Invitation to join a Research Consortium on:

NEW DEVELOPMENTS IN WELL TEST ANALYSIS

from

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EXECUTIVE SUMMARY

The Centre of Petroleum Studies at Imperial College London has been involved in research in well test analysis since 1997, sponsored mainly by consortia of oil companies. The work has already resulted in significantly improved understanding of complex well test behaviours, particularly in gas condensate and volatile oil reservoirs; in reservoirs with complex geological features; and in multilateral wells. The ability to interpret well tests has also been greatly enhanced by the development of a stable deconvolution algorithm which has now been implemented in all dominant well test analysis softwares.

The aim of this proposal is to expand the work performed to-date in three main areas:

(1) deconvolution of pressure and data from interfering wells in developed reservoirs (multiwell deconvolution)
(2) analysis of shale oil and gas well production data (from nano-scale to Darcy-scale)
(3) well test analysis in complex systems

The objective is to develop new, practical analysis methods for calculating well and reservoir parameters, for estimating reserves, and for predicting and improving well productivity in complex reservoir-fluid-well systems. Limitations and uncertainties in the analyses as a function of the data available will also be a focus of the research.

The work will be performed by staff, MSc and PhD students from the Centre for Petroleum Studies at Imperial College, in cooperation with Durham University for deconvolution and the universities of Montpellier and Marseilles in France for shale gas and oil, with input and guidance from industry partners.

BENEFITS

- Access to the results from previous research programmes (1998-2013), which include “Investigation of Alternative Methods for Testing Oil and Gas Wells to Eliminate Emissions”; “Well test analysis in gas condensate and volatile oil reservoirs below saturation pressure”; “Deconvolution”; and “Well Test Analysis in Complex Systems – Complex Fluids, Complex reservoirs, and Complex Wells”.
- New understanding of near-wellbore pressure behaviour in complex systems, and **shale oil and gas** in particular, with various well, fluid and reservoir characteristics and comprehensive and systematic interpretation of typical well test data from different complex systems from industry partners and corresponding well test analysis reports.
- **Multiwell deconvolution**
- Annual forum at Imperial College to review progress and provide input into research directions.

RESEARCH AREA

The objective of well test analysis research at Imperial College is to explain complex well test behaviours, provide practical methods for interpreting them, and assess uncertainties and limitations of the corresponding analysis results as a function of the information available. The starting point is well test data provided by our sponsors, which ensures that the research addresses actual problems. This approach has led to many advances in well test analysis[1].

Well test analysis is used to assess well condition and obtain reservoir parameters. The evolution of well test analysis techniques over the years is illustrated in Fig. 1. Major improvements have occurred approximately 20 years apart, driven by the availability of both new types of data and new interpretation tools. Early interpretation methods (by use of straight lines or log-log pressure plots) were limited to the estimation of well performance. With the formulation of an integrated methodology in the early 1980s, the introduction of pressure-derivative analysis in 1983, the development of complex interpretation models that are able to account for detailed geological features, and the derivation of a stable deconvolution algorithm in the early 2000's, well test analysis has become a very powerful tool for reservoir characterization

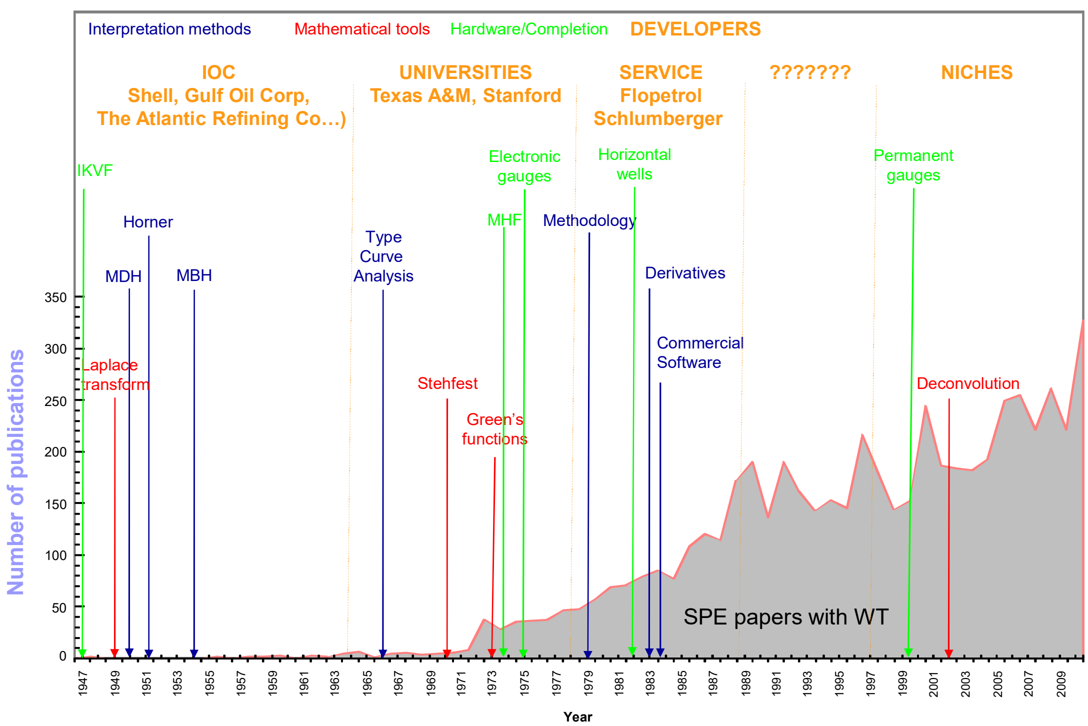

Figure 1: Evolution of well test analysis

Although not strategically driven, progress in well test analysis techniques has essentially resulted in a significant increased capability for (1) identifying an applicable interpretation model and (2) verifying the consistency of that interpretation model, as illustrated in Fig. 2. As a result, the amount of information that one can extract from well test data and more importantly, the confidence in that information, has increased significantly.

[1] Gringarten A. C.:" From Straight lines to Deconvolution: the Evolution of the State of the art in Well Test Analysis," paper SPE 102079, presented at the 2006 SPE Annual Technical Conference and Exhibition, San Antonio, Texas, U.S.A., 24–27 September 2006; *SPEREE* (Feb. 2008) 11-1 pp. 41-62.

