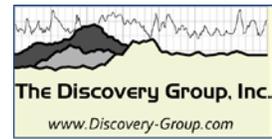


Petrophysics Elements

Daniel A Krygowski, Senior Petrophysical Advisor, The Discovery Group
And other instructors as appropriate and necessary.



The Discovery Group offers courses in petrophysics for your people, at your location, at a date convenient to your needs and internal schedules. The courses will benefit geologists, engineers, geophysicists, and geotechs, and can be of benefit to other specialists who routinely work with those geotechnical specialists. The best class size is from about 10 to 25 people from a variety of specialties who can share their professional experiences in the context of a greater understanding of petrophysics.

Synopsis: This is intended to be a longer-term, lower-intensity course (about 18 units, depending on the topics chosen, and about 16 hours per week) that introduces and goes into the details of openhole petrophysical measurements and their interpretation. The course is designed to be taken as part of participants' normal job duties at their work location.

While the course is focused on wireline and LWD measurements, it also addresses data from other sources (cores, tests, etc.) that can focus and enhance the interpretations made from logging measurements. The course also considers the details of the reservoir properties which the measurements are intended to describe.

The course uses data from the client to illustrate measurements and their interpretation, and where possible uses that data in exercises which support the topics being explored

Course aim:

To increase the understanding and use of openhole petrophysical measurements and interpretive techniques in the evaluation of conventional and unconventional reservoirs.

Course goals:

- To be able to determine quantitative reservoir properties of interest from petrophysical data and interpretive methods.
- To be aware of both primary and secondary measurement goals of openhole well logging tools.
- To have a basic understanding of the physics of the measurements, the parameters needed to go from the measurement to the property of interest, and how those parameters are dependent on formation properties and drilling conditions.
- To provide a basic understanding of the geology in which the measurements are made, and the engineering properties and issues related to production of fluids of economic interest.
- To understand how differences between the formation and borehole environments and the measurement design criteria will affect the measurements that are made, and how those differences affect the estimation of formation properties.
- To be aware of, and to be able to better integrate, petrophysical information in the context of common job duties.

Course objectives:

Specific objectives are detailed in each unit of the course.

Length: Most units take one day, with some taking one-half day. Two days of class per week are planned.

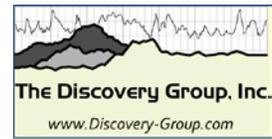
Equipment needed: Calculator with exponent functions, straight-edge, pencil or pen.

Laptop with Microsoft Excel, to be used in small group exercises.

Access to other software, including petrophysical software, may be appropriate for some units.

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Topics:

The topics used in execution of a course, and the order of the topics, will be determined, in part, by the client and The Discovery Group.

Unit	Length days	Week	Topic <i>(Phrases in quotes are other RDG course names)</i>
pre	NA	0	Requirements before the pre-course topics begin
pre	NA	0	Participant preparation for course; pre-course assessment
1	0.5	1	Opening day: expectations, tasks, schedule
2	0.5	1	Reservoir properties, workflows, and subsurface conditions
3	1	1	Standard core measurements
4	2	2	Correlation/Reservoir logs: GR, SP, caliper, Tension
5	0.6	3	Acoustic logs
6	0.6	3	Density logs
7	0.6	3	Neutron logs
			<i>Break: No classes</i>
8	1	4	Lithology: porosity log combinations, elemental spectroscopy ("Beyond Porosity")
9	0.5	4	Resistivity logs
10	0.5	4	Data preparation and quality assurance ("Data Cleanse Diet")
11	1	5	Mudlogging
12	0.5	5	Permeability
13	0.5	5	Saturation, Capillary pressure
			<i>Break: No classes</i>
14	1	6	Clean formation interpretation; pattern recognition techniques: ("Beyond Resistivity")
15	0.5	6	Shaly sand interpretation
16	0.5	6	Carbonate and mixed lithology interpretation
17	1	7	Unconventional reservoir interpretation
18	1	7	Core workshop: ("Speed Dating with Cores"), digital core description
19	1	8	Workflow and methodology review
20	0.5	8	Course close: post-course assessment; recommendations
post	NA	0	Reporting of post-course assessments to individual participants, and summary to management

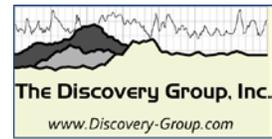
The topics above are executed in 8 weeks, with two additional weeks to provide breaks in the training.

Pre-course preparation begins several weeks before the course begins.

Post-course results include reporting of pre- and post-course assessment details to course participants. Management sees only summaries of those assessments to gauge the overall success of the course, but does not get enough specific individual information to judge the improvements of individuals.

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About the instructor: The course will use several instructors, based on the specific expertise of each instructor with respect to the topics being covered and the availability of the instructor.

Primary instructor and course contact: Daniel A. Krygowski



Dan Krygowski is a Senior Petrophysical Advisor at The Discovery Group, in Denver, Colorado, USA. In this role, he has worked petrophysical interpretation projects in a variety of international and US domestic locations. Currently he is spending most his time providing and developing training courses in basic and intermediate openhole petrophysics. The courses include the common instructor-led formats, as well as longer-term, lower intensity formats that allow participants to spend more time with the course material while delving deeper into areas of personal interest.

Since the late Cretaceous, Dan has taught the AAPG Basic Well Log Analysis course with Dr. George Asquith. In recent years, Rick Lewis, with Schlumberger, has joined George and Dan in instruction in the course. In 2004, the AAPG published *Basic Well Log Analysis*, co-authored by Dan and George, with Steve Henderson and Neil Hurley.

The book is the second edition of George's similarly-named book which was one of AAPG's all-time best sellers, and the second edition has also become an AAPG best seller.

Dan earned a BA in Physics from the State University of New York at Geneseo. He then earned MS and Ph.D. degrees in Geophysics from the Colorado School of Mines, where he focused on petrophysics under Dr. George R. (Dick) Pickett.

After completing his formal education, Dan worked for Cities Service Company (now part of Occidental Petroleum), Atlantic Richfield (now part of bp), Petrophysical Solutions, Landmark Graphics (a Halliburton company), and Chevron. At several of those companies, he held positions in petrophysics and petrophysical software development, with both technical and management responsibilities. He joined The Discovery Group in late 2006.

Dan has been active in the Denver Well Logging Society, serving two terms as Director, and terms as Vice-President Technology, and Vice-President Membership. Dan is a member of SPWLA, AAPG, SPE, SEG, DWLS, and RMAG.

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