Who Wants To Be A Petrophysicist?

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The format of some slides in this presentation is based on the TV gameshow “Who Wants to be a Millionaire”.

The presentation has been put together by incorporating material from various sources.

Credit is given to the reference sources at the right hand bottom corner of the individual slides.

This presentation is prepared for knowledge sharing purposes and not for commercial ones.

Any opinions put forward are purely the presenter’s own.
What is petrophysics?

A: Mumbo jumbo
B: Log analysis
C: Rock physics
D: Something else
What is petrophysics?

Petrophysics is the study of the physical and chemical properties that describe the occurrence and behavior of rocks, soils and fluids. It is the study of the mechanics of the reservoir rock and the fluids contained therein.
What is a petrophysicist?

A: Fortune teller
B: Scientist
C: Magician
D: Diplomat
What is a petrophysicist?

A petrophysicist is a scientist, a magician and a diplomat, all-in-one.

In other words, a Superman
A good petrophysicist needs to have strengths in physics, chemistry, reservoir engineering, mathematics, reservoir geology and exploration geophysics.
Why a magician?

The synthesis of all the required subjects needs a bit of magic, supplied by his/her imagination, inspiration, experience and inventiveness (usually called hunches or “gut feeling”).
Why a diplomat?

Diplomacy is needed at several levels. At the well site, he/she often deals with many people, not under his/her control, who have their own opinions and priorities, which seldom include getting good log data.
Why a diplomat?

In the office, he/she will present opinions to people who know absolutely nothing about any of the sciences involved or who may know a great deal more than him/her in a particular science, or who may not yet trust his/her judgment or hunches. Hence, diplomacy is a must.
What does a petrophysicist do?

A: Log analysis
B: Log colouring
C: Data integration
D: Formation evaluation
What does a petrophysicist do?

The petrophysicist carries out evaluation of hydrocarbon reservoirs by making use of well logs and all other relevant well data to derive the best possible estimates of reservoir parameters in order to facilitate accurate assessment of the hydrocarbon resources in the reservoirs of interest.
A cardiologist interprets “recording of wiggly lines” called an ECG (ElectroCardioGram) to investigate the condition of a patient’s heart.

A petrophysicist interprets “recording of wiggly lines” called well logs, to investigate what is happening in a well.
Petrophysics input to Oil Field Volumetrics

\[ STOIIP = GRV \times \frac{N}{G} \times \phi \times (1 - Sw) \times \frac{1}{Bo} \]

STOIIP = Stock Tank Oil Initially In Place
What do we need to know?

- Rock
- Volume
- Fluid
- Flow

Graham Davis, Petrophysics for Dummies
The Role of Petrophysics

**RESOURCE ASSESSMENT**
- Hydrocarbon Initially In Place
- Net to Gross
- Porosity
- Fluid Saturation
- Fluid Type/Contacts

**GEOPHYSICS**
- Synthetic Seismogram
- Rock Physics
  - Edited Sonic Log
  - Edited Density Log
  - Fluid Contents
  - Fluid Saturation

**GEOLOGY**
- Well Correlation
- 3D Static Model
  - Lithology
  - Rock Types
  - Fluid Type/Contacts
  - Saturation vs Height

**PETROPHYSICS**
- Lithology
- Rock Types
- Fluid Type/Contacts
- Permeability
- Flow Units
- Fluid Type/Contacts

**PRODUCTION OPERATIONS**
- Reservoir Monitoring
- Production Logging
  - Cased Hole Logs
  - Well Composite

**PROD. TECH./DRILLING**
- Well Completion
- Geomechanics
  - Elastic Moduli
  - Cement Evaluation
  - Casing Evaluation
  - Cased Hole Logs
  - Perforating Intervals

**RESERVOIR ENGINEERING**
- Dynamic Model
- Recovery Factor
  - Saturation vs Height

ENP Core Program
A Specialist Skill

- Perceived as having a narrow skill base
- An external resource, not integrated into the project team
- Confusion over the correct nomenclature for the discipline
Developing the Role of Petrophysics

Breaking the mold
- think beyond our perceived boundaries
- question the internal and external structures of our organizations
Developing the Role of Petrophysics

- Breaking the mold
- Integration - be the unifying discipline
Developing the Role of Petrophysics

- Without Integration
  - outsourcing
  - loss of corporate research
  - remain on the periphery of projects
  - poor estimation of in place and recoverable reserves
Developing the Role of Petrophysics

- Breaking the mold
- Integration
- **Project coordination**
  - our skill is required in the complete life cycle of every development
Petrophysics Department, responsible for petrophysical data acquisition, evaluation and interpretation of well data, plays a very important role in all stages in the Life of a Field, starting from the Asset Acquisition phase to the End of Life and Abandonment of a Field.

