KMS Technologies – KJT Enterprises Inc.

Presentation

Strack, K. – M. & Truman II, R.

1999

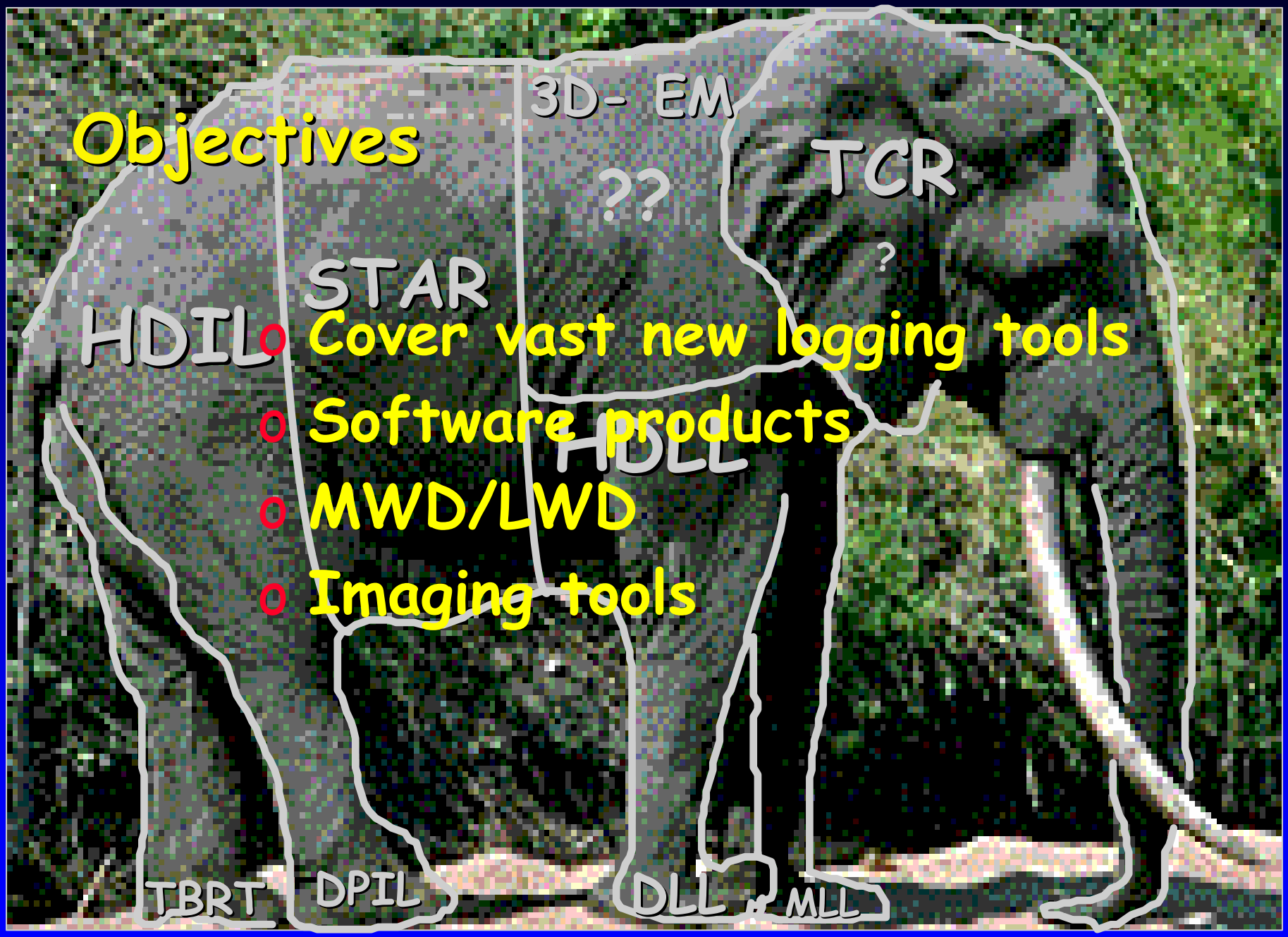
Advances in Borehole Resistivity Logging

Society of Exploration Geophysicists, Annual Meeting, Houston, Invited paper in workshop "Recent Advances in Logging Methods"

Advances in Borehole Resistivity Logging

K.-M. Strack (KMS Technology)
&
R. Truman II (Baker Atlas)

SEG workshop 1999


Objectives
3D- EM
??
TCR
?
STAR
HDIL
HDLL
o Cover vast new logging tools
o Software products
o MWD/LWD
o Imaging tools
TBRT
DPIL
DLL
MLL

