

# Dr Tara LaForce

## Curriculum Vitae

Dept of Earth Science and Engineering  
Imperial College London

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### Education

- 1996–1999 **BS**, *Colorado State University*, Ft Collins, CO, *Cum Laude*.  
Mathematics
- 2000–2002 **MS**, *University of Texas*, Austin, TX.  
Computational and Applied Mathematics
- 2002–2005 **PhD**, *University of Texas*, Austin, TX.  
Petroleum Engineering

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### PhD Thesis

- title *Mathematics of partially miscible three-phase flow*
- supervisor Prof Russ T Johns
- description This work presents the first analytical solutions for compositional three-phase porous media flow. Examples apply to remediation of contaminated groundwater and water & gas injection for enhanced oil recovery.

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### Experience

- 2007–present **Lecturer in Petroleum Engineering**, *Dept of Earth Science and Engineering, Imperial College London, UK.*
- 2006–2007 **Assistant Professor**, *Dept of Chemical and Petroleum Engineering, University of Wyoming.*
- 2005–2006 **Acting Assistant Professor**, *Dept of Petroleum Engineering, Stanford University, CA.*  
One year nontenure-track post. Job requirements were independent research, teaching and co-supervision of graduate students

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### Publications

**M. Namdar-Zanganeh, S.I. Kam, T. La Force, and W.R. Rossen**, The method of characteristics applied to oil displacement by foam, *Society of Petroleum Eng. Journal*, DOI: 10.2118/121580-PA, 2011.

**T. LaForce and K. Jessen**, Analytical and numerical investigation of multicomponent multiphase WAG displacements, *Computational Geosciences*, doi:10.1007/s10596-010-9185-3, 2010.

**T. LaForce Y. Cinar, R.T. Johns and F.M. Orr, Jr.**, Experimental confirmation of analytical composition routes in three-phase partially miscible flow, *Society of Petroleum Eng. Journal*, DOI: 10.2118/99505-PA, 2010.

**T. LaForce and R.T. Johns**, Effect of initial gas saturation on miscible gasflood recovery, *Journal of Petroleum Sci. and Eng.*, DOI: 10.1016/j.petrol.2009.11.011, 2010.

**R. Qi, T.C. LaForce and M.J. Blunt**, A three-phase four-component streamline-based simulator to study carbon dioxide storage, *Computational Geosciences*, DOI: 10.1007/s10596-009-9139-9, 2009.

**R. Qi, T.C. LaForce and M.J. Blunt**, Design of carbon dioxide storage in aquifers, *International Journal of Greenhouse Gas Control*, doi:10.1016/j.ijggc.2008.08.004, 2009.

**T. LaForce and F.M. Orr, Jr.**, Four-component gas/water/oil displacements in one dimension: Part III, Development of miscibility, *Transport in Porous Media*, DOI: 10.1007/s11242-008-9311-z, 2009.

**T. LaForce, K. Jessen and F.M. Orr, Jr.**, Four-component gas/water/oil displacements in one dimension: Part II, Example solutions, *Transport in Porous Media*, DOI: 10.1007/s11242-007-9137-0, 2008.

**T. LaForce, K. Jessen and F.M. Orr, Jr.**, Four-component gas/water/oil displacements in one dimension: Part I, Structure of the conservation law, *Transport in Porous Media*, DOI: 10.1007/s11242-007-9120-9, 2008.

**T. LaForce and R.T. Johns**, Analytical solutions for surfactant enhanced remediation of non-aqueous phase liquids (NAPLs), *Water Resources Research*, DOI: 10.1029/2004WR003862, 2005.

**T. LaForce and R.T. Johns**, Composition routes for three-phase partially miscible flow in ternary systems, *Society of Petroleum Eng. Journal*, DOI: 10.2118/89438-PA, 2005.

**J. M. Hyman and T. LaForce**, Modeling the spread of influenza among cities, *Bioterrorism: Mathematical modeling applications in homeland security*, Frontiers in Applied Mathematics Vol. 28, H.T. Banks and C. Castillo-Chavez (eds.) SIAM Pub. ISBN-10: 0898715490, 2003.

in progress

**L. Lazaro-Vallejo, M. Leahy, T. Dance and T. LaForce**, New phase behavior algorithm for simulation of CO<sub>2</sub> storage, *Computational Geosciences*, in review.

