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HIGH RESOLUTION WELL TESTING IN HUNGARY

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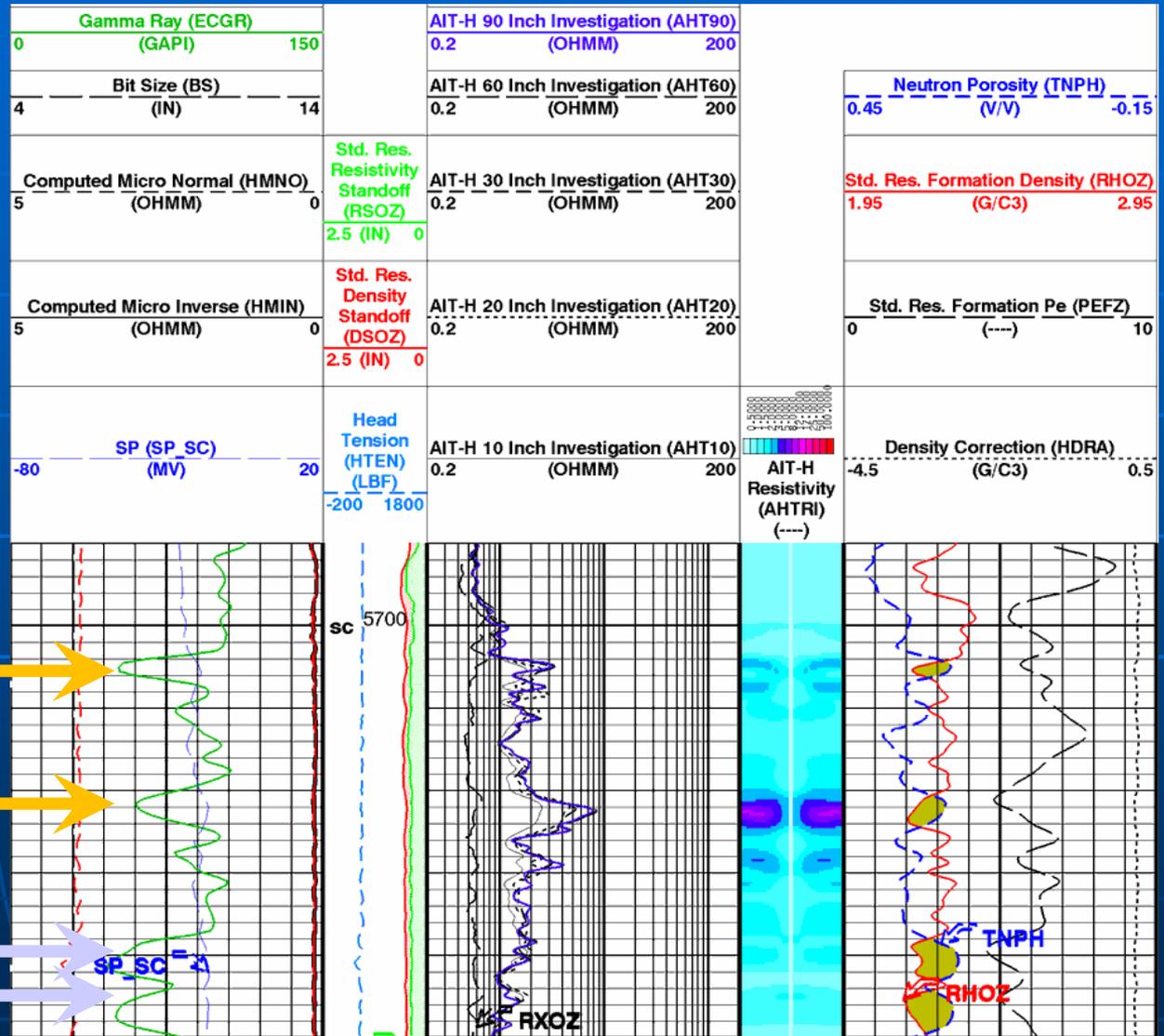
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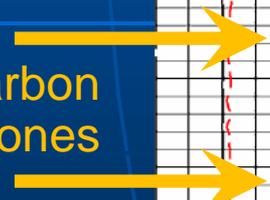
AGENDA

- HIGH RESOLUTION WELL TESTING
- HRWT TOOLS
 - PRESSUREXPRESS
 - MODULAR RESERVOIR DYNAMIC TESTER
- APPLICATIONS OF HRWT
- CASE STUDIES
 - MOL-L2 -> XPT
 - MOL-K -> XPT
 - MOL-L1 -> MDT

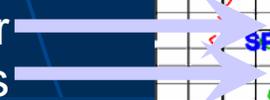
HIGH RESOLUTION WELL TEST



Potential Hydrocarbon Zones



Potential Water Zones



LOW vs HIGH RESOLUTION

LOW RESOLUTION, LARGE INVESTIGATION VOLUME

- WELL PERFORMANCE
- REPRESENTATIVE SAMPLE
- RESERVOIR PROPERTIES
 - LARGE SCALE (PRESSURE, PERMEABILITY, BOUNDARY)

■ ISSUES

- MULTIPLE ZONES
- MULTIPLE PHASES
- CEMENT QUALITY



HIGH RESOLUTION, SMALL INVESTIGATION VOLUME

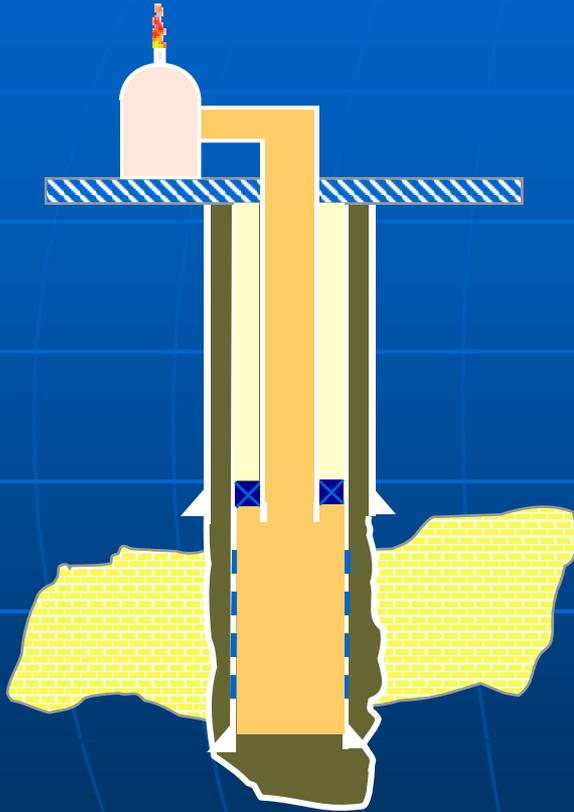
- BEFORE COMPLETION
- SHORT DURATION
- ENVIRONMENT FRIENDLY
- ZONE BY ZONE TESTING

