



BAUERBERG KLEIN
TRAINING & CONSULTING





Module 5

RESERVOIR MECHANICAL CONDITIONS

CONTENT

- *Influence of reservoir mechanical conditions on perforating performance*
- *In-situ field stresses*
- *Rock mechanical properties*
- *Pore pressure*
- *Reservoir temperature*

INFLUENCE OF RESERVOIR MECHANICAL PROPERTIES

Reservoir mechanical conditions and properties define and limit perforation performance, these properties are:

- In-situ stresses
- Rock mechanical properties (Strength and deformation)
- Pore pressure

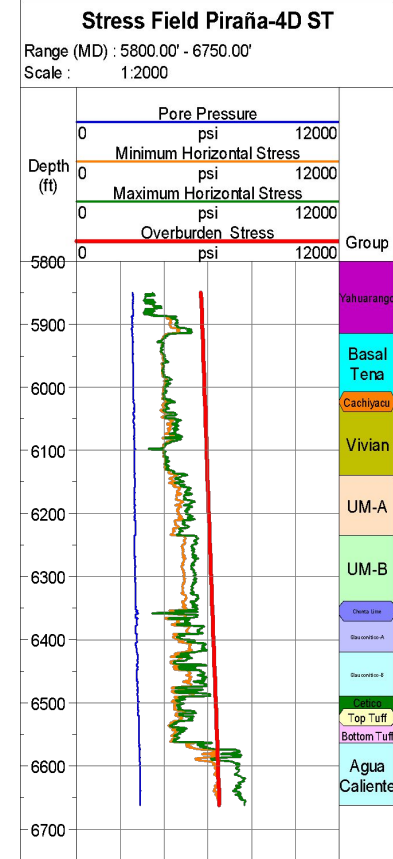
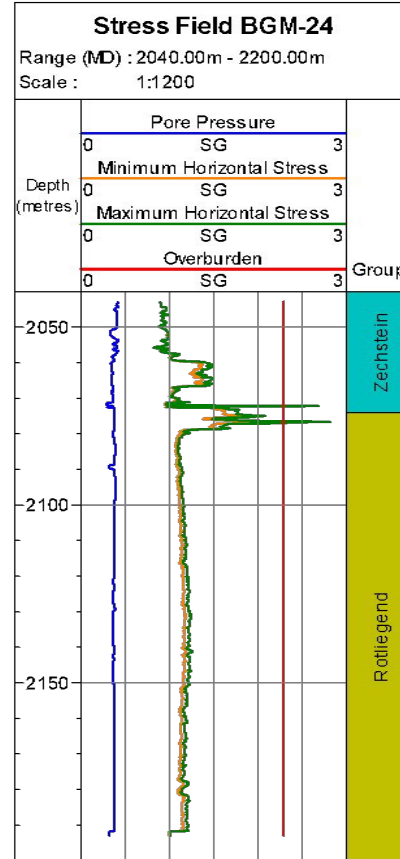
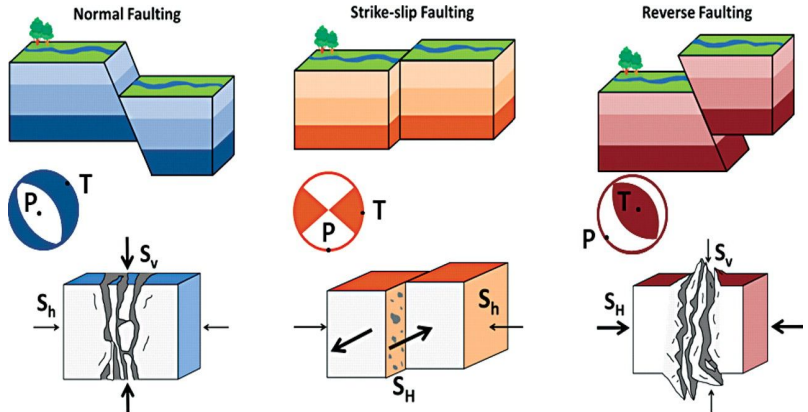
As a result, the final shape, length and productivity of a perforation tunnel is defined mainly by these conditions and properties

