InSite

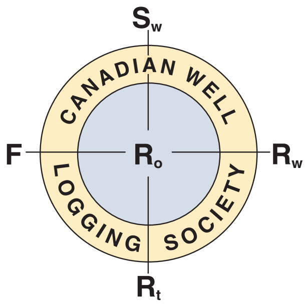
CWLS Magazine
March 2006 Issue 1 Volume 25

Inside this issue…

InSite

CWLS Magazine March 2006

Issue 1 Volume 25



Co-Editors:
Ben Urlwin & Tyler Maksymchuk

Layout and Design:
Connections Desktop Publishing

Advertising:
Mike Eddy
(403) 203-2034
meddy@totalgas.ca

Proof Readers:
Vern Mathison, Mark Ducheck, Lori Slack, Robert Bercha

Contributors:
John Nieto, Dave, Richard Bishop, Steve Cuddy, Ross Crain, Rafik Baouche, A. Nedjari, Fred Hyland, Robert Bercha

InSite is published 4 times a year by Sundog Printing for the Canadian Well Logging Society.

Table of Contents

Cover Photos: *Aerial photo of a drilling rig in Northeast British Columbia. Photo courtesy of D. Shedden.*

Logging operations in the Dawson area, AB (January, 2003). Photo courtesy R. Bercha

If you have a photo that the CWLS can use on its next InSite cover please send a high resolution jpeg format version to tmaksymchuk@br-inc.ca or ben@waveformenergy.com. Include a short description of the photo with your submission.

The 2006 - 2007 CWLS Executive:

Front row (l - r): Jeff Taylor, John Nieto, Peter Kubica, Michael Stadnyk
Back row (l - r): Gordon Uswak, Gary Drebit, Dave Ypma, Benjamin Urlwin, Tyler Maksymchuk

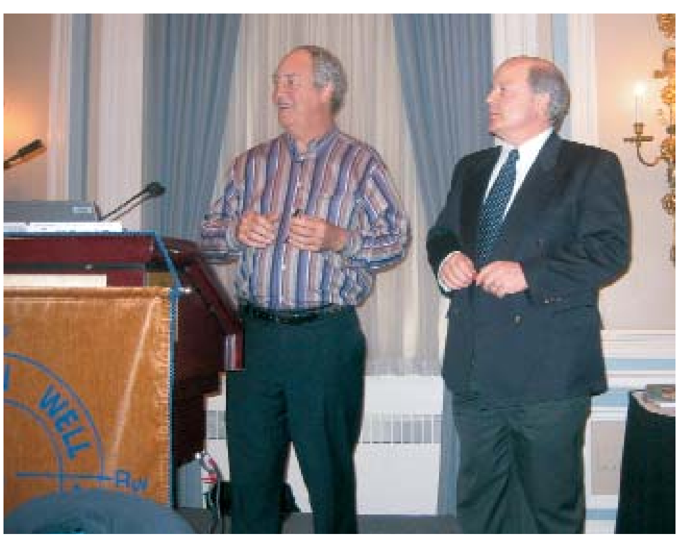
Out-going President's Message

As the new CWLS Past-President, this is my last column. I am very pleased with this year's executive committee, together we have achieved a good deal. It is with some sadness that I pass the 'gavel' on to the new President, Peter Kubica. It has been a very rewarding experience and one that I'd do again!

In this column, I'd like to take this opportunity to thank Ken Faurschou for organizing a successful AGM on February 8. I think all who attended enjoyed Dr. Patrick Moore's talk. The talk was both entertaining and informative. Dr. Moore skillfully navigated the boundary between Industrial and Greenpeace debates by giving good factual information and letting the listeners judge for themselves. Thanks Patrick!

Other highlights were honorary member, Ted Connolly who provided an entertaining experience for the membership whilst giving an overview of the 50 years of the Canadian Well Logging Society – thanks Ted!

Worth noting here are the award recipients, Robert Hawkes of BJ Services who received the $1000 President's award for 'best overall talk' for his outstanding lunch talk last year! In addition the Vice President's award of $500 for 'best local oil company paper' was given to Peter Kubica of PetroCanada – 2 in a row for PetroCanada, can they make it 3 in a row in 2006?



Dr Patrick Moore (Greenpeace founder) answering questions with Ken Faurschou, 2005 Vice-President.

(Left)Robert Hawkes (BJ Services) receiving the 2005 President's award for "Best overall lunch talk" from 2005 President, John Nieto.

(Right) Peter Kubica (PetroCanada receiving the 2005 Vice -President's award for "Best local oil company lunch talk".

Once again, thanks go out to all our lunchtime speakers, your efforts are much appreciated by the society!

So finally, let me introduce your new President, Dr Peter Kubica.

Peter Kubica is the team leader of the Petrophysical group in Petro-Canada. He holds a PEng degree in Electrical Engineering from Slovak Technical University in Bratislava, as well as an MSc and a PhD in physics from Queen's University, Kingston, Ontario. He started his oilfield experience in 1977 as a field engineer with Schlumberger of Canada in Western Canada and in the Beaufort Sea. He joined Petro-Canada in 1980 where he is working on exploration and development projects in Western Canada and on the East Coast. He is a longtime member of the CWLS, he was a VP in 1995 and participated in organizing numerous CWLS conferences. Most recently he was a chairman of the CWLS scholarship committee that made the first student awards in 2004. He is also a member of APEGGA and SPWLA.

Peter is now also a CWLS Vice-President's award winner, 2005!

I congratulate Peter and his new committee and wish them all the best for 2006!

John Nieto
Past-President

Editor's Note

Welcome to the first InSite publication for 2006! As this is my first time being exposed to this publication from the inside out, I would like to say first and foremost thank you very much to Robert Bercha and Ben Urlwin for their continuing efforts with respect to putting together such a high quality publication every quarter of this past year. This magazine takes quite a bit of effort from a lot of people and between the past executive and the new executive; I believe we will have our work cut out for us. I hope I speak for all in saying that we are very excited and challenged to uphold the standards these professionals have shown in prior years and look forward to another great year for the 51st year of the CWLS.

Next, I would like to take this opportunity to welcome the new and existing membership and sponsorship to the CWLS for 2006. It is great to see the membership numbers continue to rise as they have. The CWLS has within its membership many years of experience. It has also proved to be a great continuous learning environment. The various functions that have been sponsored by our society allow for a wonderful opportunity to network and gain valuable friendships in the industry.

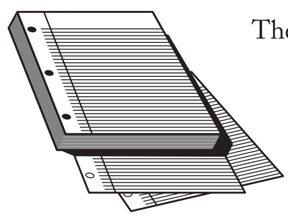
As the end of February approaches we are coming to the conclusion of what is proving to be the busiest as well as the most confusing winter drilling season Canada has ever seen. At the moment there are upwards of 600 rigs currently operating in Western Canada. The confusing part of course is the weather, that has not been cooperating to its full potential (i.e. coldness). Hopefully if the weather holds and begins to get even a little colder, we will still have a lot of work ahead of us before breakup. Here is to keeping our fingers crossed for a continued safe work environment as well as many more wells to be drilled.

This edition of the InSite is once again full of many interesting topics and discussions. We have two technical papers, the first of which comes to us from Steve Cuddy on the topic of Fuzzy Logic. Mr. Cuddy, if you remember gave us a technical luncheon presentation in April, 2005 on the application of novel techniques to Complex Tight Gas Reservoirs. He first introduced us to the use of fuzzy logic as a petrophysical characterization tool in his discussion and has presented his paper here as a follow up. The second paper also focuses on reservoir characterization using petrophysical analysis. This paper entitled Petrophysical Analysis in Reservoir Characterization is presented by R. Baouche and A. Nedjari from the gas fields of Algeria. Both papers provide some very interesting reading and we are very happy to make them available to all our membership. In addition to these two papers, our Tech Corner column provides a review of Coal Bed thickness determination and this is brought to us by Fred Hyland. Finally we have another great segment of 'As the Winch Turns' entitled Too Long in the Bush as well as a the third installment of the Petrophysical Myth series from long standing member Ross Crain. As is always mentioned, InSite is continually looking for more material and papers to publish. If you have a short paper you wish to submit, or some new technology and/or analysis that you think would be beneficial to the membership, contact information for submittal can be found throughout the magazine, or on the CWLS website (www.cwls.org).

Enjoy the InSite.

Tyler Maksymchuk
Ben Urlwin
(with Robert Bercha)

Call for Papers



The CWLS is always seeking materials for publication. We are seeking both full papers and short articles for the InSite Newsletter. Please share your knowledge and observations with the rest of the membership/petrophysical community. Contact publications co-chairs Ben Urlwin (ben@waveformenergy.com) at (403) 538-2185 or Tyler Maksymchuk (tmaksymchuk@br-inc.ca) at (403) 260-6248.

As the Winch Turns: Too Long in the Bush

It was 1996 more or less, and we were drilling in central Sudan for State Petroleum. The trips into the field were long and arduous. We would leave Calgary in the early afternoon and arrive in Frankfurt about 9 hours later. After spending three hours walking the airport, there was another 10 hours to Khartoum. Generally it would take an hour to clear customs, so we would get to bed at about 01:00 a.m. local time. The wake up call for the Twin Otter Flight was 5:00 a.m. After another 3 hours in the air and sometimes an hour drive it was time to start work.

The work was generally good and times were very good. We had one small rig, Rollin 15, about 20 Canadians and a large number of Sudanese workers. Our small size meant that we avoided the attention of the rebels and the CIA. And we were finding oil, lots of oil. In addition to my usual tasks I was training four local geologists. Their rock skills were good, probably better than mine, but they needed help with computer skills and English. I still know more DOS than most and can wax poetic about switches for hours.

Drilling was fast when it happened, but there were lots of hole and equipment problems so the geological staff tended to have periods of panic followed by periods of boredom. We would fill the slack time with computer school and long trips with my little Hilux truck. There was a complete lack of gravel in the area so I spent many happy hours wandering, looking for hills that did not exist except on satellite photographs. After a few months of fruitless searching the locals would come out of their grass houses, or leave their cows and point to the closest road when I went by. This saved everyone a lot of time.

Since I truly hated the flying, I used to work long periods and leave the country only infrequently. In time, this led to a reputation of me being somewhat of an unstable character, which I rather enjoyed. In fact, it might be safe to say that I encouraged it.

One day while snooping through the warehouse at Heglig I found 8 lifejackets or personal floatation devices, all CSA approved and ready for use. It was a bit surprising because the closest body of water was the Nile River which was about 100 kilometers south of where the rig was drilling at El Toor. So of course I took all 8 back to the rig with me.

Some time later I got up Sunday morning and put on my life jacket and went to work. The response was about what I expected. Everyone laughed. In fact the rig manager Ken Champion was laughing so hard that he could not talk and nearly fell over. Robert the truck driver almost drove into the rig while trying to figure out what was going on. I did notice the company man come out of his shack and then disappear rather quickly, but paid it no mind. I found out later he was on the sat phone to Calgary and he was not laughing.

Tuesday afternoon I was back in Calgary – without my life jacket. The verdict: too long in the bush.

Dave

CWLS 2006 to 2007 Executive

President
Peter Kubica
Petro-Canada
150 - 6th Avenue SW
Calgary, AB T2P 3E3

403-296-4241 (Office)
403-296-5176 (Fax)
kubica@petro-canada.ca

Past President
John Nieto
Anadarko Petroleum Corporation
1201 Lake Robbins Drive
The Woodlands, Texas 77380

832-636-4720 (Office)
403-471-4216 (Cellular)
832-636-8216 (Fax)
john_nieto@anadarko.com

Vice-President
Jeff Taylor
Nexen Inc.
801 - 7th Avenue S.W.
Calgary, AB T2P 3P7

403-699-4311 (Office)
403-612-8474 (Cellular)
jeff_taylor@nexeninc.com

Secretary
Dave Ypma
Tucker Wireline Services
900, 444 - 5th Avenue SW
Calgary, AB T2P 2T8

403-232-1720 (Office)
403-990-0876 (Cellular)
403-264-2118 (Fax)
dypma@tuckerenergy.com

Treasurer
Gary Drebit
Schlumberger of Canada
525 - 3rd Avenue SW
Calgary, AB T2P 0G4

403-509-4267 (Office)
403-509-4220 (Fax)
gdrebit@calgary.oilfield.slb.com

Publications Co-Chair
Ben Urlwin
Waveform Energy Ltd.
Petro-Canada Centre,
West Tower, Suite 3000
150 - 6th Avenue SW
Calgary, AB T2P 3Y7

403-538-2185 (Office)
403-813-0592 (Cellular)
403-538-2122 (Fax)
ben@waveformenergy.com

Publications Co-Chair
Tyler Maksymchuk
Burlington Resources
2100, Bow Valley Square 4
250 - 6th Avenue SW
Calgary, AB T2P 3H7

403-260-6248 (Office)
403-880-7386 (Cellular)
403-260-1059 (Fax)
tmaksymchuk@br-inc.ca

Chair of Committees
Gordon Uswak
EnCana Corporation
150 - 9th Avenue SW
PO Box 2850
Calgary, AB T2P 2S5

403-645-3484 (Office)
403-620-1418 (Cellular)
403-645-2453 (Fax)
gordon.uswak@encana.com

Membership Chair
Michael Stadnyk
Talisman Energy
Suite 3400,
888 - 3rd Steet SW
Calgary, AB T2P 5C5

403-237-1260 (Office)
403-860-5623 (Cellular)
403-231-2851 (Fax)
mstadnyk@talisman-energy.com

Executive Message

The 'Chair of Committees' (C of C) is perhaps the least intuitive of the titles assigned to the members of the Executive Committee (the functions of others like President, Treasurer, Secretary, etc. are pretty self-explanatory). So I thought I'd take a couple of minutes of your time to list the official duties of this person as defined in the Society's bylaws.

A) Attend monthly executive meetings of CWLS.

The Executive meet once a month, usually one week before the Technical Luncheons, and the C of C reports on progress or changes within the individual sub-committees which have been established.

B) Assist in the establishment of new committees as decided from time to time by the Executive Committee.

If the Executive Committee has decided to form a new sub-committee to deal with a particular topic of concern or interest to the membership, the C of C is responsible for finding a volunteer to chair that particular sub-committee and possibly help him or her to find additional volunteers to work on that topic until it is resolved.

C) Help coordinate the replacement of volunteers on sub-committees when those volunteers choose to resign from said sub-committees.

Not everybody is able to see the working life of a sub-committee through to the end, due perhaps to work or personal issues, so the C of C acts as a coordinator of volunteers to try and keep the sub-committees functioning.

D) Assist in the soliciting of and placement for individuals who offer their services for special events.