**T. LaForce**, Insight from analytical solutions for improved simulation of miscible WAG flooding, *Computational Geosciences*, in review.

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## Invited Presentations and Panels

**T. LaForce**, Insight from Analytical Solutions for Improved Simulations of Miscible WAG Flooding, *Novel multi-scale methods for porous media flow II*, Edinburgh, UK, Feb 14-16, 2011.

- T. LaForce et al.**, Maximizing subsurface storage capacity in sedimentary systems by combined CO<sub>2</sub>-H<sub>2</sub>O injection, *AAPG Annual Meeting, Theme XI: Carbon Dioxide Capture and Geologic Sequestration*, New Orleans, Louisiana, April 13, 2010.
- T. LaForce et al.**, Reducing greenhouse gas emissions: Geological storage of CO<sub>2</sub>, *University of Durham, Department of Earth Science seminar*, March 9, 2010.
- T. LaForce et al.**, Reducing greenhouse gas emissions: Geological storage of CO<sub>2</sub>, *University of Manchester, Department of Chemical Engineering seminar*, Feb 12, 2010.
- T. LaForce et al.**, Reducing greenhouse gas emissions: Geological storage of CO<sub>2</sub>, *7th Annual EOR Carbon Management Workshop*, Houston, TX, 6-8 December 2009.
- T. LaForce et al.**, Pulsed H<sub>2</sub>O - CO<sub>2</sub> injections into porous media, *International Conference on CO<sub>2</sub> Sequestration Processes*, Reykjavik, Iceland, 5-12 September 2009.
- T. LaForce et al.**, Reducing greenhouse gas emissions: Geological storage of CO<sub>2</sub> and EOR, *National Oceanography Centre, Southampton, WUN Earth Systems Video-Seminar Series*, Dec 10, 2008.
- T. LaForce**, Energy panel member at the *International forum on low carbon economy - sustainable development in Shanghai, Lingang New City and Chongming Eco-Island*, Shanghai, China Nov 19-20, 2008.
- T. LaForce and F.M. Orr, Jr.**, Fully compositional three-phase flow and the development of hydrocarbon miscibility, *Gordon Conference on Flow and Transport in Permeable Media*, Oxford, UK, July 13, 2008.
- T. LaForce, et al.**, Fully compositional three-phase flow and the development of hydrocarbon miscibility, *EUROMECH Colloquium 499*, Nancy, France June 10, 2008.
- T. LaForce, et al.**, Design of CO<sub>2</sub> Storage, and Development of hydrocarbon miscibility in WAG injection, *Saudi Aramco*, Dhahran, Saudi Arabia, April 27-28, 2008.
- T. LaForce et al.**, Reducing greenhouse gas emissions: Geological storage of CO<sub>2</sub> and EOR, *SPE EOR Conference at Oil & Gas West Asia*, Muscat, Oman, April 22, 2008.
- T. LaForce et al.**, Development of hydrocarbon miscibility in water and gas injection, *University of Cambridge Institute of Theoretical Geophysics*, March 6, 2008.
- T. LaForce et al.**, An assessment of options for geological storage of CO<sub>2</sub>, *SPE London Section Meeting*, London, UK, Feb. 26 2008.
- T. LaForce**, Reducing greenhouse gas emissions: Geological storage of CO<sub>2</sub>, *Second Nature (virtual talk)* Dec. 4, 2007 .
- T. LaForce et al.**, Semi-analytical solutions for four-component gas/water/oil displacements in one dimension, *X Workshop on Partial Differential Equations, Institute of Pure and Applied Mathematics*, Rio de Janeiro, Brazil, Aug. 6, 2007.
- T. LaForce, Y. Cinar, R.T. Johns and F.M. Orr, Jr**, Experimental confirmation for analytical composition routes in three-phase partially miscible flow, *Best of Tulsa session, EAGE conference on Improved Oil Recovery*, April 22-24, Cairo, Egypt, 2007.

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## Conference Presentations and Proceedings

**J. E. Kalunka, T. C. LaForce and M.J. Blunt**, Effects of CO<sub>2</sub> Storage in Saline Aquifers on Groundwater Supplies , *Proceedings of the 2010 Society of Petroleum Engineers International Conference on CO<sub>2</sub> Capture, Storage and Utilization*, SPE 139665, New Orleans, LA, USA, 10-12 Nov 2010.