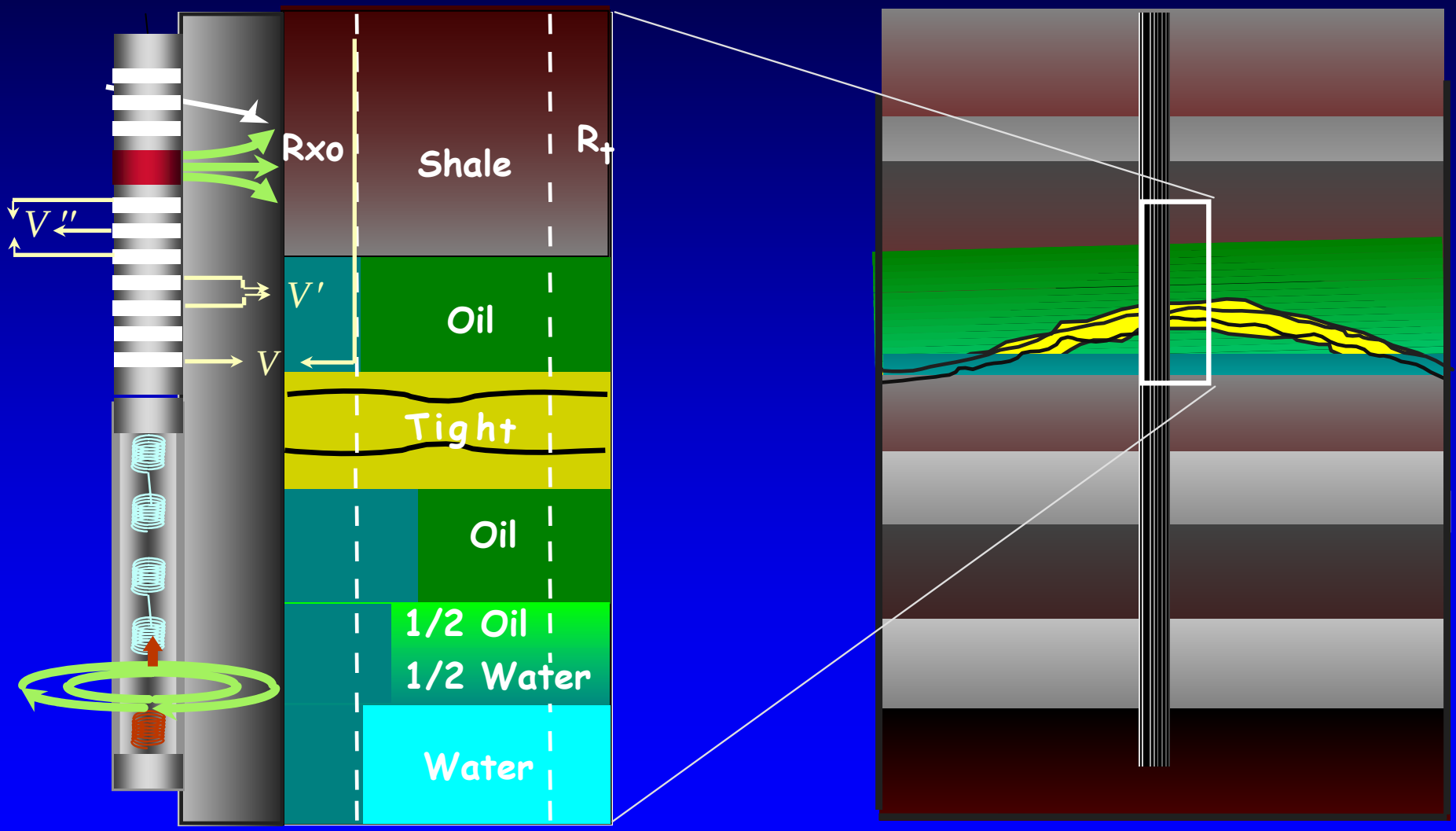
Facts:

- Resistivity logs are commonly used for reserve calculations
- Resistivities are often underestimated (=reserves too low)
- Different logs have
  - different vertical resolution
  - different depth of penetration

