

# PP&WBS prognosis and communication of uncertainties

- from an Equinor point of view

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Why are we not able to do a simple monte carlo simulation of the pore pressure prognosis to provide a prognosis with a statistical variation?

# Uncertainties related to inputs for pore pressure (PP) estimation

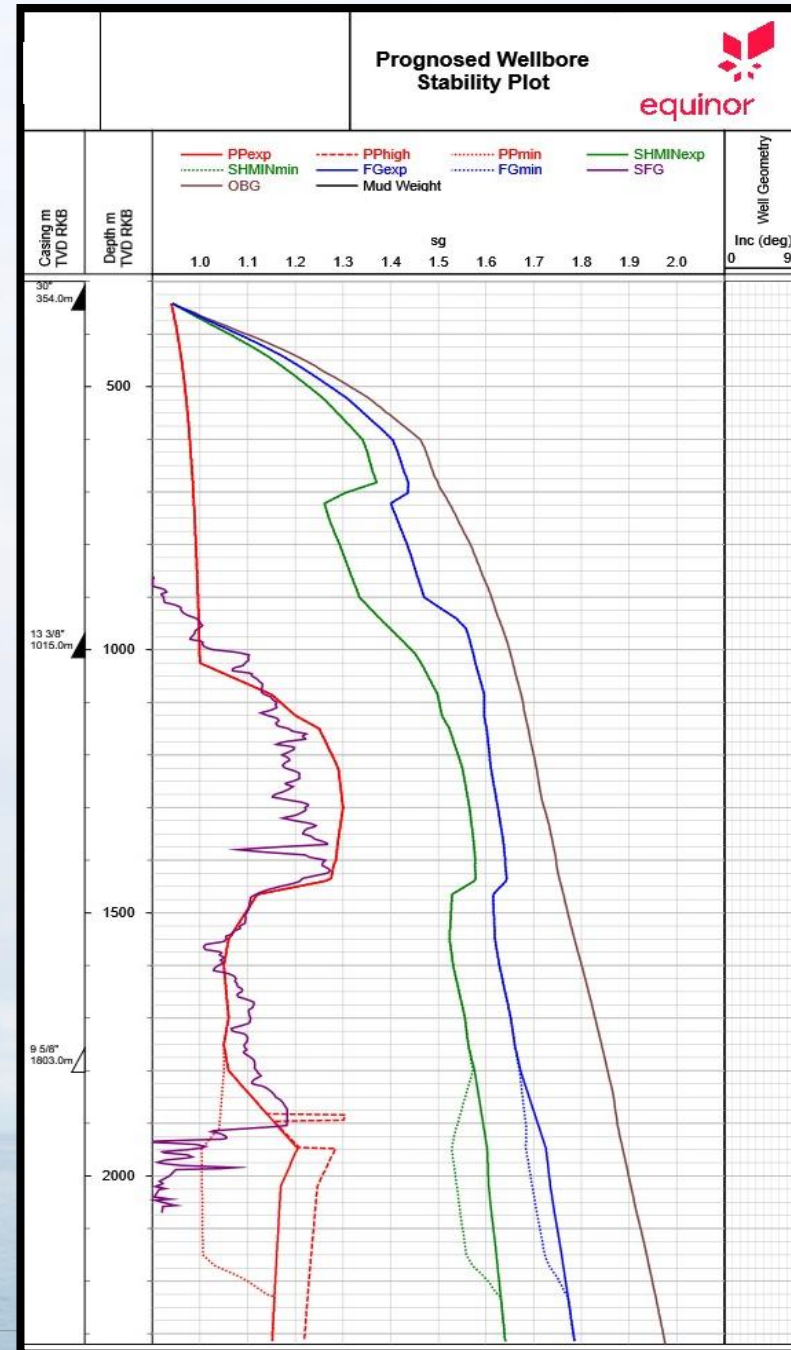
- **Effective stress = Total stress – PP**
  - Vertical stress estimation
  - Elements of multiple stress regimes?
- Formation tops
  - Time/depth conversion
  - Horizon picks and correlation
- (Un)observable faults
  - Baffles or pressure pathways
  - Juxtaposition across faults
- Lithological prediction
  - Type of rocks
  - Mineralogy effect on logs
  - Degree of cementation
- Overburden flow units
  - Subsurface plumbing
- Leakages from reservoir into overburden
  - Sub-seismic carrier «beds»
  - Sub-seismic fracture systems
- Temperature effect on
  - reference logs
  - diagenesis
  - fluid PVT
- Conflicting reference well information
- Reference data uncertainty
  - Seismic velocity
- Seismic resolution – processing
- Poor quality measurements
- $P_g$ 
  - Even with a  $P_g$  of 0.05, the prognosis would reflect a discovery..
- Depletion / injection
- Segmentation
- In-situ HC generation
- Fluid type(s) / phase(s)
- Fluid density and HWC
- Burial history and fluid retention
- Net compaction trend
- Centroid effects
- And so on and so forth...

