InSite

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December 2008 Issue 2 Volume 27

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InSite

CWLS Magazine **December 2008**

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Cover Photos: *Views of Edinburgh Castle taken during the 49th SPWLA Conference in Edinburgh, Scotland in June*

If you have a photo that the CWLS can use on its next InSite cover please send a high resolution jpeg format version to Roy_Benteau@eogresources.com or dypma@tuckerenergy.com. Include a short description of the photo with your submission.

The 2008 - 2009 CWLS Executive:

Front row (l - r): Kelly Skuce, Douglas Hardman, Jeff Taylor, Greg Schlachter.
Back row (l - r): Howard Pitts, Vern Mathison, Dave Ypma, Gary Drebit, Roy Benteau.

President's Message

I can hardly believe it but Christmas is almost here and summer and fall have disappeared as I write this column and I cannot remember being busier or more energized by our industry. I am proud to be a part of the oil and gas industry and feel lucky that fate moved me in that direction. Although overwhelmed on occasion, I am especially pleased to serve on the executive of the Canadian Well Logging Society and participate with other professionals and friends in sharing ideas and keeping our profession recognized and vital. There is a renewed focus on well logging as we investigate areas such as: heavy oil, tight gas sands, gas and oil shales, gas hydrates, CO2 sequestration and the society is more engaged than ever in the pursuit of understanding the subsurface and measurements for that purpose. Please take it upon yourself to entice new members to support our society and volunteer when needed, you and they will not be disappointed.

I was fortunate this year to attend the 49th convention of the Society of Professional Well Log Analysts held in Edinburgh, Scotland in June. It was a stellar event not only because Edinburgh is a special place but also the program was excellent and the audio-visual and other facilities were world class. The convention brought together over 1,000 attendees including a complete list of experts from around the world and the organization were almost flawless. The papers I particularly found interesting were: Barbara Anderson and Tom Barber (SLB) et al.'s follow-up paper about the response of induction logs to dielectric effects in gas shales (2008_705009HH); Dick Merkel of Encana had a follow-up paper to his earlier one about using the NMR in tight gas sand analysis (2008_758391CC) and Weatherford had an interesting paper on fracture determination in horizontal CBM wells using a compact memory imaging shuttle system (2008_148676WW). You can check out these and other papers on their website (www.SPWLA.org).

In addition to the technical part of the conference, Jeff Taylor and myself attended the Annual General Meeting of the SPWLA and also had discussions with the President, Terry Quinn. In particular we wanted to investigate ways in which our societies could co-operate to better serve our membership. I have been in recent contact with Sue Cluff, North America II regional director and we are investigating a number of ways to improve the relationship between our societies and advance technical exchange. The SPWLA will be celebrating its 50th anniversary this year and although it is a very slightly younger society than the CWLS it has a larger and more internationally diverse membership and we will all benefit from a closer association.

The joint 2008 CSPG CSEG CWLS Convention held from May 12 - 15 at the Roundup Center was a great technical and financial success this year in large part due to the efforts of Brian Glover, CWLS General Chair, Tooney Fink, CSEG General chair, Bruce Schultz, CSPG General Chair and their teams. I was a proud participant and presenter at the convention because of the quality and diversity of the technical program and smooth running organization. Dave Greenwood is the CWLS General Co-Chair and Satyaki Ray is the Technical Co-Chair for the 2009 CSPG CSEG CWLS Convention and I am confident they are up to the task. I encourage you all to volunteer your time and efforts to help Dave and Satyaki make next years convention our best ever despite how high the bar has been set by Brian.

Roy Benteau
President

CWLS 2008 to 2009 Executive

Editors Message

Welcome to the December 2008 issue of your InSite Magazine. It somehow seems fitting that this issue features an article by Ross Crain on "A Future History of Oil and Gas Development, Celebrating 150 Years of Oil in Canada" and an interview with Ross by Kathy Chernipeski. Ross, like many of us, has weathered several economic downturns like the current one and he has never lost his enthusiasm, humor or energy. Reading through the interview I felt that Kathy has done an excellent job capturing the breath of Ross's career and depth of his character. Gary Drebit and M. Tesciuba's paper "Worm Hole Predictor, Observations with Acoustic Data" is reprinted from the proceedings for the World Heavy Oil Congress 2008 and is a glimpse into new technologies. It is definitely worth reading.

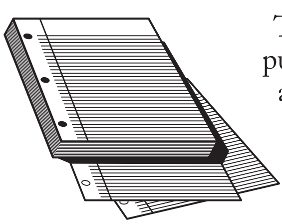
The CWLS has had some excellent luncheon speakers since our last issue. In May, Brent Warren of Q'Max Solutions discussed "Formation Damage Considerations in Unconventional Reservoirs"; in June, Dr. John Dvorkin of Ingrain talked about "The Future of Rock Physics: Imaging and Computing"; in September, Dr. Ahmed Badruzzaman of Chevron presented "Accuracy of Porosity Measurements in High-Angle or Horizontal Wells?"; in October, Nabil Al-Adani discussed "The Identification of Natural Fractures in Inclined Highly Fractured Formations"; in November, David C. Herrick of Baker Hughes presented "Porosity?! What are we talking about anyway?" and in December Richard Rosen of Shell outlined "Recent Improvements in Unconsolidated Core Analysis and Application to Heavy Oil Sands". If you were not able to attend the luncheon, most of the presentations are available as a webcast on the CWLS website.

When I decided to run for the executive of the society I had a few primary objectives: help secure the financing of the society by signing an agreement for the CWLS to participate in the joint CSPG/CSEG/CWLS convention each year; further improve the CWLS website to modernize it's look and add benefits to members; and to add to the inventory of excellent publications of the CWLS. I have always believed that it is important for each of us to nourish professional growth and read the journals and publications of our technical societies. I want the InSite magazine to be an icon of technical excellence and useful and practical tool to our members. In 2008, the focus of our volunteers has been to participate in our joint conference and add webcasts of technical luncheons and other features to our website at www.cwls.org but unfortunately we have only been able to generate two issues of the InSite magazine. I know we are all busy, but please share your knowledge and observations with the rest of the membership/petrophysical community by preparing an article or paper for publication in your magazine. I promise you I will give the current and 2009 Publication Co-Chairs all the help I can to improve our publications, including the writing of a paper for publication in the coming year. Join me in making our society better.

Thank you.

Roy Benteau
President and Editor

Call for Papers



The CWLS is always seeking materials for publication. We are seeking both full papers and short articles for the InSite Magazine. Please share your knowledge and observations with the rest of the membership/petrophysical community. Contact publications CWLS president Roy Benteau (Roy_Benteau@eogresources.com) at (403) 297-9191 or CWLS secretary David Ypma (dypma@tuckerenergy.com) at (403) 232-1720

New Members

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A Future History of Oil and Gas Development

Celebrating 150 Years of Oil In Canada

E. R. (Ross) Crain, P.Eng.
Spectrum 2000 Mindware

Introduction

The year 2008 marks the 150th anniversary of commercial oil production in Canada, and in North America, at Oil Springs, Lambton County, Ontario. The well was dug by James Miller Williams in 1858, a year before Edwin Drake's discovery in Pennsylvania, USA. To celebrate, it might be worthwhile to look forward, instead of backward, to assess the "State of Oil".

In the September 2004 CWLS InSite, I presented "A True History of Oil and Gas Development" to help set the record straight on who found what and when and where. The present article is intended to follow that development into the near future, hopefully to provoke intelligent thought and, possibly, action on the issue of "Peak Oil".

By 1958, a hundred years after the Williams well in Ontario, most of the world's largest on-shore oil discoveries had been found. You can thank British Petroleum, Shell, and Standard Oil for that. They did a good job, too, considering the seismic and logging technology of the era.

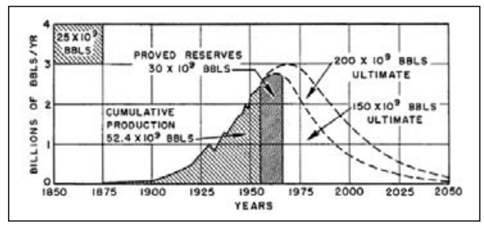
New countries were born, borders were moved, wars were fought (and are still being fought), to accommodate or protect oil production. Major international oil conglomerates exploited these tremendous, apparently limitless, resources. National oil companies took back "their" resources in many places, but relied on the multi-nationals for technical expertise and markets. The details would be too boring for words.

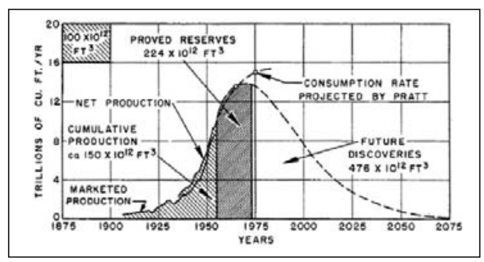
What is interesting, and pertinent, is the state of oil today, a mere 150 years after Williams' discovery. The exponential rise in use of oil over the past 50 years has placed civilization on a slippery slope of climate change (maybe), declining production capacity (probably), in the face of sky-rocketing long-term energy demand (certainly). To add a further complication, we are nearing or just past "Peak Oil". We'll know for sure very soon.

