FORMATION EVALUATION

PETE 663

NET SAND/PAY, RESOURCES, AND RESERVES

Summer 2010

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DEFINING NET PAY

- What is “net pay”?
- Several definitions; sometimes confusing
- How we determine reserves depends on objectives and data available
  - Static: resource and reserve calculations; what is there and estimated recoverable?
  - Dynamic: what will flow?
- Data used
  - Logs
  - Core
  - Well tests
  - Production
  - Seismic

NET SAND / PAY, RESOURCE AND RESERVE DETERMINATIONS

Methods

- **Volumetric (Static)**
- **Dynamic**
- **Production History**
- **Analogy**

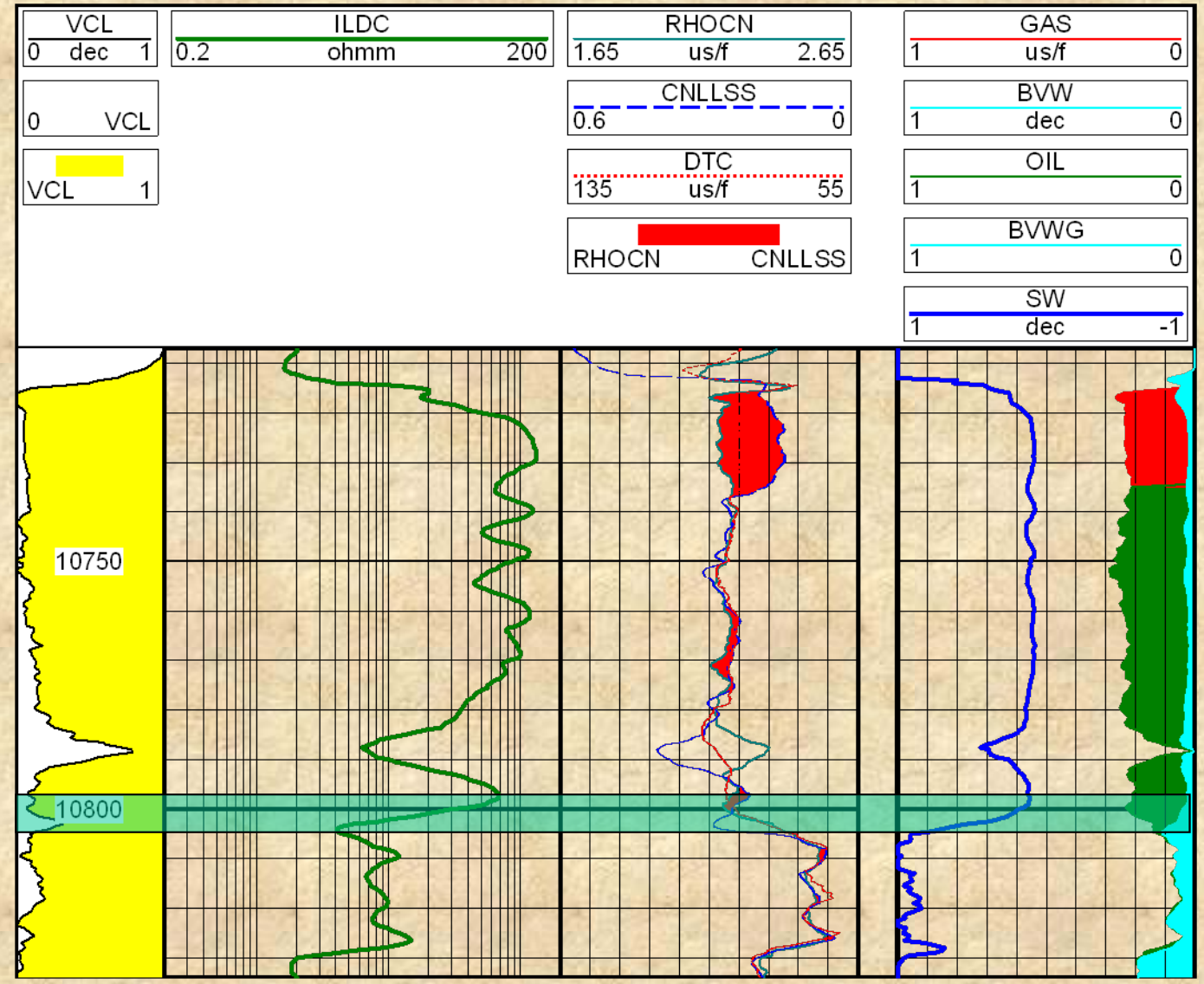
DETERMINING HYDROCARBONS IN-PLACE

- **Static Definition**

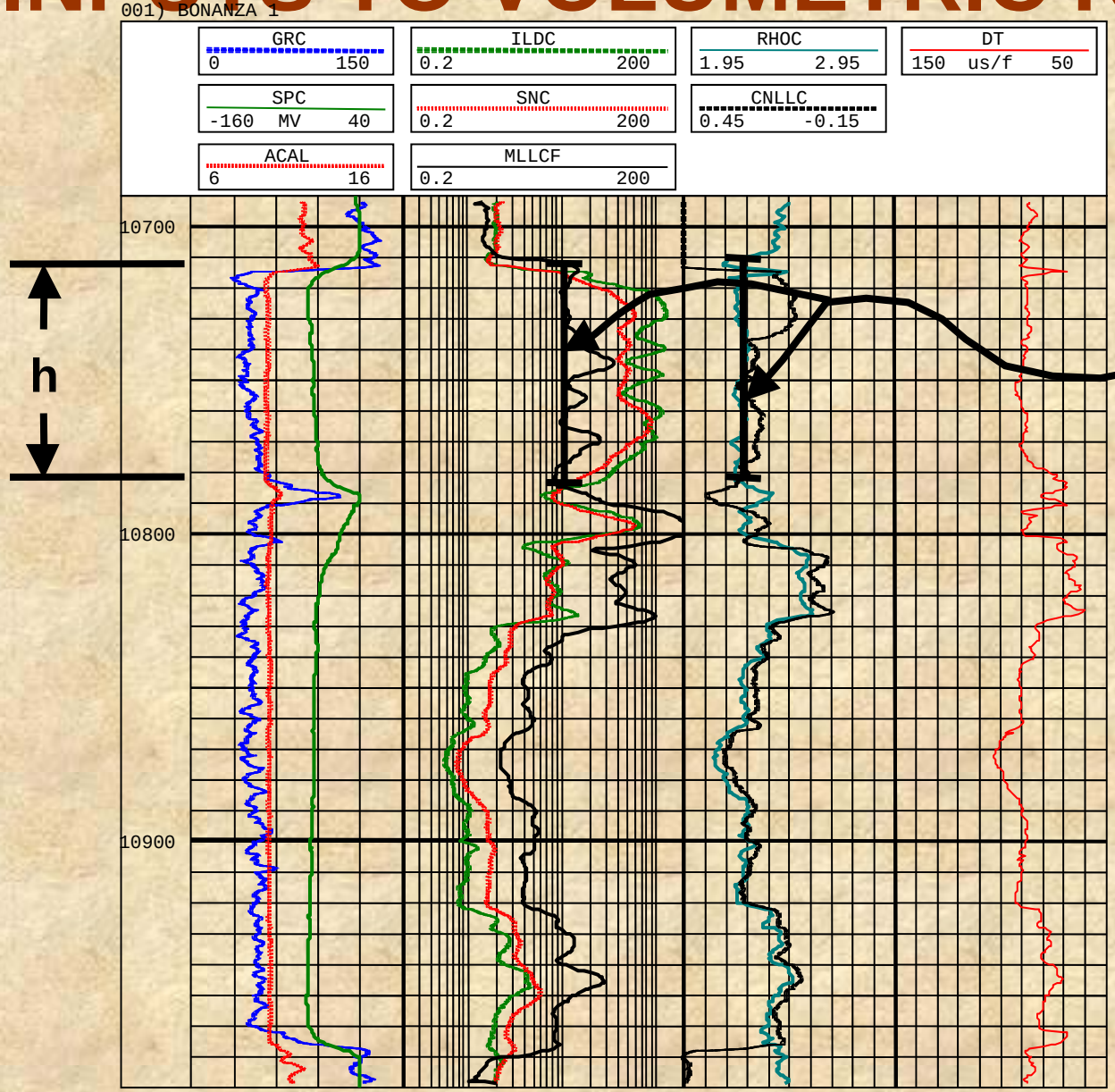
$$\underline{OOIP} = 7758\ Ah\ \phi(1 - S_w)/B_{oi}$$