Outline

- Basics
- Highlight LWD
- Array tools why?
- Modeling why?
- New applications

Oil - Resistivity relationship: borehole



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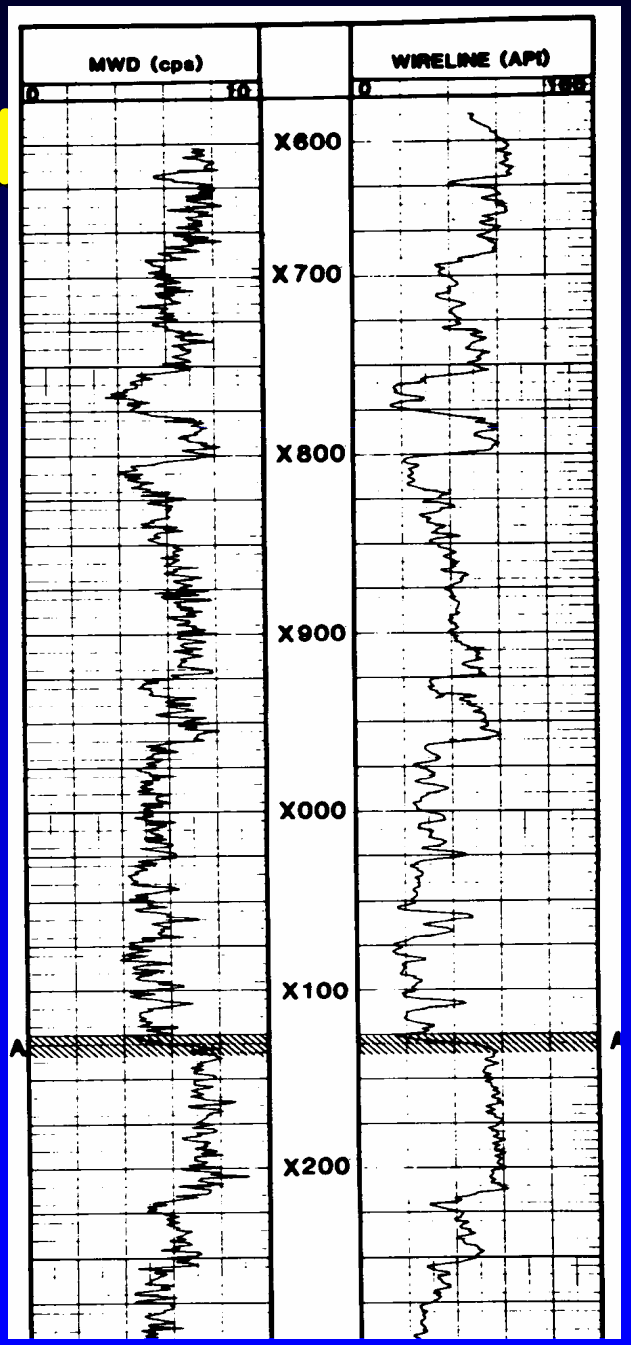
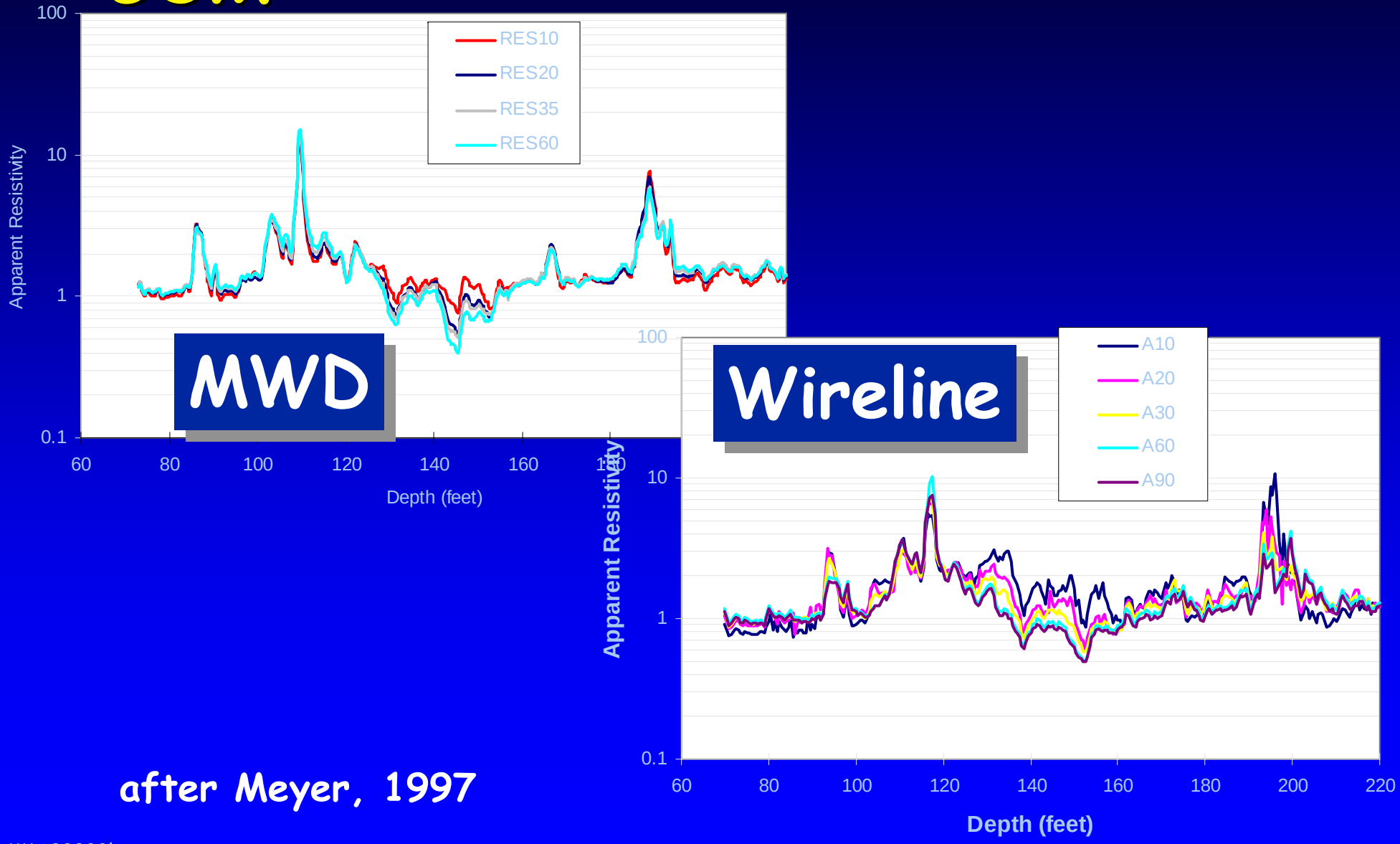
LWD and wireline method definitions:

- MWD/LWD - measurement/logging while drilling
  - sensor is part of the drill string; hostile sensor environment; basic sensors exist; making fast progress, data transmission via mud pulse (few 10 Hz) & memory packages
- Wireline - sensor attached to armored long cable
  - delicate instruments with real time surface acquisition; formation samplers to high data rate imaging tools (video).



