CANADIAN WELL LOGGING SOCIETY

CWLS NEWSLETTER

in site

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President's Remarks

Welcome to the first edition of InSite for 1999. Whether you believe this is the last or second last year of the millennium, there is something exciting about the thought of the "odometer of time" turning over in less than nine months. I'm sure there will be no end of nostalgia, summaries and reviews of the past 100 years, so I thought I would get an early start and have a brief look at some highlights of our relatively young but interesting industry.

For example, oil production for the whole world at the turn of the century was about 400,000 bbls/day. Now-a-days, some OPEC countries can cheat on their daily production quotas by this amount and get away with it for months.

In 1899 the price of crude in 1991 constant dollars was a ridiculously low US$15.00/bbl. What a difference a century makes!

In 1911 the U.S. government ordered the dismantling of Standard Oil into seven or eight smaller companies which became the likes of Exxon, Mobil and Amoco. Market conditions have obviously changed dramatically in 90 years, but I'm sure those regulators would find irony in the current merger mania.

Closer to the hearts of CWLS members, on September 5, 1927 logging operations were performed for the first time on a well in France, by a couple of brothers of French-German background.

From the late 1930's to the 1950's the balance of oil power began shifting to the Middle East, beginning with discoveries in Kuwait and Saudi Arabia in 1938 and ending with the forming of OPEC in 1960.

The first post-war frenzied oil boom took place right here in Alberta, when in 1947 Imperial Oil struck it big at Leduc.

