Palash Panja
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A. SUMMARY

5 years of industry experience, 9 years of teaching experience and 13+ years of research experience resulting in 55+ published articles specialized in energy storage, CO2 capture and utilization and storage, data analysis, machine learning, chemical process design and simulation, geothermal heat extraction, recovery of oil, and gas, and simulation of sub-surface flow in porous media. Served as supervisory committee member and mentored several PhD, MS and BS students at the University of Utah

B. PROFESSIONAL PREPARATION

Haldia Institute of Technology, India	Chem. Engineering	B. S. Degree	2003
Indian Institute of Technology Bombay, India	Chem. Engineering	M. S. Degree	2007
University of Utah, USA	Chem. Engineering	Ph. D. Degree	2014
University of Utah, USA	Energy & Geo. Inst.	Post-Doc. Res. Assoc.	2015-2017

C. APPOINTMENTS

2020-present	Research Assistant Professor, Department of Chemical Engineering, Univ. of Utah (teaching, research in process engineering, geothermal, machine learning)
2018-present	Research Scientist, Energy & Geoscience Institute, Univ. of Utah (research in oil & gas, geothermal, machine learning)
2015-2017	Post-Doctoral Research Assoc., Energy & Geoscience Institute, Univ. of Utah (teaching, research in oil & gas production, geothermal, machine learning)
2007-2010	Production Engineer, Oil and Natural Gas Corporation Limited, India (maintaining safe operations and production of condensate from offshore platform)
2004-2005	Process Engineer, Haldia Petrochemical Ltd, India (maintaining safe plant operations and process development)
2003-2004	Process Engineer, Ruchi-Soya Industries, India (maintaining safe plant operations and process development)

D. TEACHING

- ChEN 6156-Reservoir Simulation, Instructor, 2014, 2015, 2016, 2017, 2018, 2019
- ChEN 4253-Process Design I, Instructor, 2017, 2018, 2019
- ChEN 5253-Process Design II, Instructor, 2017, 2018, 2019, 2020, 2021, 2022

E. SERVICE ACTIVITIES

- Served as a Co-Chair, Unconventional Oil and Natural Gas: Science & Technology Advancement, AIChE Annual Meeting, Phoenix, AZ, 17th November 2022
- Invited Member of Panel discussion at PIVOT, 25th July 2022
- Invited Talk at Widener University, 1st April 2022
- Invited Talk at MIT Earth Resources Laboratory, 16th February 2022
- Selection committee member for recruitment of Student-Research (Requisition Number: PRN11504N, Job grade: SJ) at Energy & Geoscience Institute, 2021-22

- Selection committee member for recruitment of Industry Relationship Manager at Energy & Geoscience Institute, 2022
- Selection committee member for recruitment of Research Geologist (Requisition Number: PRN31628B, Job grade: A00) at Energy & Geoscience Institute, 2022
- Chair of the recruitment committee for Web Software Developer (Requisition Number: PRN28650B, Job Code: 1120) at Energy & Geoscience Institute, 2021
- Represented Energy & Geoscience Institute (Exhibition booth) at the American Association of Petroleum Geologists (AAPG) International Meeting for Applied Geoscience & Energy (IMAGE), Denver, Colorado, 26 September – 1 Oct 2021
- Served as a technical reviewer of 54th US Rock Mechanics/Geomechanics Symposium, 2020
- Served as a technical reviewer of 56th US Rock Mechanics/Geomechanics Symposium, 2022
- Served as a technical reviewer of Renewable Energy Development Fund of the Industrial Commission of North Dakota, 2021
- Invited Talk at Haldia institute of Technology, India, 9th July 2021
- Served as a Judge of Senior Projects, Widener University, April, 2021
- Served as an associate editor of Journal of Natural Gas Science and Engineering, 2016 -2021
- Supervised undergraduate and graduate students

