InSite

CWLS Newsletter
SEPTEMBER 2004

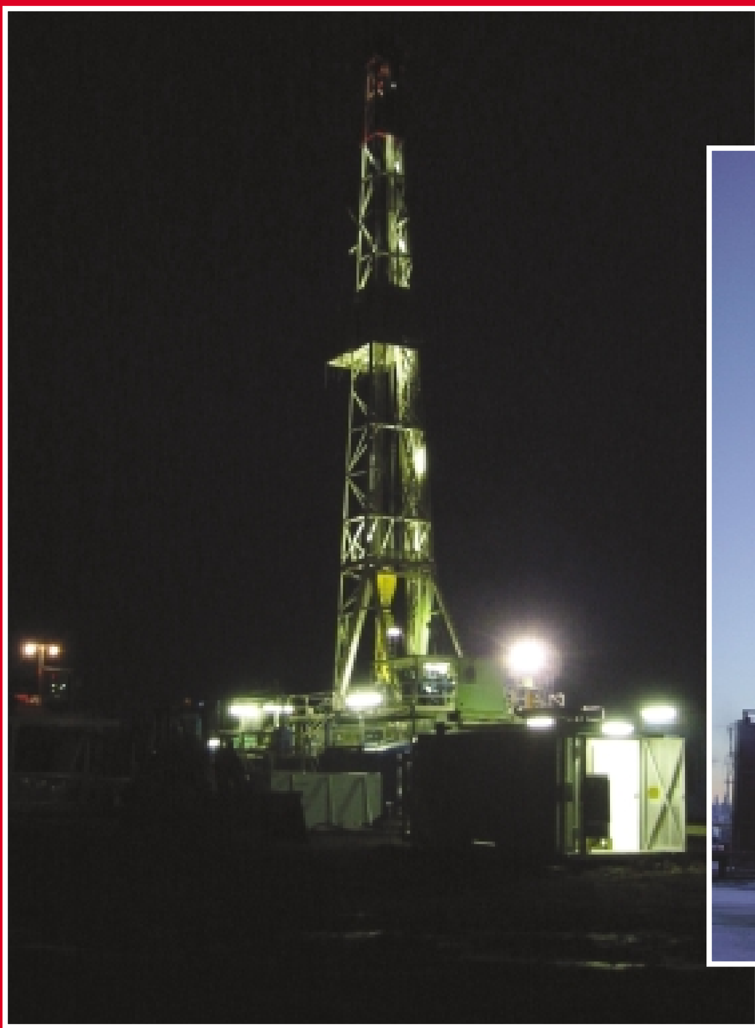


Table of Contents

Cover Photos: *Night time drilling operations near Grande Prairie. Photo Courtesy Robert Bercha.*
Early morning logging operations in the Arrowhead Area, NWT. Photo Courtesy Brian McGregor.

If you have a photo that the CWLS can use on it's next InSite cover please send a high resolution jpeg format version to Robert_Bercha@anadarko.com or meddy@wellsitegas.com. Include a short description of the photo with your submission.

President's Message

Here is one new item plus a progress report on ongoing initiatives.

50th Anniversary

The new item that has popped up is the CWLS 50th anniversary.

I am struggling with this one because I am not very sentimental about dates. The idea I was pitching around my house for celebrating the millenium was to drive into Saskatchewan at 11:45 p.m. MST. We would wait from 10:45 p.m. CST to 11:15 p.m. CST then drive back into Alberta. It would then be 12:15 p.m. MST and the whole thing would be over.

Another troublesome point is that Society documents show that the Canadian Society for Well Log Interpretation (CSLWI) was a going concern from 1955 through to 1957. The only change in 1957 was a name change to the CWLS. So do we celebrate 50 years of operations or wait and celebrate 50 years under the current name? 1955 is probably the best start date since the Society had some 10th anniversary celebrations in 1965.

Writing the above paragraph has increased my cynicism about celebrating date numbers.

Some members have expressed enthusiasm for a series of big anniversary events. That would be nice but sounds like a lot of work. And I have a hard time seeing any significant additional benefit for the Society or its members.

My inclination at this point is to have no extra anniversary events but to honour long-term/founding members through the InSite and through our Fall Social and AGM. Unless someone comes forward as a volunteer to spearhead special events, this is probably how things will end up.

Progress Report

Six months ago I listed some things I would be trying to accomplish during my term. Here's the progress report.

Create a Logging Standards Committee: There has been no progress on this. If it is still unaddressed at the end of my term I will take it on as a personal project while I am Past-President. If anyone has an interest in participating in this effort, or wants clarification on what it is we are trying to accomplish, please contact me.

Create a Log Graphic Standard Committee: Four out of the five open hole logging companies have indicated that they would be able to comply if we were to specify that the standard for black and white log graphics in digital form is a Group 4 TIFF. The fifth company does not disagree, they have just not responded to inquiries. Samples of each company's interpretation of this standard are available on the CWLS website. I would be interested in getting any feedback as to whether these sample files all behave the same in a given application.

Attract First Rate Luncheon Speakers: The recent lunches have been the best attended in recent memory (about 50% above average). This attests to the appeal of the speakers that John Nieto has been bringing in.

Encourage More Non-Commercial Local Luncheon Speakers: I think it is a little early yet to make a call on how this is going.

Run Technical Events at a Loss: Our first chance at this will be for the short course we are planning in the fall. Members can expect very attractive pricing for this event.

Bring in More Students: Students have been taking advantage of the free lunch tickets. There were four SAIT students at the June lunch. That's four more students than we usually get. The promotion of the free lunches at U of C was a bit hit-and-miss but should be on track in the fall. I have also tried to set up a technical event for students at the U of C. Either there is no interest or I have been calling the wrong people.

Spend on a Legacy Item: The one item I have identified so far is an upgrading of the Rw catalogue. I would like to pay someone to make it more user-friendly. In the last InSite we asked for expressions of interest from parties that might want to take this on. No one replied. We will look further afield for companies that will accept money for this project.

If anyone has any comments or ideas please contact me at (403) 232-1705 or jlevack@tuckerenergy.com.

Jeff Levack, CWLS President

Editor's Note

After a hot summer and some well earned vacation time many of us are back at work rolling up our sleeves and preparing for the winter drilling program. With oil prices near $48 USD a barrel the pulse of the oil patch is racing upwards and the oil patch rollercoaster shows no real signs of having reached the top yet. In all of this excitement a pause to reflect on the effect our industry has had on the development of our current civilization can be instructive.

In this InSite we have two papers. The first provides a whirlwind tour of the history of oil and gas exploration and the roots of our dependence on it. The extent of our civilization's dependence on hydrocarbons is not as obvious as it appears. The first thing that comes to mind when oil is mentioned is the gasoline that we use in our cars and trucks. However, much of what we take for granted exists only due to the creative manipulation of hydrocarbon molecules. Plastics, various chemicals, the heat in our homes; all are related to hydrocarbons in one way or another.

The second paper delves into the tricky problem of obtaining accurate porosity readings in deep, hot wellbores with carbonates. Getting accurate porosity measurements from logging tools will continue to be of paramount importance. With significant gas discoveries being made in carbonate reservoirs in the last couple years, this paper is very timely.

We have also added a new column called "Tech Corner". The column will provide a brief overview of a device or technology that is of interest to the petrophysical community. This issue we have a brief look at Spectral Core Gamma Machines.

Enjoy the InSite!

Robert Bercha
Mike Eddy
CWLS Publication Co-Chairmen

Letters to the CWLS:

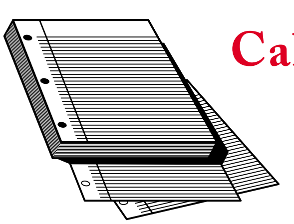
I am currently a student at SAIT (bachelor of Applied Petroleum Engineering) and a Graduate Student at the University of Calgary in Petroleum Engineering. Between the two, I was a logging engineer for 4 years.

I attended the "Formation Damage" presentation on Jun. 9, 2004 by Brant Bennion.

Currently I am involved in research on tight carbonate gas reservoirs. The presentation on Formation Damage was a "sight for sore eyes" to me. It opened up new concepts for me and confirmed my recent findings. It caused me to re-direct and fine tune my research. To make it short: "It was simply great".

I would like to express my compliments to the CWLS for the great work and for allowing students like me to attend these precious presentations (free of charge). I hope one day to have enough knowledge and experience to present to this highly professional society.

Best regards,
Hamid Farid



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 petrophysical community. Please contact publications co-chairs Mike Eddy (meddy@wellsitegas.com) at (403) 230-0630 or Robert Bercha (robert_bercha@anadarko.com) at (403) 231-0249.

As the Winch Turns

Bigger is Better??

In 1961 I worked as a log analyst at Home Oil Company Limited. At that time the standard electrical log scale was 0-50 ohm-m. After an active drilling season in Alberta we noticed that many of our reservoirs had resistivities greater than 50 ohm-m and that the traces were going off scale.

When on behalf of my company, I gave the logging companies a standing order that all future induction-electrical logs were to be run on a 0 – 100 ohm-m scale, I met a surprising reaction. The Vice President (no less) of one of the leading logging companies felt that this request was unreasonable. Apparently, certain fairly influential people, e.g. exploration managers and entrepreneur presidents, were inclined to rate the technical quality of a log by the magnitude of its deflections. Thus logs with larger deflections were considered superior and obviously of better quality then those with smaller deflections. Furthermore, the logging tools that provided these readings were also superior.

I was quite taken aback that such ridiculously twisted scientific/technical "logic" could influence the choice of logging company and electrical tool for a particular job. However, upon careful questioning the aforementioned V.P. assured me that was the case.

As interesting as this was, I could only express my condolences, and say that my standing order still stood! It is easier to add the tracks in 10 ohm-m rather than 5 ohm-m divisions. In most cases it didn't exceed 100 ohm-m keeping it on the first scale.

G.E. Dawson Grove ('D-G')
P. Eng., P. Geol., Past President, C.W.L.S

Logging tools on the catwalk. Photo courtesy Robert Bercha

CWLS 2004 to 2005 Executive

President

Jeff Levack
Tucker Wireline Services
900, 444 – 5th Avenue SW
Calgary, AB T2P 2T8

403-232-1705 (Office)
403-804-6679 (Cellular)
403-264-2118 (Fax)
jlevack@tuckerenergy.com

Past President

David Shorey
Baker Atlas
1300, 401 – 9th Avenue SW
Calgary, AB T2P 3C5

403-537-3663 (Office)
403-510-7105 (Cellular)
403-537-3801 (Fax)
Dave.Shorey@bakeratlas.com

Vice-President

John Nieto
Anadarko
425 – 1st Street SW
Box 2595 Stn M
Calgary, AB T2P 4V4

403-231-0276 (Office)
403-669-0786 (Cellular)
403-231-0463 (Fax)
john_nieto@anadarko.com

Secretary

Khrista Kellett
Talisman Energy Inc.
Suite 3400, 888 – 3rd St. SW
Calgary, AB T2P 5C5

403-237-4877 (Office)
403-860-0635 (Cellular)
403-237-1458 (Fax)
kkellett@talisman-energy.com

Treasurer

Darren Aldridge
Baker Atlas
1000, 401 – 9th Avenue SW
Calgary, AB T2P 3C5

403-537-3505 (Office)
403-863-4449 (Cell)
403-537-3767 (Fax)
darren.aldridge@bakeratlas.com

Publications Co-Chair

Mike Eddy
Wellsite Gas Detection Inc.
#1, 2010 – 30th Avenue NE
Calgary, AB T2E 7K9

403-230-0630 (Office)
403-852-9743 (Cell)
403-230-0672 (Fax)
meddy@wellsitegas.com

Publications Co-Chair

Robert Bercha
Anadarko
425 – 1st Street SW, Box 2595 Stn M
Calgary, AB T2P 4V4

403-231-0249 (Office)
403-512-9446 (Cell)
403-231-0463 (Fax)
robert_bercha@anadarko.com

Chair of Committees

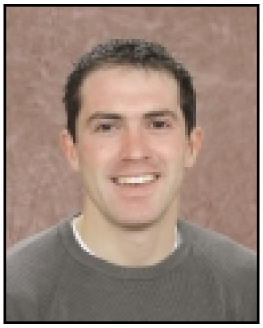
Richard Bishop
Reeves Wireline
Suite 500, 5th Avenue SW
Calgary, AB T2P 3L5

403-218-6847 (Office)
403-818-9437 (Cell)
403-237-5480 (Fax)
rbishop@ca.reeves-wireline.com

Membership Chair

Dion Lobreau
Mancal Energy Inc.
1600, 530 – 8th Avenue SW
Calgary, AB T2P 5G2

403-231-7673 (Office)
403-231-7679 (Fax)
dlobreau@mancal.com



Chair of Membership Message

To date the CWLS has close to 500 active members and 27 corporate members. This is a 20% increase over last year. Since I have been the membership chair, I have heard nothing but positive feedback on how the CWLS improves year after year. The increasing membership numbers prove this.

There were numerous new members because of the ICE convention this spring. On the membership side, being part of the ICE convention was a success.

Two new things that I would like to see happen with the CWLS membership are:

Individual Membership Numbers: The CWLS has a significant membership enrolment. As such, individual membership numbers would allow the CWLS to keep track of the members and allow for better service to its members. Membership numbers are also one step towards a more secure website where members can log on and access premium content.

CWLS Functions: More CWLS functions would allow for more exposure to people within the industry and inform them of what the CWLS has to offer. In an effort to do this we are planning a CWLS Bonspiel in the spring of 2005. Keep your ear to the ground for more information on that event as is draws closer!