	ANALYSIS METHOD	IDENTIFICATION	VERIFICATION
50's	Straight lines	Poor	None
70's	Pressure Type Curves	Fair (limited)	Fair to Good
80's	Pressure Derivative	Very Good	Very Good
00's	Deconvolution	Much better	Same as derivative
Next	?	>>>	>>>

Figure 2: Evolution of well test analysis capability

Fig. 2 also suggests that any new improvement will have to further enhance the ability to identify and verify the well test interpretation model, and provide additional information. How to achieve this has always been difficult to predict, but using richer signals is a most likely direction. **In this respect, multiwell analysis is an obvious candidate.**

BACKGROUND

Well test analysis research has been conducted at Imperial College since 1998 and has been entirely funded by industry consortia:

- The first Joint Industry Project (JIP) was on the "**Investigation of Alternative Methods for Testing Oil and Gas Wells to Eliminate Emissions**" and was sponsored by BP, Conoco, Norsk Hydro and Schlumberger (1999-2002). The objective was to evaluate options for testing exploration and appraisal wells without producing fluids to the surface. Possibilities investigated were closed-chamber testing (filling up the well with reservoir fluid, bull-heading the fluid back into the formation, and starting again), harmonic testing (testing with a periodic rate signal which oscillates around an established trend, in this case a zero rate), and re-injection in a different layer. The most significant outcome of this JIP was the development of a stable deconvolution algorithm, which was initially developed to convert the successive productions and injections in closed-chamber testing into a single production period with a duration equal to the total duration of the test. The study was documented in one PhD thesis, 3 MSc theses and 4 Society of Petroleum Engineers (SPE) publications. One of the SPE publications (*SPEJ*, Dec. 2004) received the 2005 Cedric K. Ferguson Medal for the best paper published in 2004. The Imperial College deconvolution algorithm has been implemented in TLSD, Imperial College proprietary software, and has since been used in all prevailing commercial well test analysis softwares.

- The next JIP was on **deconvolution**. It was sponsored by 14 oil and gas companies from 2005 to 2008 (BG, BHP Billiton, BP, Chevron, ConocoPhillips, ENI, Gaz de France, Occidental, Petro SA, Saudi Aramco, Schlumberger, Shell, Total and Weatherford) and by 10 companies from 2009 to 2013 (Anadarko, BG, Chevron, ConocoPhillips, Inpex, Petro SA, Saudi Aramco, Schlumberger, Shell, and Total). The purpose of this JIP was to assess the uncertainty in the well test interpretation model through deconvolution; and to extend the Imperial College deconvolution algorithm, initially developed for a single well, to multiple interfering wells. The theoretical work was performed by staff from the Department of Department of Mathematical Sciences, University of Durham, with practical applications conducted at Imperial College. Preliminary results from multiwell deconvolution (implemented in the statistical programming language R) are very encouraging, and when completed, this new algorithm should considerably enhance the capabilities of well tests analyses in developed fields. This study has been documented in 17 MSc theses and 7 SPE publications.

- A JIP was conducted in parallel on **well test analysis in gas condensate and volatile oil reservoirs below saturation pressure**. It was sponsored by 9 companies from 2002-2005 (Anadarko, Burlington, BHP Billinton, Britannia Operator Ltd, ConocoPhillips, Gaz de France, the Reservoir Engineering research Institute (RERI) of Palo Alto (USA), Total and DTI, the UK Department of Trade and Industry), and by 7 companies from 2005 to 2008 (BG group, Burlington, ConocoPhillips, ENI, Petro SA, Petrom and Total). Over 30 different fields were studied (different fluid compositions, hydraulically fractured wells, naturally fractured reservoirs, multilayered reservoirs, very tight gas condensate reservoirs) leading to 58 MSc theses, 10 PhD theses (3 in progress), and 19 conference publications. Main findings of the research are summarized below:
  1. A 2-phase bank develops around the well when the bottomhole pressure drops below the saturation pressure during production and creates an impediment to flow. The corresponding loss in well productivity can be overestimated if the capillary number effect is not accounted for.
  2. In lean gas reservoirs, the condensate bank does not evaporate during build ups and decreases in size and saturation only when the production rate decreases. In rich and volatile oil reservoirs, the saturation bank disappears in build ups if the build up pressure increases above the saturation pressure
  3. The 2-phase bank yields a two or three-region composite well test behaviour when single phase pseudo-pressures for gas condensates or pressures for volatile oil are used for analysis. No composite behaviour is

obtained if two-phase pseudo pressure is used for analysis. The radial flow derivative stabilization in that case corresponds to the reservoir absolute permeability.

4. In sandstone reservoirs, the reservoir effective permeability obtained from well test analysis is consistent with the arithmetic average core permeability. The core permeability can be used to distinguish between saturation bank and reservoir mobilities if only a single stabilization is seen on the derivative
5. A procedure was developed to calculate the two-phase bank total compressibility, which is required to estimate the bank outer radius. The calculated bank radius approximates the extent of the two-phase region at the end of preceding drawdown. Erroneous common practice typically overestimates bank radii by one order of magnitude.
6. End point relative permeabilities, fluid composition and the absolute permeability are the most important factors affecting well productivity below saturation pressure.
7. In gas condensate reservoirs, pseudo-relative permeabilities and absolute permeability, which are required for compositional simulations, can be estimated using single-phase and two-phase pseudo-pressures together, whereas the base capillary number can be estimated using single-phase pseudo-pressures.
8. Fracturing vertical wells or drilling horizontal wells is equally effective for improving productivity in gas-condensate and volatile oil reservoirs below the saturation pressure and the optimum choice can only be made from economic analysis. Vertical hydraulic fractures should be implemented early in the wells life to delay the time when the flowing bottomhole pressure drops below the saturation pressure, consequently leading to improved recovery. Fracturing a well after the saturation bank has developed makes the bank to disappear, but it eventually reappears along the fracture.
9. The skin effect vs. rate relationship is the same above and below the saturation pressure, but two-phase pseudo pressures must be used below saturation pressure.

- In a third phase sponsored by BG Group, BHP Billiton, Eon-Rurhgas, Petro SA and Schlumberger (2009-2013), the scope of the above JIP was extended to "**Well Test Analysis in Complex Systems – Complex Fluids, Complex reservoirs, and Complex Wells**". In addition to completing the work on the use of two-phase pseudo-pressures (item 3 above) and on skin effect vs. rate (item 9), much effort has been devoted to the study of shale gas and oil reservoirs.

The shale reservoir study was divided into four components:

1. Molecular Modelling to obtain the properties of a fluid confined in a shale rock at an atomic scale by: (1) selecting pore models and numerical tools for building crystal interfaces; (2) modelling hydrocarbon molecule distributions confined between crystal walls and their equilibrium with the bulk fluid; and (3) computing diffusion coefficients and residence time of the confined gas to bridge the atomic scale (this step) and the Darcy's scale (step 3).
2. Macro-scale experimental characterization through specific experimental studies of shale gas and oil production rates using actual samples, to quantify mass transfer processes and their control on petrophysical rock properties, and to obtain reliable data for testing and calibrating both atomic-scale and Darcy-scale models.
3. Darcy scale modelling to develop pore-to-Darcy scales modelling tools for evaluating the production rate at the edges of a fracture in shale, the model to be designed and calibrated using the results of step 1 (micro-scale) and step 2 (macro-scale).
4. Well test analysis and decline curve analysis of actual pressure and rate data to determine applicability of existing techniques. Current work at Imperial has shown that a combination of history matching with a simulator capable to model individual multi-fractured horizontal wells and well test analysis with deconvolution allows characterisation of flow behaviour. This is to be tested on data from different reservoirs to determine the range of applicability.

Steps 1 to 4 are still in progress and have been the subject of 4 MSc theses to-date, with one PhD thesis in progress and 2 publications pending. Step 4 was performed at Imperial College whereas Steps 1 to 3 were performed at the department of Géosciences at the University of Montpellier (France). We have obtained full data sets from Shell (Marcellus), BG and BHP (Haynesville) and Trilogy Energy (Duvernay); and core data from BG Group (Haynesville).