F. PUBLICATIONS :

PEER REVIEWED

1. Davis, R., P. Panja, J. McLennan,2023, Integrated Workflow for Interpretation of Satellite Imageries using Machine Learning to Predict Algal Bloom in Utah Lake, USA, Ecological Informatics
2. Panja, P., W. Jia, B. McPherson, 2022, Prediction of Well Performance in SACROC Formation using Stacked Long Short-Term Memory (LSTM) Network, Expert Systems With Applications
3. Panja, P., B. McPherson, and M. Deo, Techno-Economic Analysis of Amine-based CO_2 Capture Technology: Hunter Plant Case Study, Carbon Capture Science & Technology, 2022, 10.1016/j.ccst.2022.100041
4. Panja, P. and D.A. Wood, Chapter Seven - Production decline curve analysis and reserves forecasting for conventional and unconventional gas reservoirs, in Sustainable Natural Gas Reservoir and Production Engineering, D.A. Wood and J. Cai, Editors. 2022, Gulf Professional Publishing. p. 183-215.
5. Porlles, J., P. Panja, R. Sorkhabi, J. McLennan Integrated porosity methods for estimation of gas-in-place in the Muerto Formation of Northwestern Peru. Journal of Petroleum Science and Engineering, 2021. 202: p. 108558.
6. Panja, P., J. McLennan, and S. Green, Impact of permeability heterogeneity on geothermal battery energy storage. Advances in Geo-Energy Research, 2021. 5(2): p. 127-138.
7. Panja, P., J. McLennan, and S. Green, Influence of permeability anisotropy and layering on geothermal battery energy storage. Geothermics, 2021. 90: p. 101998.
8. Omotilewa, O.J., et al., Evaluation of enhanced coalbed methane recovery and carbon dioxide sequestration potential in high volatile bituminous coal. Journal of Natural Gas Science and Engineering, 2021. 91.
9. Green, S., et al., Geothermal battery energy storage. Renewable Energy, 2021. 164: p. 777-790.
10. Asai, P., et al., Flow of long chain hydrocarbons through carbon nanotubes (CNTs). Scientific Reports, 2021. 11(1): p. 11015.

