

*Luis F. Ayala is Professor of Petroleum and Natural Gas Engineering, Associate Department Head for Graduate Education, FCMG Chair in Fluid Behavior and Rock Interactions, and holder of the William A. Fustos Family Professorship in the John and Willie Leone Family Department of Energy and Mineral Engineering at The Pennsylvania State University<sup>1</sup>, USA. He has also been an Instructor in the Chemical Engineering and Petroleum Engineering Departments at Universidad de Oriente (Venezuela). His research activities focus on the areas of natural gas engineering, hydrocarbon thermodynamics, long-term production performance analysis of unconventional reservoirs, and advanced numerical modeling. He holds two summa cum laude degrees in both Chemical and Petroleum Engineering from Universidad de Oriente (Venezuela) and MS and PhD degrees in Petroleum and Natural Gas Engineering from The Pennsylvania State University. He has received the Wilson Award for Outstanding Teaching from The Pennsylvania State U., the Outstanding Technical Editor Award from the Society of Petroleum Engineers (SPE), the Presidential distinction for Academic Excellence from Venezuela, and is currently a member of a number of Editorial Boards in petroleum and natural gas engineering journals and former Editor-in-Chief of The Way Ahead, the SPE flagship magazine for young professionals in the oil and gas industry.*

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## Professional Preparation

Universidad de Oriente (UDO), Venezuela  
*Chemical Engineering Degree*, summa cum laude, 1997.

Universidad de Oriente (UDO), Venezuela  
*Petroleum Engineering Degree*, summa cum laude, 1999.

The Pennsylvania State University (PSU), USA  
*Master of Science in Petroleum and Natural Gas Engineering*, 2001.

The Pennsylvania State University (PSU), USA  
*Doctor of Philosophy in Petroleum and Natural Gas Engineering*, 2004.

## Appointments

- 2015-            **Professor** of Petroleum and Natural Gas Engineering  
John and Willie Leone Family Department of Energy and Mineral Engineering, Penn State U.
- 2013-            **Associate Department Head for Graduate Education**  
John and Willie Leone Family Department of Energy and Mineral Engineering, Penn State U.
- 2010-2015      **Associate Professor** of Petroleum and Natural Gas Engineering  
John and Willie Leone Family Department of Energy and Mineral Engineering, Penn State U.
- 2004- 2010     **Assistant Professor** of Petroleum and Natural Gas Engineering  
Department of Energy and Mineral Engineering, Penn State U.
- 2003-2004      **Instructor** of Petroleum and Natural Gas Engineering  
Department of Energy and Geo-Environmental Engineering, Penn State U.
- 2000-2003      **Graduate Assistant/Assistant Lecturer**, Penn State U.
- 1997-1999      **Instructor**, joint appointment in the Petroleum Engineering Department and Chemical Engineering Department, Universidad de Oriente, Venezuela.