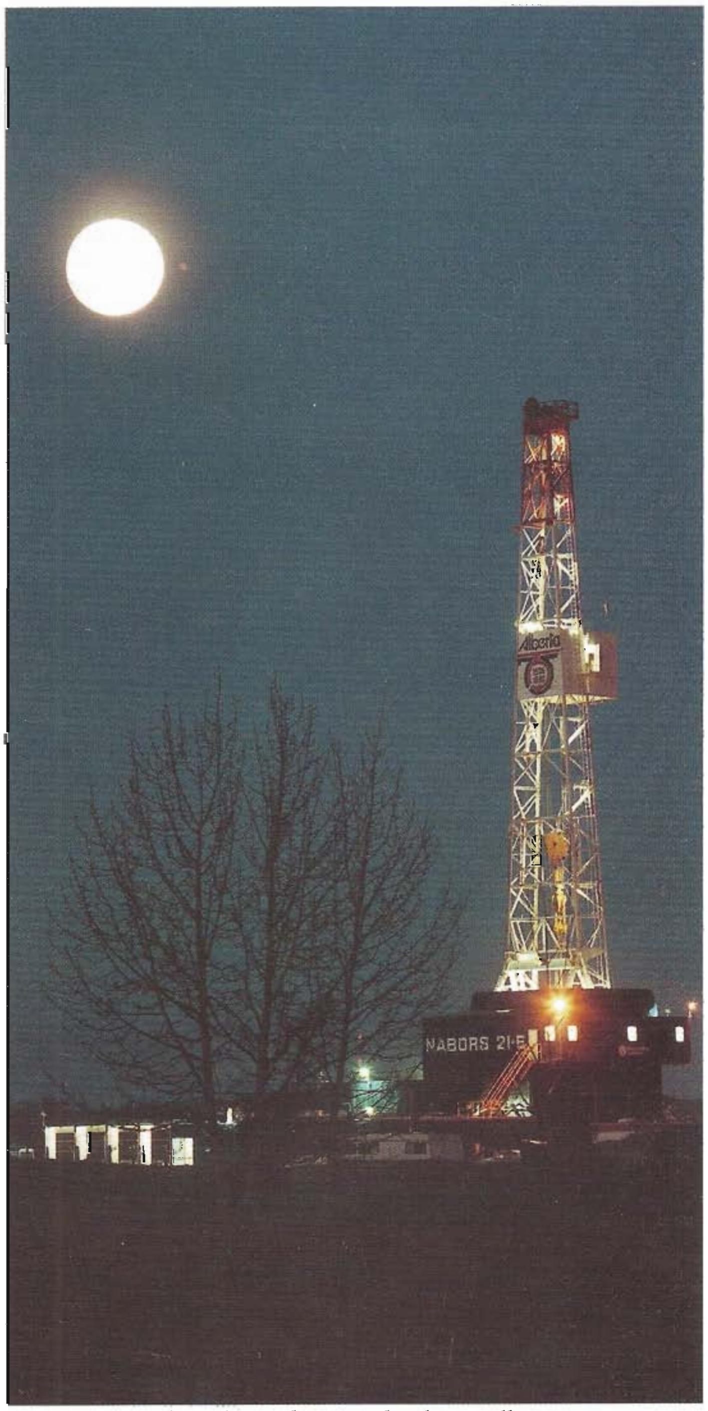

photo courtesy of Shell Canada Limited Calgary, Alberta

In the 1950's and 1960's the range of areas where oil could be discovered increased dramatically.In the late 60's oil was found in the barren, harsh, northern climates of Alaska and the North Sea. In the mid 50's it was shown that oil could also be found in warm, hospitable, secure areas such as Algeria and Nigeria!

The fourth major post-war oil crisis brought the largest percentage change in price in the history of our industry, when in 1973 the Arab oil embargo caused a jump from $2.90/bbl to $11.65/bbl in three months. Unfortunately I was in grade nine at the time and missed out on the investment opportunity.

In 1979-81 there was another huge jump in price from $13/bbl to $34/bbl. Being a little more aware of the impact of this increase on employment opportunities, I and several thousands of my fellow graduates jumped on the bandwagon and signed up for work in this prosperous industry . It was heady times in the oil patch with our "hockey stick" economic forecasts that had the price edging over $100/bbl by the end of the century. What a business!

OOOPS! 1986. One of the few good things that can be said about the oil price crash of 1986 is that it is probably the reason that there has been a lot less panic during the recent slump. While the last couple of years have not been easy on a lot of folks, I think there is a collective feeling that we've "Been There, Done That" before and things will improve once again. Let's hope that the recent upswing in oil price is more than a short-lived phenomenon.

In the face of the uncertain commodity prices that have marked the last decade or so, we must continue to focus on things within our control such as developing new technologies and techniques. It is for this reason that the CWLS supports many worthwhile ventures such as last years Geo-Triad, the upcoming Geo-Canada 2000, and our ongoing technical luncheons and publications such as The Journal and InSite.

In summary, despite being a relatively young industry, the oil business has played a fascinating, and often defining role in the 20th century. Our era has been dubbed by some as the age of 'Hydrocarbon Man', and the oil industry, despite being the single most important business of our time, or maybe because of this, has had quite a history of scandal, intrigue, collusion, bribery and questionable ethics.

Today's oil industry is much more mature and refined, but still holds the excitement of new discoveries and developments, and there is never a dull moment. I will close by sharing a bumper sticker I first saw in Liberal, Kansas during my early years in the patch. "Please Don't Tell my Mother I Work in the Oil Business; She Still Thinks I Play Piano in a Whorehouse."

Integration and Synergy

Utilizing geology, petrography, open and cased hole logging technology for a better answer

◆ Tony Fondyga, P. Eng., Schlumberger of Canada & Kevin Parks, Ph. D., P. Geol., Petro-Canada Oil and Gas

A recent Gilby area well provides a case study in integrating various disciplines to understand and predict well performance. Sandstones of the Jurassic and Cretaceous age have produced oil and gas in the Gilby area since the early 1960's. These sandstones were deposited in a series of cross-cutting valleys, possibly with estuarine or shallow marine influences (Kramers and Dolby, 1993; Stobl et al, 1993). The complex depositional history results in a complicated stratigraphy comprised of a diverse range of lithofacies (Figure 1).

Reservoir lithologies range from clean quartz arenites to kaolinitic litharenites. Non reservoir lithologies range from detrital chert-limestone breccias, pyritic shales and waxy paleosols (e.g. Strobl et al, 1993; Hopkins, 1981; Cant and Abrahamson, 1996).

To complicate development of these reservoirs, several oil pools have been on intermittent waterflood since the 1960s. Both fresh water and disposal brines have been used as injector fluids.