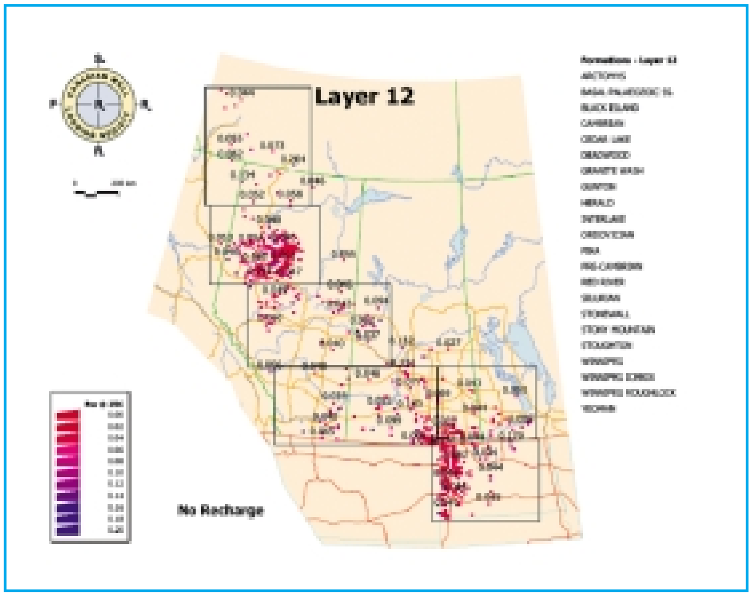
Dion Lebreau
Chair of Membership

New Members

David Cheesman – Encana
Marcelo Orellana – Exxon Mobil
Emmanuelle Piron – IPF Technologies (Canada) Inc.
Sajjad Ansari – GEOSERVICES N.A. Ltd
Stephen Kwasniowski – Zone Energy Ltd
Brian Balalzs – Rundle Resources Ltd
Ed Janicki – C.S. Lord Northern Geoscience Centre

Rigging up a sonic tool in the Hoadley area, AB.
Photo courtesy Dave Kelly

2002 CWLS Rw Catalog



Information included on CD:

- 2002 Rw Catalog
  (Over 50,000 Data Points)
  – PDF Format
  – Spreadsheet (XLS) Format
- 1987 Rw Catalog
  (5,600 Data Points)
  – PDF format
  – Original "Data on Disk" Digital Format
- LAS 2.0 and 3.0

Prices (Shipping Not Included):

Members:	$25.00 CDN (limit one per member, two per corporate member)
Non-members:	$65.00 CDN

Network License (corporate members):	$500 CDN
Network License (non-members):	$1000 CDN

To order contact the CWLS office at (403) 269-9366.

A high resolution copy of the latest newsletter is posted on the CWLS web site at www.cwls.org. For this and other information about the CWLS visit the web site on a regular basis.

Please forward this newsletter to any potentially interested co-workers. We would appreciate any feed back on anything you've read in the InSite and any suggestions on how this newsletter can better serve the interests of the formation evaluation community. Feel free to contact anyone on the CWLS executive with your comments.

A True History of Oil and Gas Development

by E. R. Crain, P.Eng.
Spectrum 2000 Mindware
1-403-845-2527
ross@spec2000.net www.spec2000.net

Introduction

The traditional view of the oil industry is that it started in the USA in 1859. Not true, I'm afraid.

The oil seeps at Baku (in present-day Azerbaijan) flowed freely for many centuries before year 1. They played a major role around 600 BC in the Zoroastrian religion of Persia and India. Uses of petroleum are mentioned in the Old Testament of the Bible. Chinese and Japanese writings that predate the first millennium by as much as 900 years describe the use of natural gas and oil from natural flows, seeps, and hand dug wells. Credit for the first drilled oil well goes to the Chinese in the year 347 AD.

Oil lamps in public buildings were in use as early as 1500 BC. A town near Grenoble France had natural gas street lamps in the year 100 !! Oil streetlights appeared in Cordoba around 900, London in 1414, and Paris in 1524.

Sir Thomas Shirley presented a paper to the Royal Society in 1658 on natural gas flows in Britain. In 1739, V.I. Veitbrecht published an article *"About Oil"* in the Russian scientific magazine *"Primechaniya na Vedomosti"* where he described the Baku area oil wells and provided a plan of the oil and gas fields. This may be the first technical paper with a reservoir description.

Coal-gas (manufactured gas) dates back to 1726 in England. Oil was extracted from oil sands in Pechelbron France in 1735. Creation of coal-oil by distillation of coal and oil shales occurred between 1781 and 1820 in England, France, and Germany.

A Canadian, Dr. Abraham Gesner, developed the distillation of kerosene from crude oil and bitumen in 1846. Kerosene helped reduce the use of whale oil for illumination. Some claim the whale oil problem had already been overcome by manufactured gas and oil from coal, but the two events certainly helped the "Save the Whales" campaign. The Americans give Benjamin Sillian credit for the invention of kerosene in 1855, but he was at least third in line after Gesner and a Polish druggist named Ignacy Lukasiewicz (1853). Coal-oil and kerosene are the same product – just different sources.

Early Exploration

Joseph de la Roche d'Allion reported seeing oil seeps in what is now New York state in 1632. Gas seeps were reported as early as 1622, also in New York. Peter Pond was the first non-native to report the discovery of oil in Canada in 1778 at what is now the Athabasca oil sands in northeast Alberta.

Azerbaijan claims the first drilled well in the modern era at Bibi-Heybat, a suburb of Baku on the Caspian Sea, in 1846. The first drilled oil wells in Europe were located near Bucharest in Romania in 1857 but Poland makes the same claim for 1854 at Bobrka.

The completion of the first commercial oil well in North America occurred in 1858 at Oil Springs, Lambton County, Ontario and was quickly followed by more oil at Petrolia, Ontario. The man's name was James Miller Williams, who had taken over a bankrupt operation. This was a hand dug well and the first drilled wells came in 1860. Some of these flowed up to 7000 barrels per day, often before anyone thought to build a storage pit or tank. Some of the early oil flowed down creeks to be wasted in the Great Lakes, but it had been doing that for eons before, from natural seepage.

There was an Oil Springs and a Petrolia in Pennsylvania too, but these wells came a year later (Edwin Drake, Titusville, 1859). There's a Petrolia in Texas, and another in California, not to mention the park in Baku set up by the Nobel brothers. It gets confusing.

It would appear that Drake's well placed the USA sixth in line in the sweepstakes for who drilled the first oil well, after China, Azerbaijan, Poland, Romania, and Canada. Until 1901, Baku's annual oil output exceeded that of the USA by as much as 25%.

Oil and Gas in Eastern Canada

As noted earlier, Peter Pond was the first non-native to report the discovery of oil in Canada in 1778 at what is now the Athabasca oil sands. Canada's first commercial oil wells were found in Oil Springs and Petrolia, near Sarnia, Ontario, in 1858, a year before Edwin Drake's discovery at Oil Springs (Titusville), Pennsylvania. Both the Oil Springs discoveries were known before these dates from flowing seeps.

The subsequent development of Canada's first petroleum complex at Petrolia is a little known part of the industrial saga of the oil industry. Canada's chemical valley in Sarnia traces its ances-

Continued on page 10…

A True History *… continued from page 9*

try directly to this area. During the period 1861 to 1897, nearly the entire requirement of Canada for crude, lubricants, waxes, kerosene, gasoline, and a widening range of chemicals for food, medicine, and industry was produced here. From 1863 to 1870, Canada was a major exporter of crude and refined products to the United States and Europe.

The contribution that Canadians made to the world's petroleum industry during the same period is even less appreciated. Men trained in the production, transportation, refining, and administration of this new resource, took their knowledge and skills to every corner of the world, opening many of the great oil fields that are still major suppliers of crude. They laboured on every continent in a hundred different countries. And the tradition continues to this day.

For more on this topic, look at *"Hard Oiler! – The Story of Early Canadian's Quest for Oil at Home and Abroad"*, by Gary May, 1998, Hounslow Press, ISBN: 1550023160. "Petroleum in Canada" by Victor Ross, 1917, Southam Press gives a similar and more contemporaneous view.

New Brunswick achieved commercial production at Stoney Creek in 1884, although it was pretty minor by early Ontario standards, and these wells continued in production until modern times. Quebec, Prince Edward Island, onshore Nova Scotia, and onshore Newfoundland never found commercial quantities of oil or gas.

Oil and Gas in Western Canada

The first gas well in Alberta was drilled at Alderson (also known as Langevin Siding), near Medicine Hat, by the Canadian Pacific Railway. They were, of course, looking for water. This well was immediately abandoned. A second well, the following year, again struck gas (it was only 8 feet away from the first one) and produced off-and-on for about 40 years. These, and similar wells, came to the notice of the Canadian government.

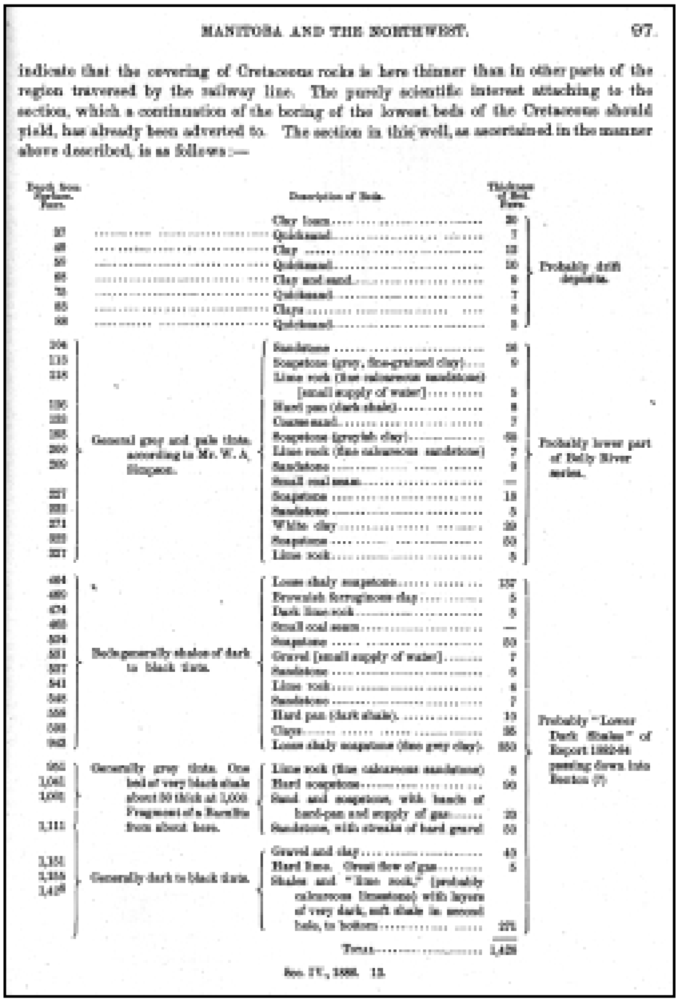
Dr. George Dawson of the Geological Survey of Canada, collected information on the wells at Langevin Siding and others, and presented a paper to the Royal Society of Canada in May, 1886. The paper was called "On Certain Borings in Manitoba and the Northwest Territory". The paper contained detailed sample descriptions of the wells – possibly the first "well logs" in Western Canada. An example is shown below (Figure 1) courtesy Petroleum History Society and author Micky Gulless.

By the early 1890s several more wells had been drilled in the Medicine Hat area, producing gas for homes and factories. This is the discovery that caused Rudyard Kipling to admit he liked Medicine Hat but "It has all Hell for a basement!"

By 1908, development of the Medicine Hat and Bow Island gas fields led to the first pipelines to deliver natural gas to Alberta communities. Construction of a 16-inch pipeline from southwest of Medicine Hat to Calgary began in April 1912 and was completed in only 86 days. A second leg reached Lethbridge in July the same year.

A view of the Halifax Harbour from just below the Global Santa-Fe's Galaxy II helipad. Note the orange lifeboat just below the helipad. Photo Courtesy of the Bercha Group.

A Whittaker single davit lifeboat (TEMPSE). This is one type of lifeboat used when it becomes necessary to evacuate an offshore platform. Photo courtesy of the Bercha Group.



MANITOBA AND THE NORTHWEST. 97.

indicate that the covering of Cretaceous rocks is here thinner than in other parts of the region traversed by the railway line. The purely scientific interest attaching to the section, which a continuation of the boring of the lowest beds of the Cretaceous should yield, has already been adverted to. The section in this well, as ascertained in the manner above described, is as follows:—

Depth from Surface. Feet.		Description of Beds.	Thickness of Bed. Feet.	
		Clay loam	20	Probably drift deposits.
27		Quicksand	7	
48		Clay	12	
58		Quicksand	10	
65		Clay and sand	6	
73		Quicksand	7	
85		Clays	5	
88		Quicksand	8	
104	General grey and pale tints, according to Mr. W. A. Simpson.	Sandstone	16	Probably lower part of Belly River series.
113		Soapstone (grey, fine-grained clay)	9	
118		Lime rock (fine calcareous sandstone) [small supply of water]	5	
130		Hard pan (dark shale)	8	
133		Coarse sand	7	
165		Soapstone (greyish clay)	32	
200		Lime rock (fine calcareous sandstone)	7	
209		Sandstone	9	
		Small coal seam	—	
227		Soapstone	18	
232		Sandstone	5	
271		White clay	39	
292		Soapstone	50	
297		Lime rock	5	
434	Beds generally shales of dark to black tints.	Loose shaly soapstone	137	Probably "Lower Dark Shales" of Report 1882-84 passing down into Benton (?)
460		Brownish ferruginous clay	5	
474		Dark lime-rock	5	
485		Small coal seam	—	
504		Soapstone	50	
521		Gravel [small supply of water]	7	
527		Sandstone	6	
541		Lime rock	6	
548		Sandstone	7	
558		Hard pan (dark shale)	10	
583		Clays	25	
962		Loose shaly soapstone (fine grey clay)	350	
962	Generally grey tints. One bed of very black shale about 50 thick at 1,000. Fragment of a Baculite from about here.	Lime rock (fine calcareous sandstone)	5	
1,061		Hard soapstone	90	
1,093		Sand and soapstone, with bands of hard-pan and supply of gas	23	
1,111		Sandstone, with streaks of hard gravel	50	
	Generally dark to black tints.	Gravel and clay	40	
1,151		Hard lime. Great flow of gas	5	
1,156		Shales and "lime rock," (probably calcareous limestone) with layers of very dark, soft shale in second hole, to bottom	271	
1,428				
		TOTAL	1,428	

Sec. IV., 1886. 13.

Figure 1: *The first well log in Western Canada???*

The Alberta oil boom didn't begin until 1914 with the drilling of Dingman #1 near Turner Valley. This wet gas success started a stock market flurry that died less than a year later with the loss of most of the investors' money.

The well was the precursor for the deeper zone discovery drilled ten years later. Royalite #4 put Turner Valley on the oil and gas map for real.

In 1919, Imperial Oil geologist Ted Link, a crew of six drillers and an ox named "Nig" made a six-week, 1200 mile journey northward by railway, river boat, and on foot to the site now known as Norman Wells NWT, along the Mackenzie River. The ox helped to build a log house and put the drilling rig in place before being butchered to provide food for the the winter. Drilling resumed in the spring with the world's most northerly oil discovery coming in August 1920.

Between 1920 and 1947, there were a dozen or so significant oil discoveries in the Cretaceous of Alberta, but no "elephants", and nothing very deep. Imperial Oil's Leduc #1 Devonian oil discovery in 1947 ended a long dry spell in the Alberta search. Although minor shows were found much earlier, 1951 saw the first commercial oil discoveries in Manitoba and NE British Columbia, followed by Saskatchewan 1953. Over the next 20 years, Canada became self sufficient in oil and gas.