MWD and wireline induction logs GOM



after Meyer, 1997

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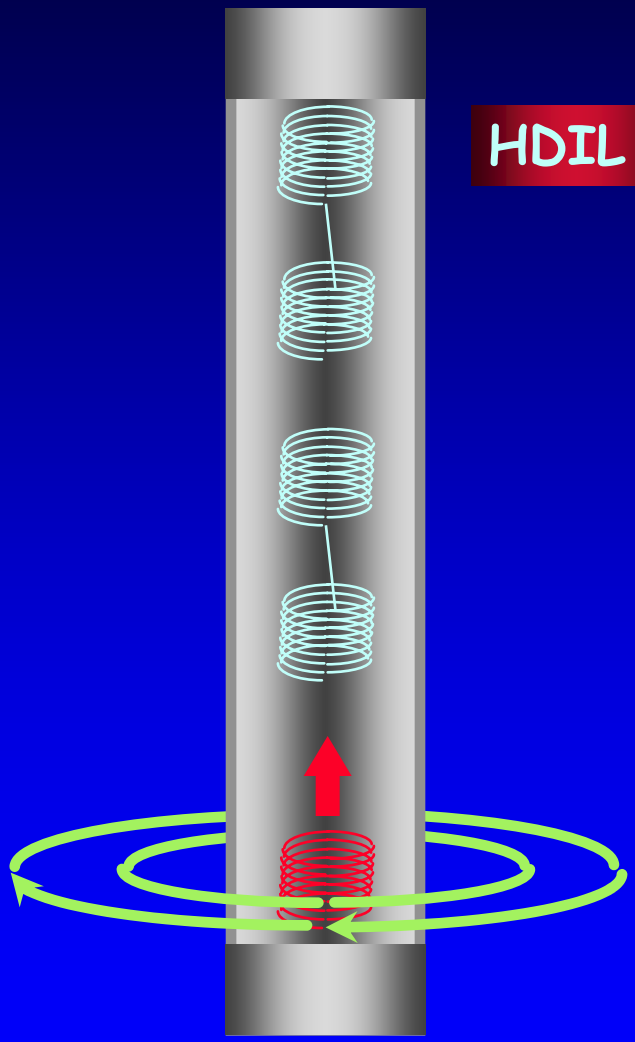
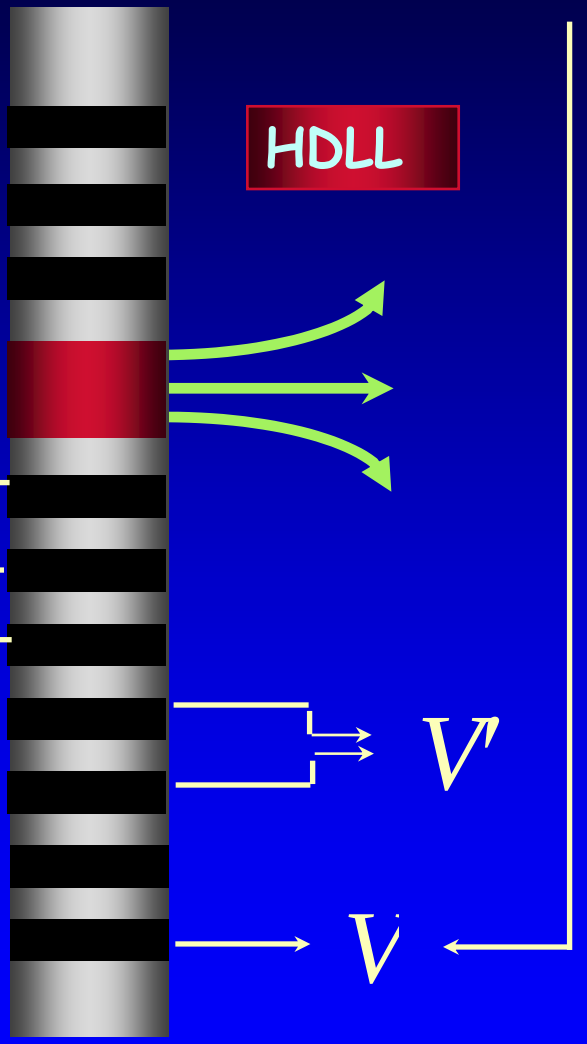
Joint: Induction & Galvanic



HDIL



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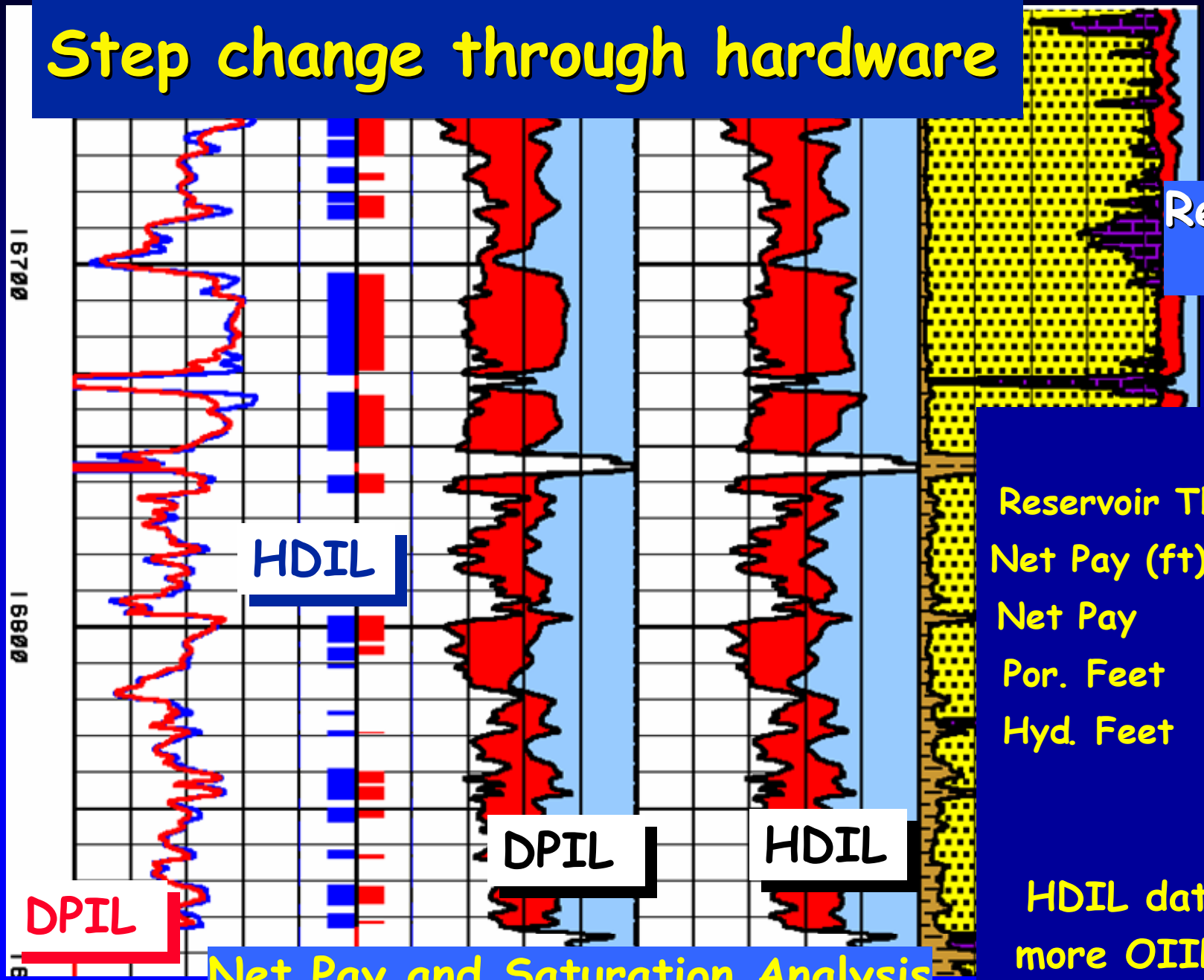
Step change through hardware