During the year, the CWLS organizes or participates in various events, such as the Fall Social or a Joint Conference. We generally need people to help out at these events, and the C of C is the volunteer contact for the Society.

E) Monitor current sub-committee information on the CWLS web site.

Our web site is the Society point-of-contact for most of our membership, so it is important that the information posted there is current.

F) Assist on individual sub-committees when appropriate.

We can't always find enough people to volunteer for all the active committees, and in any case sometimes the C of C has a particular expertise that's appropriate to one of the sub-committees. In these cases the C of C might end up sitting on that sub-committee.

G) Prepare an annual report on activities and submit to the President on January 20.

Those of you who attended the Annual General Meeting on February 8 would have seen this report printed in the table hand-outs.

H) Convey the President's Award recommendations from the Speaker Evaluation committee to the Executive prior to the Annual General Meeting.

Each year, a small sub-committee attends all the Technical Luncheons, and recommends the best presentation for a special President's Award.

Over its history, the CWLS has struck sub-committees to establish many worthwhile resources which the membership (and in many cases beyond the membership) take for granted on an almost daily basis. Examples are the LAS format, the Rw catalogue, and the Special Core Database. Without our volunteers, these endeavors would not be possible.

It's been a pleasure to serve as your Chair of Committees for these past two years, and I hope that you will continue to support my replacement, Gordon Uswak.

Richard Bishop

New Members

Michael Uland, iReservoir.com Inc.

Roy Lindseth

David Yu, Trafina Energy

Roger Whitworth, ExxonMobil Canada

Winston Lee, Precision Energy Services

Alex Saldana, Talisman Energy Inc.

Jenny Hogan, BJ Services

Christopher Di Capua, MGV Energy Inc.

Jonah Resnick, EnCana

Jaime Lo, Husky Energy

Nicole Lehocky, Precision Energy Services

Gordon Trainor

Bamidele Olutusin,
Labradorite Geological Consulting

Greg Munro, Integrated Production Sirvices

Jeff Hemsing,
Precision Energy Services-Weatherford

Trevor Coleman, Tucker Wireline Services Canada

Scott Treadwell, Precision Energy Services

Margaret Johansson, GeoMark Research

Dan Myck, HEF Petrophysical Consulting Inc.

Yomi Obiri

Mike Ranger

AnnaMarie Shankland, Weatherford Canada

Jennifer Vézina, NAL Resources

Francisco Caycedo, Schlumberger

Mark Simpson, Precision Energy Services

Doug Axani, Kereco Energy Ltd.

Karsten Nielsen, NeoExporation

Michael Stadnyk
CWLS Membership Chairman

Using Fuzziness to Repair Borehole Electrical Logs

Steve Cuddy, Principal Petrophysicist, Helix RDS Ltd.

Not everything is black or white in oil exploration. Helix-RDS use fuzzy logic to interpret those ambiguous greys.

The applications of fuzzy logic range from making washing machines 'intelligent' to controlling high speed trains. Fuzzy logic can be used to predict rock types and permeability in wells that have been logged but not cored. Fuzzy logic is also used to estimate sanding risk and to create synthetic logs to fill gaps in well logging suites, perhaps due to budget constraints, such as shear velocity logs. Their most impressive use is in the quality control and repair of electrical logs. The method is simple, intuitive and of real benefit to the oil industry.

In 1965, nearly 2500 years after Aristotle invented logic, the rules behind reasoning, Lotfi Zadeh, of the University of California at Berkeley published a paper describing an alternative way of thinking which he called fuzzy logic. Aristotle has been praised for giving mathematicians and scientists a simplistic way of thinking that has touched everybody in their everyday lives. Zadeh's ideas were dismissed, at best as unusable philosophy or at worst - nonsense. Forty years on, however, fuzzy logic is being accepted as having important practical applications. In the end of the 90s fuzzy logic had over 1500 commercial and industrial applications. By the turn of the century 2500 patents using fuzzy logic ideas had been issued or applied for.

Aristotle's central idea was the principle of bivalence, a law that says that every proposition is either true or false. This concept is one of the driving forces of science. Philosophers believe that classical logic determines how management organisations operate and even how the man in the street thinks.

Aristotle's laws are based on "X or not-X"; a thing either is, or is not. This has been used as a basis for almost everything that we do. We use it when we classify things and when we judge things. Managers want to know whether a field is 'economic' or 'not economic', juries decide whether the defendant is guilty or not guilty and even movies have stereotypical goodies and baddies. Conventional logic is an extension of our subjective desire to categorize things. Life is simplified if we think in terms of black and white. This way of looking at things as true or false was reinforced with the introduction of computers that only use the binary digits one or zero. When the early computers arrived with their machine-driven binary system, Boolean logic was adopted as the natural reasoning mechanism for them. Conventional logic forces the continuous world to be described with a coarse approximation; and in so doing, much of the fine detail is lost.

Classical logic is useful but we are left with a feeling that there is something missing. The real world is not made up of bivalent blacks and whites; there is a grey scale out there. By only accepting the two extreme possibilities, the infinite number of possibilities in between is lost. Reality does not work in black and white, but in shades of grey. Not only does truth exist fundamentally on a sliding scale, it is also perceived to vary gradually through the uncertainties in measurements and interpretations. Hence, a grey scale can be a more useful explanation than two end points.

Steve Cuddy is the Principal Petrophysicist at Helix-RDS. He is also an Honorary Research Fellow at Aberdeen University where he holds a doctorate in petrophysics. Fuzziness may sound odd, says Cuddy, but it actually is an extraordinarily powerful and (despite its appearances) a very simple tool for formation evaluation.

This is the where mathematics of fuzzy logic comes in, says Cuddy. Once the reality of the grey scale has been accepted, a system is required to cope with the multitude of possibilities. Probability theory helps quantify the greyness or fuzziness. It may not be possible to understand the reason behind random events, but fuzzy logic can help bring meaning to the complex picture. Take, for instance, a piece of reservoir rock. If one assumes that aeolian rock generally has good porosity and fluvial rock poorer porosity then, if we find a piece of rock with a porosity of 2 porosity units (pu) - is it aeolian or fluvial? Since this rock has a low porosity value we could say it is definitely fluvial and get on with more important matters. But let's say it is probably fluvial but there is a slim probability that it could be aeolian. A second assumption may be that aeolian rocks are generally clean containing little or no clay minerals whilst fluvial rocks contain some clay minerals. The same piece of rock contains 20% clay minerals. Now, is it aeolian or fluvial? We could say it is approximately equally likely to be aeolian or fluvial based on this second measurement. This is how fuzzy logic works. It does not accept something is either 'this' or 'that'. Rather, it assigns a greyness, or probability, to the quality of the prediction on each parameter of the rock, whether it is porosity or shaliness. Fuzzy logic combines these probabilities and predicts that, based on porosity, shaliness and other characteristics; a rock is most likely to be aeolian and provides a probability for this scenario. However, fuzzy logic says that there is also the possibility it could be fluvial, and provides a probability for this to be the case too.

Continued on page 10…

Using Fuzziness to Repair Borehole Electrical Logs … *continued from page 9*

In essence, fuzzy logic maintains that any interpretation is possible, but some are more likely than others. One advantage of fuzzy logic is that we never need to make a concrete decision. In addition, fuzzy logic can be described by established statistical algorithms. Computers, which themselves work in ones and zeros, can do this effortlessly for us. In practice, says Cuddy, the whole operation is even simpler, since it requires minimal human intervention. One simply asks the computer to look at the log databases and find the correlations. "You give the computer a set of logs and it says 'Easy! Based on what I've learnt in the first well I can predict what's in the next one'."

Geoscientists live with error, uncertainty and fragile correlations between data sets. These conditions are inherent to subsurface, because of the challenge of designing and building sensors to measure complex formations in hostile environments. Even in the laboratory it is difficult to relate a log response to a physical parameter. Several disturbing effects such as mineralogy, fluids and drilling mud invasion can influence all measurements. Conventional techniques try to minimize or ignore the error. Fuzzy logic asserts that there is useful information in this error. The error or fuzziness can be used to provide a powerful predictive tool.

Borehole electrical logs are acquired in a difficult environment, often at high temperatures and pressures. Although most modern electrical tools are designed to compensate for limited borehole washouts and rugosity, virtually every well contains sections of log with poor or unacceptable quality. In addition to poor logs there are often sections where the measurement has completely failed due to telemetry problems with the surface equipment or because of tool failure due to adverse conditions. These problems have increased in recent years with the introduction of Logging Whilst Drilling (LWD). The oil industry is to be commended for the development of sensors that take measurements whilst the well is actually being drilled. These real-time measurements are a real benefit to the industry as they enable quick decisions, but these measurements are taken in an extremely adverse environment, which includes drill string vibration and high-pressure drilling mud. Wireline and LWD measurements are further compromised by calibration errors, which occur because of human error or through electronic tool drift due to temperature. The Quality Control (QC) and repair of electrical logs is therefore essential before formation analysis can take place. This is a useful exercise even when the QC merely confirms that the logs are good.

The QC and repair of electrical logs is based on the premise that all logs are related. A skilled petrophysicist verifies an anomaly on one electrical log through comparison with other curves. For instance, the density log may measure extremely low densities when the tool is separated from the borehole wall, causing it to read the mud density, or because of the presence of a coal bed. In the former case, the log needs repair and in the latter, the log is correct. The petrophysicist would normally check the sonic compressional velocity, gamma-ray reading and resistivity log at the same depth in the reservoir to confirm either interpretation. Fuzzy logic is used in a similar manner to uncover the relationships between all electrical logs so that anomalies can be identified and the correct log can be predicted.

An example from the Heather field, in the North Sea, can be used to explain the process. Recent infill wells in the Heather field suffered from bad sections of LWD log data in the Brent reservoir. Well geosteering required logging in sliding mode at times, which tends to degrade log quality because the tool is not rotating and does not 'see' all around the borehole. Unexpected overpressure was encountered in parts of the reservoir, particularly Ness Formation sands and shales, caused by injection water. To control pressures, mud weight was increased to very high densities. This, in turn, caused differential sticking and hole washouts. The fuzzy logic technique was applied to repair defective log curves as shown in Figure 1.

Sections of bad-hole are identified using the curves in Track 1 of Figure 1. This shows the caliper and delta-rho curves. The over-sized caliper is shown by the difference between the caliper and the bit size. Delta-rho is used as a density quality indicator; where it moves to the right the density log may be suspect. The differential caliper and delta-rho curve point out borehole washouts at the top and base of the reservoir. The recorded density and neutron porosity logs are shown in Track 2. These logs are off the left hand side of the track and clearly poor in these intervals. A tool failure has also caused a data gap in the middle of the reservoir.

Fuzzy logic is used to uncover the relationship between the electrical logs. The density and neutron porosity logs are calibrated separately. The fuzzy logic program first scans the density data. These data are divided into twenty equal rock-types representing twenty density ranges from low density to high density. Each one of these rock-types is then compared to the other logs. The log data associated with depths in the well corresponding to each rock-type are analysed and their mean and variance are calculated. In this way, not only is the average or most probable log value associated with each rock-type calcu-

Continued on page 11…

Using Fuzziness to Repair Borehole Electrical Logs *… continued from page 10*

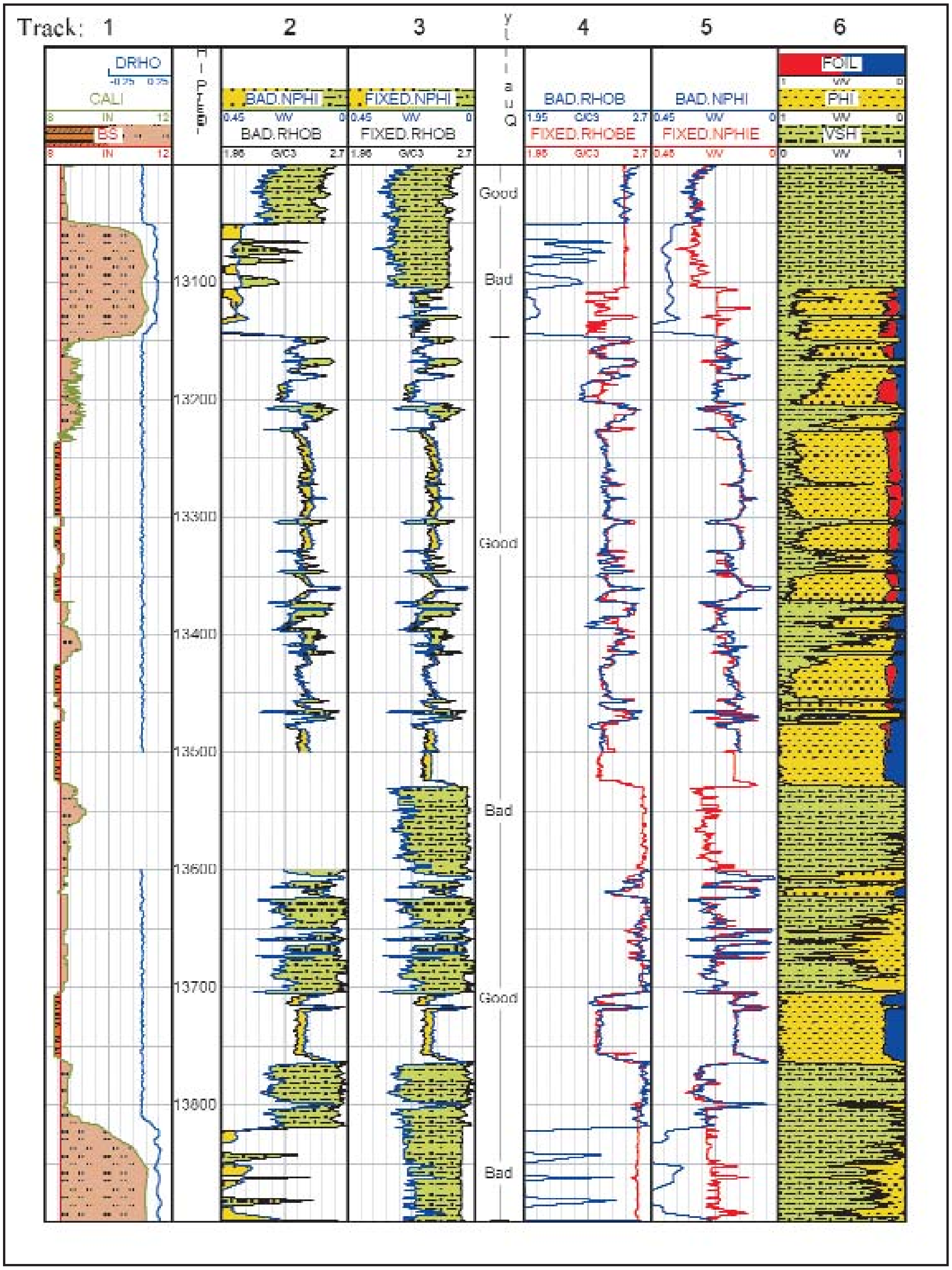


Figure 1. The QC and Repair of Electrical Logs in the Heather Field

Continued on page 12…

Using Fuzziness to Repair Borehole Electrical Logs ... *continued from page 11*

lated, but also some idea of the fuzziness in the measurement is obtained. This process is repeated for all curves. Fuzzy logic asserts that a particular electrical log value can be associated with any density value, but some are more likely than others.