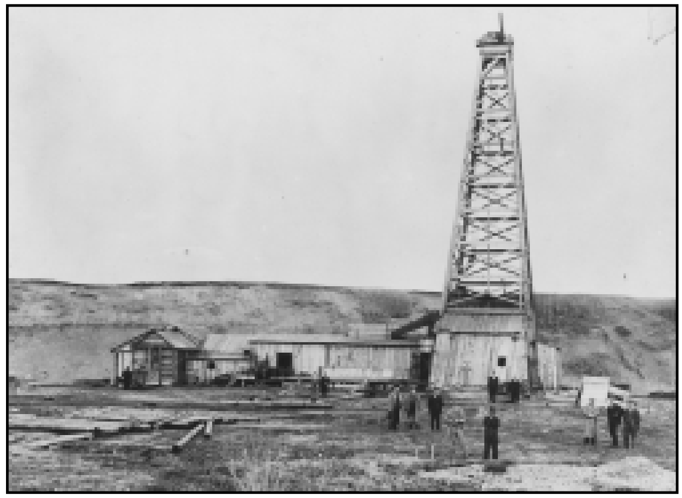


Figure 2: *Dingman #1, Turner Valley, 1914 – a replica lives at Heritage Park in Calgary (Glenbow Museum photo)*

Oil and Gas in Canada's Frontiers

Great Canadian Oil Sands Ltd (later Suncor) began production of the Athabasca tar sands north of Fort McMurray in 1967. Shell drilled offshore British Columbia that year, but found nothing. A few years later, the BC Government placed a moratorium on further drilling that has not been lifted.

On the other frontiers, hydrocarbons were found offshore Nova Scotia (gas at Sable Island, 1967, oil at Cohasset, 1973), offshore Newfoundland (oil at Terra Nova, 1984), offshore in the Beaufort Sea and MacKenzie Delta (gas at Taglu, 1971, oil at Amauligak, 1978), onshore and offshore in the High Arctic Islands (gas at Drake Point, 1969 – oil at Bent Horn, 1974). It took between 20 and 30 years for some of these to come on-stream, and Arctic gas is still shut-in.

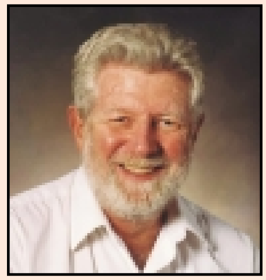
Continued on page 12…

A True History … *continued from page 11*

Bibliography

These websites cover most of the information described in this article. I certify that the material has not been *"ralphed"*.

1. Chronology of Oil – Azerbaijan
   http://www.azer.com/aiweb/categories/magazine/ai102_folder/102_articles/102_oil_chronology.html
2. Chronology of Natural and Manufactured Gas
   http://www.hatheway.net/01_history.htm
3. Chronology of Oil – World
   http://www.sjgs.com/history.html
4. Chronology of Oil – Canada
   http://www.geohelp.ab.ca/history.html
5. Chronology of Oil – World
   http://www.geohelp.ab.ca/world.html
6. Petroleum History Society – Canada
   http://www.petroleumhistory.ca/
7. History of American Oil Industry
   http://www.oilhistory.com/
8. Index to Oil History Sites
   http://www.little-mountain.com/oilwell/
9. Canadian Inventors
   http://inventors.about.com/library/weekly/aa090100a.htm



About the Author

E. R. (Ross) Crain, P.Eng. is a Consulting Petrophysicist and a Professional Engineer with over 35 years of experience in reservoir description, petrophysical analysis, and management. He has been a specialist in the integration of well log analysis and petrophysics with geophysical, geological, engineering, and simulation phases of oil and gas exploration and exploitation, with widespread Canadian and Overseas experience.

His textbook, "Crain's Petrophysical Handbook on CD-ROM" is widely used as a reference to practical log analysis. Mr. Crain is an Honourary Member and Past President of the Canadian Well Logging Society (CWLS), a Member of Society of Petrophysicists and Well Log Analysts (SPWLA), and a Registered Professional Engineer with Alberta Professional Engineers, Geologists and Geophysicists (APEGGA).

Announcement - Talk is No Longer Cheap

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

Anyone who is considering presenting at a luncheon or who has a suggestion for an interesting topic should contact John Nieto at (403) 231-0276 or john_nieto@anadarko.com.

ICE 2004

It is with great pleasure I write this article regarding the ICE 2004, Innovation, Collaboration and Exploitation. I believe this successful conference encapsulated the spirit of the Canadian Well Logging Society in our quest for continued technical excellence and membership value.

This was the first conference to be co-sponsored by the Canadian Society of Petroleum Geologists (CSPG), the Canadian Heavy Oil Association (CHOA) and the Canadian Well Logging Society (CWLS). This marriage of three quite different societies brought a strong focus in the technical program towards the more topical areas of E&P activity in Canada: heavy oil and non-conventional gas. Exceptional conference attendance shows continuing support from the sponsoring society memberships for a quality technical program.

In preparation for this writing, I referred back to my 2002 president's acceptance, capturing a key statement: "As a technical society, I believe we need to pursue involvement with the technical community. The life-blood of this involvement is the participation in technical luncheons, work shops and symposium". This statement was strongly supported by the executive and membership at that time and this support was clearly demonstrated through the conference participation.

However, vision is one thing while results are another, which brings me to the true purpose of this article; to thank all the CWLS volunteers that put in significant effort to ensure the success of this joint conference. Listed immediately below are the main CWLS volunteers. I sincerely apologize if I have missed anyone.

General Chairmen

Ken Faurschou	General Co-chair CWLS Schlumberger Canada Limited

Technical Committee

Grant Spencer	Technical Committee Co-Chair EnCana Corporation
John Nieto	Short Courses Co-Chair Anadarko Canada Corporation
Eric Wong	Posters Co-Chair Tucker Wireline Services
Mark Ducheck	Judging & Awards Co-Chair Baker Atlas
Rob Badry	Technical Session Chair Schlumberger Canada Limited
Mike Donovan	Technical Session Chair ChevronTexaco
Taras Dziuba	Technical Session Chair Burlington Resources Canada Energy LTD
Peter Kubica	Technical Session Chair Petro-Canada
Reigh MacPherson	Technical Session Chair Devon Canada Corporation
John Nieto	Technical Session Chair Anadarko Canada Corporation
Chris Pan	Technical Session Chair Core Laboratories Canada Ltd.
Dave Shorey	Technical Session Chair Baker Atlas

Exhibits Committee

Doug Hardman	Exhibit Chair Petro-Canada
Ian Cameron	Exhibits Committee Precision Wireline Technologies
Tim Steels	Exhibits Committee Schlumberger Canada Limited

Sponsorship Committee

Mike Seifert	Sponsorships Chair Recon Petrotechnologies Ltd.

ICE 2004 General Co-Chair, Ken Faurschou represented the CWLS with professionalism, quality and work ethic. His role was critical in bringing together and coordinating the resources necessary for this significant event. Ken and his General Co-Chairs Ian Moffat – CSPG and Daryl Wightman – CHOA truly did an outstanding job.

The conference was a technical success from the feedback we have received from delegates thanks to the tireless efforts of Grant Spencer and his technical committee. Grant's people did a great job in getting together these excellent presentations. The membership really stepped up too in sharing some of their work for these presentations. John Nieto organized five CWLS sponsored short courses, which were well received and generated significant profits for the CWLS. His short course coordinators must be complemented for coordinating these excellent technical sessions.

Continued on page 14…

ICE 2004 … *continued from page 13*

The conference also was one of the most financially successful to date, mainly due to the efforts of Doug Hardman and his Exhibits committee and Mike Seifert, the Sponsorship chair. The Exhibits committee was 40% over their revenue target and the indoor exhibit space was sold out well before the conference opened. Sponsorships were also well over their revenue target. Both exhibit and sponsorship targets were set at levels consistent with previous conferences, so it is a tribute to everyone involved that these previous levels were shattered. As well, we wish to extend a heart-felt thank you to our sponsors, who continue to support these technical events.

A special thank you is also extended to CSPG Convention Manager, Lori Humphrey-Clements, who worked tirelessly to ensure that each of the conference committees was aware of their responsibilities and necessary deadlines. Lori's help and guidance were invaluable and much appreciated.

John Kovacs and exhibits chairman Doug Hardman at the ICE Convention.

The level of enthusiasm and dedication displayed by the CWLS, CSPG and CHOA volunteers was impressive and the conference success is in large part due to their exhaustive efforts. We often forget that volunteers invariably spend the occasional office hour working on conference planning.

Employers of these volunteers gave freely of their staff's time; a contribution that is as important to the success of a conference as is a monetary one. Our thanks go out to these companies for their indirect support.

The CWLS membership should be proud of the efforts of all the CWLS volunteers on the I.C.E. 2004 organizing committee. These volunteers distinguished themselves before their peers at the CHOA and CSPG for their contribution to the overall success of the 2004 conference. As a result of their efforts, the CSPG has asked the CWLS to join them bi-annually in hosting a joint conference.

The ICE 2004 provided a critical vehicle for the Canadian Well Logging Society's continued pursuit of technical excellence and membership value. The demonstrated quality and effort of our volunteers, in conjunction with the strong current executive and membership, bodes well for the future of our Society.

In summary, a highly successful conference and all those who participated can take great pride in a job well done.

John Kovacs, P.Eng.
CWLS President 2002–2003

IMPROVED DENSITY LOGGING IN HOT, RUGOSE CARBONATE FORMATIONS

John Nieto, Anadarko Canada Corporation
Rob Badry, John Kovacs, Darwin Ellis, Ollivier Faivre, and Laurent Mossé, Schlumberger

This paper was prepared for presentation at the SPWLA 45th Annual Logging Symposium held in Noordwijk, The Netherlands, June 6–9, 2004.

ABSTRACT

The Canadian Rockies are a difficult logging environment because of elevated borehole temperatures (>125°C in some of the deeper formations) and large anisotropy in the stress field that results in elliptical or rugose boreholes.

This field case study focuses on the Saddle Hills area in northern Alberta, close to the Peace River Arch, where unexpected density responses were observed while logging the Wabamun carbonate formation. The responses included overcorrection of the density in bad holes and higher-than-expected bulk density and photoelectric factor (PEF) measurements from the Platform Express* integrated triple-detector density wireline logging tool in several wells.

Anadarko and Schlumberger personnel investigated the cause of the unexpected readings by reviewing all tool maintenance and calibration procedures, and conducting tool-positioning experiments in calibration blocks that were validated with tool modeling.

As a result, the density and PEF measurements can now be used quantitatively, greatly adding to the ability of the geoscience teams to evaluate these complex carbonate formations.

INTRODUCTION

The Saddle Hills area is shown in Fig. 1. It is an important core area for Anadarko Canada with current gas production in the order of 70 million cf/D. The play is hydrothermal dolomite, which has again become interesting to Canadian-based operators since the prolific "Lady Fern" discovery in the 1990s. Lithologically, the host rock is platform limestone with associated lithofacies types. The dolomitization is related to proximity to faults and porous, permeable host lithofacies to transport the magnesium-rich hydrothermal fluids. Consequently, the pattern of dolomitization is complex and difficult to predict. This means that petrophysical evaluation of lithology and identification of dolomite, limestone, and mixtures of the two are crucial. Good density and photoelectric logs, coupled with reliable wellsite lithological information, are key to evaluation of these formations.

A schematic of the hydrothermal dolomitization concept is shown in Fig. 2 (Davies 2001). The figure illustrates the complexity of the movement of hydrothermal fluids and demonstrates the importance of porous layers to fluid movement and dolomitization. The lower rock quality layers are not dolomitized and remain as the original limestone lithofacies.

The reservoir interval is easily recognized from logs, having porosity to 15 porosity units (p.u.) and correspondingly lower resistivities than the surrounding tight host limestones. Fig. 3 illustrates a typical Wabamun section, showing the correct 0-p.u. reading recorded by a Litho-Density* logging tool in the tight limestones.

FIELD OBSERVATIONS ON INTEGRATED DENSITY TOOL RESPONSE

Several density logs were recorded by the integrated triple detector density tool in the Saddle Hills area over a period of 6 months. Higher density responses than expected were noted initially where the borehole was elliptical, and physical pad contact was suspected. After rigorous calibration and procedural checks, a powered caliper tool was modified and placed with its two arms orthogonal to the integrated

*Mark of Schlumberger

Continued on page 16…

density tool in an attempt to orient the density tool in the short axis of the borehole. In addition, a lithology density tool was combined in the string orthogonally to the integrated density tool to better quantify the effect of borehole ellipticity and provide a backup measurement in case the integrated density tool went into the long axis of the borehole. Although the density tool was better oriented with these additions, quality control curves such as DSOZ (density standoff as calculated by the multisensor inversion) indicated that little or no standoff was occurring on the integrated density measurement, RHOZ. Further, intuitively, with a standoff, a lower density response was expected with a barite-free 1.1-g/cm^3 mud. Consequently, the cause for the high density effect was further explored. Anadarko continued to use the integrated density tool and short-axis orientation tool in Saddle Hills to build a database to assist in solving the response issues. Fig. 4 shows a typical integrated density tool response in Saddle Hills prior to this study. Of note is the PEFZ response, averaging 5.24 barns/electron in limestones, and the mean density (RHOZ) response of 2.718 g/cm^3 in the limestones.

Clearly these values are suspect for a limestone and, even if it is a slightly dolomitic limestone, the PEF is far too high. Lithology checks were performed, with re-description of the cuttings samples, to find any evidence of dolomite. Fig. 5 illustrates results of the sample description with little or no dolomite evident from the cutting samples in this 25-m interval. However, rare dolomite crystals are described over the same interval, which could indicate the density should be a little higher than 2.710 g/cm^3. Cores were cut in the hydrothermal dolomite reservoir intervals only, rather than these tight limestone sections, so true grain density was difficult to determine. Nevertheless, PEF and density measurements continued to be high and warranted further investigation.

DETAILED ANALYSIS OF INTEGRATED DENSITY TOOL DATA

The starting point in the response evaluation was to verify the field calibration procedure and operational technique. A tool that had been used in one of the wells was calibrated in multiple field locations by different engineers. The calibration files showed no systematic differences in calibrations, and it was clear that the irregular readings in some sections of the wells in question were not related to calibrations or field operational technique.

MODEL VERIFICATION

A study of wells logged in the problem area showed that the few wells with high measurements tended to have a lighter mud density. With this in mind, the response of the tool and the forward model were verified using a known high-density formation, small standoff, and light mud system. To this end, a special block was constructed with an 8-in. borehole diameter and a density of a 2.71 g/cm^3 to match the limestone values in the well. Measurements were made using two tools, with water acting as the light mud and with standoff from 0 mm to 6mm.