Results from Step 1 for shale gas were surprising and some differ from current belief. It was found that:

1. A stable storage of methane is impossible in the kerogen itself
2. High CH_4 molecule concentrations are trapped by K^+ ions on illite faces in kerogen-illite or illite-illite interfaces with apertures h lower than or equal to 8 Å
3. Two partial storage sites exist in larger interfaces $h \geq 10$ Å, due to irreversible anti-adhesion processes
4. The density of the stored gas in illite-illite interfaces is very high compared to pressured free gas (up to several thousands of CH_4 moles per cubic meter of interface).

5. The total gas-in-place can be evaluated by measuring the distribution and size of mineral interfaces.
6. The amount and rate of gas that can be extracted depends on the ability of enlarging clay mineral interfaces at depth (for instance by hydraulic fracturing).

Another area of study in this JIP was the investigation of geologically complex reservoir geometries such as semi-infinite channels with non-parallel boundaries, meandering channels, and pinch-out boundaries. It was shown that complex geometries yield characteristic behaviours in a well test which can be analysed as combinations of simpler, known behaviours. They can be identified on the well test pressure derivative by a non-standard transition between the main radial flow derivative stabilization and the late time boundary behaviour. This transition gives access to quantitative information related to the complex geometry that is usually ignored in routine well test interpretations.

Further information on Imperial College well test analysis research can be found at http://www.jipimperial.co.uk/

NEW DEVELOPMENTS IN WELL TEST ANALYSIS: SCOPE OF WORK

The proposed research aims at expanding the work initiated during the preceding JIP's, particularly on multiwell deconvolution and shale gas and oil.

- **MULTIWELL DECONVOLUTION**

  Our research to-date has demonstrated that multi-well deconvolution is feasible. We have developed a methodology and software for multiwell deconvolution which works on both synthetic and real data.

  Additional features are required, however, before multiwell deconvolution can be used with confidence. Non-uniqueness is obviously a problem, more so in multi-well deconvolution than in single well deconvolution: identifying the response functions is challenging enough, but separating the pressure changes into well and interference effects is particularly difficult. Deconvolution is just an estimator for the parameters of a mathematical model and places no restrictions on the estimates it generates in terms of whether they make physical sense or not. Hence, response functions which are infeasible and non-physical but give good pressure matches are still seen as 'good' results - for example non-monotonic interference effects or negative estimated rates when it is known that no injection occurred. In field examples with imperfect data and noisy observations, we have seen that we can obtain contradictory deconvolutions all of which maintain a similar quality of pressure match. Unless we introduce extra information, we will not be able to automatically identify deconvolutions which are both feasible and associated with a good pressure match.

  Enforcing realistic behaviours therefore requires the imposition of constraints on the estimation of the deconvolved derivative. Specifically, if there is a-priori information on the behaviour of the response function — beyond how it relates pressure to rate — then including it will improve the quality of the deconvolution. This information could be used to guide deconvolution away from considering infeasible response functions. For example, if we know we are dealing with a closed reservoir, we could impose the convergence of all deconvolved derivatives to a common late time unit slope straight line. We could express this information as a restriction on the range of values deconvolution parameters could take. This would reduce the range of possible deconvolutions that can obtained, and thus reduce the uncertainty associated with deconvolution results.

  Imposing constraints, however, introduces substantial additional complexity to the algorithm because the constraints must be fixed prior to deconvolution due to the nature of the algorithm used. The easiest way to introduce constraints is to incur a penalty whenever a constraint is broken, and have that penalty increase as the parameter gets more infeasible. This integrates very easily with the current error function approach:

$$\varepsilon(\hat{z},\hat{q},\hat{p}_i;\phi,\nu,\lambda) = \underbrace{\phi\|\Delta p - \Delta\hat{p}\|^2}_{\substack{pressure\\ match}} + \underbrace{\nu\|q-\hat{q}\|^2}_{\substack{rate\\ match}} + \underbrace{\rho\|p_i - \hat{p}_i\|^2}_{\substack{initial\\ pressure}} + \underbrace{\lambda\|\kappa(\hat{z})\|^2}_{curvature} + \underbrace{\psi\|u(\hat{z},\hat{q},\hat{p}_i)\|^2}_{constraints}$$

  where ε is the deconvolution error function which is minimised in the deconvolution process; ϕ, ν, ρ, λ and ψ are the weight hyperparameters for pressure match, rate match, initial pressure match, curvature penalty and constraints in the deconvolution error function, respectively; p is the vectorised collection of actual pressure data for all wells; $\hat{p}$ is the vectorised collection of estimates of the pressure data; q is the vectorised collection of actual rate data for all wells; $\hat{q}$ is the vectorised collection of estimates of the rate data; p_i is the vector of the initial pressures for all wells; $\hat{p}_i$ is the vector of estimates of the initial pressures; κ is the curvature penalty function which controls the shape of the deconvolved derivative; and u represents the additional constraints.

If constraints remain linear in the parameters, then adding a constraint term to the error function still allows the usual nonlinear least squares method to be used directly (after suitable adjustment). Currently, the deconvolved derivative is defined at discrete nodes: deconvolution estimates derivative values at these nodes which give the best match to the data. With constraints, however, we are less interested in the values at the nodes and more interested in the slopes connecting them. We must therefore change parameters to an equivalent slope form, and estimate the slopes between nodes and the corresponding intercepts instead of the values at the nodes. This requires adjustments to the core mathematics, but otherwise deconvolution is unaffected. This permits a more efficient specification of constraints, and is the most effective method for constraining deconvolution.

Examples of constraints on the response slopes could include:

- Constraining the locations of characteristics of the response function in addition to the slopes, e.g. determining the timing of the initial node for the interference effects, imposing a common slope (as well as a unit slope) at late times, etc...
- Imposing monotonicity on the interference responses
- Preventing any adapted rates from changing sign, i.e. prevent producers from injecting and vice versa
- Placing tighter or asymmetric numerical bounds on the initial pressure p_i

Significant efforts will also be devoted to:

- Improving the efficiency of the existing algorithm, and developing more efficient algorithms, as required, for the numerical solution of multiwell deconvolution
- Improving the uncertainty analysis – current methodology is exceptionally time-intensive in multiwell and constrained settings
- Testing these algorithms with simulated data sets
- Applying the algorithms to field data sets provided by the sponsors.
- Applying multiwell deconvolution to multilateral wells and multiple fractured horizontal wells (data permitting)

Finally, we will address one objective that was planned but could not be achieved in the previous JIP: to provide a methodology which gives credible predictions of reservoir properties and future flow/pressure with stated levels of accuracy. Part of the general problem involves classification of reservoirs on the basis of their deconvolved pressure signals. It is worthwhile to revisit the entire problem from a wholly Bayesian perspective to determine whether there is scope for enhancements. In particular, there may be nice ways to re-interpret the classification problem, and possibly nice ways to give a Bayesian handling of the deconvolution problem. Hence, we will reconsider the major aims of the prediction from a wholly Bayesian perspective of the overall problem, in order to identify areas which might benefit from further structuring/analysis. This is open-ended, but a holistic treatment would be probably highly rewarding in terms of delivering good and accurate results to the industry, and in providing research outputs.