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## Selected Publications

- **Ayala H., L.F.** and Morgan, E. C. Chapter 17: Natural Gas Production Engineering, peer-reviewed chapter, ASTM Handbook MNL73 Exploration and Production of Petroleum and Natural Gas Processing (eds: M.R. Riazi, and E. van Oort), 2016.
- Stumpf, T., and **Ayala H., L.F.**, Rigorous and Explicit Determination of Reserves and Hyperbolic Exponents in Gas Well Decline Analysis, SPE 180909, *SPE J.*, 2016.
- Zhang, M. and **Ayala H., L. F.**, A density-based material balance equation for the analysis of liquid-rich natural gas systems, *J. Petrol. Explor. Prod. Technol.*, 2016.
- Jin, T., **Ayala H., L.F.** Ityokumbul, M.T., Network Modeling and Prediction of Retrograde Gas Behavior in Natural Gas Pipeline Systems, *Int. J. of Eng. Sys Mod. and Simulation*, 2016.
- Zhang, M., Singh, M., and **Ayala, L.F.**, Rate Forecasting During Boundary-Dominated Multiphase Flow: The Rescaled Exponential Model, *J. Pet. Sc. and Eng.*, v.143, pp.199-210, July 2016.
- Dong, T. and **Ayala H., L.F.**, Two-Phase Flow Models for Thermal Behavior Interpretation in Horizontal Wellbores, *J. Pet. Exp. and Prod. Tech.*, v. 6, no. 1, pp. 45-61, March 2016.
- Zhang, M., Becker, M., and **Ayala H., L.F.**, A Similarity Method for Early-Transient Multiphase Flow Analysis of Liquid-Rich Unconventional Gas Reservoirs, *J. Nat. Gas Sc. & Eng.*, v. 28, pp. 572-586, Jan. 2016.
- Vardcharragosad, P., **Ayala H., L.F.** and Zhang, M., Linear vs. Radial Boundary-Dominated Flow: Implications for Gas Well Decline Analysis, SPE 176020, *SPE J.*, v. 20, n. 5, pp. 1053-1066, Oct. 2015.
- Vardcharragosad, P., and **Ayala H., L.F.**, Rate-time forecasting of gas reservoirs with significant transient flow: A density-based method, *J. Unconv. Oil & Gas Res.*, v. 11, p. 111-126, Sept. 2015.
- Zhang, M. and **Ayala H., L.F.**, Constant GOR as an Infinite-Acting Effect in Undersaturated Multiphase Reservoir Systems, SPE 175079 presented at the SPE Annual Technical Conference and Exhibition, 28-30 Sept. 2015, Houston, Texas.
- Zhang, M. and **Ayala H., L.F.**, A New Material Balance Equation for the Analysis of Liquid Rich Natural Gas Reservoirs, SPE 175081 presented at the SPE Annual Technical Conference and Exhibition, 28-30 Sept. 2015, Houston, Texas.
- Zhang, M. and **Ayala H., L.F.**, Density-Based Production Data Analysis of Gas Wells With Significant Rock Compressibility Effects, SPE 166320, SPEREE – FE J., p. 205-213, May 2015.
- Yan, Q., Lemanski, C., Karpyn, Z.T., and **Ayala H., L.F.**, Experimental Investigation of Shale Gas Production Impairment Due to Fracturing Fluid Migration During Shut-In Time, *J. Nat. Gas Sc. & Eng.*, v. 24, p. 99-105, May 2015.
- **Ayala H., L.F.** and Dong, T., Thermodynamic Analysis of Thermal Responses in Horizontal Wellbores, *J. of Energy Res. Tech.*, 137(3), p. 032903, May 2015.
- Vardcharragosad, P., and **Ayala H., L.F.**, Production Data Analysis of Gas Reservoirs With Apparent Permeability and Sorbed Phase Effects: A Density-Based Approach, *SPE-166377-PA, SPE J.*, Feb. 2015.
- Jin, T., **Ayala H., L.F.** Ityokumbul, M.T., Network Modeling and Prediction of Retrograde Gas Behavior in Natural Gas Pipeline Systems, *Int. J. of Eng. Sys Modeling and Simulation*, 2015.
- Zhang, M., Vardcharragosad, P., **Ayala H., Luis F.**, The Similarity Theory Applied to Early-Transient Gas Flow Analysis in Unconventional Reservoirs, *J. Nat. Gas Sc. & Eng.*, v. 21, p. 659-668, Nov. 2014.
- Urquidi-Macdonald, M., Tewari, A., and **Ayala H., L.F.**, A Neuro-Fuzzy Knowledge-based Model for the Risk Assessment of Microbiologically Influenced Corrosion (MIC) in Crude Oil Pipelines, *Corrosion*, Vol. 70, No. 11, pp. 1157-1166, Nov. 2014.
- Varcharragosad, P., Duplaa, A., and Ayala H., L.F. Identification of Pitfalls in PVT Gas Condensate Modeling Using Modified Black-Oil Formulations, *J. Petrol. Explor. Prod. Technol.*, v. 4, no. 4, p. 457-469, 2014.
- Zhang, M. and **Ayala H., L.F.**, Gas Production Data Analysis of Variable Pressure Drawdown/ Variable Rate Systems: A Density-Based Approach, *SPE Res. Ev. and Eng. J.*, 17(4), p. 520-529, SPE-172503-PA, 2014.
- Zhang, M. and **Ayala H., L. F.**, Gas-Rate Forecasting in Boundary-Dominated Flow: Constant-Bottomhole-Pressure Decline Analysis by Use of Rescaled Exponential Models. *SPE J.*, v. 19, n. 3, p. 410-417, SPE-168217-PA, 2014.

