South IRAQ Stratigraphic Column

Columns: SYSTEM | SERIES (GROUP) | STAGE | FORMATION | MEMBER | GENERALIZED LITHOLOGY | Lithologies Types For Each Formation, Marker (Pick Criteria) For The Formations Tops, Lithologies Description, Average TVD Thickness For Each Formation, Estimated Formation Pore Pressure, Recommendation for Drilling Mud Weigt, Down Hole Drilling Problems, Oil/Gas Reservoir Zones And Recommendation for Casing Points.

TERTIARY

DIBDIBA — PLIOCENE / LATE MIOCENE — SERRAVALLIAN AQUITIAN

Dibdiba Formation : It's usually exposed at surface, It is composed mainly of Sand / Gravel intercalation with Minor Streaks of (Limestone, Marl, Gypsum & Claystone).
Average TVD Thickness of Dibdiba Formation : +/- 225 m.
(Heaving / Hole collapse / Caving) is highly possible which will affect hole stability & casing-cement quality in Dibdiba Formation.
Sand / Gravel: Lse qtz gr, clss, transl - transp, m - crs gr, occ/ v.crs grn, sub ang - sub rd, p - mod srtd, calc cmt i/p, no vis por under visual exam.
Limestone: Wh - off wh, sft- mod hd, crypto xln - fn xln, foss i/p, wash i/p, no vis por under visual exam.
Marl: Lt gy, dk gy, occ/ grnsh gy, sft - mod hd, crypto xln,stky, hi calc occ/ gradg to hi arg Limestone, no vis por under visual exam.
Claystone: Rdsh brn, grnsh gy, sft, blky - sbblky,stky, sli calc,washable i/p.
Gypsum: Clss, wh, trans - transp, glsy, mod hd, cleavable.
Estimated Fm. PP: 64 - 65 pcf (1.03 - 1.04 gm/cc) EMW — Recommended drilling MW: 65 - 67 pcf (1.04 - 1.07 gm/cc)

LOWER FARS — MIDDLE MIOCENE — SERRAVALLIAN AQUITIAN

Lower Fars Formation : It is composed mainly of Marl and/or Limestone intercalation with Minor streaks of (Sandstone, Anhydrite & Claystone).
It is picked by appearance of Thick layer of Marl and/or Limestone with Slow ROP.
Average TVD Thickness of Lower Fars Formation : +/- 120 m.
Caving is highly possible & also issues with plastic movement could be occured (Marl & clay) in (Lower Fars Formation).
Marl: Lt gy, occ/ grnsh gy, sft - mod hd, crypto xln, stky, wash i/p, sdy i/p, hi calc occ/ gradg to hi arg Limestone, no vis por under visual exam.
Limestone: Lt gry - off wh, lt brn, mod hd, crypto xln - fn xln, foss i/p, pyrc i/p, sdy i/p, hi arg, vuggy i/p, no vis por under visual exam.
Sandstone : Lse qtz gr, clse, transl - transp, occ/ dk brn, frbl - mod hd, fn- v.fn gr, sbang- sbrnd, p -mod srtd, foss i/p, no vis por under visual exam.
Anhydrite : Mlky wh - wh, transp i/p, smky wh i/p, md hd - hd, occ/ sft, pstd, amorph.
Claystone : Gy - grnsh gy, redsh brn, sft, mod hrd i/p, blky - sbblky, slty i/p, sli calc, stky, washable i/p.
Note : Lower Fars Fm. contains heavy oil in Nahr Ibn Umer field.
Estimated Fm. PP: 64 - 65 pcf (1.03 - 1.04 gm/cc) EMW — Recommended drilling MW: 65 - 67 pcf (1.04 - 1.07 gm/cc)

GHAR — MIDDLE MIOCENE — SERRAVALLIAN AQUITIAN

Ghar Formation : It is composed mainly of Sand / Gravel & Sandstone interbeded with sandy Limestone.
It is picked by appearance of Sand / Gravel & Sandstone with Fast ROP.
Average TVD Thickness of Ghar Formation : +/- 155 m.
Sand / Gravel : Lse qtz gr, clss, transl - transp, m - crs gr, occ/ v.crs grn, sub ang - sub rd, p - mod srtd, calc cmt i/p, foss i/p, no vis por under visual exam.
Sandstone : Lse qtz gr, clse, transl - transp, occ/ yell, frbl - mod hd, fn- v.fn gr, occ/ m gr, sbang- sbrnd, p -mod srtd, calc cmt i/p, foss i/p, no vis por under visual exam.
Limestone: Lt gry - off wh, lt brn - crmy, mod hd, crypto xln - fn xln, foss i/p, sdy i/p, no vis por under visual exam.
Estimated Fm. PP: 64 - 65 pcf (1.03 - 1.04 gm/cc) EMW — Recommended drilling MW: 64 - 65 pcf (1.03 - 1.04 gm/cc)

DAMMAM — MIDDLE EOCENE — PRIABONIAN LUTETIAN

Dammam Formation : It is composed mainly of Dolomite and /or Limestone occasionally intercalation with very Minor streaks of (Anhydrite, Claystone & Marl) .
It is picked by appearance of carbonate (Dolomite or Limestone) with Slow ROP.
Average TVD Thickness of Dammam Formation : +/- 240 m.
partial / Complete Mud losses of circulation is highly possible while drilling Dammam Formation.
Dolomite: Crmy wh, off wh, tan, lt brn, mod hd - hd, micrxl - v.fnxl, vugy i/p, occ/ foss, suc tex, no vis por under visual exam.
Limestone: Tansh wh - wh, occ/ lt brn, mod hd - hd, mic xln - v.fn xln, sli arg, vugy i/p, occ/ foss, dolc no vis por under visual exam.
Anhydrite : Mlky wh - wh, off wh, mod hd - hd, pstd, amorph, w/ Gypsum.
Marl : Gnsh gy, gy, sft - mod hd, cryptoxln, stky, no vis por under visual exam.
Claystone : Dk gy - med gy, grnsh gy, rr/ redsh brn, sft, mod hrd i/p, blky - sbblky, slty i/p, sli calc, stky, washable i/p.
Note : Dammam Fm. Could be contains Fractured (Dolomite and/or Limestone) which is leads Complete lost of circulation.
Dammam Formation Casing Point : It is a regular casing point at south IRAQ, It is highly recommended to set the casing +/- 15 m into Dammam Formation top to prevent shallower formations collapsing.
Estimated Fm. PP: 64 - 65 pcf (1.03 - 1.04 gm/cc) EMW — Recommended drilling MW: 65 - 67 pcf (1.04 - 1.07 gm/cc)