In all the cases, density and PEF readings were in accordance with the block characteristics. At large mudcake or standoff values, the density reading was slightly lower than expected. Fig. 6 shows the results and the expected response for the block. Overall, the experimental measurements were accurate and verified the response of the model.

PAD-CONTACT STUDY

The model verification measurements showed that correct density and PEF values were obtained in high-density formations with light muds over a range of mudcake thicknesses (or pad standoffs). Since all density standoff corrections are based on a model of parallel standoff, the effects on the measurements in the case of non parallel standoff (Fig. 7) were studied.

Density logs commonly have low readings when the borehole is rugose and pad contact is poor, and so pad tilt may also cause a lower reading. Less intuitive is the case in which there is an apparent rotation of the skid relative to the borehole due to a elliptical borehole, which will result in a wedge-shaped standoff lengthwise along the skid.

Continued on page 17…

Shop experiments simulated the development of a wedge (or pad rotation) on one side of the pad by placing a 5-mm shim along one edge of the skid during measurements made in a calibration block. In addition to the wedge measurement, the 5-mm spacer was used to create a gap at the bottom (bottom tilt) end of the skid to simulate the effects of pad tilt. The results are shown in Fig. 8.

Contrary to what one might expect, the experiment showed an increase in the density measurement, resulting from nonparallel standoff using the standard inversion algorithm. Additional processing of data using only the long- and short-spacing detectors with a "spine and ribs" algorithm was performed for the wedge and bottom tilt (Fig. 8). The differences in density values between the processing techniques are meaningless in this case as the algorithm was not characterized for the integrated density tool. The important result was that the spine and ribs density estimate was also high for both the pad rotation and the bottom tilt cases, confirming the response was independent of processing technique and, hence, tool type.

Additional pad tilt experiments were performed in a laboratory under conditions where the standoffs could be measured accurately and controlled, using a block with characteristics closer to those in limestone formations. The results (Fig. 9**)** show an increase in density for bottom tilt and a decrease for top tilt. The magnitude of the effect is controlled by the amount of standoff and the contrast between the formation density and the fluid density, with larger density contrasts producing the largest effect. Fig. 9 also shows the effect of pad tilt on the PEF.

Given the downhole forces for pad application, it is unlikely that pad rotation or bottom tilt could occur during logging. And because top tilt decreases the apparent density, it is not relevant to the case of increased apparent density.

TEMPERATURE EFFECTS

A temperature correction must be applied to count rates when the temperature of the detectors during logging is different from that at the time of calibration. In general, such a correction adjusts the gamma ray count rates by an amount proportional to the difference in temperature. Thus as the logging temperature increases, this correction becomes more important. The example in Fig. 10 shows the net effect of temperature corrections on density and PEF measurements when tool temperature is 110°C. Without temperature correction, PEF increases from 5.00 to 5.24 B/e; there is little effect on the density. The magnitude of these effects will increase with temperature.

The original triple detector density tool is rated to 125°C and the temperature correction (Allioli, 1997) uses crystal time-decay constants to correct the count rates. In order to extend the temperature rating, the upgraded tool measures the temperature in the density pad itself and, combined with a novel temperature corrections scheme (patent pending), provides a more accurate density log at elevated temperatures.

ENHANCED BOREHOLE CORRECTIONS

Processing of the density and PEF measurements from the integrated density tool relies on the mathematical inversion of a forward model (Eyl, 1994). The forward model is an 8-in. water-filled cylindrical borehole surrounded by mudcake and formation.

The model expresses the relationship between the formation and mudcake properties and the count rates in the three tool detectors. It accepts five inputs: formation density and PEF, and mudcake thickness, density, and PEF. The model has 11 sub models, each providing the counts for a single energy window of one detector. The inversion process provides the 5 parameters optimized for the whole set of 11 count rates. In this case, "optimized" takes its sense from the model frame; i.e., assuming the borehole is 8 in. and the mud filling the borehole is water. If these conditions are not fulfilled, the model inversion will not provide an accurate result. For example, if the mud is heavy, the counts are lower. The model may interpret the low count as the result of a denser formation.

In such conditions, count rates must be corrected to compensate for the borehole size and mud prior to applying the model inversion. The corrections handle each of the 11 energy windows separately

Continued on page 18…

Reprinted with permission of the SPWLA. Paper originally printed in SPWLA 45th Annual Logging Symposium, June 6-9, 2004

and depend on the detector and window energy. The general correction (Eq. A1, Appendix) for each energy window is derived from the physical laws underlying the measurements. The correction depends on borehole geometry and on the Compton scattering and PEF effects.

$$\frac{\Delta W}{W} \propto f(geometry)\left[f(Compton) + f(photoelectric)\right]$$

For non-barite mud, the density contrast between the mud and the formation is important, and the Compton term dominates. For barite mud, which has a very high PEF, the photoelectric term is most important.

Since the correction is applied to the count rates before inversion, it is not possible to predict the inversion's effect on the answer. In other words, the effect of borehole corrections on the density is not a constant shift.

Current processing for the density and PEF measurements of the integrated density tool is different for non barite and barite mud. For non barite mud, borehole size and mud weight corrections exist for bit sizes from 8 to 17 in. and mud weights from 1.1 to 2.5 g/cm^3.

Recent measurements extended the range of the borehole corrections to include 6-inch borehole size. The results of the non barite measurements for 6-in. boreholes are shown in Fig. 11. It is clear that corrections for 6-in. boreholes are necessary to obtain accurate density estimation in high-density formations. As seen in Fig. 12, the corrected density falls within stated specifications.

No size correction exists for boreholes drilled with barite mud. This lack is partly due to the difficulty of performing reliable experiments with barite mud. Also, barite can damage the density blocks used for characterization and render comparative measurements inconsistent. However, for evaluation purposes in this study, Schlumberger performed two sets of barite mud measurements in its Environmental Effects Calibration facility with mud weights of 1.58 g/cm^3 and 2.02 g/cm^3 in bit sizes from 6 to 16 in. and block densities ranging from 1.7 g/cm^3 to 3.05 g/cm^3. These measurements allowed the formulation of a more reliable barite mud correction.

Fig. 11 and Fig. 12 show the reconstructed density RHOZ with and without barite mud borehole correction for three mud types: water, potassium acetate (1.273 g/cm^3), and calcium bromide (1.589 g/cm^3).

Figs. 13 and 14 show the RHOZ with and without barite mud correction for the two barite muds (1.58 g/cm^3 and 2.02 g/cm^3). Figs. 15 and 16 show the reconstructed PEF (PEFZ) with and without barite mud correction.

APPLICATION OF RESULTS

Results obtained before and after the enhanced borehole corrections, including the heavy mud weight characterization, are shown in Fig. 17. This well was drilled with a 149-mm (5 7/8-in.) bit. The maximum temperature recorded was 138^{o}C, and there was sufficient barite to yield a mud density of 2.2 g/cm^3.

The formation is a 0-p.u. limestone over the interval shown. The first porosity track shows the original density and PEF data without barite corrections. The middle track shows the results of barite corrections, and the right track shows the results obtained using enhanced borehole corrections. The PEF value in the right track is much closer to the expected value for limestone. The density histogram for the logs with enhanced borehole corrections shows an average density of 2.710 g/cm^3 compared to average density values of 2.722 g/cm^3 and 2.721 g/cm^3 for the other logs.

Many of the logs from the Saddle Hills wells have been adjusted using the enhanced corrections. Nevertheless, the density values on some are still higher than expected. The log in Fig. 18 shows calculated standoffs higher than expected based on caliper readings that are close to bit size. These calculations correlate to the high density readings, which suggest the data recorded in these wells do not fit the database or the model. The likely cause for this variance is some combination of borehole rugosity and density pad contact.

Continued on page 19…

Reprinted with permission of the SPWLA. Paper originally printed in SPWLA 45th Annual Logging Symposium, June 6-9, 2004

RUGOSITY CORRECTION

In the ideal case, the density pad orients itself on the low side of the borehole. Assuming the borehole shape is similar to that shown by a borehole shape analysis that uses acoustic radii measurements (Fig. 19), there should be a departure between field data and the model in case of standoff. Fig. 20 shows a plot of long-spacing and short-spacing densities (RHLA versus RHSA) with computed standoff plotted on the z-axis. We see a coherent relationship between the two computed densities, which indicates it may be possible to construct a borehole rugosity correction algorithm for this dataset.

Fig. 21 shows a fit of the data with the expected response in the case of water mudcake. It confirms our hypothesis that the recorded data do not fit the model, and an accurate correction to the density in this well cannot be made using the standard model. Also, the lower the short-spacing density (increase in computed standoff), the larger the departure between the two lines; i.e., the more standoff, the more we should overcorrect. This is clear in Fig. 22, where we plot the RHOZ computed as function of the short-spacing density with computed density standoff (DSOZ) plotted on the z-axis.

Using this dataset, a correction algorithm was developed. Fig. 23 shows the recomputed density as a function of RHSA over this zone. We do not see the previous overcorrection.

Fig. 26 shows the recomputed log on this well compared with the original log. The recomputed density agrees with the expected density for limestone. Note the significant improvement in the density over the upper section, where poor pad contact is expected given the caliper reading over this interval. The next two plots compare the histogram of RHOZ from the original log (Fig. 24) with the histogram of the recomputed log (Fig. 25). The new log histogram is centered on 2.7 g/cm^3 and is much sharper than the one from the original log

This algorithm is not a universal solution but is intended to demonstrate that, despite a nonstandard wellbore configuration, useful information can still be extracted. The log in Fig. 27 shows the results of the locally derived rugosity correction on another well in this area. In intervals of good pad contact (as defined by calculated standoffs) the standard density output (RHOZ) reads as expected. When pad contact is poor, the density values obtained with the rugosity correction algorithm are much closer to those expected, which allows quantitative evaluation of this reservoir. Post-processing of integrated density log quality control data for these wells can be used to identify this effect in limited conditions.

CONCLUSIONS

Experimental measurements have verified the integrated density tool's characterization for density and PEF, and the tool provides measurements that are within the tool specifications.

Experimental measurements have shown that the effects of pad tilt are not intuitive and can have a detrimental effect on density and PEF measurements. Without the density and resistivity standoff values computed as part of the tool system, it would not be possible to identify pad tilt effects on logs.

As a result of the collaborative work of Anadarko and Schlumberger, several changes were made to improve the quality of density measurements in the Saddle Hills wells.

- The temperature rating of the triple detector density tool has been extended to 150^{o}C through implementation of an improved temperature correction.
- Enhancements were made to borehole characterization for small boreholes and heavy mud.
- A rugosity correction was developed to correct for marginal pad contact in irregularly shaped boreholes. While not globally applicable, it was appropriate for wells in the case study. The density and PEF measurements can now be used quantitatively, greatly adding to the ability of the geoscience teams to evaluate these carbonate formations.

Reprinted with permission of the SPWLA. Paper originally printed in SPWLA 45th Annual Logging Symposium, June 6-9, 2004

Continued on page 20…

ACKNOWLEDGMENTS

The authors thank Dave Thomas, the Anadarko Saddle Hills project geologist, for his support during this evaluation of logging tool response in his project area.

REFERENCES

Allioli F et al: "A New Approach to Computing Formation Density and P_e Free of Mudcake Effects", paper K, 1997 Annual Logging Symposium Transactions, Society of Petrophysicists and Well Log Analysts, Houston, Texas USA

Eyl, K.A., et al.: "High Resolution Density Logging Using a Three Detector Device," paper SPE 28407, Society of Petroleum Engineers, Richardson, Texas, USA, 1994.

Davies, G.R., 2001 Hydrothermal (thermobaric) Dolomite Reservoir Facies. Graham Davies Geological Consultants, proprietary report, 548p., 506 text figures, and appendices.

ABOUT THE AUTHORS

John Nieto is the manager of Formation Evaluation for Anadarko in Canada. Nieto holds a BSc degree from London University and a DMT degree from Camborne School of Mines. He worked as a wellsite geologist and wireline logging engineer before joining Britoil (BP) as a petrophysicist. Nieto was global coordinator of Formation Evaluation for ExxonMobil in Houston. He is a member of the Canadian Well Logging Society (CWLS) and was awarded the CWLS President's award for best technical presentation in 2002-2003. He is also an SPE member and is on the *Journal of Petroleum Technology* Editorial Committee. Nieto has authored or coauthored 17 technical papers on formation evaluation and is championing integrated reservoir characterization, or shared-earth modeling, in Anadarko Canada. John holds the office of elected vice president of CWLS.

Rob Badry is manager of the Interpretation Development group for Schlumberger in Calgary, which provides training, technical, and interpretation support for wireline and testing services. He started with Schlumberger in 1978 as a field engineer after obtaining his BSc degree in electrical engineering from the University of Calgary. Rob held several field, sales, and log analyst assignments before joining the interpretation development group in 1988. He is a member of APEGGA and CWLS.

John Kovacs graduated at the top of his class with a BSc degree in mechanical engineering, University of Calgary, in 1973. After graduating, he joined Schlumberger, working as a field engineer for 7 years throughout Canada. A 3-yr operations manager position followed. From 1985 to date, John has held a number of technical sales and sales coordination positions in Calgary. He currently enjoys a technical, sales, and marketing role as Oilfield Services account manager. John has authored or coauthored numerous new technology and application presentations, including array induction, nuclear magnetic resonance, and coalbed methane. He is a member of CWLS and the Association of Professional Engineers, Geologists and Geophysicists of Alberta. John served as the vice president and president, and past president of CWLS.

Darwin Ellis is a scientific advisor at Schlumberger-Doll Research in Ridgefield, Conn. After obtaining a PhD degree in physics and space science from Rice University, he worked for Schlumberger in many capacities during more than three decades of well logging research and engineering. Besides formation evaluation, nuclear modeling, teaching, and writing, Darwin has always had a strong interest in applying logging technology to subsurface investigation in general. In 1996, he was a recipient of the SPWLA Distinguished Technical Achievement Award. He is the author of more than100 internal and external reports and has been granted 7 patents.

Ollivier Faivre graduated with a degree from Ecole Polytechnique in 1973 and joined Schlumberger in 1976. After working as a field engineer he moved to interpretation and held various positions as Log Analyst and interpretation manager. In 1991 he joined the Schlumberger-Riboud Product Center working on new tool interpretation. He is currently Interpretation Mètier Manager in the Beijing Geoscience Center.

Continued on page 21…

Reprinted with permission of the SPWLA. Paper originally printed in SPWLA 45th Annual Logging Symposium, June 6-9, 2004

Laurent Mossé is a nuclear physicist on the integrated density tool development team in the Schlumberger Riboud Product Center in Clamart, France. He joined Schlumberger after receiving a PhD from the Center for Atomic Energy in Saclay, France. Laurent worked 2 years for the European Center for Nuclear Research for superconductor magnet development after graduating with an engineering degree from École Supérieure d'Eléctricité in France.

