CANADIAN WELL LOGGING SOCIETY

in site

CWLS Newsletter
JANUARY 2004

President' Address

Since this is my last message in the InSite, I thought I would avoid the usual laundry list of activities and statistics and bounce a few ideas off you that I have been wrestling with for awhile. I have no ownership to the originality of the ideas I wish to describe. There is nothing I am going to say here that has not been said before by others past or present and probably better. These ideas have been the focus of conversations I have had with various individuals in the petroleum industry and the topic of several books I have read.

Many of us know the CWLS is a professional organization, but do we also think of the CWLS as a scientific organization, an organization that provides scientific value to Canada's petroleum industry? I, for one think that it is a scientific organization and does add value and I would like to show you why I believe this is so.

To do so one must ask, what is science? The word science is used to mean one or a combination of three attributes. Attributes which I believe are captured within the CWLS. Science is part a special means of discovery, sometimes referred to as the scientific philosophy or method. Sometimes it is a body of knowledge arising from discoveries, chemistry, geology, physics and petrophysics. Lastly, it maybe the new things you can do with these discoveries or the pragmatic application of science. Let's examine each of these three aspects of science in turn.

First, let's look at the pragmatic application of science. Application is the most obvious attribute of science and the one most dealt with within the CWLS. As a consequence of science, we have the ability to do something that could not have been done before. We are in the midst of an avalanche of applications for finding and recovering quantities of hydrocarbon in the most remote and difficult areas of the planet. The challenge now is that when an application does not work, to have the courage to continue to try and find new solutions.

The next attribute of science is its content, a body of knowledge. These are the building blocks resulting from hard work and disciplined thinking of scientists. This is work, not purely done for the sake of application so much as it is done for the excitement of discovery. Applications may be found later. Content is the essence of science and for the longest time I wondered if such academic thinking had a place in an organization such as ours. The difficulty I struggled with, was trying to appreciate the value of the idea without tying it to a tangible application. I now believe that it does.

The final aspect is science as a method of discovery. This method is based on the principles of observation, judging of whether something is or is not so. A rule is created which attempts to describe the observation and then attempts are made to test the rule and find exceptions, which, at first glance, prove that the rule is wrong. It is the exceptions to the rule that are the most valuable as true progress comes from finding the exceptions proving rules wrong then looking again. Further, the more precise the rule, the more interesting and the more powerful it is and the more liable it is to exception and more importantly, the more valuable it is to test.

So, here is the important point, a point each of us knows intuitively but we tend to ignore or conveniently forget. The rules of petrophysics, the ones we work with day to day may likely be wrong. The rules we use are not observations but extrapolations and the experiments used to determine them are always to some extent inaccurate or uncertain. They are in a sense, a good guess that has real value, in that it has gone through the uncertainty sieve so far. And if at some point in time, a new sieve has smaller holes, the rule may not pass, causing doubt which in turn starts us looking in a new direction for new ideas. The rate of the new development of science, the rate of discovery, is not the rate at which observations are made and known rules applied but the rate at which new ideas are tested. This is where value is created. However, you must be willing to do so.

If we did not have doubt and the willingness to question, we would not have any new ideas. So, what we call petrophysics is really a body of knowledge, or, statements with varying degrees of certainty; some more sure than others, but none certain. And when the sieve is small enough, a rule may not pass and we have doubt. Doubt is important and should be welcomed, because it creates opportunity which in turn creates value. Conversely, ignoring doubt and using any rule dogmatically, will result in lost opportunities and lost value.

Scientific value is the basis of what the CWLS stands for, and it provides a forum to our constituents to present science, formulation of rules and their application for the betterment of the Canadian petroleum industry.

Dave Shorey, CWLS President

Editor's Note

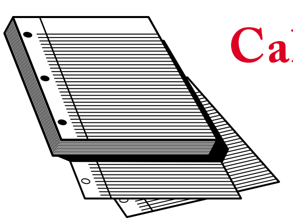
In this INSITE Mike and I have decided to look at Lag times a bit more closely and an article by Chuck Engen addresses the finer points of this mud logging procedure. We have also included and article on error analysis and the Archie equation.

I recently read an article on the role that humour plays in reducing stress. As stress has been such a dominant factor in the "leaner and meaner" oil industry, Mike and I decided to include some politically correct humour in this issue in an attempt to ease you through your day.

This is my last INSITE as my two-year term as a publications co-chairman is finished after the annual general meeting early in 2004. This has been a very busy last year for me, and Mike and I have, hopefully made the CWLS a bit more visible with a new website format, the regular publication of the INSITE and, with a bit of luck, the publication of the Journal this spring. In regards to the Journal, there is room for one more article. To date, there have been no submissions from the oil industry in Calgary and we need to be represented! I have a March deadline for all articles and this would be a good way to get the paper that you plan to deliver at the June ICE conference, written and published in less than one-year.

I have enjoyed my two-year term with the CWLS and look forward to a continued participation in the society through articles and papers in future INSITEs and Journals.

Best regards,
Steve Burnie and Mike Eddy
CWLS Publications Co-Chairmen



Call for Papers

The CWLS is always seeking materials for publication. We are seeking both full papers for the Journal and short articles for the Newsletter. Please share your knowledge and observations with the rest of the geoscience community. Please contact publications Mike Eddy (meddy@wellsitegas.com) at (403) 230-0630.

You provide the material and we will provide the soap box!

Membership Renewal Reminder

It is that time of year again; please submit your membership renewal forms as soon as possible. This will ensure that you do not miss any of the upcoming events and benefits of being a member of the CWLS. If you have not yet received your renewal forms please contact the CWLS office at (403) 269-9366.

New Corporate Members

Wellsite Gas Detection - Gold Member

New Members

Richard Anderson - Talisman Energy
Kimberley Baker - Schlumberger
Renaud Bonneville - Bonne Engineering
Steve Coulter - Talisman Energy
Roberta Delaidais
Brian Doherty - Predator
George Eden - BP Canada Energy
Caroline Guay - Pure Energy
Nasreddine Hammou - Baker Atlas
Travis Johnson -Ranchgate Energy
Qamar Aslam Khan
Lisa Mac Kinnan - Murphy Oil
Tyler Maksynchuk - Burlington Resources
John Manning - Talisman Energy
Hugh Mosher - AJM Petroleum Engineering
Paul Murynka - Lexxon Resources
Andy Nagy - Petrofund
Pui Nam - Maple Pacific
Jill Simik - Schlumberger
Andrew Vogan - Burlington Resources
Matt Walls - Wellsight Systems

On the Move

Rob Garth to Talisman Energy

Our condolences go out to the friends and family of long time CWLS member Stan Starcyk of TOR Geoscience Corp. who passed away in August 2003.