- **Assumes net properties**
- **Evaluating net**
  - **Identify any area without HC's**
  - **Logs: apply series of criteria**
    - **(Sw > cutoff) AND (Vsh > cutoff) AND (ϕ < cutoff) etc…**
    - **Compare with core, if available**
    - **Calibrate to seismic?**

Fluid Distribution



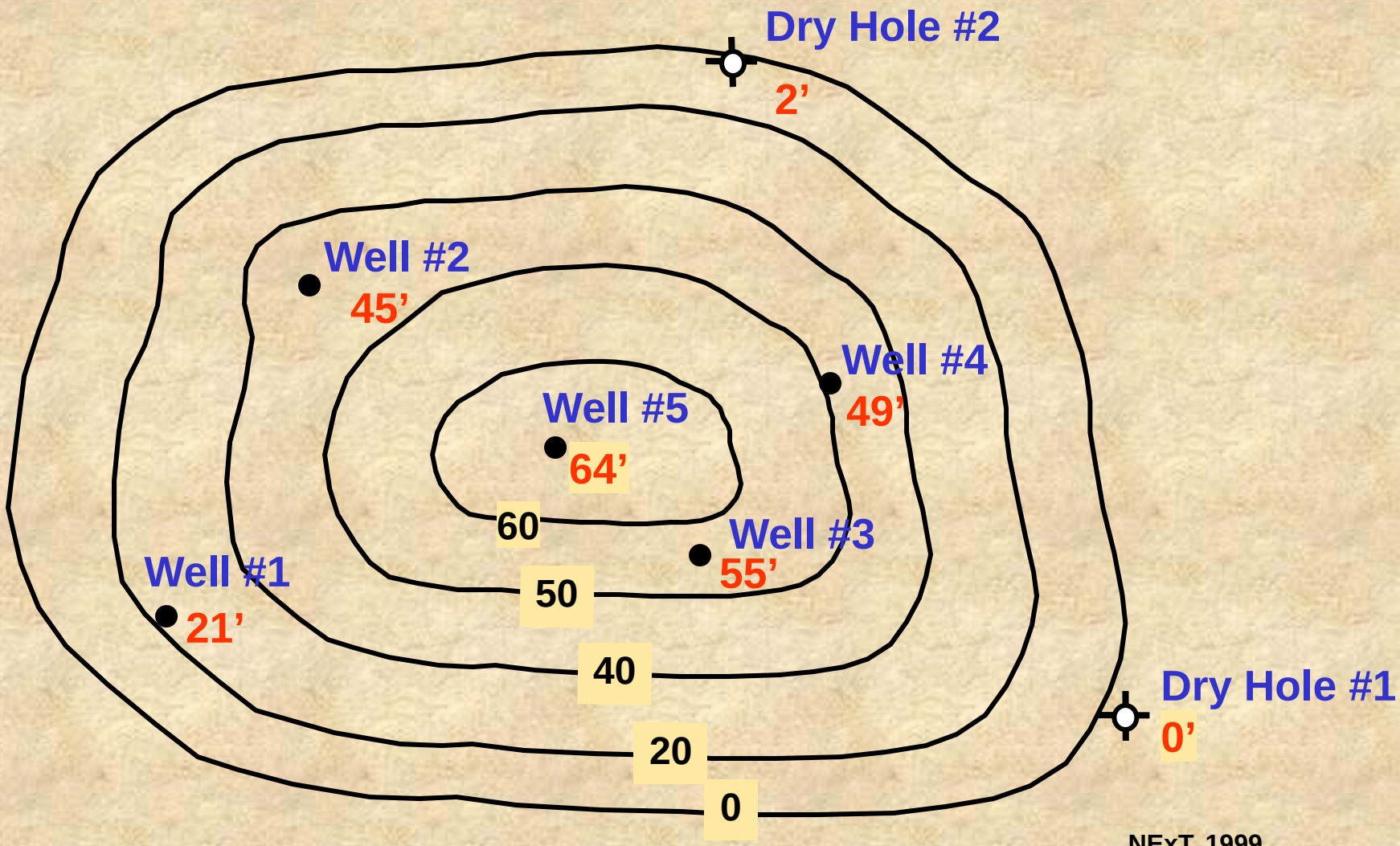
INPUTS TO VOLUMETRIC RESERVES



- Vshale
- Thickness
