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Upcoming Events

Monday 27th

February 2017

6:30pm—7:30pm

“Advanced Fractal
Modelling of
Heterogeneous and
Anisotropic
Reservoirs.”

Paul Glover,
University of Leeds

Evening Lecture

Thursday 16th

March 2017

9:00am—5:00pm

“Petrophysics-101—
Core Analysis Essen-
tials

One Day Seminar

Tuesday 4th

April 2017

6:30pm-7:30pm

“Looking ahead of the
bit while drilling: from
vision to reality”

Monica Vik
Constable, Statoil

Evening Lecture

Message from the President

Dear Members and Friends of the LPS,

Thanks to the multitudes who attended our recent ‘New Technology’ seminar on 24th January! We hosted 16 lecturers covering mud logging, core, LWD, wireline, & conveyance. The feedback received focused on the high quality of talks, with thanks to Dawn Houliston (VP Technology) for pulling it all together! A record of 85 participants illustrates the renewed optimism in our industry.

With all this technology recently available, the onus is now firmly on O&G Operators to embrace these advances in their quest to book reserves & develop resources. Most of us realize that maximizing focus on early data collection will optimize project costs over the life-time of any asset. It is the duty of our profession not only to conduct technical evaluations, but also to justify the value of adopting new technology (where appropriate) and prepare convincing financial arguments to line management & other stakeholders, of their benefit. Recent cuts in operator AFE well budgets have reduced understanding of reservoir complexities to a most basic level, yet at a time when the reservoirs we encounter are at their most complex! The economic pitfalls of under-evaluating a field has led to a cascade of unfortunate consequences for far too many operators in recent years. It is time for our profession to make a stand- for the long-term viability of producing these reserves in the most economical manner.

Our next One Day Seminar is coming up soon. ‘Essentials of Core Analysis’ will be held on Thursday 16th March. And a note that our next Evening Lecture will be held next Monday 27th Feb, where Professor Paul Glover from the University of Leeds, will present ‘Advanced Fractal Modelling of Heterogeneous Reservoirs’.

Also within this Newsletter we continue our series of technical articles, with the well-known Professor Paul F. Worthington writing ‘On the Containment of Petrophysical Uncertainty’, which I am sure you will all find a good read. And - now is the last chance to sign up for Membership and receive the presentations from our ‘New Technology’ seminar. It is currently still free - check our website.

Best Regards,

Michael O’Keefe

Michael O’Keefe - LPS President

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Mon 27th Feb	Advanced Fractal Modelling of Heterogeneous and Anisotropic Reservoirs	Paul Glover , University of Leeds
Tues 4th Apr	Looking ahead of the bit while drilling: from vision to reality	Monica Vik Constable , Statoil
Weds 10th May	Error calculation and use of first order error propagation as an integral part of petrophysical evaluation	Stein Ottar Stalheim , Statoil

The Next LPS Evening Lecture:

“Advanced Fractal Modelling of Heterogeneous and Anisotropic Reservoirs”

Presented by

Paul Glover

University of Leeds

Monday 27th Feb 6:30pm—730pm

The Geological Society, Burlington House, Picadilly

Refreshments will be available from 6pm.

Wine & Savouries will be provided after the presentation, which we would be delighted for you to join us for.

- Free Entry -

Full Abstract and bio available online at

www.lps.org.uk/events

One Day Seminar: Petrophysics101- Core Analysis

Thursday 16th March 2017
09:00am - 05:00pm



What is it About?

This one-day seminar will consist of a series of themed talks, on the essentials of core analysis for formation evaluation, each lasting around 30 minutes with five minutes for questions

Who Should Attend?

Petrophysicists, geologists, reservoir engineers, geophysicists, & technical assistants requiring an introduction or a refresher on the intricacies of core analysis

Petrophysics

£150 for delegates (LPS is not VAT registered)

Students can register for free

Includes lunch and post-seminar wine and savouries.

Doors open at 9am.