The type of reservoir (in mechanical terms) be it competent or unconsolidated required adequate design of the perforating program based on these conditions and properties

IN-SITU STRESSES

In-situ stresses are the loading acting on the reservoir represented by the main principal stresses σ_v , σ_H and σ_h

Perforating charges must overcome these stresses



ROCK MECHANICAL PROPERTIES - Strength

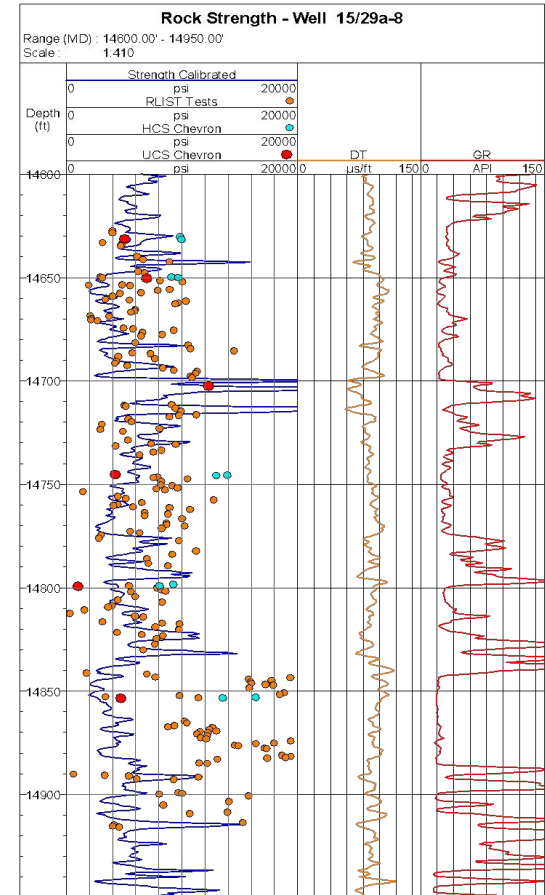
These are properties that represent rock strength and deformation behaviour. They can be static and dynamic properties