- Porosity

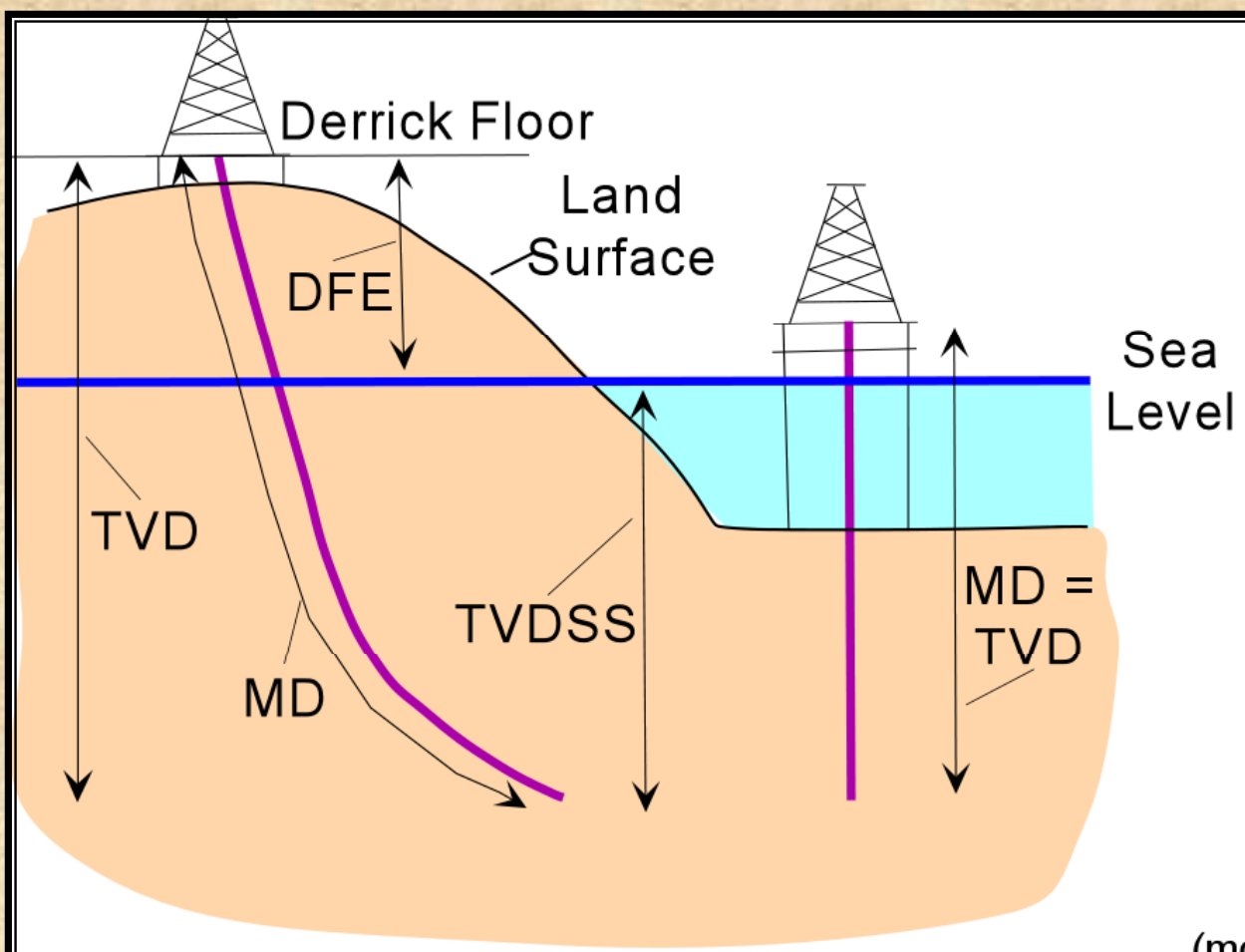
Modfoed from NExT, 1999

NET OIL PAY ISOPACH MAP



NExT, 1999

SOME TERMINOLOGY

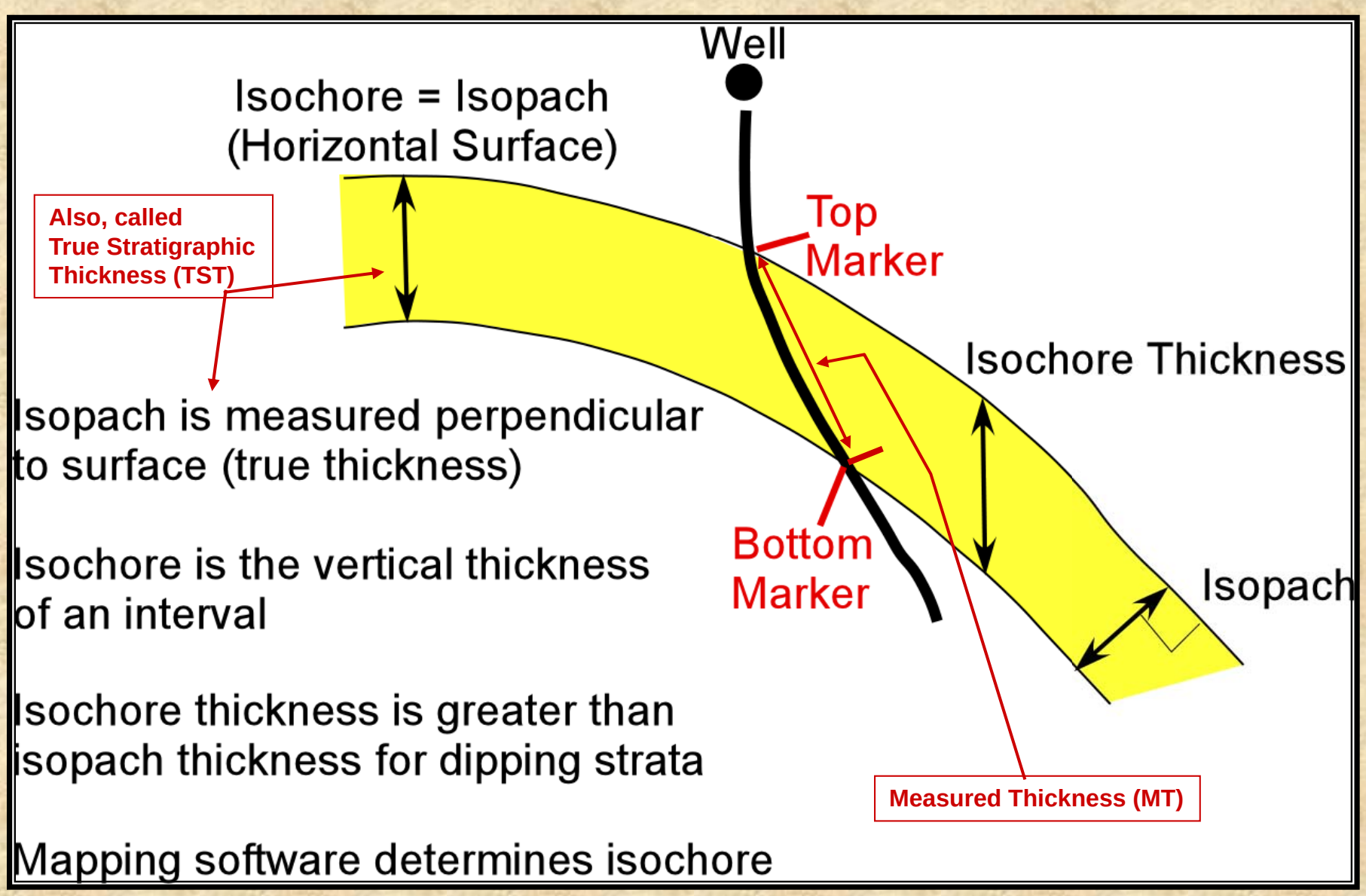


Explanation

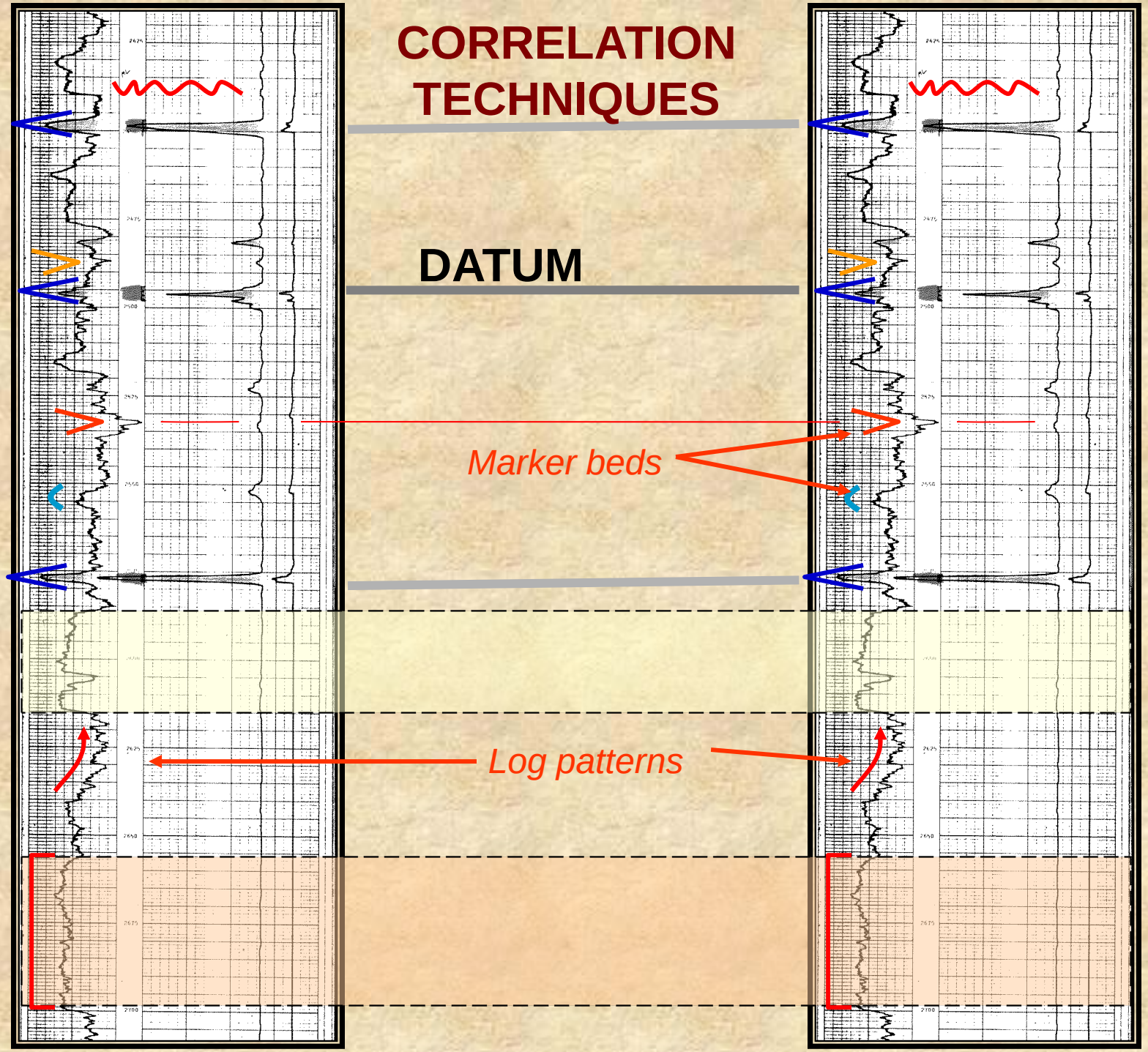
DFE	Derrick Floor Elevation
MD	Measured Depth
TVD	True Vertical Depth
TVDSS	True Vertical Depth SubSea

(modified from Jahn and others, 1998)