The very recent decline in oil price and oil demand in the fall of 2008 is only a temporary blip caused by the economic crunch in the USA. We go through these recessions every 10 to 12 years, as regularly as the sun spot cycle. I have lived through six of them: 1947-48, 1959-60, 1970-71, 1982-88, 1994-96, 2007-09. By 2012, we will be back on top of the economic roller coaster ride. A recession is only a temporary respite from our gluttonous appetite for oil and gas.

Peak Oil

M. King Hubbert developed the concept of peak oil in 1956 (Reference 1) and predicted the peak oil year for the USA (1971, Figure 1) and peak gas (1973-74, Figure 2) quite accurately. His prediction for the world's conventional oil peak was the year 2000, shown in Figure 3. Since he was unaware of deep water reserves, such as North Sea, west coast Africa, and deep Gulf of Mexico, he could be forgiven a 5 to 10 year bust in his estimate, but he appears to be very close to the truth.





Figures 1 and 2: Hubbert's original peak oil and peak gas graphs for USA from Reference 1, 1956

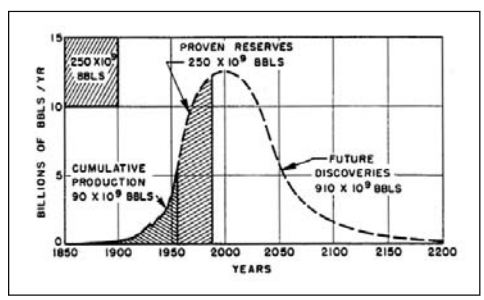


Figure 3: Hubbert's 1956 peak oil graph for the world (Reference 1). Compare to 2006 graph in Figure 4.

Hubbert's thesis was that the world's proven discoveries, plus new discoveries postulated from previous experience, would be produced at a rate that followed a Gaussian distribution (bell curve). The shape of the curve was set to fit annual production rates to date. The area under the curve would equal the sum of production-to-date plus remaining reserves, plus reserves yet to be discovered. The peak date could then be predicted by observation of the graph. He demonstrated that his concept was true for several depleted basins in the USA, then extended the concept to the entire USA, then to the whole world (as known to Shell, his employer, at the time).

The record for the last 100+ years production has been plotted by a major supplier in Figure 4, showing peak oil rate occurring around the year 2000. The flat top may indicate that so-called "swing producers" such as Saudi Arabia may not be able to produce more than they currently do to supply latent demand. This would explain the rapid rise in oil price starting in 2002, shown in Figure 5.

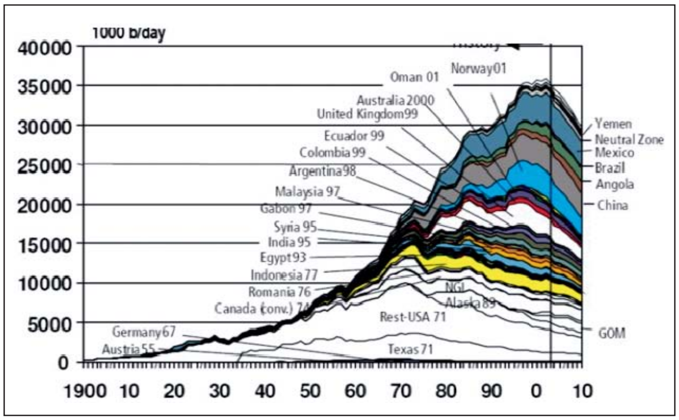


Figure 4: The current Peak Oil graph (from www.hubbertpeak.com) excludes unconventional oil, such as Canadian tar sands, but these can only add a few million barrels per day. Improving recovery factor (world average is only 36%) would offer another source of added reserves. Both come at higher cost than conventional oil.

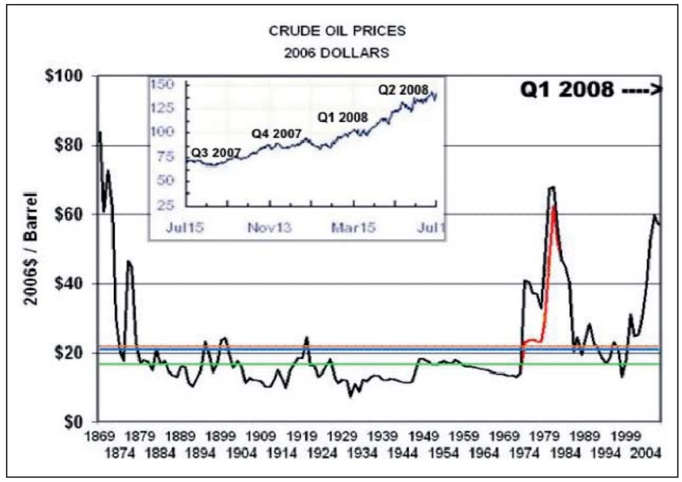


Figure 5: Oil price, in 2006 dollars, shows the median to be a little over US$21 (www.wtrg.com), but the current excursion exceeds US$140 (2nd Quarter 2008 - see inset at top left). Notice the major bumps: 1973 (OPEC oil embargo), 1979 (Iran revolution), and 2003 (Iraq war), all of which provided unnatural restrictions on oil supply. Price bumps for the 1st and 2nd World Wars are pretty minor due to rationed demand. The red line represents an ill-fated attempt at price-control by the USA.

Although Hubbert's paper spends 47 of its 57 pages discussing peak oil, peak gas, and peak coal, the purpose of the paper was to demonstrate the need to develop nuclear power to offset future declines in fossil fuel availability. That need has not disappeared, but we are 52 years further along the slippery slope than Hubbert was. No major oil company has yet integrated horizontally to include nuclear, wind, or solar technology to augment their depleting reserve base, not even Shell, which had paid Hubbert for his research.

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A Future History of Oil and Gas Development

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Hubbert's professional reputation was seriously harmed by this presentation. Most professionals of the era though oil was virtually inexhaustible. Today, most of the world's 6.5 billion people either feel this way too, or have never thought about the problem at all.

Price and production rate are highly linked, of course, and production quota limits set by OPEC tend to distort near-term trends. But the historical data is pretty revealing (Figure 5). The cost of living (price index) and rate of inflation (Figure 6) are strongly related to oil price and production rates, because everything we buy (from food to housing to clothing) has an energy component in manufacturing, delivery, or use.

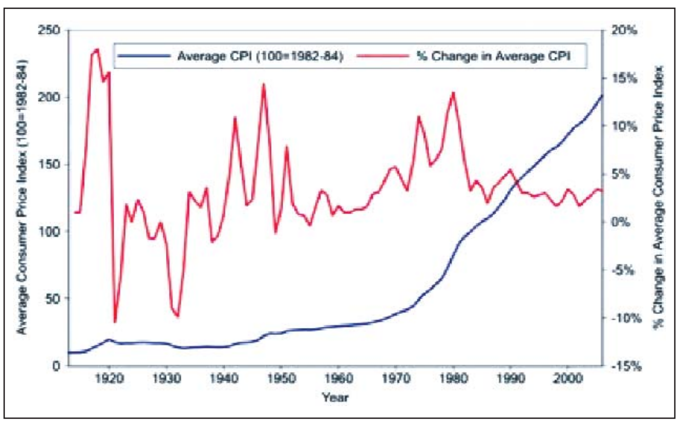

Figure 6: Price Index (blue) and Inflation Rate (red) for comparison to oil price changes in Figure 5.

Compare the red curve in Figure 6 to the oil price curve shown in Figure 5. Substitution, alternate renewable energy sources, conservation, and moral choice may reduce the impact of the Peak Oil problem, which has not yet appeared on Figure 6, which ends in 2003.

Peak natural gas curves are harder to predict, but they probably follow the general outline of the coal curves (Figure 7) if unconventional gas is included, at a price yet to be determined. Conventional gas in the US peaked in 1973, and in 2006, it took over 10,000 new wells in Texas just to maintain 2005 production rates in the USA. How long can this continue?

Only politicians, economists, and madmen believe that perpetual growth is possible in a finite world.

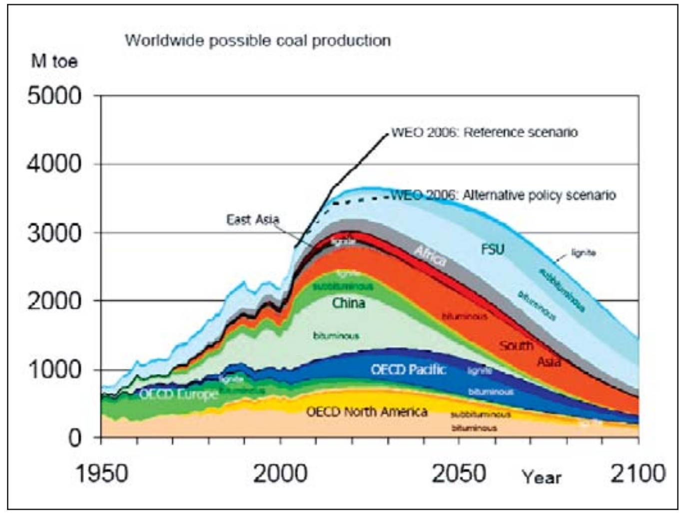

Figure 7: Coal production peak (from www.hubbertpeak.com) is about 25 to 50 years after oil and the peak is much broader. Higher price has a better chance to stretch the coal curve than the oil curve.