2003 to 2004 Executive

Front left to right:
Rosalie McDonnell - Membership Chair,
John Kovacs - Past President,
Dave Shorey - President,
Khrista Kellett - Secretary

Back left to right:
Mike Eddy - Publications Co-Chair,
Steve Burnie - Publications Co-Chair,
Darren Aldridge - Treasurer,
Jeff Levack - Vice President,
Satwant Diocee - Chairman of Committees

As the Winch Turns

In the early eighties I was on a deep logging job in the foothills west of Caroline. We could not get the logging tools to bottom. There were several cycles of running in, bridging off at various depths, then waiting while the rig did a clean-out trip. They even tried chaining out the drill pipe. This is a way of coming out of the hole without turning the pipe to break connections. Coming out this way is less likely to knock in the sides of the hole. Still, every time we bridged and came out of the hole our tool's calipers and bowsprings were jammed with pieces of shale. After several days of this, the decision was made to log with slim hole tools. Drill pipe would be run in the well to a depth just above the main zone of interest. The tools would be dropped out the end of the pipe and logged over the zone. So, the pipe was run in open-ended (no drill bit and no drill collars) and was rammed through the bridges to within a few hundred metres above TD. While the rig circulated, we checked out the slim logging tools. These types of tools did not get much use in those days. When they arrived on location the box they were in was caked in dust. This was not the kind of dust that you get from driving down gravel roads. This dust came from sitting in the shop for months and months. The tools did not work. We called for another set but there was going to be a twelve hour wait. To kill time waiting for the new tools we decided to try another regular logging run. The rig pulled out of the hole with the open-ended drillpipe. We ran in with the regular logging string. The tools went right to bottom. We logged the well and went home.

Nobody can say for sure if running in open-ended was the best way to condition the hole or if we just got lucky. Our conclusion was that the bit was banging the sides of the hole as it was pulled out.

Jeff Levack
Tucker Wireline

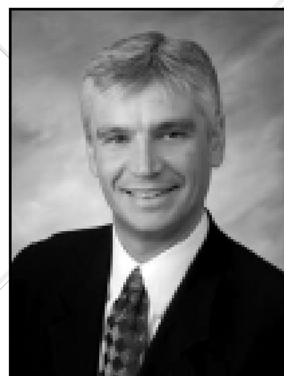
If anyone has a story they feel is worth sharing please contact the editors. Contact information for the Publications Chairs can be found on the CWLS website at cwls.org.

THE CANADIAN WELL LOGGING SOCIETY

Executive Nominations

2004 - 2005

(President)



Jeff Levack

Jeff has been the Sales Manager for Tucker Wireline Services Canada Inc. for three years. His involvement with the CWLS has included seven years as Chair of the CWLS Speaker Evaluation committee and two sessions organizing exhibits for symposiums. He is also a member of the CSPG, APEGGA and the SPWLA.

In 1982, he graduated from the University of Toronto Engineering Science program with a Bachelor of Applied Science degree specializing in Aerospace Engineering. He was disheartened to find that, for most jobs, it doesn't take a rocket scientist. He stumbled across a company that believed what they did was like rocket science only harder. After six years in the field running standard and high-tech open hole services he moved to Calgary. Since that time he has been involved in formation evaluation in the service, consulting and operating sectors of the business.

Jeff served the Society well this past year as Vice President.

(Vice President)

John Nieto

John Nieto is the Manager of Formation Evaluation for Anadarko in Canada. Nieto holds a BSc degree from London U. and a DMT degree from Camborne School of Mines. He worked as both a wellsite geologist and wireline-logging engineer before joining Britoil (BP) as a petrophysicist. Most recently, John was Global Coordinator of Formation Evaluation for ExxonMobil in Houston. He is a CWLS member and was awarded the CWLS President's award for 2002 - 2003. He is also an SPE member and is on the JPT Editorial Committee. Nieto has authored or co-authored 15 technical papers on formation evaluation and is currently championing integrated reservoir characterization, or shared-earth modeling in Anadarko Canada.

Simon Corti

A graduate from the University of Calgary (BSc. in Mechanical Engineering 1993), Simon began his career with Schlumberger in the 1993 in Grande Prairie. While in the field, he was given assignments in Canada and the US as a field engineer and field test coordinator. In 1997, he moved to Calgary and joined the Schlumberger Customer Service Team, bringing technical advice and support to two of Canada's largest independent oil & gas exploration companies.

Simon held the CWLS Membership Chair position in 2000, as part of a successful executive team. From 2000 until 2003, he managed field operations in the Southern District of Alberta and Saskatchewan for Schlumberger, returning to Calgary in the fall of 2003. He has co-authored and presented numerous internal papers, including Improvements in Fracturing Design using Mechanical Modeling in North Western Alberta and the Identification of Permeable Beds in Manville Channels Using Nuclear Magnetic Resonance Technology. Member in good status with both CWLS and APPEGA.

(Secretary)

Kimberley Baker

A graduate from the Royal Military College (BSc. in Chemical Engineering), Kim began her career with the Environmental Science Group in Kingston Ontario performing site assessments in the Northwest Territories. In 1997 Kim started with Schlumberger as a field engineer in Brooks. While in the field, she was given assignments doing Open Hole and Cased Hole logging throughout Western Canada. From 2000 to 2002 she was the Field Services Manager in Brooks and in charge of the winter projects in Wainwright and Fort McMurray. In the spring of 2002, Kim moved into Calgary as a technical sales engineer for Schlumberger. Member in good status with both PEO and CWLS.

Khrista Kellett

Khrista Kellet graduated from the University of Saskatchewan with a Bachelor of Science in Geological Engineering. She is currently employed as a Petrophysicist for Talisman Energy Inc. Khrista works primarily in Western Canada in the Peace River Arch, Northern Plains and Chauvin areas and is responsible for geological, logging and drill stem testing operations as well as formation evaluation. She is currently a member of APEGGA, CWLS and CSPG.

Khrista served the Society well as Secretary in 2003-2004.

THE CANADIAN WELL LOGGING SOCIETY

(Treasurer)

Gary Drebit

With 25 years in the oil and gas business, Gary is pleased to be running for the position of Treasurer on the CWLS executive. He graduated from the Southern Alberta Institute of Technology with a certificate in Geophysics and in 1986 completed a certificate with Honours in Geology. In addition to being a long time member of the CWLS, he is also affiliated with the CSPG and ASET. Since 1979 he has held staff positions in Log Analysis for Schlumberger. Currently he is the Senior Petrophysical Manager for Schlumberger's Data and Consulting Services Group.

Darren Aldridge

Darren Aldridge graduated from the University of Calgary with a BSc. in Electrical Engineering in 1982 and worked for Dresser/Western Baker Atlas for the past 18 years throughout Western Canada, the North Sea, Northern Africa and Italy. He has held a variety of positions from Field Engineer to Operations Manager to Log Analyst and is currently serving as Technical Sales Representative for Open Hole Logging in Calgary with Baker Atlas.

Darren was CWLS Treasurer this past year, handling the Society's financial transactions admirably.