RUS — PALEOCENE - EARLY EOCENE — YPRESIAN

Rus Formation : It is composed mainly of Anhydrite intercalation with very minor streaks of (Dolomite and/or Limestone).
It is picked by appearance of Anhydrit Slow ROP.
Average TVD Thickness of Rus Formation : +/- 150 m.
Anhydrite : Mlky wh - wh, smky wh i/p, md hd - hd, occ/ sft, pstd, amorph.
Dolomite : Tan, crmy, tansh wh, occ/ lt brn, mod hd - hd, mic xln - v.fn xln, vuggy, sli arg, no vis por under visual exam.
Limestone : Off wh - tansh wh, crmy, mod hd - hd, mic xln - v.fn xln, hi dolc, vuggy i/p, sli arg, no vis por under visual exam.
Estimated Fm. PP: 64 - 65 pcf (1.03 - 1.04 gm/cc) EMW — Recommended drilling MW: 65 - 69 pcf (1.04 - 1.11 gm/cc)

UMM ER RADHUMA — PALEOCENE - EARLY EOCENE — THANETIAN DANIAN

Umm Er Radhuma Formation : It is composed mainly of Carbonates (Dolomite and/or Dolomitic Limestone and/or Limestone) interbeded with thin streaks of (Anhydrite & Shale).
It is picked by appearance of Carbonates (Dolomite and/or Dolimitic Limestone and/or Limestone) with Fast ROP.
Average TVD Thickness of Umm Er Radhuma Formation : +/- 450 m.
Sulphurous water flow (and / or) partial / Complete Mud losses of circulation is highly possible in Umm Er Radhuma Formation.
Dolomite : Tan - tansh wh, crmy, occ/ lt brn, mod hd - hd, micrxln - v.fxln, vug i/p, occ/ sli arg, rr pyrc, no vis por under visual exam.
Limestone : Lt gy, lt brn, gysh wh, mod hd - hd, micro xln - crypto xln, sli arg i/p, no vis por under visual exam.
Dolomitic Limestone : wh - off wh, occ/ gysh brn, microxln - vfnxln,mod hd - hd,sli arg, no vis por under visual exam.
Anhydrite : Mlky wh - wh, smky wh i/p, md hd - hd, pstd, amorph.
Shale : Gy, grnsh gy, lt gy, frm - mod frm, occ/ sft, blky - sb blky, stky, dolc, occ/ slty.
Note : Umm Er Radhuma formation containing water aquifer.
Estimated Fm. PP: 64 - 65 pcf (1.03 - 1.04 gm/cc) EMW — Recommended drilling MW: 68 - 71 pcf (1.09 - 1.14 gm/cc)

CRETACEOUS

TAYARAT — UPPER — MAASTRICHTIAN

Tayarat Formation : It is composed maily of Dolomite interbedded with (Limestone and Anhydrite) layers.
It is picked by appearance of a thin Shale layer at top of Tayarat Fm. with Slow ROP.
Average TVD Thickness of Tayarat Formation : +/- 260 m.
Sulphurous water flow (and / or) partial / Complete Mud losses of circulation is possible in Tayarat Formation.
Shale : Dk gy, med gy, grnsh gy, frm - mod frm, occ/ sft, blky - sb blky, hi calc occ/ grdg to Marl.
Dolomite : Dk gy - dk brnsh gy, dk brn, occ/ off wh, lt tan, m hd - hd, micro xln - vfn xl, suc tex, localy abhydritic, vugy, hi arg, no vis por under visual exam.
Limestone: Tan, tansh brn, tansh gy, occ/ off wh, m hd - hd, micro xln - vfn xln, occ/ suc tex, vugy, dolc, hi arg grdg to Marl, no vis por, no vis por under visual exam.
Anhydrite : Mlky wh - wh, smky wh i/p, md hd - hd, pstd, amorph.
Estimated Fm. PP: 64 - 65 pcf (1.03 - 1.04 gm/cc) EMW — Recommended drilling MW: 68 - 71 pcf (1.09 - 1.14 gm/cc)

SHIRANISH — UPPER — MAASTRICHTIAN

Shiranish Formation : It is composed maily of Limestone intebedded with thin layers of Marl.
It is picked by appearance of Higly Argillaceous Limestone grading to Marl with Slow ROP.
Average TVD Thickness of Shiranish Formation : +/- 105 m.
Bit balling, Sticking & Tight hole may occur while drilling Shiranish Formation.
Limestone : Lt gy, off wh, tansh wh, tansh brn, crmy wh, med gy, mod hd, occ/sft, micro xln - crypto xln, dolc, glauc i/p, hi arg grdg to Marl, no vis por under visual exam.
Marl : Lt gy, gysh blk - dk gy, sft, occ/ mod hd, crypto xln, stky, wash i/p, no vis por under visual exam.
Estimated Fm. PP: 64 - 65 pcf (1.03 - 1.04 gm/cc) EMW — Recommended drilling MW: 69 - 71 pcf (1.11 - 1.14 gm/cc)