11. Velasco, R., P. Panja, and M. Deo, Moving boundary approach to forecast tight oil production. AIChE Journal, 2020. 67(2).
12. Panja, P., R. Velasco, and M. Deo, Understanding and modeling of gas-condensate flow in porous media. Advances in Geo-Energy Research, 2020. 4(2): p. 173-186.
13. Panja, P., T.X. Pack, and M. Deo, Operational optimization of absorption column in capturing CO2 from flue gas in coal-fired power plant. Chemical Engineering Communications, 2020: p. 1-14.
14. Goral, J., et al., Confinement Effect on Porosity and Permeability of Shales. Scientific Reports, 2020. 10(1): p. 49.
15. Deo, M., et al., Pre-processing Protocol for Nonlinear Regression of Uneven Spaced-Data. Journal of Modeling and Optimization, 2020. 12(1): p. 23-37.
16. Beti, D.R., et al., Change in Hydrocarbon Composition in Rock Samples as a Function of Time: A Thermodynamic Evaporation Model. Journal of Natural Gas Science and Engineering, 2020: p. 103238.
17. Beti, D.R., et al., Hydrocarbon distributions of incremental S1 peaks corresponding to different boiling point ranges of petroleum in rock samples. Journal of Petroleum Science and Engineering, 2020. 191: p. 107174.
18. Panja, P., J. Zhou, and M. Deo, Simplification of Complex Fracture Morphology and Its Impact on Production. International Journal of Oil, Gas and Coal Technology, 2019.
19. Panja, P., M. Pathak, and M. Deo, Productions of volatile oil and gas-condensate from liquid rich shales. Advances in Geo-Energy Research, 2019. 3(1): p. 29-42.
20. Panja, P. and M. Mukhopadhyay, Extraction of Natural Sweetener from Stevia Leaves Using Pressurized Hot Water. Journal of Nutraceuticals and Food Science, 2019. 4(1:3).
21. Asai, P., et al., Efficient workflow for simulation of multifractured enhanced geothermal systems (EGS). Renewable Energy, 2019. 131: p. 763-777.
22. Asai, P., et al., Effect of different flow schemes on heat recovery from Enhanced Geothermal Systems (EGS). Energy, 2019. 175: p. 667-676.
23. Velasco, R., et al., Analysis of North-American Tight oil production. AIChE Journal, 2018. 64(4): p. 1479-1484.
24. Velasco, R., P. Panja, and M. Deo, Simplification workflow for hydraulically fractured reservoirs. Petroleum, 2018. 4(2): p. 134-147.
25. Panja, P., et al., Application of artificial intelligence to forecast hydrocarbon production from shales. Petroleum, 2018. 4(1): p. 75-89.
26. Panja, P. and R. Velasco, Production of Liquid Hydrocarbons from Shales, in Encyclopedia of Petroleum Geoscience, R. Sorkhabi, Editor. 2018, Springer International Publishing: Cham. p. 1-11.
27. Panja, P., Green extraction methods of food polyphenols from vegetable materials. Current Opinion in Food Science, 2018. 23: p. 173-182.
28. Asai, P., et al., Fluid flow distribution in fractures for a doublet system in Enhanced Geothermal Systems (EGS). Geothermics, 2018. 75: p. 171-179.
29. Asai, P., et al., Performance evaluation of enhanced geothermal system (EGS): Surrogate models, sensitivity study and ranking key parameters. Renewable Energy, 2018. 122: p. 184-195.
30. Pathak, M., et al., Effect of the presence of organic matter on bubble points of oils in shales. AIChE Journal, 2017. 63(7): p. 3083-3095.
31. Ashley, W.J., P. Panja, and M. Deo, Surrogate models for production performance from heterogeneous shales. Journal of Petroleum Science and Engineering, 2017. 159: p. 244-256.
32. Roehner, R., P. Panja, and M. Deo, Reducing Gas Flaring in Oil Production from Shales. Energy & Fuels, 2016. 30(9): p. 7524-7531.

33. Panja, P. and M. Deo, Unusual behavior of produced gas oil ratio in low permeability fractured reservoirs. Journal of Petroleum Science and Engineering, 2016. 144: p. 76-83.
34. Panja, P. and M. Deo, Factors That Control Condensate Production From Shales: Surrogate Reservoir Models and Uncertainty Analysis. SPE Reservoir Evaluation & Engineering, 2016. 19(01): p. 130-141.
35. Panja, P., T. Conner, and M. Deo, Factors controlling production in hydraulically fractured low permeability oil reservoirs. International Journal of Oil, Gas and Coal Technology, 2016. 13(1): p. 1-18.
36. Panja, P., T. Conner, and M. Deo, Grid sensitivity studies in hydraulically fractured low permeability reservoirs. Journal of Petroleum Science and Engineering, 2013. 112: p. 78-87.
37. Mukhopadhyay, M. and P. Panja, Pressurised Hot Water as a Novel Extractant of Natural Products: A Review. Indian Chemical Engineer, 2010. 51(4): p. 311-324.
38. Mukhopadhyay, M. and P. Panja, A novel process for extraction of natural sweetener from licorice (Glycyrrhiza glabra) roots. Separation and Purification Technology, 2008. 63(3): p. 539-545.
39. Mukhopadhyay, M. and P. Panja, Recovery of Phytochemicals from Kokum (Garcinia indica choisy) Using Pressurized Hot Water. International Journal of Food Engineering, 2008. 4(8).