(Publications Co-Chair)

Robert Bercha

Robert Bercha graduated from the University of Calgary with a BSc. in Geology in 1991. Upon graduation he worked at Pembina Resources in various geological roles. In 1997, he moved to Norcen Energy (which eventually became UPRI and then Anadarko) as a Senior Geologist. Since then he has worked on numerous Western Canadian projects in Alberta, B.C. and Saskatchewan. Robert is currently employed as a Staff Geologist in Anadarko Canada's Petrophysical Department. He works primarily in the Southern and Northwest Plains areas and is responsible for petrophysical analysis, supervision of logging operations and special core analysis.

His involvement with the CWLS has included 3 years as a member of the CWLS Speaker Evaluation Committee. He is currently a member of CWLS, CSPG and APEGGA.

Travis Johnson

Travis Johnson, P.Geol. is a Senior Geologist with Ranchgate Energy. He has worked several different plays in Alberta, Saskatchewan and Ontario with Wascana Energy, Talisman Energy and Calpine Canada.

He received his BSc. Geology from the University of Calgary in 1996. Travis is a member of CSPG, APEGGA and CWLS and been a Big Brother since 1999. When not working or playing hockey, Travis is secretly honing his golf game to join the Senior PGA tour.

(Chair of Committees)

Andrew R. Vogan

Andrew Vogan, P.Geol. started his career in 1991 as an Open-Hole Engineer with Schlumberger in Red Deer. After 4 years with Schlumberger, ending with specialty services in Nisku, Andrew left the company to pursue a career as a Geologist.

Andrew then formed a company for the purpose of prospecting as well as wellsite supervision. Shortly thereafter, Renaissance Energy Ltd. hired Andrew, where he spent the next 3 years drilling wells throughout central and Southern Alberta. After drilling several hundred wells for Renaissance, Andrew was hired by Edge Energy, a junior oil company, where he spent the next 2 years.

Andrew has been working for Burlington Resources Canada Ltd. for the past year and a half as a Senior Geologist looking after shallow gas in the Central Alberta area.

Andrew Vogan, P.Geol., is a graduate in Geology from Queen's University. He is a member of APEGGA, CSPG, and CWLS.

Satwant Diocee

Satwant Diocee P.Eng, is the Manager of Computing Center at Precision Wireline Technologies. He has 19 years experience in Open Hole and Cased Hole logging, applications and training. He has held positions of Open Hole Field Engineer, Sales Engineer and Senior Log Analyst. He is experienced in the interpretation of Pulsed Neutron, Magnetic Resonance Imaging and Open Hole logs.

He is a graduate of the University of Calgary, Alberta with a BSEE and is a member of SPE, SPWLA, CWLS and a registered member of APEGGA. Satwant served the CWLS this past year as Chair of Committees.

Richard Bishop

Richard graduated in 1975 with an Engineering Science degree from Exeter University in England. He has spent 19 of the intervening years working in various capacities for well logging service companies, both Open and Cased Hole and is presently an account manager with Reeves Wireline in Calgary.

A long-term supporter of the CWLS, he previously served as Vice-President during the 1988-1989 year.

(Membership Chair)

J.R. (Randy) Smith

J.R. (Randy Smith, BSc., (Geology) has been employed in the petroleum industry for over twenty years in various roles in both geology and marketing. He has worked in the fields of petroleum EOR research, core analysis, hydrocarbon mudlogging, wellsite geology/operations, regional geology and digital image database management.

He has held positions with Motorola (Petroleum Marketing Executive), Robertson Research Group (Marketing Director), Datalog (VP International Marketing) and Tekkmark (Owner/President/Marketing Director). His company Tekkmark partnered with industry and Eastman Kodak to build the world's first petroleum digital core photo image database in 1992. As well, he has been involved with the initiation of several marketing/database systems involving both contact management (Goldmine) and E-Commerce. He has always had passion for both geology and marketing.

He is a member of the CWLS, CSPG, CSEG, CIM, PSAC, AAPG and SEG.

Dion Lobreau

Dion Lobreau graduated from Brandon University with a Bachelor of Science in Geology in 1997. Since then he has been employed with various exploration companies in Calgary, including Talisman Energy as a Geologist in the Deep Basin area. Dion recently moved to Mancal Energy to pursue his professional development in a smaller company environment. Dion is an active member of CSPG, CWLS and APEGGA. He is currently volunteering as marketing chair for the William C. Gussow Mini-Conference series - Water Resources and Energy in March 2004.

He is also interested in bringing more project Geologists on as members of the CWLS and educating the industry on the value of the CWLS.

Vern Mathison

Vern Mathison started with Precision Wireline Technologies (formerly Computalog) in November of 1980. He moved to the Calgary office in 1983 to work in the computing center while attending SAIT, receiving a diploma for Petroleum Geology Technology in 1986. Vern moved back to the field and ran a wireline unit for Computalog for 13 years before returning to Calgary in 2000 to work in the PWT sales division. He is currently a member of the CWLS, CSPG and SPWLA. Vern is involved as well in the community as a Scout Leader with the Midnapore Scouts Association.

"The Membership Chair offers a challenging and rewarding opportunity to meet many people within the petroleum industry and a chance to review the membership database and undertake any changes that may be necessary".

Error/Uncertainty and The Archie Equation

Water saturations are calculated from electric log measurements using the general Archie equation:

$S_w = ((aR_w/(R_t\phi m))^{1/n}$ 1

This equation expresses the relationship between water saturation (S_w), two measured properties of the reservoir, resistivity (R_t), and porosity (ϕ) and one measured property of the formation fluids, formation water resistivity (R_w). The three parameters: a, m, and n are specific to the rock texture and have to be measured from core. In this, the first of two articles, I have assumed that core measurements were used to define a as 1.0, m as 2.0 and n as 2.0. Therefore, the only uncertainty that exists in the calculation of S_w is in the measurement of the porosity (ϕ), resistivity (R_t) and formation water resistivity (R_w).

Using the values determined from core analysis for a, m and n, the Archie equation becomes:

$S_w = ((R_w/(R_t\phi^2)^{1/2}$.. 2

This equation can be rewritten as:

$S_w = R_w^{1/2} /(R_t^{1/2}\phi)$.. 3

Baird (1962) and Shoemaker and Garland (1962) give equations to determine the error in a variable that is calculated from other variables that have a known uncertainty. In this treatment, the uncertainty is a ± value that expresses the greatest range in values that any one measurement could have.