■ ISSUES

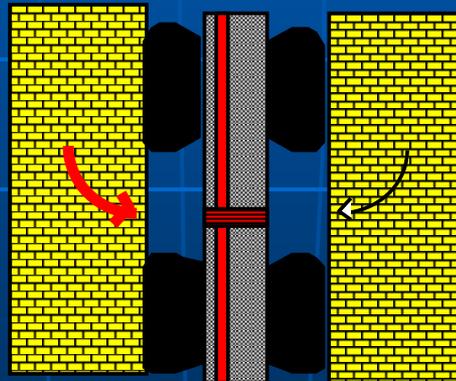
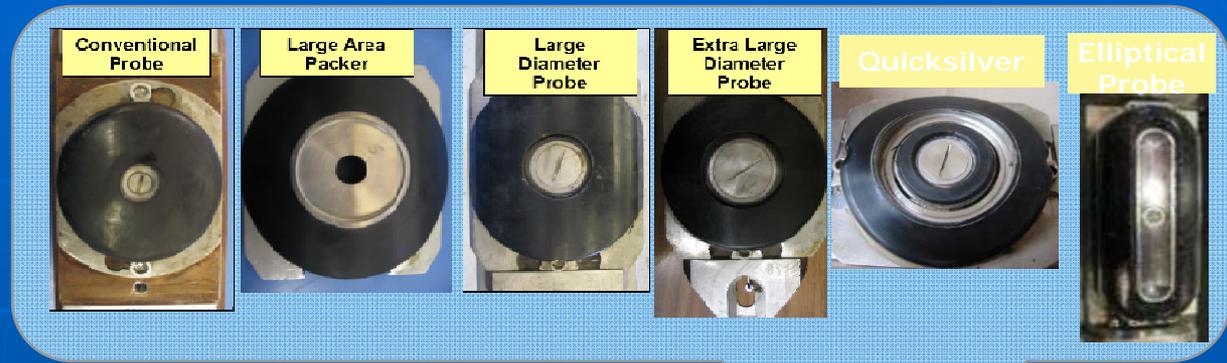
- STICKING (WIRELINER TOOL)
- TOOL PLUGGING

MDT-XPT CAN BE USED TO OPTIMIZE DST, RESULTING IN TOTAL COST REDUCTION FOR THE OPERATORS

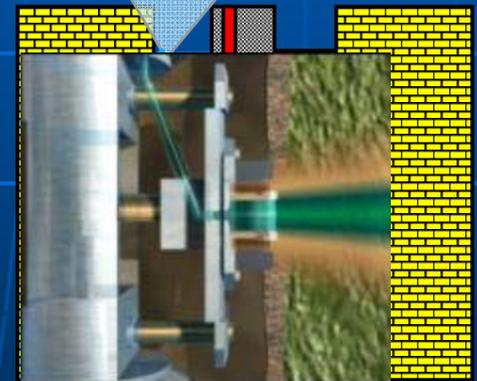
RESOLUTIONS OF WELL TESTING



**LOW RESOLUTION
CONVENTIONAL TEST**

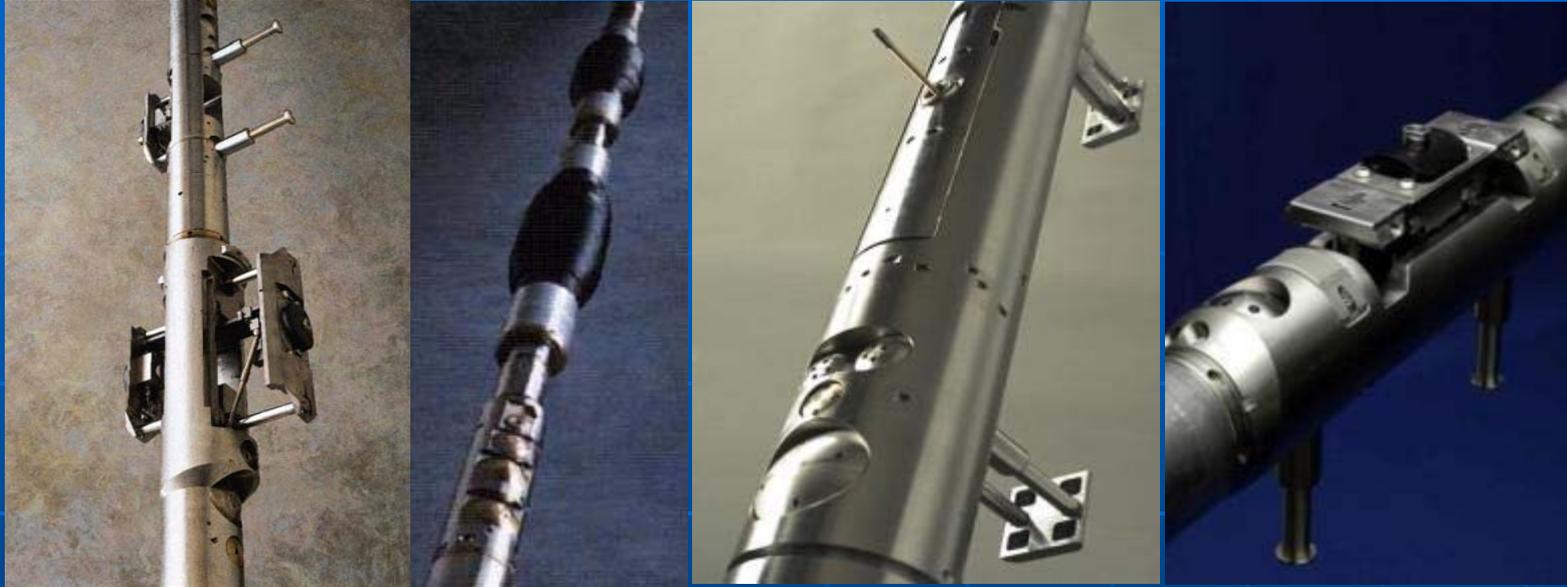


**MEDIUM RESOLUTION
DUAL PACKER MDT**



**HIGH RESOLUTION
SINGLE PROBES**

HRWT TOOLS



MDT (Open hole)

- Pressure
- Fluid analysis
- Sampling

CHDT (Cased hole)

- Pressure
- Fluid analysis
- Sampling

XPT (Open hole)

- Pressure

PRESSUREXPRESS

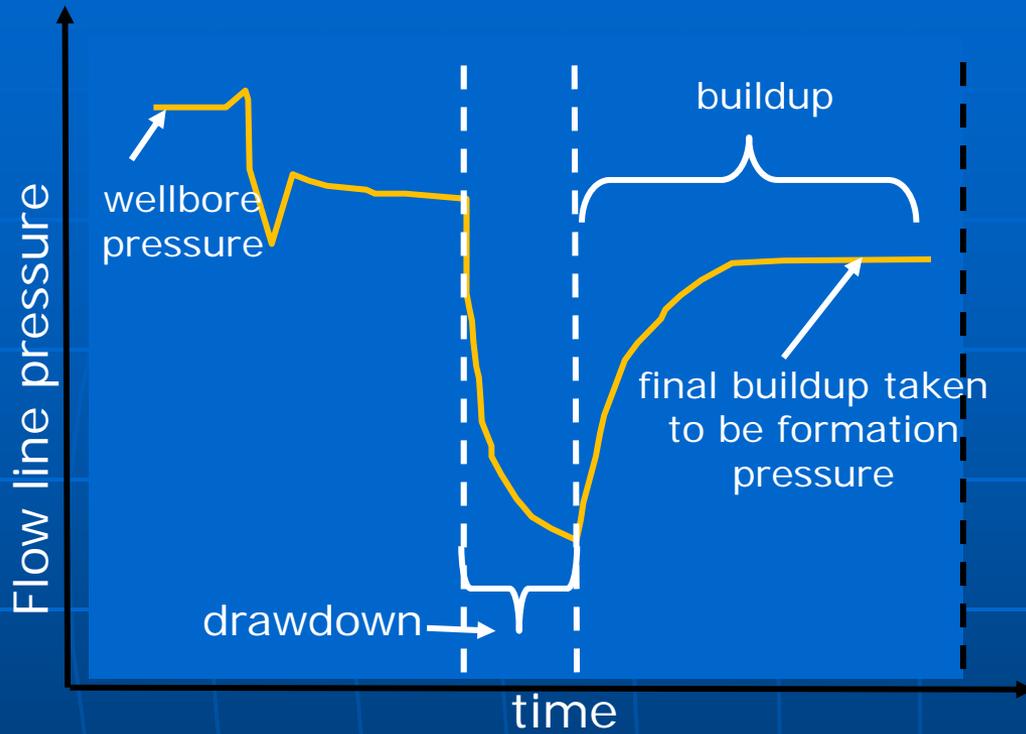
- SPECIFICALLY DESIGNED FOR PRESSURE MEASUREMENT
- COMBINES WITH MOST OF OPEN HOLE TOOLS
 - PEX, DSI, FMI, ECS, ...
- MINIMIZES RISK OF TOOL STICKING
- SMALL DIAMETER 3 7/8"
 - SHORTER TEST MEASUREMENT TIME
- HIGH PRECISION DRAWDOWN MECHANISM
 - PRETEST VOLUME OPTIMIZED TO FORMATION MOBILITY