**L. Lazaro-Vallejo, M. Leahy, T. Dance and T. LaForce**, New phase behavior algorithm for simulation of CO<sub>2</sub> storage, *Proceedings of the 2011 Society of Petroleum Engineers Reservoir Simulation Symposium*, SPE 141734, The Woodlands, Texas, USA, 21-23 Feb 2011.

**A. Mijic and T. LaForce**, Effects of non-Darcy flow in CO<sub>2</sub> injection into saline aquifers, *European Conference on the Mathematics of Oil Recovery (ECMOR)*, Oxford, UK, Sept 6-9 2010.

**A. Goater and T. LaForce**, Multicomponent multiphase transport solutions for application to CO<sub>2</sub> storage, *European Conference on the Mathematics of Oil Recovery (ECMOR)*, Oxford, UK, Sept 6-9 2010.

**A. Mijic, S.A. Mathias and T.C. LaForce**, Nonlinear flow in multiple well systems, *BHS 2010: Role of Hydrology in Managing Consequences of a Changing Global Environment*, Newcastle, UK, July 19-23 2010.

**L. Lazaro and T. LaForce**, Streamline-based simulation of geological CO<sub>2</sub> storage: Otway case-study, *EGU General Assembly*, Vienna, Austria, May 2-7 2010.

**T. LaForce**, Use of analytical solutions to optimize simulation of multicomponent three-phase displacements, *EGU General Assembly*, Vienna, Austria, May 2-7 2010.

**A. Akeze, A. Sikandar and T. LaForce**, Uncertainty evaluation in field development and export planning, *Proceedings of the 2009 SPE EUROPEC/EAGE Annual Conference and Exhibition*, SPE 121993, Amsterdam, The Netherlands, 8-11 June 2009.

**O.S. Olorunfemi and T. LaForce**, Effect of aquifer heterogeneity on CO<sub>2</sub> sequestration, *Proceedings of the 2009 SPE EUROPEC/EAGE Annual Conference and Exhibition*, SPE 121776, Amsterdam, The Netherlands, 8-11 June 2009.

**M. Namdar-Zanganeh, S.I. Kam, T. La Force and W.R. Rossen**, The method of characteristics applied to oil displacement by foam, *Proceedings of the 2009 SPE EUROPEC/EAGE Annual Conference and Exhibition*, Amsterdam, The Netherlands, SPE 121580, 8-11 June 2009.

**R. Qi, T. LaForce and M.J. Blunt**, Design of carbon dioxide storage, *International conference on deep saline aquifers for geological storage of CO<sub>2</sub> and energy*, IFP, France, 27-29 May 2009.

**A.M. AISofi, T. LaForce and M.J. Blunt**, Sweep impairment due to polymers shear thinning behavior, *Proceedings of the 2009 SPE Middle East Oil & Gas Show and Conference*, SPE 120321, Kingdom of Bahrain, 15-18 March 2009.