For more info or to register for this event please visit

www.lps.org.uk/events/

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Author: Paul F. Worthington, Park Royd P&P (England) Limited

Introduction

Petrophysicists are frequently exhorted to manage and contain uncertainty, which is often seen as an estimate of how inexact an interpretation of core and log data might be.¹ The estimate is therefore referenced to an interpretation protocol. Where the latter is followed inflexibly, perhaps because of company culture or because it is prominent within a favoured software product, data character is rendered subordinate to interpretation methodology. This reversal can cause petrophysical deliverables to be unfit for purpose, especially in problematic reservoirs.² It introduces an unhelpful downside, which can be partially obviated through practices such as the following, for which an overarching requirement is the reconciliation of different scales of measurement.

Use of Key Wells

Key wells are those selected for detailed study because they are representative of a reservoir (subdivision). The acquired key-well database includes the results of conventional and special core analysis, well logs, formation tests and mud logs. Key-well data are used to establish a fit-for-purpose petrophysical interpretation methodology. This is exported to other wells that penetrate rock of similar character. An important role of the key well is to make targeted data acquisition more efficient and effective. The application of the key-well concept has led to a reduced uncertainty in the determination of hydrocarbon pore volumes and thence to better static and dynamic reservoir models.³

Matching Petrophysical Data to Reservoir Complexity

Reservoirs are seen to become increasingly complex as more data are acquired. Rarely does the drilling of an additional well lead to a reduction in perceptions of complexity. This means that perceived complexity is likely to lag behind reality. The more subcritical databases lead to greater degrees of uncertainty. To mitigate this, some indicator of reservoir complexity is required to guide the acquisition of petrophysical core data. The needs are twofold: quantification of the variability of a reservoir property; assessment of the exactness of a petrophysical algorithm. The coefficient of variation of a property, i.e. the ratio of standard deviation to mean value, has been used as a comparative measure of dispersion to guide the number of core measurements needed to estimate the mean value of, say, porosity or effective permeability to within a stated tolerance.⁴ The approach has been extended to estimate the quantity of core data needed to establish meaningful empirical algorithms for petrophysical evaluation.⁵ These refinements reduce the risk of punitive shortfalls in a petrophysical database.

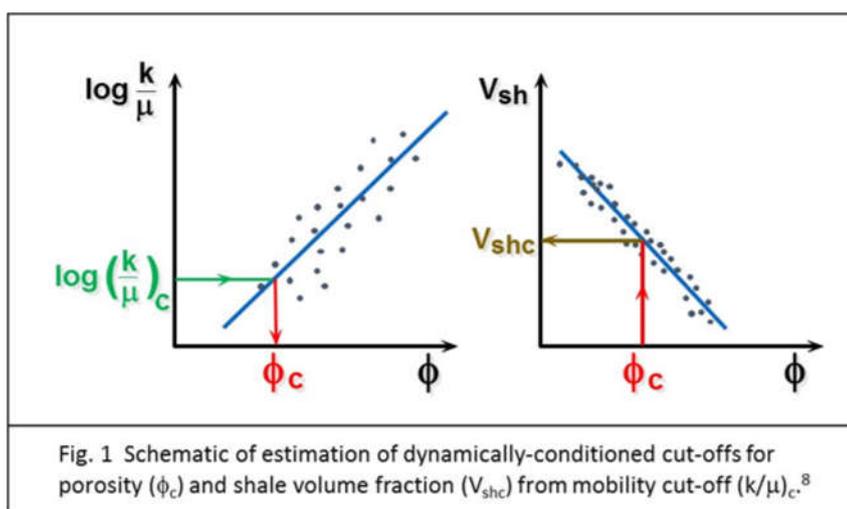
Author: Paul F. Worthington, Park Royd P&P (England) Limited

Calibrating Thin Bed Analyses

Failure to identify thin sand beds is one of the principal causes of by-passed pay in petrophysics. Whole core description does provide visual groundtruthing but logging tools such as galvanic micro-imagers, 3D induction and NMR tools sense different properties at different scales. For this reason, the calibration of log data based on core description can be a major challenge but there does need to be a tie-back of some kind. For example, both resistivity image logs and NMR logs have been calibrated to sand count from core description.^{6,7} Notwithstanding such compelling case histories, log-based thin-bed analysis is still being attempted without the benefit of key-well calibration.