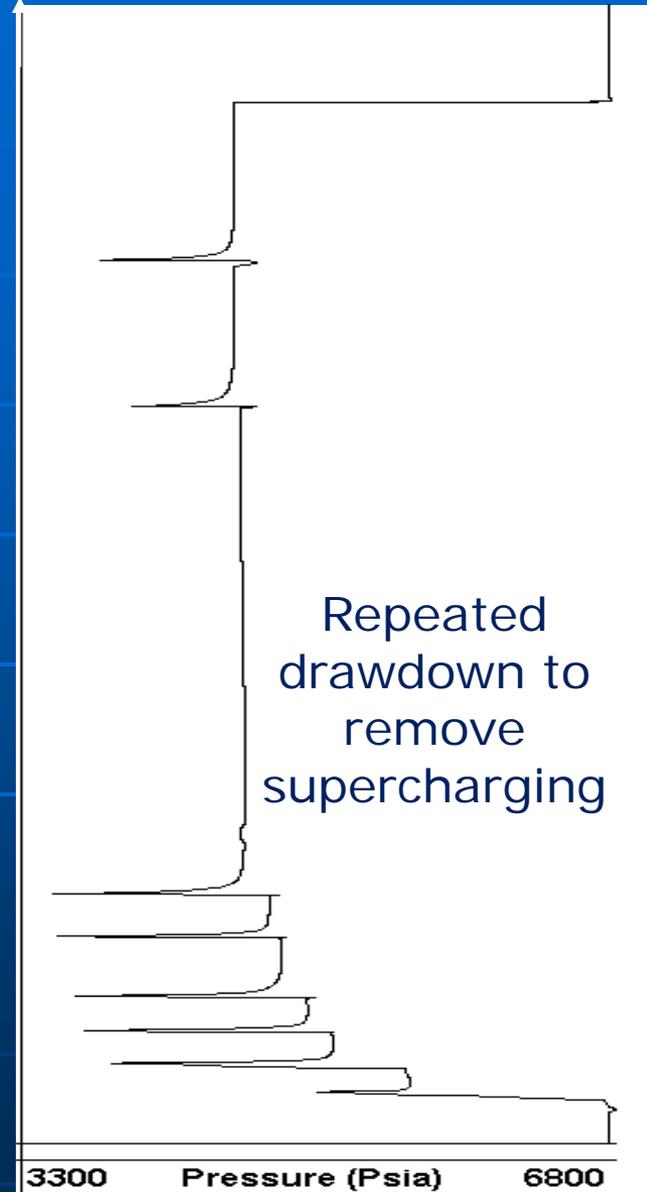
HRWT OPERATION

- VIDEO

PRESSURE

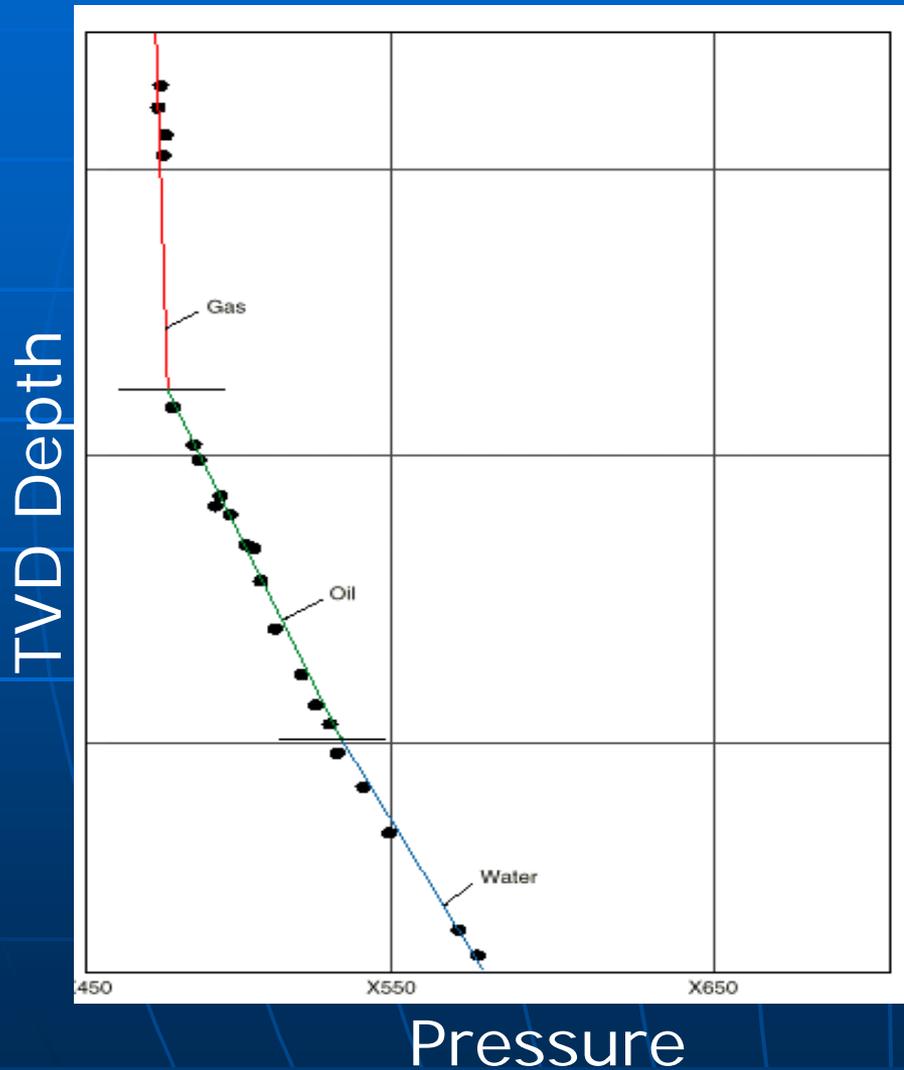


time



3300 Pressure (Psia) 6800

PRESSURE PROFILE



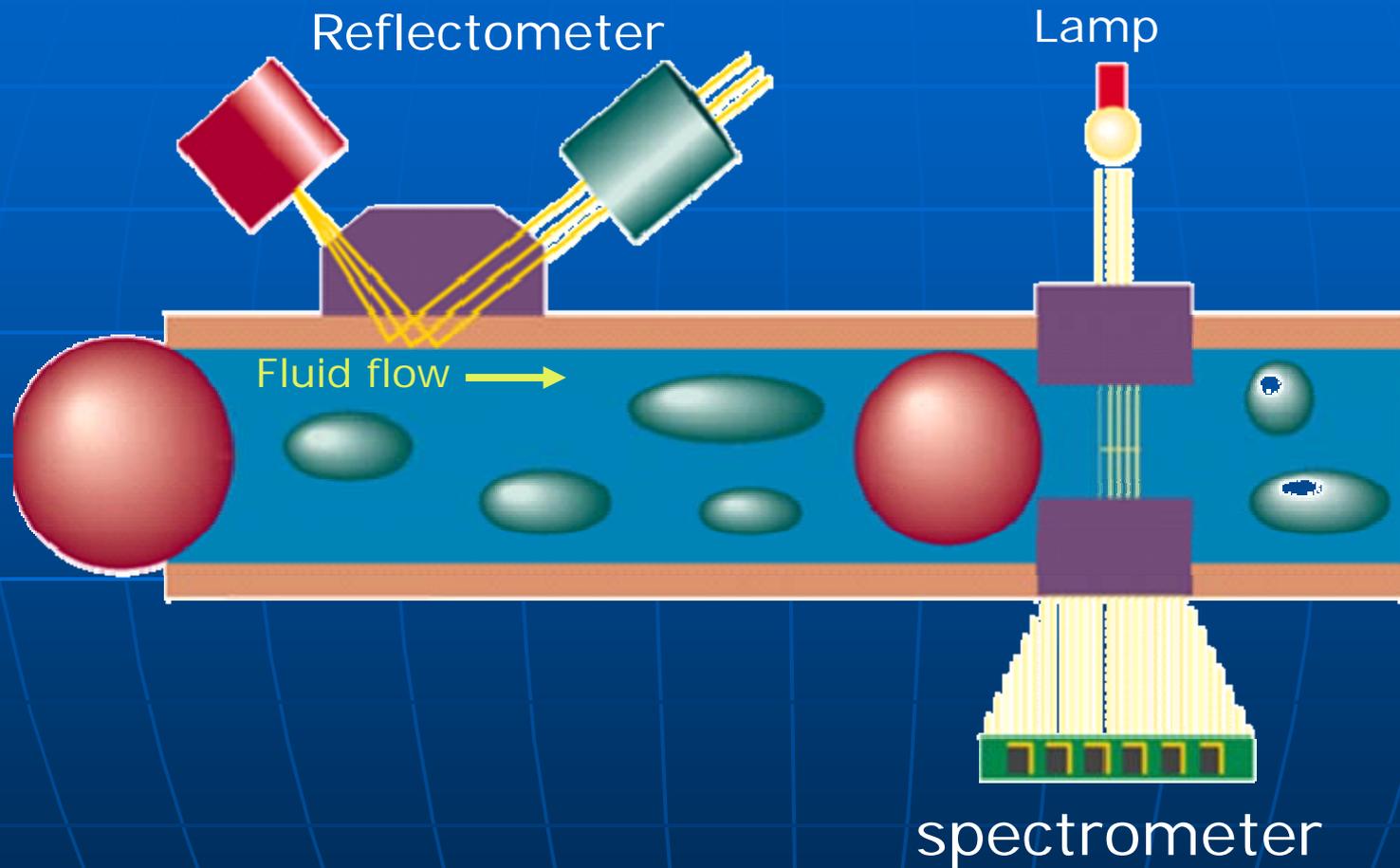
- DEPLETION
- HETEROGENEITY
- FLUID IDENTIFICATION

FLUID ANALYSIS