HARTHA — UPPER — MAASTRICHTIAN / CAMPANIAN

Hartha Formation : It is composed maily of Limestone intrbedded with Dolomite & occasionally intercalation with streaks of Shale.
It is picked by appearance of Chalky Limestone and/or Dolomite with Slow ROP.
Average TVD Thickness of Hartha Formation : +/- 195 m.
partial / Complete Mud losses of circulation is highly possible in Hartha Formation.
Dolomite : Tansh brn, lt tan, lt gy, mod hd, vfnxln - micro xln, suc tex i/p, vuggy, sli arg, pyrc i/p, no vis por under visual exam.
Limestone : Lt gy - off wh, wh, chky, occ/ lt brn, mod hd - hd, crypto xln - vfn xln, sli dolc, sli arg i/p, glauc i/p, occ/ pyrc, no vis por under visual exam.
Shale : Med gy, grnsh gy, lt grn, frm - mod frm, occ/ sft, blky - sb blky, occ/ sb flky, sli calc, slty i/p.
Estimated Fm. PP: 64 - 65 pcf (1.03 - 1.04 gm/cc) EMW — Recommended drilling MW: 70 - 73 pcf (1.12 - 1.17 gm/cc)

SADI — UPPER — CAMPANIAN

Sadi Formation : It is composed maily of Limestone.
It is picked by appearance of Chalky Argillaceous Limestone with Fast ROP.
Average TVD Thickness of Sadi Formation : +/- 300 m.
Tight hole & Sticking may occure while drilling Sadi Formation.
Limestone : Off wh - wh, crmy wh, chky, lt gy, occ/ lt brn, mod hd - hd, crypto xln - vfn xln, sli dolc, foss i/p, glauc i/p, occ/ vuggy, sli - mod arg, no vis por under visual exam.
Sadi Formation Casing Point : It is a regular casing point at south IRAQ, It is recommended to set the casing +/- 15 m into Sadi Formation top to seal off the Upper formations which has Mud Losses.
Note : Sadi formation is an oil reservoir in some fields.
Estimated Fm. PP: 64 - 65 pcf (1.03 - 1.04 gm/cc) EMW — Recommended drilling MW: 70 - 73 pcf (1.12 - 1.17 gm/cc)

TANUMA — UPPER — SANTONIAN CONIACIAN

Tanuma Formation : It is composed maily of Shale occasionally intercalation with very minor streaks of Limestone.
It is picked by appearance of Shale with Fast ROP.
Average TVD Thickness of Tanuma Formation : +/- 50 m.
Caving Shale & Tight hole may occur while drilling Tanuma Formation.
Shale : Lt gy, dk gy - dk brnsh gy, grnsh gy - grn, occ/ blk, frm - mod frm, fiss - sb fiss, occ/ sb blky, stky, wash, pyrc i/p, hi calc grdg to Marl and/or hi arg L.st.
Limestone : Lt gy - off wh, wh, brnsh gy, occ/ lt brn, mod hd - hd, crypto xln - vfn xln, sli dolc, occ/ pyrc, occ/ hi arg grdg to hi calc Shale, no vis por under visual exam.
Estimated Fm. PP: 64 - 65 pcf (1.03 - 1.04 gm/cc) EMW — Recommended drilling MW: 71 - 73 pcf (1.14 - 1.17 gm/cc)

KHASIB — UPPER — SANTONIAN CONIACIAN

Khasib Formation : It is composed maily of Argillaceous Chalky Limestone intercalation with very thin beds of Shale .
It is picked by appearance of Argillaceous Chalky Limestone with Slow ROP.
Average TVD Thickness of Khasib Formation : +/- 45 m.
Limestone : Lt gy - med gy, occ/ off wh, chky, mod hd - hd, micro xln - crypto xln, hi arg, occ/ grdg to Marl, occ/ pyrc, no vis por under visual exam.
Shale : Dk gy, grnsh gy, frm - mod frm, fiss - sb fiss, occ/ sb blky, stky, sli calc.
Note : Khasib formation is an oil reservoir in some fields.
Estimated Fm. PP: 64 - 65 pcf (1.03 - 1.04 gm/cc) EMW — Recommended drilling MW: 72 - 73 pcf (1.15 - 1.17 gm/cc)

MISHRIF — UPPER — TURONIAN / CENOMANIAN

Mishrif Formation : It is composed mainly of Limestone occasionally with very Thin stingers of Shale.
It is picked by appearance of Limestone with Slow ROP.
Average TVD Thickness of Mishrif Formation : +/- 143 m.
Limestone : Off wh - wh, crmy wh, sft - mod hd, micorxln - vfn xln, glauc, vugy i/p, sli dolc, no vis por under visual exam.
Shale : Grnsh gy, dk gy, frm - mod frm, fiss - sb fiss, occ/ sb blky, stky, hi calc.
Note : Mishrif Fm. is an oil reservoir in some fields.
Estimated Fm. PP: 64 - 65 pcf (1.03 - 1.04 gm/cc) EMW — Recommended drilling MW:72 - 73 pcf (1.15 - 1.17 gm/cc)

RUMAILA — UPPER — CENOMANIAN

Rumaila Formation : It is composed mainly of Argillaceous Chalky Limestone occasioally with very minor streaks of Shale.
It is picked by apperance of Argillaceous Chalky Limestone or Highly calcareous Shale with Slow ROP.
Average TVD Thickness of Rumaila Formation : +/- 90 m or +/- 140 m.
Limestone : Off wh, lt gy, tan gy, buff, chky, sft - mod hd, cryptoxln - microxln, pyrc i/p, hi arg, occ/ grdg to marl, no vis por under visual exam.
Shale : Grnsh gy, med - dk gy, frm - mod frm, blky - sb blky, stky, wash, hi calc occ/ grdg to hi arg L.st.
Note : Rumaila formation is an oil reservoir in some fields.
Estimated Fm. PP: 64 - 66 pcf (1.03 - 1.06 gm/cc) EMW — Recommended drilling MW:72 - 74 pcf (1.15 - 1.19 gm/cc)

