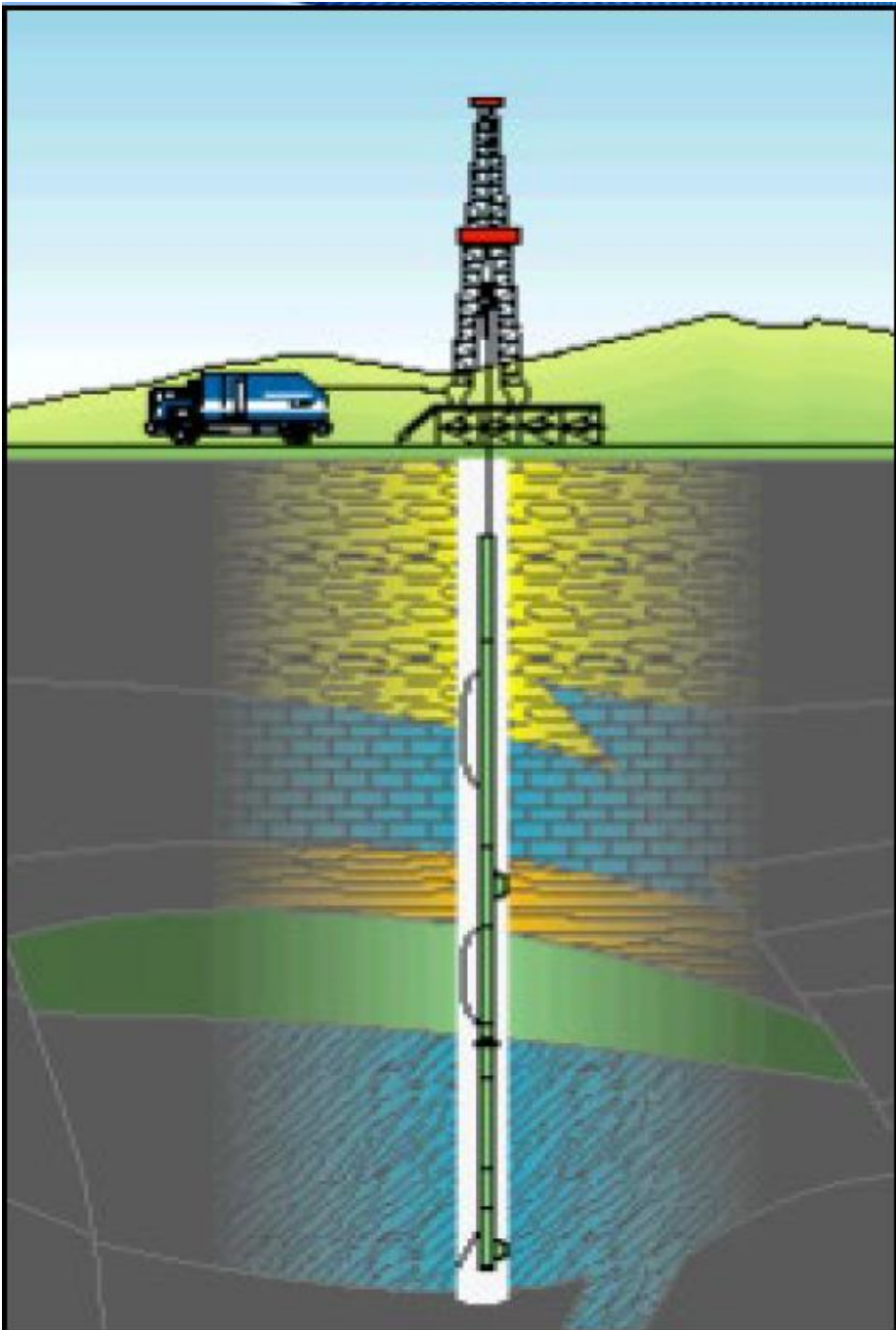


WELL LOGGING

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Motivation

- Assist in the target optimization by creating reservoir geomodel
- Assist in the perforation interval selection by supervised learning



Well Logging Applications

- Open-hole logs are used to estimate the reservoir size and hydrocarbon in place by providing either a direct measurement or good indication of:
 - Lithology, sedimentary environment, formation dip and structure
 - Porosity, both primary and secondary (fracture and vugs)
 - Water Saturation and hydrocarbon movability
 - Hydrocarbon type (oil, gas), thickness of reservoir
 - Net to gross ratio
 - Geomechanical characteristics based on the travel times of elastic waves in a formation
 - Permeability
- Cased hole logs are used to monitor primary production and evaluates applicability of water flooding. They can provide:
 - Flow rates
 - Fluid type
 - Pressure
 - Residual oil saturation
 - Cement bond log

Well Logging in Formation Evaluation

- Logging by itself cannot answer all formation evaluation questions. Coring, core analysis, and formation testing are integral parts of any formation evaluation effort.
- Essential difference between well logging and core analysis are:
 - Logs measure average porosities over a much larger volume than conventional laboratory core analysis.
 - Also, a laboratory core has been relieved of the overburden and lateral stresses and because it is an elastic medium, it will expand. Since the minerals have very low coefficient of expansion, the increase in volume must be due almost solely to the increase in porosity. Thus, the porosity measured in the laboratory at ambient conditions may be expected to be higher than at in-situ conditions.
- Advantages of well logging measurements over the other formation evaluation techniques:
 - Provide most abundant reliable data from the formation
 - Provides vertical and lateral (map) variations in rock/fluid properties
 - Modest cost
- Common pitfalls in the well logging measurements:
 - Indirect measurement
 - Depth of investigation
 - Vertical resolution
 - Nuclear hazards

Workflow

- Caliper Log
- Gamma Ray Log
- Spontaneous Potential
- Density Logs
- Neutron Logs
- Sonic Logs
- Resistivity Logs
- Nuclear Magnetic Resonance
- Lithology-Porosity Cross Plots
- Saturation Cross Plots