Peak Paradox

The First Paradox of Peak Oil is that we have to move faster on alternate energy sources now, even if we think the peak is far away. Alternatives to oil and gas take energy and time to build: nuclear, hydroelectric, clean coal, wind, and solar plants are energy intensive during construction, reconstruction, and repair. Steel, aluminum, plastic, concrete, and copper all require great amounts of energy to produce. Even enhanced recovery and infill wells will reach their economic limit in time. If we wait too long, there won't be enough energy left to build alternatives. Hubbert's graphs predicted this in 1956 and we have learned little since.

The Second Paradox is Society's unwillingness to face up to its responsibility to future generations. NIMBY rears its ugly head for most alternate energy sources. This is highly irrational. Dangers from the automobile far outweigh dangers from nuclear accidents or bird deaths from wind turbines. Automobiles and trucks kill 10 million birds a year in the USA, wind turbines only 70,000. Esthetic objections border on the insane - just look at urban sprawl, suburban outlet malls, or the downtown core of many cities if you want to see ugly.

Traffic accidents take 45,000 and firearms take 30,000 lives each year in the USA alone. These CDC stats don't count deaths from auto or coal pollution or industrial accidents at mines, drilling rigs or refineries (or the "oil wars" in Kuwait, Iraq, Sudan....). Multiply by 50 or 100 to estimate energy related deaths for the world.

By comparison, nuclear looks pretty safe at about 4000 deaths total across more than 50 years, all associated with Chernobyl in 1986, which was a primitive, inherently unsafe design. There were no deaths at Windscale (UK, 1957) or Three Mile Island (USA, 1979), the only other civilian reactor failures. A grand total of 4 deaths have been reported at military research reactors in the USA due to nuclear accidents.

The Third Paradox is irrational Government and Industry response to "junk" science. For example, there is no "hydrogen economy". There is no natural source of hydrogen - it has to be manufactured using other forms of energy. The energy input to output ratio (IOR) is 0.7, so the process is always below its economic limit. There is no Free Lunch or Perpetual Motion Machine. The corrosive and explosive nature of hydrogen, and its low energy density, makes its economical storage, distribution, and delivery to vehicles virtually impossible.

Bio-fuels from crops are merely breakeven on energy inputs. Soil degradation of mono-culture and land diversion from food crops are negative factors. Bacterial extraction of ethanol from bio-waste appears to be economic inside the plant gate, with an IOR of 7, but trucking in and out has not been counted.

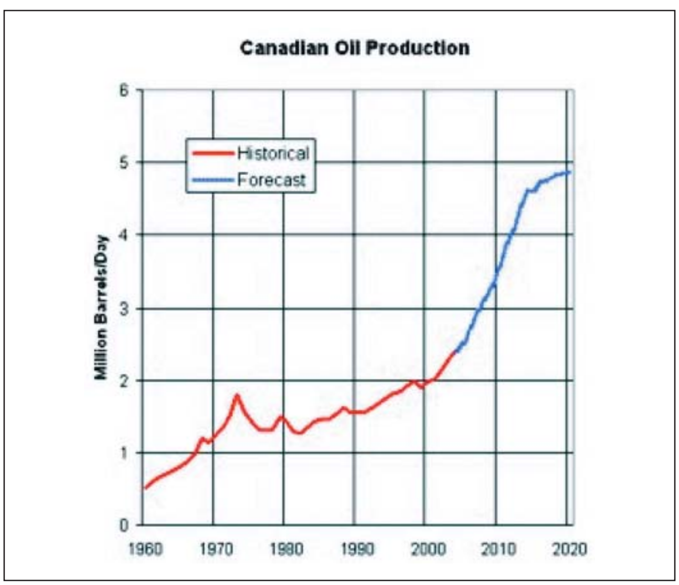

Figure 8: Increasing Canadian oil production is due to tar sand production and is expected toreach 5 million barrels per day by 2020.

The Fourth Paradox is Canada's continued increase in oil output (Figure 8), which tends to divert attention locally away from Peak Oil. Canada's conventional oil production peaked in 1974, but tar sands production has reversed the decline. Current capacity in the tar sands has brought Canadian production to more than 2.6 million barrels per day, with a target of 5 million by the year 2020 (equal to Iran, and double Venezuela or Iraq).

Although tar sands are the current darling of the Canadian oil industry (and so they should be), increases beyond 2020 are unlikely. There is not enough gas in North America or water in Alberta to produce all known reserves.

Canada's steady increase in production contrasts markedly with production declines in nearly every other major oil-producing country. For example, before and after the 1st Gulf War in 1991, Kuwait's Greater Burgan Field produced 2 million barrels per day, but cannot get past 1.4 million today. Most giant fields of the Middle East and Russia are in the same boat, according to investment banker Matthew Simmons (reference 2), with current decline rates between 5 and 10% per year. Simmons' recent (Feb 2008) presentation to the US Pentagon was pretty scary. If the Pentagon understood him, it might get scarier still.

The majority of Canadian production is exported to the United States by pipeline. Canada is the largest single supplier of US oil needs, a fact not well appreciated by US citizens or the rest of the world. "Offset" oil from the Middle East is imported into Eastern Canada - this paradox may need some re-thinking in the near future.

Aside from the tar sands, another significant reason for increased production in Canada is that independent oil companies, operating under a favourable free-enterprise tax system and rule of law, are content to produce from thin, low productivity, low quality reservoirs. The risk of political upheaval or confiscation is very low, as is exploration and development risk.

Policies, politics, and egos (not economics) make production from poor quality reservoirs difficult in most other regimes, except in the continental US and Western Europe on-shore. There is no magic bullet to cure the world's addiction to oil, so the exploitation of lower quality reservoirs will have to become "standard operating practice" very soon in the rest of the world.

Put 500 Canadian independents into Saudi or Venezuela, with Canadian rules and royalties, and the production rates would double in no time!

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Peak Critique

Critics complain that peak oil predictions are just plain wrong (oil is inexhaustible), or that decisions can be delayed (peak oil is 25 to 50 years away). The first complaint is physically impossible and the second is becoming more and more improbable. Either way, the result will be the same, sooner or later. Oil and gas will not last forever, no matter how much wishful thinking we do. It is not a question of "IF", but a question of "WHEN". Just to maintain constant production at the current rate, we need to find and develop a new "North Sea" every year. What do you think the odds are for that happening?

When the peak will occur is open to considerable debate. Princeton Professor of Geology Kenneth Deffeyes (reference 3) thinks it happened in December 2005. Matthew Simmons thinks it happened in 2007 - Figures 4 and 9 bears this out.

There is a more basic flaw in Hubbert's Peak Oil concept, perpetuated by Deffeyes and Simmons and most major oil companies. That flaw is the Giant Oil Field Fallacy. Both the US and Saudi Arabia have giant oil fields. The US also has thousands of small fields and Saudi has none. The US has 521,000 active producing wells, Saudi has only 1560. Does Saudi have no small fields?

Of course not. There are thousands of small fields in the Middle East. Oman has developed quite a few. But most Middle East national oil companies have not developed small fields, or the nooks and crannies of large fields, because to-date they haven't needed to. If we assume that nature distributed small fields in the Middle East as it did in North America, then there is more oil to be found, at a cost and effort to be determined.

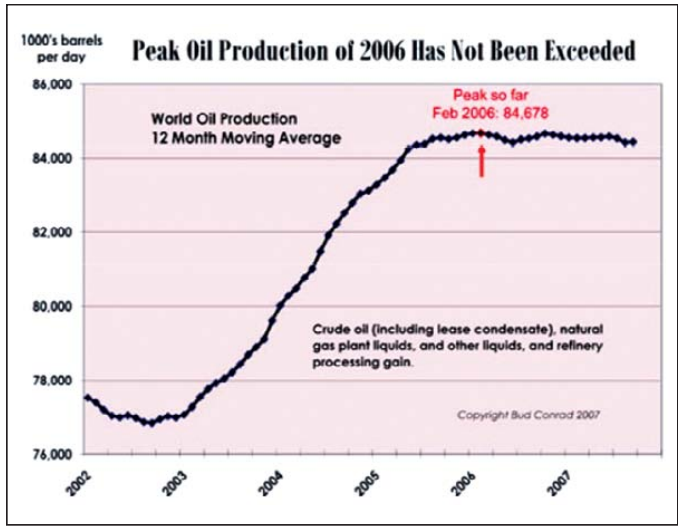

Figure 9: Detailed running average production of liquid hydrocarbons for the world shows the peak oil plateau extending from early 2005 to the present (www.caseyresearch.com). This graph includes all forms of liquid hydrocarbons; Figure 4 included only conventional crude oil. Saudi Arabia has promised (July 2008) to increase production by 200,000 barrels per day – less than 1/4 of 1 % of the current demand. Such a trivial increase will do nothing to reduce prices.

But it will take a serious paradigm shift in National oil companies to start the process. It will not prevent Peak Oil, but it will skew the Hubbert bell-curve to the right and stretch the peak to some degree. It will only take a couple hundred thousand new wells!

As we enter the 21st century, the developed world is in a trance of self-deception and denial, avoiding any rational discussion of long-term energy supply. Unless we start to act, energy security will rank well above military intelligence on the Oxymoronic Index.

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A Future History of Oil and Gas Development

…continued from page 13

Fixing Peak Oil

Well, you can't actually fix Peak Oil. It's going to happen. But, like software bugs, there are work-arounds.