- Dutta, R., Lee, C.-H., Odumabo, S., Ye, P., Walker, S.C., Karpyn, Z.T., and **Ayala H., L. F.**, Experimental Investigation of Fracturing Fluid Migration due to Spontaneous Imbibition in Fractured Low Permeability Sands, *SPE Res. Ev. and Eng. J.*, v. 17, no. 1, 2014.
- Odumabo, S.M., Karpyn, Z.T., and **Ayala H., L.F.** Investigation of gas flow hindrance due to fracturing fluid leakoff in low permeability sandstones, *J. of Nat. Gas Sc. and Eng.*, v. 17, p. 1-2, <http://dx.doi.org/10.1016/j.jngse.2013.12.002>, March 2014.
- Leong, C.Y. and Ayala H., L.F., Hybrid Approach Using Linear Analogs for Gas Network Simulation with Multiple Components, *Oil and Gas Facilities J.*, v. 3, n. 1, p. 76-88, Feb. 2014.
- **Ayala H., L.F.**, and Zhang, M., Rescaled Exponential and Density-Based Decline Models: Extension to Variable-Rate/Pressure-Drawdown Conditions. *J. Can. Pet. Tech.* **52** (6): 433-440. SPE-168223-PA., 2013.
- **Ayala H., L.F.**, and Leong, C.Y., A Robust Linear-Pressure Analog for the Analysis of Natural Gas Transportation Networks, *J. Nat. Gas Sc. and Eng.*, v. 14, pp. 174-184, September 2013.
- Bansal, Y., Ertekin, T., Karpyn, Z., **Ayala H., L.F.**, Nejad, A., Suleen, F., Balogun, O. , Liebmann, D. and Sun, Q., Forecasting Well Performance in a Discontinuous Tight Oil Reservoir Using Artificial Neural Networks, SPE Paper 164542 presented at the SPE Unconventional Resources Conference, The Woodlands, TX, Ap. 10-12, 2013.
- Ye, P. and **Ayala H., L.F.**, Straight-Line Analysis of Flow Rate vs. Cumulative Production Data for the Explicit Determination of Gas Reserves, *J. of Can. Pet. Tech.*, v. 52, n. 4, pp. 296-305, July 2013.
- **Ayala H., L.F.**, and Blumsack, S., The Braess Paradox and its Impact on Natural Gas Network Performance, *Oil and Gas Facilities J.*, v. 2, n. 3, pp. 52-64, June 2013.
- **Ayala H., L.F.**, and Ye, P., A Unified Type-Curve for Decline Curve Analysis of Natural Gas Reservoirs in Boundary Dominated Flow, *SPE J.*, v. 18, n. 1, pp. 97-113, February 2013.
- **Ayala H., L.F.**, Chapter 22: Transportation of Crude Oil, Natural Gas, and Petroleum Products, peer reviewed chapter, ASTM Handbook of Petroleum and Natural Gas Refining and Processing (eds: Riazi, M.R., Eser, S., Pena D., J.L., Agrawal, S.S.), *ASTM International*, 2013.
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- Ye, P. and **Ayala H., L.F.**, A Density Diffusivity Approach for the Unsteady State Analysis of Natural Gas Reservoirs, *J. Nat. Gas Sc. and Eng.*, v. 7, p. 22-34, 2012.
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- Al Ghamdi, B. and **Ayala H., L.F.**, Analysis of Capillary Pressure and Relative Permeability Effects on the Productivity of Naturally Fractured Gas-Condensate Reservoirs, 2010 SPE/DGS Saudi Arabia Section Technical Symposium and Exhibition, 4-7 April, Al-Khobar, Saudi Arabia.
- **Ayala H., L.F.** Jack of all Trades vs. Master of Some, Editorial, The Way Ahead- SPE Publications, v. 6, n. 1, p. 3-5, SPE Publications, 2010.
- **Ayala H., L. F.** NOCs and IOCs: The Fourteen (and plus) Sisters, The Way Ahead- SPE Publications, v. 5, n. 3, p. 2, SPE Publications, 2009.
- **Ayala H., L. F.** Carving your Own Path: The Technical vs. Managerial Career Dilemma, The Way Ahead- SPE Publications, v. 5, n. 2, p. 2-3, SPE Publications, 2009.
- **Ayala H., L. F.** The Oil Roller Coaster, The Way Ahead- SPE Publications, v. 5, n. 1, p. 3-4, 2009.
- **Ayala H., L.F.**, Alp, D., and Al-Timimy, M. Intelligent Design and Selection of Natural Gas L/V Separators, *J. of Nat. Gas Sc. and Eng.*, v. 1, n. 3, pp. 84-94, Sept. 2009.
- Fariás, M., **Ayala H., L.F.**, and Watson, R., Experimental and Zero-Dimensional Analysis of CO<sub>2</sub>-N<sub>2</sub> Gas Cyclic Injection Processes., *Pet. Sc. and Tech.*, v. 27, n. 12, pp. 1360-1379, Aug. 2009.