APPENDIX—DESCRIPTION OF BOREHOLE CORRECTIONS

The general correction (Eq. A1) for each energy window is derived from the physical laws underlying the measurements. V_{eff} is the effective volume where the borehole effect takes place. It depends on the bit size (BS), on the typical energy of the count rate window, E, and on the density contrast between the mud and the formation. Between the brackets are the two Compton, F, and photoelectric terms, G. For nonbarite mud, the relevant information is the density contrast between the mud and the formation: the F-term dominates. For barite mud, which has a very high PEF, the correction mainly depends on the G-term.

$$\frac{\Delta W}{W} \propto \underbrace{V_{eff}(BS, E, \rho_f - \rho_{mud})}_{\text{geometric}}\left[(\rho_f - \rho_{mud})F(E) + (\rho_f Pe - \rho_{mud} Pe_{mud})G(E)\right]$$

Equation A-1 —General energy window count rate correction formula

where

- ΔW: expected change in energy window count rate
- W: energy window count rate
- V_{eff}: effective volume of investigation in which the borehole effect occurs
- BS: borehole size
- E: typical energy of the energy window
- ρ_f: formation density
- ρ_{mud}: mud density
- F(E): term related to Compton scattering effect
- P_e: formation photoelectric factor
- Pe_{mud}: mud photoelectric factor
- G(E): term related to photoelectric effect.

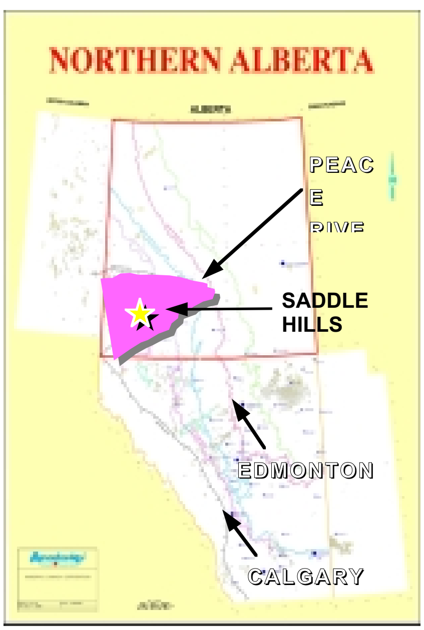
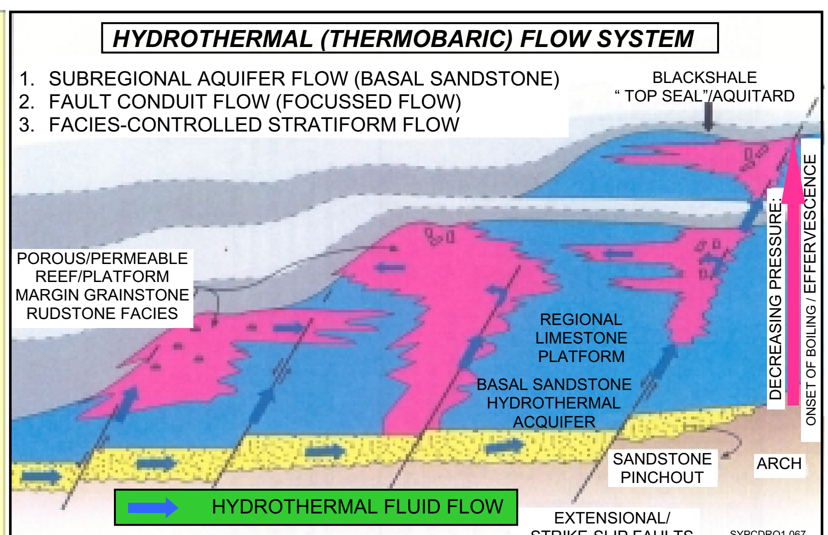


Fig. 1—Location of Saddle Hills



Schematic summary of the three major components of a subsurface hydrothermal (thermobaric) flow system responsible for the formation of hydrothermal dolomite reservoirs. The role of basal sandstone aquifers as 'feeders' for episodic flow up faults was recognized some time ago by Jeff Packard (pers. comm., 2000; also see Packard et al, 2001), but has only recently received wider attention in western Canada and in the Michigan Basin.

Fig. 2—Hydrothermal Dolomitization (Davies, 2001)

Continued on page 22…

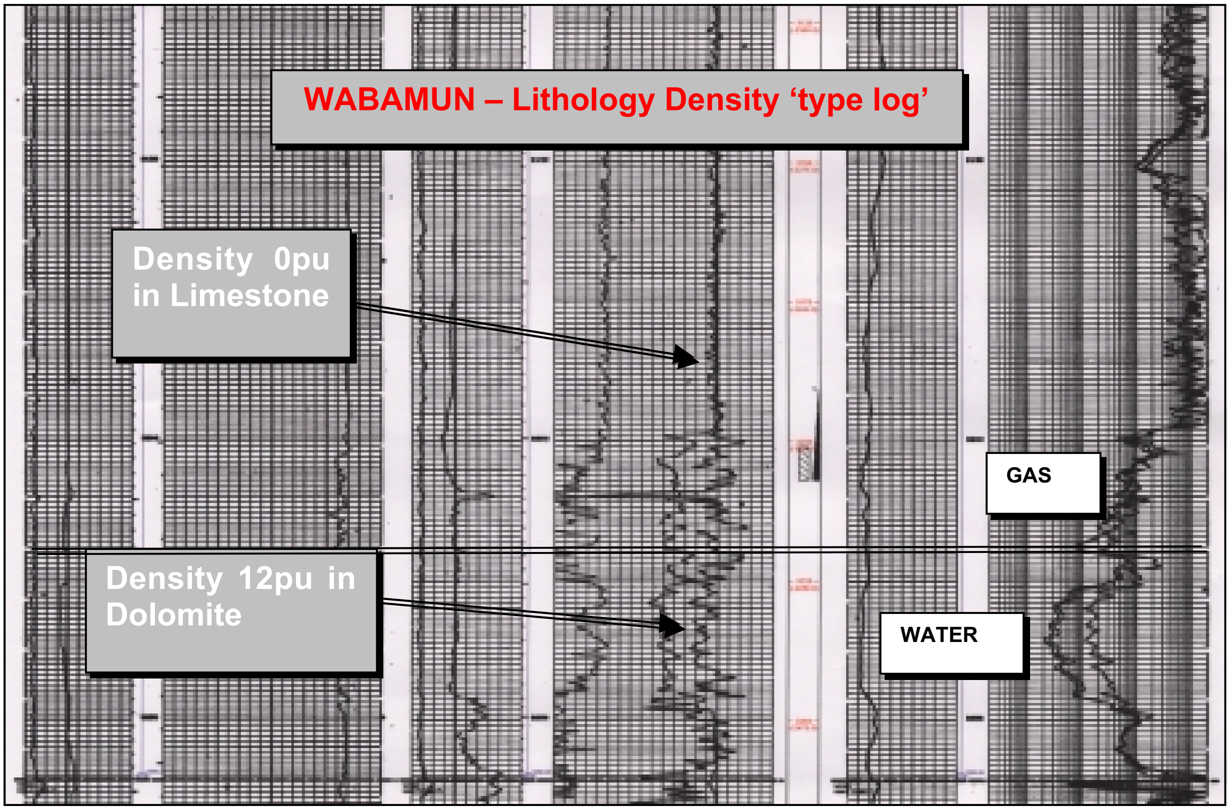


Fig. 3—Typical Wabamun Carbonate response

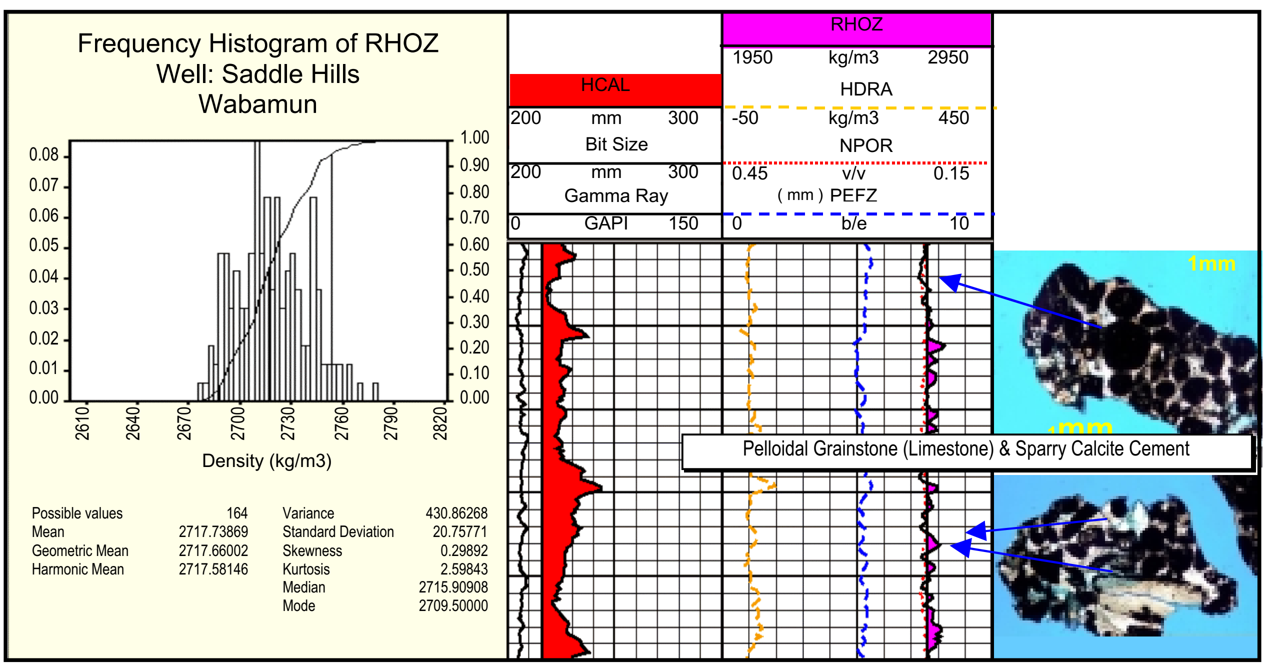


Fig. 4—Wabamun Limestone PEx Response and Sample Description

Reprinted with permission of the SPWLA. Paper originally printed in SPWLA 45th Annual Logging Symposium, June 6-9, 2004

Continued on page 23…

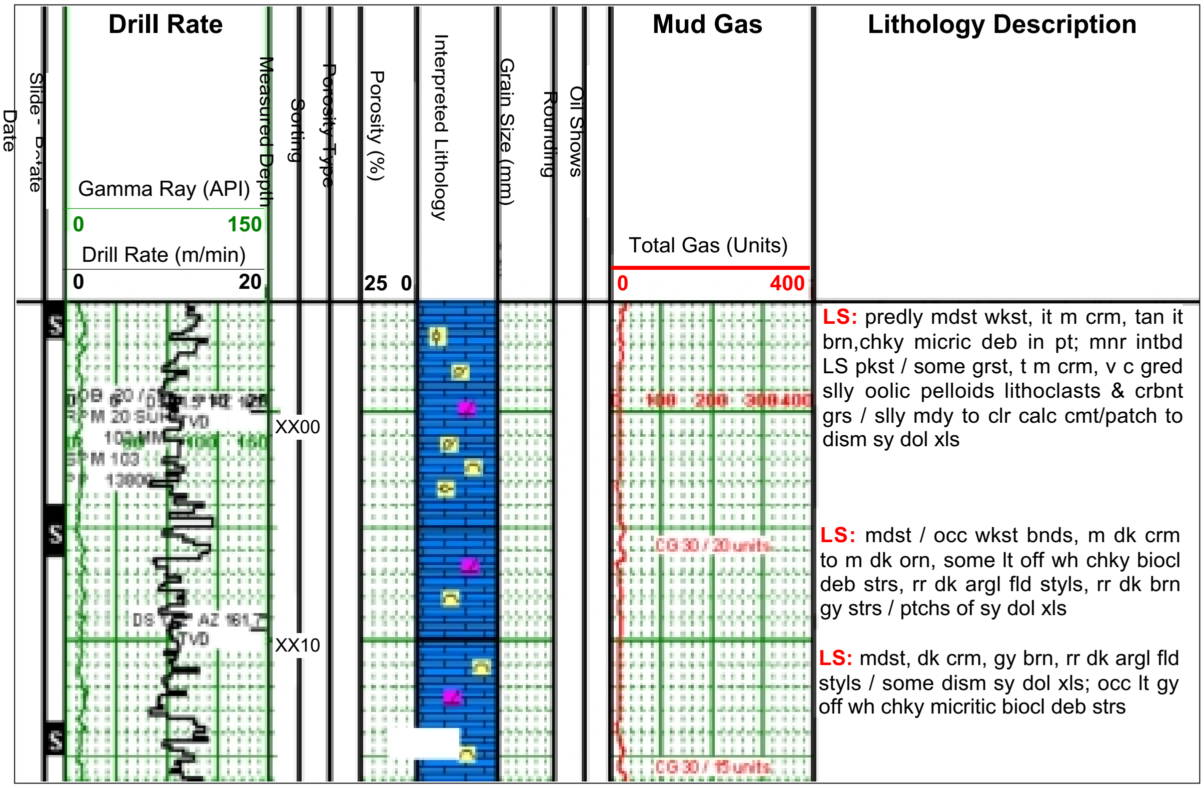


Fig. 5—Wabamun Limestone Sample Description

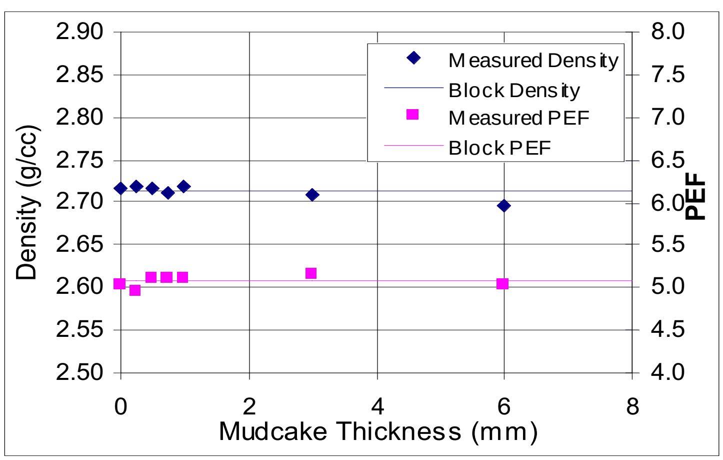


Fig. 6 —Model Verification Results, 8-in. Hole

Reprinted with permission of the SPWLA. Paper originally printed in SPWLA 45th Annual Logging Symposium, June 6-9, 2004