CONFERENCE ARTICLES

1. Vega-Ortiz, C., P. Panja, J. McLennan, B. McPherson, 2022, Injection of Flue Gas Improves CO2 Permeability and Storage Capacity in Coal: A Promising Technology, SPE Annual Technical Conference and Exhibition (ATCE), Houston, Texas, 3–5 October 2022
2. Panja, P., R. Velasco, P. Asai, M. Deo, 2022, New Discrete Fracture Networks (DFN) Model with Coupled Geomechanics and Fluid Flow, Unconventional Resources Technology Conference (URTeC), Houston, Texas, 20-22 June
3. Panja, P., R. Sorkhabi, 2022, Geomechanical Controls on Production Performance of Austin Chalk and Eagle Ford Oil Wells in Southern Texas, 56th US Rock Mechanics/Geomechanics Symposium (ARMA 2022), 26-29 June, Santa Fe, New Mexico, USA
4. Phelan, Z., P. Xing, P. Panja, Joseph Moore, John McLennan, 2022, Prediction of Formation Properties Based on Drilling Data of Geothermal Wells at Utah FORGE Site Using Machine Learning, ARMA, 56th US Rock Mechanics/Geomechanics Symposium (ARMA 2022), 26-29 June, Santa Fe, New Mexico, USA
5. Sorkhabi, R. and P. Panja. Not All Shales Play the Same Game: Comparative Analysis of US Shale Oil Formations by Reverse Engineering and Petroleum Systems. in SPE/AAPG/SEG Unconventional Resources Technology Conference. 2021.
6. Panja, P., et al. Multi-Layer Reservoir Thermal Energy Storage in the Uinta Basin. in 55th U.S. Rock Mechanics/Geomechanics Symposium. 2021.
7. Sorkhabi, R. and P. Panja. Data Analysis of the Permian Basin Wolfcamp and Bone Spring Leads to Better Understanding of Production Sweetspots. in SPE Annual Technical Conference and Exhibition. 2020.
8. Panja, P., J. McLennan, and S. Green. Temperature and Pressure Profiles for Geothermal Battery Energy Storage in Sedimentary Basins. in 54th U.S. Rock Mechanics/Geomechanics Symposium. 2020.
9. Panja, P., et al. Prediction of Geomechanical Properties from Elemental Analysis using Machine Learning Algorithm. in 54th U.S. Rock Mechanics/Geomechanics Symposium. 2020.
10. Panja, P., R. Velasco, and M. Deo, Stimulated Oil Reservoir Volume Estimation of Prominent US Tight Oil Formations, in SPE Liquids-Rich Basins Conference - North America. 2018, Society of Petroleum Engineers: Midland, Texas, USA. p. 10.
11. Velasco, R., et al., What Happens to Permeability at the Nanoscale? A Molecular Dynamics Simulation Study, in SPE/AAPG/SEG Unconventional Resources Technology Conference. 2017, Unconventional Resources Technology Conference: Austin, Texas, USA. p. 10.

12. Pathak, M., et al., Experimental Verification of Changing Bubble Points of Oils in Shales: Effect of Preferential Absorption by Kerogen and Confinement of Fluids, in SPE Annual Technical Conference and Exhibition. 2017, Society of Petroleum Engineers: San Antonio, Texas, USA. p. 10.
13. Panja, P., M. Pathak, R. Velasco, M. Deo, 2017, Study Applied LSSVM to Tight Reservoirs, Trade Journal, Special Report: Shale Resource Science, The American Oil & Gas Reporter, March
14. Pathak, M., et al., Suppression in the Bubble Points of Oils in Shales Combined Effect of Presence of Organic Matter and Confinement, in SPE Unconventional Resources Conference. 2017, Society of Petroleum Engineers: Calgary, Alberta, Canada. p. 7.
15. Velasco, R., P. Panja, and M. Deo, New Production Performance and Prediction Tool for Unconventional Reservoirs, in SPE/AAPG/SEG Unconventional Resources Technology Conference. 2016, Unconventional Resources Technology Conference: San Antonio, Texas, USA. p. 16.
16. Pathak, M., et al., Enhanced Recovery in Shales: Molecular Investigation of CO2 Energized Fluid for Re-Fracturing Shale Formations, in SPE/AAPG/SEG Unconventional Resources Technology Conference. 2016, Unconventional Resources Technology Conference: San Antonio, Texas, USA. p. 8.
17. Panja, P., et al., Least Square Support Vector Machine: An Emerging Tool for Data Analysis, in SPE Low Perm Symposium. 2016, Society of Petroleum Engineers: Denver, Colorado, USA. p. 22.
18. Pathak, M., et al., The Effect of Kerogen-Hydrocarbons Interaction on the PVT Properties in Liquid Rich Shale Plays, in SPE/CSUR Unconventional Resources Conference. 2015, Society of Petroleum Engineers: Calgary, Alberta, Canada. p. 7.