Courtesy of PDVSA Intevp

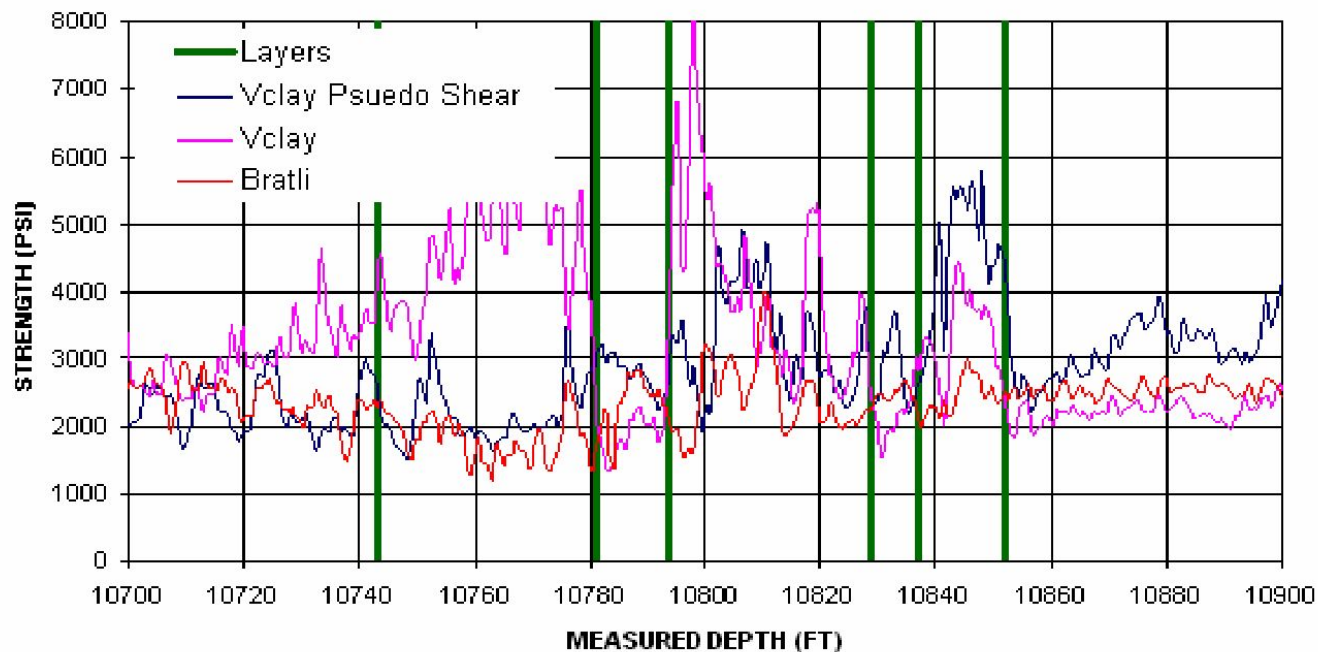


Courtesy of IESL



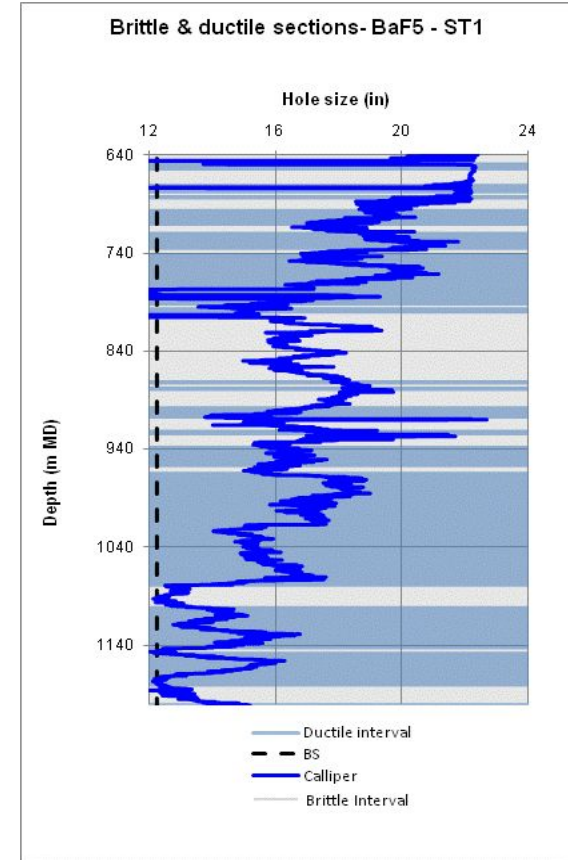
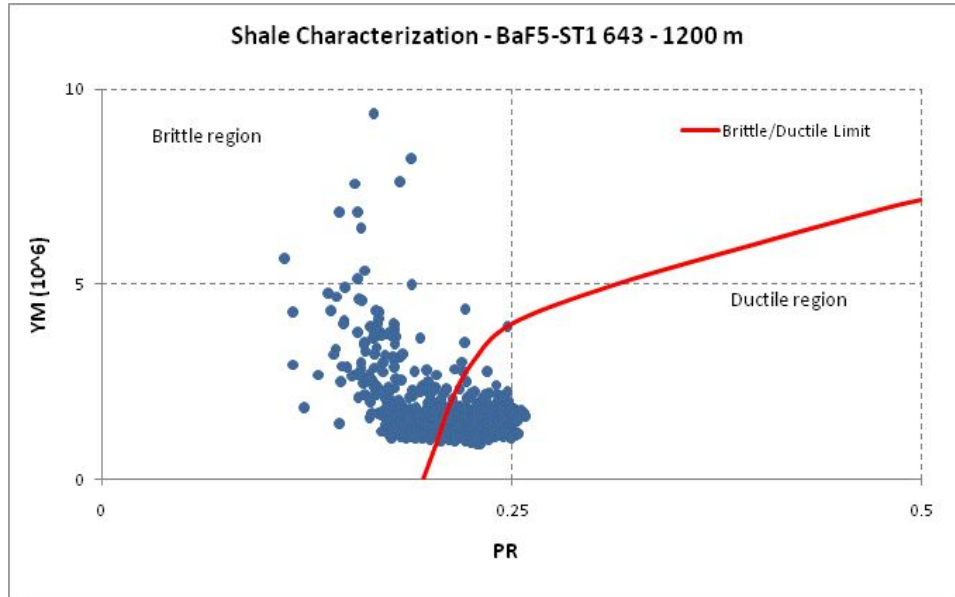
ROCK MECHANICAL PROPERTIES – Strength (Continued)