Continued on page 24…

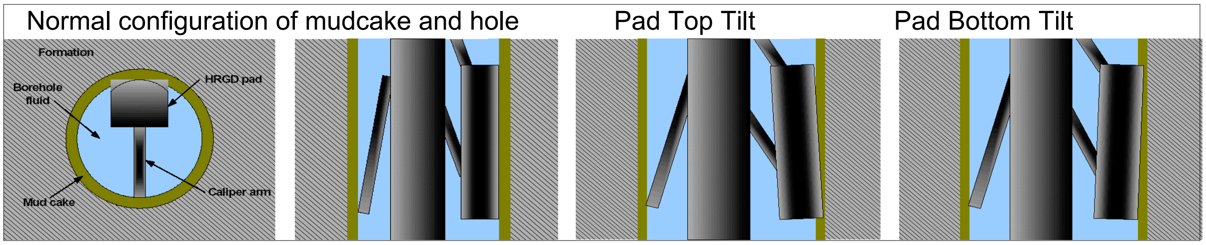


Fig. 7—Normal and Possible Density Pad Configuration in Borehole

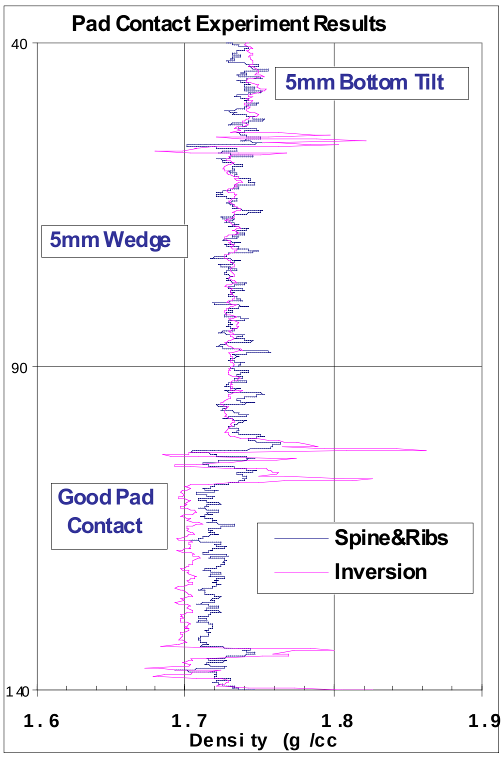


Fig. 8—Pad Contact Experiment Results

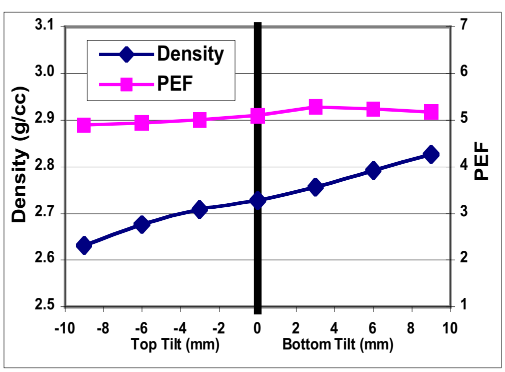


Fig. 9—Pad Tilt Effect on Density and PEF

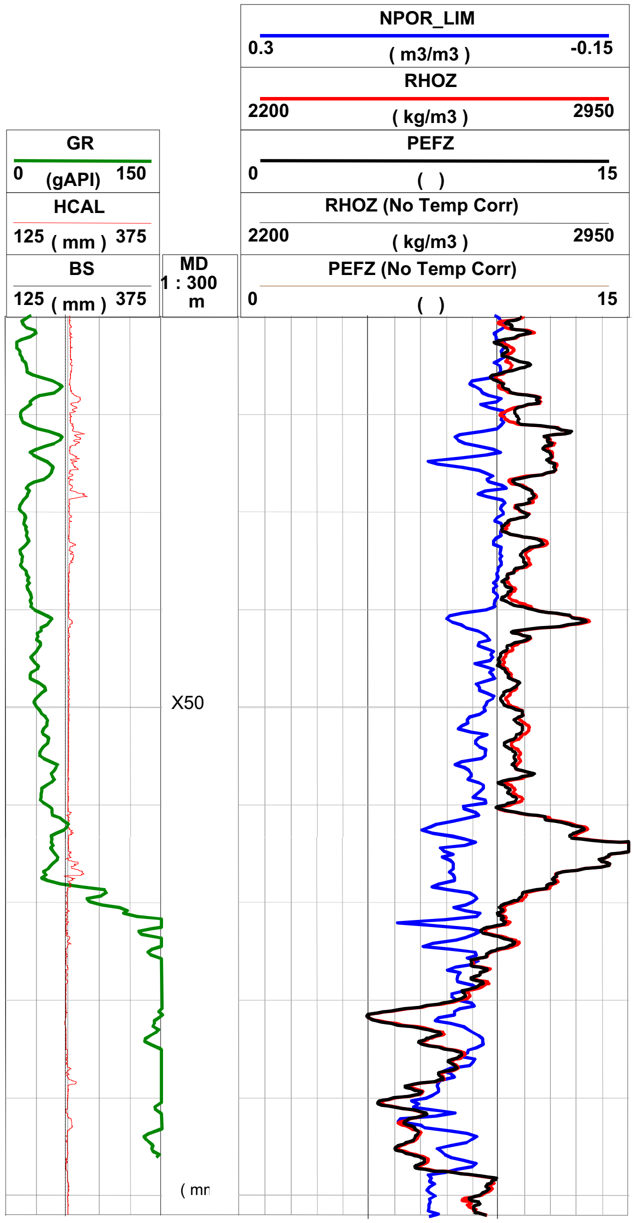


Fig. 10—Example of Density and PEF temperature correction magnitude at 110 ^oC

Continued on page 25…

Reprinted with permission of the SPWLA. Paper originally printed in SPWLA 45th Annual Logging Symposium, June 6-9, 2004

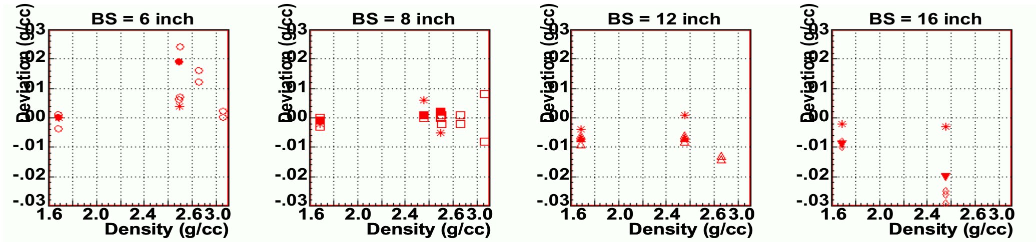


Fig. 11—Uncorrected RHOZ for non-barite mud measurements. Hollow markers show water mud filled markers represent K-acetate mud (1.27g/cc), and stars show Calcium bromide mud (1.59g/cc)

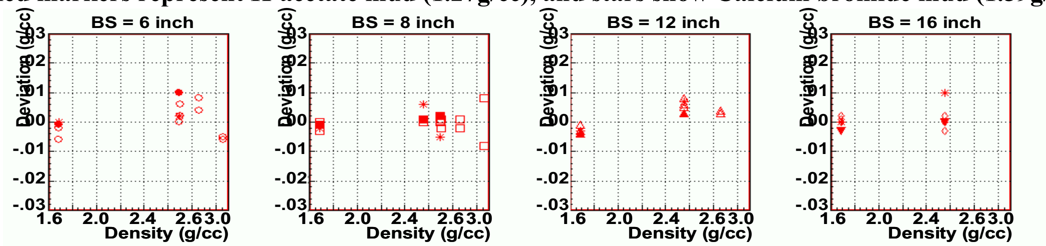


Fig. 12—Corrected RHOZ for non-barite mud measurements. Same legend as Fig. 11.

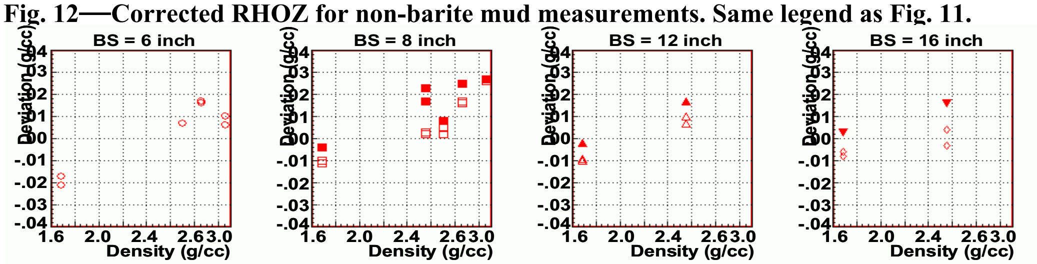


Fig. 13—Uncorrected RHOZ for barite mud measurements. Hollow markers represent barite mud of 1.58g/cc, filled markers represent barite mud of 2.02g/cc.

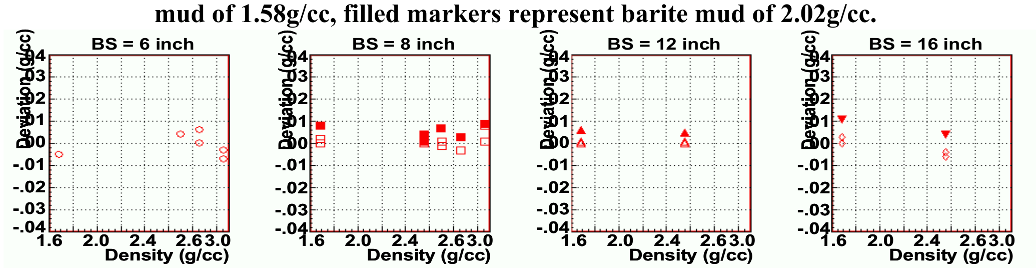


Fig. 14—Corrected RHOZ for barite mud measurements. Same legend as Fig. 13

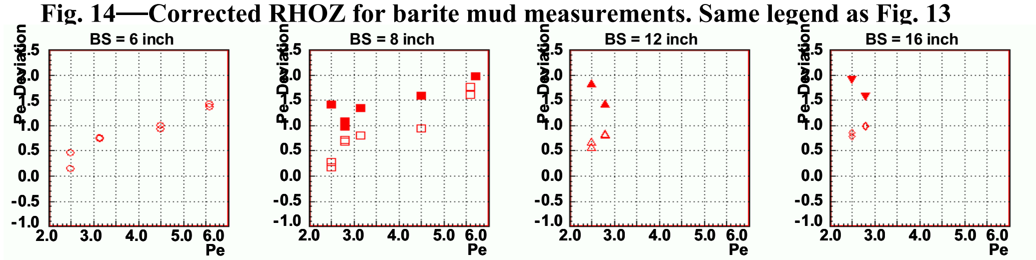


Fig. 15—Uncorrected PEFZ for barite mud measurements. Same legend as Fig. 13.

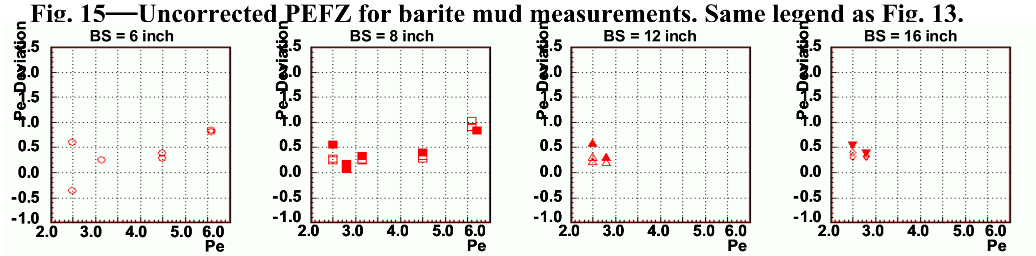


Fig. 16—Corrected PEFZ for barite mud measurements. Same legend as for Fig. 13

Continued on page 26…

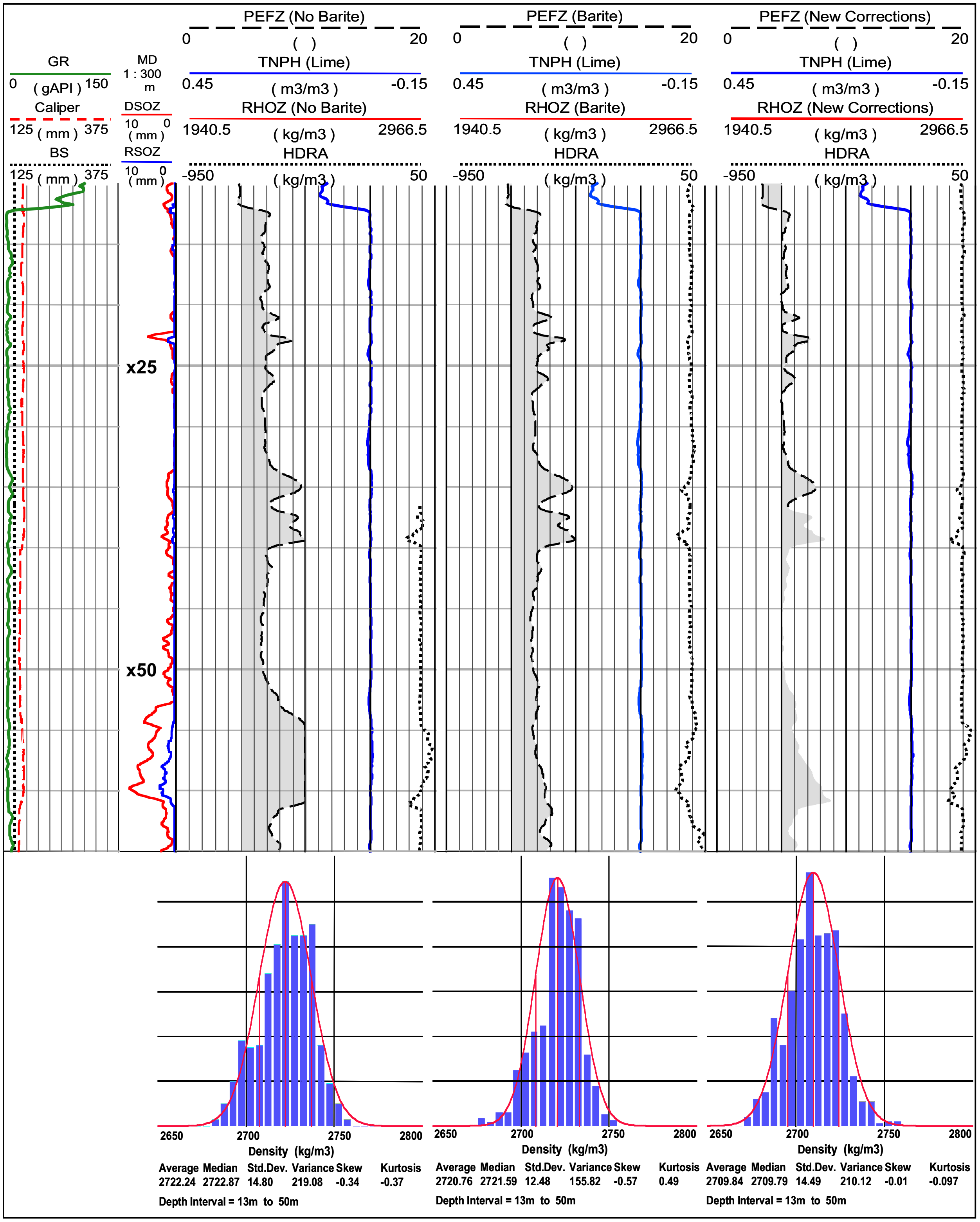


Fig. 17—Comparison of Results Before and After Enhanced Borehole Corrections

Continued on page 27…

Reprinted with permission of the SPWLA. Paper originally printed in SPWLA 45th Annual Logging Symposium, June 6-9, 2004