G. SYNERGYSTIC RESEARCH ACTIVITIES

Data Analytics and Machine Learning

We have studied an application of reverse engineering to petroleum system analysis and supports the concept of intra-formational migration in the tight (shale) oil formations in Permian basin after analyzing production data from 5000 wells. We have also developed a dimensionless factor for oil production regardless of operating parameters as well as intrinsic fluid and geologic properties. We have estimated the probabilistic Stimulated Original Oil In Place (SOOIP) of hydraulically fractured horizontal wells in prominent shale plays.

I am working on Science-informed Machine Learning to Accelerate Real Decisions in Subsurface Applications Time **(SMART funded by DOE-NETL)** to predict rate and sub-surface dynamic properties with time. We are developing machine learning (Reinforce Learning -RL) for production optimization from porous media and safe and optimum operations of chemical process plants by minimizing emissions of toxic and harmful gases such as NOx, SOx, H_2S, CO and CO_2. I have employed ML/AI techniques (ST-LSTM, ConvLSTM, CNN, MLP, U-Net) in a variety of applications and will continue to use these learnings to make further advancements.

Geothermal Heat Extraction and Storage

We have investigated the Geothermal Battery Energy Storage concept using solar radiance to heat water on the surface which is then injected into the earth (**NSF-EAGER-1912670)**. For certain reservoirs, calculations suggest that nearly 100% of the stored heat can practically be recovered, and long-term, even seasonal storage is possible. We have evaluated performance and optimized geothermal energy extraction from doublet system in enhanced geothermal system with hydraulic fractures **(DE-EE-0007080, FORGE)**. The well spacing, injection temperature, and injection rate are the key factors in heat extraction from enhanced geothermal system.

Subsurface Engineering

We have demonstrated the ability to model and simulate complex subsurface phenomena like flow behavior of oil and gas. Formation permeability, hydraulic fracture spacing and initial reservoir pressure are identified as the heavy hitters in the production of oil from shales throughout the United States including Bakken, Eagle Ford and Niobrara **(EGI - I 00973)**. The recovery from tight formation and shale can be improved by optimization of completion and operation **(EGI - I 01073)**. We have optimized injection scheme, production and injection wells configurations using water, CO_2, natural gas, ethane or propane for enhancing recovery from shales.

Process Development and Intensification

We have developed efficient operating strategy of surface facility to reduce the flaring (CO_2 emission) and venting (Methane) while maximizing oil production from fractured shales. We have simulated optimized scenario (rate and design of absorption and desorption columns) for post combustion CO_2 capture by amine-based solvent. We have also designed pipeline network system for transportation of CO_2 from power plant comprising compression and injection units to the nearest geologic formation for sequestration **(DE-FE-0029280)**. We have created protocol for remedy of calcium scale deposition inside process equipment and pipeline in a soda ash plant **(sponsored by Tata Chemicals)**. We intend to develop Process Intensification for optimal resource use and attaining greater process efficiencies combined with significant environmental and safety benefits utilizing modern process design tools such as Aspen Plus.