BASIC SURVIVAL PETROPHYSICS COURSE FOR GEOPHYSICISTS (2 DAYS)

Designed For:

Geophysicists, and their support technicians, and anyone needing a review of basic survival skills of petrophysics within the geophysics world.

You Will Learn How To:

1) Identify various rock types using log curves like a caliper for example. What type of rock can you have when you have filter cake build up identified by the calipers? What type of feature could you have when you get thin ledges of wash out identified by the calipers?

2) Identify reservoirs using standard and non standard approaches. The use of the gamma ray (GR) to select the 100% shale line and 100% sand lines. The use of the self potential (SP), if the GR is highly radioactive, to determine volume of shale (VSH). Class examples will be worked on by all in attendance.

3) Discuss electrical properties of various rock types compiled by the industry, and discuss the influence on water saturation (SW), when either of them is changed.

4) Determine porosity from all the porosity devices logged, along with the integration of well-site geologist report of their sample descriptions. Special concentrated teaching of the sonic and density logs, along with log editing using several methods.

5) Integrate core data to improve the industry standard velocity and density of the lithology matrix, and determine core to core and core to log relationships. Use of these functions to determine a better sonic, density, density- neutron and sonic- neutron xy-plot log to core fit.

6) Do in class the depth shifting of core to logs prior to fitting to logs. We have a sand and reef carbonate core analysis with all the logs from the wells, to do in class.

7) Discussion of building an appropriate logging program for wells, which depends on drilling mud used, severity of the angles of the well, and the stacking of the tools in the correct order.

8) Apply the KISS (keep it simple, stupid) method, to evaluate your well and the various formations, so as to determine the best order of doing drill stem tests (DST”S) or perforations.

9) Discuss why the operator of the well tested the way they did, and in turn have a basic interpretation of the results, by discussing the pressures and the various recoveries that can occur. What does TSTM mean, and what could 100’ recovered of oil cut drilling mud (OCM) mean?

10) Discussion of the components of the drilling mud and how they can affect various logs like the bulk density for example. If you noted barite was used in the drill mud, what would be the resultant on the density log? If an oil emulsion or diesel mud was used, and there was invasion

by the calipers indicating filter cake build up, what could this mean to the reservoir? We will discuss hydro-static over balance, and the rules of drilling a well properly, verses drilling the well as fast as possible.

11) Discuss the integration of all the well-site engineering data like ROP, RPM, WOB, FL, and torque, as some of the more important variables. We will also discuss how to use the gas detection information (mud logging), to assist in evaluating the well bore.

About The Course:

Logs have been around since the 1920's, when the Schlumberger brothers developed the first resistivity log called the Electric Log along with a very basic self potential curve (SP). Logs are the basic interpretative source for hydro-carbons (HC), and used by most geoscientists for correlation on their x-sections. The money log, or the resistivity family, is the key to the amount of HC in the reservoir, and this correct calculation, is of most importance when calculating reserves, and going for a line of credit from your banker.

A simple approach to interpretative log analysis will be taught, with instruction during the mornings and early afternoon, and then switch to example well's, that will be done together in class, to apply what was taught. The most mistakes made are made by people when looking at logs is in reading the appropriate log scales, and then getting proper values for each significant depth.

Recon, or Reconnaissance techniques will be discussed and taught for single and groups of wells. Recon approaches to evaluate 100's and even 1000's of wells within several zones have been developed, and the results have a 85% confidence factor, when viewing maps of the results, like thickness, pay, phih, sw and hcpv. There never is a 100% solution when doing batch, unless you open each well to check the results. Where the bulls eye wrap ups occur, are checked to see if log problems exist, or if we have a potential HC trend.

The instructor has 42 years of industry experience with 38 years within the petrophysics world, and has several courses which are taught to the industry.

We will also use techniques that are outside the usual petrophysical interpretation, like a Pickett and Buckles plots, to determine pay criteria, RW (resistivity of formation water) and formation constant M. The RWA (apparent resistivity of water) technique will also be discussed to determine transition and water legs from logs within sections that have some thickness. Then we will apply the technique from surface casing (SC) to total depth (TD), to see what zones do not follow increase salinity with depth profile. The zones that pop outside the trend could be HC bearing, and therefore need more work.

Course Content:

1) Volume of shale (VSH) instruction using linear and non-linear methods using GR, and then linear SP determinations for VSH.

2) Discuss well-bore objectives, so as to know what logs should be logged to get the best interpretative results.

3) Detailed discussion using well log examples profiling well bore invasion by electrical logs, calipers, and density correction.

4) Drilling processes, which usually lead to poor well bore diameter from the original bit size used to drill the well.

5) Today there are no reservoir discriminators for elimination, for shale type rocks trap gas and oil, source rocks trap gas and oil, and tight sands and carbonates trap gas and oil. The job of a petrophysicist and geoscientist becomes most interesting these days.

6) Discuss selection of perforation intervals, by analysis of cased hole services like cement bond logs, to make sure we have interval isolation from each other.

7) Discuss and work depth of logging services with each other in older wells, and depth shift core to logs, to get the best regressions to use, to improve reservoir evaluations, and the results of better Sonics' and densities.

8) Resistivity of shale's comparison from induction to latero-log resistivity devices, and discuss the repair to conductivity, the reciprocal to resistivity, when the resistivity is not calibrated properly.

9) Porosity calculations using all the porosity logs run, especially the sonic and density logs and the associated minerals that can distort logs, to read to tight, or to high of porosity.

10) Discuss the requirement to edit logs, especially the sonic and density, for the gaps between logging runs, and shifting sections of data to compare data to surrounding wells by using frequency distribution (histograms), along with xy-plots of depth verses log.

11) Discuss the simplicity of 3 formulas that need to be known to do basic survival log analysis like sonic, density, Archie and the knowledge going into them that needs to be known.

12) Discuss Pickett plots, which use the log of porosity on the Y axis, and log of deep resistivity on the X-axis. Show how this technique solves for a formation factor (F) M constant, and resistivity of water (RW).

13) Discuss full diameter coring and side wall coring, along with percussion results.

14) Using core functions of core porosity to core permeability (KMAX), determine the varying rock types if they can be distinguished, and then find them in un-cored sections of the same formation in un-cored wells.

15) Discussion of basic pressure measurements, and why the operator of the well tested or perfed intervals the way they did.

16) Basic discussion of Image Logging, how the data is collected and interrelated.

17) Petrophysics logic from data in to answers out, can be written in software code, to evaluate one well with multiple zones, or 100's and 1000's of wells.

18) Discuss how to check if logging data is quality or not, by comparing to surrounding wells.

19) Show techniques on how to best standardize log data like sonic and density data, if it's recognized to be wrong.

20) Data input into logging segments that are missing, due to multiple logging runs in certain well locations. Discuss what type of insert data makes sense and why.

21) The use of xy-plots to curve fit logging data, so as to create a sonic compression or shear curve, along with a density log, in wells that have neither service logged. A regression would be created, and used in wells to create a sonic or density curve in wells that both curves are missing.

22) Discussion and techniques of log editing of bad sonic and density data due to well bore washout will be shown, and why these techniques have a solid technical explanation.

Conclusion: This petrophysics for geophysicists course will have a review of most of the well logging services, along with concentrated explanation on the acoustic and density logging services.

Examples:

The instructor will bring WCSB examples both in sands and carbonates to be worked on in class with open discussion with all the participants. Attendees can also bring their own logs with associated problems, and we can discuss them in class, to get everyone involved.

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