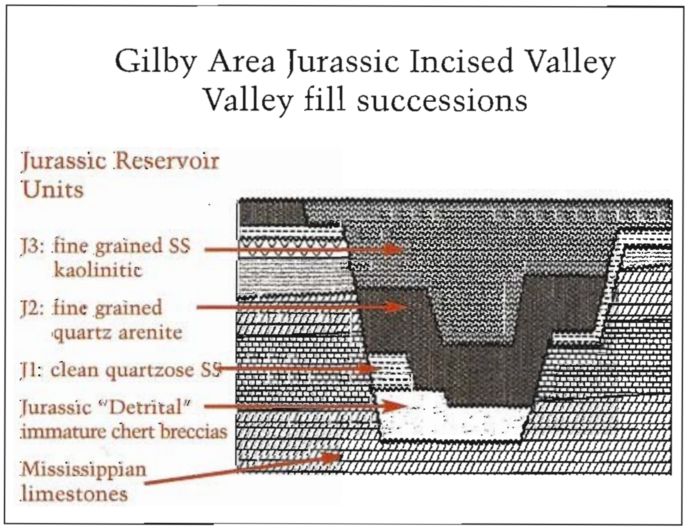

Figure 1. (after Strobl et al, 1993)

Standard Log Analysis Suggests Pay

A first look at the standard logs reveals some key information. The gamma ray indicates a clean quartz arenite facies from X155m to X132m and radioactive detrital from X158m-X166m. Increased PEF and a resistivity drop at the formation top imply heavy conductive minerals—likely pyrite and/or siderite. There is a heavy mineral effect in the radioactive detrital as well. Since the density is usually pessimistic in heavy mineral sections, a neutron porosity or ideally CMR porosity would be more accurate here. Very little neutron-density separation occurred in both facies, indicating probable low clay volumes. An apparent OWC near X145m is interpreted from a resistivity increase and reversal of resistivity profile (RXOZ vs. 90" induction). Neutron-density crossover indicates a possible gas cap at X139m. This is not substantiated by offset production history. This may be residual gas saturation after oil displaced the gas during water flood.

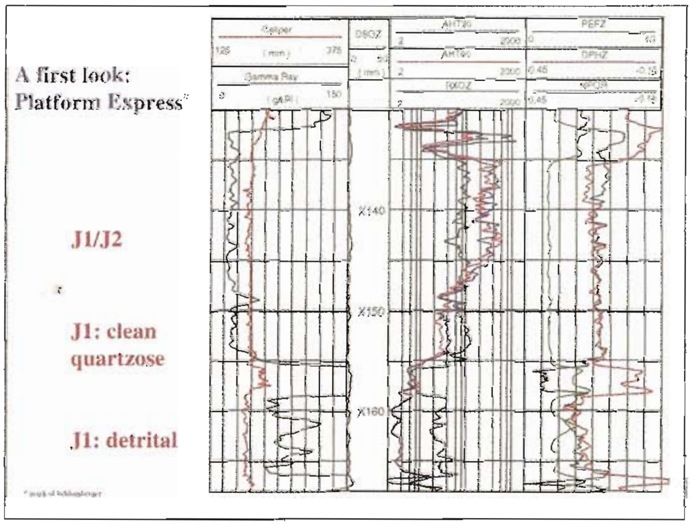

Figure 2.

Magnetic Resonance Logging and Petrography Adds Insight

The CMR* was also logged on this well, providing useful information on reservoir quality. For those unfamiliar with magnetic resonance technology, the thin sections in Figure 3 illustrate the value of the tool's T2 measurement. Two rocks of similar porosity, but different permeability can be seen in the thin sections shown. The pore size distribution is the major reason for the difference in permeability. T2 distribution is closely related to pore size distribution, giving us a better prediction of reservoir quality than possible before.

The major discovery from the CMR (figure 4) was the good reservoir quality (porosity & permeability) in the detrital, similar to the cleaner quartz arenite facies above. The T2 distribution (right track) shows almost all grain sizes from X132-X155m are fine/medium or larger, with insignificant capillary bound water. Low resistivity zones would therefore only be due to fluid contacts and not grain size changes. Only the heavy mineral zone from X132-X137m has quite low CMR porosity and permeability. Elsewhere, CMR derived perms are