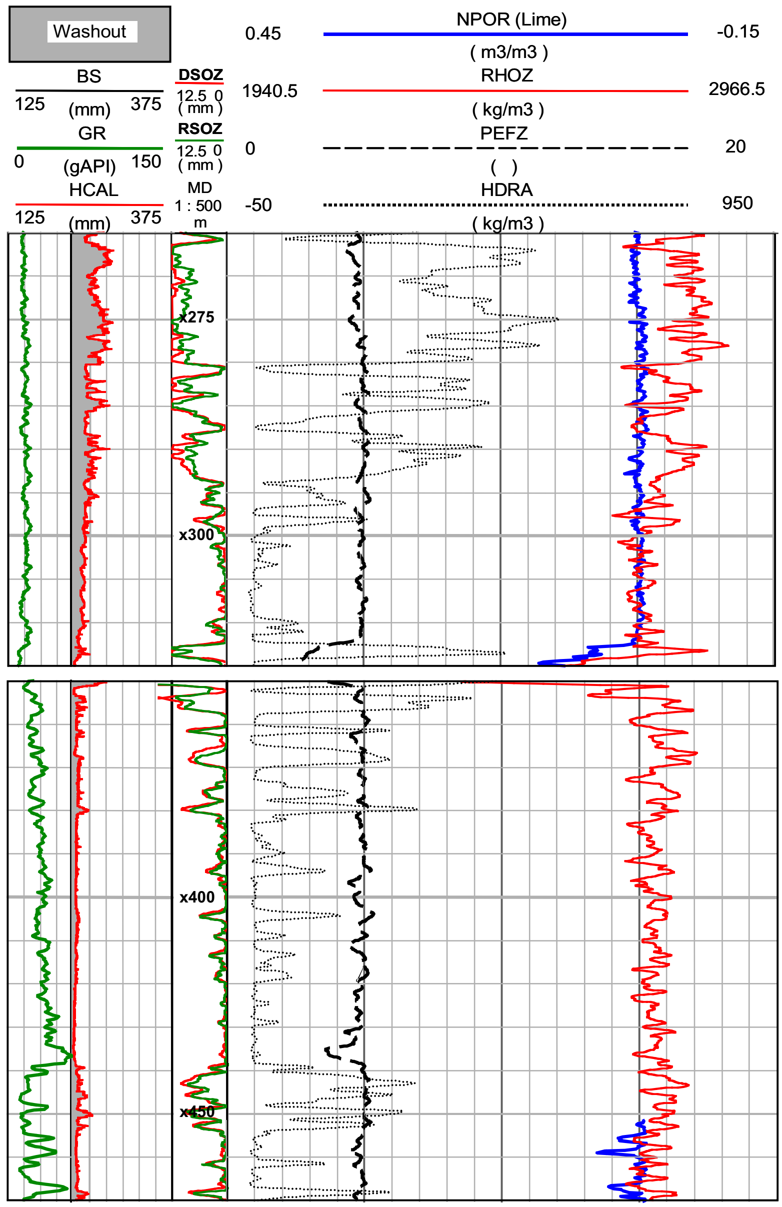


Fig. 18—Example with density heavier than expected in intervals with standoff

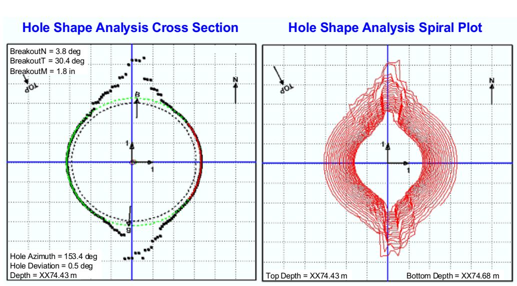


Fig. 19—Generic borehole breakout shape based on analysis using acoustic radii measurements

Continued on page 28…

Reprinted with permission of the SPWLA. Paper originally printed in SPWLA 45th Annual Logging Symposium, June 6-9, 2004

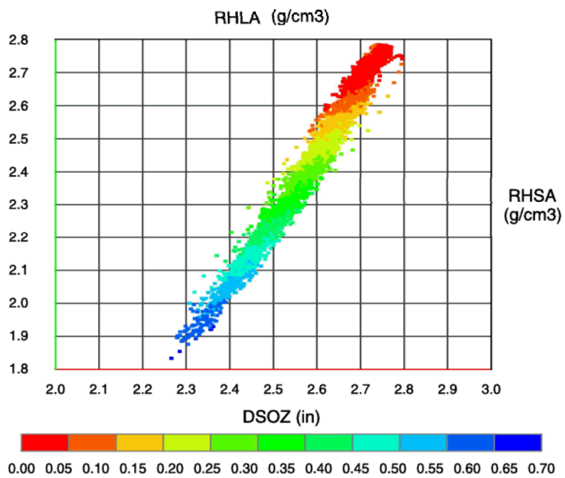


Fig. 20—RHLA_vs_RHSA for Well Data

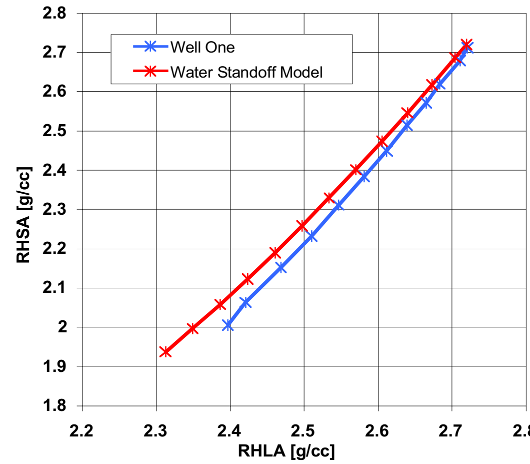


Fig. 21—Data vs. Standoff Model

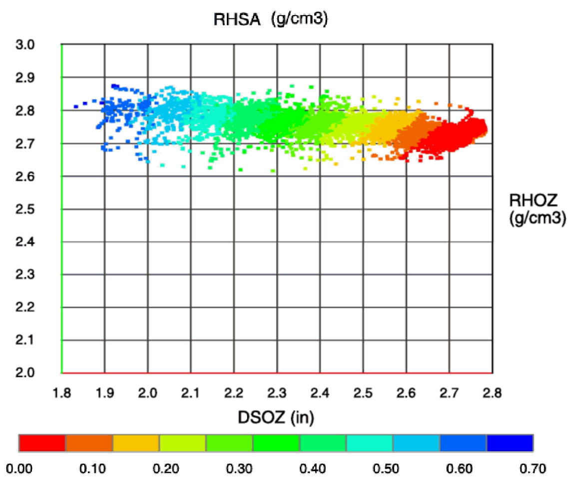


Fig. 22—RHSA-vs_RHOZ before Correction

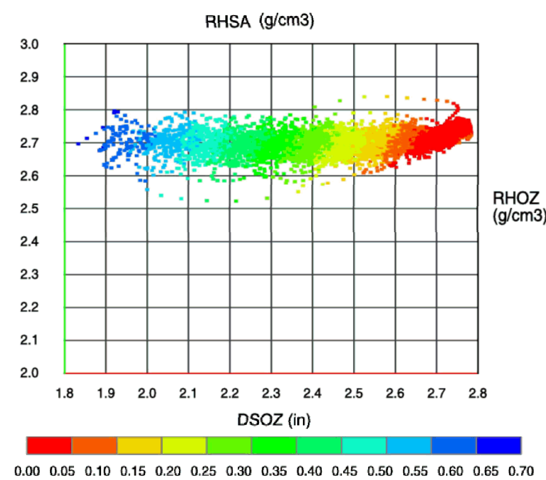


Fig. 23—RHSA_vs_RHOZ After Correction

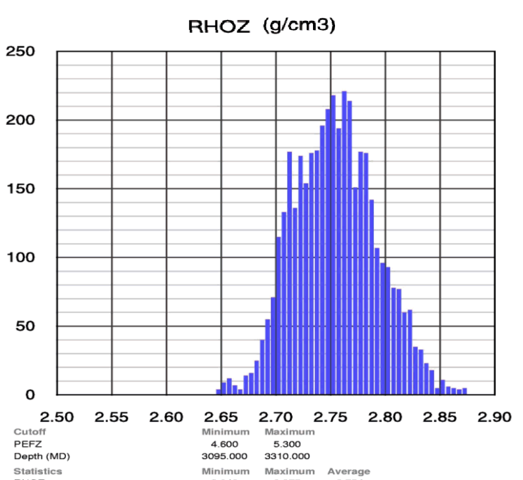


Fig. 24—Density Histogram Before Correction

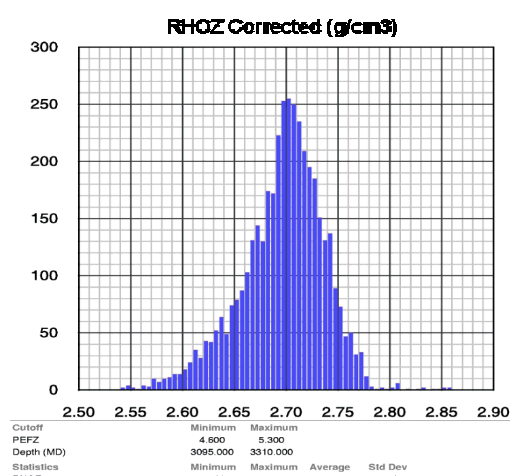


Fig. 25—Density Histogram After Field Specific Rugosity Correction

Continued on page 29…

Reprinted with permission of the SPWLA. Paper originally printed in SPWLA 45th Annual Logging Symposium, June 6-9, 2004