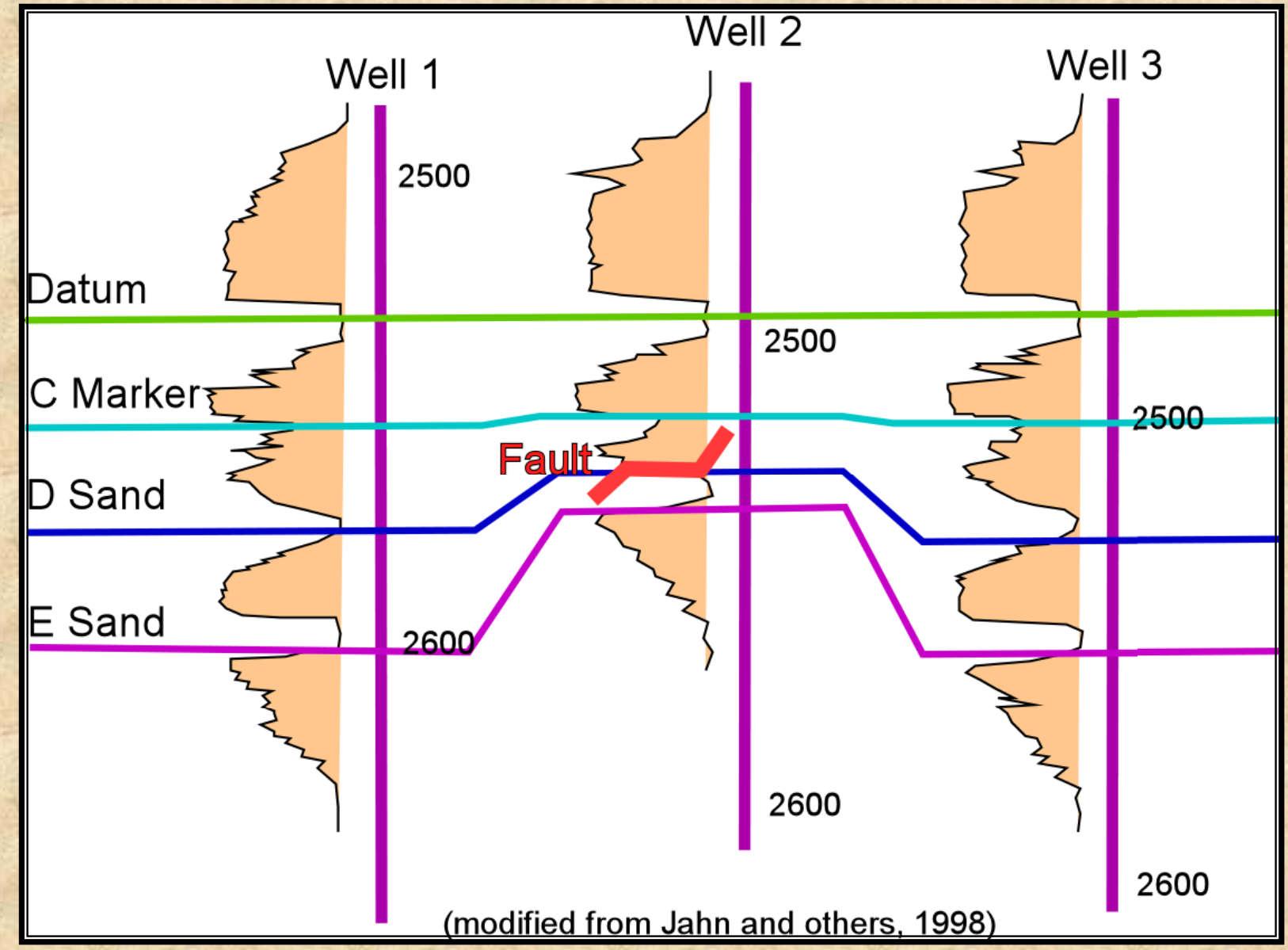
MORE TERMINOLOGY



CORRELATION TECHNIQUES

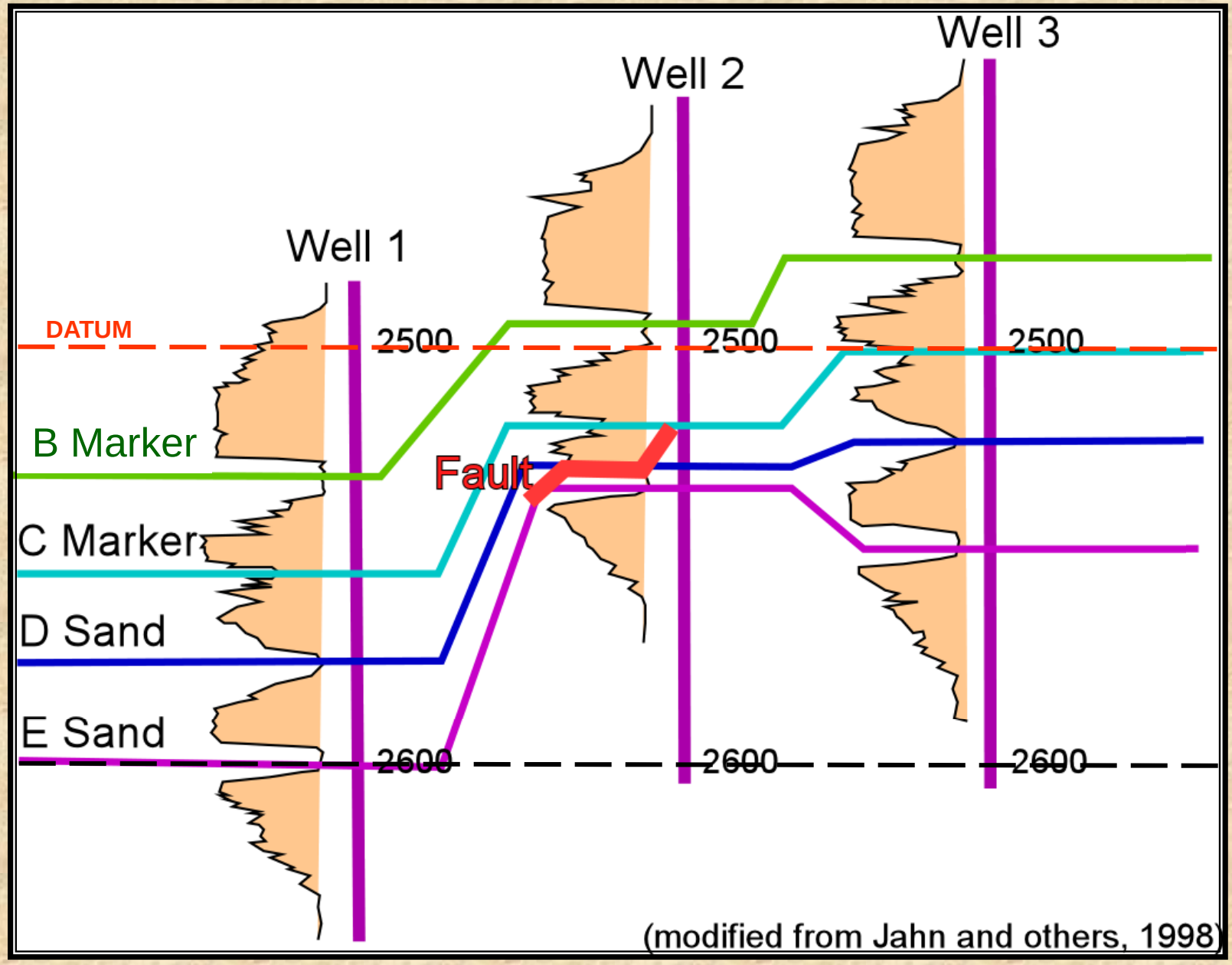


WELL-LOG CORRELATION

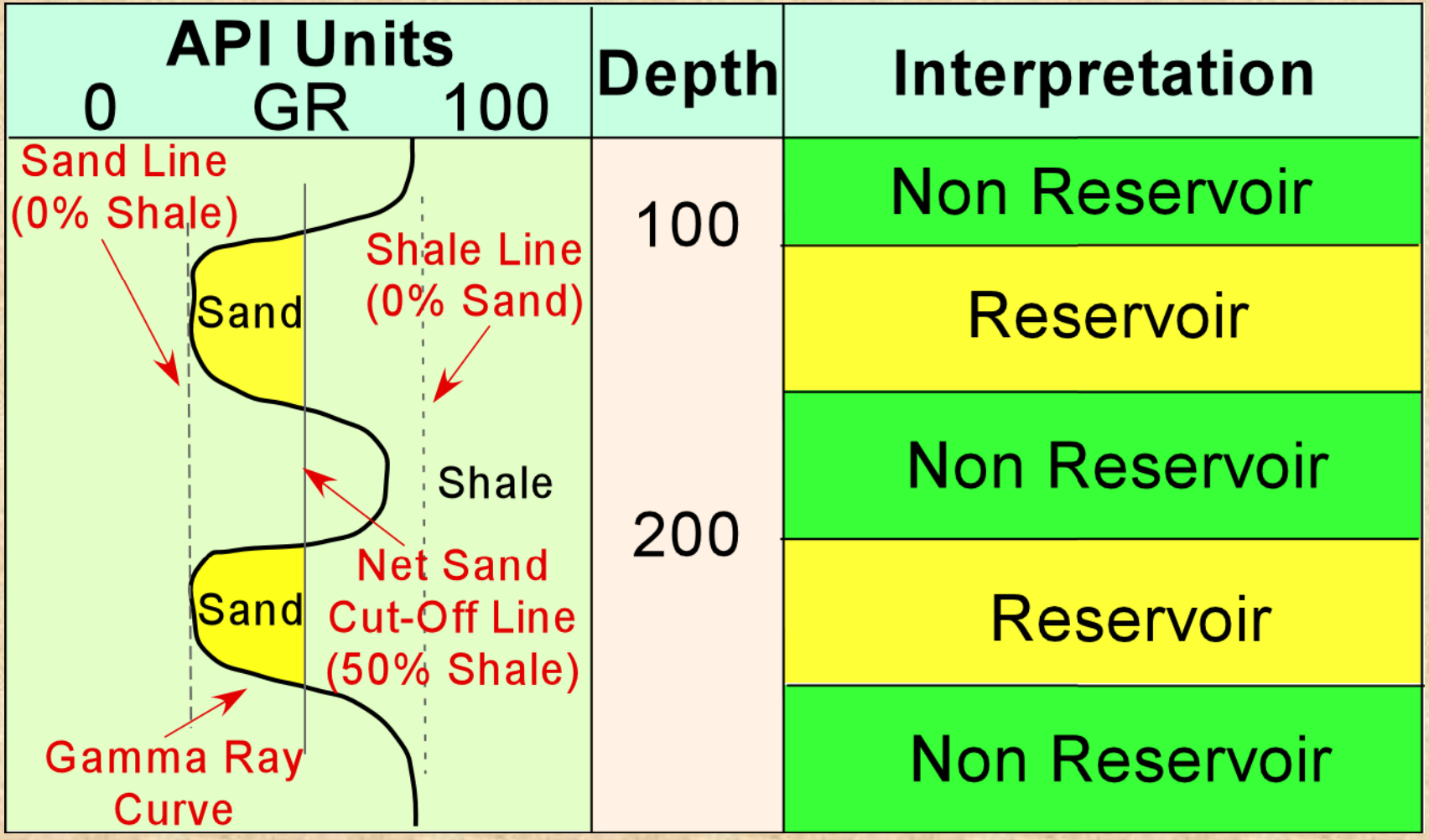


Stratigraphic Cross Section

STRUCTURAL CROSS SECTION



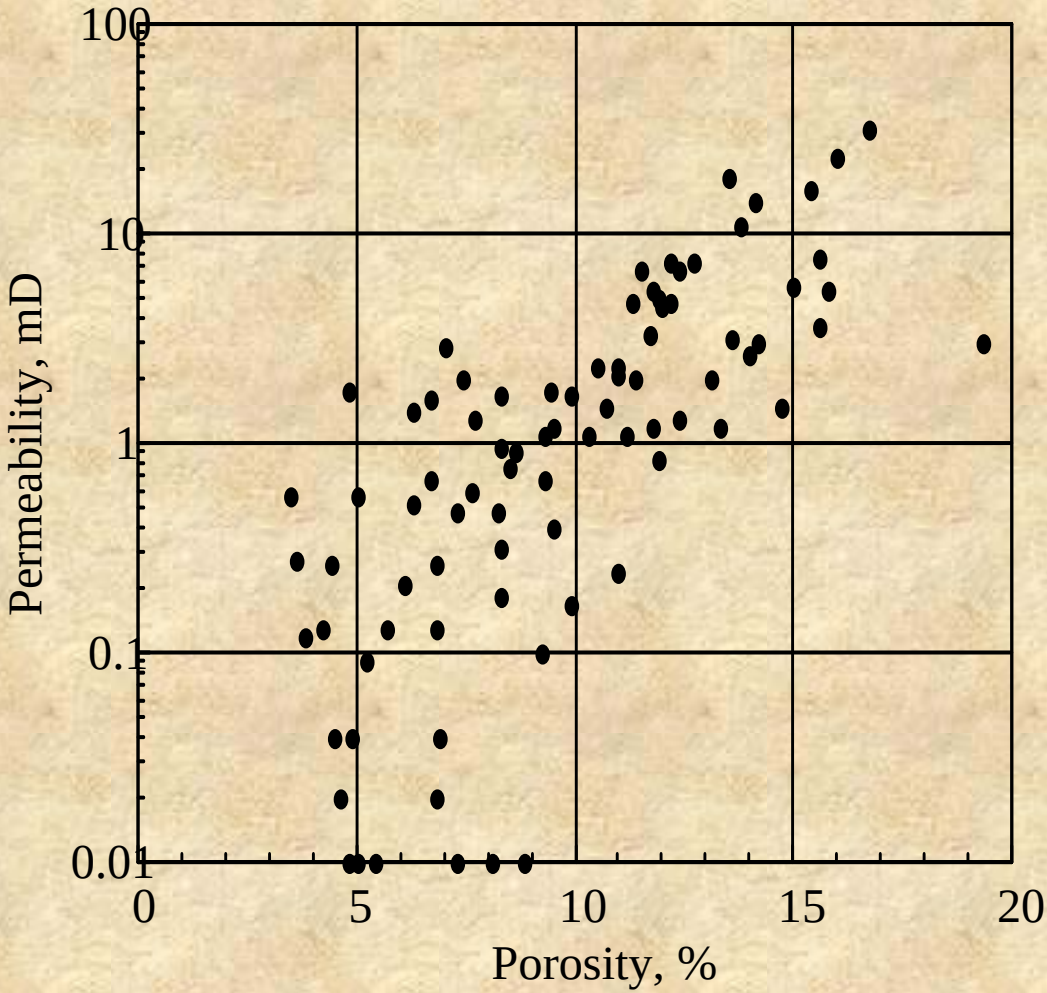