AHMADI — UPPER — CENOMANIAN

Ahmadi Formation : It is composed mainly of Shale & Limestone interbeds.
It is picked by appearance of Shale followed by Argillaceous Limestone with Fast ROP.
Average TVD Thickness of Ahmadi Formation : +/- 140 m.
Caving Shale may occur while drilling Ahmadi Formation.
Ahmadi Formation is devided into 2 parts (upper part is composed mainly of Shale with Minor Streaks of Limestone & the lower part is composed mainly of Limestone with Minor Streaks of Shale).
Limestone : Tan - tansh wh, lt gy, occ/ brn, sft - md hd, microxln - crypto xln, sli arg, suc tex i/p, no vis por under visual exam.
Shale : Brnsh gy, grnsh gry, occ/ lt brn, , frm - mod frm, sft i/p, blky - sbfiss, stky, wash i/p, sli calc.
Note : Ahmadi formation is an oil reservoir in some fields.
Estimated Fm. PP: 64 - 66 pcf (1.03 - 1.06 gm/cc) EMW — Recommended drilling MW:72 - 74 pcf (1.15 - 1.19 gm/cc)

MAUDDUD — LOWER — ALBIAN

Mauddud Member : It is composed mainly of Limestone occasionally with very thin stingers of Shale.
It is picked by appearance of Limestone occasionally with increase of Back Ground Gas with Fast ROP.
Average TVD Thickness of Mauddud Formation : +/- 110 m.
Unconformity Surface is available at Base of overlaying formation (Ahmadi Fm.) which is leads of Missing Wara Formation & go directly from Ahmadi formation to Mauddud formation at South IRAQ.
Limestone : Tansh wh, off wh, crmy wh, occ/ lt brn, mod hd, cryptoxln - vfnxln, w/ free pyr, glauc i/p, vuggy i/p, occ/ sndy, sli dolc, sli arg i/p, no vis por under visual exam.
Shale : Dk grnsh gy, brnsh gy, occ/ lt - dk gy, frm - mod frm, flky - sbflky, occ/ sb blky, pyrc i/p, mod - hi calc.
Note : Mauddud formation is an oil reservoir in some fields.
Estimated Fm. PP: 64 - 67 pcf (1.03 - 1.07 gm/cc) EMW — Recommended drilling MW:72 - 74 pcf (1.15 - 1.19 gm/cc)

NAHR UMR — LOWER — ALBIAN

Nahr Umr Formation : It is composed mainly of Sandstone interbeded with streaks of (Shale, Siltstone & Limestone).
It is picked by appearance of Sandstone and/or Shale occasionally with increase of Back Ground Gas with Fast ROP.
Average TVD Thickness of Nahr Umr Formation : +/- 260 m.
Caving Shale may occur while drilling Nahr Umr Formation.
Sandstone : lse qtz gr, transl - transp, clr, lt gy, occ/ lt brnsh gy, frble - mod hd, fn - vfn gr, occ/ med gr, sb ang - sb rnd, pr - mod srtd, sli calc cmt, occ/ w/ arg mtrx, w/ free pyr, glauc i/p, occ/ w/ TR of Coal, no vis por under visual exam.
Shale : Dk grnsh gy, brnsh gy - brn, frm - mod frm, blky - sb fiss, glauc i/p, non - sli calc, slty i/p occ/ grdg to Sltst.
Limestone : Lt gy - med gy, tansh wh - lt tan, occ/ lt brn, mod hd, microxln - vfn xln, mod - hi arg, no vis por under visual exam.
Siltstone : Lt - med gy, brnsh gy, occ/ lt brn, mod hd, blky - sb blky, glauc i/p, rr pyrc, non calc, no vis por under visual exam.
Note : Nahr Umr formation is an oil reservoir in some fields.
Estimated Fm. PP: 64 - 67 pcf (1.03 - 1.07 gm/cc) EMW — Recommended drilling MW:73 - 74 pcf (1.17 - 1.19 gm/cc)

SHUAIBA — LOWER — APTIAN

Shuaiba Formation : It is composed mainly of Carbonates (Limestone and/or Dolomite).
It is picked by appearance of Limestone and/or Dolomite with Fast ROP.
Average TVD Thickness of Shuaiba Formation : +/- 85 m.
partial / Complete Mud losses of circulation is highly possible while drilling Shuaiba Formation.
Limestone : wh, off wh, chky, occ/ crmy wh, mod hd, microxln - vfn xln, occ/ vuggy, hi dolc occ/ grdg to Dolomitic Limestone, w/ tr of free pyr, no vis por under visual exam.
Dolomite : Tan, brn, lt brn, off wh, mod hd, vfn xln - mic xln, suc tex i/p, occ/ vuggy, w/ tr of free pyr, no vis por under visual exam.
Note : Shuaiba formation is an oil bearing reservoir in some fields.
It is highly recommended to control on ROP (Minimize ROP) while drilling Shuaiba formation as it is a highly porus formation to avoid formation break down.
Estimated Fm. PP: 66 - 67 pcf (1.06 - 1.07 gm/cc) EMW — Recommended drilling MW: 73 - 74 pcf (1.17 - 1.19 gm/cc)