Let's assume Plan A is to do nothing and fritter away our dwindling heritage of easy energy. I have two tame squirrels who can do better than that - they store nuts every day even though an inexhaustible supply is always on the feeder.

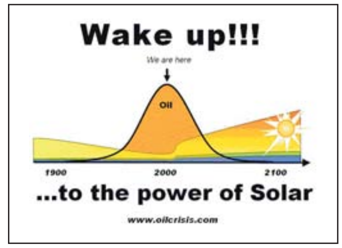
A variation of Plan A is to develop small fields and attic oil in the Middle East, Russia, and Venezuela to stretch the peak. This will take a serious price-driven propaganda exercise by consumers, and major oil company negotiations with nationalized oil agencies.

Business leaders, with or without the help of political leaders, have to come to grips with the Peak Oil issue immediately and establish plans whereby renewable energy can be built and installed, using oil and gas as needed, before this option runs out or becomes too expensive to be effective. Some may be doing this now, but they have been diligent in hiding the fact.

So Plan B might be to think beyond the short-term of share-price and move on to longer term planning, using some of the windfall from $140 oil to grease the skids. Every option can be considered, including clean-coal, nuclear, wind, solar, waves, tides.... It's called "thinking outside the box" or "widening the envelope".

Who is better qualified to do this than existing oil and gas companies? We have conquered the frigid Arctic, deep oceans, and super-hot geothermal terrains. How tough can a wind farm or nuclear reactor be? Or would you prefer a Dot-Com startup to do it for you?

By diverting oil and gas from electric generation (replacing it by alternate sources), the available hydrocarbon reserves will allow personal transportation to survive a little longer. Without hydrocarbon diversion and replacement by renewables, the automobile and airplane are a fast-dying breed, as well as suburbia, office towers, and possibly a civil society.



"Oil Companies" must become "Energy Companies", in practice as well as in name. Any oil or gas company that ignores Peak Oil will not be here 20 years from now. Energy companies of the future will be integrated horizontally across energy forms, instead of vertically across exploration, production, and marketing. Horizontal integration is the only sane solution for stretching the peak.

If existing oil and gas companies don't do it, someone else will. Oil company directors will have to explain to shareholders why they own a warehouse full of buggy-whips when all the horses are dead.

References

1. "NUCLEAR ENERGY AND THE FOSSIL FUELS" M. KING HUBBERT. Presented before the Spring Meeting of the Southern District. Division of Production, American Petroleum Institute. Plaza Hotel, San Antonio, Texas, March 7-8-9, 1956 www.hubbertpeak.com/hubbert/1956/1956.pdf
2. www.simmonsco-intl.com/ Click on Matthew R Simmons >> Speeches
3. www.princeton.edu/hubbert/index.html Links to Amazon.com

Further Reading:

http://en.wikipedia.org/wiki/Peak_oil. (contains more than 150 references)

Hubbert's Peak: The Impending World Oil Shortage by Kenneth Deffeyes

Beyond Oil: The View from Hubbert's Peak by Kenneth Deffeyes

Twilight in the Desert: The Coming Saudi Oil Shock and the World Economy by Matthew Simmons

The Party's Over: Oil, War and the Fate of Industrial Societies by Richard Heinberg

The Coming Economic Collapse: How You Can Thrive When Oil Costs $200 a Barrel by Stephen Leeb Ph.D.

The Long Emergency: Surviving the End of Oil, Climate Change, and Other Converging Catastrophes of the Twenty-first Century by James Howard Kunstler

A Thousand Barrels a Second: The Coming Oil Break Point and the Challenges Facing an Energy Dependent World by Peter Tertzakian

Energy: Physical, Environmental, and Social Impact by Gordon J. Aubrecht

Fueling the Future: How the Battle Over Energy Is Changing Everything by Andrew Solomon Ev Heintzman

The Final Energy Crisis by Andrew McKillop

About the Author

E. R. (Ross) Crain, P.Eng. is a Consulting Petrophysicist with over 45 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. He is an Honourary Member of the CWLS.

Ross has lived "off-the-grid" for more than 30 years, now with photo-voltaic power and natural gas backup. The wind generator died 10 years ago after 23 years of faithful service. He tele-commutes via the Internet, except to present courses on various facets of integrated petrophysics. A project to provide this service via the Internet is in progress.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2008 CWLS Fall Social

Thank you to the CWLS members for making this year's Fall Social a

Huge Success!

The Nov. 26th, 2008 Fall Social managed to raise $3147.00 through a silent auction and door ticket sales. A donation on behalf of the CWLS was made to the Canadian Association of Disabled Skiers (CADS) for this amount. The lucky winner of the subsequent tax receipt was Don Zver.

CWLS Convention Volunteer Recognition:
Brian Glover
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Rachel Newrick
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Bob Menard
John Kovacs
Andrew Anderson
Nicole Lehocky
Gordon Lee
Vern Mathison
John Nieto
Ross McLean
David Kelly
Munir Sharar

Canadian Association for Disabled Skiing

Naica, Chihuahua , Mexico – The Cave of the Crystals Limestone with a large pore and a large and selenite crystals

Engineering, Petrophysics, Wide-Open Spaces, Artificial Intelligence, And Everywhere Between

An Interview with Distinguished Member E. R. (Ross) Crain, P.Eng., Consulting Petrophysicist

By Kathy Chernipeski, P. Geol.
June 20, 2008

Although a community of modest size, humble ambitions, and tucked away out of sight in the foothills of Alberta, Rocky Mountain House counts as it's own a veritable petrophysical treasure! CWLS's Distinguished Member Ross Crain graciously granted some of the InSite staff an incredibly candid and eye-opening look at the development of petrophysics in the context of the petroleum industry's evolution in Alberta over the past several decades. The irony of his insight (and foresight for that matter), is that he has struggled with a progressively disabling visual impairment since he was a child. Ross left us impressed by his strength, knowledge and commitment to petrophysics, amid all his challenges, including the personal and those the whole industry faced.

Jeff Taylor landing in Rocky Mountain House

Our topics of conversation ranged from retirement, education and his website, the burgeoning interest in shale gas, and his involvement with and the history of the CWLS and InSite Magazine, to being a rancher and the environment, petrophysics and engineering, development of the first desktop computer system for log analysis, early logging tools, mentorship, family-work life balance, and artificial Intelligence, and then back again to retirement!

"There's no such thing as retirement anymore," Ross notes, and says he prefers to stay busy on things like giving his website a major overhaul (you can see it at www.spec2000.net). He recognizes the value of keeping his website updated when he gets questions in his courses about topics he hadn't covered. That's what happened about three years ago, when somebody asked about shale gas. "Never heard of it," he answered. After that course, he quickly found appropriate literature so the question could be answered next time. "You never stop learning in our business."

Now shale gas is a major play in northeast British Columbia. He shares "I've actually done one paying job on shale gas that wasn't 'shale' at all, it had porosity. I think a lot of the shale gas plays are misnamed, and are really silty shale or shaley silt…it's quite a different problem from a petrophysical point of view."

Ross has been involved so long with the CWLS, that no one quite remembers when he joined! He attended meetings in the old 400 Club in the early 1960's. Certainly he was involved by the early 1970s when he started consulting for PanArctic Oil. Then through the 1970s and 1980s he became involved in the publications of the CWLS Journal (published biennially more or less), which was the fore-runner to our InSite Magazine. His 25th Anniversary Edition was actually quite thick because by then four or five years had passed since the previous publication, and there was a sizeable accumulation of material at the society.

He thinks the InSite has interesting material, and notes that it is "nicer in many ways (than the Journal), because it comes out currently as opposed to two years from now." And he appreciates that now most of the cost of publication can be covered by advertising. The CWLS Log Analysis Handbook is widely used by petrophysicists. Ross was the originating editor, and the project was later continued by Dave Ormon. The attempt was made to get "all the suppliers of software to generate some Canadian examples, which were rare at the time. Most technical papers had US material in them, and (were) not especially pertinent to our part of the world."

He has also served as CWLS Treasurer from 1988-89 and 1989-90, and President from 1990-91, and was elected an Honourary Member in 1994.

Like many university students, Ross did not have a clear vision of his career plans when he graduated from McGill University in Montreal in 1962. Although Peterboro "was a very lovely little city," taking a job as a maintenance engineer at a local pulp

Ross Crain

mill, for example, was not the sort of life he wanted. His family had traveled extensively across Canada by car by the time he was a teen. "Heading off in an A-40 Austin, before the TransCanada Highway...you were basically driving oilfield roads from Manitoba to Vancouver. And it was so exciting at the time...just to see that much country without a fence."

So when Schlumberger offered him a job in Alberta, he remembered that original impression and says "it was the wide-open spaces, you know the classic cowboy song, that brought me out here!" He recalls working on a Schlumberger truck as an operator, carrying tools through the mud (46 years ago!), and being impressed about the sun setting in the north, and a few short hours later rising again in the north. "It was the middle of June, I wasn't thinking ahead to the middle of December."

In 1976, Ross decided on a second but parallel career – cattle ranching. He built a purebred Hereford business out of the bush near Rocky Mountain House, while continuing to develop his consulting firm. Although he has always enjoyed the agricultural lifestyle, after about 26 years, the time involved in raising cattle became difficult to manage with consulting and teaching as well. "The client wants you on a certain day, and a cow wants you on a certain day, and they may be on the same day" he chuckles.