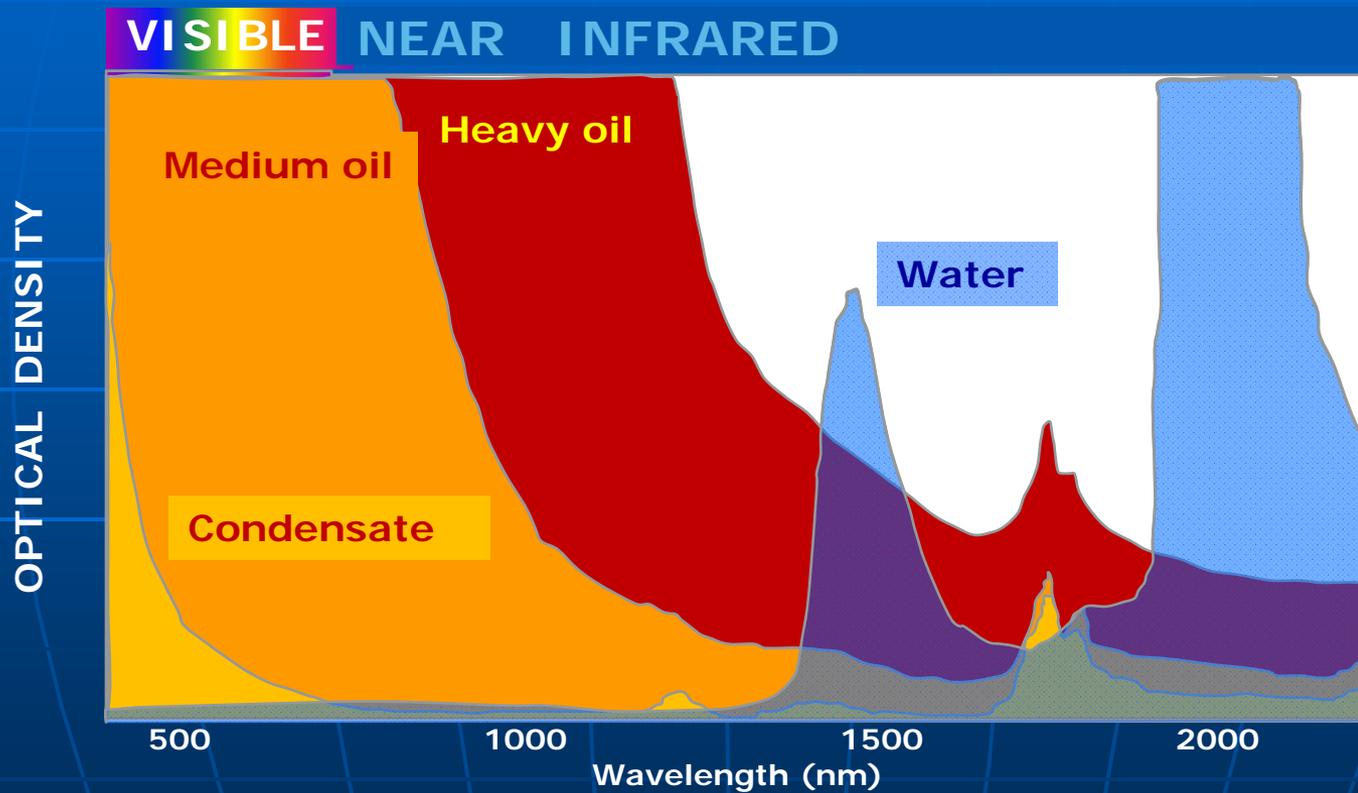
- PRESSURE GRADIENT (DENSITY)
- DOWNHOLE FLUID ANALYSIS
 - MECHANICAL (DENSITY, VISCOSITY, ...)
 - CHEMICAL (H_2S , ...)
 - ELECTRICAL (RESISTIVITY)
 - OPTICAL (PHASE IDENTIFICATION, GOR, HYDROCARBON COLORATION / COMPOSITION, FLUORESCENCE, WATER pH, CO_2 , ...)