RESERVOIR DETERMINATION



DEFINING NET PAY

Common alternatives for net pay definition

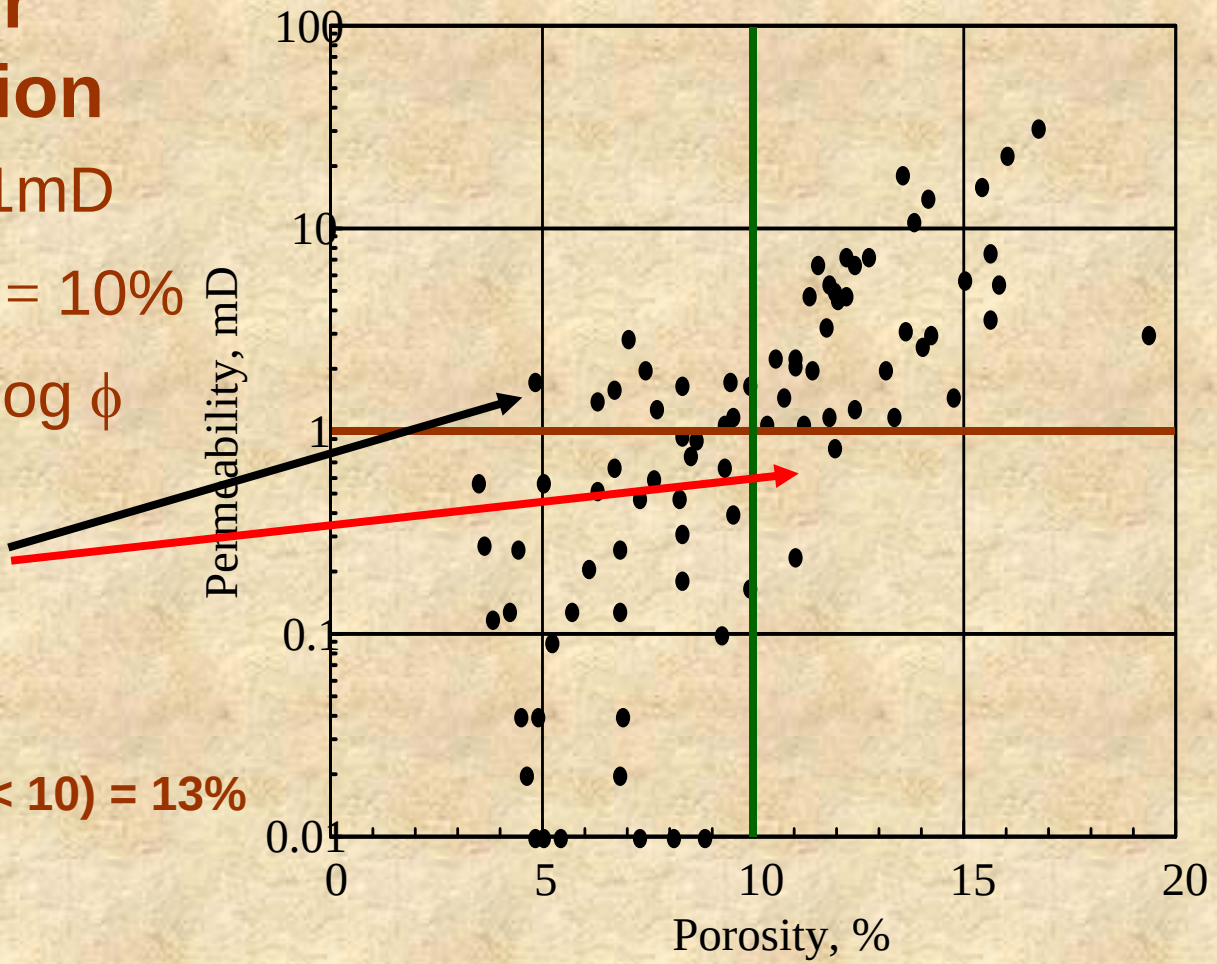
- **Use static criteria**
  - **(Sw > cutoff) AND (Vsh > cutoff) AND (ϕ < cutoff) etc…**
- **Try to correlate k with log measurements**
  - **Use core data**