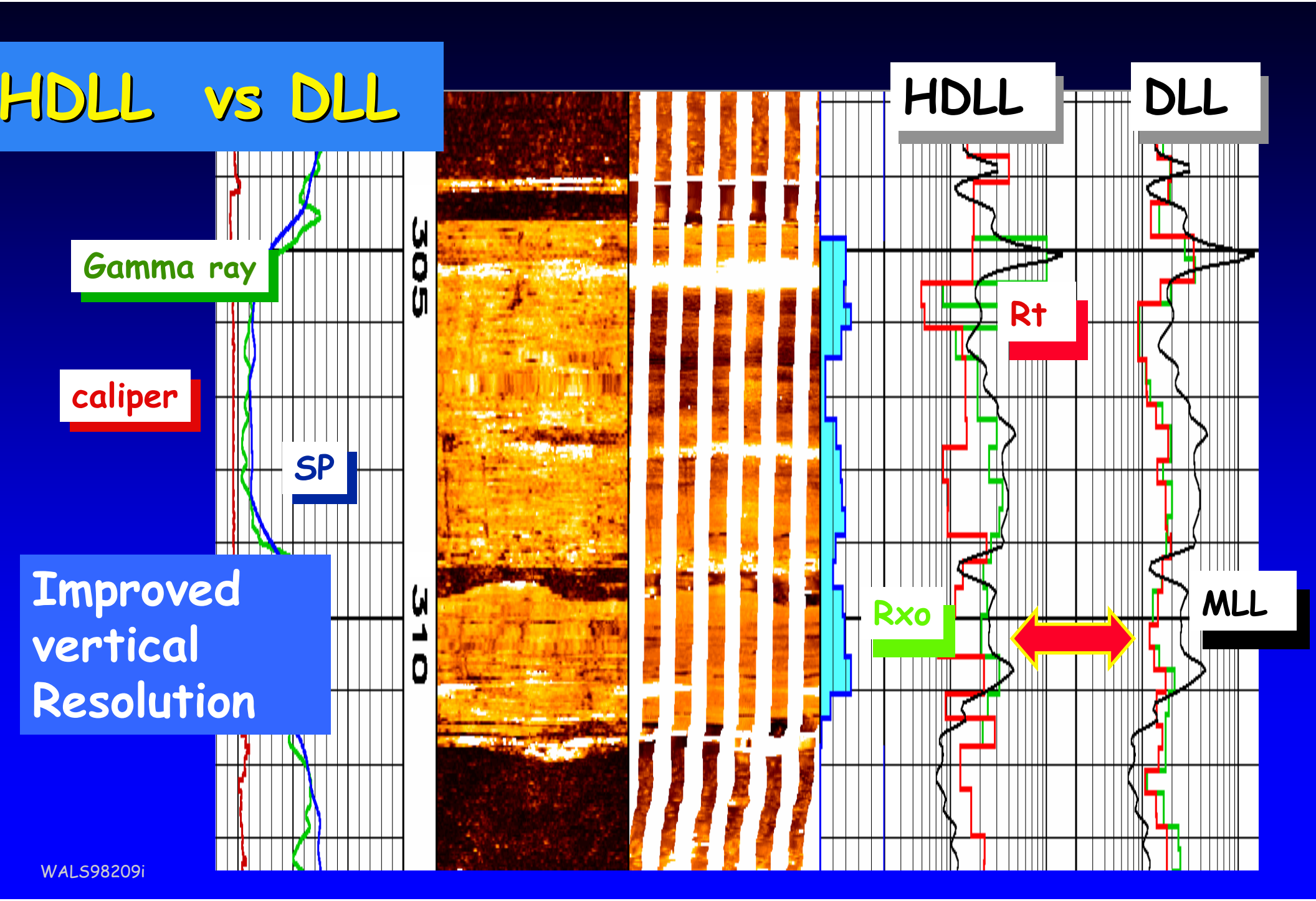
Net Pay and Saturation Analysis

Reserves estimat
DPIL vs. HDIL

	DPIL	HDIL
Reservoir Thickness:	270 ft	
Net Pay (ft)	103.6	130.1
Net Pay	38.4%	48.2%
Por. Feet	15.4 ft	18.9 f
Hyd. Feet	7.4 ft	9.2 ft

HDIL data allowed 24% more OIIP be booked.

HDLL vs DLL



Improved vertical Resolution

WALS98209i

HALLIBURTON

HRAI (High Resolution Array Induction)

HRI-type 3-receiver coil arrays
to achieve deep high resolution logs
independent of shallow measurements

- 10 receiver arrays
- one transmitter at dual frequencies
- symmetric tool
- independent vertical deconvolution for each receiver array
- radial focusing for each matched resolution
- 1-, 2-, 4-ft and dynamical resolution displays