OPTICAL FLUID ANALYSIS



OPTICAL FLUID ANALYSIS



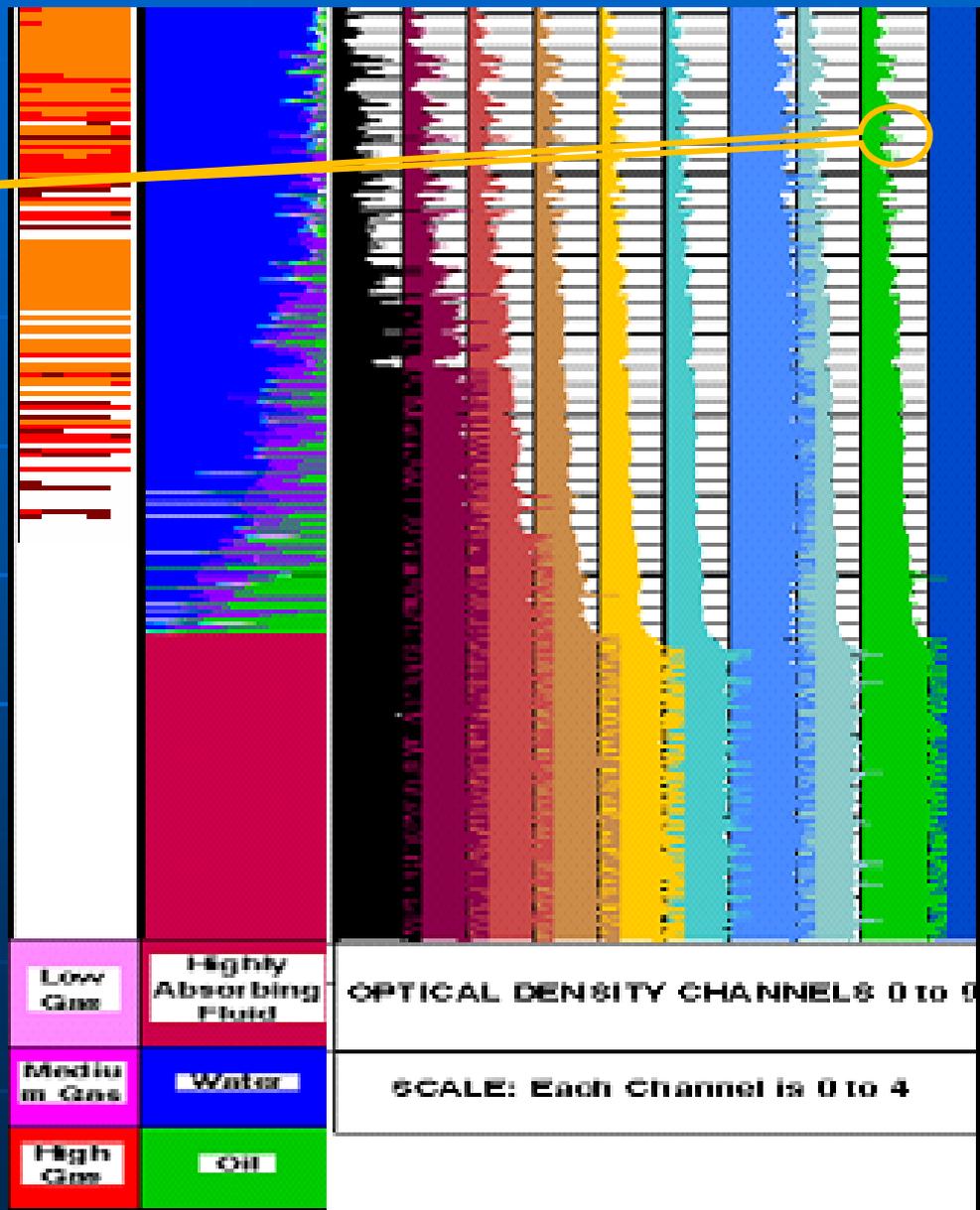
OPTICAL FLUID ANALYSIS

OIL PEAK CHANNEL 8

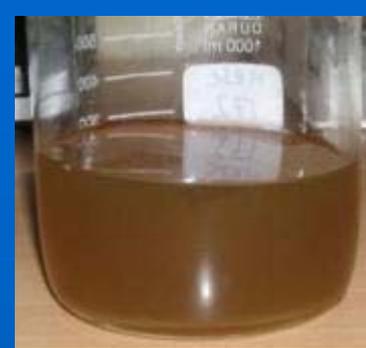


OD = 2 \Leftrightarrow 1% light transmission

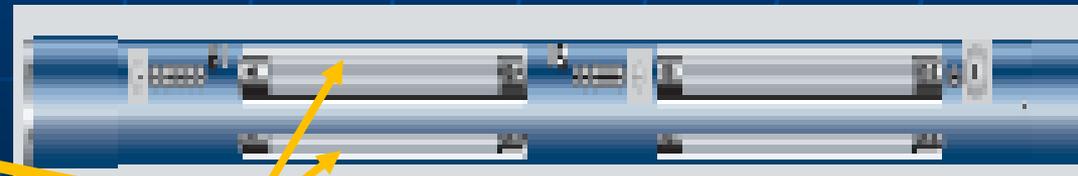
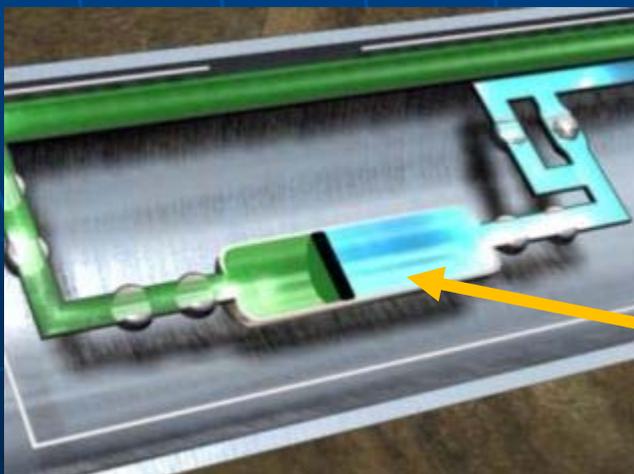
TIME