Asked about the apparent conflict between the agriculture and petroleum industries in Alberta, he shares that he's "on both sides of the fence all the time....An oil company doesn't feel like paying me for the road use agreement that we've had for 26 years, and so I'm a farmer on that day, and then of course when one of my farmer neighbors complains about a pipeline right-of-way being a little muddy, I say, 'well, give it time, it'll be ok!'"

One of his good friends, Martha Kostuck (who has since passed away) was a great environmental leader and local veterinarian. "She was instrumental in getting most of the gas flaring stopped in Alberta. We used to engage in ferocious discussions. Conversations between an oil man with cattle, and an environmentalist veterinarian were always complicated" he expresses.

The decision to never connect to the power line was made when Ross first moved to Rocky Mountain House. He has generated power in the past by wind turbine, and now with clean burning natural gas, and solar panels, and stresses to do this "you also have to be extremely frugal about your power use" and "everything (in the system) has an age component in it that you have to think about."

Being an electrical engineer, Ross says "the electrical side has always been fun and that's really why Schlumberger hired me." He recalls the electric log era, running ES logs for Schlumberger and PanArctic, right up until 1975, along with induction logs and laterologs. He "always treated both the logging job and log analysis in the early days, and petrophysics today..."(as) an engineering job 90% of the time. The balance is art work. Some geologists might disagree."

He suggests there should be a School of Petrophysics at the University of Calgary, an idea he has been promoting for the last three years or so. The idea has been falling on "dull ears" however, due to funding pressures on even the basic needs of the University. Mr. Crain explains "the Petrophysics course at the University is actually well-attended, we get 100 people every year in that course and that is the maximum you can have in the room...We do essentially four short-courses (combined into one) in one semester. It's a lot for students to absorb."

Jeff Taylor remembers Ross' early petrophysical software "Meta/Log" and the "Log/Mate" that predated that, and reminds him of it. Ross wrote his first program in 1963, and it ran on an IBM 1620 in Regina. The program did potash assaying from GR-Neutron and Sonic logs at that time. He bought a new HP Computer the week Lotus 123 was announced in 1984, and "wrote the first log analysis program on a spreadsheet that day, and it just grew and grew." Ross says since then "the math hasn't changed a great deal. We can do more alternate models, and certainly we can do the probabilis-

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Engineering, Petrophysics

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tic stuff now, which we couldn't do before, and the neural networks. These are powerful advances, but I still rely on deterministic methods."

When asked about discrimination because of his eyesight, Ross shares "it's subtle, and it's somewhat self-imposed." Meeting new people in a business or social sense, and not knowing who you are talking to, creates a sort of distance. "At an AGM meeting, I see nothing...it's embarrassing at times so you tend to withdraw. Most people are very good about introducing themselves, but some forget. I don't think anybody ever refused to give me a job, or decided I was incompetent, or anything like that...I can write a story or do a log analysis with far more confidence and feel better about me than going to meet somebody...It's an interesting disability because most people don't know you have it."

Ross also shares his views on mentorship. "I had a very good mentor and it was by accident. Al Gorrell worked for J C Sproule & Associates back in the 60s...and he put me under his wing...he was extremely generous in that sense. Sadly, he was killed in a terrorist attack in Manilla in 1984, while on a mission for the UN."

"And in a way, I've tried to do something similar (being a mentor) with the website, because all over the world, I get emails...somebody in India, or somebody in Egypt, who can't afford to buy a book to aid her education, she's using the website as her course material for her own education."

Now he is able to chuckle about it, but Ross tells of the "hell and damnation" the industry lived through when "inflation, interest rates, and (the) National Energy Program all came together...(in) one of those 'perfect storms' for small businesses." Interest rates were up to 24% and as a standard of course, oil companies weren't paying their bills for at least 120 days. "It was a very troublesome time between roughly 1982 through 1988, and it was scary for an awful lot of people...tremendous domino effect and it carried on right into the early 1990s...before things really started to smooth out again."

Ross shares "I think CWLS and CIM and organizations like them, should maintain their identity their independence, and their locality. We don't need more papers on the Gulf Coast presented in Canada, we need more papers on shale gas, CBM, and tight gas, in particular case histories describing integrated petrophysical, engineering, geological, and production projects. The only way to do that is to stay somewhat local...if there were more trade back and forth between one society and another, so much the better." He adds "lifestyles and work styles are overstretching people, which narrows their ability to produce something that is publishable. People would have more freedom if we were allowed to telecommute!"

Kathy, Ross and Tyler pose with plane flown by Jeff

Jeff mentions artificial intelligence, and Ross offers "I built a piece of it in my spreadsheet and I never use it anymore." He continues "the workflow is becoming a little better classified...(but) it was very very difficult to get the mindset of the so-called expert into a piece of code, and I can't even always describe why I picked a particular parameter value." We respond with general laughter when he adds "I'm not sure that's intelligence, let alone artificial!"

Ross notes "It's hard to do the lunch circuit now, as I don't navigate city streets by myself any more. The guidance I get from Sonja is extremely helpful. She has a special talent for intuitively transmitting information about the ups and downs of city sidewalks and dim elevator lobbies. I wouldn't be doing half of what I do now without her help."

He says "I've had, in a sense, several retirements in my day, when business is down, ok I'm retired, business is up, I'm not retired." He's not letting it bother him because it's out of his control. "Between courses, consulting, and the never ending emails, I still have time for model trains, and looking after the ranch. I never run out of things to do, just time to do them."

Mr. Crain has certainly been an inspiration and we are fortunate to have had his contribution in the CWLS. We will also be looking forward to more Distinguished Member interviews in the coming publications.


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Worm Hole Predictor

Observation with Acoustic Data

G. Drebit, Schlumberger
M. Tesciuba, Schlumberger

This paper has been selected for presentation and publication in the Proceedings for the World Heavy Oil Congress 2008. All papers selected will become the property of WHOC. The right to publish is retained by the WHOC's Publications Committee. The authors agree to assign the right to publish the above-titled paper to WHOC, who have conveyed non-exclusive right to the Petroleum Society to publish, if it is selected.

Abstract

Cold Heavy Oil production with Sand (CHOPS) is defined as primary heavy oil production that involves the deliberate initiation of sand influx into a perforated oil well and the continued production of substantial quantities of oil along with the sand. These high-porosity and high-permeability channels, through which the sand and oil are produced, are also known as wormholes. These wormholes tend to develop and grow in the weakest sand and towards the highest pressure gradient. Wormholes may not grow from each perforation of the oil well; however, they tend to be stable when they do develop. For many CHOPS operators, oil wells are drilled based on the reservoir's porosity and resistivity log measurements. The drilled wells usually contain apparent pay sections of sufficient cumulative pay thickness to justify casing and completion. However, what is not so apparent is how productive those pay sections may be. The conventional practice is to select sands with the highest porosity and resistivity along the wellbore, perforate, and attempt to produce from them. This method has shown results with a less than 50% success rate.

This paper will show that by using analytical methods one can predict with greater accuracy which zones will be poor, moderate, or good producers by differentiating weaker unconsolidated formations from stronger more competent rocks. This improved understanding of where the wormholes will begin and how they will propagate gives the operators the ability to predict more economical and producible zones, optimize their completions program, reduce their costs by not completing sands that will not produce, and finally improve their well placement.

Introduction

Cold Heavy Oil Production with Sand (CHOPS) is defined as primary heavy oil production that involves the deliberate initiation of sand influx into a perforated oil well and the continued production of substantial quantities of oil along with the sand. At the present time in Canada, CHOPS wells can produce on average heavy oil at operating expenses that are about $6.00 CAN per barrel. This is less than the discovery cost for conventional oil in this basin. Oil rates of 5-20 m^3/day are feasible. Some other characteristics of CHOPS production in Alberta are: 15% to 20% of original oil in place (OOIP) can be extracted; Produced fluids contain 1% to 8% sand; Average well life is approximately 5 to 8 years. CHOPS production is characterized by high early oil rate followed by gradual decay.

The high-porosity and high-permeability channels, also known as wormholes, through which the sand and oil are produced, provide a much greater reservoir access. Large and local drawdowns at the end of wormholes allow them to grow in the weakest sand and towards the highest pressure gradient. Therefore, the presence of wormholes results in a substantial increase in oil rates and renders the production commercially viable.

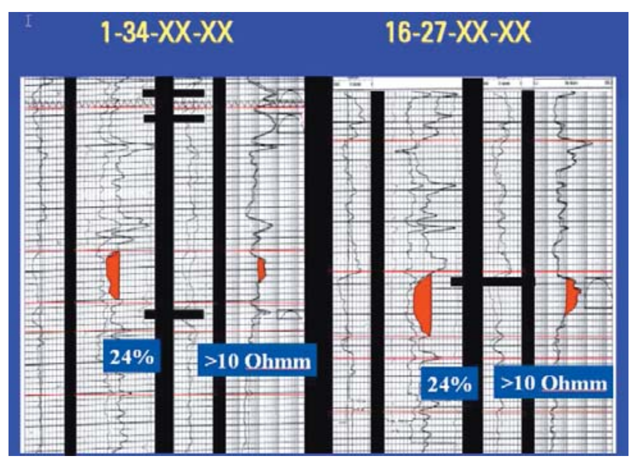

Figure 1: Problem Defined

To increase the instances of generating wormholes, operators are often using porosity and resistivity cut offs to define their perforating intervals. The higher the porosity the higher the chance of rock failure, however this rule of thumb doesn't lead to consistent production results. Figure 1 illustrates two wells, 1-34-XX-XX and 16-37-XX-XX, drilled in the same area by the same operator. Highlighted in Figure 1 are the porosity & resistivity cut offs used by this operator to determine the perforating intervals, respectively 24% and >10 Ohmm. Well 16-37-XX-XX shows a 6 meter pay zone and once perforated cumed 17,500 m^3. Well 1-34-XX-XX shows a 4 meter pay zone. The operator's expectation, due to the geographical proximity of the two wells and the use of the same cut offs, was to reach a production level approximately 2/3rd of the one reached in well 16-37-XX-XX. In actuality, the well cumed 654 m^3. The problem is thus defined. This paper will attempt to show that by using analytical methods one can predict with greater accuracy which zones will be poor, moderate or good producers by differentiating weaker unconsolidated formations from stronger more competent rocks.