It is intuitive that rock-types with low densities will generally have different gamma-ray, resistivity and sonic log readings compared to rock-types with high densities. The fuzzy logic program determines the mean and variance for each of the rock-types and saves this calibration. The calibration is then used to create the synthetic bulk density (FIXED.RHOB) and neutron porosity (FIXED.NPHI) curves, shown as the red curves in Tracks 4 and 5. The QC of the recorded logs and the quality of the prediction is confirmed by checking the overlay in the 'good' sections in these tracks between 'bad' and 'fixed' logs. The resulting repaired logs are displayed in Track 3. Consequently, a reservoir section with very poor and absent logs has been quality controlled and repaired. Interestingly, there has been little user intervention as fuzzy logic is a self-determining technique and requires no prior cross plots or parameters to run. The formation evaluation based on the corrected logs is displayed in Track 6, showing the volume of shale, porosity and formation fluids.

Interest in fuzzy logic is spreading in the oil industry. Steve Cuddy has already received invitations to present and explain the benefits in Calgary, Dallas and Stavanger. One of its attractions, he says, is that it is very simple to apply and you don't need to be an experienced petrophysicist. "People are perhaps put off initially by the name 'fuzzy logic' because they think it must be like chaos theory or superstring theory: something ferociously difficult to understand. In fact it's quite the opposite. Its beauty is its sheer simplicity, and it uses nothing more than high school mathematics".

About the Author

Steve Cuddy is the Principal Petrophysicist with Helix-RDS. He is an Honorary Research Fellow with Aberdeen University and is director with Petro-Innovations Ltd. Previously he spent 10 years with Schlumberger and 15 years with BP. He holds a doctorate in petrophysics and his principle interest is the application of soft computing techniques and Sw-height functions to formation evaluation.

Myth-Interpretation

E. R. Crain, P.Eng.
Spectrum 2000 Mindware
ross@spec2000.net 403-845-2527

This series on interpretation myths is intended to provoke discussion, rebuttal, dialog, or alternate solutions. I do not contend that my views are the only possible views, or even a correct view, on the subject. Responses should be addressed to CWLSorg@gmail.com

Myth #3: High Water Saturation Means Water Production

Sometimes this is true, but often it is not. Pore geometry changes with depth can fool the best analyst. You need more than logs to resolve the issue. Production tests of clean oil from zones with high water saturation will do the trick. So will capillary pressure data from the zone concerned. Nuclear magnetic resonance logs might help, but how many of them have you seen recently?

Vuggy porosity, very fine grained texture, open fractures, and micro-porosity are possible causes of high water saturation,

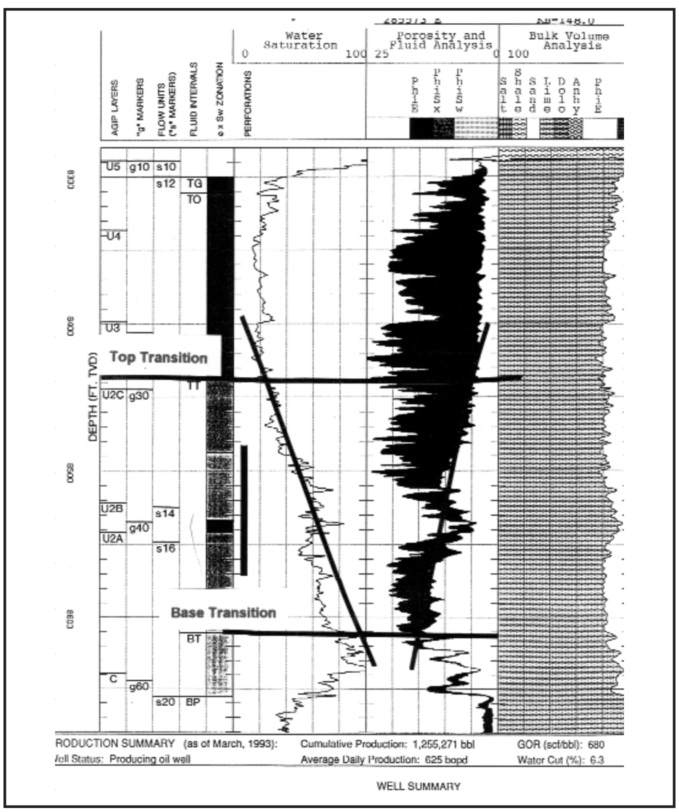


Figure 1: Example showing long apparent transition zone. Perfs in this interval produce clean oil so this cannot be a real transition zone.

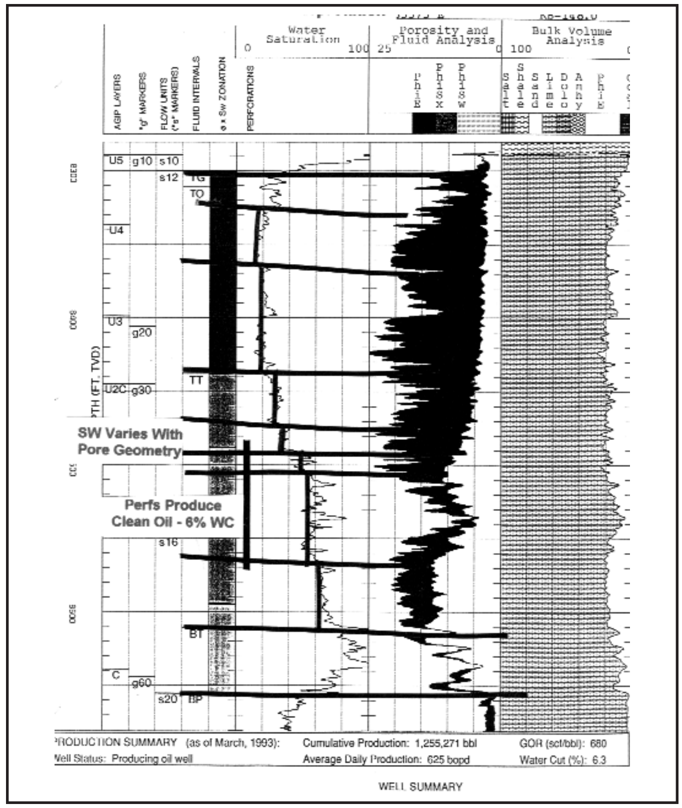


Figure 2: Same example with short transition zone adjusted to agree with production data. The black bar in the saturation track shows the perforated interval.

which can be detected from thin section petrology or SEM images.

Increased shaliness is a common cause, not from clay-bound water which is handled by appropriate clay corrections to porosity and saturation, but rather from an overall decrease in grain size coincident with the increased clay content. In a typical coarsening upward shaly sand sequence, it can be difficult to tell whether the zone is getting wet because it is getting shalier, or because we are approaching free water.

In the case of laminated shaly sands, the unexpectedly low resistivity leads to a false calculation of high water saturation. This topic was covered by the author in "Productivity Estimation in Milk River Laminated Shaly Sands, Southeast Alberta" in CWLS InSite, Dec 2004, so we will not deal with it here.

In the worst pore geometry, there may be no oil or gas because the pores are too small to contain both irreducible water and

Continued on page 15…

Myth-Interpretation *… continued from page 14*

hydrocarbons. Such an interval could occur anywhere within a hydrocarbon column, leaving some confusion as to how best to complete the zone. And there is the special case of gas over water over oil in the McMurray Tar Sands where the high water saturation does indicate moveable water between the gas and the oil.

Finally, the analyst must distinguish depleted oil zones (with residual oil) from zones with naturally high water saturation. It's a tough job but someone has to do it!

The example below is from a forensic analysis undertaken more than 10 years ago. The reservoir is a pure dolomite reef. Figure 1 illustrates the initial interpretation; Figure 2 shows the revised interpretation after production history and thin sections were reviewed. Figure 3 illustrates the different rock types on a porosity versus water saturation plot. Rock units with similar pore geometries fall along constant porosity – water saturation hyperbola.

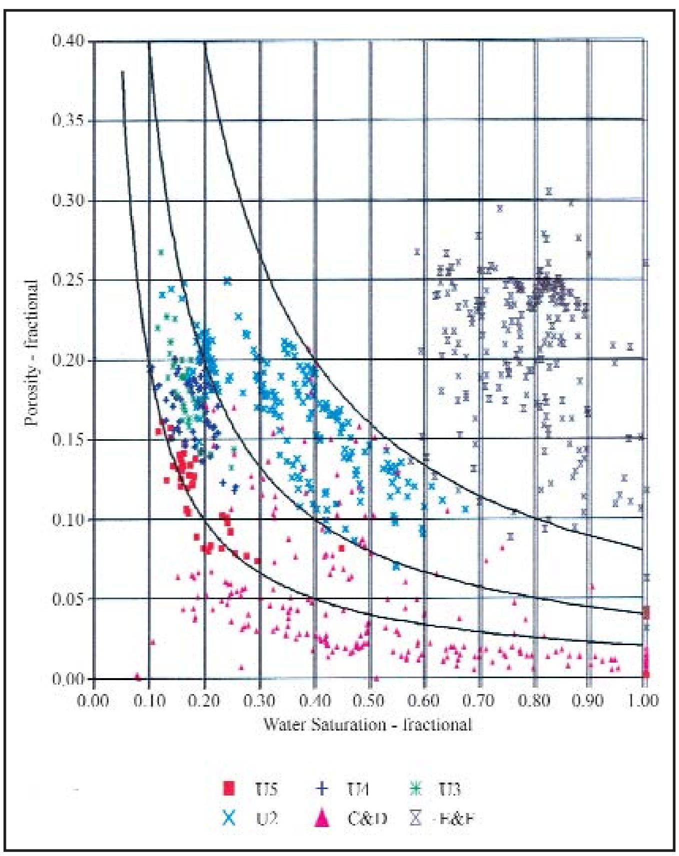
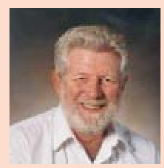


Figure 3: Porosity vs Water Saturation crossplot showing different rock types tracing different hyperbolic trends. Notice the red triangles with very high water saturation at the bottom center and right – these points will not make any water. The black "X" symbols at middle right are from the water and transition zones and will make water.

The steps shown in the saturation profile represent pore geometry changes caused by progressively increasing isolated vugs. The porosity times water saturation product defines different "rock types" or pore geometry facies. These are shown best in a porosity vs water saturation crossplot with different colours indicating the different facies, as shown in Figure 3.

It takes a sharp eye to stay dry in heavy weather. An integrated approach to petrophysics is your life preserver when it comes to predicting the possibility of water production.

About the Author



E. R. (Ross) Crain, P.Eng. is a Consulting Petrophysicist and a Professional Engineer with over 35 years of experience in reservoir description, petrophysical analysis, and management. He has been a specialist in the integration of well log analysis and petrophysics with geophysical, geological, engineering, and simulation phases of oil and gas exploration and exploitation, with widespread Canadian and Overseas experience. His textbook, "Crain's Petrophysical Handbook on CD-ROM" is widely used as a reference to practical log analysis. Mr. Crain is an Honorary Member and Past President of the Canadian Well Logging Society (CWLS), a Member of Society of Professional Well Log Analysts (SPWLA), and a Registered Professional Engineer with Alberta Professional Engineers, Geologists and Geophysicists (APEGGA).

2006 JOINT CONVENTION

WHAT'S NEXT? Where is our industry heading?

May 15 – 18, 2006
Calgary, Alberta, Canada

2006 CSPG CSEG CWLS JOINT CONVENTION - UPDATES

TECHNICAL PROGRAMME

With all the abstracts in the Technical Committee is putting the final touches on the technical programme. We are looking forward to the first class offering of talks, poster sessions, core sessions, field trips, and short courses for the upcoming 2006 Joint Convention. Please see further details on the Technical Programme in the Final Circular being distributed this month.

In the Final Circular you will find detailed information about special events, the technical programme, including talks poster sessions, core sessions, field trips, and short courses. The final circular will also contain a convention agenda, floor plan, and registration form.

We are looking forward to a successful 2006 Joint convention to find out **What's next? Where is our industry heading?**

SPECIAL EVENTS

We are excited to have **Jay Ingram** from the **Discovery Channel's** award winning **Daily Planet** as our Luncheon speaker on Monday.

As in past years, the Ice Breaker will be on Monday evening. It will be held on the Exhibition Floor and we are looking forward to a great networking opportunity between Delegates and Exhibitors.

On Tuesday there will be a Mini Ice Breaker on the exhibition floor which will conclude the exhibition part of the 2006 Convention.

The always anticipated Core Meltdown party will wrap up the convention on Thursday afternoon at the AUEB Core Research Centre – we hope to see you all there to enjoy some food and beverages with your colleagues.

REGISTRATION OPENS MONDAY MARCH 27, 2006

As you are probably already aware, the 2006 Convention will be a joint meeting of the CSPG, CSEG and CWLS. Together, the membership of these societies represents an important and significant cross-section of the petroleum industry's technical community. Along with this, the attendance of the convention is expected to be almost 4,000 delegates!

Avoid the Monday morning onsite registration rush ....REGISTER EARLY!

On-line registration is available through www.GEOconvention.org using VISA or MC.

Registrations may also be mailed, faxed or dropped off at the Convention Department c/o CSPG office. To pay by check or money order (make payable to *2006 CSPG CSEG CWLS Joint Convention*), please send registration form(s), with payment, to:

WHAT'S NEXT? Where is our industry heading?
c/o CSPG Office
160, 540-5th Ave. SW
Calgary, Alberta T2P 0M2
Fax: (403) 264-5898

Registrations received after 4:00pm Friday, May 5, 2006 will be held and processed on site. On-site registration fees will be applied.