The theoretical work will be performed by staff from the Department of Department of Mathematical Sciences, University of Durham (Dr Cumming and Prof. Wooff), with practical applications conducted by staff, MSc and PhD students at Imperial College.

- **SHALE OIL AND GAS**

We will continue the work started in the previous JIP:

1 Molecular modelling (properties of a fluid confined in a shale rock at an atomic scale)
Using a molecular modelling software (GenMol+Namd2), we will develop a periodic model, which is required to address diffusion. In a first step, we will compare results obtained in the previous JIP with a non-periodic hemispherical model with results for a periodic model (for instance for illite-illite interfaces with apertures lower than or equal to 8 Å – LL8 –) in order to validate the periodic model. Next, we will investigate different diffusion models, to identify the ones which are best suited for representing diffusion of hydrocarbons through compact clay such as illite. A main advantage of studying nanoscale diffusion is that it implicitly accounts for macroscopic parameters such as viscosity (through molecular interactions) and change of phases (through molecular density). We will also consider the possibility of having H20 and /or CO2.

2 Macro-scale experimental characterization using actual oil and gas shale samples (quantification of mass transfer processes)
We will finalize the construction of the experimental rig for measuring gas rate and composition, and performing fracking tests (GASH). Testing and validation will be made on a number of samples as large as possible as provided by our sponsors, with the goal of making GASH an efficient tool for production evaluation. Based on interest from the sponsors, a portable version of GASH could also be developed for testing cores directly in the field (using a portable Raman spectroscopy system and allowing different core size diameters, with integrated interpretation software).

3 Darcy scale Modelling (pore-to-Darcy scales modelling tools)
We will continue our efforts to make the link between molecular and macroscopic modelling by developing pore scale models using stochastic approaches. Preliminary results so far are very encouraging. We believe that we could model the effect of the local decompression around the propped fractures and determine "effective" diffusion coefficient that should be used at macro scale. We will also continue improving the existing MRMT code, in order for instance to simulate atypical production curves (abnormal diffusion) and to account more precisely for the nature of the retrieved fluid (multiphasic approach). The goal is to produce a user friendly tool for quick production modelling.

4 Well test analysis and decline curve analysis of actual pressure and rate data (physics-based interpretation models to estimate initial gas in place and predict future production)
We will continue interpreting tests provided by our sponsors to reach an understanding of the well test behaviours in shale oil and gas reservoirs.

Step 1 will be done by Molecular Modeling Consulting, La Ciotat, France (Dr Pèpe). Steps 2 and 3 will be performed at the department of Géosciences at the University of Montpellier, France (Dr Gouze and Dr Russian). Step 4 will be conducted by staff, MSc and PhD students at Imperial College.

- **OTHER COMPLEX SYSTEMS**

Based on data made available by the sponsors, we will investigate unusual and unexplained behaviours due to complex geology and complex wells. More specifically, we will investigate (1) the capability of well tests to identify and quantify geologically complex reservoirs and complex wells; and (2) the meaning of well test analysis results obtained with simple interpretation models that do not account for these complexities. This work will be conducted by staff, MSc and PhD students at Imperial College.

TIME-SCALES

The work will be performed over a period of 3 years by staff, PhD and MSc students from the Centre for Petroleum Studies at Imperial College London; by staff of Durham University; and by staff of Montpellier and Marseille Universities, with input and guidance from industry partners.

The exact amount of work that will be performed in the context of this proposal will depend on the number of companies joining the project. To do all the work described here, we will need a total of **eight participants**.

It is expected that the participants will be able to also contribute well test data to the project.

BRIEF RESUME OF PRINCIPAL RESEARCHERS

Prof. Alain C. Gringarten

Prof. Gringarten will be the principal investigator for this project. He holds the Chair of Petroleum Engineering at Imperial College in London and is also director of the Centre for Petroleum Studies, Department of Earth Science and Engineering, which covers all petroleum activities at Imperial. Before joining Imperial College in March 1997, Dr. Gringarten held a variety of senior technical and management positions with Scientific Software-Intercomp (1983-1997); Schlumberger (1978-1982); and the French Geological Survey (1973-1977); and was a Miller Research Fellow at the University of California in Berkeley from 1970 to 1972. He has over ninety publications and his research interests include fissured fluid-bearing formations; fractured wells; gas condensate and volatile oil reservoirs; high and low enthalpy geothermal energy; hot dry rocks; and radioactive waste disposal. A member of SPE since 1969, he was elected a Distinguished Member in 2002 and an Honorary Member in 2009. Dr Gringarten was a SPE Distinguished Lecturer in 2003-2004 and received the North Sea SPE Regional Service Award for 2009; the Cedric K. Ferguson Carl Ferguson certificate for 2004; the SPE John Franklin Carll award for 2003; and the SPE Formation Evaluation award for 2001. Prof. Gringarten holds MSc and PhD degrees in petroleum engineering from Stanford University; and an engineering degree from Ecole Centrale Paris, France.

Professor David Wooff

Professor Wooff is Professor of Statistics at Durham University and has directed its Statistics & Mathematics Consultancy Unit since 1996. He works on applied and industrial projects with current interests including well testing, overpressure prediction, modelling of digital commerce, and Bayesian belief networks for mental health evaluation. His research interests are Bayesian analysis and Bayes linear methods.

Dr Jonathan Cumming

Jonathan Cumming is a Post-doctoral Research Associate in the Department of Mathematical Sciences at Durham University. His research interests include statistical methods for well-test analysis, uncertainty analysis of complex models, statistical computation, and dimension reduction. He holds a BSc degree in Computer Science & Mathematics and a PhD in Statistics from Durham University.

Dr Gérard Pèpe

Dr. Pèpe is with Molecular Modeling Consulting, La Ciotat, France, and is a specialist in molecular modelling, docking simulation experiments centered on macromolecular systems (polypeptides and nucleic acids).. He is Emeritus Director of Research at the CNRS (Centre National de la Recherche Scientifique), and an expert in radiocrystallogaphy at the Mediterranean University (Marseille, France) and at the Organic Material Laboratory, where he developed Genmol over a period of approximately twenty years. He was a founder and CTO of Genoscience, a biopharmaceutical company focused on the development of new drugs for the treatment of viral diseases such HCV infection.

Dr Philippe Gouze

Dr Philippe Gouze is a research scientist at the CNRS-INSU (French National Centre for Scientific Research – Earth and Planetary Sciences Institute), University of Montpellier, France, and heads the Transport in Porous Media group of the Geosciences research unit in Montpellier. His research covers the areas of flow and transport in reservoirs, with specific applications to aquifers in sedimentary basins, underground geological storage and geothermal processes. He created the Experimental Resources Laboratory ICARE for investigating transport-reaction processes, from subsurface (ex: salt intrusion) to geothermal environments, and coordinated several projects focusing on underground storage of CO2 and hydrothermal/geothermal studies. Dr Gouze received his Ph.D. degree (modelling transport in porous media) from the University of Paris VI.

