

BASIC OPEN HOLE LOG INTERPRETATION

September 24 & 25, 2008; Morgantown, WV

BOTTOM LINE

This streamlined, one-day introductory level course provided the engineers and geologists who attended the background they need to effectively analyze and interpret open-hole log data. Basic open-hole sensor theory, application, interpretation and quality control were covered during the course of the day. A background in petroleum geology was helpful in understanding the course material, but was not necessary, as entry-level engineers benefited equally with entry-level geologists.

When preparing to select and run a suite of logs in a hole, one first must be conscious of the hole environment. Is the hole open or cased? What is in the hole: air or mud, or oil or water and mud? If water, is it fresh or saline? And finally, which tools work best in each environment? One needs to know the purpose of each tool, and the values that you need to read to enable you to make all necessary calculations using log data, because usually you measure one thing to enable you to calculate a value that you really need.

PROBLEMS ADDRESSED

Petrophysicists, petroleum geologists and petroleum engineers need to know the lithology, porosity, permeability, fluid saturation, thickness and extent of a reservoir, i.e., everything that is necessary for them to be able to estimate recoverable reserves from a well. In addition, these same energy experts would like to know or be able to determine, among other things, formation contacts, formation pressure, fluid type, shale type and shale content. The team of Weatherford instructors addressed these points, and introduced attendees to a variety of logs, interpretation charts and tools, and the theory behind each tool.

TECHNOLOGY OVERVIEW

The workshop was organized so that attendees were introduced to basic tool theory and “log reading” for each tool in the morning, and log interpretations at the end of the day. Log sensors covered included gamma ray, photo density, compensated density, dual induction, dual laterolog, micro laterolog, sonic and audio/temperature. Classroom examples focused on S_w , S_h , V_{shale} and porosity calculations.

The introductory section covered the various uses of open-hole log measurements, with an emphasis on what logs can tell us, and the realization that a set of logs run on a well mean different things to different people. For example, for a petrophysicist, porosity, fluid saturations and permeability values, plus knowledge of drainage area and reservoir

thickness, can lead to a more accurate decision on whether or not a reservoir will be commercial.

A brief review of reservoir rocks, lithology, and tools that react with lithology and porosity, was included in this section, prior to a discussion of fluid saturations and resistivities, and tools to measure saturations and resistivities.

The second section began with a discussion of drilling fluid types (water-based mud; oil-based mud; air) and their effects on log tools. This section was followed by sessions on various tools: gamma ray; induction resistivity; laterolog and micro laterolog; photo density; neutron and compensated neutron; temperature and ultra sonic gas detector logs; and compensated sonic.

The final section of the course was on basic open-hole log interpretation, during which the lithology model, log data and water saturation were covered, leading to conclusions of hydrocarbon presence and ability to be moved to a well bore. This discussion concluded with an example of calculations using a log from a Huron Shale well in Boone County, WV.

CONNECTIONS

Weatherford International, Incorporated's Wireline Division provided the instructors for this course.

SUMMARY OF EVALUATION FORMS

This course was offered on two days, the 24th and 25th. Twenty six attended on the first day, and 18 more on the second day. Eighteen of the 26 filled out an evaluation form on the first day; 15 of 18 filled out a form on the second day.

On day one, 14 of the 18 seemed to be pleased with the course, facilities and overall organization. One thought the \$150 fee was too high.

Most of the comments we received were from one person who did not like the course at all. She expected a more introductory course than the one that was presented. Another said the course needed to be two days; and another that the course needed to be more field oriented. At least one did not like one of the instructors at all.

ATTENDANCE

Attendance list:

1	Amrine	Daniel C.	Day 1 Log	Geo Tech	Petroleum Development Corporation
2	Chase	Christopher	Day 1 Log	Geologist	Equitable Production Company

3	Crawford	Chad	Day 1 Log	Geologist	Atlas Energy Resources, LLC
4	Frame	Edward	Day 1 Log	Senior Staff Geologist	Dominion Exploration & Production
5	Goodman	Michael	Day 1 Log	Staff Geologist	Atlas America, Inc.
6	Jarvis	Michael	Day 1 Log	Geologist	North Coast Energy
7	Lipinski	Brian	Day 1 Log	Geologist	Exco-North Coast Energy
8	Mackrell	Benjamin	Day 1 Log	Geologist	Energy Corporation of America
9	McBride	Patrick S.	Day 1 Log	Senior Geologist	Dominion Exploration and Production
10	Moss	Brynn	Day 1 Log	Reserve Engineer	Petroleum Development Corporation
11	Murphy	Sheldon	Day 1 Log		North Coast Energy
12	Nugent	Barnes	Day 1 Log	Coal Geologist	WVGES
13	O'Connell	Ryan	Day 1 Log	Geologist	Dominion E&P
14	Smith	Diana J.	Day 1 Log	Geo Tech	Range Resources-Appalachia, LLC
15	Smith	Valerie L.	Day 1 Log	Geology Grad Student	WVU Geology Dept. Grad Student
16	Snyder	Marjorie J.	Day 1 Log	Geo Tech	Range Resources-Appalachia
17	Suhy	Tom	Day 1 Log	Engineer	BJ Services
18	Vactor	R. Taylor	Day 1 Log	Geologist	Equitable Production Company
19	Weigand	Kristin	Day 1 Log	Geologist	Atlas Energy Resources ,LLC
20	Bucher	Jacob	Day 1 log, Day 2 Lift	Field Supervisor	Bucher Exploration LLC
21	Harpold	Kurt	Day 1 log, Day 2 Lift	Sr. Technical Professional	Halliburton
22	Hilvers	George	Day 1 Log, Day 2 Lift	Consultant	GH Services LLC
23	King	Michael	Day 1 Log, Day 2 Lift	Drilling/Prod. Manager	R.H. Adkins Companies
24	Schafer	Donovan	Day 1 log, Day 2 Lift	Petroleum Engineer	Energy Corporation of America (ECA)
25	Waits	Derek	Day 1 log, Day 2 Lift	Production Engineer	Petroleum Development Corporation

2 6	Ward	Jim	Day 1 Log, Day 2 Lift	Geologist	Red Resources
1	Bechtold	Stephen	Day 2 Log	Geologist	Sylvan Energy
2	Britton	James	Day 2 Log	Geologist	WVGES
3	Chavez	Brian	Day 2 Log	Engineer	Condevco
4	Daft., Jr.	Gary W.	Day 2 Log	Geologist II	WV Geological Survey
5	Fanning	Geoff	Day 2 Log	Drilling Manager	CNX Gas
6	Horner	James	Day 2 Log	Geologist	WVGES
7	Hunt	Paula	Day 2 Log	Geologist	WV Geological Survey
8	Johnson	Bob	Day 2 Log	Geologist	WVGES
9	Jones	David	Day 2 Log	Geologist	WV Geological Survey
1 0	Kennedy	Elizabeth	Day 2 Log	Geologist	Sylvan Energy
1 1	Orsborn	Nick P.	Day 2 Log	Geologist	Sylvan Energy
1 2	Pankowski	Katherine	Day 2 Log	Geologist	Equitable Production Company
1 3	Riethmiller	Joshua	Day 2 Log	Geologist	Sylvan Energy
1 4	Schanken	Luke	Day 2 Log	Geologist	Equitable Production Company
1 5	Stump	Jennifer	Day 2 Log	Geologist	WVGES
1 6	Sutton	Jeanne	Day 2 Log	Geologist	WVGES
1 7	Williard	Dustin	Day 2 Log	Geologist	Knox Energy
1 8	Yoders	Bill	Day 2 Log	Drill Foreman	CNX Gas