ZUBAIR — LOWER — BARREMIAN

Zubair Formation : It is composed mainly of (Sandstone & Shale) intercalation with Minor streaks of (Limestone & Siltstone).
It is picked by appearnce of Sandstone and /or Shale with Slow ROP.
Average TVD Thickness of Zubair Formation : +/- 425 m.
Caving Shale may occur while drilling Zubair Formation.
Sandstone : Lse qtz gr, clse, transl - transp, wh, off wh, occ/ lt brn, mod hd, frbl i/p, fn - vfn gr, occ/ med - crs gr, sb ang - sb rnd, poorly - mod srtd, sli calc cmt, rr glauc, pyrc i/p, no vis por under visual exam.
Siltstone: Lt gy, off wh, lt - dk brn, brnsh gy, sft - mod hd, blky - sb blky, rr pyrc, occ/ gradg to v fn sst, non - sli calc.
Shale : Dk grnsh gy, dk gy, brnsh gy - brn, sft - mod frm, fiss - sb fiss, stky i/p, occ/ w/ free pyr, washable, sli - non calc.
Limestone : Wh - tansh wh, lt brn, occ/ lt gy, mod hd - hd, crptoxln - microxln, arg i/p, glauc i/p, no vis por under visual exam.
Zubair Formation Casing Point : It is a regular casing point It is recommended to set the casing +/- 60 m into Zubair Formation Top to seal off the swelling shale of upper Nahr Umr formation.
Note : Sandstone of Zubair formation is an oil reservoir in some fields.
Estimated Fm. PP: 66 - 79 pcf (1.06 - 1.27 gm/cc) EMW — Recommended drilling MW: 73 - 90 pcf (1.17 - 1.44 gm/cc)

RATAWI — LOWER — HAUTERIVIAN

Ratawi Formation : It is composed mainly of Shale & Limestone interbeds.
It is picked by appearance of Shale with Slow ROP.
Average TVD Thickness of Ratawi Formation : +/- 262 m.
H2S & Caving Shale may occur while drilling Ratawi Formation.
Ratawi Formation is devided into 2 parts (upper part is composed mainly of Shale with minor streaks of Limestone & the lower part is composed mainly of Limestone with minor streaks of Shale).
Shale : Grnsh gy, dk brnsh gy, dk gy, mod frm - frm, blky -sb blky occ/ sb fisile, sli calc.
Limestone : Wh - off wh, brnsh gy, lt brn, mod hd - hd, crptoxln - microxln, sli - mod arg, no vis por under visual exam.
Note : Limestone section of Ratawi formation is an oil reservoir in some fields.
Estimated Fm. PP: 74 -101 pcf (1.19 - 1.62 gm/cc) EMW — Recommended drilling MW: 79 - 106 pcf (1.27 - 1.70 gm/cc)

YAMAMA — LOWER — VALANGINIAN

Yamama Formation : It is composed mainly of Limestone.
It is picked by appearance of Limestone which is below the last Shale streak at bottom of Ratawi Formation With a relatevely Fast ROP .
Average TVD Thickness of Yamama Formation : +/- 280 m.
Gas Cut Mud Weight, H2S & Diffrentatial stuck of drill string may occur while drilling drilling Yamama Formation.
Limestone : Lt tan, tansh brn, lt - med gy, occ/ v lt brn, mod hd - hd, microxln - v fnxln, sli - mod arg, occ/ hi arg, no vis por under visual exam.
Note : Yamama formation is an oil reservoir in some fields.
Estimated Fm. PP: 89 - 109 pcf (1.43 - 1.75 gm/cc) EMW — Recommended drilling MW: 90 - 114 pcf (1.44 - 1.83 gm/cc)

SULAIY — LOWER — BERRIASIAN

Sulaiy Formation : It is composed mainly of Limestone with some Shale streaks at its base.
It is picked by appearance of Limestone with Slow ROP relatevely to the previous formation top (Yamama formation).
Average TVD Thickness of Sulaiy Formation : +/- 245 m.
Gas Cut Mud Weight and/or H2S may occur while drilling Sulaiy Formation.
Limestone : Tansh wh, lt brn, med -dk brnsh gy, mod hd, rr/ hd, microxln - v f xln, sli arg, vuggy i/p, no vis por under visual exam.
Shale: :Dk gy, brnsh gy, frm - mod frm, sb flky - sb blky, mod - hi calc, occ/ hi calc grdg to hi arg Limestone.
Note : Sulaiy formation is considered High pressure zone.
Estimated Fm. PP: 95 - 123 pcf (1.52 - 1.97 gm/cc) EMW — Recommended drilling MW: 97 - 124 pcf (1.55 - 1.99 gm/cc)

JURASSIC

GOTNIA — UPPER — PORTLANDIAN / KIMMERIDGIAN

Gotnia Formation : It is composed mainly of Anhydrite & Salt intercalation with minor streaks of (Limestone & Shale).
It is picked by apperance of Anhydrite with Slow ROP.
Average TVD Thickness of Gotnia Formation : +/- 285 m.
Gotnia Formation is devided into 2 parts :

Upper Part (PORTLANDIAN)

Upper part of Gotnia Formation:
Occasionally called by Hith formation, it is composed mainly of Anhydrite intercalation with minor streaks of (Limestone & Shale).
It is picked by apperance of Anhydrite with Slow ROP.
Average TVD Thickness of Upper part of Gotnia Formation : +/- 63 m.
Anhydrite : Mlky wh, wh, occ/ off wh, rr smky wh, mod hd, occ/ sft, amorph, pstd, chky tex i/p, washable.
Limestone : Brn - brnsh gy, dk gy, occ/ lt gy, mod hd - hd, crptoxln, mod - hi arg, no vis por under visual exam.
Shale : Dk gy - dk brnsh gy, blk, occ/ lt brnsh gy, frm - mod frm, sb blky - sb flky, sli - mod calc, occ/ hi calc grdg to hi arg L.st.
Gotnia Formation Casing Point : It is a common casing point as it is highly recommended to set the casing +/- 10 m into Gotnia formation top & prior drilling Salt beds as it's highly recommended to increase Mud Weight prior drilling Salt beds to avoid up normal high pore pressure, it is conseder a critical casing point which is require to not drill more than +/- 10 m into the firist Anhydrite bed at its top.
Estimated Fm. PP: 97 - 131 pcf (1.55 - 2.10 gm/cc) EMW — Recommended drilling MW:103 - 144 pcf (1.65 - 2.31 gm/cc)