DEFINING NET PAY

Core data & logs for net pay determination

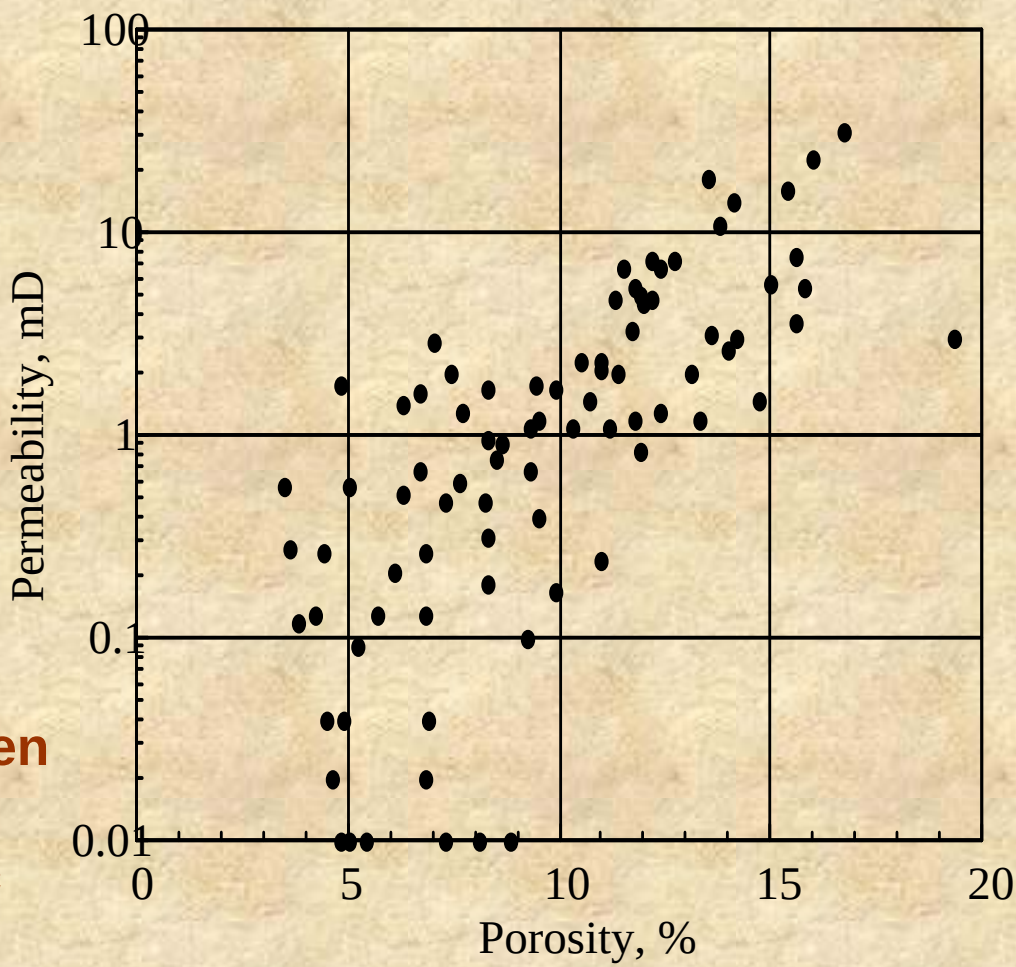
- Define k cutoff e.g., 1mD
- Define ϕ value e.g. ϕ = 10%
- Apply net pay using log ϕ value ϕ > 10%
- Note errors arise
  - **k > 1 AND ϕ < 10%**
    - **11 of 86**
    - **Prob(k > 1 AND ϕ < 10) = 13%**
  - **k < 1 AND ϕ > 10%**
    - **2 of 86**
    - **Prob(k < 1 AND ϕ > 10) = 2%**
  - **Prob(k > 1 | ϕ < 10%) = 24%**



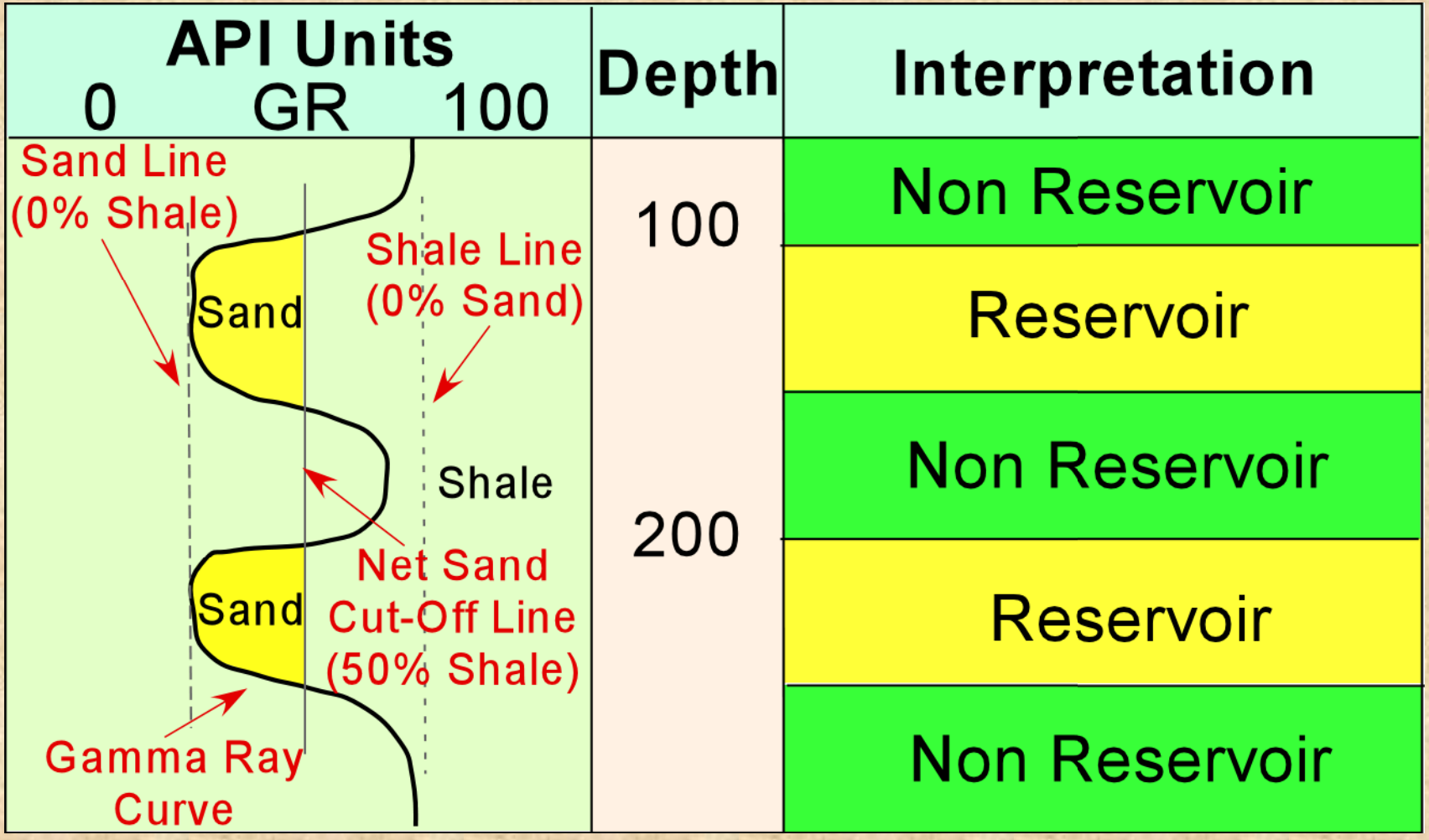
DEFINING NET PAY

Deciding on predictor log(s)