**ACQUISITION**
- Petrophysical inputs for Business Development projects
- Data room exercise
- Resource Assessment for potential assets
- Technical inputs for bidding proposals

**EXPLORATION**
- Petrophysical parameters for exploration proposals
- Design, coordination, implementation, supervision and quality control of well log data acquisition
- Well log evaluation
- Resource Assessment for future field development
- Manage well log data acquisition contracts

**DEVELOPMENT**
- Formulating Field Development Plan (petrophysical inputs)
- Design, coordination, implementation, supervision and quality control of well log data acquisition
- Provide quick petrophysical results for development wells plan
- Petrophysical analysis for PDR
- Manage well logging contracts

**PRODUCTION**
- Identify further opportunities behind casing, by passed pay zones, reservoir performance
- Design, coordination, implementation, supervision and quality control of well log data acquisition of cased hole logs
- Full Field Review projects
- IOR and EOR projects

**ABANDONMENT**
- Identify candidate wells for abandonment
- Coordinate with service contractors to implement abandonment activities safely and efficiently

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*ENP Core Program*
Modes of Well Logging
Well Logging – measurements in our Wellbores

Photo courtesy of Reeves Wireline
There is no formal degree given at any university for a petrophysicist, although one may obtain a Master’s or Doctor’s degree with petrophysics as the central research theme.

Most undergraduate degree candidates can put some of the necessary courses together in a four year program, but it is pretty tough to cover all the bases.

Petrophysics or log analysis may be as little as a 3 hour lab or up to a one semester course, or maybe nothing at all. In-house and commercial courses can overcome this deficiency, and on-the-job training is a powerful tool.
Petrophysicists have two main choices in their career path:

- Specialist Petrophysicists
- Petrophysical (Technical) Managers

In either case, good communication skills and the ability to determine the real problem or request from all the surrounding chaff is necessary.

The petrophysicist must be able to form rational opinions in the face of incomplete and contradictory information.
Main job function is to review, analyze, and research logging methods and results.

The specialist petrophysicist must understand what the end-user of the analysis does with the data.

The specialist petrophysicist exists as an advisor or staff member in an operating company.

The specialist petrophysicist is expected to know more about logs, logging tools and analysis methods than any one else in the organisation.

A career as a specialist petrophysicist requires hard work, constant updating, re-training and a lot of patience.
Petrophysical Manager

- A management line position in the organization, as opposed to the staff function of the specialist petrophysicist
- Supervision of staff who perform petrophysical analyses
- In order to supervise other petrophysicists under him, the petrophysical or technical manager must have a good technical background and knowledge of petrophysics.
Challenges facing Petrophysicists

New Technology

Understanding the principles and applications of new and advanced logging tools such as Nuclear Magnetic Resonance, Dielectric Dispersion logging, Downhole Fluid Analyzers, Image and Array logs, etc.

Application of new evaluation methodologies and techniques.

Knowledge Management

Managing and sharing of ever expanding knowledge and petrophysical data bases.
Challenges facing Petrophysicists

Evaluating Unconventional Resources

- Heavy Oil
- Fractured Basement
- Tight Gas Sands
- Coal Bed Methane
- Shale Gas
- Shale Oil
- Tar Sands
- Gas Hydrates
Handling Difficult Bosses

Your porosity is wrong!

But boss, log interpretation is not an exact science...

... it's an art
Petrophysicists can be generally divided into three groups:

- **Working Petrophysicists**
  Those who actually do the work.

- **Talking Petrophysicists**
  Those who talk, but don’t do actual work.
  (e.g. Principal Petrophysicist like the author)

- **Traveling Petrophysicists**
  Those who travel a lot from one conference to another, but don’t do actual work.

Disclaimer: The above statements are meant as a joke and are not intended to insult any persons, alive or dead.
Do you still want to be a petrophysicist?

The petrophysicist needs intelligence, knowledge, experience and communication skills to sell ideas, concepts and judgments.

If you think you can do it, go for it !!!
Thank you for your attention!