Lower Part (KIMMERIDGIAN)

Lower part of Gotnia Formation:
It is composed mainly of Salt & Anhydrite intercalation with minor streaks of (Limestone & Shale).
It is picked by apperance of Salt with very Fast ROP.
Average TVD Thickness of Lower part of Gotnia Formation : +/- 210 m
Lower part of Gotnia Fm. is Lagoon environment that's why it has a variable TVD thickness (+/- 51 m up to +/- 427 m).
Water flow asociated with (Gas & H2S) & Stuck of Drill String due to Salt mobility behavior in case of hydrostatic pressure is less than formation pore pressure may occur while drilling Lower part of Gotnia Formation.
Lower part of Gotnia formation is most critical formation while drilling & it's require to drill & set casing ASAP at Top of Najmah formation to seal off Gotnia formation to avoid its huge drilling problems.
Salt : Clss, tansl - transp, wh, clear, mod hd, xln, sol.
Anhydrite : Mlky wh, wh, occ/ off wh, rr smky wh, mod hd, occ/ sft, amorph, pstd, chky tex i/p, washable.
Limestone : Dk gy - blk, dk brnsh gy, mod hd - hd, crptoxln, hi arg occ/ grdg to hi calc Shale, no vis por under visual exam.
Shale : Dk gy - dk brnsh gy, blk, occ/ lt brnsh gy, frm - mod frm, sb blky - sb flky, sli - mod calc, occ/ hi calc grdg to hi arg L.st.
Note : Gotnia formation has Up normal High Pore pressure & it is contain mainly of 3 Salt beds separated by 3 Anhydrite streaks & impeded by thin layers of (limestone & Shale), It is occasionally contain mainly of 4 Salt beds separated by 4 Anhydrite streaks & impeded by thin layers of (limestone & Shale), ROP is faster while drilling Salt & it became Slow while drilling Anhydrite.
Estimated Fm. PP:120 - 148 pcf (1.92 - 2.37 gm/cc) EMW — Recommended drilling MW:142 - 152 pcf (2.27 - 2.44 gm/cc)

NAJMAH / NAO KELIKAN — UPPER — OXFORDIAN

Najmah / Nao kelikan Formation : It is composed mainly of Limestone & Shale interbeds.
It is picked by appearance of Limestone with increase of Back Ground Gas with Fast ROP.
Najmah Formation is devided into 2 parts (upper part is composed mainly of Limestone & the lower part is composed mainly of Shale with streaks of Limestone).
Average TVD Thickness of Najmah Formation : +/- 41 m.
Limestone : Lt gy, tansh gy - tan, gysh wh, lt brn, occ/ brnsh gy, mod hd - hd, microxln - vfn xln, non - sli arg, sli dolc i/p, no vis por under visual exam.
Shale : blk, brn, frm - mod frm, blky - sb blky, w/ blk carb matter, bituminous, hi calc occ/ grdg to hi arg L.st.
Najmah / Nao kelikan Formation Casing Point : It is a regular & Most critical csg point, it is highly recommended to set the casing +/- 5 m into Najmah Formation top to seal off Gotnia formation which has Up normal high pore pressure & also to reduce Mud Weight while drilling Najmah formation as the formation pore pressure of Najmah formation is less than the above formation pore pressure of Gotnia formation.
Najmah formation casing point is picked by appearance of Limestone with light colors as the Limestone of the above Gotnia formation with Dark colors.
Note : Najmah formation is an oil reservoir in some fields.
Estimated Fm. PP:112 - 129 pcf (1.79 - 2.07 gm/cc) EMW — Recommended drilling MW:118 - 133 pcf (1.89 - 2.13 gm/cc)

SARJELU — MIDDLE — CALLOVIAN / BATHONIAN BAJOCIAN AALENIAN

Sarjelu Formation : It is composed mainly of Limestone & Shale interbeds.
It is picked by appearance of Argillaceous Limestone with Slow ROP.
Sarjelu Formation is devided into 2 parts (upper part is composed mainly of highly argillaceous Limestone & the lower part is composed mainly of highly calcareous Shale with streaks of Limestone).
Average TVD Thickness of Sarjelu Formation : +/- 62 m.
Limestone : Brnsh gy - dk brn, crmy wh, lt gy, occ/ dk gry, mod hd - hd, micxln - cryptxl, mod - hi arg, no vis por under visual exam.
Shale : Gy, lt gy, grnsh gy, occ/ dk grn, frm - mod frm, sb blky - sb flky, stky, washable, pyrc i/p, hi calc, grdg to hi arg Lst and/or Marl.
Note : Sarjelu formation is an oil reservoir in some fields.
Estimated Fm. PP:114 - 135 pcf (1.83 - 2.16 gm/cc) EMW — Recommended drilling MW:118 - 139 pcf (1.89 - 2.23 gm/cc)

ALAN — LOWER — TOARCIAN

Alan Formation : It is composed mainly of Limestone with minor streaks of Anhydrite.
It is picked by appearance of Limestone occasionally with increase of Back Ground Gas with Slow ROP.
Average TVD Thickness of Alan Formation : +/- 80 m.
Salt water flow may occur while drilling Alan Formation.
Limestone : Dk gy, brn - brnsh gy, occ/ lt gy, mod hd - hd, micxln - cryptxl, mod - hi arg, no vis por under visual exam.
Anhydrite : Mlky wh, wh, occ/ off wh, rr smky wh, mod hd, occ/ sft, sli calc, amorph, pstd, hi washable.
Alan Formation Casing Point : It is not a regular casing point, It is recommended to set the casing +/- 50 m (or) +/- 75 m into Alan Formation top.
Estimated Fm. PP:105 - 135 pcf (1.68 - 2.16 gm/cc) EMW — Recommended drilling MW:108 - 138 pcf (1.73 - 2.21 gm/cc)