- M. Namdar-Zanganeh, T. La Force, S.I. Kam, T.L.M. van der Heijden and W.R. Rossen**, Fractional-flow theory of foam displacements with oil, *Proceedings of the 11th European Conference on the Mathematics of Oil Recovery* Bergen, Norway, 8 - 11 September 2008.
- R. Qi, T. LaForce and M.J. Blunt**, Design of carbon dioxide storage in oilfields, *Proceedings of the SPE ATCE*, SPE 115663, Denver, Colorado, Sept. 21-24, 2008 .
- T. LaForce and F.M. Orr, Jr.**, Design development of gas/oil miscibility in water and gas injection, *Proceedings of the SPE ATCE*, SPE 116119, Denver, Colorado, Sept. 21-24, 2008.
- R. Qi, T. LaForce and M.J. Blunt**, Design of carbon dioxide storage in oilfields and aquifers, *Computational Methods in Water Resources, XVII conference*, San Francisco, USA, 6-10 July, 2008.
- B. Alamdari, T. LaForce and M. Piri**, Impact of self-consistent physically based three-phase relative permeability on oil recovery by secondary gasflooding, *Proceedings of the SPE ATCE*, SPE 110507, Anaheim, California, U.S.A., November 11-14, 2007.
- T. LaForce and K. Jessen**, Analytical and numerical investigation of multicomponent multiphase WAG displacements, *Proceedings of the SPE ATCE*, SPE 110264, Anaheim, California, U.S.A., November 11-14, 2007.
- R. Qi, R., V. Beraldo, T.C. LaForce and M.J. Blunt**, Design of carbon dioxide storage in a North Sea aquifer using streamline-based simulation, *Proceedings of the SPE ATCE*, SPE 109905, Anaheim, California, U.S.A., November 11-14, 2007.
- T. LaForce, K. Jessen and F.M. Orr, Jr.**, Analytical solutions for compositional three-phase four-component displacements, *Proceedings of the SPE ATCE*, SPE 102777, San Antonio, TX, Sept. 24-27, 2006.
- C. J. Seto, K. Jessen, T. LaForce and F.M. Orr, Jr.**, Analytical modeling of CO<sub>2</sub> sequestration and enhanced coalbed methane recovery, *Proceedings of the 10th European Conference on the Mathematics of Oil Recovery* 2006..
- T. LaForce, Y. Cinar, R.T. Johns and F.M. Orr, Jr.**, Experimental confirmation for analytical composition routes in three-phase partially miscible flow, *Proceedings of the SPE/DOE 15th Symposium on IOR*, SPE 99505, April 22-26, Tulsa, OK, 2006.
- T. LaForce and R.T. Johns**, Effect of quasi-piston-like flow on miscible gas flood recovery. *Proceedings of the SPE Western Regional Meeting*, SPE 93233, March 30-April 1, Irvine, CA, 2005.
- T. LaForce and R.T. Johns**, Analytical theory for three-phase partially miscible flow in ternary systems, *Proceedings of the SPE/DOE 14th Symposium on IOR*, SPE 89438, April 17-21, Tulsa, OK, 2004.

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## Grants and Awards

- Integrated simulation technology for carbonate reservoirs, *Qatar Carbonates and Carbon Storage Research Centre*, lead PI, £2.2 million (Jan 2010-Dec 2015)
- Public engagement on: The future is low-carbon energy, *Engineering and Physical Sciences Research Council*, Public Engagement Grant Scheme PI, £12,000 (March 2010-Feb 2011)
- Near well-bore effects in carbon dioxide storage, *Grantham Institute for Climate Change*, 3 year studentship (Oct 2009-Sept 2012)
- Dispersive mixing in multicomponent multiphase flow: numerical and physical effects, *Engineering and Physical Sciences Research Council*, First Grant Program, PI, £318,000 (Oct 2008-Sept 2011)

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## Advising

### PhD Students Supervised or Co-supervised

**Ran Qi**, *Simulation of geological carbon dioxide storage*, 2008.

**Lorena Lazaro Vallejo**, *Streamline-based simulations for carbon dioxide storage: Improved thermodynamic modeling*, 2011.

**Aaron Goater**, *Streamline-based simulations for carbon dioxide storage: Higher-order numerical methods*, 2011.

**Lorraine Sobers**, *Carbon dioxide storage with enhanced heavy oil recovery*, 2011.

**Ana Mijic**, *Near well-bore effects in carbon dioxide storage*, 2012.

**Ahmad Abushaikha**, *Simulation of recovery mechanisms in fractured reservoirs*, 2012.

**Allan Leal**, *Geochemical modelling in multi-phase flow*, 2014.

### MSc Student Summer Projects

2008 **Amaka Nwogwugwu**, *Impact of fracture characterisations on optimum development scenarios for Clair field*, at Hess.

**Arnaud Lefebvre**, *Simulation of waterflood processes for heavy oil production*, at Total.

**Azuka Akeze**, *Uncertainty evaluation in a conceptual field development and export plan in Nigeria*, at Centrica Energy.

**Daoud Shaikh**, *Exploitation of oil rims*, at Fairfield Energy.

**Olalere Olorunjobi**, *Effect of heterogeneity on buoyancy-driven flow in CO<sub>2</sub> storage*.

**Stephane Pichon**, *Recovery mechanisms for a naturally fractured heavy-oil diatomite under primary recovery and steam injection*, at Perenco.

2009 **Aine McGarry**, *CO<sub>2</sub> storage and EOR: Does it add up?*.