Identification of Net Reservoir

Net reservoir is an input to conventional subsurface geocellular models. It is based on a porosity (ϕ) cut-off and possibly a shale volume fraction (V_{sh}) cut-off, too. The aim is to remove from consideration those non-reservoir volumes that make negligible contributions to hydrocarbon volumetrics and fluid flow. In this way, petrophysics can focus on the characterization of the reservoir rock with a consequent sharpening of property distributions and interpretative algorithms. Net reservoir cut-offs need to have some dynamic significance so it is desirable to tie them back to permeability (k) or to mobility (k/μ) for a given petrofacies unit (Fig. 1).⁸ Sometimes, a multivariate regression has been used to do this.⁹ If no cut-offs are applied, non-reservoir rock has to be characterized to the same degree as reservoir rock.



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Evaluating Freshwater Reservoirs

There is a widely held view that many thick hydrocarbon reservoirs that contain low-salinity formation waters are overperforming. In fact, they are not overperforming at all. It is the petrophysics that has underperformed by delivering underestimates of hydrocarbon saturation. The root cause is low water salinity (e.g. < 5000 ppm NaCl equivalent) often in the presence of shaliness. In such situations it is essential to calibrate log analysis with water saturation (S_w) extracted from low invasion core. This has led to relatively low values of the Archie saturation exponent n and/or the porosity exponent m .¹⁰ Beyond this, NMR, dielectric or fluid-analysis tools have been deployed in addition to standard well logs.¹¹ Where the use of such downhole data leads to closure with the electrical interpretation of S_w , a substantial reduction in uncertainty can be achieved.

Verification of Saturation Equation

Different software packages can contain different descriptors for equations used to calculate S_w from resistivity logs. This is particularly true for the menu option labelled “Simandoux equation” in the effective porosity system of petrophysical interpretation. There are several different forms of this shaly-sand equation and it is especially important to establish which one is being called into play. As an example, a petrophysical study of a clastic reservoir in North America used a commercial log-analysis software package wherein the “Simandoux equation” turned out to be of an inadmissible form. The shale term was a constant instead of containing the parameter S_w . Equations of this form have been used historically but they have led to erroneous S_w values at low water saturations (Fig. 2).¹² They should not be offered as a contemporary software option. It is imperative to check the software manual for quality assurance of such matters. Otherwise, the computer takes over from the practitioner.

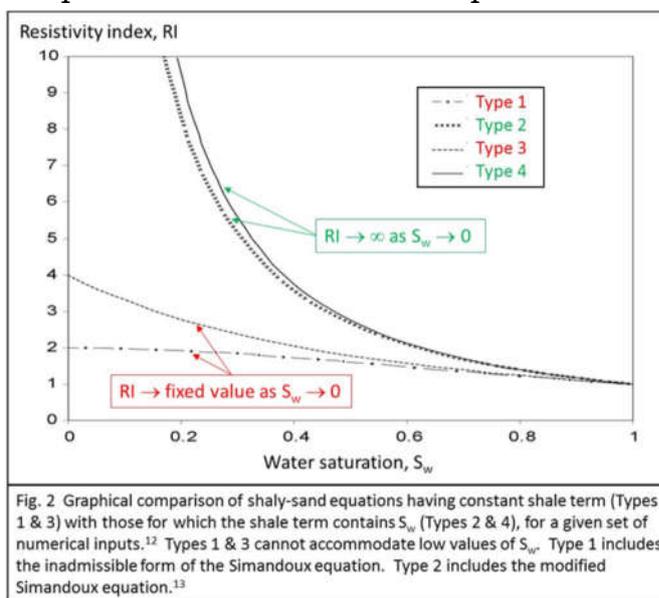


Fig. 2 Graphical comparison of shaly-sand equations having constant shale term (Types 1 & 3) with those for which the shale term contains S_w (Types 2 & 4), for a given set of numerical inputs.¹² Types 1 & 3 cannot accommodate low values of S_w . Type 1 includes the inadmissible form of the Simandoux equation. Type 2 includes the modified Simandoux equation.¹³