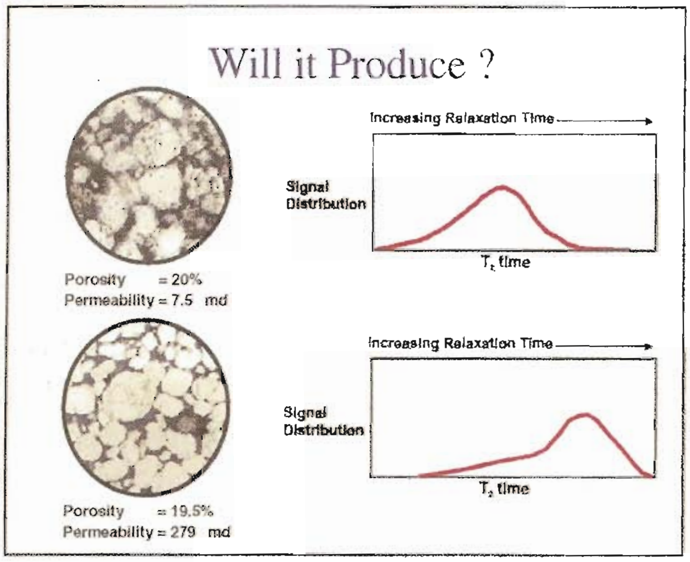

Figure 3.

in the 100 to 500 mD range, indicating that the well will produce fluids. The detrital zone shows a small increase in bound water/small pores with a bimodal pore size distribution.

Petrography Confirms CMR

Thin sections from an offset well corroborate the logs. The first thin section (figure 5) confirms the presence of pyrite. Note the apparent reduction in point count porosity (equivalent to CMR effective porosity) in the pyrite zone.

The second thin section, (figure 6) from the detrital, explains the T2 bimodal nature. Microporosity in leached chert grains exist alongside porosity from the quartz framework. Quartz to quartz pores would constitute effective porosity from CMR and point count porosity. Leached chert and subsequent microporosity would constitute "small pore" and capillary bound porosity in CMR terminology.