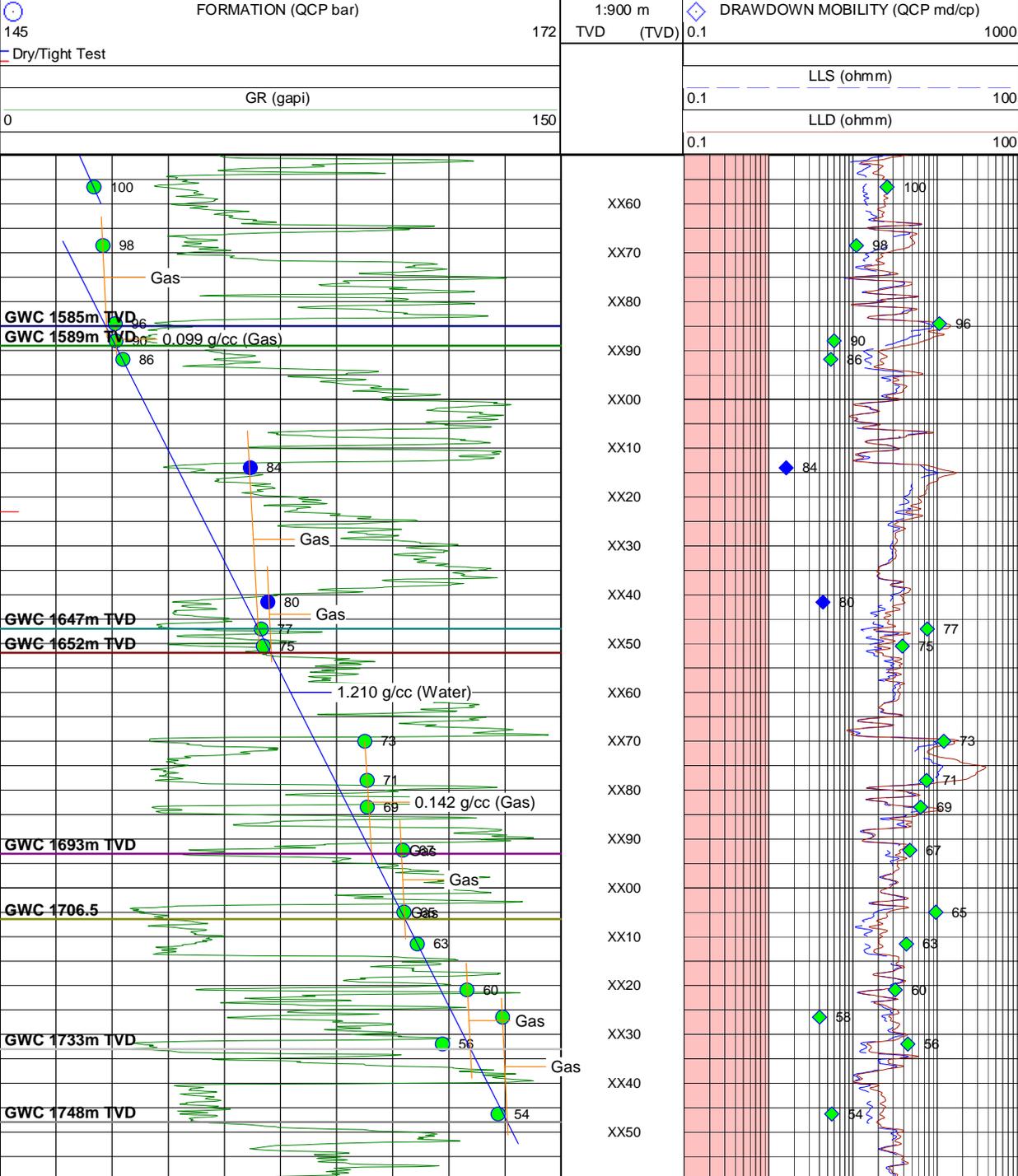
SAMPLING



- CONFIRM THE PRESENCE OF HYDROCARBONS
- DETERMINE FLUID PROPERTIES IN LABORATORY
- AVAILABLE SAMPLING CHAMBERS
 - MRSC STANDARD 1, 2 $\frac{3}{4}$ AND 6 GALLONS
 - MRMS MULTISAMPLE (6 BOTTLES) MPSR 450 CC. OR SPMC 250 CC.
- UP TO 15 SAMPLES CAN BE COLLECTED IN EACH RUN