Results

For sanding, there are four profiles that should be looked at: Pore Pressure (PP), Minimum Horizontal Stress, Elastic Parameters and rock Strength Parameters. Effectively, the logs required are Density, Compressional and Shear Velocity and Gamma Ray, which can be acquired in open or cased hole. Productivity is directly related to sand strength. Inducing failure of a pay sand, by exceeding its critical drawdown pressure (CDDP), will create a producing sand. If failure isn't achieved, that zone will not produce and those "booked" reserves will remain in place. Creating a geomechanics-based model that accounts for natural stresses and sand formation strength can play a key role in predicting a well's productivity.

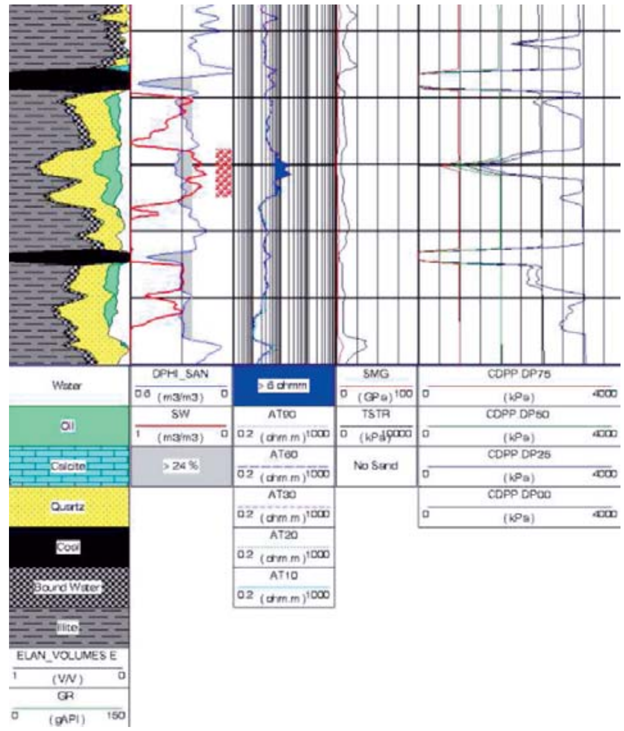

Figure 2: Example 1 – CDDP Evaluation

Example 1 (Figure 2) shows the CDDP in four stages. DP00 assumes zero depletion. Similarly DP25 assumes 25% depletion, DP50 assumes 50% depletion, and DP75 assumes 75% depletion. Per the operator's porosity and resistivity cut off standard, the zone to be perforated and produced is highlighted in red in Figure 2. Assuming there is zero depletion in this area,

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Worm Hole Predictor

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Figure 3: Example 1 – Production Results

CDDP reads 1,200 kPa. The closer the CDDP reads to zero, the more likely wormholes will form. In this case, it is thus predicted that wormholes will not form. The production chart (Figure 3) shows that initial production was close to 20 m^3/day, but soon fell off and averaged around 4 m^3/day after a year, while water production increased to 30 m^3/day within three months and remained at that level over the following year.

Example 2 (Figure 4) shows once again the four CDDP curves at four levels of depletion. At the area of interest, once again highlighted in red in Figure 4, the CDDP reads 400 kPa, assuming zero depletion in the area. In this case, it is predicted that wormholes will form since the CDDP reads close to zero. The production chart (Figure 5) shows that initial production was 8 m^3/day, less than in Example 1, however it continued to climb to over 30 m^3/day as the wormhole continued to grow. During the same time frame, water production averaged around 8 m^3/day, and never exceeded 13 m^3/day.

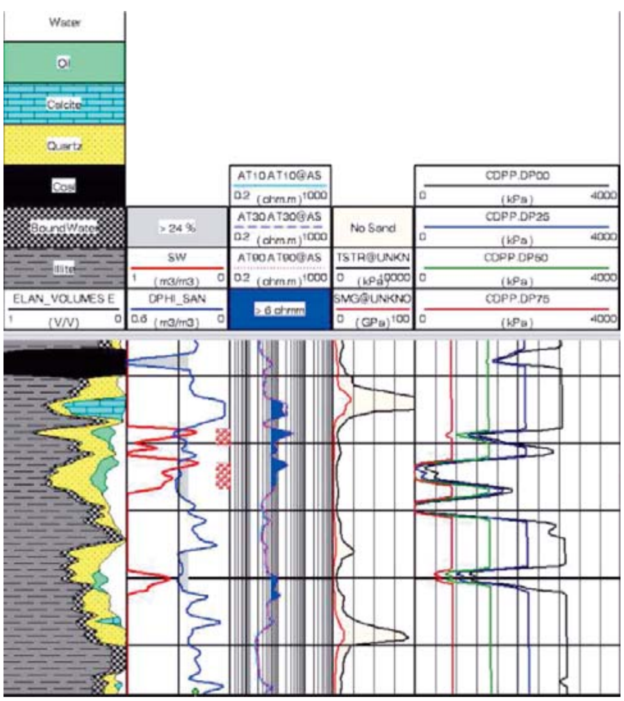

Figure 4: Example 2 – CDDP Evaluation

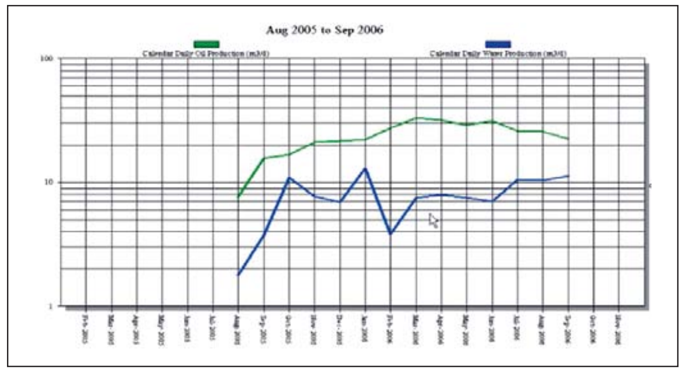

Figure 5: Example 2 – Production Results

Contrarily to Examples 1 and 2 that show data obtained in an Open Hole environment, Example 3 (Figure 6) represents a Cased Hole example where the same Density, Compressional and Shear Velocity and Gamma Ray data was obtained and analyzed. Even though the CDDP indicates that no wormhole will grow, and the logs indicated that the client's minimum porosity and resistivity criterions weren't met, the client opted to shoot the well to verify the validity of the CDDP to productivity relation. The production chart (Figure 7) confirms this relation. The well started producing at 3 m^3/day, and quickly dropped to 1.5 m^3/day where it hovered for several months before it was shut down in July 2006 when the production dropped below 1 m^3/day.

Figure 6 also illustrates the relationship between the CDDP and the shear velocity, plotted in black in track one. We see how the two curves follow each other and how the CDDP is driven by the shear velocity curve.

Though the prediction accuracy was found to be well above average with the sole evaluation of the CDDP, another element was needed to predict with much greater accuracy: Anisotropy.