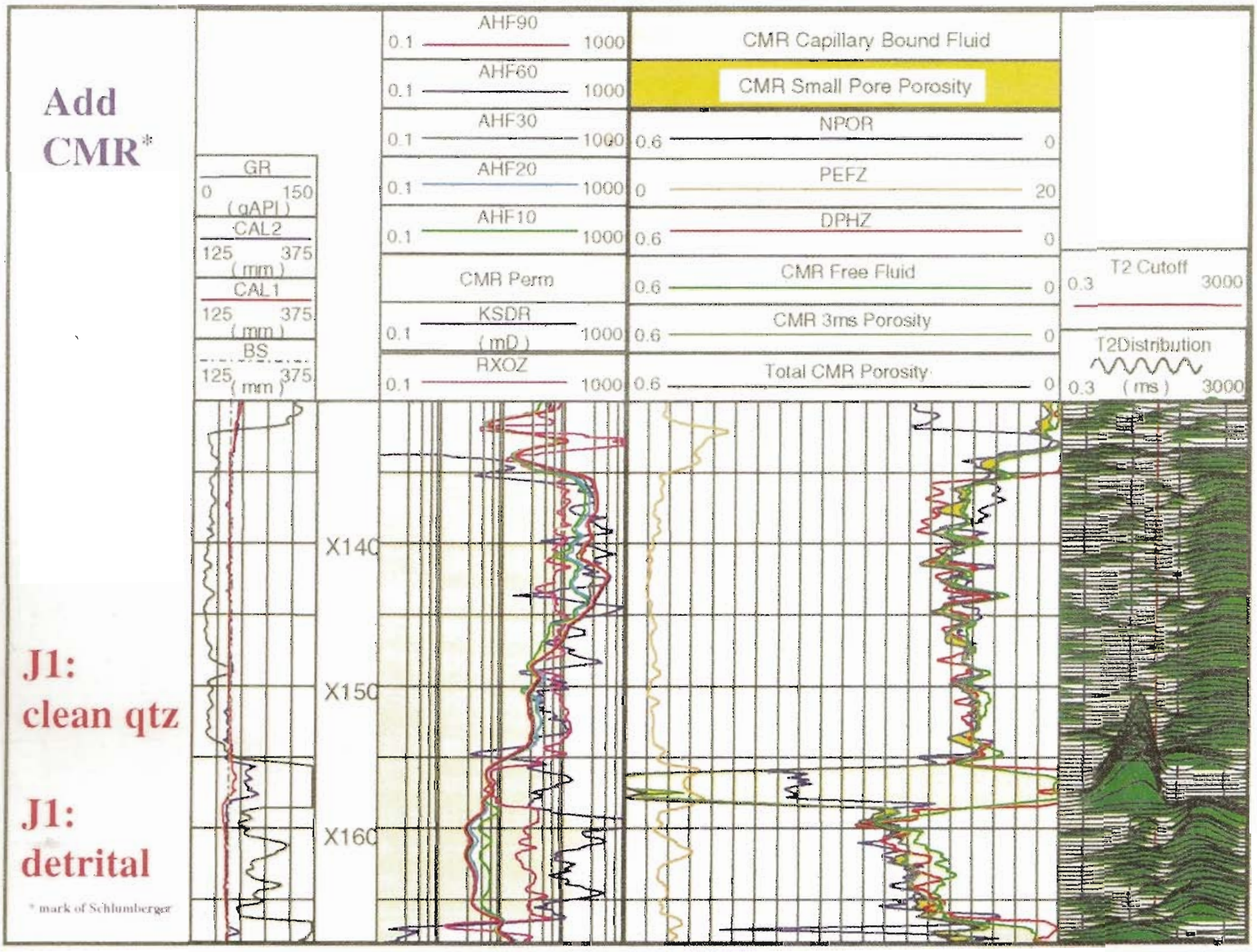

Figure 4.

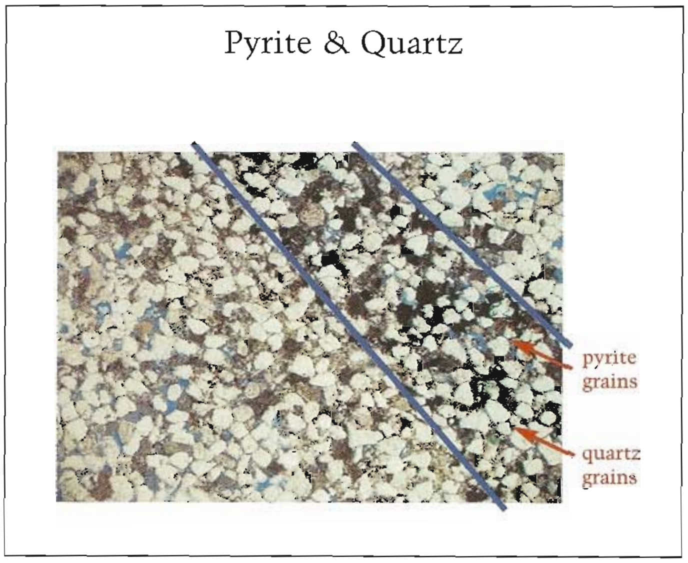

Figure 5.

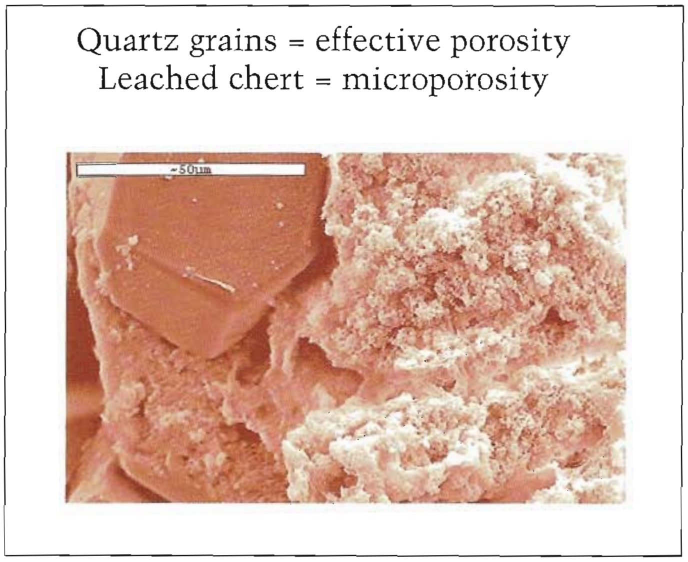

Figure 6.