Registration fees for this year's convention are as follows:
Please note prices do not include GST

	Early Bird Registration **Deadline: April 19, 2006**	Regular Registration **Deadline: May 5, 2006**	On-Site Registration **May 15 – 18, 2006**
Member (CSPG/CSEG/CWLS)	**$285**	**$385**	**$485**
Non-Member	**$385**	**$485**	**$585**
Retired Members (CSPG/CHOA/CWLS)	**$150**	**$150**	**$150**
Student	**$75**	**$75**	**$75**
Day Pass – *Exhibition Hall Only*		**$50/day**	
Luncheon Tickets		**$50 each**	

A Registration Form can be found in the 2006 Convention Final Circular or online at www.GEOconvention.org

Petrophysical Analysis in Reservoir Characterization – Application in the Triassic Hamra Gas Field, Algeria

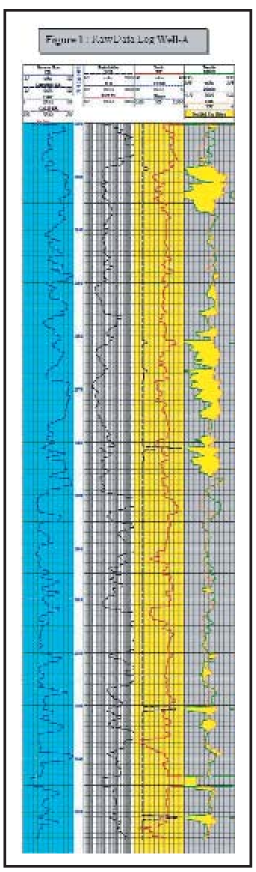
R.Baouche, Laboratory of the Earth Physical of University of Boumerdes, LABOPHYT, 2 Independent Avenue, Boumerdes, Algeria, r_baouche@yahoo.fr

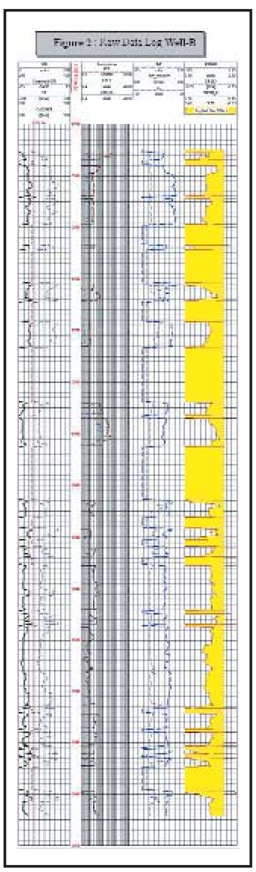
A.Nedjari, Department of Geology of Sedimentary basin, University of Houari Boumedienne,Bab Ezzouar,Algeria A.Nedjari@Caramail.com

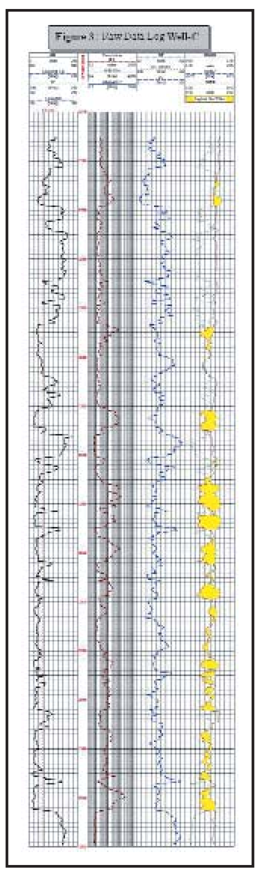
E. Said, Laboratory of the Earth Physical of University of Boumerdes, LABOPHYT, 2 Independent Avenue, Boumerdes, eladj_said@yahoo.fr

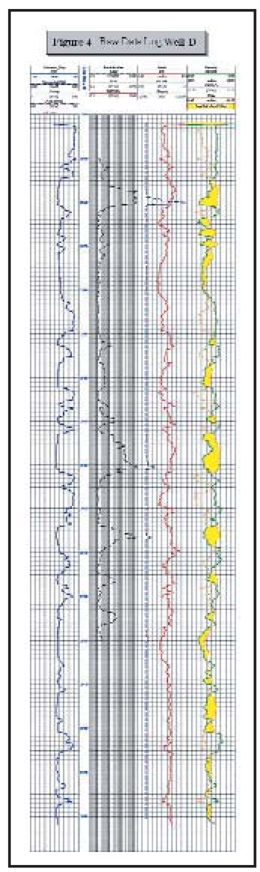
Abstract

Petrophysical evaluation of the Upper and Lower shaly gas sand reservoirs of the Sahara field, using conventional well log interpretation techniques and relating the results to core data, shows that the Upper reservoir is of very good quality and apparently better than the Lower reservoir. Evaluation of the petrophysical parameters from the wells in the field show porosities ranging from 12 to 20% and permeabilities of about 500 mD, which are similar to regional values of 12 to 20% porosity and 1000 mD permeability. A crossplot-based lithological study shows that the matrix is dominantly quartz, with calcitic and dolomitic cements, a high percentage of montmorillonite clays, and a smaller percentage of illite and micas. A study of lateral variations of petrophysical parameters shows that porosities increase from NE to SW, similar to the saturations. This study shows the role of wireline petrophysical analysis as a tool in reservoir characterization of shaly sands in the Sahara field. This paper examines the use of log analysis and mean petrophysical reservoir parameters as a tool in successfully establishing reservoir architecture and fluid-flow trends. Data from Gamma Ray, Neutron, Density, Sonic and Resistivity logs was utilized for petrophysical analysis to correlate layers in this reservoir characterization study. Petrophysical evaluation of the Shaly Sand gas reservoir (TAGS) of the Rhourde Hamra field, using conventional well log interpretation techniques and relating the results to core data, shows that the reservoir is of very good quality.









Figures 1 to 4: Well-A through D respectively

Continued on page 18…

Petrophysical Analysis in Reservoir Characterization … *continued from page 17*

The reservoir layers show a high net-to-gross ratio which makes it possible to perforate thick intervals. Maps based on petrophysical results show areas of good reservoir quality that can help guide future drilling.

Introduction

The Rhourde Hamra field is located about 220 km SE of Hassi Messaoud and about 30 km NNE of the Rhourde Nouss field. The field is found on the anticline horst of Rhourde-Nouss. It is bounded on the east by the Furrow of Flatters, on the west by another Furrow and on the north-east by the Berkin depression and on the south by Rhourde Nouss Field.

The field was discovered in the seismic campaigns during the 1950s and demonstrated by the M1 wells in the central Rhourde Nouss field. The first well in the Rhourde Hamra field was drilled in 1971, proving accumulations of gas and condensate in the Triassic reservoirs TAGS, TINT1 and TAGI.

Petroleum interest in the Rhourde Hamra field is found in the presence of two Triassic shale sand reservoirs: TAGI (Upper Triassic Shale Sand) and TAGS (Lower Triassic Shale Sand).

The TAGI reservoir is of intermediate quality, with porosity values generally varying from 5 to 15% with some isolated higher values. Permeability values are generally below 10 mD.

The uppermost Triassic TAGS reservoir consists of porous and permeable sands deposited in a fluvial environment. The reservoir represents the best quality reservoir of the region, with porosities typically between 15 and 20%. Permeabilities are bimodal, with a maximum recorded value of 1000 mD. A Silurian source rock is the origin for the oil and gas-condensate hydrocarbons present in the reservoir, and were generated during the Mesozoic period. The quantification of hydrocarbons generated in the potential kitchen suggests that the hydrocarbons currently discovered represent only 16% of the hydrocarbons generated in the region.

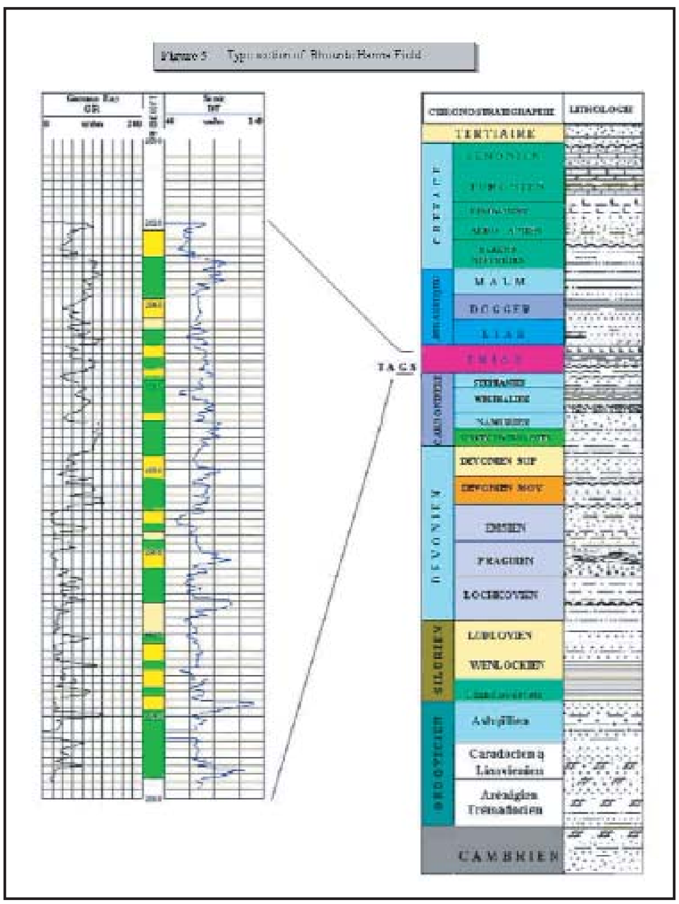


Figure 5: Type section of Rhourde Hamra

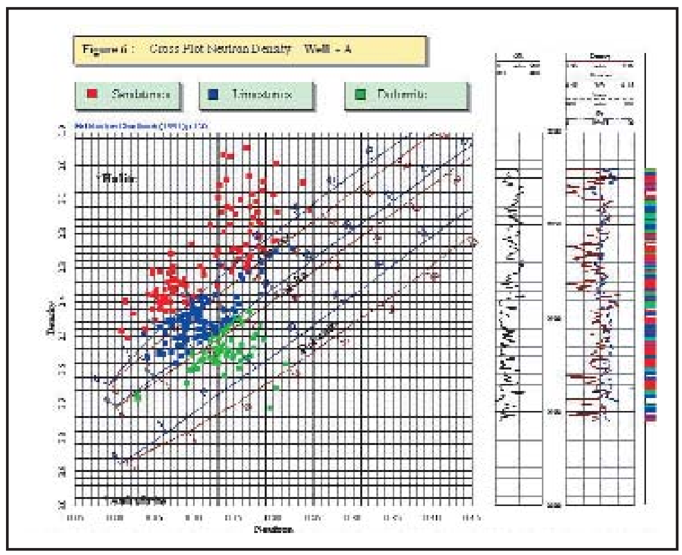


Figure 6: Density-neutron cross plot, Well-A

Continued on page 19…

Petrophysical Analysis in Reservoir Characterization … *continued from page 18*

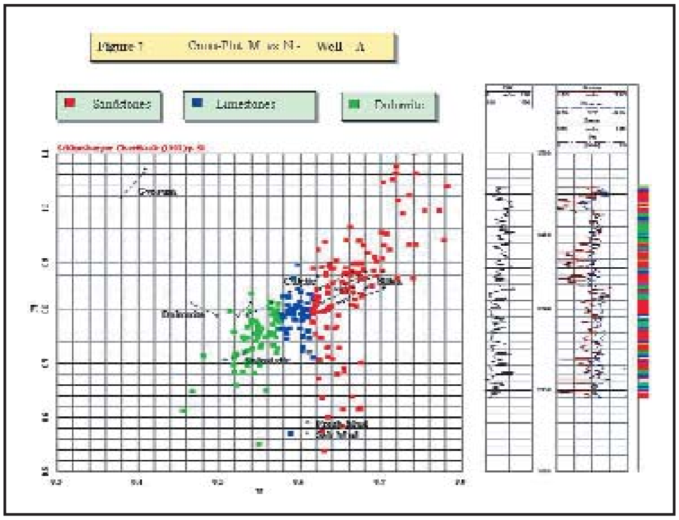


Figure 7: M-N cross plot, Well A (old fig 8)

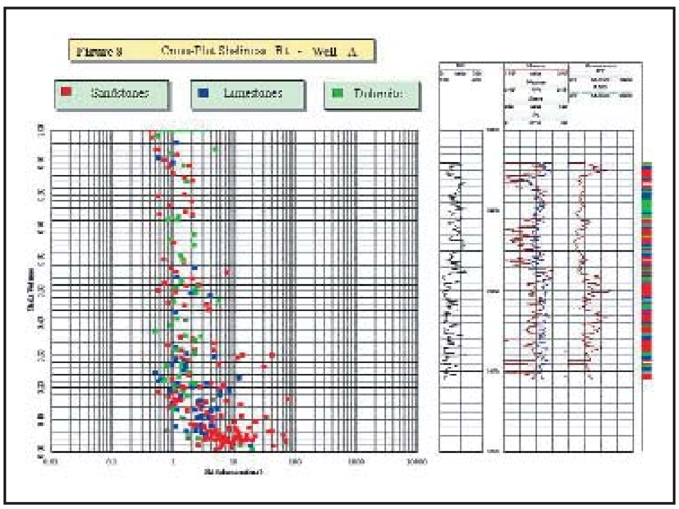


Figure 8: Shaliness vs. resistivity

The average gross thickness of the TAGS reservoir at Rhourde Hamra is 145 metres, with net sand thickness ranging from 45 to 50% of the gross thickness in any one area. The reservoir is composed of shale and sand sequences, being largely dominated by sands and gravels. The grain size ranges from medium to coarse, and often is large enough to be considered micro conglomeratic.

Largest grains are confined to the basal portions of the reservoir, with a general fining upwards trend occurring through the interval. Cements, where present, are comprised of iron-bearing clay, plus rare dolomite (at the base) and occasional anhydrite (near the top).

The TAGS reservoir can be divided into two units, the Basal Sand and Main Reservoir:

Basal Sand: A sand at the base of the TAGS, traceable over the entire Rhourde Hamra structure, with a thickness on the order of ten metres.

Main Reservoir: A 135 m thick unit above the Basal Sand divided into three sections, representing different depositional environments:

- A deposit at the base, characteristic of a high-energy braided stream environment, represented by good-quality reservoir with intercalations of shale banks difficult to correlate over the entire reservoir.
- A shale unit above this, traceable over the entire reservoir and has a thickness varying between 3 and 10 metres.
- A deposit above this, characteristic of a low-energy meander form.