MUS — LOWER — TOARCIAN

Mus Formation : It is composed mainly of Limestone & occasionally with minor streaks of Anhydrite.
It is picked by appearance of Thick bed of Limestone below Anhydrite streaks of the upper formation with Fast ROP.
Average TVD Thickness of Mus Formation : +/- 110 m.
H2S may occur while drilling Mus Formation.
Limestone : Lt gy, lt brn - lt brnsh gy, mod hd - hd, micxln - vfnxln, sli arg, no vis por under visual exam.
Anhydrite : Mlky wh, wh, occ/ off wh, rr smky wh, mod hd, occ/ sft, sli calc, amorph, pstd, hi washable.
Note : Mus formation is an oil reservoir in some fields.
Estimated Fm. PP:105 - 137 pcf (1.68 - 2.19 gm/cc) EMW — Recommended drilling MW:108 - 138 pcf (1.73 - 2.21 gm/cc)

ADAIYAH — LOWER — TOARCIAN

Adaiya Formation : It is composed mainly of Anhydrite with streaks of Limestone.
It is picked by appearance of Thick bed of Anhydrite with Slow ROP.
Average TVD Thickness of Adaiya Formation : +/- 130 m.
H2S may occur while drilling Adaiya Formation.
Anhydrite : Mlky wh, wh, occ/ off wh, rr smky wh, mod hd, occ/ sft, sli calc, amorph, pstd, hi washable.
Limestone : Lt gy, lt brn - lt brnsh gy, mod hd - hd, micxln - vfnxln, sli arg, no vis por under visual exam.
Estimated Fm. PP:105 - 137 pcf (1.68 - 2.19 gm/cc) EMW — Recommended drilling MW:108 - 138 pcf (1.73 - 2.21 gm/cc)

BUTMA — LOWER — TOARCIAN

Butma Formation : It is composed mainly of Limestone & Shale intercalation with Minor streaks of Anhydrite.
It is picked by appearance of Shale and/or highly argillaceous Limestone with Fast ROP.
Average TVD Thickness of Butma Formation : +/- 285 m.
Caving Shale & Tight hole may occur while drilling Butma Formation.
Limestone : Lt gy, lt brn, med - dk gy, mod hd - sft, cryptoxln - microxln, hi arg occ/ grdg to hi calc Shale, no vis por under visual exam.
Shale : Dk grnsh gy, lt grn, olive grn, occ/ rdsh brn - brn, frm - mod frm, blky - sb blky,non - sli calc, occ/ hi slty grdg to Siltstone.
Anhydrite : Mlky wh, wh, occ/ off wh, rr smky wh, mod hd, occ/ sft, sli calc, amorph, pstd, hi washable.
Estimated Fm. PP:105 - 138 pcf (1.68 - 2.21 gm/cc) EMW — Recommended drilling MW:106 - 139 pcf (1.70 - 2.23 gm/cc)

TRIASSIC

KURRA CHINE (JILH) — UPPER — PLIENSBACHIAN HETTANGIAN / RHAETIAN NORIAN / CARNIAN

Kurra Chine (Jilh) Formation : It is composed mainly of Carbonates (Dolomitic Limestone and/or Dolomite) with streaks of (Anhydrite, Shale & Salt).
It is picked by Appearance of Thick bed of Carbonates and/or Anhydrte with Slow ROP.
Average TVD Thickness of Kurra Chine (Jilh) Formation : +/- 530 m.
Stuck of Drill String due to Salt mobility behavior in case of hydrostatic pressure is less than formation pore pressure may occur while drilling Kurra Chine (Jilh) Formation.
Dolomitic Limestone : Off wh - lt gy, tan, crmy i/p, occ/ med - dk gy, mod hd, micxln - v.fnxln, hi arg, suc tex i/p, no vis por under visual exam.
Dolomite : Lt brn - brn, brnsh gry, mod hd - hd, v hd i/p, micxln - vfxln, succ text i/p, sli arg, no vis por under visual exam.
Anhydrite : Wh, mlky wh, occ/ off wh, mod hd - hd, amorph, pstd, washable.
Shale : gnsh gy, lt gy, occ/ dk gy, blky - sbblky, frm - sft, stky, washble, pyrc i/p, sli calc.
Salt : Clss, tansl - transp, wh, clear, mod hd, xln, sol.
ROP is Faster while drilling Salt beds.
Note : Kurra Chine (Jilh) formation is an oil reservoir in some fields.
Estimated Fm. PP:135 - 138 pcf (2.16 - 2.21 gm/cc) EMW — Recommended drilling MW:139 - 140 pcf (2.23 - 2.24 gm/cc)

GELI KHANA (JILH) — MIDDLE — LADINIAN / ANISIAN

Geli Khana (Jilh) Formation : It is composed mainly of Carbonates (Dolomitic Limestone and/or Dolomite) with streaks of (Anhydrite & Shale).
It is picked by Appearance of Carbonates below the Shale streak at above formation with Fast ROP.
Average TVD Thickness of Geli Khana (Jilh) Formation : +/- 450 m.
Dolomitic Limestone : Off wh - lt gy, tan, crmy i/p, occ/ med - dk gy, mod hd, micxln - v.fnxln, hi arg, suc tex i/p, no vis por under visual exam.
Anhydrite : Wh, mlky wh, occ/ off wh, mod hd - hd, amorph, pstd, washable.
Shale : gnsh gy, lt gy, occ/ dk gy, blky - sbblky, frm - sft, stky, washble, pyrc i/p, sli calc.
Dolomite : Lt brn - brn, brnsh gry, mod hd - hd, v hd i/p, micxln - vfxln, succ text i/p, sli arg, no vis por under visual exam.
Note : Geli Khana (Jilh) formation is an oil reservoir in some fields.
Estimated Fm. PP:135 - 138 pcf (2.16 - 2.21 gm/cc) EMW — Recommended drilling MW:139 - 140 pcf (2.23 - 2.24 gm/cc)