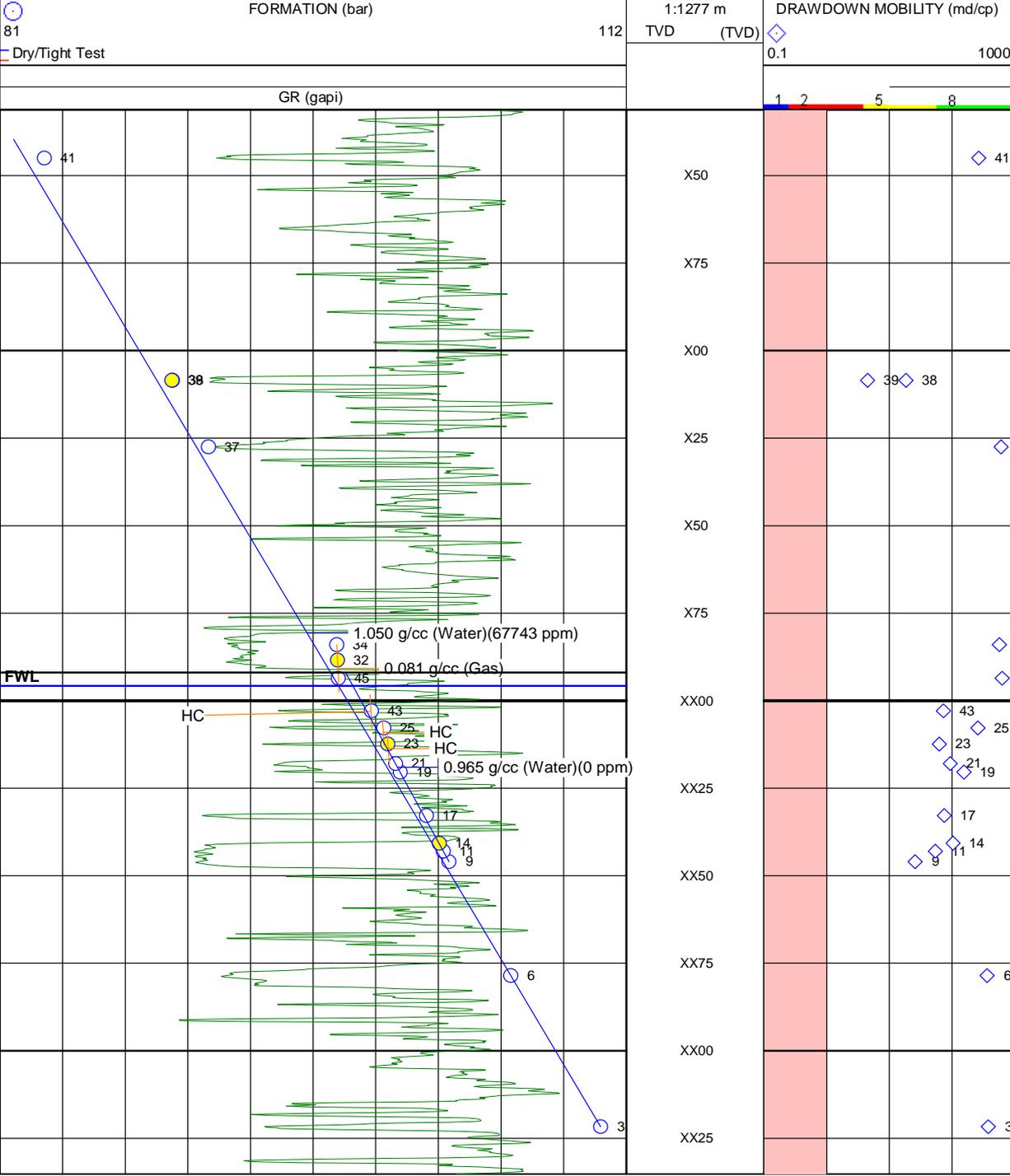


BOTTLE



MOL-L2

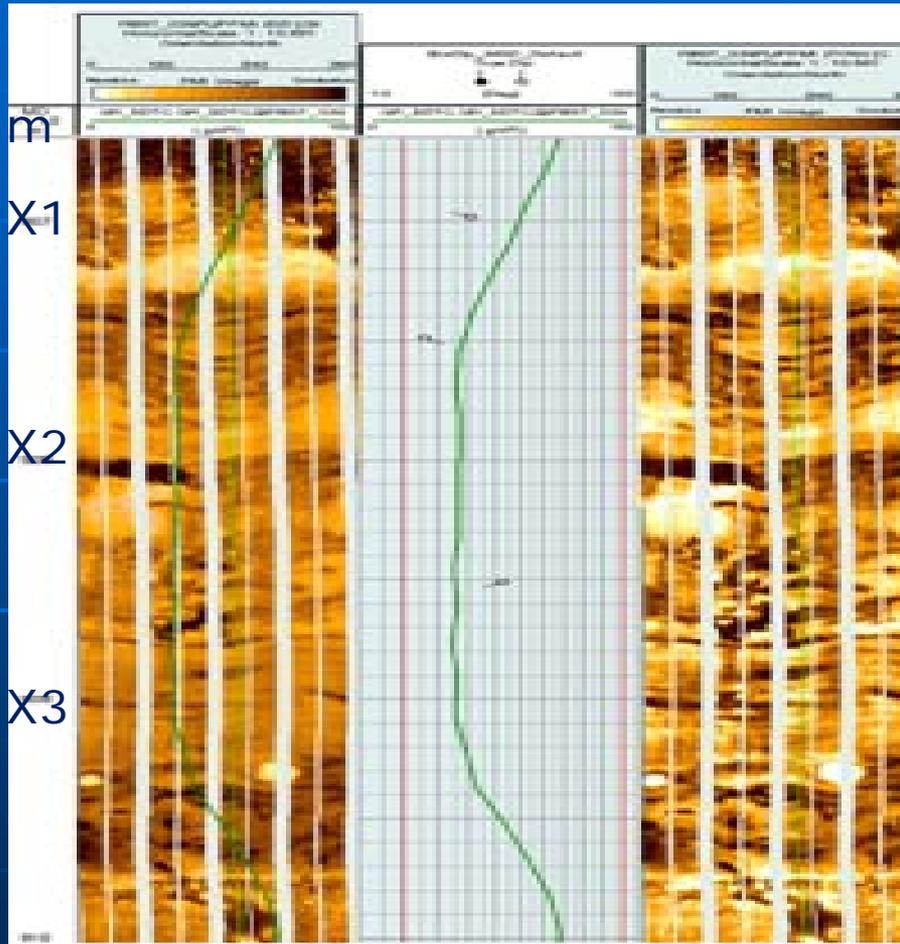
- LAYERS HYDRAULICALLY SEPARATED
- NO PRESSURE GRADIENT IN THIN LAYERS
- GAS AND WATER GRADIENT IDENTIFIED
- DIFFERENT WATER GRADIENTS (SALINITY)
- GAS-WATER CONTACTS EXTRAPOLATED, SHOULD BE CONFIRMED WITH DOWNHOLE FLUID ANALYSIS



MOL-K

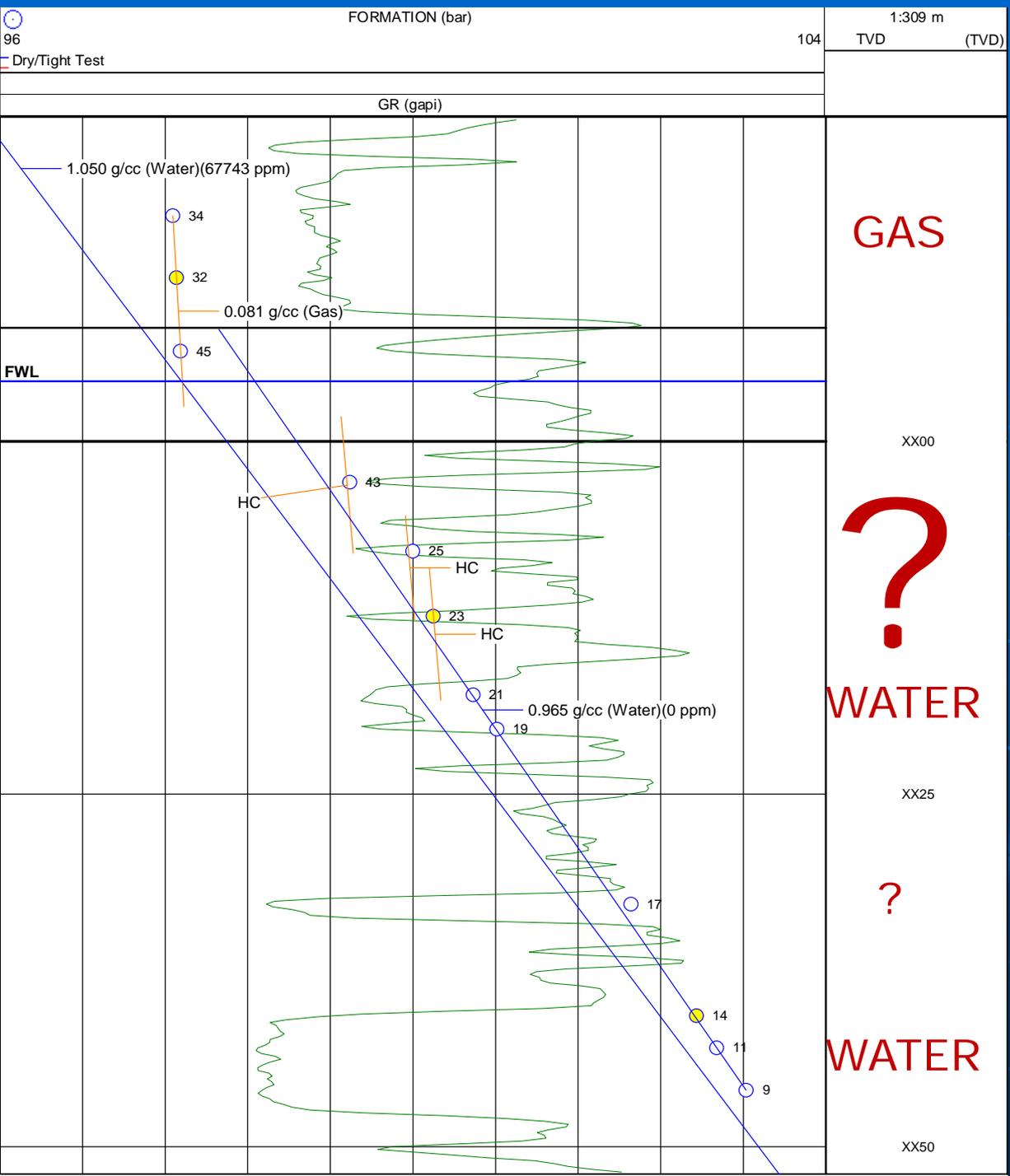
- COMPARTMENTALIZED RESERVOIR
- PRESSURE GRADIENT ACROSS LAYERS IS MEANINGLESS BECAUSE OF THE PERMEABILITY BARRIERS
- FREE WATER LEVEL NOT DEFINABLE WITH PRESSURE ONLY DUE TO COMPARTMENTS
- DOWNHOLE FLUID ANALYSIS IS THE KEY TO UNDERSTAND THE RESERVOIR FLUIDS