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Conclusions

The principal messages are to acquire a field-wide petrophysical dataset that is commensurate with reservoir complexity, to set up a quality-assured interpretation protocol at a representative key well that has been fully cored and logged, and to prepare the resulting distribution of reservoir properties for input to static and dynamic subsurface models with due attention to scale. The above practices are not exclusive. There are other sources of uncertainty such as wellbore inclination, logging tool calibration, core environmental corrections, invasion effects, anisotropy, shaliness, natural fractures and saturation distributions. In some of these cases, log analysis will have to be referred to the results of well tests, e.g. where there is no clear demarcation of net reservoir or where fracture permeability is highly significant. The most important approach to reducing uncertainty is to acquire sufficient petrophysical data to guide the identification of a meaningful interpretation methodology. The key-well concept is fundamental to this process.

Acknowledgement

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SPWLA Monthly Webinar

“Using NMR to Characterize Fluids in Tight Rock Unconventional and Shale Formations”

SPWLA Distinguished Speaker:

Boqin Sun

Chevron

Weds Feb 22nd 8am—9am US Central Time

Or

Thurs Feb 23rd 8pm—9pm US Central Time

Free to Members

Registration Link:

[https://www.spwla.org/SPWLA/Meetings_Resources/
Event_Display.aspx?EventKey=WEINAR13&WebsiteKey=d5396ba3-
8971-445b-9aa6-47b3cdb8075c](https://www.spwla.org/SPWLA/Meetings_Resources/Event_Display.aspx?EventKey=WEINAR13&WebsiteKey=d5396ba3-8971-445b-9aa6-47b3cdb8075c)

SPWLA Spring Topical Conference

“Value of Information and Uncertainty in Petrophysics”

Bogota, Colombia April 19-21, 2017

Accepting Abstracts Until Mar - 15

Registration Fee: Member \$200, Non-Member \$300,
Student \$80

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SPWLA 59th Annual Symposium

London, 2nd-6th June 2018

A geology guide required for a field trip to Jurassic Coast

A field trip to the Jurassic Coast of Southwest England will be organised as a part of the 59th Annual Symposium of Petrophysicists and Well Log Analysts.

The excursion will take place on the 2nd and 3rd June 2018.

We are looking for a field trip leader with previous experience of guiding geology field trips on the Jurassic coast. Interested candidates will be required to provide a proposed field trip itinerary with brief descriptions of field trip locations and their significance.

This is planned to be a general geology field trip but other themed itineraries are also acceptable.

The field trip leader will be also required to carry out outcrop risk assessments before the trip, prepare field trip brochures, and an emergency response plan.

It is essential that the candidates provide their proposed field trip itinerary, financial proposal, CV, and information about previous experience of guiding geology trips on the Jurassic coast.

Please send applications to ruza.cicmil@nexencnoocLtd.com by the 1st of April 2017.

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Number of Members	
Professionals	194
Students	31
Total	225

- Membership is currently **Free** - but you must Register.
- Receive presentations from 2017 'New Technology Seminar'
- Free evening Technical meetings, with wine & networking
- 'Tain Hillier' academic award scheme for post-graduates
- 'Dick Woodhouse' award for young professionals (<3yrs)
- Discounted entry to our four One-Day Seminars' every year.



To join the LPS please download the online form;

<https://lps.org.uk/membership>

and email to Sharan Dhami (VP Membership)

sharan.dhami15@imperial.ac.uk

LPS Sponsors

The LPS wish to extend our sincere appreciation to the generous companies who continue to be our Sponsors.

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