- **Ayala H., L. F.** and Fernández L., J.E., Evaluating Crystallization Risks in LNG Production, *SPE Projects, Facilities and Construction J.*, v. 4 n. 2, pp. 27-31, June 2009.
- **Ayala H., L.F.**, Radespiel, E., and Ertekin, T., Numerical Analysis of Condensate-Flow Impairment in Retrograde-Gas Naturally Fractured Reservoirs and Its Interplay With the Estimation of Diffusion Coefficients, *SPE J.*, v. 13, n. 1, pp. 95-100, March 2009.
- Silpngarmert, S., Ertekin T., and **Ayala H., L.F.**. Numerical Modeling of Methane Hydrate Reservoirs, *Int. J. of Modeling and Sim.*, v. 29, n. 4, 2009.
- Kouassi, J.P. and **Ayala H., L.F.**, An Analysis of the Pressure Transient Behavior of Gas-Condensate Reservoirs, *Energy Sources – Part A*, v. 31, p. 449-461, March 2009.
- Mann, A. and **Ayala H., L.F.**, Intelligent Design of Natural Gas Underground Storage Facilities, *Int. J. of Modeling and Sim.*, v. 29, n. 2, 2009.
- **Ayala H., L.F.** and Alp, D., Limitations of Marching Algorithms in the Analysis of Multiphase Flow in Pipelines, *J. of Energy Res. Tech.*, v. 130, n. 4, p. 4300301-4300310, Dec. 2008.
- Ertekin, T. and **Ayala H., L.F.** Numerical Analysis of Retrograde Behavior in Fissured Systems: The Single-Block Model, *Pet. Sc. and Tech.*, v. 26, n. 10-11, p. 1141-1160, July 2008.
- **Ayala H., L.F.**, Ertekin, T., and Adewumi, M., Numerical Analysis of Multi-mechanistic Flow Effects in Naturally Fractured Gas-Condensate Systems, *J. Pet. Sc. and Eng.*, v. 58, n. 1-2, p. 13-29, Aug. 2007.
- **Ayala H., L.F.**, and Ertekin, T. Neuro-Simulation Analysis of Pressure Maintenance Operations in Gas-Condensate Reservoirs, *J. Pet. Sc. and Eng.*, v. 58, n. 1-2, p. 207-226, Aug. 2007.
- **Ayala H., L.F.** and Karpyn, Z., On the Calculation of Static Bottom-Hole Pressures in Gas Wells, *Pet. Sc. and Tech.*, v. 25, n. 8, p. 1099-1104, Aug. 2007.
- Ayala, O. F., **Ayala H., L. F.**, and Ayala, O.M., Multi-phase Flow Analysis in Oil and Gas Engineering Systems and its Modeling, *Hydrocarbon World 2007* ISSN: 1753-3899, p. 57-61, Touch Briefings Ltd., London, UK, July 2007.
- Kelner, E., **Ayala H., L.F.**, and Garcia, A., Model Improves Measurement and Control; Helps Locate Liquids, *Pipeline & Gas J.*, v. 234, n. 7, p. 28-42, July 2007.
- **Ayala H., L.F.** and Koasssi, J.P., The Similarity Theory Applied to the Analysis of Multiphase Flow in Gas Condensate Reservoirs, *Energy and Fuels.*, v. 21, n. 3, p. 1592-1600, May/June 2007.
- **Ayala H., L.F.**, Ertekin, T., and Adewumi, M., Study of Gas-Condensate Reservoir Exploitation Using Neuro-Simulation, *SPE Res. Eng. and Eval. J.*, v. 10, n. 2, p. 140-149, April 2007.
- Baris, O., **Ayala, L.**, Watson, R., Numerical Modeling of Foam Drilling Hydraulics, *The Journal of Eng. Res.*, v. 4, n. 1, pp. 103-119, Jan. 2007.
- **Ayala H., L.F.**, The Role of Fluid Thermodynamic Behaviour in Natural Gas Handling and Transportation, *Business Briefing: Hydrocarbon World 2006*, ISSN: 1753-3902, p. 61-66, Touch Briefings Ltd., London, UK, Dec. 2006.
- **Ayala H., L.F.**, Ertekin, T., and Adewumi, M., Compositional Modeling of Gas-Condensate Reservoirs in Multimechanistic Flow Domains, *SPE J.*, v. 11, n. 4, p. 480-487, Dec. 2006.
- **Ayala H., L.F.**, On the Non-Ideality of Hydrocarbon Fluids: Implications for Natural Gas Engineering – Part A, *Petroleum J. Online*, e-journal of reservoir engineering, v.1, n. 1, Nov. 2006.
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- **Ayala H., L.F.**, Phase Behavior of Hydrocarbon Fluids: The Key to Understanding Oil and Gas Engineering Systems, *Business Briefing: Oil & Gas Processing Review 2006*, ISBN: 1-905052-47-2, p. 16-18, Touch Briefings Ltd., London, UK, Feb. 2006.
- **Ayala H., L.F.** and Ertekin, T., Analysis of Gas-Cycling Performance in Gas/Condensate Reservoirs using Neuro-Simulation, *Proceedings of the 2005 SPE Annual Technical Conference and Exhibition*, Dallas, TX, 9-12 Oct. 2005.
- **Ayala H., L.F.**, Ertekin, T., and Adewumi, M., Compositional Modeling of Gas-Condensate Reservoirs in Multimechanistic Flow Domains, *Proceedings of the 2005 SPE Latin American and Caribbean Petroleum Engineering Conference*, Rio de Janeiro, Brazil, 20-23 June 2005.