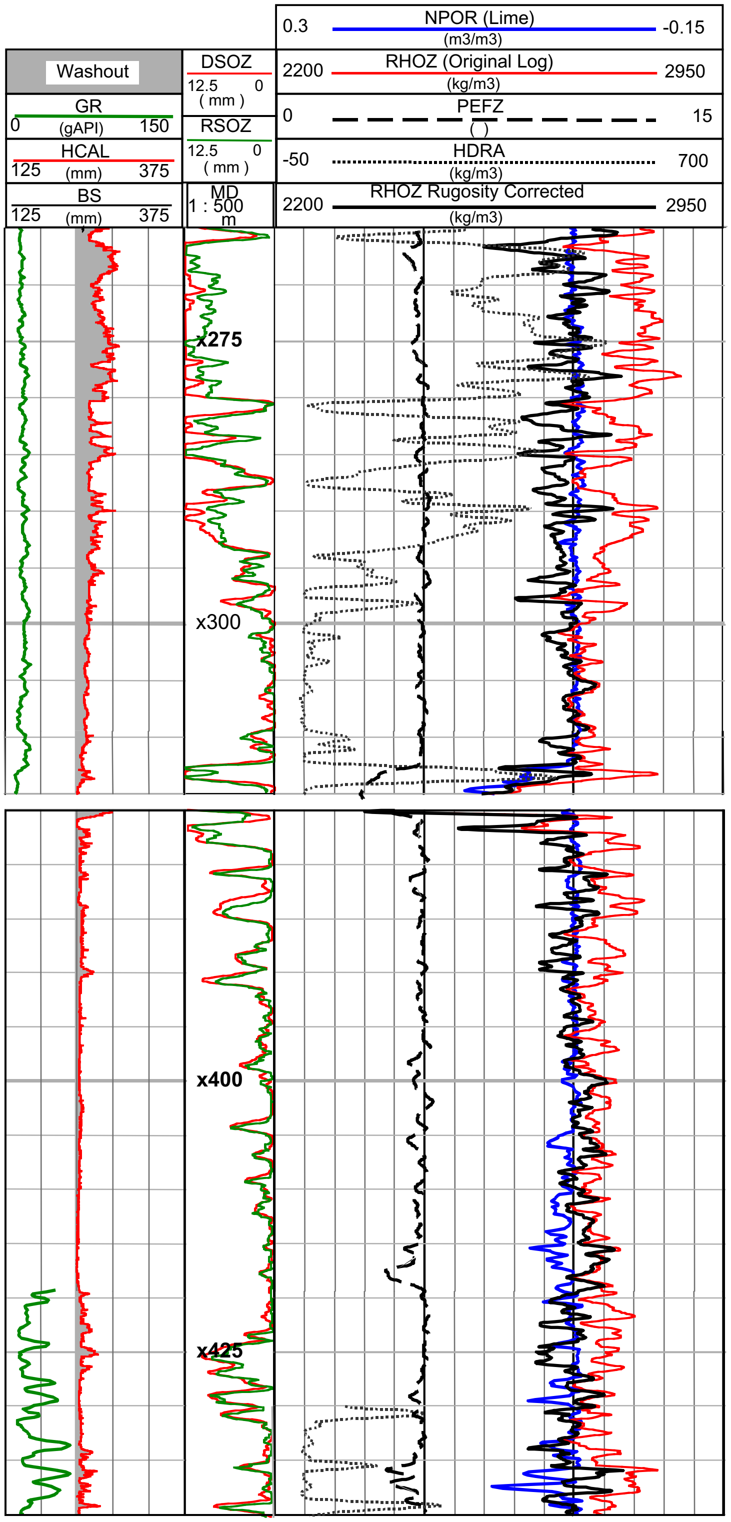


Fig. 26—Density Rugosity Correction Results on Original Well

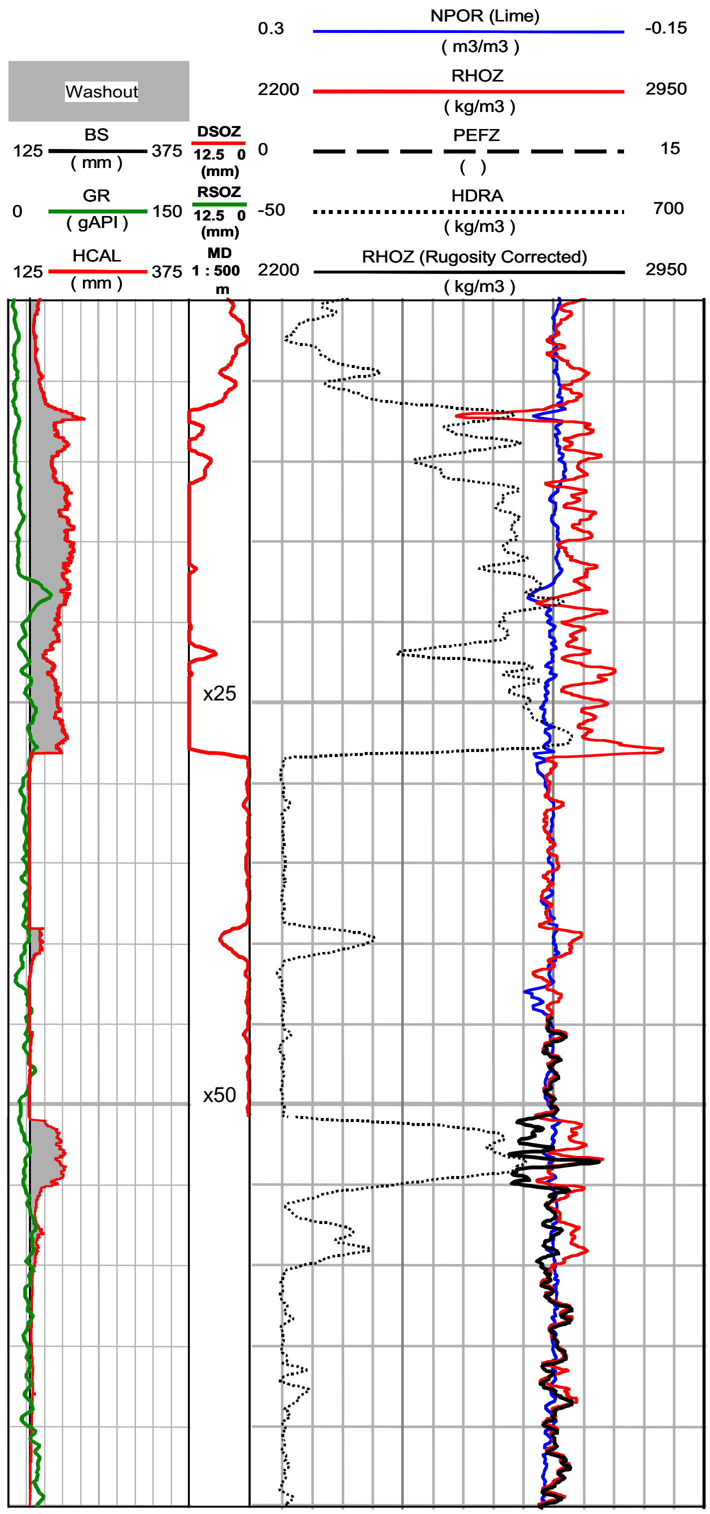


Fig. 27—Results of Density Rugosity Correction on Another Well in the Field

Canadian Well Logging Society

Wednesday, September 8th, 2004

CWLS Technical Luncheon Presentation
Fairmont Palliser Hotel 133 – 9th Avenue S.W., Calgary

Time:	**12:00 pm (Cocktails at 11:30 am)**
Reservations By:	**Friday, September 3rd, (noon) - Call 269-9366 to Confirm a Seat**
Cost:	**Members reserved meal (with confirmed seat): $25.00; Members at the door: $30.00** **Non-Members reserved meal: $30.00; Non-Members at the door: $30.00** **(Special needs meals available with advanced booking only)**
Topic:	**Predicting Hydraulic Flow Units for Enhanced Permeability Modelling Berkine Basin, Algeria**
Speaker:	**Kevin Corrigan, Anadarko Algeria Company LLC** **Chris Howells, Anadarko Algeria Company LLC**

Abstract:

The Berkine Basin represents one of the significant success stories of Algeria with the discovery of several billion barrels of hydrocarbons. One key factor in the success of the Sonatrach-Anadarko Association was the initial value of the conventional core data. To date, in excess of 8km of core have been acquired from many different fields over a geological area extending several hundred kilometres and which, in many cases, is continuous across the reservoir interval. This extensive data acquisition and analysis program has resulted in a significant increase in geological understanding of the reservoir interval and work is currently directed towards identifying geological controls on subsurface flow of hydrocarbons and the need to better describe the permeability distribution within the reservoir. The presentation focuses on a study of a Berkine Basin field, the results of which have subsequently been applied to nearby satellite fields. The ultimate objective of the study is to better describe the 3D subsurface flow in the Triassic sandstone (TAGI) reservoirs in the Berkine Basin by improving the calculation of permeability. To this end the applicability of using Hydraulic Flow Units, as predicted by the use of an artificial neural network, is tested. The approach utilizes a program called Spotfire to identify the controlling factors on permeability and to maximize the benefit of this extensive dataset. It can be shown that a single porosity-dependent permeability predictor is insufficient to describe permeability in every well, even after extensive subdivision of the TAGI sandstone layers. It has been recognized that application of a Timur-type equation leads to a significant improvement but only in zones of irreducible water saturation above each OWC. The prediction of Hydraulic Flow Units, using the method of Abaszadeh, Fujii and Fujimoto, reduces the uncertainty in the calculated permeability, once sufficient training of the artificial neural network has taken place, and gives confidence to permeability estimation where core is not present. The authors would like to thank Anadarko Algeria Company LLC and its partners Eni-Agip, Maersk Olie Algeriet AS and Sonatrach for permission to give this presentation.

Biography:

Kevin Corrigan joined Anadarko Algeria Company LLC in 1996 where he is currently a Senior Petrophysical Advisor working in the North Africa and North Atlantic region. He has over 28 years of experience in the industry, is a Chartered Engineer and holds a BSc. degree in Physics from the University of Leicester. He started work in Schlumberger in their Log Interpretation Centre in Paris, and then as a Field Engineer in Libya and the Middle East. This was followed by 5 years in BP in their International Exploration Group in London as a petrophysicist and later in Aberdeen as a Senior Petroleum Engineer. Prior to joining Anadarko, Kevin was a consultant for 11 years working on a number of integrated, international projects out of the UK.

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

Please see the CWLS Website at www.cwls.org for information regarding a Corporate Network License for the recently published CWLS Formation Water (RW) Catalog CD.

Canadian Well Logging Society

Wednesday, October 13, 2004

CWLS Technical Luncheon Presentation
Fairmont Palliser Hotel 133 – 9th Avenue S.W., Calgary

Time: **12:00 pm (Cocktails at 11:30 am)**

Reservations By: **Friday, October 8th, 2004, (noon) - Call 269-9366 to Confirm a Seat**

Cost: **Members reserved meal (with confirmed seat): $25.00; Members at the door: $30.00**
Non-Members reserved meal: $30.00; Non-Members at the door: $30.00
(Special needs meals available with advanced booking only)

Topic: **Integrated Process Improves Production of the Almond Formation in the Wamsutter Field, Wyoming – A Low Permeability Case Study of Five Years of Continuous Improvement in Well Performance**

Speaker: **Mike Mullen, Halliburton Energy Services**

Authors: **Mike Mullen, Rich Dickerman, Jack Stabenau (Halliburton Energy Services)**
Martin Dobson, Charles Olhson (Marathon Oil Company)

Abstract:

Stimulation optimization in mature fields often faces some pretty stiff opposition to changes in the way well completions are designed. There is usually a lot of inertia to continue to do things the way they have always been done to avoid taking a risk on new ideas. However for a majority of the fields the biggest unanswered question remains, is a well performing at its maximum economic potential. One of the more effective approaches to address this question is an integrated team effort between specialists from both the operator and service companies. This process involves comprehensive knowledge of the reservoir, petrophysics, geology, stimulation design, and production and completion operations.

This integrated team approach was applied to the low permeability Lewis and Almond sands in the Wamsutter field located in southwest Wyoming starting 1999. The process involved:

- high grading of pay based on log evaluation and well testing
- designing stimulation treatments that maximize the net present value from the well
- investigating the causes of under performance
- applying new technologies and techniques to overcome the causes of under performing wells
- documentation of the effect of specific changes in completion practices

At the outset a benchmark of the expected first 12 month cumulative production was established based on existing results. As a result of this ongoing effort, the original benchmark has been exceeded by over 100% over the past five years. The average production for these wells has also increased over 50%.

Biography:

Mike Mullen is a Principle Technical Professional specializing in the integration of petrophysics, reservoir simulation and economic stimulation design with Halliburton Energy Services in Denver, CO. Mike graduated from the University of Missouri - Rolla in 1976 with a BS degree in Electrical Engineering. He began his career as a logging field engineer in Hobbs, NM in 1976 and has held positions in technical support, sales and formation evaluation over the past 28 years. Mike is currently working for Halliburton Energy Services as a Senior Technical Service Advisor concerning petrophysist and formation evaluation. Mike is involved in developing formation evaluation models for open hole and cased hole logs run in the Rocky Mountain region. He also conducts multi-disciplinary field studies, economic stimulation design recommendations in unconventional reservoirs. He has 28 years of industry experience with 20 of those years with Halliburton Energy Services

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

Please see the CWLS Website at www.cwls.org for information regarding a Corporate Network License for the recently published CWLS Formation Water (RW) Catalog CD.

CWLS GENERAL INFORMATION

INCORPORATED – January 21, 1957

Objective

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

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

(B) Encouraging research and study with respect thereto.

MEMBERSHIP

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

FEES

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

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

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

ACTIVITIES

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

Research committees encourage and support research on relevant problems.

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

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

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

APPLICATION

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

CWLS MEMBERSHIP APPLICATION FORM

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

NAME:..

COMPANY:..

COMPANY
ADDRESS:..

....

HOME
ADDRESS:..

....

E-MAIL ADDRESS:..

PREFERRED MAILING ADDRESS:

E-MAIL____ OFFICE____ HOME____

BUSINESS
PHONE:...

RESIDENCE
PHONE:...

PROFESSIONAL
DISCIPLINE:..

....

SIGNATURE:...

DATE:... , 20 ....

CWLS SPONSORS: (Members in good standing)

Name: ....

Phone:...

Name: ....

Phone:...

FEES

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

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

Tech Corner: Spectral Core Gamma System

The core gamma-ray log is a standard piece of information received with the core analysis for most cores that are cut and analyzed. What is the machine called that generates this plot and how does it work? What is the optimal logging speed? This Tech Corner takes a brief look at the machine used to generate core gamma logs.

The machine used to generate core gamma logs is called a Spectral Core Gamma System (SCGS). The SCGS (Fig. #1) is used to measure the natural radioactivity from cores. Using an advanced detector and data acquisition routine, the SCGS Unit provides total gamma ray recorded in API units; elemental contributions recorded in terms of Potassium (%), Uranium (ppm), and Thorium (ppm) and a calibrated bulk density value.

Core logging speed is variable - research experiments with this unit have determined that the optimum data acquisition-logging rate is up to 0.84 metres per minute for four-inch diameter cores and 0.17 metres per minute for two-inch diameter cores. A lead shield (Fig. #2) around the detector and tunnel minimizes the effects of background gamma radiation interference.

(Photos and Technical Writeup courtesy Core Laboratories)

Figure #1: *Spectral Core Gamma Machine*

Figure #2: *Closer view of the lead shield*

UPCOMING EVENTS

September 8th, 2004

CWLS TECHINICAL LUNCHEON PRESENTATION

Fairmont Palliser Hotel, Calgary, AB

Kevin Corrigan, Anadarko Algeria Company LLC

Predicting Hydraulic Flow Units for Enhanced Permeability Modelling Berkine Basin, Algeria

October 13th, 2004

CWLS TECHINICAL LUNCHEON PRESENTATION

Fairmont Palliser Hotel, Calgary, AB

Mike Mullen, Halliburton

Integrated Process Improves Production of the Almond Formation in the Wamsutter Field, Wyoming – A Low Permeability Case Study of Five Years of Continuous Improvement in Well Performance

November 18, 2004

CWLS FALL SOCIAL

Fairmont Palliser Hotel, Calgary, AB

Penthouse Room

Starts at 5:00 p.m.

Corporate Members are:

Platinum

Anadarko Canada Corporation
Encana Corporation
IHS Energy

Gold

Baker Atlas
Burlington Resources Canada Ltd.
Conoco Philips Canada
Continental Laboratories (1985) Ltd.
Devon Canada
Husky Energy Inc.
Petro-Canada Oil & Gas
Precision Wireline Technologies
Schlumberger of Canada
Shell Canada Limited
Talisman Energy Inc.
Wellsite Gas Detection Inc.

Silver

Delta P Test Corporation
Provident Energy Ltd.
Qercus Resources Ltd.
Sproule Associates Limited
Tucker Wireline Services

Bronze

Apache Canada Ltd.
Blade Ideas Ltd.
Core Laboratories Canada Ltd.
ECL Exploration Consultants Ltd.
GeoLOGIC Systems Ltd.
Halliburton Energy Services
HEF Petrophysical Consulting Inc.
IHS AccuMap Ltd.
Landau Petroleum Ventures Inc.
LogTech Canada Ltd.
Murphy Oil Company Ltd.
Nexen Canada Ltd.
NMR Petrophysics, Inc.
Paradigm Geophysical
Paramount Resources Ltd.
Plains Perforating Ltd.
Reeves Wireline
Roke Oil Enterprises Ltd.
Suncor Energy Inc.
Taggart Petrophysical Services Inc.
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.

Robert Bercha (robert_bercha@anadarko.com) at (403) 231-0249

Discounts on business card advertisement for members.

A typical wellsite configuration with Toolpush's, Engineers, Geologists, Directional Hands and Safety Hands shacks and 400 bbl tanks.

Photo Courtesy Robert Bercha

Removing thread protectors from production casing in preparation for drifting and quality inspection.

Photo Courtesy Robert Bercha

CANADIAN WELL LOGGING SOCIETY

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

Enhance Your Image with High Resolution Micro Imager (HMI™) Service

The High-Resolution Micro Imager (HMI) sensor provides an efficient way to capture reservoir features in a single run.

PRECISION

Wireline Technologies

4500, 150 - 6th Avenue S.W.
(403) 265-6060

24 hour dispatch
1-800-661-5656

Precision Drilling

www.precisiondrilling.com