Wells and Well Log Data

This study shows the results of the interpretation of newly recorded well logs in the field of the Upper Shale Sand reservoir from the following four wells:

Well	Top (m)	Base (m)
Well-A	2808	2958
Well-B	2913	3065
Well-C	2789	2912
Well-D	2842	3002

Wireline logs recorded in each of the above wells are: Cement Bond Log, Variable Density Log, Bore Hole Compensated Sonic, Casing Collar Locater, Litho-Density Tool, Compensated Neutron Log, Dual Lateral Log, Micro Spherically Focused Log, Spontaneous Potential, Array Imager Tool, and Corrected Gamma Ray. The raw data for the four wells are shown as Figures 1 through 4.

Continued on page 20…

Petrophysical Analysis in Reservoir Characterization *... continued from page 19*

Well Log Interpretation

Prior to interpreting the well log data, all logs are environmentally corrected. The interpretation steps are:

A. Shale Volume Calculations: the shale volume is the average of the value obtained from the following calculation methods:

1. VGR = $$\frac{(GR - GR_{min})}{(GR_{max}-GR_{min})} \quad (1)$$

2. VRT = $$\frac{[R_{sh}/R_t*(R_{lim}-R_t)]}{[(R_{lim}-R_{sh})]^{1/b}} \quad (2)$$

(using b = 0.5)

3. VDN from density-neutron cross plot

4. VSD from sonic-density cross plot

5. VSN from sonic-neutron cross plot

B. Porosity Calculations: Values for effective porosity are obtained using the following methods:

1. Φ_N from charts.

2. Wyllie time-average equation:

$$\Phi_s = \frac{(DT-DT_{ma})}{(DT_f - DT_{ma})} * \frac{1}{C_p} \quad (3)$$

3. Raymer-Hunt-Gardner equation:

$$\Phi_s = \frac{(1-DT_{ma})}{(DT)} * \frac{0.69}{C_p} \quad (4)$$

4. Overton formula = modified Wyllie where DT_f is a function of GR :

$$\Phi_d = \frac{(RHOB-RHOB_{ma})}{(RHO_f - RHO_{ma})} \quad (5)$$

5. Φ_{cp} = porosity from the density-neutron cross plot. Effective porosity is :

$$\Phi_e = (\Phi_t * (1-V_{cl}) \quad (6)$$

6. Timur equation :

$$K = \frac{(Phi)^a}{(S_w)^b} \quad (7)$$

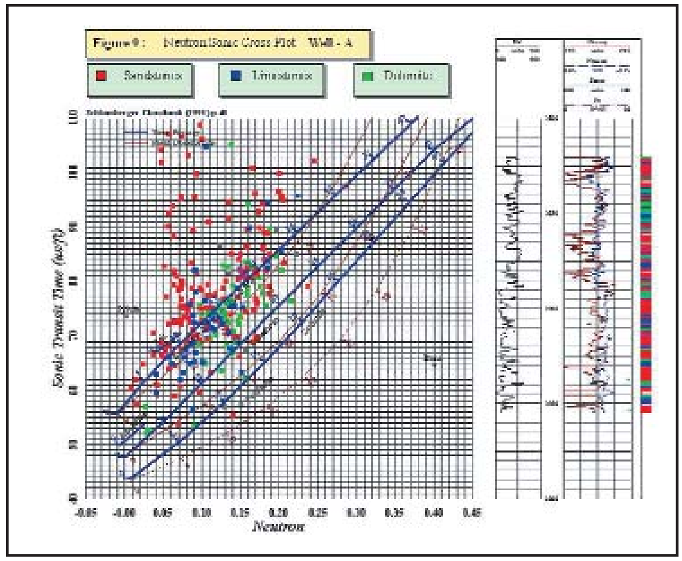


Figure 9: Neutron-sonic cross plot

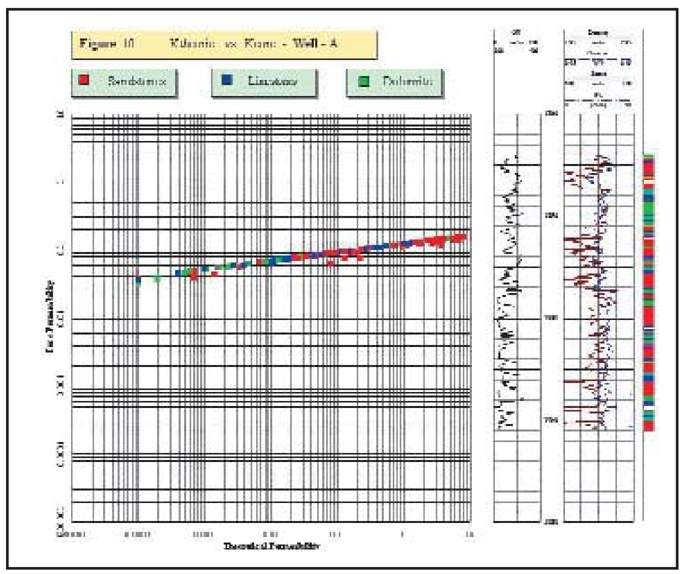


Figure 10: Theoretical perm vs. core perm

Continued on page 21...

Petrophysical Analysis in Reservoir Characterization *… continued from page 20*

C. Formation Water Saturation Calculations: Water saturation is computed from the **"Dual Water Model"** as below:

In the "Dual Water Model", In Shaly Formation we have two waters, therefore :

$$Ro = \frac{1}{\Phi_T} * \frac{(RwB + Rw)}{(\Phi B * Rw + \Phi * RWB)} \quad (8)$$

We can calculate the Water conductivity by using equation:

$$Co = \frac{1}{Fo} * \frac{\Phi_B * CWB + \Phi * CW}{\Phi_T} \quad (9)$$

With : $$\Phi_T = \Phi_B + \Phi \quad (10)$$

We can define: $$Fo = (\Phi_T)^{-} mo \quad (11)$$

With the presence of Hydrocarbon effect, we have:

$$Ct = \frac{(SwT)n}{Fo} * \frac{\Phi_B * CWB + \Phi_T * SwT * CW}{\Phi_B + \Phi_T * SwT} \quad (12)$$

And $$SwT = Sw * \frac{\Phi}{\Phi_T} \quad (13)$$

D. Hydrocarbon Corrections: an approximation of Neutron porosity is given by :

$$\Phi1 = \frac{[2 * \Phi_{NC} + 7 * \Phi_{DC}]}{9} \quad (14)$$

We can therefore deduce the water saturation Sw using the formula, as follow :

$$\frac{1}{(Rt)} = \left[\frac{Vcl}{(Rcl)^{1/2}} + \frac{(\Phi1)^{m/2}}{(aw * Rw)^{1/2}} \right] * (SwT)^{n/2} \quad (15)$$

Knowing: $$Shr = 1 - Sxo \text{ and} \quad (16)$$

$$\Phi1 = \Phi1 * (1 - 0.1\ Shr) \quad (17)$$

The flow diagram for the petrophysical interpretation is shown in Figure 5.

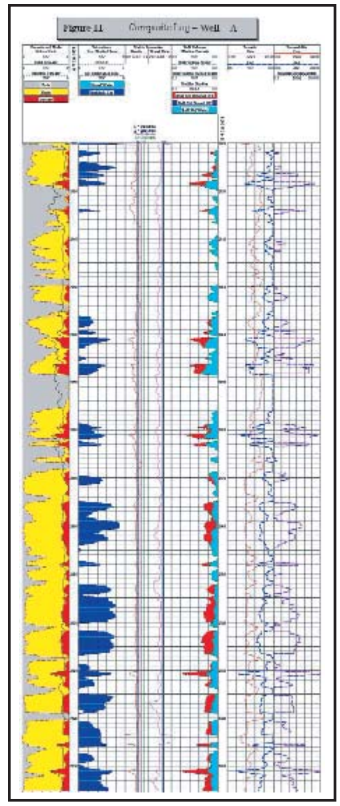


Figure 11: Well-A composite log

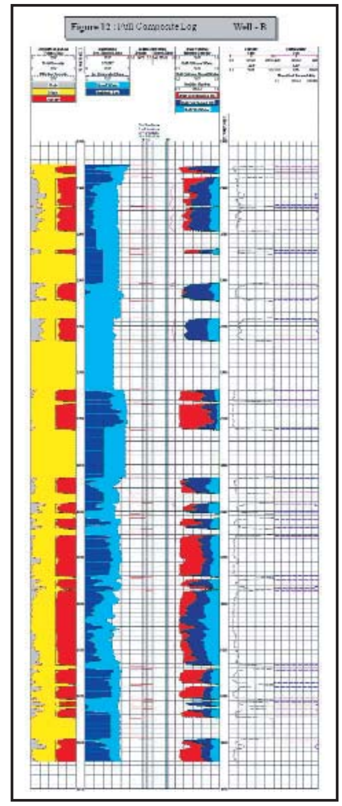


Figure 12: Well-B composite log

Petrophysical Results

The Neutron-Density cross plot (Figure 6) and MN plot (Figure 7) from Well-A show that the lithology essentially consists of sandstone in the interval from 2820 to 2875 m and of dolomite limestone in the interval 2875 to 2900 m. The clay mineral fraction consists of a high percentage of montmorillonite and a small percentage of illite and of micas. The relation between shaliness and the resistivity (Figure 8) shows that the resistivity does not vary with the volume of clay, showing a uniform sedimentological model. The neutron-sonic cross plot (Figure 9) thus shows a lithology of essentially sandy limestone. According to the neutron-density cross plot (Figure 5), the porosities are of medium values, ranging from 10 to 25% with a cutoff on the order of 8%. The agreement between log-calculated permeability and core permeability is very good, as shown in Figure 10. Permeability values range from 0.2 to 1,000 mD. The results of the log interpretation for Well-A and Well-B are shown as composite logs (Figures 11 and 12 respectively). These figures show that porosities calculated from the log are in good agreement with the core porosities.

Continued on page 22…

Petrophysical Analysis in Reservoir Characterization *… continued from page 21*

The calculated values of water saturation are in accord with the results of the wells. Low water saturation is calculated where the neutron-density separation suggests the existence of gas. The saturation values with a cutoff of 55% also show the existence of a gas-water contact in well-B, with gas down to 2993 m and water up to 3003 m.

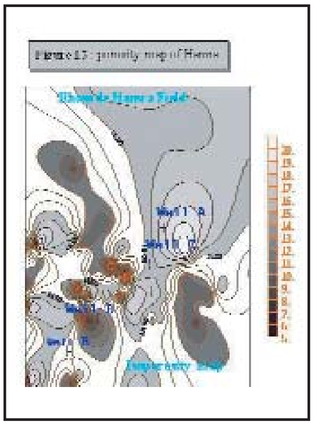


Figure 13: Porosity map

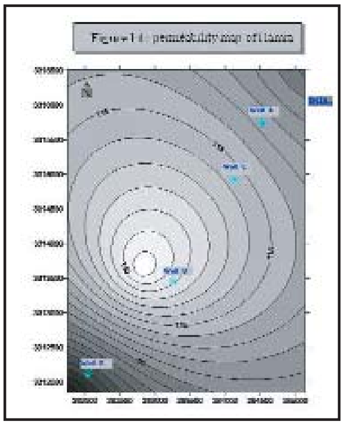


Figure 14: Permeability map

Reservoir Implications

Porosity: According to the cross-plots discussed above, the porosities vary from 10 to 25% with an 8% porosity cutoff applied.

Water saturation: The logs of Sw (Figures 11 and 12) show the existence of zones of interest, with a cutoff on the order of 55%.

Permeability: Log permeability agrees well with core permeability in Well-A, as shown in Figure 10. The permeability equation deduced from *Core porosity vs Log porosity* cross plot relationship and the permeability plot versus $((Phi)^a / (Swirr)^b)$ based on Timur equation is as follows:

$$K=52652 * (Phi)^{5.12} * (Swirr)^{1.132}.$$

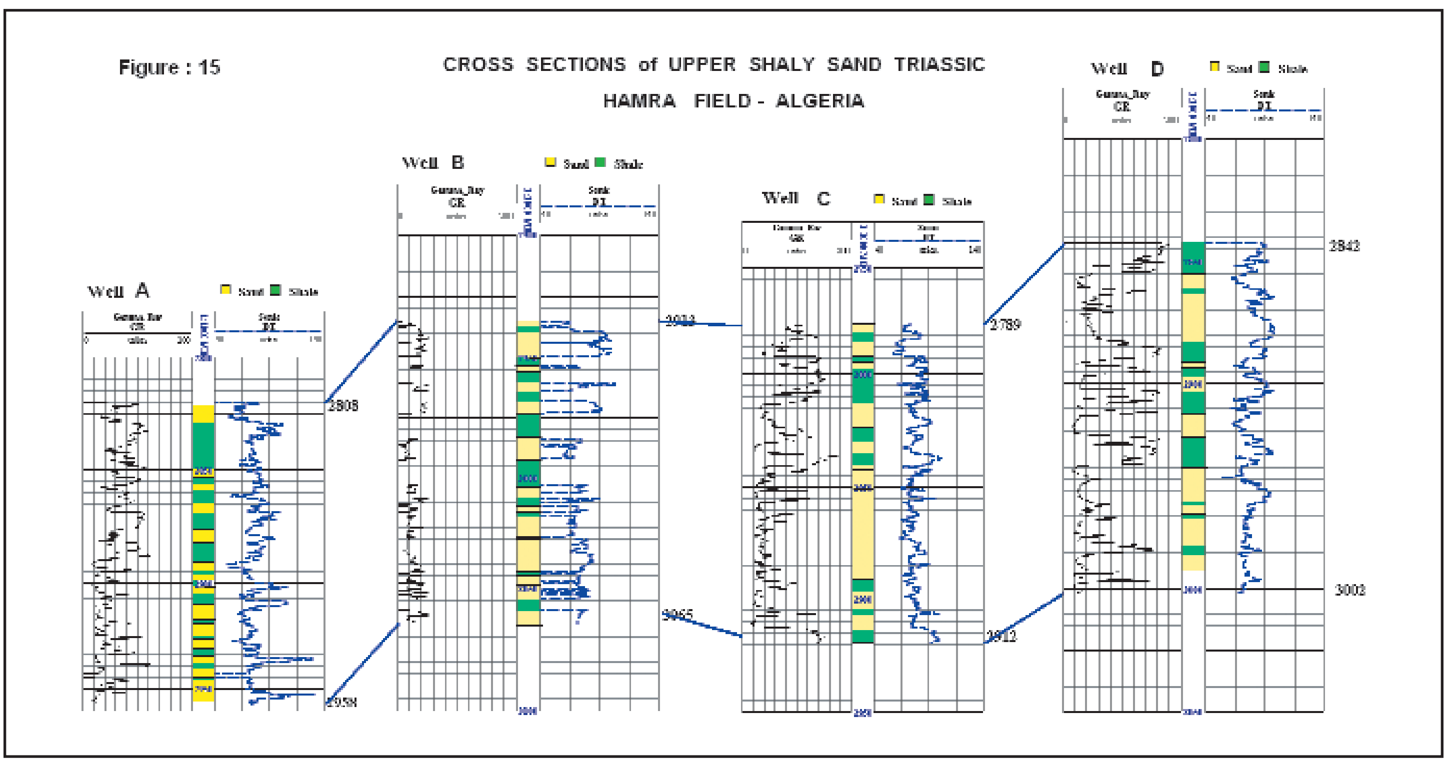


Figure 15: Cross-section

Continued on page 23…

Petrophysical Analysis in Reservoir Characterization … *continued from page 21*

Fluid contacts: based on the responses of the logs, notably the neutron-density, a gas-water contact is visible in well RHA-5, with gas down to 2993 m and water up to 3003 m. In well RHA-4 the gas-water contact is estimated at 2990 m (from Data Production).