- **Ayala H., L.F.**, Ertekin, T., and Adewumi, M., Analysis of Recovery Mechanisms for Naturally Fractured Gas-Condensate Reservoirs, *Proceedings of the 2004 SPE International Petroleum Conference*, Puebla, Mexico, 8-9 Nov. 2004.
- **Ayala H., L.F.**, Ertekin, T., and Adewumi, M., Optimized Exploitation of Gas-Condensate Reservoirs Using Neuro-Simulation, *Proceedings of 2004 SPE Asia Pacific Oil and Gas Conference and Exhibition*, Perth, Australia, 18-20 Oct. 2004.
- **Ayala H., L.F.**, and Adewumi, M., Low-Liquid Loading Multiphase Flow in Natural Gas Pipelines, *J. of Energy Res. and Tech., Trans. ASME*, v. 125, p. 284-293, Dec. 2003.
- **Ayala H., L.F.**, Eltohami, E., and Adewumi, M., A Unified Two-Fluid Model for Multiphase Flow in Natural Gas Pipelines, *Proceedings of the 25<sup>th</sup> Engineering Technology Conference on Energy of ASME*, Houston, TX, Feb. 4-5, 2002.
- **Ayala H., L.F.**, Eltohami, E., and Adewumi, M., Avoiding Pitfalls in Multiphase Thermo-hydrodynamic Coupling, *Proceedings of 25<sup>th</sup> Engineering Technology Conference on Energy of ASME*, Houston, TX, Feb. 4-5, 2002.
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- **Ayala H., L.F.**, Ayala R., O.R., and Ayala H., O.M., Multidimensional Heat Transfer Study in Foundations of Tanks for Refrigerated Storage, *Proceedings of III Latin-American Mass and Heat Transfer Congress*, Salta, Argentina, 1998.