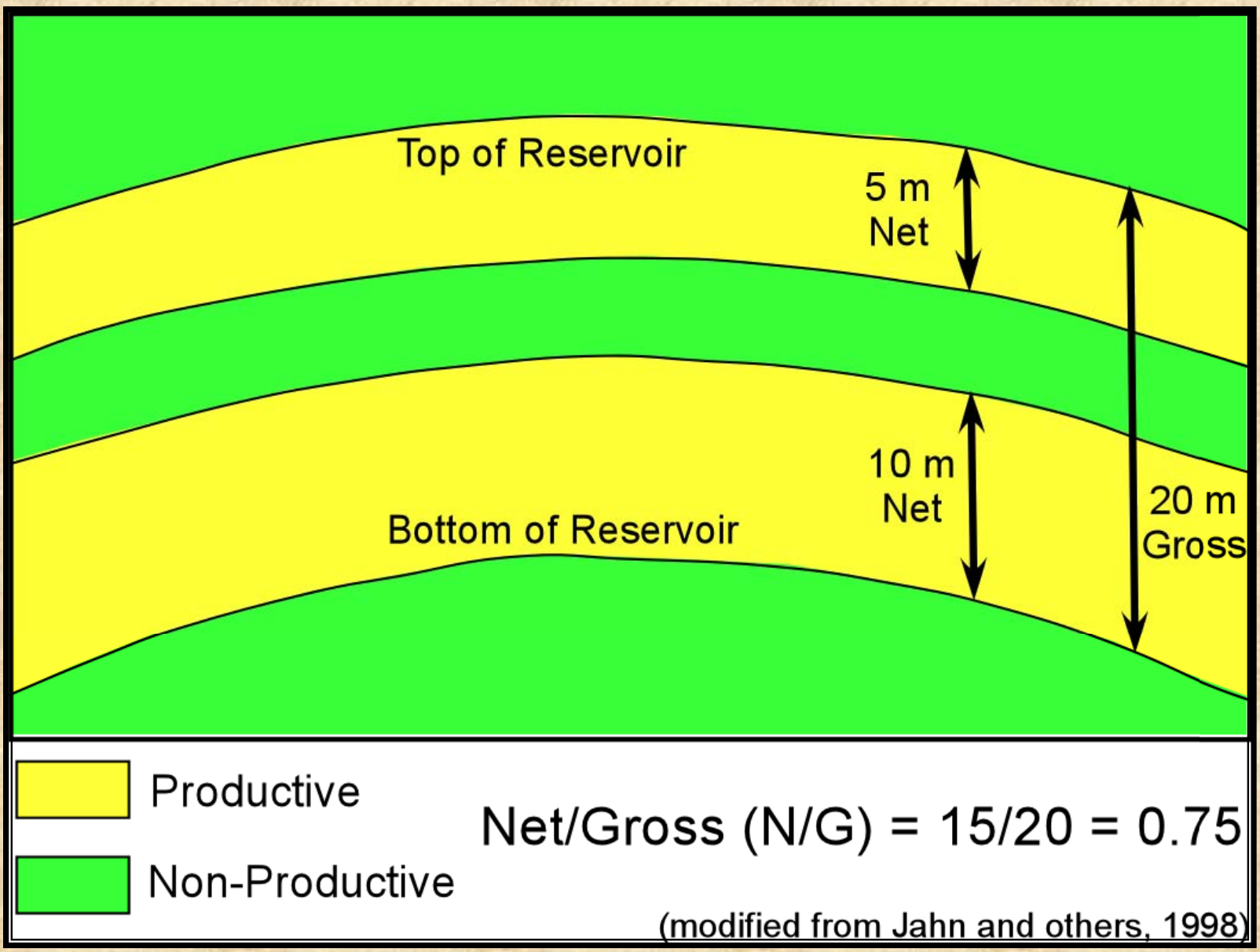
- What controls perm?
- Carbonates
  - Grain size and sorting less effect
  - Diagenesis more important
  - Critical thresholds often seen
    - Below $\phi = 10$, k variable
    - Above $\phi = 10$, k systematic