What are we able to provide- from a subsurface point of view?

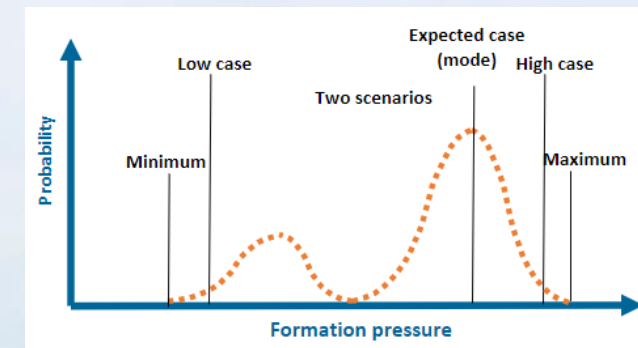
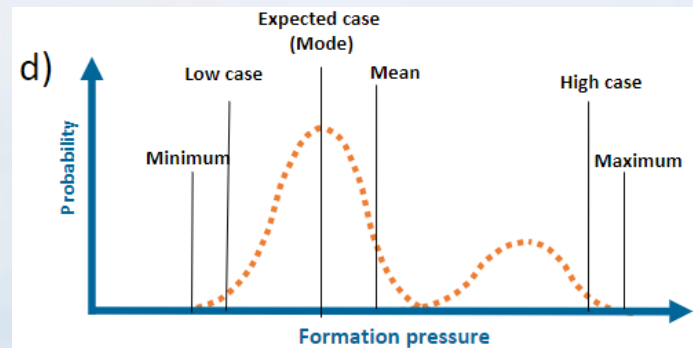
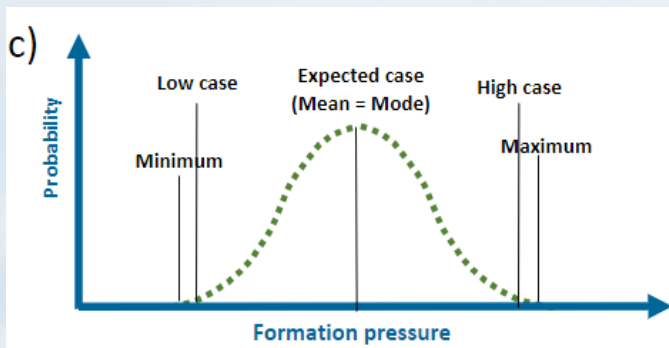
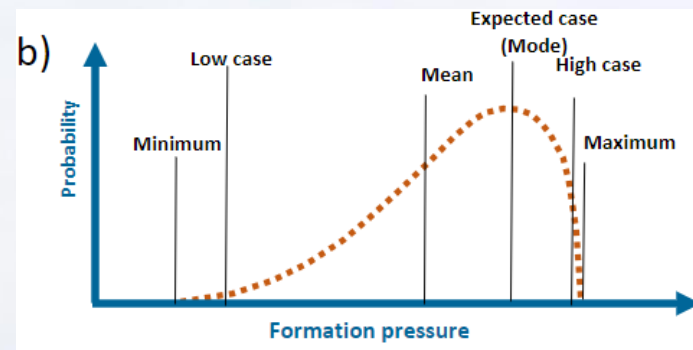
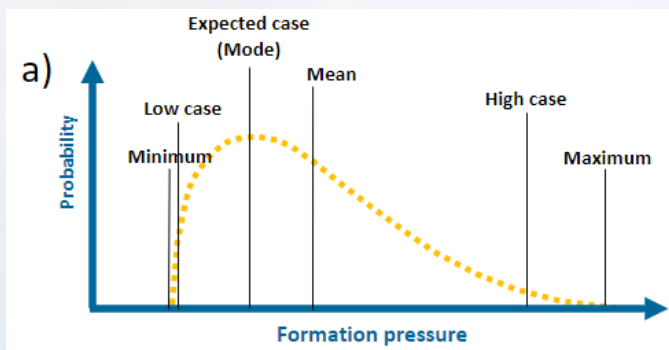