Consider the following example. Porosity can be read at any depth from a sonic, neutron or density log. As a result there is some uncertainty as to what the exact value is, but the log analyst usually feels fairly certain that it can be no more than some maximum value and no less than some minimum value. Let us say that the porosity at a particular depth in the reservoir is reasonably well known at 18 ± 1%. The resistivity at this depth is fairly high and the deep induction log is reading at 200 $\Omega m^2/m$. However, the uncertainty in this reading is about plus or minus twice the width of the log trace or ±10 $\Omega m^2/m$. The reservoir was drillstem tested and recovered 1000 m of salt water, which had a salinity that was measured on three samples, one from the down-hole sampler, one from the bottom of the recovery and the third from the middle of the recovery. The values are respectively: 100 000 ppm TDS, 150 000 ppm TDS and 125, 000 ppmTDS. Normally, the down-hole sampler gives the best estimate of formation water salinity, but in this case it has the lowest salinity. The petrophysicist felt fairly certain that the water salinity was higher than this, but could not reject any of the values as being obviously in error. Therefore, he chose to bracket the salinity as approximately 140 000 ± 10 000 ppm TDS, discounting the 100000 ppm value as an error. The analyst noted that there was considerable variation in the down hole temperature and estimated that the reservoir temperature was definitely no more than 80°C and no less than 70°C. He chose the temperature to be 75 ± 5°C. Using resistivity charts, the formation water resistivity was determined to be 0.026 ± 0.003 $\Omega m^2/m$.

In the treatment of the propagation of error (Baird,1962) the error in S_w would be calculated by taking the partial differential of equation 3 with respect to each variable. That is :

$\partial S_w/\partial\phi + \partial S_w/\partial R_t + \partial S_w/\partial R_w$.. 4

Using equation 3, the partial derivatives are determined as:

$\partial S_w/\partial\phi = d[R_w^{1/2}/(R_t^{1/2}\phi)]/d\phi$
$= R_w^{1/2} R_t^{-1/2} * -1*\phi^{-2}$ 5

$\partial S_w/\partial R_t = d[R_w^{1/2}/(R_t^{1/2}\phi)]/dR_t$
$= R_w^{1/2}\phi^{-1}*-0.5R_t^{-1.5}$ 6

$\partial S_w/\partial R_w = d[R_w^{1/2}/(R_t^{1/2}\phi)]/dR_w$
$= R_t^{-1/2}\phi^{-1}*-0.5 R_w^{-1.5}$.. 7

Therefore the total uncertainty, ∂S_w, is equal to:

$\partial S_w = (R_w^{1/2} R_t^{-1/2}*-1*\phi^{-2})\partial\phi + (R_w^{1/2}\phi^{-1}*-0.5R_t^{-1.5})\partial R_t +$
$(R_t^{-1/2}\phi^{-1}*0.5 R_w^{-1/2})\partial R_w$... 8

The relative uncertainty can be calculated as:

Relative Uncertainty = $100\partial S_w v^{-1}$ 9

The differentials, $\partial\phi$, ∂R_t, ∂R_w, can be treated as finite differences which can be regarded as the maximum uncertainties in these variables (Shoemaker and Garland, 1962).

Given that: R_w = 0.026 ± 0.002 $\Omega m^2/m$, R_t = 200 ±10 $\Omega m^2/m$, and ϕ = 18 ± 1%, S_w can be determined using equation 3 as 0.063 or 6.3%. The uncertainty in this value can be determined using equation 8 as:

$\partial S_w = -0.00352 - 0.00158 + 0.00365$ 10

Baird (1962) and Shoemaker and Garland (1962) state that all values in equation 10 must be considered as positive quantities so that the maximum error can be estimated.

$\therefore \partial S_w = 0.00875$

$\therefore S_w = 0.063 \pm 0.009$
$= 6.3\% \pm 0.9\%$

Continued on next page…

Error/Uncertainty and The Archie Equation

continued…

The relative uncertainty according to equation 9 is approximately ± 14%.

This error is quite reasonable.

The usefulness of the error analysis is two-fold. First of all, the magnitude of the error is important to the geologist and reservoir engineer from a reserves calculation point of view. Secondly, equations 8 and 10 allow the petrophysicist to assess the contribution of the three components (porosity, resistivity and formation water resistivity) to the total error. This then allows the petrophysicist to plan the logging and testing program to minimize the error.

Consider the case where the formation water is relatively fresh and the formation is a sucrosic dolomite at a relatively shallow depth (1000 m). The porosity determined from the sonic-neutron and neutron-density cross plots was 12% with an uncertainty of ± 1%. Formation resistivity was 1000 ± 100 $\Omega m^2/m$. The CWLS R_w catalogue had little data control near the well, but a value of 1.8 ± 1 $\Omega m^2/m$ at formation temperature (25°C) seemed to be reasonable. The S_w determined from equation 3 was 0.35 or 35%. Equation 8, when all of the three terms are regarded as positive values, gave the error as:

$$\begin{array}{lcccc} & & \delta\phi & \delta R_t & \delta R_w \\ (S_w & = & 0.0295 + & 0.01768 + & 0.06547 \\ & = & 0.1126 & & \end{array} \quad \text{.............................} \quad 11$$

The relative error is 32% (equation 9).

The water saturation is therefore 0.35 ± 0.11 or 35% ± 11%. The petrophysicist examined equation 11 and saw that the uncertainty could be reduced substantially by obtaining a more accurate value for R_w. He therefore requested that a water sample be taken from the underlying aquifer in the planned step-out well.

In a future article, I will consider adding error terms to equation 8 to account for the uncertainty in a, m and n.

Steve Burnie

Steve Burnie is an independent consultant and president of Skeele Petroleum Resources Inc.

On the Lighter Side

Humor is in the eye of the beholder. It also reflects the nature, often twisted, of the one telling a joke and the one hearing it. My late father-in-law definitely had a keen sense of humor and appreciated the "different" joke. He would never let me forget the time, when after his first heart attack, I gave him one of the books that I had just finished reading. The book was by Wilbur Smith and as usual was action packed. I thought it would lift his spirits and take his mind off the confinement of his unfortunate condition. I paid little attention to the title and the book was certainly not humorous. And yet I heard this devilish cackle of laughter from his room. I had leant him the book "A Time to Die".

The following excerpts are from a book entitled "Uncle John's AHH-INSPIRING BATHROOM READER".

In Court

Judge: I know you, don't I?
Defendant: Uh, Yes.
Judge: All right, how do I know you?
Defendant: Judge, do I have to tell you?
Judge: Of course, you might be obstructing justice not to tell me.
Defendant: Okay, I was your bookie.

Question: Do you have any suggestions as to what prevented this from being a murder trial instead of an attempted murder trial?

Answer: The victim lived.

Dilbert

All people are idiots
The only risk of failure is being promoted.

Fictionary

Esplanade (v.), to attempt an explanation while drunk
Coffee (n.), one who is coughed upon (as opposed to the coffer)
Eyedropper (n.), a clumsy optometrist
Zebra (n.), ze garment which covers ze bosom.

Enough already!!

All of the best in the New Year.
Steve Burnie

Lag Time Calculations

A well is deepened by the mechanical grinding and crushing action of the rock bit against the face of the rock formation that is being drilled. The crushed 'cylinder' of rock that is drilled to make the hole is released into the mud stream. Once released, these small pieces of formation, and any contained fluids (gas, oil, and water), are carried to the surface up the well annulus to the shale shaker.