Dr Anna Russian

Anna Russian is a Post-doctoral Research Associate in the Transport in Porous Media group of the Geosciences research unit in Montpellier. Her research interests include stochastic modelling, upscaling and effective equation in heterogeneous media, time-domain random walk methods for heterogeneous media with spatially varying diffusion properties. She holds a Ph.D. in Hydrodynamics (Anomalous Dynamics of Darcy Flow and Diffusion Through Heterogeneous Media) from Technical University of Catalonia, UPC Barcelona.

Centre for Petroleum Studies (CPS) at Imperial College

The Centre for Petroleum Studies is a focus for research, postgraduate teaching and professional development within the framework of Petroleum Sciences and Engineering at Imperial College. Its main objectives are to facilitate multi-disciplinary research between geologists, geophysicists, petroleum engineers and members of other key disciplines in order to advance the state of the art in exploration, appraisal/development and reservoir management, and to plan and implement related postgraduate teaching programmes which reflect current best practice within the petroleum industry. The Centre has one of the largest concentrations of petroleum scientists and engineers in a UK academic institution, with almost 50 members of staff providing research expertise across the complete Exploration-Production spectrum.

Appendix 1: "Investigation of Alternative Methods for Testing Oil and Gas Wells to Eliminate Emissions" (Green Well Testing)

Publications:

(1) Daungkaew, S., Hollaender, F. and Gringarten, A. C. :"Frequently Asked Questions in Well Test Analysis", in *Proc. 2000 SPE Ann. Tech. Conf. Exh.*, Soc. Pet. Eng., Dallas, paper SPE 63077, (2000).
(2) Hoellander, F., P. Hammond and Gringarten, A. C: "Harmonic Testing for Continuous Well and Reservoir Monitoring" in *Proc. 2002 SPE Ann. Tech. Conf. Exh.*, Soc. Pet. Eng., San Antonio, paper SPE 77692, (2002).
(3) Florian Hollaender, Jim G. Filas, Curtis O. Bennett and Alain C. Gringarten: "Use of Downhole Production/Reinjection for Zero-Emission Well Testing: Challenges and Rewards" in *Proc. 2002 SPE Ann. Tech. Conf. Exh.*, Soc. Pet. Eng., San Antonio, paper SPE 77620, (2002).

Reports:

1	Nasiru IDOWU	Testing without emission (closed chamber)	MSc 1998/99
2	Nicholas PINK	Testing without emission (production in one layer and re-injection in a different layer)	
3	Sabrina MERCIER	Testing without emission (harmonic testing)	

1	Florian HOLLAENDER	Well Testing Without Emission	PhD	2003

Appendix 2: "Well test analysis in gas condensate and volatile oil reservoirs below saturation pressure"

Publications:

1. A. C. Gringarten, A. Al-Lamki, S. Daungkaew, R. Mott, and T. M. Whittle: "Well Test Analysis in Gas-Condensate Reservoirs" paper SPE 62920 presented at the 2000 SPE Annual Conference and Exhibition, Dallas, Texas, 1–4 October 2000.
2. Daungkaew S., Ross F, and Gringarten A.C.: "Well Test Analysis of Condensate Drop-Out Behaviour in a North Sea Lean Gas Condensate Reservoir", Paper SPE 77548, presented at the 2002 SPE Annual Conference and Exhibition, San Antonio, Texas, 29 Sept. -2 October (not in proceedings).
3. M.Bozorgzadeh and A.C. Gringarten: "New Estimate for the Radius of a Condensate Bank from Well Test Data Using the Dry Gas Pseudopressure" paper SPE 89904 presented at the 2004 SPE Annual Conference and Exhibition, Houston, Texas, 26–29 September 2004.
4. A. Hashemi and A.C. Gringarten: "Well Test Analysis of Horizontal wells in Gas-Condensate Reservoirs" paper SPE 89905 presented at the 2004 SPE Annual Conference and Exhibition, Houston, Texas, 26–29 September 2004
5. T. von Schroeter and A.C. Gringarten: "Estimates For The Radius Of A Condensate Zone From A Simple Compositional Model" in Proc. 2004 SPE Ann. Tech. Conf. Exh., Soc. Pet. Eng., Houston, paper SPE 89911 (2004).
6. Gringarten, A. C.:"Making sense of well tests in gas condensate reservoirs," SPE Distinguished Lecture, 2003-2004.
7. Ali, A. M, Falcone, G., Bozorgzadeh, M., Gringarten, A. C. and Hewitt, G. F: "Experimental Investigation of Wellbore Phase Redistribution Effects on Pressure-Transient Data" SPE-96587 presented at the 2005 SPE Annual Technical Conference and Exhibition, Dallas, Tx, 9-12 Oct-2005.
8. Tarik Baig, Uwe Droegemueller and Alain C. Gringarten:"Productivity Assessment of Fractured and Non-Fractured Wells in a Lean/Intermediate Low Permeability Gas Condensate Reservoir", Paper SPE 93136 presentated at the 14th Europec Biennial Conference, Madrid, Spain, 13-16 June 2005.
9. Manijeh Bozorgzadeh and Alain C. Gringarten:"Application of Build-Up Transient Pressure Analysis to Well Deliverability Forecasting in Gas Condensate Reservoirs Using Single-Phase and Two-Phase Pseudo-Pressures", paper SPE/IADC 94018 presentated at the 14th Europec Biennial Conference, Madrid, Spain, 13-16 June 2005.
10. Abdolnabi Hashemi and Alain C. Gringarten:"Comparison of Well Productivity between Vertical, Horizontal and Hydraulically Fractured Wells in Gas-Condensate Reservoirs" paper SPE 94178 presented at the 14th Europec Biennial Conference, Madrid, Spain, 13-16 June 2005.
11. Gringarten A. C., Daungkaew S., Hashemi S. and Bozorgzadeh, M: "Well Test Analysis in Gas Condensate Reservoirs: Theory and Practice," paper SPE 100993, presented at the 2006 SPE Russian Oil and Gas Technical Conference and Exhibition, Moscow, Russia, 3–6 October 2006.
12. Sanni, M. and Gringarten A. C.:" Application of Well Testing for Well Deliverability Forecasting in Volatile Oil Reservoirs," paper SPE 118377, presented at the 2008 Abu Dhabi International Petroleum Exhibition and Conference, Abu Dhabi, UAE, 3–6 November 2008.
13. Sanni, M. and Gringarten A. C.:" Well Test Analysis in Volatile Oil Reservoirs," paper SPE 116239, presented at the 2008 SPE Annual Technical Conference and Exhibition, Denver, Co., U.S.A., 21–24 September 2008.