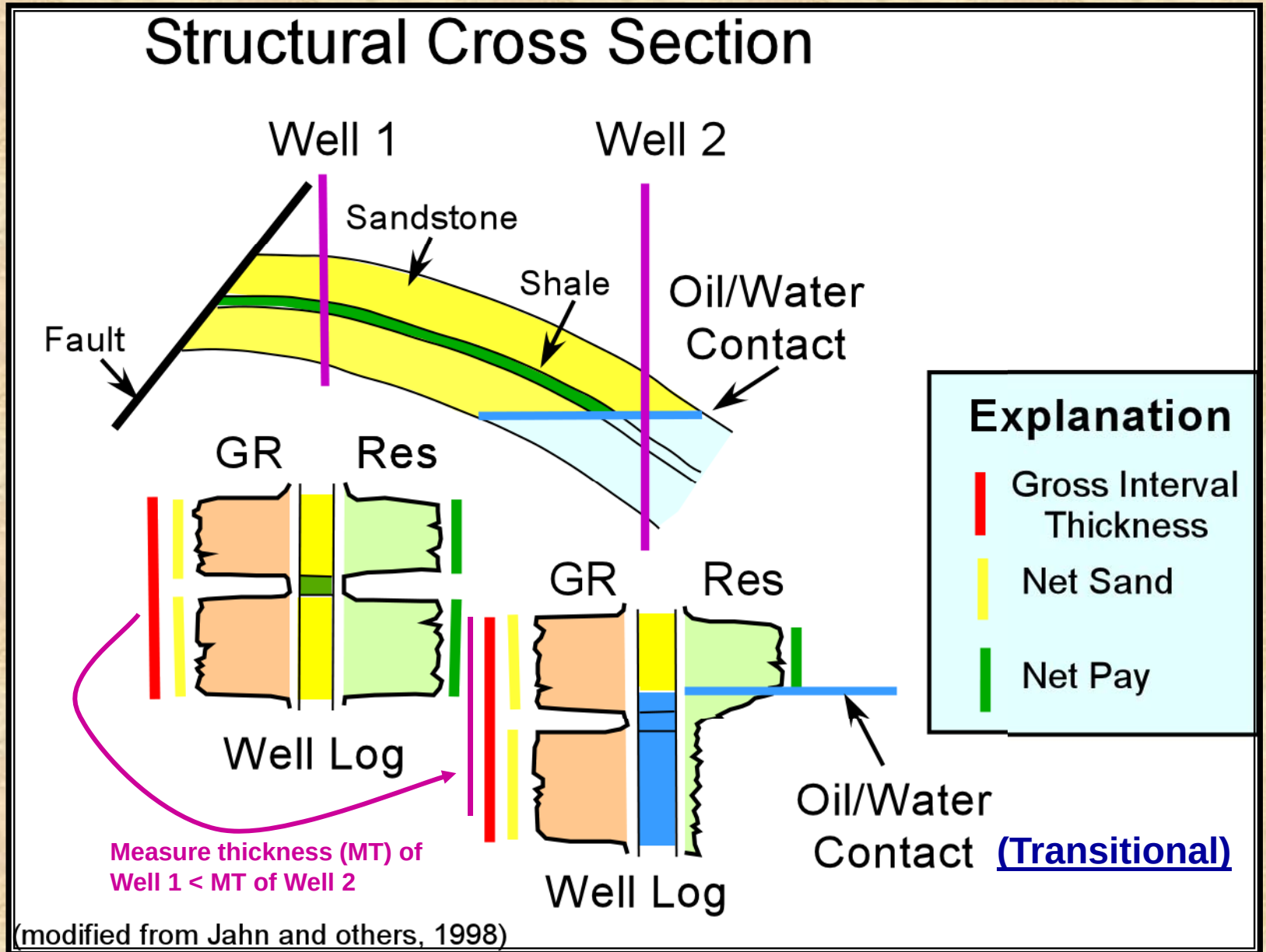
RESERVOIR DETERMINATION



Net-to-Gross Determination

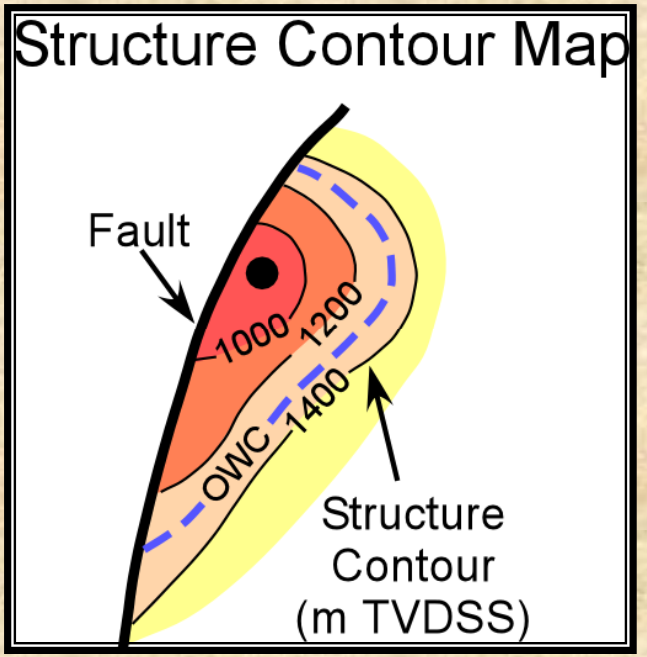


Defining Gross Thickness, Net Sand, and Net Pay

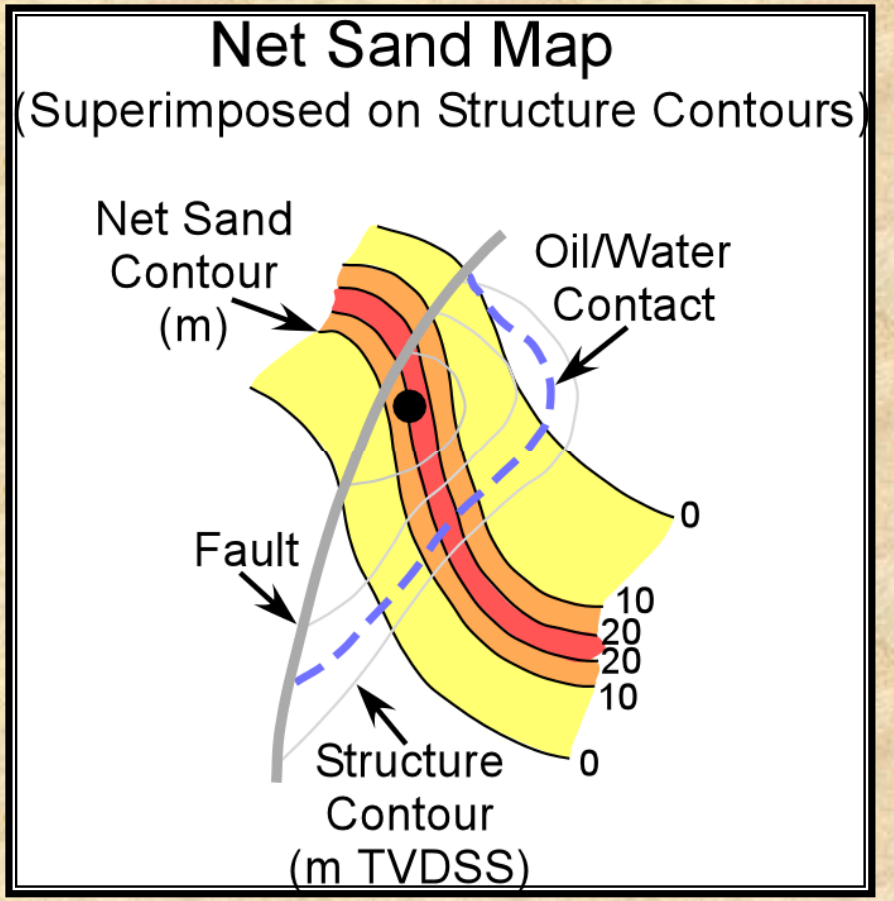


Net Pay Map Determination

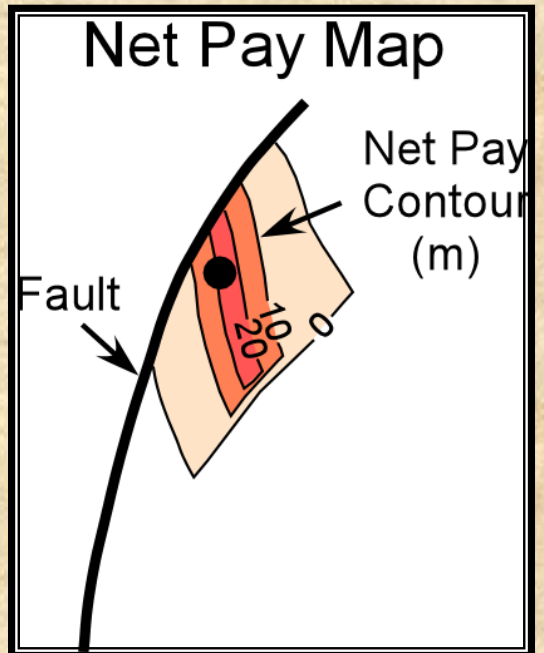
A)



B)

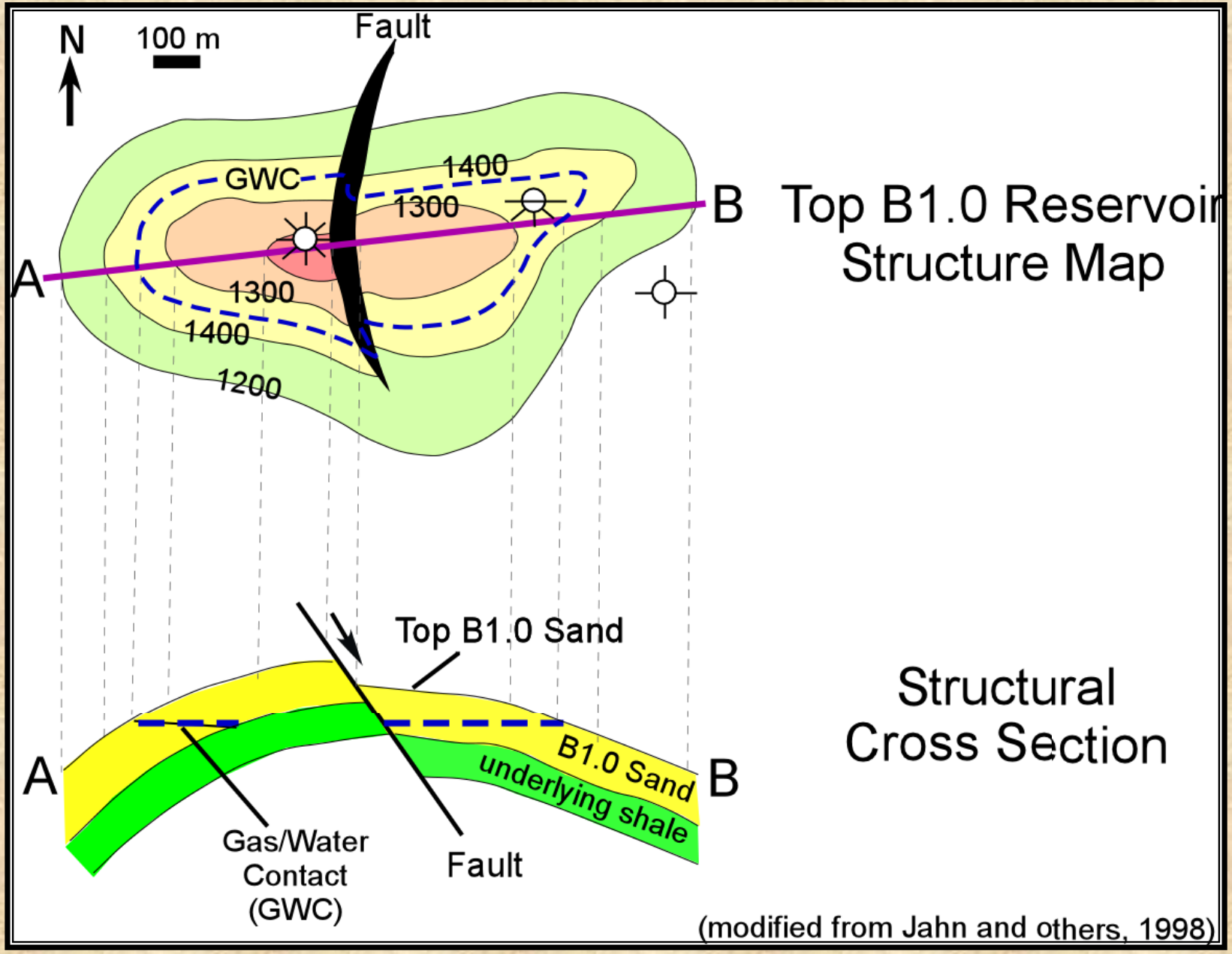


C)



<u>Combination Trap</u>:
Faulted Anticline and Stratigraphic Pinch-Out

Structure Map and Cross Section



Summary

- OOIP = 7758 Ah $\phi(1 - S_w)/B_{oi}$
- Oil reserves = OOIP x R.F.
- OGIP = 43,560 Ah $\phi(1 - S_w)/B_{gi}$
- Gas reserves = OGIP x R.F.
- Remaining reserves = Reserves at original conditions - cumulative production

Modfoed from NExT, 1999