A period of time is required to pump the samples, and associated fluids, from a particular depth to the surface where they become accessible. This period of time is called the lag or lag time. The lag always exists and changes continuously, as the hole becomes deeper. It is necessary to accurately know the lag time and apply it continuously to the returning samples, and gas, in order to be able to say with any degree of confidence that a particular sample comes from a certain depth. It is especially important to have determined an accurate real lag time prior to drilling into a zone of interest or while looking for core point or a casing seat. Determination of the real lag time is as much an art as it is a science, and the more times you perform this task, the easier it will become, and the better you will become at doing it.

It is generally quite easy to determine if your lag time is accurate or not, especially with modern gas detectors and computer generated drilling & gas curves. Since all modern gas detectors incorporate some feature to automatically lag gas readings, if the gas peaks of your plotted gas curve do not line up or correspond exactly with periods of very fast drilling (drilling breaks), your lag time requires adjustment. Examples of incorrectly and correctly lagged gas peaks are given at the end of this paper. An incorrect lag time may be either too short (i.e. your samples are being taken too soon, in which case your gas peak will occur above the drilling break), or too long (i.e. your samples are being taken too late, in which case your gas peak will occur below the drilling break. There is only one true lag time for any given depth in any particular well, and it changes continually as the well becomes deeper. That is to say, the lag time at 2000 m will be considerably different from the lag time at 3000 m. As a result of the advent of gas detectors, personal computers, and calculators, there is no excuse for the wellsite geologist to be using a grossly inaccurate lag time.

Determination of Theoretical Lag Time

There is a difference between what the lag time really is (true lag time), and what the lag time should be (theoretical lag time). A theoretical lag time is a mathematical calculation based on the well bore being 'gun barrel' smooth, without irregularities or washouts, which in fact it very seldom is. The only time you will get a perfectly smooth hole is if an intermediate string of casing is set in the well (in which case theoretical and real lag time should be very close to one another), or during the drilling of a very well consolidated or very uniform lithology. Salt, for example, may give this type of hole if it is drilled correctly. It is of course always preferable to use the true or real lag time. However, when one first arrives on location and is initially setting up, a theoretical lag time can be used until the true lag time is determined.

1. "1 Minute Per 100 Feet"

An old rule of thumb, which you may hear repeated, states that the lag time is "1 minute per 100 feet of hole" or in metric terms, 3 minutes per 100 meters of hole. Using this "rule," in a 3000 meter well the lag time would be 90 minutes (3000/100) x 3 = 90. Anyone who uses this "rule" for determining lag time, except perhaps in an 'emergency' situation, and then only for as brief a period of time as possible, are kidding themselves that it is likely to be even close to accurate. This "rule" is a legacy from the 'golden days' of the oil patch. It was "formulated" before the advent of modern, high speed, efficient triplex mud pumps. The bottom line is, today there are much better, and tremendously more accurate methods of calculating lag times and no excuse not to use them.

2. Volumetric Method

Lag time based on well volumes may be calculated quite easily. It is, after all, a very simple problem. A certain volume (m3) of mud is in the well annulus. The mud pumps displace a known amount of fluid (m3/stroke) at a known rate (strokes per minute or SPM). Therefore the lag time is simply calculated by: m3/((m3/stroke)x(stokes/minute)) = minutes, which is your theoretical lag time. The 'trick,' of course, is in determining the annular volume of the well for any given depth. The mathematics involved are not hard but they are tedious and when calculating by 'hand,' mistakes can be easily made.

The only problem in this regard is that you must assemble certain information before you can do the calculations correctly for your particular well. The information required will not be the same for any two wells. Therefore you must start over at the beginning of each new well OR when and if there is any change to the well or drill string configuration, such as an intermediate string of casing. This data is all readily available from any page of the rig tour book usually with the exception of the drill collar and drill pipe inner diameters which usually are not

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Lag Time Calculations

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recorded. Any missing items of information may be obtained from the driller, tool push or drilling supervisor.

3. Annular Velocity Method

The annular velocity method is very similar to the volumetric method in terms of the information required to perform the calculations. This method, however, is based upon the fact that a known annular volume (m3/m) is displaced at a certain rate, the pump output, (m3/min). Therefore the calculation consists of (m3/min)/(m3/m)=m/min. One then divides the length (m), of that particular annular section by the annular velocity (m/min), to obtain the transit time for that particular annular section: (m)/(m/min)=min. You must then calculate similar transit times for each annular section in the well and then add them together to determine the lag time. As with the volumetric method, the calculations are not mathematically difficult, but they are tedious, although probably less so than the volumetric method.

Determination of Real Lag Time

Having bored everyone with the preceding, we must now tell you that the calculations you did, no matter how much care and effort went into them, are almost certainly wrong. This is not a reflection on your ability to follow simple instructions, but rather is an example of how the theoretical world is often only a vague shadow of the real world. In real life, 'gun barrel' smooth well bores do not exist, with the notable exception of when a long string of casing is placed in the well. Real well bores may in fact be several times larger than the bit with which they were drilled. It is for this reason that this discussion speaks of theoretical vs. real lag time. A theoretical lag time should only be considered as a starting point until the real lag time is determined. Once you know what the real lag time is, completely abandon all the nice calculations you have performed.

1. Real Lag Time from a Gas Detector

A. Using Drilling Breaks

Determining real lag time from a gas detector is a simple process. One merely waits until a definitive drilling break (increase in the rate of penetration), which has gas associated with it. It is then a simple process of counting the elapsed time since the start of the drilling break until the start of the gas increase. The amount of time required is the real lag time. Coal seams are by far the most desirable marker to use for lag time since they drill very fast (usually < 3.0 min/m) and have a large amount of methane gas associated with them which will always show up on the gas detector. A classic example of using a gas peak to determine real lag time on an actual gas detector chart is given at the end of this discussion. The only item to be aware of is that you do not include periods of non-circulation in your count for the lag time, it must be excluded. Only time in which the rig is actually circulating mud must be counted. Thus if your drilling break occurs in the middle of one kelly and your gas does not appear until the middle of the next kelly, the time that the rig was not circulating during the intervening connection is not included. Remember also that a real lag time is truly accurate only for one depth in the well - the depth at which it was determined. The deeper you drill away from that point, the more inaccurate your lag time will be. Thus it is of utmost importance to realize that you must periodically change (increase) your lag time. Usually, but not always, the lag will increase approximately one minute for each 50-75 meters of new hole drilled. Check your real lag time continually against new drilling breaks as they occur and update it if necessary.