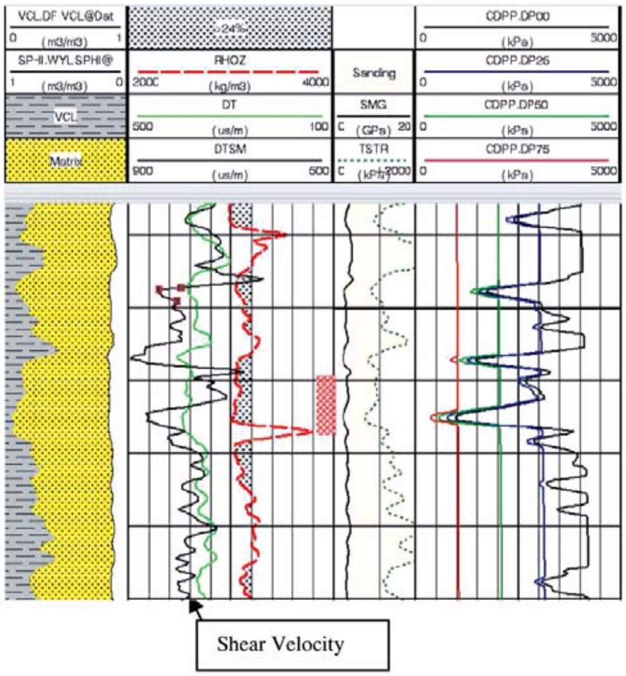

Figure 6: Example 3 – CDDP Evaluation

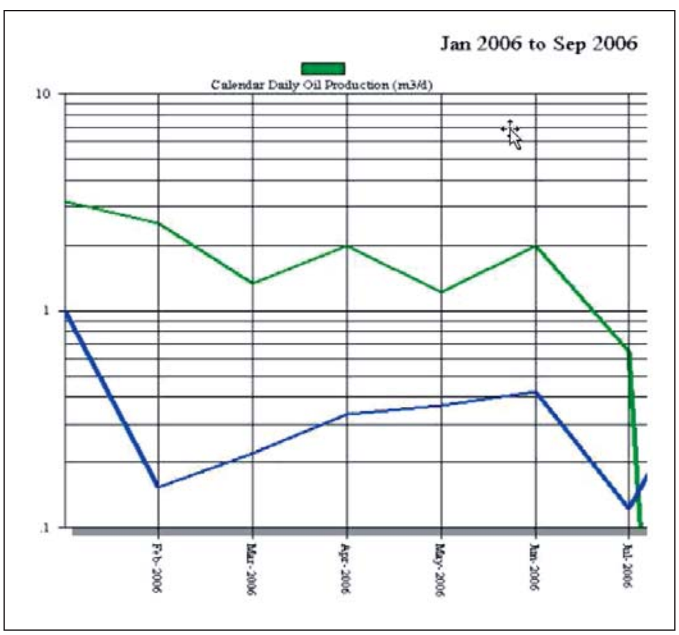

Figure 7: Example 3 – Production Results

Using the Sonic Scanner* (Figure 8) in the well illustrated in Figure 9, compressional and shear velocity data were acquired. From the dispersion plot graphed (Figure 10), we note that the X & Y dipole curves cross each other, therefore indicating that the anisotropy is stress induced and will have an impact on the sand production and perhaps direction.

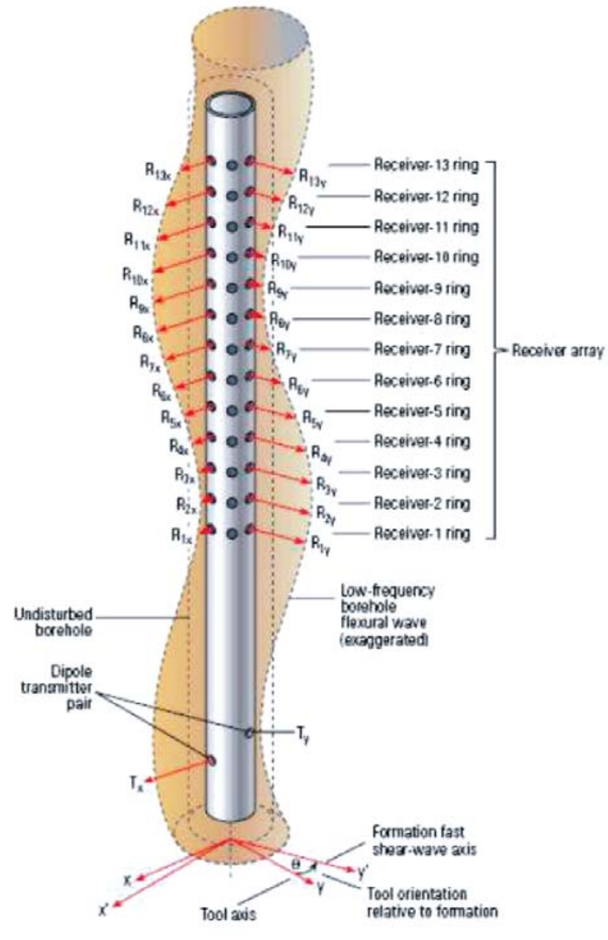

Figure 8: Sonic Scanner – Anisotropy Acquisition

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Worm Hole Predictor

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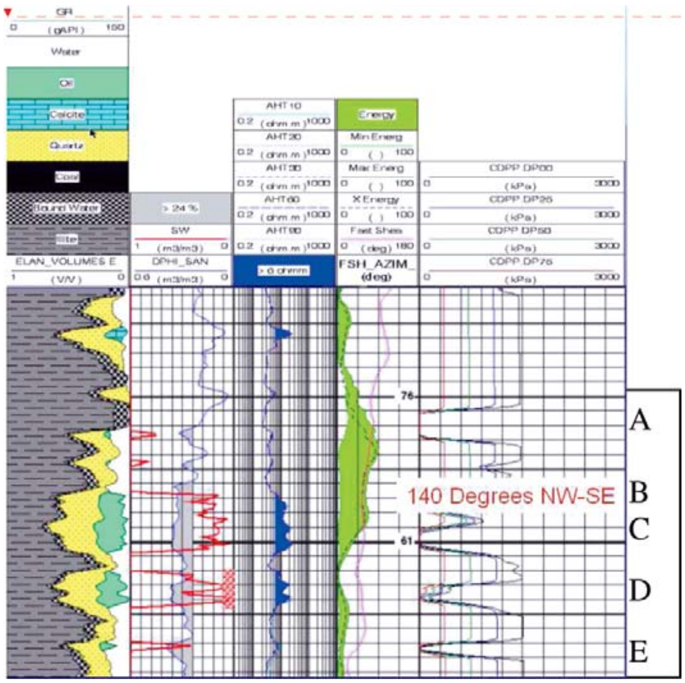

Figure 9: Example 4 – CDDP Evaluation with Anisotropy

Looking at Example 4 (Figure 9), based on the graphical representation of the oil, there should be 10.5m of net pay. According to the CDDP curves, 5 zones – A through E – will fail and therefore be prone to generate wormholes. The benefit of including the anisotropy in the analysis is that we can now distinguish among those zones and target the best producers. Zones B/C & D would previously have been considered to be equal producers, however from this analysis we can conclude that zone B/C will be a better producer since this pay zone has the possibility to generate wormholes and the rock stress is high. Zone D, on the other hand, shows low formation stress.

Anisotropy allows the user to determine the mechanism of anisotropy, in this case stress (Figure 10), where the maximum horizontal stress is at N50E and the minimum horizontal stress is 90 degrees to that.

Seven wells were studied using the Worm Hole Predictor. Figure 11 represents the location of those wells relative to one another and graphs the wormhole orientation based on the anisotropy data. It is interesting to note that the orientation of the minimum stress of those wormholes seems to follow a sand channel.

Further analysis of Figure 11 shows the criticality of the Worm Hole Predictor on well placement. In the North-East edge of

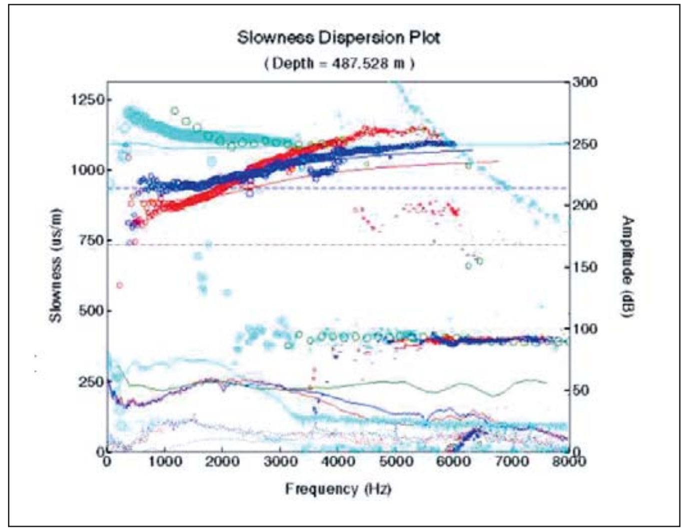

Figure 10: Example 4 – Dispersion Plot

this cluster of seven wells, we note two wormholes that will intersect and therefore jeopardize the production from both wormholes. Understanding the creation and orientation of the wormholes can therefore lengthen the life of the field and increase its production.

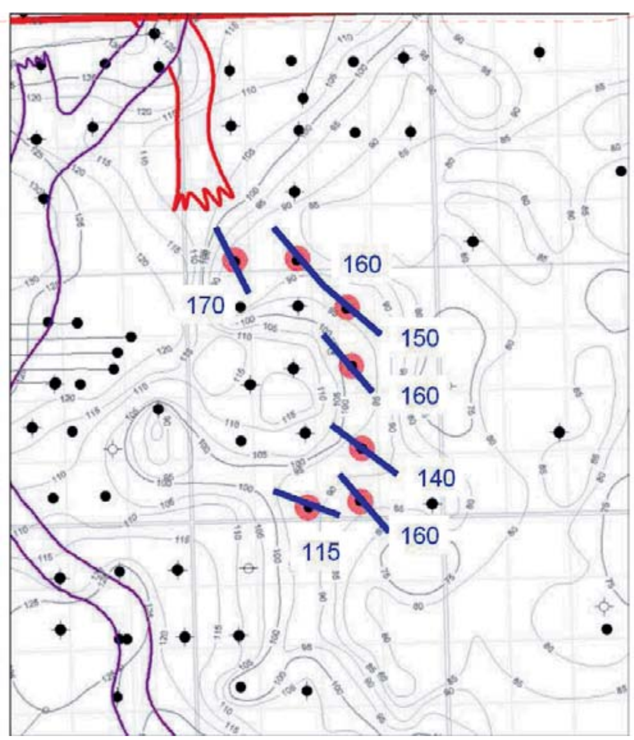

Figure 11: Structure Map

Wormhole Direction

Wormhole direction has always been a concern. Wormholes may travel between 1 to 2 Km away from the borehole. When wormholes from two boreholes intersect, there is a pressure drop in both wells and a chance that both wells may never recover to be producers again. Therefore knowing the direction of the propagation is important.