Estimated using correlations available and calibrated using measurements



ROCK MECHANICAL PROPERTIES - Deformation

Deformation is represented by Young modulus and Poisson's ratio



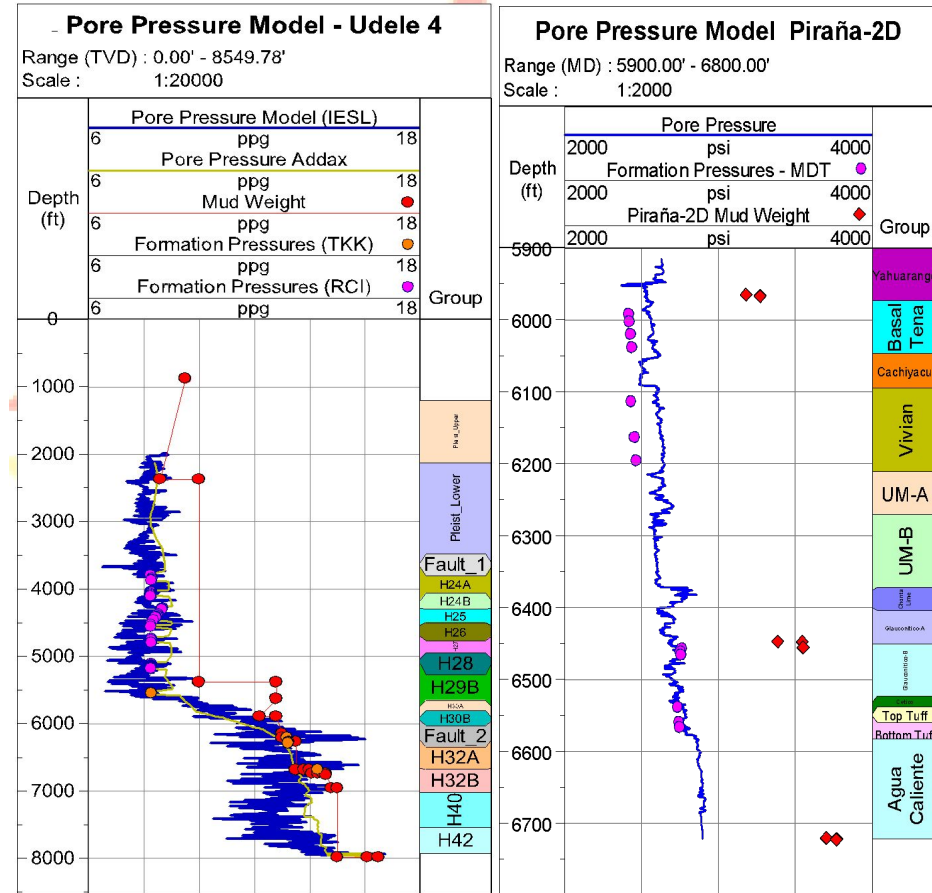
PORE PRESSURE

Pore pressure helps the rock framework to cope with the loads (Stresses)

Load transmission through grain-to-grain contact points increases with the decrease of pore pressure

Modelling of pore pressure is calibrated with measurements such as pressure surveys, MDT, RFT