A few words of caution concerning real lag time are also in order. Be aware that the rig crew must be using the same lag as you at all times or else there will not be good correlation between samples and gas. Also realize that usually the rig crew catches samples based purely on time. That is to say, if a certain sample is due to be circulated up at 10:05 pm, but in the meantime the crew does a rig service during which they are not circulating for 10 minutes, that sample will probably be caught at 10:05 pm rather than at 10:15 pm when it should be. Modern gas detectors, however, are 'smarter' than roughnecks are in that they 'know' enough not to count lag time while the rig is not circulating. In this case, while your lag time may be right on, the rig crew's won't be and there will be a discrepancy between a gas peak and what you see in the associated sample. The safest method, especially in a zone of interest, is to follow the simple rule "never trust a roughneck." In other words, catch a spot sample yourself whenever you have an important gas peak. A spot sample is a sample of the cuttings that are coming over the shaker at any particular moment in time, not those cuttings that have accumulated in whatever sample-collecting device the rig crew is using. If you catch a spot sample when the gas is just about to peak on your gas detector, you will always have a good sample of what has caused the gas show - guaranteed!

A final item concerning gas detector determined lag time concerns the length of time required to suck the gas from the gas trap to the gas detector. Usually this requires from one to two minutes. Note that if you have an exceptionally long string of polyflow (for example if you are working in BC), this length of

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Lag Time Calculations

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time could easily be 3 or 4 minutes. Therefore, the sample lag (i.e. time from bottom of the hole to the shaker) may be significantly different from the gas lag (the time from the bottom of the hole to the gas detector). This may not seem like a great difference, but it can be important when dealing with very thin potential pay zones. Wireless gas detectors however only take about 10 seconds to transport the gas compared to the 1 to 4 minutes requiring less adjustments.

B. Using an Induced Gas Show

The gas detector may also be used to determine real lag time by using an induced or artificial gas show. An induced gas show is any gas that is created for the purpose of determining real lag time. Such a gas show may be created in several ways. In 'the olden days,' a small quantity of a chemical compound called calcium carbide was wrapped in a paper towel and placed in the top of the drill pipe during a connection.

When carbide becomes wet it generates acetylene gas, which is easily picked up by either a total gas detector or a chromatograph (it appears as a propane peak). However, the powers that be have deemed carbide a hazardous chemical, and we are forced to resort to more primitive methods. Usually a quart or two of gasoline poured into the top of the drill pipe during a connection will give a gas response on the total gas detector. This technique has a problem associated with it that will become apparent to you the first time you try and do this. Usually the drill pipe has a flow of mud oozing from the top during a connection due to a phenomenon known as 'U' tubing. Of course this will make it difficult to pour anything into the drill pipe and expect it to stay there. Speak to the driller, explain what you want to do and why. They are usually just as interested as you are in knowing the true lag or bottoms up time and they can often come up with a solution.

Once you have begun an induced gas show, it is not simply a matter of waiting for the gas peak to appear on the gas detector. As a bonus, when you use an induced gas show to determine real lag, there is a very important calculation that must be performed. An induced gas show is not the same as a real gas show in so much as it does not come from the bottom of the hole, it comes from the surface or top of the hole. Therefore you must know how long it takes to pump whatever material you are using to cause the gas show from the surface to the bit and then subtract that amount of time from the total time since the mud pumps were started to when your gas peak appears. The amount of time required to pump from the surface to the bit, down the interior of the drill string, is called down time. Down time is easy to calculate, but again the calculations are tedious. Unlike the lag time calculations, downtime calculations should be very accurate since the interior dimensions of the drill string are known quantities that do not change. With regard to downtime, it is the interior or inner diameters of the drill pipe, heavy weight drill pipe and drill collars, which are critical. Usually this information is not recorded in the tour book but can be obtained from the driller or drilling supervisor.

For an induced gas show, this very simple formula is used to determine the real lag time:

Real Lag Time = Time from pump start to gas peak - Downtime - any non-circulating time (connections).

Once a real lag time has been accurately calculated from an induced gas show, it should be every bit as accurate as using a real gas show.

2. Real Lag Time by Using a Tracer

A method exists to determine the real lag time without relying on the gas detector. This is known as a tracer lag. This was the first method ever used to determine lag times. It is accurate, simple, virtually foolproof and just as valid a method today as it was 40 years ago. The only drawback being that you cannot sit comfortably in your shack and wait for a response on the gas detector. This method works the same as an induced gas show in as much as you introduce an easily seen material in the mud stream during a connection. Having noted the time at which the mud pumps were started, you then wait, and watch, at the shaker until this material appears in the returns, again noting the time. To calculate real lag time, you use the same formula as for the induced gas show method:

Real Lag Time = Time from pump start to first appearance - Downtime- any non-circulating time (connections).

Many materials, or mixtures of materials, can be used as a tracer. Common choices include uncooked rice, wheat, and popcorn kernals. A more recent popular choice is fluorescent flagging tape that has been cut into very small pieces. Always check with the drilling supervisor before you run a tracer. Tell him what you want to do and show him the material you are proposing to throw down the drill pipe. You do this because the mud comes out of the bit through orifices known as nozzles or jets, which, on occasion may become naturally plugged. This may or may not require a trip to clear them. However, if something you have introduced is shown to be responsible for plugging one or more jets and necessitating a trip, it is guaranteed

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Lag Time Calculations

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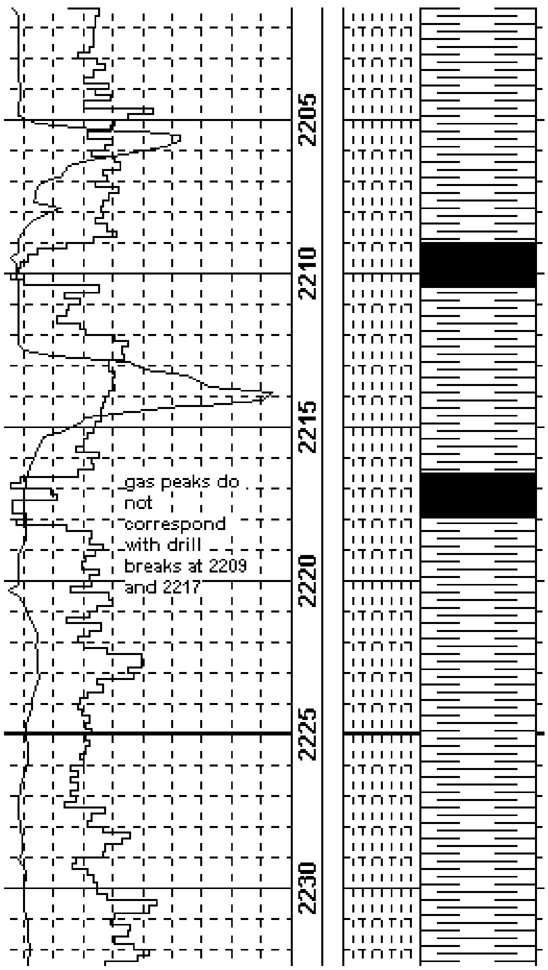
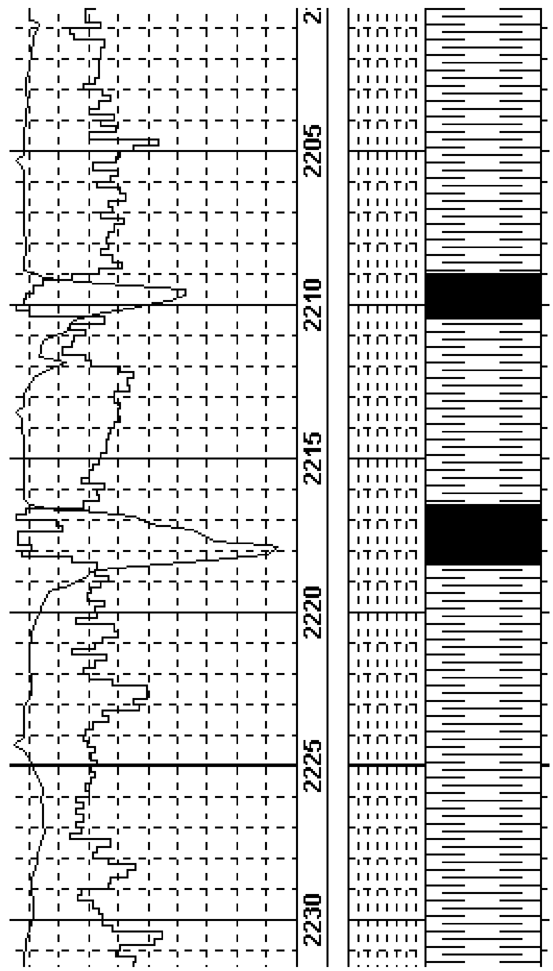