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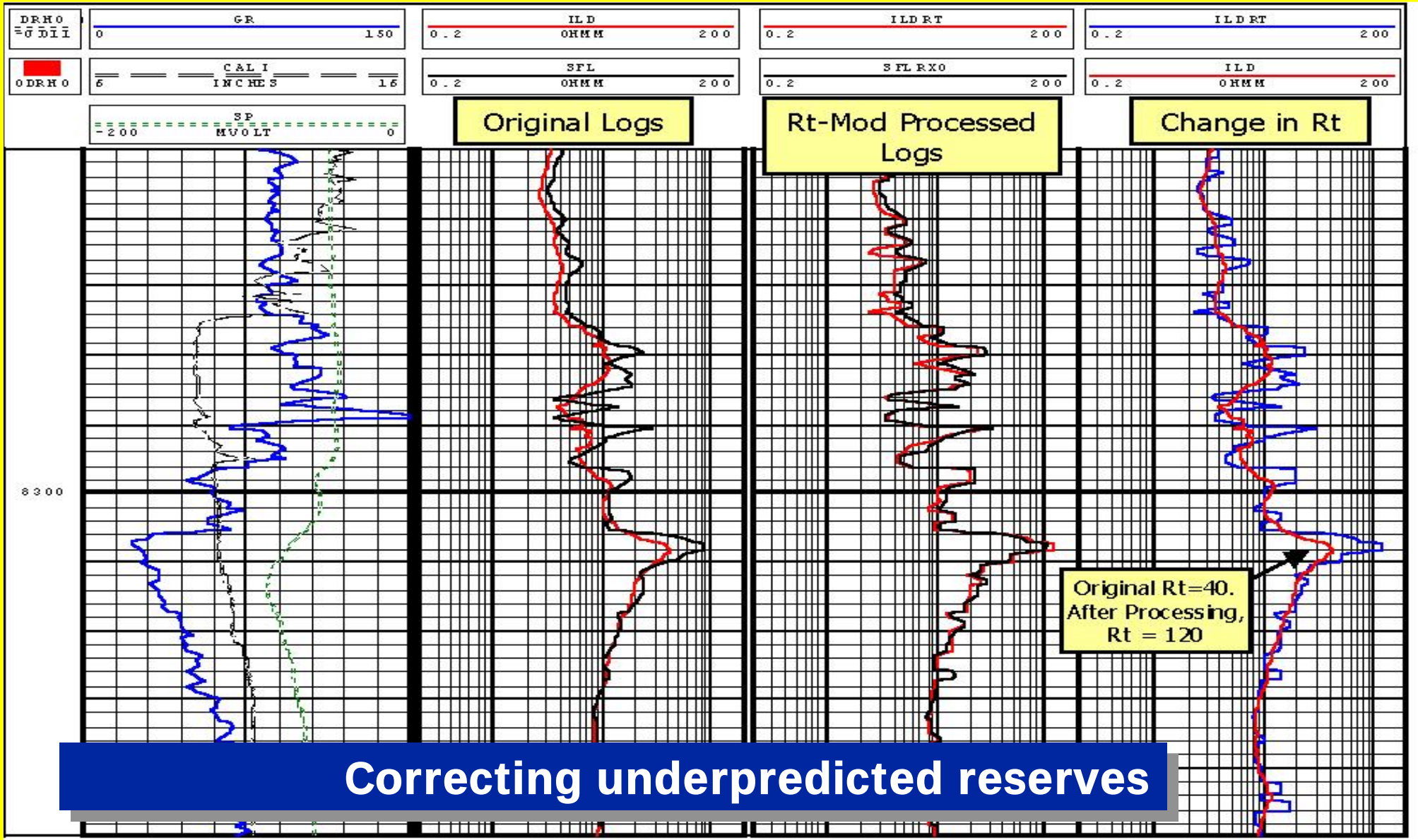
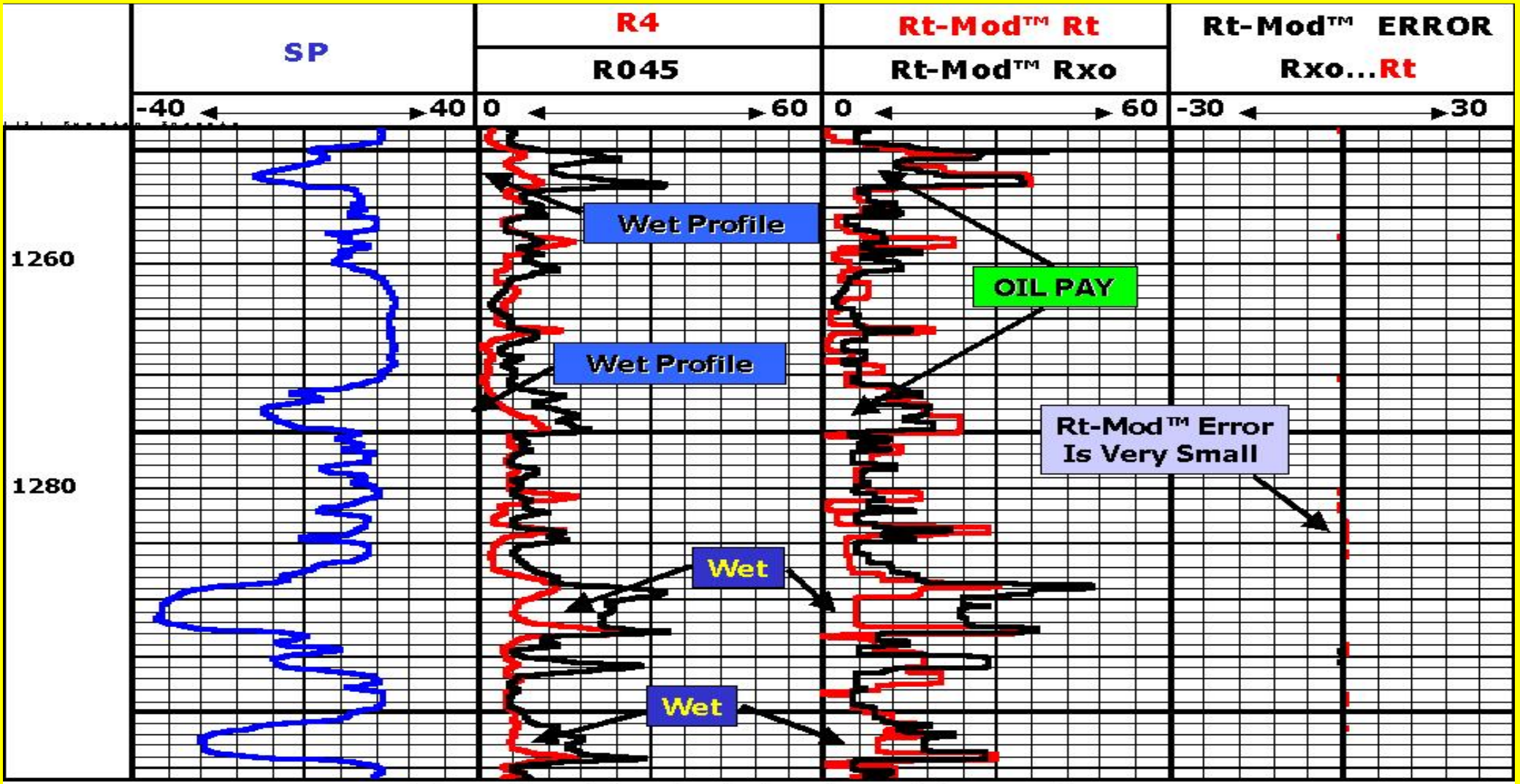
Induction Log Example - DJ Basin