Reservoir Saturation Tool Successfully Predicts Fluid Types

The Reservoir Saturation Tool (RST*), logged after casing provides the final input to the interpretation (figure 7). Lithology was computed from RST derived elemental yields of iron, calcium, silicon, and sulfur (Spectrolith* computation) This confirmed the low clay content in the detrital, corroborating CMR and thin section data. The RST also showed an increase in iron, sulfur and carbon yields in the top of the zone. This is attributed to pyrite (FeS), and siderite (FeCO3). The RST also provided a salinity independent saturation and volume of oil from its Carbon - Oxygen measurement. The volume of oil (VUOI) is displayed with porosity in the far right of the log, on the same scale and units as the porosity curve. Only a small portion of pore space is oil filled, predicting high water cut and disagreeing with other log data.

Integrating all the data to predict production

The final computed analysis, or ELAN*, (figure 8) incorporating RST C/O data now shows very high water saturation throughout, except in the uppermost (low perm)

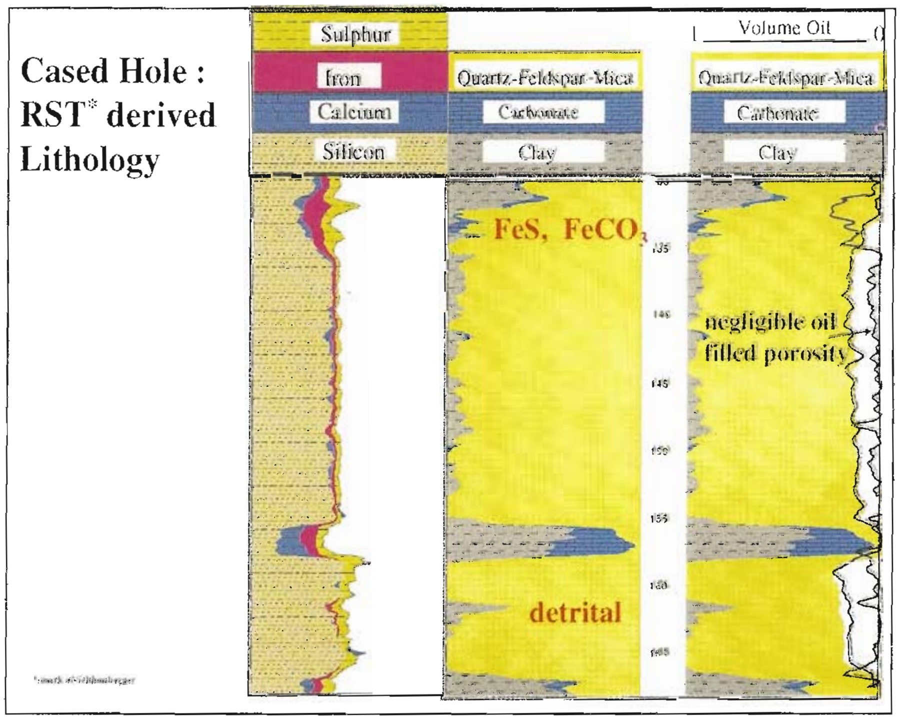

Figure 7.

heavy mineral section. The high water cut predicted was corroborated by actual production results shown. The apparent OWC seen on the induction log was actually a contact of connate saline water with a bank of fresher injected water encroaching on this well.