Bad Lagging



Good Lagging

that you will not be a popular person. Being careful is the keyword when running a tracer lag. Material such as grain can usually just be dumped into the top of the drill pipe (3-4 cups is usually sufficient). Material such a flagging tape are best wrapped in a loosely folded paper towel and then placed into the drill pipe. A wet paper towel will not plug a jet when it is being chased by several thousand kPas. If you are on a directional or horizontal well, do not consider running a tracer. The tracer material could easily plug mud motor necessitating a trip to clear them. It is by far the best practice to run a tracer lag during daylight; often these materials are not as easy to see as you might think.

Pump Output

Two types of mud pumps are used on modern drilling rigs. The triplex pump is most common, but many rigs still have duplex pumps. You must determine what type of pump(s) the rig has and which is used most often. Just as importantly, you must determine the configuration of the pump - the liner size and stroke length. These items are always in the tour book although they may not be obvious. Ask the driller if you have trouble finding them. For duplex pumps, the piston rod diameter, which must be input into the formula, is never recorded in the tour book. You can ask the driller for that information or, measure the rod yourself. It is a long, round, shinny piece of steel,

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Lag Time Calculations

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which you can see on the side of the mud pump. If the pump is running, it will be moving back and forth like a bat out of hell. It is recommended that you do any measuring when the pumps are not running or you may find yourself short a few fingers.

This spreadsheet is not the only source for pump output data. Many mud companies provide small booklets or folders with tables giving this same information. Most of these tables give outputs at a certain efficiency that is usually recorded at the top of the table. If you want to use a different efficiency (mud pumps are never 100% efficient, I usually use 95% for triplex pumps and 90% for duplex pumps), you will have to do some calculations. Yet another alternative is to ask the drilling supervisor for the needed information.

Final Words of Wisdom

As stated earlier, lag time is not constant. It changes continuously as the well is deepened and therefore you and the rig crew must continuously change or update the lag that is used. Often, but not always, this change will be approximately one minute every 50-75 meters. Check your lag time as often as possible against drilling breaks and gas shows as they occur and change it if necessary.

Lag time increases as a well is deepened, this is logical and it is true 99.9% of the time. However, be aware that under certain circumstances, the lag time can change unexpectedly. The lag time will change if the driller changes the speed of the mud pumps. For example, dropping the strokes per minute (SPM) to 75 from 105 will increase the lag time. An increase in SPM will decrease the lag time. Also, most drilling rigs have two mud pumps, which may or may not have the same configuration (liner size and stroke length) and hence output. Therefore the rig crew changing mud pumps (a not uncommon occurrence) may change your lag time. Even when the crew changes pumps, they usually try and maintain the same output rate by changing the SPM of the new pump. Always be aware of what is happening on the rig, and how sudden changes such as this may affect you and the samples. Be prepared to deal with the situation instantly.

In unusual circumstances, downhole conditions can create a decrease in lag time. When this occurs there will usually be a big time problem with the mud system. For example, if a large amount of anhydrite is drilled with a gel chem mud and it is not treated quickly enough, the mud will begin to resemble the consistency of chocolate pudding. In such a situation, the lag time has been known to actually decrease probably due to the mud creating a channel along the path of least resistance up the annulus. The manner in which this affects the samples is anyone's guess.

Lag may also be based on pump strokes rather than time. In fact, this method is more accurate since it does not matter if the rig crew changes the SPM. This is the preferred method to use in situations where a full mudlogging unit is available - usually overseas. After each sample is caught, the sample catcher zeroes or resets his stroke counters. When the counters read the number of strokes required to displace the annular volume, a sample is caught and the process is repeated. It is practically impossible to have rig crews catch samples based on strokes rather than time since it requires someone who is paying attention to the number of strokes all the time.

Lag time is not a difficult concept, but it is so fundamental to wellsite work that you must fully understand it before you can do a good job. A strip log using incorrect lag times stands out like a sore thumb and is indicative of a person who does not fully understand their duties.

C. Engen, ECL Canada Ltd.

C. Engen (Chuck) attended the University of Calgary receiving a degree in Archaeology in 1976 and a degree in Geology in 1982. He first worked as a mudlogger and then began working as a wellsite geologist in 1984. He has worked all over the world and is currently employed by ECL Canada Ltd. formerly known as Decollement Consulting.

Fall Social

This year's annual Fall Social in November was a hit with 81 people in attendance. On behalf the CWLS I would like to congratulate Grant Spencer of EnCana for winning the tax receipt. We raised $1,240.00 with all proceeds going to the Children's Cottage. I would also like to thank Baker Atlas for sponsoring the event again this year. The Fall Social is a great opportunity to network with friends and colleagues. Next year we would like to see the attendance hit the 100 mark.

Canadian Well Logging Society

Annual General Meeting
with guest speaker

Stuart McLean

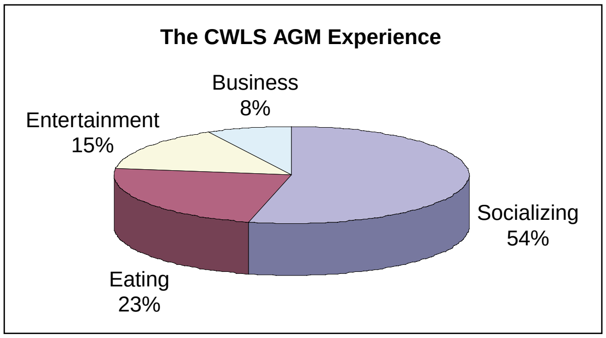
Host of CBC Radio's The Vinyl Cafe
and winner of the Stephen Leacock Award for Humour.