MOL-K



ELECTRICAL IMAGE HELPS

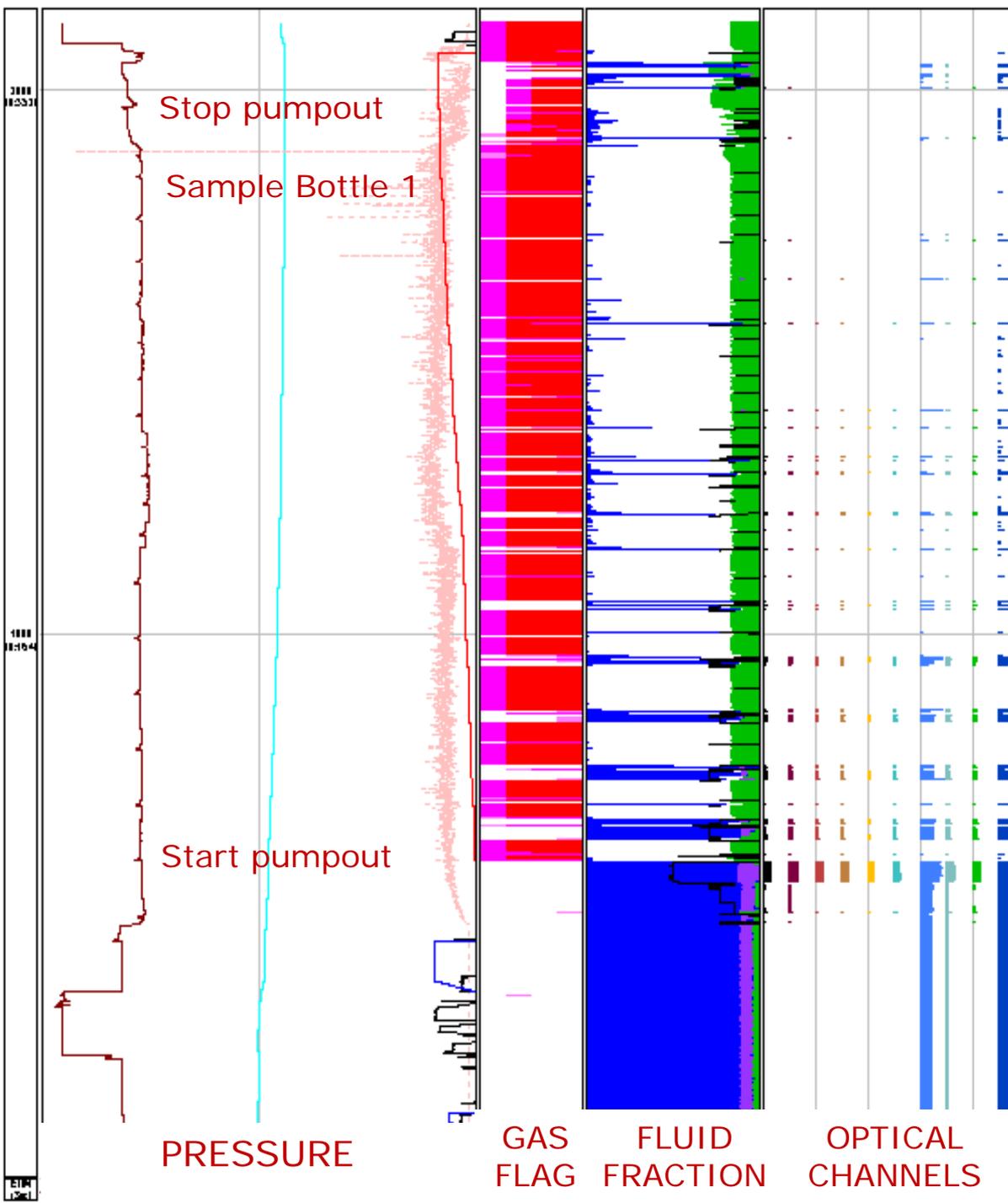
- CHARACTERIZE PERMEABILITY BARRIERS
 - LAMINATIONS, FAULTS, FRACTURES...
- VERY HIGH RESOLUTION SELECTION OF TEST POINTS
- TESTS INTERPRETATION
- DEFINE GEOLOGICAL MODEL



MOL-K

- LOW PRESSURE IN GAS
 - COMPARED TO WATER PRESSURE BELOW
 - DEPLETION IS NOT CONSIDERED IN THIS EXPLORATION WELL
 - RESERVOIR WAS PROBABLY SUBSIDED AFTER CHARGING DUE TO TECTONIC EVENTS AND PERMEABILITY BARRIERS PREVENTED PRESSURE EQUALIZATION
- TRANSITION ZONE CAN BE FULLY CHARACTERIZED WITH **FLUID SCANNING** USING DOWNHOLE FLUID ANALYSIS

MOL-L1



- RESERVOIR FLUID IS IDENTIFIED AS GAS.
- 1 GAS SAMPLE IS TAKEN
- ALTERNANCE OF BLUE AND RED IS DUE TO FLUID SEGREGATION IN THE TOOL
- RESERVOIR GAS + FILTRATE WATER PUMPED AT START

CASE STUDY RESULTS

APPLICATIONS OF HWRT IN HUNGARY

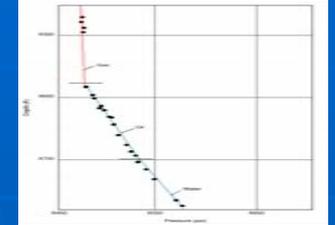
- INPUT FOR RESERVOIR MODELING
 - COMPARTMENTALIZATION
 - GEOLOGICAL MODEL, LAYER / ACQUIFER CONNECTIVITY
 - POSITIVE IDENTIFICATION OF RESERVOIR FLUIDS
- OPTIMIZE CONVENTIONAL WELL TESTING
 - DETERMINATION OF FREE WATER LEVEL, INITIAL PRESSURE, PERMEABILITY
 - SELECTION OF PERFORATION INTERVALS
 - WELL TEST INTERPRETATION
- OPTIMIZE DRILLING
 - SELECTION OF MUD WEIGHT

LESSONS LEARNED

- DOWNHOLE FLUID ANALYSIS IS THE KEY TO EVALUATE COMPLEX RESERVOIRS
 - COMPARTMENTALIZED
 - THICK TRANSITION ZONES

APPLICATIONS OF HRWT

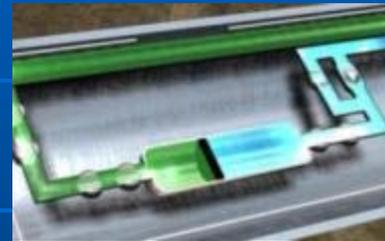
- PRESSURE / PERMEABILITY



- DOWNHOLE FLUID ANALYSIS



- SAMPLING

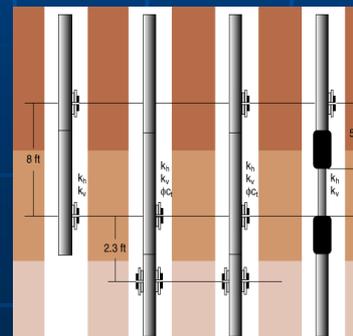


- FRACTURED RESERVOIR



- MINI DST TEST

- INTERFERENCE TEST





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QUESTIONS