BEDUH — LOWER — SCYTHIAN

Beduh Formation : It is composed mainly of Shale & Anhydrite interbeds.
It is picked by appearance of Shale and/or Anhydrite with Slow ROP.
Average TVD Thickness of Beduh Formation : +/- 55 m.
Caving Shale & Tight hole may occur while drilling Beduh Formation.
Shale : Lt brn - lt brnsh gy, dk brnsh gy, occ/ rdsh brn, occ/ dk grnsh gy, blky - sb flky, frm - mod frm occ/ sft, stky, slty i/p occ/ grdg to Siltstone, sli - hi calc i/p, occ/ grdg to hi arg L.st.
Anhydrite : Off wh, mlky wh, occ/ smky wh, mod hd - hd, amorph, pstd, washable.
Beduh Formation Casing Point : It is not a regular casing point, it is recommended to set the Liner casing +/- 10 m into Beduh Formation top in case of drilling deep wells.
Estimated Fm. PP:135 - 144 pcf (2.16 - 2.31 gm/cc) EMW — Recommended drilling MW:139 - 145 pcf (2.23 - 2.32 gm/cc)

MIRGAMIR — LOWER — SCYTHIAN

Mirgamir Formation : It is composed mainly of Highly argillaceous Limestone intercalation with streaks of (Anhydrite & Shale) & occasionally with very minor Salt streaks.
It is picked by appearance of Highly argillaceous Limestone with Fast ROP.
Average TVD Thickness of Mirgamir Formation : +/- 135 m.
Caving Shale & Tight hole may occur while drilling Mirgamir Formation.
Limestone : Lt gy, gy, off wt, mod hd, microxln - cryptoxln, dolc, mod - hi arg occ/ grdg to hi calc Shale, no vis por under visual exam.
Shale : Lt brn - lt brnsh gy, dk brnsh gy, occ/ rdsh brn, grn, occ/ dk grnsh gy, blky - sb flky, frm - mod frm occ/ sft, stky, , sli - hi calc i/p, occ/ grdg to hi arg L.st.
Anhydrite : Off wh, mlky wh, occ/ smky wh, mod hd - hd, amorph, pstd, washable.
Salt : Clss, tansl - transp, wh, clear, mod hd, xln, sol, anhc.
Estimated Fm. PP:135 - 144 pcf (2.16 - 2.31 gm/cc) EMW — Recommended drilling MW:139 - 145 pcf (2.23 - 2.32 gm/cc)

PERMIAN

CHIA ZAIRI (KHUFF) — UPPER — TATARIAN / KAZANIAN — Members: A, B, C, (D)Anhydrite, D, E

Chia Zairi (Khuff) Formation : It is composed mainly of carbonates (Limestone and/or Dolomite and/or Dolomitic Limeatone) intercalation with streaks of (Anhydrit & Shale).
It is picked by appearance of chocky Limestone with Fast ROP.
Average TVD Thickness of Chia Zairi (Khuff) Formation : +/- 940 m.
Limestone : Chky, off wt, lt gy, tansh gy, brn - dk brnsh gy, cryptoxln - microxln, sft - md hd, sli - mod arg, rr hi arg, occ/ hi dolc grdg to Dol, no vis por under visual exam.
Dolomite : Dk brnsh gy - dk brn, med gy, tan, mod hd - hd, v hd i/p, cryptoxln - micxln, hi arg, succ tex i/p, no vis por under visual exam.
Dolomitic Limestone : Lt gy, gy, gysh wt, occ/ dk gy, micxln - vfxln, occ/ crypxln, mod hd - hd, occ/ v.hd, sli arg i/p, no vis por under visual exam.
Anhydrite : Off wh, mlky wh, occ/ smky wh, mod hd - hd, amorph, pstd, washable, non - sli calc.
Shale : Dk gy, grnsh gy, rdsh brn, grn, occ/ grnsh gy, frm - mod frm, sft i/p, blky - sb blky, occ/ sb flky, mod calc.
Chia Zairi (Khuff) Formation Casing Point : It is not a regular casing point, it is recommended to set the Liner casing +/- 30 m into Khuff Formation top in case of drilling deep wells.
Khuff " D " Anhydrite is picked by appearance of Anhydrite below the base of Khuff " C " Reservoir with slow ROP.
Khuff " D " Anhydrite is exists in two separate stringers of Anhydrite, these two stringers are separated by 5 m - 10 m of carbonates layer.
Note : The Chia Zairi (Khuff) formation contains 3 gas reservoirs (Khuff A, B, and C).
Estimated Fm. PP: 116 - 147 pcf (1.86 - 2.35 gm/cc) EMW — Recommended drilling MW:146 - 147 pcf (2.34 - 2.35 gm/cc)

Legend

ANHYDRITE — SHALE — LIMESTONE — SALT — DOLOMITE — SANDSTONE
DOLOMITIC LIMESTONE — MARL — CALCARENITIC LIMESTONE — DOLOMITIC CALCARENITIC LIMESTONE — SILTSTONE — ARGILLACEOUS LIMESTONE

Remarks :

* The Estimated formation pore pressure based on (connection gases, hole condition, DC exponent and offset/drilled wells) in surrounding area and it is changed from area to another area based on the TVD (true vertical depth) for each formation and Structure Geology for each area.
* The values for both (Estimated Fm. Pore Pressure & Recommended Drilling Mud Weight) are a Minimum & Maximum Values for each Formation.
* Casing points & Average TVD formations thickness are based on drilled wells in surrounding area.
* Average TVD formations thickness could be change in the same area based on structure geology of the area also the Formations could be thick in one direction & thin in the other direction.

* PP : Pore Pressure.
MW : Mud Weight.