Correcting underpredicted reserves

Russian BKZ Example – water vs pay



Russian Resistivity Log Example

The recorded deep (R4) and shallow (R045) logs show a "wet" profile over the entire section. Rt-Mod™ processing reveals higher resistivity in the upper two zones which produced water-free oil.

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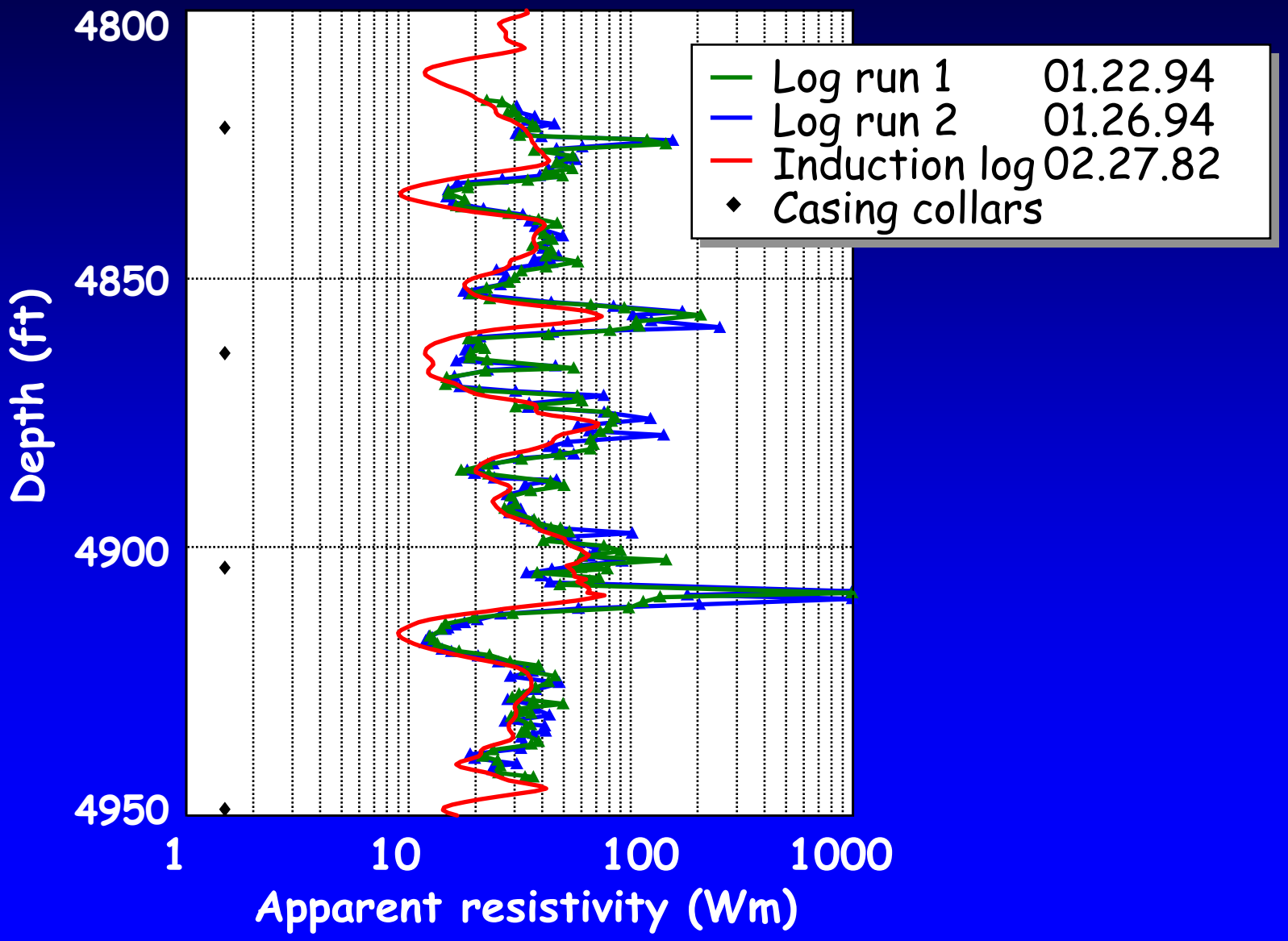
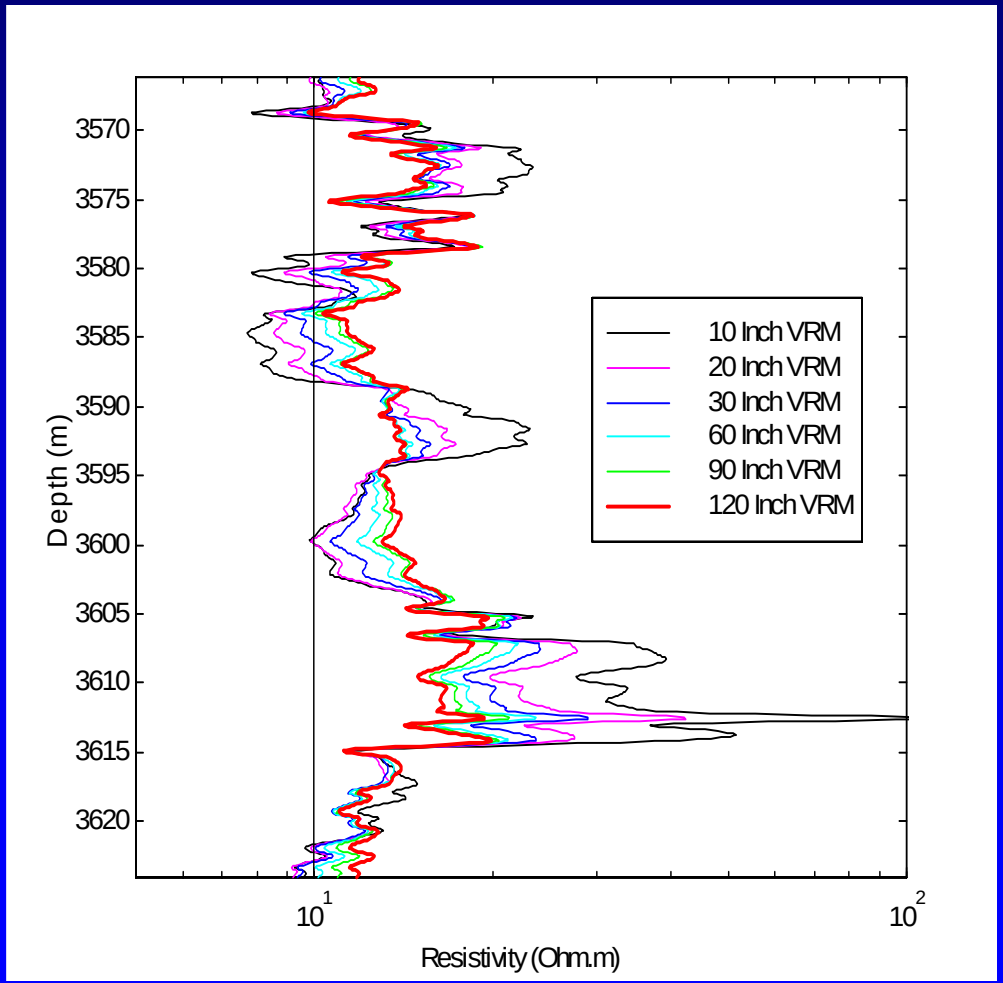
TCR Colorado test