Lateral variations of porosity and permeability: As shown in the porosity (fig 13) and permeability (fig 14) maps, the porosity and permeability generally increase from SW to NE.

Cross section of the Rhourde Hamra wells: The cross section in the TAGS reservoir at Rhourde Hamra (Figure 15) shows a lateral increase of reservoir thickness and improvement of reservoir quality from NE to SW, all with a good permeability.

The contour maps of petrophysical parameters (Figures 13 and 14) can be used to select locations of future wells.

Conclusions

Interpretation of the wells in the Rhourde Hamra field allows the estimation of reservoir parameters. The upper reservoir (TAGS) has very good reservoir properties, as shown by the Theoretical permeability vs. core permeability cross plot (Figure 10). Porosity values range from 12 to 20%, similar to other fields in the region. Permeability values average approximately 500 mD, which are comparable to the 1000 mD regional values. A study of the variations of petrophysical parameters made it possible to select future well locations.

The gas-water contacts found in wells Well-B and Well-D are in the range of the regional contact found by production tests: -2600 m sub sea. It should be noted that the Rhourde Hamra Field has very similar petrophysical characteristics to the nearby Rhourde Nouss Central field.

Continued on page 24…

Petrophysical Analysis in Reservoir Characterization … *continued from page 23*

Acknowledgments

The author would like to thank Digital Formation USA, Denver Colorado, Log Evaluation System Analysis for their help in providing the support software and critique of this study, Professor Mike Lovell of the London Petrophysical Society (LPS) for publishing this study, various SPWLA members for their help preparing this work for publication, and finally, Dr Eric Pasternack for translating this work from French.

References

Aitouche Moh-Amokrane (2003), Characterization of a Reservoir in a South Algerian Prospecting Using The Instantaneous Seismic Attributes: Efficiency And Reliability of The Instantaneous Frequency Parameter Using The Joint Time-Frequency Analysis.Boumerdes, Algeria.

Ait Ouali R., Nedjaria., The Saharian Triassic Province. 20 years of géological informations : bilan critique et réflexions. *Bulletin du Service Géologique de l'Algérie, 7 (2) (1996) 211-228.*

Nedjari A., Images and final refinements hercynians of Maghreb West (Algeria, Morocco) [Last Hercynian pictures and events in the West Maghreb (Algeria, Morocco]. *In : Dercourt J., Tefiani M. et Vila J.M. (eds.), 1994, Trias'93, Memoriam of Geological Service of Algeria, n° 6, pp. 13–40.*

Beicip: (1991): Evaluation of shaly Sand Reservoirs in the Sahara Field .Algéria.

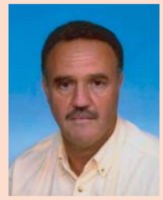
Delfiner, P., Peyret, O. et Serra, O., 1984. Automatic determination of Lithology from Well Logs. 59th Ann. Techn. Conf. SPE of Amie. Houston, Texas, Paper N° SPE 13290.

DigitalFormation (2001), Log Evaluation System Analysis (LESA).Denver Colorado, USA.

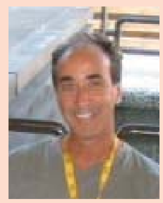
Martin, W. et Pellissier-Combescur. J., 1982. Détermination automatique des éléctrofaciès. Schlumberger. Paris

Serra, O., Delfiner, P. et Levert, J.C., 1985. Lithology determination from Well Logs. Case Studies, in 26 Annual Logging symposium transactions, paper ww. Society of professional Well Log Analysis, 19p. Houston.

About the Authors



Rafik Baouche received a Master's degree in Geophysical Applications from the University of Boumerdes in 1994, where he had worked as a Log Analyst in the Geophysical Department from 1980. From 1998 through to 2006 has been a member of the Laboratory of the Physical Earth (LABOPHYT).



Nedjari Ahmed received his Doctorate 3° cycle from the University of Paris (South), in 1980 and a Doctorate of Earth Sciences from the University of Algiers and University of Pau, France in 1991. He is currently a professor and director of the Laboratory of Geodynamics of Sedimentary Basins in the Faculty of Earth Sciences at USTHB BP 32 El Alia Bab Ezzouar, Algiers. Also, he is a reviewer of the Earth Sciences Bulletin of Geology In Algeria. From 1995 to 1996 he was a consultant at SONATRACH. nedjaria@gmail.com

Eladj Said received his Doctorate 3° cycle from the University of Moscow (Russia), in 1988 where he had worked as a Log Analyst in the Geophysical Department. From 1998 through to 2006 Eladj has been a member of the Laboratory of the Physical Earth (LABOPHYT).

Announcement – Talk is No Longer Cheap

Local talent has been under represented at our monthly technical luncheons. So, in addition to the usual President's Award for the year's best technical luncheon presentation there will be a new Vice-President's Award. This award, in the amount of $500, will be for the best luncheon talk by a Canadian-based speaker who is from an oil company or from a university or college.

Anyone who is considering presenting at a luncheon or who has a suggestion for an interesting topic should contact Ken Faurschou at (403) 509-4073 or faurschouk@slb.com.

APEGGA MEMBERS:
CWLS Luncheons and courses qualify for APEGGA Professional Development Hours.

CANADIAN WELL LOGGING SOCIETY

2200, 700 – 2nd Street S.W., Calgary, Alberta T2P 2W1
Telephone: (403) 269-9366
Fax: (403) 269-2787
www.cwls.org

Wednesday, March 15th, 2006
CWLS TECHNICAL LUNCHEON PRESENTATION
FAIRMONT PALLISER HOTEL
133, 9TH AVE. S.W. CALGARY

TIME: 12:00 PM (COCKTAILS AT 11:30 AM)
RESERVATIONS BY: Friday March 11th, 2006 (NOON) - CALL 269-9366 TO CONFIRM A SEAT

COST: MEMBERS RESERVED MEAL: $30.00; NON-MEMBERS RESERVED MEAL: $35.00
(SPECIAL NEEDS MEALS AVAILABLE WITH ADVANCED BOOKING ONLY)

TOPIC: **OPTIMAL HORIZONTAL WELL PLACEMENT USING DIRECTIONAL, DEEP LWD RESISTIVITY DEVICE**

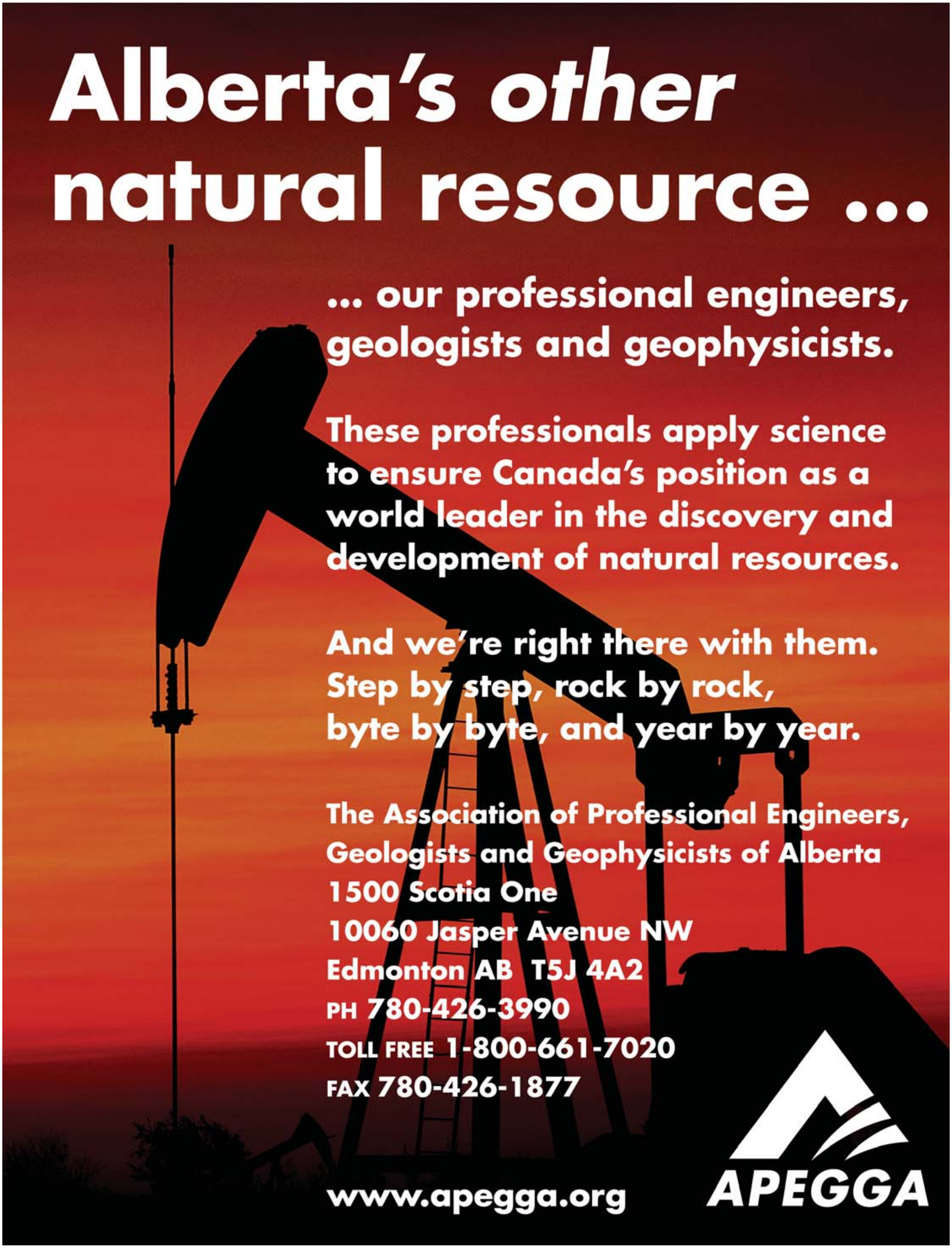
SPEAKER: Satyaki Ray – Schlumberger Data and Consulting Services

ABSTRACT:
Conventional LWD (logging while drilling) measurements are generally too shallow to identify approaching bed or fluid boundaries "in time" to prevent exit from the zone of interest in a reservoir. The challenge is compounded when the lack of directional reference to these boundaries leaves the geosteering team guessing as to whether the response on a real time log is a result of lithology / fluids above, below or to the side of the horizontal wellbore. A shallow depth of investigation while drilling often leads to less than optimal well placement given that decisions are typically made after the fact when the wellbore exits the zone of interest. This kind of reactive geosteering results in sub-optimal productive capacity, tortuous well paths, premature well drilling abandonment and difficult well completions. Schlumberger's PeriScope15* provides directional, deep resistivity imaging and this drilling technology addresses all of the above mentioned concerns. Using electromagnetic measurements for geosteering the device can detect bed boundaries and fluid contacts up to 15 feet (4.5m) away from the well bore. In addition, PeriScope can determine the direction in which those contacts / boundaries lie relative to the wellbore. As the tool approaches conductive shale bed the polarity of the directional phase shift and attenuation signal can be used to indicate the position of the bed relative to the tool. In this manner the geoscientists, directional drilling team and E&P operators can take proactive decisions to optimize horizontal / deviated wellbore placement in "real time" thereby realizing payoffs such as increased length in reservoir "sweet spots", fewer sidetracks and reduced exposure to wellbore stability problems. The applications of this novel technology are in Heavy oil, horizontal SAGD and CSS well drilling, horizontal CBM wells and conventional horizontal wells in geologically complex terrains.

BIOGRAPHY:

Satyaki Ray, P. Geol, works as a Senior Geologist / Well Placement coordinator for a joint team of Schlumberger Drilling & Measurements (D&M) and Data and Consulting Services (DCS) segments in Calgary, Alberta, Canada. He has 16 years industry experience, with 8 years in oil and gas E&P Operations and 8 years with Schlumberger Oilfield Services (conventional, Heavy oil and Coal Bed Methane analysis). Author of several international papers, Satyaki specializes in horizontal well placement, real time geosteering, LWD interpretation, Geological Modeling, fracture, structure and sedimentary analysis of rocks using outcrops, borehole FMI / OBMI images and advanced well log data. He is a professional geologist with APEGGA and is also active in geoscience consulting for conventional and unconventional reservoirs of Canada and worldwide. He earned an MS degree in Applied Geology from the Indian Institute of Technology in Roorkee, India with a First Class Gold Medal and a Master of Technology degree in Geo-exploration (Geostatistics) from the Indian Institute of Technology in Bombay

Notes: Please forward this notice to any potentially interested co-workers. Thank you.


Alberta's other natural resource ...
... our professional engineers, geologists and geophysicists.
These professionals apply science to ensure Canada's position as a world leader in the discovery and development of natural resources.
And we're right there with them. Step by step, rock by rock, byte by byte, and year by year.
The Association of Professional Engineers, Geologists and Geophysicists of Alberta
1500 Scotia One
10060 Jasper Avenue NW
Edmonton AB T5J 4A2
PH 780-426-3990
TOLL FREE 1-800-661-7020
FAX 780-426-1877
www.apegga.org
APEGGA

CWLS GENERAL INFORMATION

INCORPORATED – January 21, 1957

Objective

The objective of The Society (as stated in the Letter of Incorporation) is the furtherance of the science of well log interpretation, by:

(A) Providing regular meetings with discussion of subjects relating thereto; and

(B) Encouraging research and study with respect thereto.

MEMBERSHIP

Active membership is open to those within the oil and gas industries whose work is primarily well log interpretation or those who have a genuine interest in formation evaluation and wish to increase their knowledge of logging methods.

FEES

The CWLS fiscal year commences February 1, and all fees are due at this time.