14. Krukrubo G. J., and Gringarten, A.C.:" Predicting the onset of condensate accumulation near the wellbore in a gas condensate reservoir," paper SPE 121326 presented at the 2009 SPE EUROPEC/EAGE Annual Conference and Exhibition held in Amsterdam, The Netherlands, 8–11 June 2009.
15. Aluko, O.A. and Gringarten, A.C.:" Well Test Dynamics in Rich Gas Condensate Reservoirs under Gas Injection," paper SPE 121848 presented at the 2009 SPE EUROPEC/EAGE Annual Conference and Exhibition held in Amsterdam, The Netherlands, 8–11 June 2009.
16. Mavromoustaki A., Lim B., Ng B., Mirza S.M., Hale C.P., Manolis I., Gringarten A.C., Hewitt G.F. and Matar O.K.:"An experimental study of wellbore phase redistribution effects in gas condensate reservoirs", presented at the 4th International Conference on Multiphase Production Technology, Cannes, France, 17-19 June 2009.
17. Madahar, A., Stewart G. and Gringarten, A.C.:" Effect of Material Balance on Well Test Analysis", paper SPE 124524 presented at the 2009 SPE Annual Technical Conference and Exhibition held in New Orleans, Louisiana, USA, 4–7 October 2009.
18. Kgogo, T. C. and Gringarten, A. C.:" Comparative Well-Test Behaviours in Low-Permeability Lean, Medium-rich, and Rich Gas-Condensate Reservoirs", paper SPE 134452 presented at the 2010 SPE Annual Technical Conference and Exhibition held in Florence, Italy, 19–22 September 2010.
19. Gringarten, A.C., Ogunrewo, O., and Uxukbayev, G.:" Assessment of Rate-Dependent Skin Factors in Gas Condensate and Volatile Oil Wells," paper SPE 143592 presented at the 2011 SPE EUROPEC/EAGE Annual Conference and Exhibition in Vienna, Austria, 23–26 May 2011.
20. Kgogo, T. C. and Gringarten, A. C.:" Well Test Analysis of Medium-Rich to Rich Gas-Condensate Layered Reservoirs", paper SPE 143621 presented at the 2011 SPE EUROPEC/EAGE Annual Conference and Exhibition in Vienna, Austria, 23–26 May 2011.
21. Ogunrewo, O., Herens, T. and Gringarten, A. C.:" Well deliverability forecasting of gas condensate and volatile oil wells below saturation pressure", paper SPE 164869 presented at SPE Europec/EAGE Annual Conference, London, United Kingdom, 10–13 June 2013
22. Ogunrewo, O. and Gringarten, A. C.:"Deconvolution of Lean and Rich Gas Condensate, and Volatile Oil Wells," paper SPE 166340 presented at the SPE Annual Technical Conference and Exhibition held in New Orleans, Louisiana, USA, 30 September–2 October 2013.

Software:

Storativity ratio Calculation - Detailed (SPE89904)
Storativity Ratio Calculation - Simplified (SPE121848)
Single-Phase PP and Material Balance Correction
Two-Phase Pseudo-pressure

Reports:

1	Saifon DAUNGKAEW	Well-Test Analysis using a Triple Radial Composite Model and its Application to Gas Condensate Reservoirs	MSc 1997/98
2	William BEVERIDGE	Britannia Gas Condensate Well Deliverability Predictions	
3	Edward CHAMBERS	An Investigation and Simulation to Determine Development Sensitivities of a North Sea Gas-Condensate Field	
4	Nicolas FETTA	Flow to a Well in a Gas Condensate Reservoir	
5	Djamel OUZZANE	Experimental Study of Wettability Alteration to Gas-Wetness in Porous Media	
6	Lamia GOUAL	Modelling of Wax Precipitation in Gas Condensate Systems	

7	Ali AL-LAMKI	The effects of rate-dependent relative permeabilities on the interpretation of gas condensate well tests.	MSc 1998/99

8	Gregor COLVILLE	Effect of condensate dropout on productivity and recovery from a lean gas condensate field.	MSc1999/00
9	Hashem MONFARED	Well test analysis in multi-layer gas condensate reservoir: effect of individual layer skins.	

10	Jirades TANAPATCHAIPONG	Well test analysis in a gas condensate reservoir in the Gulf of Thailand	MSc 2000/01
11	Binayak AGARWAL	Wireline formation test interpretation in a gas condensate reservoir	
12	George MYKONIATIS	Composite behaviour in multilayer reservoirs	
13	Akepeki AKEMU	Wellbore Dynamics in Gas Condensate Wells	
14	Daniel MAROKANE	The Applicability Of Timely Gas Injection In Gas Condensate Fields To Improve Well Productivity	
15	Manijeh BOZORGZADEH	Evaluation of the potential of well 30/7A-P1 in the Judy field	
16	Abdolnabi HASHEMI	High Pressure High Temperature Well Test Interpretation: Jade Field, UKCNS	

17	Abdimurat AYAPBERGENOV	Prediction of the Production Performance of Highly Volatile Oil Reservoirs Below the Bubble Point Pressure	MSc 2001/02
18	Clare HOWAT	A Feasibility Study of Horizontal Wells in the Development of a Carbonate Reservoir Oil Rim – Comparative Sensitivities Using a Sector Model	

19	Alekan ALUKO	Well Test Analysis on a Condensate Gas Field in the North Sea	MSc 2002/03
20	Mirza Tariq BAIG	Productivity enhancement of gas condensate wells by fracturing	
21	Thierry LAUPRETRE	Determine the level of grid refinement required around Jade wells to ensure the most correct prediction of wellbore productivity below the dew point.	
22	Arsyad SIREGAR	Well test analysis in a volatile oil reservoir in Algeria	
23	Piyatad TABMANEE	Well test analysis in the Hassi R'Mel field, Algeria	

24	Bandar AL-MALKI	Well Test Analysis In Condensate Gas Reservoirs In Carbonate Formations In Saudi Arabia	MSc 2003/04
25	Ahmed ALI	Experimental investigation of phase redistribution effect on pressure transient data	
26	Moshood SANNI	Simulation of well tests in volatile oil reservoirs	

27	Aisha Alfa-Wali	Volatile Oil Well Testing 'Best Practice' and Productivity Enhancement in the MLNW Field, Algeria	MSc 2004/05
28	Babalola Abiose Daramola	Pentland Re-development Plan: Predicting the Effects of Condensate Banking in a North Sea HPHT Gas-Condensate Reservoir	
29	Nicolas Guézé	Composite well test interpretation model for horizontal wells	
30	Thabo Clifford Kgogo	Deconvolution Analysis of a Horizontal Gas Condensate Well	
31	Sabina Rattan	Evaluation Of Reservoir Heterogeneities For Modelling Gas Injection In A Retrograde Gas Condensate Reservoir	
32	Bernard P. Sinambela	Comparison Of Different Methods For Estimating Gas Condensate Well Deliverability	

33	Jean-Baptiste Berchoteau	Use of Deconvolution to Improve the Reservoir Behaviour Understanding of Some Gas Condensate Reservoirs in Britannia	MSc 2005/06
34	Perapon Fakcharoenphol	Well Test Behaviour in Multi-Layer Gas-Condensate Reservoirs	
35	Olivier Pippi	Well Test & Deconvolution Analyses of Gas Condensate Reservoirs	

36	Ali Cherif Azi	Evaluation of Confidence Intervals in Well test Interpretation Results	MSc 2006/07
37	George Krukrubo	Predicting the Onset of the Effect of Condensate Accumulation in the Build-Up Pressure Derivative Plot	
38	Amit Madahar	Effects of Material Balance on Well Test Analysis	
39	Hammed A. Shittu	Well Tests In Naturally Fractured Gas-Condensate Reservoirs	
40	Luther Sullivan	Prediction of the production performance of a Gas Condensate Well ir the North Sea: A Simulation Study	
41	Nur Suut	Modeling of Near Wellbore Flow Effects in Gas Condensate Reservoirs	