As described in SPE 98315, where sandstone outcrops in Britain (UK) were examined, J. Heiland and M. Flor noted that there are two types of failure, either Breakouts or Slot-like failures. In their experimentation, the Slot-like failures were observed on rocks with high porosity, low UCS and very little clay structure, similar to CHOPS formations, while the Breakouts failures were observed in rocks with opposite characteristics (Figure 12). It is also interesting to note that the Slot-like failure takes place in the Minimum stress direction (Figure 13).

In another study, done in 1993 by Andrew Squires in the Lloydminster area, tracer material was put into wellbores and its resurfacing in the production of other wellbores was noted. The direction noted is N45E (Figure 14), 90 degrees away from the wormhole direction indicated in Example 4. In the case of Squires experimentation, it's observed that the direction of the tracer material rotated 90 degrees as it got closer to a Shale channel. One point remains unanswered however in this study: the maximum stress wasn't measured, however it is generally agreed that N45E is the maximum stress direction in this area.

Table 1: conceptual model for failure characteristics of boreholes in sandstones

		Slot-like failure	Breakouts
Grain morphology	Grain size distribution	Narrow	Wide
	Grain shape	Rounded to well rounded	Angular
	Grain size	"Large"	"Small"
Grain contact and bonding properties	Grain contact	Tangential (Point)	Long (Planar)
	Grain bonding	Sutures, very little clay	Clay cement and / or clay coating of grains
Additional factors	Porosity	"High"	"Low"
	UCS	"Low"	"High"
			Fabric elements restricting removal of grains (i.e. fiber-shaped particles etc.)
Result	Grain bond failure and compaction	Easy	Difficult

Figure 12: SPE 983315 – Failure Characteristics
Courtesy of J.C. Heiland & M.E. Flor – SPE 98315

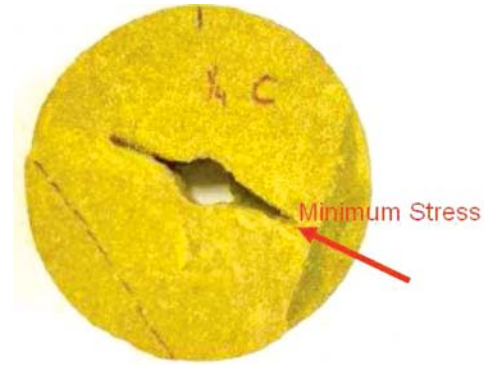

Fig 13: SPE 98315 – Failure Shape
Courtesy of J.C. Heiland & M.E. Flor – SPE 98315

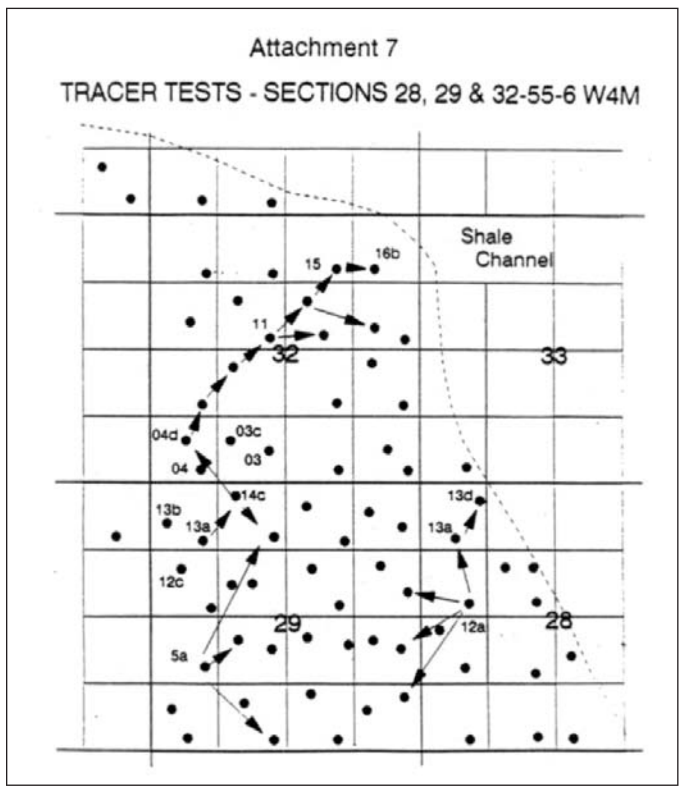

Fig 14: Tracer Test Results. Courtesy of A. Squires, "Inter-Well Tracer Results and Gel Blocking Program"

Continued on page 28…

Worm Hole Predictor

…continued from page 27

Discussion

Even though the results shown in Example 4 indicate that the wormhole tends to grow in the weakest sand and towards the highest pressure gradient, the experimental results illustrated in SPE 98315 (J. Heiland and M. Flor) and from A. Squires' study are differing. We can therefore speculate that other parameters come into play in the determination of the wormhole orientation. Such possible factor can be geological barriers and viscosity?

Assuming that the sand channel where the cluster of wells illustrated in Figure 11 is narrow and bordered by shale, than Squires results are still valid in this case. Without further geological information we can assume that the sand channel is so narrow that no wormhole can grow in the maximum stress direction. Hence our previous observation that the womholes of those seven wells grow in the minimum stress direction.

Further studies with a more complete geological picture of the area should be performed to gain a better understating of the wormhole direction and the impact of barriers on that direction.

Conclusion

For many operators of CHOPS properties, it is rare that their drilled wells do not contain apparent pay sections of sufficient cumulative pay thickness to justify casing and completion. However, what is not so apparent is how productive those pay section will be. Since productivity is directly related to sand strength, inducing a failure of pay sand, by exceeding its critical drawdown pressure (CDDP), will create a producing sand. If failure is not achieved, that zone will not produce and those "booked" reserves will remain in place.

With the acquisition of four profiles and assisted by the MEM (Mechanical Earth Model), the Worm Hole Predictor can predict the creation of the wormholes, and thus can play a key role in predicting a well's productivity by differentiating weaker, unconsolidated formation, from stronger, more competent rock.

The benefits of the Worm Hole Predictor extend to optimized completion programs, reduced cost by not completing sands that will not produce and improved well placement recommendations to avoid having wormholes intersecting and jeopardizing well production.

Nomenclature

CHOPS – Cold Heavy Oil Production with Sand

CDDP – Critical Drawdown Pressure

References

1. HEILAND, J.C. and FLOR, M.E., Influence of Rock Failure Characteristics on Sanding Behavior: Analysis of Reservoir Sandstones From the Norwegian Sea; 2006 SPE International Symposium and Exhibition on Formation Damage Control, SPE 98315, February 2006.
2. SQUIRES, A., Inter-Well Tracer Results and Gel Blocking Program; 10th Annual Heavy Oil & Oil Sands Technical Symposium, March 1993.

Frontiers + Innovation

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TOPIC: **SCAL using NMR: Current Techniques and Beyond**

SPEAKER: **Derrick P Green, President, Green Imaging Technologies**

ABSTRACT:

Green Imaging Technologies, Inc. (GIT) specializes in providing Magnetic Resonance Imaging (MRI/NMR) solutions for routine and special core analysis. In addition to traditional NMR-based pore size distribution measurements using T2 or T1, GIT has developed techniques to obtain accurate saturation distributions in the rock using reservoir fluids. These saturation distributions can be combined with centrifuge or pressure apparatus to obtain Capillary Pressure or Relative Permeability. Our current commercial product offers measurement and analysis of Capillary Pressure, T2 distributions, and Saturation/Porosity Profiles.

Traditional centrifuge capillary pressure measurements require the fluid(s) to reach equilibrium at many different speeds. This is very time consuming as each equilibrium step can take days. A new method, called GIT-CAP, directly measures the water saturation distribution in the core plug using as few as two centrifuge speeds. The measured water saturation, together with the known centrifugal force, directly leads to a capillary pressure curve. The new technique measures the capillary pressure curve more quickly and accurately, and leads to significant increases in lab throughput, giving clients their results when they need them.

This presentation will provide an overview of GIT, the underlying MRI technology, current NMR T2 Distributions, a brief description of the patented technique for finding capillary pressure. It will also summarize the results of the technical validation trial conducted in 2007, and provide a look at future work, such as relative permeability.

BIOGRAPHY

Derrick Green holds a Bachelor of Science and a PhD in Electrical Engineering from the University of New Brunswick, Canada. For the last 3 years, Mr. Green has served as President and Chief Technical Officer for Green Imaging Technologies, Inc. (GIT) in Fredericton, New Brunswick. GIT designs and markets NMR/MRI software for routine and special core analysis, aimed primarily at the petroleum industry. Before that, Derrick spent 6 years developing new medical MRI products, technologies and measurement techniques for Philips Medical Systems in Cleveland, Ohio. His strengths include research and product development, project management and developing new MRI testing techniques. Derrick has led many major research and development projects over his career and is a member of several industrial organizations, such as the Society of Petroleum Engineers and Society of Core Analysts. Derrick is a registered professional engineer in the State of Ohio.

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SCAL using NMR:
Current Techniques and Beyond,
Derrick P. Green

February 04, 2009
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