## Synergistic Activities

Associate Department Head for Graduate Education, John and Willie Leone Family Department of Energy and Mineral Engineering, (2013-); Co-Director, PSU's Unconventional Natural Resources Consortium (PSU-UNRC, 2012-); EMS Representative, Graduate School's Graduate Subcommittee for New and Revised Programs, 2014-, Chair, Graduate Council Committee on Research, The Graduate School (PSU) (2010-2011); Elected Member, *University Graduate Council* (2009-2011); Specialty Coordinator, Reservoir Description and Dynamics, 2016 SPE Annual Technical Conference and Exhibition, Dubai, U.A.E.; Chair, Reservoir Engineering Program Subcommittee 2014 SPE Annual Technical Conference and Exhibition, Amsterdam, The Netherlands; Member, Reservoir Engineering Program Subcommittee: 2015 SPE Annual Technical Conference and Exhibition, Houston, 2013 SPE Annual Technical Conference and Exhibition, New Orleans, USA, 2012 SPE Annual Technical Conference and Exhibition in San Antonio, Texas, 2011 SPE Annual Technical Conference and Exhibition in Denver, Colorado, USA, and 2010 SPE Annual Technical Conference and Exhibition in Florence, Tuscany, Italy; 2010-2011 Advisor of *The Way Ahead*, SPE; 2009-2010 Editor-in-Chief of *The Way Ahead*, Society of Petroleum Engineers (SPE) Magazine; Member, *SPE Reservoir Description and Dynamics Advisory Committee*, Society of Petroleum Engineers (SPE); Associate Editor, *Journal of Natural Gas Science and Engineering* (JNGSE); Member of Editorial Review Board of the Society of Petroleum Engineering Journals (SPEREE J.); Member of Editorial Board of Petroleum Science and Technology J. (PST); Session Chair, 2007 ASME International Conference on Offshore Mechanics and Arctic Engineering in San Diego, California; Member of Technical Committee, 2007 SPE Latin American & Caribbean Petroleum Engineering Conference in Buenos Aires, Argentina; Member of the Society of Petroleum Engineers (SPE) and National Association of Engineers of Venezuela.

## Honors and Awards

2016-2017 Fulbright Scholar, recipient of the Fulbright -Colciencias Innovation and Technology Award; William A. Fustos Family Professorship in Energy and Mineral Engineering; FCMG Chair in Fluid Behavior and Rock Interactions; Wilson Award for Outstanding Teaching; SPE Outstanding Technical Editor Award; PNGE Graduate Merit Award (PSU); Presidential Distinction for Academic Excellence "*José Félix Ribas*" awarded by the President of the Republic of Venezuela, *Summa Cum Laude* distinction in Petroleum Engineering; Diploma of Recognition for Outstanding Academic Accomplishment granted by the Board of Trustees of Universidad de Oriente (UDO, Venezuela) for obtaining the highest academic distinction (*summa cum laude*) in two engineering majors studied simultaneously; *Summa Cum Laude* distinction in Chemical Engineering; Merit Medal "21<sup>st</sup> of November" granted by the Board of Trustees of Universidad de Oriente for outstanding academic achievement.