42	Ahmed Albaqawi	Well Test Analysis In Naturally Fractured Gas Condensate Reservoirs Below Dew Point Pressure	MSc 2007/08
43	Ulan Burkitov	Simulation Of Possible Gas Condensate Banking in the Karachaganak field	
44	Sola Makinde	Estimating Storativity Ratio In Wells Producing Volatile Oil	
45	Adnan Merchant	Use of Black Oil Models for Complex Reservoir Fluids	
46	Sohaib M. Mirza	Experimental Study of Wellbore Dynamics in Gas Condensates	

47	Gadilbek Uxukbayev	Evaluating the Wellbore Skin vs. Rate Relationship in Gas Condensate and Volatile Oil Reservoirs	MSc 2008/09
bb48	Morounranti Vigo	Experimental Study Of Wellbore Dynamics In Gas Condensates	

49	Chioma Izugbokwe	Well Test Analysis in a Lean Gas Condensate field in North Africa	MSc 2009-010
50	Thibaut Hérens	Analysis of well productivity relationship for multi-layer no-crossflow Britannia gas condensate wells	

51	Bertrand Cuesta	Deliverability Of A Rich Gas Condensate Fractured Vertical Well In A Coarse And Fine Grid Model	MSc 2010-11
52	Lionel X. Martinez	How to Model Condensate Banking in a Simulation Model to Get Reliable Forecasts? Case Story of Elgin/Franklin	
53	P.D.W. Lloyd	Productivity of Gas Condensate Fields Below Dew Point: A Case Study	

54	Anastasia ALYAPINA	Production Monitoring of Condensate Gas Ratio Transients Based on Dynamics of Produced Fluid Composition	MSc 2011-12

55	Yong Han Seah	Optimizing Recovery in Gas Condensate Fields	MSc 2012-13

1	Saifon DAUNGKAEW	Well test analysis in gas condensate wells	PhD	2001
2	Djamel OUZZANE	Phase behaviour in gas condensate reservoirs	PhD	2004
3	Manijeh BOZORGZADEH	Well Test Analysis in Gas Condensate and Volatile Oil Reservoirs	PhD	2005
4	Abdolnabi HASHEMI	Horizontal Well Test Analysis in Gas Condensate Oil Reservoirs	PhD	2006
5	Gioia FALCONE	Modelling of flows in vertical pipes and its application to multiphase flow metering at high gas content and to the prediction of well performance	Part-time PhD	2006
6	Moshood Olajide SANNI	Well Test Analysis in Volatile Oil Reservoirs	PhD	2008
7	Alekan ALUKO	Well Test Dynamics of Rich Gas Condensate Reservoirs	Part-time PhD	2009
8	Thabo C. KGOGO	Well test Analysis of Low Permeability Medium-Rich to Rich Gas Condensate Homogeneous and Layered Reservoirs	Part-time PhD	2011

Appendix 3: “Deconvolution”

Publications:

1. von Schroeter, T., Hoellander, F. and Gringarten, A. C.:”Deconvolution of Well test Data as a Non-linear Total Least Square Problem”, in *Proc. 2001 SPE Ann. Tech. Conf. Exh.*, Soc. Pet. Eng., Dallas, paper SPE 71574 (2001).
2. von Schroeter, T., Hoellander, F. and Gringarten, A. C: ”Analysis of Well Test Data From Permanent Downhole Gauges by Deconvolution” in *Proc. 2002 SPE Ann. Tech. Conf. Exh.*, Soc. Pet. Eng., San Antonio, paper SPE 77688, (2002).
3. von Schroeter, T., Hoellander, F. and Gringarten, A. C: ”Analysis of Well Test Data From Permanent Downhole Gauges by Deconvolution” in *Proc. 2002 SPE Ann. Tech. Conf. Exh.*, Soc. Pet. Eng., San Antonio, paper SPE 77688 (2002); *SPEJ* (Dec. 2004).
4. T. von Schroeter and A. C. Gringarten: ”Superposition Principle and Reciprocity for Pressure Transient Analysis of Data from Interfering Wells,” paper SPE 110465 presented at the 2007 SPE Annual Technical Conference and Exhibition, Anaheim, California, 11-14 November 2007.
5. Whittle, T. and Gringarten A. C.:” The Determination of Minimum Tested Volume from the Deconvolution of Well Test Pressure Transients,” paper SPE 116239, presented at the 2008 SPE Annual Technical Conference and Exhibition, Denver, Co., U.S.A., 21–24 September 2008.
6. Whittle, T., Jiang, H., Young, S. and Gringarten A. C.:”Well Production Forecasting by Extrapolation of the Deconvolution of the Well Test Pressure Transients,” paper SPE 122299 presented at the 2009 SPE EUROPEC/EAGE Annual Conference and Exhibition held in Amsterdam, The Netherlands, 8–11 June 2009.
7. Alain C. Gringarten:” Analysis of an Extended Well Test to Identify Connectivity Between Adjacent Compartments in a North Sea Reservoir,” paper SPE 93988 presented at the 14th Europec Biennial Conference, Madrid, Spain, 13-16 June 2005.
8. Amudo C., Turner, J., Frewin J.; Kgogo, T., and Gringarten A. C.:”Integration of Well Test Deconvolution Analysis and Detailed Reservoir Modelling in 3D Seismic Data Interpretation: A Case Study,” paper SPE 100250 presented at the SPE Europec/EAGE Annual Conference and Exhibition, Vienna, Austria, 12–15 June 2006
9. Gringarten, A. C.:”Practical use of well test deconvolution,” paper SPE 134534 presented at the 2010 SPE Annual Technical Conference and Exhibition held in Florence, Italy, 19–22 September 2010
10. Cumming, J. A., Wooff, D. A., Whittle, T. M., Crossman, R. J., and Gringarten, A. C.:” Assessing the Non-Uniqueness of the Well Test Interpretation Model Using Deconvolution”, paper SPE 164870 presented at SPE Europec/EAGE Annual Conference, London, United Kingdom, 10–13 June 2013
11. Cumming, J. A., Wooff, D. A., Whittle, T. M. and Gringarten, A. C.:” Multiple Well Deconvolution,” paper SPE 166458 presented at the SPE Annual Technical Conference and Exhibition held in New Orleans, Louisiana, USA, 30 September–2 October 2013.