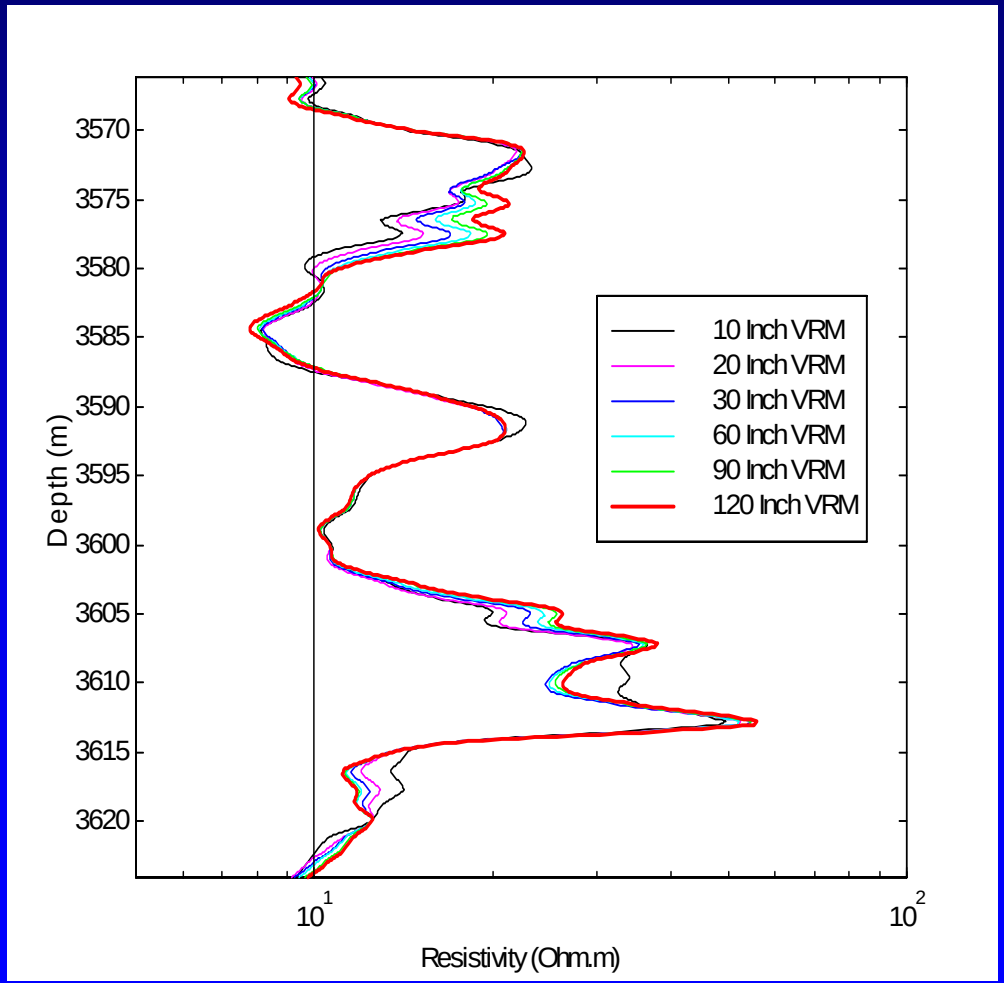
Real data: HDIL VRM curves

(Estimated dip = 75 degrees)

Processed as 0 degree



Processed after dip correction



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