# Deliverables of pore pressure

- **Expected** case pore pressure
- **Low** case pore pressure
- **High** case pore pressure
- (*Maximum case pore pressure* )



# Pressure distributions



# Quality assurance

- All pressure prognosis are QA'ed
  - Check list
- More complex wells:
  - Strengthened QA

PP & WBS QA/QC Matrix   Well Specific PP & WBS		
Prospect:		Approval
Well:		
Date:		Date
Prepared by:		Signature
QA/QC'd by:		

Phase / Section	Category	Checklist	Status	Comments	Actionlog				Identified Risk
					Action	Status	Due date	Responsible	
Overburden	Overburden Gradient	Data basis		Type your comments here					
		is waterdepth representative for the planned well?							
	Pore Pressure Gradient	is the stratigraphy representative for the planned well?							
		Data basis							
	SHMIN Gradient	Calculation method							
		Experience / Calibration points							
	Fracture Gradient	Risk elements (add as needed)							
		Calculation method							
	Shear Failure Gradient	Experience / Calibration points							
		Lithology variation							
Calculation method									
Data basis for Sonic-curve (representative and good quality)									
Reservoir	Pore Pressure Gradient	Adjustment of Sonic-curve to Stratigraphy							
		Inclination & Azimuth from wellpath							
	SHMIN Gradient	Smoothing and filtering							
		Experience / Calibration points							
	Fracture Gradient	Data basis							
		Depletion							
	Shear Failure Gradient of Reservoir Shales	Overpressure							
		Stratigraphic risk							
		Segment/fault risk							
		Calculation method							
In General	Miscellaneous	Depletion constant							
		Experience / Calibration points							
Other	Archiving	Lithology variation							
		Calculation method							
Other	Archiving	Experience / Calibration points							
		Lithology variation							
Other	Archiving	Calculation method							
		Data basis for Sonic-curve							
Other	Archiving	Adjustment of Sonic-curve to Stratigraphy							
		Inclination & Azimuth from wellpath							
Other	Archiving	Smoothing and filtering							
		Experience / Calibration points							
Other	Archiving	Storage in P601 pressbase							

What does this means towards barrier fluids and kick tolerance?





Barrier fluids

Kick tolerance



- **Equinor has a target of zero serious well control incidents**
  - the risk of kick towards the risk of losses needs to be considered
    - for wells where the drilling window closes -
    - *or* the risk introduced is considered higher than the risk they are supposed to mitigate
      - a more in- depth discussion and risk evaluation is required

Thank you!

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*Thank you also to my fellow colleagues: Fredrik Birkeland, Oddgeir Undertun, Vedran Secic, Bjørn Erik Normann and Ronny Kvalsund*

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