**Chima Ojukwu**, *Where will we put all the CO<sub>2</sub>?*.

**Johannes Kalunka**, *Effects of CO<sub>2</sub> storage in saline aquifers on groundwater supplies*.

**Julya Bonkat**, *Out-of-zone water injection: A case study*, at Statoil.

**Rosmawati Abdul Rahman**, *Characterization of cap rock and faults for CO<sub>2</sub> leakage detection and monitoring*.

2010 **Babatunde Olimene**, *Sub-seismic faults: Performance prediction and uncertainty assessment*, in collaboration with Shell Nigeria.

**Michael Hutagalung**, *Investigation of grid block size effects in in-situ combustion simulation*, at Schlumberger.

**Ruba Saleh**, *Storage constraints on the efficient design of future CCS systems for the UK*.

**Shaun Bambridge**, *The grid dependence of well inflow performance in reservoir simulation*, at Schlumberger.

**Susan Moloney**, *Three-dimensional reservoir inflow modelling using computational fluid dynamics*, at Schlumberger.

**Ualikhan Yesbolov**, *Infill drilling in CO<sub>2</sub> storage*.

**Weerayut Sopitkamol**, *Efficiency of miscible gas flooding in oil layered reservoirs*.

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## Service and Professional Activities

Deputy Director

**Imperial College Centre for Carbon Capture and Storage (IC<sup>4</sup>S)**, March 2009-present.

This is an interdisciplinary research center that is designed to enhance collaboration between CCS researchers from all disciplines at Imperial College. IC<sup>4</sup>S also maintains an affiliated research consortium of industrial sponsors. Our website is at <http://www3.imperial.ac.uk/carboncaptureandstorage>.

Organiser

**Public Engagement: The Future of Low-Carbon Energy**, *Imperial College and Second Nature*, Oct-Nov 2010.

This was an experiment in collaboration with Nature Publishing Group using an on-line forum for communicating with the public. We hosted virtual presentations on energy issues from Sir Prof Brian Hoskins, Prof Nigel Brandon, Dr Steven Sorrell, Dr Paul Fennel and Dr Tara LaForce. We also built a Facebook group of 150 members (so far) by the same name to provide a forum for discussions and sharing news on energy-related topics. The seminar slides are posted at <http://www3.imperial.ac.uk/earthscienceandengineering/research/publicseminarsonenergy>

Organiser

**Imperial/Nature virtual conference on Climate Change and CO<sub>2</sub> Storage**, *Imperial College Grantham Institute and Second Nature*, Dec. 3, 2008.

This was an experimental virtual conference co-hosted by Nature Publishing and Imperial College. The conference consisted of 3 virtual talks from Sir Brian Hoskins, Prof. Martin Blunt and Prof. Franklin M. Orr, Jr. There were also 14 posters submitted by attendees. The conference website is at <http://www3.imperial.ac.uk/earthscienceandengineering/research/climateconference08> and the proceedings are at <http://precedings.nature.com/collections/virtual-climate-conference>

co-Organiser

**Stern Review Reading Group**, *Imperial College Grantham Institute*, 2008-2009.

The purpose of this reading group was to gather climate-related researchers from across campus to read "The Stern Review on the Economics of Climate Change," one of the pivotal works on climate change in the UK, but an intimidating 692 pages long. We met twice a month for the academic year and volunteers presented 2-3 chapters per meeting. After finishing the Stern Review, we changed the name to the "climate change reading group" and now meet monthly to discuss other climate-change related reports.

Reviewer

Transport in Porous Media  
Soc. of Pet. Eng. Journal

Ind. and Eng. Chemistry Research  
SPE Reservoir Eval. and Eng.

Chemical Engineering Science

Petroleum Research Fund of the ACS

Courses Attended **Imperial College:** CASLAT (MS-level teaching qualification)

Using Special Core Analysis

**Royal Society:** Media Training

Communication Skills

Member SPE, AGU, AAPG

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## Courses Taught or co-Taught

STANFORD Fundamentals of Petroleum Eng.  
Applied Mathematics in Res. Eng.

Theory of Gas Injection Processes

U of WYOMING Math for Chem. and Pet. Eng.

Reservoir Simulation

IMPERIAL Wytch Farm Field Development  
COLLEGE Project: Phase II

Math Methods 3

First Year Tutorials

Second Year Tutorials

Analytical Methods in IOR

MSc Wytch Farm Geology Fieldtrip

Math Review for MSc Geophysicists

MSc West Texas Carbonates Fieldtrip