Software:

TLSD (Total least Square Deconvolution)
Monte Carlo Deconvolution under R

Reports:

1	Nicolas Guilloneau	Assessment of the Deconvolution Method as an Automatic Tool in Well Test Analysis	2004

2	Thabo Kgogo	Deconvolution Analysis of a Horizontal Gas Condensate Well	2005
3	Syed Banoori	Production Data Analysis	

4	Jean-Baptiste Berchoteau	Use of Deconvolution to Improve the Reservoir Behaviour Understanding of Some Gas Condensate Reservoirs in Britannia	2006
5	Olivier Pippi	Well Test & Deconvolution Analyses of Gas Condensate Reservoirs for BP Algeria	

6	Ijeoma Oragui	Application of Deconvolution on Gas Fields in Shell Nigeria and its Impact on Proved Reserve Estimates	2007

7	Hui Jiang	Well Production Forecasting Using Deconvolution Of Pressure Transient Data	2008

8	Mukhtar Sargaskayev	Well test analysis of blood pressure	2009
9	Kezzah St. Clair	Production Forecasting For Varying Operating Conditions Using Deconvolved Pressure Transient Data	

10	Carlos Mata	Analytical Methods for Establishing Interwell Connectivity in a North Sea Field	2010
11	Shari Channa	Well Test Analysis of Blood Pressure	

12	Anzhela Glebova	Well Test Analysis of Blood Pressure	2011
13	Eduard Rinas	Deconvolution of Well Test Data from the E-M Gas Condensate Field (South Africa)	
14	Rida Rikabi	Brodgar Downhole Gauge Analysis with Deconvolution	

15	Percy Paul Obeahon	Fault Seal Breakdown Analysis in HP/HT Field – A Study of Egret Field in the North Sea	2012
16	Azimah Julkipli	Well Test Analysis of Blood Pressure	
17	Percy Obeahon	Fault Seal Breakdown Analysis in a HP-HT Field in the North Sea	
18	Azimah Julkipli	Well Test Analysis of Blood Pressure	

19	Arthur Clerc-Renaud	Well Test Analysis of Blood Pressure	2013

Appendix 4: "Well Test Analysis in Complex Systems –Complex reservoirs, and Complex Wells"

Publications:

1. Zambrano, J., Zimmerman, R. W. and Gringarten, A. C.:"Influence of Geological Features on Well Test Behavior" SPE 59398, proceedings of the 2000 SPE Asia Pacific Conference on Integrated Modelling for Asset Management held in Yokohama, Japan, 25-26 April (2000).
2. T. M. Whittle, J. Lee and A.C. Gringarten: "Will Wireline Formation Tests Replace Well Tests?" in *Proc. 2003 SPE Ann. Tech. Conf. Exh.*, Soc. Pet. Eng., Denver, paper SPE 84086 (2003).
3. Gringarten, A. C.:" Well Test Analysis in Low Permeability Multilateral Wells," paper IPTC-10686, presented at the International Petroleum Technology Conference, Doha, Qatar, 21-23 November 2005.
4. Azi, A. C., Gbo, A., Whittle, T and Gringarten, A.C.:" Evaluation of confidence intervals in well test interpretation results," paper SPE 113888 presented at the 2008 SPE Europec/EAGE Annual Conference and Exhibition, Italy, 9–12 June 2008.
5. Mijinyawa, A., and Gringarten, A.C.:" Influence of Geological Features on Well Test Behavior," paper SPE 113877 presented at the 2008 SPE Europec/EAGE Annual Conference and Exhibition, Rome, Italy, 9–12 June 2008.
6. Green, A. J., Whittle, T. M, and Gringarten, A. C.:" Multi-phase Well Testing to Calibrate Relative Permeability Measurements for Reservoir Simulation", paper SPE 154851 presented at SPE Europec/EAGE Annual Conference, Copenhagen, Denmark, 4-7 June 2012.
7. Laoroongroj, A., Zechner M., Clemens, T., and Gringarten, A. C.:" Determination of the In-Situ Polymer Viscosity from Fall-Off Tests", paper SPE 154832 presented at SPE Europec/EAGE Annual Conference, Copenhagen, Denmark, 4-7 June 2012.
8. Spyrou, C. E., Nurafza, P. and Gringarten, A. C.:" Well-head Pressure Transient Analysis", paper SPE 164871 presented at SPE Europec/EAGE Annual Conference, London, United Kingdom, 10–13 June 2013
9. Alshawaf, M. H. A. and Gringarten, A. C.:" Impact of Completion on Wellbore Skin Effect", paper SPE 164872 presented at SPE Europec/EAGE Annual Conference, London, United Kingdom, 10–13 June 2013

Reports:

1	Judith Zambrano	Influence of Geological Features on Well Test Behaviour	MPhil 2000

2	AbdulRahman Mijinyawa	Influence of Geological Features on Well Test Behaviour	MSc 2006-07

3	Raheel Rizwan Baig	Triple Porosity Simulation Models	MSc 2008-09
4	Said Muratbekov	Analysis of Bounded Commingled Reservoirs	

5	Serik Bekzhigitov	Well Test Analysis in Oil and Gas Reservoirs with Very High CO2 Content	MSc 2009-10

6	Hidayat Abd Hir	Reducing Fluid Type Uncertainty with Well Test Analysis	MSc 2010-11
7	Chern Zherng Low	Packing characteristics of different shaped proppants for use with hydrofracing-A numerical investigation using 3D FEMDEM	
8	Alistair J. Green	Multi-phase Well Testing to Calibrate Relative Permeability Measurements for Reservoir Simulation	
9	Hernán De Caso	Integrated Analysis of Pressure Transient Tests in the Gulf of Mexico	
10	Ajana Laoroongroj	Interpretation of polymer solution injection fall-off tests	

11	Mohammed Alshawaf	Impact of Completion on Wellbore Skin Effect	MSc 2011-12
12	Imam Kamran	Evaluating Hydraulic Fracture Properties Using Well Test Analysis on Multi Fractured Horizontal Wells	
13	Ali Izzidien	Design of a Pressure Transient Campaign for a Giant Middle Eastern field	
14	Aristeidis Karamessinis	Evaluation of low permeability naturally fractured carbonate reservoir with Pressure Transient Analysis	
15	Charidimos Spyrou	Well Test Analysis on Well-head Pressure Build-up to Identify Well Behaviour and Under Performance	
16	Benoit Decroux	Computation of effective dynamic properties of naturally fractured reservoirs-Comparison and validation of methods	

17	Aldo A. Lopez Marmolejo	Evaluation of the Impact of Scale in the Well-Test Behaviour of Fissured Reservoirs	MSc 2012-13
18	Joelle Mitri	Wireline Formation Testers Analysis with Deconvolution	
19	Sudhakar Mishra	Uncertainty in Multi-Layered Commingled Reservoirs with Non-Uniform Formation Damage	
20	Ojameruaye Ogheneovo	Steady State And Transient Modeling Of Liquid Loading In Gas Wells: A Niger Delta Case Study	
21	Wei Cher Feng	Bilinear Flow in Horizontal Wells in a Homogeneous Reservoir: Huntington Case Study	

Reports, shale oil and gas:

1	Elliott Cox	Decline Curve Analysis in Shale Gas Wells- A Study of the Effects of Adsorbed Gas on B-Factors	MSc 2010-11
2	Samat Kabdenov	Shale Gas Well Test Analysis	
3	Frederik Van Cauter	Predicting Decline in Unconventional Reservoirs Using Analytical and Empirical Methods	MSc 2012-13
4	Rawan Al-Obaidy	Modeling of Induced Hydraulically Fractured Wells in Shale Reservoirs Using ‘Branched’ Fractals	
5	Marco Cunha	Liquids-Rich Shale Evaluation: Modelling and Optimization of Hydraulically Fractured Liquids-Rich Shale Wells	