Initiation Fee (including first year's membership fees) : $40.00
Annual Dues : $30.00
Student (no initiation fee) : $10.00

Memberships not renewed on or before June 30 of each year will be dropped from the roster and reinstatement of such a membership will only be made by re-application, which will require re-payment of the initiation fee plus the annual dues. All dues (Canadian Funds) should be submitted with the application or renewal of membership (Cheque, money order MasterCard, AMEX or Visa).

ACTIVITIES

The Society also furthers its objectives by sponsoring symposiums and exhibits.

Research committees encourage and support research on relevant problems.

The Society is the spokesman to industry and government on topics pertaining to well logging and formation evaluation.

The Society holds a monthly luncheon meeting (except July / August) to hear an address on a relevant topic.

Each active member will automatically receive the CWLS Journal, 'InSite' newsletter and Annual Report.

APPLICATION

Should our activities interest you we invite you to complete the attached application form and forward it to the CWLS membership Chair.

CWLS MEMBERSHIP APPLICATION FORM

To apply for membership to the CWLS, please complete this application form in detail.

NAME:..

COMPANY:...

COMPANY
ADDRESS:..

....

HOME
ADDRESS:...

....

E-MAIL ADDRESS:..

PREFERRED MAILING ADDRESS:

E-MAIL____ OFFICE____ HOME____

BUSINESS
PHONE:..

RESIDENCE
PHONE:..

PROFESSIONAL
DISCIPLINE:...

....

SIGNATURE:..

DATE:... , 20 ....

CWLS SPONSORS: (Members in good standing)

Name: ....

Phone:..

Name: ....

Phone:..

FEES

Please enclose initiation fees (Cheque, money order, MasterCard, AMEX or Visa) with the application of membership and mail to:

Membership Chairman
The Canadian Well Logging Society
2200, 700 – 2nd Street S.W.
Calgary, Alberta T2P 2W1
Canada

Tech Corner: Determining Coal Thickness from Commonly Available Well Logs

Fred Hyland, B.Sc. P.Geol.

Fred graduated from the University of Calgary with a Bachelors of Science in Geology. During previous employment with a CBM service company, Fred performed desorption contracts in Canada, USA and Argentina. His current goal is to broaden his understanding of unconventional reservoirs.

Abstract

Recent successful exploitation of coalbed methane resources in the Western Canadian Sedimentary Basin has lead to a renewed interest in interpreting coal data from existing well logs. This article is intended as a brief review of the fundamentals of estimating coal thickness from generally available logs. It is directed at the Geologist that has a renewed interest in coal due to the recent explosion in CBM development in Western Canada. The rapidly evolving field of modeling coal gas reservoirs by the integration of core data and log data is left for exploration by better informed authors.

When using older logs care must be exercised in estimating coal thickness, particularly in coal stratigraphy that is composed of a large number of thin coal beds occurring in vertical succession. In these instances, analysts must ensure that coal thickness estimates are accurate as such errors may lead to misrepresentation of actual reservoir thicknesses to an unacceptable degree.

Coal reservoirs composed of a small number of thick coal seams are less prone to significant coal thickness estimation errors, as these thickness errors tend to be small in relation to the seam's actual thickness. As a result, these errors tend not to be catastrophic. Additionally, if present, this error iterates over a small number of seams leading to a tolerable error in relation to actual coal seam thickness.

Recent successful exploitation of coalbed methane resources in the Western Canadian Sedimentary Basin has lead to a renewed interest in interpreting coal data from existing openhole well logs. These reservoirs are now being considered as potential targets by a broad range of operators, many of whom are making their first attempt to exploit this new, unconventional gas reservoir. With this in mind, a brief review of the value and pitfalls of estimating coal thickness from commonly available log data is warranted.

It is not the intent of this paper to reflect the current state of the art of the petrophysical evaluation of coalbed methane reservoirs. This is a rapidly evolving and complicated subject best left to future discussions and papers. This paper is intended solely as a review of the value of the readily available "workhorse" logs in determining coal thickness. These logs are familiar to Petroleum Geologists and are readily available for most wells off-setting coalbed methane prospects.

It is worthwhile to acknowledge that historical log data has been collected across the Western Canadian Sedimentary Basin with the intention of evaluating conventional reservoirs. Logging suites were selected based on their value in the evaluation of conventional reservoirs, with little importance being placed on the evaluation of potential coal or shale reservoirs. The coal industry has long recognized that logging boreholes for the purpose of assessing coal requires particular attention. The coal industry when possible has used high resolution logging tools and slow logging trip speeds to ensure the collection of more accurate coal data.

As a result, care must be exercised when utilizing petroleum industry logs to evaluate the true thickness of coal reservoirs. As with other lithologies, log curves require the adjustment of the apparent log thickness in order to accurately reflect the true thickness of coal in a given seam. Most historical geophysical logs have insufficient vertical resolution to accurately determine the true coal bed boundaries without minor adjustments. As a result, coals will tend to have an exaggerated thickness on the majority log curves. Failure to properly make the adjustments required to compensate for this may lead to significant error in the estimation of coal thicknesses, and therefore the reservoir itself, and the associated reserves.

The error incurred in failing to adequately estimate coal thickness may be relatively insignificant in the assessment of thick coals. With thick coals, such as those of the Mannville or Mist Mountain formations, the potential for significant thickness estimation error is small. Inaccuracy in estimation of coal thickness is typically trivial relative to the actual seam thickness.

In this case, if coal thickness is improperly estimated the exaggerated coal thickness on the log is small in percentage terms relative to the actual coal thickness. Even if this small error is repeated on each seam the relatively small number of seams

Continued on page 29…

Tech Corner *… continued from page 28*

leads to a limited number of iterations of this error. In this instance failure to make the appropriate thickness adjustments, while important, is unlikely to grossly misrepresent a prospect.

Conversely, thin stacked coals like those of the Edmonton Group are comparatively sensitive to errors from exaggerated estimation of coal seam thickness. Log response to thin coals leads to exaggerated thickness that is potentially sizeable in percentage terms on each seam. As a result, the failure to properly adjust the apparent log thickness to an accurate coal thickness in thin coals potentially leads to a substantial error on a seam by seam basis. This error, significant in itself, becomes intolerable when the cumulative thickness error within a given well is considered.

Since this error is cumulative, adding with each successive seam, the iteration of this error across a high number of seams leads to a grossly exaggerated estimation of net coal within a given well. Therefore, the potential for cumulative thickness error in the Edmonton Group may lead to a serious misrepresentation of net coal thickness, potentially yielding misleading economic calculations for these wells.

The gamma ray, neutron density, bulk density, sonic and caliper logs are the stalwart logs of coal identification and seam thickness determination. Typically, gamma and density logs are sufficient to determine seam thickness in an in-gauge borehole. With the caliper log being required only in the case where the borehole is sufficiently caved as to cast doubt on the accuracy of the density readings. Fortunately, these logs are commonly available for wells drilled by the petroleum industry. Other less available logs of considerable utility are the resistivity-based micro-imager tools and microlog tools.

Several other log types are used to assess coal reservoirs. Logs such as Elemental Capture Spectroscopy, and Photo-Electrical Effect logs have coal reservoir modeling applications. Since the utility of these logs is not assessing coal thickness and they are not commonly available they are not discussed. Table 1 summarizes some of the available logs and there potential value.

Table 1. Available Logs

Log Type	Comments
Gamma Ray Log	• Differing thickness adjustment required for thick and thin seams • May be used in a cased well
Neutron Density Log	• High resolution logs preferred • May be used in cased wells
Caliper Log	• Quality assurance for density data
Bulk Density Log	• May lead to exaggerated coal thickness estimate or missed seams with historical petroleum industry curve presentation
Resistivity Logs	• Micrlog offers high degree of accuracy determining thickness
Sonic Logs	• Used in coal identification not generally used to assess thickness • Useful in cased wells
Resistivity-based micro-imager tool	• High degree of accuracy determining thickness • Rarely available
Photo-Electric Effect	• May be useful for coal identification • Not a robust indicator of thickness

Continued on page 30…

Tech Corner *… continued from page 29*

Gamma Log

The organic fraction of coal emits little or no radiation. Rarely, this organic fraction may absorb radioactive material. Generally, constituents of the ash fraction of a coal, primarily clays, emit radiation. As a result, pure coals have a clean gamma signature. In instances where the coal is surrounded by lithologies that provide considerable gamma contrast, such as mudstones or clays, properly adjusted gamma ray curves are extremely useful in delineating seam thickness.

One notable strength of this log is that it is relatively immune to the effects of caving, making it a useful log in the presence of a caved borehole. Since the tool will read a considerable distance into the formation the data it acquires is robust even in the presence of substantial caving. This tool is relatively insensitive to it surroundings and is even useful in delineating coal located behind casing.

The main short coming of this log is the tools rather poor vertical resolution, often 50 centimetres. This has earned the gamma ray log a reputation as a "lazy" log due to its' slow response to lithological boundaries. This requires that differing thickness adjustments be made based on the apparent thickness indicated by the gamma curve in order to obtain the correct seam thickness. The recommended adjustments to obtain the true seam thickness differ based on the apparent log thickness indicated by the gamma curve.

When the gamma log indicates a coal seam with an apparent thickness greater than one metre the seam boundaries are drawn one-third of the distance from the first deflection from the overlying and underlying lithologies. While this will yield an accurate seam thickness for coal of one metre or greater, be forewarned, this method will often significantly over estimate the thickness of a coal seam less than 1 metre in thickness. Figure 1 illustrates correct points on the gamma curve to calculate the thickness of a seam of greater than one metre in thickness.

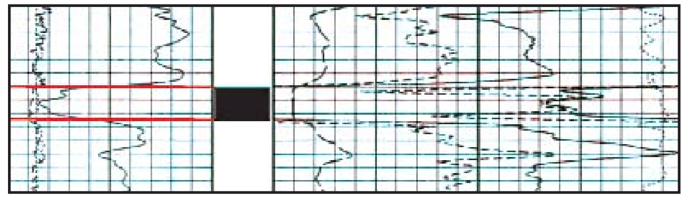


Figure 1: On coal seams greater than one meter in thickness the bed boundaries are drawn 1/3 the distance from the gamma deflection. This will generally give a thickness that closely agrees with the density log.

Coals with a log thickness of less than one metre require a subtle alteration in this technique to be taken to avoid overestimating the actual seam thickness. In order to compensate for the vertical resolution of the gamma tool, and the sloped nature of the log curve, the seam boundaries are drawn father from the point of first deflection of the gamma curve. To accurately reflect the seam thickness, a point two-thirds of the distance from the first deflection from the overlying or underlying lithologies is selected to define the coal bed boundary.

This will lead to an estimated thickness that is noticeably less than that obtained using the first method described above. While the distinction may seem trivial, the importance of making this distinction cannot be over emphasized. As described earlier, failing to make this adjustment on thin coal seams will lead to a large thickness calculation error in percentage terms, increasing accretively with the greater number of thin seams

Continued on page 31…

Tech Corner *… continued from page 30*

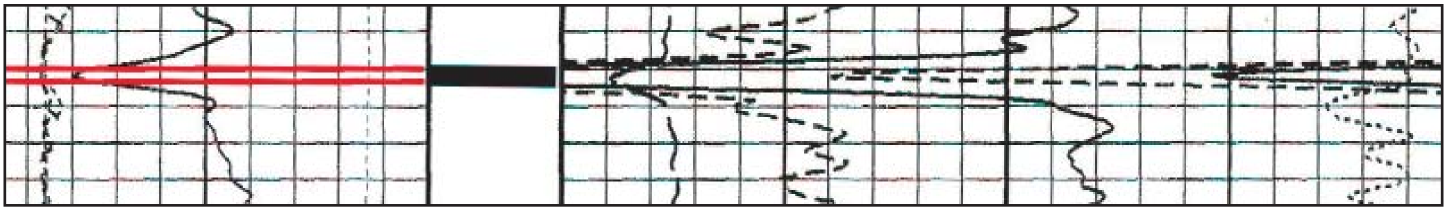


Figure 2: On coal seams which are one meter or less in thickness the bed boundaries are drawn 2/3 the distance from the gamma deflection. This method will give a seam thickness less than the previous method.

observed. The magnitude of this error has the potential to influence many mapping and reservoir engineering calculations. Figure 2 demonstrates the appropriate point on the gamma curve to obtain the correct seam thickness for thin seams.

Finally, it goes without saying that the gamma log will not yield useful thickness data in the absence of gamma contrast with adjacent or interbedded lithologies. As a result, coals neighbouring lithologies such as clean sandstones will require reference to additional log curves, such as the density curves in order to determine a coal seam's thickness.

Density Logs

For in-gauge boreholes, the density logs are the most practical log for determining coal thickness. The density of the organic fraction or macerals of the coal provide a stark property contrast to most other lithologies. With this in mind, a quick scan of gamma and density curves in a wellbore that is relatively free of cavings will provide an immediate sense as to the presence and thickness of coals present.

The standard presentation of bulk density logs within the petroleum industry makes it difficult to correctly estimate the thickness of most coal seams. The vertical and horizontal scales of these logs, and thickness of the line used to plot the curve, makes it difficult if not impossible, to estimate the true thickness of thin coal horizons. In such presentations, the thickness of the curve line may be thicker than a thin coal seam itself, making it difficult to accurately estimate the thickness of a coal seam from most printed or raster logs available in the oil and gas industry.

Alternately, if bulk density LAS files and appropriate software are available, this data is a potentially reliable source of information for the estimation of coal seam thickness. When acquired with high resolution tools, and properly drafted, the portion of the log curve with a density less than 1.75 g/cc should reflect the thickness of the clean coal within any given seam. Frequently, an analyst will have to adjust his cut-off to compensate for thin coal seams. These seams are often not well resolved due to the logging tools tendency to average the coal seams density values with those of more dense adjacent beds. The adjusted density cut-off will typically lie between 1.6 and 1.75 g/cc.

In frontier exploration areas Geologists may refer to logs generated for the purpose of coal exploration. These bulk density logs, like the gamma ray log, require adjustment of curve data for the estimation of the actual lithology boundary to compensate for the tools' lack of vertical resolution. The coal seam boundary is determined by selecting the mid-point bulk density value, the inflection point, on the density curve. Thickness determined by this method should provide close agreement with thickness obtained utilizing gamma ray log data from coal industry logs.

Oilfield density logging tools have been through several generations of innovation. Newer logging tools acquire data at higher resolution than comparable vintage tools. Therefore, it is worthwhile to determine the resolution at which density data was acquired when attempting to determine coal thickness from older logs particularly on thin coal seams. For the purpose of estimating true coal thickness, the quality of density data obtained improves markedly when acquired with high resolution tools.