The Fairmont Palliser
Tuesday, February 10th, 2004

Reception: 5:00 p.m. Dinner: 6:30 p.m.

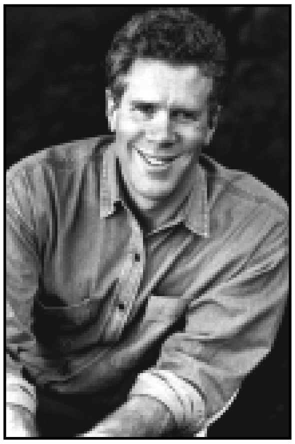
Tickets
Single - $45, Pair - $85 Corporate Table (8) - $340

For tickets call the CWLS at 269-9366
(Ticket deadline - February 5)



Stuart McLean is a best-selling author, award-winning journalist and humourist, and host of CBC Radio program The Vinyl Cafe.

Stuart began his broadcasting career making radio documentaries for CBC Radio's Sunday Morning. In 1979 he won an ACTRA award for Best Radio Documentary for his contribution to the program's coverage of the Jonestown massacre.



Following Sunday Morning, Stuart spent seven years as a regular columnist and guest host on CBC's Morningside. His first book, The Morningside World of Stuart McLean, was a Canadian bestseller and a finalist in the 1990 City of Toronto Book Awards.

Stuart has also written Welcome Home: Travels in Small Town Canada, and edited the collection When We Were Young. Welcome Home was chosen by the Canadian Authors' Association as the best non-fiction book of 1993.

Stuart's books Stories from the Vinyl Cafe, Home from the Vinyl Cafe and Vinyl Cafe Unplugged have all been Canadian bestsellers. Both Home from the Vinyl Cafe and Vinyl Cafe Unplugged received the Stephen Leacock Award for Humour.

Stuart is a tenured professor at Ryerson University in Toronto and former director of the broadcast division of the School of Journalism. In 1993 Trent University named him the first Rooke Fellow for Teaching, Writing and Research.

Since 1998 Stuart has taken The Vinyl Cafe on the road, performing in large and small towns from St. John's, Newfoundland to Whitehorse in the Yukon.

More than 700,000 people listen to The Vinyl Cafe every weekend.

ICE2004

BUILDING TO THE FUTURE · CSPG · CHOA · CWLS

MAY 31 - JUNE 4, 2004 · CALGARY, ALBERTA, CANADA

From May 31 to June 4, 2004, the CSPG, along with the Canadian Heavy Oil Association (CHOA) and the Canadian Well Logging Society (CWLS), will sponsor a joint conference – I.C.E. 2004. I for Innovation, C for Collaboration and E for Exploitation, the conference will be held at the Round Up Centre, Stampede Park, with the associated Core Conference at the AEUB Core Research Centre.

Along with the usual diverse program, I.C.E. 2004 will include a symposium on the oil sands. This is particularly appropriate with the recent realization that oil sands have put Canada into the category of truly oil rich nations.

Consistent with our general theme of Innovation, Collaboration and Exploitation, the conference will highlight new developments in the heavy oil, conventional oil and gas industries. These developments have occurred largely as the result of multi-disciplinary teams, an approach adopted by many organizations and one that is embraced in I.C.E. 2004.

Planning for the various technical and social events is now well underway, but additional volunteers are welcome – please contact one of the organizers if you would like to 'give something back' to your society. We hope that the following information outlines some of what we have planned for I.C.E. 2004. The call for abstracts will follow shortly, so plan on participating in what will undoubtedly be a memorable technical program.

Looking forward to seeing you in 2004!

Ian Moffat
General Chair, CSPG

Ken Faurschou
General Chair, CWLS

Daryl M. Wightman
General Chair, CHOA

Technical Program

Oral and Poster Presentations

Abstract Deadline: ***January 30th, 2004***
Extended Abstract Deadline: ***April 2nd, 2004***

This year's technical program is designed to reflect the importance of integration and collaboration between diverse disciplines, as we build towards a common future.

The conference will begin with a plenary session giving the floor to select high profile industry leaders who will speak on a common theme; *The Future of the Oil and Gas Business in the Western Canadian Sedimentary Basin*. The remaining two and a half days will be dedicated to high quality technical sessions specifically tailored to reflect the interests of the CSPG / CHOA / CWLS membership. Significant effort and emphasis will be put on creating sessions that capture and promote the common ground between the societies; other sessions will focus on more traditional subject matter of specific interest to the many disciplines within the joint membership. The program also encourages and accommodates student presentations.

We are now soliciting abstracts for oral and poster presentations for technical sessions which include the following themes:

- Heavy Oil - from grass roots exploration to final production, project overview, geology and geophysics, drilling and completions, reservoir and production, and facilities
- Innovations in the acquisition and application of LWD and wireline data.
- Advances in technique and application of core and cutting analysis.
- The multidisciplinary role of petrophysics – interpretation, integration and case studies.
- Exploration and development in foreign and frontier regions.
- Unconventional gas resources
- Structural controls on stratigraphy and reservoir distribution
- Pool studies: clastic and carbonate.
- Petrographic characteristics and mineralogic sensitivity of reservoirs in the WCSB.
- Recent advances in facies models

Individuals are encouraged to submit abstracts for presentation or posters that are beyond the themes listed, as the scope of individual sessions will be broadened or modified to accommodate high quality relevant presentations. Papers and posters will be grouped where appropriate to provide multidisciplinary content, with preference given to presentations integrating a variety of methodologies and techniques. Instructions for abstract submission can be found at www.cspg.org, www.choa.ab.ca or by visiting our website.

CWLS Archivist

Rosalie McDonnell of Talisman Energy has volunteered to act as the archivist for the CWLS. The society is renting space at the Glenbow Museum to house and protect artifacts of interest to the CWLS. If anyone has anything they would like to donate please contact Rosalie at (403) 231-2973 or email her at rmcdonell@talisman-energy.com.

UPCOMING EVENTS

February 10
Stuart McLean, CBC Radio
CWLS AGM

March 10
Louis Chabot (University of Calgary)
Single-Well Imaging Using Full Waveform Sonic Data

April 14
Bob Cluff (USGS)
The Permeability Jail

May 19
TBA

June 9
TBA

May 31 to June 4
CSPG/CWLS/CHOA Joint Convention

Corporate Members are:

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Vintage Petroleum Canada Inc.

For information on advertisement in the In Site and the Journal, please contact either of the publications co-chairs:

Mike Eddy (meddy@wellsitegas.com) at (403) 230-0630.

Discounts on business card advertisement for members.