Pore pressure acts against the perforation charge



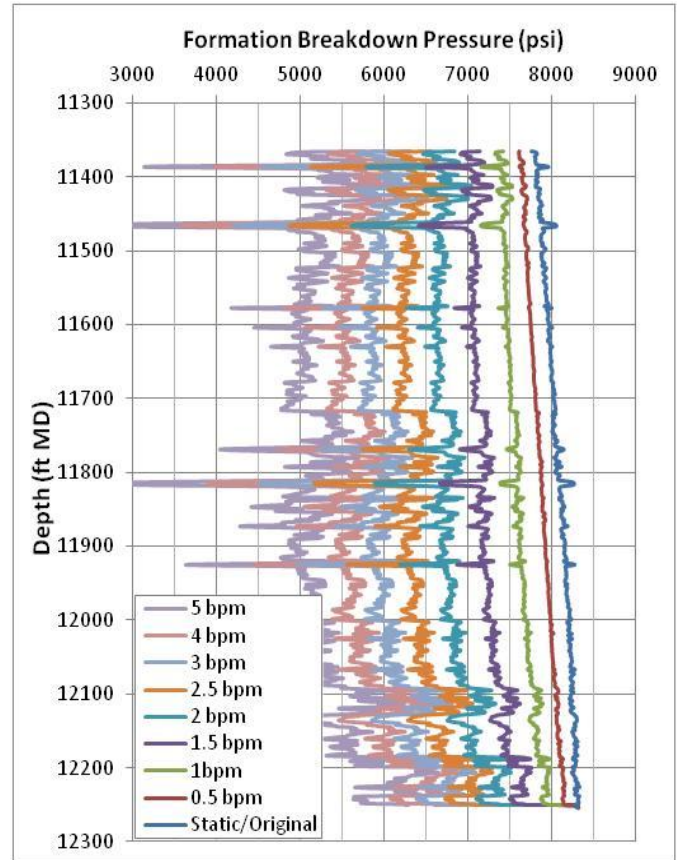
RESERVOIR TEMPERATURE

Reservoir temperature influence the mechanical properties of the reservoir

With temperature changes (From circulation etc.) the magnitude of properties such as:

- fracturing pressure,
- compressive strength and
- in-situ stresses

will vary, this effect can be used to enhance perforation performance in certain scenarios

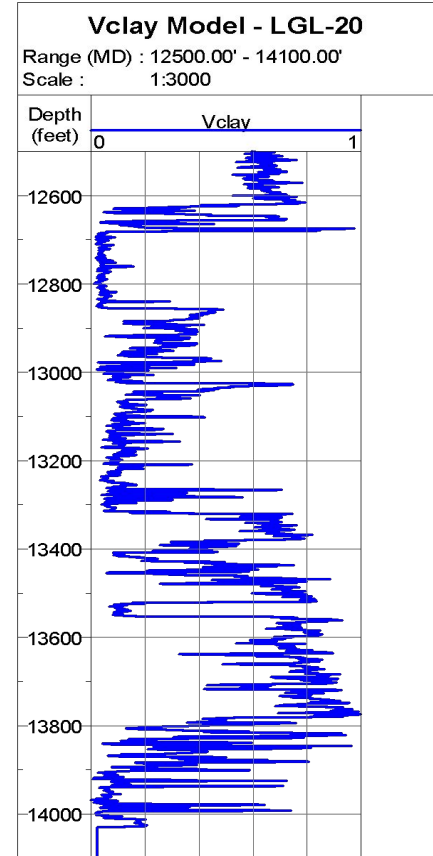


OTHER RESERVOIR PROPERTIES

Mineralogy and petrophysical properties of a reservoir can affect the mechanical behaviour of the rock during perforating by:

- Defining the manner in which deformation takes place
- Increasing or decreasing compressive strength hence the length of the perforated tunnel
- Determining the condition of the perforated tunnel and its inflow capacity

These properties are the amount of clay present in the reservoir matrix, grain size, porosity and permeability



MODULE 5 – SUMMARY

Mechanical and petrophysical properties and conditions can affect perforating performance.

Stresses, strength and pore pressure oppose the forces generated by the shot, Young modulus and Poisson's ratio define how the rock deforms during perforating

Pore pressure helps the rock framework to deal with the loading (Stresses, drawdown), a decrease in pore pressure might lead to an increase in loads on the rock

Increases/decreases in reservoir temperature modify strength/deformation properties

Other geometrical and petrophysical properties such as grain size, clay content and porosity can affect perforation performance



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