As in any well, the density data quality is dependent on direct tool contact with the borehole wall for accurate data acquisition. In instances where significant caving prevents this contact, density data will reflect an average of the density of borehole fluids and the formation bulk density. This situation has the potential to mimic the log response of coal. These erroneous density readings are a potential source of overestimation of coal thickness. For this reason, density data must not be relied on without confirmation of an in-gauge wellbore from caliper log data.

Continued on page 32…

Tech Corner *… continued from page 31*

Since, in the petroleum industry, density porosity logs are seldom available without neutron logs, analysts are urged to select the neutron density log to assess the coal seam boundaries.

Finally, with respect to density data, coal thickness and reservoir thickness may not be identical. Defining the amount of coal in a well is an arbitrary process. An unconventional reservoir may extend well beyond the arbitrary 1.75 g/cc density cut-off defining coal. Adjacent organic lithologies with higher densities may contribute significantly to gas production. In these cases, care must be taken to properly delineate reservoir boundaries using appropriate density cut-offs for the reservoir.

Neutron Logs

In the coal industry, the neutron log has a reputation for being unreliable for the determination of coal bed boundaries. Ironically, it is this log that is most commonly used for this purpose in the oil and gas industry. The thickness of a coal seam is defined by the portion of the curve displaying an apparent porosity greater than a 60 percent on the neutron porosity logs, regardless of the scale the log is presented on.

On oil and gas logs, the presentation of neutron porosity data is chosen for the purpose of assessing the porosity of conventional clastic reservoirs. The "wrapping" of data on these scales leads to a chaotic presentation of this curve across coal seams. On these logs the slope of this data curve is relatively flat and the data is "wrapped" regardless of the chosen matrix. Determining coal thickness with this log becomes a practical matter.

Continued on page 33…

Tech Corner *... continued from page 28*

Choosing the 60 percent porosity cut-off on a neutron log presented is a simple matter. Regardless of the scale of the log presentation, the thickness of a given coal seam will be approximated by the portion of the neutron curve that lies beyond the 60 percent cut off. The commonly selected log scale of 0 to 60 porosity units is the most convenient presentation for determining coal thickness. When this log scale is chosen the coal thickness is approximated by the width of the first data "wrap".

Again, thin seams will require special consideration. Thin coal stringers may not reach an apparent porosity of 60 porosity units on the neutron log. This is again a function of the tool's vertical resolution and the tool's tendency to average adjacent values. Often these thin stringers will be present on well logs as a horizon with neutron curve values greater than 45 porosity units opposite a small gamma peak. In these instances, the gamma curve method for thin seam should be employed to determine the thickness of these stringers.

Modern data provided in LAS format can greatly improve the presentation of this data. The scale of the display software can be chosen so that the maximum value of the scale is selected as 60 percent. Similar to the above method the coal thickness is approximated by the thickness of the curve lying beyond this value.

The utility of this log also extends to cased hole applications. Neutron, sonic and gamma tools may be run in cased holes to provide sufficient information identify coal and to determine coal thickness. This allows the opportunity to evaluate unconventional reservoirs in existing wells.

Caliper Logs

The caliper log provides an important quality assurance mechanism for validation of the bulk density data. Borehole caving is a common source of density data error. The caliper log provides some reassurance that density data is valid when it indicates an in-gauge borehole. Alternatively, it provides a clear indication to be wary of density data in the event of substantial caving.

Due to the way the caliper functions it will often provide a clear indication of the depth of the top of a caved section. Since the caliper will close rapidly on re-entering the in-gauge section of the borehole the caliper log will display a relatively abrupt change in wellbore diameter. Alternatively, the caliper will provide the approximate bottom of a caved section due to the tendency for the caliper arms to open slowly on entering the caved section. This will create the appearance of a sloping borehole diameter poorly defining the bottom of the caved section.

In extensively caved boreholes the caliper log, gamma ray log, rate of penetration and drill cuttings may be the only evidence of a coal seam that has caved during drilling of a coalbed methane well.

Resistivity Logs

Two resistivity based logs provide excellent thickness data. Due to their exceptional vertical resolution, and slow logging trip speeds, resistivity-based micro-imager tools and microlog tools yield excellent thickness data. The log thickness from these data requires little or no adjustment for accurate determination of seam thickness. The expense of these tools can make them impractical for the common usage, particularly solely for the determination of coal thickness.

Despite the fact that these logs are not run specifically for this purpose, if available, they are well suited to the task of determining coal thickness. In addition, these logs which have excellent vertical resolution may be utilized to determine the thickness of thin beds or non-coal partings left otherwise unresolved when consulting other logs.

Resistivity of coals varies with ash content, coal rank and coal composition. This leads to a potentially broad range of resistivity values for coals of various composition and rank. In addition to this wide-ranging variation in coal resistivity, the use of resistivity data for the determination of coal thickness is further complicated by the broad range in vertical resolution of various resistivity tools utilized in the petroleum industry.

Sonic Logs

The sonic log is helpful in coal identification, particularly in cased holes, but is not commonly used to assess coal thickness. Interpretation of sonic logs may be useful determining in-situ stresses that affect completion practices. Also, dipole sonic data may be useful in cleat interpretation.

Conclusion

When using older logs, care must be exercised in estimating coal thickness particularly in coal stratigraphy that is composed of a large number of thin coal beds occurring in vertical succession. In these instances, analysts must ensure that coal thickness estimates are accurate. Overestimation of seam thickness tends to be cumulative for reservoirs comprised of thin stacked coals. This may lead to the misrepresentation of actual reservoir thickness.

Continued on page 34...

Tech Corner *… continued from page 33*

Coal reservoirs composed of a small number of thick coal seams are less prone to significant coal thickness estimation error. Since thickness errors tend to be small in relation to the actual coal bed thickness, these errors tend not to be catastrophic. Additionally, if present this error iterates over a small number of seams leading to a tolerable error in calculated net coal in relation to actual coal thickness.

With the evolution of logging technology and the integration of core derived data, sophisticated coal reservoir models continue to emerge. Currently, logging suites are occasionally selected with the intent of maximizing data specifically for unconventional reservoirs. Improvements in logging technology has lead to improved vertical resolution on important logs, such as density logs. These improvements have lead to more robust coal seam thickness estimates as the use of these tools is now common place.

Bibliography

1. Coal bed methane: Coal Sampling Seminar/Workshop, seminar proceedings, October 11-12, 1990, Canadian Society of Petroleum Geologists, 1990
2. Coal Geology and its Application to Coal-bed Methane Reservoirs: lecture notes for short course, Edmonton, August 20-24, 1990, Alberta Research Council
3. The Geological Interpretation of Well Logs, Malcolm Rider, Whittles Publishing, 2000

Canadian Well Logging History - Water Resistivity Handbook

The CWLS Rw Catalog has been a staple offering from the CWLS since 1959. Its evolution follows that of the computer in that it began as a printed booklet, which was eventually replaced by an electronic version on a CD and finally a map based version on the world wide web/internet.

"The high point of 1959 was the final publication of the Water Resistivity Data Book. This booklet was the result of months and months of hard work by the Society and contained hundreds of water analysis for different horizons in British Columbia, Alberta, Saskatchewan and Manitoba. Over 250 copies of the Water Analysis Book were distributed in Canada and the United States." (E.T. Connelly)

The second edition of the catalog came out in 1978 and was followed by the third edition in September, 1987 (editor Case Struyk). "The CWLS's 3rd edition of the Formation Water Resistivities of Canada Catalog has been a long time in preparation. The initial groundwork started back in late 1983 when the CWLS executive determined that an update of the 1978 edition of the Rw Catalog was necessary due to the tremendous amount of new drilling taking place in Canada. The initial committee struggled through some very unproductive meetings and almost perished due to lack of commitment and interest caused by economic turmoil in the oil industry." (Dave Ormon) A total of 2500 copies were printed and sold to the CWLS membership. The familiar yellow binder of the 3rd edition still forms an integral part of the Canadian petrophysicists library.

In February, 2002 the fourth edition of the Catalog was released. The work of updating the catalog began in 1998, with the culmination of this work occurring in 2002. "In 1998, the CWLS executive decided that the Rw Catalog required updating, not only because of the large amount of new data available since the last edition, but mainly because of advances in computer technology which have facilitated the presentation of larger volumes of data." (Mark Ducheck) The editors of this edition were Pat Miller and Bob Menard. For the first time the Rw Catalog was in an electronic format on a CD. This edition of the Rw Catalog can still be purchased at the CWLS office today.

The final form of the Rw Catalog now resides on the CWLS website. The data used to create this version of the Rw catalog came from the fourth edition. By having the Catalog on the website the numerous advantages of the internet and modern computer technology have been leveraged. The new interface allows for easy and quick retrieval of data from the Rw database making it a truly useful tool in the day to day work of the CWLS membership.

Robert Bercha

Drilling rig in the Yemeni desert.
Photo Courtesy Carole Augereau.

Logging tools in storage racks prior to logging. Photo courtesy R. Bercha.

UPCOMING EVENTS

March 5-8, 2006
SPWLA Abu Dhabi Topical Conference
Permeability in Carbonates
Beach Rotana Hotel, Abu Dhabi
http://www.spwla.org/

March 15, 2006
CWLS Technical Luncheon
Speaker: Satyaki Ray of Schlumberger Canada
Optimal Horizontal Well Placement using Directional, Deep LWD Resistivity Device
Fairmont Palliser Hotel, Calgary, AB

April 2-6, 2006
Spring Topical Conference
Net Pay Determination
Westward Look Resort, Tucson, Arizona
http://www.spwla.org/

April 12, 2006
CWLS Technical Luncheon
Speaker TBA
Fairmont Palliser Hotel, Calgary, AB

May 10, 2006
CWLS Technical Luncheon
Speaker TBA
Fairmont Palliser Hotel, Calgary, AB

May 15-18, 2006
CSPG - CSEG - CWLS Joint Convention
What's Next? Where is our Industry heading?
http://www.geoconvention.org/

May 17-18, 2006
3rd European Production and Development Conference
Aberdeen

June 4-7, 2006
2006 SPWLA Annual Symposium
Veracruz, Mexico

Corporate Members are:

Platinum
Anadarko Canada Corporation
Encana Corporation
IHS Energy
Precision Wireline Technologies

Gold
Baker Atlas
Burlington Resources Canada Ltd.
Conoco Philips Canada
Continental Laboratories (1985) Ltd.
Devon Canada
Husky Energy Inc.
Hycal
Petro-Canada Oil & Gas
Qercus Resources Ltd.
Schlumberger of Canada
Talisman Energy Inc.
Wellsite Gas Detection Inc.

Silver
Delta P Test Corporation
Sproule Associates Limited
Taggart Petrophysical Services Inc.
Tucker Wireline Services
United Oil and Gas Consultants

Bronze
Apache Canada Ltd.
Arc Resources Ltd.
Blade Ideas Ltd.
Core Laboratories Canada Ltd.
ECL Exploration Consultants Ltd.
EOG Resources
HEF Petrophysical Consulting Inc.
Landau Petroleum Ventures Inc.
Nexen Canada Ltd.
NMR Petrophysics, Inc.
Northrock Resources
Provident Energy
Roke Oil Enterprises Ltd.
Suncor Energy Inc.

For information on advertising in the InSite, please contact either of the publications co-chairs:

Ben Urlwin (ben@waveformenergy.com) at (403) 538-2185

Tyler Maksymchuk (tmaksymchuk@br-inc.ca) at (403) 260-6248

Discounts on business card advertisement for members.

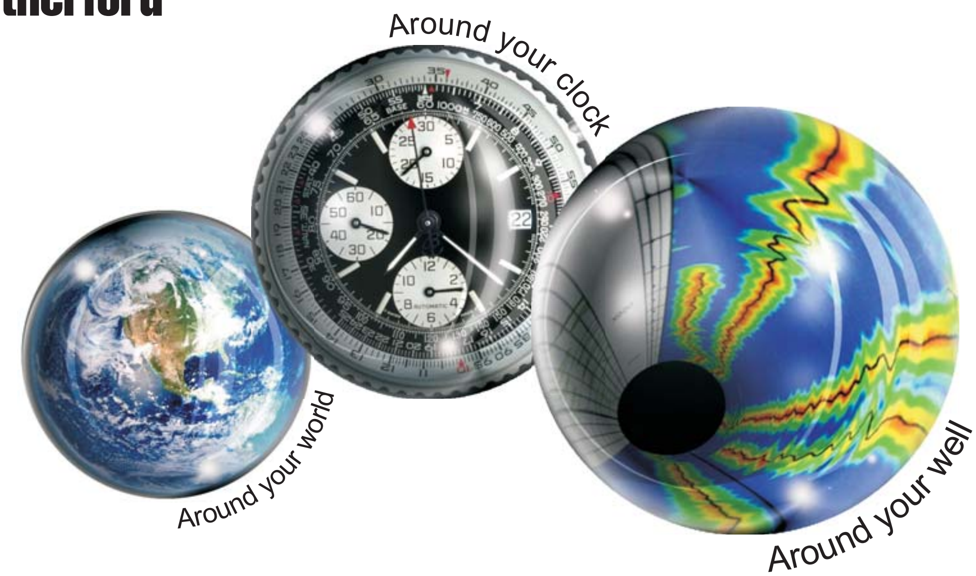
A high resolution .pdf of the latest InSite is posted on the CWLS website at www.cwls.org. For this and other information about the CWLS visit the website on a regular basis.

Drilling Rig body guard military tent by a pipeline in Yemen. Photo Courtesy Carole Augereau.

Logging tools on the cat walk after logging, Wildriver area, AB. Photo courtesy D. Kelly.

Logging operations in the Hoadley area, AB. Photo courtesy R. Bercha.

Weatherford®



All Around Faster Data

Exclusive Compact™ formation evaluator runs safely inside drillpipe at high speed.

No longer do you have to put wireline logging tools on the end of pipe and try jamming them down rugose or deviated boreholes. Our *Compact* formation evaluator (FE) system with a diameter of just 2¼ inches fits safely inside the drillpipe where it can be run as quickly as you can trip drillpipe.

Speed and efficiency make a huge difference in today's world where maximizing mature assets might involve drilling 10 times as many wells as in the past. You can run your quad combo in a fraction of the time and get better wireline measurement quality and reliability because the tools are protected.

Along with the *Compact* FE system, Weatherford's acquisition of Precision Energy Services brings many other exclusive technologies in wireline logging and directional drilling into our measurement portfolio. It's all a part of our 360 Service built around you and your needs. For more information, call **403-265-6060** or visit us at **www.weatherford.com**.

Drilling | Evaluation | Completion | Production | Intervention