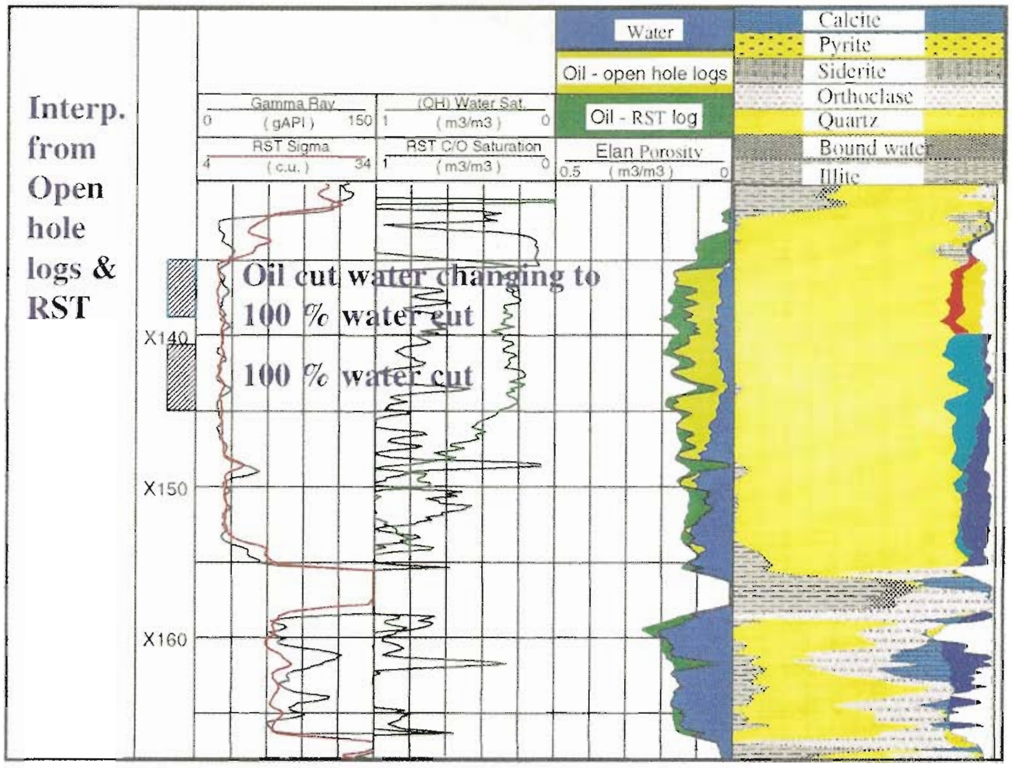

Figure 8.

Summary

We can summarize the contribution from each technology as follows.

CMR: The CMR permeability predicted fluid production. T2 distribution identified negligible clay volumes with only minor capillary bound water. It also measured correct porosity in heavy mineral and detrital zones.

Thin Sections showed little clay was present, and indicated chert microporosity.

RST: The RST successfully predicted high water cut in a fresh/variable water salinity environment. Low clay volumes measured in the radioactive detrital zone were corroborated by CMR, geology & sample descriptions. Lithology information assisted in determining the mineral model for a superior computed evaluation.

Combined technology: Integrating the open and cased hole logs, core and geology, determined porosity, permeability and lithology and explained the high water cut.

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Kramers, J.W., and G. Dolby, 1993. Jurassic/Cretaceous Boundary in west-Central Alberta, ARC openfile report 1993-26.

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Suggestion Box

It is our objective to have the "In Site" publication meet your needs. To do this we require your comments and suggestions. To date, the following articles have been suggested:

- A CWLS bulletin board with up coming CWLS events.
- News from other societies such as CSPEG, CIM, CADE, etc.
- Short articles related to log analysis and formation evaluation, in the format of the SPWLA Log Analyst article "Le Log."
- Re-publishing classical log analysis papers from the CWLS archives.
- Letters to the editor concerning current CWLS and industry activities.

Please contact David Llewellyn (David.Llewellyn@shell.ca) or Pat Miller (landau@cadvision.com) with your suggestions.

photo courtesy of Shell Canada Limited Calgary, Alberta

The man closet the camera is comparing electrical logs of field wells, while the other is working on a contour map of the area. On the wall, in the upper left corner, is part of a geological cross-section of a field. If you can identify the persons in this photo please contact the CWLS.

A Picture is worth a thousand words... and a new Digital Camera!

The CWLS is excited to announce our first ever photo contest! We are looking for your photographs that tell the story of our exciting industry. Photos should be related the oil field and/or historically significant to the CWLS. The winner will receive a digital camera, courtesy of Schlumberger. Participants should send there entries to Pat Miller at the CWLS, along with a brief description about the photograph. Pictures can be color or black & white. All entries will become the property of the CWLS for use in it's publications. Deadline for entries is November 11th 1999. The winner will be announced at the December CWLS luncheon. Good luck! The CWLS is also looking for volunteers to assist in the judging of this exciting contest. If you are interested please contact Pat Miller.

Chairman's Remarks

Welcome to the spring issue of the newsletter. Spring is a time of renewal or birth. In keeping with this we are trying to spruce up the newsletter. We hope to introduce several new article types over the next year, but as always much depends on the enthusiasm of our membership. I encourage you to become involved in one of our many committee's working to improve the quality of product provided by your society.

I'd like to extend a big thank you to Schlumberger/Anadrill for sponsoring the photo contest.

David Llewellyn
Publication Chairperson ◆

Committee Members

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1999 C.W.L.S. Executive

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