not be the main effect of stick-slip. The wells were drilled with different dips and azimuths. Figure 16-B showed dip and azimuth for wells in the same well pad with various values of dip and azimuth but without any observation of stick-slip phenomena.

The bit type (QD506FX) was used to drill through the UER, Tayarat, and about 104m of Shiranish Formation. The MSi616LPX bit was subsequently run for drilling the remaining 89m of Shiranish and 90m of Hartha before being POOH. The MSi616 bit type was checked, two broken cutters were observed, and the remaining cutting structure was green (Figure 17). MSi616 bit condition did not indicate that it was subjected to severe stick-slip levels compared with the condition of QD506FX bit (Figure 14).

Figure 16: Dip and Azimuth for A- The wells under study, B- The other wells in the same pad

Figure 17: MSi616 type of bit with just two broken cutters

The IDEAS sensitivity plots (Figure 11) do not indicate any severe vibration levels at the bit.

6. Conclusions

Severe stick slip was encountered during the 12.25" hole section and medium shocks as well. The torque was very high and unstable all the time. Mitigations were taken by adding mud lubricant and looking at bit selection.

1. Stick-slip levels were high throughout the two PDC runs and varying formations, formation strengths, drilling parameters, or bit-cutting structures showed no considerable difference in stick-slip levels.
2. Stick-Slip levels were high (~2xCRPM) during the course of both PDC runs. There is no noticeable change in stick-slip levels with varying formations, formation strengths, drilling parameters, or bit-cutting structures. The collar RPM fluctuations are within a wider range in the UER formation. The range slims down in the subsequent formations but there is no change to Stick-Slip levels.
3. As per the bit records of the offset wells, the 12 ¼” MSi616 has been used extensively in the Rumaila Field on multiple drive types and the median average ROP is around 13 m/hr. This is a well-proven design in the 12 ¼” Rumaila application.
4. The collar RPM fluctuations are within a broader range in the UER formation. The domain slims down in the subsequent formations, but there is no change to Stick-Slip levels.
5. In 8 1/2” Hole Section, BHA Design was good to Control Vertical, dogleg average was 3.7 while Dropping, No high Stick-Slip and vibration were observed, Good Steerable PDC and Good ROP, It is recommended to run this smith PDC Mdi616 in future.
6. There is no direct effect of dip and azimuth on the stick-slip problem. It will be considerable as a secondary parameter assisting to reduce this phenomenon.
7. The IDEAS sensitivity analysis on the MSi616LPX shows no severe vibration levels seen at the bit with the given drilling parameters and rock types.

Nomenclature

BHA	Bottom hole Assembly
BRT	Bit Release Tool
CRPM	Collar Round per Minute
DC	Drill Collar
Deg.	Degree
EOD	End of Drop
HWDP	Heavy Weight Drill Pipe
IDEAS	Integrated Data Evaluation & Analysis System
KCL	Potassium Chloride
LCM	Lost circulation material
MD	Measured Depth
MWD	Measurement-While-Drilling
NPT	Non-productive time
PD	Stabilized Precision Drilling
PDC	polycrystalline diamond compacts
PDM	Positive-Displacement Motors
POOH	Pull out of the hole
RIH	Run In Hole.
RKB	Rotary Kelly Bushing
ROO	Rumaila Operating Organization
ROP	Rate of Penetration

RPM	Round per Minute
RSS	Rotary Steerable System
S&S	Stick-Slip
SG	Specific Gravity
SH	Maximum Horizontal Stress
Sh	Minimum horizontal Stress
SHT	Shallow hole test
Sv	Vertical stress
TCI	Tungsten Carbide Inserts
UCS	Unconfined compressive strength
UER	Umm er Radhuma
WBM	Water-based Mud
WOB	Weight on the Bit
WRT	Wireline Riser Tensioner

Declaration of Interest

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Ethics approval

Dear Editor

We believe the findings in this paper will be of interest to the readers of journal. We declare that this manuscript is original, has not been published before and is not currently being considered for publication elsewhere.

Consent to participate

We know of no conflict of interest associated with this publication and I as corresponding author confirm that the manuscript has been read and approved for submission by all the named authors.

Consent for publication

I would like to submit the manuscript entitled: **Stick-slip of the Drill-string in Well-Drilling processes- Causes, Effects, and Mitigation. A case study for Rumaila Field, Southern Iraq.** By Ahmed N. Al-Dujaili; Maaly S. Asad to be considered for publication as an original paper in **the ArchéoSciences.**

Best regards
Ahmed N. Al-Dujaili
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